In Situ Thermal Remediation
Vapor Recovery
Operations and Maintenance Manual
Revision 1

Pasco Landfill NPL Site
Pasco, Washington

Prepared for:
Industrial Waste Area Generators Group III
Washington State Department of Ecology

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1 INTRODUCTION

This In Situ Thermal Remediation (ISTR) Vapor Recovery (VR) Operations and Maintenance (O&M) Manual (VR O&M Manual) provides information on the operation, maintenance, and monitoring of the VR portion of the Zone A ISTR system at the Pasco Landfill National Priorities List (NPL) Site in Pasco, Washington (Site). It has been prepared on behalf of the Industrial Waste Area Generators Group III (IWAG) to satisfy the requirements of the Washington State Department of Ecology (Ecology) Agreed Order No. DE 9240, Enforcement Order No. DE 16899, and Washington Administrative Codes (WAC) 173-340-400(4)(c) and (6)(b)(ii). This VR O&M Manual, the O&M Manual for the regenerative thermal oxidizer (RTO) system (RTO O&M Manual), and the RTO O&M Manual Addendum for ISTR are companion documents and together they describe changes or modifications to the existing Zone A soil vapor extraction (SVE) and RTO systems to support ISTR operations. Additionally, a Compliance Monitoring Plan (CMP), which is included as Appendix F of the Zone A Post-Excavation Engineering Design Report (EDR), includes specific details regarding performance and confirmation monitoring for the ISTR system and includes a Sampling and Analyses Plan (SAP) and Quality Assurance Project Plan (QAPP). Performance samples described in this VR O&M Manual will be collected and analyzed in accordance with the CMP SAP/QAPP. Specific references to sections in the EDR and CMP are provided where appropriate throughout this VR O&M Manual for reference.

Upon commencement of Phase 2 of ISTR treatment within Zone A, this VR O&M Manual – Revision 1 will supersede the *In Situ Thermal Remediation Vapor Recovery Operations and Maintenance Manual – March 2024*. This revision also incorporates modifications outlined in Addendum 1 to the VR O&M Manual dated July 10, 2024, and the Recycled Condensate Memorandum dated October 10, 2024. Both the VR O&M Manual and the RTO O&M Manual Addendum have been prepared to satisfy requirements of Synthetic Minor Approval Order 23AQ-E033 (Approval Order) that will serve as the air permit for the RTO, which processes effluent from the ISTR VR system.

Much of the content included in this document is based on the SVE System O&M Manual dated October 28, 2021 prepared by PBS Engineering and Environmental LLC (PBS), which reflects the system reconfiguration performed in 2020 and 2021 in accordance with the Ecology-approved Zone A Removal Action Engineering Design Report (Removal Action EDR) and subsequent Ecology-approved changes in the system and operational requirements. This VR O&M Manual focuses on the equipment and processes modified or added to the existing SVE and RTO remediation systems to facilitate collection, cooling, and treatment of the vapors recovered during ISTR. Work performed at the Site in support of O&M activities described in this manual shall be performed in accordance with the EDR and the ISTR Health and Safety Plan (HASP) developed by TRS Group, Inc. (TRS).

1.1 Purpose of the O&M Manual

The purpose of this VR O&M Manual is to provide information for on-site personnel and responsible individuals summarizing the technical operation of the system and the procedures to properly operate the system within the conditions and requirements of the Approval and Enforcement Orders and provisions of Washington State Model Toxics Control Act Regulation (WAC 173-340; Model Toxics Control Act [MTCA]). This VR O&M Manual includes start-up testing procedures, anticipated flow rates during routine operations, periodic flow adjustments and optimization measures, and routine vapor monitoring to assess the ongoing performance of the ISTR operations. The focus of this VR O&M Manual is on the ISTR components and integration with the existing SVE and RTO systems. Design, operations, and maintenance details for the existing SVE system can be found in the SVE System O&M Manual. A Site Location Map is presented in **Attachment A**.

This VR O&M Manual presents:

- Design and operational plans for ISTR system components

- Interlocks between the existing SVE and RTO systems and the ISTR system
- Technical specifications for VR system components
- Operational information

1.2 Requirements of the Plan

This VR O&M Manual presents technical guidance to ensure effective operations under both normal and emergency conditions. It includes the following elements:

1. Name and phone number of the responsible individuals
2. Process description and operating principles
3. Operating parameters and limits
4. General operating procedures, including start-up, normal operations, operation at less than design loading, shutdown, and emergency procedures
5. Procedures to take if the system shuts down due to the lower explosive limit (LEL) exceeding 40% in the inlet stream to the RTO
6. A discussion of the operation of individual ISTR system components, including a description of various controls, recommended operating parameters, safety features, and any other relevant information
7. Schedules and sample forms for the collection and management of O&M records
8. Product information and equipment specifications
9. Equipment maintenance schedules incorporating manufacturers' recommendations
10. Details of the standby vapor carbon vessels for use during RTO downtime
11. Other information as required by Ecology

The following sections describe the specific components of the VR O&M Manual as required by WAC 173-340-400(4)(c) and WAC 173-340-400 (6)(b)(ii), the Approval Order 23AQ-E033, Agreed Order No. DE 9240, and Enforcement Order No. DE 16899.

2 RESPONSIBLE INDIVIDUALS

The responsible individuals associated with implementation of the VR O&M Manual are listed in Table 1.

Table 1. Contact Information for Responsible Individuals

Position	Person, Representative Body	Cell Phone Number
IWAG Representative	Nick Garson, Chair; Technical Committee	425.269.7866
Project Coordinator	Jessi Massingale, Floyd | Snider	206.292.2078
ISTR Project Manager	Susan Avritt, TRS	828.230.3554
ISTR System Operator and Alternate	Jeff Root, TRS Erica Seiler, TRS	208.870.5777 509.578.8898
Site Operations Project Manager	Lance Moen, PBS	503.935.5516
Ecology Site Manager	Jeremy Schmidt, Ecology	509.724.1164

3 VAPOR RECOVERY SYSTEM DESCRIPTION

3.1 Operating Principles

The ISTR system is composed of a series of subsurface heaters used to transfer heat through the treatment volume of Zone A. Each heater boring will have a co-located VR screen that is screened within the vadose zone beneath Zone A. In addition, 10 standalone vapor recovery screens will be installed a minimum of 3 ft below the Touchet Bed-Upper Pasco Gravel (UPG) interface to provide additional vapor recovery beneath the heated volume, as shown on sheet Y-7 in **Attachment A**. The temperature within the treatment volume will be increased until average temperatures are between 105 and 120 degrees Celsius (°C). At these temperatures, a mixture of air, steam, and contaminant vapor will be collected under vacuum at the heater VR screens and conveyed through aboveground piping to a condensing unit. Using a plate and frame heat exchanger cooled by non-contact water from two 100-ton cooling towers, the condensing unit will lower the temperature of the vapor stream to near ambient. The recycle water within the cooling towers will be comprised of a mixture of treated condensate and potable water. The recycle water used in the cooling towers will be treated with UltraKleen® Biocide Solutions 1 and 2 or Aqucar™ GA 15 Water Treatment Microbiocide to prevent bacterial buildup in the equipment. A cut sheet and Safety Data Sheet (SDS) are included in **Attachment C**. Some recycle water will be blown down to the frac tank to prevent mineral water buildup within the heat exchanger and cooling towers. This blow down water is included as part of the condensate volume estimates discussed in section 3.2.6.3.

A vapor liquid separator (VLS) system will separate condensable liquids from the vapor stream. The condensed liquids will be pumped to an 18,000-gallon weir tank where light non-aqueous phase liquids (LNAPL) will be separated from water by gravity. This tank will discharge water through two bag filters, a 300-pound organoclay filter, and three 500-pound liquid-phase granular activated carbon (LGAC) vessels before collection in a 21,000-gallon frac tank where water will be used as makeup water for the cooling tower or tested prior to on-site reuse in accordance with the EDR. A second 21,000-gallon frac tank will be installed to store blowdown water from the condenser, and a 4,900 gallon vessel will be on standby should additional storage capacity be needed for treated water. The condensing unit, weir tank, filtration vessels, and frac tanks will be placed within a secondary containment berm. The vapor will be pulled through a rotary lobe VR blower and then through piping to existing below-grade moisture separators (BGMSs) located west of Zone A within the SVE and RTO operations yard. A process and instrumentation diagram (P&ID) can be found in **Attachment A**. The VR blower induces the vacuum required to pull vapors through the VR screens and vapor conveyance piping. In addition to the thermal VR blower, a blower bypass has been installed that will allow for the 30-horsepower (hp) SVE blower to be utilized in the event of thermal VR blower maintenance or repair. Soil vapors collected from the VR screens are treated by the existing RTO system that is permitted under the Ecology Approval Order 23AQ-E033. The RTO is operated to provide thermal destruction of organic vapors in effluent from the VR system. O&M requirements associated with the RTO system are presented in the separate RTO O&M Manual and associated addendum.

Due to the moisture content of the extracted vapor, the VR system will connect to and reuse existing components from the SVE system for additional separation and collection of condensate that may be conveyed downstream of the VR system. Condensate not collected within the ISTR VR condensing unit will be collected in the existing BGMSs and moisture separators inside the SVE Operations Building, pumped to the existing oil/water separator (OWS), then to the 3,900-gallon condensate storage tank for characterization and disposal. Alternatively, this water may be routed through the ISTR condensate LGAC treatment system for onsite reuse, as described in the previous paragraph. The moisture separators inside and outside the building will be used to ensure adequate moisture removal before the vapor stream enters the RTO. A secondary containment pad located adjacent to the SVE Operations Building contains the OWS, the condensate storage tank connected to the OWS, and an additional 1,500-gallon storage tank not connected to the OWS that

provides capacity for collection of additional condensate. LEL monitoring devices and control panel electronics that automatically shut down the VR system under certain conditions are located on the north side of the secondary containment structure.

3.2 VR System Components

This section provides details regarding the ISTR system VR process. ISTR design details for the VR portion of the system are provided in the EDR, including the design package included as Appendix E of the EDR. Key figures and a P&ID are provided in **Attachment A**. VR equipment and product information are included in **Attachment C**.

During the changeover from the existing SVE system to the VR system, the existing SVE horizontal wells were disconnected from the SVE system piping through the installation of valves immediately upstream of the BGMS. New vapor conveyance piping was routed from the VR system through existing underground piping located under Dietrich Road to the existing BGMS. The VR piping was also equipped with valves to allow for the isolation of the VR system that would support future operation of the SVE horizontal wells.

3.2.1 VR Wells

Each of the 288 heaters installed within the ISTR treatment volume will have a co-located VR screen. Each screen will consist of a 1-inch diameter, 3-foot-long stainless steel screen with 0.02-inch slotting. The screens at most heater locations will be installed starting at 1 foot below ground surface (bgs) while 16 of the VR points will be installed from the bottom of the treatment volume to 3 ft above the bottom of the treatment volume, with total depths ranging from 16 to 28 feet bgs. An additional 10 standalone deep VR points will include 5-foot-long 2-inch stainless steel screens located a minimum of 3 ft below the Touchet Bed-UPG interface. An updated site plan of the piping layout and new cross section drawing of the standalone points are included in **Attachment A**. The depth of the standalone point screens will be determined in the field based on the observed transition from the Touchet Beds to the UPG. Primary focus will be placed on ensuring the vapor recovery screen has clear access to the UPG. The standalone well labeled R34 will be installed with its 5-foot screen ending 5 to 7 feet above the water table. This will provide potential downgradient capture directly above the water table. If concentrations recovered from R34 are significantly lower than those recovered from the other wells, capture at this location may be reduced or turned off to facilitate improved capture from points with access to higher concentrations of mass.

The Zone A ISTR system will be operated in two sequential phases with approximately 56% of the treatment area in Phase 1 and 44% of the treatment area in Phase 2. The average flow at each individual VR screen will be between 3 and 9 standard cubic feet per minute (scfm) and a total air flow between 500 and 1,000 scfm per phase. The existing air permit allows for a maximum 1,000 scfm of process air to be sent to the RTO for treatment. Bleed air will be added as necessary to maintain a total flow no more than 1,000 scfm to the RTO and to control LEL throughout operations of both phases. A plan showing the layout of the VR points can be found in **Attachment A** as well as a cross-section of the standalone deep VR points. Cross-sections of the heater borings are available in the design drawings attached to the EDR.

3.2.2 VR Blower

The VR system includes one VR blower located within the ISTR treatment area on the east side of Dietrich Road, which will extract vapors from beneath Zone A through the VR screens co-located with each heater. The VR blower is a Universal Roots Model 711 (URAI), 40 horsepower, 1,000 scfm, rotary positive displacement blower. Product information and performance curves for the blower are included in **Attachment C**. The VR blower motor is equipped with a variable frequency drive (VFD) to provide consistent blower speed and maintain flow control. The human-machine interface (HMI) shows the on/off status of the VR blower and the

speed at which the VR blower motor is operating. A touchscreen on the HMI allows the operator to change the status and speed of the VR blower motor. The HMI relays operator input into the programmable logic controller (PLC), which in turn changes the status and speed of the VR blower motor. The VFD also decreases the power consumption and reduces mechanical wear by eliminating motor starters. Ball valves located at each heater are used to manually control air flow from each VR screen. The VR piping layout is provided in **Attachment B**. The ability to add fresh air dilution is controlled by gate valves on the main piping header as well as at the blower itself. Air flow is also controlled with the VFD.

3.2.3 ISTR VR System Control

Operation of the ISTR VR system sensors and components is displayed and controlled through the HMI. The HMI includes a site operating program running on a computer within the ISTR power control unit (PCU) as well as a local touchscreen monitor display at the major components of the VR system. Schematic diagrams of the various system components and their specific operating conditions are displayed to easily show the operator the status of each piece of equipment and the system. The HMI allows the operator to turn equipment on or off, adjust blower speed, and to change operating status by touching the screen or adjusting settings in the operating program. The HMI is backed up by a supervisory control and data acquisition system (SCADA) PLC that performs the necessary calculations and sends control signals to equipment as operational data are processed from the inputs throughout the system. The HMI also includes a data acquisition and storage function that records and data-logs selected operational information (e.g., flow rates, line pressures, temperatures, vacuums, LEL, condensate pumping volumes) for the VR system.

The HMI, PLC, power supply, and supporting electrical components are assembled in protective National Electrical Manufacturers Association (NEMA) cabinets or inside the PCU for protection and electrical isolation. An electrical diagram of the VR system can be found in **Attachment B**. The HMI touchscreens are mounted inside the VR blower and condenser units. The HMI interface can also be viewed and controlled remotely by means of a cellular internet interface located in the PCU. Stored operating data may also be viewed and downloaded remotely.

The PLC receives input signals, such as blower and condenser conditions, and can initiate alarms and programmed blower shutdowns. The PLC will automatically shut down the VR system for any detected emergency condition. There are “all stop” full-system interlocks within the VR system, including RTO shutdown. The PLC also contains several component-stops, such as high pressure, high vacuum, high-high condensate, and high temperature, that shut down individual system components while allowing the remainder of the system to operate. In the event of a full or partial system shutdown, a remote or manual restart is necessary.

The controller input and output list indicates the major VR operational signals that are monitored and, in some cases, controlled by the HMI. **Attachment C** contains a list of alarm status conditions that, when met, send the VR System Operator text message alarms. Flow measurements are also displayed on the HMI once they are adjusted to standard temperature and pressure. Condenser parameters, such as heat exchanger inlet and outlet temperatures and water levels in the VLS tanks and the cooling tower holding tank, are measured and displayed.

Moisture separators located within the condenser are instrumented to indicate low, high, and high-high liquid levels on the HMI screen. Condensate totals in gallons are displayed on the HMI. The HMI also displays the status of leak detectors installed in the secondary containment around the condenser, weir tank, water filtration and LGAC treatment, and frac tank. High-high levels in moisture separators within the condenser, and a high-high level in the weir or frac tank, will shut down the entire VR system, as appropriate. See section

3.2.6 for more information. In addition to the VR moisture separator system controls, the existing SVE system HMI will continue to monitor the BGMSs and OWS. Data displayed on the HMI will include low, high, and high-high liquid levels, totalized condensate accumulation, and the status of secondary containment leak detectors.

3.2.4 VR Piping and Process Air Piping

A mixture of piping materials has been selected for the VR piping. The wellhead and an approximate 8-foot section of aboveground piping at each heater will be 1-inch diameter schedule 40 Type 304 stainless steel. This section of piping allows for ambient cooling of vapors as they are routed above grade. A length of flexible 1-inch diameter NovaFlex 4705 chemical hose will be used to transition from the stainless steel to Centricast RB-2530 fiber glass piping. Chlorinated polyvinyl chloride (CPVC) piping will be used to convey vapors from the cooling Phase 1 area to the treatment system during Phase 2 operations. These materials were selected based on their abrasion-, impact-, weather-, temperature- and chemical-resistant properties. Stainless steel connections will be made with national pipe thread (NPT) connections. Hose connections will be made with hose barbs and stainless steel hose clamps; CPVC connections will be made with glued, flanged, threaded, and Morris couplings; and fiberglass connections will be made with glued connections, Morris couplings, or Victaulic fittings. All connections will be rated for the temperatures and pressures of the process stream. Following the installation of the piping, auditory leak tests will be performed on the piping to ensure that joint connections were properly performed. A plan view detailing the VR piping layout is included in **Attachment B**.

As a safeguard against condensation of tars within the standalone vapor recovery points, an inline drop leg will be installed above grade to collect condensing liquid. Weekly inspection of the drop legs will be performed to track any accumulation of condensing material. Drop leg inspection frequency will be increased as necessary based on observations of accumulation.

Gate and check valves will be included at the far end of most 4-inch diameter VR headers to facilitate the addition of dilution air to the system. These allow control of dilution air and protection against atmospheric venting through the dilution piping if the VR system is shut down. The dilution air piping is capped with screen material to prevent blockage or animal entry. Each 4-inch headed pipe will carry flow from up to 42 heaters. The header size will increase to 6 inches to carry up to 94 heaters, and 8-inch piping will be used for 95 or more heaters.

During Phase 2 operations, the Phase 1 standalone VR points, deep screens co-located with heaters and select perimeter shallow co-located screens will remain connected to vacuum to ensure continued pneumatic control as the Phase 1 area cools. The duration of continued capture will be determined using a multiple lines of evidence approach and in coordination with Ecology and IWAG. Metrics for review will include temperature trends, vapor stream concentrations and mass recovery, vacuum influence, and downgradient water concentrations. Data collected during the cooldown of the Phase 1 area will be used to inform decision making on how vapor recovery will be implemented during the cooldown of Phase 2.

All flow from the heater field will be routed to the primary condenser VLS via an 8-inch diameter fiberglass pipe. Conveyance within the condenser is through stainless steel components and then to an 8-inch CPVC piping header between the condenser effluent and VR blower inlet. The VR blower effluent will be routed to one of the existing 6-inch diameter high-density polyethylene (HDPE), standard dimension ratio (SDR) 17, conveyance pipes that connect to the existing SVE system.

3.2.5 LEL Measurement and Control

It is expected that the process piping interior will be classified as Class 1, Division 2 under the Uniform Fire Code. This classification requires that LELs within the piping be limited to no greater than 40% and that protective measures be put in place to prevent such conditions. Those protective measures include LEL-sensing equipment and system interlocks and fail-safes within the process piping of the former SVE system. All the piping in the SVE building and between the SVE building and the RTO is under negative or vacuum pressure. Sensors in this area of piping shut the system down if the pressure within the piping becomes positive. As an additional measure of safety, the RTO system limits process air to 25% LEL, down from the 40% LEL included in the Uniform Fire Code. During ISTR or RTO startup operations, manual adjustments to the VR system are used by the operations team to maintain LEL below 25% in lieu of an automatic RTO shutdown, including adjustments to ISTR power input and bleed air to maintain safe operating conditions. Priority will be placed on maintaining robust vapor capture and a negative pressure within the treatment volume. Additional safety measures related to RTO operation are described in the RTO O&M Manual.

3.2.6 Condensate Removal and Control System

The VR system for ISTR generates a significant volume of condensate. Therefore, the VR system will include several components necessary to handle the condensate that collects within the VR system piping and heat exchanger. These components are discussed below.

3.2.6.1 Moisture Separators

Extracted gases from the ISTR system will have elevated temperatures and retain high amounts of moisture. Upon reaching the surface, the gases cool and continue to cool to near ambient conditions between the wellheads and the condensing unit, causing moisture to condense on the sides of the pipes. Liquid within the piping collects in topographic low spots within the system. As a result, the VR piping will be installed on elevated stands sloped toward the condensing unit. The slope ensures that any condensation forming inside the piping will be carried to the VLS located at the condenser inlet.

The VLS at the condenser inlet will collect the condensate that forms in the VR conveyance piping and a secondary VLS within the condenser will collect the condensate that forms within the plate and frame heat exchanger. Float sensors connected to the VLS units will trigger pumping events when a high level is reached within a vessel. The blower discharge will be sent through the existing BGMS as described in section 3.1.

3.2.6.2 Weir Tank

Condensate discharge from the VLS units will be to an 18,000-gallon weir tank so that any condensed oils can be separated by gravity from the condensed steam. The transfer line will be a 1-inch diameter CPVC. The weir tank will be used to separate any non-aqueous phase liquid (NAPL) from the condensed steam produced by the heating system. LNAPL will float in the first chamber and be prevented from entering the second chamber by a wall extending down from the top of the vessel. Any solids or high-density fluid (DNAPL) entrained in the flow will settle to the bottom of the tank in the first and second chamber. A wall extending from the floor of the tank to 1-foot from the top of the tank will be used to ensure settled solids and DNAPL are contained in the first two chambers. The gravity-filtered water will continue through the tank over the wall of the second chamber into the third chamber, which is connected to an external centrifugal pump in the lower 2 feet of the tank. This pump will be controlled by a high-level switch within the third chamber of the tank. The water from the third chamber of the weir tank will be pumped through two bag filters, an organoclay filter, and three LGAC vessels as described in section 3.2.6.3 below. High- and high-high-level sensors will be included to ensure the tank is not overfilled. The piping and weir tanks will be housed within a secondary containment berm. External piping will be heat traced and insulated to prevent freezing during winter operations.

A cover was placed over the top of the tank for odor control. To ensure that off gassing from the process water does not pose a health or physical hazard, two vapor recovery lines were installed within the headspace of the weir tank to preclude the accumulation of vapors within the tank. The weir tank cross-sectional dimensions are represented on Figure P-8 in **Attachment A** and the assumed width is 8 ft. Using these measurements, a maximum headspace of approximately 101 cubic feet is expected within the first chamber. The second and third chambers will have a shared headspace of approximately 424 cubic feet. During operations both headspace volumes will be connected to a valved 1-inch vacuum pipe connected to the vapor recovery system. The vent pipes are designed to maintain a minimum of 8 scfm from each chamber. At this flowrate, a complete headspace exchange should occur at least once per hour. Fresh air will be brought into the headspace through small openings in the lid. Air intake will be regulated to ensure the applied vacuum does not create a condition where damage to the vessel could occur. The collected vapors will be routed back through the condensing unit and to the RTO for treatment.

Accumulation of NAPL in the weir tank will be monitored weekly through a combination of visual inspection, measurement with a graduated pole, and measurement of LNAPL and DNAPL (if present) with a membrane interface probe. Consistent with Section 9.5 of the EDR (and Section 7.1.6 of the CMP), a vacuum truck will be used to remove and transport NAPL to an approved facility as needed. Accumulated NAPL will be stored within the weir tank, which will be temporarily staged within the secondary containment in accordance with WA-173-303. Based on recovered LNAPL from Phase 1 operations, no more than 1,000 gallons of LNAPL is expected to be recovered between the two operational phases. The weir tank has capacity for 4,500 gallons of LNAPL storage. Callouts in Drawing P-8 in **Attachment A** highlight design parameters that will ensure LNAPL stays within the first chamber of the weir tank. LNAPL will be pumped from the first chamber of the weir tank by a vacuum truck when approximately 50% of the total LNAPL capacity has accumulated in the frac tank (approximately 2,250 gallons). Based on expected recovery, this should require a single pumping event at the end of Phase 2 operations. A P&ID of the weir tank can be found in **Attachment A**. Waste handling and management of NAPL will be consistent with Sections 4.0 and 5.0 of the Ecology-approved Waste Handling, Characterization, and Disposal Plan (Waste Plan), which is Appendix C to the Zone A Removal Action EDR. The Waste Plan provides sufficient detail to ensure compliance with relevant Washington State Dangerous Waste regulations (WAC 173-303).

A NAPL sample representative of each batch will be collected from the first chamber of the weir tank using a bailer and tested per Table C.2 of the Waste Plan and Section 5.2.3 of the CMP to determine appropriate placarding for transport and selection of the appropriate profile for disposal. Although samples will be submitted for an expedited turnaround time, there may be a small amount of additional NAPL that accumulates in the weir tank pending receipt of analytical data. Due to the limited amount of temperature increase that would occur in the several days pending receipt of data, the NAPL composition is not expected to differ. During vacuum truck removal of NAPL, the truck will be electrically bonded to the weir tank to prevent static discharge. A hatch will be opened, and an intake hose lowered into the LNAPL layer. The hose intake will be lowered manually or floated on the surface of the LNAPL to minimize the intake of water to the truck. The level of fluid removed from the first chamber of the tank will not be lower than the deep extent of the first weir wall to ensure LNAPL is not transferred to subsequent chambers. If any DNAPL accumulates in the second chamber, it will be pumped out after the LNAPL at the end of each operation phase using the same procedures. Transfer hoses will be secured such that any spill will be contained within the secondary containment. An eyewash station and spill kit will be located within 50 ft of the transfer location.

3.2.6.3 Condensate Water Treatment System

Gravity-filtered water from the weir tank will be pumped through two bag filters sized at between 5 and 50 microns, one 300-pound organoclay vessel, and three 500-pound LGAC vessels in series for treatment. The

weir tank will be pre-filled with water such that the water level will be maintained above the bottom of the first weir wall. This will prevent LNAPL from moving to the second or third chamber of the weir tank. The effluent pump position, weir wall heights, and pumping volumes will be controlled to ensure the water level in the first chamber does not drop below the weir wall. Treatment of gravity filtered water in the weir tank will be by batch. A high float switch in the third chamber of the weir tank will trigger a timed pumping event of approximately 350 gallons at a maximum flow of about 5 gallons per minute (gpm). Pressure gauges were installed before (influent), between (mid-point), and after (effluent) the LGAC vessels to monitor for any blockage within the vessels. Sample ports were also installed before, between, and after the vessels and samples will be collected to monitor for capture efficiency and for breakthrough of the contaminant mass on the first vessel, as described in Section 5.2.1 of the CMP. If breakthrough is observed, the secondary vessel will be plumbed into the primary position, the third vessel will be placed into the secondary position, the standby vessel will be placed into the third position, and the primary vessel will be moved to the standby position and will have its spent carbon replaced with fresh carbon. Carbon changeouts can typically occur without system shutdown. A fourth LGAC vessel will be kept on standby, and by using union connections and isolation valves, the standby LGAC vessel can be installed without turning off the system or with minimal downtime (<1hr). Spent LGAC will be characterized prior to offsite disposal or regeneration. Bag filters and organoclay filtration will be replaced as pressures indicate they are spent. Bags will be drummed for disposal, and organoclay will be characterized and disposed of offsite.

As described in the Recycled Condensate Memorandum dated October 10, 2024, treated condensate will be used as makeup water in the cooling towers. The use of this water as makeup will significantly reduce the volume of water requiring discharge onsite or offsite disposal. It will also reduce the volume of potable water used on site. As indicated in the site HASP, an air action limit of 5 parts per million (ppm) or greater in the treatment compound for a sustained period of 1 minute will prompt a response. For the site perimeter, readings of 1 ppm or greater for a sustained period will prompt a response. If an action level is observed an inspection of potential sources for volatile organic compound (VOC) release will be completed. If the source is determined to be the cooling towers, makeup to the cooling towers will be switched to potable only until the source of the vapors is determined and corrected. Sampling of the treatment train will be used to determine potential breakthrough of the treatment system. Potable makeup will be used until the treatment breakthrough issue has been resolved. Condensate produced during this period will be stored onsite until the treatment breakthrough has been resolved at which point it will be treated and used as makeup for the cooling towers.

Water in excess of what is needed for cooling water will be stored onsite and sampled. Consistent with the EDR and CMP, confirmation that the treated water meets on-site reuse criteria is necessary before on-site reuse can occur. It is anticipated that the discharge standard unit pH will be between 6.5 and 8.5 and that pH adjustments will not be needed. However, an optional bicarbonate injection pump has been included in the design if pH is outside this anticipated range and adjustment is needed prior to discharge. Sample collection will be completed for each batch of treated water (approximately 21,000 gallons) and each batch sample will be representative of treated water within the storage tank. The treated water discharged from the treatment system will be stored in a 21,000-gallon frac tank for use as cooling water. Water in excess of the static 21,000-gallon makeup tank will be stored in a second 21,000-gallon tank pending sampling results and additional treated water will not be added to the tank after sample collection, pending receipt of analytical results and confirmation that onsite reuse criteria are met. A 4,900-gallon storage tank is also available within the secondary containment should additional storage capacity of treated water be needed. During periods of higher rates of condensate production, an expedited turnaround time (TAT) will be requested from the laboratory for treated water samples to minimize the storage capacity needs for the site. Specific details regarding on-site reuse criteria and testing are included in Section 7.3 of the CMP.

Per Section 10.5 of the EDR, condensate is expected to be produced at an average rate of 1.5 gpm and is not expected to be greater than 5 gpm. Estimated monthly condensate production for each phase of operation is listed in Table 2. Condensate production will increase as temperatures rise in the subsurface, peaking toward the middle of the second month in each phase. During the first month of operations, treated water concentrations from the LGAC effluent will provide guidance on the need for additional treatment or storage.

Table 2. Estimated Condensate by Month

Phase 1		Phase 2	
Months Since Startup	**Observed Condensate Production (gal)**	**Months Since Startup**	**Expected Condensate Production (gal)**
1	30,000	1	30,000
2	35,000	2	40,000
3	36,000	3	40,000
4	48,000	4	50,000
5	43,000	5	50,000

3.2.6.4 Secondary Containment

The condenser, weir tank, sediment filters, organo clay vessels, LGAC vessels, and storage frac tank(s) will be located within secondary containment. The secondary containment consists of a 20-mil PVC liner with 1-foot-high walls. The volume of the secondary containment area is at least 23,100 gallons, which is approximately 110% of the volume of the largest tank within the secondary containment area.

4 VAPOR RECOVERY SYSTEM OPERATIONS AND MONITORING

4.1 Differential Pressure Meters and Transmitters

Differential pressure meters with transmitters are installed on the condenser and VR blower vapor discharge lines. The differential pressure meters/transmitters are Dwyer MS-300s. **Attachment C** includes the product information on these meters. These meters are connected to the high-pressure and low-pressure legs of the Dwyer DS-300 flow sensors and measure the differential pressure of the flowing gas in the line. The differential pressure that is exerted on a sensor within an oil medium encased between two diaphragms translates that pressure signal into a 4-20 milliamp (mA) electrical output. The transmitters send the signal to the PLC. The differential pressure value is combined with temperature and static line pressure readings within the pipe, and the PLC converts that information into a total flow value in scfm that is displayed on the HMI. The flow value on the condenser effluent is the total wellhead and dilution air flow for all wells from the treatment volume, and the post-blower reading includes any bleed air added at the blower.

4.2 Static Line Pressure

Pressure within the VR manifold will be monitored via Dwyer Instruments series A3000 photohelic pressure switch/gauge units. These units will be set to send an alarm and reduce power to the heaters if the manifold shows elevated pressure. In addition to the automated pressure sensors, manual pressure readings of the 8-inch VR manifold lines are collected weekly to monitor performance. These readings will be used along with temperature and differential pressure readings to calculate the flow within system piping.

4.3 Temperature Sensors

Resistance temperature detectors (RTD) supplied by Eustis/Pyrocom in Lynwood, Washington, will be used for temperature measurement throughout the thermal system. These sensors will be used below the ground surface to monitor both the heater temperatures and the bulk soil temperatures. There are 29 temperature monitoring points (TMPs) located in the shallow treatment zone, with 9 of these TMP locations also including a sensor placed 20 ft below the treatment zone. Temperature data collection will continue in the Phase 1 area to monitor cooling trends until Phase 2 begins. During Phase 2, manual readings will be collected periodically from TMP N23 to track the cooldown of soils in the Phase 1 area, while automated RTD readings from the Phase 2 TMPs will provide continuous temperature monitoring during active heating. To monitor cooldown post Phase 2 heating, TRS will install a TMP casing in Area 5 to a depth of 46 ft. This casing will allow for long term hand reading of temperatures within the treatment volume and UPG after thermal treatment has ended. The location of TMP K13 and a cross-section are provided in **Attachment A**. Together, this TMP network provides sufficient understanding of shallow and deep heating trends.

The sensors will also be used within the condenser and blower piping to observe the inlet and outlet temperatures of process fluids. Set points for freezing temperatures on the water-side piping and for elevated temperatures for vapor-side piping ensure the protection of equipment by either adjusting flow conditions automatically or by alerting operators via text message of the need for system adjustment.

4.4 Flow Rate

Measurements in the condenser and VR blower vapor discharge at the Dwyer Series DS-300 Flow Sensors are used to measure airflows within the VR system piping. These flow sensors are permanently affixed in-line within the VR header pipes leading to and from the blower. These flow sensors were selected due to their low head loss and their resistance to chemical attack from process vapors. **Attachment C** presents catalog sheets that provide details of the instrument and its operation. The instruments are appropriately sized for the 8-inch diameter pipes where they are used. These sensors are flow-averaging sensors that provide differential and static pressure readings using pitot tubes installed within the process piping. The condenser and blower effluent temperature signals are combined with line static and differential pressure readings discussed in the previous subsections to generate a total flow value in scfm that is displayed on the HMI. The pre-blower value will include the total flow rate from the thermal treatment volume, and the post-blower flow rate will include the treatment volume flow plus any bleed air added in the blower.

4.5 Operating Parameters and Limits

The VR system shall only be operated by personnel trained in the safe operation of the system who are knowledgeable of the system and informed of any recent modifications. The VR system has been designed to detect unsafe or undesirable operating conditions and programmed to automatically shut down if an unsafe or unwanted condition arises. In the automatic operational mode, fail safes detect and prevent unsafe and/or unwanted operating conditions. These fail safes are described in Table 3.

Table 3. Equipment Operating Limits and Automatic Failsafe Conditions

Equipment	Location(s)	Operating Limit	Failsafe Action
LEL Sensors	Two existing sensors downstream from blower	<25% LEL*	RTO and VR System Shutdown
Vapor Liquid Separator	Condenser	High-High-Level Status	Blower shutdown and heater cooldown
Field Vacuum Switches	Sensors on piping manifold	<12-inch water column vacuum	Warning Alarm
Blower Temperature	Inside blower skid	>140°F	Warning Alarm
Weir or Holding Frac Tank	Inside secondary containment	High-High-Level Status	Condensate discharge stop
Secondary Containment Berm	Inside secondary containment	High-High-Level Status	Condensate discharge stop
RTO and VR Blowers	VR Operations Yard	Positive Pressure on the discharge side of blower	System "all stop," heater cooldown

*(Although the RTO system can accept vapors up to 40% LEL, the IWAG has elected to operate the system at a <25% LEL as a measure of added safety and control.)
°F: degrees Fahrenheit

Each of the automated fail-safe actions triggers a text notification to the system operators by the PLC.

VR system flows are subject to the limit on the treatment capacity of the RTO and operational limits in the Approval Order. The Anguil RTO Model 25 has a design flow of 2,500 scfm. Among other conditions related to operation of the RTO, the Approval Order limits the maximum volume of soil vapor to 1,000 scfm.

4.5.1 VR Flows

The flows at the individual VR screens will vary depending upon blower function, VR or RTO system operation, atmospheric and/or subsurface conditions, or based upon collaboration with Ecology. Flow rates are limited by the Approval Order, the capacity of the VR screens, the capacity of the blower, and the capacity of the RTO. Operational air flows are expected to be between 3 and 9 scfm per VR screen, with a target total flow between 500 and 1,000 scfm for each operational phase. In Phase 2, flow distribution will focus enhanced capture from the deeper portions of the treatment volume by targeting approximately 400 scfm from the standalone and co-located deep VR points. The remaining flow will come from the shallow VR screens. Adjustments will be made to balance deep and shallow flow to maintain a vacuum influence throughout the volume. Vacuum and flow readings at each of the 10 new standalone vapor recovery points will be used to help optimize capture within the UPG. Precise flow readings may be difficult due to the presence of water vapor but should provide qualitative trends in vapor capture.

Although the RTO can operate up to 40% LEL, the IWAG targets system operations to no more than 25% LEL as an added measure of safety and control. While not anticipated, bleed air valves have been included in the design to facilitate removal of condensed liquids and dilution of the vapor stream, if needed. As portions of the treatment volume achieve the soil remediation levels (RELs) as defined in Section 5.0 of the EDR, they will be disconnected from power. The heaters will also be removed from the VR system approximately two weeks after heating has concluded. The total process air flow to the RTO is intended to stay below 1,000 scfm to achieve optimal dispersion within the permitted flow rate, so bleed air will be added as necessary to achieve this flow. A series of pressure monitoring points (PMPs) were installed within and beneath the treatment area to observe subsurface conditions. Pressure measurements at these locations will be used to observe the

effectiveness of the VR system. Readings from the PMPs within and at the site perimeter will be collected a minimum of 3 times per week, and more frequently during falling barometric pressure events. Adjustments to power input to the heaters and applied vacuum will be made to ensure that a negative pressure (vacuum) is maintained, and positive pressure is not observed within or outside of the treatment volume.

4.6 General Operating Conditions

4.6.1 VR, SVE, and RTO System Integration

The VR system's vapor discharge will be directed to the existing SVE and RTO system. The existing SVE subsurface wells have been bypassed for the duration of thermal system operations but will remain in place until the thermal surface cap has been installed. Once startup testing of the VR system and its integration with the existing SVE and RTO operations have been confirmed, vapor capture will commence in the Phase 1 treatment volume until the treatment criteria have been met or a point of diminishing returns has been achieved as described in Section 5.1 of the CMP. Vapor capture will continue from the VR system for a minimum two weeks after the heaters have been disconnected from power. Startup testing will be performed again prior to starting thermal treatment in the Phase 2 area one to two months after Phase 1 operations have concluded. At the end of Phase 2 operations, vapor capture will continue for a minimum of 2 weeks using the thermal VR equipment and until such time that inlet vapor temperatures are low enough for the existing SVE system to handle vapors directly should post-heating vapor recovery be necessary. As discussed in section 3.2.4, the duration of continued capture will be determined using a multiple lines of evidence approach in coordination with Ecology and IWAG, including use of data collected during the cooldown period for Phase 1 to inform decision making during the Phase 2 cooldown period.

Interactions between the thermal VR system and the existing RTO system will focus on the protection of personnel, equipment, and adherence to site permits. The RTO system will provide a go/no-go signal to the VR system blower that will indicate whether vapor from the treatment volume can be safely sent to the RTO system for processing and treatment. If the RTO system cannot accept the VR system effluent, a signal will be provided to the VR blower shutting it down. The same signal will be used to turn power down to the heaters. The likely duration of RTO system downtime will be assessed by the project team, which will decide how to optimize vapor capture until the RTO system can be restarted.

The historic performance of the existing system has achieved greater than 95% uptime, with the longest duration shutdown of approximately three days. Prior to thermal system startup, the VR and RTO systems will go through a thorough annual preventative maintenance evaluation (PME). During the surface installation of the Phase 2 system, the VR and RTO systems will go through a repeated PME as a proactive measure for maintaining uptime.

4.6.2 VR System Start-Up Procedures

Only individuals trained in the operation of the system, current operating conditions, and requirements shall start up the VR system. Whenever starting the system, the operator of the equipment shall be aware of the condition of the equipment to ensure safe start-up. The following protocols are to be applied to Phase 1 and Phase 2 when starting the ISTR VR system:

1. Ensure that a sufficiently low vacuum will be applied to the blower upon start-up by ensuring the valves at the VR wellheads are open. If some or all the valves are closed, the system will exhibit high vacuum conditions, which will immediately cause a shutdown. Valves at operating heaters should be approximately 25% open and adjusted as needed based on readings from adjacent PMPs to balance vapor capture across the treatment volume.

2. Check the HMI in the PCU site computer. Look at the alarms screen for any alarm conditions. Note and address any alarms that are displayed on the screen.
3. Check the status of the condensate tanks (VLS, weir tank, and holding tank) to see if any of the high-high alarms are engaged. This can be checked by looking at the graphical representation for the tanks on the HMI screen. If a high-high alarm is triggered, a red notification will appear on the tank on the HMI. If a high-high alarm is engaged, it is likely there is either a problem with the tank pump or the float switch that activates the pump.
4. Enter the condensing unit and observe the VR blower. Personnel must be wearing eye protection to enter the condenser when it is operating. Look for anything that might suggest less than ideal operating conditions such as odors, water on the floor, broken motor belts, high water in the moisture separators tanks' sight glass, and noises such as air leaks or improperly humming motors.
5. Assuming there are no obvious signs of inoperable equipment, under normal operating conditions, ensure that the equipment valves are in their respective positions, as identified in Table 4.
6. Confirm proper interlock function with the existing RTO and SVE HMI, including pressure alarms and go/no-go signal.
7. Ensure that the RTO is on before starting the system. Only a person familiar with the operation of the equipment can verify that the RTO is on and functioning at the intended target temperature and flow restrictions. If the RTO is not on and at operating temperature, the VR system will not start and isolation valve XV-401 will remain closed.
8. From the Alarm screen, press the alarm button at the bottom of the screen and acknowledge any alarms that shut down the system.
9. Log into the blower HMI screen and press the Auto button. The button should turn green. For the VR blower to start, the following conditions must be met: the RTO is on and up to operating temperature, the enable process air button at the RTO is on, and the blower-enabled button on the VR HMI is on. When these conditions are met, the VR blower will start up automatically. For example, if the process air button is enabled at the RTO and the VR blower button is enabled at the VR HMI, but the RTO is not up to temperature, the VR blower will come on automatically as soon as the RTO reaches its operating temperature.
10. After the blower starts, review pressures, temperatures, flow rates, and other parameters displayed on both the VR and RTO HMIs to determine if the system is functioning as intended.

Table 4. VR Equipment Nominal Valve Settings

Valve	Valve Location	Position
Field		
Heater VR Valves	Ball valves adjacent to each heater	Start at 25% open and adjust as needed to balance subsurface vacuum
Field Bleed Air Valves	Ball valves at end of 4-inch manifold piping	Closed Full
RTO Bypass Valve	Butterfly valve downstream of blower	Closed Full
Condenser		
VLS Drain Valves	Drain valve at bottom of tank	Closed Full
Cooling Tower Holding Tank Drain Valves	Drain valve at bottom of tank (external to unit)	Closed Full
Cartridge Filter Drain Valve	Ball valve	Closed Full
Recycle Pump Valve	Gate valve at pump effluent	Open Full
Cooling Tower Cross-Connect Valves	Gate valves at recycle return	Open Full
VR Blower		
Bleed Air Valve	Gate valve on blower skid	Closed Full

4.6.3 VR System Shutdown Procedures and Contingencies

An RTO bypass system will be put on standby during thermal system operations. This system will consist of two 2,000-pound vapor granular activated carbon (VGAC) vessels in series. The bypass system will be manually operated if the RTO functionality cannot be restored within a few hours of shutdown. Power to the heaters will be reduced, and flow from the field will be reduced by approximately 50% to reduce the rate of carbon consumption in the VGAC vessels. The need for continued use of the RTO bypass will be determined based on observed treatment volume pressures and the rate of VGAC usage. VGAC in the primary vessel will be replaced after each purge event unless mass recovery rates indicate breakthrough of the first vessel is unlikely. Carbon loading will be assessed monthly to ensure sufficient loading capacity is available in the event of an RTO bypass. The following subsections discuss the procedures for shutting down the VR system. Additional discussion related to VR system contingencies is included in section 10.2 of the EDR. During operations of Phase 1, concentrations within the VR piping were high enough that use of the VGAC vessels would have only lasted a few hours. These vessels will be best utilized in the event of high LEL readings observed after a shutdown period. They can be used to help purge the VR piping as bleed air valves are adjusted to reduce the LEL.

4.6.3.1 Manual VR System Shutdown

Manual shutdown of the blower can be performed by pressing the enable buttons on the HMI screen or PCU computer.

4.6.3.2 Automatic VR System Shutdown

Shutdown of the RTO system for any reason will cause the isolation valve XV-401 between the VR blower and the RTO to immediately close, which also shuts down the VR blower so there is no discharge of untreated recovered vapors to the atmosphere. If the shutdown is due to high LEL, vapors in the line between the blower and the RTO will be vented through carbon canisters before the system can be restarted. Additional information related to procedures for the carbon canisters is included in the RTO System O&M Manual.

4.6.3.3 Emergency or Immediate Shutdown

In the case of a life-threatening emergency, personnel should not enter the RTO yard on the west side of Dietrich Road or the thermal system compound on the east side of Dietrich Road. In such an event, personnel shall mobilize upwind of the compound, call 911 for emergency response, and remain on site to apprise first responders of the situation. If personnel are not in danger of injury, but when immediate shutdown is necessary to prevent a release to the environment or when continued operation of the system could potentially result in injury to personnel or a release to the environment, the emergency shutdown button to the left of the HMI should be depressed. An additional emergency shutdown button will be located adjacent to the thermal treatment equipment on the east side of Dietrich Road. These buttons will shut down the VR blower. Examples of immediate shutdown conditions and the appropriate responses are listed in Table 5:

Table 5. Example Shutdown Conditions and Responses

Immediate Response Condition	Response
Leaking vapor discharge piping	If no immediate human health threat, shut down VR blower.
Leaking condensate	Shut down the associated condensate transfer pump or piping. If the leak cannot be fixed right away, shut down the VR blower.
Any condition that may cause harm to personnel, equipment, or the environment	Shut down the VR blower.

5 DATA COLLECTION, SAMPLE FORMS, AND O&M RECORDS

Certain performance samples will be collected for laboratory analyses during ISTR operation, including vapor, treated condensate, and NAPL. Samples will be collected in accordance with Sections 5.0 through Section 8.0 of the CMP.

5.1 Data Collection and Sample Forms

Information collected during the operation of the VR system is recorded both electronically by a data-logging system in the PCU and manually by field personnel. Data and sample collection methods and procedures are described in Section 7.0 of the CMP. The VR system will operate 24 hours a day, 7 days a week under normal operating conditions and is monitored by the PLC. Specific VR system instrumentation provides continuous data signals to the PLC, which are continually monitored by a recording data logger. Information from the data logger is stored on an internet-based remote data center. This information is routinely downloaded to provide a continuous record of the system's operational conditions. The following information is logged or recorded on a daily basis:

- Blower inlet data
    - VR line
        - Date and time
        - Flow
        - Temperature
        - Operational hours

- Blower outlet data
    - VR line
        - Date and time
        - Flow
        - Temperature
- Condensate equipment data
    - Condenser
        - Heat exchanger inlet and outlet temperatures
        - Condensate total pumped
    - Weir tank
        - Depth of fluid
        - Total water pumped
    - Storage tank
        - Depth of water
        - Total water discharged per batch

In addition, the thickness of NAPL in the weir tank will be measured and documented at least weekly as described in section 3.2.6.2 and the total amount of NAPL removed from the weir tank for offsite disposal (or temporary storage) will be documented.

5.2 VR System Routine Maintenance and Record Keeping

VR system inspection and maintenance shall be performed concurrently with the operation of the ISTR system itself. Weekly inspections of certain system components shall be performed, while a more comprehensive inspection of all equipment shall be performed on a quarterly or annual basis.

In addition to the VR system protocol discussed in the following subsections., select maintenance and inspection requirements for the SVE and RTO operations yard have been included Tables 6 and 7 and as a weekly checklist in **Attachment D**. These forms cover the following existing SVE equipment that will continue to support the VR and RTO systems: LEL meter, air compressor, BGMSs, OWS, and associated process piping, pumps, and tanks.

5.2.1 Frequent Inspections (minimum Weekly)

On-site personnel shall perform a weekly inspection of the system equipment during routine operations monitoring to ensure that there are no potential health and safety risks that could arise from specific conditions and to assess whether potential failure of a system component has occurred or is imminent. On-site personnel shall perform a weekly visual inspection of the PLC display and walk through the site to look for obvious signs of potential system failure. System failures, impending system failures, or components in need of repair or maintenance shall be reported to the ISTR Project Manager, Project Coordinator, and Site Operations team immediately. In addition to the weekly inspection activities listed in Table 6, on-site personnel shall perform the following:

- Automated alarms will monitor for excessive pressure, vacuum, or temperatures on the vapor piping or VR blower.
- If the air flow readings are in error, check the orientation of the flow sensors. Ensure that the flow sensors are oriented in the correct direction. Improper orientation will cause incorrect flow readings. Check and listen for signs of leaking equipment, particularly on the discharge side of the blower.

Table 6. Weekly Inspections Equipment Conditions Requiring Servicing

Equipment	Conditions Requiring Servicing
Blower	• Excessive vibration or noise • Higher than normal temperatures • Leaking condensate • Reoccurring variable frequency drive (VFD) faults • Higher or lower than normal inlet or outlet pressures
Process Piping	• Noise or odor from leaking vacuum or pressure lines • Dripping condensate from joints, valves, etc. • Obvious signs of degradation or wear • Accumulation of condensed liquids in standalone drop legs
Condenser	• Noise from leaks on gaskets or connection piping • Leaking condensate • Evidence of corrosion, particularly at threaded fittings
Weir Tank	• Noise from leaks on gaskets or connection piping • Inward crushing from excessive applied vacuum • Leaking condensate • Evidence of corrosion, particularly at threaded fittings
Filtration Vessels (bag, organoclay, and LGAC)	• Noise from leaks on gaskets or connection piping • Leaking condensate • Evidence of corrosion, particularly at threaded fittings • Higher or lower than normal inlet or outlet pressures
Water Storage Tank(s)	• Noise from leaks on gaskets or connection piping • Inward crushing from excessive applied vacuum • Leaking condensate • Evidence of corrosion, particularly at threaded fittings
NAPL Storage Tank(s) as needed	• Noise from leaks on gaskets or connection piping • Inward crushing from excessive applied vacuum • Leaking NAPL or water • Evidence of corrosion, particularly at threaded fittings
Vapor Liquid Separator	• Noise from leaks on gaskets or connection piping • Leaking condensate • Evidence of corrosion, particularly at threaded fittings • Higher or lower than normal inlet or outlet pressures
Transfer Pumps	• Noise from leaks on gaskets or connection piping • Leaking condensate • Evidence of corrosion, particularly at threaded fittings • Higher or lower than normal inlet or outlet pressures • Longer than normal pumping times during operation
Vapor Recovery Wells	• Significant increases in vacuums • Cool temperatures on surface lines (could indicate blockage of valve or hose)
Programmable Logic Controller (PLC) / Human-Machine Interface (HMI)	• Loss of power, continual shutdowns • No response to human input commands • Wireless connection, modem not functioning • Data-logging capability is disrupted • Data-processing functions are incorrect

Equipment	Conditions Requiring Servicing
LEL Meter (SVE)	• Inconsistent, low, or high LEL readings, calibrate if needed • Hydrogen cylinder pressure
Process Piping (SVE)	• Noise or odor from leaking vacuum or pressure lines • Dripping condensate from joints, valves, etc. • Obvious signs of degradation or wear
BGMS and Pump Tanks (SVE)	• Noise from leaks on gaskets or connection piping • Inward crushing from excessive applied vacuum • Leaking condensate • Evidence of corrosion, particularly at threaded fittings
Air Compressor (SVE)	• Does not hold sufficient pressure • Air supply hoses show signs of leaks/bulging/wear • Solenoid valves improperly functioning (sticking open or closed, or leaking)
OWS (SVE)	• Evidence of leaks from piping or body • Insulation is deteriorating, water is freezing • Coalescing media plugging or deteriorating
PLC/HMI (SVE)	• Loss of power, continual shutdowns • No response to human input commands • Wireless connection, modem not functioning • Data-logging capability is disrupted • Data processing functions are incorrect

If any of the conditions in Table 6 arise, the ISTR Project Manager, Project Coordinator, ISTR System Operator, and Site Operations team should be notified immediately to take appropriate steps toward further diagnosis of the condition and/or determining an appropriate fix for the condition. Refer to Table 1 in section 2 for contact information of the responsible individuals. **Attachment D** contains inspection schedules and forms that will be used during inspections. Additional health and safety and waste management-related inspections will also be performed.

5.2.2 Inspection and Maintenance Schedules

The equipment in Table 7 shall be inspected according to the frequency indicated. Preventative maintenance of the blower, pumps, piping, and instrumentation will be conducted consistent with the manufacturers' recommendations.

Table 7. Inspection and Maintenance Schedule

Equipment	Conditions Requiring Servicing	Frequency
Blower	Change oil	Annually
	Grease Zerk fittings	Quarterly
Vapor Liquid Separator	Float switches, pumps, leak detection sensors	Semiannually
Condenser	Grease Zerk fittings	Quarterly
	Change cartridge filter	As needed based on pressure readings
LEL Meter (SVE)	Calibration	Monthly
	Manufacturer maintenance service	Annually
Air Compressor (SVE)	Manufacturer maintenance service	Annually

As discussed above, additional maintenance shall be performed on an as-needed basis with the prior notification of the ISTR Project Manager, Project Coordinator, ISTR System Operator, and Site Operations team. Emphasis will be placed on preventative maintenance to minimize VR and RTO system downtime related to component failure.

The physical condition of valves and gauges, fittings, piping, etc., will be checked to ensure that strain on these components has not weakened them. Valves and gauges that do not move freely will be replaced. Piping and fittings that show signs of significant wear, warping, or leakage will be repaired or replaced immediately. Efficiency of the VR screens will be monitored based on decreasing flows and increasing vacuums necessary to induce flow. In addition, weekly inspections using thermal imaging and surface temperature monitoring will be used to monitor for sufficient flow in the VR piping.

5.2.3 Spare Parts, Suppliers, Warranties, and Equipment Catalogs

5.2.3.1 Spare Parts

Selected spare parts for the VR system are kept in a storage Conex on site. These are for installed parts that have the potential, through normal wear and tear, to require replacement at regular intervals. The ISTR System Operator is responsible for the organization and inventorying of spare parts and for maintaining an appropriate stock of such parts. Only qualified personnel approved by the ISTR Project Manager and ISTR System Operator or approved subcontractor can replace system components. If maintenance activities or inspections reveal defective equipment, or if it appears that a component of the system needs replacement and the part is not within the spare parts inventory, spare parts will be ordered in anticipation of use. If a part or component of the system needs to be replaced, the ISTR Project Manager and ISTR System Operator shall first be notified. The approval of the ISTR Project Manager is required for the use of any part that is not identical to the failed component or if an upgrade of the failed component is planned. Following notification, the ISTR Project Manager will verify that the replacement part will satisfy the requirements necessary to properly perform its intended function. Once the ISTR Project Manager has verified the technical considerations and accepted the part as fit for use, the part can be replaced by either the ISTR System Operator or qualified and approved personnel or subcontractors.

5.2.3.2 Suppliers, Warranties, and Equipment Catalogues

All major VR system components are discussed in this manual. Equipment catalogues for VR system components that contain information regarding warranties, as applicable, can also be found in **Attachment C**. TRS will supply most of the VR system's components. TRS maintains the records of equipment that has been purchased for the VR system, and TRS will maintain additional records of equipment purchased for the VR system until such time that the product has been permanently removed or replaced.

5.3 Reporting

Consistent with Section 10.9 of the EDR, the operation of the VR system will be reported on a monthly and semiannual basis. Additionally, weekly email updates will be sent to Ecology to provide updates on ISTR system operation status.

The IWAG is required under the Approval, Agreed, and Enforcement Orders to provide Ecology with a monthly operations and activities status report. Monthly reports will be submitted to Ecology by or on the 10th of each month for the month prior and will include a summary of system operation and monitoring parameters and analytical results for samples collected from the ISTR VR system.

An ISTR Performance Assessment Memorandum will be prepared per Task A.6 of the EO SOW to document ISTR performance. The draft ISTR Performance Assessment Memorandum is due 90 days after shutdown of ISTR operations. Shutdown is defined as TRS demobilization from the Site.

Attachment A

Key Site Figures and P&IDs

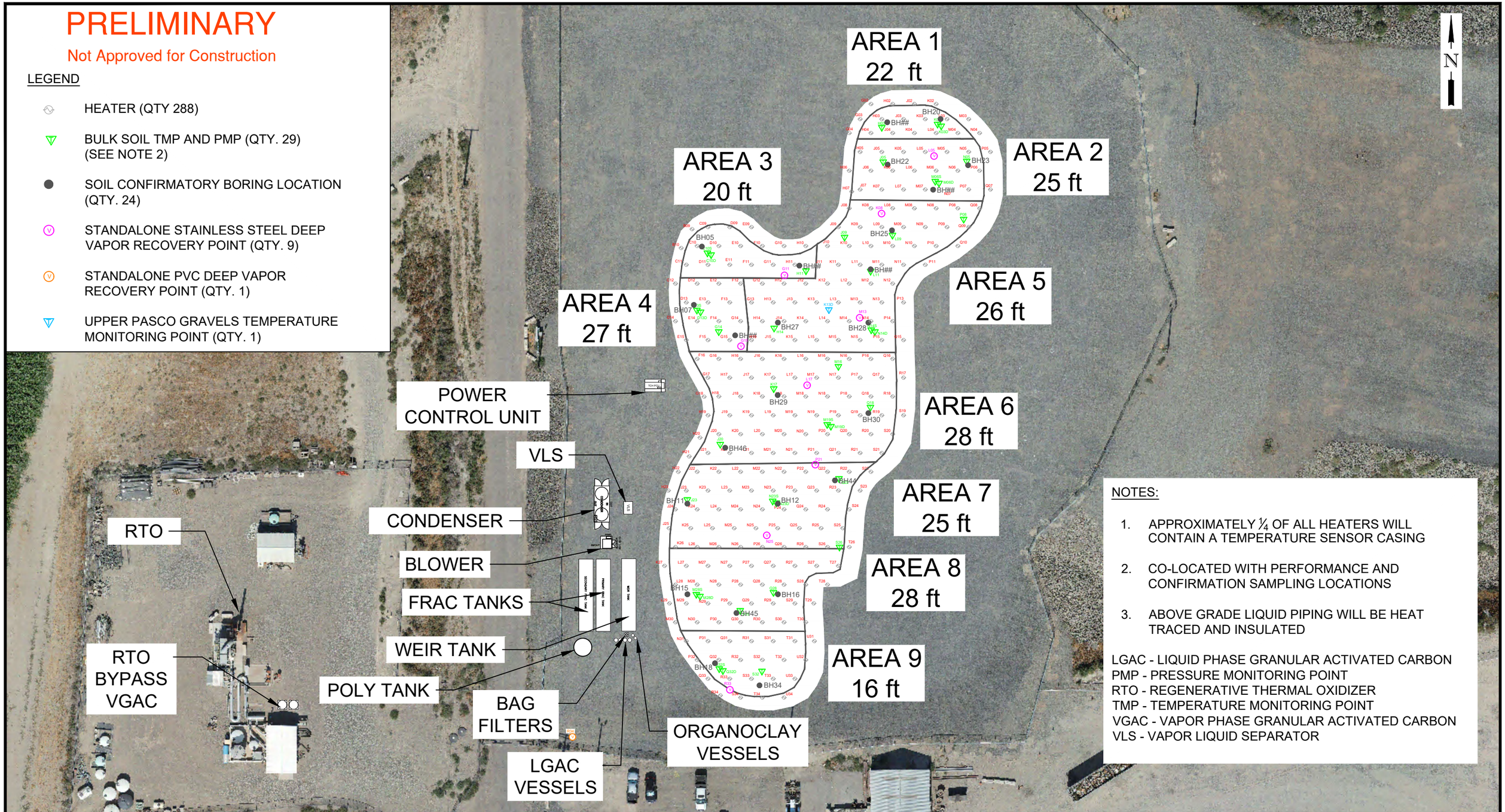
ISTR Site Plan
Groundwater Monitoring Well Locations
Standalone Deep Vapor Recovery Detail
Upper Pasco Gravels Temperature Monitoring Point
Process and Instrumentation Diagrams

PRELIMINARY

Not Approved for Construction

LEGEND

- HEATER (QTY 288)
- BULK SOIL TMP AND PMP (QTY. 29) (SEE NOTE 2)
- SOIL CONFIRMATORY BORING LOCATION (QTY. 24)
- STANDALONE STAINLESS STEEL DEEP VAPOR RECOVERY POINT (QTY. 9)
- STANDALONE PVC DEEP VAPOR RECOVERY POINT (QTY. 1)
- UPPER PASCO GRAVELS TEMPERATURE MONITORING POINT (QTY. 1)



NOTES:

1. APPROXIMATELY ¼ OF ALL HEATERS WILL CONTAIN A TEMPERATURE SENSOR CASING
2. CO-LOCATED WITH PERFORMANCE AND CONFIRMATION SAMPLING LOCATIONS
3. ABOVE GRADE LIQUID PIPING WILL BE HEAT TRACED AND INSULATED

LGAC - LIQUID PHASE GRANULAR ACTIVATED CARBON
PMP - PRESSURE MONITORING POINT
RTO - REGENERATIVE THERMAL OXIDIZER
TMP - TEMPERATURE MONITORING POINT
VGAC - VAPOR PHASE GRANULAR ACTIVATED CARBON
VLS - VAPOR LIQUID SEPARATOR

NO.	DATE	CAD	ENG	REVISIONS
1	10/5/2023	ES	CC	ADJUSTED POTABLE WATER SOURCE LOCATION
2	10/10/2023	ES	CC	SHIFTED TMP M19 APPROX. 9 FEET EAST
3	10/24/2023	ES	CC	MOVED TMP G14 TO BE SOUTH OF HEATER F14
4	2/6/2024	ES	CC	ADDED SECONDARY FRAC TANK AND SPARE LGAC VESSEL
5	7/29/2024	ES	CC	UPDATED WATER TREATMENT SYSTEM
6	7/29/2024	ES	CC	ADDED SUPPLEMENTARY SOIL SAMPLING LOCATIONS
7	10/16/2024	ES	CC	REMOVED EXTRA POLY TANKS FROM PHASE 1
8	11/4/2024	ES	CC	ADDED STANDALONE DEEP VAPOR RECOVERY POINTS
9	11/6/2024	ES	CC	ADDED SUPPLEMENTAL TMP K13D
10	11/15/2024	ES	CC	ADDED STANDALONE PVC DEEP VAPOR RECOVERY POINT

0 25 50 100
SCALE IN FEET

TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	E. SEILER
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

SITE PLAN

APPROVED FOR CONSTRUCTION
BY
DATE 2023.SEP.20

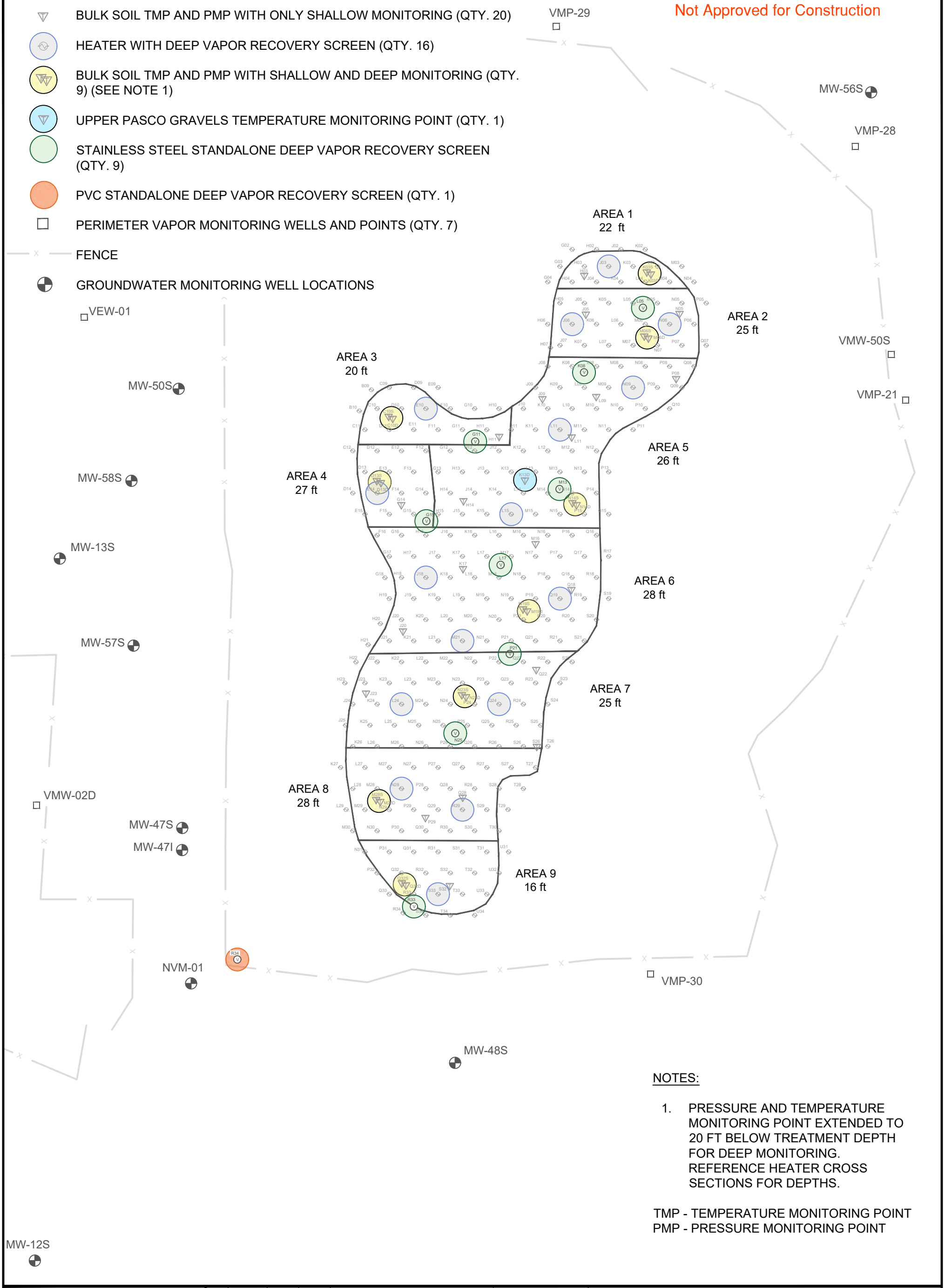
DATE 2024.NOV.15
PROJECT WA.1707
SHEET Y-1

PRELIMINARY

Not Approved for Construction

LEGEND

- HEATER WITH SHALLOW VAPOR RECOVERY (QTY 272)
- BULK SOIL TMP AND PMP WITH ONLY SHALLOW MONITORING (QTY. 20)
- HEATER WITH DEEP VAPOR RECOVERY SCREEN (QTY. 16)
- BULK SOIL TMP AND PMP WITH SHALLOW AND DEEP MONITORING (QTY. 9) (SEE NOTE 1)
- UPPER PASCO GRAVELS TEMPERATURE MONITORING POINT (QTY. 1)
- STAINLESS STEEL STANDALONE DEEP VAPOR RECOVERY SCREEN (QTY. 9)
- PVC STANDALONE DEEP VAPOR RECOVERY SCREEN (QTY. 1)
- PERIMETER VAPOR MONITORING WELLS AND POINTS (QTY. 7)
- FENCE
- GROUNDWATER MONITORING WELL LOCATIONS



NOTES:

1. PRESSURE AND TEMPERATURE MONITORING POINT EXTENDED TO 20 FT BELOW TREATMENT DEPTH FOR DEEP MONITORING. REFERENCE HEATER CROSS SECTIONS FOR DEPTHS.

TMP - TEMPERATURE MONITORING POINT
PMP - PRESSURE MONITORING POINT

TRS Accelerating Value
TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

NO.	DATE	CAD	ENG	REVISIONS
1	10/18/2024	ES	CC	FIXED MS-48S LOCATION
2	10/18/2024	ES	CC	ADJUSTED SYMBOL AND TEXT SIZE/COLOR
3	11/1/2024	ES	CC	ADJUSTED STANDALONE DEEP VR POINTS
4	11/6/2024	ES	CC	ADDED SUPPLEMENTAL TMP K13D
5	11/15/2024	ES	CC	ADDED STANDALONE DEEP VR R34
6				
7				
8				
9				
10				

0 22 44 88
SCALE IN FEET

DESIGNED BY C. CROWNOVER
DRAWN BY E. SEILER
CHECKED BY C. CROWNOVER
PROJECT MANAGER S. AVRITT
TECHNOLOGY REVIEW APPROVED

SITE PASCO ZONE A
LOCATION PASCO, WA
CLIENT IWAG

GROUNDWATER MONITORING WELL LOCATIONS

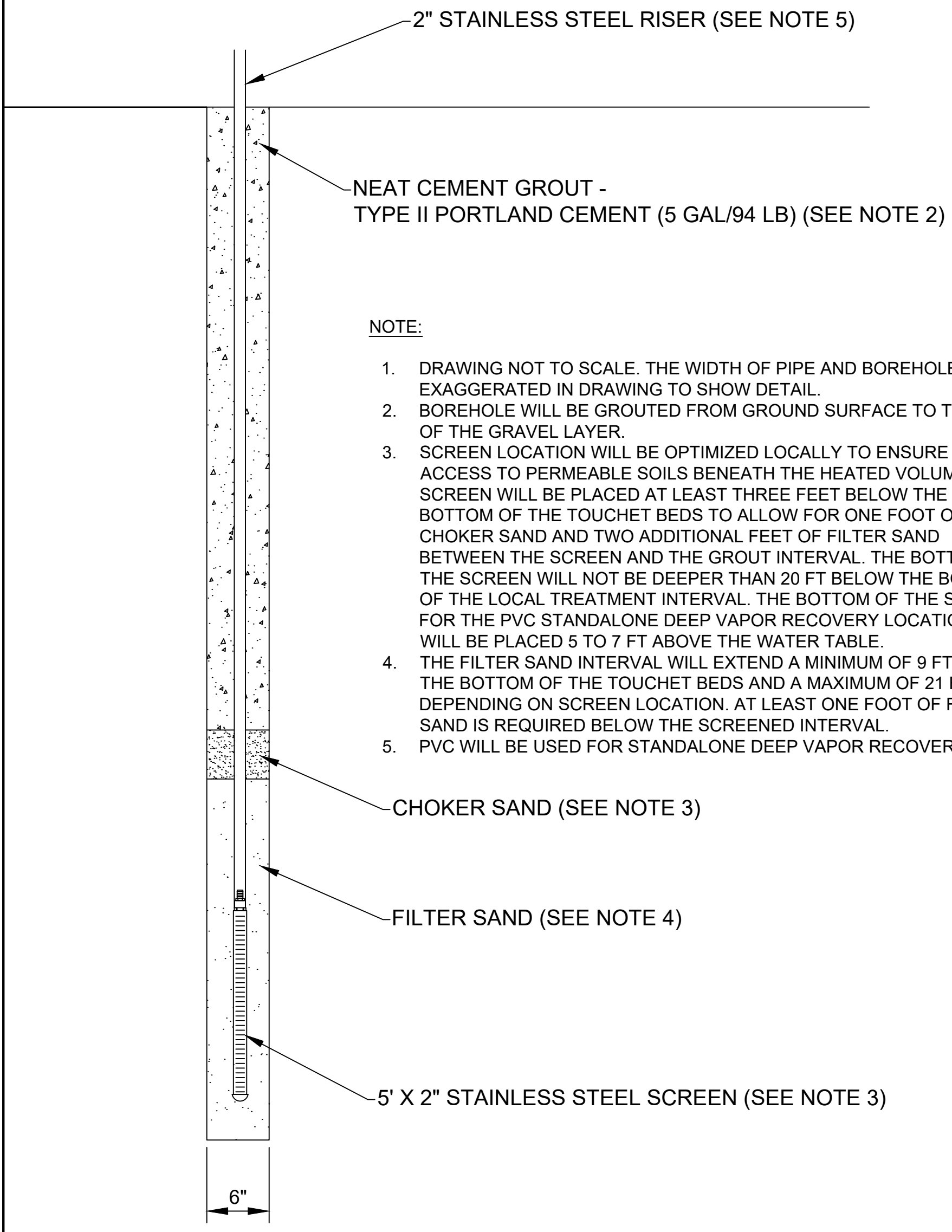
APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

DATE 2024.NOV.15
PROJECT WA.1707
SHEET Y-7

PRELIMINARY

Not Approved for Construction

STANDALONE DEEP VAPOR RECOVERY WELL (TYP. OF 10)



NOTE:

1. DRAWING NOT TO SCALE. THE WIDTH OF PIPE AND BOREHOLE ARE EXAGGERATED IN DRAWING TO SHOW DETAIL.
2. BOREHOLE WILL BE GROUTED FROM GROUND SURFACE TO THE TOP OF THE GRAVEL LAYER.
3. SCREEN LOCATION WILL BE OPTIMIZED LOCALLY TO ENSURE ACCESS TO PERMEABLE SOILS BENEATH THE HEATED VOLUME. SCREEN WILL BE PLACED AT LEAST THREE FEET BELOW THE BOTTOM OF THE TOUCHET BEDS TO ALLOW FOR ONE FOOT OF CHOKER SAND AND TWO ADDITIONAL FEET OF FILTER SAND BETWEEN THE SCREEN AND THE GROUT INTERVAL. THE BOTTOM OF THE SCREEN WILL NOT BE DEEPER THAN 20 FT BELOW THE BOTTOM OF THE LOCAL TREATMENT INTERVAL. THE BOTTOM OF THE SCREEN FOR THE PVC STANDALONE DEEP VAPOR RECOVERY LOCATION R34 WILL BE PLACED 5 TO 7 FT ABOVE THE WATER TABLE.
4. THE FILTER SAND INTERVAL WILL EXTEND A MINIMUM OF 9 FT BELOW THE BOTTOM OF THE TOUCHET BEDS AND A MAXIMUM OF 21 FT DEPENDING ON SCREEN LOCATION. AT LEAST ONE FOOT OF FILTER SAND IS REQUIRED BELOW THE SCREENED INTERVAL.
5. PVC WILL BE USED FOR STANDALONE DEEP VAPOR RECOVERY WELL

TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

NO.	DATE	CAD	ENG	REVISIONS
1	10/29/2023	ES	CC	ADJUSTED NOTES
2	11/15/2023	ES	CC	ADJUSTED TO INCLUDE PVC WELL
3				
4				
5				
6				
7				
8				
9				
10				

DESIGNED BY C.CROWNOVER

DRAWN BY E.SEILER

CHECKED BY C.CROWNOVER

PROJECT MANAGER S.AVRITT

TECHNOLOGY REVIEW APPROVED

SITE PASCO ZONE A

LOCATION PASCO, WA

CLIENT IWAG

STANDALONE DEEP VAPOR RECOVERY DETAIL

APPROVED FOR CONSTRUCTION

BY

DATE 2023.SEP.20

DATE 2024.NOV.15

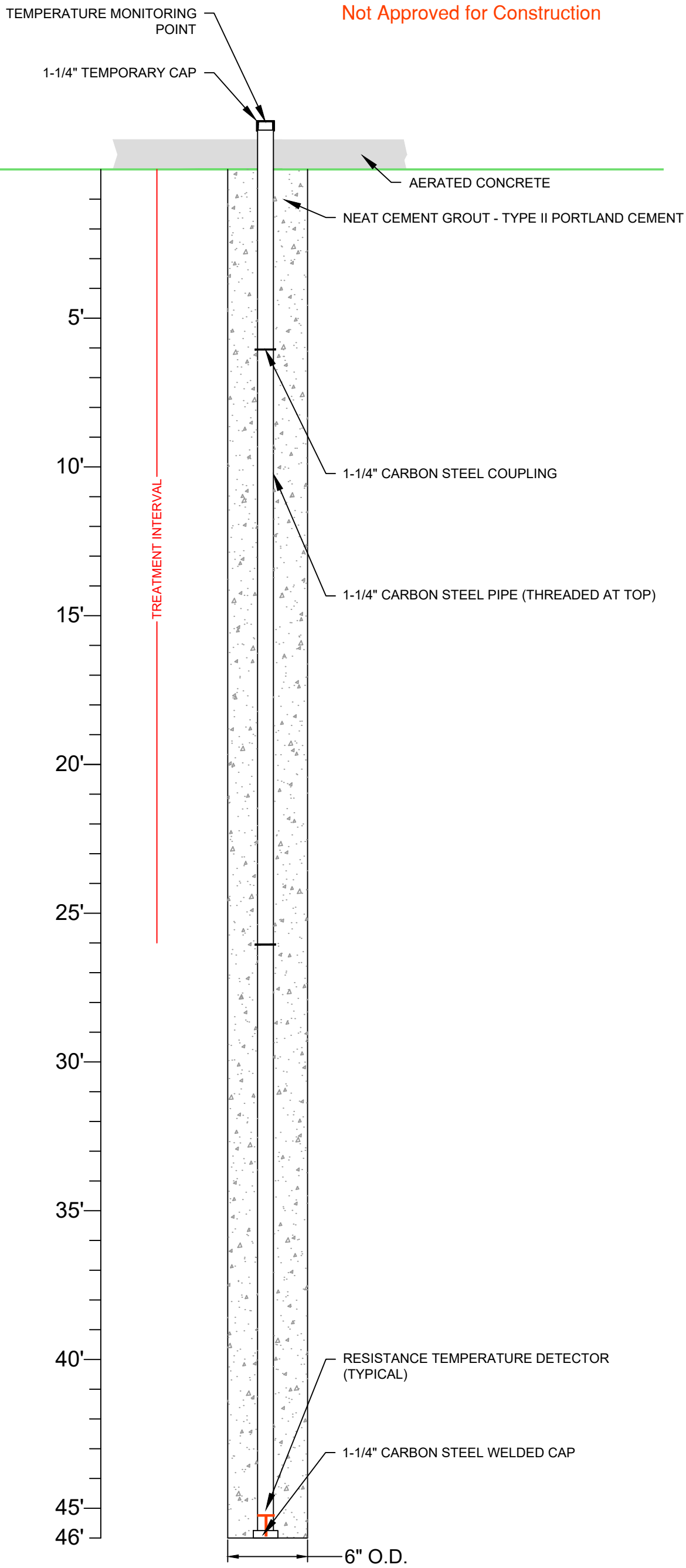
PROJECT WA.1707

SHEET M-32

PRELIMINARY

Not Approved for Construction

UPPER PASCO GRAVELS TEMPERATURE MONITORING POINT (TYPICAL OF 1)



TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

NO.	DATE	CAD	ENG	REVISIONS
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8				
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10				

DESIGNED BY C. CROWNOVER

DRAWN BY E. SEILER

CHECKED BY C. CROWNOVER

PROJECT MANAGER S. AVRITT

TECHNOLOGY REVIEW APPROVED

SITE PASCO ZONE A

LOCATION PASCO, WA

CLIENT IWAG

UPPER PASCO GRAVELS TEMPERATURE MONITORING POINT

APPROVED FOR CONSTRUCTION

BY

DATE 2023.SEP.20

DATE 2024.NOV.06

PROJECT WA.1707

SHEET M-33

PIPE MATERIAL ABBREVIATIONS

CS	CARBON STEEL
PVC	POLYVINYL CHLORIDE
SSA	STAINLESS STEEL 304
SS6	STAINLESS STEEL 316
HDPE	HIGH DENSITY POLYETHELYNE
DI	DUCTILE IRON
GS	GALVANIZED STEEL
CU	COPPER
VC	VITROUS CLAY
FRP	FIBERGLASS
PE	POLYETHLENE
PET	POLYETHYLENE TUBING
PFH	PVC FLEX HOSE
CH	CHEMICAL HOSE
LFH	LAY–FLAT HOSE (PVC)

LINE SERVICE CODE

AIR	AMBIENT AIR
AV	ATMOSPHERIC VENT
BA	BREATHING AIR
BD	BLOWDOWN
BC	BICARBONATE
BIO	BIOCIDE
BRR	BRINE RETURN
BRS	BRINE SUPPLY
CA	COMPRESSED AIR
CC	CONTAMINATED CONDENSATE
CF	COLD FLARE
CHS	CHEMICAL SEWER
CV	COLD VENT
CWR	COOLING WATER RETURN
CWS	COOLING WATER SUPPLY
DMW	DEMINERALIZED WATER
DR	DRAIN
DS	DILUTION STEAM
DW	DRINKING WATER
ER	ETHYLENE REFRIGERANT
FF	FLUSHING FLUID
FG	FUEL GAS
FO	FUEL OIL
FW	FIRE WATER
GLR	GLYCOL RETURN
GLS	GLYCOL SUPPLY
H	HYDROGEN
HS	HIGH PRESSURE STEAM
IA	INSTRUMENT AIR
IS	INTERMEDIATE PRESSURE STE AM
LNG	LIQUIFIED NATURAL GAS
LO	LUBE OIL
LPG	LIQUIFIED PETROLEUM GAS
LS	LOW PRESSURE STEAM
ME	METHANOL
MR	MIXED REFRIGERANT
MS	MEDIUM PRESSURE STEAM
N	NITROGEN
NA	CAUSTIC
NAS	CAUSTIC SEWER
NG	NATURAL GAS
NH	AMMONIA
NPW	NON POTABLE WATER
OWS	OILY WATER SEWER
OX	OXYGEN
P	GENERAL PROCESS
PA	PLANT AIR
PC	PROCESS CONDENSATE
PR	PROPYLENE REFRIGERANT
PW	PROCESS WATER
QO	QUENCH OIL
RS	RECOVERED SLOPS
RV	RELIEF VENT
RW	RAW WATER
SC	STEAM CONDENSATE
SD	STACK DISCHARGE
SG	SYNTHESIS GAS
SO	SEAL OIL
SS	SANITARY SEWER
STS	STORM SEWER
SV	SOIL VAPORS
SW	SERVICE WATER
SWR	SEA WATER RETURN
SWS	SEA WATER SUPPLY
TS	SODIUM THIOSULFATE
VAC	VACUUM

PIPING LINES

DOUBLE CONTAINMENT

PRIMARY PIPING

PRIMARY PIPING EXISTING

SECONDARY PIPING

SECONDARY PIPING EXISTING

UTILITY PIPING

HOSE

SIGNAL LINES

ELECTRICAL SIGNAL ANALOG

ELECTRICAL SIGNAL BINARY/DISCRETE

PNEUMATIC SIGNAL

SOFTWARE SIGNAL

SONIC SIGNAL

HEATER POWER DISTRIBUTION

EQUIPMENT LINES

EQUIPMENT

EQUIPMENT EXISTING

EQUIPMENT VENDOR PACKAGE

MISCELLANEOUS LINES

CAPILARY

HYDRAULIC

MECHANICAL LINK

TUBING

WATER ELEVATION

INSULATED PIPING CODE

PIPING INSULATED

XX

PIPING INSULATED AND TRACED

XX

AC	ACOUSTIC CONTROL INSULATION
CC	COLD SERVICE INSULATION
CJ	CHILLED FLUID JACKETED
CP	CONDENSATION CONTROL
CT	CHILLED FLUID TRACED
ES	INSTRUMENT ELECTRIC POWER SUPPLY
ET	ELECTRIC TRACED
FP	FIRE PROTECTION INSULATION
HC	HEAT CONSERVATION INSULATION
HJ	HOT FLUID JACKETING
HT	HOT FLUID TRACED
PF	PREVENTION FROM FREEZING INSULATION
PP	PERSONAL PROTECTION INSULATION
PS	PROCESS STABILITY INSULATION
SJ	STEAM JACKETED
ST	STEAM TRACED

FLOW DIRECTION ARROW

OPEN DRAIN

CONNECTOR NUMBER — XXXXX
DESTINATION — YYY
LINE SERVICE CODE — P&ID NO

CLOSED DRAIN

CONNECTOR NUMBER — XXXXX
DESTINATION — YYY
LINE SERVICE CODE — P&ID NO

VALVE SYMBOLS

GATE

CHECK

STOP CHECK

GLOBE

BUTTERFLY

NEEDLE

BALL

PLUG

DIAPHRAGM

3–WAY

4–WAY

PINCH

ANGLE

FLOAT

HAND

WAFER CHECK VALVE

ANTI–SIPHON VALVE

PIPE FITTING SYMBOLS

FLANGE

BLIND FLANGE

CONCENTRIC (OR GENERIC) REDUCER

ECCENTRIC REDUCER

CHEMICAL SEAL

PLUG (REFERENCE P105)

CAP

HOSE CONNECTION

WELDED CONNECTION

SPACER

BLANK

OPEN FIGURE 8 BLIND

CLOSED FIGURE 8 BLIND

PIPE SPECIALTY SYMBOLS

EXCESS FLOW VALVE

DIVERTER

ROTARY

PIPE SPECIALTY SYMBOLS CONT.

Y–TYPE STRAINER

CONE STRAINER

T–TYPE STRAINER

DUPLEX STRAINER

BASKET STRAINER

TEMPORARY STRAINER

FILTER

DETONATION ARRESTOR

FLAME ARRESTOR

DRIP TRAP

PITOT TUBE

WATER TRAP

EXHAUST HEAD

IN–LINE SILENCER

VENT SILENCER

EJECTOR/EDUCTOR

REMOVALBLE SPOOL

DESUPERHEATER

FLEXIBLE HOSE

EXPANSION JOINT

DAMPER

BREATHER

VENT COVER

MULTI–LINES

STATIC MIXER

CLEANOUT

FLOW METER TOTALIZER

OPEN VENT CAP

WALL PENETRATION

CONTROL VALVE ACTUATOR SYMBOLS

MANUAL OPERATOR

DIAPHRAGM

PRESSURE BALANCED DIAPHRAGM

HANDWHEEL – USED WITH ANY ACTUATOR

CYLINDER/PISTON

MOTOR OPERATED

ELECTRO–HYDRAULIC

SOLENOID

SOLENOID RESET

SELF–ACTUATED DEVICE SYMBOLS

PRESSURE RELIEF RUPTURE DISC

VACUUM RELIEF RUPTURE DISC

PRESSURE RELIEF VALVE

VACUUM RELIEF VALVE

PRESSURE AND VACUUM RELIEF VALVE

PRESSURE REDUCING REGULATOR

BACK PRESSURE REGULATOR

BACK PRESSURE REGULATOR WITH EXTERNAL TAP

PRESSURE REDUCING REGULATOR WITH EXTERNAL TAP

DIFFERENTIAL PRESSURE REDUCING REGULATOR

TEMPERATURE REGULATOR FILLED SYTEM TYPE

PRIMARY FLOW ELEMENT SYMBOLS

GENERAL SYMBOL IN–LINE ELEMENT XX = FS, FG, FE, FT

ORIFICE

MAGNETIC

DENSITY

TURBINE OR PROPELLER

ULTRASONIC

VORTEX

PITOT TUBE

AVERAGING PITOT TUBE

FLOW NOZZLE

VENTURI

WEDGE METER

FLUME

WEIR

POSITIVE DISPLACEMENT

ORIFICE IN QUICK CHANGE FITTING

TARGET

FLOW CONDITIONING DEVICE (e.g. STRAIGHTENING VANES)

UTILITY SYMBOLS

PA — PLANT AIR

IA — INSTRUMENT AIR

SW — SERVICE WATER

NG — NATURAL GAS

PW — POTABLE WATER

VC — VOLTAGE CONTROL

PROCESS / PAGE CONNECTOR

MATERIAL (EX: CONDENSATE) WHERE TO/WHAT IT'S DOING
PID TO/FROM # | XXXXX
FROM WHERE XXXXX

MATERIAL (EX: CONDENSATE) WHERE TO/WHAT IT'S DOING
XXXXX | PID TO/FROM #
FROM WHERE XXXXX

INSTRUMENT #

INSTRUMENT #

LINE DATA IDENTIFICATION

LINE SIZE (NUMERIC)		PIPE MAT'L (ALPHA)		LINE SERVICE CODE (ALPHA)		SEQUENCE (NUMERIC) (PAGE# STREAM#)
XX	-	XXX	-	XXX	-	XXXX

PRELIMINARY

Not Approved for Construction

NOTES

1. THIS IS AN ALL INCLUSIVE LEGEND SHEET. NOT ALL SYMBOLS WILL APPEAR ON EACH SHEET.

NO.	DATE	CAD	ENG	REVISIONS
1				
2				
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TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

LEGEND
PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

DATE 2024.FEB.08

PROJECT WA.1707

SHEET P-1

INSTRUMENTATION LEGEND

	FIRST LETTER		SUCCEEDING–LETTERS		
	MEASURED OR INITIATING VARIBLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION				
C	CONDUCTIVITY			CONTROL	
D	DENSITY OR MASS	DIFFERENTIAL			
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	GAGING (DIMENSIONAL)		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE OR HUMIDITY	MOMENTARY			MIDDLE INTERMEDIATE
N					
O			ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIBLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

INSTRUMENT SYMBOLS

LOCATION/ACCESSIBILITY	DISCRETE INSTRUMENTS	SHARED DISPLAY AND CONTROL (DCS)	PLC	DISCRETE HARDWARE INTERLOCK
FIELD MOUNTED 1. FIELD OR LOCALLY MOUNTED. 2. ACCESSIBLE TO AN OPERATOR AT DEVICE.	○	○	◇	◇
PRIMARY LOCATION NORMALLY ACCESSIBLE TO AN OPERATOR 1. CENTRAL OR MAIN CONTROL ROOM. 2. FRONT OF MAIN PANEL OR CONSOLE MOUNTED. 3. VISIBLE ON VIDEO DISPLAY. 4. ACCESSIBLE TO AN OPERATOR AT DEVICE OR CONSOLE.	⊖	⊖	◇	
PRIMARY LOCATION NORMALLY INACCESSIBLE TO AN OPERATOR 1. CENTRAL OR MAIN CONTROL ROOM. 2. REAR OF PANEL OR CABINET MOUNTED. 3. NOT VISIBLE ON VIDEO DISPLAY. 4. NOT NORMALLY ACCESSIBLE TO AN OPERATOR AT DEVICE OR CONSOLE.	⊖	⊖	◇	
AUXILIARY LOCATION NORMALLY ACCESSIBLE TO AN OPERATOR 1. SECONDARY OR LOCAL CONTROL ROOM. 2. FIELD OR LOCAL CONTROL PANEL. 3. FRONT OF SECONDARY OR LOCAL PANEL MOUNTED. 4. VISIBLE ON VIDEO DISPLAY. 5. ACCESSIBLE TO AN OPERATOR AT DEVICE OR CONSOLE.	⊖	⊖	◇	
AUXILIARY LOCATION NORMALLY INACCESSIBLE TO AN OPERATOR 1. SECONDARY OR LOCAL CONTROL ROOM. 2. FIELD OR LOCAL CONTROL PANEL. 3. REAR OF SECONDARY OR LOCAL PANEL OR CABINET MOUNTED. 4. NOT VISIBLE ON VIDEO DISPLAY. 5. NOT NORMALLY ACCESSIBLE TO AN OPERATOR AT DEVICE OR CONSOLE.	⊖	⊖	◇	

MISCELLANEOUS INSTRUMENT SYMBOLS

- PILOT LIGHT OR GAUGE GLASS ILLUMINATOR
- DUAL FUNCTION OR INSTRUMENTS SHARING COMMON HOUSING
- UNDEFINED INTERLOCK LOGIC
- FC 1230–99 — INSTRUMENT WITH LONG TAG NUMBER

FUNCTIONAL ELEMENT SYMBOLS

- Σ — SUMMING
- Σ/n — AVERAGING
- Δ — DIFFERENCE
- X — MULTIPLYING
- ÷ — DIVIDING
- √ — SQUARE ROOT
- X^N — EXPONENTIAL
- f(√) — CONVERSION INPUT/OUTPUT
- > — HIGH SELECT
- < — LOW SELECT
- >| — HIGH LIMIT
- |< — LOW LIMIT
- ± — BIAS
- f(x) — UNSPECIFIED FUNCTION
- AND — AND INTERLOCK
- OR — OR INTERLOCK

MISCELLANEOUS SYMBOLS

- H# — HEATER RTD WHERE: H = TCH HEATER WELL ID NUMBER
- VFD — VARIABLE FREQUENCY DRIVE
- MCC — MOTOR CONTROL CENTER
- 0 — LEVEL SWITCH
- XX — NOTE REFERENCE SYMBOL (XX = NOTE NUMBER, ROTATE ARROW AS REQUIRED)
- UNASSIGNED1 / UNASSIGNED2 — POINT OF CHANGE (LINE CLASS OR INSULATION REQUIREMENT)
- P XXXX — PURGE CONNECTION (XXXX = PURGE PRESSURE AND MEDIUM)
- SC XX/YY — SAMPLE CONNECTION (XX/YY = TYPE/NUMBER)
- T XXXX — TIE POINT CONNECTION (XXXX = IDENTIFICATION NUMBER)
- WATER LEVEL
- LINE BREAK
- FLOW ARROW
- SLOPE
- HOA — HAND–OFF–AUTO
- DEV — DEVIATION
- LEL — LOWER EXPLOSIVE LIMIT
- NC — NORMALLY CLOSED
- NO — NORMALLY OPENED
- TMP — TEMPERATURE MONITORING POINT

PUMPS

- HORIZONTAL CENTRIFUGAL PUMP
- POSITIVE DISPLACEMENT PUMP
- VERTICAL INLINE PUMP
- LIQUID RING VACUUM PUMP
- CENTRIFUGAL SUMP PUMP
- VERTICAL CAN PUMP
- PROGRESSIVE CAVITY PUMP
- SCREW PUMP
- AIR DIAPHRAGM PUMP
- VACUUM PUMP
- SUBMERSIBLE PUMP
- VERTICAL TURBINE PUMP
- METERING PUMP

VESSELS

- OPEN TANK
- TANK
- BARREL
- KNOCK–OUT DRUM
- DISHED ENDS VESSEL
- ION EX — WATER SOFTENER
- DOUBLE WALL TANK

BLOWERS

- POSITIVE DISPLACEMENT BLOWER
- CENTRIFUGAL BLOWER

FANS

- CENTRIFUGAL FAN

MISC

- OFFSITE TRANSPORT
- PLATE AND FRAME HEAT EXCHANGER
- FORCED DRAFT COOLING TOWER
- THERMAL INSULATION VESSEL

PRELIMINARY

Not Approved for Construction

NOTES

1. THIS IS AN ALL INCLUSIVE LEGEND SHEET. NOT ALL SYMBOLS WILL APPEAR ON EACH SHEET.

NO.	DATE	CAD	ENG	REVISIONS
1	11/13/2023	ES	CC	ADDED TMP UNDER MISCELLANEOUS SYMBOLS
2				
3				
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TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

LEGEND
PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

DATE 2024.FEB.08
PROJECT WA.1707
SHEET P-2

PRELIMINARY

Not Approved for Construction

GAS BURNER

NATURAL GAS

21

COMBUSTION AIR

22

BURNER

NOTES:

1. BYPASS IN CASE OF TEMPORARY SHUTDOWN OF THE REGENERATIVE THERMAL OXIDIZER.
2. ABOVE GRADE LIQUID PIPING WILL BE HEAT TRACED AND INSULATED.
3. ONSITE REUSE PENDING APPROVED EFFLUENT RESULTS. ADDITIONAL HOLDING TANKS WILL BE MADE AVAILABLE AS NECESSARY.

EXISTING BLOWER

BLEED AIR

2

40 HP BLOWER

EXISTING BELOW GRADE KNOCK-OUT POT

5

20

EXISTING LIQUID TREATMENT

BED 1

BED 2

EXISTING 1,000 SCFM REGENERATIVE THERMAL OXIDIZER

SEE NOTE 1

16

DISCHARGE TO ATMOSPHERE

2,000 POUND VAPOR PHASE CARBON VESSELS

V-401

V-402

23

DISCHARGE TO ATMOSPHERE

9

SEP-300 60 GALLON VAPOR LIQUID SEPARATOR

XGR-200 PLATE AND FRAME HEAT EXCHANGER

KOD-201 120 GALLON VAPOR LIQUID SEPARATOR

P-400 CONDENSATE PUMP

12

P-1000 BLOWDOWN PUMP

21,000 GALLON HOLDING TANK TANK-803

8

AIR OUT

1

17

P-201 CONDENSATE TRANSFER PUMP

SEP-100 100 GALLON VAPOR LIQUID SEPARATOR

T-700 GALLON COOLING LOOP HOLDING TANK

P-900 COOLING LOOP RECYCLE PUMP

3

10

COOLING TOWER

NAPL STORAGE TANK-802 (SIZED AS NEEDED OR SHIPPED OFFSITE)

AIR IN

7

CF-600/601 COOLING TOWER FANS

TWO 100 COOLING TON CT-300/301

FILTER HOUSING

ONSITE REUSE, RETREATMENT, OR OFFSITE DISCHARGE (SEE NOTE 3)

POTABLE WATER

SEE NOTE 2

11

10 STANDALONE DEEP VAPOR RECOVERY POINTS

288 HEATERS WITH CO-LOCATED VAPOR RECOVERY OPERATED IN 2 SEQUENTIAL PHASES

4

18,000 GALLON WEIR TANK-801

FOR OIL-WATER SEPARATION

18

6

FILTER HOUSING

ONE 300 POUND ORGANOCLAY-507/508

13

THREE 500 POUND LGAC-503/504/505/506 LIQUID PHASE GRANULAR ACTIVATED CARBON

21,000 GALLON HOLDING TANK FOR TREATED WATER TANK-804

NO.	DATE	CAD	ENG	REVISIONS
1	9/7/2023	ES	CC	MODIFIED TO INCLUDE VAPOR LIQUID SEPARATOR
2	10/6/2023	ES	CC	MODIFIED TO INCLUDE FILTERS PRIOR TO LGAC
3	11/13/2023	ES	CC	MODIFIED TEXT FOR HOLDING TANK AND ADDED NOTE 3
4	11/14/2023	ES	CC	VAPOR TREATMENT MODIFIED TO SHOW ACTUAL PROCESS FLOW
5	2/12/2024	ES	CC	REMOVED FILTERS PRIOR TO LGAC
6	6/14/2024	ES	CC	ADDED FILTERS, ORGANOCLAY, AND THIRD LGAC VESSEL
7	10/17/2024	ES	CC	ADJUSTED TO SHOW CONDENSATE REUSE IN COOLING TOWERS
8	11/1/2024	ES	CC	ADDED STANDALONE DEEP VR POINTS
9	11/15/2024	ES	CC	ADDED PVC WELL TO STANDALONE DEEP VR POINT COUNT
10				

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	E. SEILER
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

PROCESS FLOW DIAGRAM

APPROVED FOR CONSTRUCTION

BY

DATE 2024.JAN.12

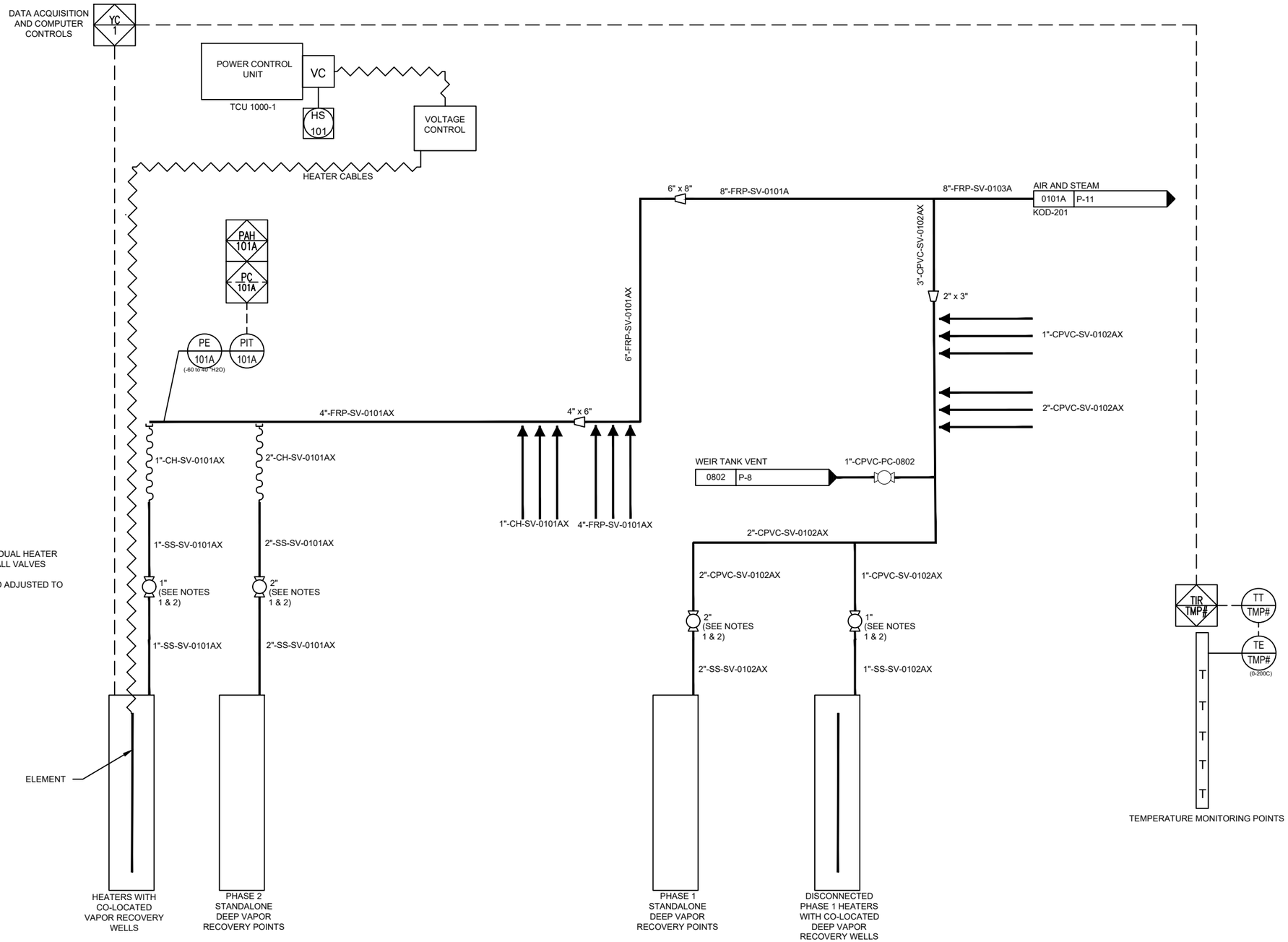
DATE 2024.NOV.15

PROJECT WA.1707

SHEET P-3

PRELIMINARY

Not Approved for Construction



NOTES:
1. BALL VALVES WILL BE CO-LOCATED WITH EACH INDIVIDUAL HEATER AND STANDALONE DEEP VAPOR RECOVERY POINT. BALL VALVES WILL BE LABELED AS "BV-" HEATER WELL NAME.
2. BALL VALVES WILL BE INSTALLED AS 75% CLOSED AND ADJUSTED TO OPTIMIZE VAPOR CAPTURE.

NO.	DATE	CAD	ENG	REVISIONS
1	11/13/2023	ES	CC	INCREASED SIZE OF SYMBOLS TO MAKE TEXT EASIER TO READ
2	2/27/2024	ES	CC	MODIFIED TO SHOW WEIR TANK VENT CONNECTION
3	11/4/2024	ES	CC	ADDED STANDALONE DEEP VAPOR RECOVERY POINTS
4				
5				
6				
7				
8				
9				
10				

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

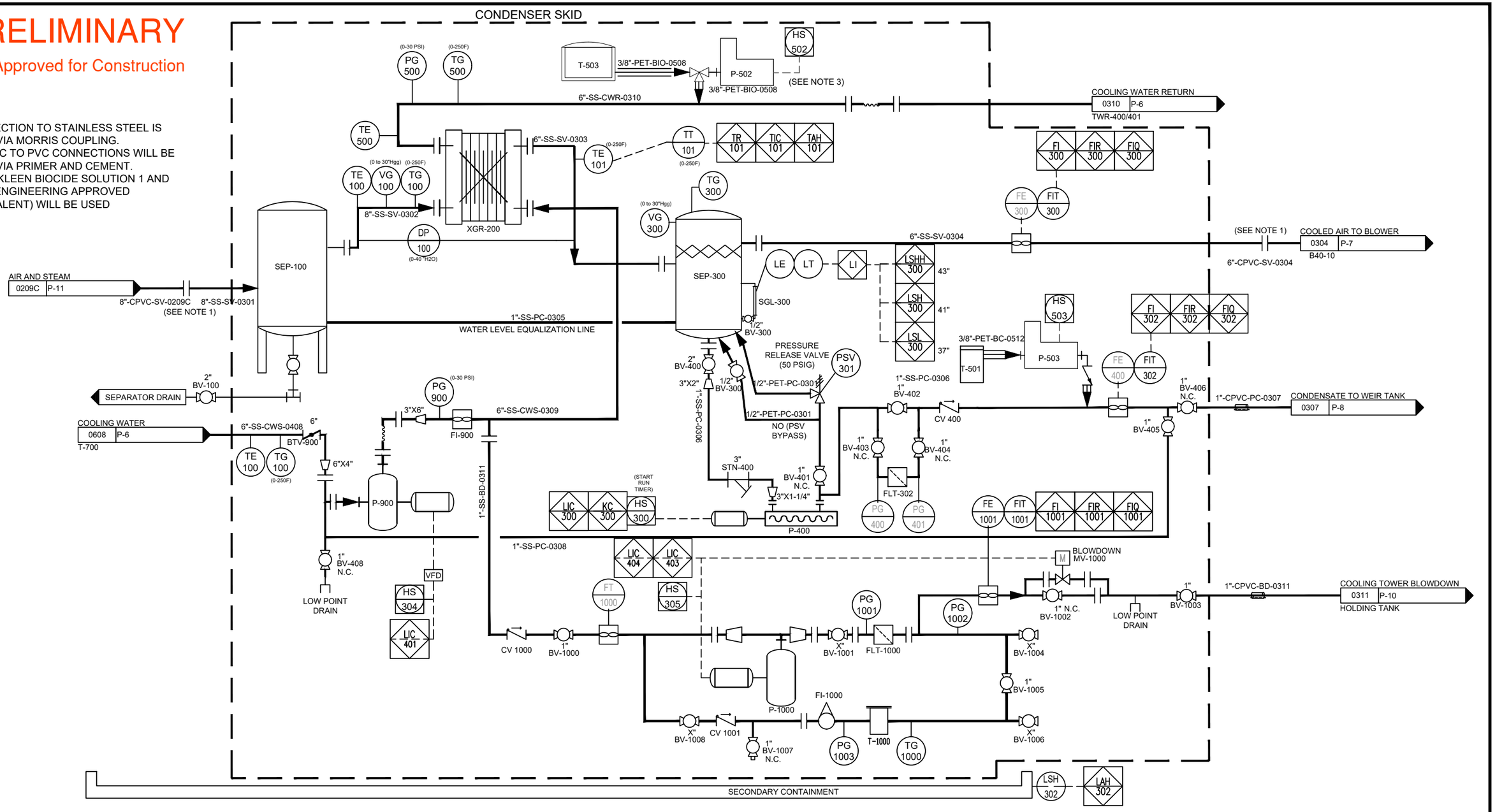
FIELD PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION		DATE	2024.NOV.05
BY		PROJECT	WA.1707
DATE	2024.JAN.12	SHEET	P-4

PRELIMINARY

Not Approved for Construction

NOTES:
1. CONNECTION TO STAINLESS STEEL IS MADE VIA MORRIS COUPLING.
2. ALL PVC TO PVC CONNECTIONS WILL BE MADE VIA PRIMER AND CEMENT.
3. ULTRAKLEEN BIOCIDE SOLUTION 1 AND 2 (OR ENGINEERING APPROVED EQUIVALENT) WILL BE USED



P-1000
DRIP PUMP
3/4 HP
480 VAC, 3 PH

P-900
COOLING WATER RECYCLE PUMP
15 HP
480 VAC, 3 PH
VFD

P-400
CONDENSATE PUMP
2 HP
480 VAC, 3 PH

P-503
CONDENSATE BICARBONATE PUMP
MAX FLOW 0.21 GPH

P-502
BIOCIDE PUMP
MAX FLOW 0.21 GPH

SEP-100
PRIMARY MOISTURE SEPARATOR
SS 3' DIA

SEP-300
SECONDARY MOISTURE SEPARATOR
SS 2.5' DIA
SS DEMISTER

FLT-302
SS
100 MICRON
RATING: 100 PSIG

T-501
CONDENSATE BICARBONATE TANK
POLY

T-503
BIOCIDE TANK
POLY
(SEE NOTE 3)

FLT-1000
POLYPROPYLENE
50 MICRON
RATING: 100 PSIG

NO.	DATE	CAD	ENG	REVISIONS
1	01/09/2024	ES	CC	ADDED NOTE SPECIFYING TYPE OF BIOCIDE
2	02/14/2024	ES	CC	CHANGED CONDENSATE AND BLOWDOWN PIPING TO CPVC AS BUILT
3				
4				
5				
6				
7				
8				
9				
10				

TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

CONDENSER
PROCESS AND INSTRUMENTATION DIAGRAM

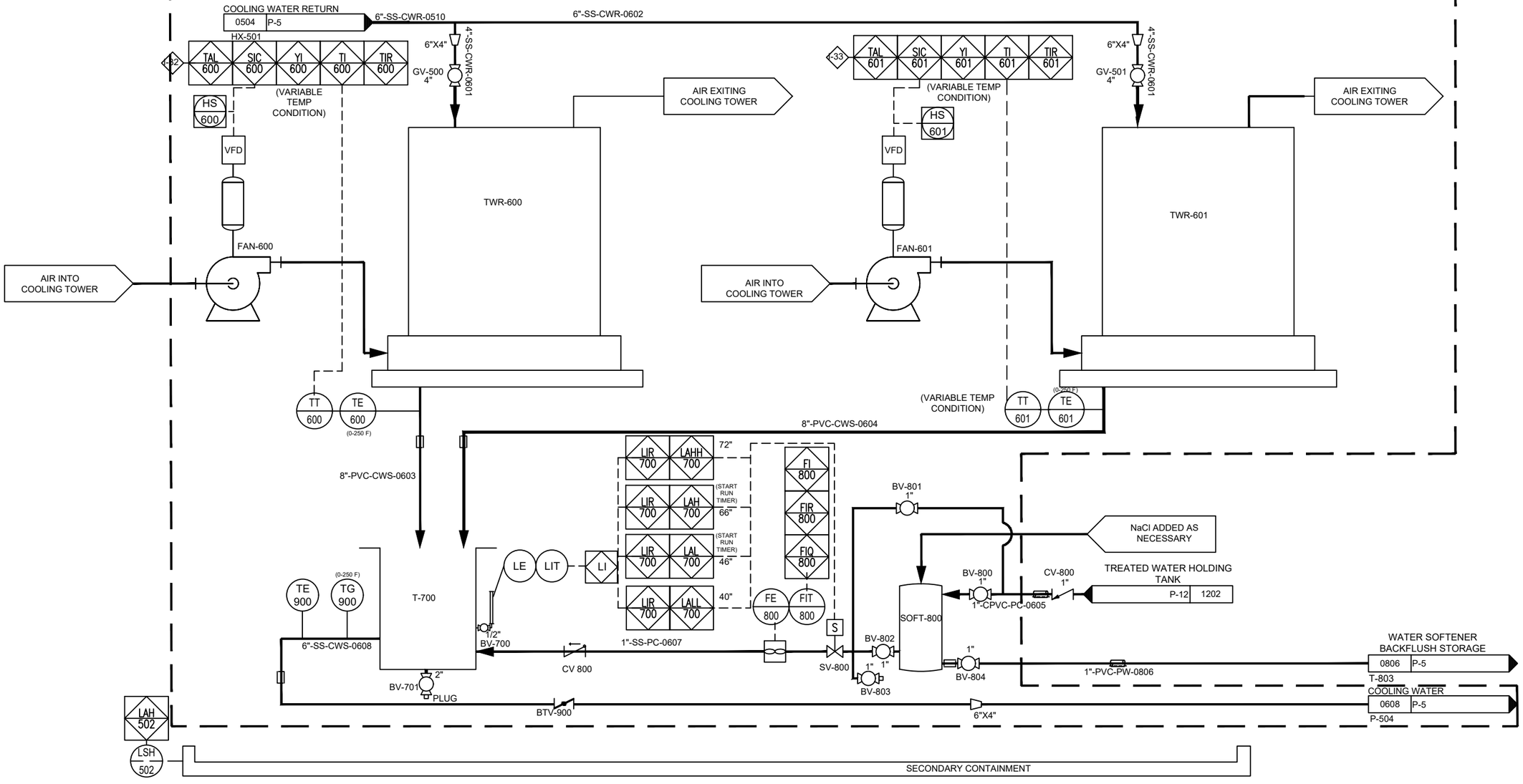
APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

DATE 2024.FEB.14
PROJECT WA.1707
SHEET P-5

CONDENSER SKID

PRELIMINARY

Not Approved for Construction



TWR-600/601
COOLING TOWER FANS
15 HP
480 VAC, 3 PH
VFD

T-700
MAKE UP WATER STORAGE TANK
STEEL

SOFT-800
WATER SOFTENER ION EXCHANGE TANK
40 GAL
POLY

NO.	DATE	CAD	ENG	REVISIONS
1	10/17/2024	ES	CC	ADJUSTED FOR CONDENSATE REUSE IN THE COOLING TOWERS
2				
3				
4				
5				
6				
7				
8				
9				
10				

TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

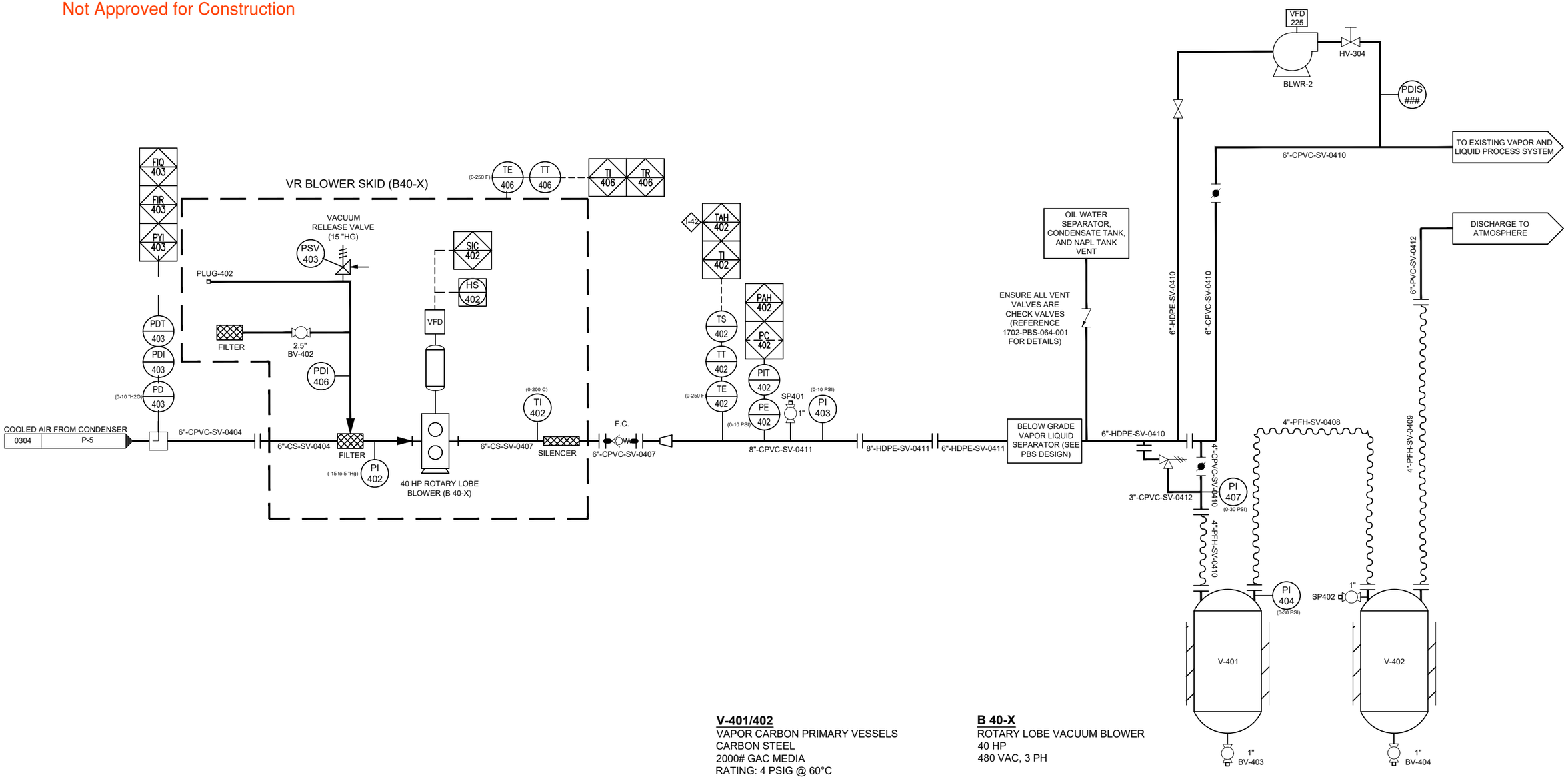
COOLING TOWER PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

DATE 2024.OCT.17
PROJECT WA.1707
SHEET P-6

PRELIMINARY

Not Approved for Construction



V-401/402
VAPOR CARBON PRIMARY VESSELS
CARBON STEEL
2000# GAC MEDIA
RATING: 4 PSIG @ 60°C
INSULATED
(VGAC IS AS REQUIRED BY LOCAL,STATE AND FEDERAL REQUIREMENTS.)

B 40-X
ROTARY LOBE VACUUM BLOWER
40 HP
480 VAC, 3 PH

NO.	DATE	CAD	ENG	REVISIONS
1	11/3/2023	ES	CC	ADDED ADDITIONAL DETAILS FOR RTO CONNECTION
2	11/30/2023	ES	CC	CHANGED VGAC PIPING TO 4" FROM 6"
3	12/1/2023	ES	CC	ADDED ADDITIONAL DETAIL ON BLOWER TO VGAC PIPING
4	2/7/2023	ES	CC	REMOVED VALVE ON BLOWER INLET
5	2/7/2023	ES	CC	CHANGED VALVE GOING INTO BLWR-2 TO A GATE VALVE
6	2/7/2023	ES	CC	CHANGED VGAC PIPING TO FLEX HOSE
7	2/7/2023	ES	CC	REMOVED UNINSTALLED TEMPERATURE SENSORS FROM VGAC PIPING
8	2/14/2023	ES	CC	ADJUSTED INSTRUMENTATION LOCATIONS TO REFLECT AS BUILTS
9				
10				

TRS Accelerating Value
TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

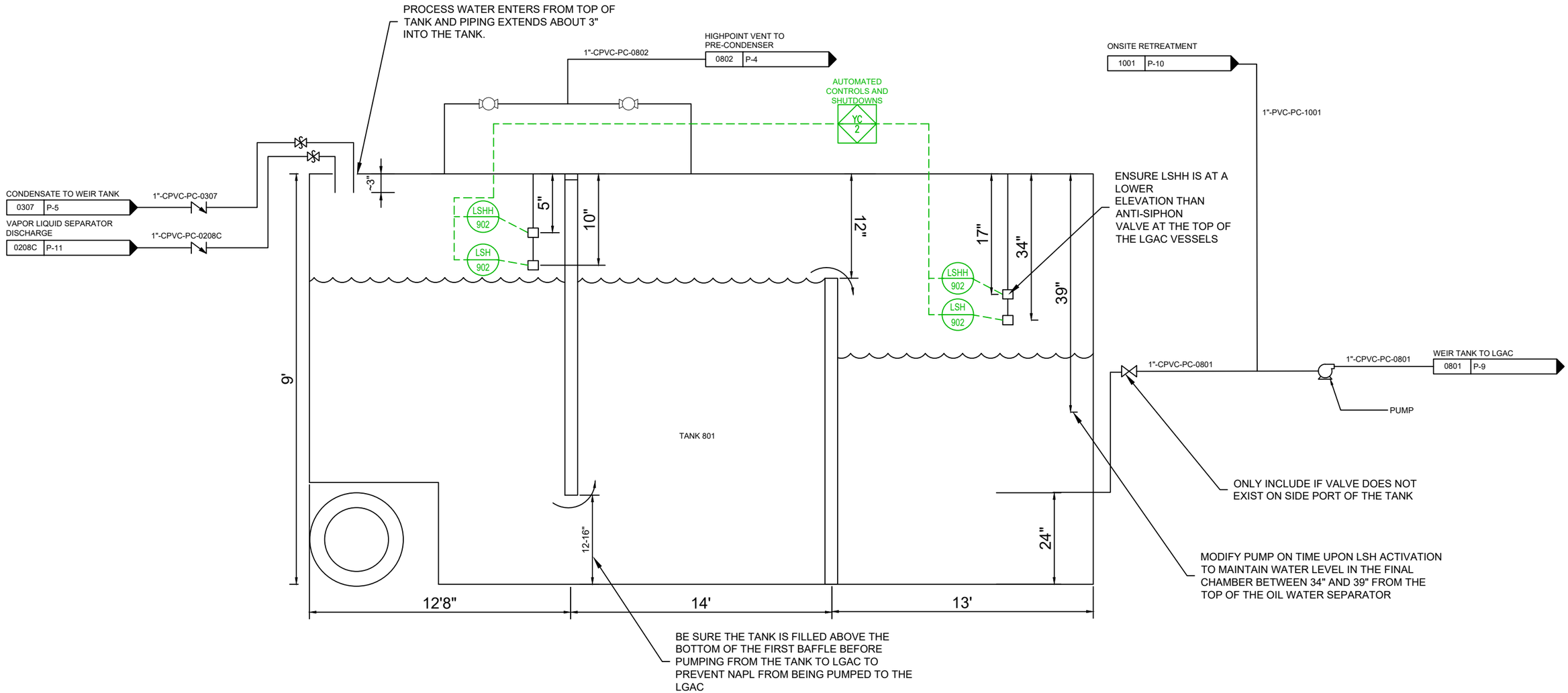
VAPOR TREATMENT PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

DATE 2024.FEB.14
PROJECT WA.1707
SHEET P-7

PRELIMINARY

Not Approved for Construction



NO.	DATE	CAD	ENG	REVISIONS
1	1/17/2024	ES	CC	ADJUSTED CALLOUT ON FIRST WEIR TANK FOR CLARIFICATION
2	1/17/2024	ES	CC	REMOVED INCORRECT REFERENCE TO SECOND WEIR TANK LENGTH
3	2/7/2024	ES	CC	ADJUSTED LENGTH LABELS TO REFLECT ACTUAL WEIR TANK
4	2/7/2024	ES	CC	ADJUSTED PROCESS WATER INLETS TO TOP OF TANK
5	2/14/2023	ES	CC	CHANGED CONDENSATE PIPING TO CPVC AS BUILT
6	2/14/2023	ES	CC	ADJUSTED POSITIONS OF ANTISIPHON VALVE ABOVE TANK INLET
7	2/27/2023	ES	CC	MODIFIED TO SHOW WEIR TANK VENT TO FIELD
8	6/14/2023	ES	CC	ADDED FRAC TANK RETREATMENT LINE
9				
10				

TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

WEIR TANK
PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION

BY

DATE 2024.JAN.12

DATE 2024.JUN.14

PROJECT WA.1707

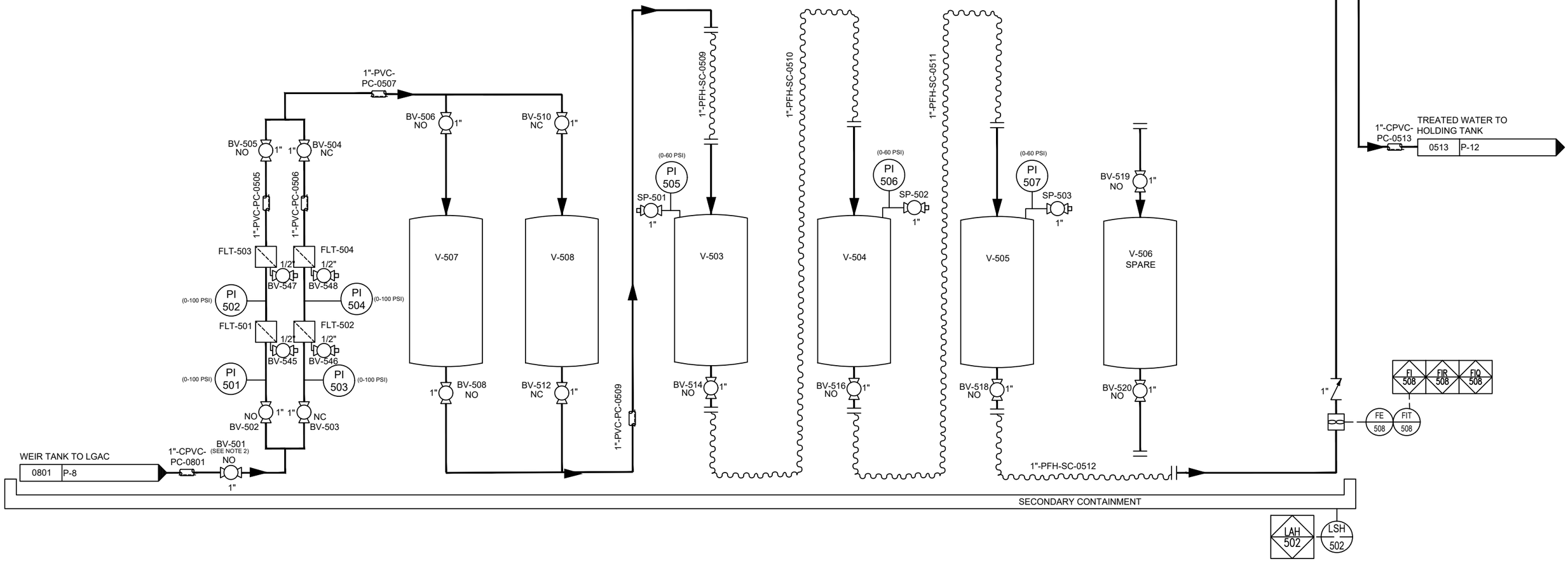
SHEET P-8

PRELIMINARY

Not Approved for Construction

NOTES:

1. OPTION FOR A MALE OR FEMALE CAM CONNECTION
2. VALVE WILL BE USED TO REGULATE FLOW TO MAINTAIN A FLOWRATE OF ABOUT 5 GALLONS PER MINUTE
3. ONLY THREE LIQUID CARBON VESSELS WILL TYPICALLY BE OPERATED AT ONCE



FLT-501/503
CARTRIDGE FILTER
50 MICRON
ALUMINUM
INSULATED AND HEATED
RATING: 100 PSIG

FLT-502/504
CARTRIDGE FILTER
5 MICRON
ALUMINUM
INSULATED AND HEATED
RATING: 100 PSIG

V-507/508
ORGANOCLAY VESSELS
FIBERGLASS
300# MEDIA
INSULATED AND HEATED
RATING: 150 PSIG @ 60°C

V-503/504/505/506
LIQUID CARBON PRIMARY VESSELS
CARBON STEEL
500# GAC MEDIA
INSULATED AND HEATED
RATING: 150 PSIG @ 60°C

NO.	DATE	CAD	ENG	REVISIONS
1	11/13/2023	ES	CC	REMOVED EXTRA LABEL INCORRECTLY SPECIFYING LGAC SIZE
2	11/28/2023	ES	CC	ADDED TOTALIZER TO EFFLUENT
3	2/7/2023	ES	CC	ENSURED ALL PIPING WAS 1" CPVC
4	2/7/2023	ES	CC	MOVED SAMPLE PORTS AND PRESSURE GAUGES TO LGAC VESSELS
5	2/12/2024	ES	CC	REMOVED FILTERS PRIOR TO LGAC
6	2/13/2024	ES	CC	ADDED NOTE ABOUT BV-501
7	2/14/2023	ES	CC	ADJUSTED INSTRUMENTATION LOCATIONS TO REFLECT AS BUILT
8	2/14/2023	ES	CC	REMOVED BLOWDOWN FROM THIS DRAWING
9	6/14/2023	ES	CC	ADDED FILTERS, ORGANOCLAY, AND THIRD LGAC VESSEL
10				

TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

WATER TREATMENT PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

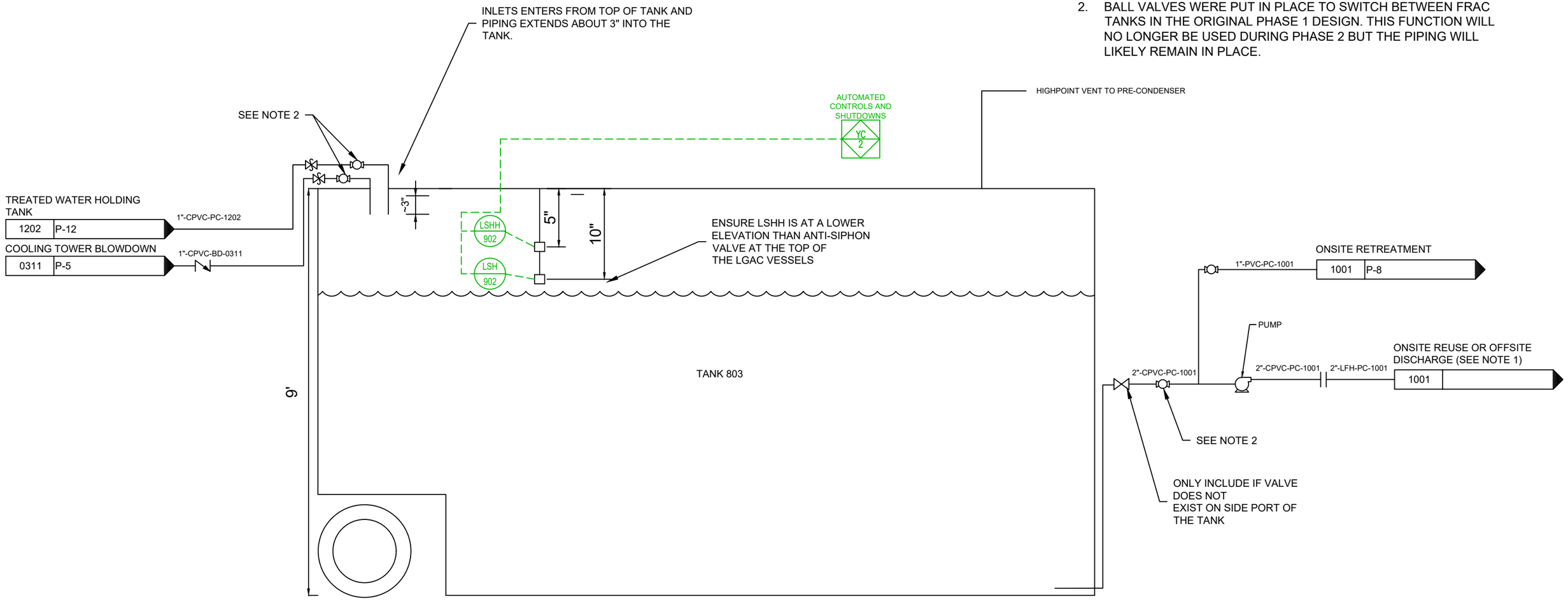
DATE 2024.JUN.24
PROJECT WA.1707
SHEET P-9

PRELIMINARY

Not Approved for Construction

NOTES:

1. ONSITE REUSE PENDING APPROVED EFFLUENT RESULTS.
2. BALL VALVES WERE PUT IN PLACE TO SWITCH BETWEEN FRAC TANKS IN THE ORIGINAL PHASE 1 DESIGN. THIS FUNCTION WILL NO LONGER BE USED DURING PHASE 2 BUT THE PIPING WILL LIKELY REMAIN IN PLACE.



NO.	DATE	CAD	ENG	REVISIONS
1	11/13/2023	ES	CC	MODIFIED END BOX AND ADDED NOTE 1
2	2/7/2024	ES	CC	MODIFIED TO SHOW CPVC IN AND OUT OF THE PUMP
3	2/7/2024	ES	CC	ADJUSTED INLETS TO TOP OF TANK
4	2/14/2023	ES	CC	CHANGED BLOWDOWN PIPING TO CPVC AS BUILT
5	2/14/2023	ES	CC	REMOVED REDUNDANT VALVES ON TREATED WATER LINE
6	2/14/2023	ES	CC	ADJUSTED NOTE 2 AND ADDED BALL VALVES
7	6/6/2023	ES	CC	ADJUSTED NOTE 2 TO INCLUDE 6,900 GALLON TANKS
8	6/14/2023	ES	CC	ADDED RETREATMENT TEE
9	10/17/2024	ES	CC	ADJUSTED FOR CONDENSATE REUSE IN THE COOLING TOWERS
10				

TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

HOLDING TANK PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION

BY

DATE 2024.JAN.12

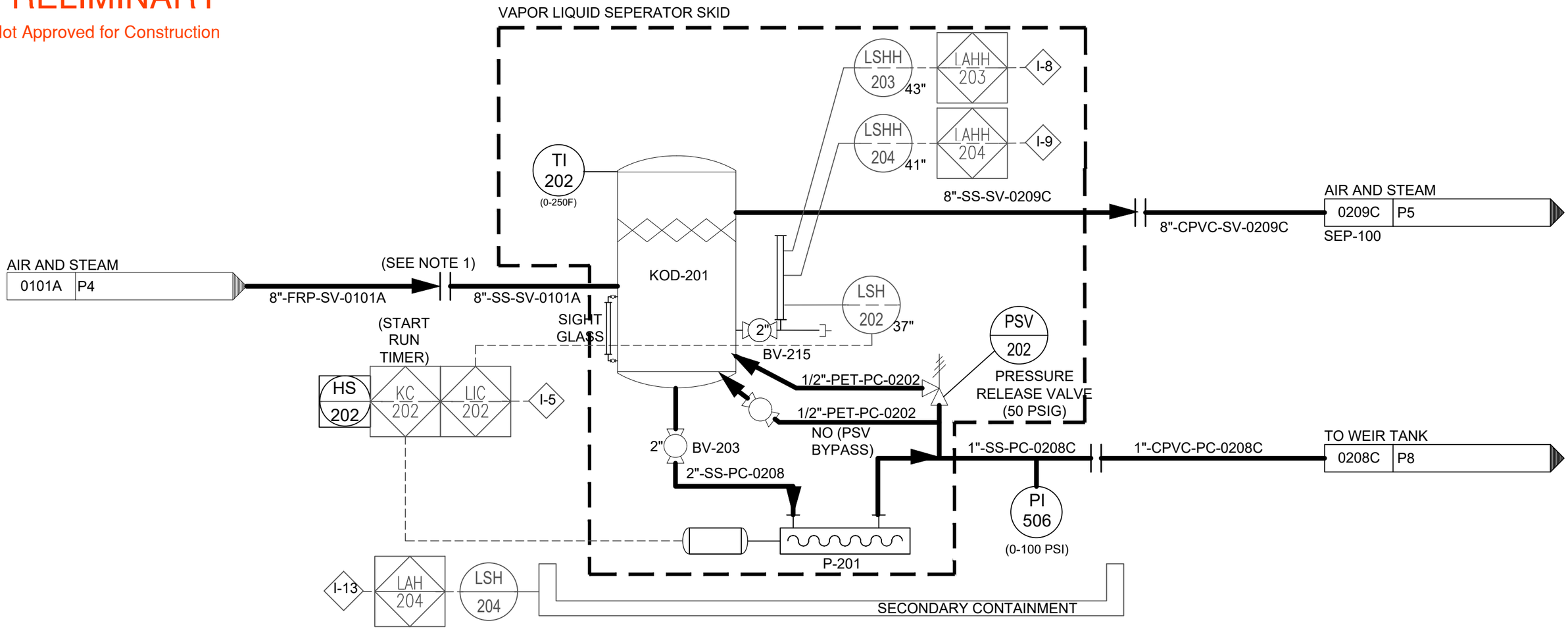
DATE 2024.OCT.17

PROJECT WA.1707

SHEET P-10

PRELIMINARY

Not Approved for Construction



KOD-201
VAPOR LIQUID SEPARATOR TANK
120 GAL
304 SS

P-201
CONDENSATE TRANSFER PUMP
1.5 HP, 3 PH

NOTES:
1. CONNECTION TO STAINLESS STEEL WILL BE MADE VIA FLANGES OR MORRIS COUPLINGS.

NO.	DATE	CAD	ENG	REVISIONS
1	11/13/2023	ES	CC	MODIFIED NOTE 1 TO SPECIFY FLANGES OR MORRIS COUPLINGS
2	2/14/2023	ES	CC	ADDED PRESSURE GAUGE TO 1" OUTLET AS BUILT
3				
4				
5				
6				
7				
8				
9				
10				

TRS Accelerating Value
TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

VAPOR LIQUID SEPARATOR PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

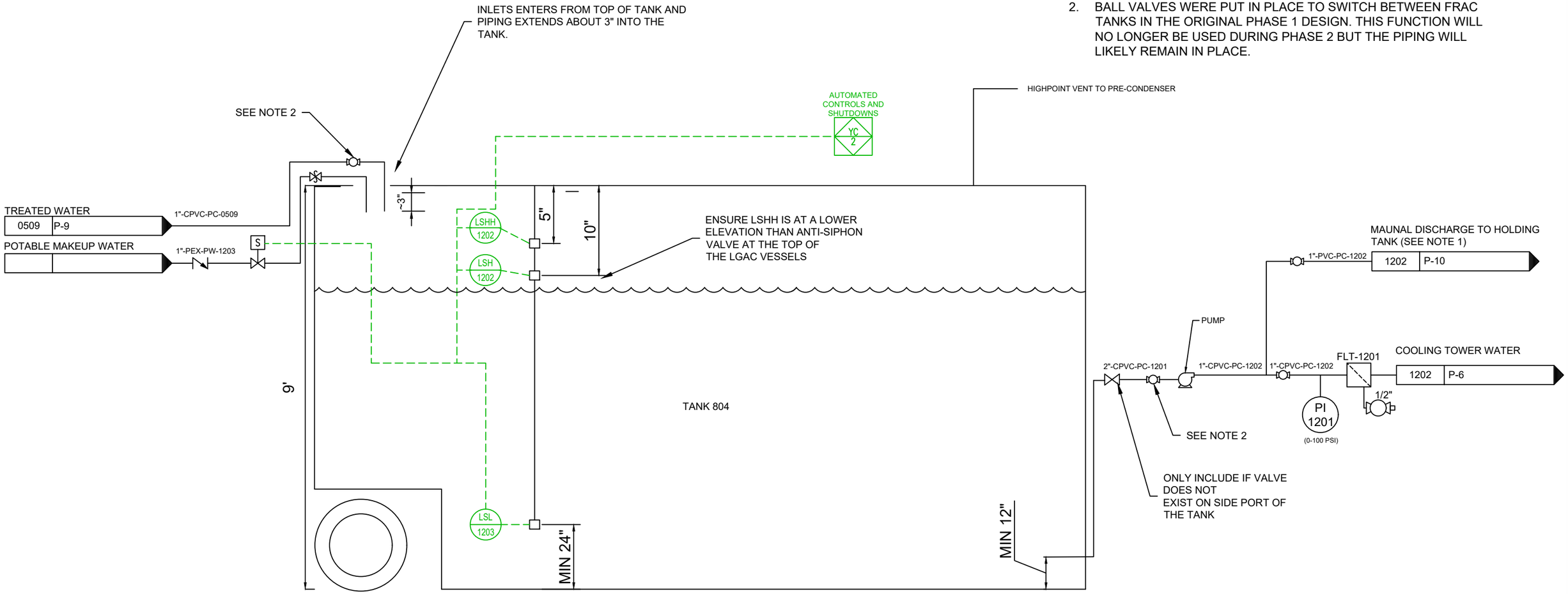
DATE 2024.FEB.14
PROJECT WA.1707
SHEET P-11

PRELIMINARY

Not Approved for Construction

NOTES:

1. MANUAL DISCHARGE TO SECONDARY HOLDING TANK WILL BE DONE AS NEEDED UPON ACTIVATION OF THE HIGH LEVEL SWITCH.
2. BALL VALVES WERE PUT IN PLACE TO SWITCH BETWEEN FRAC TANKS IN THE ORIGINAL PHASE 1 DESIGN. THIS FUNCTION WILL NO LONGER BE USED DURING PHASE 2 BUT THE PIPING WILL LIKELY REMAIN IN PLACE.



NO.	DATE	CAD	ENG	REVISIONS
1	11/13/2023	ES	CC	MODIFIED END BOX AND ADDED NOTE 1
2	2/7/2024	ES	CC	MODIFIED TO SHOW CPVC IN AND OUT OF THE PUMP
3	2/7/2024	ES	CC	ADJUSTED INLETS TO TOP OF TANK
4	2/14/2023	ES	CC	CHANGED BLOWDOWN PIPING TO CPVC AS BUILT
5	2/14/2023	ES	CC	REMOVED REDUNDANT VALVES ON TREATED WATER LINE
6	2/14/2023	ES	CC	ADJUSTED NOTE 2 AND ADDED BALL VALVES
7	6/6/2023	ES	CC	ADJUSTED NOTE 2 TO INCLUDE 6,900 GALLON TANKS
8	6/14/2023	ES	CC	ADDED RETREATMENT TEE
9	10/17/2024	ES	CC	ADJUSTED FOR CONDENSATE REUSE IN THE COOLING TOWERS
10				

TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

TREATED WATER HOLDING TANK PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION

BY

DATE 2024.JAN.12

DATE 2024.OCT.17

PROJECT WA.1707

SHEET P-12

Attachment B

VR System Design Documents

VR Piping Layout
VR System Electrical Diagram

LEGEND

- HEATER (QTY 272)
- HEATER WITH DEEP VAPOR RECOVERY SCREEN (QTY. 16)
- STAINLESS STEEL STANDALONE DEEP VAPOR RECOVERY POINT (QTY. 9)
- PVC STANDALONE DEEP VAPOR RECOVERY POINT (QTY. 1)
- BULK SOIL TMP AND PMP (QTY. 29)
- UPPER PASCO GRAVELS TEMPERATURE MONITORING POINT (QTY. 1)
- 1" SCH 80 CPVC ABOVE GRADE (SEE NOTE 1)
- 1" PEX (SEE NOTE 1)
- 2" SCH 80 CPVC (SEE NOTE 1)
- 3" SCH 80 CPVC
- 6" SCH 80 CPVC
- 6" HDPE BELOW GRADE
- 8" SCH 80 CPVC
- 8" HDPE
- 8" HDPE BELOW GRADE
- SECONDARY CONTAINMENT
- 1" STAINLESS STEEL AND CHEMICAL HOSE (1 WELL) (SEE NOTE 2)
- 2" STAINLESS STEEL
- 4" FIBERGLASS (2 TO 42 WELLS)
- 6" FIBERGLASS (43 TO 90 WELLS)
- 8" FIBERGLASS (91 TO 142 WELLS)
- 2" LAY-FLAT HOSE
- PRE-EXISTING NATURAL GAS LINE
- PRE-EXISTING SHEET PILES

PRELIMINARY

Not Approved for Construction

N

NOTES:

1. ABOVE GRADE LIQUID PIPING WILL BE HEAT TRACED AND INSULATED
2. PIPING CONNECTING INDIVIDUAL HEATERS TO THE MAIN HEADERS WILL BE COMPLETED USING STAINLESS STEEL AND CHEMICAL HOSE. SEE CROSS SECTIONS FOR DETAILS.

CPVC - CHLORINATED POLYVINYL CHLORIDE
PMP - PRESSURE MONITORING POINT
TMP - TEMPERATURE MONITORING POINT
VLS - VAPOR LIQUID SEPARATOR

TCH PCU

CONDENSER
OUT
IN
OUT
PACKS
VLS
PANEL
BLOWER
40-1 40-10
IN/OUT
SECONDARY FRAC TANK
PRIMARY FRAC TANK
WEIR TANK
4 3 2 1

TRS
Accelerating Value
TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

NO.	DATE	CAD	ENG	REVISIONS
1	10/10/2023	ES	CC	SHIFTED TMP M19 APPROX. 9 FEET EAST
2	2/6/2024	ES	CC	ADDED 2ND FRAC TANK AND SPARE LGAC
3	2/6/2024	ES	CC	ADJUSTED EQUIPMENT PIPING AS BUILT
4	2/8/2024	ES	CC	ADDED NOTE ABOUT PHASE 2 VR PIPING
5	2/28/2024	ES	CC	MODIFIED TO SHOW WEIR TANK VENT
6	10/17/2024	ES	CC	ADDED STANDALONE DEEP VR POINTS
7	10/17/2024	ES	CC	REMOVED EXTRA PHASE 1 POLY TANKS
8	11/1/2024	ES	CC	ADJUSTED STANDALONE DEEP VR POINTS
9	11/6/2024	ES	CC	ADDED SUPPLEMENTAL TMP K13D
10	11/15/2024	ES	CC	ADDED STANDALONE DEEP VR R34

0 15 30 60
SCALE IN FEET

DESIGNED BY C. CROWNOVER
DRAWN BY E. SEILER
CHECKED BY C. CROWNOVER
PROJECT MANAGER S. AVRITT
TECHNOLOGY REVIEW APPROVED

SITE PASCO ZONE A
LOCATION PASCO, WA
CLIENT IWAG

VAPOR RECOVERY PIPING PLAN

APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

DATE 2024.NOV.15
PROJECT WA.1707
SHEET Y-5

NOTES:

1. ABOVE GRADE LIQUID PIPING WILL BE HEAT TRACED AND INSULATED AS NEEDED
2. PVC MAY BE USED FOR DISCHARGE PIPING FROM SECONDARY GAC VESSELS
3. AN EXISTING 6" SCH 40 PVC PIPE WAS USED FOR THE STACK
4. FLEXIBLE HOSE ON INLET AND OUTLET OF LGAC VESSELS FOR EASE OF SEQUENCE CHANGES
5. FLEXIBLE HOSE TO TRANSFER WATER FROM THE FRAC TANKS TO THE STORAGE TANK AND FROM THE STORAGE TANK TO THE DISCHARGE PUMP NOT SHOWN

LEGEND

- HEATER (QTY 288)
- BULK SOIL TMP AND PMP (QTY. 30, INCLUDING UPPER PASCO GRAVELS TEMPERATURE MONITORING POINT K13D)
- 1" SCH 80 CPVC ABOVE GRADE (SEE NOTE 1)
- 1" PEX (SEE NOTE 1)
- 2" SCH 80 CPVC (SEE NOTES 1 AND 4)
- 3" SCH 80 CPVC
- 4" SCH 40 CPVC (SEE NOTE 4)
- 4" FLEXIBLE HOSE
- 6" SCH 40 CPVC
- 6" HDPE BELOW GRADE
- 8" SCH 40 CPVC
- 8" HDPE
- 8" HDPE BELOW GRADE
- SECONDARY CONTAINMENT
- 1" CHEMICAL HOSE (1 WELL)
- 4" FIBERGLASS (2 TO 42 WELLS)
- 6" FIBERGLASS (43 TO 94 WELLS)
- 8" FIBERGLASS (95 TO 161 WELLS)
- 2" LAY-FLAT HOSE
- PRE-EXISTING NATURAL GAS LINE
- PRE-EXISTING SHEET PILES

FROM POTABLE WATER SOURCE

CONDENSER

BLOWER

SECONDARY FRAC TANK

PRIMARY FRAC TANK

TRANSFER PUMP

DISCHARGE PUMP

LGAC VESSELS (SEE NOTE 4)

ADDITIONAL STORAGE TANKS (SEE NOTE 5)

RTO

RTO BYPASS VGAC

STACK (SEE NOTE 3)

SVE BUILDING

CONNECTION TO EXISTING SUBSURFACE CONDUIT

24'

105'

37'

CONDENSER IN OUT CDT PANEL

VLS

PANEL IN/OUT EXTRACTION 40-1-40-10

SECONDARY FRAC TANK

PRIMARY FRAC TANK

WEIR TANK

VLS

TO DISCHARGE SWALE

BAG FILTERS

WEIR TANK

PRIMARY ORGANOCLAY

SECONDARY ORGANOCLAY

PRELIMINARY

Not Approved for Construction

CPVC - CHLORINATED POLYVINYL CHLORIDE
HDPE - HIGH DENSITY POLYETHYLENE
LGAC - LIQUID PHASE GRANULAR ACTIVATED CARBON
PMP - PRESSURE MONITORING POINT
RTO - REGENERATIVE THERMAL OXIDIZER
TMP - TEMPERATURE MONITORING POINT
VGAC - VAPOR PHASE GRANULAR ACTIVATED CARBON
VLS - VAPOR LIQUID SEPARATOR

NO.	DATE	CAD	ENG	REVISIONS
1	10/5/2023	ES	CC	ADJUSTED EQUIPMENT LAYOUT & SECONDARY CONTAINMENT
2	11/28/2023	ES	CC	CHANGED 8" CPVC PARALLEL TO BLOWER TO 8" HDPE
3	2/6/2024	ES	CC	ADDED SECONDARY FRAC TANK AND SPARE LGAC VESSEL
4	2/6/2024	ES	CC	ADJUSTED EQUIPMENT PIPING TO REFLECT AS BUILT
5	2/6/2024	ES	CC	REMOVED AND REWORDED NOTES TO REFLECT AS BUILT
6	2/28/2024	ES	CC	MODIFIED TO SHOW WEIR TANK VENT
7	6/14/2024	ES	CC	ADJUSTED TO REFLECT WATER TREATMENT UPDATE
8	10/17/2024	ES	CC	REMOVED ADDITIONAL FRAC TANKS FROM PHASE 1
9				
10				

0 10 20 40
SCALE IN FEET

TRS Accelerating Value

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	E. SEILER
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
TECHNOLOGY REVIEW	APPROVED

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

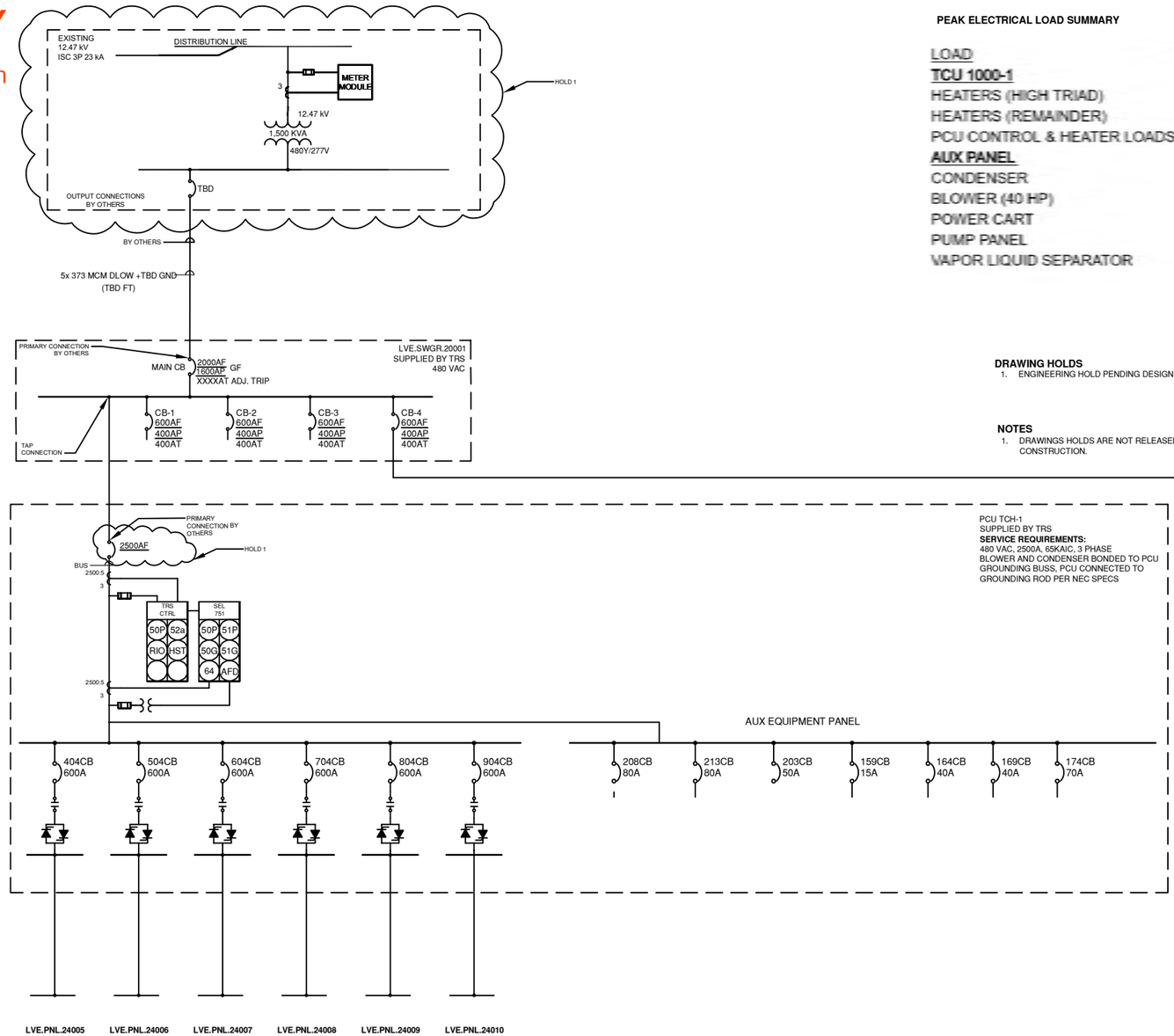
EQUIPMENT PIPING LAYOUT

APPROVED FOR CONSTRUCTION
BY
DATE 2024.JAN.12

DATE 2024.OCT.17
PROJECT WA.1707
SHEET Y-6

PRELIMINARY

Not Approved for Construction



PEAK ELECTRICAL LOAD SUMMARY

LOAD	NUMBER		CONNECTED LOAD		LOAD FACTOR		DESIGN LOAD	
TCU 1000-1								
HEATERS (HIGH TRIAD)	3	X	7.1	KVA	1.25	=	26	KVA
HEATERS (REMAINDER)	158	X	7.1	KVA	1.00	=	1117	KVA
PCU CONTROL & HEATER LOADS	1	X	15	KVA	1.00	=	15	KVA
AUX PANEL								
CONDENSER	1	X	60	KVA	1.00	=	60	KVA
BLOWER (40 HP)	1	X	46	KVA	1.00	=	46	KVA
POWER CART	2	X	30	KVA	1.00	=	60	KVA
PUMP PANEL	2	X	2	KVA	1.00	=	4	KVA
VAPOR LIQUID SEPARATOR	1	X	2	KVA	1.00	=	2	KVA
					TCU 1000-1 PEAK LOAD =		**1158**	**KVA**
					AUX PANEL PEAK LOAD =		**172**	**KVA**
					TOTAL DESIGN LOAD =		**1330**	**KVA**

DRAWING HOLDS

1. ENGINEERING HOLD PENDING DESIGN AND SETTINGS.

NOTES

1. DRAWINGS HOLDS ARE NOT RELEASED FOR CONSTRUCTION.

NO.	DATE	CAD	ENG	REVISIONS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

TRS GROUP, INC. PO BOX 737 LONGVIEW, WA 98632

DESIGNED BY	C. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	C. CROWNOVER
PROJECT MANAGER	S. AVRITT
QSAT REVIEW	QSAT PERSONNEL

SITE	PASCO ZONE A
LOCATION	PASCO, WA
CLIENT	IWAG

ELECTRICAL ONE-LINE DIAGRAM

APPROVED FOR CONSTRUCTION

BY

DATE 2024.JAN.12

DATE 2023.DEC.19

PROJECT WA.1707

SHEET E-1

Attachment C

VR Equipment Product Information

Condenser Product Information
Blower Product Information and Performance Curves
Miscellaneous Product Information
UltraKleen Biocide Product Information
Aqucar Biocide Product Information
HMI Alarm Status Conditions (pending)

ERH Condenser Fact Sheet

This fact sheet applies to: CDT-13 through CDT-25

Condenser Specifications:

Height: 96 inches
Width: 102 inches
Length: 240 inches
Weight: 22,000 pounds
Design Pressure: 150 psig
Design Temperature: 250°F
Max. Flow Rate (steam): 6,338 lbs/hr
Electrical Service: 480V, 3 Phase, 60 Hz, 80A

Cooling Tower Specifications:

Height: 96 inches
Width: 102 inches
Length: 240 inches
Weight: 8,000 pounds
Capacity: 100 cooling tons
Sump Capacity: 500 gallons
Duty Cycle: 100%

PIONEER®

Forced Draft, Counter Flow Design
10 - 100 Ton Single Modules

Pioneer® cooling towers

are forced draft counter flow design cooling towers with single module capacities from 10 to 100 cooling tons. These towers are a unitary seamless engineered plastic design that Delta has been manufacturing since 1971 and have been the standard for long-term trouble-free operation.

STANDARD FEATURES:

- Seamless Engineered Plastic (HPDE) Shell
- Corrosion Proof Construction
- Forward Curved Centrifugal Blower with Totally Enclosed Motor.
- Factory Assembled for Simple Installation
- 15 Year Shell Warranty
- PVC Water Distribution System with Non-clog Large Orifice Removable Nozzles
- High Efficiency PVC Fill
- Made in the USA

Compare the value Delta Cooling Towers offer against the value of other comparable units. You will find the benefits we can provide are unique and superior:

- Cost Reduction - save water costs and sewer taxes. A Delta cooling tower pays for itself by recirculating water.
- Non-Corrosive Materials of Construction - impervious to chemicals, acids, and salts.
- Cost Less to Maintain - will not rust, chip, or ever require painting for extraordinary tower life.
- Unique Design - provides unlimited flexibility of modular operation, future upgrade capablity, and location convenience.
- One-Piece Construction - strong and long lasting. Shell is backed by a 15 year warranty.
- Cost Less to Install - light weight construction reduces rigging and structural roof support requirements. Maintenance costs and water treatment chemicals cost are significantly lowered.

OPTIONS AVAILABLE:

- Mounting Platforms
- Two Speed Motors
- Thermostatic On/Off Fan Control Package
- Anti Freeze Basin Heaters
- Pump(s)
- Sump Level Switches
- Stainless Steel Basket Strainers
- Control Panels
- Storage Tanks

Phone: 973-227-0300 • 800-BUY-DELTA • Fax: 973-227-0458 • www.deltacooling.com

DELTA
Cooling Towers, Inc.

PIONEER®

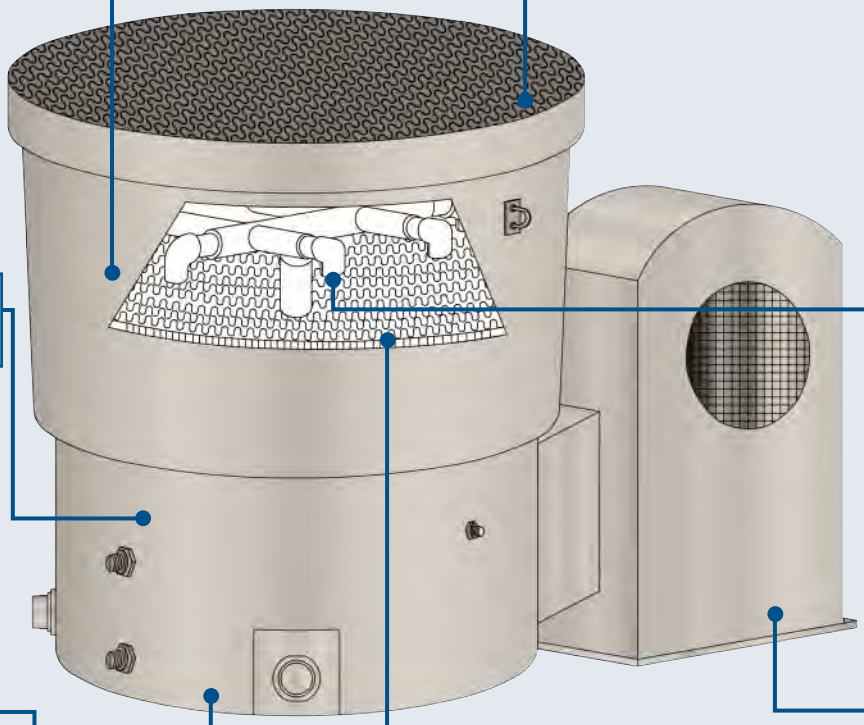
Forced Draft, Counter Flow Design
10 - 100 Ton Single Modules

CORROSION-PROOF SHELL

HDPE Plastic Construction can not corrode and is backed by 15 Year Warranty.

DRIFT ELIMINATOR

PVC drift eliminator prevents water droplets from leaving the tower.



LIGHTWEIGHT AND HEAVY DUTY

Plastic is lighter than conventional cooling towers and average wall thickness is 5-10 times sheet metal towers.

NOZZLE WATER DISTRIBUTION SYSTEM

Non-Clog large orifice removable nozzles evenly distribute the water.

LEAK-PROOF SUMP

Molded as Unitary (One-Piece) Structure that has no joints to leak or require re-caulking and sealing.

AIR MOVING SYSTEM

Totally enclosed cooling tower motor powers centrifugal blower with optional HDPE weather hood.

FILL MATERIAL

High efficiency spiral wound PVC for maximum cooling.

Model Number	Approximate Weight Shipping	Operating	Dimensions Dia. x Ht.	Capacity Tons	Fan Motor HP	Sump Capacity Gallons
Δt-10	350	705	38" x 78"	10	1	40
Δt-15	360	725	38" x 78"	15	1.5	40
Δt-20	385	750	38" x 78"	20	2	40
Δt-25	405	765	38" x 78"	25	3	40
Δt-30	710	1500	56" x 76"	30	5	75
Δt-40	730	1525	56" x 76"	40	5	75
Δt-50	910	2610	80" x 80"	50	5	157
Δt-75	970	2675	80" x 80"	75	7.5	157
Δt-100	1030	2730	80" x 80"	100	10	157

Delta Cooling Towers

Leader in Non-Corrosive Cooling Tower Technology

Tel: 973-227-0300 • Fax: 973-227-0458 • 800-BUY-DELTA • www.deltacooling.com

40 Hp Vapor Recovery Blower

Name Plate

Motor: 40 hp, TEFC, Variable Speed, 1.15 Service Factor, 240/480V, 3PH, 60Hz;

Physical Specifications:

Length – 11 feet ¼ inch
Width – 5 feet 7 ½ inches
Height – 8 feet 4 inches
Weight – 3,800 pounds

Description

Each TRS blower system is sized and configured to compliment the electrical resistance heating (ERH) technology.

At the heart of the blower system is the rotary positive displacement blower. The blower is housed in a weather-tight, sound attenuated housing. A discharge silencer and vacuum relief valve are also included in the blower system.

The controls are externally attached to the blower housing in a NEMA 4 enclosure.

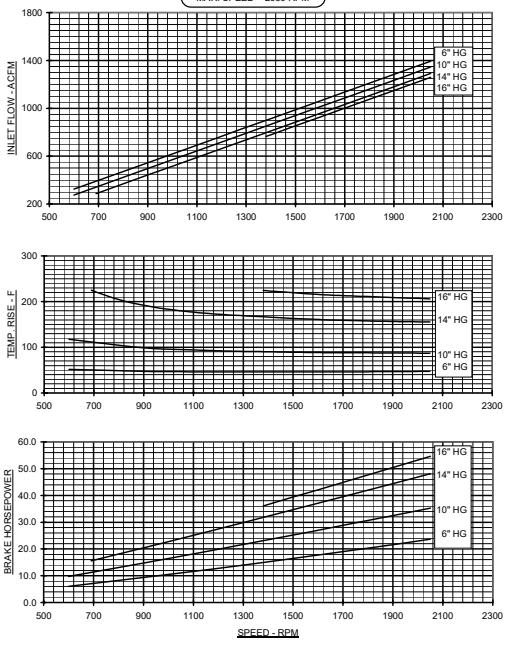
Performance Data

Gas	Air	Speed (RPM)	1652
Inlet Volume (ACFM/SCFM)	1000/517	Speed (% of maximum allowable)	81
Site Elevation (Feet)	0	Shaft Power (SHP)	35.8
Barometric Pressure (PSIA)	14.7	Discharge Temperature (°F)	241
Relative Humidity (%)	100%	Differential Temperature (°F)	141
Inlet Temperature (°F)	100	Estimated Noise Level (dBA @ 1 meter)	83
Inlet Loss (psi)	0.3		
Inlet Pressure ("Hg g)	12		
Discharge Loss (psi)	0.2		
Discharge Pressure (PSIG)	0		
Differential Pressure (psi)	6.37		

REP MFG.
800-536-9933
www.pdblowers.com

VACUUM PERFORMANCE
FRAME 711 U-RAI
MAX. VACUUM = 16" HG
MAX. SPEED = 2050 RPM

PERFORMANCE BASED ON AIR,
INLET AT 68°F
DISCHARGE PRESSURE = 30" HG ABS.
DECEMBER 2004

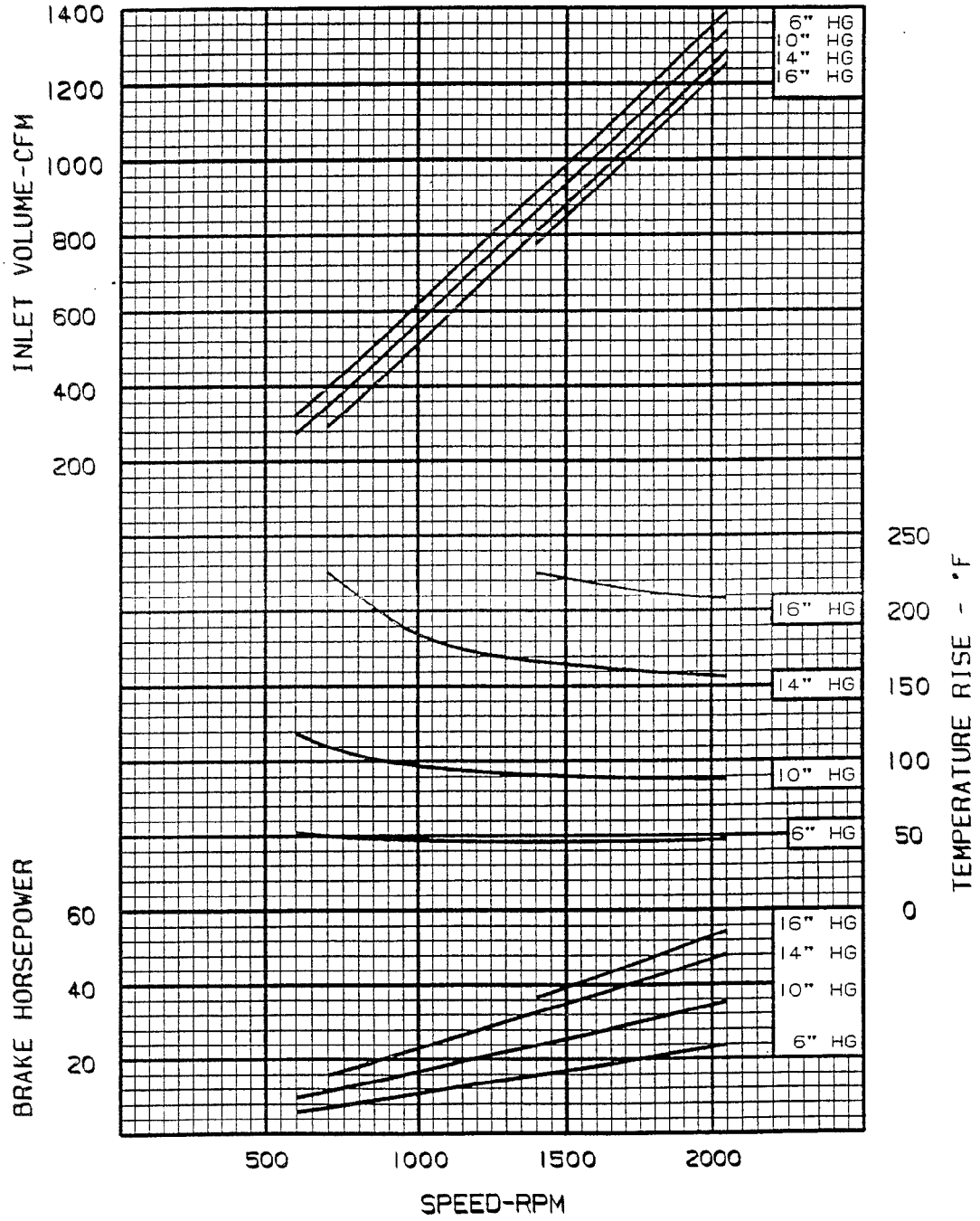


VC-12-711

DRESSER INDUSTRIES, INC.
ROOTS DIVISION
900 WEST MOUNT STREET
CONNERSVILLE,INDIANA 47331
PRINTED IN U.S.A.

PERFORMANCE BASED ON
INLET AIR = 68°F
DISCHARGE PRESSURE = 30" HG ABS.
JULY, 1994

VACUUM PERFORMANCE
FRAME 711 UNIVERSAL RAI BLOWER
MAXIMUM VACUUM=16 IN. HG
MAXIMUM SPEED=2050 RPM



/PARTS2/CRVE

VC-12-711

ESTIMATED NOISE LEVEL

TYPICAL BLOWER PACKAGE WITH PREMIUM GRADE SILENCERS

Customer:

Unit: 711 URAI

Blower RPM: 1780

Delta-P (PSI): 5.9

Noise (dBa): 91.4

Octave Band	Sound Pressure Level (dB)
31.5	76.4
63.0	76.4
125	83.4
250	87.4
500	90.4
1000	86.4
2000	83.4
4000	79.4
8000	76.4
16000	61.4

NOTE : 1) Free field sound pressure level estimate when measured per ISO 2151:2004E
2) Due to environmental influences beyond ROOTS' control, these levels cannot be guaranteed on jobsite.
3) Premium Grade Silencers are assumed.

BYPASS FILTER/SILENCER

SMALL COMPACT FILTER SILENCERS
WITH STANDARD FILTER DESIGN
"FS" Series 1/2" - 3" MPT

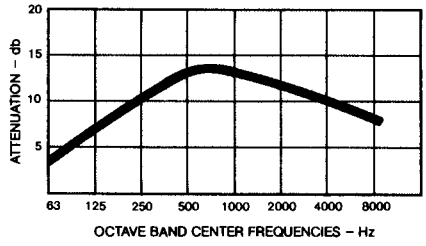
APPLICATIONS

- Industrial & Severe Duty
- Piston Compressors
- Screw Compressors
- Blowers - Side Channel & PD Type
- Hydraulic Breathers – fine filtration
- Engines
- Construction\Contractor Industry
- Workshop
- Medical\Dental Industry
- Pneumatic Conveying
- Waste Water Aeration
- Sparging

FEATURES & SPECIFICATIONS

- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron
- Fully drawn weatherhood - no welds to rust or vibrate apart
- Tubular silencing design - tube is positioned to maximize attenuation and air flow while minimizing pressure drop
- Durable carbon steel construction with baked enamel finish and powder coated weatherhood
- Interchangeable elements: Polyester, Paper
- Low pressure drop center bracket and outlet pipe design
- Temp (continuous): min -15°F (-26°C) max 220°F (104°C)
- Filter change out differential: 10"-15" H_2O Over Initial Delta P
- Pressure drop graphs available upon request

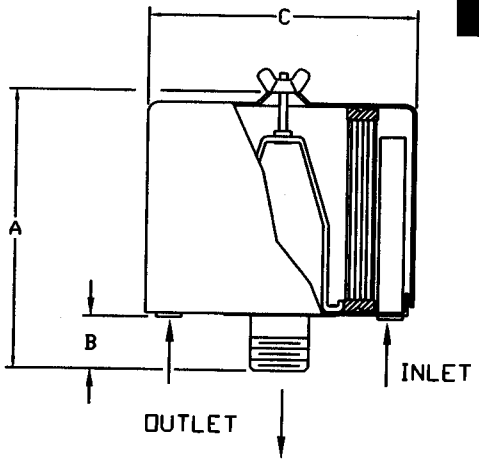
TYPICAL NOISE ATTENUATION – FS SERIES



- Noise attenuation may vary due to the wide range of applications and machines

OPTIONS (Inquiries Encouraged)

- Various media available
- 1/8" & 1/4" tap holes
- Pressure Drop Indicator
- Available in ***Stainless Steel***
- Epoxy coated housings
- Hot dipped galvanized housings
- Special connections, NPT



Dimension tolerance ± 1/8"

I = Industrial Duty S = Severe Duty

	with Polyester Element	with Paper Element	MPT Outlet	DIMENSIONS - inches A	B	C	Rated Flow SCFM Piston	Screw, Blower, Fan	Element Rating	No. of Tubes	Approx. Wt. lbs
I	FS-15-050	FS-14-050	1/2"	4	1 1/2	6	10	10	35	1	2
I	FS-15-075	FS-14-075	3/4"	4	1 1/2	6	20	25	35	2	2
I	FS-15-100	FS-14-100	1"	4	1 1/2	6	25	35	35	3	2
S	FS-19P-100	FS-18P-100	1"	6 5/8	1 5/8	6	35	55	100	3	3
I	FS-19P-125	FS-18P-125	1 1/4"	6 5/8	1 5/8	6	55	70	100	5	3
I	FS-19P-150	FS-18P-150	1 1/2"	6 5/8	1 5/8	6	70	85	100	5	4
I	FS-31P-200	FS-30P-200	2"	7 1/4	2 1/4	10	85	135	195	5	8
S	FS-231P-200	FS-230P-200	2"	12 1/4	2 1/4	10	135	135	300	7	14
I	FS-31P-250	FS-30P-250	2 1/2"	7 1/4	2 1/2	10	100	195	195	5	8
S	FS-231P-250	FS-230P-250	2 1/2"	12 1/2	2 1/2	10	195	195	300	9	15
I	FS-231P-300	FS-230P-300	3"	13	3	10	200	300	300	9	15

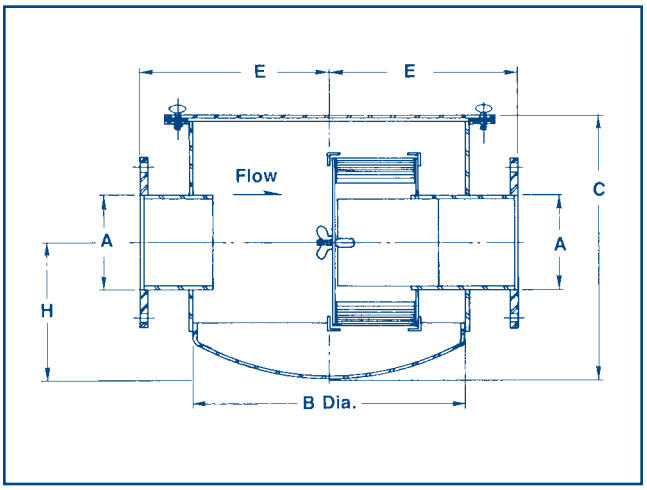
Solberg - Where the Best is in Store for You!

INLINE AIR FILTERS

F65V

INLINE AIR FILTERS - VACUUM SERVICE ONLY

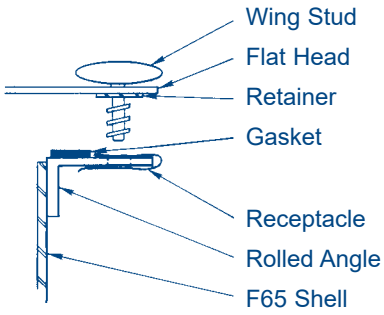
The Series F65V Inline Air Filter is designed to mount directly in the air piping system for engines, blowers or compressors. The filter element, which is fabricated from pleated paper media, has an efficiency of 99% on 1 micron particles and larger. The housing is designed to withstand a full vacuum. Pressure taps are provided on the intake and discharge nozzles for installation of a pressure drop indicator or switch by the customer. The F65V Inline Air Filter surfaces are prime coated with a red oxide primer.



ALTERNATE FILTRATION MEDIA
AVAILABLE FOR F65V

Cleanable Polyurethane Foam - 98% on 10 micron particles
Cleanable Polyester Felt - 98% on 3 micron particles
Epoxy Coated Wire Mesh - 90% on 10 micron particles
(When Oil Wetted)

FOR PRESSURE SERVICE USE F65 (See Page 2)



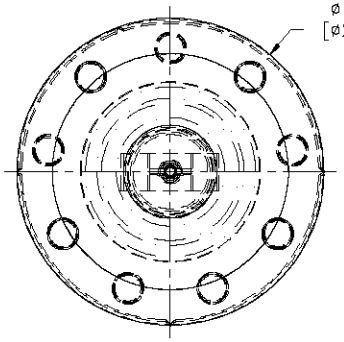
F65V up to and including 8" size:
Coarse threaded wing studs allow for easy access to the F65V for servicing the filter elements. See diagram at left.

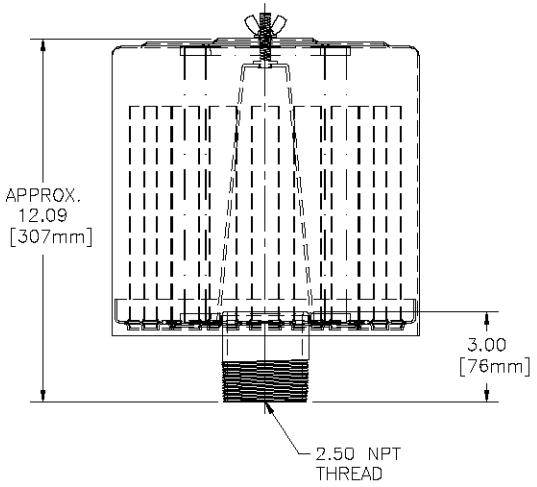
F65V SERIES

MODEL	A	B	C	E	H	RATED CFM(1)	WEIGHT	REPLACEMENT ELEMENT NUMBER
F65V-2	2 NPT	12	10 3/4	9	5	135	38	F8-108
F65V-2 1/2	2 1/2 NPT	12	10 3/4	9	5	180	40	F8-108
F65V-3	3 NPT	16	15 1/4	11	7	285	70	F8-109
F65V-4	*4 FLG	16	15 1/4	11	7	520	77	F8-109
~~F65V-5~~	~~*5 FLG~~	~~16~~	~~15 1/4~~	~~11~~	~~7~~	~~750~~	~~80~~	~~F8-109~~
F65V-6	*6 FLG	18	18 5/8	12	10	1075	100	F8-110
~~F65V-8~~	~~*8 FLG~~	~~24~~	~~19 1/2~~	~~15~~	~~10~~	~~1800~~	~~180~~	~~F8-111~~

*Flanges match 125# ASA. Diameter and Drilling.
(1) Rated capacity is based upon a maximum exit velocity of 5500 fpm.

REVISIONS						
ZONE	REV	DESCRIPTION	ECN #	CHG BY	DATE	APP'D





REPLACEMENT ELEMENT# 230P	
MATERIAL	PAPER
CFM FLOW	300
SURFACE AREA	11.8 SQ. FT.
I.D.	3.63
O.D.	5.75
HEIGHT	9.50

MODEL#	HOUSING MATERIAL	FINISH
FS-230P-250	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:

SOLBERG MANUFACTURING INC.
1151 W. ARDMORE AVE.
ITASCA, IL 60143
630/773-1363

DESCRIPTION:
FS-230P-250

SALES REP.:

APPROVALS	DATE
DRAWN: ABL	07/12/07
APPROVED:	

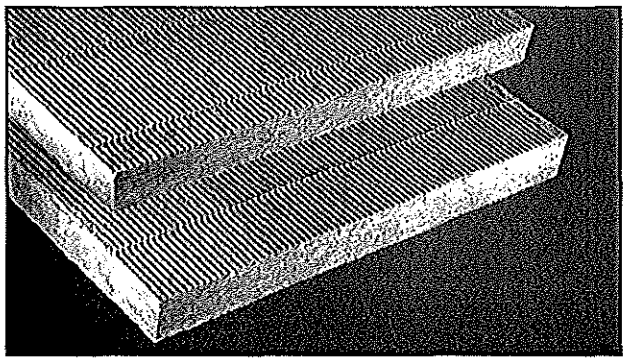
SHEET: 1 of 1 | SHEET SIZE: C | SCALE: NTS

DRAWING NUMBER: SD12895 | REV: —

IIG MinWool, LLC
A Calsilite/Johns Manville Joint Venture

MinWool-1200 Industrial Board

High Temperature Insulation



Description
IIG MinWool-1200 Industrial Board Insulation is made of inorganic fibers derived from basalt, a volcanic rock, with a thermosetting resin binder. Advanced manufacturing technology ensures consistent product quality, with high fiber density and low shot content, for excellent performance in high temperature thermal control and fire resistance applications.

Applications
MinWool-1200 Industrial Board Insulation provides excellent thermal insulation performance for mechanical/power and process piping systems operating from sub-ambient to 1200°F (649°C). These Industrial Board Insulations are easily fabricated, cutting cleanly and easily with a knife. Very low in-service shrinkage helps prevent gaps from forming at joints, preventing costly thermal leaks. The insulation is designed to be field-jacketed.

Advantages
Unique Bio-Soluble Fiber. IIG MinWool-1200 has been tested according to EU protocol ECB/TM/27, Revision 7, Directive 97/69/EC and exceeds the regulatory requirements for solubility.

Excellent Thermal Performance. Good thermal conductivity values help maximize control of heat loss, contributing to reduced operating costs and greater energy savings. High dimensional stability and low shrinkage reduce the potential for gaps forming at joints.

Good Compressive Strength. Industrial Board Insulations are semi-rigid to rigid and maintain structural integrity under severe operating conditions. Thickness stays uniform; there is less jacket damage.

Lightweight, Low Dust. Easy to handle and fabricate, these boards are easy to cut with a knife. No sawing is required. Clean handling properties help reduce irritation and minimize job clean-up time and expense. It may be installed directly on hot surfaces; system shut-down and staged heat-up are not required.

Noncombustible. These insulation boards have a flame spread rating of 5 and a smoke developed rating of 0 when tested in accordance with ASTM E 84, UL 723, CAN/ULC-S102-M. They are rated as noncombustible in accordance with ASTM E 136 and CAN4-S114-M.

Available Types
IIG MinWool-1200 Industrial Boards are available in six nominal densities in accordance with ASTM C 612 and in a range of standard thicknesses, as follows:

	Type					
Density	1230	1240	1260	1280	1210	1212
lb/ft³	2.25	3	4.5	6	7.5	9
kg/m³	36	48	72	96	120	144

Standard Size: 24" x 48" (610 mm x 1219 mm)
Standard Thicknesses: 1" to 5" (25 mm to 127 mm)
Industrial Boards are available with FSP facings on a made-to-order basis. Custom sizes are also available on a made-to-order basis.

Application Recommendations
MinWool-1200 Industrial Board Insulation can be directly installed on heated flat and curved surfaces by attaching with welded pins or studs. Pins with speed washers or studs and nuts should be installed on 16" (406 mm) spacing (max.) and not more than 4" (102 mm) from the edge of the insulation. The insulation is normally impaled over the pins or studs and the enclosing sheet metal or metal mesh is secured to the same fasteners. Joints of the sheet metal finish are offset from joints of the insulation.

For faced insulation boards, cover pins and clips with vapor-sealing pressure-sensitive patches matching the FSP facing. The insulation may also be finished with various jacketing such as sheet metal, metal mesh and insulating cement, canvass or glass fabric and paint, or rigid jacketing depending on the requirements for physical abuse, weather and chemical resistance. Jacketing may be secured using screws, rivets, or bands. If a vapor retarder is required, screws, rivets or any other penetrations must be sealed.

For temperatures over 600°F (316°C), good insulation practice suggests double-layer applications. Single-layer installation requires good workmanship to minimize heat transfer and hot or cold joints. This insulation may be installed in single or multiple layers at all temperatures up to 1200°F (649°C). In multiple-layer applications, each layer must be secured in place before the next layer is installed. Joints in multiple-layer applications should be staggered to reduce heat transfer.

Government Certification
When ordering material to comply with any government specification or any other listed specification, a statement of that fact must appear on the purchase order. Government regulations and other listed specifications require specific lot testing, and prohibit the certification of compliance after shipment has been made. There may be additional charges associated with specification compliance testing. Please refer to price page IIG-CSP-3 for Certification Procedures and Charges. Call customer service for more information.

MinWool-1200 Industrial Board

High Temperature Insulation

Specification Compliance

Maximum Continuous Use Temperature, ASTM C 411 ..... 1200°F (649°C)
ASTM C 612 ..... Types 1A,IB, II, III, IVA, -- All Boards; Types 1260, 1280, and 1212 Also Meet Type IVB
Flame Spread/Smoke Developed, ASTM E 84 , UL 723, CAN/ULC-S102-M 5/0
ASTM E 136 ..... Noncombustible
In-Service Shrinkage, ASTM C 356 ..... 0% at 1050°F (566°C); <1% at 1200°F (649°C)
Water Vapor Sorption, ASTM C 1104 ..... <1% By Weight at 120°F (49°C), 95% RH
Shot Content, ASTM C 1335 ..... 20%
US Coast Guard (164.109/7/0) ..... 164.109 (Noncombustible)
CAN/CGSB-51.10 ..... Type 2, Class 4 - Types 1240, 1260, 1280; Type 1, Class 4 - Types 1210, 1212
EU Protocol for Bio-Soluble Fiber ..... Passes
Compressive Strength, ASTM C 165 (Minimum) at 10% Deformation ..... Compressive

Strength	Type 1230	1240	1260	1280	1210	1212
lb/ft²	0.30	25	75	120	250	250
kPa	0.01	1.2	3.6	5.8	12.0	12.0

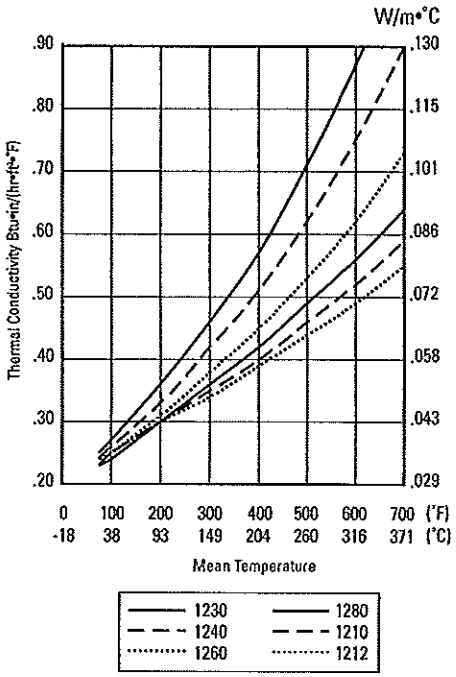
Thermal Performance (I-P Units)

Mean	Apparent Thermal Conductivity, Btu•in/(hr•ft²•°F)					
Temp. (°F)	1230	1240	1260	1280	1210	1212
75	0.25	0.24	0.23	0.23	0.23	0.24
100	0.27	0.26	0.25	0.24	0.25	0.25
200	0.36	0.33	0.31	0.30	0.30	0.30
300	0.46	0.42	0.38	0.36	0.35	0.34
400	0.57	0.51	0.45	0.42	0.40	0.39
500	0.71	0.62	0.53	0.49	0.46	0.44
600	0.87	0.75	0.62	0.56	0.52	0.49
700	1.06	0.90	0.73	0.64	0.59	0.55

Thermal Performance (SI Units)

Mean	Apparent Thermal Conductivity, W/m•°C					
Temp. (°C)	1230	1240	1260	1280	1210	1212
24	0.036	0.035	0.033	0.033	0.033	0.035
38	0.039	0.037	0.036	0.035	0.036	0.036
93	0.052	0.048	0.045	0.043	0.043	0.043
149	0.066	0.061	0.055	0.052	0.050	0.049
204	0.082	0.074	0.065	0.061	0.058	0.056
260	0.102	0.089	0.076	0.071	0.066	0.063
316	0.125	0.108	0.089	0.081	0.075	0.071
371	0.153	0.130	0.105	0.092	0.085	0.079

Thermal Conductivity ("k")



Acoustical Performance

Type	Thickness (in)	(mm)	Sound Absorption Coefficients 1/3 Octave Band Center Frequencies, Hz 125	250	500	1000	2000	4000	NRC
1240	1½	38	0.13	0.48	1.02	1.08	1.02	1.01	0.90
	2	51	0.20	0.61	1.07	1.06	1.04	1.07	0.95
	4	102	0.88	1.14	1.17	1.08	1.06	1.10	1.10
	6	152	1.32	1.14	1.11	1.09	1.06	1.07	1.10
1260	1½	38	0.18	0.62	1.08	1.08	1.03	1.07	0.95
	2	51	0.25	0.85	1.15	1.10	1.04	1.06	1.05
	3	76	0.80	1.07	1.11	0.99	0.98	0.96	1.05
	4	102	0.99	1.01	1.10	1.03	1.03	1.05	1.05
1280	1½	38	0.13	0.64	1.08	1.08	1.04	1.07	0.95
	2	51	0.32	0.90	1.11	1.07	1.01	1.05	1.00
	4	102	1.11	0.91	1.03	1.03	1.06	1.07	1.00

Industrial Insulation Group, LLC is a Calsilite/Johns Manville joint venture. IIG manufactures MinWool-1200 mineral fiber pipe, block and a variety of other insulations; Thermo-12® Gold Calcium Silicate pipe and block insulation; Super Firetemp® fireproofing board; Sproule WR-1200™ Perlite pipe and block insulation; high temperature adhesives, and insulating finishing cement.

For Customer Service and Order Placement
(866) 444-4380
Fax: (866) 444-4766

For Sales Information
(800) 866-3234
Fax: (610) 358-0602

For Technical Information
(800) 872-0338
Fax: (970) 858-9641

IIG MinWool, LLC
A Calsilite/Johns Manville Joint Venture

908 John Bussey Drive
Phenix City, AL 36869
www.iig-llc.com

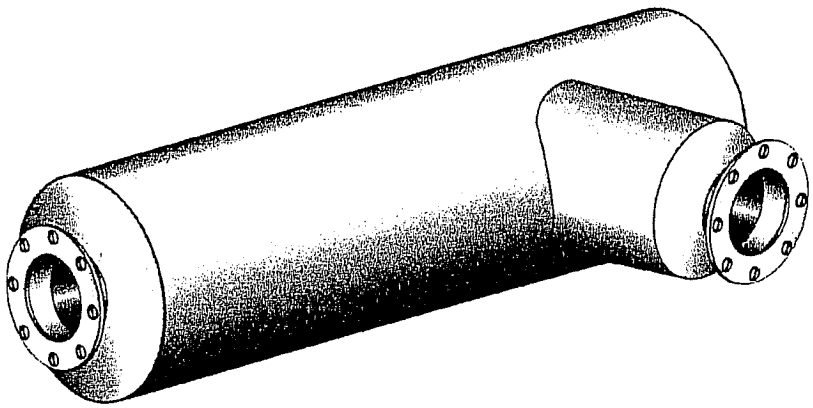
IIG-402 10-03 (New)

EM PRODUCTS™
PHILLIPS & TEMRO INDUSTRIES

Rotary Positive Blower Silencers

Model PE/PS - Series

Combination Absorptive-Chamber Type Intake/Discharge



The "P" Series intake/discharge silencer is a heavy duty two chambered combination type design. The acoustically packed blower connection, combined with optimally proportioned volume chambers, acoustically balanced by-pass tubes and ported outlet nozzle, provides excellent pulse control, and greater broad band performance for critical pitch-line applications.

Standard Construction Features

- Available in sizes from 2 inch to 30 inch
- Male NPT inlet and discharge connections sizes 2 inch to 4 inch
- 125/150# ANSI drilled plate flanges for 5 inch to 30 inch
- Full welded double shell carbon steel construction
- High density polyester acoustic blanket good to 325° F., wrapped with 304 SS wire mesh cloth and encased in a carbon steel perforated facing
- Gray phenolic resin based fast drying primer suitable for overcoating with urethanes, acrylics, epoxies and industrial enamels. Standard two mil thickness
- Side connection models have two moisture drains located in the bottom chamber of silencer

Optional Construction Features and Accessories

- Stainless steel construction
- Aluminum construction
- Aluminized steel construction
- Vertical mounting legs
- Round mounting bands
- Horizontal mounting saddles
- Horizontal and vertical shell lugs
- Special finish per specification
- Oversized flanges
- Air leak test
- ASME code construction
- Special connections for relief valves and instrumentation
- Special inlet and discharge connection locations
- Special acoustical design
- Acoustical shell lagging
- Inspection openings
- High temperature acoustic pack material
- Contact factory for additional features to meet your requirements

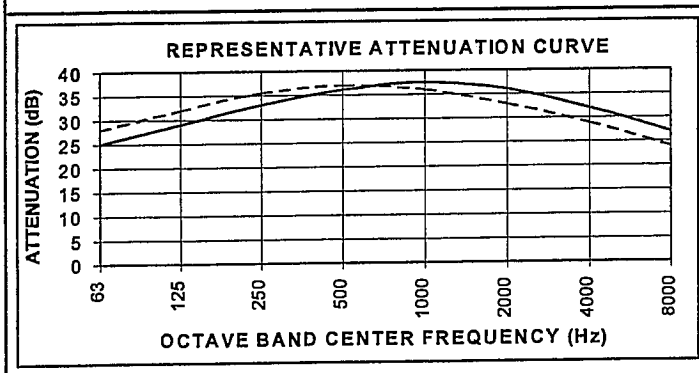
10/98
98BC-4018

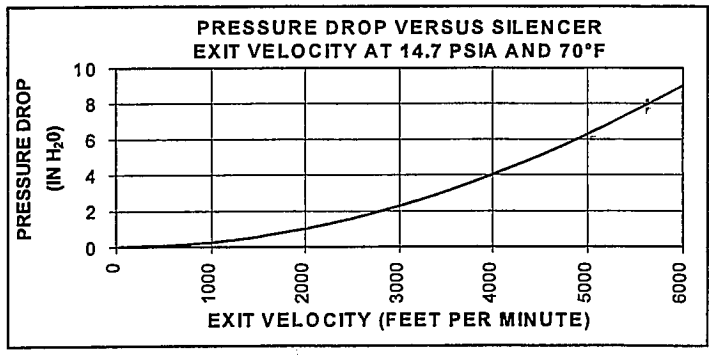
EM Products • 5380 Cottonwood Lane • Prior Lake, MN 55372 • (612) 440-9200 • Fax: (612) 440-3400 • emp@emproducts.com

EM PRODUCTS™
PHILLIPS & TEMRO INDUSTRIES

Rotary Positive Blower Silencers

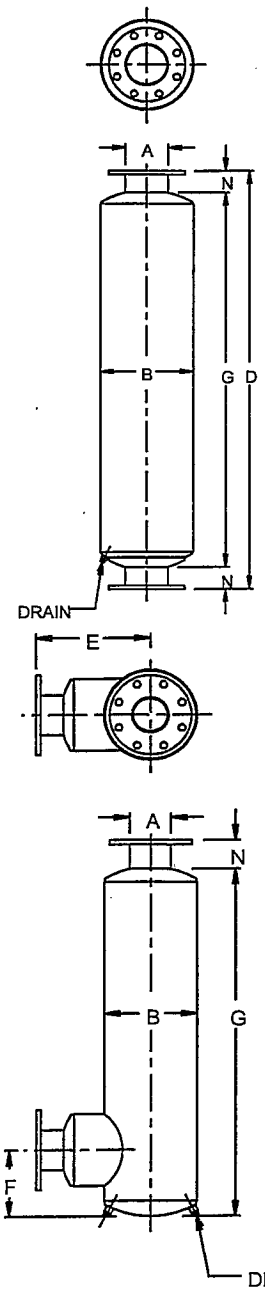
Model PE/PS - Series





—— 12" AND SMALLER ; - - - - 18" AND LARGER

						PS MODEL		
A	B	D	N	G	E	F-MIN	F-MAX	WT
1	SIZES 1" - 1 1/2" USE " U " SERIES OR " BXU " SERIES					---	---	---
1 1/2						---	---	---
2	8	33	3	27	9	FIXED	AT 6	28
2 1/2	10	34	3	28	10	FIXED	AT 7	45
3	10	46	3	40	10	FIXED	AT 7	55
3 1/2	12	52	3	46	11	FIXED	AT 8	75
4	14	53	3	47	14 1/2	8	20	100
5	16	65	3	59	16 1/2	9	26 1/2	175
6	18	72	3	66	20 1/2	10	30	220
8	22	97	3 1/2	90	24 1/2	12	45	440
10	26	122	3 1/2	115	28 1/2	14	60 1/2	660
12	30	135	3 1/2	128	35	15 1/2	66	950
14	36	161	3 1/2	154	40 1/2	17 1/2	78	1600
16	42	181	3 1/2	174	44 1/2	19 1/2	89 1/2	2150
18	48	188	3 1/2	181	47	21 1/2	95	2725
20	48	202	4 1/2	193	53 1/2	22 1/2	100	2960
22	54	204	4 1/2	195	59 1/2	24 1/2	100	3900
24	54	239	4 1/2	230	66	25 1/2	123	4800
26	60	259	4 1/2	250	72	27	130	6000
28	66	279	4 1/2	270	78	31	140	7650
30	72	304	4 1/2	295	78	32	158	8500



- Standard stock silencers have minimum "F" dimension
- 2 inch to 4 inch standard with male NPT connections; 4 inch flange connections available upon request
- 5 inch to 30 inch standard with125/150# ANSI drilled plate flange connections; 5 inch male NPT connections available upon request

Dimensions in inches, weights in pounds. Dimensions and weights are nominal and may vary slightly with production models. Request certified drawings for exact dimensions.

EM Products • 5380 Cottonwood Lane • Prior Lake, MN 55372 • (612) 440-9200 • Fax: (612) 440-3400 • emp@emproducts.com

Alfa Laval TS20

Gasketed plate heat exchanger for a wide range of applications

Introduction

Alfa Laval Industrial line is a wide product range that is used in virtually all types of industry.

The relatively short plate makes this model suitable for duties with short temperature programs and when a low pressure drop is appreciated. A large range of plate and gasket types is available.

Applications

- Biotech and Pharmaceutical
- Chemicals
- Energy and Utilities
- Food and Beverages
- Home and Personal care
- HVAC and Refrigeration
- Machinery and Manufacturing
- Marine and Transportation
- Mining, Minerals and Pigments
- Pulp and Paper
- Semiconductor and Electronics
- Steel
- Water and Waste treatment

Benefits

- High energy efficiency – low operating cost
- Flexible configuration – heat transfer area can be modified
- Easy to install – compact design
- High serviceability – easy to open for inspection and cleaning and easy to clean by CIP
- Access to Alfa Laval's global service network

Features

Every detail is carefully designed to ensure optimal performance, maximum uptime and easy maintenance. Selection of available features, depending on configuration some features may not be applicable:

- Five-point alignment
- Corner guided alignment system
- Chocolate pattern distribution area
- Glued gasket
- Clip-on gasket
- Leak chamber
- Bearing boxes
- Fixed bolt head
- Key hole bolt opening
- Lifting lug
- Lining
- Lock washer
- Pressure plate roller
- Tightening bolt cover

Alfa Laval 360° Service Portfolio

Our extensive service offering ensure top performance from your Alfa Laval equipment throughout its life cycle. The Alfa Laval 360 Service Portfolio include installation services, cleaning and repair as well as spare parts, technical documentation and trouble shooting. We also offer replacement, retrofit, monitoring and much more.

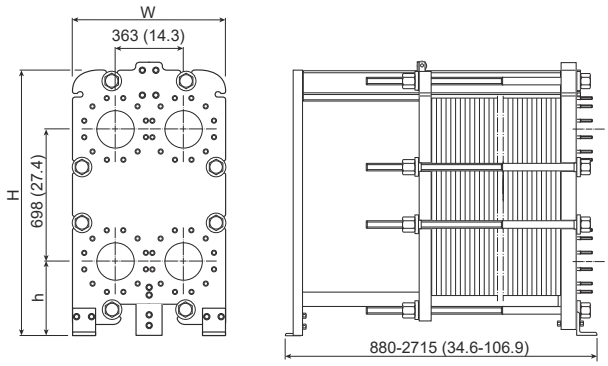
For information about our complete service offering and how to contact us - please visit www.alfalaval.com/service.

General remarks for technical information

- The global offering presented in this leaflet may not be available for all regions
- All combinations may not be configurable

Dimensional drawing

Measurements mm (inches)



Type	H	W	h
TS20-FM	1405 (55.3”)	740 (29.1”)	360 (14.2”)
TS20-FG	1405 (55.3”)	800 (31.5”)	360 (14.2”)
TS20-FS	1435 (56.5”)	800 (31.5”)	390 (15.4”)

The number of tightening bolts may vary depending on pressure rating.

Technical data

Plates	Type	Free channel, mm (inches)
TS20-M	Single plate	4.0 (0.16)

Materials	
Heat transfer plates	316/316L, 254 C-276, C-2000 Ni, Ti, TiPd
Field gaskets	NBR, EPDM, FKM, HeatSeal
Flange connections	Carbon steel Metal lined: stainless steel, Alloy C-276, titanium Rubber lined: NBR, EPDM
Frame and pressure plate	Carbon steel, epoxy painted

Other materials may be available on request

Operational data

Frame, PV-code	Max. design pressure (barg/psig)	Max. design temperature (°C/°F)
FM, pvcALS	10.0/145	180/356
FM, PED	10.0/145	210/410
FG, pvcALS	16.0/232	180/356
FG, ASME	10.3/150	177/350
FG, PED	16.0/232	180/356
FS, ASME	31.7/460	177/350
FS, PED	30.0/435	160/320

Extended pressure and temperature rating may be available on request.

Flange connections

Frame model	Connection standard
FM, pvcALS	EN 1092-1 DN200 PN10 ASME B16.5 Class 150 NPS 8 JIS B2220 10K 200A
FM, PED	EN 1092-1 DN200 PN10 ASME B16.5 Class 150 NPS 8
FG, pvcALS	EN 1092-1 DN200 PN10 ASME B16.5 Class 150 NPS 8 JIS B2220 10K 200A
FG, ASME	ASME B16.5 Class150 NPS 8
FG, PED	EN 1092-1 DN200 PN16 ASME B16.5 Class 150 NPS 8
FS, ASME	ASME B16.5 Class 150 NPS 8 ASME B16.5 Class 300 NPS 8
FS, PED	EN 1092-1 DN200 PN25 EN 1092-1 DN200 PN40 ASME B16.5 Class 300 NPS 8

Standard EN1092-1 corresponds to GOST 12815-80 and GB/T 9115.

How to contact Alfa Laval

Up-to-date Alfa Laval contact details for all countries are always available on our website at www.alfalaval.com

SEPARATOR SPECIFICATIONS:

Maximum operating vacuum: 24in. Hgg

Maximum nozzle velocity (flange): 75 ft/s

Maximum velocity across baffle section for effective separation:

- 24in. separator: 893 ACFM
- 26in. separator: 906 ACFM
- 36in separator: 1,897 ACFM

Reservoir capacity:

- 24in. separator: 40 or 60 gallons
- 26in. separator: 60 gallons
- 36in separator: 100 gallons

Shell thickness:

- 24in. diameter: 0.135in.
- 26in. diameter: 0.135in
- 36in. diameter: 0.135in.

Material:

- Body: Hot Rolled Steel or 304 Stainless Steel
- Baffles: 14 gauge 304SS (current standard, 2008+)
  14 gauge HRS (old standard)

Model LS-750
Steel Tank Sensor

Instruction Bulletin No. 157728

Environmental Products

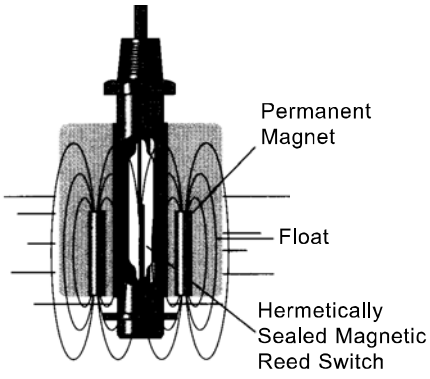
These Sensors may not be compatible with indicating and alarm equipment supplied by other manufacturers

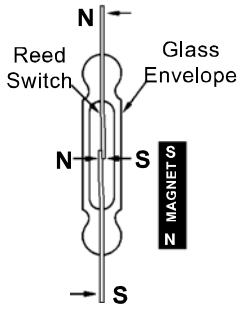
Note: LS-750 sensors are non-voltage producing devices and do not contain energy storing components. However, since primary use is in hazardous locations, an appropriate intrinsically safe interface device is required.

With its compact size, the Gems LS-750 single float, liquid level sensor is ideally suited for use in steel double-wall tanks. It requires no calibration, and is easy to install and maintain. When positioned vertically at the bottom of a steel tank's stand pipe, it reliably senses the presence of a liquid. It detects hydrocarbons and water as low as 3/4" from the bottom of a tank or sump. The LS-750 sensor features an epoxy-encapsulated design providing an environmental seal, that makes it a fine choice for harsh environments. An integral slosh shield guards the float from debris; thereby assuring dependable service.

Sensor Operating Principle

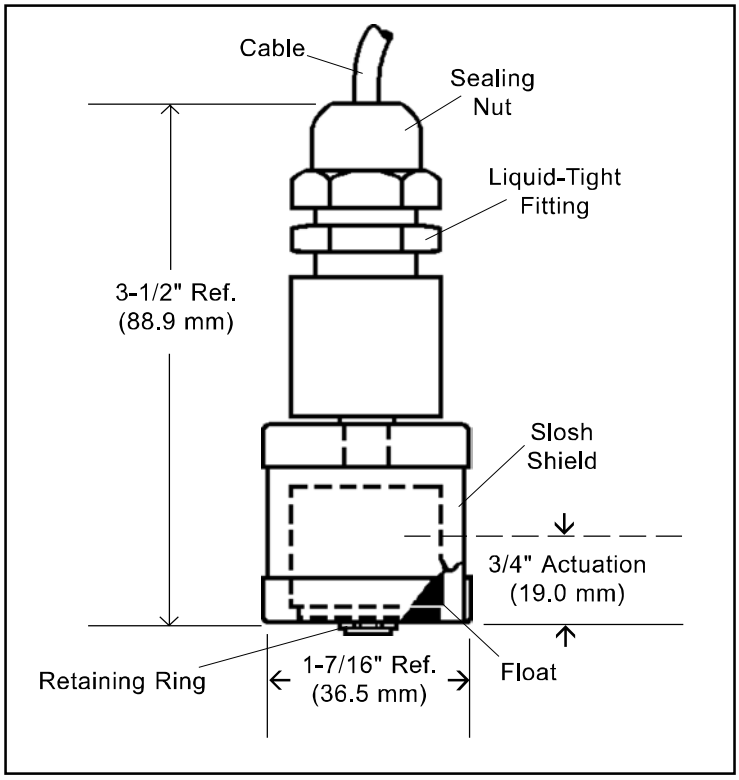
Gems LS-750 liquid level sensor operates on a direct, simple principle. A float is equipped with powerful, permanent magnets. As the float rises or lowers with liquid level, it actuates a magnetic reed switch mounted within the stem. This condition either opens or closes the electrical circuit to operate an external alarm or control circuit. When mounted vertically, this basic design provides a consistent accuracy of ±1/8th inch.





Note: Please refer to specific Gems outline drawings for operational specifications.

Dimensions



Read all instructions before beginning - Follow all safety precautions

Barricade the area

Do not allow vehicles or unauthorized people in the work area

Do not smoke or allow open flames in the work area

WARNINGS

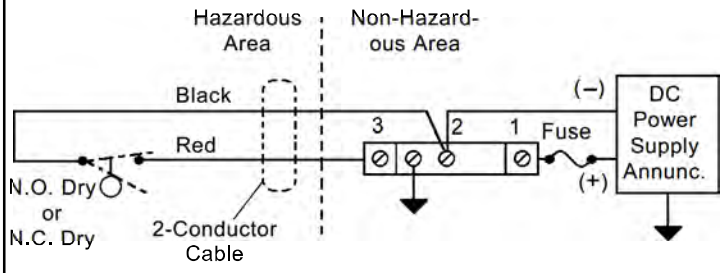
Read the instructions and warnings carefully before installing the sensor. This unit must be installed in accordance with National Electrical Code ANSI/NPFA-70, 1990; as well as Federal, State and local codes and any other applicable safety codes.

1. To avoid electrical shock, which could kill you, be sure AC power to monitor is off during installation.
2. The nature of the sensor is that it is a non-voltage producing device, containing limited energy-storing components. However, since its primary use is in a hazardous location, an appropriate intrinsically safe interface device must be used.

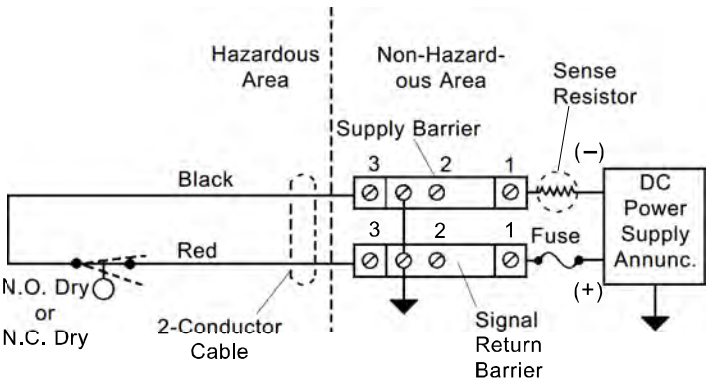
Note: Failure to observe these warnings could result in serious injury and death, as well as undetected potential environmental and health hazards.

Typical Wiring Diagrams

Non-Isolated System – Single Zener Barrier



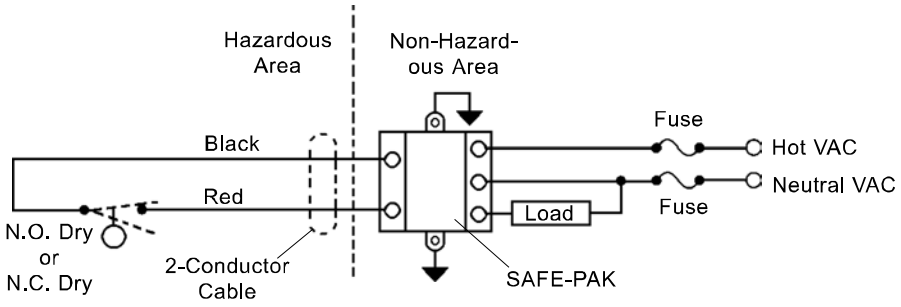
Isolated System – Dual Zener Barrier



If two signal lines must be maintained at above ground potential, an individual zener barrier is required per single line.

Single Safe-Pak® Relay

Safe-Pak® is an intrinsically safe, solid-state relay.



- IMPORTANT -

This manual assumes all preliminary site preparation is completed and that field wiring from the monitor to the sensor junction box is in place.

Installation Instructions

A. Pre-installation Sensor Testing

1. Temporarily connect the two-wire sensor cable to the field wires in the sensor junction box. Turn Power on.
3. Turn the LS-750 upside down. Audible and visual indicators should alarm.
4. To remove alarm condition, turn the sensor right side up.
5. Secure the riser cap to the riser pipe.
6. Feed the sensor cable through the cord grip on the junction box.
7. Tighten the cable bushing nuts on the riser cap and junction box to ensure a watertight seal at the cable entry.
8. Using wire nuts, connect the two-wire sensor cable to the field wires in the sensor junction box.

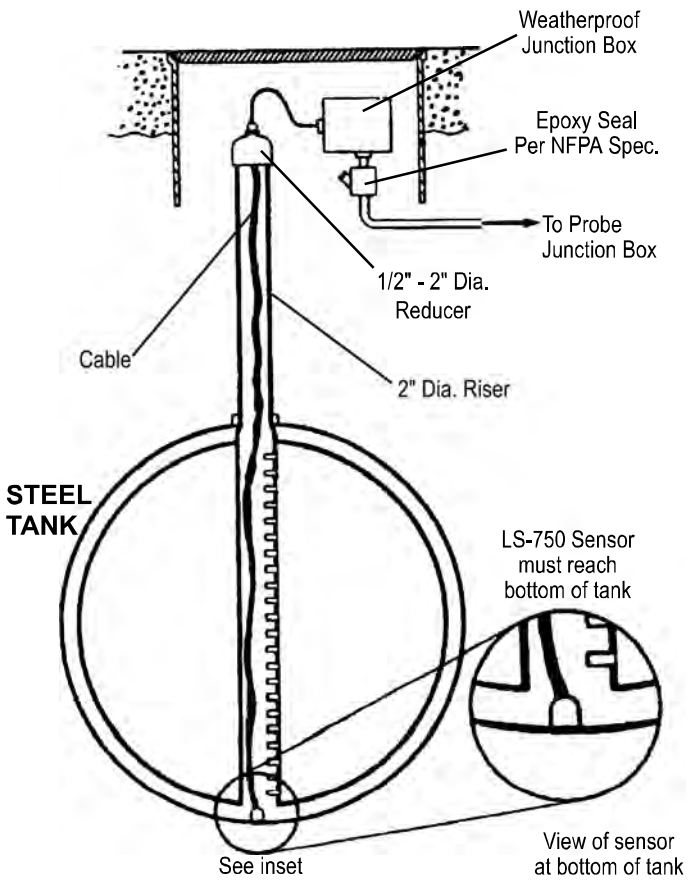
B. Sensor Installation Instructions

1. Turn off power to the control. **Note: Do not install the sensor if any liquid is present in the annular space. Failure to comply will lead to an alarm.**
2. Make sure no liquid is present in the annular space.
3. To be sure the sensor will reach the bottom of the annular space, first measure the sensor riser pipe from the bottom of the pipe to the top. Then measure the same distance up the leader cable from its connection to the sensing element and mark the leader cable.
4. Lower the float switch assembly into the riser pipe until the float switch touches the bottom of the tank.
5. Keeping the cable taut, secure the sensor assembly in place by attaching the grip cord.

Note: The float switch assembly should not hang by the cable, but should rest lightly on the bottom of the tank supported by the cable.

CE This product is suitable for Class I and Class II applications only, per the requirements of standard EN60730 and any additional specific requirements for a particular application or medium being sensed. Class I compliance of metal bodied units requires a ground connection between the metal body and the earthing system of the installation. Class I compliance of plastic bodied units in contact with a conductive medium requires that the medium be effectively earthed so as to provide an earthed barrier between the unit and accessible areas. For Class III compliance, a supply at safety extra-low voltage (SELV) must be provided. Please consult the Factory for compliance information on specific part numbers.

Typical Installation



Note: The float switch assembly should not hang by the cable, but should rest lightly on the bottom of the tank supported by the cable.

Maintenance

Note: Please consult your state E.P.A. office or appropriate regulatory agency regarding periodic inspection of the sensor. There are no user serviceable parts.

WARNING

Product must be maintained and installed in strict accordance with the National Electrical Code and the applicable GEMS technical bulletin and instruction bulletin. Failure to observe this warning could result in serious injuries or damages.

Warranty

Gems' standard warranty applies

MEMBER PEI PETROLEUM EQUIPMENT INSTITUTE

Gems Sensors Inc.
One Cowles Road
Plainville, CT
06062.1198

tel 860.747.3000
fax 860.747.4244

P/N 157728
Rev. B

North Star®
WATER CONDITIONING

NSC40UD1
ULTRA DEMAND WATER SOFTENER

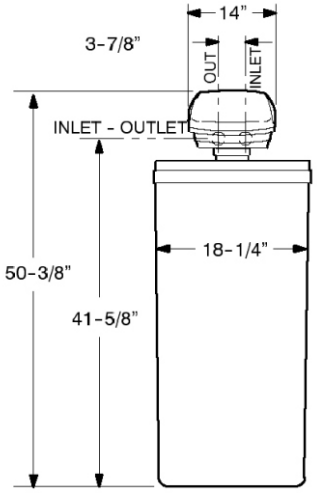
	NSC40UD1
Rated Capacity (Grains @ lb. Salt dose)	11,700 @ 2.3 30,800 @ 8.5 39,000 @ 14.7
Rated Efficiency (grains/lb @ lb. Salt dose)	5,100 @ 2.3
Amount of High-Capacity Resin (lbs / cu ft)	56.2 / 1.08
Resin Tank Nominal Size (in., Dia x height)	9 X 40
Flow Rate (gpm)	10.0
Pressure Drop at Service Flow (psi)	14
Intermittent Flow Rate @ 15 psi	10.2
Water Supply Max. Hardness (gpg)	110
Water Supply Max. Clear Water Iron (ppm)	5
Water Pressure Limits (min./max. Psi)	20 - 100
Water Temperature Limits. (°F)	40 - 120
Water Supply Min. Flow Rate (gpm)	3
Pipe Size	1”
Regeneration Cycle Flow Rates (gpm)	
Fill (flow to brine tank)	0.3
Brining (flow to drain)	0.22
Brine Rinse (flow to drain)	0.15
Backwash (flow to drain)	2.3
Fast Rinse (flow to drain)	2.3
Approx. Shipping Wt. Lbs.	120

NSF/ANSI 44 for specific performance claims as verified and substantiated by test data.

Efficiency rating is only at the lowest salt dosage. These softeners were efficiency rated according to NSF/ANSI Standard 44.

Capacity to reduce clear water iron is substantiated by WQA test data.

Intermittent flow rate does not represent the maximum service flow rate used for determining the softeners rated capacity and efficiency. Continuous operation at flow rates greater than the service flow rate may affect capacity and efficiency performance.



Features

- Designed for better water flow rates and reduced pressure loss. Great for today’s large home applications.
- Backlit LCD display - easier to read
- Features patented “Look Ahead” technology for peak performance.
- Quick set-up. Set the time and the hardness and you are done.
- Display shows: Time, Hardness, Regeneration Time, % Remaining Capacity, Current Flow, Total Daily Usage and Average Daily Usage.
- Efficiency selector - Choose either normal or high efficiency mode.
- Diagnostics: Electronic Self Diagnosis, Days in Service, Total Number of Regenerations, Turbine Check ans Switches Check
- Gallons / Litres choice
- Selectable fixed recharge frequency
- Adjustable backwash setting

INDEPENDENTLY CERTIFIED NSF

System Tested and Certified by NSF International against NSF/ANSI Standard 44 for softener performance.

ISO 9001 REGISTERED

Authorized Dealer

North Star Water Conditioning, 1890 Woodlane Drive, Woodbury, MN 55125 Toll Free 1-800-972-0135
www.NorthStarConditioning.com

Type 4X Indoor Use Only Enclosure.

NEW – DESIGN PROTECTED

GENERAL SPECIFICATIONS

VALBIA electric actuators are designed for the automation of ball and butterfly valves for the industrial, commercial and OEM markets. As a result of years of intensive R+D, advanced high-tech electrical component design and precise gearing VALBIA electric actuators offer the best in performance and long term reliability.

The range has been manufactured with the following features:

- The actuator housing is made from a V0 self-extinguish class techno-polymer material.
- The kinematics is made by two steel and techno-polymer gear wheels, sustained by hardened steel pinions, mounted on self-lubricating bushings (excluding Mod. VB015), and inserted in a rugged die-cast aluminium structure.
- The direct connection part of the actuators to the valves, is made via a painted die-cast aluminium plate, with a dual drilled ISO 5211 interface.
- The electronic circuit automatically adjusts the motor speed, (depending on the torque variations), to keep the cycle time constant.
- All actuators are provided with an electronic system and torque limiter.
- A standard heater is activated once the actuator is powered, and when the temperature inside the housing drops below 77° F to prevent condensation.
- Two auxillary limit switches are standard.
- Optional 4-20 mA 0-10v modulating boards and battery back-up protection are available.

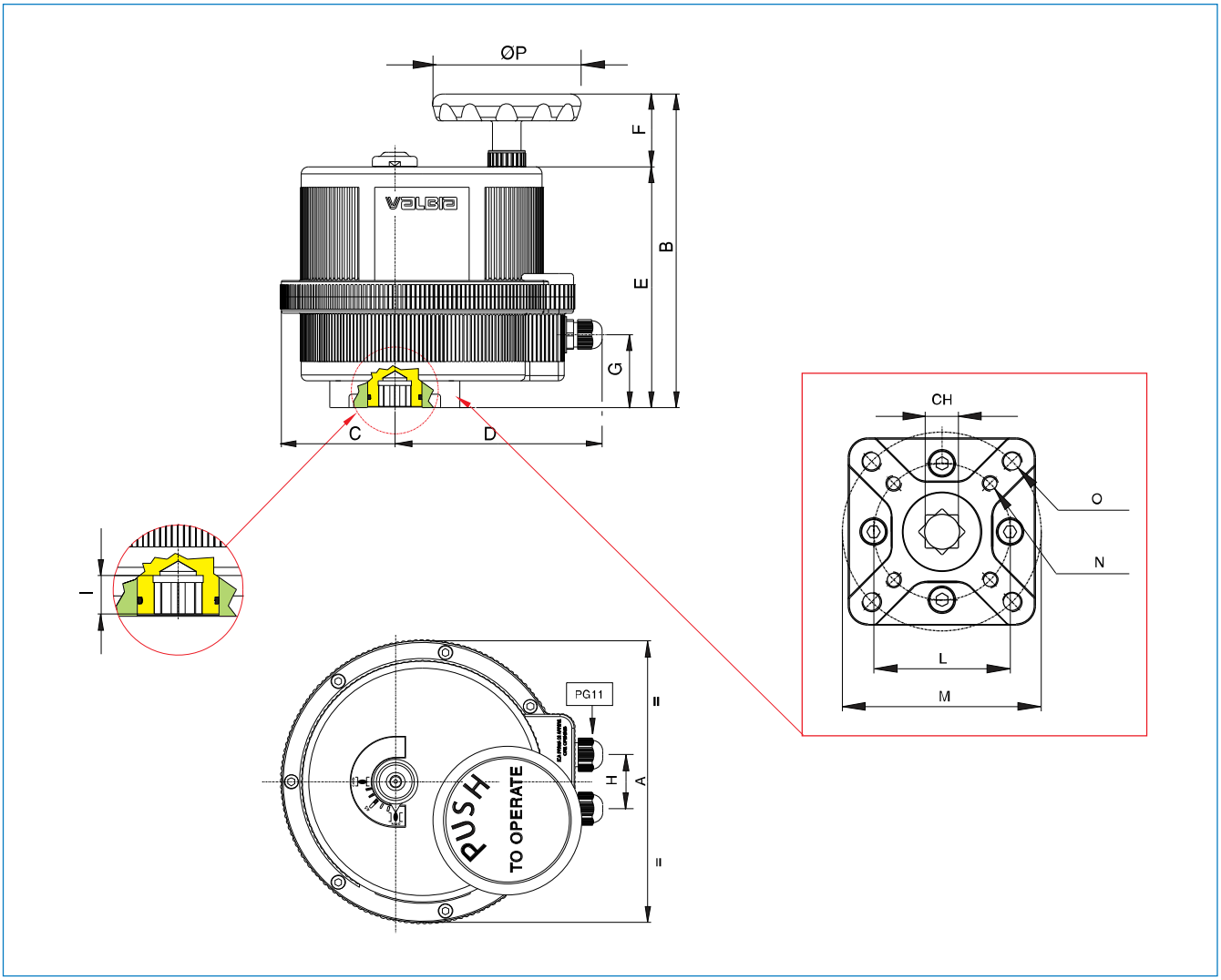
MODEL		VB015	VB030	VB060	VB110	VB190	VB270	VB350
MAX WORKING TORQUE (in-Lbs)		133	266	530	975	1680	2390	3100
VOLTAGE (V)	LOW VOLTAGE	12V AC/DC	12V DC	12V DC	12V DC	12V DC	12V DC	12V DC
		24V AC/DC	24V AC/DC	24V AC/DC	24V AC/DC	24V AC/DC	24V AC/DC	24V AC/DC
	HIGH VOLTAGE MULTITENSION	100-240V AC	100-240V AC	100-240V AC	100-240V AC	100-240V AC	100-240V AC	100-240V AC
WORKING TIME (sec)		10	8	9	27	27	50	50
TORQUE LIMITER		STD	STD	STD	STD	STD	STD	STD
DUTY RATING		50%	75%	75%	75%	75%	75%	75%
PROTECTION		IP65 * * NEMA 4 X	IP65-67 NEMA 4 X	IP65-67 NEMA 4 X	IP65-67 NEMA 4 X	IP65-67 NEMA 4 X	IP65-67 NEMA 4 X	IP65-67 NEMA 4 X
ROTATION		90°	90°	90°	90°	90°	90°	90°
UPON REQUEST		180°	180° or 270°	180° or 270°	180° or 270°	180° or 270°	180° or 270°	180° or 270°
MANUAL INTERVENTION		STD	STD	STD	STD	STD	STD	STD
POSITION INDICATOR		STD	STD	STD	STD	STD	STD	STD
WORKING TEMPERATURE		-4°F + 131°F	-4°F + 131°F	-4°F + 131°F	-4°F + 131°F	-4°F + 131°F	-4°F + 131°F	-4°F + 131°F
HEATER		STD	STD	STD	STD	STD	STD	STD
ADDITIONAL FREE LIMIT SWITCHES		n°2 STD	n°2 STD	n°2 STD	n°2 STD	n°2 STD	n°2 STD	n°2 STD
DRILLING ISO 5211 PAD		F03 - F05 *	F03 - F05 *	F05 - F07	F07 - F10	F07 - F10	F07 - F10	F07 - F10
SQUARE DRIVE		0.43	0.43	0.55	0.67	0.67	0.87	0.87
SQUARE UPON REQUEST		0.35	0.35-0.55	0.43-0.67	0.55-0.87	0.55-0.87	0.67	0.67
SAFETY BLOCK		NOT AVAILABLE	UPON REQUEST	UPON REQUEST	UPON REQUEST	UPON REQUEST	UPON REQUEST	UPON REQUEST
			NOT AVAILABLE FOR MOD 12V					
POSITIONER (4~20mA or 0~10 VDC)		NOT AVAILABLE	UPON REQUEST	UPON REQUEST	UPON REQUEST	UPON REQUEST	UPON REQUEST	UPON REQUEST
LINEAR POTENTIOMETER (5K Ω 1W)		NOT AVAILABLE	UPON REQUEST	UPON REQUEST	UPON REQUEST	UPON REQUEST	UPON REQUEST	UPON REQUEST
ELECTRICAL CONNECTIONS		PG11	PG11	PG11	PG11	PG11	PG11	PG11
WEIGHT (LBS)		3.09	5.07	7.28	10.80	10.80	13.23	13.23

* upon request F04 only

** UL pending

ELECTRIC ACTUATOR POWER CONSUMPTION

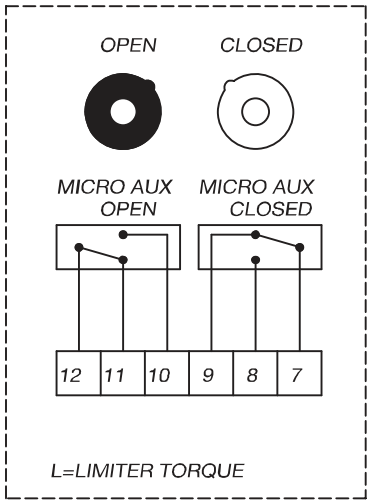
MODEL		VB015		VB030		VB060		VB110		VB190		VB270		VB350	
VERSION H	NOMINAL VOLTAGE	110V AC	230V AC	100-240V AC											
	ABSORBED CURRENT	75mA	25mA	0.3-0.2A		0.6-0.3A									
	ABSORBED POWER	6.6 VA	6 VA	30-48VA		60-72 VA									
VERSION L	NOMINAL VOLTAGE	12V AC/DC	24V AC/DC	12V DC	24V AC/DC	12V DC	24V AC/DC	12V DC	24V AC/DC	12V DC	24V AC/DC	12V DC	24V AC/DC	12V DC	24V AC/DC
	ABSORBED CURRENT	1.2A	0.6A	2.0A	1.0A	3.6A	1.8A	2.0A	1.0A	3.6A	1.8A	3.6A	1.8A	3.6A	1.8A
	ABSORBED POWER	15 VA		24 VA		44 VA		24 VA		44 VA		44 VA		44 VA	
	FREQUENCY	50/60 HZ													

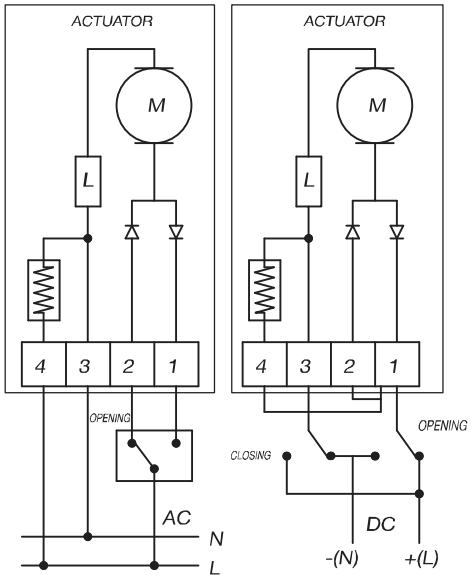


MOD.	DRILLING ISO 5211	CH	A	B	C	D	E	F	G	H	I	L	M	N	O	ØP
VB015	* F03 - F05	0.43	4.84	5.57	1.67	4.74	4.96	0.61	4.06	1.26	0.55	1.42	1.97	10-24 UNC 2BX0.47	1/4-20 UNC 2BX0.55	2.68
VB030	* F03 - F05	0.43	6.18	7.40	2.38	5.12	5.75	1.65	1.30	1.42	0.47	1.42	1.97	10-24 UNC 2BX0.47	1/4-20 UNC 2BX0.55	2.56
VB060	F05 - F07	0.55	7.28	8.46	2.66	5.77	6.81	1.65	2.01	1.42	0.63	1.97	2.76	1/4-20 UNC 2BX0.59	5/16-18 UNC 2BX0.67	2.56
VB110	F07 - F10	0.67	8.31	9.14	3.31	6.02	7.01	2.13	2.13	1.58	0.75	2.76	4.02	5/16-18 UNC 2BX0.79	3/8-16 UNC 2BX0.79	4.33
VB190	F07 - F10	0.67	8.31	9.14	3.31	6.02	7.01	2.13	2.13	1.58	0.75	2.76	4.02	5/16-18 UNC 2BX0.79	3/8-16 UNC 2BX0.79	4.33
VB270	F07 - F10	0.87	8.74	9.19	3.03	6.69	7.17	2.03	2.13	1.58	0.95	2.76	4.02	5/16-18 UNC 2BX0.79	3/8-16 UNC 2BX0.79	4.33
VB350	F07 - F10	0.87	8.74	9.19	3.03	6.69	7.17	2.03	2.13	1.58	0.95	2.76	4.02	5/16-18 UNC 2BX0.79	3/8-16 UNC 2BX0.79	4.33

* Upon request F04 only

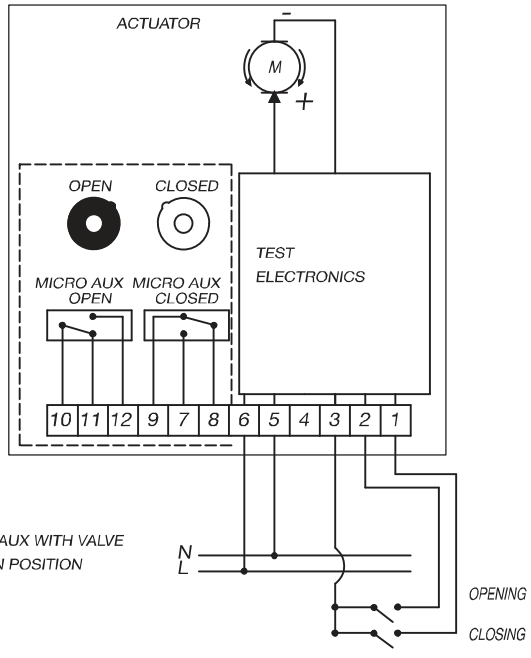
ELECTRIC WIRING VB015 12V–24V AC/DC



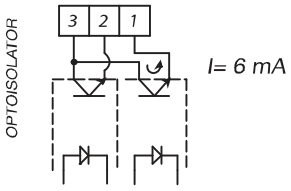


MICRO AUX WITH VALVE
IN OPEN POSITION

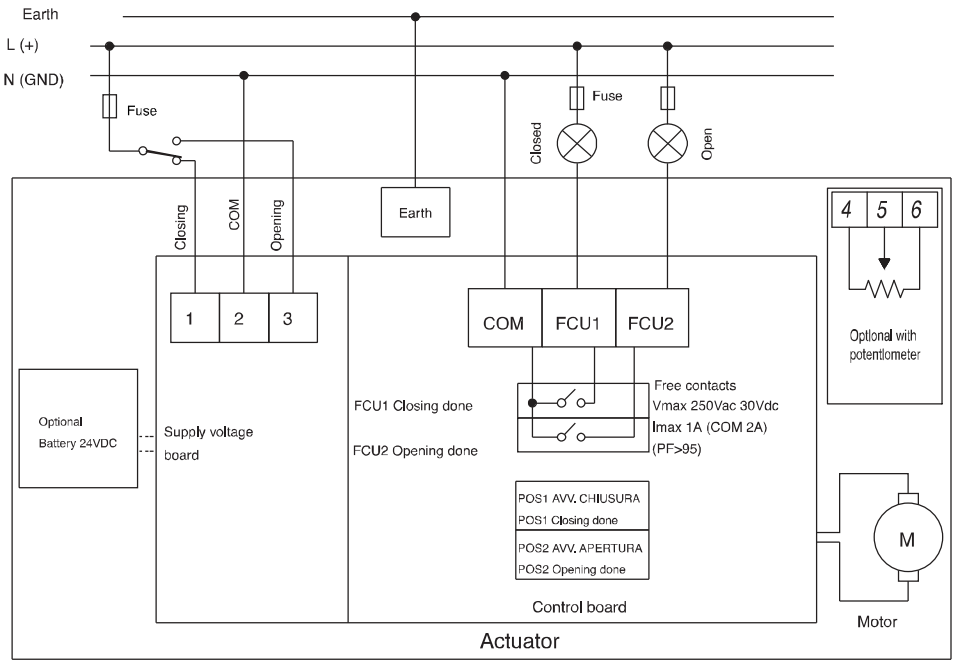
ELECTRIC WIRING VB015 115V–230V AC



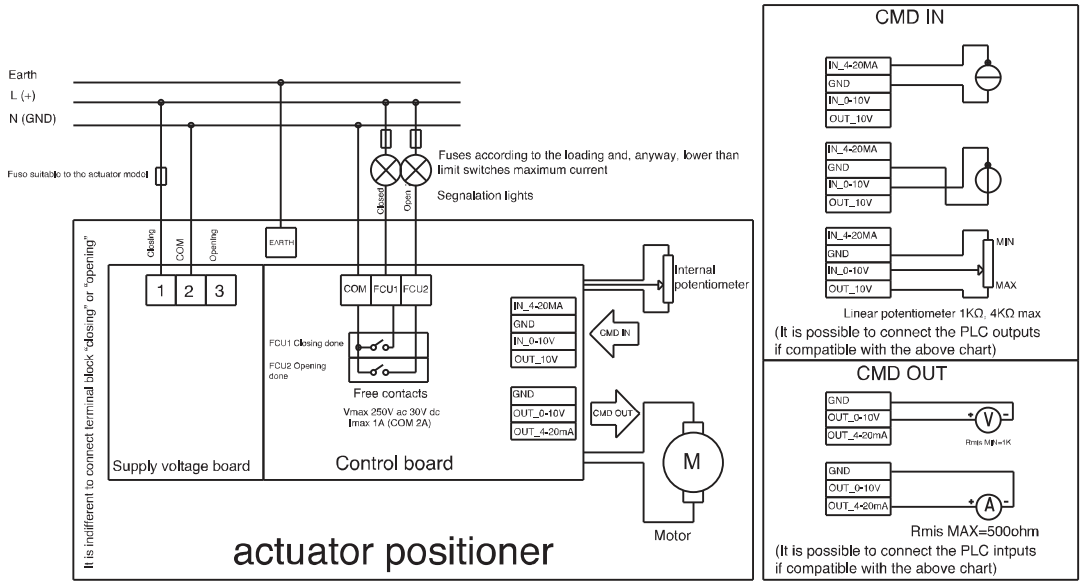
STATIC IMPULSE DRIVE OPTOISOLATED BY PLC



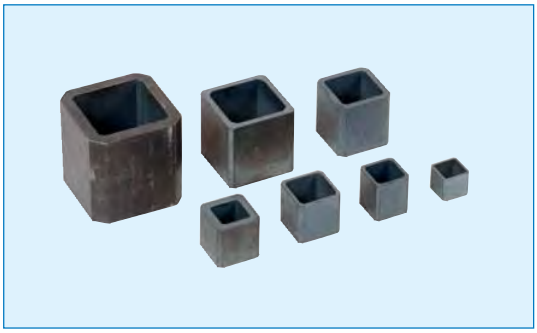
ELECTRIC SPECIFICATION FROM VB30 TO VB350 12V DC, 24V AC/DC. 110-240V AC

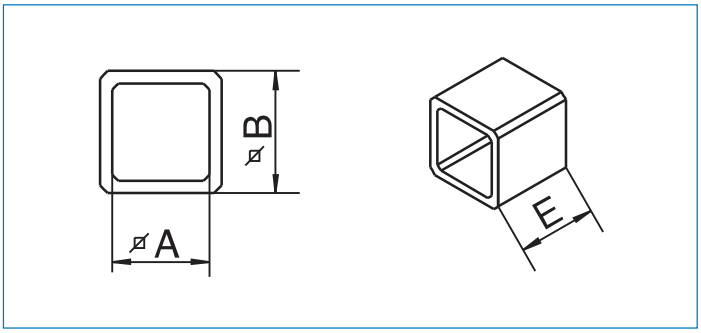


WIRING OF THE POSITIONER FROM VB30 TO VB350 12V DC, 24V AC/DC. 110-240V AC



CARBON STEEL SQUARE ADAPTER

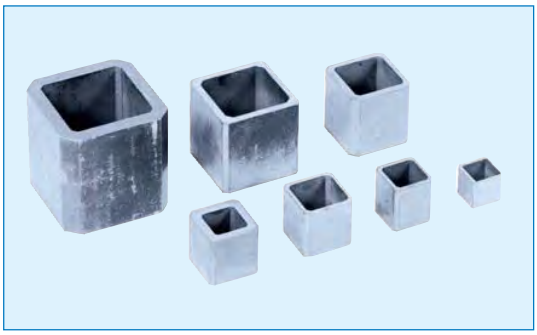


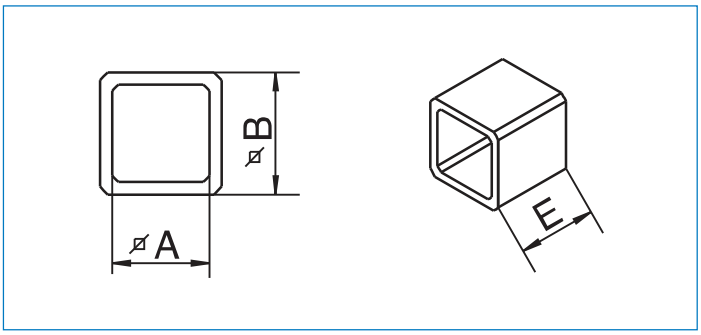


CODE	A	B	E
04400110901	0.35	0.43	0.39
04400141101	0.43	0.55	0.63
04400171101	0.43	0.67	0.67
04400171401	0.55	0.67	0.67
04400221701	0.67	0.87	0.87
04400272201	0.87	1.06	1.06
04400362701	1.06	1.42	1.42
* 04400271701	0.67	1.06	1.06

* Square 27x17 use adapter 27x22 + add 22x17

AISI 316 STAINLESS STEEL SQUARE ADAPTER



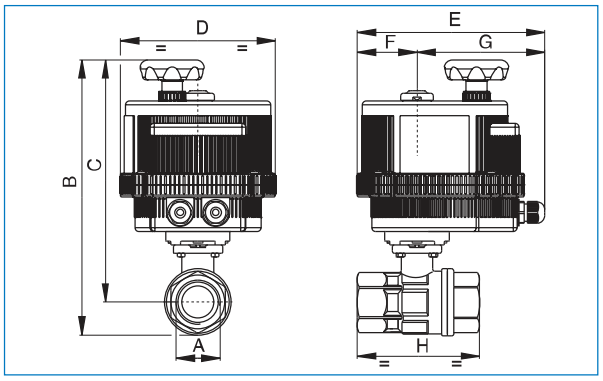


CODE	A	B	E
04400110902	0.35	0.43	0.39
04400140901	0.35	0.55	0.39
04400141102	0.43	0.55	0.63
04400171402	0.55	0.67	0.67
04400221702	0.67	0.87	0.87
04400272202	0.87	1.06	1.06
04400362702	1.06	1.42	1.42

SERIES 8E064*** - 8E068***

to 1/4" from 2"

PSI	600	600	600	600	600	600	600	600	600	600	600
DN / A	1/4"	3/8"	1/2"	3/4"	1"	1"1/4	1"1/2	2"	2"1/2	3"	4"
B	7.51	7.51	7.51	7.72	8.33	8.65	11.36	12.08	14.20	14.99	17.00
C	6.85	6.85	6.85	6.93	7.36	7.50	9.92	10.28	11.94	12.31	13.73
D	4.84	4.84	4.84	4.84	4.84	4.84	6.18	6.18	7.28	7.28	8.31
E	6.41	6.41	6.41	6.41	6.41	6.41	7.50	7.50	8.43	8.43	9.33
F	1.67	1.67	1.67	1.67	1.67	1.67	2.38	2.38	2.66	2.66	3.31
G	4.74	4.74	4.74	4.74	4.74	4.74	5.12	5.12	5.77	5.77	6.02
H	2.64	2.64	2.64	3.00	3.35	3.66	4.13	4.80	6.10	6.89	8.03
ACT.	VB 015	VB 015	VB 015	VB 015	VB 015	VB 015	VB 030	VB 030	VB 060	VB 060	VB 110

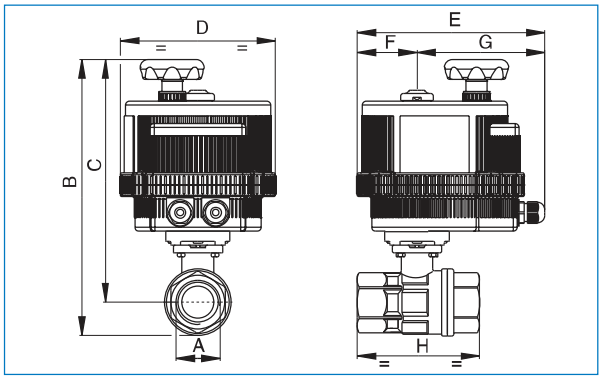


VOLTAGE SUFFIX		
	VOLTAGE SUFFIX	VOLTAGE
STANDARD	001	12V AC/DC
	002	24V AC/DC
	003	100-240 VAC
	004*	220VAC
FAIL-SAFE	012	24V AC/DC
	013	100-240 VAC
POSITIONER	021	12V AC/DC
	022	24V AC/DC
	023	100-240 VAC

*VB015

SERIES 8E067***

PSI	1000	1000	1000	1000	1000	1000
DN / A	1/2"	3/4"	1"	1"1/4	1"1/2	2"
B	7.53	7.75	8.33	8.73	11.40	12.15
C	6.85	6.93	7.32	7.46	9.88	10.24
D	4.84	4.84	4.84	4.84	6.18	6.18
E	6.41	6.41	6.41	6.41	7.50	7.50
F	1.67	1.67	1.67	1.67	2.38	2.38
G	4.74	4.74	4.74	4.74	5.12	5.12
H	2.64	3.07	3.54	3.94	4.41	5.32
ACT.	VB 015	VB 015	VB 015	VB 015	VB 030	VB 030

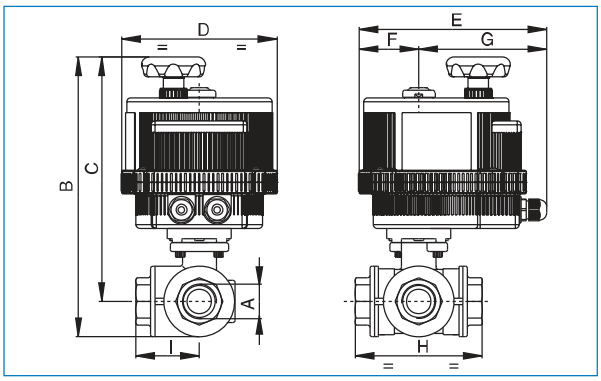


VOLTAGE SUFFIX		
	VOLTAGE SUFFIX	VOLTAGE
STANDARD	001	12V AC/DC
	002	24V AC/DC
	003	100-240 VAC
	004*	220VAC
FAIL-SAFE	012	24V AC/DC
	013	100-240 VAC
POSITIONER	021	12V AC/DC
	022	24V AC/DC
	023	100-240 VAC

*VB015

SERIES 8E065(T) * * *
8E066(L) * * *

PSI	400	400	400	400	400	400	400	400	400	400
DN / A	1/4"	3/8"	1/2"	3/4"	1"	1"1/4	1"1/2	2"	2"1/2	3"
B	7.44	7.44	7.44	7.63	9.98	10.43	11.16	13.05	14	14.04
C	6.77	6.77	6.77	6.86	9.03	9.25	9.74	11.36	11.81	11.81
D	4.84	4.84	4.84	4.84	6.18	6.18	6.18	7.38	7.28	7.28
E	6.41	6.41	6.41	6.41	7.50	7.50	7.50	8.43	8.43	8.43
F	1.67	1.67	1.67	1.67	2.38	2.38	2.38	2.66	2.66	2.66
G	4.74	4.74	4.74	4.74	5.12	5.12	5.12	5.77	5.77	5.77
H	2.64	2.64	2.87	3.19	3.74	4.39	4.86	5.73	6.93	7.08
I	1.32	1.32	1.44	1.60	1.87	2.20	2.43	2.87	3.47	3.54
ACT.	VB 015	VB 015	VB 015	VB 015	VB 030	VB 030	VB 030	VB 060	VB 060	VB 060

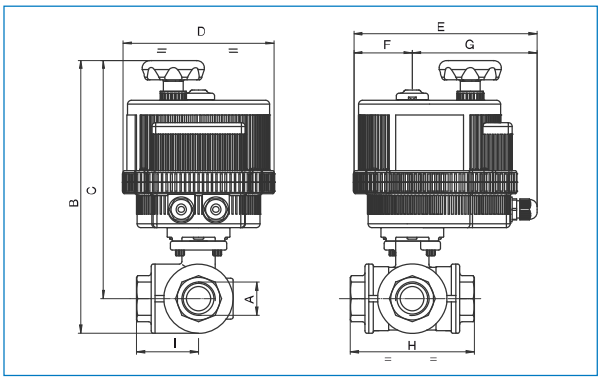


VOLTAGE SUFFIX		
	VOLTAGE SUFFIX	VOLTAGE
STANDARD	001	12V AC/DC
	002	24V AC/DC
	003	100-240 VAC
	004*	220VAC
FAIL-SAFE	012	24V AC/DC
	013	100-240 VAC
POSITIONER	021	12V AC/DC
	022	24V AC/DC
	023	100-240 VAC

*VB015

SERIES 8E069(T) * * *
8E070(L) * * *
8E071(T) * * *
8E072(L) * * *

PSI	1000	1000	1000	1000	1000	800	800	800
FULL PORT DN / A	1/4"	3/8"	1/2"	3/4"	1"	1"1/4	1"1/2	2"
STANDARD PORT DN / A	-	1/2"	3/4"	1"	1"1/4	1"1/2	2"	-
B	7.80	7.80	9.96	10.15	11.97	12.47	13.90	15.13
C	7.02	7.02	9.05	9.05	10.64	10.94	12.02	12.77
D	4.84	4.84	6.18	6.18	7.28	7.28	8.31	8.31
E	6.41	6.41	7.50	7.50	8.43	8.43	9.33	9.33
F	1.67	1.67	2.38	2.38	2.66	2.66	3.31	3.31
G	4.74	4.74	5.12	5.12	5.77	5.77	6.02	6.02
H	2.83	2.83	3.26	3.89	4.40	4.92	5.86	6.85
I	1.41	1.41	1.63	1.94	2.20	2.46	2.93	3.42
ACT.	VB 015	VB 015	VB 030	VB 030	VB 060	VB 060	VB 110	VB 190



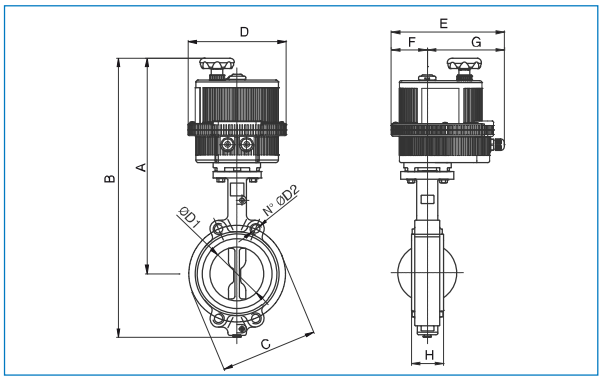
VOLTAGE SUFFIX		
	VOLTAGE SUFFIX	VOLTAGE
STANDARD	001	12V AC/DC
	002	24V AC/DC
	003	100-240 VAC
	004*	220VAC
FAIL-SAFE	012	24V AC/DC
	013	100-240 VAC
POSITIONER	021	12V AC/DC
	022	24V AC/DC
	023	100-240 VAC

*VB015

SERIES E500S***

Wt/Lbs	9.9	10.6	12.2	13.5	18.1	22.7	28.00	39.9	55.5	*
SIZE	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
A	13.11	13.40	14.29	14.53	16.33	16.80	18.04	19.38	20.69	*
B	16.08	16.89	17.79	18.27	20.82	21.80	23.51	26.27	26.68	*
C	4.74	4.74	5.49	6.00	7.50	8.50	9.50	11.75	14.25	17.00
D	6.18	6.18	6.18	6.18	7.28	7.28	8.31	8.31	8.74	*
E	7.50	7.50	7.50	7.50	8.43	8.43	9.33	9.33	9.72	*
F	2.38	2.38	2.38	2.66	2.66	3.31	3.31	3.03	3.03	*
G	5.12	5.12	5.12	5.12	5.77	6.02	6.02	6.02	6.69	*
H	1.61	1.65	1.76	1.78	2.05	2.14	2.20	2.34	2.58	3.03
N°	4	4	4	4	4	4	4	4	4	4
ØD2	0.75	0.75	0.75	0.75	0.75	0.87	0.87	0.87	1.00	1.00
ØD1	1.67	2.02	2.54	3.10	4.09	4.85	6.13	7.97	9.86	11.87
ACT.	VB 030	VB 030	VB 030	VB 030	VB 060	VB 110	VB 110	VB 190	VB 350	*

* Consult factory



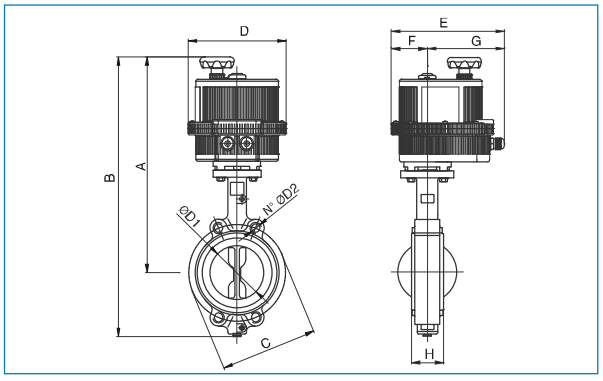
VOLTAGE SUFFIX		
	VOLTAGE SUFFIX	VOLTAGE
STANDARD	001	12V AC/DC
	002	24V AC/DC
	003	100-240 VAC
	004*	220VAC
FAIL-SAFE	012	24V AC/DC
	013	100-240 VAC
POSITIONER	021	12V AC/DC
	022	24V AC/DC
	023	100-240 VAC

*VB015

SERIES E500N***

Wt/Lbs	9.9	10.6	12.2	13.5	18.1	22.7	28.00	39.9	55.5	*
SIZE	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
A	13.11	13.40	14.29	14.53	16.33	16.80	18.04	19.38	20.69	*
B	16.08	16.89	17.79	18.27	20.82	21.80	23.51	26.27	26.68	*
C	4.74	4.74	5.49	6.00	7.50	8.50	9.50	11.75	14.25	17.00
D	6.18	6.18	6.18	6.18	7.28	7.28	8.31	8.31	8.74	*
E	7.50	7.50	7.50	7.50	8.43	8.43	9.33	9.33	9.72	*
F	2.38	2.38	2.38	2.66	2.66	3.31	3.31	3.03	3.03	*
G	5.12	5.12	5.12	5.12	5.77	6.02	6.02	6.02	6.69	*
H	1.61	1.65	1.76	1.78	2.05	2.14	2.20	2.34	2.58	3.03
N°	4	4	4	4	4	4	4	4	4	4
ØD2	0.75	0.75	0.75	0.75	0.75	0.87	0.87	0.87	1.00	1.00
ØD1	1.67	2.02	2.54	3.10	4.09	4.85	6.13	7.97	9.86	11.87
ACT.	VB 030	VB 030	VB 030	VB 030	VB 060	VB 110	VB 110	VB 190	VB 350	*

* Consult factory



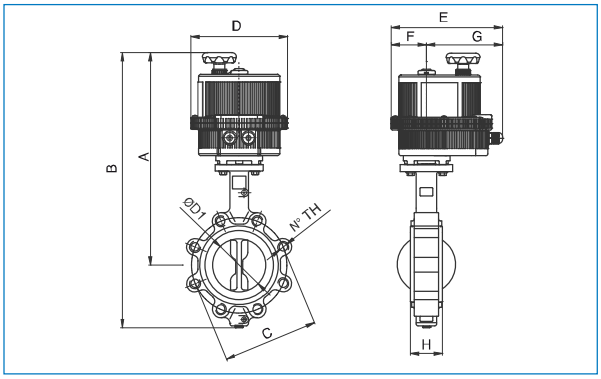
VOLTAGE SUFFIX		
	VOLTAGE SUFFIX	VOLTAGE
STANDARD	001	12V AC/DC
	002	24V AC/DC
	003	100-240 VAC
	004*	220VAC
FAIL-SAFE	012	24V AC/DC
	013	100-240 VAC
POSITIONER	021	12V AC/DC
	022	24V AC/DC
	023	100-240 VAC

*VB015

SERIES E501S ***

Wt/Lbs	12.2	13.5	14.4	15.5	27.1	31.3	42.1	50.90	72.4	*
SIZE	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
A	13.11	13.40	14.29	14.53	16.33	16.80	18.04	19.38	20.69	*
B	16.08	16.89	17.79	18.27	20.82	21.80	23.51	26.27	26.68	*
C	4.74	4.74	5.49	6.00	7.50	8.50	9.50	11.75	14.25	17.00
D	6.18	6.18	6.18	6.18	7.28	7.28	8.31	8.31	8.74	*
E	7.50	7.50	7.50	7.50	8.43	8.43	9.33	9.33	9.72	*
F	2.38	2.38	2.38	2.66	2.66	3.31	3.31	3.03	3.03	*
G	5.12	5.12	5.12	5.12	5.77	6.02	6.02	6.02	6.69	*
H	1.61	1.65	1.76	1.78	2.05	2.14	2.20	2.34	2.58	3.03
N°	4	4	4	4	8	8	8	8	12	12
TH	5/8-11	5/8-11	5/8-11	5/8-11	5/8-11	3/4-10	3/4-10	3/4-10	7/8-9	7/8-9
ØD1	1.67	2.02	2.54	3.10	4.09	4.85	6.13	7.97	9.86	11.87
ACT.	VB 030	VB 030	VB 030	VB 030	VB 060	VB 060	VB 110	VB 190	VB 350	*

* Consult factory



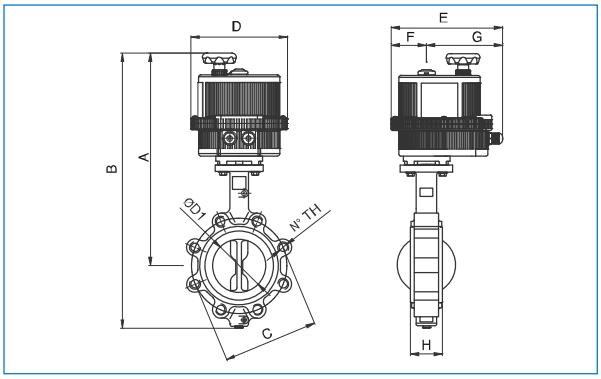
VOLTAGE SUFFIX		
	VOLTAGE SUFFIX	VOLTAGE
STANDARD	001	12V AC/DC
	002	24V AC/DC
	003	100-240 VAC
	004*	220VAC
FAIL-SAFE	012	24V AC/DC
	013	100-240 VAC
POSITIONER	021	12V AC/DC
	022	24V AC/DC
	023	100-240 VAC

*VB015

SERIES E501N ***

Wt/Lbs	12.2	13.5	14.4	15.5	27.1	31.3	42.1	50.90	72.4	*
SIZE	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
A	13.11	13.40	14.29	14.53	16.33	16.80	18.04	19.38	20.69	*
B	16.08	16.89	17.79	18.27	20.82	21.80	23.51	26.27	26.68	*
C	4.74	4.74	5.49	6.00	7.50	8.50	9.50	11.75	14.25	17.00
D	6.18	6.18	6.18	6.18	7.28	7.28	8.31	8.31	8.74	*
E	7.50	7.50	7.50	7.50	8.43	8.43	9.33	9.33	9.72	*
F	2.38	2.38	2.38	2.66	2.66	3.31	3.31	3.03	3.03	*
G	5.12	5.12	5.12	5.12	5.77	6.02	6.02	6.02	6.69	*
H	1.61	1.65	1.76	1.78	2.05	2.14	2.20	2.34	2.58	3.03
N°	4	4	4	4	8	8	8	8	12	12
TH	5/8-11	5/8-11	5/8-11	5/8-11	5/8-11	3/4-10	3/4-10	3/4-10	7/8-9	7/8-9
ØD1	1.67	2.02	2.54	3.10	4.09	4.85	6.13	7.97	9.86	11.87
ACT.	VB 030	VB 030	VB 030	VB 030	VB 060	VB 060	VB 110	VB 190	VB 350	*

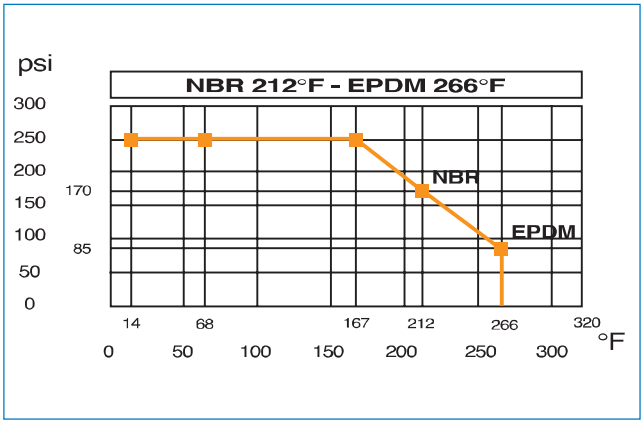
* Consult factory

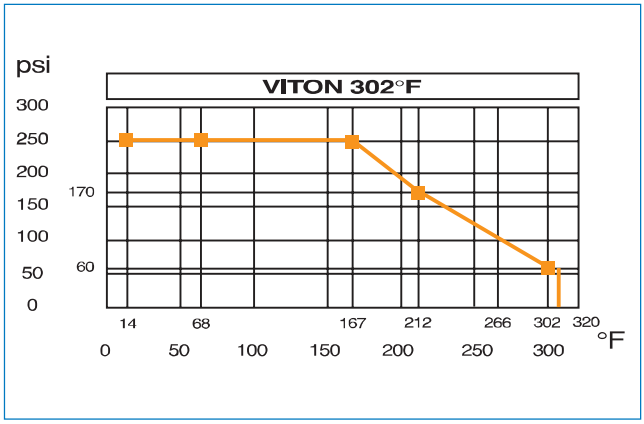


VOLTAGE SUFFIX		
	VOLTAGE SUFFIX	VOLTAGE
STANDARD	001	12V AC/DC
	002	24V AC/DC
	003	100-240 VAC
	004*	220VAC
FAIL-SAFE	012	24V AC/DC
	013	100-240 VAC
POSITIONER	021	12V AC/DC
	022	24V AC/DC
	023	100-240 VAC

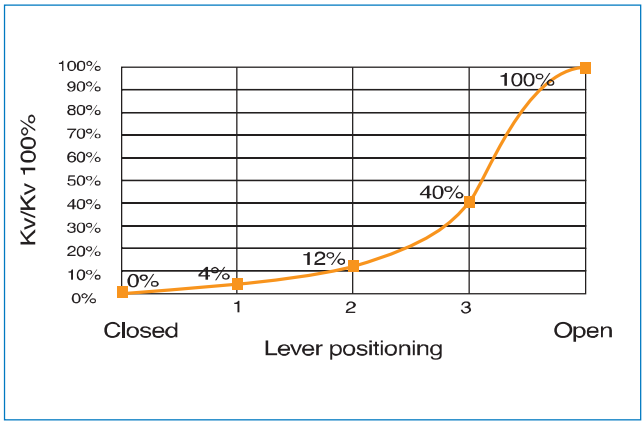
*VB015

PRESSURE - TEMPERATURE CHART FOR BUTTERFLY VALVES

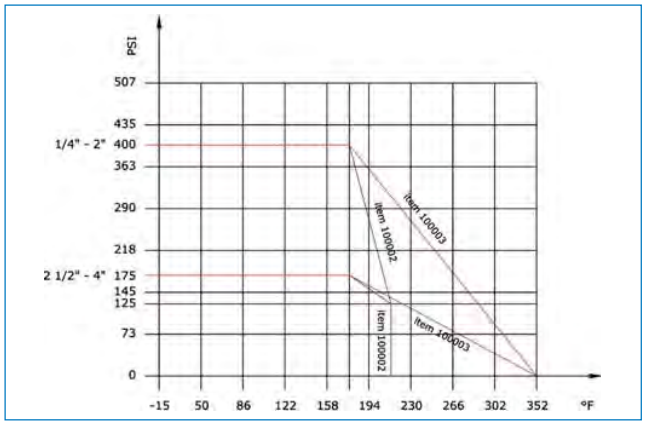




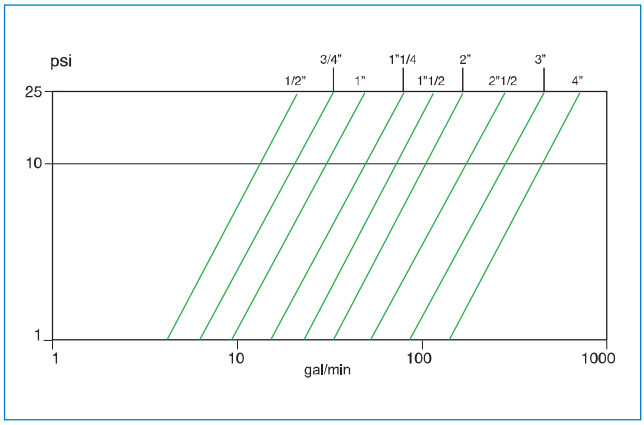
FLOW-RATE CHART FOR BUTTERFLY VALVES



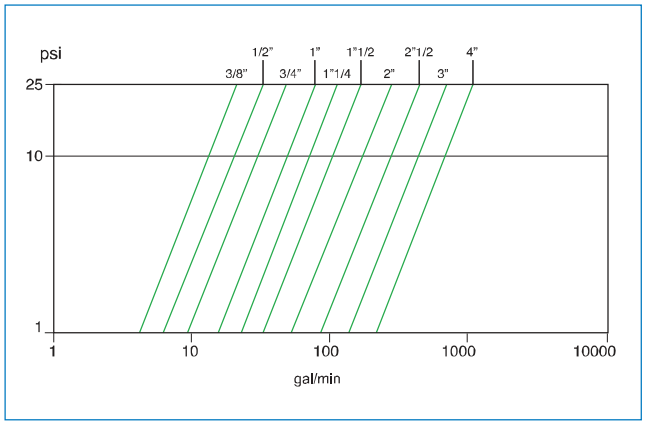
PRESSURE - TEMPERATURE CHART CHECK VALVES



FLOW-RATE CHART FOR CHECK VALVES

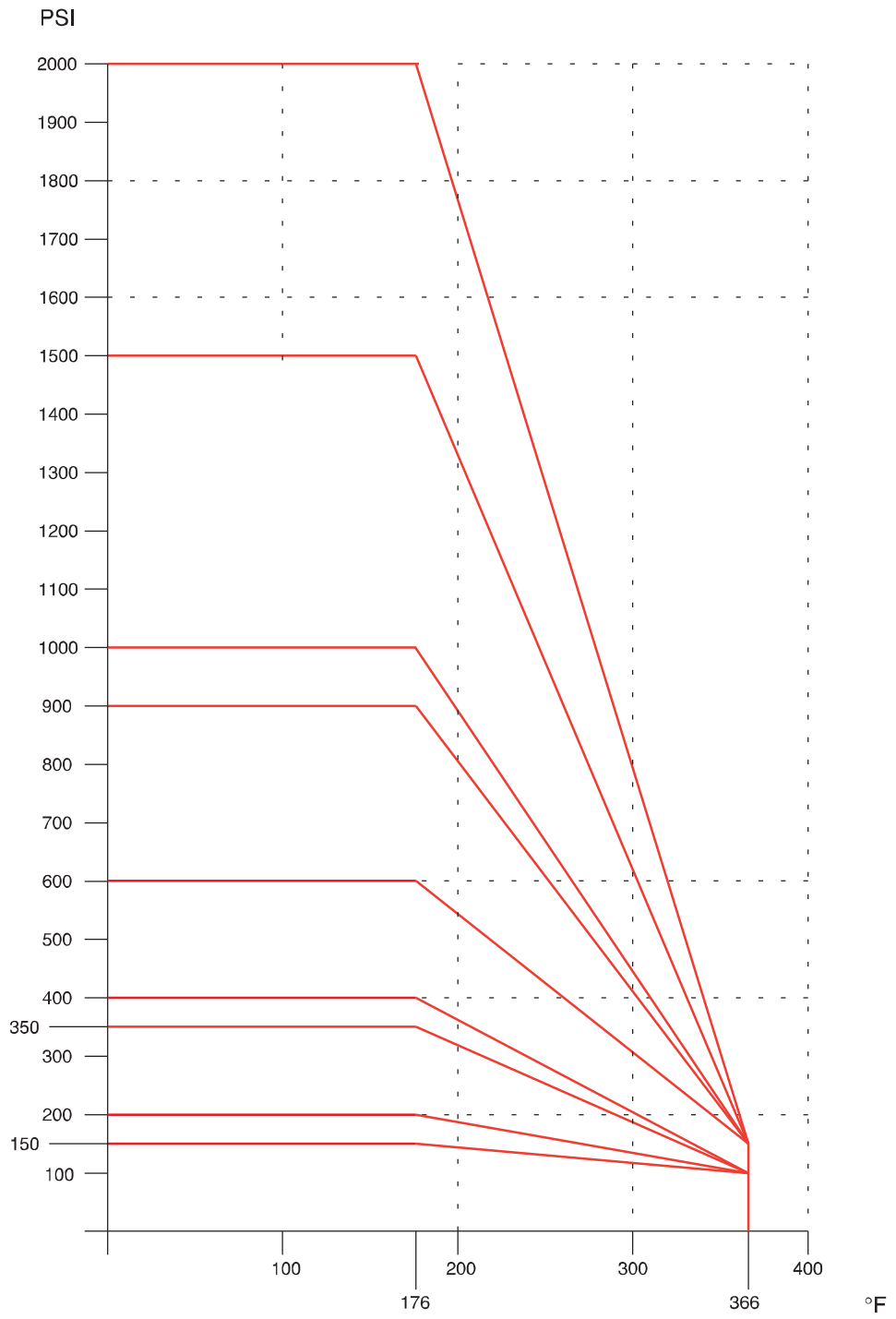


For Art. 100202



For Art. 100002-100003

PRESSURE - TEMPERATURE CHART FOR BALL VALVES



TORQUE VALUES OF STEEL AND BRASS VALVES

VALUES IN in-Lbs

Break Torque

The torque values (in-Lbs) shown in the table were measured at the test bench under following conditions:
TEMPERATURE: 68°F.
PRESSURE: 0/2000 psi.
FLUID: Demineralized water.

Steel (all series)

SIZES	15 psi	100 psi	150 psi	200 psi	350 psi	600 psi	900 psi	1500 psi	2000 psi
3/8"	27	35	35	35	44	44	44	53	53
1/2"	27	35	35	35	44	44	44	53	53
3/4"	106	115	115	133	142	159	177	195	-
1"	115	124	124	133	150	168	186	204	-
1"1/4	133	150	150	168	186	204	221	-	-
1"1/2	177	195	195	212	239	257	283	-	-
2"	257	283	292	310	345	372	416	-	-
2"1/2	487	540	540	593	646	-	-	-	-
3"	575	637	637	699	770	-	-	-	-
4"	797	956	956	1053	1159	-	-	-	-
5"	850	1018	1018	1124	1239	-	-	-	-
6"	1611	2903	2903	3186	3505	-	-	-	-
8"	2646	5824	5824	6408	-	-	-	-	-

Brass (all series except 250N-253N-355N-365N)

SIZES	15 psi	100 psi	150 psi	200 psi	350 psi	600 psi	900 psi	-	-
3/8"	48	55	55	64	64	72	72	-	-
1/2"	64	72	72	80	80	88	88	-	-
3/4"	127	135	135	143	143	151	151	-	-
1"	167	175	175	175	175	191	191	-	-
1"1/4	175	183	183	183	191	191	-	-	-
1"1/2	374	398	398	406	406	414	-	-	-
2"	382	406	430	446	470	510	-	-	-
2"1/2	478	510	566	613	693	765	-	-	-
3"	868	115	1147	1227	1386	1561	-	-	-
4"	1035	1274	1306	1386	1545	1721	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N.B. The torque values may change depending on the fluid, temperature and working condition pressure.
N.B. For valves with integral seats, shown values must be doubled.

Running torque

The torque values (in-Lbs) shown in the table were measured after 2 cycles at the test bench under following conditions:
TEMPERATURE: 68°F.
PRESSURE: 0/2000 psi.
FLUID: Demineralized water.

Steel (all series)

SIZES	15 psi	100 psi	150 psi	200 psi	350 psi	600 psi	900 psi	1500 psi	2000 psi
3/8"	27	27	31	35	35	40	44	53	62
1/2"	40	40	49	58	62	66	71	75	80
3/4"	53	53	62	62	66	75	80	89	-
1"	62	66	71	75	75	80	89	106	-
1"1/4	62	80	89	97	102	115	-	-	-
1"1/2	97	159	159	168	186	221	-	-	-
2"	266	283	292	310	327	354	-	-	-
2"1/2	310	354	398	460	487	531	-	-	-
3"	620	655	681	735	912	1115	-	-	-
4"	841	991	1044	1142	1213	1460	-	-	-
5"	974	1637	1903	2478	2567	3540	-	-	-
6"	1460	2301	2832	3620	4222	5018	-	-	-
8"	1726	4337	5177	5576	-	-	-	-	-

Brass (all series except 250N-253N-355N-365N)

SIZES	15 psi	100 psi	150 psi	200 psi	350 psi	600 psi	900 psi	-	-
3/8"	24	24	28	32	32	36	40	-	-
1/2"	36	36	44	52	56	60	64	-	-
3/4"	48	48	56	56	60	68	72	-	-
1"	56	60	64	68	67	72	80	-	-
1"1/4	56	72	80	88	92	104	-	-	-
1"1/2	88	143	143	151	167	199	-	-	-
2"	239	255	263	279	295	319	-	-	-
2"1/2	279	319	358	414	438	478	-	-	-
3"	558	589	613	661	820	1004	-	-	-
4"	757	892	940	1028	1091	1314	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

N.B. The torque values may change depending on the fluid, temperature and working condition pressure.
N.B. For valves with integral seats, shown values must be doubled.

psi	bar	psi	bar	psi	bar	psi	bar	psi	bar
1	0.07	66	4.55	255	17.58	860	59.29	1510	104.10
2	0.14	67	4.62	260	17.92	870	59.98	1520	104.79
3	0.21	68	4.69	265	18.27	880	60.67	1530	105.48
4	0.28	69	4.76	270	18.61	890	61.36	1540	106.17
5	0.34	70	4.83	275	18.96	900	62.05	1550	106.86
6	0.41	71	4.89	280	19.30	910	62.74	1560	107.55
7	0.48	72	4.96	285	19.65	920	63.42	1570	108.24
8	0.55	73	5.03	290	19.99	930	64.11	1580	108.93
9	0.62	74	5.10	295	20.34	940	64.80	1590	109.61
10	0.69	75	5.17	300	20.68	950	65.49	1600	110.30
11	0.76	76	5.24	310	31.37	960	66.18	1610	110.99
12	0.83	77	5.31	320	22.06	970	66.87	1620	111.68
13	0.90	78	5.38	330	22.75	980	67.56	1630	112.37
14	0.97	79	5.45	340	23.44	990	68.25	1640	113.06
15	1.03	80	5.52	350	24.13	1000	68.94	1650	113.75
16	1.10	81	5.58	360	24.82	1010	69.63	1660	114.44
17	1.17	82	5.65	370	25.51	1020	70.32	1670	115.13
18	1.24	83	5.72	380	26.20	1030	71.01	1680	115.82
19	1.31	84	5.79	390	26.89	1040	71.70	1690	116.51
20	1.38	85	5.86	400	27.58	1050	72.39	1700	117.20
21	1.45	86	5.93	410	28.27	1060	73.08	1710	117.89
22	1.52	87	6.00	420	28.95	1070	73.77	1720	118.58
23	1.59	88	6.07	430	26.64	1080	74.46	1730	119.27
24	1.65	89	6.14	440	30.33	1090	75.14	1740	119.96
25	1.72	90	6.20	450	31.02	1100	75.83	1750	120.65
26	1.79	91	6.27	460	31.71	1110	76.52	1760	121.33
27	1.86	92	6.34	470	32.40	1120	77.21	1770	122.02
28	1.93	93	6.41	480	33.09	1130	77.90	1780	122.71
29	2.00	94	6.48	490	33.78	1140	78.59	1790	123.40
30	2.07	95	6.55	500	34.47	1150	79.28	1800	124.09
31	2.14	96	6.62	510	35.16	1160	79.97	1810	124.78
32	2.21	97	6.69	520	35.85	1170	80.66	1820	125.47
33	2.28	98	6.76	530	36.54	1180	81.35	1830	126.16
34	2.34	99	6.83	540	37.23	1190	82.04	1840	126.85
35	2.41	100	6.89	550	37.92	1200	82.73	1850	127.54
36	2.48	105	7.24	560	38.61	1210	83.42	1860	128.23
37	2.55	110	7.58	570	39.30	1220	84.11	1870	128.92
38	2.62	115	7.93	580	39.99	1230	84.80	1880	129.61
39	2.69	120	8.27	590	40.67	1240	85.49	1890	130.30
40	2.76	125	8.62	600	41.36	1250	86.18	1900	130.99
41	2.83	130	8.96	610	42.05	1260	86.86	1910	131.68
42	2.90	135	9.31	620	42.74	1270	87.55	1920	132.36
43	2.96	140	9.65	630	43.43	1280	88.24	1930	133.05
44	3.03	145	10.00	640	44.12	1290	88.93	1940	133.74
45	3.10	150	10.34	650	44.81	1300	89.62	1950	134.43
46	3.17	155	10.69	660	45.50	1310	90.31	1960	135.12
47	3.24	160	11.03	670	46.19	1320	91.00	1970	135.81
48	3.31	165	11.38	680	46.88	1330	91.69	1980	136.50
49	3.38	170	11.72	690	47.57	1340	92.38	1990	137.19
50	3.45	175	12.06	700	48.26	1350	93.07	2000	137.88
51	3.52	180	14.41	710	48.95	1360	93.76	2010	138.57
52	3.58	185	12.75	720	49.64	1370	94.45	2020	139.26
53	3.65	190	13.10	730	50.33	1380	95.14	2030	139.95
54	3.72	195	13.44	740	51.02	1390	95.83	2040	140.64
55	3.79	200	13.79	750	51.71	1400	96.52	2050	141.33
56	3.86	105	14.13	760	52.39	1410	97.21	2060	142.02
57	3.93	210	14.48	770	53.08	1420	97.89	2070	142.71
58	4.00	215	14.82	780	53.77	1430	98.58	2080	143.40
59	4.07	220	15.17	790	54.46	1440	99.27	2090	144.08
60	4.14	225	15.51	800	55.15	1450	99.96	2100	144.77
61	4.21	230	15.86	810	55.84	1460	100.65	2110	145.46
62	4.27	235	16.20	820	56.53	1470	101.34	2120	146.15
63	4.34	240	16.55	830	57.22	1480	102.03	2130	146.84
64	4.41	245	16.89	840	57.91	1490	102.72	2140	147.53
65	4.48	250	17.24	850	58.60	1500	103.41	2150	148.22

TEMPERATURE CONVERSION FROM °C TO °F

C°	Conv	F°	C°	Conv	F°	C°	Conv	F°	C°	Conv	F°	C°	Conv	F°
-46	-50	-58	-11	12	54	23	74	165	58	136	277	92	198	388
-45	-49	-56	-11	13	55	24	75	167	58	137	279	93	199	390
-44	-48	-54	-10	14	57	24	76	169	59	138	280	93	200	392
-44	-47	-53	-9	15	59	5	77	171	59	139	282	94	201	394
-43	-46	-51	-9	16	61	26	78	172	60	140	284	94	202	396
-43	-45	-49	-8	17	63	26	79	174	61	141	286	95	203	397
-42	-44	-47	-8	18	64	27	80	176	61	142	288	96	204	399
-42	-43	-45	-7	19	66	27	81	178	62	143	289	96	205	401
-41	-42	-44	-7	20	68	28	82	180	62	144	291	97	206	403
-41	-41	-42	-6	21	70	28	83	181	63	145	293	97	207	405
-40	-40	-40	-6	22	72	29	84	183	63	146	295	98	208	406
-39	-39	-38	-5	23	73	29	85	185	64	147	297	98	209	408
-39	-38	-36	-4	24	75	20	86	187	64	148	298	99	210	410
-38	-37	-35	-4	25	77	31	87	789	65	149	300	99	211	412
-38	-36	-33	-3	26	79	31	88	190	66	150	302	100	212	414
-37	-35	-31	-3	27	81	32	89	192	66	151	304	101	213	415
-37	-34	-29	-2	28	82	32	90	194	67	152	306	101	214	417
-36	-33	-27	-2	29	84	33	91	196	67	153	307	102	215	419
-36	-32	-26	-1	30	86	33	92	198	68	154	309	102	216	421
-35	-31	-24	-1	31	88	34	93	199	68	155	311	103	217	423
-34	-30	-22	0	32	90	34	94	201	69	156	313	103	218	424
-34	-29	-20	1	33	91	35	95	203	69	157	315	104	219	426
-33	-28	-18	1	34	93	36	96	205	70	158	316	104	220	428
-33	-27	-17	2	35	95	36	97	207	71	159	318	105	221	430
-32	-26	-15	2	36	97	37	98	208	71	160	320	106	222	432
-32	-25	-13	3	37	99	37	99	210	71	161	322	106	223	433
-31	-24	-11	3	38	100	38	100	212	72	162	324	107	224	435
-31	-23	-9	4	39	102	38	101	214	73	163	325	107	225	437
-30	-22	-8	4	40	104	39	102	216	73	164	327	108	226	439
-29	-21	-6	5	41	106	39	103	217	74	165	329	108	227	441
-29	-20	-4	6	42	108	40	104	219	74	166	331	109	228	442
-28	-19	-2	6	43	109	41	105	221	75	167	333	109	229	444
-28	-18	0	7	44	111	41	106	223	76	168	334	110	230	446
-27	-17	1	7	45	113	42	107	225	76	169	336	111	231	448
-27	-16	3	8	46	115	42	108	226	77	170	338	111	232	450
-26	-15	5	8	47	117	43	109	228	77	171	340	112	233	451
-26	-14	7	9	48	118	43	110	230	78	172	342	112	234	453
-25	-13	9	9	49	120	44	111	232	78	173	343	113	235	455
-24	-12	10	10	50	122	44	112	234	79	174	345	113	236	457
-24	-11	12	11	51	124	45	113	235	79	175	347	114	237	459
-23	-10	14	11	52	126	46	114	237	80	176	349	114	238	460
-23	-9	16	12	53	127	46	115	239	81	177	351	115	239	462
-22	-8	18	12	54	129	47	116	241	81	178	352	116	240	464
-22	-7	19	13	55	131	47	117	243	82	179	354	116	241	466
-21	-6	21	13	56	133	48	118	244	82	180	356	117	242	468
-21	-5	23	14	57	135	48	119	246	83	181	358	117	243	469
-20	-4	25	14	58	136	49	120	248	83	152	360	118	244	471
-19	-3	27	15	59	138	49	121	250	84	183	361	118	245	473
-19	-2	28	16	60	140	50	122	252	84	184	363	119	246	475
-18	-1	30	16	61	142	51	123	253	85	185	365	119	247	477
-18	0	32	17	62	144	51	124	255	86	186	367	120	248	478
-17	1	34	17	63	145	52	125	257	86	187	369	121	249	480
-17	2	36	18	64	147	52	126	259	87	188	370	121	250	482
-16	3	37	18	65	149	53	127	261	87	189	372	122	251	484
-16	4	39	19	66	151	53	128	262	88	190	374	122	252	486
-15	5	41	19	67	153	54	129	264	88	191	376	123	253	487
-14	6	43	20	68	154	54	130	266	89	192	378	123	254	489
-14	7	45	21	69	156	55	131	268	89	193	379	124	255	491
-13	8	46	21	70	158	56	132	270	90	194	381	124	256	493
-13	9	48	22	71	160	56	133	271	91	195	383	125	257	495
-12	10	50	22	72	162	57	134	273	91	196	385	126	258	496
-12	11	52	23	73	163	57	135	275	92	197	387	126	259	498

USE OF THE TABLE

Please always refer to the column in the middle (conv. column). If the temperature you need to convert is in Celsius degrees you get the corresponding Fahrenheit temperature by reading the data on its right; while if it is a Fahrenheit temperature you get the Celsius one on the left side.

The general conversion formulas are:

$$F° = \frac{9}{5} °C + 32 \qquad °C = \frac{5}{9} (°F - 32)$$

USABlueBook® Multi-Cartridge Filter Housings

New lower prices!

- **For large industrial applications**
- **High flow rates from 25 to 140 gpm**
- **Withstand pressures up to 150 psi and temperatures up to 300°F**

USABlueBook is proud to offer a complete line of four- and five-round filter housings with flow rates from 25 to 140 gpm. Housings are constructed of poly-coated 304L stainless steel to withstand tough applications. The band clamp lid closure allows quick cartridge changes. Pipe fittings are easily accessible for quick installation. Order filter cartridges separately below.

Special order models include: wing-bolt closures; other process connections (2" flange, BSP, grooved and sanitary fittings); mounting tabs, legs and custom fittings; electro-polishing; 316 SS; and larger size filter housings. Contact USABlueBook for details.

Housing material:	304 stainless steel
Finish:	poly-coat
Gasket material:	Buna-N
Pressure:	150 psi
Temperature:	300°F

SIZE (OD x L)	MAX FLOW (GPM)*	PIPE SIZE NPT(M)	# OF STANDARD CARTRIDGES	STOCK #	EACH
2½" x 10"	25	2"	4	MG-35409	$ 845.95
2½" x 20"	50	2"	8	MG-35410	925.95
2½" x 30"	75	2"	12	MG-35411	1,010.95
2½" x 40"	100	2"	16	MG-35412	1,094.95
2½" x 10"	35	2"	5	MG-35413	886.95
2½" x 20"	70	2"	10	MG-35414	966.95
2½" x 30"	105	2"	15	MG-35415	1,101.95
2½" x 40"	140	2"	20	MG-35416	1,264.95

***Flow rates are guidelines only. Actual flow rates vary based on fluid, viscosity, cartridge type, micron rating and other factors.**

USABlueBook® Jumbo Filter Housings

- **Stainless steel—designed for heavy-duty industrial filtration applications**
- **Flow rates from 50 to 150 gpm**
- **Withstand pressures up to 150 psig and temperatures up to 300°F**

These rugged jumbo filter housings are constructed of poly-coated 304L stainless steel to withstand tough applications. They feature band clamp closures for quick cartridge changeout. The adjustable compression cap provides super sealing, and the pipe fittings are easily accessible for fast installation. Two installed pressure gauges let you read differential pressure at a glance.

Includes: pressure gauges, mounting legs and grounding lug. Custom fittings are available—contact USABlueBook for details. Jumbo filter housings can be used with filter cartridges on the facing page or with the jumbo filters on page 1650.

Housing material:	304L stainless steel
Finish:	poly-coat
Gasket material:	Buna-N
Pressure:	150 psi
Temperature:	300° F
Floor space required:	17½" x 17½"

SIZE (OD x L)	MAX FLOW (GPM)*	PIPE SIZE NPT(M)	STOCK #	EACH
7¾" x 9⅝"	50	2"	MG-35417	$ 1,094.95
7¾" x 19½"	100	2"	MG-35418	1,253.95
7¾" x 30¾"	150	2"	MG-35419	1,721.95

***Flow rates are guidelines only. Actual flow rates vary based on fluid, viscosity, cartridge type, micron rating and other factors.**

Clean and reuse many of our filters

Filter Cartridges for Multi-Cartridge Housings

- **Use with USABlueBook multi-cartridge filter housings and Harmsco® cartridge cluster filters**

Choose the best size for your filter application. You can clean and reuse 50 and 100 micron cartridges many times with potable water applications. You can typically clean and reuse the 5, 10 and 20 micron cartridges several times. The 0.35, 1, and 1-absolute cartridges are not reusable. Choose double- and triple-length cartridges to save on installation/ replacement time.

NOMINAL MICRON SIZE	APPLICATIONS	SINGLE LENGTH 9¾"L x 2¾"OD x 1 1/16"ID STOCK #	EACH	DOUBLE LENGTH 19½"L x 2¾"OD x 1 1/16"ID STOCK #	EACH	TRIPLE LENGTH 29¼"L x 2¾"OD x 1 1/16"ID STOCK #	EACH
0.35	Lab Certified	MG-65746	$ 13.49	—	—	—	—
1	Final Filter, Potable Water	MG-65748	10.49	MG-65800	$ 19.49	MG-65810	$ 29.95
1 Absol.	Giardia Cyst Removal	MG-65773	15.49	MG-65777	43.62	MG-65781	54.95
5	Our Most Popular Final Filter for Potable Water	MG-65750	8.09	MG-65802	16.49	MG-65812	27.95
10	Used Prior to 0.35 and 1 Micron Cartridges as a Pre-Filter	MG-65752	8.38	MG-65804	17.16	MG-65814	31.44
20	Most Popular Pre-Filter for Potable Water	MG-65754	7.59	MG-65806	16.49	MG-65816	27.95
50	Pre-Filter: Coarse Solids	MG-65756	7.59	MG-65808	16.49	MG-65818	27.95
100	Pre-Filter: Very Coarse Solids	MG-65758	7.09	—	—	—	—

Check us out for all your filtration needs!

Single-Cartridge Filter Housings

These filter housings are manufactured from the highest quality NSF-listed FDA-grade materials. Use them with the filter cartridges sold separately on pages 1649-1651. Order mounting brackets, filter sump wrenches and replacement O-rings separately.

Standard Water Filter Housings

- **Most economical choice**

Pressure relief button prevents a mess when changing filters. Flow rates are limited by the cartridge used with the housing.

SIZE (OD x L)	COLOR	INLET NPT(F)	STOCK #	EACH
2.5" x 10"	Blue	1/2"	MG-68774	$ 11.99
2.5" x 10"	Blue	3/4"	MG-68775	12.99
2.5" x 10"	Clear	1/2"	MG-68776	17.49
2.5" x 10	Clear	3/4"	MG-68777	17.49
Mounting Bracket (Includes Screws)			MG-68791	1.99
Sump Wrench			MG-68788	1.99
Replacement EPM O-Ring			MG-68796	0.69

High-Flow Water Filter Housings

- **Best option for high flows**

These housings are designed for 4.5" filters so they can handle higher flow rates. Flow rates depend on the cartridge used with the housing. Pressure relief button prevents a mess when changing filters.

SIZE (OD x L)	COLOR	INLET NPT(F)	STOCK #	EACH
4.5" x 10"	Blue	3/4"	MG-68782	$ 44.95
4.5" x 10"	Blue	1"	MG-68783	45.95
4.5' x 10"	Blue	1 1/2"	MG-68784	45.95
4.5" x 20"	Blue	3/4"	MG-68785	63.95
4.5" x 20"	Blue	1"	MG-68786	64.95
4.5" x 20"	Blue	1 1/2"	MG-68787	64.95
Mounting Bracket			MG-68793	24.95
Sump Wrench			MG-68790	4.09
Replacement EPM O-ring			MG-68798	2.29

Valve-In-Head Water Filter Housings

- **The ultimate in convenience**

These housings are designed with an integral three-way valve. The three functions include filter, bypass, and shutoff. Does not include a pressure relief button.

SIZE (OD x L)	COLOR	INLET NPT(F)	STOCK #	EACH
2.5" x 10"	Clear	3/4"	MG-68936	$ 43.95
2.5" x 10"	White	3/4"	MG-68937	32.95
Mounting Bracket (Includes Screws)			MG-68791	1.99
Sump Wrench			MG-68788	1.99
Replacement EPM O-Ring			MG-68796	0.69

USABlueBook Single-Cartridge Filter Housings

- **Only one cartridge to change or clean**
- **Flow rates from 10 to 30 gpm**
- **Withstand high pressures up to 250 psi and temperatures up to 250°F**

These low-cost, high-quality single cartridge filter housings are designed for industrial and commercial filtration applications. They are available in cast iron/steel, 304L stainless steel and 316L stainless steel heads and sumps for a variety of applications.

Housings feature automatic centering of cartridges on the bottom seal plate. Centering springs align cartridge ends with each other at the filter head. A standard drain petcock lets you drain your fluid for easy cleaning.

MAX FLOW (GPM)*	INLET NPT(F)	IRON/STEEL HEAD AND SUMP STOCK #	IRON/STEEL HEAD AND SUMP EACH	304L SS HEAD AND SUMP STOCK #	304L SS HEAD AND SUMP EACH	316L SS HEAD AND SUMP STOCK #	316L SS HEAD AND SUMP EACH
SINGLE CARTRIDGE FILTERS, 2 1/2" OD x 10"L							
10	1/2"	MG-35382	$ 99.95	MG-35391	$ 247.95	MG-35400	$ 282.95
10	3/4"	MG-35383	99.95	MG-35392	253.95	MG-35401	289.95
10	1"	MG-35384	99.95	MG-35393	262.95	MG-35402	296.95
SINGLE CARTRIDGE FILTERS, 2 1/2" OD x 20"L							
20	1/2"	MG-35385	$ 118.95	MG-35394	$ 328.95	MG-35403	$ 398.95
20	3/4"	MG-35386	118.95	MG-35395	337.95	MG-35404	407.95
20	1"	MG-35387	118.95	MG-35396	343.95	MG-35405	434.95
SINGLE CARTRIDGE FILTERS, 2 1/2" OD x 30"L							
30	1/2"	MG-35388	$ 148.95	MG-35397	$ 412.95	MG-35406	$ 523.95
30	3/4"	MG-35389	148.95	MG-35398	415.95	MG-35407	532.95
30	1"	MG-35390	148.95	MG-35399	441.95	MG-35408	537.95

***Flow rates are guidelines only. Actual flow rates vary based on fluid, viscosity, cartridge type, micron rating and other factors.**

Heavy-Duty Water Filter Housings

- **Designed for more demanding applications**

Thick side walls and heavy-duty ribs provide greater strength. Pressure relief button prevents a mess when changing filters. Flow rates depend on the cartridge used with the housing.

SIZE (OD x L)	COLOR	INLET NPT(F)	STOCK #	EACH
2.5" x 10"	Blue	3/4"	MG-68778	$ 22.47
2.5" x 10"	Clear	3/4"	MG-68779	26.66
2.5" x 20"	Blue	3/4"	MG-68780	37.95
2.5" x 20"	Clear	3/4"	MG-68781	57.95
Mounting Bracket			MG-68792	5.79
Sump Wrench			MG-68789	1.99
Replacement EPM O-Ring			MG-68797	1.39

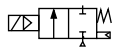
ASCO® Red-Hat®

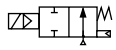
Pilot Operated

General Service Solenoid Valves

Brass or Stainless Steel Bodies

3/8" to 2 1/2" NPT

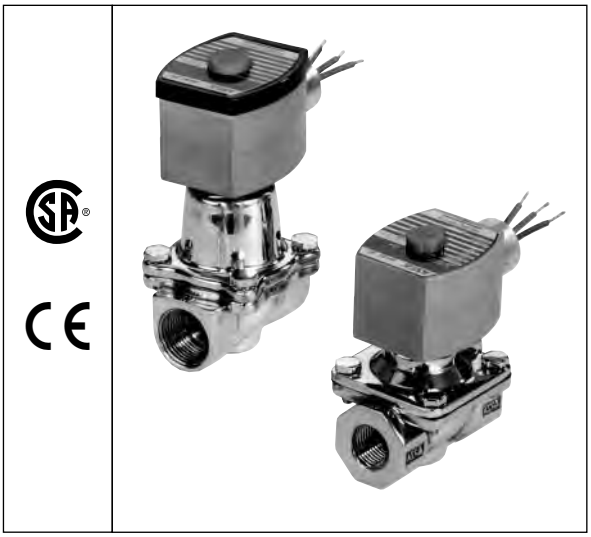
NC 

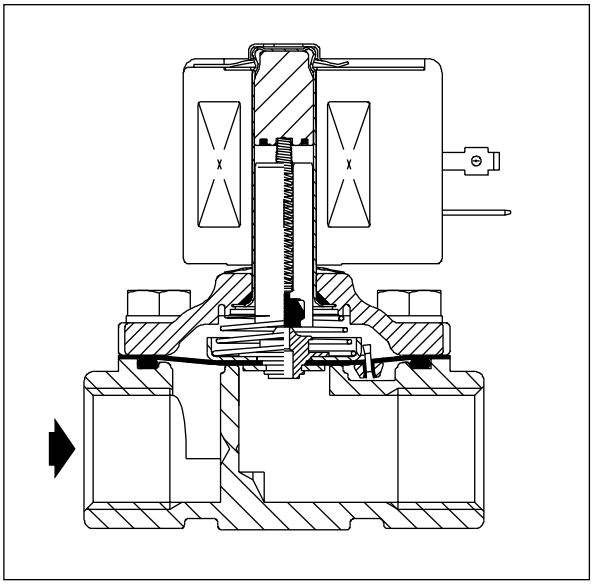
NO 

2/2 SERIES **8210**

Features

- Wide range of pressure ratings, sizes, and resilient materials provide long service life and low internal leakage.
- High Flow Valves for liquid, corrosive, and air/inert gas service.
- Industrial applications include:
  - Car wash
  - Laundry equipment
  - Air compressors
  - Industrial water control
  - Pumps





Construction

Valve Parts in Contact with Fluids		
Body	Brass	304 Stainless Steel
Seals and Discs	NBR or PTFE	
Disc-Holder	PA	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
F	16.8	16.1	35	180	272610	97617	272614	97617
F	-	17.1	40	93	238610	-	238614	-
F	-	20	43	240	99257	-	99257	-
F	-	20.1	48	240	272610	-	272614	-
H	30.6	-	-	-	-	74073	-	74073
F	40.6	-	-	-	-	238910		238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages available when required.

Solenoid Enclosures

Standard: Red-Hat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; Red-Hat - Type I.

Optional: Red-Hat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; Red-Hat - Explosionproof and Watertight, Types 3, 4, 4X, 7, and 9.
(To order, add prefix "EF" to catalog number, except Catalog Numbers 8210B57, 8210B58, and 8210B59. Valves not available with Explosionproof enclosures.)
See Optional Features Section for other available options.

Nominal Ambient Temperature Ranges:

Red-Hat II/
Red-Hat AC: 32˚F to 125˚F (0˚C to 52˚C)
Red-Hat II DC: 32˚F to 104˚F (0˚C to 40˚C)
Red-Hat DC: 32˚F to 77˚F (0˚C to 25˚C)
(104˚F/40˚C occasionally)
Refer to Engineering Section for details.

Approvals:

CSA certified. Red-Hat II meets applicable CE directives.
Refer to Engineering Section for details.

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)							Max. Fluid Temp. °F		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	3/8	1.5	①	150	125	-	40	40	-	180	150	8210G73 ③	1P	●	8210G36 ③	1P	●	6.1/F	11.6/F
3/8	5/8	3	0	150	150	-	40	40	-	180	150	8210G93	5D	❍	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G1	6D	❍	-	-	-	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	-	-	-	175	-	8210G6	5D	❍	-	-	-	17.1/F	-
1/2	7/16	2.2	①	150	125	-	40	40	-	180	150	8210G15 ③	2P	●	8210G37 ③	2P	●	6.1/F	11.6/F
1/2	5/8	4	0	150	150	-	40	40	-	180	150	8210G94	5D	❍	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	-	175	150	-	-	-	8210G87	7D	●	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G2	6D	❍	-	-	-	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G7	5D	❍	-	-	-	17.1/F	-
1/2	5/8	4	5	300	300	-	300	300	-	180	125	8210G227	5D	❍	-	-	-	17.1/F	40.6/H
3/4	5/8	4.5	0	150	150	125	40	40	-	175	150	-	-	-	8210G88	7D	●	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G9	9D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	5	0	150	150	-	40	40	-	180	150	8210G95	8D	❍	-	-	-	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G3	11D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	6	0	-	-	-	200	180	180	-	77	8210B26 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G26 ② ‡	40P	●	-	-	-	16.1F	-
1	1	13	0	-	-	-	100	100	80	-	77	8210B54 ‡	31D	-	8210D89	15D	-	-	30.6/H
1	1	13	0	150	125	125	-	-	-	180	-	8210G54	41D	●	8210G89	45D	●	16.1/F	-
1	1	13	5	150	150	100	125	125	125	180	150	8210G4	12D	❍	-	-	-	6.1/F	11.6/F
1	1	13.5	0	300	225	115	-	-	-	200	-	8210G27 ‡	42P	●	-	-	-	20.1/F	-
1	1	13.5	10	300	300	300	-	-	-	175	-	8210G78 ②	13P	-	-	-	-	17.1/F	-
1 1/4	1 1/8	15	0	-	-	-	100	100	80	-	77	8210B55 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	1 1/8	15	0	150	125	125	-	-	-	180	-	8210G55	43D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	5	150	150	100	125	125	125	180	150	8210G8	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	1 1/4	22.5	0	-	-	-	100	100	80	-	77	8210B56 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G56 ‡	44D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	5	150	150	100	125	125	125	180	150	8210G22	18D	●	-	-	-	6.1/F	11.6/F
2	1 3/4	43	5	150	125	90	50	50	50	180	150	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	1 3/4	45	5	150	125	90	50	50	50	180	150	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	125	125	80	180	150	8210G33	23D	●	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	250	200	200	250	200	200	180	180	8210G11 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	125	125	80	180	150	8210G34	23D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G30	37D	●	10.1/F	11.6/F
1/2	5/8	4	5	250	200	200	250	200	200	180	180	8210G12 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	3/4	5.5	0	150	150	125	125	125	80	180	150	8210G35	25D	●	-	-	-	10.1/F	11.6/F
3/4	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G38	38D	●	10.1/F	11.6/F
3/4	3/4	6.5	5	-	-	-	250	200	200	-	180	8210C13	24D	●	-	-	-	-	16.8/F
3/4	3/4	6.5	5	250	200	200	-	-	-	180	-	8210G13	46D	●	-	-	-	16.1/F	-
1	1	13	0	125	125	125	-	-	-	180	-	8210B57 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	1	13	5	-	-	-	125	125	125	-	180	8210D14	26D	●	-	-	-	-	16.8/F
1	1	13	5	150	150	125	-	-	-	180	-	8210G14	47D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	0	125	125	125	-	-	-	180	-	8210B58 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	1 1/8	15	5	-	-	-	125	125	125	-	180	8210D18	28D	●	-	-	-	-	16.8/F
1 1/4	1 1/8	15	5	150	150	125	-	-	-	180	-	8210G18	48D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	0	125	125	125	-	-	-	180	-	8210B59 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	1 1/4	22.5	5	-	-	-	125	125	125	-	180	8210D32	29D	●	-	-	-	-	16.8/F
1 1/2	1 1/4	22.5	5	150	150	125	-	-	-	180	-	8210G32	49D	●	-	-	-	16.1/F	-
2	1 3/4	43	5	-	-	-	125	125	125	-	150	8210103	30P	●	-	-	-	-	16.8/F
2	1 3/4	43	5	125	125	125	-	-	-	180	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	1 3/4	45	5	-	-	-	125	125	125	-	150	8210104	27P	●	-	-	-	-	16.8/F
2 1/2	1 3/4	45	5	125	125	125	-	-	-	180	-	8210G104	51P	●	-			16.1/F	-

Notes: ① 5 psi on Air; 1 psi on Water.
② Valve provided with PTFE main disc.
③ Valve includes Ultem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve. Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless Steel disc-holder.
‡ Must have solenoid mounted vertical and upright.

Specifications (Metric units)

Pipe Size (ins.)	Orifice Size (mm)	Kv Flow Factor (m3/h)	Operating Pressure Differential (bar)							Max.Fluid Temp. °C		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	10	1.29	①	10	9	-	3	3	-	81	65	8210G73 ③	1P	●	8210G36 ③	1P	●	6.1/F	11.6/F
3/8	16	2.57	0	10	10	-	3	3	-	81	65	8210G93	5D	❍	-	-	-	10.1/F	11.6/F
3/8	16	2.57	0.3	14	10	9	9	7	7	81	65	8210G1	6D	❍	-	-	-	6.1/F	11.6/F
3/8	16	2.57	0.3	21	21	21	-	-	-	79	-	8210G6	5D	❍	-	-	-	17.1/F	-
1/2	11	1.89	①	10	9	-	3	3	-	81	65	8210G15 ③	2P	●	8210G37 ③	2P	●	6.1/F	11.6/F
1/2	16	3.43	0	10	10	-	3	3	-	81	65	8210G94	5D	❍	-	-	-	10.1/F	11.6/F
1/2	16	3.43	0	10	10	9	3	3	-	79	65	-	-	-	8210G87	7D	●	17.1/F	11.6/F
1/2	16	3.43	0.3	14	10	9	9	7	7	81	65	8210G2	6D	❍	-	-	-	6.1/F	11.6/F
1/2	16	3.43	0.3	21	21	21	-	-	-	79	-	8210G7	5D	❍	-	-	-	17.1/F	-
1/2	16	3.43	0.3	21	21	-	21	21	-	81	52	8210G227	5D	❍	-	-	-	17.1/F	40.6F
3/4	16	3.86	0	10	10	9	3	3	-	79	65	-	-	-	8210G88	7D	●	17.1/F	11.6/F
3/4	19	4.29	0.3	9	9	9	7	6	5	81	65	8210G9	9D	❍	-	-	-	6.1/F	11.6/F
3/4	19	4.29	0	10	10	-	3	3	-	81	65	8210G95	8D	❍	-	-	-	10.1/F	11.6/F
3/4	19	5.57	0.3	17	10	7	9	9	9	81	65	8210G3	11D	❍	-	-	-	6.1/F	11.6/F
3/4	19	5.14	0	-	-	-	14	12	12	-	25	8210B26 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	19	5.14	0	24	21	14	-	-	-	92	-	8210G26 ② ‡	40P	●	-	-	-	16.1F	-
1	25	11.14	0	-	-	-	7	7	6	-	25	8210B54 ‡	31D	-	8210D89	15D	-	-	30.6/H
1	25	11.14	0	10	9	9	-	-	-	81	-	8210G54	41D	●	8210G89	45D	●	16.1/F	-
1	25	11.14	0.3	10	10	7	9	9	9	81	65	8210G4	12D	❍	-	-	-	6.1/F	11.6/F
1	25	11.57	0	21	16	8	-	-	-	92	-	8210G27 ‡	42P	●	-	-	-	20.1/F	-
1	25	11.57	0.7	21	21	21	-	-	-	79	-	8210G78 ②	13P	-	-	-	-	17.1/F	-
1 1/4	29	12.86	0	-	-	-	7	7	6	-	25	8210B55 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	29	12.86	0	10	9	9	-	-	-	81	-	8210G55	43D	●	-	-	-	16.1/F	-
1 1/4	29	12.86	0.3	10	10	7	9	9	9	81	65	8210G8	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	32	19.29	0	-	-	-	7	7	6	-	25	8210B56 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	32	19.29	0	10	9	9	-	-	-	81	-	8210G56 ‡	44D	●	-	-	-	16.1/F	-
1 1/2	32	19.29	0.3	10	10	7	9	9	9	81	65	8210G22	18D	●	-	-	-	6.1/F	11.6/F
2	44	36.86	0.3	10	9	6	3	3	3	81	65	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	44	38.57	0.3	10	9	6	3	3	3	81	65	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	16	2.57	0.0	10	10	9	9	9	6	81	65	8210G33	23D	●	-	-	-	10.1/F	11.6/F
3/8	16	2.57	0.3	17	14	14	17	14	14	81	81	8210G11 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	16	3.43	0	10	10	9	9	9	6	81	65	8210G34	23D	●	-	-	-	10.1/F	11.6/F
1/2	16	2.57	0	10	10	7	9	9	6	81	65	-	-	-	8210G30	37D	●	10.1/F	11.6/F
1/2	16	3.43	0.3	17	14	14	17	14	14	81	81	8210G12 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	19	4.71	0	10	10	9	9	9	6	81	65	8210G35	25D	●	-	-	-	10.1/F	11.6/F
3/4	16	2.57	0	10	10	7	9	9	6	81	65	-	-	-	8210G38	38D	●	10.1/F	11.6/F
3/4	19	5.57	0.3	-	-	-	17	14	14	-	81	8210C13	24D	●	-	-	-	-	16.8/F
3/4	19	5.57	0.3	17	14	14	-	-	-	81	-	8210G13	46D	●	-	-	-	16.1/F	-
1	25	11.14	0	9	9	9	-	-	-	81	-	8210B57 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	25	11.14	0.3	-	-	-	9	9	9	-	81	8210D14	26D	●	-	-	-	-	16.8/F
1	25	11.14	0.3	10	10	9	-	-	-	81	-	8210G14	47D	●	-	-	-	16.1/F	-
1 1/4	29	12.86	0	9	9	9	-	-	-	81	-	8210B58 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	29	12.86	0.3	-	-	-	9	9	9	-	81	8210D18	28D	●	-	-	-	-	16.8/F
1 1/4	29	12.86	0.3	10	10	9	-	-	-	81	-	8210G18	48D	●	-	-	-	16.1/F	-
1 1/2	32	19.29	0	9	9	9	-	-	-	81	-	8210B59 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	32	19.29	0.3	-	-	-	9	9	9	-	81	8210D32	29D	●	-	-	-	-	16.8/F
1 1/2	32	19.29	0.3	10	10	9	-	-	-	81	-	8210G32	49D	●	-	-	-	16.1/F	-
2	44	36.86	0.3	-	-	-	9	9	9	-	65	8210103	30P	●	-	-	-	-	16.8/F
2	44	36.86	0.3	9	9	9	-	-	-	81	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	44	38.57	0.3	-	-	-	9	9	9	-	65	8210104	27P	●	-	-	-	-	16.8/F
2 1/2	44	38.57	0.3	9	9	9	-	-	-	81	-	8210G104	51P	●	-	-	-	16.1/F	-

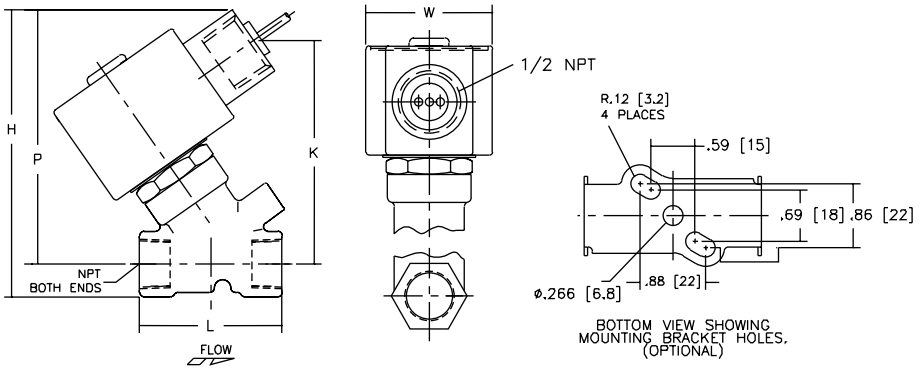
Notes: ① 0.3 bar on Air; 0.0 bar on Water.
② Valve provided with PTFE main disc.
③ Valve includes UItem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve.
Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless Steel disc-holder.
‡ Must have solenoid mounted vertical and upright.

Dimensions: inches (mm)

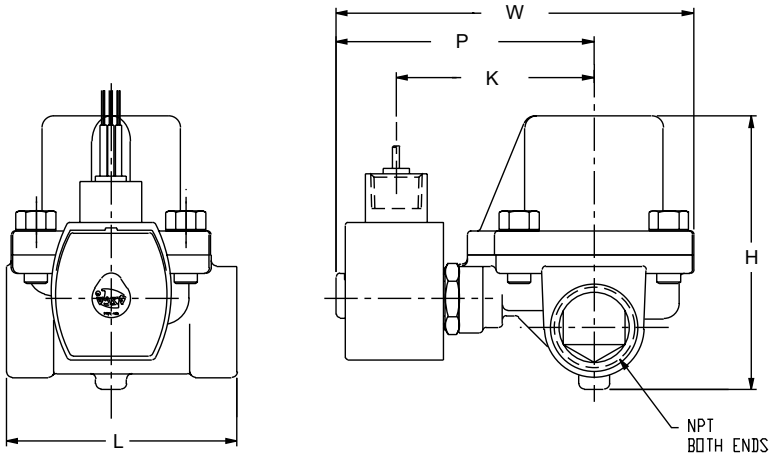
Constr. Ref. No.		H	K	L	P	W
1*	**ins.**	3.85	3.00	1.91	3.41	1.69
	mm	98	76	49	87	43
2*	**ins.**	4.17	3.25	2.28	3.63	1.69
	mm	106	83	58	92	43
13	**ins.**	4.44	3.22	3.75	4.19	5.81
	mm	113	82	95	106	147
5	**ins.**	3.84	2.31	2.75	3.28	2.28
	mm	98	59	70	83	58
6*	**ins.**	3.38	1.94	2.75	2.80	2.28
	mm	86	49	70	71	58
7	**ins.**	4.19	2.50	2.81	3.47	2.39
	mm	106	64	71	88	61
8	**ins.**	4.13	2.47	2.81	3.44	2.29
	mm	105	63	71	87	58
9*	**ins.**	3.66	2.10	2.81	2.96	2.28
	mm	93	53	71	75	58
10*①	**ins.**	5.25	X	2.81	4.59	2.31
	mm	133	X	71	117	59
11*	**ins.**	4.16	2.66	3.84	3.52	2.75
	mm	106	68	98	89	70
12	**ins.**	5.64	3.15	3.75	4.01	3.36
	mm	143	80	95	102	85
15*	**ins.**	5.34	X	3.75	4.47	3.84
	mm	136	X	95	114	98
16	**ins.**	5.64	3.15	3.66	4.01	3.56
	mm	143	80	93	102	90
18	**ins.**	6.11	3.30	4.38	4.16	3.92
	mm	155	84	111	106	100
20*	**ins.**	7.33	3.71	5.06	4.57	4.87
	mm	186	94	129	116	124
21*	**ins.**	7.33	3.71	5.50	4.57	4.87
	mm	186	94	140	116	124
23	**ins.**	4.35	2.65	2.75	3.79	2.28
	mm	110	67	70	96	58
24	**ins.**	5.06	X	3.78	4.44	2.75
	mm	129	X	96	113	70
25	**ins.**	4.64	2.81	2.81	3.94	2.28
	mm	118	71	71	100	58
26	**ins.**	6.53	X	3.75	4.91	3.19
	mm	166	X	95	125	81
27	**ins.**	8.22	X	5.50	5.47	4.87
	mm	209	X	140	139	124
28	**ins.**	6.53	X	3.66	4.91	3.19
	mm	166	X	93	125	81
29	**ins.**	7.03	X	4.38	5.06	4.40
	mm	179	X	111	129	112

① Valves must be mounted with solenoid vertical and upright.
* DC dimensions slightly larger.

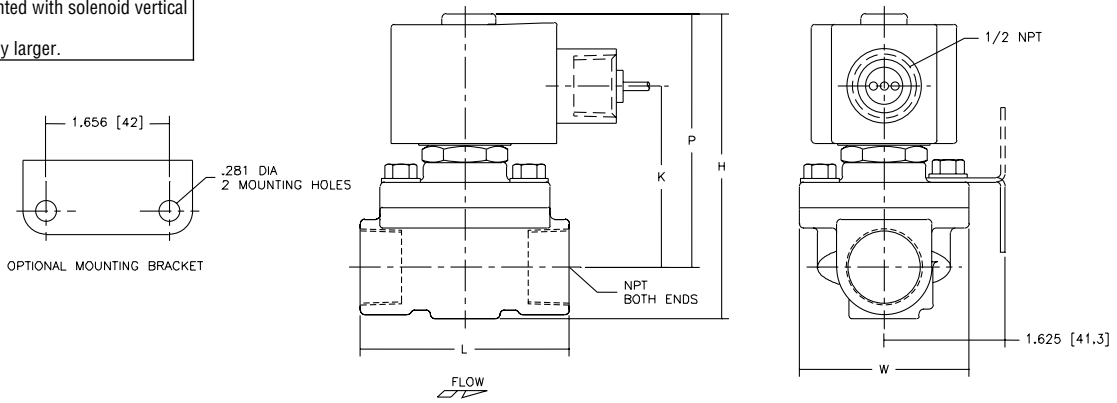
Constr. Refs. 1, 2



Constr. Ref. 13



Constr. Refs. 5-9, 11, 20, 21, 23 , 25, 37,38

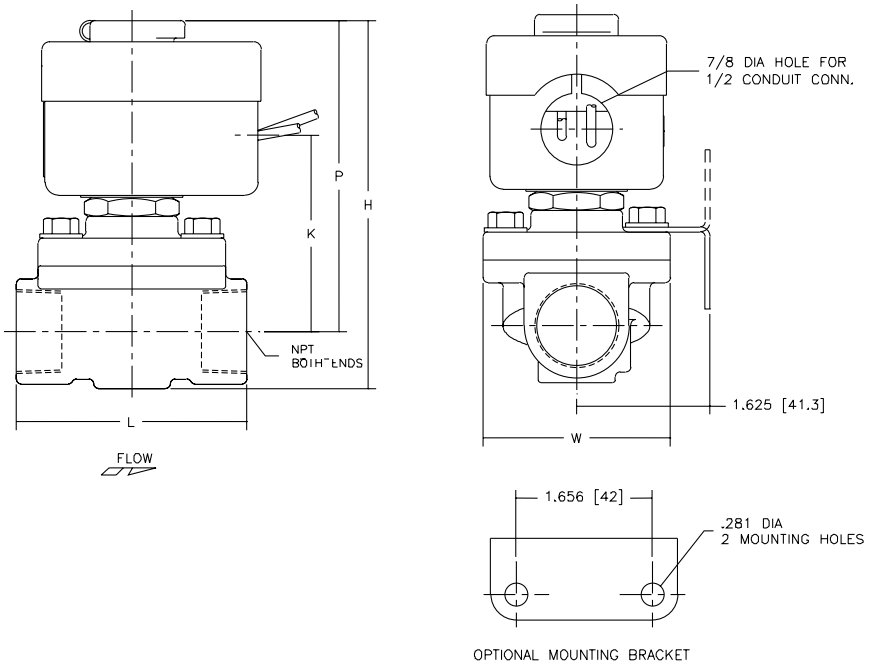


Dimensions: inches (mm)

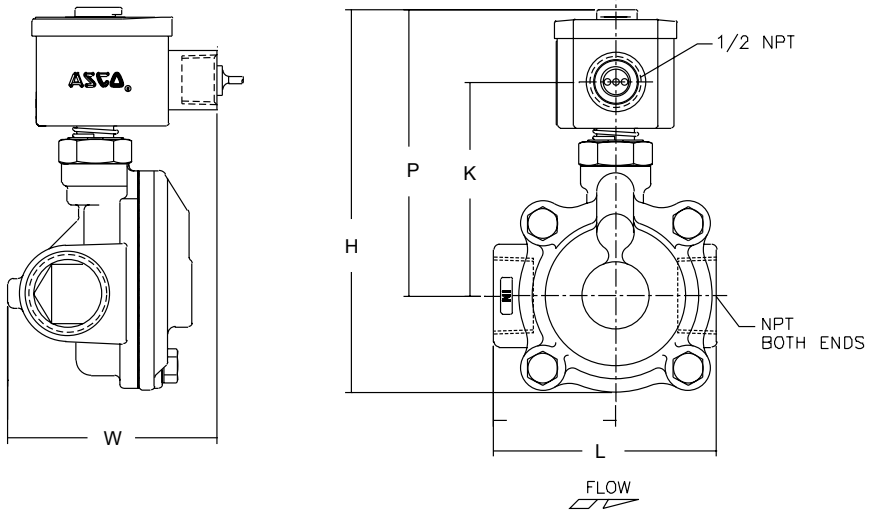
Constr. Ref. No.		H	K	L	P	W
30	**ins.**	8.22	X	5.06	5.47	4.87
	mm	209	X	129	139	124
31	**ins.**	5.25	X	3.75	4.44	3.25
	mm	133	X	95	113	83
32	**ins.**	5.69	X	3.66	4.69	3.25
	mm	145	X	93	119	83
33	**ins.**	6.06	X	4.38	4.94	3.91
	mm	154	X	111	125	99
34	**ins.**	6.91	X	3.75	6.09	3.25
	mm	176	X	95	155	83
35	**ins.**	7.34	X	3.66	6.34	3.25
	mm	186	X	93	161	83
36	**ins.**	7.66	X	4.38	6.56	3.91
	mm	1.95	X	111	167	99
37	**ins.**	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
38	**ins.**	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
39	**ins.**	5.42	2.31	2.75	4.86	3.80
	mm	138	59	70	123	97
40	**ins.**	5.20	3.29	2.81	4.50	2.28
	mm	132	83	71	114	58
41	**ins.**	5.13	3.10	3.75	4.32	3.25
	mm	130	79	95	110	83
42	**ins.**	6.43	4.40	3.93	5.62	3.25
	mm	163	112	100	143	83
43	**ins.**	5.57	3.35	3.66	4.57	3.25
	mm	142	85	93	116	83
44	**ins.**	5.90	3.57	4.38	4.79	3.91
	mm	150	91	111	122	99
45	**ins.**	5.26	3.17	3.75	4.38	3.84
	mm	134	81	95	111	98
46	**ins.**	4.95	3.10	3.84	4.31	2.75
	mm	126	79	98	110	70
47	**ins.**	6.43	3.59	3.75	4.81	3.52
	mm	163	91	95	122	90
48	**ins.**	6.43	3.59	3.66	4.81	3.73
	mm	163	91	93	122	95
49	**ins.**	6.91	3.75	4.38	4.96	4.40
	mm	176	95	111	126	112
50	**ins.**	8.13	4.15	5.06	5.37	4.87
	mm	207	105	129	136	124
51	**ins.**	8.13	4.15	5.50	5.37	5.18
	mm	207	105	140	136	132

IMPORTANT: Valves may be mounted in any position, except as noted in specifications table.

Constr. Refs. 10, 15, 24, 26-36



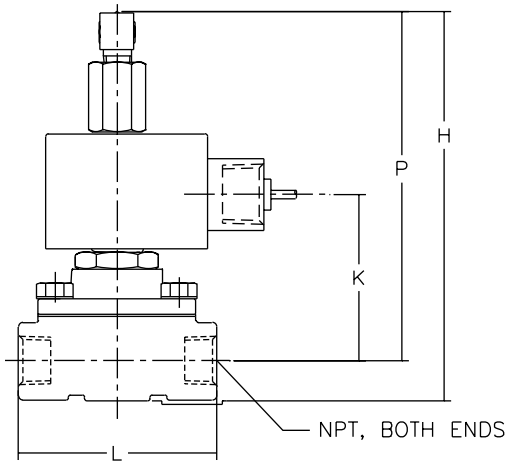
Constr. Refs. 12, 16, 18

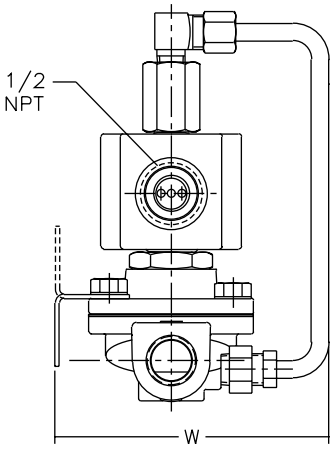


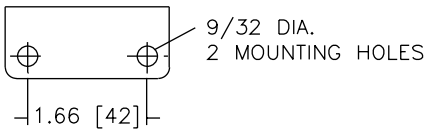
Note: Valve must be mounted with solenoid vertical and upright.

Dimensions: inches (mm)

Constr. Refs. 39

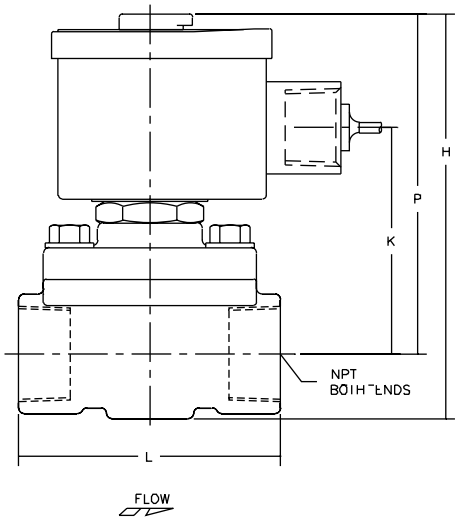


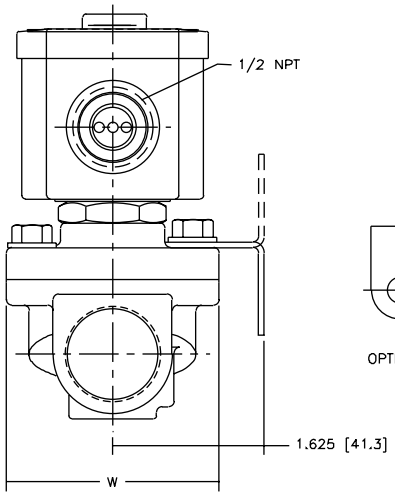


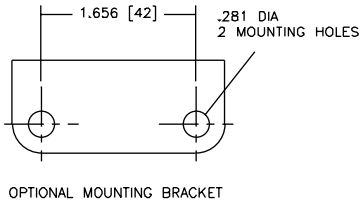


SHOWING MOUNTING
BRACKET ONLY

Constr. Refs. 40-51



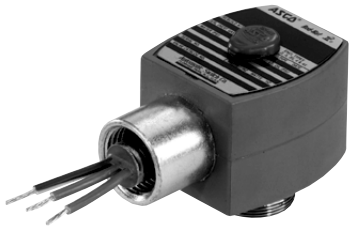
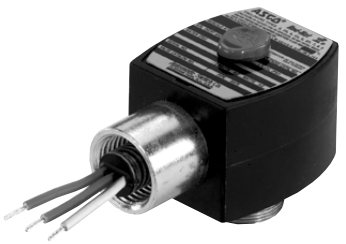




OPTIONAL MOUNTING BRACKET

Optional Features
Electrical

Important Note: One-piece molded epoxy Red-Hat II® solenoids are a unique combination of coil and enclosure. When ordering some Red-Hat II options, it may be necessary to specify the appropriate catalog number prefixes for both the enclosure and the coil.

Type 1 General Purpose Solenoids with **Class F** High-Temperature Coils	**Enclosures:** • Also meet Type 2 Dripproof, Types 3 and 3S Raintight, and Types 4 and 4X Watertight requirements. • Supplied standard with 1/2" threaded conduit hub and built-in strain relief for leads. **Coils:** • Insulation system for coil temperatures up to 311°F (155°C).① • *For ambient temperature requirement, refer to specific Series and charts in Engineering Information Section, beginning on page 11.00.* • Suitable for 50 and 60 Hz.②	**Ordering Information:** Supplied standard on all Red-Hat II valves.	
Type 1 General Purpose Solenoids with **Class H** High-Temperature Coils	**Enclosures:** • Same as Class F. **Coils:** • Insulation system suitable for coil temperatures up to 356°F (180°C).① *For ambient temperature requirements, refer to specific Series and charts in Engineering Information Section, page 11.00.* • Suitable for 50 and 60 Hz.②	**Ordering Information:** Depending on wattage, use catalog number prefix "HT" or "HB" (e.g., HT8210G2).	
Panel Mount Type 1 General Purpose Solenoids with **Class F or H** High-Temperature Coils	**Enclosures:** • Same as above, but with provision for mounting on a panel (panel not included). **Coils:** • Same as Class F or H above.	**Ordering Information:** For Class F coil, use catalog number prefix "GP" (e.g., GP8210G2) and specify voltage. For Class H coil, depending on wattage, use catalog number prefix "GPHT" or "GPHB" (e.g., GPHT8210G2) and specify voltage.	
Type 7 (A, B, C, and D) **Explosionproof** Solenoids with **Class F** High-Temperature Coils	**Enclosures:** • Also meets Types 3 and 3S Raintight, Types 4 and 4X Watertight, Types 6 and 6P Submersible, and Type 9 (E, F, and G) Dust Ignitionproof requirements. *Refer to Engineering Information Section, beginning on page 11.00 for details.* **Coils:** • Insulation systems suitable for coil temperatures up to 311°F (155°C) ① *For ambient temperature requirements, refer to specific Series charts in Engineering Section, page 11.00.* • Suitable for 50 and 60 Hz. ②	**Approvals:** UL listed; CSA certified. **Ordering Information:** Use catalog number prefix "EF" (e.g., EF8210G2) and specify voltage.	

Notes: ① UL limitations are 284°F (140°C) for Class F insulation systems and 320°F (160°C) for Class H insulation systems.
② Can be supplied for 50 Hz at a reduced voltage, which is standard throughout the world; i.e., 120/60, 110/50.

Solenoid Enclosures

ASCO offers two types of enclosures, each for a variety of applications: a one-piece molded epoxy construction called the Red-Hat II€ solenoid and a conventional Red-Hat metallic construction. Both meet ICS-6 ANSI/NEMA, and UL Standards 429, 508, and/or 1002. These standards define enclosure protection levels and the tests passed by Red Hat II

Red-Hat II®

Red-Hat II® solenoid enclosures are of one-piece molded epoxy construction, with an integral 1/2" NPT conduit hub. This epoxy encapsulation serves as the enclosure. The magnetic frame is molded into the coil.

General Purpose Enclosures:

The standard Red Hat II Enclosure is green and comes equipped with three 18" long leads. The third lead is green and serves as a ground for the enclosure. This Enclosure meets the requirements for Types 2 (Dripproof), 3 and 3S (Raintight), and 4 and 4X (Watertight-Corrrosion Resistant).
An optional Junctionbox/Terminal coil constrution is also available for spade and screw terminal constructions.

Type 7 Enclosure:

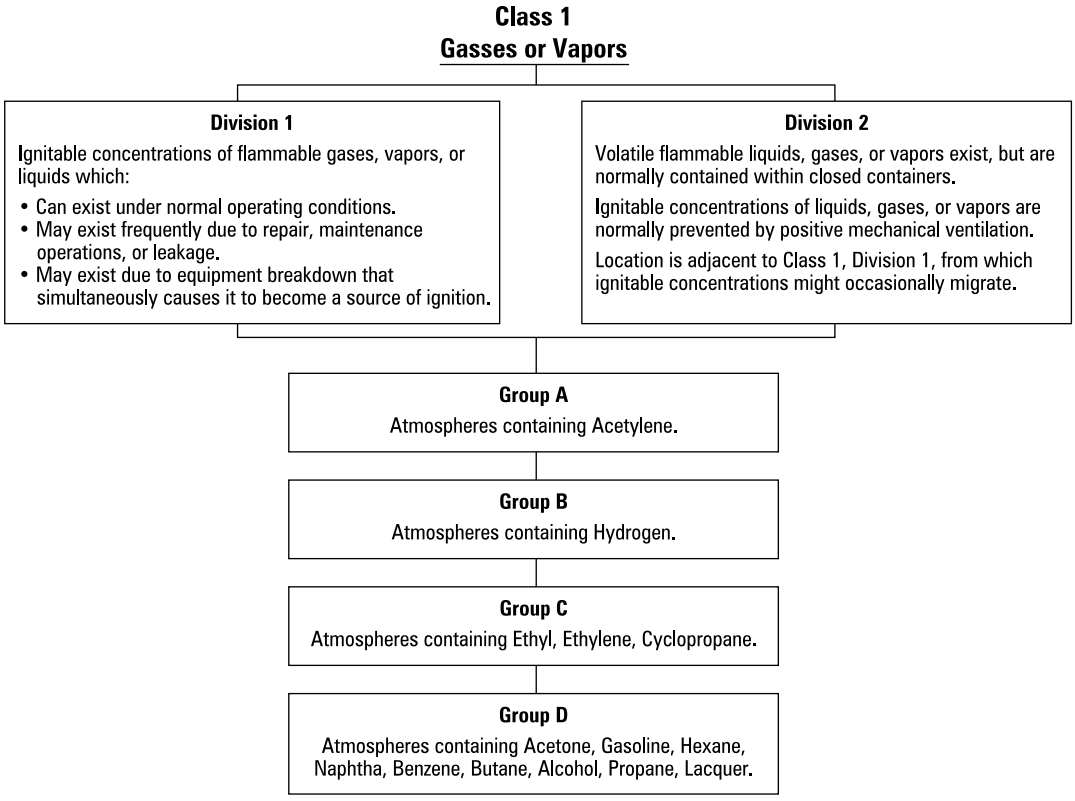
The Type 7 Red Hat II Enclosure is black and comes equippedwith three 18" long leads. The third lead is green and serves as a ground for the enclosure. This enclosure meets the requirements to Types for Types 2 (Drop-off), 3 and 3S(raintight), and 4 and 4X (Watertight-Corrrosion Resistant), Type 6 and 6P (Submersible) as well as Type 7 (A,B,C,D) Explosionproof and 9 (E, F, and G) Dust-ignition-proof for Class 1, Division 1, Groups A, B, C and D and Class II, Division 1, Groups E, F and G.

Enclosure Classifications and Types

Type 1	*General Purpose*	*Intended for indoor use, primarily to provide protection for enclosed parts in locations without unusual service conditions.*
Type 2	*Dripproof*	*Intended for indoor use, primarily to provide protection against limited amounts of falling water or dirt.*
Type 3	*Raintight, Dusttight, and Sleet (Ice) Resistant*	*Intended for outdoor use, primarily to provide protection against wind-blown dust, rain, and sleet; undamaged by the formation of ice on the enclosure.*
Type 3S	*Raintight, Dusttight, and Sleet (Ice) Resistant*	*Intended for outdoor use, primarily to provide protection against wind-blown dust, rain, and sleet; external mechanism remains operable when ice laden.*
Type 3R	*Rainproof, Sleet (Ice) Resistant*	*Intended for outdoor use, primarily to provide protection against falling rain and sleet; undamaged by the formation of ice on the enclosure.*
Type 4	*Watertight and Dusttight*	*Intended for indoor or outdoor use to provide protection against splashing water, water seepage, falling or hose-directed water, and severe external condensation; undamaged by the formation of ice on the enclosure.*
Type 4X	*Watertight, Dusttight, and Corrosion Resistant*	*Same as Type 4, but provides additional protection to resist corrosion.*
Type 6	*Submersible*	*Intended for indoor or outdoor use to provide protection against entry of water during submersion at a limited depth. (Tested to 6' for 30 minutes.)*
Type 6P	*Submersible*	*Same as Type 6 Enclosure, but provides prolonged submersion protection at a limited depth. (Tested to 6' for 24 hours.)*
Type 7 and Type 9	*See charts on next page*	

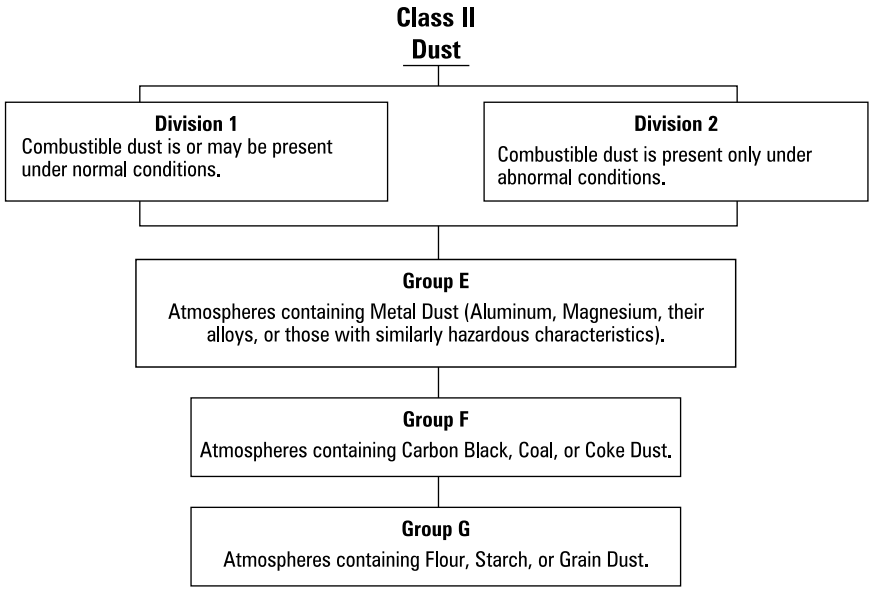
Type 7 (A, B, C, and D)

Explosionproof enclosures are designed to contain an internal explosion, without causing an external hazard, when installed in the following atmospheres or locations:



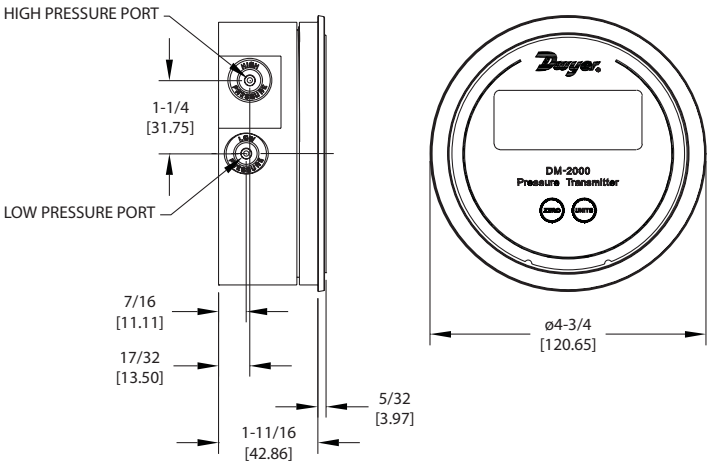
Type 9 (E, F, and G)

Dust-ignitionproof enclosures are designed to prevent the entrance of dust, and the enclosed devices do not produce sufficient heat to cause external surface temperatures capable of igniting dust on the enclosure or in the surrounding atmosphere.



Series DM-2000 Differential Pressure Transmitter

Specifications – Installation and Operating Instructions



The Dwyer Series DM-2000 Differential Pressure Transmitter senses the pressure of air and compatible gases and sends a standard 4-20 mA output signal. The DM-2000 housing is specifically designed to mount in the same diameter cutout as a standard Magnehelic® differential gage. A wide range of models are available factory calibrated to specific ranges.

Pressure connections are inherent to the glass filled plastic molded housing making installation quick and easy. Digital push-button zero simplifies calibration over typical turn-potentiometers. Single push button allows field selection of 5 engineering units (LCD models only). An optional 3.5 digit LCD shows process and engineering.

Accessories
Mounting Lugs
6-20 x 2″ Screws - 3
6-19 x 1/2″ Screws - 3

INSTALLATION

1. Location
Select a clean, dry mounting location free from excess vibration where the temperature will remain between 20 and 120˚F (-6.7 and 48.9˚C). Distance from the receiver is limited only by total loop resistance. See Electrical Connections on next page. The tubing supplying pressure to the instrument can be practically any length required, but long lengths will increase response time slightly.

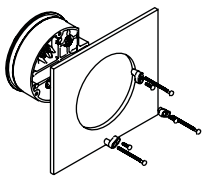
2. Position
A vertical position required. That is the position in which all standard models are spanned and zeroed at the factory.

Pressure Connections
Two integral tubing connections are provided. They are sized to fit 1/8″ (3.12 mm) I.D. tubing. Be sure the pressure rating of the tubing exceeds that of the operating ranges.

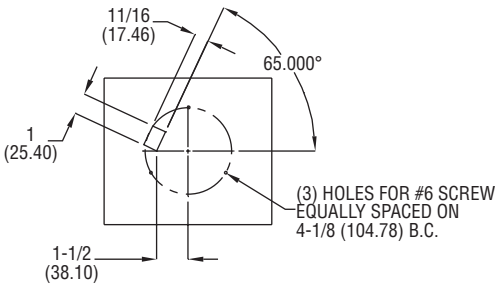
3. Mounting
Panel - Provide a 4-9/16″ diameter opening in panel. Insert gage and secure in place with provided screws and adapters.
Surface - Provide three 3/16″ diameter holes in panel on a 4-1/8″ diameter bolt circle. Cut opening for terminal block as shown in diagram to right.

SPECIFICATIONS
Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult Factory.
Accuracy: ±1% F.S. at 70°F.
Stability: ±1% F.S./yr.
Temperature Limits: 20 to 120°F (-6.67 to 48.9°C).
Pressure Limits: 10 psig (0.69 bar).
Thermal Effect: ±0.055% F.S./°F (0.099% F.S./°C).
Power Requirements: 10-35 VDC (2 wire).
Output Signal: 4 to 20 mA.
Zero and Span Adjustments: Digital push-button zero and span.
Loop Resistance: DC: 0-1250 ohms maximum.
Current Consumption: DC: 38 mA maximum.
Electrical Connections: Screw-type terminal block.
Process Connections: 1/8″ I.D. tubing.
Mounting Orientation: Vertical.
Weight: 4.8 oz (136 g).
Agency Approvals: CE

Panel



Surface



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e-mail: lit@dwyer-inst.com

ELECTRICAL CONNECTIONS

CAUTION: Do not exceed specified supply voltage ratings. Permanent damage not covered by warranty will result. This unit is not designed for 120 or 240 volts AC line operation.

Electrical connections are made to the terminal block located in back of the transmitter. Terminals are marked + and - (see *Fig. B* below).

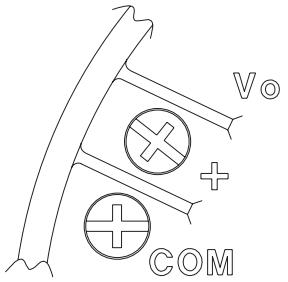

Figure B

Wire Length

The maximum length of wire connecting transmitter and receiver is a function of wire size and receiver resistance. Wiring should not contribute more than 10% of the receiver resistance to total loop resistance. For extremely long runs (over 1000 feet), choose receivers with higher resistance to minimize size and cost of connecting leads. Where wiring length is under 100 feet, hook-up wire as small as 22 AWG can be used.

2-Wire Operation

An external power supply delivering 10-35 VDC with minimum current capability of 40 mA DC (per transmitter) must be used to power the control loop. *See Fig. C for connection of the power supply, transmitter and receiver.* The range of appropriate receiver load resistance (R_L) for the DC power supply voltage available is expressed by the formula and graph in *Fig. D.* Shielded two wire cable is recommended for control loop wiring. If grounding is required, use the negative side of the control loop after the receiver.

2-Wire Connections

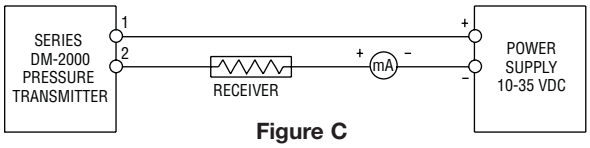

Figure C

Power Supply Voltage – VDC (2-wire)

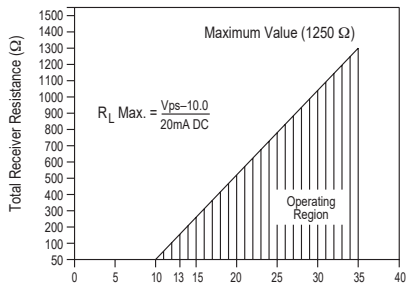

Figure D

USER CALIBRATION

The transmitter may be user calibrated with two buttons on the front. The standard models have buttons labeled “ZERO” and “SPAN”. LCD models have buttons labeled “ZERO” and “UNITS”. The “UNITS” button on the LCD models has 2 functions. If pushed for less than 2 seconds and released the pressure units that are displayed on the LCD will change when the button is released. If pushed and held for 4 - 5 seconds the “UNITS” button serves the same function as the “SPAN” button on the standard models.

To calibrate the transmitter you will need three pieces of equipment. You will need a calibrated pressure source capable of generating a stable pressure value for the maximum range of the unit under test, an instrument capable of validating the calibration pressure, and a milliameter to measure the current output from the unit under test. The transmitter is calibrated using the following procedure.

Preparation – Connect the Milliameter and power supply, being careful to observe polarities. The transmitter must be calibrated in a vertical position.

Calibrating Zero – Leaving the pressure connections vented, press and hold the “ZERO” button for 4 – 5 seconds. The zero point will now be set and the gage output will be 4 mA and if it is an LCD model the display will read zero. This zero calibration is done first as it can affect the span value.

Calibrating Span – Connect the pressure source and apply the high range rated pressure. When the pressure has stabilized, press and hold the “UNITS” button (for LCD models), or the “SPAN” button (on standard models), for 4 – 5 seconds. The span point will now be set and the gage output at full range will be 20 mA and if it is an LCD model will now read the full range calibration pressure. The zero and span setting are slightly interactive so recheck the zero calibration and repeat both zero and span calibration if necessary.

Restoring Factory Calibration Coefficients:

The user calibration coefficients are stored in non volatile memory, which retains Its content indefinitely without external power or batteries. Factory calibration can be easily restored if the user calibration must be “erased”. To do this simultaneously press both buttons on the front and hold them for 4 – 5 seconds. The factory calibration will now be restored.

MAINTENANCE

Upon final installation of the Series DM2000 Differential Pressure Transmitter and the companion receiver no routine maintenance is required. A periodic check of the system calibration is recommended following the procedures explained under *Calibration Check.* The Series DM2000 Transmitter is not field serviceable and should be returned, freight prepaid, to the factory if repair is required. Please enclose a description of the problems encountered plus any available application information.

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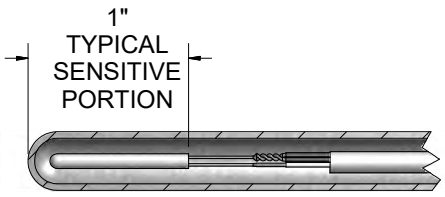
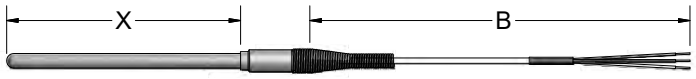
RTD

Configuration Code RT01
RTD Assemblies with Extension Leadwire
Configuration Code RT02
RTD Assemblies with Sheath Terminations

The RTD elements illustrated and described on this page are designed to measure temperature in a variety of process and laboratory applications. These RTDs are specifically designed for use in two different process temperature ranges and will provide accurate and repeatable temperature measurement through a broad range. Low range RTDs are constructed using Teflon®-insulated, silver-plated copper internal leads with potting compounds to resist moisture penetration. High range RTDs are constructed with nickel internal leads inside swaged MgO insulated cable to allow higher temperature measurements at the RTD element and provide higher temperature lead protection along the sheath. The following tables allow customer selection of standard element materials, tolerances, sheath diameters, mounting fittings and terminations. Custom-built assemblies with non-standard specifications are available upon request.





ORDER CODES

Example Order Number:

1-1	1-2(A)	1-3		1-4								
R5T185L	**48**	**3**	**-**	**006**	**-**	**Page RTD-2**	**-**	**Page RTD-3**	**-**	**Page RTD-4**	**-**	**Page RTD-5**

1-1 Single Platinum RTD Elements

1-2 Available Sheath Diameters 316SS

CODE	TOLERANCE[1]	BASE RESISTANCE @ 0 ºC (R_0)	TEMPERATURE COEFFICIENT	CODE			
LOW RANGE WIRE WOUND (-200 to 200) ºC [-328 to 392] ºF				*1/8" O.D.*	*3/16" O.D.*	*1/4" O.D.*	*3/8" O.D.*
R1T185L	Grade B	100 Ω	α = 0.003 85 ºC^{-1}	28	38	48	68
R3T185L	Class AA	100 Ω	α = 0.003 85 ºC^{-1}	28	38	48	68
R5T185L	(1/5) Class B	100 Ω	α = 0.003 85 ºC^{-1}	28	38	48	68
R1T192L	Grade B	100 Ω	α = 0.003 92 ºC^{-1}	28	38	48	68
R3T192L	Class AA	100 Ω	α = 0.003 92 ºC^{-1}	28	38	48	68
LOW RANGE THIN FILM (-50 to 200) ºC [-58 to 392] ºF							
RBF185L	Class B	100 Ω	α = 0.003 85 ºC^{-1}	28	38	48	68
RAF185L	Class A	100 Ω	α = 0.003 85 ºC^{-1}	28	38	48	68
RBF195L	Class B	1000 Ω	α = 0.003 85 ºC^{-1}	28	38	48	68
HIGH RANGE WIRE WOUND (-200 to 600) ºC [-328 to 1112] ºF							
R1T185H	Grade B	100 Ω	α = 0.003 85 ºC^{-1}	28	38	48	68
RAT185H	Class A	100 Ω	α = 0.003 85 ºC^{-1}	28	38	48	68
R1T192H	Grade B	100 Ω	α = 0.003 92 ºC^{-1}	28	38	48	68

[1] Refer to RTD tolerance information in the general information section for calculations to determine specific tolerance at temperature.

1-4 Length

CODE
3 Digit 'X' Length

1-3 Element Connection

CODE	DESCRIPTION
2	2-wire
3	3-wire
4[1]	4-wire

[1] Not available in duplex

1-1 Duplex Platinum RTD Elements

1-2 Available Sheath Diameters 316SS

CODE	TOLERANCE[1]	BASE RESISTANCE @ 0 ºC (R_0)	TEMPERATURE COEFFICIENT	CODE		
LOW RANGE WIRE WOUND (-200 to 200) ºC [-328 to 392] ºF				*3/16" O.D.*	*1/4" O.D.*	*3/8" O.D.*
R1T285L	Grade B	100 Ω	α = 0.003 85 ºC^{-1}	38	48	68
R3T285L	Class AA	100 Ω	α = 0.003 85 ºC^{-1}	38	48	68
R5T285L	(1/5) Class B	100 Ω	α = 0.003 85 ºC^{-1}	38	48	68
R1T292L	Grade B	100 Ω	α = 0.003 92 ºC^{-1}	38	48	68
R3T292L	Class AA	100 Ω	α = 0.003 92 ºC^{-1}	38	48	68
LOW RANGE THIN FILM (-50 to 200) ºC [-58 to 392] ºF						
RBF285L	Class B	100 Ω	α = 0.003 85 ºC^{-1}	38	48	68
RAF285L	Class A	100 Ω	α = 0.003 85 ºC^{-1}	38	48	68
RBF295L	Class B	1000 Ω	α = 0.003 85 ºC^{-1}	38	48	68
HIGH RANGE WIRE WOUND (-200 to 600) ºC [-328 to 1112] ºF						
R1T285H	Class B	100 Ω	α = 0.003 85 ºC^{-1}	38	48	68
RAT285H	Class A	100 Ω	α = 0.003 85 ºC^{-1}	38	48	68
R1T292H	Grade B	100 Ω	α = 0.003 92 ºC^{-1}	38	48	68

[1] Refer to RTD tolerance information in the general information section for calculations to determine specific tolerance at temperature.

1-2A

CODE	NOMINAL SHEATH DIAMETER (inches)	TIP DIA. O.D. (inches)	TIP LENGTH (inches)
88R48	1/2	1/4	1 1/4
68R38	3/8	3/16	1 1/4
48R28	1/4	1/8	1 1/4

REDUCED-TIP RTD's

Table 1-2A lists RTD elements with reduced tip sheaths. To order, use order code numbers from Tbl. 1-2A in place of straight sheath order code numbers from Tbl. 1-2. Other reduced tips are available upon request. EXAMPLE: R1T185L**88R483**-006.

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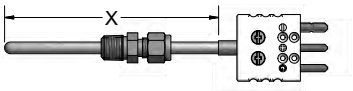
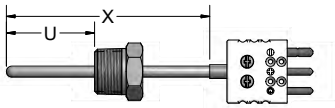
Optional Sheath Mounting Fittings and Bends

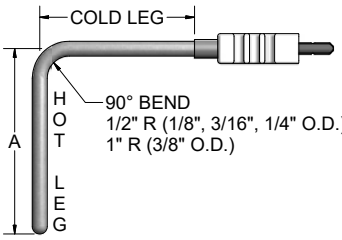
Select Sheath Mounting or Bend Options as desired from tables below.

COMPRESSION FITTING

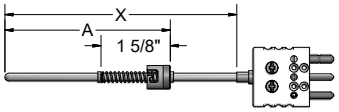


FIXED BUSHING

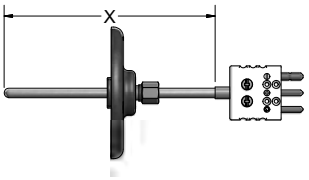




BAYONET CAP and SPRING (OPTION 13A)



ADJUSTABLE FLANGE (OPTION 14)



ORDER CODES

Example Order Number: **R5T185L483-006 - 01A,304 - PAGE RTD 3 - PAGE RTD 4 - PAGE RTD 5**

(2)

2-1 No Fitting or Bend Options

CODE	
	00

2-2 One-time Adjustable Compression Fittings

CODE	TYPE	NPT SIZE (inches)	PRESSURE RATED	AVAILABLE SHEATH DIAMETERS (inches)
01A	303 stainless steel	1/8	NO	1/8, 3/16, 1/4
05A	316 stainless steel	1/8	YES	1/8, 3/16, 1/4
05B	316 stainless steel	1/4	YES	1/8, 3/16, 1/4, 3/8
05C	316 stainless steel	1/2	YES	1/8, 1/4, 3/8
15A	Brass	1/8	NO	1/8, 3/16, 1/4
15B	Brass	1/4	NO	3/16, 1/4, 3/8
15C	Brass	1/2	NO	1/4, 3/8

2-3 Re-adjustable Compression Fittings

CODE	TYPE	NPT SIZE (inches)	AVAILABLE SHEATH DIAMETERS (inches)
10A	303 stainless steel	1/8	1/8, 3/16
10B	303 stainless steel	1/4	1/4, 3/8
10C	303 stainless steel	1/2	1/4, 3/8
12A	316 stainless steel	1/8	1/8, 3/16, 1/4
12B	316 stainless steel	1/4	1/8, 3/16, 1/4, 3/8
12C	316 stainless steel	1/2	1/8, 1/4, 3/8
11A	Brass	1/8	1/8, 3/16, 1/4
11B	Brass	1/4	1/8, 3/16, 1/4, 3/8
11C	Brass	1/2	1/4, 3/8
19C	Spring-loaded SS well fitting	1/2	3/16, 1/4
Teflon® gland standard 204 ºC [400 °F] max. For lava gland 649 ºC [1200 °F] max. opt. 10A and 10B only use letter suffix "L" after compression fitting order code. EXAMPLE: 10AL for lava gland.			

2-6 Miscellaneous Options

CODE	TYPE	AVAILABLE SHEATH DIAMETER (inches)
13A _ _ [1]	Spring-loaded bayonet fitting	1/8, 3/16
14	Adjustable flange with brass compression fitting	1/8, 3/16, 1/4, 3/8
16A	Spring-loaded adjustable bayonet compression fitting	1/8
[1] When ordering fixed bayonet fitting specify dimension "A". EXAMPLE: order code 13A06 is for a fixed bayonet adapter with 6" A Dimension.		

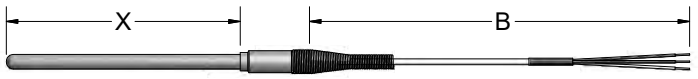
2-5 Fixed Bushings

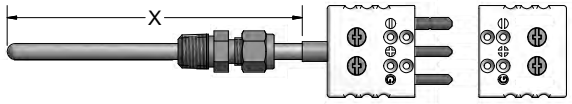
CODE 316 SS	MOUNTING THREAD NPT (inches)	AVAILABLE SHEATH DIAMETERS (inches)
8A _ _ [1]	1/8	1/8, 3/16, 1/4
8B _ _ [1]	1/4	1/8, 3/16, 1/4, 3/8
8C _ _ [1]	1/2	1/8, 3/16, 1/4, 3/8
8D _ _ [1]	3/4	1/8, 3/16, 1/4, 3/8
[1] When ordering fixed bushings, specify order code above, plus insertion length "U", as measured from hot tip to bottom of threaded bushing. EXAMPLE: order code 8A06 is 1/8" NPT, 316 SS bushing located 6" from hot tip.		

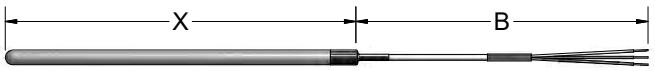
2-4 Sheath Bends

CODE	DESCRIPTION
2 _ _	Sheath bent 45º
3 _ _	Sheath bent 90º
2" minimum hot leg length	
When ordering bend options, specify hot leg dim. "A". EXAMPLE: order code 206 is a 45° bend with 6" hot leg. Total sheath length is Table 1 "X" length = hot leg plus cold leg.	

Teflon® is a registered trademark of El du Pont de Nemours and Company.







RT02 ORDER CODES RT01

Example Order Number:

R5T185L483-006-00 - 4, MC or **R5T185L483-006-01A,304 - 16 - PAGE RTD-4 - PAGE RTD-5**

(3-1 above 4, MC; 3-2 above 16)

3-1 Plug and Jack Sheath Terminations

CODE	DESCRIPTION
4[1]	Standard plug
5[1]	Standard jack
6[2]	Miniature plug
7[2]	Miniature jack
	Options
MC	Mating connector
CL	Compression L bracket to hold plug to sheath
[1] If used with 3/8" O.D., option CL must be specified [2] Not available with 1/4" O.D. or 3/8" O.D. sheath	

3-1 Sheath Terminations

CODE	DESCRIPTION
22[1]	3" individual leads with terminal pins
[1] High temp RTDs are supplied with 1" long transition	

3-2 Leadwire transitions

(Requires Table 4 and 5 selections)

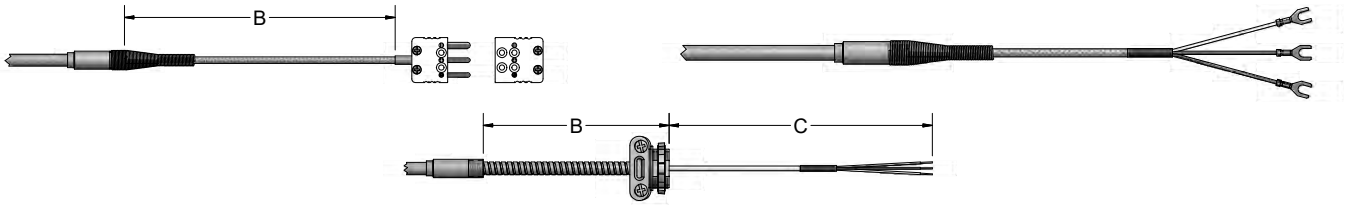
CODE	DESCRIPTION
13[1]	Same size transition with heat-shrink tubing 104 ºC [220 ºF]
15	Extension leadwire transition with relief spring 204 ºC [400 ºF]
16	Extension leadwire transition with heat-shrink tubing 104 ºC [220 ºF]
18[1]	Same size transition without heat-shrink tubing 204 ºC [400 ºF]
19	Extension leadwire transition without spring or heat-shrink tubing 204 ºC [400 ºF]
	Options
HT[2]	High temperature potting 538 ºC [1000 ºF] not available with option 13 or 16
[1] Not available with flex armor	
[2] Not available with option 13 or 16. When specifying high temp potting with Flex Armor option 19 must be selected.	

3-2 Threaded Fittings with Extension Leadwire

(Requires Table 4 and 5 selections)

CODE	DESCRIPTION
6HN23	1/2" x 1/2" NPT steel hex nipple
8HN23	1/2" x 1/2" NPT stainless steel hex nipple
9HP23	1/2" NPT stainless steel bushing (no process threads)
8RNDC23	3/4" process x 1/2" NPT stainless steel hex nipple

Select desired leadwire type by order code number, followed by desired length in inches.



ORDER CODES

Example Order Number: **R5T185L483-006-01A,304-16 - T3 036 -** PAGE RTD-5

(4) (5)

4 Extension Leadwire Type and B + C Dimension

CODE	DESCRIPTION	TEMP. RATING
FIBERGLASS		
F3J_ _ _	Fiberglass insulation - individual leads - stranded conductor (12" limit)	482 ºC [900 ºF]
F3_ _ _	Fiberglass insulation - stranded conductor	
F3A_ _ _	Fiberglass insulation - stranded conductor - flexible armor	
F3B_ _ _	Fiberglass insulation - stranded conductor - stainless steel overbraid	
TEFLON®		
T3J_ _ _	Teflon® insulation - individual leads - stranded conductor (12" limit)	204 ºC [400 ºF]
T3_ _ _	Teflon® insulation - stranded conductor	
T3A_ _ _	Teflon® insulation - stranded conductor - flexible armor	
T3B_ _ _	Teflon® insulation - stranded conductor - stainless steel overbraid	
M3_ _ _	Teflon® insulation - stranded conductor - stainless steel overbraid - Teflon® insulation	
T3M_ _ _	Teflon® insulation - stranded conductor - mylar shield	
T3MA_ _ _	Teflon® insulation - stranded conductor - mylar shield - flexible armor	
KAPTON®		
K3_ _ _	Kapton® insulation - stranded conductor	316 ºC [600 ºF]
K3A_ _ _	Kapton® insulation - stranded conductor - flexible armor	
K3B_ _ _	Kapton® insulation - stranded conductor - stainless steel overbraid	
SILICON RUBBER		
S3_ _ _	Teflon® insulation - stranded conductor - silicon rubber	204 ºC [400 ºF]
COIL CORDS		
C3060	PVC insulation - stranded conductor - coil cord - 60" extended length	104 ºC [220 ºF]
C3120	PVC insulation - stranded conductor - coil cord - 120" extended length	

Insert wire code number and 3 digit 'B' length in inches EXAMPLE: T3036 = 36" B length

For assemblies requiring leadwire beyond the flexible armor (illustrated in 'C' in drawing), insert 3 digit 'C' length after armor length. EXAMPLE: F3A036 -012 = 36" B length with additional 12" 'C' length leads beyond armor.

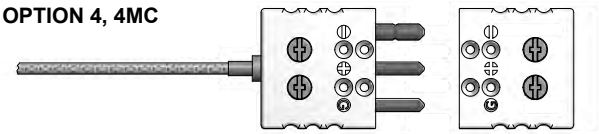
All insulated leadwires in flexible armor are available with either extruded PVC or Teflon® covering over the flexible armor. Substitute suffix codes T (Teflon®) or P (PVC) for the suffix 'A' code above. EXAMPLE: T3T is Teflon® covered armor.

Teflon® and Kapton® are registered trademarks of E. I. du Pont de Nemours and Company.

Select desired leadwire termination and options (if desired), by order code numbers below.

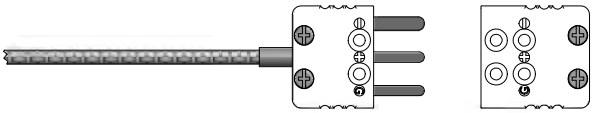
OPTION 3

OPTION 4, 4MC



OPTION 8

OPTION 6, 6MC



ORDER CODES

Example Order Number: **R5T185L483-006-01A,304-16-T3036 -** 5-1 **4,** 5-2 **MC**

5-1 Terminations

CODE	DESCRIPTION
0	Leads not stripped
2	2" split leads, 1/4" stripped
3	2" split leads with spade lugs
4	Standard plug
5	Standard jack
6	Miniature plug
7	Miniature jack
8	2" split leads with 1/4" female quick disconnects

5-2 Options

CODE	DESCRIPTION
BX	1/2" NPT BX connector with Options 0, 2, 3, or 8
CC	Plug or jack secured to leads with cable clamp
CG	Cord grip (1/2" NPT PVC)
MC	Mating connector
RB	Rubber boot

MJ/MJH-SERIES
PULSE METER

APPLICATIONS

Cooling tower chemical control

Industrial water treatment

Deduct metering

Pump Pacing

Features

- Dry top multi-jet design
- Tolerates low quality water
- Simple pulse output
- Cold or hot water models

MJ-Series meters use the multi-jet principle, which has been an internationally-accepted standard for many years. This type of meter is known for its wide range, simplicity, and accuracy in low-quality water. Seametrics offers cold or hot water models. The impeller is centered in a ring of jets, with inlet jets on one level and outlet jets on another. A gear train drives the register totalizer dials. For pulse output, one of the pointers is replaced by a magnet, which is detected by an encapsulated sensor attached to the outside of the lens. Pulse rate is determined by the dial on which the magnet is placed, and by the number of sensors (single or double).

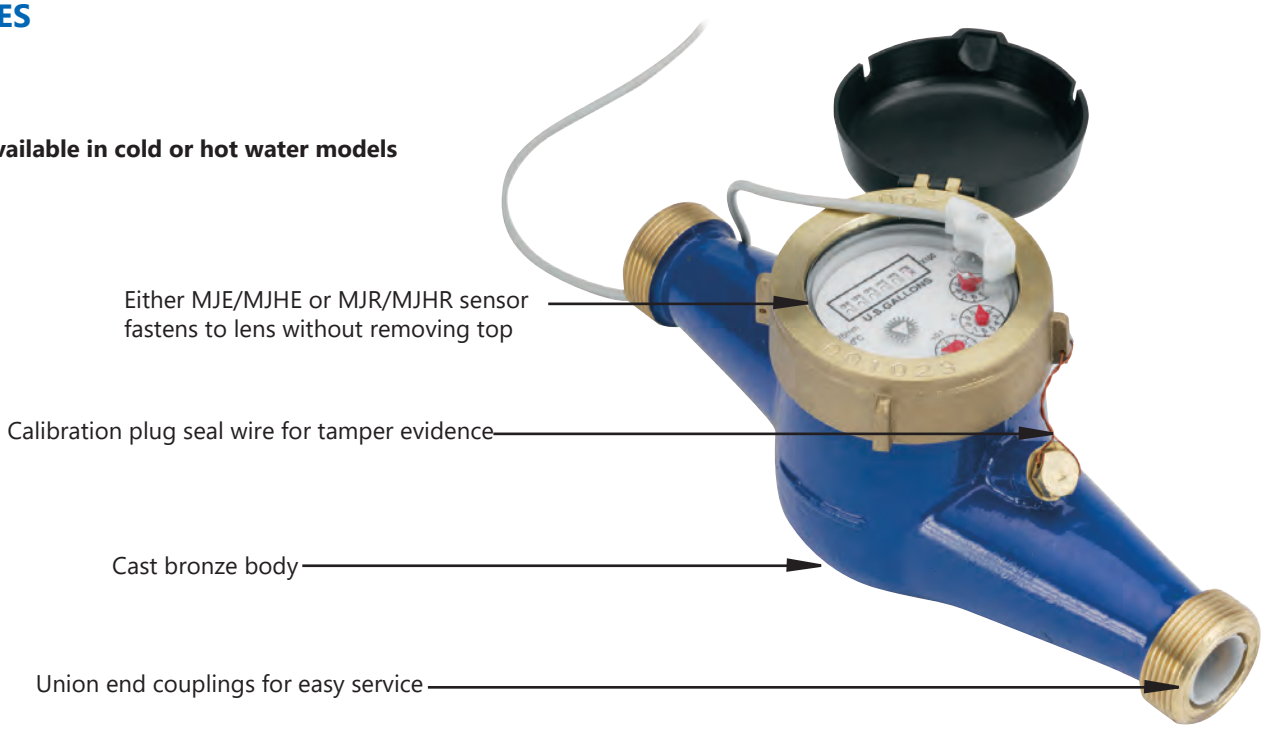
Changing the pulse rate requires no special tools and can be done in the field. Mechanically, all MJ-Series meters are the same. The difference among *MJE/MJHE, *MJR/MJHR and *MJT/MJHT meters is in the sensor. MJE/MJHE meters use a solid-state, long-lasting Hall-effect sensor, which requires power. It is suited for use with Seametrics controls and metering pumps (LMI for instance) that have sensor power. MJR/MJHR meters use a two-wire reed switch. They provide a dry contact closure and do not require power. MJT/MJHT meters totalize only and do not have a sensor.

Note on Nomenclature: Meter names that include "H" are hot water models. Without the "H" = cold water models.

Contact your Supplier

FEATURES

Available in cold or hot water models



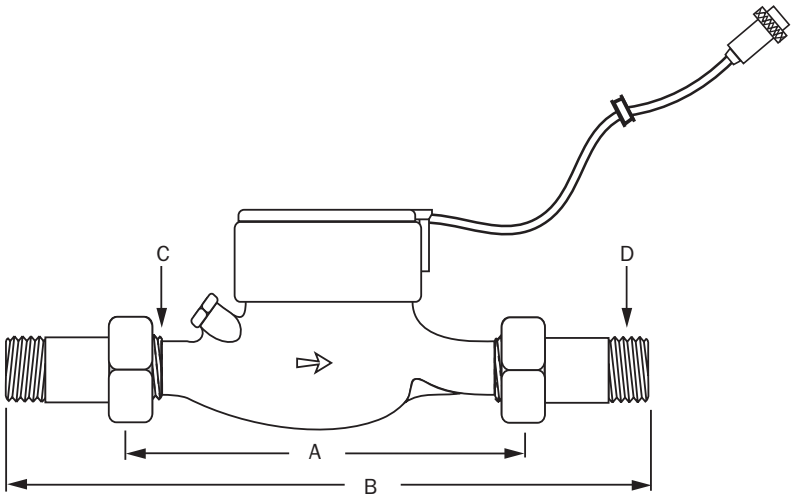
SPECIFICATIONS*

Power	6 mA at 12 Vdc (MJE/MJHE only)				
Temperature Model	Cold water	105˚ F (40˚ C) max			
	Hot Water	194˚ F (90˚ C) max			
Pressure	150 psi operating				
Materials	Body	Cast bronze, epoxy powder coated inside and out			
	Internals	Engineered thermoplastic			
	Magnet	Alnico			
Accuracy	+/- 1.5% of reading				
Pulse Output		**MJE/MJHE**	**MJR/MJHR**	**MJT/MJHT**	
	Sensor	Hall-effect device	Reed switch	Totalizer only	
	Max Current	20 mA+	20mA	n/a	
	Max Voltage	24 Vdc	24 Vdc or Vac	n/a	
Cable Length	12' (4 m) standard (2000' maximum run)				

Flow Rates (GPM)		**3/4"**	**1"**	**1-1/2"**	**2"**
	Minimum	0.22	0.44	0.88	1.98
	Maximum	22	52	88	132

Specifications subject to change • Please consult our website for current data (www.seametrics.com).

DIMENSIONS



	3/4"	1"	1-1/2"	2"
A (body)	7-1/2"	10-1/4"	11-3/4"	11-3/4"
B (w/couplings)	12-5/8"	15-5/8"	17-5/8"	17-5/8"
C (IPS thread)	1"	1-1/4"	2"	2-1/2"
D (NPT thread)	3/4"	1"	1-1/2"	2"

PULSE RATES

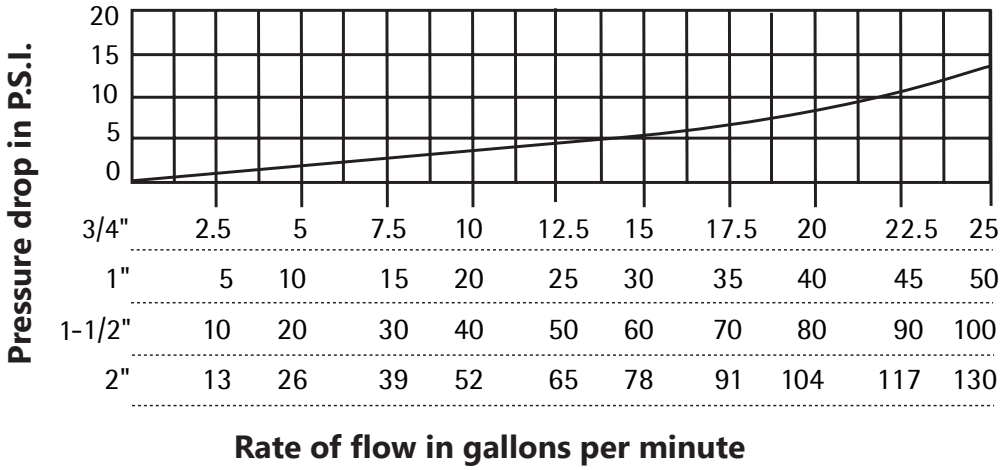
	3/4"	1"	1 1/2"	2" *(MJN only)*
Pulses per Gallon	20* 10 4† 2* 1	4† 2* 1	4† 2* 1	4† 2* 1
Gallons per Pulse	1 5* 10 50* 100	1 5* 10 50* 100	1 5* 10 50* 100	1 5* 10 50* 100
Cubic Feet per Pulse	1 5* 10	1 5* 10	1 5* 10	1 5* 10
Pulses per Cubic Meter	1 10 100	1 10 100	1 10 100	1 10 100
Liters per Pulse	1 10 100	1 10 100	1 10 100	1 10 100

**MJPR/MJNR dual reed switch meters only*
†MJPR/MJNR single reed switch meters only

FLOW RATES (GPM)

	3/4"	1"	1-1/2"	2"
Minimum	0.22	0.44	0.88	1.98
Maximum	22	52	88	132

PRESSURE DROP CURVE



HOW TO ORDER

MODEL

Cold water, Reed switch = **MJR**
Cold water, Hall-effect sensor = **MJE**
Cold water, Totalizer only = **MJT**

Hot water, Reed switch = **MJHR**
Hot water, Hall-effect sensor = **MJHE**
Hot water, Totalizer only = **MJHT**

SIZE

3/4″ = **-075**

1″ = **-100**

1-1/2″ = **-150**

2″ = **-200**

PULSE RATE

†*20 Pulse/Gal = **20P**
†10 Pulse/Gal = **10P**
*4 Pulse/Gal = **4P**
*2 Pulse/Gal = **2P**
1 Gal/Pulse = **1G**
*5 Gal/Pulse = **5G**
10 Gal/Pulse = **10G**
*50 Gal/Pulse = **50G**
100 Gal/Pulse = **100G**
1 CF/Pulse = **1CF**
*5 CF/P = **5CF**
10 CF/P = **10CF**
1 CM/P = **1CM**
10 CM/P = **10CM**
100 CM/P = **100CM**
1L/P = 1L
10 L/P = 10L
100 L/P = 100L

†3/4″ Only
*MJR/MJHR Meters Only

OPTIONS

LMI pump connector = **-06**
Seametrics control connector = **-07**

ACCESSORIES

Pulse divider = **PD10**
Pulse splitter = **PS40**
Pulse timer = **PT35**

CONTACT YOUR SUPPLIER

Seametrics • 19026 72nd Avenue South • Kent, Washington 98032 • USA
(P) 253.872.0284 • (F) 253.872.0285 • 1.800.975.8153 • seametrics.com

LT-65650059.2 20171201
12/01/17

SPECIFICATION DATA

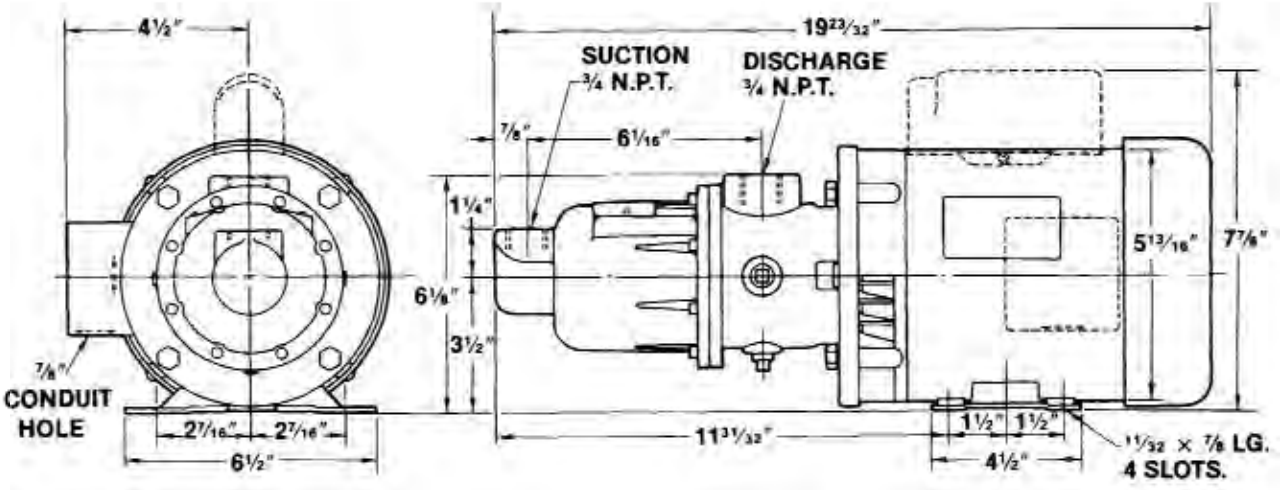
MOYNO® 500 PUMPS

300 SERIES MOTORIZED

331, 332, 333, 344, 356 AND 367 MODELS

331, 332, 333, 344 MODELS

DIMENSIONS

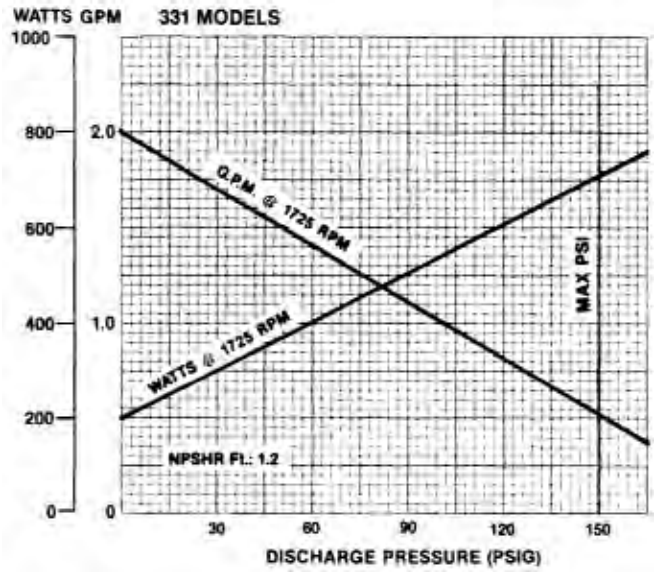


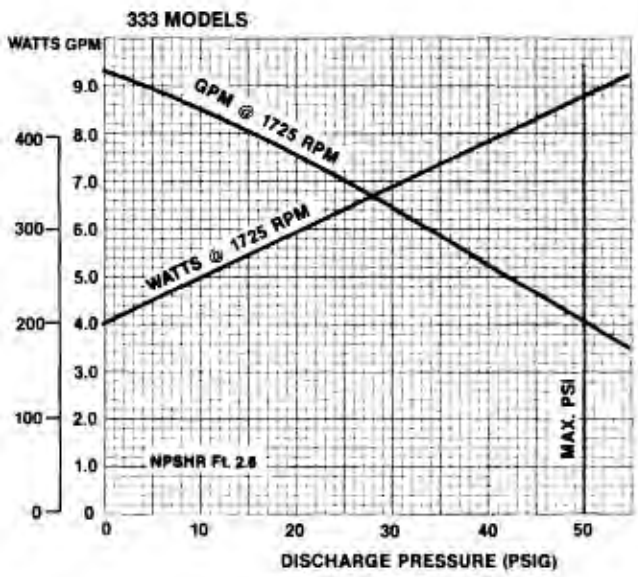
MATERIALS OF CONSTRUCTION

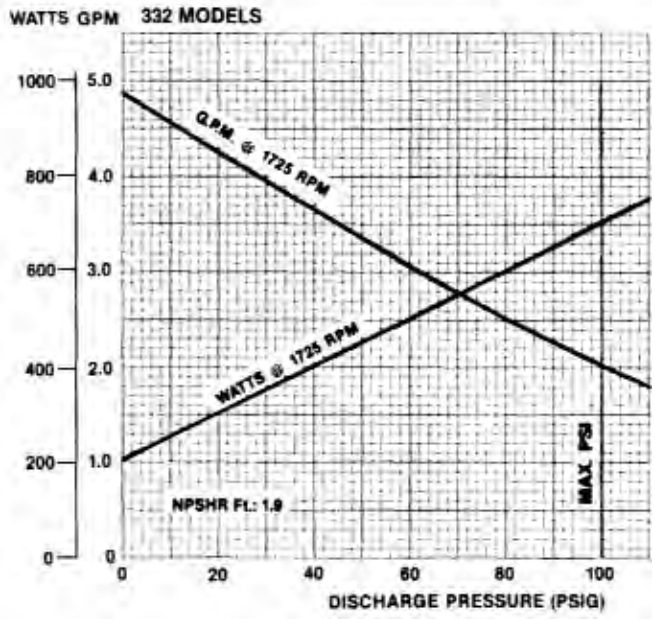
COMPONENT	MODELS			
	33159, 33259 33359, 34459	**33160, 33260 33360, 34460**	**33152, 33252 33352, 34452**	**33150, 33250 33350, 34450**
Housing	Cast iron	Cast iron	316SS	316SS
Rotor	416 SS/CP	416 SS/CP	316 SS/CP	316 SS/CP
Stator	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)
Motor Data	1/2 HP,1 PH 115/230 VAC 60 HZ TEFC	1/2 HP, 3 PH 230/440 VAC 60 HZ TEFC	1/2 HP, 1 PH 115/230 VAC 60 HZ TEFC	1/2 HP, 3 PH 230/440 VAC 60 HZ TEFC
Weight (lbs)	41	41	41	41

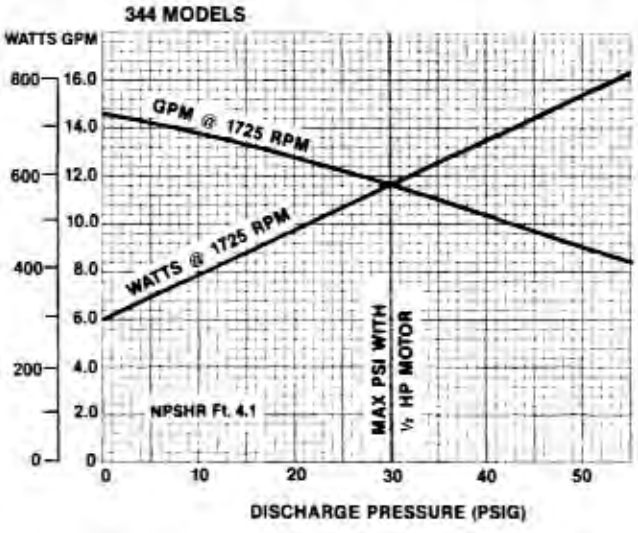
CP = Chrome plated

PERFORMANCE (Water at 70°F)







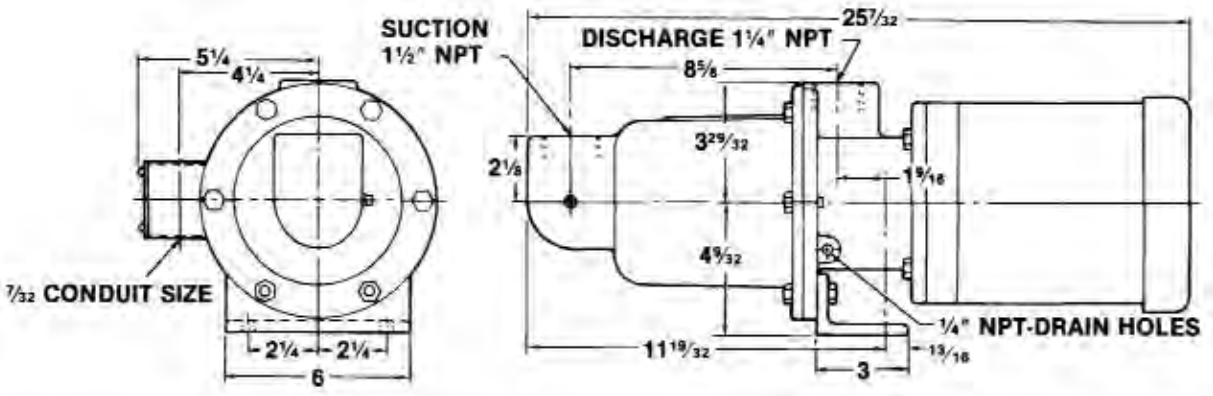


NOTE: With the standard 1/2 HP motor, maximum fluid viscosity is 100 CP (500 SSU).

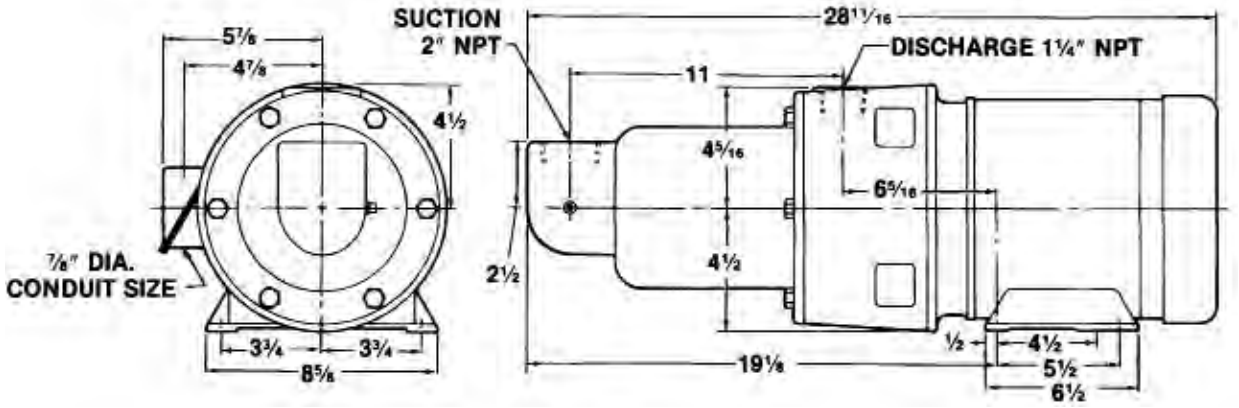
356 AND 367 MODELS

DIMENSIONS

Model 35651



Model 36751



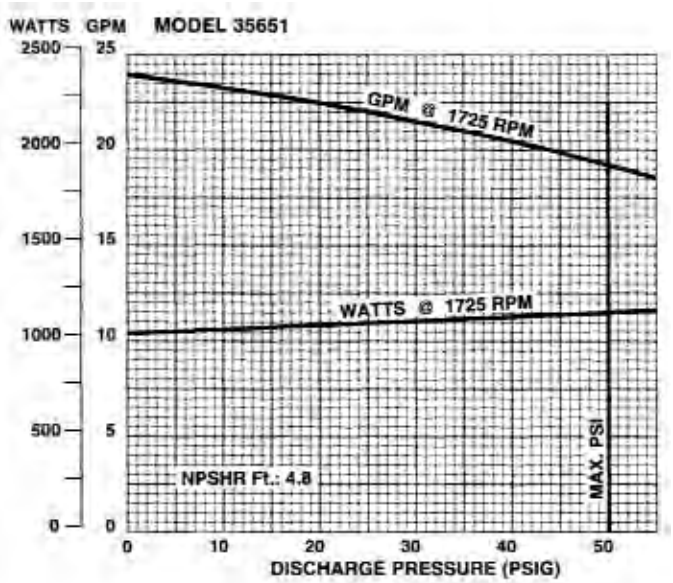
All dimensions are in inches.
Specifications subject to change without notice.

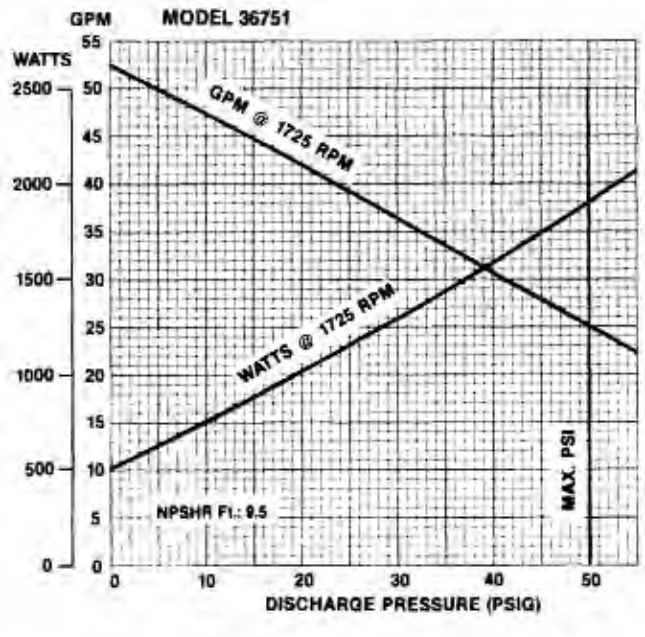
MATERIALS OF CONSTRUCTION

COMPONENT	MODELS					
	35651	36751	35650	35652	36750	36752
Housing Rotor Stator	Cast iron 416 SS/CP NBR (Nitrile)	Cast iron 416 SS/CP NBR (Nitrile)	316 SS 316 SS/CP NBR (Nitrile)	316 SS 316 SS/CP NBR (Nitrile)	316 SS 316 SS/CP NBR (Nitrile)	316 SS 316 SS/CP NBR (Nitrile)
Motor Data	1-1/2 HP, 3 PH 208/230/440 VAC 60 HZ TEFC	2 HP, 3 PH 230/440 VAC 60 HZ TEFC	1-1/2 HP, 3 PH 230/460 VAC 60 HZ TEFC	1-1/2 HP, 1 PH 115/230 VAC 60 HZ TEFC	2HP, 3 PH 230/460 VAC 60 HZ TEFC	2 HP, 1 PH 115/230 VAC 60 HZ TEFC
Weight (lbs)	68	115	68	68	115	115

CP = Chrome plated

PERFORMANCE (Water at 70°F)





NOTE: With the standard
1 ½ HP (Model 35651)
2 HP (Model 36751)
motor, maximum fluid viscosity is 100 CP (500 SSU).

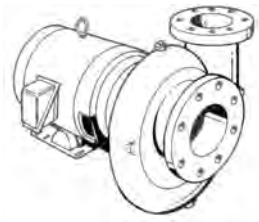
Printed in U.S.A.

ITT

SUBMITTAL

B-336.1F

JOB: Thermal Remediation Services	**REPRESENTATIVE:**	
UNIT TAG:	**ORDER NO.**	**DATE:** 2/23/2009
ENGINEER:	**SUBMITTED BY:**	**DATE:**
CONTRACTOR:	**APPROVED BY:**	**DATE:**



4BC
Series 1531
Close-Coupled Centrifugal Pumps

SPECIFICATIONS

FLOW	600	HEAD	50
HP	10.00	RPM	1750
VOLTS	460		
CYCLE	3	PHASE	60
TEFC			
APPROX. WEIGHT			
SPECIALS:			

MATERIALS OF CONSTRUCTION

☐ BRONZE FITTED ☐ ALL IRON

MAXIMUM WORKING PRESSURE

☒ 175 psi (12 bar) W.P.
with 125# ANSI flange drilling

TYPE OF SEAL

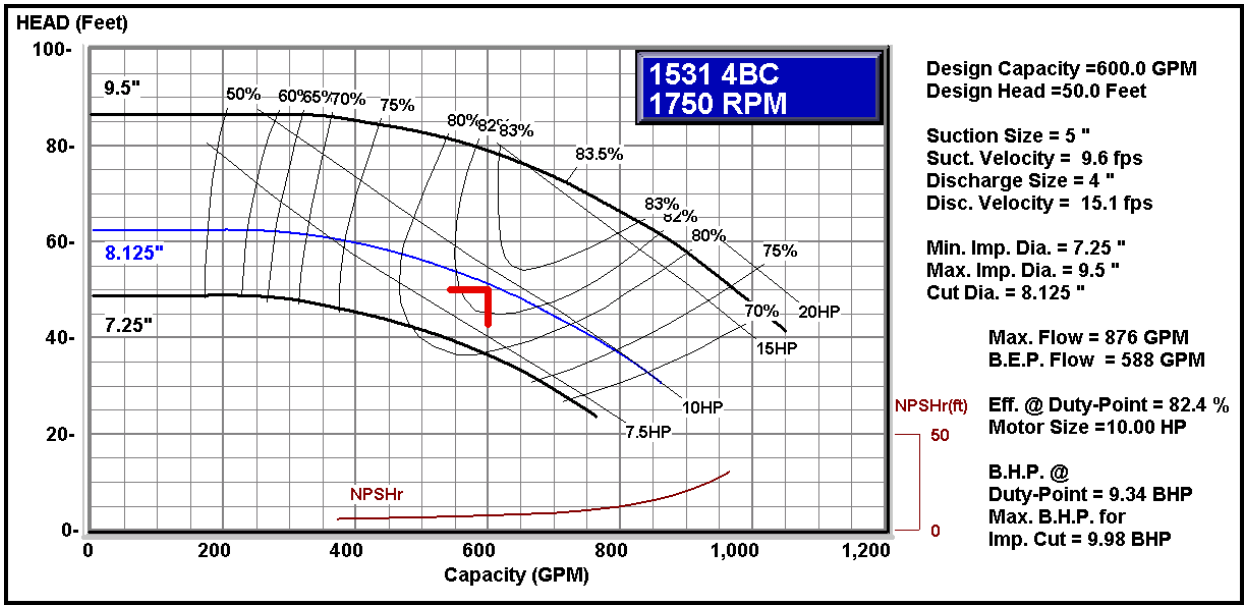
☐ 1531 Standard Seal
(Buna-Carbon/Ceramic)

☐ 1531 -F Standard Seal w/ Flush Line
(Buna-Carbon/Ceramic)

☐ 1531 -S Stuffing Box construction w/ Flushed Mechanical Single Seal
(EPR-Tungsten Carbide/Carbon)

☐ 1531 -D Stuffing Box construction w/ Flushed Double Mechanical Seal
(EPR-Carbon/Ceramic)
Requires external water source

☐ 1531 -PF Stuffing Box Construction
w/ Flushed Packing
(Graphite Impregnated Teflon)



Design Capacity =600.0 GPM
Design Head =50.0 Feet

Suction Size = 5 "
Suct. Velocity = 9.6 fps
Discharge Size = 4 "
Disc. Velocity = 15.1 fps

Min. Imp. Dia. = 7.25 "
Max. Imp. Dia. = 9.5 "
Cut Dia. = 8.125 "

Max. Flow = 876 GPM
B.E.P. Flow = 588 GPM

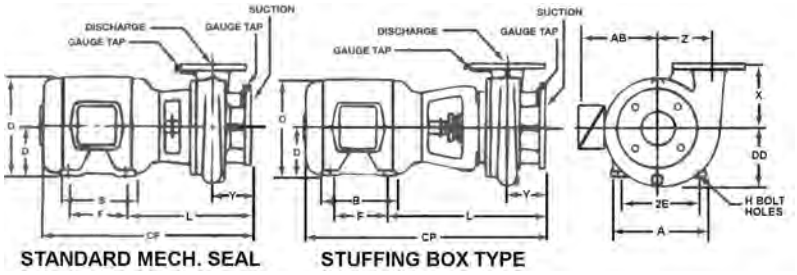
Eff. @ Duty-Point = 82.4 %
Motor Size =10.00 HP

B.H.P. @
Duty-Point = 9.34 BHP
Max. B.H.P. for
Imp. Cut = 9.98 BHP

Bell & Gossett

Series 1531 4BC Centrifugal Pump Submittal

B-336.1F



STANDARD MECH. SEAL STUFFING BOX TYPE

SIZE OF PUMP AND DISCHARGE	SUCTION	PUMP DIMENSIONS IN INCHES (MM)			
		DD	X	Y	Z
4 BC	5	8-5/8 (219)	8 (203)	5 (127)	7 (178)

125# ANSI FLANGE DIMENSIONS - INCHES (MM)				
PIPE SIZE OF FLANGE	O.D. OF FLANGE	DIA. OF BOLT CIRCLE	NO. OF BOLTS	SIZE OF BOLTS
4	9 (229)	7-1/2 (190)	8	5/8 (16)
5	10 (254)	8-1/2 (216)	8	3/4 (19)

DIMENSIONS − Inches (mm)

STANDARD SEAL 1531, 1531-F

MOTOR FRAME	A (Max)	AB (Max)	B (Max)	CP (Max)	D	2E	F	H	L	O (Max)
213JM	10-1/2 (267)	10-3/4 (273)	7-1/2 (190)	26-1/4 (667)	5-1/4 (133)	8-1/2 (216)	5-1/2 (140)	13/32 (10)	14-5/8 (371)	11-1/8 (283)
215JM	10-1/2 (267)	10-3/4 (273)	9 (229)	27-3/4 (705)	5-1/4 (133)	8-1/2 (216)	7 (178)	13/32 (10)	14-5/8 (371)	11-1/8 (283)
254JP	12-1/2 (318)	10-3/4 (273)	10-3/4 (273)	34-5/8 (879)	6-1/4 (159)	10 (254)	8-1/4 (210)	17/32 (13)	19 (483)	13-1/8 (333)
256JP	12-1/2 (318)	10-3/4 (273)	12-1/2 (318)	36-3/8 (924)	6-1/4 (159)	10 (254)	10 (254)	17/32 (13)	19 (483)	13-1/8 (333)

STUFFING BOX 1531-PF, 1531-S, 1531-D

MOTOR FRAME	A (Max)	AB (Max)	B (Max)	CP (Max)	D	2E	F	H	L	O (Max)
213JP	10-1/2 (267)	10-3/4 (273)	7-1/2 (190)	30-1/8 (765)	5-1/4 (133)	8-1/2 (216)	5-1/2 (140)	13/32 (10)	18-1/2 (470)	11-1/8 (283)
215JP	10-1/2 (267)	10-3/4 (273)	9 (229)	31-5/8 (803)	5-1/4 (133)	8-1/2 (216)	7 (178)	13/32 (10)	18-1/2 (470)	11-1/8 (283)
254JP	12-1/2 (318)	10-3/4 (273)	10-3/4 (273)	34-5/8 (879)	6-1/4 (159)	10 (254)	8-1/4 (210)	17/32 (13)	19 (483)	13-1/8 (333)
256JP	12-1/2 (318)	10-3/4 (273)	12-1/2 (318)	36-3/8 (924)	6-1/4 (159)	10 (254)	10 (254)	17/32 (13)	19 (483)	13-1/8 (333)

Dimensions are subject to change. Not to be used for construction purposes unless certified.

PRODUCT DATA

ULTRA-KLEEN™ Solution 1
WATER TREATMENT MICROBIOCIDE

DESCRIPTION AND USE

ULTRA-KLEEN Solution 1 is a unique blend of a peroxygen compound and quaternary biocide designed to effectively penetrate, remove and control biofilm. ULTRA-KLEEN Solution 1 is EPA registered as a bacteriacide, slimicide, and algicide for applications including recirculating cooling towers, air washers, brewery pasteurizing systems, dairy sweet water systems, industrial equipment, pulp & paper mill systems, dye machines and water jet looms, and deionized water systems. Low foaming surfactants and sequestrants enhance the program's unique combination of properties to oxidize, hydrolyze, and solubilize the complex components in biofilm matrixes. ULTRA-KLEEN Solution 1 can be applied as a routine maintenance treatment or to cleanup moderately and severely fouled systems. Cleanup performance will be enhanced by using ULTRA-KLEEN Solution 2 as a program adjuvant. This single (or two component program) is non-corrosive, non-volatile and contains no chlorine, phosphate, or solvents.

CHEMICAL FEEDING AND CONTROL

The ULTRA-KLEEN Solution 1 dosage rate is typically dependent upon the amount of biological foulant present. Cleaning an entire cooling system with minor to moderate fouling may require a dosage of 200 to 500 ppm (≈0.2-0.5 gallons/1000 gallons). Off-line cleaning of system components with moderate to heavy fouling may require a dosage of 1,000 to 4,000 ppm (≈1.0-4.0 gallons/1000 gallons). Maintenance dosage typically is in the 150 ppm to 250 ppm range as product dose. The product is normally shot fed to the circulating water, at the tower basin or wet well sump, or solution cleaning tank where good water agitation is available. The pH of the system MUST be 8.0 or above to get the best results with ULTRA-KLEEN Solution 1. For severely fouled systems the effectiveness of biofilm cleaning will be catalyzed as the pH rises past 9.0.

Stainless steel, polyethylene or other corrosion resistant materials are recommended for the feed system.

ULTRA-KLEEN Solution 1 treatment dosage can be controlled/monitored by a peroxide test and other indirect measurements including conventional microbiological monitoring methods of the treated water. The overall product application, dosage rate, and the specific chemical feed and control methods employed will be specified by the technical representative servicing the facility.

TYPICAL PROPERTIES

Appearance and Odor	Clear, colorless liquid with little to no odor
Specific Gravity	1.02 - 1.03
pH (neat solution)	5.0 ± 1.0

SAFETY AND HANDLING

Use appropriate safety gear, as identified in the Material Safety Data Sheet (MSDS). Rubber gloves, chemical splash goggles, and protective apron are recommended. ULTRA-KLEEN Solution 1 in concentrated form may be toxic by ingestion. Do not take internally. If ingested, wash out mouth and other skin areas contacted with water. If conscious, DO NOT induce vomiting. Drink one or two (1-2) glasses of water, milk, or milk of magnesia and get medical attention. Contact with eyes causes irritation and possible permanent eye damage. If eyes are contacted, IMMEDIATELY flush with clear water for 15 minutes and if irritation persists, get medical attention. For skin contact, wash with soap and water. For additional information, see the MSDS provided with this product.

STORAGE

ULTRA-KLEEN Solution 1 should be stored in a cool, dry place. Keep container tightly closed when not in use. Avoid storage near chemicals that are strong reducing agents.

PACKAGING

ULTRA-KLEEN Solution 1 is custom packaged in 55, 30, 15 and 5 gallon plastic containers, and also available in 275 gallon totes.

ProAsys • 318 Hendel St • Shillington PA 19607-2495 • ph: 610-775-1505 • fax: 610-775-8776
www.proasysinc.com

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date 15.05.2014 Revision: 15.05.2014

1 Identification of the substance/mixture and of the company/undertaking

· **1.1 Product identifier**

· **Trade name:** ULTRA-KLEEN SOLUTION 1

· **Article number:** 63761-3

· **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.

· **Application of the substance / the mixture** BIOCIDE

· **1.3 Details of the supplier of the Safety Data Sheet**

· **Manufacturer/Supplier:**
STERILEX CORPORATION
111 LAKE FRONT DRIVE
HUNT VALLEY MD 21030
PHONE: (443)541-8800

· **1.4 Emergency telephone number:**
CHEMTEL INC.
(800)255-3924, +1 (813)248-0585

2 Hazards identification

· **2.1 Classification of the substance or mixture**

· **Classification according to Regulation (EC) No 1272/2008**


corrosion

Skin Corr. 1B H314 Causes severe skin burns and eye damage.

· **Classification according to Directive 67/548/EEC or Directive 1999/45/EC**


C; Corrosive

R34: Causes burns.


Xn; Harmful

R22: Harmful if swallowed.

· **Information concerning particular hazards for human and environment:**
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.
Contact with skin and inhalation of aerosols/ vapours of the preparation should be avoided.

· **Classification system:**
The classification is according to the latest editions of the EU-lists, and extended by company and literature data.
The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

· **Additional information:**
Concentrated product is corrosive as shown in this document. When diluted at least 1:1 (50% or less solution) with water, product is non-hazardous.

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· **2.2 Label elements**
· **Labelling according to Regulation (EC) No 1272/2008**
The product is classified and labelled according to the CLP regulation.
· **Hazard pictograms**

GHS05

· **Signal word** Danger

· **Hazard-determining components of labelling:**
Alykl dimethyl ethyl benzyl ammonium chloride
Alkyl (C12,C14,C16) Dimethyl Benzyl Ammonium Chloride
· **Hazard statements**
H314 Causes severe skin burns and eye damage.
· **Precautionary statements**

P280	Wear protective clothing / eye protection.
P260	Do not breathe mist/vapours/spray.
P303+P361+P353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P301+P330+P331	IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

· **Hazard description:**
· **WHMIS-symbols:**
D2B - Toxic material causing other toxic effects
E - Corrosive material

· **NFPA ratings (scale 0 - 4)**

Health = 3
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

Health = 3
Fire = 0
Reactivity = 0

· **HMIS Long Term Health Hazard Substances**
None of the ingredients is listed.

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· **2.3 Other hazards**
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **3.2 Mixtures**
· **Description:** Mixture of substances listed below with nonhazardous additions.

· **Dangerous components:**

CAS: 7722-84-1 EINECS: 231-765-0 Index number: 008-003-00-9	Hydrogen Peroxide C R35; Xn R20/22; O R8 R5 Ox. Liq. 1, H271 Skin Corr. 1A, H314 Acute Tox. 4, H302; Acute Tox. 4, H332	5,5-7,2%
CAS: 85409-23-0 EINECS: 287-090-7	Alykl dimethyl ethyl benzyl ammonium chloride C R34; Xn R21/22; Xi R41; N R50 Skin Corr. 1B, H314; Eye Dam. 1, H318 Aquatic Acute 1, H400 Acute Tox. 4, H302	2,5-3,5%
CAS: 68391-01-5	Alkyl (C12,C14,C16) Dimethyl Benzyl Ammonium Chloride C R35; Xn R22; Xi R41 Skin Corr. 1A, H314; Eye Dam. 1, H318 Acute Tox. 4, H302	2,5-3,5%

· **Additional information:** For the wording of the listed risk phrases refer to section 16.

4 First aid measures

· **4.1 Description of first aid measures**
· **General information:**
Immediately remove any clothing soiled by the product.
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Immediately remove any clothing soiled by the product.
Immediately rinse with water.
If skin irritation continues, consult a doctor.
Seek immediate medical help for blistering or open wounds.
· **After eye contact:**
Remove contact lenses if worn, if possible.
Rinse opened eye for several minutes under running water. Then consult a doctor.
· **After swallowing:**
Rinse out mouth and then drink plenty of water.

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Do not induce vomiting; call for medical help immediately.
· **4.2 Most important symptoms and effects, both acute and delayed**
Strong caustic effect on skin and mucous membranes.
Coughing
Breathing difficulty
Nausea
Cramp
· **Hazards**
Danger of gastric perforation.
Danger of impaired breathing.
Danger of severe eye injury.
Danger of disturbed cardiac rhythm.
· **4.3 Indication of any immediate medical attention and special treatment needed**
If necessary oxygen respiration treatment.
Monitor circulation, possible shock treatment.
Medical supervision for at least 48 hours.

5 Firefighting measures

· **5.1 Extinguishing media**
· **Suitable extinguishing agents:** Use fire extinguishing methods suitable to surrounding conditions.
· **For safety reasons unsuitable extinguishing agents:** None.
· **5.2 Special hazards arising from the substance or mixture**
Formation of toxic gases is possible during heating or in case of fire.
· **5.3 Advice for firefighters**
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.
· **Additional information** No further relevant information available.

6 Accidental release measures

· **6.1 Personal precautions, protective equipment and emergency procedures**
Wear appropriate NIOSH respirator when ventilation is inadequate and occupational exposure limits are exceeded.
· **6.2 Environmental precautions:** Do not allow product to reach sewage system or any water course.
· **6.3 Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Pick up mechanically.
Send for recovery or disposal in suitable receptacles.
Dispose contaminated material as waste according to item 13.
· **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.

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See Section 13 for disposal information.

7 Handling and storage

· **7.1 Precautions for safe handling**
Ensure good ventilation/exhaustion at the workplace.
Prevent formation of aerosols.
Avoid splashes or spray in enclosed areas.
· **Information about fire - and explosion protection:** Keep respiratory protective device available.

· **7.2 Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:**
Avoid storage near extreme heat, ignition sources or open flame.
Unsuitable material for receptacle: aluminium.
Unsuitable material for receptacle: steel.
· **Information about storage in one common storage facility:**
Store away from oxidizing agents.
Do not store together with acids.
· **Further information about storage conditions:**
Store in cool, dry conditions in well sealed receptacles.
Storage Temperatures : <140 ° F / <60 °C.
· **7.3 Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical facilities:** No further data; see item 7.

· **8.1 Control parameters**

· **Ingredients with limit values that require monitoring at the workplace:**	
7722-84-1 hydrogen peroxide	
PEL (USA)	Long-term value: 1,4 mg/m³, 1 ppm
REL (USA)	Long-term value: 1,4 mg/m³, 1 ppm
TLV (USA)	Long-term value: 1,4 mg/m³, 1 ppm
EL (Canada)	Long-term value: 1 ppm
EV (Canada)	Long-term value: 1,4 mg/m³, 1 ppm

· **DNELs** No further relevant information available.
· **PNECs** No further relevant information available.
· **Additional information:** The lists valid during the making were used as basis.

· **8.2 Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
The usual precautionary measures are to be adhered to when handling chemicals.
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.

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Wash hands before breaks and at the end of work.
Avoid contact with the eyes and skin.
Do not inhale gases / fumes / aerosols.

· **Respiratory protection:**
Not required under normal conditions of use.
Wear appropriate NIOSH respirator when ventilation is inadequate and occupational exposure limits are exceeded.
For spills, respiratory protection may be advisable.

· **Protection of hands:**

Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation.

· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.

· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

· **Eye protection:**
Contact lenses should not be worn.

Safety glasses

· **Body protection:** Protective work clothing

· **Limitation and supervision of exposure into the environment**
No further relevant information available.

· **Risk management measures**
See Section 7 for additional information.
No further relevant information available.

9 Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**

· **General Information**

· **Appearance:**

Form:	Liquid
Colour:	Colourless
· **Odour:**	Odourless
· **Odour threshold:**	Not determined.
· **pH-value:**	3,01 - 5,86

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· **Change in condition**
Melting point/Melting range: Not Determined.
Boiling point/Boiling range: 212 ° F / 100 °C

· **Flash point:** Not applicable.

· **Flammability (solid, gaseous):** Not applicable.

· **Auto/Self-ignition temperature:** Not determined.

· **Decomposition temperature:** Not determined.

· **Self-igniting:** Product is not self-igniting.

· **Danger of explosion:** Product does not present an explosion hazard.

· **Explosion limits:**
Lower: Not determined.
Upper: Not determined.

· **Vapour pressure at 20 °C:** 23 hPa

· **Density at 20 °C:** 1 g/cm³
· **Relative density** Not determined.
· **Vapour density** Not determined.
· **Evaporation rate** Not determined.

· **Solubility in / Miscibility with water:** Fully miscible.

· **Partition coefficient (n-octanol/water):** Not determined.

· **Viscosity:**
Dynamic: Not determined.
Kinematic: Not determined.
· **9.2 Other information** No further relevant information available.

10 Stability and reactivity

· **10.1 Reactivity**
· **10.2 Chemical stability**
· **Thermal decomposition / conditions to be avoided:**
No decomposition if used and stored according to specifications.
To avoid thermal decomposition do not overheat.
· **10.3 Possibility of hazardous reactions**
Toxic fumes may be released if heated above the decomposition point.
Reacts with strong oxidizing agents.
Reacts with certain metals.
· **10.4 Conditions to avoid**
Store away from oxidizing agents.
Keep away from heat and direct sunlight.
Prevent from drying out.

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· **10.5 Incompatible materials:** No further relevant information available.
· **10.6 Hazardous decomposition products:**
Carbon monoxide and carbon dioxide
Chlorine compounds

11 Toxicological information

· **11.1 Information on toxicological effects**
· **Acute toxicity:**

· **LD/LC50 values relevant for classification:**		
7722-84-1 hydrogen peroxide		
Oral	LD50	376 mg/kg (rat)
Inhalative	LC50/4h	2,0 mg/l (rat)
68391-01-5 Alkyl (C12,C14,C16) Dimethyl Benzyl Ammonium Chloride		
Oral	LD50	650 mg/kg (rat)

· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.
· **on the eye:** Strong caustic effect.
· **Sensitization:** No sensitizing effects known.
· **Subacute to chronic toxicity:** Toxic and/or corrosive effects may be delayed up to 12 hours.
· **Additional toxicological information:**
The product shows the following dangers according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version:
Harmful
Corrosive
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

12 Ecological information

· **12.1 Toxicity**
· **Aquatic toxicity:** The product contains materials that are harmful to the environment.
· **12.2 Persistence and degradability** No further relevant information available.
· **12.3 Bioaccumulative potential** May be accumulated in organism
· **12.4 Mobility in soil** No further relevant information available.
· **Ecotoxical effects:**
· **Remark:**
The product causes an alteration of the pH-value within the testing system. The result refers to the non-neutralised sample.
· **Additional ecological information:**
· **General notes:**
Water hazard class 1 (German Regulation) (Self-assessment): slightly hazardous for water
Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
Must not reach sewage water or drainage ditch undiluted or unneutralized.

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· **12.5 Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **12.6 Other adverse effects** No further relevant information available.

13 Disposal considerations

· **13.1 Waste treatment methods**
· **Recommendation**
Do not allow undiluted product to reach sewage system.
Can be disposed of with household garbage with prior chemical-physical or biological treatment following consultation with the waste disposal facility operator and the pertinent authorities and adhering to the necessary technical regulations.
Can be burned with household garbage after consulting with the waste disposal facility operator and the pertinent authorities and adhering to the necessary technical regulations.
Contact waste processors for recycling information.

· **Uncleaned packaging:**
· **Recommendation:**
Disposal must be made according to official regulations.
Packagings that may not be cleansed are to be disposed of in the same manner as the product.
· **Recommended cleansing agents:** Water, if necessary together with cleansing agents.

14 Transport information

· **14.1 UN-Number**
· **DOT, ADR, IMDG, IATA** UN1760
· **14.2 UN proper shipping name**
· **DOT** 1760 Corrosive Liquid, n.o.s. (Alkyl (C12,C14,C16) Dimethyl Benzyl Ammonium Chloride, Alykl dimethyl ethyl benzyl ammonium chloride)
· **ADR, IMDG, IATA** 1760 CORROSIVE LIQUID, N.O.S. (Alkyl (C12,C14,C16) Dimethyl Benzyl Ammonium Chloride, Alykl dimethyl ethyl benzyl ammonium chloride)
· **14.3 Transport hazard class(es)**
· **DOT**

· **Class** 8 Corrosive substances.
· **Label** 8

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· **ADR**

· **Class**	8 (C9) Corrosive substances.
· **Label**	8

· **IMDG, IATA**

· **Class**	8 Corrosive substances.
· **Label**	8
· **14.4 Packing group**	
· **DOT, ADR, IMDG, IATA**	III
· **14.5 Environmental hazards:**	
· **Marine pollutant:**	No
· **14.6 Special precautions for user**	Warning: Corrosive substances.
· **Danger code (Kemler):**	80
· **EMS Number:**	F-A,S-B
· **14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.

· **Transport/Additional information:**

· **ADR**	
· **Limited quantities (LQ)**	5L
· **Transport category**	3
· **Tunnel restriction code**	E
· **UN "Model Regulation":**	UN1760, CORROSIVE LIQUID, N.O.S. (Alkyl (C12,C14,C16) Dimethyl Benzyl Ammonium Chloride, Alykl dimethyl ethyl benzyl ammonium chloride), 8, III

15 Regulatory information

· **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **United States (USA)**
· **SARA**

· **Section 355 (extremely hazardous substances):**	
7722-84-1	hydrogen peroxide

· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.

· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

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· **Proposition 65 (California):**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic Categories**

· **EPA (Environmental Protection Agency)**

EPA Product Registration : 63761-8.

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals. Following is the hazard information as require don the pesticide label:

DANGER
CORROSIVE
Causes irreversible eye damage and skin burns.
Harmful if swallowed.
Harmful in contact with skin.
Harmful by inhalation.

This pesticide is toxic to fish

85409-23-0	Alykl dimethyl ethyl benzyl ammonium chloride	Registered.

· **IARC (International Agency for Research on Cancer)**		
7722-84-1	hydrogen peroxide	3

· **TLV (Threshold Limit Value established by ACGIH)**		
7722-84-1	hydrogen peroxide	A3

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.

· **Canada**

· **Canadian Domestic Substances List (DSL)**	
7722-84-1	Hydrogen Peroxide
85409-23-0	Alykl dimethyl ethyl benzyl ammonium chloride
68391-01-5	Alkyl (C12,C14,C16) Dimethyl Benzyl Ammonium Chloride
7732-18-5	water, distilled, conductivity or of similar purity

· **Canadian Ingredient Disclosure list (limit 0.1%)**
None of the ingredients is listed.

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· **Canadian Ingredient Disclosure list (limit 1%)**	
7722-84-1	hydrogen peroxide

· **Other regulations, limitations and prohibitive regulations**
This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

· **Substances of very high concern (SVHC) according to REACH, Article 57**
None of the ingredients is listed.

· **15.2 Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Relevant phrases**
H271 May cause fire or explosion; strong oxidiser.
H302 Harmful if swallowed.
H314 Causes severe skin burns and eye damage.
H318 Causes serious eye damage.
H332 Harmful if inhaled.
H400 Very toxic to aquatic life.

R20/22 Harmful by inhalation and if swallowed.
R21/22 Harmful in contact with skin and if swallowed.
R22 Harmful if swallowed.
R34 Causes burns.
R35 Causes severe burns.
R41 Risk of serious damage to eyes.
R5 Heating may cause an explosion.
R50 Very toxic to aquatic organisms.
R8 Contact with combustible material may cause fire.

· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)
DNEL: Derived No-Effect Level (REACH)
PNEC: Predicted No-Effect Concentration (REACH)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
Ox. Liq. 1: Oxidising Liquids, Hazard Category 1
Acute Tox. 4: Acute toxicity, Hazard Category 4

(Contd. on page 13)

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date 15.05.2014 Revision: 15.05.2014

Trade name: Sterilex Ultra Disinfectant Cleaner Solution 1

(Contd. of page 12)

Skin Corr. 1A: Skin corrosion/irritation, Hazard Category 1A
Skin Corr. 1B: Skin corrosion/irritation, Hazard Category 1B
Eye Dam. 1: Serious eye damage/eye irritation, Hazard Category 1
Aquatic Acute 1: Hazardous to the aquatic environment - AcuteHazard, Category 1

· **Sources**

SDS Prepared by:
ChemTel Inc.
1305 North Florida Avenue
Tampa, Florida USA 33602-2902
Toll Free North America 1-888-255-3924 Intl. +01 813-248-0573
Website: www.chemtelinc.com

63761-3 7/19/2011 1 of 6

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Wendy A. McCombie
Sterilex Corporation
111 Lake Front Drive
Hunt Valley, MD 21030

JUL 19 2011

SUBJECT: Ultra Kleen Solution 1
EPA Registration Number: 63761-3
Application Dated: April 11, 2011
Receipt Date: April 22, 2011

Dear Ms. McCombie:

The following amendment, submitted in connection with registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended, is acceptable.

- Ultra Kleen Solution 1 (EPA Registration Number: 63761-3) in response to the conditions of the January 23, 2011 acceptance letter and stamped accepted label.

General Comments

Your accepted stamped label is attached. Should you have any questions concerning this letter, please contact Emilia Oiguenblik at (703) 347-0109 or Velma Noble at (703) 308-6233.

Sincerely,

Velma Noble
Product Manager (31)
Regulatory Management Branch I
Antimicrobials Division (7510P)

	CONCURRENCES							
SYMBOL								
SURNAME								
DATE								

Ultra-Kleen™ Solution 1

Penetrates and Removes Biofilm and Other Organic Contaminants. Use as a Bactericide, Slimicide, Mildewstat, and Algicide in:

- Recirculating Cooling Water Systems
- Brewery Pasteurizing Systems
- Pulp and Paper Mills producing pulp and paper that will not come in contact with food products
- Air Washers
- Dye Machines
- Water-Jet Looms
- Tanks, Piping and Industrial Equipment used to store and convey Industrial Process Water or Aqueous Mixtures not related to food processing
- Deionized Water Supply Systems not used in food processing or for human drinking water or dental lines
- Drains and Filter Traps
- Chair Side Evacuator Traps and Pump Filter Traps

Optional Marketing Language
[(Based off of) (Based on) (Including) (Includes) (Using) patented PerQuat™ technology]

May be used with **Ultra-Kleen Solution 2** to adjust pH, to inhibit corrosion and to enhance cleaning. Please consult directions for use for specific recommendations.

Active Ingredients:	
n-Alkyl(C_{14} 60%, C_{16} 30%, C_{12} 5%, C_{18} 5%) dimethylbenzylammonium chloride	3.00%
n- Alkyl(C_{12} 68%, C_{14} 32%) dimethylethylbenzylammonium chloride	3.00%
Inert Ingredients	94.00%
TOTAL	100.00%

Controls Mold and Mildew

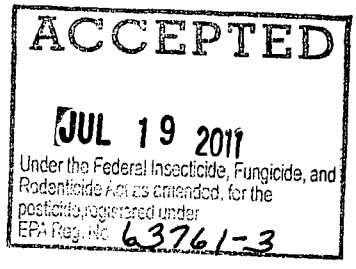
KEEP OUT OF REACH OF CHILDREN

DANGER

SEE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS AND FIRST AID

Manufactured for
Sterilex Corporation
11409 Cronhill Drive Suite L
Owings Mills, MD 21117
phone 1-800-511-1659, fax 410-581-8864

EPA Reg. No. 63761-3



EPA Est. No. 4875-NJ-001
EPA Est. No. 44636-CA-001
EPA Est. No. 21737-MN-01
EPA Est. No. 062788-AL-01
EPA Est. No. 60156-IL-001
EPA Est. No. 085684-AL-001
EPA Est. No. 56485-PA-001
EPA Est. No. 1270-GA-1
EPA Est. No. 1270-TX-1
EPA Est. No. 40849-GA-1

Net Content: {1 2.5, 5, 15, 30, 55, 275, 305} Gallons,

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER. CORROSIVE. Causes irreversible eye damage and skin burns. Harmful if swallowed or absorbed through skin. Do not get in eyes, on skin, or on clothing. Wear goggles and/or face shield, protective clothing and rubber gloves. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash clothing before reuse.

ENVIRONMENTAL HAZARDS. This product is toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, ocean or other waters unless in accordance with the requirements of a National Pollution Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously consulting the local sewage treatment plant authority. For guidance contact your local State Water Board or Regional Office of the EPA.

PHYSICAL AND CHEMICAL HAZARDS. When exposed to fire Ultra-Kleen Solution 1 may release oxygen and oxides of carbon and/or nitrogen.

FIRST AID

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

IF IN EYES: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing the eyes. Call a poison control center or doctor for treatment advice.

IF ON SKIN OR CLOTHING: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

IF SWALLOWED: Call a poison control center or doctor immediately for treatment advice. Have a person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.

NOTE TO PHYSICIAN: Probable mucosal damage may contraindicate the use of gastric lavage.

NOTE: Seller warrants that this product complies with the specifications expressed in this label. Seller makes no other warranties; and disclaims all other warranties, express or implied, including but not limited to warranties of merchantability and fitness for the intended purpose. Seller's liability for default, breach or failure under this label shall be limited to the amount of the purchase price. Seller shall have no liability for consequential damages.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by improper storage or disposal.

STORAGE: Keep product in closed original container when not in use. Store in a cool area away from potential sources of heat, open flames, sunlight or other chemicals. Product should be stored below 90°F.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities If rinsate cannot be used, follow pesticide disposal instructions. If not triple rinsed these containers are acute hazardous wastes and must be disposed in accordance with local, state and federal regulations. Triple rinse [or pressure rinse] container (or equivalent) promptly after emptying.

[(*NOTE TO REVIEWER: The following language is for nonrefillable containers having a capacity of 5 gallons or less*) Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times.]

[(*NOTE TO REVIEWER: The following language is optional for nonrefillable containers having a capacity of 5 gallons or less when "or pressure rinse" appears in the above Container Disposal statement)* Pressure rinse as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 PSI for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.]

[(*NOTE TO REVIEWER: The following language is for nonrefillable containers having a capacity greater than 5 gallons*) Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the

container ¼ full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times.]

[*(NOTE TO REVIEWER: The following language is optional for nonrefillable containers having a capacity greater than 5 gallons when "or pressure rinse" appears in the above Container Disposal statement)* Pressure rinse as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 PSI for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.]

DIRECTIONS FOR USE
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

RECIRCULATING COOLING WATER SYSTEMS, INCLUDING COOLING TOWERS, EVAPORATIVE CONDENSERS, DAIRY SWEET WATER SYSTEMS AND BREWERY PASTEURIZERS. Effectively removes and controls biofilm and other organic contaminants in commercial and industrial cooling towers: influent water systems such as flow-through filters; and heat exchange water systems.
DOSAGE RATES. **Initial Dose for badly fouled systems:** Add 1 to 4 gal. (1000-4000 ppm of this product)**Ultra-Kleen Solution 1** per 1000 gallons of water in the system. If cleaning is desired or if the pH of the system is below 8, optionally add simultaneously Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1**. Repeat until control is evident.
Routine Dose, when microbial control is evident: Subsequent slug additions of 5 oz. to 64 fl. oz. (40-499 ppm of this product) **Ultra-Kleen Solution 1** per 1000 gallons of water (and if cleaning is desired or the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1**) are applied every 2 to 5 days or as needed. The frequency of addition depends on the relative amount of bleed-off, the quality of the makeup water and rate of inflow of airborne or other contaminants. Slug additions are made in the sump of water cooling towers.
Continuous Dosage: For continuous, or semi-continuous, low level dosage of **Ultra-Kleen Solution 1**, add 1 oz. to 20 oz. (8-156 ppm of this product) **Ultra-Kleen Solution 1** per 1000 gallons of water (and if cleaning is desired or the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1**).

PULP AND PAPER MILLS. For use only in the production of pulp and paper that will not come in contact with food. Effectively removes and controls biofilm and other organic contaminants in pulp and paper mill fresh and seawater influent, water systems, wastewater treatment systems, nonpotable water systems, and other process water.
DOSAGE RATES. **Initial Dose for badly fouled systems**: Add 3 to 16 gal. (3000-16000 ppm of this product) of Ultra-Kleen Solution 1 per 1000 gallons of water in the system. If cleaning is desired or if the pH of the system is below 8, optionally add simultaneously Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1. If necessary, apply a solution containing 0.4 to 2 oz. Ultra-Kleen Solution 1 per gallon of water (and if cleaning is desired or if the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1) onto interior surfaces of the system that are not continuously submerged.
Routine Dose, when microbial control is evident: Subsequent slug additions of 8 to 50 oz. (62-390 ppm of this product) Ultra-Kleen Solution 1 per 1000 gallons of water (and if cleaning is desired or if the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1) are applied every 1 to 5 days as needed. The frequency of addition depends on the quality of the makeup water and rate of inflow of airborne or other contaminants.
Continuous Dosage: For continuous low level dosage of Ultra-Kleen Solution 1, add 1 oz. to 20 oz. Ultra-Kleen Solution 1 per 1000 gallons of water (8-156 ppm of this product) (and if cleaning is desired or the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1).

AIR WASHERS. For use only in industrial air washing systems that maintain effective mist eliminating components. Effectively removes and controls biofilm and other organic contaminants in Industrial Water Scrubbing Systems.
DOSAGE RATES. **Initial Dose for badly fouled systems:** Add 3 to 16 gal. (3000-16000 ppm of this product) of **Ultra-Kleen Solution 1** per 1000 gallons of water in the system. If cleaning is desired or if the pH of the system is below 8, optionally add simultaneously Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1**. If necessary, apply a solution containing 0.4 to 2 fl. oz. **Ultra-Kleen Solution 1** (and if cleaning is desired or the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the

volume of **Ultra-Kleen Solution 1**) per gallon of water onto interior surfaces of the system that are not continuously submerged. Repeat until control is evident.
Routine Dose, when microbial control is evident: Subsequent slug additions of 28 to 128 fl. oz. (218-1000 ppm of this product) **Ultra-Kleen Solution 1** per 1000 gallons of water and if cleaning is desired or the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1** are applied every 1 to 5 days or as needed. The frequency of addition depends on the relative amount of bleed-off, the quality of the makeup water and rate of inflow of airborne or other contaminants. Slug additions are made in the sump of Industrial Water Scrubbing Systems.

DYE MACHINES. Effectively removes and controls biofilm and other organic contaminants in Textile Dyeing Machines.
DOSAGE RATES. Add 16 to 40 gal. (16000-40000 ppm of this product) of **Ultra-Kleen Solution 1** per 1000 gallons of water in a dye storage tank. If cleaning is desired or the pH of the mixture is below 8, optionally add simultaneously Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1. Circulate the mixture from the dye storage tank through the dye machine and all associated piping and other dye storage tanks. If necessary, apply a solution containing 2 to 5 fl. oz. Ultra-Kleen Solution 1 (and if cleaning is desired or the pH of the mixture is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1) per gallon of water onto surfaces of the system that are not continuously submerged.

WATER-JET LOOMS. Effectively removes and controls biofilm and other organic contaminants in Water-Jet Looms.
DOSAGE RATES. **Initial Dose for badly fouled systems:** Prepare a mixture of 2 to 5 fl. oz. of Ultra-Kleen Solution 1 per gallon of water. If cleaning is desired or if the pH of the mixture is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1**. Pump the mixture through the Water-Jet Loom and all associated piping. If necessary, apply a solution containing 2 to 5 fl. oz. of **Ultra-Kleen Solution 1** (and if cleaning is desired or the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1**) per gallon of water onto surfaces of the system that are not continuously submerged.
Subsequent Dose, when microbial control is evident: Subsequent slug additions of 5 to 25 fl. oz. (40-195 ppm of this product) **Ultra-Kleen Solution 1** per 1000 gallons of water in the system (and if cleaning is desired or the pH of the mixture is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1) per 1000 gallons of daily water use are applied every 1 to 5 days or as needed. The frequency of addition depends on the quality of the makeup water and rate of inflow of airborne or other contaminants.

TANKS, SUMPS, AND OTHER HOLDING VESSELS, PIPING AND INDUSTRIAL EQUIPMENT USED TO STORE AND CONVEY INDUSTRIAL OR COMMERCIAL PROCESS WATER OR AQUEOUS MIXTURES~~TANKS,~~ Do Not Use in equipment that will contact food. Effectively removes and controls biofilm and other organic contaminants in Tanks, Piping and Industrial Equipment used to store and convey Industrial Process Water or Aqueous Mixtures.
DOSAGE RATES. **Dose for badly fouled systems:** Fill equipment as completely as possible with a solution of 8 to 80 gal. (8000-80000 ppm of this product) of **Ultra-Kleen Solution 1** per 1000 gallons of water in the system (and if cleaning is desired or the pH of the mixture is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1). Circulate for at least 4 hours and then drain system. Rinse system with 6 volumes of water. If necessary, apply a solution containing 1 to 10 fl. oz. **Ultra-Kleen Solution 1** (and if cleaning is desired or the pH of the mixture is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1) per gallon onto surfaces of the equipment that are not submerged.
Subsequent Dose, when microbial control is evident: Subsequent slug additions of 5 to 25 fl. oz. (40-195 ppm of this product) **Ultra-Kleen Solution 1** per 1000 gallons of water in the system (and if cleaning is desired or the pH of the mixture is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of Ultra-Kleen Solution 1) per 1000 gallons of daily water use are applied every 1 to 5 days or as needed. The frequency of addition depends on the quality of the makeup water and rate of inflow of airborne or other contaminants.

DEIONIZED WATER SUPPLY SYSTEMS NOT USED IN FOOD PROCESSING, FOR HUMAN DRINKING WATER OR DENTAL LINES. Effectively removes and controls biofilm and other organic contaminants in Tanks, Filters and Piping used to store and convey Deionized Water.
DOSAGE RATES. **Dose for badly fouled systems** : Add 3 to 16 gal. (3000-16000 ppm of this product) of **Ultra-Kleen Solution 1** per 1000 gallons of system capacity and if cleaning is desired or the pH of the mixture is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1** . Circulate for at least four hours and then drain system. Rinse system with 6 volumes of water. If necessary, apply a solution containing 0.4 to 2 fl. oz. **Ultra-Kleen Solution 1** (and if cleaning is desired or the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1**) per gallon onto surfaces of the equipment that are not submerged.

Subsequent Dose, when microbial control is evident: Add subsequent slug additions of 5 oz. to 1 gal. (40-1000 ppm) **Ultra-Kleen Solution 1** (and if cleaning is desired or the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1**) per 1000 gallons of system capacity. Circulate for at least four hours and then drain system. Rinse system with 6 volumes of water. If necessary, apply a solution containing 0.4 to 2 fl. oz. **Ultra-Kleen Solution 1** (and if cleaning is desired or the pH of the system is below 8, optionally add Ultra-Kleen Solution 2 at the rate of 1 to 3 times the volume of **Ultra-Kleen Solution 1**) per gallon onto surfaces of the equipment that are not submerged.

Penetrates and Removes Biofilm and Other Organic Contaminants. Use as a Bactericide, Slimicide, Mildewstat, and Algicide in:

DRAINS. Effectively removes and controls plugging and odors caused by accumulation of biofilm and other organic contaminants in drains. Prevents stoppage and odors.
DOSAGE RATES. Initial Dose for badly fouled systems. This product can be poured, foamed, wiped, brushed, applied using a clean in place CIP system, pumping it through the system or mopping. Apply from 6 fl. oz to 15 fl. oz Ultra-Kleen Solution 1 per gallon of water to drain. Repeat until control is evident. Optionally, pour from 1 fl. oz. Ultra-Kleen Solution 1 around or into one-inch diameter or smaller drains up to 90 fl. oz. Ultra-Kleen Solution 1 around or into three-inch diameter drains. If cleaning is desired, add simultaneously Ultra-Kleen Solution 2 at the same volume as Ultra-Kleen Solution 1 (1 – 90 fl. oz). For foam cleaning, add 6-15 oz. Sterilex Ultra-Kleen Solution 1 and an equal amount of Sterilex Ultra-Kleen Solution 2 per gallon of water to a foaming device and foam the mixture into the drain.
Subsequent Dose: When microbial control is evident, subsequent additions of 1-6 fl. oz Ultra-Kleen Solution 1 per gallon of water is applied every 7 days or as needed. This product can be poured, foamed, wiped, brushed, applied using a clean in place CIP system, pumping it through the system or mopping. If cleaning is desired, add simultaneously Ultra-Kleen Solution 2 at the same volume as Ultra-Kleen Solution 1 (1 – 6 fl. oz) per gallon of water. Optionally, subsequent additions of 1 – 6 fl. oz Ultra-Kleen Solution 1 into one-inch diameter or smaller drains up to 6 fl. oz Ultra-Kleen Solution 1 into three-inch diameter drains, are applied every 7 days or as needed. If cleaning is desired, add simultaneously Ultra-Kleen Solution 2 at the same volume as Ultra-Kleen Solution 1 (1 – 6 fl. oz). For foam cleaning, add 1 – 6 oz. Sterilex Ultra-Kleen Solution 1 and an equal amount of Sterilex Ultra-Kleen Solution 2 per gallon of water to a foaming device and foam the mixture into the drain.

CHAIR SIDE EVACUATOR TRAPS AND PUMP FILTER TRAPS. Effectively removes and controls plugging and odors caused by accumulation of biofilm in chair side evacuator traps and pump filter traps. Prevents stoppage and odor. DOSAGE RATES. Initial Dose for badly fouled systems. Mix 10 fl. oz. of Ultra-Kleen Solution 1 and 10 fl. oz. of Ultra-Kleen Solution 2 into one gallon of hot water at the end of the working day. Draw all of the solution into the trap and allow to stand overnight. Repeat until control is evident.
Subsequent Dose: When microbial control is evident, subsequent slug additions of 1.5-2 fl. oz. Ultra-Kleen Solution 1 and 1.5-2 fl. oz of Ultra-Kleen Solution 2 mixed into one gallon of hot water are applied every 7 days or as needed.

When mixtures of Ultra-Kleen Solution 1 and Ultra-Kleen Solution 2 are prepared in a batch process, always use the mixtures the same day they are prepared.

This product is water-based.

SAFETY DATA SHEET

THE DOW CHEMICAL COMPANY

Product name: AQUCAR™ GA 15 Water Treatment Microbiocide **Issue Date:** 03/18/2015
Print Date: 03/18/2015

THE DOW CHEMICAL COMPANY encourages and expects you to read and understand the entire (M)SDS, as there is important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

1. IDENTIFICATION

Product name: AQUCAR™ GA 15 Water Treatment Microbiocide

Recommended use of the chemical and restrictions on use
Identified uses: For biocidal applications. For industrial use only.

COMPANY IDENTIFICATION
THE DOW CHEMICAL COMPANY
2030 WILLARD H DOW CENTER
MIDLAND MI 48674-0000
UNITED STATES

Customer Information Number: 800-258-2436
SDSQuestion@dow.com

EMERGENCY TELEPHONE NUMBER
24-Hour Emergency Contact: 800-424-9300
Local Emergency Contact: 989-636-4400

2. HAZARDS IDENTIFICATION

Hazard classification
This material is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.
Acute toxicity - Category 4 - Oral
Acute toxicity - Category 3 - Inhalation
Skin corrosion - Category 1B
Serious eye damage - Category 1
Respiratory sensitisation - Category 1
Skin sensitisation - Category 1
Specific target organ toxicity - single exposure - Category 3

Label elements
Hazard pictograms

Signal word: **DANGER!**

Hazards
Harmful if swallowed.
Causes severe skin burns and eye damage.
May cause an allergic skin reaction.
Toxic if inhaled.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause respiratory irritation.

Precautionary statements

Prevention
Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
Wash skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in a well-ventilated area.
Contaminated work clothing should not be allowed out of the workplace.
Wear protective gloves/ protective clothing/ eye protection/ face protection.
In case of inadequate ventilation wear respiratory protection.

Response
IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
If skin irritation or rash occurs: Get medical advice/ attention.
If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.
Wash contaminated clothing before reuse.

Storage
Store in a well-ventilated place. Keep container tightly closed.
Store locked up.

Disposal
Dispose of contents/ container to an approved waste disposal plant.

Other hazards
no data available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature: aldehyde
This product is a mixture.

Component	CASRN	Concentration
Glutaraldehyde	111-30-8	15.0%
Water	7732-18-5	<= 85.0 %

4. FIRST AID MEASURES

Description of first aid measures
General advice: First Aid responders should pay attention to self-protection and use the recommended protective clothing (chemical resistant gloves, splash protection). If potential for exposure exists refer to Section 8 for specific personal protective equipment.

Inhalation: Move person to fresh air. If person is not breathing, call an emergency responder or ambulance, then give artificial respiration; if by mouth to mouth use rescuer protection (pocket mask etc). Call a poison control center or doctor for treatment advice. If breathing is difficult, oxygen should be administered by qualified personnel.

Skin contact: Take off contaminated clothing. Wash skin with soap and plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice. Wash clothing before reuse. Shoes and other leather items which cannot be decontaminated should be disposed of properly. Suitable emergency safety shower facility should be immediately available.

Eye contact: Wash immediately and continuously with flowing water for at least 30 minutes. Remove contact lenses after the first 5 minutes and continue washing. Obtain prompt medical consultation, preferably from an ophthalmologist. Suitable emergency eye wash facility should be immediately available.

Ingestion: If the person is fully alert and cooperative, have the person rinse mouth with plenty of water. In cases of ingestion have the person drink 4 to 10 ounces (120-300 mL) of water. Do not induce vomiting. Do not attempt mouth rinse if the person has respiratory distress, altered mental status, or nausea and vomiting. Call a physician and/or transport to emergency facility immediately.

Most important symptoms and effects, both acute and delayed: Aside from the information found under Description of first aid measures (above) and Indication of immediate medical attention and special treatment needed (below), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed
Notes to physician: Maintain adequate ventilation and oxygenation of the patient. May cause respiratory sensitization or asthma-like symptoms. Bronchodilators, expectorants and antitussives may be of help. Glutaraldehyde may transiently worsen reversible airways obstruction including asthma or reactive airways disease. Treat bronchospasm with inhaled beta2 agonist and oral or parenteral corticosteroids. Respiratory symptoms, including pulmonary edema, may be delayed. Persons receiving significant exposure should be observed 24-48 hours for signs of respiratory

distress. Inhalation of vapors may result in skin sensitization. In sensitized individuals, reexposure to very small amounts of vapor, mist, or liquid may cause a severe allergic skin reaction. Chemical eye burns may require extended irrigation. Obtain prompt consultation, preferably from an ophthalmologist. If burn is present, treat as any thermal burn, after decontamination. Due to irritant properties, swallowing may result in burns/ulceration of mouth, stomach and lower gastrointestinal tract with subsequent stricture. Aspiration of vomitus may cause lung injury. Suggest endotracheal/esophageal control if lavage is done. Probable mucosal damage may contraindicate the use of gastric lavage. No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient. Have the Safety Data Sheet, and if available, the product container or label with you when calling a poison control center or doctor, or going for treatment. Excessive exposure may aggravate preexisting asthma and other respiratory disorders (e.g. emphysema, bronchitis, reactive airways dysfunction syndrome).

5. FIREFIGHTING MEASURES

Suitable extinguishing media: To extinguish combustible residues of this product use water fog, carbon dioxide, dry chemical or foam.

Unsuitable extinguishing media: None known.

Special hazards arising from the substance or mixture
Hazardous combustion products: Under fire conditions some components of this product may decompose. The smoke may contain unidentified toxic and/or irritating compounds. Combustion products may include and are not limited to: Carbon monoxide. Carbon dioxide.

Unusual Fire and Explosion Hazards: This material will not burn until the water has evaporated. Residue can burn.

Advice for firefighters
Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. To extinguish combustible residues of this product use water fog, carbon dioxide, dry chemical or foam. Contain fire water run-off if possible. Fire water run-off, if not contained, may cause environmental damage. Review the "Accidental Release Measures" and the "Ecological Information" sections of this (M)SDS.

Special protective equipment for firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). Avoid contact with this material during fire fighting operations. If contact is likely, change to full chemical resistant fire fighting clothing with self-contained breathing apparatus. If this is not available, wear full chemical resistant clothing with self-contained breathing apparatus and fight fire from a remote location. For protective equipment in post-fire or non-fire clean-up situations, refer to the relevant sections.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures: Evacuate area. Keep upwind of spill. Ventilate area of leak or spill. Only trained and properly protected personnel must be involved in clean-up operations. Refer to section 7, Handling, for additional precautionary measures. Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.

Environmental precautions: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information. Spills or discharge to natural waterways is likely to kill aquatic organisms.

Methods and materials for containment and cleaning up: Avoid making contact with spilled material, glutaraldehyde will be absorbed by most shoes. Always wear the correct protective equipment, consisting of splashproof monogoggles, or both safety glasses with side shields and a wraparound full-face shield, appropriate gloves and protective clothing. A self-contained breathing apparatus or respirator and absorbents may be necessary, depending on the size of the spill and the adequacy of ventilation. Small spills: Wear the correct protective equipment and cover the liquid with absorbent material. Collect and seal the material and the dirt that has absorbed the spilled material in polyethylene bags and place in a drum for transit to an approved disposal site. Rinse away the remaining spilled material with water to reduce odor, and discharge the rinsate into a municipal or industrial sewer. Large spills: In case of nasal and respiratory irritation, vacate the room immediately. Personnel cleaning up should be trained and equipped with a self-contained breathing apparatus, or an officially approved or certified full-face respirator equipped with an organic vapor cartridge, gloves, and clothing impervious to glutaraldehyde, including rubber boots or shoe protection. Deactivate with sodium bisulfite (2-3 parts (by weight) per part of active substance glutaraldehyde), collect the neutralized liquid and place in a drum for transit to an approved disposal site.

7. HANDLING AND STORAGE

Precautions for safe handling: Do not spray or aerosolize the undiluted form of the product. Full personal protective equipment (including skin covering and full-face SCBA respirator) is required for dilutions or mixtures of the product used in a spray application.

Keep out of reach of children. Do not get in eyes, on skin, on clothing. Do not swallow. Avoid prolonged or repeated contact with skin. Avoid breathing vapor. Keep container closed. Use with adequate ventilation. Wear goggles, protective clothing and butyl or nitrile gloves. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

Conditions for safe storage: Do not store in: Aluminum. Carbon steel. Copper. Mild steel. Iron.

Storage stability
Shelf life: Use within 18 Month

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters
Exposure limits are listed below, if they exist.

Component	Regulation	Type of listing	Value/Notation
Glutaraldehyde	ACGIH	C	0.05 ppm
	ACGIH	C	DSEN, RSEN

Exposure controls
Engineering controls: Use engineering controls to maintain airborne level below exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, use only with adequate ventilation. Local exhaust ventilation may be necessary for some operations.

Individual protection measures

Eye/face protection: Use chemical goggles. If exposure causes eye discomfort, use a full-face respirator. Use a full-face respirator when material is heated or when aerosols/mists are generated. Eye wash fountain should be located in immediate work area.

Skin protection

Hand protection: Use gloves chemically resistant to this material. Examples of preferred glove barrier materials include: Butyl rubber. Examples of acceptable glove barrier materials include: Nitrile/butadiene rubber ("nitrile" or "NBR"). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

Other protection: Use protective clothing chemically resistant to this material. Selection of specific items such as face shield, boots, apron, or full body suit will depend on the task. Safety shower should be located in immediate work area. Use chemical protective clothing resistant to this material, when there is any possibility of skin contact. Remove contaminated clothing immediately, wash skin area with soap and water, and launder clothing before reuse or dispose of properly. Items which cannot be decontaminated, such as shoes, belts and watchbands, should be removed and disposed of properly.

Respiratory protection: Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required for certain operations, use an approved air-purifying respirator. This product is a respiratory irritant. If discomfort is experienced ventilation is not adequate and an approved full face air-purifying respirator is recommended. If vapors are strong enough to be irritating to the nose, or eyes, the OEL is probably being exceeded. Special ventilation or respiratory protection may be required. For operations such as spraying and other conditions such as emergencies where the exposure guideline may be greatly exceeded, use an approved positive-pressure self-contained breathing apparatus. For emergency response or for situations where the atmospheric level is unknown, use an approved positive-pressure self-contained breathing apparatus or positive-pressure air line with auxiliary self-contained air supply.

The following should be effective types of air-purifying respirators: Full-face Organic vapor cartridge with a particulate pre-filter.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	
Physical state	Liquid.
Color	Clear
Odor	Fruity
Odor Threshold	< 1 ppb *Literature*
pH	3.1 - 4.5 *ASTM E70*
Melting point/range	Not applicable to liquids
Freezing point	-7 °C (19 °F) *OECD Test Guideline 102*
Boiling point (760 mmHg)	100.7 °C (213.3 °F) *OECD Test Guideline 103*
Flash point	**closed cup** *ASTM D 56* None
Evaporation Rate (Butyl Acetate = 1)	0.8 *Calculated.*

Flammability (solid, gas)	Not applicable to liquids
Lower explosion limit	No test data available
Upper explosion limit	No test data available
Vapor Pressure	0.3 mmHg at 20 °C (68 °F) *OECD Test Guideline 104* Active ingredient
Relative Vapor Density (air = 1)	0.7 *Calculated.*
Relative Density (water = 1)	1.042 at 20 °C (68 °F) *OECD 109*
Water solubility	100 % at 20 °C (68 °F) *Calculated.*
Partition coefficient: n-octanol/water	no data available
Auto-ignition temperature	No test data available
Decomposition temperature	No test data available
Kinematic Viscosity	No test data available
Explosive properties	Not explosive
Oxidizing properties	No
Molecular weight	No test data available

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Reactivity: no data available

Chemical stability: Thermally stable at typical use temperatures.

Possibility of hazardous reactions: Polymerization will not occur.

Conditions to avoid: Active ingredient decomposes at elevated temperatures.

Incompatible materials: Avoid contact with: Amines. Ammonia. Strong acids. Strong bases. Strong oxidizers. Avoid contact with metals such as: Aluminum. Carbon steel. Copper. Iron. Mild steel.

Hazardous decomposition products: Decomposition products depend upon temperature, air supply and the presence of other materials.

11. TOXICOLOGICAL INFORMATION

Toxicological information on this product or its components appear in this section when such data is available.

Acute toxicity

Acute oral toxicity

Low toxicity if swallowed. Swallowing may result in irritation or burns of the mouth, throat, and gastrointestinal tract. Swallowing may result in gastrointestinal irritation or ulceration. Excessive exposure may cause: Headache. Dizziness. Anesthetic effects. Drowsiness. Unconsciousness. Other central nervous system effects.

Single dose oral LD50 has not been determined. Typical for this family of materials.
LD50, Rat, > 900 mg/kg

Acute dermal toxicity
Prolonged skin contact is unlikely to result in absorption of harmful amounts.

The dermal LD50 has not been determined. Typical for this family of materials.
LD50, Rabbit, > 16,000 mg/kg

Acute inhalation toxicity
Vapor from heated material or mist may cause serious adverse effects, even death. Vapor may cause severe irritation of the upper respiratory tract (nose and throat). Case reports and medical surveys link asthma and respiratory irritation to glutaraldehyde exposure, primarily in medical personnel. Asthma-like symptoms may include coughing, difficult breathing and a feeling of tightness in the chest. Occasionally, breathing difficulties may be life threatening. Asthma-like symptoms may occur in people prone to respiratory disorders or other allergies.
As product: The LC50 has not been determined.

Skin corrosion/irritation
Brief contact may cause skin burns. Symptoms may include pain, severe local redness and tissue damage.

Serious eye damage/eye irritation
May cause severe irritation with corneal injury which may result in permanent impairment of vision, even blindness. Chemical burns may occur.
Vapor may cause eye irritation experienced as mild discomfort and redness.

Sensitization
Skin contact may cause an allergic skin reaction in a small proportion of individuals.
Contains component(s) which have caused allergic skin sensitization in guinea pigs.
Contains component(s) which have demonstrated the potential for contact allergy in mice.

May cause allergic respiratory response in a small proportion of individuals.

Specific Target Organ Systemic Toxicity (Single Exposure)
May cause respiratory irritation.
Route of Exposure: Inhalation
Target Organs: Respiratory Tract

Specific Target Organ Systemic Toxicity (Repeated Exposure)
Repeated skin contact may result in absorption of amounts which could cause death.
May cause nausea and vomiting.

Carcinogenicity
In a NTP chronic 2-year inhalation study on glutaraldehyde, no carcinogenicity was seen in rats or in mice. An increase in large granular lymphocytes in Fischer rats dosed with glutaraldehyde for two years was random or a secondary carcinogenic effect due to a modifying influence on the occurrence of this common neoplasm in this rat strain.

Teratogenicity
For glutaraldehyde: Has been toxic to the fetus in laboratory animals at doses toxic to the mother. Did not cause birth defects in laboratory animals.

Reproductive toxicity
For glutaraldehyde: In animal studies, did not interfere with reproduction.

Mutagenicity
For glutaraldehyde: In vitro genetic toxicity studies were negative in some cases and positive in other cases. Animal genetic toxicity studies were predominantly negative.

Aspiration Hazard
Aspiration into the lungs may occur during ingestion or vomiting, causing tissue damage or lung injury.

COMPONENTS INFLUENCING TOXICOLOGY:

Glutaraldehyde

Acute inhalation toxicity
LC50, Rat, female, 4 Hour, dust/mist, 0.28 mg/l

LC50, Rat, male, 4 Hour, dust/mist, 0.35 mg/l

12. ECOLOGICAL INFORMATION

Ecotoxicological information on this product or its components appear in this section when such data is available.

Toxicity

Glutaraldehyde

Acute toxicity to fish
Material is highly toxic to aquatic organisms on an acute basis (LC50/EC50 between 0.1 and 1 mg/L in the most sensitive species tested).
LC50, Cyprinodon variegatus (sheepshead minnow), 96 Hour, 32 mg/l

Acute toxicity to aquatic invertebrates
LC50, copepod Acartia tonsa, semi-static test, 48 Hour, 3 mg/l

Acute toxicity to algae/aquatic plants
ErC50, Desmodesmus subspicatus (Scenedesmus subspicatus), 72 Hour, 0.6 mg/l
NOEC, Desmodesmus subspicatus (Scenedesmus subspicatus), 72 Hour, Growth rate inhibition, 0.025 mg/l

Toxicity to bacteria
EC50, activated sludge, > 50 mg/l, OECD 209 Test

Chronic toxicity to aquatic invertebrates
NOEC, water flea Daphnia magna, flow-through test, 21 d, number of offspring, 0.12 mg/l

Toxicity to Above Ground Organisms
Material is moderately toxic to birds on an acute basis (LD50 between 51 and 500 mg/kg).

Material is practically non-toxic to birds on a dietary basis (LC50 > 5000 ppm).
oral LD50, Anas platyrhynchos (Mallard duck), 408 - 466 mg/kg
dietary LC50, Colinus virginianus (Bobwhite quail), > 5,000 ppm
dietary LC50, Anas platyrhynchos (Mallard duck), > 5,000 ppm

Persistence and degradability

Glutaraldehyde

Biodegradability: 10-day Window: Pass
Biodegradation: 73 %
Exposure time: 9 d
Method: OECD Test Guideline 301A or Equivalent

Theoretical Oxygen Demand: 1.92 mg/mg

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	28 %
10 d	57 - 63 %

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 2.74 Hour
Method: Estimated.

Bioaccumulative potential

Glutaraldehyde

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): -0.333 Measured

Mobility in soil

Glutaraldehyde

Potential for mobility in soil is high (Koc between 50 and 150).
Given its very low Henry's constant, volatilization from natural bodies of water or moist soil is not expected to be an important fate process.
Partition coefficient(Koc): 120 - 500 Estimated.

13. DISPOSAL CONSIDERATIONS

Disposal methods: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. AS YOUR SUPPLIER, WE HAVE NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS

INTENDED CONDITION AS DESCRIBED IN MSDS SECTION: Composition Information. FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: Incinerator or other thermal destruction device.

14. TRANSPORT INFORMATION

DOT

Proper shipping name	Corrosive liquid, acidic, organic, n.o.s.(Glutaraldehyde)
UN number	UN 3265
Class	8
Packing group	III

Classification for SEA transport (IMO-IMDG):

Proper shipping name	CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.(Glutaraldehyde)
UN number	UN 3265
Class	8
Packing group	III
Marine pollutant	No
Transport in bulk according to Annex I or II of MARPOL 73/78 and the IBC or IGC Code	Consult IMO regulations before transporting ocean bulk

Classification for AIR transport (IATA/ICAO):

Proper shipping name	Corrosive liquid, acidic, organic, n.o.s.(Glutaraldehyde)
UN number	UN 3265
Class	8
Packing group	III

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. REGULATORY INFORMATION

OSHA Hazard Communication Standard
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312
Acute Health Hazard

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Pennsylvania Worker and Community Right-To-Know Act:
The following chemicals are listed because of the additional requirements of Pennsylvania law:

Components	**CASRN**
Glutaraldehyde	111-30-8

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)
This product contains no listed substances knownto the State of California to cause cancer, birth defects or other reproductive harm, at levels which would require a warning under the statute.

United States TSCA Inventory (TSCA)
This product contains chemical substance(s) exempt from U.S. EPA TSCA Inventory requirements. It is regulated as a pesticide subject to Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requirements.

Federal Insecticide, Fungicide and Rodenticide Act
EPA Registration Number: 464-693
This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

DANGER

Corrosive
Causes irreversible eye damage
Causes skin irritation
Harmful if inhaled
Harmful if swallowed
Harmful if absorbed through skin
Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
Causes asthmatic signs and symptoms in hyper-reactive individuals.
This pesticide is toxic to fish.

16. OTHER INFORMATION

Revision
Identification Number: 101225949 / A001 / Issue Date: 03/18/2015 / Version: 6.1
Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

Legend

ACGIH	USA. ACGIH Threshold Limit Values (TLV)
C	Ceiling limit
DSEN, RSEN	Skin and respiratory sensitizer

Information Source and References
This SDS is prepared by Product Regulatory Services and Hazard Communications Groups from information supplied by internal references within our company.

THE DOW CHEMICAL COMPANY urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.

Attachment D

Inspection and Maintenance Schedule and Forms

Condenser Maintenance Checklist

Task	Monthly (or as conditions warrant)
Inspect general condition of condenser unit.	●
Check for surface corrosion of metal parts; interior and exterior.	●
Inspect HX for leaks.	●
Inspect internal piping for leaks.	●
Inspect the recycle, blow down, condensate pumps for security, leaks, excessive noise or vibration, and excessive heat.	●
Inspect VLS tank sight gage for damage and transparency.	●
Inspect/clean metal filter in basket strainer coming from condensate VLS tank (**CAUTION: water may be hot!**)	●
If applicable, inspect drip system filters for clogging and filter housing for damage and leaks.	●
Inspect electrical connections for security.	●
With power off, inspect electrical cables and wiring for damage. Inspect condenser control, box for security/damage.	●

Cooling Tower/Holding Tank Maintenance Checklist

Procedure	Monthly	3 Months	6 Months
Inspect general condition of cooling towers.	●		
Check water level in holding tank water basin. Adjust as necessary.	●		
Check float switches and make-up valve for proper operation.	●		
Check belt tension and general condition of cooling tower V-belts.	●		
Check the line voltage and motor amperages	●		
Clean outside of cooling tower blower motors to help assure proper cooling.		●	
Lubricate blower bearings using a low pressure grease gun		●	
Check blower sheaves for dirt buildup that can cause unbalance and vibration.		●	
Inspect and clean (rinse off) the low-low, low, high and high-high level switches.		●	
Clean and flush holding tank.			●
Lubricate electric motors using a low-pressure grease gun.			●
Lubricate motor base and mounting adjusting screw.			●

Condenser System Inspection Form

Date:	**Inspector:**	**Equipment ID:**

Guidelines:

Before inspection is started – Is electrical power connected to the equipment? Y/N_____

If yes, is the equipment lockout in accordance with the TRS SOP 1-1? Y/N_____

Item	**Tightness**	**Signs of Wear/Heat Stress**	**Clean/ Dirty**	**Comments**
Condenser Control Panel				
Fuses firmly seated				
Fuse Continuity Checked				
Control Wiring				
Power Wiring				
Wired per drawings?				
Wall Mount Heaters				
Control Power Transformers				
Recycle Pump				
Condensate Pump				
Condensate Tank Level Controls				
Condensate Tank Site Glass				
Condensate Tank Thermostat				
Heat Exchanger				
Cooling Tower Control Panel Wiring				
Cooling Tower Power Wiring				
Cooling Tower – sediments/biofoul				
Cooling Tower Electrical cords				
Cooling Tower wet deck integrity				
Holding Tank TC and Thermostat				
Holding Tank Site Glass				
Level Switches				
Cooling Tower Motor				
Cooling Tower Fan & Belts				
PLC components				

Blower Maintenance Checklist

Item	Maintenance Frequency
Grease Bearings	Weekly (or every 168 hours)
Change Oil/Lube	8,000 hours
Inspect Filter	2,000 hours

Date:	
Technician:	
Equipment ID:	

	Y/N
Before initiating blower inspection: Is electrical power connected to the equipment?	
If yes, is the equipment locked out in accordance with the TRS SOP 1-1?	

Item Inspected	Tightness	Signs of Heat/Wear/Stress	Clean/Dirty	Satisfactory (Y/N)	Comments
Unit placed on a level and stable surface					
Enclosure Exterior					
Enclosure Interior					
Enclosure Cooling Fan					
Enclsoure Insulation					
Drive Belts (If applicable)					
Blower Motor Mounts					
Blower Motor Spin Check					
Blower Motor Greased?					
Blower Spin Check					
Blower Greased?					
Blower Oil/Lube Changed?					
Blower Mounts					
Pressure Relief Valve (PRV)					
Inlet Filter Housing					
Inlet Filter					
Dilution Air Filter Housing					
Dilution Air Filter					
Blower Silencer					
VR Blower Control Panel (Exterior)					
VR Blower Control Panel (Interior)					
VR Blower Control Panel Wiring					
VR Blower Control Panel Components					

VR/SVE SYSTEM <u>WEEKLY</u> INSPECTION FORM
PASCO LANDFILL NPL SITE

Item Inspected	Date: ____		Date: ____		Date: ____		Date: ____		Date: ____	
PLC and HMI										
Visual inspection of PLC display.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Walk through Operations Building - look for obvious signs of potential system failure.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
LEL Sensors										
Check the orientation of the flow sensors. Ensure flow sensors are oriented in the correct direction. Improper orientation will cause incorrect flow readings.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check for inconsistent LEL readings and recalibrate if yes.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check that the Hydrogen cylinder pressure within operational range.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Process Piping										
Check for leaking condensate from process piping joints, valves, etc., and from condensate piping, pumps, and/or tanks.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check for Obvious signs of degredation or wear.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check for Noise or odor from leaking vacuum or pressure lines.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Below-Grade Moisture Separator Tanks, Oil Water Separator, Pumps, and Tanks										
Check and listen to BGMS and diaphragm pumps, and flow totalizers air regulators and fittings for air leaks and slurping from the BGMS.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check below-grade moisture separator pump discharge lines, pumps, and flow totalizers for signs of leaking condensate.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check for longer than normal pumping times during operation of diaphragm pumps.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check that insulation of OWS is in good condition and water is not freezing during cold months.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check OWS coalescing media for plugging or deterioration.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check OWS for evidence of leaking from piping or body.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Air Compressor and Air Dryer										
Ensure that there is sufficient oil in the air compressor and positive displacement blowers.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check air supply hoses for signs of leaks, bulging, and excessive wear.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check solenoid valves for proper function.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check air compresser oil level (**daily** but not less than weekly).	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No

Inspector name: Date:

Inspector name: Date:

Inspector name: Date:

Inspector name: Date:

Inspector name: Date:

Comments