Norfolk Southern Railway Company

Operation, Monitoring, and Maintenance Plan – Wastewater Treatment System

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Operation, Monitoring, and Maintenance Plan – Wastewater Treatment System

August 2023

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Acronyms and Abbreviations

Arcadis	Arcadis U.S., Inc.
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CID	contained-in determination
DRO	diesel range organics
eV	electron volt
gpm	gallons per minute
GRO	gasoline range organics
HDPE	high-density polyethylene
HP	horsepower
lbs/day	pounds per day
LGAC	liquid-phase granular activated carbon
NSRC	Norfolk Southern Railway Company
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OM&M	operation, monitoring, and maintenance
OSR	Off-Site Rule
OWS	oil water separator
PID	photoionization detector
PLC	programmable logic controller
psi	pounds per square inch
RCRA	Resource Conservation and Recovery Act
TEFC	totally enclosed, fan-cooled
TPH	total petroleum hydrocarbons
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
V	volt
VFD	variable frequency drive
VGAC	vapor-phase granular activated carbon
VOC	volatile organic compound
WMP	waste management plan
µg/L	micrograms per liter

1 Overview

On behalf of Norfolk Southern Railway Company (NSRC), Arcadis U.S., Inc. (Arcadis) has prepared this Operation, Monitoring, and Maintenance (OM&M) Plan to document operation and maintenance of the wastewater treatment system at the NSRC East Palestine Derailment Site, in East Palestine, Ohio (Site; Figure 1). The system layout is presented on Figure 2. The purpose of the wastewater treatment system is to decrease the concentrations of vinyl chloride in wastewater collected from the derailment remediation areas to levels below risk-based standards so that a contained-in determination (CID) can be obtained by the Ohio Environmental Protection Agency (OEPA). A CID determination will allow the wastewater to be disposed of as a non-hazardous waste. To achieve this designation, the vinyl chloride concentrations in the treated effluent stream from the system must be below the Maximum Contaminant Level of 2 micrograms per liter (µg/L).

This OM&M Plan presents the standard OM&M procedures for the wastewater treatment system. A copy of this OM&M Plan will be available for review in the system building. This OM&M Plan will be updated as necessary to incorporate changes to system equipment and/or operating procedures.

For the purposes of the OM&M Plan, wastewater in the influent storage tanks and the influent stream from those tanks to the treatment system is considered untreated wastewater, and the effluent wastewater stream discharged by the system is considered treated wastewater.

2 Remedial Design and Treatment Components

2.1 Influent Wastewater Storage

Wastewater collected from the active soil remediation areas at the Site is stored within two one-million-gallon modular tanks located at Tank Farm 1 (see Figure 1). Most of the influent wastewater stream is pumped from sumps in drainage ditches/swales directly into the storage tanks. Some of the influent wastewater stream is also collected manually using vacuum trucks and unloaded into the tanks. Each tank is 70 feet in diameter and 36 feet tall with an individual capacity of 1,036,350 gallons when completely full with zero freeboard. At each tank, a valve was installed on the equalization connection pipe between the tanks. Each valve is kept closed and locked/tagged-out to reduce the potential for a release from both tanks at one time. Equalization is conducted periodically by a valve operator manually opening the valves on each tank. Wastewater is then pumped from the modular tanks to the treatment system.

Each tank currently has a maximum usable capacity of 680,000 gallons. The tanks are operated such that pumping into the tanks is suspended prior to reaching the 600,000-gallon level (15.2 feet of freeboard). In the event the operational level of 600,000 gallons is exceeded, a high-level sensor visually alarm, indicating to onsite staff to turn off all pumps that pump wastewater into the tanks. If the 600,000-gallon alarm fails to operate, an audible alarm will sound at 680,000 gallons (12.4 feet of freeboard). During a high-level alarm condition, wastewater from the tanks will continue to be sent to the wastewater treatment system and may also be trucked offsite if needed. Once water levels recede to below 600,000 gallons, pumping of wastewater into the tanks will resume.

Following planned modifications to the secondary containment system (e.g., installation of longer sheet piling around the secondary containment area), the maximum usable capacity in each tank will be increased to

950,000 gallons, which will reserve 3 feet of freeboard. At that time, the alarm float settings will be adjusted to the maximum operational capacity of 950,000 gallons (3 feet of freeboard) and the manufacturer's maximum recommended water level of 993,600 gallons (1.5 feet of freeboard).

The two tanks are installed within a single secondary containment consisting of an impermeable 120-mil linear low-density polyethylene liner, steel sheet piles, and earthen berms. The total volume of available secondary containment is 1,170,500 gallons, which provides for approximately 8 inches of freeboard.

2.2 Wastewater Treatment System

The wastewater treatment system consists of two main processes: a sediment pretreatment process, which removes particulates from the sediment-laden influent wastewater stream, and a chemical treatment process, which removes vinyl chloride and other volatile organic compounds (VOCs) from the wastewater.

2.2.1 Sediment Pretreatment

A transfer pump conveys wastewater from the modular tanks below grade under the truck unloading area immediately north of the modular tank to the pretreatment system. The pretreatment system includes the following process equipment:

- A flocculation tank – gravity feeds wastewater from the storage tanks to the clarifier.
- A chemical aided settling system – installed at the flocculation tank using Lockwood Remedial Technologies E50 coagulant and 9911 anionic polymer.
- A clarifier – for bulk sediment removal.
- A decanter centrifuge – to remove fine particles from the clarifier. Wastewater is decanted from the clarifier through the centrifuge and then discharged back to the flocculation tank.
- Sand filters – installed after the centrifugal pump before the treatment building to remove residual solids from the system.
- Bag filters – installed after the sand filters before the treatment building to remove residual solids from the system. The skid contains a total of eight filter housings arranged into four parallel sets of two bag filters in series.

The pretreatment system layout is shown on Figure 2. A piping and instrumentation diagram for the pretreatment system is provided on Figure 3. Other vendor-provided figures for the system are included in Appendix A.

The pretreatment equipment configuration may be modified after the system is placed online to optimize the sediment removal process. This is discussed further in Section 8, Contingency Modifications and Updates.

2.2.2 Chemical Treatment

The chemical treatment system is designed to remove vinyl chloride and other VOCs from the wastewater stream and includes the following process equipment:

- Oil water separator (OWS) – contingency in case of entrained product in the wastewater stream.
- Sediment bag filters – to remove particulates from the wastewater treatment stream and reduce total suspended solids.

- Organoclay vessels – installed upstream from the air stripper as a precaution to remove any residual product sheens that bypass the OWS.
- Air stripper – primary treatment process for vinyl chloride.
- Liquid-phase granular activated carbon (LGAC) vessels – installed downstream from the air stripper as a secondary contingency VOC treatment process.
- Air stripper off-gas treatment components consisting of:
  - Vapor-phase granular activated carbon (VGAC) – to remove VOCs and reduce consumption of potassium permanganate-impregnated media downstream; and
  - Potassium permanganate-impregnated media (HS600) installed downstream from VGAC to remove vinyl chloride from the vapor stream, which does not readily adsorb to carbon.

The treatment system layout is provided on Figure 2. Piping and instrumentation diagrams for the system are provided as Figures 4 through 7. Other vendor-provided figures for the system are included in Appendix A.

The treatment equipment configuration may be modified at some point after the system is placed online if warranted to optimize performance. A second chemical treatment system with the same or similar process equipment may also be installed at the Site to provide redundancy and limit downtime. The tentative layout of the potential duplicate system equipment is shown on Figure 2. These modifications would be made with concurrence from the United States Environmental Protection Agency (USEPA)/OEPA.

2.3 Treated Effluent Storage

As shown on Figure 1, treated effluent from the wastewater treatment system is pumped to storage tanks located within the CID Tank Farm northeast of the wastewater treatment system area, through an above-grade 6-inch high-density polyethylene (HDPE) line housed within a 10-inch HDPE carrier pipe for secondary containment. Treated wastewater will be managed in batches, with one batch corresponding to the daily volume of treated effluent produced by the wastewater treatment system (approximately 144,000 gallons). Each batch of treated effluent will be housed in a CID tank with sufficient capacity to accommodate the entire batch volume. There are a total of six CID tanks, which provide a total storage capacity for up to six days of operation. The effluent discharge line is manifolded at the tank farm with valves that will allow the tanks to be filled and emptied individually.

Each tank is equipped with a high-level switch that will signal the wastewater treatment system to shut down to prevent a potential overflow if activated. A level transducer is deployed in the tank that is actively filling so field personnel can monitor the water level in that tank from the ground.

The CID tanks are situated within secondary containment consisting of a 60-mil HDPE liner and berm. The containment area is sized to hold the volume of one batch of treated effluent and the precipitation from a 25-year, 24-hour rainfall event (3.96 inches). Rainwater that collects within the containment area is removed and discharged into the one-million-gallon modular tanks either by pumping through a dedicated above-grade line (6-inch HDPE with 10-inch HDPE containment pipe) or by vac trucks.

3 Treatment Equipment Specifications

A summary of treatment system equipment specifications is presented below. Manuals and cut sheets for specific equipment and the vendor-provided operating manual for the chemical treatment system are included in Appendix B.

Sediment Pretreatment Process Equipment

- System influent transfer pump (P100)
  - Godwin CD100S centrifugal pump.
  - 20 horsepower (HP), 480 volt (V), 3 phase totally enclosed, fan-cooled (TEFC) motor.
  - Capable of operating at a range of speeds using a variable frequency drive (VFD).
  - Transducer for P100 controls system process flow.
  - Oversized to provide flexibility in preparation for changing conditions.
  - Expected operating flow: 100 gallons per minute (gpm).
- Flocculation Tank
  - Lockwood Remediation Technologies LLC.
  - 200-gpm maximum flow rating.
  - Maximum capacity of 10,000 gallons.
- Clarifier
  - Lockwood Remediation Technologies LLC.
  - 200-gpm maximum flow rating.
  - Maximum capacity of 18,000 gallons.
- Centrifuge
  - Alfa Laval LYNX 500.
  - 660-gpm maximum flow rating.
  - Maximum speed of 3,250 revolutions per minute.
- Centrifuge Transfer Pump (P600)
  - Gorman-Rupp T3A3-B self-priming centrifugal pump.
  - 5 HP, 480V, 3 phase TEFC motor.
  - Capable of operating at a range of speeds using a VFD.
  - Operating flow: 20 gpm.
- Sand Filters
  - Rain for Rent Model 48-2SSK.
  - 425-gpm maximum flow rating.
  - Two 2,000-pound vessels connected in series.
- Triple Bag Filter Housings
  - Trade Size 2-Triple bag filter housing.

  - Three units total with varying filter sizes: 100-micron filter upstream from OWS, 50-micron upstream from air stripper, and 20-micron upstream from LGAC units.
  - Bag filter housings are rated for a maximum operating pressure of 150 pounds per square inch (psi).
- Clarifier Effluent Pump (P800A, P800B)
  - Goulds 3656 centrifugal pump.
  - Capable of producing 100 gpm at 115 feet of total dynamic head (TDH) during normal operation. To be operated as alternating pumps.
  - 5 HP, 480V, 3 phase TEFC motor.
  - Expected operating flow: 115 gpm.

Chemical Treatment Process Equipment

- OWS
  - MK Environmental OWS Model C100.
  - Maximum flow capacity of 100 gpm.
- Organo Clay Vessels (T202 and T203)
  - Tetrasolv HPAF-3000 vessels.
  - 120-gpm maximum flow rating.
  - Two 5,000-pound vessels connected in series.
- Low Profile Air Stripper
  - NEEP Model 2651 6-tray air stripper.
  - Stainless steel shallow tray model.
  - Estimated 99.95% vinyl chloride removal efficiency for influent vinyl chloride concentration of 12 µg/L at process flow of 100 gpm and air flow rate of 600 cubic feet per minute (cfm).
- Air Stripper Blower
  - Tuthill CP Series Model 5009 rotary positive displacement lobe blower.
  - 40 HP, 480V, 3 phase TEFC motor.
  - 600 cfm design air flow rate (maximum of 773 cfm).
- Air Stripper Blower Knockout Tank (T400)
  - MK Environmental Model KO200.
  - Protects blower by removing moisture from the from the air stripper off-gas stream.
  - Maximum capacity of 200 gallons.
- LGAC Vessels (T300 and T301)
  - Tetrasolv HPAF-3000 vessels.
  - 120-gpm maximum flow rating.
  - Two 3,000-pound vessels connected in series.
- VGAC Vessels (T401 and T402)
  - MK Environmental Model VF3000.
  - Two 3,000-pound vessels connected in series.

  - Two additional spare vessels (T403 and T404) are staged with the system if media changeout required.
- HS-600 Potassium Permanganate Impregnated Media Vessels (T405 and T406)
  - US Filter VS3000.
  - Two 6,700-pound vessels connected in series.
  - One additional 6,700-pound VS3000 vessel (T407) and one additional 4,000-pound HS400 Tetrasolv VF2000 model vessel (T408) are staged with the system as spares if media changeout required.
  - Three VS3000 vessels are housed on a single equipment skid. The HS400 vessel is stand-alone.
- Chemical Treatment System Transfer Pumps
  - OWS (P200) and Air Stripper (P300) Transfer Pumps
    - Myers 200M centrifugal pump.
    - 7.5 HP, 480V, 3 phase TEFC motor.
    - Capable of producing 100 gpm at 130 feet of dynamic head (56 psi).
    - Oversized to overcome backpressure created by fouling in bag filters.
    - Pump equipped with VFD that will adjust flow rate automatically based on influent flow to the system.
    - Design flow: 100 gpm.
  - Knockout Tank Transfer Pump (P400)
    - Myers CT10 high pressure centrifugal pump.
    - 1.5 HP, 480V, 3 phase TEFC motor.
    - Capable of producing 40 gpm at 60 feet of head.
    - Expected operating flow: 20-60 gpm.

4 System Controls, Recording Devices, and Power Requirements

4.1 Power Requirements

The electrical requirements for this system are three-phase, 277/480V, TEFC motors. Due to the presence of the air stripper operation inside the system enclosure, the treatment enclosure is classified as a Class I Division II environment. All electric work conforms to the National Electric Code and applicable state and local codes. Only National Fire Protection Association (NFPA) 70E trained persons or designated electricians will be permitted to open the main control panel or other electrical-containing equipment, other than the VFD panel, when the system has power from the generator. Preliminary electrical one line drawings for the system are provided as Figures 8, 9, and 10. Additional vendor-provided wiring diagrams and control schematics for the chemical treatment system are included in Appendix A. System power is supplied by an onsite generator. There are two generators onsite to provide redundancy and allow for maintenance to occur with minimal system downtime. Service of the generators will be completed by the vendor, Sunbelt Rental, every 300 hours of generator run time.

Fueling of the generators will be completed onsite as needed by Allison Contracting using a fuel truck until an automated refill tank can be placed for use.

4.2 System Controls

The treatment system is equipped with a relay-based control panel that will control the system equipment operations and act as a fail-safe device deactivating the system in the event of an alarm condition. The control panel interface uses physical hand-off-auto control switches for the pumps and blower, a momentary push reset button, and an emergency stop. During normal operation with no system alarms, the control panel allows the operation of the following:

- Transfer pump P100.
- Transfer pumps P200 and P300 VFDs.
- Knockout tank transfer pump P400.
- Air stripper blower VFD.
- System influent solenoid valve.
- Chemical dosing pump P500.
- Centrifuge transfer pump P600.
- Clarifier effluent pump P800A/B.

Any alarm condition will disable the system and notify the operator. If any component is in alarm mode, no system component will run except by manual control to clear the alarm. In the event of a system alarm or power loss, all pumps will stop running and the solenoid valve on the system influent line will shut. See Appendix C for the detailed alarm schedule and subsequent troubleshooting guides. System alarms are on a 30-second delay to reduce the incidence of false alarms.

The overall system flow rate is controlled by the influent flow to the system. The flow rate to the clarifier is controlled by manually adjusting the speed using the VFD on the P100 control panel and a level transducer. Two flow streams exit the clarifier. Clarifier effluent is pumped by P800A/B through sand filters and bag filters to the OWS. Operation of this pump is controlled by level switches in the effluent chamber of the clarifier. As P800A/B is single speed only, flow from this pump can be controlled by closing a valve and monitoring the flow rate at FI800.

Sludge is pumped using P600 to the centrifuge. Flow from this pump is controlled using a VFD. Solids that are dewatered by the centrifuge are allowed to fall into a roll-off beneath the centrifuge stand. Wastewater separated from the centrifuge solids will gravity drain back to the clarifier.

Transfer pumps P200 and P300 are controlled by VFDs. The transfer pump VFDs are set to maintain a constant level in their associated tanks using a level transmitter up to the system design maximum flow rate of 100 gpm (i.e., air stripper transfer pump P300 uses a level transducer located in the sump of the air stripper). Flow rates throughout the system will be balanced for a flow rate of 100 gpm or less. Knockout tank transfer pump P400 will use level switches for activation and discharge to the OWS.

If additional adjustments are required to balance the system by adjusting VFD set points, the system engineer will be contacted for further instructions. Normal onsite adjustments should only require adjustment of the butterfly valve at P100, and adjustment for the controls for the chemical dosing pump (P500) and sludge pump (P600).

The treated effluent CID tanks are equipped with high-level switches that will shut down the treatment system if actuated to prevent a potential tank overflow. Emergency stop (E-stop) buttons are located on the main system control panel and at the treated effluent tank farm that will shut down the system if actuated.

4.3 System Telemetry and Recording

The system is equipped with telemetry that will notify Site operation and maintenance personnel in the event of an alarm condition, which shuts down the system operation. The telemetry consists of an Allen Bradley programmable logic controller (PLC) and a cellular internet modem, which can send system alarm notifications by text or email. The PLC will maintain a log of system alarms, pump run times, blower run time, and system flow totals for use with the telemetry system. The telemetry system is the primary way to determine what alarm occurred to shut down the system for troubleshooting. The telemetry system will send out nightly status emails and monthly summaries of system operation. All regular system status and summary emails will be memorialized on a weekly basis and saved to a system monitoring folder. System status emails will be composed of alarm logs, pump run times, the blower run time, and system flow totals.

4.3.1 Remote Connection Procedure

The telemetry system interface can be viewed remotely using any web browser. Every user that requires access to the system telemetry will receive their own username and password. Users can access the telemetry by going to https://mkenvsos.com. Users will be prompted to log in and once they are logged in, they will be able to view data for the Site. An example of the telemetry interface is included in Appendix D.

System personnel can be added to and removed from the telemetry system by contacting the system vendor.

5 System Permitting

Treated off-gas from the air stripper will be discharged to the atmosphere under either an air permit from OEPA, or an emergency air permitting exemption letter from the OEPA director. A copy of the air permit or exemption letter will be included in Appendix E once it has been issued by OEPA, along with any applicable backup documentation. Treatment of wastewater by the system is not allowed until this permit or exemption letter is in place. Proposed system air monitoring/sampling requirements are detailed in Section 6. These will be updated as necessary to match the sampling requirements specified in the final air permit or exemption letter issued by OEPA.

System generators are 100-kilowat/125-kilovolt-amp diesel power generators. The engines are considered portable engines that meet the definition of a non-road engine as defined in Ohio Administrative Code (OAC) 3745-31-01(CCCC) and OAC 3745-31-01(CCCC)(1)(c). Non-road engines are exempt from permitting under OAC 3745-31-03(B)(1)(qq). Per the definition of a non-road engine, the generator will be considered a stationary source if it remains in the same location for more than 12 consecutive months. Thus, if it appears that the wastewater treatment system will operate for more than 12 months, a permit-to-install will be secured for the generators, or the generators will be replaced by a power drop from the local electric utility.

6 Operation and Maintenance

6.1 Initial System Startup and Startup After Extended Deactivation

Initial system startup procedures are detailed in the System Startup Checklist, which is included as Appendix F. Upon completion of initial system startup, the completed checklist shall be sent to the supervising engineer and the original included with the hard copy of this OM&M Plan that is kept with the system onsite.

Portions of the System Startup Checklist should also be completed upon restarting the system after an extended period of deactivation. The supervising engineer will be consulted to determine the steps that should be followed in this situation.

6.2 System Restart Procedure

In the event of the activation of a failsafe, the system will shut down. An alarm notification will be transmitted to parties listed in the alarm notification program. Personnel will respond to the system to troubleshoot the cause of the alarm and complete required activities to rectify the issue causing the alarm. If required, system engineer or engineering support should be contacted to discuss the issue prior to system correction and restart. Once the cause of the alarm has been identified and resolved, the alarm will be cleared by depressing the reset button, and the system will then restart in normal operation. Potential alarm conditions, probable causes, and troubleshooting are listed in Appendix C**.**

System alarms will be communicated to staff through the telemetry system, and by alarm notification lights shown on the bottom left of the control panel.

6.3 OM&M Inspections

System OM&M inspections will be completed daily, with sampling/monitoring performed at the frequency specified in Exhibit 1 below. This schedule may be adjusted as necessary based on system performance and in consultation with USEPA/OEPA and the supervising engineer. More frequent monitoring of system operations may also be required to comply with other regulations/requirements for unloading and loading of untreated wastewater and treated effluent wastewater from storage tanks.

During each OM&M inspection, system operational readings such as pressures, treatment flow rates, and air stripper effluent exhaust VOC concentrations will be recorded on a log sheet, to be maintained in this OM&M Plan. A copy of the system OM&M field log sheet is provided in Appendix G.

6.4 Preventative Maintenance

Preventative maintenance will be performed in accordance with manufacturer/vendor recommendations. Routine monitoring and preventative maintenance activities to be performed on system equipment are listed in Table 1**.** Additional equipment maintenance procedures/details are provided in Appendix G.

6.5 Spill Prevention, Control, and Countermeasure

All wastewater-containing (treated and untreated) treatment system equipment is secondarily contained for spill contingency purposes. The chemical treatment system building, which houses the air stripper, OWS, and bag filters, is designed with a containment lip surrounding the floor to hold 110% of the capacity of the largest wastewater-containing vessel inside the building. The building is equipped with a floor sump with a high-level switch that will trigger a system shutdown alarm if activated. The remaining wastewater-containing treatment system equipment and process vessels are situated within an above-grade secondary containment berm constructed on an impermeable 60-mil HDPE liner sized to contain 110% of the volume of the largest vessel in the containment. The containment area is equipped with a high-level switch that will trigger a system shutdown alarm if activated. The surrounding area is 9-inch-thick asphalt pavement, which is sloped to direct wastewater that accumulates on the pavement into two catch basins. Wastewater that accumulates in the catch basins will be removed by a pump or by a vac truck and discharged into the modular tanks for subsequent treatment. All wastewater conveyance piping not located within the system staging area is double walled, including the piping that will transfer the treated effluent from the system to the CID Tank Farm. System equipment will be inspected daily for leaks. A spill kit sized for 20 gallons will remain onsite for use in the event it is required.

6.6 Wastewater Treatment Sampling and Monitoring

Samples will be collected for laboratory analysis from the system wastewater treatment stream as specified in Exhibit 1 below for the first week of wastewater treatment operations. During this initial one-week operating period, all analyses will be performed on a 24-hour turnaround, or the fastest turnaround available from the receiving laboratory.

Exhibit 1. Initial Wastewater Treatment Sampling Plan

Location	Frequency	Analyses
OWS effluent[(1)] (SP200)	6 samples daily (1 every 4 hours)	Vinyl chloride (8260D)
	Daily	VOCs + butyl acrylate (8260D) TSS (2540D) TPH GRO/DRO (8015D)
Organo clay midfluent (SP202A)	Daily	VOCs + butyl acrylate (8260D) TSS (2540D) TPH GRO/DRO (8015D) Total RCRA metals (via SW-846 Methods 6010/7471)
Air stripper influent (SP203A)	6 samples daily (1 every 4 hours)	Vinyl chloride (8260D)
	Daily	VOCs + butyl acrylate (8260D) TSS (2540D) TPH GRO/DRO (8015D)
Air stripper effluent (SP300)	6 samples daily (1 every 4 hours)	Vinyl chloride (8260D)
	Daily	VOCs + butyl acrylate (8260D) TSS (2540D) TPH GRO/DRO (8015D)

Location	Frequency	Analyses
LGAC midfluent (SP304A)	6 samples daily (1 every 4 hours)	Vinyl chloride (8260D)
	Daily	VOCs + butyl acrylate (8260D) TSS (2540D) TPH GRO/DRO (8015D)
LGAC effluent (SP306)	6 samples daily (1 every 4 hours)	Vinyl chloride (8260D)
	Daily	VOCs + butyl acrylate (8260D) TPH GRO/DRO (8015D)
Treated effluent storage tank (SP900)	Daily	Vinyl chloride (8260D) Total RCRA metals (via SW-846 Methods 6010/7471)
Clarifier effluent (SP800)	Daily – first week of operation	TSS (2540D) Total RCRA metals (via SW-846 Methods 6010/7471)
	Weekly – after first week	
Wastewater treatment system influent (SP100)	Once at startup	TSS (2540D) TPH GRO/DRO (8015D)
	Daily	VOCs + butyl acrylate (8260D)
	Daily – first week of operation	TSS (2540D) Total RCRA metals (via SW-846 Methods 6010/7471)
	Weekly – after first week	

Notes:
(1) OWS effluent sample represents influent wastewater quality to chemical treatment system.
(2) Samples collected from sample port (SP) locations shown on Figures 3, 4, 5 and 6.
DRO – diesel range organics; GRO – gasoline range organics; TPH – total petroleum hydrocarbons; TSS – total suspended solids

Procedures for collecting system wastewater samples for laboratory analysis are provided in Appendix H.

Field measurements of pH and turbidity will also be collected from the following locations periodically during system startup and subsequent continuous operations to evaluate sediment pretreatment equipment performance:

- Wastewater treatment system influent (SP100), and
- Clarifier effluent (SP800).

After the first week of wastewater treatment, the sample results (excluding TSS) will be reviewed with USEPA/OEPA and a modified sampling plan with reduced sampling frequency will be developed that meets the approval of both agencies. This modified sampling plan will be incorporated into this OM&M Plan as a revision.

Total VOC sample results from wastewater treatment system influent port SP-100 will be used confirm that potential VOC emissions from the two open-top influent storage tanks are not exceeding the OEPA air emissions de minimis limit of 10 pounds per day (lbs/day). The total VOC concentration will be calculated for each sample specified in CID Quality Assurance Project Plan Worksheet #11-B. The resulting total VOC concentration will be compared to the threshold total VOC concentration of 41.72 milligrams per liter, which, based on air emissions modeling performed on the two influent storage tanks, is the maximum concentration at which VOC air emissions from the tanks will remain below the OEPA de minimis limit of 10 lbs/day. If sample results indicate that VOC emissions from the tanks could exceed 10 lbs/day, NSRC will notify EPA/OEPA to discuss additional actions that

may be necessary, which may include additional air modeling, submission of a permit exemption request, or a substantively compliant permit approval.

Total VOC sample results from wastewater treatment system influent port SP-100 will also be monitored to confirm that concentrations do not exceed the 10 parts per million by weight threshold specified for process vents associated with air stripping operations that manage hazardous wastes under the Organic Air Emission Standards in 40 Code of Federal Regulations (CFR) Parts 264 and 265, Subpart AA. If the total VOC concentration detected at SP-100 should exceed 10 parts per million by weight, the air stripper emissions would no longer be exempt from the conditions of Subpart AA, and NSRC will notify EPA/OEPA to discuss potential corrective actions.

6.7 Air Emissions Sampling and Monitoring

Air grab samples will be collected in SUMMA canisters, or using a comparable method, from the locations and at the frequency specified in Exhibit 2 below and analyzed for VOCs using method TO-15. Influent and effluent concentrations will be used to calculate uncontrolled and controlled emission rates and to verify the control efficiency of the VGAC and potassium permanganate.

Air sampling data will be used to evaluate the performance of system vapor treatment process equipment and to confirm that this equipment is attaining a 95% removal efficiency for VOCs, as well as that total VOC emissions from the system vapor treatment process do not exceed the 10 lbs/day de minimis threshold limit specified in OAC 3745-15-05.

The sampling frequency will gradually be decreased after the first week of wastewater treatment operations once the system vapor emission rates and media removal efficiencies are confirmed.

In addition to the roaming realtime air monitoring using handheld instrumentation in the community and the mobile laboratory route encompassing the work area, an additional AreaRAE has been set up on the work area perimeter and an additional analytical air sampling location has been set up in the community. The AreaRAE continuously monitors for VOCs and takes a reading every 15 seconds. The new AreaRAE location can be seen in Figure 12 as AR20. The analytical station is comprised of an evacuated canister that is analyzed for TO-15 + TICs and a passive dosimeter badge that is analyzed for butyl acrylate. The location of the additional analytical sample is identified as MC20 in Figure 13.

Exhibit 2. Vapor Treatment Sampling Plan

Location	Frequency	Method
First week of operation		
Air stripper effluent (SP403) VGAC midfluent (SP404) VGAC effluent (SP405) HS-600 midfluent (SP406) HS-600 effluent (SP408)	Daily	VOCs (TO-15)
First month of operation		
Air stripper effluent (SP403) VGAC midfluent (SP404) VGAC effluent (SP405) HS-600 midfluent (SP406) HS-600 effluent (SP408)	Weekly	VOCs (TO-15)
Remainder of operation		
Air stripper effluent (SP403) VGAC midfluent (SP404) VGAC effluent (SP405) HS-600 midfluent (SP406) HS-600 effluent (SP408)	Biweekly	VOCs (TO-15)

Notes:
(1) Vapor samples will be collected at the frequency described above during periods the system is treating wastewater in a state of normal operation. There may be instances where the system is not operating or has not operated for an extended period. In such instances, vapor samples should be collected soon after starting and then the normal sampling frequency should continue. Similarly, the initial wet testing of the system following completion of construction will be performed using clean potable water, not untreated wastewater collected from the Site, and thus air samples will not be collected during the wet testing period.
(2) Frequency of sampling may be adjusted pending results and follow-up with OEPA/USEPA.
(3) Samples collected from sample port (SP) locations shown on Figures 3, 4, 5, and 6.

Procedures for collecting system air samples are provided in Appendix H.

Handheld photoionization detectors (PIDs) will be utilized to monitor for breakthrough of the activated carbon and potassium permanganate vapor control devices. The PID meter will have at a minimum a 10.6-electron-volt (eV) lamp to detect vinyl chloride, which has an ionization potential of 9.99 eV. PID readings will be measured daily from the following locations for the first three months of operation. After the first three months, monitoring frequency may be reduced to weekly.

- Air stripper effluent (SP403).
- VGAC midfluent (SP404).
- VGAC effluent (SP405).
- HS-600 midfluent (SP406).
- HS-600 effluent (SP408).

The VGAC midfluent and VGAC effluent monitoring points will be used to determine breakthrough of the carbon canisters. The HS600 midfluent and HS600 effluent monitoring points will be used to determine breakthrough of the potassium permanganate canisters. When breakthrough is detected, media vessels will be changed out in a timely manner.

6.8 System Waste Management

Several waste streams will be generated during routine treatment system operation and maintenance activities. Non-media solid wastes, including but not limited to carbon, filter socks, used bag filters, and cleaning fluids, and solids generated as a result of operating the onsite treatment system (OM&M waste) will be characterized as U043 listed hazardous wastes. Non-media wastes will also be evaluated for characteristics of a hazardous waste, in particular RCRA metals. Current sampling, characterization, and disposal of waste are documented in the NSRC East Palestine Waste Management Plan (WMP), which was approved on April 18, 2023 by USEPA. The proposed waste streams that will be generated by treatment system operation and maintenance are summarized below along with a brief description of the onsite storage requirements. Additional details regarding the onsite management of waste is provided in the WMP. System operations personnel should contact the waste management coordinator to verify compliance with onsite storage in temporary units and containers and to arrange for sampling and disposal. Unified Command will be notified prior to establishment of any new temporary waste management units. All temporary waste units must be appropriately labeled in accordance with the WMP.

All hazardous wastes will require disposal at a Resource Conservation and Recovery Act (RCRA) permitted facility. Prior to offsite disposal of any wastes, the notification requirements in Paragraph 46.b of the Unilateral Administrative Order for Removal Actions will be completed in addition to any notifications NSRC has committed to. Currently Comprehensive Environmental Response, Compensation, and Liability Act Off-Site Rule (OSR) notification is being handled by USEPA. NSRC will provide USEPA with the names, addresses, and USEPA IDs of any proposed disposal facilities and will not ship waste offsite until USEPA OSR approval is received.

Dewatered Sediment

Dewatered sediment from the centrifuge will accumulate in a roll-off container located adjacent to the centrifuge. The roll-off container will be secondarily contained and inspected daily. The dewatered sediment will be characterized as a U043 listed hazardous waste and will be sampled to verify that the waste does not meet criteria of a RCRA characteristic hazardous waste or a Toxic Substances Control Act regulated waste. When the roll-off is half full, field personnel will contact the waste management coordinator to schedule sampling. The roll-off changeout will be scheduled with sufficient lead time to avoid unnecessary system shutdown due to a full container.

Spent Carbon Media

Spent carbon will be removed from vessels by a vac truck and placed into drums or supersacks. These will be staged temporarily within secondary containment within the secure system area pending USEPA approval for offsite disposition or recycling. Spent carbon may be disposed of or recycled as U043 listed hazardous waste.

Spent Organo Clay and Potassium Permanganate Impregnated Media

Spent organo clay and potassium permanganate impregnated media will be removed from vessels by a vac truck and placed into drums or supersacks, which will be staged temporarily within secondary containment within the secure system area pending USEPA approval for offsite disposition as a U043 listed hazardous waste.

Spent Bag Filters

Spent bag filters will be placed in 55-gallon United States Department of Transportation hazardous storage drums, which will be staged temporarily on secondary containment in the system area. Absorbent materials may be added before or when hazardous waste first starts to accumulate in a container [40 CFR 270.1(c)(2)(vii)]. Adding absorbent materials to hazardous waste collection containers minimizes or eliminates the amount of free liquids that could leak or spill from the collection container. Full drums will be removed periodically and transported to the central drum accumulation area prior to disposition as a U043 listed hazardous waste. Drums will be labeled and will be inspected weekly.

Solids from Air Stripper Cleaning

Residual solids from air stripper cleaning will be managed as U043 listed hazardous waste. If water is used to clean the air stripper, it should be containerized in drums and allowed to sit so the entrained solids will settle to the bottom. Once the solids have settled, the wastewater will be decanted from the solids to the extent possible/practical and transferred into the hazardous wastewater storage tanks.

6.9 Effluent Tank(s) Decontamination Process

If analytical results from a daily batch show vinyl chloride concentration above the Maximum Contaminant Level (2 ug/L), the treated wastewater will be managed as U043 wastewater and will be placed back into the H-24 and H-25 so it can be retreated, or it will be transported offsite for disposal as a U043 hazardous waste. The CID (effluent) tank that held the batch of treated wastewater containing exceedances of the Maximum Contaminant Level will be completely drained, and the liner will be rinsed with clean water before the tank can be reused for the treated wastewater. Rinse water from the cleaning of the tank will be consolidated with the other “decontamination water” and managed as a U043 waste for offsite disposal.

6.10 System Suppliers, Vendors, Subcontractors

Exhibit 3. System Vendors

Item	Lead Time	Vendor
Telemetry Updates	1 Day	MKE – Ed Tung and Jeremiah Horne Email – ETung@mkenv.com, JHorne@mkenv.com
Bag Filters	5 days	Barron Filtration Inc. Phone: (724) 223-0299
Carbon	2 Weeks	MKE – Ed Tung Phone – (847) 778-3213
HS6000	2 Weeks	MKE – Ed Tung Phone – (847) 778-3213
Sand Filters		Rain for Rent – Jeremy Sims Email – JSIMS@rainforrent.com
Clarifier / Chemical Injection System		Lockwood Remediation Technologies – Mike Deso Email – mdeso@LRT-llc.net
Centrifuge and Accessories		Xylem – Travis Staib Email – travis.staib@xylem.com
Generator and Accessories	1 Week	Sunbelt Rental – Evan Myers Phone – (303) 471-3699 Alternate Phone – (330) 650-1874
Fuel – Generator	1 Day	Allison Contracting – Noah Allison Phone – (330) 383-0481
Laboratory – Wastewater	4 Days	Eurofins (Canton, OH) – Michael DelMonico Phone – (330) 966-9783
Laboratory – Air	10 Days(1)	Eurofins (Folsom, CA) – Jade White Phone – (800) 985-5955

Note:
(1) Due to the high demand for SUMMA canisters, laboratories often have difficulty filling orders; therefore, the more lead time provided to the laboratory the better.

7 Alarm and Emergency Response

In the event that an alarm is triggered, the system should be shut down and the engineer on call should be contacted to help troubleshoot. If the situation feels unsafe, the engineer on call should be contacted immediately.

In the event an emergency occurs, including a spill, the Operations Section Site Remediation Command, Waste Chief, and System Engineer should be notified immediately of the discovery by onsite personnel. The Operations

Section Chief will notify Unified Command within 30 minutes of notification. The contact information is listed in Exhibit 4 and Exhibit below.

Exhibit 4. Alarm Response (DRAFT)

Alarm Triggered	Immediate Response	Contact
Storage Tank - Level Switch High High (LSHH100)	Shut down system. Begin system troubleshooting if safe to do so, see Appendix C. Contact on-call engineer for assistance if needed.	Engineer on call Matt Swenson: (724) 934-9514
Flocculation Tank - Level Switch High High (LSHH100)		
Clarifier - Level Switch High High (LSHH200)		
Oil Water Separator - Level Switch High High (LSHH200)		
Air Stripper Sump - Level Switch High High (LSHH300) OR Level Switch Low (LSL300)		
Knockout Tank - Level Switch High High (LSHH400)		
Air Stripper Blower - Temperature Switch High High (TSHH403)		
Storage Tank Field - Level Switch High High (LSHH306)		
Building Sump - Level Switch High High (LSHH307)		
LGAC/Organo Clay Vessel Containment - Level Switch High High (LSHH308)		
Emergency Stop (E-stop)	Evacuate area if required.	If non-emergency: Engineer on call If emergency: see contacts in Exhibit 5

Exhibit 5. Emergency Response

Event	Immediate Response	Contact
Hazard within containment	Shut down system if safe to do so.	Waste Chief: Michelle Clayton – (412) 614-1624 Command Center: Justin Gaudi – (724) 889-3305 Matt Swenson – (724) 934-9514
Spill outside of containment	Shut down system and address with onsite spill kit if safe to do so. Evacuate area as required.	

8 Contingency Modifications and Updates

The configuration of the sediment pretreatment equipment is subject to change based on the actual sediment load observed in the influent stream to the system and the sediment removal performance/efficiencies of the equipment. This will be evaluated during system startup. Sediment pretreatment equipment that is included in the current system design may be taken offline and removed from the process if it is determined to be unnecessary. Similarly, certain equipment that is currently included in the system chemical treatment process (e.g., OWS, organoclay vessels) may also be taken offline and removed if system performance monitoring data demonstrate that this equipment is not necessary to achieve wastewater treatment objectives and/or is not otherwise beneficial. Any such proposed modifications to the chemical treatment process equipment will be subject to approval by USEPA/OEPA.

A second chemical treatment system with the same or similar process equipment may be installed at the Site after the first system is up and running with the goal of maximizing system uptime. This second system would provide redundancy to limit operating downtime during both routine equipment maintenance and unplanned shutdowns. A preliminary equipment layout for the second system is shown on Figure 2. If installed, the second system would have the same treatment processes as the first with similar equipment, capacities, and treatment efficiencies, sized for a design flow rate of 100 gpm. Documentation for the second system would be incorporated into this OM&M Plan as a modification. USEPA/OEPA will be consulted prior to installing the second system at the Site.

All system modifications will be documented in Appendix I and the onsite operations and maintenance manual will be redlined and marked as applicable. Updated versions of the manual will be available online and be made available onsite as necessary based on system and maintenance updates.

Tables

Table 1
Wastewater Treatment System Monitoring/Maintenance Schedule

Unit	Time	Monitoring/Maintenance Activity
Failsafe Devices	Monthly	Inspect and test the failsafe devices shown on the P&IDs: Oil Water Separator Level Switch High High (LSHH-200) Air Stripper Sump Level Switch High High (LSHH-300) Knockout Tank Level Switch High High (LSHH-400) Air Stripper Blower Temperature Switch High High (TSHH-403) Discharge Tank Field High High (LSHH-306) Building Sump High High (LSHH-307) LGAC Treatment Area Sump High High (LSHH-308) ESTOPs
Air Stripper	Daily	Monitor sump pressures, operational flow rates, and effluent air volatile organic compound (VOC) concentrations. *See System Field Sheet.*
	As Needed	Clean stripper trays and demister pad when fouling occurs. Fouling is indicated when the differential pressure is above 26 inches of water column from the sump of the air stripper to the vent or/and air flow cannot be sustained between 600-720 standard cubic feet per minute. See equipment manufacture procedure in **Appendix G**.
Air Stripper Blower	Weekly	Check oil level in gear end and free end of blower and add oil if needed.
	Monthly	Test relief valve Clean air filters
	Quarterly	Change oil. *To be performed by system vendor personnel during regularly scheduled quarterly system maintenance visit.*
Clarifier	Daily	Inspect tanks and connections for leaks. Tighten loose fittings as necessary.
	Weekly	Gauge sludge accumulation in clarifier and flocculation tanks. Pump or vacuum excessive accumulations.
Centrifuge	Daily	Inspect centrifuge and connections for Leaks. Tighten loose fittings as necessary.
	Quarterly	Inspect bowl and motor bearings and gearbox. Apply grease as necessary to lubricate bearings. *To be performed by system vendor personnel during regularly scheduled quarterly system maintenance.*
Transfer Pumps	Daily	Monitor and record operating pressure, inspect for leaks, and tighten/repair components as necessary.
	Quarterly	Clean impeller casing and inspect seals. *To be performed by system vendor personnel during regularly scheduled quarterly system maintenance visit.*
Oil Water Separator	Weekly	Check oil reservoir for product and remove if present.
Sediment Bag Filters	Daily	Monitor and record operational pressures on each filter.
	As Needed	Replace sediment bag filters as needed when the differential pressure over the bag filter is between 10 to 15 PSI. Inspect cover gasket during filter changeouts and lubricate/replace as necessary. See equipment manufacture procedure in **Appendix G**.
Organo Clay/LGAC	Daily	Inspect vessels and cam-lock fittings for leaks. Tighten loose fittings as necessary.
	Daily	Monitor and record operational pressures.
	As Needed	Backwash the LGAC vessels and organo clay vessels per the manufacturer's instructions. Organo clay and LGAC should be backwashed when the differential pressure is observed to be 8 PSI over the vessel or 5 PSI above system start pressure. See equipment manufacture procedures in **Appendix G**.

Table 1
Wastewater Treatment System Monitoring/Maintenance Schedule

Unit	Time	Monitoring/Maintenance Activity
	As Needed	Replace spent LGAC based on laboratory analytical results as follows. Remove lead vessel and replace it with lag vessel, then install on of the spare LGAC vessels as new lag vessel. Contact media vendor to schedule carbon changeout when 2 of the 4 LGAC vessels are spent.
VGAC/HS600	Daily	Inspect vessels and cam-lock fittings for leaks. Tighten loose fittings as necessary. Collect PID readings from vapor stream as described in system O&M field collection sheet located in **Appendix G** and field monitoring described below.
	As Needed	Replace spent VGAC and HS600 media based field monitoring and/or laboratory analytical results as follows. Remove lead vessel and replace it with lag vessel, then install on of the spare media vessels as the new lag vessel. Contact media vendor to schedule changeout when 2 of the 4 VGAC and/or HS600 media vessels are spent.
Sand Filters	Monthly	Clean Y Strainer on Inlet Manifold
		Check texture and consistency of media on filters – make sure it is still loose and free of caking or crusting
	Bi Annually	Rotate Knobs on control panel to break any oxidation that may be occurring
		Check seals on control enclosure for integrity
	Semi Annually	Lubricate backwash shaft and O rings in packing gland with a molydisulfide grease or equivalent for valves that have stainless steel packing glands. For valves with PVC packing glands use 112 silicon grease. *To be performed by system vendor personnel during regularly scheduled system maintenance visit.*
		Flush actuator if heavy silting conditions exist. *To be performed by system vendor personnel during regularly scheduled system maintenance visit.*
	Annualy	Disassemble, inspect, and regrease backwash valve. *To be performed by system vendor personnel during regularly scheduled system maintenance visit.*
Spill Kit	Weekly	Inspect spill kit and replace items as required. Confirm Spill kit condition is keeping materials in useable condition in the event of a spill.

Figures

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Leak Check Valve on Transfer Piping Secondary Containment

CID Tank Storage Location

CID Truck Loading Area

See Inset For Below Grade Road Crossing Detail

Leak check valve on transfer piping secondary containment

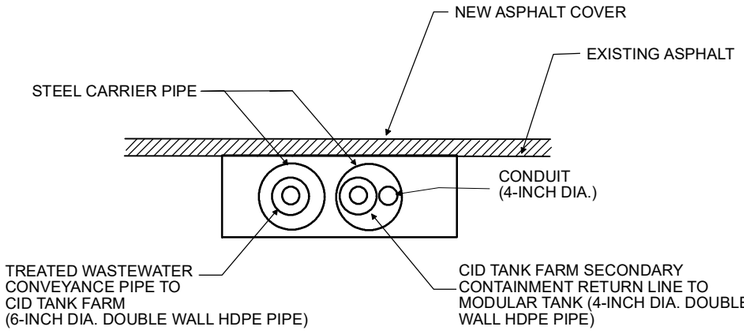
Wastewater Treatment System Equipment Lay-down Area

Approximate Extents of Proposed Treatment Area

Approximate Location of CID Treatment System

Untreated Influent Pipe to Treatment System (below grade)

Truck Staging Area



BELOW GRADE ROAD CROSSING DETAIL

NOT TO SCALE

Legend

- Approximate Location of CID Treatment System
- CID Tank Storage Location
- CID Treatment System Location
- CID Effluent Pipe to Tank Manifold (Below Grade at Road Crossing and Above Grade Elsewhere)
- Untreated Influent Pipe to Treatment System (Below Grade)
- CID Pipe Manifold
- Empty Inbound Truck
- Full Outbound Truck

Map Date: 8/16/2023

Drone image dated: 08/15/2023

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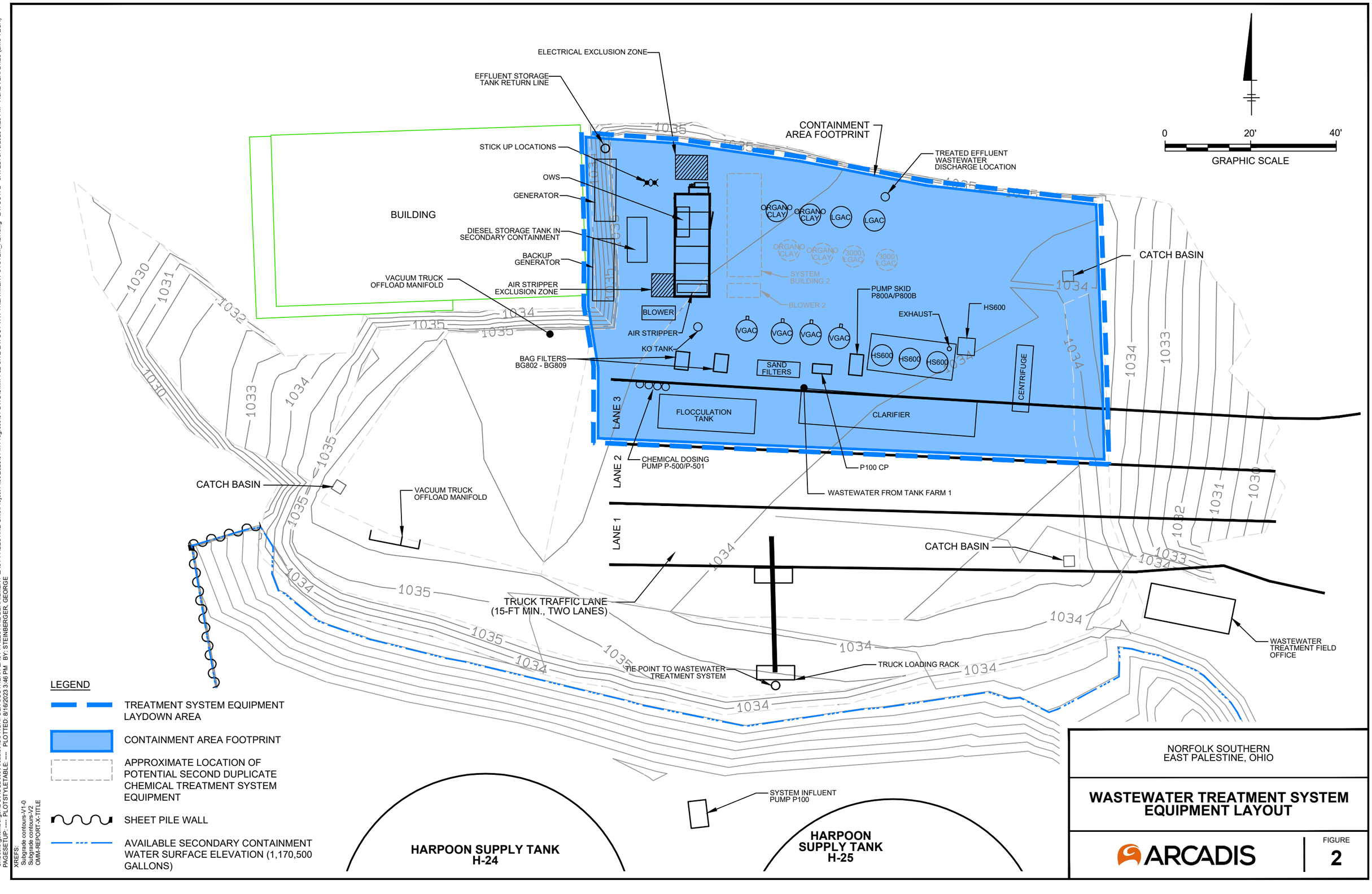
NORFOLK SOUTHERN
EAST PALESTINE, OHIO

WASTEWATER TREATMENT SYSTEM AREA LAYOUT

ARCADIS

FIGURE 1



LEGEND

- TREATMENT SYSTEM EQUIPMENT LAYDOWN AREA
- CONTAINMENT AREA FOOTPRINT
- APPROXIMATE LOCATION OF POTENTIAL SECOND DUPLICATE CHEMICAL TREATMENT SYSTEM EQUIPMENT
- SHEET PILE WALL
- AVAILABLE SECONDARY CONTAINMENT WATER SURFACE ELEVATION (1,170,500 GALLONS)

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

WASTEWATER TREATMENT SYSTEM EQUIPMENT LAYOUT

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FIGURE 2

VC SYSTEM PLC

TRANSFER PUMP VFD

INFLUENT PUMP VFD

LI 100

LEAD 200 — LEAD CALL — YC 600

LAG 200 — LAG CALL

OFF 200 — OFF CALL

YC 800

YC 801

SYSTEM INHIBIT

LSHH306A/B/C/D/E/F (FIGURE 4)

YC 100

SC 100

SPEED CONTROL

LI 100

BACKWASH

1

LT 100

HARPOON SUPPLY TANKS

H-24 AND H-25

LT 100

YC 100

SC 100

VFD

P100

SP100

CHEMICAL DOSING P500

CHEMICAL DOSING P501

FLOCCULATION TANK

1

LI 100

CLARIFIER

LEAD 200

LAG 200

OFF 200

TYP. OF 5

FI 500

DECANT STREAM

P600

MS

PI 800A

PI 800B

MS

P800A

P800B

SP800

PI 801A

PSHH 800

PI 801B

POD SAND FILTER SF801

POD SAND FILTER SF802

PI 802B

PI 802A

PI 803B

PI 803A

BAG FILTER BG802

BAG FILTER BG803

PI 804B

PI 804A

PI 805B

PI 805A

BAG FILTER BG804

BAG FILTER BG805

PI 806B

PI 806A

PI 807B

PI 807A

BAG FILTER BG806

BAG FILTER BG807

PI 808B

PI 808A

PI 809B

PI 809A

BAG FILTER BG808

BAG FILTER BG809

FI 800

SYSTEM INFLUENT STREAM (FIGURE 4)

REMOTE LOCATED BY TANK 8' BELOW TREATMENT SYSTEM

TANK CONTAINMENT

SOLID WASTE DISPOSAL

SOLID STREAM

CENTRIFUGE

P601 CHEMICAL DOSING

SECONDARY CONTAINMENT

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NORFOLK SOUTHERN
EAST PALESTINE, OHIO

SEDIMENT PRETREATMENT SYSTEM PROCESS AND INSTRUMENTATION DIAGRAM

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FIGURE
3

VC SYSTEM PLC

ZC 100
FI 100
LI 200
LSHH 200
YC 200 — START/STOP, SPEED CONTROL
SC 200
FQ 303
LSHH 307
YC 400 — START/STOP — LSH/LSL-400 (FIGURE 5)
YC 300 — START/STOP
LI 300
LSHH 300

FROM SEDIMENT PRETREATMENT SYSTEM (FIGURE 3)

SIPHON BREAK (MAY NOT BE NEEDED)
BV101D
SV 100
PI 101A
PI 101B
FQI 100
PI 102
SP200
SP102
GV200A
BV100A
BG101
BV100B
TRIPLE BAG FILTER

OWS
LT 200
LSHH 200
1

YC 100
VFD
SC 100
PI 200
SP200
GV200B
PUMP P200 VFD
BV200C

PI 201A
PI 201B
SP201
BV201A
BG201
BV201B
TRIPLE BAG FILTER

INSIDE
OUTSIDE

FROM KNOCK OUT TANK T400 (FIGURE 5)
YC 400
MS
V404
V403
PI 401
V402
SP401
PUMP P400

PI 202
BV202A
ORGANO CLAY
T202
SP202A
BV202B
DP202B

PI 203
BV203A
ORGANO CLAY
T203
SP203A
BV203B
DP203B

OUTSIDE IN DOUBLE CONTAINMENT

TO KNOCK OUT TANK T400/AIR TREATMENT (FIGURE 5)
600 CFM AIR INLET
OUTSIDE
INSIDE
AIR FLOW
FI 300
TI 300
LOW PROFILE AIR STRIPPER
SUMP T204
LT 300
LSHH 300
1
BV300A

PI 301A
PI 301B
SP301
BV301B
BG301
BV301A

PULSE
FQI 303
PI 303
SP303
TO ACTIVATED CARBON (FIGURE 6)
(2) TRIPLE BAG FILTERS
PI 302A
PI 302B
SP302
BV302B
BG302
BV302A

PI 300
SP300
BV300B
PUMP P300 VFD
VFD
YC 300

LSHH 307
1
BUILDING DOUBLE CONTAINMENT
FLOOR LEAK DETECTION

INSIDE
OUTSIDE

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

WASTEWATER TREATMENT SYSTEM PROCESS AND INSTRUMENTATION DIAGRAM - SYSTEM TREATMENT

ARCADIS

FIGURE 4

VC SYSTEM PLC

TSHH 403

FI 400

1

LSHH 400

LSH 400

TI 400

LSL 400

PI 400

SP300

FILTER

BV400

PI 402

130°F ADJUSTABLE

0-15 PSI

TSHH 403

1

PI 403

TI 403

BV403

SP403

SILENCER

BLOWER
(BLOWER CONTROLLED
BY LOCAL OPERATION)

FROM LOW PROFILE
AIR STRIPPER
(FIGURE 4)

KNOCK
OUT
TANK
T400

FILTER

TO OWS
(FIGURE 4)

0-50 WC HIGH

DPI 405

1/4" HOSE

SP404

VAPOR
CARBON
T402

0-40 WC
HIGH

DPI 404

SP405

VAPOR
CARBON
T401

0-40 WC
HIGH

DPI 406

SP406

HS600
MEDIA
T405

0-20 WC
HIGH

DPI 407

SP407

HS600
MEDIA
T406

EXHAUST TO
ATMOSPHERE

14" PIPE
14' ABOVE GRADE

TI 400

4-20mA
AIR FLOW

FT 400

SP408

DRAIN

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EAST PALESTINE, OHIO

WASTEWATER TREATMENT SYSTEM PROCESS AND INSTRUMENTATION DIAGRAM - AIR TREATMENT AND EFFLUENT

ARCADIS

FIGURE
5

VC SYSTEM PLC

LSHH 308

P300 (FIGURE 4)

YC 100

LSHH 306A | LSHH 306B | LSHH 306C | LSHH 306D | LSHH 306E | LSHH 306F

ESTOPS
- GODWIN
- MKE (PERMISSVE SENT TO TRANS. PUMP)
- TRANSFER PUMPS

FROM BAG FILTERS BG301/BG302 (FIGURE 4)

PI 304

BV304A

ACTIVATED CARBON

SP304A

BV304B

SP304B

PI 305

BV305A

ACTIVATED CARBON

SP305A

BV305B

SP305B

SP306

3" DISCHARGE

6"x10" TERMINATION SEAL

3"x6" BUSHING

~800 FEET 6" HDPE EFFLUENT LINE

LSHH 308 (1)

SECONDARY CONTAINMENT

FLOOR LEAK DETECTION

SECONDARY CONTAINMENT

(1) LSHH 306A | (1) LSHH 306B | (1) LSHH 306C | (1) LSHH 306D | (1) LSHH 306E | (1) LSHH 306F

BV500 | BV501 | BV502 | BV503 | BV504 | BV505

STORAGE TANK

T306A | T306B | T306C | T306D | T306E | T306F

SP900A | SP900B | SP900C | SP900D | SP900E | SP900F

BV506 | BV507 | BV508 | BV509 | BV5010 | BV5011

SECONDARY CONTAINMENT

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

WASTEWATER TREATMENT SYSTEM PROCESS AND INSTRUMENTATION DIAGRAM - SYSTEM EFFLUENT

ARCADIS

FIGURE 6

EQUIPMENT LEGEND:

- PRIMARY PROCESS PIPING
- EQUIPMENT ENCLOSURE
- CHECK VALVE
- BUTTERFLY VALVE
- BALL VALVE
- GATE VALVE
- SOLENOID VALVE
- WYE
- CAMLOCK FITTING
- FLANGE FITTING
- PUMP
- BLOWER
- REDUCING BUSHING
- INLINE STATIC MIXER
- CENTRIFUGE

PIPE IDENTIFICATION TAGS:

DIAMETER - SERVICE - SCHEDULE - MATERIAL - OTHER

DIAMETER: NOMINAL DIAMETER (INCHES)

SCHEDULE = US STANDARD UNITS

LOGIC INTERLOCKS:

1. SYSTEM SHUTDOWN AFTER 30 SECOND ALARM DELAY

NOTES:

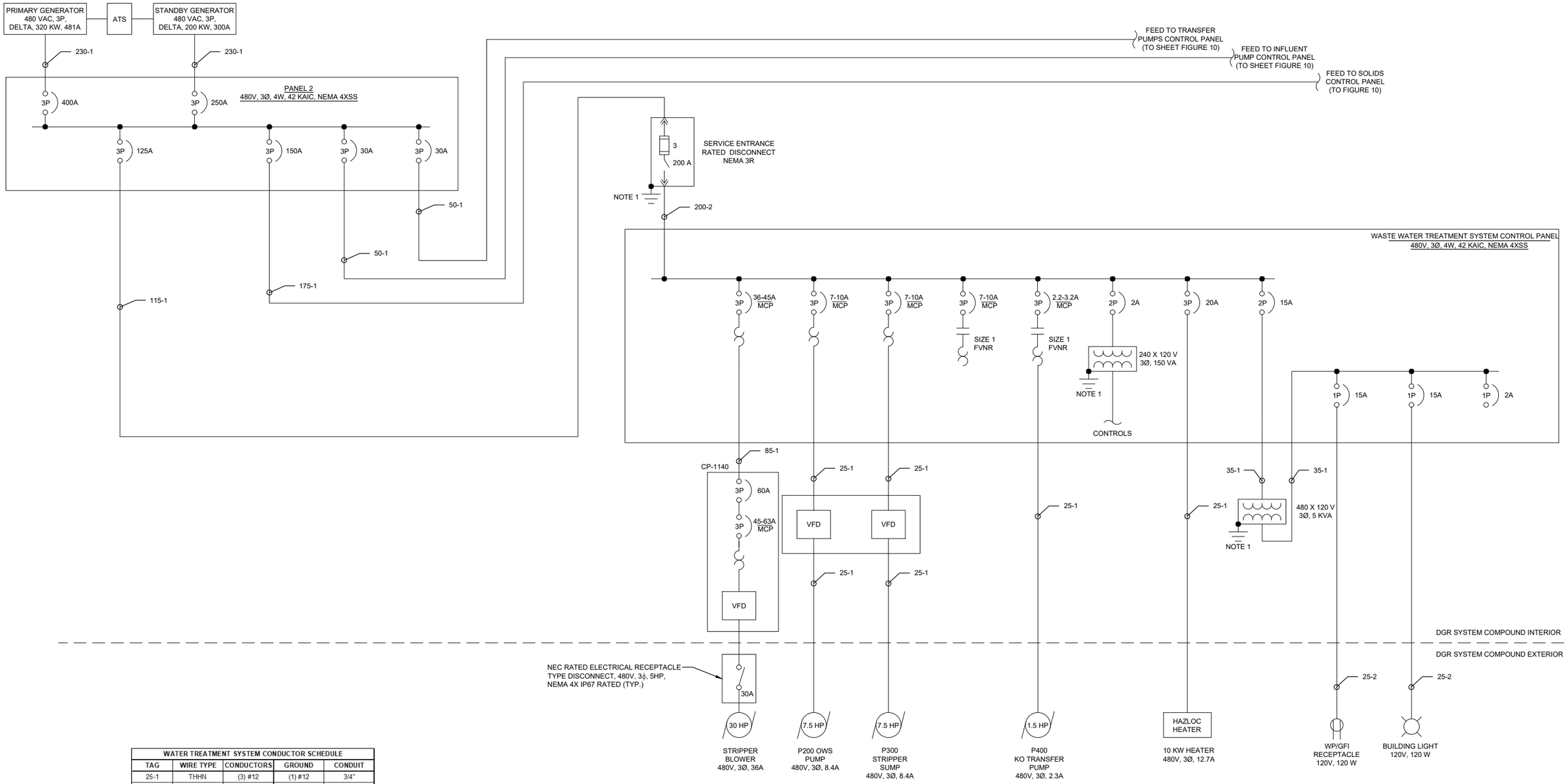
1. EMERGENCY STOP BUTTON WILL BE LOCATED INSIDE THE EQUIPMENT ROOM OF THE SYSTEM BUILDING, LOCATED NO GREATER THAN 25 FEET FROM AN OPERATING PUMP AND WILL SHUT DOWN ALL PUMPS, MOTORS, AIR STRIPPER, AND OPEN THE SOLENOID VALVE TO THE ATMOSPHERE.
2. ANTI-SIPHON TO BE PLACED ON INVERTED U PIPING TO PREVENT SIPHONING OF REMEDIAL SYSTEM.
3. ALL HOSE CONNECTIONS ARE 3" UNLESS OTHERWISE STATED.

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

WASTEWATER TREATMENT SYSTEM PROCESS AND INSTRUMENTATION DIAGRAM - LEGEND

ARCADIS

FIGURE
7



WATER TREATMENT SYSTEM CONDUCTOR SCHEDULE				
TAG	WIRE TYPE	CONDUCTORS	GROUND	CONDUIT
25-1	THHN	(3) #12	(1) #12	3/4"
25-2	MTW	(2) #12	(1) #12	3/4"
35-1	THHN	(3) #10	(1) #10	
50-1	THHN	(3) #8	(1) #6	1-1/4"
85-1	THHN	(3) #4	(1) #8	N/A
115-1	THHN	(5) #2	(1) #8	N/A
130-1	THHN	(3) #1	(1) #6	N/A
175-1	THHN	(3) #2/0	(1) #4	N/A
200-1	THHN	(3) #3/0	(1) #3/0	N/A
200-2	THHN	(3) #3/0	(1) #3/0	2"
230-1	THHN	(3) #4/0	(1) #4/0	N/A

WATER TREATMENT SYSTEM CONTROL PANEL (480 VAC)								
DEVICE	VOLTAGE	PHASE	HP	DUTY FACTOR	CONNECT LOAD - 480V (AMPS)**	DEMAND LOAD - 480V (AMPS)**	kVA	
STRIPPER BLOWER	480	3	30.00	100.0%	36.00	36.00	29.89	
P200 OWS PUMP	480	3	7.50	100.0%	8.40	8.40	6.98	
P300 STRIPPER SMP	480	3	7.50	100.0%	8.40	8.40	6.98	
P400 KO TRANSFER PUMP	480	3	7.50	100.0%	2.30	2.30	1.91	
CONTROLS	240	3	1.50	100.0%	1.00	1.00	0.72	
HEATER	480	3	--	100.0%	12.70	12.70	10.55	
UTILITY TRANSFORMER	480	3	--	100.0%	10.80	10.80	8.97	
				SUBTOTALS :	80	80	65.99	
					TOTAL ELECTRICAL LOAD:		79.37	CONNECTED AMPS
**Motor loads taken from NEC 430 or manufacturer, as available							79.37	DEMAND AMPS
MAIN BREAKER INFORMATION							99	MINIMUM BREAKER SIZE
							200	MAIN BREAKER

NOTES:

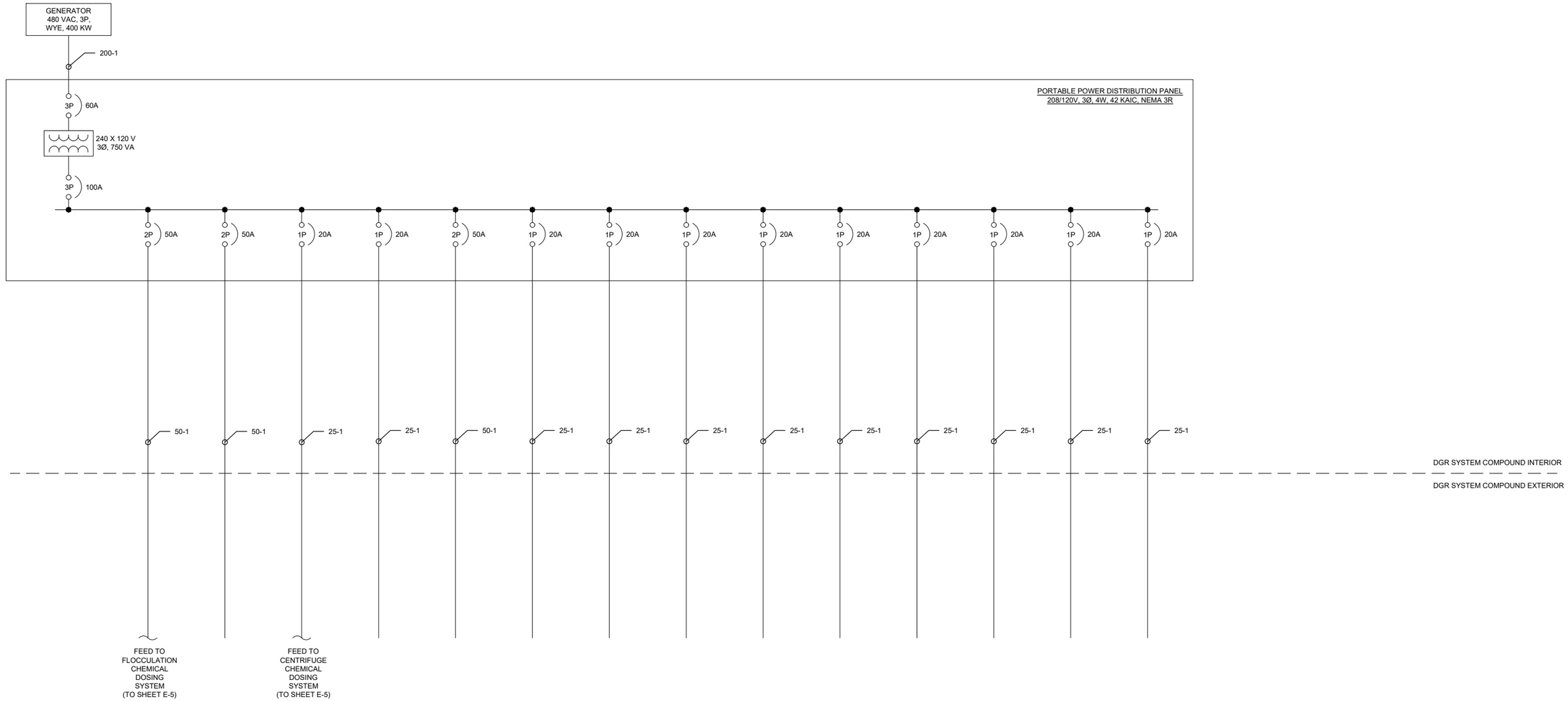
1. #2 GROUNDING ELECTRODE CONDUCTOR FOR BONDING OF GROUNDING ELECTRODE SYSTEM.

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

WASTE WATER TREATMENT SYSTEM ELECTRICAL ONE LINE DIAGRAM

ARCADIS

FIGURE
8



120/240VAC CONDUCTOR SCHEDULE				
TAG	WIRE TYPE	CONDUCTORS	GROUND	CONDUIT
25-1	THHN	(3) #12	(1) #12	3/4"
25-2	MTW	(2) #12	(1) #12	3/4"
50-1	THHN	(3) #8	(1) #6	1-1/4"
50-1	THHN	(3) #8	(1) #6	1-1/4"

NOTES:

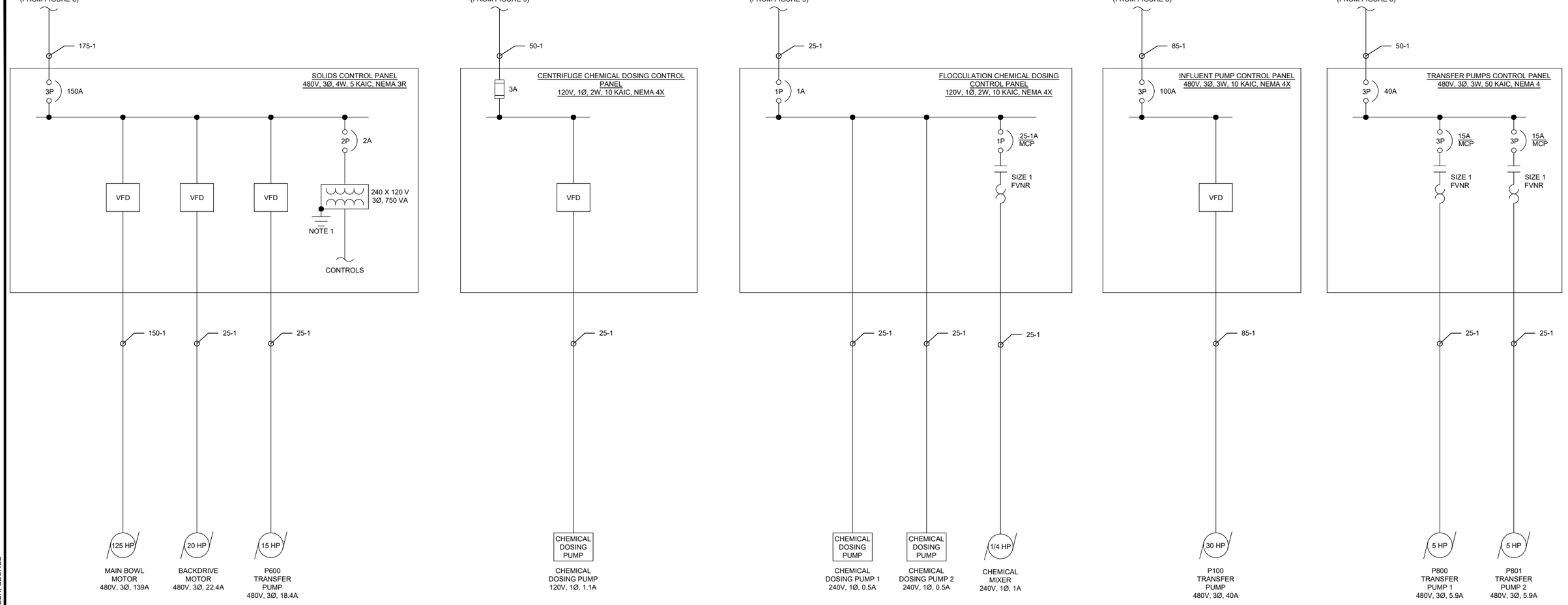
1. #2 GROUNDING ELECTRODE CONDUCTOR FOR BONDING OF GROUNDING ELECTRODE SYSTEM.

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

DEWATERING SYSTEM &120/240VAC ELECTRICAL ONE LINE DIAGRAM

ARCADIS

FIGURE
9



INFLUENT PUMP CONTROL PANEL (480 VAC)								
DEVICE	VOLTAGE	PHASE	HP	DUTY FACTOR	CONNECT LOAD - 480V (AMPS)**	DEMAND LOAD - 480V (AMPS)**	kVA	
INFLUENT PUMP	480	3	30.00	100.0%	40.00	40.00	33.22	
CONTROLS	120	1	-	100.0%	10.00	10.00	1.20	
				SUBTOTALS :	50	50	34.42	
					TOTAL ELECTRICAL LOAD:		41.40	CONNECTED AMPS
**Motor loads taken from NEC 430 or manufacturer, as available							41.40	DEMAND AMPS
MAIN BREAKER INFORMATION							52	MINIMUM BREAKER SIZE
							100	MAIN BREAKER

CONDUCTOR SCHEDULE				
TAG	WIRE TYPE	CONDUCTORS	GROUND	CONDUIT
25-1	THHN	(3) #12	(1) #8	3/4"
25-2	MTW	(2) #12	(1) #8	3/4"
50-1	THHN	(3) #8	(1) #8	
85-1	THHN	(3) #4	(1) #8	
130-1	THHN	(3) #1	(1) #6	
150-1	THHN	(3) #1/0	(1) #6	1-1/4"
200-1	THHN	(3) #3/0	(1) #4	1-1/4"
200-2	THHN	(3) #3/0	(1) #4	2"

CHEMICAL DOSING CONTROL PANEL (240 VAC)								
DEVICE	VOLTAGE	PHASE	HP	DUTY FACTOR	CONNECT LOAD - 480V (AMPS)**	DEMAND LOAD - 480V (AMPS)**	kVA	
CHEMICAL DOSING PUMP 1	240	1	-	100.0%	0.50	0.50	0.12	
CHEMICAL DOSING PUMP 2	240	1	-	100.0%	0.50	0.50	0.12	
CHEMICAL MIXER	240	1	0.25	100.0%	1.00	1.00	0.24	
				SUBTOTALS :	2	2	0.48	
					TOTAL ELECTRICAL LOAD:		0.58	CONNECTED AMPS
**Motor loads taken from NEC 430 or manufacturer, as available							0.58	DEMAND AMPS
MAIN BREAKER INFORMATION							1	MINIMUM BREAKER SIZE
							1	MAIN BREAKER

TRANSFER PUMPS CONTROL PANEL (480 VAC)								
DEVICE	VOLTAGE	PHASE	HP	DUTY FACTOR	CONNECT LOAD - 480V (AMPS)**	DEMAND LOAD - 480V (AMPS)**	kVA	
TRANSFER PUMP 1	480	3	5.00	100.0%	5.90	5.90	4.90	
TRANSFER PUMP 2	480	3	5.00	100.0%	5.90	5.90	4.90	
CONTROLS	120	1	-	100.0%	2.00	2.00	0.24	
				SUBTOTALS :	14	14	10.04	
					TOTAL ELECTRICAL LOAD:		12.07	CONNECTED AMPS
**Motor loads taken from NEC 430 or manufacturer, as available							12.07	DEMAND AMPS
MAIN BREAKER INFORMATION							15	MINIMUM BREAKER SIZE
							40	MAIN BREAKER

SOLIDS CONTROL PANEL (480 VAC)								
DEVICE	VOLTAGE	PHASE	HP	DUTY FACTOR	CONNECT LOAD - 480V (AMPS)**	DEMAND LOAD - 480V (AMPS)**	kVA	
MAIN BOWL MOTOR	480	3	150.00	100.0%	139.00	139.00	115.43	
BACKDRIVE MOTOR	480	3	20.00	100.0%	22.40	22.40	18.60	
P600 TRANSFER PUMP	480	3	20.00	100.0%	18.40	18.40	15.28	
CONTROLS	240	3	-	100.0%	1.04	1.04	0.75	
				SUBTOTALS :	181	181	150.05	
					TOTAL ELECTRICAL LOAD:		180.49	CONNECTED AMPS
**Motor loads taken from NEC 430 or manufacturer, as available							180.49	DEMAND AMPS
MAIN BREAKER INFORMATION							226	MINIMUM BREAKER SIZE
							150	MAIN BREAKER

NOTES:

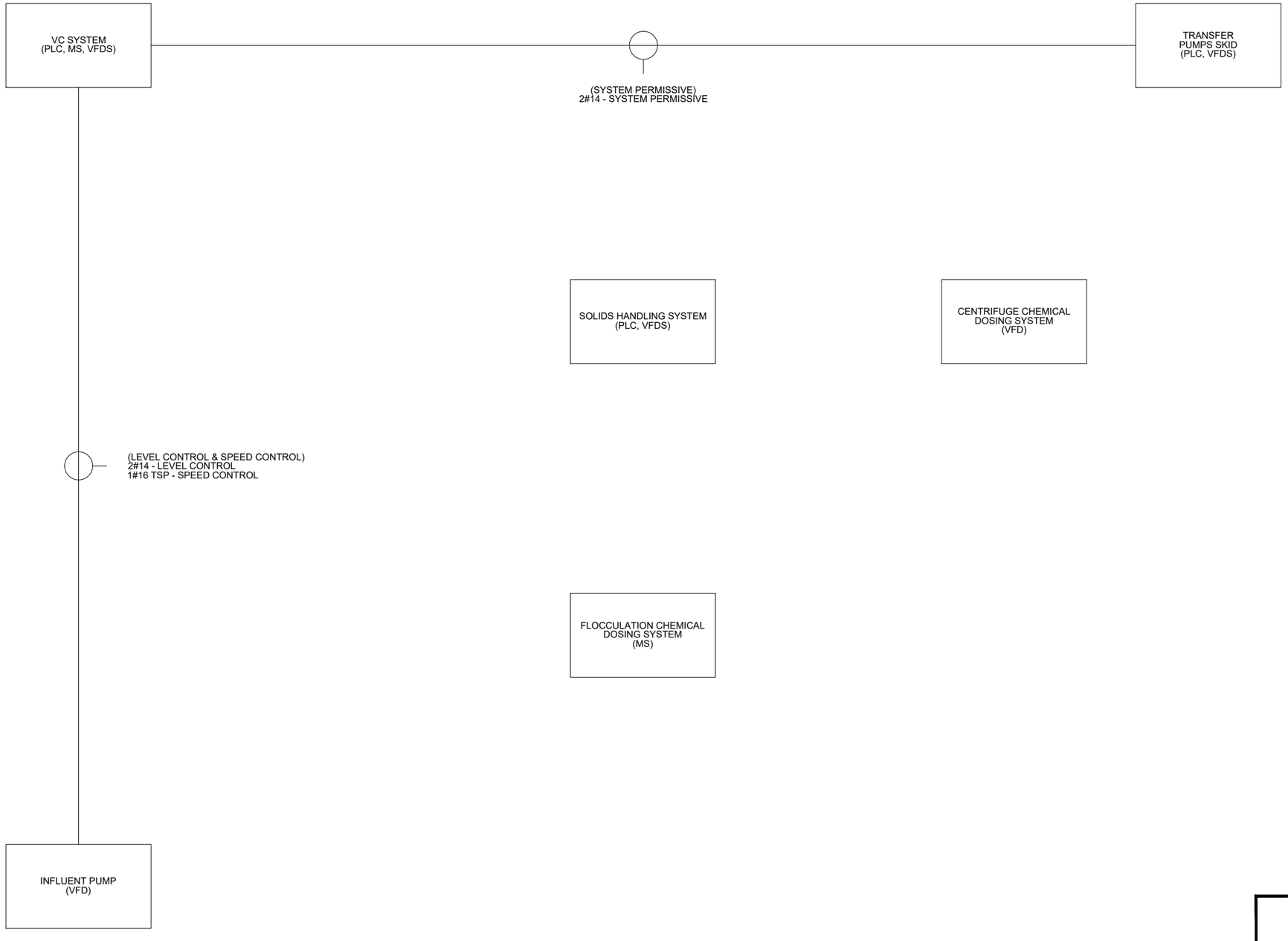
1. #2 GROUNDING ELECTRODE CONDUCTOR FOR BONDING OF GROUNDING ELECTRODE SYSTEM.

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

SOLIDS & CHEMICAL SYSTEMS ELECTRICAL ONE LINE DIAGRAM

ARCADIS

FIGURE
10



NOTES:

1. #2 GROUNDING ELECTRODE CONDUCTOR FOR BONDING OF GROUNDING ELECTRODE SYSTEM.

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

SYSTEM INTERCONNECTION INSTRUMENTATION DIAGRAM

ARCADIS

FIGURE
11

C:\Users\gsteinberger\DC\ACCDocs\Arcadis\AUS-NORFOLK SOUTHERN-EAST PALESTINE DERAILMENT-EAST PALESTINE Ohio\Project Files\2023\01-In Progress\01-DWG\OMM-F08_11-ELEC WW TREATMENT SYSTEM.dwg LAYOUT: 11 SAVED: 8/16/2023 3:30 PM ACADVER: 24.2S (LMS TECH)
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XREFS: IMAGES: PROJECTNAME: ---
REPORT-X-TITLE
Arcadis Logo_2021.PNG

CTEH® AreaRAE Location Map

East Palestine Train Derailment 02032023 | Updated 7/29/2023

0 0.07 0.14 Miles

N

Project: PROJ-024579
Client: Norfolk Southern
City: East Palestine, OH
County: Columbiana

Projection: NAD 1983 2011 StatePlane Ohio North FIPS 3401 Ft US Datum: NAD 1983 2011

Updated At: 6/3/2023 12:22 PM

CTEH®

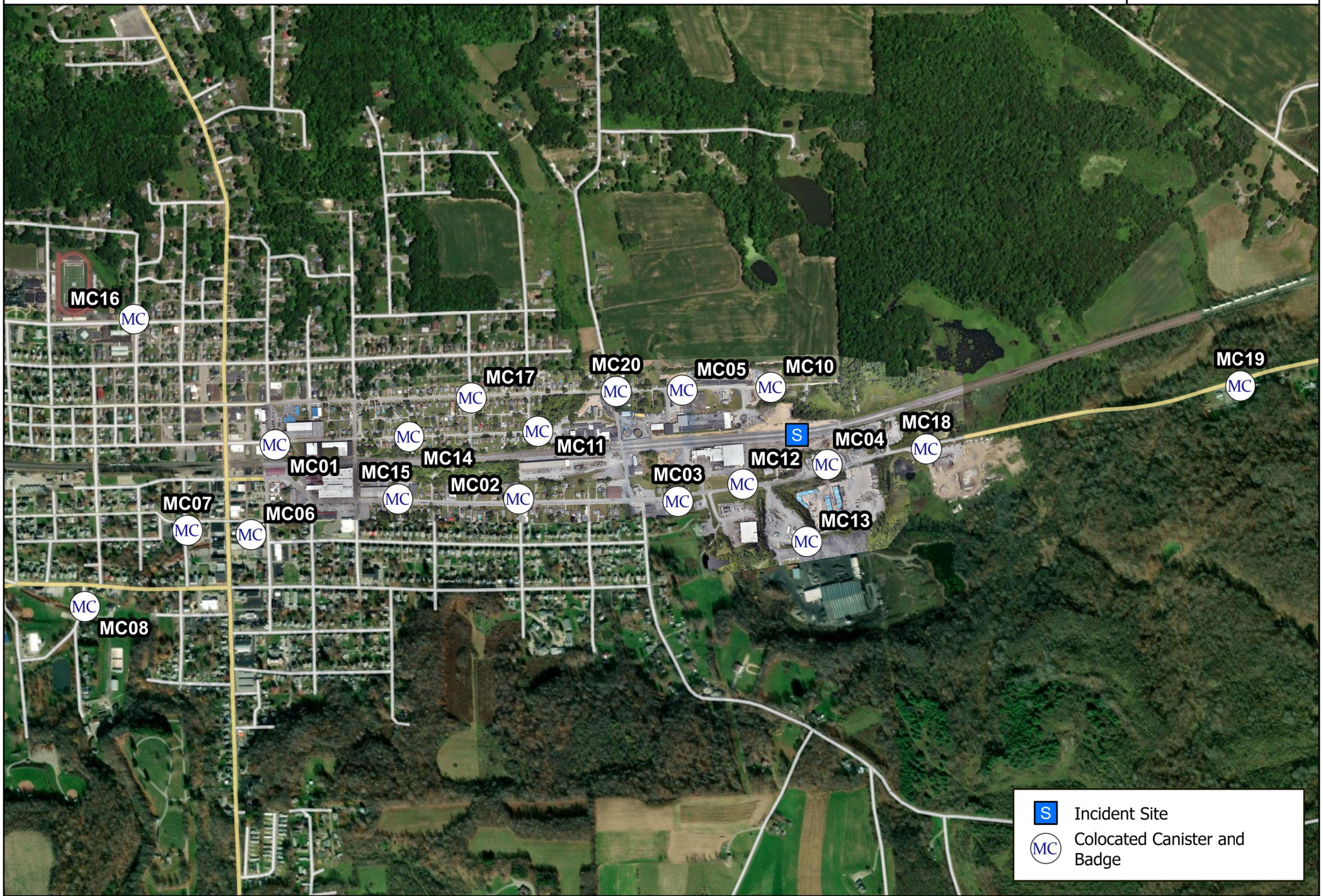
Analytical Air Sampling Locations

East Palestine Train Derailment | Updated 8/10/2023

0 0.25 0.5 Miles

N

Project: PROJ-024579
Client: Norfolk Southern
City: East Palestine, OH
County: Columbiana



Projection: NAD 1983 2011 StatePlane Ohio North FIPS 3401 Ft US Datum: NAD 1983 2011

Appendix A

Vendor Provided Figures

LRT Water Treatment System Description

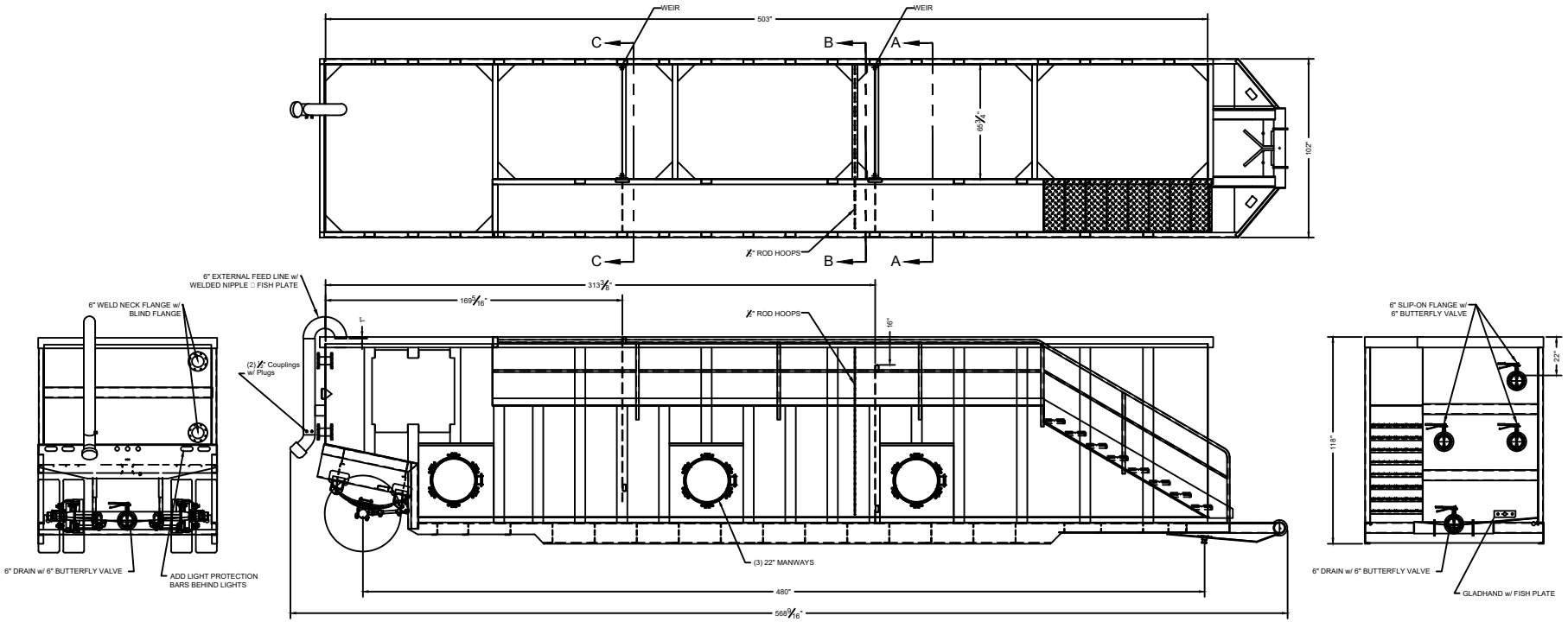
The weir tank will be elevated so that the over weir is approximately 1' higher than the weir of the clarifier to allow for proper gravity flow to the clarifier.
The influent flow will enter the weir tank at a rate of 100-150 gpm. LRT e50 coagulant will be injected directly to the influent flow and the LRT anionic polymer will be added to the tank to allow the two to properly mix in the influent portion of the weir tank.
Two chemical feed pumps and 55-gallon drums of e50 and anionic polymer will be used for chemical injections.
Following the weir tank, the water will gravity flow to one 18,000-gallon clarifier.
After the chemical injections, the precipitated total suspended solids (TSS)
will settle in the clarifiers, each with baffles, settling tube media and a V-shaped bottom equipped with sludge ports on each side that are utilized for sludge removal. Periodically, sludge will be removed from the clarifiers by pumping it with a manually operated diaphragm pump from the sludge ports to a centrifuge supplied by others.
From the clarifier, an electric centrifugal pump will transfer water to the onsite treatment system rated for 100gpm.

Coagulant will be fed into the influent stream at an initial dose of 10 ppm. This is equivalent to a dosing rate of 4 mL/min at an influent flow rate of 100 gpm.

Polymer will be fed into the Flocculation Tank at an initial dose of 50 ppm. This is equivalent to a dosing rate of 20 mL/min at an influent flow rate of 100 gpm.

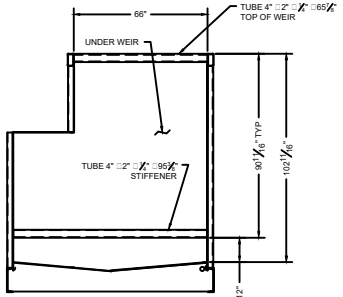
Quality of clarifier effluent shall be monitored during operation by visual inspection and periodic testing of effluent turbidity. Rapid increase in differential pressure across downstream filtration units is also an indication of poor solids removal in the clarifier system. If effluent quality is determined to be poor, polymer feed rate should be increased until improvement is noted. This situation should be discussed with the Engineering team to determine if poor treatment is due to changing influent conditions. If that is determined to be the case, further settling tests will be performed onsite by Engineering team members.

Preliminary Treatment Figures

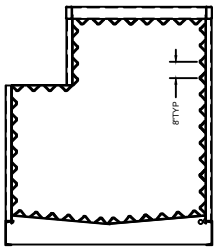


STANDARD SPECIFICATION

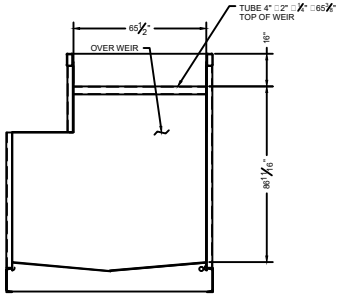
CAPACITY: .... 18,480 GALLONS (440 BBL)
SIDE SHEETS: .... 1/4" A36 PLATE
FRONT SHEET: .... 1/4" A36 PLATE
REAR SHEET: .... 1/4" A36 PLATE
FLOOR: .... 1/4" A36 PLATE
MAIN FLOOR RAILS: .... 12" □20.7# STRUCTURAL CHANNEL
FLOOR CROSSMEMBERS: .... 1/4" A36 PLATE
SIDE STAKES: .... ONE PIECE 3/16" A36 PLATE
SUSPENSION: .... 3 LEAF SPRING, 22,500 LBS. CACPACITY
AXLE: .... 77.5" TRACK, 22,500 LBS. CAPACITY
TIRES: .... 11R22.5 RADIAL
WHEELS: .... 8.25 □22.5 STEEL
MANWAYS: .... 3 - 22" DIA. CURB SIDE
VALVES: .... 3 - 6" BUTTERFLY VALVE (FRONT)
1 - 6" DRAIN BUTTERFLY VALVE (FRONT)
1 - 6" DRAIN BUTTERFLY VALVE (REAR)
2 - 6" BLIND FLANGE CONNECTION (REAR)
INLET PIPING: .... 1 - 6" PIPE SYSTEM (REAR)
BLAST: .... (INTERIOR) SSPC-SP-10 (NEAR WHITE)
(EXTERIOR) SSPC-SP-6 (COMMERCIAL BLAST)
PAINT: .... (INTERIOR) EPOXYPHENOLIC 100□ SOLID 20.0 MILS D.F.T.
(EXTERIOR) FINISH COAT POLURETHANE 4.0 TO 5.0 D.F.T.



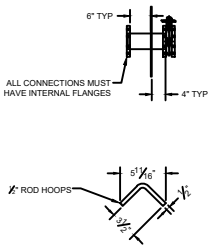
SECTION VIEW "C-C"



SECTION VIEW "B-B"



SECTION VIEW "A-A"



18,000 Gal. Weir Tank

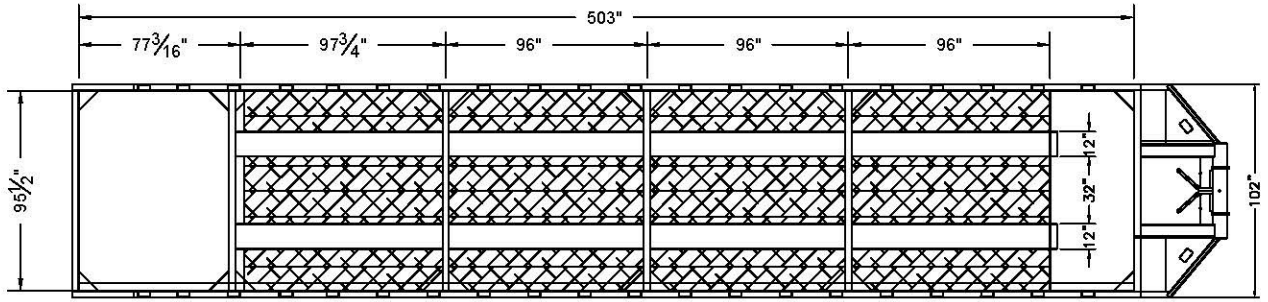
Lockwood Remediation Technologies, LLC

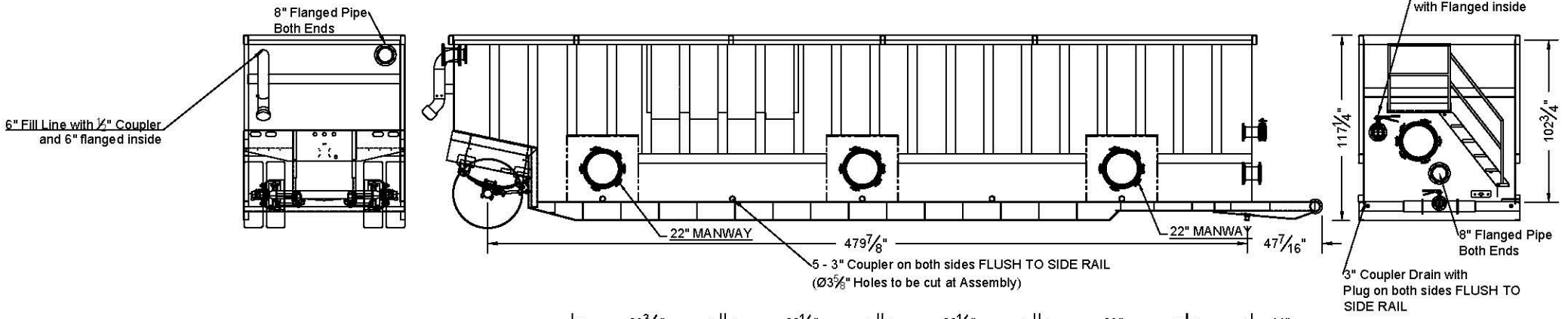
89 Crawford Street
Leominster, Massachusetts 01453
O: 774-450-7177
F: 888-835-0617

STANDARD SPECIFICATION

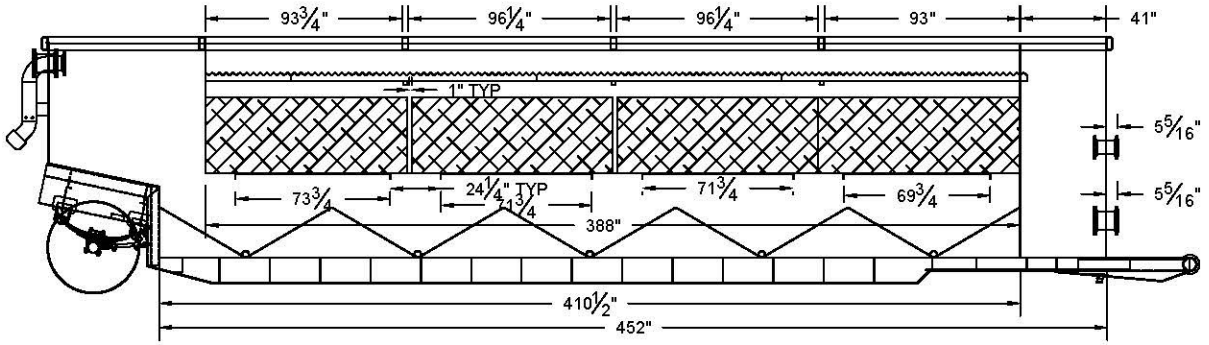
CAPACITY: .... 21,000 GALLONS (500 BBL)
SIDE SHEETS: .... 1/4" A36 PLATE
TOP SHEET: .... 1/4" A36 PLATE
FRONT SHEET: .... 1/4" A36 PLATE
REAR SHEET: .... 1/4" A36 PLATE
FLOOR: .... 1/4" A36 PLATE
MAIN FLOOR RAILS: .... 12" x 20.7# STRUCTURAL CHANNEL
FLOOR CROSSMEMBERS: .... 1/4" A36 PLATE
SIDE STAKES: .... ONE PIECE 3/16" A36 PLATE
SUSPENSION: .... 3 LEAF SPRING, 22,500 LBS. CACPACITY
AXLE: .... 77.5" TRACK, 22,500 LBS. CAPACITY
TIRES: 11R22.5
WHEELS: .... 8.25 x 22.5 STEEL
MANWAYS: .....1 - 22" DIA. FRONT
3 - 22" DIA. CURB SIDE
VALVES: .....1 - 4" BUTTERFLY VALVE (FRONT)
1 - 6" BUTTERFLY VALVE (FRONT)
INLET PIPING: .... 1 - 6" FILL LINE (REAR)
INSIDE / OUTSIDE
FLAGES.....(2) 8" FLANGE (REAR, FRONT)

BLAST: .... (INTERIOR) SSPC-SP-10 (NEAR WHITE)
(EXTERIOR) SSPC-SP-6 (COMMERCIAL BLAST)
PAINT: .... (INTERIOR) EPOXYPHENOLIC 100% SOLID 20.0 MILS D.F.T.
(EXTERIOR) PRIMER COAT EPOXY 3.0 TO 4.0 MILS D.F.T.
(EXTERIOR) FINISH COAT POLURETHANE 3.0 TO 4.0 D.F.T.





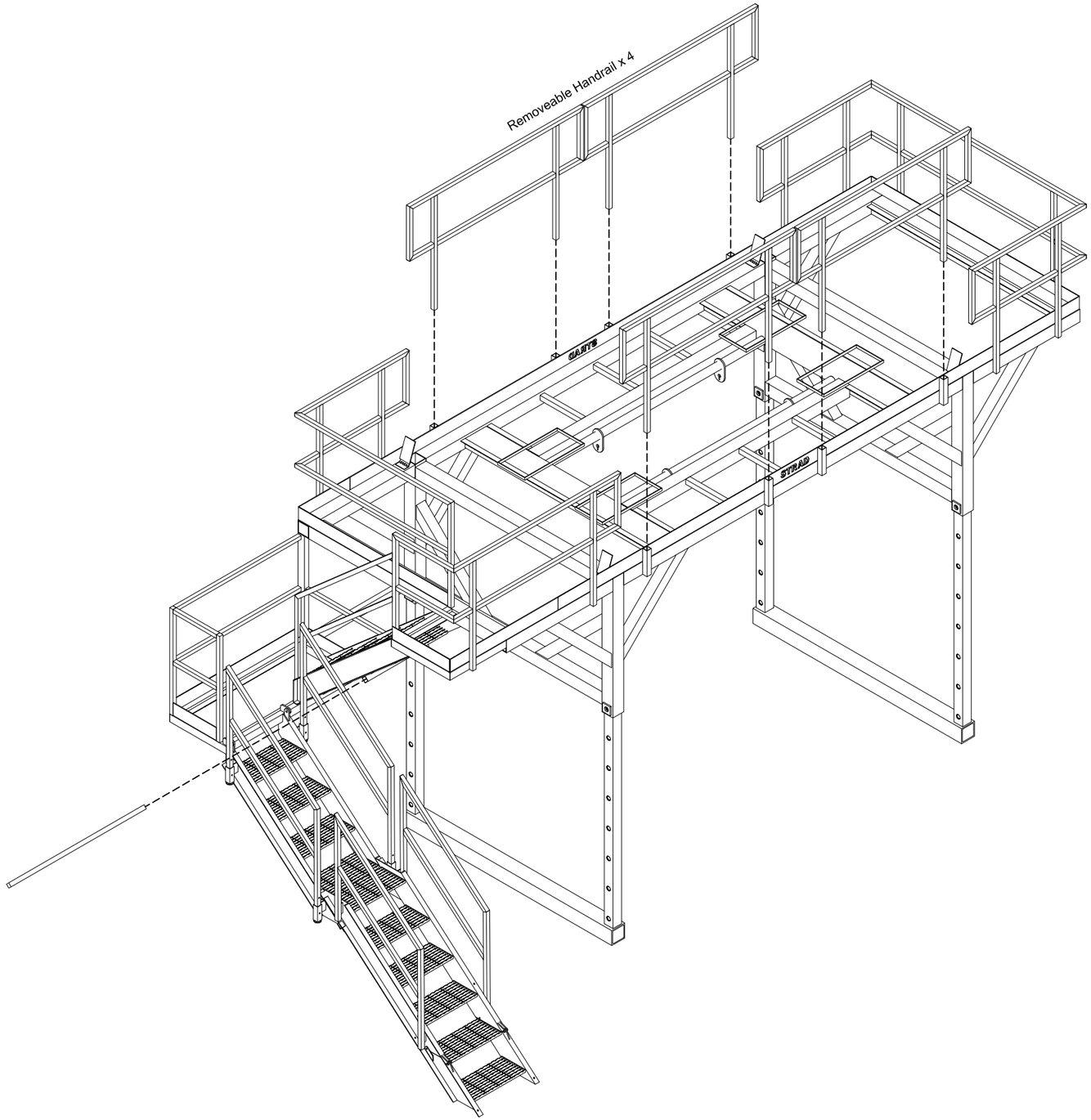
SPACING OF TOP TUBING TO ACCOMODATE INSERTION OF CLARIFIER PACKS. LOAD PACKS IN EITHER MIDDLE OPENEINGS AND SLIDE TO EITHER END. ADDED 1/2" ROUND BAR IN BETWEEN BOTTOM RESTS TO ASSIST IN SLIDING PACKS



18,000 gallon Clarifier

Lockwood Remediation Technologies, LLC

89 Crawford Street
Leominster, Massachusetts 01453
O: 774-450-7177
F: 888-835-0617



Grating Removed For Clarity

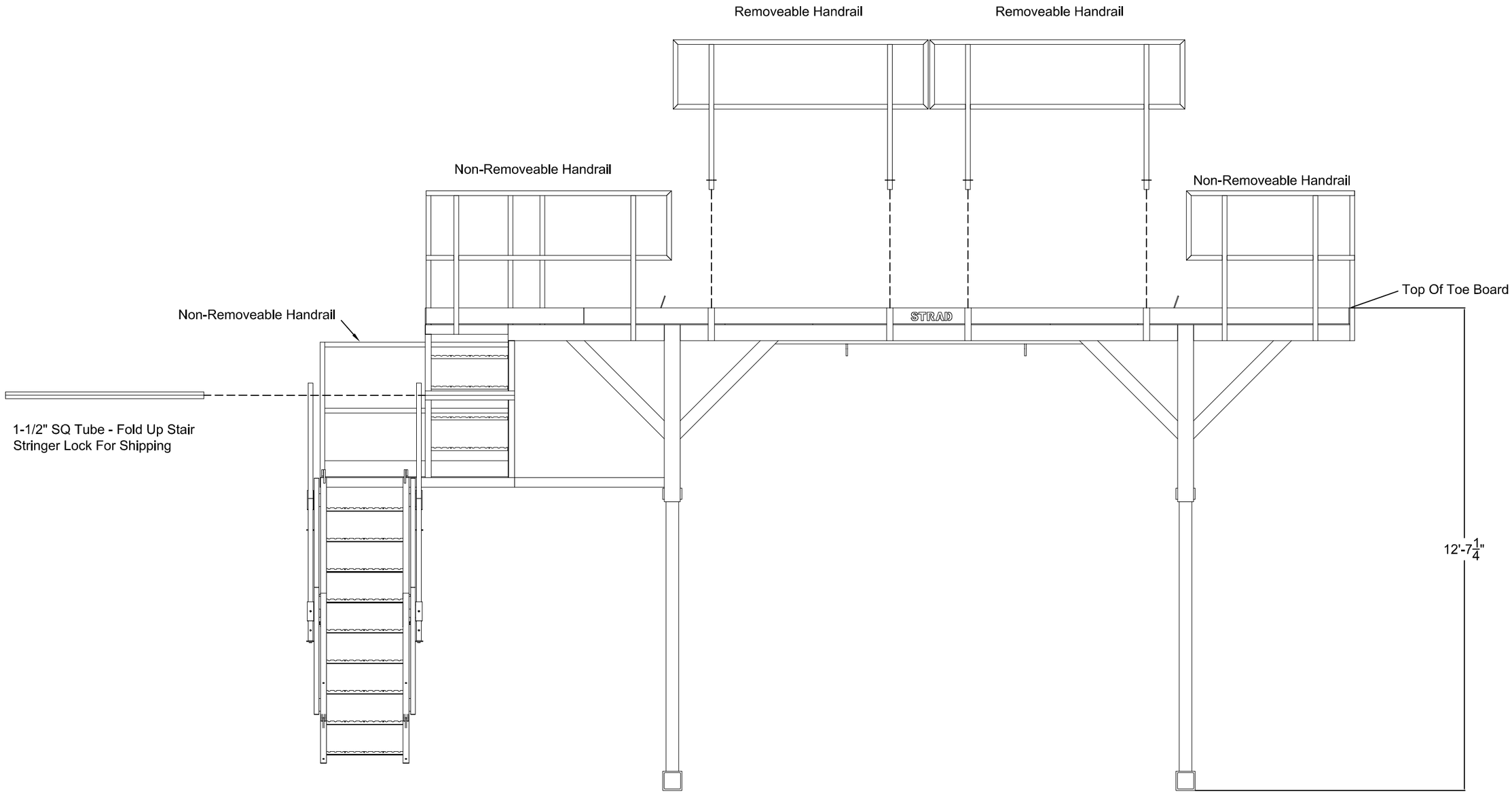
REV	DESCRIPTION	DATE	DSGNR	MGR

B's Fab & Mechanical
981 N. Hwy 174
Rio Vista, TX 76093
www.BsFab.com

DRN BY: TB
SCALE: *
PROJECT # HB-7251

CLIENT:
STRAD Energy Services
DRAWING NAME:
UCS Extended View

DATE:	DRAWING NUM:	REV:
5-7-15	*	*



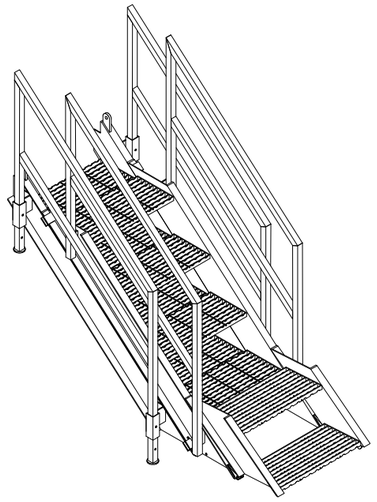
REV	DESCRIPTION	DATE	DSGNR	MGR

B's Fab & Mechanical
981 N. Hwy 174
Rio Vista, TX 76093
www.BsFab.com

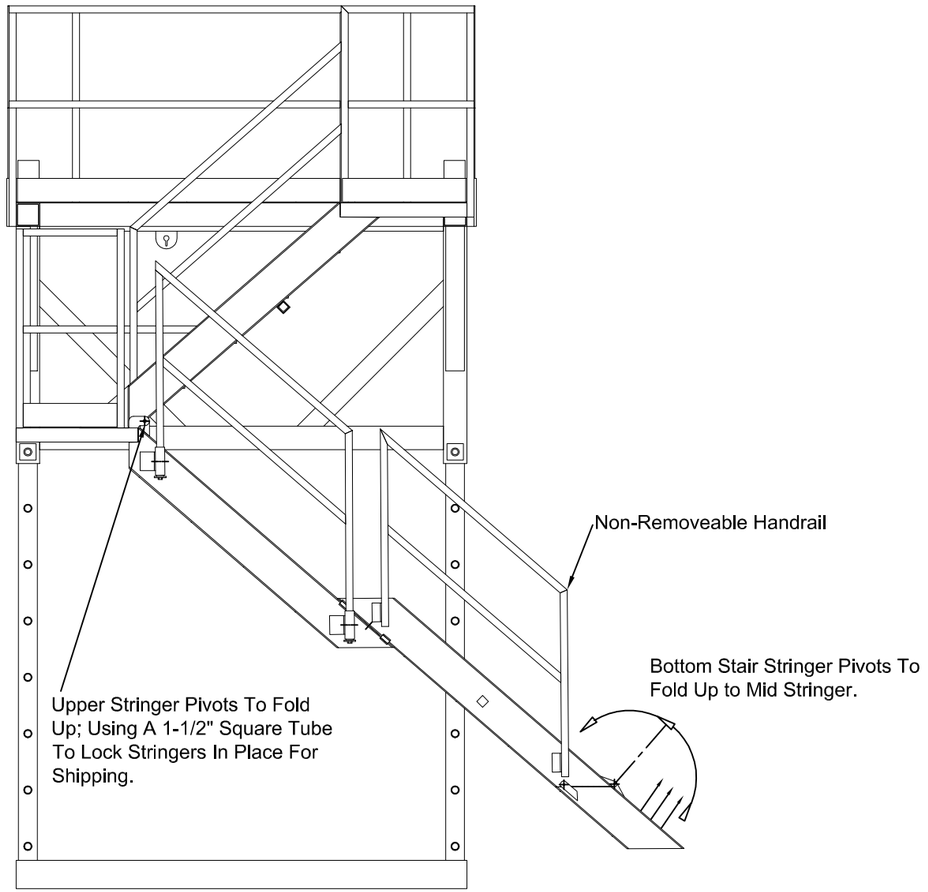
DRN BY: TB
SCALE: *
PROJECT # HB-7251

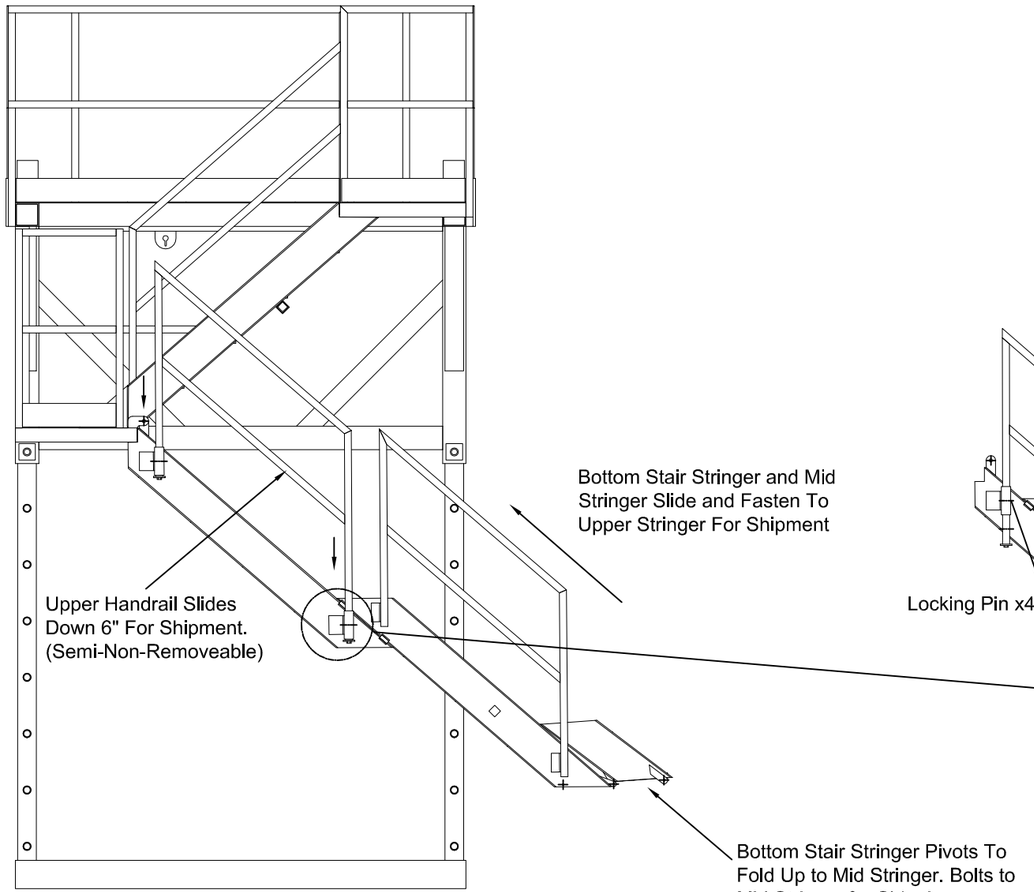
CLIENT:
STRAD Energy Services
DRAWING NAME:
UCS Extended View

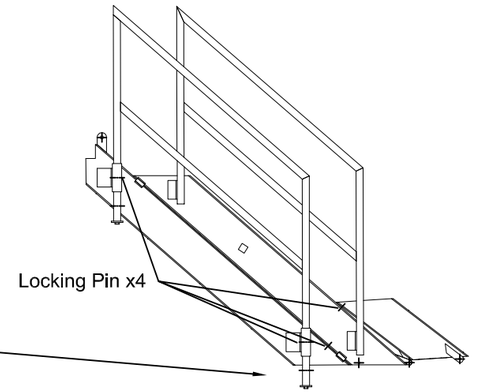
DATE:	DRAWING NUM:	REV:
5-7-15	*	*



Iso View
Folded Stair Stringer Unit







Side Profile
Folded Stair Stringer Unit

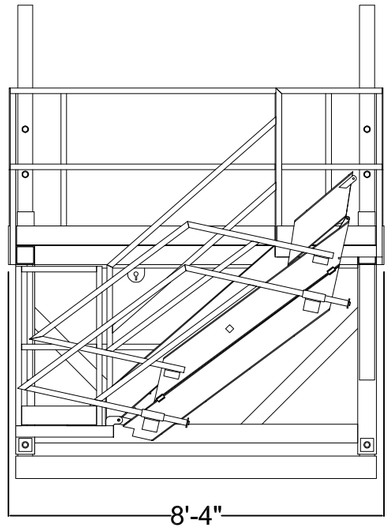
REV	DESCRIPTION	DATE	DSGNR	MGR

B's Fab & Mechanical
981 N. Hwy 174
Rio Vista, TX 76093
www.BsFab.com

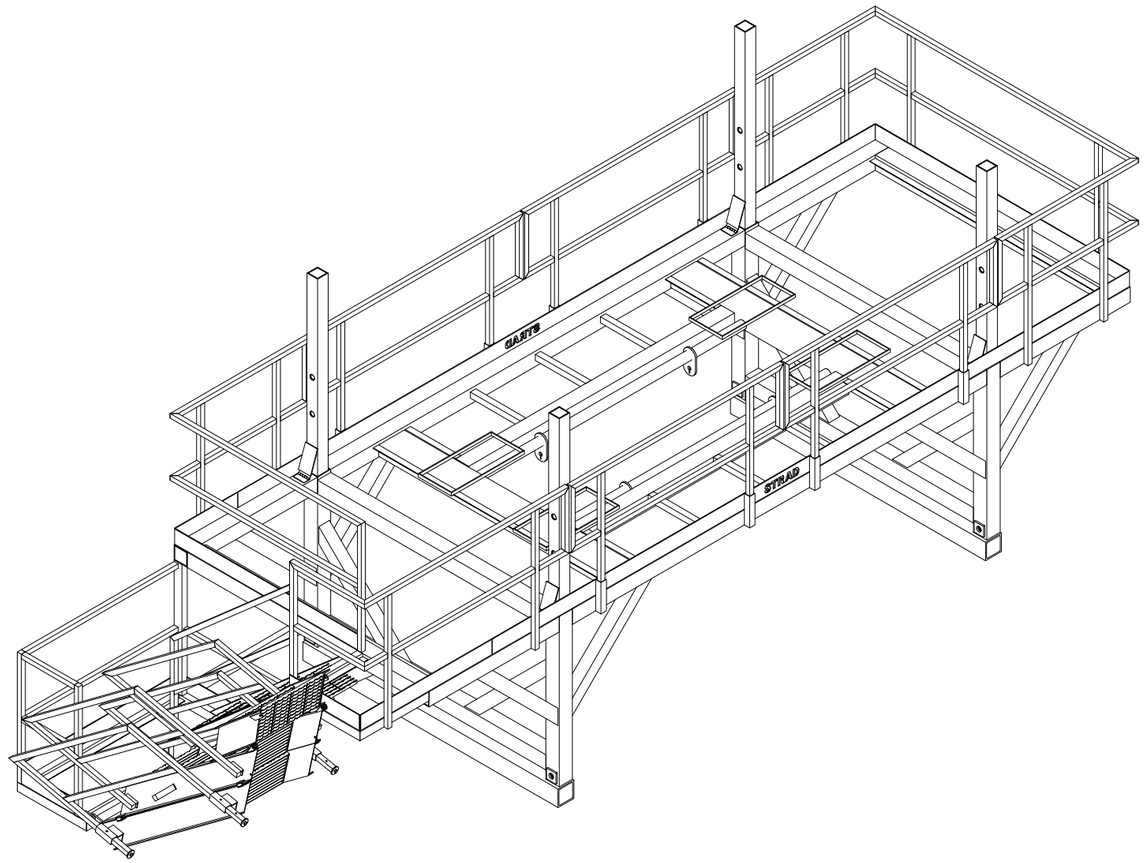
DRN BY: TB
SCALE: *
PROJECT # HB-7251

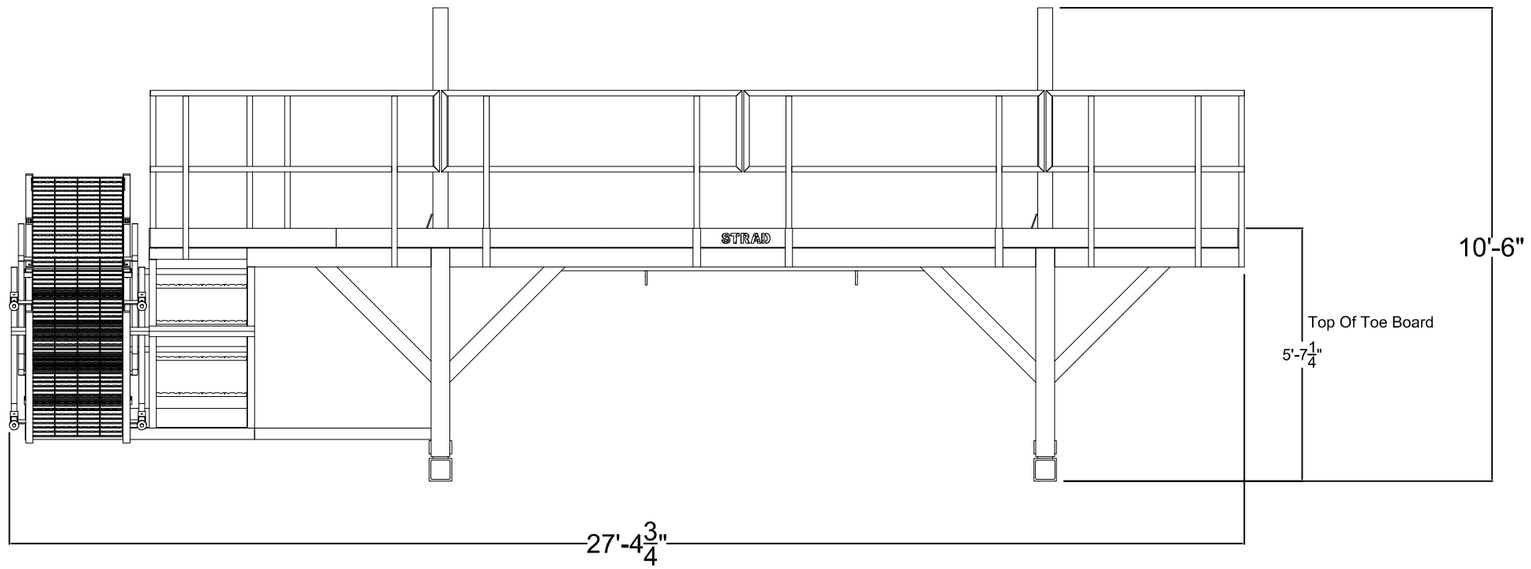
CLIENT:
STRAD Energy Services
DRAWING NAME:
UCS Stringer Desc

DATE:	DRAWING NUM:	REV:
5-7-15	*	*



Side View Of UCS





Grating Removed For Clarity

REV	DESCRIPTION	DATE	DSGNR	MGR

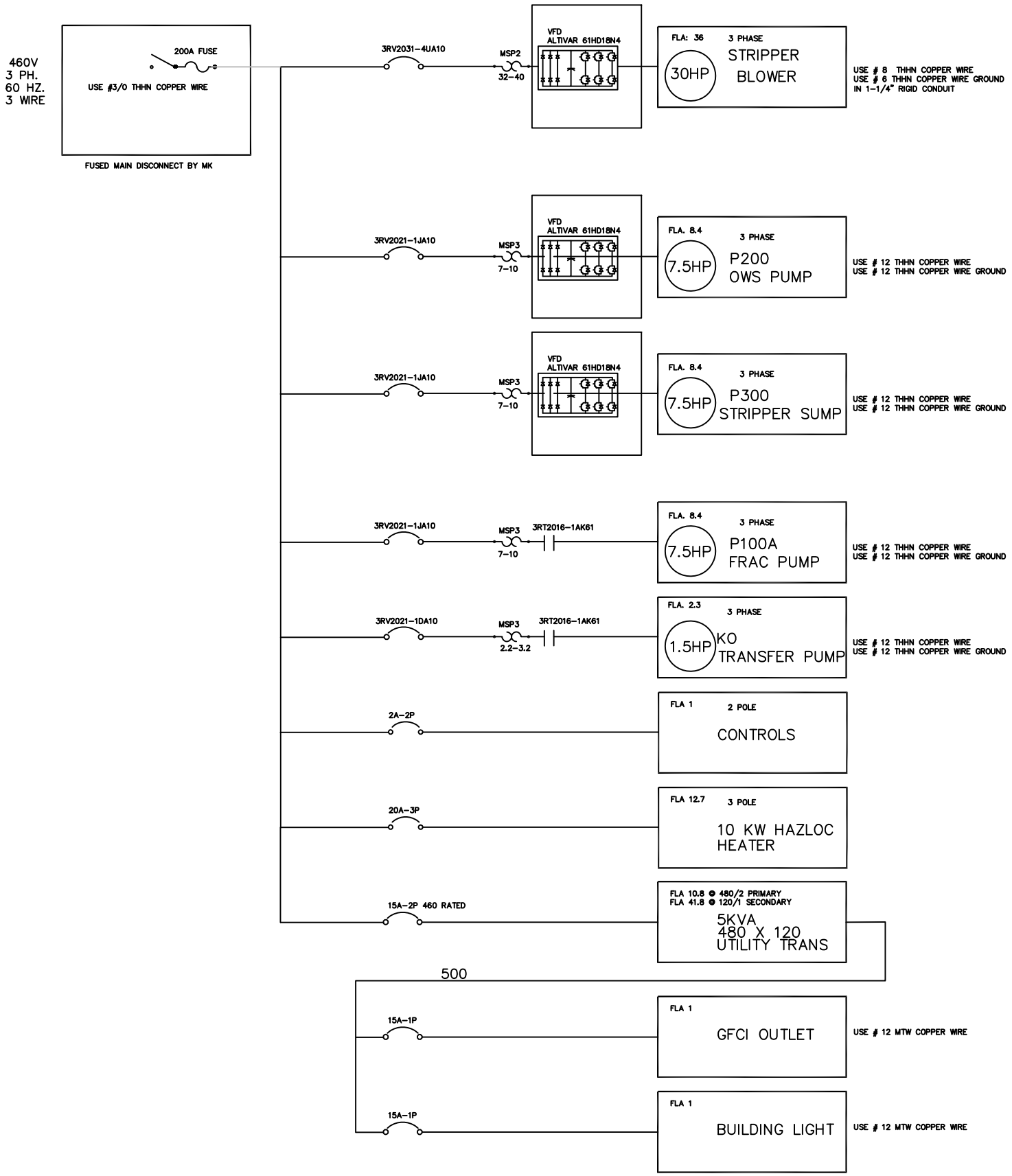
B's Fab & Mechanical
981 N. Hwy 174
Rio Vista, TX 76093
www.BsFab.com

DRN BY: TB
SCALE: *
PROJECT # HB-7251

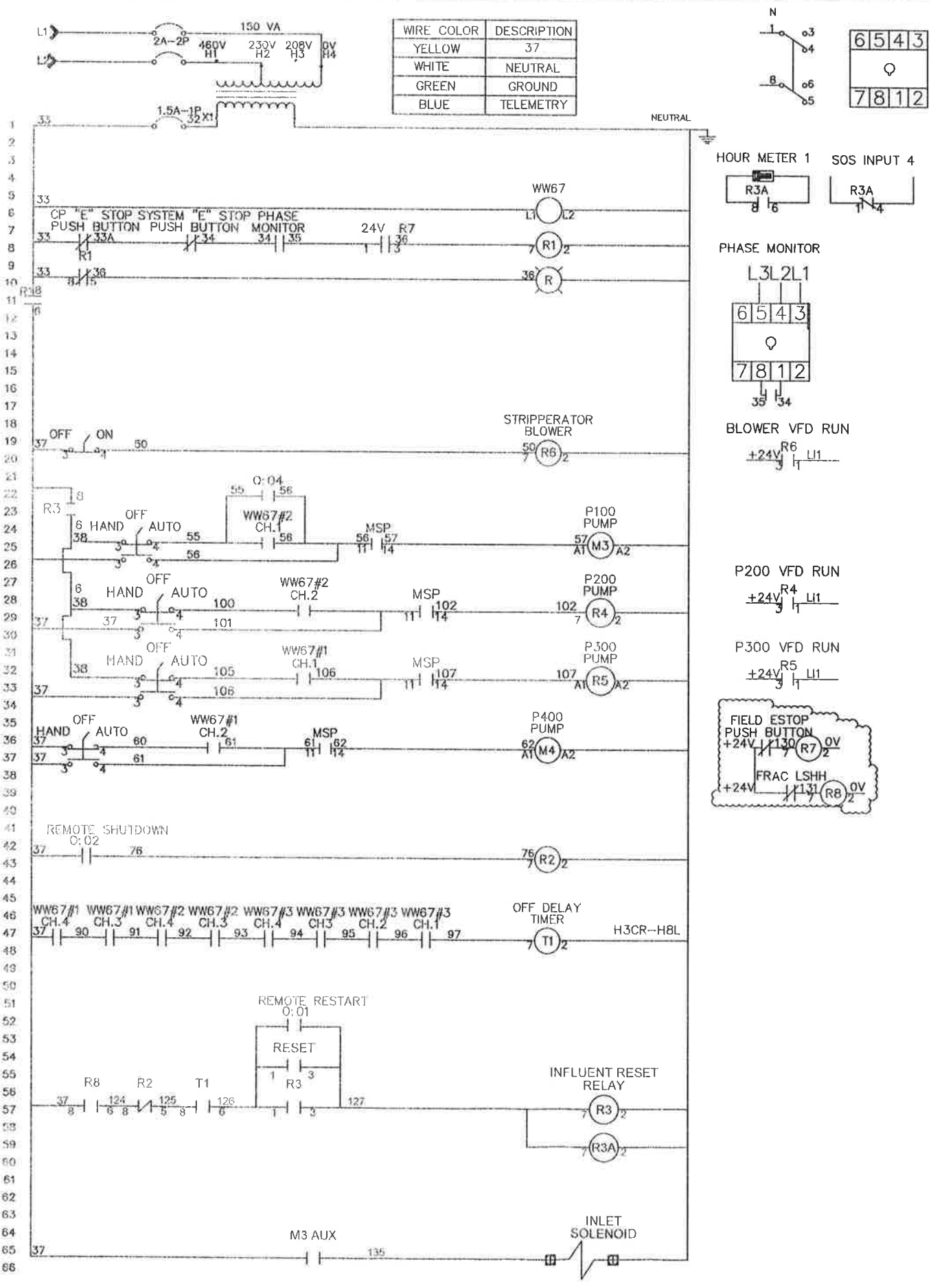
CLIENT:
STRAD Energy Services
DRAWING NAME:
UCS Shiping Arangment

DATE:	DRAWING NUM:	REV:
5-7-15	*	*

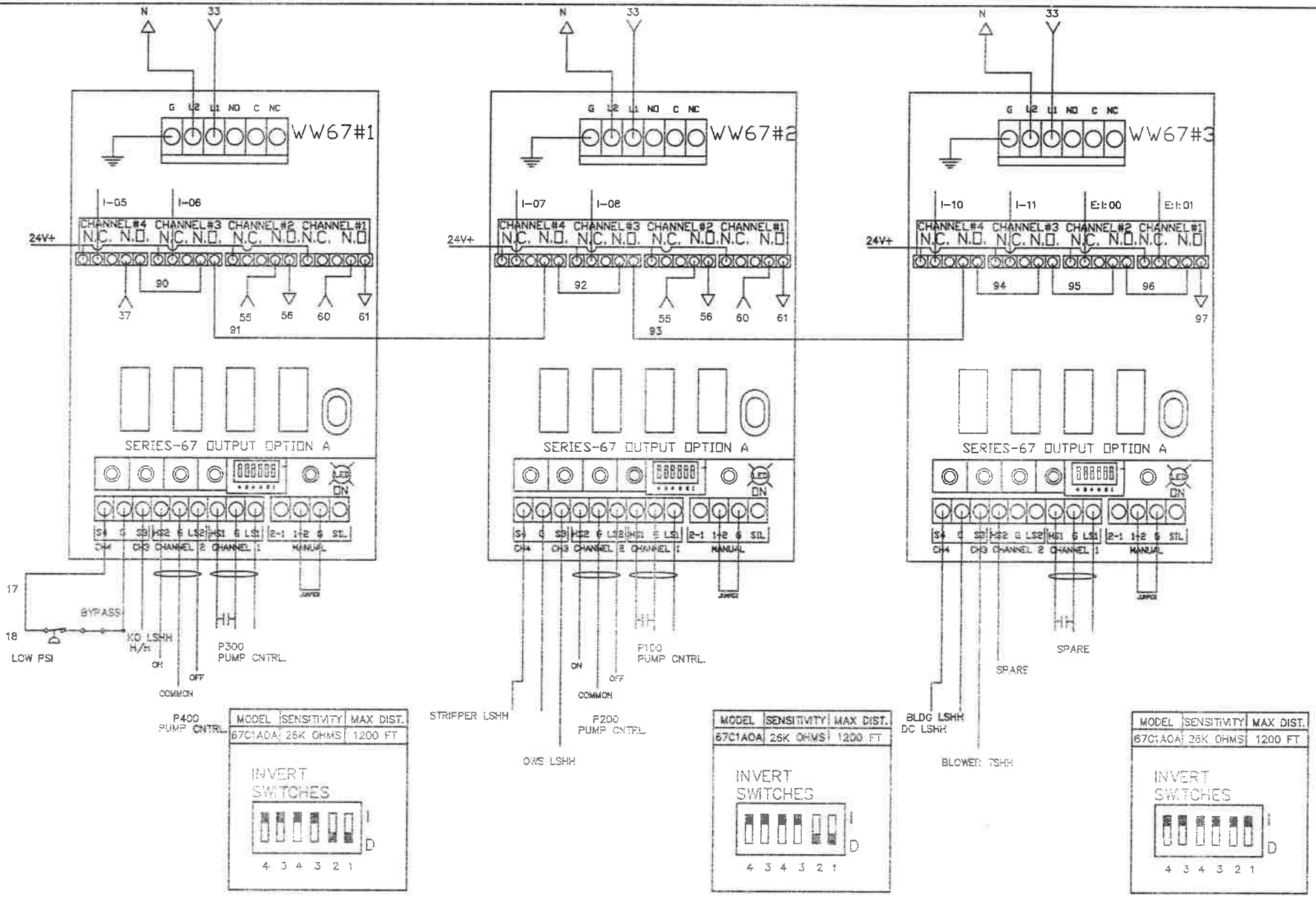
Stormwater Treatment Figures



SCALE: NONE	MK ENVIRONMENTAL INC.	ELECTRICAL ONE LINE	ARCADIS 40 SOUTH MARKET STREET EAST PALESTINE, OHIO 44413 MK PROJECT# 223508C	E-1
DESIGNED: MMG / CHECKED BY:				
DRAWN BY: MMG / DRAWN DATE: 3.27.23			1 4/3/2023 EHT DRAFT	



MK ENVIRONMENTAL INC.	LADDER LOGIC	ARCADIS 40 SOUTH MARKET STREET EAST PALESTINE, OHIO 44413 MK PROJECT# 223508C	E-2



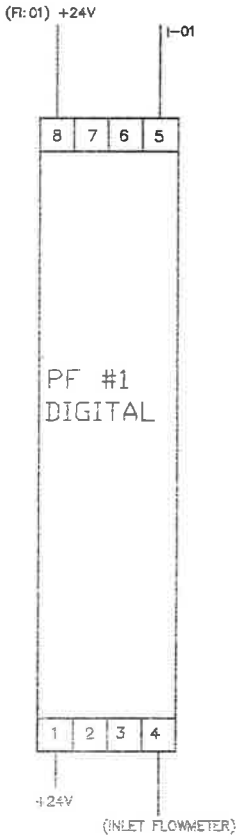
NOTE: THE TWO PUSH BUTTONS LOCATED INSIDE THE BUILDING ON THE JUNCTION BOXES.

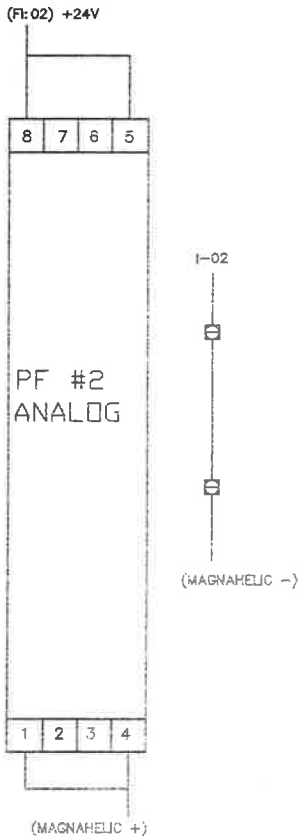
NOTE: WITH THE DIP SWITCHES ON THE WARRICK CONTROLLER IN THE INVERTED (I) MODE AS SHOWN, THE OPERATION OF THE N.O. AND N.C. CONTACTS ARE REVERSED. I.E. THE N.O. CONTACTS ARE HELD CLOSED AND VICE VERSA, WHEN POWER IS APPLIED.

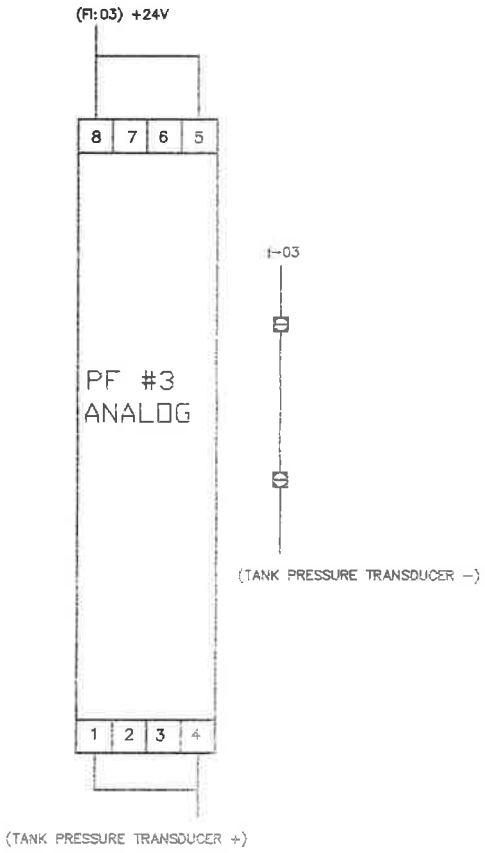
NOTE: OIL LEVEL FLOAT SWITCHES ARROWS POINT DOWN

BLUE = N.O. RED= N.C.

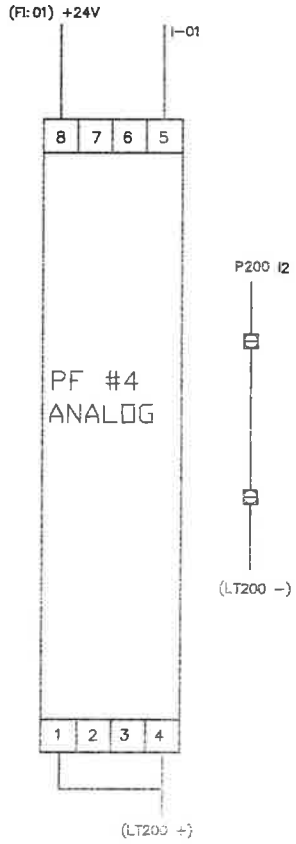
DRAWN: RONE	MK ENVIRONMENTAL INC.	INTRINSICALLY SAFE	ARCADIS 40 SOUTH MARKET STREET EAST PALESTINE, OHIO 44413 MK PROJECT# 2235030
CHECKED: 4.19.23			E-4

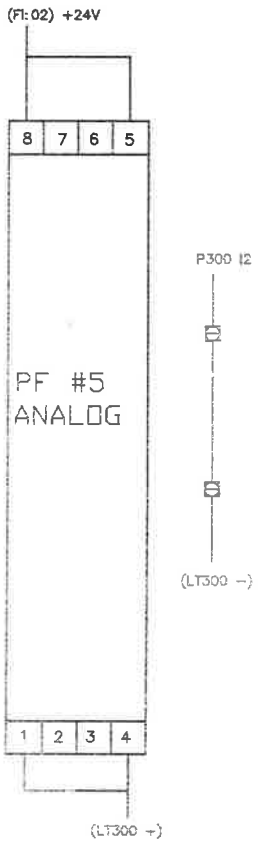






SCALE: NONE DESIGNED BY: MMG DRAWN BY: DJH	MK ENVIRONMENTAL LLC	INTRINSICALLY SAFE	ARCADIS 40 SOUTH MARKET STREET EAST PALESTINE, OHIO 44413 MK PROJECT# 223508C	E-5





NONE

4.19.23

MK ENVIRONMENTAL INC.

INTRINSICALLY SAFE

ARCADIS
40 SOUTH MARKET STREET
EAST PALESTINE, OHIO 44413
MK PROJECT# 223508C

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Appendix B

Treatment System Equipment Manuals

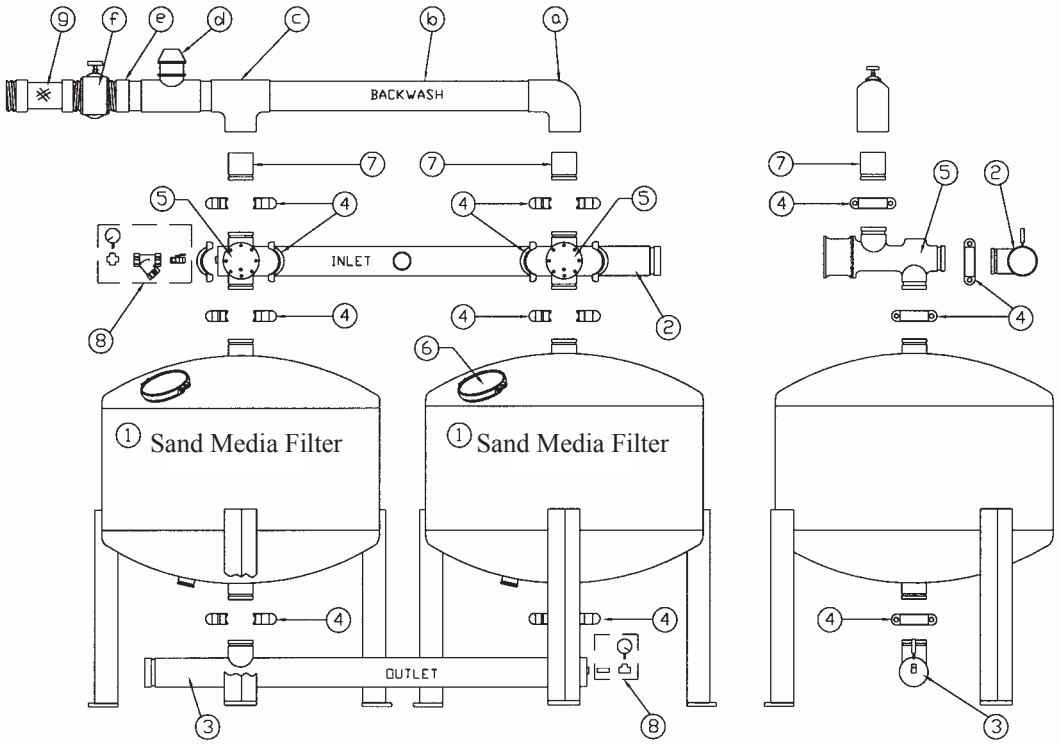
Appendix B is provided in a separate binder that accompanies this Manual

Preliminary Treatment Manuals

- 1 - GENERAL COMPONENTS

A. TANK LOCATION: PLACE FILTER UNITS ON LEVELED SURFACE IN THE APPROXIMATE POSITION IN, WHICH THEY WILL BE INSTALLED FOR OPERATION. THIS POSITION SHOULD ALLOW THE BEST ACCESS TO THE FILLPORT.

MANIFOLD AND VALVE ASSEMBLY

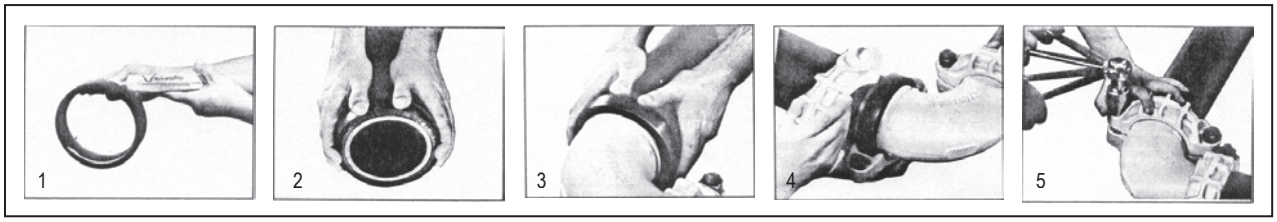


SUPPLIED WITH FILTER UNITS
1. SAND FILTER TANK
2. INLET MANIFOLD WITH COUPLING
3. OUTLET MANIFOLD WITHOUT COUPLING
4. GROOVED COUPLINGS
5. BACKWASH VALVE
NOTE: Backwash valve must be installed as shown-DO NOT REVERSE.
6. FILLPORT
7. PVC ADAPTER (GxS)
8. HYDRAULIC PICK-UP KIT (See Hydraulic Pick-Up Kit Drawing)

a. PVC 90° ELBOW
b. PVC PIPING
c. PVC TEE
d. AIR, VACUUM VENT
e. PVC MALE ADAPTER
f. RESTRICTOR VALVE
g. VIEW TUBE

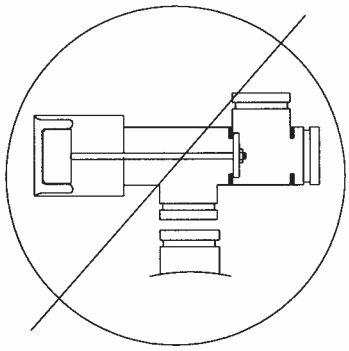
UNIT ASSEMBLY

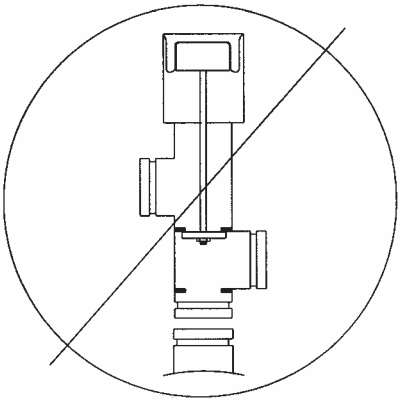
A. INSTALL OUTLET MANIFOLD: COUPLE OUTLET MANIFOLD TO TANK BOTTOM PORTS. DO NOT FULLY TIGHTEN GROOVED COUPLINGS. REFER TO GROOVE COUPLING ASSEMBLY BELOW.

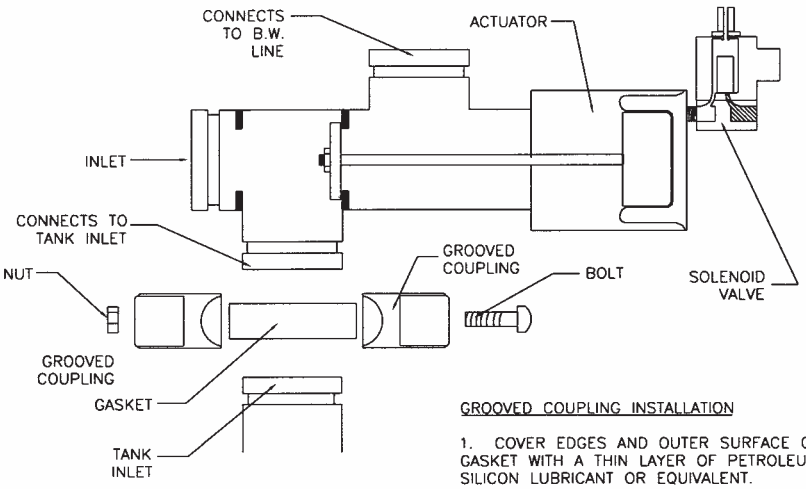


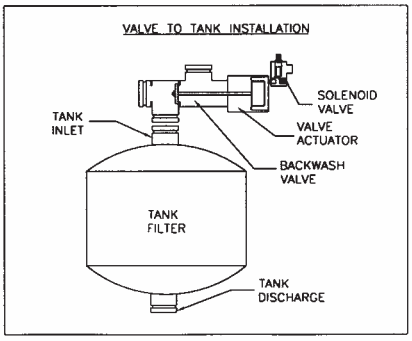
1. CHECK GASKET AND LUBRICATE: APPLY A THIN COAT OF LUBRICANT OR SOAPY WATER TO GASKET LIPS AND OUTSIDE OF GASKET.
2. INSTALL GASKET: PLACE GASKET OVER PIPE END, BEING SURE GASKET LIP DOES NOT OVERHANG PIPE END.
3. ALIGN AND BRING TWO PIPE ENDS TOGETHER AND SLIDE GASKET INTO POSITION CENTERED BETWEEN THE GROOVES ON EACH PIPE. NO PORTION OF THE GASKET SHOULD EXTEND INTO THE GROOVE ON EITHER PIPE.
4. APPLY HOUSING: PLACE HOUSINGS OVER GASKET, BEING SURE THE HOUSING KEYS ENGAGE INTO THE GROOVES. INSERT BOLTS AND APPLY NUTS FINGER TIGHT.
5. TIGHTEN NUTS ALTERNATELYAND EQUALLY UNTIL HOUSING BOLT PADS ARE FIRMLY TOGETHER. CAUTION: UNEVEN TIGHTENING MAY CAUSE GASKET TO PINCH.

B. INSTALL BACKWASH VALVES: COUPLE BACKWASH VALVES TO MEDIA TANKS AS SEEN HERE. DO NOT INSTALL BACKWASH VALVE UP SIDE DOWN. DO NOT FULLY TIGHTEN GROOVED COUPLINGS. REFER TO GROOVED COUPLING ASSEMBLY BELOW.









GROOVED COUPLING INSTALLATION

1. COVER EDGES AND OUTER SURFACE OF THE GASKET WITH A THIN LAYER OF PETROLEUM-FREE SILICON LUBRICANT OR EQUIVALENT.
2. INSTALL THE GASKET BY PLACING THE GASKET OVER THE PIPE AND ENSURE THAT THE GASKET LIP DOES NOT OVERHANG THE PIPE END.
3. BRING BOTH PIPE ENDS TOGETHER, ENSURE PROPER ALIGNMENT AND SLIDE THE GASKET INTO POSITION, PROPERLY CENTERING IT BETWEEN THE GROOVED PORTIONS OF EACH PIPE.
4. PLACE THE COUPLING HOUSINGS OVER THE GASKET SO THAT THE HOUSING KEYS FULLY ENGAGE INTO GROOVES. INSERT THE BOLTS INTO THE COUPLINGS AND ROTATE THE NUTS UNTIL FINGERTIGHT.
5. TIGHTEN BOLTS ALTERNATELY AND EVENLY.

CAUTION: UNEVEN TIGHTENING CAN CAUSE THE GASKETS TO PINCH.

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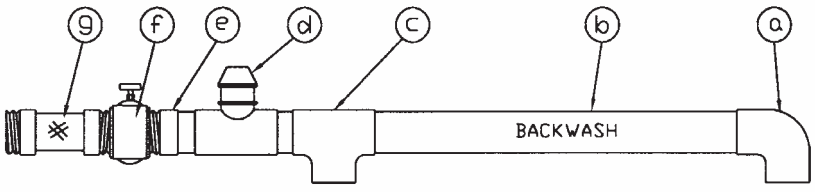
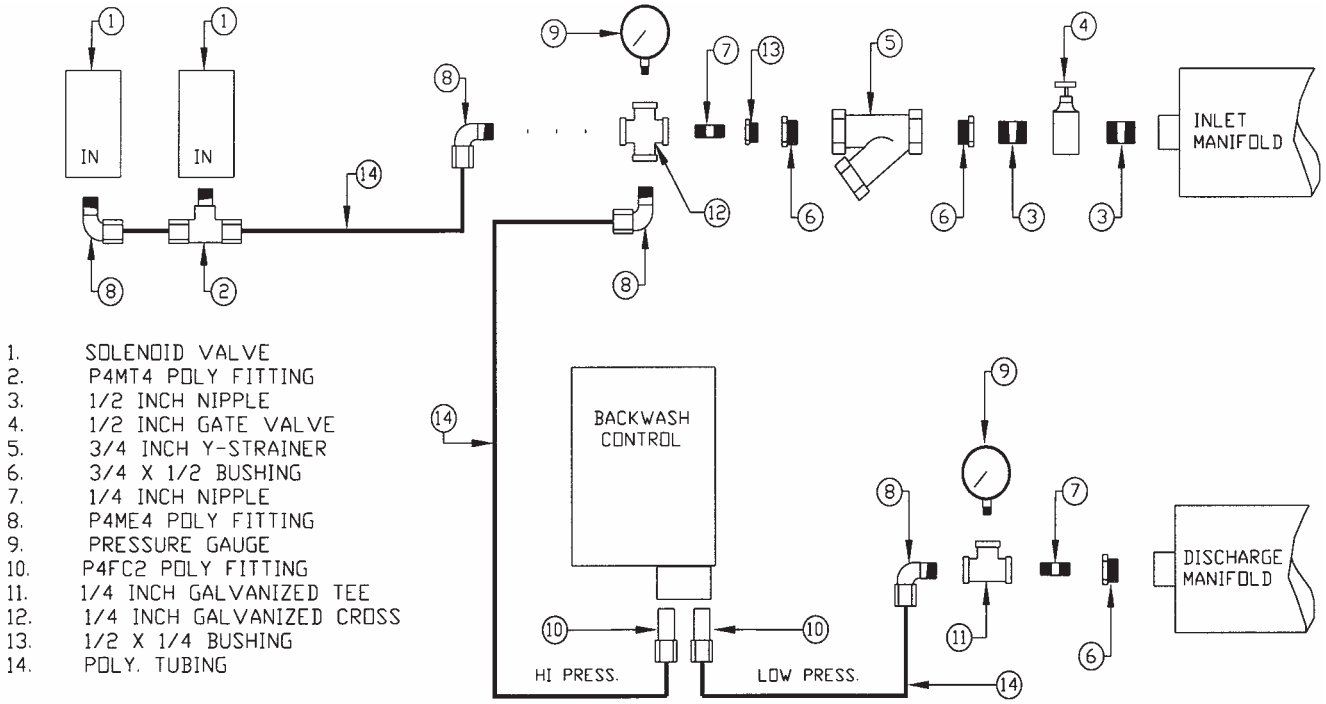
C. INLET MANIFOLD: COUPLE INLET MANIFOLD TO BACKWASH VALVE INLET PORTS. REFER TO THE 'BASIC SYSTEMS COMPONENT TP-190' DRAWING FOR CORRECT POSITIONING OF INLET MANIFOLD. DO NOT FULLY TIGHTEN GROOVED COUPLINGS.

D. INSTALL PVC GROOVED ADAPTERS: GROOVE ADAPTERS CONNECTED TO BACKWASH PORT.

E. INSTALL BACKWASH MANIFOLD ASSEMBLY: IT IS NECESSARY TO INSTALL A RESTRICTOR VALVE/GATE VALVE FOR PROPER BACKWASH FLOW REGULATION. ALWAYS INSTALL AN AIR VENT/VACUUM RELIEF VALVE ON THE BACKWASH MANIFOLD. THE OPTIONAL VIEW TUBE WILL FACILITATE PROPER ADJUSTMENT OF THE RESTRICTOR VALVE AND AID IN ADJUSTING THE LENGTH OF THE BACKWASH CYCLE.

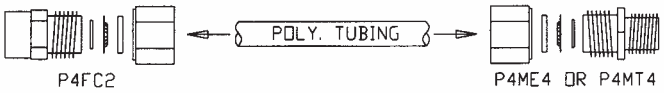


HYDRAULIC PICK-UP KIT INSTALLATION



1. SOLENOID VALVE
2. P4MT4 POLY FITTING
3. 1/2 INCH NIPPLE
4. 1/2 INCH GATE VALVE
5. 3/4 INCH Y-STRAINER
6. 3/4 X 1/2 BUSHING
7. 1/4 INCH NIPPLE
8. P4ME4 POLY FITTING
9. PRESSURE GAUGE
10. P4FC2 POLY FITTING
11. 1/4 INCH GALVANIZED TEE
12. 1/4 INCH GALVANIZED CROSS
13. 1/2 X 1/4 BUSHING
14. POLY. TUBING

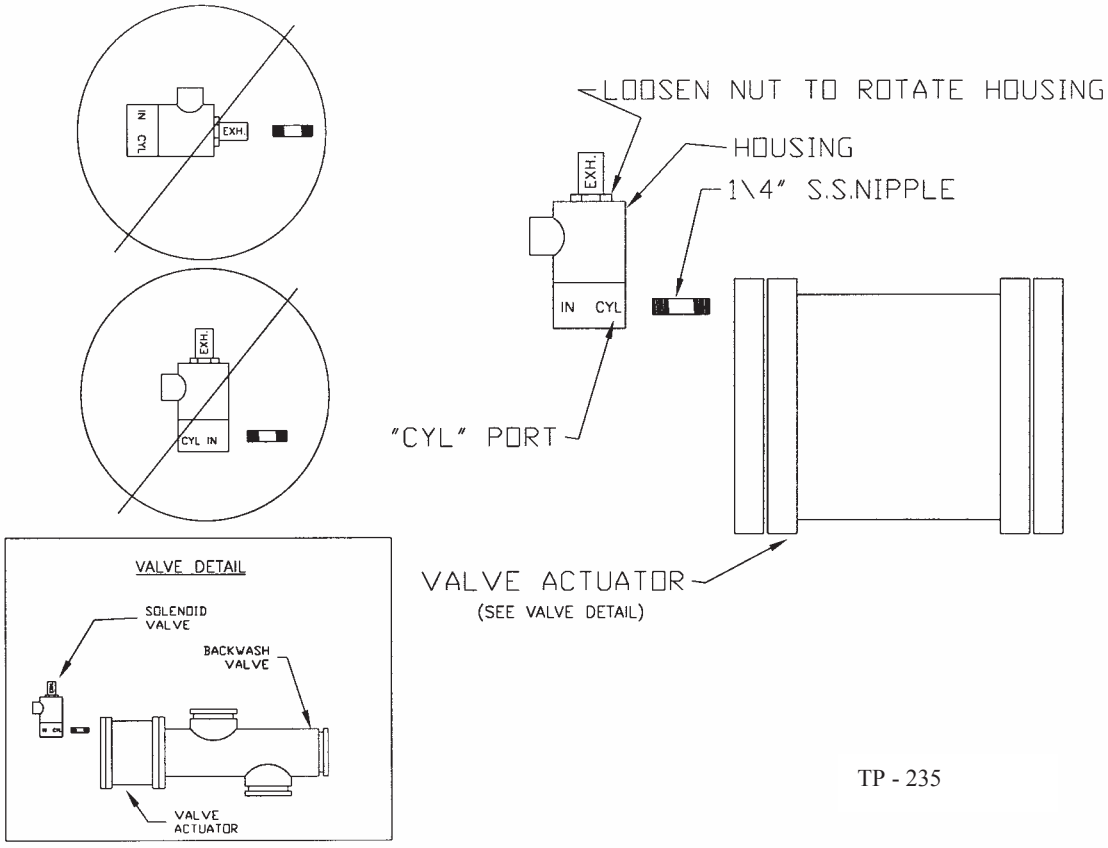
INSTALLATION OF TUBING



CUT THE TUBE SQUARELY AND REMOVE ANY BURRS. LOOSEN NUT ON FITTING UNTIL THREE THREADS ARE VISIBLE. MOISTEN END OF THE TUBE WITH WATER. PUSH TUBE STRAIGHT INTO FITTING UNTIL IT BOTTOMS ON THE FITTING'S SHOULDER. TIGHTEN NUT BY HAND.

NOTE:
A LENGTH OF TUBING SHOULD BE ATTACHED TO THE EXHAUST PORT OF EACH SOLENOID VALVE TO CHANNEL EXHAUST WATER FROM THE ACTUATOR.

SOLENOID CONNECTION:



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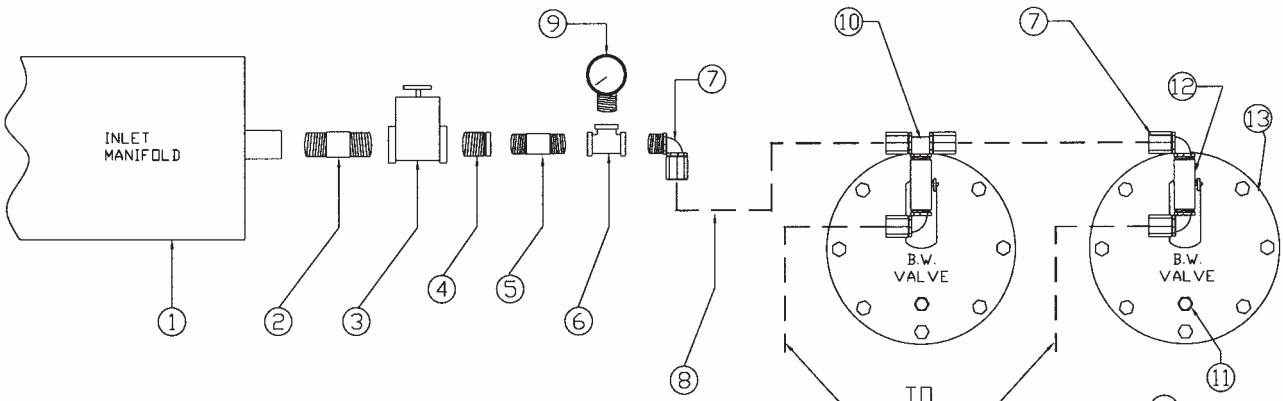
SEMI-AUTO SCHEMATIC:



1. INLET MANIFOLD
2. 1/2" CLOSE NIPPLE
3. 1/2" GATE VALVE
4. 1/2"X1/4" REDUCER BUSHING
5. 1/4" CLOSE NIPPLE
6. 1/4" TEE
7. P4ME4 POLY. FITTING
8. 1/4" O.D. POLY. TUBING
9. PRESSURE GAUGE (OPTIONAL)
10. P4MT4 POLY. FITTING
11. ACTUATOR FLUSH PLUG
12. 1/2" 3-PORT 2 WAY BALL VALVE
13. ACTUATOR CAVER
14. INSPECTION HOLE

NOTES:
1. BALL VALVES MUST BE INSTALLED WITH LEVER ON R.H. SIDE OF VALVE WHEN VIEWING COVER.
2. PUSH LEVER DOWN TO BACKWASH

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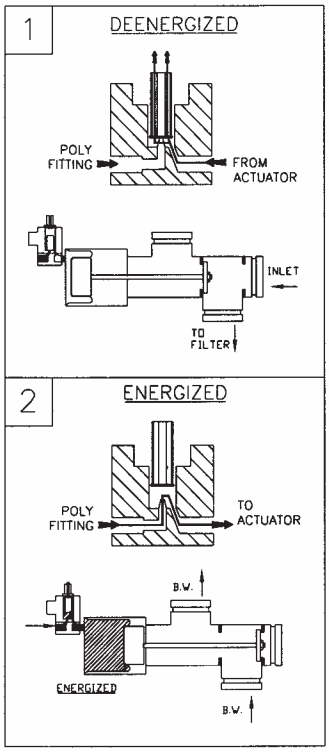
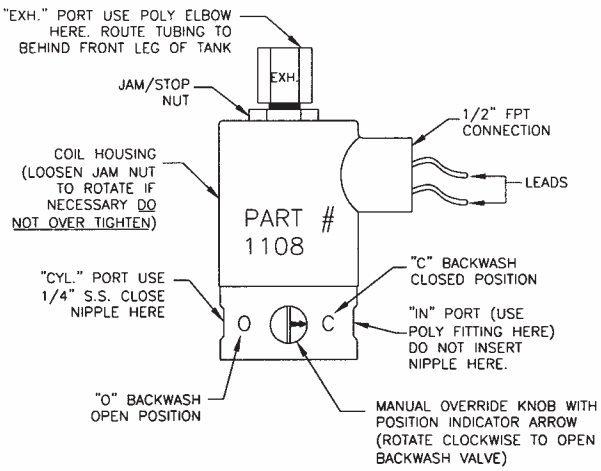
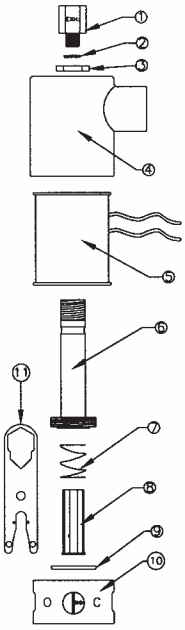
SOLENOID VALVE ASSEMBLY:





1. ADAPTER
2. ADAPTER SEAL
3. STOP NUT
4. HOUSING ASSY.
5. COIL ASSY.
6. SLEEVE ASSY.
7. SPRING
8. PLUNGER ASSY.
9. FLANGE SEAL
10. BODY
11. SPANNER TOOL



1. PLUNGER ASSEMBLY RESTS INSIDE SOLENOID BODY PREVENTING FLOW TO THE ACTUATOR. ACTUATOR IS ALLOWED TO EXHAUST THROUGH PLUNGER ASSEMBLY.

2. SOLENOID ENERGIZES, PLUNGER ASSEMBLY RISES AND FLOW IS ALLOWED INTO ACTUATOR, ACTUATOR DIAPHRAM FILLS.

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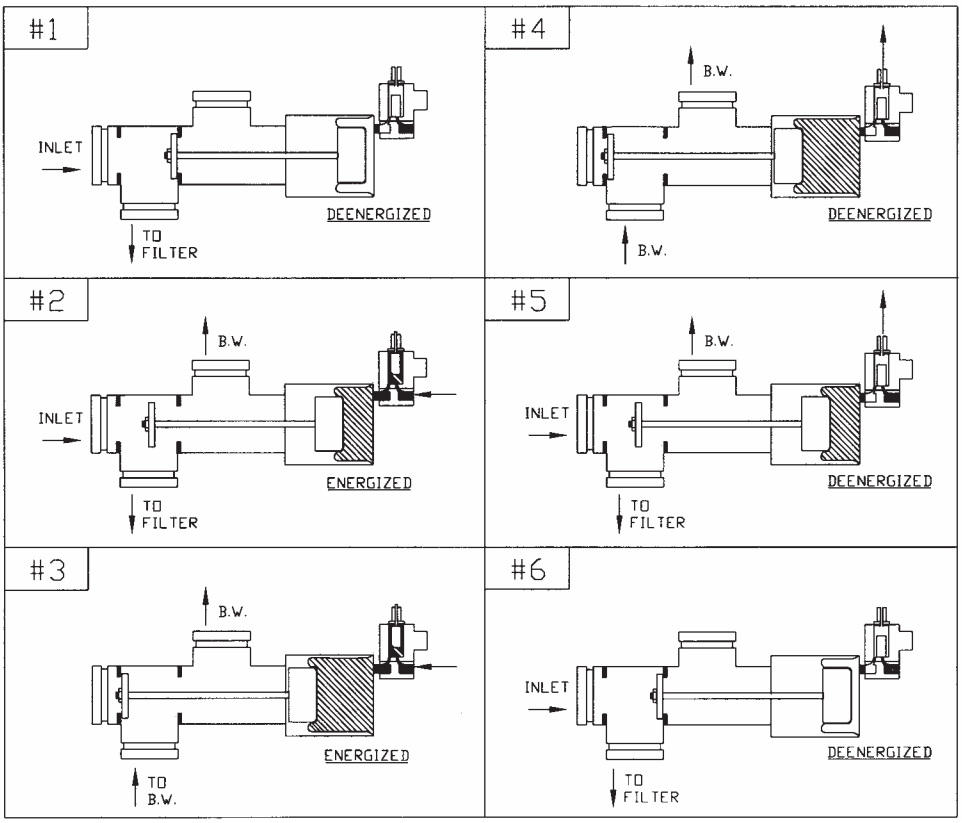
BACKWASH AND SOLENOID VALVE OPERATION:



1. FLOW FROM INLET TO FILTER. SOLENOID VALVE DEENERGIZED.
2. SOLENOID VALVE ENERGIZED. FLOW FROM INLET TO FILTER AND TO BACKWASH LINE.
3. SOLENOID VALVE ENERGIZED. FLOW FROM TANK TO BACKWASH LINE.
4. SOLENOID VALVE DEENERGIZED. FLOW FROM TANK TO BACKWASH LINE.
5. SOLENOID VALVE DEENERGIZED. FLOW FROM INLET TO FILTER AND TO BACKWASH LINE.
6. FLOW FROM INLET TO FILTER. SOLENOID VALVE DEENERGIZED.

HI PRESS. WATER

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MEDIA INSTALLATION

NOTE: SSM MODELS USE THE SAME MEDIA AMOUNTS.

1. REMOVE FILL PORT COVER AND CHARGE FILTER WITH CORRECT AMOUNT OF GRAVEL AND HALF MEDIA. SEE FIGURES 1 & 2.

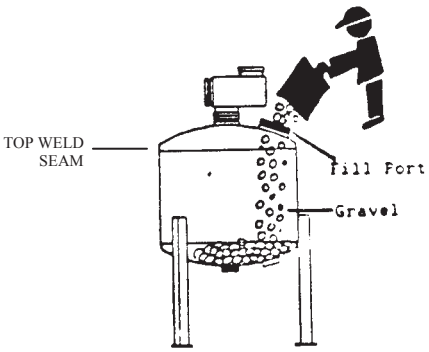

FIGURE 1

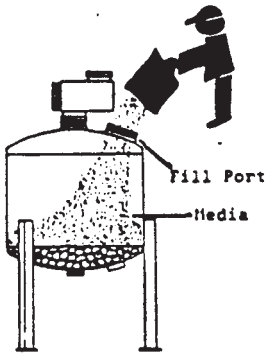

FIGURE 2

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2. REPLACE FILL PORT COVER AND TIGHTEN CLAMPS.

3. RESTRICT OR SHUT-OFF DISCHARGE (OUTLET LINE) OF FILTERS FOR MAXIMUM PRESSURE AND FLOW DURING BACKWASH.

4. START UP SYSTEM AND BACKFLUSH FILTERS. OPEN RESTRICTOR VALVE UNTIL A SMALL AMOUNT OF MEDIA IS PRESENT IN THE BACKWASH WATER (VIEW THROUGH SIGHT GLASS). REPEAT 4 OR 5 TIMES FOR EACH FILTER.

5. SHUT DOWN THE SYSTEM AND ALLOW FILTER TO DRAIN.

6. REMOVE FILL PORT COVER AND CHARGE FILTER WITH REMAINING HALF OF MEDIA.

7. REPLACE FILL PORT COVER.

8. REPEAT STEP 4.

9. SYSTEM IS NOW READY FOR NORMAL OPERATION AND FINAL ADJUSTMENT OF BACKWASH RESTRICTOR VALVE.

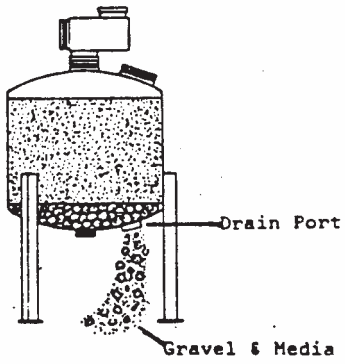
10. ADJUST RESTRICTOR VALVE FOR MAXIMUM CLEANING WHEN NORMAL OPERATING FLOW AND PRESSURE HAVE STABILIZED. MAXIMUM CLEANING IS REACHED WHEN NO MORE UNWANTED PARTICLES ARE SEEN THROUGH SIGHT GLASS.

NOTES:
FILTERS SHOULD BE BACKWASHED AT THE FOLLOWING PRESSURE DIFFERENTIAL:

25 GPM/FT^2	---- ---- ---- ---- ---- ----	7 PSI DIFFERENTIAL
20 GPM/FT^2	---- ---- ---- ---- ---- ----	5 PSI DIFFERENTIAL
15 GPM/FT^2	---- ---- ---- ---- ---- ----	3 PSI DIFFERENTIAL
10 GPM/FT^2	---- ---- ---- ---- ---- ----	2 PSI DIFFERENTIAL
BELOW 10 GPM/FT^2	---- ---- ---- ---- ---- ----	1 PSI DIFFERENTIAL

PRESSURE DIFFERENTIAL SWITCH FOR AUTOMATIC CONTROL SHOULD BE SET USING THE ABOVE PARAMETERS.

11. MEDIA REMOVAL: SHUT DOWN WATER SUPPLY TO SYSTEM AND REMOVE BOTTOM DRAIN PLUG. TURN ON WATER SUPPLY TO SYSTEM AND DRAIN MEDIA FROM TANK AS SHOW BELOW.



MEDIA CLEANING

IT IS RECOMMENDED THAT THE FILTERS BE BACKWASHED WHEN A 5-PSI DIFFERENTIAL, AT 20 GPM/FT^2 FLOW IS REACHED. TO BACKWASH, OPERATE BACKWASH VALVE FOR A MINIMUM OF TWO-MINUTE PER FILTER. CHECK DIFFERENTIAL AND IF NOT NORMAL, REPEAT BACKWASH PROCEDURE.

FILTER INSPECTION

PERIODIC INSPECTION IS NECESSARY AND SHOULD BE DONE AT LEAST MONTHLY OR MORE FREQUENTLY IN SEVERE CONDITIONS. CHECK THE FOLLOWING:

1. MEDIA ---------- ADD MEDIA WHEN 2" BELOW TOP WELD SEAM. BREAK UP ANY SOLIDIFICATION OF MEDIA AND BACKFLUSH UNTIL CLEAN. READJUST BACKWASH RESTRICTOR VALVE AS REQUIRED.

2. EXTERIOR ------- TOUCH UP OR REPAINT AS REQUIRED.

AUTOMATIC BACKWASH CONTROLS

DESCRIPTION

AUTOMATIC BACKWASH OF THESE SYSTEMS ARE ACCOMPLISHED VIA THE MODEL 94B SERIES CONTROLLERS - A SOLID STATE ELECTRONIC CONTROL UNIT, CAPABLE OF OPERATING ONE MASTER VALVE AND UP TO 12 BACKWASH VALVES.

THE CONTROL WILL INITIATE A BACKWASH CYCLE AFTER REACHING A PRE-SET TIME OR BY RECEIVING A SIGNAL FROM THE PRESSURE DIFFERENTIAL (P.D.) SWITCH INDICATING A DIRTY FILTER CONDITION.

OPERATION

THE CONTROLLER WILL BEGIN TIMING OF THE BACKWASH INTERVAL WHEN THE POWER SWITCH IS TURNED ON. WHEN THE BACKWASH INTERVAL TIME HAS EXPIRED, THE CONTROLLER WILL INITIATE A BACKWASH CYCLE. IF THE P.D. ON-OFF SWITCH IS IN THE "ON" POSITION, IT WILL INITIATE A BACKWASH CYCLE IF THE PRESSURE DIFFERENTIAL REACHES ITS SETTING AND REMAINS THERE FOR APPROXIMATELY FIFTEEN (15) SECONDS.

THE MASTER VALVE WILL ENERGIZE AND REMAIN IN THIS CONDITION AS EACH STATION IS ENERGIZED, DE-ENERGIZED AND ALLOWED TO PASS THROUGH ITS DWELL PERIOD. AT THE END OF THE BACKWASH CYCLE THE MASTER VALVE WILL DE-ENERGIZE. THE CONTROL WILL CONTINUE TO REPEAT THIS PROCEDURE UNTIL THE POWER SWITCH IS TURNED OFF.

SPECIFICATIONS:

VOLTAGES

VOLTAGE INPUT (TRANSFORMER)	120 VAC	50-60 HZ
VOLTAGE INPUT (CONTROL PANEL)	12 VDC/12 VAC	50-60 HZ
VOLTAGE OUTPUT	12 VDC	

LOADING

CONTROL PANEL DORMANT	25 MA
SEQUENCING	300 MA
MASTER VALVE	1.0 AMP
STATIONS	2.0 AMPS

TIMING

BACKWASH INTERVAL	0 HRS. TO 168 HRS.
FLUSH TIME	0 SEC. TO 330 MIN.
DWELL TIME	0 SEC. TO 90 MIN.
P.D. DELAY	0 SEC. TO 360 SEC.

CAPACITY

MASTER VALVE	1
STATIONS (STD. SOLENOID VALVES)	1-12

ENCLOSURE DIMENSIONS

HEIGHT 11.50”
WIDTH 7.62”
DEPTH 4.62”

WEIGHT

10.5 LBS.

BACKWASH VALVES (3” AND 4”)

THE BACKWASH VALVE IS A THREE (3) PORT, TWO (2) WAY VALVE, COMBINING BOTH FILTRATION AND BACKWASH MODES IN A SINGLE RUGGED UNIT. THIS ONE VALVE ACCOMPLISHES WHAT WOULD NORMALLY REQUIRE TWO VALVES MOUNTED IN A “TEE” CONFIGURATION.

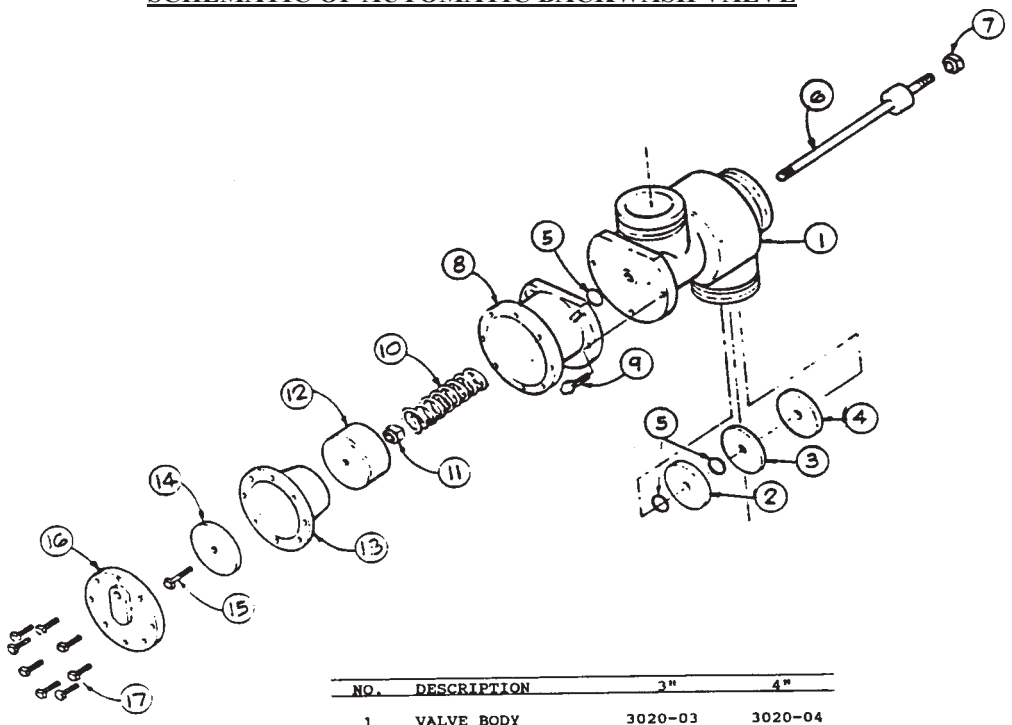
THE VALVE IS PICTURED ON THIS PAGE. IT IS FULLY OPEN IN EITHER THE FILTRATION OR BACKWASH POSITION, GIVING FULL UNRESTRICTED FLOW.

THE VALVE BODY IS CAST FROM DUCTILE IRON AND THEN COATED WITH 3M 134 FUSION BONDED EPOXY. THE USE OF THESE MATERIALS, AS COMPARED TO PLASTIC OR OTHER METALS, YIELDS AN EXTREMELY STRONG RUGGED UNIT THAT WILL WITHSTAND THE ABUSE OF HEAVY WRENCH OR OTHER OVERLOAD.

THE SHAFT IS 303 STAINLESS STEEL AND IS CORROSION AND WEAR-RESISTANT FOR LONG HEAVY DUTY SERVICE. THE POLYURETHANE VALVE SEAL IS BACKED UP WITH DUCTILE IRON SUPPORT PLATES TO ASSURE A POSITIVE SHUT OFF.

THE ACTUATOR FOR AUTOMATIC OPERATION HAS AN ALUMINUM HOUSING, PISTON AND COVER FOR LONG SERVICE LIFE. THE RETURN SPRING AND ROLLING DIAPHRAGM ARE DESIGNED TO OPERATE THE VALVE SMOOTHLY UNDER A VARIETY OF CONDITIONS, WITHOUT DANGER OF VALVE SLAMMING.

SCHEMATIC OF AUTOMATIC BACKWASH VALVE



NO.	DESCRIPTION	3"	4"
1	VALVE BODY	3020-03	3020-04
2	VALVE TOP PLATE	2039-03	2039-04
3	VALVE SEAL	1065-01	1065-02
4	VALVE BOTTOM PLATE	2040-03	2040-04
5	"O" RINGS	1066	1066
6	BACKWASH SHAFT	3018-01	3018-02
7	NUT	1069	1069
8	ACTUATOR HOUSING	2035	2035
9	BOLTS & NUTS	1071 & 1072	1071 & 1072
10	SPRING	1070	1070
11	JAM NUT	1069	1069
12	PISTON	2034	2034
13	DIAPHRAGM	1059	1059
14	DISC	2032	2032
15	CAPSCREW	1074	1074
16	COVER	2033	2033
17	BOLTS & NUTS	1077 & 1073	1077 & 1073

VALVE OPERATION

VALVE ACTUATION IS ACCOMPLISHED HYDRAULICALLY, USING WATER INTERNAL TO THE FILTER SYSTEM. THE WATER IS DRAWN OFF THE INLET MANIFOLD, THROUGH A STRAINER, AND INTO POLY TUBING, WHICH IS CONNECTED TO A SOLENOID VALVE ON EACH OF THE FILTERS IN THE SYSTEM.

WHEN THE BACKWASH CYCLE IS INITIATED THE FOLLOWING OCCURS:

1) THE BACKWASH CONTROL UNIT SENDS A SIGNAL TO THE SOLENOID VALVE THAT IS ATTACHED TO THE ACTUATOR COVER OF THE FIRST FILTER IN THE SYSTEM. (ONCE THE FIRST FILTER IS BACKWASHED, THE CONTROL WILL SEND A SIGNAL TO THE SOLENOID VALVE ON THE SECOND FILTER, AND THEREAFTER TO EACH FILTER IN TURN UNTIL ALL IN THE SYSTEM HAVE BEEN BACKWASHED.)

2) THE SOLENOID PLUNGER MOVES FROM THE CLOSED TO THE OPEN POSITION.

3) THE POLY TUBING, WHICH IS ATTACHED TO THE SOLENOID, ALLOWS WATER FROM THE INLET MANIFOLD TO PASS THROUGH THE SOLENOID AND INTO THE ACTUATOR HOUSING.

4) AS WATER ENTERS THE ACTUATOR HOUSING THE HYDRAULIC PRESSURE MOVES THE PISTON AND ROLLING DIAPHRAGM FORWARD CAUSING THE BACKWASH SHAFT TO ALSO MOVE FORWARD.

5) AS THE BACKWASH SHAFT MOVES FORWARD IT ALSO DRIVES THE VALVE PLATES AND SEAL FORWARD UNTIL THEY CLOSE OFF THE INLET PORT OF THE VALVE. THIS PREVENTS WATER IN THE INLET MANIFOLD FROM ENTERING THE FILTER.

6) AS THE INLET PORT ON THE BACKWASH VALVE IS CLOSED, THE BACKWASH PORT IS SIMULTANEOUSLY OPENED. THIS ALLOWS THE BACKWASH WATER COMING UP THROUGH THE MEDIA BED TO CARRY DEBRIS OUT THE TOP OF THE FILTER, THROUGH THE BACKWASH PORT AND INTO THE BACKWASH MANIFOLD.

7) WHEN THE END OF THE FLUSH TIME HAS BEEN REACHED, THE SOLENOID VALVE IS DE-ENERGIZED. THE WATER IN THE ACTUATOR HOUSING DRAINS OUT OF THE HOUSING AND OUT THROUGH THE EXHAUST PORT ON TOP OF THE SOLENOID VALVE. THE WATER IS CARRIED AWAY FROM THE SOLENOID VALVE VIA POLY TUBING.

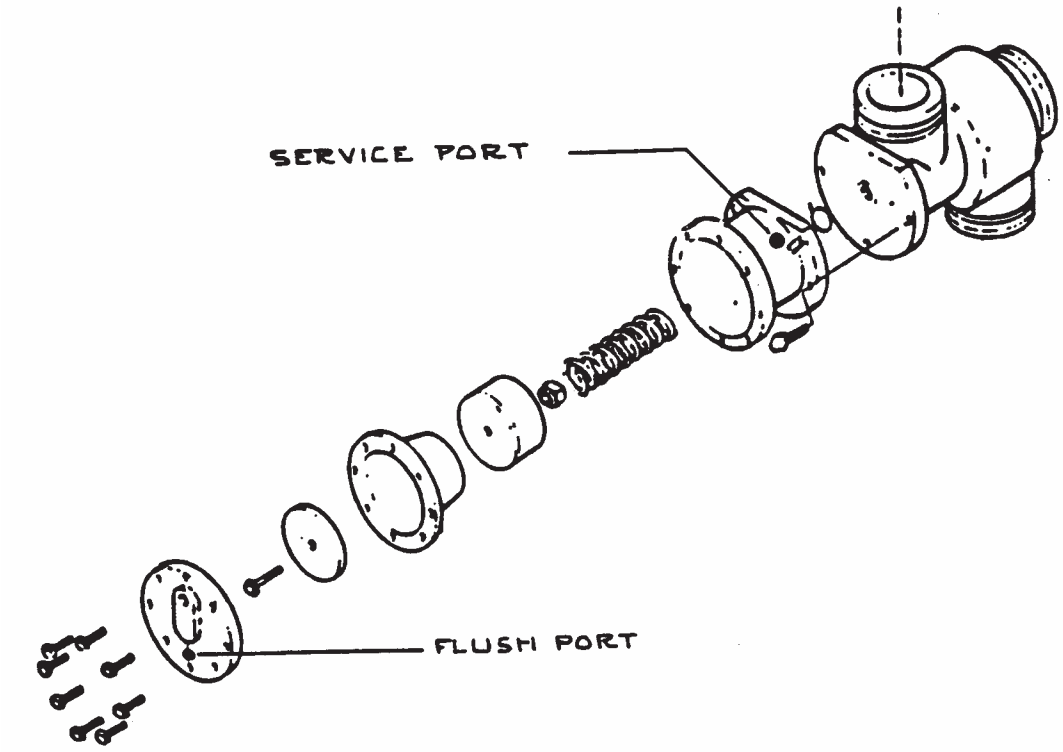
8) AS THE HYDRAULIC PRESSURE INSIDE THE ACTUATOR HOUSING DECREASES, THE PISTON AND DIAPHRAGM RETURN TO THEIR NORMAL POSITION, CAUSING THE VALVE PLATES AND SEAL TO OPEN THE INLET PORT ON THE BACKWASH VALVE AND CLOSE THE BACKWASH PORT.

9) WITH THE RE-OPENING OF THE INLET PORT, THE FILTER WILL RETURN TO THE FILTRATION MODE, AND THIS SAME PROCESS WILL BE REPEATED ONE AT A TIME WITH THE OTHER FILTERS IN THE SYSTEM.

MAINTENANCE AND SERVICING

COMPONENT	FREQUENCY	PROCEDURE
INLET MANIFOLD	**MONTHLY**	CLEAN Y STRAINER ON THE INLET MANIFOLD
FILTERS	**MONTHLY**	CHECK TEXTURE AND CONSISTENCY OF MEDIA TO MAKE SURE IT IS STILL LOOSE AND FREE OF CAKING OR CRUSTING CHECK LEVEL OF MEDIA AND ADD AS NEEDED.
	ANNUALLY	CHECK CONDITION OF EXTERIOR PAINT AND TOUCH UP AS NEEDED.
AUTO CONTROLS	**BI-ANNUALLY**	ROTATE KNOBS ON CONTROL PANEL TO BREAK ANY OXIDATION THAT MAY BE OCCURRING CHECK SEALS ON CONTROL ENCLOSURE FOR INTEGRITY

BACKWASH VALVES	**SEMI-ANNUALLY**	LUBRICATE BACKWASH SHAFT AND "O"RINGS IN PACKING GLAND WITH A MOLYDISULFIDE GREASE OR EQUIVALENT FOR VALVES THAT HAVE STAINLESS STEEL PACKING GLANDS. FOR VALVES WITH PVC PACKING GLANDS USE 112 SILICONE GREASE. FLUSH ACTUATOR IF HEAVY SILTING CONDITIONS EXIST
	ANNUALLY	DISASSEMBLE, INSPECT AND REGREASE BACKWASH VALVE



BACKWASH VALVES

SEMI-ANNUAL SERVICING

REFERRING TO THE DIAGRAM BELOW, REMOVE THE RUBBER COVER FROM THE SERVICE PORT AND INSPECT THE INTERIOR OF THE ACTUATOR HOUSING AND BACKWASH SHAFT.

LUBRICATE WITH A LIGHT WEIGHT OIL OR AEROSOL SPRAY (WD-40). HYDRAULICALLY OPERATE THE ACTUATOR TO INSURE PROPER OPERATION. REPLACE RUBBER COVER TO PROTECT ACTUATOR INTERIOR.

REMOVE THE 1/4" DRAIN PLUG FROM THE FLUSH PORT. MANUALLY OPERATE THE SOLENOID VALVE BY TURNING THE KNOB WITH THE ⟶ (ARROW) FROM THE "C" POSITION TO THE "O" POSITION. THIS WILL INITIATE A BACKWASH.

SOURCE WATER WILL ENTER THE ACTUATOR AND FLUSH THE ACCUMULATED DEBRIS OUT THE FLUSH PORT. REPEAT THIS CYCLE AS REQUIRED. REPLACE THE 1/4" DRAIN PLUG, AND TURN THE KNOB ON THE SOLENOID FROM THE "O" POSITION BACK TO THE "C" POSITION.

TROUBLE SHOOTING GUIDE

SYMPTON	POSSIBLE CAUSE
BACKWASH FREQUENCY INCREASES	A) CHANGE IN WATER QUALITY B) INCREASE IN FLOW ABOVE DESIGN PARAMETERS C) LOW MEDIA LEVEL D) BACKWASH RESTRICTOR VALVE IS SHUT E) CHANGE IN PRESSURE F) BACKWASH FLUSH TIME (DURATION) IS TOO SHORT G) MEDIA IS BECOMING HARDENED OR CRUSTED H) INLET LINE PRESSURE TOO LOW
HIGH PRESSURE DIFFERENTIAL	A) CHANGE IN WATER QUALITY B) LOW MEDIA LEVEL C) BACKWASH RESTRICTOR VALVE IS SHUT D) INCREASE IN FLOW E) INLET LINE PRESSURE TOO LOW F) INSUFFICIENT BACKWASH FREQUENCY AND/OR DURATION G) WRONG MEDIA IN FILTERS H) UNDERDRAIN SCREENS ARE BLOCKED
MEDIA NOT FLUIDIZING DURING BACKWASH OR CRUSTED	A) INSUFFICIENT BACKWASH FREQUENCY OR DURATION B) REDUCED PRESSURE C) FLOCCULATING OR COAGULATING AGENTS PREVENTING THOROUGH MEDIA CLEANING DURING BACKWASH D) RESTRICTOR VALVE IS CLOSED
SLUGGISH VALVES	A) LOW PRESSURE CAUSING VALVE TO OSCILLATE B) DRIED OUT O-RING (LUBRICATE) C) DIRTY “Y” STRAINER ON INLET LINE
LEAKAGE OUT BACKWASH LINE	A) BAD VALVE SEAT OR SEAL B) VALVE NOT COMPLETELY SEATED C) BENT BACKWASH SHAFT D) LOOSE BACKWASH SHAFT NUT
LEAKAGE OUT OF ACTUATOR	A) RUPTURED DIAPHRAGM B) COMPRESSION PLATE LOOSE
FILTER IS NOT BACKWASHING WHEN OTHERS IN SYSTEM ARE	A) SOLENOID VALVE DEFECTIVE B) HYDAULIC POLY TUBING LOOSE OR DISCONNECTED C) MALFUNCTION OF BACKWASH VALVE (DISASSEMBLE & INSPECT) D) WIRING ON CONTROL PANEL LOOSENED E) DEFECTIVE CONTROL PANEL F) SOLENOID VALVE IMPROPERLY ATTACHED

LAMPS NOT LIGHTING DURING TEST OF AUTO BACKWASH CONTROL	A) WIRING IN PANEL IS LOOSE OR DISCONNECTED B) INCORRECT VOLTAGE INPUT C) DEFECTIVE CONTROL PANEL - REPLACE
FILTER WILL NOT STOP BACKWASHING	A) SOLENOID VALVE MANUAL OVERRIDE BUTTON IS SET ON “O” INSTEAD OF “C” B) MALFUNCTION OF BACKWASH VALVE (DISASSEMBLE AND INSPECT) C) MALFUNCTION OF CONTROL PANEL

Self Priming Centrifugal Pump

STRAD

Classic T Series

Model T3A3-B

Size 3” x 3”

T SERIES Classic

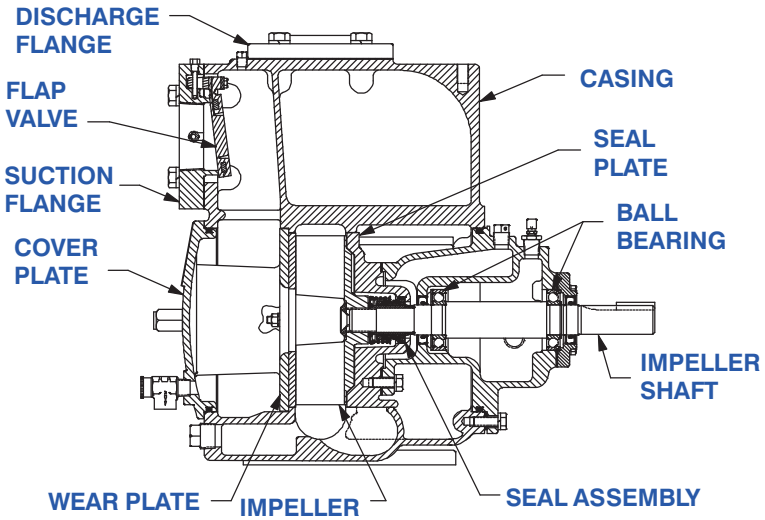
PUMP SPECIFICATIONS

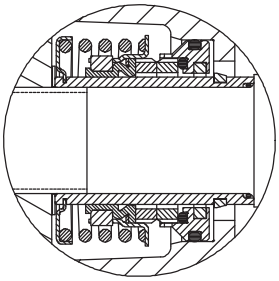
Size: 3” x 3” (76 mm x 76 mm) NPT - Female.
Casing: Gray Iron 30.
Maximum Operating Pressure 86 psi (593 kPa).*
Semi-Open Type, Two Vane Impeller: Ductile Iron 65-45-12.
Handles 2 1/2” (63,5 mm) Diameter Spherical Solids.
Impeller Shaft: Alloy Steel 4150.
Shaft Sleeve: Alloy Steel 4130.
Replaceable Wear Plate: Carbon Steel 1015.
Removable Cover Plate: Gray Iron 30; 30 lbs. (14 kg).
Seal Plate: Gray Iron 30.
Flap Valve: Neoprene w/Steel Reinforcing.
Bearing Housing: Gray Iron 30.
Radial and Thrust Bearings: Open Single Row Ball.
Bearing and Seal Cavity Lubrication: SAE 30 Non-Detergent Oil.
Flanges: 125# Gray Iron 30.
Gaskets: Buna-N w/Compressed Synthetic Fibers, Vegetable Fiber, PTFE, Cork and Rubber.
O-Rings: Buna-N.
Hardware: Standard Plated Steel.
Brass Pressure Relief Valve.
Bearing Cavity Oil Level Sight Gauge.

Optional Equipment: Stainless Steel 316 Pressure Relief Valve. Automatic Air Release Valve. G-R Hard Iron Impeller, Seal Plate and Wear Plate. 120V/240V Casing Heater. High Pump Temperature Shutdown Kit. Self-Cleaning Wear Plate. Gray Iron 30 Suction and Discharge Spool Flanges:
3” ASA **(Specify Model T3A3-B /F)**.
80 mm DIN 2527 (PN 16) **(Specify Model T3A3-B /FM)**.

**Consult Factory for Applications Exceeding Maximum Pressure and/or Temperature Indicated.*

Shown with Optional Suction & Discharge Spool Flanges (Available in ASA or DIN Standard Sizes).





SEAL DETAIL

Cartridge Type, Mechanical, Oil-Lubricated, Double Floating, Self-Aligning. Tungsten Titanium Carbide Rotating and Stationary Faces. Stainless Steel 316 Stationary Seat. Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel 18-8 Cage and Spring. Maximum Temperature of Liquid Pumped, 160°F (71°C).*

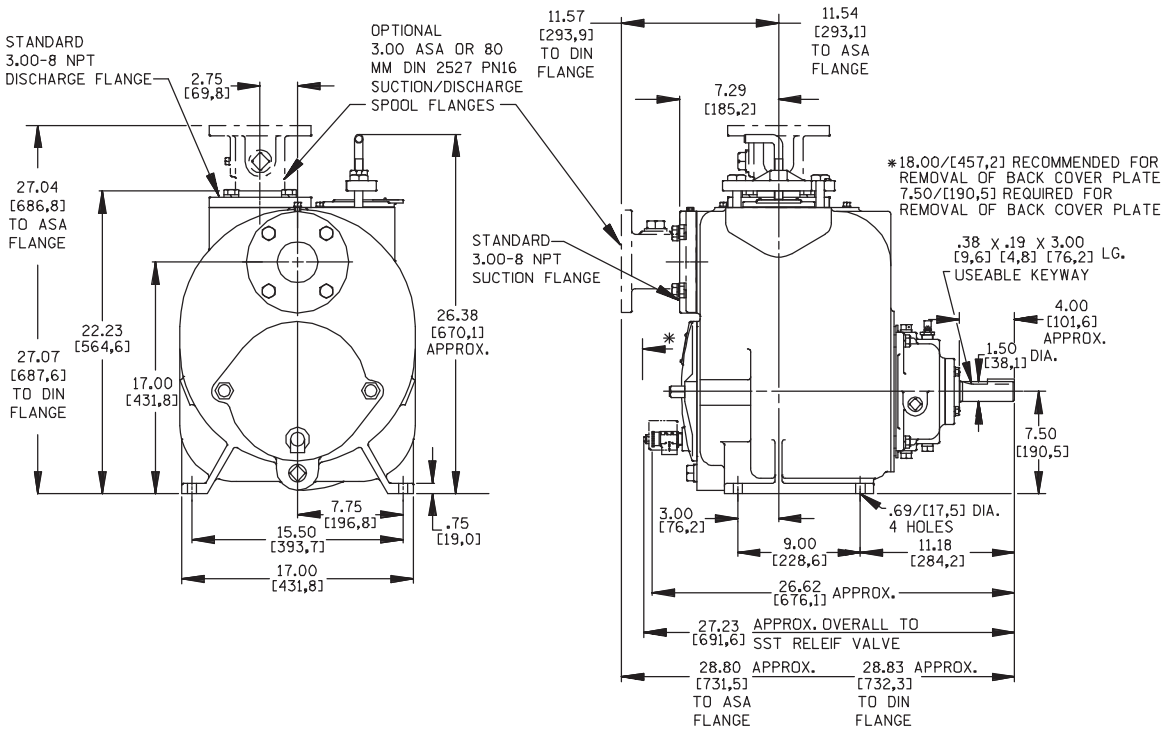
Specification Data

SECTION 55, PAGE 1000

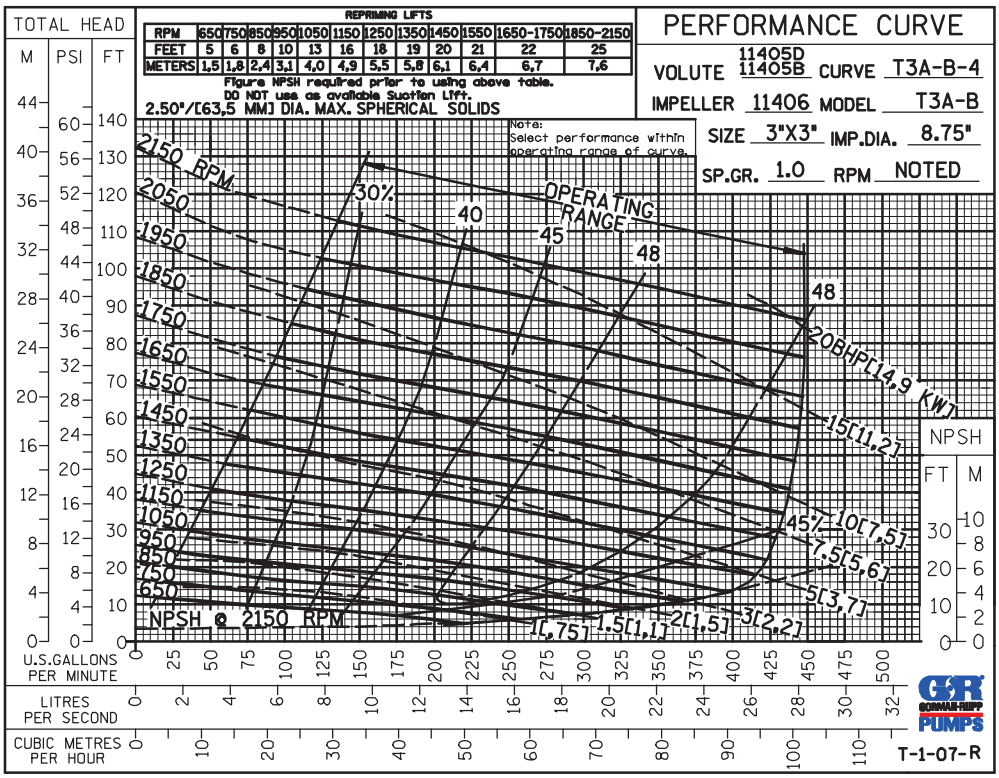
APPROXIMATE DIMENSIONS and WEIGHTS

NET WEIGHT:	**404 LBS. (183 KG.)***
SHIPPING WEIGHT:	**452 LBS. (205 KG.)***
EXPORT CRATE:	**19.3 CU. FT. (0,55 CU. M.)**

***ADD 10 LBS. (4,5 KG.) W/EACH SPOOL FLANGE**



OPTIONAL ASA OR DIN STANDARD SUCTION & DISCHARGE SPOOL FLANGES AVAILABLE



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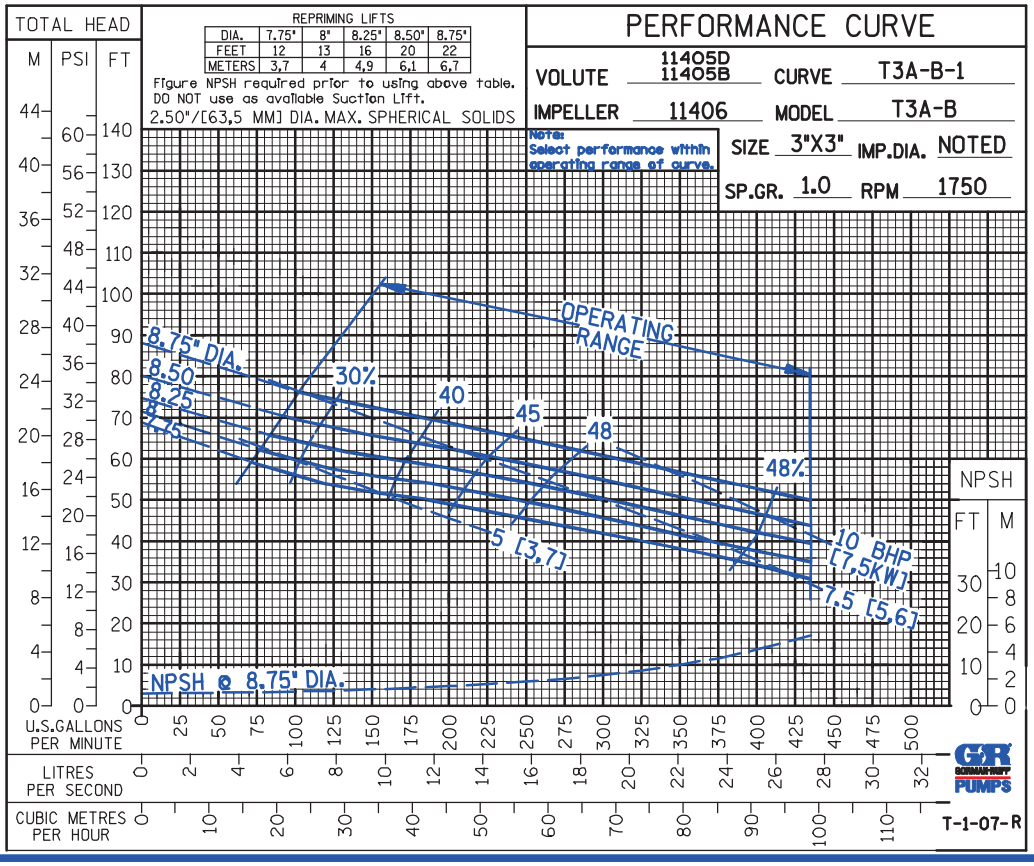

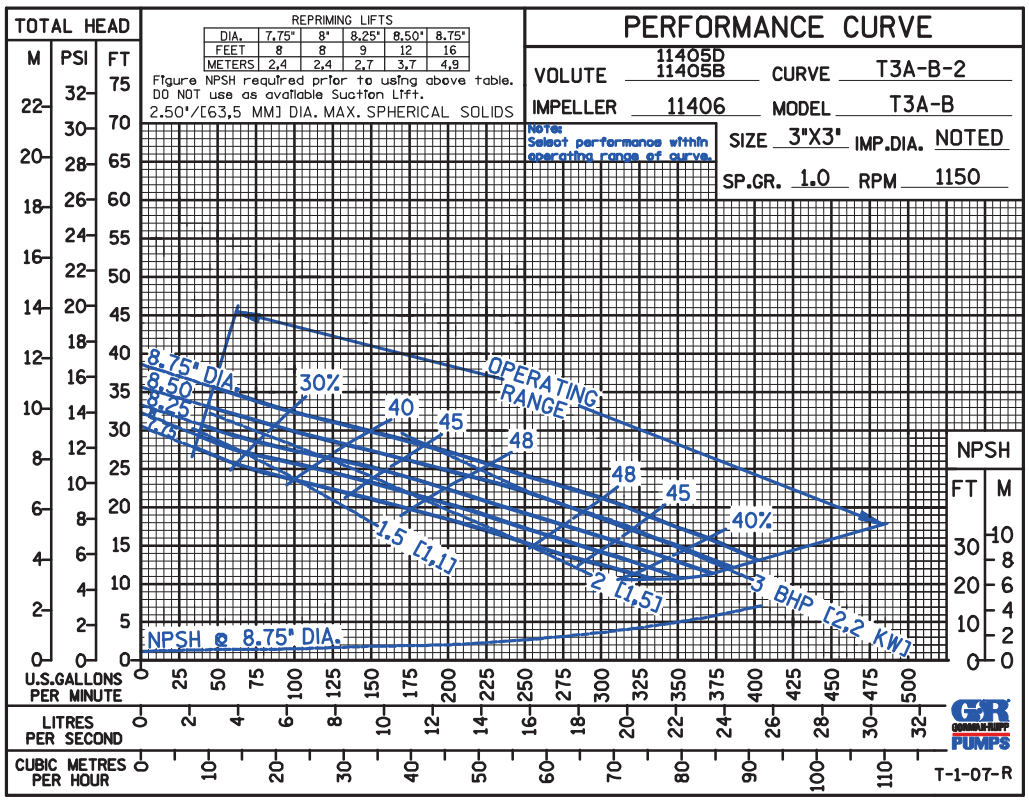

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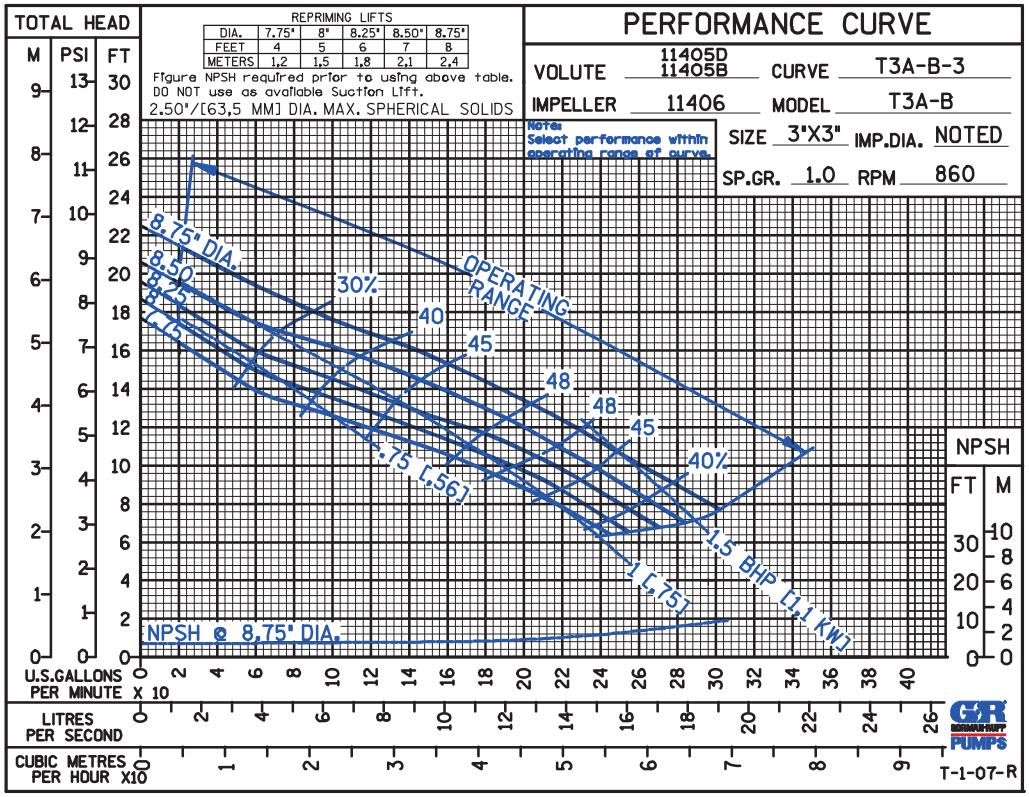

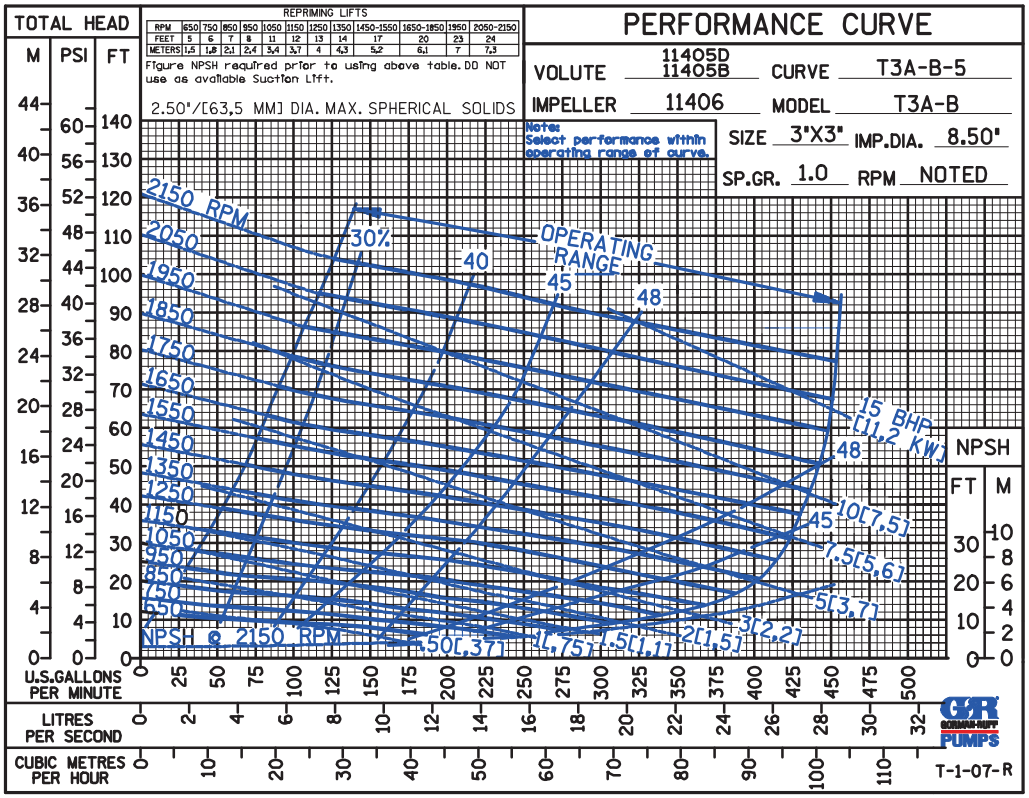

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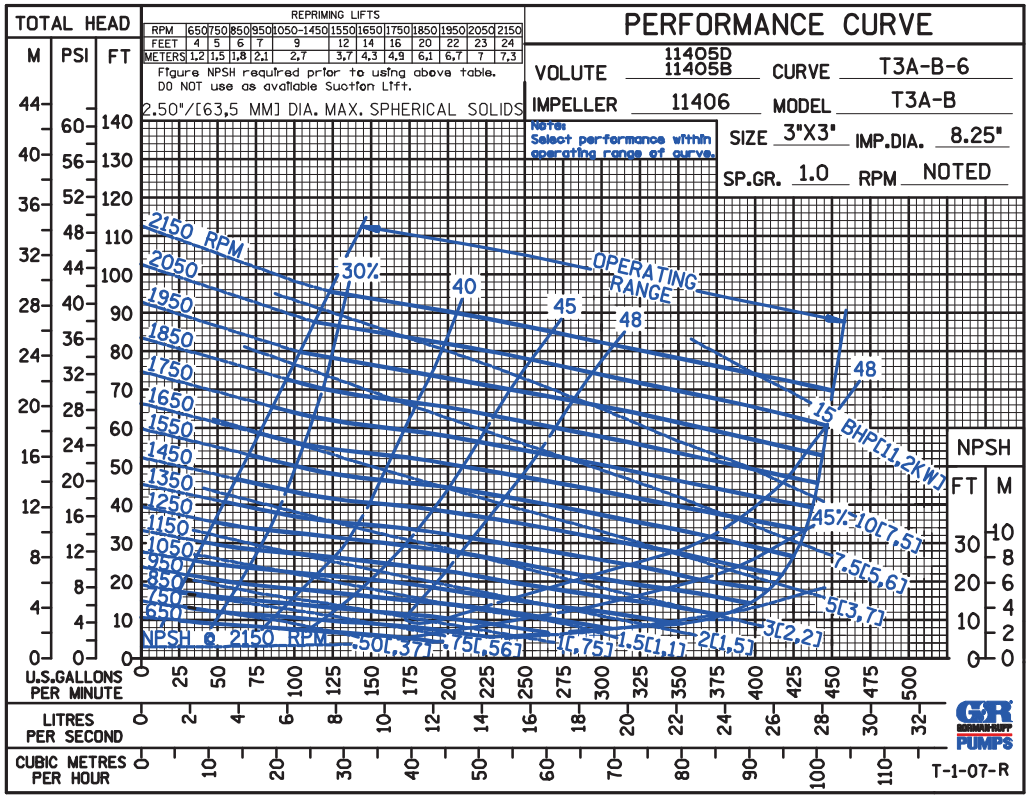

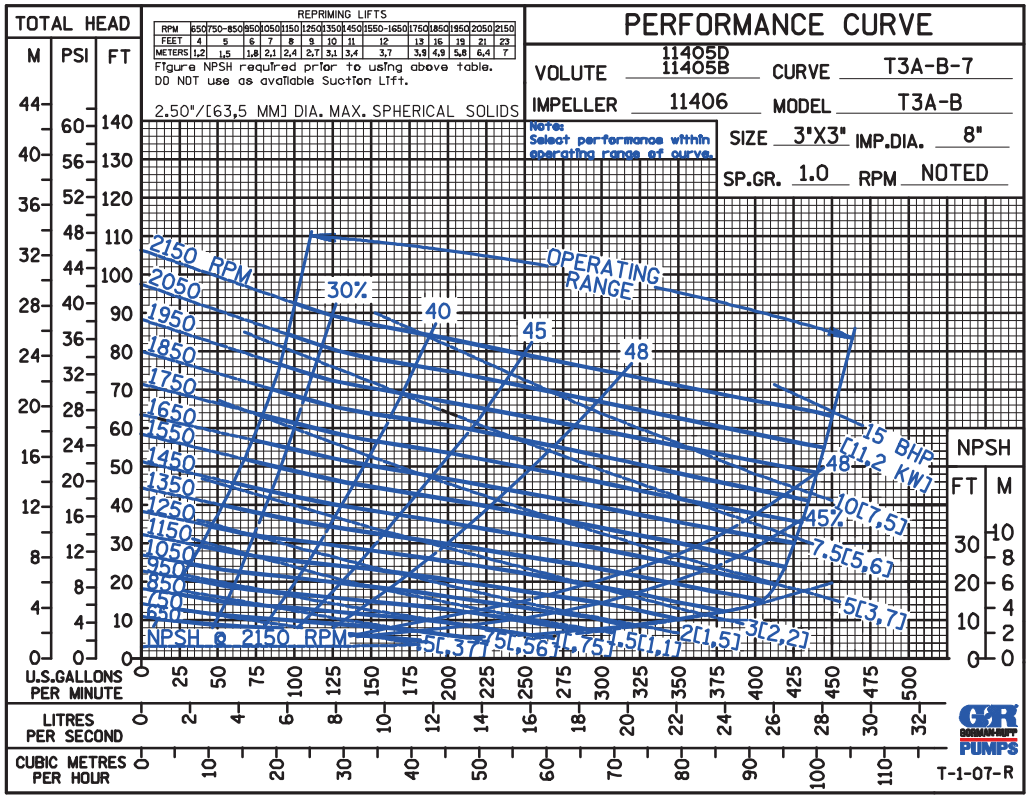

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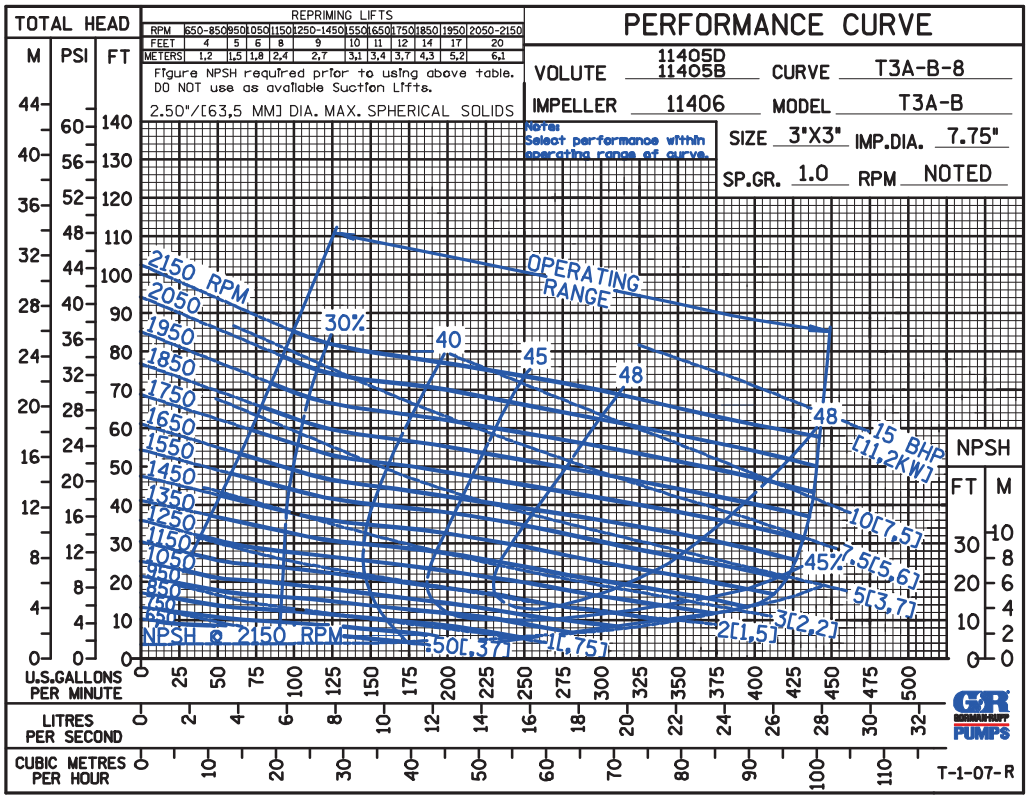
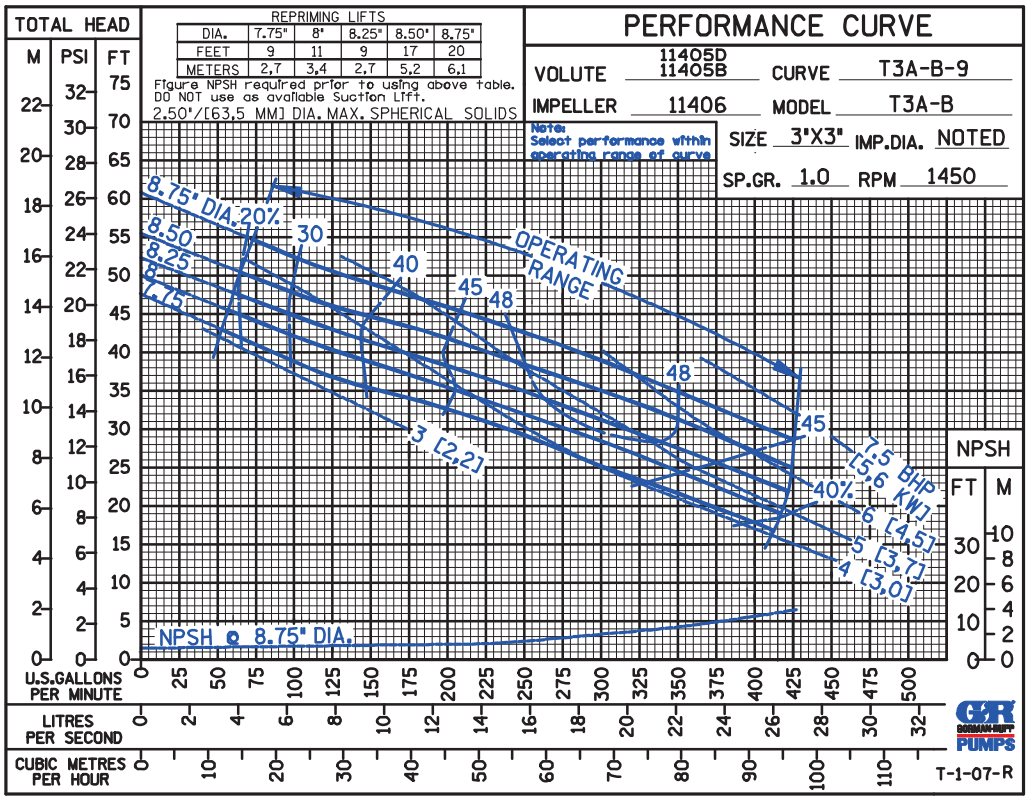


50 HERTZ



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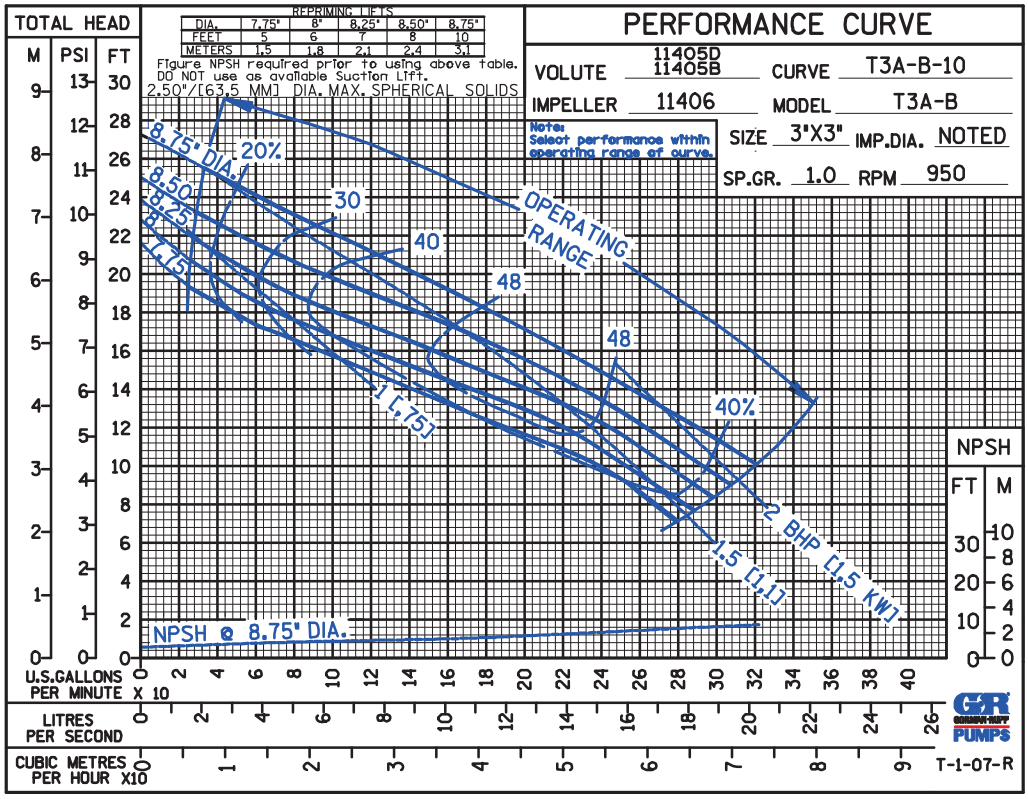

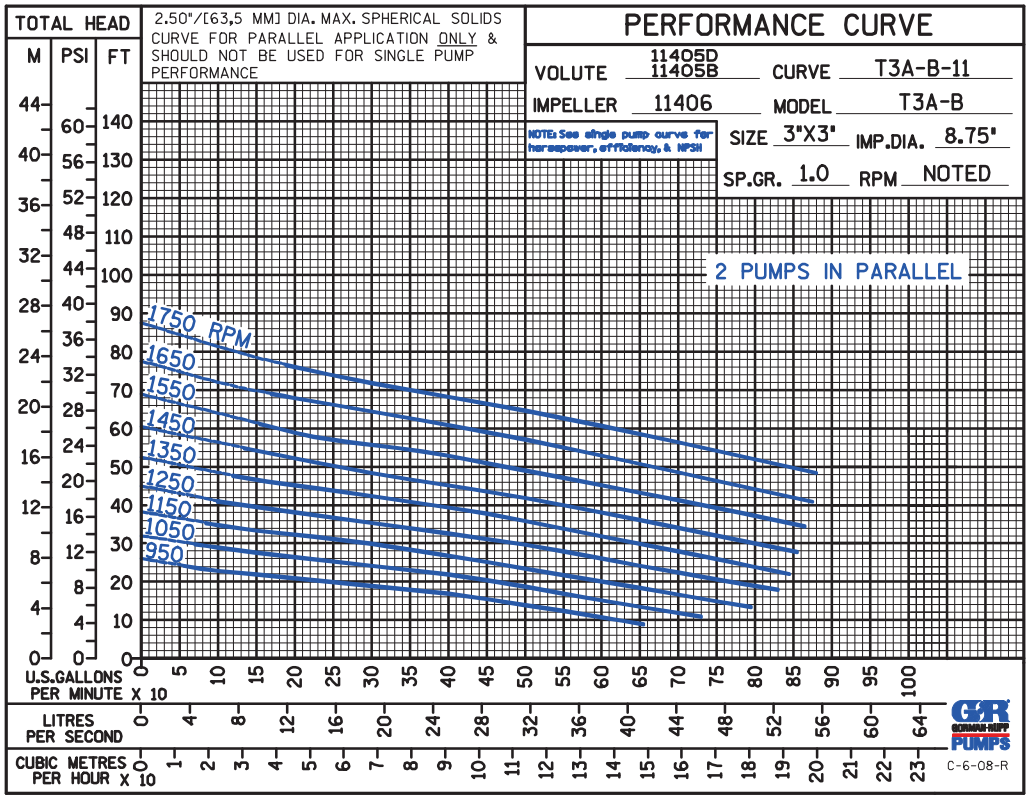

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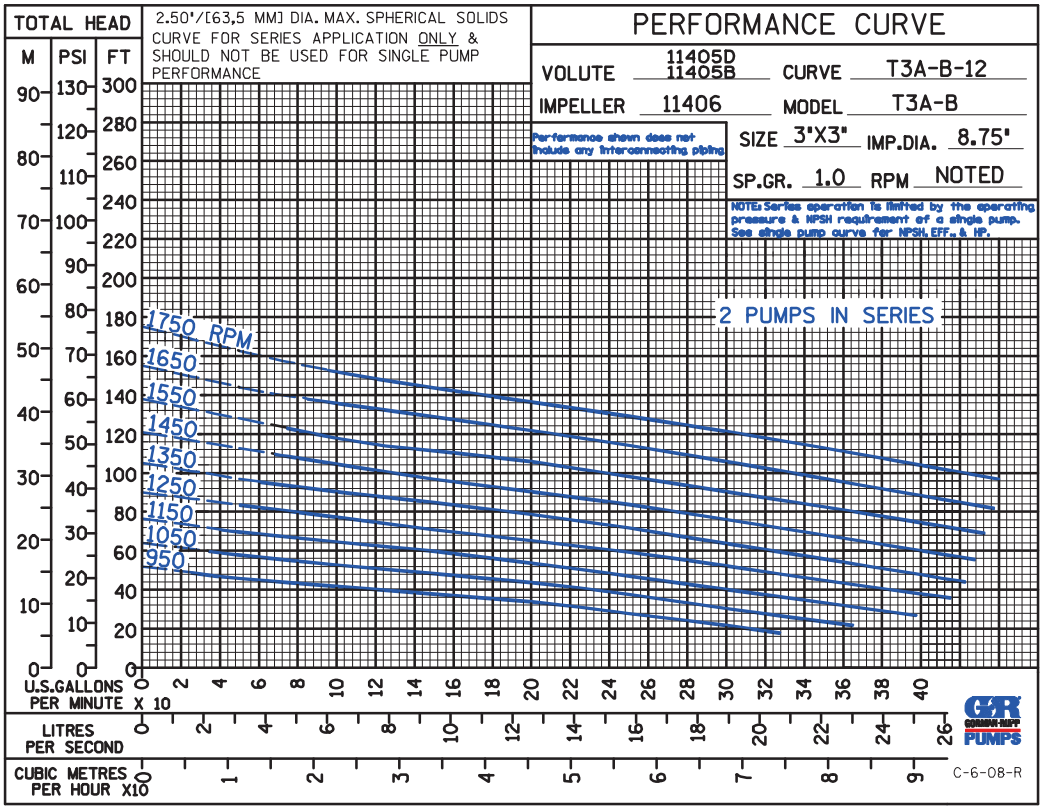


Bag Filter

BF400

ASME

Overview:

The BF400 ASME bag filter unit features four bag filter tanks and utilizes 7” x 30” bag filters for superior filtration from 1 to 100 micron for flows up to 400 GPM.

Features:

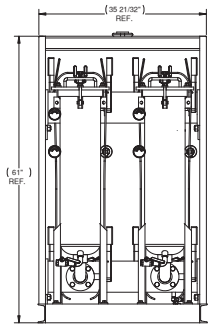
- No moving parts
- Skid mounted
- Fitted with bleed valves and pressure gauges
- Chambers constructed of 304L Stainless Steel
- Piping constructed of 304L Stainless Steel
- Stainless Steel inlet and outlet manifolds
- System can stand alone for sediment removal or be used in combination with filter equipment

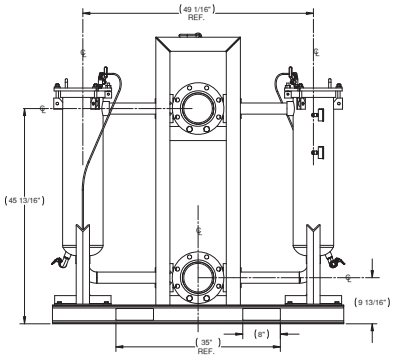
Specs:

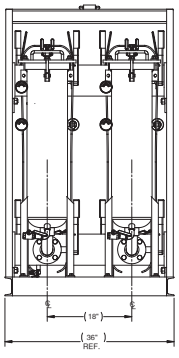
Max Flow	400 GPM
Material	304L Stainless Steel
Max PSI	150 PSI
Dry weight	800 lbs.
Footprint:	62” x 36”
Inlet x outlet	6” x 6” Flange

Accessories:

- Spillguard
- Suction and Discharge Hoses







PUMPS • TANKS • FILTRATION • PIPE • SPILLGUARDS

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Sand Media Filter

48-2SSK

Overview:

The 48-2SSK sand media filter features two media tanks for silica filtration media and provides a 25 square foot filtration area for flows up to 425 GPM.

Features:

- 500 lbs. gravel and 1300 lbs. sand per tank
- AC and DC powered automatic filter backwash controller that allows for timed, pressure differential or manual backwash intervals
- Fitted with air vents and pressure gauges
- Corrosion resistant
- Stainless steel inlet, outlet and backwash manifolds
- Pressure sustaining valve to aid in backwash operation
- Solar battery charger for DC operation in remote locations
- Filter tanks are constructed out of 304 stainless steel
- 8" media loading and removal ports
- Most effective backwash rate is 190GPM min

Specs:

Max Flow	425 GPM
Material	Stainless Steel
Max PSI	100 PSI
Dry weight	2000 lbs.
Footprint:	132" x 43"
Filtration Area:	25 square feet
Inlet x outlet	6" x 6" Victaulic

Accessories:

- Spillguard
- Stainless Steel 304 and Carbon Steel storage tanks in Bi-Level, Mixer, Weir and Manifold configurations
- Polyethylene storage tanks
- Cartridge and bag filters
- HDPE pipe and fittings
- Roll off boxes, dewatering bins and vacuum boxes
- Flow meters and pressure reducing/ sustaining valves
- Aluminum Victaulic pipe and fittings
- Suction and discharge hose

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LYNX range

Decanter centrifuges for controlling drill solids

Applications
For drill solids control, high-speed separation, barite recovery, system de-weighting and ultrafines removal.

Optimizing drilling fluids
Alfa Laval decanter centrifuges are a key component in a top-quality solids control process. This technology efficiently removes most of the fine particles that traditional solids control equipment cannot deal with.

Specially designed and built for heavy-duty jobs in this field, the Alfa Laval LYNX range of decanter centrifuges is able to handle large amounts of feed solids, as well as coping well with abrasive and coarse particles.

LYNX decanter centrifuges are available with a range of modules ideally suited for every kind of solids separation job in conjunction with the drilling fluids used on drilling rigs and platforms. These modules range from fully automated operation to simple “hands-on” capabilities, providing effective solutions to all your solids control and separation issues.

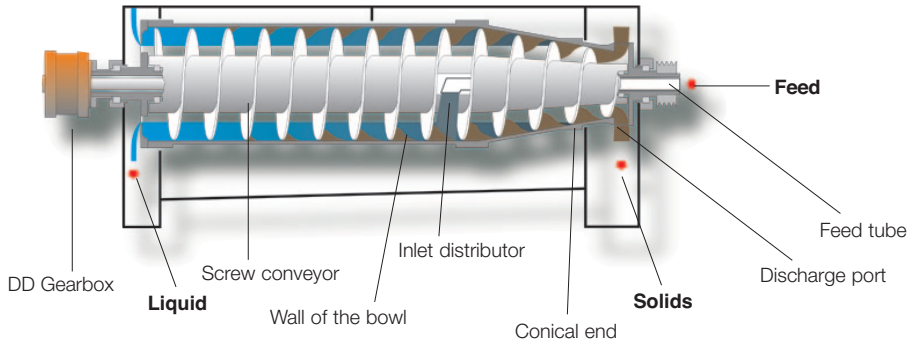
Working principle
Separation takes place in a horizontal cylindrical bowl equipped with a screw conveyor. The feed enters the bowl through a stationary inlet tube and is accelerated smoothly by an inlet rotor. Centrifugal forces cause sedimentation of the solids on the wall of the bowl. The conveyor rotates in the same direction as the bowl, but at a different speed, thus moving the solids towards the conical end of the bowl.

The LYNX design enables the decanter to scroll out high loads of solids without blockages caused by high levels of dryness. Only the very driest fraction of the sludge cake leaves the bowl through the solids discharge openings into the casing. Separation takes place along the total length of the cylindrical part of the bowl, and the clarified liquid leaves the bowl by flowing over adjustable plate dams into the casing.

The LYNX decanter centrifuge can be adjusted to suit specific requirements by varying the bowl speed, the conveying speed, the pond depth and the feed rate.

Process optimization
The LYNX decanter centrifuge can be adjusted to suit specific requirements by varying

- the bowl speed to ensure the exact G force required for the most efficient separation.
- the conveying speed for the best possible balance between liquid clarity and solids dryness.
- the pond depth in the bowl for the best possible balance between liquid clarity and solids dryness.
- the feed rate – the LYNX is designed to handle a wide range of flow rates.



Take advantage of LYNX solids separation technology

- Maximum solids recovery
- high G Force
- newest design technologies
- specially designed decanter geometry for larger process volumes

Achieve lower cut-point and optimize your solids control and drilling process. Improve fine removal and obtain better fluid clarity. Reduce mud costs.

- Outstanding improved wear protection
- patented feed zone design for optimal flow distribution
- fully covered replaceable parts in tungsten carbide
- improved solids outlet protection

Increase the lifetime of wear parts and reduce your maintenance cycles.

- Drier solids
- optimized conveyor and bowl geometries for increased compaction capabilities

Reduce your waste volumes. Reduce your disposal costs.

- 2-Touch Control System
- easy to troubleshoot and service, ensuring maximum centrifuge uptime
- compatible with multiple industry standards and communication protocols
- consistent and has easy-to-use interfaces

Improve your operating reliability and optimize your processes. Save manpower and training costs.

- Unmatched flow rate capacity/diameter
- new generation of decanter centrifuges. Latest optimized designs
- 360-degree solids outlet

Treat larger process volumes in smaller machines and reduce your total costs per volume treated.

- Easier accessibility
- Lighter and smarter cover design
- Quick adjustable pond depth

Access easily the interior of the decanter. Optimize, service and clean faster, saving time and money.

Design

Alfa Laval designed the LYNX decanter centrifuge with a focus on performance, easy access, reliability, low power consumption and low noise levels. The rotating assembly is supported on a compact welded box beam frame with main bearings at both ends. The in-line main motor is flange- or foot mounted onto the unit with adjustable brackets for belt tension adjustment. The bowl is driven at the conical end by an electric motor with a V-belt transmission.

The bowl, conveyor, casing, inlet tube, outlets and other parts in contact with the process media are made of AISI 316 or duplex stainless steel with tungsten carbide inserts in the areas most susceptible to wear.

Direct drive

The drive system that is an integral part of the LYNX design was specially developed by Alfa Laval to make it possible to control the conveying speed automatically. This ensures the best possible balance between liquid clarity and solids dryness, irrespective of any variations that may occur in the feed flow.

The Direct Drive system comprises an exceptionally efficient gearbox and variable frequency drive, which together avoid exposing the bowl drive to parasitic braking power. It also simplifies the electrical installation and keeps power consumption and CO_2 emissions to the absolute minimum. In addition, the Direct Drive is capable of accurate control within the complete range of differentials, with no need for changing belts or pulleys.

Optional extras

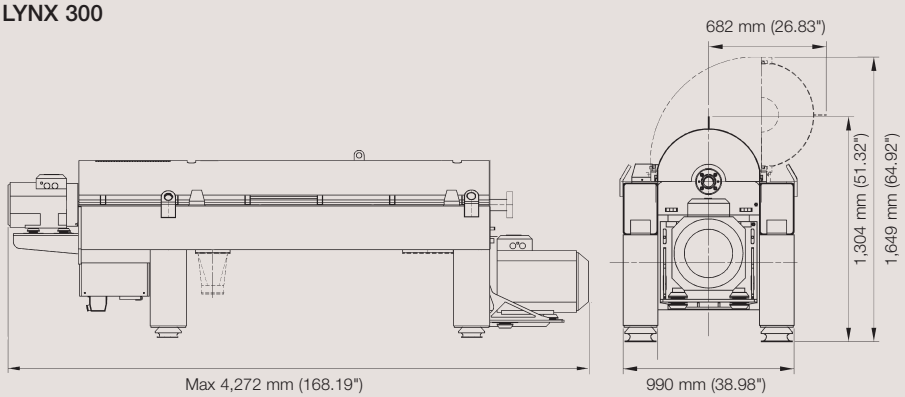
- New generation of wear protection for use with extra-harsh and abrasive feeds
- A range of different power pack designs to optimize power consumption

Optional control equipment: The 2Touch control package

Each LYNX decanter centrifuge can be equipped with an Alfa Laval 2Touch control package as standard – pre-installed and factory-tested.

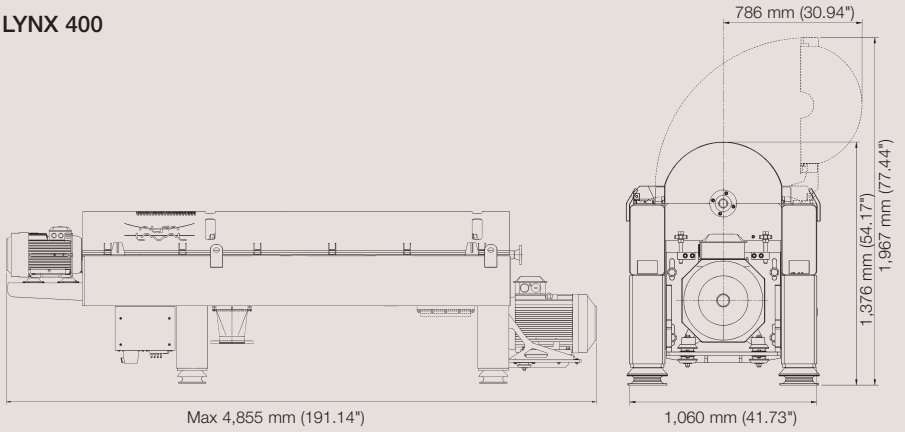
The combination of 2Touch control systems and LYNX separation technology ensures that you get the most out of any LYNX installation, at the same time as keeping costs for installation, commissioning, operation and maintenance to a minimum.

LYNX 300



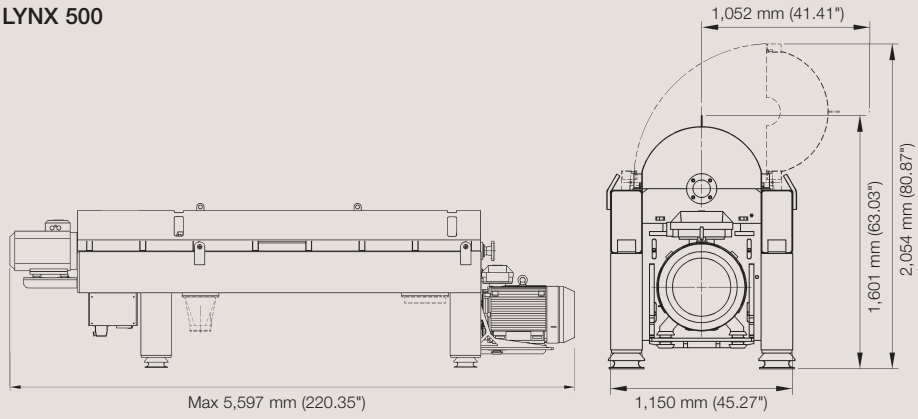
Total weight of empty decanter
2,300 kg (5,071 lbs)
Bowl dia.: 360 mm/14"
Feed rate: 60 m³/h (260 GPM)
Max. speed*: 4,200 rpm (3,550 G)
Hydraulic capacity: 70 m³/h
(310 GPM)

LYNX 400



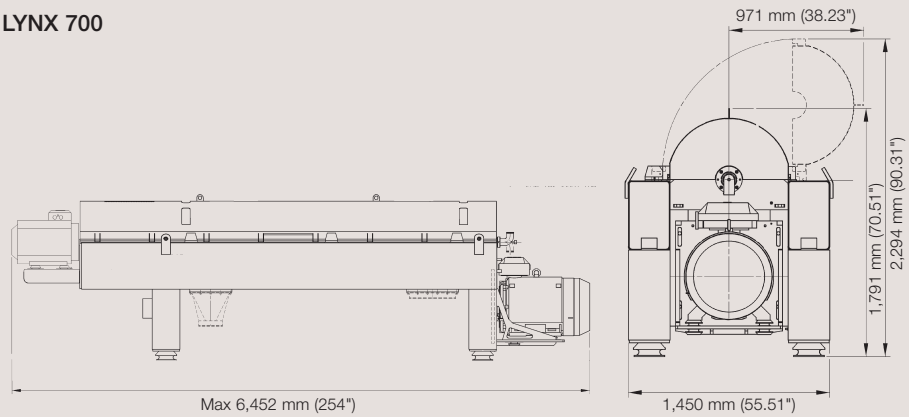
Total weight of empty decanter
3,200 kg (7,050 lbs)
Bowl dia.: 440 mm/17"
Feed rate: 93 m³/h (410 GPM)
Max. speed*: 3,800 rpm (3,550 G)
Hydraulic capacity: 120 m³/h
(530 GPM)

LYNX 500



Total weight of empty decanter
4,500 kg (9,920 lbs)
Bowl dia.: 510 mm/20"
Feed rate: 132 m³/h (580 GPM)
Max. speed*: 3,250 rpm (3,011 G)
Hydraulic capacity: 150 m³/h
(660 GPM)

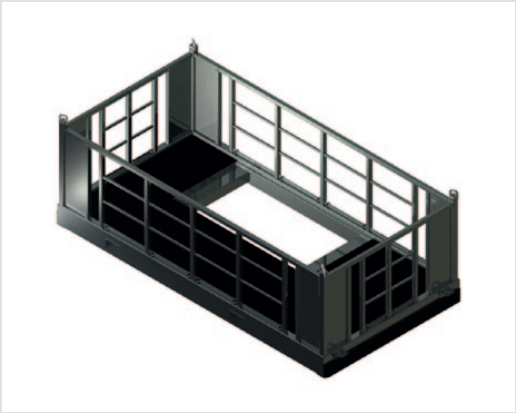
LYNX 700

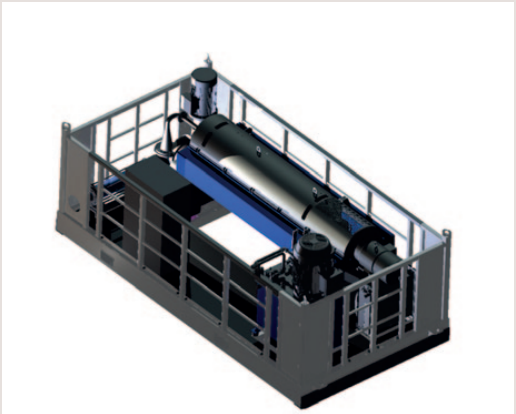


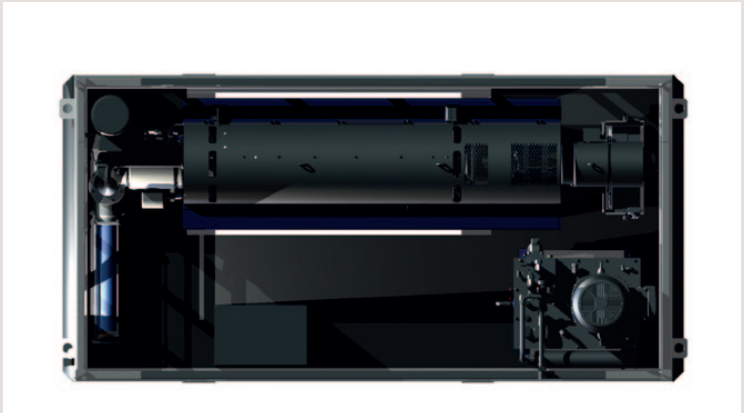
Total weight of empty decanter
6,500 kg (14,330 lbs)
Bowl dia.: 650 mm/25.6"
Feed rate: 190 m³/h (840 GPM)
Max. speed*: 3,100 rpm (3,491 G)
Hydraulic capacity: 260 m³/h
(1.144 GPM)

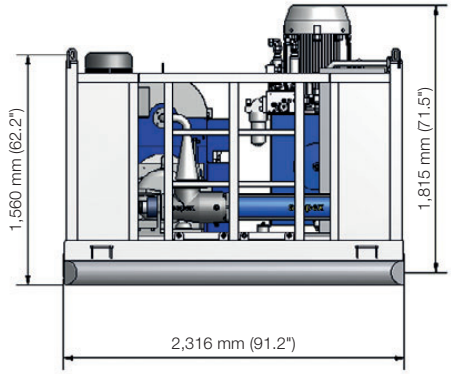
Cutpoint: D50: < 6µm, D90: < 60 µm for all sizes
* Max. speed with 2,500 kg/m3 wet solids

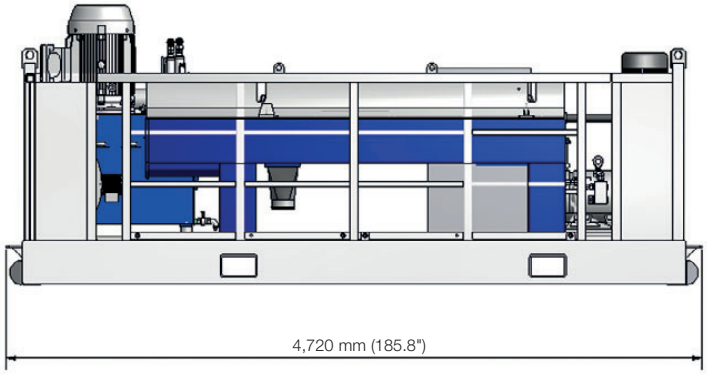
Crash frame with full hydraulic unit











Weight frame: 6,300 kg
Available frame certificates: DNV2.71

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

Stormwater Treatment Manuals

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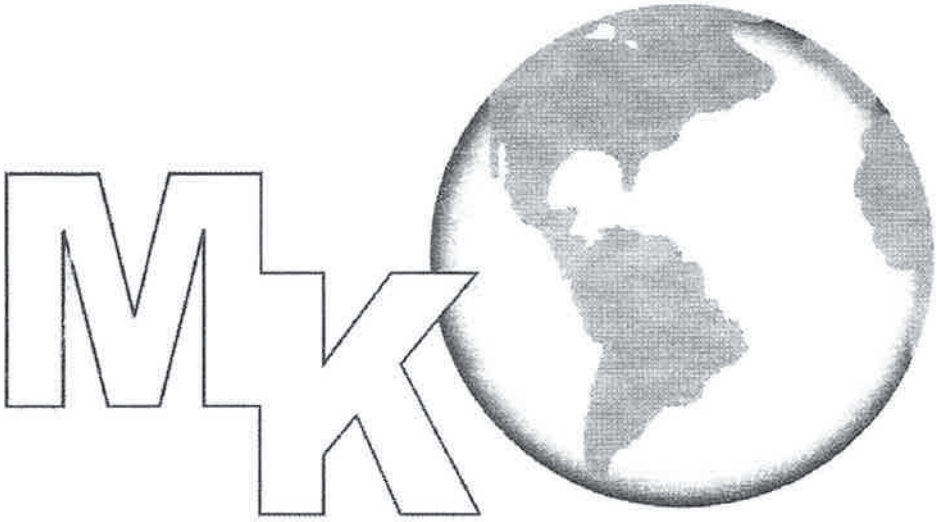


Environmental Inc.

SECTION 1.0
GENERAL INFORMATION

MK Environmental, Inc.
765 Springer Dr.
Lombard, IL., 60148
(P) 630-920-1104 (F) 866-306-8977
www.mkenv.com

PROCEDURES FOR EQUIPMENT DAMAGED DURING SHIPMENT

The customer when receiving the products must first and foremost sign for equipment.

Damaged during shipment as "DAMAGED" in the freight bill. The customer should then call MK Environmental Incorporated and inform us of the problem. The customer should then ship the product back to MK Environmental Incorporated. In the interim, we will replace the damaged goods as soon as possible. Freight company coverage pays for whatever was damaged, in addition to the shipping charges for return to MK Environmental Incorporated and re-shipped to the customer. The procedure for reporting damage claims to the freight company and coverage of cost is as follows:

1. Copy if freight bill that is sign "DAMAGED"
2. List of item(s) damaged
3. Invoice of item(s) damaged (from vendor)
4. May require invoice for total amount invoiced to customer
5. Send to the freight company responsible

Date: 2/3/2020
Rev: 1
Name: DW

UNLOADING AND SET-UP

1. PLATFORM PLACEMENT AND LEVELING

a. Unloading and Placement:

When the platform arrives at the job site on a "low-boy semi-trailer, it can be placed on its foundation pad or other supporting structure with either a crane or large forklift. Make sure lifting device is sized correctly for system weight.

i. If a crane is used, the platform may be lifted into pace using the "D" rings located at the bottom "I" beam near the corners of the structure. It is advisable to use a spreader bar at least nine (9) feet wide to avoid damage to the roof structure.

b. Leveling the Platform

While the platform is being placed on its supporting pad, check the platform with a level. The best place to take a level measurement is on the two main "I" beam supports and across the ends by placing the level on the guide track for the insulating sliding panels. It should be level to 1/8" per four (4) feet of run. If shimming is required, the best place is at each of the four corners and again at the midpoint of the main "I" beam.

It is advisable to fill in any gaps in the foundation with wood or gravel to keep out cold wind in the winter and to discourage small animals from taking up residence under the unit. There are four lift pockets located on the base of the frame which should be plugged with insulating material.

c. Anchoring the Platform

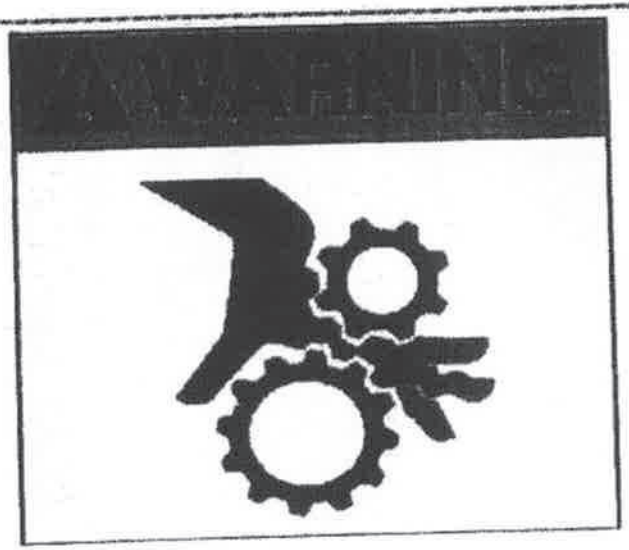
Anchor the platform in a minimum of four places, at the corners using ¾" anchor bolts firmly set into the concrete a minimum of five (5) inches or as required by legal code. Additionally, hold down chains may be used by attaching to the lifting lugs (D-rings) at the corners.

Any questions contact MK Environmental, Inc. (P) 630-920-1104

Date: 2/3/20

Rev: 1

Name: DW



MOTORS ROTATE AT HIGH SPEEDS

DO NOT OPERATE EQUIPMENT
WITHOUT SHAFT GUARDS IN PLACE

DANGER

HIGH VOLTAGE

SHUT OFF MAIN DISCONNECT PRIOR
TO PERFORMING ANY EQUIPMENT
MAINTENANCE

HEALTH SAFETY CONCERNS FOR OPERATION AND MAINTENANCE OF TYPICAL INTEGRATED SYSTEM

HIGH VOLTAGE:

Both the breaker and the control panel have high voltage circuits in them. Caution should be used whenever the doors to these panels are open.

FLAMMABLE LIQUIDS OR VAPORS:

1. NO SMOKING
2. Before entering the platform enclosure, be sure that the ventilation fan is operating
3. Wear protective gloves and clothing whenever dealing with the oil / water separator or the product tank

NOISE PROTECTION

Wear hearing protection whenever working inside the platform enclosure with the equipment running

EMERGENCY CONTACTS

Upon set up of the system, contact your local emergency response facilities and mark their phone numbers below:

Fire:_____

Police:_____

Hospital:_____

MK Environmental, Inc. (P) 630-920-1104

It is also advisable to mark these numbers on the inside of the control panel door.

READ YOUR MANUAL

Date: 2/3/20

Rev: 1

Name: DW

SUMMER AND WINTER OPERATION - HEATING AND VENTILATION

Summer Operation:

1. In warm weather the circuit breaker for the heater and the heat tape should be turned off
2. To aid in the ventilation of the enclosure, the damper that allows the air from inside the enclosure to enter the air stripper blower should be wide open
3. Remove any coverings from the air vents to allow make-up air to enter the enclosure.

Winter Operation:

1. Any time of the year that the outside air temperature could drop below 32 the circuit breakers for the heater and the heat tape must be turned on
2. Close the air damper on the air stripper blower inlet ducting that allows air to be drawn from the interior of the platform enclosure
3. Seal off the make-up vents in the side of the enclosed panels
4. Seal any of the fork pockets with insulation as well as insulating the area around the floor hatch

Date: 2/3/20

Rev: 1

Name: DW

Material Safety Data Sheet

NFPA	HMIS (U.S.A.)	Rating	Protective Clothing	DOT (pictograms)
	Health Hazard 1 Fire Hazard 1 Reactivity 0 Personal Protection B	0 Insignificant 1 Slight 2 Moderate 3 High 4 Extreme		

Section I. Chemical Product and Company Identification

Product Name	**EASY FLOW 252,353,**	**Code**	EASYFLOW252 EASYFLOW353
		DSL	See Section 15
Synonym	Not available	**TSCA**	See Section 15
Manufacturer	MK Environmental 3751 HWY 165 Columbia, LA. 71418	**In case of Emergency**	ChemTrec: 800-424-9300 Poison Control Consult local telephone directory for emergency number(s).
Material Uses	These products are used for the lubrication of air and inert gas compressors of the reciprocating, rotary, screw, and rotary vane types. These compressor oils should not be used for the compression of wet or sour hydrocarbon gases and NEVER in equipment compressing pure oxygen.		

Section II. Composition and Information on Ingredients

			Exposure Limits (ACGIH)		
Name	**CAS #**	**% (V/V)**	**TLV-TWA(8 h)**	**STEL**	**CEILING**
Mixture of severely hydrotreated and hydrocracked and/or solvent-refined base oil (petroleum).	The base oil may be a mixture of the following CAS#s: 8042-47-5, 64741-95-3, 64742-01-4, 64742-46-7, 64742-52-5, 64742-54-7, 64742-62-7, 72623-83-7, 72623-84-8, 72623-85-9, 72623-86-0, 72623-87-1, 178603-64-0, 178603-65-1, 178603-66-2, 445411-73-4	-	5 mg/m³ (oil mist)	10 mg/m³ (oil mist)	Not established
Other proprietary, non-hazardous additives.	Mixture.	-	Not applicable.	Not applicable.	Not applicable.
Manufacturer Recommendation	Not applicable				
Other Exposure Limits	Consult local, state, provincial or territory authorities for acceptable exposure limits.				

Section III. Hazards Identification.

Potential Health Effects	Prolonged or repeated contact may cause skin irritation, defatting, drying and dermatitis. Not expected to cause more than slight skin or eye irritation. With its relatively low vapour pressure, this product is not expected be inhaled in any appreciable quantity at ambient conditions. If heated to high temperatures or subjected to mechanical actions which produce vapors or mists, inhalation may cause respiratory tract irritation. Ingestion may produce a laxative effect. For more information refer to Section 11 of this MSDS.

Section IV. First Aid Measures

Eye Contact	No effects expected. If irritation does occur, flush contaminated eye(s) with lukewarm, gently flowing water for 5 minutes or until the chemical is removed. If irritation persists, obtain medical advice.
Skin Contact	Quickly and gently, blot or brush away excess chemical. Wash gently and thoroughly with water and non-abrasive soap for 5 minutes or until chemical is removed. Remove contaminated clothing, shoes and leather goods (e.g., watchbands, belts, etc.). If irritation persists, repeat flushing. Obtain medical advice immediately. Completely decontaminate clothing, shoes and leather goods before reuse or discard.
Inhalation	Remove source of contamination or move victim to fresh air. If irritation persists, obtain medical advice.
Ingestion	NEVER give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing. DO NOT INDUCE VOMITING. Have victim drink 240 to 300 mL (8 to 10 oz) of water to dilute material in stomach. If vomiting occurs naturally, rinse mouth and repeat administration of water. Obtain medical attention.
Note to Physician	Not available

Section V. Fire-fighting Measures

Flammability	May be combustible at high temperature.	**Flammable Limits**	Not available
Flash Points	Open cup: ≥195°C (383°F) (Cleveland)	**Auto-Ignition Temperature**	Fire Point: ≥227°C (440.6°F)
Fire Hazards in Presence of Various Substances	Low fire hazard. This material must be heated before ignition will occur.	**Explosion Hazards in Presence of Various Substances**	Do not cut, weld, heat, drill or pressurize empty container. Containers may explode in heat of fire.
Products of Combustion	Carbon oxides (CO, CO2), nitrogen oxides (NOx), sulphur oxides (SOx), phosphorus compounds (POx), smoke and irritating vapours as products of incomplete combustion.		
Fire Fighting Media and Instructions	NAERG2004, GUIDE 171, Substances (low to moderate hazard). If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (0.5 mile) in all directions; also, consider initial evacuation for 800 meters (0.5 mile) in all directions. Shut off fuel to fire if it is possible to do so without hazard. If this is impossible, withdraw from area and let fire burn out under controlled conditions. Withdraw immediately in case of rising sound from venting safety device or any discolouration of tank due to fire. Cool containing vessels with water spray in order to prevent pressure build-up, autoignition or explosion. SMALL FIRE: use DRY chemicals, foam, water spray or CO2. LARGE FIRE: use water spray, fog or foam. For small outdoor fires, portable fire extinguishers may be used, and self contained breathing apparatus (SCBA) may not be required. For all indoor fires and any significant outdoor fires, SCBA is required. Respiratory and eye protection are required for fire fighting personnel.		

Section VI. Accidental Release Measures

Material Release or Spill	Consult current National Emergency Response Guide Book (NAERG) for appropriate spill measures if necessary.Ensure clean-up personnel wear appropriate personal protective equipment. Extinguish all ignition sources. Stop leak if safe to do so. Dike spilled material. Use appropriate inert absorbent material to absorb spilled product. Collect used absorbent for later disposal. Avoid contact with spilled material. Avoid contaminating sewers, streams, rivers and other water courses with spilled material. Notify appropriate authorities immediately.

Section VII. Handling and Storage

Handling	Avoid contact with any sources of ignition, flames, heat, and sparks. Avoid skin contact. Avoid eye contact. Avoid inhalation of product vapours or mists.Wear proper personal protective equipment (See Section 8). Empty containers may contain product residue. Do not pressurize, cut, heat, or weld empty containers. Do not reuse containers without commercial cleaning and/or reconditioning. Personnel who handle this material should practice good personal hygiene during and after handling to help prevent accidental ingestion of this product. Properly dispose of contaminated leather articles including shoes that cannot be decontaminated.
Storage	Store away from incompatible and reactive materials (See section 5 and 10). Keep container tightly closed. Store in dry, cool, well-ventilated area.

Section VIII. Exposure Controls/Personal Protection

Engineering Controls	For normal application, special ventilation is not necessary. If user's operations generate vapours or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit. Make-up air should always be supplied to balance air removed by exhaust ventilation. Ensure that eyewash station and safety shower are close to work-station.
Personal Protection	- ***The selection of personal protective equipment varies, depending upon conditions of use.***
Eyes	As a minimum, safety glasses with side shields should be worn when handling this material.
Body	If this material may come in contact with the body during handling and use, we recommend wearing appropriate protective clothing to prevent contact with the skin. (Contact your PPE provider for more information.)

Respiratory	A minimum of NIOSH-approved air-purifying respirator with an organic vapor cartridge or canister with a dust, fume of mist filter (R, or P series) may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air-purifying respirators is limited. A NIOSH-approved positive-pressure, air-supplied respirator or self-contained breathing apparatus may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits.
Hands	If this material may come in contact with the hands during handling and use, we recommend wearing gloves of the following material(s): neoprene, nitrile, polyvinyl alcohol (PVA), fluoro-elastomer. Consult your PPE provider for breakthrough times and the specific glove that is best for you based on your use patterns.
Feet	Wear appropriate footwear to prevent product from coming in contact with feet and skin.

Section IX. Physical and Chemical Properties

Physical State and Appearance	Viscous liquid.	**Viscosity**	**353:** 36 cSt @ 40°C (104°F), 5.7 cSt @ 100°C (212°F), VI=97;
Colour	Pale yellow.	**Pour Point**	**353:** -39°C (-38°F);
Odour	Mild petroleum oil like.	**Softening Point**	Not applicable
Odour Threshold	Not available	**Dropping Point**	Not applicable
Boiling Point	Not available	**Penetration**	Not applicable
Density	0.852 - 0.876 kg/L @ 15°C (59°F).	**Oil / Water Dist. Coeff.**	Not available
Vapour Density	Not available	**Ionicity (in water)**	Not available
Vapour Pressure	Negligible at ambient temperature and pressure.	**Dispersion Properties**	Not available
Volatility	Non-volatile.	**Solubility**	Insoluble in water.

Section X. Stability and Reactivity

Corrosivity	Not available		
Stability	The product is stable under normal handling and storage conditions.	**Hazardous Polymerization**	Will not occur under normal working conditions.
Incompatible Substances / Conditions to Avoid	Reactive with oxidizing agents, acids, alkalis and reducing agents.	**Decomposition Products**	May release COx, NOx, POx, SiOx, methacrylate monomers, smoke and irritating vapours when heated to decomposition.

Section XI. Toxicological Information

Routes of Entry	Skin contact, eye contact, inhalation and ingestion
Acute Lethality	Acute toxicity information is not available for the product as a whole, therefore, data for the base oils are provided below: Acute Oral toxicity (LD50): >5000 mg/kg (rat) Acute Dermal toxicity (LD50): >2000 mg/kg (rabbit)
Chronic or Other Toxic Effects	
Dermal Route:	Prolonged or repeated contact may defat and dry skin, and cause dermatitis. Short-term exposure is expected to cause only slight irritation, if any.
Inhalation Route:	With its relatively low vapour pressure, this product is not expected be inhaled in any appreciable quantity at ambient conditions. If heated to high temperatures or subjected to mechanical actions which produce vapours or mists, inhalation may cause respiratory tract irritation.
Oral Route:	Ingestion of this product may lead to aspiration of the liquid, especially if vomiting occurs. This may result in chemical pneumonitis (inflammation of the lungs) and/or pulmonary edema (an accumulation of fluid in the lungs).May produce a laxative effect.
Eye Irritation/Inflammation:	Short-term exposure is expected to cause only slight irritation, if any.
Immunotoxicity:	Not available
Skin Sensitization:	Contact with this product is not expected to cause skin sensitization, based upon the available data and the known hazards of the components.
Respiratory Tract Sensitization:	Contact with this product is not expected to cause respiratory tract sensitization, based upon the available data and the known hazards of the components.

Continued on Next Page

Mutagenic: Reproductive	This product is not known to contain any components at >= 0.1% that have been shown to cause mutagenicity. Therefore, based upon the available data and the known hazards of the components, this product is not expected to be a mutagen.
Toxicity:	This product is not known to contain any components at >= 0.1% that have been shown to cause reproductive toxicity. Therefore, based upon the available data and the known hazards of the components, this product is not expected to be a reproductive toxin.
Teratogenicity/Embryotoxicity:	This product is not known to contain any components at >= 0.1% that have been shown to cause teratogenicity and/or embryotoxicity. Therefore, based upon the available data and the known hazards of the components, this product is not expected to be a teratogen/embryotoxin.
Carcinogenicity (ACGIH):	This product is not known to contain any chemicals at reportable quantities that are listed as Group A1 or A2 carcinogens by ACGIH.
Carcinogenicity (IARC):	This product is not known to contain any chemicals at reportable quantities that are listed as Group 1, 2A, or 2B carcinogens by IARC.
Carcinogenicity (NTP):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by NTP.
Carcinogenicity (IRIS):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by IRIS.
Carcinogenicity (OSHA):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by OSHA.
Other Considerations	No additional remark.

Section XII. Ecological Information

Environmental Fate	Not available	**Persistance/ Bioaccumulation Potential**	Not available
BOD5 and COD	Not available	**Products of Biodegradation**	Not available
Additional Remarks	No additional remark.		

Section XIII. Disposal Considerations

Waste Disposal	Spent/ used/ waste product may meet the requirements of a hazardous waste. Consult your local or regional authorities. Ensure that waste management processes are in compliance with government requirements and local disposal regulations.

Section XIV. Transport Information

DOT Classification	Not a DOT controlled material (United States).	**Special Provisions for Transport**	Not applicable.

Section XV. Regulatory Information

Other Regulations	This product is acceptable for use under the provisions of WHMIS-CPR. All components of this formulation are listed on the CEPA-DSL (Domestic Substances List). All components of this product are listed on TSCA or are exempt. A component of this product is subject to a TSCA Polymer Exemption - if you intend to import this product into the U.S. please contact Product Safety for more information. All components of this formulation are listed on EINECS or are exempt. This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR. Please contact Product Safety for more information.		
DSD/DPD (EEC)	Not classified under the Dangerous Substances or Dangerous Preparations Directives.	**WHMIS (Canada)**	Not controlled
ADR (Europe) (Pictograms)		**TDG (Canada) (Pictograms)**	

Section XVI. Other Information

References Available upon request.

Glossary

ACGIH - American Conference of Governmental Industrial Hygienists
ADR - Agreement on Dangerous goods by Road (Europe)
ASTM - American Society for Testing and Materials
BOD5 - Biological Oxygen Demand in 5 days
CAS - Chemical Abstract Services
CEPA - Canadian Environmental Protection Act
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CFR - Code of Federal Regulations
CHIP - Chemical Hazard Information and Packaging Approved Supply List
COD - Chemical Oxygen Demand
CPR - Controlled Products Regulations
DOT - Department of Transportation (U.S.A.)
DSCL - Dangerous Substances Classification and Labeling
DSD/DPD - Dangerous Substance or Dangerous Preparations Directives (Europe)
DSL - Domestic Substance List (Canada)
EEC/EU - European Economic Community/European Union
EINECS - European Inventory of Existing Commercial Chemical Substances
EPCRA - Emergency Planning And Community Right-To-Know Act
FDA - Food and Drug Administration
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act
HCS - Hazardous Communication System
HMIS - Hazardous Material Information System
IARC - International Agency for Research on Cancer
IRIS - Integrated Risk Information System
LD50/LC50 - Lethal Dose/Concentration kill 50%
LDLo/LCLo - Lowest Published Lethal Dose/Concentration
NFPA - National Fire Prevention Association
NIOSH - National Institute for Occupational Safety & Health
NPRI - National Pollutant Release Inventory
NSNR - New Substances Notification Regulations (Canada)
NTP - National Toxicology Program
OSHA - Occupational Safety & Health Administration
PEL - Permissible Exposure Limit
RCRA - Resource Conservation and Recovery Act
SARA - Superfund Amendments and Reorganization Act
STEL - Short Term Exposure Limit (15 minutes) (Europe)
TDG - Transportation Dangerous Goods (Canada)
TDLo/TCLo - Lowest Published Toxic Dose/Concentration
TLV-TWA - Threshold Limit Value-Time Weighted Average
TLm - Median Tolerance Limit
TSCA - Toxic Substances Control Act
USEPA - United States Environmental Protection Agency
USP - United States Pharmacopoeia
WHMIS - Workplace Hazardous Material Information System

For Copy of MSDS
Internet:

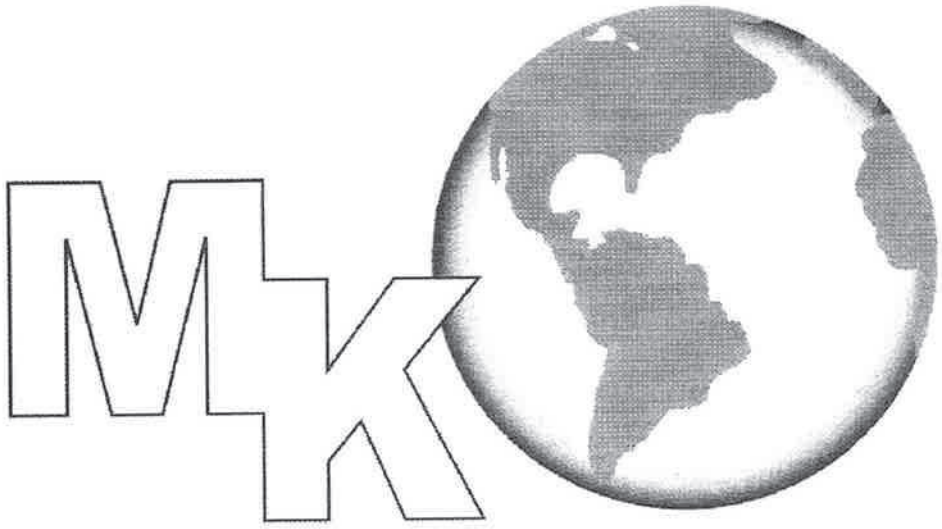
Lubricants:
318-649-8848

For Product Safety Information: (318)649-8848

Prepared by Product Safety - JDW on 6/13/2006.

Data entry by Product Safety - JDW.

2/3/2020- Rev 1; Changed to current phone number - DW.

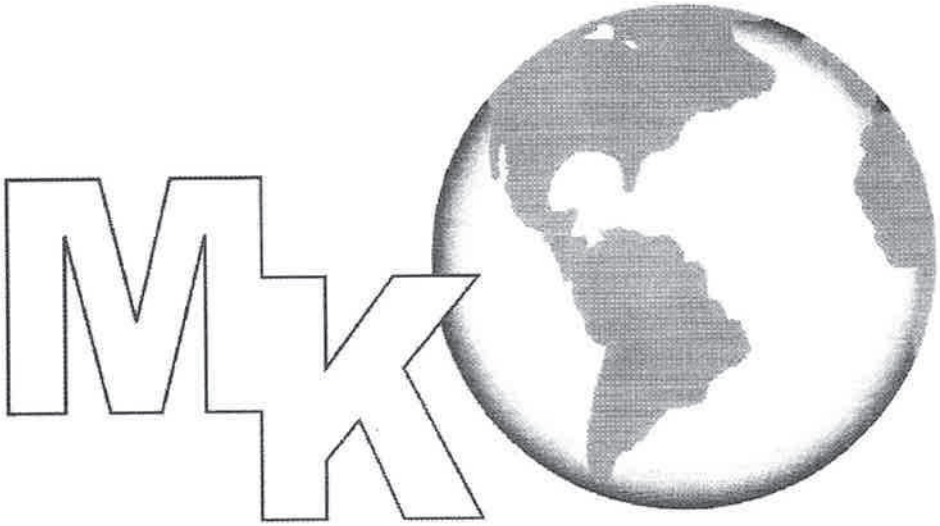


Environmental Inc.

SECTION 2.0
DRAWINGS

MK Environmental, Inc.
765 Springer Dr.
Lombard, IL., 60148
(P) 630-920-1104 (F) 866-306-8977
www.mkenv.com

SEE PLASTIC SLEEVE WITH DRAWINGS INSIDE



Environmental Inc.

SECTION 3.0
SYSTEM DESCRIPTION

MK Environmental, Inc.
765 Springer Dr.
Lombard, IL., 60148
(P) 630-920-1104 (F) 866-306-8977
www.mkenv.com

SYSTEM DESCRIPTION
SVE CLAW BLOWER WITH HOLDING TANK

This system utilizes a Regenerative SVE blower to pull a vacuum on a well header system, and is designed to extract soil vapors. The recovered vapors will go through the Air/Water separator, where any recovered groundwater will separate from the vapors. After the water and vapor have been separated, the SVE exhaust vapors are discharged to the air treatment. The water from the Air/Water separator is discharged to a 500 gallon holding tank where it is collected until proper disposal is arranged.

The standard SVE system includes the following:

1. A base frame skid constructed of structural steel with anchor clips.
2. A Regenerative SVE blower and motor.
3. A primary knockout tank AWS-1 with tangential inlet, vacuum gauge, drain valve, cleanout port, clear sight tube, a high/high level switch (LSHH), a vacuum relief valve and a dilution valve with muffler, and a transfer pump.
4. The AWS-1 Transfer Pump is sized to meet the hydraulic conditions to remove the groundwater at the system's designed vacuum level.

SYSTEM FAULT SHUT-DOWNS:

The control panel has an anti-falsing circuit that will not allow a shut down unless the fault exists for 30 seconds.

The SVE blower will shut down if any of the following fault conditions occur. All other motors continue to operate according to their level controls.

1. HIGH/HIGH LEVEL IN AWS-1. Indicates a failure of the AWS-1 transfer pump to adequately empty the recovered groundwater.
2. SVE HIGH TEMPERATURE. Indicates excessive temperature in the exhaust air of the SVE blower.
3. HIGH/HIGH LEVEL IN HOLDING TANK. Indicates that the final effluent holding tank is full. Requires service visit to remove water from tank for disposal.

START-UP AND SHUT-DOWN PROCEDURES
SVE CLAW BLOWER WITH HOLDING TANK

Specific instructions are included in the start up check list, located in Section 1 of the manual.

INITIAL START-UP - SVE SYSTEM:
Remove protective covering from air inlet vents, exhaust openings and pump / blower air exhaust.

SVE SYSTEM START-UP:

1. Install the SVE Vacuum pump inlet manifold and connect it to the AWS-1 of the system. Hook up the legs of the manifold to the recovery wells. Open the valves to the recovery wells and the main manifold valves.

2. With the panel switches in the "OFF" position, turn ON all of the circuit breakers.

3. Check motors for correct rotation.

4. Start the SVE pump

5. Monitor the vacuum gauge on the AWS-1 to see that a vacuum is developing. Adjust the recovery well valves on the inlet manifold to suit.

6. Monitor the accumulation of water in the AWS-1 and verify the operation of the transfer pump (optional).

SVE SYSTEM SHUT-DOWN:

1. To shut down the system, turn OFF the Vacuum pump.

2. For extended shut down, drain all tanks, and remove the drain plugs on all the pumps to protect from freezing. Install rust inhibiting solution into pumps.

3. For maintenance shut downs, be sure to check any system tags that pertain to piece of equipment that you are servicing.

EMERGENCY SHUTDOWN:

1. Most MK Environmental systems come equipped with an Emergency shut down switch located inside the building or attached to the main piece of equipment on non-enclosed systems.

2. Be sure to check your system to see if it is equipped with this switch. If not, follow standard shutdown procedures.

TROUBLE-SHOOTING GUIDE

SYMPTOM	CAUSE & SOLUTION

CONTROL PANEL GENERAL:

Nothing works and RED "POWER" Light is not lit.

1. Check the control transformer circuit breaker and reset if tripped.
2. Check fuses on or before the control transformer.
3. Verify that the Main Disconnect Switch is "ON".
4. Check the incoming power supply to the control panel.
5. Check the control panel wiring for loose connections.

SVE SYSTEM:

Vacuum at the well header is low and vacuum at the blower is high.

1. Inlet strainer on AWS1 is clogged.
2. Blower inlet filter is dirty. Clean or replace filter element.
3. Blockage in the vapor carbon vessels.

Blower is overheating.

1. Blower inlet filter is dirty. Clean or replace filter element.
2. Blockage in the air dilution valve muffler. Clean muffler.
3. Vacuum relief valve set too high. Readjust valve.
4. Motor voltage is too low. Check electrical power for proper voltage.

Refer to the Busch manual for troubleshooting specific to the blower

MAINTENANCE SCHEDULE

EVERY VISIT:

1. Check AWS1 inlet strainer. Strainer can be removed after the first month of operation.
2. Check, and drain/flush solids from the bottom of AWS-1 tank.
3. Check levels on storage tanks. Empty as necessary

MONTHLY:

1. Tighten all hose clamps, if any.
2. Check all hoses for deterioration, if any.
3. Inspect walls, motors, fans, and components for any damage or corrosion.

QUARTERLY:

1. Check SVE blower vacuum system piping for leaks.
2. With power off, perform a wire pull test and tighten all electrical connections in the control panel.
3. With power off, check all electrical connections at the motor junction boxes. Check the wires for corrosion.
4. Test high level and high temperature sensors and alarms.
5. Test E stop button, if any.
6. General structure inspection. Inspect door, ceiling, wall panels for leaks or damage.

YEARLY:

1. Clean out wall troughs and grease hinges, if any.
2. Replace all filter elements.

Also see the Busch manual for specific maintenance requirements

SYSTEM DESCRIPTION

REGENERATIVE SVE BLOWER

This system utilizes a Regenerative SVE blower to pull a vacuum on a well header system, and is designed to extract soil vapors. The recovered vapors will go through the Air/Water separator, where any recovered groundwater will separate from the vapors. After the water and vapor have been separated, the SVE exhaust vapors are discharged to the air treatment. Any groundwater recovered will accumulate in the Air/Water separator until the high level switch is triggered to shut down the system.

SYSTEM FAULT SHUT-DOWNS

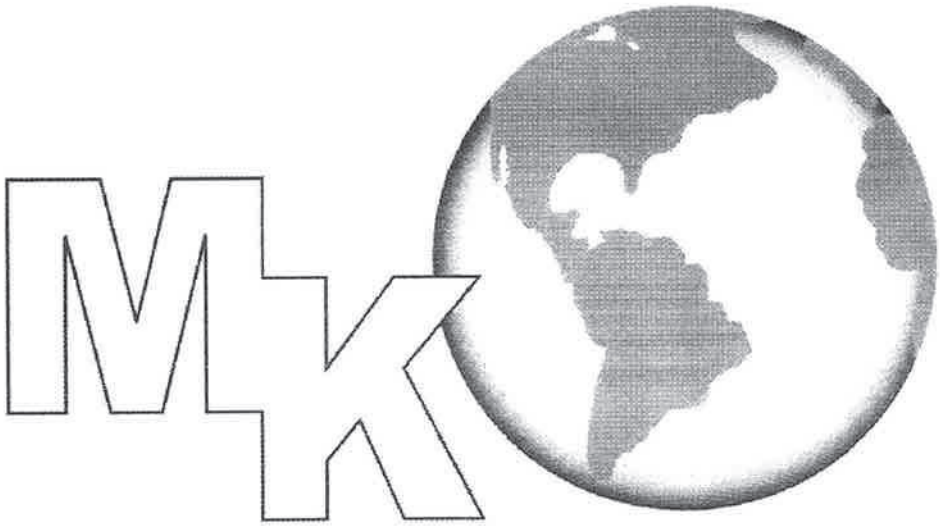
The control panel has an anti-falsing circuit that will not allow a shut down unless the fault exists for 30 seconds.

The SVE blower will shut down if any of the following fault conditions occur. All other motors continue to operate according to their level controls.

1. HIGH/HIGH LEVEL IN AWS-1. Indicates a failure of the AWS-1 transfer pump to adequately empty the recovered groundwater.
2. SVE HIGH TEMPERATURE. Indicates excessive temperature in the exhaust air of the SVE blower.

Job Name & MK#:				ARCADIS EAST PALESTINE H2O TREATMENT 223508B			
MAJOR EQUIPMENT			**MFGR.**	**MODEL #**		**SERIAL #**	**NEW/ USED/ REFURB**	**COMMENTS**
SYSTEM TYPE	**Other**	**QTY**	**30 HP, 3PH, 1725 RPM, TEFC**	**SEAL TYPE**	**SVE**	**VOLTAGE AND ELECTRICAL**	**460V 3PH TEFC**	
SVE Blower		1	Tuthill	5009-A7L2CV1-A		3572921712	Used	
SVE Motor		1	Marathon	BVJ286TTFC4026BA S		N/A	Used	30 HP
P300 Transfer Pump - Stripperator		1	Myers	200 M		N/A	Refurb	3 HP
P300 Pump Motor – Stripperator		1	Marathon	C238C		N/A	Refurb	7.5 HP
P200 Transfer Pump - OWS		1	Myers	200 M		N/A	Refurb	
P200 Pump Motor – OWS		1	Marathon	C238C		N/A	Refurb	7.5 HP
P100A Transfer Pump - Frac		1	Myers	200 M		N/A	Refurb	
P100A Pump Motor – Frac		1	Marathon	C238C		N/A	Refurb	7.5 HP
KO Tank		1	MK	300 Gal Vert		N/A	Refurb	
KO Tank Transfer Pump Motor		1	Myers/ WEG	WEG- 00156ET3E56CFL-S		20FEV2017	Refurb	1.5 HP
AWS-1		1	MK	190 Gal Hori		22-09	New	
AWS-1		1	MK	190 Gal Hori		22-10	New	
OWS		1	MK	C75		00137/ T00480	Refurb	
AOS		1	MK	Standard TDEC		10-30	Refurb	
AOS		1	MK	Standard TDEC		09-48	Refurb	
SVE Silencer		1	Stoddard	D13H-4		180138	Used	
SVE Silencer		1	Stoddard	D13H-4		N/A	Used	
Stripperator		1	MK	LP-150		2641045019	Refurb	
Telemetry		1	Allen Bradley	SOS		304666844	New	
Heater		1	Hazloc	XEV1-12-100-480360-B-F-A		XEU13885	Used	
Building		1	MK	24'		13-03	Refurb	
Disconnect		1	Siemens	200A, 600 VAC, 600 VDC		307050101	Used	
Control Panel		1	B-Line Systems	423612RHC		78205137305	New	
Transformer		1	HPS	CB01277595		C1F005LES	New	5 kVa
VFD		1	Scheneider	ATV71HD30N4		881102527005	Used	30kW - 40 HP
VFD		1	Ironhorse	ACN-45PO		550CA210437	New	5 HP 3Ph
VFD		1	Ironhorse	ACN-45PO		550CA210436	New	5 HP 3Ph
VFD Enclosure		1	IEC	4251		CP-1140	Used	
VFD Enclosure		1	SCE	24EL-2412LP		5040890	New	
Signet Magmeter		1	Signet	159001261		61409020896	New	
Signet Magmeter		1	Signet	159001261		61502111342	New	
Siemens Lvl Transmitter		1	SITRANS Probe	7ML5221-1BA11		PBD/ XO140342	New	
Siemens Lvl Transmitter		1	SITRANS Probe	7ML5221-1BA11		PBD/ L3280529	New	

Job Name & MK#:		ARCADIS EAST PALESTINE H2O TREATMENT 223508B			
MAJOR EQUIPMENT		MFGR.	SERIAL #	NEW/ USED/ REFURB	COMMENTS
SYSTEM TYPE	Other	30 HP, 3PH, 1725 RPM, TEFC	VOLTAGE AND ELECTRICAL	460V 3PH TEFC	
Bag Filter Housing		MK	1104	Refurb	
Bag Filter Housing		MK	010-01	Refurb	
Bag Filter Housing		MK	010-03	Refurb	
Bag Filter Housing		MK	12-04	Refurb	
Exterior Carbon Vessel		US Filter	16481-A	Refurb	MK 00123/ TB-011
Exterior Carbon Vessel		US Filter	16481-B	Refurb	MK 00122/ TB-011
Exterior Carbon Vessel		US Filter	16481-C	Refurb	MK 00121/ TB-011
Exterior Carbon Vessel		Tetrasolv	4778HS-4	Refurb	N/A
Exterior Carbon Vessel		Tetrasolv	N/A	Refurb	Tan Sonford Tank
Exterior Carbon Vessel		Tetrasolv	N/A	Refurb	Tan Sonford Tank
Exterior Carbon Vessel		MK	T001196	Refurb	Ext Angle Rings
Exterior Carbon Vessel		MK	T001195	Refurb	JHA SSD
Exterior Carbon Vessel		MK	T001194	Refurb	JHA SSD



Environmental Inc.

SECTION 4.0
SVE SYSTEM

MK Environmental, Inc.
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Lombard, IL., 60148
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M-D Pneumatics®

M-D Pneumatics®
Rotary Positive Displacement Blower

Manual 2017 Rev D p/n 002017 0000

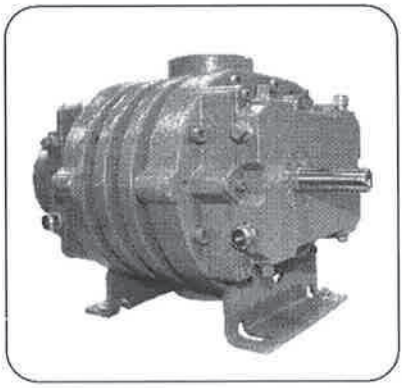
WARNING: Do Not Operate Before Reading Manual

CP Series
OPERATOR'S MANUAL

Models

2002	3002	4002	5003	6005	7006
2004	3003	4005	5006	6008	7011
	3006	4007	5009	6015	7018

Grease Lubrication / Air Service
Splash Lubrication / Air Service



Operator Manual: CP Series Rotary Positive Displacement Blower

800.825.6937 | www.mdpneumatics.com

Original Instructions

Disclaimer Statement:
All information, illustrations and specifications in this manual are based on the latest information available at the time of publishing. The illustrations used in this manual are intended as representative reference views only. Products are under a continuous improvement policy. Thus, information, illustrations and/or specifications to explain and or exemplify a product, service or maintenance improvement may be changed at any time without notice.

Product information and specifications subject to change.

Table of Contents

Table of Contents

01

INTRODUCTION

CONGRATULATIONS on the purchase of a new **CP Series Rotary Positive Displacement Blower** from **M-D Pneumatics®**. Please examine the blower for shipping damage, and if any damage is found, report it immediately to the carrier. If the blower is to be installed at a later date, make sure it is stored in a clean, dry location and rotated regularly. Make sure covers are kept on all openings. If the blower is stored outdoors, be sure to protect it from weather and corrosion.

CP Series blowers are built to exacting standards and, if properly installed and maintained, will provide many years of reliable service. Read and follow every step of these instructions when installing and maintaining the blower.

NOTE: Record the blower model and serial numbers of the machine in the OPERATING DATA form on the inside back cover of this manual. Use this identification on any replacement part orders, or if service or application assistance is required.

APPLICABLE DOCUMENTATION

The applicable documents associated with this manual are:

- 2006/42/CE – Machinery Directive
- EN 1012-1:1996 - Compressors and vacuum pumps - Safety Requirements - Part 1: Compressors

SCOPE OF MANUAL

The scope of this manual includes the bare shaft rotary positive displacement blower.

02

CONVENTIONS AND DATA PLATE

GRAPHIC CONVENTIONS IN THIS MANUAL

This manual is the result of a risk assessment according to the applicable documents referenced in ***Applicable Documentation on page 1***. The following hazard levels are referenced within this manual:

⚠ DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates a situation that can cause damage to the engine, personal property, and/or the environment or cause the equipment to operate improperly.

NOTE: Indicates a procedure, practice, or condition that should be followed in order for the equipment to function in the manner intended.

⚠ CAUTION

Read manual before operation or bodily harm may result. Attention should be given to the safety related sections of this manual.

DATA PLATE

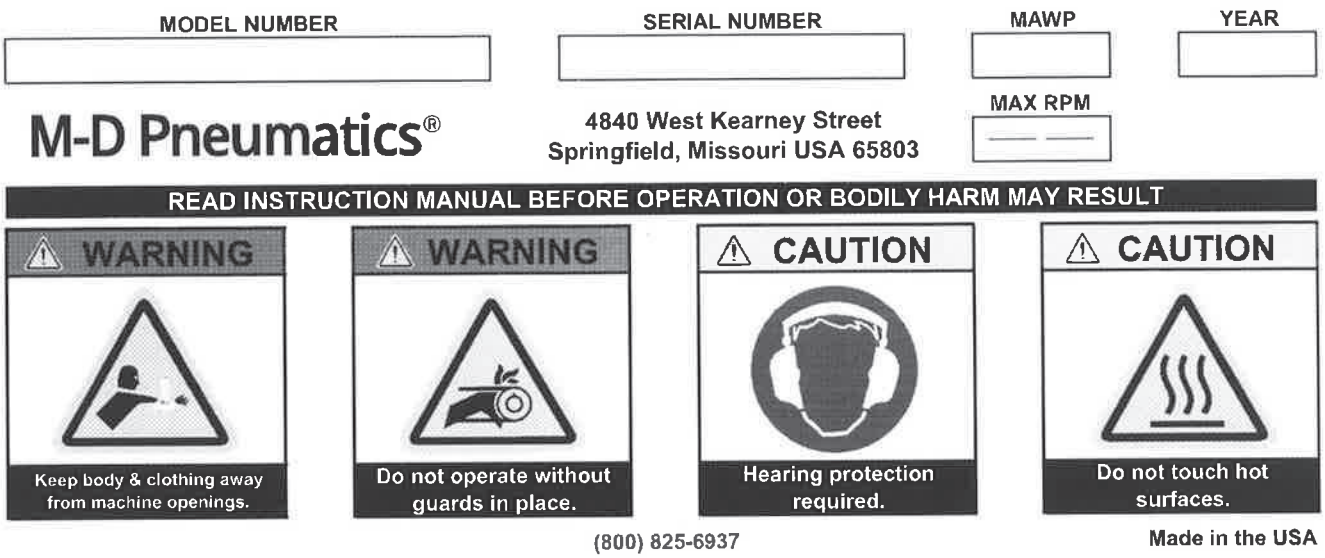


Figure 2-1 – General Operation and Symbols on Data Plate

The following information is contained on the data plate:

⚠ WARNING

Keep body and clothing away from machine.

During operation, keep body and clothing away from inlet and outlet of the blower.

⚠ WARNING

Do not operate without guards in place.

⚠ CAUTION

Hearing protection is required while the blower is in operation. Noise levels may reach as high as 81 dBA.

⚠ CAUTION

Do not touch hot surfaces.

The upper limit of the blower operation is 400°F (205°C). Do not touch the blower while it is in operation and assure blower is cool when not in operation.

MODEL NUMBER: The specific model of the blower

SERIAL NUMBER: Unique to each blower

YEAR: Year of manufacture

MAWP: Maximum Allowable Working Pressure

The standard MAWP is per ***Table 4-2 – Maximum Operating Limits on page 9***. The MAWP shall not be exceeded.

03

LIFTING

⚠ WARNING

The blower must be handled using an appropriate device such as a fork truck or appropriate lifting device. *See Table 4-1 on page 8* for approximate weights. Care should be taken to assure blower does not overturn during handling and installation.

04

DESCRIPTION

NOTICE

Refer to specific data sheets for flow capacities and vacuum capacities.

NOTE: Refer to diagrams in this manual for proper rotation and orientation in inlet and discharge.

M-D Pneumatics CP Series model rotary lobe blowers are positive displacement type units, whose pumping capacity is determined by size, operating speed, and differential pressure conditions. Blowers employ rotors rotating in opposite directions within a housing closed at the ends by end plates.

The inlet to the discharge is sealed with operating clearances that are very small. Internal lubrication is not needed, as there is no moving contact.

Clearances between the rotors during rotation are maintained by a pair of accurately machined helical timing gears, mounted on the two shafts extended outside the air chamber. The intermeshing rotary lobes are designed to rotate and trap air or gas between each rotor and the housing. As the rotor lobes rotate past the edge of the suction port, the trapped air or gas is essentially at suction pressure and temperature. Since the blower is a constant volume device, the trapped air remains at suction pressure until the leading rotor lobe opens into the discharge port. The close clearances between the rotors inhibit back slippage of the trapped volume from between the rotors, and the trapped volume is forced into the discharge piping. Compression occurs not internal to the blower but by the amount of restriction, either downstream of the blower discharge port or upstream of the blower inlet port.

Figure 4-1 illustrates the air movement within the machine. In addition, the machine can operate in either direction.

Never attempt to control capacity by means of a throttle valve in the intake or discharge piping. This will increase the power load on the drive system, will increase operating temperatures, and can overload and/or seriously damage the blower. Likewise, if the possibility exists that flow to the blower inlet may be cut off during normal operation of a process, install an adequate vacuum relief valve. A pressure-type relief valve in the discharge line near the blower is also recommended for protection against cutoff or blocking in this line. Use check valves on each blower when more than one blower is connected to a discharge line.

When a belt drive is used, it is possible to adjust blower speed to obtain the desired capacity by changing the diameter of one or both sheaves, or by using a variable-speed motor pulley. In a direct-coupled arrangement, a variable-speed motor or transmission is required. Gas blowers can use bypasses, but some applications may require additional cooling. If there is a large volume of high-pressure air or gas downstream of the blower, a check valve in the piping downstream of the blower will protect the blower from overspeeding in a backward direction upon shutdown.

Consult a M-D Pneumatics sales professional if questions arise.

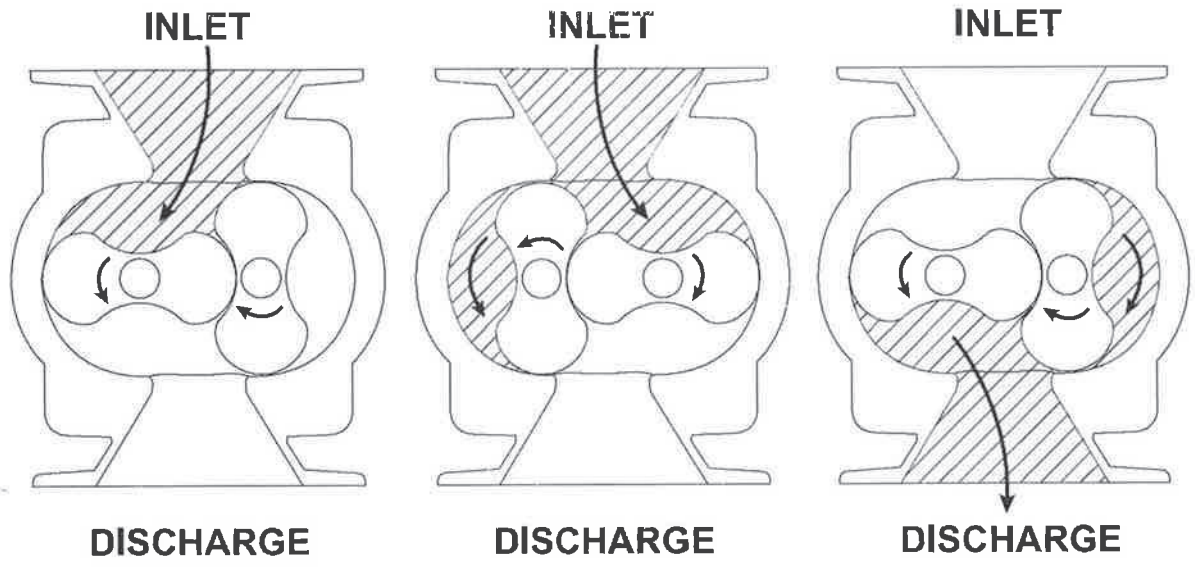


Figure 4-1 – General Operation Principle

FLOW BY DIRECTION AND ROTATION

⚠ WARNING

Refer to diagrams in this manual for proper rotation and orientation in inlet and discharge.

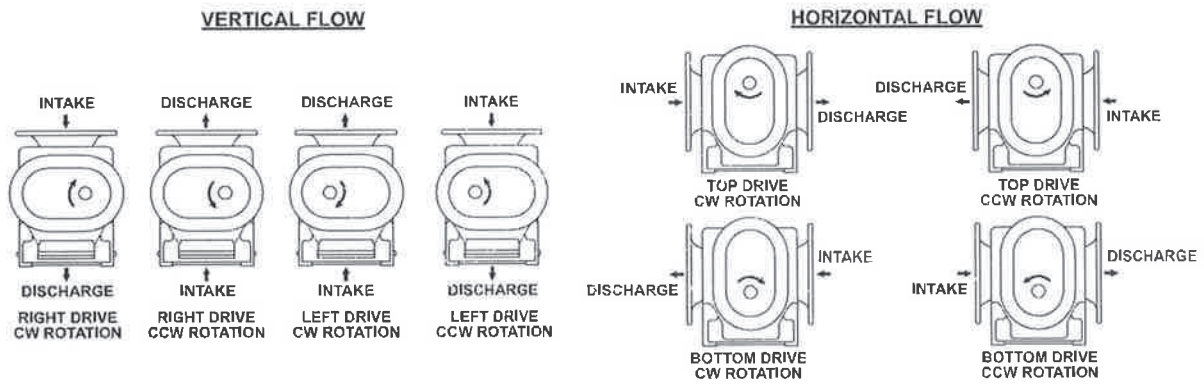


Figure 4-2 – Flow Direction by Rotation

SPECIFICATIONS

MODEL	APPROXIMATE OIL CAPACITY[1]				PORT SIZE	MAXIMUM RPM	APPROXIMATE WEIGHT
	VERTICAL FLOW		HORIZONTAL FLOW				
	GEAR END[2]	DRIVE END[3]	GEAR END[2]	DRIVE END[3]			
2002	3.4 oz (101 mL)	–	1.7 oz (50 mL)	–	1 in. (25 mm)	5,275	41 lb (19 kg)
2004	3.4 oz (101 mL)	–	1.7 oz (50 mL)	–	2 in. (51 mm)	5,275	53 lb (24 kg)
3002	6.0 oz (177 mL)	4.0 oz (118 mL)	3.4 oz (101 mL)	2.5 oz (74 mL)	1.25 in. (32 mm)	3,600	78 lb (35 kg)
3003	6.0 oz (177 mL)	4.0 oz (118 mL)	3.4 oz (101 mL)	2.5 oz (74 mL)	2 in. (51 mm)	3,600	83 lb (38 kg)
3006	6.0 oz (177 mL)	4.0 oz (118 mL)	3.4 oz (101 mL)	2.5 oz (74 mL)	2.5 in. (64 mm)	3,600	113 lb (51 kg)
4002	8.5 oz (251 mL)	6.4 oz (189 mL)	5.8 oz (172 mL)	4.7 oz (139 mL)	1.5 in. (38 mm)	3,600	95 lb (43 kg)
4005	8.5 oz (251 mL)	6.4 oz (189 mL)	5.8 oz (172 mL)	4.7 oz (139 mL)	2.5 in. (64 mm)	3,600	127 lb (58 kg)
4007	8.5 oz (251 mL)	6.4 oz (189 mL)	5.8 oz (172 mL)	4.7 oz (139 mL)	3 in. (76 mm)	3,600	146 lb (66 kg)
5003	18.3 oz (541 mL)	10.2 oz (302 mL)	7.1 oz (210 mL)	5.4 oz (160 mL)	2.5 in. (64 mm)	2,850	152 lb (69 kg)
5006	18.3 oz (541 mL)	10.2 oz (302 mL)	7.1 oz (210 mL)	5.4 oz (160 mL)	4 in. (102 mm)	2,850	185 lb (84 kg)
5009	18.3 oz (541 mL)	10.2 oz (302 mL)	7.1 oz (210 mL)	5.4 oz (160 mL)	4 in. (102 mm)	2,850	222 lb (101 kg)
6005	25.5 oz (754 mL)	18.0 oz (532 mL)	16.9 oz (500 mL)	9.0 oz (266 mL)	3 in. (76 mm)	2,350	250 lb (113 kg)
6008	25.5 oz (754 mL)	18.0 oz (532 mL)	16.9 oz (500 mL)	9.0 oz (266 mL)	5 in. (127 mm)	2,350	310 lb (141 kg)
6015	25.5 oz (754 mL)	18.0 oz (532 mL)	16.9 oz (500 mL)	9.0 oz (266 mL)	6 in. (152 mm)	2,350	456 lb (207 kg)
7006	28.7 oz (849 mL)	–	20.3 oz (600 mL)	–	4 in. (102 mm)	2,050	425 lb (193 kg)
7011	28.7 oz (849 mL)	–	20.3 oz (600 mL)	–	6 in. (152 mm)	2,050	555 lb (252 kg)
7018	28.7 oz (849 mL)	–	20.3 oz (600 mL)	–	8 in. (203 mm)	2,050	675 lb (306 kg)

1 Oil capacities are based on filling from dry condition. Less oil may be needed depending on emptiness of oil reservoir(s) after draining. Always fill the gear housing until oil drips out of the oil level hole. Replace plugs in their respective holes. Following this procedure will ensure proper oil level.
2 Gear End amounts apply to all CP Series blowers.
3 Drive End amounts apply only to Splash Lubrication models.

Table 4-1 – Specifications

MODEL	MAXIMUM RPM	MAXIMUM PRESSURE DIFFERENTIAL*	MAXIMUM VACUUM*	MAXIMUM TEMPERATURE RISE*	MAWP
2002	5,275	12 psi (827 mbar)	15 inch-Hg (542 mbar)	225°F (125°C)	15 psi (1,034 bar)
2004	5,275	7 psi (483 mbar)	15 inch-Hg (542 mbar)	185°F (103°C)	15 psi (1,034 bar)
3002	3,600	15 psi (1,034 mbar)	16 inch-Hg (542 mbar)	210°F (117°C)	15 psi (1,034 bar)
3003	3,600	12 psi (827 mbar)	15 inch-Hg (508 mbar)	180°F (100°C)	15 psi (1,034 bar)
3006	3,600	7 psi (483 mbar)	15 inch-Hg (508 mbar)	170°F (94°C)	15 psi (1,034 bar)
4002	3,600	15 psi (1,034 mbar)	16 inch-Hg (542 mbar)	220°F (122°C)	17 psi (1,172 bar)
4005	3,600	10 psi (690 mbar)	16 inch-Hg (542 mbar)	210°F (117°C)	15 psi (1,034 bar)
4007	3,600	7 psi (483 mbar)	15 inch-Hg (508 mbar)	170°F (94°C)	15 psi (1,034 bar)
5003	2,850	15 psi (1,034 mbar)	16 inch-Hg (542 mbar)	195°F (108°C)	17 psi (1,172 bar)
5006	2,850	13 psi (1,034 mbar)	16 inch-Hg (542 mbar)	195°F (108°C)	15 psi (1,034 bar)
5009	2,850	7 psi (483 mbar)	15 inch-Hg (508 mbar)	160°F (89°C)	15 psi (1,034 bar)
6005	2,350	15 psi (1,241 mbar)	16 inch-Hg (542 mbar)	250°F (139°C)	17 psi (1,241 bar)
6008	2,350	14 psi (965 mbar)	16 inch-Hg (542 mbar)	240°F (133°C)	15 psi (1,034 bar)
6015	2,350	7 psi (483 mbar)	14 inch-Hg (406 mbar)	180°F (100°C)	15 psi (1,034 bar)
7006	2,050	15 psi (1,034 mbar)	16 inch-Hg (542 mbar)	235°F (131°C)	17 psi (1,172 bar)
7011	2,050	10 psi (690 mbar)	16 inch-Hg (542 mbar)	210°F (117°C)	15 psi (1,034 bar)
7018	2,050	6 psi (414 mbar)	12 inch-Hg (406 mbar)	120°F (67°C)	15 psi (1,034 bar)

* Maximum conditions based upon 70°F (21°C) inlet temperature and 14.7 psi (1 bar) absolute inlet pressure.

Table 4-2 – Maximum Operating Limits

Description

⚠ WARNING

The maximum pressure differential is based on the difference between the inlet pressure and the outlet pressure. The maximum pressure differential shall not be exceeded. Exceeding the maximum pressure differential will cause serious damage to the equipment and could cause bodily injury.

⚠ WARNING

The maximum allowable working pressure (MAWP) is based on the absolute pressure of the blower housing and is NOT the maximum allowable pressure differential. Exceeding the MAWP will cause serious damage to the equipment and could cause bodily injury.

To permit continued satisfactory performance, a blower must be operated within certain approved limiting conditions. The manufacturer's warranty is, of course, also contingent on such operation.

Maximum limits for pressure, temperature, and speed are specified in ***Table 4-2 on page 9*** for various blower sizes when operated under the standard atmospheric conditions. Do not exceed any of these limits.

NOTICE

Specially ordered blowers with nonstandard construction, or with rotor end clearances greater than shown in ***Assembly Clearances on page 32****, will not have the operating limits specified here. Contact your M-D Pneumatics sales representative for specific information.*

NOTICE

Special attention must be paid when a blower has a higher than standard ambient suction temperature. Special recommendations for operating parameters and/or additional cooling may be recommended. Consult the factory or local representative for appropriate information.

05

INSTALLATION

GENERAL

⚠ DANGER

The blower is not intended to be used with explosive products or in explosive environments. The blower is not intended to be used in applications that include hazardous and toxic gases. Consult the factory for support.

⚠ DANGER

It is the responsibility of the installer to assure that proper guarding is in place and compliant with all applicable regulatory requirements.

⚠ WARNING

The bare shaft blower can generate excessive noise. Methods to reduce the noise levels by installing inlet and outlet silencers will be required. Even with inlet and outlet silencers, hearing protection will be required.

⚠ WARNING

Customers are warned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards in the installation and operation of this equipment in the system or facility.

⚠ WARNING

The standard MAWP is per *Table 4-2*. The MAWP shall not be exceeded unless specific factory testing of the pressure containing components of the blower has been performed.

⚠ WARNING

***Table 4-2* states the maximum operating speed in RPM (rotations per minute) and maximum temperature. Do not exceed these limits. The installation of the blower shall take these critical operating parameters into account and adequate control features implemented.**

⚠ WARNING

Upon completion of the installation, and before applying power, rotate the drive shaft by hand. It must move freely. If it does not, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment or any other cause of binding. If blower is removed and still does not move freely, check inside the blower housing for foreign material.

NOTICE

Remove the protective covers from the shaft and inspect for damage.

Carefully check to ensure that no transit damage has been sustained. If damage has occurred from shipment, file a claim with the carrier immediately. Preserve the shipping container for inspection by the carrier.

NOTICE

In the event that your unit sustains damage while being shipped to your facility, do not return it to the factory without first obtaining shipping instructions from M-D Pneumatics.

Do not remove protective covers and plugs until the connections are complete. Mount the blower on a flat, level surface. Use a baseplate that is rigid, solidly supported, and structurally sound. Shim under the legs where necessary so that each leg of the blower supports an equal share of the blower weight. This is necessary to prevent twisting of the blower. Make sure the feet rest evenly on the mounting surface before fastening down. Twisting or cramping the blower during mounting will cause rotor contact and binding during operation, resulting in a condition called "soft foot." ***See Soft Foot on page 14*** for further details and preventative measures.

A blower that is factory-mounted on a base should not require such adjustments. However, since the assembly can become twisted in shipping or installation, check for soft foot after installing the base. Shims may be needed for alignment. Loosen the foot hold-down screws to check foot contact with the mounting surface. Mount the base on a solid foundation or heavy flooring, using shims as necessary at bolting points to prevent warping the assembly.

Transmission of small operating vibrations to a support structure may be objectionable in some applications. Use of vibration isolators or vibration-absorbing materials can be effective in overcoming this transmission. To avoid causing distortion, apply the treatment under the common motor/blower base or mounting plate rather than directly under the feet alone.

Make sure piping is accurately squared with the blower and supported independently. Stress imparted from incorrectly aligned piping or mounting will create problems with bearing and seal life, possibly leading to premature internal contact. The blower should sit stress free and evenly on its supporting surface. Take care to evenly tighten the mounting bolts to avoid imparting undue stress into the blower. Stress can be checked in a free state with feeler stock or verified on a previously installed blower with the aid of a dial indicator. Spring or gap should be less than 0.002 in. (0.05 mm).

Use only clean, new pipe and make certain it is free of scale, cuttings, weld beads, dirt, or any other foreign material. To guard against damage to the blower, make sure that an inlet filter is used. Clean the filter of collected debris after 3 hours of operation and periodically thereafter. ***See Piping Connections on page 18*** for additional details.

Figure 5-1 shows a typical complete installation of the blower and accessories. Note the absence of throttle or shut-off valves in both discharge and intake piping. If it is possible for airflow to be cut off in either line, add a pressure and/or vacuum relief valve. In some installations, it may be desirable to use only an inlet silencer-cleaner supported directly from the blower connection. Keep the weight of accessories and piping to a minimum to prevent blower casing distortion. If the weight exceeds 10% of blower weight, support the components independently of the blower and connect them with a flexible hose or connectors. The approximate weight of the blower is listed in ***Table 4-1 on page 8***.

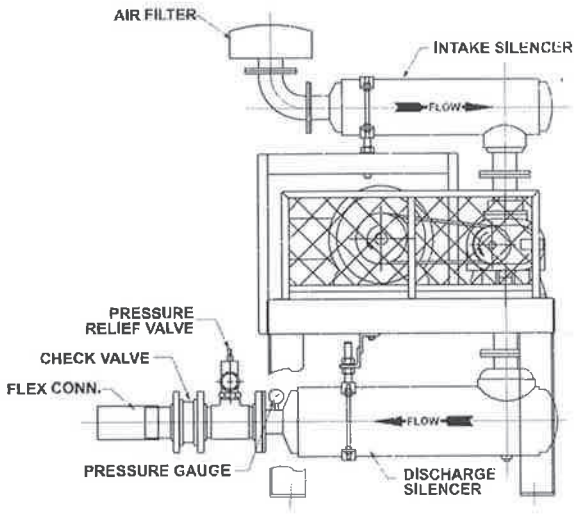


Figure 5-1 – Typical Blower Installation

A blower may be driven by direct-coupling to the driver or by V-belt drive for the purpose of obtaining other speeds within the approved range. ***See Motor Drives on page 19*** for more information.

Blowers from M-D Pneumatics are internally and externally treated after factory assembly and testing to protect against rusting in normal atmospheric conditions prior to installation. The maximum period of internal protection is considered to be 6 months under average conditions, provided closing plugs and seals are not removed. Protection against chemical or salt-water atmosphere is not provided. Avoid opening the blower until ready to begin installation, as protection will be quickly lost due to evaporation. For recommended preparations for long-term storage (longer than 6 months), ***see Long-Term Storage on page 29***.

Location

Install the blower in a room or outdoor area that supplies adequate space and lighting for routine maintenance. Make sure that indoor installation areas are well ventilated and kept as cool as possible, because operating the blower at elevated temperatures can result in nuisance overload or temperature shutdowns. An unprotected outdoor installation is satisfactory only when correct lubrication for the expected temperatures is provided, as per ***Recommended Lubricants for Blowers and Vacuum Boosters on page 34***.

Foundation

The blower does not need a special foundation. However, it does require a solid, level floor and adequate frame support. Bolt the blower system to the floor and seal any cracks.

Blower Air Intake

To minimize maintenance, supply the blower with the cleanest air possible. The air must not contain any flammable or toxic gases, as the blower will concentrate these gases. This could result in damage to the blower and surrounding property and lead to personal injury or death. Do not block or restrict the opening of the blower, as the motor could overheat and fail.

Do not use blowers on explosive or hazardous gases. Do not exceed the limits described in ***Table 4-2 on page 9*** on performance criteria such as pressure differential, running speed, and discharge temperature.

If it is necessary to take air from a remote source, such as in a vacuum application, make sure the diameter of the piping is at least equal to the diameter of the blower inlet. For distances greater than 20 ft (6 m), enlarge the pipe diameter to reduce inlet restriction. Excessive restriction will reduce the efficiency of the blower and elevate its discharge temperature. The piping used should also be corrosion-resistant and free of scale and dirt. Keep the inlet covered to keep out foreign objects and rain. Vacuum kits are available.

Soft Foot

Soft foot is a condition in which one of the blower feet does not sit flat on the base. Soft foot is usually due to irregularities in the surface to which the blower is mounted. When the bolt on the foot gets tightened, a slight distortion occurs that can affect bearing and seal life as well as internal contact between parts.

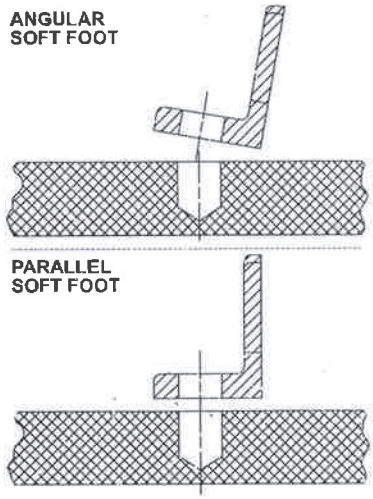


Figure 5-2 – Illustrations of Soft Foot

1. Place the blower on the base.
2. Check each foot for gaps between the foot and base (soft foot). Shim as necessary to fill the gap within 0.002 in. (0.05 mm).
   Figure 5-2 shows the two most common types of soft foot conditions. If either type is present at a measurement of more than 0.003 in. (0.076 mm), the blower may fail prematurely.
3. Tighten all bolts.
4. Mount a dial indicator on the base contacting one foot at 12 o'clock position.
5. Loosen the bolt on that foot. Observe indicator travel and add shims as needed to reduce "spring" to less than 0.002 in. (0.05 mm). Repeat steps 4 and 5 on the remaining feet.

SAFETY

M-D Pneumatics recommends the use of relief valves to protect against excessive pressure or vacuum conditions. Test these valves at initial start-up to be sure they are properly adjusted to relieve at or below the maximum pressure differential rating of the blower.

⚠ DANGER

It is the responsibility of the installer to assure that proper guarding is in place and compliant with all applicable regulatory requirements.

⚠ DANGER

Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. The blower should never be run with the inlet or discharge piping removed. If it becomes necessary to inspect the rotating parts of the blower or to change V-belts, be absolutely sure that all power to the motor controls has been shut off, the motor controls are locked out, and properly tagged before proceeding.

⚠ DANGER

Assure that properly sized vacuum breaks/ relief valves are used on the inlet side of the blower. Also assure that properly sized pressure relief valves are used on the outlet of the blower. The sizing shall be such to assure that the proper flow can be achieved without exceeding the rated vacuum and pressure ratings.

⚠ DANGER

Blower housing and associated piping or accessories may become hot enough to cause major skin burns on contact.

⚠ WARNING

Use lock out/tag out procedures to disable the electrical energy source before any service or work is done on the blower.

⚠ WARNING

Avoid extended exposure in close proximity to machinery with high intensity noise levels. Wear adequate ear protection.

NOTE: Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.

LUBRICATION

Every blower from M-D Pneumatics is factory-tested, oil-drained, and shipped dry to its installation point. Fill both independent oil reservoirs to the proper level before operation.

Shaft bearings at the gear end of the blower are splash-lubricated by one or both gears dipping into an oil reservoir formed in the gear end plate and cover. Shaft bearings at the drive end of the blower are lubricated by a slinger assembly dipping into an oil reservoir. Before starting the blower, fill the oil sumps as described in ***Filling Procedure on page 16***.

Add oil to the blower in the quantity listed in***Table 4-1 on page 8***. Make sure oil level is maintained within the notched area of the sight glass. ***See Figure 5-3***. Lower drive blowers have "bull's eye" type oil level gauges. Maintain oil levels at the center of the glass.

⚠ WARNING

Never attempt to change or add lubrication while the blower is running. Failure to heed this warning could result in damage to the equipment or personal injury. Oil must be checked when the blower is NOT running.

⚠ WARNING

Properly dispose of the spent lubricants. Refer to the manufacturer of the lubricant and any regulations to assure proper and safe disposal.

⚠ WARNING

Do not start the blower until you are sure oil has been put in the gear housing and rear cover. Operation of the blower without proper lubrication will cause the blower to fail and void the warranty.

NOTICE

Most CP Series blowers are shipped from the factory in a left hand drive, vertical flow configuration. If drive shaft location is changed, the oil level plugs, sight glasses and breathers must be relocated to proper positions, as shown in ***Figure 5-3****. Failure to change plug location will result in blower failure and void the product warranty.*

Filling Procedure

See Figure 5-3. See Recommended Lubricants for Blowers and Vacuum Boosters on page 34 for suggested lubricants and grease.

1. Remove the fill plugs or breathers from both gear end and drive end plates.
2. Slowly pour oil through the fill until oil appears in the oil sight glass. Bring the oil level to the center of the sight glass.
3. Verify oil level is at proper level in both gear end and drive end sight glasses.
4. Replace the fill plugs or breathers that were removed in step 1.

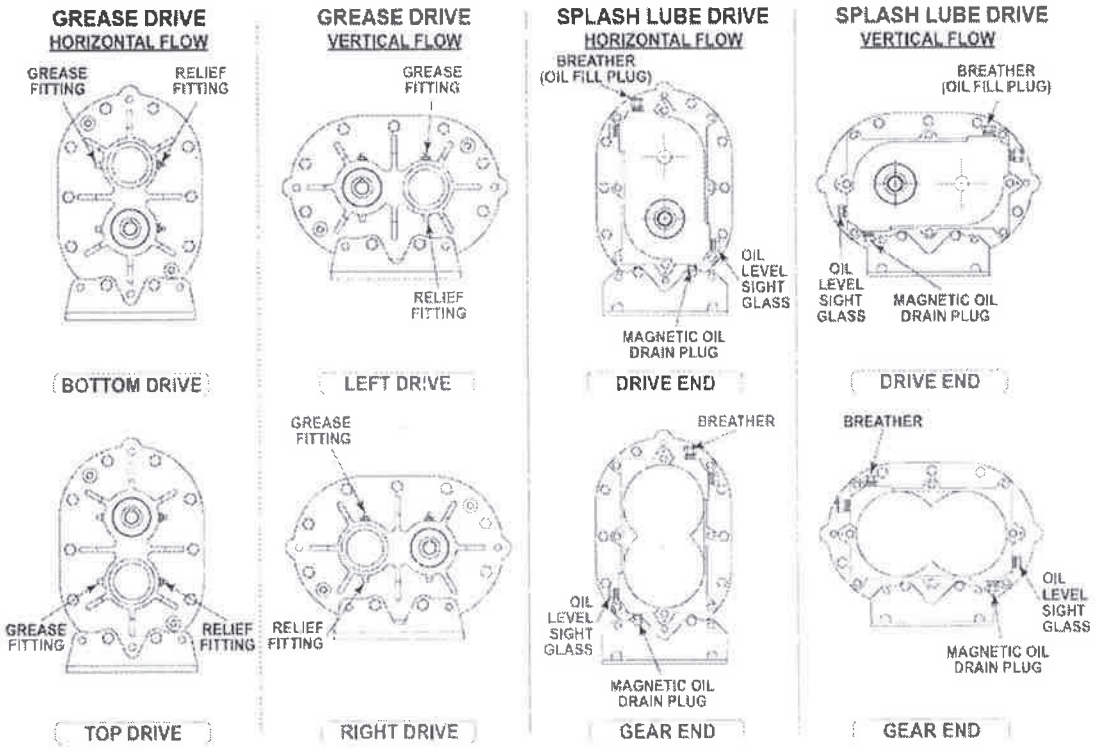


Figure 5-3 – Location of Oil Fill, Drain and Level Gauges on CP Series Blowers

Frequently Asked Questions Regarding Lubrication

What is the functional detriment if the "wrong oil" is used?

The lubricant is selected based on bearing speed, gear speed, and operating temperature. If the lubricant is too light, it increases wear by not separating the sliding surfaces and it will not remove the heat adequately. If the lubricant is too thick, the drag in the bearings is increased, causing them to run hotter. Thicker lubricant will not flow as readily into the gears and it will reduce the available backlash. Lubricants at our conditions are incompressible.

What is the functional detriment if the oil is not serviced?

If the lubricant is not serviced at the proper interval, the shearing action in the bearing and the gears will begin to take its toll and the lubricant will thicken. The blower will run hotter and the wear on moving parts will increase. The lubricant will generally appear dirtier, caused by material rubbing off the components. The lubricant will discolor because of overheating. An indicator of the breakdown of a lubricant is the increase in the Total Acid Number (TAN) and a change of 10 percent in the base viscosity.

Several things are happening as the lubricant goes through the blower. First, it is absorbing frictional energy in the form of heat. This heat has to be dissipated through either surface contact with cooler materials or in a rest volume of lubricant. While reducing the friction, the lubricant is also going through a shearing process and the molecular structure is broken down.

The result is that the lubricant will begin to thicken because of the shorter molecular chains and the drop out of additive packages. The thickened lubricant will cause more drag, increasing the friction and heat and further degrading the lubricant.

Operation of the blower (environment, run time, speed, and pressure) has a direct effect on duty cycles. The published cycles are based on worst-case conditions.

Hazards Associated With Breakdown or Ignition of Lubrication

⚠ DANGER

There is a risk associated with the lubrication media breaking down and resulting in a hazardous fluid or vapor. There may also be a hazard associated with the ignition of the lubrication media. Refer to the lubrication manufacturer's applicable instruction for safety precautions.

Release Lubricated Bearings – Grease Lubrication Series Only

Service the drive end bearing at regular intervals (see ***Table 5-1***). Use NLGI #2 premium-grade, petroleum-base grease with high temperature resistance and good mechanical stability, such as M-D Pneumatics MD Oil grease, available from a local M-D Pneumatics professional. Use a pressure gun to force new grease into each bearing until traces of clean grease come out of the relief fitting.

SPEED IN RPM	OPERATING HOURS PER DAY		
	8	16	24
	GREASING INTERVALS IN WEEKS		
750 – 1,000	7	4	2
1,000 – 1,500	5	2	1
1,500 – 2,000	4	2	1
2,000 – 2,500	3	1	1
2,500 – 3,000	2	1	1
3,000 and up	1	1	1

Table 5-1 – Suggested Lubrication Intervals for Grease Lubricated Bearings

NOTICE

To avoid blowing out the drive shaft seal, do not grease too rapidly.

NOTE: See *Figure 5-3* for locations of grease fittings and grease reliefs for horizontal and vertical flow blowers.

PIPING CONNECTIONS

⚠ WARNING

Pipe loading on the blower should be negligible as pipe loading can cause distortion of the blower. Use proper supports and pipe hangers to assure that there is no loading.

NOTICE

Remove the protective covers from the inlet and outlet ports and inspect for dirt and foreign material.

Inlet and outlet connections on all blowers are large enough to handle maximum volume with minimum friction loss. Maintain same-diameter piping. Do not support silencers by the blower. Avoid stress loads and bending moments.

Be certain all piping is clean internally before connecting to the blower. Place a 16-mesh wire screen backed with hardware cloth at or near the inlet connections for the first 50 hours of use until the system is clean. Clean the screen after 3 hours of operation and completely discard it once the system is clean, as it will eventually deteriorate and small pieces going into the blower can cause serious damage. A horizontal or vertical airflow piping configuration is easily achieved by rearranging the mounting feet position.

Hazards Associated With Hazardous Process Fluids

⚠ DANGER

It shall be the responsibility of the installer to ensure that piping is adequate, sealing between pipe joints is adequate for the process fluids and proper process and pressure protection devices are in place. It is also the responsibility of the installer to assure that process gases are not vented in a manner that would be hazardous.

Refer to the manufacturer of the process media to assure that proper safety precautions are in place.

Blockage or Restriction

⚠ WARNING

Damage to the blower could occur if there is blockage in the inlet or outlet ports or piping. Care should be taken when installing the blower to assure that there are no foreign objects or restrictions in the ports or piping.

MOTOR DRIVES

Two drive connections commonly used are direct drive and V-belt drive.

Direct Coupled

When installing the motor directly to the blower, align the shafts to the coupling according to the coupling manufacturer's instructions. Blowers shipped with the motor directly coupled and mounted on a common base have been aligned prior to shipment. Further alignment is not normally necessary, but be sure to check the alignment and make adjustments if necessary prior to starting the blower.

Coupling halves must correctly fit the blower and drive shafts so that only light tapping is required to install each half. The two shafts must be accurately aligned. A direct-coupled blower and motor must be aligned with the two shafts having no more than 0.005 in. (13 mm) Total Indicator Reading (TIR). Make sure the face is aligned within 0.002 in. (0.05 mm).

Establish proper gap between coupling halves according to the coupling manufacturer's instructions with the motor armature. Proper gap will minimize the chance for end thrust on the blower shaft. Re-align and grease all direct-coupled base-mounted blowers after field installation.

V-Belts

If the motor and blower are V-belt connected, the sheaves on both the motor and blower shafts should be as close to the shaft bearings as possible. Blower sheave is not more than 1/4 in. (6.5 mm) from the blower drive end cover. The drive sheave is as close to the driver bearing as possible. Take care when installing sheaves on the blower and motor shafts. Make sure the face is accurately in line to minimize belt wear.

Adjust the belt tension to the manufacturer's specifications using a belt tension tester. Check new belts for proper tension after 24 hours of run time. When manufacturer data is not available, industry guidelines recommend 1/64 in. deflection for each inch of span (0.157 mm deflection per centimeter of span) at 8 – 10 lb (3.6 – 4.5 kg) of force in the center of the belt.

Insufficient tensioning is often indicated by slipping (squealing) at start-up. Do not use belt dressing on V-belts. Keep sheaves and V-belts free of oil and grease. Remove tension from belts if the drive is to be inactive for an extended period of time. For more specific information, consult the drive manufacturer. In a V-belt drive, the blower sheave must fit its shaft accurately, run true, and be mounted as close to the bearing housing as possible to minimize bearing loads.

A tight or driving fit will force the drive shaft out of its normal position and cause internal damage. A loose fit will result in shaft damage or breaking. Make sure the motor sheave fits correctly and is properly aligned with the blower sheave.

Adjust the motor position on its sliding base so that belt tension is in accordance with drive manufacturer's instructions. Always avoid excessive belt tension. Recheck tension after the first 10 hours of operation and periodically thereafter to avoid slippage and loss of blower speed.

Check the blower after installation and before applying power by rotating the drive shaft by hand.

If the drive shaft does not rotate freely:

- Look for uneven mounting, piping strain, excessive belt tension, or coupling misalignment
- Check the blower to make sure oil was added to the reservoirs

Setting V-Belt Tension

Proper belt tension is essential to long blower life. ***Figure 5-4***, ***Figure 5-5***, and the following procedure are provided to aid in field-adjusting V-belts (when the blower is so equipped) for maximum performance. A visual inspection of the V-belt drive should yield the appearance shown in ***Figure 5-4***.

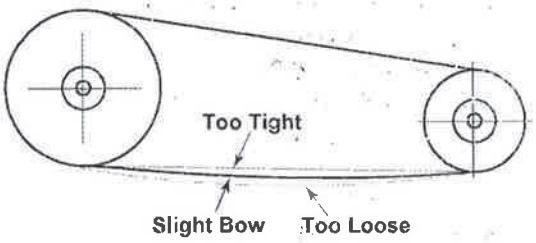


Figure 5-4 – General appearance of a V-belt drive

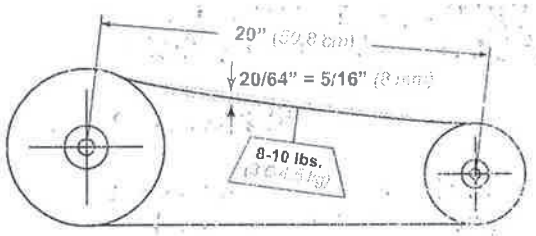


Figure 5-5 – Setting of proper tension for a V-belt drive

Factors outside the control of the belt tensioning system used on an individual blower package assembly, such as environmental factors and quality of the belts installed, may contribute to decreased belt life. Such factors can cause wear of the belts beyond the ability of the tensioning system to compensate.

As such, it is recommended to check belt tension monthly and make any manual adjustments found necessary.

1. Turn off and lock out power.
2. Remove the belt guard fasteners (if equipped).
3. Remove the belt guard.
4. Check and adjust the belt tension as necessary. Tension should be 1/64 in. deflection per inch of span (0.157 mm deflection per centimeter of span) between sheaves, with 8 – 10 lb (3.6 – 4.5 kg) force applied at the center point of the top section of belt.
5. Install the belt guard, making sure that all drive components are free of contact with the guard.
6. Install the belt guard fasteners that were removed in step 2.
7. Unlock the power and start the blower.
8. Resume normal operation.

V-Belt Troubleshooting

PROBLEM	POSSIBLE CAUSES	SOLUTION
Belts slip (sidewalls glazed)	Not enough tension	Replace belts; apply proper tension.
Drive squeals	Shock load	Apply proper tension.
	Not enough arc of contact	Increase center distance.
	Heavy starting load	Increase belt tension.
Belt(s) turned over	Broken cord caused by prying on sheave	Replace set of belts and install correctly.
	Overloaded drive	Redesign drive.
	Impulse loads	Apply proper tension.
	Misalignment of sheave and shaft	Re-align drive.
	Worn sheave grooves	Replace sheaves.
	Excessive belt vibration	Check drive design. Check equipment for solid mounting. Consider use of banded belts.
Mismatched belts	New belts installed with old belts	Replace belts in matched sets only.
Breakage of belt(s)	Shock loads	Apply proper tension; recheck drive.
	Heavy starting loads	Apply proper tension; recheck drive. Use compensator starting.
	Belt pried over sheaves	Replace set of belts correctly.
	Foreign objects in drives	Provide drive guard.
Rapid belt wear	Sheave grooves worn	Replace sheaves.
	Sheave diameter too small	Redesign drive.
	Mismatched belts	Replace with matched belts.
	Drive overloaded	Redesign drive.
	Belt slips	Increase tension.
	Sheaves misaligned	Align sheaves.
	Oil or heat condition	Eliminate oil. Ventilate drive.

MOTOR AND ELECTRICAL CONNECTIONS

⚠ WARNING

The motor and connections shall be protected to assure that product and environmental condensation does not come in contact with the electrical connections.

NOTICE

It is the responsibility of the installer to assure that the motor is in compliance with the latest edition of IEC 60204-1 and all electrical connections are performed per IEC 60204-1, this includes overcurrent protection.

Wire the motor and other electrical devices, such as solenoid valves and temperature switch, to the proper voltage and amperage as indicated on the nameplate of the component being wired. Turn the blower by hand after wiring is completed to determine that there are no obstructions and that the blower turns freely. Then, momentarily start the blower to check the direction of rotation. ***Figure 4-2*** shows direction of airflow in relation to rotor rotation. The airflow direction can be reversed by reversing the appropriate motor leads.

06

OPERATION

GENERAL

⚠ DANGER

The blower is not intended to be used with explosive products or in explosive environments. The blower is not intended to be used in applications that include hazardous and toxic gases. Consult the factory for support.

⚠ WARNING

Do not operate without guards in place.

⚠ WARNING

Maximum operating speed: *Table 4-2* states the maximum operating speed in RPM (rotations per minute), the maximum pressure differential, maximum vacuum and maximum temperature rise. Do not exceed these limits.

⚠ WARNING

The blower can generate excessive noise. Hearing protection is required while the unit is in operation.

Before starting the blower for the first time under power, recheck the installation thoroughly to reduce the likelihood of difficulties. Use the following checklist as a guide, but consider any other special conditions in your installation.

1. Be certain no bolts, rags, or dirt have been left in blower.
2. Be certain that inlet piping is free of debris. If an open outdoor air intake is used, be sure the opening is clean and protected by an inlet filter. This also applies to indoor use.
3. If installation is not recent, check blower leveling, drive alignment, belt tension, and tightness of all mounting bolts.
4. Be certain the proper volume of oil is in the oil reservoir chambers.
5. Be certain the driving motor is properly lubricated and connected through suitable electrical overload devices.
6. With electrical power off and locked out to prevent accidental starting, rotate the blower shaft several times by hand to make sure the blower is rotating freely. Unevenness or tight spots are indicators of a condition that should be corrected before progressing.

7. Check motor rotation by momentarily pushing the START button and then checking the flow direction of the blower. Reverse the motor connections if the flow is in the wrong direction.

Carry out initial operation under "no load" conditions by opening all valves and venting the discharge to the atmosphere, if possible. Then, start the motor briefly, listen for unusual noises, and make sure the blower coasts freely to a stop. If no problem appears, repeat this check and let the motor run slightly longer. If any questions exist, investigate before proceeding.

Assuming all tests are satisfactory, the blower will now be ready for continuous full-load operation. During the first several days, check periodically to make sure all conditions remain acceptable and steady. These checks may be particularly important if the blower is part of a process system where conditions may vary. At the first opportunity, stop the blower and clean or remove the inlet filter. Also recheck leveling, coupling alignment or belt tension, and mounting bolts for tightness.

START-UP CHECKLIST

It is recommended that these start-up procedures be followed in sequence and checked off (☑) in the boxes provided in any of the following cases.

• During initial installation • After any shutdown period	• After maintenance work has been performed • After blower has been moved to a new location

DATES CHECKED:			
☐☐☐☐	Check the unit for proper lubrication. Proper oil level is critical. ***See Lubrication on page 15. See Recommended Lubricants on page 34*** for information on acceptable lubricants for the product.		
☐☐☐☐	Check the V-belt drive for proper belt alignment and tension.		
☐☐☐☐	Carefully turn the rotors by hand to be certain they do not bind.		

⚠ WARNING

Disconnect power. Make certain power is off and locked out before touching any rotating element of the blower, motor, or drive components.

☐☐☐☐	"Bump" the unit with the motor to check rotation (counterclockwise when facing the shaft) and to be certain it turns freely and smoothly.
☐☐☐☐	Start the unit and operate it for 30 minutes at no load. During this time, feel the cylinder for hot spots. If minor hot spots occur, ***see Troubleshooting on page 30.***
☐☐☐☐	Apply the load and observe the operation of the unit for 1 hour.
☐☐☐☐	If minor malfunctions occur, discontinue operation and ***see Troubleshooting on page 30.***

⚠ DANGER

The blower is not intended to be used with explosive products or in explosive environments. The blower is not intended to be used in applications that include hazardous and toxic gases. Consult the factory for support.

⚠ WARNING

Physical harm may occur if human body parts are in contact or exposed to the process vacuum. Assure that all connections are protected from human contact.

⚠ WARNING

If rated vacuum or pressure levels are exceeded, process fluids will migrate to other parts of the blower and system.

⚠ CAUTION

Do not touch hot surfaces.

Do not touch the blower while it is in operation and assure blower is cool when not in operation.

NOTICE

The upper temperature limits are not intended for continuous operation. Consult with factory for detailed information assistance.

STOPPING

⚠ CAUTION

Do not stop the blower if there are high outlet pressures in the outlet piping. Unload the outlet piping prior to shutting down the blower.

Stop the blower by turning off the motor. Isolate the blower from the vacuum system and vent the blower to the atmosphere.

RECOMMENDED SHUTDOWN PROCEDURE TO MINIMIZE RISK OF FREEZING OR CORROSION

When an air piping system has high humidity or moisture, water condensation can occur after the blower is shut down and it begins to cool. Condensation creates an environment favorable to corrosion of the iron internal surfaces and to ice formation in cold weather. Both conditions can close the operating clearances, causing the blower to fail upon future start-up.

The following shutdown procedure minimizes the risk of moisture condensation, corrosion, and freezing.

NOTICE

Care must be taken not to overload or overheat the blower during this procedure.

1. Isolate the blower from the moist system piping, allowing the blower to intake atmospheric air. Operate the blower under a slight load, allowing the blower to heat within safe limits. The heat generated by the blower will quickly evaporate residual moisture.
2. For carpet cleaning applications, or other applications where a high moisture content within the blower may present, after the work is completed, allow the blower to run 3 – 5 minutes with the suction hose and wand attached. The suction hose and wand will provide enough load to the blower to evaporate the moisture quickly.
3. For extended shutdown, inject a small amount of a light lubricating oil such as 3-in-One® or a spray lubricant such as WD-40® into the inlet of the blower just before shutdown *(3-in-One and WD-40 are registered trademarks of WD-40 Company)*. The lubricant will provide an excellent protective coating on the internal surfaces. If using a spray lubricant, take care to prevent the applicator tube from getting sucked into the blower. The applicator tube will damage the blower, likely to a degree where repair would be required.
4. If the blower is being taken out of commission for an extended period of time, ***see Long-Term Storage on page 29.***

07

MAINTENANCE

GENERAL

Regular inspection of the blower and its installation, along with complete checks on operating conditions, will pay dividends in added life and usefulness. Also, service the drive per the manufacturer's instructions and lubricate the coupling or check the belt drive tension. Use thermometers and gauges to make sure that blower operating temperature and pressure remain within allowed limits.

⚠ DANGER

The blower and parts may contain hazardous media. Assure that pump and parts are evacuated of hazardous media prior to servicing.

⚠ CAUTION

The electrical service must be isolated and de-energized prior to maintenance. Apply appropriate procedures to assure electrical supply is de-energized and cannot be inadvertently energized during maintenance.

Assure piping and product is isolated prior to maintenance of blower. Apply appropriate procedures to assure piping and product is isolated and that inadvertent opening of valves cannot occur during maintenance.

⚠ CAUTION

During routine maintenance, inspect and assure that guards are in place and secure.

Pay special attention to lubrication of timing gears and bearings according to the information in ***Lubrication on page 15.***

When a blower is taken out of service, it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgment based on existing conditions as well as length of downtime. Under atmospheric conditions producing rapid corrosion, protect the blower immediately. ***See Long-Term Storage on page 29.***

REGULAR MAINTENANCE

A well-designed maintenance program will add years of service to the blower.

Check a newly installed blower frequently during the first month of operation, especially lubrication. With the blower at rest, check the oil level in both the gear (drive) end and free (non-drive) end of the blower and add oil as needed. Complete oil changes are recommended every 1,000 – 1,200 operating hours, or more frequently depending on the type of oil and operating temperature. Also change the oil more frequently if pumping corrosive vapors or where excessive operating temperatures are encountered. The following is recommended as a minimum maintenance program.

DAILY	WEEKLY	MONTHLY
1. Check and maintain oil level, and add oil as necessary. 2. Check for unusual noise or vibration (***see Troubleshooting on page 30***).	1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage. 2. Check the relief valve to make sure it is operating properly.	1. Inspect the entire system for leaks. 2. Inspect the condition of the oil and change if necessary. 3. Check drive belt tension and tighten if necessary.

NOTICE

Oil levels should be checked every 24 hours of operation.

Proper oil drain schedules require oil be changed before the contaminant load becomes so great that the lubricating function of the oil is impaired or heavy disposition of suspended contaminants occurs. To check the condition of the oil, drain a sample into a clean container and check for the presence of water or solids. Slight discoloration of the oil should not necessitate an oil change.

SPARE PARTS

Should adjustments or replacement be needed, repairs can often be performed locally as described in this manual after obtaining the required parts. Personnel should have a good background of mechanical experience and be thoroughly familiar with the procedures outlined in this manual. For major repairs not covered in this manual, contact the nearest M-D Pneumatics service representative.

When ordering parts, supply the blower nameplate information, as well as the item number and parts description as per the parts lists and assembly drawings. Repair kits are available for all models. These kits contain all the seals, bearings, O-rings, locks, and special retaining screws necessary for an overhaul. For convenience when ordering parts, complete the **Operating Data Form** included on the inside back cover of this manual.

In developing a stock of spare parts, consider the following factors:

- The degree of importance in maintaining the blower in a "ready" condition
- The time lag in parts procurement
- Cost
- Shelf life (seals and O-rings)

FACTORY SERVICE AND REPAIR

With proper care, M-D Pneumatics blowers will provide years of reliable service. The parts are machined to close tolerances and require special tools by mechanics who are skilled at this work. Should major repairs become necessary, contact the factory for the location of the nearest service facility. Blowers that are still under warranty must be returned to the factory, freight prepaid, for service.

NOTICE

Current regulations require Material Safety Data Sheet to be completed and forwarded to M-D Pneumatics on any unit being returned for any reason which has been handling or involved with hazardous gases or materials. This is for the protection of the employees of M-D Pneumatics who are required to perform service on this equipment. Failure to do so will result in service delays.

NOTICE

When returning a blower to the factory for repair, under warranty, please note the factory will not accept any unit that arrives without authorization. Contact the Service Department for return authorization.

LONG-TERM STORAGE

Any time the blower will be stored for an extended period of time, make sure it is protected from corrosion by following this procedure:

1. Spray the interior (lobes, housing, and end plates) with rust preventative. Repeat as conditions dictate and on an at least a yearly basis.
2. Fill both end covers completely full of oil.
3. Firmly attach a prominent tag stating that the end covers are full of oil and must be drained and refilled to proper levels before start-up.
4. Apply a rust-preventative grease to the drive shaft.
5. Spray all exposed surfaces, including the inlet and discharge flanges, with rust preventative.
6. Seal the inlet, discharge, and vent openings. It is not recommended that the blower be set in place, piped to the system, and allowed to remain idle for a prolonged amount of time. If any component is left open to the atmosphere, the rust preventative will escape and lose its effectiveness.
7. During storage, make sure the blower does not experience excessive vibration.
8. Attach a desiccant bag to one of the covers to prevent condensation from occurring inside the blower. Make sure any desiccant bag (or bags) is attached to the covers so that they will be removed before start-up of the blower.
9. Store the blower in an air conditioned and heated building if possible. If air conditioned and heated storage is not possible, make conditions as dry as possible.
10. If possible, rotate the drive shaft by hand at least monthly to prevent seals from setting in one position.

08

TROUBLESHOOTING

Although M-D Pneumatics blowers are well designed and manufactured, problems may occur due to normal wear and the need for readjustment. The following chart lists symptoms that may occur along with probable causes and remedies.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Loss of oil	Gear housing not tightened properly	Tighten gear housing bolts.
	Lip seal failure	Disassemble and replace lip seal.
	Insufficient sealant	Remove gear housing and replace sealant.
	Loose drain plug	Tighten drain plug.
Excessive bearing or gear wear	Improper lubrication	Correct oil level. Replace dirty oil. ***See Lubrication on page 15.***
	Excessive belt tension	Check belt manufacturer's specifications for tension and adjust accordingly.
	Coupling misalignment	Check carefully. Re-align if necessary.
Lack of volume	Slipping belts	Check belt manufacturer's specifications for tension and adjust accordingly.
	Worn lobe clearances	Check for proper clearances. ***See Assembly Clearances on page 32.***
	Speed too low	Increase blower speed within limits.
	Obstruction in piping	Check system to ensure an open flow path.
Knocking	Blower out of time	Re-time.
	Distortion due to improper mounting or pipe strains	Check mounting alignment and relieve pipe strains.
	Excessive pressure differential	Reduce to manufacturer's recommended pressure. Examine relief valve and reset if necessary.
	Worn gears	Replace timing gears.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Excessive blower temperature	Too much or too little oil in gear reservoir	Check oil level. ***See Lubrication on page 15.***
	Too low operating speed	Increase blower speed within limits.
	Clogged filter or silencer	Remove cause of obstruction.
	Excessive pressure differential	Reduce pressure differential across the blower.
	Elevated inlet temperature	Reduce inlet temperature.
	Worn lobe clearances	Check for proper clearances. ***See Assembly Clearances on page 32.***
Rotor end or tip drag	Insufficient assembled clearances	Correct clearances. ***See Assembly Clearances on page 32.***
	Case or frame distortion	Check mounting and pipe strain.
	Excessive operating pressure	Reduce pressure differential.
	Excessive operating temperature	Reduce pressure differential or reduce inlet temperature.
Vibration	Belt or coupling misalignment	Check carefully. Re-align if necessary.
	Lobes rubbing	Check cylinder for hot spots, and then check for lobe contact at these points. Correct clearances. ***See Assembly Clearances on page 32.***
	Worn bearings or gears	Check condition of gears and bearings. Replace if necessary.
	Unbalanced or rubbing lobes	Possible build-up on casing or lobes, or inside lobes. Remove build-up and restore clearances.
	Driver or blower loose	Check mounting and tighten if necessary.
	Piping resonance	Check pipe supports, check resonance of nearby equipment, and check foundation.

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ASSEMBLY CLEARANCES

MODEL	LOBES TO END PLATES			INTERLOBE	LOBE TO CASING	
	DRIVE END	GEAR END	TOTAL		TIP-DOWEL	TIP-PORT
2002	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.003 – 0.005 in. (0.08 – 0.13 mm)	0.008 – 0.011 in. (0.20 – 0.28 mm)	0.005 – 0.009 in. (0.13 – 0.23 mm)	0.002 – 0.004 in. (0.05 – 0.10 mm)	0.003 – 0.006 in. (0.08 – 0.15 mm)
2004	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.003 – 0.005 in. (0.08 – 0.13 mm)	0.008 – 0.011 in. (0.20 – 0.28 mm)	0.005 – 0.009 in. (0.13 – 0.23 mm)	0.002 – 0.004 in. (0.05 – 0.10 mm)	0.003 – 0.006 in. (0.08 – 0.15 mm)
3002	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.003 – 0.005 in. (0.08 – 0.13 mm)	0.008 – 0.012 in. (0.20 – 0.30 mm)	0.006 – 0.012 in. (0.15 – 0.30 mm)	0.002 – 0.005 in. (0.05 – 0.13 mm)	0.004 – 0.007 in. (0.10 – 0.18 mm)
3003	0.005 – 0.008 in. (0.13 – 0.20 mm)	0.003 – 0.005 in. (0.08 – 0.13 mm)	0.009 – 0.012 in. (0.23 – 0.30 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.002 – 0.005 in. (0.05 – 0.13 mm)	0.004 – 0.007 in. (0.10 – 0.18 mm)
3006	0.006 – 0.010 in. (0.15 – 0.25 mm)	0.003 – 0.005 in. (0.08 – 0.13 mm)	0.010 – 0.013 in. (0.25 – 0.33 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.002 – 0.005 in. (0.05 – 0.13 mm)	0.004 – 0.007 in. (0.10 – 0.18 mm)
4002	0.004 – 0.009 in. (0.10 – 0.23 mm)	0.004 – 0.006 in. (0.10 – 0.15 mm)	0.009 – 0.013 in. (0.23 – 0.33 mm)	0.012 – 0.016 in. (0.30 – 0.41 mm)	0.003 – 0.006 in. (0.08 – 0.15 mm)	0.005 – 0.008 in. (0.13 – 0.20 mm)
4005	0.005 – 0.010 in. (0.12 – 0.25 mm)	0.004 – 0.006 in. (0.10 – 0.15 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.012 – 0.016 in. (0.30 – 0.41 mm)	0.003 – 0.006 in. (0.08 – 0.15 mm)	0.005 – 0.008 in. (0.13 – 0.20 mm)
4007	0.005 – 0.010 in. (0.12 – 0.25 mm)	0.004 – 0.006 in. (0.10 – 0.15 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.012 – 0.016 in. (0.30 – 0.41 mm)	0.003 – 0.006 in. (0.08 – 0.15 mm)	0.005 – 0.008 in. (0.13 – 0.20 mm)
5003	0.004 – 0.009 in. (0.10 – 0.23 mm)	0.004 – 0.006 in. (0.10 – 0.15 mm)	0.009 - 0.013 in. (0.29 - 0.33 mm)	0.014 – 0.018 in. (0.36 – 0.46 mm)	0.003 – 0.006 in. (0.08 – 0.15 mm)	0.005 – 0.008 in. (0.13 – 0.20 mm)
5006	0.005 – 0.010 in. (0.13 – 0.25 mm)	0.004 – 0.006 in. (0.10 – 0.15 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.014 – 0.018 in. (0.36 – 0.46 mm)	0.003 – 0.006 in. (0.08 – 0.15 mm)	.005 – .008 in. (0.13 – 0.20 mm)
5009	0.005 – 0.010 in. (0.13 – 0.25 mm)	0.004 – 0.006 in. (0.10 – 0.15 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.014 – 0.018 in. (0.36 – 0.46 mm)	0.003 – 0.006 in. (0.08 – 0.15 mm)	0.005 – 0.008 in. (0.13 – 0.20 mm)
6005	0.008 – 0.013 in. 0.20 – 0.33 mm)	0.005 – 0.007 in. (0.12 – 0.18 mm)	0.015 – 0.019 in. (0.38 – 0.48 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.006 – 0.009 in. (0.15 – 0.23 mm)
6008	0.008 - 0.013 in. (0.20 - 0.33 mm)	0.005 – 0.007 in. (0.12 – 0.18 mm)	0.015 – 0.019 in. (0.38 – 0.48 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.006 – 0.009 in. (0.15 – 0.23 mm)
6015	0.009 – 0.014 in. (0.23 – 0.36 mm)	0.005 – 0.007 in. (0.13 – 0.18 mm)	0.016 – 0.020 in. (0.40 – 0.50 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.006 – 0.009 in. (0.15 – 0.23 mm)
7006	0.008 – 0.012 in. (0.20 – 0.30 mm)	0.005 – 0.007 in. (0.13 – 0.18 mm)	0.015 – 0.018 in. (0.38 – 0.46 mm)	0.012 – 0.016 in. (0.30 – 0.41 mm)	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.006 – 0.009 in. (0.15 – 0.23 mm)
7011	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.005 – 0.007 in. (0.13 – 0.18 mm)	0.017 – 0.020 in. (0.43 – 0.51 mm)	0.012 – 0.016 in. (0.30 – 0.41 mm)	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.006 – 0.009 in. (0.15 – 0.23 mm)
7018	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.005 – 0.007 in. (0.13 – 0.18 mm)	0.017 – 0.020 in. (0.43 – 0.51 mm)	0.012 – 0.016 in. (0.30 – 0.41 mm)	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.006 – 0.009 in. (0.15 – 0.23 mm)

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TORQUE CHART

Data shown represents "wet" torque values in foot-pounds and *(Newton-meters)*.

PART DESCRIPTION	TORQUE
CAP SCREW 10-32UNF	3 ft-lb *(4 N-m)*
CAP SCREW 1/4"-20UNC GR5	6 ft-lb *(8 N-m)*
CAP SCREW 5/16"-18UNC GR5	13 ft-lb *(17 N-m)*
CAP SCREW 3/8"-16UNC GR5	23 ft-lb *(31 N-m)*
CAP SCREW 1/2"-13UNC GR5	57 ft-lb *(77 N-m)*
CAP SCREW 5/8"-14UNC GR5	113 ft-lb *(153 N-m)*
CAP SCREW 3/4"-10UNC GR5	200 ft-lb *(271 N-m)*

11

RECOMMENDED LUBRICANTS

RECOMMENDED LUBRICANTS FOR BLOWERS AND VACUUM BOOSTERS

Positive displacement blowers and vacuum boosters require proper lubrication for bearings, seals and gears to operate effectively and efficiently. Oil is distributed from the oil reservoir to the critical components by means of oil slingers that are attached to the rotor shaft. In certain models of CP Series blowers, a high-performance grease rated for high temperatures is used on the drive-end bearings.

MD full synthetic lubricants are recommended for blowers and vacuum boosters. MD lubricants are specifically formulated using unique additives that provide maximum protection and extend the life of your product over mineral oils or semi-synthetic lubricants.

⚠ WARNING

Do not overfill the oil sumps. Overfilling can result in gear damage or oil leaks.

⚠ CAUTION

Units are shipped without oil in the sumps. Ensure adequate oil has been added before operating.

MD oils are suitable for a wide range of operating temperatures that are based on model, operating speed and discharge temperature of the product.

FOR OXYGEN-ENRICHED SERVICE

Blowers and vacuum boosters operated in oxygen enriched applications should only use non-flammable, PFPE full synthetic lubricants. Blowers and vacuum boosters used in hydrogen service should only MD full synthetic oil

NOTE: Oxygen-enriched service only applicable for PD Plus blowers and vacuum boosters.

⚠ CAUTION

M-D Pneumatics and Kinney does not accept responsibility for damage caused by use of lubricants that are not recommended by M-D Pneumatics and Kinney.

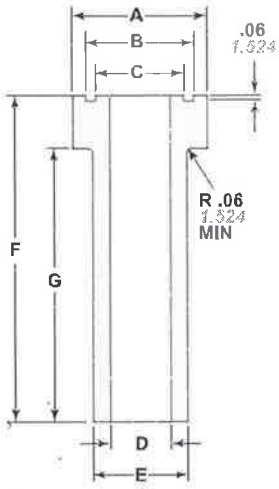
MD BLOWER & BOOSTER LUBRICANTS SPECIFICATIONS:				
PRODUCTS	**MD ONE**	**MD PLUS**	**MD MAX**	**MD FG**
VISCOSITY INDEX	150	150	150	141
@40°C, CST	99.1	342	232	99.3
@100°C, CST	14.4	32.8	25.4	13.9
FLASH POINT °F (°C)	510 (266)	485 (252)	485 (252)	515 (268)
POUR POINT °F (°C)	- 44 (-43)	-47 (-44)	-44 (-43)	-44 (-43)

NOTE: MD One Vapor Pressure: (mm Hg) 100°F <0.00004; 200°F <0.00018

MD BLOWER & BOOSTER LUBRICANTS OPTIONS					
MD OIL TYPE	**1 QUART**	**1 GALLON**	**5 GALLON**	**55 GALLON BARREL**	**CASE 12 QUARTS**
MD ONE	16444-MD1-Q	16444-MD1-G	16444-MD1-5G	16444-MD1-B	16444-MD1-Q-C
MD PLUS	16444-MD2-Q	16444-MD2-G	16444-MD2-5G	16444-MD2-B	16444-MD2-Q-C
MD MAX	16444-MD3-Q	16444-MD3-G	16444-MD3-5G	16444-MD3-B	16444-MD3-Q-C
MD FG	16444-MD1-Q-FG	16444-MD1-G-FG	16444-MD1-5G-FG	16444-MD1-B-FG	16444-MD1-Q-C-FG

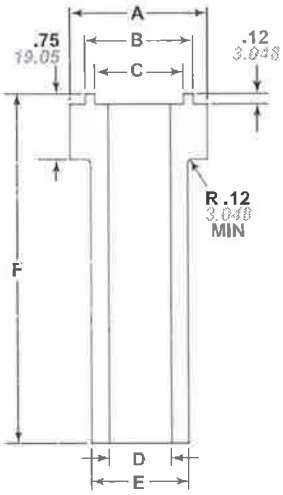
12

SPECIAL TOOL DRAWINGS



MODEL	A ±.001 ± 0.0254	B ±.005 ± 0.127	C ±.005 ± 0.127	D ±.005 ± 0.127	E ±.005 ± 0.127	F ±.005 ± 0.127	G ±.005 ± 0.127
2000	1.560 39.624	1.27 32.258	.98 24.892	.70 17.78	1.10 27.94	3.50 88.9	3.00 76.2
3000	2.035 51.689	1.70 43.18	1.335 33.909	1.015 25.781	1.415 35.941	3.75 95.25	3.00 76.2
4000	2.425 61.595	2.02 51.308	1.61 40.894	1.21 30.734	1.61 40.894	4.50 114.3	3.75 95.25
5000	2.820 71.628	2.42 61.468	1.81 45.974	1.41 35.814	1.81 45.974	5.00 127	4.25 107.95
6000	3.135 79.629	2.73 69.342	2.00 50.8	1.605 40.767	2.00 50.8	6.25 158.75	5.50 139.7
7000	3.525 89.535	2.98 75.692	2.46 62.484	1.605 40.767	2.00 50.8	6.25 158.75	5.50 139.7

Figure 12-1 – Bearing Pressing Tool



MODEL	A ±.001 ± 0.0254	B ±.005 ± 0.127	C ±.005 ± 0.127	D ±.005 ± 0.127	E ±.005 ± 0.127	F ±.005 ± 0.127
2000	1.560 39.624	1.24 31.496	1.04 26.416	.70 17.78	1.10 27.94	4.00 101.6
3000	2.035 51.689	1.74 44.196	1.54 39.116	1.015 25.781	1.415 35.941	4.37 110.99
4000	2.425 61.595	1.865 47.371	1.665 42.291	1.21 30.734	1.61 40.894	5.25 133.35
5000	2.820 71.628	2.427 61.645	2.227 56.565	1.41 35.814	1.81 45.974	5.68 144.272
6000	3.135 79.629	2.74 69.596	2.54 64.516	1.605 40.767	2.00 50.8	7.00 177.8
7000	3.525 89.535	2.99 75.946	2.79 70.866	1.605 40.767	2.00 50.8	7.00 177.8

Figure 12-2 – Seal Pressing Tool

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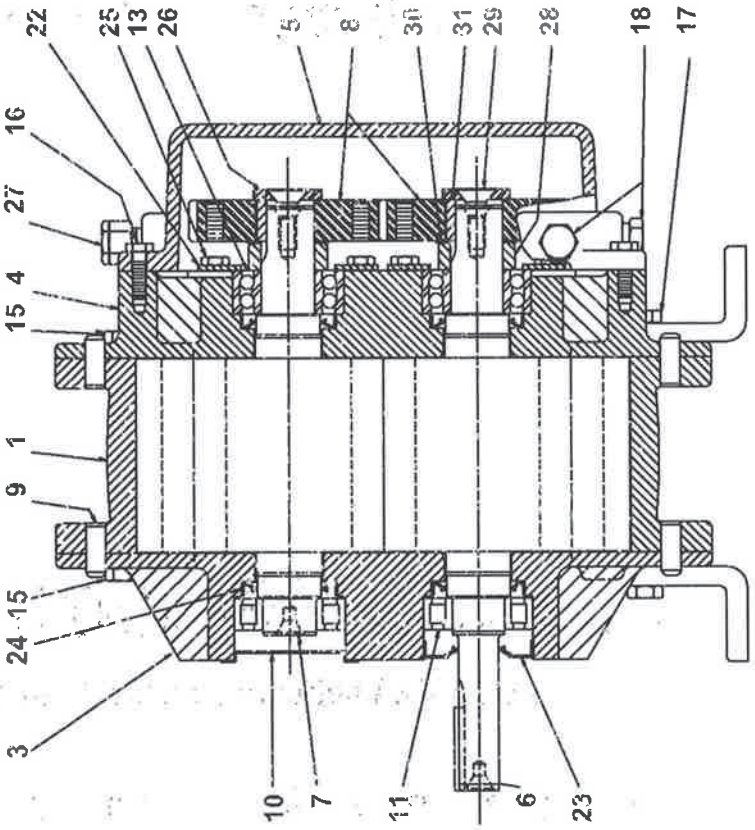
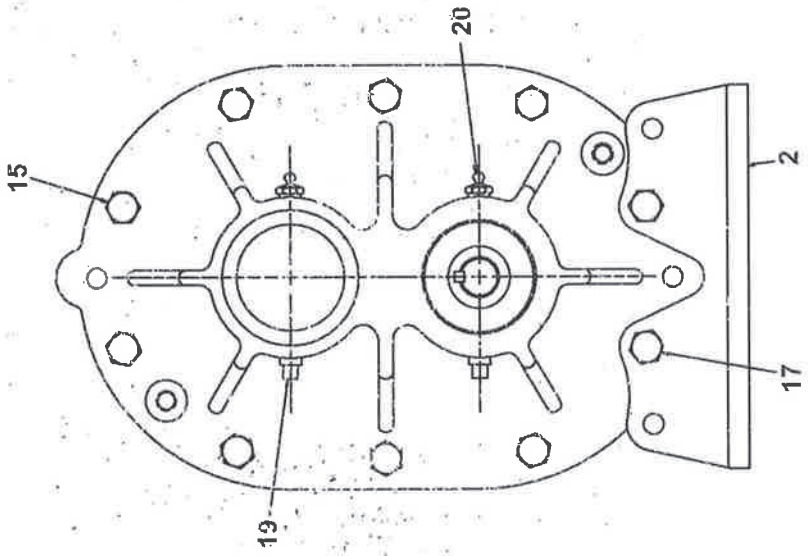
Cutaway Drawing for Grease Lubrication / Air Service





PARTS LIST

Parts List for Model CP Series – Grease Lubrication / Air Service

ITEM NO.	PART DESCRIPTION	QTY
1	Housing	1
2	Mounting Foot	2
3	Drive End Plate	1
4	Gear End Plate	1
5	Gear Cover	1
6	Drive Rotor	1
7	Driven Rotor	1
8	Gear Set	1
9	Dowel Pin	4
10	Cover Grease	1
11	Bearing	1
12*	Bearing	1
13	Bearing	2
15	Screw, Socket Head	14
16	Screw, Socket Head	8
17	Screw, Socket Head	6
18	Pipe Plug	3
18	Magnetic Plug	2
19	Relief Fitting	2
20	Grease Fitting	2
22	Bearing Retainer	2
23	Lip Seal	1
24	Lip Seal	4
25	Screw, Hex Head	8
26	Washer	2
27	Breather	1
28	Spacer	2
29	Cap Screw	2
30	Shim	6
30	Shim	2
30	Shim	2
31	Key Gear	2
42*	Nameplate	1

ITEM NO.	PART DESCRIPTION	QTY
45*	Lifting Lug	2

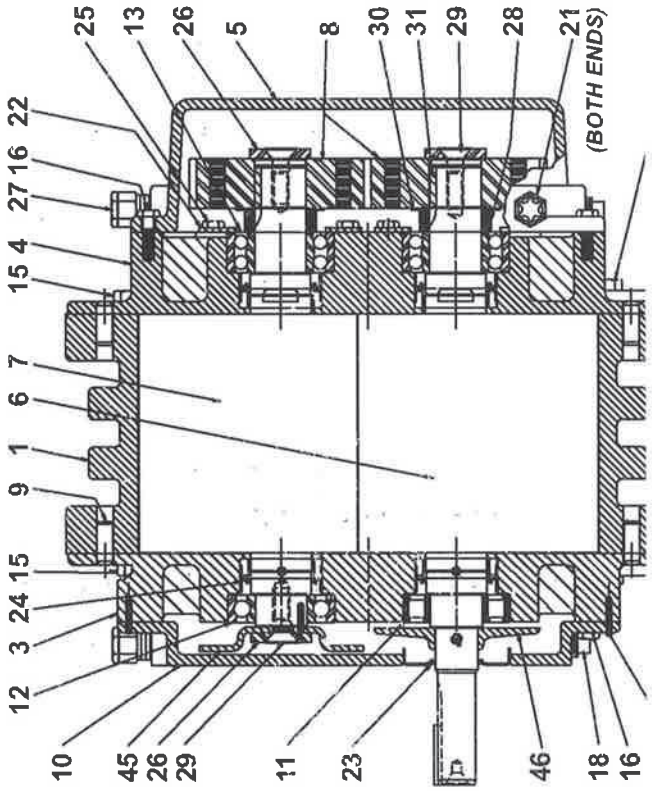
* Not shown

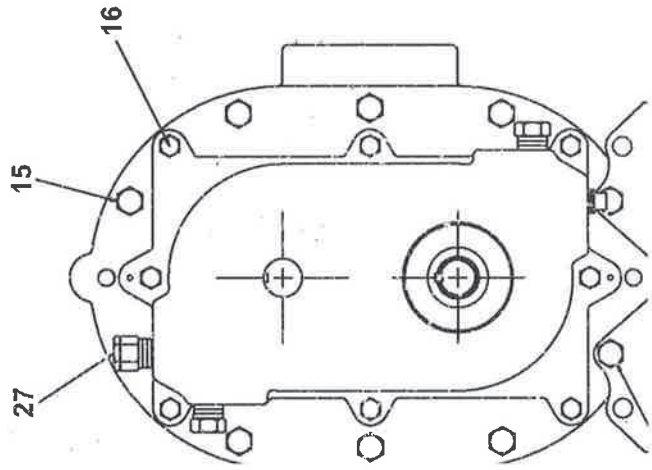
NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES. QUANTITIES MAY VARY BETWEEN BLOWER.

PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.

Cutaway Drawing for Splash Lubrication / Air Service





Parts List for Model CP Series – Splash Lubrication / Air Service

ITEM NO.	PART DESCRIPTION	QTY
1	Housing	1
2	Mounting Foot	2
3	Drive End Plate	1
4	Gear End Plate	1
5	Gear End Cover	1
6	Drive Rotor	1
7	Driven Rotor	1
8	Gear Set	1
9	Dowel Pin	4
10	Drive End Cover	1
11	Bearing	1
12	Bearing	1
13	Bearing Ball	2
15	Screw, Socket Head	14
16	Screw, Socket Head	16
17	Screw, Socket Head	6
18	Pipe Plug	8
18	Magnetic Plug	4
21	Oil Sight Glass	4
22	Bearing Retainer	2
23	Lip Seal	1
24	Lip Seal	4
25	Screw, Hex Head	8
26	Washer	3
27	Breather	2
28	Spacer	2
29	Cap Screw	3
30	Shim	6
30	Shim	2
30	Shim	2
31	Key Gear	2
42*	Nameplate	1
44	Roll Pin	2
45*	Lifting Lug	2
46*	Slinger Oil-2, Machine-1	2
48*	Roll Pin	2

* Not shown

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES. QUANTITIES MAY VARY BETWEEN BLOWER.

PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.

WARRANTY -- BLOWER PRODUCTS

Subject to the terms and conditions hereinafter set forth and set forth in General Terms of Sale, M-D Pneumatics (the Seller) warrants products and parts of its manufacture, when shipped, and its work (including installation and start-up) when performed, will be of good quality and will be free from defects in material and workmanship. This warranty applies only to Seller's equipment, under use and service in accordance with seller's written instructions, recommendations and ratings for installation, operating, maintenance and service of products, for a period as stated in the table below. Because of varying conditions of installation and operation, all guarantees of performance are subject to plus or minus 5% variation. (Non-standard materials are subject to a plus or minus 10% variation)

PRODUCT TYPE	TYPE OF APPLICATION	
	ATMOSPHERIC AIR OR PROCESS AIR WITHOUT LIQUIDS PRESENT	PROCESS GASES OTHER THAN AIR, OR ANY LIQUID INJECTED APPLICATION
New *(Qx™ models only)*	30 months from date of shipment, or 24 months after initial startup date, whichever occurs first.	Consult Factory
New *(all other models)*	24 months from date of shipment, or 18 months after initial startup date, whichever occurs first	18 months from date of shipment, or 12 months after initial startup date, whichever occurs first
Repair	12 months from date of shipment, or remaining warranty period, whichever is greater	12 months from date of shipment, or remaining warranty period, whichever is greater

THIS WARRANTY EXTENDS ONLY TO BUYER AND/OR ORIGINAL END USER, AND IN NO EVENT SHALL THE SELLER BE LIABLE FOR PROPERTY DAMAGE SUSTAINED BY A PERSON DESIGNATED BY THE LAW OF ANY JURISDICTION AS A THIRD PARTY BENEFICIARY OF THIS WARRANTY OR ANY OTHER WARRANTY HELD TO SURVIVE SELLER'S DISCLAIMER.

All accessories furnished by Seller but manufactured by others bear only that manufacturer's standard warranty.

All claims for defective products, parts, or work under this warranty must be made in writing immediately upon discovery and, in any event within one (1) year from date of shipment of the applicable item and all claims for defective work must be made in writing immediately upon discovery and in any event within one (1) year from date of completion thereof by Seller. Unless done with prior written consent of Seller, any repairs, alterations or disassembly of Seller's equipment shall void warranty. Installation and transportation costs are not included and defective items must be held for Seller's inspection and returned to Seller's Ex-works point upon request.

THERE ARE NO WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS OF PURPOSE.

After Buyer's submission of a claim as provided above and its approval, Seller shall at its option either repair or replace its product, part, or work at the original Ex-works point of shipment, or refund an equitable portion of the purchase price.

The products and parts sold hereunder are not warranted for operation with erosive or corrosive material or those which may lead to build up of material within the product supplied, nor those which are incompatible with the materials of construction. The Buyer shall have no claim whatsoever and no product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action nor for problems resulting from build-up of material within the unit nor for problems due to incompatibility with the materials of construction.

Any improper use, operation beyond capacity, substitution of parts not approved by Seller, or any alteration or repair by others in such manner as in Seller's judgment affects the product materially and adversely shall void this warranty.

No employee or representative of Seller other than an Officer of the Company is authorized to change this warranty in any way or grant any other warranty. Any such change by an Officer of the Company must be in writing.

The foregoing is Seller's only obligation and Buyer's only remedy for breach of warranty, and except for gross negligence, willful misconduct and remedies permitted under the General Terms of Sale in the sections on CONTRACT PERFORMANCE, INSPECTION AND ACCEPTANCE and the PATENTS Clause hereof, the foregoing is BUYER'S ONLY REMEDY HEREUNDER BY WAY OF BREACH OF CONTRACT, TORT OR OTHERWISE, WITHOUT REGARD TO WHETHER ANY DEFECT WAS DISCOVERED OR LATENT AT THE TIME OF DELIVERY OF THE PRODUCT OR WORK. In no event shall Buyer be entitled to incidental or consequential damages. Any action for breach of this agreement must commence within one (1) year after the cause of action has occurred.

May 2008

OPERATING DATA FORM / PRODUCT REGISTRATION

It is to the user's advantage to have the requested data filled in below and available in the event a problem should develop in the blower or the system. This information is also helpful when ordering spare parts.

Model No. _____ V-Belt Size _____ Length _____

Serial No. _____ Type of Lubrication _____

Startup Date _____ _____

Pump RPM _____ Operating Vacuum _____

Pump Sheave Diameter _____ Any other Special Accessories Supplied or in use:

Motor Sheave Diameter _____ _____

Motor RPM _____ HP _____ _____

NOTES: _____

_____

_____

_____

IMPORTANT

All blowers manufactured by M-D Pneumatics are date coded at time of shipment. In order to assure you of the full benefits of the product warranty, please complete, tear out and return the product registration card. You may also register your product online at www.mdpneumatics.com or contact Customer Service.

M-D Pneumatics®

For Service & Repair, Technical Support, or Product Sales contact:

M-D Pneumatics
4840 West Kearney Street
Springfield, Missouri USA 65803-8702
O 417.865.8715 800.825.6937
F 417.865.2950
www.mdpneumatics.com

MEMBER OF CAGI Compressed Air & Gas Institute

Manual 2017 Rev D p/n 002017 0000
04/21

START-UP AND SHUT-DOWN PROCEDURES

Please read Section 1 first regarding Unloading and Set up.

SVE SYSTEM

INITIAL START-UP - SVE SYSTEM:

Remove protective covering from air inlet vents, exhaust openings and pump / blower air exhaust.

SVE SYSTEM START-UP:

1. Install the SVE Vacuum pump inlet manifold and connect it to the AWS-1 of the system. Hook up the legs of the manifold to the recovery wells. Open the valves to the recovery wells and the main manifold valves.

2. With the panel switches in the "OFF" position, turn ON all of the circuit breakers.

3. Check motors for correct rotation.

4. Start the SVE pump and monitor the vacuum gauge on the AWS-1 to see that a vacuum is developing. Adjust the recovery well valves on the inlet manifold to suit.

5. Monitor the accumulation of water in the AWS-1 and verify the operation of the transfer pump.

SVE SYSTEM SHUT-DOWN:

1. To shut down the system, turn OFF the Vacuum Pump.

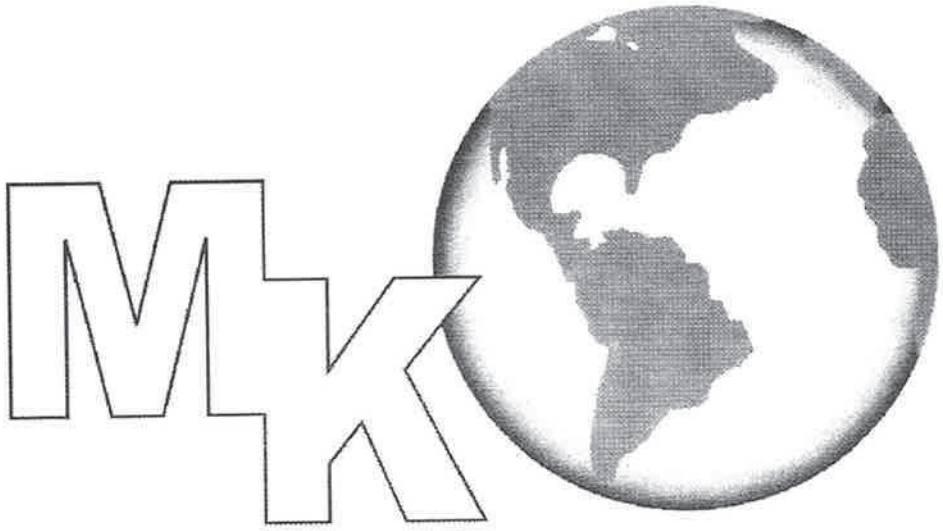
2. For extended shut down, drain all tanks, OWS and remove the drain plugs on all the pumps to protect from freezing. Install rust inhibiting solution into pumps.

3. For maintenance shut downs, be sure to check any system tags that pertain to piece of equipment that you are servicing.

EMERGENCY SHUTDOWN

1. Most MK Environmental systems come equipped with an Emergency shut down switch located inside the building or attached to the main piece of equipment on non-enclosed systems.

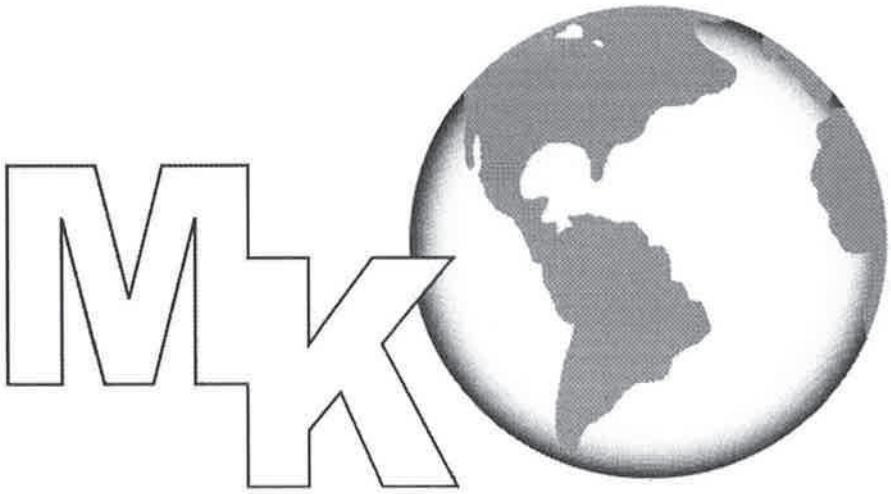
2. Be sure to check your system to see if it is equipped with this switch. If not, follow standard shutdown procedures.



Environmental Inc.

SECTION 5.0
WATER TREATMENT

MK Environmental, Inc.
765 Springer Dr.
Lombard, IL., 60148
(P) 630-920-1104 (F) 866-306-8977
www.mkenv.com



Environmental Inc.

SA STRIPPERATOR
Operation & Maintenance Manual

JANUARY-2009

7150 South Madison Street
Willowbrook, IL 60527-5505
630-920-1104
630-920-8013
www.mkenv.com
info@mkenv.com

TABLE OF CONTENTS

1.0 SYSTEM COMPONENTS

The MKE Stripperator is a single process unit which integrates oil/water separation and air stripping. The Stripperator consists of five major components: the oil/water separation chamber, the air stripping chamber, effluent sump, lid and blower. The units are engineered to treat most groundwater applications with flow rates from 15 to 50 GPM.

1.1 Oil/Water separation chamber

Contaminated ground water and free phase hydrocarbon enter the Stripperator through a NPT coupling located in the separation chamber. Fluid passes through a flow disperser and directly through a foul-resistant coalescing pack. The free phase hydrocarbon coalesces and accumulates a layer on top of the contaminated water. The water flows by gravity through a water leg into the air stripping chamber. Any free phase hydrocarbon is removed by an adjustable product effluent weir and flows by gravity into an optional external product storage tank.

1.2 Air Stripping chamber

The water from the oil/water separation chamber enters the first of the aeration channels in the air stripping chamber. The channels are connected in a continuous serpentine pattern. Fresh air from the blower is introduced through 5/16 inch holes located in flexible nylon aeration tubes. The aeration tubes distribute air uniformly throughout each channel. Effluent air accumulates in the headspace above the tray where it passes through a 10-inch air exhaust port. Depending on model ordered the air stripper may have a second trey to increase air stripping capacity.

The contaminants are removed from the water as it flows through the aerated channels. The resulting clean water exits the last channel through an effluent weir that is factory set to maintain level in the air stripping chamber.

1.3 Effluent sump

Treated water from the air stripping chamber flows by gravity into the effluent sump. The final Stripperator effluent exits the effluent sump through a gravity drain or optional water effluent transfer pump. A 10-inch diameter inspection hatch is included.

1.4 Lid

A gasketed lid allows for easy access to the separation (OWS) and air stripping chambers. The lid is secured with quick release latches and may be removed without interference of influent and effluent piping and ducting. In all models, the lids are hinged for easy access to the Stripperator and OWS internals.

1.5 Blower

Fresh air enters a 2 hp radial-blade type pressure blower for the SA15 through a dynamically balanced inlet damper and screen. The standard blower has an electrical requirement of 230 volts three phase. See Blower curves in appendix. A pressure gauge is included to monitor blower pressure.

SA50 models operate in the same fashion but include a 5hp radial-blade type blower.

2.0 INSTALLATION, OPERATION AND MAINTENANCE

2.1 Installation

A. General

The Stripperator must be placed on a level surface. Failure to do this will adversely affect the removal efficiency of the unit. The oil water separation chamber must also be primed with approximately 100 gallons of clean water to prevent contamination of the outlet piping. Make sure that all clean-out drains and valves are closed. Piping and ducting locations should not interfere with access to the unit or the removal of the lid.

B. Oil/water influent and effluent lines

The Stripperator can accommodate gravity or pumped influent through a NPTF coupling. It should be noted that unlike air stripping towers, a minimum flow rate is not necessary to assure effective operation of the Stripperator. In fact, flow rates less than the rated flow result in even higher levels of contaminant removal.
Product flows through the 1 1/2 inch NPT Product effluent weir by gravity. Connections and piping to an external product storage drum (if required) must be made at or below the elevation of the product effluent weir. The product effluent weir may be adjusted to allow for various product specific gravities. A minimum product thickness of 1/2 inch is recommended in the separation chamber.

The effluent water exits the sump through a pump or coupling where gravity flow to a sewer of infiltration gallery is permissible. We recommend a 2 inch minimum diameter piping. Restrictions such as valves, flow meters, filters and uphill piping runs should be avoided for proper operation. Excessive restrictions may cause flooding of the air stripping chamber and reduced levels of contaminant removal.

Optional 1.5 or 3hp effluent transfer pump with controls is provided for conditions where gravity flow is not feasible. An effluent connection is provided.

C. Exhaust air vent system

The Stripperator is designed to operate at 600-800 SCFM at a maximum pressure of 8 inch water column. Excessive restrictions in the air exhaust piping may reduce levels of contaminant removal. Exhaust air should be directed through a minimum 10 inch diameter pipe section. Air influent piping (6 inch minimum diameter) may be used where desired. The damper is preset at the factory to supply the system with the proper air flow.

The damper position is appropriate for a simple duct system. Adding longer distances or elbows in order to route the exhaust air around physical constraints requires consideration of increased friction losses. Additional friction losses due to the installed vent system will result in increased back pressure at the blower discharge, and therefore reduced air flow. Appendix A contains design data and blower performance curves. After the exhaust system is installed, air flow rate measurements can be taken at the vent with a pitot tube and gauge. The damper can also be reset.

D. Separation Chamber Vent

A vent connection is integral to the design. No additional piping is required

E. Power Supply

The Stripperator requires three phase unless otherwise specified. The blower motor is 2 or 5 hp. A motor starter with thermal overload protection is required. If this option was selected for your unit, power is connected through the seal on top of the motor starter. See appendix C for additional information.

2.2 Operation

The Stripperator operates without a great need for constant attention. The pressure gauge should be monitored periodically. A gradual increase in back pressure indicates a buildup of scale blocking the holes in the tubes and therefore reduced air flow to the system. The rate at which the aerator tubes become coated with scale and/or other contaminants can vary widely depending on the water quality and flow rate at each particular site.

2.3 Maintenance

A. Aerator tubes

When inspection or cleaning is required the lid must be removed to access aerator tubes. It may be desirable to drain the tray before cleaning the tubes. The lid should remain in place during operation. The scale can be removed from the tubes by tapping the end of the tube on the ground and/or rubbing the tube with your hand. Remove all accumulated scale on the air tubes and loose sediment. Cleaning of the tank walls is not necessary unless it interferes with the water flow or flakes off excessively. Cleaning of the tank walls serves no real purpose.

The Stripperator has been designed for easy disassembly to facilitate maintenance. The lid gasket material should never be glued or otherwise permanently sealed.

B. Motor (for blower)

Dirt accumulations can cause the motor to overheat as well as causing a fire hazard. Motors can be cleaned with air jet (wear eye protection). Periodically inspect the installation. Check for dirt accumulations; unusual noises or vibration; overheating; worn or loose couplings; high motor current; poor wiring or overheating connections; loose mounting bolts or guards; and worn motor starter contacts. Ball-bearing motors with

lubrication provisions are provided and require periodic re-lubrication.

C. Separator maintenance

The corrugated plate oil/water separator contains no moving parts and the adjustable product draw off elbows is set at the time of start-up; therefore, there is very little maintenance required. Once the separator is put into operation, it should never be allowed to stand dry. If the unit is to be taken out of service or cleaned, the following procedures should be used to minimize the amount of contamination of the outlet side of the unit.

1. Turn the product draw off elbows down to skim off all product.
2. Open the drain valve to remove any sediment and the water in the separator. (Note: The water in the separator may contain dissolved contaminants and should be dealt with in an appropriate manner.
3. A high pressure water hose may be used to clean sludge from the separator. The packing can be removed for further cleaning and inspection.
4. Replace all packing, close all valves and fill with clean, cold water.

3. OPTIONS

3.1 Transfer Pump (with controls)

The pump is a horizontal sump pump. The transfer pump is controlled by conductivity probe level sensors that signal the pump when to turn off and on. The probes require intrinsically-safe power which is accomplished with the use of an intrinsically safe relay

Probes are also provided to sense a high level in the sump which would cause the system to flood. These probes are located in the same controller as those that signal the pump.

On the transfer pump discharge, a pressure gauge and sample port are provided. The gauge can help diagnose obstructions in the discharge line.

Inspect the condition of the sump pump basin and clean out the bottom as required. This is aided by the easy removal of the hatch on the sump. If sediment is allowed to accumulate at the bottom of basin, the pump will eventually become clogged and undue wear will occur on the pump impeller and housing.

3.2 Air Pressure Alarm

The purpose of the air chamber pressure alarm option is to provide an interlock for alarm and/or control in case of air chamber under pressurization. Under pressurization of the air chamber could occur as the result of loss of power, blower failure or a major air header leak. Over-pressurization of the air chamber would be the result of excessive clogging of the aerator tubes or obstruction of the exhaust air vent. In either situation, the desired contaminant removal will not be achieved.

A low pressure switch is housed in a single enclosure along with the gauge that measures air chamber back pressure. The switches and gauge are connected to the air chamber at the factory. The set points for the switch is set at the factory at 3 inches water column.

3.3 High Level Switch

The purpose of this option is to provide an interlock for alarm and/or control in case of high water level in the sump. A high level in the sump would occur if the discharge line became obstructed. This condition can also occur if the level in a gravity-fed effluent sump were forced to go too high due to restriction caused by a flowmeter installed in the discharge line, or if too small a discharge line were installed. As stripping air will only flow to units that are not flooded, high water level would result in reduced removal efficiency.

4. FAN TROUBLESHOOTING

In the event that trouble is experienced in the field, the following are the most common fan difficulties. These points should be checked in order to prevent needless delay and expense.

1. CAPACITY OR PRESSURE BELOW RATING

a) Incorrect direction of wheel rotation.
b) Speed too slow.
c) Dampers not properly adjusted.
d) Poor inlet or outlet conditions (elbows, restrictions).
e) Air leaks in system.
f) Damaged wheel.
g) Total resistance of system higher than anticipated.
h) Wheel mounted backwards on shaft.
i) Fan not properly selected for a high altitude application.

2. VIBRATION AND NOISE

a) Misalignment of bearings, coupling, wheel or V-belt drive.
b) Unstable foundation or supports.
c) Foreign material in inlet causing unbalance.
d) Worn bearings.
e) Damaged wheel or motor.
f) Broken or loose bolts and set screws.
g) Bent shaft.
h) Fan wheel or drive unbalanced.
i) Fan delivering more than rated capacity.
j) Loose dampers
k) Vibration transmitted to fan from some other source.

3. OVERHEATED BEARINGS

a) Check bearing lubrication.
b) Poor alignment.
c) Damaged wheel or drive.
d) Bent shaft.
e) Abnormal end thrust.
f) Dirt in bearings.
g) Excessive belt tension.

4. OVERLOAD ON MOTOR

a) Speed too high.
b) Fan over capacity due to existing system resistance being higher than original rating.
c) Specific gravity or density of gas above design value.
d) Wrong direction of wheel rotation.
e) Shaft bent.
f) Poor alignment.
g) Wheel wedging or binding on fan housing.
h) Bearings improperly lubricated.
i) Motor improperly wired.
j) Defective motor. Motor must be tested by motor manufacturers authorized repair shop.

Form: IPCA-910
Effective: 9/20/10
Supersedes IPCA-707
Part No.: 01167

Instructions & Procedures for Model PB and SPB Blowers

⚠ DANGER

The instructions and procedures in this manual should only be performed by authorized personnel with mechanical machine training or experience.

Proper eyewear safety and all applicable OSHA safety regulations must be utilized while performing the procedures contained herein.

Before starting any of the procedures contained herein, power to the motor must be disabled using OSHA lock-out/tag-out procedures.

Do not attempt to start these procedures until the blower wheel inside the blower housing, has come to a complete stop.

Failure to follow these instructions could result in blower failure, property damage, severe personal injury and death.

Cincinnati Fan
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Mason, HO 45040-9135
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Fax: (513) 573-0640
www.cincinnatifan.com

Models PB & SPB

I. INSTRUCTIONS TO CHANGE THE BLOWER WHEEL SET SCREWS ONLY.

1. **Make sure the power to the motor has been disabled using the proper OSHA Lock-out/Tag-out procedures, and the blower wheel has come to a complete stop. If you were not trained in the OSHA Lock-out/Tag-out procedures, consult a licensed electrician that has been trained.**
2. Disconnect any duct work or hose connections from the inlet and/or discharge of the blower housing. If necessary, or easier, disconnect the blower base and move the complete blower, motor and base assembly to a work bench.
3. Loosen and remove all the bolts, washers and nuts around the perimeter of the blower housing that hold the two housing halves together.

   NOTE: Since there was a sealant applied when the blower was manufactured, performing this **Step 3** might require two people to eliminate the chance for personal injury. One person to do the prying and one to hold the inlet side of the housing from falling. Pry the two housing halves apart with a screw driver or pry bar. The sealant also acts as a bonding agent. On Model PB, be careful not to crack the cast aluminum housing.
4. Loosen and remove the two set screws in the side of the wheel hub with an Allen wrench. **Discard the used set screws.**
5. Replace the two set screws. **DO NOT** tighten them yet. Use new set screws that have a nylon "locking patch" on the threaded side of the screw. The head of the screws should have a **"knurled cup-point head"**. These two features of the set screw are only good for one time use, but will prevent the set screws from vibrating loose while the blower is operating.

   NOTE:
   The set screws must be tightened to the proper torque as shown in Table 1 below. DO NOT use an air driven tool such as an impact wrench or pneumatic wrench. These tools could weaken or strip the threads in the wheel.
6. **IMPORTANT:** Tighten the set screw over the keyway first. Then tighten the set screw onto the shaft.

Table 1

SET SCREW TORQUE VALUES			TORQUE VALUES FOR TAPER-LOCK BUSHINGS	
Diameter Number - Threads Per Inch	Hex Wrench Size (Across flats)	Required Torque (in Inch Pounds)	Taper-Lock Bushing Size	Required Torque (in Inch Pounds)
1/4-20	1/8"	65	H	95
5/16-18	5/32"	165	B & P	192
3/8-16	3/16"	228	Q & R	350

7. The sealant that was initially applied between the two housing halves must be removed. Using gloves, apply a degreaser such as Naphtha or Toluene to remove the silicone. **DO NOT USE GASOLINE.**
8. Apply a fresh bead of silicone sealant to the mating flange of the motor side of the housing.

   NOTE: On Models PB-8 through PB-15A housing sizes, there is a tongue surface on one side of the housing and groove surface on the other side of the housing. Apply the bead of silicone into the **groove** on the grooved side housing.
9. Re-attach the inlet side of the housing using the same hardware. Tighten all the hardware.
10. ***Carefully*** reach into the blower inlet and spin the wheel by hand to make sure it is not rubbing anywhere inside the blower housing and that it rotates freely. If there is a rubbing or grinding sound, locate the cause and correct it.
11. Re-install the blower, motor, base assembly back into the system, if it was removed.
12. Reconnect any duct work, guards or accessories that were removed in **Step 2** above.
13. Reconnect the wiring to the motor in accordance with National Electric Code (NEC) standards.
14. **"Bump start"** the motor and turn the power off. As the wheel is slowing down, check to make sure it is turning the proper rotation. If it is not, reverse any two power leads (on 3 Phase motors only) and repeat this step until the proper rotation is achieved.
15. Perform a vibration test to make sure the vibration levels do not exceed the limits shown in the maintenance manual. You will need to refer to the maintenance manual for the fan model and arrangement for the correct information. All maintenance manuals can be found on our web site listed on the front cover of these instructions.

NOTE: Any open inlet, discharge, belts and sheaves or couplings MUST be guarded per OSHA standards.

II. INSTRUCTIONS TO CHANGE CAST ALUMINUM WHEELS IN PB & SPB BLOWERS.

1. **Make sure the power to the motor has been disabled using the proper OSHA Lock-out/Tag-out procedures, and the blower wheel has come to a complete stop. If you were not trained in the OSHA Lock-out/Tag-out procedures, consult a licensed electrician that has been trained.**
2. Follow **Steps 2, 3** and **4** on page 2.
3. Position two pry bars 180° apart, behind the back plate of the wheel and behind where two opposite blades connect to the back plate of the wheel. Carefully pry the wheel off of the shaft by applying force between the back plate of the wheel and the blower housing.
   CAUTION: Make sure the wheel can't fall off the end of the shaft and injure your legs or feet.
4. Remove the key in the motor or blower shaft keyway and discard it.
5. Clean the motor or blower shaft of any foreign material. All nicks and burrs in the shaft must be removed with a file and emery paper.
6. **ALL** wheels are supplied with two set screws, installed before the wheel is balanced at the factory. Check to make sure that the two set screws in the new wheel are not protruding into the bore or keyway of the new wheel.
7. In most cases the blower wheel can be mounted on the blower or motor shaft by hand and with little force. If the wheel does not slide on, check the wheel bore and the blower or motor shaft for nicks or burrs. The wheels are bored with a -.000" to +.001" tolerance so slight interference may occur between the wheel bore and the blower or motor shaft. If this is the case, a moderate amount of force may be required by using a rawhide or hard rubber mallet. **DO NOT USE A STEEL HAMMER. Using a steel hammer may damage the blower or motor bearings and it can deform the wheel and/or crack the hub.**
8. The wheel should be positioned on the fan or motor shaft so there is a 1/8" minimum to 1/4" maximum clearance between the back plate of the wheel and the inside of the blower housing.
9. Install a new key of adequate length. For 14" diameter and larger wheels, the length of the key should be 1" minimum.

   NOTE: Each blower wheel is supplied with two set screws. One is over the keyway and the other is 90°-120° away. All set screws have a nylon "locking patch" on the side of the screw and a **"knurled, cup point head"**

   DO NOT use an air driven tool such as an impact wrench or pneumatic wrench to tighten the set screws. These tools could weaken or strip the threads in the wheel. The set screws must be tightened to the proper torque as shown in Table 1 below.
10. **IMPORTANT:** Tighten the set screw over the keyway **first**. Then tighten the set screw onto the shaft.
11. The sealant that was initially applied between the two housing halves must be removed. Using gloves, apply a degreaser such as Naphtha or Toluene to remove the silicone. **DO NOT USE GASOLINE.**

Table 1

SET SCREW TORQUE VALUES			TORQUE VALUES FOR TAPER-LOCK BUSHINGS	
Diameter Number - Threads Per Inch	Hex Wrench Size (Across flats)	Required Torque (in Inch Pounds)	Taper-Lock Bushing Size	Required Torque (in Inch Pounds)
1/4-20	1/8"	65	H	95
5/16-18	5/32"	165	B & P	192
3/8-16	3/16"	228	Q & R	350

12. Apply a fresh bead of silicone sealant to the mating flange of the motor side of the housing.
    NOTE: On Models PB-8 through PB-15A housing sizes, there is a tongue surface on one side of the housing and groove surface on the other side of the housing. Apply the bead of silicone into the **groove** on the grooved side housing.
13. Re-attach the inlet side of the housing using the same hardware. Tighten all the hardware.
14. ***Carefully*** reach into the blower inlet and spin the wheel by hand to make sure it is not rubbing anywhere inside the blower housing and that it rotates freely. If there is a rubbing or grinding sound, locate the cause and correct it.
15. Re-install the blower, motor, base assembly back into the system, if it was removed.
16. Reconnect any duct work, guards or accessories that were removed in **Step 2** above.
17. Reconnect the wiring to the motor in accordance with National Electric Code (NEC) standards.
18. **"Bump start"** the motor and turn the power off. As the wheel is slowing down, check to make sure it is turning the proper rotation. If it is not, reverse any two power leads (on 3 Phase motors only) and repeat this step until the proper rotation is achieved.
19. Perform a vibration test to make sure the vibration levels do not exceed the limits shown in the maintenance manual. You will need to refer to the maintenance manual for the fan model and arrangement for the correct information. All maintenance manuals can be found on our web site listed on the front cover of these instructions.

NOTE: Any open inlet, discharge, belts and sheaves or couplings MUST be guarded per OSHA standards.

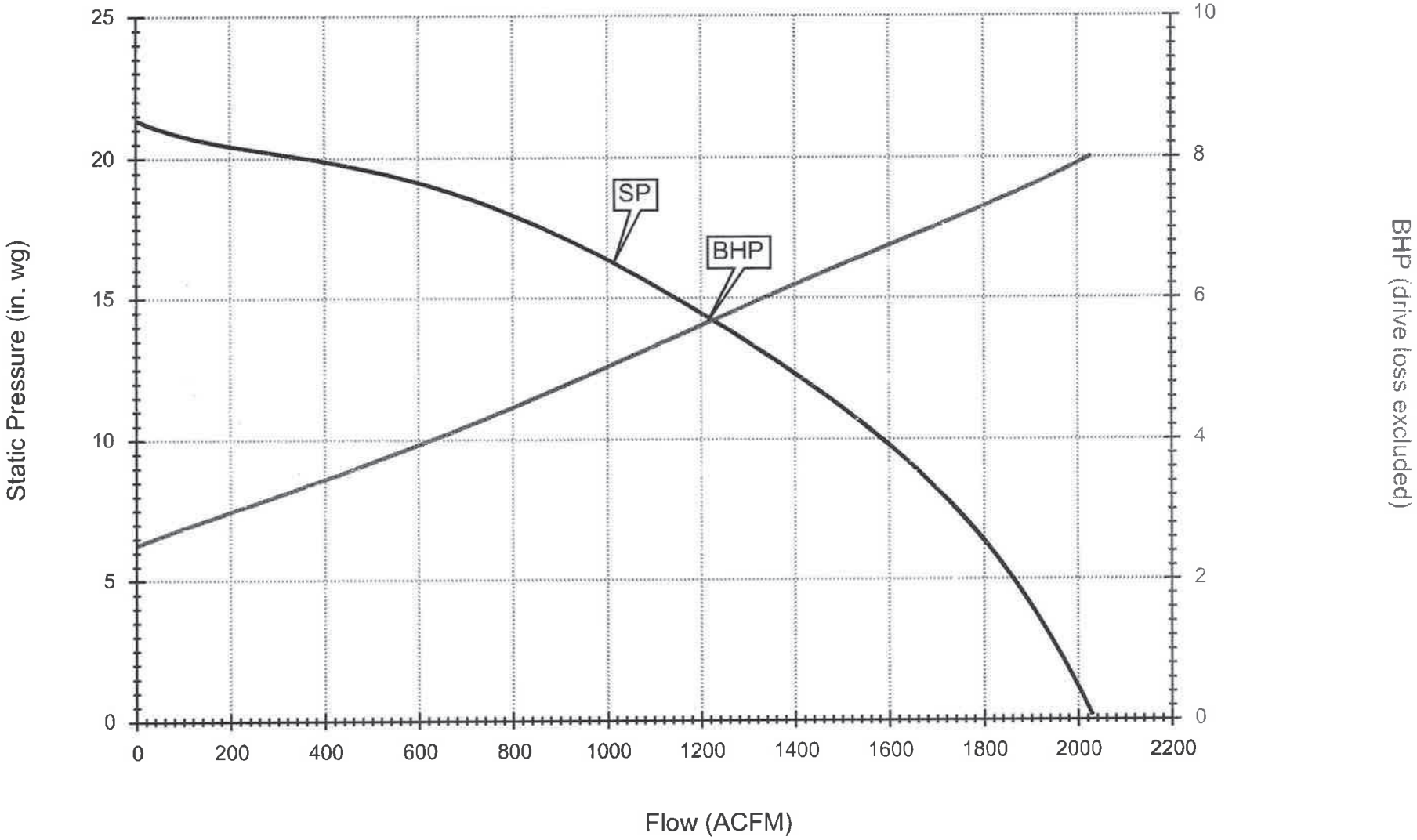
III. INSTRUCTIONS TO CHANGE ROTATION ON MODELS PB-14A, PB-15A, PB-18 AND PB-18WA, WITH REMOVABLE SIDE PLATES.

1. **Make sure the power to the motor has been disabled using the proper OSHA Lock-out/Tag-out procedures, and the blower wheel has come to a complete stop. If you were not trained in the OSHA Lock-out/Tag-out procedures, consult a licensed electrician that has been trained.**
2. Follow Steps **2, 3** and **4** on page 2.
3. Position two pry bars 180° apart, behind the back plate of the wheel and behind where two opposite blades connect to the back plate of the wheel. Carefully pry the wheel off of the shaft by applying force between the back plate of the wheel and the blower housing.
   CAUTION: Make sure the wheel can't fall off the end of the shaft and injure your legs or feet.
4. Remove the key in the motor or blower shaft keyway and discard it.
5. Clean the motor or blower shaft of any foreign material. All nicks and burrs in the shaft must be removed with a file and emery paper.
6. Remove the four outer circle bolts, nuts and washers holding the drive side of the housing to the drive side plate of the housing that is bolted to the blower base. Pry the two castings apart
7. Remove the four bolts, nuts and washers holding the inlet side of the housing to the inlet side plate of the housing. Carefully pry the two castings apart.
8. The sealant that was initially applied between the cast parts must be removed. Using gloves, apply a degreaser such as Naphtha or Toluene to remove the silicone. **DO NOT USE GASOLINE.**
9. Apply a fresh bead of silicone sealant to all the same mating surfaces of the housing and side plates where you removed the old silicone.
   NOTE: On Models PB-14A and PB-15A housings, there is a tong surface on one side of the housing and a groove surface on the other side of the housing. Apply the bead of silicone into the **groove** on the grooved side housing.

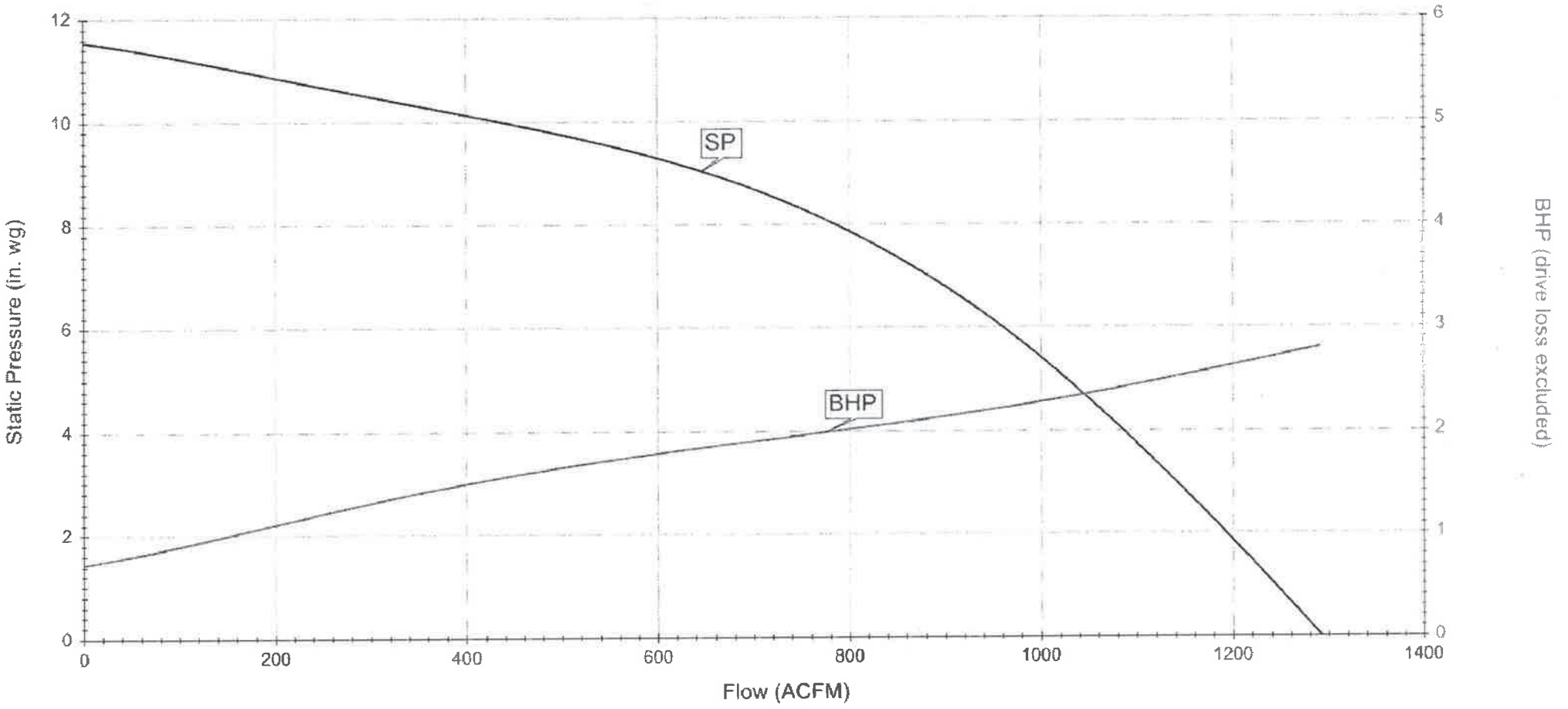
   NOTE: When reinstalling the two housing halves, the original inlet side now becomes the drive side and the original drive side now becomes the inlet side.
10. Install the old inlet side housing onto the motor side plate with the original hardware and tighten it.
11. Install the inlet side plate onto the old motor side housing with the original hardware and tighten it.
12. For the rest of the assembly, follow **Steps 6** through **19** on page 3.

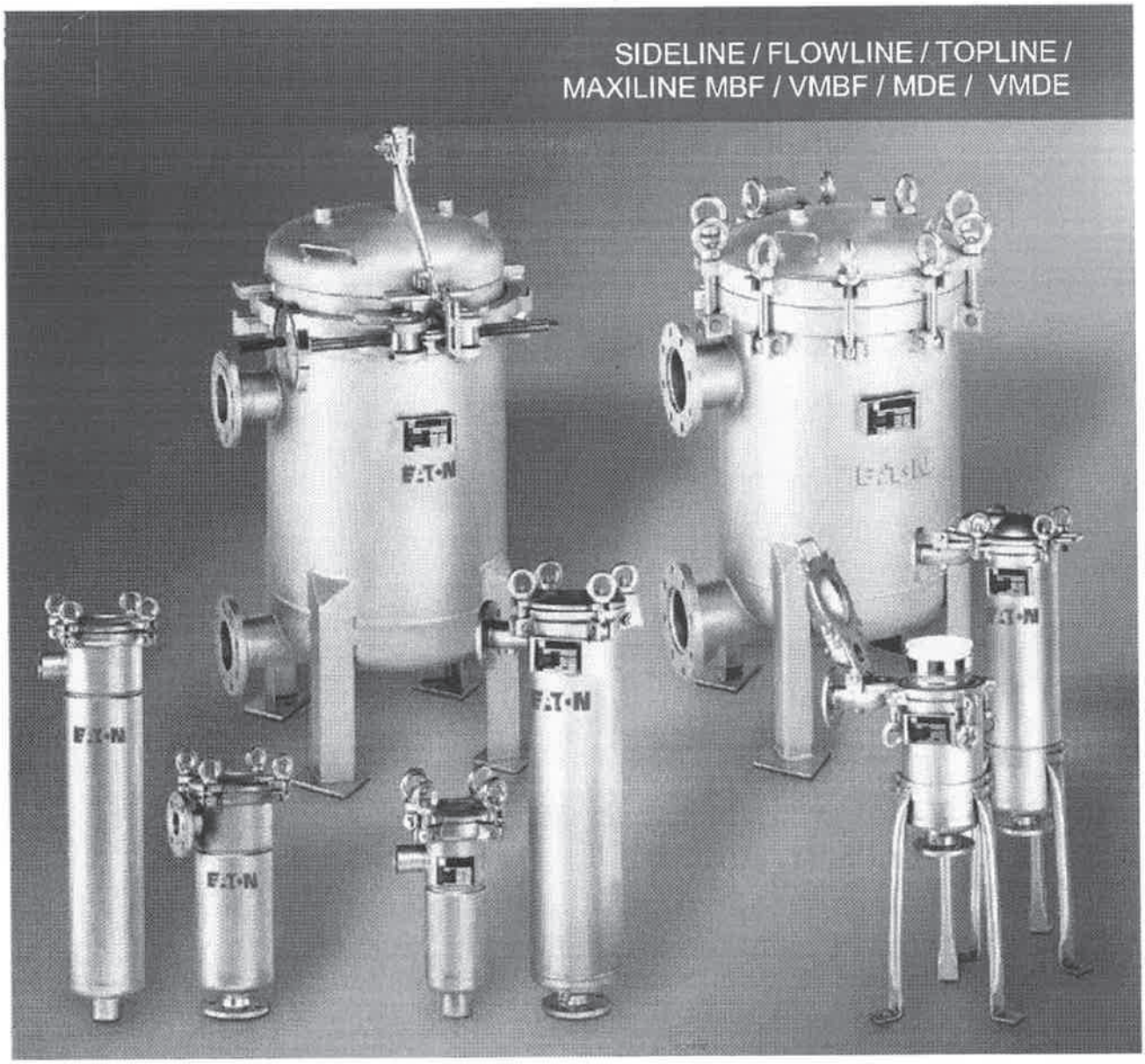
NOTE: Any open inlet, discharge, belts and sheaves or couplings MUST be guarded per OSHA standards.

Cincinnati Fan PB-15A 16-1/2 X 5 Radial Wheel (Full Width) @ 3,450 RPM
0.075lb./ft.³ Density, 6.0 in. Inlet



Cincinnati Fan SPB-12 13 X 3-1/4 Radial Wheel (Full Width) @ 3,450 RPM
0.075lb./ft.³ Density, 6.0 in. Inlet





Operating Manual

The content of this manual has been reviewed for correctness however it is the user's responsibility to confirm all instructions and to operate the equipment in a safe and correct manner.

Powering Business Worldwide

Powering Business Worldwide

Standard and Special Models

Index:

1.0 General Instructions

The operating manual is part of the filter equipment and instructions contained herein must be followed.

Eaton bag filters are carefully constructed and manufactured using the stringent quality controls of our ISO 9001:2015 certification.
However, the filter may become a hazard if not used or installed properly.
The operator must evaluate the impact of filter failure on the environment within the framework of his own safety guidelines and decide whether additional measures are necessary to ensure operator and facility safety.
The filter must be operated in a safe manner.
All normal and customary rules and regulations for safe operation and avoidance of injury must be followed.
For the operation of the filter vessel the existing national regulations need to be followed.
Additionally, we would draw your attention to the following CE Directives:

89/391/EEC: on the introduction of measures to encourage improvements in the safety and health of workers at work
89/655/EEC: (changed 95/63/EG): on the Minimum Safety and Health Requirements for the Use of Work Equipment.

No work on a filter should be performed without first shutting it down completely and releasing the pressure.

Eaton filter housings are to be serviced by authorized personnel only.

The operating manual is part of the pressure equipment (filter) and has to be kept for the equipment life cycle. It must be available at all times for the operator and in case of loss or damage immediately replaced. Operating manuals are available from the manufacturer or its authorized dealer.

1.1 Residual hazards

Reading and paying attention to operating instructions is essential.

1.1.1 Residual risks due to pressure and temperature

If the maximum pressure is higher than atmospheric pressure, then the vessel must be equipped with an adequate and accurate pressure-measuring device, such as a pressure gauge. Should the temperature of the medium be a safety hazard (e.g. by exceeding the boiling point), a temperature-measuring device has to be installed.
Depending on the operating conditions, the surface of the filter vessel may become very hot. Adequate safety measures must be taken by the customer when operating the filter to protect against the danger of getting burned.

Appropriate precautions can be: isolation, protection against contact and access restrictions

1.1.2 Residual hazard due to pressure:

Exceeding the rated operating pressure must be prevented by means of suitable devices or equipment located either at the pressurized equipment or at the assembly (if the pressurized equipment cannot be cut off).
Pressures briefly exceeding the rated pressure are permissible, but only if they are less than 10% greater than the maximum rated pressure.
The protective devices or equipment must properly and only fulfill their safety functions.
Safety devices and equipment must operate in a manner that is foolproof, reliable and suitable for the intended mode of operation.

1.1.3 Residual hazard due to corrosion or chemical effects:

In general, filters are used to filter many different types of liquids. The user must take into consideration how the filtered liquid will affect filter housing and accessories. These affects may include corrosion, dissolving or weakening of the filter housing. This applies to all material in contact with the liquid being filtered, especially parts under pressure, such as gaskets, seals, shaft bushings and bolted connections. The user must select an appropriate housing material for the intended use and confirm its suitability.
Regular inspections must be performed while the equipment is in service. It is recommended to record the inspections and to keep the record.

1.1.4 Residual hazards due to external loads:

Possible external loads from—wind, snow, earthquake or traffic, and the impact on nozzles, legs and supports have to be identified and an assessment made on consequences to the pressure equipment. If not specifically mentioned the equipment is **not** designed for, nor should it be subjected to these types of load.

1.1.5 Residual hazard due to filling or emptying:

The user must take suitable measures to ensure that liquids under pressure cannot escape in an uncontrolled manner from open degassing (exhaust) lines, for example, whilst the pressurized equipment (filter) is being filled. This applies to both draining and emptying the equipment.
The closure elements must be fashioned such that secure operation is possible.
All connections to the filter must be executed professionally and in accordance with the standard piping practices. When choosing O-ring process media leakage and operational conditions must be considered. A permanent connection is preferred in all cases. Should flexible hoses be used it is important to consider all circumstances that may have an effect on sealing, process media leakage and reliability as well as other safety and relevant issues. This is also relevant in reference to connections that have to do with de-gassing or venting, such as pressure warning systems.
If emptying (also faulty emptying) can cause positive operating pressure, then this risk needs to be secured through a bursting disc or connected emptying and venting equipment.

1.1.6 Residual hazard due to wear:

Under certain conditions, failure of material due to known chemical effects (corrosion) or mechanical effects (wear) must be taken into consideration. This is often dealt with by using increased wall thicknesses, casings or coatings.
For operational continuity, the user must employ suitable means to ensure that planned, periodic inspections are performed. Any damage must be immediately corrected.

1.1.7 Residual hazard due to external fire:

External fire can damage the equipment and cause safety issues. The user must evaluate the potential for this type of damage and take suitable precautions to limit or prevent it.

1.1.8 Residual hazards due to decomposition of unstable fluids

An assessment of the risk of damage to the equipment from decomposition of unstable fluids has to be made and protected against.

1.1.9 Residual hazards due to the character of operating and during maintenance

Filtration of flammable fluids could be dangerous during filter element change out.
The filter element itself may cause hazards during change out and use.
Textile filter media tends to have an electrostatic charge. This has to be observed if explosive atmospheres are present in the filter or the area around the filter (filtration of flammable solvents).
Also possible are reactions between filter media and filtrate or the trapped solids (auto ignition).
The filter element normally contains product residue. (fluid residue or wetted cake).
If the fluid is dangerous (caustic, corrosive, carcinogenic, mutagenic, toxic, flammable, etc.) suitable protection for operators must be provided.
Examples as described above have to be assessed by the user and prevented with appropriate procedures.
Counter measures may include: appropriate earthing, venting, flushing with harmless fluids, drying, inert gas flushing, minimizing of residual fluid, etc.

1.2 Warning notices

The following warnings have been placed on the equipment. Please see where crossed:

None	☒
Warning: Do not open under pressure	☐
Warning: Spring under tension	☐

1.3 Housing life cycle

There is no general lifetime for the equipment. In regards to the design and character of the construction, please check the correct cover page.

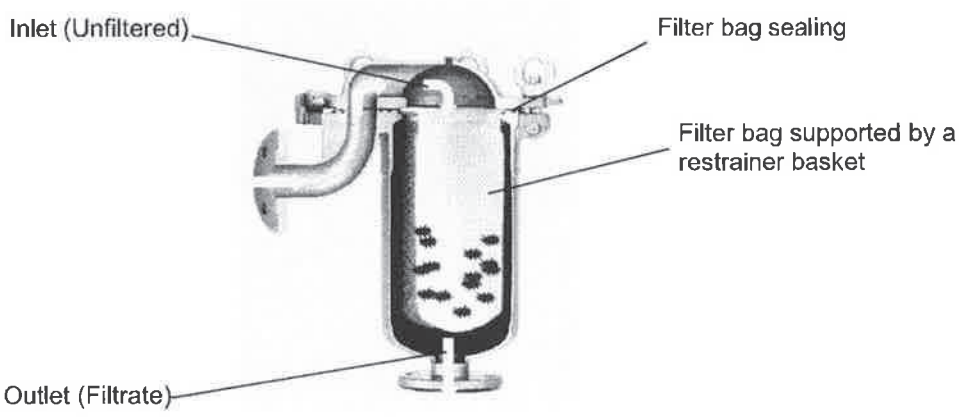
Standard housings are designed for 1000 operational start-up and shut offs. Pressure changes between ambient pressure and the design pressure.
Pressure changes within 10% of the design pressure are permanently allowed.
Pressure changes other than these are noted in the equipment's coversheet or in the construction drawing.
Regular checks of the equipment are advised, according to local regulations of pressure vessels. Check periods may be regulated by national regulations, work conditions or laws. The operator is obliged to make sure that these regulations are known and observed.

See also: Maintenance of the Bag Filter

2.0 Specification, functional principle, typical designs

2.1 Functional principle

The main element of the bag filter systems is the filter bag.
The filter bag is typically made of textiles like needle-felt, melt-blown or woven materials of mono- or multi-filament fibers. Metal strainer baskets may also be used. The filter bag is inserted into a restrainer basket. This basket supports the bag and holds up to the pressures applied with increasing differential pressures. The restrainer basket is seated in position inside the housing between the incoming unfiltered liquid (inlet side) and the clean filtrate (outlet side). The filter bag is held in place by a bag hold-down device.
The dirty liquid flows through the filter material where dirt is trapped. The fact that particles are collected and retained inside the filter bag is one of the significant characteristics of the bag filter system. These systems are simple, secure and operator-friendly.



Bag filter housings may contain between 1 and 24 filter bags, depending on type and design. The different designs are adapted to individual applications and may vary greatly. The designs take into consideration operating conditions, materials of construction, connection types and positions, as well as surface finish and operating parameters.

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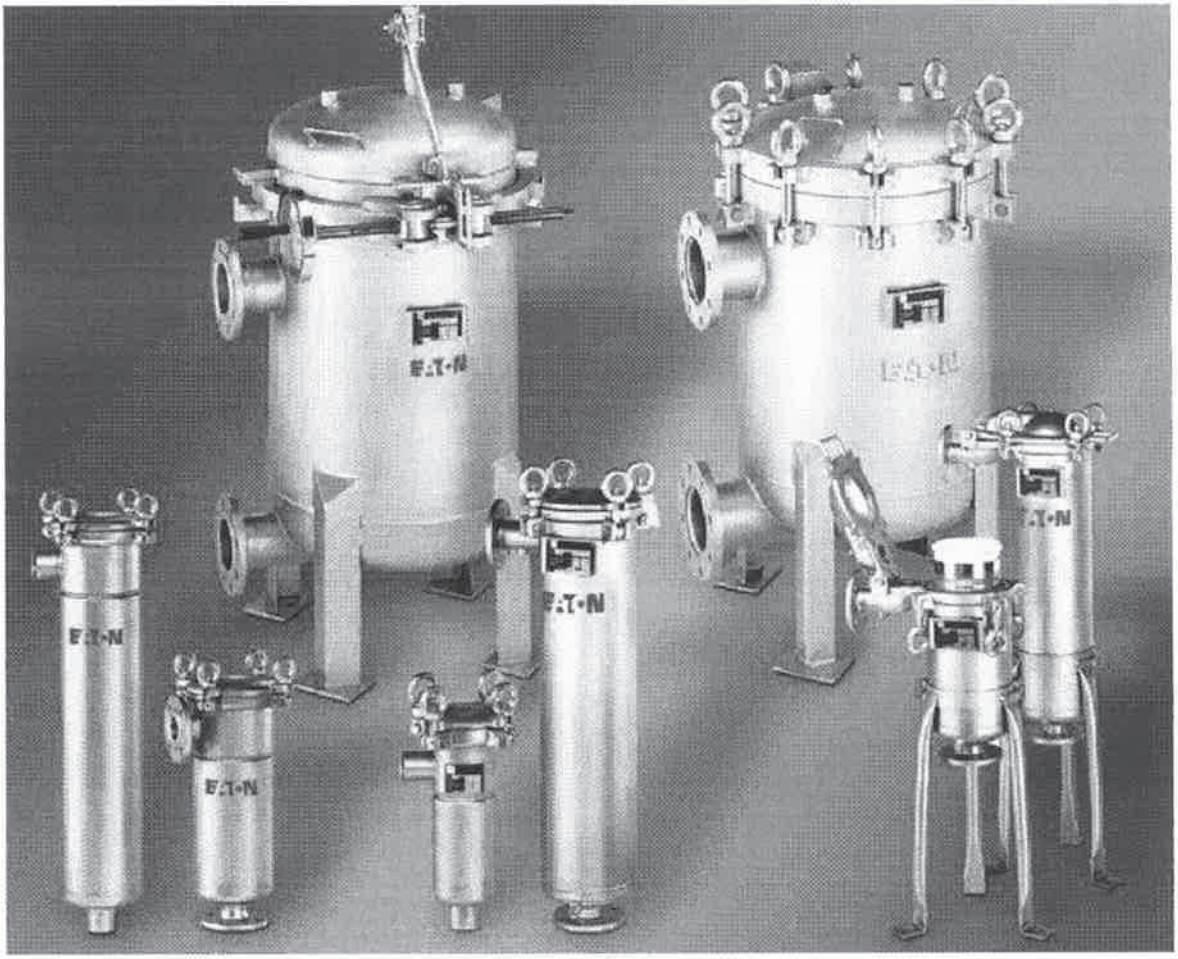
2.2 Typical Design

MAXILINE VMBF **MAXLINE MBF**



FLOWLINE **SIDELINE** **TOPLINE**

3.0 Storing and transport, installation and adjustment

3.1 Storing

Equipment must be stored in a secure location.
Equipment should not be stored in a corrosive environment.
Necessary steps to ensure a clean housing interior should be taken. Openings at the connections should be plugged, if this is not already done by the manufacturer. If extreme cleanliness of the housing is necessary, a safety atmosphere with inert gas (nitrogen) should be used.

3.2 Transport

Appropriate means are to be used for any transport of equipment. If a filter needs to be lifted with a carrying belt (without original packaging) adequate lifting points need to be chosen. If extra carrying elements (ring nuts or carrying devices) are available, these must be used. Security precautions should be taken to protect people and equipment.

e.g. adequate security distances
no person or equipment below suspended equipment
adequate secure lifting attachments

3.3 Installation and adjustment

Important Notice:
Before installing the bag filter check that the operating parameters have been met.
The specifications on the bag filter label must be checked against operating conditions. Do not exceed the listed operating pressure and temperature.
Excess of operating conditions are to be avoided by the operator through adequate equipment (installation of pressure relieve valve).

Also make sure that the materials—which are going to come into contact with the product—are chemically suitable. This applies to the materials used for the filter housing, the gaskets and the filter media.

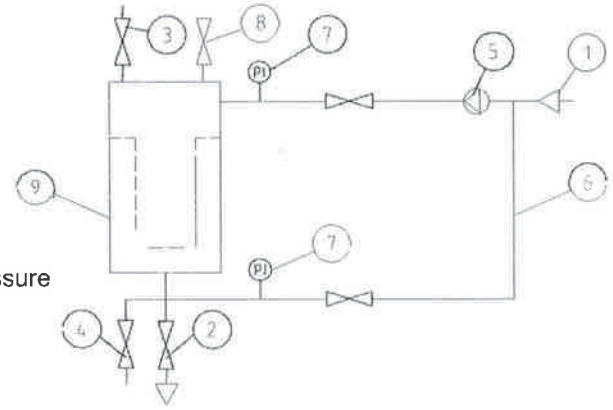
Because of the unlimited number of operating conditions only general guidance can be given. The responsibility for the choice of materials for specific applications lies exclusively with the operator. Eaton is not responsible for and provides no guarantee for the suitability of materials.

Installation instructions:

Carefully unpack and check for damage.
Remove all enclosed operating instructions, data sheets, illustrations etc., read carefully and set aside for future use. Make sure all accessories are enclosed. Remove the plastic protective caps from the flanges.

Here is a diagram of a typical filter installation:

1. Inlet
2. Outlet
3. Vent
4. Drain
5. Pump
6. Circulation line
7. Pressure gauge
8. Safety device against excess pressure
9. Filter housing

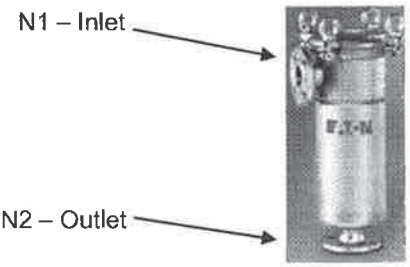


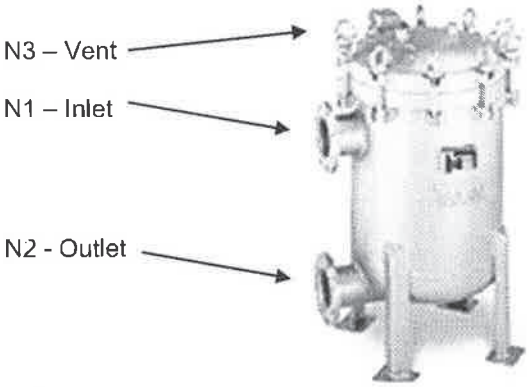
The filter housing shown above is equipped with shut-off devices for discharge and venting. Pressure gauges for measuring the differential pressure are installed in the inlet and outlet connections.

There should be a re-circulation line for cleaning the system if this is feasible and suitable.

Please note:
The parts described above are not included with the equipment.

When installing take care not to reverse the inlet and outlet.
The direction of flow is not always marked, but can be determined by noting that the inlet lies above the outlet. The outlet is usually at the bottom.
The inlet allows the liquid to flow into the filter bag so that the direction of flow is from the inside to the outside.





General regulation:
Filter bags are used with flow from inside to outside.
Mesh strainers are used with flow from inside to outside.
Any deviations are explained separately under point 4 operating system.

Observe national and local regulations when setting and running the pressure vessel, and also:

Establish security areas and distances where necessary for the protection of employees and others.
Ensure an easy access and secure work area for the housing.
Ensure secure installation (bolting) to prevent shifting or other movement by external forces; such as the housings own weight, pressure or the fluids entering the housing.

Important Notice:
Pipe connections must be made so that they are stress free.
Additional weight on the connections is not allowed unless explicitly stated.
It is expected that the installation of the filter housing into the piping system, including additional accessories, is executed professionally and according to national and local codes and regulations.

4.0 Start up

Notice:
Normally after the installation of the filter housing, a pressure seal test as well as a cleaning of the housing is done.

Cleaning of:

a. Particles inside the housing
Filter housings are usually blasted with glass beads and cleaned afterwards. It is unavoidable that some beads may remain in the housing. It is suggested to clean the filter housing with a process suitable cleaning liquid. (see general operations suggestions).
In certain cases filter housings are treated with pickling acid and cleaned with demineralized water.

b. Anti-corrosives
In some cases parts may be protected with anti-corrosives. For example, carbon steel filter housings with anti-rust protection (oiled, waxed or similar). This protection is to be removed (through steam-cleaning or solvents) should this material be likely to cause harm to the process media or related equipment.

c. Lubricants
Depending on the design of the filter certain movable parts may be factory-lubricated: the QIC-LOCK quick-closure mechanism. The lubrication is based upon mineral oil, lithium-soap and additives. The lubricant is not rated as dangerous. Should a reaction with the production liquid be seen as a possible hazard, then these parts need to be cleaned carefully before start-up. It is then recommended to replace the lubricant with an alternative, more suitable lubricant.

Pressure seal test

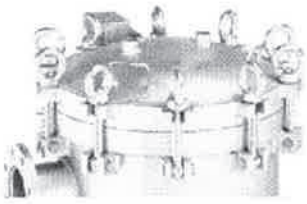
It is generally recommended to perform a pressure test after the installation of the filter housing. The choice of test media is to be based upon the following operating conditions. Opening and closing procedures of the filter housing are described below.
The recommended operating conditions may not be exceeded.

4.1 Cover lid - opening

4.1.1 Bolted joint design

This particular design is found in filter types: FLOWLINE-FBF, SIDELINE-SBF, TOPLINE-TBF, MAXILINE-MBF and MDE



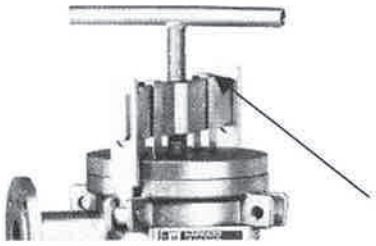


To open the housing: first loosen the eye nuts on the top. The eye nuts can loosened using a small bar. Where hexagon nuts are used the appropriate wrench should be used. If swing bolts are used the nuts should be loosened enough to allow for them to be swung clear of the cover.
Similar procedures are to be followed for segment clamp-screws.
If stud bolts are used the hexagon nuts must be removed completely.

The cover of the housing may now be taken off or hinged back against the end-stop.
Multi-bag filter housings, type MAXILINE have a spring-lift or davit mechanism to aid the opening of the cover. These mechanisms, where appropriate, are described on the following pages.
Notice that depending on the size of the filter housing the cover may have significant weight. Opening quickly can therefore cause great forces and significant damaged can be caused by striking other objects. (A similar process is the rapid opening or closing of door, which can cause personal injuries). Therefore the cover must be opened and closed slowly.

4.1.2 Centre bolt closure (T-bolt closure)

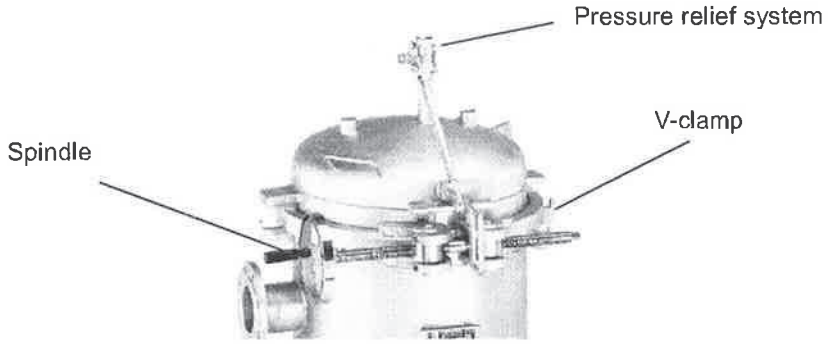
For example filter type SIDELINE-TSBF
TOPLINE-TTBF



SIDELINE-TSBF and TOPLINE-TTBF filter housings with a centre bolt closure should only be opened and closed by hand.
Depending on style and design these filter housings may be equipped with an additional security device. This device is to be opened first to enable the main opening mechanism. In case of a quick-closure mechanism additional seal break devices are installed on the cover that ensure a slight lifting of the cover before full opening to break the seals in case the sealing surfaces are stuck together for some reason. The opening sequence is automatic and can only be manipulated through the removal (dismantling) of security devices. Their removal is not permitted in any circumstance. The proper function of all security devices is to be checked and maintained on a regular basis. The cover of the housing can now be opened and rested against the hinge-stop.

4.1.3 Design with QIC-LOCK spindle closure

MAXILINE VMBF and VMDE are example filter types with this design.



The QIC-LOCK mechanism is a two piece V-shaped clamp that can be opened and closed using a hand operated spindle mechanism. The V-shape closes over the housing and cover flange that seals with an O-ring. The V-clamp is then locked by closing a handle that closes a pressure relief device. This device needs to be opened first in order to operate the spindle.

In the case of a quick-closure mechanism, additional seal break devices are installed on the cover that enforce a slight lifting of the cover before full opening to break the seals in case the sealing surface are stuck together for some reason. The opening sequence is automatic and can only be changed through the removal (dismantling) of security devices. Their removal is not permitted in any circumstances. The correct operation of all security devices must be checked and maintained on a regular basis. The cover of the housing can now be opened and rested against the hinge-stop.

Multi-bag filter housings (MAXILINE series) are equipped with a spring-assisted mechanism, a davit, or a spring for lifting the cover. This mechanism will be explained below.

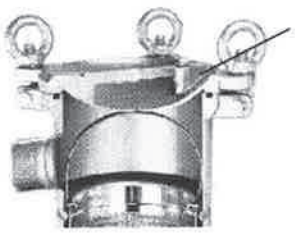
Notice that depending on the size of the filter housing the cover may have significant weight. Opening quickly can therefore cause great forces and significant damaged can be caused by striking other objects. A similar process is the rapid opening or closing of door, which can cause personal injuries. Therefore the cover must be opened and closed slowly.

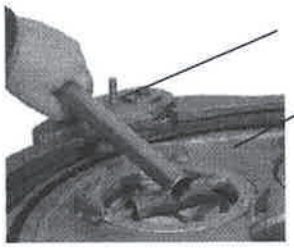
4.2 Filter bag insertion

Previous special instructions for the preparation and installation of filter elements into the filter housing should be followed first. Filter housings are normally not shipped with filter bags installed. Without support, filter bags are not able to withstand the differential pressure that occurs during operation. This support is provided by the restrainer basket.

If not pre-installed, the restrainer baskets must be installed into the filter housing. Depending on the construction the basket may contain a bead that together with an extraction tool makes removal of the basket easier. The extraction tool is inserted into the basket with the flat end (round edges) first and then hooked under the bead to remove the basket. With the restrainer basket installed, the filter bag can now be inserted into the basket. Remove the filter bag label and retain for information for tracking and reordering.

The sealing ring of the filter bag must be positioned exactly on the edge of the restrainer basket to provide a good seal. The filter bag should be opened against the basket so that the bag is fully supported. Depending on the type of filter housing the filter bag is locked in position by using a bag-fixing ring (spring supported) or bayonet ring. The bayonet rings should be tightened down using the ring lock tool.





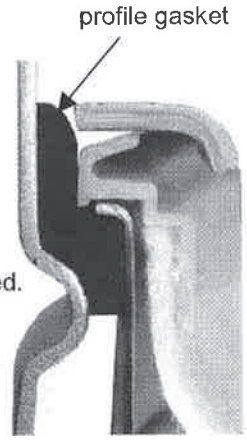
Bag-fixing rings for FLOWLINE and SIDELINE housings have a spring steel band for hold down. The pressure is provided by the cover of the filter housing. It is important that the pressure is applied onto the sealing ring of the filter bag; if it does not the bag-fixing ring may need to be adjusted.

MAXILINE MBF and VMBF multi-bag filter housings are equipped with bag-fixing rings that are locked by bayonets. A special tool is available to lock the ring. This tool is supplied with the filter housing.

Beware:

FLOWLINE bag filter housings (unlike other housings) are equipped with a profile gasket in the basket seating area. This gasket is made of elastomer (FPM). This gasket offers technical advantages but special care must be taken with its use.

Due to changing pressure, high differential pressure, pulsating pressure, chemical attack or high temperature the profile gasket may become damaged. As a result the basket may fall through to the bottom of the housing causing the filter to malfunction.
Check to ensure the operating parameters of the application are compatible with this seal. If in doubt, contact Eaton for technical support.



4.3 Cover lid - closing

Before closing the cover ensure that the sealing surfaces along with the gasket are clean and damage free. Make sure the gasket is sitting in its correct position. Replace gasket if faulty.

Remove and discard damaged gaskets!

To close the filters reverse the above steps.

Bag filter housings are usually equipped with one or on special designs with more than one O-ring. Depending on the application special housing designs may also be equipped with flat gaskets.

Less cover bolt torque is required on housings with O-ring gaskets than with flat gaskets.

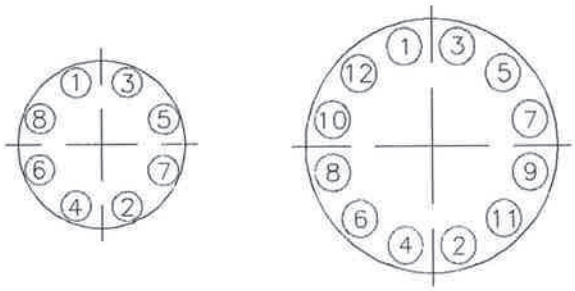
The applicable maximum torque values for the bolts must not be exceeded. When using standard equipment and normal physical strength these torque values will not be exceeded.
When using extensions on spanners, wrenches or an air gun make sure that the bolts are not over tightened. The recommended maximum bolt torque values are listed below.

Please note:
If the pressure equipment is equipped with segment clamp screws it is essential that all the required clamp quantities are engaged (see cover sheet or vessel name plate).

Max torque in Nm						
Metric ISO thread	M12	M16	M20	M24	M 27	M30
Hex/ring-nut/ thru bolt	36	86	168	290	425	580
Segment clamp screw	-	80	200	340	550	680

These are reference values and are valid for typical zinc plated bolts of strength class 5.6 according to DIN 267, or zinc plated segment clamp screws made of 21CrMoV57.

Application of high force to the bolts to close a leaking pressure equipment (to overcome a damaged gasket) must be avoided. Over-tightening may damage bolts or the housing cover lid. To avoid stress in the cover tighten the bolts in accordance with the following sequence:



When using maximum allowable torque the bolts are to be tightened in three steps.

1. 50 % of torque
2. 80 % of torque
3. Max torque

To close SIDELINE bag filters with a center bolt closure. Hand-tight pressure on the center bolt will be sufficient to seal the housing. Tools to give extra leverage should not be used otherwise the mechanism is likely to be damaged. Check that the holding bar is properly positioned so that it will not slip out under pressure.

Filter housings with QIC-LOCK quick closure mechanism are closed by hand. Where a hex-nut is used in place of the spindle wheel the applied torque must not exceed 200 Nm. The pressure-release device must be locked down in place to complete the closure. The V-clamp is now locked.

4.4 Start up

The filter is now ready for use. Slowly open the valve on the inlet; avoid opening too fast as shock loads can damage the filter media and the housing. The vent valve should be open to ensure no air is locked in the top of the filter housing. The valve should be closed as soon liquid runs out. In all cases (whether or not hazardous liquids are being filtered) precautions should be taken to prevent injury from spraying liquid.
If the filter is not vented any air in the filter will reduce the efficiency of the filter media. Generally, if air gets into the system it should be vented off immediately. When filtering gaseous fluids, the filter should be vented at regular periods.
The outlet valve is now to be opened slowly.

Due to the fact that filter bags may release some particles when first used, we recommend re-circulation of the filtrate. The length of time for re-circulation will depend on the individual filter bag and level of filtration. This will ensure particles from newly installed filter bags will be collected and safely removed from filtrate.

5.0 Use, handling and maintenance

5.1 Use and Handling

To achieve maximum results from the equipment we recommended that adequate training be provided to all users and maintenance personnel. This manual should be part of this training. The training should also include: the correct and safe operation of the equipment, process requirement, type of filter, types of media, and special treatment of fluids and general safety rules.

The equipment must not be incorrectly used and measures should be taken to prevent this.
Incorrect use includes:

- exceeding of the permissible pressure rating or temperature
- filtration of non-compatible fluids
- use of incorrect spare parts (e.g. bolts and gaskets)
- exceeding of permissible component load
- operating errors like opening under pressure or improper emptying or filling

Possible consequences with damage to persons or property may be:

- failure of the pressure equipment (bursting or exploding)
- emission of hazardous fluids (toxic, caustic, flammable).
- leakage and corrosion

Control systems (pressure and temperature) must be checked regularly for proper function. If the use of the pressure equipment has an associated risk due to the nature of the fluid and/or the operating conditions it is recommended to record the inspections. The operator should have access to the file (pressure equipment book) at any time.

5.2 Maintenance of the filter housing

The filter itself does not need any special maintenance with normal use. All parts should be regularly checked for corrosion and other damage.
Install a new filter bag at every product change or if the bag becomes dirty and is no longer efficient. Differential pressure (the difference in pressure before and after the filter) will determine if this point has been reached.

Eaton recommends changing the filter bag at a differential pressure of 1.5 bar, however, a maximum of 3.5 bar is permissible.

To remove the filter bag release the pressure in the housing by opening the pressure relief valve. The procedure for opening and closing the housing is described in Section 4.
Attention should always be given to the gaskets and sealing surfaces ensuring that they are clean and undamaged. Damaged gaskets should be replaced

Note:
Eaton joins many gasket manufacturers in recommending that gaskets be replaced whenever a pressurized container is opened. Going against this recommendation may result in a faulty seal and a defect in the system. In practice, gaskets are often used many times.

It is important to verify that the correct gasket is being used. This applies to the size and the material of the gasket

If the filter housing contains movable parts, (e.g. QIC-LOCK spindle closure) these need to be lubricated to ensure easy movement. Common grease—which is compatible with the process—may be used. The parts should not be over greased. Greasing is also recommended for all threads. Stainless steel bolts should always be greased with an adequate lubricant to avoid premature wearing of parts.

Special models, such as TTBF with central T-bolt also need to be lubricated in the proper areas. Usually lubricating nipples are provided on these models.

Adequate cleaning and maintenance of all equipment is necessary at all times for trouble free operation. Where a potential hazard exists for operators, such as material escaping or the process itself, we recommend that all service and maintenance be documented, especially the condition of the seals and sealing surfaces and the function of moving parts.

If the filter housing is protected from corrosion through an applied coating a regular check of the surface to identify possible damage is important. Any damage to the coating should be repaired professionally.

Security equipment, such as pressure monitoring equipment, pressure relief systems on quick-closure mechanisms, locking devices, seal breaking devices, pressure measurement equipment, temperature control devices, leakage warning systems, etc., must be regularly tested for proper operation and repaired immediately in the case of malfunction.

The QIC-LOCK closure mechanism is equipped with an enforced locking device at the spindle. This device is linked to the pressure release vent. Its correct operation is to be verified with each opening and closing of the housing. Any malfunction should be corrected before the pressure vessel is put into service.

5.3 Recurring inspections

This section describes the scheduled maintenance and operation of pressure vessels. Maintenance schedules may be defined by national or local codes and regulations or plant norms. The operator must ensure that governing regulations are known and adhered to. We recommend that all servicing and maintenance be documented.

6.0 Maintenance of the spring-assisted lid lift (only MAXILINE Series Types)

The spring lifting and stainless steel device operates mechanically and can be adjusted. Even heavy housing covers can be close to weightless with its support, while the cover remains still in position.

6.1 Maintenance

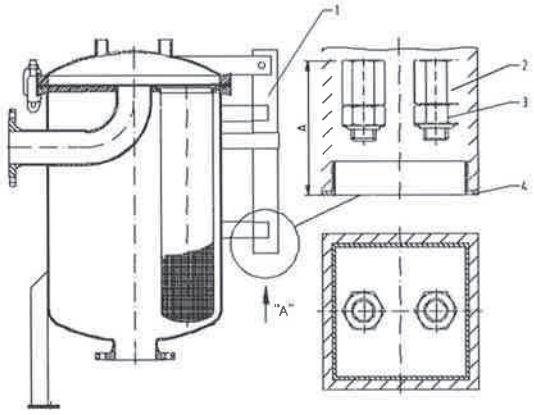
The quick closing mechanism does not require any special maintenance.

Sounds made by the spring lifting device (jarring or grating) have no influence on the function of the lifting device, but can reduced by spraying with a lubricant. In adverse conditions there may be risk of corrosion of weight bearing parts and a failure of the spring. The spring is only under tension when the housing is closed and relaxes when the housing is opened.
Should the closure fail, it would usually be under full tension when the cover is closed.

It would be a rare occurrence for the closure to fail. See also security measures for more details. Should the spring- assisted lid lift fail unexpectedly the housing cover may not be opened unless secured with a rope or chain.

6.2 Adjustment

The spring lift device is balanced at the factory before the housing is shipped. The addition of equipment, gauge, valves etc. may increase the weight of the cover making a new adjustment necessary.



For re-adjustment the dust cap below the spring lift device is to be removed. When viewed from below two threaded bars with hexagon nuts can be seen. Two hexagon nuts are secured with additional self-securing hexagon nuts to guard against misalignment and removal through counters. The counter hexagon nuts must be loosened.

Turning of both hexagon nuts adjusts the lifting capacity of the spring. Turning the nuts to the right (clockwise) increases the tension and bearing capacity. Turning the nuts to the left (counter clockwise) reduces the tension and bearing capacity.
After the adjustment the counter hexagon nuts are to be tightened. The dust cap can now be put into place again. Measurement A may not be exceed 200mm respectively go not under the limit of 80mm in the final position (open and closed).

6.3 Caution

The spring lift device must be protected against aggressive and corrosive materials.
If the spring lift device is in a high humidity environment, such as cleaning operations with steam cleaners there is a risk of corrosion. If this risk exists please contact the manufacturer to be consulted further.
We recommend the filter be installed so that no personnel can reach under the spring lift device. Never place your head under the spring lift device for maintenance work.
Always use a mirror for visual inspection. The spring lift device is very safe, but during operation should be placed under the lifted weight, which is true for all heavy items.

Important:
The removal and maintenance of the spring lift device may only be done when the cover is opened (usually upright position of the cover). Under tension the spring contains potential energy. This energy may be released suddenly and can lead to serious damage to people and property.

7.0 Technical Data

Measurements, details, spare parts and other materials can be found on the current Datasheets and Sales Drawings and full drawings if these are part of the full documentation package furnished with the housing. Missing Information can be requested from Eaton by providing the serial number of the housing.

8.0 Filter housing with heating jacket

For external heating or cooling the filter housings can be fabricated with an integral jacket, which can be operated using either liquid or gaseous products for heating or cooling as required.
Before installation check operating parameters. Compare them with the design data of the filter housing details, which can be found on the nameplate. Do not exceed the specified operating pressure and temperature.
Exceeding the permissible operating conditions should be avoided by use of equipment such as pressure relief valves.
Heating media materials that come into contact with the housing have to be checked in regards to their chemical compatibility with the housing.
Because of the number of possible applications Eaton can make only limited recommendations
The responsibility for defining the correct materials for a specific application is the sole responsibility of the operator or user. Eaton does not assume any liability or provide guarantees for correctness.
In regards to the heating media the flow direction is to be chosen such that adequate venting of the jacket is guaranteed. Otherwise a portion of the surface will not be available for heating.
The heating media should usually enter from the bottom and exit at the top. This makes venting easy. With gas or steam the directions should be reversed. This is so that any condensate that develops can easily be removed from the bottom. Refer to Residual Hazards as described under Point 1.1.

9.0 Information about bag filters with coatings

Depending upon the application a bag filter housing may be coated on the inside and/or outside as a protection against corrosion. A standard coating is E-CTFE (HALAR). Other coatings like PFA, Epoxy or PA may also be used.
The suitability of the coating must be checked carefully against its chemical resistance, temperature resistance, mechanical tension, abrasion, etc. Installation and start-up should be done according to the operating instructions however special care should be taken to avoid any mechanical damage to the applied coating.

Special attention must be paid to the maintenance of filter housings with an applied coating.
The coating is used as a protection against corrosion. The coating put on is totally non-porous, no diffusion occurs, so it offers high chemical resistance and excellent corrosion protection.
Mechanical damage of the coating must be avoided.
No work should be performed on the filter with tools or parts that could damage the coating. Particular care should be taken during regular maintenance of the filter and filter bag exchanges. Do not use the filter if the coating is damaged. Damaged coatings should be repaired and over time in demanding applications it may be necessary to re-coat the entire housing.
Technical data on coatings is available on request from Eaton.

10.0 General operating instructions

Filter bags that are used in the filter housings are usually made from industrial felt, monofilament mesh or melt-blown micro-fibers. In addition, strainer baskets are also used for coarse filtration. For technical details please refer to the appropriate literature.

The velocity of the flow of the process fluid through the filter is a major factor in achieving good as well as economic filtering results. The goal, with a few exceptions, is to keep the velocity as low as possible. Low pressure on the filter enhances filtration and increases the service life of the filter bag, thus reducing the operating cost of the whole system.
At the same time the flow should be as even as possible, for a feed pump a centrifugal pump is a better choice than a piston-driven one which delivers pulsating velocities. As a rule it is better to avoid uneven feed or intermittent operation as much as possible to prevent backup-up in the filter housing.
Such conditions could cause the filter bag to lift up and float with pressure changes in the filter housing so that it no longer fits exactly in the restrainer basket. At worst, this could result in a bursting of the filter bag. Filter bag lift up can be effectively prevented by the use of an optional bag-positioning device.

11.0 Use with Strainer Baskets

Depending on the application the filter system may be used with metal strainer baskets instead of the filter bags. The strainer basket replaces normally the restrainer baskets but where applicable the housings may be equipped with only one strainer basket with special dimensions, i.e. a 4 bag sized housing is equipped with one basket with a larger diameter instead of 4 baskets with the standard dimensions.
From experience strainer baskets are used for safety filtration (low solid removable) or to separate larger amounts of solids (high weight). Therefore it has to be observed that in case of basket changing or cleaning an adequate lifting device is used and precautions are taken to protect persons and equipment. Depending on the type of strainer basket there is the danger of squeezing fingers during insertion into the housing. The insertion should be done carefully.

The cleaning of the baskets has to be done carefully depending on the design of the basket.
The filter media may be a very thin and the stainless steel screen easily damaged. Cleaning with a high pressure cleaner or steam pressure cleaner is recommend only if cleaning is done in the flow direction. Cleaning against the flow direction (screen is normally not supported) will consequently damage the basket.

LIQUID PHASE CARBON INSTRUCTIONS

1.0 PRE-OPERATION CHECK-OUT

Specific activities to complete before operating the adsorption equipment should include the following:
1. Check all piping connections for proper installation and tightness.
2. Ensure that all gauges and instruments are functional and installed correctly.
Re-zero or re-calibrate if necessary.
3. Close all valves in the absorber piping system.

2.0 WETTING (DEAERATING THE CARBON)

In a typical bed of carbon, the pore volume is approximately 40% of the bed volume. Carbon which is shipped dry will contain air in these pores. Therefore, the carbon must be properly wetted prior to being placed on stream. If this is not done, the air within these pores will displace into the void spaces between the carbon particles during operation and cause high pressure drop and channeling in the absorbers. These problems can cause premature breakthrough of contaminants. Air will not migrate out of the bed during normal down flow operation. The time required for wetting is a function of liquid temperature and viscosity. Generally, a minimum wetting period of 24 hours is required using water at ambient temperatures, although a period of up to 72 hours is preferred for complete wetting. After wetting, backwash able adsorbers should be backwashed to remove air and segregate the carbon bysize. The adsorber should be filled up flow at 4 gpm/ft2, maximum.

If the unit must be placed on-stream before the carbon has been wetted, the adsorbers should be drained and backfilled when the pressure drop becomes prohibitive or after two days of operation, whichever occurs first. For process applications, the same procedure is required. If the process liquid cannot be diluted with water and the carbon must be wetted with the process liquid there will be a significant heat of adsorption.

3.0 BACKWASHING AND BACKFLUSHING

3.1 BACKWASH/BACKFLUSH – GENERAL

Backwashing and backflushing are procedures involving running clean, contaminant-free water upflow through the adsorber. Backwashing or backflushing of a carbon bed can be done after fresh carbon has been transferred into an adsorber and wetted, or during operation to remove sediment from the top of the bed. If the adsorbers are to be backwashed during operation, they should be backwashed prior to startup. The reasons for backwashing before placing fresh carbon on-line are to:

(1) size segregate the carbon so subsequent backwashing will return the carbon to the same relative position in the bed,
(2) remove any remaining air from the bed, and
(3) remove carbon fines which can, in some cases, lead to excessive pressure drop and flow restriction.

Backwashing is done during operation to remove:
(1) sediment from the top of the bed,
(2) carbon fines that may be plugging the underdrain nozzles, and
(3) air that is binding the bed.

The need to backwash is indicated by an increased bedpressure drop. Backwashing an adsorber results in expanding the carbon bed, removing air, suspended solids and carbon fines and classifying the carbon particles. The backwash flow rate depends upon the carbon particle mesh size and the water temperature. Generally, rates in the range of 10 to 15 gpm/ft$_2$ are sufficient to remove solids, remove air, and expand the bed. A fresh carbon fill should be backwashed to classify the carbon. The time required for this step is approximately 30 minutes or until the backwash discharge is free of fines.

Note that the above procedure can also be applied for backflushing when the adsorbers are non-backwashable. The only difference for backflushing is that the flow rate is lower and the time required to backflush is longer.

3.2 RESTARTING SYSTEM AFTER BACKWASHING - SERIES FLOW

The adsorber system is normally operated in a series mode. Valves in the influent and effluent lines are opened or closed, as required, to set the operation of the carbon vessels in the desired configuration. The first bed in the system is called the lead bed. The second bed is referred to as the polish or lag bed. The following sequence of steps should be followed to bring an adsorption system on-line in the series mode:

1. Check that all the valves in the adsorption system are closed.
2. Place the feed pump (s) in service to supply the adsorption module at the required flow and pressure.
3. Open the valve in the effluent line from the polish adsorber
4. Start the feed pump and open the valve in the pump discharge line.
5. Slowly open the valve in the influent line to the lead adsorber and allow the pressure to increase to the operating level.

At this point, flow should be established down flow through both vessels and they will be on-line in series. Set the flow rate to the system at the desired value after flow is established to the unit. In order to obtain full utilization of the carbon and prevent air entrapment and channeling in the bed, the water level must remain above the carbon bed. To prevent the bed from draining due to gravity or loss of influent supply, a vacuum break (anti-siphon) loop or backpressure is included by the customer in the effluent piping.

4.0 STEADY STATE OPERATION

Once flow is established to both vessels and the flow rate is set, no further adjustments are made during normal operation. The operator should establish a routine to check the adsorbers and to collect operating data. This data can be used to establish a maintenance schedule, to determine when backwashing or backflushing is necessary, or to determine when fresh carbon is needed.

4.1 MONITORING

Sample connections are provided on the influent and effluent lines from each vessel to take periodic samples for analysis. Pressure gauges are provided to determine the pressure drop across each carbon bed.
Taking periodic pressure readings will provide the operator with historic data for troubleshooting purposes. In the event that operating conditions change, the operator has the capability of taking corrective action.

4.2 SHUTDOWN

4.2.1 SHORT TERM SHUTDOWN

For short duration shutdowns lasting less than one or two weeks, little needs to be done. Close all valves in the adsorber piping system, and open the vent line valves on each vessel. The feed pumps should be shut down and the valves closed in the lines to and from the pumps. Any drain valves in the pump casing should be opened for the duration of the shutdown. Freeze protection measures such as draining lines at the low points should be taken when there is a chance of freezing. Freeze protection measures are usually the responsibility of the client.

4.2.2 EXTENDED SHUTDOWNS

For extended shutdowns, the adsorbers should be drained of all water and filled with clean plant water. When the adsorbers are started up again, the carbon beds may require disinfection. If disinfection is required, call MK. Once the disinfection is complete, backwashable adsorbers should be backwashed prior to startup. After disinfection, bring the adsorber back on-line in the downflow mode, monitor the effluent for coliform count and monitor the pressure drop.

Environmental Inc.

SECTION 6.0
TELEMETRY

MK Environmental, Inc.
765 Springer Dr.
Lombard, IL., 60148
(P) 630-920-1104 (F) 866-306-8977
www.mkenv.com

Installation Instructions

Allen-Bradley

Micro820 20-Point Programmable Controllers

Catalog Numbers 2080-LC20-20QWB, 2080-LC20-20QBB, 2080-LC20-20AWB, 2080-LC20-20QWBR, 2080-LC20-20QBBR, 2080-LC20-20AWBR

http://rockwellautomation.com/literature

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Table of Contents

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://rockwellautomation.com/literature) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard and recognize the consequences.
	**SHOCK HAZARD:** Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures.
IMPORTANT	**IMPORTANT:** Identifies information that is critical for successful application and understanding of the product.

Environment and Enclosure

ATTENTION: This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR 11. Without appropriate precautions, there may be difficulties with electromagnetic compatibility in residential and other environments due to conducted and radiated disturbances.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA or be approved for the application if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see:

- Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1, for additional installation requirements.
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

Prevent Electrostatic Discharge

ATTENTION: This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

North American Hazardous Location Approval

The following modules are North American Hazardous Location approved: 2080-LC20-20QWB, 2080-LC20-20QBB, 2080-LC20-20AWB, 2080-LC20-20QWBR, 2080-LC20-20QBBR, 2080-LC20-20AWBR

The following information applies when operating this equipment in hazardous locations:	**Informations sur l'utilisation de cet équipement en environnements dangereux:**
Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.	Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.
WARNING: EXPLOSION HAZARD • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. • Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product. • Substitution of any component may impair suitability for Class I, Division 2. • If this product contains batteries, they must only be changed in an area known to be nonhazardous.	**AVERTISSEMENT: RISQUE D'EXPLOSION** • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. • La substitution de tout composant peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. • S'assurer que l'environnement est classé non dangereux avant de changer les piles.

WARNING:

- If you connect or disconnect the serial cable with power applied to this module or the serial device on the other end of the cable, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.
- If you connect or disconnect the communications cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.
- When used in a Class I, Division 2, hazardous location, this equipment must be mounted in a suitable enclosure with proper wiring method that complies with the governing electrical codes.
- Exposure to some chemicals may degrade the sealing properties of materials used in the Relays. It is recommended that the User periodically inspect these devices for any degradation of properties and replace the module if degradation is found.
- If you insert or remove the plug-in module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding. Refer to the Wiring Diagram for each plug-in module for additional details regarding removal or insertion under power.
- When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

ATTENTION:

- The serial cables are not to exceed 3.0 m (9.84 ft).
- Do not wire more than 2 conductors on any single terminal.
- Do not remove the Removable Terminal Block (RTB) until power is removed.

ATTENTION:

- To comply with the CE Low Voltage Directive (LVD), this equipment must be powered from a source compliant with the following: Safety Extra Low Voltage (SELV) or Protected Extra Low Voltage (PELV).
- To comply with UL restrictions, this equipment must be powered from a Class 2 or Limited Voltage Limited Current Source (LVLC).
- For Class I Division 2 applications, use only Class I Division 2 listed or recognized accessories and modules approved for use within the Micro800® platform.

ATTENTION:

- Electrostatic discharge can damage semiconductor devices inside the module. Do not touch the connector pins or other sensitive area pins.
- Be careful when stripping wires. Wire fragments that fall into the controller could cause damage. Once wiring is complete, make sure the controller is free of all metal fragments.
- Do not connect directly to line voltage. Line voltage must be supplied by a suitable, approved isolating transformer or power supply having short circuit capacity not exceeding 100 VA maximum equivalent.

Additional Resources

Resource	Description
Micro820™ 20-point Programmable Controllers User Manual, publication 2080-UM005	A more detailed description of how to install and use your Micro820 programmable controller.
Micro800® Plug-in Modules User Manual, publication 2080-UM004	Installation and wiring descriptions for the different Micro800 plug-in modules.
Micro800 AC Power Supply Installation Instructions, publication 2080-IN001	Information on wiring and installing the optional AC power supply.
Micro820 Remote LCD Installation Instructions, publication 2080-IN010	Information on wiring and installing the Micro800 Remote LCD, 2080-REMLCD.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	More information on proper wiring and grounding techniques.

If you would like a manual, you can:

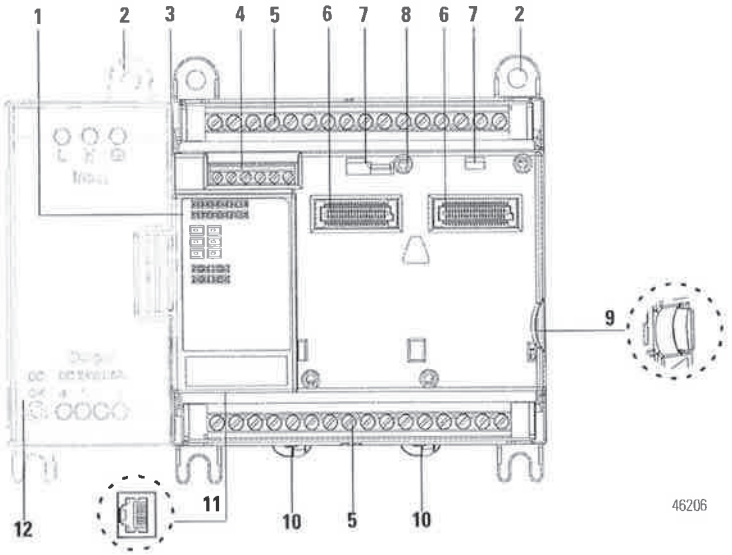
- download a free electronic version from the Internet: http://rockwellautomation.com/literature
- purchase a printed manual by contacting your local Allen-Bradley distributor or Rockwell Automation representative

Overview

The Micro820 20-point controller is an economical brick style controller with embedded inputs and outputs. It can accommodate up to two plug-in modules, any 24V DC output power supply that meets minimum specifications such as the optional Micro800 power supply, 2080-PS120-240VAC.

The Micro820 controller can also support a remote LCD (2080-REMLCD) through an RS232 port. This remote LCD can be mounted on the same DIN rail as the controller.

Controller Overview



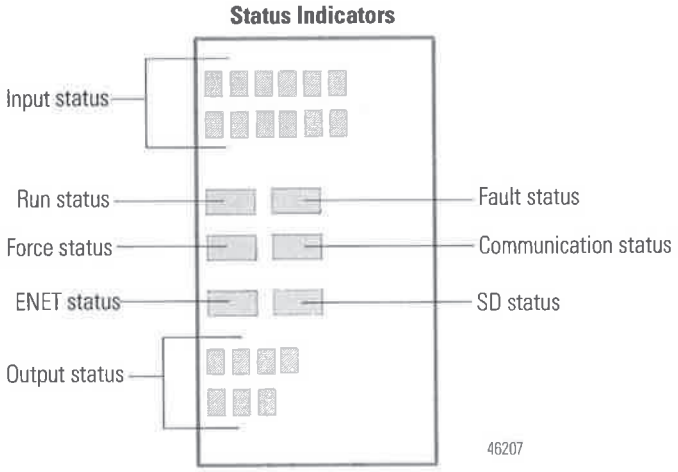
Controller Description

	Description		Description
1	Status indicators	7	Plug-in latch
2	Optional power supply panel mounting latch hole	8	Plug-in screw hole
3	Optional power supply slot	9	microSD™ (Micro Secure Digital) card slot
4	RS232/RS485 non-isolated combo serial port	10	DIN rail mounting latch
5	Removable/fixed[1] terminal block	11	RJ-45 Ethernet connector port
6	40-pin high speed plug-in connector	12	Optional power supply

(1) Removable terminal blocks are available on modules with catalog numbers that end in R. Catalog numbers that do not end in R have fixed terminal blocks.

Status Indicators

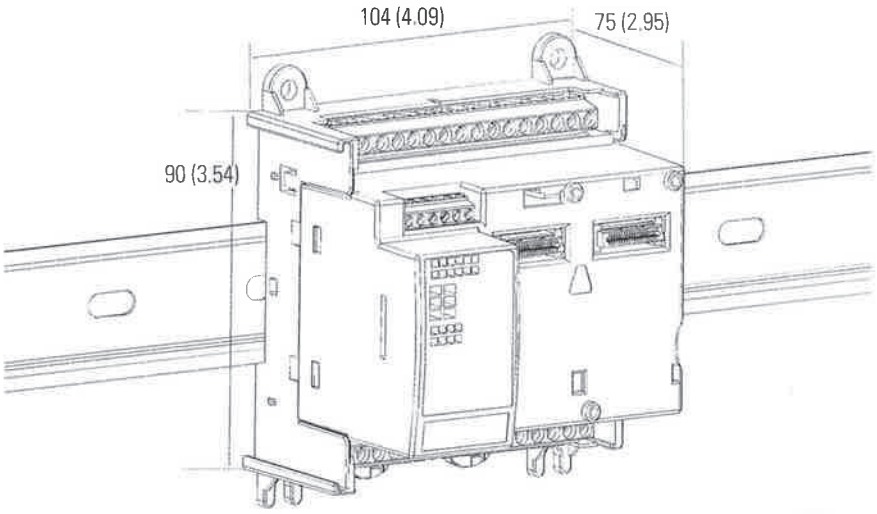
Controller status LED indicators are located at the leftmost side of the controller, next to the two plug-in slots.



Mount the Module

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference and environmental exposure. Locate your controller as far as possible from power lines, load lines, and other sources of electrical noise such as hard-contact switches, relays, and AC motor drives. For more information on proper grounding guidelines, see the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Mounting Dimensions and DIN Rail Mounting



Mounting dimensions do not include mounting feet or DIN rail latches.
Measurements are in millimeters (inches).

Module Spacing

Maintain spacing from objects such as enclosure walls, wireways and adjacent equipment. Allow 50.8 mm (2.0 in.) of space on all sides for adequate ventilation. If optional accessories/modules are attached such as the optional power supply, 2080-PS120-240VAC, make sure that there is 50.8 mm (2 in.) of space on all sides after attaching the optional parts.

DIN Rail Mounting

The module can be mounted using the following DIN rails: 35 x 7.5 mm and 35 x 15 mm (EN 50 022 - 35 x 7.5 and EN 50 022 - 35 x 15).

TIP For environments with greater vibration and shock concerns, use the panel mounting method, instead of DIN rail mounting.

Before mounting the module on a DIN rail, use a flat-blade screwdriver in the DIN rail latch and pry it downwards until it is in the unlatched position.

1. Hook the top of the DIN rail mounting area of the controller onto the DIN rail, and then press the bottom until the controller snaps onto the DIN rail.

2. Push the DIN rail latch back into the latched position.

To remove your controller from the DIN rail, pry the DIN rail latch downwards until it is in the unlatched position.

Panel Mounting

The preferred mounting method is to use four M4 (#8) screws per module. Hole spacing tolerance: ±0.4 mm (0.016 in.).

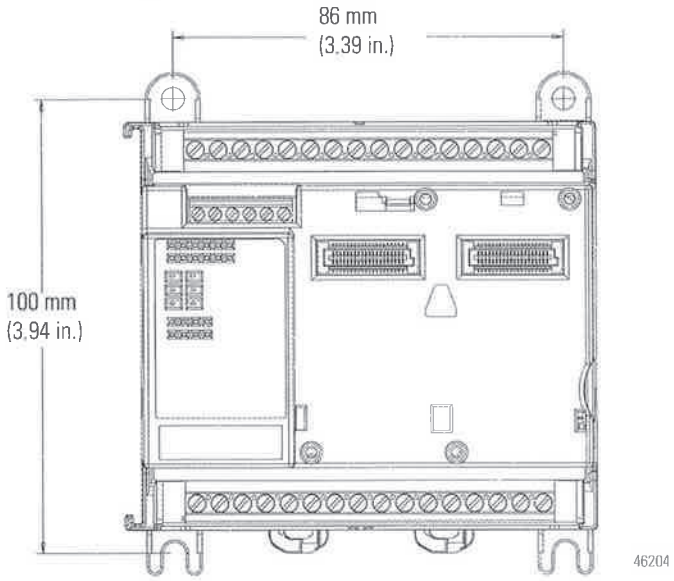
Follow these steps to install your controller using mounting screws.

1. Place the controller against the panel where you are mounting it. Make sure the controller is spaced properly.

2. Mark drilling holes through the mounting screw holes and mounting feet then remove the controller.

3. Drill the holes at the markings, then replace the controller and mount it. Leave the protective debris strip in place until you have finished wiring any other devices.

Panel Mounting Dimensions



Install the microSD Card

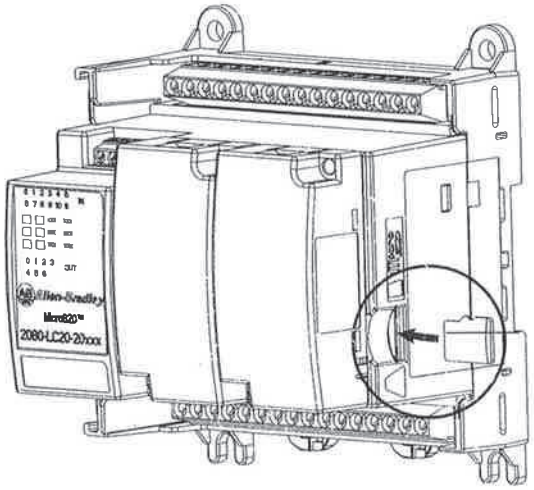
The Micro820 controller has a card slot for a microSD card. The microSD card is primarily used for project backup and restore. It is also used for data-logging and recipe and to change controller mode under specific conditions.

WARNING: When you insert or remove the microSD card while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.
Be sure that power is removed or the area is nonhazardous before proceeding.

IMPORTANT Micro820 controllers support industrial grade microSD cards through an embedded microSD card slot. It supports Class 6 and 10 SDSC and SDHC microSD cards, with FAT32/16 formats, 32 GB maximum size. Industrial grade cards such as Swissbit S-200u/S300u are recommended. The microSD card file system supports only one file partition.

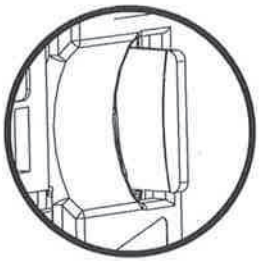
Micro820 controllers do **not** support Class 4 microSD cards.

1. Insert the microSD card into the card slot.
   You can install the microSD card in one orientation only. The beveled corner should be at the bottom. If you feel resistance when inserting the microSD card, pull it out and change the orientation.



Insert the microSD card into the slot.

2. Gently press the card until it clicks into place.



46219

3. To remove the microSD card from the slot, gently press the card until it clicks back and releases itself from the slot.

Use Surge Suppressors

Because of the potentially high current surges that occur when switching inductive load devices, such as motor starters and solenoids, we recommend the use of some type of surge suppression to protect and extend the operating life of the controllers output contacts. Switching inductive loads without surge suppression can *significantly* reduce the life expectancy of relay contacts. By adding a suppression device directly across the coil of an inductive device, you prolong the life of the output or relay contacts. You also reduce the effects of voltage transients and electrical noise from radiating into adjacent systems.

Refer to the Micro820 Programmable Controllers User Manual, publication 2080-UM005, for suitable surge suppression methods and recommended surge suppressors.

Minimizing Electrical Noise on Analog Channels

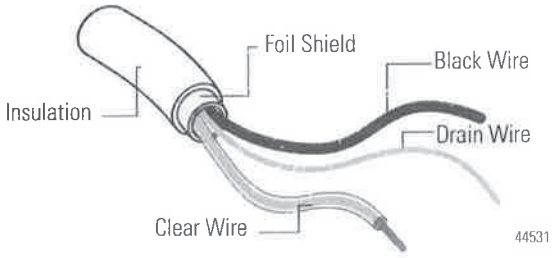
Inputs on analog channels employ digital high-frequency filters that significantly reduce the effects of electrical noise on input signals. However, because of the variety of applications and environments where analog controllers are installed and operated, it is impossible to ensure that all environmental noise will be removed by filters.

Several specific steps can be taken to help reduce the effects of environmental noise on analog signals:

- Install the Micro800 system in a properly rated (NEMA/IP) enclosure. Make sure that the Micro800 system is properly grounded.
- Use Belden cable #8761 for wiring the analog channels, making sure that the drain wire and foil shield are properly earth grounded, (see Grounding Your Analog Cable on page 13 for more information).
- Route the Belden cable separately from any AC wiring. Additional noise immunity can be obtained by routing the cables in grounded conduit.

Grounding Your Analog Cable

Use shielded communication cable (Belden #8761). The Belden cable has two signal wires (black and clear), one drain wire, and a foil shield. The drain wire and foil shield must be grounded at one end of the cable.



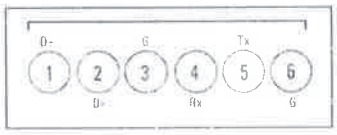
IMPORTANT Do not ground the drain wire and foil shield at both ends of the cable.

Wiring Your Plug-In Modules

Wiring diagrams for your Micro800 plug-in modules are available in the Rockwell Automation Literature Library, http://rockwellautomation.com/literature.

Wire the Controller

Serial Port Terminal Block



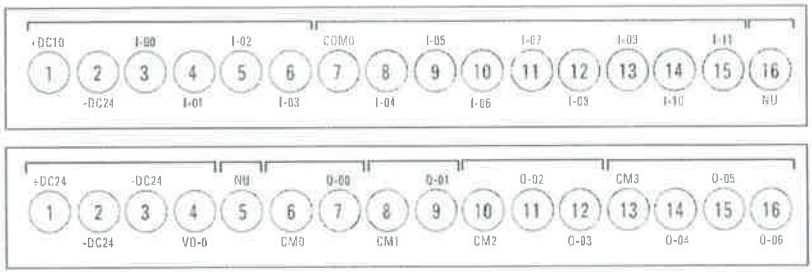
(View into terminal block)

Pin 1	RS485	Data +
Pin 2	RS485	Data -
Pin3	RS485	Ground[1]
Pin 4	RS232	Receive
Pin 5	RS232	Transmit
Pin 6	RS232	Ground[1]

(1) Non-isolated.

2080-LC20-20AWB / 2080-LC20-20AWBR / 2080-LC20-20QWB / 2080-LC20-20QWBR

Input Terminal Block



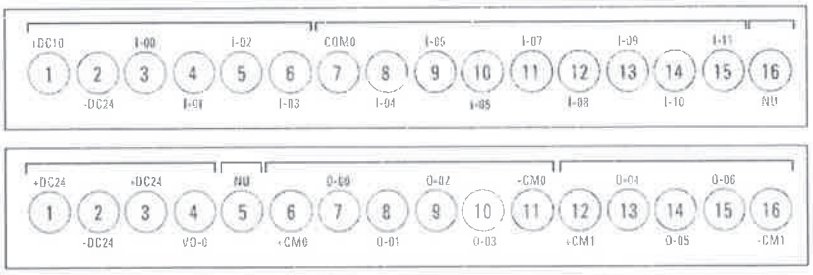
Output Terminal Block

46212

ATTENTION: For 2080-LC20-20AWB/R, inputs 0...3 are limited to 24V DC. All other inputs (4...11) are limited to 120V AC.

2080-LC20-20QBB / 2080-LC20-20QBBR

Input Terminal Block



Output Terminal Block

46211

Specifications

General Specifications

<table>
<tr><th>Attribute</th><th>2080-LC20-20AWB(R)</th><th>2080-LC20-20QBB(R)</th><th>2080-LC20-20QWB(R)</th></tr>
<tr><td>Number of I/O</td><td colspan="3">12 inputs, 8 outputs</td></tr>
<tr><td>Dimensions
HxWxD</td><td colspan="3">90 x 104 x 75 mm
(3.54 x 4.09 x 2.95 in.)</td></tr>
<tr><td>Shipping weight, approx.</td><td colspan="3">0.38 kg (0.83 lb)</td></tr>
<tr><td>Wire size</td><td colspan="3">
For fixed terminal blocks:
<table>
<tr><th></th><th>Min</th><th>Max</th><th></th></tr>
<tr><td>Solid</td><td>0.14 mm^2
(26 AWG)</td><td>2.5 mm^2
(14 AWG)</td><td rowspan="2">rated @ 90 °C
(194 °F) insulation max</td></tr>
<tr><td>Stranded</td><td>0.14 mm^2
(26 AWG)</td><td>1.5 mm^2
(16 AWG)</td></tr>
</table>
For removable terminal blocks:
<table>
<tr><th></th><th>Min</th><th>Max</th><th></th></tr>
<tr><td>Solid and Stranded</td><td>0.2 mm^2
(24 AWG)</td><td>2.5 mm^2
(14 AWG)</td><td>rated @ 90 °C
(194 °F) insulation max</td></tr>
</table>
For RS232/RS485 serial port:
<table>
<tr><th></th><th>Min</th><th>Max</th><th></th></tr>
<tr><td>Solid</td><td>0.14 mm^2
(26 AWG)</td><td>1.5 mm^2
(16 AWG)</td><td rowspan="2">rated @ 90 °C
(194 °F) insulation max</td></tr>
<tr><td>Stranded</td><td>0.14 mm^2
(26 AWG)</td><td>1.0 mm^2
(18 AWG)</td></tr>
</table>
</td></tr>
<tr><td>Wiring category[1]</td><td colspan="3">2 – on signal ports
2 – on power ports
2 – on communication ports</td></tr>
<tr><td>Wire type</td><td colspan="3">Use copper conductors or shielded cables</td></tr>
<tr><td>Terminal screw torque</td><td colspan="3">For removable and fixed terminal blocks:
0.5...0.6 Nm (4.4...5.3 lb-in.) using a 0.6 x 3.5 mm flat-blade screwdriver.
Note: Use a handheld screwdriver to hold down the screws at the side.

For RS232/RS485 serial port:
0.22...0.25 Nm (1.95...2.21 lb-in.) using 0.4 x 2.5 x 80 mm 2-component grip with non-slip grip screwdriver.</td></tr>
<tr><td>Input circuit type</td><td colspan="3">24V DC sink/source (standard) – for 2080-LC20-20QWB(R), 2080-LC20-20QBB(R)
120V AC – for 2080-LC20-20AWB(R) for Inputs 4...11 only</td></tr>
</table>

General Specifications

Attribute	2080-LC20-20AWB(R)	2080-LC20-20QBB(R)	2080-LC20-20QWB(R)
Output circuit type	Relay	24V DC source (standard and high-speed)	Relay
Power input	24V DC		
Power consumption	5.62 W (without plug-ins, max)...8.5 W (with plug-ins, max)		
Power dissipation	6 W		
Power supply voltage range	20.4...26.4 V DC, Class 2, or Limited Voltage Limited Current Source (LVLC)		
Auxiliary power supply output for thermistor	10V		
I/O rating	Input: 120V AC 16 mA Output: 2 A, 240 V AC 2A, 24V DC	Input: 24V DC, 8.8 mA Output: 24V DC, 1 A per point (Surrounding air temperature 30°C) 24 V DC, 0.3 A per point (Surrounding air temperature 65 °C)	Input: 24V DC, 8.8 mA Output: 2 A, 240 V AC, 2A, 24V DC
Isolation voltage	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs. 150V (continuous), Reinforced Insulation Type, Input to Aux and Network. Type tested for 60 s @ 3250 V DC Output to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 1950 V DC Input to Aux and Network.	50V (continuous), Reinforced Insulation Type, I/O to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 720 V DC, I/O to Aux and Network, Inputs to Outputs.	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs. 50V (continuous), Reinforced Insulation Type, Input to Aux and Network. Type tested for 60 s @ 720 V DC, Inputs to Aux and Network, 3250 V DC Outputs to Aux and Network, Inputs to Outputs.
Pilot duty rating	C300, R150	–	C300, R150
Insulation stripping length	• 7 mm for the removable and fixed terminal blocks • 5 mm for the RS232/RS485 serial port		
Enclosure type rating	Meets IP20		
North American temp code	T4		

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Analog Input Specifications for I-00...I-03

Attribute	Value
Number of inputs	4
Type	Voltage (single-ended)
Data range	0...4095
Input voltage range	0...10V DC
Maximum input	26.4V DC
Input impedance	14.14 kΩ
Resolution	12-bit, 2.5 mV/count
Smoothing	None
Input time constant, typical	0.44 ms
Isolation	None
Accuracy (25...55 °C)	5% of full-scale (2% with calibration)

AC Input Specifications for I-04...I-11 for 2080-LC20-20AWB(R)

Attribute	Value
Number of inputs	8
On-state voltage	120V AC, nom 79V AC, min 125V AC, max
On-state current	5 mA, min 16 mA, max
Input frequency	50/60 Hz, nom 47 Hz, min 63 Hz, max
Off-state voltage, max	20V AC
Off-state current, max	2.5 mA
Inrush current, max	250 mA @ 125V AC
Inrush decay time constant, max	22 ms

DC Input Specifications

Attribute	Non-isolated, shared with analog inputs (Inputs 00...03)	Isolated inputs (Inputs 04...11) – for 2080-LC20-20QWB(R), 2080-LC20-20QBB(R) only
Voltage category	24V DC Sink	24V DC Sink/Source
On-state voltage, nom	12/24V DC	24V DC
On-state voltage range	9.8...26.4V DC	24V DC, nom 10...26.4V DC @ 65 °C (149 °F) 10...30V DC @ 30 °C (86 °F)
Off-state voltage, max	5V DC	
Off-state current. max	0.5 mA	1.5 mA
On-state current, min	0.75 mA @ 10.8V DC 1.0 mA @ 15V DC	1.8 mA @ 10.8V DC 2.7 mA @ 15V DC
On-state current, nom	2.1 mA @ 24V DC	8.5 mA @24V DC
On-state current, max	2.6 mA @ 26.4V	12.0 mA @ 30V DC
Nominal impedance	14.1 kΩ (non-isolated)	3.74 kΩ (isolated)
IEC input compatibility	Type 1	Type 3

Relay Output Specifications for O-00...06 for 2080-LC20-20QWB(R), 2080-LC20-20AWB(R)

Attribute	Value
Voltage, min	5 V, AC 5 V, DC
Voltage, max	250 V, AC
Maximum switching time	10 ms, turn on 10 ms, turn off
Life	10,000,000 cycles (mechanical) 100,000 cycles (Electrical with UL test load)

Relay Contact Ratings

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
120 V AC	15 A	1.5 A	2 A	1800	180
240 V AC	7.5 A	0.75 A			
24 V DC	1.0 A		1 A	28	
125 V DC	0.22 A				

Analog Output Specifications

Attribute	Value
Output count range	0...4008
Output type	Voltage
Output Voltage Range	0...10V
Voltage Output Maximum Load (Resistive)	>1000 Ohms
Accuracy	2% of full scale for voltage
Resolution	12-bit, 2.5 mV/count
Output update rate (with no output capacitance), max	20 ms
Channel-to-bus isolation	No isolation
Channel-to-channel isolation	No isolation

DC Output Specifications for 2080-LC20-20QBB(R)

Attribute	Standard Outputs (Outputs O-00...O-05)	High Speed Output [1] (Output O-06)
User supply voltage	10V DC, min 26.4V DC, max	10V DC, min 26.4V DC, max
Load current, min	10 mA	
On state voltage drop, max	1V @ load current 2.5V @ surge current	1.5V @ load current
Current ratings per point	0.3 A @ 65 °C, max 1.0 A @ 30 °C, max 1.0 mA, min 1.0 mA, max leakage	100 mA (high speed operation) 1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)
Surge current per point peak current max surge duration max rate of repetition @ 30 °C max rate of repetition @ 65 °C	 4.0 A 10 ms once each second once every two seconds	

DC Output Specifications for 2080-LC20-20QBB(R)

Attribute	Standard Outputs (Outputs O-00...O-05)	High Speed Output [1] (Output O-06)
Controller current, max total	3 A	–
Turn-on time, max	0.1 ms	0.2 µs
Turn-off time, max	1.0 ms	2.5 µs
Response time, max	10 ms	
Frequency rate	NA	2%

[1] High speed output operation is greater than 5 Khz.

PWM Output Duty Cycle Error

Turn On/Off time for the Micro820 controllers for the PWM output port is 0.2 µs and 2.5 µs max, respectively. Duty cycle error is:

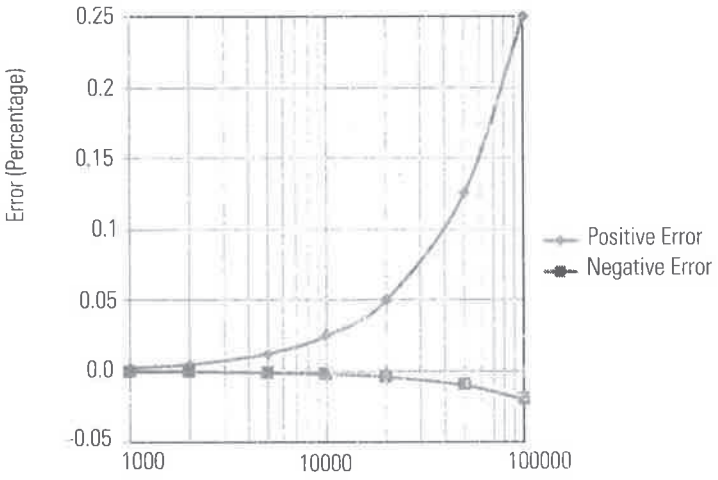
Positive error = 2.5 µs * F

Negative error = -0.2 µs * F

The plot below shows duty cycle error vs. frequency.

To get the duty cycle error at a certain frequency, for example, the user sets frequency to 20 KHz, and sets duty cycle to 30% in Connected Components Workbench, then actual duty cycle is

$30\%\ ^{+5\%}_{-0.4\%}$



Auxiliary Power Supply for Thermistor Applications

Attribute	Value
Output voltage	9.5V, min 10.04V, typical 10.5V, max
Output current	10 mA, typical 50 mA, max

Embedded RTC

Attribute	Value
Resolution	1 sec
Accuracy	± 52 sec/month @ 25 °C ± 160 sec/month @ 0...55 °C
Power off	Supercap – 4 days @ 25 °C Supercap life – 5 years @ 40 °C, 14.5 years @ 25 °C

Environmental Specifications

Attribute	Value
Temperature, operating	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20...65 °C (-4...149 °F)
Temperature, surrounding air, max	65 °C (149 °F)
Temperature, nonoperating	IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock): -40...85 °C (-40...185 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Damp Heat): 5...95% non-condensing
Vibration	IEC 60068-2-6 (Test Fc, Operating): 2 g @ 10...500 Hz
Shock, operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 25 g
Shock, non-operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 45 g
Emissions	CISPR 11 Group 1, Class A
ESD immunity	IEC 61000-4-2: 6 kV contact discharges 8 kV air discharges

Environmental Specifications

Attribute	Value
Radiated RF immunity	IEC 61000-4-3: 10V/m with 1 kHz sine-wave 80% AM from 80...2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B immunity	IEC 61000-4-4: ±2 kV @ 5 kHz on power ports ±2 kV @ 5 kHz on signal ports ±1 kV @ 5 kHz on communication ports
Surge transient immunity	IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on power ports ±1 kV line-line(DM) and ±2 kV line-earth(CM) on signal ports ±1 kV line-earth(CM) on communication ports
Conducted RF immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz

Certifications

Certification (when product is marked)[1]	Value
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E322657. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E334470.
CE	European Union 2004/108/EC EMC Directive, compliant with: EN 61326-1; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
EtherNet/IP	ODVA conformance tested to EtherNet/IP specifications
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3

(1) See the Product Certification link at http://www.rockwellautomation.com/products/certification for Declaration of Conformity, Certificates, and other certification details.

Notes:

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://support.rockwellautomation.com.

Installation Assistance

If you experience a problem within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your product up and running.

United States	1.440.646.3434 Monday – Friday, 8 a.m. – 5 p.m. EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

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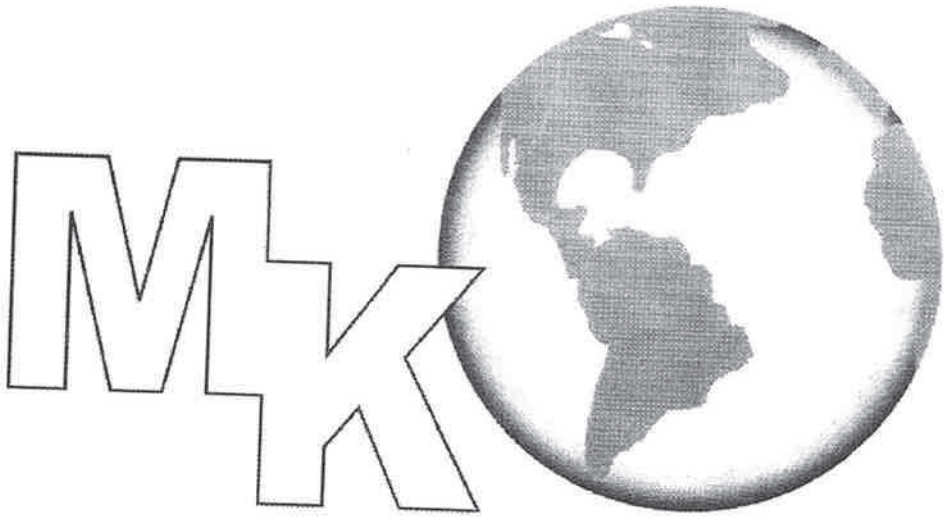


Environmental Inc.

SECTION 7.0
ELECTRICAL COMPONENTS

MK Environmental, Inc.
765 Springer Dr.
Lombard, IL., 60148
(P) 630-920-1104 (F) 866-306-8977
www.mkenv.com

Installation, Operation and Maintenance Instructions

for AC Induction Motors
56- 6800 Frames (NEMA)
63 – 280 Frames (IEC)

MARATHON ELECTRIC
Contact Motor Customer Service at:
Phone: (715) 675-3311
www.marathonelectric.com

Form 5554E

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE
OWNER: READ AND SAVE THESE INSTRUCTIONS

SAFETY INSTRUCTIONS

⚠ **This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.**

⚠ **WARNING**

Before installing, using, or servicing this product, carefully read and fully understand the instructions including all warnings, cautions, & safety notice statements. To reduce risk of personal injury, death and/or property damage, follow all instructions for proper motor installation, operation and maintenance.

These instructions are not intended as a complete listing of all details for installation, operation, and maintenance. If you have any questions concerning any of the procedures, STOP, and call the appropriate Regal-Beloit motor company.

Table of Contents

motor is suitable for use on Pulse Width Modulated (PWM) type VFD power. In addition, the nameplate must be marked with the inverter rating; for example, "2:1 CT", "2 to 1 Constant Torque", etc.

1.0 INSTALLER/OWNER/OPERATOR RESPONSIBILITY:

1.1 ELECTRICAL SAFETY

⚠ WARNING: ELECTRICAL SHOCK HAZARD

Electrical connections shall be made by a qualified electrical personnel in accordance with all applicable codes, ordinances and sound practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage. Only qualified personnel who are familiar with the applicable National Code (USA = NEC) and local codes should install or repair electrical motors and their accessories.

⚠ WARNING: ELECTRICAL LIVE CIRCUIT HAZARD

Do not touch electrically live parts. Disconnect, lockout and tag input power supply before installing or servicing motor (includes accessory devices). Use a voltmeter to verify that power is off before contacting conductors.

⚠ WARNING: ELECTRICAL GROUNDING HAZARD

Failure to properly ground motors, per the National Electrical Code (NEC) Article 430 and local codes may cause serious injury or death to personnel. For general information on grounding refer to NEC Article 250. (Also see "Ground Connections section 3.4.4").

⚠ WARNING: AUTOMATIC RESET PROTECTOR HAZARD

Do not use automatic reset protectors if automatically restarting the motor will place personnel or equipment at risk. . Failure to follow this instruction could result in serious personal injury, death and/or property damage

⚠ WARNING: MANUAL RESET PROTECTOR HAZARD

If a tripped manual reset thermal protector is exposed to a temperature less than –7°C (20°F) it may reset and restart the motor automatically. If an application requires a motor with a manual reset thermal protector that will be operated at temperatures less than –7°C (20°F) contact the manufacturer to review the application / motor requirements. Failure to follow this instruction could result in serious personal injury, death and/or property damage

1.2 MECHANICAL SAFETY

⚠ WARNING: LOOSE PARTS HAZARD

Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ WARNING: ROTATING PARTS HAZARD

Keep extremities, hair, jewelry and clothing away from moving parts. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

1.3 ENVIRONMENTAL SAFETY

⚠ WARNING: HAZARDOUS LOCATIONS

(1) The NEC and the local authority having jurisdiction must be consulted concerning the installation and suitability of motors for use in Hazardous Locations. The local authority having jurisdiction must make the final determination of what type of motor is required. The application and operation is beyond the control of the motor manufacturer.

(2) Division 1 Hazardous Locations motors can only be modified or reworked by the manufacturer or a facility that is Listed under UL's category "Motors and Generators, Rebuilt for use in Hazardous Locations". Failure to follow these instructions could result in serious personal injury, death and/or property damage.

(3) Do not use a Hazardous Locations motor with a Variable Frequency Drive (VFD) unless the motor nameplate specifically states that the

2.0 RECEIVING AND INSPECTION

2.1 INITIAL INSPECTIONS

2.1.1 CHECK PACKING LIST AND INSPECT the packaging to make certain no damage has occurred in shipment. If there is visible damage to the packaging, unpack and inspect the motor immediately. Claims for any damage done in shipment must be made by the purchaser against the transportation company.

2.1.2 TURN MOTOR SHAFT by hand to be certain that it rotates freely. Note: Shaft seals and bearing seals may add drag.

2.1.3 CHECK NAMEPLATE for conformance with purchase order requirements and compliance with power supply and control equipment requirements.

2.2 HANDLING:

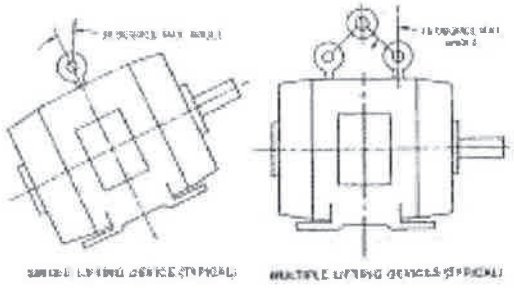
⚠ WARNING: FALLING OBJECT HAZARD

Eyebolts or lifting lugs, where provided, are intended for lifting only the motor and accessories mounted by the motor manufacturer (unless specifically stated otherwise on the motor). Utilizing the motor lifting provision to lift other components such as pumps and gear boxes could result in serious personal injury, death and/or property damage.

⚠ WARNING: FALLING OBJECT HAZARD

Before using the lifting provision, check the eyebolts and/or other lifting means to assure they are not bent or damaged and are completely threaded, seated & secured to the motor. Equipment to lift motor must have adequate lifting capacity. While lifting the motor DO NOT stand under or in the vicinity of the motor. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

2.2.1 LIFTING ANGLE LIMITATIONS



2.3 STORAGE: Motors, not put into service immediately, must be stored indoors in a clean, dry location. Avoid locations with large temperature swings that will result in condensation. Motors must be covered to eliminate airborne dust and dirt. If the storage location exhibits high vibration, place isolation pads under motor to minimize damage to motor bearings.

2.3.1 BEARING LUBRICATION: Bearings are grease packed at the factory; relubrication upon receipt of motor or while in storage is not necessary. If stored more than one year, add grease per lubrication instructions (Table 4-4) before start-up.

2.3.2 SHAFT ROTATION: It is recommended that the motor shaft be rotated 5 to 10 rotations every three months to distribute the grease in the bearings. This will reduce the chance for corrosion to form on the bearing rolling elements and raceways. Note: Shaft seals and bearing seals may add drag.

2.3.3 DAMP OR HUMID STORAGE LOCATIONS: Treat unpainted flanges, shafts, and fittings with a rust inhibitor. Apply appropriate power to the motor's space heaters (if so equipped)

3.0 INSTALLATION AND OPERATION

⚠ **WARNING:** Only qualified personnel who are familiar with the appropriate national code, local codes and sound practices should install or repair electrical motors and their accessories. Installation should conform to the appropriate national code as well as local codes and sound practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ **WARNING: ELECTRICAL LIVE CIRCUIT HAZARD**

Do not touch electrically live parts. Disconnect, Lockout and Tag input power supply before installing or servicing motor (includes accessory devices). Use a voltmeter to verify that power is off before contacting conductors.

3.1 LOCATION

3.1.1 SELECTING A LOCATION: Consideration should be given to environment and ventilation. Motors should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. A motor with the proper enclosure for the expected operating condition should be selected. Provide accessible clearance for cleaning, repair, service, and inspections (See section 3.1.3 for construction clearances). The location should be considered for possible future motor removal / handling. The free flow of air around the motor should not be obstructed.

3.1.2 AMBIENT TEMPERATURE LIMITS: The ambient temperatures of the air inlet to the motor should not exceed 40°C (104°F) or be less than -30°C (-22°F) unless the motor nameplate specifically states an ambient temperature outside of these limits. The ambient inside an enclosure built around the motor shall not exceed the nameplate ambient. For ambient temperatures outside of these limits consult the motor manufacturer.

⚠ **CAUTION: INSULATION DEGRADATION WARNING**

Insulation at high temperatures ages at an accelerated rate. Each 10°C increase in temperature reduces the insulation life by one half.

⚠ **WARNING: HAZARDOUS LOCATIONS AMBIENT LIMIT:** Division 1 Hazardous Locations motors shall **NOT** be operated below –25°C (-13°F) ambient. (Low temperatures reduce the component mechanical properties.)

3.1.3 CONSTRUCTION SELECTION per LOCATION:

3.1.3.1 DRIPPROOF (OPEN) MOTORS are intended for use indoors where the atmosphere is relatively clean, dry, and non-corrosive. Recommended a minimum clearance of ½ the shaft height between vent openings and the nearest obstruction.

3.1.3.2 TOTALLY ENCLOSED MOTORS are suitable for indoor or outdoor standard service applications.

TEAO or AOM (Totally Enclosed Air Over) motors must be mounted in the air stream. When the motor nameplate states a minimum airflow the motor must be mounted in an air stream meeting this minimum value.

TEFC (Totally Enclosed Fan Cooled) motors must meet a minimum distance of ½ the shaft height between the fan guard grill openings and the nearest obstruction.

3.1.3.3 HAZARDOUS LOCATIONS MOTORS: Hazardous Locations motors are intended for installations in accordance with NEC Article 500. For all installations involving Hazardous Locations motors, consult the applicable national codes, local codes, and the authority having jurisdiction.

Division 1 Installations – includes Class I & II: Use only motors that are UL Listed and CSA Certified or UL Listed and UL Certified for Canada. These motors bear a separate nameplate that includes the UL Listing Mark and CSA Certification Mark or includes the UL Listing Mark and the UL Mark for Canada. This plate also bears the phrase: " Electric motor for Hazardous Locations" and is marked with the Class, Group and Operating Temperature Code.

Division 2 Installations – Class I only: Use only motors that are CSA Certified and bear the CSA Certification Mark. These motors include a phrase on the main motor nameplate that indicates the motor is CSA Certified for Class I, Division 2 / Zone 2 locations.

Division 2 Installation – Class II only: Use only Class II motors as described above under "Division I Installations".

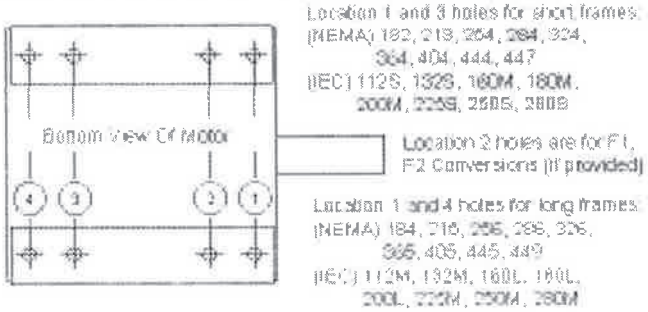
⚠ **WARNING: EXPLOSION HAZARD**

A motor should never be placed in an area with a hazardous process or where flammable gases or combustible materials may be present unless it is specifically designed and nameplated for this type of service. Hazardous Locations motors are intended for installations in accordance with NEC Article 500. For all installations involving Hazardous Locations motors, consult the NEC, local codes, and the authority having jurisdiction. Failure to follow these instructions could result in serious personal injury, death and/or property damage. (For other limitations see section 1.3)

3.2 MOUNTING MOTOR:

3.2.1 RIGID BASE (FOOTED): The motor must be securely installed to a rigid foundation or a mounting surface to minimize vibration and maintain alignment between the motor shaft and the load's shaft. The mounting surfaces of the four mounting pads must be flat within 0.01 inches for 210 frame & smaller; 0.015 inches for 250 frame & larger. [IEC 0.25 mm for 130 frame & smaller, 0.38 mm for 160 frame & larger]. This may be accomplished by shims under the motor feet. For special isolation mounting, contact manufacturer for assistance

3.2.2 RIGID BASE HOLE SELECTION -6 OR 8 HOLES



3.2.3 VERTICAL MOUNTING:

CAUTION: ENCLOSURE PROTECTION CAUTION: Most Dripproof rigid base (footed) motors do **NOT** meet "Dripproof" requirements when mounted vertically. If the motor is located in unprotected environments, the addition of a drip cover may be available. Drip covers not available for cast iron rigid base motors.

⚠ **WARNING: FALLING OBJECT HAZARD**

The lifting provision on standard horizontal footed motors is not designed for lifting the motor in a vertical shaft up or shaft down position. (see 2.2.1 lifting angles). Lifting method / provisions for

mounting a rigid base (footed) motor vertically is the responsibility of the installer.

VERTICAL SHAFT DOWN: Most standard horizontal motors thru 449 Fr. (excluding brake motors) can be mounted in a vertical shaft down orientation. For vertical brake motors see section 3.3.6.2.

VERTICAL SHAFT UP:

⚠ **WARNING: HAZARDOUS LOCATIONS VERTICAL MOUNT:** Hazardous locations motors must **NOT** be mounted vertically shaft up without approval by the motor manufacturer. Without proper retaining provisions the rotor may move axially and contact components, creating a spark hazard.

Belted or Radial Load when mounted vertically: The following frame sizes / constructions with applied (axial) down loads within the limit stated are acceptable when mounted vertical shaft up.

Table 3-1 Belted or Radial Load Applications (All speeds)

Frame Size	Enclosure	Construction	Shaft Up OK	Max Applied Down Load[3]
56	TEFC & ODP	Steel	Yes	25 lbs
140	TEFC	Steel & Cast Iron	Yes	25 lbs
	ODP	Steel	Yes	25 lbs
180	TEFC	All	Yes	35 lbs
	ODP	Steel	Yes	35 lbs
210	TEFC	All	Yes	40 lbs
	ODP	Steel	Yes	40 lbs
250	TEFC	All	Yes	40 lbs
	ODP	Steel	Yes	40 lbs
		Cast Iron	No[2]	N/A
280-320	320 TTFC models	Cast Iron	Eng[1]	N/A
	All Other TEFC	Cast Iron & Aluminum	Yes	30 lbs
	ODP	Cast Iron	No[2]	N/A
	TEFC & ODP	Steel	Build Up Only[4]	N/A
360 & Up	TEFC	Cast Iron	Build Up Only[4]	N/A
	ODP	Cast Iron	No[2]	N/A
	TEFC & ODP	Steel	Build Up Only[4]	N/A

Notes:

1 For TEFC model numbers beginning with 324TTFC or 326TTFC consult the motor manufacturer to determine if a build up motor is required.

2 The max applied down load is any applied load external to the motor, including such things as sheave weight, fan loads, axial belt force, pump load, etc. If the application is direct drive with no applied radial load, consult the motor manufacturer.

3 "Build-up only", refers to motors that are specifically ordered and built for shaft up applications. It does not imply that all build-up motors are suitable for shaft up applications.

3.3 APPLICATION ASSEMBLY TO MOTOR:

⚠ **CAUTION: EQUIPMENT DAMAGE:**
Do not connect or couple motor to load until correct rotational direction is established.

3.3.1 GENERAL: PROPER ALIGNMENT of the motor and driven equipment minimizes vibration levels, maximizes bearing life, and extends the overall life of the machinery. Consult the drive or equipment manufacturer for more information.

⚠ **CAUTION: BEARING FAILURE**
During assembly do NOT force components onto the shaft. Striking or hammering the component may result in bearing damage.

3.3.2 DIRECT COUPLING: Use flexible couplings if possible. For applications that apply radial, axial or moment loading on the motor shaft see section 3.3.3.

⚠ **CAUTION: BEARING FAILURE**
Unless approved by the motor manufacturer do **NOT** direct couple a vertical shaft up or roller bearing motor. Direct coupling a vertical shaft up motor or a motor with a roller bearing may result in bearing damage.

3.3.3 DIRECT CONNECTED: Radial loading for direct connected equipment (gears, fans etc.) must be approved by the motor manufacturer unless within the maximum overhung load limits (Table 3-2). Combined loading (axial, radial and/or moments) must be approved by motor manufacturer. For belted loads see section 3.3.4.

Table 3-2 Maximum Radial Load (lbf) @ Middle of the Shaft Extension Length

Frame Number	Motor Rated RPM			
	3600	1800	1200	900
143T	106	166	193	210
145T	109	170	199	218
182T	187	230	261	287
184T	193	237	273	301
213T	319	317	470	510
215T	327	320	480	533
254T	500	631	729	793
256T	510	631	736	820
284T	-	866	990	1100
286T	-	871	1005	1107
324T	-	950	1100	1215
326T	-	950	1113	1230
364T	-	1078	1365	1515
365T	-	1078	1380	1540
404T	-	1388	1590	1762
405T	-	1400	1610	1780
444T	-	1580	1795	2005
445T	-	1520	1795	1985
447T	-	1455	1765	1985
449T	-	1640	1885	2130

Values based on 26,280 hrs B-10 Life
For "End of Shaft" Load multiply value by 0.88
To convert from lbf to N multiply value by 4.4482.

3.3.4 BELTED:

The goal of any belted system is to efficiently transmit the required torque while minimizing the loads on the bearings and shafts of the motor and driven equipment. This can be accomplished by following four basic guidelines:

1. Use the largest practical sheave diameter.
2. Use the fewest number of belts possible.
3. Keep sheaves as close as possible to support bearings.
4. Tension the belts to the lowest tension that will still transmit the required torque without slipping. It is normal for V-belts to squeal initially when line starting a motor

3.3.4.1 Sheave Diameter Guidelines:

In general, smaller sheaves produce greater shaft stress and shaft deflection due to increased belt tension. See Table 3-3 for recommended minimum sheave diameters. Using larger sheaves increases the contact with belts which reduces the number of belts required. It also increases the belt speed, resulting in higher system efficiencies. When selecting sheaves, do not exceed the manufacturer's recommended maximum belt speed, typically 6,500 feet per minute for cast iron sheaves. Determine belt speed by the following formula:

Figure 1

$$\text{BELT SPEED (Ft/min)} = \frac{\textit{Shaft RPM x 3.14 x Sheave Dia (inches)}}{12}$$

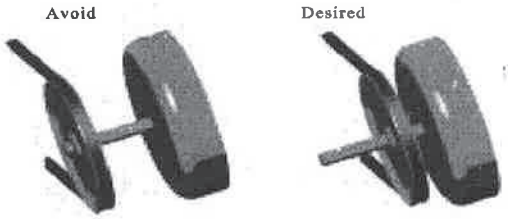
3.3.4.2 Number of Belts

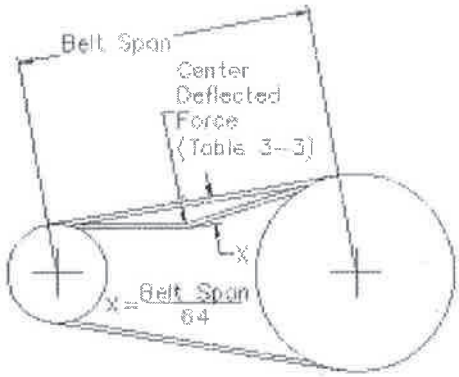
In general, use the fewest number of belts that will transmit the required torque without slipping. See Table 3-3 for recommended maximum number of belts. Each belt adds to the tension in the system, which increases load on the shafts and bearings. Belts are most efficient when operated at or near their rated horsepower.
If the sheaves have more grooves than the number of belts required, use the grooves closest to the motor.

3.3.4.3 Sheave Location

Install sheaves as close to the housing as possible to increase the bearing life of the motor and driven equipment

Figure 2





3.3.4.4 Belt Tension

⚠ CAUTION: Equipment Failure Caution
Belt tensioning by feel is **NOT** acceptable. Tensioning by "feel" can be very misleading, and can damage motor and equipment.
It is normal for V-belts to squeal initially when line starting a motor.

In general, belt tensions should be kept as loose as possible while still transmitting the required torque without slipping. Belt tensions must be measured with a belt tension gage. These inexpensive gages may be obtained through belt manufacturers, or distributors.

Proper belt tension is determined by measuring the force required to deflect the center of the belt a given distance. The proper deflection (in inches) is determined by dividing the belt span in inches by 64. Calculate the proper deflection and then see Table 3-3 for the required "Deflected Force" to achieve that deflection.
After tensioning the belt, rotate the sheaves for several rotations or operate the system for a few minutes to seat belts into the grooves, then re-tension the belts. New belts will stretch during use, and should be retensioned after the first eight hours of use.

Table 3-3 Recommended Minimum Sheave Diameters, Belt Type, Number of Belts and Deflected Force

Motor Hp	1200 rpm				1800 rpm				3600 rpm			
	Min Sheave Dia (in)	Belt Type	Max # of Belts	Avg. Deflected Force (lbs)	Min Sheave Dia (in)	Belt Type	Max # of Belts	Avg. Deflected Force (lbs)	Min Sheave Dia (in)	Belt Type	Max # of Belts	Avg. Deflected Force (lbs)
0.75	2.0	3VX	1	2.4	2.0	3VX	1	2.0	2.0	3VX	1	1.2
1	2.4	3VX	1	4.0	2.2	3VX	1	3.1	2.2	3VX	1	1.6
1.5	2.4	3VX	2	3.1	2.4	3VX	2	2.1	2.2	3VX	1	2.5
2	2.4	3VX	3	2.8	2.4	3VX	2	2.9	2.4	3VX	1	2.7
3	3.0	3VX	2	3.3	2.4	3VX	3	2.9	2.4	3VX	2	2.3
5	3.0	3VX	3	4.0	3.0	3VX	3	3.7	2.4	3VX	3	2.5
7.5	3.8	3VX	4	4.7	3.0	3VX	4	4.1	3.0	3VX	2	4.2
10	4.4	3VX	4	5.4	3.8	3VX	4	4.3	3.0	3VX	3	3.8
15	4.4	3VX	5	5.4	4.4	3VX	4	5.4	3.8	3VX	3	4.4
20	5.2	3VX	6	6.0	4.4	3VX	6	4.8	4.4	3VX	3	5.0
25	6.0	3VX	7	5.6	4.4	3VX	7	5.2	4.4	3VX	4	4.7
30	6.8	3VX	7	5.9	5.2	3VX	7	5.3				
40	6.8	5VX	4	11.6	6.0	3VX	7	6.0				
50	8.2	5VX	4	14.6	6.8	3VX	8	5.9				
60	8.2	5VX	5	14.1	7.4	5VX	4	13.3				
75	10.0	5VX	5	14.5	8.6	5VX	4	14.3				
100	10.0	5VX	6	16.0	8.6	5VX	6	13				
125	12.0	5V	7	14.1	10.5	5V	6	13.1				
150	13.2	5V	7	15.4	10.5	5V	7	13.4				
200	15.0	5V	8	16.0	13.2	5V	8	13.1				
250	15.0	8V	6	27.6	14.0	5V	9	13.8				
300	16.0	8V	7	27.1	14.0	5V/**8V**	11 / **7**	23.4				
350	16.5	8V	7	30.3	14.5	5V/**8V**	12 / **7**	26.0				
400	17.5	8V	8	29.1	15.0	5V/**8V**	13 / **8**	25.7				
450	18	8V	8	31.6	16.0	5V/**8V**	14 / **9**	25.2				
500	18.5	8V	9	30.7	16.5	5V/**8V**	15 / **9**	26.9				
600					17.5	8V	11	26.3				
700					19.0	8V	12	27.3				
800					20.0	8V	13	28.2				

Contact Motor Manufacturer when Belting 3600 rpm Motors Greater than 25 HP

Notes:

1. Horsepower is the nameplate motor horsepower, and RPM is the motor (driver) speed.
2. Minimum sheave diameters are from NEMA standards where applicable.
3. **For variable speed applications or values outside these recommendations, consult motor manufacturer.**
4. Selections are based on a 1.4 service factor, 5 to 1 speed ratio and various Power Transmission Manufacturers' catalogs.
5. These selections are for Narrow V-belt sections only. Consult manufacturer for details on conventional V-belt sections (A, B, C, D and E), or other belt types.
6. "Average Deflected Force is per section 3.3.4.4 of this document and is the force required to deflect the center of a belt 1/64 of the belt span distance. Tolerance on this force is ±1 lbf for forces ≤10 lbs, and ±2 lbs for forces >10 lbs as measured utilizing a belt tension gage.
7. When more than one belt is required the belts must be a matched set (matched for length).
8. If possible, the lower side of the belt should be the driving side to increase the length of wrap on the sheave).
9. For belted loads do not exceed 125% of 60 Hz operating RPM.

3.3.5 VFD (Variable Frequency Drives) OPERATION:

⚠ WARNING: VFD Motors with Reset Thermal Protectors
UL Recognition, UL Listing, or CSA certification does not apply to motors that are equipped with a manual or automatic reset thermal protector when the motor is operated on VFD power.

⚠ WARNING: Power Factor Correction Capacitors:
Power factor correction capacitors should never be installed between the drive and the motor.

⚠ CAUTION: VFD / Motor Setup:
It is the responsibility of the startup personnel during set up of the VFD / motor system to properly tune the drive to the motor for the specific application per the VFD user manual. The correct voltage boost and volts per hertz settings are application dependent and unique to each motor design. Failure to connect over temperature devices (when provided) will void the warranty.

3.3.5.1 Overspeed Capability:

Belted loads: Do not exceed 125% of 60 Hz operating RPM.

Table 3-4 Maximum Safe Continuous Speed (RPM) For Coupled and Direct Connected Loads

NEMA / [IEC] Frame Size	2-Pole	4, 6, or 8 Pole
56-180 [80-110]	7200 *	5400 *
210-250 [130-160]	5400 *	4200*
280 [180]	5400 *	3600
320 [200]	4500 *	3600
360 [225]	4500 *	2700
400-440 [250-280]	3600	2700
>440 [>280]	3600	1800

* = Fan cooled motors (Totally Enclosed & Hazardous Locations Motors) are limited to a maximum safe continuous speed of 4000 RPM **For higher speeds or shortened duty cycle contact motor manufacturer**

3.3.5.2 Cable Lengths: For optimum insulation life, limit VFD to motor cable lengths of general purpose motors

to Table 3-5 values. Definite purpose VFD motors may accommodate longer cable lengths. For additional information contact motor manufacturer.

Table 3-5 Max Cable Lengths General Purpose Motors
These values are based on 3 kHz carrier frequency. Add suitable VFD output-side filters when exceeding the listed values.

Frame Size	230V	460 V	575 V
NEMA 56-320	600 ft.	125 ft.	40 ft.
NEMA 360-5011	1000 ft.	225 ft.	60 ft.
IEC 80-200	180 m.	40 m.	12 m.
IEC 225-280.	300 m.	70 m.	18 m.

3.3.5.3 VFD Grounding: Equipment grounding conductors may be run in the same conduit as the AC motor power leads. This wire must be used as the equipment ground for the motor and not as the fourth current carrying wire of a "WYE" motor circuit. The grounded metal conduit carrying the output power conductors can provide EMI shielding, but the conduit does not provide an adequate ground for the motor; a separate grounding conductor must be used. Grounding the motor neutral (WYE) of a VFD powered motor may result in a VFD ground fault trip. Improper grounding of an inverter fed motor may result in frame voltages in excess of 500 Volts. Refer to Grounding section 3.4.4

3.3.5.4 VFD – Single Phase:
CAUTION: SINGLE PHASE MOTOR FAILURE:
Single Phase motors are **NOT** suitable for use on VFD power. Connecting a Single Phase Motor to a VFD voids the warranty.

3.3.5.5 Stray Voltage on Accessory Leads:
VFD's will couple stray (common-mode) voltage to motor-mounted RTDs, thermistors, thermostats and space heaters. The leads of these elements must be properly insulated and control input circuits must be designed to withstand this common-mode voltage.

3.3.6 ACCESSORIES / PROVISIONS:
3.3.6.1 General: Carefully read and understand the accessory manufacturer's instructions, supplied with motor. Contact the manufacturer for additional information.

3.3.6.2 Brake Motors:
⚠ CAUTION: Vertical Motor Premature Brake Failure
Motors with brakes that are designed for vertical applications are equipped with springs to support the brake pressure plate. Mounting a horizontal brake motor vertically shaft up or down may require a pressure plate spring modification. Failure to modify the brake for the vertical application may result in premature brake failure. If in question, consult brake literature or brake manufacturer.

Brake Solenoid Wiring: Do NOT connect the brake solenoid to the output of a VFD. The brake solenoids must be wired to 50/60 Hz line power

3.3.6.3 Space Heaters:
Motors provided with space heaters have two leads that are brought into the conduit box or into an auxiliary box. These leads are marked "H1", "H2" ("H3", "H4" if a second space heater is supplied). See the space heater nameplate on motor for heater rating.

⚠ WARNING: DIVISION 2 EXPLOSION HAZARD
The space heater temperature rating when used in Class I, Division 2 motors shall **NOT** exceed 80% of the auto ignition temperature of the hazardous gas or vapor. See the space heater nameplate on motor for heater Temperature Code and heater rating. Failure to follow this instruction could result in serious personal injury, death and/or property damage

3.3.6.4 Thermal Protection:

General Information: When thermal protection is provided, one of the following will be stamped on the nameplate:

1. **"THERMALLY PROTECTED"** This motor has built in thermal protection. Thermal protectors open the motor circuit electrically when the motor overheats or is overloaded. The protector cannot be reset until the motor cools. If the protector is automatic, it will reset itself. If the protector is manual, disconnect motor from power supply. After protector cools (five minutes or more) press the reset button and reapply power to the motor. In some cases a motor is marked "Auto" and the connection diagram on the motor will identify T'Stat leads – see "2 " below. (See warnings on Manual and Automatic reset protectors - section 1.1)

2. **"WITH OVERHEAT PROTECTIVE DEVICE"**: This motor is provided with an overheat protective device that does not directly open the motor circuit. Motors nameplated with this phrase have either thermostats, thermisters or RTD's. The leads to these devices are routed into the motor conduit box or into an auxiliary box. The lead markings are defined on the nameplate (normally "P1", "P2") . The circuit controlled by the overheat protection device must be limited to a maximum of 600 volts and 360 volt-amps. See connection decal provided inside the terminal box cover. Failure to connect these over temperature devices (when provided) will void the warranty.

⚠ WARNING: EXPLOSION HAZARD
For Hazardous Locations motors provided with thermostats UL and the NEC require connection of thermostat leads into the control portion of a manual reset start circuit. Failure to follow this instruction could result in serious personal injury, death and/or property damage

Resistance Temperature Detectors (RTD): When winding and/or bearing RTDs are provided the RTD lead markings are defined on the nameplate. (Normally "R1", "R2", "R3" etc.)

3.3.6.5 RTD Alarm & Trip Settings:
Tables 3-6 & 3-7 are suggested initial RTD alarm and trip settings. For motors found to operate significantly below these values the settings may be reduced accordingly.

Table 3-6 Winding RTD – Temperature Limit (°C)
40 °C Max Ambient

Motor Load	Class B Temp Rise≤ 80°C		Class F Temp Rise≤ 105°C	
	Alarm	Trip	Alarm	Trip
Up to 1.0 SF	130	140	155	165
>1.0 to 1.15 SF	140	150	160	165

Table 3-7 Bearing RTD – Temperature Limit (°C)
40 °C Max Ambient

Ambient	Alarm	Trip
Up to 40°C	95	100
> 40°C	110	115
Bearings that are Heat Stabilized to 150 °C	130	135

3.3.7 GUARDS:
⚠ WARNING: ROTATING PARTS HAZARD
When devices are assembled to the motor shaft, be sure to install protective devices such as belt guards, chain guards, and shaft covers. These devices must protect against accidental contact with extremities, hair, and clothing. Consider the application and provide guarding to protect personnel. Remove all unused shaft keys and loose rotating parts to prevent them from flying off and causing bodily injury. Failure to follow this warning could result in serious personal injury, death and/or property damage.

3.4 ELECTRICAL CONNECTIONS:

⚠ WARNING: ELECTRICAL HAZARDS

Before proceeding read Section 1-1 on Electrical Safety. Failure to follow the instructions in Section 1-1 could result in serious personal injury, death and/or property damage

3.4.1 POWER SUPPLY / BRANCH CIRCUIT

⚠ WARNING: POWER SUPPLY INCOMPATIBILITY HAZARD

Check power supply to make certain that voltage, frequency and current carrying capacity are in accordance with the motor nameplate. Failure to match motor nameplate values could result in serious personal injury, death and/or property damage

⚠ WARNING: BRANCH CIRCUIT SUPPLY HAZARD

Motor and control wiring, fusing, overload protection, disconnects, accessories and grounding must always conform to the applicable electrical codes as well as local codes and sound practices.

3.4.1.1 Branch Circuit Supply to a motor should include a disconnect switch, short circuit current fuse or breaker protection, motor starter (controller) and correctly sized thermal elements or overload relay protection.

3.4.1.2 Fuses, Breakers, Overload Relays

Short Circuit Current Fuses or Breakers are for the protection of the branch circuit. Starter or motor controller overload relays are for the protection of the motor. Each of these should be properly sized and installed per the applicable electrical codes as well as local codes and practices.

⚠ WARNING: PROTECTIVE DEVICE DISABLED HAZARD

DO NOT bypass or disable protective devices. Protection removal could result in serious personal injury, death and/or property damage

3.4.1.3 AC Power Supply Limits

Motors are designed to operate within the following limits at the motor terminals:

1- AC power is within +/- 10 % of rated voltage with rated frequency applied. (Verify with nameplate ratings) **OR**

2- AC power is within +/- 5% of rated frequency with rated voltage **OR**

3- A combined variation in voltage and frequency of +/- 10% (sum of absolute values) of rated values, provided the frequency variation does not exceed +/-5% of rated frequency.

4- For 3 phase motors the line to line full load voltage must be balanced within 1%.

5- If the motor is rated 208-230V, the voltage deviations must be calculated from 230V.

CAUTION: Reduced Motor Performance

Operation outside of these limits will degrade motor performance and increase operating temperature.

3.4.2 TERMINAL BOX:

3.4.2.1 Conduit Opening: For ease of connections, motors are typically provided with large terminal boxes. Most motors have conduit access in 90 degree increments, the terminal box conduit opening is typically provided via knockouts, holes with covers, or the terminal box is rotate-able. Fabricated conduit boxes may have a removable plate for the installer to provide correctly sized hole(s).

3.4.2.2 Hazardous Locations Motors:

⚠ WARNING: EXPLOSION HAZARDS

(1) Terminal Boxes mounted to motor with a pipe nipple: If a pipe nipple mounted terminal box is removed or rotated it must be reassembled with a minimum of five full threads of engagement.

(2) Component Removal: Do not set a terminal box component on its machined surfaces. Prior to component reassembly wipe clean all machined surfaces.

(3) Machined Surface Gap (Hazardous Locations Terminal Boxes): The gap between mating surfaces with the machined terminal box MUST BE LESS THAN 0.002 inches. This gap must be checked with a feeler gage along the entire perimeter. If there is visible damage to the mating surfaces, or if the gap between these surfaces exceeds 0.002 inches, DO NOT complete the installation and contact the motor manufacturer. Failure to follow these instructions could result in serious personal injury, death and/or property damage

3.4.3 LEAD CONNECTIONS

Electrical connections to be made per nameplate connection diagram or separate connection plate. In making connections follow the applicable electrical code as well as local codes and practices.

⚠ WARNING: ELECTRICAL CONNECTION HAZARD

Failure to correctly connect the motor leads and grounding conductor can result in injury or death. Motor lead connections can short and cause damage or injury if not well secured and insulated.

3.4.3.1 Wire Size (Single Phase) Requirements

The minimum wire size for Single Phase, 115 & 230 Volt Circuits must meet table 3-8 for a given distance between motor and either Fuse or Meter Box.

Table 3-8 Minimum Wire Gage Size Single Phase 115 & 230 Volt Circuits

Distance (Feet) - Motor to Fuse or Meter Box								
Motor	100 Ft.		200 Ft.		300 Ft.		500 Ft.	
HP	115	230	115	230	115	230	115	230
1/4	14	14	10	12	8	10	6	8
1/3	12	14	10	12	6	10	4	8
1/2	10	12	8	10	6	8	4	6
3/4	10	12	6	10	4	8	2	6
1	8	10	6	8	4	6		4
1 1/2	4	10	0	8		6		4
2		8		6		4		2
3		8		6		4		2
5		6		4		2		0

3.4.3.2 Extension Cords (Single Phase Motors):

Where an extension cord(s) is utilized to provide power to the motor the extension cord(s) must be…(1) the proper gauge size per table 3-8, (2) in good working condition (3) properly grounded.

3.4.4 GROUND CONNECTION(S):

⚠ WARNING: ELECTRICAL GROUNDING HAZARD

For general information on grounding (USA) refer to NEC Article 250. Improper grounding of an inverter fed motor may result in frame voltages in excess of 500 Volts. In making the ground connection, the installer must make certain that a good electrical connection is obtained between motor and grounding lead. Failure to properly ground motors, per the applicable national code (such as NEC Article 430) and local codes may cause serious injury or death to personnel.

Primary "Internal" Ground: A grounding conductor must be connected to the grounding terminal provided in the terminal housing. This grounding terminal is either a ground screw, ground lug, or a tapped hole to be used with a separately provided ground screw. The internal grounding feature is accessible inside the terminal housing and must be used as the primary grounding connection.

Secondary "External" Ground: Some motors are provided with a supplemental grounding terminal located on the external surface of the motor frame or feet. This external terminal is for supplemental bonding connections where local codes permit or require such connection

3.4.5 START UP:

⚠ WARNING: ELECTRICAL SHOCK HAZARD:

Be certain that all connections are secure and the conduit box cover is fastened in place before electrical power is connected. Failure to follow these instructions could result in serious personal injury, death, and/or property damage.

⚠ WARNING: LOOSE & ROTATING PARTS HAZARD
Before proceeding read Section 1-2 on Mechanical Safety. Failure to follow the instructions in Section 1-2 could result in serious personal injury, death and/or property damage

⚠ WARNING: EXCESSIVE SURFACE TEMPERATURE HAZARD
Motors with the temperature code stated on the nameplate are designed to operate within this limit. Improper application or operation can cause the maximum surface temperature to be exceeded. A motor operated in a Hazardous Location that exceeds this surface temperature limit increases the potential of igniting hazardous materials. *Therefore, motor selection, installation, operation, and maintenance must be carefully considered to ensure against the following conditions:* (1) Motor load exceeds service factor value, (2) Ambient temperature above nameplate value, (3) Voltages outside of limits (3.4.1.3), (4) Loss of proper ventilation, (5) VFD operation exceeding motor nameplate rating, (6) Altitude above 3300 feet / 1000 meters, (7) Severe duty cycles, (8) Repeated starts, (9) Motor stall, (10) Motor reversing, and (10) Single phase operation. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ CAUTION: HOT SURFACE
Normal motor surface temperatures may exceed 90 ° C (194° F). Touching the motor frame may cause discomfort or injury. Surface temperatures should only be measured with suitable instruments and not estimated by hand touch.

3.4.5.1 Start Up - No Load Procedure

1. **Check Instructions:** Before startup carefully read and fully understand these instructions including all warnings, cautions, and safety notice statements.
2. **Motor out of storage after more than three months:** Check winding insulation integrity with a Megger. If winding resistance to ground is less than 1.5 Meg-ohms consult the local authorized service shop before energizing the motor.
3. **Check Installation: Mechanical** - Check tightness of all bolts and nuts. Manually rotate the motor shaft to ensure motor shaft rotates freely. Note: Shaft & bearing seals will add drag.
   Electrical - Inspect all electrical connections for proper terminations, clearance, mechanical tightness and electrical continuity. Be sure to verify connections are made per the nameplate connection diagram or separate connection plate. Replace all panels and covers that were removed during installation before energizing the motor.
4. **Energize Motor: Check Rotation**
   If practical check motor rotation before coupling to the load. Unlock the electrical system. Momentarily provide power to motor to verify direction of rotation. If opposite rotation is required, lock out power before reconnecting motor. If motor has a rotational arrow only operate the motor in the rotation identified. Reapply power to ensure proper operation.
5. **Record No Load Amps, Watts & Voltage:**
   Recommend - To establish a baseline value check and record the no load amps, watts, and voltage.

3.4.5.2 Start Up – Load Connected Procedure

1. **Check Instructions:** Before startup carefully read and fully understand these instructions including all warnings, cautions, & safety notice statements.
2. **Coupling Installation:** Check that the connected equipment is properly aligned and not binding. Check that all guards and protective devices are properly installed.
3. **Energize Motor:** When all personnel are clear of the machine, apply power and verify that the load is not transmitting excessive vibration back to the motor though the shaft or the foundation. Verify that motor amps are within nameplate rating. For repeated starts see 3.4.5.3. The equipment can now be fully loaded and operated within specified limits as stated on the nameplate.

3.4.5.3 Jogging and/or Repeated Starts

Do not start more than twice in succession under full load. Repeated starts and/or jogs of induction motors can cause overheating and immediate failure. Contact the motor manufacturer if it is necessary to repeatedly start or jog the motor.

4.0 MAINTENANCE:

⚠ WARNING: Hazardous Locations Motor Repair HAZARD:
Division 1 Hazardous Locations motors can only be modified or repaired by the manufacturer or a facility that is Listed under UL's category "Motors and Generators, Rebuilt for use in Hazardous Locations". Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ WARNING: ELECTRICAL SHOCK HAZARD
Electrical connections are to be made by qualified electrical personnel in accordance with all applicable codes, ordinances and sound practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage. Only qualified personnel who are familiar with the applicable national codes, local codes and sound practices should install or repair electric motors and their accessories.

⚠ WARNING: ELECTRICAL LIVE CIRCUIT HAZARD
Do not touch electrically live parts. Disconnect, lockout and tag input power supply before installing or servicing motor (includes accessory devices).

4.1 GENERAL INSPECTION

Inspect the motor approximately every 500 hours of operation or every three months. whichever occurs first. Keep the motor clean and the ventilation and fin openings clear. The following steps should be performed at each inspection:

4.1.1 VENTILATION: Check that the ventilation openings and/or exterior of the motor is free of dirt, oil, grease, water, etc, which can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.

4.1.2 INSULATION: Use a "Megger" periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. If winding resistance to ground is less than 1.5 Meg-ohms consult the local authorized service shop before re-energizing the motor.

4.1.3 ELECTRICAL CONNECTIONS: Check all electrical connectors to be sure that they are tight.

4.2 LUBRICATION & BEARINGS:

The lubricating ability of grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Longer bearing life can be obtained if the listed recommendations are followed:

NOTE: If lubrication instructions are provided on the motor nameplate, the nameplate instructions will supersede these instructions. Motors marked "Permanently Lubricated" do not require additional service.

⚠ CAUTION: BEARING / MOTOR DAMAGE WARNING
Lubricant should be added at a steady moderate pressure. If added under heavy pressure bearing shield(s) may collapse. Over greasing bearings greatly increases bearing friction and can cause premature bearing and/or motor failure.

4.2.1 GREASE TYPE (unless nameplate states otherwise):
Nameplate Ambient Temperature between -30°C (-22°F) to 65°C (150°F) inclusive: Recommended grease for standard service conditions is Mobil Polyrex ® EM. Equivalent and compatible greases include: Texaco Polystar RB, Rykon Premium #2, Pennzoil Pen 2 Lube, Chevron SRI & Mobil SHC 100.

Nameplate Ambient Temperature below -30°C (-22°F): Special low temperature grease is recommended, such as Aeroshell 7 or Beacon 325 for ball bearings and Mobil SHC 100 for roller bearings.

Nameplate Ambient Temperature above 65°C (150°F): Dow Corning DC44 or equivalent, a special high temperature grease is required. Note that Dow Corning DC44 grease does not mix with other grease types.

For RTD settings see Table 3-7.

4.2.2 BEARING OPERATING TEMPERATURE:

⚠ CAUTION: HOT SURFACE

The external surface temperature of the end shield (bracket) bearing hub may reach 100° C (212° F) during normal operation. Touching this surface may cause discomfort or injury. Surface temperatures should only be measured with suitable instruments and not estimated by hand touch.

4.2.3 LUBRICATION INTERVALS: (For motors with regreasing provisions)

Eq. 4.2 Lubrication Interval = [(Table 4-1) hrs] x [Interval Multiplier (Table 4-2)] x [Construction Multiplier (Table 4-3)]

Table 4-1 Lubrication Intervals (Hours) These values are based on average use.

NEMA / [IEC] Frame Size	Operating Speed – RPM (See Table 3.4 for Maximum Operating Speed)					
	<7200	<5400	<4500	<3600	<1800	<1200
56-180 [80-110]	2500 Hrs.	4000 Hrs	5000 Hrs	6000 Hrs.	17000 Hrs.	20000 Hrs.
210-250 [130-160]		2500 Hrs	4000 Hrs	5000 Hrs.	12000 Hrs.	16000 Hrs.
280 [180]		2000 Hrs	3000 Hrs	4000 Hrs.	10000 Hrs.	14000 Hrs.
320 [200]			2000 Hrs	3000 Hrs.	9000 Hrs.	12000 Hrs.
360 [225]			1500 Hrs	2000 Hrs.	8000 Hrs.	10000 Hrs.
400-440 [250 – 280]				1500 Hrs.	4000 Hrs.	7000 Hrs.
>440 [>280]				1000 Hrs.	3000 Hrs.	5000 Hrs.

Seasonal Service: If motor remains idle for more than six months, Lubricate at the beginning of the season, then follow lubrication interval.
Do not exceed maximum safe operating speed Table 3-4 without manufacturer's approval

Table 4-2 Service Conditions

Use highest level Multiplier: Maximum Ambient Temperature and Contamination are independent factors

Severity of Service	Maximum Ambient Temperature	Atmospheric Contamination	Multiplier
Standard	Less than 40° C (104° F)	Clean, Slight Corrosion, indoors, less than 16 hrs per day	1.0
Severe	Above 40° C (104° F) to 50° C	Moderate dirt or Corrosion or outdoors or more than 16 hrs per day	0.5
Extreme	Greater than 50° C or Class H Insulation	Severe dirt or Abrasive dust or Corrosion	0.2

Table 4-3 Construction Multiplier

Construction	Multiplier
Angular Contact or Roller Bearing	0.5
Vertical Motor	0.5
All others	1.0

Table 4-4 Relubrication Amounts

Frame Size		Volume		
NEMA	IEC	Cu. In.	Fluid oz	ml
48-56	80	0.25	0.14	4.0
143-145	90	0.25	0.14	4.0
182-184	110	0.50	0.28	8.0
213-215	130	0.75	0.42	12.5
254-256	160	1.00	0.55	16.0
284-286	180	1.50	0.83	25.0
324-326	200	2.00	1.11	33.0
364-365	225	3.00	1.66	50.0
404-405	250	3.80	2.11	62.0
444-449	280	4.10	2.27	67.0
>449	>280	4.50	2.50	74.0

For regreasing while operating multiply volume by 125%.

4.2.4 LUBRICATION PROCEDURE: (For Motors with Regreasing Provisions)

CAUTION: BEARING DAMAGE WARNING
Added grease must be compatible with the original equipment's grease. If a grease other than those stated in 4.2.1 is to be utilized contact the motor manufacturer. Nameplate information supersedes section 4.2.1 (GREASE TYPE). New grease must be free of dirt. Failure to follow these instructions and procedure below may result in bearing and/or motor damage.

For an extremely dirty environment, contact the motor manufacturer for additional information.

LUBRICATION PROCEDURE:

1. Clean the grease inlet plug or zerk fittings prior to regreasing.
2. (If present) Remove grease drain plug and clear outlet hole blockage.

CAUTION: GREASE DRAIN PLUGGED:
Old grease may completely block the drain opening and must be mechanically removed prior to regreasing. Forcing a blocked drain open by increased greasing pressure may collapse bearing shields and / or force excess grease through the bearings and into the motor.

3. Add grease per Table 4-4
4. Re-install grease inlet and drain plugs (if removed).

⚠ WARNING: EXPLOSION HAZARD
Do NOT energize a Hazardous Locations motor without all grease fittings properly installed.

4.2.5 EXAMPLE: LUBRICATION

Assume - NEMA 286T (IEC 180), 1750 RPM Vertical motor driving an exhaust fan in an ambient temperature of 43° C and the atmosphere is moderately corrosive.

1. Table 4-1 list 10,000 hours for standard conditions.
2. Table 4-2 classifies severity of service as "Severe" with a multiplier of 0.5.
3. Table 4-3 lists a multiplier value of 0.5 for "Vertical"
4. (Eq. 4.2) Interval = 10,000 hrs x 0.5 x 0.5 = 2500 hrs

Table 4-4 shows that 1.5 in^3 of grease is to be added.

Relubricate every 2,500 hrs of service with 1.5 in^3 of recommended grease.

4.3 TROUBLE-SHOOTING

⚠ WARNING: READ INSTRUCTIONS:
Before trouble-shooting a motor, carefully read and fully understand the warnings, cautions, & safety notice statements in this manual.

⚠ WARNING: Hazardous Locations Motor Repair:
Motors nameplated for use in Division 1 Hazardous Locations can only be disassembled, modified or repaired by the plant of manufacturer or a facility that is Listed under UL's category "Motors and Generators, Rebuilt for use in Hazardous Locations". Failure to follow these instructions could result in serious personal injury, death and/or property damage

CAUTION: DISASSEMBLY APPROVAL REQUIRED:
Motor disassembly must be performed by a party approved by the motor manufacturer. To disassemble the motor without approval voids the warranty.

4.3.1 GENERAL TROUBLE-SHOOTING WARNINGS

1. **DISCONNECT POWER TO THE MOTOR BEFORE PERFORMING SERVICE OR MAINTENANCE.**
2. **Discharge all capacitors before servicing motor.**
3. **Always keep hands and clothing away from moving parts.**
4. **Be sure required safety guards are in place before starting equipment.**
5. **If the problem persists contact the manufacturer.**

4.3.2 Motor Trouble-shooting Cause / Corrective Action - Table 4-5

Issue:	Likely Cause:	Corrective Action:
Motor fails to start upon initial installation:		
A.)	Supply voltage is too low or is severely unbalanced (one phase is low or missing).	(1) Check power supply fuses (2) Match motor lead wiring to nameplate connection diagram and supply voltage (3) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3). Correct as needed (4) Obtain correct motor to match actual supply voltage.
B.)	Motor leads are miswired at conduit box.	
C.)	Driven load exceeds motor capacity	(1) Verify that motor & load turn freely (2) Disconnect motor from load & ensure motor turns freely. Note: Roller bearings make noise when motor is uncoupled and shaft is rotated (3) Verify that motor starts when disconnected from load (4) Remove excessive / binding load if present.
D.)	Load is jammed.	
E.)	Fan guard is bent and making contact with fan	Replace fan guard & fan (if blades are damaged)
F.)	VFD with power factor capacitors installed	Remove power factor correction capacitors if equipped
G.)	VFD with motor neutral lead grounded	Ensure that motor neutral lead is ungrounded
H.)	VFD programmed incorrectly	(1) Repeat checks listed above (2) Verify that VFD current limit and starting boost are set correctly (5) Double-check motor and feedback parameter settings and VFD permissives (6) Repeat autotune (for vector drives) procedure (7) Consult VFD supplier.
Motor has been running, then slow down, stalls, or fails to restart:		
A.)	Supply voltage has drooped or has become severely unbalanced	(1) Replace fuse or reset circuit breaker. Allow motor to cool down before resetting manual protector on motor. **Warnings** - See section 1.1 for automatic and manual reset protector warnings (2) Verify that rated and balanced supply voltage has been restored before restarting motor. Measure voltage during restart. Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3).
B.)	Motor is overloaded	(1) Verify that motor & load turn freely. Repair binding components as needed (2) Reduce driven load to match motor capacity or increase motor size to match load requirements.
C.)	Motor bearings are seized	
D.)	Load Is jammed.	
E.)	VFD will not restart motor after tripping	(1) Check fault codes on VFD and follow VFD troubleshooting procedures (2) Verify that VFD input voltage is balanced and within limits (3) Remove excessive mechanical load if present.
F.)	Capacitor failure on single phase motor (if equipped)	**Warning: Potential Shock Hazard**: Contact service shop to check capacitor.
Motor takes too long to accelerate:		
A.)	Motor leads are not connected correctly	Match motor lead wiring to nameplate diagram.
B.)	Supply voltage has drooped or become severely unbalanced.	(1) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3). Correct as needed (2) Obtain correct motor to match actual supply voltage.
C.)	Load exceeds motor capability	Determine correct motor size and contact motor representative to obtain replacement motor.
D.)	Faulty start capacitor (Single Phase)	Motor may be too small for load. Record acceleration time. Start capacitors may fail if acceleration time exceeds 3 seconds.
E.)	Mechanical Failure	(1) Check to make sure motor & load turn freely (2) Disconnect motor from load & ensure motor turns freely
Motor rotates in the wrong direction:		
A.)	Incorrect wiring connection at motor	[Single Phase] Reconnect motor according to wiring schematic provided. Note: Some motors are non-reversible
		[Three Phase] Interchange any two power supply (phase) leads.
Motor overheats or overload protector repeatedly trips		
A.)	Driven Load is excessive	(1) If motor current exceeds nameplate value, ensure that driven load has not increased. Correct as needed. (2) If new motor is a replacement, verify that the rating is the same as the old motor. If previous motor was a special design, a general purpose motor may not have the correct performance.
B.)	Ambient temperature too high	Most motors are designed to operate in an ambient up to 40 °C. (See section 4.2.2 Hot Surface Caution)
C.)	Motor cooling fins and/or vent openings blocked	Remove foreign materials – clear vent openings, fan guard air inlets and frame fins (TEFC motors)
D.)	Insufficient Air Flow	TEAO (Totally Enclosed Air Over) motors: Measure airflow next to motor surface and obtain minimum requirements from motor manufacturer.

E.)	Motor is started too frequently	See section 3.4.5.3
F.)	Supply voltage too low, too high, or unbalanced	(1) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3) Correct as needed (2) Reconnect motor per input voltage (3) Obtain correct motor to match power supply.

Motor Vibrates

A.)	Motor misaligned to load.	Realign load
B.)	Load out of balance (Direct drive application)	(1) Ensure that load is dynamically balanced: (2) Remove motor from load and inspect motor by itself. Verify that motor shaft is not bent. Rule of thumb is 0.002" runout for shafts extension lengths up to 3.00". Add 0.0005" per every additional inch of shaft length beyond 3.00".
C.)	Uneven tension on multiple belts	Mixing new with used belts. Replace multiple belt applications with a complete set of matched belts.
D.)	Driven load operating at resonant point / natural frequency.	(1) De-energize motor and record vibration as load coasts from 100% speed to 0 RPM. If vibration drops immediately, vibration source is electrical. If levels do not drop immediately, source is mechanical (2) Redesign system to operate below the resonant point (3) On VFD-driven loads, program skip frequencies to bypass resonant points (4) Increase carrier frequency to obtain <3% THD current (5) On variable torque loads reduce volts/hertz below base speed.
E.)	VFD torque pulsations	(1) Adjust VFD to obtain <3% THD current @ rated motor current (2) Adjust VFD stability for smooth operation. Vector drives may be unstable at light load.
F.)	Motor miswired at terminal box	Match motor lead wiring to nameplate connection diagram.
G.)	Uneven, weak or loose mounting support.	Shim, strengthen or tighten where required.
H.)	Motor bearings defective	Test motor by itself. If bearings are bad, you will hear noise or feel roughness. Roller bearings are normally noisy when operated without load. If sleeve bearing, add oil per nameplate instructions. For motors with regreasing provisions, add grease per relubricating instructions (see section 4.2.3). If noise persists contact warranty service.
I.)	Motor out of balance	Disconnect from load. Set motor on rubber pads on solid floor. Secure a ½ height key in shaft keyway and energize from balanced power supply @ rated voltage. Record vibration levels and compare with appropriate standards. If excessive vibration persists contact motor manufacturer.

Bearings repeatedly fail.

A.)	Load to motor may be excessive or unbalanced	(1) If belt drive check system per section 3.3.4. (2) Other than belting, check loading on motor shaft. An unbalanced load will also cause the bearings to fail. (3) Check runouts of mating components, such as a C-face and pump flange.
B.)	Bearings contaminated.	Motor enclosure not suitable for environment. Replace with correct enclosure construction
C.)	Incorrect grease or bearings for ambient extremes.	See section 4.2.1
D.)	VFD bearing damage	Ground brush, common mode filter, or insulated bearings must be added. Contact motor manufacturer.

Motor, at start up, makes a loud rubbing, grinding, or squealing noise.

A.)	Contact between rotating and stationary components	Belt squeal during across the line starting is normal: (1) Verify that supply voltage is within limits (see section 3.4.1.3). (2) Ensure that motor lead wiring matches nameplate connection diagram: (3) Isolate motor from load. (4) To locate point of contact turn motor shaft by hand. (5) If point of contact is not located contact motor service shop.

Start capacitors repeatedly fail.

A.)	The motor acceleration time is too long	Motor may be too small for load. Record acceleration time. Start capacitors may fail if acceleration time exceeds 3 seconds.
B.)	Motor is being started too frequently	Excessive starting will damage motor capacitors. Contact motor manufacturer if motor is started more than 20 times/hour or if acceleration time exceeds 3 seconds.
C.)	Motor voltage low	Verify that voltage at the motor terminals is within limits (see section 3.4.1.3).
D.)	Defective start switch inside motor	Motor internal switch failure overheats start capacitor. Contact service shop or motor manufacturer.

Run capacitor fails.

A.)	High ambient temperature	Verify that the ambient does not exceed motor's nameplate value

	B.)	Input voltage exceeds limit	Verify that voltage to the motor terminals is within limits (see section 3.4.1.3).
	C.)	Power surge to motor (caused by lightning strike or other high transient voltage).	If a common problem, install surge protector.

Gems Sensors

Warrick® Series 67
Intrinsically Safe Multi-Function Control
Installation and Operation Bulletin

Table of Contents

Notes:

Gems Sensors Inc.
One Cowles Road
Plainville, CT 06062-1198
Tel: 860-793-4579
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Installation: Intrinsically Safe Sensing Circuits

This bulletin should be used by experienced personnel as a guide to the installation of the series 67. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Gems Sensors or its local representative if further information is required.

IMPORTANT: BEFORE PROCEEDING TO INSTALL AND WIRE THE SERIES 67 CONTROL, READ AND THROUGHLY UNDERSTAND THESE INSTRUCTIONS.

When installing according to these instructions, this device provides intrinsically safe sensing circuits for interface into Class I; Groups C & D, Class II; Groups E, F, & G and Class III; Hazardous Areas. Electrical equipment connected to associated apparatus should not exceed maximum ratings marked on product.

MOUNTING LOCATION

The control must be situated in a non-hazardous area where an explosive atmosphere will not exist at any time; otherwise, it must be mounted in a suitable U.L. approved explosion-proof enclosure with suitable U.L. approved explosion-proof seals.

WIRING: GENERAL INFORMATION

1. Intrinsically safe wiring must be kept separate from non-intrinsically safe wiring.
2. Intrinsically safe and non-intrinsically safe wiring may occupy the same enclosure or raceway if they are at least 2 inches (50mm) apart and separately tied down. Inside panels, field wiring terminals for intrinsically safe circuits must be separated by at least 2 inches (50 mm) from non-intrinsically safe wiring.
3. Wire the control device(s) to the Series 67 relay as shown in figure 1. A separate rigid metallic conduit should be used to enclose the conductors of the intrinsically safe control circuit.
4. An approved seal should be used at the point where the intrinsically safe control circuit wiring enters the hazardous area.

For intrinsically safe output wiring use #14 or #16 AWG type MTW or THHN wire. By using these wire types in conjunction with the following distance recommendations, you will not exceed the maximum capacitance for field wiring. Use Table 1 as a guide for maximum wire runs.

Table 1

Model Number	Sensitivity	Distance
67AXXXA	4.7K Ohms	4,000 Feet
67BXXXA	10K Ohms	2,400 Feet
67CXXXA	26K Ohms	1,200 Feet
67DXXXA	50K Ohms	600 Feet
67EXXXA	100K Ohms	300 Feet

Installation: Intrinsically Safe Sensing Circuits

GROUNDING:

The four mounting holes on the Series 67 provide an electrical connection for earth grounding between the control's internal solid state circuitry and the enclosure chassis. To insure proper grounding, use only metal screws and lock washers when mounting this control. Terminal G on the supply line/load side terminal strip is a redundant system ground terminal and must be connected to earth ground buss of the control's AC supply line feeder.

Note:

1. Intrinsically safe terminals can be connected to any non-energy generating or storing switch device such as a pushbutton, limit or float type switch or any Warrick electrode and fitting assembly.
2. To prevent electrical shock from supply line/load side powered connections, the Series 67 should be mounted in a tool accessible enclosure of proper NEMA rated integrity.
3. For U.L. 913 Listed panels, a metallic partition may be necessary to provide adequate spacing between non-intrinsically safe and intrinsically safe wiring and /or terminals.
4. For additional guidance on "Hazardous Location Installation" and "Intrinsically Safe Devices", consult ANSI/ISA standard RP 12-6 or NEC articles 500-516 and local codes.

SENSOR WIRING

The Series 67 control has four independent intrinsically safe channels, which can be connected to different types of sensors including floats, conductance probes, pressure switches and other non-powered contacts or sensors. The connections of the sensors to the terminals will not vary with normally open or closed sensors. However, the Inverse/Direct DIP switches must be set to the proper mode for each channel to achieve the correct operation. Consult tables 2 and 3 for the proper DIP switch setting for various sensors and functions.

The following sections cover the intrinsically safe sensor connections for single and differential level service.

SINGLE LEVEL SERVICE:

All four channels can be used for single level service. Each channel is independent and can be used for its own single point function. However, only channels 3 and 4 have the alarm bell and silence capabilities. Consult the alarm sections for more information regarding the installation and operation of the alarm circuitry. Table 2 covers the sensor style to terminal connections for all four channels.

Table 2

Sensor Style	Terminal Connections	DIP Switch Settings
Normally Open: Closes on Alarm Condition	Channel 1 - HS1 & G* Channel 2 - HS2 & G* Channel 3 - S3 & G Channel 4 - S4 & G	Inverse Mode - Up Position
Normally Open: Opens on Alarm Condition	Channel 1 - HS1 & G* Channel 2 - HS2 & G* Channel 3 - S3 & G Channel 4 - S4 & G	Direct Mode - Down Position
Normally Closed: Closes on Alarm Condition	Channel 1 - HS1 & G* Channel 2 - HS2 & G* Channel 3 - S3 & G Channel 4 - S4 & G	Inverse Mode - Up Position
Normally Closed: Opens on Alarm Condition	Channel 1 - HS1 & G* Channel 2 - HS2 & G* Channel 3 - S3 & G Channel 4 - S4 & G	Direct Mode - Down Position

* **Note**: Channels 1 & 2 cannot activate the alarm bell contacts and do not have the silence/acknowledge capabilities

Installation: Intrinsically Safe Sensing Circuits

DIFFERENTIAL LEVEL SERVICE:
Channels 1 and 2 are designed to provide differential on/off points to control pumps, solenoid valves or other equipment. These channels can also be used in single level service for alarms and cutoffs, however the control's built-in silence circuitry and bell contacts cannot be used. Consult the Alarm section for more information.

When channels 1 and 2 are used for differential level service, the associated sensors must be normally open. The Inverse/Direct DIP switches must also be set to the proper mode for each channel to achieve the correct operation. Table 3 gives the correct sensor to terminal connections an DIP switch settings for various applications.

FOR APPLICATIONS THAT DO NOT REQUIRE DUPLEX ALTERNATION, A JUMPER WIRE MUST BE PLACED FROM THE "G" TO "1-2" TERMINAL.

Table 3

Application	Sensor Contact Style	Sensor Terminal Connections	DIP Switch Setting
Simplex Pump-Down or Solenoid Valve Drain**	Normally Open - Closes on Rising Level	Start Pump / Open Valve - HS1 & G* Stop Pump / Close Valve - LS1 & G*	Direct - Down Channels 1 or 2
Simplex Pump-Up or Solenoid Valve Fillll	Normally Open - Closes on Rising Level	Start Pump / Open Valve - LS1 & G* Stop Pump / Close Valve - HS1 & G*	Inverse - Up Channels 1 or 2
Duplex Pump-Down - Common Pump Stop	Normally Open - Closes on Rising Level	Duty Pump Start - HS1 & G* Standby Pump Start - HS2 & G* Duty and Standby Pump Stop - LS1 & G* Jumper - LS1 and LS2	Direct - Down Channels 1 or 2
Duplex Pump-Up - Common Pump Stop	Normally Open - Closes on Rising Level	Duty Pump Start - LS1 & G* Standby Pump Start - LS2 & G* Duty and Standby Pump Stop - HS1 & G* Jumper - HS1 and HS2	Inverse - Up Channels 1 or 2
Duplex Pump-Down - Separate Pump Stops	Normally Open - Closes on Rising Level	Duty Pump Start - HS1 & G* Standby Pump Start - HS2 & G* Duty and Standby Pump Stop - LS1 & G* Jumper - LS2 and G*	Direct - Down Channels 1 or 2
Duplex Pump-Up - Separate Pump Stops	Normally Open - Closes on Rising Level	Duty Pump Start - LS1 & G* Standby Pump Start - LS2 & G* Duty and Standby Pump Stop - HS1 & G* Jumper - HS2 & G*	Inverse - Up Channels 1 or 2

* **Note 1**: If conductance probes are being used, only one "G" connection is required. Terminal "G" must be grounded to the vessel if metallic. If the electrode fitting being used has a metallic body and is supported directly upon a metallic vessel, the ground connection is facilitated by securing that end of the ground connector beneath the head of one of the screws which fasten the terminal housing to the body of the fitting. When the vessel is non-metallic, terminal "G" must be connected to an additional electrode of length equal to or longer than, the longest electrode. If wire suspension electrodes are being used, more than one Ground/ Reference probe may be required.

** **Note 2:** This setup is based on the use of a Normally Closed (N.C.) solenoid valve that energizes to open when power is applied to the coil circuit.

Installation: Intrinsically Safe Sensing Circuits

ALARM CHANNEL WIRING:

SILENCE CIRCUITRY:
A normally open pushbutton is required for the Series 67's alarm silence circuitry. The N.O. pushbutton must be connected to the "SIL" and "G" terminals. For more information about the operation of the silence circuitry consult the Alarm Operation section on page 11. **NOTE: THE SILENCE PUSHBUTTON IS CONNECTED TO THE INTRINSICALLY SAFE CIRCUITRY. THEREFORE THE PUSHBUTTON AND ITS ASSOCIATED WIRING SHOULD BE SEPARATED FROM THE NON-INTRINSICALLY SAFE WIRING AND DEVICES. CONSULT GENERAL WIRING INFORMATION FOR MORE INFORMATION.**

ALARM DIP SWITCHES:
The alarm DIP switches for channels 3 and 4 can be set to enable the bell contacts for one or both alarm channels. However, this does not disable the alarm contact for that channel. Table 4 covers the DIP switch settings for various alarm conditions.

Table 4

DIP Switch Settings	Bell Contact Status
3 Off - Down	Channel 3 - Off - Disabled
4 Off - Down	Channel 4 - Off - Disabled
3 On - Up	Channel 3 - On - Enabled
4 Off - Down	Channel 4 - Off - Disabled
3 On - Up	Channel 3 - On - Enabled
4 On - Up	Channel 4 - On - Enabled
3 Off - Down	Channel 3 - Off - Disabled
4 On - Up	Channel 4 - On - Enabled

ALTERNATION CIRCUITRY

AUTO OR MANUAL:
Series 67's built-in alternator can be used to automatically alternate between two loads controlled by channels 1 and 2. However, the automatic alternation may be by-passed to become a manual operation. This can be accomplished with the use of jumper wires or a three position switch connected to the 2-1, 1-2 and "G" terminals. Table 5 covers the jumper connections for manual alternation. Refer to figure 1 for more wiring information on the wiring of the three position selector switch. **NOTE: THE MANUAL ALTERNATION CIRCUITRY IS CONSIDERED INTRINSICALLY SAFE. THEREFORE THE SELECTOR SWTICH, JUMPER WIRES AND THEIR ASSOCIATED WIRING SHOULD BE SEPARATED FROM NON-INTRINSICALLY SAFE WIRING DEVICES. CONSULT GENERAL WIRING INFORMATION FOR MORE INFORMATION ON INTRINSIC SAFETY.**

Table 5

Alternation Status	Jumper Required	LED Status Pump-Down*	LED Status Pump-Up*
Automatic*	None	Either	Either
Manual 1-2	Terminals 1-2 to "G"	No. 1**	No. 1**
Manual 2-1*	Terminals 2-1 to "G"	No. 2**	No. 2**

Notes

* For non-alternation applications jumper 1-2 to "G"

** The position of the 1-2 and 2-1 indicating LED's is dependent on the application. The position changes for pump-up or pump-down. Consult control diagram figure 6-1 for more information.

Installation: High Voltage Circuits

A.C. SUPPLY:

Connect the incoming supply HOT lead to the L1 terminal, NEUTRAL lead to the L2 terminal and EARTH GROUND lead to the "G" Terminal. Note: the incoming power supply should have the same electrical characteristics as indicated on the control's label.

GROUNDING

Terminal "G" on the supply line/load side terminal strip is a redundant system ground terminal and must be connected to the earth ground buss of the panel's AC supply line feeder.

OUTPUT CONTACTS

Channels 1-4: Each channel has a dedicated non-powered contacts. These can be either Form C or Form A & B depending on the model. These contacts will change state when their respective channel activates. In DIRECT mode the relay will energize and the contacts will change state when the probe circuit sensor closes. In INVERSE mode the relay will energize and contacts will change state upon power up. The channel will then de-energize and return the contacts to their shelf state when the probe circuit sensor closes.

Form C- This contact configuration consists of one (1) Normally Open contact and one (1) Normally Closed contact. There are three terminals for electrical connections, N.O., N.C. and Common. Each terminal will accept up to two (2) #14 AWG wires

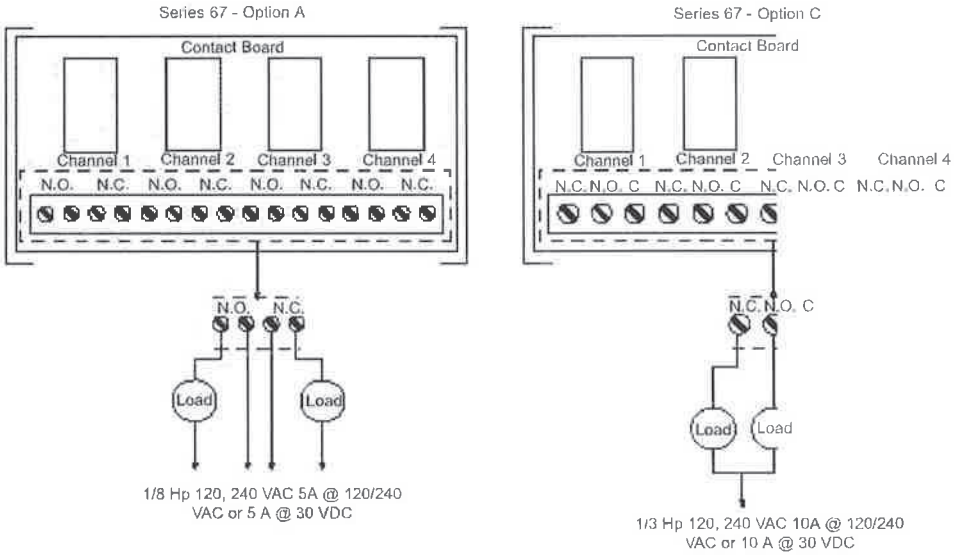
Form A & B: This contact configuration consists of one (1) Normally Open contact and one (1) Normally Closed contact which are electrically isolated from each other. There are two terminals for each contact. Each will accept one (1) # 14 AWG wire.

Alarm Bell: The alarm bell contacts are non-powered Form C construction. This contact configuration consist of consists of one (1) Normally Open contact and one (1) Normally Closed contact. There are three terminals for electrical connections, N.O., N.C. and Common. Each terminal will accept up to two (2) #14 AWG wires

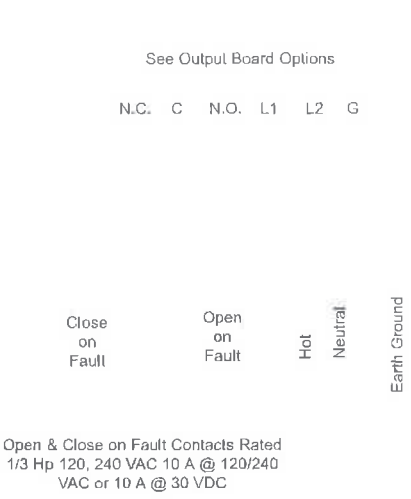
When the output contacts are used to drive loads they should be wired in series with the load. This series branch circuit should then be connected across a power source compatible with the load. See figure 1.

Figure 1

Load Contacts

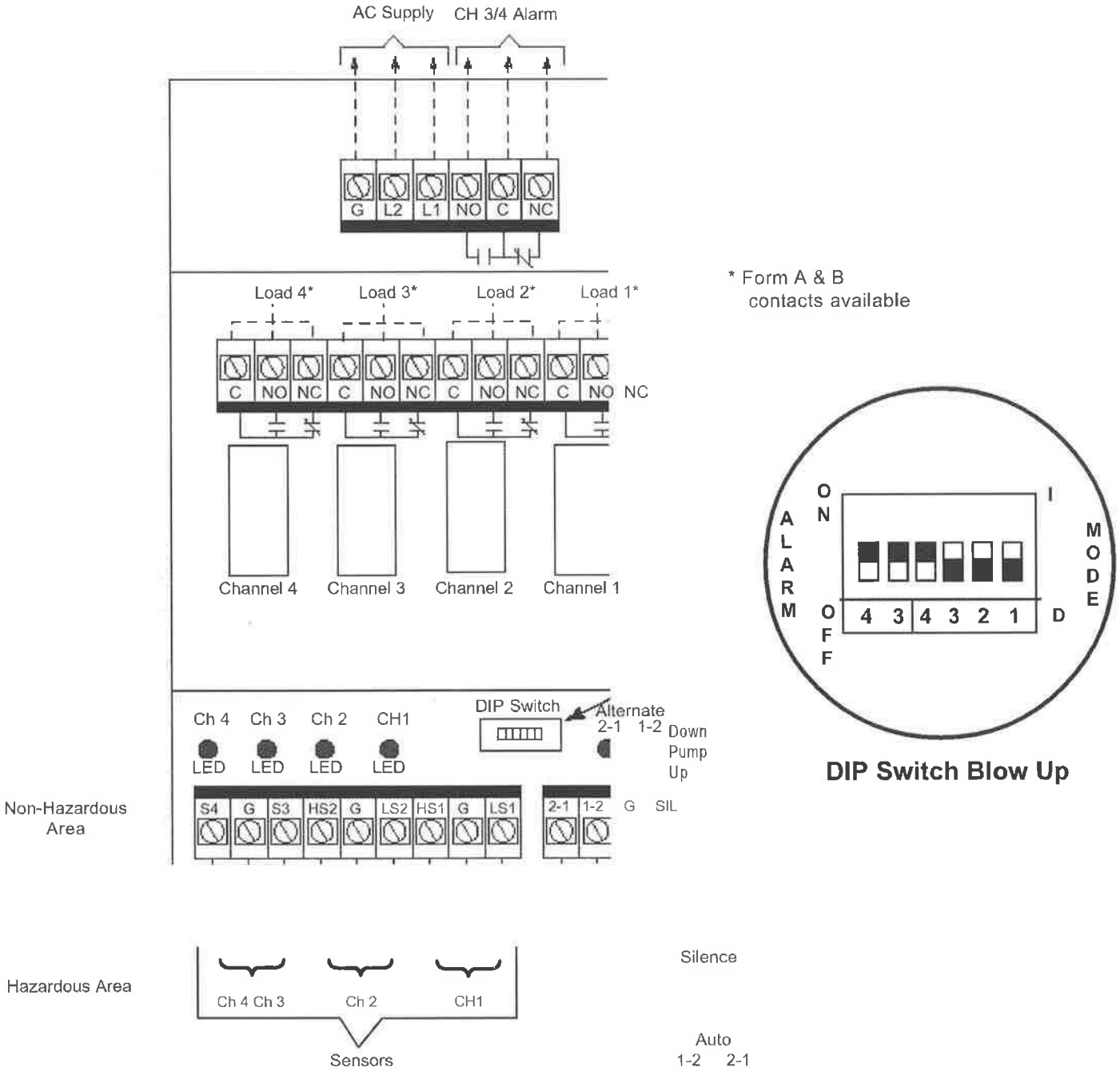


Alarm Bell Contacts



Control Diagram

Figure 2



Note: For applications that do not require duplex alternation, a jumper wire must be placed from the "G" to "1-2" terminal.

Technical Information

SPECIFICATIONS

Contact Design: Standard SPDT (1 form C): one normally open (N.O.) and one normally closed (N.C.), non powered contacts Contact Ratings for each channel. Optional 1 Form A (N.O.) and 1 Form B (N.C.) isolated
Load Contact Ratings: Standard Form C- 10A @ 120/240 VAC resistive and 30 VDC resistive, 1/3 Hp @ 120/240 VAC. Optional Form A & B - 5A @120/240 VAC and 30 VDC resistive, 1/8 Hp @ 120/240 VAC.
Bell Contacts: 1 Form C (N.O.), N.C., C)
Bell Contact Ratings: 10A @ 120/240 VAC and 30 VDC resistive, 1/3 Hp @ 120/240 VAC
Contact Life: Mechanical - 10 million operations. Electrical - 1,000,000 operations minimum at rated load.
Primary Voltage: 120 or 240 VAC models + 10% - 15%, 50/60 Hz.
Supply Current: Relays energized - 60ma @ 120 VAC, 30ma @ 240 VAC
Secondary Circuit: 12 VAC RMS voltage on probes, 6ma current RMS.
Sensitivity: Models operate from 4700-100,000 ohms maximum specific resistance
Temperature: -40° to 150° F Ambient
Electronics Module: Solid state components enclosed in a black nylon housing
Terminals: Standard Form C removable terminal strip containing a size 4 pan head screw with a clamping plate. Will accept up to two (2) #14 AWG wires per terminal. Optional Form A & B relay board will accept up to one (1) #14 AWG wire per terminal. Use copper (60-75° C) wire only. Torque to 20 inch pounds.
Listings: U.L. Intrinsically Safe (UL 913) File Number: E87112

ORDERING INFORMATION

67 X X X X X

A	4.7K
B	10K
C	26K
D	50K
E	100K

1	120 VAC
2	240 VAC

A	1 Form A & B (N.O.) & N.C. Isolated) for each channel
C	1 Form C (N.O., N.C.) for each channel

0	None
1	NEMA 1
4	NEMA 4

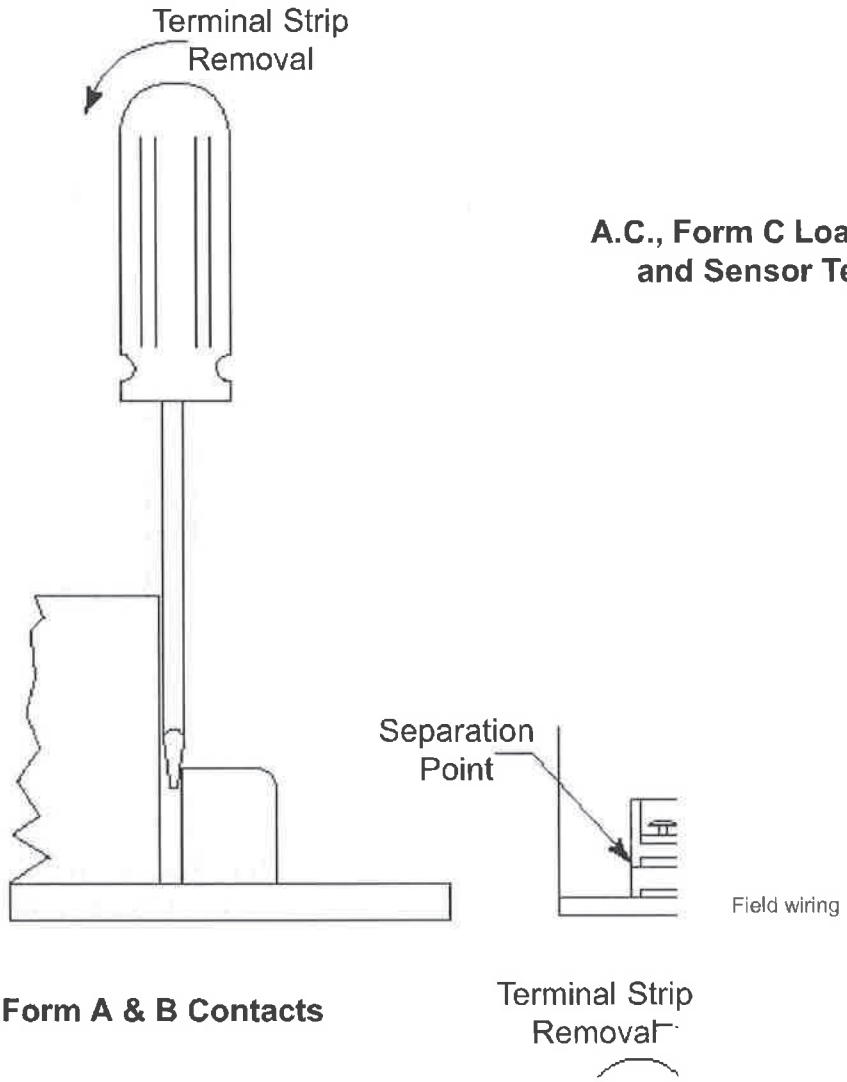
A	AC on Probe Circuit
D	DC on Probe Circuit

MODULE REPLACEMENT

If the electronic module needs to be replaced:

1. Turn off power to the control and load devices
2. Remove the metal partition located across the center of the module (when required).
3. Remove all field wiring terminal blocks from the electronic module. **The field wires do not need to be removed from the terminal blocks.** The terminal blocks separate from the board as show in figure 8-1.
4. Remove the four (4) retaining screws from the base of the electronic module. The module can now be removed from the control panel.
5. Install a new module and reinstall all of the terminal blocks.
6. Reinstall the metal partition (when required).
7. Set all DIP switches according to previous instructions.

Diagram 3



A.C., Form C Load Contacts and Sensor Terminals

Form A & B Contacts

Operation Instructions

The Series 67 multi-function control can be used for many different applications including: pump control, solenoid valve control and alarm activation. The following instructions cover the most common applications. If your application is not included, contact Gems Sensors or our authorized representative in your area for assistance.

The operating instructions are broken up into two general categories: SINGLE and DIFFERENTIAL LEVEL SERVICE. The alarm functions are covered under the SINGLE LEVEL SERVICE heading while the pumping and solenoid valve functions are covered under the DIFFERENTIAL LEVEL SERVICE heading.

SINGLE LEVEL SERVICE: CONTACT OPERATION

LOAD CONTACTS: CHANNELS 1-4

The activation of these contacts is dependent upon the type of sensor (normally open or closed) and the mode of operation (direct or inverse). The table 6 gives the sensor activation condition, DIP switch settings, contact status and LED status for various applications and sensors.

Table 6

Application	Warrick Sensor	Sensor" Alarm Activation Condition	DIP Switch Setting	Relay Status Upon Alarm	LED Status Upon Alarm
High Level Alarm Normally Open Float	FE - Reed Switch Float for M Tilt Float	Closes on Rising Level	Inverse UP "I"	De-Energized	ON
High Level Alarm Normally Closed Float	FE - Reed Switch Float for M Tilt Float	Opens on Rising Level	Direct DOWN "D"	De-Energized	OFF
Low Level Alarm Normally Open Float	FE - Reed Switch Float for M Tilt Float	Opens on Falling Level	Direct DOWN "D"	De-Energized	OFF
Low Level Alarm Normally Closed Float	FE - Reed Switch Float for M Tilt Float	Closes on Falling Level	Inverse UP "I"	De-Energized	ON
High Level Alarm Conductance Probes	3R, 3T, 3W, 3Y, 3H or 3S	Probes in Contact with Conductive Liquid	Invers UP "I"	De-Energized	ON
Low Level Alarm Conductance Probes	3R, 3T, 3W, 3Y, 3H or 3S	Probes not in Contact with Conductive Liquid	Direct DOWN "D"	De-Energized	OFF
UNKNOWN SENSOR Normally Open		Closes on Fault	Inverse UP "I"	De-Energized	ON
UNKNOWN SENSOR Normally Closed		Opens on Fault	Direct DOWN "D"	De-Energized	OFF

SINGLE LEVEL SERVICE: ALARM FUNCTIONS

BELL CONTACTS:

Under NORMAL operating conditions the alarm bell relay is held energized. The relay will de-energize to activate an alarm device when an abnormal condition exists on either channels 3 and/or 4. Either one or both alarm bell circuits can be disabled by adjusting the alarm DIP switches. Consult table 4 for more information on the bell DIP switch settings.

SILENCE CIRCUITRY:

Should an abnormal condition exist on either channels 3 and/or 4 the normally closed (N.C.) alarm bell relay contacts will close, activating an alarm device. The N.C. alarm bell contacts can be returned to their normal state (open) silencing the alarm, by depressing a normally open pushbutton connected to the "SIL" and "G" terminals. This will NOT affect the load contacts for channels 3 or 4 as they act independent from the alarm bell contacts.

Operation Instructions

DIFFERENTIAL LEVEL SERVICE:

The following operating instructions are based on correct DIP switch settings and sensor types. Any deviation from these requirements may result in incorrect system operations. Consult table 7 for further instructions.

Table 7

Application	Warrick Sensor	DIP Switch Setting	Activation Condition	Contact Status	LED Status Sensor Closed
Simplex Pump-Down or Solenoid Valve Drain	Normally Open: F, M, FE, FOE 3R, 3T, 3W, 3Y, 3H or 3S	Direct "Down"	Sensor Closes on Rising Level	N.O. - Closes N.C. - Opens	ON
Simplex Pump-Up or Solenoid Valve Fill	Normally Open: F, M, FE, FOE 3R, 3T, 3W, 3Y, 3H or 3S	Inverse "Up"	Sensor Closes on Rising Level	N.O. - Opens N.C. - Closes	OFF
Duplex Pump-Down - Common Pump Stop	Normally Open: F, M, FE, FOE 3R, 3T, 3W, 3Y, 3H or 3S	Direct "Down"	Sensor Closes on Rising Level	N.O. - Closes N.C. - Opens	ON
Duplex Pump-Up - Common Pump Stop	Normaliy Open: F, M, FE, FOE 3R, 3T, 3W, 3Y, 3H or 3S	Inverse "Up"	Sensor Closes on Rising Level	N.O. - Opens N.C. - Closes	OFF
Duplex Pump-Down - Separate Pump Stop	Normally Open: F, M, FE, FOE 3R, 3T, 3W, 3Y, 3H or 3S	Direct "Down"	Sensor Closes on Rising Level	N.O. - Closes N.C. - Opens	ON
Duplex Pump-Up - Separate Pump Stop	Normally Open: F, M, FE, FOE 3R, 3T, 3W, 3Y, 3H or 3S	Inverse "Up"	Sensor Closes on Rising Level	N.O. - Opens N.C. - Closes	OFF

DIFFERENTIAL LEVEL SERVICE: SIMPLEX

Simplex Pump Down- Should the level rise to the PUMP START sensor the N.O. load contacts will close starting the pump. The pump will remain running until the level recedes below the PUMP STOP sensor and the load contacts open.

Simples Pump UP- Should the level recede below the PUMP START sensor the N.O. load contacts will close starting the pump. The pump will remain running until the level rises to the PUMP STOP sensor and the load contacts open.

Solenoid Valve Drain- Should the level rise to the VALVE OPEN sensor the N.O. load contacts will close energizing the normally closed valve to open. The valve will remain open until the level recedes below the VALVE CLOSE sensor and the load contacts open

Solenoid Valve Fill- Should the level recede below the VALVE OPEN sensor, the N.O. load contacts will close energizing the normally closed valve to open. The valve will remain open until the level rises to the VALVE CLOSE sensor and load contacts open.

Operation Instructions

DIFFERENTIAL LEVEL SERVICE: DUPLEX PUMP DOWN WITH ALTERNATION

Common Pump Stop- The pumps will alternate each cycle with the duty pump starting when the level rises to the DUTY PUMP START sensor and stops when the level recedes below the PUMP(S) STOP sensor.

If the duty pump fails or cannot meet the demand of the system and the level rises to the STANDBY PUMP START sensor, the standby pump will be started and will continue in operation until the level recedes below the PUMP(S) STOP sensor.

Separate Pump Stops- The pumps will alternate each cycle with the duty pump starting when the level rises to the DUTY PUMP START sensor and stops when the level recedes below the DUTY PUMP STOP sensor.

If the duty pump fails or cannot meet the demand on the system and the level rises to the STANDBY PUMP START sensor, the standby pump will be started and will continue in operation until the level recedes below the STANDBY PUMP STOP sensor.

DIFFERENTIAL LEVEL SERVICE: DUPLEX PUMP UP WITH ALTERNATION

Common Pump Stop- The pumps will alternate each cycle with the duty pump starting when the level recedes below the DUTY PUMP START sensor and stops when the level rises to the PUMP(S) STOP sensor.

If the duty pump fails or cannot meet the demand of the system and the level recedes to the STANDBY PUMP START sensor, the standby pump will be started and will continue in operation until the level rises to the PUMP(S) STOP sensor.

Separate Pump Stops- The pumps will alternate each cycle with the duty pump starting when the level recedes to the DUTY PUMP START sensor and stops when the level rises to the DUTY PUMP STOP sensor.

If the duty pump fails or cannot meet the demand on the system and the level recedes to the STANDBY PUMP START sensor, the standby pump will be started and will continue in operation until the level rises to the STANDBY PUMP STOP sensor.

DIFFERENTIAL LEVEL SERVICE: DUPLEX PUMP DOWN WITHOUT ALTERNATION

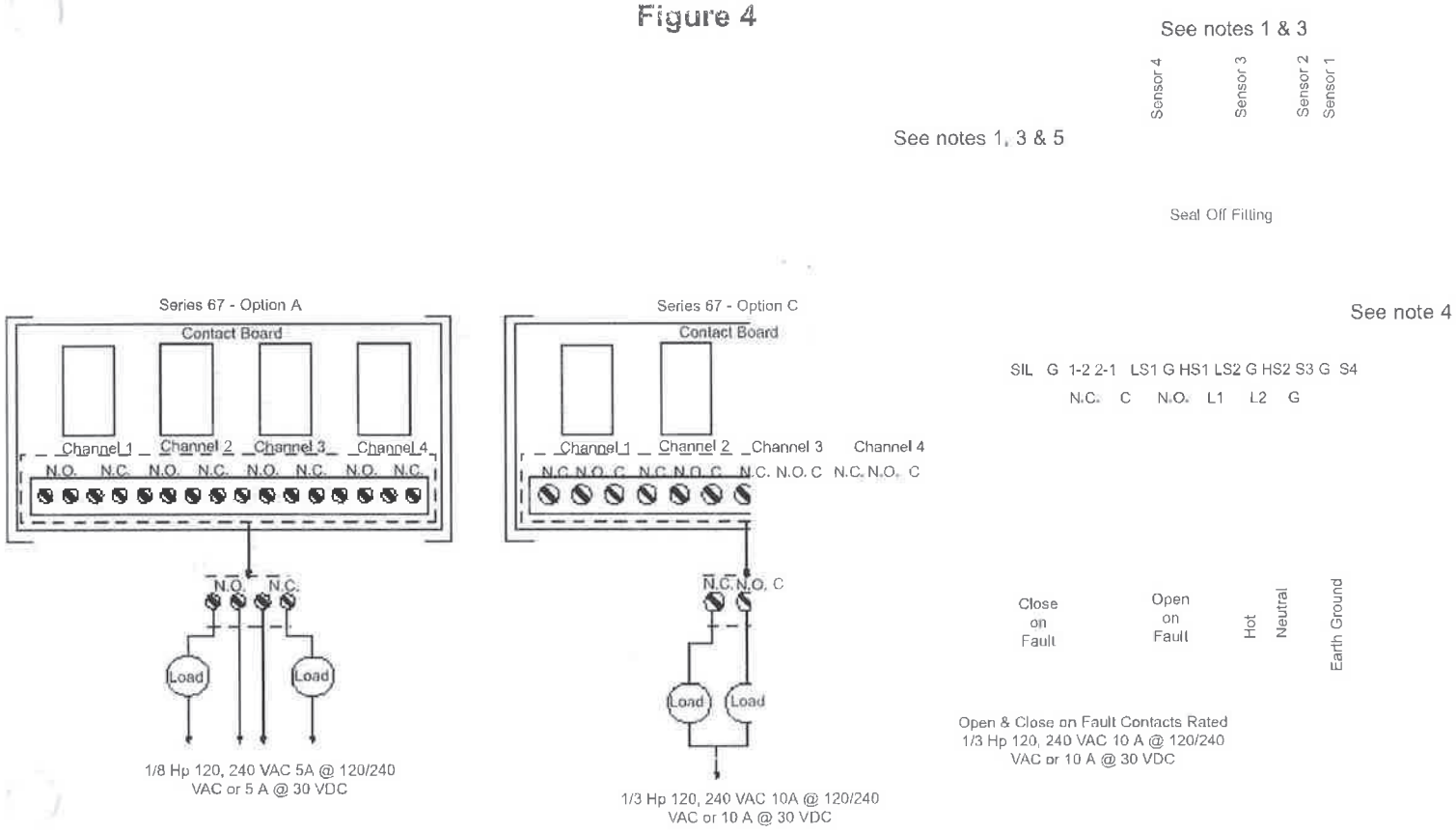
Same operation as above disregarding the alternation sequence. Use appropriate jumper to determine manual pump start sequence. Refer to table 5 for the manual alternation jumper information.

DIFFERENTIAL LEVEL SERVICE: DUPLEX PUMP UP WITHOUT ALTERNATION

Same operation as above disregarding the alternation sequence. Use appropriate jumper to determine manual pump start sequence. Refer to table 5 for the manual alternation jumper information.

General Control Information

Figure 4



Notes:

1. **All intrinsically safe wiring must be installed in accordance with article 504 of the National Electric Code, publication ANSI/NFPA 70 or CEC, Part 1 as applicable.**

2. **Grounding- The four mounting holes on the Series 67 provide an electrical connection for earth grounding between the controls internal solid state circuitry and the enclosure chassis. To insure proper grounding, use only metal screws and lock washers when mounting the control.**

   Terminal "G" on the supply line/load side terminal strip is a redundant system ground terminal and must be connected to the earth ground buss of the controls A.C. supply line feeder. The resistance between the system ground terminals and the earth ground buss must be less than 1 ohm.

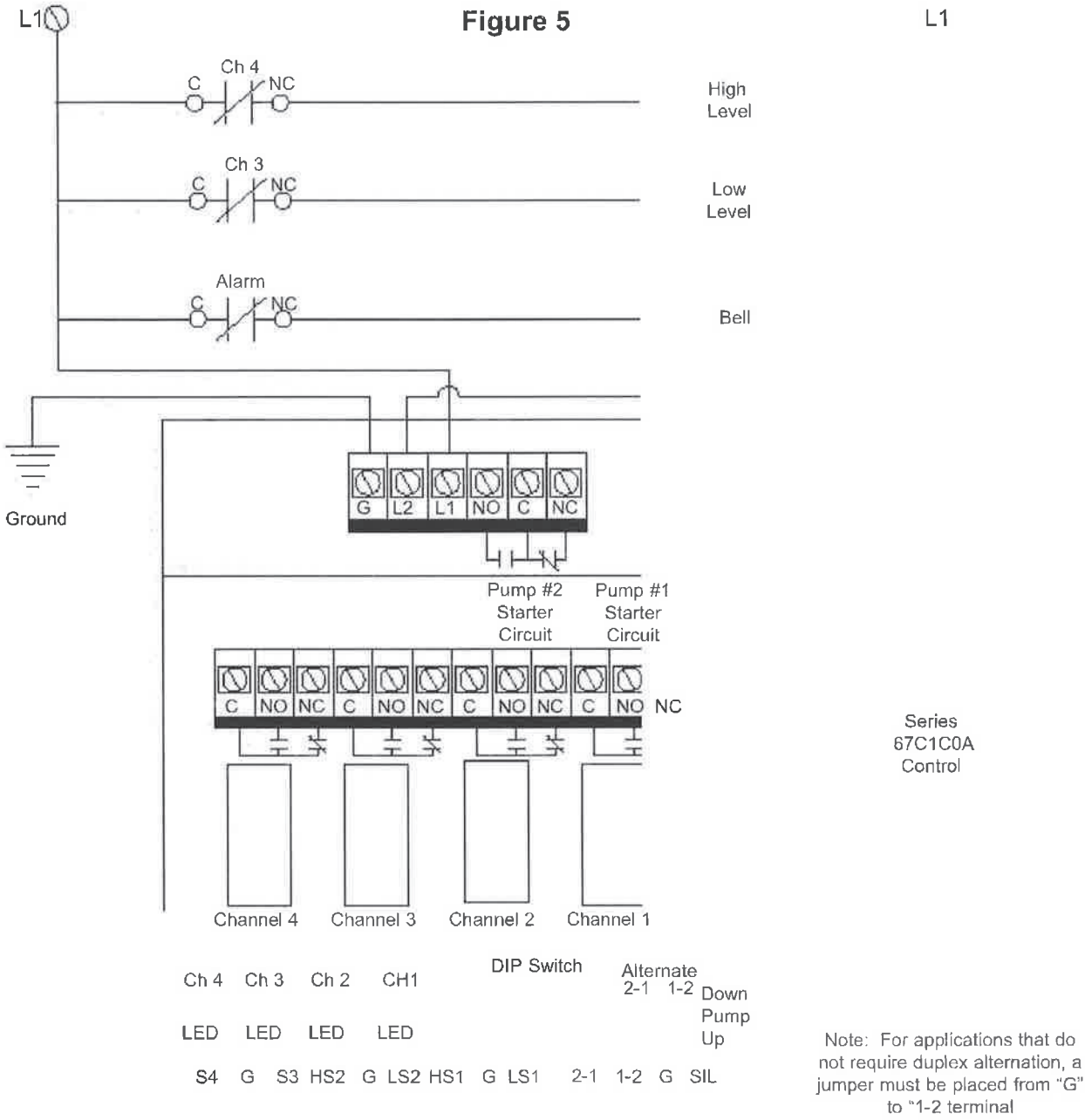
   To prevent electrical shock from supply line/load side powered connections, the Series 67 should be mounted in a metal enclosure of proper NEMA integrity.

3. **The maximum total length of all of the intrinsically safe wiring (of each conductor) shall not exceed an accumulative value of 16,000 feet, excluding any ground wiring.**

4. **The intrinsically safe terminals of the Series 67 can be connected to any non-energy generating or storing switch device such as a push button, a limit or float type switch or any of Warrick's electrode fitting assemblies.**

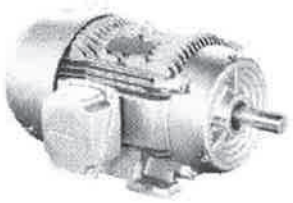
5. **When wiring alternation and bell silence switches, the switches and wiring must be separated from non-intrinsically safe circuits and wired in accordance with article 504 of the National Electric Code, publication ANSI/NFPA 70 or CEC, Part 1 as applicable.**

Sample Wiring Diagram



SIEMENS

NEMA Motor Data



Ordering data : **1LE2121-2BA21-4AA3**

Client order no. :
Order no. :
Offer no. :
Remarks :

Item no. :
Consignment no. :
Project :

Nameplate Data

Type	GP100A - NEMA Premium Efficiency		
HP	20.0	Rating	Cont.
Voltage	(14) 208-230/460V,	Ins. Class	Class F (Standard)
Amps	45.0 / 22.5 A	S.F.	1.15
FL RPM	3515	Amb. Temp.	40 deg C
FL Efficiency	91.0 %	Temp. Rise	Class B
FRAME	256T	kVA Code	G
DE AFBMA	45BC02JPP30	NEMA Des	B
ODE AFBMA	45BC02JPP30	Mtr WT	231.04
60 Hertz	3 Ph TEFC	IP	35

Typical Performance Data

Load	No Load	1/2	3/4	Full Load	LRC
Efficiency		92.1 %	91.6 %	91.0 %	
Power Factor		86.2	91.3	91.5	
Current (A)	5.2 A	11.8 A	16.8 A	45.0 / 22.5	145.0 A

Inverter Duty	VT	20:1	CT	4:1

Mounting and motor protection

Type of construction	(A) Foot mounted - End shield
Motor protection	(A) No winding protection
Terminal box design	(3) Mounting - F-1

Bearing Data

	DE	ODE
Bearing Size	6209 ZZ C3 S0	6209 ZZ C3 S0
Bearing Type	Ball Bearing	Ball Bearing
AFBMA	45BC02JPP30	45BC02JPP30

Mechanical Data

SAFE STALL TIME	HOT (s)	20	COLD (s)	45	
Rtr wt (lbs)	57.40	Rtr WK2	1.35		
FLT (lb-ft)	30.000	LRT	183	BDT	230

Ext Load Inertia (WK2) Capability 105.0 lb-ft²

Typical Noise Data

A-weighted Sound	Octave Band Center Frequencies Hertz (Hz)								
Pressure Level	125	250	500	1000	2000	4000	8000	SPL	83
at 3 feet	53	65	77	78	77	71	61	SPwrL	93

Wiring Connection Information

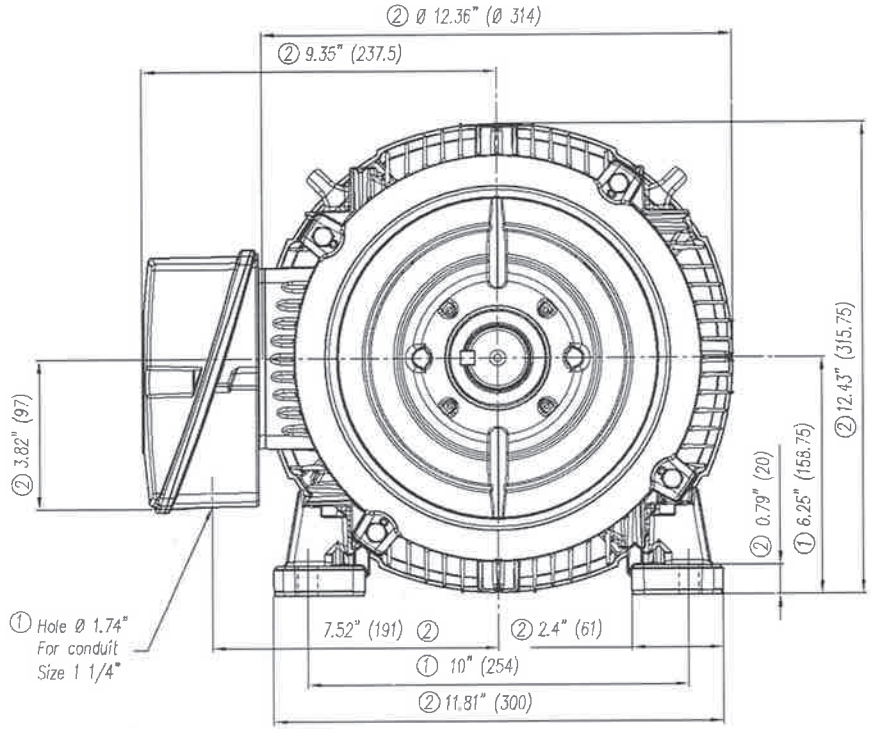
Description 3 PHASE - 9 LEAD - WYE

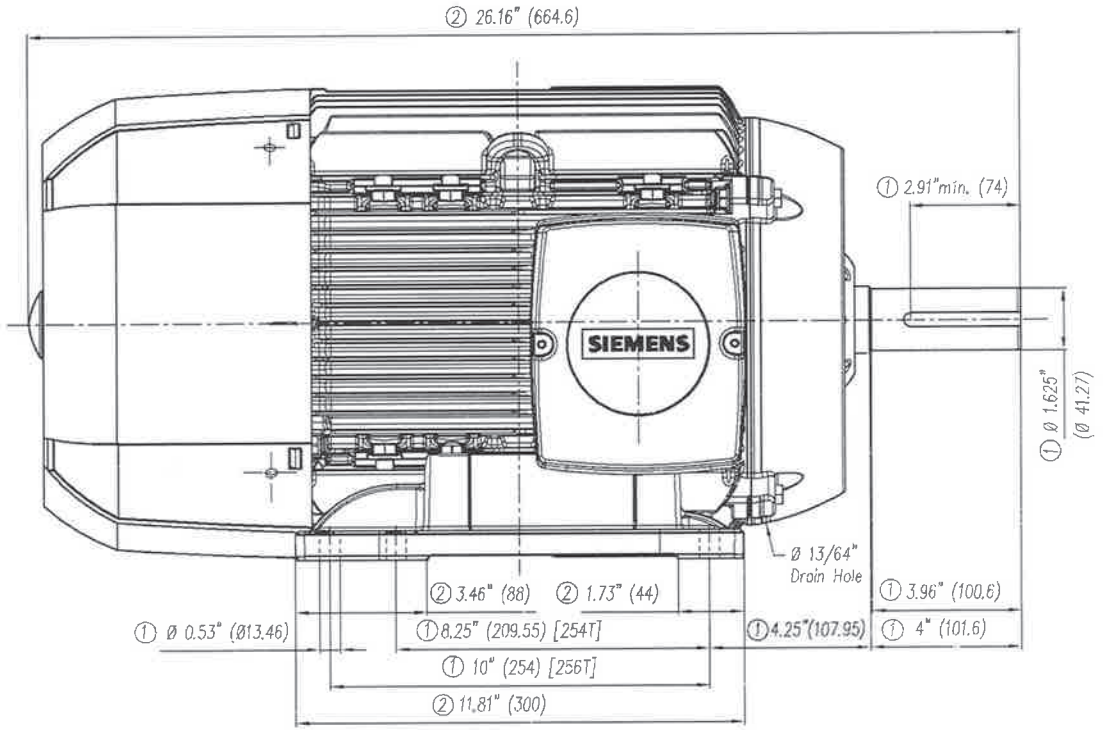
Voltage	L1	L2	L3	Connected together	
LOW	T1 T7	T2 T8	T3 T9	T4 T5 T6	Y Y
HIGH	T1	T2	T3	T4 T7-T5 T8-T6 T9	Y

Special design :

Lubrication Information

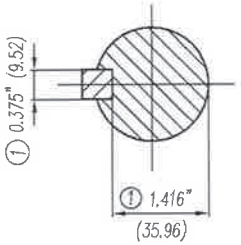
Manufacturer	Mobil Polyrex EM or equal
Type	Polyurea (standard)
DE Capacity (oz.)	0.50
ODEnd Capacity (oz.)	0.50





①Tolerances According to NEMA Std.

②All these dimensions corresponding to assemblies and castings shall have a tolerance as per DIN standard 1686-GTB 19.



Keyseat detail

CERTIFIED PRINT

CUSTOMER						
PO#		SO#				
HP	RPM	FRAME	TYPE	VOLTS	PH	HZ

② Tolerance in mm. according to DIN-1686-GTB-19

to 18	± 4.5
Over 18 to 30	± 4.7
Over 30 to 50	± 5
Over 50 to 80	± 5.5
Over 80 to 120	± 6
Over 120 to 180	± 6.5
Over 180 to 250	± 7
Over 250 to 315	± 7.5
Over 315 to 400	± 8
Over 400 to 500	± 8.5
Over 500 to 630	± 9.5
Over 630 to 800	± 10

Quantity 04 03 02 01

Remark

Parts and Measure | Drawing No. Norm No. | Item No. | Material | Weight Lbs.

European Projection | Modific.

Dimensions in inches

	Date	Name
Drawn	17/05/06	Fdo.Macias
Checked		
Std. Ckd.		

Dimension Drawing NEMA

NNM

Type: 1LE2 GP100A 254/256T FRAME 2,4 Y 6 Pol.

Scale W/O

SIEMENS
GUADALAJARA FACTORY

3MSE 223 0855

Ref 3MSE 223 0850 | Replace.

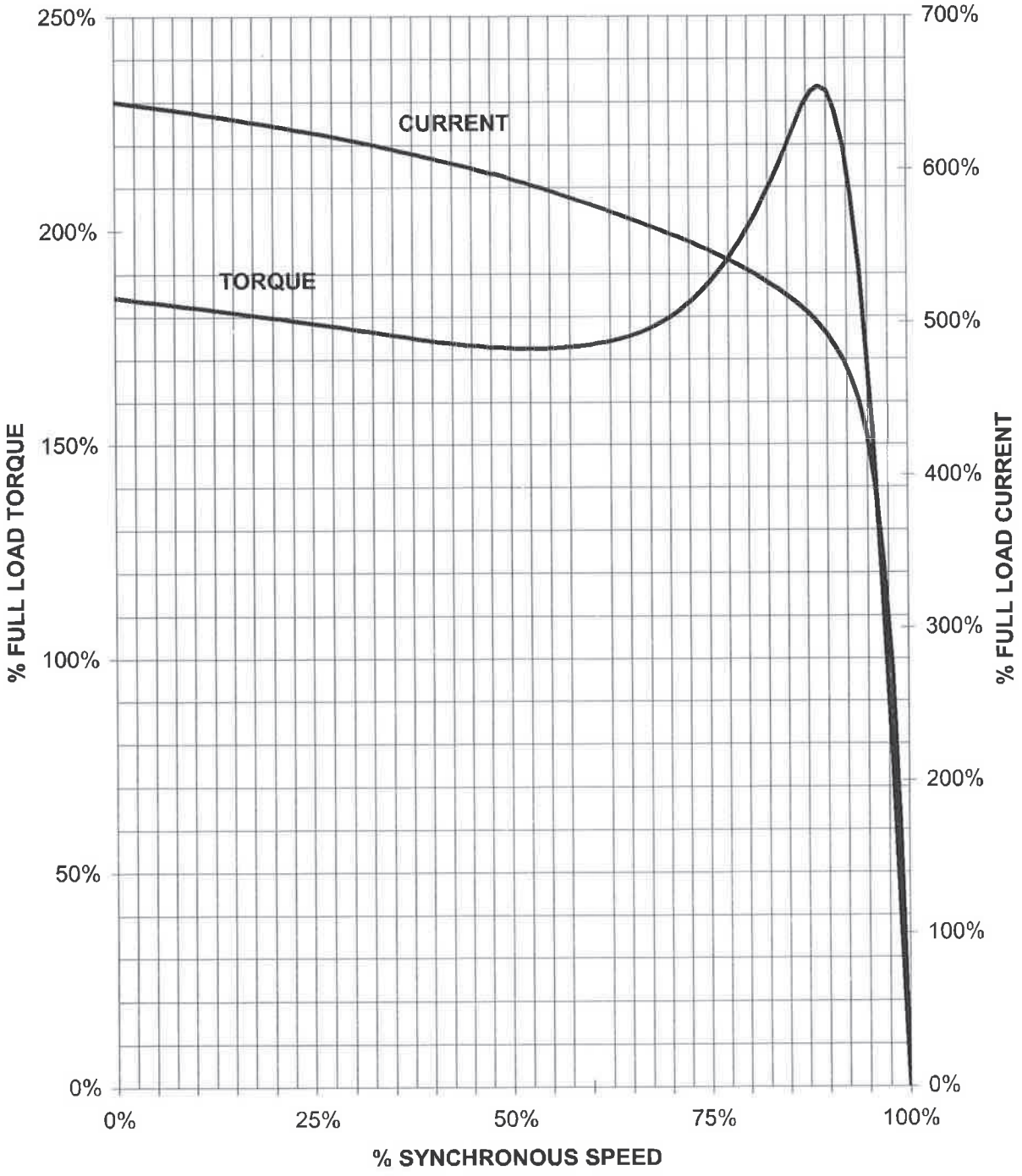
2/2

F-DW/1999

SIEMENS INDUSTRY, INC.

HP	20	VOLTS	< 600V	RPM	3600	TYPE	GP100A
HZ	60	PHASE	3	FRAME	256T	NEMA	B

TORQUE & CURRENT VS. SPEED

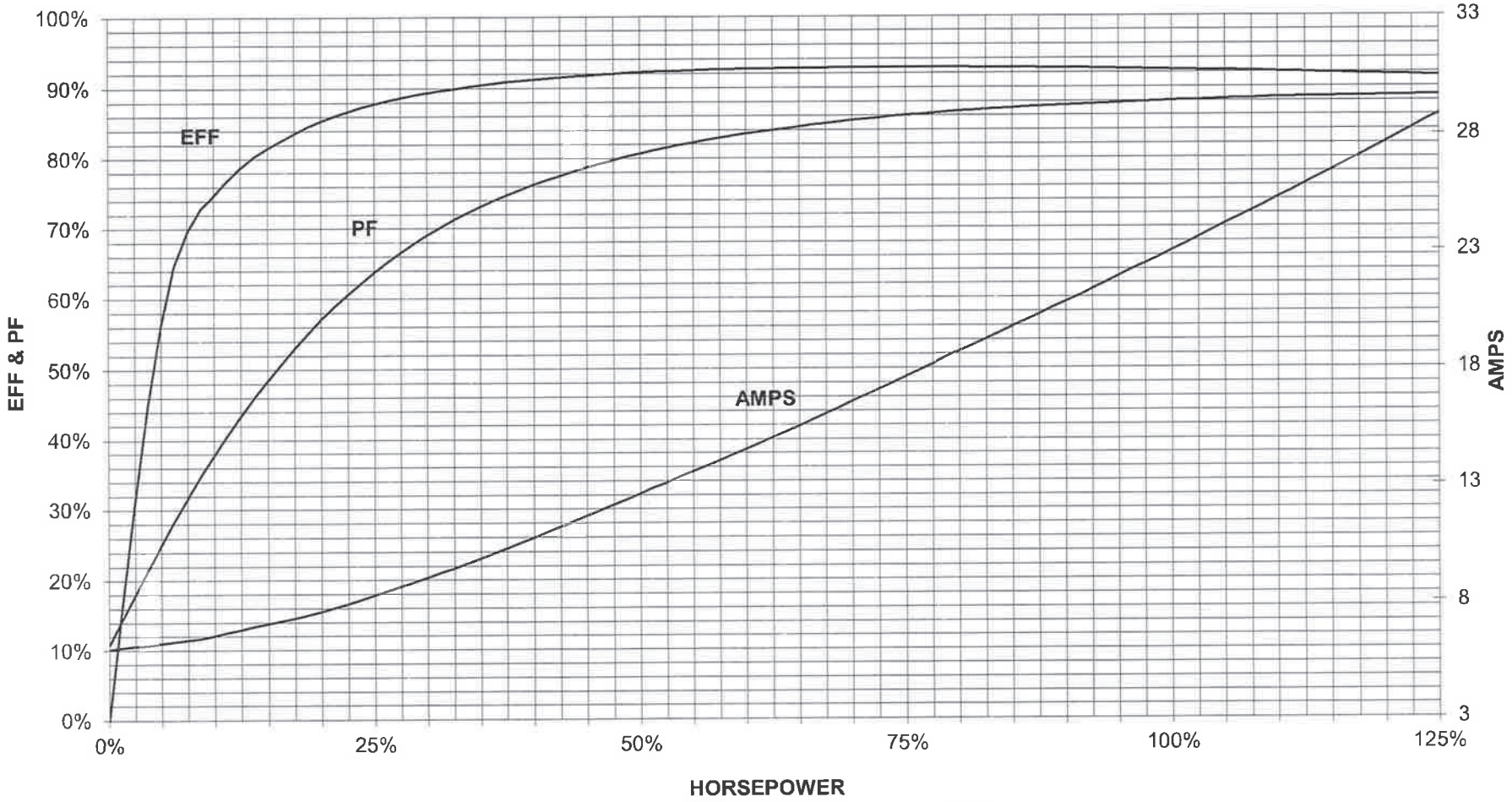


CUSTOMER: _____ ORDER#: _____

PERFORMANCE BASED ON DESIGN CALCULATIONS. SUBJECT TO CHANGE WITHOUT NOTICE.
REV. 1

20 HP 3600 RPM 256 FRAME 460 VOLTS 3 PHASE NEMA DESIGN B

SIEMENS INDUSTRY, INC.
PERFORMANCE CURVE
GP100A NP



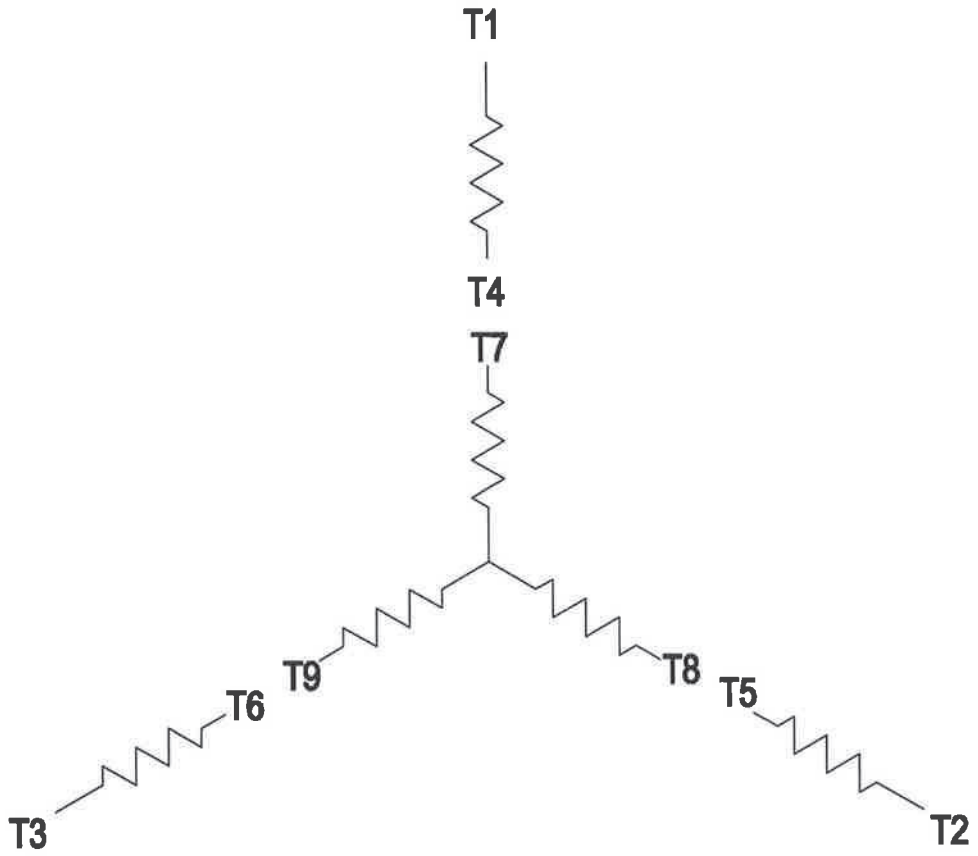
CUSTOMER_____ ORDER #_____ PO #_____

PERFORMANCE BASED ON DESIGN CALCULATIONS. SUBJECT TO CHANGE WITHOUT NOTICE.

REV. 1

3 PHASE - 9 LEADS - WYE

VOLTS	LINES			CONNECTED TOGETHER	CONN.
	L1	L2	L3		
LOW	T1 T7	T2 T8	T3 T9	T4 T5 T6	Y Y
HIGH	T1	T2	T3	T4 T7–T5 T8–T6 T9	Y



THIS IS A CAD DRAWING
DO NOT MAKE MANUAL CHANGES

01	09-27-07	TYPE	-CONFIDENTIAL- PROPERTY OF Siemens Energy & Automation, Inc. Industrial Motor Division – Little Rock, AR
		FRAME / HP	NAME: WIRING DIAGRAM
		VOLTS / RPM / HZ / PH: 3	Customer
		DRAWN 9.24.07 DATE JRH; CHECKED DATE; APP DATE	PO # / SO #
			SHEET 1 OF 1 / Sim. To / PART NO. 51-382-114-501 / A

MotorSaver®
THREE-PHASE ELECTRIC MOTOR PROTECTOR

INSTALLATION INSTRUCTIONS FOR SYMCOM'S MOTORSAVER®
MODEL 201A-AU

DANGER!

HAZARDOUS VOLTAGES MAY BE PRESENT DURING INSTALLATION.
Electrical shock can cause death or serious injury.
Installation should be done by qualified personnel following all national, state and local electrical codes.

BE SURE POWER IS DISCONNECTED PRIOR TO INSTALLATION!
FOLLOW NATIONAL, STATE AND LOCAL CODES.
READ THESE INSTRUCTIONS ENTIRELY BEFORE INSTALLATION.

! WARNING !

UNEXPECTED OUTPUT ACTUATION CAN OCCUR.
Use hard-wired safety interlocks where personnel and/or equipment hazards exist.
Failure to follow this instruction can result in death, injury or equipment damage.

The Model 201A-AU MotorSaver® is an auto-ranging voltage monitor designed to protect 3-phase motors regardless of size. The MotorSaver® is used on 190–480VAC, 50/60 Hz motors to protect from damage caused by single-phasing, low voltage, high voltage, phase reversal, and voltage unbalance.

CONNECTIONS

1. Mount the MotorSaver® in a convenient location in or near the motor control panel. If the location is wet or dusty, it should be mounted in a NEMA 4 or 12 enclosure. The MotorSaver® can be mounted to a back panel using two #6 or #8 x 5/8 screws or DIN rail mounted.
2. Connect L1, L2 and L3 (Pins 3, 4 & 5) to the LINE SIDE of the motor starter (Figures 1 & 2).
3. Connect the output relay to the circuitry to be controlled. For motor control, connect the normally open contact in series with the magnetic coil of the motor starter as shown in Figure 1. For alarm operation, connect the normally closed contact in series with the control circuit as in Figure 2.
4. If a normally open (NO) pushbutton (not included) is used with a Model 201A-AU-MR, connect it between pins 6 and 7 (see Figures 1 & 2).

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Motor Protection & Controls Since 1974
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(800) 843-8848 · (605) 348-5580
www.symcom.com

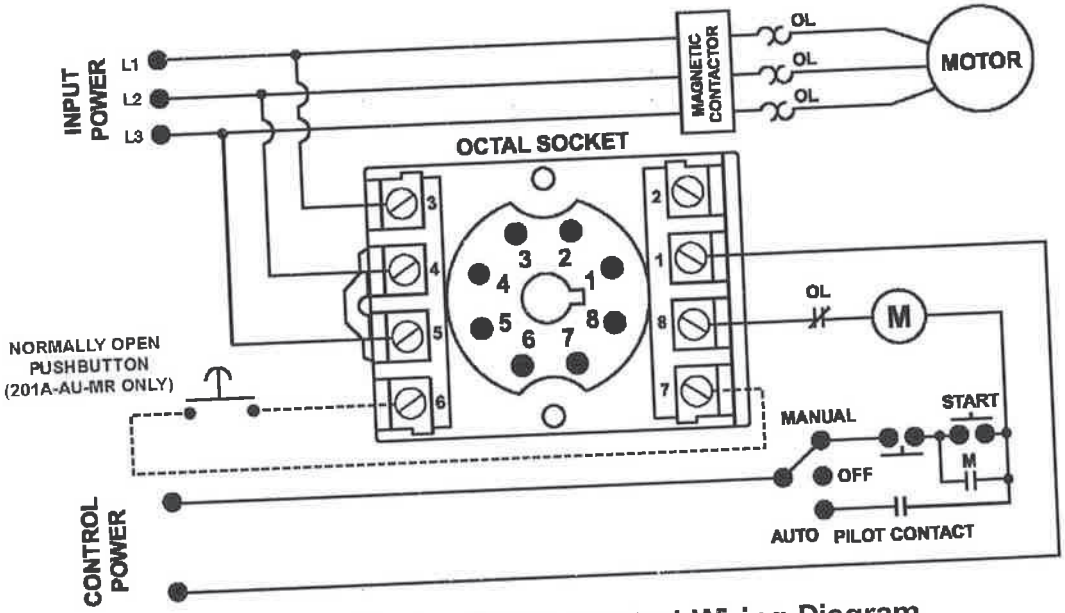


Figure 1. Typical Motor Control Wiring Diagram

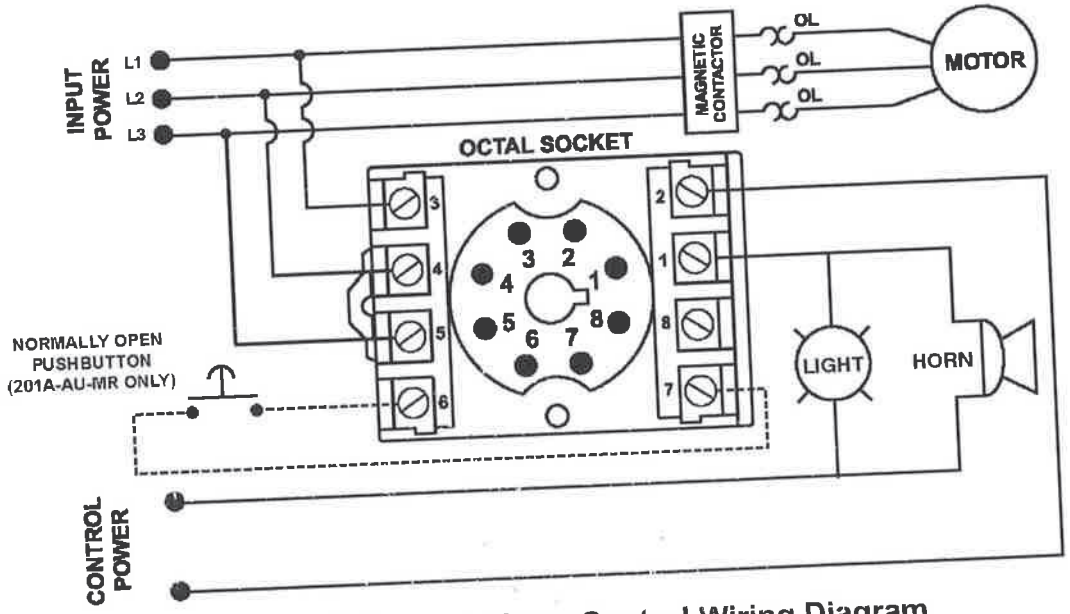
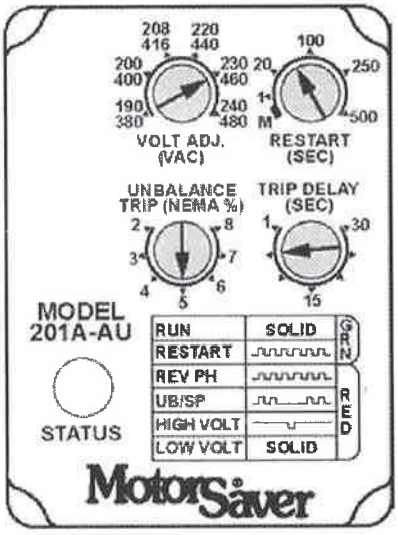


Figure 2. Typical Alarm Control Wiring Diagram

SETTINGS

1. **LINE VOLTAGE ADJUSTMENT:** Rotate the **VOLT ADJ. (VAC)** knob to the nominal 3-phase line voltage feeding the motor to be protected.

2. **RESTART DELAY ADJUSTMENT:** Rotate the **RESTART (SEC)** knob to the desired position. The restart delay is the time between the MotorSaver® measuring acceptable voltage and closing its output contacts. For compressor applications, the restart delay should be set for the approximate time it takes for the head pressure to bleed off of the compressor. For other applications, the restart delay is typically set between 10 and 20 seconds.



3. **TRIP DELAY ADJUSTMENT:** Rotate the **TRIP DELAY (SEC)** knob to the desired setting. This setting does not affect the trip delay on single-phasing faults. Typically, the trip delay is set between 1 and 5 seconds. In areas where voltage fluctuations are frequent, the trip delay may be set greater than 10 seconds.

4. **VOLTAGE UNBALANCE ADJUSTMENT:** Rotate the **UNBALANCE TRIP (NEMA%)** knob to the desired unbalance trip level. The NEMA MG1 standard does not recommend operating a motor above 1% voltage unbalance without derating the motor. The NEMA MG1 standard also recommends against operating a motor above a 5% voltage unbalance under any circumstances. SymCom recommends consulting the motor manufacturer for specific tolerances.

NEMA MG1 UNBALANCE FORMULA

$$\text{\% Voltage Unbalance} = \frac{\text{Maximum Deviation from the Average}}{\text{Average}} \times 100\%$$

Example: The measured line-to-line voltages are 203, 210, and 212.

$$\text{Average} = \frac{203 + 210 + 212}{3} = 208.3$$

The maximum deviation from the average is the largest difference between the average voltage (208.3) and any one voltage reading.

208.3 - 203 = 5.3 210 - 208.3 = 1.7 212 - 208.3 = 3.7

The maximum deviation from the average is 5.3.

$$\frac{5.3}{208.3} \times 100 = 2.5\% \text{ unbalance}$$

OPERATION

Automatic Reset Mode: Set the RESTART (SEC) knob to the desired restart delay time. Apply 3-phase power to the motor. The MotorSaver's green RUN light will blink during the restart delay. Once the restart delay time has expired, the MotorSaver® will energize its output contacts and the green RUN light will illuminate.

Manual Reset Mode: Set the RESTART (SEC) knob to **M** to operate in manual reset mode. When the MotorSaver® trips on a fault, the red STATUS light will display the fault code until the condition clears and the unit is reset. If power is lost before the MotorSaver® is reset, the fault code will again be displayed once power is reapplied. This allows for identification of the last fault even after power conditions have returned to normal.

NOTE: If no voltage faults are present, but a light pattern other than solid green or blinking green is displayed (in manual reset mode), the MotorSaver® is displaying the last fault detected. The fault code will continue to be displayed until the unit is manually reset.

DIAGNOSTIC INDICATOR LIGHTS	
RUN	**GREEN**
RESTART DELAY (Automatic Reset Mode)	 **GREEN**
MANUAL RESET REQUIRED (Manual Reset Mode)	 **GREEN**
REVERSE PHASE	 **RED**
UNBALANCE / SINGLE PHASE	 **RED**
HIGH VOLTAGE	 **RED**
LOW VOLTAGE	**RED**

MODEL 201A-AU-MR OPERATION

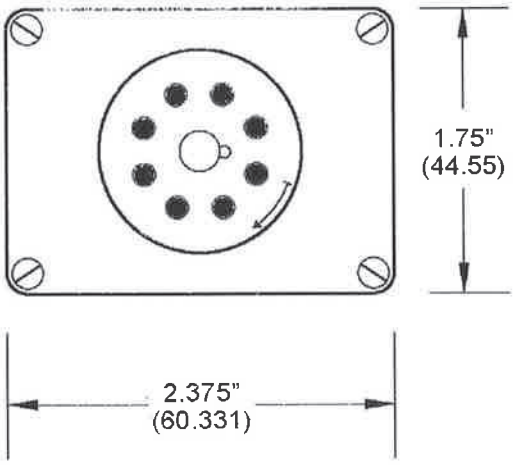
The Model 201A-AU-MR operates the same as the Model 201A-AU but offers an external manual reset option. The RESTART (SEC) knob must be set to **M** to operate in manual reset mode. The MotorSaver® can be reset by turning the restart delay knob out of the manual position **or** by pressing a normally open (NO) pushbutton connected between terminals 6 and 7 (see Figures 1 and 2).

TROUBLESHOOTING

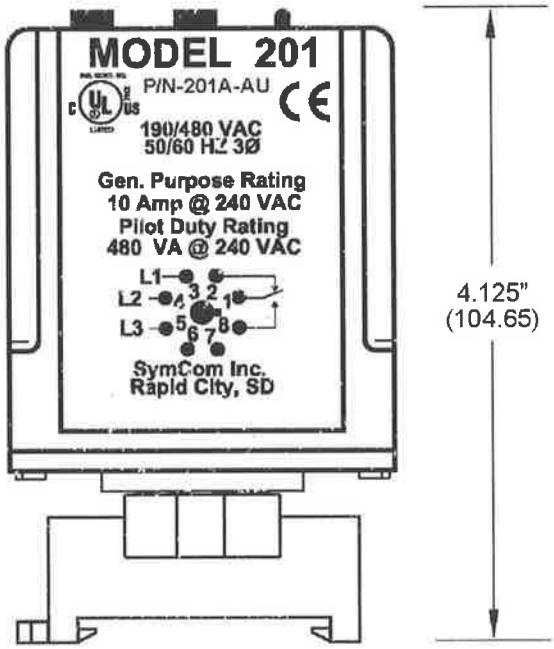
SYMPTOM	LIGHT PATTERN	SOLUTION
No lights are on - the unit seems completely dead	**N/A**	Measure the three line-to-line voltages. If any of the voltages are below 150VAC, the MotorSaver® does not have enough power to operate its internal electronics. If the voltages are correct, call SymCom at (800) 843-8848 or (605) 348-5580.
Red light is blinking (on initial power-up)	 **RED**	Turn off the 3-phase power. Swap any two leads powering the MotorSaver® (L1, L2, or L3) There is a 50-50 chance of connecting L1, L2 and L3 correctly the first time. Reapply 3-phase power.
Red light is blinking (after the motor has previously been running)	 **RED**	The incoming lines have been reverse-phased. The MotorSaver® is preventing the motor from running backwards. Correct the phase sequence.
Red light is blinking in this pattern	 **RED**	The voltage is unbalanced or single-phased. Measure the incoming line voltages and calculate the % unbalance. If the voltage unbalance does not exceed the % unbalance reset value, call SymCom at (800) 843-8848 or (605) 348-5580.
Red light is blinking in this pattern	 **RED**	The voltage is high. Measure the three line-to-line voltages. Calculate the average according to the NEMA unbalance formula (page 3). If the average is 7% above the nominal voltage as selected by the LINE VOLTAGE ADJUST, the MotorSaver® is functioning properly. If the voltage is within 7%, call SymCom at (800) 843-8848 or (605) 348-5580.
Red light is on steady	**RED**	The voltage is low. Measure the three line-to-line voltages. Calculate the average according to the NEMA unbalance formula (page 3). If the average is 7% below the nominal voltage as selected by the LINE VOLTAGE ADJUST, the MotorSaver® is functioning properly. If the voltage is within 7%, call SymCom at (800) 843-8848 or (605) 348-5580.
Green light blinks and motor is not running	 **GREEN**	The MotorSaver® is timing through the restart delay and will energize its contacts when finished or the MotorSaver® is in manual reset mode and requires a manual reset to energize its contacts and start the motor.
Green light is on steady, but motor does not start	**GREEN**	The MotorSaver® is in run mode. Ensure other control devices are allowing the motor to start. Check control circuit for loose wires or malfunctioning switches.

MOTORSAVER® 201A-AU SPECIFICATIONS	
3-Phase Line Voltage	190–480VAC
Frequency	50/60Hz
Low Voltage (% of setpoint)	
Trip	90% ±1%
Reset	93% ±1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Voltage Unbalance (NEMA)	
Trip	2–8% adjustable
Reset	Trip setting minus 1% (5–8% settings) Trip setting minus 0.5% (2–4% settings)
Trip Delay Time	
Low, High and unbalanced voltage	1–30 seconds adjustable
Single-phasing faults (>15% UB)	1 second fixed
Restart Delay Time	
After a fault	Manual, 1–500 seconds adjustable
After a complete power loss	Manual, 1–500 seconds adjustable
Output Contact Rating – SPDT	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC
Power Consumption	5 Watts
Weight	9 oz.
Enclosure	Polycarbonate
Safety Marks	
UL Listed (OT08 octal socket required)	UL508 (File #E68520)
CE	IEC 60947-6-2
Standards Passed	
Electrostatic Discharge (ESD)	IEC 100-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	159 MHz, 10V/m
Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5kV input power and controls
Surge	
IEC	IEC 1000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-Potential Test	Meets UL508 (2 x rated V +1000 V for 1 minute)
Environmental	
Temperature Range	Ambient Operating: -40° to 70°C (-40° to 158°F)
Class of Protection	IP20, NEMA 1 (Finger Safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

DIMENSIONS



BOTTOM



SIDE
WITH OT08* SOCKET

*The OT08 octal socket is 35mm DIN rail compatible. The use of OT08 octal sockets is required for Model 201A-AU and 201A-AU-MR to qualify as UL Listed devices.

Did you know SymCom engineers and manufactures custom control boards? Call for details!

Visit our website at www.symcom.com for our complete catalog and product listings!

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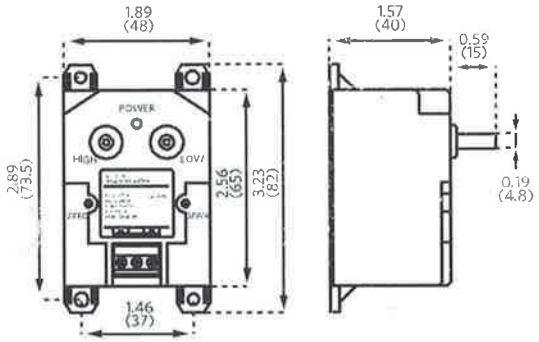
SERIES 211 Differential Pressure Transmitter

- **Compact Design**
- **0.25% Accuracy**
- **LED Power Indication**
- **4 - 20 mA or 0 - 10 V output**

The Series 211 Differential Pressure Transmitter can accurately measure positive, negative, or differential pressure and send the corresponding 4 - 20 mA output signal. The Series 211 Differential Pressure Transmitter is not position sensitive and can be mounted in any orientation without compromising accuracy. It also features a power LED, so you always know when the transmitter is operating. The compact, lightweight design makes installation simple and easy.

DIMENSIONS



SPECIFICATIONS

Maximum Pressure:
Ranges ≤ 5 PSI (35 kPa) = 15 PSI (100 kPa) Max
Ranges > 5 PSI (35 kPa) = 30 PSI (200 kPa) Max

Media Compatibility: Air and compatible non-combustible, non-corrosive gasses

Accuracy: Ranges ≤ 4" w.c. (1 kPa) 1.0% Ranges ≥ 5" w.c. (1.25 kPa) 0.25%

Temperature Ranges:
Compensated: 15° to 120°F (-10° to 50°C)
Operating: -10° to 155°F (-25° to 70°C)

Thermal Effect: +/- 0.028% FS/°F (+/- 0.050%/°C)

Stability: +/- 0.25% FS/year

Output Signal: 4-20 mA, 2 wire or 0-10V

Loop Resistance: 250 Ω @ 24 VDC

Power Supply: 12-30 VDC

Housing Material: ABS Plastic

Electrical Connections: screw terminals

Process Connection: Push on connection for 3/16" I.D. tubing

Agency Approvals: CE

MODEL NUMBERS

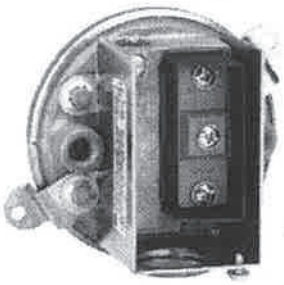
Model	Pressure Range	Accuracy
211-D001I-1	0 - 1"	1%
211-D002I-1	0 - 2"	1%
211-D004I-1	0 - 4"	1%
211-D006I-3	0 - 6"	0.25%
211-D010I-3	0 - 10"	0.25%
211-D020I-3	0 - 20"	0.25%
211-D040I-3	0 - 40"	0.25%
211-D005P-3	0 - 5 PSI	0.25%
211-D010P-3	0 - 10 PSI	0.25%
211-D015P-3	0 - 15 PSI	0.25%
211-D250A-1	0 - 250 Pa	1%
211-D500A-1	0 - 500 Pa	1%
211-D001K-1	0 - 1 kPa	1%
211-D002K-3	0 - 2 kPa	0.25%
211-D003K-3	0 - 3 kPa	0.25%
211-D005K-3	0 - 5 kPa	0.25%
211-D010K-3	0 - 10 kPa	0.25%
211-D025K-3	0 - 25 kPa	0.25%
211-D050K-3	0 - 50 kPa	0.25%
211-D100K-3	0 - 100 kPa	0.25%

For 0 - 10V output, add **-V** to the end of the part number.
Consult factory for other calibration ranges including zero center ranges.

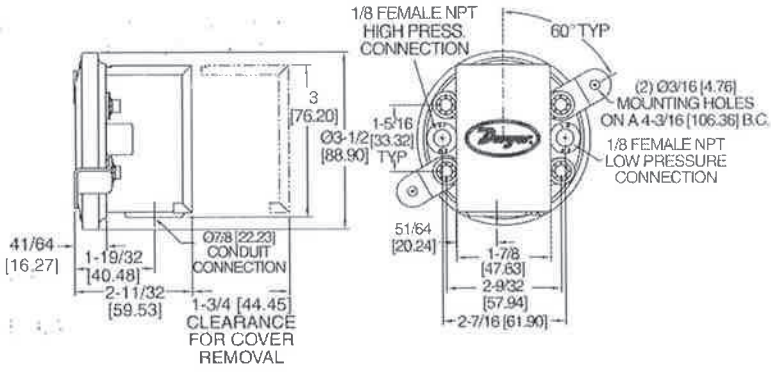
Series 1900 Pressure Switch

Specifications - Installation and Operating Instructions

Series 1910 pressure switch. All pressure and electrical connections and set point adjustments are on one side for easy installation.



Series 1910 switch with conduit enclosure off. Shows electric switch and set point adjustment screw.



The Dwyer-engineered force-motion amplifier increases the leverage of diaphragm movement and results in a switch with excellent sensitivity and repeatability.

Advanced design and precision construction permit these switches to perform many of the tasks of larger, costlier units. Designed for air conditioning service, they also serve many fluidics, refrigeration, oven and dryer applications. For use with air and non-combustible gases. Series 1900 switches are available with set points of 0.07 to 20 inches water column. Set point adjustment can be made easily - before or after installation. Range screw is inside conduit enclosure to help prevent tampering. For easy mounting and access, pressure and electrical connections and set point adjustment are located on one side. This permits installation in corners or spaces too small for other switches.

SPECIAL MODELS & ACCESSORIES

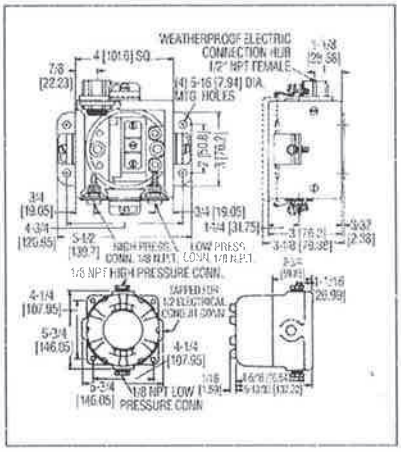
Special close coupled street elbow for right angle pressure connections. Can be installed on switch anytime. Zinc plated aluminum.

Weatherproof Housing

16 ga. steel enclosure with gasketed cover (NEMA 4) for wet or oily conditions. Withstands 200 hour salt spray test. Wt. 5 lbs. (2.3 kg). Switch must be factory installed. Change 1910 base number to 1911 and add -WP suffix. Example: 1911-1-WP.

Explosion-Proof Housing

Cast iron base with brass cover. Rated Class I, Div. 1 & 2, Groups D; Class II, Div. 1 & 2, Groups E,F,G; Class III and NEMA 7, 9 NEMA 3, (7 lbs). Switch must be factory installed. Change model to 1911 and add -EXPL suffix. Example: 1911-1-EXPL.



SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -30 to 180°F (-34 to 82.2°C) (32°F for non dry air).
Pressure Limits: 45" w.c. (11.2 kPa) continuous, 10 psig (68.95 kPa) surge.
Switch Type: Single-pole double-throw (SPDT).
Repeatability: ±3%.
Electrical Rating: 15 A @ 120-480 VAC, 60 Hz. Resistive 1/8 HP @125 VAC, 1/4 HP @ 250 VAC, 60 Hz. Derate to 10 A for operation at high cycle rates.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8" female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type inside conduit enclosure.
Weight: 1lb. 4.5 oz. (581 g).
Agency Approvals: CE, UL, CSA, FM.

SERIES 1910 SWITCHES — MODELS OPERATING RANGES, DEADBANDS

Model Number	Operating Range, Inches W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1910-00	0.07 to 0.15	0.04	0.04
1910-0	0.15 to 0.55	0.10	0.10
1910-1	0.40 to 1.6	0.15	0.16
1910-5	1.40 to 5.5	0.30	0.30
1910-10	3.0 to 11.75	0.40	0.40
1910-20	4.0 to 20.0	0.40	0.50

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e-mail: info@dwyer-inst.com

INSTALLATION

1. Select a location that is free from excessive vibration, corrosive atmosphere and where the ambient temperature is within the limits for these switches.

2. Mount standard switches with the diaphragm in a vertical plane and with switch lettering and Dwyer nameplate in an upright position. Some switches are position sensitive and may not reset properly unless they are mounted with the diaphragm vertical. (Special units can be furnished for other than vertical mounting arrangements if required.)

3. Connect switch to source of pressure, vacuum or differential pressure. Metal tubing with 1/4" O.D. is recommended, but any tubing which will not restrict the air flow can be used. Connect to the two 1/8" female NPT pressure ports as noted below:

   - Differential pressures - connect pipes or tubes from source of greater pressure to high pressure port marked HI-PR and from source of lower pressure to low pressure port marked LO-PR.
   - Pressure only (above atmospheric) - connect tube from source of pressure to high pressure port. The low pressure port is left open to atmosphere.
   - Vacuum only (below atmospheric pressure) - connect tube from source of vacuum to low pressure port. The high pressure port is left open to atmosphere.

4. Electrical connections to the standard single pole, double throw snap switch are provided by means of screw terminals marked "common", "norm open", and "norm closed". The normally open contacts close and the normally closed contacts open when pressure increases beyond the set point.

5. Switch loads should not exceed the maximum specified current rating of 15 amps resistive. Switch capabilities decrease with high load inductance or rapid cycle rates. Whenever an application involves either of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonging switch life.

OPERATION

Pressure acting on the power diaphragm rotates the amplifying lever, which in turn extends the range spring and rotates the snap switch input lever. When the set point is reached, the snap switch is actuated and the electrical contacts make or break.

ADJUSTMENT

To change the set point, proceed as follows:

A. Remove the snap-on cover from the conduit enclosure by loosening its retaining screw and pulling firmly at its bottom end. Turn the slotted adjustment screw at the top of range spring housing clockwise to raise the set point pressure and counter-clockwise to lower the set point.

B. The recommended procedure for calibrating or checking calibration is to use a "T" assembly with three rubber tubing leads. all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to the manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point very slowly. Note that manometer and pressure switch will have different response times due to different internal volumes, lengths of tubing, fluid drainage etc. Be certain the switch is checked in the position it will assume in use, i.e. with diaphragm in a vertical plane and switch lettering and Dwyer nameplate in an upright position.

C. For highly critical applications it is a good idea to check the set point adjustment and reset it as necessary once or twice in the first few months of operation. This will compensate for any change in initial tension which may occur in the spring and diaphragm. For most applications this change will not be significant and no resetting will be required.

MAINTENANCE

Moving parts of these switches are sealed in and are permanently tamper proof. The single adjustment is that of the set point. Care should be taken to keep the switch reasonably dry and free from dust or dirt. No lubrication or unusual precautions are required for normal use.

INSTALLATION INSTRUCTIONS FOR SYMCOM'S MODEL 77C-KW/HP ELECTRONIC OVERLOAD RELAY

BE SURE POWER IS DISCONNECTED PRIOR TO INSTALLATION!! FOLLOW NATIONAL, STATE AND LOCAL CODES! READ THESE INSTRUCTIONS ENTIRELY BEFORE INSTALLATION.

DANGER!

HAZARDOUS VOLTAGES MAY BE PRESENT DURING INSTALLATION.
Electrical shock can cause death or serious injury.
Installation should be done by qualified personnel following all national, state and local electrical codes.

CONNECTIONS

1. Using the four corner tabs OR the DIN rail mounting bracket, mount the Model 77C-KW/HP directly above or below the magnetic contactor. To use the DIN rail bracket, hook the top clip first, then apply downward pressure until the lower clip "clicks" onto the rail, then stop applying downward pressure.

2. Insert the motor conductors through the round holes marked "A" and "B." Terminate the conductors at the line or load side of the magnetic contactor. **Note: For motors with full load amps less than 25 Amps,** loop the conductors through the holes marked "A" and "B" according to Table No. 1 below. The rectangular holes behind the holes marked "A" and "B" are provided for wire looping. (see Figure No. 1).

3. **For motors with full load current above 90 A**, an external Current Transformer must be used (see Figure No. 2). SymCom recommends that the external CT have terminals for installation convenience. When using an external CT, five passes must be made through the holes in the Model 77C-KW/HP.

4. Connect the single-phase power from the line side of the contactor to "L1" and "L2." First insert a #12 - #18 AWG copper wire into the top of the terminal marked "L1" and tighten the screw on the front of the overload relay. Then, connect the other end of the wire to the line side of the contactor. Repeat these two steps for "L2." (see Figure No. 1).

5. Connect the output relay to the circuitry to be controlled (see Figure No. 1). To control a motor, connect the normally open contact in series with the magnetic coil of the motor starter as shown. To sound an alarm, connect the normally closed contact in series with the alarm (not shown).

PROGRAMMING

1. Select the feature to program by rotating the "MODE SELECT" switch to the desired position. The "MULT" setting must be programmed before any of the current settings to ensure proper display of actual current setpoints. Therefore, SymCom recommends programming the "LV" setting first, then move clockwise through the positions to complete the process.

2. Push and hold the "RESET / PROGRAM" button.

3. Rotate the "DISPLAY / PROGRAM" adjustment to the desired setting of the feature as shown in the LED display.

4. Release the "RESET/PROGRAM" button. The Model 77C-KW/HP is programmed when the button is released.

5. Continue steps 1-4 until all features are programmed.

SymCom Inc
Motor Protection & Controls Since 1978
2880 North Plaza Drive, Rapid City, SD 57702 • (800) 843-8848

Full Load Amps	# of Loops (Required on B phase only)	# of Conductors through B	MULT to Program (CT ratio)
2.0 - 2.5	9	10	10
2.6 - 3.0	8	9	9
3.1 - 3.5	7	8	8
3.6 - 4.0	6	7	7
4.1 - 5.0	5	6	6
5.1 - 6.0	4	5	5
6.1 - 8.0	3	4	4
8.1 - 12	2	3	3
13 - 25	1	2	2
26 - 90	0	1	1
EXTERNAL CTs REQUIRED. SEE WIRING DIAGRAM FOR EXTERNAL CTs.			
91 - 110	4	5	100 (100:5)
111 - 160	4	5	150 (150:5)
161 - 220	4	5	200 (200:5)
221 - 320	4	5	300 (300:5)
321 - 420	4	5	400 (400:5)
421 - 520	4	5	500 (500:5)
521 - 620	4	5	600 (600:5)
621 - 800	4	5	800 (800:5)

Table 1: Wiring configuration based on motor amps.

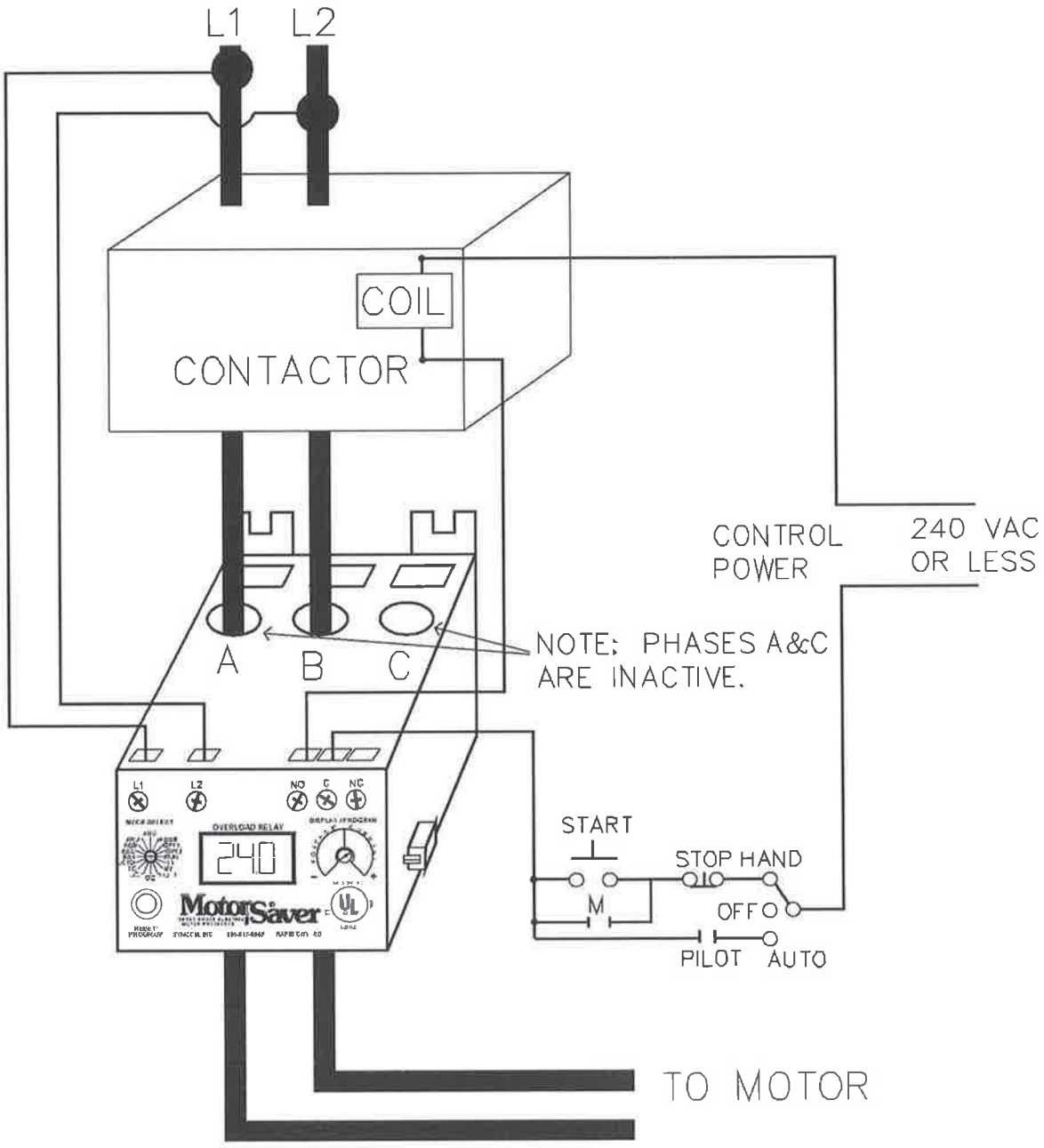


Figure No. 1: Typical Wiring Diagram

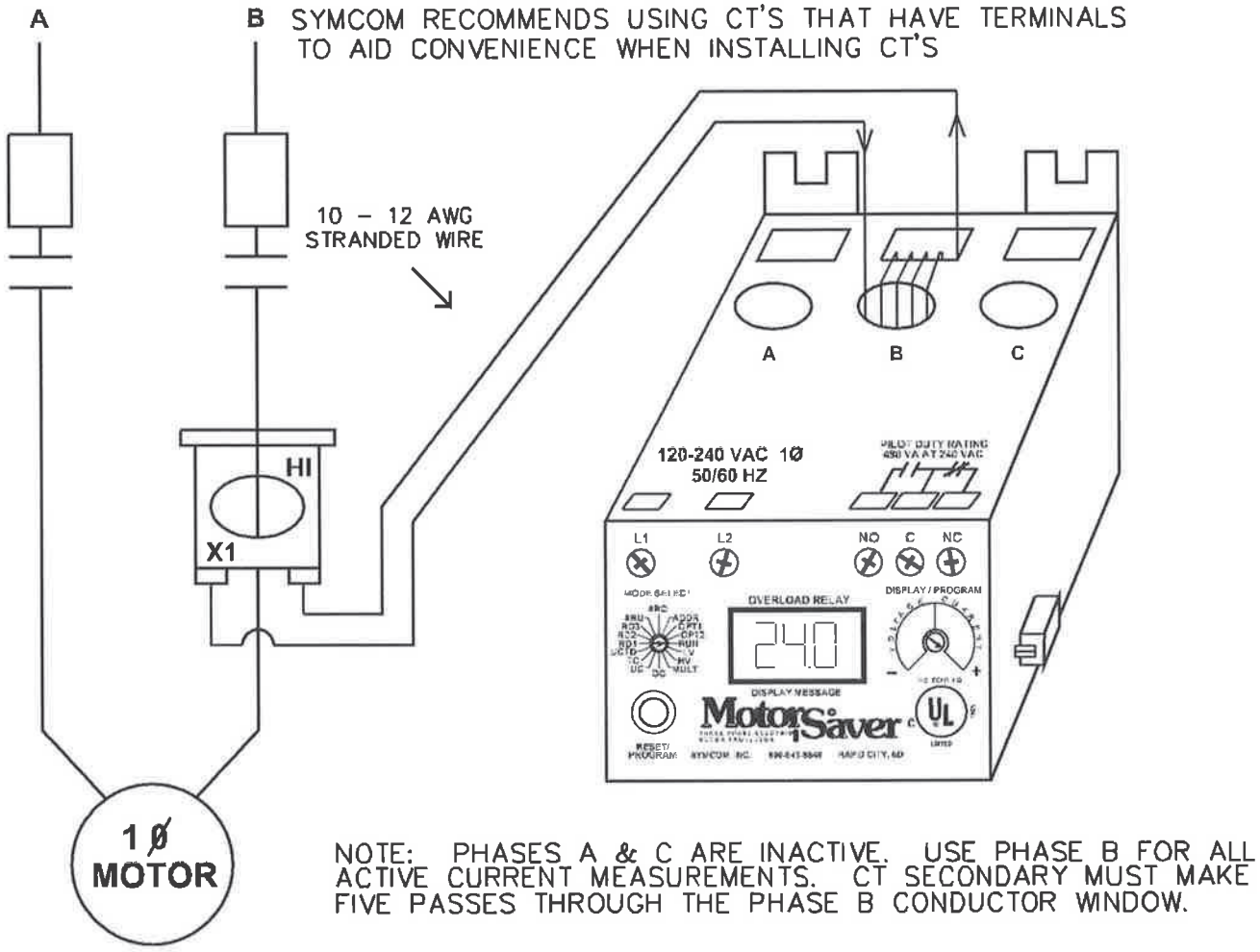
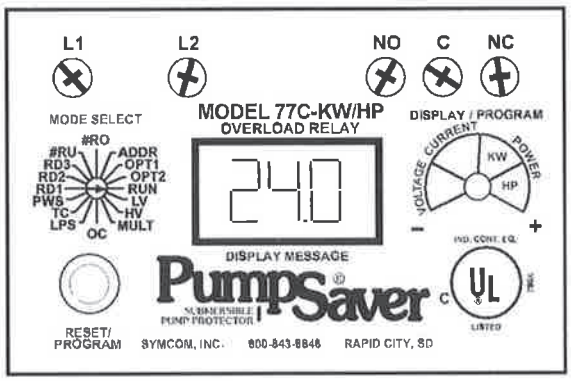


Figure No. 2: Typical wiring diagram when CT is used.

SUGGESTED SETTINGS (Consult the Motor Manufacturer for their recommendations.)
[Don't forget to read the programming examples on page 5.]

LV/HV- The recommended settings for **"LV"** (low voltage) and **"HV"** (high voltage) depend on many factors such as motor usage, motor size, environmental factors and tolerance of the motor. The motor manufacturer should be consulted for "HV" and "LV" settings. However, the NEMA MG1 standard recommends that "LV" and "HV" be set to no more than ±10% of the motor's nameplate voltage. The setting can be determined by multiplying the motor's nameplate voltage by the recommended percent over and under voltage. (eg., The motor nameplate voltage is 230 V, set "LV" to 0.9x230=207, set "HV" to 1.10x230=253) "LV" can not be set higher than "HV", so "HV" may have to be adjusted higher before the proper "LV" setting can be programmed.



MULT- "MULT" is the multiplication factor for determining true current settings and represents the number of conductors passing through the main current windows marked "A" and "B," or current transformer ratio of external CTs. The appropriate number can be determined from Table No. 1 on page 1. "MULT" must be correctly programmed in order to accurately program the current settings.

OC- **Represents the motor's maximum service factor amperage.** The "OC" (overcurrent) setting depends on many factors such as motor usage, motor size, environmental factors and tolerance of the motor. The motor manufacturer should be consulted for "OC" settings. However, "OC" is typically between 110% and 125% of full load amperage (FLA).

LPS- LP (low power setting) is used to shut down the motor or pump on an underload condition. Setting LP to 0 disables the underload trip feature. LP is set in either kilowatts (KW) or horsepower (HP) depending on the PWS setting. NOTE: PWS must be set before setting LPS

TC- "TC" designates the trip class for overload protection. The trip class defines the trip delay when an overload is detected (see Table No. 2). Trip class is determined by the type of motor and application. Your motor manufacturer should be consulted for the proper setting. The following table shows the trip class and a general description of the applications.

RD1- "RD1" is the rapid cycle timer. It will engage when the motor is first powered-up or after the motor controls shut down the motor. An "RD1" setting of 20-30 seconds will generally protect the motor from rapid, successive power outages or short cycling caused by the motor controls. A setting of 0 seconds will allow the motor to start immediately after power-up or after a normal shutdown.

RD2- "RD2" is the restart delay after the overload relay trips on overload. This delay allows the motor to cool down after experiencing an overcurrent. It is also known as a motor cool down timer. Your motor manufacturer should be contacted to determine this setting. Under normal circumstances, a setting of 5-10 minutes will give the motor enough time to cool down between faults.

RD3- "RD3" is the restart delay after an undercurrent. It is also known as a dry well recovery timer and is usually used in submersible pumping applications. The setting of "RD3" depends on the recovery time of the water well and varies widely from application to application.

#RU- "#RU" is the number of successive restart attempts allowed after an undercurrent fault before the overload relay requires manual reset. A setting of "0" is manual reset and a setting of "A" is continuously automatic reset.

ADDR- "ADDR" is the address setting for RS485 communications. Available settings are from A01 - A99.You may ignore this setting if RS485 communications are not used.

#RO- "#RO" is the number of successive restart attempts allowed after an overcurrent fault. The following settings are available: 0, 1, 2, 3, 4 and A. A setting of "0" is manual reset and a setting of "A" is continuously automatic.

PWS - PWS (power scale) is the range setting for the LP setting.
1=0.01 - 0.99 KW; 2=1.00 - 9.95 KW; 3=10.0 - 99.5 KW; 4=100 - 650 KW
5=0.01 - 1.30 HP; 6=1.34 - 13.3 HP; 7=13.4 - 133.0 HP; 8=134 - 871 HP
Settings 1-4 will allow the LP setting to display in KW.
Settings 5-8 will allow the LP setting to display in HP.

OPT1- Linear overcurrent trip delay (2-60 seconds). This programming position is used only if the TC position is set to LIn. This setting will determine the period of time that will expire before tripping on overcurrent, after the amperage exceeds the OC setting. (See Programming Example #2).

OPT2- RD2 & RD3 time units programming. This position sets the time units used by the RD2 and RD3 timers. (e.g., RD2 = 10, RD3 = 20, OPT2 = 2 from the table below; RD2 = 10 seconds and RD3 = 20 minutes.)

SETTING	RD2	RD3
0	Minutes	Minutes
1	Minutes	Seconds
2	Seconds	Minutes
3	Seconds	Seconds

Trip Class	Application Description
5	Small fractional horsepower motors where acceleration times are almost instantaneous or where extremely quick trip times are required.
10	(Fast Trip) Hermetic refrigerant motors, compressors, submersible pumps and general purpose motors that reach rated speed in less than 4 seconds.
15	Specialized applications.
20	(Standard Trip) Most NEMA-rated general purpose motors will be protected by this setting.
30	(Slow Trip) Motors with long acceleration times (>10 seconds) or high inertia loads.
J Prefix	Programming any of the trip classes with the J Prefix will enable jam protection. This additional protection is enabled 1 minute after the motor starts and provides a 2 second trip time for motors exceeding 400% of the "OC" setting, regardless of trip class.
LIn	Programming the trip class to LIn disables the normal trip classes shown above and enables a linear trip delay on overcurrent. The linear trip delay is set in program position OPT1.

Table 2: Trip Class Descriptions

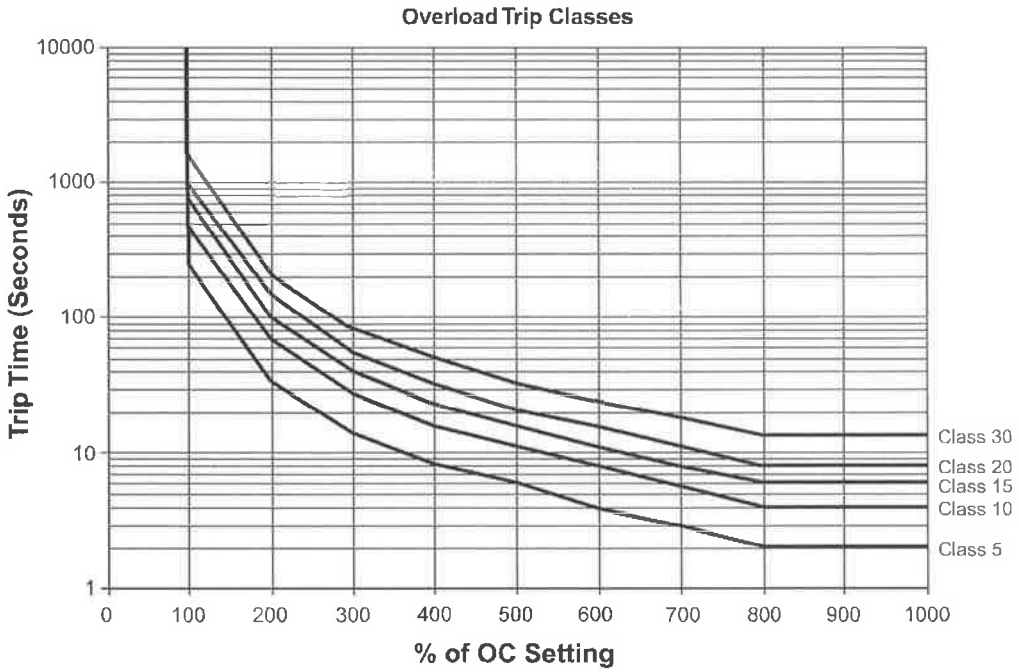


Figure 3: Overload Trip Curves

PROGRAMMING EXAMPLES

#1 Motor To Be Protected: 1Ø, 230 Volt, 10 Hp raw material transfer auger. This auger moves material from a large bulk delivery pit to the production area main storage hopper. The motor has a full load amperage rating of 50 Amps and a maximum service factor of 57 Amps. Use the following calculations and reasoning to determine the appropriate settings for this application.

LV- 230 x 0.90 = 207
HV- 230 x 1.10 = 253

MULT - From Table No. 1; MULT = 1

OC- 57

LKW- Since the motor current will unload at least 20% if a shaft shear pin breaks or the auger runs out of material, LKW = 50A x 0.80 = 40

TC- Because the motor is a general purpose motor and the motor should be protected from being jammed by a foreign object, TC = J20

KWS- 5-10 seconds

RD1- To protect the motor from rapid successive power outages, RD1 = 20

RD2- N/A, see #RO setting.

RD3- N/A, see #RU setting.

#RU- Setting #RU to 0 will require a manual reset after undercurrent. Therefore, RD3 has no affect in this application. This setting will allow the auger to be started, and left unattended, and will run until the delivery pit is empty. Pressing a remote reset button will start the auger for the next load.

#RO- Setting #RO to 0 will require a manual reset after an overcurrent. Therefore, RD2 has no affect.

ADDR- N/A.

OPT1- N/A.

OPT2- N/A.

#2 - Application: A 3Ø, 460 Volt, 50 Hp motor with 65 FLA and 75 SFA is used to shred plastic for recycling. The shredder is fed by a conveyor. This example shows how the Model 77C-KW/HP is used to control the conveyor to prevent the 50 Hp shredder motor from being overloaded by excess material being fed by the conveyor.

LV- 460 Volt Panel, with 115V controls, 115 x 0.90 = 104

HV- 115 x 1.10 = 126

MULT - From Table No. 1, MULT = 1

OC- 70 Amps, keeps motor from reaching service factor Amps during normal operation.

LKW- The conveyor should be stopped only on severe undercurrent conditions; i.e., broken shear pin on shredder. LKW = 65 x 0.50 = 32

TC- Because the shredder can become quickly overloaded by excessive material feed, TC = LIn.

KWS- 5-10

RD1- Rapid cycling is not a concern in this application, RD1 = 0.

RD2- The motor will quickly regain its speed after the conveyor stops feeding material, RD2 = 5. This will allow the conveyor to start feeding material 5 seconds after tripping on overcurrent.

RD3- N/A, see #RU.

#RU- Because an undercurrent would indicate a serious problem, #RU = 0.

#RO- This system will potentially overload many times, #RO = A.

ADDR- N/A.

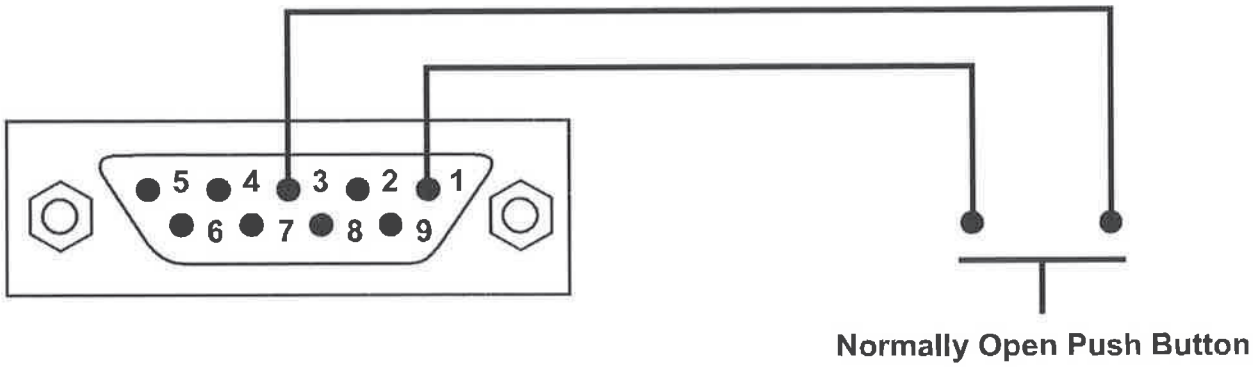
OPT1- Linear overcurrent trip delay = 2 seconds. This will stop the conveyor 2 seconds after it starts to overload and exceeds 70 amps.

OPT2- RD2 must be in seconds. Therefore, a setting of 2 in OPT2 should be used in this application.

COMMUNICATIONS PORT / REMOTE RESET

The Model 77C-KW/HP comes standard with a 9-pin Sub D connector for remote communications. The Model 77C-KW/HP supports RS-485 communication standard. This standard allows up to 99 Model 77C-KW/HPs to be controlled and monitored from a single remote personal computer. NOTE: An RS-485 module and software is required to operate the communications bus. (Refer to RS-485 Installation Instructions for more information on this subject.)

The communications port also provides connections for remote reset as shown below.



MULTI-FUNCTION SYSTEM DISPLAY

The output display can show various system operating parameters: L1-L2 Voltage, L2 Current (B).

When the "MODE SELECT" switch is in the "RUN" position, the LED will display one of the above operating parameters. To select or change the displayed parameter, turn the "DISPLAY / PROGRAM" adjustment to the desired position as shown on its label.

The multifunction display also announces system faults such as low voltage and high voltage. Any time the "MODE SELECT" switch is in the "RUN" position, the "RESET/PROGRAM" button may be pushed to view the last fault which occurred. The table below shows the possible messages.

Displayed Message	Meaning
oc	Tripped on Overcurrent
LPR	Tripped on Low Power
H I	Tripped on High Voltage
Lo	Tripped on Low Voltage
oFF	A stop command was issued from a remote source.

TROUBLESHOOTING

PROBLEM	SOLUTION
The unit will not start. Display alternates "HI" or "Lo" with the "DISPLAY / PROGRAM" switch parameter value.	The incoming voltage is not within the limits programmed in the "HV" and "LV" settings. Adjust the "DISPLAY / PROGRAM" switch to read the incoming line voltage value. Correct the incoming power problem and check programmed limits to verify they are correct.
Display alternates "oc" with "RUN."	The overload relay has tripped on overcurrent and is timing down "RD2" before restarting.
Display alternates "LPR" with "RUN."	The overload relay has tripped on low power and is timing down "RD3" before restarting. If undercurrent is not a normal condition for this installation, check for broken shafts, broken belts, etc.
Display is showing a solid "oc."	The unit has tripped on overcurrent and manual reset is required because of the programmed setting in "#RO." Check the system for problems that would produce the overload fault like a jam.
Display is showing a solid "uc."	The unit has tripped on undercurrent and a manual reset is required because of the programmed setting in "#RU." Check the system for problems that would produce an underload condition like a broken belt or shear pin.
Unable to change parameters	See Tamper Guard Page 11

If you need further assistance, call us at 1-800-843-8848 . . . we'd be happy to help!!!!

OPERATION

Once the overload relay has been programmed, turn the "MODE SELECT" switch to the "RUN" position. The LED display will flash "RUN" alternatively with a number representing the parameter indicated by the "DISPLAY / PROGRAM" adjustment. After the period of time programmed into RD1, the output contacts will close and the value of the parameter indicated by the "DISPLAY / PROGRAM" adjustment will appear on the LED display.

If a message other than those indicated above is shown on the LED display, see the TROUBLESHOOTING section on page 9 to diagnose the problem.

SPECIFICATIONS	OVERLOAD RELAY
Electrical	
Input Voltage	100-240 VAC, 1Ø
Frequency	50-60 Hz
Motor Full Load Amp Range - 77C-KW/HP	2-25 Amps, 3Ø(Loops Required) 26-90 Amps, 3Ø(Direct) 91-800 Amps, 3Ø(External CT's)
Motor Full Load Amp Range - 77CLR-KW/HP	1.0 Amps - 2.5 Amps (Loops Required) 2.0 Amps - 9.0 Amps (Direct)
Short Circuit	100kA per UL, 10kA per CSA
Power Consumption	10W (Maximum)
Output Contact Rating SPDT (Form C)	Pilot duty rating: 480 VA @ 240 VAC General purpose: 10A @ 240 VAC
Expected Life	
Mechanical	1 x 10^7 operations
Electrical	1 x 10^5 operations at rated load
Accuracy at 25° C (77° F)	
Voltage	±1%
Current	±3% (Direct, No External CT's)
Timing	5% ± 1 second
Power	±10%***
Repeatability	
Voltage	± 0.5% of nominal voltage
Current	± 1% (Direct, No External CT's)
Safety Marks	
UL	UL508, UL1053
CE	IEC 60947-1, IEC 60947-5-1
Standards Passed	
Electrostatic Discharge (ESD)	IEC 1000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI), Conducted	IEC 1000-4-6, Level 3 10V/m
Radio Frequency Immunity (RFI), Radiated	IEC 1000-4-3, Level 3 10V/m
Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5 kV input power
Surge	
IEC	1000-4-5 Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Vibration	IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis
Shock	IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse
Mechanical	
Dimensions	3.0"H x 5.1 " D x 3.6"W
Terminal Torque	7 inch•lb
Enclosure Material	polycarbonate
Weight	1.2 lbs
Maximum Conductor Size Through 77C-KW/HP	0.65" with insulation
Environmental	
Temperature Range	Ambient Operating: -20° - 70° C (-40° - 158°F) Ambient Storage: -40° - 80° C (-40° - 176°F)
Pollution Degree	3
Class of Protection	IP20, NEMA 1
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Programmable Operating Points	Range
LV- Low Voltage Threshold	85V - HV Setting
HV- High Voltage Threshold	LV Setting - 264V
MULT- # of Conductors or CT Ratio (XXX:5)	77C-KW/HP: 1-10 Conductors or 100-800 Ratio 77C-LR-KW/HP: 1 or 2
OC- Overcurrent Threshold	(20-100A) ÷ MULT or 80-120% of CT Primary
LPS- Low Power Threshold	See PWS below or 0=off
CUB- Current Unbalance Threshold	2 - 25% or 999%
TC- Overcurrent Trip Class *	5, J5, 10, J10, 15, J15, 20, J20, 30, J30, or LIn (linear)
RD1- Rapid Cycle Timer	0, 2 - 500 Seconds
RD2- Restart Delay After All Faults Except Undercurrent (motor cool down timer)**	2 - 500 Minutes/Seconds
RD3- Restart Delay After Undercurrent (dry well recovery timer)	2 - 500 Minutes/Seconds
#RU- Number of Restarts After Undercurrent	0, 1, 2, 3, 4, A(Automatic)
ADDR- RS485 Address	A01- A99
#RO-Number of Restarts After Overcurrent ***	0, 1, 2, 3, 4, A(Automatic)
UCTD- Undercurrent Trip Delay	2 - 60 Seconds
PWS- Power Setpoint Range (1,2,3,4)(5,6,7,8)	1 = 0.01 - 0.99 kw
(Settings within ranges are adjusted in LPS settings.)	2 = 1.00 - 9.95 kw
	3 = 10.0 - 99.5 kw
	4 = 100 - 650 kw
	5 = 0.01 - 1.30 hp
	6 = 1.34 - 13.3 hp
	7 = 13.4 - 133 hp
	8 = 134 - 871 hp

NOTES: SymCom's Overload Relay can be preprogrammed prior to installation by applying 120 VAC between the L1 and L2 terminals.

*If J Prefix is displayed in trip class setting, jam protection is enabled. If programmed to LIn position, overcurrent trip delays are fixed linear time delays set in OPT1 position.

**RD2 & RD3 can be changed from minutes to seconds under program position OPT2.

***Given current range within nominal specified range and power factor>60%

Clearing Last Fault

The last fault stored can be cleared on the MotorSaver.
This procedure is outline as follows:

1. Rotate the Mode Select Switch to 'OPT2'.
2. Press and hold the Reset/Program Button. Adjust the Display/Program adjustment until cLr appears on the display. Release the Reset/Program Button.

To verify the last fault was cleared, place the Mode Select switch in the Run position. Then press and hold the Reset/Program Button, cLr should be on the display.

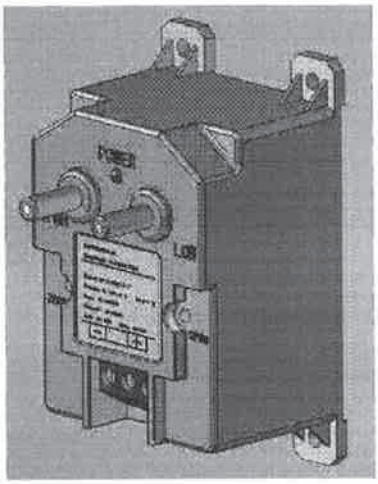
Tamper Guard

The MotorSaver can be protected from unauthorized program changes by locking in the setpoints.
This procedure is outlines as follows:

1. Rotate the Mode Select switch to 'OPT2'.
2. Rotate Display/Program adjustment fully clockwise.
3. Press and hold the Reset Button. Adjust the Display/Program adjustment until 'Loc' appears in the display.
4. Release the Reset Button.
5. Turn Mode Select switch to 'run'.

The program is now locked, but all settings can be viewed. The unit can be unlocked by following the procedure above except step three. This step should say: Press and hold the Reset Button. Adjust the Display/Program adjustment until 'unL' appears in the display.

Series 211 – Installation and Operation Manual



1. INTRODUCTION

The Series 211 Differential Pressure Transmitter can accurately measure positive, negative, or differential pressure. The Series 211 is not position sensitive and can be mounted in any orientation without compromising accuracy. The compact, lightweight design makes installation simple and easy.

1.1 Model Numbers

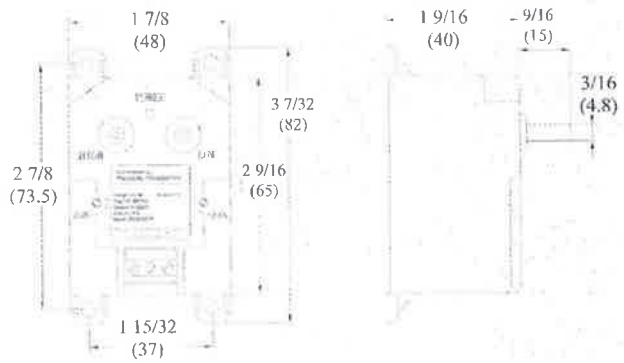
Model	Range	Accuracy
211-D001I-1	0-1 in w.c.	1.0%
211-D002I-1	0-2 in w.c.	1.0%
211-D004I-1	0-4 in w.c.	1.0%
211-D006I-2	0-6 in w.c.	0.5%
211-D006I-3	0-6 in w.c.	0.25%
211-D010I-2	0-10 in w.c.	0.5%
211-D010I-3	0-10 in w.c.	0.25%
211-D020I-2	0-20 in w.c.	0.5%
211-D020I-3	0-20 in w.c.	0.25%
211-D040I-2	0-40 in w.c.	0.5%
211-D040I-3	0-40 in w.c.	0.25%
211-D005P-2	0-5 PSI	0.5%
211-D005P-3	0-5 PSI	0.25%
211-D010P-2	0-10 PSI	0.5%
211-D010P-3	0-10 PSI	0.25%
211-D015P-2	0-15 PSI	0.5%
211-D015P-3	0-15 PSI	0.25%
211-Z001I-1	0.5-0-0.5 in w.c.	1.0%
211-Z002I-1	1-0-1 in w.c.	1.0%
211-Z004I-1	2-0-2 in w.c.	1.0%
211-Z010I-2	5-0-5 in w.c.	0.5%
211-Z010I-3	5-0-5 in w.c.	0.25%

Other ranges available upon request.

1.2 Specifications

Maximum Pressure: Ranges ≤ 5 PSI – Max 15 PSI
Ranges > 5 PSI – Max 30 PSI
Media compatibility: Air and compatible non combustible, non corrosive gasses
Accuracy: Ranges ≤ 4" w.c. 1.0%
Ranges ≥ 5" w.c. 0.5% or 0.25%
Temperature Ranges:
Compensated: 15° to 120°F (-10° to 50°C)
Operating: -10° to 155°F (-25° to 70°C)
Thermal Effect: +/- 0.028% FS/°F
Stability: +/- 0.25% FS/year
Output Signal: 4-20 mA, 2-wire
Loop Resistance: 250 Ω @ 24 VDC
Power Supply: 12-30 VDC
Housing Material: ABS Plastic
Electrical Connections: screw terminals
Process Connection: Push on connection for $^1/_8$" I.D. tubing

1.3 Dimensional Drawings



2. INSTALLATION

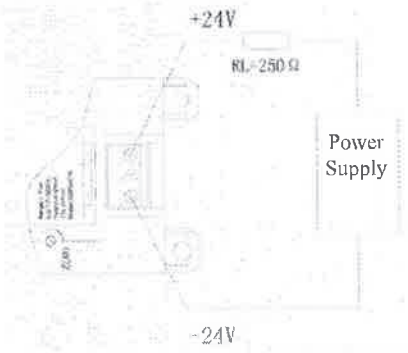
2.1 Mounting

The Series 211should be mounted in a clean, dry location free from excess vibration. The transmitter can be mounted in any orientation and should be attached by using the 4 holes provided on the housing.

2.2 Pressure Connection

Two push on pressure connections are located on the front of the unit, labeled "High" and "Low". For best results, connect 1/8" I.D. push on tubing to the pressure connections. For differential pressure measurement, the higher pressure should be connected to the "High" pressure port. For positive pressure, the "Low" pressure port should be left vented to atmospheric pressure. For negative pressure measurement, the "High" pressure port should be vented to atmospheric pressure.

2.3 Electrical Connections



3. CALIBRATION

The Series 211 is factory calibrated and should not require calibration out of the box. Periodically, it may be necessary to recalibrate the gauge to maintain the accuracy of the product. To "zero" the gauge, remove the pressure connections from both pressure ports and adjust the zero potentiometer until the output is 4 mA. To "span" the gauge, apply the full scale pressure to the High pressure port and adjust the span potentiometer until the output is 20 mA.

To properly calibrate the product, it is necessary to have an accurate pressure standard. If you do not have one available or would like calibration traceable to NIST, please contact Sensocon.

4. LIMITED WARRANTY

LIMITED WARRANTY

SENSOCON warrants its products to be free from defects in materials and workmanship for a period of one (1) year from the date of shipment, subject to the following terms and conditions: Without charge, SENSOCON will repair, replace, or refund the purchase price at SENSOCON's option products found to be defective in materials or workmanship within the warranty period; provided that:

i. the product has not been subjected to abuse, neglect, accident, incorrect wiring not our own, improper installation or servicing, or use in violation of labels or instructions provided by SENSOCON;

ii. the product has not been repaired or altered by anyone except SENSOCON;

iii. the maximum ratings label and serial number or date code have not been removed, defaced, or otherwise changed;

iv. examination discloses, in the judgment of SENSOCON, the defect in materials or workmanship developed under normal installation, use and service; and

v. SENSOCON is notified in advance of and the product is returned to SENSOCON transportation prepaid before expiration of the warranty period.

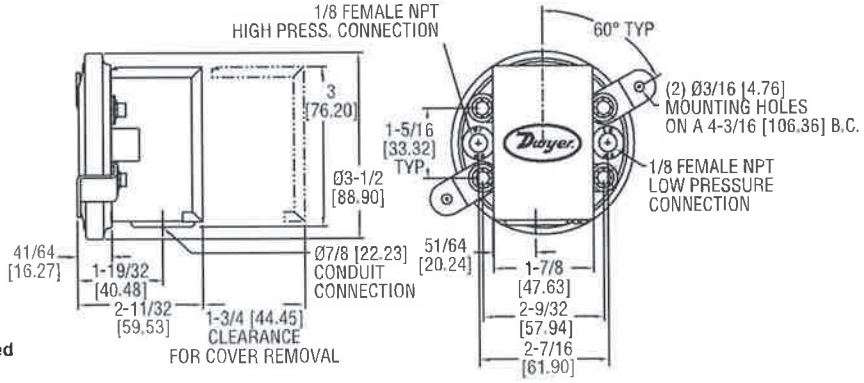
THIS EXPRESS LIMITED WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER REPRESENTATIONS MADE BY ADVERTISEMENTS OR BY AGENTS AND ALL OTHER WARRANTIES, BOTH EXPRESS AND IMPLIED. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABLILTY OR OF FITNESS FOR A PARTICULAR PURPOSE FOR GOODS COVERED HEREUNDER.

Dwyer

COMPACT LOW DIFFERENTIAL PRESSURE SWITCHES

Set Points from 0.07 in to 20 in w.c. Repetitive Accuracy within 3%

Series 1910 switch with conduit enclosure off. Shows electric switch and set point adjustment screw located on same side for easy installation.



The Dwyer-engineered force-motion amplifier increases the leverage of diaphragm movement and results in a switch with excellent sensitivity and repeatability.

Scan here to watch product video

Our most popular **SERIES 1900** combines advanced design and precision construction to make these switches able to perform many of the tasks of larger, costlier units. Designed for air conditioning service, they also serve many fluidics, refrigeration, oven and dryer applications. Series 1900 switches have set points from 0.07 to 20 in w.c. (1.8 to 508 mm). Set point adjustment is easy with range screw located inside conduit enclosure. Internal location helps prevent tampering. UL, CE and CSA listed, and FM approved. For use with air or compatible gages.

FEATURES/BENEFITS

- Compact size and repeatability, provides a high-value switch for many industrial and OEM applications
- Wide range of models from 0.07 in w.c. to 20 in w.c. can meet exacting OEM specifications for a low pressure switch
- Range screw protected inside enclosure provides simplifies making adjustments but prevents tampering

APPLICATIONS

- Air conditioning refrigeration coil icing detection; defrost cycle initiation.
- Clogged filter detection.
- Variable air volume controller

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -30 to 180°F (-34 to 82.2°C).
Pressure Limits: 45 in w.c. (11.2 kPa) continuous, 10 psig (68.95 kPa) surge.
Switch Type: Single-pole double-throw (SPDT).
Repeatability: ±3%.
Electrical Rating: 15 A @ 120-480 VAC, 60 Hz. Resistive 1/8 HP @125 VAC, 1/4 HP @ 250 VAC, 60 Hz. Derate to 10 A for operation at high cycle rates.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8" female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type inside conduit enclosure.
Weight: 1 lb 4.5 oz (581 g).
Agency Approvals: CE , CSA, FM, and UL. Optional-EXPL explosion-proof enclosure does not possess any agency approvals.

MODEL CHART

Model	Operating Range, in w.c.	Approximate Deadband		Price
		At Min. Set Point	At Max. Set Point	
1910-00	0.07 to 0.15	0.04	0.04	**$48.50**
1910-0	0.15 to 0.5	0.10	0.10	**45.75**
1910-1	0.40 to 1.6	0.15	0.16	**45.75**
1910-5	1.40 to 5.5	0.30	0.30	**45.75**
1910-10	3.0 to 11.75	0.40	0.40	**45.75**
1910-20	4.0 to 20.0	0.40	0.50	**45.75**

OPTIONS

Weatherproof Housing
16 ga. steel enclosure with gasketed cover (NEMA 4, IP66) for wet or oily conditions. Withstands 200 hour salt spray test. Wt. 5-1/2 lb (2.5 kg). Switch must be factory installed.
Note: To order, change 1910 base number to 1911, add -WP suffix and **+$212.00**(N).
Example: 1911-1-WP

Explosion-Proof Housing
Cast iron base with brass cover. Rated Class I, Groups D; Class II, Div. 2, Groups E, F, G; Class III and NEMA 7, 9 NEMA 3. (7 lb). Switch must be factory installed.
Note: To order, change 1910 base number to 1911, add -EXPL suffix and **+$616.00**(N). **Example:** 1911-1-EXPL

Manual Reset Option (Model 1900 MR)
Includes special snap switch which latches on pressure increase above the setpoint. Switch must be manually reset after pressure drops below the setpoint. Available on -1, -5,-10 or -20 ranges only. Option is not UL, CSA or FM listed. For use only in single positive pressure applications.
Note: To order, change 1910 base number to 1900, add -MR suffix and **+$24.50**.
Example: 1900-10-MR

(N) Items are net priced and are not subject to any discount.

ACCESSORIES

Model	Description	Price
A-399	Duct pressure monitor kit; for use with standard or manual reset model switches; includes mounting flange, tubing and adapters	**$36.75**
A-329	Street ell; brass adapter for applications requiring right angle connections; two required for differential pressures	**5.90**
A-302F-A	303 SS static pressure tip with mounting flange; for 3/16" ID rubber or plastic tubing; 4" insertion depth; includes mounting screws	**9.10**
A-489	4" straight static pressure tip with flange	**6.67**

Manual Reset Option

Process Tubing Options: See page 443 (Gage Tubing Accessories)

Hazloc Heaters™

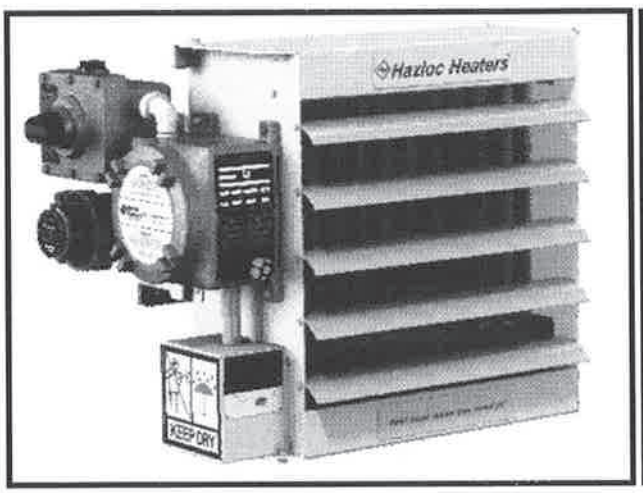
Safe heat when you need it!

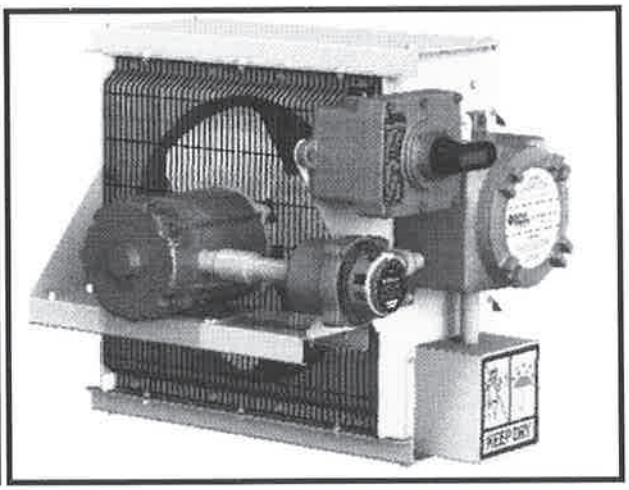
XEU1

Electric Forced-Air Explosion-Proof Heater

Owner's Manual, Version: XEU1-OM-H

This manual covers installation, maintenance, repair, and replacement parts.





Forced-Air Heater for Hazardous Locations

Class I, Division 1 & 2, Groups C & D
Class II, Division 1 & 2, Groups F & G
Temperature Code T3B (3kW/35kW = T3A)

Class I, Zone 1 & 2 , Groups IIA & IIB, T3

C SP® US

235730

WARNING!

Please adhere to all instructions published in this manual.
Failure to do so may be dangerous and may void your warranty.

***Note:** XEU1 heaters must not be exposed to rain or snow. This applies to installed & stored heaters. The XEU1 heater should not be modified in any way.*

www.HazlocHeaters.com

Printed in Canada

Part No. XEU1-OM-H

XEU1 Model Coding on Data Plate

Full Model Code & Option Sequence

Model Code | **Option Codes**

XEU | 1 | - | 12 | - | 100 | - | 480 | 3 | 60 | - | A | - | Y | - | B | T1, D, P, etc.

(stamped in separate field of data plate)

Model Series

Generation
For major revisions

Fan Size

12 Inches	12
16 Inches	16
20 Inches	20

Power Output

3 kW	030	12 inch fan size
5 kW	050	12 inch fan size
7.5 kW	075	12 inch fan size
10 kW	100	12 inch fan size
15 kW	150	16 inch fan size
20 kW	200	16 inch fan size
25 kW	250	20 inch fan size
30 kW	300	20 inch fan size
35 kW	350	20 inch fan size

Heater Line Voltage

208 Volts	208	3 to 15 kW sizes only
240 Volts	240	3 to 15 kW sizes only
480 Volts	480	All kW sizes
600 Volts	600	All kW sizes

Product Revision No.
For minor revisions

Factory Built-in Options

N	No options selected
Y	Yes, options selected

Options Codes (stamped in separate field of data plate)

T1	Thermostat, Bi-metal (BTX1-N-A)
T2	Thermostat, Electronic (XET1-1-N-A)
D	Disconnect Switch
P	Pilot Light (Heat On)
F	Continuous Fan
H1	Heresite Core
H2	Heresite Cabinet
H3	Heresite Core/Cabinet

Requires 24VAC control voltage >

Includes louvers & fan blade >

Includes louvers & fan blade >

Control Voltage

A	120VAC
B	24VAC (safer)

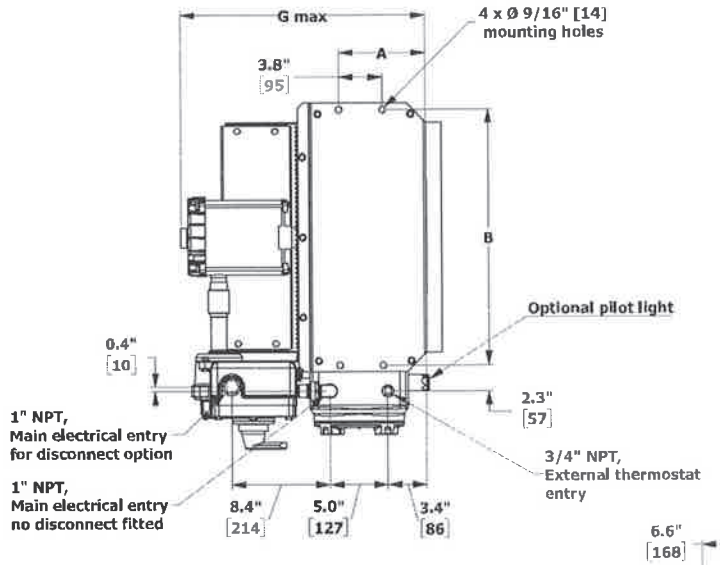
Frequency

60	60 Hertz

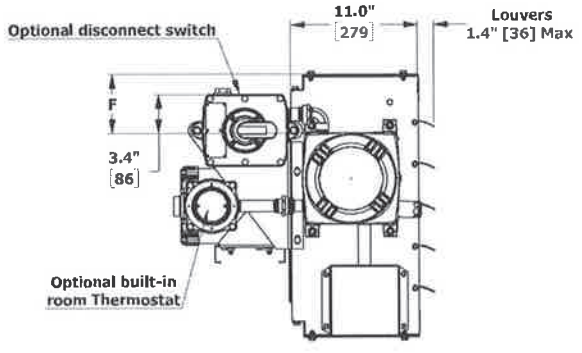
Phase

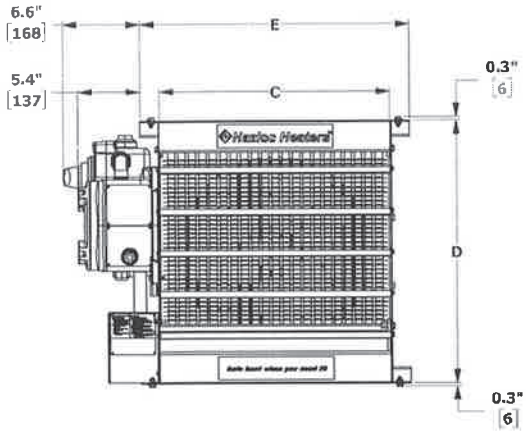
1	1 Phase
3	3 Phase

XEU1 Physical Dimensions



Heater Size	12 (3-10kW)	16 (15-20kW)	20 (25-35kW)
Dim.	Inches (mm)	Inches (mm)	Inches (mm)
A	7.5 (191)	7.5 (191)	7.5 (191)
B	18.2 (462)	22.3 (566)	26.3 (668)
C	16.3 (414)	20.3 (516)	24.3 (617)
D	19.0 (483)	23.0 (584)	27.0 (686)
E	19.5 (495)	23.5 (597)	27.5 (699)
F	3.1 (79)	5.1 (130)	7.1 (180)
G	22.3 (566)	22.3 (566)	23.3 (592)





XEU1 Specifications By Model Size

Model		XEU1-12				XEU1-16		XEU1-20		
Fan Diameter	in. (mm)	12 (304.8)				16 (406.4)		20 (508.0)		
Nominal kW		3	5	7.5	10	15	20	25	30	35
Air Delivery	CFM	350	400	600	800	1200	1700	2100	3000	
	m^3/hr	595	680	1019	1359	2039	2888	3568	5097	
Approx. Air Velocity	FPM	422	479	718	958	808	1145	916	1309	
	m/s	2.1	2.4	3.6	4.9	4.1	5.8	4.6	6.6	
Approx. Horizontal Air Throw	ft	13	15	22	30	33	46	41	61	
	m	3.9	4.6	6.7	9.1	10.1	14.0	12.5	18.6	
Motor Power	HP (Watts)	¼ (186)				¼ (186)		½ (373)		
Maximum Mounting Height	ft	7	7	7.5	9.5	10	11	12	15	
(to underside of heater)	m	2.1	2.1	2.3	2.9	3.0	3.4	3.6	4.6	
Approx. Net Weight Lbs (kg)	(without disconnect)	129 (58.5)			133 (60.3)	161 (73.0)		192 (87.1)		
	(with disconnect)	142 (64.4)			146 (66.2)	174 (78.9)		205 (92.9)		
Approx. Shipping Weight Lbs (kg)	(without disconnect)	188 (85.3)			192 (87.1)	224 (101.6)		261 (118.4)		
	(with disconnect)	201 (91.2)			205 (93.0)	237 (107.5)		274 (124.3)		

XEU1 General Specifications

Approvals	Certification	cCSAus 235730 - Certified to Canadian and U.S. standards.
	North American Hazardous Location Classifications	Class I, Division 1 & 2, Groups C & D Class II, Division 1 & 2, Groups F & G Temperature Code T3B (3kW/35kW =T3A) Class I, Zone 1 & 2, Groups IIA & IIB, T3
	Temperature Code	Division System - T3B 165°C (329°F); [3kW/35kW = T3A 180°C (356°F)] Zone System - T3 200°C (392°F)
Cabinet	Cabinet Material	14-gauge (0.075 in.) (1.9 mm) steel. Yellow epoxy/polyester powder coated with five-stage pretreatment, including iron phosphate.
	Fan Guard	Split design with close wire spacing. A 3/8 in. (9.5 mm) diameter probe will not enter. Black polyester powder coated.
	Louver Blades	Anodized extruded aluminum.
	Conduit Materials & Fittings	Plated steel and aluminum alloy for corrosion resistance.
	Fasteners	Zinc plated steel for corrosion resistance.
	Enclosures	Cast aluminum (non-copper alloy) NEMA Type 7 & 9 with O-ring.
	Mounting Holes	9/16" diameter holes – Four located on the top face of heater.
Motor/Fan	Motor Type	Explosion-proof, thermally protected, 1725 RPM permanently lubricated ball bearing type with 56 frame and "easy-off" fan blade replacement feature.
	Fan	Three-blade aluminum, steel spider and hub with 5/8 in. bore
Heat Exchanger	Heating Elements	Long-life, low watt-density, high grade metal-sheathed elements.
	Heat Transfer Fluid	Ethylene glycol and water including corrosion inhibitors.
	Header Material	Carbon steel.
	ExCaliber™ Core	Carbon steel headers and element housing with O-ring. Fin tubes are carbon steel tubes with copper-free, roll-formed aluminum fins @ 10 fins per in. Vacuum sealed. Coated with black, high-heat enamel.
Protection	Temperature High Limits	One automatic reset rated for 100,000 cycles, and one manual reset. Both are snap-action bimetal type, open on temperature rise.
	Pressure Relief	High-quality stainless steel pressure relief device.
Controls	Control Circuit	Built-in 120VAC or 24VAC control (24VAC recommended).
	Control Contactor	40 FLA (50A resistive per pole) Definite Purpose. Rated for 500,000 mechanical operations.
	Control Transformer	Multitap primary, 120VAC or 24VAC secondary.
	Fuse Protection	Thermal delay fuse with spare, .25" x 1.25" , 120VAC = 1/4A, 24VAC = 1A.
	Room Thermostat With Lockable Temperature Dial (option code T1 or T2)	Built-in, BTX1-N-A (T1) or XET1-1-N-A (T2) explosion-proof thermostat, 40°F to 80°F (5°C to 25°C). Conduit is factory sealed between enclosures. Wall mount versions also available. ***Note:*** *Optional BLK1-N-A thermostat conversion kit allows simple interchangeability from a built-in to a wall mount configuration.*
Load Isolation	Disconnect Switch (option code D)	Built-in, XDC-01 explosion-proof disconnect switch, 600VAC, 50A max with lock-out feature. Conduit is factory sealed between enclosures. Wall mount disconnect available.
Additional Options	Pilot Light (option code P)	Built-in "Heat on" Green LED pilot light with lens guard.
	Continuous Fan (option code F)	Continuous fan operation. Circulates air and prevents gas pockets from forming.
	Heresite Coating (option code H1, H2, H3)	H1 = Heresite Core; or H2 = Heresite Cabinet (includes louvers & fan blade); or H3 = Heresite Core and Cabinet. Note: Contact factory for Heresite delivery lead time.
Operating Limits	Ambient Temperature	-40°F to 104°F (-40°C to 40°C). Storage: -58°F to 140°F (-50°C to 60°C)
	Maximum Altitude	10,000 ft (3048 m) above sea level.

— WARNING! —

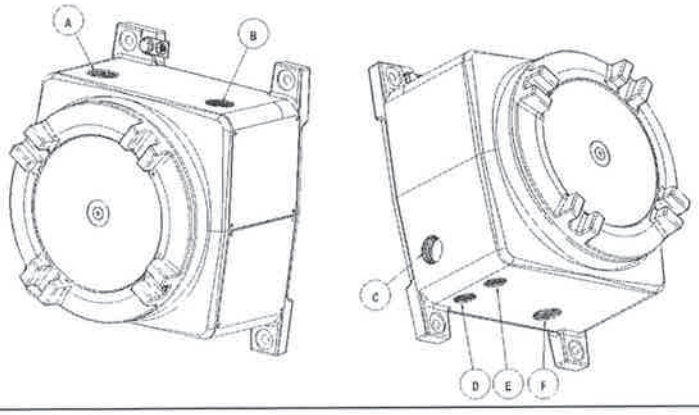
Read and follow the instructions in this manual. Failure to do so may result in severe or fatal injury.

IMPORTANT SAFETY INFORMATION

1. Heater is to be connected and serviced only by qualified electrician experienced with hazardous location equipment. It is the responsibility of the installer to verify the safety and suitability of the installation.
2. Installation and wiring of the heater must adhere to all applicable codes. Heater must be effectively grounded to eliminate shock hazard.
3. Heater is to be used only in atmospheres having an ignition temperature higher than the heater's maximum rated operating temperature as shown on the heater data plate. For details of hazardous locations with potential for explosion, refer to the Canadian Electrical Code, Part 1, Section 18 or Articles 500 through 516 of the National Electrical Code.
4. Do not operate heater in ambient temperatures above 40°C (104°F).
5. Do not plug heater outlet with gloves, clothing, etc. or operate heater with louvers fully closed.
6. **Explosion/Electric Shock Hazard.** Disconnect heater from power supply or fuse box before opening enclosures or servicing heater. Lock the switch in the "OFF" (open) position and/or tag the switch to prevent unexpected power application.
7. Operate the heater only while it is permanently mounted in an upright position. Failure to comply will cause overheating of the heat exchanger and shutting down of the unit by tripping the high temperature cutout.
8. **This heater is equipped with two bimetal thermal high-limit cutouts**, one automatic reset type and one manual reset type. The heater is not to be operated with the high-limit cutouts disabled or disconnected from the control circuit.
9. Keep all electrical enclosure covers tightly closed and secured with all bolts and threads. Cover joints must be clean before replacing covers. Keep away from rain or snow. Heater is for dry indoor use only.
10. All unused threaded openings not used for supply wiring or remote mount room thermostat must be fitted with threaded plugs approved for use in hazardous locations.
11. The heat exchanger is a factory vacuum-sealed unit. Do not attempt to loosen or tighten the vacuum plug or pressure relief device. A loss of vacuum could cause nuisance tripping of the thermal cutouts or high pressures which will cause the relief device to actuate with an accompanying loss of fluid.
12. The heat exchanger is filled with a mixture of water and inhibited **ethylene glycol** which **is poisonous**. Contact with the fluid at operating temperatures may produce a burn hazard. Suggested first aid consists of flushing eyes with plenty of water and to wash off skin in flowing water or shower. If any fluid leakage occurs from the heater, disconnect it from the power supply and have the heat exchanger replaced with a factory supplied unit.
13. Heater must be kept clean. When operating in a dirty environment, regularly clean the fin tubes, fan, and fan guard. Refer to recommended maintenance procedures.
14. Do not operate heater in atmospheres which are corrosive to aluminum or steel.
15. See applicable electrical codes for seal requirements in field installed conduits. Factory installed conduits require no further sealing.
16. **Crackling or pinging noises within the heat exchanger during start up may occur. This is normal.**
17. Air discharge at the bottom of the heater may be warmer than at the top. This is normal.
18. Do not attempt to install a Remote Fan Only Switch. **Do not modify the heater in any way.**
19. Use factory approved replacement parts only. Contact factory for any questions or concerns.

Enclosure Entries

Entry	Entry Type	Entry Detail
A	Threaded: 1" NPT	Main power
B	Threaded: 3/4" NPT	Accessories
C	Threaded: 3/4" NPT	System wires (conduit)
D	Threaded: 1/2" NPT	Accessories
E	Threaded: 1/2" NPT	Accessories
F	Threaded: 3/4" NPT	Element wires (vertical conduit)



— WARNING! —
Read and follow the instructions in this manual. Failure to do so may result in severe or fatal injury.

— INSTALLATION —
Mechanical

Location

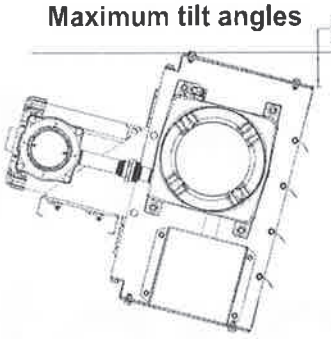
Please follow guidelines below for optimum heating results:

1. Do not install heaters such that airflow is blocked or impeded by equipment or walls.
2. For occupant comfort, position heaters so that air discharge is directed across areas of highest heat loss, such as doors, windows, and outside walls.
3. For large areas, arrange heaters such that the air discharge of one heater is directed towards the inlet of the next heater. This sets up a rotational airflow with air circulation in the central area of the building.
4. For equipment freeze protection, direct air discharge at equipment.
5. For large workshops or warehouses it may be acceptable to use fewer, larger heaters.
6. Locate remote mount room thermostat on interior partition walls or posts away from cold drafts, internal heat sources, and away from heater discharge air streams.

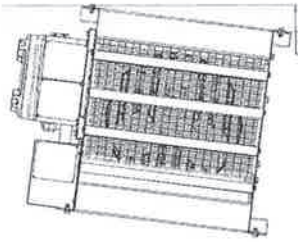
Mounting

1. A variety of mounting brackets are available from the factory to aid in installation.
2. If using mounting hardware or a supporting structure not supplied by the factory, the unit should be suspended through the four 9/16 in. (14 mm) mounting holes on top of the unit with Grade 5, 1/2 in. UNC bolts. Lock washers should be used on all mounting nuts and bolts to ensure they don't vibrate or work loose due to fan vibration or other vibration transmitted to the heater. If in doubt consult factory.
3. It is essential that adequate structural support be provided for installation. **The mounting structure must be strong enough to support the heaters weight**, provide sufficient stiffness to prevent excessive vibration, and withstand all probable abusive situations such as transportable installations where truck off-loading impacts, etc. may occur. Refer to table on Page 3, XEU1 Specifications by Model Size, for heater net weights.

Maximum tilt angles

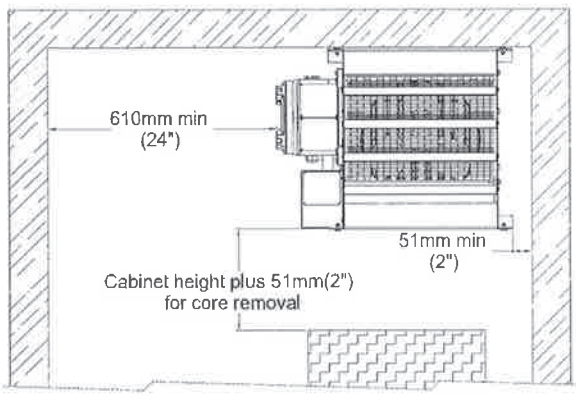


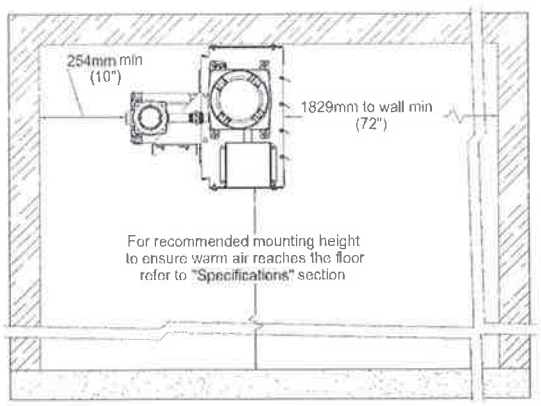
Heater Fan Size



Mounting Heights and Clearances

1. To ensure that warm air reaches the floor observe the recommended maximum mounting heights in table on Page 3, XEU1 Specifications by Model Size. Heaters may be mounted at higher elevations and still provide warm air at floor level however, the maximum mounting elevation at which this occurs depends on location and operational conditions.
2. Louvers may be adjusted to provide greater downward deflection of the discharge air. However, louvers must not be set less than 30 degrees of the closed position.





— WARNING! —

Read and follow the instructions in this manual. Failure to do so may result in severe or fatal injury.

— INSTALLATION —
Electrical

1. Heater is to be connected and serviced only by qualified electrician experienced with hazardous location equipment. It is the responsibility of the installer to verify the safety and suitability of the installation.
2. **Explosion/Electric Shock Hazard.** Disconnect heater from power supply or fuse box before opening enclosures or servicing heater. Lock the switch in the "OFF" (open) position and/or tag the switch to prevent unexpected power application.
3. Use copper conductors only for supply wires and approved explosion-proof means of wiring during installation. Use minimum 90°C rated wire. Refer to "Supply Wire Requirements" table and heater data plate for conductor wire rating.
4. Installation must include appropriate over-current protection devices (fusing or circuit breakers) as required by the CEC or NEC. Refer to "Supply Wire Requirements" table and heater data plate for current ratings. Supply voltage is to be within 10% of the data plate voltage.
5. Confirm that the electrical power supply matches the nameplate voltage, phase, amperage and frequency rating of the heater to be connected.
6. Supply conductors and ground conductor pass through the 1 in. NPT rigid conduit opening on the control enclosure.
7. Proper installation of the heater requires that an adequate grounding conductor be connected to the ground terminal. This terminal is made of copper and is located on the top right-hand corner of the printed circuit board within the control enclosure.
8. Heater may be supplied with a factory installed integral room thermostat with lockable temperature dial (See Figure 1). If a **remote explosion-proof room thermostat** is used, connection is to be made via the 3/4" NPT entry (entry "B" listed in the "Enclosure Entries" table on page 4). Refer to the thermostat installation manual and the wiring diagrams on page 9 to connect the remote thermostat.
9. Refer to wiring diagram on Page 9 to ensure that all connections are as required and securely fastened.
10. For heaters supplied with a factory installed integral disconnect switch (See Figure 1), field wiring is as follows:
    a. Remove the Disconnect cover assembly from the base by removing the six (6) cover bolts. Set the cover assembly aside. CAUTION: Damaging the mating surfaces of the enclosure could destroy the flame path and jeopardize the integrity of the flame proof enclosure.
    b. Supply conductors and ground conductor pass through the 1 in. NPT rigid conduit opening located on the top or bottom of Disconnect Enclosure. Supply conductors to be wired to DIN rail mounted Disconnect Switch inside. Ground conductor to be wired to Ground Lug fastened to inside of Disconnect Enclosure. Refer to wiring diagram on Page 9.
    c. Attach cover to the enclosure using the six (6) bolts. **Tighten to 150 inch-pounds ± 5 in-lbs.**
11. **All** unused threaded openings in enclosures, not used for supply wiring or external room thermostat, must be fitted with threaded plugs approved for use in hazardous locations (included). Factory installed conduits require no additional sealing.
12. Installer must seal each conduit run within 18" (457 mm) of enclosure. This seal must be suitable and listed for hazardous locations. Ensure that any liquids used in the sealing process do not enter into any of the electrical enclosures.
13. Ensure that input conductors and conduit have adequate strain relief at installation.
14. Before application of electrical power, recheck all connections to ensure compliance with the wiring diagram and any code requirements. Remove any foreign objects from the control box and heater. Ensure all wire terminals are tight and not pinching the wire insulation. Reinstall cover tightly.
15. **On all three-phase heaters, it is necessary to verify that the fan rotation is correct** (counter clockwise when facing the rear of the heater). If air delivery is not from the front of the heater, reverse any two supply leads at the main power contactor located in the control enclosure.
16. The explosion-proof control enclosure and element enclosures are designed with O-rings, threaded joints and metal-to-metal contact at the lid or cover joint to prevent an explosion. Do not attempt to install gasket material of any type at these joints. A light coating of anti-seize compound may be applied to the threads to prevent seizing.

XEU1 Supply Wire Requirements

Model	kW	Volts	Ø	Total Current Amps	Minimum Circuit Ampacity	Max Fuse Amps	Supply Wire (AWG)
XEU1-12-030-208160-	3	208	1	16.7	20.9	25	10
XEU1-12-030-240160-	3	240	1	14.9	18.6	20	12
XEU1-12-030-208360-	3	208	3	9.4	11.8	15	14
XEU1-12-030-240360-	3	240	3	8.3	10.4	15	14
XEU1-12-030-480360-	3	480	3	4.2	5.2	15	14
XEU1-12-030-600360-	3	600	3	3.3	4.1	15	14
XEU1-12-050-208160-	5	208	1	26.3	32.9	35	8
XEU1-12-050-240160-	5	240	1	23.2	29.0	30	10
XEU1-12-050-208360-	5	208	3	15.0	18.7	20	12
XEU1-12-050-240360-	5	240	3	13.1	16.4	20	12
XEU1-12-050-480360-	5	480	3	6.6	8.2	15	14
XEU1-12-050-600360-	5	600	3	5.2	6.6	15	14
XEU1-12-075-208160-	7.5	208	1	38.4	47.9	50	8
XEU1-12-075-240160-	7.5	240	1	33.7	42.1	45	8
XEU1-12-075-208360-	7.5	208	3	21.9	27.4	30	10
XEU1-12-075-240360-	7.5	240	3	19.1	23.9	25	10
XEU1-12-075-480360-	7.5	480	3	9.6	12.0	15	14
XEU1-12-075-600360-	7.5	600	3	7.6	9.6	15	14
XEU1-12-100-240160-	10	240	1	44.1	55.1	60	6
XEU1-12-100-208360-	10	208	3	28.9	36.1	40	8
XEU1-12-100-240360-	10	240	3	25.2	31.4	35	8
XEU1-12-100-480360-	10	480	3	12.6	15.7	20	12
XEU1-12-100-600360-	10	600	3	10.1	12.6	15	14
XEU1-16-150-208360-	15	208	3	42.7	53.4	60	6
XEU1-16-150-240360-	15	240	3	37.2	46.5	50	8
XEU1-16-150-480360-	15	480	3	18.6	23.2	25	10
XEU1-16-150-600360-	15	600	3	14.9	18.6	20	12
XEU1-16-200-480360-	20	480	3	24.6	30.8	35	8
XEU1-16-200-600360-	20	600	3	19.7	24.6	25	10
XEU1-20-250-480360-	25	480	3	31.3	39.1	40	8
XEU1-20-250-600360-	25	600	3	25.1	31.3	35	8
XEU1-20-300-480360-	30	480	3	37.3	46.6	50	8
XEU1-20-300-600360-	30	600	3	29.9	37.3	40	8
XEU1-20-350-480360-	35	480	3	43.3	54.1	60	6
XEU1-20-350-600360-	35	600	3	34.7	43.3	45	8

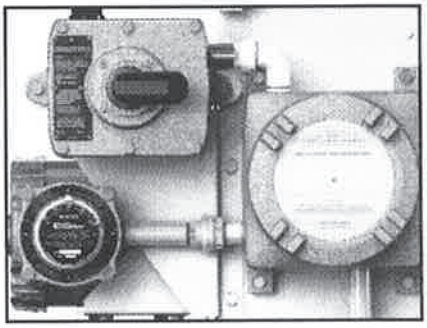


Figure 1

— WARNING! —

Heater is to be serviced only by qualified electrician experienced with hazardous location equipment.

Explosion/Electric Shock Hazard. Disconnect heater from power supply or fuse box before opening enclosures or servicing heater. Lock the switch in the "OFF" (open) position and/or tag the switch to prevent unexpected power application.

— Repair and Replacement —

Heat Exchanger Replacement (See Page 10 for assembly diagram)

The heat exchanger core assembly has been fluid filled and vacuum sealed at the factory and is not field repairable. Replacement heat exchanger core assemblies are available from the factory and are inspected and electrically tested for correct heat output and proper operation of the high-limits.

1. **Explosion/Electric Shock Hazard.** Disconnect heater from power supply or fuse box before opening enclosures or servicing heater. Lock the switch in the "OFF" (open) position and/or tag the switch to prevent unexpected power application.
2. To prevent burn hazard, be sure heat exchanger and fluid has been allowed to cool before proceeding.
3. Remove cabinet bottom panel, element housing cover, element enclosure cover, & control enclosure cover.
4. From the control enclosure, disconnect two high-limit wires from printed circuit board terminal block marked 3 & 4 and disconnect three output heating element wires from contactor terminals marked T1, T2, & T3.
5. Slightly loosen all cabinet bolts and louver screws to prevent heat exchanger from binding.
6. The heat exchanger is secured by three 1/4 in. bolts on the right-side cabinet panel (when facing front of heater) and one 1/4 in. bolt located on the left side of heater. On 3 - 10 kW models the left-side bolt is located at the top right-hand foot of control enclosure. On 15 - 35 kW models the left-side bolt is located above the control enclosure. With an assistant supporting the weight of the heat exchanger remove these 4 bolts. Carefully lower the heat exchanger from the cabinet.
7. Reverse the above procedure when installing a new heat exchanger.

Temperature High-Limit Replacement (See Page 10 for assembly diagram)

This heat-exchanger includes one automatic reset & one manual reset temperature high-limit that are wired in series. The automatic reset high-limit is rated for 100,000 cycles and is for a temporary failure condition. Continuous nuisance tripping of the automatic reset is generally not the fault of the high-limit but is usually caused by incorrect operating voltage, blocked air inlet or outlet, fan/motor malfunction, high ambient temperatures, excessively dirty heat exchanger or leaking heat exchanger. **Care should be taken to determine the exact reason that the automatic reset high-limit control tripped so the problem can be resolved immediately.** The automatic reset high-limit normally fails in the open position, however, it can also fail closed.

If the automatic reset fails in the open position the heater will not function and the high-limit should be replaced. **The occurrence of the manual reset high-limit control to trip is an abnormal condition and indicates that the automatic reset high-limit has failed in the closed position. If this occurs remove the heater from service immediately and replace both the automatic and manual reset high-limits. Determine the exact reason that the automatic reset high-limit control tripped so the problem can be resolved immediately.** If the manual reset high-limit shuts down the heater it will have to be reset by pressing on the small reset button protruding from the center of the high-limit device.

1. De-energize the heater electrical supply circuit.
2. Remove element housing cover, and element enclosure cover.
3. Remove the wires from both the auto and manual high limits, make note of the wire position and connection points.
4. Remove automatic reset high-limit assembly by unscrewing (counter-clockwise), clean the inside of the thermowell. A clean thermowell ensures good thermal contact.
5. Remove manual reset high-limit assembly by removing the two retaining screws, clean any residual heat sink compound from the housing surface. A clean housing surface ensures good thermal contact
6. Replace both the auto and manual high-limits with factory supplied units only. Apply heat sink compound to the bottom of the auto high-limit, and screw into thermowell. Apply heat sink compound to the bottom of the manual high-limit and attach to the housing using the two screws.
7. Re-attach the wires to both high limits.
8. Replace element housing cover, and element enclosure cover.
9. Energize the heater electrical supply circuit and let run for 15 minutes to reach a stable operating temperature.
10. If heater operation appears to be normal, place unit into service.

— WARNING! —

Heater is to be serviced only by qualified electrician experienced with hazardous location equipment.

Explosion/Electric Shock Hazard. Disconnect heater from power supply or fuse box before opening enclosures or servicing heater. Lock the switch in the "OFF" (open) position and/or tag the switch to prevent unexpected power application.

— Repair and Replacement, Continued —

Fan, Fan Guard or Motor Replacement (See Page 10 for assembly diagram)

The motor is a sealed unit that requires no lubrication. If the motor is defective, it must be replaced with an original factory supplied motor.

1. Remove four bolts holding motor to the motor mount, and covers from junction box and control enclosure. On units with an integral room thermostat, remove 4 bolts on front face of thermostat enclosure .
2. Detach and remove two-piece fan guard assembly by removing top and bottom screws that attach the fan guard to the cabinet.
3. Loosen fan blade set screw and remove fan blade from end of motor shaft leaving it in fan panel opening.
4. Unscrew the expansion union fitting between motor and motor enclosure (or integral thermostat enclosure).
5. **If replacing motor**, note wire connections for future reference and cut all wires leading to the motor close to the terminations. All motor wires are permanently marked according to the nameplate on the motor. Lift the motor assembly off the motor mount.
6. **If replacing fan blade only** do not cut any wires and move the motor assembly back sufficient to assist fan blade removal.
7. To reassemble, place fan blade inside fan panel opening and then place motor onto motor mount. Slip fan blade onto motor shaft and ensure fan hub is flush with end of motor shaft. Tighten set screw to 150 in-lbs torque.
8. Fasten the two-piece fan guards to the cabinet.
9. Tighten conduit fittings between motor and motor enclosure (or integral thermostat enclosure). Center fan in fan-panel opening and leave approximately 1/16" to 3/16" (1.6 to 4.8 mm) gap between motor face and fan guard.
10. Bolt motor to motor mount, tighten nuts to 250 in-lbs torque. Manually spin the fan blade to ensure it rotates freely before reconnecting heater to power supply. Fan must rotate counterclockwise when viewed from rear of heater.

Torque Settings	
Item	**Torque (in-lbs)**
Fan blade set screw (1 only)	150
5/16 - 18 UNC motor nuts	250
5/16 - 18 UNC motor mount bolts	250
1/4 - 20 UNC fan panel bolts	100
1/4 - 20 UNC fan guard self tapping screws	100
#10 - 24 UNC louver blade screws	28

Contactor (See Page 10 for assembly diagram)

1. Loosen, but do not remove contactor mounting screws. Slide contactor off mounting screws.
2. Replace with a factory supplied contactor of the same rating.

Transformer (See Page 10 for assembly diagram)

1. Replace with a factory supplied transformer of the same rating.
2. On the new transformer, select primary wires to match heater voltage. Ensure that the correct transformer secondary lead is grounded (see Page 9 wiring diagram). Individually terminate all unused wires using closed end connections.

Printed Circuit Board (See Page 10 for assembly diagram)

1. Replace with a factory supplied printed circuit board (see Page 9 wiring diagram).

Thermal Delay Fuse (See Page 10 for assembly diagram)

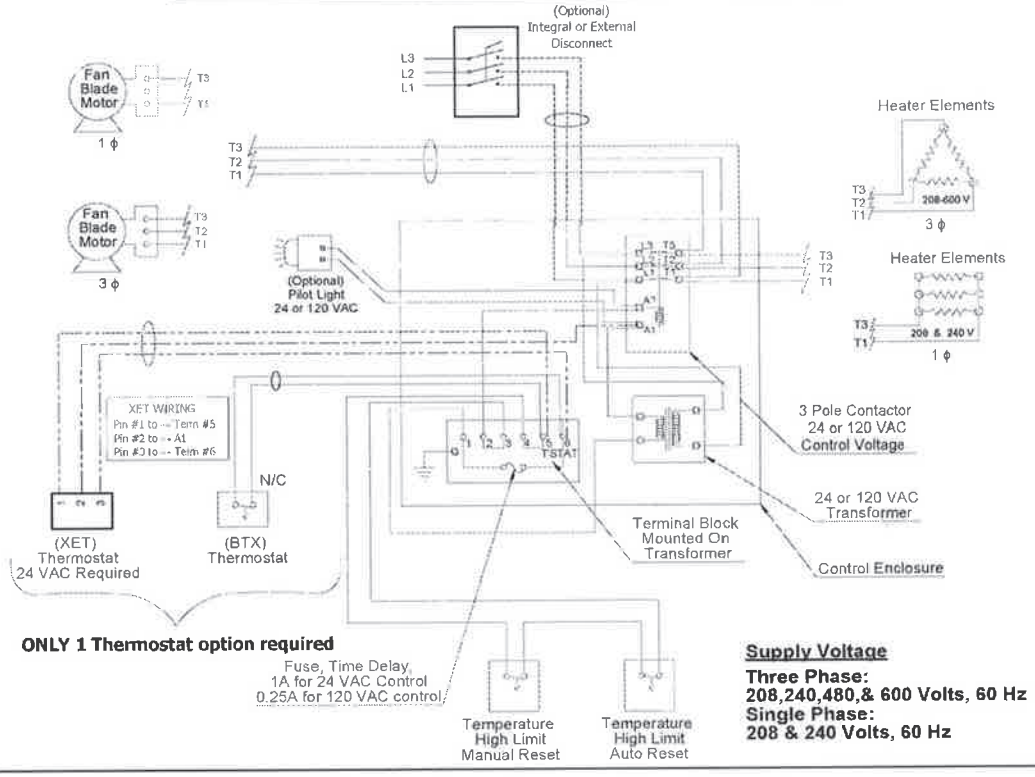
1. Replace fuse with one of the same type and rating as indicated on printed circuit board or refer to parts list. An extra fuse should be stored in the clips marked "SPARE".

— Warning —

Wiring should only be connected by qualified personnel experienced in electrical work.

— Electrical Wiring —

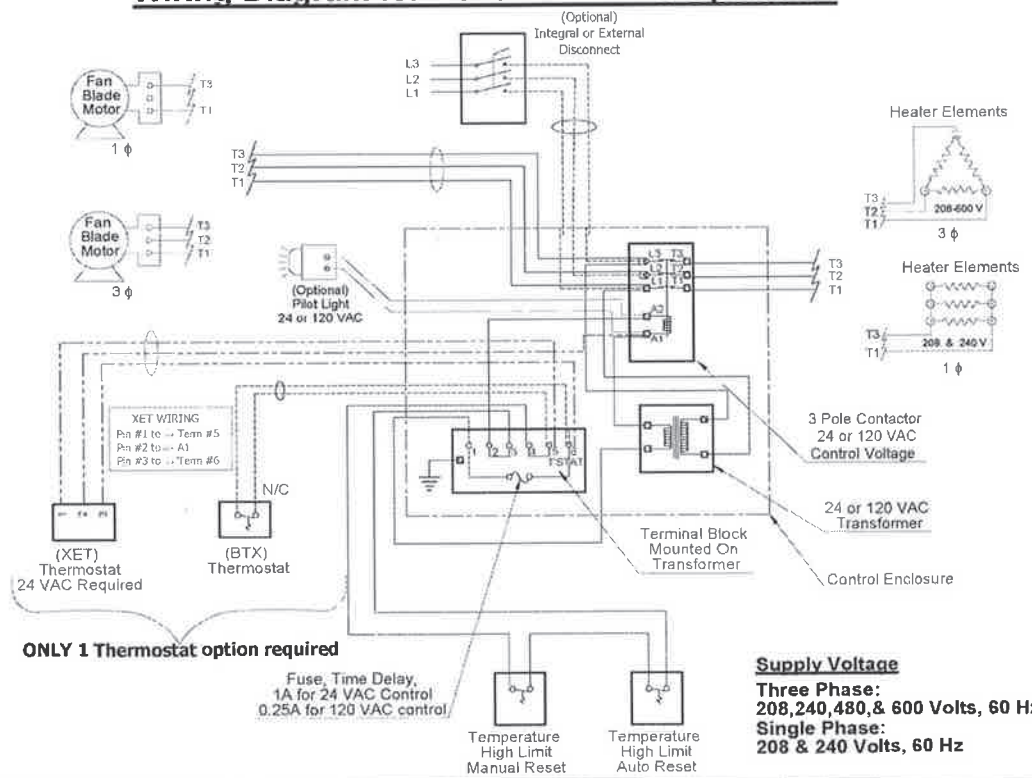
Wiring Diagram for Standard Fan Operation



Supply Voltage

Three Phase:
208,240,480,& 600 Volts, 60 Hz
Single Phase:
208 & 240 Volts, 60 Hz

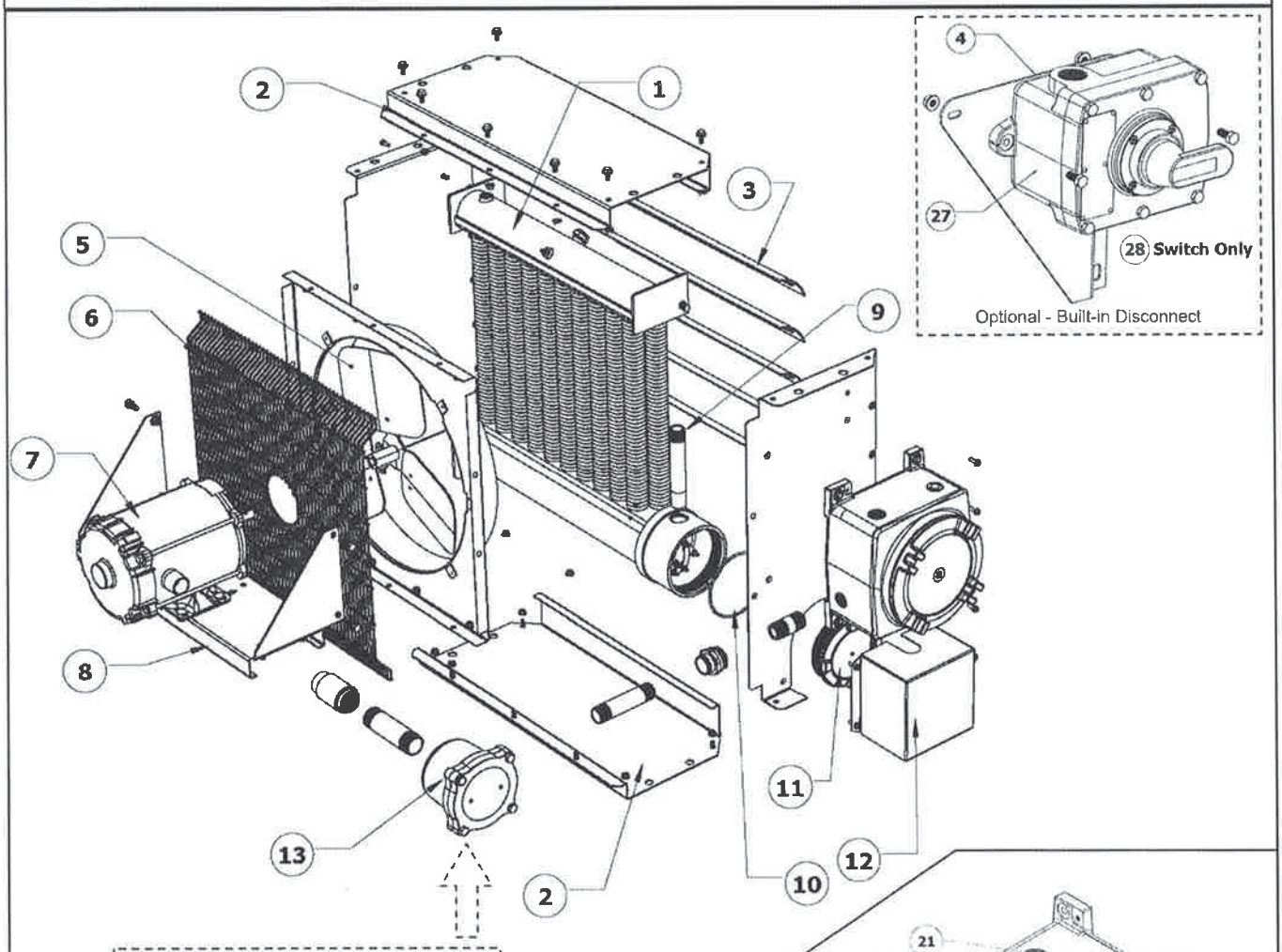
Wiring Diagram for Continuous Fan Operation

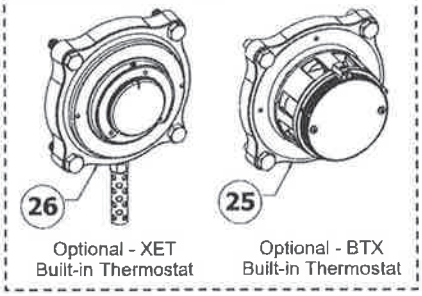


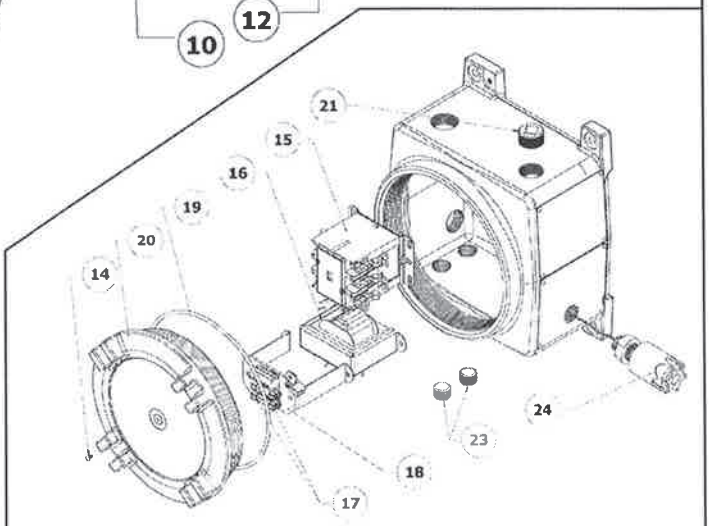
Supply Voltage

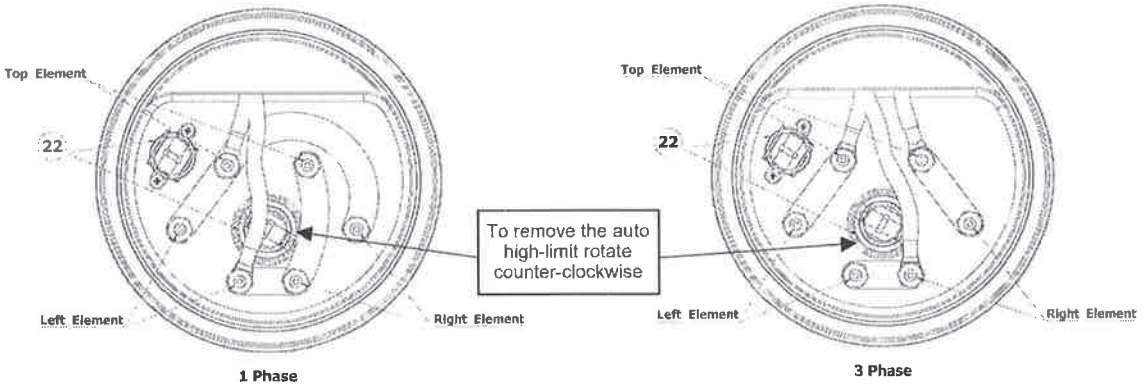
Three Phase:
208,240,480,& 600 Volts, 60 Hz
Single Phase:
208 & 240 Volts, 60 Hz

— Assembly Diagram —









— Parts List —

*** Please have model & serial number available before calling ***

Item No.	Description	12" Fan Size		16" Fan Size	20" Fan Size
		3, 5 & 7.5 kW	10 kW	15 & 20 kW	25, 30 & 35 kW
1	Core Assembly (with bus bars)	Specify Voltage, Phase, and Kilowatts (V-Ph-kW)			
2	Panel, Top or Bottom	1048		1049	1050
3	Louver Blade Kit	1625		1626	1627
4a	Bracket, Disconnect Switch, Left	1456			
4b	Bracket, Disconnect Switch, Right	1457			
5	Fan Blade	3.0 kW = 1544 5.0 kW = 1545 7.5 kW = 1546	10.0 kW = 1547	15.0 kW = 1548 20.0 kW = 1549	25.0 kW = 1550 30.0 & 35.0 kW = 1551
6	Fan Guard Kit	1157		1158	1159
7	Motor, Explosion-proof	115/208-230V, 1Ø, 60Hz = G639 208-230/460V, 3Ø, 60Hz = G646 575V, 3Ø, 60Hz = G664			208-230/460V, 3Ø, 60Hz = G649 575V, 3Ø, 60Hz = G666
8	Motor Mount Kit	1151		1152	1153
9	Vertical Conduit Kit	1072		1073	1074
10	O-ring, Element Enclosure Cover	1080			
11	Element Enclosure Cover Kit (includes o-oring, item #10)	1081			
12	Guard, Element Enclosure	1082			
13	Junction Box, BLK1, Built-in	1630			
14	Set Screw, Control Enclosure	1083			
15	Contactor	120V = 1553, 24V = 1084			
16	Transformer	120V = 1555, 24V = 1554			
17	Fuse, Time Delay	120V = 1/4 Amp (1556), 24V = 1 Amp (1087)			
18	Printed Circuit Board Assembly (includes #17, 2 pieces)	120V = 1307, 24V = 1086			
19	O-ring, Control Enclosure Cover	1088			
20	Control Enclosure Cover Kit (includes #14 and #19)	1089			
21	Plug, 3/4" NPT Explosion-proof	1090			
22	High Limit Kit (includes both auto and manual high limits)	1102			
23	Plug, 1/2" NPT Explosion-proof	1094			
24	Light, Pilot (Green LED)	120V = 1558, 24V = 1557			
25	Thermostat, BTX1, Built-in	1628 - 120VAC or 24VAC			
26	Thermostat, XET1, Built-in	1629 - 24VAC Only			
27	Disconnect, XDC-01, 600V, 50 Amp	1583			
28	Switch, 600V, 50 Amp (for XDC-01)	1632			

— WARNING! —

Heater should only be service by qualified personnel experienced in electrical work.

Disconnect unit heater from power supply before starting any service or repair work. Lock the disconnect switch in the "OFF" (open) position and/or tag the switch to prevent unexpected power application. Failure to follow these procedures may result in severe or fatal injury.

— Maintenance Program —

Regular inspection, based on a schedule determined by the amount of dirt in the atmosphere, assures maximum operating economy and heating capacity.

Annual Inspection (before each heating season)

1. Check all terminal connections and electrical conductors for damage, looseness, defects, fraying, etc. and replace or tighten where applicable.
2. Inspect contactor contacts. If badly pitted, burned or welded shut, replace with factory supplied contactor. It is recommended that the contactor be replaced every two (2) years.
3. Inspect thermal delay fuses. Fuse rating and type are printed on circuit board. Correct fuse must be in the "ACTIVE" fuse clip. An extra fuse should be stored in the clips marked "SPARE".
4. Check for fluid leakage from heat-exchanger. The heat exchanger is filled with a mixture of water and inhibited **ethylene glycol, which is poisonous,** and is factory vacuum-sealed. If fluid leakage occurs, remove heater from service and have the heat-exchanger replaced by a factory replacement unit. Refer to "Repair and Replacement" section for complete details. Do not attempt to loosen or tighten the vacuum plug or pressure relief device. A loss of vacuum could cause nuisance tripping of the thermal cutouts or high pressures which will cause the relief device to actuate with an accompanying loss of fluid.
5. Check all explosion-proof conduit and fittings. Replace damaged components. All threaded conduit connections must have a minimum 5 turns of engagement. Taper threaded connections must be at least hand tight. Inside of enclosures must be clean, dry, and free from any foreign materials. Enclosure covers must also be completely on and tight.
6. Check electrical resistance on all load side legs. Reading should be balanced (± 5%).
7. Check motor shaft bearing play. Replace motor if play is excessive or if motor does not run quietly and smoothly. Motor bearings are permanently lubricated.
8. Check fan blade. Replace immediately if cracked or damaged.
9. Check louvers. Louver screws should be tight. Louvers must not be set less than 30 degrees of the closed position.
10. Check the tightness of all hardware. All nuts and bolts, including mounting hardware, must be tightened to correct torque settings on Page 8.
11. Turn heater motor on for a minimum of 10 minutes. Crackling or pinging noises within the heater during start up may occur. This is normal. Check for air exiting heater through louvers and smooth running of motor.

Periodic Maintenance (before and as required during heating season)

1. Clean the following (remove dust using compressed air):
   - Finned tubes
   - Fan
   - Fan Guard
   - Motor
   - Louvers

   ⇒ Wipe cabinet with a damp cloth to remove any remaining dirt / dust and to mitigate any electrostatic charge buildup

2. Check the following:
   - Motor for smooth and quiet operation
   - Louvers for proper angle and tightness
   - All explosion-proof covers and fittings for tightness
   - Contactor for signs of wear or pitting
   - Drain in control enclosure is free of blockage (if installed)

HEATER MAINTENANCE RECORD

Heater Model: _____ Serial No.: _____

Date of Maintenance	Performed By	Maintenance Performed

NOTES

NOTES

Limited 36-Month Warranty

Hazloc Heaters™ warrants all **XEU1** series of explosion-proof electric heaters against defects in materials and workmanship under normal conditions of use for a period of thirty-six (36) months from date of purchase based on the following terms:

1. The heater must not be modified in any way.
2. The heater must be stored, installed and used only in accordance with the owner's manual and attached data plate information.
3. Replacement parts will be provided free of charge as necessary to restore any unit to normal operating condition, provided that the defective parts be returned to us freight prepaid and that the replacement parts be accepted freight collect.
4. The complete heater may be returned to our manufacturing plant for repair or replacement (at our discretion), freight charges prepaid.
5. Components damaged by contamination from dirt, dust, etc. or corrosion will not be considered as defects.
6. This warranty shall be limited to the actual equipment involved and, under no circumstances, shall include or extend to installation or removal costs, or to consequential damages or losses.

Hazloc Heaters™
Safe heat when you need it!

#1, 666 Goddard Ave. NE
Calgary, Alberta T2K 5X3
Canada
Tel.: +1-403-730-2488
Fax: +1-403-730-2482
Customer Toll Free (U.S. & Canada):
+1-866-701-Heat (4328)
www.HazlocHeaters.com

PRINTED IN CANADA

Overview

SITRANS Probe LU is a 2-wire loop powered ultrasonic transmitter for level, volume, and flow monitoring of liquids in storage vessels and simple process vessels, as well as in open channels.

Benefits

- Continuous level measurement up to 12 m (40 ft) range
- Easy installation and simple startup
- Programming using infrared intrinsically safe handheld programmer, SIMATIC PDM, or HART® Communicator
- Communication using HART
- ETFE or PVDF transducers for chemical compatibility
- Patented Sonic Intelligence signal processing
- Extremely high signal-to-noise ratio
- Auto False-Echo Suppression for fixed obstruction avoidance

Application

The SITRANS Probe LU is ideal for level monitoring in the water and wastewater industry and chemical storage vessels.

The range of SITRANS Probe LU is 6 or 12 meters (20 or 40 feet). Using Auto False-Echo suppression for fixed obstruction avoidance, as well as an improved signal-to-noise ratio, and improved accuracy of 0.15% of range or 6 mm (0.25"), the Probe LU provides unmatched reliability.

SITRANS Probe LU includes Sonic Intelligence® signal processing from the field-proven Milltronics Probe, and incorporates new echo processing features and the latest micro-processor and communications technology.

The transducer on the Probe LU is available as ETFE or PVDF to suit the chemical conditions of your application. As well, for applications with varying material and process temperatures, the Probe LU incorporates an internal temperature sensor to compensate for temperature changes.

Technical specifications

Mode of operation	
• Measuring principle	Ultrasonic level measurement
• Typical application	level measurement in storage vessels and simple process vessels
Inputs	
Measuring range	
• 6 m (20 ft) model	0.25 to 6 m (10" to 20 ft)
• 12 m (40 ft) model	0.25 to 12 m (10" to 40 ft)
Frequency	54 KHz
Outputs	
mA	
• range	4 to 20 mA
• accuracy	± 0.02 mA
• span	proportional or inversely proportional
Beam angle	10°
Performance	
• Resolution	≤ 3 mm (0.12")
• Accuracy	± the greater of 0.15% of range or 6 mm (0.25")
• Repeatability	≤ 3 mm (0.12")
• Blanking distance	0.25 m (10")
• Update time at 4 mA	≤ 5 seconds
• Temperature compensation	built-in to compensate over temperature range
Rated operating conditions	
• Ambient conditions	
- Location	Indoor/outdoor
- Ambient temperature	-40 to 80 °C (-5 to 176 °F)
- Relative humidity/ingress protection	Suitable for outdoor
- Installation category	I
- Pollution degree	4
• Medium conditions	
- Temperature at flange or threads	-40 to 85 °C (-5 to 185 °F)
- Pressure (vessel)	ambient, vented to atmosphere
Design	
• Material (enclosure)	PBT (Polybutylene Terephthalate)
• Degree of Protection	Type 4X/NEMA 4X, Type 6/NEMA 6/IP67/IP68 enclosure
• Weight	2.1 kg (4.6 lbs)
• Cable inlet	2 x M20x1.5 conduit gland or 2 x ½" NPT thread
• Transducer (2 options)	ETFE (Ethylene Tetrafluoroethylene) or PVDF (Polyvinylidene Fluoride)
• Process connection	
- threaded connection	2" NPT, BSP, or G/PF
- flange connection	3" (80 mm) universal flange
- other connection	FMS 200 mounting bracket or customer supplied mount

SITRANS Probe LU

Display and Controls

• Interface	HART: standard, integral to analog output
• Configuration	Using Siemens SIMATIC PDM (PC) or HART handheld communicator, or Siemens Milltronics infrared handheld programmer
• Memory	non-volatile EEPROM, no battery required

Programmer (optional infrared keypad)

• approval	ATEX II 1 G, EEx ia IIC T4
• ambient temperature	-20 to 40 °C (-5 to 104 °F)
• interface	proprietary infrared pulse signal
• power	3 V lithium battery (non-replaceable)

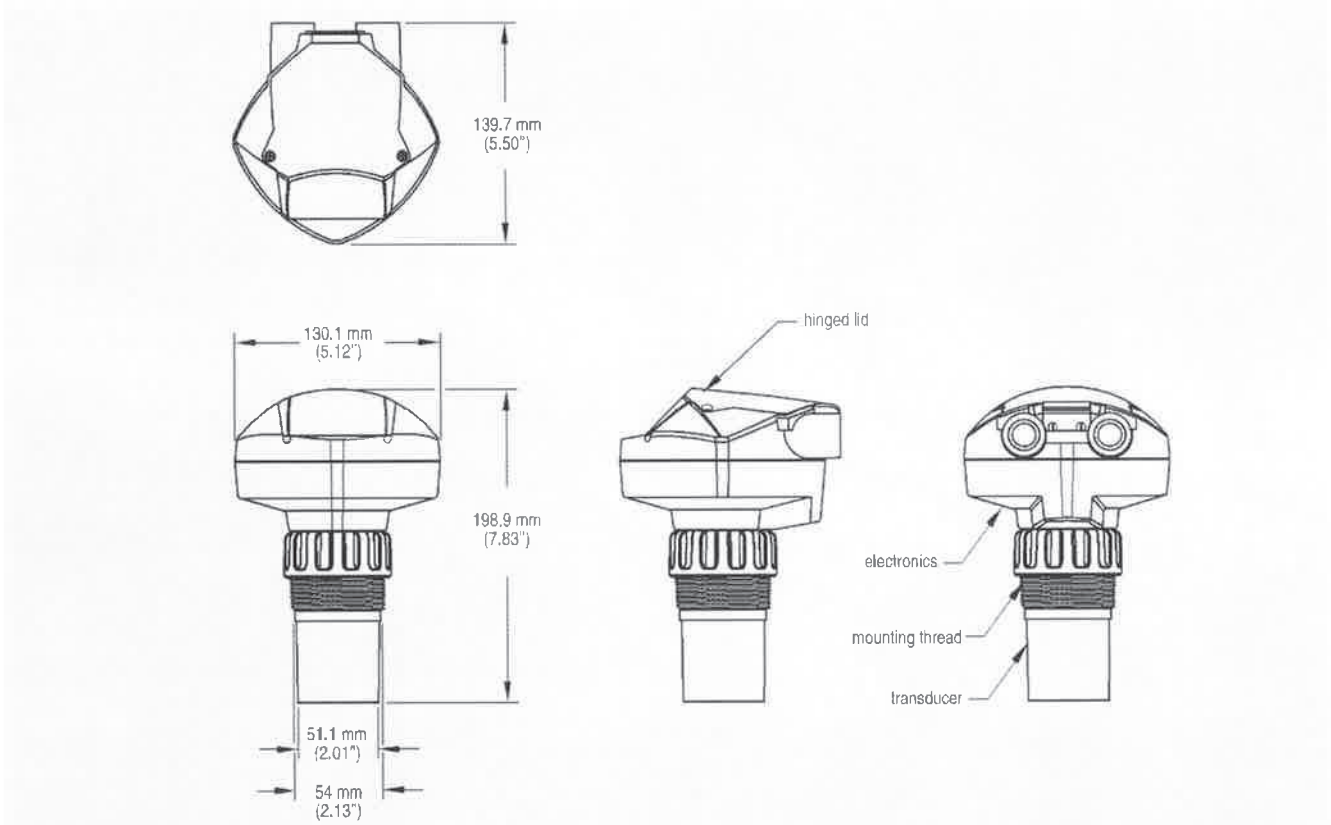
Power supply

Standard	nominal 24 V DC with 550 ohm maximum; maximum 30 V DC 4 to 20 mA

Approvals

General	$CSA_{US/C}$, FM, CE
Hazardous	
• Europe	ATEX II 1G EEx ia IIC T4
• USA	FM Class 1, Div. 1, Groups A, B, C, D (barrier required); Class II, Div. 1, Groups E, F, G; Class III
• Canada	CSA Class 1, Div. 1, Groups A, B, C, D (barrier required); Class II, Div. 1, Group G; Class III

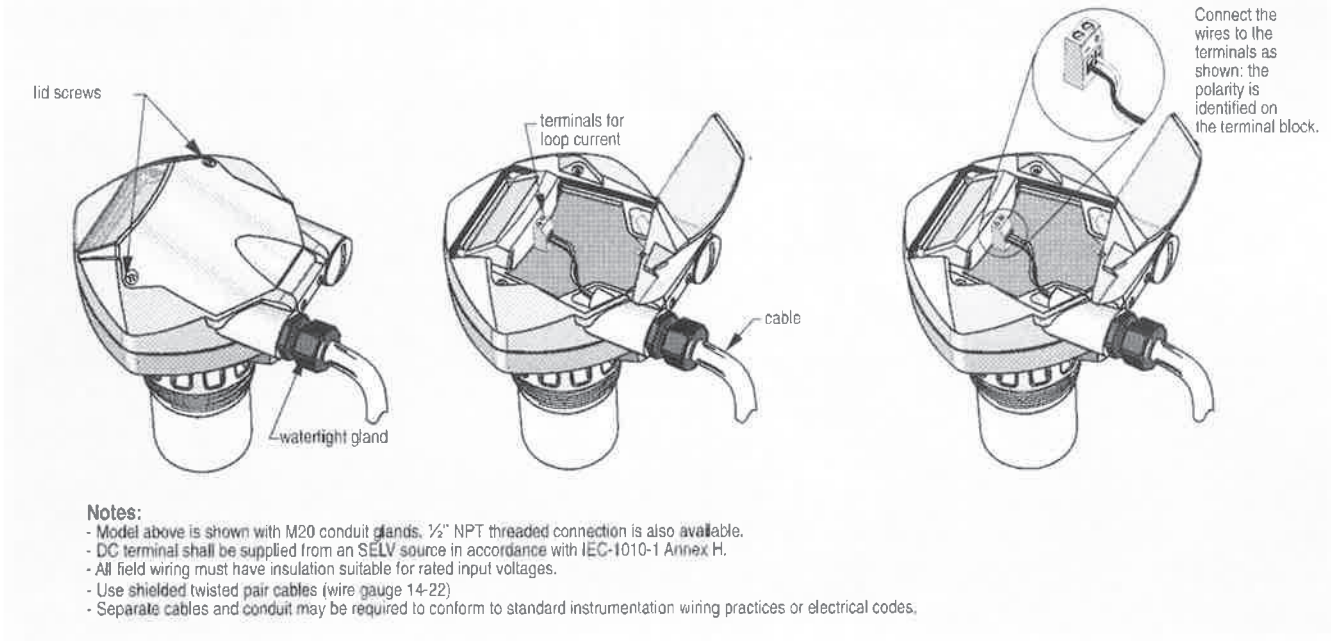
Dimensional drawings



Note: Above model is shown without M20 conduit glands or ½" NPT conduit connectors.

SITRANS Probe LU dimensions

Schematics



Notes:
- Model above is shown with M20 conduit glands. ½" NPT threaded connection is also available.
- DC terminal shall be supplied from an SELV source in accordance with IEC-1010-1 Annex H.
- All field wiring must have insulation suitable for rated input voltages.
- Use shielded twisted pair cables (wire gauge 14-22)
- Separate cables and conduit may be required to conform to standard instrumentation wiring practices or electrical codes.

SITRANS Probe LU connections

SITRANS Probe LU

Ordering data		Order No.
SITRANS Probe LU	C)	**7ML5221 -**
2-wire loop powered ultrasonic transmitter for level, volume, and flow monitoring of liquids		■■■■■
Enclosure		
Plastic (PBT), Qty 2 x M20x1.5		1
Plastic (PBT), Qty 2 x 1/2" NPT		2
Range / Sensor material		
6 meter (20 ft), ETFE		A
6 meter (20 ft), PVDF Copolymer		B
12 meter (40 ft), ETFE		C
12 meter (40 ft), PVDF Copolymer		D
Process Connection		
2" NPT		A
2" BSP		B
2" G / PF2		C
Communication / Output		
4 to 20 mA, HART		1
Approvals		
General purpose, FM, CSA, CE		1
Intrinsically Safe, FM Class 1, Div. 1, Groups A, B, C, D (barrier required); Class II, Div. 1, Groups E, F, G; Class III, ATEX II 1G EEx ia IIC T4		2
Intrinsically Safe, CSA Class 1, Div. 1, Groups A, B, C, D (barrier required); Class II, Div. 1, Group G; Class III		3
Instruction Manual		
English	C)	**7ML1998-5HT01**
German	C)	**7ML1998-5HT31**
Note: The instruction manual should be ordered as a separate item on the order.		
Additional Quick start manual		
Multi-language Quick start manual	C)	**7ML1998-5QR81**
Note: Due to ATEX regulations, one Quick start manual is included with every product.		
Optional Equipment		
Hand programmer, Intrinsically Safe, EEx ia		**7ML5830-2AH**
HART modem (for use with a PC and SIMATIC PDM)	A)	**7MF4997-1DA**
Siemens Intrinsically Safe Barrier (DC powered), ATEX II 1 G, EEx ia		**7NG4122-1AA10**
2" NPT locknut, plastic		**7ML1830-1DT**
2' BSP locknut, plastic		**7ML1830-1DQ**
Universal Mounting Adapter, 2" NPT		**7ML1830-1BT**
Universal Mounting Adapter, 2" BSP		**7ML1830-1BU**
Universal Mounting Adapter, 2" G / PF2		**7ML1830-1BV**

A) Subject to export regulations AL: N, ECCN: EAR99H

C) Subject to export regulations AL: N, ECCN: EAR99

ENGLISH

Quick Start Guide - ATV 61

S1B8697400

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand this quick start guide before performing any procedure with this drive.
- The user is responsible for compliance with all international and national electrical code requirements with respect to grounding of all equipment.
- Many parts of this drive, including the printed circuit boards, operate at the line voltage. DO NOT TOUCH. Use only electrically insulated tools.
- DO NOT touch unshielded components or terminal strip screw connections with voltage present.
- DO NOT short across terminals PA/+ and PC/- or across the DC bus capacitors.
- Before servicing the drive:
  - Disconnect all power, including external control power that may be present.
  - Place a "DO NOT TURN ON" label on all power disconnects.
  - Lock all power disconnects in the open position.
  - WAIT 15 MINUTES to allow the DC bus capacitors to discharge.
  - Measure the voltage of the DC bus between the PA/+ and PC/- terminals to ensure that the voltage is less than 42 Vdc.
  - If the DC bus capacitors do not discharge completely, contact your local Schneider Electric representative. Do not repair or operate the drive
- Install and close all covers before applying power or starting and stopping the drive.

Failure to follow these instructions will result in death or serious injury.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this product.

Information below is designed to use **single drive** connected to **single asynchronous motor with a motor cable length less than 50 meters (164ft).** In any other case, consult the drive installation manuals (1760643 or 1760655) and programming manual (1760649) on www.schneider-electric.com.

❶ Check the delivery of the drive

- Remove the drive from the packaging and check that it has not been damaged.

⚠ WARNING

DAMAGED DRIVE EQUIPMENT

Do not operate or install any drive or drive accessory that appears damaged.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

- Check that the drive reference printed on the label matches the delivery note and corresponding purchase order.

Write the drive Model Reference: _____ _____and Serial Number: _____

❷ Check the line voltage compatibility

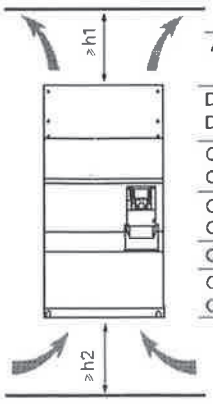
- Check that the **line voltage** is compatible with the supply range of the drive.

Line voltage _____ Volts Drive voltage range _____ Volts

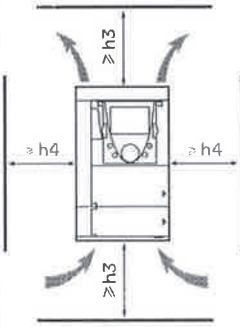
Drive range: ATV●●●●●● M3 = 200/ 240 V three-phase - ATV●●●●●● N4 = 380 /480 V three-phase

ATV●●●●●● Y = 500 /690 V three-phase - ATV●●●●●● S6 = 500 /600 V three-phase

❸ Mount the drive vertically



ATV61H	h1 mm (in.)	h2 mm (in.)
D55M3X, D75M3X, D90M3X, D90N4, C11N4	100 (3.9)	100 (3.9)
C13N4, C16N4, C22N4, C11Y, C13Y, C16Y, C20Y	150 (5.9)	150 (5.9)
C25N4, C31N4, C25Y, C31Y, C40Y	200 (7.8)	150 (5.9)
C40N4, C50N4	300 (11.8)	250 (9.8)
C63N4, C50Y, C63Y, C80Y	400 (15.7)	250 (9.8)



ATV61H	h3 mm (in.)	h4 mm (in.)
D18M3X to D45M3X, D22N4 to D75N4 U30Y to D90Y	100 (3.9)	50 (1.9)
075M3 to D15M3X, 075N4 to D18N4, U22S6X to U75S6X		

Free space in front of the drive: 10 mm (0.4 in.) minimum

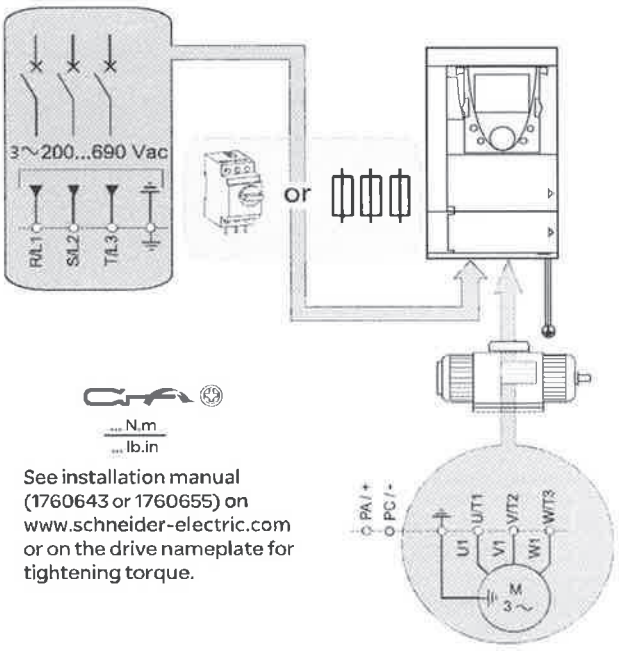
Install the drive vertically at ± 10°.

For a surrounding air temperature up to 50 °C (122°F), see installation manual (1760643 or 1760655) on www.schneider-electric.com for other thermal conditions.

Schneider Electric

❹ Connect the drive: Power

- Wire the drive to the ground.
- Check circuit breaker rating or fuse rating (See SCCR annex S1B86981).
- Check that the motor voltage is compatible with the drive voltage. Motor voltage _____Volts.
- Wire the drive to the motor.
- Wire the drive to the line supply.



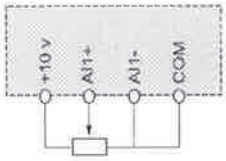
... N.m
... lb.in

See installation manual (1760643 or 1760655) on www.schneider-electric.com or on the drive nameplate for tightening torque.

❺ Connect the drive: Control by external reference (Fr1 = AI1)

0,6 N.m
5,3 lb.in

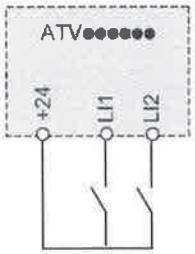
- **Wire the speed reference:**



- **Wire the command:**

Control command 2-wire:
Parameter t C C = 2 C

LI1: forward
LI2: reverse



⚠⚠ DANGER

HAZARD OF FIRE OR ELECTRIC SHOCK

- To avoid overheating or loss of contact, connections must be carried out according to the cable sizes and tightening torques visible on the label stuck on the ATV●●.
- The use of multi-wire cable without a lug is forbidden for the mains connection.
- Carry-out a pull out test to check that terminal screws are correctly tighten.

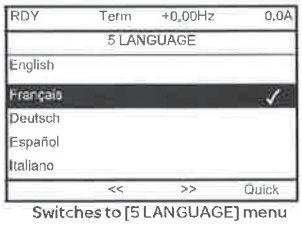
Failure to follow these instructions will result in death or serious injury.

❻ Apply power to the drive

- Check that Logic Inputs are not active (LI1, LI2, see drawing ❺).
- Apply power to the drive.
- At first power up, it's displaying the drive state.

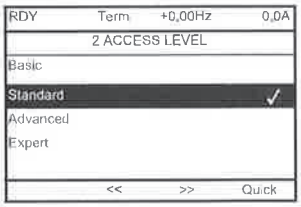
Display for 3 seconds following power-up

3 seconds



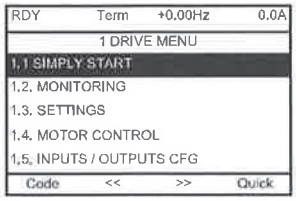
Switches to [5 LANGUAGE] menu automatically after 3 seconds. Select the language and press ENT

ENT



ENT

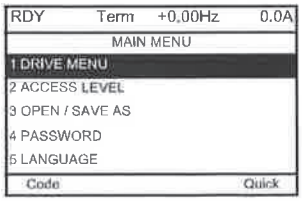
Switches to [2 ACCESS LEVEL] menu



Switches to [1 DRIVE MENU]

ESC

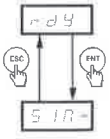
2 times



Press ESC to return to [MAIN MENU].

With integrated display terminal.

At first power ON



❼ Set motor parameters for asynchronous motor.

- See on the motor Nameplate to set the following parameters .

Menu	Code	Description	Factory setting	Customer setting
5 IN - [1.1 SIMPLY START]	bFr	[Standard mot. freq]: Standard motor frequency (Hz)	[50Hz IEC] 50	
	nPr	[Rated motor power]: Nominal motor power on motor nameplate (KW)	drive rating	
	UnS	[Rated motor volt.]: Nominal motor voltage on motor nameplate (Vac)	drive rating	
	nCr	[Rated mot. current]: Nominal motor current on motor nameplate (A)	drive rating	
	FrS	[Rated motor freq.]: Nominal motor frequency on motor nameplate (Hz)	50	
	nSP	[Rated motor speed]: Nominal motor speed on motor nameplate (rpm)	drive rating	
	ItH	[Mot. therm. current]: Motor thermal protection current on the motor's rating plate (A)	drive rating	

Menu	Code	Description	Factory setting	Customer setting
5 IN - [1.1 SIMPLY START]	tUn	Set [Auto tuning] (tUn) parameter to YES. Auto-tuning is performed as soon as possible, then the parameter automatically changes to [Done] (dOnE).	no	

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK OR ARC FLASH

- During auto-tuning, the motor operates at rated current.
- Do not service the motor during auto-tuning.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

DAMAGED DRIVE EQUIPMENT

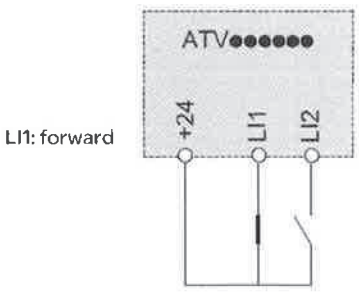
- **Asynchronous motor:** It is essential that the following parameters UnS, FrS, nCr, nSP and nPr are correctly configured before starting autotuning.
- **Synchronous motor:** It is essential that the following parameters nCrS, nSPS, PPnS, PHS, LdS and LFS are correctly configured before starting autotuning.
- When one or more of these parameters have been changed after auto-tuning has been performed, YES will return to dOnE and the procedure will have to be repeated.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

❽ Set basic parameters

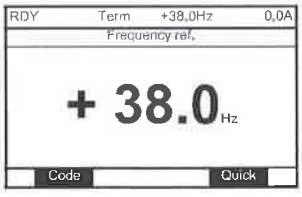
Menu	Code	Description	Factory setting	Customer setting
5 IN - [SIMPLY START]	ACC	[Acceleration]: Acceleration time (s)	3.0	
	dEC	[Deceleration]: Deceleration time (s)	3.0	
	LSP	[Low speed]: Motor frequency at minimum reference (Hz)	0	
	HSP	[High speed]: Motor frequency at maximum reference (Hz)	50	

❾ Start the motor



LI1: forward

Graphic display terminal



Integrated display terminal

Menus structure

Access level

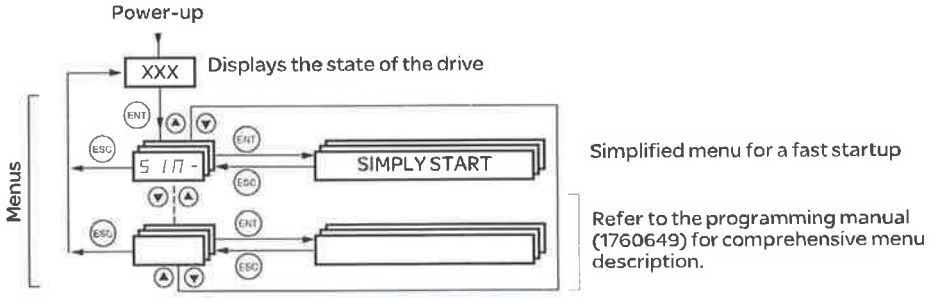
Comparison of the menus that can be accessed on the graphic display terminal/integrated display terminal

Graphic display terminal		Integrated display terminal	[2. ACCESS LEVEL] (LAC-)
[2 ACCESS LEVEL]		LAC -	[Basic] bAS / [Standard] Std (factory setting) / [Advanced] AdU / [Expert] EPr
[3 OPEN/SAVE AS]		-	
[4 PASSWORD]		COd -	
[5 LANGUAGE]		-	
[1 DRIVE MENU]	[1.1 SIMPLY START]	SIM -	
	[1.2 MONITORING]	SUP -	
	[1.3 SETTINGS]	SEt -	
	[1.11 IDENTIFICATION]	-	
	[1.12 FACTORY SETTINGS]	FCS -	
	[1.13 USER MENU]	USr -	
A single function can be assigned to each input.			
	[1.4 MOTOR CONTROL]	drC -	
	[1.5 INPUTS / OUTPUTS CFG]	I-O -	
	[1.6 COMMAND]	CtL -	
	[1.7 APPLICATION FUNCT.]	FUn -	
	[1.8 FAULT MANAGEMENT]	FLt -	
	[1.9 COMMUNICATION]	COM -	
	[1.10 DIAGNOSTICS]	-	
	[1.14 PROGRAMMABLE CARD] (1)	PLC -	
[6 MONITORING CONFIG.]		-	
A single function can be assigned to each input.			
[7 DISPLAY CONFIG.]		-	
Several functions can be assigned to each input			
Expert parameters		EPr -	
Several functions can be assigned to each input.			

(1) can be accessed if the PLC card is present.

Accessing SIMPLY START and parameters.

A dash appears after menu and submenu codes to differentiate them from parameter codes.
Example: [1.1 SIMPLY START] (SIM-), [2/3 wire control] (tCC) parameter.



Certificate CE/ATEX

See on www.schneider-electric.com

CE

ATV61H CE Certificate
ATV61W CE Certificate
ATV61E5 CE Certificate

Ex

07ATEX0004X

ENGLISH

Getting Started
With Altivar Process ATV600

EAV6325304

1 Download The Manuals

You must have detailed information to be able to carry out the installation and commissioning. This information can be found in the following manuals that can be downloaded on www.se.com
or scan the QR code in front of the Drive.

- The Installation manual (EAV64301)
- The Programming manual (EAV64318)

The Getting Started manual does not replace the Installation and the Programming manuals.

Verify the Key Points of your installation, identified by this symbol.

You can watch our Video

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this drive system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.

- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Many components of the product, including the printed circuit boards, operate with mains voltage.
- Only use properly rated, electrically insulated tools and measuring equipment.
- Do not touch unshielded components or terminals with voltage present.
- Motors can generate voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors of the motor cable.
- Do not short across the DC bus terminals or the DC bus capacitors or the braking resistor terminals.
- Before performing work on the drive system:
  - Disconnect all power, including external control power that may be present. Take into account that the circuit breaker or main switch does not de-energize all circuits.
  - Place a **Do Not Turn On** label on all power switches related to the drive system.
  - Lock all power switches in the open position.
  - Wait 15 minutes to allow the DC bus capacitors to discharge.
  - Follow the instructions given in the chapter "Verifying the Absence of Voltage" in the installation manual of the product.
- Before applying voltage to the drive system:
  - Verify that the work has been completed and that the entire installation cannot cause hazards.
  - If the mains input terminals and the motor output terminals have been grounded and short-circuited, remove the ground and the short circuits on the mains input terminals and the motor output terminals.
  - Verify proper grounding of all equipment.
  - Verify that all protective equipment such as covers, doors, grids is installed and/or closed.

Failure to follow these instructions will result in death or serious injury.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this product.

2 Verify The Delivery Of The Drive

Unpack the drive and verify that it has not been damaged. Damaged products or accessories may cause electric shock or unanticipated equipment operation.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Do not use damaged products or accessories.

Failure to follow these instructions will result in death or serious injury.

Contact your local Schneider Electric sales office if you detect any damage whatsoever.

Verify compatibility between your drive and your application with our

Product Selector

3 Verify The Supply Mains Compatibility With The Drive

3-phase supply mains:_____V~

Drive mains voltage: _____V~

ATV••••••M3 = 200/240 V~
ATV••••••N4• = 380/480 V~
ATV••••••S6• = 600 V~
ATV••••••Y6 = 500/690 V~

Verify the quality of the supply mains (harmonics, voltage...).

4 Verify Upstream Protective Device

or

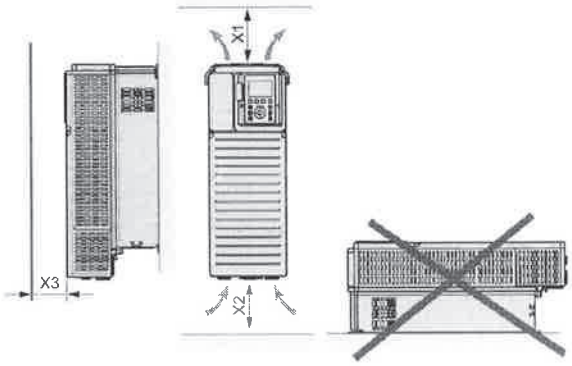
- For IEC, on ATV600 Catalog DIA2ED2140502EN

or

- For UL fuse rating, with attached SCCR annex EAV64300.

Schneider Electric

5 Mount The Drive Vertically ☑

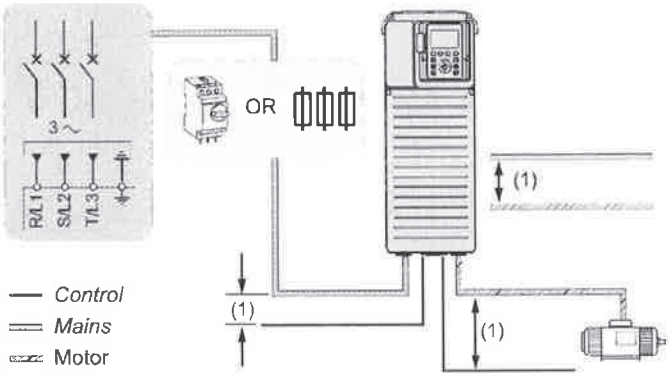


Drive	X1	X2	X3
ATV630U07●●...ATV630D90N4●, ATV630U22S6X...ATV630D15S6X, ATV630●●●S6, ATV630●●●Y6, ATV650●●●●●●	≥ 100 mm (3.94 in.)	≥ 100 mm (3.94 in.)	≥ 10 mm (0.39 in.)
ATV630D55M3...ATV630D75M3, ATV630C11N4●...ATV630C16N4●	≥ 250 mm (9.84 in.)	≥ 250 mm (9.84 in.)	≥ 100 mm (3.94 in.)
ATV630C22N4●...ATV630C31N4●	≥ 200 mm (7.87 in.)	≥ 150 mm (5.91 in.)	≥ 10 mm (0.39 in.)

See thermal conditions in the Installation manual (EAV64301).

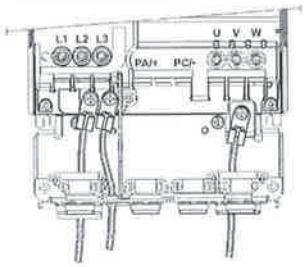
6 Connect The Drive: Ground and Power ☑

1. Connect the ground cables ⏚ .
2. Connect the drive to the mains (R/L1, S/L2, T/L3).
3. Connect the drive to the motor (U/T1, V/T2, W/T3).
4. Ensure minimum distance between the "Control" and "Power" cables.

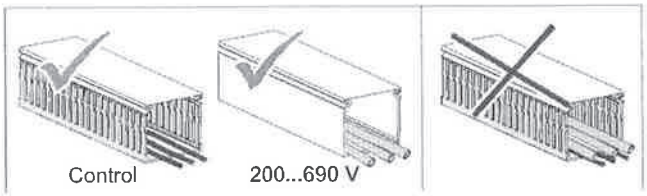


(1) Defined by *Practical Installation guidelines* (deg999en).

Example on frame size 3



See other Frame sizes in chapter *Wiring the Power Part* of the Installation manual (EAV64301)



For more information, download the white paper *An Improved Approach for Connecting VSD and Electric Motors* (998-2095-10-17-13AR0_EN).

5. Refer to the tightening torque instructions on the nameplate ☑

⚠⚠ DANGER

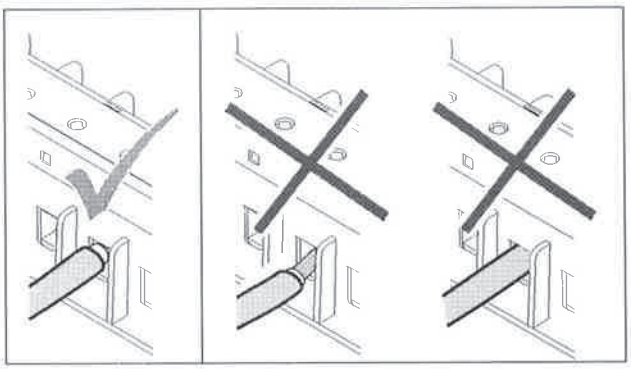
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Wire cross sections and tightening torques must comply with the specifications provided in the installation manual.

Failure to follow these instructions will result in death or serious injury.

Stripping lengths  **and Cabling** ☑

Refer to the instructions given in the installation manual (EAV64301).

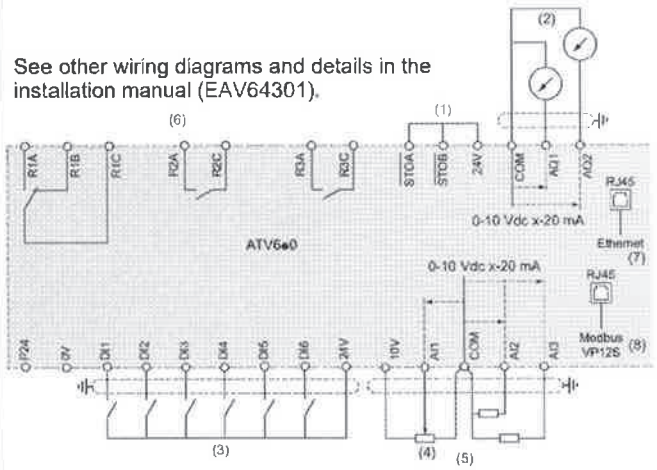


7 Connect The Drive: Control

Wiring Example

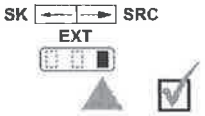
1. For reference frequency, connect **AI1**, **10V** and **COM** with a potentiometer 1...10 kΩ (ex. SZ1RV1002)
2. Connect the command **DI1** to **24V**
   DI1 = forward (control command 2-wire - factory setting)

See other wiring diagrams and details in the installation manual (EAV64301).



(1) STO Safe Torque Off, (2) Analog Outputs, (3) Digital Inputs,
(4) Reference potentiometer 1...10 kΩ (ex. SZ1RV1002), (5) Analog Inputs,
(6) Relay Outputs, (7) Cable specification: min. Cat 5e, twisted-pair, 8 x 0.25 mm² (AWG 22), max. length 100 m (328 ft),
(8) See Catalog DIA2ED2140502EN for cable references

Verify that the switch is on default position = SRC mode (right position)



Sink (SK) - Sink External (EXT) - Source (SRC)

SOURCE (SRC) position is used for PLC outputs with PNP transistors. Refer to the instructions given in the installation manual (EAV64301).

NOTICE

INCORRECT VOLTAGE

Only supply the digital inputs with 24 Vdc.

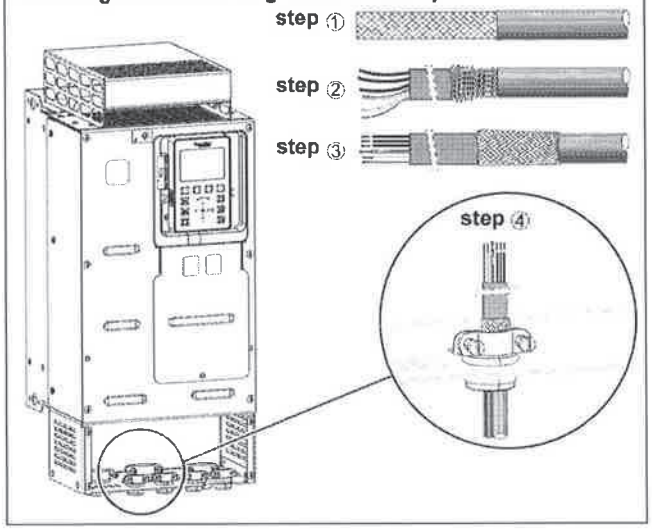
Failure to follow these instructions can result in equipment damage.

Tightening torque and screwdriver type

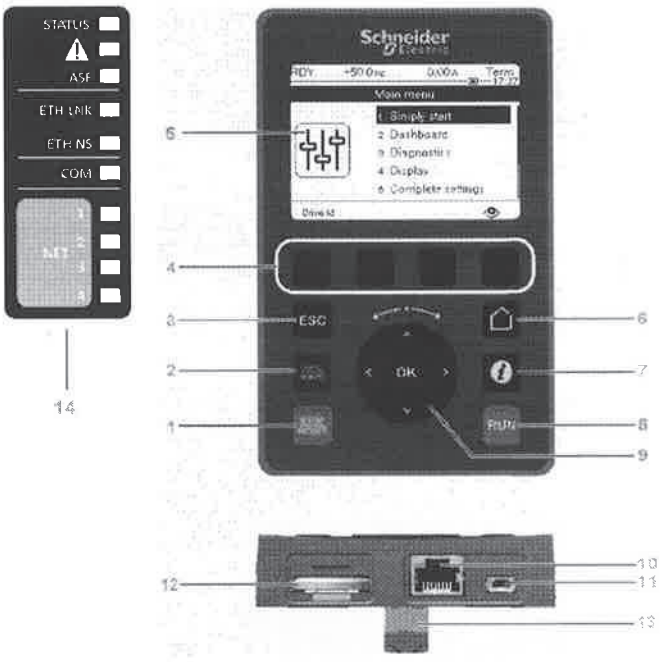
0.5 N.m
4.4. lb.in

Relay Output Wire Cross Section		Other Wire Cross Section	
Minimum	Maximum	Minimum	Maximum
mm² (AWG)	mm² (AWG)	mm² (AWG)	mm² (AWG)
0.75 (18)	1.5 (16)	0.5 (20)	1.5 (16)

Shielding connection to ground: DI example



8 LEDs and Graphic Display Terminal



1. STOP / RESET: Stop command / apply a Fault Reset.
2. LOCAL / REMOTE: used to switch between local and remote control of the drive.
3. ESC: used to quit a menu/parameter or remove the currently displayed value in order to revert to the previous value retained in the memory.
4. F1 to F4: function keys used to access drive id, QR code, quick view, and submenus.
5. Graphic display.
6. Home: used to access directly at the home page.
7. Information: to get more information about parameters.
8. RUN: executes the function assuming it has been configured.
9. Touch wheel / OK: used to save the current value or access the selected menu/parameter. The touch wheel is used to scroll fast into the menus. Up/down arrows are used for precise selections, right/left arrows are used to select digits when setting a numerical value of a parameter.
10. RJ45 Modbus serial port: used to connect the Graphic Display Terminal to the drive. This connection requires specific cables to be ordered separately, see the Catalog (DIA2ED2140502EN).
11. Mini USB port: used to connect the Graphic Display Terminal to a computer.
12. Battery (10 years service life. Type: CR2032).
13. RJ45 male connector to plug on the drive or on the door mounting kit.

14. For a detailed description of the LEDs, refer to the section *Description of the Product Front LEDs* of the Programming manual (EAV64318).

9 [Simply start]

- Verify that digital input is not active (**DI1** open, see step 7 wiring diagram).
- Apply power to the drive.
- If requested, set the date, time, and language.

10 Set Motor Parameters For Asynchronous Motor

NOTE: For other motor types, refer to the Programing manual (EAV64318).

See the motor nameplate to set the following

Menu	Parameter	Factory Setting		Customer Setting
		ATV••••••M3 ATV••••••N4•• ATV••••••Y6	ATV••••••S6•	
[Simply start]	[Motor Standard] bFr: Standard motor frequency	[50 Hz IEC] 50 (Hz)	[60 Hz IEC] 60 (Hz)	
	[Nominal Motor Power] nPr: Nominal motor power on motor nameplate	drive rating (kW)	drive rating (HP)	
	[Nom Motor Voltage] UnS: Nominal motor voltage on motor nameplate	drive rating (Vac)		
	[Nom Motor Current] nCr: Nominal motor current on motor nameplate	drive rating (A)		
	[Nominal Motor Freq] FrS: Nominal motor frequency on motor nameplate	50 (Hz)		
	[Nominal Motor Speed] nSP: Nominal motor speed on motor nameplate	drive rating (rpm)		
	[2/3-Wire Control] tCC: Command control by 2 wire or 3 wire control	2C		
	[Max Frequency] tFr: Maximum motor frequency	60 (Hz)	72 (Hz)	
	[Motor Th current] ItH: Motor thermal current on motor nameplate	drive rating (A)		

11 Perform A Motor [Autotuning] For Asynchronous Motor

NOTE: Perform autotuning with the motor cold. If you modify motor parameters after having performed autotuning, you must re-perform autotuning.

⚠ WARNING

UNEXPECTED MOVEMENT

Autotuning moves the motor in order to tune the control loops.

- Only start the system if there are no persons or obstructions in the zone of operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

During [Autotuning], the motor makes small movements. Noise development and oscillations of the system are normal.

Menu	Parameter
[Simply start]	[Autotuning] tUn: Set parameter to [Apply Autotuning] YES. [Autotuning] tUn is done immediately.

12 Set Basic Parameters

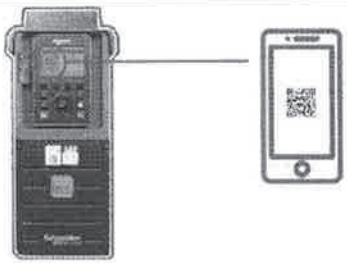
Menu	Parameter	Factory Setting		Customer Setting
		ATV••••••M3 ATV••••••N4•• ATV••••••Y6	ATV••••••S6•	
[Simply start]	[Acceleration] ACC: Acceleration time	10.0 (s)		
	[Deceleration] dEC: Deceleration time	10.0 (s)		
	[Low speed] LSP: Motor frequency at minimum reference	0 (Hz)		
	[High speed] HSP: Motor frequency at maximum reference	50 (Hz)	60 (Hz)	

13 Start And Stop The Motor

- Switch on **DI1** (forward).
- Use the potentiometer on **AI1** to set the reference frequency, adjustable from [Low speed] LSP to [High speed] HSP.
- Switch off **DI1** (forward) to stop the motor.

Troubleshooting

Scan the QR code on the RED screen or refer to the Programming manual (EAV64318), to get the error code explanations.



Other Tools To Configure The Drive

- **SoMove** is a setup software for PC designed to configure Schneider Electric motor control devices.
  You can download the SoMove FDT (SoMove_FDT), the DTM in English (ATV6xx_DTM_Library_EN) and language pack, on www.se.com.
- **Embedded Webserver**: See the Embedded Ethernet manual (EAV64327) for more information.

IRONHORSE®

ACN AC Drive

This quick start reference is included in the VFD packaging and is meant to be a supplement to the User Manual, which is available for free download at Automationdirect.com. This reference informs the installer of the proper steps for mounting, wiring, and basic programming/operation of the ACN VFD up to 22kW/30HP.

CAUTION: IMPROPER WIRING AND OPERATION MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH

Follow the recommended wiring practices suggested in this document as well as the User Manual. The minimum size of the protective earth (ground) conductor shall comply with local safety regulations and applicable codes.

Please review all ACN related documents included with the product before proceeding with any installation and wiring.

STEP 1 – ACN MODEL NUMBER AND MOUNTING

MODEL NUMBER

Verify that you have the appropriate VFD by checking the namplate information. Utilize the example name plate below to assist you with this.

MODEL : ACN-2020 QR Code

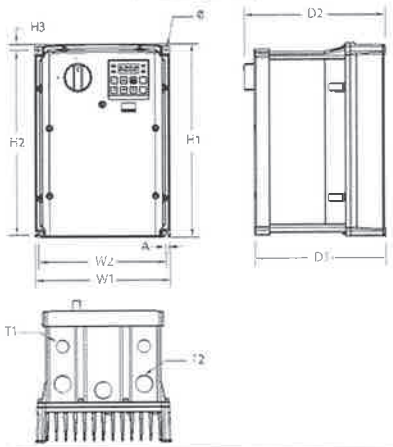
INPUT: 3PH 200-240V 50/60Hz 66.7A
SHORT CIRCUIT CURRENT: 100KA
OUTPUT: 3PH 200-240V 60.0A 22.9kVA 15.0kW/20.0 HP
FREQUENCY RANGE : 0-400Hz

IRONHORSE
Automationdirect.com

NOTE: Verify that the input voltage rating matches the voltage source which will be applied to the VFD.

NOTE: Confirm that the output power of the VFD is equal to or greater than the rating of the motor which will be connected. Ratings for Single phase input power can be found in the manual.

DIMENSIONS



NOTE: Drive diagram (Frame1) is a reference for dimensions chart. See manual for specific Drive Frame diagrams as they differ slightly

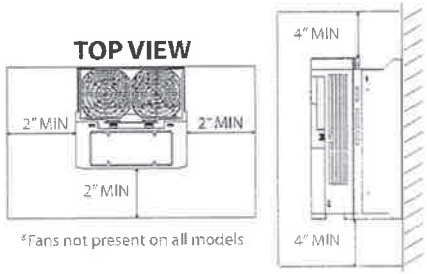
Dimensions												
Frame	Part no	W1	W2	H1	H2	H3	D1	D2	A	B	T1	T2
1	ACN(ND)-20P5	180 (7.09)	170 (6.69)	256.6 (1010)	245 (9.65)	8.2 (0.32)	174.2 (6.86)	188.2 (7.41)	4.5 (0.18)	4.5 (0.18)	22.3 (0.88)	-
	ACN(ND)-21P0											
	ACN(ND)-40P5											
	ACN(ND)-41P0											
2	ACN(ND)-22P0	220 (8.66)	204 (8.03)	258.8 (10.19)	241 (9.49)	11.8 (0.46)	201 (7.91)	215 (8.46)	5.5 (0.22)	5.5 (0.22)	22.3 (0.88)	28.6 (1.13)
	ACN(ND)-23P0											
	ACN(ND)-25P0											
	ACN(ND)-42P0											
	ACN(ND)-43P0											
	ACN(ND)-45P0											
3	ACN(ND)-27P5	250 (9.84)	232 (9.13)	328 (12.91)	308 (12.13)	11 (0.43)	227.2 (8.94)	241.2 (9.50)	6 (0.24)	6 (0.24)	22.3 (0.88)	28.6 (1.13)
	ACN(ND)-2010											
	ACN(ND)-47P5											
	ACN(ND)-4010											
4	ACN(ND)-2015	260 (10.24)	229 (9.02)	399.6 (15.73)	377 (14.84)	14.6 (0.57)	245.4 (9.66)	259.6 (10.22)	6 (0.24)	-	22.3 (0.88)	34.9 (1.37)
	ACN(ND)-4015											
	ACN(ND)-4020											
5	ACN(ND)-2020	300 (11.81)	270.8 (10.66)	460 (18.11)	436.5 (17.19)	15.5 (0.61)	250 (9.84)	264 (10.39)	6 (0.24)	-	22.3 (0.88)	44.5 (1.75)
	ACN(ND)-4025											
	ACN(ND)-4030											

Units: mm (in)

MOUNTING

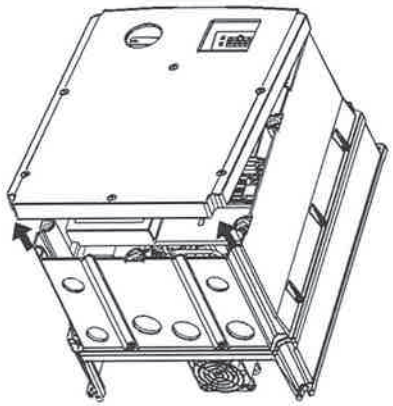
When selecting an installation location consider the following points:

- *The drive must be installed on a wall or panel that can support the drive's weight.*
- *The location must be free from vibration. Vibration can adversely affect the operation of the drive.*
- *The drive can become very hot during operation. Install the drive on a surface that is fire-resistant or flame-retardant and with sufficient clearance around the drive to allow air to circulate. The illustrations below detail the required minimum installation clearances.*



COVER REMOVAL

After mounting, fully loosen all screws from the cover and lift from the bottom.



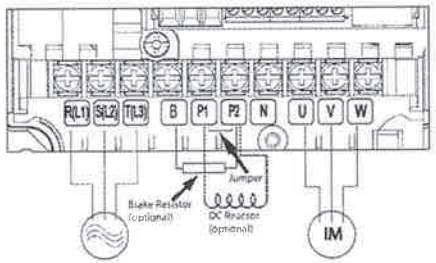
Step 2 – Connect Line and Motor Power

Utilize the below wiring diagrams to properly wire the main power connections to the VFD. This step should be done with power OFF! Refer to the User Manual for additional wire recommendations. Be sure to follow good wiring and grounding practices. Follow applicable local codes if needed.

DANGER: Lethal voltages are present. Be sure that all power is turned OFF while performing the recommended power wiring. Reinstall all protective covers on the ACN before reapplying power

Proper wiring for 3-Phase applications is shown below. The physical terminal layout varies according to frame size. Terminal names (e.g. R, S, T, etc) will remain consistent.

Three Phase Input



3-phase AC Input **Motor**

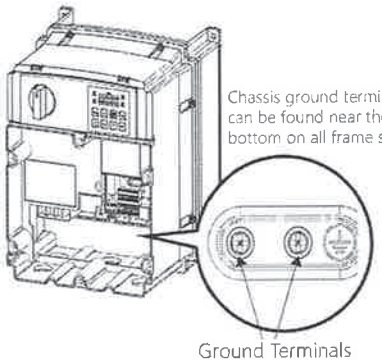
*NOTE: **For single phase input**, use R&T terminals only.*

B, P1,P2 and N terminals should not be connected to power or ground.

Remove P1-P2 jumper before connecting a DC reactor.

Power Terminals Wire Size and Torque				
Part Number	Power Terminal Screw Size	Screw Torque (Nm)	Recommended Wire size AWG (mm2)	
			Power R,S,T ; U,V,W	Ground
ACN(ND)-20P5	M3.5	0.2-0.6	14 (2)	12 (4)
ACN(ND)-21P0	M3.5	0.2-0.6	14 (2)	12 (4)
ACN(ND)-22P0	M3.5	0.2-0.6	14 (2)	12 (4)
ACN(ND)-23P0	M3.5	0.2-0.6	14 (2)	12 (4)
ACN(ND)-25P0	M4	0.2-0.6	12 (3.5)	12 (4)
ACN(ND)-27P5	M4	0.2-0.6	10 (6)	10 (5.5)
ACN(ND)-2010	M4	0.2-0.6	10 (6)	10 (5.5)
ACN(ND)-2015	M5	0.4-1.0	6 (16)	6 (14)
ACN(ND)-2020	M5	0.4-1.0	6 (16)	6 (14)
ACN(ND)-40P5	M3.5	0.2-0.6	14 (2)	12 (4)
ACN(ND)-41P0	M3.5	0.2-0.6	14 (2)	12 (4)
ACN(ND)-42P0	M3.5	0.2-0.6	14 (2)	12 (4)
ACN(ND)-43P0	M3.5	0.2-0.6	14 (2)	12 (4)
ACN(ND)-45P0	M4	0.2-0.6	14 (2)	12 (4)
ACN(ND)-47P5	M4	0.2-0.6	14 (2.5)	12 (4)
ACN(ND)-4010	M4	0.2-0.6	12 (4)	12 (4)
ACN(ND)-4015	M5	0.4-1.0	12 (4)	8 (8)
ACN(ND)-4020	M5	0.4-1.0	10 (6)	8 (8)
ACN(ND)-4025	M5	0.4-1.0	8 (10)	6 (14)
ACN(ND)-4030	M5	0.4-1.0	8 (10)	6 (14)

Use copper wires with 600V, 75°C for power terminal wiring.



Chassis ground terminals can be found near the bottom on all frame sizes

Ground Terminals

Step 3 – Keypad Navigation and Parameter Changes

Operation Group

From the main screen (0.00), the UP and DOWN arrows will navigate through the Operation group. The Operation group contains many basic start up parameters for control and monitoring. See the list of Operation group parameters below.

Display	Operation Group
0.00	Command Frequency
drC	Rotation Direction Select
nOn	Reserved
vOL	Output Voltage
dCL	DC Voltage
rPm	Motor RPM
CUr	Output Current
St3	Multi-Step Frequency 3
St2	Multi-Step Frequency 2
St1	Multi-Step Frequency 1
Fr9	Frequency Source Reference
drv	Command Source
dEC	Deceleration Time 1
ACC	Acceleration Time 1

Parameter Groups

Pressing the LEFT or RIGHT arrows will move through the different parameter groups. While the UP and DOWN arrows will navigate through the different parameter code #'s in the selected group.

Display	Parameter Group
dr	Drive
bA	Basic
Ad	Expanded
Cn	Control
In	Input Terminal Block
OU	Output Terminal Block
CM	Communication
AP	Application
AO	Optional I/O Card (ACN-EIO card is installed)
Pr	Protection
M2	2nd Motor (In.65-69-> any one of these parameters is set to 26)
US	User Sequence (AP.02 =1 or CM.95=1)
UF	User Sequence Function (AP.02 =1 or CM.95=1)

Any of the above parameters and monitors settings can be accessed by pressing the ENT key. Pressing the ENT key again, or the ESC key will go back to the previous display.

Changing Acceleration Time Example

1) *Press UP arrow from the main display (0.00) until ACC is displayed.*
2) *Press ENT key one time to display the present value.*
3) *Use the UP and DOWN arrows to increase and decrease the value.*
4) *Use the LEFT or RIGHT arrows to move the cursor over to select different digits.*
5) *Press the ENT key TWO TIMES once the desired value is set. This saves the change.*
6) *ACC will be displayed again indicating the parameter change has taken effect.*

*NOTE: Press the ENT key **TWO** times to save parameter changes!*

STEP 4 – CONNECT CONTROL WIRING

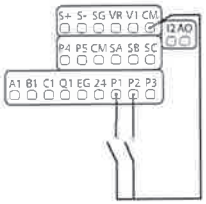
CONTROL WIRE SIZE

Terminal	Terminal Screw Size	Screw Torque (Nm)	Wire Size AWG (mm2) Bare Wire	Wire Size AWG (mm2) with Bootlace Ferrule
P1–P5/ CM/VR/ V1/I2/AO/ Q1/EG/24/ SA,SB,SC/ S+,S-,SG	M2	0.22–0.25	18 (0.75)	20 (0.5)
A1/B1/C1	M2.6	0.4	17 (1.0)	15 (1.5)

*see manual for crimp terminal cable size and detail

RUN COMMAND WIRING

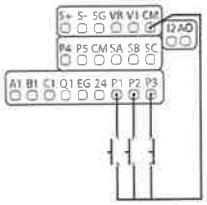
2-Wire Control



2-wire control consists of maintained run signals. This can be accomplished via toggle switches, relays, jumpers. etc. Default parameters support this operation.

P1=Forward Run (Fx)
P2=Reverse Run (Rx)
CM=Common

3-Wire Control

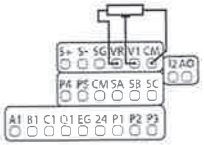


3-Wire control consists of momentary push buttons to run and stop the VFD. The Forward and Reverse buttons are Normally Open while the Stop button is Normally Closed. Set parameter In.67=14 if using P3 (like below) for the Stop button.

P1 = Forward Run (Fx)
P2 = Reverse Run (Rx)
P3 = Stop (3-Wire)
CM = CommonFrequency Reference Wiring

FREQUENCY REFERENCE WIRING

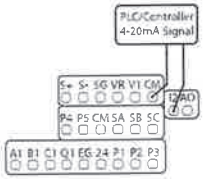
Speed Pot Wiring (0–10VDC)



Controlling the VFD with an external speed POT can be accomplished by setting Operation Menu parameter Fr9=2 and wiring according to the example below. For 0-10VDC signals from a PLC or Controller simply wire to V1 and CM.

VR = 10VDC
VI = Wiper
CM = Common

PLC or Controller Wiring (4–20mA)



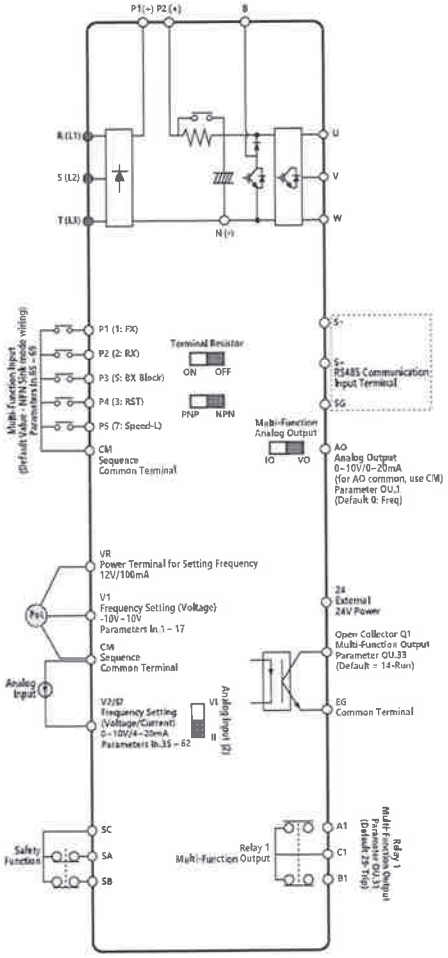
For speed control with a 4–20mA signal, set Operation Menu parameter Fr9=5.

I2 = + Signal
CM = - Common

NOTE: Verify that SW2 dip switch on the terminal board to 'II' (down) for 4-20mA signal.

We strongly recommend that customers use the STO safety feature. The Safe Torque Off (STO) function turns off the power supplied to the motor through the hardware, so that the motor cannot produce torque. This method of removing power from the motor is considered an emergency stop, also known as "coast to stop." To use this feature, disconnect the appropriate factory-installed jumpers and wire a safety relay, safety PLC, or E-Stop pushbutton as shown. Use terminals SA,SB,SC shown in control wiring diagram

IO WIRING



NOTE: Default is marked in blue.

STEP 5 – BASIC SETUP PARAMETERS

REQUIRED MOTOR PARAMETERS

Set these motor parameters based on the nameplate.

Group	No	Description	Default	Set Options
dr	14	Motor Capacity	Model Dependent	Model Dependent
bA	11	Poles	4	2–12
bA	13	Motor Rated Current	Model Dependent	Model Dependent
bA	15	Motor Voltage	Model Dependent	Model Dependent

dr.14: HP to kW Conversion Chart (Parameter in kW)

HP	kW
1/4	0.2
1/2	0.4
1	0.75
1.5	1.1
2	1.5
3	2.2
5	3.7
7	5.5
10	7.5
15	11
20	15
25	18.5
30	22
40	30
50	37
60	45
75	55
100	75

Motor RPM to Poles Chart

RPM	3600	1800	1200
Poles	2	4	6

EXAMPLE: If actual motor RPM is 3450. Set Motor Poles = 2. This is due to motor slip. In this example, the motor has 150 RPM of slip. (Slip=Synchronous speed - Rated Speed)

OPTIONAL PARAMETERS

- *To automatically start after a power loss, set Ad.10=1. To enable power-on run, set the Operation Group drv parameter to Fx/Rx-1 or Fx/Rx-2. Run signal must stay present on power up.*
- *Enable phase loss protection by setting the virtual dipswitches in Pr.5 both to the up (top) position.*
- *Enable auto restart after a fault trip by setting the below...*
  - *Pr.8 = 1*
  - *Pr.9 = # of retry attempts*

STEP 5 – BASIC SETUP PARAMETERS (CONT'D)

FAULT CODES

Keypad Display	LCD Display	Description
olt	Over Load	Motor overload trip. Operates when Pr.20 > 0
ult	Under Load	Motor under-load trip. Operates when Pr.27 >0
oct	Over Current 1	Drive output current exceeds 200% of rated current
ovt	Over Voltage	Internal DC voltage exceeds the specified value
lvt	Low Voltage	Internal DC circuit voltage less than the limit
lv2	Low Voltage2	Internal DC circuit voltage less than limit during operation
gft	Ground Trip*	Grnd Flt trip occurs on drive output side and causes the current to exceed limit
eth	E-Thermal	Thermal load calculation determines motor overheating. Operates when Pr.40 >0
pot	Out Phase Open	Drive output phase(s) in open circuit condition. Operates when Pr.05 Bit 1=1
ipo	In Phase Open	3-ph drive input phase(s) in an open circuit condition. Operates when Pr.05 bit2=1
iol	Drive OLT	Overload and resultant overheating based on thermal limits
nmt	No Motor Trip	Motor is not connected during drive operation. Operates when Pr.31=1
oht	Over Heat	Drive heat sink temperature exceeds limit
oc2	Over Current2	DC circuit detection of excessive, short circuit current
ext	External Trip	External fault input signal is ON. Operates when In.65-69=4
bx	BX	Bx input signal is ON. Operates when In.65-69=5
hwt	H/W-Diag	Memory error detected (EEPRom)
ntc	NTC Open	Insulated Gate Bipolar Transistor (IGBT) Temperature sensor error
fan	Fan Trip	Cooling Fan malfunction. Operates when Pr.79 =0
pid	Pre-PID Fail	Pre-PID is operating and controlled variable PID feedback < set value
xbr	Ext-Brake	External Brake output signal is ON & VFD output current <Ad.41.Operates when OU.31/32= 35
sfa sfb	Safety A(B) Err	Either safety input signal is off
lcr	Lost Command	Frequency or operation command error detected during drive operation Operates when Pr.12>0
iot hold	IO Board Trip	I/O board, communication card malfunction
errc		Error code continues for more than 5 sec
par	ParaWrite Trip	Communication fails during parameter writing with LCD keypad(ACN-LCD)
opt	Option Trip-1	Comm error is detected between the drive and the comm board, Operates when ACN-ETH is installed

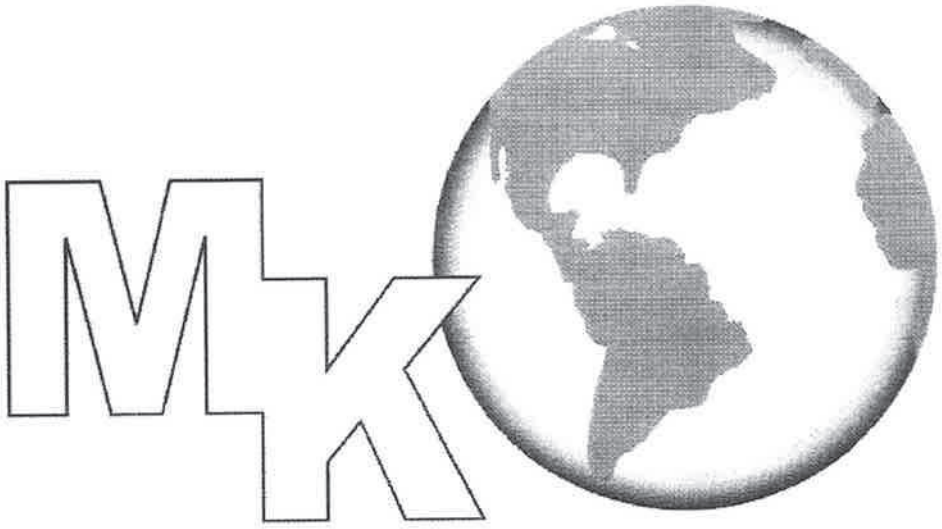
ACN drives rated for 4.0kW or less do not support the ground fault trip (GFT) feature. Therefore, an over current trip (OCT) or over voltage trip (OVT) may occur when there is a low-resistance ground fault.

COMMONLY SET PARAMETERS

Pr.Code	Parameter Name	Setting Range		Units	Initial Value
Op Menu: 0.00	Command Frequency	Start Freq(dr.19) - Max Freq(dr.20)		Hz	0
Op Menu: ACC	Acceleration Time	0.0 - 600.0		sec	20.0
Op Menu: dEC	Deceleration Time	0.0 - 600.0		sec	30.0
Op Menu: drV	Command Source	0 : Keypad 1: Fx/Rx -1 (Fwd/Rev Run) 2: Fx/Rx -2 (Run/Dir)	3: Int 485 4: Field Bus 5: UserSeqLink	-	1- Fx/Rx -1
Op Menu: Fr9	Frequency Source Reference	0 :Keypad-1 1 :Keypad-2 2 :V1 4 :V2 5 :I2 6 :Int 485	8 :Field Bus 9 :UserSeqLink 12 :Pulse 13 :V3 15 :V4 16 :I4	-	0 Keypad-1
dr.9	Control Mode	0 :V/F 2 :Slip Compensation	4 :IM Sensorless 6 :PM Sensorless	-	0 V/F
dr.11	JOG Frequency	0.00, Start frequency-Maximum frequency		Hz	10.00
dr.12	Jog Run Acceleration Time	0.0 - 600.0		sec	20.0
dr.13	JOG Dec Time	0.0 - 600.0		sec	30.0
dr.18	Base Frequency	30.00 - 400.00		Hz	60.0
dr.19	Start Frequency	0.01 - 10.00		Hz	0.50
dr.20	Maximum Frequency	40.00~400.00(Hz) [V/F, SlipCompen] 40.00~120.00(Hz) [IMSensorless] 40.00~180.00(Hz) [PMSensorless]		Hz	60.0
dr.93	Parameter Initialize (Reset to Defaults)	0 : No 1: All Groups 2: dR group 3: bA group 4: Ad group 5: Cn group 6: In group 7: OU group	8: CM group 9: AP group 12: Pr group 13: M2 group 14: US group 15: UF group 16: SPS group	-	0
bA.19	AC Input Volt	170 - 480		v	220 / 480
Ad.9	Rotation Direction	0 : None 1 : Forward Prevent	2 : Reverse Prevent	-	0: None
In.1	Max Analog input Freq	Start freq [dr.19] - Max freq [dr.20] (Hz)		Hz	Max Freq
In.65	P1 Define	See Multifunction Discrete Input Selection Chart		-	1: Fx
In.66	P2 Define			-	2: Rx
In.67	P3 Define			-	3: Bx
In.68	P4 Define			-	4: Rst
In.69	P5 Define			-	5: Speed-L
OU.31	Relay 1 (A1/B1/C1)	See Multifunction Discrete Output Selection Chart		-	29: Trip
OU.33	Q1 Define			-	14: Run
OU.1	Analog output 1	See Analog Output (AO) Selection Chart		-	0: Freq
Pr.21	OL Trip Level	30 - 180		%	180
Pr.22	OL Trip Time	0 - 60.0		sec	60

MULTIFUNCTION INPUT/OUTPUT SELECTION CHARTS

Multi-Function P1-P5 Discrete Input Selections	Multi-Function R1/Q1 Discrete Output Selections	Multi-Function AO Selections
0 : None	0 : None	0 : Frequency
1 : Fx	1 : FDT-1	1 : Output Current
2 : Rx	2 : FDT-2	2 : Output Voltage
3 : Reset	3 : FDT-3	3 : DCLink Voltage
4 : Ext Trip	4 : FDT-4	4 : Torque
5 : BX (Block)	5 : Over Load	5 : Output Power
6 : JOG	6 : IOL	6 : Idse
7 : SpdL	7 : Under Load	7 : Iqse
8 : SpdM	8 : Dan Warning	8 : Target Freq
9 : SpdH	9 : Stall	9 : Ramp Freq
11 : XcelL	10 : Over Voltage	10 : Speed Fdb
12 : XcelM	11 : Low Voltage	12 : PID Ref Value
13 : RUN Enable	12 : Over Heat	13 : PID Fdb Value
14 : 3-wire	13 : Lost Command	14 : PID Output
15 : 2nd Source	14 : Run	15 : Constant
16 : Exchange PWR	15 : Stop	
17 : Spd Up	16 : Steady	
18 : Spd Down	17 : Inverter Line	
20 U/D clear	18 : Comm Line	
21 : Analog Hold	19 : Speed Search	
22 I Term Clear	22 : Ready	
23 : PID openloop	28 : Timer Out	
24 : P Gain2	29 : Trip	
25 : Xcel Stop	31 : DB Warn%ED	
26 : 2nd Motor	34 : On/Off Control	
34 : Pre Excite	35 : BR Control	
38 : Timer in	38 : Fire Mode	
40 : Dis Aux Ref	39 : TO (Q1 Only)	
46 : FWD JOG	40 : KEB Operation	
47 : REV JOG		
49 : Xcel-H		
50 : User Seq		
51 : Fire Mode		
52 : KEB-1 Select		
54 : TI (P5 only)		



Environmental Inc.

SECTION 8.0
TRANSFER PUMPS & MISC. COMPONENTS

MK Environmental, Inc.
765 Springer Dr.
Lombard, IL., 60148
(P) 630-920-1104 (F) 866-306-8977
www.mkenv.com

CT Series

High Pressure Centrifugal Pumps
½ - 2½ HP
Heads to 140 Feet
Capacities to 95 GPM

ADVANTAGES BY DESIGN

- Heavy duty cast iron construction.
- Back pull-out design.
- Dependable double ball bearing motor
- Continuous duty rating motor.
- Choice of brass or composite impeller.
- Brass impeller pumps rated 212° F.
- Composite impeller pumps rated 140° F.
- Maximum working pressure of 125 psi.
- CSA listed.

Applications

- Booster service
- Irrigation
- Circulating
- Cooling towers
- Air conditioning
- Liquid transfer
- Sprinkling systems
- General industrial service

Note: MK Environmental uses oversized pump motors. See below

MYERS CT SERIES LINE OF HIGH PRESSURE CENTRIFUGAL PUMPS PROVIDES QUALITY AT A COMPETITIVE PRICE. The complete line of ¼ to 2½ HP units provide strong pressures up to 140 feet and flows up to 95 gpm.

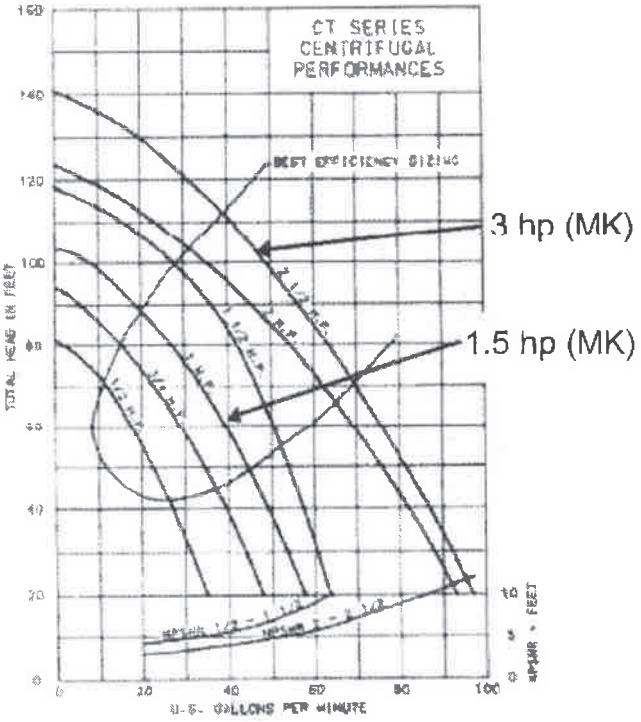
The rugged cast iron body construction is available with either a corrosion resistant composite or brass impeller. The brass impeller unit is equipped with a high temperature, viton seal for more demanding applications. The heavy duty motor features a double ball bearing, 50° C ambient, dual voltage design for dependable service. The compact, back pullout design provides easy installation and serviceability

The quality features of the CT series will provide dependable service for a wide variety of applications.

SPECIFICATIONS

HP	Catalog No. Composite Impeller	Catalog No. Brass Impeller	Pipe Tapping Sizes Suction (NPT)	Pipe Tapping Sizes Discharge (NPT)	Motor Voltage	Phase	Approx. Wt. Lbs.
½	CT05	CT05B	1"	1"	115/230	1	30
	CT05B3	CT05B3	1"	1"	208/230/460	3	30
¾	CT07	CT07B	1"	1"	115/230	1	32
	CT07B3	CT07B3	1"	1"	208/230/460	3	32
1	CT10	CT10B	1"	1"	115/230	1	35
	CT10B3	CT10B3	1"	1"	208/230/460	3	35
1½	CT15	CT15B	1"	1"	115/230	1	40
	CT15B3	CT15B3	1"	1"	208/230/460	3	40
2	CT20	CT20B	1½"	1¼"	115/230	1	57
	CT20B3	CT20B3	1½"	1¼"	208/230/460	3	57
2½	CT25	CT25B	2"	1½"	115/230	1	62
	CT25B3	CT25B3	2"	1½"	208/230/460	3	62

PUMP PERFORMANCE



WHERE INNOVATION MEETS TRADITION

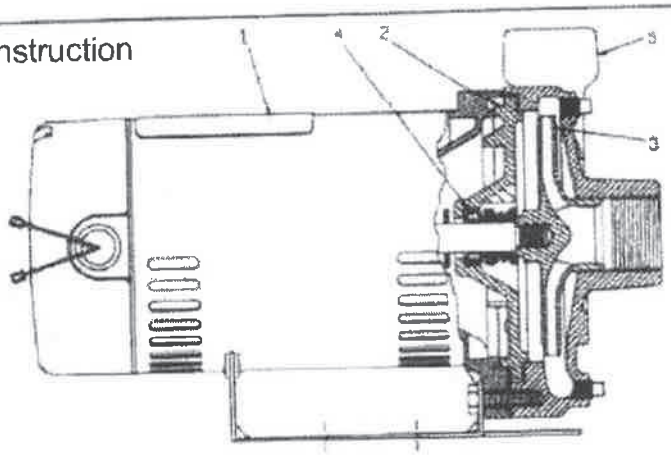
Myers

ISO 9001 Certified Company

CT Series

High Pressure Centrifugal Pumps
½ - 2½ HP
Heads to 140 Feet
Capacities to 95 GPM

1. MOTOR MK standard is TEFC construction
- NEMA standard
- Double ball bearing
- Open drip proof
- 60 Hz, 3450 rpm
- Stainless steel shaft
- Single phase with built-in overload protection
- Three phase require overload protection in starter unit
- Non-overloading
- Continuous duty
- Strong capacitor start design

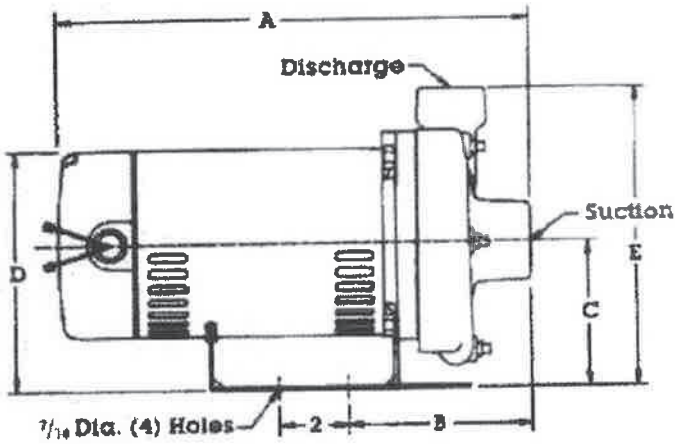


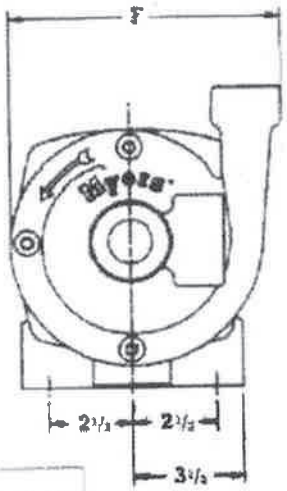
2. SEAL PLATE
- Heavy duty cast iron for dependable service and long life

3. IMPELLER
- Reinforced composite for applications to 140° F.
- Threaded SST insert on composite impellers
- Brass for applications to 212° F.
- Enclosed design for high efficiencies
- Balanced for smooth operation

4. MECHANICAL SEAL
- Standard carbon/ceramic faces, Buna elastomers, 300 series SST components (standard for pumps with composite impellers)
- High temperature carbon/ceramic faces, viton elastomers, 300 series SST components (standard for pumps with brass impellers)

5. CASING
- Heavy duty cast iron construction
- Back pull-out design
- Discharge can be rotated in four positions
- Tapped openings for priming, venting and draining.
- Vertical discharge standard





HP	Dimensions, inches							
	A	B	C	D	E	F	Suct.	Disch.
½	13⅞	5½	4⅛	7⅛	9	8	1¼	1
¾	14⅜	5½	4⅛	7¼	9	8	1¼	1
1	15⅛	5½	4⅛	7¼	9	8	1¼	1
1½	15⅜	5½	4⅛	7¼	9	8	1¼	1
2	16½	6¼	4½	7½	9½	8⅞	1½	1¼
2½	16½	6¼	4½	7½	9½	8⅞	2	1½

Myers®

CT Kit Pumps

INSTALLATION

PACKAGE CONTENTS - 1. The catalog lists all parts included with package
2. Be sure all parts have been furnished and that nothing has been damaged in shipment.
3. OPEN PACKAGES AND MAKE THIS CHECK BEFORE GOING ON JOB.

PIPING - Pipes must line up and not be forced into position by unions. **Piping should be independently supported near the pump so that no strain will be placed on the pump casing.** Where any noise is objectionable, pump should be insulated from the piping with rubber connections. Always keep pipe size as large as possible and use a minimum of fittings to reduce friction losses.

SUCTION PIPING - Suction pipe should be direct and as short as possible. It should be at least one size larger than suction inlet tapping and should have a minimum of elbows and fittings. The piping should be laid out so that it slopes upward to pump without dips or high points so that air pockets are eliminated. The highest point in the suction piping should be the pump inlet except where liquid flows to the pump inlet under pressure. A foot valve must be used to keep pump primed. Where liquid flows to the pump, it may be desirable to use a check valve in the suction line or discharge line to keep pump primed.

To prevent air from being drawn into suction pipe due to a suction whirlpool, the foot valve should be submerged at least three feet below the low water level. The suction pipe must be tight and free of air leaks or pump will not operate properly.

DISCHARGE PIPING - Discharge piping should never be smaller than pump tapping and should preferably be one size larger. A gate valve should always be installed in discharge line for throttling if capacity is not correct. To protect the pump from water hammer and to prevent backflow, a check valve should be installed in the discharge line between the pump and gate valve.

ELECTRICAL CONNECTIONS - Be sure motor wiring is connected for voltage being used. Unit should be connected to a separate circuit, direct from main switch. A fused disconnect switch or circuit breaker must be used in this circuit. Wire of sufficient size should be used to keep voltage drop to a maximum of 5%. All motors, unless provided with built-in overload protection, must be protected with an overload switch, either manual or magnetic.

Never install a pump without proper overload protection. When motor is mounted on a base plate or on slide rails for adjustment, flexible metallic conduit should be used to protect the motor leads.

PRIMING - The pump must be primed before starting. The pump casing and suction piping must be filled with water before starting motor. Remove vent plug in top of casing while pouring in priming water. A hand pump or ejector can be used for priming when desired. When water is poured into pump to prime, use care to remove all air before starting motor.

If pump does not start immediately, stop and reprime.

STARTING - It is good practice to close the discharge valve when starting the pump as it puts less starting load on the motor. When the pump is up to operating speed, open the discharge valve to obtain desired capacity or pressure. Do not allow the pump to run for long periods with the discharge valve tightly closed. If the pump runs for an extended period of time without liquid being discharged, the liquid in the pump case can get extremely hot.

ROTATION - The pump must run in direction of arrow on pump case. All single phase motors are single rotation and leave factory with proper rotation. Three phase motors may run either direction. If rotation is wrong when first starting motor, interchange any two line leads to change rotation.

STOPPING - Before stopping pump, close the discharge valve. This will prevent water hammer and is especially important on high head pumps.

FREEZING - Care should be taken to prevent the pump from freezing during cold weather. It may be necessary, when there is any possibility of this, to drain the pump casing when not in operation. Drain by removing the pipe plug in the bottom of the casing.

ROTARY SEAL - CT pumps are fitted only with a rotary seal. This seal is recommended for water free from abrasives. If liquid contains abrasives, the CT pump should not be used.

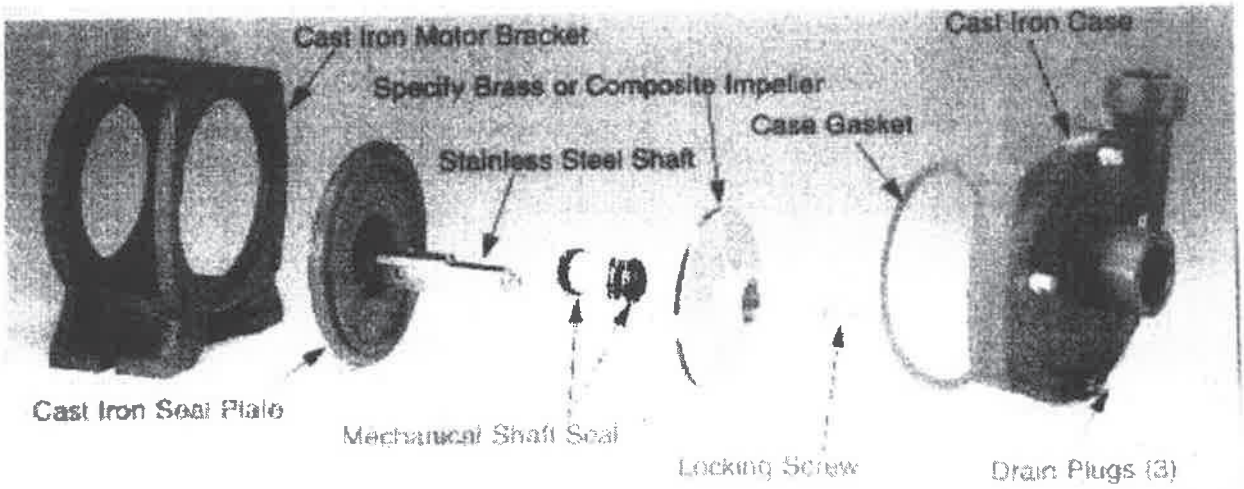
MOTOR Customer supplied standard NEMA 56C frame, single or three phase.

BEARINGS - The pump motor uses sealed ball bearings that are factory lubricated and do not require further lubrication.

SERVICE

TROUBLE SHOOTING GUIDE

A	No water delivered				
B	Not enough water delivered				
C	Not enough pressure				
D	Pump runs for short while; then loses prime				
	POSSIBLE CAUSE OF PROBLEM	D	C	B	A
1.	Pump not properly primed; repeat priming operation				X
2.	Discharge head too high. Check total head with gauge at pump inlet and discharge. (With no water, the gauge at discharge would show shut-off pressure.)			X	X
3.	Excessive volume being discharged. Throttle discharge valve.		X		
4.	Speed too low. Check pump drive belts for slippage. If hot, tighten belts. Check motor voltage and speed.		X	X	
5.	Rotation wrong. Change shaft rotation.		X	X	X
6.	Suction lift too high. Check with vacuum gauge. This should not exceed 15 feet.	X		X	X
7.	Air leak in suction line. Check line under pressure to find leak.	X	X	X	X
8.	Air pocket in suction line. Check line for proper slope.	X			X
9.	Insufficient submergence of suction pipe. Foot valve should be three feet below lowest water level.	X		X	
10.	Sediment chamber clogged. Remove and clean thoroughly. Make sure gasket is in good condition and sealing surfaces clean before reassembly of sediment chamber cap.		X		
11.	Impeller or suction line plugged.		X	X	X
12.	Impeller and volute case badly worn. Disassemble pump; if clearance on diameter is over .030", replace worn impeller and worn volute case.		X	X	
13.	Suction strainer plugged. Clean strainer.	X			
14.	Impeller diameter too small for condition required.		X	X	
15.	Seal leaking - seal is worn or seal face cocked. Replace with new seal and carefully follow directions.				



DISASSEMBLY INSTRUCTIONS

All pumping parts can be removed from case without disturbing the piping.

POWER SUPPLY - Open the power supply switch contacts and remove fuses. Disconnect the electrical wiring from the motor.

VOLUTE CASE

(a) Drain pump case by removing drain plugs.
(b) Remove the bolts securing volute case to pump bracket.
(c) To pry components apart, use two screwdrivers opposite each other. (Fig. 1)

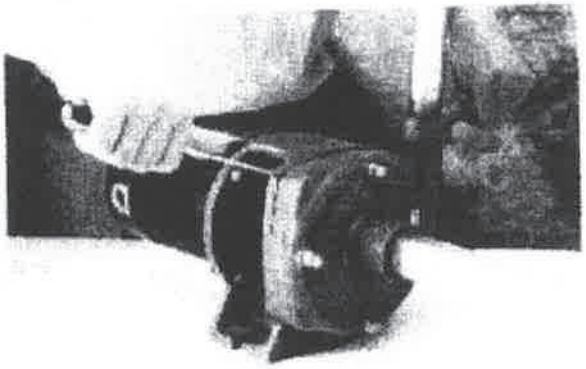


FIG. 1

IMPELLER

(a) Remove impeller by holding stub shaft with water pump pliers and unscrewing capscrew by hand. (Fig. 2)
(b) Turn impeller counter-clockwise to remove from stub shaft.

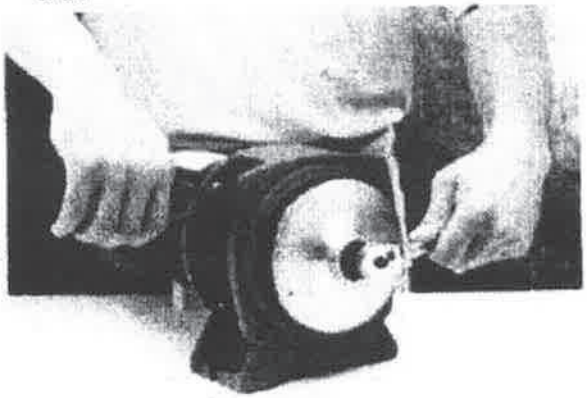


FIG. 2

SEAL

(a) The seal used is ⅝"
(b) Always replace both rotating assembly and stationary ceramic seat. DO NOT USE OLD STATIONARY SEAT WITH NEW ROTATING SEAL ASSEMBLY.
(c) Using two screwdrivers, pry out rotating assembly of shaft seal. (Fig. 3)
(d) The stationary seat can be pressed from the seal plate.
(e) A new shaft seal should always be used when rebuilding a pump. All pump parts should be cleaned thoroughly before being reassembled

FIG. 3

MOTOR

(a) Remove four bolts holding bracket to motor and remove motor (Fig. 4)
(b) Remove set screws in stub shaft coupling to disconnect motor pump shaft.

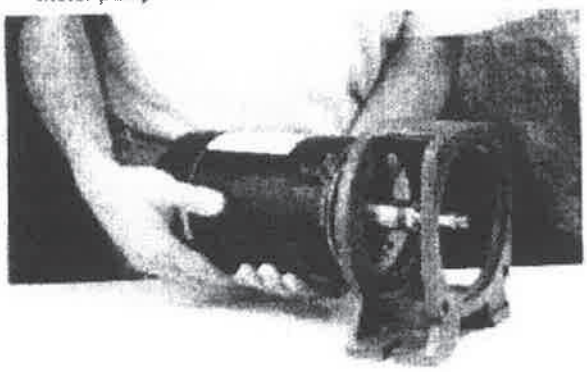


FIG. 4

Model Number	Impeller	HP	Eng. Number	Impeller Number	Impeller Diameter
CT05FAP	Plastic	½	26500D103	26441B005	4 11/16
CT07FAP		¾	26500D104	26440B005	5
CT10FAP		1	26500D105	26439B011	5
CT15FAP		1½	26500D106	26439B010	5 3/16
CT05FAB	Brass	½	26500D003	26441B004	4 11/16
CT07FAB		¾	26500D004	26440B004	5
CT10FAB		1	26500D005	26439B009	5 1/16
CT15FAB		1½	26500D006	26439B008	5 3/16
CT20FAP	Plastic	2	26500D101	26487C009	5 3/16
CT20FAB	Brass	2	26500D001	26487C007	5 3/16
CT25FAP	Plastic	2½	26500D102	26487C008	6 1/16
CT25FAB	Brass	2½	26500D002	26487C006	6 1/16

FIG. 5

ASSEMBLY INSTRUCTIONS

SPOTTING MOTOR SHAFT - Locate "Spotting Position" from motor mounting face to center of spot. A drilling guide and locating fixture is recommended for uniform and accurate spotting. Make two spots with a drill point, at 90 degrees apart - must not be on motor shaft keyway. (Fig 6)

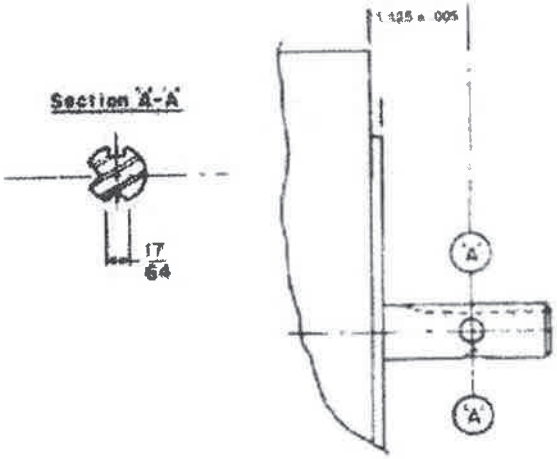


FIG. 6

MOTOR

(a) Place rubber deflector over motor shaft, slide shaft extension into position and tighten set screws.

(b) Assemble motor and shaft onto bracket, using (4) 3/8-16 UNC Hex Head Cap Screws, 1 1/2" long.

SEAL INSTALLATION

(a) Insert seal seat in position by using light pressure on non-abrasive seal installation tool and press firmly and squarely until it bottoms. The use of light oil (SAE10) on the rubber element will facilitate assembly. Care must be taken to keep oil, grease and dirt off face areas of seal. Be sure the seal faces are not damaged during assembly (cracked, scratched or chipped) or the seal will leak during operation.

(b) Check dimension from face of ceramic seat to shaft shoulder. This distance should be as noted in Figure 7 within a tolerance of ± 1/64.

(c) Install rotating element of seat on shaft (Fig. 8), be sure the carbon lapped sealing surface is toward seal seat, and assemble impeller. When installing hi-temp seal (21181A021), furnished with brass impeller models, remove the 1 1/16 diameter cupped stainless steel washer that is packed with the seal. Use of this washer will damage the seal when used with this pump. Check diameter of impeller against motor horsepower rating to insure proper performance (Fig. 5).

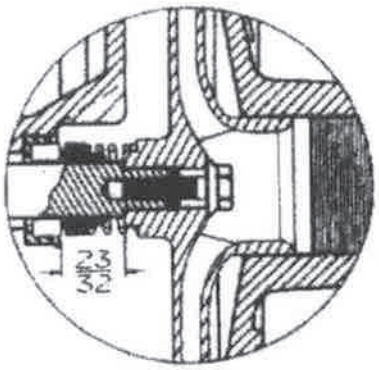


FIG. 7

IMPELLER

(a) On ½ - 1½ HP units, screw on impeller and secure using special washer and 1/4-28UNF cap screw, 7/8" long -- must be stainless steel

(b) On 2-2½ HP units, screw on impeller and secure using special washer and 1/4-28UNF cap screw, 1 1/4" long -- must be stainless steel.

FIG. 8

VOLUTE CASE

(a) Worn volute case will cause excessive leakage with a new impeller, thereby reducing the amount of service obtained from a new impeller.

(b) Assemble gasket and volute case with (4) 3/8-16UNC hex head cap screws 1 1/4" long.

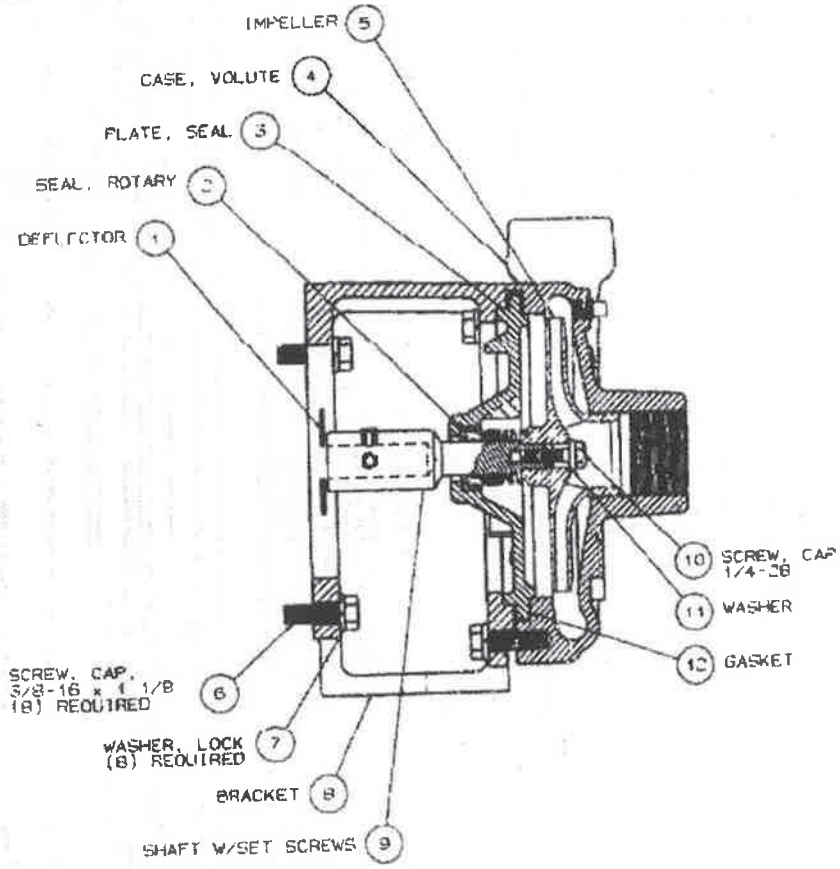
Rotate pump shaft with fingers, being sure that there is no tight spot or binding of assembly. A uniform drag of the seal faces will be present.

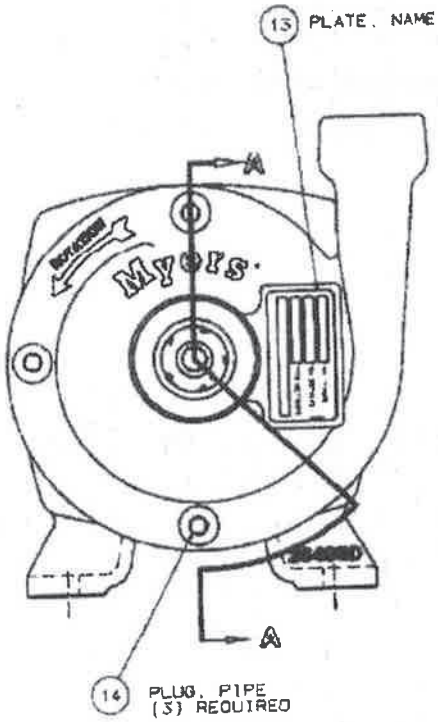
Crusader CT Kit Series Parts List
½, ¾, 1 and 1½ HP

Ref. No.	Description	Part No.	Qty. Req'd.
1	Deflector	05059A318	1
2	Seal, Rotary 5/8 Shaft		
	Standard Seal with Polycarbonate Impeller	14525A010	1
	Hi-Temp Seal with Brass Impeller	21181A021	1
3	Plate, Seal (Cast Iron)	26442C000	1
4	Case, Volute (Cast Iron)	26443D001	1
5	Impeller		
	Polycarbonate (½ HP)	26441B005	1
	Polycarbonate (¾ HP)	26440B006	1
	Polycarbonate (1 HP)	26440B011	1
	Polycarbonate (1½ HP)	26439B010	1
	Bronze (½ HP)	26441B004	1
	Bronze (¾ HP)	26440B004	1
	Bronze (1 HP)	26439B009	1
	Bronze (1½ HP)	26439B008	1
6	Cap Screw, 3/8-16 UNC x 1⅛ Long	19101A016	8
7	Washer, Lock 3/8	05454A007	8
8	Bracket	26498D000	1
9	Shaft with Set Screws	26499B000	1
10	Cap Screw, 1/4-28 UNF x ⅞ Long	19099A032	1
11	Washer, Bronze Special 11/16 O.D.	10186A000	1
12	Gasket, 6⅜ x 5¹⁹/₃₂ x 1/32 Vell.	05059A446	1
13	Plate, Name	26539A000	1
14	Pipe Plug 1/8 NPT	05022A021	3

Crusader CT Kit Series Parts List
2 and 2½ HP

Ref. No.	Description	Part No.	Qty. Req'd.
1	Deflector	05059A318	1
2	Seal, Rotary 5/8 Shaft		
	Standard Seal with Polycarbonate Impeller	14525A010	1
	Hi-Temp Seal with Brass Impeller	21181A021	1
3	Plate, Seal (Cast Iron)	26485D000	1
4	Case, Volute (Cast Iron)		
	2 HP	26484D003	1
	2½ HP	26484D002	1
5	Impeller		
	Polycarbonate (2 HP)	26487C009	1
	Polycarbonate (2½ HP)	26487C008	1
	Bronze (2 HP)	26487C007	1
	Bronze (2½ HP)	26487C000	1
6	Cap Screw, 3/8-16 UNC x 1⅛ Long	19101A016	8
7	Washer, Lock 3/8	05454A007	8
8	Bracket	26498D000	1
9	Shaft with Set Screws	26499B000	1
10	Cap Screw, 1/4-28 UNF x 1⅛ Long	19099A031	1
11	Washer, Bronze Special 11/16 O.D.	10186A000	1
12	Gasket, 6.582 x 6.135 x 1/32 Vell.	05059A447	1
13	Plate, Name	26539A000	1
14	Pipe Plug 1/8 NPT	05022A021	3





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Troubleshooting Guide for transfer pump:

1. Inspect & clean stainless steel float rods.
2. Use sand paper, file or pocket knife to scrap off calcium/iron deposits on the float level rods.
3. Verify the flowmeter is not clogged. There is an inlet basket internally located on the inlet side of this meter.
4. Remove all stainless steel rods (4) from the blue warrick junction box. From the top of the box, mark and then remove the wires. Then unscrew the rod insulator by using a 13/16" deep well socket. Loosen the ¼" jam nut and remove the ¼" rod. Remove all red colored "lock tight" from the threads on each rod with a wire brush. Install rods back into the sump.
5. Verify in the master control panel that the Warrick 67 controller(s) have a green ground wire jumpered run from each Warrick 67 to each other and then to the ground bar located at the bottom right side on the control panel. The Warrick 67 ground is located on the right side of the Warrick controller labeled (G), above the L2 terminal.
6. Debris inside pump impeller. Take pump apart and look for deposits or PVC shavings inside the impeller
7. inspect/clean/replace check valve and all fittings going into and out of transfer pump. Even if it looks good, there may be small cracks, especially in the cast brass parts. Also, after some freezing temperatures, this is a possibility
8. replace transfer pump mechanical seal. On 1.5 hp pumps, use Grainger number 1R298.
9. make sure all gaskets are in good condition when putting pump back together
10. Please have a volt meter available if these items do not correct the problem. Call the factory for additional troubleshooting.

If the system does not appear to make vacuum

1. Vacuum relief valve is opening
2. leak in piping somewhere/dilution valve is open
3. to confirm whether the pump is working right or not, close off all valves to the wells. Should climb to 20+"hg
4. if #3 works, it is the wells
5. not enough seal water. Try turning on the tap water, either via telemetry or flip dip switch #3
6. If a liquid ring pump gets enough seal water and it is spinning, it will make air. Usually something else.

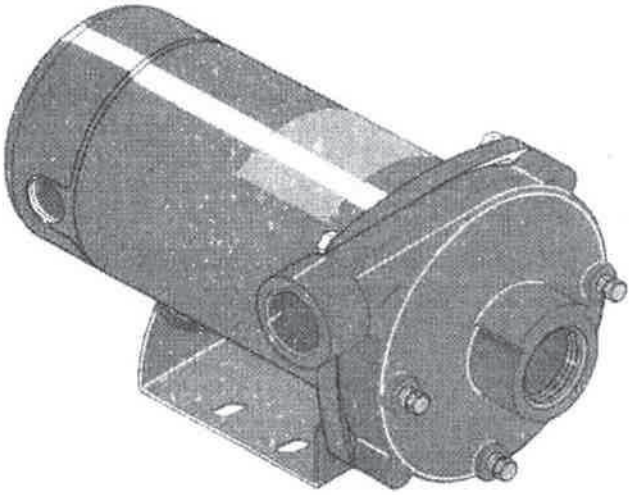
PENTAIR

MYERS®

OWNER'S MANUAL

60 Cycle CT Series Centrifugal Pump

INSTALLATION AND OPERATING INSTRUCTIONS
REPAIR PARTS LIST



HP	MODELS			
1/2	CTJ05B	CTJ05B3	CTJ05	CTJ053
3/4	CTJ07B	CTJ07B3	CTJ07	CTJ073
1	CTJ10B	CTJ10B3	CTJ10	CTJ103
1-1/2	CTJ15B	CTJ15B3	CTJ15	CTJ153
2	CTJ20B	CTJ20B3	CTJ20	CTJ203
2-1/2	CTJ25B	CTJ25B3	CTJ25	CTJ253

293 WRIGHT STREET, DELAVAN, WI 53115 WWW.FEMYERS.COM
PH: 888-987-8677 ORDERS FAX: 800-426-9446

490 PINEBUSH ROAD, UNIT 4, CAMBRIDGE, ONTARIO N1T 0A5
PH: 800-363-7867 ORDERS FAX: 888-606-5484

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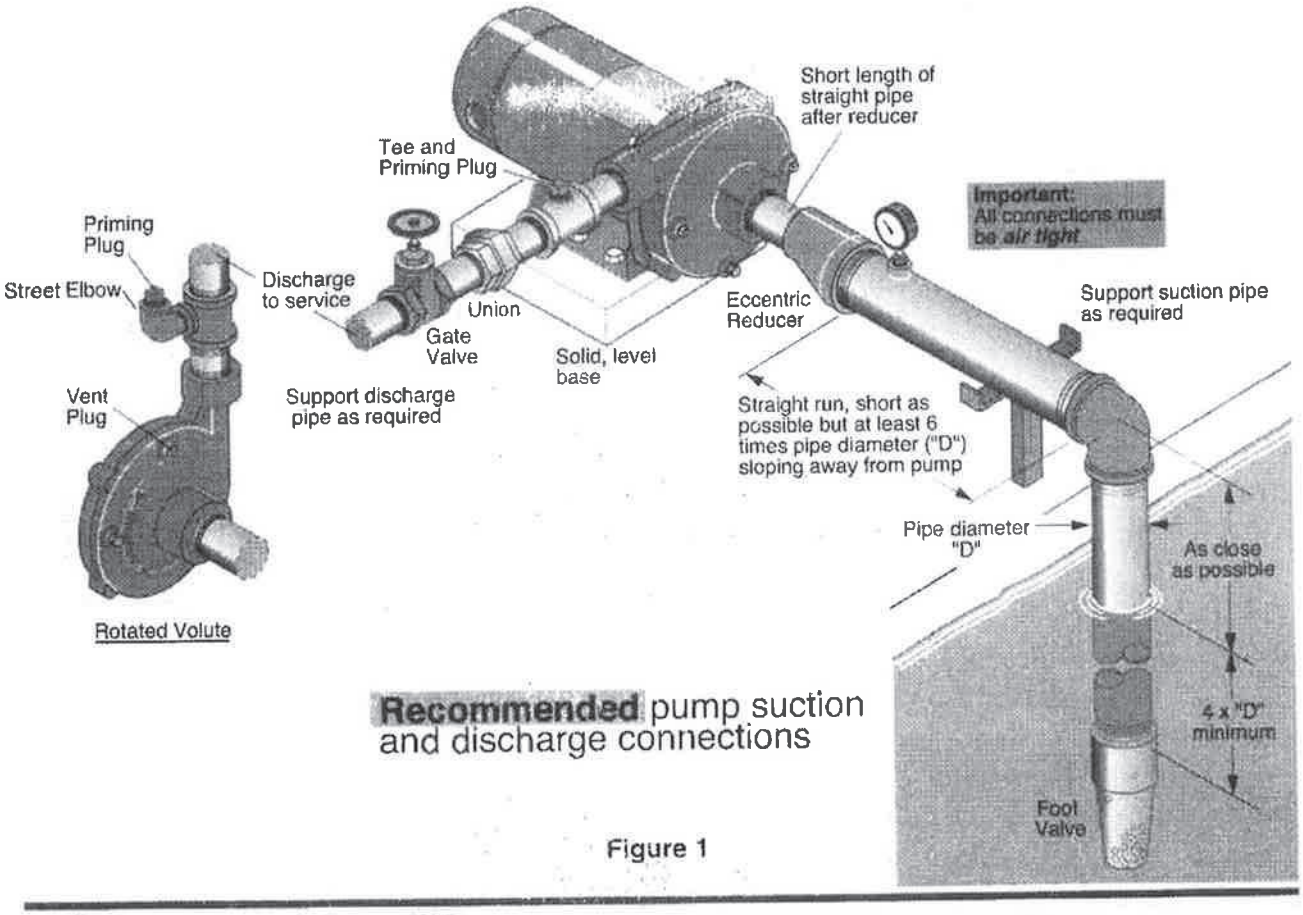
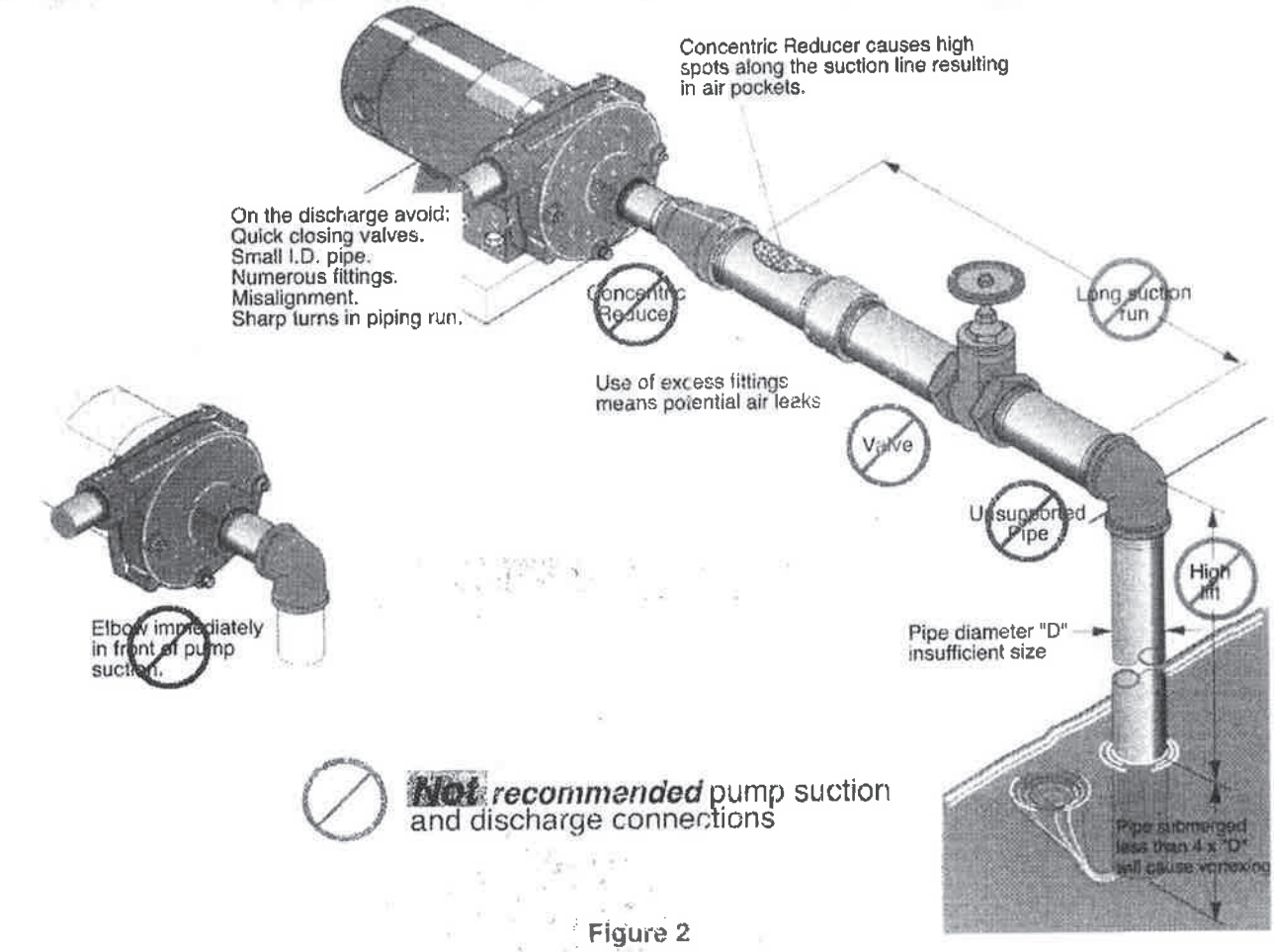


Recommended pump suction and discharge connections

Figure 1



Not recommended pump suction and discharge connections

Figure 2

California Proposition 65 Warning

⚠ WARNING This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

PIPING - GENERAL

Support both suction and discharge piping independently at a point near the pump to avoid putting a strain on the pump housing. Start all piping **AT THE PUMP.**

Increase pipe diameter at both the suction and discharge by one (1) standard pipe size (minimum) to obtain desired performance and flow rate. Refer to Table I when sizing pipe for your pumping system.

NOTICE: Do not use pipe with **smaller** diameter on the suction side of pump.

TABLE I

Pipe Tapping Size On Pump		Recommended Pipe Size	
Suction	Discharge	Suction	Discharge
1-1/4	1	1-1/2	1-1/4
1-1/2	1-1/4	2	1-1/2
2	1-1/2	3	2

SUCTION PIPE

Increase pipe size from pump tapping as shown in Table I.

Figure 1 (Page 2) depicts a recommended run of pipe and fittings for the suction side of a centrifugal pump. Please refer to this illustration when choosing pipe and fittings for your suction connection.

IMPORTANT: All connections must be air tight!

Figure 2 (Page 2) depicts conditions that are **NOT DESIRABLE** on the suction side of a centrifugal pump and may cause problems in flow rate and priming. Please look this illustration over carefully before choosing pipe and fittings for your suction connection.

DISCHARGE PIPING

Increase pipe size from pump tapping as show in Table I. Figure 1 (Page 2) depicts a recommended run of pipe and fittings for the discharge. Install tee with priming plug as close to pump as possible. Figure 2 (Page 2) notes conditions that should be avoided. Please read over carefully before making discharge connection.

PRIMING THE PUMP

A pump is primed when all air in the suction line and pump volute has been evacuated and replaced with water.

To Prime:

1. Close valve in discharge line.
2. Remove priming plug from tee and fill pump and suction line with water until water is flowing back out of tee.
3. Replace priming plug.
4. Start pump and slowly open valve until desired water flow is achieved.
   NOTICE: If water is not being pumped, turn off pump, close valve, and repeat steps 1 thru 4.

If pump volute is rotated as shown in Figure 1 (Page 2), loosen vent plug when priming to evacuate air trapped inside volute and tighten when volute is completely filled with water.

⚠ WARNING **Risk of explosion and scalding.** Never run pump against closed discharge. To do so can boil water inside pump, causing hazardous pressure buildup and possible explosion.

⚠ CAUTION **Risk of flooding.** Do not run the pump dry. This will damage mechanical seal and void warranty. It may cause burns to person handling pump.

⚠ CAUTION **Motor normally operates at high temperature and will be too hot to touch.** It is protected from heat damage during operation by an automatic internal cutoff switch. Before handling pump or motor, stop motor and allow it to cool for 20 minutes.

TABLE II - RECOMMENDED FUSING AND WIRING DATA - 60 CYCLE MOTORS

MOTOR HP	MAX. LOAD AMPERES	BRANCH FUSE* RATING AMPS	DIAMETER IN FEET FROM MOTOR TO METER					
			0' TO 50'	51' TO 100'	101' TO 200'	201' TO 300'	301' TO 400'	401' TO 500'
			WIRE SIZE					
SINGLE PHASE - 115/230 VOLT								
1/3	9.4/4.7	15/15	14/14	14/14	10/14	10/14	6/14	6/12
1/2	9.4/4.7	15/15	14/14	14/14	10/14	10/14	6/14	6/12
3/4	12.2/6.1	20/15	12/14	12/14	10/14	8/14	6/12	6/12
1	14.8/7.4	20/15	12/14	12/14	8/14	6/14	6/12	4/10
1-1/2	19.9/9.95	25/15	10/14	10/14	8/14	6/12	4/10	4/10
2	24.0/12.0	30/15	12/14	10/14	6/14	6/12	4/10	4/10
2-1/2	21.0/10.5	15/15	14/14	14/14	14/14	12/12	12/12	10/10
THREE PHASE - 230/460 VOLT								
1/2	2.3/1.15	15/15	14/14	14/14	14/14	14/14	14/14	14/14
3/4	3.1/1.55	15/15	14/14	14/14	14/14	14/14	14/14	14/14
1	3.6/1.8	15/15	14/14	14/14	14/14	14/14	14/14	14/14
1-1/2	4.7/2.35	15/15	14/14	14/14	14/14	14/14	14/14	14/14
2	6.8/3.4	15/15	14/14	14/14	14/14	14/14	12/14	12/14
2-1/2	8.5/4.25	15/15	14/14	14/14	14/14	14/14	12/14	10/14

* Time delay fuse or circuit breakers are recommended in any motor circuit.

ELECTRICAL

Connection diagram for dual voltage, single-phase motors. Your dual-voltage motor's terminal board (under the motor end cover) will match one of the diagrams below. Follow that diagram if necessary to convert motor to 115 Volt power.

Connect power supply wires to L1 and L2. For 3-phase motors, or if motor does not match these pictures, follow the connection diagram on the motor nameplate.

THE MOTOR IS SET FOR 230 VOLTS WHEN SHIPPED.

To change the motor to use 115 volts:

1. Turn off power
2. Remove the back motor cover.
3. Use a 1/2" wrench and turn the voltage selector dial counterclockwise until 115 shows in the dial opening.
4. Reinstall the motor cover.

⚠WARNING Hazardous voltage. Can shock, burn, or cause death. Disconnect power to motor before working on pump or motor. Ground motor before connecting to power supply.

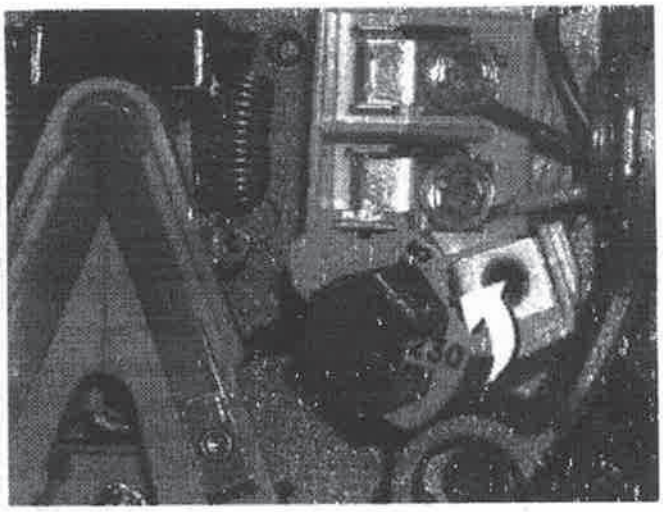


Figure 3: Changing the Voltage Setting

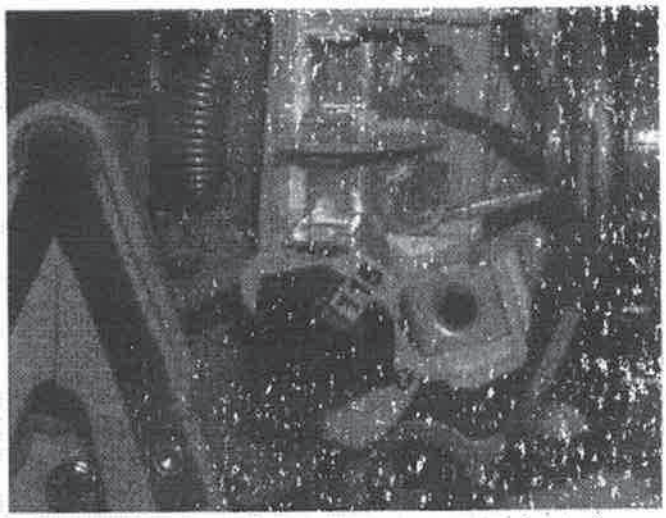


Figure 4: Motor Set for 115 Volt Operation

WIRING

Ground motor before connecting to electrical power supply. Failure to ground motor can cause severe or fatal electrical shock hazard.

Do not ground to a gas supply line.

To avoid dangerous or fatal electrical shock, turn OFF power to motor before working on electrical connections.

Supply voltage must be within ±10% of nameplate voltage. Incorrect voltage can cause fire or damage motor and voids warranty. If in doubt consult a licensed electrician.

Use wire size specified in Wiring Chart (Page 3). If possible, connect pump to a separate branch circuit with no other appliances on it.

Wire motor according to diagram on motor nameplate. If nameplate diagram differs from diagrams above, follow nameplate diagram.

1. Install, ground, wire and maintain your pump in compliance with the National Electrical Code (NEC) in the U.S., or the Canadian Electrical Code (CEC), as applicable, and with all local codes and ordinances that apply. Consult your local building inspector for code information.
2. Provide a correctly fused disconnect switch for protection while working on motor. For switch requirements, consult your local building inspector for information about codes.
3. Disconnect power before servicing motor or pump. If the disconnect switch is out of sight of pump, lock it open and tag it to prevent unexpected power application.
4. Ground the pump permanently using a wire of the same size as that specified in wiring chart (Page 3). Make ground connection to green grounding terminal under motor canopy marked GRD. or ⏚.
5. Connect ground wire to a grounded lead in the service panel or to a metal underground water pipe or well casing at least 10 feet long. Do not connect to plastic pipe or insulated fittings.
6. Protect current carrying and grounding conductors from cuts, grease, heat, oil, and chemicals.
7. Connect current carrying conductors to terminals L1 and L2 under motor canopy. When replacing motor, check wiring diagram on motor nameplate. If the motor wiring diagram does not match either diagram in Figure 3, follow the diagram on the motor.

IMPORTANT: 115/230 Volt single phase models are shipped from factory with motor wired for 230 volts. If power supply is 115 volts, remove motor canopy and reconnect motor as shown in Figure 3. Do not try to run motor as received on 115 volt current.

8. Motor has automatic internal thermal overload protection. If motor has stopped for unknown reasons, thermal overload may restart it unexpectedly, which could cause injury or property damage. Disconnect power before servicing motor.
9. If this procedure or the wiring diagrams are confusing, consult a licensed electrician.

PUMP SERVICE

This centrifugal pump requires little or no service other than reasonable care and periodic cleaning. Occasionally, however, a shaft seal may become damaged and must be replaced. The procedure as outlined below will enable you to replace the seal.

NOTICE: Pumps use mechanical seals with a rubber seat ring or a sealing O-Ring. THESE SEALS ARE COMPLETELY INTERCHANGEABLE.

NOTICE: The highly polished and lapped faces of this seal are easily damaged. Read instructions and handle the seal with care.

Some models are equipped with an impeller screw, which has a left hand thread. Before unscrewing the impeller, remove the impeller screw.

REMOVAL OF OLD SEAL

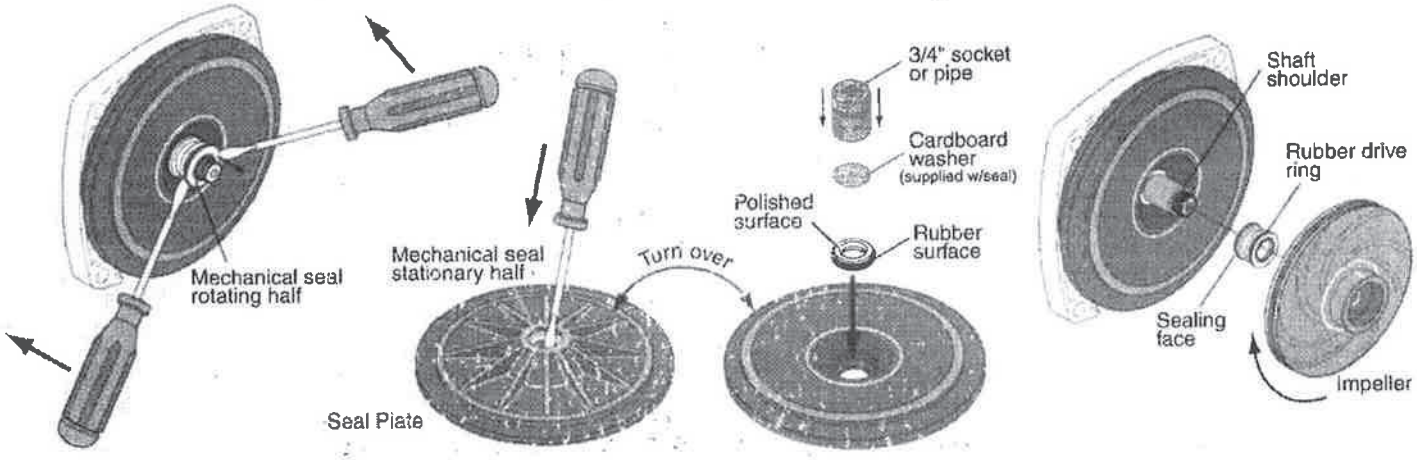
1. After unscrewing impeller, carefully remove rotating part of seal by prying up on sealing washer, using two screwdrivers (see Figure 5A). Use care not to scratch motor shaft.
2. Remove seal plate from motor and place on flat surface, face down. Use a screwdriver to push ceramic seat out from seal cavity (see Figure 5B).

INSTALLATION OF FLOATING SEAT (Figure 5C)

1. Clean polished surface of floating seat with clean cloth.
2. Turn seal plate over so seal cavity is up, clean cavity thoroughly.
3. Lubricate outside rubber surface of ceramic seat with soapy water and press firmly into seal cavity with finger pressure: If seat will not locate properly in this manner, place cardboard washer over polished face of seat and press into seal cavity using a 3/4" socket or 3/4" piece of standard pipe.
4. **DISPOSE OF CARDBOARD WASHER.** Be sure polished surface of seat is free of dirt and has not been damaged by insertion. Remove excess soapy water.

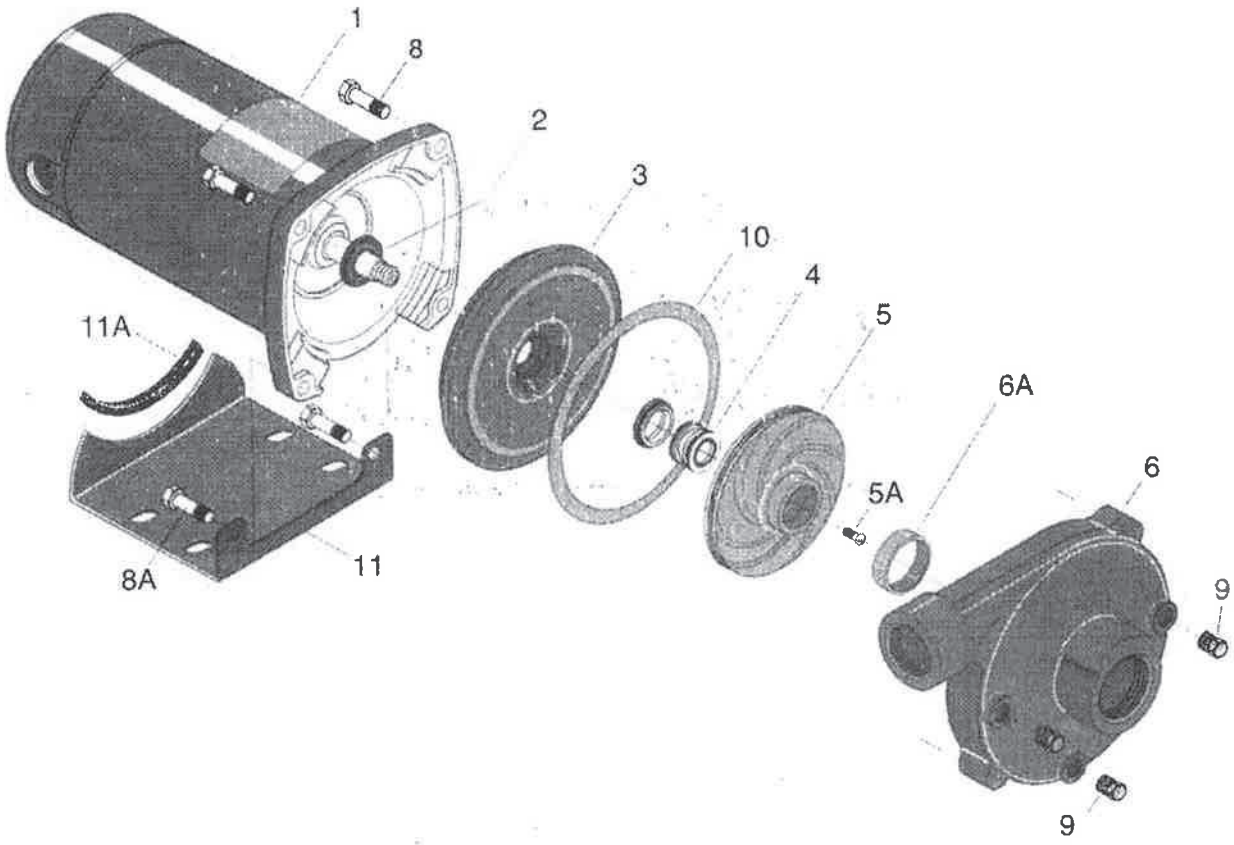
INSTALLATION OF ROTATING PART OF SEAL UNIT (Figure 5D)

1. Reinstall seal plate using extreme caution not to hit ceramic portion of seal on motor shaft.
2. Inspect shaft to make sure that it is clean.
3. Clean face of sealing washer with clean cloth.
4. Lubricate inside diameter and outer face of rubber drive ring with soapy water and slide assembly on motor shaft (sealing face first) until rubber drive ring hits shaft shoulder.
5. Screw impeller on shaft until impeller hub hits shaft shoulder. This will automatically locate seal in place and move the sealing washer face up against seat facing. Reinstall impeller screw (if used).



A-Seal removal-rotating half B-Seal removal-stationary half C-Stationary half installation D-Rotating half installation

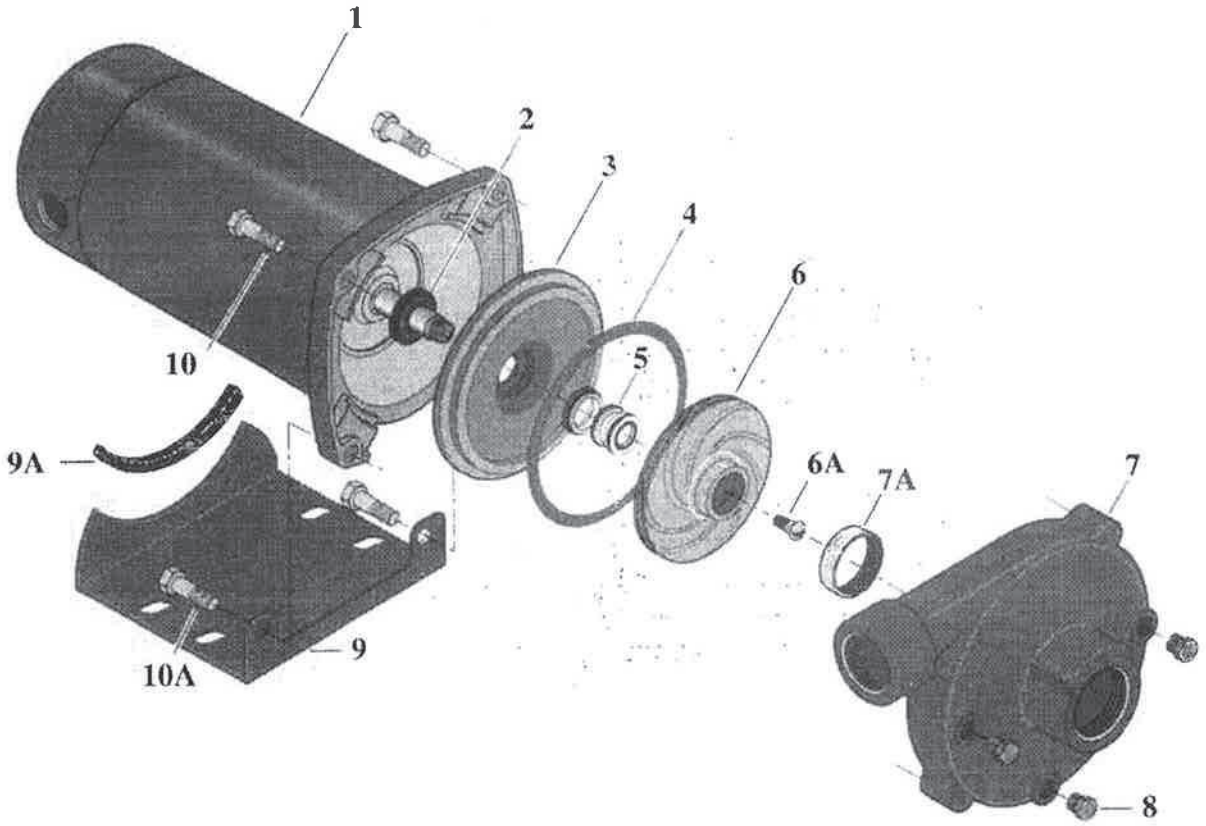
FIGURE 5



REPAIR PARTS LIST – CT SERIES

Key No.	Part Description	No. Used	MOTOR AND HORSEPOWER					
			CTJ05 CTJ053 1/2 HP	CTJ07 CTJ073 3/4 HP	CTJ10 CTJ103 1 HP	CTJ15 CTJ153 1-1/2 HP	CTJ20 CTJ203 2 HP	CTJ25 CTJ253 2-1/2 HP
1*	Motor, 115/230V, Single Phase	1	J218-582APKG	J218-590PKG	J218-596PKG	J218-601PKG	J218-883APKG	J218-628APKG
1*	Motor, 230/460V, Three Phase	1	AP100CL	AP100DL	AP100EL	AP100FL	AP100GL	AP100G5L
†2	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009
3	Seal Plate	1	C3-178	C3-178	C3-178	C3-178	C3-181	C3-181
†4	Shaft Seal	1	U109-6A	U109-6A	U109-6A	U109-6A	U109-6A	U109-6A
5	Impeller - Single Phase	1	C105-92PN	C105-92PM	C105-92PL	C105-92PB	–	C105-92PAB
5	Impeller - Three Phase	1	C105-95PNA	C105-95PMA	C105-95PLA	C105-95PBA	C105-95PCAB	C105-95PAB
5A	Impeller Screw - Three Phase	1	C30-14SS	C30-14SS	C30-14SS	C30-14SS	C30-14SS	C30-14SS
6	Volute Assembly with Wear Ring	1	C101-284E	C101-284E	C101-284E	C101-284E	C101-264E	C101-264EB
6A	Wear Ring	1	C23-27	C23-27	C23-27	C23-27	C23-19	C23-19
8	Hex capscrew - 3/8 - 16 x 1" Lg.	2	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP
8A	Hex capscrew - 3/8 - 16 x 1-1/4" Lg.	2	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP
9	Pipe Plug - 1/4" NPT	3	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV
†10	Gasket - Volute	1	C20-121C	C20-121C	C20-121C	C20-121C	C20-122C	C20-122C
11	Base	1	J104-9F	J104-9F	J104-9F	J104-9F	J104-9F	J104-9F
11A	Motor Pad	1	C35-5S	C35-5S	C35-5S	C35-5S	C35-5S	C35-5S
	SERVICE KIT							
	Seal and Gasket Kit	1	PP1700	PP1700	PP1700	PP1700	PP1700	PP1700
	NOTE: † Included in Seal and Gasket Kit.							

* For repair or service to motors, always give the motor Model Number and any other data found on the Motor Model Plate.



REPAIR PARTS LIST – CTB SERIES

Key No.	Part Description	No. Used	MOTOR AND HORSEPOWER					
			CTJ05B CTJ05B3 1/2 HP	CTJ07B CTJ07B3 3/4 HP	CTJ10B CTJ10B3 1 HP	CTJ15B CTJ15B3 1-1/2 HP	CTJ20B CTJ20B3 2 HP	CTJ25B CTJ25B3 2-1/2 HP
1	Motor, 115/230V, 1 Phase	1	J218-582APKG	J218-590PKG	J218-596PKG	J218-601PKG	J218-883APKG	J218-628APKG
1	Motor, , 230/460V, 3 Phase	1	AP100CL	AP100DL	AP100EL	AP100FL	AP100GL	AP100G5L
†2	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009
3	Seal Plate	1	C3-178	C3-178	C3-178	C3-178	C3-181	C3-181
†4	Gasket, Seal Plate	1	C20-121C	C20-121C	C20-121C	C20-121C	C20-122C	C20-122C
†5	Shaft Seal	1	U109-6A	U109-6A	U109-6A	U109-6A	U109-6A	U109-6A
6	Impeller, Single Phase	1	C5-256BA	C5-256BAA	C5-254BA	C5-254BC	C5-257BB	C5-257B
6	Impeller, Three Phase	1	C5-256BA	C5-256BAA	C5-254BA	C5-254BC	C5-257BB	C5-257B
6A	Impeller Screw, Three Phase	1	C30-14SS	C30-14SS	C30-14SS	C30-14SS	C30-14SS	C30-14SS
7	Volute Assembly with Wear Ring	1	C101-284E	C101-284E	C101-284E	C101-284E	C101-264E	C101-264EB
7A	Wear Ring	1	C23-27	C23-27	C23-27	C23-27	C23-27	C23-27
8	Pipe Plug, 1/4" NPT Hex Hd.	3	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV
9	Base	1	J104-9F	J104-9F	J104-9F	J104-9F	J104-9F	J104-9F
9A	Motor Pad	1	C35-5S	C35-5S	C35-5S	C35-5S	C35-5S	C35-5S
10	Hex Capscrew, 3/8" - 16 x 1" Lg.	2	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP
10A	Hex Capscrew, 3/8" - 16 x 1-1/4" Lg.	2	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP
	SERVICE KIT							
	Seal and Gasket Kit	1	PP1700	PP1700	PP1700	PP1700	PP1700	PP1700
	NOTE: † Included in Seal and Gasket Kit.							

* For repair or service to motors, always give the motor Model Number and any other data found on the Motor Model Plate.

TROUBLESHOOTING

TROUBLE AND CAUSE	REMEDY
FAILURE TO PUMP	
1. Pump not properly primed.	1. Make sure pump casing and suction line are full of water. See priming instructions.
REDUCED CAPACITY AND/OR HEAD	
1. Air pockets or leaks in suction line. 2. Clogged impeller.	1. Check suction piping. 2. Remove and clean.
PUMP LOSES PRIME	
1. Air leaks in suction line. 2. Excessive suction lift and operating too near shut-off point. 3. Water level drops while pumping, uncovering suction piping.	1. Check suction piping 2. Move pump nearer to water level. 3. Check water supply. Add length of pipe to suction to keep submerged end under water.
MECHANICAL TROUBLES AND NOISE	
1. Bent shaft and/or damaged bearings. 2. Suction and/or discharge piping not properly supported and anchored.	1. Take motor to authorized motor repair shop. 2. See that all piping is supported to relieve strain on pump assembly.

Limited Warranty

Myers warrants to the original consumer purchaser ("Purchaser" or "You") of the products listed below, that they will be free from defects in material and workmanship for the Warranty Period shown below.

Product	Warranty Period whichever occurs first:
Jet pumps, small centrifugal pumps, submersible pumps and related accessories	12 months from date of original installation, or 18 months from date of manufacture
Fibrewound Tanks	5 years from date of original installation
Steel Pressure Tanks	5 years from date of original installation
Sump/Sewage/Effluent Products	12 months from date of original installation, or 36 months from date of manufacture
Battery Backup Units	
MBSP-2, MBSP-2C	12 months from date of original installation, or 18 months from date of manufacture
MBSP-3, MBSP-3C	24 months from date of original installation, or 30 months from date of manufacture
Wastewater Solids Handling Pumps	12 months from date of shipment from factory or 18 months from date of manufacture

Our warranty applies only where such products are used in compliance with the requirements of the applicable product catalog and/or manuals. For additional information, please refer to the applicable standard limited warranty featured in the product manual.

Our warranty will not apply to any product that, in our sole judgement, has been subject to negligence, misapplication, improper installation, or improper maintenance. Without limiting the foregoing, operating a three phase motor with single phase power through a phase converter will void the warranty. Note also that three phase motors must be protected by three-leg, ambient compensated, extra-quick trip overload relays of the recommended size or the warranty is void.

Your only remedy, and MYERS's only duty, is that MYERS repair or replace defective products (at MYERS's choice). You must pay all labor and shipping charges associated with this warranty and must request warranty service through the installing dealer as soon as a problem is discovered. No request for service will be accepted if received after the Warranty Period has expired. This warranty is not transferable.

MYERS SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, OR CONTINGENT DAMAGES WHATSOEVER.

THE FOREGOING LIMITED WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE FOREGOING LIMITED WARRANTIES SHALL NOT EXTEND BEYOND THE DURATION PROVIDED HEREIN.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on the duration of an implied warranty, so the above limitations or exclusions may not apply to You. This warranty gives You specific legal rights and You may also have other rights which vary from state to state.

This Limited Warranty is effective April 1, 2014 and replaces all undated warranties and warranties dated before April 1, 2014.

F.E. MYERS
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Phone: 888-987-8677 • Fax: 800-426-9446 • www.femyers.com
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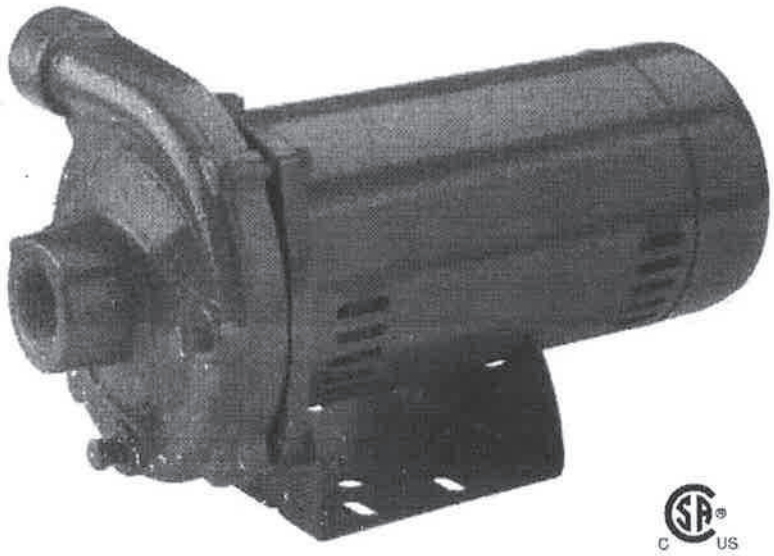
Phone: 800-363-7867 • Fax: 888-606-5484

MYERS® CT Series
General Purpose Centrifugal Pumps

The CT Series have a rugged cast iron construction and can be coupled with either a corrosion resistant Noryl, or a lead-free brass impeller.



APPLICATIONS

- **Water systems and sprinkling...** for homes, farms and industry.

SPECIFICATIONS

Body and Seal Plate – Close-grained cast iron

Base – Steel 10 gauge

Impeller Types – Noryl® and brass

Shaft – 416 stainless steel

Mechanical Seal – Carbon/ceramic, Buna-N

FEATURES

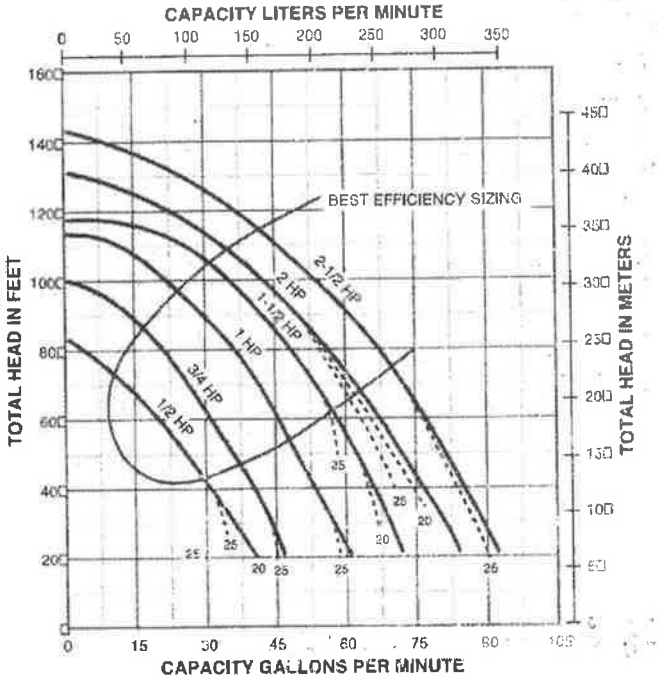
- **1/2 through 2-1/2 HP** – High head models, with heavy-duty motors, easy service design and four-position discharge.
- **Drain Port** – Provided for easy winterizing.
- **High Head** – Up to 140' of head with capacities to 90 GPM.
- **Easy Serviceability** – All models include replaceable wear ring and feature back pull-out design.
- **Noryl® Impellers** – Abrasion-resistant for normal applications with working temperatures to 140°F.
- **Silicon Bronze Impellers** – Pumps equipped with shaft seals rated for temperatures to 225°F.

ORDERING INFORMATION

Catalog Number	HP	Suction	Discharge	Impeller Material	Phase
CTJ05	1/2	1-1/4"	1"	Composite	1
CTJ053		1-1/4"	1"	Composite	3
CTJ05B		1-1/4"	1"	Brass	1
CTJ05B3		1-1/4"	1"	Brass	3
CTJ07	3/4	1-1/4"	1"	Composite	1
CTJ073		1-1/4"	1"	Composite	3
CTJ07B		1-1/4"	1"	Brass	1
CTJ07B3		1-1/4"	1"	Brass	3
CTJ10	1	1-1/4"	1"	Composite	1
CTJ103		1-1/4"	1"	Composite	3
CTJ10B		1-1/4"	1"	Brass	1
CTJ10B3		1-1/4"	1"	Brass	3
CTJ15	1-1/2	1-1/4"	1"	Composite	1
CTJ153		1-1/4"	1"	Composite	3
CTJ15B		1-1/4"	1"	Brass	1
CTJ15B3		1-1/4"	1"	Brass	3
CTJ20	2	1-1/2"	1-1/2"	Composite	1
CTJ203		1-1/2"	1-1/2"	Composite	3
CTJ20B		1-1/2"	1-1/2"	Brass	1
CTJ20B3		1-1/2"	1-1/2"	Brass	3
CTJ25	2-1/2	2"	1-1/2"	Composite	1
CTJ253		2"	1-1/2"	Composite	3
CTJ25B		2"	1-1/2"	Brass	1
CTJ25B3		2"	1-1/2"	Brass	3

MYERS® CT Series
General Purpose Centrifugal Pumps

PUMP PERFORMANCE (Capacity in Gallons Per Minute)

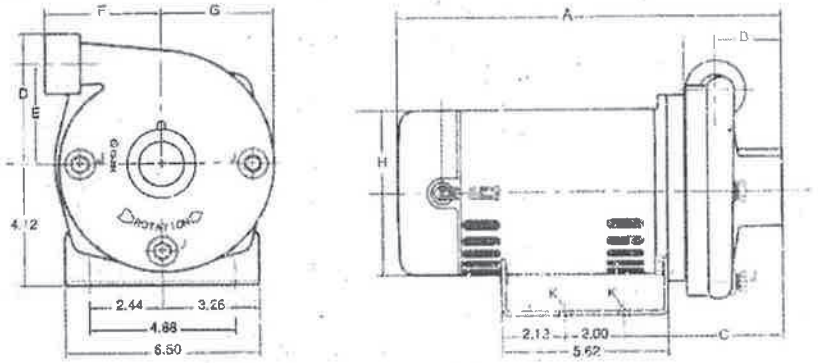


HP	Discharge Pressure		Dynamic Suction Lift				
	PSI	Feet Head	5'	10'	15'	20'	25'
1/2	10	23.1	—	34	32	29	26
	20	46.2	25	21	18	15	11
	30	69.3	10	—	—	—	—
3/4	10	23.1	—	—	42	39	37
	20	46.2	35	32	30	28	26
	30	69.3	24	22	19	15	10
1	20	46.2	48	46	45	43	40
	30	69.3	38	35	31	28	25
	40	92.4	23	20	15	—	—
1-1/2	20	46.2	62	60	58	55	52
	30	69.3	50	48	44	40	37
	40	92.4	37	32	29	22	—
2	30	69.3	60	57	52	59	45
	40	92.4	45	40	36	31	24
	50	115.5	22	15	—	—	—
2-1/2	20	46.2	81	79	76	74	71
	30	69.3	69	67	63	60	56
	40	92.4	56	51	47	44	38
	50	115.5	33	30	22	15	—

Tested and rated in accordance with Water Systems Council Standards.

NOTE: Pumps installed with a Pro-Source® tank require a 100 PSI relief valve. Pumps with a conventional tank require a 75 PSI relief valve. Relief valve must be capable of relieving entire flow of pump at relief pressure.

OUTLINE DIMENSIONS



Dimensions (in inches) are for estimating purposes only.

DIMENSIONS (In Inches)

HP	NPT Suct.	NPT Disch.	A (1 Phase)	A (3 Phase)	B	C	D	E	F	G	H	NPT J	K
1/2	1-1/4	1	11-21/32	13-3/8	2-1/16	5-9/16	4-1/2	3-7/16	3-7/8	3-15/16	5-5/8	1/4	3/8 Dia.
3/4	1-1/4	1	11-25/32	13-3/8	2-1/16	5-9/16	4-1/2	3-7/16	3-7/8	3-15/16	5-5/8	1/4	3/8 Dia.
1	1-1/4	1	12-25/32	13-7/8	2-1/16	5-9/16	4-1/2	3-7/16	3-7/8	3-15/16	5-5/8	1/4	3/8 Dia.
1-1/2	1-1/4	1	13-39/64	14-3/8	2-1/16	5-9/16	4-1/2	3-7/16	3-7/8	3-15/16	5-5/8	1/4	3/8 Dia.
2	1-1/2	1-1/4	16-3/4	16-15/16	2-13/16	6-5/16	4-27/32	3-13/32	4-5/8	4	6-7/16	1/4	3/8 Dia.
2-1/2	2	1-1/2	17-3/4	17-1/4	2-13/16	6-5/16	4-27/32	3-13/32	4-5/8	4	6-7/16	1/4	3/8 Dia.

PENTAIR

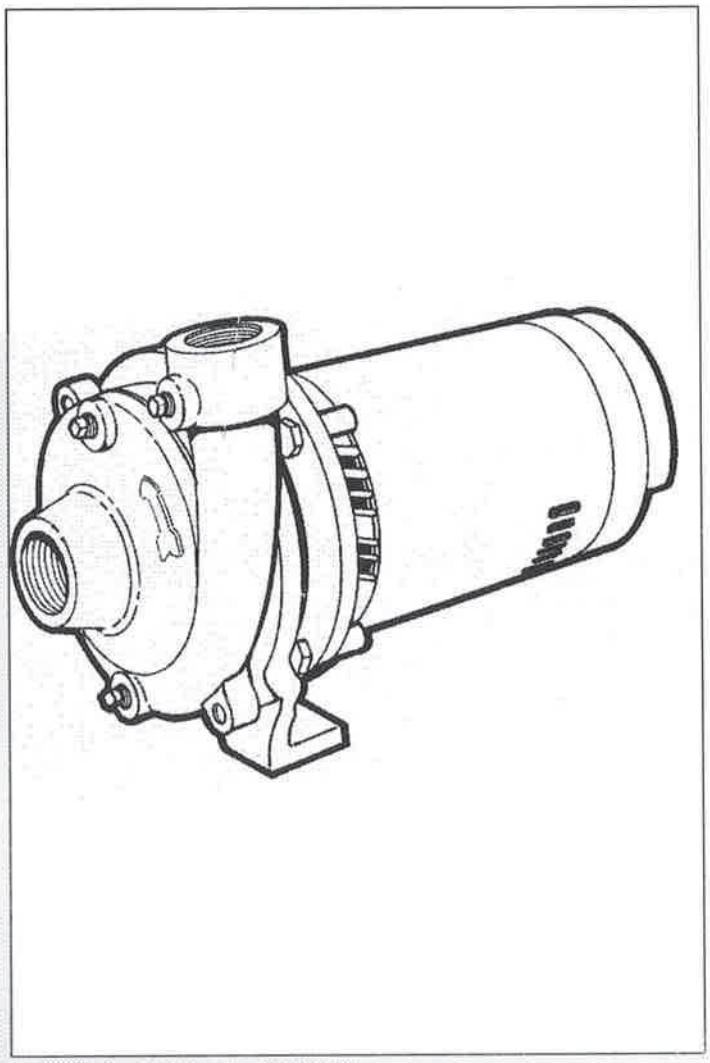
USA 293 WEIGHT STREET, DELAVAN, WI 53115 WWW.PENTAIR.COM PH: 888-987-8677 ORDERS FAX: 800-426-9446
CANADA 490 PINEBUSH ROAD, UNIT 4, CAMBRIDGE, ONTARIO, N1T 0A5 PH: 800-363-7867 ORDERS FAX: 888-606-5484

M11986WS (12/13/16)

INSTALLATION AND SERVICE MANUAL

CENTRI-THRIFT CENTRIFUGAL PUMPS

Models
125M/B, 150M/B
and 200M/B



ENGLISH: PAGES 2-8

Installation and Service Manual

NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.

PENTAIR
MYERS

Part # 13800A085 | © 2018 Pentair plc | 8/24/18

Important safety instructions! Read carefully before installation.

California Proposition 65 Warning:

⚠ WARNING This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

Safe Drinking Water Act:

⚠ WARNING This product is to be used exclusively for non-potable water services. This product is not anticipated to be used for human consumption so is not designed for the low lead levels stated in the Safe Drinking Water Act. It is illegal to use this product for potable water applications for human consumption, such as drinking water, oral hygiene, hand washing, food preparation and dishwashing.

Failure to follow these instructions and comply with all codes may cause serious bodily injury and/or property damage.

Before installing or servicing your pump, be certain the pump power source is turned off and disconnected.

All installation and electrical wiring must adhere to state and local codes. Check with appropriate community agencies or contact your local electrical and pump professionals for help.

Pump must be connected to a separate electrical circuit directly from the entrance box. There must be an appropriately sized fuse or circuit breaker in this line. Tying into existing circuits may cause circuit overloading, blown fuses, tripped circuit breakers or a burned-up motor.

Do not connect pump to a power supply until the pump is grounded. For maximum safety, a ground fault interrupter should be used. Failure to ground this unit properly may result in severe electrical shock.

Reduced risk of electric shock during operation of this pump requires acceptable grounding. If the means of connection to the supply-connection box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit conductors supplying the pump, to the grounding screw provided within the wiring compartment.

This pump is provided with a means for grounding. To reduce the risk of electric shock from contact with adjacent metal parts, bond supply box to the pump-motor-grounding means and to all metal parts accessible including metal discharge pipes, by means of a clamp, a weld or both if necessary, secured to the equipment-grounding terminal.

The voltage and phase of the power supply must match the voltage and phase of the pump.

Do not use an extension cord. Above ground joints must be made in an approved junction box.

Never operate a pump with a frayed or brittle power cord, and always protect it from sharp objects, hot surfaces, oil and chemicals. Avoid kinking the cord.

Never service a motor or power cord with wet hands or while standing in or near water or damp ground.

Do not use this pump in or near a swimming pool.

The three phase units must be wired by a qualified electrician, using an approved starter box and switching device.

Single phase motors are equipped with automatic resetting thermal protectors. The motor may restart unexpectedly, causing the leads to energize or pump to turn on. Three phase motors should be protected by proper thermal and amperage protection. (Check local codes.)

Check for nicks in the wire and pump insulation by using an ohmmeter and checking resistance to ground after installing the pump. If in doubt on the proper procedure, check with a qualified electrician.

Do not pump gasoline, chemicals, corrosives or flammable liquids; they could ignite, explode or damage the pump, causing injury and voiding the warranty.

Never work on the pump or system without relieving the internal pressure.

Do not pump water above 120° F.

Never exceed the pressure rating of any system component.

INSTALLATION

Piping

Pipes must line up and not be forced into position by unions. Piping should be independently supported near the pump so that no strain will be placed on the pump casing. Where any noise is objectionable, pump should be insulated from the piping with rubber connections. Always keep pipe size as large as possible and use a minimum of fittings to reduce friction losses.

Suction Piping

Suction pipe should be direct and as short as possible. It should be at least one size larger than suction inlet tapping and should have a minimum of elbows and fittings. The piping should be laid out so that it slopes upward to pump without dips or high points to eliminate air pockets. The highest point in the suction piping should be the pump inlet except where liquid flows to the pump inlet under pressure. A foot valve must be used to keep pump primed. Where liquid flows to the pump, it may be desirable to use a check valve in the suction line or discharge line to keep pump primed.

To prevent air from being drawn into suction pipe due to a suction whirlpool, the foot valve should be submerged at least three feet below the low water level. The suction pipe must be tight and free of air leaks.

Discharge Piping

Discharge piping should never be smaller than pump tapping and should preferably be one size larger. A gate valve should always be installed in discharge line to serve as a shut-off for throttling if capacity is not correct. To protect the pump and foot valve from water hammer and to prevent back flow, a check valve should be installed in the discharge line between the pump and gate valve.

Electrical Connections

Be sure motor wiring is connected for voltage being used.

Unit should be connected to a separate circuit, direct from main switch. A fused disconnect switch or circuit breaker must be used in this circuit. Wire of sufficient size should be used to keep voltage drop to a maximum of 5%. All motors, unless provided with built-in overload protection, must be protected with an overload switch, either manual or magnetic. Three phase motors require overload protection. Single phase motors are equipped with built-in overload protection. Never install a pump without proper overload protection. A flexible metallic conduit should be used to protect the motor leads.

Priming
The pump must be primed before starting. The pump casing and suction piping must be filled with water before starting motor. Remove vent plug in top of casing while pouring in priming water. A hand pump or ejector can be used for priming when desired. Use care to remove all air before starting motor. If pump does not start immediately, stop and reprime.

Starting
Close the discharge valve when starting the pump as it puts less starting load on the motor. When the pump is up to operating speed, open the discharge valve to obtain desired capacity or pressure. Do not allow the pump to run for long periods with the discharge valve tightly closed. This will create superheated water, which could damage the seal and shorten the life of the motor. This superheated water could also cause severe burns. Always use a pressure relief valve, set below the rating of the tank system.

Rotation
The pump must run in direction of arrow on pump case. All single phase motors are single rotation. Three phase motors may run either direction. If rotation is wrong when first starting motor, interchange any two line leads to change rotation.

Stopping
Before stopping pump, close the discharge valve. This will prevent water hammer and is especially important on high head pumps.

Freezing
Care should be taken to prevent the pump from freezing during cold weather. Drain the pump casing when not in operation. Drain by removing the pipe plug in the bottom of the casing.

Rotary Seal
Centrifugal pumps are fitted with rotary seal. This seal is recommended for water free from abrasives. If liquid contains abrasives, the centrifugal pump should not be used.

Bearings
Lubricate motor bearings in accordance with motor manufacturer's instructions.

Single seal ball bearings are used on 125B, 150B and 200B bearing bracket units. Proper amount of grease has been provided in the bracket cavity between the bearings. This should be sufficient grease for 4,000 hours of operation. After 4,000 hours of operation the old grease should be cleaned out and new grease added. Use only best grade ball bearing greases

DISASSEMBLY INSTRUCTIONS

Open the power supply switch contacts and remove fuses. Disconnect the electrical wiring from the motor. Then drain pump case by removing drain plugs.

Remove the bolts securing volute case to pump bracket, and pry components apart. Then remove impeller.

Always replace both rotating assembly and stationary ceramic seat. Do not use old stationary seat with new rotating seal assembly. Pry out rotating assembly of shaft seal and remove ceramic ring from housing. A new shaft seal should always be used when rebuilding a pump. All pump parts should be cleaned thoroughly before being reassembled.

Remove four bolts holding bracket to motor and remove motor. Then remove set screw in stub shaft coupling to disconnect motor pump shaft.

ASSEMBLY INSTRUCTIONS

Place rubber deflector over motor shaft, slide shaft extension into position and tighten set screws. Assemble motor and shaft onto bracket.

Insert seal seat in position by using finger pressure to press firmly and squarely until it bottoms. The use of light oil on the rubber element will facilitate assembly. Care must be taken to keep oil, grease and dirt off face areas of seal. Be sure the seal faces are not damaged during assembly or the seal will leak during operation.

Check dimension from face of ceramic seat to shaft shoulder. This distance should be within a tolerance of ±1/64. Install rotating element of seal on shaft. Be sure the lapped sealing surface is toward seal seat and assemble impeller. Check diameter of impeller against motor horsepower rating to ensure proper performance.

Secure impeller using key, impeller retainer washer, 5/16 stainless steel helical spring lockwasher and socket head cap screw, 1" long. Then rotate pump shaft with fingers, making sure there is uniform drag of the seal faces.

Centri-Thrift Centrifugal Pump Parts List

		1-1/2" Suction - 1-1/4" Discharge		2" Suction - 1-1/2" Discharge		
Pump Nameplate Catalog Number Horsepower		**125M-2 2**	**125M-3 3**	**150M-2 2**	**150M-3 3**	**150M-5 5**
Description	**No. Req.**	**Part No.**	**Part No.**	**Part No.**	**Part No.**	**Part No.**
Motor - See Chart Below.	1					
Pump Shaft Assembly - See Chart Below	1					
Bracket - See Chart Below	1					
Set Screw for Shaft Assembly, Single Phase Motor	2	05013A015	06024A001	05013A015	06024A001	06024A001
Set Screw for Shaft Assembly, Three Phase Motor	2	05013A015	05013A015	05013A015	05013A015	05013A015
Cap Screw - Bracket to Motor, 3/8"-16NC x 1-1/8"	4	19101A016	19101A016	19101A016	19101A016	-
Cap Screw - Bracket to Motor, 1/2"-13NC x 1-1/4"	4	-	19103A004	-	-	19103A004
Cap Screw - Bracket to Motor, 3/8"-16 NC x 1"	4	-	19101A013	-	19101A013	-
Cap Screw - Bracket to Case, 3/8"-16NC x 1-1/8"	8	19101A016	19101A016	19101A016	19101A016	19101A016
Lockwasher - 3/8"	12	05454A007	05454A007	05454A007	05454A007	05454A007
Lockwasher - 3/8"	8	-	-	-	-	05454A007
Lockwasher - 1/2"	4	-	05454A004	-	05454A004	05454A004
Shaft Seal	1	11716A001K	11716A001K	RTF	RTF	RTF
Impeller	1	11725B002	11725B003	12935B003	12935B001	12935B003
Key for Impeller	1	05818A025	05818A025	05818A025	05818A025	05818A025
Washer - Special	1	11718A000	11718A000	12933A000	12933A000	12933A000
Lockwasher - 5/16"	1	05454A014	05454A014	05454A014	05454A014	05454A014
Cap Screw - Stainless Steel	1	19100A004	19100A004	06106A008	06106A008	06106A008
Gasket - Case to Bracket	1	05863A013	05863A013	-	-	-
Volute Case	1	11726D001	11726D001	12937D001	12937D001	12937D001
Wearing Ring - For Units w/Wearing Ring	1	-	-	12934A000	12934A000	12934A000
Pipe Plug - 1/8"	4	05022A004	05022A004	05022A004	05022A004	05022A004
Pipe Plug - 1/4"	1	05022A009	05022A009	05022A009	05022A009	05022A009
Deflector - Rubber, for 5/8" Shaft	1	05059A318	05059A318	05059A318	-	-
Deflector - Rubber, for 7/8" Shaft	1	05059A320	05059A320	-	05059A320	-
Deflector - Rubber, for 1-1/8" Shaft	1	-	05059A321	-	05059A321	05059A321

Motor Horsepower	2	2	2	2	2	2	3	3	3
Pump Serial Number	654	654	756	756	1056	1056	654	654	157
Motor Number	-	-	13229A000	20051A000	13229A000	20051A000	RTF	-	RTF
Voltage	115/230	220/440	115/230	220/440	115/230	220/440	230	220/440	220/440
Phase	Single	Three	Single	Three	Single	Three	Single	Three	Three
Motor Bolt Circle	5-7/8"	5-7/8"	5-7/8"	5-7/8"	5-7/8"	5-7/8"	7-1/4"	7-1/4"	5-7/8"
Motor Shaft Diameter	7/8"	7/8"	5/8"	5/8"	5/8"	5/8"	1-1/8"	7/8"	7/8"
Shaft - Rotary Seal	11723B001	11723B001	11714B001	11714B001	11714B001	11714B001	11914B001	RTF	RTF
Bracket - Rotary Seal	11715D000	11715D000	11715D000	11715D000	11715D000	11715D000	11912D000	11912D000	RTF

Motor Horsepower	3	3	3	3	5	5
Pump Serial Number	974	974	1056	1056	1056	1056
Motor Number	21206A000	21207A000	RTF	-	18939A000	18941A000
Voltage	208/230	230/460	230	220/440	230	220/440
Phase	Single	Three	Single	Three	Single	Three
Motor Bolt Circle	5-7/8"	5-7/8"	7-1/4"	7-1/4"	7-1/4"	7-1/4"
Motor Shaft Diameter	5/8"	5/8"	1-1/8"	7/8"	1-1/8"	1-1/8"
Shaft - Rotary Seal	11714B001	11714B001	11914B001	RTF	11914B001	11914B001
Bracket - Rotary Seal	11715D000	11715D000	11912D000	11912D000	11912D000	11912D000

Centri-Thrift Centrifugal Pump Parts List

2-1/2" Suction -2" Discharge

Pump Nameplate Catalog Number Horsepower		200M-3 3	200M-5 5	200M-7-1/2 7-1/2
Description	**No. Req.**	**Part No.**	**Part No.**	**Part No.**
Motor - See Chart Below.	1			
Pump Shaft Assembly - See Chart Below	1			
Bracket - See Chart Below	1			
Set Screw for Shaft Assembly, Single Phase Motor	2	06024A001	06024A001	06024A001
Set Screw for Shaft Assembly, Three Phase Motor	2	05013A015	06024A001	06024A001
Cap Screw - Bracket to Motor, 3/8"-16NC x 1-1/8"	4	19101A016	-	-
Cap Screw - Bracket to Motor, 1/2"-13NC x 1-1/4"	4	19103A004	19103A004	19103A004
Cap Screw - Bracket to Motor, 3/8"-16 NC x 1"	4	19101A003	-	-
Cap Screw - Bracket to Case, 3/8"-16NC x 1-1/8"	8	19101A016	19101A016	19101A016
Lockwasher - 3/8"	12	05454A007	-	-
Lockwasher - 3/8"	8	-	05454A007	05454A007
Lockwasher - 1/2"	4	05454A004	05454A004	05454A004
Impeller	1	12936B002	12936B001	12936B003
Key for Impeller	1	05818A025	05818A025	05818A025
Washer - Special	1	12933A000	12933A000	12933A000
Lockwasher - 5/16"	1	05454A014	05454A014	05454A014
Gasket - Case to Bracket	1	05863A013	05863A013	05863A013
Volute Case	1	12938D001	12938D001	12938D001
Wearing Ring - For Units w/Wearing Ring	1	12934A000	12934A000	12934A000
Pipe Plug - 1/8"	4	05022A004	05022A004	05022A004
Pipe Plug - 1/4"	1	05022A009	05022A009	05022A009
Deflector - Rubber, for 5/8" Shaft	1	05059A318	-	-
Deflector - Rubber, for 7/8" Shaft	1	05059A320	-	-
Deflector - Rubber, for 1-1/8" Shaft	1	05059A321	05059A321	05059A321

Motor Horsepower	3	3	3	3	3	5	5	7-1/2
Pump Serial Number	974	974	1056	1056	157	1056	1056	1056
Motor Number	21206A000	21207A000	RTF	-	RTF	18939A000	18941A000	18944A000
Voltage	208/230	230/460	230	220/440	220/440	230	220/440	220/440
Phase	Single	Three	Single	Three	Three	Single	Three	Three
Motor Bolt Circle	5-7/8"	5-7/8"	7-1/4"	7-1/4"	5-7/8"	7-1/4"	7-1/4"	7-1/4"
Motor Shaft Diameter	5/8"	5/8"	1-1/8"	7/8"	7/8"	1-1/8"	1-1/8"	1-1/8"
Shaft - Rotary Seal	11714B001	11714B001	11914B001	RTF	RTF	11914B001	11914B001	11914B001
Bracket - Rotary Seal	11715D000	11715D000	11912D000	11912D000	RTF	11912D000	11912D000	11912D000

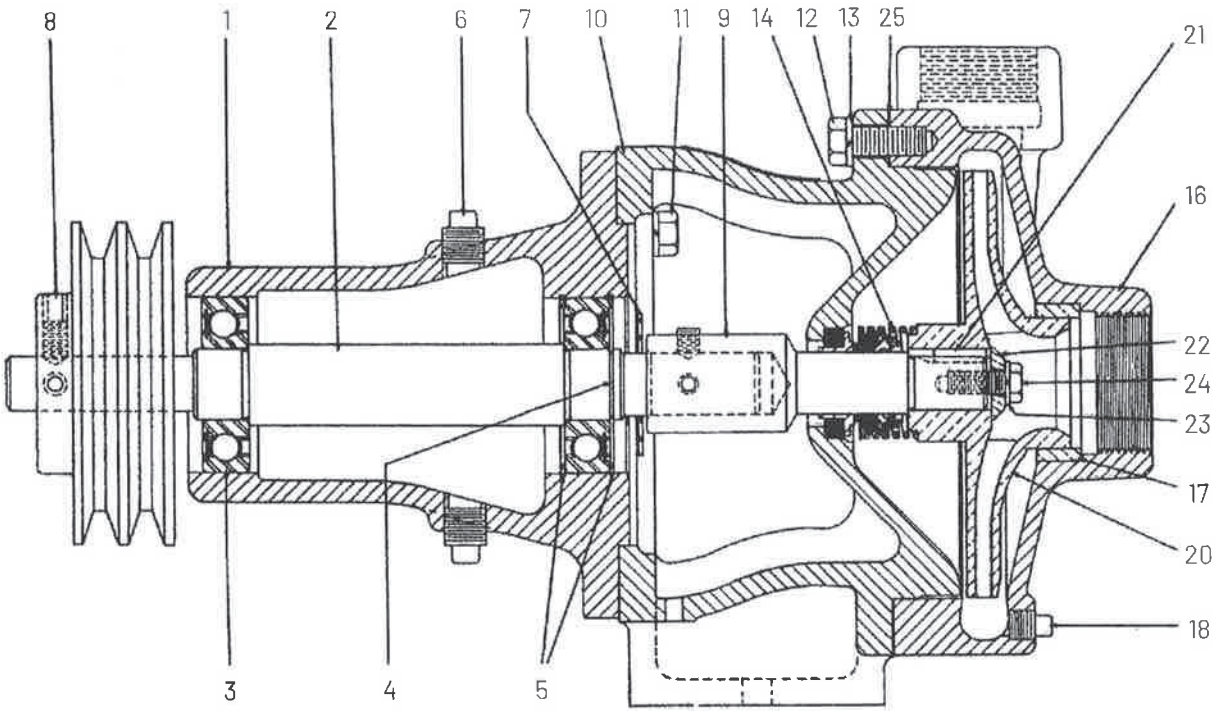
Part Number	Description
16837A002	Kit - Cat. No. 125M-2FA
16837A014	Kit - Cat. No. 125M-3FA
16837A005	Kit - Cat. No. 150M-2FA
16837A015	Kit - Cat. No. 150M-3FA

Part Number	Description
16837A008	Kit - Cat. No. 150M-5FA
16837A016	Kit - Cat. No. 200M-3FA
16837A011	Kit - Cat. No. 200M-5FA
16837A012	Kit - Cat. No. 200M-7-1/2FA

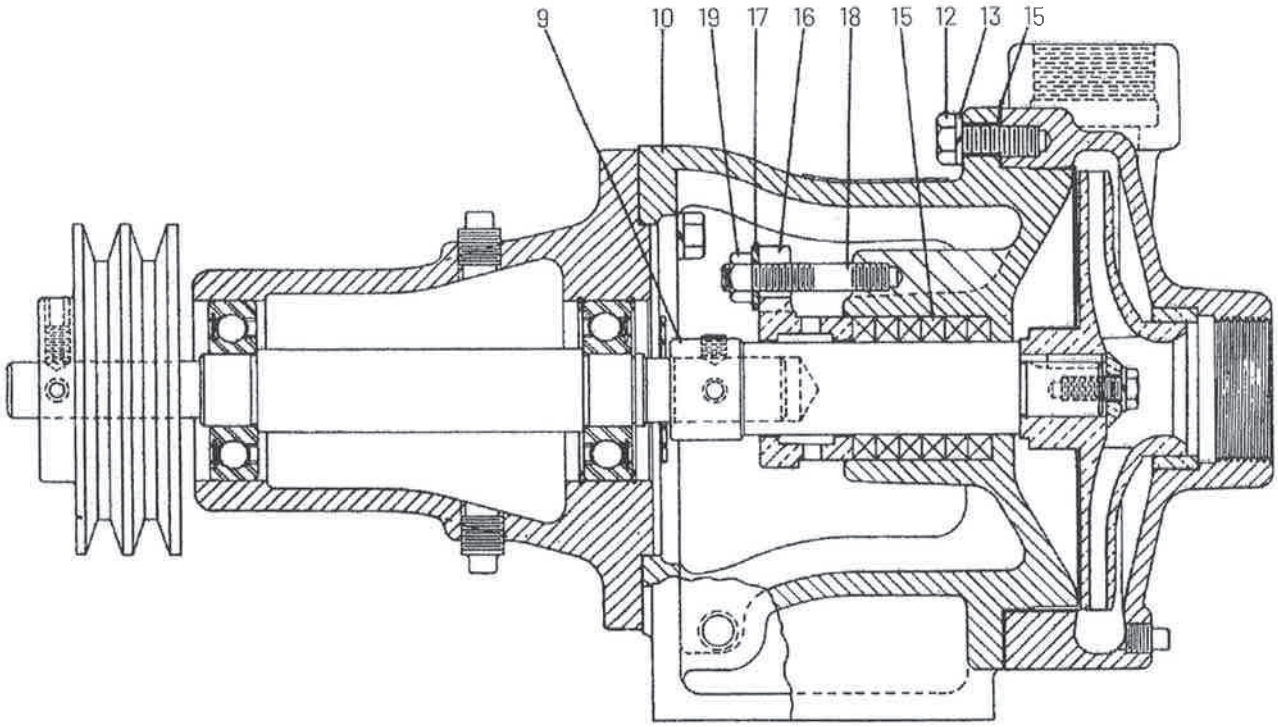
Centri-Thrift Centrifugal Pump Parts List

Belt Driven

Pump Name and Plate Catalog Number			125B	125B	150B	200B
Pump Nameplate Serial Number			654 Plus Year Made	856 Plus Year Made	1056 Plus Year Made	1056 Plus Year Made
Suction			1-1/2"	1-1/2"	2"	2-1/2"
Discharge			1-1/4"	1-1/4"	1-1/2"	2"
Ref. No.	Name of Part	No. Req.	Part No.		Part No.	Part No.
1	Bearing Housing Only	1	11727C000	11727C000	11727C000	11727C000
2	Shaft for Belt Driven Head	1	RTF	11728B001	11728B001	11728B001
3	Bearing for Housing - Belt Driven Head	2	11729A001	11729A001	11729A001	11729A001
4	Snap Ring - Belt Driven Head	1	10848A003	10848A003	10848A003	10848A003
5	Snap Ring - Belt Driven Head	2	10848A004	10848A004	10848A004	10848A004
6	Pipe Plug - 1/4", Belt Driven Head	3	05022A060	05022A060	05022A060	05022A060
7	Deflector - Rubber, for 7/8" Shaft	1	05059A320	05059A320	05059A320	05059A320
8	Set Screw - 5/16"-18NC, 5/8" Long, Headless	2	05013A007	05013A007	05013A007	05013A007
-	Key for Pulley - 3/16" x 3/16" x 1-3/4" Long	1	-	05818A015	05818A015	05818A015
9	Pump Shaft Assembly - Rotary Seal	1	11723B001	11723B001	11723B001	11723B001
-	Set Screw for Shaft Assembly- 5/16"-18NC, 5/16" Long	2	05013A015	05013A015	05013A015	05013A015
10	Bracket for Use with Rotary Seal	1	11715D000	11715D000	11715D000	11715D000
11	Cap Screw - 3/8"-16NC, 1-1/8" Long, Bracket to Bearing Housing	4	19101A016	19101A016	19101A016	19101A016
12	Cap Screw - 3/8"-16NC, 1-1/8" Long, Bracket to Case	8	19101A016	19101A016	19101A016	19101A016
13	Lockwasher - 3/8"	12	05454A007	05454A007	05454A007	05454A007
14	Shaft Seal	1	RTF	RTF	RTF	RTF
15	Gasket - Case to Bracket	1	05863A013	05863A013	05863A013	05863A013
16	Volute Case with Wearing Ring	1	11726D001	11726D001	12937D001	12938D001
17	Wearing Ring Only	1	RTF	RTF	12934A000	12934A000
18	Pipe Plug - 1/8"	4	05022A004	05022A004	05022A004	05022A004
19	Nut for Studs	2	19109A021	19109A021	19109A021	19109A021
20	Impeller	1	11725B003	11725B003	12935B003	12936B003
21	Key for Impeller - 3/16" x 3/16" x 3/4" Long	1	05818A025	05818A025	05818A025	05818A025
22	Washer - Special	1	11718A000	11718A000	12933A000	12933A000
23	Lockwasher - 5/16"	1	05454A014	05454A014	05454A014	05454A014
24	Cap Screw - Stainless Steel	1	19100A004	19100A004	06106A008	06106A008



Belt Driven Head with Rotary Seal



Belt Driven Head with Stuffing Box

Limited Warranty

Myers warrants to the original consumer purchaser ("Purchaser" or "You") of the products listed below, that they will be free from defects in material and workmanship for the Warranty Period shown below.

Product	Warranty Period whichever occurs first:
Jet pumps, small centrifugal pumps, submersible pumps and related accessories	12 months from date of original installation, or 18 months from date of manufacture
Fibrewound Tanks	5 years from date of original installation
Steel Pressure Tanks	5 years from date of original installation
Sump/Sewage/Effluent Products	12 months from date of original installation, or 36 months from date of manufacture
Battery Backup Units	
MBSP-2, MBSP-2C	12 months from date of original installation, or 18 months from date of manufacture
MBSP-3, MBSP-3C	24 months from date of original installation, or 30 months from date of manufacture
Wastewater Solids Handling Pumps	12 months from date of shipment from factory or 18 months from date of manufacture

Our warranty applies only where such products are used in compliance with the requirements of the applicable product catalog and/or manuals. For additional information, please refer to the applicable standard limited warranty featured in the product manual.

Our warranty will not apply to any product that, in our sole judgement, has been subject to negligence, misapplication, improper installation, or improper maintenance. Without limiting the foregoing, operating a three phase motor with single phase power through a phase converter will void the warranty. Note also that three phase motors must be protected by three-leg, ambient compensated, extra-quick trip overload relays of the recommended size or the warranty is void.

Your only remedy, and MYERS's only duty, is that MYERS repair or replace defective products (at MYERS's choice). You must pay all labor and shipping charges associated with this warranty and must request warranty service through the installing dealer as soon as a problem is discovered. No request for service will be accepted if received after the Warranty Period has expired. This warranty is not transferable.

MYERS SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, OR CONTINGENT DAMAGES WHATSOEVER.

THE FOREGOING LIMITED WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE FOREGOING LIMITED WARRANTIES SHALL NOT EXTEND BEYOND THE DURATION PROVIDED HEREIN.

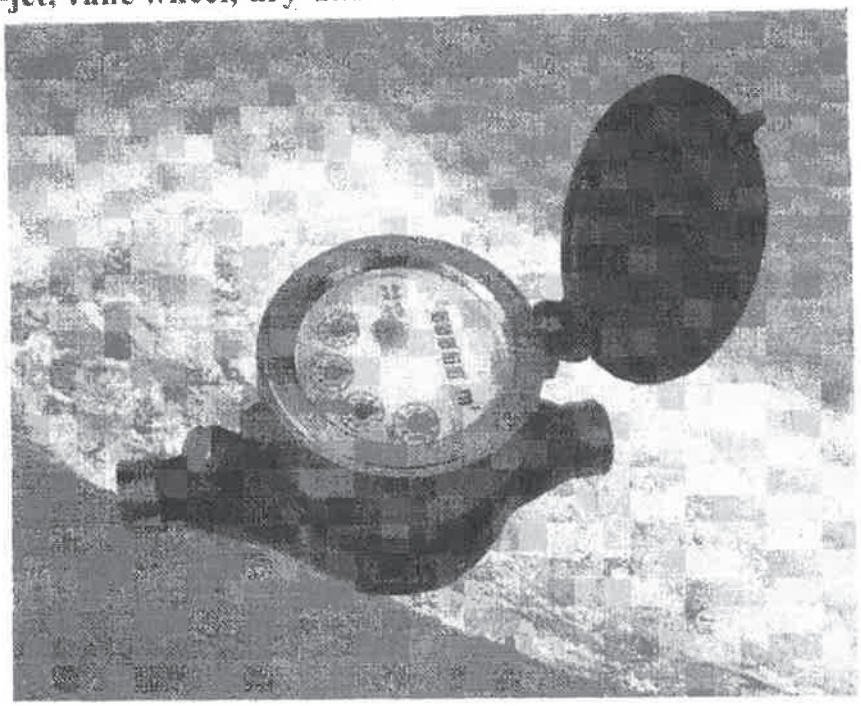
Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on the duration of an implied warranty, so the above limitations or exclusions may not apply to You. This warranty gives You specific legal rights and You may also have other rights which vary from state to state.

This Limited Warranty is effective April 1, 2014 and replaces all undated warranties and warranties dated before April 1, 2014.

F.E. MYERS
293 Wright Street, Delavan, WI 53115
Phone: 888-987-8677 • Fax: 800-426-9446 • www.femyers.com
In Canada: 490 Pinebush Road, Unit 4, Cambridge, Ontario N1T 0A5
Phone: 800-363-7867 • Fax: 888-606-5484

PENTAIR

LXSG-15～50
Multi-jet, vane wheel, dry-dial water meter



Application:

--Measuring the total volume of cold portable water passing through the pipeline.

Feature:

--Multi-jet, dry-dial, easy for maintenance;

--Magnetic drive reliable characteristic, long working life;

--Vacuum sealed register ensures the dial keep free from fog and frost, Keep the reading clear in a long term service;

-- Technical data conform to international standard ISO4064 Class B

Working condition:

Water temperature: 0.1℃～40℃ for cold water meter.
0.1℃～90℃ for hot water meter.

Water pressure : ≤1.0Mpa or1.6Mpa

Maximum permissible error:

(1) in the lower zone from q_{min} inclusive up to but excluding q_t is ±5%.

(2) in the upper zone from q_t inclusive up to and including q_s is ±2%;
Hot water meter ±3%

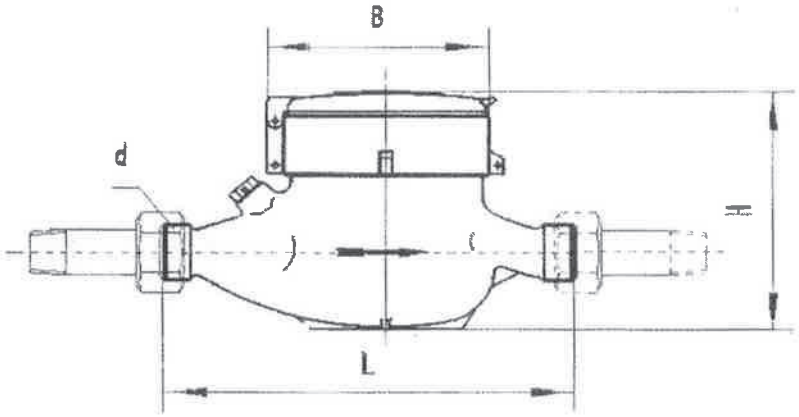
XINGTAI SHANGHONG MECHANICAL EQUIPMENT IMPORT & EXPORT CO.,LTD
Tel: 0086 319 3131896 Fax:0086 319 3131896 M:0086 15132910127
Skype ID: live:rita.wu_3
E-Mail: rita.wu@sh-mech.com
URL: www.shmech.en.alibaba.com

MAIN TECHNICAL SPECIFICATIONS

Type	Size (mm)	Class	q_s Overload Flow	q_p Permanent Flow	q_t Transitional Flow	q_{min} Minimum Flow	Minimum Reading	Maximum Reading
			m^3/h		L/h		m^3	
LXSG-15	15	B	3	1.5	120	30	0.00005	99,999
LXSG-20	20	B	5	2.5	200	50	0.00005	99,999
LXSG-25	25	B	7	3.5	280.0	70	0.00005	99,999
LXSG-32	32	B	12	6.0	480	120	0.00005	99,999
LXSG-40	40	B	20	10	800	200	0.00005	99,999
LXSG-50	50	B	30	15	3000	450	0.00005	99,999

DIMENSIONS

Type	Size	L Length	B Width	H Height	d Connecting Thread
	mm				
LXSG-15	15	165	98	116	G3/4B
LXSG-20	20	190	98	117	G1B
LXSG-25	25	260	103.5	124	G1¼B
LXSG-32	32	260	103.5	124	G1½B
LXSG-40	40	300	125	162	G2B
LXSG-50	50	300	125	162	G2½B
		280	160	187.5	Flange connect ISO 7005-2:1988 Φ D=125



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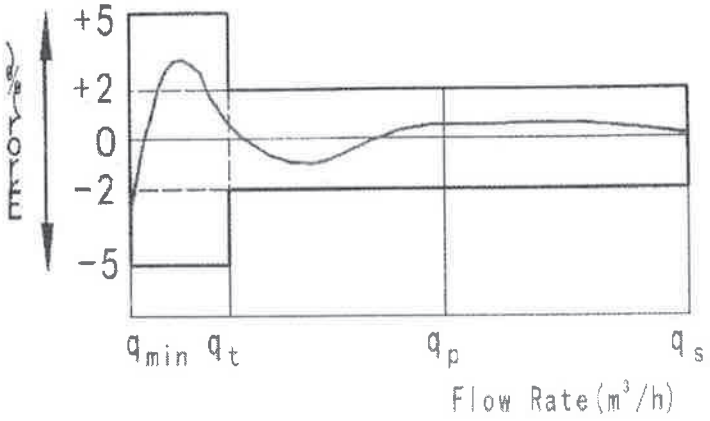
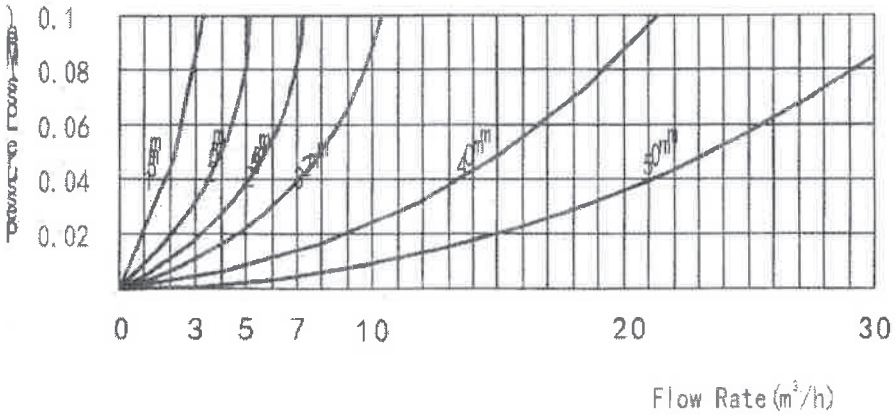
Flow Error Curve



Pressure Loss Curve



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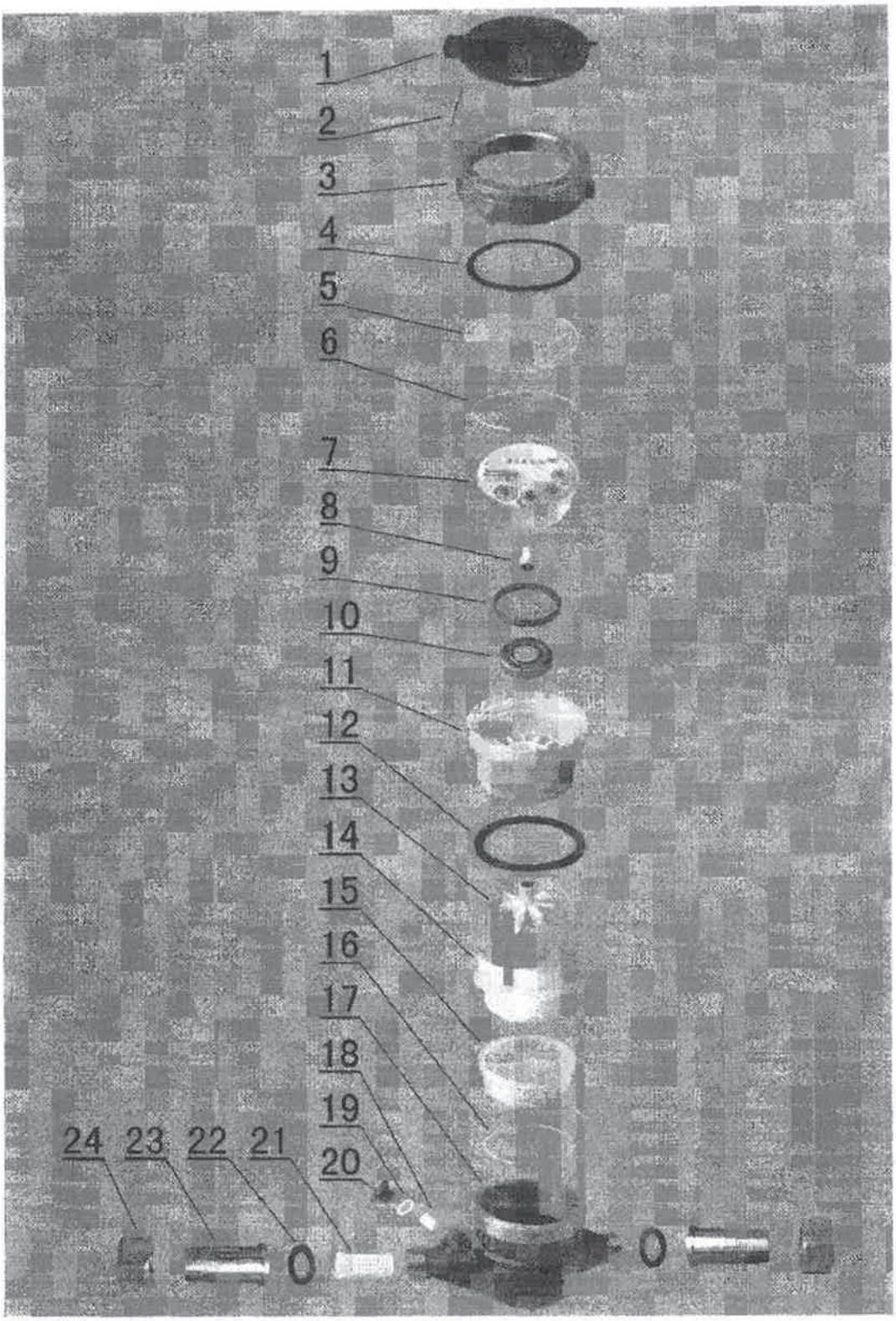
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LXSG-15~50 MULTI-JET, VANE WHEEL, DRY-DIAL WATER METER

Code	Description	Material	QTY
1	Lid	HDPE	1
2	Hinge Pin	Brass	1
3	Cap	Brass	1
4	Sliding Gasket	PP	1
5	Glass	Toughened Glass	1
6	O-ring	Silicon Rubber	1
7	Register	Assembly	1
8	Central Gear	Component	1
9	Magnetic Shield Ring	Iron	1
10	Magnetic Shield Ring	Iron	1
11	Gearing box	ABS Plastic	1
12	Tightening Gasket	Rubber	1
13	Turbine Component	Component	1
14	Measuring Chamber	HIPS	1
15	Bottom Strainer	LDPE	1
16	Gasket	Silicon Rubber	1
17	Body	Brass	1
18	Adjusting Screw	POM	1
19	Adjusting Gasket	Nylon	1
20	Adjusting Plug	Brass	1
21	Inlet Strainer	PP	1
22	Coupling Gasket	Rubber	2
23	Coupling Tail Piece	Brass	2
24	Coupling Nut	Brass	2

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TB Wood's

Sure-Flex® Couplings

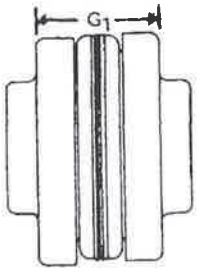
Installation Instructions

Sure-Flex flanges (outer metallic parts) and sleeves (inner elastomeric members) come in many sizes and types. First, determine the size and type of components being used. Remove all components from their boxes, and loosely assemble the coupling on any convenient surface. (Do not attempt to install the wire ring on the two-piece E or N sleeve at this time.) Also check maximum RPM values in Table 2 against operating speed. All rubber sleeves (EPDM and Neoprene) have the same ratings for a given size and may be used interchangeably. However, because rubber and Hytrel sleeves have completely different ratings, they never should be used interchangeably.

1 Inspect all coupling components and remove any protective coatings or lubricants from bores, mating surfaces and fasteners. Remove any existing burrs, etc. from the shafts.

2 Slide one coupling flange onto each shaft, using snug-fitting keys where required. With the Type B flange, it may be necessary to expand the bore by wedging a screwdriver into the saw cut of the bushing.

3 Position the flanges on the shafts to approximately achieve the G_1 dimension shown in Table 2. It is usually best to have an equal length of shaft extending into each flange. Tighten one flange in its final position. Refer to Table 1 for fastener torque values. Slide the other far enough away to install the sleeve. With a two-piece sleeve, do not move the wire ring to its final position; allow it to hang loosely in the groove adjacent to the teeth, as shown.



4 Slide the loose flange on the shaft until the sleeve is completely seated in the teeth of each flange, (The "G_1" dimension is for reference and not critical.) Secure the flange to the shaft using the torque values from Table 1.

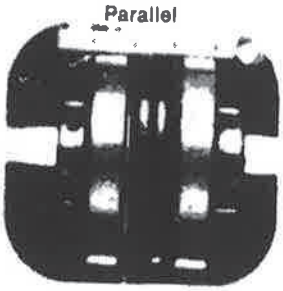
TABLE 1 — FASTENER TORQUE VALUES (ft.-lbs.)

Coupling Size	TYPE J	TYPE S	TYPE B	TYPE SC*		TYPE C	
	2 Setscrews at 90°	2 Setscrews at 90°	3 Hex Head Cap Screws	4 Hex Head Cap Screws Flange to Hub	1 Setscrew over Keyway in Hub	Clamping Screws	1 Setscrew over Keyway
3	3	...	...	...	...	...	...
4	3	...	...	5½**	13	...	...
5	7	13	...	4	13	...	...
6	13	13	5	9	13	15	13
7	13	13	5	9	13	30	13
8	23	23	9	18	23	55	13
9	...	23	9	31	23	55	13
10	...	23	15	50	50	130	13
11	...	23	30	75	50	130	13
12	...	50	60	150	100	250	13
13	...	100	75	150	165	...	...
14	...	100	75	150	165	...	...
16	...	100	135	150	165	...	...

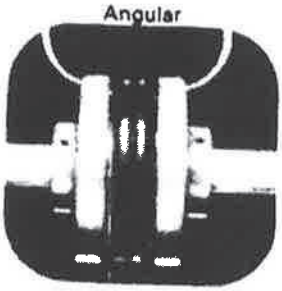
*Torque values apply to hub size when different than flange size.
**Value for socket head clamping screw.

Sure-Flex *Installation Instructions (continued)*

Different coupling sleeves require different degrees of alignment precision. Locate the alignment values for your sleeve size and type in Table 2 below.



5 Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum offset at various points around the periphery of the coupling **without rotating** the coupling. If the maximum offset exceeds the figure shown under "Parallel" in Table 2, realign the shafts.



6 Check angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions **without rotating** the coupling. The difference between the maximum and minimum must not exceed the figure given under "Angular" in Table 2. If a correction is necessary, be sure to recheck the parallel alignment.

TABLE 2 – MAXIMUM RPM AND ALLOWABLE MISALIGNMENT
(Dimensions in inches)

Sleeve Size	Maximum RPM	Types JE, JN, JES, JNS, E & N			*Type H & HS		
		Parallel	Angular	G_1	Parallel	Angular	G_1
3	9200	.010	.035	1.188	....	....	....
4	7600	.010	.043	1.500	....	....	....
5	7600	.015	.056	1.938	....	....	....
6	6000	.015	.070	2.375(1)	.010	.016	2.375
7	5250	.020	.081	2.563	.012	.020	2.563
8	4500	.020	.094	2.938	.015	.025	2.938
9	3750	.025	.109	3.500	.017	.028	3.500
10	3600	.025	.128	4.063	.020	.032	4.063
11	3600	.032	.151	4.875	.022	.037	4.875
12	2800	.032	.175	5.688	.025	.042	5.688
13	2400	.040	.195	6.625	.030	.050	6.625
14	2200	.045	.242	7.750	.035	.060	7.750
16	1500	.062	.330	10.250	....	....	....

Note: Values shown above apply if the actual torque transmitted is more than 1/4 the coupling rating. For lesser torque, reduce the above values by 1/2.

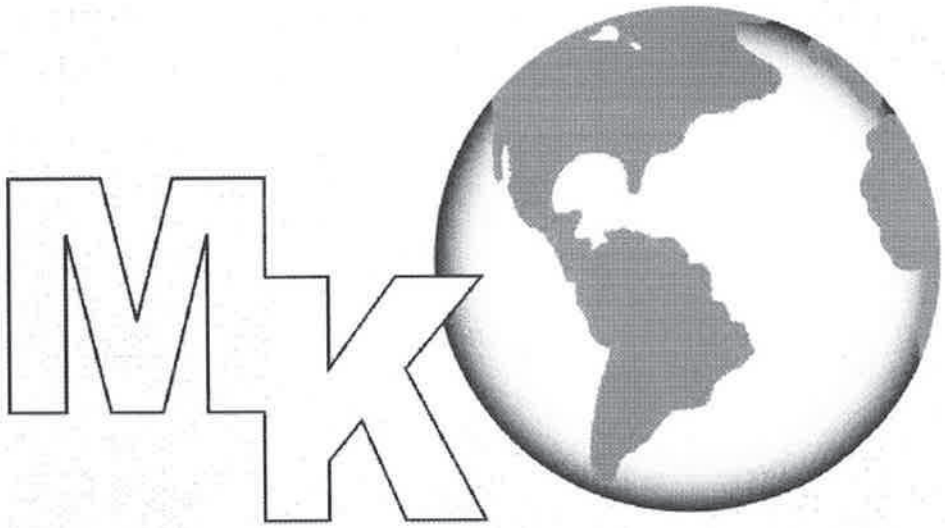
* Type H and HS sleeves **should not** be used as direct replacements for EPDM or Neoprene sleeves.

(1) Value when using 6J flanges is 2.125.

7 If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

8 Install coupling guards per OSHA requirements.

CAUTION: Coupling sleeves may be thrown from the coupling assembly with substantial force when the coupling is subjected to a severe shock load or abuse.



Environmental Inc.

SVE SYSTEM

SECTION 9.0
TROUBLESHOOTING GUIDE

MK Environmental, Inc.
765 Springer Dr.
Lombard, IL., 60148
(P) 630-920-1104 (F) 866-306-8977
www.mkenv.com

TROUBLE-SHOOTING GUIDE
SVE SYSTEM

SYMPTOM	CAUSE & SOLUTION

CONTROL PANEL GENERAL:

Nothing works

1. Check the control transformer circuit breaker and reset if tripped.
2. Check fuses on or before the control transformer.
3. Verify that the Main Disconnect Switch is "ON".
4. Check the incoming power supply to the control panel.
5. Check the control panel wiring for loose connections.

SVE SYSTEM:

Vacuum at the well header is low and vacuum at the blower is high.

1. Inlet strainer on AWS1 is clogged.
2. Blower inlet filter is dirty. Clean or replace filter element.
3. Stinger is too deep or does not have holes drilled in it.

Blower is overheating.

1. Blower inlet filter is dirty. Clean or replace filter element.
2. Blockage in the air dilution valve muffler. Clean muffler.
3. Vacuum relief valve set too high. Readjust valve.
4. Motor voltage is too low. Check electrical power for proper voltage.
5. Blockage on discharge of system

TRANSFER PUMP:

Pump can't keep up with flow and discharge pressure gauge reads high. (Consult the pump curve for the model pump.

1. The discharge throttling valve is closed or isn't open enough. Open the discharge throttling valve.
2. There is a blockage in the line or process down stream from the pump. Check and clean bag filters, carbon filters and flow meters.
3. Some of the impeller vanes are blocked with debris. Clean the pump impeller.

Pump can't keep up with flow and discharge pressure gauge reads low. (Consult the pump curve for the model pump.

1. Pump impeller is blocked with debris. Clean the pump impeller.
2. Valve on the suction line to the pump is closed or isn't wide open. Open the valve.
3. Blockage of the suction line or suction fitting in the sump or tank. Check the sump or tank for floating debris. Clean the line and sump or tank. (Note: Clear plastic bags are very hard to see in water.)
4. Inspect and clean level controls.

SPARGE COMPRESSOR SYSTEM

Discharge pressure is too low.

1. Compressor inlet filter and/or silencer are dirty. Clean filter.
2. Pressure relief valve is set too low. Readjust valve.
3. Bleed air valve is too far open. Close valve until correct pressure is reached.
4. Dust in compressor. (See Busch manual for cleaning procedure.)

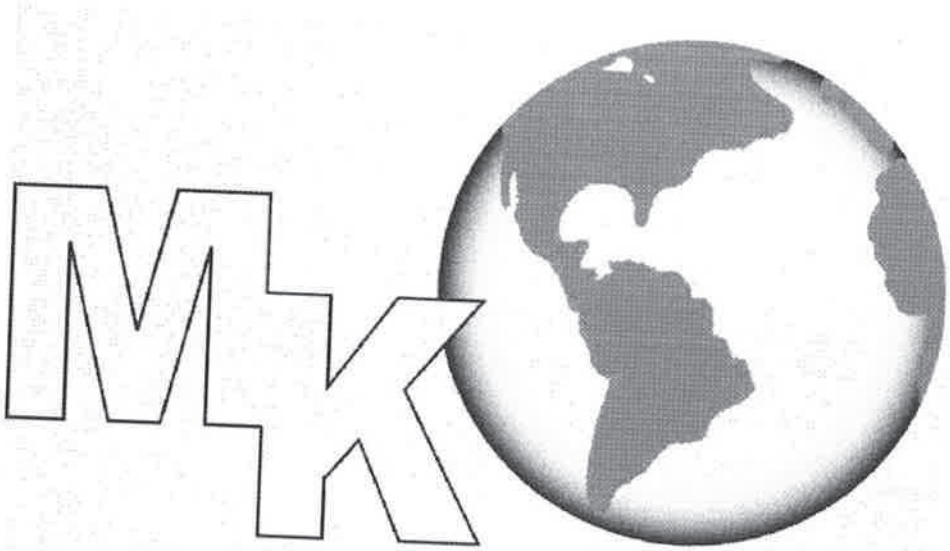
Pressure too high at compressor.

1. Pressure relief valve is set too high. Readjust pressure setting.
2. Blockage in the manifold system or a header valve is closed. Open valves.
3. Open bleed air valve until the correct pressure is reached.

Compressor motor overload.

1. Dirty compressor inlet filter. Clean filter.
2. Pressure relief valve is set too high. Readjust valve.
3. Blockage in the discharge header system. Check all valves to verify that they are open.
4. Motor voltage is too low. Check electrical power.

Refer to the blower manual for troubleshooting specific to the compressor



Environmental Inc.

SVE SYSTEM

SECTION 10.0
MAINTENANCE SCHEDULE

MK Environmental, Inc.
765 Springer Dr.
Lombard, IL., 60148
(P) 630-920-1104 (F) 866-306-8977
www.mkenv.com

STANDARD MAINTENANCE SCHEDULE
SVE SYSTEMS

EVERY SITE VISIT:

1. Visually inspect all storage tank levels (if installed) and empty when ¾ full, or as determined by monitoring the rate of product capture between maintenance visits.
2. Note the backpressure of the Stripper blower at every visit to site. An increasing backpressure that exceeds more than 50% of normal, indicates that the aeration tubes are restricted, and need be cleaned.
3. Visually inspect the operation of the AWS-1 and Stripper effluent pumps, verify conductivity controls are working, starting and stopping the pump correctly.
4. Check AWS-1 for solids, drain and flush solids from AWS-1 and place into operations approved container.
5. Note the reading of the Effluent Totalizing flow meter. Monitor the operation of the totalizing flow meter to verify smooth operation. Maintenance may be required if erratic readings/operation are observed.
6. For systems with Liquid carbon, back flush carbon vessels individually by switching the influent and effluent lines and discharge to an approved area. Allow 2 to 3 pump cycles and return hoses to original positions.

MONTHLY:

1. Visually inspect the OWS packing, if heavy solids are built up on packing where packing is no longer visible, maintenance cleaning should be done.
2. Visually inspect the aeration tubes in the Stripper, if tubes are covered/buried in silt clean/remove silt and flush tubes.
3. Maintenance – Shut system off lock-out tag-out. Remove and clean the effluent totalizing flowmeter strainer, check for smooth operation.
4. Maintenance – Remove and clean all conductivity level probe rods in AWS-1, AWS-2 and Stripperator sump. Test probes and pump operation after re-install.
5. Visually inspect all hoses for cuts, leaks, deterioration. Replace or repair as needed.
6. Visually inspect - walls, motors, fans, components for wear, stress cracking, damage or corrosion.
7. Service SVE blower per the manufacturer recommendations.

QUARTERLY:

1. Maintenance - Clean the Stripperator aeration tubes if not previously cleaned in prior monthly maintenance.
2. Maintenance - Clean Stripperator OWS packing and drain solids from the bottom of the OWS chamber if not previously cleaned in the prior monthly maintenance.
3. Maintenance - Chemically descale / clean transfer pumps using approximately 50% Rydlyme / 50% water solution.
4. Maintenance – Visually check Stripperator effluent sump, clean solids from the effluent sump place into operations approved container.
5. Maintenance - Chemically descale / clean Liquid Ring pump section. (REFER TO CLEANING INSTRUCTIONS)
6. Maintenance - With POWER OFF perform a wire pull test and tighten all loose electrical connections in the control panel.
7. Maintenance – With POWER OFF pull test, visually inspect all electrical connections at the motor junction box. Inspect the wires for wear and corrosion.
8. Visually Inspect heat exchangers and hoses for mineral build up inside of the hoses and exchanger tubes. Replace hose/clean heat exchanger as needed.

9. Test high level and high temperature shutdown sensors and alarm signals.
10. Test E stop operation. Verify E-stop prevents all electrically operated equipment from operating.
11. Maintenance - Calibrate vacuum transducer with vacuum off, verify zero vacuum. Calibrate within telemetry settings.

YEARLY:

1. Maintenance - Replace AWS-1 and Stripperator sump transfer pumps mechanical seals and pump discharge check valves.
2. Maintenance - Replace seal water system circulation hoses.
3. Visually inspect SVE drive coupling belts for wear and abrasion replace if wear is apparent.
4. Building Maintenance – clean out wall troughs and grease all hinges, and doors.
5. Maintenance – Replace Liquid Ring air inlet filter element and dilution air filter element.

OPTIONS MAINTENANCE SCHEDULES: SEE SHEETS

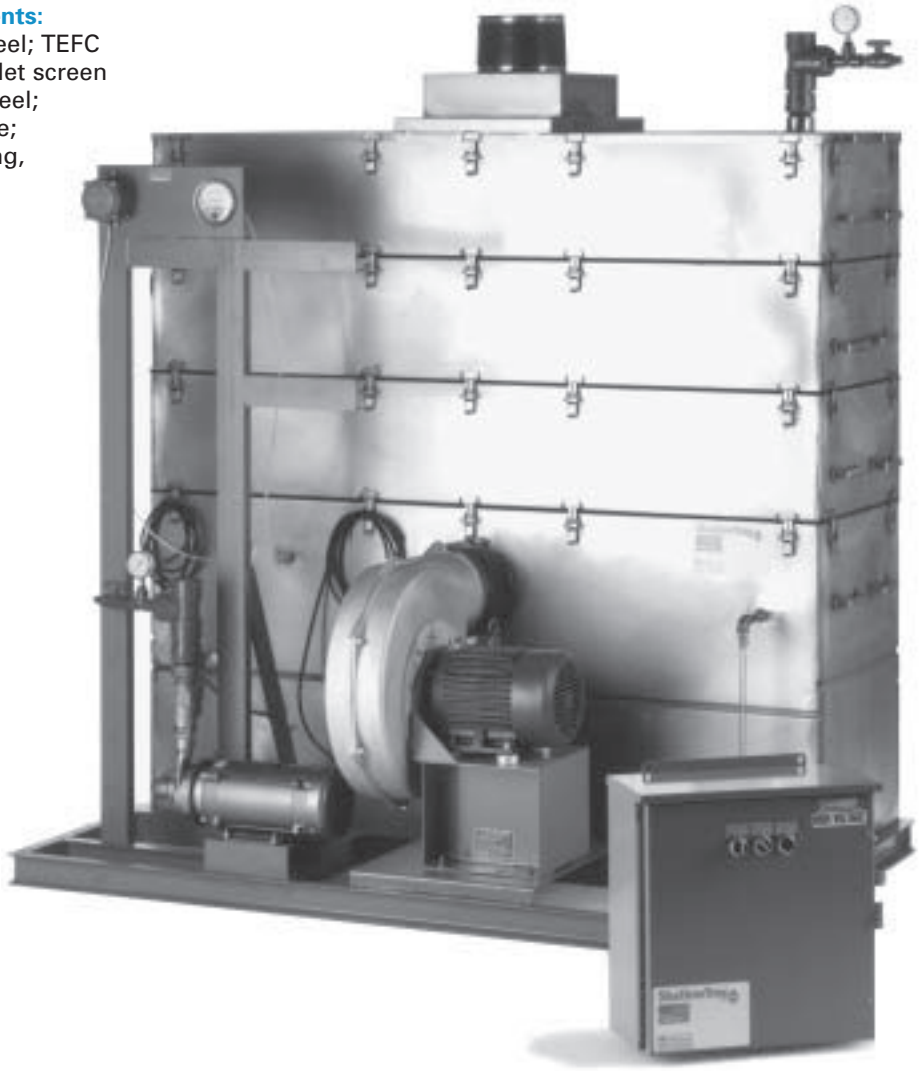
- Air Lift
- Electric Ground Water Pumps
- Settling Poly Tank system
- Chemical Injection system

ShallowTray®
low profile air strippers

2600 Series

Model Pictured: 2631

Basic system includes the following components:
Sump tank, cover, and trays, 304L stainless steel; TEFC air blower sized to number of trays; Blower inlet screen and damper; Mist eliminator, 304L stainless steel; Water inlet spray nozzle; Water level sight tube; Gaskets; Latches, stainless steel; Internal piping, Schedule 80 PVC; Tray cleanout ports.



Options chosen for model pictured:

- ☑ Air pressure gauge
- ☐ Gravity discharge
- ☑ Steel frame
- ☑ EXP blower motors
- ☑ Discharge and/or feed pump, TEFC or EXP
- ☐ Blower start/stop panel only
- ☐ Main disconnect switch
- ☐ Standard NEMA 3R system control panel with alarm interlocks, motor starter, relays, alarm light, UL listed
- ☑ NEMA 3R control panel with level controls for pumps, alarm interlocks, motor starters, relays, alarm light, UL listed
- ☐ PurgePanel™: NEMA 4X enclosure, small blower, pressure switch, and a small explosion-proof enclosure (NEMA 7)
- ☑ Control panel IS components for remote mounted NEMA 3R panel, UL listed
- ☐ NEMA 7 and/or custom control panel
- ☐ Strobe alarm light
- ☐ Alarm horn
- ☑ Low air pressure alarm switch
- ☑ High water level alarm switch
- ☑ Discharge pump level switch
- ☑ Water pressure gauges
- ☐ Digital water flow indicator and totalizer
- ☐ Air flow meter
- ☐ Temperature gauges
- ☑ Line sampling ports
- ☐ Air blower silencer
- ☐ Auto dialer
- ☐ Automatic operation components for multiple wells
- ☐ Viewports
- ☑ Other custom requirements (Please call)
  Intermittent operation for the blower

The full range of options are available to meet your project's specifications.

Models	flow rate	# trays	width	length	height	cfm
2611	2-115gpm 0.5-26m³/hr	1	4'2" 1.3m	6'2" 1.9m	4'5" 1.3m	600 1020m³/hr
2621	2-115gpm 0.5-26m³/hr	2	4'2" 1.3m	6'2" 1.9m	5'2" 1.6m	600 1020m³/hr
2631	2-115gpm 0.5-26m³/hr	3	4'2" 1.3m	6'2" 1.9m	5'11" 1.8m	600 1020m³/hr
2641	2-115gpm 0.5-26m³/hr	4	4'2" 1.3m	6'2" 1.9m	6'8" 2.1m	600 1020m³/hr
2651	2-115gpm 0.5-26m³/hr	5	4'2" 1.3m	6'2" 1.9m	7'5" 2.3m	600 1020m³/hr

ShallowTray®
Low Profile Air Stripper

Installation, Operation,
&
Maintenance Manual

Serial Number:

_____

108 Pond Street
Seekonk, MA 02771
Phone: (508) 399-5771 Fax: (508) 399-5352

Rev:March2015

Not modeled: Ethanol, 2-Ethylhexyl acrylate, n-Butyl acrylate, Methylcyclohexane, cyclohexane, Cumene.

Diesel Range Organics (C10)-(C28) modeled as Napthalene

ShallowTray® low profile air strippers

System Performance Estimate

Client and Proposal Information:

HIGH FLOW

Series chosen:	2600	2600
Water Flow Rate:	100.0 GPM US	22.7 m3/hr
Air Flow Rate:	600 CFM	1019 m3/hr
Water Temp:	50 °F	10.0 °C
Air Temp:	60 °F	15.6 °C
A/W Ratio:	45 :1	45 :1
Safety Factor:	5%	5%
Water Discharge Temp.	50.1 °F	10.1 °C

INDUCED DRAF

Contaminant	Untreated Influent / Effluent Target	Model 2611 Effluent Lbs/hr ppmv %removal	Model 2621 Effluent Lbs/hr ppmv %removal	Model 2631 Effluent Lbs/hr ppmv %removal	Model 2641 Effluent Lbs/hr ppmv %removal	Model 2651 Effluent Lbs/hr ppmv %removal	Model 2661 Effluent Lbs/hr ppmv %removal
Acetone	21.1 ppb	21 ppb	21 ppb	21 ppb	21 ppb	21 ppb	21 ppb
Solubility 50,000 ppm	ppb	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
Mwt 58.08 67-64-1		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Due to its miscibility with water, acetone removal is difficult to predict. Call your representative for more information							
Vinyl Chloride	12 ppb	2 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb
Solubility 2,700 ppm	ppb	0.00 0.09	0.00 0.10	0.00 0.10	0.00 0.10	0.00 0.10	0.00 0.10
Mwt 62.5 75-01-4		84.95%	97.73%	99.66%	99.95%	99.99%	100.00%
Styrene	10 ppb	4 ppb	2 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb
Solubility 300 ppm	ppb	0.00 0.03	0.00 0.04	0.00 0.05	0.00 0.05	0.00 0.05	0.00 0.05
Mwt 104.14 100-42-5		58.15%	82.48%	92.67%	96.93%	98.72%	99.46%
Toluene	2.2 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb
Solubility 515 ppm	ppb	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01
Mwt 92.13 108-88-3		66.65%	88.88%	96.29%	98.76%	99.59%	99.86%
Benzene	1.9 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb
Solubility 1,780 ppm	ppb	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01
Mwt 78.12 71-43-2		68.79%	90.26%	96.96%	99.05%	99.70%	99.91%
Xylenes	6.9 ppb	2 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb
Solubility 175 ppm	ppb	0.00 0.02	0.00 0.03	0.00 0.03	0.00 0.03	0.00 0.03	0.00 0.03
Mwt 106 1330-20-7		69.25%	90.55%	97.09%	99.11%	99.73%	99.92%
MEK	2.5 ppb	3 ppb	3 ppb	3 ppb	3 ppb	3 ppb	3 ppb
Solubility 353,000 ppm	ppb	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
Mwt 72.1 78-93-3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Due to its high solubility, MEK removal is difficult to predict. Call your representative for more information							
Tetrachloroethylene	2.9 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb
Solubility 150 ppm	ppb	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01
Mwt 165.83 127-18-4		70.47%	91.28%	97.43%	99.24%	99.78%	99.93%
Ethyl Benzene	2.4 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb	<1 ppb
Solubility 152 ppm	ppb	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01
Mwt 106.16 100-41-4		70.49%	91.29%	97.43%	99.24%	99.78%	99.93%
Naphthalene	4200 ppb	4200 ppb	4200 ppb	4200 ppb	4200 ppb	4200 ppb	4200 ppb
Solubility 30 ppm	ppb	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
Mwt 128.16 91-20-3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total ppb	4262 ppb	4235 ppb	4227 ppb	4225 ppb	4224 ppb	4224 ppb	4224 ppb
Total VOC Lbs/hr - ppmv		0.00 0.17	0.00 0.21	0.00 0.23	0.00 0.23	0.00 0.23	0.00 0.23
Total		0.64%	0.81%	0.87%	0.89%	0.89%	0.90%

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Section 1: ShallowTray Process

1-1 THE SHALLOWTRAY TREATMENT PROCESS

The purpose of air stripping is to remove dissolved volatiles from liquids. Such dissolved volatiles include radon and carbon dioxide removed from potable well water, volatile organic compounds (VOCs) removed from contaminated groundwater plumes, and VOCs removed from industrial process and wastewater treatment streams.

The stripping mechanism of the proprietary ShallowTray low profile perforated plate air stripper is dependent on the flow of an influent liquid through a long, narrow channel on a discrete number of trays while subject to a countercurrent flow of ambient air at a fixed flowrate.

The intense formation and rupture of billions of bubbles in the confined narrow path of water flowing counter-current to multiple fresh air vents is a dynamic process that provides a mass transfer mechanism that displaces the dissolved volatiles from the aqueous stream into the vapor stream.

The ShallowTray low profile air stripper mechanism is a proprietary process protected under U.S. Patent # 5045,215 and 5,240,595.

1-2 THE SHALLOWTRAY BASIC SYSTEM

ShallowTray systems are fabricated from 304L stainless steel, 316L stainless steel, or rotationally molded polyethylene, and are provided with components to facilitate the requirements of the process, including the following:

Forced Draft Versus Induced Draft

Forced Draft (F.D.) System: The blower is installed so that the air is fed under positive pressure into the stripper sump below the stripper trays. This arrangement is used when the maximum total blower discharge pressure (air stripper plus other downstream pressure losses) does not exceed 26 inches (56cm) water column (w.c.) pressure for plastic strippers, or 32 inches (82cm) w.c. for stainless steel strippers.

Induced Draft (I.D.) System The blower is installed such that it pulls air into the stripper sump, up through the trays, and into the blower inlet, thus subjecting the stripper interior to a slight vacuum. Removal efficiency is not changed by this arrangement. The blower is therefore sized to provide the pressure drop required for the ShallowTray, plus the pressure drop required by downstream offgas treatment devices.

High Water Flow Versus Low Water Flow

Due to increased froth heights on the trays at higher flowrates, two water flow ranges are considered in the design of the basic system, **Low Flow** and **High Flow**. The high flow system requires a blower that produces an additional 4 inches (10.2 cm) w.c. pressure drop across the stripper as compared to the low flow system blower. The Low and High water flow ranges for each ShallowTray series are listed in the table below:

ShallowTray Series	Low Water Flow Range	High Water Flow Range
1300P	0.5 - 15 gpm	N/A
1300	0.5 - 15 gpm	16 - 22.5 gpm
2300P	1 – 30 gpm	31 - 50 gpm
2300	1 - 30 gpm	31 - 45 gpm
2400	1 - 32 gpm	33 - 65 gpm
2500	2 - 37 gpm	38 - 75 gpm
2600	2 - 60 gpm	61 - 115 gpm
3600	3 - 90 gpm	91 - 160 gpm
3800	4 - 100 gpm	126 - 250 gpm
31000	4 - 120 gpm	121-375 gpm
31200	4 - 150 gpm	151 - 425gpm
41200	6 - 200 gpm	201- 550 gpm
51200	10 – 275 gpm	278 - 800 gpm
61200	12 - 350 gpm	351 - 1000 gpm
71400	16 - 540 gpm	541 - 1300 gpm
81200	16 - 540 gpm	541 - 1300 gpm

1-3 Basic System Components

Components information sheets ("cut sheets") from the manufacturer are included in the Components Information Section (Section 5) at the back of this manual

Blower

The blower supplied with the ShallowTray low profile air stripper unit is typically type B spark resistant with a cast aluminum wheel, direct driven @ 3450 rpm, with motor options of Totally Enclosed Fan Cooled (TEFC) or Explosion Proof (EXP), as determined by the power available and electrical code classification of the site.

Each blower is selected to provide air flow that exceeds the minimum standard cubic feet per minute (SCFM) air flow required at the required working pressure (inches of w.c.) of the system. It is important that the blower damper be set to provide the unit with the required fresh air flow.

It is also important that water not enter the blower housing while the blower is in operation; this will damage the blower and void the warranty. During normal operation, the high water level alarm switch prevents this from happening. Confirm that this switch is installed properly.

The installed motor horsepower is selected to provide an operating range with a significant safety margin. However, there is the potential for the blower motor to overload if it is not working against sufficient pressure drop. Therefore, the blower must be protected with a thermal overload switch.

The blower damper should be set so that the blower produces the minimum stripper air flow requirement (see table below), and at the same time the motor does not exceed its nameplate amperage maximum.

Air Flow Damper

The stripper blower is fitted with an adjustable damper, used to make air flow rate (SCFM) adjustments to the stripper. Open the damper to increase air flow rate, and close the damper to decrease air flow rate. Note that air pressure may vary as the air flow rate is changed. To get an accurate air flow measurement, install an air flow meter in the air duct.

If air flow meter installation is not possible, an estimated air flow can be obtained by measuring the stripper pressure drop. At initial start-up, adjust the damper until the air pressure is at the minimum required for the system. (Refer to the pressure gauge description for minimum pressure readings).

Be aware that when making damper adjustments after the system has been operating, fouling may occur in the system, which may reduce the air flow rate and may increase the air pressure reading.

The following table gives the minimum and maximum airflow rate for each ShallowTray series:

ShallowTray Series	Air Flow Minimum	Air Flow Maximum
1300 & 1300P	150 SCFM (255 m3/hr)	180 SCFM (305 m3/hr)
2300 & 2300P	300 SCFM (510 m3/hr)	360 SCFM (610 m3/hr)
2400	400 SCFM (680 m3/hr)	480 SCFM (816 m3/hr)
2500	500 SCFM (850 m3hr)	600 SCFM (1020 m3/hr)
2600	600 SCFM (1020 m3/hr)	720 SCFM (1220 m3/hr)
3600	900 SCFM (1530 m3/hr)	1080 SCFM (1830 m3/hr)
3800	1200 SCFM (2040 m3/hr)	1440 SCFM (2448 m3/hr)
31000	1500 SCFM (2550 m3/hr)	1800 SCFM (3060 m3/hr)
31200	1800 SCFM (3060 m3/hr)	2160 SCFM (3670 m3/hr)
41200	2400 SCFM (4080 m3hr)	2880 SCFM (4900 m3/hr)
51200	3000 SCFM (5100 m3/hr)	3600 SCFM (6120 m3/hr)
61200	3600 SCFM (6120 m3/hr)	4320 SCFM (7340 m3/hr)
71400	4800 SCFM (8160 m3/hr)	5760 SCFM (9797 m3/hr)
81200	4800 SCFM (8155 m3/hr)	5760 SCFM (9785 m3/hr)

Mist Eliminator

A wire mesh mist eliminator is installed beneath the air exhaust port, located on the top cover of the ShallowTray. The purpose of the mist eliminator is to remove water droplets that would have blown through the vent line. It is possible, though unlikely, that the mist eliminator may become plugged or fouled. If this occurs, the mist eliminator is easily removed for cleaning. Disconnect the vent line, take off the top cover, and remove the retaining plates on the bottom of the cover. The mist eliminator can be cleaned with a pressure washer, or replaced with a new one.

Gasket

A black nitrile (or neoprene on the 2300-P) sponge is used to form an airtight/watertight seal between the sump tank, cover, and stripper trays. A replacement gasket can be glued to the sealing flange using an industrial contact adhesive. Please contact Hydro Quip, Inc.. prior to making any gasket repairs or adjustments.

Sight Tube

The sight tube provides a means of visually monitoring the water level in the sump tank. Make sure the valve to the sight tube is open during stripper operation.

Inlet Dip Tube / Spray Nozzle

An inlet spray nozzle is only installed upon request. The dip tube directs the influent water to the top tray inlet chamber.

Note: System performance is based on ShallowTray operation without a nozzle, and the performance warranty is valid whether a nozzle is installed or not.

SHALLOWTRAY ACCESSORY OPTIONS

ShallowTray System Options

ShallowTray low profile air strippers are custom built to meet site and project specifications. Please refer to the components list insert (Section 5) to see which options were selected for this system. Component information cut sheets are included in (Section 5) of this manual.

Air Blower Silencer

An air blower silencer can reduce the noise level of the blower. The size of the silencer and the type of connection used to mount it are dictated by the size of the blower, and whether the silencer is mounted horizontally or vertically. Silencers should be supported to avoid over-stressing the connections, and should be secured if exposed to high wind loads.

Air Flow Meter

An air flow meter measures the amount of air flowing through the system. It consists of a pitot tube mounted in the air duct and connected via two (2) lengths of tubing to a differential pressure gauge. The measured velocity pressure can be converted to an airflow velocity. The pitot tube must be located at least 8 1/2 pipe diameters downstream of any pipe fitting or transition, and at least 1 1/2 diameters of straight pipe upstream of the end of the duct or any elbow. The best pitot tube location is before the stripper because the air is less humid and the gauge tubing is less likely to fill with condensate.

The air flow meter typically gives readings in inches of water column, (w.c.), which is converted to feet per minute (FPM) using the provided chart or the gauge scale calibrated for the specific duct inside diameter. As stated in the damper section, the air flow meter in conjunction with the pressure gauge provides the most accurate damper adjustments, especially after initial start-up.

The table below lists the minimum vapor exhaust duct diameters.

Stripper Series	Minimum Exhaust Duct Diameter
1300	6 “Ø (16 cm)
2300	6 “Ø (16 cm)
2400	8 “Ø (20 cm)
2500	8 “Ø (25 cm)
2600	8 “Ø (40cm)
3600	10 “Ø (45cm)
3800	12 “Ø (45cm)
31000	16 “Ø (45cm)
31200	16 “Ø (20 cm)
41200	18 “Ø (25 cm)
51200	18 “Ø (40cm)
61200	18 “Ø (45cm)
71400	18 “Ø (45cm)
81200	18 “Ø (45cm)

Note: Restricted airflow is the most common cause of poor removal efficiencies. An airflow meter is highly recommended to help ensure adequate air flow.

Air Pressure Gauge
The air pressure gauge reads the pressure differential across the stripper trays in inches of water column (w.c.). The gauge is connected to the system via tubing that attaches to a pressure port on the system. Instructions to connect the gauge for the types of systems are as follows:

Forced Draft System – Using tubing, connect the "High" pressure port on the gauge to the 1/8"Ø (3mm) shutoff valve/hose barb located on the air stripper sump. The "Low" pressure port on the gauge is left open to the atmosphere. The highest pressure drop is between the sump tank and the surrounding atmosphere.

Induced Draft System - Using tubing, connect the "Low" pressure port on the gauge to the hose barb located on the exhaust vent line on the air stripper. The "High" pressure port on the gauge is left open to the atmosphere. The highest pressure drop (vacuum) is between the cover exhaust and the surrounding atmosphere.

Note: there are two pairs of pressure ports on the gauge, one pair for side entry, the other pair for rear entry. One pair should be used to measure the differential pressure, and the other unused pair must be sealed with a plug.

At initial start-up, the pressure gauge can be used to measure blower damper adjustments. Adjustments should be made according to the following nominal differential air pressure table:

Nominal Differential Air Pressure

Number of trays	Low Water Flow Sys	High Water Flow System
1 tray system	4-6 in. w.c. (10-15 cm.)	7-10 in. w.c. (18-25 cm.)
2 tray system	7-10 in. w.c. (18-25 cm.)	11-14 in. w.c. (28-36 cm.)
3 tray system	11-14 in. w.c. (28-36 cm.)	16-18 in. w.c. (40-46 cm.)
4 tray system	16-18 in. w.c.(40-46 cm.)	20-22 in. w.c. (50-56 cm.)
5 tray system	20-22 in. w.c. (50-56 cm.)	24-26 in. w.c. (60-66 cm.)
6 tray system	24-26 in. w.c. (60-66 cm.)	28-30 in. w.c. (71-76 cm.)

Refer to high/low water flow range description in Section 1-3 above.

Note: The nominal differential pressures shown are for the air stripper pressure drop only, and do not include additional air stream equipment pressure requirements.

After initial start-up, fouling may occur in the system, which may increase the nominal air pressure reading, and may decrease the airflow rate.

Control Panel

The control panel serves two basic functions for operation of the system. The first is to provide the necessary starting and circuit protection components for each motor load, consistent with NEC electrical code. These components include fuses, circuit breakers, motor starter contactors, overload relays, and lock-out/tag-out (LOTO) features.

The second function is to provide process control and alarm status/interlock components. Alarm circuit monitors several conditions, most basically the low air pressure alarm switch and the high water level alarm switch. If either of these alarms occurs, the alarm interlock will provide shut off signal to the incoming water source (feed or well pumps), if the appropriate interconnects have been made. Other alarm options are also available.

Control Panel: Intrinsically-Safe (I.S.) Components

ShallowTray low profile air stripper systems that operate in or near potentially explosive concentrations of vapors will require special hardware to meet code requirements for power wiring and for instrument and switch connections. In such cases, intrinsically safe (I.S.) isolation of signals to and from switches and instruments is employed to limit the energy to a level lower than the energy required to generate a spark. Typical components that need I.S. protected signals are float switches and well probes. Determination of when I.S. signals are required is the responsibility of the design engineer with knowledge of the site-specific code requirements.

Digital Water Flow Indicator/Totalizer

Water flow meters with totalization are often supplied as part of the ShallowTray air stripper. Available in several designs and sizes, flowmeters are typically installed in the water feed piping to the stripper, and usually provide a local readout of flowrate (gpm) and the totalized flow (gallons). Refer to the components list insert Section 5 to see which flowmeter was provided with this system. Component information cut sheets are included in Section 5 of this manual.

Flowmeters are sensitive mechanisms that require proper care and maintenance for reliable service. It is prudent to install a strainer or bag filter upstream of the flowmeter to protect it from mechanical damage from debris in the pipeline. If the strainer and/or flowmeter become plugged, disassemble and clean in accordance with the manufacturer's instructions.

Feed and Discharge Pumps

If pump(s) are included by HYDRO QUIP, INC. as part of your system, they have been selected to meet the required flow and pressure requirements. The pumps are typically end suction, flooded inlet, direct coupled, centrifugal pumps, with either EXP or TEFC motors. The pumps are not self-priming. Prior to initial start-up, the pumps must be primed by filling the pump impeller housing

with clean water. Throttling valves are typically installed on the effluent pump discharge**.** If the pump is running wide open and it is not pumping against the required head, the pump may cavitate. This is the nature of centrifugal pumps; they must be throttled back if they are not pumping against the required head. The valve should be throttled until the motor amperage is less than the nameplate motor amps rating.

Before system start-up, it is important to check for proper rotation of the impeller. A pump rotating in the wrong direction could cause the pump impeller to spin off, causing serious damage to the pump.

Systems using discharge pumps must have the flow rates balanced so that the discharge flow rate is greater than the inlet flow rate.

Refer to the components list insert (Section 5) to see which pump(s) were provided with this system. Component information cut sheets are included in (Section 5) of this manual.

High Water Level Alarm Float Switch

The high water level alarm float switch is one of the alarm sensors that must be connected prior to system start-up. The purpose of the high water level alarm float switch is to sense an excessively high level of water in the stripper sump, and provide a signal to communicate to the upstream water source to shut off the incoming water. The high water level float switch is a normally closed microswitch that opens when the float rises approximately 3 1/2 inches (9cm) above its coupling's centerline.

Component information cut sheets for the float switch are included in (Section 5) of this manual.

Line Sampling Ports

Line sampling port(s) (when included) are provided to take water samples of incoming contaminated water and outgoing clean water. The sampling ports are typically 1/2” (1cm) ball valves.

When taking a water sample, open the valve and let the water flow for at least 1 minute prior to bottling the sample. This purges the sample port of any stagnant water.

When purging the sample ports be sure to capture the water and properly dispose of it. When starting the unit for the first time double check that the valves on the sample ports are closed.

Low Air Pressure/Vacuum Alarm Switch

The low air pressure/Vacuum alarm switch monitors the blower for continuous water treatment. This switch is one of the alarm interlocks that must be properly connected by a licensed electrician prior to the system’s initial start-up. Please see Special Precautions at the beginning of Operating Instructions section for more information.

Should the blower fail, the low air pressure switch is wired to shutoff all incoming water. Using tubing, connect the switch to the hose barb on the tank (pressure system) or the hose barb in the cover exhaust duct (vacuum system).

Pressure system – The air hose is connected from the sump rank 1/8 " (3mm) hose barb (without valve) to the "high" pressure port on the switch using the provided hose barb. The "low" pressure port must be open to the atmosphere. The switch measures the differential pressure between the sump tank and the atmosphere.

Vacuum system – The air hose is connected from the exhaust piping 1/8" (3mm) hose barb to the "low" pressure port on the switch using the provided hose barb. The "high" pressure port must be open to the atmosphere. The switch measures the differential pressure between the top tray and the atmosphere.

Periodically inspect the air hose for water build-up, which will affect the switch's operation. The tubing must remain open at all times.

Test the switch at initial start-up by removing the air hose from the hose barb on the sump tank or exhaust pipe once the system is in full operation. This should set the system into an alarm condition and shut off the incoming contaminated water.

High Air Pressure/Vacuum Alarm Switch

The high air pressure/vacuum alarm switch prevents the system from exceeding its highest rated pressure/vacuum value. If the blower has the ability to produce pressure/vacuum higher than 32 inches (82cm) W.C, for stainless units or 26 inches (56cm) W.C. for plastic units then it should have a high pressure/vacuum alarm switch. Be sure to check that the setpoint for alarm shutdown is at the proper setting for the system.

Panel Disconnect Switch

The panel disconnects switch removes power from the ShallowTray low Profile air stripper control panel. Make sure a qualified licensed electrician installs the power supply into the disconnect switch. Be sure to ground the switch to the main service ground.

Water Temperature Gauge

Water temperature gauges can be installed on both the inlet and outlet piping. Influent water temperature is an important variable affecting the system's removal efficiency.

Water Pressure Gauge

Water pressure gauges can be installed on both the inlet and outlet water piping. Excessively high readings could signal that something in the piping system is plugged. Large pressure fluctuation could be a sign that the water flow rate is varying.

Section 2: Operating Instructions

2-1 Special Precautions:

It is important that a qualified licensed electrician perform these installations.

The following operations must be carried out prior to initial system start-up:

Step 1: Connect the Interlock switches.

High Water level Interlock
If the water level in the sump tank rises beyond the maximum level, it could flood the blower. This may damage the blower and void the warranty. The high water level interlock switch is used to shut off the feed water pump in an emergency situation.

Low Air Pressure/Vacuum Interlock
If the blower fails, untreated water could be discharged. The low air pressure/vacuum interlock switch will shut off the feed water pump to prevent additional water from entering the stripper.

High Air Pressure/ Vacuum Interlock
If the system has a blower capable of producing more than 32 inches (82cm) of water column (w.c.) for a stainless stripper or more than 26 inches (56cm) w.c. for a polyethylene stripper, then the system requires a high pressure/vacuum switch. If a unit fouls or pressure increases due to off-gas treatment, it may exceed the maximum pressure rating of the system and cause damage to the gaskets, sump, or trays.

Note: These interlock options might not have been provided as part HYDRO QUIP, INC.'s scope of supply.

Step 2: Fill the Sump Tank and each tray's inlet Chamber.

On initial start-up the sump tank must be filled with **clean water** to a height of about 5 inches (13cm). Make sure the valve to the sight tube is open. The sump tank can be filled via the clean-out ports on the end of the stainless units, or through the inlet water port located on the cover. The inlet chamber on each tray (referred to as seal pots) can be filled manually by pouring **clean water** through the 1 inch (3cm) inlet chamber filling ports, or the 4 inches (10cm) clean out ports located on the ends of the stainless units, or by disassembling the plastic units and filling the seal pots as you reassemble. The seal pots on both the plastic and stainless systems can also be filled at initial start-up by connecting a **clean water** line to the inlet water port and running the system for ten minutes with the blower on and the damper 1/4 open. For complete instructions on this method, please follow initial Start-up procedures later in this section.

Do Not Run Free-Product Through the ShallowTray Air Stripper.

Free product contaminates the unit by coating the side walls with a film of free-product. ShallowTray units are designed to remove dissolved VOC's only.

Fresh air is required for the system air intake. Air that is heavily contaminated with VOC's will significantly reduce the ShallowTray's performance.

2-2 EQUIPMENT SET-UP

Drawings: Drawings referred to in the following sections are located in Section 5.

Follow codes. The plumbing and electrical installations must be performed by qualified personnel, and must be done in accordance with local, state, and national codes.

Protect critical items from the environment. In areas that could be below freezing, the stripper should be installed in a heated building. Plastic units, control panels, and motors should be protected from direct sun. Explosion-proof motors should be protected from rain due to the absence of motor gaskets.

Install adequate supports. Since **none** of the external piping associated with the ShallowTray unit is designed to support process water lines or air piping, adequate supports must be installed.

Assemble Unit. All ShallowTray units are assembled and hydraulically tested at the factory. However, to safeguard the units from shipping damage, some components are removed prior to shipping and will require reassembly. Follow all relevant steps in this section to set-up the ShallowTray system.

Check for loose fittings. Shipping the system to the site may have caused pipe joints or assembly hardware to loosen. Re-tighten as necessary.

Bolt unit together. For shipping purposes, the ShallowTray unit may come in two sections; the blower skid assembly and the sump and tray skid assembly. Bolt the base frames together using the bolts and spacers provided. (This step is done at the factory for the 1300 and 2300 series.)

Connect Blower. For forced draft (F.D., or positive pressure) systems, install the provided rubber coupling to connect the blower outlet to the air inlet on the sump tank. (See Section 5 coupling layout drawing for air inlet location.) For induced draft (I.D., or vacuum) systems, install an exhaust duct from the stripper air exhaust located on the top cover to the blower intake. Hydro Quip, Inc.. may not have provided this piping. Make sure the pipe diameter is large enough to maintain the required airflow without adding a pressure drop. Also, be sure the pipe has a suitable vacuum rating to prevent collapse.

Caution: Blower must draw air. Do not vent storage tanks that contain substances that will contaminate the air in the same room the blower draws air from. Do not duct intake air from an area that has contaminated air. Contaminated air will contaminate the water.

Assemble trays and level the ShallowTray unit. Large ShallowTrays may have the top tray and cover shipped separately. Install trays shipped separately by lining up the match-marked arrows and numbers on the trays and cover. To prevent damaging the gasket, do not drag the trays or cover across the gasket during assembly. Fasten all latches properly. The tray being installed must have the downcomers from each upper tray line up with the sealpots on the tray below. Check all the trays to make sure they are installed correctly, and not backwards. If the system is not set up properly, the water could bypass a tray allowing water to miss a large portion of the treatment path. Refer to the "basic subassembly" exploded view drawing in Section 5.

Level the ShallowTray. This is a critical step in the proper assembly of the equipment. If not level, the water depth on the trays will be uneven, causing the water to weep through the tray holes untreated.

For a gravity discharge unit (no discharge pump): Install the outlet pipe.
The plumbing components are typically shipped in a separate box. Refer to the Section 5 outlet piping drawings to assemble.

F.D. systems require a riser pipe (inverted U-trap) to compensate for the pressure generated by the blower. It is important that the riser pipe height be adjusted to create a 5 inch (13 cm) water depth in the sump tank during normal operating conditions. The provided anti-siphon valve must be installed in the high point of the riser pipe to prevent the sump from siphoning to below the 5inch depth. It is essential that the riser pipe be properly supported. Use proper pipe sealant and PVC cement for the riser pipe. We recommend running the system and adjusting the riser pipe before permanently bonding the fitting.

The purpose of having the 5 inch (13cm) water depth in the sump tank is twofold. First, it is to keep the downcomer (from the bottom tray) and the water discharge port (which elbows down internally) submerged. Both are set to a height of 2 inches (5cm) from the bottom of the sump. Keeping them submerged forms a water seal, which prevents air from escaping up the downcomer pipe or out the discharge trap.

Second, the 5 inch (13cm) depth is low enough to allow our high water level switch to reset. The switch, located in its typical position, has an approximate reset deadband of six inches, meaning the water level must drop 6 inches (15cm) below the alarm trip point before it resets. Consult HYDRO QUIP, INC. for additional options or questions about float switch location or normal operating water depth.

For a unit with a discharge pump: Install the outlet pipe.
For a pumped discharge unit: Refer to the Section 5 outlet piping drawing to assemble the water line from the sump tank to the pump suction, using components delivered in a separate box. Install downstream piping to the pump discharge port. A ball valve is typically provided and should be

used to adjust flow. Use proper pipe sealant or PVC cement as required. If a check valve is required, install on discharge side of pump. To reduce pressure losses, it is recommended that the connected pipe size remain at least as large as the pump discharge fitting.

Prime the pump.
Pour clean water in the pump's inlet port until it has filled the entire pump chamber. Remove the top air bleed plug on the pump housing to let air bleed out, then replace plug.

Install the inlet piping manifold.
Install the inlet piping manifold (typically shipped in a separate box). Follow the Section 5 inlet piping diagram for proper installation.

Caution: For systems other than 31200 , 41200, 61200 and 81200, there are two inlet port couplings on the cover; one is over the discharge side of the tray and cannot be used, so it is plugged. The other coupling is the active inlet, and has the dip tube inside the top cover. The 31200 , 41200, 61200 and 81200 series have three, four, six and 8 ports respectively, and all are used. The feed must enter the inlet located above the sealpot of the top tray. Otherwise contaminated water will bypass the treatment path of the first tray and fall directly into the downcomer to the next tray. This will result in poor removal efficiency.

Install the sump drain valve and the sight tube.
Install the sump drain valve and the sight tube. Refer to the Section 5 coupling layout drawing for port locations. Be sure to open the valve to the sight tube during start-up and operation. The valve should be closed only to replace a damaged sight tube.

Connect the water lines.
If the seal pots have not yet been filled with clean water, connect a clean water line to the inlet port or piping manifold and fill the seal pots according to the steps outlined in the initial start-up section above. If the seal pots are filled with clean water, connect the process water line to the inlet piping manifold. Connect the discharge water line. Firmly support the process water lines to prevent stress on the piping and ports. The system is not designed to support the weight of the process water lines.

Connect the air pressure tubing.
Connect the tubing from the ShallowTray to the low air pressure/vacuum switch (if provided), and/or the high air pressure/vacuum gauge (if provided). Read the component description on each for detailed connection information, and also refer to the Section 5 drawings. For the air pressure gauge, be sure to install the tubing to the 1/8" (3mm) shutoff valve. Open the valve only when a reading is required. This will reduce condensation build-up in the gauge. The air pressure switch tubing should always be open for continuous sensing. The switch is designed to drain excess condensation.

Connect the air discharge line.
Connect an air exhaust duct to the air outlet, either on the top of the unit for F.D. installations, or at the blower discharge for I.D. installations. Do not use an exhaust duct with a smaller diameter that the discharge port. A smaller diameter may cause a pressure drop larger than the blower was

designed for, resulting in low air flow and poor removal efficiency. Support the vent line independently of the air stripper so that it can be easily disconnected for maintenance purposes.

Wire the electrical components.
Have a qualified licensed electrician wire the electrical components in compliance with local, state, and national codes. Make sure the safety interlocks, described in the Special Precautions section, are connected properly. If Hydro Quip supplied the control panel, see Section 5 wiring diagrams.

Install optional items:

Air flow meter
Mount the pitot tube on the vent line per Dwyer bulletin # H-11 (located in the separate shipping box) or per the Section 5 "air flow meter assembly" drawings using the mounting hardware provided. Connect pitot tube to the 0-0.5 or 0-1.0 inches w.c.. air pressure gauge using the tubing provided. (See pitot tube mounting diagram in Section 5.) There are two air hoses required, one connects to the high pressure port on the gauge and on the pitot tube, and measures internal static pressure plus velocity pressure. The other connects to the low pressure ports on the gauge and on the pitot tube, and measures the internal static pressure only. The optimum pitot tube location is before the stripper, because the air is less humid and the tubing will be less prone to filling with condensation.

Blower Silencer:
Forced Draft system – Install the silencer on the inlet side of the blower. If the silencer is to be in the vertical position, install the piping and elbow as shown on the Section 5 silencer diagram. If the silencer is in the horizontal position, attach it directly to the blower inlet using a rubber coupling.

Induced Draft system – Install the silencer on the blower. The standard silencer's maximum pressure/vacuum rating is 20 inches (50cm) w.c. Be sure not to exceed the silencer's limit

Water flow meter

Install the water flow meter into the inlet piping per the Section 5 water inlet piping diagrams. The flow meter owner's manual was sent with the unit. Be sure to refer to it when installing the meter. It is prudent to install a strainer in the incoming process water line prior to the water flow meter. This will prevent rotor jamming.

Note: There may be other optional equipment that requires installation or assembly. Please refer to the Section 5 specification sheet and drawings for more information.

2-3 INITIAL SYSTEM START UP

Upon completion of the equipment set-up and mechanical/electrical installation, proceed with the following steps:

Step 1: Check all connections and close drain and sample valves.
Double check that all electrical, water, and vent connections are properly made. Close drain port and sample valves. Be sure that the sight valve is open.

Step 2: Power up.
Turn all panel control switches to the 'OFF' position, then turn 'ON' the panel disconnect switch. Systems with intermittent operation feature will show an alarm condition (low air pressure) five seconds after power is applied because the blower is not operating. Once the blower is supplying proper pressure, the alarm low air pressure condition will reset. Some systems may require pushing an 'Alarm Reset' button.

Step 3: Check the blower rotation.
Check the blower rotation by momentarily switching 'ON' (bumping) the blower switch and observing whether the blades turn in the direction of the arrow on the blower casing. You can also observe the motor's cooling fan blades for proper rotation. If system panel has the intermittent operation feature, the blower motor must be bumped in the 'Hand" position. Refer to the Routine Operation Section for a description of "intermittent operation". If blower rotates in the wrong direction, turn the main disconnect off and have a electrician make wiring changes to correct the rotation.

Step 4: Attach clean water line to the inlet.
If you did not fill the seal pots on each tray manually, fill them now by attaching a (clean) water line to the water inlet piping manifold or port, and then follow Step 5. If you have already filled the seal pots manually, skip Step 5 and go to Step 6.

Step 5: Fill the seal pots (inlet chamber) with clean water.
Use clean water when filling the seal pots. If contaminated water is used it will go through the system untreated.

To fill the seal pots (inlet chambers), set the blower damper to 1/4 open, and start the blower and the clean water flow to the unit. Let the blower and clean water run for about five to ten minutes, then shut them off. Setting the damper at 1/4 open reduces the air flow enough to allow the water to flow through the downcomers and into the seal pots.

If the system has the intermittent operation feature, the blower must be started in the 'Hand" position for this procedure. If you have trouble filling the seal pots by this method you can fill them manually, either by using the one inch sealpot filling ports (stainless units only), or by spraying a stream of clean water through the clean-out ports (stainless units only). The stream of water must be directed into the sealpots on the opposite side of the unit, until the sealpot is full. For plastic units you must remove the trays and fill the sealpots manually.

Step 6: Connect contaminated feed water line.
Connect contaminated feed line. Install all piping allowing provision for future removal for maintenance or repair. Make sure piping is supported independently of the ShallowTray. Start system with the blower damper 1/2 open. For systems with intermittent operation, you must turn 'OFF' the power at the panel disconnect, turn all control switches to the auto position, and then reapply panel disconnect power. All motors will start automatically based on control function. Each control panel is custom designed for each site. Become familiar with the panel logic and proper operation before attempting to start the system. The panel might have been provided by a panel manufacturer other then HYDRO QUIP, INC..

Step 7: Check the air pressure reading and set damper.
Run the unit for 5 minutes, and then adjust the blower damper setting to produce the required air pressure/vacuum reading on the pressure gauge. Since the blowers provided by HYDRO QUIP, INC. are selected and tested to exceed the minimum flow requirements of the system, you can use the table in Section 1-3 to set the damper during initial start-up.

Double check pressure reading after system has been running for about 1/2 hour. Adjust damper again if needed. Also check the airflow meter for proper airflow rate. Pressure readings may vary somewhat depending on your venting system.

The System is ready for operation.
It is not necessary to perform initial start-up procedures each time the system is shut down. However, note that anytime water is completely removed from the seal pots or sump tank, the initial start-up procedure must be done again. For example, after the system has been taken apart for cleaning, or after an extended shutdown where the water have may evaporated from the tank or seal pots.

2-4 Routine Operation

From the tables in Section 1-3 adjust the airflow to within the required operating range in SCFM. The airflow must be a least the minimum shown for proper stripping efficiency.

Adjust water flow rate by setting the water throttle valves. Now that the system has been primed per the initial start-up procedures, it is ready for fine tuning. Adjust throttle valves on inlet and outlet piping to obtain the desired water flow rates and minimum pump cycles, if applicable. Refer to the Section 5 specification sheet for your systems design and maximum water flow rates. To prevent a high water level alarm, it is critical that the discharge pump flow rate exceed the influent water flow rate.

Pumps provided by HYDRO QUIP, INC. have throttle valves on the discharge side of the pump. Once the desired water flow rate is achieved, check the amp draw of the motor. It must not exceed the pump nameplate amp draw.

High water level alarm switch: The switch is typically installed in the middle of three half inch switch ports located on the front of the unit (refer to the Section 5 coupling layout drawings). If the float is moved to the highest port and the discharge line plugs or the discharge pump fails, the water level could rise above the air inlet port, allowing water to drain into the F.D. blower housing or onto the floor. The blower may become damaged if it is running while water is in the blower housing. Be sure to check that the 1/8"Ø (3mm) coupling in the bottom of the blower housing is open to allow for drainage of water that may get into the housing.

Section 3: Cleaning Procedures

Minerals dissolved in high concentrations tend to precipitate out of groundwater during air stripping processes. These minerals form insoluble deposits commonly referred to as 'fouling.' Although the ShallowTray low profile air stripper system is designed to be fouling resistant, proper steps must be taken when treating water with high mineral concentrations. Deposits from iron-rich feed water can be reduced by pretreating the feed stream with sequestering agents. The recommended cleaning procedure for deposits is pressure washing with detailed instructions as follows:

Equipment Required:

Pressure Washer: 2 gpm minimum flow at 900 psig (minimum). Equipment rental companies can usually supply electric or gasoline driven units on a daily rental basis.

Washer Wand: Washer wand with spray nozzle, (obtainable from HYDRO QUIP, INC. as an option) and an adapter to connect the wand to the pressure washer hose end. All washer connections are 1/4" (6mm) NPT.

Clean Water Supply: Clean water supply with a capacity of at least 2 gpm at 20 psig. Connect to the pressure washer using an ordinary garden hose.

System Shut Down:
Shut feed water off.
Shut off the water feed to the system.
Wait 5 minutes to allow the water in the stripper trays to be completely treated, then shut off the blower. Treated water in the trays will drain into the sump tank, so it is important to keep the outlet pump in "auto" to remove this extra water.
Shut off the power at the main disconnect switch if the shutdown is more than temporary.

Caution: If proper shut down procedures are not followed, contaminated water will drain into the sump tank. This will contaminate the water that has been collected in the tank. Therefore, always allow the blower to run an additional 5 minutes after the feed water is shut-off.

Cleaning the Unit:

Step 1: Turn off equipment.
Turn off the feed water to the stripper.

Step 2: Provide for Waste Disposal.
Make provisions for disposing of the sludge and waste generated during cleaning. A wet/dry vacuum may be required, or possibly the outlet pump (if provided) can pump out to a storage tank. Be aware that large pieces of debris might possibly clog the outlet pump or check valve.

Step 3: Remove cleanout port covers.
Remove all cleanout port covers.

Step 4: Turn on water and pressure washer.
Turn on the water supply to the pressure washer. Then, turn on the pressure washer. Wear protective goggles or face shield while spraying.

Step 5: Insert wand and start pressure washer water flow.
Insert the wand all the way through the 8" (20cm) cleanout port on the sump tank. Have the spray nozzle pointed up toward the bottom of the bottom tray. Holding the wand tightly, pull the trigger to start the pressurized water flow. Expect the wand to kick back as flow starts.

Step 6: Move wand side to side.
Move the wand side to side at a rate of about 1 inch (3cm) per second. Be sure to cover the entire tray bottom area. Recommended cleaning times for one side of one tray are given below:

Model 1300	2 min
Model 2300	4 min
Model 2400	5 min
Model 2500	6 min
Model 2600	8 min
Model 3600	12 min
Model 3800	16 min
Model 31000	18 min
Model 31200	23 min
Model 41200	32 min
Model 51200	40 min
Model 61200	48 min
Model 71400	60 min
Model 81200	64 min

Step 7: Inspect cleaned area.
Periodically stop the cleaning operation and inspect the cleaned area by shining a light into the unit. The area is clean when there are no deposits in or around the stripper tray holes.

Step 8: Clean top side of tray.
When the bottom surface appears clean, move the wand to the top side of the same tray by inserting it in the next highest cleanout port. Continue spraying with the nozzle pointed down onto the top surface of the tray. Remove all visible deposits from the tray baffles and the walls of the unit.

Step 9: Repeat for all trays.
Repeat the procedure for the bottom of the next higher tray, etc., working up to the top tray.

Step 10: Rinse.
After the cleaning operation is finished, rinse the trays, baffles, and walls with the pressure sprayer. Work down from the top tray to the sump tank. Make sure the surfaces are clean and the holes are not blocked by loosened debris.

Step 11: Clean cover.
Remove the top cover. Flip it over, and wash the bottom side. Inspect spray nozzle and the wire mesh mist eliminator pad for fouling. Clean the spray nozzle and the mist eliminator pad.

Step 12: Replace the mist eliminator pad.
Mist eliminator pads that are excessively plugged should be replaced. The old pad is removed by loosening the retainer plates on the corners of the pad. Reinstall the new pad in the same orientation as the old one.

Section 4: Trouble Shooting

Note: A competent electrician should perform any work inside the electrical control panel. Do not perform troubleshooting if you are not familiar with the procedures or the equipment.

Problem Blower Won't Start Or Run

No power to blower
Check that all switches are in "ON" or "AUTO" position.
Position main disconnect switch to "ON" position. Turn control switches to" on" or "AUTO".

Blown Fuse
Check to see if fuses are ok.
Check fuses in main disconnect switch and in control panel. If blown, replace with fuse of the same size and rating to avoid the risk of fire or electrical shock.

Overload relay Trips
Locate reset button on blower overload relay.
Push reset button in. Reasons for tripping; incorrect line voltage, motor wired incorrectly, inadequate ventilation, worn bearings.

Tubing to air pressure switch plugged
Remove tubing from air pressure switch and blow into it towards tank. Clean or replace tubing if plugged or kinked.

Blower dose not rotate freely.
TURN OFF ALL POWER to the system. Try to spin wheel by hand. Wheel should rotate freely. If not, call HYDRO QUIP, INC..

Problem Outlet Pump Won't Shut Off

Suction or Discharge piping to pump is clogged.
Check water flow from discharge pipe. Piping should be clean inside. Look for narrowing caused by scale or iron accumulation. Remove piping. Inspect, clean, or replace as necessary.

Float switch in tank is stuck in down position.
Remove 8"Ø or 12"Ø (30cm) inspection cap and check that all floats are floating on the water. Clean all deposits from float. Replace float if necessary.

Normal Operation: Water level in sump is OK. Pump will stop when water level reaches pre-determined height in tank. Allow water level to decrease until pump turns off. Let water level reach predetermined lower level, which will cause outlet pump to turn off. Water level may be just below the bottom of clear sight tube before pump shuts off – this is normal.

Problem — Outlet Pump Won't Run Or Pump Water

No power to Pump

Check that all switches are in "ON' or "AUTO" position.
Position panel disconnect switch to "ON position. Turn control switches to "ON" or "AUTO."

Blown fuse

Check to see if fuses are ok.
Check fuses in main disconnect Switch and in control panel. If blown, replace with fuse of the sane size and rating to avoid the risk of fire or electrical shock.

Overload relay trips

Locate reset button on pump overload relay.
Push reset button in. Reasons for tripping; incorrect line voltage, motor wired incorrectly, inadequate ventilation, worn bearings.

Normal operation: Water level in sump is OK. Pump will start when water level reaches predetermined height in tank. Allow water level to increase until pump turns on. Be sure pump switch is in "AUTO" position. Let water level reach predetermined upper level, which will cause outlet pump to turn on.

Level switch in tank is wired incorrectly in control panel

Check wiring circuit against diagram. See that all connections are tight and no short circuits exist because of worn insulation, crossed wires, etc. Rewire any incorrect circuits. Tighten connections, replace defective wires.

Pump does not rotate freely

TURN OFF ALL POWER TO THE SYSTEM. Try to turn impeller by hand.If impeller won't turn, remove housing and locate source of binding. It could be due to impeller, seal, or bearing damage, or excessive fouling.

Impeller or check valve is fouled.

TURN OFF POWER**.** Remove pump outer housing and inspect impeller for blocked openings. Be sure to have a new housing gasket kit available before removing housing. Remove check valve from line and inspect for stuck or fouled valve. Clean or replace impeller or check valve as necessary.

Problem Low Air Pressure/Vacuum in Stripper Tank.

Blower damper closed.

Visually check position of damper on inlet of blower. Open damper to get proper reading on pressure gauge. Firmly tighten damper set screw.

Motor rotation backwards

Watch rotation of blower wheel at slow speed. It must match direction of the rotation arrow on the blower housing. Have electrician reconnect wiring for proper rotation as per motor diagram.

Gravity discharge trap installed incorrectly

Trap should be positioned vertically, as an "upside down U." Install discharge trap per outlet plumbing drawings located in Section 5.

Inlet chamber (sealpot) in each tray not full of water.

Remove 4"Ø (10cm) rubber caps, or slide tray aside and look at water level in chambers. Remove 4 inch (10cm) rubber caps on end of trays. Fill up inlet chambers with a hose, or follow the sealpot fill procedure as described in the initial Start Up section.

Rubber clean out caps not in place.

All cleanout ports must have a rubber cap installed. Tighten clamps on all rubber caps.

Tubing to pressure gauge

Remove tubing from pressure gauge and blow into it towards tank. Clean or replace tubing if plugged or kinked.

Gravity feed not flowing

Unit has gravity feed and inlet pipe on inside of ShallowTray cover is not submerged in inlet chamber water. Remove cover and measure length of piping hanging from inside of cover. Length is to be about 10 1/2 inches (27cm) from cover surface. Adjust length of inlet pipe on inside of cover until total length is about 10 1/2 inches (27cm). DO NOT INSTALL NOZZLE ON A GRAVITY FEED UNIT.

Blocked blower intake

Look at blower intake screen. Remove debris from screen.

Normal operation: When inlet pump starts, the blower will start and air pressure will increase to required operational level. No action necessary.

Problem High Pressure/Vacuum in Stripper

Air exhaust is restricted

Check vent piping for bird nest or other obstructions. Check that vent pipe diameter does not decrease. Intake or exhaust air pipe diameter must be at least as big as the cover vent or blower intake diameters.

Air holes in trays plugged

Remove inspection and cleanout caps and visually inspect holes. For iron fouling, clean out the unit with a pressure washer. For scaling, scrape or bang the scale from all surfaces, then use a pressure washer to open the 3/16 inch (5mm) diameter holes. Consider using a sequestering agent to prevent scaling.

Mist eliminator is plugged

Remove cover from ShallowTray and inspect the bottom of the mist eliminator pad in the cover. Remove mist eliminator pad from cover and clean. If fouled, replace with a new mist eliminator.

Problem Water won't flow into unit

Inlet/well pump function

Allow water level to rise in well pump, which will turn on the inlet pump and start water flow to system. No action necessary.

Stripper air pressure in low alarm condition

Read sump tank air pressure from pressure gauge. System should be in alarm condition if pressure is below about 2" inches (5cm) w.c. Check that blower is operating properly, and has correct rotation. Check that all rubber caps are in place on end of trays.

Inlet piping plugged

Remove cover and inspect nozzle and piping for debris and buildup. Clean or replace clogged parts.

Problem Iron Fouling Is A Problem

Iron build-up

Iron precipitates out of water when treated with an air stripper, causing iron build up in unit. Remove cleanout caps and inspect inside of tray for buildup/fouling. Clean out unit with pressure washer

on a routine basis. Pretreat incoming water to reduce fouling problems in stripper. Meter a sequestering agent into the water.

Problem VOC Removal Is Less Than Expected

There are many possible reasons for poor stripper efficiency. Review the following list of questions to troubleshoot what the problem might be.

1. Have the trays been taken apart? Are they put back together as supplied from the factory, i.e., dip tube over sealpot, downcomers from each tray underwater in the sealpot of the tray below?

2. What is the sump tank air pressure reading? Is it steady, slowly changing over time, or rapidly fluctuating?

3. What is the flow rate through the stripper? How is it measured? Where is the sensor mounted?

4. What is the air intake and exhaust piping design (size of ducts, number of elbows, length of pipe run, GAC, heaters, other restrictions)? Are sample ports installed on each tray to verify pre-tray removal efficiency?

5. Is sump tank contaminated? Where are effluent samples taken from?

6. Are sample ports purged for 30 seconds-1 minute before taking sample?

7. Are samples being taken, stored, and tested per approved methods?

8. Are seal pots on each tray full of water?

9. Dose the sump tank have at least 4 inches (10cm) of water at all times?

10. Is the water suction elbow in the tank pointing down and always underwater?

11. What is the inlet water temperature?

12. What else is in the water besides the contaminates in question?

13. Are there occasional slugs of free product, or much higher than normal contaminant concentrations that could enter the stripper?

14. Is inlet water supplied as a continuous stream (as from an electric pump.)? Or is the flow pulsed (as from a pneumatic pump)?

15. Are their surfactants, detergents, greases, fats, etc. in the water that are causing foaming in the stripper?

16. Is there equipment near the blower intake that could be contaminating the air?

17.Has the air entering the blower been tested for VOCs?

18. How far away from each other are the air intake and air exhaust points? Is the air intake downwind of upwind from the exhaust? Is it possible for contaminated air to be sucked back into the stripper air intake?

19. Is the blower spinning in the correct direction (top of blower wheel spinning towards tank)? Watch wheel when it is almost stopped.

20. Is there air coming out of the discharge pipe?

21. Is outlet piping siphoning all water out of the sump tank, until it sucks air from tank?

22. What is the outlet plumbing design (gravity discharge, pumped discharge, uphill, downhill, other equipment in-line, size of piping. etc.)?

23. What do the bubbles look like in each tray? Install view ports to see.

24. Are the undersides of the trays free of drips and drizzles?

25. Are tray holes closed or plugged? Is there any scaling or fouling on the trays?

26. Is the system level and plumb?

27. When shutting system down, is inlet water shut off, blower allowed to operate for an additional 5 minutes, then blower shut off?

Fulflo® CB Filter Vessels

- Carbon Steel
- 304 Stainless Steel

Bag Filter Vessel Series

CB Model Bag Filter Vessels are Designed for Economical Filtration of a Wide Variety of Industrial Liquids

The CB bag filter vessel series is an economical design that features the integrity of a bolted closure. The CB series is available in either carbon steel or 304 stainless steel. Both models have zinc plated closure bolts and zinc plated legs for corrosion resistance. The integral basket support provides a smooth interior for easy cleaning and bag installation. The CB is for use with either single or double length bags with flex type bag bands and can also be used with solid ring and plastic ring bags by using the optional bag sealing insert and adding an o-ring under the basket rim. The adjustable legs offer installation flexibility by allowing various inlet elevations and nozzle orientations.

Applications

- Potable Water
- Process Water
- Edible Oils
- Coatings
- Lubricants
- Coolants
- Cutting Oils
- Solvents

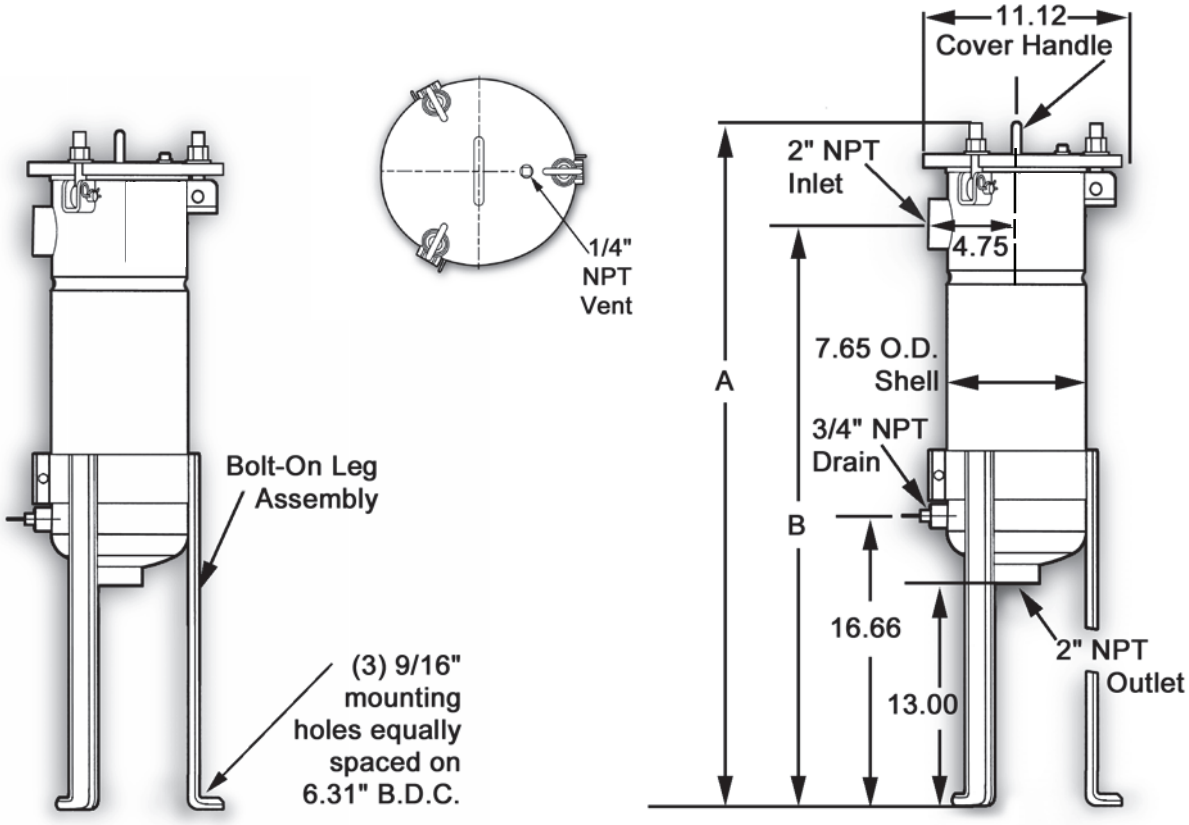
Features and Benefits

- Single o-ring design closure assures quick, positive cover sealing.
- Swing bolts for fast, easy and safe opening and closing of cover.
- Buna-N o-ring standard with optional EPR and Viton*.
- Maximum design pressure is 175 psi (12 bar) at 250°F** (121°C).
- Good manufacturing practice industrial design.
- Threaded vent and drain connections.
- Carbon steel with zinc plated support basket or 304SS with 316SS support basket.
- Adjustable leg height.
- Side inlet allows cover to open without disconnecting piping.
- Integral basket support design provides a smooth interior for easy wash-out and cleaning.
- Pivot pin cover allows cover to remain attached when opened.
- Positive seal of "C" style flex band bags prior to closing the vessel cover.
- Optional hold-down assembly for conversion to solid ring and plastic ring style bags.
- Zinc plated closure bolts and legs for corrosion resistance.

Process Filtration Division

Bulletin C-5006 Effective 08/02

Parker Filtration



Design Specifications

Model	Bag Style	Typical Aqueous Flow+(gpm)	Dimensions *(in)* A	B	Shipping Weight (lbs)	Volume (gallons)
CB11-2	Single	80	40.50	33.25	65	4.3
CB12-2	Double	160	55.50	48.25	90	7.2

+Actual flow rate is dependent on fluid viscosity, micron rating, contaminant and media type. Consult flow charts for each application.

Ordering Information

4	CB	11 ——	2
Material	*Model*	*Media Requirement*	*Inlet/Outlet Size*
No Symbol = Carbon Steel 4 = 304 Stainless Steel		11 = One Single Bag 12 = One Double Bag	2" NPT

Process Filtration Division

* A trademark of E. I. du Pont de Nemours & Co.

** Operating temperature limited to 250°F (121°C) by standard Buna-N O-ring and exterior paint on carbon steel models. Optional O-ring materials are available.

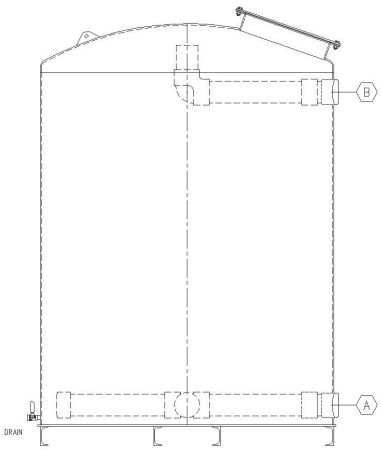
Parker Hannifin Corporation
Process Filtration Division
6640 Intech Boulevard
Indianapolis, Indiana 46278
Toll Free 1-888-C-FULFLO (238-5356)
Telephone (317) 275-8300
Fax (317) 275-8410
http://www.parker.com

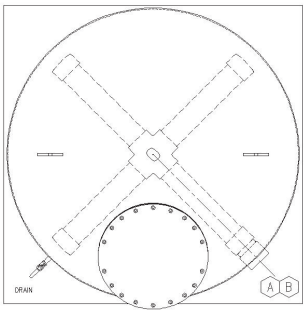
PRODUCT DATA

VFV SERIES FILTERS

with MK Modifications

VFV series filters are designed to treat vapor streams in a wide variety of adsorption applications. The modular design enables the units to easily fit into a wide variety of installations. Standard features include steel construction with epoxy internal coating, efficient internal distributor array, forklift skid and lifting eyes.





A - Process Inlet
B - Process Outlet
C - Drain
Manway standard size 18" Round

Standard Model Shown - Detailed Submittal Drawings Available

VFV SERIES STANDARD SPECIFICATIONS

Model Number	VFV-250	VFV-500	VFV-1000	VFV-2000	VFV-3000	VFV-5000	VFV-10000
Overall Height	3'11"	5'3"	6'5"	7'7"	7'10"	9'0"	9'4"
Diameter	24"	30"	36"	48"	60"	72"	96"
Process Connection	2" FNPT	2" FNPT	3" FNPT	4" FNPT	8" flange	6" FNPT	6" FNPT
Typical GAC Fill (28#/FT³)	250 Lbs	500 Lbs	1,000 Lbs	2,000 Lbs	3,000 Lbs	5,000 Lbs	10,000 Lbs
Shipping Weight (empty)	165 Lbs	375 Lbs	500 Lbs	925 Lbs	1,375 Lbs	2,300 Lbs	3,150 Lbs
Operational Weight	500 Lbs	1,050 Lbs	1,800 Lbs	3,500 Lbs	5,250 Lbs	8,750 Lbs	15,800 Lbs
Air flows for standard conditions	30 to 180 CFM	50 to 300 CFM	70 to 420 CFM	125 to 750 CFM	200 to 1200 CFM	280 to 1680 CFM	500 to 3000 CFM
Available Bed Volume	9 FT^3	19.5 FT^3	35 FT^3	75 FT^3	117 FT^3	196 FT^3	400 FT^3
Maximum Pressure	10 PSIG	10 PSIG	10 PSIG	10 PSIG	5 PSIG	10 PSIG	10 PSIG
Maximum Vacuum	28" Hg	28" Hg	28" Hg	28" Hg	15" Hg	28" Hg	28" Hg

Vent-Scrub® Vapor Phase Adsorbers

Applications

The Vent-Scrub® adsorbers have been proven to be the simplest and most cost effective way to treat malodorous and VOC emission problems. Sturdy steel construction and specially formulated corrosion resistant internal coating ensures long service life and low maintenance. Applications for Vent-Scrub® adsorbers include:

- API separator vents
- VOC control from soil vapor extraction (SVE) systems and airstrippers
- Wastewater and product storage tank vents
- Process vents
- Refinery and chemical plant wastewater sewer vents
- Laboratory hood exhausts

Installation, Startup and Operation

Siemens can provide a total service package that includes utilizing OSHA trained personnel providing on-site carbon changeouts, packaging and transportation of spent carbon for recycling at our reactivation facilities, where the contaminants are thermally destroyed.

We provide instructions on sampling the spent carbon and completion of our spent carbon profile form. Spent carbon acceptance testing can be performed at our certified laboratory.

When requested, a certificate of reactivation will be issued.

Benefits and Design Features

- Durable, carbon steel construction.
- Abrasion and corrosion resistant baked epoxy lining; urethane exterior finish (Vent-Scrub® 1000, 2000, 3000, 8000 adsorbers).
- Ready-to-use systems: simple installation and operation.
- Applications to 3750 SCFM.
- The Vent-Scrub® 1000, 2000, 3000 and 8000 adsorbers have forklift channels for easy handling.
- The Vent-Scrub® 200, 400, 1000 and 2000 adsorbers are UN/DOT approved transportation containers for RCRA hazardous spent carbon.
- Hose kit and pipe manifold options are available to simplify installation and operation.

Piping Manifold (Optional)

- 2"/3" sch 80 PVC piping and valves (optional carbon steel and stainless steel piping).
- Series or parallel operation.
- Sampling ports and pressure gauges.
- Flexible hoses with Kamlock fittings allow easy installation and removal during service exchange operations (Vent-Scrub® 200, 400, 1000 and 2000 adsorbers).

Specification					
Vent-Scrub® Adsorber Model No.	200	400	1000/2000	3000	8000
Dimensions, diameter x overall height	22" x 34"	32" x 43"	48" x 59"/48" x 95"	60" x 112"	96" x 131"
Inlet Connection	2" FNPT	4" FNPT	4" FNPT	10" Flange	16" Flange
Outlet Connection	2" MPT	4" FNPT	4" FNPT	10" Flange	16" Flange
Manway	Top	Top	18" Top	16" Top	20" Top/Side
Internal Distribution[1]	PVC	PVC	PVC	FRP/PPL	FRP/PPL
Interior Coating	Epoxy	Epoxy	Epoxy	Epoxy	Epoxy
Exterior Coating	Enamel	Enamel	Epoxy/Urethane	Epoxy/Urethane	Epoxy/Urethane
Carbon Fill Volume (Cu.ft.)	6.8	14	34/68	107	273
Cross Sectional Area (sq.ft.)	2.8	4.9	12.3	19.6	50.2
Approx. Carbon Weight (lbs)	200	400	1000/2000	3000	8000
Empty Vessel Weight (lbs)	50	80	890/1190	2500	5500
Flow, CFM (max.)	100	300	500	1500	3750
Pressure, psig (max.)	3	3	14.9	5	5
Temperature, deg. F (max)[4]	140	140	140	140	140
Vacuum, in. Hg (max.)	N/A	N/A	12/12[2]	6[3]	12[3]

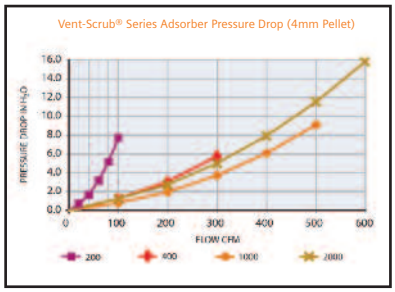
[1]*Carbon steel and stainless steel internals are also available.*
[2]*For vacuum greater than 12 in. Hg on Vent-Scrub® 2000 Adsorber, contact your Siemens representative.*
[3]*For vacuum service on Vent-Scrub® 3000 and 8000 Adsorber, contact your Siemens representative.*
[4]*For higher temperatures, stainless and carbon steel internals are available.*
For detailed dimensional information or drawings, contact your local Siemens sales representative.

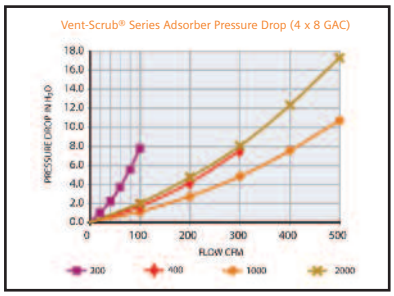
Warning

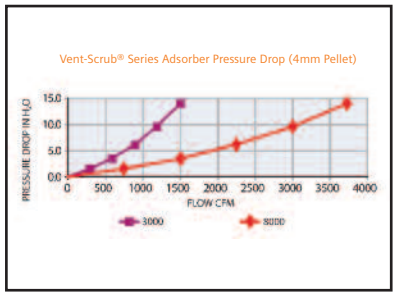
The adsorption of organic compounds onto activated carbon generates heat. In rare instances, adsorbed compounds may also react on the carbon surface to generate additional heat. If these heat sources are not properly dissipated, the carbon bed temperature may rise to the point where the carbon can ignite, leading to a fire or other hazardous condition. A description of industry-accepted engineering practices to assure the dissipation of heat and safe operation of the carbon bed can be provided upon request. In certain applications where the risk of ignition is significant, activated carbon may not be a recommended treatment technology. Please contact your Technical Sales Representative for more details.

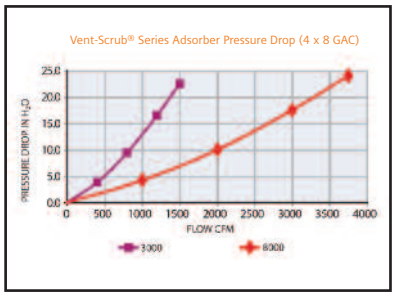
Wet activated carbon readily adsorbs atmospheric oxygen. Dangerously low oxygen levels may exist in closed vessels or poorly ventilated storage areas. Workers should follow all applicable state and federal safety guidelines for entering oxygen depleted areas.

All information presented herein is believed reliable and in accordance with accepted engineering practices. Siemens makes no warranties as to the completeness of this information. Users are responsible for evaluating individual product suitability for specific applications. Siemens assumes no liability whatsoever for any special, indirect or consequential damages arising from the sale, resale or misuse of its products.









Siemens
Water Technologies
866.613.5620 phone

WS-VSCdr-DS-0910

CABOT

NORIT ACTIVATED CARBON

JUN 2013 No. 2280

NORIT® VAPURE™ REACT GRANULAR ACTIVATED CARBON

WHY CABOT

Cabot Norit Activated Carbon is a premier activated carbon manufacturer respected for experienced people, diverse products and strong customer relationships. Cabot's history of innovation, product performance, technical expertise and customer focus ensure that you receive the right products and solutions for your specific purification needs.

BSI
ISO 9001
FM 39843

NORIT VAPURE REACT is a granular reactivated carbon produced under closely controlled operating conditions in our state-of-the-art facility. Quality and screen size are designed to provide high performance levels in the removal of odors, toxic vapors, and irritants from various gas streams. This product is a recycled activated carbon and not for food grade or potable water applications.

PRODUCT SPECIFICATIONS

Iodine number	850 min.	mg/g
Hardness number (ASTM)	95 min.	
Moisture	3 max.	% as packed
Mesh size (U.S. Sieve Series)		
Greater than 4 mesh (4.75 mm)	5 max.	%
Less than 10 mesh (2.00 mm)	5 max.	%

TYPICAL PROPERTIES*

Butane activity, (ASTM)	23**	%
Apparent density, vibrating feed	0.50	g/mL
	31	lb/ft^3

*For general information only, not to be used as purchase specifications.
**This butane activity value is equivalent to a carbon tetrachloride adsorption value of 62%.

PACKAGING/TRANSPORTATION

Standard package is woven polypropylene bulk bags, 800 lb net.
Activated carbon (NOT REGULATED)
Exempt from DOT, IATA, and IMDG regulations
Import/Export classification: 3802.10.0000 (HS Tariff Classification)
Domestic Freight Classification: NMFC 040560
CAS # 7440-44-0

NORIT® VAPURE™ REACT

MATERIAL HANDLING

Wet activated carbon depletes oxygen from air and, therefore, dangerously low levels of oxygen may be encountered. Whenever workers enter a vessel containing activated carbon, the vessel's oxygen content should be determined and work procedures for potentially low oxygen areas should be followed. Appropriate protective equipment should be worn. Avoid inhalation of excessive carbon dust. No problems are known to be associated in handling this material. Please see the product Material Safety Data Sheet for details. Long-term inhalation of high dust concentrations can lead to respiratory impairment. Use forced ventilation or a dust mask when necessary for protection against airborne dust exposure (see Code of Federal Regulations - Title 29, Subpart Z, par. 1910.1000, Table Z-3).

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NORIT ACTIVATED CARBON

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Elgin, IL 60120

REACTION FOR THE REMOVAL OF VINYL CHLORIDE USING POTASSIUM PERMANGANATE

The reaction of permanganate ion with vinyl chloride monomer is outlined in Figure 1. The reaction produces 1,2 dihydroxy, chloroethane, an addition product, and a precipitate of manganese dioxide. A short description of the reaction is also included below. The typical oxidation reaction for an alkene by permanganate ion may be found in any general organic chemistry text.

The oxidation of an alkene leads to the formation of a compound with hydroxyl groups on the carbon atoms that were involved in the double bond, a 1,2 diol. Manganese (VII) in permanganate ion is ultimately reduced to manganese (IV) in manganaese dioxide. The carbon atoms of the double bond are oxidized. Even if no base is added at first, the solution becomes progressively more basic as the reaction proceeds.

In this oxidation reaction, the two hydroxyl groups become attached to the same face of the double bonds. The permanganate ion is believed to add to the double bond to give a cyclic intermediate, a manganate ester. The first step of this reaction is the syn (same side) addition of permanganate ion to the double bond. This intermediate breaks down in the presence of water to give the cis-1,2 diol. Thus, there are no appreciable quantities of chlorine gas or formaldehyde formed in the reaction.

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Reaction Mechanism of Permanganate Ion with VCM (Vinyl Chloride Monomer)

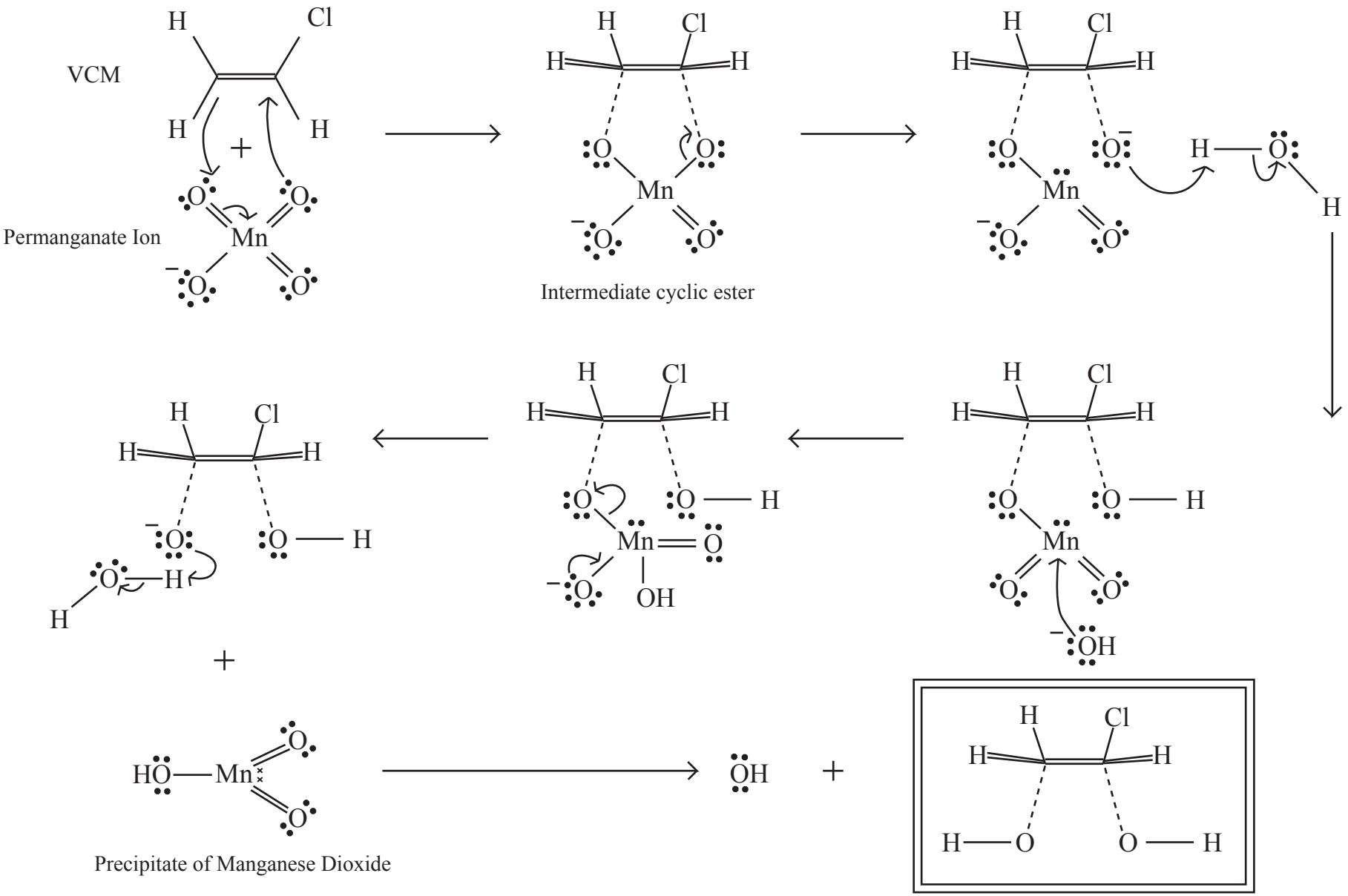

FIGURE 1

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➢ HS-600 provides a significantly longer service life than potassium hydroxide impregnated carbon.

Hydrosil HS-600 has 3.6 pounds of active ingredient as compared to 1.6 pounds of active ingredient (32 pounds per cubic foot times 5.0%). Mathematically, the service life of HS-600 is 125% greater.

➢ HS-600 is effective on a broader spectrum of gaseous pollutants.

Potassium permanganate used in the Hydrosil HS-600 production process chemically produces manganese dioxide (MnO_2) and manganese tetraoxide (MnO_4), in addition to potassium hydroxide (KOH). Manganese dioxide/tetraoxide is effective in removing sulfur dioxide, nitrogen dioxide, chlorine dioxide and mercaptans. These chemicals are not present in potassium hydroxide impregnated carbon. Typically corrosive pollution in a plant environment is caused by a broad group of chemicals and potassium hydroxide impregnated carbon is too focused to handle this broad spectrum.

➢ HS-600 does not support combustion.

Potassium hydroxide impregnated carbon will support combustion.

➢ HS-600 provides a visual indicator when the media is spent.

The manganese dioxide/tetraoxide produces a purple color, which evolves to a dull brown as the media is spent. Testing is the only reliable way of knowing the remaining productive service life of the media. Visual indications are useful in prioritizing the need to test.

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www.hydrosilintl.com

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Effectiveness of Chemisorption on Chlorinated Solvents

- Mechanism of removing vinyl chloride in air with potassium permanganate

Activated carbon is used to remove many chlorinated solvents in air streams. If the isotherm (adsorption capacity) is good this is the best method. In the case of low molecular weight chlorinated solvents this isotherm is not very good. In these cases we must use other mechanisms for the removal of the pollutant gas. The alternative to adsorption/absorption is to have the gas adsorbed into a substrate and have a chemical reaction to neutralize or oxidize the pollutant. This mechanism is understood to be chemisorption.

Potassium permanganate is a very good chemical to perform both the neutralization and oxidization process in air. When potassium permanganate is hydrated it will form three compounds. These compounds are potassium hydroxide, manganese tetraoxide and manganese dioxide. The in the case of vinyl chloride the manganese tetraoxide will oxidize the vinyl chloride into potassium chloride and carbon dioxide. The potassium chloride will remain in the pore structure of the substrate that contains the hydrated potassium permanganate.

Hydrosil impregnates a molecular sieve of zeolite with 6% by weight potassium permanganate. This media is called HS-600. Field applications of this media in removing vinyl chloride from air streams have been proven to be efficient and economically better than that of activated carbon. In field studies, the spent media was tested and determined that it did not pose a hazardous waste. The spent material was disposed in a landfill. In using this media, a representative sample should be tested for hazardous materials prior to disposal in a landfill as a non-hazardous waste.

It should be noted that if other higher molecular weight chlorinated substances are present in the air stream it is advisable to place activated carbon scrubber systems prior to the potassium permanganate system. This will increase the efficiency of the systems and result in decreased operating costs.

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Remaining Service Life

The percentage of available potassium permanganate and the density of the gas phase media can be correlated to the active service life left in the product. If the media in the adsorber is Hydrosil HS-600 or an activated alumina based product, the following schedule can be followed:

Hydrosil HS-600 Percentage of Potassium Permanganate (% by weight)		Activated Alumina Percentage of Potassium Permanganate (% by weight)
2.2 to 6.0	**SAFE**	2.6 to 4.0
1.6 to 2.2	**BORDERLINE**	1.9 to 2.6
1.2 to 1.6	**CHANGE**	1.4 to 1.9
0.0 to 1.2	**CHANGE IMMEDIATELY**	0.0 to 1.4

The comments are intended to mean the following:

SAFE - Reanalyze in 90 days

BORDERLINE - Change in 30-60 days

CHANGE - Change in 30 days, breakthrough could occur quickly under plant "spill" conditions

CHANGE IMMEDIATELY - Change Immediately

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Hydrosil HS-600

Hydrosil vigorously controls the production process. Data is reviewed and maintained on each batch as it is being produced through and including the moisture content of the HS-600 being delivered to our customer.

➢ HS-600 Specifications

The potassium permanganate impregnated media shall have no less than 3.6 pounds of potassium permanganate per cubic foot, a bulk density of no less than 60 pounds per cubic foot, a moisture content of 12-15% by weight and shall not dust. The media shall have an irregular particle size of 4 x 8 mesh.

The performance characteristics of the air filtration media shall meet or exceed a service life of no less than 72 hours for breakthrough of hydrogen sulfide at the following test conditions:

Media Bed Volume: 76.00 cubic centimeters
Bed Configuration: 2.54 cm (id) x 15.00 cm
Flow Rate: 3000 (+/- 100) ml/minute
Relative Humidity: 70%
Challenge Gas: hydrogen sulfide
Challenge Gas Concentration: 10 (+/- 0.25) PPM

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Elgin, IL 60120

Phone: 1-800-787-7531
Emergency Phone: 1-847-741-1600
Telex*: 1-847-741-1616

Hydrosil HS-600

Identity (Trade Name As Used On Label)

MSDS Number*

CAS Number*

January 1, 2011 to December 31, 2011

Date Prepared

William J. Waldschmidt

Prepared By*

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

SECTION 1 - MATERIAL IDENTIFICATION AND INFORMATION

COMPONENTS - Chemical Name & Common Names (Hazardous Components 1% or greater; Carcinogens 0.1% or greater)	%*	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
hydrated potassium permanganate forming ionic	6-8%	5 mg/m^3	5 mg/m^3	None
potassium hydroxide (CAS # 1310-58-3) and				
ionic manganese tetraoxide (CAS # 1317-35-7)				
Non-Hazardous Ingredients molecular sieve/moisture	92-94%			
TOTAL	**100**			

SECTION 2 - PHYSICAL / CHEMICAL CHARACTERISTICS

Boiling Point: N/A

Specfic Gravity (H_2O = 1): Density 59-61 #/ft^3

Vapor Pressure (mm Hg and Temperature): N/A

Melting Point: N/A

Vapor Density (Air = 1): N/A

Evaporation Rate (_____ = 1): N/A

Solubility in Water: $KMnO_4$ - yes, molecular sieve - no

Water Reactive: N/A

Appearance and Odor: purple granules, odorless

SECTION 3 - FIRE AND EXPLOSION HAZARD DATA

Flash Point and Method Used	Auto-Ignition Temperature	Flammability Limits in Air % by Volume	LEL	UEL
N/A	N/A	N/A	N/A	N/A

Extinguisher Media: None

Special Fire Fighting Procedures: None

Unusual Fire and Explosion Hazards: None

SECTION 4 - REACTIVITY HAZARD DATA

STABILITY
■ Stable
☐ Unstable

Conditions To Avoid: Protect in containers against puncture and physical damage, keep in a dry area, avoid exposure to water

Incompatability (Materials to Avoid): None

Hazardous Decomposition Products: None

HAZARDOUS POLYMERIZATION
☐ May Occur
■ Will Not Occur

Conditions To Avoid: None

SECTION 5 - HEALTH HAZARD DATA

PRIMARY ROUTES OF ENTRY
☐ Inhalation ☐ Ingestion
☐ Skin Absorption ■ Not Hazardous

CARCINOGEN LISTED IN
☐ NTP ☐ OSHA
☐ IARC Monograph ■ Not Listed

HEALTH HAZARDS

Acute: May be irritating to body tissue upon contact

Chronic: None

Signs and Symptoms of Exposure: May stain body tissue

Medical Conditions Generally Aggravated by Exposure: Open wounds, burns, and mucous membranes

EMERGENCY FIRST AID PROCEDURES - Seek medical assistance for further treatment, observation and support if necessary

Eye Contact: Immediately flush with large amounts of water for 15 minutes

Skin Contact: Immediately flush with soap and water

Inhalation: Leave contaminated area

Ingestion: Drink several glasses of water or milk. Seek medical attention.

SECTION 6 - CONTROL AND PROTECTIVE MEASURES

Respiratory Protection (Specify Type): Treat as low level nuisance dust, Use NIOSH/MSA #TC-21C-132

Protective Gloves: Rubber or plastic gloves

Eye Protection: Safety glasses

VENTILATION TO BE USED
☐ Local Exhaust ■ Mechanical (general) ☐ Special
☐ Other (specify)

Other Protective Clothing and Equipment: Regular work clothing

Hygienic Work Practices: Wash your hands before eating. Wash contaminated clothing.

SECTION 7 - PRECAUTIONS FOR SAFE HANDLING AND USE/ LEAK PROCEDURES

Steps to be Taken If Material is Spilled Or Released: Sweep up granules and dispose of in accordance with local, state, and federal regulations.

Waste Disposal Methods: Reduce potassium permanganate with hypo (10% sodium thiosulfate) solution and deposit in permitted landfill.

Precautions to be Taken in Handling and Storage: Protect containers against physical damage. Store in a cool dry area in closed containers.

Other Precautions and/or Special Hazards: Avoid exposure to water and contaminated air, otherwise the media is rendered useless

NFPA Rating* Health _____ Flammability _____ Reactivity _____ Special _____

HMIS Rating* Health _____ Flammability _____ Reactivity _____ Special _____

* Optional

tetraSOLV FILTRATION

Tetrasolv Filtration Inc
Vapor Phase Adsorption Model

System Conditions	
System Temperature (oF)	90.000
Flow Rate (acfm)	600.000
System Pressure (mmHg)	760.000
System Operation (hrs/day)	24.000

Rev 13

45036.447

Project

Component	Inlet Concentration ppm	Inlet Concentration lb/day	Activated carbon 55 CTC Capacity % (w/w)	Usage lb/day	
ACETALDEHYDE	0.000	0.000	0.000	0.000	
ACETONE	0.230	0.029	0.464	6.196	
ACETIC ACID	0.000	0.000	0.000	0.000	
ACRYLONITRILE	0.000	0.000	0.000	0.000	
ALLYLCHLORIDE	0.000	0.000	0.000	0.000	
ANILINE	0.000	0.000	0.000	0.000	
BENZENE	0.015	0.003	2.900	0.087	
BUTANE-n	0.000	0.000	0.000	0.000	
BUTANOL-n	0.000	0.000	0.000	0.000	
BUTOXY ETHANOL-2	0.000	0.000	0.000	0.000	
BUTYL ACETATE-n	0.000	0.000	0.000	0.000	
BTEX	15.680	5.592	53.444	10.463	*
CARBON TETRACHLORIDE	0.000	0.000	0.000	0.000	
CHLOROBENZENE	0.000	0.000	0.000	0.000	
CHLOROFORM	0.000	0.000	0.000	0.000	
CUMENE	0.009	0.002	16.244	0.014	
CYCLOHEXANE	0.050	0.009	4.621	0.196	*
DICHLOROBENZENE	0.000	0.000	0.000	0.000	
DICHLOROETHANE-1,2	0.000	0.000	0.000	0.000	
DICHLOROETHYLENE-1,1	0.000	0.000	0.000	0.000	
DICHLOROMETHANE	0.000	0.000	0.000	0.000	
DIETHYLENE GLYCOL MONOBUTYL ETHER	0.000	0.000	0.000	0.000	
DIETHYL ANILINE	0.000	0.000	0.000	0.000	
DIMETHYLPENTANE-2,2	0.000	0.000	0.000	0.000	
ETHANOL	57.890	5.735	7.208	79.572	
ETHYL ACETATE	0.000	0.000	0.000	0.000	
ETHYLBENZENE	0.014	0.003	12.491	0.026	
ETHYL CHLORIDE	0.000	0.000	0.000	0.000	
ETHYLENE GLYCOL MONOPROPYL ETHER	0.000	0.000	0.000	0.000	
HEPTANE-n	0.000	0.000	0.000	0.000	
HEXANE-n	0.000	0.000	0.000	0.000	
ISOPRENE	0.000	0.000	0.000	0.000	

ISOPROPANOL	0.000	0.000	0.000	0.000	
ISOPROPYL ACETATE	0.000	0.000	0.000	0.000	
ISOPENTYL ACETATE	7.080	1.982	34.954	5.671	*
METHANOL	0.000	0.000	0.000	0.000	
METHYL-2-PYROLIDONE	0.000	0.000	0.000	0.000	
METHYL ACRYLATE	0.000	0.000	0.000	0.000	
METHYL CHLORIDE	0.000	0.000	0.000	0.000	
METHYL ETHYL KETONE	0.018	0.003	0.883	0.316	
METHYL ISOBUTYL KETONE	0.000	0.000	0.000	0.000	
METHYL METHACRYLATE	0.000	0.000	0.000	0.000	
METHYL TERT BUTYL ETHER	0.000	0.000	0.000	0.000	
METHYLENE CHLORIDE	0.000	0.000	0.000	0.000	
NAPTHALENE	0.000	0.000	0.000	0.000	
PENTANE-n	0.000	0.000	0.000	0.000	
PHENOL	0.000	0.000	0.000	0.000	
PROPANE	0.000	0.000	0.000	0.000	
PROPANOL	0.000	0.000	0.000	0.000	
PROPYLENE GLYCOL-1,2	0.780	0.128	30.427	0.420	*
STYRENE	0.064	0.014	19.034	0.075	
TPH-GRP	0.000	0.000	0.000	0.000	
TETRACHLOROETHYLENE	0.010	0.004	12.778	0.028	
TETRACHLOROETHANE	0.000	0.000	0.000	0.000	
TETRAHYDROFURAN	0.000	0.000	0.000	0.000	
TOLUENE	0.015	0.003	7.222	0.041	
TRI-O-CRESYL PHOSPHATE	0.000	0.000	0.000	0.000	
TRICHLOROETHANE-1,1,1	0.000	0.000	0.000	0.000	
TRICHLOROETHYLENE (TCE)	0.000	0.000	0.000	0.000	
TRICHLOROTRIFLUOROETHANE-1,1,2	0.000	0.000	0.000	0.000	
TRIMETHYLAMINE	0.000	0.000	0.000	0.000	
VINYLCHLORIDE	0.124	0.017	0.042	39.800	
XYLENE	0.043	0.010	16.166	0.061	*
Total Usage	82.022	13.533		142.966	
Average Adsorption Capacity (% w/w)			0.095		

The Adsorption Capacity Is Estimated Using The Polanyi Adsorption Theory And Toluene

Note: estimated based on models, results not guaranteed.

* Compound	Surrogate used
2-Ethylhexyl acrylate	PROPYLENE GLYCOL-1,2
n-Butyl acrylate	ISOPENTYL ACETATE
Methylcyclohexane	CYCLOHEXANE. Added to cyclohexane
Diesel Range Organics (C10)-(C28)	BTEX
o-xylene	included in total xylenes

Note: Surrogate are used for compounds where isotherms were not available for carbon modeling. Surrogates were chosen based on similar chemical characteristics (i.e. chemical structure, MW, etc.).

HYDROSIL
INTERNATIONAL LTD.

Hydrosil HS-600 Product Usage on Vapors

Contaminant	CAS	HAP	Input Concentration	HS-600 Usage
			lb/day	lb/day
2-Ethylhexyl acrylate	103-11-7		0.01	0
Acetone	67-64-1		0.001	0
Ethanol	64-17-5		0.29	0
n-Butyl acrylate	141-32-2		0.10	0
Vinyl chloride	75-01-4	HAP	0.02	1.2
Styrene	100-42-5	HAP	0.001	0
Toluene	108-88-3	HAP	0.0001	0
Benzene	71-43-2	HAP	0.0001	0
o-xylene	95-47-6	HAP	0.0002	0
xylenes, total	1330-20-7	HAP	0.0005	0
2-Butanone (MEK)	78-93-3		0.0002	0.009
Tetrachloroethene	127-18-4	HAP	0.0002	0.008
Ethylbenzene	100-41-4	HAP	0.0002	0
Cyclohexane	110-82-7		0.0001	0
Isopropylbenzene (cumene)	98-82-8	HAP	0.0001	0
Methylcyclohexane	108-87-2		0.0004	0
Diesel Range Organics (C10)-(C28)	n/a		0.29	0

Note: Influent vapor concentrations assume 0% of Vinyl Chloride mass in air stripper effluent is removed by carbon and 95% of remaining VOC mass is removed by carbon.

Total 1.2

Modular Tank Summary Sheet

Harpoon Tanks

- Two (2) tanks will be used to store water collected across the Site during response activities.
- Both tanks are 70-foot diameter by 36-foot tall with an individual maximum capacity of 24,675 barrels (bbls; 1,036,350 gallons) when completely full (i.e., at zero freeboard).
- The tanks are expected to be filled to a maximum usable capacity of 22,619 bbls (950,000 gallons) reserving approximately 3 feet of freeboard.
- Both tanks have been plumbed such that the volume of stored water will equalize between the tanks. At each tank, a valve was installed on the connecting pipe between the tanks. Each valve is kept closed and locked/tagged-out to reduce the potential for a release from both tanks at one time.
- Equalization will be conducted periodically by a valve operator manually opening the valves on each tank. The tanks will be monitored throughout the equalization process by the valve operator and other on-site personnel, staffed 24/7. The valves are shut and locked/tagged-out as soon as equalization is complete.
- Tank levels will be monitored by transducers. A display is mounted on the exterior of each tank.

Secondary Containment

- Both tanks were installed within a single secondary containment consisting of an impermeable liner, steel sheet piles, and earthen berms.
- The impermeable liner consists of a 120 mil Linear Low-Density Polyethylene (LLDPE) liner manufactured by ATARFIL.
- The total volume of available secondary containment is: 27,870 bbls (1,170,500 gallons), which provides for approximately 8 inches of freeboard when containing 113% of the volume of the largest tank 24,675 bbls (1,036,350 gallons).
    - The containment was designed to meet the requirements of 40 CFR Subpart J 265.193(e)(1) whereby the capacity is sufficient to contain precipitation from a 25-year, 24-hour rainfall event, which is 3.96 inches (reference: NOAA Atlas 14, Volume 2, Version 3, East Palestine, Ohio)
    - The containment calculation also accounts for the following:
        - Displacement of one tank
        - Displacement of the pumping equipment
- Stormwater that accumulates within the secondary containment area is collected by two sumps and will be pumped into the tanks.
- The tanks will be visually inspected daily by on-site personnel, staffed 24/7 to monitor for leaks into the secondary containment.
- The truck unloading/loading area will be paved with a 9-inch-thick asphalt pavement section and a 12-inch-tall asphalt curb to provide secondary containment. This area will also be sloped to a catch basin inlet that will be piped to the collection sumps located within the tank secondary containment area. From this point any water will be pumped back into the tanks.

Tank Loading Operations

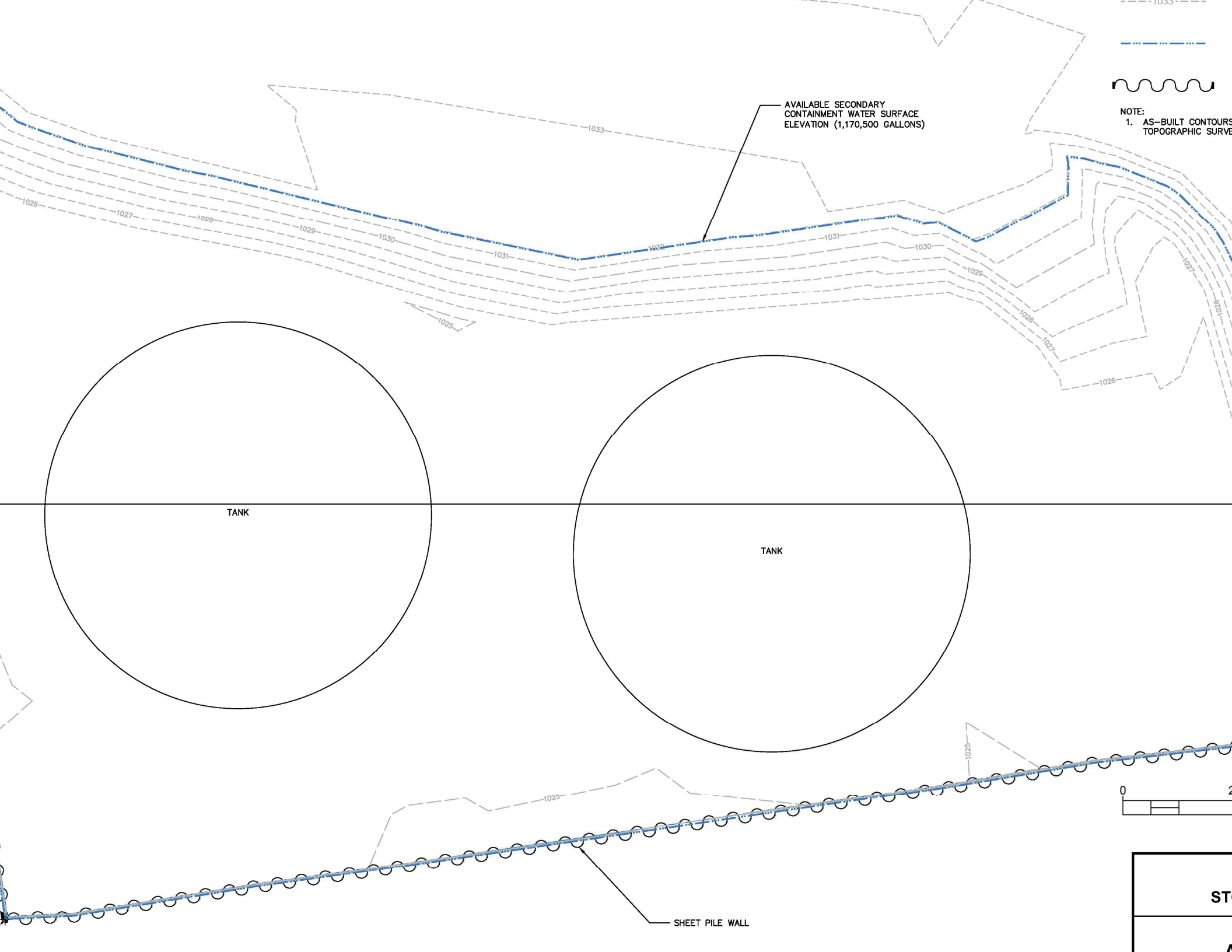
- Industrial vacuum trucks will offload into the tanks using a manifold system that gravity feeds to a pump within the containment area. The pump will convey water up into the tanks. There will be one manifold installed with the ability to scale-up the system to accommodate more loading points if needed.
- Air monitoring will occur during loading operations at all connections in accordance with the procedures and action levels in the HASP by trained CTEH personnel
- Water from the North Ditch will be pumped directly into the tanks.
- Flow meters will be installed on the manifold to monitor input into the tanks. Flow meters will also be installed on the piping from North Ditch pump.

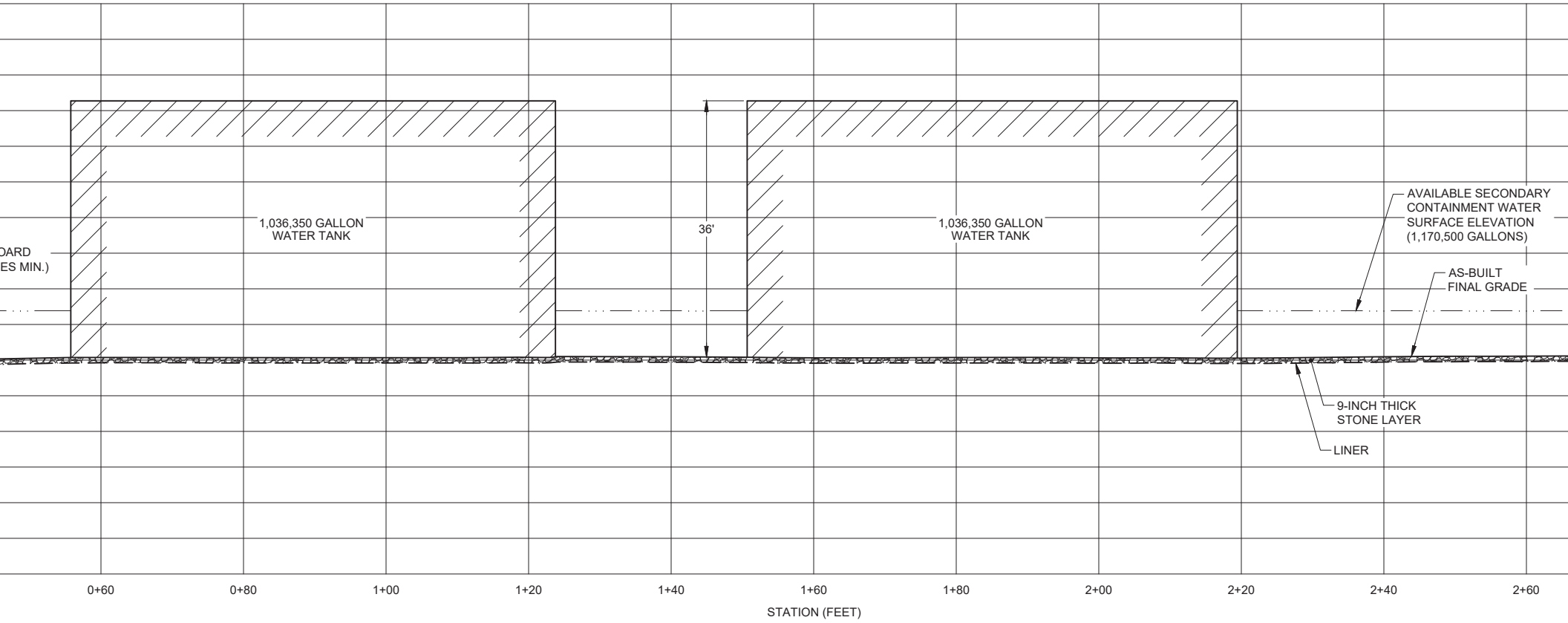
Tank Offloading Operations

- An offload pumping system will be installed to the north of the tanks with the ability to simultaneously load two tanker trucks directly from the tanks.
- Plumbing will be installed to connect a third loading platform for use as a backup offloading area, if needed.
- Flow meters will be installed on the load-out pipes to meter truck filling.
- Air monitoring will occur during offloading operations using the same procedures as loading operations.

Emergency Procedures

- Visual and audible high-level alarms will be installed on each tank. The first level alarm will be set at 3 feet of freeboard in the tank (i.e., maximum usable capacity). The second alarm level will be set to the manufacturer's recommended minimum freeboard of 1.5 feet.
- All tank inflow pumps will be programmed to automatically shut down when the tank level reaches the maximum usable capacity as indicated by the first level alarm.
- In the event of a first alarm or direct spill, the Operations Section Chief, Deputy Operations Section Chiefs, and Wastewater Transfer Group Supervisor will be notified immediately of discovery by on-site personnel. by on-site personnel.
- The Operations Section Chief will notify Unified Command within 30 minutes of notification.
- Refer to Incident Action Plan ICS 204 Wastewater Transfer Group and ICS 205a Communication List for contact information.


AVAILABLE SECONDARY CONTAINMENT WATER SURFACE ELEVATION (1,170,500 GALLONS)
NOTE:
1. AS-BUILT CONTOURS
TOPOGRAPHIC SURVE
TANK
TANK
SHEET PILE WALL
0
1033
1032
1031
1030
1029
1028
1027
1026
1025



HARPOON TANKS CROSS SECTION

(NO VERTICAL EXAGGERATION)

T: (720) 690-6989

DOC #00157

*Harpoon Install Report

H20p-05 & 06 East Palestine OH 2 25k

Sent By	Sent At
Cody Phillips 005	26 March 2023 at 11:21 PM

Submitted By:

Cody

Weather:

Nice/sunny

Report #:

J1

Customer:

Rain For Rent

Field Contact:

Phone #:

(___) ___-____

Supervisor Name:

Cody

Groundwork Supervisor:

Cody

Lease Name:

East Palestine Train Derailment

State/Province:

Oh

Directions to Location:

Tank Size:

25k

Start Time:

Fluid Composition:

NonPot/Vinyl Chloride/fire suppression

Finish Time:

Equipment Type:

Lifting Implements Serial #:

09 & 12

Lifting Implements Visually Inspected?:

(•) Yes ( ) No

Groundwork Details:

Description:

Flat

Pad Grade Within Spec:

(•) Yes ( ) No

Pad Compaction Sufficient:

(•) Yes ( ) No

Photos of Pad:

Equipment Used:

Tank Panels Serial #:

H20p-06

Tank Panels Visually Inspected?:

(•) Yes ( ) No

Tank Panels Properly Installed?:

(•) Yes ( ) No

Comments:

Liner Type:

TPU

Liner Serial #:

HL25k-09

Liner Visually Inspected?:

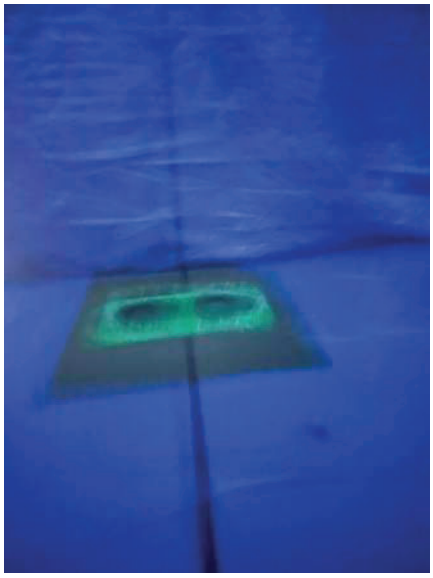
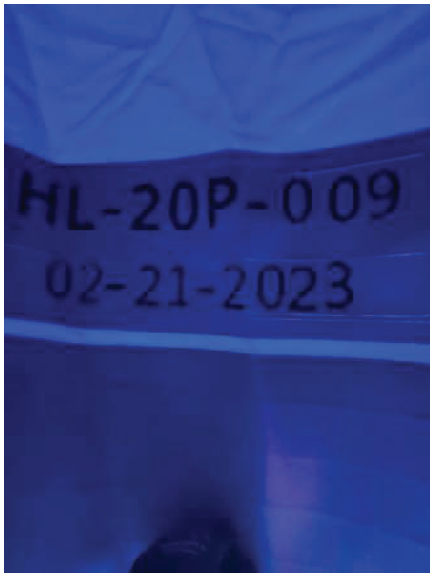
(•) Yes ( ) No

Liner Properly Installed?:

(•) Yes ( ) No

Liner Installed By:

C2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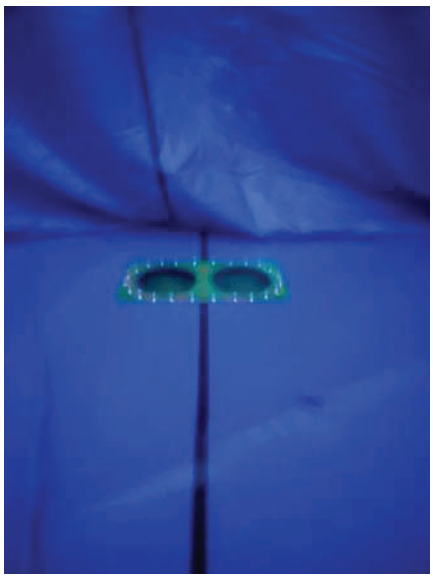
02-21-2023



Comments:

Groundcloth Visually Inspected?:

(•) Yes ( ) No

Groundcloth Properly Installed?:

(•) Yes ( ) No

Manifold Set Serial #:

29

Manifold Set Visually Inspected?:

(•) Yes ( ) No

Manifold Set Properly Installed?:

(•) Yes ( ) No

Additional Items Installed or Left On Location:

Hydrm23

Additional Items Installed Not Listed:

All Liner Connections Double Checked?

Yes

- [x] Fill Manifold Connection
- [x] Suction Manifold Connection
- [x] Inner Manway Connection

☑ Outer Manway Connection

Third Party Vendors:

○ Yes ◉ No

General Project Comments:

Tank install complete

Signed on Corfix

X Cody Phillips

Cody Phillips 005
(cody@hydrera.com)

Signed 11:21:52 PM Sun Mar 26 2023
From IP 76.76.73.224, 172.31.20.230

FIELD COMPACTION TEST DATA
R. D. ZANDE ASSOCIATES, INC.

Project: NS East Palestine Derailment
Project Number: 172607922

Density/Moisture Gauge Information

Tested By: Matthew Macielewicz Date: 03/16/2023
Checked By:_____Date:_____
Material Tested [1]: ODOT #304 Limestone

Standard Density Count: 1716 % Change: 0
Standard Moisture Count: 635 % Change: 0

TEST NUMBER	1	2	3	4
LOCATION	Eastern tank pad, Northern half	Eastern tank pad, Southern half	Western tank pad, Northern half	Western tank pad, Southern half
LIFT NUMBER	1	1	1	1
NUMBER OF PASSES	5	5	5	5
LIFT THICKNESS (INCHES)	12	12	12	12
GAUGE READINGS				
PROBE DEPTH [2] (IN)	6	6	6	6
WET DENSITY (PCF)	140.6	136.4	143.3	141.2
DRY DENSITY (PCF)	136.4	132.4	139.3	136.7
MOISTURE (PCF)	4.2	4	4	4.6
MOISTURE (%)	3.1	3	2.9	3.3
LABORATORY DATA				
PROCTOR CURVE NUMBER				
MAX. DRY DENSITY (PCF)	138.6	138.6	138.6	138.6
OPTIMUM MOISTURE (%)	8	8	8	8
RESULTS				
% COMPACTION	98.41	95.53	100.51	98.63
PASS/NONCOMPLIANCE [3]	PASS	PASS	PASS	PASS
RETESTED NUMBER/DATE				

Remarks: ODOT #304 Limestone was compacted with a vibratory smooth drum roller

[1] Material Types
Structural Fill
Subbase
Recompacted Soil Liner/Barrier
Drainage Layer
Test Pad (Recompacted Soil)

[2] Probe Depth
Depths choices are in two inch increments
(2 through 12) and backscatter (BS)

[3] Pass/Noncompliance Key
P: Passed - test results comply with specs
NC1: Noncompliance - Low Density
NC2: Noncompliance - Low Moisture
NC3: Noncompliance - High Moisture

Project: NS East Palestine Derailment
Project Number: 172607922

Density/Moisture Gauge Information
Model No.:_____
Serial No.:_____

Tested By: Matthew Macielewicz Date: 03/16/2023
Checked By:_____Date:_____
Material Tested [1]: ODOT #304 Limestone

Standard Density Count: 1716 % Change: 0
Standard Moisture Count: 635 % Change: 0

TEST NUMBER	5	6	7	8
LOCATION	Eastern tank pad, Southern half	Eastern tank pad, Northern half	Western tank pad, Northern half	Western tank pad, Southern half
LIFT NUMBER	2	2	2	2
NUMBER OF PASSES	4	4	4	4
LIFT THICKNESS (INCHES)	12	12	12	12
GAUGE READINGS				
PROBE DEPTH [2] (IN)	6	6	6	6
WET DENSITY (PCF)	137	139.5	140.6	140.8
DRY DENSITY (PCF)	133.7	135.3	136	135.4
MOISTURE (PCF)	3.3	4.2	4.6	5.4
MOISTURE (%)	2.4	3.1	3.3	4
LABORATORY DATA				
PROCTOR CURVE NUMBER				
MAX. DRY DENSITY (PCF)	138.6	138.6	138.6	138.6
OPTIMUM MOISTURE (%)	8	8	8	8
RESULTS				
% COMPACTION	96.46	97.62	98.12	97.69
PASS/NONCOMPLIANCE [3]	PASS	PASS	PASS	PASS
RETESTED NUMBER/DATE				

Remarks: ODOT #304 Limestone was compacted with a vibratory smooth drum roller

[1] Material Types
Structural Fill
Subbase
Recompacted Soil Liner/Barrier
Drainage Layer
Test Pad (Recompacted Soil)

[2] Probe Depth
Depths choices are in two inch increments
(2 through 12) and backscatter (BS)

[3] Pass/Noncompliance Key
P: Passed - test results comply with specs
NC1: Noncompliance - Low Density
NC2: Noncompliance - Low Moisture
NC3: Noncompliance - High Moisture

T: (720) 690-6989

DOC #00156

*Harpoon Install Report

H20p-05 & 06 East Palestine OH 2 25k

Sent By	Sent At
Cody Phillips 005	26 March 2023 at 11:11 PM

Submitted By:

Cody

Weather:

Rain/snow

Report #:

J1

Customer:

Rain For Rent

Field Contact:

Phone #:

(___) ___-____

Supervisor Name:

Cody

Groundwork Supervisor:

Cody

Lease Name:

NS East Palestine Train Derailment

State/Province:

Oh

Directions to Location:

East Palestine OH

Tank Size:

25k

Start Time:

Fluid Composition:

NonPot water/vinyl chloride/fire suppression

Finish Time:

Equipment Type:

Lifting Implements Serial #:

09&12

Lifting Implements Visually Inspected?:

(•) Yes ( ) No

Groundwork Details:

Description:

Flat

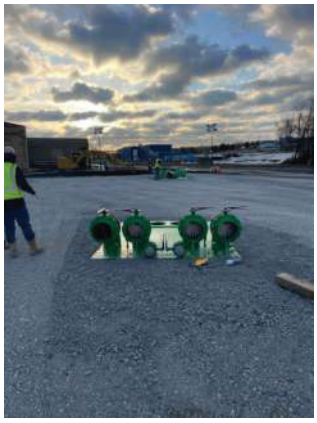
Pad Grade Within Spec:

(•) Yes ( ) No

Pad Compaction Sufficient:

(•) Yes ( ) No

Photos of Pad:



Equipment Used:

Tank Panels Serial #:

H20p-05

Tank Panels Visually Inspected?:

(●) Yes ( ) No

Tank Panels Properly Installed?:

(●) Yes ( ) No

Comments:

Liner Type:

TPU

Liner Serial #:

HL25k-008

Liner Visually Inspected?:

(•) Yes ( ) No

Liner Properly Installed?:

(•) Yes ( ) No

Liner Installed By:

C2

Comments:

Groundcloth Visually Inspected?:

(•) Yes ( ) No

Groundcloth Properly Installed?:

(•) Yes ( ) No

Manifold Set Serial #:

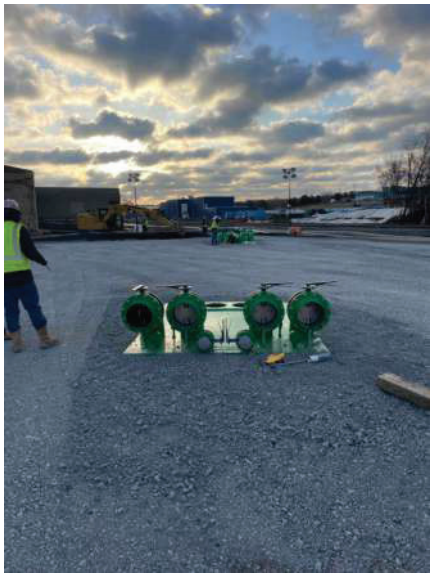
28

Manifold Set Visually Inspected?:

(•) Yes ( ) No

Manifold Set Properly Installed?:

(●) Yes ( ) No



Additional Items Installed or Left On Location:

Hydrm24

Additional Items Installed Not Listed:

All Liner Connections Double Checked?

Yes

[x] Fill Manifold Connection

- [x] Suction Manifold Connection
- [x] Inner Manway Connection
- [x] Outer Manway Connection

Third Party Vendors:

○ Yes ◉ No

General Project Comments:

Tank completed, sone plates were randomly hard to get on

Signed on Corfix

X Cody Phillips

Cody Phillips 005

(cody@hydrera.com)

Signed 11:11:46 PM Sun Mar 26 2023

From IP 76.76.73.224, 172.31.1.95

5101 Office Park Drive, Suite 100
Bakersfield, CA 93309

Mr. Bryan Martin
VP - Midwest
Hepaco
2647. Hamilton Ln
Hamilton, OH

Rain for Rent has verified with Cody Phillips, owner of C2 Services LLC, and Partner and Field Supervisor for Hydrera Water, he has certified that H20P-05 & H20P-06, located at the East Palestine OH derailment pad site, have been set up in accordance to Hydrera Harpoon Installation SOP, both tanks we set on a 95% compacted and leveled pad per spec. Tanks 05 & 06 were setup consecutively on March 19th & 20th. Both tanks had 1' of fresh water put in to seat liner. Tanks have been inspected since install on 3/29 via aerial manlift after secondary containment was completed. Tanks are in appropriate working order ready for operational use.

We are submitting for your review the install reports from C2 Services based on the set up and conditions of the 2 – 25k Harpoon Tanks that are onsite were installed correctly per manufacturers SOP.

Sincerely,

Steve Bayda
Midwest Regional Vice President
Rain for Rent

Cc: Rich Speidel Midwest Regional Sales Manager

Appendix C

Alarm Schedule and Troubleshooting Guidance

Appendix C.1
Wastewater Treatment System Alarm Schedule

Equipment	Alarm Device	Probable Cause
Storage Tank	Level Switch High High (LSHH-100)	VFD/level transducer malfunction Backpressure on Pump P-100 or pump fault Inline static mixer fouling Switch fault Wiring issue
Flocculation Tank	Level Switch High High (LSHH-100)	VFD/level transducer malfunction Backpressure on Pump P-100 or pump fault Inline static mixer fouling Switch fault Wiring issue
Clarifier	Level Switch High High (LSHH-200)	Backpressure on transfer pump Pump fault (P-800) Sand filter fouling Switch fault Wiring issue
Oil Water Separator	Level Switch High High (LSHH-200)	VFD/level transducer malfunction Backpressure on Pump P-200 or pump fault Bag filter fouling Organo clay fouling Switch fault Wiring issue
Air Stripper Sump	Level Switch High High (LSHH-300) OR Level Switch Low (LSL-300)	VFD/level transducer malfunction Pump P-300 loss of prime or fault Bag filter fouling Switch fault Wiring issue
Knockout Tank	Level Switch High High (LSHH-400)	Backpressure on transfer pump Pump fault (P-400) Switch fault Wiring issue
Air Stripper Blower	Temperature Switch High High (TSHH-403)	VFD malfunction Blower fault Switch fault Wiring issue
Storage Tank Field	Level Switch High High (LSHH-306)	Receiving tank full VFD/level transducer malfunction Switch fault Wiring issue
Building Sump	Level Switch High High (LSHH-307)	Water leak from system equipment/piping Roof leak Condensation Switch fault Wiring issue
LGAC/organo clay vessel containment	Level Switch High High (LSHH-308)	Water leak from treatment vessel Precipitation accumulated in containment Switch fault Wiring
E-STOP		Manual stop Wiring

Note:

Once reviewed for probable cause, refer to Appendix C.2 for additional troubleshooting

Appendix C.2
Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
Electrical Motor		
Motor will not start and there is no noise.	Motor may not be receiving the proper power.	Check fuses and power distribution between power lines to motor. See Note 1.
	Overload is tripped.	Reset Overload. See Note 1.
	Main power may be off.	Check main power. See Note 1.
	Contactor may not be closing because motor is in manual position.	Switch motor to back to Auto position.
	Contactor may not be closing because PLC is not telling output to be on.	Check PLC operating sequence to determine if a start requirement is not met.
Motor does not start but makes a humming noise.	One of the phases of power is not getting to the motor as a result of a blown fuse.	Change fuse.
	One of the phases of power is not getting to the motor as a result of a poor wire connection.	Check wiring for a loose wire or a poor connection.
	The driven component, i.e., pump, will not spin and could be seized up.	Disassemble driven component, check clearances and clean internal components, and replace any damaged components.
	Bearing on drive shaft of motor or driven component may be seized up.	Replace bearings.
Overloads trip immediately after startup.	Check for short circuit in motor windings.	Re-wind motor. See Note 1.
	One of the phases of power is not getting to the motor as a result of a blown fuse.	Change fuse. See Note 1.
	Motor power wires may be shorting out to ground.	Search for wiring short and replace wiring if required.
	Motor may have too much load or backpressure as a result of operating the driven component outside of its operating capabilities.	Check operating capabilities of driven component. Ensure positive displacement pump is not over pressured or that centrifugal pump is not operating at too high a flow rate.
Motor amps are above the allowable value on the nameplate.	Motor may be designed to operate on the upper limit.	Calculate maximum allowable amps. Name plate amps x safety factor.

Appendix C.2
Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
	Driven component may have scale built up inside.	Clean internal components of driven component.
	Driven component may be rotating in the wrong direction.	Check direction of rotation and switch rotation of motor if it is incorrect.
	Check voltage of power. Low voltage results in high amps.	Adjust overloads for higher amps if the difference is only slight or change power or motor. See Note 1.
Centrifugal Pumps		
Pump does not produce sufficient pressure/vacuum.	Pump is not primed.	Prime pump.
	Wrong direction of rotation.	Check and change rotation if required.
	Vacuum or pressure gauge is faulty.	Replace gauge.
	Pump is not operating at required RPM.	Check and replace motor if required.
	Pump has wrong sized impeller.	Check impeller and replace if required.
	Pump pressure or vacuum is lost due to obstruction located between pump and gauge.	Check for flow restrictions and clean strainers or piping if required.
	Coupling between pump and motor is no longer connected, preventing the pump from rotating with the motor.	Reconnect and realign motor and pump.
Pump is leaking.	Gaskets are worn or faulty.	Replace gaskets.
	Mechanical seal has been overheated. Often a result of operating the pump without any water.	Replace mechanical seal.
	Fittings are leaking on or around pump.	Tighten fittings.
	Water may be coming from another location.	Check for leaks around pump.
Pumps flow rate is too low.	Backpressure is too high for pump.	Reduce backpressure.
	Pump may not be sized correctly for process.	Replace pump.
	Pump impeller is too small.	Change pump impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter.	Replace filter and clean line.

Appendix C.2
Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
Pump is making excessive noise during operation.	Manually rotate pump impeller and listen for clearance problems.	Disassemble pump and fix clearance problems.
	Alignment of pump may be off, causing the flexible coupling to degrade.	Check alignment and reset alignment if it is a problem. Replace flexible coupling if it is degraded.
Sand Filters		
Backwash frequency increases.	Change in water quality.	Discuss with Engineering team.
	Increase in flow above design parameters.	Discuss with Engineering team.
	Low medial level.	Change out media.
	Backwash restrictor valve is shut.	Open valve.
	Change in pressure.	Inspect sand filters to determine change in pressure.
	Backwash flush duration is too short.	Discuss with Engineering team to increase backwash flush duration.
	Media is becoming hardened or crusted.	Change out media.
	Inlet pressure is too low.	Adjust valving to increase inlet pressure.
High pressure differential.	Change in water quality.	Discuss with Engineering team.
	Low media level.	Change out media.
	Backwash restrictor valve is shut.	Open valve.
	Increase in flow.	Discuss with Engineering team to dial back flow.
	Inlet pressure is too low.	Adjust valving to increase inlet pressure.
	Insufficient backwash frequency and/or duration.	Discuss with Engineering team to adjust backwash frequency/duration.
	Wrong media in filter.	Change out media.
	Underdrain screens are blocked.	Inspect and if needed clean underdrain screens.
Media not fluidizing during backwash or crusted.	Insufficient backwash frequency and/or duration.	Discuss with Engineering team to adjust backwash frequency/duration.
	Reduced pressure.	Inspect system for potential pressure losses.

Appendix C.2
Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
	Flocculating or coagulating agents preventing thorough media cleaning during backwash.	Inspect chemical dosing pump and inline static mixers. Discuss any changes to chemical dosing with Engineering team.
	Backwash restrictor valve is shut.	Open valve.
Leakage out backwash line.	Bad valve seat or seal.	Inspect valve. Replace or fix valve.
	Valve not completely sealed.	Completely seal the valve.
	Bent backwash shaft.	Replace shaft.
	Loose backwash shaft nut.	Tighten nut.
Leakage out actuator.	Ruptured diaphragm.	Replace diaphragm.
	Compression plate loose.	Tighten or replace compression plate.
Filter not backwashing when others are.	Solenoid valve defective.	Replace solenoid valve.
	Hydraulic poly tubing loose or disconnected.	Replace or reconnect poly tubing.
	Malfunction of backwash valve.	Disassemble and inspect valve.
	Wiring on control panel loosened.	Discuss with Engineering team. Get an electrician to inspect control panel.
	Defective control panel.	Discuss with Engineering team. Get an electrician to inspect control panel.
	Solenoid valve improperly attached.	Attach solenoid valve properly.
Lamps not lighting during test of auto backwash.	Wiring in panel is loose or disconnected.	Discuss with Engineering team. Get an electrician to inspect control panel.
	Incorrect voltage input.	
	Defective control panel – replace.	
Filter will not stop backwashing.	Solenoid valve manual override button is set on “O” instead of “C”.	Set to “C”.
	Malfunction of backwash valve.	Disassemble and inspect.
	Malfunction of control panel.	Discuss with Engineering team. Get an electrician to inspect control panel.

Appendix C.2
Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
Oil Water Separator		
Water is in the oil outlet.	Skimmer opening is below the oil/water interface.	Adjust skimmer alignment to allow more oil to collect before skimming.
Oil is making its way to the outlet.	Water flow rate is too high.	Reduce flow rate through system.
	Filter media is plugged.	Replace or clean media.
	Oil discharge is plugged, backing up OWS.	Drain oil manually through opening at top of unit. See Note 2.
Vapor Phase Separator		
Water will not pump out of phase separator.	Base of separator may be plugged with sand.	Flush sand and debris out of separator.
	Pump is not functioning.	See pump troubleshooting section.
Level Switches		
Level switch is staying closed when water in tank drops below switch.	Level switch is upside down or on its side.	Check orientation of level switch. Level switch may be designed as normally closed and therefore will be upside down.
	Sight glass is plugged, giving a false level in the tank.	Clean sight glass.
	Level switch has dirt or film causing it to stick up.	Remove level switch, clean and test for normal operation using a millimeter.
	Level switch may be damaged or faulty and failed closed regardless of the switch position.	Replace switch.
	Wiring to level switch may be shorting out to ground, causing the switch to appear closed at all times.	Disconnect switch from system wiring and separate system wires so they are not in contact with each other or any metal. If the input is still on, then the input wiring is being grounded somewhere. Find short and replace or fix wiring.
	IS barrier is shorted out internally.	Switch IS barrier with working barrier and if problem goes away, then the barrier may be faulty and should be changed.
	Input wiring is loose in terminal strip.	Tighten terminal strip where field wiring is brought into panel.
	Level switch is wired incorrectly.	Consult input wiring diagram and inspect wiring of level switch. Change if required.

Appendix C.2
Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
Level switch stays open when water in tank is above the switch.	Level switch is upside down or on its side.	Check orientation of level switch. Level switch may be designed as normally closed and therefore will be upside down.
	Sight glass is plugged, giving a false level in the tank.	Clean sight glass.
	Level switch has dirt or film causing it to stick down.	Remove level switch, clean and test for normal operation using a millimeter.
	Level switch may be damaged or faulty and failed open regardless of the switch position.	Replace switch.
	IS barrier is blown, preventing the level switch signal from crossing the barrier.	Switch IS barrier with working barrier and if problem goes away, then the barrier may be blown. If barrier is blown, then the input wire on the right side of the barrier will have 24 V DC and the wire on the opposite side will have 0 V DC.
	Level switch is wired incorrectly.	Consult input wiring diagram and inspect wiring of level switch. Change if required.
Blowers		
Blower does not produce sufficient pressure/vacuum.	Blower is not turned on.	Turn on blower.
	Wrong direction of rotation.	Check and change rotation if required.
	Vacuum or pressure gauge is faulty.	Replace gauge.
	Blower is not operating at required RPM.	Check and replace motor if required.
	Pressure or vacuum is lost due to obstruction located between blower and gauge.	Check for flow restrictions and clean strainers or piping if required.
Blower is leaking.	Fittings are leaking on or around blower.	Tighten fittings.
Blower flow rate is too low.	Backpressure is too high for blower.	Reduce backpressure.
	Blower may not be sized correctly for process.	Replace blower.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter.	Replace filter and clean line.

Appendix C.2
Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
Air Stripper		
Stripper water leaks.	Gaskets are leaking.	Apply silicon grease to gaskets and close up stripper. If they cannot be fixed, the gaskets may need to be replaced.
Pressure or vacuum is building up in stripper.	Stripper is being fouled by mineral precipitates.	Clean stripper with pressure washer or scraper. See Note 2 if occurs regularly.
	Air flow rate through stripper has risen or is above the design value.	Decrease air flow rate.
Stripper is not cleaning contaminants sufficiently.	Inlet concentrations are higher than the design values.	Decrease water flow rate to obtain required stripping capacity.
	Flow rate of water through stripper is too high.	Decrease flow rate, allowing longer residence time in stripper.
	Air flow rate is not high enough.	Increase air flow rate or decrease water flow rate.
	Some products that are not easily strippable may be in higher concentrations than originally planned.	Consult manufacturer with test results of discharge contaminants.
	Stripper may have been shut down manually causing the contaminated water in the trays to fall into the sump without being cleaned.	Allow stripper to go through proper shutdown cycle when stopping the unit.
	Stripper may be set up wrong, allowing the water to bypass trays.	Check orientation of trays to ensure water will flow through each tray properly.
	Some contaminants may be present that are affecting the ability to strip other contaminants.	Consult manufacturer with test results of intake and discharge contaminants.
	Increase in pressure causes a decrease in air flow that will result in a decrease of contaminant concentrations.	See pressure rise in stripper troubleshooting above.
Water is collecting in discharge piping of stripper.	Air leaving the stripper is very humid and condense some water in the lines.	Install a knockout drum in discharge line before air is piped to another section of the process.
	The stripper can cause foaming of the water that will result in water collecting in the discharge lines.	Test for foaming contaminants such as soaps and install antifoaming dosing system to prevent foaming.

Appendix C.2
Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
	Air flow rate is higher than the design value, causing water to be carried over into the discharge lines.	Decrease flow rate to within design range.
Stripper often shuts down on a high stripper sump alarm.	Influent pump is operating at a higher flow rate than the effluent pump.	Slow transfer pump, speed up discharge pump or adjust level set points of VFD for pumps as required. See Note 2.
	Discharge pump is not working properly.	Troubleshoot discharge pump and VFD.
Pressure Switch/Vacuum Switch		
Switch is not reacting at desired set point.	Switch is out of adjustment.	Change set point to desired value.
Switch is not working.	Switch may be faulty.	Remove input wires and test switch at desired pressure. If it does not trigger, then it should be replaced.
Flow Meter		
Flow meter is not rotating, or probes are not reading.	Dirt could have caused meter internals to jam up or covered electrodes.	Disassemble flow meter and clean internal components.
Flow meter is rotating but pulse input is not working.	Switch on meter may be faulty.	Remove wiring and test contacts on meter to ensure that they are opening and closing. If not, then meter head needs to be replaced. See Note 1 and Note 2.
	Input wiring may be grounding out preventing the signal from opening and closing.	Test input wiring by isolating input wires and checking if input is on. If so, then you have a grounded input wire. See Note 1 and Note 2.
	Input to PLC is not working.	Simulate rotating meter by contacting input wires together and check for a detected flow rate and change in totalized flow. See Note 2.
Direct/Belt Driven Assemblies		
Oil leaks.	Check orientation of blower and that motor is level.	Adjust orientation if required.

Appendix C.2
Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
Carbon Vessel (both phases)		
Vessel is operating over pressure.	Build up may have collected in water phase vessel.	Remove lid and check for buildup. Remove top layer or replace vessel. Backwash vessel.
Vessel is breaking through earlier than expected.	Flow rate through vessel may be too high. Check design specifications.	Decrease flow rate.
	Air contaminant concentrations are higher than expected.	Test inlet concentrations.
	Check piping orientation to ensure that water is going in the top of water phase vessels and air is going in the bottom of air phase vessels.	Re-plumb vessel if piping is wrong.
	Ensure that there is not a large, trapped air gap in the top of the water phase carbon vessel allowing the water to bypass a portion of the carbon.	Release air gap if present.
Bag Filter		
Vessel is operating over pressure.	Bag filter may be fouled.	Remove cover and check for sediment or other buildup in the bag. Replace filter element if required.
	Equipment downstream of bag filter may be plugging.	Check for pressure buildup downstream of filter and fix pressure buildup downstream if found.
Water will not flow through filter fast enough.	Pump may not be able to supply enough pressure.	Check pressure output of pump with pump curve. Replace pump if required.
Filters are plugging too fast.	Filter element micron size may be too low.	Install larger micron filter element.
	Filter pressure switch setpoint may be too low.	Increase high pressure shutdown setpoint.
Telemetry PLC/Radio		
Power is on, Lights are on, but PLC is not sending alarms or summaries.	PLC may not be in run mode. If the power has been off to the panel for an extended period, then the PLC will switch out of run mode and stop running the logic.	Use external switch on PLC to switch from “term” to “run” then back to “term”. This will force the PLC back into run mode. The run light should now indicate that the PLC is in run mode. See Note 1.

Appendix C.2
Troubleshooting Chart

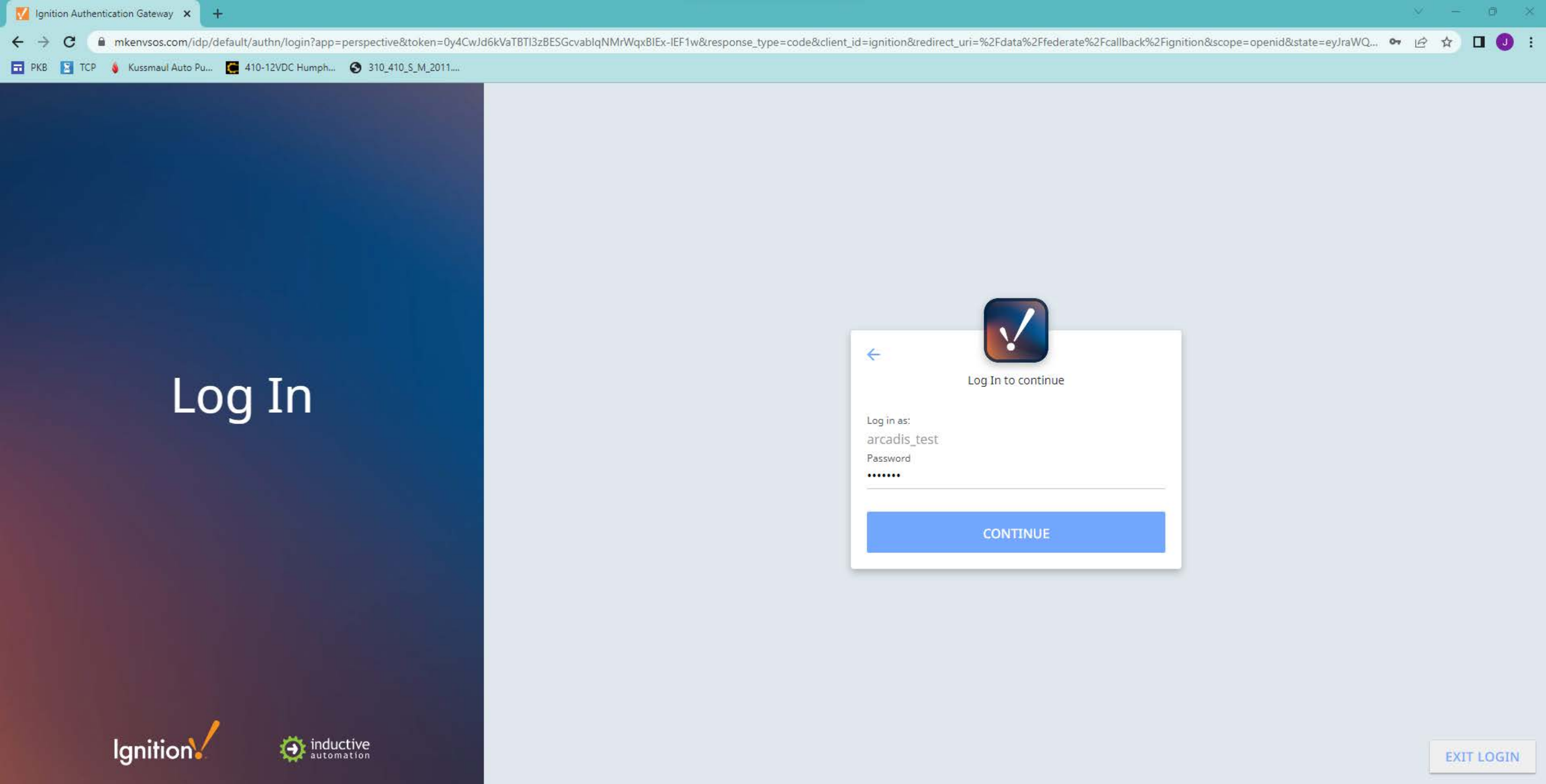
Symptom	Potential Cause	Possible Solution
Power is on but wireless radio is not on.	Fuse for wireless radio is pulled out or blown.	Test wireless radio fuse and replace if necessary. See Note 1.
	Antenna has been damaged or disconnected.	Inspect antenna cable and antenna for damage.
Power is on to panel, but PLC lights are not on.	Fuse for PLC is pulled out or blown.	Test PLC fuse and replace fuse if necessary. See Note 1.

Notes:

1) Any electrical work that cannot be completed using lock out tag out and be completely de-energized will be completed by qualified individuals possessing NFPA70E training or a licensed electrician.
2) Contact engineer for additional assistance.

Appendix D

Telemetry Login and Interface Example


Ignition Authentication Gateway
mkenvsos.com/idp/default/authn/login?app=perspective&token=0y4CwJd6kVaTBTI3zBESGcvablqNMrWqxBIEx-IEF1w&response_type=code&client_id=ignition&redirect_uri=%2Fdata%2Ffederate%2Fcallback%2Fignition&scope=openid&state=eyJraWQ...
PKB
TCP
Kussmaul Auto Pu...
410-12VDC Humph...
310_410_S_M_2011....
Log In
Log In to continue
Log in as:
arcadis_test
Password
CONTINUE
Ignition
inductive automation
EXIT LOGIN

MKENVSOS

mkenvsos.com/data/perspective/client/MKENVSOS/systems

PKB TCP Kussmaul Auto Pu... 410-12VDC Humph... 310_410_S_M_2011....

MK Environmental

Home Systems Diagnostics Administration

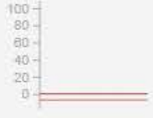
Theme Light

SYSTEM OVERVIEW

ARCADIS

EAST PALESTINE

Active Alarms	0
Unack Alarms	28
Last Seen	9.81 day ago
SYS Hrs	30.7 hrs



	4-28-2023 8:38:33	24 hr	7 day
Discharge Flow (gal)	0	0	0
Air Flow (CFM)	0	0	0
Feed Tank Lvl (PSI)	-7.2	-7.2	-7.2

PALESTINE, OH Alarms E-Mail Details

MK Environmental

Home Systems Diagnostics Administration

Theme Light

ARCADIS

EAST PALESTINE

Active Alarms 0

Unack Alarms 28

Last Seen 9.81 day ago

Back

Export

SYS Hrs 30.7 hrs

		24 hr	7 day
Discharge Flow (gal)	0	0	0
Air Flow (CFM)	0	0	0
Feed Tank Lvl (PSI)	-7.2	-7.2	-7.2

AIR FLOW	0		FEED TANK LEVEL	-7.2				
INLET FLOWMETER	OK	16695 Counts	SYSTEM ON/OFF	OK	75 Counts	LOW PSI	OK	85 Counts
KO LSHH	OK	32 Counts	STRIPPER LSHH	OK	64 Counts	OWS LSHH	OK	47 Counts
PHASE MONITOR	OK	23 Counts	BLDG LSHH	OK	46 Counts	BLOWER TSHH	OK	33 Counts
DISCHARGE FLOWMETER	OK	2252 Counts	FRAC TANK LSHH	OK	7 Counts			

REMOTE RESTART GW TREATMENT Off REMOTE RESTART GW TREATMENT

REMOTE STOP Off REMOTE STOP

MK Environmental

ARCADIS

EAST PALESTINE

Active Alarms	0
Unack Alarms	28
Last Seen	9.81 day ago

Back

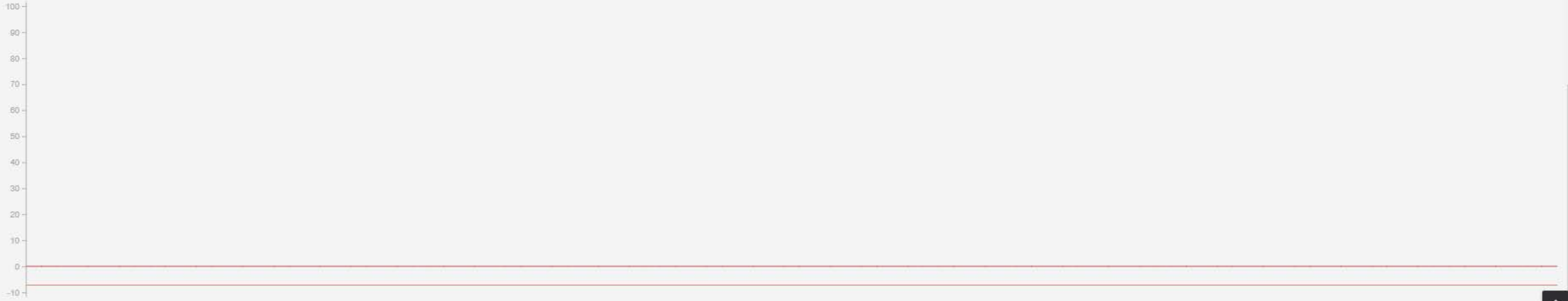
Export

SYS Hrs **30.7 hrs**

		24 hr	7 day
Discharge Flow (gal)	0	0	0
Air Flow (CFM)	0	0	0
Feed Tank Lvl (PSI)	-7.2	-7.2	-7.2

REMOTE RESTART GW TREATMENT Off GW TREATMENT

REMOTE STOP Off REMOTE STOP



Appendix E

Water Treatment System Air Permitting

To Be Provided
When Complete

Appendix F

System Startup Check List

Appendix F – System Startup Checklist

Wet testing shall be completed at the system's first startup and will be completed using potable water and recirculating at minimum three volumes through the system. Potable water will be pulled from a temporary storage tank and discharged to another temporary tank, both of which will be staged adjacent to the system. Temporary piping/hose will need to be installed between the potable water storage tank and system influent transfer pump P-100 and from the system effluent discharge line to the effluent discharge storage tank for the initial system wet testing.

Startup Preparation

_ Add proper safety and other signage/labeling to system doors, equipment, and panels.
_ Add content labels and flow direction arrows to system piping.
_ Fill carbon vessels with water, within one inch of top.

Initial Wet Startup Procedure with Potable Water

_ Check and tighten all control panel wiring connections.
_ Make sure all piping and equipment are clear of obstructions and confirm all valves are in the correct position.
    - Confirm that the Chemical Dosing Pump (P-500) is closed off to the system.
_ Connect system to clean water influent for initial testing.
_ Remove protective covering from air inlet, exhaust coverings, and pump/blower air exhaust.
_ Connect all air conveyance piping and confirm all valves are in correct positions.
_ Confirm all system motors are in OFF position.
_ Turn on generator and main disconnect on control panel.
_ Turn on and check operation of building interior lights.
_ Turn on and check operation of building heater.
_ Energize and check operation of GFCI receptacles.
_ Vent all vent louvers in system building.
_ Verify all piping, valves, filters, gauges, sensors, transmitters, etc. are present and installed as shown on P&ID drawing. Mark any updates on drawing and send to project engineer to update P&ID drawing.
_ Check oil level in blower and refill if necessary.
_ Push the reset button to clear any active alarms.
_ Start up blower VFD.
_ Confirm all applicable valves are open or closed as required.
_ Test system failsafe devices/alarms/interlocks and ensure all are functioning properly prior to testing, and that set points are correct. Adjust set points if needed.
_ Trigger E-STOP to test.
_ Test vacuum relief valve on air stripper blower and confirm set point is correct or adjust if needed.
_ Put P100 hand/auto/off switch to auto to fill the flocculation tank and clarifier.
_ When water is flowing over the weir into the clarifier effluent chamber, shut down P100 and verify that no leaks are present from the flocculation tank, clarifier, or interconnecting piping.
_ Put P600 hand/auto/off switch to auto to pump water to the centrifuge.

_ Start the centrifuge using the switch on the centrifuge control panel.
_ Allow water to flow through the centrifuge and drain back to the clarifier. Check centrifuge and associated piping for leaks.
_ Shut down P600 by setting the hand/auto/off switch to off.
_ Restart P100.
_ Put hand/auto/off switches to auto, beginning with P800, then P200, P300, and P400.
    - Wait for water to cover pump influent pipe before activating that pump.
    - Bleed air from sand and bag filter housings as needed.
_ Monitor level in the clarifier effluent chamber and adjust the speed of P100 as necessary to maintain a stable level.
_ Troubleshoot any alarms according to the operation manuals.
    - Level switches that are not accessible for actuation by hand can be tested by shutting the nearby valve and filling the sight tube with potable water to activate the alarm.
    - Level switches that are accessible (secondary containment sumps) can be actuated by hand.
_ Check system piping, equipment, and fittings for leaks and fix if observed.
_ Spot check readings on all flow indicators and pressure indicators.
    - Air flow to be confirmed using heated anemometer.
    - Pressure to be confirmed using nearby pressure gauges.
_ Run for 3 cycles at 50 gpm.
    - One cycle is ~6,170 gallons at 50 gpm.
    - 3 cycles at 100 gpm.
_ Take readings on all pressure gauges, temperature gauges, and flow indicators every hour and record on O&M field sheet.
_ Ensure system is running appropriately and increase VFD setting to 100 gpm.
    - Run for minimum of 1 hour.
_ Check differential pressure across air stripper sump and record in OM&M Plan to use a baseline for evaluating when air stripper cleaning is required.
_ Record initial air flow rate through the air stripper. Adjust air flow to design flow rate by throttling valve on air stripper blower if necessary. Record initial operating flow rate to use as baseline for evaluating when air stripper cleaning is required.
_ Record initial differential pressure across sand filter skid.
_ Check differential pressure across bag filters and record as baseline for determining when filter changeouts are needed.
_ Check differential pressure across in-line filter on air stripper blower and record as baseline to determining when filter replacement is necessary. Record initial pressures across LGAC vessels.
_ Record initial pressures across organoclay vessels.
_ Record initial pressures across VGAC vessels.
_ Record initial pressures across HS-600 vessels.
_ While system is running, confirm telemetry module is sending out proper notifications.
_ System to be blanked off from discharge upon completion. Shut down and lock out power to system, close valves, and reinstall protective coverings on air inlets, exhaust ports, and other openings. System to be reconnected once final discharge plan for treated water approved and in place. System components can be left filled with water after initial wet testing.

Initial Startup with Wastewater

_ Make sure all piping and equipment are clear of obstructions and confirm all valves are in the correct position.
_ Connect system to clean water influent for initial testing.
_ Remove protective covering from air inlet, exhaust coverings, and pump/blower air exhaust.
_ Connect all air conveyance piping and confirm all valves are in correct positions.
_ Confirm all system motors are in OFF position.
_ Turn on generator and main disconnect on control panel.
_ Start up blower VFD.
_ Confirm all applicable valves are open or closed as required.
_ Confirm all system motors are in OFF position.
_ Check that the main disconnect is ON.
_ Push the reset button to clear any active alarms.
_ Test system failsafe devices/alarms/interlocks and ensure all are functioning properly prior to testing.
_ Trigger E-STOP to test.
_ Put all hand/auto/off switches to auto, beginning with P100, then P500, P600, P-800, P200, P300, and P400.
    - Wait for water to cover pump influent pipe before activating that pump.
    - Bleed air from bag filter housings as needed.
_ Troubleshoot any alarms according to the operation manuals.
    - Level switches that are not accessible for actuation by hand can be tested by shutting the nearby valve and filling the sight tube with potable water to activate the alarm.
    - Level switches that are accessible (secondary containment sumps) can be actuated by hand.
_ Check system piping, equipment, and fittings for leaks and fix if observed.
_ Spot check readings on all flow indicators and pressure indicators.
    - Air flow to be confirmed using heated anemometer.
    - Pressure to be confirmed using nearby pressure gauges.
_ Run for 3 cycles at 50 gpm.
    - One cycle is ~6,170 gallons at 50 gpm.
_ Take readings on all pressure gauges, temperature gauges, and flow indicators every hour and record on O&M field sheet.
_ Take water and air samples from the system at the locations and frequencies specified in the system OM&M Plan for first week of wastewater treatment operations.
_ Ensure system is running appropriately and increase VFD setting to 100 gpm.
    - Run for minimum of 4 hours.
_ While system is running, confirm telemetry module is sending out proper notifications.

Appendix G

Equipment Maintenance Procedures

Table of Contents

East Palestine
System Field Sheet

Note: Leave no blank spaces (especially for bolded Items). Provide and explanation for all Non-measurements (NM)

Arrival

Site Name:	East Palestine	Date/ of event:		Time of reading collection:	
Site Location:	N James Street and E Clark St	Personnel:			
Project No:	30169714	Weather:			

System Operation Status Upon Arrival:

System Operating (Y/N): Calibration Gas

System Performance Data

Pre-Treatment		**Air Treatment**	
Pump P100 Pressure (PI-100)	psi	Knockout Tank Liquid Level (T-400)	inches
Chem Pump Flow Rate (P-500)	gpm	KO Tank Pressure (PI-400)	psi
Pump P800 Pressure (PI-810)	psi	Pre-Blower Pressure (PI-402)	psi
Bag Filter 2 Pressure (PI-802A)	psi	Blower Discharge Pressure (PI-403)	in wc
Bag Filter 3 Pressure (PI-803A)	psi	Blower Discharge Temperature (TI-403)	deg F
Bag Filter 4 Pressure (PI-804A)	psi	VGAC T-402 Pressure (PI-405)	psi
Bag Filter 5 Pressure (PI-805A)	psi	VGAC T-401 Pressure (PI-404)	psi
Bag Filter 6 Pressure (PI-806A)	psi	Vapour Phase GAC T-402 (INF)	ppmv
Bag Filter 7 Pressure (PI-897A)	psi	Vapour Phase GAC T-401 (EFF)	ppmv
Bag Filter 8 Pressure (PI-808A)	psi	HS600 T-407 Pressure (PI-406)	psi
System Influent Flow (FI-800)	gpm	HS600 T-406 Pressure (PI-407)	psi
Pump P600 Pressure (PI-600)	psi	HS600 Media T-407 (INF)	ppmv
Decant Stream Flow (FI-500)	gpm	HS600 Media T-406 (EFF)	ppmv
OWS		Post Treatment Airflow (FI-400)	iwc
Bag Filter 101 Pressure (PI-101A)	psi	Post Treatment Air Temp (TI-400)	deg F
OWS Influent Flow (FQI-100)	gpm	**Water Treatment**	
OWS pressure (PI-102)	psi	Pump P300 Pressure (PI-300)	psi
Oil Water Seperator Level	in H2O	Bag Filter 301 Pressure (PI-301A)	psi
Pump P200 Pressure (PI-200)	psi	Bag Filter 302 Pressure (PI-302A)	psi
Bag Filter 201 Pressure (PI-201A)	psi	Post Bag Filter Pressure (PI-303)	psi
Organo Clay (Outside)		Water Treatment Flow (FQI-303)	gpm
Organo Clay Pressure (PI-202)	psi	LGAC Pressure (PI-304)	psi
Organo Clay Pressure (PI-203)	psi	LGAC 2 Pressure (PI-305)	psi
Air Stripper			
Air Flow Meter (FI-300)	iwc		
Air Temp (TI-300)	deg F		

Air Samples

Sample Location	Time	Analysis	Comments

Water Samples

Sample Location	Time	Analysis	Comments

Daily Tasks

Monitor sump pressures and operational flow rates		Inspect granular activated carbon (LGAC) vessels and cam-lock fittings for leaks. Tighted loose fittings as necessary. Collect PID from vapor stream.	(Y/N)
Transfer Pumps: Monitor and record operation pressure, inspect for leaks, and tighten/repair components as necessary		Monitor and record operational pressures of LGAC tanks	(Y/N)
Inspect System Bag Filters 1-4 and Pre Treatment Bag filters 1-8 cover gasket, lubricate/ replace as necessary		Backwash LGAC tanks (as needed)	
Monitor and record operational pressures of bag filters System 1-4 and Pre Treatment 1-8		Check fire extinguishers	(Y/N)
Replace bag filters (as needed)			

Weekly Tasks			
Check oil reservoir for product and remove if present		Inspect spill kit and replace items as required. Confirm spill kit is in usable condition	

Monthly Tasks			
Inspect and test the failsafe devices:	(Y/N)		
Storage Tank T-100 Level Switch High High (LSHH-100)		Knockout Tank Level Switch High High (LSHH-400)	
Flocculation Tank Level Switch High High (LSHH-100)		Air Stripper Blower Temperature Switch High High (TSHH-403)	
Clarifier Tank Level Switch High High (LSHH-200)		Discharge Tank Field High High (LSHH-307)	
Oil Water Separator Level Switch High High (LSHH-200)		Building Sump High High (LSHH-307)	
Oil Water Separator Level Switch High High (LSHH-200)		LGAC Treatment Area Sump High High (LSHH-308)	
Air Stripper Sump Level Switch High High (LSHH-300)		ESTOP	

Quarterly Tasks				
Check and Clean Air Stripper trays and demister pads when fouling occurs	(Y/N)	Replace spent LGAC based on labaratory results (as needed)		(Y/N)
Transfer pumps- Clean impreller casing and inspect Viton Seals (performed by vendor)		Replace spent VGAC based on labaratory results (as needed)		(Y/N)
		Replace spent HS600 based on labaratory results (as needed)		

Departure	
Groundwater System Operating (Y/N):	If NO, explain why:

Comments

GENERAL PROCEDURE FOR ALL MAINTENANCE

Moving Walls in Treatment Building

- At least two people are required to remove any wall panels
- Unlatch desired panel from adjacent panels
- Slide the panel out of the frame with one person on each side
- Once panel is removed, place it out of the work area

- To replace the panel, slide it into the track on the building. Watch for potential pinch points
- Once in place relatch all fasteners on both adjacent panels
- Visually inspect to ensure both sides of the panel are secure in the track

OIL WATER SEPERATOR

SEPARATOR START-UP INSTRUCTIONS

1. Before putting hydrocarbon contaminated water through the separator, it should first be primed with clean, cold water to prevent contamination of the outlet piping.

2. Check the product draw off elbows for proper adjustment. The product draw off elbows should be approximately 1/2" - 3/4" above the water level in the separator at its operating, flow. To simplify the adjustment, the operator may choose to turn the elbows to their highest position to insure that water cannot be skimmed into the product storage compartment. The elbows can then be readjusted to skim the product layer. It is a good idea to leave 1/2" - 3/4" layer of product in the separator to insure that only clean product is skimmed into the product storage compartment.

3. The separator has one 1-1/2" vents on the separator which have to be piped to the outside of the building to prevent abnormal operation of the separator due to pressurizaton. Consult local codes for standards covering placement and sizing of tank vent piping.

4. There is a 1-1/4" product drain port that will have to be piped and fitted with a valve to allow the accumulated product to be pumped by a scavenger service.

5. Separator should be installed on a level pad. It should be level to within a 1/4" over the lenght of the separator and 1/8" over the width of the separator.

SEPARATOR MAINTENANCE

The MKE corrugated plate Oil/Water Separator contains no moving parts and the adjustable product draw off elbows are set at the time of start-up; therefore, there is very little maintenance required. Once the Separator is put into operation, it should never be allowed to stand dry. If the unit is to be taken out of service or cleaned, the following procedures should be used to minimize the amount of contamination of the outlet side of the unit.

1. Turn the product draw off elbows down to skim off all product.
2. Pump all oil out of the product holding compartment.
3. Open the two drain valves to remove any sediment and the water in the Separator.

   (Note: The water in the Separator may contain dissolved contaminants and should be dealt in an appropriate manner.)
4. A high pressure water hose may be used to clean sludge from the Separator. The packing can be removed for further cleaning and inspection.
5. Replace all packing, close all valves, and fill with clean, cold water.

AIR STRIPPER

High water level alarm switch: The switch is typically installed in the middle of three half inch switch ports located on the front of the unit (refer to the Section 5 coupling layout drawings). If the float is moved to the highest port and the discharge line plugs or the discharge pump fails, the water level could rise above the air inlet port, allowing water to drain into the F.D. blower housing or onto the floor. The blower may become damaged if it is running while water is in the blower housing. Be sure to check that the 1/8"Ø (3mm) coupling in the bottom of the blower housing is open to allow for drainage of water that may get into the housing.

Section 3: Cleaning Procedures

Minerals dissolved in high concentrations tend to precipitate out of groundwater during air stripping processes. These minerals form insoluble deposits commonly referred to as 'fouling.' Although the ShallowTray low profile air stripper system is designed to be fouling resistant, proper steps must be taken when treating water with high mineral concentrations. Deposits from iron-rich feed water can be reduced by pretreating the feed stream with sequestering agents. The recommended cleaning procedure for deposits is pressure washing with detailed instructions as follows:

Equipment Required:

Pressure Washer: 2 gpm minimum flow at 900 psig (minimum). Equipment rental companies can usually supply electric or gasoline driven units on a daily rental basis.

Washer Wand: Washer wand with spray nozzle, (obtainable from HYDRO QUIP, INC. as an option) and an adapter to connect the wand to the pressure washer hose end. All washer connections are 1/4" (6mm) NPT.

Clean Water Supply: Clean water supply with a capacity of at least 2 gpm at 20 psig. Connect to the pressure washer using an ordinary garden hose.

System Shut Down:
Shut feed water off.
Shut off the water feed to the system.
Wait 5 minutes to allow the water in the stripper trays to be completely treated, then shut off the blower. Treated water in the trays will drain into the sump tank, so it is important to keep the outlet pump in "auto" to remove this extra water.
Shut off the power at the main disconnect switch if the shutdown is more than temporary.

Caution: If proper shut down procedures are not followed, contaminated water will drain into the sump tank. This will contaminate the water that has been collected in the tank. Therefore, always allow the blower to run an additional 5 minutes after the feed water is shut-off.

Cleaning the Unit:

Step 1: Turn off equipment.
Turn off the feed water to the stripper.

Step 2: Provide for Waste Disposal.
Make provisions for disposing of the sludge and waste generated during cleaning. A wet/dry vacuum may be required, or possibly the outlet pump (if provided) can pump out to a storage tank. Be aware that large pieces of debris might possibly clog the outlet pump or check valve.

Step 3: Remove cleanout port covers.
Remove all cleanout port covers.

Step 4: Turn on water and pressure washer.
Turn on the water supply to the pressure washer. Then, turn on the pressure washer. Wear protective goggles or face shield while spraying.

Step 5: Insert wand and start pressure washer water flow.
Insert the wand all the way through the 8" (20cm) cleanout port on the sump tank. Have the spray nozzle pointed up toward the bottom of the bottom tray. Holding the wand tightly, pull the trigger to start the pressurized water flow. Expect the wand to kick back as flow starts.

Step 6: Move wand side to side.
Move the wand side to side at a rate of about 1 inch (3cm) per second. Be sure to cover the entire tray bottom area. Recommended cleaning times for one side of one tray are given below:

Model 1300	2 min
Model 2300	4 min
Model 2400	5 min
Model 2500	6 min
Model 2600	8 min
Model 3600	12 min
Model 3800	16 min
Model 31000	18 min
Model 31200	23 min
Model 41200	32 min
Model 51200	40 min
Model 61200	48 min
Model 71400	60 min
Model 81200	64 min

Step 7: Inspect cleaned area.
Periodically stop the cleaning operation and inspect the cleaned area by shining a light into the unit. The area is clean when there are no deposits in or around the stripper tray holes.

Step 8: Clean top side of tray.
When the bottom surface appears clean, move the wand to the top side of the same tray by inserting it in the next highest cleanout port. Continue spraying with the nozzle pointed down onto the top surface of the tray. Remove all visible deposits from the tray baffles and the walls of the unit.

Step 9: Repeat for all trays.
Repeat the procedure for the bottom of the next higher tray, etc., working up to the top tray.

Step 10: Rinse.
After the cleaning operation is finished, rinse the trays, baffles, and walls with the pressure sprayer. Work down from the top tray to the sump tank. Make sure the surfaces are clean and the holes are not blocked by loosened debris.

Step 11: Clean cover.
Remove the top cover. Flip it over, and wash the bottom side. Inspect spray nozzle and the wire mesh mist eliminator pad for fouling. Clean the spray nozzle and the mist eliminator pad.

Step 12: Replace the mist eliminator pad.
Mist eliminator pads that are excessively plugged should be replaced. The old pad is removed by loosening the retainer plates on the corners of the pad. Reinstall the new pad in the same orientation as the old one.

Section 4: Trouble Shooting

Note: A competent electrician should perform any work inside the electrical control panel. Do not perform troubleshooting if you are not familiar with the procedures or the equipment.

Problem Blower Won't Start Or Run

No power to blower
Check that all switches are in "ON" or "AUTO" position.
Position main disconnect switch to "ON" position. Turn control switches to" on" or "AUTO".

Blown Fuse
Check to see if fuses are ok.
Check fuses in main disconnect switch and in control panel. If blown, replace with fuse of the same size and rating to avoid the risk of fire or electrical shock.

Overload relay Trips
Locate reset button on blower overload relay.
Push reset button in. Reasons for tripping; incorrect line voltage, motor wired incorrectly, inadequate ventilation, worn bearings.

Tubing to air pressure switch plugged
Remove tubing from air pressure switch and blow into it towards tank. Clean or replace tubing if plugged or kinked.

Blower dose not rotate freely.
TURN OFF ALL POWER to the system. Try to spin wheel by hand. Wheel should rotate freely. If not, call HYDRO QUIP, INC..

Problem Outlet Pump Won't Shut Off

Suction or Discharge piping to pump is clogged.
Check water flow from discharge pipe. Piping should be clean inside. Look for narrowing caused by scale or iron accumulation. Remove piping. Inspect, clean, or replace as necessary.

Float switch in tank is stuck in down position.
Remove 8"Ø or 12"Ø (30cm) inspection cap and check that all floats are floating on the water. Clean all deposits from float. Replace float if necessary.

Normal Operation: Water level in sump is OK. Pump will stop when water level reaches pre-determined height in tank. Allow water level to decrease until pump turns off. Let water level reach predetermined lower level, which will cause outlet pump to turn off. Water level may be just below the bottom of clear sight tube before pump shuts off – this is normal.

Problem — Outlet Pump Won't Run Or Pump Water

No power to Pump

Check that all switches are in "ON' or "AUTO" position.
Position panel disconnect switch to "ON position. Turn control switches to "ON" or "AUTO."

Blown fuse

Check to see if fuses are ok.
Check fuses in main disconnect Switch and in control panel. If blown, replace with fuse of the sane size and rating to avoid the risk of fire or electrical shock.

Overload relay trips

Locate reset button on pump overload relay.
Push reset button in. Reasons for tripping; incorrect line voltage, motor wired incorrectly, inadequate ventilation, worn bearings.

Normal operation: Water level in sump is OK. Pump will start when water level reaches predetermined height in tank. Allow water level to increase until pump turns on. Be sure pump switch is in "AUTO" position. Let water level reach predetermined upper level, which will cause outlet pump to turn on.

Level switch in tank is wired incorrectly in control panel

Check wiring circuit against diagram. See that all connections are tight and no short circuits exist because of worn insulation, crossed wires, etc. Rewire any incorrect circuits. Tighten connections, replace defective wires.

Pump does not rotate freely

TURN OFF ALL POWER TO THE SYSTEM. Try to turn impeller by hand.If impeller won't turn, remove housing and locate source of binding. It could be due to impeller, seal, or bearing damage, or excessive fouling.

Impeller or check valve is fouled.

TURN OFF POWER**.** Remove pump outer housing and inspect impeller for blocked openings. Be sure to have a new housing gasket kit available before removing housing. Remove check valve from line and inspect for stuck or fouled valve. Clean or replace impeller or check valve as necessary.

Problem Low Air Pressure/Vacuum in Stripper Tank.

Blower damper closed.

Visually check position of damper on inlet of blower. Open damper to get proper reading on pressure gauge. Firmly tighten damper set screw.

Motor rotation backwards

Watch rotation of blower wheel at slow speed. It must match direction of the rotation arrow on the blower housing. Have electrician reconnect wiring for proper rotation as per motor diagram.

Gravity discharge trap installed incorrectly

Trap should be positioned vertically, as an "upside down U." Install discharge trap per outlet plumbing drawings located in Section 5.

Inlet chamber (sealpot) in each tray not full of water.

Remove 4"Ø (10cm) rubber caps, or slide tray aside and look at water level in chambers. Remove 4 inch (10cm) rubber caps on end of trays. Fill up inlet chambers with a hose, or follow the sealpot fill procedure as described in the initial Start Up section.

Rubber clean out caps not in place.

All cleanout ports must have a rubber cap installed. Tighten clamps on all rubber caps.

Tubing to pressure gauge

Remove tubing from pressure gauge and blow into it towards tank. Clean or replace tubing if plugged or kinked.

Gravity feed not flowing

Unit has gravity feed and inlet pipe on inside of ShallowTray cover is not submerged in inlet chamber water. Remove cover and measure length of piping hanging from inside of cover. Length is to be about 10 1/2 inches (27cm) from cover surface. Adjust length of inlet pipe on inside of cover until total length is about 10 1/2 inches (27cm). DO NOT INSTALL NOZZLE ON A GRAVITY FEED UNIT.

Blocked blower intake

Look at blower intake screen. Remove debris from screen.

Normal operation: When inlet pump starts, the blower will start and air pressure will increase to required operational level. No action necessary.

Problem High Pressure/Vacuum in Stripper

Air exhaust is restricted

Check vent piping for bird nest or other obstructions. Check that vent pipe diameter does not decrease. Intake or exhaust air pipe diameter must be at least as big as the cover vent or blower intake diameters.

Air holes in trays plugged

Remove inspection and cleanout caps and visually inspect holes. For iron fouling, clean out the unit with a pressure washer. For scaling, scrape or bang the scale from all surfaces, then use a pressure washer to open the 3/16 inch (5mm) diameter holes. Consider using a sequestering agent to prevent scaling.

Mist eliminator is plugged

Remove cover from ShallowTray and inspect the bottom of the mist eliminator pad in the cover. Remove mist eliminator pad from cover and clean. If fouled, replace with a new mist eliminator.

Problem Water won't flow into unit

Inlet/well pump function

Allow water level to rise in well pump, which will turn on the inlet pump and start water flow to system. No action necessary.

Stripper air pressure in low alarm condition

Read sump tank air pressure from pressure gauge. System should be in alarm condition if pressure is below about 2" inches (5cm) w.c. Check that blower is operating properly, and has correct rotation. Check that all rubber caps are in place on end of trays.

Inlet piping plugged

Remove cover and inspect nozzle and piping for debris and buildup. Clean or replace clogged parts.

Problem Iron Fouling Is A Problem

Iron build-up

Iron precipitates out of water when treated with an air stripper, causing iron build up in unit. Remove cleanout caps and inspect inside of tray for buildup/fouling. Clean out unit with pressure washer

on a routine basis. Pretreat incoming water to reduce fouling problems in stripper. Meter a sequestering agent into the water.

Problem VOC Removal Is Less Than Expected

There are many possible reasons for poor stripper efficiency. Review the following list of questions to troubleshoot what the problem might be.

1. Have the trays been taken apart? Are they put back together as supplied from the factory, i.e., dip tube over sealpot, downcomers from each tray underwater in the sealpot of the tray below?

2. What is the sump tank air pressure reading? Is it steady, slowly changing over time, or rapidly fluctuating?

3. What is the flow rate through the stripper? How is it measured? Where is the sensor mounted?

4. What is the air intake and exhaust piping design (size of ducts, number of elbows, length of pipe run, GAC, heaters, other restrictions)? Are sample ports installed on each tray to verify pre-tray removal efficiency?

5. Is sump tank contaminated? Where are effluent samples taken from?

6. Are sample ports purged for 30 seconds-1 minute before taking sample?

7. Are samples being taken, stored, and tested per approved methods?

8. Are seal pots on each tray full of water?

9. Dose the sump tank have at least 4 inches (10cm) of water at all times?

10. Is the water suction elbow in the tank pointing down and always underwater?

11. What is the inlet water temperature?

12. What else is in the water besides the contaminates in question?

13. Are there occasional slugs of free product, or much higher than normal contaminant concentrations that could enter the stripper?

14. Is inlet water supplied as a continuous stream (as from an electric pump.)? Or is the flow pulsed (as from a pneumatic pump)?

15. Are their surfactants, detergents, greases, fats, etc. in the water that are causing foaming in the stripper?

16. Is there equipment near the blower intake that could be contaminating the air?

17.Has the air entering the blower been tested for VOCs?

18. How far away from each other are the air intake and air exhaust points? Is the air intake downwind of upwind from the exhaust? Is it possible for contaminated air to be sucked back into the stripper air intake?

19. Is the blower spinning in the correct direction (top of blower wheel spinning towards tank)? Watch wheel when it is almost stopped.

20. Is there air coming out of the discharge pipe?

21. Is outlet piping siphoning all water out of the sump tank, until it sucks air from tank?

22. What is the outlet plumbing design (gravity discharge, pumped discharge, uphill, downhill, other equipment in-line, size of piping. etc.)?

23. What do the bubbles look like in each tray? Install view ports to see.

24. Are the undersides of the trays free of drips and drizzles?

25. Are tray holes closed or plugged? Is there any scaling or fouling on the trays?

26. Is the system level and plumb?

27. When shutting system down, is inlet water shut off, blower allowed to operate for an additional 5 minutes, then blower shut off?

KNOCK OUT TANK

Knock Out Tank

1. Check that tank is clear of debris and blockage

BLOWER

07

MAINTENANCE

GENERAL

Regular inspection of the blower and its installation, along with complete checks on operating conditions, will pay dividends in added life and usefulness. Also, service the drive per the manufacturer's instructions and lubricate the coupling or check the belt drive tension. Use thermometers and gauges to make sure that blower operating temperature and pressure remain within allowed limits.

⚠ DANGER

The blower and parts may contain hazardous media. Assure that pump and parts are evacuated of hazardous media prior to servicing.

⚠ CAUTION

The electrical service must be isolated and de-energized prior to maintenance. Apply appropriate procedures to assure electrical supply is de-energized and cannot be inadvertently energized during maintenance.

Assure piping and product is isolated prior to maintenance of blower. Apply appropriate procedures to assure piping and product is isolated and that inadvertent opening of valves cannot occur during maintenance.

⚠ CAUTION

During routine maintenance, inspect and assure that guards are in place and secure.

Pay special attention to lubrication of timing gears and bearings according to the information in ***Lubrication on page 15.***

When a blower is taken out of service, it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgment based on existing conditions as well as length of downtime. Under atmospheric conditions producing rapid corrosion, protect the blower immediately. ***See Long-Term Storage on page 29.***

REGULAR MAINTENANCE

A well-designed maintenance program will add years of service to the blower.

Check a newly installed blower frequently during the first month of operation, especially lubrication. With the blower at rest, check the oil level in both the gear (drive) end and free (non-drive) end of the blower and add oil as needed. Complete oil changes are recommended every 1,000 – 1,200 operating hours, or more frequently depending on the type of oil and operating temperature. Also change the oil more frequently if pumping corrosive vapors or where excessive operating temperatures are encountered. The following is recommended as a minimum maintenance program.

DAILY	WEEKLY	MONTHLY
1. Check and maintain oil level, and add oil as necessary. 2. Check for unusual noise or vibration (***see Troubleshooting on page 30***).	1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage. 2. Check the relief valve to make sure it is operating properly.	1. Inspect the entire system for leaks. 2. Inspect the condition of the oil and change if necessary. 3. Check drive belt tension and tighten if necessary.

NOTICE

Oil levels should be checked every 24 hours of operation.

Proper oil drain schedules require oil be changed before the contaminant load becomes so great that the lubricating function of the oil is impaired or heavy disposition of suspended contaminants occurs. To check the condition of the oil, drain a sample into a clean container and check for the presence of water or solids. Slight discoloration of the oil should not necessitate an oil change.

SPARE PARTS

Should adjustments or replacement be needed, repairs can often be performed locally as described in this manual after obtaining the required parts. Personnel should have a good background of mechanical experience and be thoroughly familiar with the procedures outlined in this manual. For major repairs not covered in this manual, contact the nearest M-D Pneumatics service representative.

When ordering parts, supply the blower nameplate information, as well as the item number and parts description as per the parts lists and assembly drawings. Repair kits are available for all models. These kits contain all the seals, bearings, O-rings, locks, and special retaining screws necessary for an overhaul. For convenience when ordering parts, complete the **Operating Data Form** included on the inside back cover of this manual.

In developing a stock of spare parts, consider the following factors:

- The degree of importance in maintaining the blower in a "ready" condition
- The time lag in parts procurement
- Cost
- Shelf life (seals and O-rings)

FACTORY SERVICE AND REPAIR

With proper care, M-D Pneumatics blowers will provide years of reliable service. The parts are machined to close tolerances and require special tools by mechanics who are skilled at this work. Should major repairs become necessary, contact the factory for the location of the nearest service facility. Blowers that are still under warranty must be returned to the factory, freight prepaid, for service.

NOTICE

Current regulations require Material Safety Data Sheet to be completed and forwarded to M-D Pneumatics on any unit being returned for any reason which has been handling or involved with hazardous gases or materials. This is for the protection of the employees of M-D Pneumatics who are required to perform service on this equipment. Failure to do so will result in service delays.

NOTICE

When returning a blower to the factory for repair, under warranty, please note the factory will not accept any unit that arrives without authorization. Contact the Service Department for return authorization.

LONG-TERM STORAGE

Any time the blower will be stored for an extended period of time, make sure it is protected from corrosion by following this procedure:

1. Spray the interior (lobes, housing, and end plates) with rust preventative. Repeat as conditions dictate and on an at least a yearly basis.
2. Fill both end covers completely full of oil.
3. Firmly attach a prominent tag stating that the end covers are full of oil and must be drained and refilled to proper levels before start-up.
4. Apply a rust-preventative grease to the drive shaft.
5. Spray all exposed surfaces, including the inlet and discharge flanges, with rust preventative.
6. Seal the inlet, discharge, and vent openings. It is not recommended that the blower be set in place, piped to the system, and allowed to remain idle for a prolonged amount of time. If any component is left open to the atmosphere, the rust preventative will escape and lose its effectiveness.
7. During storage, make sure the blower does not experience excessive vibration.
8. Attach a desiccant bag to one of the covers to prevent condensation from occurring inside the blower. Make sure any desiccant bag (or bags) is attached to the covers so that they will be removed before start-up of the blower.
9. Store the blower in an air conditioned and heated building if possible. If air conditioned and heated storage is not possible, make conditions as dry as possible.
10. If possible, rotate the drive shaft by hand at least monthly to prevent seals from setting in one position.

08

TROUBLESHOOTING

Although M-D Pneumatics blowers are well designed and manufactured, problems may occur due to normal wear and the need for readjustment. The following chart lists symptoms that may occur along with probable causes and remedies.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Loss of oil	Gear housing not tightened properly	Tighten gear housing bolts.
	Lip seal failure	Disassemble and replace lip seal.
	Insufficient sealant	Remove gear housing and replace sealant.
	Loose drain plug	Tighten drain plug.
Excessive bearing or gear wear	Improper lubrication	Correct oil level. Replace dirty oil. ***See Lubrication on page 15.***
	Excessive belt tension	Check belt manufacturer's specifications for tension and adjust accordingly.
	Coupling misalignment	Check carefully. Re-align if necessary.
Lack of volume	Slipping belts	Check belt manufacturer's specifications for tension and adjust accordingly.
	Worn lobe clearances	Check for proper clearances. ***See Assembly Clearances on page 32.***
	Speed too low	Increase blower speed within limits.
	Obstruction in piping	Check system to ensure an open flow path.
Knocking	Blower out of time	Re-time.
	Distortion due to improper mounting or pipe strains	Check mounting alignment and relieve pipe strains.
	Excessive pressure differential	Reduce to manufacturer's recommended pressure. Examine relief valve and reset if necessary.
	Worn gears	Replace timing gears.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Excessive blower temperature	Too much or too little oil in gear reservoir	Check oil level. ***See Lubrication on page 15.***
	Too low operating speed	Increase blower speed within limits.
	Clogged filter or silencer	Remove cause of obstruction.
	Excessive pressure differential	Reduce pressure differential across the blower.
	Elevated inlet temperature	Reduce inlet temperature.
	Worn lobe clearances	Check for proper clearances. ***See Assembly Clearances on page 32.***
Rotor end or tip drag	Insufficient assembled clearances	Correct clearances. ***See Assembly Clearances on page 32.***
	Case or frame distortion	Check mounting and pipe strain.
	Excessive operating pressure	Reduce pressure differential.
	Excessive operating temperature	Reduce pressure differential or reduce inlet temperature.
Vibration	Belt or coupling misalignment	Check carefully. Re-align if necessary.
	Lobes rubbing	Check cylinder for hot spots, and then check for lobe contact at these points. Correct clearances. ***See Assembly Clearances on page 32.***
	Worn bearings or gears	Check condition of gears and bearings. Replace if necessary.
	Unbalanced or rubbing lobes	Possible build-up on casing or lobes, or inside lobes. Remove build-up and restore clearances.
	Driver or blower loose	Check mounting and tighten if necessary.
	Piping resonance	Check pipe supports, check resonance of nearby equipment, and check foundation.

11

RECOMMENDED LUBRICANTS

RECOMMENDED LUBRICANTS FOR BLOWERS AND VACUUM BOOSTERS

Positive displacement blowers and vacuum boosters require proper lubrication for bearings, seals and gears to operate effectively and efficiently. Oil is distributed from the oil reservoir to the critical components by means of oil slingers that are attached to the rotor shaft. In certain models of CP Series blowers, a high-performance grease rated for high temperatures is used on the drive-end bearings.

MD full synthetic lubricants are recommended for blowers and vacuum boosters. MD lubricants are specifically formulated using unique additives that provide maximum protection and extend the life of your product over mineral oils or semi-synthetic lubricants.

⚠ WARNING

Do not overfill the oil sumps. Overfilling can result in gear damage or oil leaks.

⚠ CAUTION

Units are shipped without oil in the sumps. Ensure adequate oil has been added before operating.

MD oils are suitable for a wide range of operating temperatures that are based on model, operating speed and discharge temperature of the product.

FOR OXYGEN-ENRICHED SERVICE

Blowers and vacuum boosters operated in oxygen enriched applications should only use non-flammable, PFPE full synthetic lubricants. Blowers and vacuum boosters used in hydrogen service should only MD full synthetic oil

NOTE: Oxygen-enriched service only applicable for PD Plus blowers and vacuum boosters.

⚠ CAUTION

M-D Pneumatics and Kinney does not accept responsibility for damage caused by use of lubricants that are not recommended by M-D Pneumatics and Kinney.

MD BLOWER & BOOSTER LUBRICANTS SPECIFICATIONS:				
PRODUCTS	**MD ONE**	**MD PLUS**	**MD MAX**	**MD FG**
VISCOSITY INDEX	150	150	150	141
@40°C, CST	99.1	342	232	99.3
@100°C, CST	14.4	32.8	25.4	13.9
FLASH POINT °F (°C)	510 (266)	485 (252)	485 (252)	515 (268)
POUR POINT °F (°C)	- 44 (-43)	-47 (-44)	-44 (-43)	-44 (-43)

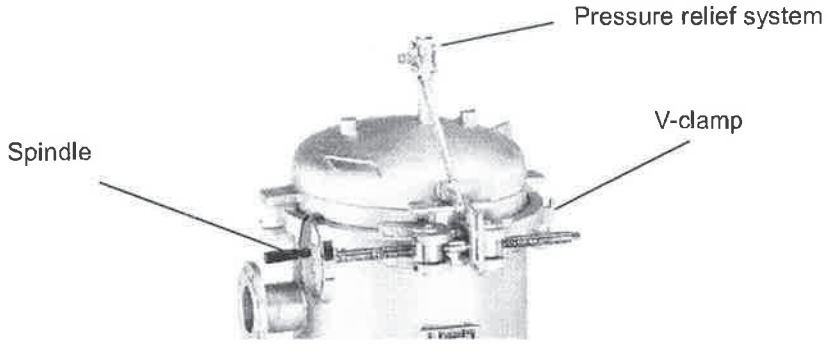
NOTE: MD One Vapor Pressure: (mm Hg) 100°F <0.00004; 200°F <0.00018

MD BLOWER & BOOSTER LUBRICANTS OPTIONS					
MD OIL TYPE	**1 QUART**	**1 GALLON**	**5 GALLON**	**55 GALLON BARREL**	**CASE 12 QUARTS**
MD ONE	16444-MD1-Q	16444-MD1-G	16444-MD1-5G	16444-MD1-B	16444-MD1-Q-C
MD PLUS	16444-MD2-Q	16444-MD2-G	16444-MD2-5G	16444-MD2-B	16444-MD2-Q-C
MD MAX	16444-MD3-Q	16444-MD3-G	16444-MD3-5G	16444-MD3-B	16444-MD3-Q-C
MD FG	16444-MD1-Q-FG	16444-MD1-G-FG	16444-MD1-5G-FG	16444-MD1-B-FG	16444-MD1-Q-C-FG

BAG FILTERS

4.1.3 Design with QIC-LOCK spindle closure

MAXILINE VMBF and VMDE are example filter types with this design.



The QIC-LOCK mechanism is a two piece V-shaped clamp that can be opened and closed using a hand operated spindle mechanism. The V-shape closes over the housing and cover flange that seals with an O-ring. The V-clamp is then locked by closing a handle that closes a pressure relief device. This device needs to be opened first in order to operate the spindle.

In the case of a quick-closure mechanism, additional seal break devices are installed on the cover that enforce a slight lifting of the cover before full opening to break the seals in case the sealing surface are stuck together for some reason. The opening sequence is automatic and can only be changed through the removal (dismantling) of security devices. Their removal is not permitted in any circumstances. The correct operation of all security devices must be checked and maintained on a regular basis. The cover of the housing can now be opened and rested against the hinge-stop.

Multi-bag filter housings (MAXILINE series) are equipped with a spring-assisted mechanism, a davit, or a spring for lifting the cover. This mechanism will be explained below.

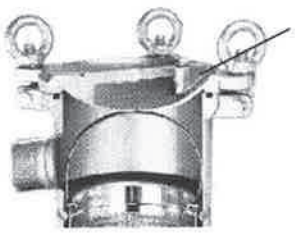
Notice that depending on the size of the filter housing the cover may have significant weight. Opening quickly can therefore cause great forces and significant damaged can be caused by striking other objects. A similar process is the rapid opening or closing of door, which can cause personal injuries. Therefore the cover must be opened and closed slowly.

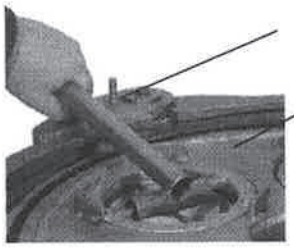
4.2 Filter bag insertion

Previous special instructions for the preparation and installation of filter elements into the filter housing should be followed first. Filter housings are normally not shipped with filter bags installed. Without support, filter bags are not able to withstand the differential pressure that occurs during operation. This support is provided by the restrainer basket.

If not pre-installed, the restrainer baskets must be installed into the filter housing. Depending on the construction the basket may contain a bead that together with an extraction tool makes removal of the basket easier. The extraction tool is inserted into the basket with the flat end (round edges) first and then hooked under the bead to remove the basket. With the restrainer basket installed, the filter bag can now be inserted into the basket. Remove the filter bag label and retain for information for tracking and reordering.

The sealing ring of the filter bag must be positioned exactly on the edge of the restrainer basket to provide a good seal. The filter bag should be opened against the basket so that the bag is fully supported. Depending on the type of filter housing the filter bag is locked in position by using a bag-fixing ring (spring supported) or bayonet ring. The bayonet rings should be tightened down using the ring lock tool.





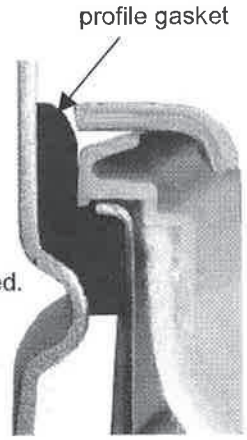
Bag-fixing rings for FLOWLINE and SIDELINE housings have a spring steel band for hold down. The pressure is provided by the cover of the filter housing. It is important that the pressure is applied onto the sealing ring of the filter bag; if it does not the bag-fixing ring may need to be adjusted.

MAXILINE MBF and VMBF multi-bag filter housings are equipped with bag-fixing rings that are locked by bayonets. A special tool is available to lock the ring. This tool is supplied with the filter housing.

Beware:

FLOWLINE bag filter housings (unlike other housings) are equipped with a profile gasket in the basket seating area. This gasket is made of elastomer (FPM). This gasket offers technical advantages but special care must be taken with its use.

Due to changing pressure, high differential pressure, pulsating pressure, chemical attack or high temperature the profile gasket may become damaged. As a result the basket may fall through to the bottom of the housing causing the filter to malfunction.
Check to ensure the operating parameters of the application are compatible with this seal. If in doubt, contact Eaton for technical support.



4.3 Cover lid - closing

Before closing the cover ensure that the sealing surfaces along with the gasket are clean and damage free. Make sure the gasket is sitting in its correct position. Replace gasket if faulty.

Remove and discard damaged gaskets!

To close the filters reverse the above steps.

Bag filter housings are usually equipped with one or on special designs with more than one O-ring. Depending on the application special housing designs may also be equipped with flat gaskets.

Less cover bolt torque is required on housings with O-ring gaskets than with flat gaskets.

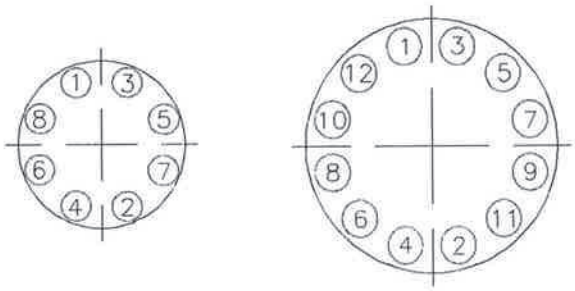
The applicable maximum torque values for the bolts must not be exceeded. When using standard equipment and normal physical strength these torque values will not be exceeded.
When using extensions on spanners, wrenches or an air gun make sure that the bolts are not over tightened. The recommended maximum bolt torque values are listed below.

Please note:
If the pressure equipment is equipped with segment clamp screws it is essential that all the required clamp quantities are engaged (see cover sheet or vessel name plate).

Max torque in Nm						
Metric ISO thread	M12	M16	M20	M24	M 27	M30
Hex/ring-nut/ thru bolt	36	86	168	290	425	580
Segment clamp screw	-	80	200	340	550	680

These are reference values and are valid for typical zinc plated bolts of strength class 5.6 according to DIN 267, or zinc plated segment clamp screws made of 21CrMoV57.

Application of high force to the bolts to close a leaking pressure equipment (to overcome a damaged gasket) must be avoided. Over-tightening may damage bolts or the housing cover lid. To avoid stress in the cover tighten the bolts in accordance with the following sequence:



When using maximum allowable torque the bolts are to be tightened in three steps.

1. 50 % of torque
2. 80 % of torque
3. Max torque

To close SIDELINE bag filters with a center bolt closure. Hand-tight pressure on the center bolt will be sufficient to seal the housing. Tools to give extra leverage should not be used otherwise the mechanism is likely to be damaged. Check that the holding bar is properly positioned so that it will not slip out under pressure.

Filter housings with QIC-LOCK quick closure mechanism are closed by hand. Where a hex-nut is used in place of the spindle wheel the applied torque must not exceed 200 Nm. The pressure-release device must be locked down in place to complete the closure. The V-clamp is now locked.

4.4 Start up

The filter is now ready for use. Slowly open the valve on the inlet; avoid opening too fast as shock loads can damage the filter media and the housing. The vent valve should be open to ensure no air is locked in the top of the filter housing. The valve should be closed as soon liquid runs out. In all cases (whether or not hazardous liquids are being filtered) precautions should be taken to prevent injury from spraying liquid.
If the filter is not vented any air in the filter will reduce the efficiency of the filter media. Generally, if air gets into the system it should be vented off immediately. When filtering gaseous fluids, the filter should be vented at regular periods.
The outlet valve is now to be opened slowly.

Due to the fact that filter bags may release some particles when first used, we recommend re-circulation of the filtrate. The length of time for re-circulation will depend on the individual filter bag and level of filtration. This will ensure particles from newly installed filter bags will be collected and safely removed from filtrate.

5.0 Use, handling and maintenance

5.1 Use and Handling

To achieve maximum results from the equipment we recommended that adequate training be provided to all users and maintenance personnel. This manual should be part of this training. The training should also include: the correct and safe operation of the equipment, process requirement, type of filter, types of media, and special treatment of fluids and general safety rules.

The equipment must not be incorrectly used and measures should be taken to prevent this.
Incorrect use includes:

- exceeding of the permissible pressure rating or temperature
- filtration of non-compatible fluids
- use of incorrect spare parts (e.g. bolts and gaskets)
- exceeding of permissible component load
- operating errors like opening under pressure or improper emptying or filling

Possible consequences with damage to persons or property may be:

- failure of the pressure equipment (bursting or exploding)
- emission of hazardous fluids (toxic, caustic, flammable).
- leakage and corrosion

Control systems (pressure and temperature) must be checked regularly for proper function. If the use of the pressure equipment has an associated risk due to the nature of the fluid and/or the operating conditions it is recommended to record the inspections. The operator should have access to the file (pressure equipment book) at any time.

5.2 Maintenance of the filter housing

The filter itself does not need any special maintenance with normal use. All parts should be regularly checked for corrosion and other damage.
Install a new filter bag at every product change or if the bag becomes dirty and is no longer efficient. Differential pressure (the difference in pressure before and after the filter) will determine if this point has been reached.

Eaton recommends changing the filter bag at a differential pressure of 1.5 bar, however, a maximum of 3.5 bar is permissible.

To remove the filter bag release the pressure in the housing by opening the pressure relief valve. The procedure for opening and closing the housing is described in Section 4.
Attention should always be given to the gaskets and sealing surfaces ensuring that they are clean and undamaged. Damaged gaskets should be replaced

Note:
Eaton joins many gasket manufacturers in recommending that gaskets be replaced whenever a pressurized container is opened. Going against this recommendation may result in a faulty seal and a defect in the system. In practice, gaskets are often used many times.

It is important to verify that the correct gasket is being used. This applies to the size and the material of the gasket

If the filter housing contains movable parts, (e.g. QIC-LOCK spindle closure) these need to be lubricated to ensure easy movement. Common grease—which is compatible with the process—may be used. The parts should not be over greased. Greasing is also recommended for all threads. Stainless steel bolts should always be greased with an adequate lubricant to avoid premature wearing of parts.

Special models, such as TTBF with central T-bolt also need to be lubricated in the proper areas. Usually lubricating nipples are provided on these models.

Adequate cleaning and maintenance of all equipment is necessary at all times for trouble free operation. Where a potential hazard exists for operators, such as material escaping or the process itself, we recommend that all service and maintenance be documented, especially the condition of the seals and sealing surfaces and the function of moving parts.

If the filter housing is protected from corrosion through an applied coating a regular check of the surface to identify possible damage is important. Any damage to the coating should be repaired professionally.

Security equipment, such as pressure monitoring equipment, pressure relief systems on quick-closure mechanisms, locking devices, seal breaking devices, pressure measurement equipment, temperature control devices, leakage warning systems, etc., must be regularly tested for proper operation and repaired immediately in the case of malfunction.

The QIC-LOCK closure mechanism is equipped with an enforced locking device at the spindle. This device is linked to the pressure release vent. Its correct operation is to be verified with each opening and closing of the housing. Any malfunction should be corrected before the pressure vessel is put into service.

5.3 Recurring inspections

This section describes the scheduled maintenance and operation of pressure vessels. Maintenance schedules may be defined by national or local codes and regulations or plant norms. The operator must ensure that governing regulations are known and adhered to. We recommend that all servicing and maintenance be documented.

6.0 Maintenance of the spring-assisted lid lift (only MAXILINE Series Types)

The spring lifting and stainless steel device operates mechanically and can be adjusted. Even heavy housing covers can be close to weightless with its support, while the cover remains still in position.

6.1 Maintenance

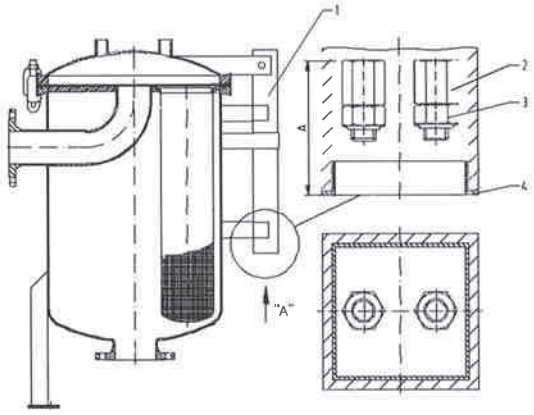
The quick closing mechanism does not require any special maintenance.

Sounds made by the spring lifting device (jarring or grating) have no influence on the function of the lifting device, but can reduced by spraying with a lubricant. In adverse conditions there may be risk of corrosion of weight bearing parts and a failure of the spring. The spring is only under tension when the housing is closed and relaxes when the housing is opened.
Should the closure fail, it would usually be under full tension when the cover is closed.

It would be a rare occurrence for the closure to fail. See also security measures for more details. Should the spring- assisted lid lift fail unexpectedly the housing cover may not be opened unless secured with a rope or chain.

6.2 Adjustment

The spring lift device is balanced at the factory before the housing is shipped. The addition of equipment, gauge, valves etc. may increase the weight of the cover making a new adjustment necessary.



For re-adjustment the dust cap below the spring lift device is to be removed. When viewed from below two threaded bars with hexagon nuts can be seen. Two hexagon nuts are secured with additional self-securing hexagon nuts to guard against misalignment and removal through counters. The counter hexagon nuts must be loosened.

Turning of both hexagon nuts adjusts the lifting capacity of the spring. Turning the nuts to the right (clockwise) increases the tension and bearing capacity. Turning the nuts to the left (counter clockwise) reduces the tension and bearing capacity.
After the adjustment the counter hexagon nuts are to be tightened. The dust cap can now be put into place again. Measurement A may not be exceed 200mm respectively go not under the limit of 80mm in the final position (open and closed).

6.3 Caution

The spring lift device must be protected against aggressive and corrosive materials.
If the spring lift device is in a high humidity environment, such as cleaning operations with steam cleaners there is a risk of corrosion. If this risk exists please contact the manufacturer to be consulted further.
We recommend the filter be installed so that no personnel can reach under the spring lift device. Never place your head under the spring lift device for maintenance work.
Always use a mirror for visual inspection. The spring lift device is very safe, but during operation should be placed under the lifted weight, which is true for all heavy items.

Important:
The removal and maintenance of the spring lift device may only be done when the cover is opened (usually upright position of the cover). Under tension the spring contains potential energy. This energy may be released suddenly and can lead to serious damage to people and property.

7.0 Technical Data

Measurements, details, spare parts and other materials can be found on the current Datasheets and Sales Drawings and full drawings if these are part of the full documentation package furnished with the housing. Missing Information can be requested from Eaton by providing the serial number of the housing.

8.0 Filter housing with heating jacket

For external heating or cooling the filter housings can be fabricated with an integral jacket, which can be operated using either liquid or gaseous products for heating or cooling as required.
Before installation check operating parameters. Compare them with the design data of the filter housing details, which can be found on the nameplate. Do not exceed the specified operating pressure and temperature.
Exceeding the permissible operating conditions should be avoided by use of equipment such as pressure relief valves.
Heating media materials that come into contact with the housing have to be checked in regards to their chemical compatibility with the housing.
Because of the number of possible applications Eaton can make only limited recommendations
The responsibility for defining the correct materials for a specific application is the sole responsibility of the operator or user. Eaton does not assume any liability or provide guarantees for correctness.
In regards to the heating media the flow direction is to be chosen such that adequate venting of the jacket is guaranteed. Otherwise a portion of the surface will not be available for heating.
The heating media should usually enter from the bottom and exit at the top. This makes venting easy. With gas or steam the directions should be reversed. This is so that any condensate that develops can easily be removed from the bottom. Refer to Residual Hazards as described under Point 1.1.

9.0 Information about bag filters with coatings

Depending upon the application a bag filter housing may be coated on the inside and/or outside as a protection against corrosion. A standard coating is E-CTFE (HALAR). Other coatings like PFA, Epoxy or PA may also be used.
The suitability of the coating must be checked carefully against its chemical resistance, temperature resistance, mechanical tension, abrasion, etc. Installation and start-up should be done according to the operating instructions however special care should be taken to avoid any mechanical damage to the applied coating.

Special attention must be paid to the maintenance of filter housings with an applied coating.
The coating is used as a protection against corrosion. The coating put on is totally non-porous, no diffusion occurs, so it offers high chemical resistance and excellent corrosion protection.
Mechanical damage of the coating must be avoided.
No work should be performed on the filter with tools or parts that could damage the coating. Particular care should be taken during regular maintenance of the filter and filter bag exchanges. Do not use the filter if the coating is damaged. Damaged coatings should be repaired and over time in demanding applications it may be necessary to re-coat the entire housing.
Technical data on coatings is available on request from Eaton.

10.0 General operating instructions

Filter bags that are used in the filter housings are usually made from industrial felt, monofilament mesh or melt-blown micro-fibers. In addition, strainer baskets are also used for coarse filtration. For technical details please refer to the appropriate literature.

The velocity of the flow of the process fluid through the filter is a major factor in achieving good as well as economic filtering results. The goal, with a few exceptions, is to keep the velocity as low as possible. Low pressure on the filter enhances filtration and increases the service life of the filter bag, thus reducing the operating cost of the whole system.
At the same time the flow should be as even as possible, for a feed pump a centrifugal pump is a better choice than a piston-driven one which delivers pulsating velocities. As a rule it is better to avoid uneven feed or intermittent operation as much as possible to prevent backup-up in the filter housing.
Such conditions could cause the filter bag to lift up and float with pressure changes in the filter housing so that it no longer fits exactly in the restrainer basket. At worst, this could result in a bursting of the filter bag. Filter bag lift up can be effectively prevented by the use of an optional bag-positioning device.

11.0 Use with Strainer Baskets

Depending on the application the filter system may be used with metal strainer baskets instead of the filter bags. The strainer basket replaces normally the restrainer baskets but where applicable the housings may be equipped with only one strainer basket with special dimensions, i.e. a 4 bag sized housing is equipped with one basket with a larger diameter instead of 4 baskets with the standard dimensions.
From experience strainer baskets are used for safety filtration (low solid removable) or to separate larger amounts of solids (high weight). Therefore it has to be observed that in case of basket changing or cleaning an adequate lifting device is used and precautions are taken to protect persons and equipment. Depending on the type of strainer basket there is the danger of squeezing fingers during insertion into the housing. The insertion should be done carefully.

The cleaning of the baskets has to be done carefully depending on the design of the basket.
The filter media may be a very thin and the stainless steel screen easily damaged. Cleaning with a high pressure cleaner or steam pressure cleaner is recommend only if cleaning is done in the flow direction. Cleaning against the flow direction (screen is normally not supported) will consequently damage the basket.

LIQUID PHASE CARBON VESSELS

LIQUID PHASE CARBON INSTRUCTIONS

1.0 PRE-OPERATION CHECK-OUT

Specific activities to complete before operating the adsorption equipment should include the following:
1. Check all piping connections for proper installation and tightness.
2. Ensure that all gauges and instruments are functional and installed correctly.
Re-zero or re-calibrate if necessary.
3. Close all valves in the absorber piping system.

2.0 WETTING (DEAERATING THE CARBON)

In a typical bed of carbon, the pore volume is approximately 40% of the bed volume. Carbon which is shipped dry will contain air in these pores. Therefore, the carbon must be properly wetted prior to being placed on stream. If this is not done, the air within these pores will displace into the void spaces between the carbon particles during operation and cause high pressure drop and channeling in the absorbers. These problems can cause premature breakthrough of contaminants. Air will not migrate out of the bed during normal down flow operation. The time required for wetting is a function of liquid temperature and viscosity. Generally, a minimum wetting period of 24 hours is required using water at ambient temperatures, although a period of up to 72 hours is preferred for complete wetting. After wetting, backwash able adsorbers should be backwashed to remove air and segregate the carbon bysize. The adsorber should be filled up flow at 4 gpm/ft2, maximum.

If the unit must be placed on-stream before the carbon has been wetted, the adsorbers should be drained and backfilled when the pressure drop becomes prohibitive or after two days of operation, whichever occurs first. For process applications, the same procedure is required. If the process liquid cannot be diluted with water and the carbon must be wetted with the process liquid there will be a significant heat of adsorption.

3.0 BACKWASHING AND BACKFLUSHING

3.1 BACKWASH/BACKFLUSH – GENERAL

Backwashing and backflushing are procedures involving running clean, contaminant-free water upflow through the adsorber. Backwashing or backflushing of a carbon bed can be done after fresh carbon has been transferred into an adsorber and wetted, or during operation to remove sediment from the top of the bed. If the adsorbers are to be backwashed during operation, they should be backwashed prior to startup. The reasons for backwashing before placing fresh carbon on-line are to:

(1) size segregate the carbon so subsequent backwashing will return the carbon to the same relative position in the bed,
(2) remove any remaining air from the bed, and
(3) remove carbon fines which can, in some cases, lead to excessive pressure drop and flow restriction.

Backwashing is done during operation to remove:
(1) sediment from the top of the bed,
(2) carbon fines that may be plugging the underdrain nozzles, and
(3) air that is binding the bed.

The need to backwash is indicated by an increased bedpressure drop. Backwashing an adsorber results in expanding the carbon bed, removing air, suspended solids and carbon fines and classifying the carbon particles. The backwash flow rate depends upon the carbon particle mesh size and the water temperature. Generally, rates in the range of 10 to 15 gpm/ft$_2$ are sufficient to remove solids, remove air, and expand the bed. A fresh carbon fill should be backwashed to classify the carbon. The time required for this step is approximately 30 minutes or until the backwash discharge is free of fines.

Note that the above procedure can also be applied for backflushing when the adsorbers are non-backwashable. The only difference for backflushing is that the flow rate is lower and the time required to backflush is longer.

3.2 RESTARTING SYSTEM AFTER BACKWASHING - SERIES FLOW

The adsorber system is normally operated in a series mode. Valves in the influent and effluent lines are opened or closed, as required, to set the operation of the carbon vessels in the desired configuration. The first bed in the system is called the lead bed. The second bed is referred to as the polish or lag bed. The following sequence of steps should be followed to bring an adsorption system on-line in the series mode:

1. Check that all the valves in the adsorption system are closed.
2. Place the feed pump (s) in service to supply the adsorption module at the required flow and pressure.
3. Open the valve in the effluent line from the polish adsorber
4. Start the feed pump and open the valve in the pump discharge line.
5. Slowly open the valve in the influent line to the lead adsorber and allow the pressure to increase to the operating level.

At this point, flow should be established down flow through both vessels and they will be on-line in series. Set the flow rate to the system at the desired value after flow is established to the unit. In order to obtain full utilization of the carbon and prevent air entrapment and channeling in the bed, the water level must remain above the carbon bed. To prevent the bed from draining due to gravity or loss of influent supply, a vacuum break (anti-siphon) loop or backpressure is included by the customer in the effluent piping.

4.0 STEADY STATE OPERATION

Once flow is established to both vessels and the flow rate is set, no further adjustments are made during normal operation. The operator should establish a routine to check the adsorbers and to collect operating data. This data can be used to establish a maintenance schedule, to determine when backwashing or backflushing is necessary, or to determine when fresh carbon is needed.

4.1 MONITORING

Sample connections are provided on the influent and effluent lines from each vessel to take periodic samples for analysis. Pressure gauges are provided to determine the pressure drop across each carbon bed.
Taking periodic pressure readings will provide the operator with historic data for troubleshooting purposes. In the event that operating conditions change, the operator has the capability of taking corrective action.

4.2 SHUTDOWN

4.2.1 SHORT TERM SHUTDOWN

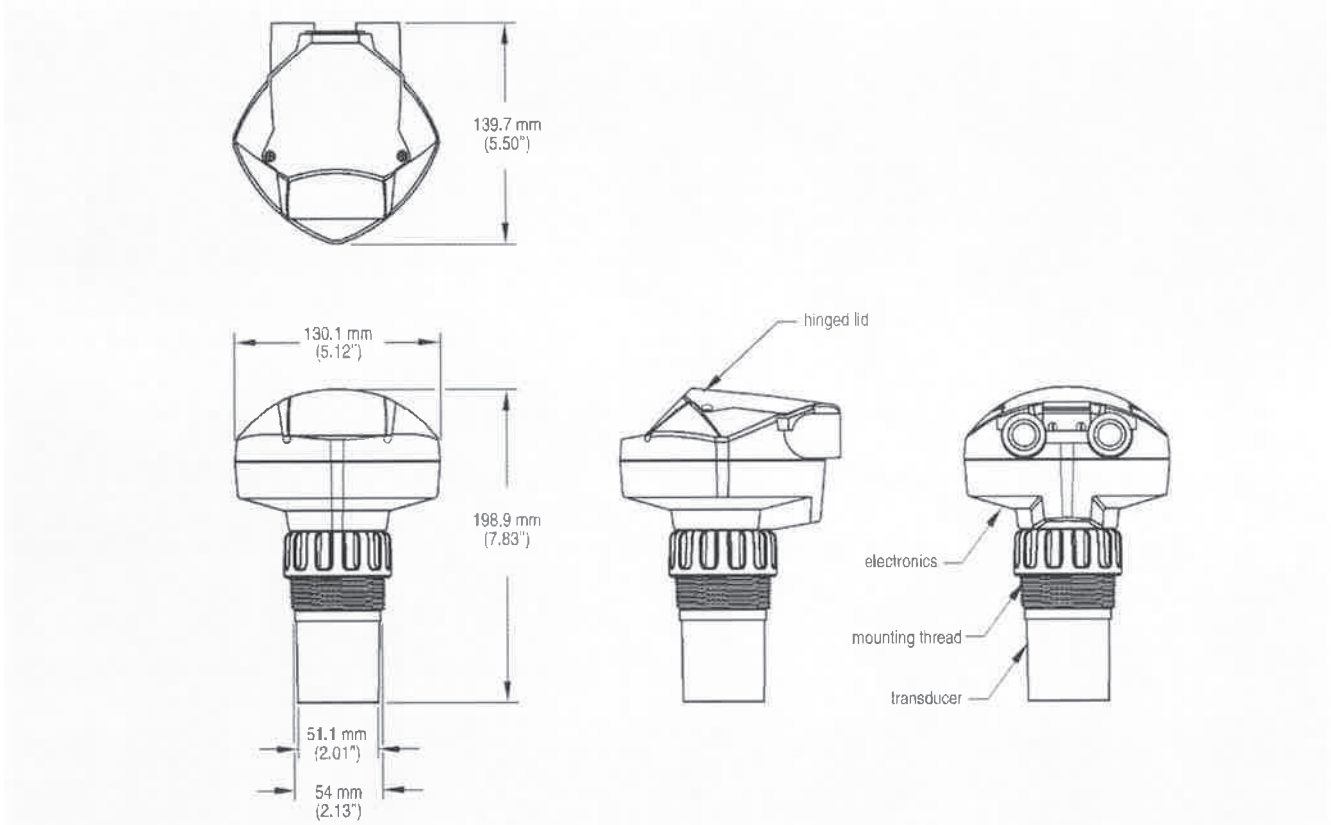
For short duration shutdowns lasting less than one or two weeks, little needs to be done. Close all valves in the adsorber piping system, and open the vent line valves on each vessel. The feed pumps should be shut down and the valves closed in the lines to and from the pumps. Any drain valves in the pump casing should be opened for the duration of the shutdown. Freeze protection measures such as draining lines at the low points should be taken when there is a chance of freezing. Freeze protection measures are usually the responsibility of the client.

4.2.2 EXTENDED SHUTDOWNS

For extended shutdowns, the adsorbers should be drained of all water and filled with clean plant water. When the adsorbers are started up again, the carbon beds may require disinfection. If disinfection is required, call MK. Once the disinfection is complete, backwashable adsorbers should be backwashed prior to startup. After disinfection, bring the adsorber back on-line in the downflow mode, monitor the effluent for coliform count and monitor the pressure drop.

LEVEL TRANSMITTER

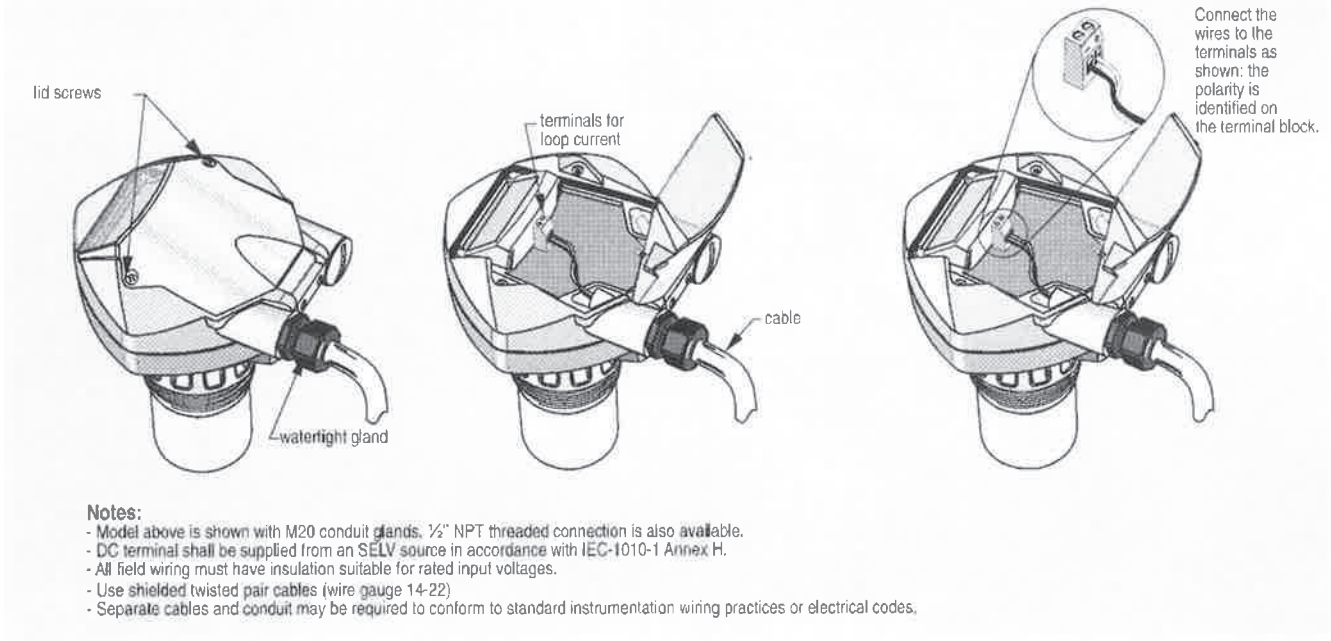
Dimensional drawings



Note: Above model is shown without M20 conduit glands or ½" NPT conduit connectors.

SITRANS Probe LU dimensions

Schematics



Notes:
- Model above is shown with M20 conduit glands. ½" NPT threaded connection is also available.
- DC terminal shall be supplied from an SELV source in accordance with IEC-1010-1 Annex H.
- All field wiring must have insulation suitable for rated input voltages.
- Use shielded twisted pair cables (wire gauge 14-22)
- Separate cables and conduit may be required to conform to standard instrumentation wiring practices or electrical codes.

SITRANS Probe LU connections

SITRANS Probe LU

Ordering data		Order No.
SITRANS Probe LU	C)	**7ML5221 -**
2-wire loop powered ultrasonic transmitter for level, volume, and flow monitoring of liquids		■■■■■
Enclosure		
Plastic (PBT), Qty 2 x M20x1.5		1
Plastic (PBT), Qty 2 x 1/2" NPT		2
Range / Sensor material		
6 meter (20 ft), ETFE		A
6 meter (20 ft), PVDF Copolymer		B
12 meter (40 ft), ETFE		C
12 meter (40 ft), PVDF Copolymer		D
Process Connection		
2" NPT		A
2" BSP		B
2" G / PF2		C
Communication / Output		
4 to 20 mA, HART		1
Approvals		
General purpose, FM, CSA, CE		1
Intrinsically Safe, FM Class 1, Div. 1, Groups A, B, C, D (barrier required); Class II, Div. 1, Groups E, F, G; Class III, ATEX II 1G EEx ia IIC T4		2
Intrinsically Safe, CSA Class 1, Div. 1, Groups A, B, C, D (barrier required); Class II, Div. 1, Group G; Class III		3
Instruction Manual		
English	C)	**7ML1998-5HT01**
German	C)	**7ML1998-5HT31**
Note: The instruction manual should be ordered as a separate item on the order.		
Additional Quick start manual		
Multi-language Quick start manual	C)	**7ML1998-5QR81**
Note: Due to ATEX regulations, one Quick start manual is included with every product.		
Optional Equipment		
Hand programmer, Intrinsically Safe, EEx ia		**7ML5830-2AH**
HART modem (for use with a PC and SIMATIC PDM)	A)	**7MF4997-1DA**
Siemens Intrinsically Safe Barrier (DC powered), ATEX II 1 G, EEx ia		**7NG4122-1AA10**
2" NPT locknut, plastic		**7ML1830-1DT**
2' BSP locknut, plastic		**7ML1830-1DQ**
Universal Mounting Adapter, 2" NPT		**7ML1830-1BT**
Universal Mounting Adapter, 2" BSP		**7ML1830-1BU**
Universal Mounting Adapter, 2" G / PF2		**7ML1830-1BV**

A) Subject to export regulations AL: N, ECCN: EAR99H

C) Subject to export regulations AL: N, ECCN: EAR99

ENGLISH

Quick Start Guide - ATV 61

S1B8697400

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand this quick start guide before performing any procedure with this drive.
- The user is responsible for compliance with all international and national electrical code requirements with respect to grounding of all equipment.
- Many parts of this drive, including the printed circuit boards, operate at the line voltage. DO NOT TOUCH. Use only electrically insulated tools.
- DO NOT touch unshielded components or terminal strip screw connections with voltage present.
- DO NOT short across terminals PA/+ and PC/- or across the DC bus capacitors.
- Before servicing the drive:
  - Disconnect all power, including external control power that may be present.
  - Place a "DO NOT TURN ON" label on all power disconnects.
  - Lock all power disconnects in the open position.
  - WAIT 15 MINUTES to allow the DC bus capacitors to discharge.
  - Measure the voltage of the DC bus between the PA/+ and PC/- terminals to ensure that the voltage is less than 42 Vdc.
  - If the DC bus capacitors do not discharge completely, contact your local Schneider Electric representative. Do not repair or operate the drive
- Install and close all covers before applying power or starting and stopping the drive.

Failure to follow these instructions will result in death or serious injury.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this product.

Information below is designed to use **single drive** connected to **single asynchronous motor with a motor cable length less than 50 meters (164ft).** In any other case, consult the drive installation manuals (1760643 or 1760655) and programming manual (1760649) on www.schneider-electric.com.

❶ Check the delivery of the drive

- Remove the drive from the packaging and check that it has not been damaged.

⚠ WARNING

DAMAGED DRIVE EQUIPMENT

Do not operate or install any drive or drive accessory that appears damaged.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

- Check that the drive reference printed on the label matches the delivery note and corresponding purchase order.

Write the drive Model Reference: _____ _____and Serial Number: _____

❷ Check the line voltage compatibility

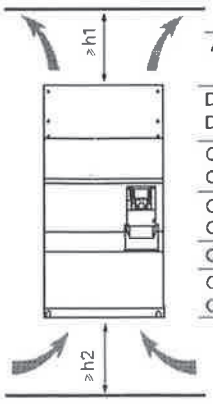
- Check that the **line voltage** is compatible with the supply range of the drive.

Line voltage _____ Volts Drive voltage range _____ Volts

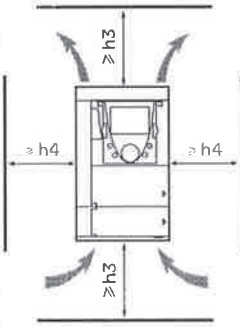
Drive range: ATV●●●●●● M3 = 200/ 240 V three-phase - ATV●●●●●● N4 = 380 /480 V three-phase

ATV●●●●●● Y = 500 /690 V three-phase - ATV●●●●●● S6 = 500 /600 V three-phase

❸ Mount the drive vertically



ATV61H	h1 mm (in.)	h2 mm (in.)
D55M3X, D75M3X, D90M3X, D90N4, C11N4	100 (3.9)	100 (3.9)
C13N4, C16N4, C22N4, C11Y, C13Y, C16Y, C20Y	150 (5.9)	150 (5.9)
C25N4, C31N4, C25Y, C31Y, C40Y	200 (7.8)	150 (5.9)
C40N4, C50N4	300 (11.8)	250 (9.8)
C63N4, C50Y, C63Y, C80Y	400 (15.7)	250 (9.8)



ATV61H	h3 mm (in.)	h4 mm (in.)
D18M3X to D45M3X, D22N4 to D75N4 U30Y to D90Y	100 (3.9)	50 (1.9)
075M3 to D15M3X, 075N4 to D18N4, U22S6X to U75S6X		

Free space in front of the drive: 10 mm (0.4 in.) minimum

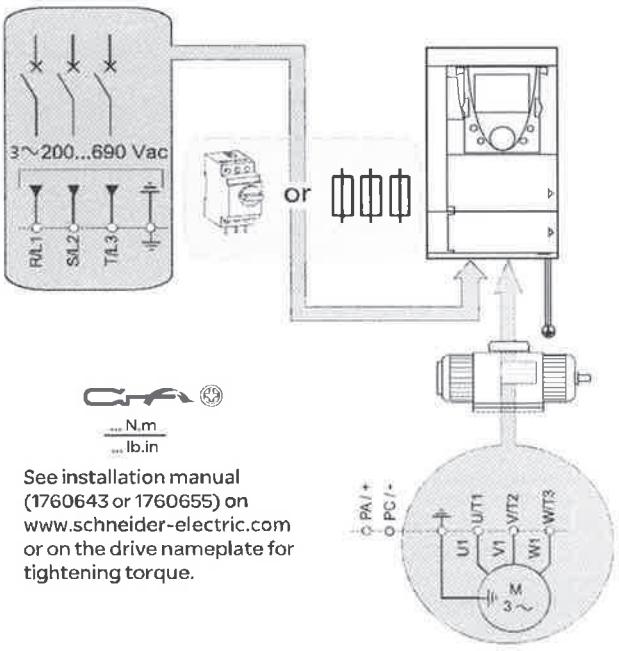
Install the drive vertically at ± 10°.

For a surrounding air temperature up to 50 °C (122°F), see installation manual (1760643 or 1760655) on www.schneider-electric.com for other thermal conditions.

Schneider Electric

❹ Connect the drive: Power

- Wire the drive to the ground.
- Check circuit breaker rating or fuse rating (See SCCR annex S1B86981).
- Check that the motor voltage is compatible with the drive voltage. Motor voltage _____Volts.
- Wire the drive to the motor.
- Wire the drive to the line supply.



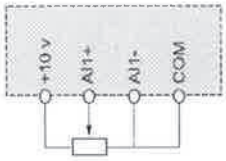
... N.m
... lb.in

See installation manual (1760643 or 1760655) on www.schneider-electric.com or on the drive nameplate for tightening torque.

❺ Connect the drive: Control by external reference (Fr1 = AI1)

0,6 N.m
5,3 lb.in

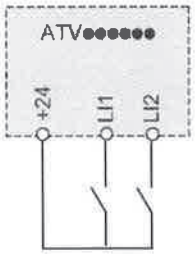
- **Wire the speed reference:**



- **Wire the command:**

Control command 2-wire:
Parameter t C C = 2 C

LI1: forward
LI2: reverse



⚠⚠ DANGER

HAZARD OF FIRE OR ELECTRIC SHOCK

- To avoid overheating or loss of contact, connections must be carried out according to the cable sizes and tightening torques visible on the label stuck on the ATV●●.
- The use of multi-wire cable without a lug is forbidden for the mains connection.
- Carry-out a pull out test to check that terminal screws are correctly tighten.

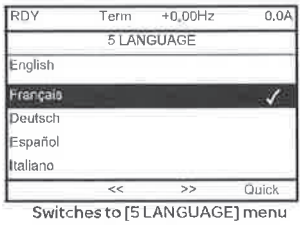
Failure to follow these instructions will result in death or serious injury.

❻ Apply power to the drive

- Check that Logic Inputs are not active (LI1, LI2, see drawing ❺).
- Apply power to the drive.
- At first power up, it's displaying the drive state.

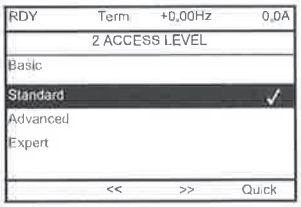
Display for 3 seconds following power-up

3 seconds



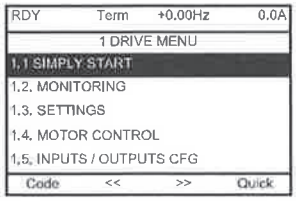
Switches to [5 LANGUAGE] menu automatically after 3 seconds. Select the language and press ENT

ENT



ENT

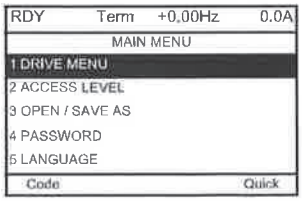
Switches to [2 ACCESS LEVEL] menu



Switches to [1 DRIVE MENU]

ESC

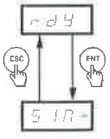
2 times



Press ESC to return to [MAIN MENU].

With integrated display terminal.

At first power ON



❼ Set motor parameters for asynchronous motor.

- See on the motor Nameplate to set the following parameters .

Menu	Code	Description	Factory setting	Customer setting
5 IN - [1.1 SIMPLY START]	bFr	[Standard mot. freq]: Standard motor frequency (Hz)	[50Hz IEC] 50	
	nPr	[Rated motor power]: Nominal motor power on motor nameplate (KW)	drive rating	
	UnS	[Rated motor volt.]: Nominal motor voltage on motor nameplate (Vac)	drive rating	
	nCr	[Rated mot. current]: Nominal motor current on motor nameplate (A)	drive rating	
	FrS	[Rated motor freq.]: Nominal motor frequency on motor nameplate (Hz)	50	
	nSP	[Rated motor speed]: Nominal motor speed on motor nameplate (rpm)	drive rating	
	ItH	[Mot. therm. current]: Motor thermal protection current on the motor's rating plate (A)	drive rating	

Menu	Code	Description	Factory setting	Customer setting
5 IN - [1.1 SIMPLY START]	tUn	Set [Auto tuning] (tUn) parameter to YES. Auto-tuning is performed as soon as possible, then the parameter automatically changes to [Done] (dOnE).	no	

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK OR ARC FLASH

- During auto-tuning, the motor operates at rated current.
- Do not service the motor during auto-tuning.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

DAMAGED DRIVE EQUIPMENT

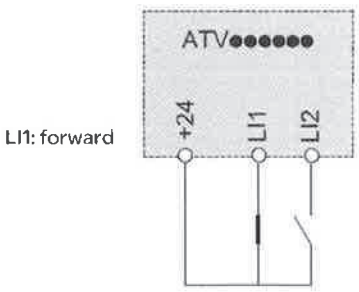
- **Asynchronous motor:** It is essential that the following parameters UnS, FrS, nCr, nSP and nPr are correctly configured before starting autotuning.
- **Synchronous motor:** It is essential that the following parameters nCrS, nSPS, PPnS, PHS, LdS and LFS are correctly configured before starting autotuning.
- When one or more of these parameters have been changed after auto-tuning has been performed, YES will return to dOnE and the procedure will have to be repeated.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

❽ Set basic parameters

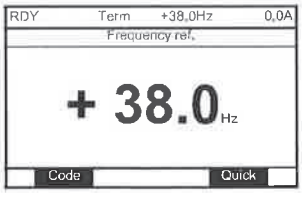
Menu	Code	Description	Factory setting	Customer setting
5 IN - [SIMPLY START]	ACC	[Acceleration]: Acceleration time (s)	3.0	
	dEC	[Deceleration]: Deceleration time (s)	3.0	
	LSP	[Low speed]: Motor frequency at minimum reference (Hz)	0	
	HSP	[High speed]: Motor frequency at maximum reference (Hz)	50	

❾ Start the motor



LI1: forward

Graphic display terminal



Integrated display terminal

Menus structure

Access level

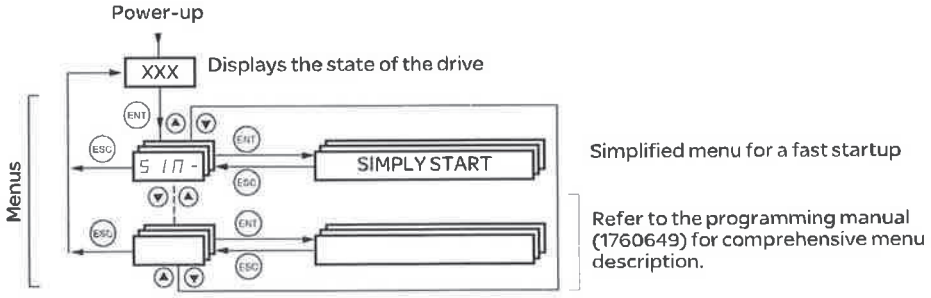
Comparison of the menus that can be accessed on the graphic display terminal/integrated display terminal

Graphic display terminal		Integrated display terminal	[2. ACCESS LEVEL] (LAC-)
[2 ACCESS LEVEL]		LAC -	[Basic] bAS / [Standard] Std (factory setting) / [Advanced] AdU / [Expert] EPr
[3 OPEN/SAVE AS]		-	
[4 PASSWORD]		COd -	
[5 LANGUAGE]		-	
[1 DRIVE MENU]	[1.1 SIMPLY START]	SIM -	
	[1.2 MONITORING]	SUP -	
	[1.3 SETTINGS]	SEt -	
	[1.11 IDENTIFICATION]	-	
	[1.12 FACTORY SETTINGS]	FCS -	
	[1.13 USER MENU]	USr -	
A single function can be assigned to each input.			
	[1.4 MOTOR CONTROL]	drC -	
	[1.5 INPUTS / OUTPUTS CFG]	I-O -	
	[1.6 COMMAND]	CtL -	
	[1.7 APPLICATION FUNCT.]	FUn -	
	[1.8 FAULT MANAGEMENT]	FLt -	
	[1.9 COMMUNICATION]	COM -	
	[1.10 DIAGNOSTICS]	-	
	[1.14 PROGRAMMABLE CARD] (1)	PLC -	
[6 MONITORING CONFIG.]		-	
A single function can be assigned to each input.			
[7 DISPLAY CONFIG.]		-	
Several functions can be assigned to each input			
Expert parameters		EPr -	
Several functions can be assigned to each input.			

(1) can be accessed if the PLC card is present.

Accessing SIMPLY START and parameters.

A dash appears after menu and submenu codes to differentiate them from parameter codes.
Example: [1.1 SIMPLY START] (SIM-), [2/3 wire control] (tCC) parameter.



Certificate CE/ATEX

See on www.schneider-electric.com

CE

ATV61H CE Certificate
ATV61W CE Certificate
ATV61E5 CE Certificate

Ex

07ATEX0004X

ENGLISH

Getting Started
With Altivar Process ATV600

EAV6325304

1 Download The Manuals

You must have detailed information to be able to carry out the installation and commissioning. This information can be found in the following manuals that can be downloaded on www.se.com
or scan the QR code in front of the Drive.

- The Installation manual (EAV64301)
- The Programming manual (EAV64318)

The Getting Started manual does not replace the Installation and the Programming manuals.

Verify the Key Points of your installation, identified by this symbol.

You can watch our Video

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this drive system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.

- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Many components of the product, including the printed circuit boards, operate with mains voltage.
- Only use properly rated, electrically insulated tools and measuring equipment.
- Do not touch unshielded components or terminals with voltage present.
- Motors can generate voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors of the motor cable.
- Do not short across the DC bus terminals or the DC bus capacitors or the braking resistor terminals.
- Before performing work on the drive system:
  - Disconnect all power, including external control power that may be present. Take into account that the circuit breaker or main switch does not de-energize all circuits.
  - Place a **Do Not Turn On** label on all power switches related to the drive system.
  - Lock all power switches in the open position.
  - Wait 15 minutes to allow the DC bus capacitors to discharge.
  - Follow the instructions given in the chapter "Verifying the Absence of Voltage" in the installation manual of the product.
- Before applying voltage to the drive system:
  - Verify that the work has been completed and that the entire installation cannot cause hazards.
  - If the mains input terminals and the motor output terminals have been grounded and short-circuited, remove the ground and the short circuits on the mains input terminals and the motor output terminals.
  - Verify proper grounding of all equipment.
  - Verify that all protective equipment such as covers, doors, grids is installed and/or closed.

Failure to follow these instructions will result in death or serious injury.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this product.

2 Verify The Delivery Of The Drive

Unpack the drive and verify that it has not been damaged. Damaged products or accessories may cause electric shock or unanticipated equipment operation.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Do not use damaged products or accessories.

Failure to follow these instructions will result in death or serious injury.

Contact your local Schneider Electric sales office if you detect any damage whatsoever.

Verify compatibility between your drive and your application with our

Product Selector

3 Verify The Supply Mains Compatibility With The Drive

3-phase supply mains:_____V~

Drive mains voltage: _____V~

ATV••••••M3 = 200/240 V~
ATV••••••N4• = 380/480 V~
ATV••••••S6• = 600 V~
ATV••••••Y6 = 500/690 V~

Verify the quality of the supply mains (harmonics, voltage...).

4 Verify Upstream Protective Device

or

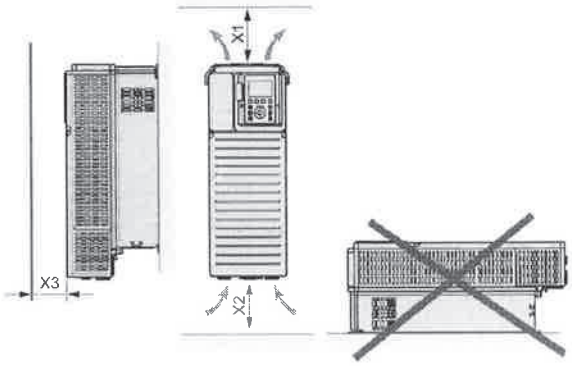
- For IEC, on ATV600 Catalog DIA2ED2140502EN

or

- For UL fuse rating, with attached SCCR annex EAV64300.

Schneider Electric

5 Mount The Drive Vertically ☑

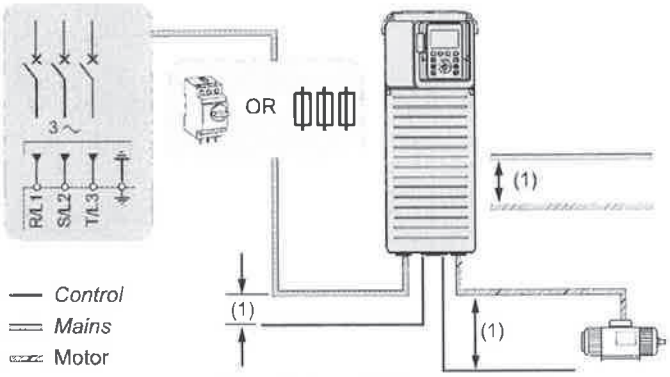


Drive	X1	X2	X3
ATV630U07●●...ATV630D90N4●, ATV630U22S6X...ATV630D15S6X, ATV630●●●S6, ATV630●●●Y6, ATV650●●●●●●	≥ 100 mm (3.94 in.)	≥ 100 mm (3.94 in.)	≥ 10 mm (0.39 in.)
ATV630D55M3...ATV630D75M3, ATV630C11N4●...ATV630C16N4●	≥ 250 mm (9.84 in.)	≥ 250 mm (9.84 in.)	≥ 100 mm (3.94 in.)
ATV630C22N4●...ATV630C31N4●	≥ 200 mm (7.87 in.)	≥ 150 mm (5.91 in.)	≥ 10 mm (0.39 in.)

See thermal conditions in the Installation manual (EAV64301).

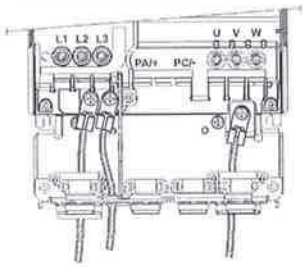
6 Connect The Drive: Ground and Power ☑

1. Connect the ground cables ⏚ .
2. Connect the drive to the mains (R/L1, S/L2, T/L3).
3. Connect the drive to the motor (U/T1, V/T2, W/T3).
4. Ensure minimum distance between the "Control" and "Power" cables.

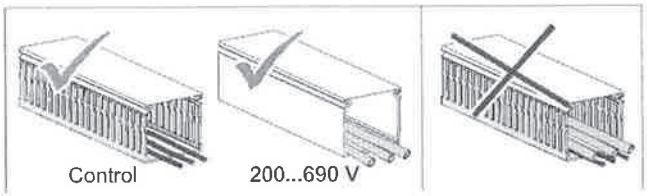


(1) Defined by *Practical Installation guidelines* (deg999en).

Example on frame size 3



See other Frame sizes in chapter *Wiring the Power Part* of the Installation manual (EAV64301)



For more information, download the white paper *An Improved Approach for Connecting VSD and Electric Motors* (998-2095-10-17-13AR0_EN).

5. Refer to the tightening torque instructions on the nameplate ☑

⚠⚠ DANGER

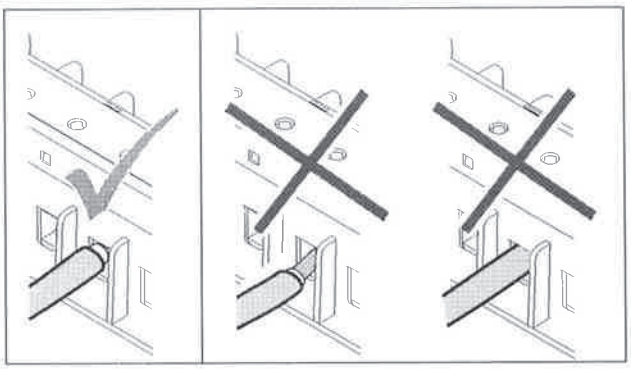
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Wire cross sections and tightening torques must comply with the specifications provided in the installation manual.

Failure to follow these instructions will result in death or serious injury.

Stripping lengths  **and Cabling** ☑

Refer to the instructions given in the installation manual (EAV64301).

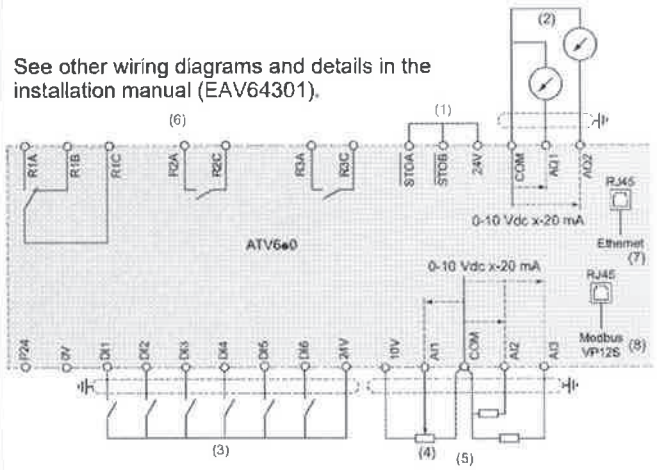


7 Connect The Drive: Control

Wiring Example

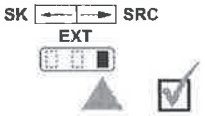
1. For reference frequency, connect **AI1**, **10V** and **COM** with a potentiometer 1...10 kΩ (ex. SZ1RV1002)
2. Connect the command **DI1** to **24V**
   DI1 = forward (control command 2-wire - factory setting)

See other wiring diagrams and details in the installation manual (EAV64301).



(1) STO Safe Torque Off, (2) Analog Outputs, (3) Digital Inputs,
(4) Reference potentiometer 1...10 kΩ (ex. SZ1RV1002), (5) Analog Inputs,
(6) Relay Outputs, (7) Cable specification: min. Cat 5e, twisted-pair, 8 x 0.25 mm² (AWG 22), max. length 100 m (328 ft),
(8) See Catalog DIA2ED2140502EN for cable references

Verify that the switch is on default position = SRC mode (right position)



Sink (SK) - Sink External (EXT) - Source (SRC)

SOURCE (SRC) position is used for PLC outputs with PNP transistors. Refer to the instructions given in the installation manual (EAV64301).

NOTICE

INCORRECT VOLTAGE

Only supply the digital inputs with 24 Vdc.

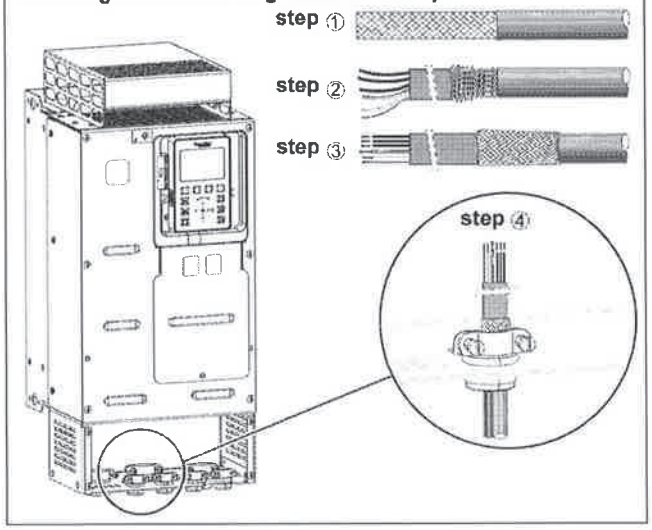
Failure to follow these instructions can result in equipment damage.

Tightening torque and screwdriver type

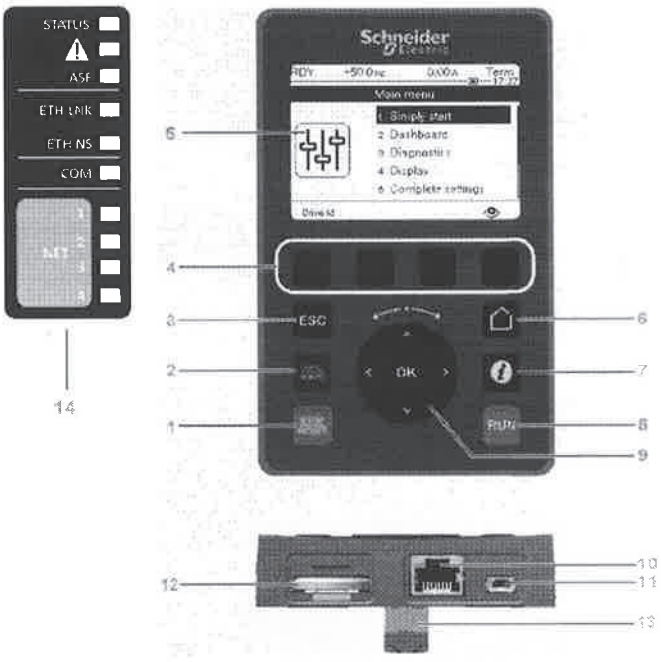
0.5 N.m
4.4. lb.in

Relay Output Wire Cross Section		Other Wire Cross Section	
Minimum	Maximum	Minimum	Maximum
mm² (AWG)	mm² (AWG)	mm² (AWG)	mm² (AWG)
0.75 (18)	1.5 (16)	0.5 (20)	1.5 (16)

Shielding connection to ground: DI example



8 LEDs and Graphic Display Terminal



1. STOP / RESET: Stop command / apply a Fault Reset.
2. LOCAL / REMOTE: used to switch between local and remote control of the drive.
3. ESC: used to quit a menu/parameter or remove the currently displayed value in order to revert to the previous value retained in the memory.
4. F1 to F4: function keys used to access drive id, QR code, quick view, and submenus.
5. Graphic display.
6. Home: used to access directly at the home page.
7. Information: to get more information about parameters.
8. RUN: executes the function assuming it has been configured.
9. Touch wheel / OK: used to save the current value or access the selected menu/parameter. The touch wheel is used to scroll fast into the menus. Up/down arrows are used for precise selections, right/left arrows are used to select digits when setting a numerical value of a parameter.
10. RJ45 Modbus serial port: used to connect the Graphic Display Terminal to the drive. This connection requires specific cables to be ordered separately, see the Catalog (DIA2ED2140502EN).
11. Mini USB port: used to connect the Graphic Display Terminal to a computer.
12. Battery (10 years service life. Type: CR2032).
13. RJ45 male connector to plug on the drive or on the door mounting kit.

14. For a detailed description of the LEDs, refer to the section *Description of the Product Front LEDs* of the Programming manual (EAV64318).

9 [Simply start]

- Verify that digital input is not active (**DI1** open, see step 7 wiring diagram).
- Apply power to the drive.
- If requested, set the date, time, and language.

10 Set Motor Parameters For Asynchronous Motor

NOTE: For other motor types, refer to the Programing manual (EAV64318).

See the motor nameplate to set the following

Menu	Parameter	Factory Setting		Customer Setting
		ATV••••••M3 ATV••••••N4•• ATV••••••Y6	ATV••••••S6•	
[Simply start]	[Motor Standard] bFr: Standard motor frequency	[50 Hz IEC] 50 (Hz)	[60 Hz IEC] 60 (Hz)	
	[Nominal Motor Power] nPr: Nominal motor power on motor nameplate	drive rating (kW)	drive rating (HP)	
	[Nom Motor Voltage] UnS: Nominal motor voltage on motor nameplate	drive rating (Vac)		
	[Nom Motor Current] nCr: Nominal motor current on motor nameplate	drive rating (A)		
	[Nominal Motor Freq] FrS: Nominal motor frequency on motor nameplate	50 (Hz)		
	[Nominal Motor Speed] nSP: Nominal motor speed on motor nameplate	drive rating (rpm)		
	[2/3-Wire Control] tCC: Command control by 2 wire or 3 wire control	2C		
	[Max Frequency] tFr: Maximum motor frequency	60 (Hz)	72 (Hz)	
	[Motor Th current] ItH: Motor thermal current on motor nameplate	drive rating (A)		

11 Perform A Motor [Autotuning] For Asynchronous Motor

NOTE: Perform autotuning with the motor cold. If you modify motor parameters after having performed autotuning, you must re-perform autotuning.

⚠ WARNING

UNEXPECTED MOVEMENT

Autotuning moves the motor in order to tune the control loops.

- Only start the system if there are no persons or obstructions in the zone of operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

During [Autotuning], the motor makes small movements. Noise development and oscillations of the system are normal.

Menu	Parameter
[Simply start]	[Autotuning] tUn: Set parameter to [Apply Autotuning] YES. [Autotuning] tUn is done immediately.

12 Set Basic Parameters

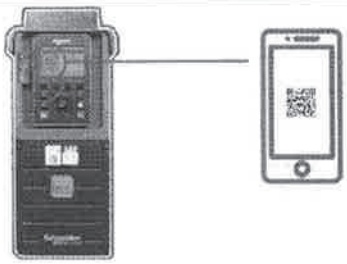
Menu	Parameter	Factory Setting		Customer Setting
		ATV••••••M3 ATV••••••N4•• ATV••••••Y6	ATV••••••S6•	
[Simply start]	[Acceleration] ACC: Acceleration time	10.0 (s)		
	[Deceleration] dEC: Deceleration time	10.0 (s)		
	[Low speed] LSP: Motor frequency at minimum reference	0 (Hz)		
	[High speed] HSP: Motor frequency at maximum reference	50 (Hz)	60 (Hz)	

13 Start And Stop The Motor

- Switch on **DI1** (forward).
- Use the potentiometer on **AI1** to set the reference frequency, adjustable from [Low speed] LSP to [High speed] HSP.
- Switch off **DI1** (forward) to stop the motor.

Troubleshooting

Scan the QR code on the RED screen or refer to the Programming manual (EAV64318), to get the error code explanations.



Other Tools To Configure The Drive

- **SoMove** is a setup software for PC designed to configure Schneider Electric motor control devices.
  You can download the SoMove FDT (SoMove_FDT), the DTM in English (ATV6xx_DTM_Library_EN) and language pack, on www.se.com.
- **Embedded Webserver**: See the Embedded Ethernet manual (EAV64327) for more information.

TRANSFER PUMPS

CT Series

High Pressure Centrifugal Pumps
½ - 2½ HP
Heads to 140 Feet
Capacities to 95 GPM

ADVANTAGES BY DESIGN

- Heavy duty cast iron construction.
- Back pull-out design.
- Dependable double ball bearing motor
- Continuous duty rating motor.
- Choice of brass or composite impeller.
- Brass impeller pumps rated 212° F.
- Composite impeller pumps rated 140° F.
- Maximum working pressure of 125 psi.
- CSA listed.

Applications

- Booster service
- Irrigation
- Circulating
- Cooling towers
- Air conditioning
- Liquid transfer
- Sprinkling systems
- General industrial service

Note: MK Environmental uses oversized pump motors. See below

MYERS CT SERIES LINE OF HIGH PRESSURE CENTRIFUGAL PUMPS PROVIDES QUALITY AT A COMPETITIVE PRICE. The complete line of ¼ to 2½ HP units provide strong pressures up to 140 feet and flows up to 95 gpm.

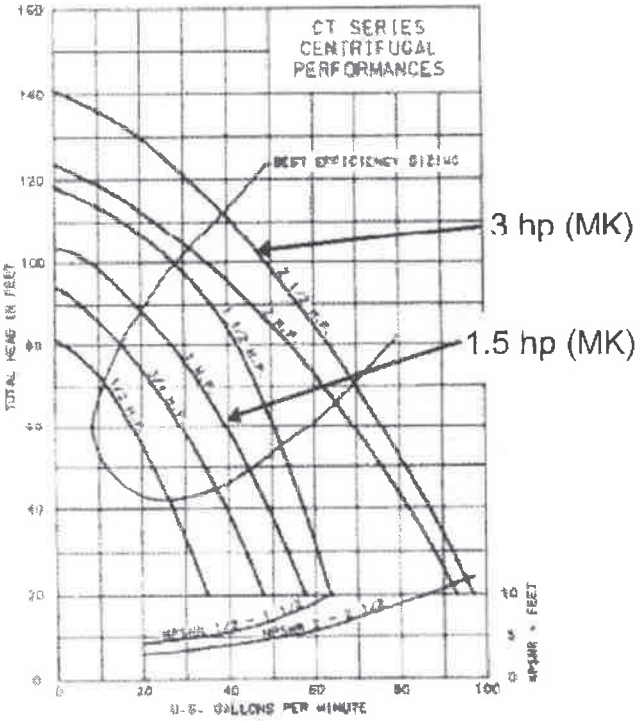
The rugged cast iron body construction is available with either a corrosion resistant composite or brass impeller. The brass impeller unit is equipped with a high temperature, viton seal for more demanding applications. The heavy duty motor features a double ball bearing, 50° C ambient, dual voltage design for dependable service. The compact, back pullout design provides easy installation and serviceability

The quality features of the CT series will provide dependable service for a wide variety of applications.

SPECIFICATIONS

HP	Catalog No. Composite Impeller	Catalog No. Brass Impeller	Pipe Tapping Sizes Suction (NPT)	Pipe Tapping Sizes Discharge (NPT)	Motor Voltage	Phase	Approx. Wt. Lbs.
½	CT05	CT05B	1"	1"	115/230	1	30
	CT05B3	CT05B3	1"	1"	208/230/460	3	30
¾	CT07	CT07B	1"	1"	115/230	1	32
	CT07B3	CT07B3	1"	1"	208/230/460	3	32
1	CT10	CT10B	1"	1"	115/230	1	35
	CT10B3	CT10B3	1"	1"	208/230/460	3	35
1½	CT15	CT15B	1"	1"	115/230	1	40
	CT15B3	CT15B3	1"	1"	208/230/460	3	40
2	CT20	CT20B	1½"	1¼"	115/230	1	57
	CT20B3	CT20B3	1½"	1¼"	208/230/460	3	57
2½	CT25	CT25B	2"	1½"	115/230	1	62
	CT25B3	CT25B3	2"	1½"	208/230/460	3	62

PUMP PERFORMANCE



WHERE INNOVATION MEETS TRADITION

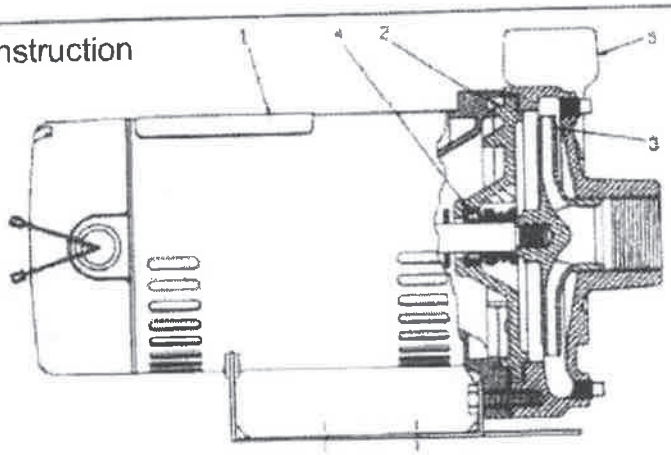
Myers

ISO 9001 Certified Company

CT Series

High Pressure Centrifugal Pumps
½ - 2½ HP
Heads to 140 Feet
Capacities to 95 GPM

1. MOTOR MK standard is TEFC construction
- NEMA standard
- Double ball bearing
- Open drip proof
- 60 Hz, 3450 rpm
- Stainless steel shaft
- Single phase with built-in overload protection
- Three phase require overload protection in starter unit
- Non-overloading
- Continuous duty
- Strong capacitor start design

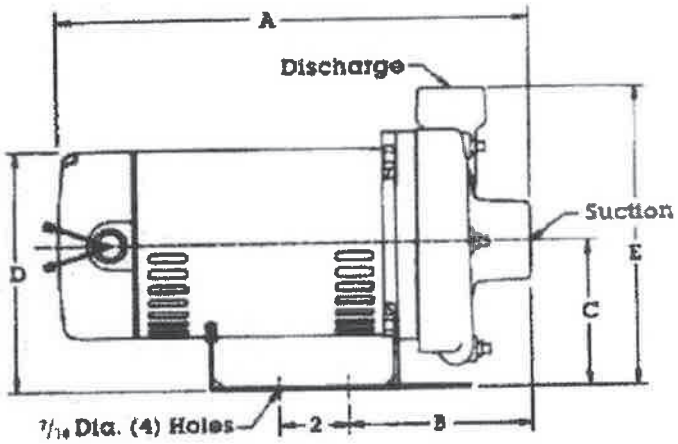


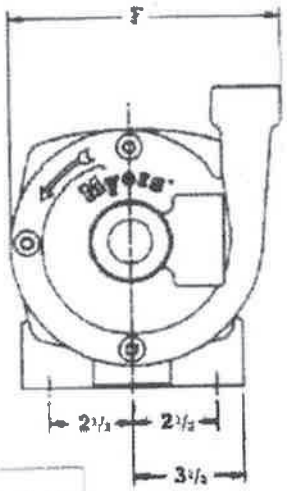
2. SEAL PLATE
- Heavy duty cast iron for dependable service and long life

3. IMPELLER
- Reinforced composite for applications to 140° F.
- Threaded SST insert on composite impellers
- Brass for applications to 212° F.
- Enclosed design for high efficiencies
- Balanced for smooth operation

4. MECHANICAL SEAL
- Standard carbon/ceramic faces, Buna elastomers, 300 series SST components (standard for pumps with composite impellers)
- High temperature carbon/ceramic faces, viton elastomers, 300 series SST components (standard for pumps with brass impellers)

5. CASING
- Heavy duty cast iron construction
- Back pull-out design
- Discharge can be rotated in four positions
- Tapped openings for priming, venting and draining.
- Vertical discharge standard





HP	Dimensions, inches							
	A	B	C	D	E	F	Suct.	Disch.
½	13⅞	5½	4⅛	7⅛	9	8	1¼	1
¾	14⅜	5½	4⅛	7¼	9	8	1¼	1
1	15⅛	5½	4⅛	7¼	9	8	1¼	1
1½	15⅜	5½	4⅛	7¼	9	8	1¼	1
2	16½	6¼	4½	7½	9½	8⅞	1½	1¼
2½	16½	6¼	4½	7½	9½	8⅞	2	1½

Myers®

CT Kit Pumps

INSTALLATION

PACKAGE CONTENTS - 1. The catalog lists all parts included with package
2. Be sure all parts have been furnished and that nothing has been damaged in shipment.
3. OPEN PACKAGES AND MAKE THIS CHECK BEFORE GOING ON JOB.

PIPING - Pipes must line up and not be forced into position by unions. **Piping should be independently supported near the pump so that no strain will be placed on the pump casing.** Where any noise is objectionable, pump should be insulated from the piping with rubber connections. Always keep pipe size as large as possible and use a minimum of fittings to reduce friction losses.

SUCTION PIPING - Suction pipe should be direct and as short as possible. It should be at least one size larger than suction inlet tapping and should have a minimum of elbows and fittings. The piping should be laid out so that it slopes upward to pump without dips or high points so that air pockets are eliminated. The highest point in the suction piping should be the pump inlet except where liquid flows to the pump inlet under pressure. A foot valve must be used to keep pump primed. Where liquid flows to the pump, it may be desirable to use a check valve in the suction line or discharge line to keep pump primed.

To prevent air from being drawn into suction pipe due to a suction whirlpool, the foot valve should be submerged at least three feet below the low water level. The suction pipe must be tight and free of air leaks or pump will not operate properly.

DISCHARGE PIPING - Discharge piping should never be smaller than pump tapping and should preferably be one size larger. A gate valve should always be installed in discharge line for throttling if capacity is not correct. To protect the pump from water hammer and to prevent backflow, a check valve should be installed in the discharge line between the pump and gate valve.

ELECTRICAL CONNECTIONS - Be sure motor wiring is connected for voltage being used. Unit should be connected to a separate circuit, direct from main switch. A fused disconnect switch or circuit breaker must be used in this circuit. Wire of sufficient size should be used to keep voltage drop to a maximum of 5%. All motors, unless provided with built-in overload protection, must be protected with an overload switch, either manual or magnetic.

Never install a pump without proper overload protection. When motor is mounted on a base plate or on slide rails for adjustment, flexible metallic conduit should be used to protect the motor leads.

PRIMING - The pump must be primed before starting. The pump casing and suction piping must be filled with water before starting motor. Remove vent plug in top of casing while pouring in priming water. A hand pump or ejector can be used for priming when desired. When water is poured into pump to prime, use care to remove all air before starting motor.

If pump does not start immediately, stop and reprime.

STARTING - It is good practice to close the discharge valve when starting the pump as it puts less starting load on the motor. When the pump is up to operating speed, open the discharge valve to obtain desired capacity or pressure. Do not allow the pump to run for long periods with the discharge valve tightly closed. If the pump runs for an extended period of time without liquid being discharged, the liquid in the pump case can get extremely hot.

ROTATION - The pump must run in direction of arrow on pump case. All single phase motors are single rotation and leave factory with proper rotation. Three phase motors may run either direction. If rotation is wrong when first starting motor, interchange any two line leads to change rotation.

STOPPING - Before stopping pump, close the discharge valve. This will prevent water hammer and is especially important on high head pumps.

FREEZING - Care should be taken to prevent the pump from freezing during cold weather. It may be necessary, when there is any possibility of this, to drain the pump casing when not in operation. Drain by removing the pipe plug in the bottom of the casing.

ROTARY SEAL - CT pumps are fitted only with a rotary seal. This seal is recommended for water free from abrasives. If liquid contains abrasives, the CT pump should not be used.

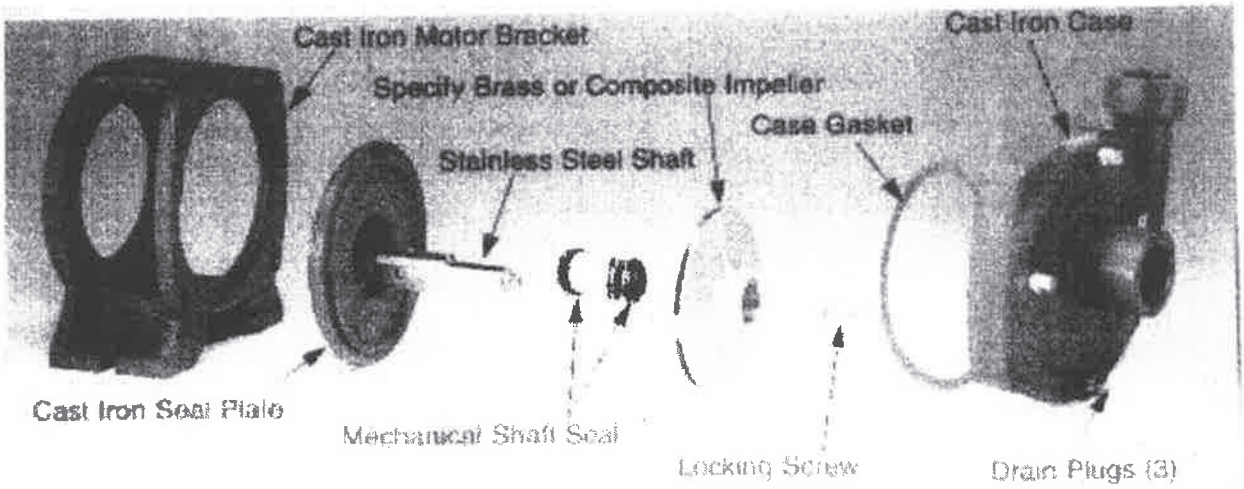
MOTOR Customer supplied standard NEMA 56C frame, single or three phase.

BEARINGS - The pump motor uses sealed ball bearings that are factory lubricated and do not require further lubrication.

SERVICE

TROUBLE SHOOTING GUIDE

A	No water delivered				
B	Not enough water delivered				
C	Not enough pressure				
D	Pump runs for short while; then loses prime				
	POSSIBLE CAUSE OF PROBLEM	D	C	B	A
1.	Pump not properly primed; repeat priming operation				X
2.	Discharge head too high. Check total head with gauge at pump inlet and discharge. (With no water, the gauge at discharge would show shut-off pressure.)			X	X
3.	Excessive volume being discharged. Throttle discharge valve.		X		
4.	Speed too low. Check pump drive belts for slippage. If hot, tighten belts. Check motor voltage and speed.		X	X	
5.	Rotation wrong. Change shaft rotation.		X	X	X
6.	Suction lift too high. Check with vacuum gauge. This should not exceed 15 feet.	X		X	X
7.	Air leak in suction line. Check line under pressure to find leak.	X	X	X	X
8.	Air pocket in suction line. Check line for proper slope.	X			X
9.	Insufficient submergence of suction pipe. Foot valve should be three feet below lowest water level.	X		X	
10.	Sediment chamber clogged. Remove and clean thoroughly. Make sure gasket is in good condition and sealing surfaces clean before reassembly of sediment chamber cap.		X		
11.	Impeller or suction line plugged.		X	X	X
12.	Impeller and volute case badly worn. Disassemble pump; if clearance on diameter is over .030", replace worn impeller and worn volute case.		X	X	
13.	Suction strainer plugged. Clean strainer.	X			
14.	Impeller diameter too small for condition required.		X	X	
15.	Seal leaking - seal is worn or seal face cocked. Replace with new seal and carefully follow directions.				



DISASSEMBLY INSTRUCTIONS

All pumping parts can be removed from case without disturbing the piping.

POWER SUPPLY - Open the power supply switch contacts and remove fuses. Disconnect the electrical wiring from the motor.

VOLUTE CASE

(a) Drain pump case by removing drain plugs.
(b) Remove the bolts securing volute case to pump bracket.
(c) To pry components apart, use two screwdrivers opposite each other. (Fig. 1)

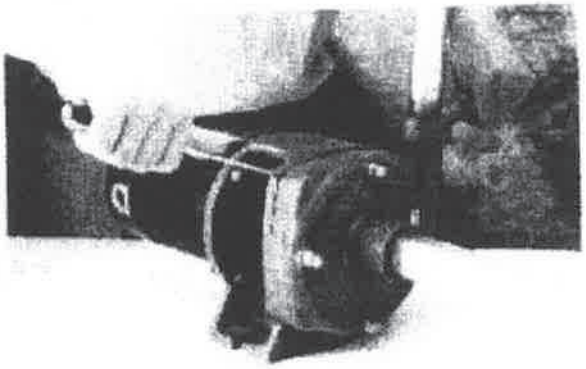


FIG. 1

IMPELLER

(a) Remove impeller by holding stub shaft with water pump pliers and unscrewing capscrew by hand. (Fig. 2)
(b) Turn impeller counter-clockwise to remove from stub shaft.

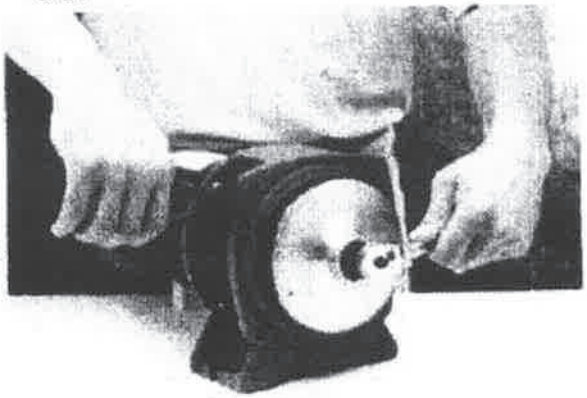


FIG. 2

SEAL

(a) The seal used is ⅝"
(b) Always replace both rotating assembly and stationary ceramic seat. DO NOT USE OLD STATIONARY SEAT WITH NEW ROTATING SEAL ASSEMBLY.
(c) Using two screwdrivers, pry out rotating assembly of shaft seal. (Fig. 3)
(d) The stationary seat can be pressed from the seal plate.
(e) A new shaft seal should always be used when rebuilding a pump. All pump parts should be cleaned thoroughly before being reassembled

FIG. 3

MOTOR

(a) Remove four bolts holding bracket to motor and remove motor (Fig. 4)
(b) Remove set screws in stub shaft coupling to disconnect motor pump shaft.

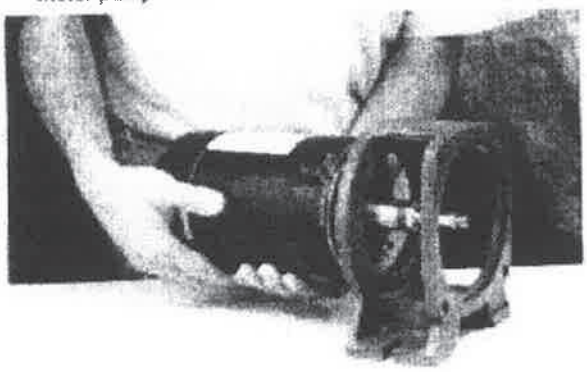


FIG. 4

Model Number	Impeller	HP	Eng. Number	Impeller Number	Impeller Diameter
CT05FAP	Plastic	½	26500D103	26441B005	4 11/16
CT07FAP		¾	26500D104	26440B005	5
CT10FAP		1	26500D105	26439B011	5
CT15FAP		1½	26500D106	26439B010	5 3/16
CT05FAB	Brass	½	26500D003	26441B004	4 11/16
CT07FAB		¾	26500D004	26440B004	5
CT10FAB		1	26500D005	26439B009	5 1/16
CT15FAB		1½	26500D006	26439B008	5 3/16
CT20FAP	Plastic	2	26500D101	26487C009	5 3/16
CT20FAB	Brass	2	26500D001	26487C007	5 3/16
CT25FAP	Plastic	2½	26500D102	26487C008	6 1/16
CT25FAB	Brass	2½	26500D002	26487C006	6 1/16

FIG. 5

ASSEMBLY INSTRUCTIONS

SPOTTING MOTOR SHAFT - Locate "Spotting Position" from motor mounting face to center of spot. A drilling guide and locating fixture is recommended for uniform and accurate spotting. Make two spots with a drill point, at 90 degrees apart - must not be on motor shaft keyway. (Fig 6)

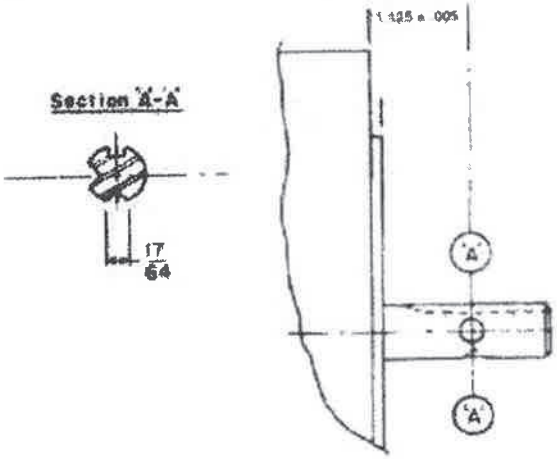


FIG. 6

MOTOR

(a) Place rubber deflector over motor shaft, slide shaft extension into position and tighten set screws.

(b) Assemble motor and shaft onto bracket, using (4) 3/8-16 UNC Hex Head Cap Screws, 1 1/2" long.

SEAL INSTALLATION

(a) Insert seal seat in position by using light pressure on non-abrasive seal installation tool and press firmly and squarely until it bottoms. The use of light oil (SAE10) on the rubber element will facilitate assembly. Care must be taken to keep oil, grease and dirt off face areas of seal. Be sure the seal faces are not damaged during assembly (cracked, scratched or chipped) or the seal will leak during operation.

(b) Check dimension from face of ceramic seat to shaft shoulder. This distance should be as noted in Figure 7 within a tolerance of ± 1/64.

(c) Install rotating element of seat on shaft (Fig. 8), be sure the carbon lapped sealing surface is toward seal seat, and assemble impeller. When installing hi-temp seal (21181A021), furnished with brass impeller models, remove the 1 1/16 diameter cupped stainless steel washer that is packed with the seal. Use of this washer will damage the seal when used with this pump. Check diameter of impeller against motor horsepower rating to insure proper performance (Fig. 5).

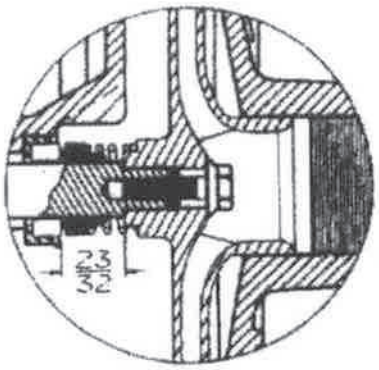


FIG. 7

IMPELLER

(a) On ½ - 1½ HP units, screw on impeller and secure using special washer and 1/4-28UNF cap screw, 7/8" long -- must be stainless steel

(b) On 2-2½ HP units, screw on impeller and secure using special washer and 1/4-28UNF cap screw, 1 1/4" long -- must be stainless steel.

FIG. 8

VOLUTE CASE

(a) Worn volute case will cause excessive leakage with a new impeller, thereby reducing the amount of service obtained from a new impeller.

(b) Assemble gasket and volute case with (4) 3/8-16UNC hex head cap screws 1 1/4" long.

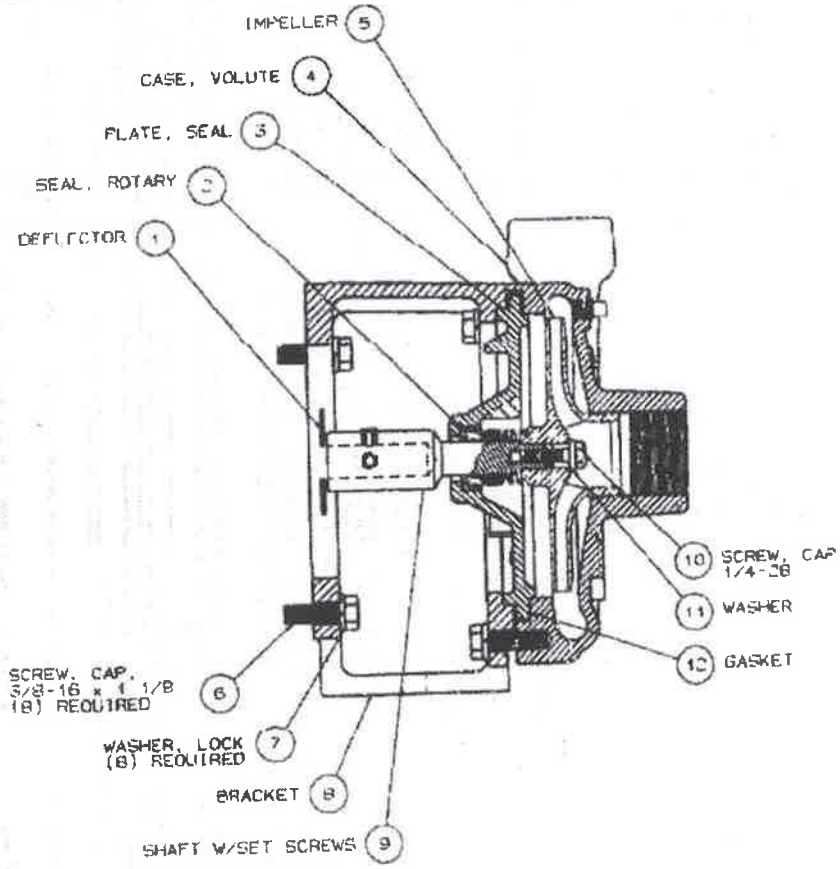
Rotate pump shaft with fingers, being sure that there is no tight spot or binding of assembly. A uniform drag of the seal faces will be present.

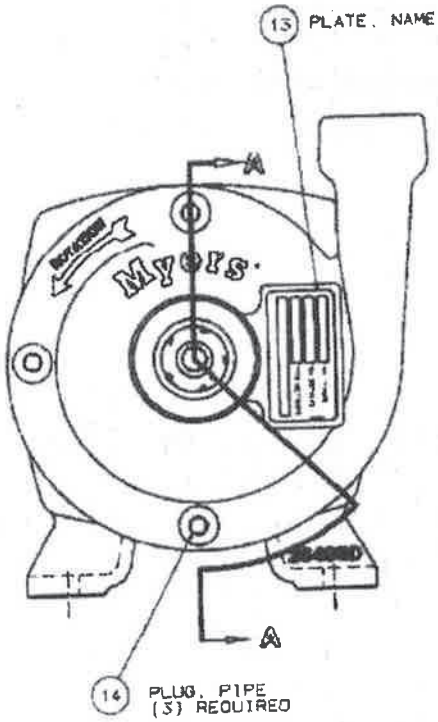
Crusader CT Kit Series Parts List
½, ¾, 1 and 1½ HP

Ref. No.	Description	Part No.	Qty. Req'd.
1	Deflector	05059A318	1
2	Seal, Rotary 5/8 Shaft		
	Standard Seal with Polycarbonate Impeller	14525A010	1
	Hi-Temp Seal with Brass Impeller	21181A021	1
3	Plate, Seal (Cast Iron)	26442C000	1
4	Case, Volute (Cast Iron)	26443D001	1
5	Impeller		
	Polycarbonate (½ HP)	26441B005	1
	Polycarbonate (¾ HP)	26440B006	1
	Polycarbonate (1 HP)	26440B011	1
	Polycarbonate (1½ HP)	26439B010	1
	Bronze (½ HP)	26441B004	1
	Bronze (¾ HP)	26440B004	1
	Bronze (1 HP)	26439B009	1
	Bronze (1½ HP)	26439B008	1
6	Cap Screw, 3/8-16 UNC x 1⅛ Long	19101A016	8
7	Washer, Lock 3/8	05454A007	8
8	Bracket	26498D000	1
9	Shaft with Set Screws	26499B000	1
10	Cap Screw, 1/4-28 UNF x ⅞ Long	19099A032	1
11	Washer, Bronze Special 11/16 O.D.	10186A000	1
12	Gasket, 6⅜ x 5¹⁹/₃₂ x 1/32 Vell.	05059A446	1
13	Plate, Name	26539A000	1
14	Pipe Plug 1/8 NPT	05022A021	3

Crusader CT Kit Series Parts List
2 and 2½ HP

Ref. No.	Description	Part No.	Qty. Req'd.
1	Deflector	05059A318	1
2	Seal, Rotary 5/8 Shaft		
	Standard Seal with Polycarbonate Impeller	14525A010	1
	Hi-Temp Seal with Brass Impeller	21181A021	1
3	Plate, Seal (Cast Iron)	26485D000	1
4	Case, Volute (Cast Iron)		
	2 HP	26484D003	1
	2½ HP	26484D002	1
5	Impeller		
	Polycarbonate (2 HP)	26487C009	1
	Polycarbonate (2½ HP)	26487C008	1
	Bronze (2 HP)	26487C007	1
	Bronze (2½ HP)	26487C000	1
6	Cap Screw, 3/8-16 UNC x 1⅛ Long	19101A016	8
7	Washer, Lock 3/8	05454A007	8
8	Bracket	26498D000	1
9	Shaft with Set Screws	26499B000	1
10	Cap Screw, 1/4-28 UNF x 1⅛ Long	19099A031	1
11	Washer, Bronze Special 11/16 O.D.	10186A000	1
12	Gasket, 6.582 x 6.135 x 1/32 Vell.	05059A447	1
13	Plate, Name	26539A000	1
14	Pipe Plug 1/8 NPT	05022A021	3





Myers®

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Troubleshooting Guide for transfer pump:

1. Inspect & clean stainless steel float rods.
2. Use sand paper, file or pocket knife to scrap off calcium/iron deposits on the float level rods.
3. Verify the flowmeter is not clogged. There is an inlet basket internally located on the inlet side of this meter.
4. Remove all stainless steel rods (4) from the blue warrick junction box. From the top of the box, mark and then remove the wires. Then unscrew the rod insulator by using a 13/16" deep well socket. Loosen the ¼" jam nut and remove the ¼" rod. Remove all red colored "lock tight" from the threads on each rod with a wire brush. Install rods back into the sump.
5. Verify in the master control panel that the Warrick 67 controller(s) have a green ground wire jumpered run from each Warrick 67 to each other and then to the ground bar located at the bottom right side on the control panel. The Warrick 67 ground is located on the right side of the Warrick controller labeled (G), above the L2 terminal.
6. Debris inside pump impeller. Take pump apart and look for deposits or PVC shavings inside the impeller
7. inspect/clean/replace check valve and all fittings going into and out of transfer pump. Even if it looks good, there may be small cracks, especially in the cast brass parts. Also, after some freezing temperatures, this is a possibility
8. replace transfer pump mechanical seal. On 1.5 hp pumps, use Grainger number 1R298.
9. make sure all gaskets are in good condition when putting pump back together
10. Please have a volt meter available if these items do not correct the problem. Call the factory for additional troubleshooting.

If the system does not appear to make vacuum

1. Vacuum relief valve is opening
2. leak in piping somewhere/dilution valve is open
3. to confirm whether the pump is working right or not, close off all valves to the wells. Should climb to 20+"hg
4. if #3 works, it is the wells
5. not enough seal water. Try turning on the tap water, either via telemetry or flip dip switch #3
6. If a liquid ring pump gets enough seal water and it is spinning, it will make air. Usually something else.

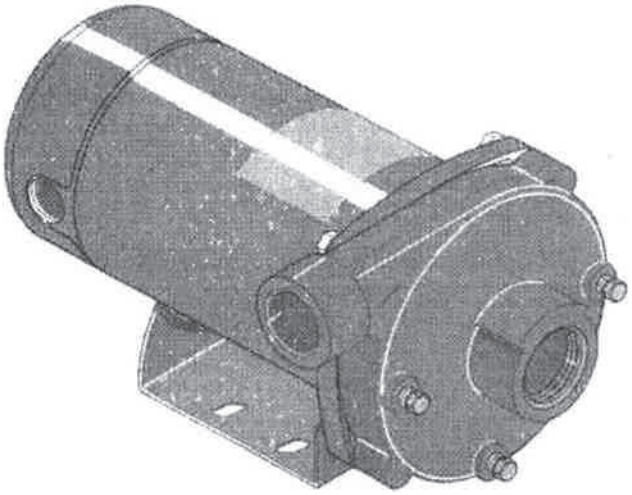
PENTAIR

MYERS®

OWNER'S MANUAL

60 Cycle CT Series Centrifugal Pump

INSTALLATION AND OPERATING INSTRUCTIONS
REPAIR PARTS LIST



HP	MODELS			
1/2	CTJ05B	CTJ05B3	CTJ05	CTJ053
3/4	CTJ07B	CTJ07B3	CTJ07	CTJ073
1	CTJ10B	CTJ10B3	CTJ10	CTJ103
1-1/2	CTJ15B	CTJ15B3	CTJ15	CTJ153
2	CTJ20B	CTJ20B3	CTJ20	CTJ203
2-1/2	CTJ25B	CTJ25B3	CTJ25	CTJ253

293 WRIGHT STREET, DELAVAN, WI 53115 WWW.FEMYERS.COM
PH: 888-987-8677 ORDERS FAX: 800-426-9446

490 PINEBUSH ROAD, UNIT 4, CAMBRIDGE, ONTARIO N1T 0A5
PH: 800-363-7867 ORDERS FAX: 888-606-5484

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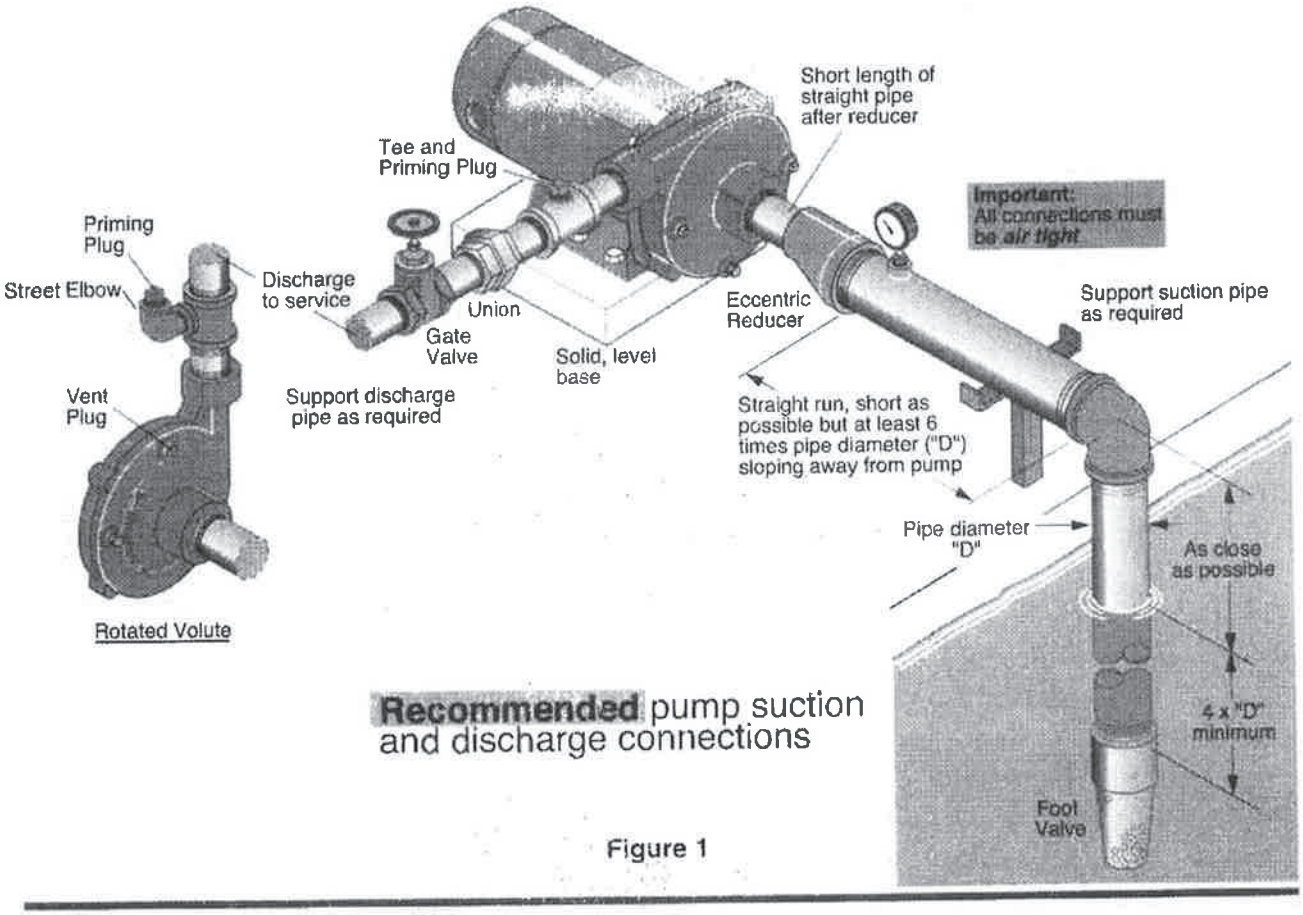
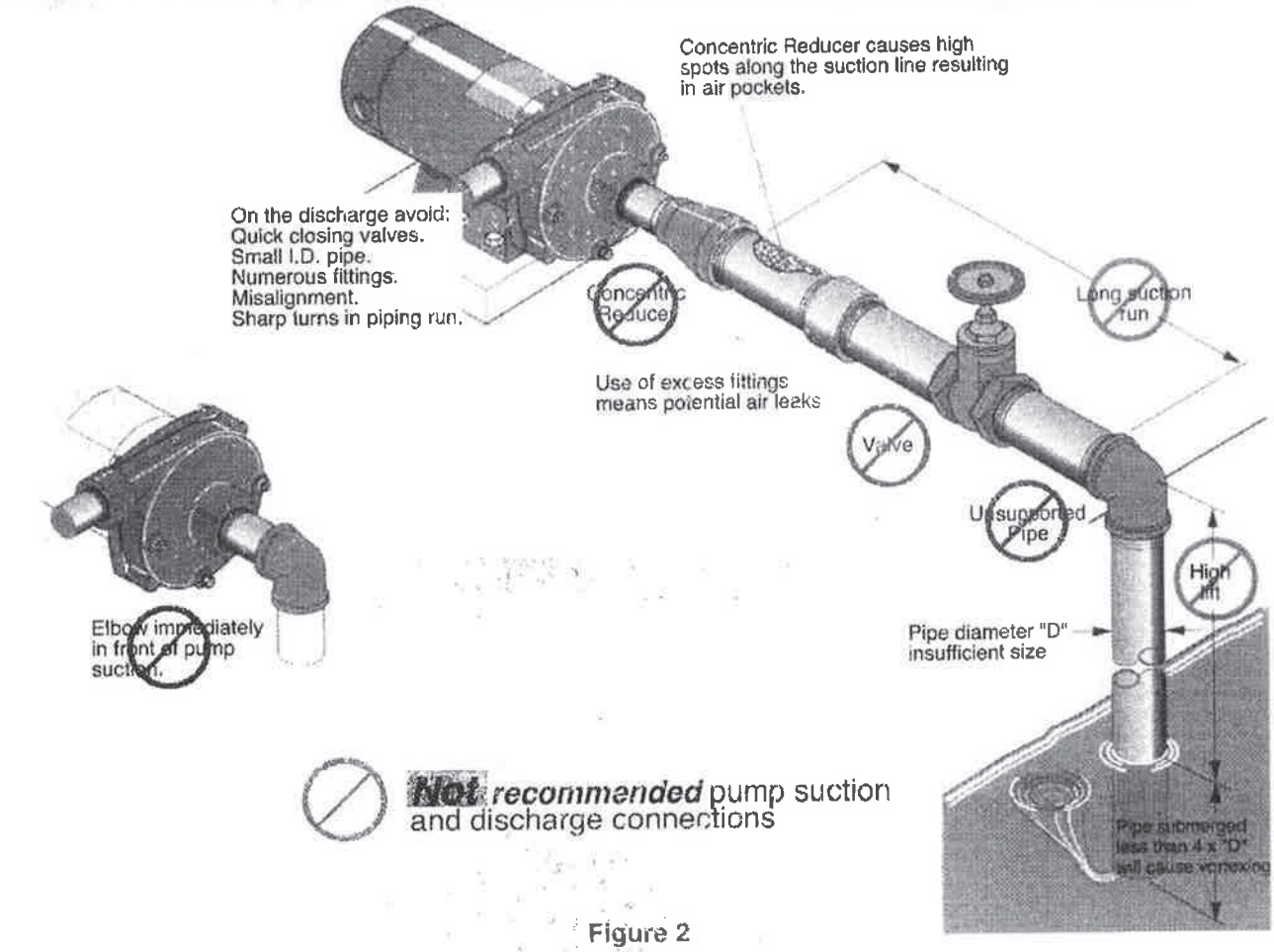


Recommended pump suction and discharge connections

Figure 1



Not recommended pump suction and discharge connections

Figure 2

California Proposition 65 Warning

⚠ WARNING This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

PIPING - GENERAL

Support both suction and discharge piping independently at a point near the pump to avoid putting a strain on the pump housing. Start all piping **AT THE PUMP.**

Increase pipe diameter at both the suction and discharge by one (1) standard pipe size (minimum) to obtain desired performance and flow rate. Refer to Table I when sizing pipe for your pumping system.

NOTICE: Do not use pipe with **smaller** diameter on the suction side of pump.

TABLE I

Pipe Tapping Size On Pump		Recommended Pipe Size	
Suction	Discharge	Suction	Discharge
1-1/4	1	1-1/2	1-1/4
1-1/2	1-1/4	2	1-1/2
2	1-1/2	3	2

SUCTION PIPE

Increase pipe size from pump tapping as shown in Table I.

Figure 1 (Page 2) depicts a recommended run of pipe and fittings for the suction side of a centrifugal pump. Please refer to this illustration when choosing pipe and fittings for your suction connection.

IMPORTANT: All connections must be air tight!

Figure 2 (Page 2) depicts conditions that are **NOT DESIRABLE** on the suction side of a centrifugal pump and may cause problems in flow rate and priming. Please look this illustration over carefully before choosing pipe and fittings for your suction connection.

DISCHARGE PIPING

Increase pipe size from pump tapping as show in Table I. Figure 1 (Page 2) depicts a recommended run of pipe and fittings for the discharge. Install tee with priming plug as close to pump as possible. Figure 2 (Page 2) notes conditions that should be avoided. Please read over carefully before making discharge connection.

PRIMING THE PUMP

A pump is primed when all air in the suction line and pump volute has been evacuated and replaced with water.

To Prime:

1. Close valve in discharge line.
2. Remove priming plug from tee and fill pump and suction line with water until water is flowing back out of tee.
3. Replace priming plug.
4. Start pump and slowly open valve until desired water flow is achieved.
   NOTICE: If water is not being pumped, turn off pump, close valve, and repeat steps 1 thru 4.

If pump volute is rotated as shown in Figure 1 (Page 2), loosen vent plug when priming to evacuate air trapped inside volute and tighten when volute is completely filled with water.

⚠ WARNING **Risk of explosion and scalding.** Never run pump against closed discharge. To do so can boil water inside pump, causing hazardous pressure buildup and possible explosion.

⚠ CAUTION **Risk of flooding.** Do not run the pump dry. This will damage mechanical seal and void warranty. It may cause burns to person handling pump.

⚠ CAUTION **Motor normally operates at high temperature and will be too hot to touch.** It is protected from heat damage during operation by an automatic internal cutoff switch. Before handling pump or motor, stop motor and allow it to cool for 20 minutes.

TABLE II - RECOMMENDED FUSING AND WIRING DATA - 60 CYCLE MOTORS

MOTOR HP	MAX. LOAD AMPERES	BRANCH FUSE* RATING AMPS	DIAMETER IN FEET FROM MOTOR TO METER					
			0' TO 50'	51' TO 100'	101' TO 200'	201' TO 300'	301' TO 400'	401' TO 500'
			WIRE SIZE					
SINGLE PHASE - 115/230 VOLT								
1/3	9.4/4.7	15/15	14/14	14/14	10/14	10/14	6/14	6/12
1/2	9.4/4.7	15/15	14/14	14/14	10/14	10/14	6/14	6/12
3/4	12.2/6.1	20/15	12/14	12/14	10/14	8/14	6/12	6/12
1	14.8/7.4	20/15	12/14	12/14	8/14	6/14	6/12	4/10
1-1/2	19.9/9.95	25/15	10/14	10/14	8/14	6/12	4/10	4/10
2	24.0/12.0	30/15	12/14	10/14	6/14	6/12	4/10	4/10
2-1/2	21.0/10.5	15/15	14/14	14/14	14/14	12/12	12/12	10/10
THREE PHASE - 230/460 VOLT								
1/2	2.3/1.15	15/15	14/14	14/14	14/14	14/14	14/14	14/14
3/4	3.1/1.55	15/15	14/14	14/14	14/14	14/14	14/14	14/14
1	3.6/1.8	15/15	14/14	14/14	14/14	14/14	14/14	14/14
1-1/2	4.7/2.35	15/15	14/14	14/14	14/14	14/14	14/14	14/14
2	6.8/3.4	15/15	14/14	14/14	14/14	14/14	12/14	12/14
2-1/2	8.5/4.25	15/15	14/14	14/14	14/14	14/14	12/14	10/14

* Time delay fuse or circuit breakers are recommended in any motor circuit.

ELECTRICAL

Connection diagram for dual voltage, single-phase motors. Your dual-voltage motor's terminal board (under the motor end cover) will match one of the diagrams below. Follow that diagram if necessary to convert motor to 115 Volt power.

Connect power supply wires to L1 and L2. For 3-phase motors, or if motor does not match these pictures, follow the connection diagram on the motor nameplate.

THE MOTOR IS SET FOR 230 VOLTS WHEN SHIPPED.

To change the motor to use 115 volts:

1. Turn off power
2. Remove the back motor cover.
3. Use a 1/2" wrench and turn the voltage selector dial counterclockwise until 115 shows in the dial opening.
4. Reinstall the motor cover.

⚠WARNING Hazardous voltage. Can shock, burn, or cause death. Disconnect power to motor before working on pump or motor. Ground motor before connecting to power supply.

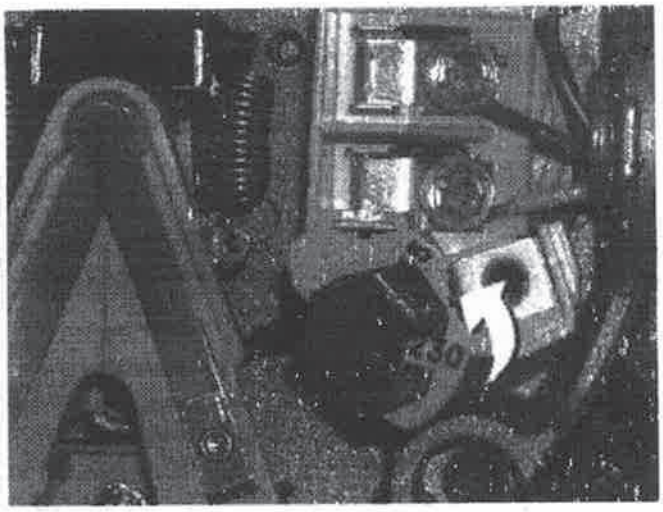


Figure 3: Changing the Voltage Setting

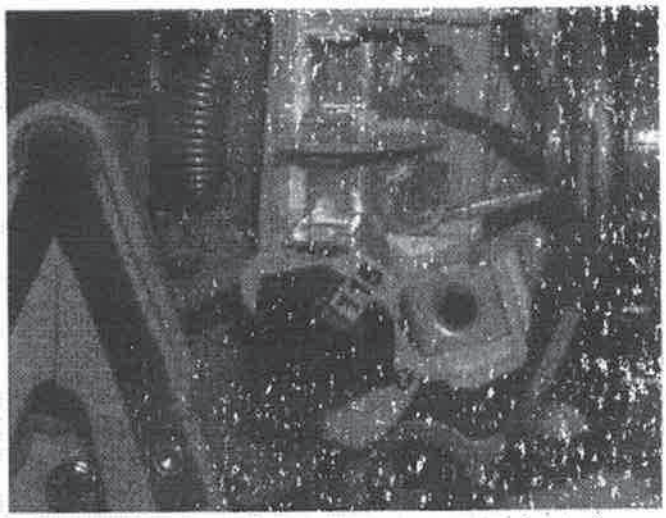


Figure 4: Motor Set for 115 Volt Operation

WIRING

Ground motor before connecting to electrical power supply. Failure to ground motor can cause severe or fatal electrical shock hazard.

Do not ground to a gas supply line.

To avoid dangerous or fatal electrical shock, turn OFF power to motor before working on electrical connections.

Supply voltage must be within ±10% of nameplate voltage. Incorrect voltage can cause fire or damage motor and voids warranty. If in doubt consult a licensed electrician.

Use wire size specified in Wiring Chart (Page 3). If possible, connect pump to a separate branch circuit with no other appliances on it.

Wire motor according to diagram on motor nameplate. If nameplate diagram differs from diagrams above, follow nameplate diagram.

1. Install, ground, wire and maintain your pump in compliance with the National Electrical Code (NEC) in the U.S., or the Canadian Electrical Code (CEC), as applicable, and with all local codes and ordinances that apply. Consult your local building inspector for code information.
2. Provide a correctly fused disconnect switch for protection while working on motor. For switch requirements, consult your local building inspector for information about codes.
3. Disconnect power before servicing motor or pump. If the disconnect switch is out of sight of pump, lock it open and tag it to prevent unexpected power application.
4. Ground the pump permanently using a wire of the same size as that specified in wiring chart (Page 3). Make ground connection to green grounding terminal under motor canopy marked GRD. or ⏚.
5. Connect ground wire to a grounded lead in the service panel or to a metal underground water pipe or well casing at least 10 feet long. Do not connect to plastic pipe or insulated fittings.
6. Protect current carrying and grounding conductors from cuts, grease, heat, oil, and chemicals.
7. Connect current carrying conductors to terminals L1 and L2 under motor canopy. When replacing motor, check wiring diagram on motor nameplate. If the motor wiring diagram does not match either diagram in Figure 3, follow the diagram on the motor.

IMPORTANT: 115/230 Volt single phase models are shipped from factory with motor wired for 230 volts. If power supply is 115 volts, remove motor canopy and reconnect motor as shown in Figure 3. Do not try to run motor as received on 115 volt current.

8. Motor has automatic internal thermal overload protection. If motor has stopped for unknown reasons, thermal overload may restart it unexpectedly, which could cause injury or property damage. Disconnect power before servicing motor.
9. If this procedure or the wiring diagrams are confusing, consult a licensed electrician.

PUMP SERVICE

This centrifugal pump requires little or no service other than reasonable care and periodic cleaning. Occasionally, however, a shaft seal may become damaged and must be replaced. The procedure as outlined below will enable you to replace the seal.

NOTICE: Pumps use mechanical seals with a rubber seat ring or a sealing O-Ring. THESE SEALS ARE COMPLETELY INTERCHANGEABLE.

NOTICE: The highly polished and lapped faces of this seal are easily damaged. Read instructions and handle the seal with care.

Some models are equipped with an impeller screw, which has a left hand thread. Before unscrewing the impeller, remove the impeller screw.

REMOVAL OF OLD SEAL

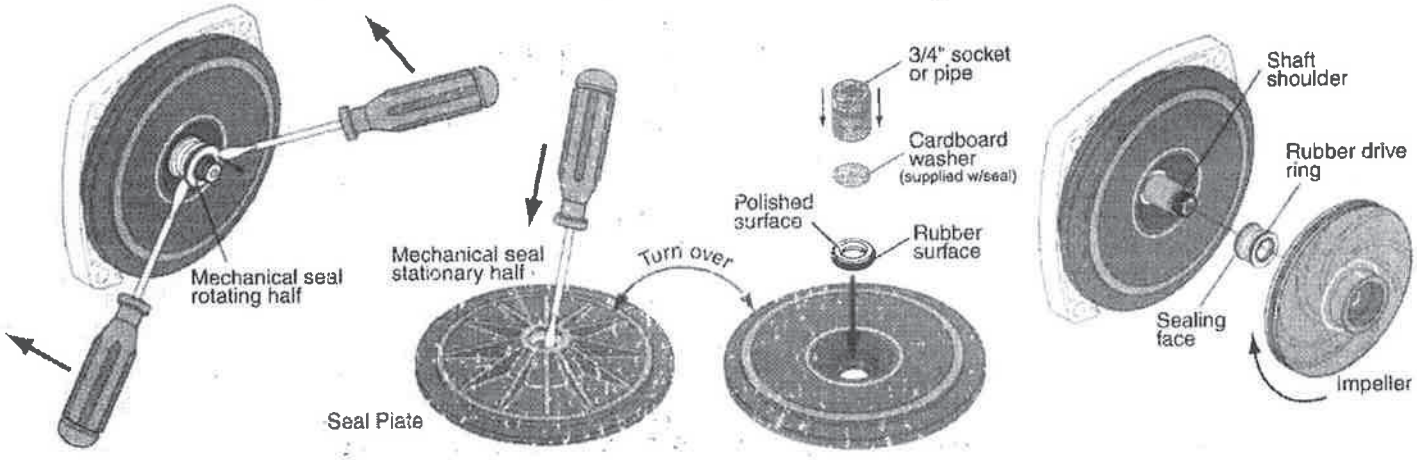
1. After unscrewing impeller, carefully remove rotating part of seal by prying up on sealing washer, using two screwdrivers (see Figure 5A). Use care not to scratch motor shaft.
2. Remove seal plate from motor and place on flat surface, face down. Use a screwdriver to push ceramic seat out from seal cavity (see Figure 5B).

INSTALLATION OF FLOATING SEAT (Figure 5C)

1. Clean polished surface of floating seat with clean cloth.
2. Turn seal plate over so seal cavity is up, clean cavity thoroughly.
3. Lubricate outside rubber surface of ceramic seat with soapy water and press firmly into seal cavity with finger pressure: If seat will not locate properly in this manner, place cardboard washer over polished face of seat and press into seal cavity using a 3/4" socket or 3/4" piece of standard pipe.
4. **DISPOSE OF CARDBOARD WASHER.** Be sure polished surface of seat is free of dirt and has not been damaged by insertion. Remove excess soapy water.

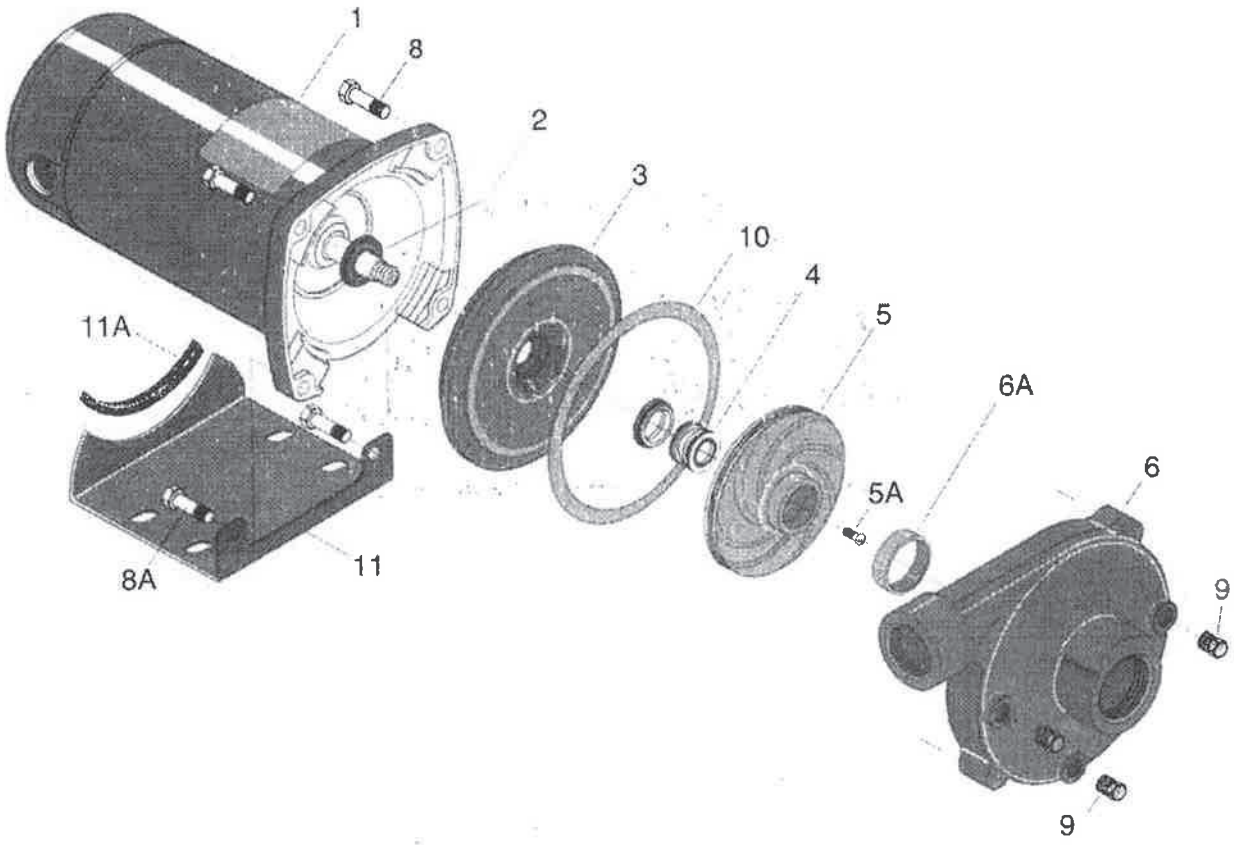
INSTALLATION OF ROTATING PART OF SEAL UNIT (Figure 5D)

1. Reinstall seal plate using extreme caution not to hit ceramic portion of seal on motor shaft.
2. Inspect shaft to make sure that it is clean.
3. Clean face of sealing washer with clean cloth.
4. Lubricate inside diameter and outer face of rubber drive ring with soapy water and slide assembly on motor shaft (sealing face first) until rubber drive ring hits shaft shoulder.
5. Screw impeller on shaft until impeller hub hits shaft shoulder. This will automatically locate seal in place and move the sealing washer face up against seat facing. Reinstall impeller screw (if used).



A-Seal removal-rotating half B-Seal removal-stationary half C-Stationary half installation D-Rotating half installation

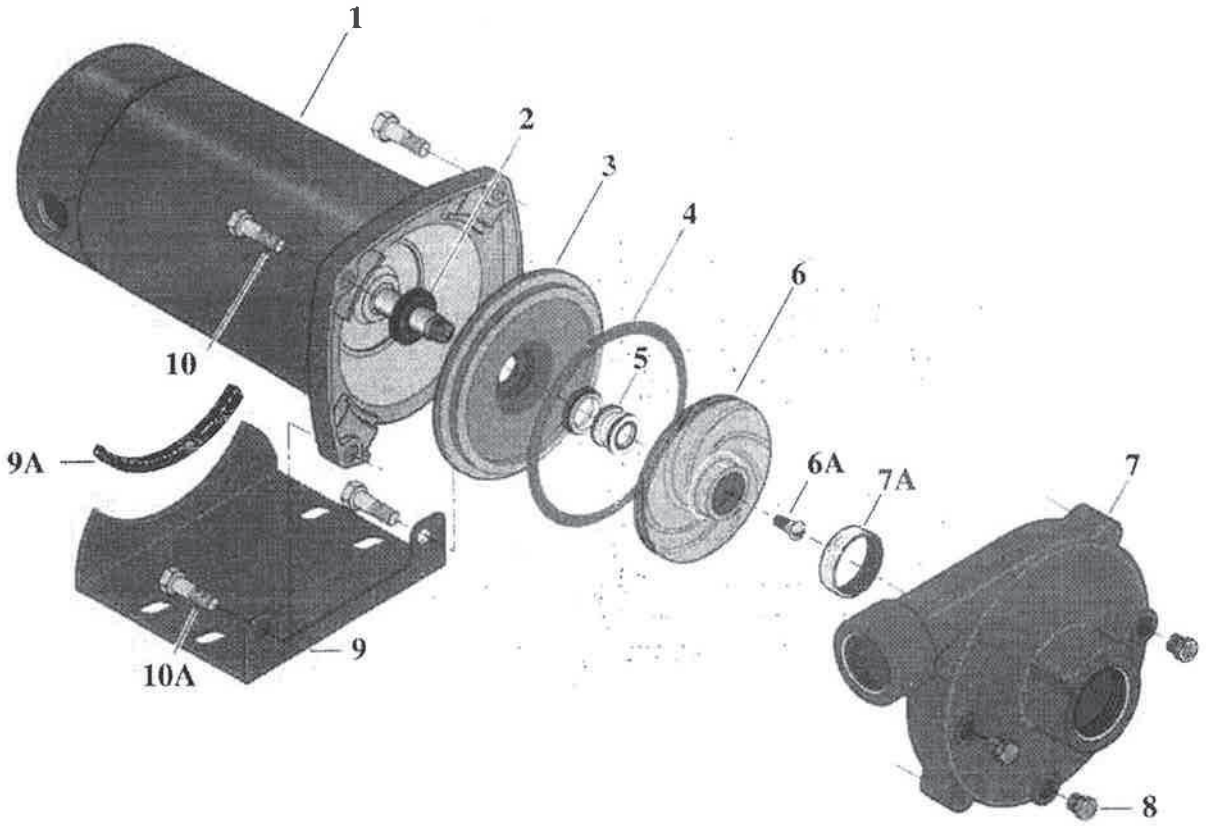
FIGURE 5



REPAIR PARTS LIST – CT SERIES

Key No.	Part Description	No. Used	MOTOR AND HORSEPOWER					
			CTJ05 CTJ053 1/2 HP	CTJ07 CTJ073 3/4 HP	CTJ10 CTJ103 1 HP	CTJ15 CTJ153 1-1/2 HP	CTJ20 CTJ203 2 HP	CTJ25 CTJ253 2-1/2 HP
1*	Motor, 115/230V, Single Phase	1	J218-582APKG	J218-590PKG	J218-596PKG	J218-601PKG	J218-883APKG	J218-628APKG
1*	Motor, 230/460V, Three Phase	1	AP100CL	AP100DL	AP100EL	AP100FL	AP100GL	AP100G5L
†2	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009
3	Seal Plate	1	C3-178	C3-178	C3-178	C3-178	C3-181	C3-181
†4	Shaft Seal	1	U109-6A	U109-6A	U109-6A	U109-6A	U109-6A	U109-6A
5	Impeller - Single Phase	1	C105-92PN	C105-92PM	C105-92PL	C105-92PB	–	C105-92PAB
5	Impeller - Three Phase	1	C105-95PNA	C105-95PMA	C105-95PLA	C105-95PBA	C105-95PCAB	C105-95PAB
5A	Impeller Screw - Three Phase	1	C30-14SS	C30-14SS	C30-14SS	C30-14SS	C30-14SS	C30-14SS
6	Volute Assembly with Wear Ring	1	C101-284E	C101-284E	C101-284E	C101-284E	C101-264E	C101-264EB
6A	Wear Ring	1	C23-27	C23-27	C23-27	C23-27	C23-19	C23-19
8	Hex capscrew - 3/8 - 16 x 1" Lg.	2	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP
8A	Hex capscrew - 3/8 - 16 x 1-1/4" Lg.	2	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP
9	Pipe Plug - 1/4" NPT	3	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV
†10	Gasket - Volute	1	C20-121C	C20-121C	C20-121C	C20-121C	C20-122C	C20-122C
11	Base	1	J104-9F	J104-9F	J104-9F	J104-9F	J104-9F	J104-9F
11A	Motor Pad	1	C35-5S	C35-5S	C35-5S	C35-5S	C35-5S	C35-5S
	SERVICE KIT							
	Seal and Gasket Kit	1	PP1700	PP1700	PP1700	PP1700	PP1700	PP1700
	NOTE: † Included in Seal and Gasket Kit.							

* For repair or service to motors, always give the motor Model Number and any other data found on the Motor Model Plate.



REPAIR PARTS LIST – CTB SERIES

Key No.	Part Description	No. Used	MOTOR AND HORSEPOWER					
			CTJ05B CTJ05B3 1/2 HP	CTJ07B CTJ07B3 3/4 HP	CTJ10B CTJ10B3 1 HP	CTJ15B CTJ15B3 1-1/2 HP	CTJ20B CTJ20B3 2 HP	CTJ25B CTJ25B3 2-1/2 HP
1	Motor, 115/230V, 1 Phase	1	J218-582APKG	J218-590PKG	J218-596PKG	J218-601PKG	J218-883APKG	J218-628APKG
1	Motor, , 230/460V, 3 Phase	1	AP100CL	AP100DL	AP100EL	AP100FL	AP100GL	AP100G5L
†2	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009
3	Seal Plate	1	C3-178	C3-178	C3-178	C3-178	C3-181	C3-181
†4	Gasket, Seal Plate	1	C20-121C	C20-121C	C20-121C	C20-121C	C20-122C	C20-122C
†5	Shaft Seal	1	U109-6A	U109-6A	U109-6A	U109-6A	U109-6A	U109-6A
6	Impeller, Single Phase	1	C5-256BA	C5-256BAA	C5-254BA	C5-254BC	C5-257BB	C5-257B
6	Impeller, Three Phase	1	C5-256BA	C5-256BAA	C5-254BA	C5-254BC	C5-257BB	C5-257B
6A	Impeller Screw, Three Phase	1	C30-14SS	C30-14SS	C30-14SS	C30-14SS	C30-14SS	C30-14SS
7	Volute Assembly with Wear Ring	1	C101-284E	C101-284E	C101-284E	C101-284E	C101-264E	C101-264EB
7A	Wear Ring	1	C23-27	C23-27	C23-27	C23-27	C23-27	C23-27
8	Pipe Plug, 1/4" NPT Hex Hd.	3	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV	U78-941ZPV
9	Base	1	J104-9F	J104-9F	J104-9F	J104-9F	J104-9F	J104-9F
9A	Motor Pad	1	C35-5S	C35-5S	C35-5S	C35-5S	C35-5S	C35-5S
10	Hex Capscrew, 3/8" - 16 x 1" Lg.	2	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP	U30-74ZP
10A	Hex Capscrew, 3/8" - 16 x 1-1/4" Lg.	2	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP	U30-75ZP
	SERVICE KIT							
	Seal and Gasket Kit	1	PP1700	PP1700	PP1700	PP1700	PP1700	PP1700
	NOTE: † Included in Seal and Gasket Kit.							

* For repair or service to motors, always give the motor Model Number and any other data found on the Motor Model Plate.

TROUBLESHOOTING

TROUBLE AND CAUSE	REMEDY
FAILURE TO PUMP	
1. Pump not properly primed.	1. Make sure pump casing and suction line are full of water. See priming instructions.
REDUCED CAPACITY AND/OR HEAD	
1. Air pockets or leaks in suction line. 2. Clogged impeller.	1. Check suction piping. 2. Remove and clean.
PUMP LOSES PRIME	
1. Air leaks in suction line. 2. Excessive suction lift and operating too near shut-off point. 3. Water level drops while pumping, uncovering suction piping.	1. Check suction piping 2. Move pump nearer to water level. 3. Check water supply. Add length of pipe to suction to keep submerged end under water.
MECHANICAL TROUBLES AND NOISE	
1. Bent shaft and/or damaged bearings. 2. Suction and/or discharge piping not properly supported and anchored.	1. Take motor to authorized motor repair shop. 2. See that all piping is supported to relieve strain on pump assembly.

Limited Warranty

Myers warrants to the original consumer purchaser ("Purchaser" or "You") of the products listed below, that they will be free from defects in material and workmanship for the Warranty Period shown below.

Product	Warranty Period whichever occurs first:
Jet pumps, small centrifugal pumps, submersible pumps and related accessories	12 months from date of original installation, or 18 months from date of manufacture
Fibrewound Tanks	5 years from date of original installation
Steel Pressure Tanks	5 years from date of original installation
Sump/Sewage/Effluent Products	12 months from date of original installation, or 36 months from date of manufacture
Battery Backup Units	
MBSP-2, MBSP-2C	12 months from date of original installation, or 18 months from date of manufacture
MBSP-3, MBSP-3C	24 months from date of original installation, or 30 months from date of manufacture
Wastewater Solids Handling Pumps	12 months from date of shipment from factory or 18 months from date of manufacture

Our warranty applies only where such products are used in compliance with the requirements of the applicable product catalog and/or manuals. For additional information, please refer to the applicable standard limited warranty featured in the product manual.

Our warranty will not apply to any product that, in our sole judgement, has been subject to negligence, misapplication, improper installation, or improper maintenance. Without limiting the foregoing, operating a three phase motor with single phase power through a phase converter will void the warranty. Note also that three phase motors must be protected by three-leg, ambient compensated, extra-quick trip overload relays of the recommended size or the warranty is void.

Your only remedy, and MYERS's only duty, is that MYERS repair or replace defective products (at MYERS's choice). You must pay all labor and shipping charges associated with this warranty and must request warranty service through the installing dealer as soon as a problem is discovered. No request for service will be accepted if received after the Warranty Period has expired. This warranty is not transferable.

MYERS SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, OR CONTINGENT DAMAGES WHATSOEVER.

THE FOREGOING LIMITED WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE FOREGOING LIMITED WARRANTIES SHALL NOT EXTEND BEYOND THE DURATION PROVIDED HEREIN.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on the duration of an implied warranty, so the above limitations or exclusions may not apply to You. This warranty gives You specific legal rights and You may also have other rights which vary from state to state.

This Limited Warranty is effective April 1, 2014 and replaces all undated warranties and warranties dated before April 1, 2014.

F.E. MYERS
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Phone: 888-987-8677 • Fax: 800-426-9446 • www.femyers.com
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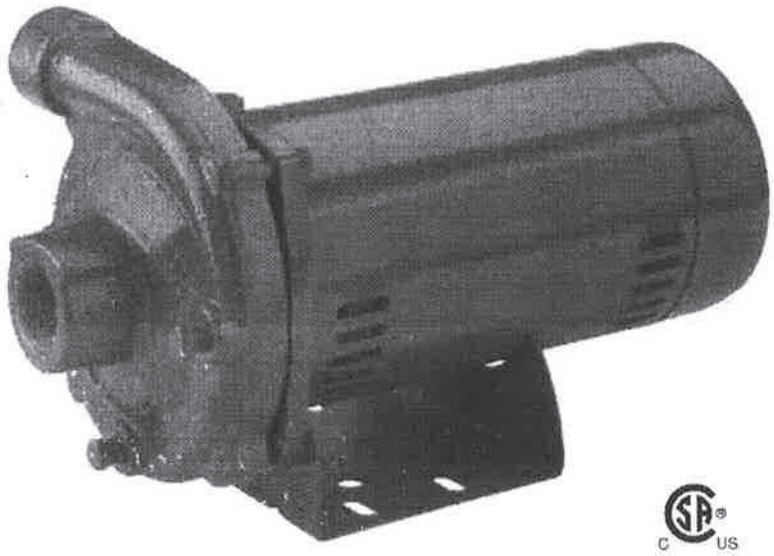
Phone: 800-363-7867 • Fax: 888-606-5484

CENTRIFUGAL PUMPS

MYERS® CT Series
General Purpose Centrifugal Pumps

The CT Series have a rugged cast iron construction and can be coupled with either a corrosion resistant Noryl, or a lead-free brass impeller.



APPLICATIONS

- **Water systems and sprinkling...** for homes, farms and industry.

SPECIFICATIONS

Body and Seal Plate – Close-grained cast iron

Base – Steel 10 gauge

Impeller Types – Noryl® and brass

Shaft – 416 stainless steel

Mechanical Seal – Carbon/ceramic, Buna-N

FEATURES

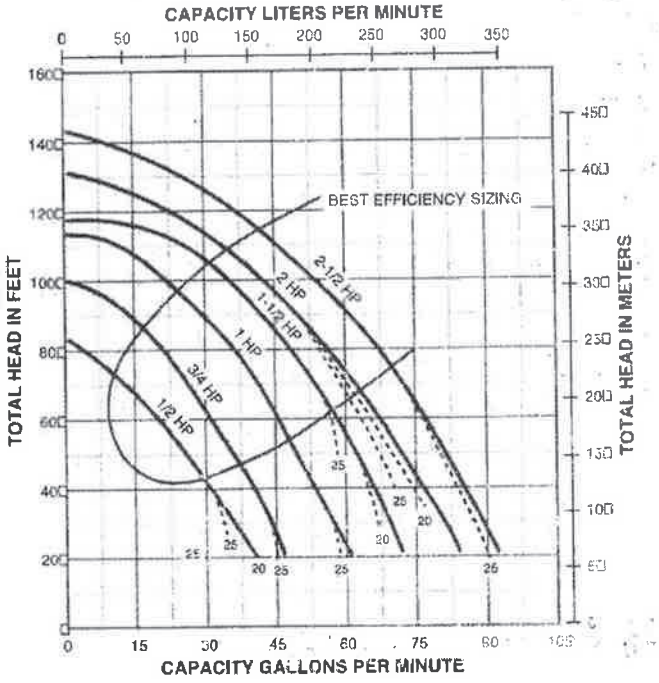
- **1/2 through 2-1/2 HP** – High head models, with heavy-duty motors, easy service design and four-position discharge.
- **Drain Port** – Provided for easy winterizing.
- **High Head** – Up to 140' of head with capacities to 90 GPM.
- **Easy Serviceability** – All models include replaceable wear ring and feature back pull-out design.
- **Noryl® Impellers** – Abrasion-resistant for normal applications with working temperatures to 140°F.
- **Silicon Bronze Impellers** – Pumps equipped with shaft seals rated for temperatures to 225°F.

ORDERING INFORMATION

Catalog Number	HP	Suction	Discharge	Impeller Material	Phase
CTJ05	1/2	1-1/4"	1"	Composite	1
CTJ053		1-1/4"	1"	Composite	3
CTJ05B		1-1/4"	1"	Brass	1
CTJ05B3		1-1/4"	1"	Brass	3
CTJ07	3/4	1-1/4"	1"	Composite	1
CTJ073		1-1/4"	1"	Composite	3
CTJ07B		1-1/4"	1"	Brass	1
CTJ07B3		1-1/4"	1"	Brass	3
CTJ10	1	1-1/4"	1"	Composite	1
CTJ103		1-1/4"	1"	Composite	3
CTJ10B		1-1/4"	1"	Brass	1
CTJ10B3		1-1/4"	1"	Brass	3
CTJ15	1-1/2	1-1/4"	1"	Composite	1
CTJ153		1-1/4"	1"	Composite	3
CTJ15B		1-1/4"	1"	Brass	1
CTJ15B3		1-1/4"	1"	Brass	3
CTJ20	2	1-1/2"	1-1/2"	Composite	1
CTJ203		1-1/2"	1-1/2"	Composite	3
CTJ20B		1-1/2"	1-1/2"	Brass	1
CTJ20B3		1-1/2"	1-1/2"	Brass	3
CTJ25	2-1/2	2"	1-1/2"	Composite	1
CTJ253		2"	1-1/2"	Composite	3
CTJ25B		2"	1-1/2"	Brass	1
CTJ25B3		2"	1-1/2"	Brass	3

MYERS® CT Series
General Purpose Centrifugal Pumps

PUMP PERFORMANCE (Capacity in Gallons Per Minute)

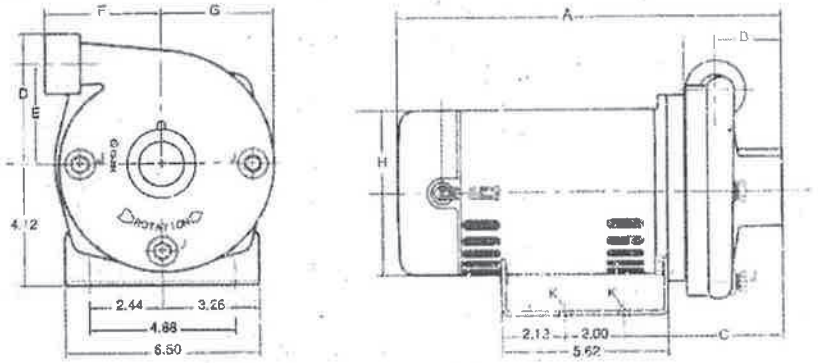


HP	Discharge Pressure		Dynamic Suction Lift				
	PSI	Feet Head	5'	10'	15'	20'	25'
1/2	10	23.1	—	34	32	29	26
	20	46.2	25	21	18	15	11
	30	69.3	10	—	—	—	—
3/4	10	23.1	—	—	42	39	37
	20	46.2	35	32	30	28	26
	30	69.3	24	22	19	15	10
1	20	46.2	48	46	45	43	40
	30	69.3	38	35	31	28	25
	40	92.4	23	20	15	—	—
1-1/2	20	46.2	62	60	58	55	52
	30	69.3	50	48	44	40	37
	40	92.4	37	32	29	22	—
2	30	69.3	60	57	52	59	45
	40	92.4	45	40	36	31	24
	50	115.5	22	15	—	—	—
2-1/2	20	46.2	81	79	76	74	71
	30	69.3	69	67	63	60	56
	40	92.4	56	51	47	44	38
	50	115.5	33	30	22	15	—

Tested and rated in accordance with Water Systems Council Standards.

NOTE: Pumps installed with a Pro-Source® tank require a 100 PSI relief valve. Pumps with a conventional tank require a 75 PSI relief valve. Relief valve must be capable of relieving entire flow of pump at relief pressure.

OUTLINE DIMENSIONS



Dimensions (in inches) are for estimating purposes only.

DIMENSIONS (In Inches)

HP	NPT Suct.	NPT Disch.	A (1 Phase)	A (3 Phase)	B	C	D	E	F	G	H	NPT J	K
1/2	1-1/4	1	11-21/32	13-3/8	2-1/16	5-9/16	4-1/2	3-7/16	3-7/8	3-15/16	5-5/8	1/4	3/8 Dia.
3/4	1-1/4	1	11-25/32	13-3/8	2-1/16	5-9/16	4-1/2	3-7/16	3-7/8	3-15/16	5-5/8	1/4	3/8 Dia.
1	1-1/4	1	12-25/32	13-7/8	2-1/16	5-9/16	4-1/2	3-7/16	3-7/8	3-15/16	5-5/8	1/4	3/8 Dia.
1-1/2	1-1/4	1	13-39/64	14-3/8	2-1/16	5-9/16	4-1/2	3-7/16	3-7/8	3-15/16	5-5/8	1/4	3/8 Dia.
2	1-1/2	1-1/4	16-3/4	16-15/16	2-13/16	6-5/16	4-27/32	3-13/32	4-5/8	4	6-7/16	1/4	3/8 Dia.
2-1/2	2	1-1/2	17-3/4	17-1/4	2-13/16	6-5/16	4-27/32	3-13/32	4-5/8	4	6-7/16	1/4	3/8 Dia.

PENTAIR

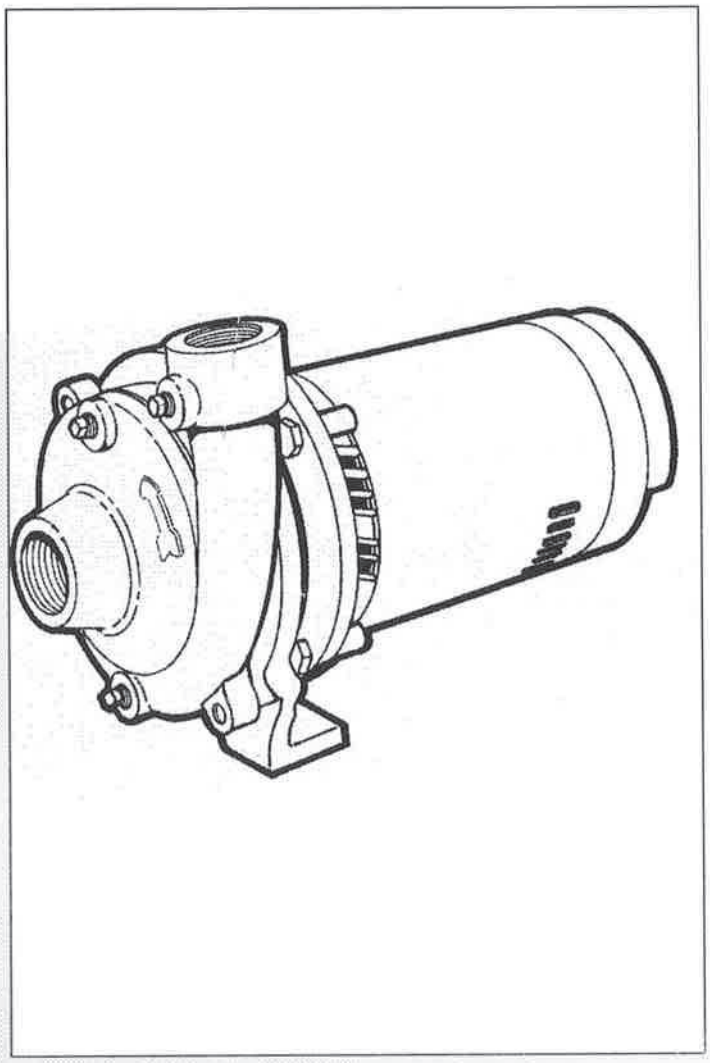
USA 293 WEIGHT STREET, DELAVAN, WI 53115 WWW.PENTAIR.COM PH: 888-987-8677 ORDERS FAX: 800-426-9446
CANADA 490 PINEBUSH ROAD, UNIT 4, CAMBRIDGE, ONTARIO, N1T 0A5 PH: 800-363-7867 ORDERS FAX: 888-606-5484

M11986WS (12/13/16)

INSTALLATION AND SERVICE MANUAL

CENTRI-THRIFT CENTRIFUGAL PUMPS

Models
125M/B, 150M/B
and 200M/B



ENGLISH: PAGES 2-8

Installation and Service Manual

NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.

PENTAIR
MYERS

Part # 13800A085 | © 2018 Pentair plc | 8/24/18

Important safety instructions! Read carefully before installation.

California Proposition 65 Warning:

⚠ WARNING This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

Safe Drinking Water Act:

⚠ WARNING This product is to be used exclusively for non-potable water services. This product is not anticipated to be used for human consumption so is not designed for the low lead levels stated in the Safe Drinking Water Act. It is illegal to use this product for potable water applications for human consumption, such as drinking water, oral hygiene, hand washing, food preparation and dishwashing.

Failure to follow these instructions and comply with all codes may cause serious bodily injury and/or property damage.

Before installing or servicing your pump, be certain the pump power source is turned off and disconnected.

All installation and electrical wiring must adhere to state and local codes. Check with appropriate community agencies or contact your local electrical and pump professionals for help.

Pump must be connected to a separate electrical circuit directly from the entrance box. There must be an appropriately sized fuse or circuit breaker in this line. Tying into existing circuits may cause circuit overloading, blown fuses, tripped circuit breakers or a burned-up motor.

Do not connect pump to a power supply until the pump is grounded. For maximum safety, a ground fault interrupter should be used. Failure to ground this unit properly may result in severe electrical shock.

Reduced risk of electric shock during operation of this pump requires acceptable grounding. If the means of connection to the supply-connection box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit conductors supplying the pump, to the grounding screw provided within the wiring compartment.

This pump is provided with a means for grounding. To reduce the risk of electric shock from contact with adjacent metal parts, bond supply box to the pump-motor-grounding means and to all metal parts accessible including metal discharge pipes, by means of a clamp, a weld or both if necessary, secured to the equipment-grounding terminal.

The voltage and phase of the power supply must match the voltage and phase of the pump.

Do not use an extension cord. Above ground joints must be made in an approved junction box.

Never operate a pump with a frayed or brittle power cord, and always protect it from sharp objects, hot surfaces, oil and chemicals. Avoid kinking the cord.

Never service a motor or power cord with wet hands or while standing in or near water or damp ground.

Do not use this pump in or near a swimming pool.

The three phase units must be wired by a qualified electrician, using an approved starter box and switching device.

Single phase motors are equipped with automatic resetting thermal protectors. The motor may restart unexpectedly, causing the leads to energize or pump to turn on. Three phase motors should be protected by proper thermal and amperage protection. (Check local codes.)

Check for nicks in the wire and pump insulation by using an ohmmeter and checking resistance to ground after installing the pump. If in doubt on the proper procedure, check with a qualified electrician.

Do not pump gasoline, chemicals, corrosives or flammable liquids; they could ignite, explode or damage the pump, causing injury and voiding the warranty.

Never work on the pump or system without relieving the internal pressure.

Do not pump water above 120° F.

Never exceed the pressure rating of any system component.

INSTALLATION

Piping

Pipes must line up and not be forced into position by unions. Piping should be independently supported near the pump so that no strain will be placed on the pump casing. Where any noise is objectionable, pump should be insulated from the piping with rubber connections. Always keep pipe size as large as possible and use a minimum of fittings to reduce friction losses.

Suction Piping

Suction pipe should be direct and as short as possible. It should be at least one size larger than suction inlet tapping and should have a minimum of elbows and fittings. The piping should be laid out so that it slopes upward to pump without dips or high points to eliminate air pockets. The highest point in the suction piping should be the pump inlet except where liquid flows to the pump inlet under pressure. A foot valve must be used to keep pump primed. Where liquid flows to the pump, it may be desirable to use a check valve in the suction line or discharge line to keep pump primed.

To prevent air from being drawn into suction pipe due to a suction whirlpool, the foot valve should be submerged at least three feet below the low water level. The suction pipe must be tight and free of air leaks.

Discharge Piping

Discharge piping should never be smaller than pump tapping and should preferably be one size larger. A gate valve should always be installed in discharge line to serve as a shut-off for throttling if capacity is not correct. To protect the pump and foot valve from water hammer and to prevent back flow, a check valve should be installed in the discharge line between the pump and gate valve.

Electrical Connections

Be sure motor wiring is connected for voltage being used.

Unit should be connected to a separate circuit, direct from main switch. A fused disconnect switch or circuit breaker must be used in this circuit. Wire of sufficient size should be used to keep voltage drop to a maximum of 5%. All motors, unless provided with built-in overload protection, must be protected with an overload switch, either manual or magnetic. Three phase motors require overload protection. Single phase motors are equipped with built-in overload protection. Never install a pump without proper overload protection. A flexible metallic conduit should be used to protect the motor leads.

Priming
The pump must be primed before starting. The pump casing and suction piping must be filled with water before starting motor. Remove vent plug in top of casing while pouring in priming water. A hand pump or ejector can be used for priming when desired. Use care to remove all air before starting motor. If pump does not start immediately, stop and reprime.

Starting
Close the discharge valve when starting the pump as it puts less starting load on the motor. When the pump is up to operating speed, open the discharge valve to obtain desired capacity or pressure. Do not allow the pump to run for long periods with the discharge valve tightly closed. This will create superheated water, which could damage the seal and shorten the life of the motor. This superheated water could also cause severe burns. Always use a pressure relief valve, set below the rating of the tank system.

Rotation
The pump must run in direction of arrow on pump case. All single phase motors are single rotation. Three phase motors may run either direction. If rotation is wrong when first starting motor, interchange any two line leads to change rotation.

Stopping
Before stopping pump, close the discharge valve. This will prevent water hammer and is especially important on high head pumps.

Freezing
Care should be taken to prevent the pump from freezing during cold weather. Drain the pump casing when not in operation. Drain by removing the pipe plug in the bottom of the casing.

Rotary Seal
Centrifugal pumps are fitted with rotary seal. This seal is recommended for water free from abrasives. If liquid contains abrasives, the centrifugal pump should not be used.

Bearings
Lubricate motor bearings in accordance with motor manufacturer's instructions.

Single seal ball bearings are used on 125B, 150B and 200B bearing bracket units. Proper amount of grease has been provided in the bracket cavity between the bearings. This should be sufficient grease for 4,000 hours of operation. After 4,000 hours of operation the old grease should be cleaned out and new grease added. Use only best grade ball bearing greases

DISASSEMBLY INSTRUCTIONS

Open the power supply switch contacts and remove fuses. Disconnect the electrical wiring from the motor. Then drain pump case by removing drain plugs.

Remove the bolts securing volute case to pump bracket, and pry components apart. Then remove impeller.

Always replace both rotating assembly and stationary ceramic seat. Do not use old stationary seat with new rotating seal assembly. Pry out rotating assembly of shaft seal and remove ceramic ring from housing. A new shaft seal should always be used when rebuilding a pump. All pump parts should be cleaned thoroughly before being reassembled.

Remove four bolts holding bracket to motor and remove motor. Then remove set screw in stub shaft coupling to disconnect motor pump shaft.

ASSEMBLY INSTRUCTIONS

Place rubber deflector over motor shaft, slide shaft extension into position and tighten set screws. Assemble motor and shaft onto bracket.

Insert seal seat in position by using finger pressure to press firmly and squarely until it bottoms. The use of light oil on the rubber element will facilitate assembly. Care must be taken to keep oil, grease and dirt off face areas of seal. Be sure the seal faces are not damaged during assembly or the seal will leak during operation.

Check dimension from face of ceramic seat to shaft shoulder. This distance should be within a tolerance of ±1/64. Install rotating element of seal on shaft. Be sure the lapped sealing surface is toward seal seat and assemble impeller. Check diameter of impeller against motor horsepower rating to ensure proper performance.

Secure impeller using key, impeller retainer washer, 5/16 stainless steel helical spring lockwasher and socket head cap screw, 1" long. Then rotate pump shaft with fingers, making sure there is uniform drag of the seal faces.

COUPLINGS

TB Wood's

Sure-Flex® Couplings

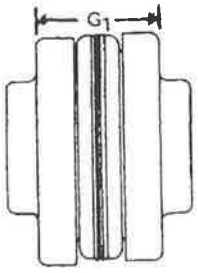
Installation Instructions

Sure-Flex flanges (outer metallic parts) and sleeves (inner elastomeric members) come in many sizes and types. First, determine the size and type of components being used. Remove all components from their boxes, and loosely assemble the coupling on any convenient surface. (Do not attempt to install the wire ring on the two-piece E or N sleeve at this time.) Also check maximum RPM values in Table 2 against operating speed. All rubber sleeves (EPDM and Neoprene) have the same ratings for a given size and may be used interchangeably. However, because rubber and Hytrel sleeves have completely different ratings, they never should be used interchangeably.

1 Inspect all coupling components and remove any protective coatings or lubricants from bores, mating surfaces and fasteners. Remove any existing burrs, etc. from the shafts.

2 Slide one coupling flange onto each shaft, using snug-fitting keys where required. With the Type B flange, it may be necessary to expand the bore by wedging a screwdriver into the saw cut of the bushing.

3 Position the flanges on the shafts to approximately achieve the G_1 dimension shown in Table 2. It is usually best to have an equal length of shaft extending into each flange. Tighten one flange in its final position. Refer to Table 1 for fastener torque values. Slide the other far enough away to install the sleeve. With a two-piece sleeve, do not move the wire ring to its final position; allow it to hang loosely in the groove adjacent to the teeth, as shown.



4 Slide the loose flange on the shaft until the sleeve is completely seated in the teeth of each flange, (The "G_1" dimension is for reference and not critical.) Secure the flange to the shaft using the torque values from Table 1.

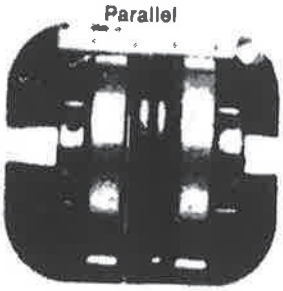
TABLE 1 — FASTENER TORQUE VALUES (ft.-lbs.)

Coupling Size	TYPE J	TYPE S	TYPE B	TYPE SC*		TYPE C	
	2 Setscrews at 90°	2 Setscrews at 90°	3 Hex Head Cap Screws	4 Hex Head Cap Screws Flange to Hub	1 Setscrew over Keyway in Hub	Clamping Screws	1 Setscrew over Keyway
3	3	...	...	...	...	...	...
4	3	...	...	5½**	13	...	...
5	7	13	...	4	13	...	...
6	13	13	5	9	13	15	13
7	13	13	5	9	13	30	13
8	23	23	9	18	23	55	13
9	...	23	9	31	23	55	13
10	...	23	15	50	50	130	13
11	...	23	30	75	50	130	13
12	...	50	60	150	100	250	13
13	...	100	75	150	165	...	...
14	...	100	75	150	165	...	...
16	...	100	135	150	165	...	...

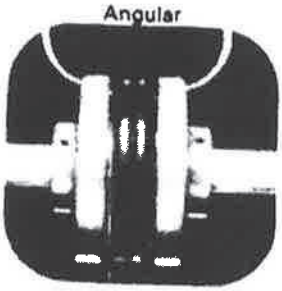
*Torque values apply to hub size when different than flange size.
**Value for socket head clamping screw.

Sure-Flex *Installation Instructions (continued)*

Different coupling sleeves require different degrees of alignment precision. Locate the alignment values for your sleeve size and type in Table 2 below.



5 Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum offset at various points around the periphery of the coupling **without rotating** the coupling. If the maximum offset exceeds the figure shown under "Parallel" in Table 2, realign the shafts.



6 Check angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions **without rotating** the coupling. The difference between the maximum and minimum must not exceed the figure given under "Angular" in Table 2. If a correction is necessary, be sure to recheck the parallel alignment.

TABLE 2 – MAXIMUM RPM AND ALLOWABLE MISALIGNMENT
(Dimensions in inches)

Sleeve Size	Maximum RPM	Types JE, JN, JES, JNS, E & N			*Type H & HS		
		Parallel	Angular	G_1	Parallel	Angular	G_1
3	9200	.010	.035	1.188	....	....	....
4	7600	.010	.043	1.500	....	....	....
5	7600	.015	.056	1.938	....	....	....
6	6000	.015	.070	2.375(1)	.010	.016	2.375
7	5250	.020	.081	2.563	.012	.020	2.563
8	4500	.020	.094	2.938	.015	.025	2.938
9	3750	.025	.109	3.500	.017	.028	3.500
10	3600	.025	.128	4.063	.020	.032	4.063
11	3600	.032	.151	4.875	.022	.037	4.875
12	2800	.032	.175	5.688	.025	.042	5.688
13	2400	.040	.195	6.625	.030	.050	6.625
14	2200	.045	.242	7.750	.035	.060	7.750
16	1500	.062	.330	10.250	....	....	....

Note: Values shown above apply if the actual torque transmitted is more than 1/4 the coupling rating. For lesser torque, reduce the above values by 1/2.

* Type H and HS sleeves **should not** be used as direct replacements for EPDM or Neoprene sleeves.

(1) Value when using 6J flanges is 2.125.

7 If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

8 Install coupling guards per OSHA requirements.

CAUTION: Coupling sleeves may be thrown from the coupling assembly with substantial force when the coupling is subjected to a severe shock load or abuse.

BACKWASH PROCEDURE

HOSING TO OFFLOAD MANIFOLD

EFFLUENT ORGANOCLAY BACKWASHING MANIFOLD

EFFLUENT LGAC BACKWASHING MANIFOLD

ELECTRICAL EXCLUSION ZONE

CONTAINMENT AREA FOOTPRINT

TREATED EFFLUENT WATER DISCHARGE LOCATION

FRAC TANK AND PUMP

0 20' 40'

GRAPHIC SCALE

STICK UP LOCATIONS

FROM HOLDING TANK

GENERATOR

BUILDING

OWS

TO/FROM CLAY & LGAC

BACKUP GENERATOR

OFFLOAD MANIFOLD

AIR STRIPPER EXCLUSION ZONE

ORGANO CLAY

ORGANO CLAY

3000 LGAC

3000 LGAC

INFLUENT ORGANOCLAY BACKWASHING MANIFOLD

INFLUENT LGAC BACKWASHING MANIFOLD

CATCH BASIN

BLOWER

BLOWER 2

EXHAUST

HS600 4000

AIR STRIPPER

VGAC 3000

VGAC 3000

VGAC 3000

VGAC 3000

KO TANK

HS600 6700

HS600 6700

HS600 6700

BAG FILTERS

SAND FILTERS

CENTRIFUGE

LANE 3

FLOCCULATION TANK

CLARIFIER

CHEMICAL DOSING PUMP P-500/P-501

OFFLOAD MANIFOLD

CATCH BASIN

LANE 2

LANE 1

CATCH BASIN

TRUCK TRAFFIC LANE (15-FT MIN., TWO LANES)

OFFLOAD MANIFOLD

OFFLOAD MANIFOLD

TO 1 MILLION GALLON TANKS

1030 1031 1032 1033 1034 1035

LEGEND

TREATMENT SYSTEM EQUIPMENT LAYDOWN AREA

CONTAINMENT AREA FOOTPRINT

APPROXIMATE LOCATION OF POTENTIAL SECOND DUPLICATE CHEMICAL TREATMENT SYSTEM EQUIPMENT

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

WATER TREATMENT SYSTEM EQUIPMENT LAYOUT

ARCADIS

FIGURE 5

C:\Users\mwasilewski\ACCDocs\Arcadis\AUS-NORFOLK SOUTHERN-EAST PALESTINE DERAILMENT-EAST PALESTINE Ohio\Project Files\2023101-In Progress\01-DWG\GMM-F02-SITE LAYOUT WW TREATMENT SYSTEM_ALT.dwg LAYOUT: 2 SAVED: 6/29/2023 4:21 PM ACADVER: 24.1S (LMS TECH)
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Subgrade contours-Screenshot 2023-05-02 143418.png
REPORT-X-TITLE Arcadis Logo_2021.PNG

GENERAL TROUBLESHOOTING

TROUBLE-SHOOTING GUIDE

WATER TREATMENT SYSTEM

SYMPTOM	CAUSE & SOLUTION

CONTROL PANEL GENERAL:

Nothing works

1. Check the control transformer circuit breaker and reset if tripped.
2. Check fuses on or before the control transformer.
3. Verify that the Main Disconnect Switch is "ON".
4. Check the incoming power supply to the control panel.
5. Check the control panel wiring for loose connections.

WATER TREATMENT SYSTEM

AIR STRIPPER BLOWER IS OVERHEATING

1. Blower inlet filter is dirty. Clean or replace filter element.
2. Blockage in the air dilution valve muffler. Clean muffler.
3. Vacuum relief valve set too high. Readjust valve.
4. Motor voltage is too low. Check electrical power for proper voltage.
5. Blockage on discharge of system

TRANSFER PUMP:

Pump can't keep up with flow and discharge pressure gauge reads high. (Consult the pump curve for the model pump.

1. The discharge throttling valve is closed or isn't open enough. Open the discharge throttling valve.
2. There is a blockage in the line or process down stream from the pump. Check and clean bag filters, carbon filters and flow meters.
3. Some of the impeller vanes are blocked with debris. Clean the pump impeller.

Pump can't keep up with flow and discharge pressure gauge reads low. (Consult the pump curve for the model pump.

1. Pump impeller is blocked with debris. Clean the pump impeller.
2. Valve on the suction line to the pump is closed or isn't wide open. Open the valve.
3. Blockage of the suction line or suction fitting in the sump or tank. Check the sump or tank for floating debris. Clean the line and sump or tank. (Note: Clear plastic bags are very hard to see in water.)
4. Inspect and clean level controls.

Appendix H

Sample Collection Procedures

Norfolk Southern East Palestine Derailment
Treatment System Equipment Air Sample Collection Procedure

This document describes the methods and procedures for collecting air samples for laboratory analysis from wastewater treatment system process equipment using passivated stainless-steel canisters (SUMMA).

Equipment List

- SUMMA canisters (1 canister for each sampling location)
- Flow controllers with in-line particulate filters and vacuum gauges
- Open-end wrench (typically need 9/16 inch wrenches)
- ¼ inch outside diameter (OD) tubing
- 1 L Tedlar™ bags
- Photoionization detector with minimum 10.6 electron volt (eV) lamp to detect vinyl chloride, which has an ionization potential of 9.99 eV
- Permanent marker/pen
- Chain of custody (COC)
- Nitrile gloves

Procedure

- Identify sampling locations. See OM&M Plan for sampling locations.
- Record SUMMA canister serial number and flow controller number.
- Label sample containers prior to collecting samples. The following sample nomenclature should be followed:
  - WTS-SP###-YEARMMDD(TIME)-VOC#
- Collect samples when pumps and air stripper blower are in operation.
- Calibrate PID per the manufacturer's instructions including zeroing the equipment in a clean area without detectable contaminants.
- Confirm that a fresh desiccant filter is installed properly on the tip of the PID probe to help prevent moisture and particulates from interfering with PID operation and measurement.
- Proceed to first sampling location.
- Perform initial field screening:
  - Use clean Tedlar™ bag for each screening.
  - Connect sample tubing to clean Tedlar™ bag and sample port.
  - Open the valve of the sample port, then the valve of the sample bag, and allow the Tedlar™ bag to fill slowly.
  - Once the bag is filled, close the valve on the bag and then close the valve on the sample port, and then disconnect the bag and tubing from the sample port.

  - Connect the calibrated PID to the bag via the sampling tubing and open the valve of the bag. Record measurement in ppm after readings have stabilized.
- Collect sample for laboratory analysis:
  - Remove the brass dust cap from the SUMMA canister with the wrench. Attach the independent gauge to the canister. Check initial pressure (vacuum) of SUMMA canister and check for leaks. If the initial pressure registers less than –25 inches of mercury (inHg), then the canister is not appropriate for use and another canister should be used. Record initial pressure reading prior to sampling.
  - Attach the flow controller and integrated vacuum gauge to the canister with the wrench. Note, flow controlled should be preset by laboratory to zero or shortest sample collection time possible.
  - Connect a SUMMA canister directly to the given sample port using a new clean length of tubing. Canisters shall be connected to the sampling port using the shortest length of tubing feasible and the air in the tubing shall be purged out before connecting to the canister to avoid sample dilution.
  - After connecting the canister to the tubing, open the valve on the sample port, and then open the valve of the SUMMA canister. A fully opened 1 liter SUMMA canister with an initial pressure of –25 inHG or more will typically completely fill under less than a minute or at a flow rate of approximately 1 liter/minute. When the vacuum in the canister has dropped to approximately –5 inHG, close the SUMMA canister valve. Record initial and final times and pressures.
  - Close the sample port valve and disconnect the sample canister. Remove the flow controller from the canister, reinstall the brass plug on the canister fitting, and tighten with the wrench.
- Proceed to subsequent sampling locations and repeat the process until all samples are collected.
- Collect the following quality control (QC) samples as required in accordance with the CID Quality Assurance Project Plan (QAPP):
  - Field duplicate sample for volatile organic compound (VOC) analysis 1 for every 10 field samples.
- Fill out the laboratory chain of custody as samples are collected.
- When finished sampling, package the canisters and flow controllers for shipment in accordance with Department of Transportation regulations (the canister does not require preservation with ice or refrigeration), complete laboratory chain of custody, and prepare samples for shipment to laboratory in accordance with site procedures.

Norfolk Southern East Palestine Derailment
Treatment System Equipment Turbidity and pH Field Monitoring Procedure

This document describes the methods and procedures for collection and onsite analysis of wastewater samples from the wastewater pretreatment system clarifier during system startup and subsequent continuous operation to evaluate sediment pretreatment equipment performance.

Equipment List

- Turbidity HACH kit
- pH HACH kit
- Permanent marker/pen
- Nitrile gloves

Procedure

- Samples will be collected from the clarifier influent (SP-100) and clarifier effluent (SP-800) sample ports. Identify sampling locations in field prior to sampling.
- With the system in operation, follow the manufacturer's instructions for collecting turbidity and pH samples.
- Perform turbidity field reading
    - Calibrate the turbidity meter using the calibration standards supplied (20 nephelometric units [NTU], 100 NTU, 800 NTU) and follow the instructions supplied.
    - Approach the sample port with a clean and empty sample vial.
        - Vials should be cleaned between each sampling.
    - Open the vial and place under the valve of the sample port. Allow the vial to fill slowly to the line specified in the manufacturer's instructions.
    - Once the vial is filled, place the vial into the turbidity meter, perform the turbidity test, following the manufacturer's instructions, and record the turbidity reading.
    - Pour out the sample wastewater into a 5-gallon bucket. Clean the vial with clean water and pour that water into the 5-gallon bucket.
    - Approach the other sampling location and perform the sampling steps.
        - NOTE: Calibration should be performed once per day on days where samples are collected and analyzed.
- Perform pH field reading
    - Approach the sample port with the two clean and empty vials.
        - Vials should be cleaned between each sampling.
    - Open the vials and place under the valve of the sample port. Allow the vial to fill slowly to the first line (5 milliliters).
    - Put one vial on the left opening of the color comparator box.

  - Add 6 drops of wide range pH indicator solution to the second vial.
  - Swirl to mix.
  - Put the second vial into the color comparator box.
  - Hold the color comparator box in front of a light source. Turn the color disc to find the color match.
  - Read the results in pH units in the scale window. Record.
  - Dispose of the wastewater sample in a 5-gallon bucket. Clean out the vials with clean water and dispose of that water in the 5-gallon bucket.
  - Approach the other sampling location and perform the sampling steps
- Pour all sample-related wastewater in the 5-gallon bucket back into the clarifier where it will be treated.

Norfolk Southern East Palestine Derailment
Treatment System Equipment Water Sample Collection Procedure

This document describes the methods and procedures for collecting wastewater samples for laboratory analysis from wastewater treatment system process equipment and for collecting waste samples for the CID and startup sampling.

Equipment List

- Cooler
- Sealing plastic bags
- Ice
- Laboratory-provided sample collection bottles with labels
- Permanent marker/pen
- Chain of custody (COC)
- Nitrile gloves
- 5-gallon bucket or similar container
- Bailer with string

WASTEWATER TREATMENT SYSTEM PROCESS EQUIPMENT

Procedure

- Sample from the expected cleanest sample location (treated effluent) to the most impacted sample location (system influent) to limit the potential for cross-contamination. See OM&M Plan for sampling locations.
- Collect samples when pumps and air stripper blower are in operation.
- Label sample containers prior to collecting samples. The following sample nomenclature should be followed:
  - WTS-SP###-YEARMMDD(TIME)-TSS#
  - WTS-SP###-YEARMMDD(TIME)-VOCBA##
  - WTS-SP###-YEARMMDD(TIME)-VC##
  - WTS-SP###-YEARMMDD(TIME)-TPHDRO#
  - WTS-SP###-YEARMMDD(TIME)-TPHGRO#
- Proceed to first sampling location.
  - Open valve on sample port and let wastewater drain into bucket for 5 to 10 seconds to purge any debris that might be present in the port. Adjust stream to manageable flow for filling sample containers.
  - Fill sample containers for required analyses as specified in OM&M Plan.
    - Fill containers for volatiles analysis first, and then remaining analyses.
    - Volatile organic compound (VOC) containers should be filled to zero headspace.
    - Take care not to overfill preserved containers as this could result in loss of preservative.
    - Cap each container when done filling and place in sample cooler filled with ice so that samples are chilled and stored at a temperature of 4 degrees Celsius.
    - Close sample port valve between containers and keep stream directed into bucket otherwise.

- Proceed to subsequent sampling locations and repeat the process above until all samples are collected.
- Collect quality control (QC) samples (e.g., VOC trip blanks) as necessary. QC samples should be collected at the following frequencies as specified in the CID Quality Assurance Project Plan (QAPP). Note, equipment blanks are not required since no sampling equipment will be reused between locations to collect samples.

Analytical Group	No. of Field Duplicates	No. of MS/MSDs	No. of Trip Blanks
VOCs	One/10 field samples	One/20 field samples	One set of 3 vials/cooler
Total Petroleum Hydrocarbons (TPH) – Gasoline Range Organics (GRO)	One/10 field samples	One/20 field samples	N/A
TPH – Diesel Range Organics (DRO)	One/10 field samples	One/20 field samples	N/A
Total Suspended Solids	One/10 field samples	N/A	N/A

- Fill out laboratory chain of custody as samples are collected.
- When finished sampling, complete laboratory chain of custody, finish packing sample cooler, and prepare for shipping to laboratory in accordance with site procedures.
- Discharge any wastewater accumulated in bucket back into sediment pretreatment process equipment.

CID WASTEWATER SAMPLING

Procedure

- For the CID grab samples, collect samples directly from treated effluent sample port SP-306. See OM&M Plan process and instrumentation diagram for sampling locations.
- Collect samples when pumps and air stripper blower are in operation.
- Label sample containers prior to collecting samples. The following sample nomenclature should be followed:
  - WC-SP###-T#-YEARMMDD(TIME)-VC#
- Proceed to SP-900 sampling location.
  - Open valve on sample port and let wastewater drain into bucket for 5 to 10 seconds to purge any debris that might be present in the port. Adjust stream to manageable flow for filling sample containers.
  - Collect the sample directly from the SP-900 port (effluent grab samples).
  - Fill sample containers for total vinyl chloride analysis.
    - Containers should be filled to zero headspace.
    - Take care not to overfill preserved containers as this could result in loss of preservative.

- Cap each container when done filling and place in sample cooler filled with ice so that samples are chilled and stored at a temperature of 4 degrees Celsius.
- Close sample port valve between containers and keep stream directed into bucket otherwise.

- For the CID composite sample, collect sample at the end of batch generation (when treated wastewater will be shut off to that tank and will begin to be collected in a new tank).
- Label sample containers prior to collecting samples. The following sample nomenclature should be followed:
  - WC-SP###-T#-YEARMMDD(TIME)-VC#
- After reviewing the job hazard analysis (JHA) for tank sampling, proceed to top of the CID tank. Make sure to use 3 points of contact and close the safety bar on the stairway when you reach the top.
  - Using a bailer, collect a sample of the wastewater directly from the tank (batch composite sample).
  - Fill sample containers for total vinyl chloride analysis.
    - Containers should be filled to zero headspace.
    - Take care not to overfill preserved containers as this could result in loss of preservative.
    - Cap each container when done filling and place in sample cooler filled with ice so that samples are chilled and stored at a temperature of 4 degrees Celsius.
    - Close sample port valve between containers and keep stream directed into bucket otherwise.
- Collect QC samples (e.g., VOC trip blanks) as necessary. QC samples should be collected at the following frequencies as specified in the CID QAPP. Note, equipment blanks are not required since no sampling equipment will be reused between locations to collect samples.

Analytical Group	No. of Field Duplicates	No. of MS/MSDs	No. of Trip Blanks
VOCs	One/10 field samples	One/20 field samples	One set of 3 vials/cooler

- Fill out laboratory chain of custody as samples are collected.
- When finished sampling, complete laboratory chain of custody, finish packing sample cooler, and prepare for shipping to laboratory in accordance with site procedures.
- Discharge any wastewater accumulated in bucket back into the CID tank from which the composite sample was collected.

Appendix I

System Modification Log

Appendix I
System Modification Log

Date	Personnel	Modification	Comments

Appendix J

Chemical SDS

SAFETY DATA SHEET

Revision date 2019-27-9

Revision number 2

SECTION 1) CHEMICAL PRODUCT AND SUPPLIER'S IDENTIFICATION

Product ID:	FOC ND-9911
Product Name:	Waste/Water Treatment. For industrial use only
Revision Date:	Sep 27,2019
Supersedes Date:	April 28, 2019
Manufacturer's Name:	Azure Water Services
Address:	280 Callegari Drive West Haven, CT, US, 06516
Emergency Phone:	Chemtrec 800-424-9300, in US and Canada only

SECTION 2) HAZARDS IDENTIFICATION

Classification

Eye Irritation - Category 2

Skin Irritation - Category 3

Pictograms

Signal Word

Warning

Hazardous Statements - Health

Causes serious eye irritation

Causes mild skin irritation

Precautionary Statements - General

If medical advice is needed, have product container or label at hand.

Keep out of reach of children.

Read label before use.

Precautionary Statements - Prevention

Wash thoroughly after handling. Wear protective gloves/protective clothing/eye protection/face protection.

Precautionary Statements - Response

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

If eye irritation persists: Get medical advice/attention.

If skin irritation occurs: Get medical advice/attention.

Precautionary Statements - Storage

No precautionary statement available.

Precautionary Statements - Disposal

No precautionary statement available.

Hazards Not Otherwise Classified (HNOC)

None.

SECTION 3) COMPOSITION / INFORMATION ON INGREDIENTS

Substances/Mixtures

Chemical nature: Anionic Polyacrylamide

This product is not classified as Hazardous under the OSHA Hazard Communication Standard (29 CFR 1910.1200).

All of the product's ingredients are either listed or exempt from the TSCA Inventory.

Some specific chemical identity is being withheld as a trade secrets
None of the chemicals in this product are hazardous according to the GHS.

SECTION 4) FIRST-AID MEASURES

Inhalation

Remove source of exposure or move person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor/. If breathing has stopped, trained personnel should begin rescue breathing or, if the heart has stopped, immediately start cardiopulmonary resuscitation (CPR) or automated external defibrillation (AED).

Eye Contact

Remove source of exposure or move person to fresh air. Rinse eyes cautiously with lukewarm, gently flowing water for several minutes, while holding the eyelids open. Remove contact lenses, if present and easy to do. Continue rinsing for a flushing duration of 30 minutes. Take care not to rinse contaminated water into the unaffected eye or onto the face. Immediately call a POISON CENTER/doctor.

Skin Contact

Take off immediately all contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Rinse skin with lukewarm, gently flowing water/shower for a duration of 30 minutes or until medical aid is available. Immediately call a POISON CENTER/doctor. Wash contaminated clothing before re-use or discard.

Ingestion

Rinse mouth with water. Do NOT induce vomiting. Give 1 to 2 cups of milk or water to drink. Never give anything by mouth to an unconscious person. If vomiting occurs naturally, lie on your side, in the recovery position. Immediately call a POISON CENTER/doctor.

Most Important Symptoms and Effects, Both acute and Delayed

No data available.

Indication of Any Immediate Medical Attention and Special Treatment Needed

No data available.

SECTION 5) FIRE-FIGHTING MEASURES

Suitable Extinguishing Media

Dry chemical, foam, carbon dioxide. Sand or earth may be used for small fires only.

Use extinguishing agent suitable for type of surrounding fire.

Unsuitable Extinguishing Media

Do not use direct water stream since this may cause fire to spread.

Specific Hazards in Case of Fire

In case of fire, hazardous decomposition products may include sulphur oxides.

Fire-Fighting Procedures

Isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Water may be ineffective but can be used to cool containers exposed to heat or flame. Caution should be exercised when using water or foam as frothing may occur, especially if sprayed into containers of hot, burning liquid. Dispose of fire debris and contaminated extinguishing water in accordance with official regulations.

Special Protective Actions

Wear protective pressure self-contained breathing apparatus (SCBA) and full turnout gear.

SECTION 6) ACCIDENTAL RELEASE MEASURES

Emergency Procedure

Isolate hazard area and keep unnecessary people away. Remove all possible sources of ignition in the surrounding area. Notify authorities if any exposure to the general public or the environment occurs or is likely to occur.

Absorb spill with absorbent material or vacuum spill into polyethylene lined steel or plastic drums.

Do not touch or walk through spilled material.

If spilled material is cleaned up using a regulated solvent, the resulting waste mixture may be regulated.

Recommended Equipment

Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).

Personal Precautions

Avoid breathing vapor or mist. Avoid contact with skin, eye or clothing. Ensure adequate ventilation. Do not touch damaged containers or spilled materials unless wearing appropriate protective clothing.

Environmental Precautions

Stop spill/release if it can be done safely. Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems and natural waterways by using sand, earth, or other appropriate barriers.

Methods and Materials for Containment and Cleaning Up

Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Contaminated absorbent material may pose the same hazard as the spilled product.

SECTION 7) HANDLING AND STORAGE

General

Wash hands after use.
Do not get in eyes, on skin or on clothing.
Do not breathe vapors or mists.
Use good personal hygiene practices.
Eating, drinking and smoking in work areas is prohibited.
Remove contaminated clothing and protective equipment before entering eating areas.
Eyewash stations and showers should be available in areas where this material is used and stored.

Ventilation Requirements

Use only with adequate ventilation to control air contaminants to their exposure limits. The use of local ventilation is recommended to control emissions near the source.

Storage Room Requirements

Keep container(s) tightly closed and properly labeled. Store in cool, dry, well-ventilated areas away from heat, direct sunlight and strong oxidizers. Store in approved containers and protect against physical damage. Keep containers securely sealed when not in use. Indoor storage should meet OSHA standards and appropriate fire codes. Containers that have been opened must be carefully resealed to prevent leakage. Empty containers retain residue and may be dangerous.
Use ventilation systems where this product is used and stored.

SECTION 8) EXPOSURE CONTROLS, PERSONAL PROTECTION

Eye Protection

Wear eye protection with side shields or goggles. Wear indirect-vent, impact and splash resistant goggles when working with liquids. If additional protection is needed for entire face, use in combination with a face shield.

Skin Protection

Use of gloves approved to relevant standards made from the following materials may provide suitable chemical protection: PVC, neoprene or nitrile rubber gloves. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Use of an apron and over-boots of chemically impervious materials such as neoprene or nitrile rubber is recommended to avoid skin sensitization. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace. Launder soiled clothes or properly disposed of contaminated material, which cannot be decontaminated.

Respiratory Protection

If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker, a respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed. Check with respiratory protective equipment suppliers.

Appropriate Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

SECTION 9) PHYSICAL AND CHEMICAL PROPERTIES

Physical and Chemical Properties

Density	5.85 lb/gal
Specific Gravity	0.65 - 0.85

Appearance	Off white granular solid
pH	6.0 - 8.0
Odor Threshold	N/A
Odor Description	characteristic odor
Water Solubility	< 2%
Viscosity	N/A
Vapor Pressure	Similar to water
Vapor Density	N/A
Freezing Point	<32 °F
Boiling Point	>212 °F
Evaporation Rate	N/A
Flammability	Flash point at or above 200°F/93°C

SECTION 10) STABILITY AND REACTIVITY

Stability

Stable under normal storage and handling conditions.

Conditions To Avoid

Avoid heat, sparks, flame, high temperature and contact with incompatible materials.

Hazardous Reactions/Polymerization

Hazardous polymerization will not occur.

Incompatible Materials

Strong bases, acids, oxidizing and reducing agents.

Hazardous Decomposition Products

May produce carbon monoxide, carbon dioxide.

SECTION 11) TOXICOLOGICAL INFORMATION

Likely Routes of Exposure

Inhalation, ingestion, skin absorption.

Acute Toxicity

Acute Oral Toxicity: Results displayed may not be the result of actual testing of this material but based on a similar tested material
LD50, Rat, 4 hr > 2,500 mg/kg (estimated)
Acute Inhalation Toxicity: LC50, Rat, 4 hr, > 20mg/l (estimated)

Acute Dermal Toxicity: LD50, Rabbit, > 10,000 mg/kg (estimated)

Carcinogenicity

Based on available data, the classification criteria are not meet.

Respiratory/Skin Sensitization

No Data Available

Serious Eye Damage/Irritation

Causes serious eye irritation

Skin Corrosion/Irritation

Causes mild skin irritation

Specific Target Organ Toxicity - Repeated Exposure

No Data Available

Specific Target Organ Toxicity - Single Exposure

No Data Available

SECTION 12) ECOLOGICAL INFORMATION

Ecotoxicity effects

Aquatic Toxicity: Ecotoxicological information provided is based on a structurally or compositionally similar product.

LC50, Bluegill sunfish (Lepomis macrochirus), 96 hr, > 100 mg/kg	OECD Test Guideline 203
LC50, Rainbow Trout (Oncorhynchus mykiss), 96 hr, > 100 mg/l	OECD Test Guideline 203
EC50, Water Flea (Daphina Magna), 48 hr, > 100 mg/l	OECD Test Guideline 202
EC50, Amphipoda (Corophium Volutator), 10 d, 1415 mg/l	OECD Test Guideline 202
EC50, Copepod (Acartia Tonsa), 48 hr, 342 mg/l	OECD Test Guideline 202
IC50, Green Algae (Selenastrum capricornutum), 72 hr, > 100mg/l	OECD Test Guideline 201
IC50, Diatom (Skeletonema Costatum), 72 hr, 2,276 mg/l	OECD Test Guideline 201

Mobility in Soil

Water Solubility: Limited by viscosity.
Surface Tension: Not applicable

Persistence and degradability

Ecotoxicological information provided is based on a structurally or compositionally similar product.

Not Readily Biodegradable.

Ready Biodegradability: d:< 10%	OECD Test Guideline 301 D/28
Biodegradability in Seawater: d: 1.7%	OECD Test Guideline 306/28

Bioaccumulative potential

Bioaccumulation is unlikely. Because of the high molecular weight of the polymer diffusion through biological membranes is very small.

Partion coefficient

N-octanol/water: Not applicable

Other adverse effects

This material is not classified as dangerous for the environment .

SECTION 13) DISPOSAL CONSIDERATIONS

Waste Disposal

Under RCRA it is the responsibility of the user of the product to determine at the time of disposal whether the product meets RCRA criteria for hazardous waste. Waste management should be in full compliance with federal, state and local laws.
Empty Containers retain product residue which may exhibit hazards of material, therefore do not pressurize, cut, glaze, weld or use for any other purposes. Return drums to reclamation centers for proper cleaning and reuse.

SECTION 14) TRANSPORT INFORMATION

U.S. DOT Information

For all transportation accidents, call CHEMTREC at 800/424-9300. All spills and leaks of this material must be handled in accordance with local, state, and federal regulations.

DOT Shipping Designation:

Non-hazardous under 29-CFR 1910.1200. Water treatment compound

SECTION 15) REGULATORY INFORMATION

CAS	Chemical Name	% By Weight	Regulation List
No applicable CAS	No applicable chemical	-	-

SECTION 16) OTHER INFORMATION

Glossary

ACGIH- American Conference of Governmental Industrial Hygienists; ANSI- American National Standards Institute; Canadian TDGCanadian Transportation of Dangerous Goods; CAS- Chemical Abstract Service; Chemtrec- Chemical Transportation Emergency Center(US); CHIP- Chemical Hazard Information and Packaging; DSL- Domestic Substances List; EC- Equivalent Concentration; EH40 (UK)- HSE Guidance Note EH40 Occupational Exposure Limits; EPCRA- Emergency Planning and Community Right-To-Know Act; ESL Effects screening levels; HMIS- Hazardous Material Information Service; LC- Lethal Concentration; LD- Lethal Dose; NFPA- National Fire Protection Association; OEL- Occupational Exposure Limits; OSHA- Occupational Safety and Health Administration, US Department of Labor; PEL- Permissible Exposure Limit; SARA (Title III)- Superfund Amendments and Reauthorization Act; SARA 313- Superfund Amendments and Reauthorization Act, Section 313; SCBA- Self Contained Breathing Apparatus; STEL-Short Term Exposure Limit; TCEQ Texas Commission on Environmental Quality; TLV- Threshold Limit Value; TSCA- Toxic Substances Control Act Public Law 94-469; TWA Time Weighted Value; US DOT- US Department of Transportation; WHMIS- Workplace Hazardous Materials Information System.

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

DISCLAIMER

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist. The above information pertains to this product as currently formulated, and is based on the information available at this time. Addition of reducers or other additives to this product may substantially alter the composition and hazards of the product. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information.

Hydrosil International LTD.
125 Prairie Lake Road - East Dundee, IL 60118
Phone: 847-844-0680
Emergency Phone: 847-844-0680
Fax: 847-844-0799

HS-200 Safety Data Sheet

Revision date : 2015

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

1.1 - Product Identifier

Product Name: HS-200

1.2 - Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Filtration

1.3 - Details of the supplier of the safety data sheet

Hydrosil International Ltd.
125 Prairie Lake Rd
East Dundee, IL 60118

T 847-844-0680 - F 847-844-0799
www.hydrosilintl.com

1.4 - Emergency telephone number

Emergency number : 1-847-844-0680

Section 2: Hazards Identification

2.1 - Classification of the substance or mixture

GHS-US classification
Eye Dam. 1 H318
STOT SE 3 H335

2.2 - Label Elements

GHS-US labeling
Hazard pictograms (GHS-US) :

Signal word (GHS-US) : Danger
Hazard statements (GHS-US) :

H318 - Causes serious eye damage
H335 - May cause respiratory irritation

Precautionary statements (GHS-US) :

P261 - Avoid breathing dust/fume/gas/mist/vapors/spray
P271 - Use only outdoors or in a well-ventilated area
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTER/doctor/…
P312 - Call a POISON CENTER/doctor/…/if you feel unwell
P403+P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up
P501 - Dispose of contents/container to ...

2.3 - Other Hazards

No additional information available

2.4 - Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/information on ingredients

3.1 - Substances

Not applicable

3.2 - Mixture

Name	Product Identifier	%	GHS-US Classification
Zeolite	(CAS No.) 1318-02-1	85.2 - 86.2	STOT SE 3, H335
Water	(CAS No.) 7732-18-5	8.4 - 11.4	Not classified
N,N,N-Trimethyl-1-hexadecanaminium chloride	(CAS No.) 112-02-7	3.4 - 5.4	Skin Irrit. 2, H315 Eye Dam. 1, H318 Aquatic Acute 1, H400

SECTION 4: First aid measures

4.1 - Description of first aid measures

First-aid measures after inhalation : Remove person to fresh air. If not breathing, administer CPR or artificial respiration. Get immediate medical attention.
First-aid measures after skin contact : If skin reddening or irritation develops, seek medical attention.
First-aid measures after eye contact : Immediately flush eyes with plenty of water for at least 15 minutes. If irritation persists get medical attention.
First-aid measures after ingestion : If the material is swallowed, get immediate medical attention or advice. DO NOT induce vomiting unless directed to do so by medical personnel.

4.2 - Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation : May cause respiratory irritation.
Symptoms/injuries after skin contact : Causes skin irritation.
Symptoms/injuries after eye contact : Causes serious eye irritation.
Symptoms/injuries after ingestion : May be harmful if swallowed.

4.3 - Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1 - Extinguishing media

Suitable extinguishing media : If involved with fire, flood with plenty of water.
Unsuitable extinguishing media : None.

5.2 - Special hazards arising from the substance or mixture

Fire hazard : None known.
Explosion hazard : None known.

5.3 - Advice for firefighters

Protection during firefighting : Firefighters should wear full protective gear.

SECTION 6: Accidental release measures

6.1 - Personal precautions, protective equipment and emergency procedures

General measures : Avoid contact with the skin and the eyes.
For non-emergency personnel : No additional information available
For emergency responders : No additional information available

6.2 - Environmental precautions

None.

6.3 - Methods and material for containment and cleaning up

For containment : If possible, stop flow of product.
Methods for cleaning up : Shovel or sweep up and put in a closed container for disposal.

6.4 - Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1 - Precautions for safe handling

Precautions for safe handling : Wet carbon/coal removes oxygen from air causing a severe hazard to workers inside carbon vessels or confined spaces.

7.2 - Conditions for safe storage, including any incompatibilities

Storage conditions : Protect containers from physical damage. Store in dry, cool, well-ventilated area.

7.3 - Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1 - Control parameters

No additional information available

8.2 - Exposure controls

Appropriate engineering controls : Local exhaust and general ventilation must be adequate to meet exposure standards.
Hand protection : Use impervious gloves.
Eye protection : Safety glasses.
Skin and body protection : Wear suitable working clothes.
Respiratory protection : If airborne concentrations are above the applicable exposure limits, use NIOSH approved respiratory protection.

SECTION 9: Physical and chemical properties

9.1 - Information on basic physical and chemical properties

Physical state : Solid
Appearance : Irregular shaped.
Color : White
Odor : No data available
Odor threshold : No data available
pH : No data available
Relative evaporation rate (butyl acetate=1) : No data available
Melting point : No data available
Freezing point : No data available
Boiling point : No data available
Flash point : No data available
Self ignition temperature : No data available
Decomposition temperature : No data available
Flammability (solid, gas) : No data available
Vapor pressure : No data available
Relative vapor density at 20 °C : No data available
Relative density : 57-59 lb/ft3
Solubility : No data available
Log Pow : No data available
Log Kow : No data available
Viscosity, kinematics : No data available
Viscosity, dynamic : No data available
Explosive properties : No data available
Oxidizing properties : No data available
Explosive limits : No data available

9.1 - Other information

No additional information available

SECTION 10: Stability and Reactivity

10.1 - Reactivity

No additional information available

10.2 - Chemical stability

Stable under normal conditions.

10.3 - Possibility of hazardous reactions

Will not occur

10.4 - Conditions to avoid

None

10.5 - Incompatible materials

Strong oxidizing and reducing agents.

10.6 - Hazardous decomposition products

Organic chlorides, amines, hydrogen chloride may be produced.

SECTION 11: Toxicological information

11.1 - Information on toxicological effects

Acute toxicity : Not classified

Zeolite (1318-02-1)	
LD50 oral rat	5000 mg/kg
LD50 dermal rabbit	> 2000 mg/kg
LC50 inhalation rat (mg/l)	2.4 mg/l (Exposure time: 1 h)
ATE (oral)	5000 mg/kg

Skin corrosion/irritation : Not classified
Serious eye damage/irritation : Causes serious eye damage.
Respiratory or skin sensitization : Not classified
Germ cell mutagenicity : Not classified
Carcinogenicity : Not classified

Zeolite (1318-02-1)	
IARC group	3

Reproductive toxicity : Not classified
Specific target organ toxicity (single exposure) : May cause respiratory irritation.
Specific target organ toxicity (repeated exposure) : Not classified
Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1 - Toxicity

Zeolite (1318-02-1)	
LC50 fishes 1	1800 mg/l (Exposure time: 96 h - Species: Brachydanio rerio [semi-static])
EC50 Daphnia 1	1000 - 1800 mg/l (Exposure time: 48 h - Species: Daphnia magna)
EC50 other aquatic organisms 1	18 mg/l (Exposure time: 96 h - Species: Desmodesmus subspicatus)
LC50 fish 2	3200 - 5600 mg/l (Exposure time: 96 h - Species: Oryzias latipes [semi-static])

12.2 - Persistence and degradability

No additional information available

12.3 - Bioaccumulative potential

No additional information available

12.4 - Mobility in soil

No additional information available

12.5 - Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1 - Waste treatment methods

Waste disposal recommendations : Dispose of contents/container in accordance with local/regional/national/international regulations.

SECTION 14: Transport information

In accordance with DOT / ADR / RID / ADNR / IMDG / ICAO / IATA

14.1 - UN number

Not applicable

14.2 - UN proper shipping name

Not applicable

SECTION 15: Regulatory information

15.1 - US Federal regulations

15.2 - US State regulations

No additional information available

SECTION 16: Other information

Full text of H-phrases:

Aquatic Acute 1	Hazardous to the aquatic environment - Acute Hazard Category 1
Eye Dam. 1	Serious eye damage/eye irritation Category 1
Skin Irrit. 2	skin corrosion/irritation Category 2
STOT SE 3	Specific target organ toxicity (single exposure) Category 3
H315	Causes skin irritation
H318	Causes serious eye damage
H335	May cause respiratory irritation
H400	Very toxic to aquatic life

NFPA health hazard : 2 - Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt
medical attention is given.
NFPA fire hazard : 0 - Materials that will not burn.
NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

Revision date 2019-15-4

SAFETY DATA SHEET

Revision number 1

SECTION 1) CHEMICAL PRODUCT AND SUPPLIER'S IDENTIFICATION

Product Name:	Redux E50
Product Use:	Water and Wastewater Treatment Coagulant/Flocculant
Revision Date:	Apr 15, 2019
Supersedes Date:	Mar 5, 2015
Manufacturer's Name:	Azure Water Services
Address:	280 Callegari Dr. West Haven CT, 06516
Emergency Phone:	Chemtrec, (1) 800-424-9300, in US and Canada only

SECTION 2) HAZARDS IDENTIFICATION

Classification

Corrosive to metals - Category 1

Eye Irritation - Category 2

Skin Irritation - Category 2

Pictograms

Signal Word

Warning

Hazardous Statements - Health

Causes serious eye irritation

Causes skin irritation

Hazardous Statements - Physical

May be corrosive to metals

Precautionary Statements - General

If medical advice is needed, have product container or label at hand.

Keep out of reach of children.

Read label before use.

Precautionary Statements - Prevention

Keep only in original packaging.

Wash thoroughly after handling.

Wear protective gloves/protective clothing/eye protection/face protection.

Precautionary Statements - Response

Absorb spillage to prevent material damage.

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

If eye irritation persists: Get medical advice/attention.

IF ON SKIN: Wash with plenty of water.

Specific treatment (see first-aid on this SDS).

If skin irritation occurs: Get medical advice/attention.

Take off contaminated clothing. And wash it before reuse.

Precautionary Statements - Storage

Store in a corrosive resistant container with a resistant inner liner.

Precautionary Statements - Disposal

No precautionary statement available.

Hazards Not Otherwise Classified (HNOC)

None.

SECTION 3) COMPOSITION / INFORMATION ON INGREDIENTS

CAS	Chemical Name	% By Weight
PROPRIETARY	Trade Secret Ingredient	45 - 55%

Specific chemical identity and/or exact percentage (concentration) of the composition has been withheld to protect confidentiality.

SECTION 4) FIRST-AID MEASURES

Inhalation

Remove source of exposure or move person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor/. If breathing has stopped, trained personnel should begin rescue breathing or, if the heart has stopped, immediately start cardiopulmonary resuscitation (CPR) or automated external defibrillation (AED).

Eye Contact

Remove source of exposure or move person to fresh air. Rinse eyes cautiously with lukewarm, gently flowing water for several minutes, while holding the eyelids open. Remove contact lenses, if present and easy to do. Continue rinsing for a flushing duration of 30 minutes. Take care not to rinse contaminated water into the unaffected eye or onto the face. Immediately call a POISON CENTER/doctor.

Skin Contact

Take off immediately all contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Rinse skin with lukewarm, gently flowing water/shower for a duration of 30 minutes or until medical aid is available. Immediately call a POISON CENTER/doctor. Wash contaminated clothing before re-use or discard.

Ingestion

Rinse mouth with water. Do NOT induce vomiting. Give 1 to 2 cups of milk or water to drink. Never give anything by mouth to an unconscious person. If vomiting occurs naturally, lie on your side, in the recovery position. Immediately call a POISON CENTER/doctor.

Most Important Symptoms and Effects, Both acute and Delayed

No data available.

Indication of Any Immediate Medical Attention and Special Treatment Needed

No data available.

SECTION 5) FIRE-FIGHTING MEASURES

Suitable Extinguishing Media

Dry chemical, foam, carbon dioxide. Sand or earth may be used for small fires only.

Use extinguishing agent suitable for type of surrounding fire.

Unsuitable Extinguishing Media

Do not use direct water stream since this may cause fire to spread.

Specific Hazards in Case of Fire

In case of fire, hazardous decomposition products may include sulphur oxides.

Fire-Fighting Procedures

Isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Water may be ineffective but can be used to cool containers exposed to heat or flame. Caution should be exercised when using water or foam as frothing may occur, especially if sprayed into containers of hot, burning liquid. Dispose of fire debris and contaminated extinguishing water in accordance with official regulations.

Special Protective Actions

Wear protective pressure self-contained breathing apparatus (SCBA) and full turnout gear.

SECTION 6) ACCIDENTAL RELEASE MEASURES

Emergency Procedure

Isolate hazard area and keep unnecessary people away. Remove all possible sources of ignition in the surrounding area. Notify authorities if any exposure to the general public or the environment occurs or is likely to occur.

Absorb spill with absorbent material or vacuum spill into polyethylene lined steel or plastic drums.

Do not touch or walk through spilled material.

If spilled material is cleaned up using a regulated solvent, the resulting waste mixture may be regulated.

Recommended Equipment

Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).

Personal Precautions

Avoid breathing vapor or mist. Avoid contact with skin, eye or clothing. Ensure adequate ventilation. Do not touch damaged containers or spilled materials unless wearing appropriate protective clothing.

Environmental Precautions

Stop spill/release if it can be done safely. Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems and natural waterways by using sand, earth, or other appropriate barriers.

Methods and Materials for Containment and Cleaning Up

Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Contaminated absorbent material may pose the same hazard as the spilled product.

SECTION 7) HANDLING AND STORAGE

General

Wash hands after use.
Do not get in eyes, on skin or on clothing.
Do not breathe vapors or mists.
Use good personal hygiene practices.
Eating, drinking and smoking in work areas is prohibited.
Remove contaminated clothing and protective equipment before entering eating areas.
Eyewash stations and showers should be available in areas where this material is used and stored.

Ventilation Requirements

Use only with adequate ventilation to control air contaminants to their exposure limits. The use of local ventilation is recommended to control emissions near the source.

Storage Room Requirements

Keep container(s) tightly closed and properly labeled. Store in cool, dry, well-ventilated areas away from heat, direct sunlight and strong oxidizers. Store in approved containers and protect against physical damage. Keep containers securely sealed when not in use. Indoor storage should meet OSHA standards and appropriate fire codes. Containers that have been opened must be carefully resealed to prevent leakage. Empty containers retain residue and may be dangerous.

Use non-sparking ventilation systems, approved explosion-proof equipment and intrinsically safe electrical systems in areas where this product is used and stored.

SECTION 8) EXPOSURE CONTROLS, PERSONAL PROTECTION

Eye Protection

Wear eye protection with side shields or goggles. Wear indirect-vent, impact and splash resistant goggles when working with liquids. If additional protection is needed for entire face, use in combination with a face shield.

Skin Protection

Use of gloves approved to relevant standards made from the following materials may provide suitable chemical protection: PVC, neoprene or nitrile rubber gloves. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Use of an apron and over-boots of chemically impervious materials such as neoprene or nitrile rubber is recommended to avoid skin sensitization. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace. Launder soiled clothes or properly disposed of contaminated material, which cannot be decontaminated.

Respiratory Protection

If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker, a respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed. Check with respiratory protective equipment suppliers.

Appropriate Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

SECTION 9) PHYSICAL AND CHEMICAL PROPERTIES

Physical and Chemical Properties

Density	11.10 lb/gal
Specific Gravity	1.33 - 1.35
Appearance	Colorless to yellow liquid
pH	3 - 4
Odor Threshold	N/A
Odor Description	N/A
Water Solubility	complete
Viscosity	< 100cps @20C
Vapor Pressure	Similar to water
Vapor Density	N/A
Freezing Point	<19 °F
Boiling Point	>212 °F
Evaporation Rate	N/A
Flammability	Will not burn

SECTION 10) STABILITY AND REACTIVITY

Stability

Stable under normal storage and handling conditions.

Conditions To Avoid

Avoid heat, sparks, flame, high temperature and contact with incompatible materials.

Hazardous Reactions/Polymerization

Hazardous polymerization will not occur.

Incompatible Materials

Strong bases, acids, oxidizing and reducing agents.

Hazardous Decomposition Products

May produce carbon monoxide, carbon dioxide.

SECTION 11) TOXICOLOGICAL INFORMATION

Likely Routes of Exposure

Inhalation LC50 : Not Available
Oral LD50 : Not Available
Dermal LD50 : Not Available

Acute Toxicity

Component	weight-%	Oral LD50	Dermal LD50	Inhalation LC50
Trade Secret Ingredient	45 - 55%	= 9187 mg/kg (Rat)	> 2000 mg/k (Rat)	--

Aspiration Hazard

No Data Available

Respiratory/Skin Sensitization

No Data Available

Serious Eye Damage/Irritation

Causes serious eye irritation

Skin Corrosion/Irritation

Causes skin irritation

Specific Target Organ Toxicity - Repeated Exposure

No Data Available

Specific Target Organ Toxicity - Single Exposure

No Data Available

SECTION 12) ECOLOGICAL INFORMATION

Ecotoxicity

Acute aquatic toxicity - Product Information

Fish
LC 50 (96 hour, static) 776.4 mg/L *Pimephales promelas* (Fathead Minnow) [1]
EC 50 (96 hour, static) 265.5 mg/L *Pimephales promelas* (Fathead Minnow) [1]

Crustacea
LC 50 (48 hour, static) 803.8 mg/L *Ceriodaphnia dubia* (Water Flea) [1]
EC 50 (48 hour, static) 33.2 mg/L *Ceriodaphnia dubia* (Water Flea) [1]

Algae/aquatic plants
No information available

Acute aquatic toxicity - Component Information

Component	weight-%	Algae/aquatic plants	Fish	Toxicity to daphnia and other aquatic invertebrates
Trade Secret Ingredient	45 - 55%	--	LC50 (96 h static) 100 - 500 mg/L (Brachydanio rerio)	--

Mobility in Soil

No data available.

Bio-accumulative Potential

No data available.

Persistence and Degradability

No data available.

Other Adverse Effect

No data available.

SECTION 13) DISPOSAL CONSIDERATIONS

Waste Disposal

Under RCRA it is the responsibility of the user of the product to determine at the time of disposal whether the product meets RCRA criteria for hazardous waste. Waste management should be in full compliance with federal, state and local laws.
Empty Containers retain product residue which may exhibit hazards of material, therefore do not pressurize, cut, glaze, weld or use for any other purposes. Return drums to reclamation centers for proper cleaning and reuse.

SECTION 14) TRANSPORT INFORMATION

U.S. DOT Information

NOT REGULATED FOR TRANSPORTATION

This product is excepted from DOT regulations under 49 CFR 173.154(d) when shipped by road or railway. The product exception is referenced in 49 CFR 172.101 Table. Packaging material must not be aluminum, steel or be degraded by this product

SECTION 15) REGULATORY INFORMATION

CAS	Chemical Name	% By Weight	Regulation List
No applicable CAS	No applicable chemical	-	-

SECTION 16) OTHER INFORMATION

Glossary

ACGIH- American Conference of Governmental Industrial Hygienists; ANSI- American National Standards Institute; Canadian TDGCanadian Transportation of Dangerous Goods; CAS- Chemical Abstract Service; Chemtrec- Chemical Transportation Emergency Center(US); CHIP- Chemical Hazard Information and Packaging; DSL- Domestic Substances List; EC- Equivalent Concentration; EH40 (UK)- HSE Guidance Note EH40 Occupational Exposure Limits; EPCRA- Emergency Planning and Community Right-To-Know Act; ESL Effects screening levels; HMIS- Hazardous Material Information Service; LC- Lethal Concentration; LD- Lethal Dose; NFPA- National Fire Protection Association; OEL- Occupational Exposure Limits; OSHA- Occupational Safety and Health Administration, US Department of Labor; PEL- Permissible Exposure Limit; SARA (Title III)- Superfund Amendments and Reauthorization Act; SARA 313- Superfund Amendments and Reauthorization Act, Section 313; SCBA- Self Contained Breathing Apparatus; STEL-Short Term Exposure Limit; TCEQ Texas Commission on Environmental Quality; TLV- Threshold Limit Value; TSCA- Toxic Substances Control Act Public Law 94-469; TWA Time Weighted Value; US DOT- US Department of Transportation; WHMIS- Workplace Hazardous Materials Information System.

Additional Information

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

Version 1.0:

Revision Date: Apr 15,2019

First Edition.

DISCLAIMER

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist. The above information pertains to this product as currently formulated, and is based on the information available at this time. Addition of reducers or other additives to this product may substantially alter the composition and hazards of the product. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information.

Common Name: SODIUM THIOSULFATE, 0.100 NORMAL (N/10)
Manufacturer: RICCA CHEMICAL
SDS Revision Date: 10/6/2021
SDS Format: No Format Specified

Item Number(s): 45F698, 45F701, 45F703
Manufacturer Model Number(s):

SDS Table of Contents

Click the desired link below to jump directly to that section in the SDS.

R
RICCA CHEMICAL COMPANY(R*)

SAFETY DATA SHEET

CLASSIFIED ACCORDING TO OSHA HAZARD COMMUNICATION STANDARD (HCS)

SECTION 1: IDENTIFICATION

top

1.1. PRODUCT IDENTIFIER:

TRADE NAME OR DESIGNATION: SODIUM THIOSULFATE, 0.100 NORMAL (N/10)

PRODUCT NUMBER: 7950

OTHER IDENTIFYING PRODUCT NUMBERS:
7950-1, 7950-16, 7950-1CS, 7950-1CT, 7950-2.5, 7950-32, 7950-32CS, 7950-4, 7950-5, 7950-55

1.2. RECOMMENDED USE AND RESTRICTIONS ON USE:
GENERAL LABORATORY REAGENT

1.3. DETAILS OF THE SUPPLIER OF THE SAFETY DATA SHEET:

COMPANY: RICCA CHEMICAL COMPANY

ADDRESS:
448 WEST FORK DRIVE
ARLINGTON, TX 76012
USA

TELEPHONE: 888-467-4222

1.4. EMERGENCY TELEPHONE NUMBER (24 HOURS)
CHEMTREC (USA): 800-424-9300
CHEMTREC (INTERNATIONAL): 1+ 703-527-3887

SECTION 2: HAZARD(S) IDENTIFICATION

top

2.1. CLASSIFICATION OF THE SUBSTANCE OR MIXTURE:
FOR THE FULL TEXT OF THE HAZARD AND PRECAUTIONARY STATEMENTS LISTED BELOW, SEE SECTION 16.

HAZARD CLASS	CATEGORY	HAZARD STATEMENTS	PRECAUTIONARY STATEMENTS
SKIN SENSITIZER	CATEGORY 1	H317	P261, P272, P280, P302+P352, P332+P313, P321, P363, P501

2.2. GHS LABEL ELEMENTS:

PICTOGRAMS: EXCLAMATION MARK

SIGNAL WORD: WARNING

HAZARD STATEMENTS:

HAZARD NUMBER	HAZARD STATEMENT
H317	MAY CAUSE AN ALLERGIC SKIN REACTION.

PRECAUTIONARY STATEMENTS:

PRECAUTIONARY NUMBER	PRECAUTIONARY STATEMENT
P261	AVOID BREATHING FUMES, MIST, VAPORS, OR SPRAY.
P272	CONTAMINATED WORK CLOTHING MUST NOT BE ALLOWED OUT OF THE WORKPLACE.
P280	WEAR PROTECTIVE GLOVES AND EYE PROTECTION.
P302+P352	IF ON SKIN: WASH WITH PLENTY OF SOAP AND WATER.
P321	SPECIFIC TREATMENT (WASH AREAS OF CONTACT WITH WATER).
P332+P313	IF SKIN IRRITATION OCCURS: GET MEDICAL ATTENTION.
P363	WASH CONTAMINATED CLOTHING BEFORE REUSE.
P501	DISPOSE OF CONTENTS IN ACCORDANCE WITH LOCAL, STATE, FEDERAL AND INTERNATIONAL REGULATIONS.

2.4. HAZARDS NOT OTHERWISE CLASSIFIED OR COVERED BY GHS:
DATA NOT AVAILABLE.

SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS

top

3.1. COMPONENTS OF SUBSTANCE OR MIXTURE:

CHEMICAL NAME	FORMULA	MOLECULAR WEIGHT	CAS NUMBER	WEIGHT%
WATER	H2O	18.01 G/MOL	7732-18-5	97.26
SODIUM THIOSULFATE PENTAHYDRATE	NA2S2O3x5H2O	248.18 G/MOL	10102-17-7	2.48
PROPRIETARY	PROPRIETARY	DATA NOT AVAILABLE.	PROPRIETARY	0.24
SODIUM CARBONATE	Na2CO3	105.98 G/MOL	497-19-8	0.02

SECTION 4: FIRST-AID MEASURES

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4.1. GENERAL FIRST AID INFORMATION:

EYE CONTACT: MAY CAUSE SLIGHT IRRITATION.

INHALATION: NOT EXPECTED TO REQUIRE FIRST AID. IF NECESSARY, REMOVE TO FRESH AIR.

SKIN CONTACT:

IF ON SKIN:
WASH WITH PLENTY OF SOAP AND WATER. MAY CAUSE SLIGHT IRRITATION.

INGESTION: DILUTE WITH WATER OR MILK. CALL A PHYSICIAN IF NECESSARY.

4.2. MOST IMPORTANT SYMPTOMS AND EFFECTS, ACUTE AND DELAYED:
MAY CAUSE AN ALLERGIC SKIN REACTION. MAY BE IRRITATING TO THE EYES AND SKIN. WASH AREAS OF CONTACT WITH WATER. DOES NOT PRESENT ANY SIGNIFICANT HEALTH HAZARDS. IF INGESTED, DILUTE WITH WATER AND CALL A PHYSICIAN IF NECESSARY.

EYE CONTACT: MAY CAUSE SLIGHT IRRITATION.

SKIN CONTACT: MAY CAUSE SLIGHT IRRITATION.

4.3. MEDICAL ATTENTION OR SPECIAL TREATMENT NEEDED:
SPECIFIC TREATMENT (WASH AREAS OF CONTACT WITH WATER). IRRIGATE IMMEDIATELY WITH LARGE QUANTITY OF WATER FOR AT LEAST 15 MINUTES. CALL A PHYSICIAN IF IRRITATION DEVELOPS. REMOVE TO FRESH AIR. GIVE ARTIFICIAL RESPIRATION IF NECESSARY. IF BREATHING IS DIFFICULT, GIVE OXYGEN. FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. CALL A PHYSICIAN IF IRRITATION DEVELOPS. DILUTE WITH WATER OR MILK. CALL A PHYSICIAN IF NECESSARY.

SECTION 5: FIRE-FIGHTING MEASURES

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5.1. EXTINGUISHING MEDIA:
USE ANY MEANS SUITABLE FOR EXTINGUISHING SURROUNDING FIRE.

5.2. SPECIFIC HAZARDS ARISING FROM THE SUBSTANCE OR MIXTURE:
NOT CONSIDERED TO BE A FIRE OR EXPLOSION HAZARD.

5.3. SPECIAL PROTECTIVE EQUIPMENT FOR FIREFIGHTERS:
USE PROTECTIVE CLOTHING AND BREATHING EQUIPMENT APPROPRIATE FOR THE SURROUNDING FIRE.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES:
WEAR PROTECTIVE GLOVES AND EYE PROTECTION.

6.2. CLEANUP AND CONTAINMENT METHODS AND MATERIALS:
COLLECT LIQUID AND DILUTE WITH WATER. RELEASE TO DRAIN IF LOCAL REGULATIONS ALLOW. FOR LARGER SPILLS, ABSORB WITH SUITABLE MATERIAL (VERMICULITE, CLAY, ETC.). COLLECT THE SOLID RESIDUE AND SAVE FOR DISPOSAL.

SECTION 7: HANDLING AND STORAGE

7.1. PRECAUTIONS FOR SAFE HANDLING AND STORAGE CONDITIONS:
AS WITH ALL CHEMICALS, WASH HANDS THOROUGHLY AFTER HANDLING. AVOID CONTACT WITH EYES AND SKIN. PROTECT FROM FREEZING AND PHYSICAL DAMAGE.

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 CONTROL PARAMETERS:

CHEMICAL NAME LIMIT TYPE COUNTRY EXPOSURE LIMIT INFORMATION SOURCE

DATA NOT AVAILABLE.

8.2. EXPOSURE CONTROLS:

ENGINEERING CONTROLS:
NO SPECIFIC CONTROLS ARE NEEDED. NORMAL ROOM VENTILATION IS ADEQUATE.

RESPIRATORY PROTECTION: NORMAL ROOM VENTILATION IS ADEQUATE.

SKIN PROTECTION:
WEAR PROTECTIVE GLOVES AND EYE PROTECTION. CHEMICAL RESISTANT GLOVES.

EYE PROTECTION:
WEAR PROTECTIVE GLOVES AND EYE PROTECTION. SAFETY GLASSES OR GOGGLES.

8.3. PERSONAL PROTECTIVE EQUIPMENT:
WEAR PROTECTIVE GLOVES AND EYE PROTECTION. NORMAL ROOM VENTILATION IS ADEQUATE. CHEMICAL RESISTANT GLOVES. SAFETY GLASSES OR GOGGLES.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. BASIC PHYSICAL AND CHEMICAL PROPERTIES:

APPEARANCE: COLORLESS LIQUID

PHYSICAL STATE: LIQUID

ODOR: DATA NOT AVAILABLE.

ODOR THRESHOLD: DATA NOT AVAILABLE.

PH: DATA NOT AVAILABLE.

MELTING/FREEZING POINT: APPROXIMATELY 0 DEG. C

INITIAL BOILING POINT/RANGE:

APPROXIMATELY 100 DEG. C - APPROXIMATELY 100 DEG. C

FLASH POINT: DATA NOT AVAILABLE.

EVAPORATION RATE: DATA NOT AVAILABLE.

FLAMMABILITY: DATA NOT AVAILABLE.

FLAMMABILITY/EXPLOSIVE LIMITS: DATA NOT AVAILABLE.

VAPOR PRESSURE: DATA NOT AVAILABLE.

VAPOR DENSITY: DATA NOT AVAILABLE.

RELATIVE DENSITY: 1.01

SOLUBILITY: MISCIBLE

PARTITION COEFFICIENT: DATA NOT AVAILABLE.

AUTO-IGNITION TEMPERATURE: DATA NOT AVAILABLE.

DECOMPOSITION TEMPERATURE: DATA NOT AVAILABLE.

VISCOSITY: DATA NOT AVAILABLE.

EXPLOSIVE PROPERTIES: DATA NOT AVAILABLE.

OXIDIZING PROPERTIES: DATA NOT AVAILABLE.

SECTION 10: STABILITY AND REACTIVITY

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10.1. REACTIVITY AND CHEMICAL STABILITY:
STABLE UNDER NORMAL CONDITIONS OF USE AND STORAGE. ALL THIOSULFATE SOLUTIONS ARE SUBJECT TO SOME BACTERIAL CONTAMINATION AND SLOW CHEMICAL DETERIORATION.

10.2. POSSIBILITY OF HAZARDOUS REACTIONS: DATA NOT AVAILABLE.

10.3. CONDITIONS TO AVOID AND INCOMPATIBLE MATERIALS:
METAL NITRATES, SODIUM NITRITE, IODINE, ACIDS, LEAD, MERCURY, AND SILVER SALTS.

10.4. HAZARDOUS DECOMPOSITION PRODUCTS: WILL NOT OCCUR.

SECTION 11: TOXICOLOGICAL INFORMATION

top

11.1. INFORMATION ON TOXICOLOGICAL EFFECTS:

ACUTE TOXICITY - ORAL EXPOSURE: NOT APPLICABLE.

ACUTE TOXICITY - DERMAL EXPOSURE: NOT APPLICABLE.

ACUTE TOXICITY - INHALATION EXPOSURE: NOT APPLICABLE.

ACUTE TOXICITY - OTHER INFORMATION: NO LD50 INFORMATION FOUND.

SKIN CORROSION AND IRRITATION: NOT APPLICABLE.

SERIOUS EYE DAMAGE AND IRRITATION: NOT APPLICABLE.

RESPIRATORY SENSITIZATION: NOT APPLICABLE.

SKIN SENSITIZATION:
MAY CAUSE AN ALLERGIC SKIN REACTION. AVOID BREATHING FUMES, MIST, VAPORS, OR SPRAY. CONTAMINATED WORK CLOTHING MUST NOT BE ALLOWED OUT OF THE WORKPLACE. WEAR PROTECTIVE GLOVES AND EYE PROTECTION.

IF ON SKIN: WASH WITH PLENTY OF SOAP AND WATER.

IF SKIN IRRITATION OCCURS:
GET MEDICAL ATTENTION. SPECIFIC TREATMENT (WASH AREAS OF CONTACT WITH WATER). WASH CONTAMINATED CLOTHING BEFORE REUSE. DISPOSE OF CONTENTS IN ACCORDANCE WITH LOCAL, STATE, FEDERAL AND INTERNATIONAL REGULATIONS.

GERM CELL MUTAGENICITY: NOT APPLICABLE.

CARCINOGENICITY: NOT APPLICABLE.

REPRODUCTIVE TOXICITY: NOT APPLICABLE.

SPECIFIC TARGET ORGAN TOXICITY FROM SINGLE EXPOSURE: NOT APPLICABLE.

SPECIFIC TARGET ORGAN TOXICITY FROM REPEATED EXPOSURE: NOT APPLICABLE.

ASPIRATION HAZARD: NOT APPLICABLE.

ADDITIONAL TOXICOLOGY INFORMATION: DATA NOT AVAILABLE.

SECTION 12: ECOLOGICAL INFORMATION

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12.1. ECOTOXICITY: NOT APPLICABLE.

12.2. PERSISTENCE AND DEGRADABILITY: DATA NOT AVAILABLE.

12.3. BIOACCUMULATIVE POTENTIAL: DATA NOT AVAILABLE.

12.4. MOBILITY IN SOIL: DATA NOT AVAILABLE.

12.5. OTHER ADVERSE ECOLOGICAL EFFECTS: DATA NOT AVAILABLE.

SECTION 13: DISPOSAL CONSIDERATIONS

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13.1. WASTE TREATMENT METHODS: DATA NOT AVAILABLE.

SECTION 14: TRANSPORTATION INFORMATION

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14.1. TRANSPORTATION BY LAND-DEPARTMENT OF TRANSPORTATION (DOT, UNITED STATES OF AMERICA): NOT REGULATED ACCORDING TO DOT REGULATIONS.

14.2. TRANSPORTATION BY AIR - INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA): NOT REGULATED ACCORDING TO IATA DANGEROUS GOODS REGULATIONS.

14.3 TRANSPORTATION OF DANGEROUS GOODS (TDG, CANADA):
NOT REGULATED ACCORDING TO TDG REGULATIONS.

SECTION 15: REGULATORY INFORMATION

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15.1. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) HAZARDS:
NOT LISTED.

15.2. SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) 302 EXTREMELY HAZARDOUS SUBSTANCES: NOT LISTED.

15.3. SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) 311/312 HAZARDOUS CHEMICALS: NOT LISTED.

15.4. SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) 313 TOXIC RELEASE INVENTORY (TRI): NOT LISTED.

15.5. MASSACHUSETTS RIGHT-TO-KNOW SUBSTANCE LIST: NOT LISTED.

15.6. PENNSYLVANIA RIGHT-TO-KNOW HAZARDOUS SUBSTANCES:
WATER (CAS # 7732-18-5): PRESENT

15.7. NEW JERSEY WORKER AND COMMUNITY RIGHT-TO-KNOW COMPONENTS: NOT LISTED.

15.8. CALIFORNIA PROPOSITION 65: NOT LISTED.

15.9. CANADA DOMESTIC SUBSTANCES LIST / NON-DOMESTIC SUBSTANCES LIST (DSL/NDSL):
SODIUM THIOSULFATE PENTAHYDRATE (CAS # 10102-17-7): PRESENT (DSL)
SODIUM CARBONATE (CAS # 497-19-8): PRESENT (DSL)
WATER (CAS # 7732-18-5): PRESENT (DSL)

15.10. UNITED STATES OF AMERICA TOXIC SUBSTANCES CONTROL ACT (TSCA) LIST:
ALL COMPONENTS OF THIS SOLUTION ARE LISTED AS ACTIVE ON THE TSCA INVENTORY OR ARE MIXTURES (HYDRATES) OF ACTIVE ITEMS LISTED ON THE TSCA INVENTORY.

SODIUM THIOSULFATE PENTAHYDRATE (CAS # 10102-17-7): PRESENT

SODIUM CARBONATE (CAS # 497-19-8): PRESENT

WATER (CAS # 7732-18-5): PRESENT

15.11. EUROPEAN INVENTORY OF EXISTING COMMERCIAL CHEMICAL SUBSTANCES (EINECS), EUROPEAN:

LIST OF NOTIFIED CHEMICAL SUBSTANCES (ELINCS), AND NO LONGER POLYMERS (NLP):
SODIUM THIOSULFATE PENTAHYDRATE (CAS # 10102-17-7): 231-867-5
SODIUM CARBONATE (CAS # 497-19-8): 207-838-8
SODIUM CARBONATE (CAS # 497-19-8): 231-420-4
WATER (CAS # 7732-18-5): 231-791-2
WATER (CAS # 7732-18-5): 232-148-9

SECTION 16: OTHER INFORMATION

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16.1. FULL TEXT OF HAZARD STATEMENTS AND PRECAUTIONARY STATEMENTS:

MAY CAUSE AN ALLERGIC SKIN REACTION.

AVOID BREATHING FUMES, MIST, VAPORS, OR SPRAY. CONTAMINATED WORK CLOTHING MUST NOT BE ALLOWED OUT OF THE WORKPLACE. WEAR PROTECTIVE GLOVES AND EYE PROTECTION.

IF ON SKIN:
WASH WITH PLENTY OF SOAP AND WATER. SPECIFIC TREATMENT (WASH AREAS OF CONTACT WITH WATER).

IF SKIN IRRITATION OCCURS:
GET MEDICAL ATTENTION. WASH CONTAMINATED CLOTHING BEFORE REUSE.

DISPOSE OF CONTENTS IN ACCORDANCE WITH LOCAL, STATE, FEDERAL AND INTERNATIONAL REGULATIONS.

16.2. MISCELLANEOUS HAZARD CLASSES:
CANADIAN CARCINOGENICITY HAZARD CLASS: NOT APPLICABLE.
PHYSICAL HAZARDS NOT OTHERWISE CLASSIFIED (PHNOC): NOT APPLICABLE.
HEALTH HAZARDS NOT OTHERWISE CLASSIFIED (HHNOC): NOT APPLICABLE.
BIOHAZARDOUS INFECTIOUS MATERIALS HAZARD CLASS: NOT APPLICABLE.

16.3. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATING:
HEALTH 1
FLAMMABILITY 0
REACTIVITY 0
SPECIAL HAZARD

16.4. DOCUMENT REVISION:

LAST REVISION DATE: 2021-10-06

DISCLAIMER:
WHEN HANDLED PROPERLY BY QUALIFIED PERSONNEL, THE PRODUCT DESCRIBED HEREIN DOES NOT PRESENT A SIGNIFICANT HEALTH OR SAFETY HAZARD. ALTERATION OF ITS CHARACTERISTICS BY CONCENTRATION, EVAPORATION, ADDITION OF OTHER SUBSTANCES, OR OTHER MEANS MAY PRESENT HAZARDS NOT SPECIFICALLY ADDRESSED HEREIN AND WHICH MUST BE EVALUATED BY THE USER. THE INFORMATION FURNISHED HEREIN IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST DATA CURRENTLY AVAILABLE TO US. NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE AND RICCA CHEMICAL COMPANY ASSUMES NO LEGAL RESPONSIBILITY OR LIABILITY WHATSOEVER RESULTING FROM ITS USE.

SAFETY DATA SHEET

Prepared in accordance with the United States Hazard Communication Standard: 29 CFR 1910.1200 (2012)

Revision date: Jan 19, 2022

According to the United States Hazard Communication Standard, a Safety Data Sheet (SDS) must be provided for hazardous substances or mixtures. This product does not meet the classification criteria of the standard. Therefore such document is outside the scope of the standard and the requirements for content in each section do not apply.

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product name:
Stags CJ7, Stags Ultra Low, Stags 800, Stags 800L, Stags 800R, Stags 800GA, Stags 800G, Stags 400, Stags 830, Stags 400G, Stags 400 GA, Stags 400 CA, Stags Ultra Low 400, Stags 500, Stags CV 1100, CV46, Stags WWPAC, Stags FHG, Stags Watercarb 1000, Stag BV48, Stags CVR, Stags CVR-C, Stags BV 410, Stags 4ODR, Stags BV1050, Stags 4VOC, Stags WCPAC,

Synonyms:
Activated carbon

Recommended use:
Liquid and vapor applications (purification, decolorization, separation, catalyst and deodorization)

Restrictions on use:
No information available.

Supplier:
Tetrasolv Services Inc
1424 Abraham Dr
Anderson, IN 46013
765.643.3941

US: CHEMTREC 1-800-424-9300 or 1-703-527-3887
International CHEMTREC: +1 703-741-5970 or +1-703-527-3887

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status:
This chemical is not considered hazardous by the United States 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Label Elements:

Pictogram: None
Signal Word: None
Hazard statements: None

Hazards not otherwise classified (HNOC)

Odorless black granules or powder. Avoid contact with skin and eyes. Avoid breathing dust. Activated carbon (especially when wet) can deplete oxygen from air in enclosed spaces, and dangerously low levels of oxygen may result. Prior to entering a confined space that contains or previously contained activated carbon, the space should be evaluated for oxygen and carbon monoxide concentrations, and any other hazards, by a qualified person.

Workers should also take appropriate precautions when dealing with spent (used) activated carbons which may exhibit hazardous properties associated with the adsorbed materials.

Avoid dust formation. Powdered material may form an explosible dust-air mixture. If transferring product under pressure, avoid generation of dust if an ignition source is present.

Activated carbons have high surface area which may cause self-heating during oxidation. See Section 5.

Do not generate dust because airborne respirable crystalline silica may be generated.

Potential health effects

Principle Routes of Exposure: Inhalation, Eye contact, Skin Contact

Eye Contact: May cause mechanical irritation. Avoid contact with eyes.

Skin Contact: May cause mechanical irritation. Avoid contact with skin.

Inhalation: Dust may be irritating to respiratory tract. Provide appropriate local exhaust ventilation at machinery and at places where dust can be generated. See also Section 8.

Ingestion: Adverse health effects are not known or expected under normal use.

Carcinogenicity: See Section 11.

Target Organ Effects: Lungs, Eyes, Skin

Medical Conditions Aggravated by Exposure: Asthma, Respiratory disorder, Skin disorders

Potential Environmental Effects: No special environmental precautions required. See also Section 12.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms: Activated carbon.

Chemical name	CAS No	weight-%	Trade secret
Activated Carbon	7440-44-0	<100	

This product, which is manufactured from a naturally occurring raw material(s), contains <10% total crystalline silica (quartz, CASRN 14808-60-7).

4. FIRST AID MEASURES

FIRST AID MEASURES

Skin Contact Wash thoroughly with soap and water. Seek medical attention if symptoms develop.

Eye contact Flush eyes immediately with large amounts of water for 15 minutes. Seek medical attention if symptoms develop.

Inhalation If cough, shortness of breath or other breathing problems occur, move to fresh air. Seek medical attention if symptoms persist. If necessary, restore normal breathing through standard first aid measures.

Ingestion Do not induce vomiting. If conscious, give several glasses of water. Never give anything by mouth to an unconscious person.

Most important symptoms and effects, both acute and delayed

Symptoms: The most important known symptoms and effects are described in Section 2 and/or in Section 11.

Indication of any immediate medical attention and special treatment needed

Note to physicians: Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media: Use foam, carbon dioxide (CO2), dry chemical or water spray. A fog is recommended if water is used.

Unsuitable Extinguishing Media: DO NOT USE a solid water stream as it may scatter and spread fire. In the event of a fire, spreading large amounts of activated carbon is not recommended due to the risk of creating uncontrolled dust emissions.

Specific hazards arising from the chemical: Burning produces irritant fumes. If transferring product under pressure, avoid generation of dust if an ignition source is present.

Activated carbons have high surface area which may cause self-heating during oxidation. An adequate air gap between packages of activated carbon is recommended to reduce risk of propagation of the event. Activated carbon is difficult to ignite and tends to burn slowly (smolder) without producing smoke or flame.

Hazardous combustion products: Used activated carbon may produce additional combustion products which are based on the substance(s) adsorbed. Materials allowed to smolder for long periods in enclosed spaces may produce amounts of carbon monoxide which reach the lower explosive limit (carbon monoxide LEL = 12.5% in air). Carbon monoxide (CO). Carbon dioxide (CO2).

Protective equipment and precautions for firefighters: In the event of fire, wear self-contained breathing apparatus. Wear suitable protective equipment.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions: Avoid dust formation. Ensure adequate ventilation. Use personal protective equipment. See also Section 8.

Environmental Precautions:

Environmental Precautions: No special environmental precautions required. Local authorities should be advised if significant spillages cannot be contained.

Methods and material for containment and cleaning up

Methods for containment: Prevent further leakage or spillage if safe to do so.

Methods for cleaning up: Avoid dry sweeping and use water spraying or vacuum cleaning systems to prevent airborne dust generation. Use of a vacuum with high efficiency particulate air (HEPA) filtration is recommended. Do not create a dust cloud by using a brush or compressed air. Pick up and transfer to properly labelled containers. Spent granular activated carbon may be recyclable. Dispose of virgin (unused) carbon (surplus or spillage) in a facility permitted for non-hazardous wastes. Spent (used) carbon should be disposed of in accordance with applicable laws. Do not reuse empty bags: dispose of in a facility permitted for non-hazardous wastes. See Section 13.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling: Avoid contact with skin and eyes. Avoid dust formation. Do not breathe dust. Provide appropriate local exhaust ventilation at machinery and at places where dust can be generated. Do not create a dust cloud by using a brush or compressed air. Dust may form explosible mixture in air.

Activated carbons have high surface area which may cause self-heating during oxidation. Take precautionary measures against static discharges. All metal parts of the mixing and processing equipment must be earthed/grounded. Ensure all equipment is electrically earthed/grounded before beginning transfer operations. Fine dust is capable of penetrating electrical equipment and may cause electrical shorts. If hot work (welding, torch cutting, etc.) is required the immediate work area must be cleared of product and dust.

Conditions for safe storage, including any incompatibilities

Storage Conditions: Keep in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Do not store together with strong oxidizing agents. Keep in properly labeled containers. Activated carbon is difficult to ignite and tends to burn slowly (smolder) without producing smoke or flame. Dust deposits should not be allowed to accumulate on surfaces, as these may form an explosible mixture if they are released in the atmosphere in sufficient concentrations. Prior to entering a confined space that contains or previously contained activated carbon, the space should be evaluated for oxygen and carbon monoxide concentrations, and any other hazards, by a qualified person.

Incompatible materials: Strong oxidizing agents. Strong acids.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure guidelines: .

Exposure limits for components or similar components are stated below.

Dust, or Particulates Not Otherwise Specified:	Austria MAK:	10 mg/m³, STEL 2x30 min, Inhalable dust 5 mg/m³, TWA, Inhalable dust
	Belgium:	10 mg/m³, TWA, Inhalable 3 mg/m³ TWA, Respirable
	Canada (Saskatchewan):	10 mg/m³, TWA, Inhalable 3 mg/m³ TWA, Respirable
	China:	8 mg/m³, TWA 10 mg/m³, STEL
	France:	10 mg/m³, TWA Inhalable dust 5 mg/m³, TWA Respirable dust
	Germany - TRGS 900:	10 mg/m³, TWA, Inhalable 3 mg/m³, Respirable fraction
	Hong Kong:	10 mg/m³, TWA
	Ireland:	10 mg/m³, TWA, Total inhalable 4 mg/m³, TWA, Respirable
	Italy:	10 mg/m³, TWA, Inhalable 3 mg/m³, TWA, Respirable
	Japan:	3 mg/m³ TWA, Respirable
	Malaysia:	10 mg/m³, TWA, Inhalable 3 mg/m³, TWA, Respirable
	The Netherlands:	3.5 mg/m³, Inhalable
	Spain:	10 mg/m³, VLA, Inhalable 3 mg/m³, VLA, Respirable
	Sweden:	10 mg/m³, NGV, Total inhalable 5 mg/m³, NGV, Respirable
	United Kingdom - WEL:	10 mg/m³, TWA, Total Inhalable dust 4 mg/m³, TWA, Respirable dust
	US ACGIH - PNOS:	10 mg/m³, TWA, Inhalable 3 mg/m³, TWA, Respirable
	US OSHA - PEL:	15 mg/m³, TWA, Total dust 5 mg/m³, TWA, Respirable

Silica, Crystalline (Quartz) CAS RN 14808-60-7:	Austria MAK:	0.15 mg/m³, TWA (Respirable)
	Belgium:	0.1 mg/m³, TWA (Alveolar fraction)
	Denmark:	0.1 mg/m³, TWA (Respirable)
	Finland:	0.05 mg/m³, TWA (Respirable)
	France:	0.1 mg/m³, VME (Alveolar fraction)
	Ireland:	0.1 mg/m³, TWA (Respirable)
	Italy:	0.025 mg/m³, TWA (Respirable)
	Japan:	(3 mg/m³)/(1.19%SiO2 + 1) (Respirable)
	Switzerland:	0.15 mg/m³, TWA (Respirable)
	UK WEL:	0.1 mg/m³, TWA (Respirable)
	US OSHA PEL:	(10 mg/m³) /(%SiO2 + 2) (Respirable)
		(30 mg/m³)/(%SiO2 + 2) (Total)
	US ACGIH TLV:	0.025mg/m³ (Respirable)

MAK: Maximale Arbeitsplatzkonzentration (Maximum Workplace Concentration)
NGV: Nivå Gräns Värde (Level Limit Value)
PEL: Permissible Exposure Limit
STEL: Short Term Exposure Limit
TLV: Threshold Limit Value
TRGS: Technische Regeln für Gefahrstoffe (Technical Rule for Hazardous Materials)
TWA: Time Weighted Average
US ACGIH: United States American Conference of Governmental Industrial Hygienists
US OSHA: United States Occupational Safety and Health Administration
VLA: Valore Límite Ambientales (Environmental Limit Value)
WEL: Workplace Exposure Limit

Engineering Controls: Ensure adequate ventilation to maintain exposures below occupational limits. Provide appropriate local exhaust ventilation at machinery and at places where dust can be generated.

Personal protective equipment [PPE]

Respiratory Protection: Approved respirator may be necessary if local exhaust ventilation is not adequate.

Hand Protection: Wear suitable gloves.

Eye/face Protection: Wear eye/face protection. Wear safety glasses with side shields (or goggles).

Skin and Body Protection: Wear suitable protective clothing. Wash clothing daily. Work clothing should not be allowed out of the workplace.

Other: Handle in accordance with good industrial hygiene and safety practice. Emergency eyewash and safety shower should be located nearby.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information given is based on data obtained from this substance or from similar substances.

Physical State:	Solid	**Odor:**	Generally odorless. May produce slight sulfur smell when wet.
Appearance:	Granular	**Odor threshold:**	Not Applicable
Color:	Black		

Property	Values	Remarks • Method
pH:		Not Applicable
Melting point/freezing point:		Not Applicable
Boiling point / boiling range:		Not Applicable
Evaporation Rate:		Not Applicable
Vapor pressure:		Not Applicable
Vapor Density:		Not Applicable
Density:		No information available
Bulk Density:	28 - 34 lbs/ft^3	
Specific Gravity at 20°C:		No information available
Water solubility:		Insoluble
Solubility(ies):		No information available
Partition Coefficient (n-octanol/water):		No information available
Decomposition temperature:		No information available
Viscosity:		No information available
Kinematic viscosity:		No information available
Dynamic viscosity:		No information available
Oxidizing Properties:		Not Applicable
Softening point:		No information available
VOC content (%):		Not Applicable
% Volatile (by Volume):		No information available
% Volatile (by Weight):		No information available
Surface Tension:		No information available
Explosive properties:		No information available
Flash Point:		Not Applicable
Flammability (solid, gas):		No information available
Flammability Limit in Air:		No information available
Explosion Limits in Air - Upper (g/m^3):		No information available
Explosion Limits in Air - Lower (g/m^3):		No information available
Autoignition Temperature:		No information available
Minimum Ignition Temperature:		No information available
		No information available
Minimum Ignition Energy:		No information available
Ignition Energy:		No information available
Maximum Absolute Explosion Pressure:		No information available
Maximum Rate of Pressure Rise:		No information available
Burn Velocity:		No information available
Kst Value:		No information available
Dust Explosion Classification:		No information available

10. STABILITY AND REACTIVITY

Reactivity: May react exothermically upon contact with strong oxidizers.

Stability: Stable under recommended handling and storage conditions.

Possibility of hazardous reactions: None under normal processing.

Hazardous polymerization: Hazardous polymerization does not occur.

Conditions to avoid: Keep away from heat and sources of ignition. Avoid dust formation. Activated carbon (especially when wet) can deplete oxygen from air in enclosed spaces, and dangerously low levels of oxygen may result.

Activated carbons have high surface area which may cause self-heating during oxidation.

Incompatible materials: Strong oxidizing agents. Strong acids.

Explosion data See also Section 9.

Sensitivity to Mechanical Impact: None.

Sensitivity to Static Discharge: Dust may form explosible mixture in air. Do not create a dust cloud by using a brush or compressed air.

Hazardous decomposition products: Used activated carbon may produce additional combustion products which are based on the substance(s) adsorbed. Materials allowed to smolder for long periods in enclosed spaces may produce amounts of carbon monoxide which reach the lower explosive limit (carbon monoxide LEL = 12.5% in air). Carbon oxides.

11. TOXICOLOGICAL INFORMATION

Information given is based on data obtained from this substance or from similar substances.

Acute toxicity

Not classified.

Oral LD50: LD50/oral/rat = >2000 mg/kg. (OECD 423).

Inhalation LC50: LC50/inhalation/1h/rat = >8.5 mg/L (OECD 403)

Dermal LD50: Absorption highly unlikely, no health effects known.

Skin corrosion/irritation: Not classified
Skin irritation test, rabbit (OECD 404): Not irritating

Serious eye damage/eye irritation: Not classified. Eye irritation test, rabbit (OECD 405): Not irritating.

Sensitization: Not classified. Not sensitizing based on Local Lymph Node Assay (OECD 429).

Mutagenicity: Not classified.
- Gene mutation in bacteria (Bacterial Reverse Mutation Assay/Ames) (OECD 471): not mutagenic.
- In vitro Mammalian Chromosome Aberration Test (OECD 473): not clastogenic.
- In vitro Mammalian Cell Gene Mutation Test (OECD 476).: non-mutagenic.

Carcinogenicity: Not classified.

Contains a component (crystalline silica) that is listed by IARC as group 1, by ACGIH as group A2, and by NTP as a known human carcinogen.

Reproductive Toxicity: Not classified. Repeated dose inhalation toxicity test showed no reproductive target organ effects, and a toxicokinetic study showed no product migration to reproductive organs.

STOT - single exposure: Not classified.

STOT - repeated exposure: Not classified. Repeated dose toxicity study, inhalation (rat) 90 days (OECD 413): NOAEC 7.29 mg/m^3 (respirable). This test was conducted on activated carbon containing negligible crystalline silica; therefore activated carbon itself is not classified for STOT-RE. Although respirable crystalline silica is classified as STOT-RE1, this product contains <1% respirable crystalline silica, therefore it is not classified for STOT-RE.

Aspiration Hazard: Based on industrial experience and available data, no aspiration hazard is expected.

12. ECOLOGICAL INFORMATION

Information given is based on data obtained from this substance or from similar substances.

Aquatic Toxicity: Non toxic. The substance is highly insoluble in water and the substance is unlikely to cross biological membranes. No adverse ecological effects are known.

Terrestrial Toxicity: Earthworm reproduction study (OECD 222), NOAEC for body weight reduction 1000 mg/kg soil; NOAEC for reproduction 3200 mg/kg soil. Non toxic in soil.

ENVIRONMENTAL FATE

Persistence and degradability Not expected to degrade

Bioaccumulation Not expected due to physicochemical properties of the substance.

Mobility: Not expected to migrate. Insoluble.

Distribution to Environmental Compartments: Insoluble. Expected to remain on soil surface.

Other adverse effects: No information available.

13. DISPOSAL CONSIDERATIONS

Disclaimer: Information in this section pertains to the product as shipped in its intended composition as described in Section 3 of this MSDS. Contamination or processing may change waste characteristics and requirements. Regulations may also apply to empty containers, liners or rinsate. State/provincial and local regulations may be different from federal regulations.

RCRA: Unused product is not a hazardous waste under U.S. RCRA, 40 CFR 261. Spent (used) product may be hazardous based on the substance adsorbed.

Disposal of wastes

Activated carbon, in its original state, is not a hazardous material or hazardous waste. Follow applicable regulations for waste disposal.

Spent (used) activated carbon may be classified as a hazardous waste depending upon its use, the substance(s) adsorbed, and how it is ultimately managed. Follow applicable regulations for disposal.

Recycling (reactivation) may be a viable alternative to disposal. Dust formation from residues in packaging should be avoided and suitable worker protection assured. Store used packaging in enclosed receptacles.

14. TRANSPORT INFORMATION

Not classified as dangerous in the meaning of transport regulations.

DOT

UN/ID no	Not regulated
Proper Shipping Name	Not regulated
Hazard Class	Not regulated
Packing group	Not regulated

ICAO (air)

UN/ID no	Not regulated
Proper Shipping Name	Not regulated
Hazard Class	Not regulated
Packing group	Not regulated

IATA

UN/ID no	Not regulated
Proper Shipping Name	Not regulated
Hazard Class	Not regulated
Packing group	Not regulated

IMDG

UN/ID no	Not regulated
Proper Shipping Name	Not regulated
Hazard Class	Not regulated
Packing group	Not regulated

RID

UN/ID no	Not regulated
Proper Shipping Name	Not regulated
Hazard Class	Not regulated
Packing group	Not regulated

ADR

UN/ID no	Not regulated
Proper Shipping Name	Not regulated
Hazard Class	Not regulated
Packing group	Not regulated

15. REGULATORY INFORMATION

Hazard Classification

United States - OSHA (29 CFR 1910.1200): Not Hazardous
Canada - WHMIS Classification (CPR, SOR/88-66): Not controlled
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the M/SDS contains all the information required by the Controlled Products Regulations.

Chemical name	WHMIS - Ingredient Disclosure
Quartz (respirable) 14808-60-7	1

International Inventories

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory	Complies
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List	Complies
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances	Complies
ENCS - Japan Existing and New Chemical Substances	Complies
IECSC - China Inventory of Existing Chemical Substances	Complies
KECL - Korean Existing and Evaluated Chemical Substances	Complies
PICCS - Philippines Inventory of Chemicals and Chemical Substances	Complies
AICS - Australian Inventory of Chemical Substances	Complies
NZIoC - New Zealand Inventory of Chemicals	Complies
TCSI - Taiwan Chemical Substance Inventory	Complies

US Federal Regulations

SARA 311/312 Hazard Categories

Acute Health Hazard	NO
Chronic Health Hazard	NO
Fire hazard	NO
Sudden release of pressure hazard	NO
Reactive Hazard	NO

Clean Air Act Amendments of 1990 (CAA, Section 112, 40 CFR 82):
This product does not contain any components listed as a Hazardous Air Pollutant, Flammable Substance, Toxic Substance, or Class 1 or 2 Ozone Depletor

CWA (Clean Water Act)
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA

This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

US State Regulations

California Proposition 65

This product contains the following Proposition 65 chemicals.

Chemical name	California Proposition 65
Quartz (respirable) 14808-60-7 (<10)	Carcinogen

U.S. State Right-to-Know Regulations

Chemical name	New Jersey	Massachusetts	Pennsylvania	Louisiana:
Quartz (respirable) 14808-60-7	X	X	X	

16. OTHER INFORMATION

Disclaimer:

The information set forth is based on information that Tetrasolv believes to be accurate. No warranty, expressed or implied, is intended. The information is provided solely for your information and consideration and Tetrasolv assumes no legal responsibility for use or reliance thereon. In the event of a discrepancy between the information on the non-English document and its English counterpart, the English version shall supersede.

Prepared by: Tetrasolv Services Inc
Revision date: January 19, 2017
Previous Revision Date: 14/May/2015

Reason for Revision: Revision to Section(s) 1

End of Safety Data Sheet

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