NORTHEAST AREA
GROUNDWATER OPERATION & MAINTENANCE PLAN

W.R. GRACE SUPERFUND SITE
ACTON, MASSACHUSETTS

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REVISION 01

Disclaimer: This document is a document prepared by W. R. Grace under a government Consent Decree. The opinions, findings, and conclusions, expressed are those of the author and not those of USEPA and MassDEP.

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1.0 INTRODUCTION

The Northeast Area Groundwater Operation & Maintenance Plan (O&M Plan) for the W. R. Grace & Co. – Conn. (Grace) Acton Superfund Site (the Site) is submitted in accordance with the Operable Unit Three (OU-3) Remedial Design/Remedial Action (RD/RA) Statement of Work (SOW), as approved by the United States Environmental Protection Agency (USEPA) and the Massachusetts Department of Environmental Protection (MassDEP) on August 30, 2006 (USEPA, 2006).

This O&M Plan provides a general description of the equipment and operating procedures for the Ground Water Treatment System (GWTS) located in the Northeast Area of the Site. The GWTS is designed to remove volatile organic compounds (VOCs) and arsenic from approximately 20 gallons per minute (gpm) of extracted ground water and discharge the treated water into reinjection wells.

A map showing the treatment system location is presented in Figure 1-1 and the GWTS as-built design drawings are included in Appendix A. Further details on the site background and design are presented in previous documents, including the *Northeast Area Groundwater Concept Design* (GeoTrans, 2009).

The major components of the GWTS include an influent manifold, a low-profile air stripper, particulate filtration, an arsenic reduction system, liquid-phase granular activated carbon (LGAC), a reinjection manifold and vapor-phase granular activated carbon (VGAC).

1.1 ELEMENTS OF THE O&M PLAN

The O&M Plan is comprised of the following elements:

- Equipment Description
- System Operations
- System Maintenance
- Monitoring and Sampling
- Potential Operating Problems and Remedies
- Documentation and Reporting
- Safety Issues

Each of the elements is discussed in detail in Sections 2.0 through 8.0, respectively.

1.2 IMPORTANT MESSAGES AND WARNINGS

This manual should be in the possession of the personnel who operate and maintain the GWTS. The purpose of this manual is to instruct and advise operators and maintenance personnel. This manual will remain a valuable resource for the safe, economical, efficient operation and maintenance of the GWTS.

Failure to properly follow instructions, take notice of warnings, and take proper precautions and preventive measures may be dangerous and could cause serious injury, equipment damage, and/or environmental problems.

Mechanical modifications or substitutions of parts on equipment that may affect structural or operational safety shall not be made without prior manufacturer's approval or engineer's advice. Modifications other than those approved may defeat protective features originally designed into the equipment and its controls; and therefore, shall not be made.

Only qualified personnel who have been properly instructed in this equipment's proper operation and maintenance requirements and in its potential hazards shall be allowed to operate and maintain it.

2.0 EQUIPMENT DESCRIPTION

The GWTS is a modular-based treatment system, fully-assembled and tested in a pre-fabricated enclosure. The groundwater treatment system includes an air stripper, liquid-phase carbon, vapor-phase carbon, and metals adsorption for arsenic removal. The air stripper is designed to remove VOCs to below Interim Groundwater Cleanup Levels (IGCLs). Liquid-phase carbon will remove the VPH (C5-C8 Hydrocarbons). Vapor-phase carbon will remove odors from the air prior to discharge. Metals adsorption will remove arsenic to below IGCLs. IGCLs for the Site are summarized in Table 2-1 below:

Table 2-1
Interim Groundwater Cleanup Levels

Volatile Organic Compounds	
1,1-Dichloroethene	7
1,2-Dichloroethane	5
1,2-Dichloropropane	5
Benzene	5
Methyl tert butyl ether	16
Methylene Chloride	5
Trichloroethene	5
Vinyl Chloride	2
Semi-Volatile Organic Compounds	
Bis(2-chloroethyl)ether	5
Bis(2-ethylhexyl)phthalate	6
Inorganic Compounds	
Antimony	6
Arsenic	10
Beryllium	4
Chromium	100
Lead	15
Manganese	300*
Nickel	100
Concentrations in µg/L. * A background value, to be determined during remedial design, may be selected as the IGCL for manganese.	

The treatment system components include:

- Extraction Well Manifold;
- Influent Equalization Tank and Transfer Pump;
- Low Profile Air Stripper;
- Vapor-Phase Granular Activated Carbon;
- Bag Filter Unit;
- Arsenic Reduction System;
- Liquid-Phase Granular Activated Carbon;
- Discharge Equalization Tank and Transfer Pump;
- Reinjection Well Manifold; and,
- Electrical Controls

The treatment system is housed in a 10-foot by 24-foot prefabricated wooden building with a roof height of approximately 12 feet. This building has a shingle roof, heaters, exhaust fans, lighting, and an area for spare parts storage. Appendix A contains the as-built system drawings and includes a process and instrumentation diagram and an equipment building layout. The following sections describe the function and design of each component of the GWTS sequentially as water flows through the influent manifold to the reinjection system.

2.1 EXTRACTION WELL MANIFOLD

Groundwater is pumped from the extraction well through underground piping to an influent manifold constructed of 2-inch, Schedule 80 PVC pipe located in the treatment building. This manifold contains the appropriate fittings and instrumentation for flow measurement, sample collection; and pressure measurement, as described below (refer to Drawing 03 in Appendix A).

2.1.1 Influent Flow Meter

A flow meter is located on the incoming extraction well line. The Signet 2551 Magmeter is an insertion-style magnetic flow sensor with no moving parts. The sensor displays both instantaneous flow measurement as well as totalizing flow volume, and has an integrated flow transmitter to send a 4-20 mA analog output signal to the GWTS programmable logic controller (PLC). Manufacturer specifications for flow meters are provided in Appendix B.

2.1.2 Influent Sample Ports

A stainless steel influent sample port is located on the influent line. The sample port is completed with a short piece of teflon tubing to facilitate sample collection. Manufacturer specifications for sample ports are provided in Appendix B.

2.1.3 Influent Pressure Gauges

A stainless steel liquid-filled pressure gauge (0-60 psi) is installed on the influent line. This gauge provides a direct read of pressure. Manufacturer specifications for the influent pressure gauges are provided in Appendix B.

2.2 INFLUENT EQUALIZATION TANK AND TRANSFER PUMP

Ground water from the extraction well discharges into a 600 gallon, polyethylene inlet equalization tank. This tank allows control of the groundwater flow rate through the air stripper for maximum treatment efficiency. The tank is outfitted with level controls to operate a pump that transfers the extracted groundwater from the equalization tank into the air stripper. A high/high level alarm will stop the extraction well pump in the event of a unit operation failure. Off-gases from the equalization tank are vented to the atmosphere outside the building. The pump specifications are as follows:

- Gould's NPE Series model #1ST1F5C4;
- 460v, 3-phase, 1.5 hp motor; and,
- 1 to 30 gpm flow capacity
-

Manufacturer information is provided in Appendix C.

A valve and pressure gauge are located on the outlet side of the pump. These can be used for rough flow control of water from the pump located in the influent equalization tank.

2.3 LOW-PROFILE AIR STRIPPER

Water flows from the influent equalization tank though piping equipped with the appropriate fittings and instrumentation for flow measurement, sample collection, and pressure measurement to an air stripper. The QED tray air stripper is utilized to remove dissolved-phase VOCs from the extracted groundwater. The air stripper is a low-profile design constructed of stainless steel housing and stainless steel trays. The air stripper is capable of treating a maximum of 25 gpm continuous throughput. The air stripper has an integral sump outfitted with a level indicator and controls for effluent transfer pump operation. In addition, a high sump level alarm will stop the influent transfer pump from conveying water to the air stripper if a high sump alarm occurs.

An integral main blower supplies fresh air to the air stripper. Approximately 300 cubic feet per minute (cfm) of ambient air is pulled-up through the trays countercurrent to the water. The air exits through an exhaust stack, and is routed through vapor-phase activated carbon for odor control. Water is introduced at the top tray of the air stripper and falls downward through successive trays into the sump at the bottom of the air stripper. Air stripper specifications are as follows:

- QED Model EZ-4.4SS;
- 4 tray unit;
- Stainless steel housing;
- Stainless steel trays; and
- 1 to 25 gpm flow capacity.

Air stripper manufacturer information is provided in Appendix D.

2.3.1 Air Stripper Flow Meter, Sample Port and Pressure Gauge

A Blue-White F-420N, inline, variable area flow meter is located at the inlet to the air stripper to provide a visual measurement of the combined water flow into the stripper. A sample port is located prior to the air stripper to be used for collection of a combined water sample prior to treatment in the air stripper. A stainless steel liquid-filled pressure gauge (0-60 psi) is installed at the inlet to the air stripper to provide a direct read of pressure. Manufacturer specifications for this equipment are provided in Appendix B.

2.3.2 Air Stripper Blower

An oil-free regenerative blower provides the air required for the air stripper. It is located on the exhaust side of the stripper and pulls the air through the trays. The unit has sealed bearings and requires minimal maintenance. Specifications are as follows:

- Busch Samos model SB0430
- 3.5 Hp, 460 volt, 3-phase
- 300 CFM @ 28 in. water column

Manufacturer information is provided in Appendix D.

2.3.3 Air Stripper Transfer Pump

Level controls in the air stripper sump operate a pump that pumps the water through the bag filtration unit and arsenic reduction system into the discharge equalization tank. The pump specifications are identical to the other GWTS transfer pumps:

- Gould's NPE Series model #1ST1F5C4;
- 460v, 3-phase, 1.5 hp motor; and,
- 1 to 30 gpm flow capacity

Manufacturer information is provided in Appendix C.

A valve and pressure gauge are located on the outlet side of the pump to roughly control flow from the pump. Manufacturer specifications are provided in Appendix B.

2.4 VAPOR-PHASE GRANULAR ACTIVATED CARBON

The air exiting the air stripper will be passed through vapor-phase granular activated carbon (VGAC) in order to minimize any potential discharge odors. A single, 30-inch diameter canister of carbon will be utilized.

The specifications are as follows:

- Model VR-400;
- 400 pound carbon capacity; and,
- 300 cfm flow capacity.
-

Manufacturer information is provided in Appendix E.

A pressure gauge, temperature gauge and a self-averaging pitot tube flow sensor are located in the exhaust stack so that the discharge air flow can be calculated. Manufacturer specifications are provided in Appendix B.

2.5 BAG FILTER UNIT

Bag filtration is used to remove suspended solids or particulate matter from the extracted groundwater stream. This helps minimize particulate build-up in the arsenic reduction system and potential clogging in the reinjection wells. The bag filter housing is carbon steel and contains one high capacity bag filter. Specifications are as follows:

- CSD OEM model #007A1304L020N2V4;
- Single-bag;
- 100 gpm flow capacity; and,
- 150 psi rating.
-

Manufacturer specifications are provided in Appendix F.

A sample port is located prior to the bag filter. The port can be used for collection of a water sample post air stripping and pre-bag filtration and arsenic treatment. Pressure gauges are located on either side of the bag filter so that the pressure drop across the bag can be visually monitored as an indication of when to change the filter.

2.6 ARSENIC REDUCTION SYSTEM

An iron-based granular media arsenic reduction system is utilized to reduce the dissolved-phase arsenic from the extracted groundwater. The system consists of two 30-inch diameter treatment vessels operated in series (lead/lag). Each filter vessel contains approximately 500 pounds of iron based granular media. After the lead treatment vessel has been exhausted, it will be replaced with the lag vessel and a fresh vessel will be placed in the lag position. Specifications are as follows:

- Adedge Bayoxide E33 (granular ferric oxide) filter media;
- Tetrasolv HPP-500 filter vessels, 30-inch dia. by 74-inch tall;
- 17 cubic feet media capacity;
- 25 gpm flow capacity; and
- 125 psi rating.

Manufacturer information is provided in Appendix G.

Sample ports are located on either side of each vessel so that samples may be collected and analyzed to determine the performance of the arsenic reduction system. Pressure gauges are located on either side of each vessel so that the pressure drop across each vessel can be visually monitored to provide an indication of when to backwash or change the vessels. In addition, a differential pressure switch senses the overall pressure drop across the

vessels, and, in the case of high pressure, will send an alarm to the PLC indicating that the vessels should be backwashed or changed.

2.6.1 Backwash Operation

The arsenic reduction vessels are manifolded and valved so that each vessel can be periodically backwashed. Supply water for backwashing comes from the effluent equalization tank, which contains treated water just prior to final polish with liquid-phase granular activated carbon. After use, the backwashed water discharges to the influent equalization tank for treatment. The equalization tanks were sized to accommodate the backwashing cycles without upsetting the GWTS operation.

2.7 LIQUID-PHASE GRANULAR ACTIVATED CARBON

The liquid-phase granular activated carbon is utilized to remove the VPH (C5-C8 hydrocarbons) from the extracted groundwater. The system consists of one 30-inch diameter treatment vessel. The vessel contains approximately 500 pounds of granular activated carbon. After the vessel has been exhausted, the carbon will be replaced with fresh carbon. Specifications are as follows:

- Westates AquaCarb 830 carbon;
- PV-500 filter vessel, 30-inch dia. by 67-inch tall;
- 500 pounds carbon capacity;
- 25 gpm flow capacity; and
- 75 psi rating.

Manufacturer information is provided in Appendix L.

2.8 DISCHARGE EQUALIZATION TANK AND TRANSFER PUMP

Treated water from the arsenic reduction system enters a 600-gallon, polyethylene equalization tank prior to reinjection. This tank allows control of the groundwater flow rate to the reinjection wells. A high/high level alarm will stop the air stripper discharge pump. Off-gases from the equalization tank are vented to the atmosphere outside the building. In addition, the tank is outfitted with level controls to operate a pump that sends the treated water to through the liquid-phase granular activated carbon unit and into the reinjection wells. The pump specifications are identical to the other GWTS transfer pumps:

- Gould's NPE Series model #1ST1F5C4;
- 460v, 3-phase, 1.5 hp motor; and,
- 1 to 30 gpm flow capacity

Manufacturer information is provided in Appendix F.

2.9 REINJECTION WELL MANIFOLD

Treated ground water is pumped from the discharge equalization tank through the liquid-

phase granular activated carbon unit and into injection manifold to the reinjection wells. The manifold is a single 2-inch, Schedule 80 PVC header pipe. This manifold contains the appropriate fittings and instrumentation for sample collection, pressure measurement, and valves to control which well(s) discharge water flows. (refer to Drawing 03 in Appendix A).

Each of the two reinjection wells are fed by an individual line containing the appropriate fittings and instrumentation for sample collection, flow measurement and pressure measurement (refer to Drawing 03 in Appendix A). A check valve and an anti-siphon valve have been installed at the discharge of the transfer pump. There are also down well check valves on each reinjection well to keep the discharge lines to the wells full of water to reduce air introduction to the wells. Discharge piping to the reinjection wells is below grade outside the GWTS.

2.9.1 Discharge Flow Meters

Individual flow meters are located on each reinjection well line. The meters display both instantaneous flow measurement as well as totalizing flow volume, and have an integrated flow transmitter to send a 4-20 mA analog output signal to the GWTS PLC. Manufacturer specifications for the flow meters are provided in Appendix B.

2.9.2 Discharge Sample Ports

A stainless steel sample port is located on each reinjection line. Manufacturer specifications are provided in Appendix B.

2.9.3 Discharge Pressure Gauges

A stainless steel liquid-filled pressure gauge is installed on each reinjection well discharge line to provide direct read of pressure at each location. The gauge specifications are identical to those described in section 2.2.3. Manufacturer specifications are provided in Appendix B.

2.9.4 High Water Level Shut Down Controls

A high water level shut down control switch is installed in each reinjection well to shut down the treatment system in the event of flow issues with the reinjection well. Manufacturer specifications are provided in Appendix B.

2.10 ELECTRICAL CONTROLS

The GWTS is fully-automated and is designed to operate continuously unattended. The building includes a 200-amp main power disconnect with lockable operating handle. The system control panel contains all motor starters and electrical circuits, distributes power to all of the equipment, and includes a PLC to monitor and process all alarms and control operation of the GWTS. As-built electrical schematics for the GWTS are provided in Appendix A.

2.10.1 Control Panel

The GWTS control panel is located within the system enclosure. The operation and visualization of all equipment is facilitated through a Human Machine Interface (HMI). The HMI has a viewing screen so the operator can access the status of all treatment operations and can make process modifications.

The control panel includes all overload and short-circuit protection devices. The control panel also includes surge protection for a modem and phone line. Manufacturer information is provided in Appendix H.

2.10.2 Programmable Logic Controller

The treatment components listed above are operated through a TWIDO PLC. Instrumentation and programmed system logic allow the treatment system to operate with minimal operator intervention and allows for remote reporting and operation of the system.

Telemetry capability allows the operator to monitor and control the GWTS equipment through a dial-up, cellular modem connection. The TWIDO PLC software has been programmed and tailored to match the process system equipment configuration and allows the operator to remotely control equipment operations, monitor data, and/or retrieve data, through a graphical interface. Manufacturer information is provided in Appendix I.

2.10.3 Alarms and Instrumentation

Instrumentation is provided to indicate and control process operation both locally and from a remote terminal connected by telephone modem. System alarms are indicated locally and also activate a fax or telephone call. The instrumentation and alarm actions for the GWTS are described below:

Influent Flow Meter:

Range:	0 to 20 gpm
Display:	Local flow rate (gpm), and totalizer (gallons)
Output:	4 to 20 milliamps

Influent Equalization Tank:

Level controls:	Mercury activated float switches (3)
Levels and Actions:	Low level (turns off equalization tank pump) High level (turns on equalization tank pump) High alarm (turns off recovery well pump and autodials an alarm)
Alarm Reset:	Automatically clears or manually by operator

Low Profile Air Stripper:

Level Controls:	Wet well sump utilizes mercury activated float switches (2) to activate the air stripper pump and protect against overfill.
Levels and Actions:	Low level (turns off air stripper pump) High level (turns on air stripper pump) High alarm (turns off influent equalization tank transfer pump)
Alarm Reset:	Automatically clears or manual restart
Pressure Sensor:	Low blower pressure Levels and Actions: Low pressure (turns off recovery wells and process equipment and autodials an alarm)
Alarm Reset:	Manually by operator

Arsenic Reduction System Filters (2):

Pressure Sensor:	High line pressure differential
Levels and Actions:	High pressure differential (autodials an alarm)
Alarm Reset:	Manually by operator

Discharge Equalization Tank:

Level controls:	Mercury activated float switches (3)
Levels and Actions:	Low level (turns off equalization tank pump) High level (turns on equalization tank pump) High alarm (turns off air stripper sump pump and autodials an alarm)
Alarm Reset:	Automatically clears or manually by operator

Discharge Flow Meters (2):

Range:	0 to 20 gpm
Display:	Local flow rate (gpm), and totalizer (gallons)
Output:	4 to 20 milliamps

Reinjection Wells (2):

Level Sensor:	Conductivity probes (2) Levels and Actions: High-high (turns off discharge pump and recovery well pump and autodials an alarm)
Alarm Reset:	Manually by operator

Building Environmental Monitors:

Temperature Sensor:	Thermostatatically controlled heating/ventilation
Levels and Actions:	Low building temperature (turns on forced-air heater) High building temperature (turns on exhaust fan)
Alarm Reset:	No alarm

2.10.4 Building Heating and Ventilation

The GWTS is enclosed in a wood-frame building and contains thermostatically controlled heating and ventilation. The ventilation fan is a New York Blower model EN-122H exhaust fan with a 1/4-Hp motor. Heating is provided by a 7.5 KW Dayton model 2YL67 forced-air heater. Manufacturer specifications are provided in Appendix J. The construction of the building is shown on Drawing 06 in Appendix A.

3.0 SYSTEM OPERATION

Operation of the GWTS is in accordance with manufacturer's recommendations and the procedures outlined in this document. The groundwater treatment system is designed for continuous unattended operation and will require minimal operator assistance. The system has automatic shutdown controls in case of upset conditions. The control panel includes a remote access telemetry system for remote monitoring of treatment unit operations and notification of maintenance personnel in the event of a system alarm or shutdown condition.

3.1 START-UP PROCEDURE

Normal startup of the GWTS should only be done locally at the control panel within the treatment building. Remote startup via telemetry is not recommended without a local operator present and in communication with the person connected via telemetry.

To perform a normal GWTS startup, follow these steps:

1. Inspect all system components for leaks or other problems;
2. Verify that there is electrical power and no breakers are tripped;
3. Verify on the phase monitor that proper electrical power exists;
4. Read any alarm conditions noted on the HMI screen;
5. Reset the system from the HMI screen;
6. The auto-startup process in the PLC should take control;
7. Place all control panel switches to the "AUTO" position; and,
8. Inspect all system components for proper operation; make sure there are no leaks or other problems.

3.2 NORMAL OPERATING CONDITIONS

The GWTS will be operated continuously except for short periods of time when it will be shutoff to inspect or repair components and backwash the arsenic filters. Under normal operation, water will be pumped from the ground water extraction well through the manifold piping and into the GWTS influent equalization tank. The total influent water flow rate is approximately 20 gpm. In sequential order, the following treatment processes occur; air stripping, particulate filtration, arsenic reduction and liquid-phase activated carbon polish. Then the treated water is conveyed to the reinjection wells. Refer to Drawing 03 Piping & Instrumentation Diagram in Appendix A for a depiction of the treatment processes and locations of sample ports, pressure gauges, and flow meters. The GWTS design operating conditions are listed in Table 3-1.

Table 3-1
GWTS Design Operating Conditions

Parameter	Representative Value	Comment
Average water flow rate	20 gpm	Range 0 – 20 gpm
Air stripper differential pressure	20 inches water	> 32 inches of water indicates fouling of trays
Bag filter pressure	< 5 psi	> 20 psi indicates clogged bag
Arsenic filter differential pressure	< 20 psi	> 45 psi indicates clogged vessel(s)
Liquid phase activated carbon differential pressure	< 5 psi	> 30 psi indicates clogged vessel(s)

3.3 NORMAL SHUT-DOWN PROCEDURE

Normal shutdown of the GWTS can be done either locally at the control panel within the treatment building, or remotely via telemetry.

3.3.1 Local Shutdown

To shut down the system for routine maintenance or any non-emergency reason, follow these steps:

1. Turn off the extraction well pump by turning the operating switch on the control panel to "OFF". All treatment process equipment will continue to operate until the water level in all equipment reaches minimum levels. The air stripper fan will shut off approximately 30 minutes after the last influent equalization tank pump cycle.
2. If necessary, operating switches for all pumps and equipment can be turned to off once the operator verifies that it is safe to do so.
3. Follow lock-out/tag-out procedures and any other safety procedures before conducting any maintenance activities.

3.3.2 Remote Shutdown

To shut down the system for routine maintenance or any non-emergency reason via telemetry, follow these steps:

1. Initiate the auto-shutdown process while remotely connected to the PLC via telemetry. This will turn off the extraction well pump while allowing all other treatment process equipment to operate until the water level in all equipment reaches minimum levels. The air stripper fan will shut off approximately 30 minutes after the last influent equalization tank pump cycle.
2. If necessary, operating switches for all pumps and equipment can be turned to off once the operator verifies that it is safe to do.
3. Follow lock-out/tag-out procedures and any other safety procedures before conducting any maintenance activities.

3.4 EMERGENCY SHUT-DOWN PROCEDURE

Although the normal shutdown procedure is the preferred method for shutting down the system, the following procedure is recommended when rapid shutdown is necessary during emergency conditions such as fire or catastrophic failure of tanks, pipes, etc:

1. Shut off electrical power to the system by pressing the red "Emergency Stop" button on the GWTS control panel.
2. Shut off electrical power to the system by turning the main disconnect on the outside wall of the treatment system to the "OFF" position. This will turn off all electricity to the GWTS.

4.0 SYSTEM MAINTENANCE

The following sections describe routine and major system maintenance, as well as, listing spare parts to be kept on Site for routine maintenance and steps to be taken to winterize the system.

4.1 ROUTINE MAINTENANCE

Routine maintenance will be completed in accordance with manufacturer's recommendations. Maintenance inspections will be performed during scheduled monitoring events and as needed throughout the treatment systems operation. Activities will include a detailed and thorough examination of the entire groundwater treatment system. All equipment, piping and instrumentation will be inspected with maintenance performed per manufacturer's specifications. Typical maintenance activities will include:

- Cleaning and redevelopment of the extraction well and pump;
- Cleaning of the air stripper trays;
- Replacement of filter bags;
- Replacement of the arsenic reduction system filter units;
- Replacement of liquid-phase carbon;
- Cleaning of the level switch systems and flow meters; and,
- Cleaning and redevelopment of the reinjection wells.

System inspections will be done weekly for the first eight weeks of operation, then monthly thereafter. Table 4-1 summarizes activities that will be performed during routine monitoring and Table 4-2 summarizes the frequency of routine maintenance tasks. Contact information for the manufacturers and vendors of the equipment is presented in Table 4-3. Specific information regarding key maintenance tasks is provided below.

Table 4-1
Summary of Routine Maintenance

Item	Maintenance Activity
Extraction Well	Check the condition of the well head.
	Check water level in the extraction well.
	Record flow and pressure from the extraction well.
	Check that the flow control valve position is correct for the extraction well.
	Check that the flow meter is operating properly for the extraction well.
	Check for leaks in the process piping.
	Adjust feed flow rate to design conditions.
Influent Equalization Tank and Transfer Pump	Check that the water level in the equalization tank is within the normal operating range.
	Check that the level controls are operating properly.
	Check that there is no excessive buildup of foreign material on the level switches.
	Check for solids buildup in the bottom of the equalization tank.
	Check for proper operation of the transfer pump.
	Check for leaks.
Air Stripper	Check and record tray differential pressure gauge reading.
	Check see through panel on front of tray unit for foreign material buildup.
	Check that the air stripper main air blower and auxiliary carbon blower are operating properly.
	Check that the sump level control system is operating properly.
	Check for proper operation of the transfer pump.
Bag Filter	Check bag filter pressure gauge.
	Change bag filters if required.
Arsenic Reduction System	Check pressure gauges on arsenic reduction system.
	Check for leaks.
Liquid-phase carbon	Check pressure gauges before and after LGAC.
	Check for leaks.
Discharge Equalization Tank and Transfer Pump	Check that the water level in the equalization tank is within the normal operating range.
	Check that the level controls are operating properly.
	Check that there is no excessive buildup of foreign material on the level switches.
	Check for solids buildup in the bottom of the equalization tank.
	Check for proper operation of the transfer pump.
	Check for leaks.

Table 4-1 (cont'd.)
Summary of Routine Maintenance

Reinjection Wells	Record flow and pressure for each reinjection well.
	Check water level for each reinjection well.
	Check that the flow control valve position is correct for each reinjection well.
	Check for leaks in the process piping.
	Check the condition of each well head.
Vapor-Phase Granular Activated Carbon	Check that unit is operating properly.
	Check general condition of vessel.

Table 4-2
Schedule of Routine Maintenance

Maintenance Task	Frequency	
	For 1st Month	After 1st Month
Inspect general operation and performance of the GWTS	weekly	monthly
Check for alarms or shutdowns on PLC panel	weekly	monthly
Check for presence of trapped gas in multi-bag filter and manually vent	weekly	monthly
Check for presence of trapped gas in the liquid-phase carbon vessel by manually venting via the valve at the top of the vessel.	weekly	monthly
Inspect air stripper effluent and equalization tank pumps	weekly	monthly
Inspect piping, valves, flow meters, and transmitters	weekly	monthly
Inspect electrical and telemetry system	weekly	monthly
Inspect bag filter and arsenic reduction system	weekly	monthly
Calibrate flow meters	Quarterly or as required	
Perform pump manufacturer specified maintenance	As specified	
Inspect and clean air stripper trays that show signs of significant fouling, hardness deposits, etc.	As necessary	
Replace bag filters when pressure drop reaches 20 psi	As necessary	
Backwash arsenic vessels when pressure drop reaches 30 psi	As necessary	
Replace arsenic vessel when breakthrough is observed	As necessary	
Replace worn or faulty equipment or components	As necessary	
Check system status after major storm events	As necessary	
Redevelop extraction well	As necessary	
Redevelop reinjection wells	As necessary	

4.1.1 Filter Bag Replacement

Occasionally, particulates build up in the bag filter and it becomes necessary to change the filter bag. The 25-micron polypropylene filter bag should be inspected and replaced when the differential pressure across the filter element is **greater than 20 psi** under normal operations. The pressure differential is manually read on pressure gauges located on either side of the filter housing.

The following procedure should be followed to inspect and replace the filter bags without shutting down the GWTS. Bag filter replacement can also be completed with the system shut down normally.

1. Shut off the air stripper sump pump. This is best done right after the pump has

finished a pumping cycle.

2. Verify that the pressure in the bag filter housing has bled to zero psi. Vent with vent valve, if necessary.
3. Loosen the lid nuts and rotate lid off of vessel.
4. Remove the filter bags with caution. Make sure to wear gloves during bag replacement.
5. Inspect filter bag basket for roundness and flange condition.
6. Verify that basket and bag bearing surfaces are clean and free of nicks.
7. Insert new bag filter elements, making sure that all the bags are properly seated.
8. Inspect and clean gasket and gasket groove, if necessary. If gasket is worn out or nicked, replace.
9. Rotate lid over vessel and align bolt and nut brackets.
10. Close the lid; engage all bolts and hand tighten nuts.
11. Moderately torque nuts at 180° to each other, rotating around the vessel until tight.
12. Turn the air stripper sump pump to AUTO.
13. Bleed any remaining air from the vessel by opening the vent valve slowly until water starts to come out.
14. Close vent valve.

4.1.2 Air Stripper Maintenance

Prior to performing maintenance on the interior of the air stripper, the operator should stop all influent water sources and allow the air stripper to treat the remaining water cascading through the trays, allowing the system to stop on its own. Once the air stripper has completely treated the remaining water and the effluent pump has stopped, the operator can lockout the system and open the tray access doors.

The suggested maintenance of the air stripper is clearly outlined by QED in the operation manual provided in the Appendix D. Frequency of maintenance and cleaning is determined by the measured airflow rate and backpressure on the blower. Airflow rate should be maintained at 300 cfm to ensure high removal efficiencies and the backpressure should be kept below 32 inches of water. The key air stripper maintenance items include:

- Air Stripper Trays - should be clean and free of debris and deposits especially at the aeration holes;
- Demister Pad - should be clean and free of biological fouling and debris to minimize backpressure on the blower;
- Sight glass tubing - should be clean and free of algae and deposits;
- Gasket seals and Tray Felt seals - check seals for rips or tears, repair with silicone as necessary;
- Air Stripper Effluent pumps - should be lubricated in accordance with the pump operation manual; and
- Overall Appearance - Exterior of the air stripper and pumps should be maintained clean of deposits and stains.

4.1.3 Arsenic Reduction Vessel Backwash

The arsenic reduction vessels are designed for continuous operation with regular maintenance. If the differential pressure across the vessels becomes **greater than 30 psi,** backwashing will be necessary to re-fluff the media.

The procedure for backwash of a single vessel is as described below. The procedure has been written to backwash the lead vessel without shutting the system down. The same procedure will be used to backwash the lag vessel with the exception of the valve sequencing.

Important: Change the valves in the following order, otherwise you risk deadheading the pumps resulting in potential equipment and/or piping damage. As an alternative, the operator can shut down the air stripper sump pump temporarily, quickly make valve changes, and then restore the pump operation before the air stripper sump reaches the high level alarm.

1. Open the backwash outlet valve (rerouting water to the influent equalization. tank).
2. Close the isolation valve between the vessels (isolating the lag vessel).
3. Open the backwash inlet valve between the two vessels.
4. Manually operate the discharge equalization tank pump for the desired backwash duration. **Do not allow the pump to run dry.**
5. Close the discharge equalization tank valve (rerouting water through the lead vessel).

Important: So that the process flow is restored to the original series flow, change valves in the following order:

1. Open the discharge equalization tank valve.
2. Place the discharge equalization tank pump back in AUTO mode.
3. Close the backwash inlet valve between the two vessels.
4. Open the isolation valve between the vessels.
5. Close the backwash outlet valve.

4.1.4 Arsenic Reduction Vessel Replacement

When breakthrough (concentration of 10 ppb or greater) of arsenic is detected at the outlet of the lead vessel, the lead arsenic reduction vessel will be taken out of service. The lag vessel will be moved to the lead position, and a new vessel with fresh media will be installed in the lag position. The spent media and vessel will either be properly disposed of in total, or the vessel will be filled with fresh media and held as a spare. The operator will coordinate the profiling, replacement and disposal of the spent media according to all applicable regulations.

If the system is not shut down during change out, the lead vessel will be temporarily taken out of service and the water will be routed to the lag vessel. Once a new vessel is installed, the operator should fill the vessel with water and allow the media to soak as suggested by the vendor. After soaking the media, the new vessel should be backwashed to remove the fine

particulates prior to use.

4.1.5 Liquid-Phase Carbon Replacement

When breakthrough (concentration of >75 ppb or greater) of VPH (C5-C8 hydrocarbons) is detected at the outlet of the LGAC the carbon will be scheduled for replacement. Fresh carbon will be installed in the LGAC. The spent carbon will be shipped out for regeneration. The operator will coordinate the profiling, replacement and shipment of the spent carbon according to all applicable regulations.

4.1.6 Transfer Pump Maintenance

The transfer pumps in use with the GWTS require minimal maintenance. The manufacturer (Gould's Pumps) information in Appendix C describes pump maintenance and repair procedures in detail. These include but are not limited to procedures for lubrication, greasing, maintenance of bearing isolators, disassembly and assembly.

4.1.7 Residuals Management

The following treatment residuals will be periodically generated from the treatment system:

- Filter bags;
- Vapor-phase carbon;
- Liquid-phase carbon;
- Arsenic reduction media; and,
- Material related to cleaning equipment and/or wells.

These residuals are not expected to be hazardous. The vapor-phase carbon, liquid-phase carbon and arsenic reduction media will be sampled per the vendor's disposal requirements.

A representative sample a bag filter will be collected and analyzed for total arsenic.

4.2 MAJOR MAINTENANCE

Major maintenance is any effort needed to repair or replace equipment to continue system operation. The need for major maintenance would result from a major malfunction causing the system to be inoperative. Major maintenance also refers to system design changes and/or maintenance requiring significant downtime. The appropriate equipment manufacturer can be contacted when any major maintenance is called for. Contact information for the equipment and materials vendors is provided in Table 4-3.

Table 4-3
Contact Information for Equipment Manufacturers/Suppliers

Equipment	Manufacturer	Telephone	Vendor	Contact	Telephone
Extraction Well Pump	Grundfos Pumps Corp.	(559) 292-8000			
Low Profile Air Stripper	QED Environmental Systems	(800) 624-2026	QED Environmental Systems		
Transfer Pumps	Goulds Pumps	(315) 568-7123	Goulds Pumps		
Arsenic Reduction Vessels	Tetrasolv Filtration, Inc.	(800) 441-4034	Seneca Environmental	Dan Nolan	(515) 262-5000
Arsenic Reduction Media	AdEdge Technologies, Inc.	(678) 835-0052	AdEdge Technologies, Inc.	Valarie Rhodes	(678) 835-0052
Flow Meters/Transmitters	Georg Fischer Signet, LLC	(781) 438-5646	Georg Fischer Signet, LLC	Kevin Buchanan	(781) 454-9928
Vapor Phase Carbon	Tetrasolv Filtration, Inc.	(800) 441-4034			
Liquid Phase Carbon	Siemens	978-614-7428	Siemens	AnnieLu DeWitt Santini	603-767-1118
Bag Filters	Custom Service & Design	(248) 340-9005			
Control Panel and Telemetry	Seneca Environmental	(515) 262-5000	Seneca Environmental	Rich Richards	(515) 262-5000
Intake Filters	Stoddard Silencers, Inc.	(847) 223-8636			

4.3 SPARE PARTS

A reasonable supply of spare parts should be maintained according to the maintenance requirements for each item of equipment. Table 4-4 is a list of recommended spare parts. For additional information, part numbers, etc. of the different system components; please

refer to the appropriate manufacturer's information contained in the Appendices of this document.

Table 4-4
Recommended Spare Parts

Item	Make / Model	Vendor	Contact	Suggested Spare Inventory
Bag Filters	25-micron polypropylene	Custom Service & Design	(248) 340-9005	10
Intake Filters	F64-6" housing/ F8-110 filter	Stoddard Silencers, Inc.	(847) 223-8636	2
Vacuum Gauges	3005 liquid-filled	Ashcroft, Inc.	(800) 328-8258	2

4.4 WINTERIZATION

Winter maintenance activities are those required to protect the system from damage during periods of freezing temperatures. The extraction well and reinjection wells should be inspected prior to the onset of freezing conditions. Snow or heavy ice accumulation should be removed. The GWTS heating system should be checked to ensure that the heater is working in treatment building.

5.0 MONITORING, SAMPLING AND REPORTING

This section describes the long-term monitoring, sampling and reporting related to the Northeast Area remedy. Monitoring and sampling will be done according to procedures outlined the *Field Sampling Plan* for the Site (HSI GeoTrans, 2000 and GeoTrans, 2007). Sample bottles, preservatives, and laboratory holding times and analytical methods to be used for sampling are specified in the *Quality Assurance Project Plan* for the Site (HSI GeoTrans, 2000; GeoTrans, 2007).

5.1 WATER LEVEL MONITORING

Groundwater level monitoring in the Northeast Area will continue to be performed according to the Operable Unit Three (OU-3) monitoring program, as defined by the Groundwater Monitoring Plan (GeoTrans, 2006) and modified by annual monitoring reports. The current water level monitoring program includes annual measurement of water levels at approximately 60 locations in the Northeast Area.

Grace proposes to collect additional water level data during start-up of the Northeast Area Remedial Action. Start-up is defined to occur after installation, development and testing of all the extraction and reinjection wells. More specifically, pressure transducers will be installed in:

- monitoring wells MW-43S and MW-43D, located adjacent to the LNAPL source area, and
- MW-06S, MW-06D, MW-06D1, MW-06D2, MW-06B, MW-04S and MW-04D, RE-1OBS and RE-2OBS located near the extraction/reinjection wells.
-

Water levels will be measured from these locations on an hourly basis starting approximately two weeks before system start-up through the first two weeks of operation. Water level data collected from these locations will provide an indication as to the hydraulic impacts that the extraction/reinjection system has on the shallow aquifer system in the vicinity of the reinjection wells as well as in the vicinity of the Linde light non-aqueous phase liquid (LNAPL related contamination.

Water level monitoring will also be done at the extraction and reinjection wells. Water levels will be measured by hand in each extraction well on a monthly basis. Water levels will be collected on a daily basis from each active reinjection well using a pressure transducer/data logger. The extraction and reinjection well water level data will be used to evaluate changes in well efficiency over time and will be used to determine if and when wells need to be redeveloped. Water level monitoring proposed specifically for the Northeast Area Remedial Action is summarized in Table 5-1.

5.2 GROUNDWATER QUALITY MONITORING

Groundwater quality monitoring in the Northeast Area will continue to be performed according to the Operable Unit Three (OU-3) monitoring program, as defined by the Groundwater Monitoring Plan (GeoTrans, 2006) and modified by annual monitoring reports.

The current monitoring program includes annual sampling and analysis of groundwater from 20 locations in the Northeast Area for VOCs, 8 locations for 1, 4-dioxane and 8 locations for inorganic compounds. Figure 2-1 shows the locations that are sampled and what parameters they are sampled for.

In addition to the OU-3 monitoring program sampling, Grace will collect groundwater samples from three locations and analyze them for extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH). Samples will be collected from monitoring well MW-49, which is completed across the water table, MW-06D1, which is completed in the shallow till, and MW-06D2, which is completed in the deep till. These three monitoring wells are located between the Linde LNAPL-related contamination and the area where groundwater will be extracted from the bedrock. Groundwater quality results from these locations will provide an indication as to whether the Linde LNAPL-related contamination is migrating to the north toward the Grace extraction and reinjection wells. During system operation, Grace will sample these three wells every six months for the first two years of extraction well operation, then annually thereafter. The first set of samples will be collected prior to activation of the Northeast Area remedy to provide a baseline condition. This data will be reported in the *Annual Monitoring Program Reports* for the Site. Groundwater quality monitoring proposed specifically for the Northeast Area Remedial Action is summarized in Table 5-1.

5.3 TREATMENT SYSTEM MONITORING

Groundwater samples will be collected from extraction well NE-1 weekly for the first four weeks, then on a monthly basis. These samples will be analyzed for VOCs, 1, 4-dioxane, EPH/VPH, total arsenic, iron and manganese. SVOCs and other inorganic compounds will be analyzed for if results from samples collected during extraction well step-testing indicate that they are present at levels that would be of concern. The results from the extraction well samples will give an indication as to the quality of groundwater being extracted from the bedrock as well as the water quality influent to the treatment system.

Water samples will be collected from the effluent of the liquid-phase carbon unit weekly for the first four weeks and then on a monthly basis. The results from these samples will be used to monitor the efficiency of the treatment system. Water quality results from the liquid-phase carbon unit effluent will represent the compliance point sample results and the quality of water being reinjected into the aquifer. These treatment system water quality samples will be analyzed for VOCs, 1,4-dioxane, total arsenic, iron, manganese, and VPH. In the event that EPH is detected in the air stripper influent, it will be added to other sampling points within the treatment train, as necessary. During the monthly sampling events pH and turbidity will be measured on site at the effluent of the liquid-phase carbon unit. A total arsenic sample will be collected between the two arsenic reduction system vessels weekly for the first eight weeks. The arsenic sample collected mid-way through the arsenic reduction system will be used to evaluate breakthrough of the lead vessel. Following review of the first eight-weeks of sample results, a determination will be made as to the continued frequency needed for these samples. The sampling frequency will depend on actual arsenic influent concentrations and breakthrough time for the lead vessel.

A VPH sample will be collected after the arsenic reduction system and prior to the liquid-phase activated carbon unit weekly for the first four weeks and then on a monthly basis. This VPH result in conjunction with the effluent VPH results will be used to evaluate the efficiency of the carbon unit.

No air samples are proposed to be collected since the vapor-phase carbon has no specific mass removal requirements. The mass of VOCs discharged to the air will be calculated based on the water quality sample results.

Odor will be evaluated during weekly operational visits for the first 8 weeks and monthly thereafter. Carbon change-out is anticipated to be performed on an as needed basis when odor monitoring indicates change-out is necessary. Treatment system monitoring for the Northeast Area Remedial Action is summarized in Table 5-1.

The following treatment residuals will be periodically generated from the treatment system:

- Filter bags;
- Vapor-phase carbon;
- Liquid-phase carbon;
- Arsenic reduction media; and,
- Material related to cleaning equipment and/or wells.

These residuals are not expected to be hazardous. The vapor-phase carbon, liquid-phase carbon and arsenic reduction media will be sampled per the vendor's disposal requirements.

A representative sample a bag filter will be collected and analyzed for total arsenic.

USEPA will be notified immediately in the event that groundwater exceeding an Interim Groundwater Cleanup Level (IGCL) or any other Applicable or Relevant and Appropriate Requirement (ARAR) is reinjected. IGCLs for the Site are summarized in Table 2-1.

5.4 EXTRACTION / REINJECTION WELL MONITORING

Extraction and reinjection well monitoring will be done weekly for the first four weeks, then monthly thereafter. The following data will be recorded during each monitoring event:

- Record totalizer reading and flow rate for each extraction and reinjection well;
- Record individual extraction well / reinjection well pressure; and
- Record pH and turbidity for each extraction well.

5.5 REPORTING

Monitoring and sampling results related to installation and start-up of the Northeast Area remedial action will be included in the Northeast Area Groundwater Remedial Action Report, which will be submitted within 90 days after USEPA determines that construction is complete and that the Northeast Area Groundwater Remedial Action is "Operational and

Functional".

Long-term monitoring and sampling results related to the Northeast Area remedial action will be reported in one of two documents:

- *Annual Monitoring Program Reports* for the Site or
- *Annual Northeast Area Treatment System Reports.*

The *Annual Monitoring Program Reports* for the Site will be submitted following completion of the annual Site-wide water level and groundwater sampling round. The following information will be included in the *Annual Monitoring Program Reports*:

- A brief description of the water level and water quality sampling procedures;
- A table summarizing the water level measurements;
- Unconsolidated deposits and bedrock potentiometric maps showing water level elevations and potentiometric contours;
- Tables summarizing the water quality data;
- Unconsolidated deposits and bedrock water quality maps indicating the VDC, vinyl chloride, and benzene concentrations detected in each monitoring well;
- Contour maps showing the distribution of VDC, vinyl chloride, and benzene concentrations above MCLs;
- Maps showing the distribution of arsenic in groundwater;
- Time-concentration plots of VDC, vinyl chloride and benzene;
- A discussion of any statistically significant water quality concentration trends observed;
- Discussion/proposal of changes to the monitoring program, including a listing of monitoring wells, if any, that should be dropped from annual sampling; and
- Evaluation of impacts of the remedy, if any, to the Linde LNAPL-related contamination.

The *Annual Northeast Area Treatment System Reports* for the Site will be submitted by the end of the first quarter of each calendar year. The following information will be included in the *Annual Northeast Area Treatment System Reports*:

- Tables summarizing the treatment system water quality sampling results;
- Estimate of the VOC mass removed by the remedy;
- Evaluation to confirm if air emissions are at or below a level of No Significant Risk to human health and public welfare;
- Summary of air stripper, arsenic reduction system and liquid-phase activated carbon removal efficiencies;
- Tables summarizing extraction and reinjection rates;
- Discussion of operation and maintenance activities performed; and
- Discussion of issues, if any, related to the treatment system operation.

After the remedy has been operational for three years, and if necessary, every two

years thereafter, an evaluation will be conducted to determine if pumping can be discontinued. The evaluation will include the following:

- Information from the Acton Water District regarding yield and drawdown at the three Public Water Supply Wells located in the School Street Well Field;
- Contaminant concentrations at each of the three Public Water Supply Wells located in the School Street Well Field and whether they are meeting, and are expected to continue to meet drinking water standards; and,
- The effectiveness of the extraction and treatment system.

Table 5-1
Monitoring and Sampling for Northeast Area Remedial Action

Location	Analysis	Frequency
Water Level Monitoring		
MW-43S, MW-43D, MW-04S, MW-04D, MW-06S, MW-06D, MW-06D1, MW-06D2, MW-06B, RE-1OBS, RE-2OBS	Pressure transducer/data logger	Hourly for 2 weeks prior to system start-up through first 2 weeks of operation
Extraction Wells	Hand measurement	Monthly
Reinjection Wells	Pressure transducer/data logger	Daily
Groundwater Quality Monitoring		
MW-49 MW-06D1 MW-06D2	EPH VPH	Prior to system start-up Every 6 months for first 2-years Annually while system operating
Treatment System Monitoring		
Extraction Well NE-1 (Influent)	VOCs, 1,4-dioxane, EPH/VPH Total arsenic, iron and manganese	Weekly for first 4 weeks; Monthly thereafter
Between Arsenic Reduction System Vessels	Total arsenic	Weekly for first 8 weeks Long-term frequency to be determined after 8 weeks
After Arsenic Reduction System and before Liquid-Phase Carbon Unit	VPH	Weekly for first 4 weeks; Monthly thereafter
Liquid-Phase Carbon Effluent	VOCs, VPH 1,4-dioxane Total arsenic, iron and manganese Add EPH if detected in influent	Weekly for first 4 weeks Monthly thereafter
Air	Odor monitoring	Weekly for first 8 weeks Monthly thereafter
Extraction/Reinjection Well Monitoring		
Extraction Well NE-1	Totalizer Reading/Flow Rate Well Pressure	Weekly for first 4 weeks Monthly thereafter
Reinjection Wells RE-1 and RE-2		

6.0 POTENTIAL OPERATING PROBLEMS AND CORRECTIVE ACTIONS

This section is a listing of the most likely potential problems with the system, their possible causes and corrective actions.

6.1 EQUIPMENT MALFUNCTIONS

Table 6-1 lists individual equipment malfunctions, probable causes, and in most cases, corrective actions to be taken. By no means is this list complete. It is intended only as a guide for the maintenance personnel to help them in properly identifying and isolating equipment malfunctions. If in doubt as to the actual cause of a malfunction, consult the equipment manufacturer for assistance.

The system will automatically shut down and will need to be restarted manually under the following conditions:

1. Motor fault in any pump.
2. High-high level alarm in either of the two reinjection wells.
3. Low pressure (indicating low air flow) in the air stripper.
4. Differential pressure across arsenic reduction vessels **greater than 30 psi.**

In the event the system shuts down, the cause will be investigated, an appropriate remedy will be implemented, and the system will be restarted. All other alarms are either not anticipated to occur frequently or do not require immediate attention by the operator.

6.2 EXCEEDANCE OF A GROUNDWATER DISCHARGE STANDARD

In the event the effluent from the groundwater treatment system exceeds a groundwater discharge standard, the following steps will be taken:

1. If a VOC discharge standard is exceeded inspect/clean the air stripper system and resample the treatment system effluent; or,
2. If the arsenic discharge standard is exceeded inspect/replace the arsenic reduction system vessels, as necessary and resample the treatment system effluent.

If the effluent sample collected after the above actions have been taken exceeds a groundwater discharge standard or, if a compound which is not being treated by the system exceeds a groundwater discharge standard, then an evaluation of potential modifications to the treatment process necessary for the system to meet the groundwater discharge standards will be done. In the unlikely event that modifications are not feasible, for practical or cost-effectiveness reasons, Grace will consider the feasibility of installing a compliance point between the reinjection wells and the School Street Well Field Zone II boundary. Modifications to the treatment system and/or implementation of a compliance point other than the treatment system discharge will be proposed to the USEPA for their review and

approval. As with all correspondence related to the Northeast Area remedial action, Linde, the property owner, will be copied on all correspondence related to treatment system or compliance point modifications.

Table 6-1
Potential Operational Problems and Remedies

Potential Problem	Cause	Remedy
High Level Alarm in Air Stripper	Feed flow rate too high.	Adjust feed flow rate to design conditions.
	Pump Failure.	Repair / replace pump.
	Pump operation level switch malfunctioning.	Clean / repair / replace pump switch.
Low air flow rate through the air stripper	Damper closed too much	Open damper on the effluent side of the air blower.
	Fouled trays or demister pad	Clean trays and/or demister pad of fouling.
High level alarm in equalization tank	Groundwater extraction rate too high.	Adjust extraction flow rate to design conditions.
	Pump failure.	Repair / replace pump.
	Pump operation level switch malfunctioning.	Clean / repair / replace pump switch.
Low level of water in an equalization tank	Pump operation level switch malfunctioning.	Clean / repair / replace pump switch.
	Pump feeding tank is malfunctioning.	Check feed pump operation level switch. Repair / replace pump.
No flow in influent header	Influent piping is clogged.	Check clean-outs. Snake line if necessary.
	Extraction pumps not operating properly.	Check pump. Clean or replace if necessary.
High pressure readings across the bag filter	Filter bag is clogged.	Replace filter bag.
High differential pressure readings across the arsenic filters	Filters are plugged.	Backwash or change filter.

Inoperable flow meters	Loose connections	Check connections. Re-tighten if necessary.
	Particulate build-up	Remove flow sensor and clean if there is a build-up
High level alarm in reinjection well(s)	Discharge flow rate too high.	Adjust extraction flow rate to design conditions.
	High-high level alarm switch malfunctioning.	Clean / repair / replace high-high switch.
	Reinjection well(s) fouled.	Redevelop reinjection well(s).
Odor detected outside of treatment building	Leak in piping to carbon.	Check for leaks. Repair as necessary.
	Vapor-phase carbon is spent	Replace vapor-phase carbon.

7.0 DOCUMENTATION

An important factor in operating any efficient extraction and treatment system is the completion of accurate operational and maintenance records. Without a record of past operational performance, it is impossible to identify trends in any process. Records provide the operators with valuable information upon which to base their decisions concerning the system operation.

Four types of GWTS records will be maintained at the site: operating reports, maintenance records, emergency condition records, and personnel records. These records are discussed further in the following sections.

7.1 OPERATING REPORTS

Detailed operating reports will be maintained for GWTS operation. These reports can be used to record information that is integral to observing and controlling operational trends of the GWTS. Table 7-1 presents an example Monthly GWTS Inspection Report. Table 5-1 summarizes the frequency of data collection.

Table 7-1
Monthly GWTS Inspection Report
W. R. Grace Superfund Site, Acton Massachusetts
Northeast Area Remedial Action

Date:_____ Weather: _____
Equipment/Personnel On-Site: _____
_____
Description of Work Performed: _____
_____
_____
_____

Extraction Well Flow Rate _____ gpm Total Flow _____ gallons
Extraction Well Pressure _____ psi
Influent Equalization Tank Pump Pressure _____ psi
Air Stripper Run Time_____ hours Air Stripper Diff. Pressure _____ in. H2O
Air Stripper Influent Flow Rate _____ gpm Air Stripper Sump Pump Pressure_____ psi
Bag Filter Inlet Pressure _____ psi Bag Filter outlet Pressure _____ psi
Lead Arsenic Vessel Inlet Pressure _____ psi Lead Arsenic Vessel Outlet Pressure ____ psi
Lag Arsenic Vessel Inlet Pressure _____ psi Lag Arsenic Vessel Outlet Pressure ____ psi
Discharge Equalization Tank Pump Pressure _____ psi
Reinjection Well RE-1 Flow Rate _____ gpm Total Flow _____ gallons
Reinjection Well RE-1 Pressure _____ psi
Reinjection Well RE-2 Flow Rate _____ gpm Total Flow _____ gallons
Reinjection Well RE-2 Pressure _____ psi
Vapor-Phase Carbon Diff. Pressure _____in. water
Vapor-Phase Carbon Temperature _____ °F
Odor Present Yes/No If yes, please describe:_____
Additional Information:

7.2 MAINTENANCE RECORDS

Record completion and retention is the most important aspect of the maintenance program. From a review of the maintenance records, operating personnel, the responsible regulatory agency, and the design engineer can identify recurring problems with various pieces of equipment, select the appropriate list of spare parts to be maintained on site, and develop and design solutions to overcome these problems.

A log book will be maintained onsite to record daily maintenance activities. In addition, a running record of maintenance performed on each piece of equipment will be kept. The equipment inspection and service record provides an easily identifiable list of maintenance performed on each piece of equipment. Data concerning the preventive maintenance necessary on each item of equipment is obtained from the manufacturer's O&M manuals, and the next scheduled servicing can be easily indicated. Table 7-2 presents an example Equipment Service Record.

Table 7-2
Equipment Service Record
W. R. Grace Superfund Site, Acton Massachusetts
Northeast Area Remedial Action

Equipment:		
Date:	**Work Done:**	**Comments:**

7.3 NON-ROUTINE CONDITIONS

A record of non-routine conditions affecting the system will be maintained in the site logbook. Example non-routine conditions include: area wide power failures, extraction pump failures, or natural disasters. The logbook also serves as a register of major emergencies or alarm conditions, with supplemental reports filed describing the occurrence, damage, cause, emergency corrective actions taken, costs attributed to the situation, and permanent corrective actions taken, if required.

7.4 PERSONNEL RECORDS

A record of onsite personnel and any visitors, subcontractors, regulatory agency personnel, etc. will be maintained at the site.

8.0 SAFETY ISSUES

A site-specific O&M HASP has been prepared for the Site and is included in Appendix K of this O&M Plan. The HASP contains the following information:

- organization and responsibilities of the project/health and safety team;
- characterization of the chemical and physical hazards present at the Site;
- a description of the medical program required for O&M personnel;
- instruction on selection and use of personal protective equipment (PPE) and action levels for upgrading or downgrading PPE;
- proper delineation of work zones and equipment personal decontamination; and
- an accident prevention and contingency plan.

8.1 GENERAL SITE SAFETY

Any piece of equipment can be dangerous if operated improperly. Safety is ultimately the responsibility of those operating and maintaining the equipment. All personnel operating and maintaining the GWTS and its proper implementation must be familiar with all of the system components, and observe all OSHA, federal, state and local safety codes and requirements. The personnel should also be active participants in the approved company health and safety program.

Failure to properly follow instructions and failure to take proper safety precautions is dangerous and can cause serious personal injury, needless equipment damage, and unnecessary environmental harm. Mechanical modifications and/or substitutions of parts on equipment that will affect structural, operational, or environmental safety should not be made. Modifications that may defeat protective features originally designed into the equipment and its controls should not be made.

Table 8-1 summarizes the hazards associated with the GWTS operation. The following is a partial list of general precautions to follow but in no case is the list exhaustive nor is it intended to be. Operators and maintenance personnel should expand on this list after first reviewing the entire GWTS and its operation with the appropriate health and safety authorities.

- Keep areas clean. A clean work area is a much safer area.
- Keep all equipment guards in place. If removed to service the equipment, make sure the guards are replaced properly.
- Wear eye and face protection around rotating and pumping equipment and whenever working around or handling chemicals. Be especially cautious for splash when disconnecting piping, valves and fittings.
- Wear ear protection if necessary.
- Wear proper apparel. Do not wear loose clothing, or jewelry, which could be caught in machinery.
- Wear a proper respirator around chemicals and in areas where vapors and/or gases may be present.

- Non-skid footwear is recommended and always wear protective gloves when feasible.
- Remove adjusting screws or wrenches. Form a habit of checking to see that all tools are removed from equipment.
- Make sure all personnel are familiar with OSHA approved Material Safety Data Sheets for all hazardous materials they may encounter.

Reporting mechanisms for medical emergencies are described in the site health and safety plan (nearest hospital or medical treatment facility, etc.). Signs containing 24-hour emergency phone number contacts should be posted in the control room and system compound gates.

Table 8-1
Hazards Associated with GWTS Operation

Hazard	Precautionary Measures
Noise levels greater than 65 decibels	Wear hearing protection.
Slipping, tripping on equipment and pads	Be aware of surroundings.
Leaks from piping and equipment	Wear protective gloves, goggles and steel toe boots.
Spurting of water during change out/replacement of equipment and piping	Wear goggles and gloves while fixing any leaks. Wash hands properly if there is any contact with liquids.
Electrical shock	Stay clear of damaged electrical wiring. Use common sense. Use proper lock-out/tag-out procedures.

9.0 REFERENCES

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USEPA, 2005. Record of Decision, W. R. Grace & Co. (Acton Plant) Superfund Site, Operable Unit Three, Towns of Acton and Concord, Middlesex County, Massachusetts. September 2005.

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APPENDIX A

GROUNDWATER TREATMENT SYSTEM AS-BUILT DESIGN DRAWINGS

O & M, Inc.

W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETS
PROJECT #6354105

DESCRIPTION	SHEET NUMBER

Seneca Companies
The Complete Solution

W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETTS

TITLE DIAGRAM

7/7/2004
DARRICK WORRALL
DAN NOLAN
NO SCALE
6354105S01
6354105
01

SYMBOL SPECIFICATION

INSTRUMENT TYPE:

PS	PRESSURE SWITCH	VI	VACUUM INDICATOR
PI	PRESSURE INDICATOR	TSH	TEMPERATURE SWITCH HIGH
FE	FLOW ELEMENT	DP	DIFFERENTIAL PRESSURE
FI	FLOW INDICATOR	PSL	PRESSURE SWITCH LOW
FQI	FLOW METER (TOTALIZING)	PSH	PRESSURE SWITCH HIGH
CI	CAPACITIVE SENSOR	LSHH	LEVEL SWITCH HIGH HIGH
TI	TEMPERATURE INDICATOR	LSH	LEVEL SWITCH HIGH
TT	TEMPERATURE TRANSDUCER	LSL	LEVEL SWITCH LOW
TS	TEMPERATURE SENSOR		
LEL	EXPLOSIVITY METER		
SL	STATUS LAMP		
PC	PRESSURE CONTROL		

LINE DESIGNATION:

2 - XXX - YY - Z

2: SIZE IN INCHES

XXX: PROCESS LINE ABBREVIATION

AIR	AIR, ATMOSPHERIC PRESSURE
ASP	AIR SPARGE
BW	BACKWASH
CA	COMPRESSED AIR
CGW	CONTAMINATED GROUNDWATER
D	DRAIN
EFF	EFFLUENT
EXH	EXHAUST
GW	GROUNDWATER
NPW	NON-POTABLE WATER
P	PRODUCT
PW	POTABLE WATER
S	SANITARY
SL	SLUDGE
SP	SAMPLE PORT
SS	STORM SEWER
TF	TOTAL FLUIDS
V	VENT
VAP	VAPOR

YY: PIPING DESIGN TABLE ABBREVIATION

CPVC	CHLORINATED POLYVINYL CHLORIDE
CSP	CARBON STEEL PIPE
COP	COPPER PIPE
CMP	CORRUGATED METAL PIPE
CIP	CAST IRON PIPE
DIP	DUCTILE IRON PIPE
GAL	GALVANIZED STEEL PIPE
PE	POLYETHYLENE PIPE
PP	POLYPROPYLENE PIPE
PVC	POLYVINYL CHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
RUB	RUBBER HOSE
SSP	STAINLESS STEEL PIPE
VCP	VITRIFIED CLAY PIPE

Z: INSULATION CLASS

A	FIBERGLASS, ALUMINUM JACKET
B	FIBERGLASS, PVC JACKET
C	CLOSED-CELL POLYETHYLENE FOAM

INSTRUMENTATION CONTROLS & EQUIPMENT

PUMP

BLOWER

M — MOTOR

MS — MOTOR STARTER

I — INTERLOCK

HOA — HAND, OFF, AUTO

VALVES, FITTINGS & PIPING

- HAND CONTROL
- BLOWDOWN
- GATE VALVE
- CLOSED VALVE
- GLOBE VALVE
- CHECK VALVE
- PLUG
- BALL VALVE
- BUTTERFLY OR DAMPER
- NEEDLE VALVE
- THREE WAY VALVE
- ELECTRIC CONTROL GATE
- ELECTRIC BUTTERFLY OR DAMPER
- BLEED OR PURGE CONNECTION
- AIR RELEASE VALVE
- SOLENOID VALVE
- VACUUM RELIEF VALVE
- PRESSURE RELIEF VALVE
- ANTI-SIPHON VALVE
- FOOT VALVE
- FLEXIBLE PIPE
- CROSSOVER
- FLANGED CONNECTION
- SCREWED CONNECTION
- UNION
- COUPLING
- REGULATOR
- EXPANSION JOINT/SLEEVE
- HOSE CONNECTION
- INLINE TRAP
- INLINE FILTER
- STRAINER
- PLUG
- PIPE CAP
- SLIP UPDRAFT VENT CAP
- ELBOW - TURNED UP
- ELBOW - TURNED DOWN
- ELBOW - 90°
- ELBOW - 45°
- ELBOW - LONG RADIUS
- REDUCING ELBOW
- QUICK CONNECT COUPLING
- BUSHING
- REDUCER (CONCENTRIC)
- TEE - REDUCING
- TEE - OUTLET UP
- TEE - OUTLET DOWN
- TEE
- SAMPLE PORT

ARCHITECTURAL SYMBOL DESIGNATIONS

- 1 — OBJECT IDENTIFICATION
- A — REVISION REFERENCE NUMBER
- 1 — ROOM/SPACE IDENTIFICATION
- 2 — VERTICAL GRID REFERENCE LINE
- A — HORIZONTAL GRID REFERENCE LINE
- INDICATES SECTION/DETAIL NUMBER
- A-1 — INDICATES DRAWING SHEET ON WHICH SECTION/DETAIL IS SHOWN
- INDICATES SECTION/DETAIL NUMBER
- [1/A-1] — INDICATES DRAWING SHEET ON WHICH SECTION/DETAIL IS SHOWN
- INDICATES AREA SHOWN IN REFERENCED DETAIL
- ELEVATION REFERENCE DRAWING NUMBER
- INDICATES SECTION NUMBER
- SECTION CUT
- INDICATES DRAWING SHEET ON WHICH SECTION IS SHOWN
- TITLE/TYPE OF DRAWING
- SCALE OF DRAWING

ELECTRICAL SYMBOLS

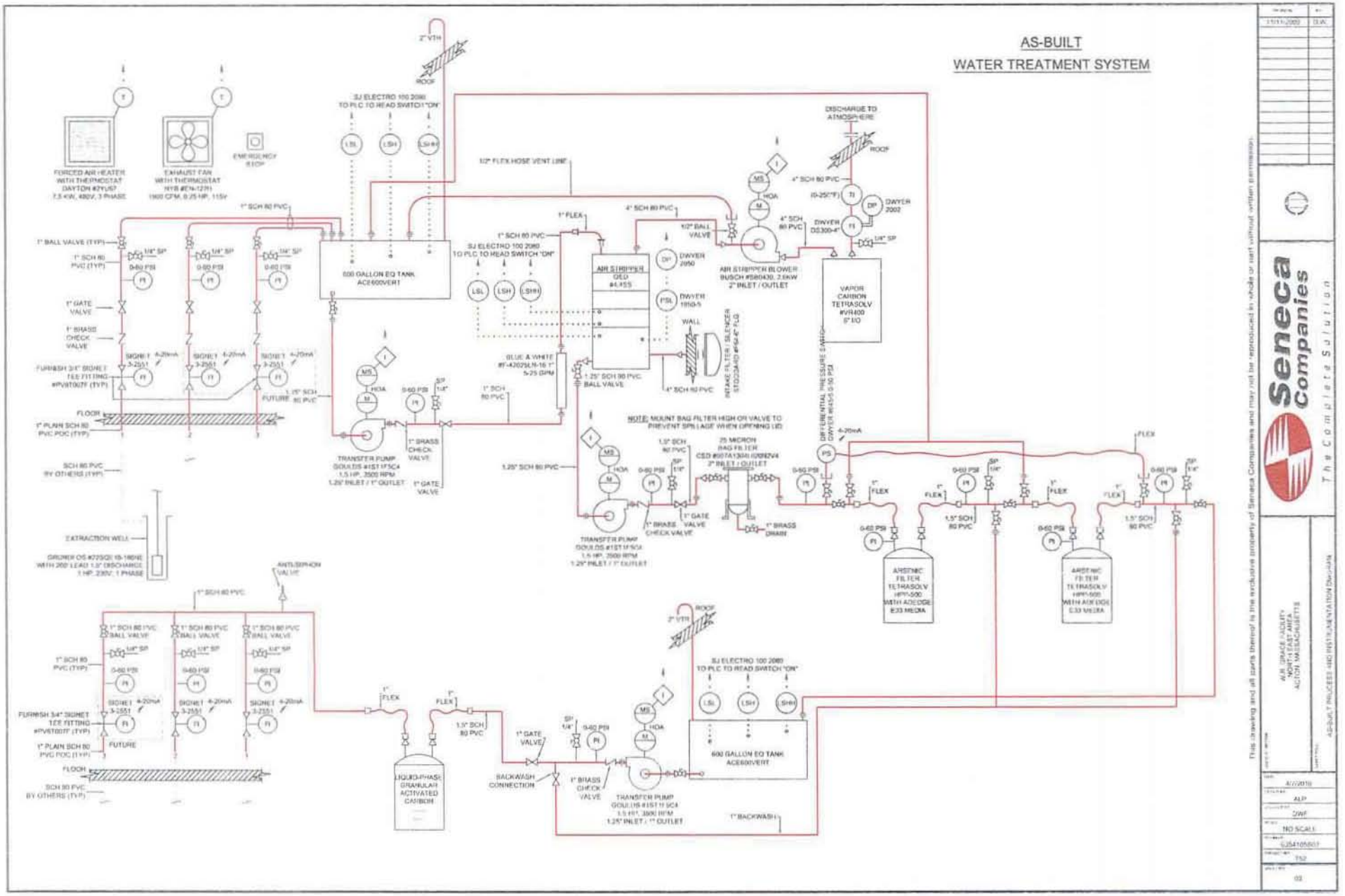
- NORMALLY OPEN FLOAT SWITCH
- NORMALLY CLOSED FLOAT SWITCH
- NORMALLY OPEN CONTACT
- NORMALLY CLOSED CONTACT
- OPEN / CLOSED — TWO POSITION SWITCH
- MS — MOTOR STARTER / COIL
- OL — OVERLOAD RELAY/NORMALLY CLOSED
- MOTOR STARTER W/THERMAL OVERLOAD
- THREE PHASE MOTOR
- SINGLE PHASE MOTOR
- CONTROL TRANSFORMER (H1, H2, X1, X2)
- CIRCUIT BREAKER
- INLINE FUSE
- FUSE (BOX)
- ISCM — INTRINSICALLY SAFE CONTROL MODULE
- GROUND
- C — INDICATING LAMP (C = COLOR OF LENS)
- HM — HOUR METER
- ENCLOSURE
- NOT CONNECTED
- CONNECTED
- DEVICE TERMINAL
- CONTROL TERMINAL
- EXTERNAL TERMINAL
- HAZARDOUS AREA/CLASS 1

Seneca Companies
The Complete Solution

W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETTS

SYMBOL AND LEGEND DIAGRAM

DATE: 7/7/2009
DRAWN BY: DARRICK WORRALL
CHECKED BY: DAN NOLAN
SCALE: NO SCALE
FILENAME: 6354105502
PROJECT NO: 5354106
SHEET NO: 02


AS-BUILT
WATER TREATMENT SYSTEM
FORCED AIR HEATER WITH THERMOSTAT DAYTON 4ZYU57 7.5 KW, 480V, 3 PHASE
EXHAUST FAN WITH THERMOSTAT NYB #EN-12TH 1900 CFM, 0.25 HP, 115V
EMERGENCY STOP
2" VTH
ROOF
SJ ELECTRO 100 2080 TO PLC TO READ SWITCH "ON"
LSL
LSH
LSHH
1/2" FLEX HOSE VENT LINE
DISCHARGE TO ATMOSPHERE
4" SCH 80 PVC
0-25(°F)
DWYER 7002
DWYER DS300-4"
1/4" SP
1" SCH 80 PVC
1" BALL VALVE (TYP)
1/4" SP
1" SCH 80 PVC (TYP)
0-60 PSI
PI
600 GALLON EQ TANK ACE600VERT
1" GATE VALVE
1" BRASS CHECK VALVE
FURNISH 3/4" SIGNET TEE FITTING #PVBT007F (TYP)
SIGNET 3-2551
4-20mA
FLOOR
1" PLAIN SCH 80 PVC POC (TYP)
SCH 80 PVC BY OTHERS (TYP)
SJ ELECTRO 100 2080 TO PLC TO HEAD SWITCH "ON"
1" FLEX
4" SCH 80 PVC
1/2" BALL VALVE
AIR STRIPPER GED #4455
DWYER 2950
DWYER 1910-5
PSL
AIR STRIPPER BLOWER BUSCH #580430, 2.6KW 2" INLET / OUTLET
WALL
BRAKE FILTER / SILENCER ST0203A-FD #64-4" PLG
VAPOR CARBON TETRASOLV #VR400 6" I.O
BLUE & WHITE #F-42025LN-16 1" 5-25 GPM
1.25" SCH 80 PVC BALL VALVE
4" SCH 80 PVC
1" SCH 80 PVC
1.25" SCH 80 PVC
M
MS
HOA
SP 1/4"
TRANSFER PUMP GOULDS #1ST1F5C4 1.5 HP, 3500 RPM 1.25" INLET / 1" OUTLET
1" BRASS CHECK VALVE
1" GATE VALVE
NOTE: MOUNT BAG FILTER HIGH OR VALVE TO PREVENT SPILLAGE WHEN OPENING LID
1.5" SCH 80 PVC
25 MICRON BAG FILTER CSD #007A13041/025BZV4 2" INLET / OUTLET
1" BRASS DRAIN
DIFFERENTIAL PRESSURE SWITCH DWYER #A3A-D-5-5 PSI
4-20mA
FLEX
1" FLEX
1.5" SCH 80 PVC
ARSENIC FILTER TETRASOLV HPF-500 WITH ADEDGE E33 MEDIA
EXTRACTION WELL
GRUNDFOS 45 #723GS 15-18EHE WITH 200' LEAD 1.5" DISCHARGE 1 HP, 230V, 1 PHASE
ANTI-SIPHON VALVE
1" SCH 80 PVC BALL VALVE
FUTURE
FLOOR
SCH 80 PVC BY OTHERS (TYP)
LIQUID-PHASE GRANULAR ACTIVATED CARBON
BACKWASH CONNECTION
1" BACKWASH
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The Complete Solution
AIR SPACE FACILITY
ACTON, MASSACHUSETTS
AS-BUILT PROCESS AND INSTRUMENTATION DIAGRAM
4/7/2010
ALP
DWF
NO SCALE
0.25410.0601
752
02

PLAN NOTES:

PLAN NOTE	DESCRIPTION	MANUFACT.	MODEL NO	VOLTAGE	PHASE	POWER	NOTES
1	54"x12" FLOOR OPENING	SENECA					
2	MPE INFLUENT LINES	SENECA					
3	REINJECTION MANIFOLD	SENECA					
4	EQUALIZATION TANK	NORVERT	ACE600VERT				600 GALLON
5	TRANSFER PUMP	GOULDS	1ST1FSC4	460V	3	1.5 HP	TEFC
6	VAPOR PHASE CARBON	TETRASOLV	VR-400				
7	INTAKE FILTER/SILENCER	STODDARD	F84-6"				REPLACEMENT ELEMENT F8-110, RATED FOR 1235 CFM
8	AIR STRIPPER BLOWER	BUSCH	#SB0430	460V	3	3.5 HP	300 CFM @ 28" WC
9	AIR STRIPPER	CED	EZ 4.4				
10	BAG FILTER	CSD	007A1304L020N2V4				25 MICRON REPLACEMENT FILTER ELEMENT #PEG25P2SH
11	ARSENIC TREATMENT SYSTEM	TETRASOLV	HPP-500				125 PSI RATED WITH GRAVEL SUPPORT BED AND ADEDGE E33 MEDIA
12	FORCED AIR HEATER W/ THERMOSTAT	DAYTON	2YU67	460V	3	7.5 KW	
13	EXHAUST FAN	NYB	EN-122H	115V	1	0.25 HP	1900 CFM
14	PASSIVE VENT						
15	FLUORESCENT LIGHTING	SENECA					
16	LIGHT SWITCH	PASS & SEYMOUR		115V	1		
17	THERMOSTAT	COLUMBUS ELECTRIC	EP-ETD-80				
18	EMERGENCY STOP SWITCH	APPLETON					
19	CONTROL PANEL	SENECA	CUSTOM	460V	3	200 AMP	
20	MAIN DISCONNECT	SENECA	CUSTOM	460V	3		

SHIPPING ITEMS:

ITEM	DESCRIPTION	MANUFACTURER	MODEL NO.	QUANTITY	UNIT	NOTES
1	AIR STRIPPER INTAKE FILTER/SILENCER	STODDARD	F84-6" FLG	1	EA	SHIP LOOSE
2	AIR STRIPPER EXHAUST STACK	SENECA	4-INCH	1	EA	SHIP LOOSE
3	3-INCH WELL PUMP, 1.5" DISCHARGE, 1HP, 230V, 1PH W/ 200' TEFLON MOTOR LEAD	GRUNDFOS	22SQE10-180NE	1	EA	SHIP LOOSE
4	INFRARED REMOTE CONTROL	GRUNDFOS	R100	1	EA	SHIP LOOSE

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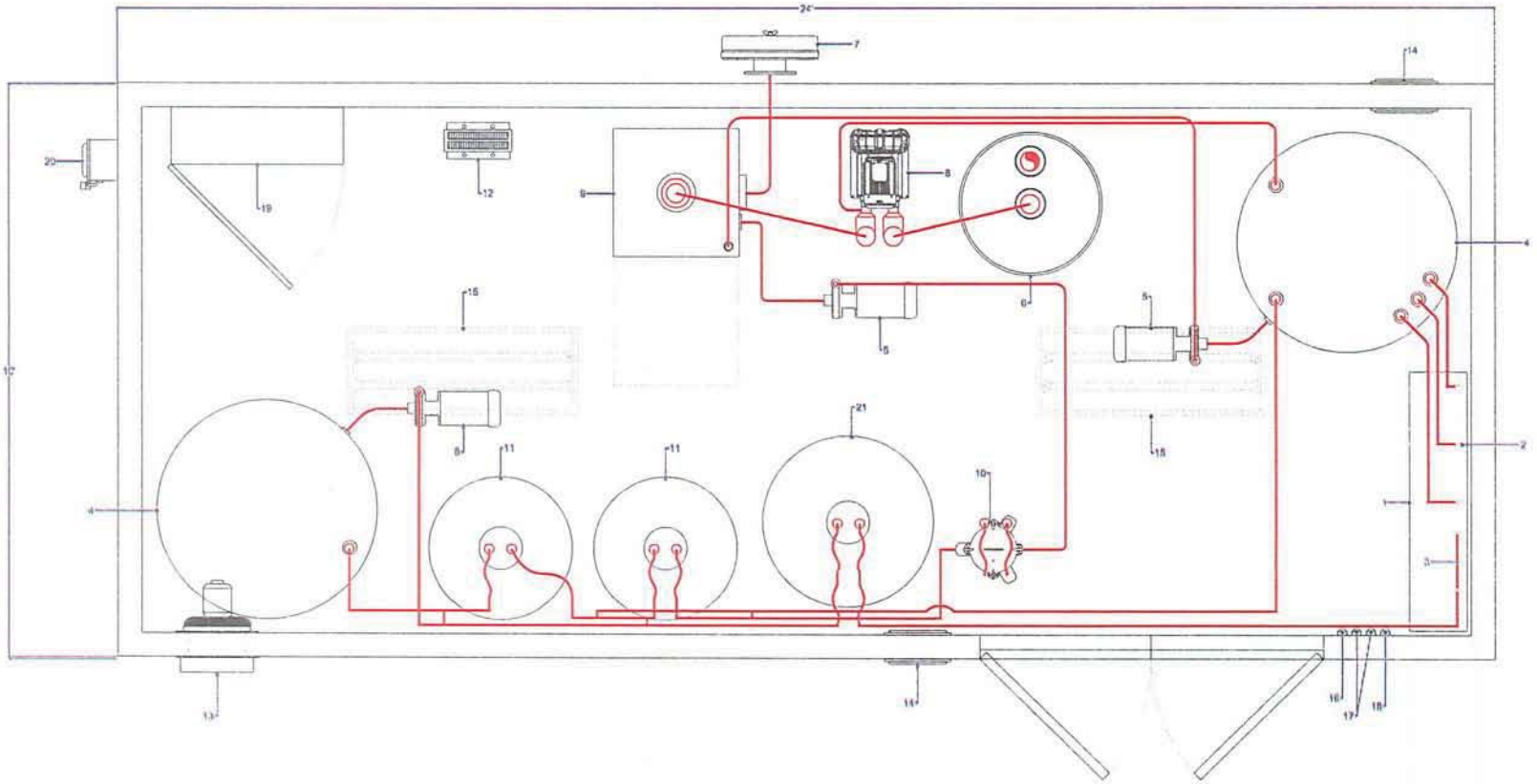
W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETTS

PLAN NOTES

DATE: 7/7/2009
DRAWN BY: DARRICK WORRALL
CHECKED BY: DAN NOLAN
SCALE: NO SCALE
FILENAME: 6354105504
PROJECT NO: 6354105
SHEET NO: 04



NOTES:
1. PIPE SUPPORTS TO BE INSTALLED AS REQUIRED.
2. REFER TO PROCESS AND INSTRUMENTATION DIAGRAM FOR PIPING DETAIL (VALVES, SAMPLE PORTS, ETC.) AND SEQUENCE OF OPERATION.
3. BUILDING INTERIOR IS CONSTRUCTED AS AN NEC CLASS 1, DIVISION 2, GROUP D HAZARDOUS LOCATION.
4. SYSTEM TO BE 3RD PARTY CERTIFIED.

11/11/2020	D.W.

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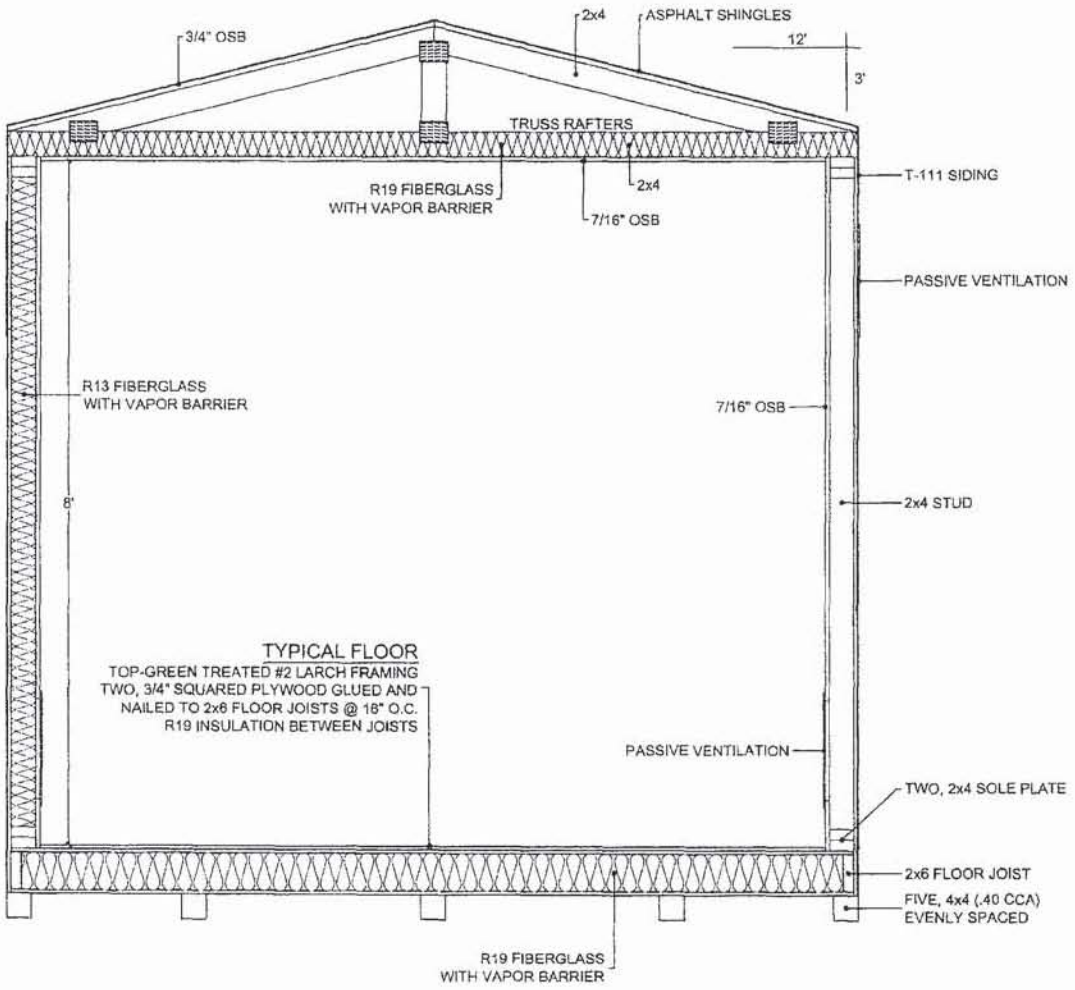
DESCRIPTION	AS-BUILT EQUIPMENT LAYOUT
	XIR GRACE FACILITY 400 CHAPMAN STREET ACTON, MASSACHUSETTS
DATE	4/7/2010
DRAWN BY	ALR
CHECKED BY	DWF
SCALE	1/2"=1'
PROJECT #	0354105505
DRAWING #	8354105
REVISION	05

WALL SECTION



NOTES:

1.) RAFTERS ARE DOUGLAS FIR PRE-MANUFACTURED STRUT RAFTERS 16" ON CENTER.
2.) RAFTERS TO BE TIED TO HEADER WITH SCREWS USING SIMPSON H1 HURRICANE BRACKETS.
3.) BOTTOM PLATE TO BE SEALED WITH SILICON TO TREATED 2x4 LUMBER WITH TOP BOARD BEING #2 PINE.
4.) BOTTOM SILL TO BE LAG BOLTED TO WOOD FRAME WITH 5/8" LAGS.
5.) SIDING AND ROOFING OSB TO BE NAILED ON ALL STUDS.
6.) ALL WALL STUDS ARE #2 PINE 16" ON CENTER.

☐ ACCEPTED AS IS ☐ REVISE AND SUBMIT

☐ ACCEPTED AS CORRECTED ☐ ACCEPTED AS CORRECTED

Corrections or comments addressed under headings REVISE AND SUBMIT, or NOT ACCEPTED does not constitute that these plans are final. All corrections, or changes will be made and a follow up set of plans will be submitted for acceptance.

Date: 5-19-09 By: Client

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W.R. GRACE FACILITY
NORTH ENTRANCE
ACTON, MASSACHUSETTS

WALL SECTION

DATE: 7/7/2009
DRAWN BY: DARRICK WORRALL
CHECKED BY: DAN NOLAN
SCALE: NO SCALE
FILENAME: 8354106B08
PROJECT NO: 8354106
SHEET NO: 08

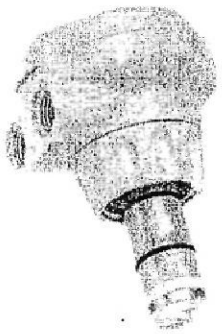
APPENDIX B

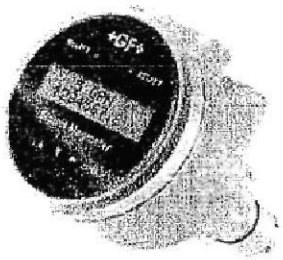
PROCESS INSTRUMENTATION SPECIFICATIONS AND VENDOR INFORMATION

Signet 2551 Magmeter Flow Sensor

+GF+

Availabe in a variety of wetted materials and ideal for pipe sizes up to DN300 (12 in.)





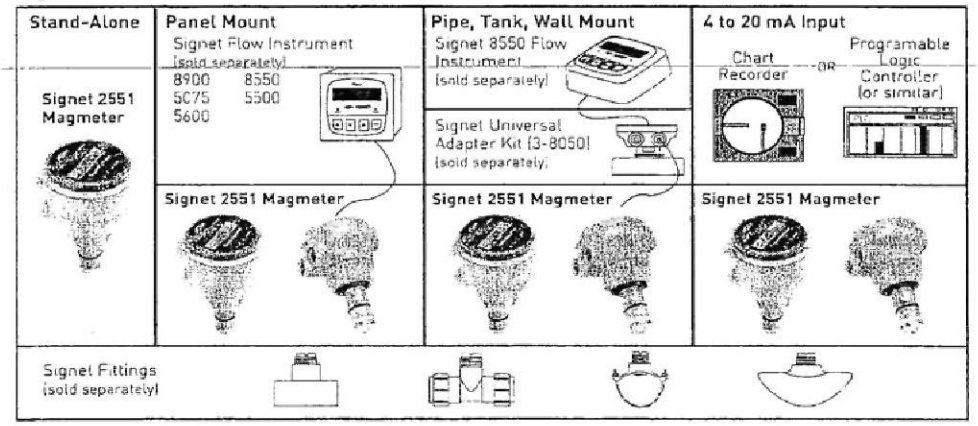
Description

The Signet 2551 Magmeter is an insertion style magnetic flow sensor that features no moving parts. The patented* sensor design is available in corrosion-resistant materials to provide long-term reliability with minimal maintenance costs. Material options include PP with stainless steel, PVDF with stainless steel, PVDF with Hastelloy-C, or PVDF with Titanium. Utilizing the comprehensive line of Signet installation fittings, sensor alignment and insertion depth is automatic. These versatile, simple-to-install sensors deliver accurate flow measurement over a wide dynamic range in pipe sizes ranging from DN15 to DN300 (0.5 to 12 inches), satisfying the requirements of many diverse applications.

Signet 2551 Magmeters offer many output options of frequency/digital (S^3L), 4 to 20 mA or relays which are available on both the blind and display versions. The frequency or digital (S^3L) sensor output can be used with Signet's extensive line of flow instruments while the 4 to 20mA output can be used for a direct input to PLCs, chart recorders, etc. Both the 4 to 20 mA output and digital (S^3L) sensor interface is available for long distance signal transmission of up to 1,000 ft. An additional benefit is the empty pipe detection which features a zero flow output when the sensors are not completely wetted. Also, the frequency output is bi-directional while the 4 to 20mA output can be set for uni- or bi-directional flow using the display or the RS232 set-up tool which connects to PCs for programming capabilities.

In addition the display version of the 2551 Magmeter is available with relays and features permanent and resettable total values which can be seen on the display. Also, the display contains multi-languages with English, Spanish, German, French, Italian and Portuguese menu options.

System Overview



Features

- Patented Magmeter technology
- No moving parts
- Bi-directional flow
- Empty pipe detection
- Installs into pipe sizes DN 15 to DN 300 (0.5 to 12 in.)
- Flow rate range 0.05 to 10 m/s (0.15 to 33 ft/s)
- Accurate measurement even in dirty liquids
- Blind 4 to 20 mA, digital/frequency, relay output
- No pressure drop
- Corrosion resistant materials; PP or PVDF with SS, Hastelloy C, or Titanium
- Multi-language display menu available

Applications

- Chemical Processing
- Demineralization Regeneration
- Water and Waste Water Monitoring
- Metal Recovery and Landfill Leachate
- Commercial Pools, Spas, and Aquariums
- HVAC
- Irrigation
- Scrubber Control
- Neutralization Systems
- Industrial Water Distribution

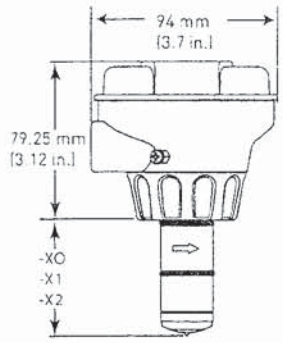
CE c UL us LISTED MEASURING EQUIPMENT 77CJ

* U.S. Patent No: 7,055,396 B1

+GF+

Dimensions

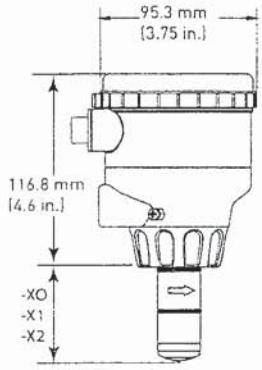
Blind Version



Pipe Range
1/2 to 4 in. -XO = 58 mm (2.3 in.)
5 to 8 in. -X1 = 91 mm (3.6 in.)
10 to 12 in. -X2 = 167 mm (6.6 in.)

X = Sensor Body P, T, V, or W

Display Version



Pipe Range
1/2 to 4 in. -XO = 58 mm (2.3 in.)
5 to 8 in. -X1 = 91 mm (3.6 in.)
10 to 12 in. -X2 = 167 mm (6.6 in.)

X = Sensor Body P, T, V, or W

Specifications

General

Pipe size range:DN15 to DN 300 (0.5 in. to 12 in.)
Flow Range
- Minimum: 0.05 m/s (0.15 ft/s)
- Maximum: 10 m/s (33 ft/s)

Linearity: ±1% reading plus 0.01m/s (0.033 ft/s)
Repeatability: ±0.5% of reading @ 25°C (77°F)
Minimum Conductivity: 20 µS/cm

Wetted Materials:

Sensor body/Electrodes and Grounding ring:
- -P0, -P1, -P2: Polypropylene/316LSS
- -T0, -T1, -T2: PVDF/Titanium
- -V0, -V1, -V2: PVDF/Hastelloy-C
- -W0, -W1, -W2: PVDF/316LSS

O-rings:
- FPM (standard)
- EPDM, Kalrez (optional)

Case: PBT
Display Window: Polyamide
Protection rating: NEMA 4X/IP65

Electrical

Power Requirements
- 4 to 20 mA: 21.6 to 26.4 VDC, 22.1 mA max.
- Frequency: 5 to 26.4 VDC, 15 mA max.
- Digital (S³L): 5 to 6.5 VDC, 15 mA max.
- Auxiliary (only required for units with relays): 9 to 24 VDC, 0.4A max

Reverse polarity and short circuit protected

Current output (4 to 20 mA):
- Loop Accuracy: 32 µA max. error (25°C @ 24 VDC)
- Isolation: Low voltage < 48 VAC/DC from electrodes and auxilary power
- Maximum cable: 300 m (1000 ft.)
- Error condition: 22.1 mA
- Max. Loop Resistance: 300Ω
- Compatible with PLC, PC or similar equipment

Frequency output:
- Output modes: Freq., Freq÷10, or Mirror Relay
- Max. Pull-up Voltage: 30 VDC
- Max. Current Sink: 50 mA, current limited
- Maximum cable: 300 m (1000 ft.)
- Compatible with Signet Model 5075, 5500, 5600, 8550, 8900

Digital (S³L) Output:
- Serial ASCII, TTL level 9600 bps
- Compatible with Model Signet 8900 instrument

Relay Specifications
- #1, #2 Type: Mechanical SPDT
  Rating: 5A @ 30 VDC max.,
  5A @ 250 VDC max.
- #3 Type: Solid State
  Rating: 50mA @ 30 VDC,
  50mA @ 42 VAC

Hysteresis: User adjustable, plus timer delay
Trigger Delay: Adjustable (0 to 9999.9 sec.)

Relay Modes: Off, Low, High, Window, and Proportional Pulse
Relay Source: Flow Rate, Resettable Totalizer
Error Condition: Selectable; Fail Open or Closed

Display

Characters: 2 x 16
Contrast: User-set in four levels
Backlighting (only on relay versions):
Requires external 9-24 VDC,
0.4 mA max.

Environmental Requirements

Storage Temperature:
-20° to 70°C (-4° to 158°F)
Relative Humidity :
0 to 95% (non-condensing)
Operating Temperature
- Ambient: -10° to 70°C (14° to 158°F)
- Media: 0° to 85°C (32° to 185°F)

Max. operating pressure:
10.3 bar @ 25°C (150 psi @ 77°F)
1.4 bar @ 85°C (20 psi @ 185°F)

See Temperature and Pressure Graphs for more information

Standards and Approvals
- CE
- UL, CUL (for display versions with relays)
- NEMA 4X / IP65 Enclosure (with cap installed)
- EMC: EN55011: 1998 +A1:99+A2:02 Class B Emissions
  EN61326: 1997 +A1:98+A2:01
  EN61000-6-2:2001
- Safety: EN61010-1:2001
- U.S. Patent No. 7,055,396 B1

Ordering Information

+GF+

Sensor Part No.					
3-2551					
	Sensor Body (Transducer) and electrodes/grounding ring materials - Choose one				
	-P	Polyoropylene and 316L SS			
	-T	PVDF and Titanium			
	-V	PVDF and Hastelloy C			
	-W	PVDF and 316L SS			
		Pipe size - Choose one			
		0	DN15 to DN100 (1/2 to 4 in.)		
		1	DN125 to DN200 (5 to 8 in.)		
		2	DN250 to DN300 (10 to 12 in.)		
			Display Options - Choose One		
			-1	No Display	
			-2	With Display, two SPDT relays, one solid state relay	
			-4	With Display	
				Output options - Choose One	
				1	Frequency, Digital (S³L) out, (Freqency÷10, Mirror Relay* (open collector)]
				2	4 to 20 mA output
3-2551	**-P**	**0**	**-2**	**2**	**Example Part Number**

*This option is a programmable open collector output that is available with display versions only.

Application Tips:

- Note minimum process liquid conductivity requirement is 20 µs/cm
- Install sensor using standard Signet installation fittings for best results
- Sensor is capable of retrofitting into existing 515 and 2536 fittings.

Mfr. Part No.	Code
3-2551-P0-11	159 001 105
3-2551-P0-12	159 001 110
3-2551-P0-21	159 001 267
3-2551-P0-22	159 001 273
3-2551-P0-41	159 001 261
3-2551-P0-42	159 001 279
3-2551-P1-11	159 001 106
3-2551-P1-12	159 001 111
3-2551-P1-21	159 001 268
3-2551-P1-22	159 001 274
3-2551-P1-41	159 001 262
3-2551-P1-42	159 001 280
3-2551-P2-11	159 001 107
3-2551-P2-12	159 001 112
3-2551-P2-21	159 001 435
3-2551-P2-22	159 001 438
3-2551-P2-41	159 001 432
3-2551-P2-42	159 001 441
3-2551-T0-11	159 001 108
3-2551-T0-12	159 001 113
3-2551-T0-21	159 001 436
3-2551-T0-22	159 001 439
3-2551-T0-41	159 001 433
3-2551-T0-42	159 001 442
3-2551-T1-11	159 001 109
3-2551-T1-12	159 001 114
3-2551-T1-21	159 001 437
3-2551-T1-22	159 001 440
3-2551-T1-41	159 001 434
3-2551-T1-42	159 001 443
3-2551-T2-11	159 001 448
3-2551-T2-12	159 001 449
3-2551-T2-21	159 001 454
3-2551-T2-22	159 001 455
3-2551-T2-41	159 001 460
3-2551-T2-42	159 001 461

Mfr. Part No.	Code
3-2551-V0-11	159 001 257
3-2551-V0-12	159 001 259
3-2551-V0-21	159 001 269
3-2551-V0-22	159 001 275
3-2551-V0-41	159 001 263
3-2551-V0-42	159 001 281
3-2551-V1-11	159 001 258
3-2551-V1-12	159 001 260
3-2551-V1-21	159 001 270
3-2551-V1-22	159 001 276
3-2551-V1-41	159 001 264
3-2551-V1-42	159 001 282
3-2551-V2-11	159 001 450
3-2551-V2-12	159 001 451
3-2551-V2-21	159 001 456
3-2551-V2-22	159 001 457
3-2551-V2-41	159 001 462
3-2551-V2-42	159 001 463
3-2551-W0-11	150 001 230
3-2551-W0-12	159 001 231
3-2551-W0-21	159 001 271
3-2551-W0-22	159 001 277
3-2551-W0-41	159 001 265
3-2551-W0-42	159 001 283
3-2551-W1-11	159 001 232
3-2551-W1-12	159 001 233
3-2551-W1-21	159 001 272
3-2551-W1-22	159 001 278
3-2551-W1-41	159 001 266
3-2551-W1-42	159 001 284
3-2551-W2-11	159 001 452
3-2551-W2-12	159 001 453
3-2551-W2-21	159 001 458
3-2551-W2-22	159 001 459
3-2551-W2-41	159 001 464
3-2551-W2-42	159 001 465

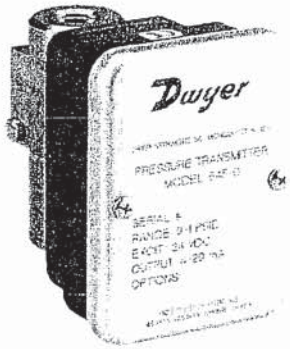
Accessories and Replacement Parts

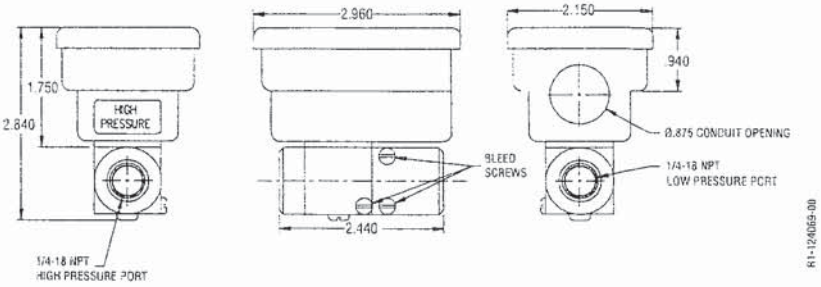
Mfr. Part No.	Code	Description
O-Rings		
1220-0021	198 801 186	O-ring, FPM (Viton®)
1224-0021	198 820 006	O-ring, EPDM
1228-0021	198 820 007	O-ring, FFPM (Kalrez®)
Replacement Transducers		
3-2551-P0	159 001 211	PP/316LSS, DN15 to DN100 (0.5 to 4 in.) pipe
3-2551-P1	159 001 212	PP/316LSS, DN125 to DN200 (5 to 8 in.) pipe
3-2551-P2	159 001 444	PP/316LSS, DN250 to DN300 (10 to 12 in.) pipe
3-2551-T0	159 001 213	PVDF/Titanium, DN15 to DN100 (0.5 to 4 in.) pipe
3-2551-T1	159 001 214	PVDF/Titanium, DN125 to DN200 (5 to 8 in.) pipe
3-2551-T2	159 000 445	PVDF/Titanium, DN250 to DN300 (10 to 12 in.) pipe
3-2551-V0	159 001 376	PVDF/Hastelloy-C, DN15 to DN100 (0.5 to 4 in.) pipe
3-2551-V1	159 001 377	PVDF/Hastelloy-C, DN125 to DN200 (5 to 8 in.) pipe
3-2551-V2	159 000 446	PVDF/Hastelloy-C, DN250 to DN300 (10 to 12 in.) pipe
3-2551-W0	159 001 234	PVDF/316LSS, DN15 to DN100 (0.5 to 4 in.) pipe
3-2551-W1	159 001 235	PVDF/316LSS, DN125 to DN200 (5 to 8 in.) pipe
3-2551-W2	159 001 447	PVDF/316LSS, DN250 to DN300 (10 to 12 in.) pipe
Replacement Electronics Module		
3-2551-11	159 001 215	Magmeter electronics, frequency or digital (S^3L) output
3-2551-12	159 001 215	Magmeter electronics, 4 to 20mA output
3-2551-21	159 001 372	Magmeter Display Electronics, frequency or digital (S^3L) output
3-2551-22	159 001 373	Magmeter Display Electronics, 4 to 20mA output
3-2551-41	159 001 374	Magmeter Display Electroncis, frequency or digital (S^3L) output, w/relays
3-2551-42	159 001 375	Magmeter Display Electroncis, frequency or digital (S^3L) output, w/relays
Other		
7300-7524	159 000 687	24VDC Power Supply 7.5W, 300mA
7300-1524	159 000 688	24VDC Power Supply 15W, 600mA
7300-3024	159 000 689	24VDC Power Supply 30W, 1.3A
7300-5024	159 000 690	24VDC Power Supply 50W, 2.1A
7300-1024	159 000 691	24VDC Power Supply 100W, 4.2A
3-8551.521	159 001 378	Clear plastic cap for display
1222-0042	159 001 379	O-ring for clear plastic cap, EPDM
3-0232	159 000 865	4 to 20mA spanning CD with RS232 Converter

Please refer to Wiring, Installation, Accessories and Fittings sections for more information.

Series 645 Wet/Wet Differential Pressure Transmitter

Specifications - Installation and Operating Instructions





GENERAL

The Series 645 Wet/Wet Differential Pressure Transmitter is designed for use with any gas or liquid compatible with 17-4 PH stainless steel, 300 Series stainless steel, Viton and Silicone O-rings and bleed screw seals. Units can accurately measure the differential pressure even when liquid is applied to both ports. The transmitter contains a fast response capacitance sensor and a unique isolation system.

The isolation system transmits the motion of the differential pressure sensing diaphragm from the high line pressure environment to the dry enclosure where it moves one of a pair of capacitance plates proportionally to the diaphragm movement. The variable capacitance is converted to a current proportional to the differential pressure by the capacitance sensing and signal conditioning circuit located in the enclosure. The electronic circuit linearizes output versus pressure, standardizes the output, and compensates thermal effects of the sensor.

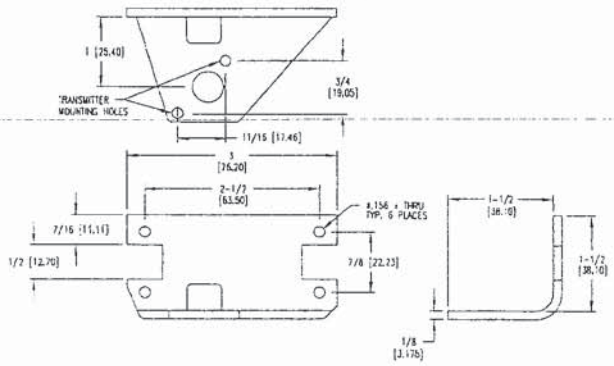
INSTALLATION

The Series 645 Differential Pressure Transmitter is supplied with a mounting bracket and two 6-32 × 3/8 hex head screws. First attach the bracket to mounting location using holes or band clamp notches available on large section of the bracket. Attach the transmitter to the bracket by using the two 6-32 × 3/8 hex head screws and the two tapped holes located on the underside of the transmitter. See Figure 1 at right.

SPECIFICATIONS

Service: Compatible gases or liquids applied to both pressure and reference ports.
Output: 4 to 20 mA, two-wire.
Supply Voltage: 11 to 30 VDC.
Loop Resistance: 0 to 1000Ω.
Maximum Line Pressure: 250 psig.
Maximum Overload Pressure: (High side) 1 to 5 psi: 20 × FS, 10 to 25 psi: 10 × FS, 50 psi: 5 × FS, 100 psi: 2.5 × FS; (Low side) 2-3 × FS.
Zero and Span: Adjustable, non-interactive, ±1 mA.
Accuracy: ±0.25% FS.
Temperature Limits: Operating: 0 to 175°F (-22 to 80°C), Storage: -65 to 260°F (-54 to 126°C).
Response Time: 30 to 50 msec.
Thermal Effects: (includes zero and span) ±0.02% FS/°F, 30 to 150°F (-1 to 65°C).
Wetted Parts: 17-4 PH stainless steel, 300 Series stainless steel, Viton and Silicone O-rings and bleed screw seals.
Housing: Stainless steel/Aluminum.
Process Connection: 1/4 - 18 NPT(F).
Electrical Connection: Barrier strip terminal block with conduit enclosure and .875 (22 mm) diameter conduit opening.
Weight: 14.4 oz (0.4 kg).

Mounting



DWYER INSTRUMENTS, INC.
P. O. BOX 373 MICHIGAN CITY, INDIANA 46361, U.S.A.

Telephone 219/879-8000
Fax 219/872-9057

NOTE:
For differential pressure measurements at high line pressure (250 psig max.), it is recommended that the pressure sensor be installed with a valve in each line, plus a shunt valve across the high and low (reference) pressure ports as indicated in Figure 2 below. The high pressure port is labeled with the word "HIGH".

System Set-up

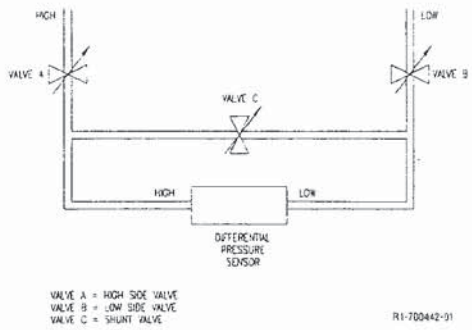


Figure 2

Valve C should be open and Valves A and B closed whenever the system is first being wetted or pressurized. Valves A and B should then be opened slowly to avoid hammering. Valve C can then be closed and the system is operating. When removing the differential pressure sensor, open Valve C first, then close Valves A and B.

Bleeding the Pressure Ports

Three bleed screws are located on the side of the unit (two for low pressure port, one for high pressure port).

Install the transmitter in its intended location and pressurize the ports. Back off the first bleed screw mounted on the flat side of the sensor body (2 turns max.) until liquid begins to flow out. After only bubble-free liquid flows out, retighten the bleed screw. Repeat the same procedure for the second set of bleed screws located on the round section of the low pressure fitting.

Electrical Connections

The Series 645 Wet/Wet Differential Pressure Transmitters are true 2-wire, 4-20 mA current output devices and deliver rated current into any external load of 0 to 800 ohms.

The units are supplied with a 7/8" diameter knockout intended for a 1/2" ID conduit connection. It is suggested that any electrical cable shield be connected to the system's loop circuit ground to improve electrical noise reduction.

When making electrical connections, be sure to observe polarity—units are designed to have current flow in one direction only. The minimum supply voltage is 11 +.02 × (Resistance of receiver plus line. The maximum supply voltage is 30 + .004 × (Resistance of receiver plus line). To access electrical connections, remove cover on top of the unit. See Figure 3 for correct electrical connections.

Wiring

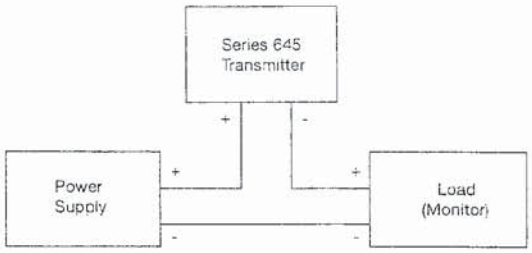


Figure 3

OPERATION

The Series 645 Wet/Wet Differential Pressure Transmitters are carefully calibrated to the specific input pressure range versus current output at the factory. Little or no field calibrating is necessary.

Zero and Span Adjustment

To gain access to the zero and span adjustments, remove the top cover of the transmitter. Loosen the 6-32 seal screws in the plastic terminal block. The zero and span adjustments are located under the plastic terminal block. Be careful not to disconnect any internal wiring. After all adjustments are made, remember to re-install the 6-32 seal screws. The Series 645 transmitters with 4-20 mA output are factory calibrated using a 250 ohm load at 24 VDC. Zero and span adjustments are approximately ±1 mA, individually.

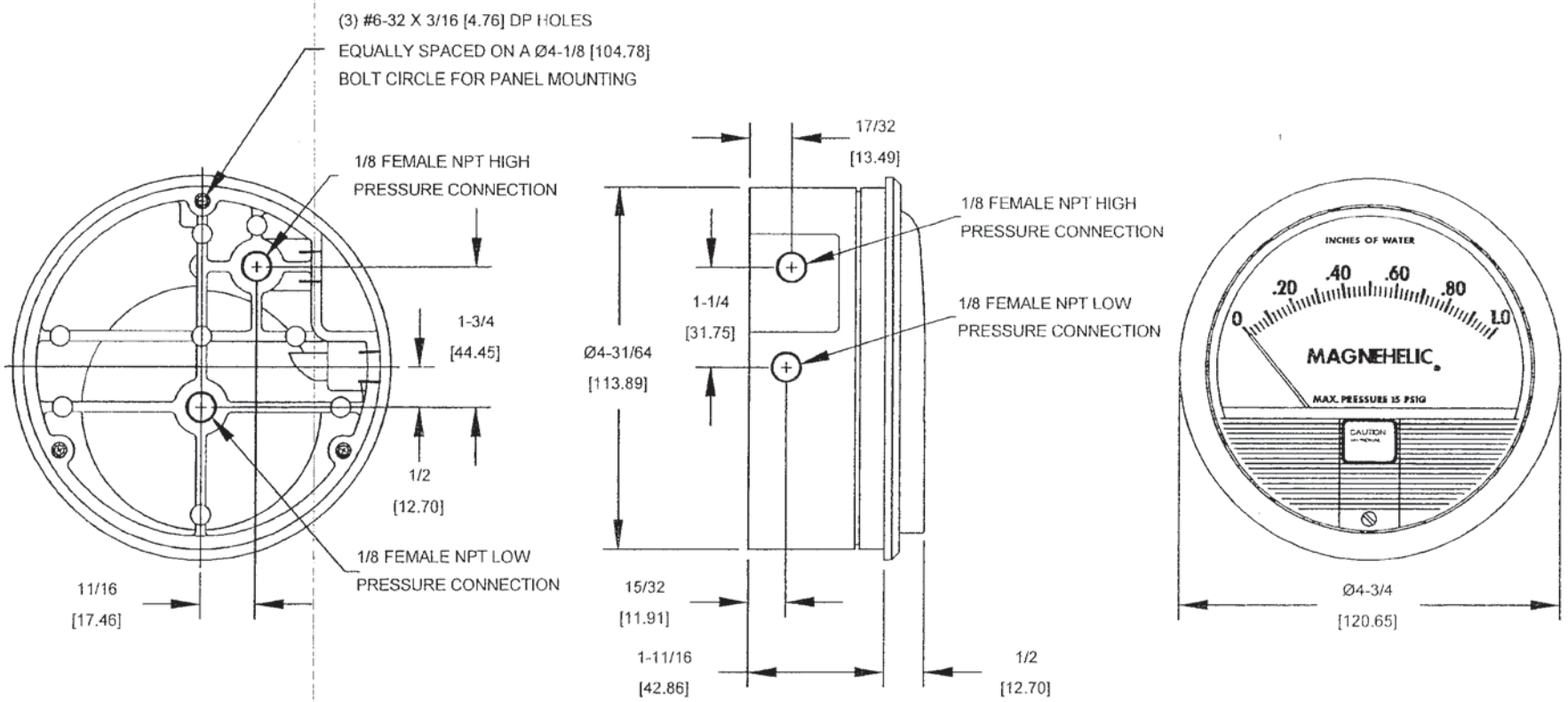
MAINTENANCE

After final installation of the Series 645 Wet/Wet Differential Pressure Transmitter, no routine maintenance is required. Periodic checks of connections is recommended. Please contact Dwyer Instruments, Inc. before returning unit for repair to review information relative to your application. When returning a product to the factory, carefully package and ship freight prepaid. Be sure to include a complete description of the application and problem and identify any hazardous material used with the product.

Printed in U.S.A. 7/97

FR R1-440983-00

DWYER INSTRUMENTS, INC.
P.O. Box 373, Michigan City, Indiana 46360, U.S.A.
Phone: 219/879-8000 Fax: 219/872-9057



STANDARD TOLERANCES UNLESS NOTED
ALL DECIMAL DIMENSIONS ± .005
ALL ANGLES ± 1°

SCALE 1:2

NO.	CHANGES	BY/DATE
1	UPDATED DIMENSIONS PER 12622	CB 5-31-01

DATE 9-25-00
DWN BY CB
CHKD CAT
APPD BLP

NAME: BULLETIN ARTWORK MAGNEHELIC

ACADR14

MATERIAL

FINISH

DWYER INSTRUMENTS, INC.
MICHIGAN CITY, INDIANA 46360 U.S.A.

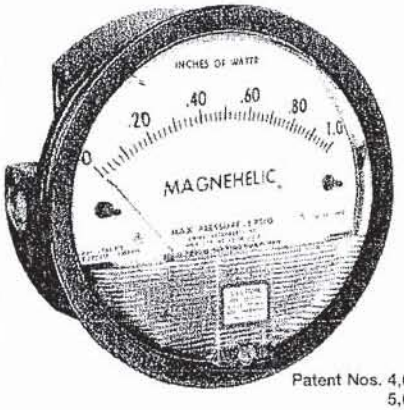
FR. NO. 12-700024-00

1

12-700024-00

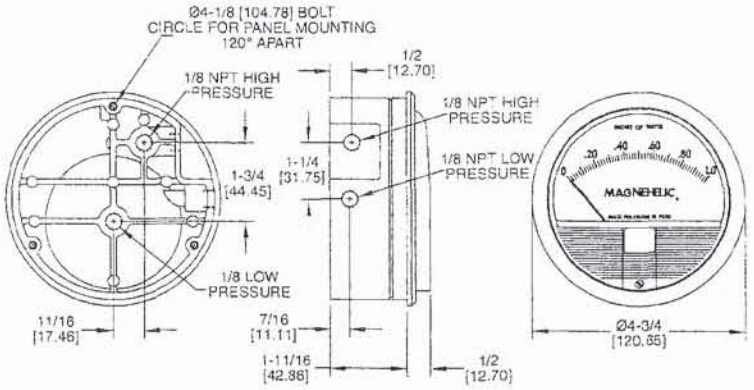
Series 2000 Magnehelic® Differential Pressure Gages

Indicate Positive, Negative or Differential, Accurate within 2%



Patent Nos. 4,030,365
5,012,678

Standard Magnehelic® Pressure Gage has a large, easy-to-read 4" dial.



Dimensions, Standard Series 2000 Magnehelic® Pressure Gages. (Slightly different on medium and high pressure models)

Select the Dwyer Magnehelic® gage for high accuracy – guaranteed within 2% of full scale – and for the wide choice of 81 models available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

The Magnehelic® is the industry standard to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

Note: May be used with Hydrogen where pressures are less than 35 psi.

Flush ...Surface...or Pipe Mounted

MOUNTING. A single case size is used for most models of Magnehelic® gages. They can be flush or surface mounted with standard hardware supplied. With the optional A-610 Pipe Mounting Kit they may be conveniently installed on horizontal or vertical 1¼" - 2" pipe. Although calibrated for vertical position, many ranges above 1" may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic® gages ideal for both stationary and portable applications. A 4⅛" hole is required for flush panel mounting. Complete mounting and connection fittings plus instructions are furnished with each instrument.

VENT VALVES

In applications where pressure is continuous and the Magnehelic® gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.

HIGH AND MEDIUM PRESSURE MODELS

Installation is similar to standard gages except that a 4"⅜" hole is needed for flush mounting. The medium pressure construction is rated for internal pressures up to 35 psig and the high pressure up to 80 psig. Available for all models. Because of larger case, the medium pressure and high pressure models will not fit in a portable case size. Installation of the A-321 safety relief valve on standard Magnehelic® gages often provides adequate protection against infrequent overpressure.

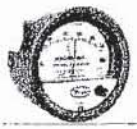
SPECIFICATIONS

Service: Air and non-combustible, compatible gases. (Natural Gas option available.)
Wetted Materials: Consult factory.
Housing: Die cast aluminum case and bezel, with acrylic cover. Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy: ±2% of full scale (±3% on - 0 -100 Pa, -125 Pa, 10MM and ±4% on - 00, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20" Hg. to 15 psig.† (-0.677 bar to 1.034 bar); MP option: 35 psig (2.41 bar), HP option: 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 bar), standard gages only.
Temperature Limits: 20 to 140°F.* (-6.67 to 60°C).
Size: 4" (101.6 mm) Diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8" female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).
Standard Accessories: Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapter and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)
*Low temperature models available as special option.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

OPTIONS AND ACCESSORIES

Transparent Overlays
Furnished in red and green to highlight and emphasize critical pressures.

Adjustable Signal Flag
Integral with plastic gage cover. Available for most models except those with medium or high pressure construction. Can be ordered with gage or separate.



LED Setpoint Indicator
Bright red LED on right of scale shows when setpoint is reached. Field adjustable from gage face, unit operates on 12-24 VDC. Requires MP or HP style cover and bezel.

Portable Units
Combine carrying case with any Magnehelic® gage of standard range, except high pressure connection. Includes 9 ft. (2.7 m) of ⅛" I.D. rubber tubing, standhang bracket and terminal tube with holder.

Air Filter Gage Accessory Package
Adapts any standard Magnehelic® for use as an air filter gage. Includes aluminum surface mounting bracket with screws, two 5 ft. (1.5 m) lengths of ¼" aluminum tubing two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

Quality design and construction features

Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

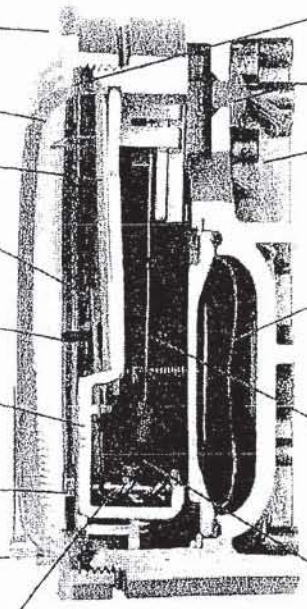
Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on the helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Jeweled bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in the plastic cover, and is accessible without removing cover. O-ring seal provides pressure tightness.



O-ring seal for cover assures pressure integrity of case.

Blowout plug of silicone rubber protects against overpressure on *5 psig rated models. Opens at approximately 25 psig.

Die cast aluminum case is precision made and iridite-dipped to withstand 168 hour salt spray corrosion test. Exterior finished in baked dark gray hammerloid. One case size is used for all standard pressure options, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded O-ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Calibrated range spring is flat spring steel. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

Samarium Cobalt magnet mounted at one end of range spring rotates helix without mechanical linkages.

Helix is precision made from an alloy of high magnetic permeability. Mounted in jeweled bearings, it turns freely, following the magnetic field to move the pointer across the scale.

MODELS

Dual Scale English/Metric Models		
Model Number	Range, In. W.C.	Range, Pa or kPa
2000-0D	0-0.5	0-125 Pa
2001D	0-1.0	0-250 Pa
2002D	0-2.0	0-500 Pa
2003D	0-3.0	0-750 Pa
2004D	0-4.0	0-1.0 kPa
2006D	0-6.0	0-1.5 kPa
2008D	0-8.0	0-2.0 kPa
2010D	0-10	0-2.5 kPa

SERIES 2000 MAGNEHELIC® — MODELS AND RANGES

The models below will fulfill most requirements. Page 11 also shows examples of special models built for OEM customers. For special scales furnished in ounces per square inch, inches of mercury, metric units, etc., contact the factory.

Model Number	Range Inches of Water
2000-00†••	0-.25
2000-0†•	0-.50
2001	0-1.0
2002	0-2.0
2003	0-3.0
2004	0-4.0
2005	0-5.0
2006	0-6.0
2008	0-8.0
2010	0-10
2015	0-15
2020	0-20
2025	0-25
2030	0-30
2040	0-40
2050	0-50
2060	0-60
2080	0-80
2100	0-100
2150	0-150

Model Number	Range Zero Center Inches of Water
2300-0†•	.25-0-.25
2301	.5-0-.5
2302	1-0-1
2304	2-0-2
2310	5-0-5
2320	10-0-10
2330	15-0-15

Model Number	Range PSI
2201	0-1
2202	0-2
2203	0-3
2204	0-4
2205	0-5
2210*	0-10
2215*	0-15
2220*	0-20
2230**	0-30

*MP option standard
**HP option standard

Dual Scale Air Velocity Units

Model Number	Range in W.C. Velocity, F.P.M.
2000-00AV†••	0-.25/300-2000
2000-0AV†•	0-.50/500-2800
2001AV	0-1.0/500-4000
2002AV	0-2.0/1000-5600
2010AV	0-10/2000-12500

For use with pitot tube.

Model Number	Range MM of Water
2000-6MM†••	0-6
2000-10MM†•	0-10
2000-25MM	0-25
2000-50MM	0-50
2000-80MM	0-80
2000-100MM	0-100

Zero Center Ranges

2300-20MM†	10-0-10

Model Number	Range, CM of Water
2000-15CM	0-15
2000-20CM	0-20
2000-25CM	0-25
2000-50CM	0-50
2000-80CM	0-80
2000-100CM	0-100
2000-150CM	0-150
2000-200CM	0-200
2000-250CM	0-250
2000-300CM	0-300

Zero Center Ranges

2300-4CM	2-0-2
2300-10CM	5-0-5
2300-30CM	15-0-15

Model Number	Range, Pascals
2000-60PA†••	0-60
2000-100PA†•	0-100
2000-125PA†•	0-125
2000-250PA	0-250
2000-300PA	0-300
2000-500PA	0-500
2000-750PA	0-750

Zero Center Ranges

2300-250PA	125-0-125
2300-500PA	250-0-250

Model Number	Range, Kilopascals
2000-1KPA	0-1
2000-1.5KPA	0-1.5
2000-2KPA	0-2
2000-3KPA	0-3
2000-4KPA	0-4
2000-5KPA	0-5
2000-8KPA	0-8
2000-10KPA	0-10
2000-15KPA	0-15
2000-20KPA	0-20
2000-25KPA	0-25
2000-30KPA	0-30

Zero Center Ranges

2300-1KPA	.5-0-.5
2300-3KPA	1.5-0-1.5

Accessories

A-299, Surface Mounting Bracket
A-300, Flat Flush Mounting Bracket
A-310A, 3-Way Vent Valve
A-321, Safety Relief Valve
A-432, Portable Kit
A-605, Air Filter Kit
A-610, Pipe Mount Kit

Options — To order, add suffix I.E. 2001-ASF
ASF (Adjustable Signal Flag)
HP (High Pressure Option)
LT (Low Temperatures to -20°F)
MP (Med. Pressure Option)
SP (Setpoint Indicator)

Scale Overlays — Red, Green, Mirrored or Combination, Specify Locations

Special Purpose Ranges

Scale No. 2401	Scale No. 2402
Square Root	Blank Scale
Specify Range	Specify Range

Model 2000-00N, range -.05 to +.20" W.C. For room pressure monitoring

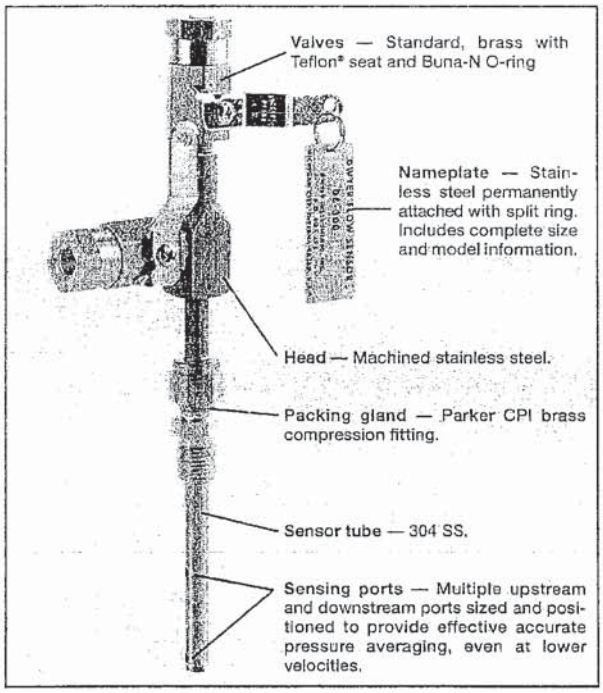
†These ranges calibrated for vertical scale position.
• Accuracy +/-3%. •• Accuracy +/-4%

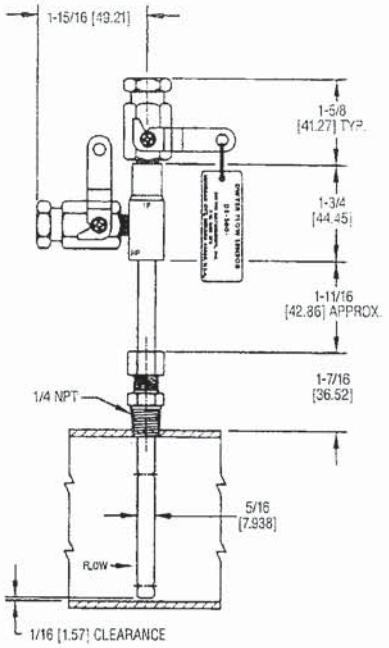
1011R01-0298P

Series DS

In-Line Flow Sensors

Use with the Dwyer Differential Pressure Gages or Transmitters





Dwyer Flow Sensors are averaging Pitot tubes that provide accurate and convenient flow rate sensing for schedule 40 pipe. When purchased with a Dwyer Capsuhelic® differential pressure gage of appropriate range, the result is a flow indicating system delivered off the shelf at an economical price.

Pitot tubes have been used in flow measurement for years. Conventional pitot tubes sense velocity pressure at only one point in the flowing stream. Therefore, a series of measurements must be taken across the stream to obtain a meaningful average flow rate. The Dwyer flow sensor eliminates the need for "traversing" the flowing stream because of its multiple sensing points and built-in averaging capability.

Dwyer Series DS-300 flow sensors are designed to be inserted in the pipeline through a compression fitting. They are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with ⅛" female NPT connections. Accessories include adapters with ¼" SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® kit. Standard valves are rated at 200 psig (13.7 bar) and 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 flow sensors are available for pipe sizes from 1" to 10".

DS-400 Averaging Flow Sensors are quality constructed from extra strong ¾" dia. stainless steel to resist increased forces encountered at higher flow rates with both air and water. This extra strength also allows them to be made in longer insertion lengths up to 24 inches (61 cm). All models include convenient and quick-acting quarter-turn ball valves to isolate the sensor for zeroing. Process connections to the valve assembly are ⅛" female NPT. A pair of ⅛" NPT × ¼" SAE 45° flared adapters are included, compatible with hoses used in the Model A-471 Portable Capsuhelic® Gage Kit. Supplied solid brass mounting adapter has a ¾" dia. compression fitting to lock in required insertion length and a ¾" male NPT thread for mounting in a thred-o-let (not included).

Select model with suffix which matches pipe size

DS-300-1"
DS-300-1¼"
DS-300-1½"
DS-300-2"
DS-300-2½"
DS-300-3"
DS-300-4"
DS-300-6"
DS-300-8"
DS-300-10"

DS-400-6"
DS-400-8"
DS-400-10"
DS-400-12"
DS-400-14"
DS-400-16"
DS-400-18"
DS-400-20"
DS-400-24"

Options and Accessories

A-160 Thredolet,¾" NPT, forged steel, 3000 psi

A-161 Brass Bushing, ¼" x ⅜"

(DS-300) To order, add suffix -LVdeduct

Ⓑ Items subject to Schedule B discounts

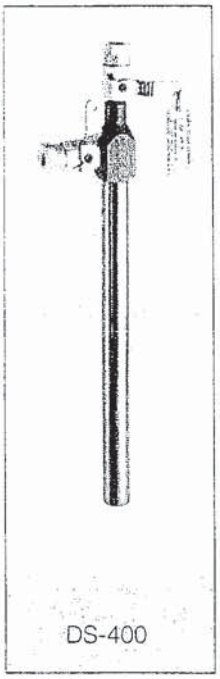
How To Order

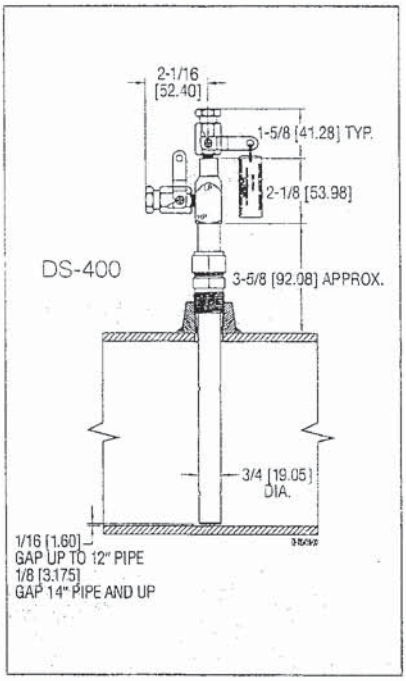
Merely determine the pipe size into which the flow sensor will be mounted and designate the size as a suffix to Model DS-300. For example, a flow sensor to be mounted in a 2" pipe would be a Model No. DS-300-2".

For non-critical water and air flow monitoring applications, the chart below can be utilized for ordering a stock Capsuhelic® differential pressure gage for use with the DS-300 flow sensor. Simply locate the maximum flow rate for the media being measured under the appropriate pipe size and read the Capsuhelic® gage range in inches of water column to the left. The DS-300 sensor is supplied with installation and operating instructions, Bulletin F-50. It also includes complete flow conversion information for the three media conditions shown in the chart below. This information enables the user to create a complete differential pressure to flow rate conversion table for the sensor and differential pressure gage employed. Both the Dwyer Capsuhelic® gage and flow sensor feature excellent repeatability so, once the desired flow rate is determined, deviation from that flow in quantitative measure can be easily determined. You may wish to order the adjustable signal flag option for the Capsuhelic® gage to provide an easily identified reference point for the proper flow.

Capsuhelic® gages with special ranges and/or direct reading scales in appropriate flow units are available on special order for more critical applications. Customer supplied data for the full scale flow (quantity and units) is required along with the differential pressure reading at that full flow figure. Prior to ordering a special Capsuhelic® differential pressure gage for flow read-out, we recommend you request Bulletin F-50 to obtain complete data on converting flow rates of various media to the sensor differential pressure output. With this bulletin and after making a few simple calculations, the exact range gage required can easily be determined.

Large 3/4 Inch Diameter for Extra Strength in Lengths to 24 Inches



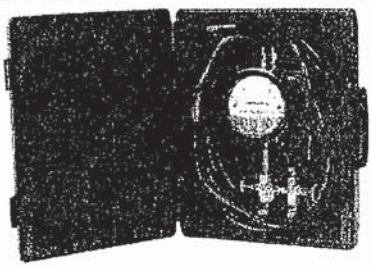


GAGE RANGE (IN. W.C.)	MEDIA @ 70°F	FULL RANGE FLOWS BY PIPE SIZE (APPROXIMATE)									
		1"	1¼"	1½"	2"	2½"	3"	4"	6"	8"	10"
2	Water (GPM)	4.8	8.3	11.5	20.5	30	49	86	205	350	560
	Air @ 14.7 PSIA (SCFM)	19.0	33.0	42.0	65.0	113	183	330	760	1340	2130
	Air @ 100 PSIG (SCFM)	50.0	90.5	120.0	210.0	325	510	920	2050	3600	6000
5	Water (GPM)	7.7	14.0	18.0	34.0	47	78	138	320	560	890
	Air @ 14.7 PSIA (SCFM)	30.0	51.0	66.0	118.0	178	289	510	1200	2150	3400
	Air @ 100 PSIG (SCFM)	83.0	142.0	190.0	340.0	610	820	1600	3300	5700	10000
10	Water (GPM)	11.0	19.0	25.5	45.5	67	110	195	450	800	1260
	Air @ 14.7 PSIA (SCFM)	41.0	72.0	93.0	163.0	250	410	725	1690	3040	4860
	Air @ 100 PSIG (SCFM)	120.0	205.0	275.0	470.0	740	1100	2000	4600	8100	15000
25	Water (GPM)	18.0	32.0	40.5	72.0	108	173	310	720	1250	2000
	Air @ 14.7 PSIA (SCFM)	63.0	112.0	155.0	255.0	390	640	1130	2630	4860	7700
	Air @ 100 PSIG (SCFM)	185.0	325.0	430.0	760.0	1200	1800	3300	7200	13000	22000
50	Water (GPM)	25.0	44.0	57.5	100.0	152	247	435	1000	1800	
	Air @ 14.7 PSIA (SCFM)	90.0	161.0	205.0	360.0	560	900	1600	3700	6400	
	Air @ 100 PSIG (SCFM)	260.0	460.0	620.0	1050.0	1700	2600	4600	10000	18500	
100	Water (GPM)	36.5	62.0	82.0	142.0	220	350	620	1500		
	Air @ 14.7 PSIA (SCFM)	135.0	230.0	300.0	505.0	800	1290	2290	5000		
	Air @ 100 PSIG (SCFM)	370.0	660.0	870.0	1500.0	2300	3600	6500	15000		

Model A-471 Portable Kit

The Dwyer Series 4000 Capsuhelic® differential pressure gage is ideally suited for use as a read-out device with the DS-300 Flow Sensors. The gage may be used on system pressures of up to 500 psig even when the flow sensor differential pressure to be read is less than 0.5" w.c. With accuracy of ±3% of full scale, the Capsuhelic® gage can be used in ambient temperatures from 32 to 200°F (0 to 93.3°C). Zero and range adjustments are made from outside the gage. The standard gage with a die cast aluminum housing can be used with the flow sensor for air or oil applications. For water flow measurements, the optional forged brass housing should be specified. The Capsuhelic® gage may be panel or surface mounted and permanently plumbed to the flow sensor if desired. The optional A-610 pipe mounting bracket allows the gage to be easily attached to any 1¼" - 2" horizontal or vertical pipe.

For portable operation, the A-471 Capsuhelic® Portable Gage Kit is available complete with tough polypropylene carrying case, mounting bracket, 3-way manifold valve, two 10' high pressure hoses, and all necessary fittings. See pages 6 and 7 for complete information on the Capsuhelic® gage.



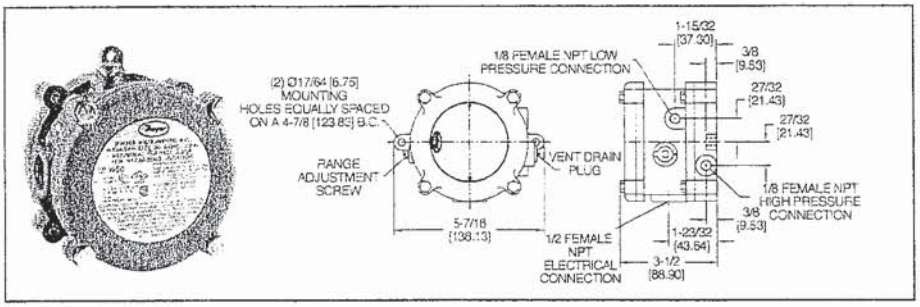
CAPSUHELIC® GAGE SHOWN INSTALLED IN A-471 PORTABLE KIT

Series 1950

Explosion-Proof Differential Pressure Switches

Compact, Low Cost, Explosion-proof and Weatherproof

CE UL SA FM APPROVED



Model 1950 Explosion-Proof Differential Pressure Switch combines the best features of the popular Dwyer series 1900 with an integral explosion-proof and weather-proof housing, making it an exceptional value for either application. It is CE, UL and CSA listed, FM approved for use in Class I, Div 1, Groups C and D, Class II Groups E, F, and G and Class III hazardous atmospheres (NEMA 7 & 9), Raintight (NEMA 3). Weatherproof features include a drain plug and O-ring seal in cover. Electrical connections are easily made by removing front cover. For convenience the set point adjustment screw is located on the outside of the housing. Twelve models offer set points from .03 to 20" w.c. (7.5 to 5 kPa) and from .5 to 50 psi (0.035 to 3.5 bar). The unit is very light and compact – about half the weight and bulk of other explosion-proof or weather-proof switches with separate enclosures.

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -40 to 140°F (-40 to 60°C); 0 to 140°F (-17.8 to 60°C) for 1950P-8, 15, 25, and 50. -30 to 130°F (-34.4 to 54.4°C) for 1950-02.
Pressure Limits:
Continuous: 1950's - 45" w.c. (0.11 bar); 1950P's - 35 psi (2.41 bar); 1950P-50 only - 70 psi (4.83 bar).
Surge: 1950's - 10 psi (0.69 bar),. 1950P's - 50 psi (3.45 bar), 1950P-50 only - 90 psi (6.21 bar).
Enclosure Rating: IP64, NEMA 3, 7 and 9.
Switch Type: Single-pole double-throw (SPDT)
Electrical Rating: 15 A @, 125, 250, 480 VAC, 60 Hz. Resistive 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC, 60 Hz.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8" female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 3.25 lb (1.5 kg); 1950-02 model, 4.4 lb (2 kg).
Agency Approvals: CE, UL, CSA, FM.

SERIES 1950 SWITCHES - MODELS, OPERATING RANGES AND DEAD BANDS

Model Number	Range, Inches W.C.	Approximate Dead Band at	
		Min. Set Point	Max. Set Point
1950-02-2S	.03 to .10	.025	.05
1950-00-2F	.07 to .15	.04	.05
1950-0-2F	.15 to .50	.10	.15
1950-1-2F	.4 to 1.6	.15	.20
1950-5-2F	1.4 to 5.5	.30	.40
1950-10-2F	3 to 11	.40	.50
1950-20-2F	4 to 20	.40	.60

Model* Number	Range, PSID	Approximate Dead Band at	
		Min. Set Point	Max. Set Point
1950P-2-2F	0.5 to 2	.3	.3
1950P-8-2F	1.5 to 8	1.0	1.0
1950P-15-2F	3 to 15	.9	.9
1950P-25-2F	4 to 25	.7	.7
1950P-50-2F	15 to 50	1.0	1.5

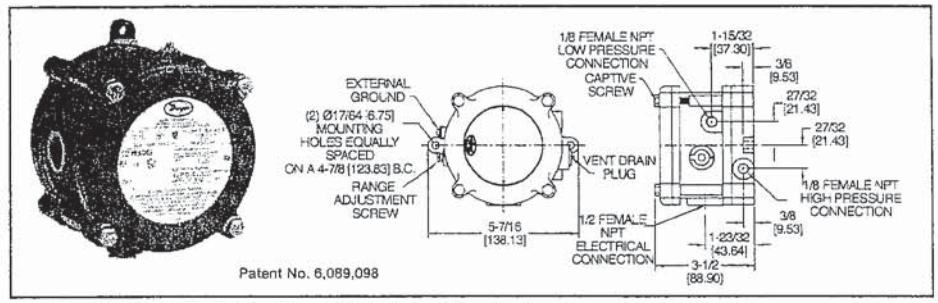
CAUTION: For use only with air or compatible gases. Applications with hazardous atmospheres and a single positive pressure may require special venting.
*P=PSID range models

Series 1950G

Explosion-Proof Differential Pressure Switch

Explosion-Proof, Weatherproof, Compatible with Natural Gases

Ex CE UL SA FM APPROVED



Patent No. 6,089,098

The Model 1950G Explosion-Proof Switch combines the best features of the popular Dwyer Series 1950 Pressure Switch with the benefit of natural gas compatibility. Units are rain-tight for outdoor installations, and are UL listed for use in Class I, Groups A, B, C, & D; Class II, Groups E, F, & G and Class III atmospheres, Directive 94/9/EC (ATEX) Compliant for CE Ex II 2 G EExd IIB & Hydrogen T6 and CSA & FM approved for Class I, Div 1, Groups B, C, D; Class II, Div 1, Groups E, F, G and Class III atmospheres. The 1950G is very compact, about half the weight and bulk of equivalent conventional explosion-proof switches.
Easy access to the SPDT relay and power supply terminals is provided by removing the top plate of the aluminum housing. A supply voltage of 24 VDC, 120 or 240 VAC is required. A captive screw allows the cover to swing aside while remaining attached to the unit. Adjustment to the set point of the switch can be made without disassembly of the housing.

SPECIFICATIONS

Service: Air and compatible combustible gases.
Wetted Materials: Contact Factory.
Temperature Limits: 0 to 140°F (-17 to 60°C). Note: Set point drift may occur with ambient temperature changes.
Pressure Limits: 45" w.c. (11.2 kPa) continuous; 10 psig (68.95 kPa) surge.
Enclosure Rating: IP64, NEMA 3, 7 and 9.
Switch Type: 1 Form C relay (SPDT).
Electrical Rating: 10A, 120/240 VAC, 28 VDC. Resistive 50mA, 125 VDC.
Power Requirements: 24 VDC ±10%. 120 or 240 VAC ±10% optional.
Electrical Connections: Internal terminal block.
Process Connections: 1/8" female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 2 lb, 15.7 oz (1.35 kg).
Agency Approvals: CE, UL, CSA, FM, ATEX.

MODELS

Model Number[1]	Range, Inches W.C.	Approximate Dead Band at	
		Min. Set Point	Max. Set Point
1950G-00-B-24	.07 to .15	.04	.06
1950G-0-B-24	.15 to .50	.06	.11
1950G-1-B-24	.4 to 1.6	.11	.29
1950G-5-B-24	1.4 to 5.5	.4	.9
1950G-10-B-24	3 to 11	.9	1.8
1950G-20-B-24	4 to 20	1.2	3.0

[1]Note: For alternate supply voltages change 24 to 120 or 240. Example: 1950G-0C-B-120

Blue-White® Industries, Ltd.

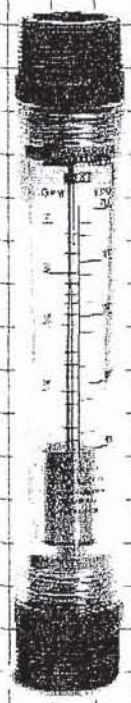
Variable Area Flow Meters

Engineering and Technical Data

F-420N

1" F/NPT, 1-1/2" M/NPT

Rod Guided Float



Features:

- Tough machined acrylic meter body, highly polished to a clear finish.
- Direct reading permanent scale.
- White back reflector for easy reading.
- 1" F/NPT or 1-1/2" M/NPT adapters with high grade Viton o-ring seals .
- 316 stainless steel or Hastelloy rod guided floats.
- Acceptable in direct sunlight applications.

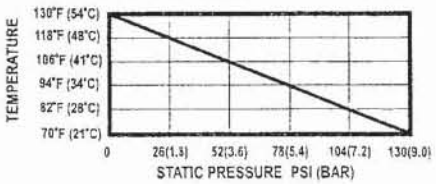
Materials of Construction:

Meter Body: .....Cast Acrylic Rod
Adapters: .....PVC
Guide Rod Holder: .....Polysulfone
O-ring seals: .....Viton® (optional EP)
Float:
Standard Series 316SS
K- Series .....Hastelloy
Guide Rod:
Standard Series 316SS
K- Series .....Hastelloy

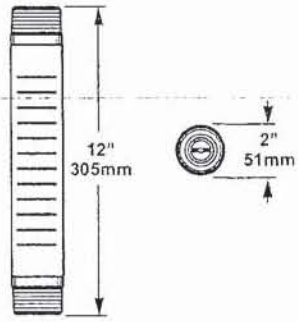
Specifications:

Max. working pressure: .....130 PSI (8.9 bar) @ 70° F (21° C)
Max. Fluid Temperature: .....130° F (54° C) @ 0 PSI
Full scale accuracy: .....+/- 5%
Calibration fluid: .....water, specific gravity 1.0
Scale length: .....4" (100mm)
Environment: .....Acceptable for direct sunlight exposure.
Maximum pressure drop: .....2 PSI
Approximate shipping wt: ...2 lb. (.91 kg)

Maximum Temperature vs. Pressure



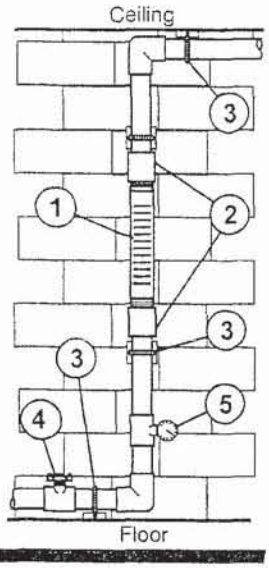
Dimensions:



Blue-White® Industries, Ltd.

Variable Area Flow Meters

Installation Requirements:



1. Misalignment will damage the meter!

Flowmeter must be installed in an exact vertical plane to ensure accuracy. Be certain of proper plumbing alignments. Misalignment may cause the o-ring seals to leak.

2. Pipe dope and glue will damage the meter!

Use only Teflon® tape on the threaded adapters. The meter body and plastic fittings cannot tolerate PVC Glue and/or pipe dope. Even fumes can cause severe damage. If you are installing your flowmeter to a glued pipe configuration, install the flowmeter *after* all glued fittings are dried and lines are purged of all fumes. Never hold the meter body with pliers or like tools. DO NOT OVER-TIGHTEN!

3. Vibration and heavy loads will damage the meter!

Wall, floor and ceiling mounts and supports must be carefully aligned with the meter body and sturdy enough to support the plumbing and prevent vibration. Never allow the flowmeter to support the weight of related piping.

4. Solenoid valves will damage the meter!

Avoid a system that will impose a sudden burst of flow to the meter. Such a burst will cause the float to impact the float stop with destructive force. Solenoid valves, or other quick opening valves cannot be used unless meter is protected against sudden bursts of flow.

5. High pressures and temperatures will damage the meter!

The maximum acceptable temperature and pressure is interdependent. The maximum acceptable working pressure is dependant on the actual fluid temperature. The maximum acceptable fluid temperature is dependant on the actual working pressure. (see Temperature Vs. Pressure chart).

Flow Range and Model Options:

Standard Series

- Equipped with 316 SS guide rod

Models for Liquid

MODEL NUMBER	Dual Scale Range GPM	LPM	Adapter Pipe Size	Adapter Material	Float Material
F-42025LN-16	5 to 25	20 to 100	1" F/NPT	PVC	316 SS
F-42025LN	5 to 25	20 to 100	1-1/2" M/NPT	PVC	316 SS
F-42040LN-16	8 to 40	30 to 150	1" F/NPT	PVC	316 SS
F-42040LN	8 to 40	30 to 150	1-1/2" M/NPT	PVC	316 SS
F-42050LN-16	10 to 50	40 to 200	1" F/NPT	PVC	316 SS
F-42050LN	10 to 50	40 to 200	1-1/2" M/NPT	PVC	316 SS

K-Series

- Equipped with Hastelloy guide rod

K-Series models are specially equipped for highly corrosive applications.

Models for Liquid

MODEL NUMBER	Dual Scale Range GPM	LPM	Adapter Pipe Size	Adapter Material	Float Material
F-42025LK-16	5 to 25	20 to 100	1" F/NPT	PVC	Hastelloy
F-42025LK	5 to 25	20 to 100	1-1/2" M/NPT	PVC	Hastelloy
F-42040LK-16	8 to 40	30 to 150	1" F/NPT	PVC	Hastelloy
F-42040LK	8 to 40	30 to 150	1-1/2" M/NPT	PVC	Hastelloy
F-42050LK-16	10 to 50	40 to 200	1" F/NPT	PVC	Hastelloy
F-42050LK	10 to 50	40 to 200	1-1/2" M/NPT	PVC	Hastelloy

Correction factor formulas for AIR models

PRESSURE CORRECTION	TEMPERATURE CORRECTION
$\sqrt{\frac{14.7 + \text{Working PSIG}}{14.7}}$	$\sqrt{\frac{520}{460 - \text{Working Temp °F}}}$

Notes:
1) Liquid models calibrated with water, Sp.Gr. 1.0. Custom Sp.Gr. calibrations available. Contact the factory.
2) Air models calibrated at standard Conditions (70°F @ 14.7 PSIa). Temperature and pressure correction may be required. Contact the factory for custom calibrations.

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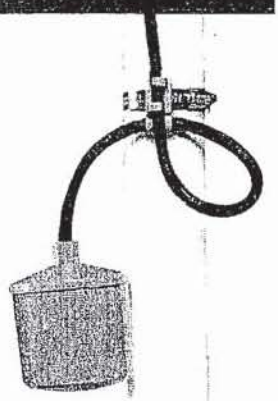
www.blue-white.com Email: sales@blue-white.com

Technical data sheet #85000-034 rev.081105

SUPER SINGLE® Pump Switch

Mercury activated, wide-angle switch designed to control pumps up to 1 HP at 120 VAC and 2 HP at 230 VAC.



U.S. Patent No. 4,302,641

This mercury activated, wide-angle pump switch provides automatic control of pumps in non-potable water and sewage applications. This switch is not sensitive to rotation or turbulence.

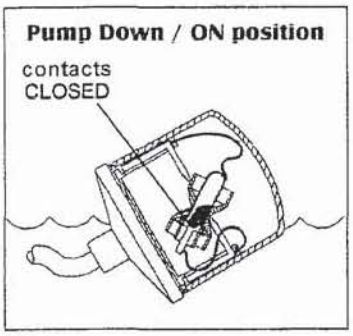
The **Super Single®** pump switch is suitable for use with intrinsically safe circuits. Contact SJE-Rhombus regarding specific intrinsically safe applications.

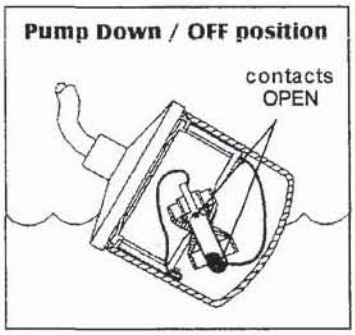
FEATURES

- Patented tumbler assembly gives positive pump on or pump off.
- Controls pumps up to 1 HP at 120 VAC and 2 HP at 230 VAC.
- Adjustable pumping range of 6.5 to 13.5 inches (17 to 34 cm).
- Includes standard mounting clamp and boxed packaging.
- UL Recognized for use in non-potable water and sewage.
- CSA Certified.
- Three-year limited warranty.

LR54245

Hydraulic





OPTIONS

This switch is available:

- for pump down or pump up applications as specified by part number.
- with a 120 VAC or 230 VAC piggy-back plug.
- without a plug for direct wiring in 120 VAC or 230 VAC applications.
- in standard cable lengths of 10, 15, 20, or 30 feet and 3, 5, 6, or 10 meters (longer lengths available).

SPECIFICATIONS

CABLE: flexible 14 gauge, 2 conductor (UL, CSA) SJOW, water-resistant (CPE)

FLOAT: 3.38 inch diameter x 4.25 inch long (8.58 x 10.80 cm) high impact, corrosion resistant, PVC housing for use in sewage and non-potable water up to 140°F (60°C)

MERCURY SWITCH: mercury-to-mercury contacts, hermetically sealed in a steel capsule

ELECTRICAL:

120 VAC 50/60Hz Single Phase:

Maximum Pump Running Current:
15 amps
Maximum Pump Starting Current:
55 amps
Recommended Pump HP:
1 HP or less

230 VAC 50/60Hz Single Phase:

Maximum Pump Running Current:
12 amps
Maximum Pump Starting Current:
35 amps
Recommended Pump HP:
2 HP or less

NOTE: This switch must be used with pumps that provide integral thermal overload protection.

SJE Rhombus®

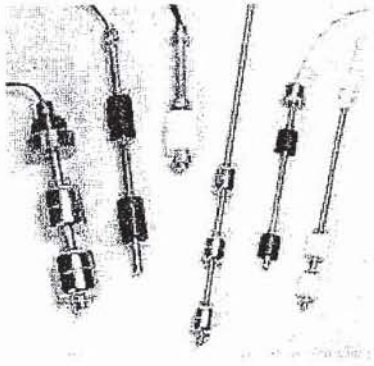
PO Box 1708, Detroit Lakes, MN 56502
1-888-DIAL-SJE • 1-218-847-1317
1-218-847-4617 Fax
email: sje@sjerhombus.com
www.sjerhombus.com

Madison Co.
27 Business Park Dr.
Branford, CT 06405 US
Phone: 203-488-4477
Fax: 203-481-5036
Toll-free: 800-466-5383
Email: info@madisonco.com
Website: http://www.madisonco.com

Stainless Steel Multi-Point Float Switches

Madison Company offers a complete line of Standard and Configured (slightly modified Standard designs) models. These products continue to meet the needs of applications in many markets, at competitive prices. In addition, Madison Company offers the capability to design specific liquid level switches for OEM applications that require unique considerations in materials, configurations and system interfacing.

Engineered designs incorporate over 45 years of experience in liquid level switch applications in a variety of environments and installation configurations. High reliability of the magnetic reed switch technology assures repeatability at an economical price. Our design experience and flexible manufacturing techniques also offer customers many value-added design and assembly options to reduce their product cost.



Features

- Multi-point
- Custom design capability using our on-line Product Configurator for an instant price quote
- Magnetic reed switch technology
- High reliability
- Wide selection of available materials
- Three basic sizes : full, miniature and subminiature
- Direct interface to controllers available
- BSPP & BSPT style fittings now available

Multi-point switches are available in many materials and configurations and can contain as many float actuation points as the application and switch design may allow (normally up to five). These rugged units can be mounted within any vessel, utilizing the mounting options shown above, or customized to the specific application. The actuation points are defined by the customer and can be engineered to address offset locations within the vessel, allowing for the bypass of obstructions or saddle type tanks. For turbulent conditions, slosh shields, as well as electronic interface components and accessories, can be provided. Temperature sensors can also be incorporated into these models.

Results 1 - 7 of 7

Item #	Stem Material	Float Material	Max. Temperature	Float SG	Max. Pressure	Lead Time
M5602	316 Stainless Steel	316 Stainless Steel	200 °C	0.55	200 psig	4 days
M5605	316 Stainless Steel	316 Stainless Steel	200 °C	0.55	200 psig	3 weeks
M4602	316 Stainless Steel	Buna-N	105 °C	0.45	150 psig	4 days
M8602	316 Stainless Steel	Polypropylene	105 °C	0.75	100 psig	4 days
M5002	316 Stainless Steel	316 Stainless Steel	200 °C	0.70	300 psig	4 days
M4402	316 Stainless Steel	Buna-N	105 °C	0.45	150 psig	4 days
M8002	316 Stainless Steel	Polypropylene	105 °C	0.80	100 psig	4 days

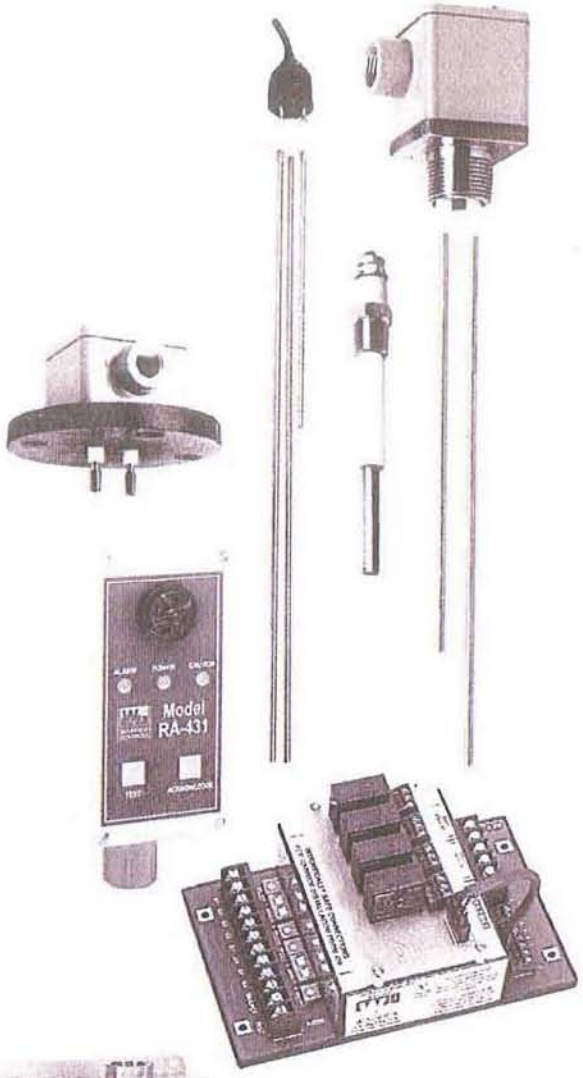
Results 1 - 7 of 7

Warrick® Conductivity-Based Liquid Level Control

For over 50 years Warrick® sensors and controls have offered dependable no-moving-parts control and monitoring of conductive liquids. Now as part of the Gems Sensors family, Warrick brand conductivity controls continue to offer reliability, process automation, labor savings, flexibility and operator safety at an economical cost.

The concept is simple: Take advantage of a liquid's conductive properties to complete a circuit and cause a control relay to actuate. Use of permanently-mounted stationary electrodes gives the user precise accuracy, repeatability and no-moving-parts reliability.

This simple concept has led to the development of a complete line of conductivity-based controls and electrode fittings shown here. For OEM's we also have the capability to custom configure controls and electrode fittings to meet your specific application requirements.



Application Versatility

Pumps. Warrick control systems control the operation of pumps in countless applications: feeding of elevated tanks; drainage of wastewater from industrial sumps; batch processing; irrigation and flood control; sewage disposal.

Boilers. One of the earliest uses for Warrick level controls, service on boilers, supervises feedwater flow and provides critical low water cutoff protection and/or alarm functions.

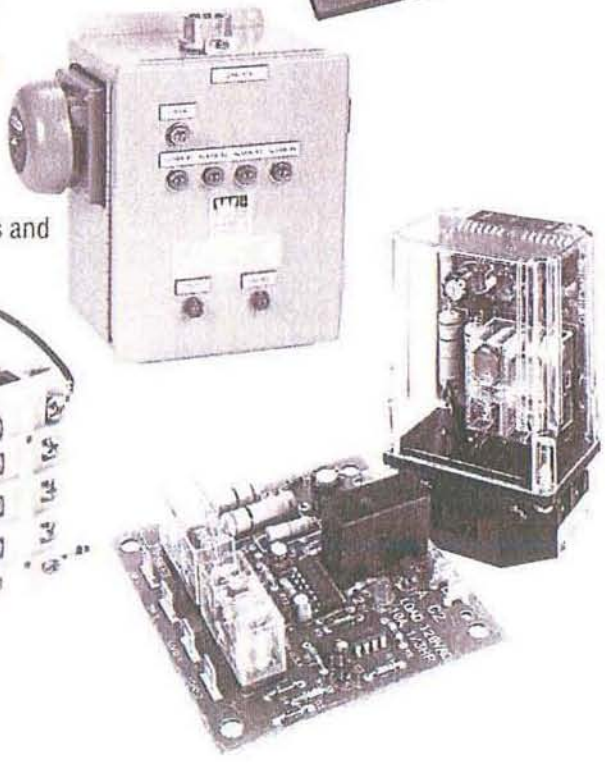
Steam Cookers. Steam cookers and similar equipment such as steam generators, evaporators, sterilizers and water heaters all depend on Warrick liquid level controls for protection. In applications of this kind the controls automatically shut off the heat source in the event of a low water level, as well as maintain the proper water level, through the energizing of a solenoid valve.

Drink Dispensers. In this industry, level controls are essential in controlling the carbonator tanks' water level.

Sump Pumps. The original use of Warrick conductance-actuated controls, service on sump pumps, is still one of the most common applications.

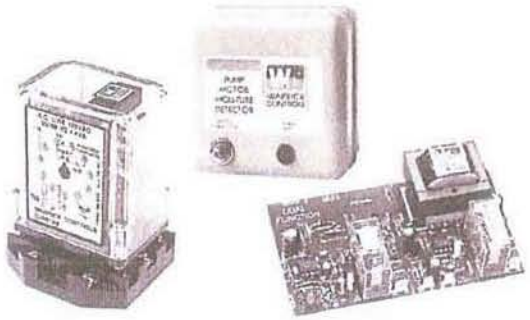
High and/or Low Level Alarms. Warrick conductance probe-type controls also provide assured safety and peace of mind as high and/or low level alarms in boilers, process and storage tanks and similar equipment.

Solenoid Control. As simple on/off devices, Warrick controls offer dependable process control in a wide variety of applications. For example, in a cooling tower, a Warrick control would activate the solenoid which brings water into the tower.



System Components

The illustration, below, graphically defines the typical Warrick® liquid level control system, which includes three basic elements:



1. **Controls.** The control is an electrical device with contacts that open and close in response to liquid levels sensed by the probes. Because it is wired directly to the power source and to the sensing source, it can send signals that activate or de-activate solenoids, pumps, or alarms.

   Warrick® controls are available in many different designs and sensitivity ratings for a wide range of application requirements.

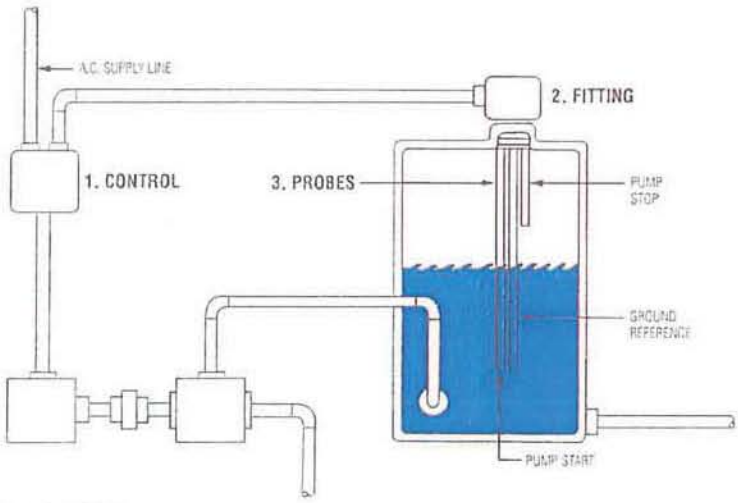
2. **Fittings.** The fitting is a housing that holds the probes (or floats), insulates them from the vessel, and provides a means of connection to the control.

   Warrick® fittings are available for single-probe or multi-probe applications, for mounting to vessels in a variety of ways, and in open or pressure tight styles.

3. **Probes.** The probe is a sensor that extends downward from the fitting, with the tip positioned precisely at the level where the control should be activated.

   Warrick® probes are available in a variety of materials to suit different liquids and a variety of lengths to fit different depth requirements.

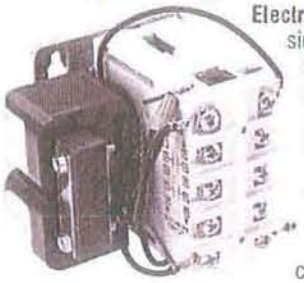
The liquid level control system shown here is designed for "pump up" application. The pump will start refilling the vessel when the liquid reaches the lower probe tip, then stop refilling the vessel when the liquid reaches the higher probe tip.



Pump-up system

Contents — Page Start

Principle of Operation



Electromechanical Controls employ a simple series circuit which includes the transformer, relay coil, electrode probes and the liquid media being monitored. When liquid contacts both the reference and set point electrode probes, current flows through the liquid media which in turn energizes the relay coil and mechanically changes the output contacts state.

When liquid is below the electrode probes, the probe circuit is open, the relay coil is not energized, and the output contacts return to their 'normal' state.

Sensitivity (the maximum liquid resistance allowable) is adjusted by changing the secondary voltage passed through the electrodes and liquid media (500 VAC max).

Solid State Controls employ two separate circuits, one for sensing and comparing current flow and one for energizing the output relay. This 'switch within a switch' allows solid state controls to operate at much lower secondary voltages (12VAC typical), and much higher sensitivities. Advantages of this technology include reduced shock hazard, one moving part the output relay, wide sensitivity range and latching capability for auto refill or empty applications.

Intrinsically Safe Controls are solid state controls which limit current and voltage to a level incapable of igniting flammable gasses, vapors or dust. They can be used as conductivity liquid level controls or with dry contact devices such as Gems Flow and Level Switches or other non voltage storing or producing devices.

Sensitivity Data

Sensitivity vs. Maximum Probe Wire Distances – in feet*

Ohms	Controls								
	Series 1	Series 16, 16D, 16M, 16DM, 16VM	Series 17	Series 27, 37	Series 47	Series 67	Series 26, 26M	Series 19MR	Series DF
50	75000	—	—	—	—	—	—	—	—
450	7500	—	—	—	—	—	—	—	—
1,500	1750	—	—	—	—	—	—	—	—
3,000	—	—	—	4000	—	—	—	—	—
3,300	—	—	5000	—	—	—	—	—	—
4,700	—	10000	3500	—	—	4000	900	—	900
7,000	500	—	—	—	—	—	—	—	—
10,000	—	5700	1750	900	—	2400	600	—	600
11,000	—	—	—	—	—	—	—	5500	—
19,000	—	—	—	—	—	—	—	3000	—
20,000	150	—	—	—	—	—	—	—	—
22,000	—	—	1000	—	—	—	—	—	—
26,000	—	2200	—	—	1500	1200	250	—	250
47,000	—	—	500	—	—	—	—	—	—
50,000	—	1075	—	—	900	600	—	—	—
100,000	—	570	250	75	—	—	—	—	—
470,000	—	270	—	—	—	—	—	—	—
1,000,000	—	38	—	—	400	300	—	—	—
3,000,000	Contact factory for more information								
5,500,000									

* Based on type MTW or THHN #14 or #16 AWG wire. Other wire size and sensing medium may reduce overall maximum distance.

Notes:
1. DC on probe circuit-maximum distance between control and probe is limited to the total resistance of the wire and liquid.
2. Total resistance must not exceed the sensitivity of the control.
3. On controls directly connected to floats rather than probes, maximum distance is limited only to the total resistance of the wire.
4. AC on probe circuit has greater restrictions on maximum distance.

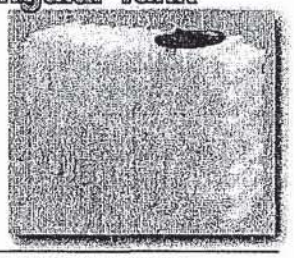
APPENDIX C

TANK, PUMP & PIPING SPECIFICATIONS AND VENDOR INFORMATION

SPECIALTY TANKS

Spec. Rectangular Tank

Gallon
220 US
Gal. Wt.24"
Lt.72"
Ht.48"
part# WST220RT
$882.00



NOR400RECT
400 Gallon Capacity
No Framework Required
List Price $965.00

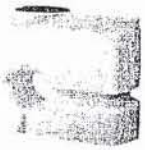
NORWESCO

Length 61 1/2" Height 64" Width 29"

300 GALLON Free Standing

Tank...#NOR300RECT
List Price $ 807.00

NORWESCO

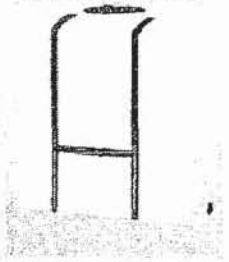


Ht 49" Wt. 29" Length 62"

375 GALLON RECTANGULAR

Tank...#NOR375RECT
List Price $1194.00
with Required Framework

NORWESCO



Ht 59 3/4" Wt. 30" Length 62"

RECTANGULAR POLY TANKS

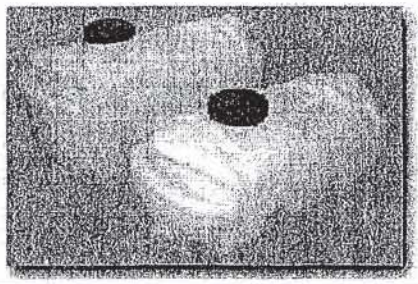
*Ideal for agricultural, nursery, residential and commercial turf units.
*Attractive.....compact design requiring no complex support structures.*5* screw on cap.

SIZE	PT#	PRICE
8 gal.	SOL8RECT	$76.00

H=10"(overall ht.=15.5" / L=16" / W=12"

12 gal.	SOL12RECT	$105.00

H=12"(overall ht.=17" / L=18" / W=14"

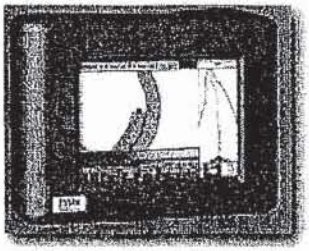


SPOT SPRAYER TANKS

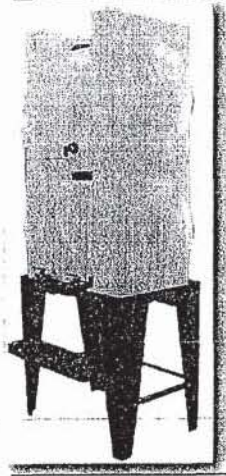
Dimensions:
14gal = h14",l31",w14"
25gal = h17",l36",w18"

Free standing with mount for 12 volt pumps and six 5/16" mounting lug holes on bottom

SIZE	PT#	LIST PRICE
14 gal.	PK14SPOT	$80.50
25 gal.	PK25SPOT	85.60



See The Zynx X15 in the Guidance Section of This Catalog! Unbelievale Features!



BULK OIL STATIONS with STANDS,

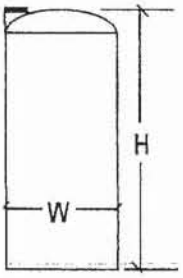
Valves & Spill Tray
Each Tank is 70 Gallons

Two Tank System
140 Gallons Total
Part# BOS-140C $ 915.00

Three Tank System
210 Gallons Total
Part# BOS-210C $ 1237.00

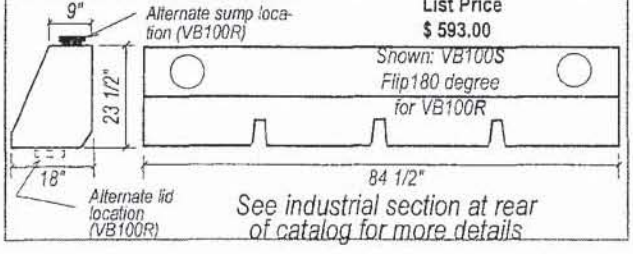
Tank Only-ACE70LT-STACK
List Price $ 280.00

SPECIALTY TANKS NARROW & TALL



Gallons	W	H	Pt#	List$
50	18"	53"	NOR50VERT	183.00
65	23"	42"	NOR65VERT	222.00
75	23"	50"	NOR75VERT	240.00
75	18"	79"	NOR75VERT-18	122.00
100	28"	43"	NOR100VERT	267.00
105	23"	63"	NOR105VERT	279.00
150	30"	72"	NOR150VERT	351.00
165	31"	55"	NOR165VERT	375.00
200	30"	72"	NOR200VERT	451.00
210	32"	69"	NOR210VERT	440.00
260	32"	84"	NOR260VERT	481.00
300	35"	78"	NOR300VERT	486.00
425	42"	72"	ACE425VERT	548.00
500	48"	72"	NOR500VERT	639.00
500	46"	76"	ACE500VERT	701.00
600	46"	88"	ACE600VERT	780.00
750	48"	102"	NOR750VERT	865.00
1000	64"	79"	NOR1000VERT	1107.00

V-TANK 100 Gallon

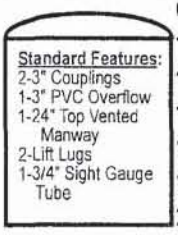


See industrial section at rear of catalog for more details

100 Gallon "V" Tanks

List Price
$ 593.00

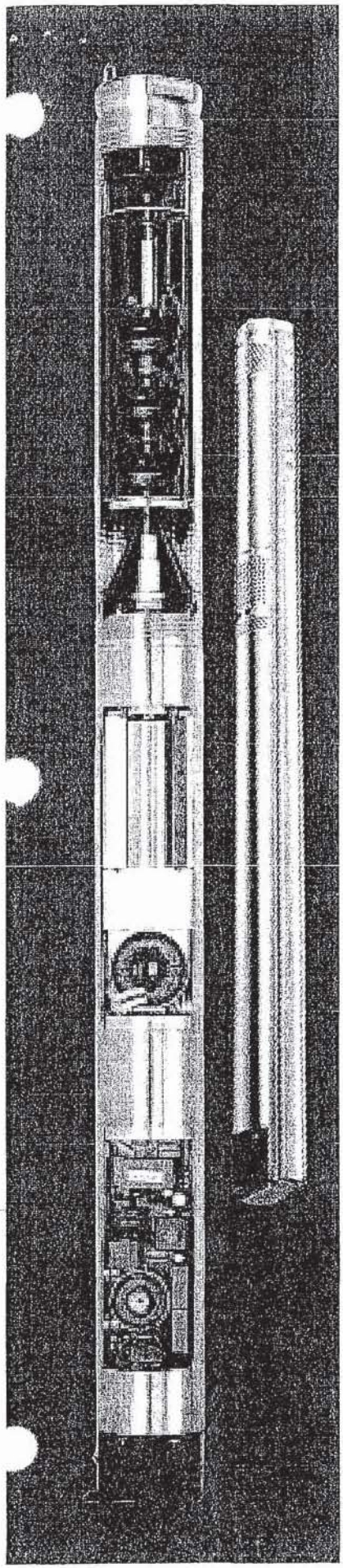
FIBERGLASS Vertical Storage Tanks



Standard Features:
2-3" Couplings
1-3" PVC Overflow
1-24" Top Vented Manway
2-Lift Lugs
1-3/4" Sight Gauge Tube

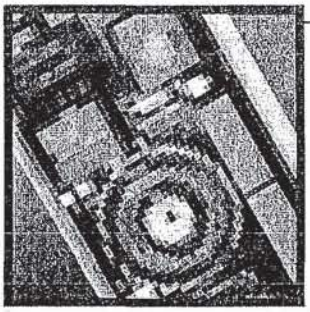
Gallons	Dia.	Sidewall Ht.	List $
10,000	10'	17'	$Quoted
11,780	10'	20'	Only
12,400	11'-6"	16'	
14,100	10'	24'	
15,500	11'-6"	20'	
20,000	11'-6"	26'	

Call For Freight Quote. Other Sizes Available-Call 1-800-351-1587



Redi-Flo3

Grundfos brings environmental pumping systems into the 21st century with the new Redi-Flo3 submersible pump.



Advanced Electronics

By combining advanced electronics, permanent-magnet motors, and Grundfos' own micro-frequency converter, we are now able to control and communicate with pumps in ways never before possible. A few of the features that come out of this combination are Fluid Level Control, Soft-Start and integrated Dry-Run Protection.

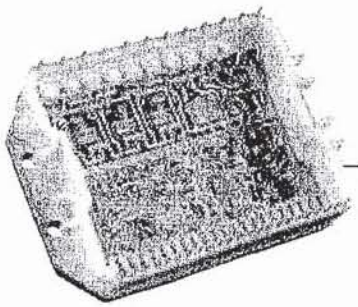
Permanent-Magnet Motor

The Redi-Flo3 features a newly developed permanent-magnet motor, controlled by advanced electronics, featuring Grundfos' micro-frequency converter.

As a result of the high and flat performance curve of the motor, a wider performance ratio can be covered by fewer models as compared to pumps with conventional motors.

The motor has a soft-start system which allows the pump to start with gradually increasing speed and with the highest possible starting torque.

The starting torque is 1.5 times greater than a conventional 3-wire motor.

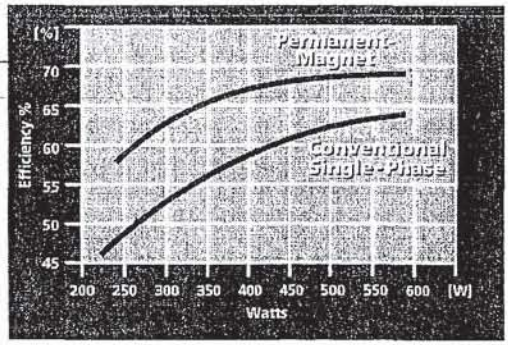


Micro-Frequency Converter

The Grundfos' designed micro-frequency converter controls the permanent-magnet motor.

Motor Efficiency Curve

Permanent-magnet motors produce a high efficiency over a wide load range as compared to conventional single-phase motors.



GRUNDFOS

Leaders in Pump Technology

Redi-Flo3

Technical Data

Status Box/R100 Infrared Remote

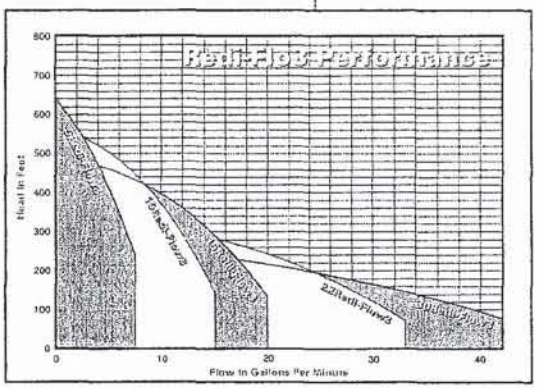
The optional Redi-Flo3 status box and R100 at the surface allows you to communicate with the pumps integrated electronics through the standard power leads. No additional wires are required! This feature provides the direct use of multiple sensors, digital input and relays without adding any extra electronics and cost. Pump status readout and parameter changes can easily be performed at the surface with the R100 or the Redi-Flo3 PC Tool.

Rugged Design

Redi-Flo3 pump design uses "floating" impellers. Each impeller has its own tungsten carbide/ceramic bearing. This design and the environmentally tough 316 stainless steel and PVDF construction provide excellent wear resistance and solids handling capability

Reliable Check Valves

Reliable built-in spring loaded check valves let you operate the pump in any position from vertical to horizontal.



ELECTRIC

Supply Voltage:	1x200-240v, 50/60 Hz
Operation via Generator:	The generator output must be equal to the motor P1[KW] -10%.
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate.
Starting:	Soft-start
Run-up Time:	Maximum: 2 seconds
Motor Protection:	The motor is protected against: dry-run, overvoltage, undervoltage, overload, over temperature.
Power Factor:	PF = 1
Power Lead:	Continuous length Tefzel Cable Kit.

PIPING CONNECTION

Discharge Port:	5-Redi-Flo3 - 1" NPT 10-15-Redi-Flo3 - 1 1/4" NPT 22-30-Redi-Flo3 - 1 1/2" NPT

APPROXIMATE DIMENSIONS AND WEIGHT

Motor Dimensions (MSE 3-NE):	
0.33-0.50A Hp	20.9" length x 2.68" diameter
0.50-0.75B Hp	20.9" length x 2.68" diameter
1.0-1.5C Hp	22.3" length x 2.68" diameter
Motor Weights (MSE 3-NE):	
0.33-0.50A Hp	6.0 lbs
0.50-0.75B Hp	7.1 lbs
1.0-1.5C Hp	8.2 lbs
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions (min. and max.):	
5-Redi-Flo3	10.6" to 18.0"
10-Redi-Flo3	10.6" to 16.9"
15-Redi-Flo3	10.6" to 16.9"
22-Redi-Flo3	10.6" to 16.9"
30-Redi-Flo3	10.6" to 13.7"
Pump End Weights (min. and max.):	
All Models	2.2 lbs to 3.5 lbs
Well Diameter (minimum):	3"

GRUNDFOS

Leaders in Pump Technology

Grundfos Pumps Corporation
3131 N. Business Park Avenue, Fresno, CA 93727
(559) 292-8000 FAX (559) 291-1357

Grundfos Canada, Inc.
2941 Brighton Rd.
Oakville, Ontario L6H 6C9, Canada
(905) 829-9533 FAX (905) 329-9512

Bombas Grundfos de Mexico, S.A. de C.V.
Boulevard TLC #15, Parque Industrial Stiva Aeropuerto
C.P. 66600 Apodaca, N.L. Mexico
52-8-144-4000 FAX 52-8-144-4010

Visit our website at www.us.grundfos.com

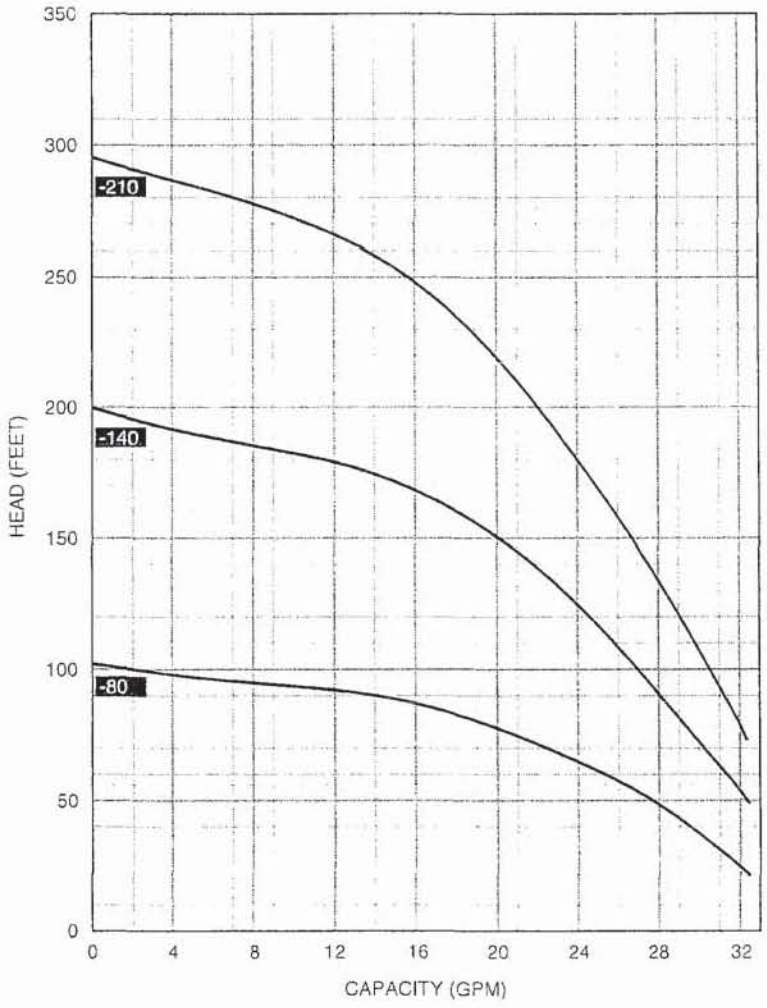
Available from:

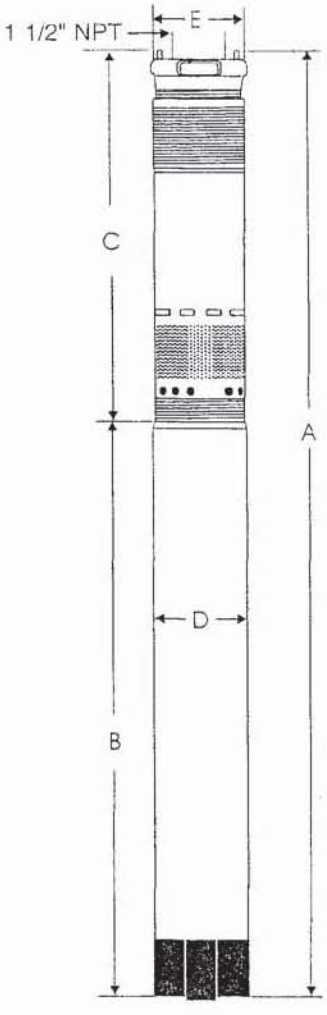
Performance curves and technical information listed as a range only and subject to change without notice. Consult Grundfos product data for exact pump specifications.

LRFSL-005 | 4/00
PRINTED IN U.S.A.

Model #	HP	Size	Disch. Size	Dimensions in Inches					Approx. Ship Wt.
				A	B	C	D	E	(pounds)
22Redi-Flo3-80	1/2A	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
22Redi-Flo3-140	3/4B	3"	1 1/2" NPT	33.6	19.8	13.7	2.6	2.9	13
22Redi-Flo3-210	1 1/2C	3"	1 1/2" NPT	38.2	21.3	16.9	2.6	2.9	16

Note: Weights include pump ends with motors





LIMITED WARRANTY

Products manufactured by GRUNDFOS are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS factory or authorized service station, any product of GRUNDFOS manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

MANUFACTURER WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE. EXCEPT AS EXPRESSLY HEREIN PROVIDED THE GOODS ARE SOLD "AS IS", THE ENTIRE RISK AS TO QUALITY AND FITNESS FOR A PARTICULAR PURPOSE, AND PERFORMANCE OF THE GOODS IS WITH THE BUYER, AND SHOULD THE GOODS PROVE DEFECTIVE FOLLOWING THEIR PURCHASE, THE BUYER AND NOT THE MANUFACTURER, DISTRIBUTOR, OR RETAILER ASSUMES THE ENTIRE RISK OF ALL NECESSARY SERVICING OR REPAIR.

Some jurisdictions do not allow the exclusion or limitation of implied warranties of merchantability and fitness for a particular purpose, of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last or require you to pay certain expenses as set forth above. Therefore, 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 jurisdiction to jurisdiction.

The telephone number of our service and repair facilities central directory, from which you can obtain the locations of our service and repair facilities is, 1-800-333-1366.

GRUNDFOS

Leaders in Pump Technology

Grundfos Pumps Corporation • 3131 N. Business Park Ave., Fresno, CA 93727
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Visit our website at www.us.grundfos.com

L-RF-IO-008 Rev.2/00
PRINTED IN USA

Redi-Flo 3

SQE-NE
Environmental Pumps

Installation and Operating Instructions

- Efficient Permanent Magnet Motor
- High Starting Torque
- Soft Start
  (2 seconds to reach maximum rpm, and maximum pressure)
- Built-in "Smart" Motor Protection with automatic restart
- Communication Through the Redi-Flo3 Status Box
- Integrated Protection Against Adverse Conditions
- Environmental Materials of Construction

Please leave these instructions with the pump for future reference

GRUNDFOS

Leaders in Pump Technology

SAFETY WARNING

Electrical Work

WARNING: To reduce the risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected 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 supplying the pump) to the grounding screw provided within the wiring compartment.

Pre-Installation Checklist

1. Well Preparation

If the pump is to be installed in a new well then the well should be fully developed and bailed or blown free of cuttings and sand. The construction of the GRUNDFOS Redi-Flo3 submersibles makes it resistant to abrasion; however, no pump made of any material can forever withstand the destructive wear that occurs when constantly pumping sandy water.

2. Make Sure You Have the Right Pump

Determine the maximum depth of the well, and the drawdown level at the pump's maximum capacity. Pump selection and setting depth should be made based on this data.

3. Pumped Fluid Requirements

Submersible well pumps are designed for pumping turbid free, cool water; free of air or gases. Possible decreased pump performance and life expectancy can occur when operating in conditions outside of this chemistry. Water temperature ideally should not exceed 104°F. Extended pump life and optimal performance can best be obtained through proper well development and in the case of higher fluid temperatures use a cooling shroud.

A check should be made to ensure that the installation depth of the pump will always be at least three feet below the maximum drawdown level of the well (Fig.1). The bottom of the motor should never be installed lower than the bottom of the screen.

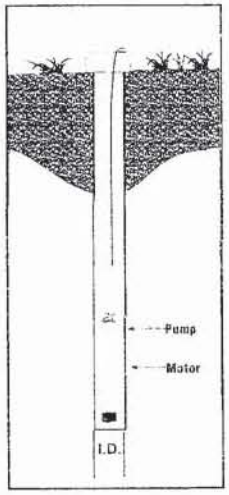


Fig. 1

4. Motor Cooling Requirements

To ensure proper motor cooling refer to the table below for minimum flow requirements:

Flow velocity past the motor	Maximum liquid temperature
0.0 f/s (free convection)	86° F(30°C)
Min. 0.5 f/s	104°F (40°C)

If the pump is to be installed horizontally, e.g. in a tank, and there is a risk that the pump might be covered by mud, it must be installed in a flow sleeve.

Liquid temperatures/cooling

Figure 2 shows an operating Redi-Flo3 pump installed in a well.

Figure 2 illustrates the following:

- Well diameter.
- Pump diameter.
- Temperature of pumped liquid.
- Flow past the motor to the pump strainer.

Note: The well diameter must be at least 3". If there is a risk that the motor will be covered with sediment or the pumped fluid is at an elevated temperature then it is recommended the pump be placed in a Flow Sleeve. The motor should always be installed above the well screen.

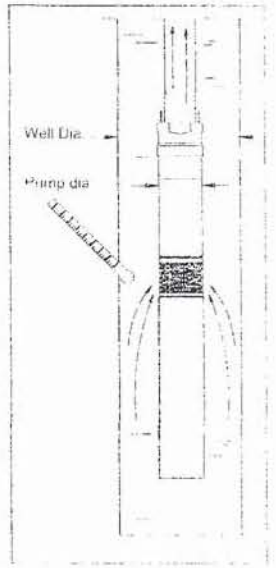


Fig. 2

5. Applications

Typical applications:

Environmental applications such as:

- Remediation pumping.
- Leachate recovery.
- Pollution recovery.
- Dewatering

6. Motor Preparation

GRUNDFOS MSE3-NE submersible motors have water-lubricated slide bearings. No additional lubrication is required.

The submersible motors are factory-filled with a special GRUNDFOS motor liquid (type SML 2), which will protect the motor fluid down to -4°F(20°C) and to prevent the growth of bacteria. The level of motor fluid is important for the operating life of the bearings and consequently the life of the motor.

Refilling of motor liquid

It is recommended to check and if needed, refill the motor with GRUNDFOS motor fluid SML 2.

Pre-Installation Checklist

To refill the motor, proceed as follows:

1. Remove the cable guard and separate the pump end from the motor.

2. Place the motor in vertical position with an inclination of approx. 10°.

3. Remove the filling plug using a screwdriver or a similar tool.

4. Inject motor liquid into the motor with a filling syringe or similar tool,see fig. 3.

5. To allow possible air to escape, move the motor from side to side. And turn the shaft.

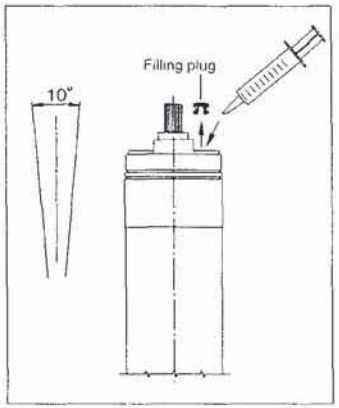


Fig. 3

6. Replace the filling plug and make sure it is tight.

7. Assemble pump end and motor.

8. Install the cable guard.

The pump is now ready for installation.

7. Installation Postions

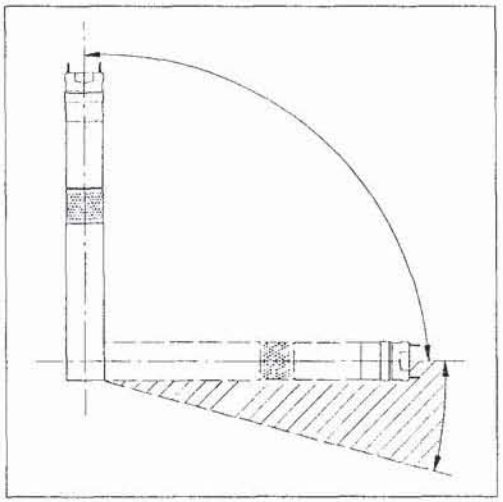


Fig. 4

Positional requirements
The pump is suitable for vertical as well as horizontal installation, however, the pump shaft must never fall below the horizontal plane, see fig. 4.

Installation Procedures

8. Electrical connection

General
The electrical connection should be carried out by an authorized electrician in accordance with local regulations.

Before starting work on the pump, make sure the electricity supply has been switched off and that it cannot be accidentally switched on. The pump must be grounded. The pump must be connected to an external mains switch.

The supply voltage, rated maximum current and power factor (PF) appear on the motor nameplate. The required voltage for GRUNDFOS submersible MSE3-NE motors, measured at the motor terminals, is +6%/–10% of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables).

If the pump is connected to an installation where a Ground Fault circuit breaker (GFI) is used as additional protection, this circuit breaker must trip out when ground fault currents with DC content (pulsating DC) occur.

Supply voltage:1 x 100-115V or 1 x 200-240 V +6%/–10%, 50/60 Hz.

The current consumption can only accurately be measured by means of a true RMS instrument. If other instruments are used, the value measured will differ from the actual value.
The Redi-Flo3 pumps can be connected to a Redi-Flo3 status box.

Note: The pump must never be connected to a capacitor or to another type of control box other than a Redi-Flo3 status box. The pump must never be connected to an external frequency converter.

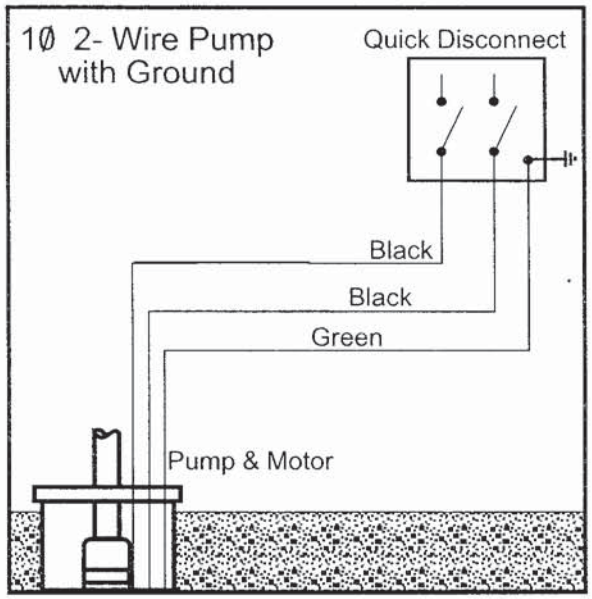
Motor protection
The motor has built-in automatic thermal overload protection and requires no additional motor protection.

Connection of motor
The motor can be connected directly to the main circuit breaker.

9. Making the Wiring Connections

WARNING!
To reduce the risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected 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 supplying the pump.

Single-Phase 2-wire Wiring Diagram for GRUNDFOS Motors



A capacitor or control box should NEVER be connected to a Redi-Flo3 submersible pump.

Fig. 5

10. Cable Sizing

SINGLE-PHASE 60 HZ Maximum Cable Length Motor Service to Entrance

Motor Rating		Copper Wire Size								
VOLTS	HP	14	12	10	8	6	4	2	0	00
115	1/3	130	210	340	540	840	1300	1960	2910	
	1/2	100	160	250	390	620	960	1460	2160	
230	1/3	550	880	1390	2190	3400	5250	7960		
	1/2	400	650	1020	1610	2510	3880	5880		
	3/4	300	480	760	1200	1870	2890	4370	6470	
	1	250	400	630	990	1540	2380	3610	5360	6520
	1 1/2	190	310	480	770	1200	1870	2850	4280	5240

11. Motor Cable

Redi-Flo3 pumps are specifically designed to be used with Grundfos SQE-NE Tefzel motor leads. Standard SQE-NE Tefzel motor leads are available between 25 and 300 foot lengths in 5 foot increments. Custom lengths longer than 300 feet are available in 10 foot increments up to 600 feet from the factory.

General

Note: Do not lower or lift the pump by means of the motor cable.

The loose data plate supplied with the pump should be placed close to the installation site.

12. Installing the cable plug to the motor

To install the cable plug, proceed as follows:

1. Check that the cable is of the correct type, cross-section and length.
2. Check that the mains on the location has correct connection to ground.
3. Check that the motor socket is clean and dry.
4. Press the cable plug into the motor socket. The plug will only fit one way, see fig. 6.
5. Install and tighten the four nuts, see fig. 6. When the plug has been installed, there must not be a clearance between the motor and the cable plug.

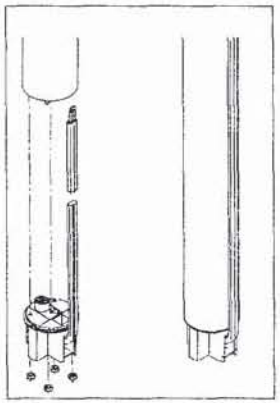


Fig. 6

13. Installing the cable guard

To fit the cable guard, proceed as follows:

1. Make sure that the motor lead lies flat in the cable guard.
2. The two flaps of the cable guard must engage with the upper edge of the pump sleeve, see fig. 7.

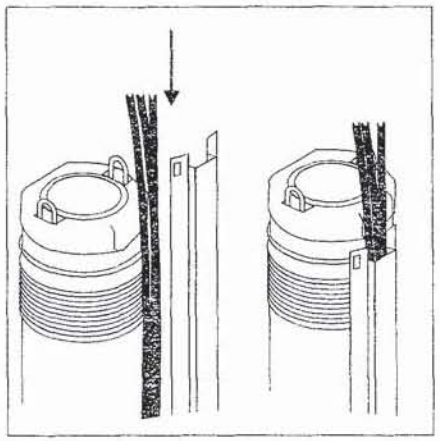


Fig. 7

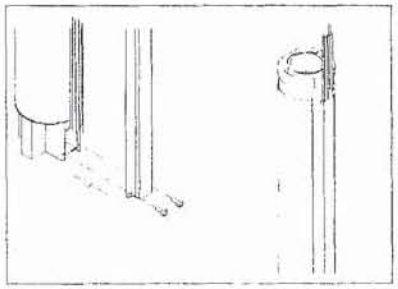


Fig. 8

3. Fasten the cable guard to the cable plug with the four screws supplied, see fig. 8.

14. Piping

- The pump should only be gripped by the two flats at the top of the pump, as shown in fig. 9.
- The pump can be installed vertically or horizontally. During operation, the pump must always be completely submerged in water.
- When plastic pipe is used, a stainless steel safety wire is recommended for lowering and lifting the pump. Fasten the wire to the eyelet on the pump, as shown in fig. 10.
- The threaded joints must be well cut and fit together tightly to ensure that they do not work loose.

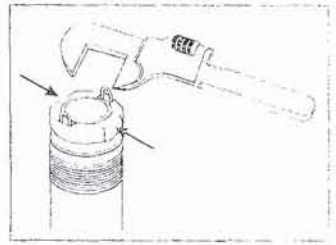


Fig. 9

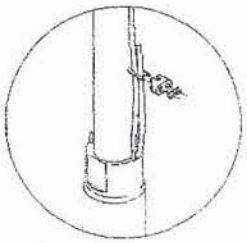


Fig. 10

15. Installing the Pump

Installation Depth

The dynamic water level should always be above the pump see fig. 11.

A = Dynamic water level
B = Static Water Level
C = Minimum 3" well diameter
D = Drawdown
E = Installation depth below static water level. Maximum 500 feet

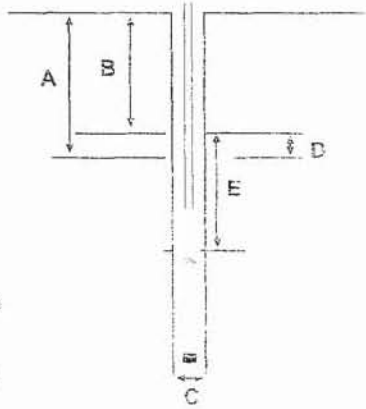


Fig. 11

Procedures

To install the pump, follow these steps:

1. Install the enclosed data plate sticker at the well head.
2. Check the well for proper clearance — the well must be at least 3" in diameter. It is a good idea to check the well for clearance using a plumb ring (2.95 ø x 10 in.).
3. Attach the first section of riser pipe to the pump.

16. Installing the Pump(cont.)

4. Lower the pump into the well. Make sure the motor cable is not damaged when the pump is lifted or lowered into the well — especially in 3" wells. ***NOTE***: **Do not lower or lift the pump using the motor cable.**
5. When the pump has been installed to the required depth, the installation should be finished by means of a well seal. Note that the dynamic water level should always be above the pump.
6. Loosen the safety wire so that it becomes unloaded and lock it to the well seal using a cable clamp.
7. Attach the supplemental information label at the electrical installation site.
8. Complete the electrical connections. **Remember that a capacitor or a control box should NEVER be connected to a Redi-Flo3 submersible pump.**

Installation depths

Maximum installation depth: below the static water level: 500 feet,
Minimum installation depths: 1.75' below the dynamic water level:

Vertical installation:

During start-up and operation, the pump must always be completely submerged in water.

Horizontal installation:

The pump must be installed at least 1.75 ft. below the dynamic water level. If there is a risk that the pump might be covered by mud, the pump must always be placed in a flow sleeve.

17. Generator Operation

- It is OK to operate the Redi-Flo3 with a generator.

The generator must be sized 10% above the pumps P1 (Input Power) values.
Use the table to select the correct size generator for the motor HP.

Motor HP	Min. Generator Size (Watts)
1/3 - 1/2 A	1000
1/2 - 3/4 B	1700
1- 1½ C	2000

18. Starting the Pump for the First Time

When the pump has been connected correctly, the pump should be started with the discharge valve closed approximately one-third. Due to the soft start feature, the pump takes approximately 2 seconds to develop full pressure.

Motor Cooling and Other Considerations

- Make sure the well is capable of yielding a minimum quantity of water corresponding to the pump capacity.
- Do not start the pump until it is completely submerged in the liquid.
- As the valve is being opened, the drawdown should be checked to ensure that the pump always remains submerged.
- To ensure the necessary cooling of the motor, the pump should never be set so low that it gives no water. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield.

Water Impurities

- If there are impurities in the water, the valve should be opened gradually as the water becomes clearer. The pump should not be stopped until the water is clean, otherwise the pump parts and the check valve may become clogged.
- When the water is clean the valve should be fully opened.

Minimum flow rate

- To ensure the necessary cooling of the motor, the pump flow rate should never be set to a value lower than .2 gpm. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield.

Note: The pump's dry-running protection is effective only within the recommended duty range of the pump.

Note: Do not let the pump run against a closed discharge valve for more than 5 minutes. When the discharge valve is closed, there is no cooling flow and there is a risk of overheating in motor and pump.

Operating the Pump

Built-in protection
The motor incorporates an electronic unit which protects the motor in various damaging situations.

In case of overload, the built-in overload protection will stop the pump for 5 minutes. After 5 minutes, the pump will attempt to restart.
If the pump is started and the well has not recovered, the pump will stop after 30 seconds.

If the pump has been stopped as a result of dry running, it will start automatically after 5 minutes or the reset time set by the R100.

Resetting the pump:
Switch off the electricity supply for 1 minute.
The motor is protected against the following conditions:
- dry running,
- voltage surges (up to 5000 V),
- overvoltage,
- undervoltage,
- overload
- overtemperature.

MSE 3NE Motors:
Note: To set Dry-Run limit in the MSE-NE pumps, you need to connect the pump to a Redi-Flo3 status box. Refer to Redi-Flo3 status box I&O for proper connections.

To set Dry-Run protection, follow these steps:
1. Start the pump against closed discharge.
2. Rapidly read the power consumption value (W) in the R100 display 2.5.
3. Multiply this value by 0.9.
4. Within the R100, go to display 4.6 and enter the new value (minimum power limit).
5. Go to display 4.7 and change the setting to "Active".

For further information on dry-running, refer to RediFlo3 Status Box I&O.

Maintenance and service:
The pumps are normally maintenance-free. Deposits and wear may occur. For that purpose, service kits and service tools are available from GRUNDFOS. The GRUNDFOS Service Manual is available on request. The pumps can be serviced at a GRUNDFOS service center.

19. Assembly of Pump and Motor

To assemble pump end and motor, proceed as follows:

1. Place the motor horizontally in a vice and tighten it, see fig. 12.
2. Grease the motor shaft end with a vegetable based grease.
3. Screw the pump end on the motor. A spanner may be used on the clamping faces of the pump part, see fig.12.
4. Install cable guard as described on page 7.

When pump end and motor have been assembled correctly, there must not be a clearance between pump end and motor.

To disassemble reverse procedure.

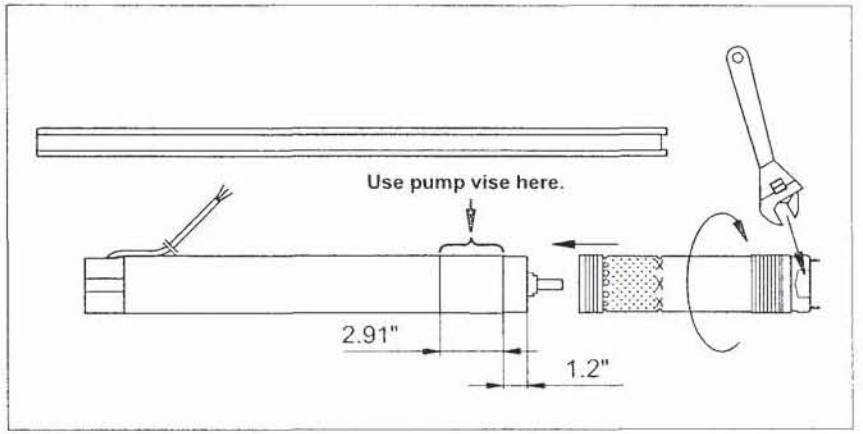


Fig. 12

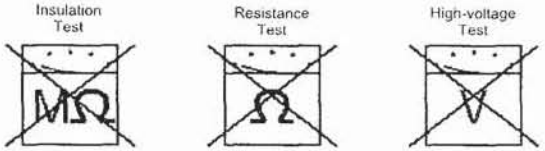
Troubleshooting

Fault	Cause	Remedy
1. The pump does not run	a. The fuses are blown	Replace the blown fuses. If the new fuses blow too, check the electrical installation and the drop cable.
	b. The GFI circuit breaker has tripped.	Reset the circuit breaker.
	c. No electricity supply.	Contact the Electricity provider.
	d. The motor protection has cut off the electricity supply due to overload.	Check for motor/pump blockage.
	e. The drop cable is defective.	Repair/replace the pump/cable.
	f. Overvoltage has occurred.	Check the electricity supply
2. The pump runs but gives no water.	a. The discharge is closed.	Open the valve
	b. No water or too low water level in well.	See item 3a.
	c. Check valve is stuck in it's closed position.	Pull the pump and clean or replace the valve.
	d. The suction strainer is closed.	Pull the pump and clean the strainer.
	e. The pump is defective.	Repair/replace the pump.
3. The pump runs at reduced capacity.	a. The drawdown is larger than anticipated.	Increase the installation depth of the pump, throttle the pump or replace it with a smaller capacity model.
	b. The valve s in the discharge pipe are partly closed/blocked.	Check and clean/replace the valves as necessary.
	c. The discharge pipe is partly chocked by impurities (Iron bacteria).	Clean/replace the discharge pipe.
	d. The non- return valve of the pump is blocked.	Pull the pump and check/replace the valve.
	e. The pump and the riser pipe are partly choked	Pull out the pump. Check and clean or replace the pump, if
	by impurities (Iron bacteria).	necessary. Clean the pipes.
	f. The pump is defective.	Repair/replace the pump.
	g. Hole in discharge pipe.	Check and repair the piping.
	h. The riser pipe is defective.	Replace.
	i. Undervoltage has occurred.	Check the electricity supply.
4. Frequent starts and stops.	a. The differential of the pressure switch between the start and stop pressures is too small.	Increase the differential. However, the stop pressure must not exceed the operating pressure of the pressure tank, and the start pressure should be high enough to ensure sufficient water supply.
	b. The water level electrodes or level switches in the reservior have not been installed correctly	Adjust the intervals of the electrodes/level switches to ensure suitable time between the cutting-in and cutting-out of the pump. See installation and operating instructions for the automatic devices used. If the intervals between start/stop cannot be changed via the automatics, the pump capacity may be reduced by throttling the discharge valve.
	c. Checkvalve is leaking or stuck half-open.	Pull the pump and clean/replace the non-return valve.
	d. The supply voltage is unstable.	Check the electrical supply.
	e. The motor temperature is too high.	Check the water temperature.

Troubleshooting

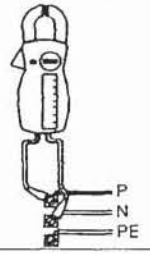
Instruments not allowed:

Note: The use of the following instruments is not allowed during fault finding:



Note: When measuring, use RMS-instruments.

Checking the motor and cable:

1. Supply voltage 	Measure the voltage L1 (RMS) between phase and L2. Connect the voltmeter to the terminals at the connections.	The voltage should, when the motor is loaded, be within the range specified on Page 4, large variations in supply voltage indicate poor electricity supply, and the pump should be stopped until the problem has been corrected.
2. Current consumption 	Measure the current (RMS) while the pump is operating at a constant discharge head(if possible, at capacity where the motor is heavily loaded). For maximum current, see motor nameplate.	If the current exceeds the full load current, there are the following possible faults: Poor connection in the leads, possibly in the cable joint. Too low supply voltage, see item 1 on Page 13.

Environment

During handling, operation, storage and transport, all environment regulations dealing with the handling of hazardous materials must be observed.

When the pump is taken out of operation, it must be ensured that no hazardous material is left in the pump and in the riser pipe, which can be injurous to persons and the environment.

Disposal

Disposal of this product or parts of it must be carried out according to the following guidelines:

1. Use the local public or private waste collection service.
2. If such waste collection service does not exist or cannot handle the materials used in the product, please deliver the product or any hazardous materials from it to your nearest GRUNDFOS company or service center.

Technical Data

Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE
Operation via Generator:	As a minimum, the generator output must be equal to the motor P1[KW] +10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft starting
Run-up Time:	Maximum : 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF= 1
Service Factor:	0.33-0.50A[HP]-1.75 at 230V 0.50-0.75A[HP]-1.4 at 230V 1.0 -1.5C[HP] -1.15 at 230V
Motor Cable: Length	3 Wire, 12 AWG TEFZEL Available in 5 ft. increments from 25ft.- 300ft.
Motor Liquid: **pH Values:**	Type SML 2 Redi-Flo3: 5 to 9
Liquid Temperature:	The temperature of the pumped liquid must not exceed 104°F.
Note: if liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
Discharge Port:	5SQE-NE- 1"NPT 10-15SQE-NE- 1 1/4" NPT 22-30SQE-NE- 1 1/2" NPT
STORAGE CONDITIONS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Freeze Protection:	If the pump has to be stored after use, it must be stored on a frost-free location or it must be ensured that the motor liquid is frost-proof. (**The motor must be stored without being filled with motor liquid.**)
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	34°F
Maximum Ambient Fluid Temperature:	+104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MSE3-NE):	
0.33-0.50A[hp]	20.9" length x 2.68" diameter
0.50-0.75B[hp]	20.9" length x 2.68" diameter
1.0-1.5C[hp]	22.3" length x 2.68" diameter
Motor Weights (MSE3-NE):	
0.33-0.50A[hp]	6.0 Lbs
0.50-0.75B[hp]	7.1 Lbs
1.0-1.5C[hp]	8.2 Lbs
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions(min. and max.):	
5SQE-NE	8.1" to 13.6"
10SQE-NE	8.1" to 14.5"
15SQE-NE	8.1" to 14.5"
22SQE-NE	8.1" to 14.5"
30SQE-NE	8.1" to 11.3"
Pump End Weights(min. and max.):	
All Redi-Flo3 Models	2.2 lbs to 3.5 lbs
Well Diameter (minimum):	3"
Installation Depth (Maximum):	500 feet, below static water level.

PUMP TYPE	HP	VOLTAGE	MAX. AMPS
5SQE03A-90-NE	1/3 A	230V/115V	3.9/7.8
5SQE03A-120-NE	1/3 A	230V/115V	3.9/7.8
5SQE05A-170-NE	1/2 A	230V/115V	4.9/9.8
5SQE05B-210-NE	1/2 B	230V	4.9
5SQE05B-250-NE	1/2 B	230V	4.9
5SQE07B-290-NE	3/4 B	230V	7.6
5SQE10C-340-NE	1 C	230V	7.6
5SQE10C-380-NE	1 C	230V	7.6
5SQE10C-420-NE	1 C	230V	7.6
10SQE03A-100-NE	1/3 A	230V/115V	3.9/7.8
10SQE05A-140-NE	1/2 A	230V/115V	4.9/9.8
10SQE05B-180-NE	1/2 B	230V	4.9
10SQE07B-220-NE	3/4 B	230V	7.6
10SQE10C-260-NE	1 C	230V	7.6
10SQE10C-300-NE	1 C	230V	7.6
10SQE15C-340-NE	1 1/2 C	230V	11.1
15SQE03A-70-NE	1/3 A	230V/115V	3.9/7.8
15SQE05A-110-NE	1/2 A	230V/115V	4.9/9.8
15SQE05B-130-NE	1/2 B	230V	4.9
15SQE07B-170-NE	3/4 B	230V	7.6
15SQE10C-200-NE	1 C	230V	7.6
15SQE10C-230-NE	1 C	230V	7.6
15SQE15C-270-NE	1 1/2 C	230V	11.1
22SQE03A-40-NE	1/3 A	230V/115V	3.9/7.8
22SQE05A-80-NE	1/2 A	230V/115V	4.9/9.8
22SQE05B-110-NE	1/2 B	230V	4.9
22SQE07B-140-NE	3/4 B	230V	7.6
22SQE10C-180-NE	1 C	230V	7.6
22SQE15C-210-NE	1 1/2 C	230V	11.1
30SQE05A-40-NE	1/2 A	230V/115V	4.9/9.8
30SQE05B-80-NE	1/2 B	230V	7.6
30SQE10C-120-NE	1 C	230V	7.6
30SQE15C-160-NE	1 1/2 C	230V	11.1

ACCESSORIES	
PRODUCT	PART NUMBER
CU 300	96422776
Flow Sleeve	96037505
Grease	96037562
Grundfos SPP1 Potentiometer	625468
RediFlo3 Motor Leads - available in 5ft. increments	See price list
25ft	96037428
50ft	96037429
75ft	96037430
100ft	96037431
125ft	96037432
150ft	96037433
175ft	96037434
200ft	96037435
225ft	96037436
250ft	96037437
300ft	96037438
R100 Infrared Remote	625333
HP Infrared Printer 822408	620480

ITT

Commercial Water

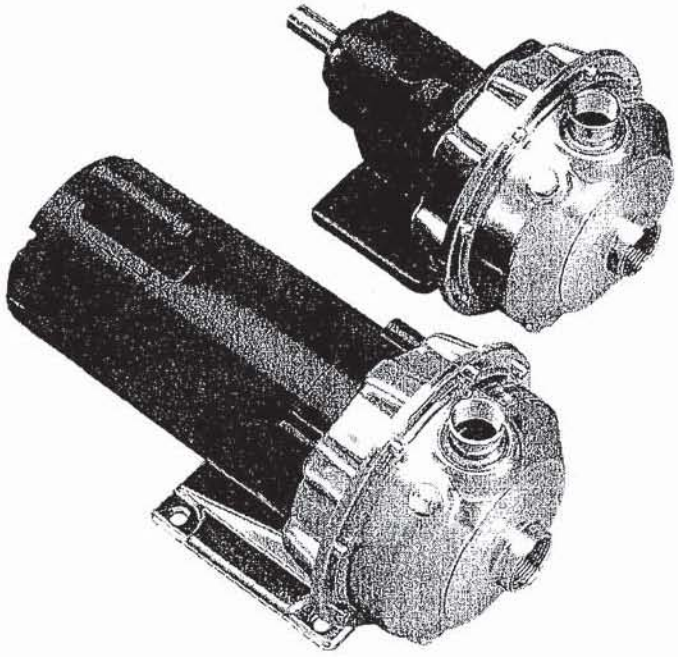
Goulds Pumps

G&L Series NPE

316L SS

NPE Series End Suction Centrifugal Pumps

Bombas Centrífugas de Succión Final Serie NPE



GOULDS PUMPS

Goulds Pumps is a brand of ITT Residential and Commercial Water.

Goulds Pumps es una marca de fábrica de ITT Agua Residencial y Comercial.

www.goulds.com

Engineered for life

A Full Range of Product Features
Una Gama Total de Características del Producto

Superior Materials of Construction: Complete AISI 316L stainless steel liquid handling components and mounting bracket for corrosion resistance, quality appearance, and improved strength and ductility.

High Efficiency Impeller: Enclosed impeller with unique floating seal ring design maintains maximum efficiencies over the life of the pump without adjustment.

Casing and Adapter Features: Stainless steel construction with NPT threaded, centerline connections, easily accessible vent, prime and drain connections with stainless steel plugs. Optional seal face vent/flush available.

Mechanical Seal: Standard John Crane Type 21 with carbon versus silicon-carbide faces, Viton elastomers, and 316 stainless metal parts. Optional high temperature and chemical duty seals available.

Motors: NEMA standard open drip-proof, totally enclosed fan cooled or explosion proof enclosures. Rugged ball bearing design for continuous duty under all operating conditions.

Materiales Superiores de Construcción: *Componentes completos para manejo de líquidos en acero inoxidable AISI 316L y consola para el montaje para resistencia a la corrosión, apariencia de calidad, y fuerza y ductilidad mejoradas.*

Impulsor de Eficiencia Superior: *El impulsor encerrado con un diseño único de anillo del sello flotante, mantiene sin ajustes, la eficiencia máxima sobre la vida de la bomba.*

Características de la Carcasa y del Adaptador: *Construcción en acero inoxidable con NPT roscado, conexiones centrales, válvulas de fácil acceso, conexiones de cebado y drenaje con enchufes de acero inoxidable. Cara del sello válvula/chorro opcional disponible.*

Sello Mecánico: *Estándar John Crane Tipo 21 con carbón en contraste con caras de silicón-carbide, elastómeros de Viton, y partes metálicas de acero inoxidable 316. Sellos de alta temperatura y productos químicos están disponibles.*

Motores: *Estándar NEMA a prueba de goteo, ventilador totalmente encerrado o recintos a prueba de explosión. Diseño robusto de balineras de bolas para trabajo continuo en todas las condiciones de funcionamiento.*

NPE Product Line Numbering System
Línea de Producto NPE Sistema de Numeración

Example Product Code,
Ejemplo Código del Producto

1 ST 2 C 1 A 4 F

Seal Vent/Flush Option,
Opción de Sello Válvula/ChorroSeal Ven

Mechanical Seal and O-ring
4 = Pre-engineered standard
For optional mechanical seal modify catalog order no. with seal code listed below.

Sello Mecánico y Anillo 'O'
4 = Estándar aprobado
Para sello mecánico opcional modificar el número de orden del catálogo con el código del sello anotado abajo.

John Crane Type 21 Mechanical Seal (⅝" seal), *Sello Mecánico John Crane Tipo 21 (sello de ⅝")*					
Seal Code, *Código del Sello*	Rotary, *Rotativo*	Stationary, *Estacionario*	Elastomers, *Elastómeros*	Metal Parts, *Partes Metálicas*	Part No., *Pieza Número*
2	Carbon	Silicon Carbide	EPR	316 SS	10K18
4			Viton		10K55
5	Silicon Carbide		EPR		10K81
6			Viton		10K62

Impeller Option . . . No Adder Required
For optional impeller diameters modify catalog order no. with impeller code listed. Select optional impeller diameter from pump performance curve.

Código del Impulsor Opcional
Para impulsores con diámetros opcionales modificar el número de orden del catálogo con el código del impulsor anotado. Escoger el impul con diámetro opcional de la curva de funcionamiento de la bomba.

Impeller Code, *Código del Impulsor*	Pump Size, *Tamaño de la Bomba*		
	1 x 1¼ – 6	1¼ x 1½ – 6	1½ x 2 – 6
	Diameter	Diameter	Diameter
K	–	6⅛	–
G	–	5 15/16	5⅜
H	–	5½	5
A	6⅛	5¼	4¼
B	5¾	5 15/16	4½
C	5 15/16	4⅞	4⅜
D	4¾	4⅝	4 11/16
E	4 11/16	4¼	3¾
F	4 11/16	3⅞	–

Driver, *Conductor*
1 = 1 PH, ODP 7 = 3 PH, XP
2 = 3 PH, ODP 8 = 575 V, XP
3 = 575 V, ODP 9 = 3 PH, TEFC Premium Eff.
4 = 1 PH, TEFC 0 = 1 PH, XP
5 = 3 PH, TEFC
6 = 575 V, TEFC

HP Rating, *HP Potencia*
C = ½ HP E = 1 HP G = 2 HP J = 5 HP
D = ¾ HP F = 1½ HP H = 3 HP

Driver: Hertz/Pole/RPM,
Conductor: Hercios/Polo/RPM
1 = 60 Hz, 2 pole, 3500 RPM
2 = 60 Hz, 4 pole, 1750 RPM
3 = 60 Hz, 6 pole, 1150 RPM
4 = 50 Hz, 2 pole, 2900 RPM
5 = 50 Hz, 4 pole, 1450 RPM

For frame mounted version, substitute the letters "FRM" in these positions.
Para la versión con el armazón montado, sustituya las letras "FRM" en estas posiciones.

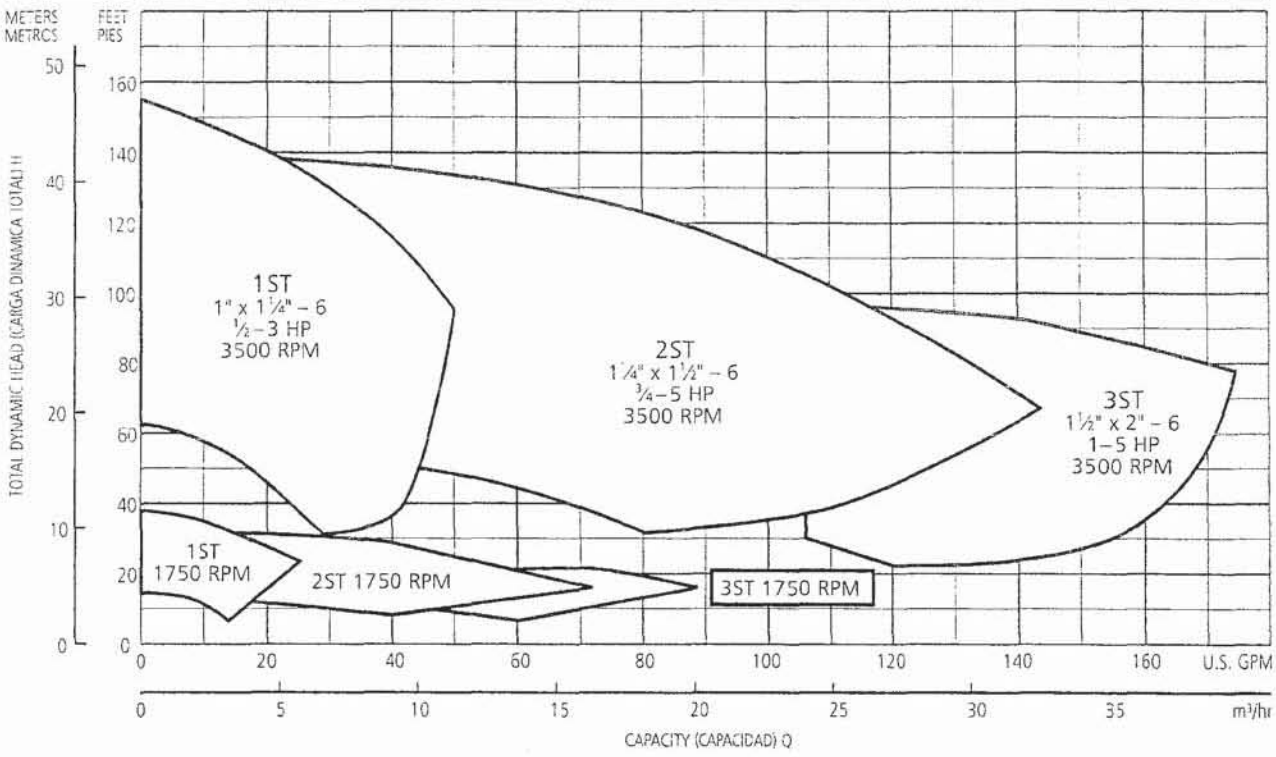
Material
ST = Stainless steel, *Acero inoxidable*

Pump Size, *Tamaño de la Bomba*
1 = 1 x 1¼ – 6 2 = 1¼ x 1½ – 6 3 = 1½ x 2 – 6

The various versions of the NPE are identified by a product code number on the pump label. This number is also the catalog number for the pump. The meaning of each digit in the product code number is shown at left.

Las diferentes versiones de la NPE se identifican con un número de código del producto en la etiqueta de la bomba. Este número es también el número del catálogo para la bomba. El significado de cada dígito en el número de código del producto se muestra a la izquierda.

Performance Coverage (60 Hz)
Alcance de Funcionamiento (60 Hz)



NOTES:

Not recommended for operation beyond printed H-Q curve.

For critical application conditions consult factory.

Not all combinations of motor, impeller and seal options are available for every pump model. Please check with G&L on non-cataloged numbers.

All standard 3500 RPM ODP and TEFC motors supplied by Goulds Pumps, have minimum of 1.15 service factor. Standard catalog units may utilize available service factor. Any motors supplied other than Goulds Pumps check available service factor.

NOTAS:

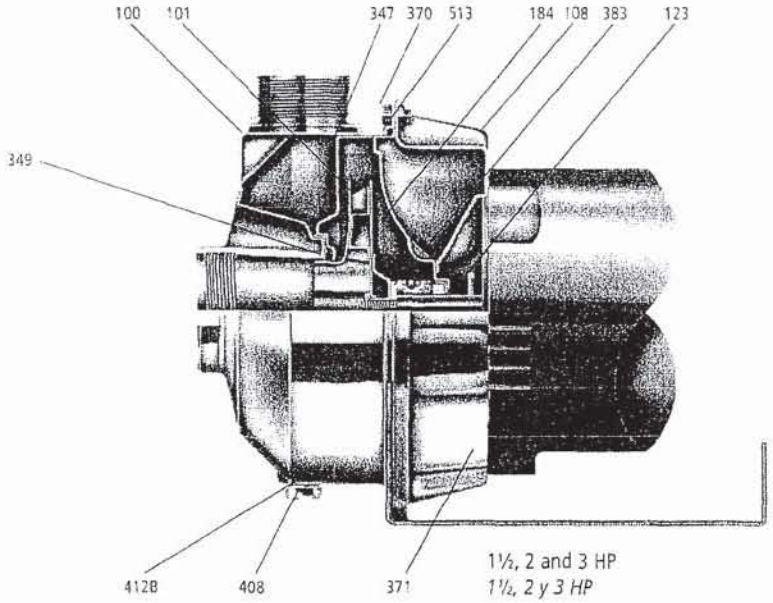
No se recomienda para funcionamiento superior al impreso en la curva H-Q.

Para condiciones de aplicaciones críticas consultar con la fábrica.

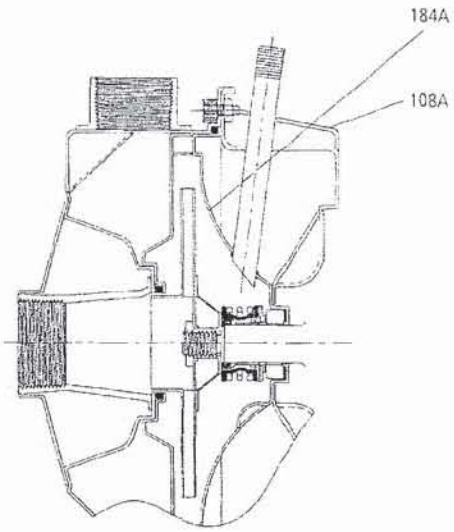
No todas las combinaciones de las opciones de motor, impulsor y sello están disponibles para cada modelo de bombas. Por favor verifique con G&L en los números no catalogados.

Todos los motores estándar de 3500 RPM, ODP (abiertos resguardados) y TEFC (totalmente encerrados con enfriamiento forzado) provistos por Goulds Pumps tienen un factor mínimo de servicio de 1,15. Las unidades estándar de catálogo pueden utilizar el factor de servicio disponible. Verificar el factor de servicio disponible de todo motor no provisto por Goulds Pumps.

NPE Close Coupled Pump Major Components: Materials of Construction
Bomba Cerrada Acoplada NPE Componentes Principales: Materiales de Construcción

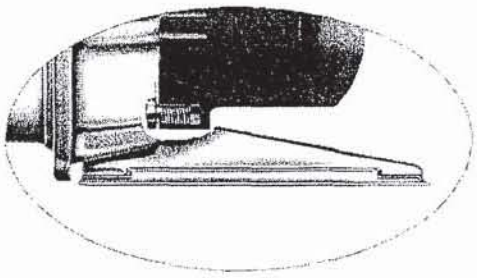


1½, 2 and 3 HP
1½, 2 y 3 HP



Seal Face Vent/Flush Option,
Opción Cara del Sello Válvula/Chorro

Item No., Parte No.	Description, Descripción	Materials, Materiales
100	Casing, *Carcasa*	AISI 316L SS, *AISI 316L Acero inoxidable*
101	Impeller, *Impulsor*	
108	Motor adapter, *Adaptador del motor*	
108A	Motor adapter seal vent/flush, *Sello válvula/chorro del adaptador del motor*	
123	Deflector, *Deflector*	BUNA-N
184	Seal housing, *Alojamiento del sello*	AISI 316L SS, *AISI 316L Acero inoxidable*
184 A	Seal housing seal vent/flush, *Sello válvula/chorro del alojamiento del sello*	
347	Guidevane, *Difusor*	
349	Seal ring, guidevane; *Anillo del sello, difusor*	Viton
370	Socket head screws, casing; *Encajes cabezas de tornillos, carcasa*	AISI 410 SS, *AISI 410 Acero inoxidable*
371	Bolts, motor; *Tornillos, motor*	Plated steel, Acero chapeado
383	Mechanical seal, *Sello mecánico*	**see chart, *ver tabla*
408	Drain and vent plug, casing, *Enchufes de drenaje y válvula, carcasa*	AISI 316L SS, *AISI 316L Acero inoxidable*
412B	O-ring, drain and vent plug; *Anillo 'O', enchufe de drenaje y válvula*	Viton (Standard, *estándar*) EPR (Optional, *Opcional*)
513	O-ring, casing; *Anillo 'O', carcasa*	
Motor *Motor*	NEMA standard, 56J flange; *NEMA estándar, brida 56J*	

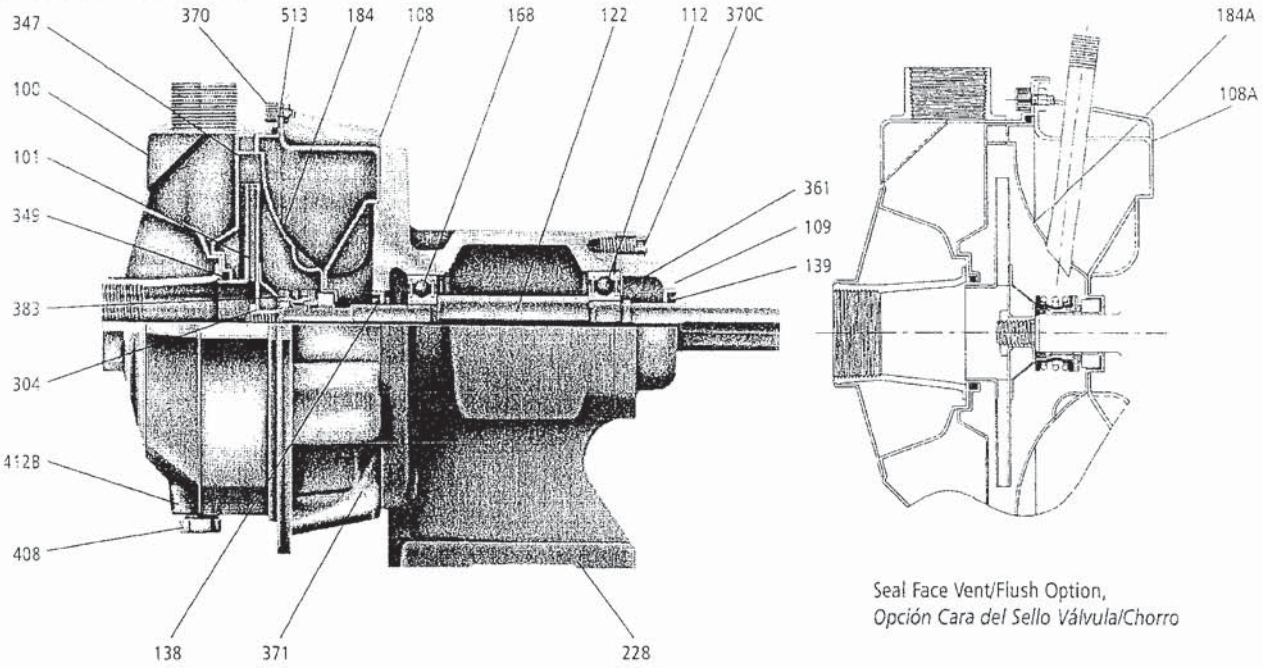


½, ¾ and 1 HP
½, ¾ y 1 HP

Footed motor for 5 HP ODP and TEFC, all explosion proof motors, see page 13.

Motor con pie para 5 HP ODP y TEFC, a prueba de explosiones motores, en la página 13.

NPE Frame Mounted Pump Major Components: Materials of Construction
Bomba NPE de Armazón Montado Componentes Principales: Materiales de Construcción

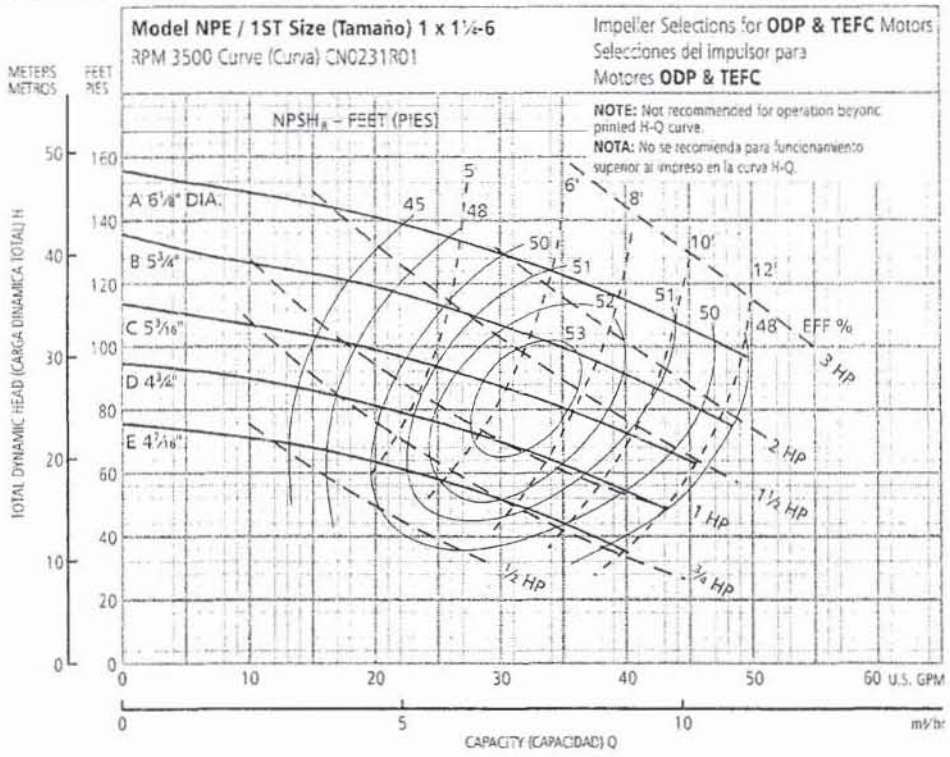


Seal Face Vent/Flush Option,
Opción Cara del Sello Válvula/Chorro

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
100	Casing, *Carcasa*	AISI 316L SS, *AISI 316L Acero inoxidable*
101	Impeller, *Impulsor*	
108	Adapter, *Adaptador*	
108A	Motor adapter seal vent/flush, *Sello válvula/chorro del adaptador del motor*	
109	Bearing cover, *Cubierta de balineras*	Cast iron, *Hierro fundido*
112	Ball bearing (outboard), *Balineras de bolas (exterior)*	Steel, *Acero*
122	Shaft, *Eje*	AISI 316 SS, *AISI 316 Acero inoxidable*
138	Lip-seal (inboard), *Sello cubierto (interior)*	BUNA/steel, *BUNA/acero*
139	Lip-seal (outboard), *Sello cubierto (exterior)*	BUNA/steel, *BUNA/acero*
168	Ball bearing (inboard), *Balineras de bolas (interior)*	Steel, *Acero*
184	Seal housing, *Alojamiento del sello*	AISI 316L SS, *AISI 316L Acero inoxidable*
184 A	Seal housing seal vent/flush, *Sello válvula/chorro del alojamiento del sello*	
228	Bearing frame, *Armazón de balineras*	Cast iron, *Hierro fundido*

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
304	Impeller locknut, *Contratuerca del impulsor*	AISI 316 SS, *AISI 316 Acero inoxidable*
347	Guidevane, *Difusor*	
349	Seal ring, guidevane; *Anillo del sello, difusor*	Viton
361	Retaining ring, *Anillo de retención*	Steel, Acero
370	Socket head screws, casing; *Encaje cabeza del tornillo, carcasa*	AISI 410 SS, *AISI 410 Acero inoxidable*
370C	Hex head screw, bearing cover; *Tornillo de cabeza hexagonal, cubierta de balineras*	Plated steel, *Acero chapeado*
371	Hex head screw, bearing frame; *Tornillo de cabeza hexagonal, armazón de balineras*	Plated steel, *Acero chapeado*
383	Mechanical seal, *Sello mecánico*	**see chart, ver tabla
400	Shaft key, *Llave del eje*	Steel, Acero
408	Drain and vent plug, casing; *Enchufes de drenaje y válvula, carcasa*	AISI 316 SS, *AISI 316 Acero inoxidable*
412B	O-ring, drain and vent plug; *Anillo 'O', enchufe de drenaje y válvula*	Viton (Standard, *estándar*) EPR (Optional, *Opcional*)
513	O-ring, casing; *Anillo 'O', carcasa*	

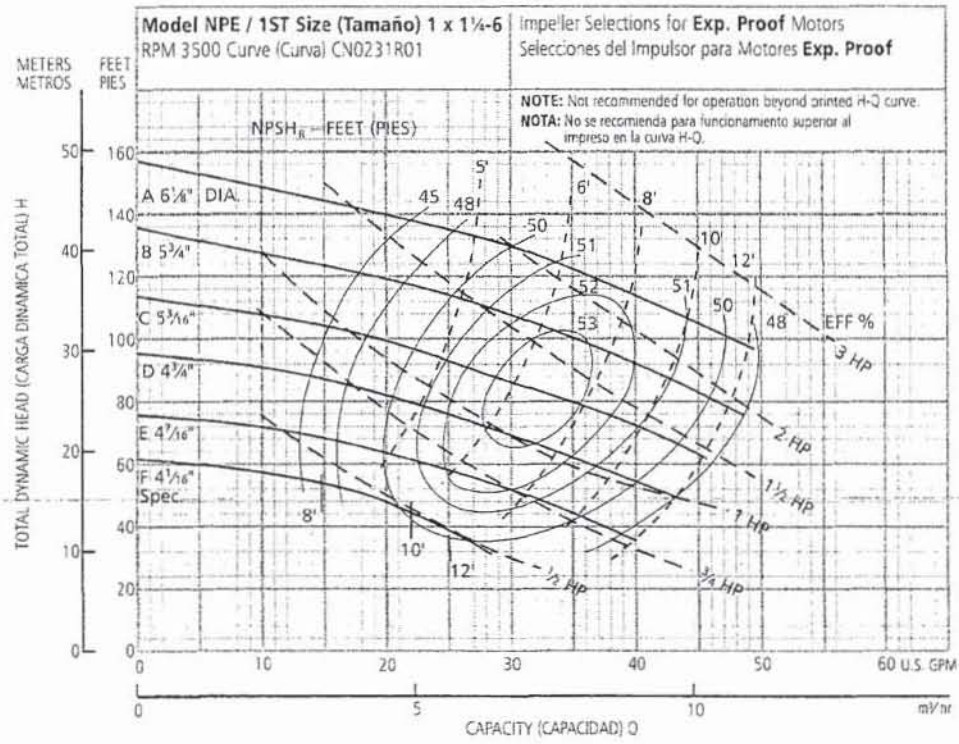
Performance Curves – 60 Hz, 3500 RPM
Curvas de Funcionamiento - 60 Hz, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	½	4⁷⁄₁₆"
D	¾	4¾
C	1	5³⁄₁₆
B	1½	5¾
A	2	6⅛

NOTE: Although not recommended, the pump may pass a ⁵⁄₁₆" sphere.

NOTA: Si bien no se recomienda, la bomba puede pasar una esfera de ⁵⁄₁₆".



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	½	4¹⁄₁₆" spec.
E	¾	4⁷⁄₁₆
D	1	4¾
C	1½	5³⁄₁₆
B	2	5¾
A	3	6⅛

NOTE: Although not recommended, the pump may pass a ⁵⁄₁₆" sphere

NOTA: Si bien no se recomienda, la bomba puede pasar una esfera de ⁵⁄₁₆".

HARVEL

PVC Industrial Pipe: Schedule 80

Application:

Corrosion resistant pressure pipe. IPS sizes ¼" through 24" for use at temperatures up to and including 140° F. Pressure rating (210 psi to 1230 psi) varies with schedule, pipe size, and temperature as stated in Harvel Plastics, Inc. engineering bulletin (Product Bulletin 112-401). Generally resistant to most acids, bases, salts, aliphatic solutions, oxidants, and halogens. Chemical resistance data is available and should be referenced for proper material selection. Pipe exhibits excellent physical properties and flammability characteristics (independently tested flame and smoke characteristics-ULC). Typical applications include: chemical processing, plating, high purity applications, potable water systems, water and wastewater treatment, irrigation, agricultural, and other industrial applications involving corrosive fluid transfer.

Scope:

This specification outlines minimum manufacturing requirements for Polyvinyl Chloride (PVC) Schedule 80 iron pipe size (IPS) pressure pipe. This pipe is intended for use in applications where the fluid conveyed does not exceed 140° F. This pipe meets and or exceeds the industry standards and requirements as set forth by the American Society for Testing and Materials (ASTM) and the National Sanitation Foundation (NSF International).

PVC Materials:

The material used in the manufacture of the pipe shall be domestically produced rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784, trade name designation H707 PVC. This compound shall be gray in color as specified, and shall be approved by NSF International for use with potable water (NSF Std 61).

Dimensions:

PVC Schedule 80 pipe shall be manufactured in strict accordance to the requirements of ASTM D1785 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to this standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM D1785. All belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D2672. All PVC Schedule 80 pipe must also meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid PVC pipe for pressure applications, and shall bear the mark of these Listing agencies. This pipe shall have a flame spread rating of 0-25 when tested for surface burning characteristics in accordance with CAN/ULC-S102-2-M88 or equivalent.

Marking:

Product marking shall meet the requirements of ASTM D1785 and shall include: the manufacturer's name (or the manufacturer's trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73°F; the ASTM designation D1785; the independent laboratory's seal of approval for potable water usage; and the date and time of manufacture.

Sample Specification:

All PVC Schedule 80 pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785, consistently meeting and/or exceeding the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be manufactured in the USA, using domestic materials, by an ISO 9001 certified manufacturer. Standard lengths of pipe sizes 6" and larger shall be beveled each end by the pipe manufacturer. All pipe shall be stored indoors after production at the manufacturing site until shipped from factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications. All pipe shall be manufactured by HARVEL PLASTICS, INC.

PVC Industrial Pipe: Schedule 80

Schedule 80 Dimensions

Nom. Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nom. Wt./Ft.	Max. W.P.
1/8	0.405	0.195	0.095	0.063	1230
1/4	0.540	0.282	0.119	0.105	1130
3/8	0.675	0.403	0.126	0.146	920
1/2	0.840	0.526	0.147	0.213	850
3/4	1.050	0.722	0.154	0.289	690
1	1.315	0.936	0.179	0.424	630
1-1/4	1.660	1.255	0.191	0.586	520
1-1/2	1.900	1.476	0.200	0.711	470
2	2.375	1.913	0.218	0.984	400
2-1/2	2.875	2.290	0.276	1.500	420
3	3.500	2.864	0.300	2.010	370
3-1/2	4.000	3.326	0.318	2.452	350
4	4.500	3.786	0.337	2.938	320
5	5.563	4.768	0.375	4.078	290
6	6.625	5.709	0.432	5.610	280
8	8.625	7.565	0.500	8.522	250
10	10.750	9.493	0.593	12.635	230
12	12.750	11.294	0.687	17.384	230
14	14.000	12.410	0.750	20.852	220
16	16.000	14.213	0.843	26.810	220
18	18.000	16.014	0.937	33.544	220
20	20.000	17.814	1.031	41.047	220
24	24.000	21.418	1.218	58.233	210

The pressure ratings given are for water, non-shock, @ 73°F. The following temperature de-rating factors are to be applied to the working pressure ratings (WP) listed when operating at elevated temperatures.

Multiply the working pressure rating of the selected pipe at 73°F by the appropriate de-rating factor to determine the maximum working pressure rating of the pipe at the elevated temperature chosen.

EX:
10" PVC SCH 80 @ 120°F = ?
230 psi x 0.40 = 92 psi max. @ 120°F

De-Rating Factor

Operating Temp (°F)	De-Rating Factor
73	1.00
80	0.88
90	0.75
100	0.62
110	0.51
120	0.40
130	0.31
140	0.22

THE MAXIMUM SERVICE TEMPERATURE FOR PVC IS 140°F.

Solvent-cemented joints should be utilized when working at or near maximum temperatures. Harvel Plastics does not recommend the use of PVC for threaded connections at temperatures above 110°F; use flanged joints, unions, or roll grooved couplings where disassembly is necessary at elevated temperatures.

Thread only Schedule 80 or heavier walls. *Threading requires a 50% reduction in pressure rating stated for plain end pipe @73°F.* Threading of Schedule 40 PVC pipe is not a recommended practice due to insufficient wall thickness.

Chemical resistance data should be referenced for proper material selection and possible de-rating when working with fluids other than water. Refer to Harvel Plastics 112-401 Product Bulletin for chemical resistance, installation data, and additional information.

ASTM STANDARD D1784 MATERIAL EQUIVALENTS:

Cell Classification 12454 = PVC Type I Grade 1 = PVC1120

Pipe sizes shown are manufactured in strict compliance with ASTM D1785.

APPENDIX D

LOW-PROFILE AIR STRIPPER SPECIFICATIONS AND VENDOR INFORMATION

QED Environmental Systems

6155 Jackson Ave. Ann Arbor, MI 48103 Phone: 800-624-2026 Fax:734-995-1170

QED EZ-Tray™ Air Stripper System
Operations and Maintenance Manual

QED Treatment Equipment, P.O.Box 3726, Ann Arbor, MI 48106
Phone: (800)-624-2026, Fax: (734)-995-1170
p/n 95167 Rev 3/18/04

EZ-TRAY™ AIR STRIPPER
OPERATION AND MAINTENANCE MANUAL

TABLE OF CONTENTS

Thank you for relying on QED Treatment Systems to handle your treatment needs. After reading your Operation and Maintenance Manual, if you have any questions regarding the startup or operation of your system, please contact the **QED Service and Repair Department at 1-800-624-2026.**

PLEASE NOTE!

Read your QED Operation and Maintenance Manual First!
The manual will assist you in the proper procedure for equipment hookups, installation, startup, maintenance, and troubleshooting.

It is Important That a Qualified, Licensed Electrician Perform All Electrical/Wiring Installation Work.
Please see Equipment Set-Up in the Operating Instructions section of this manual.

Follow the Manufacturers Instructions
All the mechanical equipment that was supplied with your air stripper system should include the respective manufacturer's instruction manual for each piece of equipment. The documentation will either be found with the actual piece of equipment (if shipped loose) or found within a QED Operation and Maintenance manual that includes all relevant manufacturers' instruction sheets.

Follow Safe Work Practices
Be sure to follow all associated safety practices.

BASIC SYSTEM DESCRIPTION

EZ-Tray™ systems are fabricated from rugged stainless steel, or treated carbon steel. Each system is pre-assembled and factory tested before shipment to your site. EZ-Tray™ low profile air strippers are built to meet site and project specifications, which can include a number of standard or optional pieces of equipment. Depending upon the specifics of your order, the equipment described in this manual may or may not be included with your system configuration. Please refer to your sales order for the equipment that should be included with your system. Equipment information will be found either within this O&M manual or in separate documentation provided in addition to this manual.

Air Pressure Gauge (Standard)
The standard pressure gauge reads the differential pressure between the sump pressure and atmospheric pressure, in inches of water column. The gauge is connected to the system via tubing that is attached to a pressure port on the air stripper sump. The air hose connected to the sump leads to the "high" pressure port on the gauge. The "low" pressure port is left open to the atmosphere.

Demister (Standard)
A demister pad is installed beneath the air discharge stack located on the top cover of the unit. The purpose of the demisting pad is to remove entrained water droplets that would have blown through the discharge stack. It is possible, though unlikely, that the demisting pad may become plugged or fouled. If this occurs the demisting pad is easily removed. Disconnect the vent line, take off the demister cap, and remove the demister. The demisting pad can be cleaned with a pressure washer or replaced with a new one.

Gaskets (Standard)
Three gaskets are used in the EZ-Tray™ air stripper units. One gasket is installed in the air discharge stack flange, one gasket is used to form an airtight seal between the front hatch and aeration trays, and a felt gasket is located on the underside of each aeration tray. Through the course of regular maintenance, these gaskets will eventually wear and will not seal effectively. When the gaskets are ripped, worn, or do not seal properly, these gaskets should be replaced. Contact QED for replacement gaskets and adhesive. Please contact QED prior to making any gasket repairs or adjustments.

Sight Tube (Standard)
The sight tube provides a means of easily viewing the water level in the sump tank.

Blower
The blowers on the EZ-Tray™ low profile air stripper units are typically cast aluminum type B spark resistant, direct drive @ 3450 rpm, with motor options of TEFC or EXP. Each blower is selected to meet the proper air flow requirements (cfm) at the anticipated working pressures (inches of water column) of each system.

It is critical that the blower damper be opened wide enough to provide the unit with the designated minimum flow. If the damper is opened too wide, however, high airflow can cause water entrainment, with water droplets caught up in the airstream and sent out of the air stripper discharge stack.

It is also critical that water does not enter the blower housing while the blower is in operation; this will damage your blower and void the warranty. The high water level alarm switch prevents this from happening. Make sure it is installed correctly. If not installed by QED, it is recommended that the blower piping be of an inverted-U design, capable of collecting water within the blower piping and minimizing the potential for blower flooding. Please refer to Figure 3 for a typical blower piping configuration.

If water does accumulate in the blower, it must be removed from the blower housing before continuing operation. A small drain hole may be drilled and plugged on the bottom side of the blower housing to provide a means of discharging any water that may accumulate. Remove the plug temporarily to drain any water. Else, take off the front panel of the fan housing and remove the water.

When starting the unit for the first time, *check that the blower wheel is rotating in the direction of the arrow on the blower housing.* If you hear the blower wheel rubbing or any odd sounds shut down the system immediately and call QED.

Damper

The standard QED blowers normally have a damper on the discharge side of the blower. The damper is used to make adjustments to the air flow rate (cubic feet per minute) of your system. The air flow rate is increased (higher cfm's) by opening the damper, and decreased by closing the damper.

Use the damper to adjust the sump pressure to its proper operating value. By adjusting the sump pressure, the proper operating airflow through the air stripper will be achieved. Follow the instructions given in the earlier "Air Pressure Gauge" section to obtain the correct sump operating pressure. Using an air flow meter and an air pressure gauge together is desirable for confirming airflow and sump pressure, especially when attempting to troubleshoot any problems encountered with the air stripper operation. It is also recommended that you keep a log book of pressure readings so you can determine when and the frequency of system fouling.

Air Blower Silencer

The air blower silencer reduces the dynamic noise level of the blower. The size of the silencer and the type of connection used to mount it is dictated by the size of the blower and the choice of options. If a silencer is purchased through QED, they are typically shipped loose, for customer installation. The silencer can be mounted either horizontally or vertically (through the use of an elbow) but should be properly supported to avoid over-stressing the blower housing. Silencers exposed to high wind velocities should also be properly secured.

Air Flow Meter

The air flow meter measures the amount of air flowing through the system. If it is a pitot tube-type, two air tubes lead from the air piping to a meter/gauge. To operate effectively, the pitot tube must be located a minimum required distance upstream and downstream from elbows, valves, etc. Refer to manufacturer's installation instructions for proper installation procedures.

The air flow meter typically gives readings in feet per minute, which is then multiplied by the cross sectional area, square feet, of the vent line to give cubic feet per minute (CFM). As stated in the damper section, the air flow meter is needed to make damper adjustments, especially after initial start-up.

Control Panel

The control panel serves two basic functions required for the safe operation of the system. The first is to provide the required electrical safety components for each motor (blowers and pumps) per NEC standards. These components consist of fuses, motor starters, and overload relays.
The second function is to provide the required process safety alarm components. The alarm circuit monitors the low air pressure switch and the high water level alarm switch. If either of these alarms occur then the alarm contacts will shut off the incoming water source (feed or well pumps) if the appropriate connections have been made. A qualified, licensed electrician should perform any and all electrical connections.

Control Panel Intrinsically Safe Components

EZ-Tray™ low profile air stripper systems that process potentially explosive concentrations of vapors require intrinsically safe (IS) signals to all electrical components housed in non-explosion proof enclosures. The IS signal does not have enough energy to ignite the concentration of any NEC classified explosive vapor. Typical components that need IS signals are the float switches and well probes. Determination of when IS signals are required is generally the responsibility of the groundwater remediation engineer who has placed the order for a system. A qualified, licensed electrician should perform any and all electrical connections.

Water Flow Indicators and Totalizers

The digital water flow indicator, typically installed in the incoming process water line or shipped loose, reads the rate of flow (GPM) and the totalized flow (gallons). The flow meters are selected to exceed the maximum flow of your system while providing a wide working range. The digital face plate is battery operated and intrinsically safe. The mechanical components of the meter is the turbine styled rotor which spins around a shaft that is axial to the flow of water.

The standard nutating disc meters have a totalizing function only. They operate upon the positive-displacement principle, where the flow of water through the meter moves a disc which in turn rotates a magnet. Every magnet rotation corresponds to a fixed volume of fluid which is then added to the summed total of flow.

Feed and Discharge Pumps

Any transfer pumps included in the air stripper order have been selected by our engineering staff to meet all known flow and pressure requirements. The standard pumps are typically stainless steel centrifugal-type with motor options of EXP or TEFC. The standard pumps are not self-priming; they must be primed *before starting* by filling either the discharge port or the priming port with clean water until the entire pump chamber is full. The pipe/hose leading into the pump should also be full of water, too. Install throttle valves on the discharge lines for adjusting water flowrate. The valve should be throttled back until the motor draws the nameplate current rating. Warning: If the pump is running wide open and it is not pumping against the required head, the pump will cavitate and adversely affect pump performance and pump life.

Centrifugal transfer pumps used by QED typically must be throttled back if they are not pumping against the required head. Before initial system startup, double check the pump rotation. A pump shaft rotating in the wrong direction could spin off the pump impeller and cause serious damage to the pump. Pumps operating in the wrong

rotation will show poor performance. Systems using pumps should have the flow rates tuned so that the discharge is keeping up with the feed pump.

High Water Level Alarm Switch

The high water level alarm switch is one of the two alarm interlocks that must be properly connected by a licensed electrician prior to the system's initial start-up. Please see the Special Cautions at the beginning of the Operating Instructions section for more information. The purpose of the high water level alarm switch is to prevent water from flooding the blower by shutting off the incoming contaminated water once it has reached a designated level. The high water level switch will send an alarm signal when it is approximately 3½ inches above the coupling its cord emerges from.

Line Sampling Ports

The line sampling ports provide a quick and easy means to take a water sample of both incoming contaminated water and outgoing clean water. The sampling ports are the ball valves located on both of the inlet and outlet piping. When starting the unit for the first time double check that the valves on the sample ports are closed.

When taking a water sample, open the valve and let the water flow for at least 1 minute prior to taking the sample. This purges the sample port of any stagnant water. When purging the sample port on the contaminated water line, make the contaminated water is collected in some sort of storage container and then properly dispose of the water after sampling.

Low Air Pressure Alarm Switch

The low air pressure alarm switch is one of the two alarm interlocks that must be properly connected by a licensed electrician prior to the system's initial start up. Please see the Special Cautions at the beginning of Operating Instructions section for more information. The low air pressure alarm switch monitors the blower for continuous water treatment.

Should the blower fail, the low air pressure switch should be wired to shut off all incoming water. It, like the air pressure gauge, is connected to the system via an air hose which is attached to a pressure port on the sump tank. The air hose is connected to the "high" pressure port on the switch. The "low" pressure port is open to the atmosphere. Periodically inspect and remove any water which may have accumulated in the tubing. The presence of water can affect proper switch operation.

Test the switch, at initial start up, by removing the air hose from the pressure port on the sump tank once the system is in full operation. This should set the system into an alarm condition and shut off the incoming contaminated water.

Main Disconnect Switch

The main disconnect switch removes power from the EZ-Tray™ low profile air stripper. A disconnect is required by the National Electric Code (NEC) and must be installed. Some control panels, not supplied by QED, contain an internal disconnect or circuit breaker to remove power. Disconnects supplied by QED are external to the control panel, providing flexibility in situations where a site already contains a disconnect for the air stripped system. A qualified, licensed electrician should perform any and all electrical connections.

Intermittent Operation

Some systems are ordered with the intermittent operation option. EZ-Tray™ low profile air stripper systems can be designed to run intermittently when continuous blower

operation is a concern. When the feed water is flowing into the system, the blower will be in operation and the outlet pump (if provided) will maintain proper sump tank levels. When the feed water is shut down, the blower will run for an additional period of time to treat the water that had previously entered the air stripper before shutting down. When the feed water is restored, the blower will start up to treat the new incoming water. The benefits of intermittent operation are lower operating costs, better control of noise, and longer motor life.

Water Temperature Gauge

The temperature gauges can be installed on both the inlet and outlet piping. The water temperature represents an important factor when estimating the system's performance since it directly effects removal efficiency. Temperature gauges provided by QED typically have read outs of 0-140 degrees F.

Water Pressure Gauge

Water pressure gauges can be installed on both the inlet and outlet water lines. The gauges can be used to determine the water pressures entering and exiting the system. Excessively high readings could signal that something in your system is plugged. Large fluctuations in the pressure readings could be a sign that the water flow rate is varying.

EQUIPMENT SET UP

Special Cautions!

Use a Licensed, Qualified Electrician for Any and All Electrical/Wiring Work, and Always Use Proper Work Safety Practices!

Follow All Applicable Codes
The plumbing and electrical installations must be performed by qualified personnel. All installations must be done in accordance with local, state and national codes.

Install Adequate Supports on Piping and Ductwork
The external process piping that will connect into and from the QED equipment should be properly supported to minimize stresses and vibration from non-QED equipment. The QED equipment is not designed to support the process water and air lines without proper structural support.

Do Not Run Free Product, Oil or Grease Through the Air Stripper
Free product will contaminate the unit by coating the sidewalls with a film of free-product. Air strippers are not designed to treat free product, oil, grease, or any other type of immiscible phase.

Equipment Setup Steps Depending upon how the system was ordered, some of the following instructions may not apply.

Setup Step 1. Secure/Mount the Equipment
For shipping purposes, the EZ-Tray™ unit may come either already skid-mounted or the equipment shipped loose. If shipped loose, locate the equipment as required and firmly secure to the floor, base, etc.

Setup Step 2. Install the Blower Piping
If the blower is not already pre-piped on a QED skid, install the blower piping to connect the blower outlet to the air inlet nozzle on the air stripper sump. Refer to Figure 3 for an example of a blower piping configuration.

Setup Step 3. Level the EZ-Tray™ Unit
Level the EZ-Tray™ unit. This is a critical step in the proper assembly of the equipment. The aeration trays must be as close to level as possible.

Setup Step 4. Install Discharge Piping, either gravity-discharge or pump-discharge.

Install the Gravity Discharge Pipe (For Gravity Discharge Units Only)
Refer to the outlet piping drawing in Figure 4 to assemble the piping kit and vacuum breaker. Customers providing their own gravity discharge piping must ensure that proper water sump levels are maintained during operation.
It is essential that the piping be mounted vertically and that it be properly supported. Install outlet piping from the pump's discharge port. Use proper pipe sealant, PVC cement, and proper plumbing techniques as necessary.

Caution: The vertical height of the piping should not be changed from that provided in the kit unless air stripper conditions have changed dramatically from the originally-specified flows. The piping kit includes flexible couplings to allow easy vertical height adjustment, should it be necessary.

Install the Pump Discharge Pipe (For Pump Discharge Units Only)
For a unit with a discharge pump that has not come mounted to a QED skid, install the water line from the air stripper sump to the pump inlet. If customer has purchased a QED pump kit, the components will be found in a separate box. Install outlet piping from the pump's discharge port. Use proper pipe sealant, PVC cement, and proper plumbing techniques as necessary.

Prime the pump. Allow the inlet line and pump chamber to fill completely.

Setup Step 5. Install the Sump Drain Valve and the Sight Tube (if not already installed at the factory)

Setup Step 6. Connect the Water Lines

Connect the process water lines to the inlet and discharge piping. **Firmly support the process water lines to prevent excessive stress on the piping. The piping is not designed to support the weight of the customer's process water lines.**

Use proper pipe sealant, PVC cement, and proper plumbing techniques as necessary.

Setup Step 7. Connect the Tubing Between Pressure Gauges, Pressure Switch(es), and Air Stripper Sump
Connect the air line tubing from the hose barb located on the top of the sight tube to the high pressure ports on both the air pressure gauge and the air pressure switch(es). Keep the low pressure ports open to the atmosphere (remove plugs or caps).

Setup Step 8. Install Air Discharge Stack
Install any necessary extension to the air stripper air discharge stack as necessary. **Caution: Any added extension should have an inner diameter at least as large as the air stripper stack.** Connect the stack extension to the exhaust stack using a flexible rubber coupling or other suitable means. Support the extension independently of the air stripper so that it can be easily disconnected if the demister element must be removed for maintenance purposes.

Setup Step 9. Wire the Electrical Components
Have a qualified, licensed electrician wire up the electrical components in compliance with local, state, and national codes.

IMPORTANT! Make sure the safety interlocks are connected properly! To avoid damage to the blower and flooding of the equipment with contaminated feed water, install the high water level and low air pressure interlock switches. If the water level in the sump tank rises beyond the maximum level water could

flood the blower. This will destroy the blower and void the warranty. The high water level interlock switch will shut off the feed water pump in an emergency situation. The low air pressure interlock switch will shut off the feed water pump in the event of a blower failure. This reduces the risk of having untreated water passing through the air stripper.

If QED is supplying the control panel, refer to the appropriate wiring diagrams.

Setup Step 10. Install Optional Items
Refer to manufacturers' installation instructions for all equipment and properly support all equipment in an appropriate manner. This also applies to the optional air stripper blower silencer which requires support to avoid overstressing the air stripper blower housing.

START UP

Please refer to Figures 1 and 2 at the end of this manual for a general drawing of an E-Z Tray air stripper and its aeration tray. Upon completion of the equipment set-up procedure (above), mechanical and electrical installation (including float switches, air pressure switches, etc.), proceed as follows:

Startup Step 1. Turn Off Electrical Components Using the Site's Appropriate "Lock-Out" Procedure. Close Drain and Sample Valves.
Check that all electrical components associated with the unit are turned off, and all drain and sample valves are closed.

Startup Step 2. IMPORTANT! Fill the Inlet Chambers with Clean Water.
Each downcomer (see Figures 1 and 2) must be sealed by having its end immersed in the seal pot water of the tray below it. Remove the air stripper front hatch and fill the seal pots to their proper levels (to the height of the weir). Failure to do so may create a situation where not enough back pressure is provided upon blower startup, causing the blower motor overload to trip.

Startup Step 3. IMPORTANT! Fill the Sump Tank with One Foot of Clean Water.

On initial start-up, the sump tank must be filled with clean water to a height of about one foot. The sump tank can be filled by taking off the front hatch and filling the sump directly or by disconnecting the water inlet piping and using a hose applied through the water inlet connection. The water level should be seen in the sight tube.

Startup Step 4. Power May Now Be Supplied to the System.

Startup Step 5. IMPORTANT! Check the Blower Rotation (IMPORTANT for proper air stripper operation)
Check the blower rotation by momentarily turning the Hand-Off-Auto (HOA) Switch to the "Hand" position ("bumping" the motor). Verify that the fan turns in the direction of the arrow on the blower casing. If rotation is incorrect 1) have a licensed electrician correct the wiring per manufacturer's instructions, and 2) check and correct the rotation of the other motor(s) in the system. **(This is a common oversight and very often is the reason for inadequate blower operation. If the blower is not providing the expected airflow or backpressure, please double-check this step).**

Startup Step 6. Connect a Clean Water Line to the Air Stripper Inlet. Trial-run Air Stripper System Using Clean Feed Water at the Expected Flowrate.

Start the QED Air Stripper System by closing the Blower Damper and Placing the Appropriate HOA Switches in the "Auto" Position. Carefully open the damper to achieve the desired tray pressure or air flowrate at the anticipated water flowrate for the system.

Startup Step 7. Monitor the Trial Run and Adjust the System Accordingly.

The following items should be monitored as water builds up on each tray:

1. Proper sump pressure. This may require 15-30 minutes for the water to reach the proper depth on each tray. Once the blower has reached its operational speed and water flow is steady, the blower can be throttled to adjust airflow to optimal conditions. QED wet-tests every EZ-Tray unit for proper sump pressures at the customer's expected water flow rates for "clean tray" and "fouled tray" conditions. The wet-test values are normally printed on a label and affixed to the side of the air stripper. Adjustments should be made first by referring to these wet-test pressure values. If no values are given, refer to the table below. The values are estimates, and vary depending upon the influent water flowrates. The table assumes there is no additional pressure from equipment downstream of the air stack. If downstream equipment adds backpressure, these values may not be accurate.

# of Trays	Typical Sump Operating Pressures, (approximate*)
1 tray system	4-6" wc
2 tray system	8-12" wc
3 tray system	12-18" wc
4 tray system	16-24" wc
etc.	etc.

IT IS RECOMMENDED THAT A BOOSTER BLOWER BE USED IF IT IS EXPECTED THAT THE COMBINED PRESSURE LOSS OF THE QED AIR STRIPPER AND ANY DOWNSTREAM EQUIPMENT EXCEEDS 40" WC.

Be careful when making damper adjustments—fouling of the system over time will affect the air flow rate. A "fouled" system will have lower air flow at the same sump pressure reading than a clean system. A severely fouled air stripper will not produce the minimum air flow the system requires for proper performance. The blower damper should therefore be adjusted to the proper sump pressure after the trays have been properly cleaned. Refer to the "Equipment Maintenance Instructions" for proper cleaning procedures.

2. Check for any leaks and correct.

Note: If the blower overload trips, the system will shut down. This overload may indicate that the damper needs to be parially closed. Reset the overload and try to start the system again.

Once Step 7 is successfully completed, turn HOA switches to "Off" and proceed to Step 8.

Startup Step 8. Replace the Clean Water Feed Line with the Contaminated Feed Line.
Install the inlet piping according to proper plumbing practices. Use proper pipe sealant and PVC cement where necessary.

Startup Step 9. Initiate Full Operation.
Switch all air stripper system HOA switches to "Auto".

PLEASE NOTE: The blower damper should now already be in its proper position to provide the desired airflow for the system's anticipated influent water flowrate; however, the airflow through the air stripper upon initiating "full operation" will be greater until water builds up on the trays. If this increased airflow is a concern, it is advised to close the damper slightly to throttle the airflow until the water has built up to it final height on each tray.

Startup Step 10. Inspect and Record Unit's Operation Data
Inspect the unit's operation at regular intervals and take pertinent instrument readings. Record readings and performance data in an operations log book.

Startup Step 11. Set the Throttle Valve on Discharge Pump
Units with a discharge pump are supplied with a throttle valve. The valve should be set so that the pump matches the influent flow rate without cavitation and draws no more than the rated full load amps stamped on the pump motor.

SYSTEM SHUT DOWN PROCEDURE

Shut Down Step 1. Shut Water Off
Shut off the water feed to the system.

Shut Down Step 2. Wait 5 Minutes Before Blower Shutoff
Wait 5 minutes to allow the water in the aeration trays to be completely treated, then shut off the blower.

Shut Down Step 3. Shut Power Off
Shut off power at the main disconnected switch if more than a temporary shut down is anticipated.

Caution:
If proper shut down procedures are not followed contaminated water will drain into the sump and contaminate the water that has collected in the sump. Allow the blower to run the additional 5 minutes after the feed water is shut off.

EQUIPMENT MAINTENANCE INSTRUCTIONS

This information describes how to clean the QED EZ-Tray™ Air Stripper unit. Please refer to the manufacturer's instructions for maintenance on the non-air stripper equipment.

Tray Fouling

With normal operation of the air stripper, the sump pressure will typically increase over time. This typically indicates that the air stripper trays are becoming fouled. If this occurs, shut down the system. Remove the door and visually inspect for signs of fouling and clean the air stripper as outlined in the "Maintenance" section of this manual. Occasionally inspect the pressure gauge tubing for water build up. Water trapped in the air tubing could produce an erroneous reading. A pinch clamp is provided on the tubing and should be closed when no one is at the site in order to prevent potential condensate accumulation. Condensation buildup will ruin the pressure gauge.

Dealing with High Mineral Concentrations

Minerals, dissolved in high concentrations, tend to precipitate out of groundwater during aeration processes. These minerals form insoluble deposits commonly referred to as "fouling". Deposits from iron-rich or mineral-rich feed water can be reduced by pre-treating it with sequestering agents or possibly other types of technologies. There are a number of sequestering suppliers that should be able to offer recommendations or suggestions. The recommended cleaning procedure is pressure washing. Follow the instructions detailed below.

Cleaning the Air Stripper

Recommended cleaning equipment:

Pressure Washer with Washer Wand

2 GPM minimum flow at 900 PSI maximum. Equipment rental companies can usually supply such a unit on a daily rental basis.

Clean Water Supply

Clean water supply with a capacity of at least 2 GPM at 20 PSI, connected to the pressure washer by means of an ordinary garden hose.

Cleaning the Unit. The QED air stripper is designed for easy cleaning. Trays can either be removed for cleaning or left in the unit and cleaned. Another option would be for the customer to purchase a spare set of trays which would allow maintenance personnel to replace the fouled trays with clean trays and reduce air stripper downtime and allow the maintenance personnel to clean the trays at a more convenient time.

Cleaning Step 1. Turn Off Equipment, Perform Electrical "Lockout" Procedure

Turn off the feed water supply and all associated electrical equipment.

Cleaning Step 2. Provide for Waste Disposal

Make provisions for disposing of the sludge and waste generated during cleaning.

Cleaning Step 3. Remove Front Cover(s). Either remove the trays from the air stripper unit or leave them in for cleaning.

Cleaning Step 4. Turn On Water and Pressure Washer
Turn on the water supply to the pressure washer. Then, turn on the pressure washer itself. Wear protective goggles while spraying.

Cleaning Step 5. Insert Wand into Air Stripper (This step is for cleaning trays while they remain in the air stripper unit. If trays have been removed for cleaning, skip step 5 and proceed to step 6.)

Insert the wand all the way into the door opening. Point the spray nozzle up towards the bottom of the lowest tray.

Cleaning Step 6. Clean Bottom Side of Tray
Holding the wand tightly, pull the trigger to start the pressurized water flow. Expect the wand to kick back as flow starts. Move the wand side to side at a rate of about 1" per second. Be sure to cover the entire tray bottom area. The tray holes must be cleaned of all deposits. Periodically stop the cleaning operation and inspect the cleaned area. The area is clean when there are no deposits around the aeration holes.

Cleaning Step 7. Clean Top Side of Tray
Move the wand to the top side of the tray. Continue spraying with the nozzle pointed down onto the top surface of the tray. Also clean the downcomer and sealpot areas. Remove all visible deposits from the tray baffles and the walls of the unit. Inspect the cleaned area for deposits.

Cleaning Step 8. Repeat for all Trays
Repeat the procedure for all trays, working up to the top-most tray.

Cleaning Step 9. Spray the Ceiling and Walls of the Air Stripper. If the air stripper is a mild-steel unit with coal tar epoxy coating, extra care must be taken not to remove the epoxy with the high pressure water. Cleaning the walls and ceiling are not necessarily required for proper air stripper operation.

Cleaning Step 10. Rinse
After the cleaning operation is finished, rinse the ceiling, trays, baffles, and walls with the pressure sprayer. Work down from the top down to the sump tank. Make sure the surfaces are clean and the holes are not blocked by loosened debris.

Cleaning Step 11. Check the Demister Pad and Replace as Necessary
Inspect the demister pad and clean as needed.
Use the pressure sprayer to remove debris, deposits and gummy residues sometimes found on the demister pad.
Demister pads that are excessively plugged should be replaced.

Cleaning Step 12. Inspect the Air Stripper

Visually inspect the air stripper box for the following:

1. Gasket integrity
2. a. If this is a mild steel unit, the internal and external epoxy-coatings must be inspected for exposed areas. Scratches, chips, burns, etc. will expose the mild steel to water, contaminants, and the elements, creating potential for corrosion. These exposed areas must be cleaned, dried, and re-epoxyed before commencing air stripper operation. Contact QED for touchup epoxy.
   b. If this is a steel unit, inspect the air stripper for any damage and repair as necessary.
3. Aeration tray integrity. Inspect trays for structural damage, felt gasket integrity, and acceptable silicone sealant in the sealpot area. Check the downcomer of each tray for holes, rips, etc. Replace as necessary. Contact QED for replacement items.
4. Inspect the internal piping (typically PVC piping) and replace as necessary.

Cleaning Step 13. Follow Manufacturer's Instructions for Maintenance on Non-Air Stripper Equipment

TROUBLESHOOTING

Problem 1. 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 okay. Check fuses in main disconnect switch and in control panel.

If blown, replace with fuse of same size and rating.

Overload Relay Trips
Locate reset button on blower overload relay.

Rush reset button in. Reasons for tripping: incorrect line voltage, motor wired incorrectly, inadequate ventilation, bearings are bad.

Tubing to Pressure Switch Plugged with Water or Debris
Remove tubing from pressure switch and blow into it towards tank.

Clean or replace tubing if plugged or kinked.

Blower Wheel Jammed Against Side of Housing
TURN OFF ALL power to the system. Try to spin wheel by hand. Wheel should rotate freely. Call QED.

Problem 2. Outlet Pump Won't Shut Off

Suction or Discharge Piping for 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 and clean or replace as necessary.

Float Switch in Tank is Stuck in Down Position
Look into sump and check that all floats are floating on the water.

Clean all deposits from float. Replace float is necessary.

Normal Operation - Water Level in Sump is Okay
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 pre-determined lower level, which will cause outlet pump to turn off.

Problem 3. Outlet Pump Won't Start or Run

No Power to Pump
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 okay. Check fuses in main disconnect switch and in control panel.

If blown, replace with fuse of same size and rating.

Overload Relay Trips

Locate reset button on pump overload relay.

Push reset button in. Reasons for tripping: incorrect line voltage, motor wires incorrectly, inadequate ventilation, bearings are bad.

Normal Operation - Water Level in Sump is Okay
Pump will start when water level reaches pre-determined height in tank.

Allow water level to increase until pump turns on. be sure pump switch is in "Auto" position.

Let water level reach pre-determined 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.

Impeller, Seal or Bearing Damaged
TURN OFF POWER. Try to turn impeller by hand.

If impeller won't turn, remove housing and locate source of binding.

Problem 4. Low Air Pressure 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 screws.

Motor Rotation Backwards
Watch rotation of blower wheel at slow speed.

Reconnect for proper rotation as per motor diagram.

Gravity Discharge Trap Installed Incorrectly
Tray should be positioned vertically.

Install discharge trap per outlet plumbing drawings provided in Figure 4.

Inlet Chamber (Sealpot) in each Tray is Not Full of Water
Slide tray aside and look at water level in chamber.

Remove front cover. Fill up inlet chambers with a hose. Or, follow inlet chambers fill up procedures above in Initial Start Up.

Front Cover not in Place
Front cover must be secured during operation.

Tubing to Pressure Gauge Plugged with Water or Debris
Remove tubing from pressure gauge and blow into it towards tank.

Clean or replace tubing if plugged or kinked.

Debris Blocking Blower Intake
Look at blower intake. Remove any accumulated debris.

Normal Operation for Automatic Unit
When inlet pump starts, blowers will start, air pressure will rise to operational level.

No action necessary.

Problem 5. High Pressure in Stripper

Air Exhaust Piping is Restricted
Check vent piping for obstructions. Check that vent pipe diameter does not decrease.

Vent piping diameter must be the same as the outlet vent diameter on the cover.

Air Holes in Bottom of Trays are Plugged
Remove inspection and cleanout caps and visually inspect holes.

For iron fouling, clean out unit with a 1000 PSI pressure washer. For scaling, scrape or bang scale from all surfaces, then use a pressure washer to open holes. Consider using sequestering agent or other technology to reduce scaling.

Demister Pad is Plugged
Inspect the bottom of the demister pad in the cover. Clean and/or replace as necessary.

Problem 6. Water Won't Flow into Unit

Inlet/Well Pump Functioning Properly
Allow water level to rise in well pump, which will turn on inlet pump to system.

No action necessary.

Tank Air Pressure is Low. System is in Alarm Condition
Read tank air pressure from pressure gauge. System should be in alarm condition if pressure is below about 2 inches w.c.

Check that blower is operating properly. Check that all rubber caps are in place on end of trays.

Inlet Piping is Plugged
Remove inlet piping and inspect for debris and buildup.

Clean or replace clogged parts.

Problem 7. Iron Fouling is a Problem

Iron Precipitates Out of Water When Treated with an Air Stripper Causing Iron Build Up in Unit
Remove the front door(s) and inspect inside of tray for buildup/fouling.

Clean out unit with 1000 PSI pressure washer on routine basis.

Pretreat incoming water using sequestering agents or other appropriate technology.

QED TREATMENT EQUIPMENT WARRANTY

QED Environmental Systems Inc. (QED) warrants to the original purchaser of its products that, subject to the limitations and conditions provided below, the products, materials and/or workmanship shall reasonably conform to descriptions of the products and shall be free of defects in materials and workmanship. Any failure of the products to conform to this warranty will be remedied by QED in the manner provided herein.

QED warrants the equipment components of its manufacture for a period of one (1) year from date of delivery. Our sole obligation during this warranty will be to repair or replace (at our option) the defective components. We are not responsible for consequential damages. Labor costs are not included.

Purchaser's exclusive remedy for breach of said warranty shall be as follows: if, and only if, QED is notified in writing within the applicable warranty period of the existence of any such defects in the said products, and QED upon examination of any such defects, shall find the same to be within the term of and covered by the warranty running from QED to Purchaser, QED will, at its option, as soon as reasonably possible, replace or repair any such product, without charge to Purchaser. If QED for any reason, cannot repair a product covered hereby within four (4) weeks after receipt of the original Purchaser's notification of a warranty claim, then QED's sole responsibility shall be, at its option, either to replace the defective product with a comparable new unit at no charge to the Purchaser, or to refund the full purchase price. In no event shall such allegedly defective products be returned to QED without its consent, and QED's obligations of repair, replacement or refund are conditioned upon the Purchaser's return of the defective product to QED.

IN NO EVENT SHALL QED ENVIRONMENTAL SYSTEMS INC. BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF SAID WARRANTY.

The foregoing warranty does not apply to major subassemblies and other equipment, accessories, and other parts manufactured by others, and such other parts, accessories, and equipment are subject only to the warranties supplied by their respective manufacturers. In the event of failure of any such product or accessory, QED will give assistance to Purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in light of the manufacturer's own warranty.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY (INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANT ABILITY AND FITNESS FOR A PARTICULAR PURPOSE), WHICH OTHER WARRANTIES ARE EXPRESSLY EXCLUDED HEREBY, and of any other obligations or liabilities on the part of QED, and QED neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with said products, materials and/or workmanship.

It is understood and agreed that QED shall in no event be liable for incidental or consequential damages resulting from its breach of any of the terms of this agreement, nor for special damages, nor for improper selection of any product described or referred to for a particular application.

This warranty will be void in the event of unauthorized disassembly of component assemblies. Defects in any equipment that result from abuse, operation in any manner outside the recommended procedures, use and applications other than for intended use, or exposure to chemical or physical environment beyond the designated limits of materials and construction will also void this warranty.

The equipment is warranted to perform as specified under the conditions specified here and within the air stripper model or QED will make the necessary changes at no cost to the owner. Some restrictions apply. Requirements for warranty consideration include, (but are not limited to):

1. Current operating conditions do not differ from the previously-modeled conditions.
2. The system should be cleaned regularly to maintain system performance.
3. The equipment is installed, operated and maintained according to QED's instruction or non-QED manufactured subassembly manufacturer's instructions.
4. Air stripper influent air is not "dirty" (does not contain VOC's, etc.).
5. No surfactants, oils, greases, or other immiscible phases are present in the water.
6. Each influent contaminant does not exceed 25% of its maximum solubility under modeled conditions.

QED shall be released from all obligations under all warranties if any product covered hereby is repaired or modified by persons other than QED's service personnel unless such repair by others is made with the consent of QED. If any product covered hereby is actually defective within the terms of this warranty, Purchaser must contact QED for determination of warranty coverage. If the return of a component is determined to be necessary, QED will authorize the return of the component, at owner's expense. If the product proves not to be defective within the terms of this warranty, then all costs and expenses in connection with the processing of the Purchaser's claim and all costs for repair, parts and labor as authorized by owner hereunder shall be borne by the Purchaser.

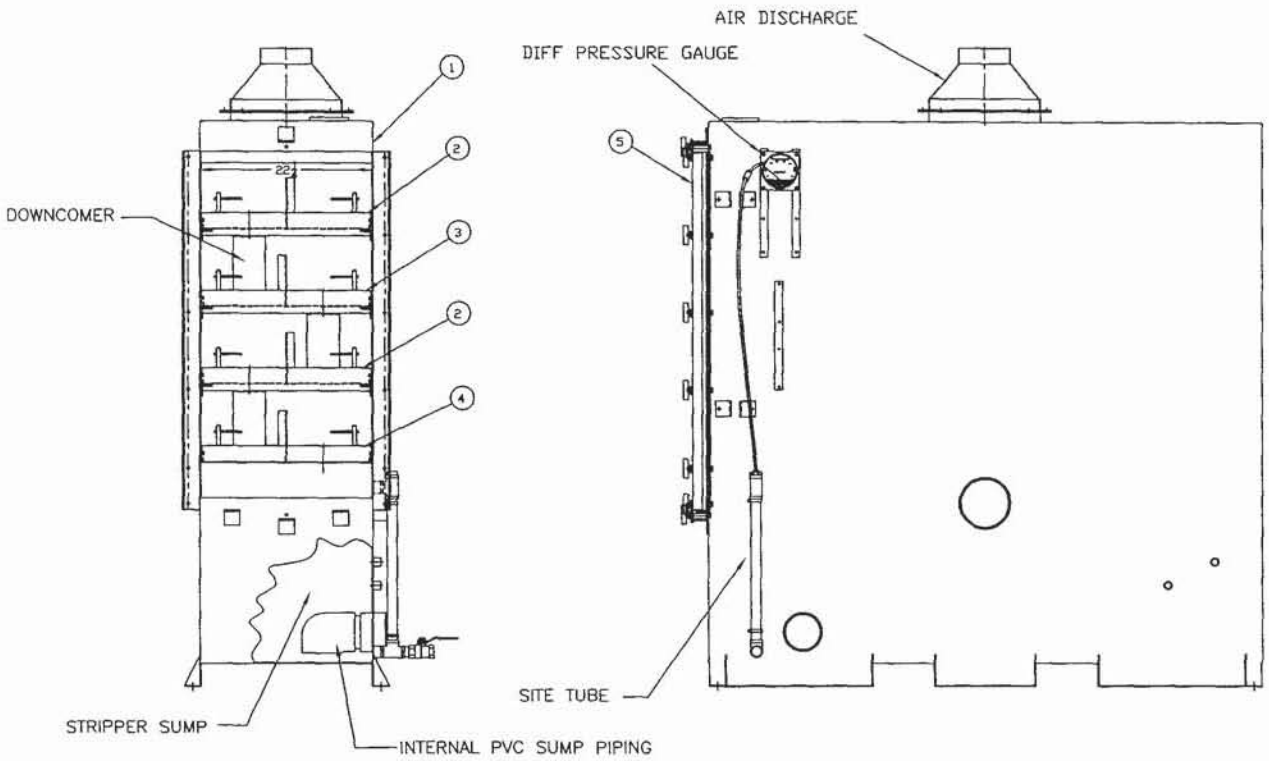
In the event of air stripper performance issues, QED may require customer to conduct a variety of troubleshooting steps. These include, but are not limited to, modifying operational parameters, cleaning air stripper system, modifying (temporarily or permanently) process piping, and obtaining reasonable and necessary influent/effluent samples. These steps are the responsibility of the customer and will be conducted by customer prior to consideration by QED for a site visit. These steps and the associated costs incurred are the responsibility of the customer, regardless of future action. Should customer request a site visit by QED or accept a site visit offer by a QED-trained technician, the visit and associated costs: a) will be the responsibility of the customer at $500/day, plus travel, lodging, and meals, if the visit finds improper sampling, process piping installation, or equipment operation inconsistent with QED's Operation and Maintenance Manual; or b) will be the responsibility of QED if the visit finds QED responsible for the performance issue(s) raised.

The original Purchaser's sole responsibility in the instance of a warranty claim shall be to notify QED of the defect, malfunction, or other manner in which the terms of this warranty are believed to be violated. You may secure performance of obligations hereunder by contacting the Customer Service Department of QED and:

1. Identify the product or system involved by job number or QED order number.
2. Specifying where, when, and from whom the product was purchased.
3. Describing the nature of the defect or malfunction covered by this warranty.
4. If applicable, send the malfunctioning component, ***after receiving a Return Authorization Code (RAC) Number by the QED Service Department, to:***

QED Environmental Systems Inc.
6241 Jackson Road
Ann Arbor, MI 48103
Attn: ***R.A.C. No.*** *(Return Authorization Code Number provided by QED Service Dept.)*

FIGURE 1. GENERAL DWG OF E-Z TRAY AIR STRIPPER



HATCH REMOVED

ITEM	QTY	DESCRIPTION	REMARKS
6	1	WELDMENT, DEMISTER	QED #807048
5	1	STANDARD HATCH	QED #807019
4	1	SIEVE TRAY ASSEMBLY, BOTTOM RH	QED #807062
3	1	SIEVE TRAY ASSEMBLY, INTERMEDIATE RH	QED #807056
2	2	SIEVE TRAY ASSEMBLY, INTERMEDIATE LH	QED #807059
1	1	BOX ASSEMBLY 12.4 R.H. AIR STRIPPER	QED #807044

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES AND INCLUDE PLATING REMOVE ALL BURRS

TOLERANCES
.XX+/-.01 FRACT +/-1/64
.XXX+/-.005 ANGLES+/-1/2
OTHER TOLERANCES AS SPECIFIED

DRAWN BY MEB DATE 01/20/97
CHECKED BY DATE
APPROVED BY DATE
MFG. APPROVAL
MATERIAL
FINISH

NEXT ASS'Y USED ON

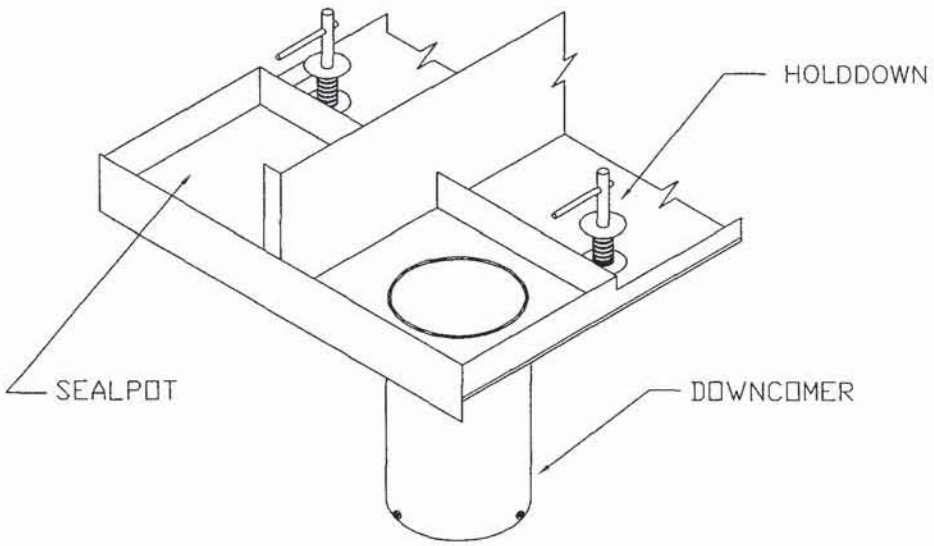
Q.E.D.
ENVIRONMENTAL SYSTEMS INC.
6155 JACKSON ROAD, ANN ARBOR, MI.

TITLE
EZ-TRAY AIR STRIPPER DWG

DRAWING NUMBER eztdwg.dwg REV
SCALE SHEET 1 OF 1

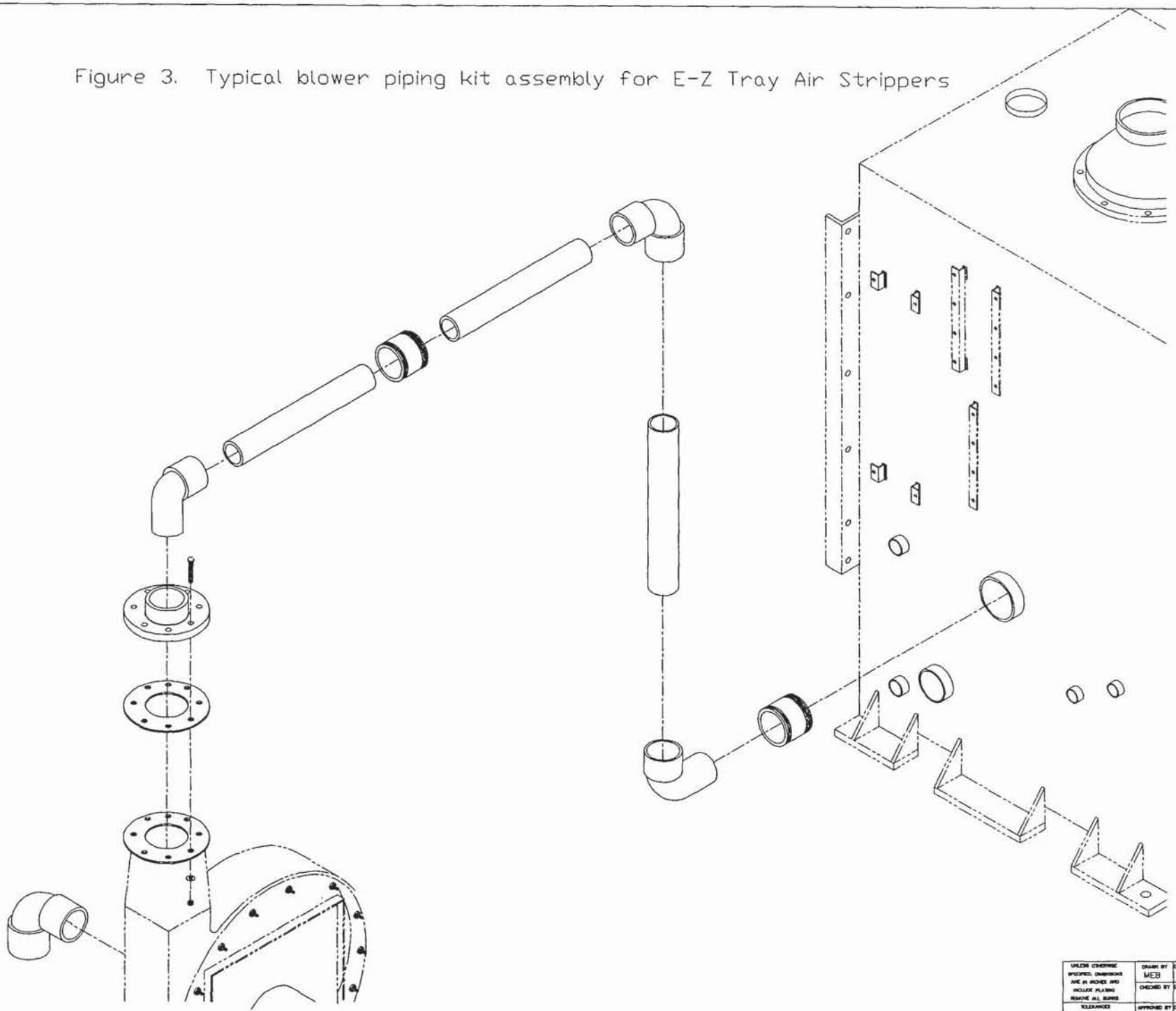
2/18/99, meb

FIGURE 2. TYPICAL TRAY ASSEMBLY



ITEM QTY	DESCRIPTION	REMARKS
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES AND INCLUDE PLATING REMOVE ALL BURRS	DRAWN BY MEB DATE 01/20/97	Q.E.D. ENVIRONMENTAL SYSTEMS INC. 6155 JACKSON ROAD, ANN ARBOR, MI.
TOLERANCES .XX+/-.01 FRACT +/-1/64 .XXX+/-.005 ANGLES+/-1/2	CHECKED BY DATE	
OTHER TOLERANCES AS SPECIFIED	APPROVED BY DATE	TITLE TYP. TRAY ASSEMBLY
12.X, 24.X AIR STRIPPER	MFG. APPROVAL	
NEXT ASS'Y USED ON	MATERIAL	DRAWING NUMBER TRAY REV A
	FINISH	SCALE SHEET 1 OF 1

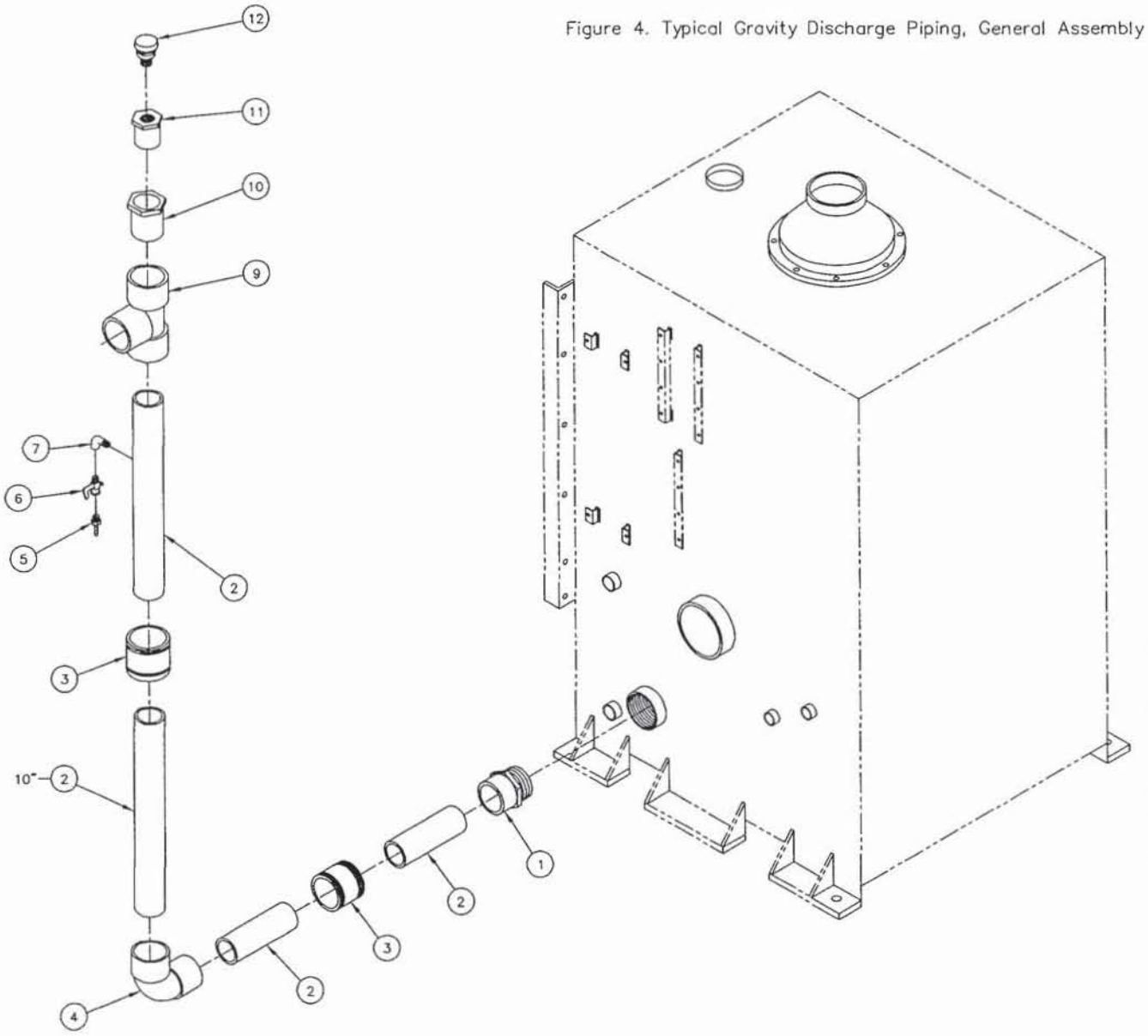
Figure 3. Typical blower piping kit assembly for E-Z Tray Air Strippers



2/18/99, meb

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES AND INCLUDE PLATING REMOVE ALL BURRS	DRAWN BY MEB	DATE 9/16/97	Q.E.D. ENVIRONMENTAL SYSTEMS INC. 6155 JACKSON ROAD, ANN ARBOR, MI.
TOLERANCES .XX=+/-.01 FRACT +/-1/64 .XXX=+/-.005 ANGLES+/-1/2 OTHER TOLERANCES AS SPECIFIED	CHECKED BY	DATE	TITLE BLOWER KIT W/O BLOWER ASSEMBLY/BOM/KIT
	APPROVED BY	DATE	
	MFG. APPROVAL		
	MATERIAL		DRAWING NUMBER eztblkt.dwg REV A
NEXT ASSY. USED ON	FINISH		SCALE N.T.S. SHEET 1 OF 1

Figure 4. Typical Gravity Discharge Piping, General Assembly



NOTE:

1. CENTER LINE OF WATER OUT (ITEM 1) TO CENTER LINE OF DRAIN CONNECTOR (ITEM 9) TO BE 27" – 6 TRAY
   18" – 4 TRAY

(DIMENSIONS ARE APPROXIMATE--REQUIRES SOME ADJUSTMENT AS NECESSARY BASED UPON SUMP PRESSURES AND WATER FLOWS. ASSUMES STANDARD OPERATING CONDITIONS.)

ITEM	QTY	DESCRIPTION	PART #
12	1	BREAKER, VACUUM RELIEF 1/2"	
11	1	BUSHING, SPI X THD PVC SCH 80	
10	1	BUSHING, REDUCER SPI. X SOC.	
9	1	TEE, SOCKET PVC SCH 80	
8			
7	1	ELBOW, STREET 1/8" FPT BRASS	
6	1	COCK, SHUTOFF 1/8"MPT X 1/8"FPT BRASS	
5	1	BARB, 1/8"MPT X 3/16" BARB	
4	1	ELBOW, 90 DEGREE PVC SCH 80 SOCKET	
3	2	FERNCO, FLEXIBLE PVC	
2	TBD	PIPE, PVC SCH 80	
1	1	ADAPTER, PVC SCH 80	

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES AND INCLUDE PLATING REMOVE ALL BURRS

TOLERANCES
.XX+/-.01 FRACT +/-1/64
.XXX+/-.005 ANGLES+/-1/2
OTHER TOLERANCES AS SPECIFIED

EZ-TRAY (24.X)

NEXT ASS'Y | USED ON

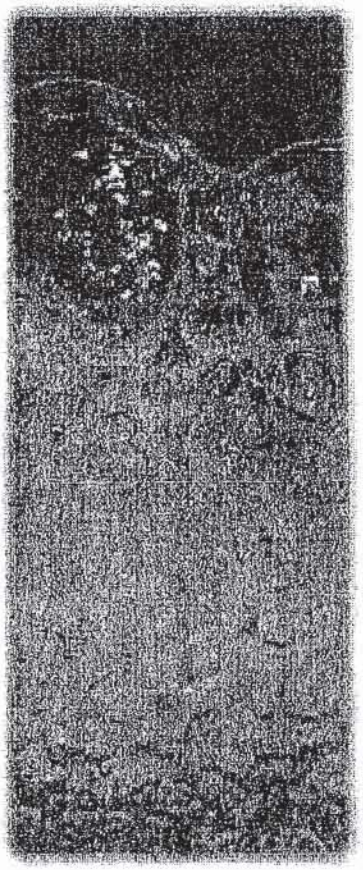
DRAWN BY MEB | DATE 10/29/99
CHECKED BY | DATE
APPROVED BY | DATE
MFG. APPROVAL
MATERIAL
FINISH

QED
ENVIRONMENTAL SYSTEMS INC.
6155 JACKSON ROAD, ANN ARBOR, MI.

TITLE
GRAVITY DRAIN ASSEMBLY/BOM/KIT

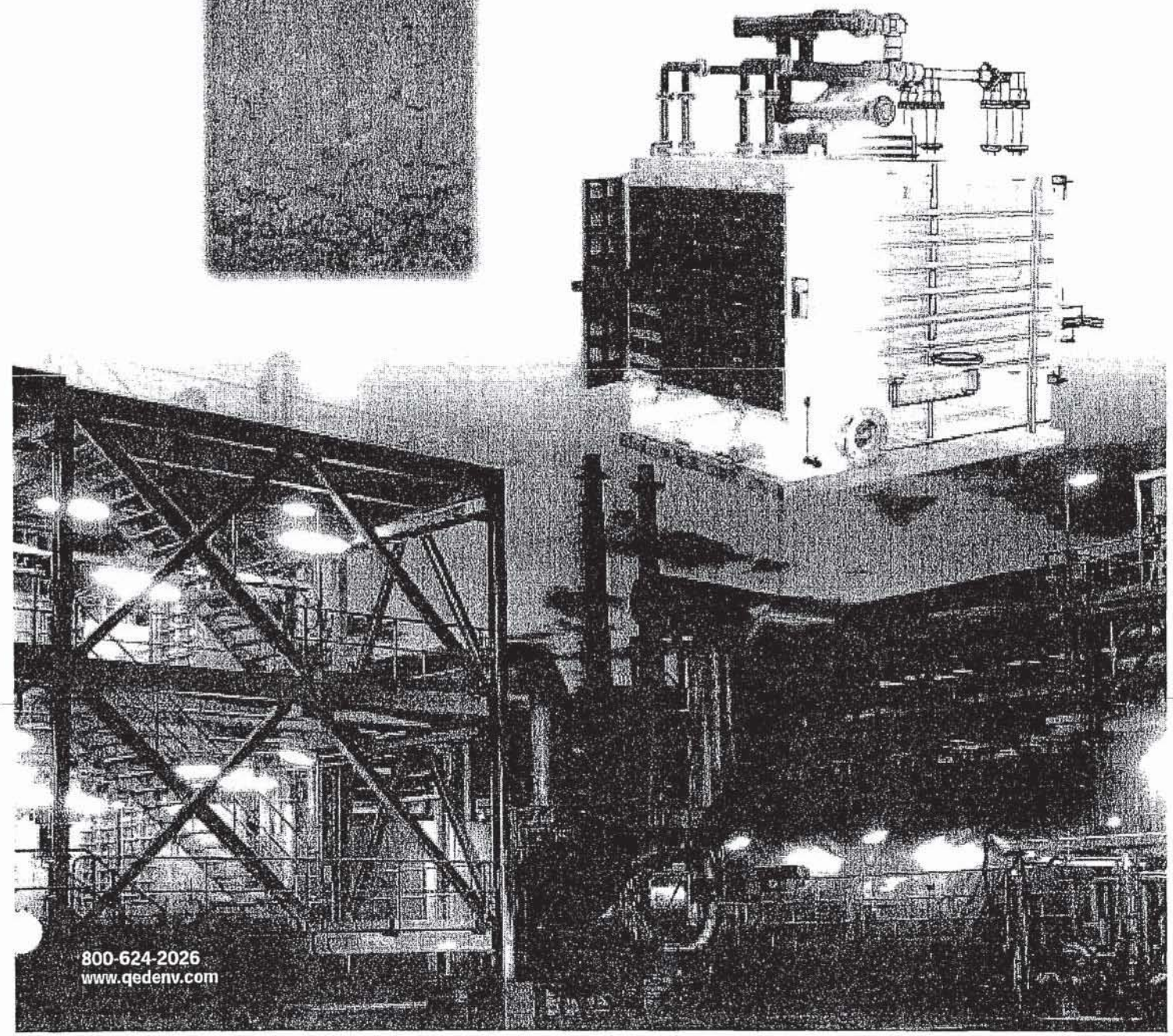
DRAWING NUMBER eztgravdis | REV

SCALE N.T.S. | SHEET 1 OF 1



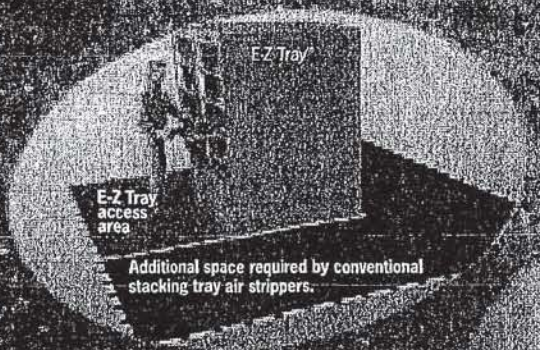
QED
Environmental Systems
A TestAmerica Company

Sliding Tray, High-Efficiency Air Strippers for VOC Removal

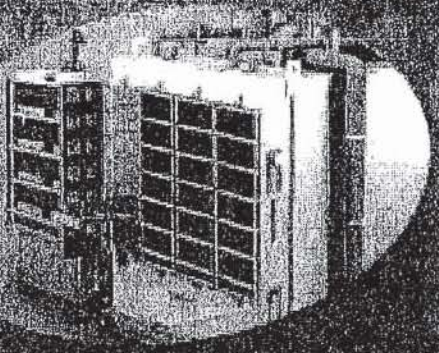


800-624-2026
www.qedenv.com

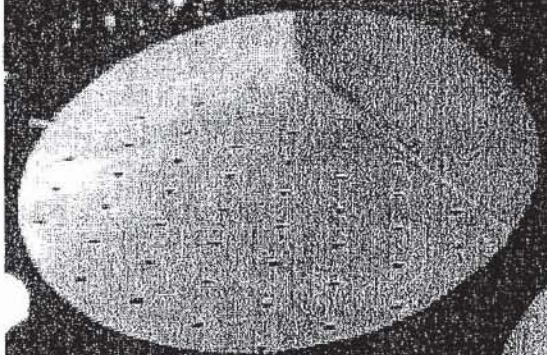
Flow Rates from 1 to 1,000 gpm and Options to Fit Every Treatment Project



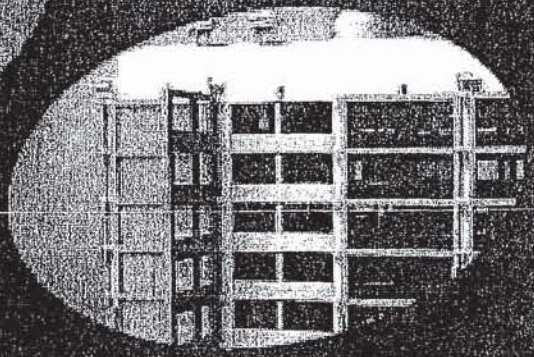
Conventional air strippers need more than twice the access and tray removal space than E-Z Tray® air strippers.



Flow rates available from 1 to 1,000 gpm.



Air flows up through perforated trays creating a turbulent froth zone with a high air-to-liquid surface area for mass transfer of volatile organic compounds (VOCs)



Hinged door option allows for easy access without door removal.

Front access slide-out trays allow unit maintenance by one person.

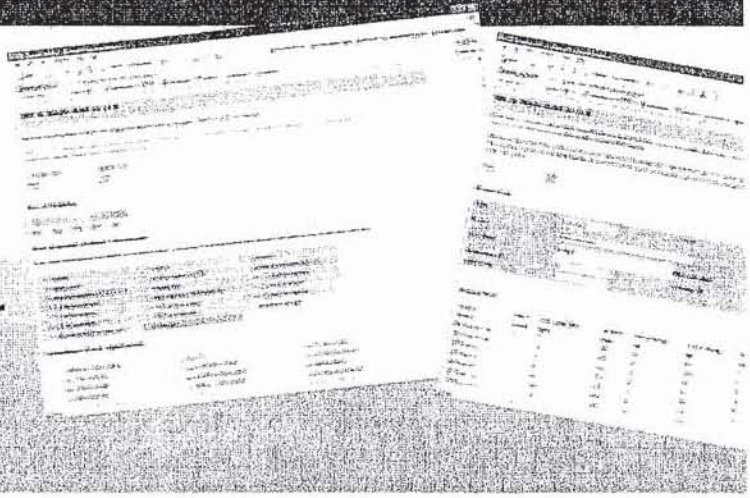
Front access hatches seal tight and are removed quickly with hand-knobs.

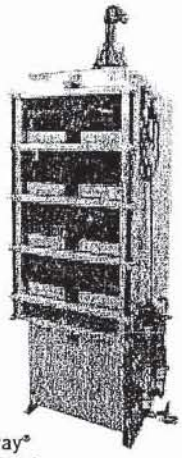
Split-tray option reduces maximum tray weight to only 28 lbs., even on the 1,000 gpm unit!

The QED VOC Removal Advantage

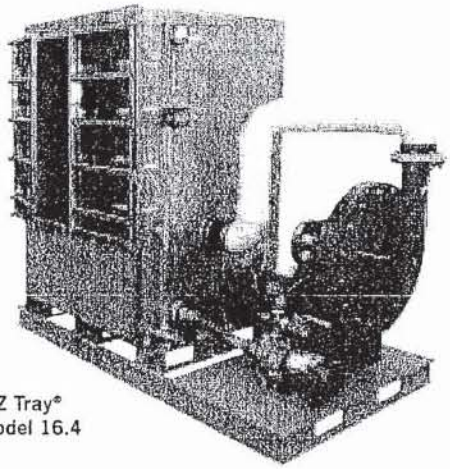
Proven equipment, expert help with its selection and installation, and support you can c

Exclusive Online Performance Modeler has been developed to assist you in selecting the most effective air stripping package for your groundwater cleanup project

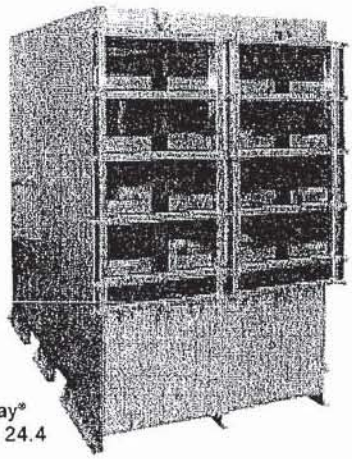




E-Z Tray®
Model 6.4



E-Z Tray®
Model 16.4



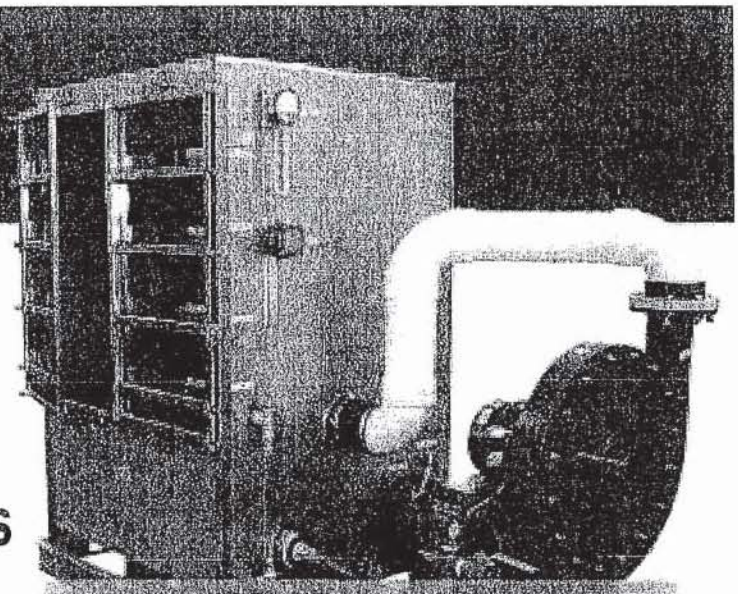
E-Z Tray®
Model 24.4

Air Stripper Specifications

Model No.	Maximum Flow Range	Dry Weight	Operating Weight	Shell Dimension (LxWxH)	Trays Per Tier
4.4	1-50 gpm (4-189 Lpm)	630 lbs. (286 kg)	985 lbs. (447 kg)	29 x 27 x 82 in. (74 x 69 x 208 cm)	4 x 29 lbs. (4 x 13 kg)
4.6	1-50 gpm (4-189 Lpm)	780 lbs. (354 kg)	1,219 lbs. (553 kg)	29 x 27 x 102 in. (74 x 69 x 259 cm)	6 x 29 lbs. (6 x 13 kg)
6.4	1-65 gpm (4-246 Lpm)	790 lbs. (358 kg)	1,285 lbs. (583 kg)	37 x 27 x 82 in. (94 x 69 x 208 cm)	4 x 40 lbs. (4 x 18 kg)
6.6	1-65 gpm (4-246 Lpm)	978 lbs. (443 kg)	1,591 lbs. (722 kg)	37 x 27 x 102 in. (94 x 69 x 259 cm)	6 x 40 lbs. (6 x 18 kg)
8.4	1-75 gpm (4-284 Lpm)	955 lbs. (433 kg)	1,580 lbs. (717 kg)	49 x 27 x 82 in. (124 x 69 x 208 cm)	4 x 50 lbs. (4 x 23 kg)
8.6	1-75 gpm (4-284 Lpm)	1,182 lbs. (536 kg)	1,956 lbs. (887 kg)	49 x 27 x 102 in. (124 x 69 x 259 cm)	6 x 50 lbs. (6 x 23 kg)
12.4	1-120 gpm (4-454 Lpm)	1,165 lbs. (528 kg)	2,105 lbs. (955 kg)	73 x 27 x 82 in. (185 x 69 x 208 cm)	4 x 60 lbs. (4 x 447 kg)
12.6	1-120 gpm (4-454 Lpm)	1,442 lbs. (654 kg)	2,606 lbs. (1,182 kg)	73 x 27 x 102 in. (185 x 69 x 259 cm)	6 x 60 lbs. (6 x 447 kg)
16.4	1-150 gpm (4-566 Lpm)	1,625 lbs. (737 kg)	2,870 lbs. (1,302 kg)	49 x 52 x 84 in. (124 x 132 x 213 cm)	8 x 50 lbs. (8 x 23 kg)
16.6	1-150 gpm (4-566 Lpm)	2,011 lbs. (912 kg)	3,553 lbs. (1,612 kg)	49 x 52 x 104 in. (124 x 132 x 264 cm)	12 x 50 lbs. (12 x 23 kg)
24.4	1-250 gpm (4-946 Lpm)	2,100 lbs. (953 kg)	3,980 lbs. (1,805 kg)	73 x 52 x 84 in. (185 x 132 x 213 cm)	8 x 60 lbs. (8 x 27 kg)
24.6	1-250 gpm (4-946 Lpm)	2,599 lbs. (1,179 kg)	4,926 lbs. (2,234 kg)	73 x 52 x 104 in. (185 x 132 x 264 cm)	12 x 60 lbs. (12 x 27 kg)
48.4	1-500 gpm (1,893 Lpm)	5,000 lbs. (2,268 kg)	12,500 lbs. (5,670 kg)	98 x 71 x 84 in. (249 x 180 x 213 cm)	16 x 60 lbs. (16 x 27 kg)
48.6	1-500 gpm (1,893 Lpm)	5,500 lbs. (2,495 kg)	13,000 lbs. (5,897 kg)	98 x 71 x 104 in. (249 x 180 x 264 cm)	24 x 60 lbs. (24 x 27 kg)
96.4	1-1,000 gpm (3,785 Lpm)	11,000 lbs. (4,990 kg)	25,000 lbs. (11,340 kg)	142 x 98 x 84 in. (361 x 249 x 213 cm)	32 x 60 lbs. (32 x 27 kg)
96.6	1-1,000 gpm (3,785 Lpm)	11,500 lbs. (5,216 kg)	30,000 lbs. (13,608 kg)	142 x 98 x 104 in. (361 x 249 x 264 cm)	48 x 60 lbs. (48 x 27 kg)

Standard construction is 304 SS, other alloys upon request. *Allow additional space for accessory components. (blower, piping, etc.)

E-Z Tray®



Easier tray cleaning and superior technical support make E-Z Tray® air strippers a smart choice!

The E-Z Tray® Air Stripper (U.S. Patent Number 5,518,668) is a sliding tray, stainless steel air stripper used to remove volatile organic compounds (VOC) from contaminated groundwater and waste streams. The exclusive design of the E-Z Tray stripper results in very high removal efficiencies in an easier to maintain process unit.

Any air stripping process subject to fouling conditions has to contend with periodic cleaning in order to retain treatment efficiencies and capacity. Tower air strip pers can become maintenance headaches when the tower packing becomes clogged and cemented together with bio-fouling or precipitants. When the perforated trays in stacking tray air strippers become fouled they require major disassembly, cranes or hoists, and lots of room.

Unlike these traditional types of air strippers, QED's E-Z Tray air strippers use removable, lightweight, front slide-out trays. This unique feature provides many advantages, including one person cleaning and less building space.

E-Z Tray Advantages

E-Z Tray	Tower Air Strippers	Stacking Tray Air Strippers
• Single person cleaning	• Condition of packing and liquid and air flow distribution are very difficult to observe	• Major disassembly steps and crew needed
• Easy process monitoring and inspection, even while in operation	• Small footprint but very tall structure required	• Difficult to impossible to observe air and liquid flow distribution during operation
• Reduced footprint for installation and maintenance	• More difficult to keep at design performance	• Lots of space needed for disassembly, to access all sides and to lift and store tray stages
• High removal efficiencies easier to maintain	• More complex process assistance required	• More difficult to keep at design performance
• Easily modeled online by customer to help process evaluation		• Online modeler not offered

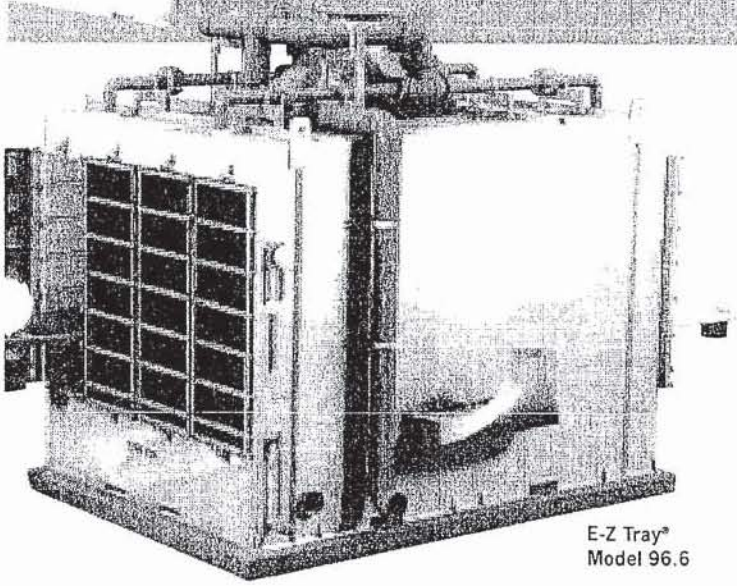
E-Z Tray air strippers are available in configurations with 4 or 6 trays, with maximum flow rates from 1-25 gpm (4-100 Lpm) all the way up to 1,000 gpm (3,784 Lpm).

NEW – High Capacity Process Air Strippers
These air strippers are engineered to serve in larger, process-type projects involving multiple treatment stages, where they are an effective component of large-scale water or wastewater processes in manufacturing, refining, chemical processing and other industries. They can act as a pre-treatment stage for other process elements, such as large aerobic biotreatment units, removing VOCs at much lower airflow rates to reduce the costs of off-gas treatment.

All of this combined with the easier maintenance and smaller footprint of QED's sliding tray air strippers, has led E-Z Tray to become the preferred choice for major remediation and process stream projects in the U.S. and abroad.

ount on when you need it

Try it for yourself today! Use our exclusive online stripper modeler at **www.qedenv.com/model/model.html** *to spec the exact size and configuration for your project. Then talk to a QED applications specialist toll-free at* **(800) 624-2026** *for fast, free system design assistance and a price quote.*

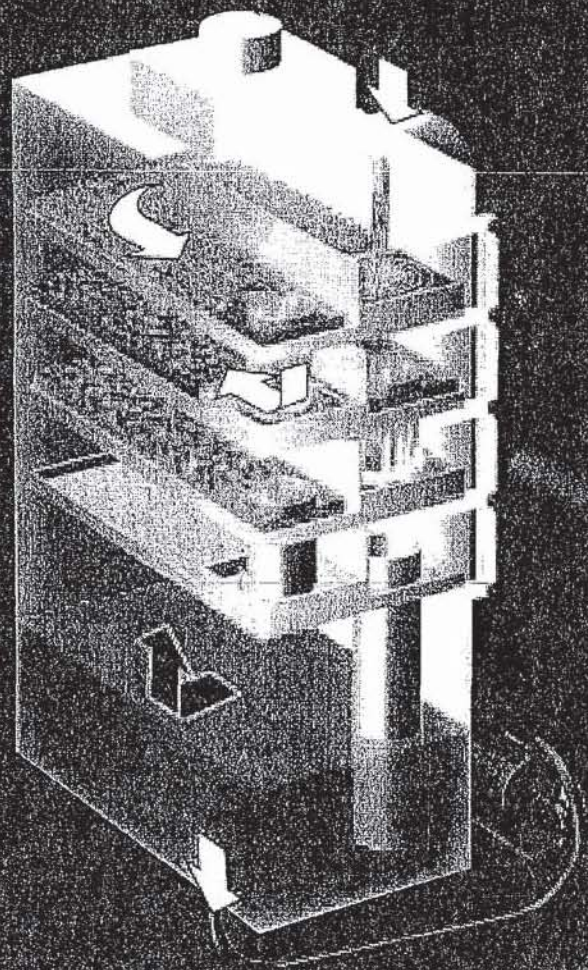


E-Z Tray®
Model 96.6

Active Area	Nominal Air Flow	Additional Space for Tray Removal*
2.8 ft.² (0.26 m²)	210 cfm (5.95 m³/min)	27 in. (69 cm)
2.8 ft.² (0.26 m²)	210 cfm (5.95 m³/min)	27 in. (69 cm)
3.8 ft.² (0.35 m²)	320 cfm (9.06 m³/min)	35 in. (89 cm)
3.8 ft.² (0.35 m²)	320 cfm (9.06 m³/min)	35 in. (89 cm)
5.6 ft.² (0.52 m²)	420 cfm (11.89 m³/min)	47 in. (119 cm)
5.6 ft.² (0.52 m²)	420 cfm (11.89 m³/min)	47 in. (119 cm)
8.8 ft.² (0.82 m²)	600 cfm (16.99 m³/min)	71 in. (180 cm)
8.8 ft.² (0.82 m²)	600 cfm (16.99 m³/min)	71 in. (180 cm)
11.1 ft.² (1.03 m²)	850 cfm (24.07 m³/min)	47 in. (119 cm)
11.1 ft.² (1.03 m²)	850 cfm (24.07 m³/min)	47 in. (119 cm)
17.5 ft.² (1.63 m²)	1,300 cfm (36.81 m³/min)	72 in. (183 cm)
17.5 ft.² (1.63 m²)	1,300 cfm (36.81 m³/min)	72 in. (183 cm)
27 ft.² (2.51 m²)	2,600 cfm (73.62 m³/min)	72 in. (183 cm)
27 ft.² (2.51 m²)	2,600 cfm (73.62 m³/min)	72 in. (183 cm)
54 ft.² (5.02 m²)	5,200 cfm (147.25 m³/min)	2 x 72 in. (2 x 183 cm)*
54 ft.² (5.02 m²)	5,200 cfm (147.25 m³/min)	2 x 72 in. (2 x 183 cm)*

How it Works

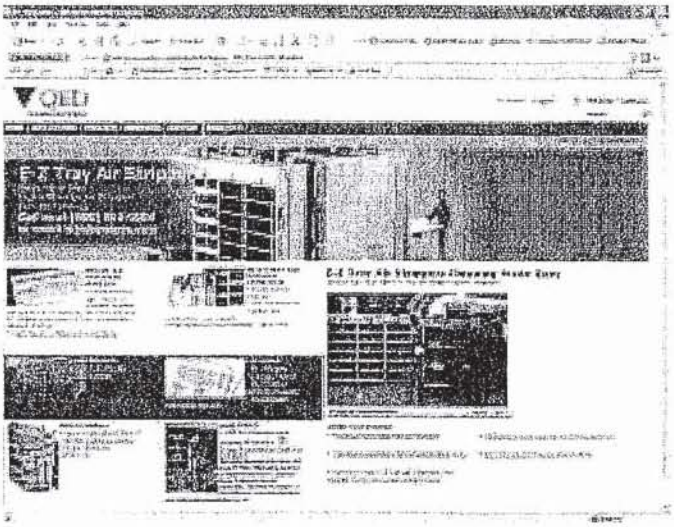
As contaminated groundwater enters through the top of the air stripper, millions of air bubbles are forced by blower pressure up through the perforated trays. This creates a turbulent froth zone with an extremely high air-to-liquid surface area for mass transfer of volatile organic compounds (VOCs) from liquid to air. Using the froth instead of a conventional tower packing delivers high VOC removal efficiencies even under fouling conditions, and is easier to inspect and maintain.



QED Quality Control, Manufacturing Standards and Customer Service

Experienced site owners, including major oil companies, are increasingly choosing E-Z Tray® air strippers from QED due to their unique features and solid technical support, including:

- **Lower long-term O&M costs due to easier tray maintenance than tower-type or stacking tray air strippers.**
- **Lightweight, slide-out trays don't require hoists, regardless of the size of the air stripper.**
- **E-Z Tray air strippers need less building space, which can lower building costs.**
- **QED's staff and resources are #1 in air stripper technical and service support, including for unusual applications.**
- **Online Performance Modeler tool available 24/7 to help you select the proper air stripper.**
- **QED quote & delivery times are quick and dependable.**



Visit qedenv.com/air-strippers to view and use the exclusive Online Performance Modeler, which allows you to model your process conditions and select the most efficient air stripping package for your VOC removal project. You can also view case studies where E-Z Tray air strippers were the top choice in successful projects.

The World Leader in Air-Powered Remediation

For Remediation, Landfills and Groundwater Sampling

QED
Environmental Systems

A TestAmerica Company

6095 Jackson Road
Ann Arbor, MI 48106-3726
USA

800-624-2026
T: 734-995-2547
F: 734-995-1170
info@qedenv.com
www.qedenv.com

1565 Alvarado Street
San Leandro, CA 94577
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800-624-2026
T: 510-346-0400
F: 510-346-0414
info@qedenv.com
www.qedenv.com

CODE 2336 4/09

ENGINEERING DATA SHEET 1
AIR STRIPPER (STACKABLE TRAY)

GENERAL PRODUCT DATA

Model No.	Max. Flow (GPM)	Dry Weight (lbs)	Oper. Weight (lbs)	Shell Dimension ("DIA x H)	Trays (no x lbs)	Active area (sq ft)	Nom. airflow (cfm)	*Required Clearance (inches)
2.4P	1-25	103	483	27 x 83	4 x 16	2.6	140	4 x <27
2.6P	1-25	135	531	27 x 103	6 x 16	2.6	140	4 x <27
4.4P	1-40	155	1,004	37 x 83	4 x 24	5.8	280	4 x <37
4.6P	1-40	203	1,134	37 x 102	6 x 24	5.8	280	4 x <37

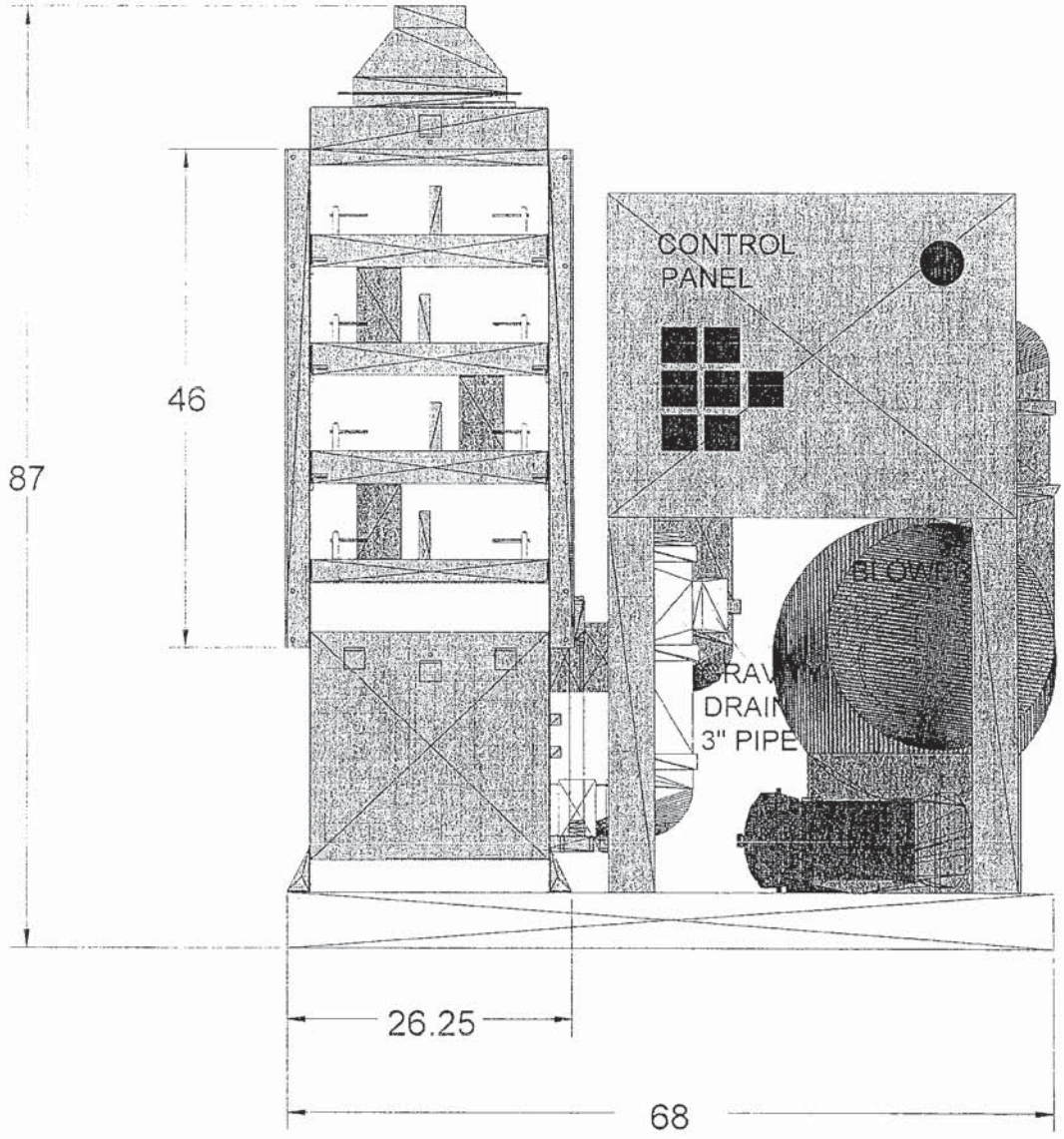
*Required clearances (back/sides by front, installed on standard skid)

INSTALLATION DATA

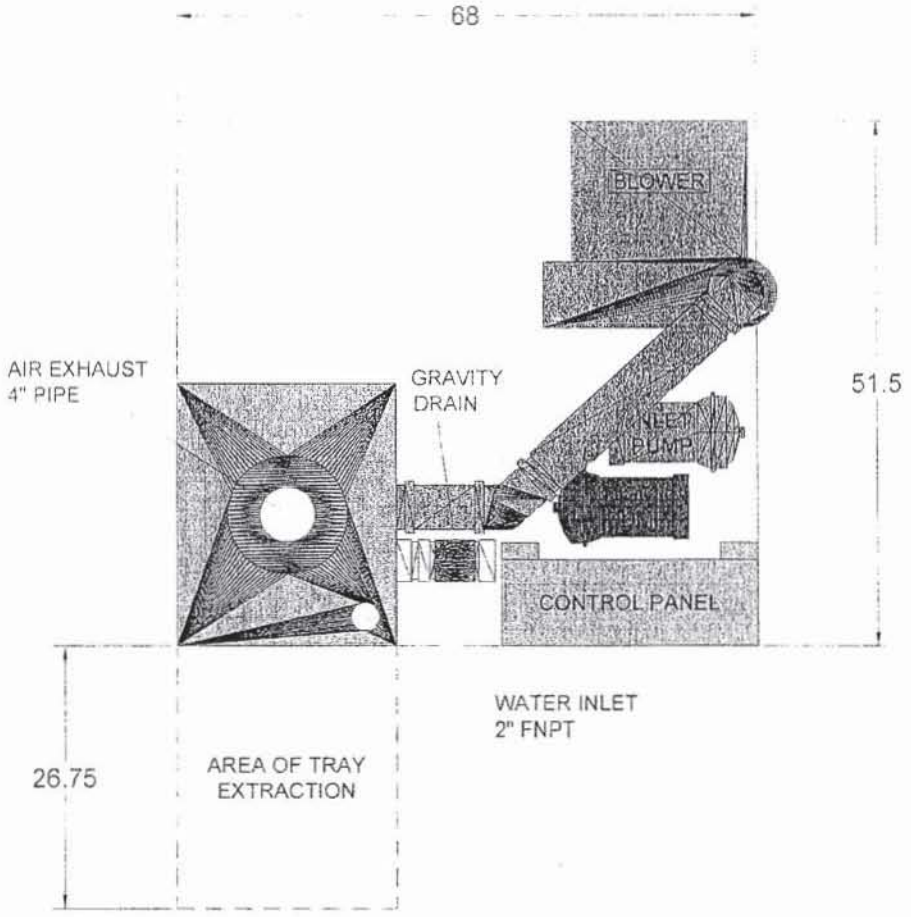
Model No.	Water Inlet (" FNPT)	Water Outlet + (" FNPT)	Blower Inlet (" FNPT)	Exhaust Outlet (" O.D. pipe)	Sump drain (" FNPT)	#Exhaust Stack size (inches)	*Max back pressure ("H2O)
2.4P	1 w/o pump 1 w/pump	2 w/o pump 1 w/pump	2	4.5	1	4	25
2.6P	1 w/o pump 1 w/pump	2 w/o pump 1 w/pump	2	4.5	1	4	17
4.4P	1 w/o pump 1 w/pump	3 w/o pump 2 w/pump	4	6.25	1	6	25
4.6P	1 w/o pump 1 w/pump	3 w/o pump 2 w/pump	4	6.25	1	6	17

+ Gravity drain if no pump is installed
# Minimum recommended nominal diameter of exhaust stack if added
* Maximum exhaust back-pressure allowed without auxiliary blower

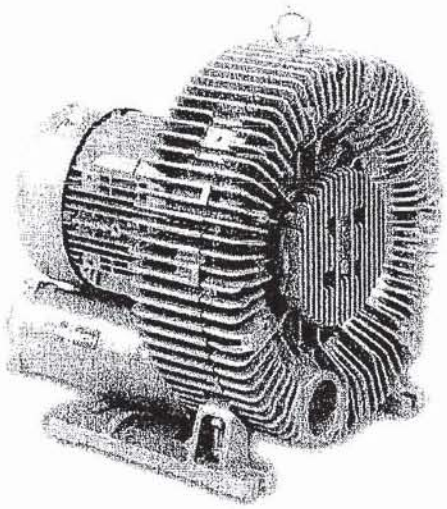
QED EZ-Tray Model 4.4 - Front View



QED EZ-Tray Model 4.4 - Top View



Samos
SB 0050 – 1400 D/D2



Samos SB 0530 D

Description

Busch Samos SB regenerative blowers are designed for either pressure or vacuum. They are available in single and two stage models so they can operate over a wide range of flow and differential pressure.

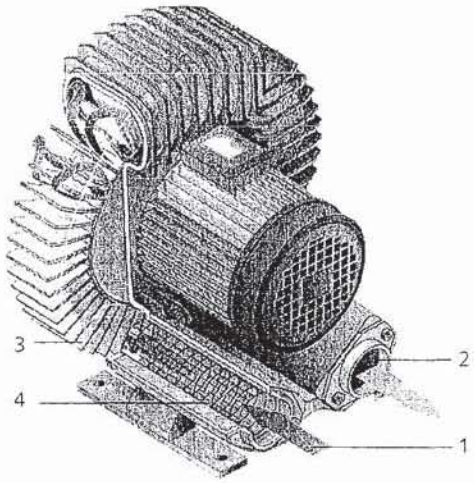
Low Maintenance and Environmentally Friendly

Samos low maintenance features include: rugged construction, sealed-for-life bearings, a fan cooled motor and a non-contacting impeller. They are oil-free, have a low power consumption, and are quiet due to internal silencers. Samos blowers can be installed in either a vertical or horizontal position.

Regenerative Blowers

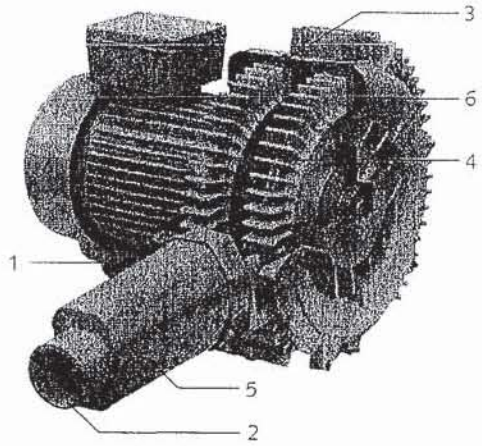
Operating Principle

Single-stage version



1. Gas Inlet
2. Gas outlet
3. Impeller
4. Silencer

Two-stage version



1. Gas inlet
2. Gas outlet
3. Impeller 1st stage
4. Impeller 2nd stage
5. Silencer
6. Side channel

Operating Principle

Gases are drawn in through the blower inlet. As the impeller rotates, it transfers kinetic energy to the gases being pumped. As a result, the gases move forward through a corkscrew shaped path and are compressed, then discharged through the pressure side exhaust silencer. The impeller is mounted directly on the motor shaft.

Applications

Pneumatic conveying

Transport and lifting system

Carton forming and packaging

Vacuum holddown

Materials handling

Soil remediation

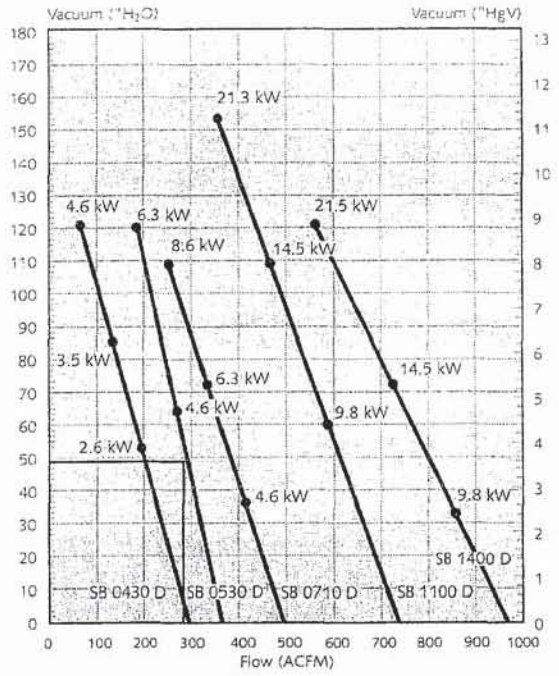
Trim removal

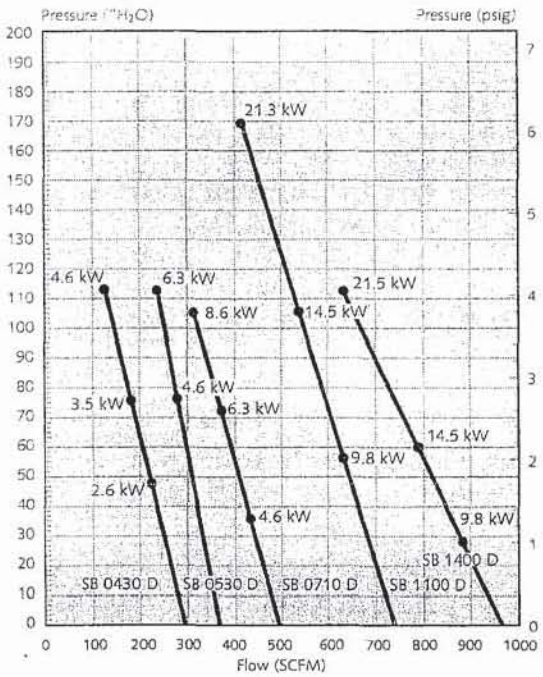
Wood routers

Printing industry applications

Regenerative Blowers

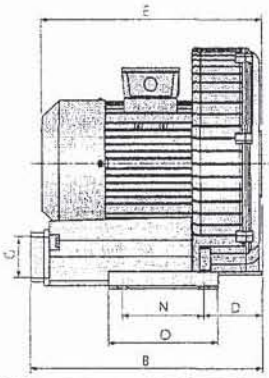
Technical Data Samos SB 0430 - 1400 D (single stage)

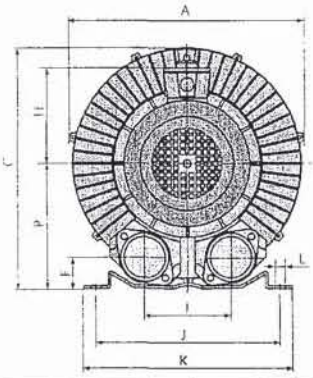




Technical Data	Nominal Pumping Speed	Max. Vacuum		Max Pressure		Motor (60 Hz)			Sound	Weight
Model	ACFM	"H2O	"Hg	"H2O	psig	kW	Hp	RPM	dB (A)	lbs
SB 0430 D	294	52	3.8	48	1.7	2.6	3.5	3450	73	64
SB 0430 D	294	85	6.2	76	2.7	3.5	4.7	3450	73	75
SB 0430 D	294	121	8.9	113	4.1	4.6	6.2	3450	73	92
SB 0530 D	365	64	4.7	56	2.0	4.6	6.2	3450	74	246
SB 0530 D	365	121	8.9	113	4.1	6.3	8.4	3450	74	251
SB 0710 D	494	36	2.6	36	1.3	4.6	6.2	3450	74	246
SB 0710 D	494	72	5.3	72	2.6	6.3	8.4	3450	74	277
SB 0710 D	494	109	8.0	105	3.8	8.6	11.5	3450	74	282
SB 1100 D	736	60	4.4	56	2.0	9.8	13.1	3450	79	378
SB 1100 D	736	109	8.0	105	3.8	14.5	19.4	3450	79	420
SB 1100 D	736	153	11.2	169	6.1	21.3	28.6	3450	79	449
SB 1400 D	968	32	2.3	28	1.0	9.8	13.1	3450	80	383
SB 1400 D	968	72	5.3	64	2.3	14.5	19.4	3450	80	425
SB 1400 D	968	121	8.9	113	4.1	21.5	28.8	3450	80	453

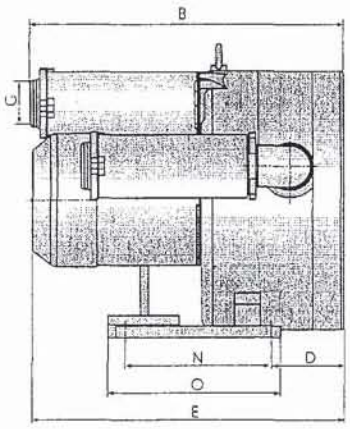
Dimensions Samos SB 0050 - 1400 D (single stage)

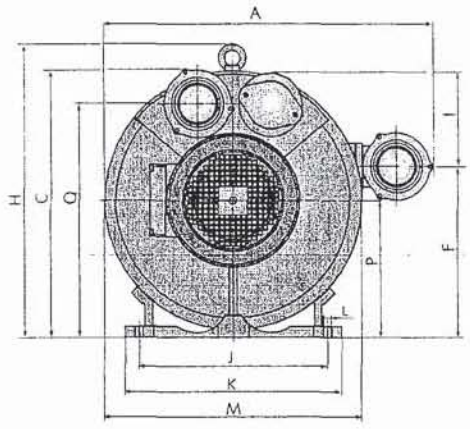




Model	A	B	C	D	E	F	G (NPT)	H	I	J	K	L	N	O	P
SB 0050 D	9 3/4	9 1/16	9 13/16	2 13/16	10 3/16	1 9/16	1 1/4	4 3/8	3 9/16	8 1/16	9 1/16	3/8	3 1/4	4 1/4	5 1/8
SB 0080 D	9 3/4	9 1/16	9 13/16	2 13/16	10 3/16	1 9/16	1 1/4	4 3/8	3 9/16	8 1/16	9 1/16	3/8	3 1/4	4 1/4	5 1/8
SB 0140 D	11 5/16	9 1/2	12	3	10 11/16	1 13/16	1 1/2	5 3/16	4 1/2	8 7/8	10 1/16	1/2	3 3/4	5 1/8	6 1/8
SB 0200 D	13 1/4	11 3/4	13 3/8	3 7/16	12 1/2	1 7/8	2	6 1/4	4 3/4	10 1/4	11 5/8	9/16	4 1/2	6 1/8	6 15/16
SB 0310 D	15 1/16	13 1/8	15 3/16	4 5/16	14 15/16	2 1/8	2	7 3/16	4 15/16	11 7/16	12 13/16	9/16	5 1/2	7 1/16	7 7/8
SB 0430 D	14 7/8	14 3/16	15 3/16	3 7/8	17 3/16	2 1/8	2	5 13/16	4 15/16	11 7/16	12 13/16	9/16	5 1/2	7 1/16	7 7/8
SB 0530 D	19 11/16	19 1/2	20 5/16	1 3/8	18 5/8	3 3/16	2 1/2	NA	5 11/16	14 3/8	16 9/16	9/16	11	12 7/16	10 1/2
SB 0710 D	19 11/16	19 1/2	20 5/16	1 1/16	19 7/16	3 3/16	2 1/2	NA	5 11/16	14 3/8	16 9/16	9/16	11	12 7/16	10 1/2
SB 1100 D	21 15/16	28 7/8	24 7/8	4 1/4	24 5/16	3 9/16	4	NA	8 1/8	14 3/16	16 5/16	9/16	23 7/16	NA	11 7/8
SB 1400 D	21	24 13/16	22 3/8	4 1/4	27 11/16	3 9/16	4	7 3/4	8 1/8	14 3/16	16	9/16	23 7/16	NA	11 7/8

Dimensions Samos SB 0530 D2 (two stage)

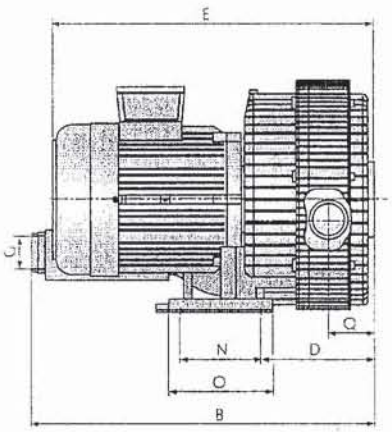


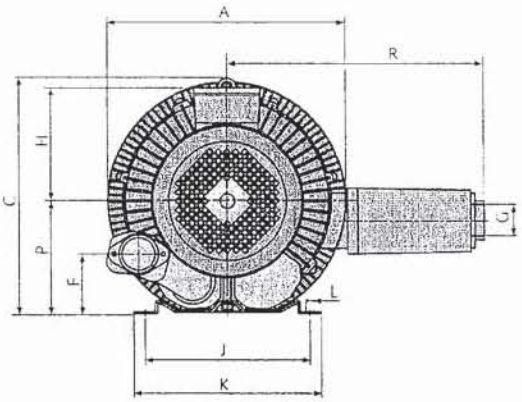


Model	A	B	C	D	E	F	G (NPT)	H	I	J	K	L	M	N	O	P	Q
SB 0530 D2	25 1/8	23 3/4	20 5/16	5 9/16	23 11/16	13 1/8	2 1/2	22 3/8	7 3/16	14 3/8	16 9/16	9/16	19 11/16	11	12 7/16	10 1/2	17 15/16

All dimensions in inches unless otherwise noted.

Dimensions Samos SB 0080 - 1100 D2 (two stage)





Model	A	B	C	D	E	F	G (NPT)	H	J	K	L	N	O	P	Q	R
SB 0080 D2	11 1/4	11 3/8	10 3/4	5 3/16	12 9/16	1 9/16	1 1/4	4 3/8	8 1/16	9 1/16	3/8	3 1/4	4 1/4	5 1/8	1 3/16	12 1/2
SB 0140 D2	12 11/16	12 1/2	12 1/2	6	15 7/8	1 13/16	1 1/2	5 1/16	8 7/8	10 1/16	1/2	3 3/4	5 1/8	6 1/8	1 13/16	12 11/16
SB 0200 D2	14 5/8	15 1/8	14 3/4	5 5/16	18 7/16	1 7/8	2	5 5/16	10 1/4	11 5/8	9/16	4 1/2	6 1/8	6 15/16	2 3/16	16 1/4
SB 0310 D2	16 7/8	17 1/2	16 5/8	8 1/16	20 11/16	2 1/8	2	5 1/16	11 7/16	12 13/16	9/16	5 1/2	7 1/16	7 7/8	2 7/8	17 7/16
SB 1100 D2	22 1/16	32 7/8	22 1/2	9 1/2	30 3/16	3 9/16	4	13 1/8	14 3/16	16 5/16	9/16	23 7/16	NA	11 7/8	5 13/16	32 3/8

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www.buschpump.com
1-800-USA-PUMP

APPENDIX E

VAPOR-PHASE CARBON SPECIFICATIONS AND VENDOR INFORMATION

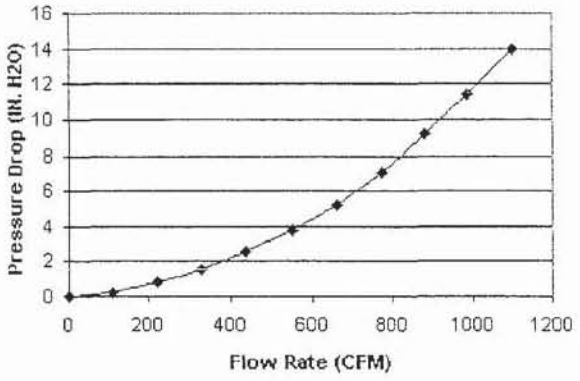
VR SERIES FILTERS
MODEL VR-400

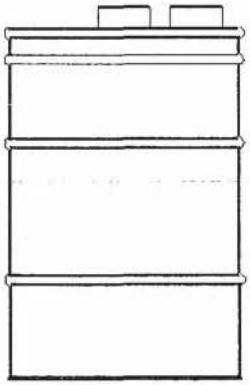
Picture
Not
Available

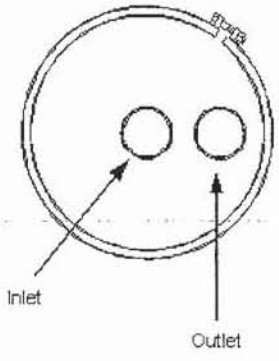
The VR-400 filter is a radial flow filter vessel designed to treat vapor streams where pressure drop is a strong concern. With the radial design in certain applications the user can obtain higher flow rates than could be obtained in similar upflow filters. Some applications include:

- Soil Vapor Extraction Treatment
- Air Stripper Off Gas Treatment
- Odor Removal System
- Storage Tank Purge Vapor Treatment
- Industrial Process Treatment

PRESSURE DROP GRAPH
*(As Filled 4*10 GAC)*







VR-400 SPECIFICATIONS			
Overall Height	3'11"	Vessel/Internal Piping Materials	CS/ SCH 40 PVC
Diameter	30"	Internal Coating	Polyamide Epoxy Resin
Inlet / Outlet (FNPT)	6"	External Coating	Urethane Enamel
Drain / Vent (FNPT)	OPT	Maximum Pressure / Temp	2 PSIG / 150° F
GAC Fill (lbs)	400	Cross Sectional Bed Area	8.8 FT^2
Shipping / Operational Weight (lbs)	500/575	Bed Depth/Volume	11.7 IN / 14.25 FT^3

APPENDIX F

BAG FILTER SPECIFICATIONS AND VENDOR INFORMATION

Custom Service & Design, Inc.

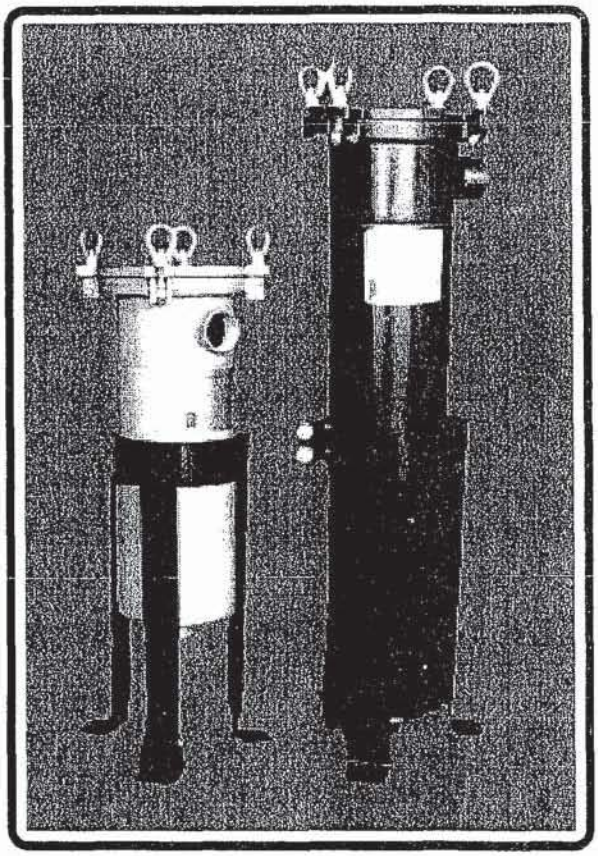
P.O. Box 214923
Auburn Hills, MI 48321

Phone: 248.340.9005
Fax: 248.340.9002

BULLETIN: 07A4L01-1

OEM BAG VESSEL DESIGN

CSD'S NEW OEM BAG VESSEL DESIGN IS SETTING NEW STANDARDS IN THE FILTRATION INDUSTRY. UTILIZING STANDARD BAG SIZES (P1S & P2S) AND MAINTAINING 150 PSI RATING. THIS UNIQUE STATE-OF-THE-ART VESSEL IS THE MOST COMPETITIVELY PRICED VESSEL ON THE MARKET.

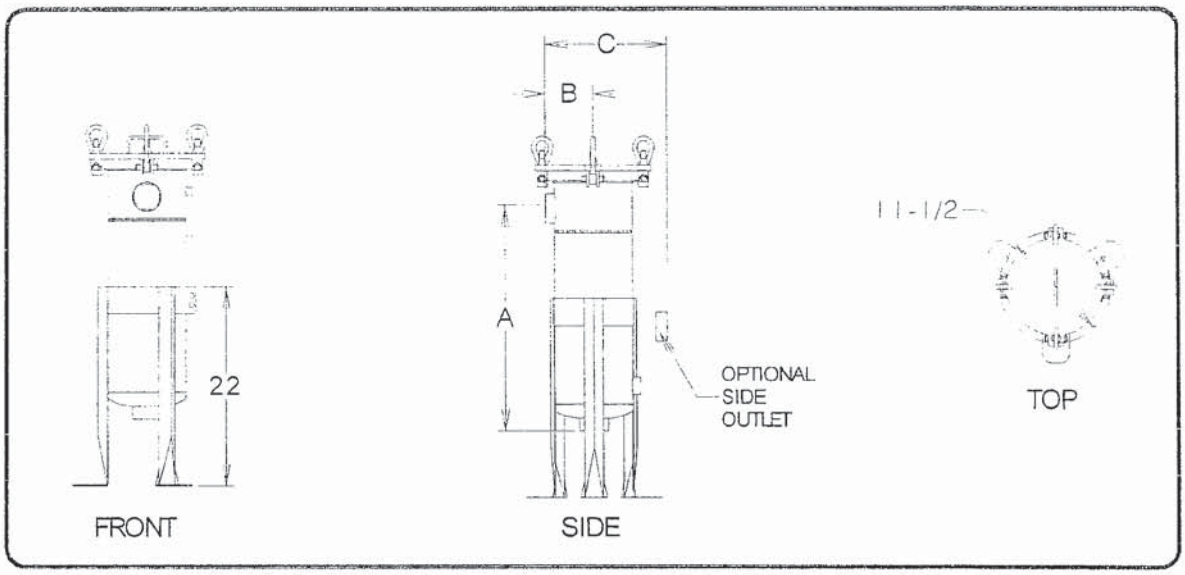


STANDARD FEATURES:

- CARBON STEEL
- 304 STAINLESS STEEL
- STAINLESS STEEL RESTRAINER BASKETS
- 150 PSI @ 300F
- 4 LUG LID HOLDDOWN
- GAUGE, VENT, DRAIN PORTS
- 2" NPT CONNECTIONS
- SIDE INLET / BOTTOM OUTLET
- BUNA / EPDM SEALS
- TRIPOD LEGS (ADJUSTABLE)

OPTIONS:

- ADDITIONAL INLET / OUTLET SIZES
- INLET / OUTLET LOCATION
- FLANGED, VICTOLIC, SANITARY CONNECTIONS
- MANUAL / AUTOMATIC DUPLEXING
- RESTRAINER BASKET PERFORATION / MESH SIZES
- O RING / SEAL MATERIAL
- BAG HOLD DOWN ASSEMBLY
- SPECIALTY VESSELS



VESSEL	SIZE	A	B	C
15	2" NPT	20-3/4	4-7/16	8-7/8
30	2" NPT	33-3/4	4-7/16	8-7/16

Building a CSD Part Number

007A1304L020N1BC

Type	Vessel	# of Elements	Basket Length	Vessel Design	Connection Size	Style	Inlet / Outlet Location	Seals	Construction
0	07	01	30	4L	020	N	1	B	C
Regular	07	1	30"	4 Lug	2"	NPT	Side In / Bottom Out	Buna	Carbon Steel

Distributed By:

Custom Service & Design, Inc.
Phone: 248.340.9005
Fax: 248.340.9002

P.O. Box 214923
Auburn Hills, MI 48321

Ph.: 248.340.9005
Fax: 248.340.9002
www.customserviceanddesign.com

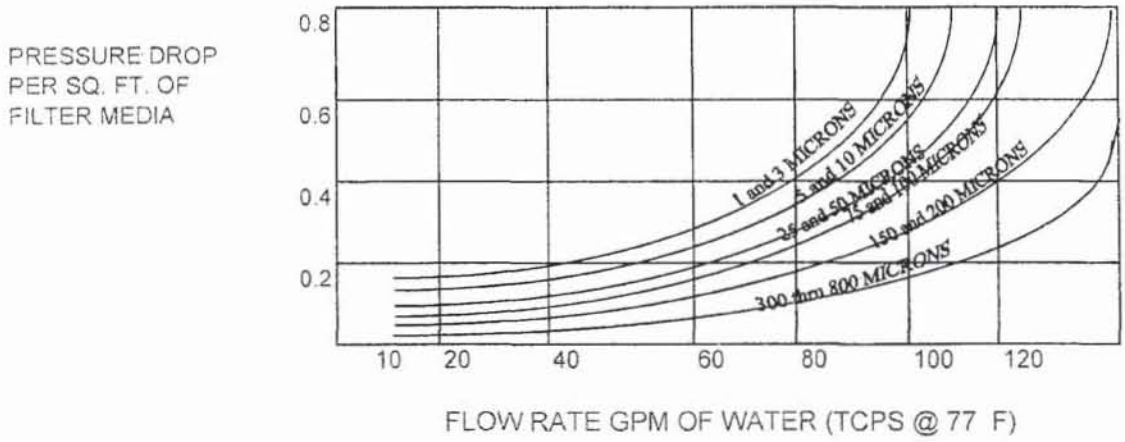
Custom Service & Design, Inc.

Bulletin: DPB07-1

High Capacity Filter Bags

Pressure Drop Data

The graph shows pressure drop through clean filter bag media of various micron ratings.
The curves do not consider pressure drop through the filter housing.



Bag Size Correction

To obtain pressure drop correction for a specific bag size, divide the pressure drop obtained from the graph by the square foot area of the bag

Bag Size	Surface Area (Sq. Ft.)	Surface Area (Sq. Ft.)
P3S/P3P/X1	0.5	0.5
P4S/P4P/X2	1	1
P1S/P1P	2	2
P2S/P2P	4	4

Viscosity Correction

If viscosity is higher than one, multiply the corrected pressure drop as obtained above by the appropriate viscosity correction factor.

Viscosity (CPS)	Correction Factor
50	4.5
100	8.3
200	16.6
400	27.7
800	50
1000	56.2
1500	77.2
2000	113.6
4000	161
6000	250
8000	325
10000	430

P.O. Box 214923
Auburn Hills, MI 48321

Phone 248.340.9005
Fax: 248.340.9002
www.customserviceanddesign.com

Custom Service & Design, Inc.

Conversion Table
Bulletin: CT01-06

Mesh	Micron	Inches
4	5205	0.2030
8	2487	0.0970
10	1923	0.0750
14	1307	0.0510
18	1000	0.0394
20	840	0.0331
25	710	0.0280
30	590	0.0232
35	500	0.0197
40	420	0.0165
45	350	0.0138
50	297	0.0117
60	250	0.0098
70	210	0.0083
80	177	0.0070
100	149	0.0059
120	125	0.0049
140	105	0.0041
170	88	0.0035
200	74	0.0029
230	62	0.0024
270	53	0.0021
325	44	0.0017
400	37	0.0015
550	25	0.0009
800	15	0.0006
1250	10	0.0004
---	5	0.0002

APPENDIX G

ARSENIC REDUCTION SYSTEM SPECIFICATIONS AND VENDOR INFORMATION

SMALL WATER SYSTEM SOLUTIONS
APU & MODULAR SYSTEM APPLICATIONS

adedge

Adsorption Media – Arsenic Reduction

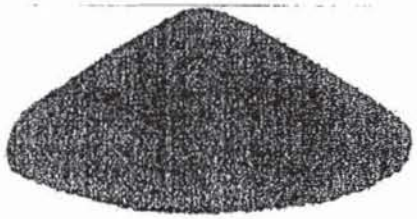
Adedge Technologies' Bayoxide®E33 media is the industry standard for arsenic reduction that reduces up to 99% of total arsenic, including both arsenic (III) and arsenic (V). It is also effective in reducing other heavy metals such as lead, cadmium, chromium, antimony and molybdenum. This revolutionary new iron-based granular adsorption media has 4 to 10 times the capacity of many adsorption medias. Adedge's product is specifically designed for commercial and residential POE and small systems to meet the new EPA arsenic standard of 10 ppb. Developed in the mid-nineties, this ferric oxide-based product has been successfully used in large-scale drinking water applications since 1999. The new E33 media is discardable when spent and requires no chemicals or regeneration. It has become the premier product of choice for commercial drinking water treatment systems for reliable, cost-effective, proven reduction of arsenic.

✓ Removal of up to 99% of total Arsenic in water, including As (III) & As (V) with no wasting of water.	✓ NSF 61 product listing (see AdEdge for listing site/product details) ✓ Effective over broad water chemistry.
✓ Spent media discarded as non-hazardous household waste.	✓ Simple application for commercial applications for arsenic removal.
✓ Reliable performance, low maintenance ✓ Adaptable add-on to water softening or other existing equipment.	✓ 2 - 2.5 times lighter than other iron-based media; easily backwashable; arsenic not released or discharged in backwash water.
✓ Effective for reducing lead, chromium, cadmium, molybdenum and antimony.	✓ Imparts no harmful chemicals into the treated product water. ✓ No salt, chemicals or regeneration needed

TECHNICAL SPECIFICATIONS

E33 provides cost effective centralized arsenic treatment with a typical life of 6-36 months before replacement. The media exhibits high operating capacity across a wide range of pH, influent arsenic concentrations and flow rates. It is simple to apply in standard pressure vessels with flow rates ranging from 10-300 gallons per minute. Once the media is exhausted, E33 can be discarded as a non-hazardous waste (specific state requirements should be consulted). Media is easy to handle and can be stored and shipped dry.

Physical Properties	E33 Media
Matrix	Iron Oxide Composite
Physical Form	Dry granular media
Color	Amber
Particle Size Distribution	10x35 or 14x18 mesh
Moisture Content	< 15% by wt.
Packaged	Dry



Adedge Technologies, Inc.
5152 Belle Wood Court Suite A, Buford, GA 30518
Toll Free: (866) 8ADEDGE Fax: (678) 835-0057 www.adedgetechnologies.com

Bayoxide® E33

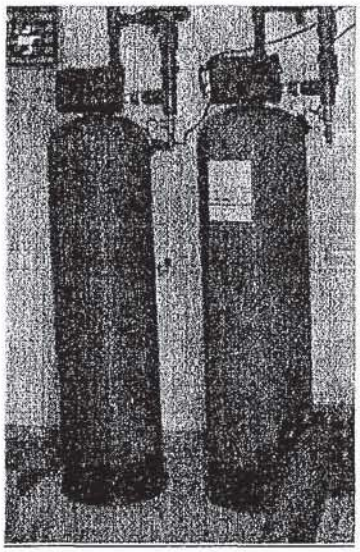
Arsenic Removal Performance (POE)	
Arsenic concentration range [1,2]	10 – 100+ ppb
Arsenic species reduced	As (III) and As (V)
Removal efficiency	Up to 99%
Estimated media life	6-36 months
Expected life bed volumes [3]	site specific
Spent media disposal [4]	Non-hazardous waste
Empty bed contact time	3 minutes typical

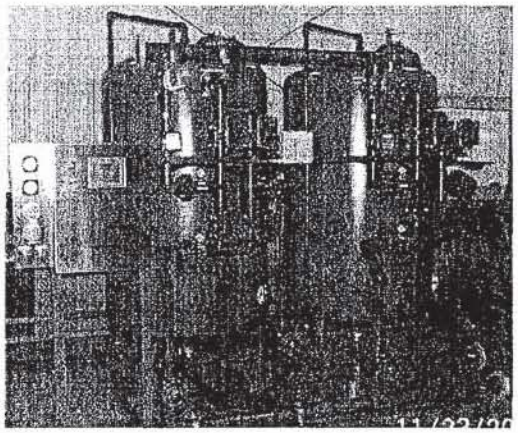
Notes:
1. Typical arsenic contamination in U.S. < 50 ppb.
2. Capable of removing higher As concentrations. Consult AdEdge for applications above 100 ppb.
3. Actual bed volumes based on water quality.
4. Reference US EPA TCLP protocol

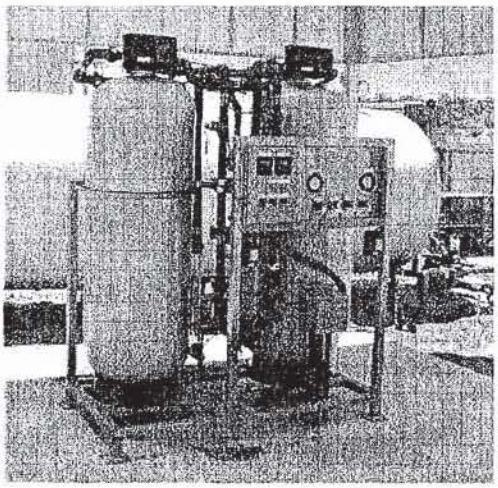
Parameter	Value [1]
pH range [2]	5.5 - 8.5
Arsenic [3]	< 100 ug/L
Iron	< 0.3 mg/L
Manganese	< 0.05 mg/L
Phosphate	< 0.5 mg/L
Silica	< 30 mg/L
Sulfate	< 100 mg/L
Sulfides	< detect mg/L
TSS	< 5 mg/L
Fluoride	< 1 mg/L
Hardness	< 300 mg/L
Turbidity	5 NTU

WATER QUALITY CRITERIA

Notes:
1. Recommendations for best performance.
2. Water > 8.5 pH may require pH adjustment for best results. Contact Adedge for technical support.
3. For all applications, complete Adedge POE profile sheet to pre-qualify site for proper use; consult Adedge Authorized dealer or distributor for details
4. Pre-treat for tannins if present prior to adsorption







Use of E33 media in typical Modular and APU system installations.

Notes:
1. Media life based on gallon usage and water profile; will vary by individual site based on water quality and usage
2. AdEdge recommends effluent testing and monitoring program to determine media breakthrough.

adedge
Adedge Technologies, Inc.
5152 Belle Wood Court Suite A, Buford, GA 30518
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Technical Bulletin 2002-01 (rev3)
INSTALLATION AND START-UP PROCEDURES

For AdEdge Residential Point-Of-Entry Systems Using E33 Granular Ferric Oxide

AdEdge Technologies, Inc. (AdEdge) Bayoxide® E33 arsenic adsorption material is a dry, granular, flow able material designed for easy installation in traditional water treatment vessels in a down flow manner and periodic backwash. The material is supplied in fiber drums, super sacks, corrugated boxes and other appropriate containers. These procedures are intended to be guidelines for start-up of AdEdge POE treatment units and those containing AdEdge Bayoxide E33 (NSF 61 Certified granular ferric oxide) designed or those designed, assembled and sold which are consistent with AdEdge use specifications. Details may vary based on the specific application and adsorption media employed. This bulletin is not intended to provide comprehensive use instructions. Please consult AdEdge Technologies for details. Installations are to be performed by licensed mechanical contractors, plumbers or water treatment professionals familiar with water treatment equipment.

Media Loading

1. Wear appropriate safety equipment i.e. eyewear, gloves, respirator, or other.
2. Fill the mineral tank 1/3 full with potable water to reduce dust and prevent damage to the internals.
3. Sanitize system by pouring 1-2 ounces of common 5.25% or 6% household bleach into the mineral tank.
4. Cover the riser tube to prevent media from entering the distributor and riser tube.
5. Using a large open funnel fill the mineral tank with gravel or appropriate under-bed material, verify the distributor is covered.
6. Add the AdEdge Bayoxide E33 filtration media.
7. Upon filling verify the approximate void space from the top of the media to the threads of the tank.

Model: POE-5-1252:	15"
Model: POE-7-1354:	12"
Model: POE-10-1465:	12"

8. Remove the material covering the riser tube to provide a clear path for water in operation.
9. Fill mineral tank with water and allow 2-3 hours minimum for the media to soak before preparing system for operation, permitting trapped air to release and preventing unnecessary service issues on start-up.

Upon completing media loading and installation follow the startup procedures to prepare the system for operation.

Start-Up Procedures

1. The media has been soaking during installation and set up (2 – 3 hours minimum) to absorb water and release air.
2. Before pressurizing the treatment system, place the system into the backwash cycle.
3. Unplug the power source to remain in the backwash cycle.
4. Slightly open the inlet water line to allow less than 1/3 water flow. Allow the system to backwash until the backwash water is clear and free of media fines. Typically 10-15 minutes.
5. Incrementally increase by 1/3 or less flow rate and verify the water is clean and clear before increasing water flow.
6. With the system backwashing take a rubber mallet and repeatedly tap on the exterior of the tank. Tap high and low on the tank, the vibration is intended to free media from clinging to the sides or bottom of the tank.
7. Once full flow is reached and the backwash water is clear allow at least 15 or 20 minutes for a complete backwash.
8. Open the outlet bypass valve handle and all sample ports to purge air in the plumbing system.
9. Restore power to the treatment system.
10. Advance to the rinse cycle.
11. Allow the system to rinse for 2 minutes and return to the service position.
12. Before drawing a test sample allow the water to run 5-10 minutes to ensure steady state conditions are achieved for an accurate test.
13. Before leaving the site, program the valve to backwash overnight at the scheduled time of day.

Failure to follow startup procedures may result in poor water quality and substandard performance.

AdEdge Technologies, Inc.
5152 Belle Wood Ct
Buford, GA 30518

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Fax: (678) 835-0057
www.adedgetechnologies.com

Technical Bulletin 2009-08
MEDIA REPLACEMENT PROCEDURES

For AdEdge Residential Point-Of-Entry Systems Using E33 Granular Ferric Oxide

AdEdge Technologies, Inc. (AdEdge) Bayoxide® E33 arsenic adsorption material is a dry, granular, flow able material designed for easy installation in traditional water treatment vessels in a down flow manner and periodic backwash. The material is supplied in fiber drums, super sacks, corrugated boxes and other appropriate containers. These procedures are intended to be guidelines for start-up of AdEdge POE treatment units and those containing AdEdge Bayoxide E33 (NSF 61 Certified granular ferric oxide) designed or those designed, assembled and sold which are consistent with AdEdge use specifications. Details may vary based on the specific application and adsorption media employed. This bulletin is not intended to provide comprehensive use instructions. Please consult AdEdge Technologies for details. Installation should be performed by licensed mechanical contractors, plumbers or water treatment professionals familiar with water treatment equipment.

Media Replacement

1. Wear appropriate safety equipment i.e. eyewear, gloves, respirator, or other.
2. Place the treatment system in a bypass position; advance the valve operation to backwash and depressurize the system; siphon or drain all water from the tank.
3. Remove media; wet/dry vacuum equipment, mineral extractor, scoop or poor media out of tank.
4. Remove free liquids and containerize media for land disposal.
5. Follow local, state and federal regulations for disposal.

The Toxicity Characteristics Leaching Procedure (TCLP) and Waste Extraction Test (WET) have demonstrated Bayoxide E33 to be a non-hazardous waste for disposal in a sanitary landfill when applied as directed.

AdEdge Technologies, Inc.
5152 Belle Wood Ct
Buford, GA 30518

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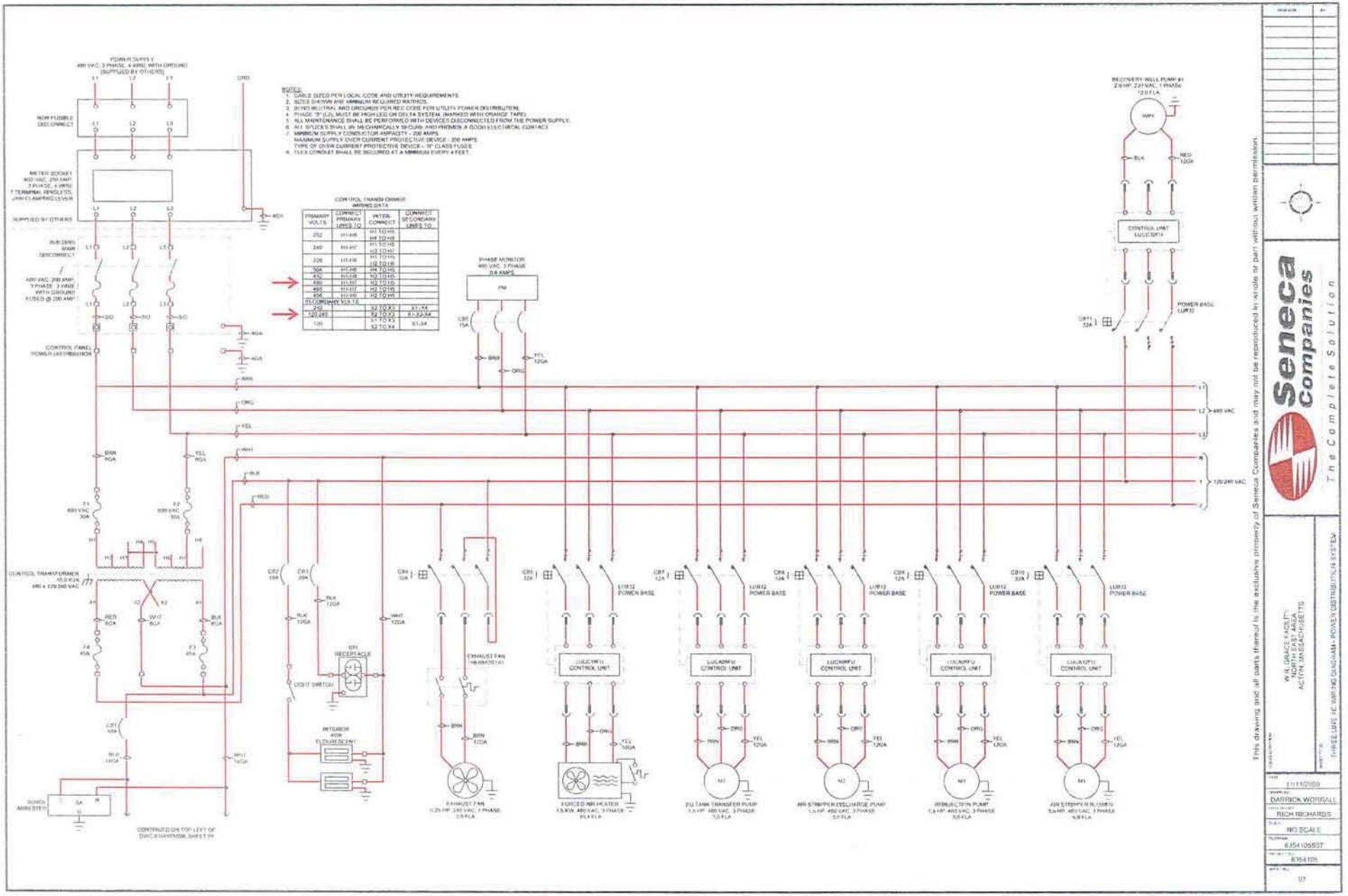
APPENDIX H

CONTROL PANEL SPECIFICATION AND VENDOR INFORMATION


POWER SUPPLY
480 VAC, 3 PHASE, 4 WIRE WITH GROUND
(SUPPLIED BY OTHERS)
NOTES:
1. CABLE SIZED PER LOCAL CODE AND UTILITY REQUIREMENTS.
2. SIZES SHOWN ARE MINIMUM REQUIRED RATINGS.
3. BOND NEUTRAL AND GROUNDS PER NEC CODE FOR UTILITY POWER DISTRIBUTION.
4. PHASE "B" (L2) MUST BE HIGH LEG ON DELTA SYSTEM. (MARKED WITH ORANGE TAPE)
5. ALL MAINTENANCE SHALL BE PERFORMED WITH DEVICES DISCONNECTED FROM THE POWER SUPPLY.
6. ALL SPLICES SHALL BE MECHANICALLY SECURE AND PROVIDE A GOOD ELECTRICAL CONTACT.
7. MINIMUM SUPPLY CONDUCTOR AMPACITY - 200 AMPS.
MAXIMUM SUPPLY OVER CURRENT PROTECTIVE DEVICE - 250 AMPS.
TYPE OF OVER CURRENT PROTECTIVE DEVICE - "R" CLASS FUSES.
8. FLEX CONDUIT SHALL BE SECURED AT A MINIMUM EVERY 4 FEET.
CONTROL TRANSFORMER WIRING DATA
PRIMARY VOLTS
CONNECT PRIMARY LINES TO
INTER-CONNECT
CONNECT SECONDARY LINES TO
252
H1 TO H5
H4 TO H8
240
H1 TO H5
H3 TO H7
226
H1 TO H5
H2 TO H6
504
H1 TO H5
H4 TO H8
480
H1 TO H5
H2 TO H6
480
H1 TO H5
H2 TO H6
456
H1 TO H5
H2 TO H6
RECOMMENDED TAPS
240
X2 TO X3
X1-X4
120/240
X2 TO X3
X1-X2-X4
120
X1 TO X3
X2 TO X4
X1-X4
PHASE MONITOR
480 VAC, 3 PHASE
0.6 AMPS
PM
CB6
15A
BRN
YEL
12GA
ORG
RECOVERY WELL PUMP #1
2.9 HP, 230 VAC, 1 PHASE
12.0 FLA
WP1
BLK
RED
12GA
CONTROL UNIT
LUC12FU
POWER BASE
LUB12
CB11
12A
CB7
12A
CB8
12A
CB9
12A
CB10
30A
LUB12 POWER BASE
LUCA32FU CONTROL UNIT
LUCA50FU CONTROL UNIT
480 VAC
120/240 VAC
CONTROL TRANSFORMER
15.0 KVA
480 x 120/240 VAC
T1
600 VAC
30A
T2
600 VAC
30A
F1
80A
F2
80A
F3
80A
F4
45A
F5
45A
CB1
20A
CB2
15A
CB3
10A
CB4
10A
CB5
10A
GFI
RECEPTACLE
LIGHT SWITCH
INTERIOR
40W
FLOURESCENT
EXHAUST FAN
HBB4MD01A1
EXHAUST FAN
0.25 HP, 230 VAC, 1 PHASE
2.5 FLA
FORCED AIR HEATER
7.5 KW, 480 VAC, 3 PHASE
10.4 FLA
EU TANK TRANSFER PUMP
1.5 HP, 460 VAC, 3 PHASE
3.0 FLA
AIR STRIPPER DISCHARGE PUMP
1.5 HP, 460 VAC, 3 PHASE
3.0 FLA
INJECTION PUMP
1.5 HP, 460 VAC, 3 PHASE
3.0 FLA
AIR STRIPPER BLOWER
3.0 HP, 460 VAC, 3 PHASE
4.8 FLA
CONTINUED ON TOP LEFT OF DWG # (WHICH SHEET ?)
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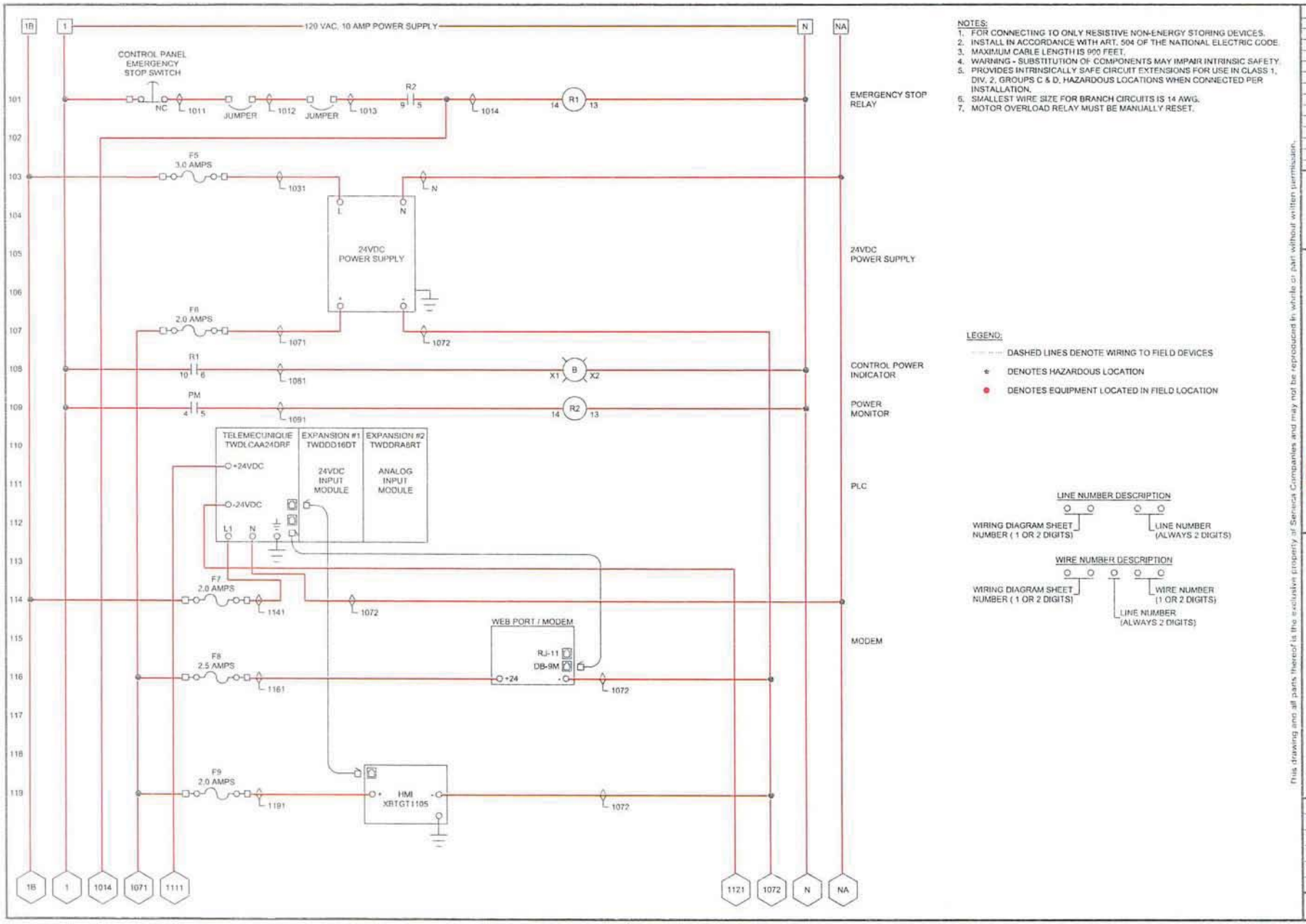
W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETTS
THREE LINE AC WIRING DIAGRAM - POWER DISTRIBUTION SYSTEM
Seneca Companies
The Complete Solution
11/11/2009
DARRICK WORRALL
RICH RICHARDS
NO SCALE
8054105507
8054105
07



NOTES:
1. FOR CONNECTING TO ONLY RESISTIVE NON-ENERGY STORING DEVICES.
2. INSTALL IN ACCORDANCE WITH ART. 504 OF THE NATIONAL ELECTRIC CODE.
3. MAXIMUM CABLE LENGTH IS 900 FEET.
4. WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
5. PROVIDES INTRINSICALLY SAFE CIRCUIT EXTENSIONS FOR USE IN CLASS 1, DIV. 2, GROUPS C & D, HAZARDOUS LOCATIONS WHEN CONNECTED PER INSTALLATION.
6. SMALLEST WIRE SIZE FOR BRANCH CIRCUITS IS 14 AWG.
7. MOTOR OVERLOAD RELAY MUST BE MANUALLY RESET.

LEGEND:
- DASHED LINES DENOTE WIRING TO FIELD DEVICES
- DENOTES HAZARDOUS LOCATION
- DENOTES EQUIPMENT LOCATED IN FIELD LOCATION

LINE NUMBER DESCRIPTION
WIRING DIAGRAM SHEET NUMBER (1 OR 2 DIGITS)
LINE NUMBER (ALWAYS 2 DIGITS)

WIRE NUMBER DESCRIPTION
WIRING DIAGRAM SHEET NUMBER (1 OR 2 DIGITS)
LINE NUMBER (ALWAYS 2 DIGITS)
WIRE NUMBER (1 OR 2 DIGITS)

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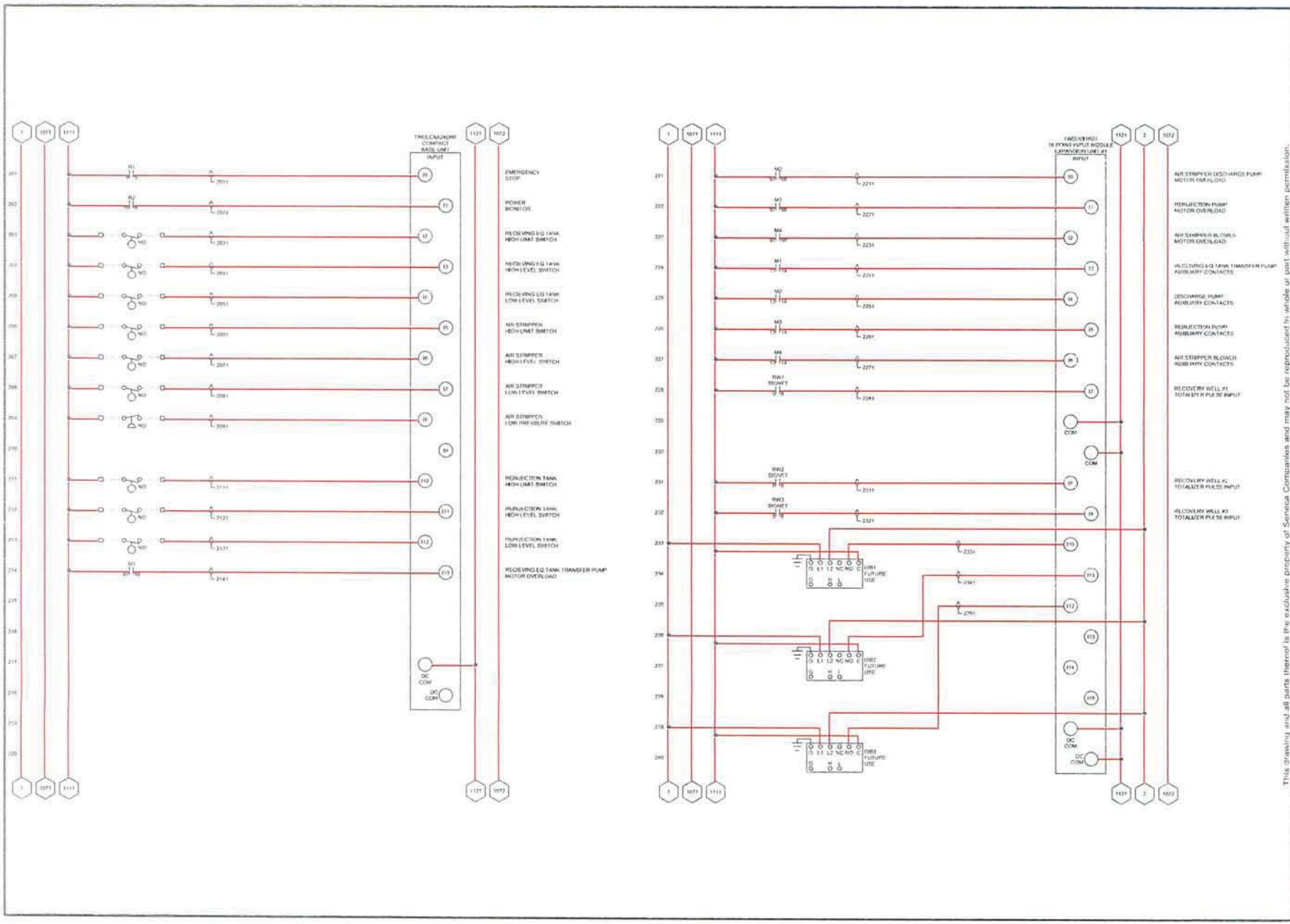
MAIN CONTROL PANEL POWER WIRING

11/11/2005
DARNOCK WORRALL
RICH RICHARDS
NO SCALE
6354105S08
6354105
08



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W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETTS

MAIN CONTROL PANEL PLC DISCRETE INPUTS

11/11/2009

DARRICK WORRALL

RICH RICHARDS

NO SCALE

6354105S05

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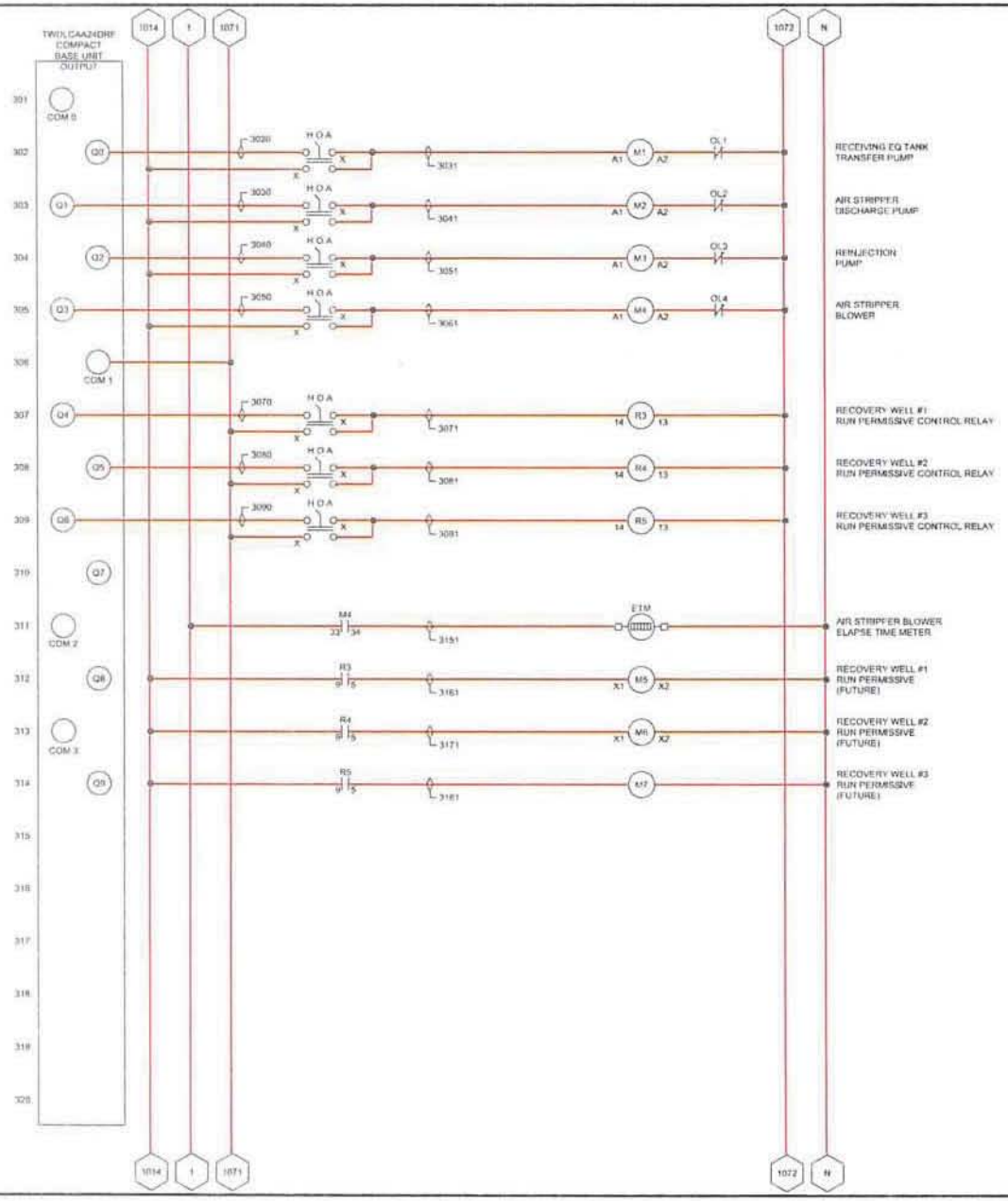

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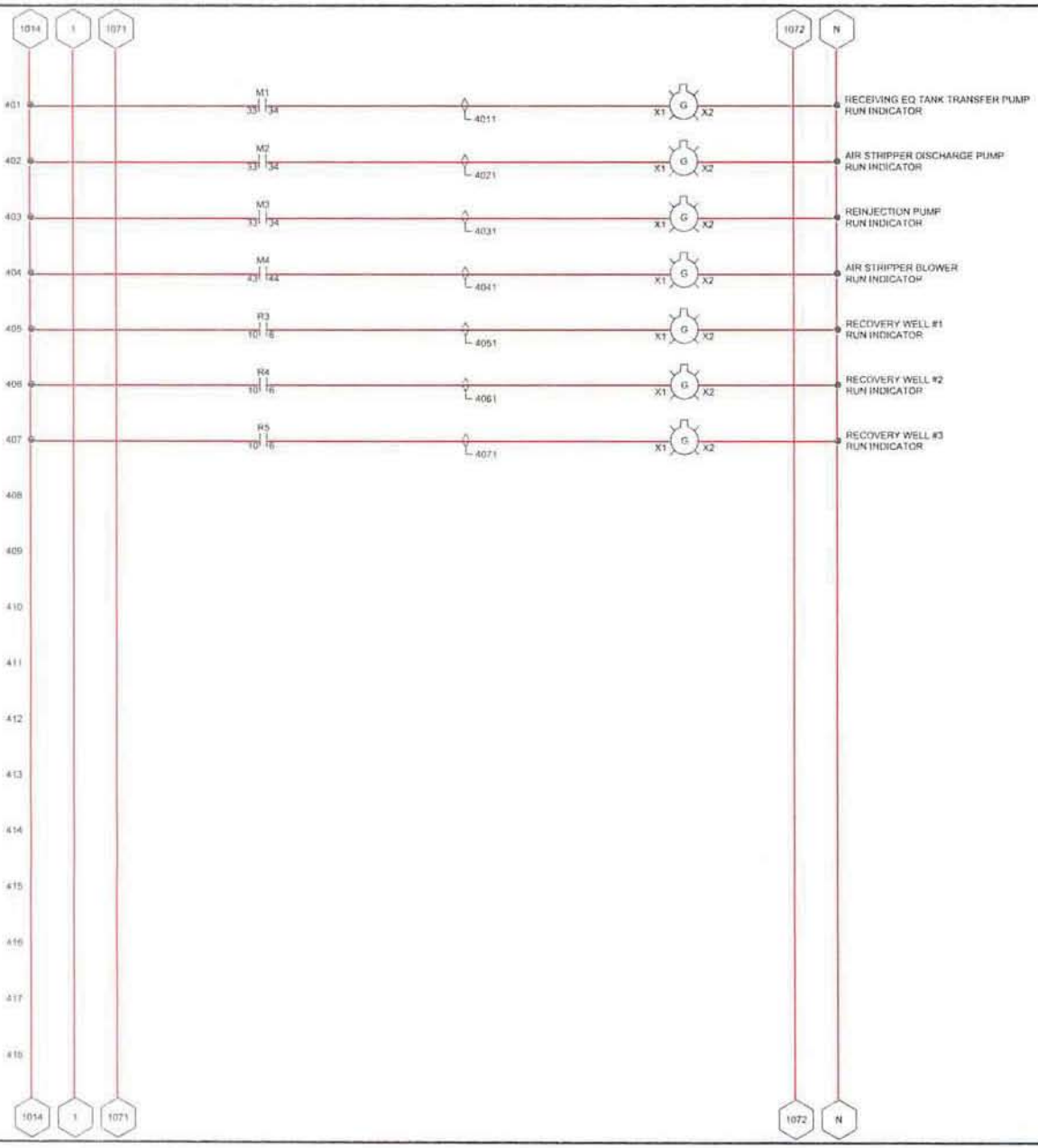
W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETTS

MAIN CONTROL PANEL PLC DISCRETE OUTPUTS

DATE	11/11/2009
DRAWN BY	DARRICK WORRALL
CHECKED BY	RICH RICHARDS
SCALE	NO SCALE
DRAWING NO.	C3541055 10
PROJECT NO.	03541115
SHEET NO.	10



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W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETTS

MAIN CONTROL PANEL LADDER LOGIC

11/11/2009
LAWRENCE WORRALL
RICH RICHARDS
NO SCALE
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635410R
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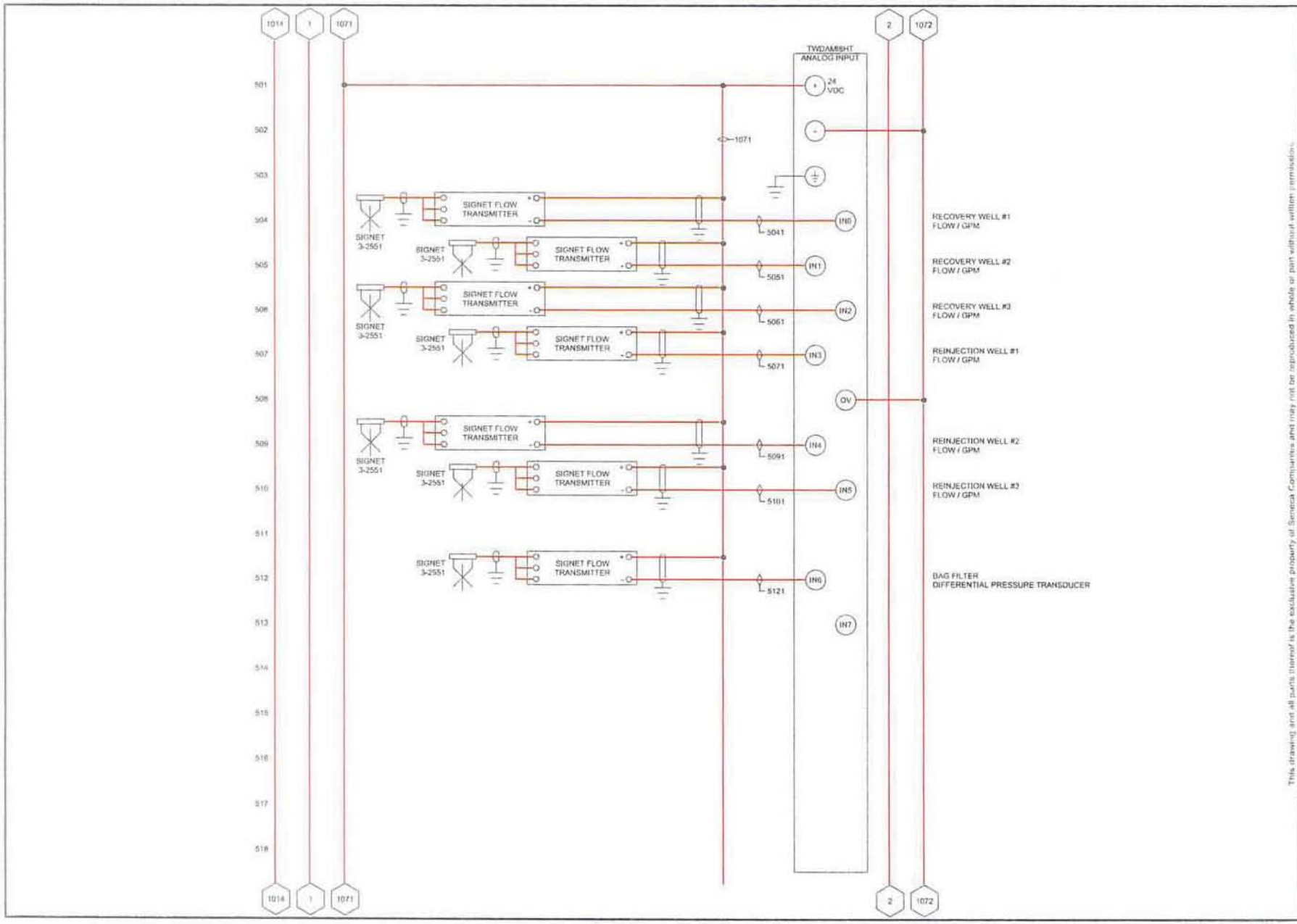

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NORTH EAST AREA
ACTON MASSACHUSETTS

MAIN CONTROL PANEL RLC ANALOG DEVICES

11/11/2009
DARRICK WORRALL
RICH RICHARDS
NO SCALE
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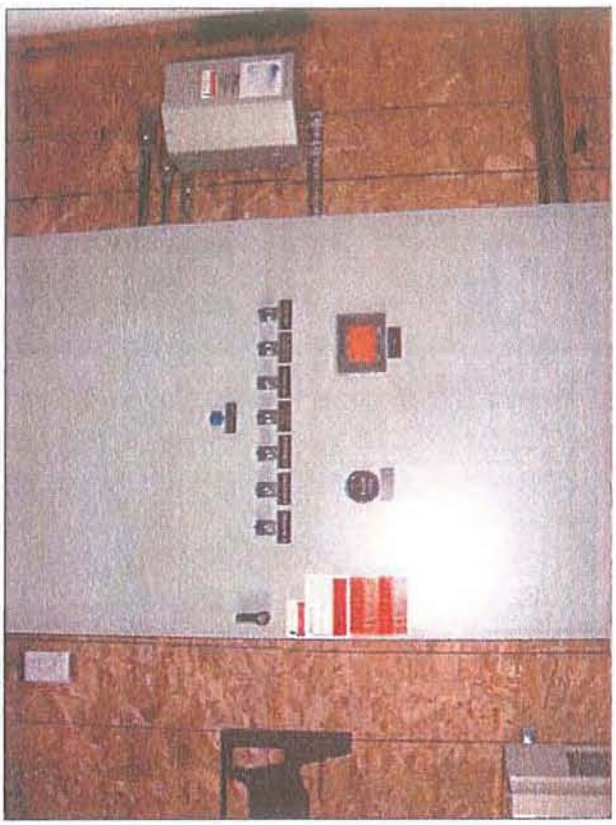
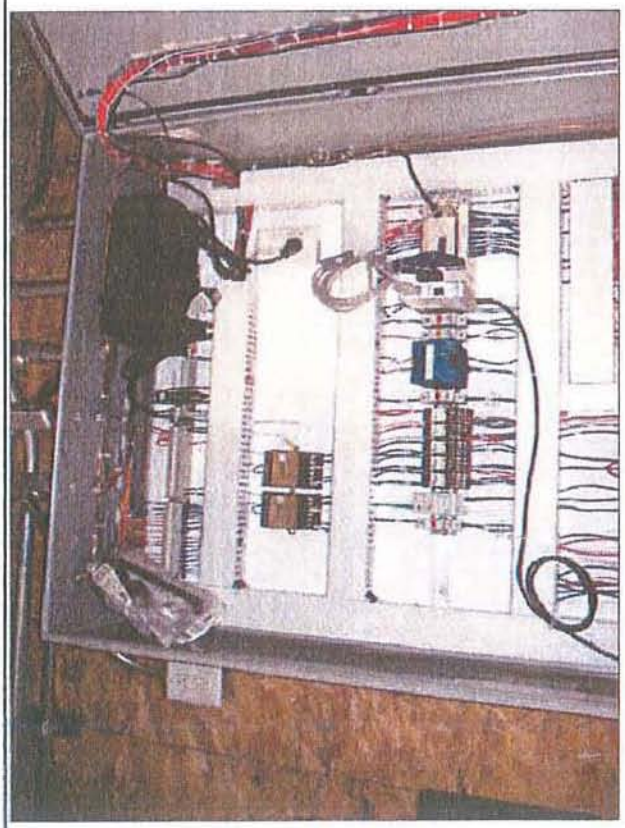
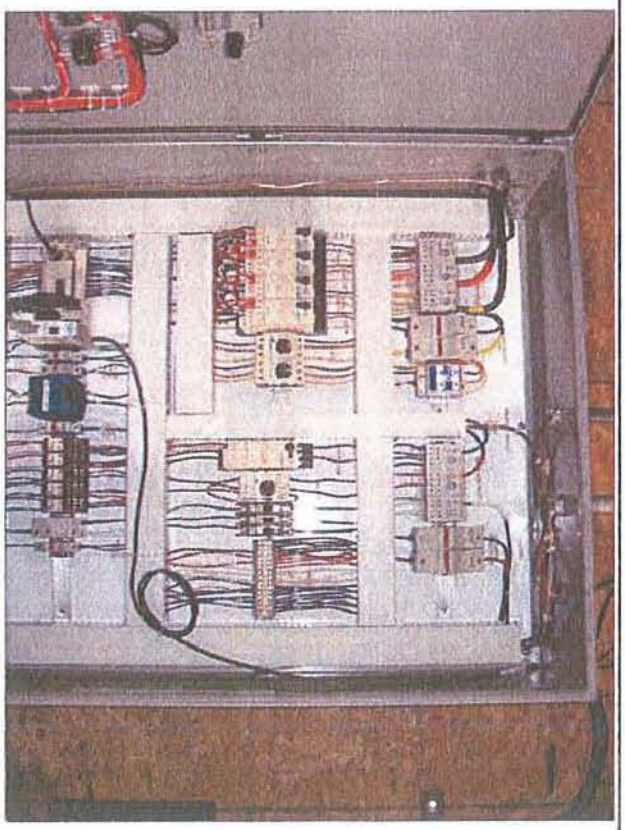
6354105
12







W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETTS

MAIN CONTROL PANEL - SWING BACK PANEL LAYOUT

Seneca Companies
The Complete Solution

QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
	Panel Hardware		
1	Enclosure	Hoffman	C-SD603617
1	Sub Panel	Hoffman	C-P6036
1	Drawing Pocket	Hoffman	A-DP2
1	Door Handle	Hoffman	C-WHK
	Panel Switches		
1	Emergency Stop Switch	Telemecanique	ZB4BS54
1	Contact Block (N.C.)	Telemecanique	ZB4BZ102
5	Hand-Off-Auto Switch Maintain - Run	Telemecanique	ZB4BK1332
5	Contact Block	Telemecanique	ZB4BW0G13
	Panel Labels		
5	Legend Plate Hand-Off-Auto	Telemecanique	ZBY2387
1	Legend Plate E-Stop	Telemecanique	ZBY9330
	Motor Starters-Overloads-Breakers		
	Air Stripper		
1	Motor Starter 3.5 HP 460V	Telemecanique	LUB32
1	Overload Relay (3-12A)	Telemecanique	LUCA12FU
1	Auxiliary Contacts	Telemecanique	LUFN20
1	Auxiliary Contacts - Overload	Telemecanique	LUA1C20
1	Incoming Line Barrier	Telemecanique	LU9SPO
	EQ Transfer Pump		
1	Motor Starter 1.5 HP 460V	Telemecanique	LUB12
1	Overload Relay (1.25-5A)	Telemecanique	LUCA05FU
1	Auxiliary Contacts	Telemecanique	LUFN20
1	Auxiliary Contacts - Overload	Telemecanique	LUA1C20
1	Incoming Line Barrier	Telemecanique	LU9SPO
	Discharge Transfer Pump		
1	Motor Starter 1.5 HP 460V	Telemecanique	LUB12
1	Overload Relay (1.25-5A)	Telemecanique	LUCA05FU
1	Auxiliary Contacts	Telemecanique	LUFN20
1	Auxiliary Contacts - Overload	Telemecanique	LUA1C20
1	Incoming Line Barrier	Telemecanique	LU9SPO
	Reinjection Pump		
1	Motor Starter 1.5 HP 460V	Telemecanique	LUB12
1	Overload Relay (1.25-5A)	Telemecanique	LUCA05FU
1	Auxiliary Contacts	Telemecanique	LUFN20
1	Auxiliary Contacts - Overload	Telemecanique	LUA1C20
1	Incoming Line Barrier	Telemecanique	LU9SPO
	Forced Air Heater		
1	Disconnect/Circuit Breaker 7.5 KW, 460V 1	Telemecanique	GV2P14
	Exhaust Fan		
1	Disconnect/Circuit Breaker 0.25 HP, 230V	Telemecanique	GV2P05
	PLC		
1	PLC - TWIDO 24 IO	Telemecanique	TWDLCAA40DRF
1	Input Module 16pt	Telemecanique	TWDDDI16DT
1	Analog Module	Telemecanique	TWDAMM6HT
1	Comm. Card Adpt. RS485	Telemecanique	TWDNAC485D
1	Multi Function Modbus Comm. Cable	Telemecanique	TSXPCX1031
1	Option Comm Card Adpt RS485	Telemecanique	TWDNAC485D
1	HMI	Telemecanique	XBTGT1105
1	Comm. Cable HMI - Twido	Telemecanique	XBTZ9780
	Modem		
1	Modem - Cellular Network	Spectrum	WP2301
1	Antenna Kit w/2M Extension Cable & Bulk Head	Spectrum	WP4800S
	Battery Back-up		
1	Battery Backup	APC	BE550G
	Panel Protection		
1	Phase Monitor	SymCom	460
	Misc. Panel Items		
1	Power Supply 24vdc	Puls	ML100.100
6	Power Distribution	Ferraz/Shawmut	FSPDB3A
1	Grounding Bus Bar	Square-D	PK15GTAL
4	Din Rail	IDEC	BNDN-1000
10	Din Rail Retainers	IDEC	BNL-5
40	Terminal Blocks	Square-D	9080GM6
4	End Barrier	Square-D	9080GM6B
1	Fuse Holder Cntl Trans Primary 480vac	Ferraz/Shawmut	USCC21
1	Fuse Holder Cntl Trans Secondary 120/240v	Ferraz/Shawmut	USCC21
3	Fuse Primary Cntl Trans 600vac 10A	Ferraz Shawmut	ATQR10
3	Fuse Secondary Cntl Trans 600vac 25A	Ferraz Shawmut	ATQR25
3	Fuse Holder 24vdc Power Supply	Ferraz/Shawmut	USM1I-DC24P
2	Fuse Holder 120vac Power Supply	Ferraz/Shawmut	USM1I
3	Fuse 250vac 3.0a	Gould Shawmut	ATQR3
2	Fuse 250vac 2.0a	Gould Shawmut	ATQR2
2	Fuse 250vac 2.5a	Gould Shawmut	ATQR2-1/2
1	Breaker/Overload Power Monitor 3P 480V	Telemecanique	GV2P06
	Other Items		
2	Light	Lithonia	DMW 2-32-MV-GE 8105
4	Light Bulbs 4' 120V Bulbs	GE	F32T8/SP41/ECO
1	480-120/240V Transformer 10.0 KVA	Acme	T-2-53514-3S
	Main Disconnect 200 Amp		**480 V 3 Phase**
1	Main Disconnect	Square-D	H364RB
3	Main Fuses	Gould Shawmut	TRS200R
7	Hand-Off-Auto Switch Maintain - Run	Telemecanique	ZB4BK1333
7	Contact Block	Telemecanique	ZB4BW0G13
1	Motor Starter 2.0 HP 230V 1Ph	Telemecanique	LUB32
1	Overload Relay (8-32A)	Telemecanique	LUCC32FU
1	Auxiliary Contacts	Telemecanique	LUFN20
1	Auxiliary Contacts - Overload	Telemecanique	LUA1C20
1	Incoming Line Barrier	Telemecanique	LU9SPO
3	Fuse Primary Cntl Trans 600vac 30A	Ferraz Shawmut	ATQR30
3	Fuse Secondary Cntl Trans 600vac 45A	Ferraz Shawmut	ATQR45
1	480-120/240V Transformer 10.0 KVA	Acme	T-2-53016-3S
1	Legend Plate Hand/Off/Auto	Telemecanique	ZBY2387

W.R. GRACE FACILITY
NORTH EAST AREA
ACTON, MASSACHUSETTS

MAIN CONTROL PANEL - BILL OF MATERIAL

Seneca
Companies
The Complete Solution

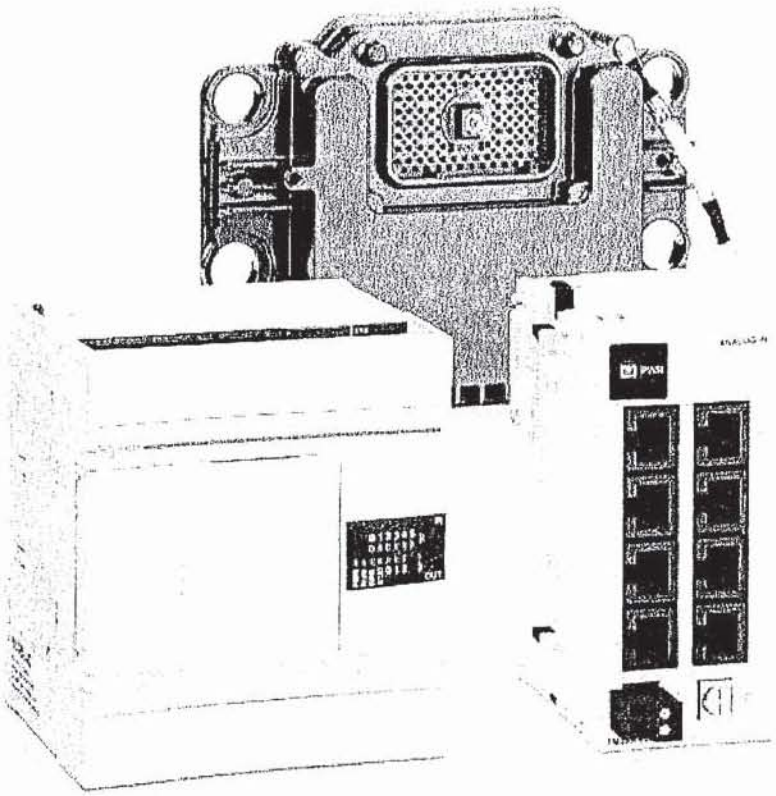
11/11/2009
DARRICK WORRALL
RICH RICHARDS
NO SCALE
6354105S14
6354105
14

APPENDIX I

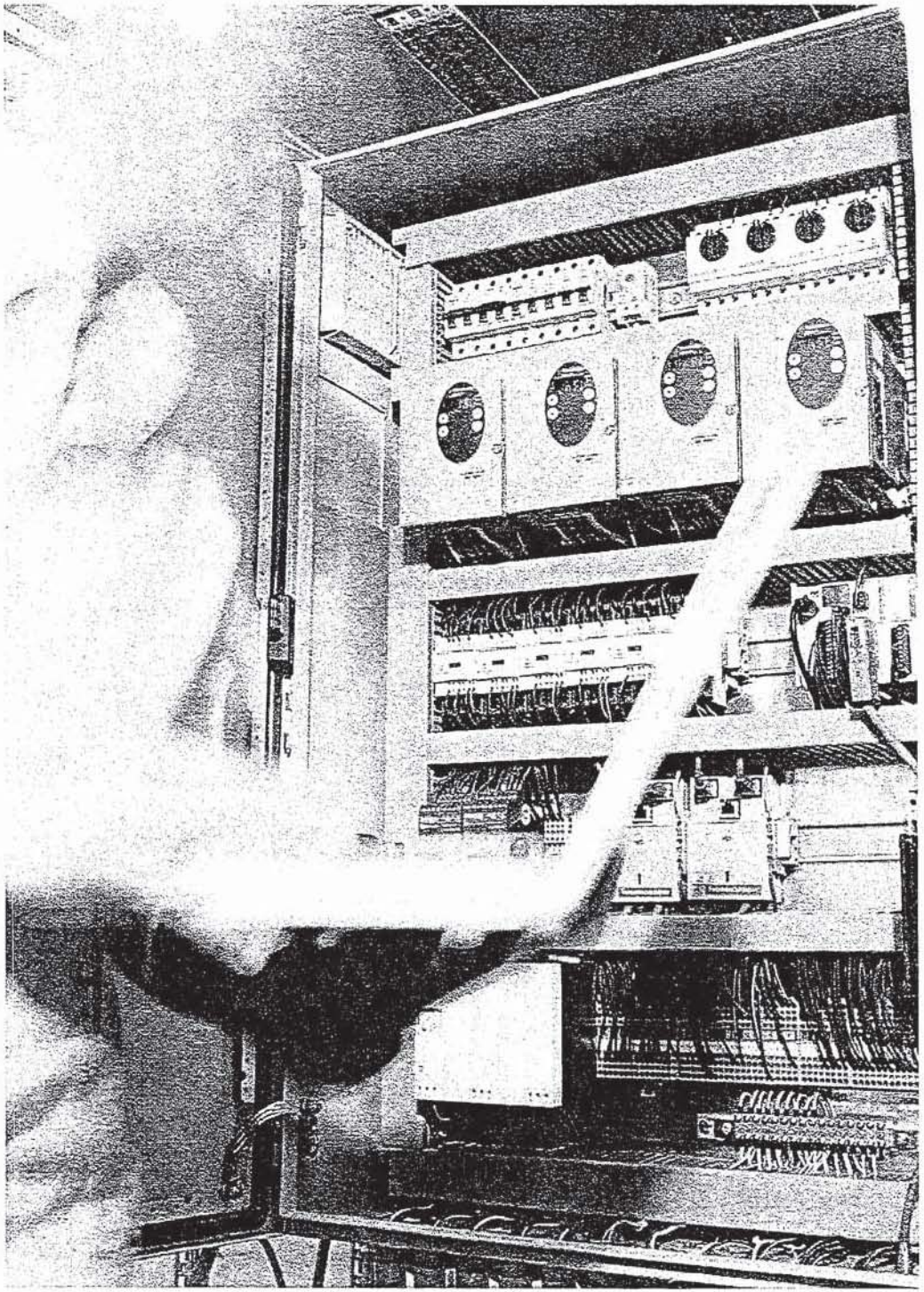
PLC AND REMOTE TELEMETRY SPECIFICATIONS AND VENDOR INFORMATION

Your peace of mind...

Twido
Programmable controllers



Schneider Electric



Need efficient, flexible, small automation gear?

- Flexibility
- Openness

The assurance of finding your optimised solution

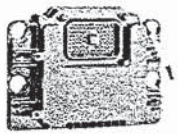
Select your type of base

> Twido Compact

- "All in one" product
- Screw terminal connection
- 10 compact bases
  - 10, 16, 24 and 40 I/O
  - 24 VDC or
  - 100 ... 24 VAC supply
  - Modbus, CANopen / Internal integrated on 40 I/O.

> Twido Modular

- Very compact and expandable
- Removable screw terminals or HE10 pre-wired connection
- 6 bases: 20 or 40 I/O, expandable using 4 to 7 modules
  - 24 VDC supply
  - Modbus, CANopen, Ethernet.

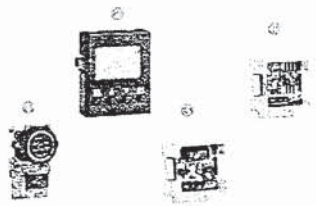


> Twido Extreme

- IP67
- Temperature -40°C to +110°C
- 1 non-expandable base, 41 I/O (Digital, Analogue or PWM)
  - 12 or 24 VDC supply
  - Modbus, CANopen, CAN J1939 integrated.

Adapt the Twido Compact and Modular bases to your applications!

> I/O expansions
- Up to 32 I/O
- Wide variety of connection options



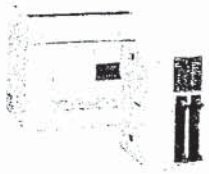
① Serial link
Integrated communication interface.

② Display
Menu and parameter search, set points.

③ Calendar timer
For actions determined by time or date, or time changes for consumption of energy.

④ Memory expansion
Double the Twido program memory capacity.

Select from a wide variety of digital I/Os



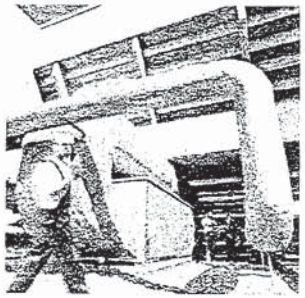
> Out for quick connection

The Multiple Advantage Module enables connection of 10 wires per I/O point, and up to 24 points, with a single screw.
TWDNOM10M3

Help reduce your costs with the analogue I/Os

> More measuring options
- 2 x K, J, T thermocouple inputs
- 2 x 0 ...10 VDC, 4 ...20 mA inputs
- 4 x 0 ...10 VDC, 0 ...20 mA or Pt/Ni sensor inputs
- 8 x PTC/NTC inputs
- 5 x 0 ...10 VDC, 0 ...20 mA inputs
- 8 temperature inputs (terminal)
- 8 temperature inputs (RJ11)
- 1 x 0 ...10 VDC, 4 ...20 mA output
- 2 x +/- 10 V outputs
- 2 inputs, 1 output (0 ...10 VDC, 4 ...20 mA)
- 2 thermocouple or temperature inputs, 1 output (0 ...10 VDC, 4 ...20 mA)
- 4 inputs, 2 outputs (0 ...10 VDC, 4 ...20 mA)

> More regulation
Up to 14 easily configurable PID loops using fast mode, with analogue or digital (PWM) output.

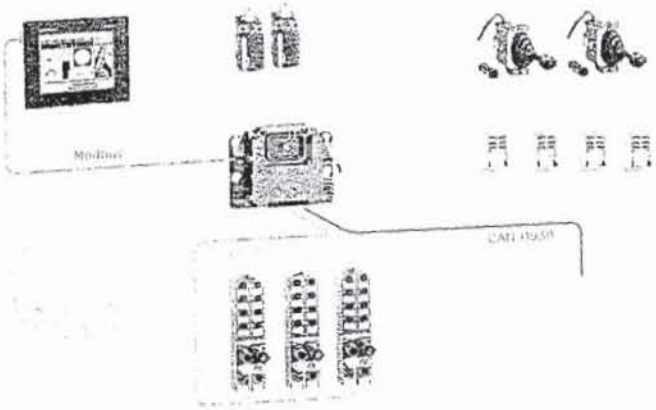


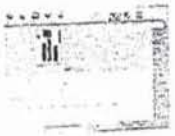
Easily communicate with your environment

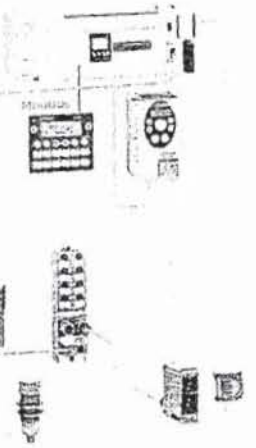
How to exchange data simply?

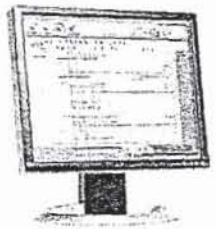
How to exchange data easily?

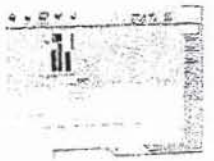
How to exchange data efficiently?











Number of digital I/O	10	16	24	40
Number of digital inputs (24 VDC)	6 sink/source	9 sink/source	14 sink/source	24 sink/source
Number of digital outputs	4 relay, 2 A	7 relay, 2 A	10 relay, 2 A	14 relay, 2 A, 2 solid-state 1 A
Type of connection	Screw terminals, non-removable			
Possible I/O expansion modules	-	-	1	7
Counting	2 x 5 kHz, 1 x 20 kHz			4 x 5 kHz, 2 x 20 kHz
PWM positioning	-	-	-	2 x 7 kHz
Serial ports	1 x RS 485	1 x RS 485 / option: 1 x RS 232C or RS 485		
Protocol	Modbus master/slave, ASCII, I/O relocation			
Ethernet port	-	-	-	RJ45 Ethernet
Dimensions, W x D x H	90 x 70 x 90 mm		85 x 70 x 90 mm	150 x 70 x 90 mm
Flat Supply voltage 100...240 VAC	TWDLCAA10DRF	TWDLCAA16DRF	TWDLCAA24DRF	TWDLCAE40DRF
Supply voltage 19.2...30 VDC	TWDLCDA10DRF	TWDLCDA16DRF	TWDLCDA24DRF	TWDLCDE40DRF
Real-time clock (option)	TWDXCPRTC			
Display unit (option)	TWDXCPODC			
Memory cartridge (option)	TWDXCPMFK32[1]			TWDXCPMFK64[1]

[1] For more information, see the product data sheet.

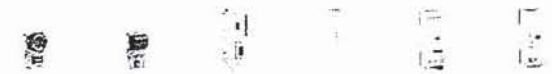
Number of digital I/O	24		40
Number of digital inputs (24 VDC)	12 sink/source		24 sink/source
Number of digital outputs	8 transistor, source 0.3 A	8 relay (8 A) and 2 transistor, source 0.3 A	16 transistors, source 0.1 A
Type of connection	1 IL10 connector	Removable screw terminals	1 IL10 connector
Possible I/O expansion modules	1	7	
Supply voltage	24 VDC		
Counting	2.5 kHz, 2 x 20 kHz		
PLS / PWM positioning	2 x 7 kHz		
Serial ports	1 x RS 485 / option: 1 x RS 232C or RS485		
Protocol	Modbus master/slave, ASCII, I/O relocation		
Dimensions, W x D x H	35.4 x 70 x 90 mm	47.5 x 70 x 90 mm	
References	TWDLMDA20DTK[1]	TWDLMD 1200RT	TWDLMDAM40DTK[1]
Real-time clock (option)	TWDXCPRTC		
Display unit (option)	TWDXCPODM		
Memory cartridge (option)	TWDXCPMFK32[1]	TWDXCPMFK64[1]	

[1] For more information, see the product data sheet.

Number of digital I/O	41
Degree of protection	IP67
Temperature	10 °C ... 55 °C (cartridge: -40 °C ... +70 °C)
Relative humidity	90 % without condensation
Number of I/O digital inputs	24
Number of I/O digital outputs	16
Number of PWM inputs	1
Number of digital outputs	100 mA @ 5 VDC (when AS-i VDC)
Number of PWM outputs	1
Supply voltage	19.2 or 24 VDC
Frequency	1 x 10 MHz
Communication ports	RS 485, CAN, USB, CANopen master
Serial line protocols	Modbus RTU master/slave, ASCII
Dimensions, W x D x H	166.61 x 45.72 x 200
References	TWDLLDCK1

Number of digital I/O	8	16		32	16 / 16	16 / 16	
Type of connection	Removable screw terminals		HE10 connectors		Removable screw terminals	Spring terminals (non-removable)	
References 24 VDC sink inputs	TM2DDI8DT	-	-	-	-	-	
24 VDC sink/source inputs	-	TM2DDI16DT	TM2DDI16DK	TM2DDI32DK	-	-	
120 V sink inputs	TM2DAI8DT	-	-	-	-	-	
2 A relay outputs	TM2DRA8RT	TM2DRA16RT	-	-	-	-	
0.5 A transistor, source outputs	TM2DDO8TT	-	-	-	-	-	
0.4 A transistor, source outputs	-	-	TM2DDO16TK	TM2DDO32UK	-	-	
0.1 A transistor, source outputs	TM2DDO8UT	-	TM2DDO16UK	TM2DDO32TK	-	-	
24 VDC sink/source outputs + 2 A relay outputs	-	-	-		TM2DMM24DRT	TM2DMM24DRF	

Inputs and/or outputs	2 I		4 I	8 I				I/O	12 I / 8 O
Type of connection	Removable screw terminals						RJ45	Removable screw terminals	
Inputs range	Thermocouple: K, J, T	0 ... 10 V / 4 ... 20 mA / Pt100, Pt1000, Ni100, Ni1000	0 ... 10 V / 4 ... 20 mA / Pt100, Pt1000, Ni100, Ni1000	0 ... 10 V / 0 ... 20 mA	PTC / NTC	Thermocouple: K, J, T, E, R, S, B, N, C / Pt100, Pt1000, Ni100, Ni1000 / -200 ... +1820 °C		-	0 ... 10 V / 0 ... 20 mA / 4 ... 20 mA
resolution	12 bits (4096 points)			10 bits (1024 points)		12 bits (4096 points)		-	12 bits (4096 points)
Outputs range	-							+/- 10 V	0 ... 10 V / 4 ... 20 mA
resolution	-							11 bits + sign	12 bits
Measuring accuracy	0.2% of the full scale value								
Supply voltage	24 VDC								
Dimensions, W x D x H	23.5 x 70 x 90 mm								
References	TM2AMI2LT	TM2AMI2HT	TM2AMI4LT	TM2AMI8HT	TM2AMO1HT	TM2AMM6HT	TM2ARI8LRJ	TM2AVO8HT	TM2AMM3HT



Physical layer (not isolated)	RS 232 C	RS 485	RS 232 C	RS 485	-	-	-	-
Number of modules	-		-		1	1	-	-
Type of connection	Mini-DIN connector		Mini-DIN connector		Screw terminals	RJ45	RJ45	RJ45
Protocol	Modbus Maître/esclave, ASCII, départ d'E/S				-			
Terminal base compatibility	Module base TWDXCMDM		Connector base TWDXCDM10F / TWDXCDM10RF. Modular base no integrated supply, module TWDXCPODC		16, 24 or 40 I/O base	All models	All models	All models
References	TWDNOZ232D	TWDNOZ485D[1]	TWDNAC232D[1]	TWDNAC485D[1]	TWDNOD01M	499TWD01100	TWDXCAISO	TWDXCATSRJ

[1] Custom-tailored version available: replace the letter **D** at the end of the reference by the letter **T**. TWDNAZ485D becomes TWDNAZ485T and TWDNAC485D becomes TWDNAC485T.

Supply voltage	19...28 VDC	19...24 VDC	
Description	-	RTC modem	GSM modem
References	TWDNOM24M	SR2MOD01	SR2MOD03

[1] For more information, see page 30/11.

Number of modules	1	0	0 / 1 / 0
Type of connection	-	Removable screw terminals	
Inputs range	-	0 ... 10 V / 4 ... 20 mA / Pt100, Pt1000, Ni100, Ni1000	Pt100, Pt1000, Ni100, Ni1000
resolution	-	12 bits (4096 points)	
Outputs range	0 ... 10 V / 4 ... 20 mA		
resolution	12 bits		
Measuring accuracy	0.2 % FE		
Supply voltage	24 V DC		
Dimensions, W x D x H	35.4 x 70 x 90 mm		
References	TMAAMO1HT	TMAAVM6HT	TMAAM6T

Indications	2" with Windows XP or Vista	Type A PC USB port	For PC not fitted with Bluetooth	For Twido controller	
References	TWDBTPU10M	TSXCUSB485[1]	VW3A8115	VW3A8114	

[1] For more information, see the catalogue on page 30/10.

Schneider Electric Industries SAS

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France

Giving a % energy in standards and equipment, the characteristics given in the text and images in this document are not binding until they have been confirmed with us.

Photo: Schneider Electric
Design: Blue Soft
Photos: Schneider Electric

ART.823362

02 / 2009

DIA3ED1070301EN

Presentation

Twido analogue I/O expansion modules enable the acquisition of various analogue values encountered in industrial applications, such as :

- High-level inputs (voltage 0...10 V or current 4...20 mA).
- High-level outputs (voltage 0...10 V or current 4...20 mA).
- Low level inputs from thermocouples type K, J and T.
- Low level inputs from 3-wire Pt 100 temperature probes, range -100...500 °C.

Analogue output modules are used to control the preactuators in devices such as variable speed drives, valves and applications that require process control. The output current or the voltage is proportional to the numerical value defined by the user program. When the Twido controller stops, the outputs can be configured with fallback (reset to the lowest scale value or hold the last value received). This function, when set to 'hold', is useful when debugging the application or when a fault occurs, in order not to disturb the process being controlled.

The 4 following analogue I/O modules are available :

- One module with 2 high-level inputs.
- One module with 1 high-level input.
- One mixed module with 2 inputs and 1 high-level output.
- One mixed module with 2 thermocouple or temperature probe inputs and 1 high-level output.

All Twido analogue extension modules offer 12-bit resolution (4096 points) with connection by removable screw terminal block. An external ⎓ 24 V power supply is required for each analogue module.

Like discrete I/O modules, analogue I/O modules are connected to the base controller by stacking them on a DIN rail, starting from the right-hand side panel of the base controller, according to the following rules :
- For 24 I/O compact base controller TWD LCAA 24DRF : 4 modules max. (see characteristics page 41001/4).
- For 20 I/O modular base controllers TWD LMDA 20D●K : 4 modules max. (see characteristics page 41002/5).
- For 40 I/O modular base controllers TWD LMDA 20DRT/40D●K : 7 modules max. (see characteristics page 41002/5).

All analogue I/O modules are electrically isolated with the use of a photocoupler between the internal electronic circuit and the input/output channels.

Description

Twido analogue I/O modules comprise :

1. An extension connector for electrical connection to the previous module *(1)*.
2. A block for displaying the channels and module diagnostics.
3. A removable screw terminal block for connection of the ⎓ 24 V external power supply, the sensors and the preactuators.
4. A latching mechanism for attachment to the previous module.

These modules are mounted on a symmetrical DIN rail. Fixing kit TWD XMT 5 (supplied in lots of 5) allows plate or panel mounting.

(1) A connector on the right-hand side panel ensures continuity of the electrical link with the next I/O module.

General characteristics

Temperature		°C	Operation : 0...+ 55. Storage : - 25...+ 70.
Relative humidity			30 to 95 %, without condensation
Degree of protection			IP 20
Altitude		m	Operation : 0...2000. Storage : 0...3000.
Vibration resistance	Mounted on ⊔ rail	Hz	10...57, amplitude 0.075 mm, acceleration 57...150 Hz
		m/s^2	9.8 (1 gn)
	Plate or panel mounted (using fixing kit TWD XMT5)	Hz	2...25, amplitude 1.6 mm, acceleration 25...100 Hz
		m/s^2	39.2 (4 gn)
Shock resistance		m/s^2	147 (15 gn) for 11 ms

Analogue input characteristics

Module type			TWD AMI 2HT/AMM 3HT		TWD ALM 3LT	
Number of channels			2 high-level inputs		2 low-level inputs	
Range			Voltage 0...10 V	Current 0...20 mA	Thermocouple Type K (0...1300° C) Type J (0...1200° C) Type T (0...400° C)	Temperature probe Pt probe, 3-wire type (- 100...500° C)
Type			Non differential	Differential		
Resolution			4096 points (12 bits)			
LSB value			2.5 mV	4 µA	0.325° C (type K) 0.3° C (type J) 0.1° C (type T)	0.15° C
Connection			Removable screw terminal block			
Permissible continuous overload			⎓ 13 V	40 mA	–	
External supply		V	Rated voltage : ⎓ 24. Voltage range : ⎓ 20.4...28.8			
Input impedance			1 MΩ min	10 Ω	250 Ω max	5 Ω max
Max. sampling duration		ms	16		50	
Sampling repetition time		ms	16		50	
Acquisition period		ms	32 + 1 controller cycle time		100 + 1 controller cycle time	
Measuring precision	Max. error at 25° C	% PE	± 0.2		0.2 + precision of cold junction compensation (± 4° C max)	± 0.2
	Temperature coefficient	% PE/°C	± 0.006			
	Repeat accuracy after stabilisation time	% PE	± 0.5			
	Non linearity	% PE	± 0.2			
	Total error	% PE	± 1			
Common mode rejection			- 50 dB			
Cross talk			2 low significance bits max.			
Cabling			Twisted shielded pair recommended		–	
Dielectric strength		V rms	∿ 500 between the input and the supply circuit			
Type of protection			Photocoupler between the input and the internal circuit			
Consumption		mA	⎓ 5 V internal supply : 50. ⎓ 24 V external supply : 40			

Analogue output characteristics

Module type			TWD AMO 1HT/AMM 3HT/ALM 3LT	
Number of channels			1 output	
Range			Voltage 0...10 V	Current 4...20 mA
Resolution			4096 increments (12 bits)	
LSB value			2.5 mV	4 µA
Load impedance		Ω	2000 min	300 max
Applicable load			Resistive	
Stabilisation time		ms	20	
Total output system transfer time		ms	20 + 1 controller scan time	
External supply		V	Rated voltage : ⎓ 24. Voltage range : ⎓ 20.4...28.8	
Measuring precision	Max. error at 25° C	% PE	± 0.2	
	Temperature coefficient	% PE/°C	± 0.015	
	Repeat accuracy after stabilisation time	% PE	± 0.5	
	Output error	% PE	± 1	
	Non linearity	% PE	± 0.2	
	Output ripple		1 low significance bit max.	
	Total error	% PE	± 1	
Cabling			Twisted shielded pair recommended	
Dielectric strength		V rms	∿ 500 between the input and the supply circuit	
Consumption (for TWD AMO 1HT)	⎓ 5 V internal supply	mA	50	
	⎓ 24 V external supply	mA	40	

TWD AMI 2HT

TWD ALM 3LT

References

These analogue I/O expansion modules are mounted on symmetrical DIN rails to the right of the Twido base controller. The sensors/preactuators are connected to a removable screw terminal block (supplied with each module). The maximum number of analogue I/O modules which may be mounted depends on the type of base controller :

Base types	TWD LCAA 10DRF	TWD LCAA 16DRF	TWD LCAA 24DRF	TWD LMDA 20D•K	TWD LMDA 20DRT	TWD LMDA 40D•K
Number of modules	0	0	4	4	7	7

Analogue I/O modules

Channel type	Input range	Output range	Resolution	Reference	Weight kg
2 inputs	0...10 V 4...20 mA	–	12 bits	TWD AMI 2HT	0.085
1 output	–	0...10 V 4...20 mA	12 bits	TWD AMO 1HT	0.085
2 inputs and 1 output	0...10 V 4...20 mA	0...10 V 4...20 mA	12 bits	TWD AMM 3HT	0.085
	Thermocouple K, J, T Temperature probe Pt 100	0...10 V 4...20 mA	12 bits	TWD ALM 3LT	0.085

Separate component

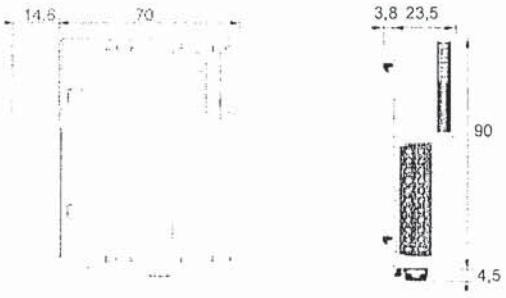
Description	Application	Sold in	Reference	Weight kg
Fixing kit	Plate mounting	Lots of 5	TWD XMT5	–

Replacement part

Description	Application	Sold in	Reference	Weight kg
Screw terminal block	11 contacts	Lots of 2	TWD FTB 2T11	–

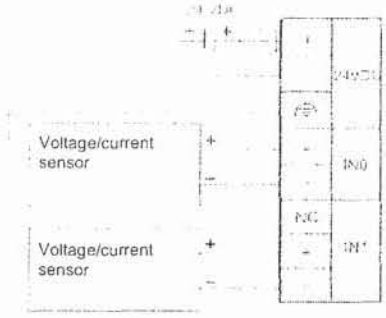
Dimensions

Analogue I/O modules



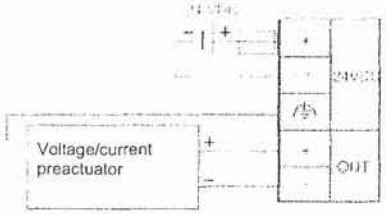
Connections

Input module TWD AMI 2HT



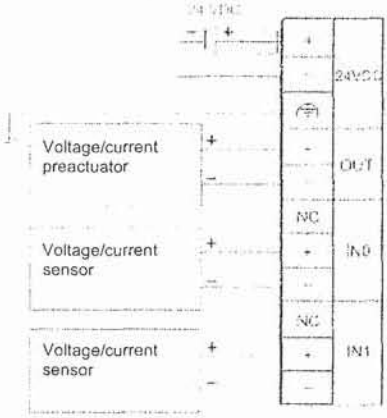
- Fit a fuse of appropriate size for the sensor type.
- Do not connect any wires to the unused channel.

Output module TWD AMO 1HT



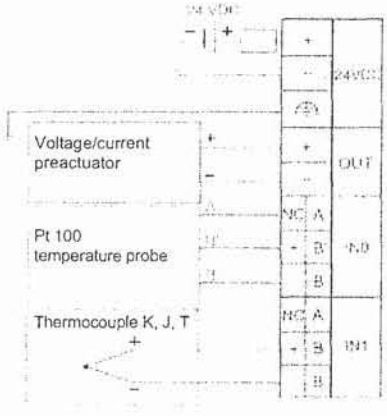
- Fit a fuse of appropriate size for the preactuator type.
- Do not connect any wires if the channel is unused.

Mixed input/output module TWD AMM 3HT

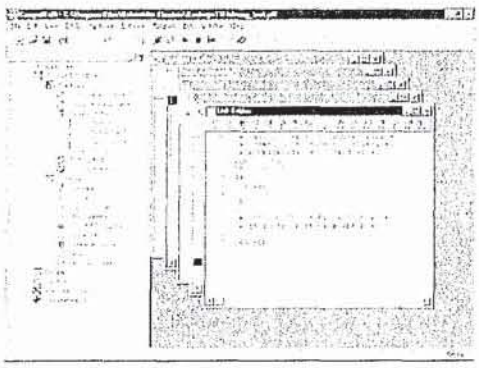


- Fit a fuse of appropriate size for the sensor and preactuator types.
- Do not connect any wires to unused channels.

Mixed input/output module TWD ALM 3LT



- Fit a fuse of appropriate size for the sensor and preactuator types.
- For a Pt 100 3-wire temperature probe (RTD), connect the three wires to terminals A , B' and B (channels IN0 and IN1).
- For a Pt 100 2-wire temperature probe (RTD), connect the two wires to terminals A and B' and make a bridge between B' and B (channels IN0 and IN1).
- For a thermocouple, connect the two wires to the + and - terminals (channels IN0 and/or IN1).
- Do not connect any wires to unused channels.



Presentation

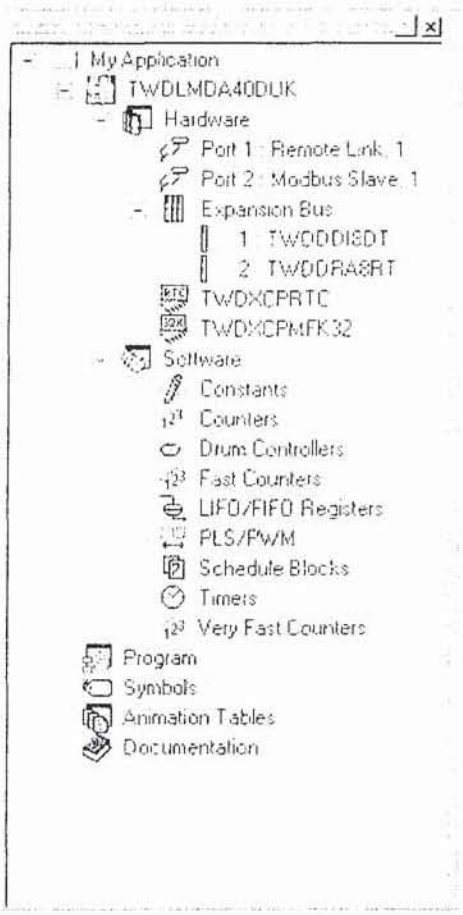
TwidoSoft is a graphical development environment for creating, configuring and managing applications for Twido programmable controllers. TwidoSoft is a 32-bit Windows-based program which runs on a PC with Microsoft Windows 98 (second edition) or Windows 2000 operating system. TwidoSoft software is based on a standard interface which offers the user-friendly features of the Windows environment with which users are already familiar : windows, toolbars, pull-down menus, balloon tips, context-sensitive help, etc.

For development work, TwidoSoft provides a comprehensive set of features to simplify programming and configuration :
- Programming in Instruction List or Ladder language. These two languages are reversible.
- Application browser with multiple window views, aiding easy software configuration.
- Editors for main programming and configuration functions.
- Cut, copy and paste functions.
- Symbolic programming.
- Cross-referencing.
- Duplication of application programs.

On site (on-line mode), TwidoSoft provides the following main functions :
- Real-time animation of program and/or data elements.
- Diagnostics on programmable controller operation.
- Monitoring of the application's use of memory.
- Downloading and uploading of controller programs.
- Backup of controller programs to the optional EEPROM modules.

Connecting a PC to a Twido controller

The PC is connected to the built-in serial port of the Twido controller by means of a TSX PCX 1031 multifunction cable. This cable converts RS 232 output signals from the PC to RS 485 signals for the controller. It is supplied with TwidoSoft software (according to version).
Connection of a PC, via cable, to the built-in port of Twido base controllers automatically sets the communication protocol of this port to a protocol which is compatible with TwidoSoft.



User interface

TwidoSoft provides an intuitive, Windows-based user interface, including balloon tips and on-line help. The Twido user interface offers the following features :

- Application browser : this browser is a window providing the directory structure of the application. The windows and toolbars can be moved and attached to the borders of the main window. The elements of an application appear in a logical hierarchy based on their structure within the application. They are arranged as an indented tree structure which can be expanded or collapsed. The application browser can be used to view, program and manage a Twido application and to configure hardware using a graphical representation of the base controllers, I/O extensions and options.

- Status bar : this is a panel at the bottom of the main window which displays information about the application, the controller status and the TwidoSoft software mode. This bar includes a "a memory usage indicator", indicating the percentage of total memory used by the program. A warning message is displayed when available memory is getting low.

- Operating modes : TwidoSoft software can operate in on-line mode (PC connected to the Twido base controller) and off-line mode (PC disconnected from the Twido base controller). Off-line mode is used to develop an application. This application must then be transferred from the PC memory to the controller memory (downloaded) in order to be able to run on the controller. On-line mode is used to debug and adjust this application. In this mode, the application program in the PC memory is identical to the application in the controller memory. Program changes can therefore be made directly to the application in the Twido controller.

Editors and viewers

Twidosoft provides special windows, called editors, for performing the main tasks necessary to develop an application. A TwidoSoft application consists of a program, configuration data, symbols allocated to the variables and documentation. These components can be used in any order when creating an application.

Developing each part of an application using separate editors makes it possible to rationalise the development process. TwidoSoft software provides :

- Instruction List language and Ladder language editors.
- A configuration editor.
- Variables editors (with symbols) and animation table editors.
- Ladder language, cross reference and program error viewers.

TwidoSoft software also provides security features to protect the integrity of programs. "Application protection" right of access prevents access to the controller application. This option prohibits unauthorised transfers of an application. Password protection is selected when an application is transferred to the controller to make access to the application secure.

Configuration of hardware and software

Configuring Twido programmable controllers consists of selecting options for the controller's hardware and software resources. These resources can be adapted at any time while creating a program :

- Hardware resources allow the user to define the type and number of Twido components in a configuration : base controller, remote controllers, I/O expansion modules and optional modules.
- Software resources consist of configurable and non configurable functions. Function blocks (also called variables) are blocks created in memory to execute automation functions which will be used by the program. For example, when configuring a counter function block, memory addresses in the controller are assigned to represent the values associated with the parameters of this counter (current values, preset values). Other software resources are called internal memory blocks, such as bits, words, constant words, system words, network exchange words.

These resources are configured using TwidoSoft software.

Programming

TwidoSoft allows the user to write a controller program in either Ladder language or instruction List language. The language selected depends on user preference and does not affect the application :

- Ladder language consists of a series of ladder rungs, represented graphically, together with text comments.
- Instruction List language consists of a series of text-based instructions.

In either language, the program is "written" in the logical order required to control the machine or process. It is recommended that the programs be "documented" by adding comments (explanatory text inserted at program instruction level).

These two languages are reversible, provided that a few basic rules are followed :

Ladder programming

A program written in Ladder language consists of networks of linked graphical elements (similar to electromagnetic contact diagrams), organised into rungs which are executed sequentially by the controller when it is in RUN mode.

Each rung comprises graphical elements (contacts, coils) linked by horizontal and vertical "lines", organised into a programming grid starting with a potential bar on the left and ending with a second potential bar on the right. The graphical elements are associated with :

- Controller inputs and outputs, such as sensors, pushbuttons and relays.
- Arithmetic, logic and numeric value comparison operations.
- Automation function blocks, such as timers, counters, drum controllers, registers, etc.
- Controller internal variables, such as internal bits and words.

Instruction List programming

A program written in Instruction List language consists of a series of instructions executed sequentially by the controller. Each instruction is represented by a single program line and consists of three components :

- Line number - line numbers are generated automatically when the instructions are entered.
- Instruction code - the instruction code is a symbol linked to an operand identifying the operation to be performed on this operand. These operations are generally of the boolean and numerical type.
- Operand - an operand is a reference, a symbol or a number representing a piece of physical data. For example, in the program opposite, the operand %I0.4 is the reference corresponding to a controller discrete input.

Programmable controller variables

An instruction can include from zero to three operands, depending on the type of instruction code. The operands may be :

- Sensor image inputs (detectors, control buttons, etc.)
- Preactuator output images (contactors, solenoid valves, pilot lights, etc.)
- Internal bits (equivalent to the internal relays in electromagnetic control equipment)
- Control equipment function blocks (timers, counters, drum controllers, registers).
- ...

Integrated counter function

The counter function allows the controller to count a large number of pulses within one program scan cycle. Using its integrated 16-bit counters, Twido can count up to 65 535 pulses generated by ⎓ 24 V sensors. It can compare the current counter value with a preset value and trigger an output when the preset value is reached. This type of counter function can be used for counting parts or events, or for measuring length or position.

The number of integrated fast-counters depends on the type of base controller :

Base controller type	Compact TWD LCAA 10/12/24DRF	Modular LMDA 20D•K
Counter - VFC (20 kHz)	1	2
Counter - FC (5 kHz)	3	2

Very fast counter - VFC (20 kHz)

The 20 kHz VFC (Very Fast Counter) is an up/down counter with possibility of auxiliary inputs. The counter is accessed by means of a function block (%VFCi) programmed using TwidoSoft. The %VFCi function block can be used to execute one of the following 5 functions, all with a maximum frequency of 20 kHz :

- Up/Down counter
- Up/Down counter with detection of running direction.
- Single Up counter.
- Single Down counter.
- Frequency meter.

The pulses to be counted may come from an incremental encoder or from 2 proximity sensors (up/down counting) connected to inputs I0 and I1 of Twido base controllers.

Fast counter - FC (5 kHz)

The fast counter is available for up or down counting of pulses (rising edges) on the discrete inputs of Twido base controllers, at a maximum frequency of 5 kHz. The Up and Down counters are accessed by means of a function block (%FCi) programmed using TwidoSoft. Using the configuration editor, the user must select either Up or Down counting mode for each function block, define the initial value of the preset %FCi.P (1...65 535) and select the attribute "adjustable" in order to be able to change the preset value %FCi.P and the current value %FCi.V in real time.

Within function block %FCi, the current value %FCi.V varies by :

- Incrementing the value 0 to the preset value %FCi.P in counter mode.
- Decrementing the preset value %FCi.P to 0 in down counter mode.

Positioning

Twido modular controllers include two positioning functions (frequency 7kHz) which can be used, for example, for controlling step motors :

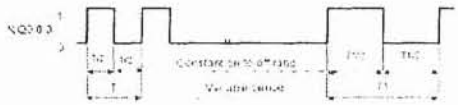
- Function PLS (pulse) - pulse generator output
- Function PWM - pulse width modulation output. This function can also be used for applications with light or sound intensity control (controller function).

PLS function (pulse, 7kHz)

The PLS function block generates pulses of fixed ratio. In some cases, the frequency can be fixed and in others variable (as in control of slopes when driving step motors). The %PLS function block can be programmed to generate a number of specific pulses.

%PLS function blocks are assigned to outputs %Q0.0.0 or %Q0.0.1 on modular base controllers.

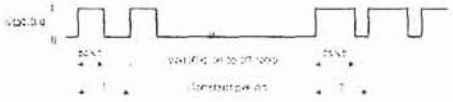
The pulse generator signal has a variable period, but with a constant duty cycle which establishes an ON to OFF ratio of 50 % of the period (see illustration opposite).



PWM function (7 kHz)

The PWM function block generates pulses of fixed frequency, with a variable ratio between the high state and low state of the output signal. The ON to OFF duration ratio is a dynamic variable called %PWM.R, with a range from 0 % to 100 %.

PWM function blocks are assigned to outputs %Q0.0.0 or %Q0.0.1 on a base controller. The PWM function can be used to control the output of analogue modules. The user-defined %PWM function block generates a signal on output %Q0.0.0 or %Q0.0.1 of modular base controllers (see illustration opposite).



Characteristics

Instructions

Combinational List instructions

- **LD, LDN, LDR, LDF** : read the state of a bit, (direct, inverse, rising and falling edges)
- **ST, STN, S, R** : write an output (direct, inverse, set, reset)
- **AND, ANDN, ANDR, ANDF** : logic AND with a bit (direct, inverse, rising and falling edges)
- **OR, ORN, ORR, ORF** : logic OR with a bit (direct, inverse, rising and falling edges)
- **LD (, AND (, OR(,)** : open and close brackets (8 possible levels)
- **XOR, XORN, XORR, XORF** : exclusive OR with a bit
- **MPS, MRD, MPP** : buffer memory management for divergence towards output bits
- **N** : negation

List title and comments

- Title : 122 characters before each **LD, LDN, LDR, LDF** instruction
- Comments : 4 lines of 122 characters before each **LD, LDN, LDR, LDF** instruction
- Possibility of associating a comment of 122 characters with each instruction

Grafcet List instructions

- **-*-i** : step ($1 \leq i \leq 62$)
- **=*=i** : initial step ($1 \leq i \leq 62$)
- **#i** : activate step i, after deactivation of current step
- **#** : deactivate current step
- **#Di** : deactivate step i after another step
- **=*=POST** : start post-processing
- **%Xi** : bit associated with step i

Instructions on program

- **MCS, MCR** : master relay
- **END, ENDC, ENDCN** : end of program (conditional or unconditional)
- **JMP, JMPC, JMPCN** : jump to a label % L (conditional or unconditional)
- **SRn** : call subroutine n ($0 \leq n \leq 15$)
- **RET** : end of subroutine
- **NOP** : non-operative instruction

Ladder rungs

- 10 contacts of 7 lines with 1 output per line
- Title : 122 characters per rung
- Comments : 4 lines of 122 characters

Ladder language graphical symbols

- Normally open, normally closed and on edge contacts
- Direct, inverse, SET and RESET coils
- Program jump, subroutine call

Standard function blocks *(1)*

- Timers :**%TMi** ($0 \leq i \leq 31$) 0 to 9999 (word)
- Up/Down counters :**%Ci** ($0 \leq i \leq 15$) 0 to 9999 (word)
- 4 16-bit LIFO or FIFO registers :**%Ri** ($0 \leq i \leq 3$)
- 4 Drum controllers :**%DRi** ($0 \leq i \leq 3$) 8 steps
- Real-time clock : **%RTCi** ($0 \leq i \leq 15$) month, day, hour, minute, with Nano 16 and 24 I/O

Numerical instructions

- Assignment in word, indexed word, word table bit strings : **:=**
- Arithmetic : **+, -, x, /, REM, SQRT**
- Logic : **AND, OR, XOR, NOT, INC, DEC**
- Shift operation : **SHL, SHR, ROL, ROR** (logic and rotate)
- Conversion : **BTI, ITB** (BCD <-> Binary)
- Comparison : **>, <, <=, >=, =, <>**

Specific function blocks *(1)*

- Transmission/reception of message of 64 words maximum (internal or constant) : **EXCH**
- Exchange control : **%MSG** available output, fault output
- 8 shift bit registers : **%SBRi** ($0 \leq i \leq 7$), shift one step to the left or right (max. 16 steps)
- 8 step counter blocks : **%SCi** ($0 \leq i \leq 7$), move forward or back one step (max. 256 steps)
- Fast counter (5 kHz), Up/Down counter : **%FC**
- Very fast counter 20 kHz, Up/Down counter, frequency meter **%VFC**
- Pulse width modulated output : **%PWM with modular base controller**
- Pulse generator output : **%PLS with modular base controller**

Specific functions

- 1 input for controller RUN/STOP command
- 1 Security output : controller "block" error
- Real time display of Grafcet steps used
- Symbol table management

Addressable objects

Bit objects (1)

- **% I/Qx.y** : I/O bits
- **% Mi** : internal bits
- **% Si** : system bits
- **%Xi** : 62 Grafcet steps
- **% ●●i.j** : function block bits
- **% ●●i:Xk** : bits extracted from internal words, system words, constant words, input and output words

Bit objects (1)

- **% MWi** : internal words
- **% KWi**: 64 constant words
- **% SWi** : 128 system words
- **% INWi.j** : 4 input words per controller (exchange words for inter-controller communication)
- **% QNWi.j** : 4 output words per controller (exchange words for inter-controller communication)

Bit string and word table objects

- **%●i:L** : bit strings (I/O, internal, system and Grafcet bits)
- **%●Wi:L** : word tables (internal, constant and system words)

(1) When the numbers of objects are not indicated, see characteristics pages 41001/4 and 41002/4

References

The multi-language software packages (English, French, German, Italian and Spanish) are for use on PCs *(1)* with Windows 98 or Windows 2000 operating system.
These software packages include :
- A CD-ROM containing TwidoSoft multi-language software and multi-language documentation for hardware and software setup.
- Depending on the model, a PC/Twido base connection cable, reference TSX PCX 1031 which is compatible with Twido, Micro and Premium programmable controllers (length 2.5 m).

TwidoSoft software packages

Description	Reversible languages	PC connection cable	Reference *(1)*	Weight kg
TwidoSoft multi-language packs	Ladder Instruction List	TSX PCX 1031	**TWD SPU 1001 V10M**	–
		–	**TWD SPU 1002 V10M**	–

TwidoPack kits

Schneider Electric offers two TwidoPack kits to help you discover and become familiar with the new range of Twido programmable controllers. TwidoPack, which is inexpensive and easy to use, is available in two versions, each comprising :
- A Twido base controller.
- A set of options.
- A TwidoSoft software package (with cable) TWD SPU 1001 V10M.
- A teach-yourself E-Learning CD-Rom.

Description	Twido base controller	Options	Reference *(2)*	Weight kg
TwidoPack Compact	TWD LCAA 10DRF 10 I/O Compact ∿ 100...240 V, relay outputs	□ Real-time clock cartridge TWD XCP RTC □ 6-input simulator TWD XSM 6	**TWD XDP PAK1●**	–
TwidoPack Modular	TWD LMDA 20DTK 20 I/O Modular ⎓ 24V supply, relay outputs	□ Real-time clock cartridge TWD XCP RTC □ Built-in display module TWD XCP ODM □ Serial interface adapter TWD NAC 485T □ Pre-formed cable (3 m) TWD FCW 30M	**TWD XDP PAK2●**	–

User documentation

Description	Format	Language	Reference	Weight kg
Twido installation and setup manual Hardware and software	Hard copy (216 x 181 mm)	English	**TWD USE 10AE**	–
		French	**TWD USE 10AF**	–
		German	**TWD USE 10AD**	–
		Spanish	**TWD USE 10AS**	–
		Italian	**TWD USE 10AI**	–

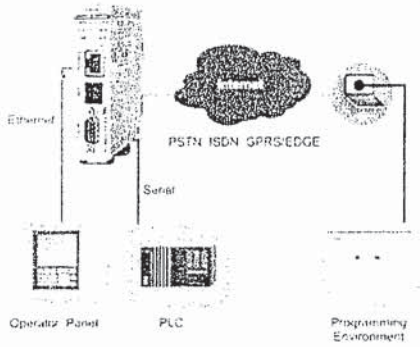
(1) Typical recommended configuration : 300 MHz processor, 128 Mb of RAM with 40 Mb of free hard disk space.
(2) Replace the ● at the end of the reference with **E**: *English,* **F**: *French.*

SPECTRUM CONTROLS

I/O, Communications and Operator Interface Products for Automation

Industrial Internet Router

	Series 300	Series 2000	Series 4000
PSTN Modem		WP23204	WP43204
EDGE Quad Band Modem		WP23207	WP43207



Modem IP Router within a Remote Access Service (RAS) connection

Remote access for PLC maintenance

Alarm notification, remote diagnosis and remote maintenance/monitoring

Series 4000 WebPort add Data Logging and ViewOn e-SCADA Capability

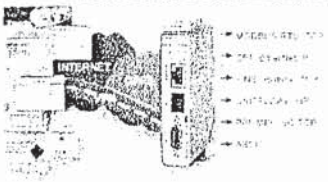
Talk2M

1. IP Router

Take advantage of Internet to connect your remote site. Using VPN technology, it is now possible to establish a secure, encrypted, bi-directional tunnel through the Internet between any Internet connected PC and a remote WebPort-connected device.

2. Internet PLC Remote Maintenance

With its embedded modem, WebPort's your access and your service gateway to perform Remote Maintenance on distant equipment. Once the call is established, your programming application accesses the PLC (or the device) transparently, from the programming port or from the Ethernet socket, as if it were in the room next door



3. Centralized Monitoring/Extranet

Several alarm thresholds are available on each WebPort data tag, with individual settings for dead band and activation delays. WebPort manages the complete alarm cycle, including acknowledgements logging, and triggers multiple actions on each alarm (SMS, email, SNMP traps and put FTP).

Serial to Ethernet Protocol Conversion

Enable serial devices to connect to your Ethernet network. [more]

Industrial Modem Router

The easy way to remotely connect to you machine. [more]

Industrial Internet Router

Secure connectivity to your machine over the Internet. [more]

Industrial LAN/Modem Router

Secure LAN access from a remote location. [more]

VPN Remote Connectivity

Talk2M

Hosted VPN connectivity for your WebPort-enabled machines. [more]

ViewOn 2

ViewON 2

Build a dynamic WebPort site allowing real-time data display and control. [more]

SPECTRUM CONTROLS

Industrial IP Router

WebPort 2300

Embedded PSTN or GSM/GPRS modem

Ethernet 10/100mb port (RJ45)

RS232/485/422 serial port

Transparent gateway:
- *MODBUS TCP/RTU*
- *FINS TCP/Hostlink*
- *ISOTCP/PPI*
- *Ethernet/IP DF1*
- *XIP/Unitelway*

Alarms management on PLC variables

Alarms notification by SMS, email or trap SNMP

24 VDC power supply, DIN rail mounting

1x digital input (alarms) and 1x digital output (fail safe)

Configuration by embedded web page

TALK2M VPN Support

WebPort®

Powered By: eWON

A Better Way to Manage Your Data

Typical Applications

- Industrial TCP/IP router
- PLC remote maintenance (teleservice) via PSTN or GSM/GPRS
- Alarms management and notification

PLC and Device Support

- Allen-Bradley SLC500 and Logix families with DF1 and Ethernet/IP
- Schneider TSX Premium & Micro with UNITELWAY and XIP
- Schneider TWIDO with MODBUS/RTU
- Schneider Momentum/Quantum with MODBUS TCP and RTU
- Wago I/O modules with MODBUS TCP or RTU
- Siemens S7-200 with PPI and S7-300/400 using ISOTCP
- Omron CJ and CS with FINS TCP/UDP and FINS Hostlink
- LEM QWave power quality analyzer and much more...

Highlights

- PLC remote maintenance on the programming serial port with the original PLC software
- PLC remote maintenance on the Ethernet port with the original PLC software
- Tagnames data acquisition by Modbus, DF1, FINS Hostlink, PPI, Unitelway serial protocols and ISOTCP, EIP, MODBUS TCP, FINS TCP Ethernet protocols
- Alarms management on user threshold and notification by email, FTP put and SNMP trap
- Secure Internet connectivity using Talk2M hosted VPN technology

Specifications

Gateways Ethernet/serial	- MODBUS TCP / MODBUS RTU - XIP / UNITE - Ethernet/IP / DF1 - FINS TCP / FINS Hostlink - ISO TCP / PPI - VCOM / ASCII
Programmable Gateways	PPI, DF1, Unitelway, FINS Hostlink to MODBUS/TCP or SNMP ASCII dedicated protocol to FTP, SNMP, MODBUS/TCP.
Data Acquisition	Data acquisition (Tagnames) in MODBUS/RTU, MODBUS/TCP, Unitelway, DF1, PPI, FINS Hostlink, FINS TCP, Ethernet/IP, ISO TCP, ASCII protocol.
Alarms	Alarm notification via email, FTP put and/or SNMP trap. Thresholds: low, lowlow, high, highhigh + deadband and activation delay. Alarms logs in http and via FTP. Alarms cycle: ALM, RTN, ACQ and END.
Script	Dedicated application to be programmed using the BASIC language.
Synchronization	Embedded real-time clock, manual set-up via http or automatic NTP setup.
File Management	FTP client and server for configuration, firmware update and data transfer.
Web Site	Security: DAA and session control. HTML standard supports all PDA browsers. WebPort system and user web site.
Maintenance	SNMP v1 with MIB2 and/or via FTP files.
Hardware	Din Rail Mounting. ARM processor at 75Mhz, 16Mb SDRAM, 8Mb Flash. Power supply: 12-24VDC +/-20%, SELV; consumption: 3-6 watts. 1x SUBD9 serial port: RS232, RS422 or RS485 not isolated or MPI port isolated. 1x RJ45 Ethernet 10/100 Base-TX; 1.5kV isolation. 1x digital input: 0/24VDC; 3.5kV isolation. 1x digital output: open collector 200mA at 30VDC; 3.5kV isolation. Internal modem: PSTN 56kbds, or GSM/GPRS class 10. Operating temperature range: 0° to 50° C, 80% humidity (non condensing). Dimensions: 4.72" depth x 4.13" height x 1.02" width, Weight: <300g. Certifications: CE, UL.
VPN Tunnelling	Open VPN 2.0 either in SSL UDP or HTTPS
VPN Security	The VPN security model is based on using SSL/TLS for session authentication and the IPSec ESP protocol for secure tunnel transport over UDP. It supports the X509 PKI (public key infrastructure) for session authentication, the TLS protocol for key exchange, the cipher-independent EVP (DES, 3DES,AES, BF) interface

Product Reference

Catalog No.	*Description*
WP23201	WebPort 2003 with Ethernet and Talk2M VPN
WP23204	WebPort 2003 with Ethernet and PSTN 56k internal modem and Talk2M VPN
WP23207	WebPort 2003 with Ethernet and Quad Band EDGE internal modem and Talk2M VPN

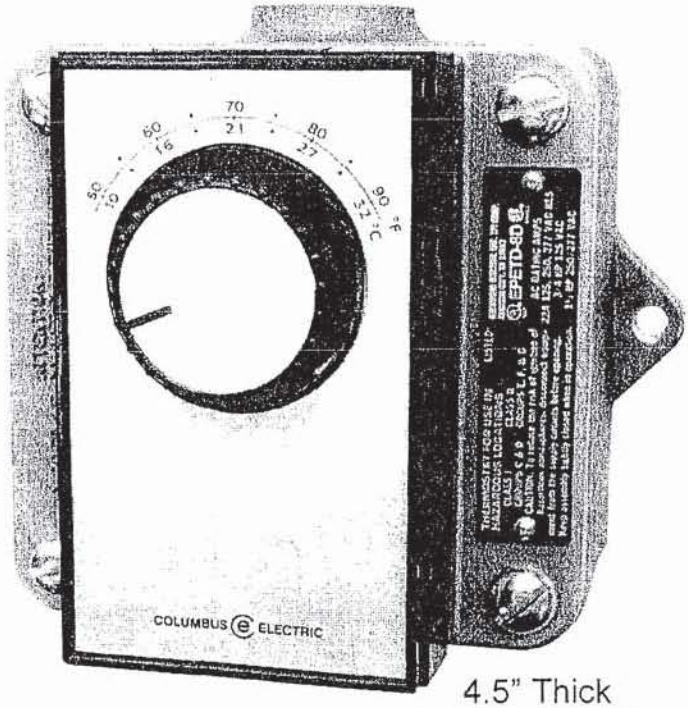
Spectrum Controls, Inc.
P.O. Box 5533 | Bellevue, WA 98006 USA
Tel 425-746-9481 | **Fax** 425-641-9473
Email spectrum@spectrumcontrols.com
www.spectrumcontrols.com

APPENDIX J

BUILDING HEATING & VENTILATION SPECIFICATIONS AND VENDOR INFORMATION

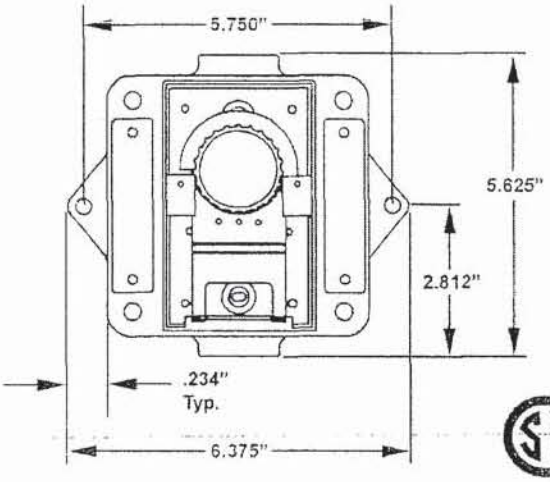
EPET Series

Hazardous Location Thermostats



4.5" Thick

From base to top of knob



Features:

- SPDT Models
- DPDT Models
- Snap Action Switches
- Casting Tapped Top & Bottom for 3/4" Conduit
- 1/2" Thick Cast Aluminum Explosion/Dust Proof Case
- Includes (1) 3/4" to 1/2" Conduit adapter
- Includes (1) Conduit Plug
- Screw Terminal Connections
- Bi-Metal Temperature Sensor

Operational Specifications

Setpoint Temperature Range
50-90°F / 10-32oC
Rated Differential
2-4°F
Voltage
120-277VAC or 480VAC
Amp Rating
22 Amps, Resistive Max.
Approvals
Class I Group C &D
Class II Group E, F, & G
NEMA Class Seven Div I

Packaging Specifications

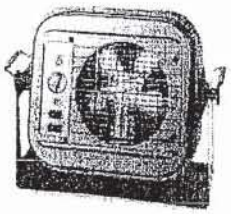
Product Size
5.5"H x 6.375"W x 5.625"D
Depth is from wall to top of knob.
Individual Carton Size
6.5"L x 7"W x 5.75"D
Individual Carton Weight
6 lb
Master Carton Qty
4 Pcs
Master Carton Size
16"L x 14.5"W x 6"H
Master Carton Weight
24 LBS (varies slightly by model)

Model	PCN #	DESCRIPTION	Voltage	Amps	Positive Off	Anticipator
EPETD8D	05380702	DPDT Hazardous Location	120-277VAC	22 Amps Max	No	No
EPETD8S	05381002	SPDT Hazardous Location	120-277VAC	22 Amps Max	No	No
EPETP8D	05280702	DPDT Hazardous Location	480VAC	22 Amps Max	No	No
EPETP8S	05280602	SPDT Hazardous Location	480VAC	22 Amps Max	No	No

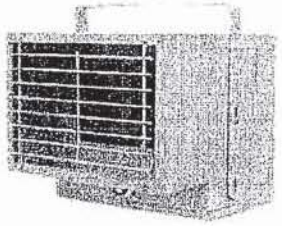
Electric Utility Convection Heaters

Dayton

No. 3UG73



No. 4E169



No. 2HDA1

- Automatic thermal protection
- Fan-forced
- Built-in thermostat

UTILITY

UL and C-UL Listed. No. 4E169 has High/Low heat selector and fan-only option. 71°F temp. rise. Horizontal or vertical mount. Meets NEC and OSHA requirements. When used for portable applications, this heater requires optional cord set No. 4E170.

Uses: Can be used as auxiliary, supplemental, or primary heat source.

FREEZE PROTECTION

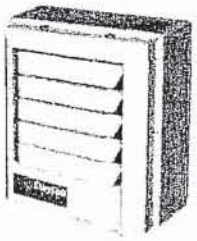
Concealed-space and plenum heater is rated for zero clearance. NEMA 12K control box is gasketed to keep out moisture and dust. ETL Classified for U.S. and Canada; meets City of Chicago codes for plenum use.

Description	kW	BtuH	Voltage	Amps AC	Dim. (In.) H	W	D	Includes	Item No.		$ Each
Electric Utility Heater	5/4.1/3.3/2.5	17,100/14,000/11,300/8500	208	20.8/17.1/13.8/10.4	12½	14	11¼	Ceiling/Wall Mounting Bracket, Bronze/Brown Adjustable Louvers	3UG74	✓	414.50
Electric Utility Heater	5/4.1/3.3/2.5 3.7/3.1/2.5/1.8	17,100/14,000/11,300/8500 12,600/10,600/8500/6100	240 208	20.9/17.4/13.9/10.4 17.8/14.9/10.4/8.7	12½	14	11¼	Ceiling/Wall Mounting Bracket, Bronze/Brown Adjustable Louvers	3UG73	✓	432.00
Electric Utility Heater	5.0/3.3 3.7/2.5	17,060/11,260 12,624/8530	240 208	20.8/13.8 17.8/12.0	22	9¾	18⅛	Ceiling/Wall Mounting Bracket with Pre-Drilled 16" O.C. Holes, Doubles as Handle or Floor Stand	4E169	✓	492.25
Freeze Protection Heater	2.5/1.95	8530 / 6650	240/208	10.7 / 9.42	12½	14	14	Mounting Bracket, Thermostat with 40 to 90° Range with Positive Off	2HDA1	✓	427.50

Description	Voltage	For Use With	Includes	Item No.	$ Each
Accessory					
Cord Set 6-Ft.	240	4E169	NEMA 6-30 Plug	4E170	62.10

Electric Unit Heaters

Dayton



No. 2YU61

- Automatic reset thermal protection
- Adjustable outlet louvers
- Fan-forced
- Ceiling- or wall-mount, vertically or horizontally

30"H units require 3/8"-16 rods for mounting (see page 2658). UL and C-UL Listed. Meet NEC and OSHA requirements.

3- and 5-kW single-phase units are wired for direct line voltage control. All others feature 24V low-voltage control circuit. 3-phase 30- and 50-kW units are wired for 1- or 2-stage low-voltage control and contain 2-speed motor for High/Low fan selection.

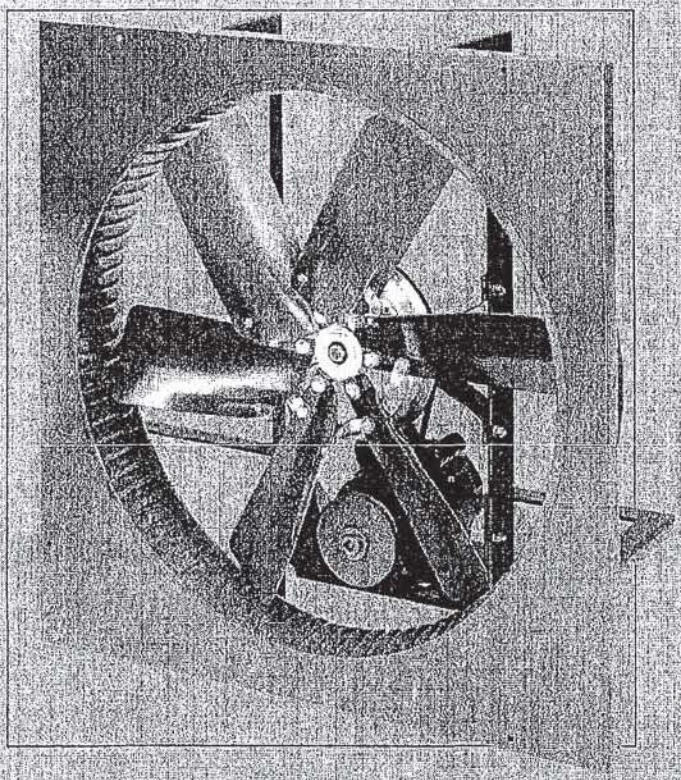
Note: Wall-mounted or unit-mounted thermostat required; sold separately on page 3883.

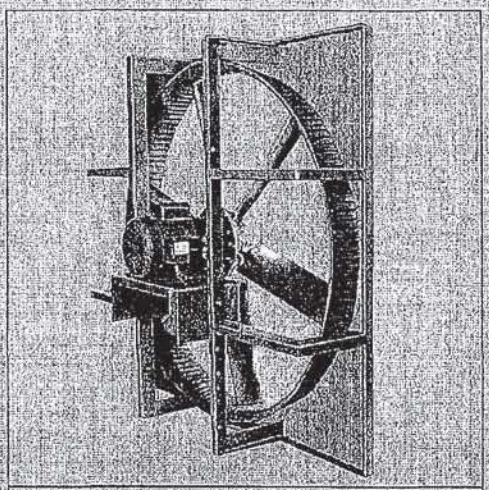
kW	BtuH	Voltage	Phase	Amps* AC	CFM‡	Temp. Rise (°F)	Dimensions (In.) H	W	D	Max. Mounting Height (Ft.)	Horizontal Air Throw (Ft.)	Item No.		$ Each
3.0	10,200	208	1	14.5	350	27	16	14	8½	8	12	2YU61	✓	474.50
3.0/2.2	10,200/7500	240/208	1	12.5/11.0	350	27	16	14	8½	8	12	2YU58	✓	474.50
3.0	10,200	277	1	11.0	350	27	16	14	8½	8	12	2YU60	✓	474.50
3.0	10,200	480	3	3.6	350	27	16	14	8½	8	12	2YU59	✓	661.50
5.0	17,000	208	1 or 3	24.0	350	45	16	14	8½	8	12	2YU65	✓	488.75
5.0/3.7	17,000/12,600	240/208	1 or 3	21.0/18.0	350	45	16	14	8½	8	12	2YU62	✓	526.50
5.0	17,000	277	1	18.0	350	45	16	14	8½	8	12	2YU64	✓	560.50
5.0	17,000	480	3	6.0	350	45	16	14	8½	8	12	2YU63	✓	708.50
7.5	25,600	208	1 or 3	36.0	650	37	21¾	19	8½	9	18	2YU68	✓	771.50
7.5/5.6	25,600/19,100	240/208	1 or 3	31.3/27.0	650	37	21¾	19	8½	9	18	2YU66	✓	776.00
7.5	25,600	480	3	9.0	650	37	21¾	19	8½	9	18	2YU67	✓	795.50
10.0	34,100	208	1 or 3	48.0	650	49	21¾	19	8½	9	18	2YU71	✓	838.50
10.0/7.5	34,100/25,600	240/208	1 or 3	42.0/36.0	650	49	21¾	19	8½	9	18	2YU69	✓	848.50
10.0	34,100	480	3	12.0	650	49	21¾	19	8½	9	18	2YU70	✓	898.50
15.0	51,200	208	1 or 3	72.0	910	52	21¾	19	13¾	11	35	2YU74	✓	1278.00
15.0/11.2	51,200/38,200	240/208	3	36.1/31.3	910	52	21¾	19	13¾	11	35	2YU72	✓	1278.00
15.0	51,200	480	3	18.0	910	52	21¾	19	13¾	11	35	2YU73	✓	1386.00
20.0/15.0	68,200/51,200	240/208	3	48.0/41.2	1320	48	21¾	19	13¾	12	41	2YU75	✓	1704.00
20.0	68,200	480	3	24.0	1320	48	21¾	19	13¾	12	41	2YU76	✓	1704.00
30.0	102,300	208	3	84.0	2100/1800	45/53	30	26⅛	13¾	12	50	2YU79	✓	2813.00
30.0/22.5	102,000/77,000	240/208	3	72.3/63.0	2100/1800	45/53	30	26⅛	13¾	12	50	2YU77	✓	2813.00
30.0	102,300	480	3	36.0	2100/1800	45/53	30	26⅛	13¾	12	50	2YU78	✓	2813.00
50.0 / 37.5	170,000/127,000	240/208	3	120.4/104.2	3000/2600	53/61	30	26⅛	18⅛	15	60	2YU80	✓	3751.00
50.0	170,500	480	3	60.2	3000/2600	53/61	30	26⅛	18⅛	15	60	2YU81	✓	3751.00

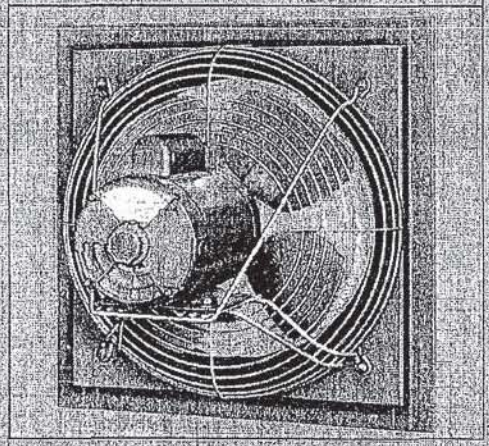
(*) Maximum amp rating reflects single phase on combination single/3-phase units. To obtain amperage draw on 3-phase power supply, divide single-phase rating by 1.73. (‡) Air delivery data on dual voltage units reflects high voltage.

BULLETIN 731
FEBRUARY, 2002

BELT-DRIVE AND DIRECT-DRIVE
PROPELLER FANS







BELT-DRIVE

- Exhaust or supply
- Capacities to 117,800 CFM
- Static pressures to 3/4"WG

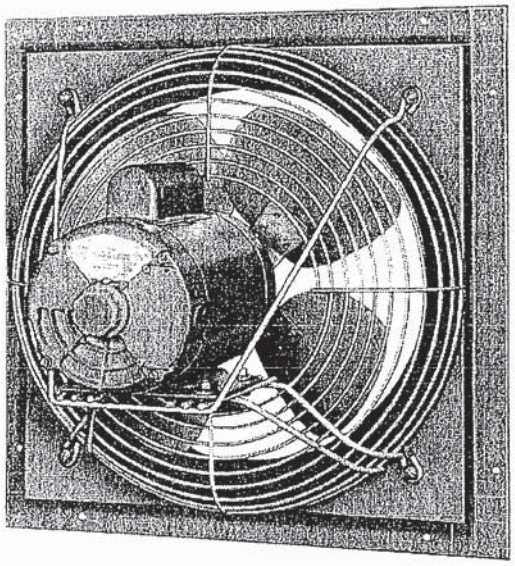
DIRECT-DRIVE

- Exhaust or supply
- Capacities to 61,400 CFM
- Static pressures to 3/4"WG

nyb | The New York Blower Company®

7660 QUINCY STREET–WILLOWBROOK, ILLINOIS 60527-5530
TEL: (630) 794-5700 • FAX: (630) 794-5776 • WEB: http://www.nyb.com • E-MAIL: nyb@nyb.com

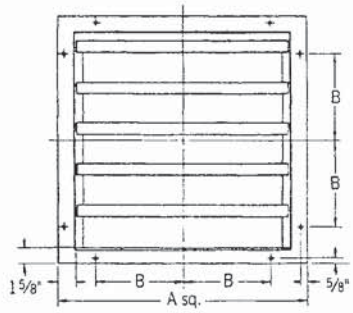
DIRECT-DRIVE PROPELLER FANS

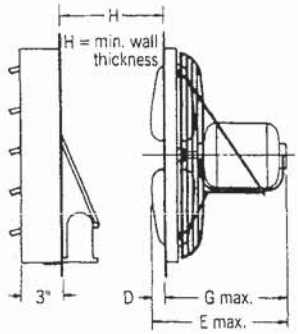


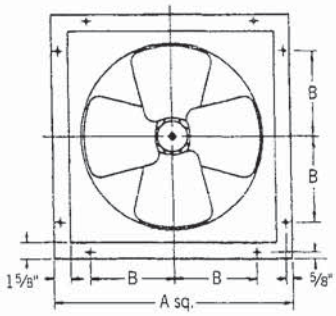
MODEL N

EXHAUST or SUPPLY

- **Eight wheel diameters**—8" through 24".
- **250 to 6400 CFM**—up to 1/2" static pressure.
- **Panels**—square steel construction with streamlined venturi inlet...venturi is reversed in supply-fan panels...baked-green enamel finish.
- **Wheels**—aluminum blades with steel hubs.
- **Motor mounts**—wire-guard-type motor mount [see photo at left] is standard on all Model N units...guard is zinc-plated steel.
- **Motors**—standard motors are totally enclosed air over with pre-lubricated ball bearings except 1/12 and 1/20 HP motors, which are shaded-pole totally enclosed permanently lubricated sleeve-bearing type. Motors 1/4 HP and larger are suitable for either horizontal or vertical service...specify "for vertical mounting" to have wheel locked to motor shaft...1/20 and 1/12 HP motors are not suitable for vertical service.







SPECIFICATIONS DIMENSIONS IN INCHES.

Application	Model	Wheel diameter	A	B	D	E†	G†	H minimum		Mounting hole no. and diameter		Weight* [lbs.]
								Auto-matic	Motor-operated	Fan	Shutter	
EXHAUST	EN82-	8	13 1/4	3		10 1/4	10 1/4	1 5/8	4 1/2	8 - 5/16	8 - 9/32	25
	EN102-	10	15 1/4	4	1/4	10 3/8	10 1/8	1 5/8	4 3/4	8 - 5/16	8 - 9/32	29
	EN122-	12	17 1/4	5	7/8	11 1/2	10 3/4	2	5 3/8	8 - 5/16	8 - 9/32	35
	EN142-	14	20 1/4	6 1/2	5/8	11 1/4	10 5/8	2	5 1/8	8 - 5/16	8 - 9/32	40
	EN162-	16	23 1/4	8	1	12	11	2	5 1/2	8 - 5/16	8 - 9/32	50
	EN182-	18	24 1/4	8 1/2	5/8	11 1/2	10 7/8	2	5 1/8	8 - 5/16	8 - 9/32	65
	EN202-	20	27 1/4	10	7/8	12 7/8	12	2	5 3/8	8 - 5/16	8 - 9/32	80
	EN242-	24	30 1/4	11 1/2	1	13 3/8	12 3/8	2	5 1/2	8 - 5/16	8 - 9/32	95
SUPPLY	SN82-	8	13 1/4	3		10 1/4	10 1/4	Auto-matic shutter not available	9 1/2	8 - 5/16	8 - 9/32	25
	SN102-	10	15 1/4	4		10 1/4	10 1/4		9 1/2	8 - 5/16	8 - 9/32	29
	SN122-	12	17 1/4	5		11	11		9 1/2	8 - 5/16	8 - 9/32	35
	SN142-	14	20 1/4	6 1/2		11 5/8	11 5/8		9 1/2	8 - 5/16	8 - 9/32	40
	SN162-	16	23 1/4	8	1/8	11 1/4	11 1/8		9 1/2	8 - 5/16	8 - 9/32	50
	SN182-	18	24 1/4	8 1/2		12	12		9 1/2	8 - 5/16	8 - 9/32	65
	SN202-	20	27 1/4	10		12 1/2	12 1/2		9 1/2	8 - 5/16	8 - 9/32	80
	SN242-	24	30 1/4	11 1/2	1/4	12 1/2	12 1/4		9 1/2	8 - 5/16	8 - 9/32	95

† E and G based on longest motor used for each size fan. * Shipping weights shown are maximum and include totally enclosed motors and weight of packaging.
NOTE: Exhaust units are available with either automatic or motorized shutters. Supply units require motorized supply shutter.
When ordering, specify complete model number as shown on page 3. Dimensions not to be used for construction unless certified. Tolerance: ± 1/8"

Model EN Direct-Drive Exhaust performance ratings

Model	HP	RPM	CFM						Max. BHP*
			0"SP	1/10"SP	1/8"SP	1/4"SP	3/8"SP	1/2"SP	
EN82-H	1/20	1550	418	258	243				
EN82-H-3	†1/20	1550/1300/1100	418/350/297	258/216/183	243/204/172				
EN102-H	1/20	1550	900	735	680				
EN102-H-3	†1/20	1550/1300/1100	900/755/639	735/616/511	680/570/483				
EN122-M	1/12	1075	1200	965	790				
EN122-H	1/4	1725	1900	1790	1750	1500			
EN122-MH	1/4	1725/1140	1900/1257	1790/1182	1750/1158	1500/992			
EN142-M	1/12	1050	1340	1150	1095				
EN142-H	1/4	1725	2150	2020	1980	1820	1660		
EN142-MH	1/4	1725/1140	2150/1420	2020/1335	1980/1310	1820/1202	1660/1098		
EN162-M	1/4	1140	2070	1880	1820	1600			
EN162-H	1/2	1750	3050	2910	2880	2720	2560		.45
EN162-MH	1/3	1725/1140	3010/1990	2880/1902	2840/1878	2680/1770	2510/1660		.45
EN182-M	1/4	1140	2620	2400	2330	2050			
EN182-H	1/2	1725	3860	3720	3690	3500	3290	3050	.54
EN182-MH	1/2	1725/1140	3860/2560	3720/2460	3690/2440	3500/2310	3290/2180	3050/2020	.54
EN202-M	1/4	1140	3360	3110	3050	2670			
EN202-H	3/4	1725	5000	4850	4800	4600	4400	4180	.82
EN242-L	1/4	1140	4250	4000	3930	3500			
EN242-M	1/2	1140	5380	5100	5020	4620	4200		.53
EN242-H	★3/4	1140	6420	6150	6070	5650	5210	4650	.84

Model SN Direct-Drive Supply performance ratings

[If shutters are required, use motorized supply type]

Model	HP	RPM	CFM						Max. BHP*
			0"SP	1/10"SP	1/8"SP	1/4"SP	3/8"SP	1/2"SP	
SN82-H	1/20	1550	442	316	270				
SN82-H-3	†1/20	1550/1300/1100	442/371/314	316/265/224	270/226/192				
SN102-H	1/20	1550	870	755	720				
SN102-H-3	†1/20	1550/1300/1100	870/730/617	755/633/536	720/604/511				
SN122-M	1/12	1075	1150	920	850				
SN122-H	1/4	1725	1815	1675	1650	1475			
SN122-MH	1/4	1725/1140	1815/1200	1675/1106	1650/1090	1475/975			
SN142-M	1/12	1050	1350	1160	1100				
SN142-H	1/4	1725	2100	1990	1960	1840	1680		
SN142-MH	1/4	1725/1140	2100/1390	1990/1315	1960/1295	1840/1216	1680/1110		
SN162-M	1/4	1140	2000	1800	1750	1450			
SN162-H	1/2	1750	2950	2830	2800	2650	2500		.45
SN162-MH	1/3	1725/1140	2900/1915	2790/1840	2760/1756	2600/1718	2440/1610		.45
SN182-M	1/4	1140	2610	2400	2340	1960			
SN182-H	1/2	1725	3920	3750	3700	3490	3280	3000	.57
SN182-MH	1/2	1725/1140	3920/2590	3750/2480	3700/2440	3490/2305	3280/2165	3000/1980	.57
SN202-M	1/4	1140	3570	3260	3200	2810			
SN202-H	3/4	1725	5300	5100	5000	4820	4600	4350	.92
SN242-L	1/4	1140	4400	4150	4080	3700			
SN242-M	1/2	1140	5380	5100	5030	4650	4200		.52
SN242-H	★3/4	1140	6400	6100	6020	5600	5120	4480	.79

NOTE Static pressure rating on multispeed fans is at the higher speed. Low-speed performance ratings are shown for the identical system.

* Maximum BHP over cataloged range. Motors are rated on internal temperature rise rather than nameplate HP.

† Shaded-pole motor. Three-speed capacities shown are obtainable with 3-speed switch furnished with unit.

★ Available in 3-phase only.

Bulletin "FA"

Stoddard Silencers

Specialists in Industrial Silencing

Stoddard Silencers, Inc.
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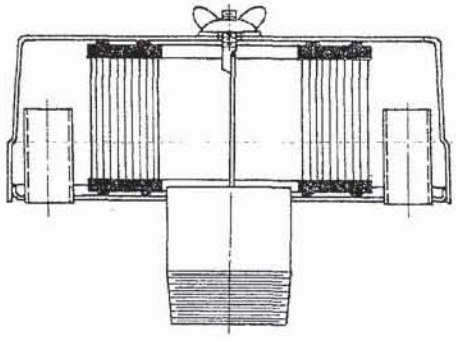
INTAKE FILTERS and FILTER SILENCERS



F64 Air Intake Filters and Filter Silencers

Air Intake Filter and Filter Silencer

The Series F64 Air Intake Filter and Filter Silencer is designed to mount directly on the inlet of an engine, blower or compressor. It will provide 16dB to 20dB noise reduction and the paper filter media has an efficiency of 99% on 1 micron particles.

SERVICE LIFE & CLEANING: The service life of the element is dependent upon the surrounding environment and cannot be predicted.

To prevent COLLAPSING of the filter element, STODDARD SILENCERS recommends the differential pressure across the filter element NOT exceed 15 inches of water column. Positive indication that the element requires cleaning or replacement can be provided with STODDARD SILENCERS model A40-108 Pressure Drop Indicator, at an extra charge.

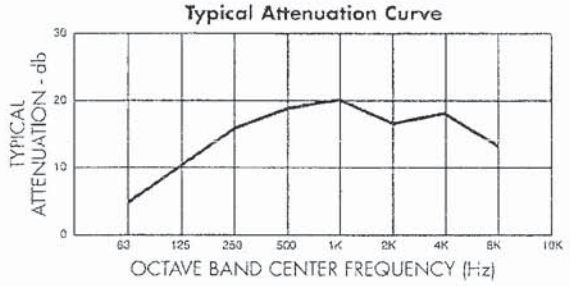
To extend service life, rap element gently to dislodge accumulated dirt. An alternate method is to direct compressed air (75 PSIG max) through the element opposite to the direction of air flow. THE FILTER ELEMENT MUST EVENTUALLY BE REPLACED.

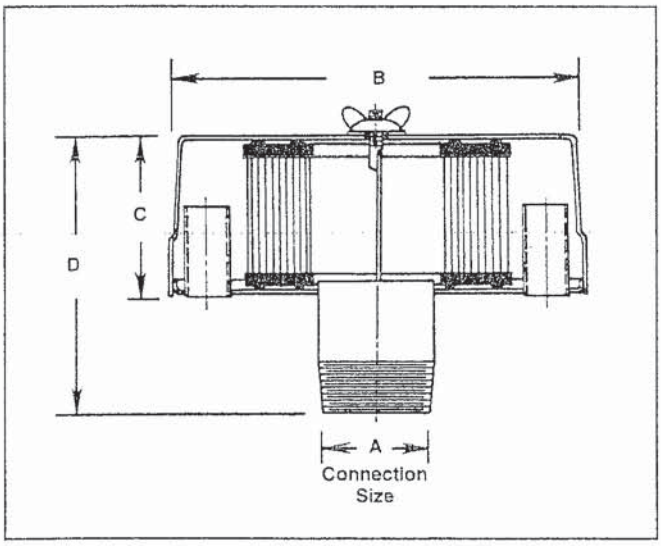
ALTERNATE FILTRATION MEDIA
AVAILABLE FOR F64

REFER TO PAGE FOUR

Pre-Filter wrap available at added cost
Consult Factory
(90% on 75 micron particles and larger)

Typical Attenuation Curve





F64 shown with optional A40-108 Pressure Drop Indicator.

F64 Series

Model	A Connection Size	B	C	D	Rated CFM	Wt.	Replacement Element Number
F64-1	1" NPT	10	4	7	35	9	F8-108
F64-1½	1½" NPT	10	4	7	80	9	F8-108
F64-2	2" NPT	10	4	7	135	10	F8-108
F64-2½	2½" NPT	10	4	7	180	10	F8-108
F64-3	3" NPT	16	5	8	285	20	F8-109
F64-4	4" NPT	16	5	8	520	20	F8-109
F64-5	5" NPT/FLG	16	5	8	750	23	F8-109
F64-6	6" Flange	20	5	8	1235	40	F8-110
F64-8	8" Flange	20	10	13	2125	50	F8-11[illegible]
F64-10	10" Flange	26	15½	20	3335	95	F8-137
F64-12	12" Flange	26	15½	20	4675	100	F8-137
F64-14	14" Flange	26	15½	20	5655	115	F8-137

Sizes 10", 12" and 14" are FILTERS only

APPENDIX K

SITE-SPECIFIC HEALTH AND SAFETY PLAN

W. R. Grace Superfund Site
Acton, MA

DRAFT 0

November 2009

O&M, Inc.
450 Montbrook Lane
Knoxville, TN 37919

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O&M, Inc. HEALTH & SAFETY AND PLAN

This Health and Safety and Plan (HSP) will be kept on the site during field activities and reviewed as necessary. The plan adopts, by reference, the Standards of Practice (SOPs) in the O&M, Inc. Corporate Health and Safety Program, as appropriate All Site personnel are to be familiar with these SOPs and the contents of this plan. O&M, Inc. personnel and its subcontractors must sign as acknowledgment they have become familiar with the contents of this HSP.

Project Information and Description

PROJECT/SITE NAME: W. R. Grace Superfund Site – Acton, MA

SITE ADDRESS: 50 Independence Road, Acton, MA 01720

WORK AREA: The work area consists of the NE Area Ground Water System and the Landfill Area Ground Water System.

O&M, Inc. Project Manager: David Fuerst

O&M, Inc. Corporate Safety Officer: Valerie Rule

O&M, Inc. Project Engineer: Anton Plaines

O&M, Inc. Site Safety Officers/Technicians: Jim Champa/James Remotti

DATES OF SITE WORK: November 2009 - Completion

SITE ACCESS: Sign in at the O&M, Inc. NE Area or Landfill Area treatment building.

SITE DESCRIPTION AND HISTORY: The W.R. GRACE ACTON & Co., Inc. ACTON PLANT (GRACE ACTON) site is the former American Cyanamid Company and Dewey & Almy Chemical Company which formally produced sealant, latex, plastizers, resins, and other products. These companies were purchased by W.R. Grace in 1954 where effluent waste was discharged in four lagoons, while hazardous waste was buried in several locations. The site is approximately 260 acres partially enclosed by 4-foot and 6-foot high chain link fence primarily designed to restrict motorized vehicle traffic.

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED: The work activity covered under this HSP includes the following:

- Ground water and surface water monitoring
- Ground water treatment system operations and maintenance
- Roadway and landfill cap maintenance
- Well maintenance
- Swale Maintenance
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REVISION OF THE HSP: This HSP needs to be reviewed frequently. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available.

1.0 TASKS ADDRESSED UNDER THIS PLAN

1.1 Description of Major Tasks

The major work activities that will occur at the W.R. Grace Superfund Site are the operations and maintenance of the ground water treatment systems in the NE Area and Landfill Area of the Site. Refer to project documents for detailed task information.

Health and safety risk analyses will be performed for each new task. This Health and Safety Plan will be amendment or revised, as necessary, to incorporate any additional tasks or requirements.

1.1.1 Employee Orientation

Employees expecting to access the site are required to attend an employee orientation. The training provided to the employees in the employee orientation needs to include:

- Review this Health and Safety and Plan (HSP).
- Present an overall site safety briefing (general site safety).
- Review employee responsibilities including O&M, Inc. Drug Policy applicability.
- Review emergency procedures and evacuation plan.
- Review injury and incident reporting procedures.
- Review reporting procedures for hazardous conditions and/or hazardous activities.
- Empower all employees with "stop work authority" when they observe a potentially dangerous condition or work practice.

1.1.2 Employee Training

Training documentation will be provided to O&M, Inc. personnel prior to start of work operations. This documentation/certification includes areas such as Hazwoper, hazard communication (HAZCOM), forklift, crane, heavy equipment, fall protection, scaffold, ladder, etc.

O&M, Inc. will ensure that its employees do not perform a given task without the required training. If it is determined that an employee has been allowed to perform work without the prerequisite training, he/she will not be allowed to continue to perform that task until training has been satisfactorily completed.

1.1.3 Hazwoper-Regulated Tasks

- Ground water treatment facility operations.
- Ground water sampling.
- Removal and/or disposal of pipelines, pumps and processes.

1.1.4 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. In order to use non-Hazwoper-trained personnel, it must be demonstrated that the tasks can be performed without the possibility of exposure. **Prior approval from the Project Manager is required before these tasks are conducted on the regulated areas of the site.**

Potential Tasks	Controls
• Clearing and grubbing • General heavy equipment work (excavation, grading, etc.) • General construction • Electrical installation • Mechanical installations (equipment, pumps, etc.) • Oversight of remediation and construction • Equipment/material delivery • Surveying	• Brief personnel on hazards, limits of access, and emergency procedures • Identify &/or mark perimeter of contaminant areas as appropriate • Observe, sample and monitor as appropriate

1.1.5 Task Hazard Analysis—Construction

POTENTIAL HAZARDS	TASKS							
	Clearing and Grubbing	Treatment System Installation	Electrical	Mechanical	Equipment/ Material Delivery	Surveying	Earth-moving	General Oversight
Flying debris/objects	X	X	X	X	X	X	X	X
Noise > 85dBA	X						X	
Electrical		X	X	X				X
Lockout/tagout			X	X				
Heat Stress/Cold Stress		X		X	X		X	X
Suspended loads	X	X		X	X		X	X
Buried utilities	X	X	X				X	X
Slip, trip, fall	X	X	X	X	X	X	X	X
Back injury	X	X	X	X	X	X	X	X
Trench/excavation		X	X				X	X
Visible lightning	X	X	X	X		X	X	X
Vehicle traffic	X	X	X	X	X	X	X	X
Elevated work areas/falls		X	X	X	X		X	X
Fires								X
Entanglement	X		X	X			X	X
Heavy equipment	X	X		X	X		X	X
Working near water						X	X	X

1.1.6 Task Hazard Analysis—Water Treatment System O&M

POTENTIAL HAZARDS	Treatment System Sampling	GAC Change-out	Treatment System O&M	Equipment Cleaning	Ground Water Sampling	Misc. Maintenance, Electrical and Cleaning Tasks
Flying debris/objects			X	X		X
Noise > 85dBA						
Energized electrical – lockout/tagout			X	X		X
Slip, trip, fall	X	X	X	X	X	X
Back injury	X	X	X	X	X	X
Confined space entry			X	X		X
Visible lightning	X	X	X	X	X	X
Vehicle traffic		X	X			X
Elevated work areas/falls		X	X	X		X
Entanglement				X		X
Heavy equipment		X	X			
Vacuum truck operations		X	X	X		
High-pressure washing			X	X		

2.0 HAZARD CONTROLS

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. O&M, Inc. employees must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. O&M, Inc. employees who do not understand any of these provisions should contact the SS, or the Project Manager for clarification.

In addition to the controls specified in this section, selected SOPs may contain checklists that are to be used in identifying and controlling potential hazards and assess the adequacy of O&M, Inc. site-specific safety requirements. Checklists should be completed at the beginning of tasks, when tasks or conditions change, and/or or when otherwise specified by the Project Manager. The checklists, including documented corrective actions, should be made part of the permanent project records, and be promptly submitted to the SS.

2.1 Project-Specific Hazards

Project-specific hazards include the items presented in the following sections. SOPs have been developed for these tasks. Employees working on the task are required to review all task-applicable SOPs prior to proceeding with the work. Any task that does not have an applicable SOP shall be brought immediately to the attention of the Project Manager. A variance must be issued by the Project Manager, prior to beginning work, for any task that does not have an approved SOP and/or must deviate from the approved SOP in order to complete the task.

2.1.1 General Worker Protection Requirements

All personnel who enter the areas designated by the Project Manager as Active Work Areas shall have the following as a minimum.

- Sleeved Shirt (no sleeveless "tank top")
- Long Pants
- Safety Glasses
- Steel Toe Boots
- Access to Hearing Protection (keep a pair of ear plugs nearby)

2.1.2 Working Above, On or Near Water

All personnel who work above, on or near the water shall have adequate protection against falling and drowning. This also applies to land-based personnel working near a shoreline (typically within 20 feet) where a fall could result in contacting the water.

- Fall protection should be provided to prevent personnel from falling into water for all work above the water.
- Inspect PFDs prior to each use. Do not use defective PFDs.
- Always have operating communication equipment (project or marine radios, cell phones, etc).
- Personnel working above, on or near the water are to never work alone. Always have a "Buddy".
- Use sampling and other equipment according to the manufacturers' instructions.

2.1.3 Survey Lasers

- Laser beams used in surveying may be hazardous to the eyes. The severity of the hazard depends on the type of laser and its power.
- Avoid direct eye contact with the beam. This is most important when wearing corrective eyeglasses, which can intensify the beam's focus on the retina.
- Lasers used in surveying are usually low power.
- Lasers must be posted with safety warning signs.

2.1.4 Aerial Lifts

Refer to following SOPS prior to beginning a task using Aerial Lifts: "Powered Industrial Trucks"; "Personal Protective Equipment"; "Lifting Devices" and "Unsafe Condition Tag-Out". Only authorized and trained personnel are permitted to operate aerial lifts and/or powered industrial trucks.

- Inspect aerial lifts and test lift controls prior to each use. The last lift may have damaged something.
- Wear a full body harness with lanyard attached to the boom or platform.
- Do not attach lanyard to any adjacent structures or equipment while working from an aerial lift.
- Stand firmly on the floor of the platform and do not sit or climb on the railings of the platform. NEVER use planks, ladders, or other devices to increase working height.
- Remain in the platform at all times and do not leave the platform to climb to adjacent structures.

- Position aerial lifts on firm, level surfaces when possible, with the brakes set. Use wheel chocks on inclines. If outriggers are provided, position on solid surfaces or cribbing.
- Maintain safe clearance distances (minimum 10 feet) between overhead power lines and any part of the aerial lift or conducting material.
- If work must occur within 10 feet, or less, of an overhead power line and/or energized device, the power lines must be de-energized, grounded and locked-out/tagged-out.
- Never exceed the boom and basket load limits.
- Never use aerial lifts as cranes, unless specifically designed and approved by the lift manufacturer.
- Never work or stand below aerial lift operations.
- Do not use aerial lifts out of doors when winds exceed 30 miles per hour.
- The Aerial Lift Inspection Form is provided in the Powered Industrial Truck SOP.

2.1.5 Cranes, Hoists, and Rigging

Refer to following SOPS prior to beginning a task using Aerial Lifts: "Powered Industrial Trucks"; "Personal Protective Equipment"; "Lifting Devices" and "Unsafe Condition Tag-Out". Only authorized and trained personnel are permitted to operate aerial lifts and/or powered industrial trucks.

Only certified crane operators and riggers are permitted to operate cranes and complete rigging. O&M, Inc. employees are expressly forbidden from operating cranes or completing rigging unless granted a variance by Senior Management.

- A crane should be kept as far as possible from overhead electrical lines or energized equipment.
- Maintain safe distance from operating cranes and stay alert of crane movement.
- Avoid positioning between fixed objects and operating cranes and crane pinch points.
- Remain outside of the crane swing and turning radius.
- Never turn your back on operating cranes.

- Approach cranes only after receiving the operator's attention. The operator shall acknowledge your presence and stop movement of the crane. Never approach operating cranes from the side or rear where the operator's vision is limited or blocked completely.
- When required to work in proximity to operating cranes, wear high-visibility vests made of reflective material or include a reflective stripe or panel to increase visibility to operators.
- Stay as clear as possible of all hoisting operations. Loads shall never be hoisted overhead of personnel.
- Cranes shall never be used to lift or lower personnel.
- If crane becomes electrically energized, personnel shall be instructed not to touch any part of the crane and to "clear" the area. Personnel should never attempt to touch any person who may be inside the crane and/or in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the crane.
- Do not exceed hoist load limits.
- Ensure load is level and stable before hoisting. Use tag lines to stabilize load during hoisting.
- Inspect all rigging equipment prior to use. Slings and cables must be labeled and inspected by a certified inspector prior to use, in accordance with OSHA requirements. Do not use defective rigging for any reason.
- Only use rigging equipment for the purpose it was designed and intended.

2.1.6 Rigging

Refer to SOP "Lifting Devices" prior to using rigging or hoists. Only properly trained riggers are to complete rigging operations. O&M, Inc. employees are expressly forbidden to complete rigging unless granted a variance by Senior Management.

- Stay clear of all hoisting operations.
- Inspect all powered equipment prior to use
- Inspect all rigging-related items (straps, wire ropes, chokers, chains, etc.) before each use. The last lift may have damaged it and rendered it unsafe for use. Do not use defective rigging for any reason.
- Loads shall never be hoisted overhead of personnel.
- Hoists shall never be used to lift or lower personnel.

- Never exceed hoist load limits.
- Ensure load is level and stable before hoisting.
- Only use rigging equipment for the purpose it was designed and intended.

2.1.7 Energized Electrical

Refer to the following SOPs prior to beginning any task involving energized lines or equipment: "Lockout/Tagout"; "Electrical Safety"; "Fire Protection"; 'Personnel Protective Equipment"; and "General Safety Rules".

- Only qualified personnel, as determined by the Project Manager, are permitted to work on unprotected energized electrical systems.
- Only authorized personnel are permitted to enter high-voltage areas.
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented.
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service. Defective equipment will be tagged and brought to the attention of the Project Manager.
- All temporary wiring, including extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
  - Equipped with third-wire grounding.
  - Covered, elevated, or protected from damage when passing through work areas.
  - Protected from pinching if routed through doorways.
  - Not fastened with staples, hung from nails, or suspended with wire.
- Electrical power tools and equipment must be effectively grounded or double-insulated UL approved.
- Operate and maintain electric power tools and equipment according to manufacturers' instructions.
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have

been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet from overhead power lines for voltages of 50 kV or less, and 10 feet plus 0.5 inch for every 1 kV over 50 kV.

- Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage.
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.
- Electrical wiring and equipment shall be de-energized in accordance with Lockout/Tagout SOPs and standard industry practices prior to conducting work.
- A variance shall be obtained from the Project Manager for situations where it can be demonstrated that de-energizing introduces additional or increased hazards or is unfeasible due to equipment design or operational limitations.
- All electrical systems shall be considered energized until lockout/tagout procedures are implemented.
- Always "double-check" to ensure power is not flowing through the line or equipment by using a voltage tester or similar device.
- The Energized Electrical Work Permit provided in the Lockout/Tagout SOP must be completed prior to working on unprotected energized electrical systems.
- Follow all control measures and procedures identified on the Energized Electrical Work Permit and all applicable SOPs, industry and OSHA practices.

2.1.8 Lockout/Tagout

Refer to the following SOPs: "Lockout/Tagout"; and "Unsafe Condition Tagout". Lockout/Tagout refers to all electrical and/or mechanically energized equipment.

- Ensure the equipment cannot "start" while work is occurring on that equipment by disconnecting battery terminals, unplugging the device from power and/or other methods recommended by the manufacturer.
- Never work on equipment when the unexpected operation could result in injury, unless lockout/tagout procedures are implemented.
- Standard lockout/tagout procedures include the following six steps:

- Notify all personnel in the affected area of the lockout/tagout,
- Shut down the equipment using normal operating controls,
- Isolate all energy sources,
- Apply individual lock and tag to each energy isolating device,
- Relieve or restrain all potentially hazardous stored or residual energy (e.g., hydraulic pressure, residual electrical charges in capacitors, etc.).
- Verify through the use of a measurement device (if possible) that isolation and de-energizing of the equipment has been accomplished. Once verified that the equipment is at the zero energy state, work may begin.

- NEVER remove another person's lock or tag. If the work extends over a shift change, and under the direct supervision of the SS, the next crew shall replace the previous crews' locks with their own, one worker at a time. Work shall not resume until the SS is confident the requirements of the SOPs have been followed and it is safe to return to work.

- All safe guards must be put back in place, all affected personnel notified that lockout/tagout has been removed, and controls positioned in the safe mode prior to lockout/tagout removal.

2.1.9 Excavation

Refer to the following SOPs prior to beginning excavation tasks: "Excavation"; and "Heavy Equipment";

- Do not enter the excavations unless necessary, and only after the competent person has completed the required inspection and has authorized entry.

- Follow all excavation entry requirements established by the competent person.

- Do not enter excavations where protective systems are damaged or unstable.

- Do not enter excavations where objects or structures above the work location may become unstable and fall into the excavation.

- Do not enter excavations with the potential for a hazardous atmosphere until the air has been tested and found to be at safe levels.

- Do not enter excavations with accumulated water unless precautions have been taken to prevent excavation cave-in.

2.1.10 Forklifts

Refer to the following SOPs prior to using a forklift: "Powered Industrial Trucks"; "Personal Protective Equipment"; and "General Safety Rules".

- Only authorized and trained personnel may operate forklifts.
- Forklifts shall be inspected by the operator prior to use.
- Complete the Forklift Inspection Form found in the Powered Industrial truck SOP
- The operator shall use a seat belt (if available).
- Only the operator may ride on the forklift. Passengers are expressly forbidden.
- No part of a load must pass over any personnel.
- Forklifts left unattended must be immobilized and secured against accidental movement and forks, buckets or other attachments must be in the lowered position or be firmly supported.
- No load may exceed the maximum rated load and loads must be handled in accordance with the height and weight restrictions on the load chart.
- When a load is in the raised position, the controls must be attended by an operator.
- If an operator does not have a clear view of the path, a signaler must be used.
- Loads must be carried as close to the ground or floor as the situation permits.
- Loads that may tip or fall must be secured.
- Where a forklift is required to enter or exit a vehicle to load or unload, the vehicle must be immobilized and secured against accidental movement.
- Forklifts shall not be used to support, raise, or lower workers.
- Forklifts operators shall wear seatbelts at all times.
- Concentrations of carbon monoxide created by forklift operation indoors, or in and near excavations, must be monitored when the

potential exists for reaching or exceeding permissible exposure limits.

- Barriers, warning signs, designated walkways or other safeguards must be provided where pedestrians are exposed to the risk of collision.

2.1.11 Scaffolds

Refer to the following SOPs prior to erecting and performing any work on scaffolds": "Fall Protection"; "Ladder Safety"; "Personal Protective Equipment"; and "General Safety Rules".

- Scaffolding must be designed and constructed by a competent person.
- Do not access scaffolds until the competent person has completed the work shift inspection and has authorized access.
- Follow all requirements established by the competent person or as identified on the scaffold tag.
- Do not access scaffolds that are damaged or unstable at any time and for any reason.
- Only access scaffolds by means of a ladder, stair tower, ladder stand, ramp, integral prefabricated scaffold access, or other equivalent safe means of access. Scaffold cross bracing shall not be used to access scaffold platforms.
- Remain within the scaffold guardrail system when provided. Leaning over or stepping across a guardrail system is not permitted.
- Use personal fall arrest systems when required by the competent person and when working from suspension scaffolds or boatswains' chairs.
- Do not stand on objects (boxes, buckets, bricks, blocks, etc.) or ladders on top of scaffold platforms to increase working height unless the platform covers the entire floor area of the room.
- Do not work on scaffolds covered with snow, ice, or other slippery material or work on scaffolds during storms or high winds unless personal fall arrest systems or wind screens are provided and the competent person determines it is safe to remain on the scaffold.

2.1.12 Welding and Cutting

Refer to the following SOPs prior to performing "Burning and Welding"; "Fire Protection"; "Eye/Face Protection"; Powered Hand Tools"; "Personal Protective Equipment"; and "General Safety rules".

- Only trained personnel are permitted to operate welding/cutting equipment.
- Do not enter areas where welding/cutting operations are taking place unless completely necessary and only after receiving permission from the welding/cutting operator.
- If you must be present in an area during welding/cutting operations, position yourself behind flash screens or wear glasses/goggles with lenses of appropriate darkness.
- Do not look directly at the welding/cutting flash or at reflective surfaces surrounding welding/cutting operations.
- Avoid contacting compressed gas cylinders. Cylinders should be properly and firmly secured in an upright position at all times.
- Be aware of tripping hazards created by welding hoses, power cables, leads, and cords positioned on walking surfaces.
- The Hot Work Permit is provided in the Burning and Welding SOP.

2.1.13 Compressed Gas Cylinders

Refer to the following SOPs: "Burning and Welding"; "Eye/Face Protection; and "General Safety Rules".

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

2.1.14 Fall Protection

Refer to the following SOP prior to beginning tasks that have fall potential: "Fall Protection", "Ladder Safety"; and "General safety Rules".

- Fall protection systems must be used to eliminate fall hazards when performing construction activities or general industry activities at a height of 4 feet or greater.
- All project personnel that may be exposed to fall hazards must review the Fall Protection SOP.
- Never use fall protection systems on which you have not been trained.
- The SS shall act as competent person and shall inspect and oversee the use of fall protection systems.
- Follow all requirements established by the competent person for the use and limitation of fall protection systems.
- Only one person shall be simultaneously attached to a vertical lifeline.
- Remain within the guardrail system when provided. Leaning over or stepping across a guardrail system is not permitted.
- Do not stand on objects (boxes, buckets, bricks, blocks, etc.) or ladders to increase working height on top of platforms protected by guardrails.
- Inspect personal fall arrest systems prior to each use. Do not use damaged fall protection systems at any time, or for any reason.
- Set up personal fall arrest systems so that you can neither free-fall more than 4 feet or contact any lower level.
- Only attach personal fall arrest systems to anchorage points capable of supporting at least 5,000 pounds.
- Use fall protection equipment for fall protection only and not to hoist materials. Do not use personal fall arrest systems that have been subjected to impact loading.

2.1.15 Earthmoving Equipment

Reference the following SOPs prior to performing earth moving related tasks: "Heavy Equipment" and "General Safety Rules".

- Only authorized personnel are permitted to operate earthmoving equipment.

- Maintain a safe distance from operating equipment and stay alert of equipment movement. Avoid positioning between fixed objects and operating equipment and equipment pinch points, remain outside of the equipment swinging and turning radius. Pay attention to backup alarms, but do not rely on them for protection. Never turn your back on operating equipment.
- Approach operating equipment only after receiving the operator's attention. The operator shall acknowledge your presence and stop movement of the equipment. Caution shall be used when standing next to idle equipment; when equipment is placed in gear it can lurch forward or backward. Never approach operating equipment from the side or rear where the operator's vision is limited or blocked.
- When required to work in proximity to operating equipment, wear high-visibility vests to increase visibility to equipment operators.
- Do not ride on earthmoving equipment unless it is specifically designed to accommodate passengers. Only ride in seats that are provided for transportation and that are equipped with seat belts.
- Unless directly involved with the work activity, stay clear of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Earthmoving equipment shall not be used to lift or lower personnel.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.

2.1.16 Hand Tools

Refer to the following SOPs prior to using hand tools: ""Eye and Face Protection"; "Powered Hand Tools"; "Hearing Protection"; "Unsafe Condition Tagout" and "General Safety Rules".

- Operate all tools according to the manufacturers' instructions, within design limitations and only to perform tasks for which they were designed.
- All hand and power tools shall be maintained in a safe condition.

- Tools are to be inspected and tested before use. If a tool is found to be defective it is to be tagged "Do Not Use" and removed from service until repaired.
- Personal protective equipment (PPE), such as gloves, safety glasses, earplugs, and face shields, are to be used when exposed to a hazard from the tool.
- Power tools are not to be carried or lowered by the cord or hose.
- Disconnect tools from energy sources when not in use, before servicing and cleaning, and when changing blades, bits, and cutters.
- Safety guards on tools are to remain installed while the tool is in use and promptly replaced after repair or maintenance has been performed.
- Tools are to be stored properly, where they will not be damaged or come in contact with hazardous materials.
- If a cordless tool is connected to its recharge unit, both pieces of equipment must conform strictly with electrical standards and manufacturer's specifications.
- Tools used in an explosive environment must be rated (e.g., intrinsically safe, spark proof, etc.) for work in that environment.
- When using a knife or blade tool, stroke or cut away from the body with a smooth motion taking care not to use excessive force that could damage tool, material being cut or unprotected hands.
- Wrenches, including adjustable, pipe, end, and socket wrenches, shall not be used when jaws are sprung to the point that slippage occurs.
- Impact tools, such as drift pins, wedges, and chisels, shall be kept free of mushroomed heads.
- The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight in the tool.
- Manual and pistol-grip hand tools may involve work with highly repetitive movement, extended elevation, constrained postures, or positioning of body members (e.g., hand, wrist, arm, shoulder, neck, etc.). Consider alternative tool design, improved posture, selection of appropriate materials, work organization, and sequencing to prevent muscular skeletal, repetitive motion, and cumulative trauma stress.

- Tools with safety devices shall be tested each day before use to see that the safety devices are in proper working condition. The method of testing shall be in accordance with the manufacturer's recommended procedure.
- Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains, or other reciprocating, rotating or moving parts of equipment shall be guarded if such parts are exposed to contact by employees or otherwise create a hazard.
- All liquid fuel-powered tools shall be stopped while being refueled, serviced, or maintained.

2.2 General Hazards

2.2.1 Housekeeping

Refer to the "Housekeeping" SOP.

- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness requires sufficient illumination intensity to read a newspaper without difficulty.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces. Spill kits and fire

extinguishers will be maintained in fuel storage areas and fueling stations.

2.2.2 Hazard Communication

Refer to the following SOPs: "Hazard Communication Program"; "Materials Handling Program"; "General Safety Rules"; "Personal Protective Equipment "; "Respiratory Protection";

The SS is to perform the following:

- Complete an inventory of chemicals brought onsite by O&M, Inc. using Attachment A in the Hazard Communications SOP.
- Confirm that an inventory of chemicals, and their MSDS', brought onsite by subcontractors is available.
- O&M, Inc. shall obtain material safety data sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which O&M, Inc. employees and subcontractors potentially are exposed.
- Before or as the chemicals arrive onsite, obtain an MSDS for each hazardous chemical and retain a copy with the HSP onsite.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give the employee's necessary chemical-specific HAZCOM training.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

2.2.3 Shipping and Transportation of Chemical Products

Refer to the appropriate regulations found in the US Department of Transportation (USDOT) 49 CFR Parts 100-185. In the event wastes are being shipped off-site, the following regulations may be applicable: US Environmental Protection agency regulations (USEPA) that pertain to Resource Conservation and Recovery Act (RCRA) 40 CFR Parts 256,261, 262 and the Toxic Substances Control Act (TSCA) 40 CFR 700-789.

- Any person who offers hazardous materials for transportation must label the package or container
- Chemicals brought to the site might be defined as hazardous materials by the USDOT.
- All staff who ship the materials or transport them by road must receive appropriate training in shipping dangerous goods.

- All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, manifested and documented by authorized staff.
- Contact the SS, or the Project Manager for additional information.

2.2.4 Lifting

Refer to the following SOPs prior to beginning a lifting related task: 'Lifting and Carrying"; and "General Safety Rules".

- Proper lifting techniques must be used when lifting any object.
  - Plan storage and staging to minimize lifting or carrying distances.
  - Get assistance when moving any materials weighing greater than 50 pounds.
  - Split heavy loads into smaller loads.
  - Use mechanical lifting aids whenever possible.
  - Have someone assist with the lift, regardless of weight, for any awkward loads.
  - Make sure the path of travel is clear prior to the lift.

2.2.5 Fire Prevention

Refer to the following SOPs: "Fire Protection"; "Housekeeping"; and "Burning and Welding".

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
  - Be maintained in a fully charged and operable condition,
    Be of the proper type to extinguish a potential fire form the material used, stored, or encountered,
  - Be visually inspected each month, and
  - Undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet from any building.

- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.
- Obtain a Hot Work Permit prior to any activity involving welding, cutting, grinding, or similar, activities.

2.2.6 Ladders

Refer to the following SOPs prior to using a ladder in a task: "Ladders"; "Unsafe Condition Tag Out"; and General Safety Rules".

- Ladders must be inspected by a competent person for visible defects prior to each day's use.
- Defective ladders must be tagged-out and removed from service.
- Ladders must be used only for the purpose for which they were designed and shall not be loaded beyond their rated capacity.
- Only one person at a time shall climb on, or work from, an individual ladder.
- User must face the ladder when climbing up and down; keep belt buckle between side rails.
- Ladders shall not be moved, shifted, or extended while in use.
- User must use both hands to climb; use rope to raise and lower equipment and materials.
- Straight and extension ladders must be placed on a firm surface, secured to prevent the base from slipping and secured at the top.
- Ladders that may be displaced by work activities or traffic must be secured or barricaded.
- Portable ladders must extend at least 3 feet above landing surface.
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder.
- Stepladders are to be used in the fully opened and locked position.
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top or straddle a stepladder.
- Fixed ladders $\geq$ 24 feet in height must be provided with fall protection devices.

- Fall protection should be considered when working from extension, straight, or fixed ladders greater than six feet from lower levels and both hands are needed to perform the work, or when reaching or working outside of the plane of ladder side rails.

2.2.7 Heat Stress

Refer to the "Heat Stress" SOP.

- Stay hydrated. Disposable cups and water maintained at 50 to 60°F should be available. Under severe heat conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day.
- Never use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (i.e., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSO to avoid progression of heat-related illness.

SYMPTOMS AND TREATMENT OF HEAT STRESS					
	Heat Syncope	**Heat Rash**	**Heat Cramps**	**Heat Exhaustion**	**Heat Stroke**
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool— but not cold—water. Call ambulance, and get medical attention immediately!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (greater than 50 percent), or when workers exhibit symptoms of heat stress. The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next

rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

2.2.8 Cold Stress

Refer to the "Cold Temperature Work" SOP.

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather.
- Personnel who are required to work outside must have their own cold weather apparel and are required to have this apparel with them at the project site during the cold weather months.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines such as the wind-chill index.
- Wind-chill index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a general guideline to warn workers of situations that could cause cold-related illnesses.
- Observe one another for initial signs of cold-related disorders. Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SS and/or Safety Officer and seek proper treatment to avoid progression of cold-related illness.
- Review the weather forecast—be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

SYMPTOMS AND TREATMENT OF COLD STRESS			
	Immersion (Trench)Foot	**Frostbite**	**Hypothermia**
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm	Remove victim to a warm place. Have

		area quickly in warm – but not hot – water. Have victim drink warm fluids, but not coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	victim drink warm fluids, but not coffee or alcohol. Get medical attention.

2.2.9 Procedures for Locating Buried Utilities

Local Utility Mark-Out Service

Name: Dig Safe
Phone: 1-888-344-7233

Underground Utilities

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities has been conducted by the local utility clearance company and the SS issues his approval to proceed.

- Use as-built drawings and utility company records, if available, as sources of identifying the general locations of utilities.
- Underground utility locations must be physically verified by hand digging using wood or fiberglass-handled tools when any excavation or drilling work is expected to come within 5 feet of the marked underground system.
- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the SS must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Conduct a detailed site briefing about the utilities, their hazards, and the means by which the operation will maintain a safe working environment.
- Always watch for signs of subsurface utilities during drilling and/or excavation work.

2.2.10 Confined Space Entry

Refer to the "Confined Space Entry" SOP. Refer to additional SOPs applicable to the work and environment of the planned task.

The following requirements must be met prior to confined space entry:

- Confined space entrants, attendants, and entry supervisors must complete the Confined Space Entry training.
- A Confined Space Entry Permit (CSEP) must be completed and posted near the space entrance point for review.
- Each confined space entrant and attendant must attend a pre-entry briefing conducted by the entry supervisor and Site Safety Officer.
- Each confined space entrant and attendant must verify that the entry supervisor has authorized entry and that all permit or certificate requirements have been satisfied.
- Only individuals listed on the Authorization/Accountability Log are permitted to enter the space.
- Each confined space entrant and attendant must verify that atmospheric monitoring has been conducted at the frequency specified on the permit or certificate and that monitoring results are documented and within acceptable safe levels.

The following requirements must be met during confined space entry:

- Communication must be maintained between the attendant and entrants to enable the attendant to monitor entrant status.
- Entrants must use equipment specified on the permit or certificate accordingly.
- All permit or certificate requirements must be followed.
- Entrants must evacuate the space upon orders of the attendant or entry supervisor, when an alarm is sounded, or when a prohibited condition or dangerous situation is recognized.
- Entrants and attendants must inform the entry supervisor of any hazards confronted or created in the space or any problems encountered during entry.

2.2.11 Vehicle Safety—Operator Safety

- Operate vehicle only when in possession of valid driver's license.
- Employees shall not operate vehicles while under the influence of drugs or alcohol. Consumption of drugs or alcoholic beverages

before or during work shift/driving is prohibited, as is possession of them within vehicle.

- All vehicle occupants must use seat belts at all times. Familiarize yourself with rental vehicle features (e.g., mirror & seat adjustments).
- Adjust headrest to proper position.
- Always drive within the speed limit.
- Do not drive if you are fatigued.
- Tie down loose items when driving a pickup, truck or van.
- Exercise caution when exiting traveled way or parking along street—avoid sudden stops, use flashers when stopping at work areas.
- Park in a manner that will allow for safe exit from vehicle, and where practicable, park vehicle so the vehicle can pull forward to leave the parking space.
- Pull off the road, and put the car in park before talking on a mobile phone.
- Maintain both a First Aid kit and Fire Extinguisher in the field vehicle at all times.

2.2.12 Working/Walking Adjacent to Vehicle Traffic

- When possible, walk along edge of parking lots and roads, or in designated pedestrian ways.
- Work as far from traveled way as possible to avoid creating confusion for drivers.
- Remain aware of factors that influence traffic related hazards and required controls—sun glare, rain, wind, flash flooding, limited sight-distance, hills, curves, guardrails, width of shoulder etc.
- Always remain aware of an escape route—behind an established barrier, parked vehicle, guardrail, etc.
- Always pay attention to moving traffic—never assume drivers see you.
- Remain aware of approaching traffic for signs of erratic driver behavior.

- Obtain the proper traffic control devices to ensure that they are adequate to protect your work area. Traffic control devices should: (1) convey a clear meaning/warning, (2) be understood by the typical driver, and (3) be placed to give drivers adequate time for proper response.

2.2.13 Vehicles Entering/Exiting Site

- If heavy equipment must be backed into the site, a flagman/spotter must be used.
- If vehicle will impede (is slow-moving) the normal flow of traffic when pulling into/out of the site, a flagger must also be used. Once the vehicle is on the road way, a field vehicle equipped with flashing lights will follow the heavy equipment vehicle.
- It is imperative that truck operations do not pose a traffic hazard to pedestrians and normal road traffic.

2.2.14 Uneven Walking/Working Surfaces

- Employees walking in ditches, swales and other drainage structures adjacent to roads or across undeveloped land must use caution to prevent slips and falls, which can result in twisted or sprained ankles, knees, and backs.
- Whenever possible, work or observe from a flat surface and do not enter a steep ditch or side of a steep road bed.
- If steep terrain must be negotiated, sturdy shoes or boots with good traction that provide ankle support should be used.

2.2.15 Slips, Trips, and Falls

Refer to the following SOPs: "General Safety Rules"; "Housekeeping" and any additional SOPs specifically related to the planned task. Sprained and strained joints can require a long recovery period.

- Institute and maintain good housekeeping practices at all times.
- Pick up tools, remove debris and eliminate tripping hazards in the work area.
- Place extension cords, air lines, ropes, etc., under a barricade to eliminate tripping hazards.
- Walk or climb only on equipment and/or surfaces specifically designed for personnel access.
- Watch for slippery/poor footing and other potential slipping and tripping hazards in the work area that could result in a fall or serious injury.

2.2.16 Pressure Washing Operations

Refer to the following SOPs: "Eye and Face Protection"; "Hearing Protection"; "Personal Protective Equipment"; and "General Safety Rules"

- Wear appropriate personal protective equipment when operating a pressure washer that includes a face shield, hearing protection, gloves and other protective clothing.
- Follow manufacturer's safety and operating instructions.
- Use extended pressure wash wands to minimize contact with overspray.
- Inspect pressure washer before use and confirm deadman switch is fully operational.
- NEVER wash your hands, boots or other items with a pressure washer.

2.2.17 Vacuum Truck Operations

Refer to the following SOPs: "Eye and Face Protection"; "Hearing Protection"; "Fire Prevention"; "Personal Protective Equipment"; and "Powered Industrial Trucks".

- Qualified subcontractors are the only personnel authorized to operate a vacuum truck.
- Locate the observers upwind of the tank or container being emptied.
- Keep hands from vacuum hose inlet.
- Wear protective gloves and hearing protection in the immediate vicinity.

2.2.18 Inclement Weather

Adverse weather conditions and work situations requiring immediate suspension of field work activities are defined in the following list:

- Any observable thunder or lightning means stop work and immediately go to shelter. Remember, if you can hear thunder you can be struck by lightning.
- Use thunderstorm watches or warnings issued by the National Weather Service as an alert to potential electric activity.
- Typically, when thunder and/or lightning are observed, a 30-minute stand-down occurs to allow the storm cell to pass the area.

- If lightning or thunder is observed within the stand down period, the 30-minute time frame is extended until electrical activity ceases.
- The Site personnel can monitor multiple sources to track developing potential for lightning. These are the following:
  - Doppler radar reports from the Internet
  - National Weather Service radio reports
- Field crews are to immediately report any observations of lightning or thunder in their area to the SSO.
- Cease high profile work when sustained wind speeds of 25 mph or wind gusts of 35 mph are observed and where wind chill is not a factor, i.e., greater than 60°F.
- Cease all other land-based work when sustained wind speeds of 40 mph or wind gusts of 45 mph are observed.
- Cease hoisting operations during moderate to heavy rain and/or snow fall events. Freezing rain is also cause for suspension of hoist use.
- An equivalent wind chill factor of -24°F on the wind chill factor chart (below) will trigger systematic shut down of all non-emergency work activities.
- A tornado warning for the general area or county will result in a site work stoppage. Move immediately to a proper shelter until the threat has passed and the SS informs you it is safe to return.

Wind Chill Chart

Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T = Air Temperature (°F) V = Wind Speed (mph)

Effective 11/01/01

2.3 Radiological Hazards and Controls

To date, radiological levels are within background levels and do not present a problem.

2.4 Biological Hazards and Controls

2.4.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

2.4.2 Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

2.4.3 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to ¼-inch in size. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bull's-eye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

2.4.4 Wasps, Bees and Other Stinging Insects

Wasps, Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum.

- Carry a "Sting Kit "if you have had allergic reactions in the past and immediately seek help if you are stung. In severe allergic reaction cases, the time from
- Inform the SSO if you are allergic to wasp and bee stings.
- If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice.
- If you have never experienced an allergic reaction to a sting, do not assume you will not have one. Watch the sting area for an allergic reaction (excessive swelling, difficult breathing, light headed, etc). Inform your supervisor and seek medical attention if a reaction develops.

2.4.5 Blood Borne Pathogens

Refer to the following SOPs: "Exposure Control Plan for Blood Borne Pathogens"; and "Personal Protective Equipment".

Exposure to blood borne pathogens may occur when rendering first aid to a co-worker who has been injured and bleeding and/or through giving CPR. Exposure controls and personal protective equipment (PPE) are required as specified in the SOP.

Individuals who know they have an easily communicable disease shall discuss this condition, and the work they are expected to perform, with their medical professional. These individuals must have specific written permission from their medical professional before reporting to the site to work. Hepatitis B vaccination must be offered to each employee before the person participates in a task where exposure is a possibility.

2.4.6 Mosquitoes and West Nile Virus

Human illness from West Nile virus is rare, even in areas where the virus has been reported. On rare occasions, West Nile virus infection can result in a severe and sometimes fatal illness known as West Nile encephalitis (an inflammation of the brain). The risk of severe disease is higher for persons 50 years of age and older.

Most infections of West Nile encephalitis are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high

fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and rarely, death. The incubation period in humans (i.e., time from infection to onset of disease symptoms) for West Nile encephalitis is usually 3 to 15 days. If symptoms occur, see your doctor immediately.

You can reduce your chances of becoming ill by protecting yourself from mosquito bites. To avoid mosquito bites:

- Apply insect repellent containing DEET (N, N-diethyl-meta-toluamide) when you're outdoors. Apply sparingly to exposed skin. DEET in high concentrations (greater than 35 percent) provides no additional protection.
- Spray clothing with repellents containing permethrin/DEET since mosquitoes may bite through clothing.
- Read and follow the product directions whenever you use insect repellent, particularly if they contain permethrin.
- Wear long-sleeved clothes and long pants treated with repellent and stay indoors during peak mosquito feeding hours (dusk until dawn) to further reduce your risk.

2.5 Contaminants of Concern

Refer to the following SOPs: "Personal Protective Equipment"; "Hazard Communication Program"; "Materials Handling Program"; and "General Safety Rules".

Volatile organic compounds (1, 1-dichloroethene, 1, 1-dichloroethane, 1, 2-dichloroethane, 1, 2-dichloropropane, benzene, methyl tert butyl ether, methylene chloride, trichloroethene, vinyl chloride, and 1, 4-dioxane), and arsenic.

Workers who have the potential to be in direct contract with the ground water will be provided PPE in accordance with the referenced SOPs.

2.6 Potential Routes of Exposure

Refer to the following SOPs: 'Personal Protective Equipment"; "Respiratory Protection"; "Materials Handling"; and "General Safety Rules".

The following are the primary routes of exposure:

- **Dermal:** Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in the SOP.
- **Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring.

- **Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3.0 PROACTIVE HEALTH & SAFETY PROGRAM

O&M, Inc. will use a proactive approach to health and safety. Personnel are expected to actively participate in the H&S program by ensuring they have the proper PPE, tools and training prior to beginning a task and also by watch for unsafe conditions while they are working.

Everyone has the authority to temporarily stop work on a task when they observe a situation that could result in injury to themselves, co-workers, equipment and/or property. When an unsafe situation exists, stop the activity and point out the problem. You are then expected to assist your co-workers in correcting the problem and then to notify the SSO, and Project Manager. Inform the person you contacted what occurred, and how it was corrected. Further inform them if there is a potential for the problem to reoccur.

A proactive health and safety systems uses "tools" which allows all the workers to participate in the process. The basic loss prevention tools that will be used on this project to implement a proactive approach to health and safety on this project include:

- Pre-Task Safety Meeting
- Loss and Near Loss Investigations

3.1 Daily Pre-Task Safety Meeting

Daily safety meetings (also known as "Tailgate Safety Meeting") are brief safety and work orientation meetings held at the beginning of each shift. All project personnel are required to be in attendance, to review the applicable and required health and safety procedures, and to discuss any other important information regarding the task to be accomplished.

Typically, the safety meetings are held between the crew supervisor and their work crews to focus on those tasks assigned, procedures to be followed and the hazards posed to individual work crews. Usually each major work area will hold its own safety meeting. If the need arises to hold a site-wide safety meeting, the crew supervisors will be informed of the meeting location and to direct their personnel to meeting. All site personnel are required to sign a safety meeting attendance form every day.

3.2 Incident Investigations

Incident Investigations shall be performed for the all O&M, Inc. incidents involving:

- Person injuries/illnesses
- Equipment/property damage
- Spills, regulatory violations

- Motor vehicle accidents

The cause of incidents are similar, so by identifying and correcting the causes of near loss causes, future loss incidents may be prevented. The following is the Incident Investigation Process:

- Gather all relevant facts, focusing on fact-finding, not fault-finding, while answering the "who, what, when, where and how" questions.
- Draw conclusions supported by the facts (not opinions), pitting those facts together into a probable scenario.
- Determine incident root cause(s), which are basic causes on why an unsafe act/condition existed.
- Develop and implement solutions, matching all identified root causes with solutions.
- Filed follow-up on implemented corrective active action to confirm solution is appropriate.

The Project Manager shall perform an investigation, as soon as practical after incident occurrence during the day of the incident, for Incidents that occur on the project. A preliminary report shall be submitted to the Project Manager within 24 hours of when the incident occurs.

4.0 Project Organization and Personnel

4.1 O&M, Inc. Project Personnel

The following personnel have been assigned to the W. R. Grace Site in the following capacity:

Employee Name	Office	Responsibility	Mobile Phone Number
David Fuerst	O&M, Inc.	Project Manager	865-804-6314
Anton Plaines	O&M, Inc.	Project Engineer	727-743-2829
Valerie Rule	de maximis, inc.	Corporate Safety Officer	865-691-6254
James Remotti	O&M, Inc.	SSO/Technician	860-883-3798
Jim Champa	O&M, Inc.	Assistant SSO/Technician	860-614-4690

4.1.1 O&M, Inc. Employee Responsibilities

The site workers are to be compliant with state and federal hazardous waste operations requirements for hazardous Waster Operations

(HAZWOPER). This would include, but not be limited to, 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Employees designated "Supervisor" will have completed the required training, and have documented requisite field experience. All workers who are currently certified by the American Red Cross, or equivalent, in First Aid and CPR (FA-CPR) are requested to provide a copy of their training to their supervisor. A list of FA-CPR trained personnel will be posted in each treatment building.

At least one FA-CPR designated employee must be present during tasks performed in exclusion or decontamination zones.

Pregnant females are required to inform the Project Manager. Additionally, these workers must obtain a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Each worker is responsible for the following performance objectives:

- During any task, employees must consider the possible effects of their actions on themselves and others and take appropriate protective measures.
- Complete a health and safety orientation prior to being authorized to enter the project work areas
- Employees are required to review, be familiar with, and adhere to site-specific jobsite health and safety plans, procedures, practices, precautions, and permits.
- Use only safe means of access to and from work areas.
- Perform work in a safe manner and produce quality results; complete work without injury, illness, or property damage. Report to your supervisor any observed defects beyond your ability to repair.
- Use the right tool or equipment for the job.
- All disruptive activities, such as horseplay, practical jokes, etc., are forbidden.
- Practice good housekeeping and keep your work area clear of debris and extra tools. At the end of each phase of work, return all tools and excess material to proper storage areas. Clean up all debris as work progresses. Each employee is responsible for keeping their work areas clean.

- The employee is responsible for wearing appropriate personal protective equipment in operations where there is exposure to hazardous conditions, or where need is indicated to reduce hazards. Hard hats, safety shoes, high-visibility safety vests and safety glasses will be worn at all times within designated work areas on-site.

- Hearing protection will be worn in when sound levels may exceed 85 decibels. A practical test to determine if hearing protection is needed is if you cannot easily hear a person speaking to you in a normal conversational voice from 2 feet away then you need to use hearing protection.

4.1.2 Progressive Discipline Policy

All O&M, Inc. individuals associated with this project must work in an injury-free and drug-free environment. All personnel must comply with the project HSP, O&M, Inc. policies and procedures, any project-specific safety requirements.

Safety Infractions

Any noncompliance with the project HSP procedures and other project-specific safety requirements will be considered safety infractions. These will include, but will not be limited to:

- Violation of established safety rules, regulations, codes or other requirements.
- Poor housekeeping.
- Failure to report on-the-job injuries or unsafe conditions, and
- Failure to wear the appropriate personal protective equipment.

Intolerable Offenses

Intolerable offenses and actions will include, but will not be limited to, the following:

- Any manager, supervisor, foreman or other person in charge of the work being performed who requires, requests, asks, threatens with their job, allows, or condones employees to work in or around unsafe acts or conditions

- Any employee, supervisor, or manager who knowingly falsifies any investigative documents or testimony involving an investigation

- Any employee, supervisor, or manager who openly exhibits disregard, defiance, or disrespect for the safety program

- Any employee, supervisor, or manager who engages in a physical altercation (fight) and or who engages in physical or emotional intimidation of co-workers.

- Any supervisor, foreman or manager who fails to keep sufficient and accurate records of their work activities, materials handled and used and/or related process data. Your records must show what activities occurred, equipment being used, processes the crew were operating, problems encountered, etc., in the event of an incident, accident or illness.
- Any employee who violates established safety rules, regulations, or codes that endanger themselves or other employees.
- Any employee, supervisor, or manager failing to comply with the Project Manager, or any and all federal, state, or local safety laws and regulations that creates the potential for serious or costly consequences.
- Any employee who commits repeated minor offenses and shows a lack of responsible effort to correct these offenses.

Enforcement and Discipline

This policy will be thoroughly reviewed with each employee during the employee health and safety orientation. All personnel will indicate their review of the Project Manager and project rules by signing the employee signoff form.

Safety Infractions

Safety infractions will be handled as follows:

- First Offense—Employee will receive a verbal warning.
- Second Offense—Employee will receive a written warning and a 2-day suspension without pay.
- Third Offense—Employee will be discharged.

Intolerable Offenses

This project will practice zero tolerance for intolerable offenses. Those individuals found participating in such offenses will be:

- Receive a written warning containing conditions for returning to work along with being suspended from work for 3 days without pay, or
- Immediately discharged and not allowed to return

4.1.3 Drug-Free Workplace

O&M, Inc. does not tolerate illegal drugs, or any use of drugs, controlled substances, or alcohol that impairs an employees work performance or behavior. O&M, Inc. employees shall not be involved in any manner with the unlawful manufacture, distribution, dispensation, possession, sale, or use

of illegal drugs in the workplace. Any violation of these prohibitions may result in discipline or immediate discharge. All employees will be subject to post-incident testing in the event of an accident and/or injury requiring medical attention.

4.2 Field Team Chain of Command and Communication Procedures

4.2.1 Project Manager

Project Manager (PM)
David Fuerst
Phone: 865-691-6254
Cell Phone: 865-804-6314

The Project Manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of the H&S process. The PM has overall management responsibility for the project. The PM may explicitly delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this document:

- Incorporate standard terms and conditions, and contract-specific roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors).
- Select safe and competent subcontractors.
- Obtain, review, and accept or reject subcontractor pre-qualification questionnaires.
- Ensure that acceptable certificates of insurance, including O&M, Inc. as named additional insured, are secured as a condition of subcontract award.

Incorporate H&S information in subcontract agreements, and ensure that appropriate site-specific safety procedures, training, and medical monitoring records are reviewed and accepted prior to the start of subcontractor's field operations.

- Maintain copies of subcontracts and subcontractor certificates of insurance, bond, contractor's license, training and medical monitoring records, and site-specific safety procedures in the project file accessible to site personnel.
- Provide oversight of subcontractor practices per the site-specific safety plan.
- Manage the site and interface with third parties in a manner consistent with contract and subcontract agreements.

- Ensure that the overall, job-specific, H&S goals are fully and continuously implemented.

4.2.2 Corporate Health and Safety Officer

Valerie Rule
Phone: 865-691-5052 or cell 865-388-5425

The Corporate HS&E manager is responsible for the following:

- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor's field operations.
- Assist with program implementation as needed.
- Provide technical support.
- Conduct H&S audits.

4.2.3 Site Safety Officers/Technicians

James Remotti
Phone (cell): 860-883-3798

Jim Champa
Phone (cell): 860-614-4690

The SSO/Technicians are responsible for the following:

- Verify that the project is conducted in a safe manner.
- Verify that the HSP is current and amended when project activities or conditions change.
- Verify team members and subcontractors read the HSP and sign the Employee Signoff Form, prior to commencing field activities.
- Verify and document team members have completed any required specialty training (e.g., fall protection, confined space entry) and medical surveillance.
- Verify compliance with the requirements of the HSP and applicable subcontractor health and safety plan(s).
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in the HSP.
- Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in the HSP.

- Verify that safety meetings are conducted and documented in the project file as needed throughout the course of the project (e.g., as tasks or hazards change).
- Verify that project health and safety forms and permits are being used as outlined in the HSP.
- Implement Drug-Free Workplace Policy.
- Ensure that programs are effectively functioning to prevent and control hazards on the project.

4.2.4 O&M, Inc. Subcontractors

Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to O&M, Inc. for our records before the start of field work. Subcontractors must comply with the minimum standard established by this HSP.

O&M, Inc.'s oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s) and applicable federal and state safety regulations.

O&M, Inc. personnel should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. O&M, Inc. is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SSO is responsible for confirming, via observation, subcontractor compliance the subcontractor's safety plan and applicable practices defined in this HSP.

Health and safety related communications with O&M, Inc. subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form.
- Request subcontractor(s) to brief the project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action. The subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.

- When an apparent imminent danger exists, immediately remove all affected employees and subcontractors. Notify subcontractor's safety representative, and stop affected work until adequate corrective measures are implemented. Notify the SSO and/or, Project Manager as appropriate.
- Document all significant verbal health and safety related communications in project field logbook, daily reports, or other records.

5.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Refer to the following SOPs: "Personal Protective Equipment"; "Respiratory Protection"; and "General Safety Rules".

PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
General site entry Surveying Observation of material loading for offsite disposal Oversight of remediation and construction Construction-related activities Work activities adjacent to/over water	D	Work clothes – no shorts; ANSI Z41–approved work boots; work glove and leather work gloves for handling metal, loading/unloading equipment, and any sharp objects. Personal Flotation Device (PFD)	ANSI Z89 -approved Hardhat [c] ANSI Z87 – approved Safety glasses with side shields Hearing protection [d]	None required
Ground water treatment without contact with media	D	Work clothes – no shorts; ANSI Z41–approved work boots; work glove.	ANSI Z89 -approved Hardhat [c] ANSI Z87 – approved Safety glasses with side shields Hearing protection [d]	None required
Ground water treatment with contact with media	Modified D	**Body**: Proshield-2 Tyvek® coveralls or similar (must protect for PCB contact hazard) and non-slip protective (steel toe) footwear or rubber steel-toe	ANSI Z89 -approved Hardhat [c] ANSI Z87 – approved Safety glasses with side shields	None required

	over boots **Gloves:** Surgical-style nitrile gloves and or nitrile gloves. Leather gloves over nitrile surgical gloves for handling equipment.	Face Shield – required for decontamination of equipment and any "aggressive" work operations where employee may be splashed in the face) Hearing protection [d]

Reasons for Upgrading or Downgrading Level of Protection

Upgrade	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Action levels are exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decrease the hazard. • Change in work task that will reduce contact with hazardous materials.

a Modifications are as indicated. O&M, Inc. will provide PPE only to O&M, Inc. employees.
b No facial hair that would interfere with respirator fit is permitted.
c Hardhat and splash-shield areas are to be determined by the SSO.
d Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.
e Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the SSO.

6.0 H&S MONITORING AND SAMPLING

Real-time worker safety air monitoring and sampling is not anticipated to be required during this project. However, should the need arise due to unforeseen events, the appropriate air sampling parameters will be identified, a supplement to this HSP prepared, and a monitoring plan will be implemented.

7.0 DECONTAMINATION

Decontamination is not anticipated to be required.

8.0 SITE-CONTROL PLAN

8.1 Site-Control Procedures

Refer to the following SOPs: "Safety Meeting Program"; "Hazard Communication Program"; and "General Safety Rules".

- The SSO will conduct a site safety briefing with personnel before each new field activity and/or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SSO records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with OSHA requirements.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio and/or cellular telephone
- Establish offsite communication.
- Establish and maintain the "buddy system."
- The SSO is to conduct periodic inspections of work practices to determine the effectiveness of this plan. Deficiencies are to be recorded in the logbooks, discussed with the activity supervisor and appropriate corrections implemented.

8.2 Hazwoper Compliance

Refer to the following SOPs: "Hazard Communication Program"; "Personal Protective Equipment".

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Potentially, Hazwoper tasks might occur consecutively or concurrently with respect to non-Hazwoper tasks. Non-Hazwoper-trained personnel (typically office support staff) must be trained in accordance with applicable state and federal OSHA requirements.

- In certain occurrences (e.g., chemical or fuel spill) , air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors in the work area before non-Hazwoper-trained personnel are allowed on the site and/or while non-Hazwoper-trained staff is working in proximity to Hazwoper activities. Other data may be required to document that there is no potential for exposure. The Project Manager must approve the interpretation of these data.
- When non-Hazwoper-trained personnel are at risk of exposure, the SSO must post the exclusion zone and inform non-Hazwoper-trained personnel of the following:

- Nature of the existing contamination and its locations
- Limitations of their access
- Emergency action plan for the site

- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.

9.0 EMERGENCY PLAN

This section outlines the Plan to be followed in case of a site-wide emergency.

9.1 Pre-Emergency Planning

The SSO performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with onsite parties, and local emergency service providers (as appropriate).

- Review the facility emergency assembly locations for each major operational area.
- Determine what onsite communication equipment is available (e.g., two-way radio, cell phones).
- Determine what offsite communication equipment is needed and its location (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Treatment buildings: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Establish a clear and simple protocol to communicate if or when, there is an emergency (e.g., shouting "Mayday at WTP" on the radio).
- Inform emergency room supervisors and the chief of the local emergency response team(s) that site work has resumed ambulance access points and the potential types of site emergencies.
- Check site emergency equipment, supplies, and potable water are present and/or functional.
- Communicate emergency procedures to the workers for personnel injury, exposures, fires, explosions, and releases.

- Supervisors are to rehearse the emergency response plan before site activities begin, including a "practice run" by driving the route to the hospital.
- Brief new workers on the emergency response plan.
- The SSO will evaluate emergency response actions and initiate appropriate follow-up actions.
- Throughout the project, review changes in site conditions, onsite operations, and personnel in relation to emergency response procedures.

9.1.1 Site Communications

- Post emergency numbers near the Site telephones and in all field vehicles.
- Ensure that personnel work under the use of a "buddy" system.
- Furnish selected personnel (typically supervisors) with two-way radios.
- Each major subcontractor shall assign a person who shall report directly to the O&M, Inc. Safety Officer. This person shall be responsible for keeping safety equipment and facilities clean and properly equipped and maintained for their personnel and for their subcontractors. This person may, most likely, perform other duties for the contractor, but the first priority shall be maintenance of protective equipment and the personnel decontamination area.

9.2 Emergency Equipment and Supplies

The locations of emergency equipment will me marked on the site map.

Emergency Equipment and Supplies	Location
Two 20-lb fire extinguishers (ABC type dry chemical)	Each treatment building
First aid kits	Each treatment building
Portable Emergency Eye Wash	Each treatment building
Hand held emergency Air Horns	SSO/Technician
Blood borne-pathogen kit	Each treatment building

9.3 Incident Response

In fires, explosions, or major chemical releases (spills), actions to be taken include the following:

- Shut down operations and evacuate the immediate work area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

9.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents.

Injuries and illnesses (including overexposure to chemicals or fuels) must be reported to the SSO and Project Manager. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the SSO and Project Manager.

- If appropriate, notify emergency response authorities:
- Police/Fire/Ambulance - 911
- Police (Routine) 978-264-9638
- The SSO, and/or Project Manager will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Secure the cause of the injury, if possible, to prevent further injury and/or injury to others. REMEMBER: lifesaving, first aid and/or medical treatment take priority over everything else.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where appropriate and feasible.
- Make certain that the injured person is accompanied to the emergency room, preferably by his/her crew supervisor
- When communicating the emergency medical professional, state your name and telephone number, the name of the injured person, the extent of the injury or exposure (if known), what caused the injury (if known) and the on-site location where the injury occurred.
- Report incident as outlined in this HSP.

9.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are required for each major operational.

- Evacuation route(s) and assembly area(s) will be designated by the SS based on information form the various crew supervisors before work begins. These routes and areas will be posted at each major operational area.
- Immediately upon hearing the emergency signal for evacuation, all personnel will shut down their equipment (if any) and assemble at the pre-determined location for their operational area.
- The SSO is to confirm all of their personnel are present and accounted for in their assembly area before performing any other task.
- The SSO, Project Manager and/or a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- A designated person will account for personnel at alternate assembly area(s), (if any established).
- The SSO, Project Manager will document the incident as soon as possible after it occurs and submit a report to the Project Manager.

9.6 Evacuation Signals

Non-verbal signals are often necessary to communicate in emergency situations. The project will use the signal methods listed in this table during evacuations.

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

9.7 Incident Notification and Reporting

- All personnel are to immediately notify their Project Manager in the event of an incident, serious illness, fire, spill, accident, injury, or loss.
- For O&M, Inc. work-related injuries or illnesses, the injury/illness report must be completed within 24 hours of incident.
- Notify and submit reports to client as required.

DIRECTIONS:
To: HOSPITAL
157 Union Street
Marlborough, MA 01752

FROM: 50 INDEPENDENCE ROAD, ACTON, MA

A	50 Independence Rd, Acton, Middlesex, Massachusetts 01720	
	1. Head **southwest** on **Independence Rd** toward **Assabet Crossing**	go 0.2 mi total 0.2 mi
	2. Continue onto **Parker St** About 2 mins	go 0.7 mi total 1.0 mi
	3. Continue onto **Concord St** About 4 mins	go 0.9 mi total 1.9 mi
↱	4. Slight **right** at **Summer St** About 2 mins	go 1.1 mi total 2.9 mi
	5. Continue onto **Pompicitticutt St**	go 0.4 mi total 3.3 mi
117	6. Turn **right** at **Great Rd/MA-117 W/MA-62 W** About 2 mins	go 1.1 mi total 4.4 mi
62	7. Turn **left** at **Gleasondale Rd/MA-62 W** Continue to follow MA-62 W About 7 mins	go 3.7 mi total 8.2 mi
62	8. Turn **right** at **MA-62 W/Main St** About 3 mins	go 1.6 mi total 9.7 mi
85	9. At the traffic circle, take the 3rd exit onto **MA-85 S/Washington St** Continue to follow MA-85 S About 5 mins	go 3.0 mi total 12.7 mi
↱	10. Turn **right** at **Union St** Destination will be on the right About 1 min	go 0.3 mi total 13.0 mi
B	157 Union St, Marlborough, MA 01752	

10.0 SECURITY PLAN:

The purpose of this security plan is to provide security and facilities to protect the work sites from unauthorized entry, vandalism, and theft. A security program will be initiated at the time of resumption of major site activities and will be maintained throughout operation of the facility.

10.1 Security Components and Required Actions

- No trespassing signs will be posted as appropriate.
- Allow entrance only to authorized persons/vehicles with proper identification.
- Maintain a log of workers and visitors. Include date, name, address, company employed by, company/person visited, time in and time out for each person, and record of deliveries and security incidents.
- Do not allow cameras on the work site or photographs to be taken except with prior written approval of O&M, Inc.

- If unauthorized personnel are observed on the site, notify the Site Supervisor. Request the supervisor contact the appropriate law enforcement officials if the situation requires assistance or legal action.
- Visitors to the work site will always be escorted and will be required to adhere to the requirements of the HSP.

10.2 Entrance and Traffic Control Procedures

- Access to the work areas will be denied for persons who do not have proper identification and training.
- Each subcontractor is to maintain a list of persons authorized for work area entry. The list will be available on request to the Site Supervisor.
- Require that all personnel, including regulators, O&M, Inc. employees, lower-tier contractors, suppliers, vendors and visitors having access to the work areas sign in and sign out at the treatment building(s).
- Control vehicle traffic on and through the work areas to provide safe and efficient operations.
- Regulate parking areas to prevent unrestricted entry to and exit from the work areas.
- All employees are instructed to immediately report suspected security to the Site Supervisor.

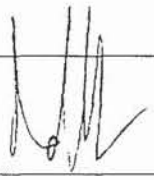
10.3 Security Measures for Operation of the Containment Facility

Security measures have been, or will be, implemented to prevent accidents, injuries, vandalism, theft, and tampering arising from improper or unauthorized entry of work areas.

11.0 APPROVAL

This site-specific Health and Safety and Plan has been written for use by *O&M, Inc.* only. *O&M, Inc.* claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

11.1 Original Plan

Approved By:  **Date:** 11-5-09

11.2 Revisions

Revisions Made By: **Date:**

Revisions to Plan:

Revisions Approved By: **Date:**

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The O&M, Inc. project employees and O&M, Inc. subcontractors (and lower tier subcontractors) listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions (including drug testing and discipline protocols).

Project Name: W. R. Grace Superfund Site – Acton, MA **Project Number:**

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

STANDARD
OPERATIONAL
PROCEDURES

O&M, Inc.

EXPOSURE CONTROL PLAN FOR BLOOD BORNE PATHOGENS

I. PURPOSE

A. To provide a program for minimizing the exposure and infection of for *O&M, Inc.* employees, from blood borne pathogens that may be encountered during employment. The intent of this policy is to eliminate any transmission of blood borne pathogens. This protocol stresses the concept of universal precautions and the full use of personal protective equipment whenever possible. Any employee infected by a particularly virulent form of a disease, that is easily communicable, shall be barred access on to the site until cleared by a healthcare professional, (i.e., Medical Doctor). Examples of such diseases are, but not necessarily limited to: Tuberculosis, Meningitis (airborne), etc....

II. SCOPE

This policy applies to all applicable employees involved in an exposure incident at *O&M, Inc.*

III. REFERENCES

A. OSHA standard 29 CFR 1910.1030.
B. *O&M, Inc.* Personal Protective Equipment SOP

IV. DEFINITIONS

Blood borne Pathogens means pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Exposure Incident means a specific eye, mouth, other mucous membrane, non intact skin, or parental contact with blood or other potentially infectious materials that result from the performance of an employee's duty.

Parental means piercing mucous membranes or the skin barrier through such events as needle sticks, human bites, cuts, and abrasions.

Universal Precautions is an approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other blood borne pathogens.

First Aid Provider is a person(s) operating on an emergency response basis that has been trained in basic First Aid and CPR skills.

V. PROCEDURE

A. Areas of Potential Exposure

1. First Aid response anywhere on *O&M, Inc.* jobsites or facilities.

2. Emergency response involving human tissue, blood, fecal material and any items which may have come in contact with the same.

B. Persons with reasonable potential for exposure to blood borne pathogens.

1. Persons operating on an emergency response basis that have been trained in basic First Aid and CPR skills.

2. Any employee responding on a "Non Mandatory" basis to a medical emergency.

3. Any employee responding to a project involving any item which may have had exposure to blood borne materials.

C. Infection Control

1. General-Universal precautions

a. General-Universal precautions shall be observed by employees at *O&M, Inc.*

b. All bodily fluids shall be considered potentially infectious materials.

2. Hand washing facilities

a. Whenever normal hand washing facilities are not feasible, *O&M, Inc.* shall provide either an appropriate antiseptic hand cleanser in conjunction with clean cloth/paper towels or antiseptic towelettes.

b. Whenever these alternative hand cleansing materials are utilized, the employee shall wash his or her hands with soap and running water as soon as possible.

3. Personal Protective Equipment (PPE)

a. Employees shall don gloves and safety glasses whenever contact with bodily fluids is likely.

1. Surgical and nitrile gloves are preferred because of tactile sensation. However, in extreme circumstances, latex and even PVC gloves may be substituted.

b. Surgical masks shall be worn by First Aid providers whenever treating an employee with an infectious disease.

1. In extreme circumstances, a respirator or "dust mask" may be substituted for a surgical mask.

   NOTE: When using a respirator, the person must be approved for respirator usage.

c. In the unlikely event an employee must be administered Cardiopulmonary Resuscitation (CPR) or artificial respiration, the First Aid provider shall use, whenever possible, a one-way mask.

D. Reporting Procedures

Any *O&M, Inc.* employee that is involved in an exposure incident must immediately report the exposure to his/her supervisor.

E. Hepatitis B Vaccination

The Hepatitis B vaccination is offered at no cost to employees at *O&M, Inc.* Also, if an *O&M, Inc.* employee is exposed to blood, saliva or any other infectious materials, the Hepatitis B Vaccination should begin within 24-hours of exposure. It will be completed by three injections over a six-month period. If the aforementioned employee declines the vaccination they shall sign the Hepatitis B Vaccine Declination form (Attachment 1)

F. Post Exposure Evaluation and Follow-up

Following a report of an exposure incident, *O&M, Inc.* shall make immediately available to the exposed employee a confidential Medical evaluation and follow-up, including at least the following elements.

1. Documentation of Routes of Exposure and the circumstances under which the exposure incident occurred.

2. Identification and documentation of the Blood status of the source individual, to determine HBV and HIV.

3. The exposed employee shall be informed of applicable laws and regulations concerning disclosure of the identity and infectious status of the source individual.

4. The exposed employee shall obtain a Healthcare professional's written opinion for post exposure evaluation and follow-up within 15 days of the evaluation.

G. Disposal of Infectious Materials

1. Disposal of sharps, such as needles, lancets, etc., shall be discarded as soon as possible in approved containers that are closable, puncture resistant, leak-proof on sides and bottom and shall be color coded red and labeled with the Biohazard Symbol.

2. Any other infectious material that had been used in treatment and must be discarded shall be disposed of in a closable container that prevents leakage or spillage of the material and shall be color coded red and labeled with the Biohazard Symbol.

H. Training

1. All field employees of *O&M, Inc.*

   a. Shall have training in the concept of general-universal precautions.

   b. Shall have proper training in the use of personal protective equipment.

   1. The training shall encompass proper usage and disposal of used PPE.

   c. Shall receive training on diseases, modes of transmission and related topics.

2. Field employees shall receive additional training upon assignment to tasks or procedures that specifically include occupational exposure to Blood borne Pathogens.

   a. Additional training shall be continuous as need dictates. This training shall be conducted on a yearly basis.

   b. Records shall be maintained of all training sessions and occupational exposure for a period of employment plus 30 years.

3. All *O&M, Inc.* Employees.

   a. Shall have access to a copy of *O&M, Inc.'* Exposure control plan for Blood borne Pathogens

O&M, Inc.

HEPATITIS B VACCINE DECLINATION

I understand that due to my occupational exposure to blood or other potentially infectious materials I may be at risk of acquiring hepatitis B virus (HBV) infection.

I have been given the opportunity to be vaccinated with hepatitis B vaccine, at no charge to myself. However, I decline hepatitis B vaccination at this time. I understand that by declining this vaccine, I continue to be at risk of acquiring hepatitis B, a serious disease.

If in the future, should I decide that I want to be vaccinated with the hepatitis B vaccine, I can receive the vaccination at no charge to me, but must notify the *O&M, Inc.* Safety Manager with a written request.

Signature: _____ Date: _____

Witness Signature: _____ Date: _____

O&M, Inc.

HEPATITIS B VACCINE ACCEPTANCE

Due to my potential occupational exposure to Hepatitis B, I have been offered the opportunity by *O&M, Inc.* to receive the Hepatitis B vaccine. I understand the following information and requirements.

1. *O&M, Inc.* will provide the vaccination at no cost.
2. The vaccination is a series of 3 shots taken over a 5 to 6 month period.
3. Once I initiate the vaccination process I will complete the series of inoculations within the time frame noted.

I agree to be vaccinated against the Hepatitis B virus under the above information and conditions.

Signature: _____ Date: _____

Print Name: _____

Witness: _____ Date: _____

O&M, Inc.

BURNING AND WELDING PROCEDURES

I. PURPOSE

To provide a procedure to insure that burning and welding operations are performed safely in hazardous or potentially hazardous locations.

II. SCOPE

This procedure applies to *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1910.252 Occupational Safety and Health Standard, Subpart Q, Welding, Cutting, and Brazing; Final Rule, dated Wednesday April 11, 1990

IV. PROCEDURE

A. Responsibility for Welding and Cutting

1. Management should:

a. recognize their responsibility for the safe usage of equipment on the job site;

b. establish approved areas for welding and cutting (as applicable);

c. establish procedures for approving the work to be done;

d. designate an individual to be responsible for authorizing operations in areas not specifically designed or approved for such process (said individual should be aware of the fire hazards involved);

e. arrange for the use of any approved apparatus, such as torches, manifolds, regulators or pressure reducing valves, and acetylene generators;

f. make sure that welders or cutters and their supervisors have been suitably trained in the safe operation of their equipment, the safe use of the process, and emergency procedures in the event of a fire;

g. select only contractors who have properly trained and experienced personnel and who have any awareness of the magnitude of the risks involved;

h. advise all contractors about flammable materials or hazardous conditions of which the contractors may not be aware.

2. Supervisors should:

a. be responsible for the safe handling of the welding and cutting equipment and for the safe work practices of the workers;

b. determine the combustible and flammable materials and hazards present or likely to be present in a work location;

c. protect combustibles from ignition by doing the following:

1. Moving the work to a location free from dangerous combustibles,

2. If the work cannot be moved, having the combustibles moved to a safe distance from the work or having the combustibles properly shielded against ignition,

3. Scheduling the welding and cutting so that operations that might expose combustibles to ignition are not started during such work;

d. secure authorization and post Hot Work Permit from the Department Manager or the Production Supervisor (as applicable) prior to starting work;

e. make sure that employees secure their approval and conditions are safe before beginning work;

f. make sure that fire protection and extinguishing equipment is properly located at the site;

g. make sure that fire watches are at the site when necessary;

h. make a final check-up, one-half hour after the completion of welding and cutting operations to detect and extinguish possible smoldering fires, when fire watches have not been provided.

3. Welders and cutters should:

   a. handle the equipment safely and use it so as to not endanger lives and property;

   b. have written approval from their Supervisor in the form of a burn permit before starting to weld or cut;

   c. only weld or cut where conditions are safe and only continue so long as conditions are unchanged from those under which approval was granted.

B. Precautions

1. Welding or cutting shall not be permitted under the following conditions:

   a. in unauthorized areas.

   b. in the presence of explosive atmospheres (mixtures of flammable gases, vapors, liquids, or dusts in the air) or explosive atmosphere that may develop inside uncleaned or improperly prepared drums, tanks or other containers, or equipment which have previously contained such materials;

   c. in areas near the storage of large quantities or exposed, readily ignitable materials.

2. Before welding or cutting is permitted, the area should be inspected by the supervisor responsible for authorizing welding and cutting operations in that area. This supervisor should designate precautions to be followed in granting authorization to proceed, in the form of a written permit and should sign the permit or otherwise authorize the work and should verify that;

   a. welding and cutting equipment to be used is in satisfactory operating condition and in good repair;

   b. when combustible materials such as paper, wood, or textile fibers are on the floor, the floor is swept clean for a radius of 35 feet. Combustible floors (except wood on concrete) should be kept wet, covered with damp sand, or protected by fire-resistant shields. Where floors have been wet down, personnel operating arc welding or cutting equipment should be protected from possible shock;

   c. where practicable, all combustibles are relocated at least 35 feet horizontally from the work site. Where relocation is impracticable,

combustibles should be protected from flame-resistant covers. The edges of covers should be tight at the floor to prevent sparks from going under them. This precaution is also important at overlaps where several covers are used to protect a large pile;

d. openings or cracks in walls, floors or ducts within 35 feet of the work area are tightly covered to prevent the passage of sparks to adjacent areas;

e. where cutting or welding is done near walls, partitions, ceilings or roofs of combustible construction, fire-resistant shields or guards are used to prevent ignition. If welding is to be done on a metal wall, partition, ceiling or roof, precautions should be taken to prevent ignition of combustibles on the other side due to conduction or radiation, preferably by relocating combustibles. Where combustibles are not relocated, a fire watch on the opposite side from the work should be provided. Welding should not be attempted on a metal partition, wall ceiling or roof having a combustible covering, or on walls or partitions of combustible sandwich-type panel construction;

f. welding or cutting on pipes or other metal in contact with combustible walls, partitions, ceiling or roofs is not started if the work is close enough to cause ignition by conduction;

g. fully charged and operable fire extinguisher(s), appropriate for the type of possible fire, are available at the work area;

h. the work area must be adequately ventilated;

i. vapors emitting from the worksite shall be exhausted through the use of fans or blowers;

j. the person performing the welding, cutting, or burning is using the appropriate safety gear, which may include gloves, sleeves, body, eye, hearing, and respiratory protection;

k. nearby personnel are suitably protected from heat, sparks, slag, etc, and should not look at the welding arc. This can be accomplished by either providing a welding shield or have all exposed employees wear protective (tinted) glasses.

3. Fire Watches:

a. Are required whenever such work is performed in locations where other than a minor fire may develop, or any of the following conditions exist:

1. appreciable combustible material in building construction or contents closer than 35 feet to the point of operations;

2. an appreciable quantity of combustible material more than 35 feet away but easily ignited by sparks;

3. wall or floor openings within a 35 foot radius which expose combustible materials in adjacent areas including concealed spaces in walls or floors;

4. combustible materials adjacent to the opposite side of metal partitions, walls, ceilings, or roofs which are likely to be ignited by conduction or radiation;

b. have fire extinguishing equipment readily available and be trained in its use, including practice on test fires;

c. be familiar with facilities and procedures for sounding an alarm in the event of a fire;

d. watch for fires in all exposed areas, and try to extinguish them first only when obviously within the capacity of the equipment available, or otherwise sound the alarm immediately;

e. be maintained for at least a half hour after completion of welding or cutting operations to detect and extinguish possible smoldering fires; Waiting period may need to be longer based on conditions;

f. will observe all personnel movement around and adjacent to the welding operations. When employees get near the welding operations, the fire watch will warn the employees of the additional eye hazard.

C. Training

A training program should emphasize that welders or cutters can provide for their safety and the safety of all co-workers by observing the following safe practices:

1. For work at more than 4 feet above the floor or ground, use a platform with railings, or a safety harness and lifeline;

2. Wear respiratory protection as needed and a safety harness with attached lifeline for work in confined spaces, such as tanks and pressure vessels. The lifeline should be tended by a similarly equipped helper whose duty is to observe the welder or cutter and effect rescue in an emergency;

3. Take special precautions if welding or cutting in a confined space is stopped for some time. Disconnect the power on arc welding or cutting units and remove the electrode from the holder. Turn off the torch valves on gas welding or cutting units, shut off the gas supply at a point outside the confined area, and, if possible remove the torch and hose from the area;

4. After welding or cutting is completed, mark hot metal or post a warning sign to keep workers away from heated surfaces;

5. Follow safe housekeeping principles. Don't throw electrode or rod stubs on the floor - discard them in the proper waste containers. Keep tools and other tripping hazards off the floor by putting them in a safe storage area.

D. Gas Welding and Cutting

1. Handling Cylinders

a. Only accept cylinders approved for use in interstate commerce for transportation of compressed gases.

b. Do not remove or change numbers or marks stamped on cylinders.

3. Cylinders are to be secured from falling at all times, chained or strapped to the cart or work station.

E. Hot Work Permit

1. All hot work permits will be obtained through the appropriate Supervisor prior to performing hot work.

2. All hot work permits must be placed as close to the work area as possible. The permit must be displayed at all times while the work is being performed.

3. The hot work permit must be returned to the Supervisor by the end of the work shift. The employee requesting the hot work permit is responsible for returning it to the Supervisor.

4. The Supervisor will be responsible for placing a copy in the project records and submit the original to the Safety Officer.

6. Hot work permits will be kept on file as required by applicable guidance.

O&M, Inc.

HOT WORK PERMIT

(Permit must be returned to the Supervisor initiating the document after the work is completed.)

LOCATION _____ GOOD FOR THIS DATE ONLY

1. Permission is granted to _____ for

2. THIS PERMIT IS SUBJECT TO COMPLIANCE WITH THE FOLLOWING PRECAUTIONS:

3. THIS PERMIT IS VALID ONLY SO LONG AS SAFE WORK CONDITIONS EXISTING AT THE TIME OF ITS ISSUANCE CONTINUE, AND EXPIRES UPON OCCURRENCE OF HAZARDOUS CONDITIONS SUCH AS GAS LEAKS, LIQUID SPILLS, DRASTIC OPERATING CHANGES IN ADJACENT EQUIPMENT, CHANGE IN WIND DIRECTION BLOWING VAPORS INTO WORK AREA, ETC.

4 WRITE IN YES OR NO. IF QUESTION DOES NOT APPLY, CHECK IT OFF, INDICATING THAT IT HAS BEEN GIVEN CONSIDERATION.

A.	Gas tests have been made - O_2 _____ LEL _____ CO _____ H_2S _____		_____
B.	Proper Preventive measures have been taken concerning involved electrical equipment		_____
C.	Warning tags have been attached		_____
D.	Equipment and all attached piping has been cleaned and purged with:	Water	_____
		Steam	_____
		Inert Gas	_____
		Air	_____
E.	Equipment has been cooled and ventilated		_____
F.	Connections have been blinded off or disconnected		_____
G.	Are there any precautions to be observed as to grounding equipment, oil soaked or nitrate materials, etc.?		_____
H.	Does adjacent equipment present hazards?		_____
I.	Can sparks ignite material in vicinity or on other floors or levels		_____
J.	Can this work be done other than by the use of heat?		_____
K.	Can the equipment be removed from the area or building?		_____
L.	Has necessary protective equipment been prescribed in Section No. 2 above?		_____
M.	Are portable combustion engines permissible in area?		_____
N.	Have affected personnel been informed of work to be performed?		_____

APPROVED BY:

Signed _____ Title _____

Signed _____ Title _____

I have read and understand the above information and will follow the burning and welding SOP.

Employee: _____

Employee: _____

_____

,e Watch:

O&M, Inc.

COLD TEMPERATURE WORK GUIDANCE

To ensure the health and safety of all *O&M, Inc.* employees working in cold temperatures, the following guidance shall apply:

1: Each full time employee, required to work outside, is to own cold weather apparel to combat the cold climate while working (e.g., hard hat liners, insulated coats and coveralls, etc). You are required to have this apparel with you at all times during cold weather, typically November thru March.

2: Whenever the ambient temperature drops to 18 F, check the internet weather site (www.weather.com) or call the local airport or a local radio station to determine the wind chill - see attached wind chill chart if the wind is known:

3: If the temperature in which you are working, including wind chill, is between -9 F & -24 F (-23 C & -31 C) your work will be limited to the following conditions:

- v Exposure is limited to 40 minute intervals, with 20 minute working breaks in a WARM PLACE*.

4: If the temperature in which you are working, including wind chill, is between -25 F & -60 F (-32 C & -51 C) the Supervisor must request a variance to begin or continue working.

5: If the temperature in which you are working, including wind chill, is lower than -60 F (-51 C), you will not work, unless under emergency circumstances as approved, via a variance, through senior management.

***WARM PLACE: >61 F (16 C)**

WIND CHILL FACTORS

OUTSIDE TEMPERATURE 0 F

WIND SPEED	15	10	5	0	-5	-10	-15	-20	-25
4	15	10	5	0	-5	-10	-15	-20	-25
6	8	2	-3	-9	-14	-20	-25	-31	-36
8	2	-4	-10	-16	-21	-27	-33	-39	-45
10	-3	-9	-15	-21	-27	-33	-40	-46	-52
12	-7	-13	-19	-26	-32	-39	-45	-51	-58
14	-10	-17	-23	-30	-36	-43	-50	-56	-63
16	-13	-20	-26	-33	-40	-47	-54	-60	-67
18	-15	-22	-29	-36	-43	-50	-57	-64	-71
20	-18	-25	-32	-39	-46	-53	-60	-67	-75
22	-19	-27	-34	-41	-48	-56	-63	-70	-78
24	-21	-29	-36	-43	-51	-58	-65	-73	-80
26	-23	-30	-38	-45	-53	-60	-68	-75	-83
28	-24	-32	-39	-47	-54	-62	-69	-77	-85
30	-25	-33	-41	-48	-56	-64	-71	-79	-86
35	-28	-36	-43	-51	-59	-67	-75	-82	-90
40	-29	-37	-45	-53	-61	-69	-77	-85	-93

O&M, Inc.

CONFINED SPACE ENTRY POLICY

1.0 PURPOSE

To provide a procedure for the safe entry of a confined space to effect repairs, inspection or testing.

2.0 SCOPE

This policy applies to *O&M, Inc.* employees.

3.0 REFERENCES

A. 29 CFR 1910.146 Occupational Safety and Health Standard, Subpart J, Permit required Confined Spaces for General Industry; Final Rule, April 15, 1993.

B. *O&M, Inc.* SOPs, as appropriate. **Without exception**, the O&M, Inc. Safety Officer, located in Knoxville, Tennessee, shall be contacted prior to any confined space entry.

4.0 DEFINITIONS

A. AUTHORIZED ENTRANT - An employee authorized by the Entry Supervisor to enter a permit space.

B. CONFINED SPACE ENTRY PERMIT - At any point in time, the employee's head breaks the plane of the entry point into a class (A) or (B) confined space, a permit is required.

C. CONFINED SPACE (PERMIT REQUIRED) & (NON PERMIT REQUIRED) - For the purpose of this procedure, a confined space is defined as a space which by design has limited openings for entry and exit; unfavorable nature ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. Confined spaces include but are not limited to transformer tanks, storage tanks, tank containments, process vessels, pits, silos, vats reaction vessels, low lying areas and tank trucks. The majority of confined space entries performed will be classified under one of the following classes:

1. Class "A" - (Permit Required Confined Space) A confined space that presents a situation that is immediately dangerous to life or health (IDLH). These include but are not limited to oxygen deficiency, explosive or flammable atmospheres, and/or concentrations of toxic substances.

2. Class "B" - (Permit Required Confined Space) A confined space that has the potential for causing injury and illness, if preventive measures are not used, but not immediately dangerous to life and health.

3. Class "C" - (Non Permit Confined Space) A confined space in which the potential hazard would not require any special modification of the work procedures.

D. EMERGENCY RESPONSE PLAN: - The emergency response plan shall be determined by the Entry Supervisor. This information shall be indicated on the Confined Space Entry Permit Form and shall include:

1. How will emergency medical response be notified?
2. How will the entrant be removed/rescued from the confined space?
3. What personnel will perform the rescue service?

E. ENTRY SUPERVISOR: - The Supervisor or Group leader is responsible for determining if acceptable entry conditions are present at a permit space where entry is planned. Only those Entry Supervisors approved by the *O&M, Inc.* Safety Officer will be allowed to issue a Confined Space Entry Permit.

F. HAZARDOUS ATMOSPHERE: - An atmosphere that may expose employees to the risk of death, incapacitation and impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

1. Any flammable gas, vapor, or mist, that is detected, that is, a greater reading than zero "0" on the LEL monitor is considered a hazardous atmosphere and entry into the confined space is prohibited. A flammable atmosphere generally arises from enriched oxygen atmospheres, vaporization of flammable liquids, by products of work, chemical reactions, concentrations of combustibles, dust, and absorption of chemicals from inner surfaces of the confined space.

2. Airborne combustible dust at a concentration that meets or exceeds its LEL. - This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52m) or less.

3. Atmosphere oxygen concentration below 19.5 percent or above 23.5 percent. - The consumption of oxygen takes place during combustion of flammable substances, as in welding, heating, cutting, and brazing operations. Oxygen can also be consumed during chemical reactions, as in the formation of rust on the exposed surfaces of the confined space (iron oxide). An additional factor in oxygen deficiency is the oxygen is displaced by another gas. Gases such as nitrogen, argon, carbon dioxide and methane can displace the air and create an environmental immediately dangerous to life and health.

4. Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in 29 CFR 1910 Subpart G, Occupational Health and Environmental Control, or in 29 CFR 1910 Subpart Z, Toxic and Hazardous Substances, of this part and which could result in employee exposure in excess of its dose or permissible exposure limit.

5. A corrosive atmosphere may or may not produce immediate evidence of irritation. In many cases the body's sensitivity abilities can be generally weakened due to damage of the nerve endings, and the worker is not aware of any increase in the exposure to toxic substances.

G. NON PERMIT CONFINED SPACE: - A confined space that does not contain nor, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm. Also included are: Class (A) or (B) confined spaces.

H. ATTENDANT (ATTENDANT) PERSON: - An individual stationed outside a permit required confined space who monitors the authorized entrants and who will perform all duties assigned by the Entry Supervisor.

5.0 PROCEDURES

5.1 Training

All employees whose work will involve confined spaces will be trained prior to being assigned to such duties. The training will consist of the following areas;

a. How to identify a confined space
b. How to determine if a space is a non permit area
c. How to use air monitoring equipment for entry
d. How to enter confined spaces safely
e. How to properly fill out a permit form
f. Duties of an attendant
g. Rescue procedures and equipment. Rescue training will be practiced at least every 12 months.

Training will be also be completed for any changes in hazards, equipment or procedures.

All training will be recorded and a certificate of training issued to each employee show the date of training, the trainer's signature and subject covered.

5.2 Entry Supervisor:

It is not always obvious what constitutes a confined space. For this reason, the Supervisor will always be contacted and perform and inspection whenever the possibility of engaging in any type of Confined Space activity. Before entry into a Permit or a Non Permit required confined space, the following shall occur:

A. The Entry Supervisor will determine the classification of the confined space. The following battery of monitoring tests shall be performed to make the following assessment:

1. Flammable Atmosphere
2. Toxic Atmospheres
3. Oxygen Deficiency
4. Any Other Harmful Physical Agents

The Entry Supervisor shall then contact the *O&M, Inc.* Safety Officer and determine the best course of action.

B. Appropriate breathing air tests shall be made as necessary to ensure that the atmosphere is safe for entry. The minimum percentage of oxygen for entry shall be no less than 19.5% and no more than 23.5% oxygen by volume.

To determine the possible exposure to a flammable environment, a combustible gas indicator shall be used to measure what levels are present. Flammability is measured in terms of the Lower Explosive Limit "LEL". This is the smallest concentration of a combustible gas in air that will explode when it contacts a spark or open flame. If a reading indicates a level greater than zero "O", entry is prohibited and forced ventilation is required until an "O" indication is achieved.

All Lock Out Procedures and Burn Permits must be issued when warranted.

C. Confined Space Entry Procedures for the Entry Supervisor Conducting Atmospheric Checks

1. The Confined Space Entry meter shall be calibrated within (30) days prior to entry.

2. The sample probe should be placed in the manway of the vessel, tank, pipe, etc, using extra care to hold the probe off the bottom of the confined space, to avoid pumping liquid into the analyzer. The atmosphere sampling area shall be tested approximately every 4 feet (1.22m) in the direction of travel and to each side.

3. Longer lengths of sample tubing may be necessary in deep vessels to avoid entering the vessels.

4. If it is necessary to enter a vessel to obtain a 0_2 check at a work area some distance from the manway:

   a. An attendant person must be outside the entrance before it is entered (as described in this procedure).

   b. The atmosphere should be checked just inside the manway.

   c. After entering the vessel, the atmosphere shall be continuously monitored while slowly moving through the vessel.

   d. If lights are to be used, a flashlight, 12-volt light system, or ground fault interruption device must be used.

   e. Safety harness or wristlets with a "life-line" will be required for vessel entry for the purpose of monitoring the atmosphere.

5. If entering a Permit Required Confined Space with a SCBA, air purifying respirator or an airline respirator then O_2 levels shall be continuously

monitored for the period of the entry. The LEL, CO and other known hazardous atmospheric materials shall be monitored, no less then every 15 minutes for the period of the entry.

D. Confined Space Ventilation - The Entry Supervisor is responsible for ventilating each Permit Required Confined space. This will include:

1. Inerting the space: This will involve the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to the extent that the resulting atmosphere is non combustible. This procedure produces an IDLH oxygen-deficient atmosphere. A self-contained breathing apparatus with safety harness is required to enter an ILDH atmosphere.

2. If entering a Permit Required or a Non Permit Required Confined Space transformer unit or a vault in which a fire or fault occurred to the transformer, then all authorized entrants are to be in SCBA's.

E. The next to last step in issuing the Permit Required Confined Space:

1. The Entry Supervisor will obtain verbal approval from both the *O&M, Inc.* Safety Officer and the project manager.

F. The last step: Issue written permit

1. If a Non Permit Required Confined Space is determined then the Entry Supervisor will provide a general review of the entry hazards with the entrants.

2. If a Permit Required Confined Space is determined, then the Entry Supervisor will review the potential employed hazards about the particular confined space with all entry participants. The Entry Supervisor will authorize the entrants, orientate the Attendant Person, and inform the crew of the Emergency Rescue Plan.

5.3 Authorized Entrant: - The person entering a Permit required confined space entry shall:

A. Be in full Safety Equipment/Clothing as outlined in Section (9) of this procedure, and be wearing a safety harness with lifeline as outlined in Section (8).

B. Be fully aware of any and all hazards which are or may become present within the confined space and has signed the Confined Space Entry Permit prior to performing any work in the space. The entrants or their representatives are entitled to request additional monitoring at any time before and during the entry.

5.4 Authorized Attendant Person - An attendant is required anytime someone is working in a Permit Required Confined Space. The Attendant Person must:

A. Know who is in the space.

B. Keep unauthorized people out of the area. This includes the use of barriers or signs to prevent pedestrian or vehicle traffic from endangering the entrants.

C. Recognize early symptoms of danger in the space. This includes using the air monitoring meters and recording the results. The attendant will also stay in verbal contact with the entrants to verify their condition.

D. Watch for hazards outside as well as inside the space.

E. The attendant will only watch one confined space at a time. Additional confined spaces will require an attendant for each space entered.

F. The attendant, along with the supervisor, will coordinate with other contractors on site, entry operations so that employees of other contractors do not endanger *O&M, Inc.* employees

G. Maintain clear access to and from the space. If rescue is necessary, the attendant must:

1. Call for rescue personnel. (Activate Emergency Rescue Plan)
2. Stay outside until back-up personnel arrive/keeping unauthorized people out.
3. Perform the rescue from outside whenever possible. Try to ventilate the space.

H. Employees working inside a Permit Required Confined Space must be under constant observation of a fully instructed observer.

I. Before anyone enters a Permit Required Confined Space, the Attendant Person will be instructed by the Entry Supervisor that:

1. A Permit Required Confined Space Entry Permit has been executed and posted.

2. Rescue harness and life line are in use.

3. The Attendant Person must know the location of the nearest:

   a. Telephone or cell
   b. Safety Shower
   c. Fire Extinguisher

   d. The Attendant Person must be able to describe the location where the entry is taking place.

   e. The Attendant Person must be instructed how to shut down welding/burning equipment

   f. As long as anyone is inside the vessel, the Attendant Person must remain in continuous contact with the Authorized Entrant(s). He/she is not to leave the observation point, except to report an

emergency after first sounding his alarm horn, or other wise alerting help.

g. Under no circumstances shall the Attendant Person enter the vessel. If the Authorized Entrant(s) in the vessel becomes ill or injured, the Attendant Person will sound the alarm and call for help. He/she should speak clearly and give the details about what has happened and where the emergency is. He/she is to be sure the message is repeated back correctly before breaking contact.

h. The Attendant Person still does not enter the vessel. He/she returns to the vessel and directs the rescue team.

i. Every person entering any vessel for rescue purposes must wear a harness with life line attached and a positive pressure air supplied respirator or self contained breathing apparatus (SCBA).

j. In the event of an emergency which requires entry to affect a rescue either the local Fire Dept or an *O&M, Inc.* rescue crew will be used to perform this duty. An air line from a dry air system should be placed into the space until the rescue team arrives. It will be determined before entry is started who will be providing rescue services. If the host company or an outside rescue service, Fire Dept. will be used they must agree to this ahead of time and be allowed to examine the entry site and either confirm or decline rescue services. If the host company is providing these services it must be stated in the work contract.

k. Special Instructions

A Permit Required Confined Space Entry permit becomes void if any of the following occur:

1. The job is interrupted for more than 60 minutes, for any reason.

2. An Authorized Entrant working in the vessel becomes ill or injured.

3. A power failure occurs which renders the lighting or the telephone inoperative.

4. Change in atmospheric conditions within the space.

5. At the end of the work shift.

6. At the completion of the work which required the entry. The supervisor will review the permit for completeness and sign off with the date and time for cancellation of the permit.

5.5 **Required Equipment and Tools** - Equipment and tools to be used in a confined space shall be inspected and meet the following requirements:

A. Hand tool must be clean and in good condition.

B. Any time 110 volt electrical power is to be used in confined space entry, power must be provided through a ground fault interrupter. For lighting, fixtures specifically designed as "Spark Proof" are required any time a flammable condition is suspected or may occur. The spark proof lighting must be used in conjunction with a ground fault interrupter. The ground fault interrupter must be located outside of the vessel and as close to permanent wiring as possible to ensure against shock hazards from faulty or damaged power tools and extension cords.

C. Air driven tools shall be used when flammable liquids are present.

D. Cylinders of compressed gases shall never be taken into a confined space.

E. Portable ladders shall be adequately secured.

F. Scaffolding and staging shall be properly designed and erected to carry the maximum expected load.

G. An approved life line and harness shall be used whenever an employee enters a Permit Required Confined Space.

5.6 **Required Safety Equipment and Clothing** - The entry permit shall include a list of necessary protective equipment to be used in the confined space. Items normally used to protect against traumatic injury include:

A. Eye and Face Protection

1. Non Permit required Confined Spaces - Occupational Safety Glasses with Side shields.
2. Face shields for grinding and welding.

B. Hearing Protection

1. Hearing Protection shall be worn under the following conditions:

   a. Noise levels exceed 85 dba
   b. Air or power tools are being used.
   c. Normal conversation between employees cannot be heard.

C. Respiratory Protection

1. No entry will be permitted unless the readings on the atmosphere meet the above standards.

2. A half face respirator with particulate/fume filters is required if welding will be performed in the space.

F. Hand Protection

1. As required per Health & Safety policy E-6

G. Foot Protection - Steel toe shoes.

HOT WORK - Refer to the *O&M, Inc.* Burning and Welding Policy.

LOCK OUT/TAG OUT - Refer to the *O&M, Inc.* Policy Lockout/Tagout Policy

5.7 **Permit System** - The Permit Required Confined Space Entry is an authorization and approval in writing that specifics the location and type of work to be done, and certifies that all existing hazards have been evaluated by an Entry Supervisor, and necessary protective measures have been taken to insure the safety of each worker.

A. The permit for a confined space shall be posted in a conspicuous place, close to entrance. The original permit is to be filed with the Safety Officer upon completion of work.

B. The permit shall be dated and carry an expiration time that will be valid for one shift only. The permit shall be updated for each shift with the same requirements. At the completion of the work the permit will be signed off by the supervisor as completed.

C. The permit is to be filled out completely, all questions should be answered, where the questions are "not applicable" then fill in NA for those questions. Entry into the confined space cannot be executed until all questions are addressed and all required signatures are obtained.

5.8 Plan Review

a. The plan will be reviewed annually for updates to the regulations and for usability; any unauthorized entry of a confined space, any hazards not covered by the permit and any occurrence of an injury or near miss. Also for any employee complaints.

b. All confined space permits will be reviewed for the prior year for completeness and general information

O&M, Inc. Confined-Space Alternative Procedure Certificate

Alternative procedures may be used for permit-required confined-space entry if the only hazard within the space is an atmospheric hazard and the hazard can be controlled to acceptable safe levels solely by forced-air ventilation. If the space must be entered to determine hazards, the initial entry must be done in full compliance with the requirements of a confined-space-entry permit.

These alternative procedures are valid as long as the atmospheric hazards are controlled by forced-air ventilation. If additional hazards arise within the space, or the forced-air ventilation is inadequate in controlling the atmospheric hazard, personnel must exit the space immediately and the space must be reevaluated.

1.0 GENERAL INFORMATION

Project:	Project #:	PM:
Date of Entry:	Duration of Entry:	Certification Expiration Date:
Space Location:		
Description of Space:		
Purpose of Entry:		
Atmospheric Hazards Expected: ☐ Oxygen Deficiency ☐ Oxygen Enrichment ☐ Flammable Vapors ☐ Toxics (specify)::		
Entry Supervisor (ES):	Attendant(s):	

2.0 CERTIFICATE REQUIREMENTS

☐ Nonatmospheric hazards do not exist in this space

☐ Communication methods established between entrants and the attendant

☐ Covers can be removed safely

☐ Space openings guarded from fall hazards and falling objects

☐ Continuous forced-air ventilation from a clean air source is positioned in the immediate area where entrants are working and continue until they have left the space

3.0 ATMOSPHERIC MONITORING

Frequency: ☐ Prior to Entry ☐ Continuous ☐ Periodic (specify):

Instruments: ☐ Combustible Gas Indicator ☐ FID ☐ PID ☐ Colorimetric Tubes ☐ CO Monitor ☐ H_2S Monitor ☐ Other(specify):

Substances Monitored: ☐ Oxygen ☐ Flammables ☐ CO ☐ H2S ☐ Other (specify):

Monitoring Results			**Oxygen**	**Flammability**	**Toxicity**		
Monitors	Limits		19.5 – 23.5 %	< 10 % of LEL	< PEL/TLV		
Initials	Date	Time	%	% of LEL	Substance	Level	Limit

4.0 CERTIFICATE AUTHORIZATION AND CANCELLATION

	Entry Supervisor Signature	Employee Number	Date	Time
Entry Authorized				
Entry Canceled				

Problems Encountered During Entry

5.0 AUTHORIZATION/ACCOUNTABILITY LOG

The following individuals have successfully completed confined-space training, have attended a pre-entry briefing, and are authorized to enter the space.

	ES Initials		Attendant - check each time an individual enters or exits the space.											
Name of Entrant	Trained	Briefed	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out

O&M, Inc.

DRUM AND CONTAINER HANDLING

I. PURPOSE

A. To provide a method to ensure the proper handling of drums and containers of hazardous and non-hazardous materials during *O&M, Inc.* operations.

B. To provide a specific procedure for the unloading, storage, and inspection of hazardous waste drums and containers and stored at *O&M, Inc.*

II. SCOPE

This applies to all employees working with drummed materials or creating drummed materials at *O&M, Inc.*

III. REFERENCES

A. *O&M, Inc.* SOP PPE
B. *O&M, Inc.* SOP Hazard Communication
C. 49 CFR Part 172.101

IV. PROCEDURE

A. Personnel Protective Equipment (PPE) shall be used in accordance with PPE policies in this Manual.

B. All drums and containers of hazardous materials and hazardous wastes shall be labeled in accordance with the *O&M, Inc.* Hazard Communication Policy, DOT, and EPA regulations.

C. Drums and containers of hazardous waste must be closed at all times except when adding or removing waste.

D. When practical, drums and containers shall be inspected and their integrity shall be assured prior to being moved.

E. Work performed requiring movement of drums and containers shall be planned and organized to minimize the movement of the materials.

F. When a container holding hazardous waste is not in good condition, (e.g. severe rusting, apparent structural defects) or if it begins to leak, the waste must be immediately transferred to another container or otherwise processed to remedy the situation.

G. Spill response materials and equipment shall be available in any area where spills, leaks, or ruptures may occur.

H. Major spills shall be handled in accordance with the Emergency Response Plan (SPCC plan).

IV. RECEIVING AND STORAGE

A. Unloading Process

1. All tractor-trailers will be secured in place using the tractor brakes and wheel chocks. Trailers only will require a safety jack and wheel chocks.

2. The forklift driver will unload the trailer and place the material in the drum storage area.

B. Placement in Storage of wastes (See Attachment 1 for specific storage criteria)

1. Drums should not be placed on a pallet in such a way that the edge of the drum extends beyond the edge of the pallet. The drums are to be banded together at a level in the top 1/3 of their height for safety if the pallet will be placed on another pallet of drums.

2. Wastes shall be placed in storage according to their compatibility. At no time will incompatible wastes be placed on the same pallet.

3. Drums will be placed in drum storage in rows or racks separated by aisles at least two feet (24") wide in such a way that all drums on each pallet are visible for inspection, including the label.

4. The pallets should not be placed so that they overlap the next pallet.

C. Inspection

1. Inspection for leaking drums shall be performed at least monthly.

   a. Any leaking drum (when waste can be seen on the outside of the drum or on the pallet) will be removed and repackaged or processed as appropriate.

2. Drum storage inspections shall be performed using the criteria defined in Attachment 1 of this procedure.

ATTACHMENT 1

RULES FOR STORAGE OF CONTAINERS IN THE DRUM STORAGE DIKE

1. NO FULL CONTAINERS OF WASTE (55 GALLON) ARE TO BE STACKED OVER THREE CONTAINERS HIGH. EACH LEVEL MUST BE ON A PALLET. IF DRUMS ARE STACKED THREE HIGH, EACH LAYER OF DRUMS MUST BE BANDED OR SHRINK WRAPPED. FULL CONTAINERS (55 GALLON) OF NEW MATERIALS CAN BE STACKED THREE HIGH IF NEEDED. EMPTY CONTAINERS MAY BE STACKED FOUR HIGH PROVIDED THE DRUMS ARE ON PALLETS AND ARE BANDED TOGETHER AT A LEVEL IN THE TOP 1/3 OF THEIR HEIGHT FOR SAFETY.

2. AISLE SPACE BETWEEN ROWS MUST BE MAINTAINED TO AT LEAST 2 FEET.

3. CONTAINERS MAY NOT BE ALLOWED TO LEAN

4. ALL WASTE CONTAINERS MUST BE LABELED WITH THE FOLLOWING INFORMATION:

   A. EACH CONTAINER MUST BE LABELED AS TO ITS CONTENTS USING EITHER THE YELLOW HAZARDOUS WASTE LABEL OR THE NON HAZ GREEN LABEL.
   B. THE DATE THE WASTE WAS FIRST PLACED INTO THE CONTAINER.
   C. ANY DOT LABELS REQUIRED FOR SHIPPING.
   4. EPA PCB LABEL IF WASTE MATERIAL IS PCB CONTAMINATED.
   5. INITIALS/NAME OF THE PERSON PREPARING THE DRUM FOR STORAGE.

5. CONTAINERS MUST NOT BE ALLOWED TO LEAK. SPILLS MUST BE IMMEDIATELY CLEANED UP AND ANY CLEANUP ABSORBENTS REMOVED.

6. CONTAINERS MUST NOT BE LEFT OPEN EXCEPT WHEN ADDING OR REMOVING WASTE.

7. IF A CONTAINER IS FOUND TO BE OPEN, REPLACED THE COVER OR STOPPER. IF THE COVER OR STOPPER (BUNG) IS DAMAGED SECURE A NEW COVER OR STOPPER. WHERE A GOOD SEAL IS NOT POSSIBLE OR THE CONTAINER IS DAMAGED, THE WASTE MUST BE TRANSFERRED TO A NEW OR SECURE CONTAINER (TAPE OR WRAPPING IS NOT SUFFICIENT).

8. IF A WET SPOT IS DISCOVERED ON THE FLOOR ASSUME IT IS WASTE, UNLESS IT IS KNOWN TO BE RAINWATER. IF THE WET SPOT IS WASTE, IT MUST BE CLEANED UP IMMEDIATELY. IF THE WET SPOT IS RAINWATER, IT SHOULD BE DRIED AND CLEANED UP WITHIN 24 HOURS AFTER THE RAIN EVENT.

O&M, Inc.

ELECTRICAL SAFETY

I. PURPOSE

To provide a guideline for safe use of electrical equipment and to set minimum standards for the quality of electrical devices.

II. SCOPE

This policy applies to all *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1910, Occupational Safety and Health Standards, Subpart S, Electrical

IV. PROCEDURE

A. General

Employees may not wear or hang any watches, rings, chains, keys or any other metal on their body while working on or near energized electrical equipment.

B. Breaker boxes, junction boxes, extension cords

1. All breaker switches will be labeled to identify the circuit for which it is being used.

2. Breaker boxes will be labeled when there is a single switch which could interrupt power to a series of circuits.

3. A detailed log will be kept identifying the location and function of each electrical breaker box and switch box.

4. The area around a circuit breaker boxes will be kept clear 30" in all directions

5. Bare or exposed wiring will not be tolerated.

6. Junction boxes will be sealed with all weather plates intact.

7. Electrical extension cords will be used only if all the following regulations are met:

   a. Cords will be inspected before each use for deterioration, fraying, or other external damage.

   b. Cords will not be used if damaged or frayed (damaged cords will be discarded).

   c. Splicing of cords will not be permitted.

   d. There must be a ground plug on the cord.

   e. A GFI, ground fault interrupter, will be used with all electrical power tools and devices.

   f. Cords will not be run down stairs, through doors, or through holes in walls.

   g. Extension cords will not be used as a substitute for fixed wiring.

7. Electrical switches will be visually inspected before each use and will be replaced as necessary.

8. Electrical repairs will be made under the direction of the maintenance department.

C. Electrical fixtures used in hazardous atmospheres or confined spaces.

1. Electrical equipment (tools, wiring, lights, radios, etc.) must be intrinsically safe (lights must be approved with a Class I Div. I rating) as indicated in the National Electric Code Part 500 -5.

D. Electrical Lockouts

The *O&M, Inc.* Lockout Tag-out Health & Safety Policy shall be followed.

E. Specific Electrical Policies/Programs

1. Maintenance Work

Sometimes maintenance work in your area will require an electrical **Lockout**. Maintenance cuts off the power and attaches a lock so the equipment can't be energized. Only that maintenance person has the key to the lock. Don't try to start equipment that's locked out. (See **LOCKOUT POLICY**)

2. Electrical Panels And Boxes

You may need to turn the power to an electrical panel on or off. This is done by operating the switch on the outside right hand side of the box. **ALWAYS OPERATE THESE SWITCHES WITH YOUR LEFT HAND**. This positions your face and body right of the box instead of directly in front. Sometimes panels and boxes explode when these switches are operated.

If you aren't sure how to do something safely, **GET HELP and ASK YOUR SUPERVISOR.**

TABLE 1 - APPROACH DISTANCES FOR QUALIFIED EMPLOYEES - ALTERNATING CURRENT

Voltage range (phase to phase)	Minimum approach distance
300V and less	Avoid Contact
Over 300V, not over 750V	1 ft. 0 in. (30.5 cm).
Over 750V, not over 2kV	1 ft. 6 in. (46 cm).
Over 2kV, not over 15kV	2 ft. 0 in. (61 cm).
Over 15kV, not over 37kV	3 ft. 0 in. (91 cm).
Over 37kV, not over 87.5kV	3 ft. 6 in. (107 cm).
Over 87.5kV, not over 121kV	4 ft. 0 in. (122 cm).
Over 121kV, not over 140kV	4 ft. 6 in. (137 cm).

O&M, Inc.

EXCAVATION

I. PURPOSE

This procedure outlines requirements for excavating soil and is intended to protect personnel from the hazards of excavation collapse.

II. SCOPE

Employees are not to work in or around excavations unless excavations are properly shored or sloped. This policy applies to all *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1926.65, 1926.651, and 1926.652

IV. PROCEDURE

Safe operations while working in and around excavations involve many factors. Factors to be evaluated and discussed at daily safety meetings before starting work include:

A. Soil Structure: Excavations in wet soil, sandy soil, or areas that have been backfilled are relatively unstable and must be supported or sloped if employees are to enter the excavation.

B. Weather Conditions: Changing weather conditions greatly affect the safety of working in and around excavations. Excess water from rain or snow loosens and adds weight to the soil, increasing the chance of the soil caving in. Excavation should be diked, pumped, or covered, to prevent an excessive amount of water from accumulating.

C. Superimposed Loads: Superimposed loads in the vicinity of excavation walls increase the probability of a cave-in. Heavy equipment and materials should be kept back as far as possible. Heavy equipment should be placed on wooden mats or planking to spread the weight more evenly. Considerations must also be taken when buildings, curbs, trees, utility poles, and other structures are around the excavation. Soil excavated must be stored away from the edge and be barricaded or retained in an effective manner.

V. SPECIFIC REQUIREMENTS

Specific requirements in this safety plan are minimum regulations which are contained in 29 CFR Subpart P 1926.65, 1926.651, and 1926.652.

A. Walkways and sidewalks shall be kept clear of excavated materials. Sidewalks which must be undermined must be shored to carry a load of 125 pounds per square foot.

B. Planks used for walkways shall be laid parallel to the length of the walkway and fastened together.

C. Employees subjected to vehicle traffic in excavating operations shall don reflective clothing.

D. Excavations shall be inspected at the start of the workday and after any breaks (lunch, etc.); if the possibility of cave-in or slide exists, employees shall not be permitted into the excavation. This inspection shall be performed by the designated competent person. If during the excavation conditions are noted that indicates a possible cave-in, employees will immediately exit the space until proper precautions have been taken.

E. Prior to opening an excavation, all efforts shall be made to locate all underground utilities. The utilities shall be marked.

F. Excavations deeper than 5 feet which are entered by employees shall be sloped, shored, or protected by some other equivalent means.

G. Excavations below the level of the base of footings of a subsurface structure shall not be permitted, unless the wall is underpinned.

H. When employees are required to work in an excavation 4 feet or deeper, a ladder shall be provided. The maximum horizontal travel distance to the ladder shall be 25 feet. The ladder shall extend a minimum of 3 feet above the excavation and be secured. This ladder shall not be removed until all employees have exited the excavation. Ladders shall be provided in an excavation regardless of sloped ends or benched sides.

I. Guardrail or fences shall be placed at all excavations which are close to sidewalks, drives, or other thoroughfares. Adequate protection shall also exist at remote excavations where workers are not present.

J. Excavated soil must be kept at least 2 feet from the edge of the excavation. The excavated soil shall not be permitted to extend higher than the maximum allowable slope for the excavation.

K. Atmospheric monitoring will be conducted in conjunction with the daily inspections of the excavation and prior to allowing employees to enter or re-enter an excavation. Personnel will monitor for lower explosive limit (LEL), oxygen, and carbon monoxide (CO). In addition, hydrogen sulfide (H_2S) will be monitored on landfill projects. If excavations occur in contaminated soils, refer to the HASP for additional monitoring requirements.

VI. MAXIMUM ALLOWABLE SLOPE

A. OSHA requires that all excavations more than 5 feet deep that will be entered by employees shall be sloped, shored, sheeted, braced, or supported.

B. The preferred method is to slope the sides of the excavation to the maximum allowable slope, or the angle of control at which the soil will remain at rest. The maximum allowable slope varies with different kinds of soil; this angle must be determined on each individual excavation. The minimum allowable slope for excavations is 1:1.

C. The second method of support is shoring, sheeting, tightly placed timber shores, bracing, trench jacks, piles, or other materials installed in manner strong enough to resist the pressures surrounding the excavations. This method requires a design approved by a professional engineer licensed in the state where the work is performed.

D. The third method is to use a trench box, which is a prefabricated movable trench shield made of steel plates, welded to a steel frame.

O&M, Inc.

EYE/FACE PROTECTION

I. PURPOSE

To eliminate the possibility of eye/face injury resulting from contact with physical or chemical agents.

II. SCOPE

This policy applies to all *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1926.102 & 1910.133, Occupational Safety and Health Standard, Eye and Face Protection

B. American National Standard Z87.1 - 2003, Occupational and Educational Eye and Face Protection

IV. PROCEDURE

A. GENERAL

1. All eye protection used at a site shall meet the design and approval specifications of ANSI Z87.1 - 2003.

2. Non-prescription safety glasses will be available at each project location.

3. Face shields will be provided as required by a specific task under a site-specific HASP.

4. Prescription safety glasses will be provided by the employee. The following stipulations apply to this policy:

   a. Full time employees **may** have cost reimbursement through insurance or *O&M, Inc.* benefits.

   b. The employee is responsible for obtaining any eyeglass prescription.

5. Tinted or shaded safety glasses will not be worn inside any building or structure, or during any non-daylight work shift.

6 Safety glasses shall not be worn when wearing a full face respirator. If prescription glasses are required, the company will provide inserts to be worn inside the respirator face-piece. Employee will provide the prescription lenses to fit the frames. Note: see section IV A.3.

7. The use of individually owned eye protection will be permitted as long as the intent of this policy is met and the eye protection meets ANSI Z87 standards. Eyewear not meeting this standard must be protected by additional approved protection such as goggles or slip over safety glasses.

8. Metal-framed safety glasses shall not be worn in any energized substation or work area where high voltage contact is possible. Slip over plastic safety glasses may be worn over metal frames for protection.

9. All safety glasses worn shall have side-shields in place at all times when in a designated area or while performing a designated process.

B. USAGE OF EYE PROTECTION

1. Eye protection shall be worn at all times when in a work area as defined in the *O&M, Inc.* Personal Protective Equipment Policy.

2. Specific areas and duties that require a minimum of standard safety glasses include but are not limited to:

   a. Production areas, warehouse areas and parking/driveway areas when any work activity is occurring.
   b. Inside designated work areas at project sites in the field.
   c. When required by a customer.
   d. When a supervisor believes it is required.
   e. Whenever, regardless of location, work is being performed that involves the movement of materials or potential exposure to chemical hazards.

C. ADDITIONAL EYE PROTECTION

1. Additional eye protection, such as goggles, face shields, welding helmets, or brazing shields, shall be worn when necessary to protect from physical and chemical hazards present.

2. Approved face shields, along with safety glasses, will be worn for activities that include but are not limited to:

   a. Grinding
   b. Sanding
   c. Cutting with power tools
   d. Chemical handling/pumping of liquids
   c. Painting
   d. Chain saw usage

O&M, Inc.

FALL PROTECTION

I. PURPOSE

A. To provide a procedure to use when working in a location exceeding 4 feet in the facility and 6 feet in the field above a surface where fixed fall protection is not provided or is inadequate. This distance is measured from the floor or grade to the level at which the worker is standing or sitting.

II. SCOPE

This procedure applies to all *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1910.21-30 Walking, Working Surfaces
B. 29 CFR 1926.104 Occupational Safety and Health Standard; Safety Belts, Lifelines and Lanyards
C. 29 CFR 1926.500 OSHA Subpart M-Fall Protection Standards.
D. 29 CFR 1910-303 OSHA Standard; Electrical - General

IV. PROCEDURE

1. All employees will receive training in the proper procedures and use of fall protection before being assigned any work above 4 ft in the warehouses or 6 ft in field operations including work around excavations. The training will consist of the following areas:

    a. to be able to recognize a fall protection required work.
    b. to be able to recognize the hazards of falling
    c. correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems
    d. the use of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, controlled access zones and other protection to be used
    e. the handling and storage of equipment, materials and erecting of overhead protection
    f. the role of employees in fall protection plans
    g. a review of the fall protection standard

2. The instructor conducting the training will be qualified in those areas and be considered a competent person under the regulations.

3. A certificate of training will be issued and kept on file. The certificate will contain the name of the student, the name of the instructor with his signature, the date of training. Prior training by other companies will be reviewed for compliance with these regulations and standards.

4. A fall protection program will be created for each situation involving working at heights above 6 ft. The program will be prepared by a qualified person such as the Compliance Manager or a field supervisor who has received specific fall protection information for the creation of such plans.

5. Any accidents or serious incidents will be investigated and reported under *O&M, Inc.*' accident reporting policy B-2. The incident will be investigated for any changes necessary to this policy to prevent similar accidents.

6. Any personnel performing elevated work shall be provided with one or more of the following types of protection;

   a. Full body harness and lanyards, which are tied to a secure object, lifeline, or horizontal fixed line. When a full body harness with lanyard is used as the sole means of fall protection, the lanyard is to be attached to a firm support close enough to the worker so that if a fall occurs, it will be as close to vertical as possible to minimize swinging and so the fall will be limited to six feet or less. Lanyards used as personal fall protection are to have a maximum length of 6 feet and a minimum size of 1/2" nylon or equivalent. Where tie-offs cannot be made in accordance with this standard, the use of nets, cranes, cherry pickers, etc., must be considered and used as appropriate. NOTE: before each use the employee must inspect all harness, belts, & lanyards for condition, no broken parts or tears in the webbing. All fall protection equipment purchased will be ANSI/ASTM rated and approved.

   b. Fixed work platforms or scaffolds equipped with solid guard rails;

   c. When working off straight ladders, the ladders will be equipped with safety shoes and tie-off ropes, which are secured to appropriate structures prior to initiating the work. A second person shall steady the ladder until the tie-off is completed. See policy on Ladders.

   d. Vehicles with mounted elevating and rotating work platforms, which have their scaffolds and platforms securely attached to the vehicles and their brakes set prior to persons occupying the elevated scaffolds or platforms. Personnel occupying the scaffold or platform shall wear a full body harness with lanyards securely attached to the scaffold, platform, or basket.

7. All open-sided floors, platforms, runways, and roof, wall, and earth openings that qualify as elevated work locations shall be effectively barricaded in accordance with OSHA regulation 29 CFR 1926.500. Subpart M details safeguards to be used for floor, wall openings and stairways. Effective barricades are usually railings with toe-boards or floor hole covers.

8. Assignments on flat or low pitched roof type structures with a ground-to-eave height greater than ten feet, or a slope greater than or equal to 4 inches rise in 12 inches, employees shall be protected from falling from all unprotected sides and edges of the roof as follows:

    a. By the use of a motion-stopping safety system (body harness/belt and lanyard including rope grab device) on lines or lanyards; or,

    b. By the use of a highly visible warning line system erected not less than 6 feet from the roof edge or where there is no alternate methods for use of fall protection equipment a monitoring system will be utilized. The monitor will recognize the fall hazards, warn employees if they are unaware of a fall hazard or are acting in an unsafe manner, be on same working surface and in visual sight and stay close enough for verbal communication. The monitor can not have other duties that would take his attention from the monitoring function.

9. Materials and tools are not to be "dropped" from or "tossed" to any elevated levels. Equipment/tools that must be raised or lowered must be controlled by the use of hand lines or mechanical lifting devices. The equipment/tools must also be contained by rigging, use of tool buckets, tool belts, chutes, etc.

10. Mobile work platforms and portable ladders used in close proximity to electrical lines have appropriate clearance as specified in 29 CFR 1910.303

11. Personnel protection from falling while in transit to and from an elevated work site will be considered in all job planning and execution.

FALL PROTECTION PROCEDURES

O&M, Inc. policy requires fall protection when working at any height over 4 feet above floor level.

OPTIONS

1. Ladders must be tied off the first time up. Check the non-skid feet on the ladder before use. Don't stand on the top two steps; get a longer ladder if needed. If you are standing inside a manhole, or inside a tank, you do not need fall protection.

2. When possible, employees should work from a lift platform. We have platforms fastened to a forklift, single person electric lifts, and multiple person electric lifts. Scaffolds are also available. Harnesses/lanyards are not needed if you can do the job from the lift platform or scaffold. Remember to fasten safety chains or gates, and position the platform as close as possible to the work area.

3. The next choice is a full body harness hooked to an inertial reel that is fastened to a solid anchor point. If the lid is on the transformer unit, a tether pole can be bolted to the attachment plate and the inertial reel attached to the pole. One person only can be hooked to the pole at one time. The mounting bracket needs placed on the lid with 1/2" x 2" studs. These studs will be removed when unit is ready for shipping. The inertial reel is good for an 8' radius. Place the bracket in the center of a lid when the lid is approximately 16' in length and 2 poles spaced in from the end 1/3 when lid is longer than 16'. When the lid is off, the inertial reel must be fastened to either a jib crane or the overhead crane hook. When the crane is used for fall protection, the operator must stand by the controls to make sure they are not operated while an employee is attached to the crane. Jib crane controls should be locked out by the employee using them, or kept with the worker to prevent accidental operation while in use as an anchor.

4. A body belt with a 4 ft lanyard may be used while on a lid of a transformer if the lanyard can be attached so that the person can not fall off the edge of the unit. A body belt is not fall protection it is a positioning device to prevent you from reaching the edge. Do not use a body belt if there is a chance that a fall of more than 2 ft can occur.

5. Before using any harness or belt, visually inspect its condition, looking for any fraying or tears. Check the contrasting colored stitching--if it is broken anywhere, the equipment has been over strained and should be taken out of service and returned to the safety person.

   If you are not sure what to use, or if you have any questions about the correct way to use the equipment, ask your supervisor or the safety person before you continue working.

O&M, Inc.

FIRE PROTECTION

I. PURPOSE

A. To provide a method to ensure the safety of personnel, property, and the environment from injury and damage due to a fire, both at O&M, Inc. fixed and field work locations.

B. To provide an effective fire prevention program through planning, training, education and inspections.

II. SCOPE

This procedure applies to all employees of *O&M, Inc.*

III. REFERENCES

A. 29 CFR 1910.38, Occupational Safety and Health Standards, Emergency Plans and Fire Prevention Plans

B. 29 CFR 1910, Occupational Safety and Health Standard, Subpart L - Fire Protection

C. *O&M, Inc.* Safety Policy

IV. PROCEDURE

A. General

1. Every work & office area of this building or structure and each mobile operation have been provided with fire extinguishing equipment appropriate for the fire hazards present or potentially present at each location.

2. All fire extinguishing equipment will be maintained in close proximity to the area of protection and access to this equipment shall not be blocked at any time.

3. All buildings are provided with appropriate exits with exit signs. These exits shall be kept clear and free of obstruction at all times.

B. Smoking

1. Smoking, including the use of matches and lighters, is permitted only in approved areas.

2. Smoking is also forbidden in any area where flammable liquids or gases are present.

3. Cigarettes, cigars, etc. shall be properly, completely extinguished prior to disposal, and shall be disposed of in proper receptacles.

C. Maintenance and Inspection

1. Listings are attached (Attachment 1) of major workplace fire hazards for O&M, *Inc.* offices and operations. These listings include the hazard, handling method, ignition sources and fire protection systems applicable.

2. Regular, monthly, inspections of fire protection equipment shall be performed to ensure proper operation and accessibility of equipment.

3. Monthly inspections shall also include looking for general fire hazards, inclusive of housekeeping concern.

D. Categories of Fires

1. Class A fires are those involving ordinary combustible materials such as wood, paper, cloth, and some rubber and plastic materials. Use a Class A fire extinguisher on this type of fire.

2. Class B fires involve combustible liquids (such as oils, gasoline, etc), flammable gases, greases and similar materials. Use a Class B fire extinguisher on this type of fire.

3. Class C fires involve energized electrical equipment where the electrical non-conductivity of the extinguishing agent is of importance (where electrical equipment is turned off at the power source, extinguishers of other classifications may be used safely). Use a Class C fire extinguisher on a Class C fire.

4. Class D fires are combustible metals, such as magnesium, titanium, zirconium, sodium, and potassium. Dry Powders that exclude oxygen and do

not react adversely with the metals are effective extinguishing agents. Use only a Class D fire extinguisher or dry powder on this type of fire.

E. Burning and Welding (Hot Work)

All burning, cutting torch, or welding operations, including any activity that may involve sparks, high heat or open flames, shall be performed in accordance with approved Burning and Welding Procedures.

F. Compressed Gas

1. All compressed gas cylinders shall be stored in well ventilated areas. The cylinders shall be secured upright at all times, and when not in use, the protective cap shall be placed over the cylinder's valve.

2. Flammable substances such as oil and volatile liquids should not be stored in the same area.

3. Cylinders of oxygen should not be stored within 20 feet of cylinders containing flammable gases. If storage must be closer that 20 feet, then the cylinders shall be separated by a fire-resistive wall (such as concrete partition) at least 5 feet high and have a fire rating of at least 1/2 hour.

G. Training and Education

1. All *O&M, Inc.* personnel that may respond to a fire are trained on the following:

   a. Fire hazards of the materials and processes in their areas.

   b. Categories of fires and fire fighting theory for each.

   c. Proper use of fire fighting equipment available for their use.

2. All trained personnel shall receive appropriate training.

ATTACHMENT I

MAJOR WORKPLACE FIRE HAZARDS

OFFICES:

HAZARD:

- Paper, trash, furniture, electric appliances

HANDLING METHOD TO REDUCE HAZARD:

- Remove trash daily
- Materials in proper storage area
- Proper disposal of smoking material
- Portable electric heaters w/tip over switches
- Coffee units turned off at end of work

IGNITION SOURCES:

- Smoking materials
- Coffee making equipment
- Overloaded electrical circuits

FIRE PROTECTION:

- Portable ABC or pressurized water fire extinguishers
- Use ABC or BC only on electrical fires, do not use water!

TRAFFIC/WAREHOUSE OPERATIONS

HAZARD:

- Gasoline/Diesel/Propane

HANDLING METHOD TO REDUCE HAZARD:

- Use gasoline safety container
- Never refuel running or hot equipment

IGNITION SOURCES:

- Smoking materials
- Hot engines
- torches - cutting & welding

FIRE PROTECTION:

- Portable BC & CO2 fire extinguishers

MAIN FACILITIES:

HAZARD:

- Flammable/combustible liquids in Stockroom & solvent storage oils, paints
- Compressed flammable gases

HANDLING METHODS TO REDUCE HAZARD:

- Prevent spills - Watch for leaks
- Keep cylinders chained upright & shut-off after use

IGNITION SOURCES:

\
- Smoking materials
- Open flames - welding, cutting, brazing

FIRE PROTECTION:

- Portable ABC & BC & CO2 fire extinguisher

O&M, Inc.

GENERAL SAFETY RULES

1. Employees must inform their supervisor immediately of any situations beyond their ability or authority to correct.

2. Supervisors shall insist that employees observe and obey every safety rule, regulation and order as necessary for the safe conduct of the work, and shall take such action as is necessary to obtain compliance.

3. Only qualified and/or licensed employees may operate any piece of equipment.

4. Anyone known to be under the influence of alcohol and/or drugs shall not be allowed on the job while in that condition. Anyone suspected of being under the influence will be required to submit to testing.

5. No one shall knowingly be permitted or required to work while his or her ability or alertness is so impaired by fatigue, illness or other cause that might expose the individual or others to injury.

6. Work shall be planned and supervised to prevent injuries in all work processes, particularly when working with equipment and handling heavy materials.

7. Employees shall immediately report any personal injury or damage to property to their supervisor, no matter how trivial, regardless of the amount of damage and irrespective of cause or fault.

SUPERVISOR'S RESPONSIBILITIES

1. To set examples of safe practices by their own conduct.

2. To investigate and correct, or have corrected promptly, unsafe conditions which have come to their attention.

3. To know, observe and enforce all general safety rules and such special instructions as are set up for their department.

4. To thoroughly acquaint each employee with safety instructions and practices and carefully observe them at their work.

5. To take part in work place safety and health program activities and contribute to their success.

6. To investigate and report all personal injuries, illnesses and property damage sustained on the job by the personnel within their area of responsibility.

7. To welcome and utilize, as far as practical, the safety suggestions which may be made by employees.

8. To see that the employees have and use personal protective equipment as determined by the Safety department and company SOGs.

9. To see that all tools and equipment are and remain in safe and proper working conditions.

EMPLOYEES RESPONSIBILITIES

1. Be alert to see that all guards and other protective devices are in their proper places and adjusted. Guards are not to be removed except by authorized personnel. Report all deficiencies promptly to your supervisor.

2. Horseplay, scuffling and other acts which tend to endanger the safety or well being of employees are prohibited.

3. Obey all posted warning and/or instructional signs.

4. Do not use equipment that has been tagged out until repairs have been made and the tags have been removed by authorized personnel.

5. You are responsible for housekeeping at your project site and in your work areas.

6. The access to all fire extinguishers, electrical panel boxes, eye washes, first aid kits and exits must be kept clear at all times. Any defective, damaged or missing fire protection or safety equipment must be reported immediately to your supervisor.

7. Keep flammable liquids only in the designated storage areas and in authorized and labeled containers which correctly identify the contents.

8. All aisles must be kept clear and open for traffic.

9. Smoking is permitted only in designated outdoor areas. Smoking is prohibited in company buildings and vehicles.

These rules are not all inclusive and are a summary of the specific rules in the Safety manual. Please familiarize yourself with these procedures and policies to produce a safe work place.

O&M, Inc.

HAZARD COMMUNICATION PROGRAM

I. PURPOSE

To facilitate worker health and safety through effective communication of the presence of hazardous materials, their associated hazards, and proper handling requirements in compliance with 29 CFR 1910.1200.

II. SCOPE

The Hazard Communication Program is applicable to all *O&M, Inc.* employees.

III. REFERENCES

A. Occupational Safety and Health Standards 29 CFR 1910.1200 Hazard Communications.

IV. PROCEDURE

1. *O&M, Inc.* shall meet the following criteria of the OSHA 1910.1200 Hazard Communication Standard:

   a. The Occupational Health & Safety Administration (OSHA) which is part of the Federal Department of labor requires chemical manufactures to access the hazards of chemicals which they produce and manufacturing employees to provide information to employees concerning hazardous chemicals in the workplace.

   b. OSHA has established the Hazard Communication Standard to reduce the possibility of chemically-related occupational injuries and illnesses to employees.

   c. The program's requirements are designed to ensure that *O&M, Inc.* receives the hazard information from our suppliers to enable us to inform our employees properly and implement the Hazard Communication Program. In addition, it provides necessary hazard information to associates, so that they can meaningfully participate in, evaluate and support the program instituted for *O&M, Inc.'* work places.

   d. The components of the Hazard Communication Plan involve:
      1. Hazard Determination
      2. Labeling and Warnings on Containers
      3. Material Safety Data Sheets
      4. Hazardous Chemicals used in the Workplace (Chemical Inventory)
      5. Associate Information and training
      6. Hazards of Non-Routine Work Assignments
      7. Contractors in the *O&M, Inc.* Workplace

2. This written program has been developed to meet the above criteria.

3. All chemicals purchased will have an MSDS made available to the Safety dept for listing and use in training. These chemicals will then be listed on the inventory. The MSDS will be kept in the Safety dept and copies available in the warehouse and on jobsites as required.

4 All employees will receive training on hazardous chemicals at *O&M, Inc.*;

   a. requirements of this program
   b. where chemicals are present in the work area
   c. location of the written program
   d. review a listing of MSDS available
   e. methods to detect the presence or release of chemicals by monitoring devices, visual appearance or odor
   f. the physical & health hazards of chemicals
   g. protective measures to be utilized to prevent exposure, work practices, emergency procedures and proper PPE to be used
   h. explanation of the labeling program

5. Since *O&M, Inc.* is an environmental project management company most operations outside of the office will require the use of a HASP (health and safety plan) which will detail all non routine tasks and any chemical exposures. A MSDS will be obtained for all identified chemicals which employees may be exposed to during field activities before activities begin.

6. When working on sites which involve multi employer situations the project manager and/or field supervisor will contact the other employers and advise them of where *O&M, Inc.* 'MSDS are located and at that time determine what chemicals the other contractors will be using in the shared work areas.

   a. All containers will have labels identifying the contents along with any appropriate hazard warnings. The name and address of the manufacturer shall also be on the container.

   b. Any containers which lose their label or whose contents are repackaged will have the information applied to the container thru the use of the HMIS labeling system. This system consists of 4 colored sections using a numbering system ranging from zero for no hazard to four for the highest hazard. The health, fire, reactivity and any specific hazard will be identified.

   c. Any employees who can not read or understand English will receive specific hands on training to understand the handling of the chemicals in the language they understand.

   d. See attachment A for a listing of known chemicals.

Attachment A – MSDS Listing

PRODUCT NAME				MANUFACTURER			
Complete this attachment when project chemicals and products are identified							

O&M, Inc.

HEAD PROTECTION

I. PURPOSE

To provide a method to ensure the appropriate use of protection to prevent head injuries resulting from contact with flying/falling objects, impact or low hanging equipment as well as limited electrical shocks and burns.

II. SCOPE

These requirements apply to all employees at *O&M, Inc.*

III. REFERENCES

A. 29 CFR 1910.135 and 1926.100, Occupational Safety and Health Standard, Occupational Head Protection

B. American National Standard Z89.1-2003, Safety Requirements, for Industrial Head Protection

IV. PROCEDURE

A. General

1. Hard hats shall meet the design and approval specifications of Policy E-1, ANSI Z89.1-2003, and Class E & G.

2. Individual hard hats will be provided to employees and will be replaced as necessary.

3. A supply of clean hard hats will be kept on hand for use by visiting personnel.

4. Hard hats shall be worn in the manner designed by the manufacturer and should be discarded and replaced if dented, chipped, chemically corroded, or otherwise damaged in any way.

5. Contaminated or potentially contaminated hard hats shall be decontaminated to minimize the spread of hazardous materials to clean areas. If they can not be decontaminated, they will be containerized for proper disposal, and the Supervisor notified.

6. Hard hats shall be worn at all times when in a work area as defined by the *O&M, Inc.* Personal Protective Equipment Policy. Specific hard hat use requirements are as follows:

   A. At all times on project sites
   B. Anytime in an electrical substation
   C. Warehouse Facilities - In posted areas
   D. When a supervisor believes it is required for safety

   NOTE: If Customer requirements are more stringent then *O&M, Inc.* policies, they shall take preference over *O&M, Inc.* requirements.

7. Hard Hats are normally not required:

   A. In Office Areas
   B. In Break Areas
   C. While donning or doffing other equipment required where temporary removal is required to facilitate the correct use of PPE.
   D. As approved by the project manager.

O&M, Inc.

HEARING PROTECTION

I. PURPOSE

To prevent hearing loss resulting from repeated exposure to excessive noise levels.

II. SCOPE

This policy applies to all *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1910.95, Occupational Safety and Health Standard, Occupational Noise Exposure

IV. PROCEDURE

Hearing protection devices will be worn at all times in designated areas.

A. Hearing protection will be required in those areas in which it has been determined that the 8 hour TWA (Time Weighted Average) exceeds 85 dba and the employee will be exposed for periods of greater than 15 minutes duration.

B. Designated hearing protection areas will be marked for easy identification by employees.

C. Employees consistently in and out of hearing protection areas shall keep their protective personal hearing protection devices to be used throughout the day.

D. Approved hearing protection devices are provided as necessary, by the Safety department.
   1. Foam/rubber inserts
   2. Muffs

E. If an employee believes noise in the work area is uncomfortable, he/she may use hearing protection at their own discretion - provided the Supervisor and other co-workers are notified.

F. Operations/areas, and the employees performing those job functions, requiring hearing protection are as follows:

1. Grinding/Polishing with Power Equipment
2. Air or power tools being used.
3. Painting
4. Client job sites that are marked as hearing protection required.
5. When normal conversation between two employees can not be heard due to background noise.

The above is not all inclusive of types of operations requiring hearing protection.

G. All employees who are exposed at or above an 8 hour time-weighted average of 85 decibels will have an annual audiogram conducted. The audiogram will be conducted by a certified/accredited vendor, whose procedures meet the requirements of 29 CFR 1910.95.

O&M, Inc.

HEAT STRESS

I. PURPOSE

To provide a method to minimize the risk of heat stress and to properly respond to heat stress cases that occur on the job.

II. SCOPE

This procedure applies to any *O&M, Inc.* personnel performing tasks in an area where, as a result of high temperature, strenuous work in protective clothing, etc., there is a reasonable risk of heat stress. This applies to employees working in the field.

III. REFERENCES

A. 29 CFR 1910.151, Occupational Safety and Health Standard, Subpart K, Medical and First Aid.

IV. PROCEDURE

A. Heat stress occurs when the body's temperature control system stops working properly because of exposure to internal and external heat sources in conjunction with other physical, cooling-restricting conditions. The following are precautions that should be taken to prevent heat stress:

1. Drink liquids to replace water lost by perspiration. Avoid alcohol and very cold drinks. If available, drink beverages which can provide electrolyte replacement, for example, Gatorade brand. If going on a planned project bring your own water cooler/jug to assure yourself of a source of water while on the project site. Stay away from sodas and teas and other drinks with caffeine as these make the body lose water. **Note: Do not drink Gatorade exclusively. Water is necessary to maintain a proper balance of fluids.**

2. Pace yourself during periods of heavy, hot work.

3. Take extra breaks and rotate duties when practical to reduce heat exposure time.

4. Avoid eating lots of heavy, fatty foods. Eat sensible meals.

5. Get plenty of rest when off the job.

6. Don't report to work with a hangover.

B. Types of heat stress, signs and symptoms, and treatment:

1. Heat Cramps

Signs and symptoms: Painful muscle spasms, usually of the leg muscles, that occurs after vigorous exercise. This is usually accompanied by profuse sweating.

Treatment: Move to a cooler area and remove excessive layers of clothing to aid in cooling the body. Sit or lie down and rest the cramping muscles. Drink cool (not cold) water.

2. Heat Exhaustion

Signs and symptoms: Profuse (heavy) sweating, skin is usually cold and clammy and face is a gray color. May be dizzy, weak, nauseous and complain of a headache.

Treatment: Remove yourself from hot environment immediately, loosen any tight clothing and remove all excessive layers of clothing. Have the person lie down. If the person is fully alert, have him/her drink up to 1 liter of water. If the person is not fully alert, DO NOT GIVE HIM/HER ANYTHING BY MOUTH.

3. Heat Stroke

Signs and symptoms: Hot, dry, flushed skin; they will not be sweating profusely because the sweating mechanism of the body is not functioning adequately. However, there may be some remaining moisture on the skin from the stages leading up to heat stroke. The person is usually not fully alert and may loose consciousness.

Treatment: **NOTIFY MEDICAL RESPONDERS IMMEDIATELY!** It is extremely important to cool this person off as quickly as possible. Remove all clothing to apply wet, cool towels or sheets to the body to aid in the cooling process. If possible, direct a fan directly on the person and DO NOT GIVE ANYTHING TO EAT OR DRINK. This person will require rapid transporting to a medical treatment facility.

C. The above treatments should be started immediately in all cases. The more extreme the case of heat stress (heat stroke) can be life threatening. Of course, in all cases of heat cramps, heat exhaustion or heat stroke, notify the required medical responder(s) immediately. However, treatment should be started without waiting for the responders to arrive on the scene.

D. All first aid and medical treatment rendered or obtained, including first aid considered non-emergency status shall be recorded and required notifications shall be performed.

O&M, Inc.

HEAVY EQUIPMENT SAFETY AWARENESS

I. PURPOSE

To provide awareness when working around heavy/moveable equipment.

II. SCOPE

This policy applies to all *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1926.602 Material Handling Equipment

IV. PROCEDURE

A. GENERAL

1. During certain projects *O&M, Inc.* may use heavy equipment such as a bobcat, bull dozer, excavators, scrapers, backhoes and other similar equipment for the excavation of soils and concrete. Employees must be aware of their presence on the project site and the safety concerns while working around such equipment.

2. Red Zones: When working around the following equipment a safe distance must be maintained.

3. Non extendable equipment; 15 feet in front of the machine and 15 feet behind the machine (with the side limits established during the job briefing according to individual circumstances).

4. Extendable equipment; 10 feet beyond the maximum reach of any extended portion of the machine in any direction.

5. Workers must not enter a machine's Red Zone without first communicating with the operator either through hand signals or a radio.

6. Operators must not allow the machine to approach workers closer than 15 feet without first communicating with them using a horn, hand signals or a radio.

7. Blind spots: remember, if the worker can not see the eyes of the operator, the operator can not see him.

O&M, Inc.

HOUSEKEEPING

I. PURPOSE

To provide a procedure defining housekeeping standards required to reduce accidents, minimize exposure to hazardous materials, and provide an efficient and effective work place.

II. SCOPE

This procedure applies to all *O&M, Inc.* employees at all work locations.

III. REFERENCES

A. 29 CFR 1910.22, Occupational Safety and Health Standard, Walking-Working Surfaces, General Requirements

IV. PROCEDURE

A. General

1. All stairways, passageways, gangways, and aisles must be kept free of materials, supplies, and obstructions at all times.

2. The floor of every work area must be maintained in a clean and, as far as practical, a dry condition.

3. All exits must be kept free of materials, supplies, and obstructions at all times for use in emergencies.

4. All fire extinguishers and eye wash stations must be kept clear for emergency use.

5. Tools, materials, extension cords, hose, or debris must not cause tripping or other hazards.

6. Tools, materials, and other equipment subject to falling must be adequately secured.

7. Accumulation of flammable and combustible liquids on floors, walls, etc., is prohibited. All spills of flammable or combustible liquids must be cleaned up immediately.

8 All electrical panel boxes, circuit breakers, and other electrical control equipment must be kept clear for an area of 30" in all directions.

B. Break, Office and Change Areas

1. Break, Office and Change areas must be maintained in a clean condition at all times.

2. No one with chemical contaminated clothing (Tyvek, gloves, etc.) shall enter a break, office or change area without proper decontamination per Personnel Decontamination Policy.

C. Trash

1. All chemical contaminated clothing (Tyvek, gloves, etc.) shall be placed inside appropriately labeled waste containers and lids secured.

2. All clean, non-contaminated trash shall be disposed of properly in clean waste receptacles.

D. Hazardous Material Work Areas

1. Environmental cleanliness (good housekeeping) is essential in maintaining the lowest exposure levels. Work areas shall be cleaned frequently to reduce levels of contaminants present and decrease chances of exposure through inhalation, ingestion and/or absorption.

E. Spills

1. Each individual shall be responsible for cleaning or seeing that any spill material is promptly cleaned up. If the employee can not handle the material or quantity spilled, the project manager and/or site supervisor shall be notified to provide additional help.

2. All spills shall be cleaned up in accordance with the HASP and other site-specific guidance, if applicable.

O&M, Inc.

LADDER SAFETY

I. PURPOSE

To describe the required procedures regarding Ladder Safety in the workplace.

II. SCOPE

All employees who might be expected to use a ladder during the course of work should be familiar with this document. This standard operating procedure covers all types of ladders, including step, extension, and fixed ladders. Ladder users must be able to recognize and avoid ladder hazards and be aware of safe practices in setting up, storing, moving and working from this equipment.

III. REFERENCES

CFR 1926. 1950-1960 Subpart X contains specific information on these rules.

IV RESPONSIBILITY

1. It is the responsibility of all employees who may use a ladder read and understand this SOP.
2. It is the responsibility of the field supervisor to review basic ladder training safety
3. It is the responsibility of all employees to inspect any ladder being used are free from defects and the all moving parts are working properly.

A. Ladder Categories

- Type IA-300 pounds extra heavy duty
- Type I-250 pounds, heavy duty
- Type II-225 pounds, medium duty
- Type III-200 pounds, light duty

B. Fixed Ladder - A ladder that can not be easily moved or carried, and may be an integral part of a structure.

C. Procedure

1. All employees who use ladders should have Ladder Safety Training.
2. Ladder Safety Training will consist of recognition of possible hazards associated with ladder use, proper maintenance and safety precautions to be taken when using ladders.
3. All employees must inspect them for defects or possible hazards before the ladders are used. Ladders with loose parts or faulty rungs should be taken out of service immediately, be tagged "Defective" and removed from the work area.
4. Whenever possible have someone within shouting distance while on a ladder.

D. Safe Ladder Setup

1. All ladders must be placed on a firm surface and secured from slipping.
2. Do not set ladders on boxes, blocks or other objects that might move.
3. Do not lean or reach out while standing on ladders.
4. Secure ladders whenever a danger of slippage might occur. If a ladder cannot be secured from slipping (e.g., on a smooth concrete surface) then an assistant must hold the ladder while the worker is on the ladder.
5. Do not use ladders in high wind or during inclement weather conditions.
6. Never set up ladders in front of or around doors, unless the door is posted, blocked and/or locked.
7. Do not sit on ladders.
8. Use safety shoes when climbing a ladder.
9. NEVER join 2 ladders together. If your ladder is not long enough, get a longer one.

E. Climbing and Standing on Ladders Safely

1. Always face a ladder when climbing up or down.
2. Avoid carrying materials or tools when climbing a ladder. Climb the ladder first then pull up the materials with a rope.
3. Rungs and steps should be clear of grease, oil, wet paint, snow, and ice before climbing.
4. Do not climb onto a ladder from the side.

5. Do not slide down a ladder.

6. Climb or stand on a ladder with your feet in the center of the rung.

7. NEVER stand on the top rung or step of a ladder and NEVER higher than the second step from the top of a step ladder.

F. Proper Use and Care of Ladders

1. Never use metal ladders near exposed electrical wires or circuits.

2. Place warning signs or traffic barriers around a ladder before use in or near roads, sidewalks or other vehicle or walking access areas.

3. Do not move a ladder while someone is on it.

4. Never use a ladder when under the influence of alcohol or prescription medications.

5. Do not leave tools or materials on top of ladders.

6. Only one person should be on a ladder at a time.

7. Do not use a ladder on a scaffold, in a man lift or on top of heavy equipment.

8. Do not try to "rock" or "bounce" a ladder to move it.

9. Store wood ladders where they will not be exposed to the elements.

10. Make sure ladders are properly secured when transported.

11. Do not paint wood ladders. Painting could hide potentially dangerous defects.

12. Remove defective ladders from service immediately, be tagged "Defective", and removed from the work area

G. Step Ladder Safety

1. Never use a stepladder over 20 feet in length.

2. Always open a stepladder completely and make sure the spreader is locked before use.

3. NEVER stand higher then the second step from the top of a step ladder.

4. NEVER straddle a stepladder.

H. Extension Ladder Safety

1. The sections of an extension ladder must sufficiently overlap to retain the strength of the ladder. See Table 1
2. Never splice or tie two short ladders together.
3. When using a ladder for access to a landing, it must extend 3 rungs or 3 feet above the landing.
4. The top of an extension ladder should rest against a flat, firm surface.
5. Elevate and extend these extension ladders only from the ground.
6. When practical, secure extension ladders at both the base and the top.

I. Extension Ladder Setup

1. Lay the ladder on the ground when it is collapsed.
2. Have someone foot the ladder or make sure it is braced against something.
3. Pick up the ladder and walk it to an upright position, making sure it will not be obstructed by trees or wires.
4. Slide the bottom of the ladder outwards to the proper angle and set the feet correctly.
5. Then extend the ladder by pulling the extension line.
6. Make sure the rungs on the upper half of the ladder are properly secured by the locking mechanism.
7. If possible, tie the ladder off or have someone steady the ladder as you climb it.

J. Fixed Ladder Safety

1. Fixed ladders must be secured to the object they are attached to.
2. Fixed ladders over 20 feet must have a safety cage surrounding the ladder.
3. The safety cage should have 15" clearance to all points from the center.
4. Defects in fixed ladders should be repaired as soon as possible.
5. When a defect is not repairable the ladder must be taken out of service.

Table 1

Length of Ladder	Required Overlap
Up to 36'	3 Feet
Over 36'to 48'	4 Feet
Over 48' to 60'	5 Feet

O&M, Inc.

LIFTING AND CARRYING

I. PURPOSE

To provide a method to minimize the risk of injuries resulting from the movement, lifting and carrying of tools, materials and equipment at work locations.

II. SCOPE

This procedure applies to all O&M, Inc. employees performing tasks involving the movement of materials that may cause short term, immediate injury or long term, cumulative trauma.

III. REFERENCES

A. N/A

IV. PROCEDURE

A. General

1. In order to minimize the probability of injuries resulting from movement of materials, the two basic types of injuries must be taken into consideration:

    a. Short term, immediate injury
    b. Cumulative trauma and/or repetitive motion

2. Short Term, Immediate Injury

    a. These are injuries that occur as a result of a specific, immediate event such as a pulled muscle, sprained wrist, etc.

    b. Injury severity may be minor requiring no medical response or treatment, or severe up to and including permanent disability and death.

3. Cumulative Trauma and/or Repetitive Motion

   a. Any and all activities performed by the human body results in stress ("wear and tear") on the musculoskeletal system. Lifting and carrying is particularly stressful, as well as activities performed repetitively.

   b. Musculoskeletal stresses repeatedly occurring over long periods of time can result in Cumulative Trauma Disorders (CTD's) that affect the spine, joints, muscles, nerves, etc. A commonly known CTD is Carpal Tunnel Syndrome. The likelihood of a CTD and its severity is related to three factors:

      - Frequency: How often the activity is performed.
      - Position: The position of the worker's body, extremities, etc. while performing the activity.
      - Pressure/Force: How much pressure or force is exerted when performing the activity?

4. Injury prevention during lifting and carrying can be accomplished by the following:

   a. Use materials handling equipment properly when available.

   b. Get assistance when for moving any materials weighing greater than 50 pounds (or awkward to carry, regardless of weight).

   c. Use proper lifting and carrying techniques at all times.

   d. Do not move materials unnecessarily.

   e. When tasks require material movement in awkward physical positions (e.g. arms extended, lifting overhead, etc.), consult with your supervisor or the Safety dept. for determination of best available procedure.

B. Use of Materials Handling Equipment

1. Where available, materials handling equipment should always be used to move materials from one point to another, regardless of the distance traveled.

2. Proper safety procedures, as described in this manual, shall be followed at all times when using materials handling equipment. Recommended manufacturer's procedures should also be followed.
3. Materials handling equipment that should be used includes but is not limited to:

    a. Hand trucks
    b. Hoists
    c. Forklifts
    d. Drum lifting tools

C. Guidelines for Lifting and Carrying

a. Less than 50 pounds lift: one person
b. 50 - 100 pounds lift: two persons required
c. 101 pounds or greater lift: material handling equipment must be used

D. Proper Manual Lifting and Carrying

1. The load should be tipped to test whether it is light enough for a one-man lift.

2. When ready to lift:

    a. One foot should be placed beside the object, and one foot behind it.

    b. The back should be kept straight. Nearly vertical.

    c. The chin should be tucked in, to help keep the back straight.

    d. The object should be lifted by bending the knees and gripping with the whole hand, not just the fingers.

    e. Arms and elbows must be kept close to the body.

    f. The object should be drawn close to the body and body weight should be centered over the feet.

    g. The body should be shifted until a straight lift can be made by pushing up with the leg muscles, not putting a strain on the back or getting in awkward positions.

    h. Lifting to a position above the waist should not be with one motion. The load should first be raised waist high (using the procedure just described) then rested on a support while grip is changed. The knees should be bent again to get leg muscles into the final lift.

3. When something is carried, the grip and position should not be adjusted without stopping and resting the load on a support.

4. To set the load down, just follow the lifting procedure, but in reverse, bending the legs, not the back, setting one corner down first to slide hands out so they won't get pinched.

5. Help should be obtained to lift large or heavy objects. When two or more persons carry a load, the procedure should be reviewed beforehand and the route and clearances checked. One person should act as a leader and position himself so he can watch and coach the others. If the object is long, each person should carry it on the same side of his body - and everyone should walk in step. Items cannot be safely stacked without a safe base.

E. Injury Prevention

1. The use of back belts is an optional procedure when doing any lifting and carrying. Back belts have, in some situations, found to be a help when lifting and carrying is a constant job requirement.

2. Following the above procedures will help eliminate many situations where a pulled or strained back would occur.

O&M, Inc.

LIFTING DEVICES

I. PURPOSE

To establish a procedure for proper operation and inspection of Material Handling Lifting Devices.

II. SCOPE

This procedure applies to *O&M, Inc.* personnel and equipment.

III. REFERENCES

A. 29 CFR 1910.176, Occupational Safety and Health Standard, Handling Materials - General

B. 29 CFR 1910.179, Occupational Safety and Health Standard, Overhead and Gantry Cranes.

C. 29 CFR 1910.184, Occupational Safety and Health Standard, Slings.

IV. PROCEDURE

For your own and other *O&M, Inc.* employees safety, Material Handling Equipment must be used and maintained as recommended by the Manufacturer. Failure to adhere to the following recommendations could endanger your life. Use good common sense and judgment at all times. Safety is the responsibility of the operator of the equipment. You must be competent and attempt to foresee and avoid all hazardous conditions. To be safe as possible, the hoist must be given proper preventative maintenance and testing.

A. Before Operating Hoist and completing Rigging

1. Do not operate hoist or completed rigging unless you are properly trained, physically fit, and authorized to do so. You must be familiar with all operating controls of the hoist, warnings, and instructions on the hoist, the safe hoisting practices, and service guides.

2. On powered hoists, test all controls and limit switches and make sure hoist is well lubricated at the beginning of each shift. Make sure needed lubrication, adjustments, or repairs are made by appointed personnel before operations are begun.

3. Conduct periodic visual inspections as described by the Service manuals, and make sure necessary lubrication or repairs are made.

B. Wire Rope

A wire rope is a piece of flexible, multi-wired, stranded machinery made of many precision parts.

Any wire rope in use should be inspected on a regular basis. You have too much at stake in lives and equipment to ignore thorough examination of the rope at prescribed intervals.

The purpose of inspection is to accurately estimate the service life and strength remaining in a rope so that maximum service can be had within the limits of safety. Results of the inspection should be recorded to provide a history of rope performance on a particular job. On most jobs, wire rope must be replaced before there is any risk of failure.

The Occupational Safety and Health Act has made periodic inspection mandatory for most wire rope applications.

C. Wire Rope Inspection

All wire rope will be inspected once a month during the monthly shop inspections and signed and dated inspection report maintained. The Inspection Check List(s) attached can be used to record these inspections.

WIRE ROPE SHOULD BE REPLACED IF ANY OF THE FOLLOWING CONDITIONS ARE NOTED:

1. Six (6) randomly distributed broken wires in one rope lay, or three (3) broken wires in one strand in one rope lay.

2. Reduction of three-sixty-fourths inch (3/64) of the original diameter of outside individual wires.

3. Kinking, crushing, bird-caging, or any distortion of the wire rope structure.

4. Evidence of heat damage, or excessive corrosion.

5. Reduction from nominal diameter due to loss of core support, internal or external corrosion, wearing of outer wires.

D. Hoisting Equipment

1. All cables, chokers, chains and slings shall be thoroughly inspected before use. Defective ones will be cut and discarded.

2. All come-a-longs, chains, hoists and hydraulic rams shall be thoroughly inspected before use. Defective ones will be repaired before use.

3. The employee must be thoroughly familiar with the safe working load of the cable, sling, chain and/or any other lifting equipment. There is no room for guess work. If you do not know the lifting capability of the equipment please consult your supervisor or the Safety department.

4. Loads with sharp edges should be properly protected to avoid damage to load or slings.

5. A chain or cable must never be used on loads with smooth surfaces because slippage may occur. A rope or fabric sling is safest for this use.

6. All hoist blocks must be directly over the load before lifting.

7. Only qualified and duly authorized persons may operate heavy equipment, or do necessary rigging and signaling.

8. It is the responsibility of the person rigging the load to see that the load is securely fastened and balanced.

9. The crane is designed to carry weight at its center, not on the point.

10. Personnel are to be lifted only in equipment specifically designed for that purpose.

11. Loads should be lifted just high enough to clear obstacles on the floor or ground. When the loads are to be carried over a distance to a higher position, they should be carried as stated and then lifted to the desired height.

12. When using come-a-longs, the supporting member should be checked to make sure it will carry the load.

13. A load should never be lifted and left unattended.

O&M, Inc.

HOIST INSPECTIONS

HOIST #:	TYPE:	DATE:

INSPECTED BY:	OK	DEFECTIVE
Guards in Place		
Manual Controls		
Wire rope (defective if six randomly broken wires in one rope lay or three broken wires in one strand in one rope lay)		
Limit devices		
Abrasion scrubbing, flattening or peening of wire rope		
Electrical connections		
Evidence of heat damage		
Hook (deformed or cracked)		

COMMENTS:

O&M, Inc.

SYNTHETIC SLING INSPECTION

SLING NO.	TYPE:	DATE:

INSPECTED BY:	OK	DEFECTIVE
Abnormal Wear		
Powdered fiber between strands		
Signs of stretching		
Discolored or rotting		
Distortion of hardware		
Marked or coded for capacity		
Snag, puncture, tear or cuts		
Broken or worn stitches		

COMMENTS:

O&M, Inc.

SLING INSPECTION FORM

FACILITY: _____

DATE	INSPECTOR	SYNTHETIC WEB SLINGS (torn, punctured, snapped, frayed, cut)	WIRE ROPE SLINGS (kinked, broken wires, other distortions)	CHAIN SLINGS (damage)	ACTION TAKEN

SlingInsp.Form

O&M, Inc.

LOCKOUT/TAGOUT POLICY
(ZERO MECHANICAL-ELECTRICAL STATE)

I. PURPOSE

To provide a procedure to ensure isolation of electrical power or electrically driven equipment, engine driven equipment, lines carrying hazardous substances and or high pressure systems.

II. SCOPE

This policy applies to *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1910.147 Occupational Safety and Health Standard, Subpart J, The Control of Hazardous Energy (Lockout/Tagout), dated September 20, 1990.

IV. PROCEDURES

Before anyone works on or in electrical power or electrically driven equipment, engine driven equipment piping connected to pumps or tanks, the following procedures must be followed:

A. Stationary Electrical Power Equipment (including but not limited to transformers, regulators, reactors, tap changers, switches, and breakers).

1. All electrical switchgear and breakers which energize equipment to be serviced must be de-energized, locked and tagged, tested, and grounded prior to any service being performed. Refer to the "Safety in Preparing Stationary Electrical Power Equipment for Servicing" Section 5 of this procedure, for details.

2. Levers, switches, actuators, controllers, etc. which supply power to any equipment involved in servicing must be inspected and tested to verify all related circuits have been de-energized. These devices must be locked and clearly tagged to identify the equipment's status.

3. All locks and tags, utilizing a multiple lock adapter, must be attached or removed only by a Supervisor. The Supervisor shall be responsible for worker safety during the lockout.

4. Each employee engaged in any service work involving a lockout shall install his/or her lock and tag on the equipment.

5. In the event of the client prohibiting contractor locks in the field, a variance will have to be approved by the project manager and the client prior to proceeding with the alternate log-out/tag-out procedure.

6. In the case of a Supervisor change of duty, the Incoming Supervisor shall install his or her lock and tag prior to the outgoing Supervisor removing theirs.

7. Only upon completion of the servicing, including a thorough inspection of the site, equipment, and personnel shall the locks and tags be removed by the Supervisor.

B. Stationary Electrically Driven Equipment

1. All electrical switchgear to be worked on with energized moving equipment, such as pumps, blowers, screw conveyors, agitators, conveyers, centrifuges, compactors, etc., must be locked/tagged out.

2. Push buttons which operate the equipment to be worked on must be tried to ensure that the proper electrical circuit(s) have been isolated.

3. In cases where pumps or similar equipment are activated by a float valve, or where it is impossible to make a positive check on the safety of the lock out, safety jacks must be removed from Rowan starters and fuses pulled from all other type starters.

4. If such pumps, motors or equivalent are actuated by mechanical devices, such as floats, the devices must be tried manually to ensure that proper deactivation has been achieved.

5. All drive belts must be removed on multiple line shaft driven equipment.

6. Switches controlling electrical equipment must be locked out using a multiple lock adaptor. One padlock shall be used for each employee involved in the job. This is to prevent exposure to moving equipment when one employee completes his assignment and another employee is remaining, performing additional tasks.

7. Each employee who will work on equipment involving a lockout is to be provided with his or her own lock and key.

8. A padlock is to be installed by the employee involved in the job at the beginning of the job or work period and removed at the end of the job or work period. The employee or employees doing the work will retain the key to the padlocks being used.

9. When subsequent work crews are required on the job, actual changes of padlocks are involved. Incoming workers will attach their padlocks before the relieved workers remove theirs.

10. When locks are changed, the Supervisor(s) concerned should completely and thoroughly check the lockout as originally made to assure the continued protection of employees.

11. A **"Danger - Do Not Operate"** tag must be installed on the switches being locked out. The tag must be filled out with the date and name(s) of personnel involved on each crew. The tag to be filled out by the Supervisor.

C. Engine Driven Vehicles

1. When work must be performed on equipment or vehicles powered by an internal combustion engine, the engine must be rendered inoperable by one of the following means:

   a. Removal of the ignition or starter actuation key.

   b. Disconnecting of the battery cables and insertion of a padlock through the disconnected wire terminal.

   c. Isolation by means of a lock type battery disconnect switch.

2. Attempt to actuate the equipment by operating the switch, button, or lever. Air and hydraulic pressure must be relieved when necessary.

3. The employee(s) working on the equipment will retain the keys to the ignition switch and/or padlocks used.

4. A **"Danger - Do Not Operate"** tag must be installed on the control panel and/or at the battery disconnect point. The tag must be filled in by the Supervisor with the date and name(s) of personnel involved on the job.

D. Interlocked Controllers and Starters

1. Interlocked controllers, controller and starters should be rendered safe by an electrician or qualified employee as determined by the Safety & Operations Departments.
2. No fuses shall be removed or replaced unless being performed with a fuse puller.

E. When piping valves cannot be locked out, the line must be double blocked or blanked. This will prevent any pressure, heated water or chemical from being introduced into the operation.

If repair is to be made on any lines where the leak can cause employee injury, the system will be shut down for repairs.

F. Danger Tags

1. White, plastic danger tags will be used in conjunction with the lock-out of all equipment being prepared for maintenance work or isolating equipment for production reasons.

2. When equipment is isolated for maintenance work, the Supervisor will date and sign the danger tag, then attach it to the valves, breakers or controls that are required to isolate the equipment. Only when the employee(s) has informed the Supervisor that the work has been completed and the equipment can be checked out for service, can the danger tag be removed. NOTE: When exposed to weather conditions plastic tags should be used.

V. SAFETY IN PREPARING STATIONARY ELECTRICAL POWER EQUIPMENT FOR SERVICING

Depending on the service to be performed, the equipment may or may not be de-energized. The Supervisor will make whatever arrangements are necessary with the affected employees or the customer, if field service, for performing the servicing in either mode, and outline this information with the employees involved.

In many cases, the transformer being serviced will be de-energized, but much of the equipment surrounding it will still be energized. Employees must know the work site and recognize what's energized and what's de-energized before performing any work. If employees are uncertain of anything, they must consult the Supervisor prior to commencing work.

To prepare a transformer for safe de-energized servicing, there are three major functions with several steps that must be performed prior to starting the actual servicing work.

The functions are:

a. Switching - to de-energize primary and secondary of the transformer.
b. Testing - to verify transformer is de-energized.
c. Grounding - to ground the transformer primary and secondary to protect service personnel.

The Supervisor will make all necessary arrangements and inform the employees as to what their jobs will be in these functions. Only qaulified personnel, as determined by the project manager or field supervisor, may perform these functions. By performing this work unapproved, employees may endanger themselves or other workers. Always use extreme caution whenever working with electrical equipment, in either energized or reenergized modes. As always the minimum safety equipment in a substation is a hard hat, occupational safety glasses with side shields, and appropriate safety shoes.

A. Switching

1. The Supervisor will make arrangements to organize times, sequence, and durations of power outages.

2. With proper arrangements made, the load from the secondary breakers is removed. Once assured the load is off, the proper secondary breakers would be opened. The normal sequence would be to open the small "feeder" breakers first, then de-energize the main secondary breaker. The secondary main should then be racked out of the cubicle, then locked and tagged out of the circuit. However, in some substations there may be a tie breaker which allows the feeder breakers to receive power from another source, which in turn would allow de-energizing of the main breaker from the secondary of the transformer to be serviced, while the feeders are operated off

another secondary main which may be at the substation being serviced, or a remote area. If this is the case, be extremely careful as conductors to the feeders will be energized. Employees must always check with the Supervisor for verification on what type system they are working with and what will remain energized.

3. After the transformer's secondary breaker is removed, the primary voltage shall be removed from the transformer's primary side. Typically, for an indoor substation there would be a switch located at the transformer which would be opened and locked out. The next step would be to open, remove, tag, and lock out the high voltage breaker which supplies the primary voltage to the transformer.

4. Verify all proceeding steps have been met, and all personnel involved are satisfied with the lockout and tagging before proceeding to the testing function.

B. Testing

1. High Voltage or Primaries

a. The Supervisor will verify all switching procedures and give the "all clear" for testing to begin.

b. After physically verifying its being de-energized, the access panels to the high voltage side of the transformer would be carefully removed, allowing access to the primary bushings. Under no circumstances should contact be made with any conductor until it is verified de-energized and properly grounded.

c. The actual testing for the presence of voltage is done with a voltage detector which is properly "sized" for the voltage being tested. The person performing this testing or detecting shall wear "hot" gloves and protectors while performing the tests along with the usual hard hat and safety glasses, and safety shoes. When utilizing a detector or indicator, the first step before testing the transformer primary bushings and switch for voltage shall be to test the voltage detecting/indicating device to assure it is operating properly. This may be done by testing the instrument for operation by using it on a voltage source known to be energized. If it responds to the known energized source, the next step is to verify the transformer primary bushings and switch are de-energized. (No presence of voltage indicated.) The final step is to retest on the known energized source to verify the instrument is still operating properly.

d. Should any parts of the high voltage switch or cabling being worked on or adjoining equipment remain "energized", then these areas must be covered with dielectric blankets and tagged accordingly. All personnel involved must be aware of this before proceeding.

2. The Secondary Voltage

   a. The transformer's secondary access panels should be carefully removed. Under no circumstances should contact be made with any conductor until it is verified de-energized and properly grounded.

   b. When utilizing a detector or indicator, the first step before testing the transformer secondary bushings and breaker for voltage would be to test the voltage detecting/indicating device to assure it is operating properly. This may be done by testing the instrument for operation by using it on a voltage source known to be energized. If it responds to the known energized source, the next step is to verify the transformer secondary bushings and breaker are de-energized. (No presence of voltage indicated). The final step is to retest on the known energized source to verify the instrument is still operating properly.

   c. Should any parts of the secondary switchgear/breaker panel being worked on adjoining equipment remain energized, these areas must be covered with protective dielectric blankets to isolate them, and tagged to warn all involved personnel.

3. Once both the primary and secondary of the transformer are tested and verified de-energized, the grounding function would take place.

C. Grounding

1. The Supervisor will verify all testing procedures and give the "all clear" for grounding to begin.

2. The person installing the grounding cables should first install the "tail" line of the ground cables to a secure substation ground, with (1), three phase set dedicated to the primary and (1), three phase set dedicated to the secondary of the transformer.

3. The installer would then put on "hot" gloves with protective covers (he or she should already have a hard hat, occupational safety glasses with side shields, and steel toed safety shoes) to actually install the cables on the transformer, using a "hot" stick.

4. Taking (1), three phase set of ground cables, and wearing all appropriate safety gear, the installer would approach the primary conductors, and turn his head and "tap" the grounded cable against each conductor to verify that there is not residual inductance or capacitance on these lines.

5. Next, each phase would have an individual cable attached securely to it. Now the grounding of the primary is complete.

6. Taking the second three phase set of ground cables the installer would approach the secondary conductors, and turn his head and "tap" the grounded cable against each conductor to verify that there is not residual inductance or capacitance on these lines.

7. Next, each phase would have an individual cable attached securely to it. Now the grounding of the secondary is complete.

8. All ground cables are to remain attached until all personnel are completed with the transformer servicing, and an "all clear" is given by the Supervisor to remove the ground.

VI. SPECIAL INSTRUCTIONS

A. Removal of Locks

1. In the event an employee who installed a padlock or removed an ignition key from a piece of equipment has left the site for any reason, the following procedure shall be used:

   a. The Supervisor must be assured that the employee is no longer at work on the equipment in question.

   b. The Supervisor may cut the lock from the secured equipment after all other locks are removed by the respective employees.

   c. The Supervisor assumes full responsibility for the safe re-energizing of the equipment involved. If the equipment belongs to a client, the client shall be responsible for actually re-energizing the equipment.

   d. A written record should be made of the circumstances. (Attachment)

O&M, Inc.

REMOVAL OF LOCK(S) WRITTEN VERIFICATION FORM

DATE:_____

Employee(S) LOCK BEING REMOVED: _____

_____

_____

_____

SUPERVISOR REMOVING LOCK:

PRINT NAME:_____ SIGNATURE:_____

WITNESS TO THE REMOVAL OF LOCK:

PRINT NAME:_____ SIGNATURE:_____

LOCKOUT PROCEDURE

Date: _____ Authorized maintenance employee:

Equipment to be locked out:

Dept. & Location:

Circle energy sources: electrical, air, hydraulic, spring, flywheel, thermal, chemical, engine

Location to place isolating lockout(s):

1. Notify affected employees that the machine is to be shut down and locked out.

Employees notified:

2. If in operation, shut down machine with normal stopping procedure.

Circle method: turn off switch, turn off key, unplug, push stop button, other

3. Isolate all energy sources and apply lock(s). (ex. breaker locked off, "on" switch locked off)

Method:

4. Block or dissipate all stored energy.

Method:

5. Verify lockout by (circle) **A**. testing operating controls, **B**. test with electrical meter, **C**. visually verifying contact is open inside panel. **Power can still be connected even though the switch says OFF! REMEMBER TO RETURN CONTROLS TO "OFF" AFTER TEST.**

When machine is operational **remove tools, replace guards**, and return to service as follows:

1. Check that all employees are safely positioned: (Circle) YES NO

2. Notify all affected employees machine is ready for operation and locks will be removed.

Notified:

3. Remove all locks, blocks, or other energy restraints.

4. Restore all energy to the machine.

O&M, Inc.

MATERIALS HANDLING PROGRAM

I. PURPOSE

To provide a method to ensure proper handling of hazardous materials and proper usage of materials handling equipment at *O&M, Inc.*

II. SCOPE

This applies to all employees, contractors and visitors at *O&M, Inc.*

III. REFERENCES

A. *O&M, Inc.* HASP and SOP Personal Protective Equipment.

B. *O&M, Inc.* SOP Forklift Operating.

C. *O&M, Inc.* SOP Drum & Container Handling.

IV. PROCEDURE

A. The performance of any task at *O&M, Inc.* whether it involves hazardous materials/waste or not, requires compliance with all applicable safety and health procedures in the HASP.

B. When operating or riding on or in any vehicle while on *O&M, Inc.* property or while conducting company business regardless of location, seat belts **shall be worn at all times**. This applies to company cars, trucks, personal vehicles being used for company business, as well as "industrial trucks" such as forklifts, if equipped.

C. Powered industrial trucks (fork lifts, man-lifts, etc) shall be operated, inspected, and maintained in accordance with the Powered Industrial Trucks SOP.

D. Commercial vehicles shall be operated, inspected, and maintained in accordance with the Commercial Vehicle Procedure, Section G-3 of this manual.

E. Lifting devices used at *O&M, Inc.* shall be used, inspected and maintained in accordance with the Lifting Devices SOP.

F. Potential hazardous materials exposures of personnel, plant equipment, grounds, and the environment shall be minimized by performing work practices in compliance with effective contamination control procedures and decontamination.

G. Drums and containers of hazardous materials and hazardous waste shall be handled in accordance with standard safe handling practices.

H. Material handling equipment used to move drums and containers of hazardous materials shall be selected, positioned, and operated to minimize sources of ignition related to the equipment from vapors released from ruptured drums or containers.

I. Shipping and Transport

1. Drums and containers shall be identified and classified prior to packaging for shipment.

2. Drum or container staging areas shall be kept to a minimum number necessary to identify and classify materials safely and prepare them for transport.

3. Staging areas shall be provided with adequate access and egress routes.

4. Bulking of hazardous materials and hazardous wastes shall be permitted only after thorough characterization of the materials has been completed.

O&M, Inc.

POWER HAND TOOLS

I. PURPOSE

To insure safe handling of portable power hand tools in order to prevent injury and reduce the possibility of accidents.

II. SCOPE

This procedure applies to *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1910, Occupational Safety and Health Standards, Subpart P, Hand and Portable Powered Tools

IV. PROCEDURE

A. General

1. All hand tools shall be in good repair and used only for the purpose for which it was designed.

2. Tools having defects shall be removed from service.

3. When work is being performed overhead, tools not in use shall be secured or placed in holders.

4. Throwing materials or tools from one location to another, from one person to another, or dropping them to lower levels, shall not be permitted.

5. Only non-sparking tools shall be used in locations where sources of ignition may cause a fire or explosion.

6. Power tools shall be inspected, tested, and determined to be in safe operating condition prior to use.

7. Rotating or reciprocating portable power tools shall have a constant pressure switch that will shut off the power when the tool is released by the operator.

8. Ground wires are mandatory on all power tools.

B. Grinding Tools

1. Portable grinding tools shall be guarded so that a maximum of 180 degrees of the grinding wheel is exposed; and the guard shall be located so as to be between the operator and the wheel during use.

2. Work or tool rests shall not be adjusted while the grinding wheel is in motion.

3. Tool rests on power grinders shall not be more than one-eighth inch distance from the wheel.

4. All abrasive wheels shall be closely inspected and ring tested before mounting. Cracked or damaged grinding wheels shall be destroyed, and/or properly disposed of.

5. Floor stand and bench mounted abrasive wheels, used for external grinding, shall be provided with safety guards.

6. Face shield shall be worn during the grinding operation.

7. Cotton or leather gloves should be worn during the grinding operation.

C. Pneumatic Tools and Equipment

1. Safety clips or retainers shall be installed and maintained on pneumatic impact tools to prevent dies and tools from being accidentally expelled from the barrel.

2. Pressure shall be shut off and exhausted from the line before disconnecting the line from any tool or connection.

3. Defective hoses shall be removed from service.

4. Hoses shall not be laid over ladders, steps, scaffolds, or walkways to create tripping hazards.

5. The use of compressed air for blowing dirt from hands, face, or clothing is prohibited.

6. Compressed air shall not be used for other cleaning purposes except where reduced to less than 30 psi. When cleaning with air, face shield or Mono goggles shall be worn. At no point in time will compressed air be used to blow dirt from clothing.

7. Hoses shall not be used for hoisting or lowering tools.

8. Hearing protection shall be used when working with or around operating air compressors.

D. Power Saws

1. Circular saws shall be equipped with guards that automatically and completely enclose the cutting edges, splinters, and anti-kickback devices.

2. Cracked, bent, or damaged blades shall be destroyed.

3. Power saws shall not be left running unattended.

4. All portable, power-driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for level cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

5. All power saws shall be equipped with a pressure driven switch only. No locking devices allowed.

6. Extra eye protection is required when operating power saws, (face shields with safety glasses)

O&M, Inc.

POWERED INDUSTRIAL TRUCKS

I. PURPOSE

To provide a procedure to ensure the safe operation of powered industrial trucks at *O&M, Inc.* work locations.

II. SCOPE

This procedure applies to forklifts, man-lifts, backhoes, front-end loaders, etc. used at O&M, Inc. work locations.

III. REFERENCES

A. 29 CFR 1910.178, Occupational Safety and Health Standards, Powered Industrial Trucks

IV. PROCEDURE

A. Operators

1. The operation of powered industrial trucks at *O&M, Inc.* shall be performed only by trained and qualified operators.

2. Operators must use safety belts, if equipped, while operating any powered industrial truck.

3. Operator training for all equipment shall include:

   a. Classroom training on the knowledge required to correctly inspect and safely operate the vehicle.

   b. Practical skill demonstration that shows the operator is capable of performing required skills on the vehicle.

   c. Documentation to verify the above training and practical exercise has been completed.

4. Qualifications of drivers may be suspended or revoked as a result of violation(s) of operating procedures or unsafe actions while operating a vehicle.

B. Inspection

1. All vehicles shall be formally inspected prior to use. For vehicles used on a regular basis, this inspection shall be performed at the beginning of each shift.

   a. If the vehicle is found to be in need of repair, defective, or in any way unsafe, it shall be taken out of service until it is restored to a safe condition.

   b. Document the inspection using the Operator's Lift Truck Inspection Form attached.

2. Each Operator shall perform a brief inspection every time prior to starting a vehicle, checking brakes, hydraulic lines, tires, etc. for obvious unsafe conditions.

C. Operation

1. When an operator discovers any unsafe condition during vehicle operation, the operator shall immediately take the vehicle out of service and notify the maintenance department or the Supervisor to effect repairs.

2. Trucks shall not be driven up to anyone standing in front of a bench or other fixed object that could result in a worker being "caught between" a vehicle and a fixed, immovable object.

3. No person shall be allowed to stand or pass under the elevated portion of any truck, whether loaded or empty.

4. Unauthorized personnel shall not be permitted to ride on any truck. Other than the operator, the only time personnel may ride on a vehicle is when an approved personnel carrying device is used.

5. Arms and legs shall not be placed between the uprights of the mast or outside the running lines of the truck.

6. Fire aisles, access to stairways and emergency response equipment shall be kept clear at all times.

7. Operator shall slow down and sound horn at cross aisles, doorways, and other locations where vision is obstructed. Operator shall also sound horn when starting to back up.

8. If the load being carried obstructs forward view, the driver shall travel in reverse, with the load trailing.

9. The Operator shall look in the direction of travel at all times, <u>including when backing up,</u> and keep a clear view of the path of travel.

D. Parking

NOTE: A powered industrial truck is considered unattended when the operator is 25 feet or more away from the vehicle which remains in his view, or whenever the operator leaves the vehicle and it is not in his view.

1. When the operator gets off the vehicle, whether it is unattended or remains attended, brakes shall be set and load engaging means shall be fully lowered.

2. When a vehicle is left unattended, brakes shall be set, power shut off, load engaging means fully lowered, and controls shall be neutralized.

OPERATOR'S DAILY REPORT & INSPECTION
ENGINE POWERED LIFT TRUCKS

THIS INSPECTION MUST BE PERFORMED BY EACH SHIFT ON A DAILY BASIS

TRUCK NO._____ MAKE_____ LOCATION/DEPT._____

NOTE: ALL SAFETY ITEMS MUST BE OPERATING OR THE LIFT TRUCK MUST BE TAKEN OUT OF SERVICE UNTIL REPAIRED. IF ITEMS ARE FOUND INOPERATIVE, IMMEDIATELY NOTIFY THE MAINTENANCE DEPARTMENT AND TAG THE LIFT OUT OF SERVICE TO EFFECT REPAIRS. WHENFORMISFULL AND COMPLETED RETURN TO MAINTENANCE FOR FILING.

CHECK EACH ITEM - P/F	DATE/SHIFT:	DATE/SHIFT:	DATE/SHIFT:	DATE/SHIFT:	DATE/SHIFT:	DATE/SHIFT:
BRAKES-SERVICE/PARKING						
LIGHTS-HEAD, TAIL & WARNING						
HORN						
STEERING						
TIRES						
HYDRAULIC CONTROLS						
BACK-UP ALARM						
SEAT BELT						
OIL LEVEL & PRESSURE						
WATER LEVEL & FAN BELT						
OPTIONAL-FUEL LEVEL						
OTHER CONDITIONS						
INSPECTOR'S INITIALS						

REMARKS AND/OR ACTIONS TAKEN: _____

O&M, Inc.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

I. PURPOSE

To provide an overview of the types, purpose, and procedures required for the use of personal protective equipment by *O&M, Inc.* personnel.

II. SCOPE

The policy applies to all *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1910, Occupational Safety and Health Standard, Subpart I, Personal Protective Equipment
B. *O&M, Inc.* Safety SOP, Respiratory Protection
C. *O&M, Inc.* Safety SOP, Eye/Face Protection
D. *O&M, Inc.* Safety SOP, Head Protection
E. *O&M, Inc.* Safety SOP, General Safety Rules
F. *O&M, Inc.* Safety SOP, Hand Protection
G. *O&M, Inc.* Safety SOP, Hearing Protection
H. *O&M, Inc.* Safety SOP, Electrical Safety

IV. DEFINITIONS

Work Areas: Areas where work is being or to be performed that may present physical or health hazards as a result of process operations, maintenance, materials handling etc. These areas include, but are not limited to, areas such as operations, maintenance and storage areas in the field.

Office Areas: Areas where work is performed and equipment is present that is customarily employed with routine, administrative types of activities. This includes offices with copiers, typewriters, computers, etc., and office hallways that are not used for work areas as previously defined.

Break Areas: A designated location at the workplace where employees and visitors routinely take breaks, eat and drink.

Basic Work PPE: Long pants, sleeved shirts (no tank tops), occupational safety glasses with permanently attached side shields, steel toed work boots/shoes, hard hat, leather palm work gloves (typical).

Additional PPE: Additional requirements are defined in the HSP. Additional requirements may also be implemented due to task modifications and/or other project events as defined by the Safety Officer.

V. PROCEDURE

A. Appropriate PPE shall be used, and maintained in a sanitary and reliable condition. PPE will be required where ever it is necessary, by reason of hazards, processes, environment, chemical hazards, and/or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

B. Protective clothing shall not be ripped, torn or unzipped in any way except during its final removal.

O&M, Inc.

RESPIRATORY PROTECTION

I. PURPOSE

A. To define general respiratory protection program requirements.

B. To clearly identify respiratory protection areas and conditions.

C. To provide a step by step procedure covering the proper inspection, use, and maintenance of respiratory protection equipment, both routine use and emergency or escape equipment.

D. To provide a procedure to maintain compliance with respiratory protection standards when working, supervising or inspecting in an area where it has been determined or is suspected that exposure to toxic substances could exceed allowable levels.

II. SCOPE

This applies to all *O&M, Inc.* employees.

III. REFERENCES

A. 29 CFR 1910.134 Occupational Safety and Health Standard, Respiratory Protection

IV. PROCEDURE

1. The requirements governing the selection and use of respirators during routine operations and in emergencies shall be job specific.

2. Respirators shall be selected on the basis of hazards to which the employee is exposed in accordance with ANSI Z88.2 (1969).

3. Respirators will be assigned to individual employees or be of a one use type. Respirators shall be stored in a sanitary condition.

4. Employees shall not be assigned to tasks requiring the use of respirators unless it has been determined by a medical examination that they are physically able to perform the work and use the equipment. The company physician shall determine the ability of an associate to wear a respirator and perform his work by reviewing the respirator user's health history and recent (12 month's less) physical examination record, or by a current exam that included a pulmonary function evaluation.

5. Only respiratory protection devices approved by the National Institute for Occupational Safety and Health (NIOSH) shall be worn.

A. Job Assignments Requiring the Use of Respirators

1. Full Face air purifying

    1. Painting
    2. Air arcing
    3. Welding
    4. Entry into an atmosphere where chemical PELs are exceeded
    5. Entry into an unknown chemical/product situation.

2. Dust mask

    a. Sanding
    b. Grinding
    c. Sweeping
    d. General cleaning

3. Abnormal Circumstances

NOTE: This requirement may be instituted at any time, in any area by the project manager or the field supervisor.

a. Appropriate cartridge respirator shall be worn in the areas where, due to unforeseen conditions, have become suspect of approaching maximum permissible exposure level.

b. In atmospheres containing 19.5% oxygen or lower, supplied air respiratory protection must be used.

B. Respirator Wearer Requirements

1. Medical Certification

a. Before any negative pressure (cartridge type) respirator may be used, Respirator Clearance must be issued by the Company's physician.

b. Medical clearance will include the minimum of medical history, report of respiratory ailments, a pulmonary function exam and a chest x-ray.

2. Personal Hygiene

a. No person shall wear a negative pressure (cartridge type) respirator which requires a seal if they have facial hair which may affect to any degree the sealing ability of the face piece.

b. Mustaches and sideburns are permitted as long as they are neatly trimmed and do not extend into the sealing area of the respirator.

c. Beards, goatees or other facial hair shall not be allowed within the sealing radius of the respirator.

C. Use of Respirators

1. The respirators shall be worn at all times by all personnel in areas where their use is designated, or whenever their use is justified by a particular exposure in a given work assignment.

2. Standard procedures governing the use and maintenance of respirators shall be issued to all users. This information will be included in the employee respirator usage guidelines.

3. Respiratory protection is no better than the respirator in use even though it is worn conscientiously. Inspections shall be conducted by the field supervisor to ensure that respirators are properly used, cleaned, and maintained.

4. For the safe use of any respirator, it is essential that the user be properly instructed in its use and maintenance. Training shall provide employees with an opportunity to handle the respirator, have it fitted properly, and its face piece to face seal tested. This training will be documented according to the requirements listed below.

D. Inspection, Maintenance and Care of Respirators

1. All respirators shall be inspected by the wearer routinely before use. Respirator inspection shall include a check of the tightness of connection and condition of the face piece, headband, hoses, connectors and valves. Rubber or elastomer parts shall be inspected for pliability and signs of deterioration.

2. Respirators are to be washed and disinfected after each day's use, even if foreign matter is not visible. Initial cleaning and decontamination of the outer body of the respirator should be performed by using an alcohol wipe pad on all exterior surfaces. Discard the pad in the contaminated waste when visible soiled, using the quantity necessary to effectively clean the respirator. Upon completion, let air dry. Remove the protective lens cover from the face piece, then, using Windex or equivalent, clean both the outside and inside of the lens. Replace the lens cover with a new one when dry. Spray both interior and exterior surfaces of the respirator with Clean-Gear disinfectant or equivalent. Let it set for ten minutes, then wipe dry. Clean all internal areas of the respirator using alcohol wipe pads, replacing when visibly soiled. Let air dry. Filters should be replaced under the following guidance;

    a. The air flow is restricted due to blockage.
    b. A calculated use time has been determined based on chemical knowledge, PPM, humidity and work activity.
    c. At the end of every shift.

(This section does not apply to disposable respirators.)

3. After inspection, cleaning, and any necessary repair, place the cleaned and disinfected dry respirator in a sterile respirator storage bag. Respirators may not be stored in lockers or tool boxes unless they are in carrying cases or cartons. Respirators shall be stored in a clean container.

4. Respirators stored for emergency use must be inspected monthly. An inspection checklist attached.

E. Training and Education

1. For the safe use of any respirator, it is essential that the user be properly instructed in its selection, use and maintenance.

2. The training shall include the following:

   a. Instruction in the nature of the hazard and an honest appraisal of what may happen if the respirator is not used.

   b. A discussion of why this is the proper type of respirator for this particular purpose.

   c. A discussion of the respirator's capabilities and limitations.

   d. Instructions and training in the actual use of the respirator. Training shall provide each employee an opportunity to handle the respirator, have it fitted properly, test its face-to-face piece seal and wear it in normal air for a ten-minute familiarity period.

   e. The manufacturer's instructions and caution for each respirator model shall be discussed. These instructions must be followed for the respirators to work properly.

   f. The need for a good fit and the effect facial hair has on the fit will be discussed.

3. The respirator user shall be briefed in the following procedures for cleaning and disinfecting respirators, including the following:

   a. Removal of any filters, cartridges, canisters or tanks.

   b. Disassembly of other parts, as required, and washing in a cleaner/disinfectant.

   c. Rinsing completely in clean water.

   d. Allowing parts to air dry.

   e. Inspection of valves, gaskets, head straps and other parts, replacing with new parts if necessary.

f. Inspection of new filters, cartridges, canisters of tanks. (This section not applicable to disposable respirators.)

4. Training in the maintenance and care of respirators shall provide each employee an opportunity to disassemble, inspect and reassemble the respirator, where applicable, and become familiar with the respirator cleaning procedures.

5. A suitable fit test shall be used to determine that a proper seal is obtained. A poor face-to-face piece seal can cause contaminants to be inhaled through the respirator sealing surfaces, instead of through the cartridge, canister, filter or air supply system.

Proper fit test procedures will depend on the type of respirator being fitted and may include:

a. Negative pressure test
b. Positive pressure test
c. Irritant smoke test
d. Bitrex test

F. Fit Test Procedure

Each type of negative pressure cartridge respirator shall be fit tested on every employee whose job it might require its use. Either the Irritant Smoke protocol or the Bitrex vapor test will be performed. All tests will be conducted in accordance will the protocols listed in 29 CFR 1019.1025, App. D.

G. Recordkeeping

1. A record will be kept for each employee for all initial and review training sessions. The records will include:

a. Medical respirator evaluation -- to be completed by the consulting physician. Approval by the physician shall be updated during each subsequent periodical physical examination.

b. Training record -- to be completed by the training instructor after initial training.

Periodic review training must also be documented for each employee (see Attachment 2). No employee shall be assigned to a task where respiratory protection is required unless proper training has been given and documented and a medical evaluation has been rendered indicating that the employee is physically fit to wear the required respiratory protection device(s).

H. Types of Respirators

In this procedure the word "respirator" is used to mean any of the various respiratory protection devices approved for use within the limits prescribed by the manufacturer. Some

types of devices are described below for information only. Selection of the proper type of respirator(s) for use in each program shall be designated by qualified individuals.

A. Air Purifying - Particulate Removing Filter Respirators.

1. These are generally called "dust", "mist" or "fume" respirators

2. They are available in disposable (single use), quarter-mask, half-mask and full-face piece types for various contaminates at prescribed levels.

3. This type of respirator does not provide oxygen, so it can never be worn in oxygen deficient atmospheres.

4. Particulate removing filter respirators offer no protection in atmospheres containing gases or vapors.

5. These respirator types should not be used if the air concentration of dusts, fumes and/or mists exceeds 10 times the PEL for airborne contaminants.

6. These respirator types should not be used for abrasive blasting conditions.

B. Air Purifying - Chemical Cartridge and Canister Respirators for Gases and Vapors.

1. These respirators remove gases and vapors by trapping them on materials such as activated charcoal.

2. They are available in quarter-mask, half-mask, and full-mask face piece types for various chemicals and groups of chemicals. Some half-mask types are available in disposable form.

3. The element providing protection is the cartridge (or canister) which is designed to remove a particular contaminant. The specific label will tell you what the cartridge (or canister) protects against and at what concentration.

4. Canisters used in conjunction with cartridge respirators are required to be specifically color coded and specifically labeled. (See Attachment 3)

5. This type of respirator does not provide oxygen, so it can never be worn in oxygen deficient atmospheres.

6. They may not be used if the chemical to be protected against lacks adequate warning properties -- odor, taste or irritant. Warnings such as these are necessary to alert the user that; (1) the chemical absorbent is saturated, and (2) the contaminant is passing through the cartridge or canister and you are breathing the contaminant.

7. They must not be used in atmospheres immediately dangerous to life and health (IDLH).

I. Cautions

1. Respiratory protection devices are approved for a particular usage when used as supplied by and in accordance with manufacture's instructions.

2. Parts from one respiratory protection device must not be interchanged with that of any other, even if the parts seem to fit properly or the devices are approved for the same contaminant.

3. Respirators must be used with all originally equipped parts intact. For example: if a respirator was originally equipped with two headbands, it must always be used with both headbands properly in place.

4.

Attachment 1

O&M, Inc.

RESPIRATOR EVALUATION

_____ DATE_____

EMPLOYEE'S NAME

_____

SOCIAL SECURITY NUMBER

was examined by me on the above date. The examination and diagnostic test results indicate no apparent malfunction or medical condition which would render the employee unfit to wear a respiratory protection device, of the filter type or air supply type, in the course of his/her employment.

_____ _____

PHYSICIAN'S NAME (Print) PHYSICIAN'S SIGNATURE

_____

DATE

Attachment 2

O&M, Inc.

Qualitative Respirator Fit Test Report

Subject's Name: _____

Last 4 numbers of SS: _____

EQUIPMENT: ½ Mask ☐Full Face SCBA Size: S M L

Make: _____

Model: _____

FITTING: Positive Pressure Check – Pass Fail
Negative Pressure Check – Pass Fail

EXERCISES:

Normal breathing	Deep breathing
Turning head side to side Talking (Rainbow Passage)	Moving head up and down
	Bending over or jogging

TEST AGENT:

☐Irritant Smoke	Banana Oil
☐Saccharin	Bitrex

RESULTS: The subject passed the fit test. The subject failed the fit test.

This fit test is valid for one year from the test date.
This face piece fit test is valid with any approved cartridge.

SUBJECT'S STATEMENT: I have been trained in the use of the respirator and I understand that my use of the respirator must be in accordance with company work rules, manufacturer's instructions and OSHA regulations.

SUBJECT'S SIGNATURE: _____ **DATE:** _____

TESTER'S SIGNATURE: _____ **DATE:** _____

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch with its path high above and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

O&M, Inc.

IDENTIFICATION OF CANISTERS

1. LABELING

Labeling must state "permissible chemical cartridge for:

_____

"(name of atmospheric contaminant)"

2. COLOR CODING

Color coding is required as follows:

	ATMOSPHERIC CONTAMINANT (to be protected against)	COLOR ASSIGNED
*	Acid Gases	White
*	Organic Vapors	Black
*	Ammonia Gas/Methyl Amine	Green
*	Acid Gas/Ammonia Gas	Green stacked on yellow (2 cartridges)
*	Acid Gases/Organic Vapors/Ammonia Gases	Green stacked on yellow (2 cartridges)
*	Radioactive Material (except Tritiam, Noble Gas, and Highly Toxic Particulates, dust, fumes, mists, fogs or smoke)	Purple (Magenta)
*	Organic Vapor/Acid Gas/Chlorine/Hydrogen Sulfide	Yellow

Attachment 4

O&M, Inc.

GAS ASSOCIATION COMMODITY SPECIFICATION

GRADE 'D' BREATHING AIR

Limiting Characteristics	Amount
Oxygen (0), balance predominantly nitrogen	19-23%
Water (see Note 1)	-------
Hydrocarbons	5 mg/^{3}m*
Carbon Monoxide	20 ppm**
Odor (See Note 2)	--------
Carbon Dioxide	1,000 ppm**

Note 1: The waste content of compressed air required for any particular grade may vary with the intended use from saturated to dry. If a specific water limit is required, it should be specified as a limiting dew point or concentration in ppm (v/v).

Note 2: Specific measurement of odor in Grade "D" air is impractical. Air normally may have a slight odor. The presence of a pronounced odor should render the air unsatisfactory for breathing purposes.

*mg/m - milligrams of hydrocarbon per cubic meter of air

**ppm - parts of containment per million parts of air

Attachment 5

O&M, Inc.

EMERGENCY EQUIPMENT
RESPIRATOR INSPECTION

RIG NO.:	LOCATION:	DATE:

INSPECTED BY:	OK	DEFECTIVE
Defects (including leak check)		
Clean and disinfect		
Repairs necessary		
SCBA - tank full		
SCBA - regulator function		
SCBA - hoses deteriorated		
SCBA - warning devices		

COMMENTS:

O&M, Inc.

DAILY RESPIRATOR INSPECTION FORM

INSPECTION DATE	EMPLOYEE NAME	RESPIRATOR TYPE	FINDINGS/COMMENTS

O&M, Inc.

SAFETY MEETING PROGRAM

I. PURPOSE

To ensure employees maintain an awareness of applicable safety issues through periodic (daily) safety meetings.

II. SCOPE

This policy applies to all *O&M, Inc.* employees including supervisors, managers, etc.

III. REFERENCES

A. *O&M, Inc.* Health and Safety Policy

IV. PROCEDURE

A. All Operation personnel shall attend. Topics covered will normally include but are not limited to:

1. Updates on safety performance results.

2. Review of recent accidents/incidents, either at *O&M, Inc.* and/or other applicable locations.

3. New or changed safety policy requirements.

4. Reinforcement of current policy (based on feedback from accident reports, employee corrective actions, etc.).

B. Group Safety Meetings ("Safety Talks")

1. All groups shall perform periodic safety meetings on topics pertinent to the safety and health of personnel in the group.

2. This meeting should be in conjunction with the daily safety talk at field site locations.

3. Topics discussed should be taken from one of the following sources:

a. Group specific topic (see Attachment 1).

b. *O&M, Inc.* Safety Bulletins.

c. Hazard Communication Program (for example, an MSDS review of a specific material used in the work group, labeling requirements, etc.).

d. Newspaper or magazine articles pertaining to accidents or other safety and health issues at other industry facilities.

4. Document meetings using an *O&M, Inc.* Safety Meeting Attendance Form (Attachment 2).

a. Send a copy of the form to the Safety Officer.

C. Special Safety Meetings

Special safety meetings may be conducted at any time, either company wide or group specific, when deemed necessary by *O&M, Inc.*.

ATTACHMENT 1

SAFETY MEETINGS
GROUP SPECIFIC TOPICS

The Safety and Health Program Manual should be a major source for meeting topics. All sections should be covered; however, particularly applicable sections for certain groups should be emphasized.

Manual sections that are lengthy should be broken down into different meeting topics to ensure an accurate retention of information covered. For example, a group may elect to discuss safe forklift operation during a meeting and then cover forklift inspections at the next meeting.

Date:_____. Meeting conducted by: _____
_____.

Topics discussed in today's meeting:

1.

2.

3.

4.

5.

ATTACHMENT 2

O&M, Inc.

TRAINING SIGN IN SHEET

SUBJECT		DATE: TRAINER:
NAME - Print	COMPANY	SIGNATURE

O&M, Inc.

SAFETY POLICY ENFORCEMENT

I. PURPOSE

A. To strengthen the safety awareness program and to provide a means of implementing the Safety and Health Policies at *O&M, Inc.*

II. SCOPE

This policy applies to all employees at *O&M, Inc.*

NOTE: This procedure is provided to support normal personnel disciplinary procedures. This procedure should not interfere with nor otherwise circumvent the interpretation and implementation of the normal personnel procedures.

III. REFERENCES

A. See Company Human Resources Policies

IV. PROCEDURE

SAFETY POLICY ENFORCEMENT

Employees that violate the *O&M, Inc.* Health & Safety Policies will be issued warnings as follows:

1st offense - Verbal warning (documented in writing in project logbook)
2nd offense - Written warning and unpaid retraining in safety areas in question
3rd offense - 2nd written warning; unpaid retraining & subject to days off without pay
4th offense - 3rd written warning; unpaid retraining & subject to reduction in hourly pay rate, and/or days off without pay or termination.

A. Serious violations that significantly endanger the health and safety of any facility personnel (including the offender) may result in the bypassing of the normal disciplinary progression up to and including immediate termination for the first offense.

B. Warnings may be initiated by any *O&M, Inc.* supervisor or manager, and will be issued to the employee by the supervisor.

C. Each warning will stay in the employee's file.

O&M, Inc.

SCAFFOLD SOP

I. PURPOSE

To provide guidelines to O&M, Inc. employees in the safe use of scaffolding, and to reduce the risk of injury to themselves and others while using scaffolding.

II. SCOPE

To define the procedures, responsibilities and safety of *O&M, Inc.* personnel who work with or around scaffolding.

III. REFERENCES

- Code of Federal Regulations 29, 1910.28, Safety requirements for scaffolding
- Code of Federal Regulations 29, 1910.29, Manually propelled mobile ladder stands and scaffolds (towers)
- Code of Federal Regulations 29, 1926.450-454, Scaffolds

IV. DEFINITIONS

Competent Person: Is a person who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Qualified Person: Is a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his/her ability to solve or resolve problems related to the subject matter, the work, or the project.

A. Scaffolding

Scaffolds are a source of accidents when not used properly. The National Institute for Occupational Safety and Health's (NIOSH) research data suggests that fatal falls occur as a result of defective scaffold equipment, improper installation of equipment, improper training of workers, or failure to use appropriate personal fall protection equipment.

B. General requirements for scaffolding

1. The standard requires fall protection at a 4-foot height above a lower level for employees.

2. Scaffolds shall not be erected, moved, dismantled, or altered except under the supervision of a competent person.

3. The footing or anchorage for scaffolds must be sound, rigid, and capable of carrying the maximum intended load without settling or moving.

4. Unstable objects such as barrels, boxes, loose brick, or concrete blocks must not be used to support scaffolds or planks.

5. An access ladder or equivalent safe access must be provided.

6. Scaffolds four to ten feet high, having a minimum horizontal dimension in either direction of less than 45 inches, must have standard guardrails installed on all open sides and ends of the platform. Scaffolding more than 10 feet above the ground or floor must have guardrails and toe-boards installed at all open sides and ends.

7. Guardrails:

   - Must be made of not less than 2 x 4 lumber or other material providing equal protection. Guardrails must be approximately 42 inches high.

   - Must have a mid-rail of at least 1 x 6 lumber or other material giving equal protection.

   - The height of the top rail for scaffolds manufactured and placed in service before January 1, 2000 can be between 36 inches and 45 inches. The height of the top rail for scaffolds manufactured and placed in service after January 1, 2000 must be between 38 inches and 45 inches.

8. Toe-boards:

   - Must be a minimum of four inches in height.

   - Where persons are required to work or pass under a scaffold, a wire mesh screen must be installed between the toe board and the guardrail.

9. Extend scaffold planks over their end supports a minimum of six to twelve inches.

10. When the cross-point of cross bracing is used as a top rail, it must be between 38 inches and 48 inches above the work platform.

11. Mid-rails must be installed approximately halfway between the top rail and the platform surface.

12. When a cross point of cross bracing is used as a mid-rail, it must be between 20 inches and 30 inches above the work platform.

13. Erecting and dismantling - When erecting and dismantling supported scaffolds, a competent person must determine the feasibility of providing a safe means of access and fall protection for these operations.

14. Inspections - Before each work shift and after any occurrence that could affect the structural integrity, a competent person must inspect the scaffold and scaffold components for visible defects.

15. Overhand bricklaying - A guardrail or personal fall arrest system on all sides except the side where the work is being done must protect employees doing overhand bricklaying from supported scaffolds.

16. The revised scaffold standard may require more than one competent person on each job site.

17. Scaffold planking must be of scaffold grade or equivalent.

18. The height of a stationary scaffold should not exceed four times its base, unless it is tied, guyed or otherwise.

C. Tubular welded frame scaffolding

1. Scaffold legs must be set on adjustable or plain bases placed on mud sills or other foundations adequate to support the maximum rated load.

2. Properly brace scaffolds by cross bracing or using diagonal braces, or both, for securing vertical members together laterally. Cross braces must be long enough so they will automatically square and align vertical members. In this way, erected scaffolds will always be plumb, square, and rigid.

3. All brace connections must be secure.

D. Training – Employers must train each employee who works on a scaffold on the hazards and the procedures to control the hazards. Training shall include:

1. The nature of any electrical hazards, fall hazards and falling object hazards in the work area.

2. The correct procedures for dealing with electrical hazards and for erecting, maintaining, and disassembling the fall protection systems and falling object protection systems being used.

3. The proper use of the scaffold, and the proper handling of materials on the scaffold.

4. The maximum intended load and the load-carrying capacities of the scaffolds used.

Protect yourself and/or your employees from serious injuries and even death. Employers and employees should be familiar with key provisions of the scaffolding standard:

- A qualified person must provide safety training for each worker who uses a scaffold.
- A competent person must give safety training to any worker who assembles, takes apart, moves, operates, repairs, maintains, or inspects scaffolds.
- If the worksite changes or the type of scaffold or safety equipment changes, workers using scaffolds must be retrained.

E. Summary

The goals of this plan are to reduce and eliminate personnel injuries and fatalities, and any damage to equipment and facilities from incidents involving scaffolding.

COMPETENT PERSON SCAFFOLD INSPECTION LIST

The competent person checklist is for daily inspections and is to be used as a guide. Refer to regulations and manufacturer for full technical detail.

OSHA

The *competent person* should use this checklist for daily inspections of the scaffold. It is not all-inclusive and should be used as a starting point for the *competent person* to develop a checklist specific to the type of scaffold and jobsite conditions encountered.

Are scaffolds and scaffold components inspected before each work shift by a competent person?

Have employees who erect, disassemble, move, operate, repair, maintain, or inspect the scaffold been trained by a *competent person* to recognize the hazards associated with this type of scaffold and the performance of their duties related to this scaffold?

Have employees who use the scaffold been trained by a qualified person to recognize the hazards associated it with this scaffold and know the performance of their duties relating to it?

Is the maximum load capacity of this scaffold known and communicated to all employees?

Is the load on the scaffold (including point loading) within the maximum load capacity of this particular scaffold?

Is the scaffold plumb, square, and level?

Is the scaffold on base plates and are mudsills level, sound, and rigid?

Is there safe access to all scaffold platforms?

Are all working platforms fully planked?

Do planks extend at least 6 inches and no more than 12 inches over the supports?

Are the planks in good condition and free of visible defects?

Does the scaffold have all required guardrails and toeboards?

Are 4:1 (height to width) scaffolds secure to the structure as required?

O&M, Inc.

SAFETY SHOWERS AND EYE WASH

I. PURPOSE

To provide a method to ensure the availability, proper operation, and usage of safety showers and eye wash stations used in the event of a personnel contamination incident.

II. SCOPE

This applies to all *O&M, Inc.* employees working in the field

III. REFERENCES

A. 29 CFR 1910.151, Occupational Safety and Health Standard, Subpart K, Medical and First aid

IV. PROCEDURE

A. Access and Availability

1. Where the eyes or body of any associate may be exposed to injurious corrosive or other chemical materials, safety showers and eye washes shall be provided.

2. Each associate has the personal responsibility to make sure that they are thoroughly familiar with the locations of the shower and eye wash units in the work area and how to use them.

3. Access to safety showers must be kept clear at all times.

4. Each new employee must be thoroughly oriented on the locations of shower and eye wash units before being permitted to work alone.

5. If portable units are subject to freezing, they should be kept in a heated area such as heated truck cabs to prevent freezing.

B. Inspection

1. Shower and eye wash units must be inspected and tested at least monthly, and more frequently in those areas where is has been determined necessary to do so.

2. Any shower or eye wash unit found to be inoperative MUST be reported immediately to the Project Manager.

3. Safety showers are not to be used for connection of additional water hoses or lines.

4. If a customer's eye wash/shower is identified for potential use, then the Supervisor or Lead Technician shall perform a usage inspection.

C. Usage

NOTE: Notify the Safety Department as soon as possible after an incident has occurred to ensure the necessary assistance is obtained.

1. Safety Shower

   a. For whole body contamination, stand directly under the shower, rinsing contaminants off of outer clothing prior to removal.

   b. Care must be taken to avoid getting hazardous materials in the eyes, nose or mouth during showering.

   c. Remove outer clothing while continuing to shower.

   d. Stay under the shower for a minimum of 15 minutes.

2. Eye Wash

   a. Holding eyelids open, flush for a minimum of 15 minutes.

   b. Get medical assistance immediately.

   c. Where portable eyewash only is available, wash eyes thoroughly. Transport to nearest medical facility immediately.

O&M, Inc.

UNSAFE CONDITION TAG-OUT

I. PURPOSE

A. To prevent *O&M, Inc.* employees from using unsafe equipment and entering unsafe areas.

II. SCOPE

A. This policy applies to all *O&M, Inc.* employees.

III. REFERENCES

A. *O&M, Inc.* Safety & Health Manual

IV. PROCEDURE

1. As a means of communicating, assessing and preventing unsafe conditions at both fixed and field work sites of *O&M, Inc.*, a Repair Tag shall be installed on the item or area in question until the situation is corrected.

2. The tag shall be installed by the employee who discovers the problem and may be removed only when the condition has been corrected.

3. The top and bottom part of the tag is to be filled out with the relevant information and the bottom part removed and given to the operations coordinator for recording and submittal for repair or correction.

4. Only after the manager in charge of the item or area, or the Safety Officer, is satisfied the item or area has been corrected will it be released for use.

UNDER NO CIRCUMSTANCES MAY ANY EMPLOYEE REMOVE A TAG, UTILIZE OR OPERATE, A TAGGED OUT ITEM OR ENTER A TAGGED OUT AREA WITHOUT PERMISSION FOLLOWING SPECIFIED PROCEDURES. DOING SO MAY CAUSE A SERIOUS INJURY OR FATALITY AND WILL BE CAUSE FOR DISCIPLINARY ACTION AND POSSIBLE IMMEDIATE DISMISSAL.

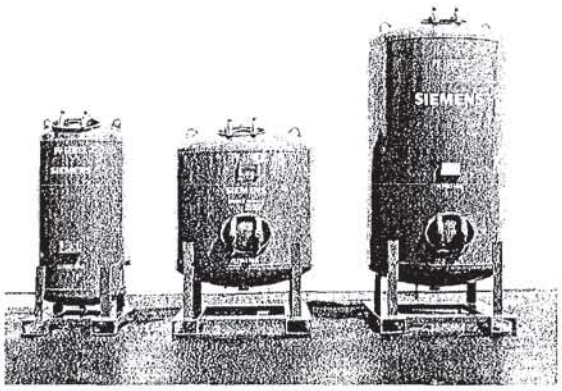
APPENDIX L

Liquid-Phase Granular Activated Carbon

The PV® Series adsorbers are designed for use in a wide range of low/high flow and pressure applications.

- Groundwater remediation
- Wastewater filtration
- Tank rinse water treatment
- Pilot testing
- Underground storage tank clean up
- Leachate treatment
- Dechlorination
- Spill cleanup
- Hydrotesting

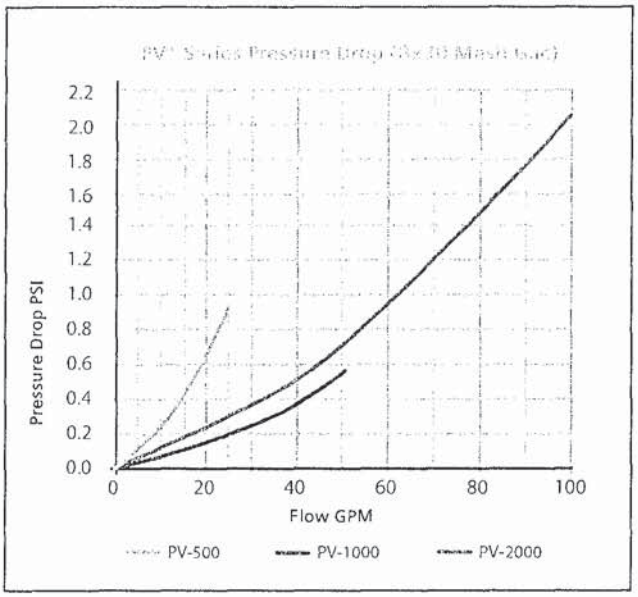
Siemens can provide a total service package that includes utilizing OSHA trained personnel providing on-site carbon changeouts, packaging and transportation of spent carbon for recycling at our reactivation facilities.



At the time of purchase or rental of the adsorbers, arrangements should be made for the reactivation of the spent carbon. Siemens will provide instructions and assistance on how to obtain acceptance of the spent carbon at our reactivation facilities. Spent carbon cannot be accepted for reactivation until the acceptance process is completed.

	PV-500	PV-1000	PV-2000
Dimensions (Dia. x Overall Height – Approx.)	30" x 5'7"	48" x 5'7"	48" x 8'8"
Inlet Connection, (Top)	2"	3" NPT (Female)	3" NPT (Female)
Outlet Connection, (Bottom)	2"	3" NPT (Male)	3" NPT (Male)
Manway, Top & Lower Side	11" X 15" (top only)	11" X 15"	11" X 15"
Internal Piping	PVC	PVC	PVC
Interior Coating (All Units)	Epoxy	Epoxy	Epoxy
Exterior Coating (All Units)	Epoxy/Urethane	Epoxy/Urethane	Epoxy/Urethane
Carbon Fill Volume (Cu.ft.)	18.5	34	68
Vessel Weight (lbs.):			
Shipping (With Carbon)	1050	1910	3200
Operating (Approx.)	1750	4300	7500
Flow, GPM (Nominal)	25	50	100
Pressure, PSIG (Maximum)1	75	75	75
Temperature °F. (Maximum)	140	140	140
Pounds Of Activated Carbon	500	1000	2000
Contact Time @ Max Flow/Min	5	5	5
Backwash Rates (GPM) @ 55°F	30	75	75

1The PV® Series adsorbers are not ASME code stamped. Pressure rating applies to liquid only.
For detailed dimensional information or drawings, contact your local Siemens sales representative.
For information on the HP® Series ASME code stamped adsorbers, contact your local Siemens representative.



Safety Note: 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 completeness of 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.

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WS-PV2dr-DS-0308

AquaCarb® 830 and AquaCarb® 1240 carbons are high activity granular activated carbons manufactured from selected grades of bituminous coal. Manufactured by direct activation, they exhibit exceptional hardness and attrition resistance and have become a cost effective choice for use in municipal, industrial and remedial water treatment applications. These high surface area microporous carbons have been specifically developed for the removal of a broad range of organic contaminants from potable, waste and process waters.

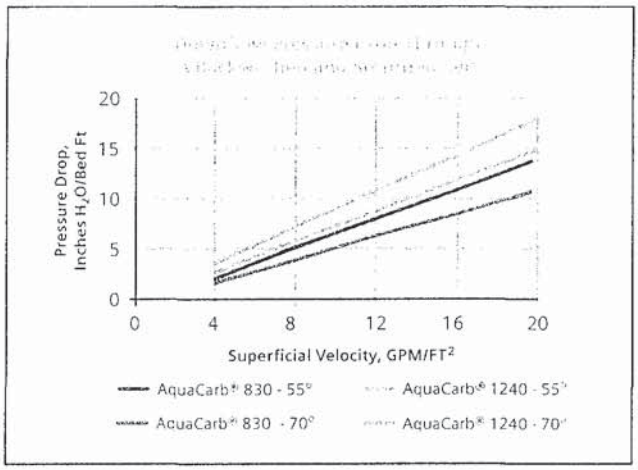
Cost effective AquaCarb® activated carbons developed by Siemens have been demonstrated to provide superior performance in an extensive array of liquid phase treatment applications. AquaCarb® activated carbons are available for:

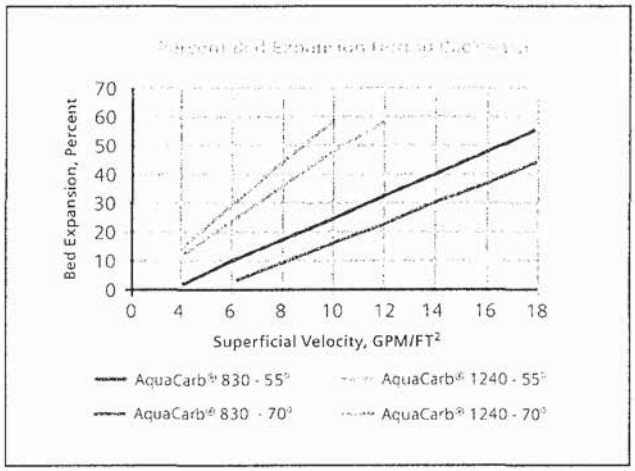
- Dechlorination/chloramine reduction
- Removal of organic contaminants
- Taste and odor reduction
- Disinfection-by-product (DBP) removal
- Pesticide removal
- Drinking water treatment
- Groundwater remediation
- Wastewater treatment
- Industrial process water treatment
- Biological activated carbon support

AquaCarb® activated carbons are extensively quality checked at our State of California certified environmental and carbon testing laboratory located in Los Angeles, CA. Siemens' laboratory is fully equipped to provide complete quality control analyses using ASTM standard test methods in order to assure the consistent quality of all Westates® carbons.

Our technical staff offers hands-on guidance in selecting the most appropriate system, operating conditions and carbon to meet your needs. For more information, contact your nearest Siemens representative.

Parameter	AquaCarb® 830	AquaCarb® 1240
Carbon Type	Bituminous Coal	Bituminous Coal
Mesh Size, U.S. Sieve	8 x 30	12 x 40
Effective Size, mm	0.8 - 1.1	0.55 - 0.75
Uniformity Coefficient	2.1	1.9
Iodine No., mgI_2/g	900	1000
Abrasion No., Wt. %	80	80
Apparent Density, g/cc	0.46 - 0.54	0.46 - 0.54





Safety Note: Under certain conditions, some compounds may oxidize, decompose or polymerize in the presence of activated carbon causing a carbon bed temperature rise that is sufficient to cause ignition. Particular care must be exercised when compounds that have a peroxide-forming tendency are being adsorbed. In addition the adsorption of VOCs will lead to the generation of heat within a carbon bed. These heats of reaction and adsorption need to be properly dissipated in order to fully assure the safe operation of the bed.

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.

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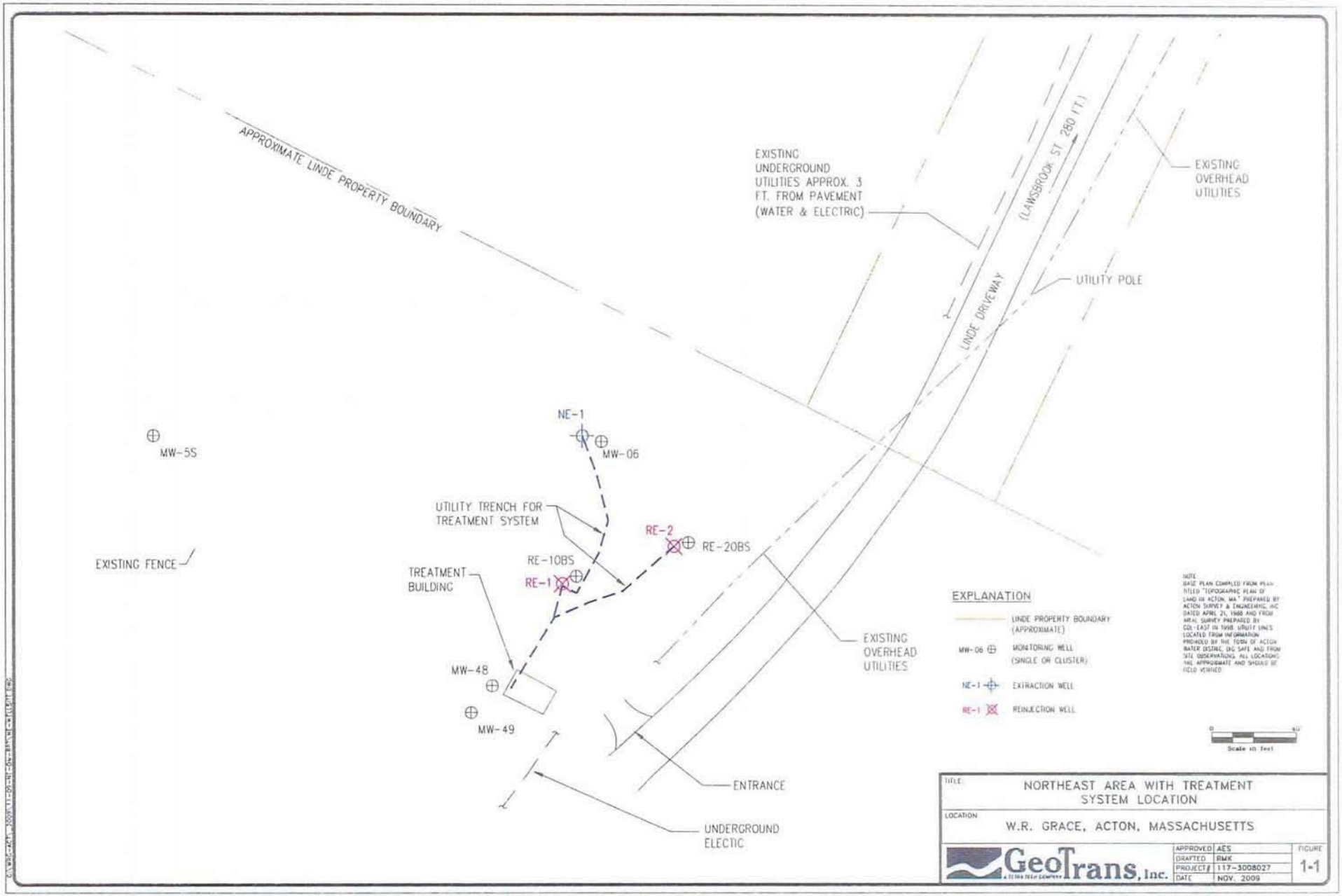
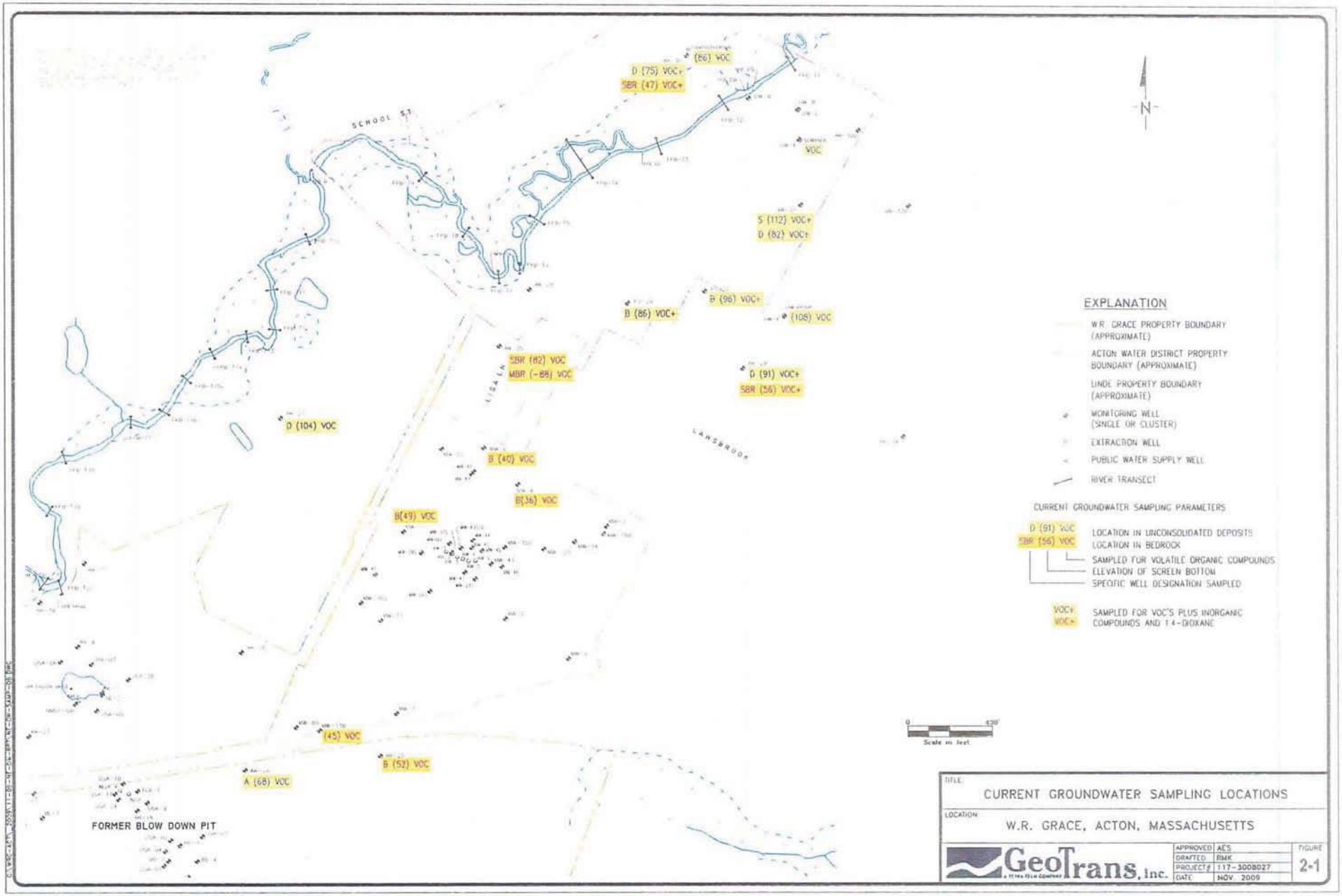

APPROXIMATE LINDE PROPERTY BOUNDARY
EXISTING UNDERGROUND UTILITIES APPROX. 3 FT. FROM PAVEMENT (WATER & ELECTRIC)
(LAWSBROOK ST. 260 FT.)
EXISTING OVERHEAD UTILITIES
LINDE DRIVEWAY
UTILITY POLE
NE-1
MW-06
MW-5S
UTILITY TRENCH FOR TREATMENT SYSTEM
RE-2
RE-20BS
RE-10BS
RE-1
EXISTING FENCE
TREATMENT BUILDING
MW-48
MW-49
EXISTING OVERHEAD UTILITIES
ENTRANCE
UNDERGROUND ELECTIC
EXPLANATION
LINDE PROPERTY BOUNDARY (APPROXIMATE)
MW-06 MONITORING WELL (SINGLE OR CLUSTER)
NE-1 EXTRACTION WELL
RE-1 REINJECTION WELL
NOTE
BASE PLAN COMPILED FROM PLAN TITLED "TOPOGRAPHIC PLAN OF LAND IN ACTON, MA" PREPARED BY ACTON SURVEY & ENGINEERING, INC DATED APRIL 21, 1988 AND FROM AERIAL SURVEY PREPARED BY COL-EAST IN 1988. UTILITY LINES LOCATED FROM INFORMATION PROVIDED BY THE TOWN OF ACTON WATER DISTRICT, DIG SAFE AND FROM SITE OBSERVATIONS. ALL LOCATIONS ARE APPROXIMATE AND SHOULD BE FIELD VERIFIED
Scale in feet
TITLE
NORTHEAST AREA WITH TREATMENT SYSTEM LOCATION
LOCATION
W.R. GRACE, ACTON, MASSACHUSETTS
GeoTrans, Inc.
APPROVED AES
DRAFTED RMK
PROJECT # 117-3008027
DATE NOV. 2009
FIGURE 1-1



TITLE: CURRENT GROUNDWATER SAMPLING LOCATIONS

LOCATION: W.R. GRACE, ACTON, MASSACHUSETTS

GeoTrans, Inc.

APPROVED	AES
DRAFTED	RMK
PROJECT #	117-3008027
DATE	NOV. 2009

FIGURE 2-1