Appendix G -
Mobile Oily Water Separator (OWS) Manual

Baffinland Iron Mines Corporation

Mobile Oily Water Separator (OWS) Manual

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TABLE OF CONTENTS

List of Figures

List of Tables

List of Appendices

1 PURPOSE AND SCOPE

The purpose of this manual is to provide guidance for the commissioning, operation, and decommissioning of the mobile oily water separator (OWS) in a safe, efficient and environmentally responsible manner.

2 REQUIREMENTS

2.1 REGULATIONS

Type A Water Licence No: "2AM–MRY1325 – Amendment No. 1", Nunavut Water Board

Nunavut Mine Health and Safety Act and Regulations.

2.2 HAZARDS AND REQUIRED HSE EQUIPMENT

2.2.1 HAZARDS

Identified hazards associated with commissioning, operation and decommissioning of the OWS include:

- Working with energized equipment and pressurized lines
- Working with electrically energized equipment near water
- Exposure to contaminated water and hazardous chemicals (i.e. diesel, bentonite)
- Working from heights
- Elevated noise levels (generator)
- Spills

2.2.2 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

The following personal protective equipment (PPE) requirements have been assigned to the commissioning, operation and decommissioning of the OWS:

Standard PPE

- Hard hat
- Reflective vest
- Safety glasses
- Steel toed boots
- Rubber gloves

Additional PPE

- Face respirator and P100 particulate cartridge (for handling bentonite and lead media)
- Rubber gloves and hip waiters (when installing the berm sump)
- Nitrile gloves, safety glasses and lab coat when performing sample analysis

- Ear protection (when working near generator)

All PPE must comply with applicable Baffinland's PPE policy and be inspected for damage prior to use.

2.2.3 Additional Safety and Environmental Equipment

The following safety and environmental equipment should be available at the OWS unit during operation.

- Fire extinguisher
- Spill kit
- Radio
- Spill pads (for fuel and free product tank)
- Quatrex bags (for used bag filters and spent media)

2.3 General Safety Instructions

- Monitor all pressure gauges and immediately shut down the OWS system if any exceedances occur
- Watch for pinch-points when exchanging bag filters
- Only trained personnel shall open or work on the electrical panels
- As a precaution against arc flashing, use your left hand and turn your body away from the electrical panel when switching off main breaker to the OWS
- When opening valves to vent air, do so slowly and carefully. Do not stand directly in front of valve.
- Ensure all electrical cords are in good condition and safely secured
- Practice good housekeeping inside and around the OWS unit
- Walk carefully between adsorption units, being careful not to become entangled with hoses or shut off valves by accident
- Wear all required PPE when working at OWS

2.4 Training and/or Qualifications

Any person commissioning, operating or decommissioning the OWS at the Project is required to have read and be familiar with this document. All operators will be trained by an experienced operator.

3 DEFINITIONS

Total Adsorption Tank Bed Volume: the maximum total volume of water that the three (3) media vessels can hold when full of their respective medias (i.e. GAC, bentonite, anthracite).

GAC: granular activated carbon

GPM: gallons per minute

LPC: liquid phase carbon

HMI (Human Machine Interface): refers to the screen in the OWS control room.

API: refers to the baffled tank in the first stage of treatment where free product is removed.

BTE: refers to benzene, toluene and ethylbenzene.

4 RESPONSIBILITIES

The following responsibilities have been assigned to Baffinland's Environmental and Surface Works Personnel regarding the commissioning, operation and decommissioning of the OWS.

4.1 ENVIRONMENTAL COORDINATOR

Under the supervision of the Environmental Superintendent, the Environmental Coordinator will be responsible for implementing this SOP at their Project site. In the absence of the Environmental Coordinator, the Project Site Environmental Lead or his/her designate will assume all responsibilities outlined in this procedure. Specifically, the Environmental Coordinator shall:

- Ensure Environmental staff operating the OWS have read, understand and follow this SOP;
- Review and modify this SOP, as necessary;
- Provide updates to the Environment Superintendent and/or Environment Manager on the status and current operations of the OWS;
- Oversee and supervise all OWS operations;
- Report sample analysis results to the Environment Superintendent and/or Environment Manager.

4.2 OPERATORS

Under the supervision of the Environmental Coordinator, OWS operators will be responsible for adhering to and following this manual. Specifically, operators shall:

- Read and adhere to the protocols outlined in this manual
- Wear all required PPE;
- Conduct routine inspections of the OWS work area to ensure adequate controls are in place to mitigate known hazards;

- Maintain a detailed log of all actions undertaken during operations and record all required data in the Daily Log Sheet (Appendix D);
- Complete required sampling and sample analysis (Section 5.5) to ensure OWS is operating as designed and that the final effluent meets water quality discharge criteria

4.3 Surface Works Personnel

Surface Works personnel shall support OWS operations, as necessary. Specifically Surface Works personnel shall:

- Provide a vacuum truck and operator for removing spent media;
- Assist in transporting, relocating and levelling the OWS unit;
- Assist operators in commissioning OWS by providing electrical support regarding power generation and ancillary components (wiring configuration and electrical switches);
- Provide logistical support in transporting barrels, Quatrex bags, supplies and other components to and from the OWS unit, as required.

5 PROTOCOL

5.1 Oily Water Separator (OWS) Overview

The OWS is a prefabricated system housed in a 40' foot seacan and is designed to remove oil, grease and BTE compounds from wastewater contaminated by hydrocarbons. The unit includes an API type separator to remove free product, a bag filter for solids removal and three adsorption units (one clay and two GAC) for hydrocarbon removal. In the event that the wastewater has lead concentrations that exceed the discharge limits outlined in Baffinland's Type 'A' Water License (2AM-MRY1325 Amendment No. 1), additional treatment barrels containing lead removal media will be added to the end of the OWS system. Refer to Section 5.3 for additional information on configuring the lead treatment barrels.

The OWS unit (Newterra model OWS-24) is sized for a water temperature of 7°C, specific gravity of 0.88 (diesel/furnace oil), TOG concentration of 50mg/L and flow rate of 50 gpm.

Error! Reference source not found. shows the Process Flow Diagram for the OWS.

Refer to Appendix A - Section 3 in the Newterra OWS O&M Manual for process and instrumentation drawings These drawings include equipment sizing, valves, and instrumentation as well as equipment/instrument tag and model numbers.

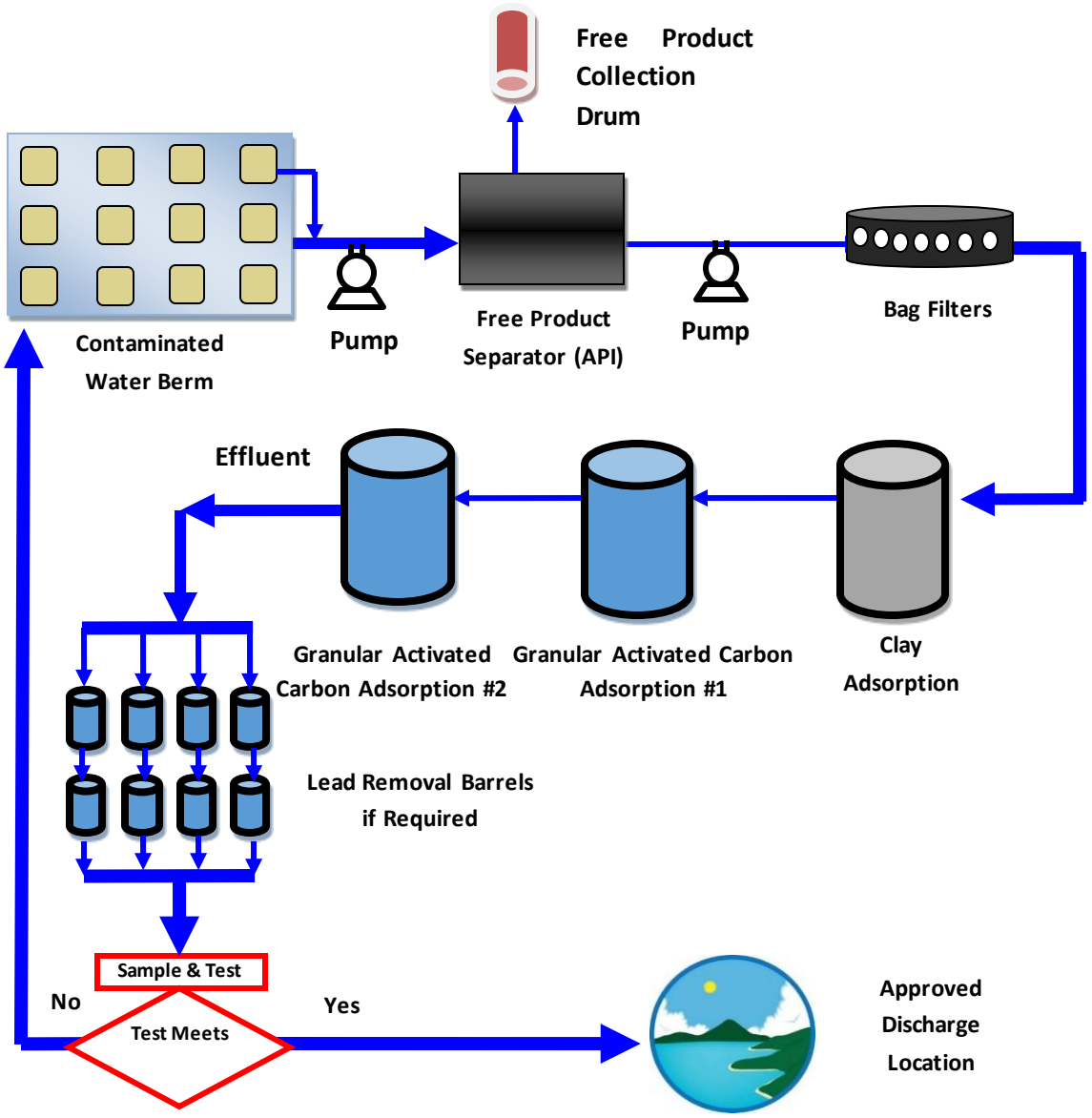

FIGURE 5-1 – OWS PROCESS FLOW DIAGRAM

The following protocols discuss in detail how to operate the OWS unit in a safe, efficient and environmentally responsible manner. Protocols discuss the commissioning, decommissioning and general operation procedures of the OWS unit as well as the water quality discharge criteria outlined in Baffinland's Type 'A' Water Licence (2AM-MRY1325 Amendment No. 1).

5.2 Water Quality Discharge Criteria

The main sources of the contaminated water (wastewater) that the mobile OWS unit will be treating are the Bulk Fuel Containment Facilities/Berms and the Landfarm Facilities (including the Contaminated Snow Containment Berms).

All discharges from Bulk Fuel Storage Facilities will not exceed the following effluent quality limits outlined in Table 5-1. Applicable Monitoring Stations include MP-03, MP-MRY-7, MS-03, MS-04, MS-MRY-6, SP-04 and SP-05.

TABLE 5-1 – EFFLUENT QUALITY DISCHARGE LIMITS FOR BULK FUEL STORAGE FACILITIES

Parameter	Maximum Concentration of Any Grab Sample (ug/L)
Benzene	370
Toluene	2
Ethylbenzene	90
Total Lead	1
Oil and Grease	15,000 and no visible sheen

*Source: Type A Water Licence (2AM-MRY1325 – Amendment 1) Table 8

All discharges from Landfarm Facilities, including the Contaminated Snow Containment Berms, will not exceed the following effluent quality limits outlined in Table 5-2. Applicable Monitoring Stations include MP-04, MS-05 and SP-06.

TABLE 5-2 – EFFLUENT QUALITY DISCHARGE LIMITS FOR LANDFARM FACILITIES

Parameter	Maximum Concentration of Any Grab Sample (ug/L)
pH	Between 6.0 and 9.0
TSS	15
Oil and Grease	15,000 and no visible sheen
Total Lead	1
Benzene	370
Toluene	2
Ethylbenzene	90

*Source: Type A Water Licence (2AM-MRY1325 – Amendment 1) Table 9

5.3 Commissioning the Oily Water Separator

Prior to commissioning the OWS, operators should review the OWS Commissioning Job Hazard Analysis (JHA) presented in Appendix B and inventory all chemicals/equipment required for OWS operation, including the supplies needed for sampling and conducting internal sample analysis.

As previously mentioned, the OWS system is a treatment train comprised of an API separator, a bag filter and three adsorption media vessels (tanks). The first process in the system's treatment train is the API separator which separates free-floating product with a skimmer and densely emulsified product with coarse screen filters. After the API separator, contaminated water is put through a bag filter unit to remove solids and is then percolated through three adsorption media tanks to remove any remaining hydrocarbon fractions. The first adsorption tank contains clay media comprised of two chemicals: anthracite and bentonite. Anthracite is a course media which is added to the tank first so that the anthracite is located at the bottom of the tank near the outlets. Anthracite is added first to prevent the finer bentonite media (added after the anthracite) from clogging the outlet filters located at the bottom of the tank. Following the clay adsorption tank, the second and third adsorption tanks are referred to as the GAC (LPC) tanks and are filled entirely with granulated activated carbon (GAC).

Table 5-3 provides the media types used in the OWS adsorption media tanks and their respective quantities.

TABLE 5-3 – ADSORPTION TANK MEDIAS AND QUANTITIES

OWS Adsorption Tank	Media Type	Quantity	# of bags/boxes
Clay (Tank 1)	Anthracite (added first and is utilized as course media around the outlet ports at the bottom of the tank)	1,000 lbs	18
Clay (Tank 1)	Bentonite	5000 lbs	103
GAC #1 (Tank 2)	Granulated Activated Carbon	3000 lbs	54.5
GAC #2 (Tank 3)	Granulated Activated Carbon	3000 lbs	54.5
Lead media (2 barrels per train, 3-4 trains in parallel)	Metsorb HMRG	3.5 cubic feet	3.5

Before commissioning the OWS system for the upcoming season, the influent and effluent TOG results from the previous year's treatment records should be assessed to determine if the existing media in the

OWS adsorption tanks needs to be replaced. Percent removals for each applicable parameter (i.e. BTE, TOG, lead, etc.) should be calculated using the previous year's influent and effluent analysis results just prior to the previous year's winterization/decommissioning of the OWS system.

$$\text{Percent removal} = \frac{Conc\ influent\ -\ Conc\ effluent}{100}$$

The media is completely spent (used) and will need to be replaced when the influent concentration is equal to the effluent concentration (i.e. percent removal = 0%). The percent removal is used to assess and determine whether the media is capable of effectively treating current hydrocarbon concentrations found in the wastewater to be treated. The media will need to be replaced if the percent removal is not sufficient to reduce the contaminants concentrations below the discharge requirements outlined in Section 5.2. Contact Environmental Coordinator for direction if unsure.

The following steps are required to replace media from the adsorption media tanks:

1. Review JHA (Appendix B) with supervisor. Modify JHA, if necessary.
2. Wear all appropriate PPE (including respirator and P100 particulate cartridge)
3. Remove lids from adsorption tanks.
4. Contact Surface Works to provide vacuum truck to remove media from tanks.
5. Transfer spent media into labelled Quatrex bags (white).
6. Refill tanks with quantities listed in Table 5-3.
   Note: *Bentonite contains silica dust which is carcinogenic and therefore requires personnel to wear a half mask respirator equipped with a P100 particulate cartridge when handling bentonite. Refer to MSDS for full instructions before handling or opening bags.*
7. Reattach adsorption tank lids.

Whether the existing media from the previous year or brand new media is being used, the media in the adsorption tanks must be soaked in clean freshwater for 24 hours prior to running contaminated water through the system. This allows air trapped in the media's pores to be removed and the full surface area of the media to be utilized in treatment.

The following steps are required to soak the media within the adsorption tanks:

1. Contact Surface Works to provide a water truck with a full load of freshwater.
2. Open up all inlet and outlet valves on adsorption tanks except the outlet valve on the last adsorption tank (GAC#2). This will allow water to equalize among all three adsorption tanks
3. Open pressure valves on the top of each adsorption tank for air venting.
4. Hook up water line to inlet of the first adsorption tank.
5. Begin pumping water into the adsorption tanks using water truck. Ensure water truck pump is throttled to its lowest setting.
6. As tanks fill, use a rubber mallet to hit around the circumference of each tank to release any remaining air.

7. Monitor pressure valves on adsorption tanks and ensure tank pressures **NEVER exceed 40 psi.** If necessary, shut off water truck periodically to allow pressure to release and equalize among tanks.
8. Shut off top pressure valves on each adsorption tank once water begins to come out of the each valve.
9. Shut off water truck once water has come out of each adsorption tank's top pressure valve.
10. Allow media to soak for 24 hours.

The OWS does not have its own power supply and therefore will need to be hooked up to a diesel generator to operate. For a generator and fuel tank, contact Surface Works. Refer to the Newterra OWS manual presented in Appendix A for engineered drawings and detailed instructions on how to hook-up the power line/supply, sump pump, water level float and free-product float.

Prior to starting the OWS unit, the wastewater to be treated (influent) should be sampled and analyzed internally to confirm the OWS unit is able to treat the hydrocarbon (TOG) levels found in the wastewater. If TOG levels are determined to be greater than 120 mg/L, contact the Environmental Coordinator for instruction.

Prior to discharging treated effluent from the OWS to the receiving environment, contaminated water should be re-circulated between the OWS unit and the wastewater containment berm. This is done to (1) flush out the freshwater used to soak the media in the adsorption tanks and (2) confirm the treated effluent discharged from the OWS meets the water quality discharge criteria outlined in Section 5.2 Approximately 10 m^3 (2640 USG) of wastewater must be recirculated through the OWS unit to flush the system of freshwater and confirm effluent quality.

Once the freshwater has been flushed out of the system, effluent samples can be collected for internal and external analysis. External effluent samples should collected and tested for all parameters required by the facility's effluent discharge criteria presented in Section 5.2. Internal samples should be taken in parallel to external samples and tested for TOG on-site using the procedure outlined in Section 5.5.3.

If after receiving the external analysis results, it is determined that lead treatment barrels will be required to ensure that the treated effluent meets the facility's discharge criteria, barrels will be setup following the third adsorption tank (GAC#2) of the OWS. Lead media barrels are typically configured into four trains in parallel with each train made of two barrels hooked up in series. The number of trains used is the limiting factor that determines the overall flow rate that can pass through the system, with each train having an approximate flow rate of 5 gpm. Each lead media barrel is equipped with a pressure gauge and water vent at the inlet valve located at the top of the barrel and an outlet valve at the bottom of the barrel. The effluent manifold should be placed at a higher elevation than the barrels to ensure barrels remain flooded when system is off. Air should be purged from the system upon start up. For more details on how to configure the lead treatment barrels and replace the lead removing media refer to Section 5.4.8.

Do NOT discharge any treated effluent from the OWS system to the receiving environment unless it has been authorized by the Environmental Manager.

5.4 Operation and Maintenance Procedures

The following procedures provide detail on how to safely operate and monitor the mobile OWS system. Prior to operating the OWS, all operators should review the OWS Operation JHA presented in Appendix C.

5.4.1 Target Operating Conditions

The following table outlines the initial target operating conditions:

TABLE 5-4 – INITIAL OPERATING TARGETS

Parameter	Units	Initial Target
Flow rate from Pump 4901 (FQI 7001) without Lead Treatment trains.	gpm	45-50
Flow rate from Pump 4901 (FQI 7001) with four (4) Lead Treatment trains.	gpm	15-20
Discharge Pressure of Pump 4901 (PI 4901)	psi	55
Max Bag Filter Inlet Pressure (PI 6701)	psi	40
Max Adsorption Unit Inlet Pressure (PI 7001)	psi	40
Max Lead Treatment Barrel Inlet Pressure	psi	10

5.4.2 System Start-up

1. Turn generator **ON** if not already running. Ensure sufficient oil in generator and diesel in fuel tank. **Note:** All operators must be trained by Surface Works electricians on the proper starting and fueling procedures when operating the OWS system.
2. Ensure electrical panel is securely closed/locked. **Note:** Only trained personnel should open and adjust breakers in electrical panel.
3. Turn **ON** main disconnect for power to the OWS if not already on. **DO NOT** stand directly in front of panel when turning **ON** or **OFF** main disconnect.
4. The HMI screen will display system status and active alarms. Scroll right or left to view the active alarms. Address any alarms present. Refer to Section 3 of the Newterra O&M Manual presented in Appendix A for a list of alarms and activation/deactivation conditions.

Note: Immediate power surge alarm will show on the HMI screen after power up. This will reset itself after five minutes. Address any other alarms present (float switches, free product barrel level, pressure alarms, etc.).

5. Once alarms are addressed go to main menu and clear alarms.
6. Walk through system to check for leaks and ensure influent pump and discharge lines are properly connected. Ensure all valves are properly positioned. Ensure there are no obstacles over any moving parts.
7. Ensure influent/sump pump and discharge lines are properly positioned and connected. If discharging, make sure a dissipater plate is in place at the discharge point to prevent surface erosion.
8. If no issues are observed turn the system **ON** at the HMI. Pumps should be manually set to **AUTO** mode.
9. Observe system operation to ensure the OWS is operating as designed. Check flow rates, pressures and confirm discharge.
10. Open valves at top of adsorption units and bag filter to purge air as described above.

5.4.3 System Shutdown

1. Turn system **OFF** on HMI.
2. Shutdown generator if system will be off for more than approximately 12 hours.
   Important Note: Turn **OFF** main disconnect in the OWS control room if personnel plan on conducting work on the OWS while the system and generator are off.

5.4.4 Routine System Checks

During normal operation the OWS system should be checked every four (4) hours at a minimum. As the amount of wastewater in the berm decreases or as specific concerns arise, the OWS system should be checked more regularly to ensure excessive amounts of sand or free product are NOT entering the system. The following instructions outline the tasks that should be completed during these routine checks.

1. Walk through system to check for leaks and ensure influent pump and discharge lines are properly placed/connected.
2. Confirm discharge flow and conduct visual inspection for any sheen or odor at the discharge location.
3. Record flow rates and pressures. Complete Daily Log presented in Appendix D. Collect samples as outlined in Section 5.5.2.
4. At the API, check level of free product using dipstick and water-detecting paste. If the free product level is 1/4" or more thick adjust the slotted pipe at the far end of the API using a 4" pipe wrench. The slit in the pipe should be at the surface of the liquid, just enough to remove any free product, and leave any remaining water in the tank. **Note: This is a completely manual step. Do not leave the slotted pipe at the liquid surface unattended for long periods of time as the free product**

level will change over time and result in the free product collection barrel quickly filling up with water.

5. Check level of free product around sump in the berm. If there is significant free product present protect the intake pump with booms. If necessary, the OWS may need to be shut down temporarily to remove excessive amounts of free product within the sump area.
6. Adjust flow balance between influent pump (P 4001) and API discharge pump (P 4901) using the appropriate ball/globe valve if required.
   Note: The target flow rate from the API effluent pump (P 4901) is 30 gpm (20 gpm if using four lead treatment barrel trains in parallel). Flow balance should be such that the desired flow rate through the system is achieved, and the influent pump runs continuously if possible. If the influent pump flow rate is greater than the API effluent pump the LAHH 4901 switch will turn the influent pump off to prevent overflowing the API. This will result in frequent LAHH 4901 alarms on the HMI. A significant amount of flow rate monitoring and adjustment may be required during the initial startup/commissioning of the system to achieve the proper flow balance.
7. Monitor bag filter inlet pressure. Replace bag filters if the maximum bag filter inlet pressure, 35 psi, is reached. Bag filters may require frequent replacement. Refer to Section 5.4.7.
8. Replace GAC/clay media if inlet pressure to the first adsorption unit exceeds 35 psi or if breakthrough of contaminants is observed in the final effluent (visual sheen or high TOG results).
9. Purge any air collected in the system via the vents on the bag filter/adsorption units.
10. Perform/schedule any required maintenance as per the Newterra O&M manual.
11. Collect and analyze samples according to Section 5.5 and take appropriate action.
12. If at any point during the operation of the mobile OWS, the final effluent at the discharge point is discovered to have a sheen or hydrocarbon odour, the OWS must be shut off and all discharge to the natural environment must stop immediately. Contact Environmental Coordinator.
13. If at any point during the operation of the mobile OWS, the internal TOG analyses indicates the final effluent does not meet the required discharge criteria outlined in Section 5.2, the OWS must be shut off and all discharge to the natural environment must stop immediately. Contact Environmental Coordinator.

5.4.5 System Alarms

The OWS system has several shutdown alarms and non-critical alarms. Shutdown alarms will turn the system off. Non-critical alarms will be displayed in the HMI and will activate the alarm light but will not shutdown the system. If an alarm appears on the HMI, investigate the cause and take the appropriate action. Once the issue has been addressed, clear the alarm using the HMI.

Refer to Section 3 in the Newterra O&M manual for details on the how the alarms are activated/deactivated.

5.4.6 MAINTENANCE

Several maintenance activities will need to be carried out after a recommended number of operating hours have passed. Refer to Section 8 in the Newterra O&M manual for details on the maintenance procedures and required, daily, weekly, monthly and yearly checks.

- Strainer cleaning: every 200 operating hours
- Pumps: every 800 operating hours
- Pressure gauges: every 4000 operating hours

In addition to these activities the filter bags and media will need to be replaced based on system pressures and water quality. See the following sections for more information.

5.4.7 FILTER BAG REPLACEMENT

Filter bags will need to be replaced when the inlet pressure to the filter housings reaches 35 psi. At 40 psi an alarm will be initiated.

To change out the filter bags complete the following steps:

1. Turn the system **OFF**.
2. Close inlet and outlet valves.
3. Relieve the pressure in the bag filter housing via the valve at the top of the housing.
4. Undo the housing bolts and remove lid.
5. If possible remove some of the water from the filter housing by partially draining the housing through the two inch line at the bottom of the stand or by removing the water from the top. Ensure drained water is contained and not spilled on floor. The bag filters can be replaced without removing the water however replacing the filter bags is easier when the housings is not full of water.
6. Place used filter bags into a pail or other container for disposal. The bags will be water logged and heavy. Use two people if required and proper lifting techniques (lift with knees NOT back). Filters can be burned and should be dropped off at the Waste Management Building to be incinerated onsite.
7. Insert new filter bags into the housing. The bags should fit flush at the top. Change all seven bags at the same time.
8. Apply silicon grease to the O-ring to prevent leaks from the lid if required.
9. Close the lid and bolt the lid down.
10. Check strainers and empty if required.
11. Open valves to bag filters.
12. Perform pre-start checks of system and turn system **ON**. Remove air trapped in filter housing by opening valve at top of housing until water is observed.

5.4.8 Lead Removal Media

As discussed in Section 5.3, eight barrels containing lead removal media (Metsorb HMRG) should be added downstream of the system following the adsorption tanks if lead concentrations in the effluent exceed discharge criteria. The maximum flow through one barrel is 5 gpm, therefore the maximum flow through four barrels in parallel is 20 gpm. At an influent concentration of 5 µg/L (effluent of >1 µg/L) 1 ft^3 of media should be able to process approximately 70 m^3 of wastewater. Other heavy metals and contaminants in the wastewater will also be adsorbed by the media so the volume of water processed by each cubic foot of media will vary and depend on the total amount of metals in the wastewater. Taking samples of the final effluent and the discharge from the first row of barrels will indicate when the media needs to be replaced.

5.4.8.1 Lead Media Replacement Procedure

If breakthrough (exceedance) is observed at the discharge of the first row of four barrels, the media in these barrels should be replaced and the order of the barrels switched. **The four barrels with new media will be moved to the second row and barrels that were originally in the second row with be moved to the first row.**

To change out the lead media in the barrels complete the following steps:

1. Drain barrels.
2. Remove lids and scoop out spent media into labelled Quatrex bags for hazardous waste disposal.
3. Rinse barrels with a small amount of clean water.
4. Replace or rinse filter sock on bottom piping inside the barrels.
5. Put on appropriate respirators and review MSDS for procedures on handling media. Slowly pour new media into barrels being careful not to damage piping at bottom of barrels. Barrels will be approximately 1/3 full of media with 3-3.5 ft^3 of media. Settling of media inside the barrel can be aided by tapping the barrel sides with a rubber mallet.
6. Replace lids and ensure adequate seal.

5.5 Sampling Schedule, Supplies and Procedures

The following table provides the sampling schedule and requirements for the commissioning and normal operation of the OWS. Confirm with Environmental Coordinator when sending out external samples.

Table 5-5 – **Sampling Schedule**

Parameter	Location within OWS	Internal Sampling Frequency	External Sampling Frequency
Oil and Grease	Influent	Start of open water season at each source/facility that contains wastewater potentially requiring treatment	Start of open water season at each source/facility that contains wastewater potentially requiring treatment
	API Effluent	Every 4 hours	
	Final Effluent	Every 4 hours	Prior to discharge/ Weekly during discharge
Total Lead pH TSS (only effluent)	Influent		Start of open water season at each source/facility that contains wastewater potentially requiring treatment
	Final Effluent		Prior to discharge/ Weekly during discharge
Benzene Toluene Ethylbenzene	Influent		Start of open water season at each source/facility that contains wastewater potentially requiring treatment.
	GAC #1 Effluent		Weekly
	Final Effluent		Prior to discharge/ Weekly during discharge

5.5.1 SAMPLING EQUIPMENT

- Required PPE (refer to Section 2.2.2)
- Sampling bottles: Group 5 bottle set for external samples (See Appendix E for exact bottle set requirements), 250 mL glass wide-mouth jars for internal samples.

5.5.2 SAMPLING PROCEDURE

1. Obtain and wear appropriate PPE listed in Section 2.2.2.
2. Obtain sampling equipment outlined Section 5.5.1.
3. Check HMI to identify any active alarms.
4. Conduct a visual inspection to identify any leaks, system failures, and potential hazards (high pressures, electrical malfunctions, improperly opened valves, poor discharge/recirculation lines, etc.),
5. Record any system failures, leaks, hazards or inconsistencies observed on the Daily Log (refer to Appendix D).
6. Record all readings on the Daily Log.
7. Collect water samples at designated sampling ports for analyses (see Table 5-5 for required sampling locations and analysis).
8. Use 250mL wide-mouthed glass jars to collecting internal samples. Samples should be labeled with the date, time and sampling location/station. Internal sampling jars can be reused for internal analyses however, if reused, sampling jars should be used for the same sampling locations within the system (i.e. influent, effluent, etc.). Replace jars if suspected cross contamination is occurring.
9. All internal samples should be collected by following steps 1 through 6 at the required intervals outlined by Table 5-5.
10. Analyze internal samples for TOG following the analysis procedure outlined in Section 5.5.3.
11. Complete Daily Log with all the required information filled out including the date, time of routine checks, pressure readings throughout the system, totalizer values and internal TOG results. At the end of the day, information on the Daily Log will be transferred to the electronic Discharge Log located on the Mine Site Environmental Server (refer to Appendix D).
12. External samples must be collected according the Sampling Schedule (Table 5-5) and should be delivered to the onsite ALS lab within 24 hours of being collected accompanied with a completed COC.

5.5.3 TOG Sample Analysis Procedure

Required Lab Supplies, Equipment and PPE

- 2 x 20ml glass graduated cylinder
- Glass funnel
- TOG analyzer + cuvette(s)
- Sulphuric Acid (98%) + pump
- S-316 Solvent
- Sodium Sulfate, anhydrous
- Spoon
- Pipette and tips
- Two glass mix jars for influent and effluent samples with 100ml marked
- Whatman filter Paper
- Kim wipes
- Nitrile gloves
- Lab coat
- Safety glasses

1. Turn TOG analyzer **ON** if it is not already on. Allow TOG analyzer to warm up for 1 hour.
   Note: The TOG analyzer can be kept on for the entire length of time the mobile OWS is operating.
2. Rinse all glassware with solvent: Horiba S-316 (i.e. funnels, graduated cylinders, pre marked 100mL mix jars, and cuvettes)
3. Add 100mL of sample to pre-marked mix jar.
4. Add 1mL of sulfuric acid (~98% conc.) to sample in mix jar.
5. Shake for 10 seconds.
6. Add 11mL of solvent to sample. The volume of solvent should be 10% of the total volume of solvent-sample mix.
7. Shake the mix jar for 2 minutes, opening mix jar at least twice to release any vapour buildup.
8. Allow mix jar contents to settle. A solvent layer containing the hydrocarbons in the sample should form at the bottom of the mix jar.
9. Fill cuvette with solvent, wipe thoroughly with Kim wipe and place in analyzer. This will serve as a blank.
10. Press and hold ZERO on analyzer. BAL will display on the screen followed by a number. Leave the cuvette in the analyzer and press RUN. If the result is within ± 2 mg/L the analyzer is zeroed.
    Note: The cuvette should be placed in the analyzer with the frosted side facing you. The cuvette should always be placed in the analyzer in the same direction.
11. Add 1 spoonful of sodium sulfate to a folded Whatman filter in the glass funnel.
12. Extract settled solvent layer from bottom of mix jar with a 10mL pipette and filter it through the sodium sulfate inside the Whatman filter and into a clean graduated cylinder. This will remove any remaining water captured during the extraction of the solvent. Only 3-5 mL of filtered solvent

is required to analyze the solvent layer and determine the hydrocarbon concentration in the sample (i.e. effluent, influent, etc.).

13. Fill cuvette with the filtered solvent, wipe thoroughly with Kim wipe and place in analyzer.
14. Press **RUN** to analyze.
15. Record results on Daily Log.
16. If TOG results seem high in comparison to external results, clean all glassware with solvent and redo analysis. If the hydrocarbon concentration in the influent sample water is equal or greater than 120 mg/L, system checks should be done more frequently and sampling should increase to every two (2) hours. Notify Environmental Coordinator of inflated TOG levels in influent.
17. If at any point during the operation of the mobile OWS, the internal TOG analyses indicates the final effluent does not meet the required discharge criteria outlined in Section 5.2, the OWS must be shut off and all discharge to the natural environment must stop immediately. Contact Environmental Coordinator.

5.6 Decommissioning the Oil Water Separator

The following procedures should be followed to safely and effectively decommission the mobile OWS unit when transporting the unit between Project sites or for winterization/end of season storage.

5.6.1 Decommissioning For Transport

Before transporting the mobile OWS unit between Project sites, the unit must be drained. The draining procedure required for transport is identical to seasonal storage draining procedure (refer to Section 5.6.2), however since this is completed to reduce weight for shipping, the lines and pumps are not required to be drained since this is a very time consuming process. Only media vessels and the API tank are required to be drained prior to transport. Additionally, all valves should remain closed during transport.

5.6.2 Decommissioning For Seasonal Storage

The decommissioning of the mobile OWS unit for seasonal storage requires all water to be drained from the system. Electricians are required to disconnect all wiring. All drained sensors and pumps should be placed and stored inside the control room. All hoses and lines must be drained of any residual water so that lines can be disassembled and will not rupture due to ice expansion. Hoses and lines should be drained using the valves at low points and available ports. Residual water must be drained back into the berm or captured in pails/tubs to be eventually transferred back into berm. Spilling contaminated water onto the ground is considered a spill and must be reported.

Complete removal of all water is required for the adsorption tanks and API tank.

To drain the three (3) adsorption tanks, a 3" trash pump must be hooked up to the bottom ball valve of each adsorption tank and used to effectively pump out all remaining water out of each tank. To minimize the possibility of removing any media in this process, the bottom ball valve on the bottom of each adsorption tank should only be partially opened and the trash pump should be throttled down to its lowest

setting to reduce the overall flow rate/vacuum at the outlet of each adsorption tank. When each tank is empty and the trash pump begins to suck in air, the trash pump must be shut-down for 5-10 minutes to allow residual water to gravity drain through media and collect at the bottom of the adsorption tank.

Leave the bottom ball valve of each adsorption tank in the open position with a pail placed underneath the valve to catch any residual water dripping out of the tanks (empty as necessary). Open the lid on the top of each media vessel and allow the media to dry for a 2-3 days. If weather is cold, turn heaters on in the OWS unit or use a frost fighter to expedite the drying process.

To drain the API tank, setup a tub underneath the drain port on the outside of the OWS unit. Open the lowest ball valve on the drain port to allow the water in the API tank to gravity drain into the tub. Transfer contaminated water from the tub to the facility's containment berm.

Double-check that all valves and drain ports are opened and drained to ensure ALL residual water has been removed. It is absolutely critical that all lines, pipes, tanks and vessels have been completely drained of any water prior to freeze up.

5.7 OWS Discharge Log, Results Dissemination and Approval for Discharge

All the monitoring documentation to be completed during the operation of the OWS unit is located in the OWS Discharge Log file on the Mine Site Environmental Server at FINAL File System\2.0 ENV MANAGEMENT, MONITORING PLANS (BIM INTERNAL)\2.08 Oily Water Separators. This file contains the Summary Sheet, the External Results Sheet and the Daily Log Forms presented in Appendix G, Appendix F and Appendix D, respectively.

The External Results Sheet presented in Appendix F must be updated upon receipt of any external sample results, including preliminary results. The Environmental Coordinator or his/her designate will provide the results to the Environment Superintendent and/or Manager who will assess the results and determine whether the effluent quality is acceptable for discharge or will assign instructions for additional treatment.

The Daily Log (refer to Appendix D) must be updated to include all internal samples and weekly external samples (if applicable) throughout the treatment process. End-of-shift cumulative discharge values and additional notes must also be recorded on the Daily Log.

The Summary Sheet (refer to Appendix G) must be filled out after all wastewater has been treated for a specific facility (i.e. Bulk Fuel Storage Facility, Landfarm Facility, etc.).

All documentation must be added to the appropriate site server location (FINAL File System\2.0 ENV MANAGEMENT, MONITORING PLANS (BIM INTERNAL)\2.08 Oily Water Separators). Upon the completion of wastewater treatment at a facility, the completed OWS Discharge Log must be provided to the Environmental Coordinator, Superintendent and Manager.

6 REFERENCES

AMEC FW, (2014). Baffinland Iron Mines field notes OWS. July, 2014

Water Licence No: 2AM-MRY1325 – Amendment No. 1, Nunavut Water Board (July 21, 2015)

Newterra, (2013), Process Treatment System Project # 102140. Operation and Maintenance Manual

APPENDIX A -

NEWTERRA OWS O&M MANUAL

1.0 Start Up Procedure
Commissioning Checklist

Test Records
Packing List

2.0 Mechanical Drawings

3.0 Electrical Drawings

4.0 Control Panel Module

5.0 Components

6.0 Specs

7.0 Manuals

8.0 System Maintenance, Troubleshooting

RTS - 151
150 GPM WATER TREATMENT SYSTEM
STARTUP PROCEDURE

- If the system is being started for the first time then work your way through the commissioning checklist in the installation guide or system manual before starting the system.
- If kill switch on panel (red mushroom shaped button) is pulled out then push it in to confirm that system is off.
- Pull kill button out in process room so the system can start at the appropriate time.
- Walk through process piping and check the position of all process valves.
- Check that there are no obstructions over any moving parts.
- Check that main disconnect is on.
- Put all hand/off/auto switches in auto.
- Pull the kill Button (red button on panel) out to start the process.
- Push the reset button on the operator interface to reset all alarms.
- Push the start button on the Operator Interface.
- If an alarm occurred on startup, then review the alarm descriptions and troubleshooting guide in the installation guide or manual for guidance on how to troubleshoot the problem. Fix the alarm condition and restart the system with the above procedure.

RTS - 151 150 GPM

Mech Eng:		Control:	Tester #1:	Warren, Kevin
Mechanical Team:	Electrical Team:	Panel Team:	Tester #2:	
-Select One-	-Select One-	-Select One-		
			Start Date:	8/20/2013
			End Date:	8/27/2013

SECTION A - PRE-TEST FLOW RATES AND POWER DETAILS

P-VLS		B-STRIP	
B-SVE		P-STRIP	
P-OWS		C-SPRG	
OTHER:		OTHER:	

System Certifications	Panel Standard	System Standard	SETPOINTS
Building #1 / Room #1:	UL 698A	MET us, Classified	
Building #2 / Room #2:	N/A	N/A	
Site Power Requirements			
Voltage:	208 Vac	3-Phase , 3-Wire	
Amperage:	125 Amps		

Notes:

SECTION B - WALK AROUND	OK / NA	INITIALS
Check That Walk Through Issues Have Been Resolved, Review Shop Aids	OK	KW
Lay Down Electrical Safety Mat and Set Up Testing Cart	OK	KW
Ensure That Testing Tote Is Connected and That Hoses Are Secure	OK	KW
Ensure That Carbon Vessels Are Bypassed	OK	KW
Verify That Exhaust Mufflers and Elbows are Installed (SVE/Sparge/Compressed Air)	OK	KW
Make Sure That Building Fan and Louvre Shipping Braces Have Been Removed	OK	KW

SECTION C - WALK THROUGH	OK / NA	INITIALS
Inspect Valves and Process Lines	OK	KW
Check Transmitter / Magnehelic Lines for Low Lying Spots Where Moisture can Collect	N/A	KW
Check That Floor Vents Have Been Installed	N/A	KW
Record Process Equipment Model and Serial Numbers* and Motor Nameplates	OK	KW
Notify Project Manager and Production Staff of Any Outstanding Issues	OK	KW

* This includes motors, blowers, compressors, oxygen/ozone generators, pumps, etc.

SECTION D - PANEL OFF INSPECTION	OK / NA	INITIALS
Check for Dielectric Test Label	OK	KW
Check for Auto Re-Start Label, Check for Ground, L1, L2, L3 and High Leg Labels	OK	KW
Check for IS Wiring Warning Stickers in Panel and on Lines From Panel	OK	KW
Ensure Neutral Wire is Connected To Terminal Block	OK	KW
Inspect 24Vdc and 120Vac Relays for Proper Connections	OK	KW
Check That Spare IS Input Wires Are Pulled	OK	KW
Cross Check Fuses, Circuit Breakers and Starters with Fuse Schedule	OK	KW
Determine Service Factor Amps and Set Motor Overloads	OK	KW

SECTION E - PANEL ON INSPECTION	OK / NA	INITIALS
Record Test Supply Voltages		
Primary: L1/L2 213, L2/L3 213, L3/L1 213 Vac; L1/N 124, L2/N 124, L3/N 124 Vac — **Secondary:** L1/L2 245 Vac; L2/L3 124; L3/L1 124 Vac; L3/N Vac		
Record 24Vdc Supply Voltage 24 Vdc	OK	KW
Test GFI and non GFI Outlets	OK	KW
Check "Push To Test" Panel Indicators	OK	KW
	N/A	KW

SECTION F - INITIAL SYSTEM SETUP AND TESTING	OK / NA	INITIALS
Archive Pre-Test Program Revisions and Create New Revision	N/A	KW
Check E-mail Configuration Through ECOM Card on PLC	N/A	KW
Record H0-ECOM100 Firmware Revision v.	N/A	KW
Update PLC Firmware and Record Revision: v.	OK	KW
Initialize Scratch Pad of Automation Direct PLCs	OK	KW
Upload PLC Program	OK	KW
Set PLC Clock and Calendar	OK	KW
Check Functionality of All Discrete Inputs	OK	KW
Check Functionality of All Discrete Outputs	OK	KW
Check Functionality of All Analog Inputs and Outputs	OK	KW
Switch System Outputs to AUTO Mode	OK	KW
Set and Test All Setpoints	OK	KW

SECTION G - OPERATOR INTERFACE (PANEL DOOR / TOUCHSCREEN)	OK / NA	INITIALS
Type of Operator Interface: -Select One-		
Update Display Screen Firmware, Record Revision v.	OK	KW
Upload Panel Program	OK	KW
Test Panel Menu Hierarchy	OK	KW
Check PLC to Panel Communication, Remove Ground Jumper if Necessary	OK	KW
Verify Value, Scale, Significant Digits and Units of Analogue Signals	N/A	KW
Check Functionality of All Discrete Inputs	OK	KW
Check Functionality of All Discrete Outputs	OK	KW
Test All User-Adjustable Setpoints	OK	KW
Verify Correct Hourmeter Values, Ensure Proper Time is Kept	OK	KW

SECTION H - VFD / SOFT START DEVICES	OK / NA	INITIALS
Drive Type and Application: N/A N/A		
Verify Drive Parameter Settings Match Electrical Drawings	N/A	KW
Test Frequency Control	N/A	KW
Check VFD Noise on Analog Signals / Adjust Carrier Frequency Accordingly	N/A	KW
Save VFD Set-up Variables From PowerSuite / Record VFD Settings	N/A	KW
Verify Integrity of RS-485 Communications, Record Settings	N/A	KW
BAUD: N/A PARITY: N/A STOP BITS: N/A CARRIER: N/A		

SECTION I - ANALOG SIGNALS	INITIALS
PLC Card Slot #1: N/A - Not Installed	KW
PLC Card Slot #2: N/A - Not Installed	KW
PLC Card Slot #3: N/A - Not Installed	KW
PLC Card Slot #4: N/A - Not Installed	KW

Check mA Signals at Different Operating Points for Device Hysterisis and Calibration	N/A	KW
Check Conversion Math and Square Root Functions in PLC Logic	N/A	KW

SECTION J - SYSTEM OPERATION	OK / NA	INITIALS
Check Building Fan(s) and/or Heater(s) Operation	OK	KW
Test All Kill Buttons	OK	KW
Bump Motors and Check For Excessive or Abnormal Current Draw	OK	KW
Ensure that LSL Switches are Above Pump Intakes	OK	KW
Set and Test Pressure and Vacuum Relief Valves According to P&ID	N/A	KW
Thoroughly Test Control Logic	OK	KW
Check Functionality of Oxidizer Interlocks	N/A	KW
Run System In Full Automatic	OK	KW
Simulate All Alarms, Check That Non-Critical Alarms Do Not Shut Down System	N/A	KW
Check Magnehelic Gauges for Accuracy, Verify Air Flows Using Hot Wire Anemometer	N/A	KW
Measured CFM: @ PSI/"Hg/"WC		
Measured CFM: @ PSI/"Hg/"WC		
Measured CFM: @ PSI/"Hg/"WC		
Measured CFM: @ PSI/"Hg/"WC		
Verify Logic and Flow For All Solenoid Valves, Including Auto-Oilers	N/A	KW
Run System With Doors Closed and Monitor Ventilation	N/A	KW
Verify Auto Restart Functionality of Whole System (Including VFD)	OK	KW
Check for Water / Compressed Air (Bubble Test) Leaks	OK	KW

SECTION K - PLC FINAL CHECK	OK / NA	INITIALS
Check Hour Meter Variable Memory Locations and Minute Counters	N/A	KW
Force Datalogging	N/A	KW
Update PLC Program Revision(and Operator Interface if Applicable)	OK	KW
Final Program Revision # : v. 2.0		

SECTION L - TELEMETRY	√OK/ NA	INITIALS
Select Communication Type:		
Confirm Remote Access, Record Method	N/A	KW
Check Modem Auto-Reboot Feature	N/A	KW
Test System Operation Using Offsite Package, Review Datalog Files	N/A	KW
Test System Email Out	N/A	KW
Configure Autodialer (Set Sensaphone Passwords to "2000" and "s2000")	N/A	KW
Test Autodialer Alarm Dial-out and Report	N/A	KW

SECTION M - FINAL SYSTEM TESTING / AS BUILT	OK/ NA	INITIALS
Record Max Noise Level dBA @ ft.	N/A	KW
Record Motor Voltages, Currents and Operating Conditions	OK	KW
Add Flow Charts, Piping Labels (Hot**, Directional), Oxygen / Ozone Generator Labels	OK	KW
Pump Water Out Of System	OK	KW
Turn Off All Breakers and HOA Switches	OK	KW
Take System Pictures	OK	KW
Email Project Manager and Production Staff	OK	KW
Update System Approval Data Plates, Fuse Schedule and Startup Procedure	OK	KW
Ensure appropriate approval labels are obtained (GP, Haz). **Rentals require US and CAN.**	OK	KW
Attach System Approval Stickers, Fuse Schedule and Startup Procedure	OK	KW
Take Panel Pictures and Transfer All Pictures to Project Folder	OK	KW
Check Off "Testing" as Being Complete in APES	N/A	KW
Make Changes to the IO and Alarms Tables Are Captured in the Markups	OK	KW
Update Project Software Folder	OK	KW

Copy Completed Test Sheets to Electrical As-Builts Directory with DWG Files and Bill of Materials
Check Off "As-Builts" Box in APES
** Hot Labels to be Applied to Any Piping >/= 140 DegF as Determined by IR Readings

MECHANICAL TEST RECORD

Device Name:	**P-4901**	Manufacturer:	**GOULDS**
Device Model #:	**4SH2K52COW**	Device Serial #:	**F1200054**
Motor Manufacturer:	**WEG**	Area Classification Tag Checked:	
Motor Model #:	**JM007402**	Motor Serial #:	**1014500858**
HP:	**7.50**	Voltage: **208**	Frame: **184JM** RPM: **3480**
Phase:	**3**	Current: **20.70**	SF: **1.15** ENCL.: **TEFC**

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
20.9	**20.6**	**21.4**	Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
213	**213**	**213**	Vac				Vac

Device Name:	**P-4001**	Manufacturer:	**GOULDS**
Device Model #:	**WS15112BHF**	Device Serial #:	**RC-061**
Motor Manufacturer:	**GOULDS**	Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:	**1.50**	Voltage: **230**	Frame: RPM: **3450**
Phase:		Current: **18.00**	SF: ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
17.1			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
213			Vac				Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:		Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:		Voltage:	Frame: RPM:
Phase:		Current:	SF: ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
			Vac				Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:		Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:		Voltage:	Frame: RPM:
Phase:		Current:	SF: ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
			Vac				Vac

MECHANICAL TEST RECORD

Device Name: | Manufacturer:
Device Model #: | Device Serial #:
Motor Manufacturer: | Area Classification Tag Checked:
Motor Model #: | Motor Serial #:
HP: | Voltage: | Frame: | RPM:
Phase: | Current: | SF: | ENCL.:

Factory Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1 Vac
Field Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1 Vac

Device Name: | Manufacturer:
Device Model #: | Device Serial #:
Motor Manufacturer: | Area Classification Tag Checked:
Motor Model #: | Motor Serial #:
HP: | Voltage: | Frame: | RPM:
Phase: | Current: | SF: | ENCL.:

Factory Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1 Vac
Field Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1 Vac

Device Name: | Manufacturer:
Device Model #: | Device Serial #:
Motor Manufacturer: | Area Classification Tag Checked:
Motor Model #: | Motor Serial #:
HP: | Voltage: | Frame: | RPM:
Phase: | Current: | SF: | ENCL.:

Factory Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1 Vac
Field Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1 Vac

Device Name: | Manufacturer:
Device Model #: | Device Serial #:
Motor Manufacturer: | Area Classification Tag Checked:
Motor Model #: | Motor Serial #:
HP: | Voltage: | Frame: | RPM:
Phase: | Current: | SF: | ENCL.:

Factory Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1 Vac
Field Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1 Vac

MECHANICAL TEST RECORD

Device Name: | Manufacturer:
Device Model #: | Device Serial #:
Motor Manufacturer: | Area Classification Tag Checked:
Motor Model #: | Motor Serial #:
HP: | Voltage: | Frame: | RPM:
Phase: | Current: | SF: | ENCL.:

Factory Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1
Field Test: L1 L2 L3 Amps; L1/L2 L2/L3 L3/L1

Vac	Vac

Device Name:	Manufacturer:
Device Model #:	Device Serial #:
Motor Manufacturer:	Area Classification Tag Checked:
Motor Model #:	Motor Serial #:
HP: Voltage:	Frame: RPM:
Phase: Current:	SF: ENCL.:
Factory Test:	Field Test:
L1 L2 L3 Amps	L1 L2 L3 Amps
L1/L2 L2/L3 L3/L1 Vac	L1/L2 L2/L3 L3/L1 Vac

Device Name:	Manufacturer:
Device Model #:	Device Serial #:
Motor Manufacturer:	Area Classification Tag Checked:
Motor Model #:	Motor Serial #:
HP: Voltage:	Frame: RPM:
Phase: Current:	SF: ENCL.:
Factory Test:	Field Test:
L1 L2 L3 Amps	L1 L2 L3 Amps
L1/L2 L2/L3 L3/L1 Vac	L1/L2 L2/L3 L3/L1 Vac

Device Name:	Manufacturer:
Device Model #:	Device Serial #:
Motor Manufacturer:	Area Classification Tag Checked:
Motor Model #:	Motor Serial #:
HP: Voltage:	Frame: RPM:
Phase: Current:	SF: ENCL.:
Factory Test:	Field Test:
L1 L2 L3 Amps	L1 L2 L3 Amps
L1/L2 L2/L3 L3/L1 Vac	L1/L2 L2/L3 L3/L1 Vac

Pre-commissioning Checklist

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Please return copy of completed form to newterra prior to startup Project number and name:

The purpose of this report is that the customer is prepared for startup.

Please send us the completed Pre-Commissioning Checklist 5 days prior to our site visit.

Return to Shane Henderson at shenderson@newterra.com or Fax 613-345-7633

Checked by: Date:

Checklist	Ck
Verify site power is correctly installed to the control panel and necessary electrical approvals have been completed.	
Verify that all input wiring is completed and wired into the control panel according to the installation guide.	
Verify that all power wiring is completed and wired into the control panel according to the installation guide.	
Verify that Compressed air will be connected to system (if required).	
Verify that Fresh Water supply is installed to system (if required).	
Verify that all process piping will be installed and completed.	
Verify that the required approvals are in place to allow the system to discharge air and water as designed.	
Verify that system has been installed on a level pad.	
Verify that all field piping will be completed and wells will be connected to the operating system.	
Verify that phone line is installed and activated if required.	
Additional Checklist Items related to Oxidizers	
Verify that all necessary wiring is completed between the oxidizer and the main control system.	
Verify that all piping between oxidizer and treatment system is completed.	
Verify that Power is connected to oxidizer and necessary electrical approvals have been completed.	
Verify that the required approvals are in place to allow the oxidizer to discharge air to the atmosphere.	
Verify that Gas is connected to the oxidizer and activated to allow for testing of the oxidizer. Note: Please ensure that the gas supply valves are not locked out by the local gas installer at time of commissioning.	
If local gas approval is required for oxidizer, ensure that this is completed or planned to occur during the commissioning.	

******All Tasks will be completed No Later Than 5 Business days prior to newterra Technicians arrival onsite.***

Please note if newterra arrives onsite and items have not been completed there will be a charge associated.

Site Address: _____

_____

_____

Onsite Contact Name & Number: _____

_____

Customer Sign-off Date

System Field Test Checklist

This purpose of this report is to test the functionality of electrical, control, and mechanical components to ensure the system operates as originally designed. This testing is then documented so it can be referenced at a later date if needed.

The following field test records must be completed by the startup technician on site before operating the process system. This is the last quality check ensuring the process equipment is ready for continuous operation.

newterra™ highly recommends that the system is started by a newterra factory trained startup technician to ensure the long term success of your project. We understand that this may not always be feasible in which case we would require a highly skilled technician capable of troubleshooting both mechanical and electrical aspects of a process treatment system and be familiar with our manual, equipment and capable of training the operator on operating and maintenance requirements of the treatment system.

This checklist must be sent back to Product Support department at newterra to validate your equipment warranty which begins on the date of shipment from the factory. It can be sent back in one of the following methods:

Email: service@newterra.com

Fax: Att: Product Support
(613) 345 7633
If you choose to fax the document then, please follow up with an email explaining that a fax was sent so we can ensure that we received the fax and properly validated the equipment warranty.

Project number: _____
Project name: _____

Tested By: _____
Company: _____
Date Tested: _____

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System Field Test Checklist

Minimum Tools Required:

Clamp style amp meter	Socket Set
Multi meter for AC/DC Volts and ma signals	Wire Cutters
Instrumentation Screw Driver	Wire Strippers
Screw Driver Set	Channel Locks
Wrench Set	Pipe Wrenches
Straight Edge for Aligning couplings and belts	

Testing Checklist	Ck	Initial	Date
Verify site power per system design criteria			
Verify building process flow and instrumentation matches P +ID drawing, check off drawing components against actual (preferably with the customer present)			
Ensure all unions are tight, as some are loosened to prevent stress in shipping.			
Walk through system and open all valves that are required to run the system in automatic			
Check panel for lose wiring			
Tighten all terminals where wires are terminated			
Check alignment of motors			
Check field wiring and piping as per drawings			
Check all motor belt tensions			
Turn power on. Measure site voltage. L1/L2_____ L2/L3_____ L3/L1_____ L1/GRD_____ L2/GRD_____ L3/GRD_____			
Test that incoming power has correct phase sequence. Bump a safe 3 phase motor to test rotation.			
Check voltage on AC step down transformer			
Check voltage on DC transformer			
Check rotation of all motors that were field wired.			
Check that PLC Run light is on and the stop/term/run switch is in term			
Manually test inputs as per input table			

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System Field Test Checklist

Check connections of all field wiring to ensure it was completed per the electrical drawings and per the NEC.			
Manually test control logic for each output			
Manually test all shut down alarms			
Manually test that non-critical alarms do not shut down SVE			
Run through complete logic and alarm sequence with customer and make allowable changes.			
Note name of individual and company with whom logic was reviewed:			
Check overload settings for all motors			
Check/Install filter bag in bag filters			
Test analogue inputs			
Run system in full automatic			
Fill out mechanical test record on each motor and check amperage and voltage. Document amperage on the System test records in the operating manual in the Field test load section.			
Wet test all control inputs and outputs			
Wet test all shut down alarms			
Check systems for leaks (liquid and vapor)			
Test position of ball float switches for proper start/stop level			
Test vacuum and pressure relief valve			
Test air stripper and discharge pump operating sequence			
Check flow rate on all pulse meters such that digital and analogue reading increment at the same rate			
Test operation of building exhaust fan			
Test operation of building heater			
Install louver hoods on system			
Test remote access			

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System Field Test Checklist

Test operation of Auto dialer and program if necessary.			
Note newterra modem offsite web address			
Check flow rate discharging from VLS, should maximize flow to prevent a high level shutdown. If you have a centrifugal pump ensure flow rate is low enough to prevent cavitation on the inlet under vacuum.			
Check the skimmer on the oil water separator should be ½" above water level when water is flowing at full speed. Adjust if necessary.			
If Kaeser Compressor Present – Confirm warranty validation has been completed and submitted to Kaeser for warranty			
Check water flow rate into stripper, should be set to minimum flow to keep up with incoming water to maximize contact time in the air stripper. Adjust flow rate if necessary.			
Check flow rate exiting the air stripper, if there is no carbon filters down stream then allow pump to discharge at maximum flow rate. If carbon vessels are installed, then set pump flow rate to the designed system flow rate			

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System Field Test Checklist

Customer Training Checklist			
Review the operating manual with the customer explaining the various components of the manual and sources of information.			
Review the startup and shutdown procedure with operator.			
Review operation of treatment system and describe the maintenance required for each piece of equipment.			
Describe operation of panel and panel components.			
Train customer to troubleshoot alarms based on input conditions to the PLC or relays in the panel.			
Discuss the operating logic with the customer so they understand how the system is configured to work.			

System Field Test Checklist

Operating Data and Records

The following table is a guideline to document the operating conditions of the system when running in automatic mode. The startup technician should document the operating conditions at all the locations in the system. This information can be used at a later date to troubleshoot problems that can arise.

Location of Record Description	Recorded Value
Air Vacuum readings:	
Air Pressure Readings	
Water Pressure Readings	
Water Flow Rates	
Air Flow Rates	
Operating Temperatures:	

System Field Test Checklist

Site Contractor Information: It is important that we capture the site contractor's information who was involved in the mechanical and electrical installation of equipment on site. We may be required to contact these companies during the project life to provide services at a later date.

Electrical Contractor:

Company Name: _____

Contact: _____

Phone Number: _____

Mechanical Contractor:

Company Name:

Contact: _____

Phone Number:

Quality Issues Identified during startup: The intension in this section is to list any problems, deficiencies or quality issues that were identified during startup. If the problem was solved during startup, please indicate. If MLE is required to follow up then please indicate.

Issue 1: Identified:

_____

_____

_____

Check box that applies: newterra Follow up Required ☐ Sorted out on Startup ☐

Issue 2: Identified:

_____

_____

_____

Check box that applies: newterra Follow up Required ☐ Sorted out on Startup ☐

Issue 3: Identified:

_____

_____

_____

Check box that applies: newterra Follow up Required ☐ Sorted out on Startup ☐

System Field Test Checklist

Customer Feedback: newterra is committed to the success of our customers'. Please take a moment and provide any suggestions you may have for our quality and product support teams. We appreciate your comments and look forward to working with you again in the near future.

Please list one item you like about the system you have received:

Please indicate if there are items we could improve upon:

System Field Test Checklist

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MECHANICAL TEST RECORD

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:			
Motor Model #:		Motor Serial #:	
HP:	Voltage:	Frame:	RPM:
Phase:	Current:	SF:	ENCL.:

Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:			
Motor Model #:		Motor Serial #:	
HP:	Voltage:	Frame:	RPM:
Phase:	Current:	SF:	ENCL.:

Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:			
Motor Model #:		Motor Serial #:	
HP:	Voltage:	Frame:	RPM:
Phase:	Current:	SF:	ENCL.:

Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:			
Motor Model #:		Motor Serial #:	
HP:	Voltage:	Frame:	RPM:
Phase:	Current:	SF:	ENCL.:

Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

System Field Test Checklist

newterra

MECHANICAL TEST RECORD							
Device Name:				Manufacturer:			
Device Model #:				Device Serial #:			
Motor Manufacturer:							
Motor Model #:				Motor Serial #:			
HP:		Voltage:		Frame:		RPM:	
Phase:		Current:		SF:		ENCL.:	
Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Device Name:				Manufacturer:			
Device Model #:				Device Serial #:			
Motor Manufacturer:							
Motor Model #:				Motor Serial #:			
HP:		Voltage:		Frame:		RPM:	
Phase:		Current:		SF:		ENCL.:	
Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Device Name:				Manufacturer:			
Device Model #:				Device Serial #:			
Motor Manufacturer:							
Motor Model #:				Motor Serial #:			
HP:		Voltage:		Frame:		RPM:	
Phase:		Current:		SF:		ENCL.:	
Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Device Name:				Manufacturer:			
Device Model #:				Device Serial #:			
Motor Manufacturer:							
Motor Model #:				Motor Serial #:			
HP:		Voltage:		Frame:		RPM:	
Phase:		Current:		SF:		ENCL.:	
Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Project Packing List

PMProjNum **102140**

SOLD - USED RTS151 - Baffinland 150GPM W

PM_ShippingNotes:

Tag	Part Number	Part Description	Req / Rec	PO # / Line	EngMemo
2	18661	Hose, Assembly, J300, 3"	2	-	
Inlet & Outl	ea	Green Hose	0		
Type: G		-3" x 50' Hose assembly with camlocks		0	
2	10541	Camlock Fitting, Aluminum, 3", Part "F"	4		Male Camlocks
Inlet & Outl	ea	Male Adapter x Male Thread Cam Lock Fitting	4		
Type: F		-	102140-003	2	
2	M1108	Switch, Level, Mech Float, Wide Angle, N.O.,	1	---	
LSH-4001	ea	Tilt Float Level Switch 90deg, w 40' cable	1		
Type: I		13A, SPST, N/O ---	102140-011	9	
2	17149	Manual, System, Hard Copy	2	---	
Manual	ea		0		
Type: P		---		0	
2	9999	Misc Part, See Details	1	---	
OWS VEN	ea	As per detailed specification below	0		
Type: P		2IN. X 4FT. PVC OWS VENT STACK		0	
2	RC061	Pump, Sump, Goulds, 100GPM @ 40'	1	---	
P-4001	month	WS1512BHF, w/ switch	0		
Type: R		230V 1 Ph, 1-1/2 HP ---		0	
2	RTS151	WTS, 150 gpm, OWS-24, Carbon, 40' Contair	1	---	
System	month	208/120V, 3ph, Cl1 Div 2	0		
Type: R		Max Water 150gpm @ 40psi ---		0	
5200	M1272	Camlock Fitting, Aluminum, 2", Part "F"	1	---	
5200-Stack	ea	Male Adapter x Male Thread Cam Lock Fitting	0		
Type: F		---		0	
5200	M1137	Drum, Black, Steel, 45 gal, 2 hole lid, bottom :	1	-	
PST-5201	ea	including palletization	1		
Type: I		-	102140-011	4	
5200	9999	Misc Part, See Details	1	---	
PST-5201	ea	As per detailed specification below	0		
Type: P		2IN. X 5 FT. TANK TRUCK HOSE ASSEMBLY WITH CAMLOCK, TYPE C AND TYPE F		0	
5200	9999	Misc Part, See Details	1	---	
PST-5201	ea	As per detailed specification below	0		
Type: P		2IN. X 4FT. PVC PST VENT STACK		0	

Tag	Part Number	Part Description	Req	PO #		EngMemo
			Rec	Line		
7900	10908	Lock, Passage, 107188, Taymor	2		---	
7900	ea	107188	0			
	Type: I	---			0	
7900	10909	Lock, Deadbolt, 289648, Taymor, 1 cyl, S/S	2		---	
7900	ea	keyed alike #289648	0			
	Type: I	---			0	
7900	24662	Hood, Fan, 27" - on use up	2		---	
F-7901	ea	Fits 24" Fan	2			
	Type: I	---	102140-011		6	
7900	23989	Hood, 15"	2		---	
F-7902	ea	Fits 12" Fan & Louver	2			
	Type: I	---	102140-011		5	

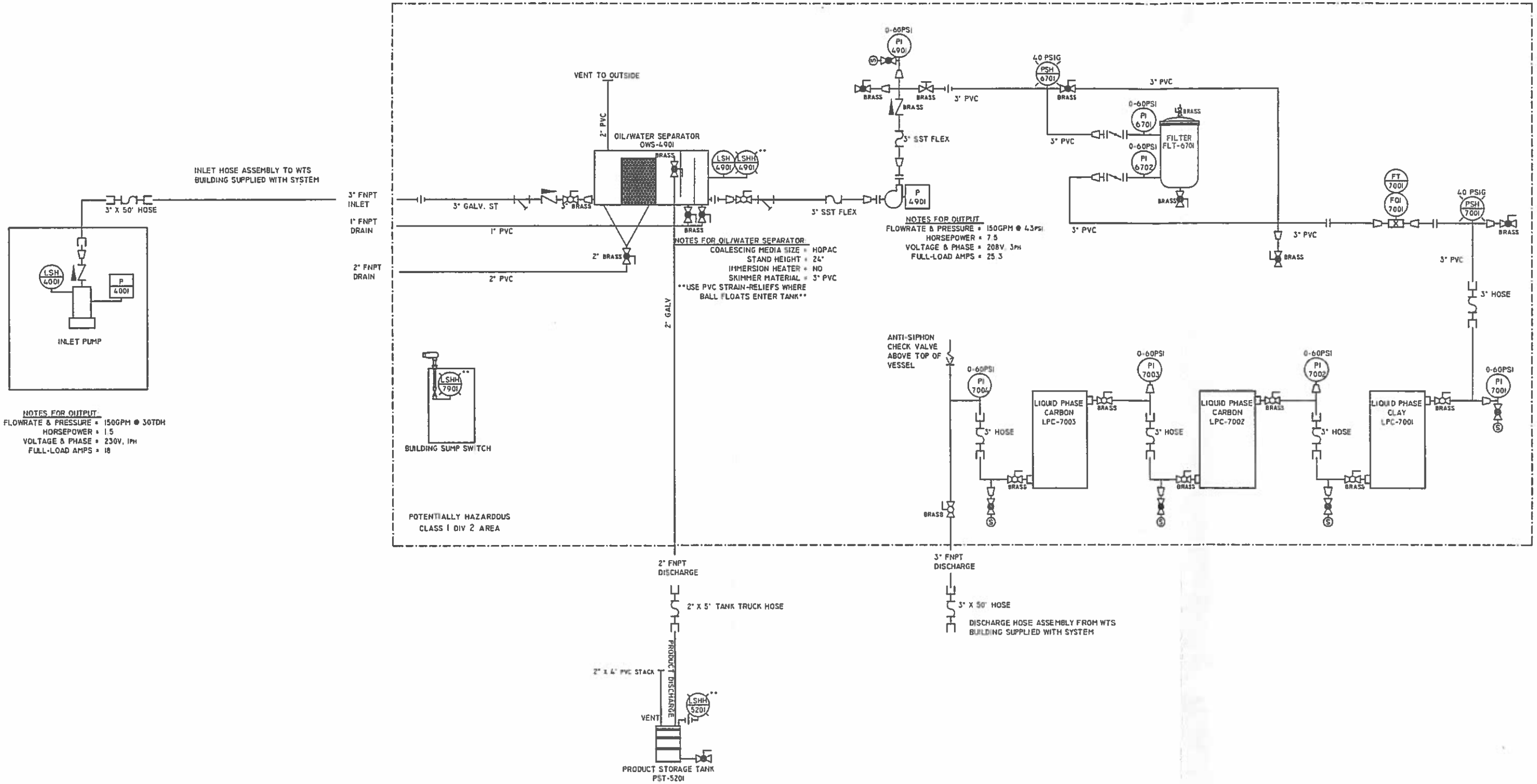
Project Packing List

PMProjNum **102140A**

Baffinland 20' Container for Loose Components

PM_ShippingNotes:

Tag	Part Number	Part Description	Req / Rec	PO # / Line	EngMemo
1	11686	Filter, Bag, FOS P2P, 7" x 32"	120	---	
EXTRA	ea	Oil Absorbing Bags, Sub-micron, Plastic Ring	0		
	Type: P	Box Quantity, 20 per box ---		0	
1	25263-T	Melt-Blown Spaghetti Media	15	---	
EXTRA	ea	Filter Bag Insert, Oil-Absorbing, Polypropylene	0		
	Type: I	25 lbs/bag ---		0	
1	11214	Media, Clay, TM100	5000	---	
EXTRA	lb	(stocked and ordered in lbs)	0		
	Type: I	---		0	
1	20220	Media, Carbon, Liquid, Virgin, 8 x 30 Coconut	6000	---	
EXTRA	lb	Sold in 1100 lb (500 Kg) sacks per pound	0		
	Type: I	---		0	
1	9999	Misc Part, See Details	2	---	
EXTRA	ea	As per detailed specification below	0		
	Type: P	O-ringsm 4155-1490-B (V6427)		0	
1	21891	Gasket, Flange, Tetrasolv AF Series	6	---	
EXTRA	ea	18" Hatch Gasket	0		
	Type: P	Fits, AF250, AF500, AF1000, AF2000, AF300 ---		0	
1	22353	Pump, Part, SSH, Mechanical Seal Kit	2	---	
EXTRA	ea	P/N: RPKSSHS	0		
	Type: P	---		0	
1	21605-T	Media, Coal, Anthracite, .9 to .95mm	20	---	
EXTRA	lb	52 lbs/bag; sold in lbs.	0		
	Type: I	---		0	
1	11610	Container, 8' x 20' x 8'6"	1	---	
EXTRA PA	ea	5-8 yr	0		
	Type: P	---		0	



BUILDING EQUIPMENT AND CONTROL PANEL

BORDER DEFINES THE LIMITS OF THE ENCLOSURE

CONTROL PANEL

TO BE LOCATED ON BUILDING. PANEL TO BE A MINIMUM OF 36" FROM ANY HAZARDOUS PROCESS EQUIPMENT, AND A MINIMUM OF 36" ABOVE GRADE.

TSL 7901, TSL 7902, TSH 7901, TSH 7902, H 7901, H 7902, H 7903, F 7901, F 7902, LSHH 7901**, KILL 7901**

WIRING TO BE CLASS I DIVISION 2, AS PER THE CEC.

IS INPUT WIRING TO BE WIRED FOR INDOORS, ACCORDING CEC FOR HAZARDOUS LOCATIONS.

PIPING DETAILS:
- WATER FLOW METERS: PROVIDE 10 DIA. OF STRAIGHT PIPE BEFORE AND 5 DIA. OF STRAIGHT PIPE AFTER METERS. ENSURE THAT THROTTLING VALVES ARE NOT DIRECTLY IN LINE WITH METERS.
- AIR FLOW METERS: PROVIDE 8 DIA. OF STRAIGHT PIPE BEFORE AND 3 DIA. OF STRAIGHT PIPE AFTER METERS, IF POSSIBLE. AVOID TEES AND ELBOWS BEFORE AND AFTER METERS.
- MATERIALS OF VALVES AND FITTINGS TO BE THE SAME AS THE DESCRIPTION AT THE LINE. IF THERE IS A TRANSITION FROM PVC TO STEEL, THE VALVE SHOULD BE BRASS
- THERE ARE NO SPECIAL PIPING REQUIREMENTS OTHER THAN WHAT IS EXPLAINED ON THE DIAGRAM.
- WHEN PVC HOSE IS SPECIFIED, ALWAYS USE VACUUM HOSE. USE GREEN HOSE FOR PRESSURES LESS THAN 60PSI. USE TANK TRUCK HOSE FOR PRESSURES BETWEEN 60PSI AND 150PSI.
- PVC PIPE MAY BE SUBSTITUTED WITH EQUAL-SIZED PVC HOSE WHERE A FLEXIBLE CONNECTION IS PREFERRED.

C	2013-08-20	DM	AS BUILT
B	2013-08-06	DAM	FOR PRODUCTION

DWG. NO: 102140-01 (PAGE 1 OF 2)

TITLE: PROCESS & INSTRUMENTATION DRAWING

CUSTOMER: MARY RIVER PROJECT BAFFINLAND

newterra LTD.

VALVES AND PIPING

NO NC

BALL VALVE -
GATE VALVE -
GLOBE VALVE -
NEEDLE VALVE -
SLIDE VALVE -
SOLENOID VALVE -
BUTTERFLY VALVE -
SWING CHECK VALVE -
WAFER CHECK VALVE -
SPRING CHECK VALVE -
WYE STRAINER -
SAMPLE PORT -
PRESSURE RELIEF VALVE -
VACUUM RELIEF VALVE -
CAMLOCK CONNECTION -
FERNCO CONNECTION - FERNCO
FLEXIBLE CONNECTION -
FLANGED CONNECTION -
REDUCER -
UNION -
ADSORBENT FILTER - A DRAIN
COALESCING FILTER - DRAIN
PARTICULATE FILTER - DRAIN
FILTER, SILENCER -
PRESSURE REGULATOR -
REGULATOR W/ FILTER -

EQUIPMENT

AIR STRIPPER

OIL/WATER SEPARATOR

VAPOR/LIQUID, SEAL FLUID SEPARATOR

BAG FILTER

CARBON VESSEL

PRODUCT STORAGE DRUM, TANK

OXIDIZER

CHEMICAL DRUM

STANDARD, CONICAL-BOTTOM TANK

EQUIPMENT

CENTRIFUGAL PUMP -
PROGRESSIVE-CAVITY PUMP -
CHEMICAL-INJECTION PUMP -
CENTRIFUGAL, REGENERATIVE BLOWER -
POSITIVE-DISPLACEMENT BLOWER -
ROTARY-CLAW BLOWER -
LIQUID-RING PUMP -
ROTARY-VANE COMPRESSOR -
RECIPROCATING COMPRESSOR -
HEAT EXCHANGER -
PASSIVE COOLING FINS -

EQUIPMENT

AS - AIR STRIPPER
BLD - BUILDING, TRAILER OR SKID
FLT - FILTER VESSEL
LPC - LIQUID-PHASE CARBON VESSEL
MFD - MANIFOLD
OWS - OIL/WATER SEPARATOR
OX - OXIDIZER
PST - PRODUCT STORAGE TANK
SOS - SEAL OIL SEPARATOR
SWS - SEAL WATER SEPARATOR
TNK - TANK
VLS - VAPOR/LIQUID SEPARATOR
VPC - VAPOR-PHASE CARBON VESSEL

FLOW MEASUREMENT

AVERAGING PITOT TUBE - RANGE PDI 101 H L

VENTURI - RANGE PDI 101 H L

ROTOMETER - RANGE FI 101

WATER FLOW METER - FQI 101

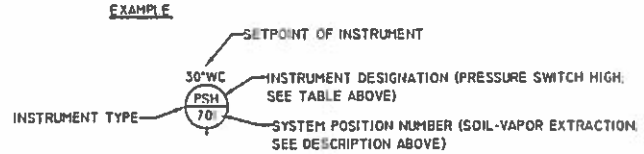
INSTRUMENT DESIGNATION

	INPUT	1ST MODIFIER	2ND MODIFIER	3RD MODIFIER	OUTPUT	1ST MODIFIER	
A			ALARM				A
B						BLOWER	B
C	CYCLE					COMPRESSOR	C
D		DIFFERENTIAL				AIR DRYER	D
E							E
F	FLOW					FAN	F
G	GAS (LEL)		GAUGE				G
H				HIGH	HAND	HEATER	H
I	CURRENT		INDICATOR				I
J							J
K							K
L	LEVEL			LOW			L
M					MOTORIZED		M
N							N
O							O
P	PRESSURE				PNEUMATIC	PUMP	P
Q		QUANTITY					Q
R							R
S	SPEED		SWITCH		SOLENOID		S
T	TEMPERATURE		TRANSMITTER				T
U							U
V						VALVE	V
W							W
X							X
Y							Y
Z	POSITION						Z

INSTRUMENT IDENTIFICATION

- INDICATING INSTRUMENT
- DIGITAL INPUT TO CONTROL PANEL
- DIGITAL INPUT CAUSING ALARM
- ** DIGITAL INPUT CAUSING SYSTEM SHUTDOWN ALARM
- ANALOG INPUT TO CONTROL PANEL
- ANALOG OUTPUT FROM CONTROL PANEL

EXAMPLE



SYSTEM POSITION DESIGNATION

100 - VACUUM INLET MANIFOLD
300 - INLET HEAT EXCHANGER
400 - VAPOR/LIQUID SEPARATOR
500 - VAPOR/LIQUID SEPARATOR - 2
700 - SOIL-VAPOR EXTRACTION
1000 - LIQUID-RING PUMP
1300 - SVE HEAT EXCHANGER
1600 - VAPOR-PHASE CARBON
1900 - OXIDIZER
2200 - AIR SPARGE
2500 - SPARGE HEAT EXCHANGER
2800 - SPARGE OUTLET MANIFOLD
3100 - AIR COMPRESSOR
3400 - COMPRESSED-AIR OUTLET MANIFOLD
3700 - PNEUMATIC WELL PUMPS
4000 - SUBMERSIBLE WELL PUMPS
4300 - SURFACE-MOUNT WELL PUMPS
4600 - GROUNDWATER INLET MANIFOLD
4900 - OIL/WATER SEPARATOR
5200 - PRODUCT STORAGE TANK
5500 - INLET TANK
5800 - UPSTREAM BAG FILTER
6100 - CHEMICAL INJECTION
6400 - AIR STRIPPER
6700 - PRE-CARBON BAG FILTER
7000 - LIQUID-PHASE CARBON
7100 - PRE-MEDIA BAG FILTER
7200 - ACTIVATED ALUMINA
7300 - DISCHARGE TANK
7400 - POST-TREATMENT BAG FILTER
7600 - REINJECTION
7900 - BUILDING, TRAILER OR SKID
8200 - CONTROL PANEL
8500 - ELECTRICAL PARTS
9900 - EXTRAS

PIPING DETAILS
- WATER FLOW METERS: PROVIDE 10 DIA. OF STRAIGHT PIPE BEFORE AND 5 DIA. OF STRAIGHT PIPE AFTER METERS. ENSURE THAT THROTTLING VALVES ARE NOT DIRECTLY IN LINE WITH METERS.
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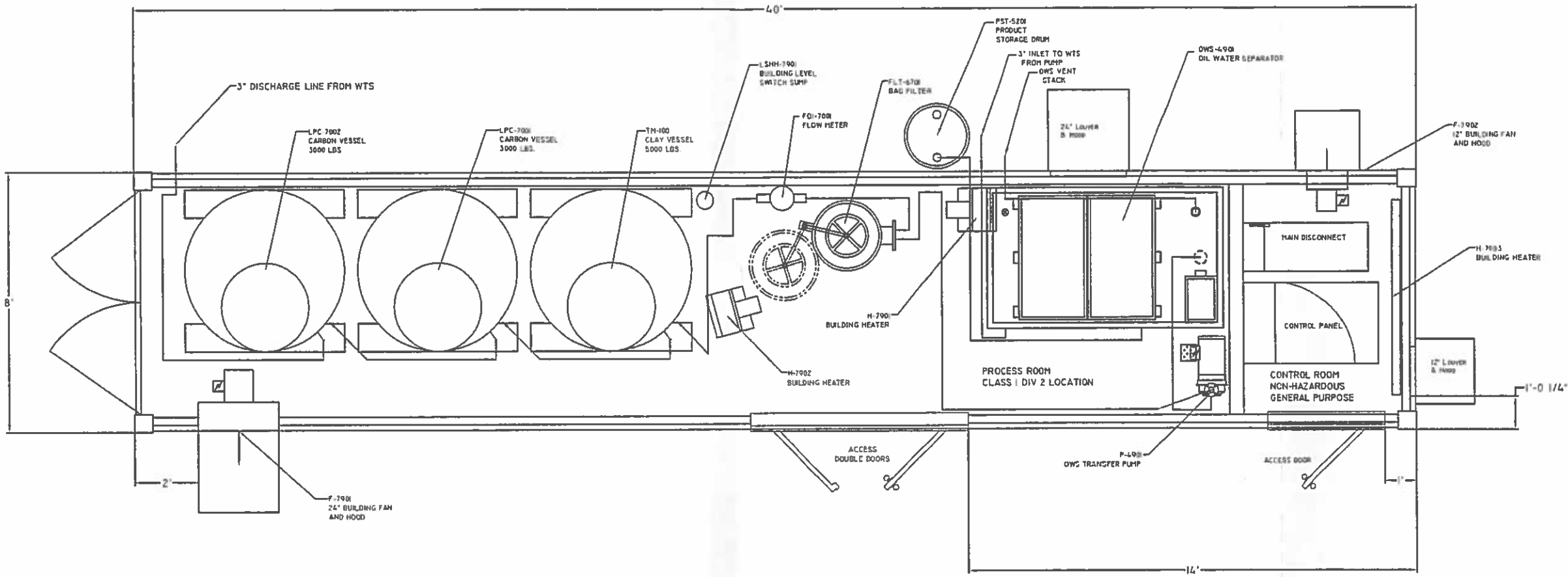
B	2013-08-06	DAM	FOR PRODUCTION	

DWG. NO: 102140-01 (PAGE 2 OF 2)
TITLE: PROCESS & INSTRUMENTATION DRWG LEGEND
CUSTOMER: MARY RIVER PROJECT BAFFINLAND

SCALE BAR, EACH BLOCK IS 12" LONG



PLEASE NOTE: THIS BUILDING IS SHIPPING ON A BOAT AND MUST NOT BE MORE THE 96" IN WIDTH. THIS INCLUDES ALL EQUIPMENT AND CONNECTIONS THAT PROTRUDE THROUGH THE ENCLOSURE.

**** CIVIL CONSTRUCTION NOTES ****

- BUILDING TO BE PAINTED WITH HEMPATEX HI BUILD 46410 BLUE. HEMPEL COLOUR CODE 33930
- DOOR COLOUR TO BE THE SAME AS BUILDING
- FLOOR TO BE GATOR GUARDED
- PROVIDE WOOD LIP AROUND PERIMETER TO ALLOW SUMP SWITCH TO TRIP
- INSTALL GRATING BETWEEN BUILDING FANS AND OUTSIDE LOUVERS.
- THERMAL INSULATION ON WALLS AND CEILING

****MECH /ELECT ASS'Y NOTES ****

- MAXIMUM WIDTH FOR SHIPPING IS 96". THIS INCLUDES ALL CONNECTIONS THAT PROTRUDE THROUGH THE SIDES OF THE ENCLOSURE
- PLUG AND SEAL (WITH WASHERS) ANY HOLES IN THE FLOOR TO CONTAIN WATER SPILLS.
- LOCATE COOLING THERMOSTAT IN THE WARMEST LOCATION AT CEILING LEVEL.
- LOCATE HEATING THERMOSTAT AT FLOOR LEVEL.

***** COMMISSIONING NOTES *****

- NEWTERRA RECOMMENDS PAD BE AT LEAST 12" LARGER THAN ENCLOSURE IN ALL DIRECTIONS LOCAL CODES MAY REQUIRE ALTERNATE DIMENSIONS.
- BUILDINGS NEED TO BE SHIMMED ON SITE TO ALLOW DOORS TO OPEN FREELY. PLEASE HAVE SHIMMING MATERIAL READY DURING BUILDING INSTALLATION
- FOR BUILDINGS IN COLD WEATHER CLIMATES WHERE THE BUILDING IS ELEVATED, A SKIRT MUST BE BUILT AROUND THE BASE TO PREVENT THE FLOOR FROM FREEZING.
- [illegible] AND LOUVER HOODS NEED TO BE INSTALLED [illegible]. CANNOT SHIP WITH HOODS ATTACHED

***** DIMENSION INFORMATION *****

DESCRIPTION	DIM (L X W X H)	WEIGHT
40' CONTAINER	8' X 42' X 9.5'	?????

FLOW DIRECTION
ELECTRICAL CONNECTION
FLOW INTO THE PAGE
FLOW OUT OF THE PAGE
THIS AREA REPRESENTS SERVICE SPACE REQUIRED

LEVEL	DATE:	BY	REVISION:
F	2013-08-20	DM	AS BUILT FOR 102140
F2	2013-08-07	DM	PRODUCTION RELEASE FOR 102140

DWG NO: 102140 - 02
TITLE: SYSTEM LAYOUT
CUSTOMER: BAFFINLAND MARY RIVER PROJECT
newterra LTD.

MET US SYSTEM CLASSIFIED

CMET SYSTEM CLASSIFIED

WARNING: INTRINSICALLY SAFE CIRCUIT INSIDE

WARNING : SYSTEM WILL AUTOMATICALLY RESTART AFTER POWER FAILURE

CAUTION: DISCONNECT THE POWER BEFORE OPENING

CMET&US PANEL

DS201

MAIN DISCONNECT

200 AMP
125A FUSES
208V 3PH
108 FLA

OP101
MICRO-GRAPHIC

F1 F2 F3 F4 F5

P-4901
G
LT614

P-4001
G
LT608

SYSTEM ALARM
R
LT755

OFF HAND AUTO
SW609

OFF HAND AUTO
SW615

PUSH TO STOP PULL TO START
KILL318

REC337

15A GFI

NOTE 1: NEMA 3R LOCKABLE PANEL(S)

NOTE 2: LIGHTS & SWITCHES MOUNTED ON INNER SWING PANEL DOOR

WIRE LEGEND

BLACK: POWER
RED: CONTROL
WHITE: NEUTRAL
BLUE: +24VDC & I.S.(Intrinsically Safe)
BL/WH: 0VDC
YELLOW: INTERLOCKS

NOTES:

MET US CERTIFIED, CONTROL ROOM BUILT TO NEC GENERAL PURPOSE STANDARDS, PROCESS ROOM BUILT TO NEC CLASS 1 DIV 2 STANDARDS, ALL WIRING COMPLETE AND ALL EQUIPMENT PRE-PIPED, FACTORY TESTED AND MOUNTED IN ENCLOSURE.

REV	DATE(mm/dd/yy)	BY	DESCRIPTION
E	08/14/13	dbeliste	FOR PROJECT 102140

	NAME	DATE(mm/dd/yy)
DRAWN	PR	JUN18/07
CKD		
APPR		

newterra

1325 CALIFORNIA AVE.
BROCKVILLE, ONTARIO
CANADA
K6V 5Y6
www.newterra.com

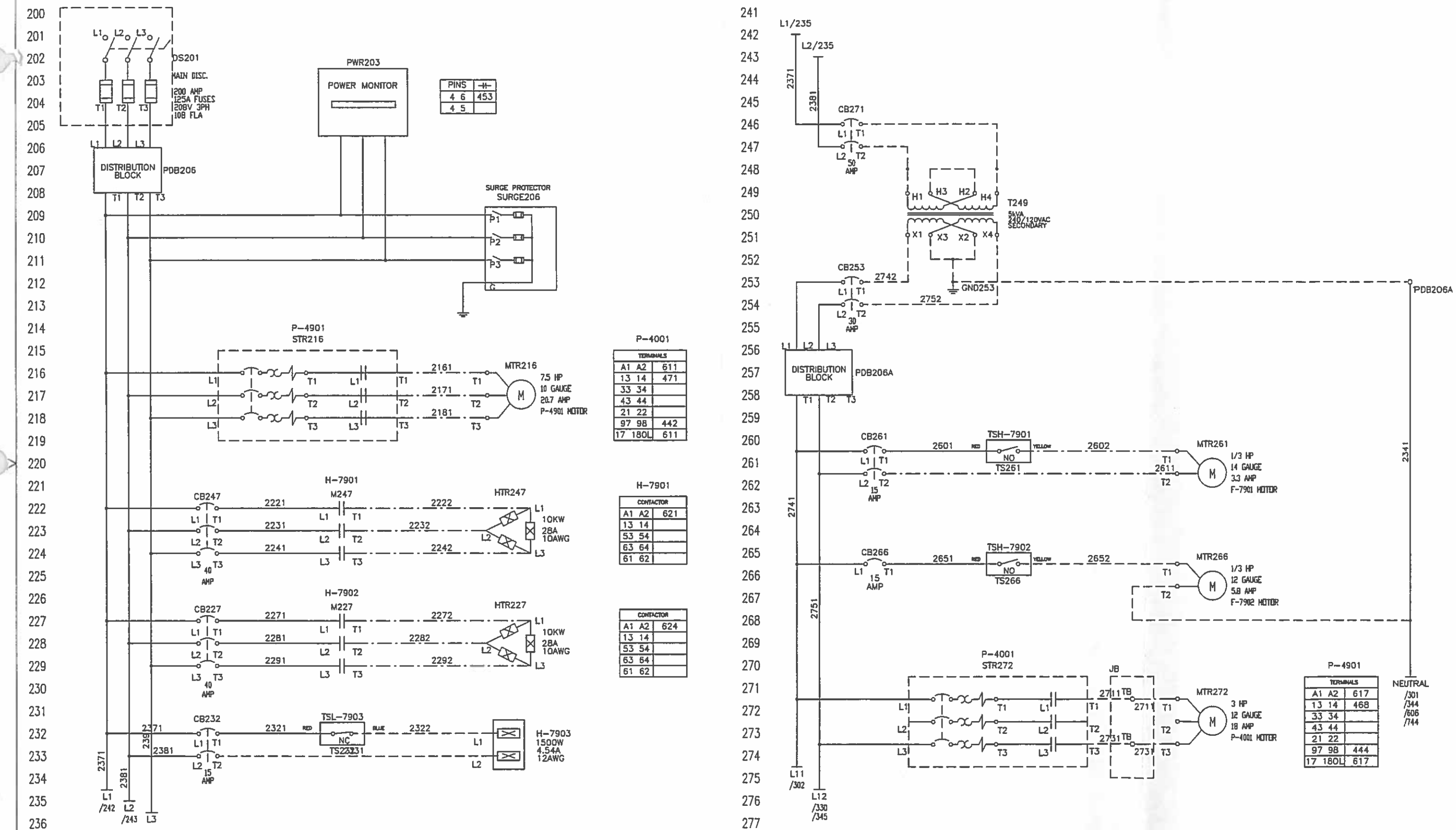
PROJECT:
RTS151 / 150GPM OWS
Baffinland Iron Mines Corp
Mary River Project/ PM 005

DRAWING-NO:

JOB-NO:
102140

PAGE DESCRIPTION
PANEL VIEW

PAGE:
1 OF 8



WIRE LEGEND

BLACK: POWER
RED: CONTROL
WHITE: NEUTRAL
BLUE: +24VDC & I.S.(Intrinsically Safe)
BL/WH: 0VDC
YELLOW: INTERLOCKS

NOTES:

MET US CERTIFIED, CONTROL ROOM BUILT TO NEC GENERAL PURPOSE STANDARDS, PROCESS ROOM BUILT TO NEC CLASS 1 DIV 2 STANDARDS, ALL WIRING COMPLETE AND ALL EQUIPMENT PRE-PIPED, FACTORY TESTED AND MOUNTED IN ENCLOSURE.

REV	DATE(mm/dd/yy)	BY	DESCRIPTION
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	NAME	DATE(mm/dd/yy)
DRAWN	PR	JUN18/07
CKD		
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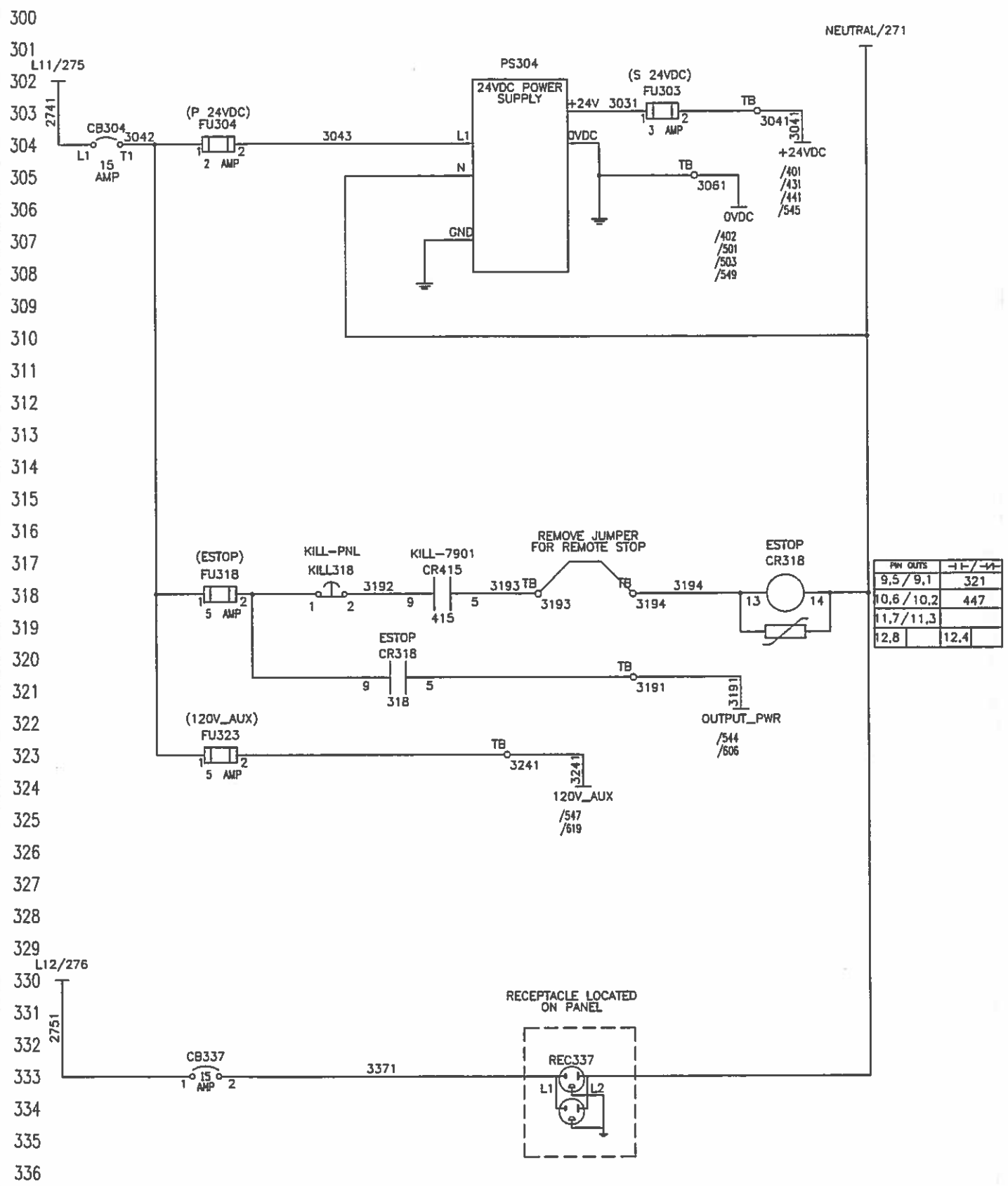
PROJECT:
RTS151 / 150GPM OWS
Baffinland Iron Mines Corp
Mary River Project/ PM 005

DRAWING-NO:

JOB-NO:
102140

PAGE DESCRIPTION
MOTORS

PAGE:
2 OF 8



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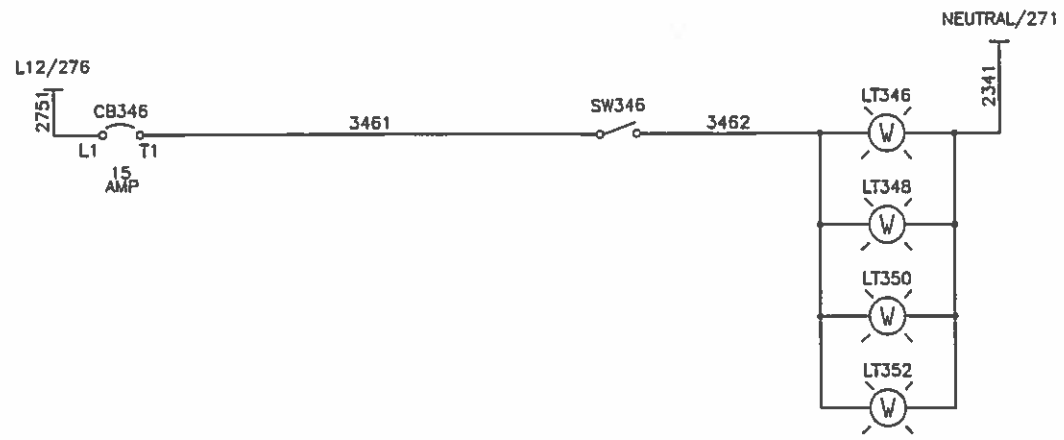

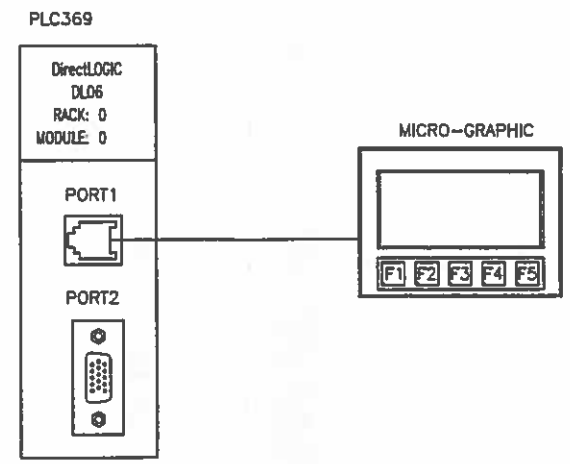

WIRE LEGEND

BLACK: POWER
RED: CONTROL
WHITE: NEUTRAL
BLUE: +24VDC & I.S.(Intrinsically Safe)
BL/WH: 0VDC
YELLOW: INTERLOCKS

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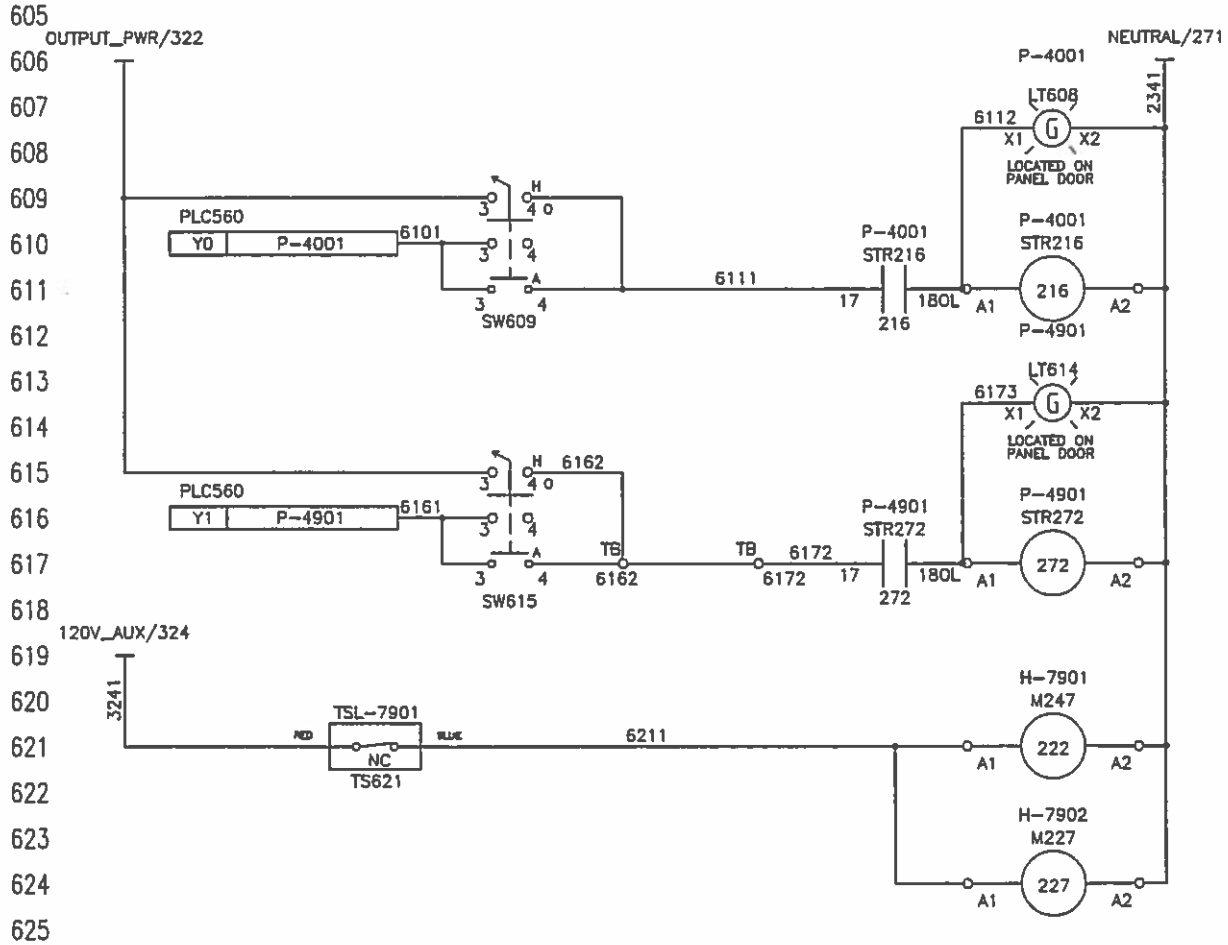
PAGE: 3 OF 8



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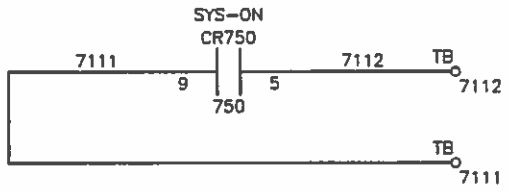
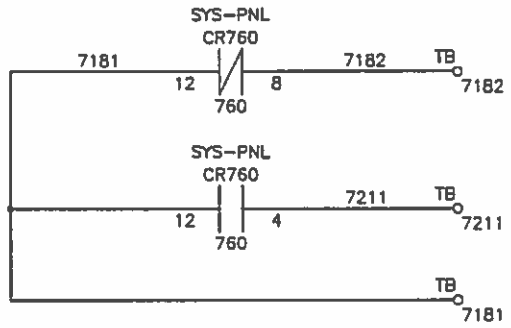
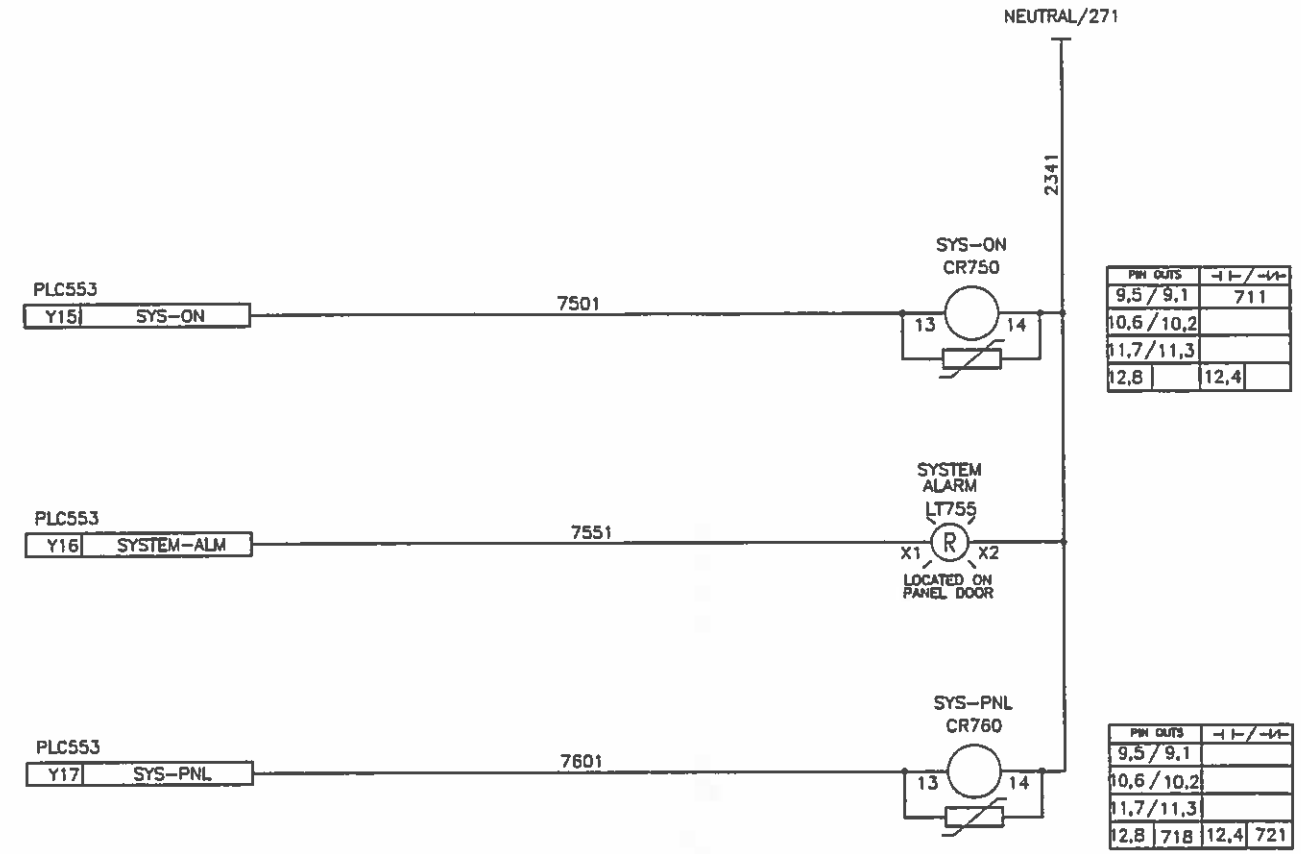
PAGE DESCRIPTION
PLC OUTPUTS

PAGE:
6 OF 8







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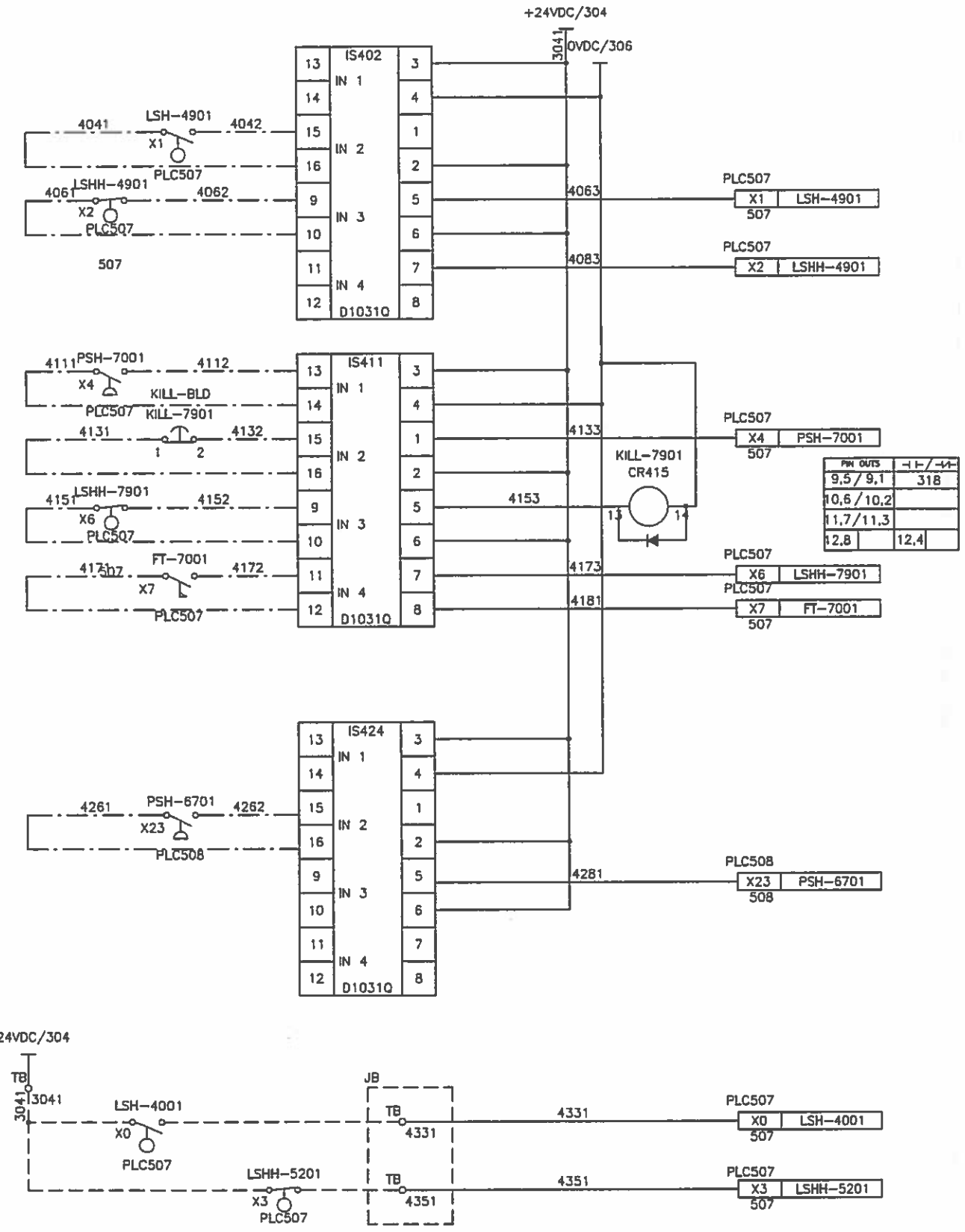
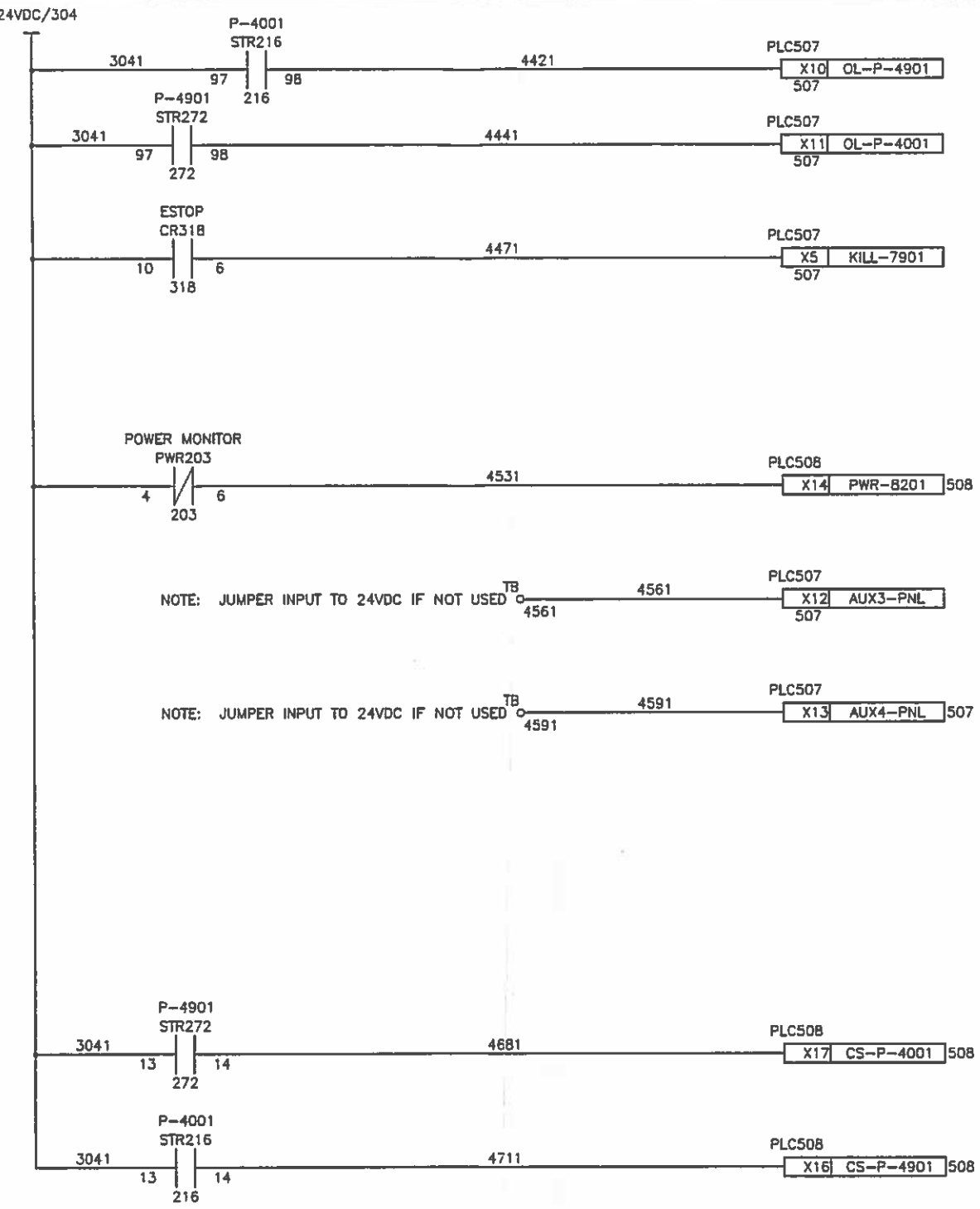
PAGE DESCRIPTION
PLC OUTPUTS

PAGE:
7 OF 8





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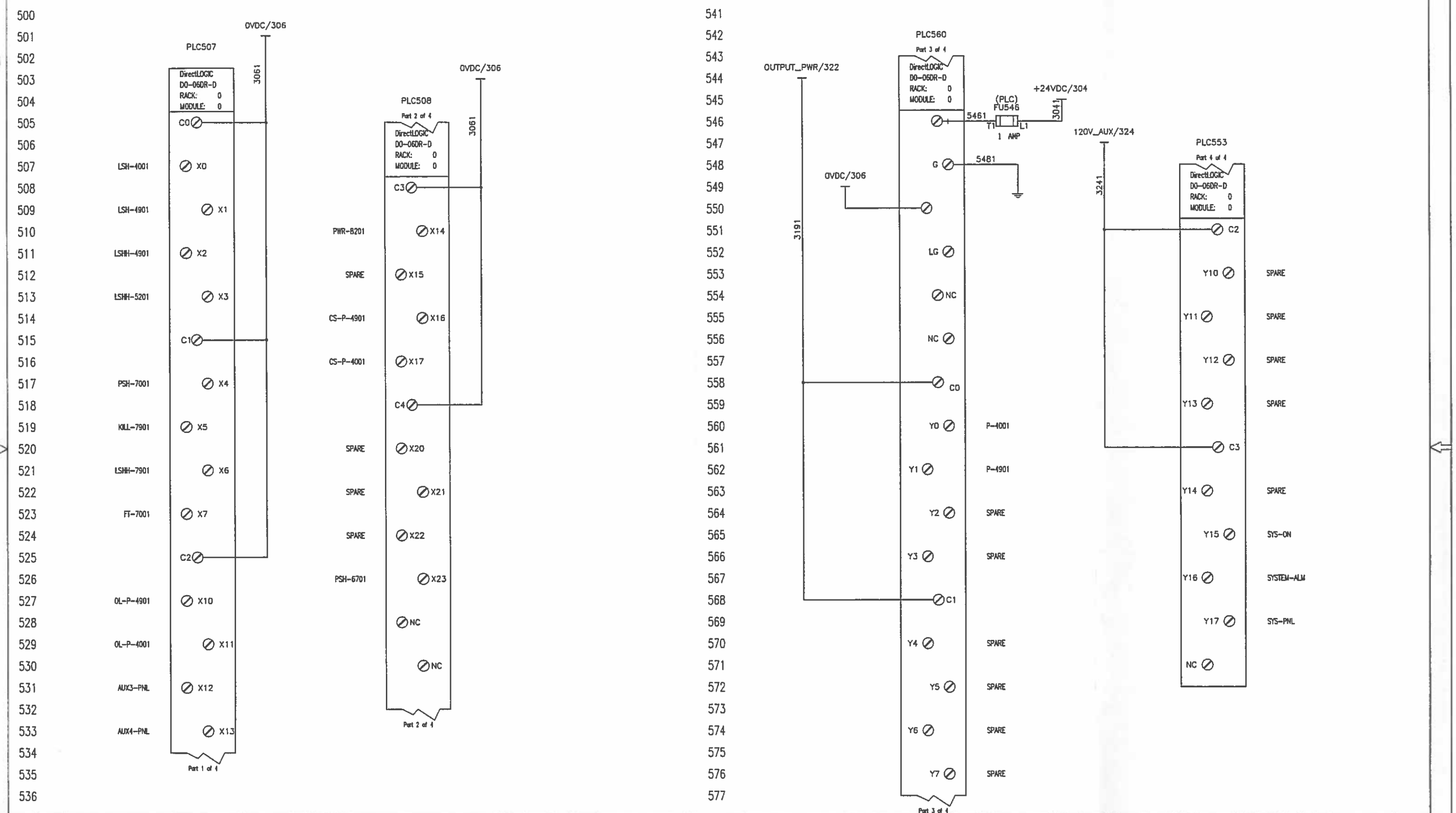
PAGE DESCRIPTION: PLC INPUTS

PAGE: 4 OF 8



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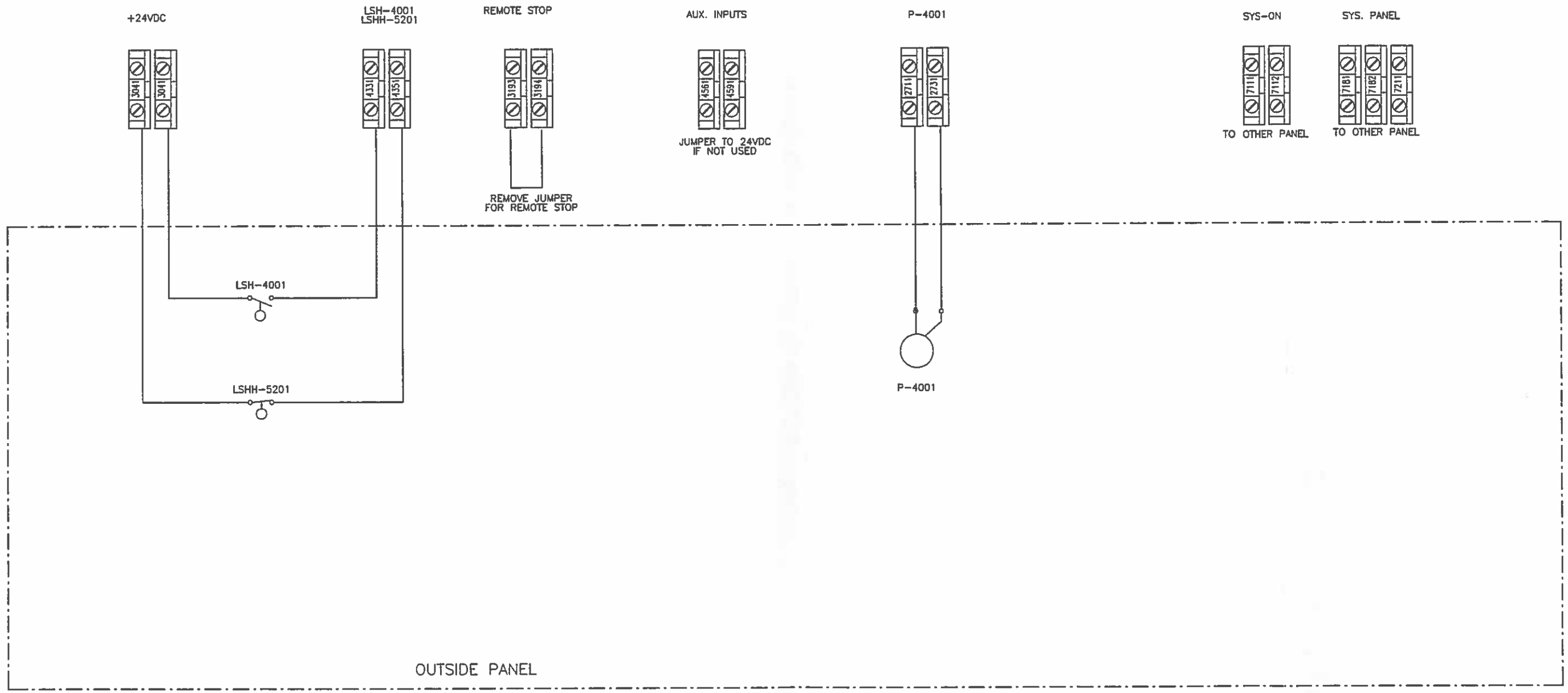
PAGE DESCRIPTION
PLC LAYOUT

PAGE:
5 OF 8

TERMINAL PLAN



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FIELD WIRING

PAGE:
8 OF 8

Inputs and Setpoints — *Project: RTS151 WTS, 150gpm, OWS-24, Carbon, 4*

Input Summary	
Digital PLC Inputs:	15
Digital PLC Frequency:	1
Analog(4-20) Inputs:	0
Analog(5V) Inputs:	0
Analog(10V) Inputs:	0

IS Barrier Summary	
Analog IS:	0
Digital IS :	9

Legend for Class

ISA : Intrinsically Safe Analog
ISD: Intrinsically Safe Digital
GP: Wire General Purpose
D1: Wire as DI/1
D2: Wire as DI/2

				PLC		Signal							Datalogger (DLO6)	
Tag	Name	Type	Class	Input	Value	State	Low	High	Units	SQRT	Fctr	Offsite_Col	Note	Main	Monthly (Daily for 30 days)
Digital_PLC															
4000 Submersible Pump															
LSH-4001	Level Switch Hi Well Pump 4001	Digital_PLC	ISD	X000		NormOpen	0	0		☐	0			☐ 0	☐ 0
CS-P-4001	P-4001 Status	Digital_PLC	GP	X017		NormOpen	0	0		☐	0			☐ 0	☐ 0
4900 Oil/Water Separator															
LSH-4901	Level Switch High - Oil Water Separato	Digital_PLC	ISD	X001		NormOpen	0	0		☐	0			☐ 0	☐ 0
LSHH-4901	Level Switch High High - Oil Water Sep	Digital_PLC	ISD	X002		NormClose	0	0		☐	0			☐ 0	☐ 0
CS-P-4901	P-4901 Status	Digital_PLC	GP	X016		NormOpen	0	0		☐	0			☐ 0	☐ 0
5200 Product Storage Tank															
LSHH-5201	Level Switch High High - Product Stora	Digital_PLC	ISD	X003		NormClose	0	0		☐	0			☐ 0	☐ 0
6700 Bag Filter															
PSH-6701	Pressure Switch High Bag Filter 6701	Digital_PLC	ISD	X023		NormOpen	0	0		☐	0			☐ 0	☐ 0
7000 Liquid Phase Carbon															
PSH-7001	High Pressure Switch	Digital_PLC	ISD	X004		NormClose	0	0		☐	0			☐ 0	☐ 0
7900 Building, Trailer or Skid															
KILL-7901	Kill Switch 1 - Building	Digital_PLC	ISD	X005		NormClose	0	0		☐	0			☐ 0	☐ 0
LSHH-7901	Level Switch High High - Building	Digital_PLC	ISD	X006		NormClose	0	0		☐	0			☐ 0	☐ 0
8200 Main Control Panel															
OL-P-4901	P-4901 Overload	Digital_PLC	GP	X010		NormOpen	0	0		☐	0			☐ 0	☐ 0
OL-P-4001	P-4001 Overload	Digital_PLC	GP	X011		NormOpen	0	0		☐	0			☐ 0	☐ 0
AUX-8201	Auxiliary Contact - Control Panel	Digital_PLC	GP	X012		NormClose	0	0		☐	0			☐ 0	☐ 0
AUX-8202	Auxiliary Contact - Control Panel	Digital_PLC		X013		NormClose	0	0		☐	0			☐ 0	☐ 0
PWR-8201	Power/Phase Monitor Panel	Digital_PLC		X014		NormClose	0	0		☐	0			☐ 0	☐ 0
Digital_PLC_Freq															
7000 Liquid Phase Carbon															
FT-7001	Flow Transmitter - Liquid Phase Carbo	Digital_PLC_	ISD	X007		NormOpen	0	0		☐	0			☐ 0	☐ 0
Direct															
7900 Building, Trailer or Skid															
TSH-7901	Temperature Switch High - Room #1	Direct				NormOpen	0	0		☐	0			☐ 0	☐ 0
TSH-7902	Temperature Switch High - Room #2	Direct				NormOpen	0	0		☐	0			☐ 0	☐ 0
TSL-7901	Temp Switch Low - Room #1	Direct				NormClose	0	0		☐	0			☐ 0	☐ 0

				PLC		Signal							Datalogger (DLO6)	
Tag	Name	Type	Class	Input	Value	State	Low	High	Units	SQRT	Fctr	Offsite_Col	Note	Main	Monthly (Daily for 30 days)
TSL-7902	Temp Switch Low - Room #2	Direct				NormClose	0	0		☐	0			☐ 0	☐ 0

Outputs Project RTS151 WTS, 150gpm, OWS-24, Carbon, 40

Largest Motor	7.5

575V-3ph:	0
460V-3ph:	0
230V-3ph:	0
208V-3ph:	20.46

230V-1ph	11.43
208V-1ph	0
115V-1ph	12

230V/115-3ph	0

Tag	PLC Loc	Device	Voltage	Watts	HP	Amps	Switches: At Device	Switches: On Panel	Panel Setup: Hourmeter	Panel Setup: Ammeter	Analog Setup: Signal_Low	Analog Setup: Signal_High	Offsite Communication Package: Offsite_Switch	Offsite_Color	Offsite_Name	Hourmeter	Ammeter	Datalog: Monthly	Datalog: Mai
							Logic												
Digital PLC																			
4000 Submersible Pump																			
P-4001	Y000	Motor Cntr	230V-1ph		1.5	7.83	None	Hand/Off/Auto	Display Only	None						☐	☐	☐ 0	☐ 0
Well Pump 4001							PUMPS FEEDING OWS PUMP START: SYSTEM IN RUN AND LAHH-4901 OFF PUMP STOP: SYSTEM NOT IN RUN OR LAHH-4901 ON												
4900 Oil/Water Separator																			
P-4901	Y001	Motor Cntr	208V-3ph		7.5	20.46	None	Hand/Off/Auto	Display Only	None						☐	☐	☐ 0	☐ 0
Pump - Oil Water Separator							PUMP START: SYSTEM IN RUN AND LSH-4901 ON PUMP STOP: SYSTEM NOT IN RUN OR LSH-4901 OFF												
8200 Main Control Panel																			
AL-8201	Y016	Light	115V-1ph				None	None	None	None						☐	☐	☐ 0	☐ 0
Alarm Light							LIGHT ON: SYSTEM IN ALARM. LIGHT OFF: SYSTEM NOT IN ALARM.												
AR-8201	Y017	Relay(110)	115V-1ph				None	None	None	None						☐	☐	☐ 0	☐ 0
Alarm Relay							RELAY ON: SYSTEM IN SHUTDOWN ALARM. RELAY OFF: SYSTEM NOT IN SHUTDOWN ALARM.												
SYS ON	Y015	Relay(110)	115V-1ph				None	None	None	None						☐	☐	☐ 0	☐ 0
System On Relay							RELAY ON: SYSTEM IN RUN AND KILL SWITCH NOT PRESSED RELAY OFF: SYSTEM NOT IN RUN OR KILL SWTICH PRESSED												
Power																			
7900 Building, Trailer or Skid																			
F-7901		Fan	230V-1ph		0.33	3.6	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Fan - Process Room							FAN START: TSH-7901 ON FAN STOP: TSH-7901 OFF												
F-7902		Fan	115V-1ph	0	0.25	2	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Fan - Control Room							FAN START: TSH-7902 ON FAN STOP: TSH-7902 OFF												
H-7901		Heater	208V/120V-3	10000	0	28	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Heater - Process Room #1							HEATER START: TSL-7901 OFF HEATER STOP: TSL-7901 ON												
H-7902		Heater	208V/120V-3	10000		28	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Heater - Process Room #2							HEATER START: TSL-7901 OFF HEATER STOP: TSL-7901 ON												
H-7903		Heater	208V/120V-3	1500	0	4.1	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Heater - Control Room							HEATER START: TSL-7902 OFF HEATER STOP: TSL-7902 ON												
Lights		Light	115V-1ph	600		5	None	None	None	None						☐	☐	☐ 0	☐ 0
Inside Lights							LIGHTS ON: LIGHT SWITCH ON LIGHTS OFF: LIGHT SWITCH OFF												

Tag		PLC Loc	Device	Voltage	Watts	HP	Amps	Switches: At Device	Switches: On Panel	Panel Setup: Hourmeter	Panel Setup: Ammeter	Analog Setup: Signal_Low	Analog Setup: Signal_High	Offsite Communication Package: Offsite_Switch	Offsite_Color	Offsite_Name	Hourmeter	Datalog: Ammeter	Datalog: Monthly	Datalog: Mai
								Logic												
1200	Main Control Panel																			
	120V CB		Control Powe	115V-1ph	600		5	None	None	None	None						☐	☐	☐ 0	☐ 0
	120V Control Power																			

Alarms Project RTS151 WTS, 150gpm, OWS-24, Carbon, 40' Contai

Tag		PLC Loc / Logic	Alarm Type	Delay(sec)	Alarms On..	Alarm Setting / Comment
Type: Alarm_PLC						
4900 Oil/Water Separator						
LAHH-4901	**High High Level Alarm - Oil Water Separator**	C103	Recovers	5	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND LSHH-4901 OPEN FOR DELAY SHOWN ALARM STOP: SYSTEM RESET				
5200 Product Storage Tank						
LAHH-5201	**High High Level Alarm - Product Storage Tank**	C104	Sys_Shutdown	5	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND LSHH-5201 DEACTIVATED FOR DELAY SHOWN (see table) ALARM STOP: SYSTEM RESET				
5800 Bag Filter						
PAH-6701	**High Pressure Alarm Bag Filter 6701**	C110	Light_Only	5	Open	0
		SOFT ALARM: ALARM START: SYSTEM IN RUN AND PSH-6701 ACTIVATED FOR 5 SECONDS ALARM STOP: SYSTEM RESET				
7000 Liquid Phase Carbon						
PAH-7001	**Pressure Alarm High**	C106	Sys_Shutdown	5	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM ON AND PSH-7001 OPEN FOR DELAY SHOWN (see table) ALARM STOP: SYSTEM RESET				
7900 Building, Trailer or Skid						
KILLA-7901	**Kill Switch Alarm 1 - Building**	C102	Sys_Shutdown	0	Open	0
		SYSTEM SHUTDOWN: ALARM START: ANY KILL INPUT OPEN ALARM STOP: SYSTEM RESET				
LAHH-7901	**Level Alarm High High - Building**	C105	Sys_Shutdown	5	Open	0
		STANDARD LOGIC SYSTEM SHUTDOWN: ALARM START: LSHH-7901 OPEN FOR DELAY SHOWN ALARM STOP: SYSTEM RESET				
8200 Main Control Panel						
OLA-P-4901	**Overload Alarm OWS Discharge Pump**	C111	Sys_Shutdown	1	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND OL-P-4901 ACTIVATED ALARM STOP: SYSTEM RESET				

Tag		PLC Loc	Alarm Type	Delay(sec)	Alarms On..	Alarm Setting
		Logic				Comment
OLA-P-4001	**Overload Alarm Inlet Discharge Pump**	C112	Sys_Shutdown	1	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND OL-P-4001 ACTIVATED ALARM STOP: SYSTEM RESET				
AUXA-8201	**Auxiliary Alarm - Control Panel**	C113	Sys_Shutdown	5	Open	0
		STANDARD LOGIC SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND AUX-8201 DEACTIVATED ALARM STOP: SYSTEM RESET				
AUXA-8202	**Auxiliary Alarm - Control Panel**	C113	Sys_Shutdown	5	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND AUX-8202 DEACTIVATED ALARM STOP: SYSTEM RESET				
PWRA-8201	**Panel Power Alarm**	C114	Sys_Shutdown	0	Open	0
		SYSTEM SHUTDOWN: ALARM START: POWER LOSS OR INCOMING VOLTAGE FAULT ALARM STOP: SYSTEM RESET AND INCOMING POWER IS WITHIN LIMITS Note. Power limits and tolerance, as well as recovery time is all set locally on device.				

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1 Using the newterra Site-Link: Remote Offsite Telemetry

1.1 Document purpose

This document details the various features and functionality of and procedure for logging in to and using the **newterra** Site-Link: Remote Offsite Telemetry portal.

Revision control

Revision	Author	Date
Rev 1. Original draft.	T Coates/ W Moulton	11 April 2012

2 Table of Contents

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3 Overview

The **newterra** Site-Link: Remote Offsite Telemetry is a customized software program and hardware configuration which provides a real-time link to a process control system via cellular modem using our secure Site-Link Server.

Site-Link does not require any additional software to be downloaded or installed and simply uses your favourite internet browser* to view your system from anywhere you can get internet and is Operating System independent (ie Windows/ MAC). This means that you have access to your system via your internet browser enabled computer, smart phone or similar device. To access your system simply type the following address into your browser: https://sitelink.newterra.com.

** **newterra** recommends Internet Explorer 8.0® or higher for best performance with 800x600 resolution or higher.*

Site-Link comes with the following features:

- Customized P&ID layout with System Status
- Start/ Stop/ Reset of System
- Manual Control of most system components†
- Data and Alarm logging exports in .csv format
- Alarm History including Current Alarm Status
- Hour Meters for Equipment††
- Customization of all system set points†

† certain restrictions apply.
†† only applies when hour meters are quoted with system.

Multiple users can have access to Site-Link, each with their own unique login details. Users can have read and write privileges for monitoring and control, or read only privileges for monitoring only. For customers with multiple systems with Site-Link capability, all those systems will be available via the one login account.

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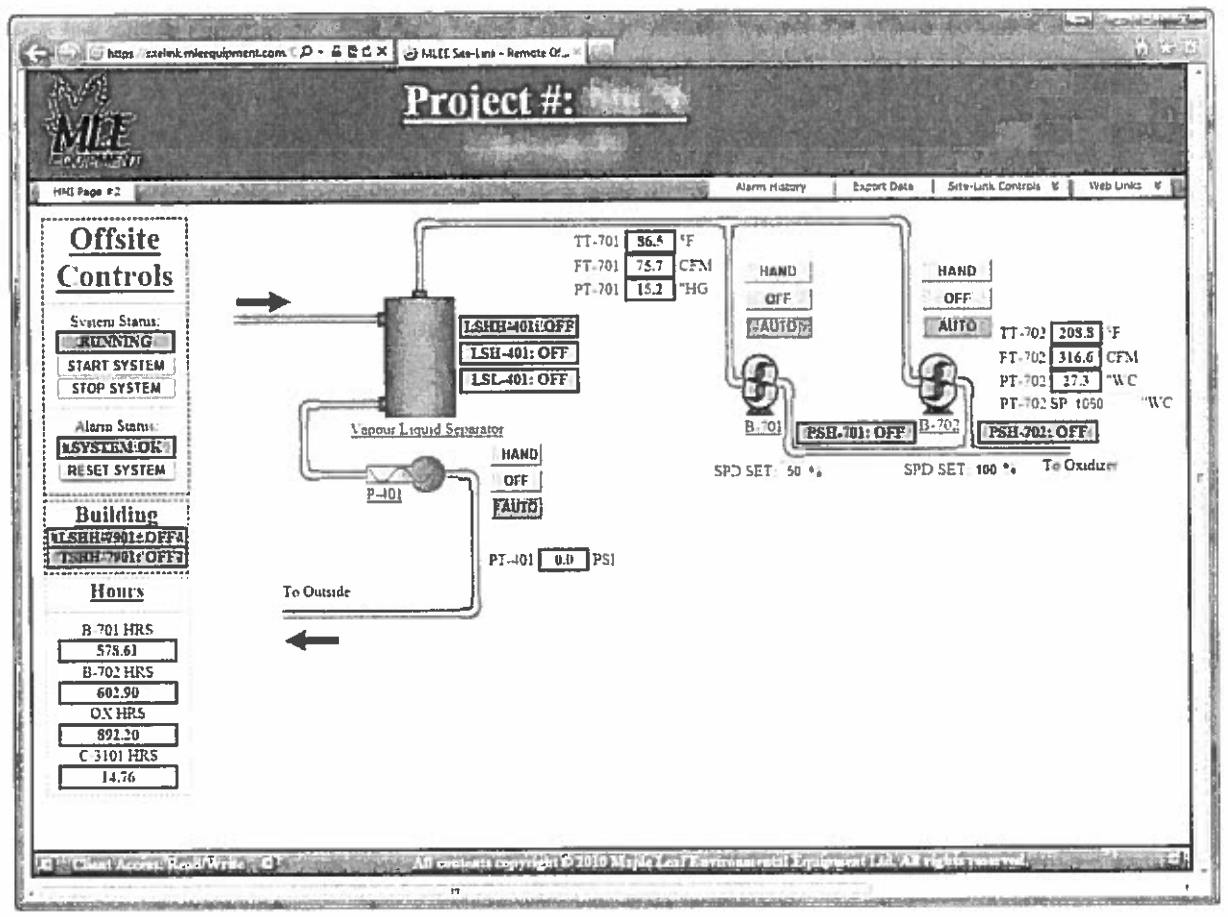
4 P&ID Page 1

P&ID page 1 typically includes system status dialog box (Shutdown/ Running). Start and Stop buttons. Reset button to reset alarms. Alarm status box (System OK/ Alarm). Soft HOA switches for motors/ valves etc. Visual indicators for level switches, active pumps/ motors/ valves etc.
Depending on the components used in the system; instantaneous flow, total flow, analog transmitters and SetPoints.
Tabs for P&ID page 2 (if applicable), alarm history and export data.



Display refresh rate is once per minute unless a Site-Link button is pressed, in which case the display refresh will be approximately 5 seconds.

To change analog SetPoints simply type into the text box provided and then press the enter key on your computer keyboard.

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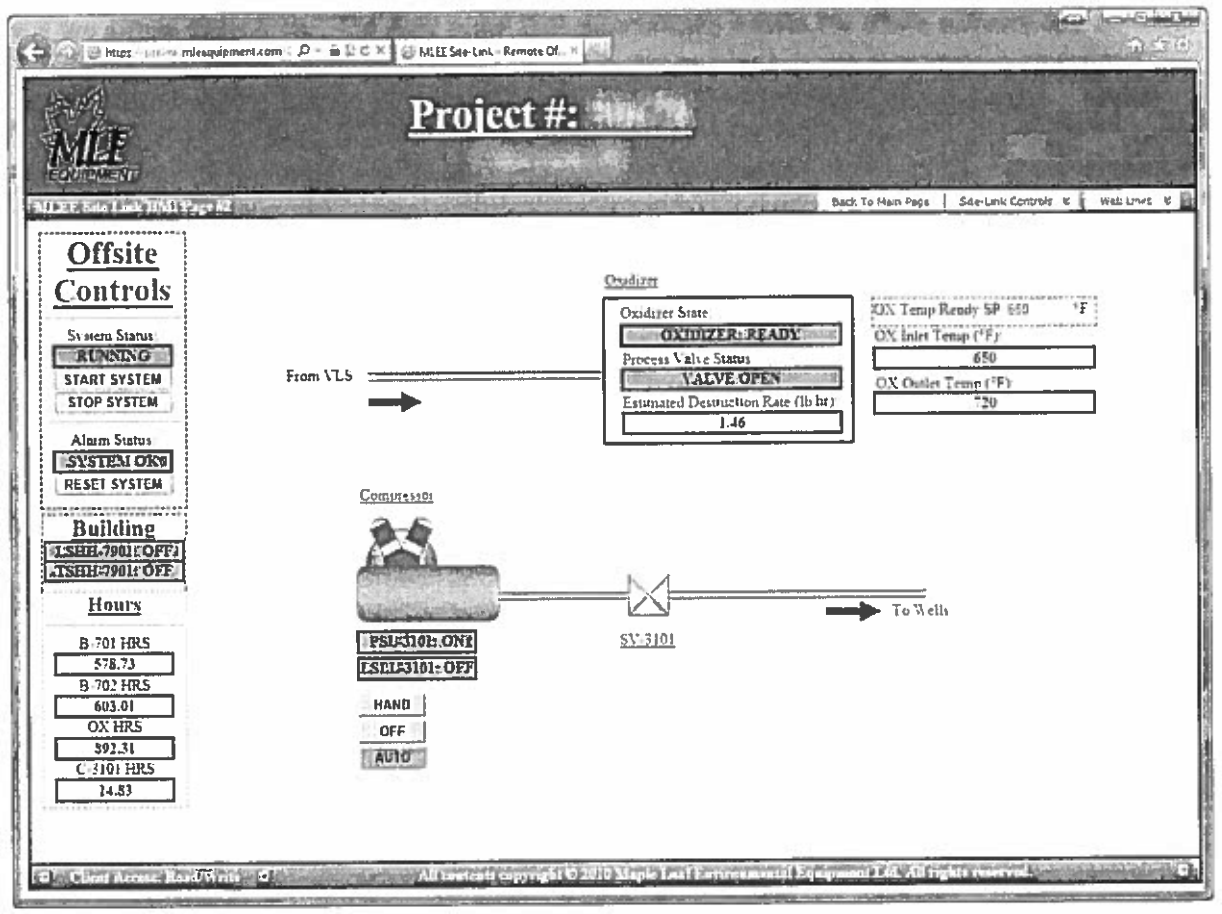
5 P&ID Page 2

P&ID page 2 is typically used for larger systems and includes many or all of the same features as mentioned above, depending on the system.



6 Datalogging

Analog values and flow data (if present on the system) and hour meters are logged automatically. If the system only has hour meters the standard logging rate is once per day. If the system has analog values and/ or flow data the standard logging rate is once every 10 minutes.

Note: Data is only retained on the server for 90 days before the oldest data starts to be overwritten by the newest data. Therefore it is recommended that downloads are performed every 2 months (see Export Data section below).

7 Yellow/ orange boxes with ?????

Yellow/ orange boxes with ????? instead of the usual red/ green boxes means the Site-Link server is unable to pull any data from the PLC on site. This typically means there is no power to the control panel or possibly an issue with the wireless signal or modem. If symptoms persist please call **newterra**.

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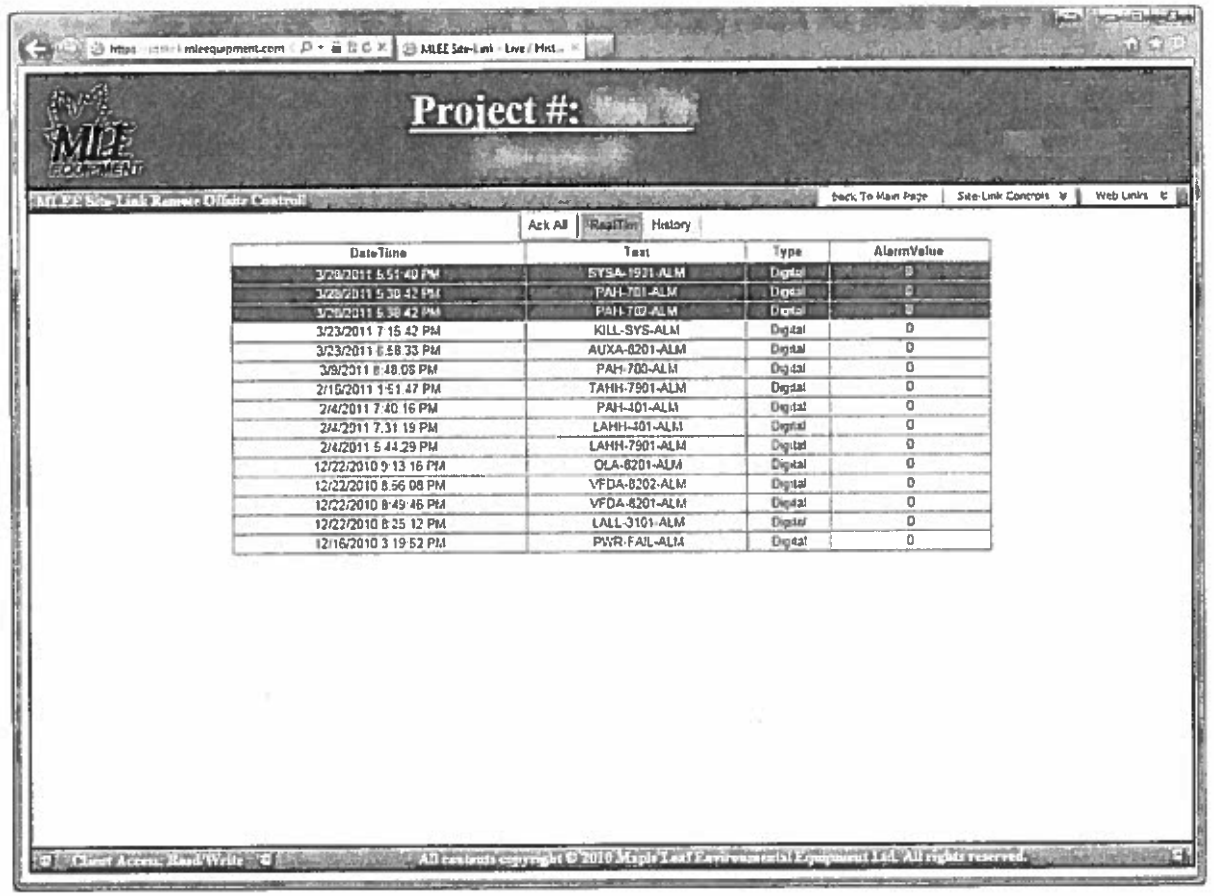
8 Alarm History

This is a list of all the alarms the system is capable of generating, in the order that the alarm status last changed. It details the last date/ time that alarm changed state. For more detailed alarm history the alarm export data download can be performed.



DateTime: Date and time the alarm status changes. (**Note:** All times are taken from the Site-Link server clock which is Eastern Time, EST or EDT depending on the time of year).
Text: Short form alarm code. Please refer to O&M manual for more detailed description.
Type: This will always display Digital.
AlarmValue: 0 indicates that the alarm is inactive. 1 indicates that the alarm is active.
Colour: Yellow indicates alarm statuses that have been acknowledged, even if the alarm is still active. Red indicates alarm statuses that have not been acknowledged since it last changed state, even if the alarm is no longer active (so red does not necessarily mean the alarm is active, just that it has changed state since it was last acknowledged).
Ack All: This will acknowledge all the alarms in the table and turn all the lines yellow, whether the alarm is active or inactive. Please note that this does not physically cancel or reset any alarms on the subject system. An active alarm that has been acknowledged and is displayed on a yellow line will change to a red line once the alarm deactivates, as the alarm has changed state.
History: Provides limited alarm history, it is recommended to use the alarm Export Data download outlined in the next section.

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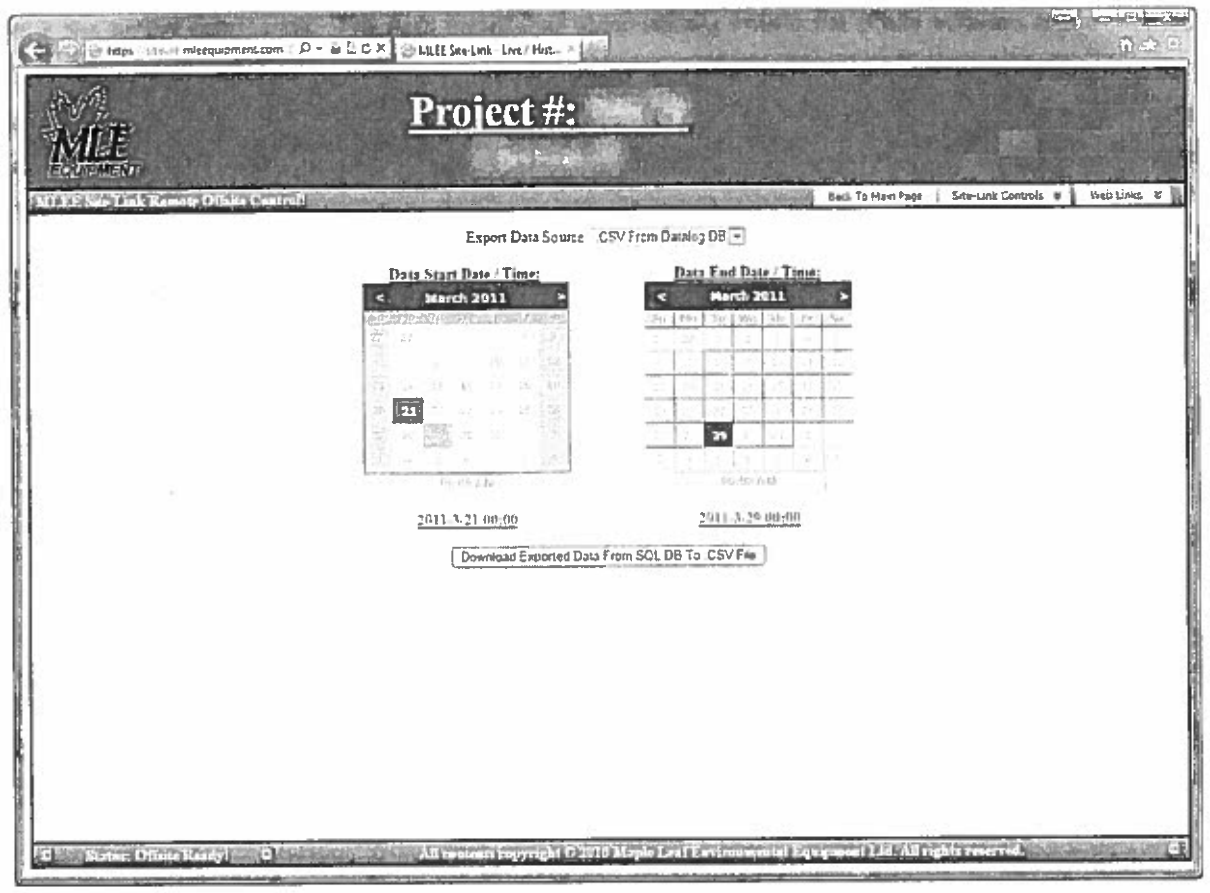
9 Export Data

Data and/ or alarm logs can be downloaded for recording, reporting or trending purposes. **Note:** Data is only retained on the server for 90 days before oldest data starts to be overwritten by the newest data. Therefore it is recommended that downloads are performed every 2 months.



Select data source: Select the data export source from the drop down box, either Datalog DB or Alarm DB.

Select Start Date/ Time: Select the start date by navigating the Data Start Date/ Time calendar to the desired year/ month and click on the day. Set the desired start time in the box below the calendar. (**Note:** All times are taken from the Site-Link server clock which is Eastern Time, EST or EDT depending on the time of year).

Select End Date/ Time: Select the end date by navigating the Data End Date/ Time calendar to the desired year/ month and click on the day. (**Note:** You have to click on the day even if it is today's date, as today's date will always be highlighted and it looks like it is highlighted but it is not). Set the desired start time in the box below the calendar. (**Note:** All times are taken from the Site-Link server clock which is Eastern Time, EST or EDT depending on the time of year).

Download Data: Click on the 'Download Exported Data From SQL DB To .CSV File' button. When prompted by the File Download dialog box click on the Save button to save the .csv file and then navigate to the location you want to save the file to.

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10 Sample Data Download snap shot

Copy and paste from a data download .csv file from a system with only hour meters.

DateAndTime	V_STATUS	C3101_HRS	C3201_HRS	P4901_HRS	B6401_HRS	P6401_HRS
3/13/2012 12:00:00 AM	2	73	159	6	0	0
3/14/2012 12:00:00 AM	2	76	165	6	0	0
3/15/2012 12:00:00 AM	2	81	173	6	0	0
3/16/2012 12:00:00 AM	2	86	180	6	0	0
3/17/2012 12:00:00 AM	2	90	187	7	0	0
3/18/2012 12:00:00 AM	2	95	195	7	0	0
3/19/2012 12:00:00 AM	2	99	202	7	0	0
3/20/2012 12:00:00 AM	2	103	209	7	0	0
3/21/2012 12:00:00 AM	2	109	217	7	0	0
3/22/2012 12:00:00 AM	102	112	220	7	0	0
3/23/2012 12:00:00 AM	114	113	221	7	0	0
3/24/2012 12:00:00 AM	1	116	225	8	0	0
3/25/2012 12:00:00 AM						
3/26/2012 12:00:00 AM	1	116	225	8	0	0
3/27/2012 12:00:00 AM	2	119	228	9	0	0
3/28/2012 12:00:00 AM	2	126	235	12	0	0
3/29/2012 12:00:00 AM	2	132	242	15	0	0
3/30/2012 12:00:00 AM	2	139	249	18	0	0
3/31/2012 12:00:00 AM	2	145	254	20	0	0
04/01/2012 0:00	2	151	261	23	0	0
04/02/2012 0:00	2	158	268	26	0	0
04/03/2012 0:00	2	164	275	29	0	0
04/04/2012 0:00	2	170	282	32	0	0
04/05/2012 0:00	105	177	288	35	0	0
04/06/2012 0:00	105	183	294	37	0	0
04/07/2012 0:00	105	189	301	40	0	0
04/08/2012 0:00	105	196	307	42	0	0
04/09/2012 0:00	105	202	313	43	0	0

DateAndTime: Date and time data log was taken (Eastern Time). If there are no values for a particular data log date/ time then the server was unable to connect to the system (eg power outage at the system).
V_STATUS: Internal PLC status bit used by Site-Link to determine whether the system is running (2), stopped (1) or in alarm (other value).
C3101_HRS: Accumulated run time hours for component.

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11 Sample Alarm Download snap shot

Cut and paste from alarm download .csv file.

AlarmID	AlarmType	AlarmGroup	Priority	AlarmText	Active	Acked	TimeDelay	AlarmValue	ClearedValue	AlarmDateTime
200213.C-SYSTEM-KILL-ALM_Dig	Digital	ALM200213	0	SYSTEM-KILL-ALM	TRUE	FALSE	0	1		3/21/2012 10:02:22 AM
200213.C-SYSTEM-KILL-ALM_Dig	Digital	ALM200213	0	SYSTEM-KILL-ALM	TRUE	FALSE	0	0		3/22/2012 5:13:44 PM
200213.C-CGA-3101-ALM_Dig	Digital	ALM200213	0	CGA-3101-ALM	TRUE	FALSE	0	1		3/22/2012 7:26:07 PM
200213.C-CGA-3101-ALM_Dig	Digital	ALM200213	0	CGA-3101-ALM	TRUE	FALSE	0	0		3/23/2012 8:16:04 AM
200213.C-SYSTEM-KILL-ALM_Dig	Digital	ALM200213	0	SYSTEM-KILL-ALM	TRUE	FALSE	0	1		3/23/2012 8:25:28 AM
200213.C-SYSTEM-KILL-ALM_Dig	Digital	ALM200213	0	SYSTEM-KILL-ALM	TRUE	FALSE	0	0		3/23/2012 8:25:41 AM
200213.C-LALL-3101-ALM_Dig	Digital	ALM200213	0	LALL-3101-ALM	TRUE	FALSE	0	1		3/23/2012 10:36:42 AM
200213.C-LALL-3101-ALM_Dig	Digital	ALM200213	0	LALL-3101-ALM	TRUE	FALSE	0	0		3/23/2012 11:03:57 AM
200213.C-LAHH-4901-ALM_Dig	Digital	ALM200213	0	LAHH-4901-ALM	TRUE	FALSE	0	1		3/23/2012 11:04:03 AM

AlarmID: Short form alarm code. Please refer to O&M manual for more detailed description.
AlarmType: Will always will report Digital. Unable to suppress column.
AlarmGroup: Will always report ALMxxxxxx. Unable to suppress column.
Priority: Will always report zero. Unable to suppress column.
AlarmText: Short form alarm code. Please refer to O&M manual for more detailed description.
Active: Will always report True. Unable to suppress column.
Acked: Will always report False. Unable to suppress column.
TimeDelay: Will always report zero. Unable to suppress column.
AlarmValue: 1 means alarm is/ became active. 0 means alarm is/ became inactive.
ClearedValue: Will always be blank. Unable to suppress column.
AlarmDateTime: Date and time at which alarm changed state (became active and/ or inactive)

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12 PLC Program Changes

Wireless telemetry also enables **newterra** to perform remote PLC program/ system troubleshooting and upload PLC program modifications remotely.

13 Logging in

Each user is added to the Site-Link database and set up with an account by an Administrator at **newterra**. Once this has been done the user will receive an automated Email similar to the one shown below.

From: MLEE Site-Link Admin <sitelink@newterra.com>
Date: 12 April 2012 08:11
Subject: Re: New User Account Created For: jsmith
To: jsmith <jsmith@email.com>

Site-Link Account Information

Project # / Username: jsmith
Contact E-Mail Address: jsmith@email.com

New Random Password: 96a35b

Please feel free to return to https://sitelink.newterra.com to change your password at any time

----
*Thank You Very Much For Using The **newterra** Site-Link Offsite Software,*

~The Site-Link Administrator

Multiple users can have access to Site-Link, each with their own unique login details. Users can have read and write privileges, for monitoring and control, or read only privileges for monitoring only. For customers with multiple systems with Site-Link capability, all those systems will be available with the one login.

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14 E-Alarm

An instant Email or Email to cell phone text is optionally available as a separate service. Personnel on the call out list will receive an automated Email or text similar to the one shown below.

From: 200000 - ABC Air Sparge [mailto:plc@newterra.com]
Sent: April 13, 2012 8:33 AM
To: plc201217
Subject: ALARM! 200000 - ABC Airsparge

C103 - PAH-2401 SPG1
04/13/12,12:32PM
Help: http://goo.gl/upNS6

14.1 E-Alarm Re-Email

Any alarm condition will re-Email every 2 hours (unless specified otherwise by the customer) until the alarm either self clears (if it is recoverable) or is reset via the Site-Link P&ID page.

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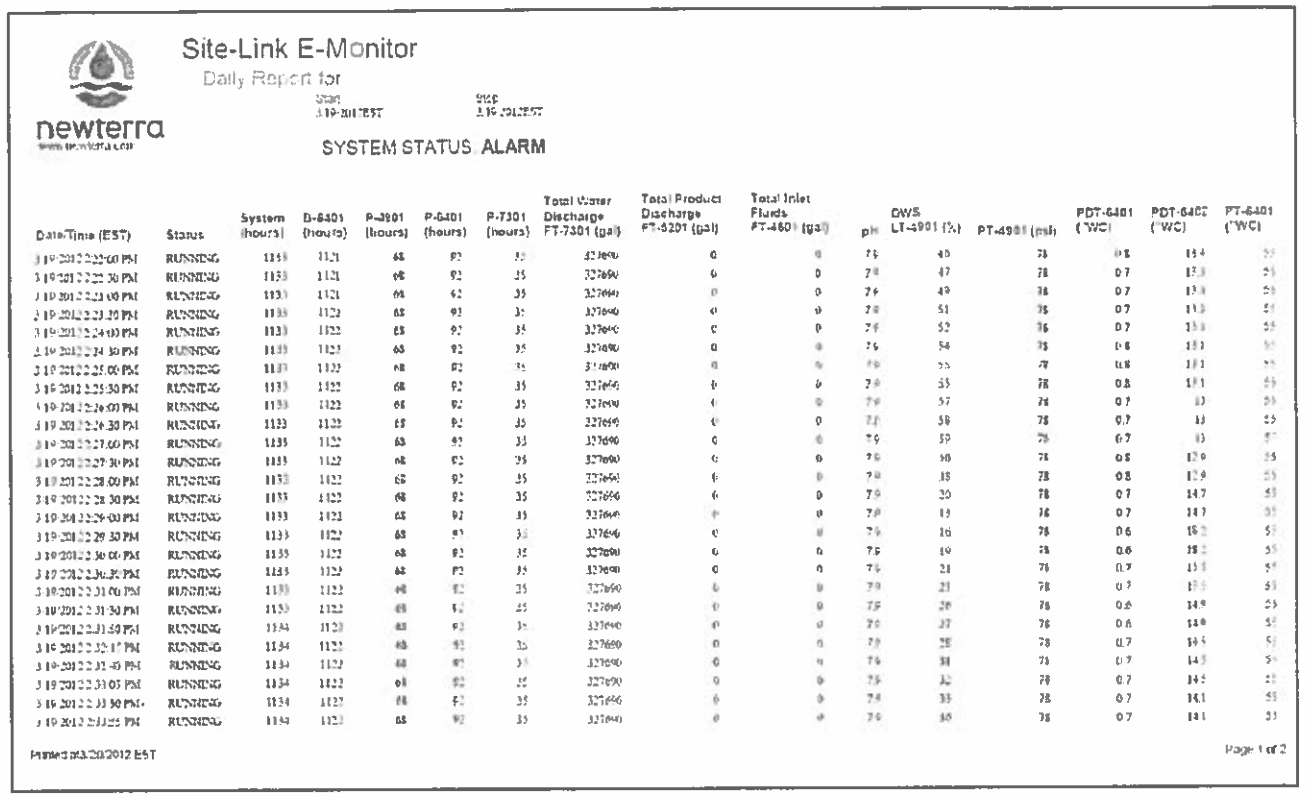
15 E-Monitor

A daily system status Email is optionally available as a separate service. Personnel on the call out list will receive a daily automated Email similar to the ones shown below, the more complex the system the more detailed the report.



Site-Link E-Monitor

Daily Report for

Start: 3-19-2012 EST Stop: 3-19-2012 EST

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SYSTEM STATUS: ALARM

Date-Time (EST)	Status	System (hours)	B-6401 (hours)	P-4901 (hours)	P-6401 (hours)	P-7301 (hours)	Total Water Discharge FT-7301 (gal)	Total Product Discharge FT-5201 (gal)	Total Inlet Fluids FT-4601 (gal)	pH	DWS LT-4901 (%)	PT-4901 (psi)	PDT-6401 ("WC)	PDT-6402 ("WC)	PT-6401 ("WC)
3-19-2012 2:22:00 PM	RUNNING	1159	1121	68	92	35	327690	0	0	79	46	78	0.8	15.4	59
3-19-2012 2:22:30 PM	RUNNING	1159	1121	68	92	35	327690	0	0	79	47	78	0.7	15.3	59
3-19-2012 2:23:00 PM	RUNNING	1159	1121	68	92	35	327690	0	0	79	49	78	0.7	15.3	59
3-19-2012 2:23:30 PM	RUNNING	1159	1122	68	93	35	327690	0	0	79	51	78	0.7	15.3	59
3-19-2012 2:24:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	52	78	0.7	15.3	59
3-19-2012 2:24:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	54	78	0.8	15.3	59
3-19-2012 2:25:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	55	78	0.7	15.3	59
3-19-2012 2:25:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	55	78	0.8	15.1	59
3-19-2012 2:26:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	57	78	0.7	15	59
3-19-2012 2:26:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	58	78	0.7	15	59
3-19-2012 2:27:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	59	78	0.7	15	59
3-19-2012 2:27:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	60	78	0.8	15.0	59
3-19-2012 2:28:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	38	78	0.8	15.0	59
3-19-2012 2:28:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	20	78	0.7	14.7	59
3-19-2012 2:29:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	18	78	0.7	14.7	59
3-19-2012 2:29:30 PM	RUNNING	1159	1122	68	93	35	327690	0	0	79	16	78	0.6	15.0	59
3-19-2012 2:30:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	19	78	0.6	15.0	59
3-19-2012 2:30:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	21	78	0.7	15.0	59
3-19-2012 2:31:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	21	78	0.7	15.0	59
3-19-2012 2:31:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	20	78	0.6	14.9	59
3-19-2012 2:31:59 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	22	78	0.6	14.9	59
3-19-2012 2:32:17 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	25	78	0.7	14.9	59
3-19-2012 2:32:45 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	31	78	0.7	14.9	59
3-19-2012 2:33:05 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	32	78	0.7	14.9	59
3-19-2012 2:33:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	33	78	0.7	14.9	59
3-19-2012 2:33:55 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	35	78	0.7	14.9	59

Printed at 3-20-2012 EST

Page 1 of 2

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Site-Link E-Monitor

Daily Report for

Start
3/22/2012 9:50:00 AM

Stop
3/23/2012 9:20:00 AM

SYSTEM STATUS: **RUNNING**

Analogs:

	VT-LRP
MIN:	16.200000762939
MAX:	17.8999996
AVERAGE:	17.3577464

ALARM STATUS

Last Alarm	Active
KILL-SYS-ALM 3/13/2012 2:42:10 PM	NO

HOUR METERS:

DP-PS	2272
VP-LRP	3043
DP-OWS	505
AB-STRP	1406
DP-STRP	423

3/23/2012 9:22:52 AM

Page 1 of 1

Project As-Built Document

27-Aug-13

RTS151 **WTS, 150gpm, OWS-24, Carbo**

Customer: newterra ltd.

System Site Specifications

Elevation:	0 ft
Max Temp	0 deg F
Min Temp:	0 deg F
Noise Target:	
Gas Required:	
Water Required:	
Telephone Reqd:	
Building:	

System Electrical Specifications

Voltage:	208V/120V-3ph
Main Disconnect	100amp
Panel Approval:	MET1604(CL Class CL1DIV2
System Approval:	Class CL1DIV2
Panel Type:	PLC-DL06
Telemetry:	
Autodialer:	
EMonitor:	Server:

System SVE (First Blower)

0 @ 0

Blower Disch Temp:	0 deg F
Inlet Legs:	0
Disch Press:	0 in wc
Water Flowrate:	0 gpm
Heat xchg Disch:	0 deg F

System SVE (Second Blower)

0 @ 0

Blower Disch Temp:	0 deg F
Inlet Legs:	0
Disch Press:	0 in wc
Water Flowrate:	0 gpm
Heat xchg Disch:	0 deg F

Air Sparge

0 @ 0 psi

Sparge Disch Temp:	0 deg F
Disch Legs:	0
Heat xchg Disch:	0 deg F

Other Specifications

Other Inlet Liquid Flow:	0 gpm
Disch Flow:	150 gpm @ 40 psi
AirTreatment:	None
Water_Treatment:	Carbon
Stripper Airflow:	0 cfm
Stripper Dsn Flow:	0 gpm
OWS_Dsn_Flow:	150 gpm

Contaminants

Other Information May be Presented Below

Connection Info:

Shipping Information

Parts

Module Code: 0

Insulation, Foil Back Foam, 1", R, Thinsulate, 4x8	Part:	10636
	Qty:	34
	Mfg:	
	Mfg Part:	356075
Lumber, Spruce, Dry, 2" x 4" x 10'	Part:	10912
818011	Qty:	96
	Mfg:	
	Mfg Part:	818011
Lumber, Plywood, Spr, STD, 4 x 8 x 3/8"	Part:	14463
620295	Qty:	34
	Mfg:	
	Mfg Part:	620295
Switch, Temperature, Probe, A19ABC-24D	Part:	15651
range -30/100F	Qty:	2
	Mfg:	Johnson Controls
	Mfg Part:	
Breaker, Techna, JTEC4892C40	Part:	17700
240V 40 AMP 2P C Trip Curve	Qty:	1
10k SCCR	Mfg:	Fusetek
	Mfg Part:	JTEC4892C40
Combination Starter, SQT LUCC32FU	Part:	19434
TeSysU 1 Phase Control Unit 8-32A	Qty:	1
110/120VAC coil	Mfg:	Telemecanique
	Mfg Part:	SQT LUCC32FU
Wire, Stranded, T90, #1 AWG, Black	Part:	25152
	Qty:	10
	Mfg:	
	Mfg Part:	T901BLK

FLT-6701

Filter, Bag, Dewatering, Assembly, Four (4)	Part:	RC036
	Qty:	1
	Mfg:	
---	Mfg Part:	---

PI-6701

Gauge, Pressure, 0-60psi, Indumart, P16K2-FG-60 (back)	Part:	19393
SS, brass internals, Glyc. Filled, back mount	Qty:	8
	Mfg:	
---	Mfg Part:	P16K2-FG-60

PSH-6701

Switch, Pressure, A1F-0-SS-1-2	Part:	20589
4-75 PSI Range	Qty:	1
Deadband at Min Range 4 - Max Range 15	Mfg:	Dwyer
---	Mfg Part:	

Rental Components

Module Code: 2

RCHOSE DISCH

Hose, Assembly, J300, 3"	Part:	18661
Green Hose	Qty:	50
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-

RCHOSE-INLET

Hose, Assembly, J300, 3"	Part:	18661
Green Hose	Qty:	50
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-

Submersible Pump

Module Code: 4000

LSH-4001

Switch, Level, Mech Float, Wide Angle, N.O., Red	Part:	M1108
Tilt Float Level Switch 90deg, w 40' cable	Qty:	1
13A, SPST, N/O	Mfg:	Warrick Controls
---	Mfg Part:	GR20W4000

P-4001

Pump, Sump, Goulds, 160GPM @ 40'	Part:	RC073
WS2038BHF, 200V, 3 Ph, 2 HP, w/o switch	Qty:	1
3" Type F Camlock Fitting	Mfg:	Goulds
---	Mfg Part:	

Oil/Water Separator

Module Code: 4900

LSHH-4901

Switch, Level, Mech Float, Narrow Angle, N.C., YEL	Part:	19279
N/C, Yellow float	Qty:	1
	Mfg:	
---	Mfg Part:	PY2CW4000

OWS-4901

Media, Coalescing, HD Q-PAC	Part:	13959
0.25" spacing, 132 sqft/cuft	Qty:	24
	Mfg:	
---	Mfg Part:	HD Q-PAC
Oil Water Separator, OWS-24, Stainless	Part:	16263
24 cubic feet of packing, 304SS	Qty:	1
Note: Build up price from Price Sheet	Mfg:	Maple Leaf Environmental Equipment
To be removed from RTS-148, SVE, WTS returning fron Veron,TX. Purchased used equipment, 50430 Jerry Wood #2 project.	Mfg Part:	
Strain Relief, Connector, PVC, 1/2"	Part:	16884
TSRC10	Qty:	2
	Mfg:	
None	Mfg Part:	TSRC10
Oil Water Separator, Assembly, OWS-24	Part:	17535
	Qty:	1
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-
Switch, Level, Mech Float, Wide Angle, N.O., Red	Part:	m1108
Tilt Float Level Switch 90deg, w 40' cable	Qty:	1
13A, SPST, N/O	Mfg:	Warrick Controls
None	Mfg Part:	GR20W4000
Valve, Ball, Brass, 2", 150#	Part:	p1065
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	Kitz
None	Mfg Part:	601-2
Valve, Ball, Brass, 2", 150#	Part:	p1065
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	Kitz
None	Mfg Part:	601-2
Valve, Ball, Brass, 1", 150#	Part:	p1067
NPT, Teflon seats, 600 PSI WOG	Qty:	3
	Mfg:	Kitz
None	Mfg Part:	601-1
Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	3
	Mfg:	
---	Mfg Part:	601-3

P-4901

Valve, Gate, Brass, 3"	Part:	10167
	Qty:	1
	Mfg:	
None	Mfg Part:	514T10
Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60	Part:	16203
SS, brass internals, Glyc. Filled, bottom mount	Qty:	1
	Mfg:	Indumart
None	Mfg Part.	
Reinforced, Adapter, PVC 80, Female, 3", SxSS	Part:	17055
Fitting, transition, socket x SS	Qty:	1
	Mfg:	
---	Mfg Part:	835-030SR
Pump, Piping, Centrifugal, 3" x 3", 170gpm	Part:	17316
	Qty:	1
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-
Pump, Suction, Goulds, SSH Series, 4SH2K52C0	Part:	21028
7.5hp, 3ph, 208-230/460V, TEFC	Qty:	1
C Impeller	Mfg:	Goulds
---	Mfg Part:	---
Hose, Braided, SS, 3", MNPT fittings, 12" long	Part:	21971
5680K2	Qty:	2
304SS	Mfg:	
None	Mfg Part:	5680K2
Strainer, Wye, Brass, 3"	Part:	M1523
threaded	Qty:	1
	Mfg:	
None	Mfg Part:	145T10
Valve, Check, Swing, Brass, 3"	Part:	M1524
	Qty:	1
	Mfg:	
None	Mfg Part:	521T10
Valve, Check, Swing, Brass, 3"	Part:	M1524
	Qty:	1
	Mfg:	
None	Mfg Part:	521T10
Union, Galv, 3"	Part:	M1530
	Qty:	2
	Mfg:	
None	Mfg Part:	3GLU
Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	
-	Mfg Part:	601-3

Product Storage Tank

Module Code: 5200

LSHH-5201

Switch, Level, Almeg, Vertical, ATB3-48B 1/4NPT ---	Part: Qty: Mfg: Mfg Part:	12351 1 Almeg ATB3-48B
Reducer, Bushing, Galv, 2" x 1/2" Hex ---	Part: Qty: Mfg: Mfg Part:	P1021 1 2X12GZB
Union, Galv, 2" ---	Part: Qty: Mfg: Mfg Part:	P1093 1 2GZU

PST-5201

Tee, Galv, 2" 1 ---	Part: Qty: Mfg: Mfg Part:	10136 1 2GZT
Drum, Black, Steel, 45 gal, 2 hole lid, bottom 2" port including palletization ---	Part: Qty: Mfg: Mfg Part:	M1137 1 SOH00733
Elbow, 90deg, Galv, 2" ---	Part: Qty: Mfg: Mfg Part:	P1058 4 2GZE9
Valve, Ball, Brass, 2", 150# NPT, Teflon seats, 600 PSI WOG ---	Part: Qty: Mfg: Mfg Part:	P1065 1 Kitz 601-2
Nipple, Galv, 2" x Short ---	Part: Qty: Mfg: Mfg Part:	P1192 5 2xSHGZN

Bag Filter

Module Code: 5800

FLT-5801

O-Ring, Buna-N, 8-3/8" OD, 3/16" Thick A70 Hardness * Fits most Filter Innovation EB112 series ---	Part: Qty: Mfg: Mfg Part:	21619 25 369 BUNA
Filter, Bag, Dewatering, Assembly, Four (4) ---	Part: Qty: Mfg: Mfg Part:	RC033 1 ---

FLT-5802

Reducer, Bushing, Galv, 3" x 2" Hex ---	Part: Qty: Mfg: Mfg Part:	10019 4 3X2GZB
Tee, Galv, 2" 1 ---	Part: Qty: Mfg: Mfg Part:	10136 2 2GZT
Nipple, Galv, 2" x Close ---	Part: Qty: Mfg: Mfg Part:	10222 14 2XCLGZN
Tee, Galv, 3" ---	Part: Qty: Mfg: Mfg Part:	10302 2 3GZT
Valve, Ball, Brass, 1/2", 150# NPT, Teflon seats, 600 PSI WOG ---	Part: Qty: Mfg: Mfg Part:	10538 2 601-1/2
Nipple, Galv, 1/2" x Close ---	Part: Qty: Mfg: Mfg Part:	10619 2 12CLGZN
Skid, 2ft x 4ft ---	Part: Qty: Mfg: Mfg Part:	15152 1 Maple Leaf Environmental Equipment
Sample Port Assembly, 1/4" -	Part: Qty: Mfg: Mfg Part:	18682 2 Maple Leaf Environmental Equipment -
Filter, Bag, Housing, #2, Carbon Steel SS Basket, CS legs ---	Part: Qty: Mfg: Mfg Part:	19117 2

Reducer, Bushing, Galv, 2" x 1/2"	Part:	P1021
Hex	Qty:	2
	Mfg:	
---	Mfg Part:	2X12GZB
Valve, Ball, Brass, 2", 150#	Part:	P1065
NPT, Teflon seats, 600 PSI WOG	Qty:	4
	Mfg:	Kitz
---	Mfg Part:	601-2
Union, Galv, 2"	Part:	P1093
	Qty:	4
	Mfg:	
---	Mfg Part:	2GZU

PI-5801

Gauge, Pressure, 0-60psi, Indumart, P16K2-FG-60 (back)	Part:	19393
SS, brass internals, Glyc. Filled, back mount	Qty:	12
	Mfg:	
---	Mfg Part:	P16K2-FG-60

PSH-5801

Switch, Pressure, A1F-0-SS-1-2	Part:	20589
4-75 PSI Range	Qty:	1
Deadband at Min Range 4 - Max Range 15	Mfg:	Dwyer
---	Mfg Part:	

Bag Filter

Module Code: 6700

FLT-6701

Nipple, Galv, 3" x Close	Part:	11220
	Qty:	6
	Mfg:	
—	Mfg Part:	3CLGZN
Flange, Companion, Galv, 6"	Part:	12572
threaded	Qty:	2
	Mfg:	
—	Mfg Part:	6GZCIF / 12.0905
Valve, Butterfly, Wafer, Ductile Iron, 6"	Part:	15019
316SS disc & stem, BUNA, 10 position lever	Qty:	2
	Mfg:	
—	Mfg Part:	CIWB-SBL 6" CO
Reducer, Bushing, Galv, 6" x 3"	Part:	19681
Hex	Qty:	2
	Mfg:	
—	Mfg Part:	
Tee, PVC 40, 3", SxSxS, 401-030G	Part:	22578
	Qty:	2
	Mfg:	
—	Mfg Part:	
Elbow, 90deg, PVC 40, 3", SxS, 406-030G	Part:	22619
	Qty:	8
	Mfg:	
—	Mfg Part:	406-030G
Misc Part, See Details	Part:	9999
As per detailed specification below	Qty:	1
	Mfg:	
Pricing from Steve Hughes, Aug. 7th,2013 e-mail	Mfg Part:	Qo8L100RB9
V6427-A, Muilti-Bag Filter Housing - 7 Bag Model - 304 Stainless		
Vessel A - Inlet and Outlet are on the right hand side of the unit when looking at the label.		
Misc Part, See Details	Part:	9999
As per detailed specification below	Qty:	2
	Mfg:	
4155-1490-B, O-rings for V6427-A Bag Filter Housing	Mfg Part:	Qo8L100RB9
Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	
—	Mfg Part:	601-3
Elbow, 90deg, Galv, 3"	Part:	P1220
	Qty:	1
	Mfg:	
—	Mfg Part:	3GZE9

FT-6701

Reinforced, Adapter, PVC 80, Female, 3", SxSS	Part:	17055
Fitting, transition, socket x SS	Qty:	4
	Mfg:	
---	Mfg Part:	835-030SR

PSH-6701

Switch, Pressure, A1F-0-SS-1-2	Part:	20589
4-75 PSI Range	Qty:	1
Deadband at Min Range 4 - Max Range 15	Mfg:	Dwyer
---	Mfg Part:	

Liquid Phase Carbon

Module Code: 7000

7000

Nipple, Galv, 3" x Close	Part:	11220
	Qty:	2
	Mfg:	
---	Mfg Part:	3CLGZN
Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	
---	Mfg Part:	601-3
Adapter, PVC 80, Female, 3", SxT, 835-030G	Part:	P1153
	Qty:	2
	Mfg:	
---	Mfg Part:	835-030

FQI,FT-7001

Meter, Water, 2", US Gal, w/ pulse, Turbine, DLJ	Part:	15499
Flange	Qty:	1
	Mfg:	Daniel L. Jerman Co.
---	Mfg Part:	DLJ200TC

LPC-7001

Reducer, Bushing, Galv, 3" x 2"	Part:	10019
Hex	Qty:	5
	Mfg:	
---	Mfg Part:	3X2GZB
Tee, Galv, 3"	Part:	10302
	Qty:	5
	Mfg:	
---	Mfg Part:	3GZT
Nipple, Galv, 3" x Short (3")	Part:	10445
	Qty:	4
	Mfg:	
---	Mfg Part:	3SHGZN
Camlock Fitting, Aluminum, 3", Part "F"	Part:	10541
Male Adapter x Male Thread Cam Lock Fitting	Qty:	6
	Mfg:	Bayco Industries
-	Mfg Part:	BAL-300F
Camlock Fitting, Aluminum, 3", Part "C"	Part:	10542
Female Adapter x Hose Shank Cam Lock Fitting	Qty:	6
	Mfg:	Bayco Industries
-	Mfg Part:	BAL-300C
Hose, Suction, PVC, Green, 3", J300	Part:	12043
TigerFlex, 65psi@70F, 40psi@100F	Qty:	30
PVC,150F, (min 100ft order)	Mfg:	Kuriyama
-	Mfg Part:	J300
Reinforced, Adapter, PVC 80, Female, 3", SxSS	Part:	17055
Fitting, transition, socket x SS	Qty:	6
	Mfg:	
---	Mfg Part:	835-030SR

Hose, Assembly, J300, 3"	Part:	18661
Green Hose	Qty:	3
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-
Sample Port Assembly, 1/4"	Part:	18682
	Qty:	3
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-
Valve, Check, Spring, Brass, 2"	Part:	M1529
	Qty:	1
	Mfg:	
—	Mfg Part:	2BPUCV
Clamp, Hose, SS, 3", HAS48	Part:	P1044
	Qty:	12
	Mfg:	
None	Mfg Part:	HAS48
Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	4
	Mfg:	
—	Mfg Part:	601-3
Reducer, Bushing, Galv, 2" x 1/4"	Part:	P1219
Hex	Qty:	5
	Mfg:	
—	Mfg Part:	2x14GZB

PI-7001

Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60	Part:	16203
SS, brass internals, Glyc. Filled, bottom mount	Qty:	2
	Mfg:	Indumart
—	Mfg Part:	

PI-7004

Gauge, Pressure, 0-60psi, Indumart, P16K2-FG-60 (back)	Part:	19393
SS, brass internals, Glyc. Filled, back mount	Qty:	1
	Mfg:	
—	Mfg Part:	P16K2-FG-60

PSH-7001

Switch, Pressure, A1F-0-SS-1-2	Part:	20589
4-75 PSI Range	Qty:	1
Deadband at Min Range 4 - Max Range 15	Mfg:	Dwyer
—	Mfg Part:	

Building, Trailer or Skid

Module Code: 7900

7900

Door, Single, 36", Steel slab/no brick moulding, No sill ext 1103A,wooden frame,open out,RH **to be pre drilled for passage and deadbolt** -	Part: Qty: Mfg: Mfg Part:	10822 1 1103-Dalmen
Lock, Passage, 107188, Taymor 107188 None	Part: Qty: Mfg: Mfg Part:	10908 1
Lock, Deadbolt, 289648, Taymor, 1 cyl, S/S keyed alike #289648 None	Part: Qty: Mfg: Mfg Part:	10909 1
Container, Painting, 40ft exterior/interior Building exterior, to be painted our standard white finish.	Part: Qty: Mfg: Mfg Part:	12063 1
Container, Shipping, Tilt load ---	Part: Qty: Mfg: Mfg Part:	13593 1
Container, 8' x 40' x High Cube ---	Part: Qty: Mfg: Mfg Part:	15512 1
Container, Modification As per specification below or drawing provided. ---	Part: Qty: Mfg: Mfg Part:	15513 1
Door, Assembly, 72", Double -	Part: Qty: Mfg: Mfg Part:	19012 1 Maple Leaf Environmental Equipment -
Door, Assembly, 36", Single -	Part: Qty: Mfg: Mfg Part:	19014 1 Maple Leaf Environmental Equipment -

Access Cover

Misc Part, See Details As per detailed specification below As per attached drawing. For 36"x36" Carbon Access Cover	Part: Qty: Mfg: Mfg Part:	9999 3 ---

F-7901

Fan, Building, 24", 1/3hp, 1625rpm, 120/230V, 1ph, XPF SD24-XPF, OSHA Guard,Turnout Box ---	Part: Qty: Mfg: Mfg Part:	10329 1 Canarm SD24-XPF-OSHA

Fan Shutter Assembly,KD,24",KDS24-SS - Use 23082	Part:	10330
	Qty:	1
	Mfg:	Canarm
---	Mfg Part:	KD24-SS
Fan, Hood, White,24",HFPW-24	Part:	M1411
	Qty:	2
	Mfg:	Canarm
---	Mfg Part:	HFPW-24

F-7903

Fan, Shutter, Backdraft damper, 12"x12"	Part:	23080
Non-Motorized	Qty:	1
	Mfg:	Canarm
---	Mfg Part:	SR3212X12
Hood, 15"	Part:	23989
Fits 12" Fan & Louver	Qty:	2
	Mfg:	
---	Mfg Part:	
Fan, Building, 12", 1/4hp, 1750rpm, 120V, 1ph, TEFC	Part:	M1072
CSA Approved, S12-E1	Qty:	1
	Mfg:	Canarm
---	Mfg Part:	SD120311

H-7901

Switch, Temperature, Johnson Controls, Assembly	Part:	18985
	Qty:	2
	Mfg:	Johnson Controls
-	Mfg Part:	-

H-7903

Heater, Baseboard, Ouellet, 1.5kW, OFM1508	Part:	22314
208V, 66" long	Qty:	1
	Mfg:	Ouellet
---	Mfg Part:	OFM1508

TSH-7903

Switch, Temperature, Probe, A19ABC-24D	Part:	15651
range -30/100F	Qty:	1
	Mfg:	Johnson Controls
-30 - 100 F option	Mfg Part:	
Switch, Temperature, Probe, WEL 14A-602R	Part:	15653
Bulb, Well for Temperature Switch, Brass	Qty:	1
	Mfg:	Johnson Controls
-30 - 100 F option	Mfg Part:	WEL 14A-602R
Switch, Temperature, Johnson Controls, Assembly	Part:	18985
	Qty:	1
	Mfg:	Johnson Controls
-	Mfg Part:	-

TSL-7903

Switch, Temperature, Probe, A19ABC-24D	Part:	15651
range -30/100F	Qty:	1
	Mfg:	Johnson Controls
-30 - 100 F option	Mfg Part:	

Switch, Temperature, Probe, WEL 14A-602R	Part:	15653
Bulb, Well for Temperature Switch, Brass	Qty:	1
	Mfg:	Johnson Controls
-30 - 100 F option	Mfg Part:	WEL 14A-602R
Switch, Temperature, Johnson Controls, Assembly	Part:	18985
	Qty:	1
	Mfg:	Johnson Controls
-	Mfg Part:	-

Main Control Panel

Module Code: 8200

8200

Contactor, SQD LC1D32G7	Part:	10520
32A, 10/10/20/25HP	Qty:	1
120VAC coil	Mfg:	Square D
---	Mfg Part:	SQD LC1D32G7
Disconnect, 3ph, D324N	Part:	11163
200A, UL.240V,Nema 1,fusible disconnect	Qty:	1
	Mfg:	Square D
---	Mfg Part:	SQD D324N
Contactor, SQD LC1D09G7	Part:	12547
9A, 2/2/5/7.5HP	Qty:	1
120VAC coil	Mfg:	Square D
---	Mfg Part:	SQD LC1D09G7
Contactor, SQD LC1D50AG7	Part:	12548
50A, 15/15/40/40HP	Qty:	1
120VAC coil	Mfg:	Square D
---	Mfg Part:	SQD LC1D50G7
Modem, Antenna, Airlink GPRS, N-Female	Part:	13723
120-110-2107	Qty:	1
MAX-BMLPVDB800/1900 Antenna & MAX-MTPM-800 Hardwar	Mfg:	
---	Mfg Part:	120-110-2107
PLC, EA1-S3ML	Part:	17233
C-more micro graphic user interface	Qty:	1
	Mfg:	Automation Direct
---	Mfg Part:	EA1-S3ML
PLC, DV-1000CBL	Part:	17234
2m Cable RJ12 to RJ12	Qty:	1
C-more Micro to DL05/06/205	Mfg:	Automation Direct
---	Mfg Part:	DV-1000CBL
Breaker, Techna, JTEC4892C30	Part:	17543
480/277V 30 AMP 2P C Trip Curve	Qty:	1
10k SCCR	Mfg:	Fusetek
---	Mfg Part:	JTEC4892C30
Breaker, Techna, JTEC4893C06	Part:	17709
480/277V 6 AMP 3P C Trip Curve	Qty:	1
10k SCCR	Mfg:	Fusetek
---	Mfg Part:	JTEC4893C06
Breaker, Techna, JTEC4893C40	Part:	17717
240V 40 AMP 3P C Trip Cuve	Qty:	2
10k SCCR	Mfg:	Fusetek
---	Mfg Part:	JTEC4893C40
Breaker, Techna, JTEC4893C50	Part:	17718
240V 50 AMP 3P C Trip Curve	Qty:	1
10k SCCR	Mfg:	Fusetek
---	Mfg Part:	JTEC4893C50

Breaker, Techna, JTEC4891C15 240V 15A, 1P C Trip Curve 10k SCCR ---	Part: Qty: Mfg: Mfg Part:	18359 1 Fusetek JTEC4891C15
Motor Saver, 460 w/Diagnostic 3ph Finger Safe, DIN Rail Mountable ---	Part: Qty: Mfg: Mfg Part:	18396 1 Symcom 460
Combination Starter, SQT LUB12 TeSysU Power Base 12A 3HP@208/240, 7.5HP@480, 10HP@600 ---	Part: Qty: Mfg: Mfg Part:	19264 1 Telemecanique SQT LUB12
Combination Starter, SQT LUA1C20 TeSysU Aux Contact Module 1NO Ready 1NO Fault ---	Part: Qty: Mfg: Mfg Part:	19269 2 Telemecanique LUA1C20
Combination Starter, SQT LU9SP0 TeSysU UL508 Type E Phase Barrier ---	Part: Qty: Mfg: Mfg Part:	19270 2 Telemecanique SQT LU9SP0
Combination Starter, SQT LUB32 TeSysU Power Base 32A 10HP@208/240, 20HP@480, 25HP@600 ---	Part: Qty: Mfg: Mfg Part:	19273 1 Telemecanique SQT LUB 32
Combination Starter, SQT LUCA32FU TeSysU Standard Control Unit 8-32A 110/120VAC coil ---	Part: Qty: Mfg: Mfg Part:	19274 1 Telemecanique SQT LUCA32FU
Combination Starter, SQT LUCC12FU TeSysU 1 Phase Control Unit 3-12 110/120VAC coil ---	Part: Qty: Mfg: Mfg Part:	19456 1 Telemecanique LUCC12FU
Transformer, Hammond, HAT Q005YEKF 208V to 240V,5KVA,UL/CSA,3R,1ph ---	Part: Qty: Mfg: Mfg Part:	19999 1 Hammond Power Solutions HAT Q005BECF
Modem, Cable, RF, N-Male to SMA-Male, 15' Length GW195-180-SM-NM Use with Raven XE ---	Part: Qty: Mfg: Mfg Part:	20569 1 GW195-180-SM-N
Relay, SQT RXM4AB1F7 Miniature Relay 4PDT 120 V AC ---	Part: Qty: Mfg: Mfg Part:	21887 1 Telemecanique SQT RXM4AB1F
Relay, SQT RXM4AB1BD Miniature Relay 4PDT 24 V DC ---	Part: Qty: Mfg: Mfg Part:	21888 1 Telemecanique SQT RXM4AB1B

Relay, SQT RXZE2S114M	Part:	21889
Base/Socket for RXM4 4P Relays	Qty:	1
	Mfg:	Telemecanique
---	Mfg Part:	SQT RXZE2S114
Relay, SQT RXZE2S114M	Part:	21889
Base/Socket for RXM4 4P Relays	Qty:	1
	Mfg:	Telemecanique
---	Mfg Part:	SQT RXZE2S114
Relay, SQT RXZE2S114M	Part:	21889
Base/Socket for RXM4 4P Relays	Qty:	1
	Mfg:	Telemecanique
---	Mfg Part:	SQT RXZE2S114
Modem, Bracket, Mounting, Airlink Raven XE	Part:	22143
100-170-1015	Qty:	1
Use with Raven XE	Mfg:	
---	Mfg Part:	100-170-1015
Modem, Airlink Raven, XE V2228E-SA w/AC Pwr Adapter, Sprint	Part:	22170
V2228E-SA	Qty:	1
Requires mounting bracket MLE# 22143	Mfg:	Airlink_Communications
---	Mfg Part:	V2221E-SA
Fuse, GLD GDL3	Part:	E1187
3A 250V Time Delay	Qty:	1
Miniature 1/4"x1-1/4"	Mfg:	Ferraz Shawmut
---	Mfg Part:	GLD GDL3
Fuse, GLD TR125R	Part:	E1206
125A 240V Time Delay	Qty:	3
Class R	Mfg:	Ferraz Shawmut
---	Mfg Part:	GLD TR125R

Panel

Misc Part, See Details	Part:	9999
As per detailed specification below	Qty:	1
	Mfg:	
Use and modify the old RTS070 PLC Control panel and Disconnect in the rental tent.	Mfg Part:	---

Bill of Material

Project RTS151
Description Baffinland Iron Mines Corp^Mary River Project/ PM
Ordernumber 102140
Drawing Number

1325 CALIFORNIA AVE.
BROCKVILLE. ONTARIO
CANADA
K6V 5Y6

Installation

No.	Device Id	Function Text	Quantity	Partnumber	Description	Technical Des	Manufacturer
1	CB227		1	17717	Breaker, Techna, JTE	Breaker, Techna, JTEC4893C40 , 240V 40 AMP 3P C Trip Cuve	
2	CB232		1	17397	Breaker, Techna, JTE	Breaker, Techna, JTEC4892C15 , 480/277V 15 AMP 2P C Trip Curve	
3	CB247		1	17717	Breaker, Techna, JTE	Breaker, Techna, JTEC4893C40 , 240V 40 AMP 3P C Trip Cuve	
4	CB253		1	17698	Breaker, Techna, JTE	Breaker, Techna, JTEC4892C20 , 480/277V 20 AMP 2P C Trip Curve	
5	CB261		1	17397	Breaker, Techna, JTE	Breaker, Techna, JTEC4892C15 , 480/277V 15 AMP 2P C Trip Curve	
6	CB266		1	18359	Breaker, Techna, JTE	Breaker, Techna, JTEC4891C15 , 240V 15A, 1P C Trip Curve	Fusetek
7	CB271		1	17701	Breaker, Techna, JTE	Breaker, Techna, JTEC4892C50 , 240V 50 AMP 2P C Trip Curve	
8	CB304		1	18359	Breaker, Techna, JTE	Breaker, Techna, JTEC4891C15 , 240V 15A, 1P C Trip Curve	Fusetek
9	CB337		1	18359	Breaker, Techna, JTE	Breaker, Techna, JTEC4891C15 , 240V 15A, 1P C Trip Curve	Fusetek
10	CB346		1	18359	Breaker, Techna, JTE	Breaker, Techna, JTEC4891C15 , 240V 15A, 1P C Trip Curve	Fusetek
11	CR318	ESTOP	1	21887	Relay, SQT RXM4AB1F7	Relay, SQT RXM4AB1F7 , Miniature Relay 4PDT 120 V AC	Telemechanique
12	CR318	ESTOP	1	21889	Relay, SQT RXZE2S114	Relay, SQT RXZE2S114M , Base/Socket for RXM4 4P Relays	Telemechanique
13	CR415	KILL-7901	1	21888	Relay, SQT RXM4AB1BD	Relay, SQT RXM4AB1BD , Miniature Relay 4PDT 24 V DC	Telemechanique
14	CR415	KILL-7901	1	21889	Relay, SQT RXZE2S114	Relay, SQT RXZE2S114M , Base/Socket for RXM4 4P Relays	Telemechanique
15	CR750	SYS-ON	1	21887	Relay, SQT RXM4AB1F7	Relay, SQT RXM4AB1F7 , Miniature Relay 4PDT 120 V AC	Telemechanique
16	CR750	SYS-ON	1	21889	Relay, SQT RXZE2S114	Relay, SQT RXZE2S114M , Base/Socket for RXM4 4P Relays	Telemechanique
17	CR760	SYS-PNL	1	21887	Relay, SQT RXM4AB1F7	Relay, SQT RXM4AB1F7 , Miniature Relay 4PDT 120 V AC	Telemechanique
18	CR760	SYS-PNL	1	21889	Relay, SQT RXZE2S114	Relay, SQT RXZE2S114M , Base/Socket for RXM4 4P Relays	Telemechanique
19	DS201	200 AMP	1	11163	Disconnect, 3ph, D32	Disconnect, 3ph, D324N , 200A, UL,240V,Nema 1,fusible disconnect	SQD
20	DS201	200 AMP	1	E1206	Fuse, GLD TR125R	Fuse, GLD TR125R , 125A 240V Time Delay	Gould
21	DS201	200 AMP	1	E1206	Fuse, GLD TR125R	Fuse, GLD TR125R , 125A 240V Time Delay	Gould

Installation

No.	Device Id	Function Text	Quantity	Partnumber	Description	Technical Des	Manufacturer
22	DS201	200 AMP	1	E1206	Fuse, GLD TR125R	Fuse, GLD TR125R , 125A 240V Time Delay	Gould
23	FU303		1	E1187	Fuse, GLD GDL3	Fuse, GLD GDL3 , 3A 250V Time Delay	Gould
24	FU303		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
25	FU304		1	E1186	Fuse, GLD GDL2	Fuse, GLD GDL2 , 2A 250V Time Delay	Gould
26	FU304		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
27	FU318		1	E1188	Fuse, GLD GDL5	Fuse, GLD GDL5 , 5A 250V Time Delay	Gould
28	FU318		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
29	FU323		1	E1188	Fuse, GLD GDL5	Fuse, GLD GDL5 , 5A 250V Time Delay	Gould
30	FU323		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
31	FU546		1	E1190	Fuse, GLD GGC1	Fuse, GLD GGC1 , 1A 250V Fast Acting	Gould
32	FU546		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
33	IS402		1	12475	Barriers, IS, D1031Q	Barriers, IS, D1031Q , Must be marked with UL Approval	GMI
34	IS411		1	12475	Barriers, IS, D1031Q	Barriers, IS, D1031Q , Must be marked with UL Approval	GMI
35	IS424		1	12475	Barriers, IS, D1031Q	Barriers, IS, D1031Q , Must be marked with UL Approval	GMI
36	KILL318		1	14607	Button, E-Stop, ZB5	Button, E-Stop, ZB5 AT4 , E-Stop Button	SQD
37	KILL318		1	14607	Button, E-Stop, ZB5	Button, E-Stop, ZB5 AT4 , E-Stop Button	SQD
38	KILL318		1	14609	Button, ZB5 AZ105	Collar with 1-N/0 and 1-N/C Contact Block	SQD
39	KILL318		1	14609	Button, ZB5 AZ105	Collar with 1-N/0 and 1-N/C Contact Block	SQD
40	KILL318		1	23054	Label, Emergency Sto	Label, Emergency Stop, SQT ZBY9330 ,	
41	KILL318		1	23054	Label, Emergency Sto	Label, Emergency Stop, SQT ZBY9330 ,	
42	LT608	P-4001	1	18625	Button, XB7EV03GP	Button, XB7EV03GP , Green LED Pilot Light 120VAC	Square D
43	LT614	P-4901	1	18625	Button, XB7EV03GP	Button, XB7EV03GP , Green LED Pilot Light 120VAC	Square D
44	LT755	SYSTEM	1	18626	Button, XB7EV04GP	Button, XB7EV04GP , Red LED Pilot Light 120VAC	Square D
45	M227	H-7902	1	10520	Contactor, SQD LC1D3	Contactor, SQD LC1D32G7 , 32A, 10/10/20/25HP	SQD
46	M247	H-7901	1	10520	Contactor, SQD LC1D3	Contactor, SQD LC1D32G7 , 32A, 10/10/20/25HP	SQD
47	OP367	MICRO-GRAPHIC	1	17233	PLC, EA1-S3ML	PLC, EA1-S3ML , C-more micro graphic user interface	
48	OP367	MICRO-GRAPHIC	1	17234	PLC, DV-1000CBL	PLC, DV-1000CBL , 2m Cable RJ12 to RJ12	
49	PDB206		1	E1217	Power Block, GLD 675	Power Block, GLD 67583 , 175A 1Pri 8Sec Aluminum	Gould
50	PDB206		1	16071	Power Block, GLD 857	Power Block, GLD 8570 , safety cover	Gould
51	PDB206		1	16071	Power Block, GLD 857	Power Block, GLD 8570 , safety cover	Gould
52	PDB206		1	16071	Power Block, GLD 857	Power Block, GLD 8570 , safety cover	Gould
53	PDB206A		1	E1215	Power Block, GLD 631	Power Block, GLD 63163 , 90A 1Pri 4Sec Aluminum 3P	Gould

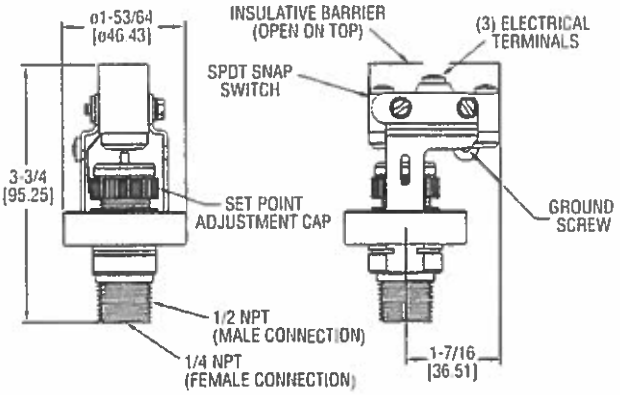
Installation

No.	Device Id	Function Text	Quantity	Partnumber	Description	Technical Des	Manufacturer
54	PDB206A		1	16010	Power Block, GLD 853	Power Block, GLD 8530 , safety cover	Gould
55	PDB206A		1	16010	Power Block, GLD 853	Power Block, GLD 8530 , safety cover	Gould
56	PDB206A		1	16010	Power Block, GLD 853	Power Block, GLD 8530 , safety cover	Gould
57	PLC369		1	DLO6			
58	PLC507		1	12752	PLC, D0-06DR-D	PLC, D0-06DR-D , 20PT 24VDC Input 16PT Relay Output Base Unit DL06	Koyo
59	PLC507		1	E1024	PLC, D2-Bat-1	PLC, D2-Bat-1 , Battery for PLC DL05/06/205	
60	PLC508		1	D0-06DR-D			
61	PS304		1	20780	Power supply, Teleme	Power supply, Telemecanique ABL7 RM24025 , In 100-240VAC Out 24VDC 2.5A	Telemechanique
62	PWR203		1	18396	Motor Saver, 460 w/D	Motor Saver, 460 w/Diagnostic 3ph , Finger Safe, DIN Rail Mountable	
63	REC337		1	GFI-15			
64	STR216	P-4001	1	19274	Combination Starter,	Combination Starter, SQT LUCA32FU , TeSysU Standard Control Unit 8-32A	
65	STR216	P-4001	1	19273	Combination Starter,	Combination Starter, SQT LUB32 , TeSysU Power Base 32A	
66	STR216	P-4001	1	19269	Combination Starter,	Combination Starter, SQT LUA1C20 , TeSysU Aux Contact Module	Telemechanique
67	STR216	P-4001	1	19270	Combination Starter,	Combination Starter, SQT LU9SP0 , TeSysU UL508 Type E Phase Barrier	
68	STR272	P-4901	1	20669	Combination Starter,	Combination Starter, SQT LUCC18FU , TeSysU 1 Phase Control Unit 4.5-18	
69	STR272	P-4901	1	19273	Combination Starter,	Combination Starter, SQT LUB32 , TeSysU Power Base 32A	
70	STR272	P-4901	1	19269	Combination Starter,	Combination Starter, SQT LUA1C20 , TeSysU Aux Contact Module	Telemechanique
71	STR272	P-4901	1	19270	Combination Starter,	Combination Starter, SQT LU9SP0 , TeSysU UL508 Type E Phase Barrier	
72	SW609		1	14660	Button, ZB5 AD3	Button, ZB5 AD3 , 3 Pos. Switch, Maintained	SQD
73	SW609		1	14610	Button, ZB5 AZ103	Button, ZB5 AZ103 , 3	SQD
74	SW615		1	14660	Button, ZB5 AD3	Button, ZB5 AD3 , 3 Pos. Switch, Maintained	SQD
75	SW615		1	14610	Button, ZB5 AZ103	Button, ZB5 AZ103 , 3	SQD
76	T249		1	19999	Transformer, Hammond	Transformer, Hammond, HAT Q005YEKF , 208V to 240V,5KVA,UL/CSA,3R,1ph	

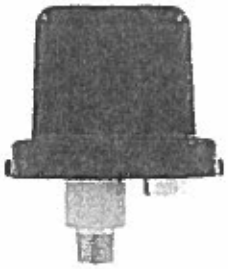
Mercoid® Series A1F Compact OEM Pressure Switch

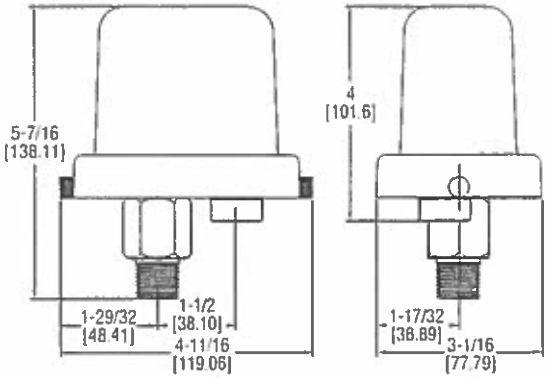
Specifications - Installation and Operating Instructions

A1F



A1F with A-447





The Series A1F Compact OEM Pressure Switch is ideal for panel mounting wherever a high-quality, economical open-case or weatherproof control is required.

INSTALLATION

1. Location: Select a location where the temperature limits of -40 to 180°F (-40 to 82°C) will not be exceeded. Locate the switch as close as possible to the pressure source. Long lengths of piping will not affect accuracy of the actuation point but will slightly add to response time.

2. Mounting and Processing Connection: Avoid mounting surfaces with excess vibration which could cause false actuation when pressure is near setpoint. The switch should be mounted within 20° of vertical for proper operation. Mount the switch by connecting it to the process piping using either 1/4" NPT female or 1/2" male connection. Pipe joint compound or TFE thread tape should be used to prevent leakage.

3. Electrical Connections: The SPDT snap switch includes normally open, normally closed and common connections. The common and normally open contacts will close and the common and normally closed contacts will open when pressure increases to the setpoint. The actions will reverse when pressure decreases below the setpoint minus the deadband. A green grounding screw is provided on the switch bracket. All wiring should be in accordance with local codes.

SETPOINT ADJUSTMENT

1. Determine the setpoint pressure. The approximate actuation point can be set by turning the adjustment cap up or down, aligning the top of the O-ring, located above the cap, with the appropriate scale graduation.
2. Connect tubing or piping from the pressure port on bottom of switch to one leg of a tee. Connect the second leg to a pressure test gage of known accuracy and in an appropriate range. The third leg should be connected to a controllable source of pressure.
3. Connect a volt/ohm meter or other circuit tester to the snap action terminals to indicate when switching occurs.
4. Slowly apply pressure to the system and note the pressure at which switching occurs.
5. Operate the switch through several cycles to confirm proper actuation point.
6. Remove test apparatus and attach switch to pressure source and control circuit wiring. Place switch in service.

SPECIFICATIONS

Service: Compatible liquids and gases.
Wetted Materials:
Pressure Chamber: 316 SS.
Diaphragm: Fluorocarbon.
Temperature Limit: -40 to 175°F (-40 to 80°C).
Pressure Limits: 750 psig (51 bar).
Enclosure Rating: No rating for open construction. Installed properly within an optional A-447 enclosure meets NEMA 4X standards.
Switch Type: SPDT snap switch.
Electrical Rating: 15A @ 120/240/480 VAC, 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC.
Electrical Connection: Screw terminals.
Process Connection: 1/4" female NPT and 1/2" male NPT.
Mounting Orientation: Within 20° of vertical.
Set Point Adjustment: Knurled screw cap with indicating scale.
Deadband: Fixed, See deadband chart.
Weight: 10.5 oz (297 g).

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Example of how to order:

A1F - O - SS - 1 - 4
1 2 3 4 5

1. Diaphragm Designation:
   F - Fluorocarbon
2. Enclosure Designation:
   O - Open Construction No Enclosure
3. Housing Material Designation:
   SS - 316SS
4. Switch Designation:
   1 - SPDT Snap Action Switch
5. Operating Pressure Range Designation:
   1 - 2 to 15 psig
   2 - 4 to 75 psig
   3 - 8 to 225 psig
   4 - 16 to 450 psig

Series A1F Deadband Chart-psig (bar)

Range	Deadband at Minimum Range	Deadband at Maximum Range
2 to 15 (0.14 to 1.03)	2 (0.14)	3 (0.21)
4 to 75 (0.28 to 5.17)	4 (0.27)	15 (1.0)
8 to 225 (0.55 to 15.5)	8 (0.55)	25 (1.7)
16 to 450 (1.1 to 31.0)	15 (1.0)	50 (3.5)

MAINTENANCE

Upon final installation of the Series A1F Compact OEM Pressure Switch, no routine maintenance is required. A periodic check of the system calibration is recommended. The Series A1F is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

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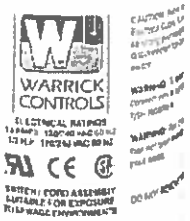
Series M
Mechanical Tilt Float Level Switch

- Non-Mercury Switch
- Sealed Cable
- Impact & Corrosion Resistant ABS Shell
- N.O., N.C., SPDT Contacts
- Various Cable Lengths
- Color Coded Body

Designed for level control and alarm applications in difficult liquids such as sewage and waste water. Series M mechanical tilt floats are ideal for applications where the presence of mercury is a concern. Series M Switches have impact resistant ABS shell and neoprene jacketed cable.



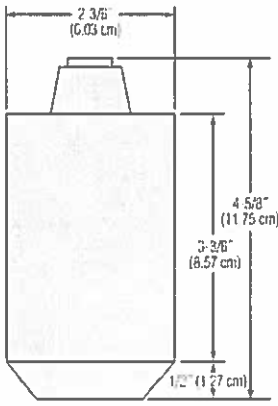
Specifications

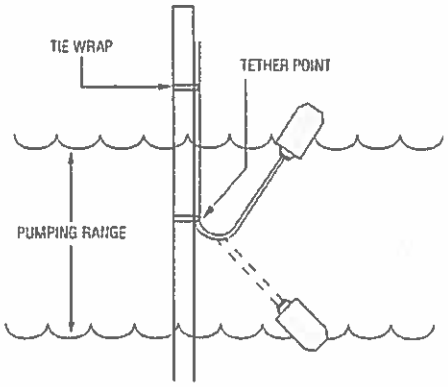
Cord	2 or 3 conductor 16 AWG wire SJOW Oil Resistant CPE
Contact Rating	13 amp @ 120/240 VAC 1/2 hp
Contact Design	SPST, Normally Open or Normally Closed Common with N.O. & N.C. (form C)
Temperature Rating	
Dry	32°F to 194°F (0°C to 90°C)
Water Resistant	32°F to 140°F (0°C to 60°C)
Overall Weight	1.0 lbs. (not including weight)
Tether Method	Tie-wrap nylon, weight: 2.5 lbs.
Approvals	U.L. Recognized, CSA Cert.

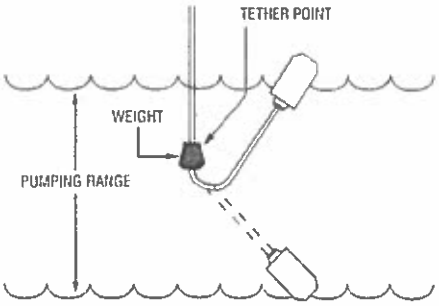
Applications

- Level Control
- Alarms
- Sewage Lift Systems
- Slurries
- Drainage Sumps
- Wastewater Treatment
- Holding Tanks

Dimensions







How to Order

Use the **Bold** characters from the chart below to construct a product code.

M XXX XX X

Series
M

Contact Configuration
BLU – SPST, Normally Open, narrow angle[1]
YEL – SPST, Normally Closed, narrow angle[1]
RED – SPST, Normally Open, wide angle[2]
WHI – SPST, Normally Closed, wide angle[2]
GRE – SPDT, Form C, wide angle[2]

Length
40 – 40 feet (12.19 m)

Tether Method
T – Tie
W – Weight

Tether Method	Part Number
Tie Wrap	7762360
Weight	7762381

Notes:
1. Narrow angle pumping range approximately 2 in. to 8 in.
2. Wide angle pumping range approximately 5 in. to 18 in.

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OIL WATER SEPARATORS – OWS SERIES

Application:

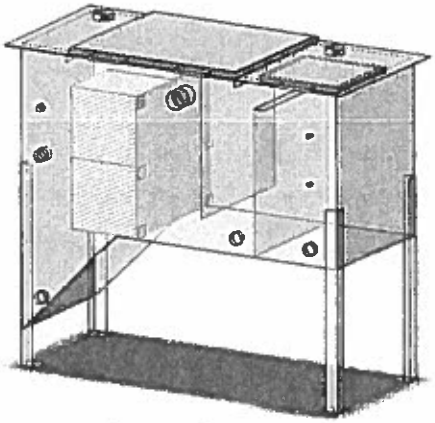
newterra Oil Water Separators are designed to remove oil from a liquid phase inlet stream. As the oil/water mixture is passed through the coalescing oil/water separator, larger oil droplets migrate to the surface to be collected and skimmed off. The media collects the smaller droplets until they are large and buoyant enough to float to the surface.

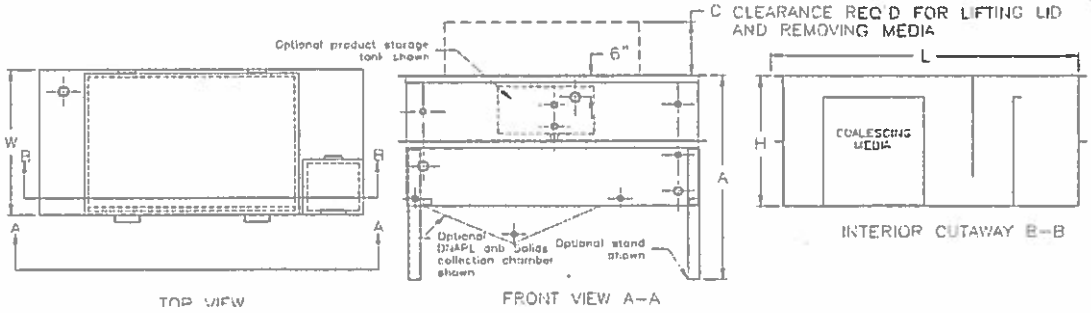
Construction:

The standard OWS Series are fabricated from carbon steel. For corrosion resistance, the interior is epoxy coated and the exterior is painted. Optional stainless steel construction is also available. A large lid allows access to the coalescing media and oil skimmer while a small lid allows access to the pump-out tank.

Standard Features:

- Standard finish: Interior is epoxy coated. Exterior is painted **newterra** blue over zinc primer (except stainless steel option)
- Sacrificial anode to prevent corrosion of tank.
- 11 AWG carbon steel construction
- Sludge containment section
- Adjustable oil skimmer
- Water underflow/overflow weir design
- Easy removal of coalescing media for cleaning
- High Alarm Level Coupling and Pump High/Low Level Coupling in the pump-out chamber





Dimension Chart:

Part Number	Width "W"	Standard Height "H"	Standard Overall Length	Length with Extended Pump-out	Height with Elevated Pump-out "A"	Overhead Clearance "C"	Standard Pump-out Volume	Extended Pump-out Volume	Elevated Pump-out Volume	Product Tank Volume
OWS-2	16"	30"	64"	76"	n/a	14"	23 Gal	41 Gal	n/a	8.1 Gal
OWS-4	28"	30"	64"	76"	n/a	26"	46 Gal	81 Gal	n/a	8.1 Gal
OWS-8	28"	30"	76"	88"	n/a	26"	46 Gal	81 Gal	n/a	8.1 Gal
OWS-12	40"	30"	76"	88"	n/a	38"	70 Gal	122 Gal	n/a	8.1 Gal
OWS-18	40"	30"	88"	n/a	60"	24"	70 Gal	n/a	130 Gal	12.2 Gal
OWS-24	52"	30"	88"	n/a	60"	24"	93 Gal	n/a	173 Gal	12.2 Gal
OWS-36	52"	42"	88"	n/a	72"	24"	133 Gal	n/a	212 Gal	17.8 Gal
OWS-45	64"	42"	88"	n/a	72"	24"	166 Gal	n/a	265 Gal	17.8 Gal
OWS-72	100"	42"	88"	n/a	72"	24"	266 Gal	n/a	425 Gal	17.8 Gal

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OIL WATER SEPARATORS – OWS SERIES

Specification Chart:

Part Number	HQ PAC		½" Packing		¾" Packing		1¼" Packing		Slant Plate	
	Oil (0.9)	Gas (0.72)	Oil (0.9)	Gas (0.72)	Oil (0.9)	Gas (0.72)	Oil (0.9)	Gas (0.72)	Oil (0.9)	Gas (0.72)
OWS-2	9.7	27.0	5.0	14.1	3.5	9.8	2.3	6.3	0.9	2.5
OWS-4	19.3	54.0	10.1	28.2	7.0	19.7	4.5	12.7	1.8	4.9
OWS-8	38.6	108.1	20.2	56.5	14.0	39.3	*9.1*	*25.4*	*3.5*	*9.8*
OWS-12	57.9	162.1	30.3	84.7	21.1	59.0	13.6	38.1	5.3	14.7
OWS-18	86.9	243.2	45.4	127.1	31.6	88.4	20.4	57.1	7.9	22.1
OWS-24	115.8	324.2	60.5	169.5	42.1	117.9	27.2	76.1	10.5	29.5
OWS-36	159.2	445.8	68.1	190.7	47.4	132.6	30.6	85.7	11.8	33.2
OWS-45	199.0	557.3	85.1	238.4	59.2	165.8	38.2	107.1	14.8	41.5
OWS-72	318.5	891.7	136.2	381.4	94.7	265.3	61.2	171.3	23.7	66.3

Rated US GPM (Based on 25 micron particles at 65 deg F and design safety factor of 1.25)
Larger spaced packing will not plug as quickly as closely spaced packing allowing longer intervals between maintenance requirements. The coalescing slant plate should be used in applications with heavy sludge loads because it does not foul quickly.

Options Table:

Option	Description
Stand	The separator will be elevated above ground to assist in gravity discharge or to provide room underneath the separator for blowers and pumps. This replaces the standard foot mounts. The maximum stand height for 8' clearance is 36" for OWS-18 and OWS-24 and 24" for OWS-36 and larger.
Oversize Pump-out (Extended)	OWS-2, OWS-4, OWS-8 and OWS-12 only. The final section of the separator can be oversized to allow a greater water pump-out volume. For the OWS-2, OWS-4, OWS-8 and OWS-12 the oversized pump-out will be an extended length of the final section of the separator.
Oversize Pump-out (Elevated)	OWS-18, OWS-24, OWS-36 and OWS-45 only. The final section of the separator can be oversized to allow a greater water pump-out volume. For the OWS-18, OWS-24, OWS-36 and OWS-45 the separator will be raised on a stand and the final section will extend to the ground to give the oversized volume.
Top Inlet	A top mounted option is available to allow for pre-separation of air and liquid at the inlet to the separator.
Product Storage Tank	A tank may be mounted on the front of the separator to collect the oil from the skimmer. The volume of the product storage tank is: OWS-2, OWS-4, OWS-8 and OWS-12: 8.1 US Gal OWS-18, OWS-24 12.2 US Gal OWS-36, OWS-45 17.8 US Gal
Teleretle Basket	A teleretle basket may be added to allow for a high surface area polishing media for final hydrocarbon removal.
Oversize Inlet and Outlet	The inlet and outlet couplings may be increased by one size to allow for higher flow through the separator.
Stainless Steel	Each separator can be purchased with Stainless Steel construction instead of the standard Carbon Steel.
Main Tank Low Coupling	Additional couplings may be added to allow for the installation of a low level switch in the main separator tank. NOTE: This option covers only the cost of installing the coupling, the switches must be purchased separately.
Main Tank High High Coupling	Additional couplings may be added to allow for the installation of a high high level switch in the main separator tank. NOTE: This option covers only the cost of installing the coupling, the switches must be purchased separately.
Custom Size	A custom sized separator can be designed to meet specific project needs.
Media	Custom media available for contaminants other than oil/BTEX such as chlorinated solvents and other DNAPL products.
DNAPL Separation	The separator can be supplied with a DNAPL sump to capture heavy fluids and solids and allow collection below the media of the oil water separator.

Sample Ordering Format:

OWS-4 with ½" Packing
SG: 0.9
Temp: 65 deg F
Minimum Micron Size: 25
Design Safety Factor: 1.25
Options:
Oversize Pumpout (Extended)
Product Storage Tank
Stand: 24"

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ATB 3 and ATS3 Series Spec Sheet
Level Switch - Small Size - Heavy Duty

The ATB3 is designed for high or low level alarm or switch point applications in rugged situations similar to oil tank reservoirs or industry vessels that require a more robust level switch. Notice the larger brass one piece machined hex to get a wrench on - this model also has an optional brass set screw locking collar in place of the clip.

Internal reed switch selection is the same Almeg quality standard but we've beefed up the external part as well as fully encapsulated the reed switch to maintain a complete moisture free environment. The leads are wire wrapped (not clipped) soldered and heat shrink sealed to the reed switch before encapsulating.

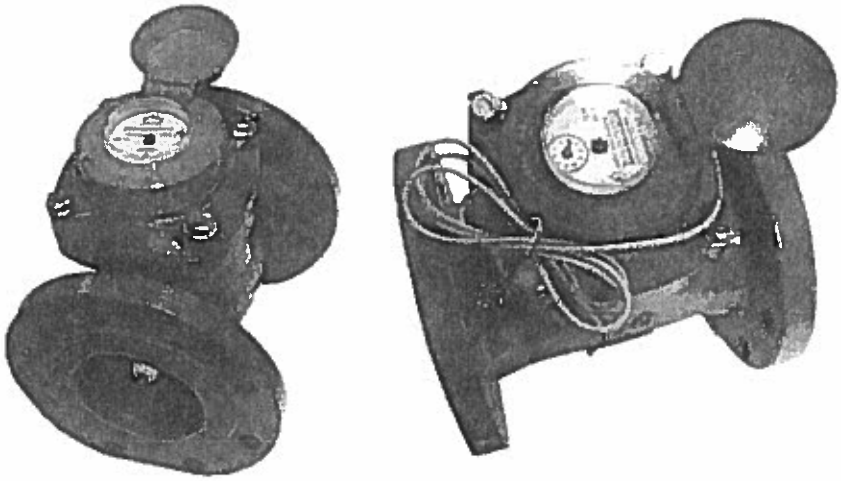
The TRUE closed cell Buna float will not swell or take on moisture - even if cut or drilled. It is designed like a tight bee hive or honey comb construction.

100% of our controls are tested before shipping.

The ATB3 is available in a single order or OEM applications.

DLJ Epoxy Coated Cast Iron Turbine Meters

200T, 250T, 300T, 400T, 600T, 800T



Description

Operation DLJ Turbine Meters are horizontal Woltman type water meters designed for installation where occasional low and moderate to high sustained flows are demanded. Water flow drives a vertical impeller in direct proportion to the quantity of water passing through the meter. Impeller revolutions are transferred to the register assembly through a reduction gear and magnetic drive.

Compliance The DLJ Turbine Meters comply with AWWA C701 and ISO 4064 Class B standards.

Installation The meter must be installed in a clean pipeline, free of any foreign materials. Install the meter with direction of flow as indicated by the arrow cast into the meter body. You can install the meter vertically or horizontally and the registers are fully revolvable for ease of reading. It is recommended to strain the incoming water to prevent foreign debris damage and to reduce the effects of water turbulence.

Application The DLJ Cold Water Turbine Meters are for use only with cold water up to 120 degrees F (50 degrees C)

Construction The meter consists of a fully epoxy coated cast iron main case with the flow direction cast into it and a removable measuring element for easy maintenance.

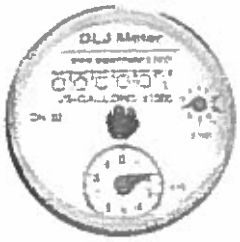
	Specifications					
Characteristics	**DLJ 200T 2"**	**DLJ 250T 2 1/2"**	**DLJ 300T 3"**	**DLJ 400T 4"**	**DLJ 600T 6"**	**DLJ 800T 8"**
Flow Rating (gpm)	325	395	495	1250	2500	3450
Continuous Flow (gpm)	250	300	375	1000	2000	2800
Low Flow (gpm)	4	5	6	9	32	38
Maximum Pressure (psi)	175	175	175	175	175	175
Maximum Temperature (°F)	120	120	120	120	120	120
Sweep Hand Registers (Gallons)	10/100	10/100	10/100	10/100	10/100	10/100
Register Capacity (Millions of Gallons)	1000	1000	1000	1000	1000	1000

DLJ Meter

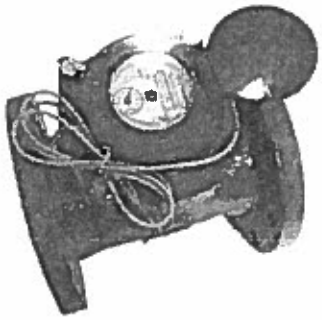
DLJ Epoxy Coated Cast Iron Turbine Meters

200T, 250T, 300T, 400T, 600T, 800T

Direct Read Register The register is contained in a hermetically sealed nylon casing with a 5mm tempered glass lens. The totalizer wheels are large and easy to read and the sweep hands are offset on seperate 10 gallon and 100 gallon register wheels. The large black spinning trickle indicator is excellent for leak detection. Each register clearly show's it's applicable meter size.



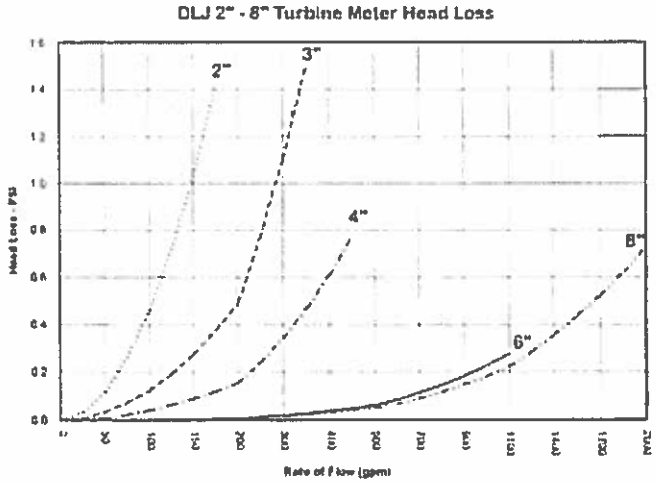
Pulse Output The DLJ line is available with a dry contact reed switch pulse output. This requires external DC power, 4 watts, 30VDC maximum. Contact closure is 1 pulse per 100 gallons on the 2 - 3" Turbines and 1 pulse per 1000 gallons on the 4 - 8" Turbines



Magnetic Drive The magnetic drive design eliminates all miscouplings associated with conventional right angle drives. Excess torque is eliminated in the encased undergear assembly, ensuring constant magnet coupling.

Maintenance The register/measuring assembly is easily removable and replaceable if needed, and doesn't require taking the meter off line.

Connections The DLJ Turbine Meters are available with standard Class 150lb ANSI flanges (4 bolt in 2, 2 1/2" and 3", 8 bolt in 4, 6 and 8"). Companion Flange sets in Cast Iron or PVC and Uni-Flanges are available for ease of connection.



Characteristics	Specifications					
	DLJ 200T 2"	DLJ 250T 2 1/2"	DLJ 300T 3"	DLJ 400T 4"	DLJ 600T 6"	DLJ 800T 8"
Length (Inches)	12	7.75	8.75	9.75	11.6	13.6
Weight (Pounds)	32	29	35	40	92	141
Crated Weight (Pounds)	43	40	47	50	110	150

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DLJ Meter

www.watermeters.com

Stacking Shipping Containers on Land for an Off-Axis Detector

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Fermi National Accelerator Laboratory, Batavia, IL 60510

(May 29, 2003)

Introduction

Fig. 1 shows a typical International Standards Organization (ISO) Series 1 shipping container.

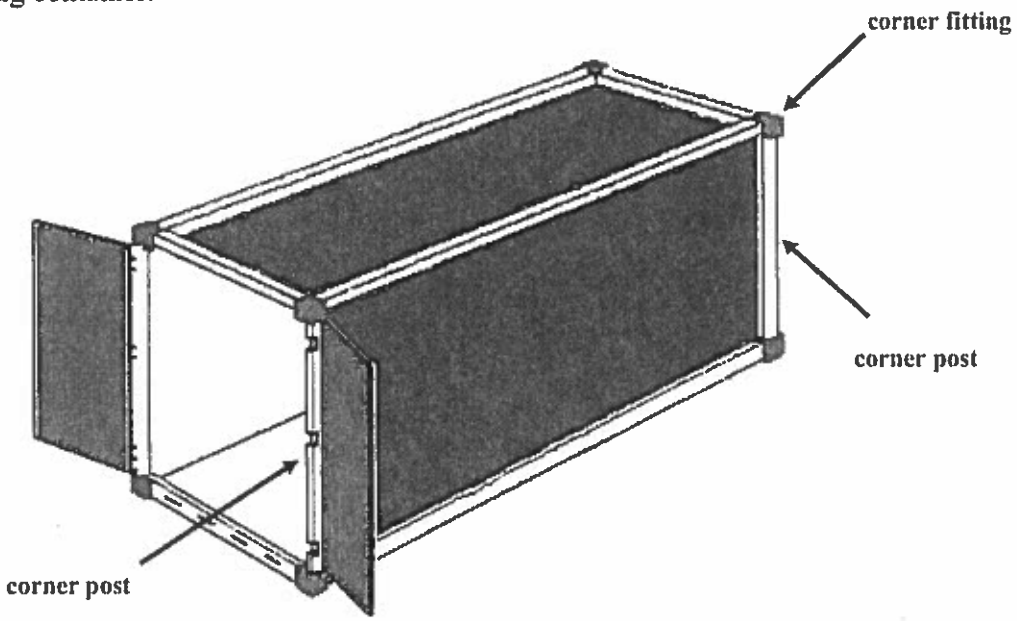


Figure 1. ISO Series 1 Shipping Container

These containers are designed to make vertical contact with each other through discrete corner fittings; when stacked, all vertical force is transferred through these fittings, in turn loading the corner posts, and not the walls, of the container. The number of containers which can be stacked on each other is determined by the strength of the corner posts.

ISO Standard 1496[1] states that the corner posts of ISO Series 1 containers should be tested to a load of 86,400 kg (190,480 lbs). This is the load applied to the posts of the bottom container in an 8-on-1 stack of 24,000 kg (gross weight) containers,

multiplied by a factor of 1.8. This extra factor is used to take into account "conditions aboard ship and the relative eccentricities between superimposed containers."[1] The "conditions aboard ship" were derived from a 1964 study of maximum acceleration values under the worst sea and wind conditions.[2]

Calculating the safe stacking height for loaded containers *on land* requires some understanding of the corner posts, their material properties, possible failure modes, and what constitutes an adequate factor of safety.

Corner Post Geometry and Compressive Load-Bearing Capacity

Corner post steels typically correspond to the specification ASTM A-572, with a yield stress of 47,000 psi, and an ultimate stress of 70,000 psi. This is a low alloy columbium or vanadium steel commonly used for high-strength steel weldments, such as bridges. The load-bearing characteristics of corners posts are complex, because in a walled container the posts receive substantial lateral stability, and compressive cross sectional area, from the participation of the walls and doors.

The corner post can fail in two ways: The first is collapse, or buckling. This occurs in a slender column when the compressive load reaches a critical load P_{cr} which is so large that the column can no longer recover from small lateral displacements along its length. The result is sudden and catastrophic loss of stiffness, and gross deformation of the column and its attached material.

A second type of failure can occur if the compressive load P_{comp} exceeds the value S_yA, where S_y is the yield stress of the material, and A is the cross sectional area of the post. Even a column which is stable against buckling failure can fail from compressive yielding. Failures of this type are rare for columns, since the yielding will tend to produce larger cross sectional area through plastic deformation, and eventually become self-limiting. This self-limit may not be reached before even a very short column becomes unstable, however, resulting in a type of collapse that is characterized by large amounts of plastic deformation.

The most likely failure mode, given the substantial lateral constraint offered by the walls, is probably a combination of collapse and gross yielding, a type of failure referred to as elastic/plastic collapse.

The calculation of collapse (buckling) loads for long, slender steel columns uses the Euler equation:

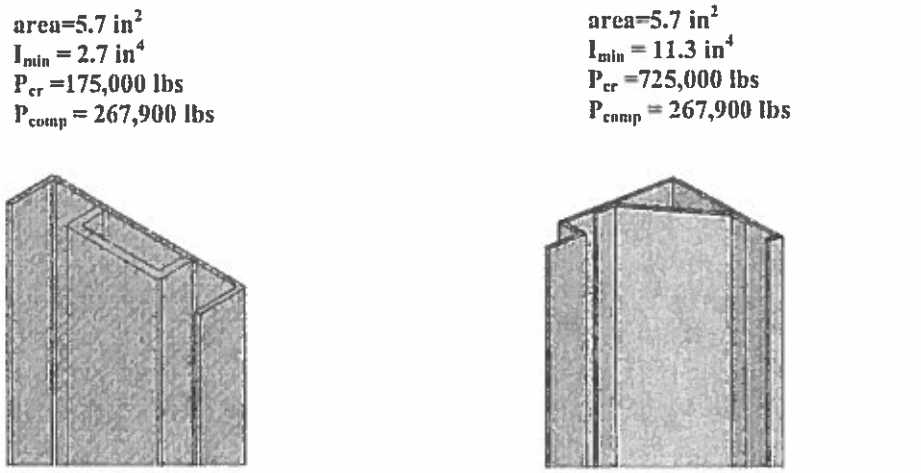
$$P_{cr} = k\pi^2 EI/L^2$$

where P_{cr} = critical (collapse) load
E = modulus of elasticity of steel = 30e6 psi
I = minimum moment of inertia of section
L = length of column
k = factor for end rotational restraint (theoretical range from 1-4)

For the corner posts, the degree of end rotational restraint is difficult to quantify. The top, bottom, and side rails will serve to provide substantial restraint, and even the corner fitting contact of the loading container above a corner post will tend to limit rotation. Therefore, a k factor of 2 is chosen for calculating the estimates of collapse load.[3] This is less than the complete rotational restraint (k = 4), but greater than free rotation (k = 1).

In addition to resisting collapse, the corner post must also work at a compressive stress that is below the yield of the material. Corner posts will yield at a stress of 47,000 psi. Therefore, the minimum cross sectional area for resisting the corner post loads is A = 190,840/47,000 = 4.05 in^2.

While the minimum performance of a corner post is standardized via ISO, the actual geometry of the post is not. Manufacturers have explored many different designs for many different types of containers, all of which will pass the ISO test load of 86,400 kg or 190,840 pounds. Figure 2 shows the most common corner post cross-sections at the door and walled ends of a Series 1 container. These posts are made of 6mm thick pressed steel shapes welded together along the length of the post. In the case of the door end post, a piece of hot rolled channel 113 x 40 x 10 mm is welded to the 6mm plate. Both posts in Figure 2 have adequate cross sectional area from the standpoint of compressive stress. However, the Door End post (a), has a collapse load which is less than the load required by the ISO standard, and therefore must rely on interaction with the walls and doors of the container to produce the necessary load-bearing capacity.



(a) Corner Post at Door End **(b) Corner Post at Walled End**

Figure 2. Corner Post Cross Sections -- Properties and Load Capacities without Wall/Door Participation

The effect of participation of the walls and doors is illustrated in Fig. 3 The profile of Fig. 2(a) has been used with a 3-inch wide strip of adjacent container sidewall (3.6 mm thick) and a 2-inch wide strip of door panel (2 mm thick), to form a column of considerably higher strength than the profile of Fig. 2(a) alone. The cross section shown, with walls, has a critical load of approximately 252,000 lbs, which is well above the 175,000 lbs of the corner post alone, and well above the 190,480 lbs required by the ISO Standard.

These calculations show that the door is an important part of the load path under stacking, providing additional cross-sectional area for compression and stability. The door also acts as a sheer wall, preventing the parallelogram deformation of the end referred to as "racking" or "sidesway." For these reasons, in commercial practice, the doors on a container within a stack are presumably never opened. This is not a constraint on the way the containers are used in commerce, since only one container at a time is loaded or unloaded at terminals, with stacking occurring only during transit.

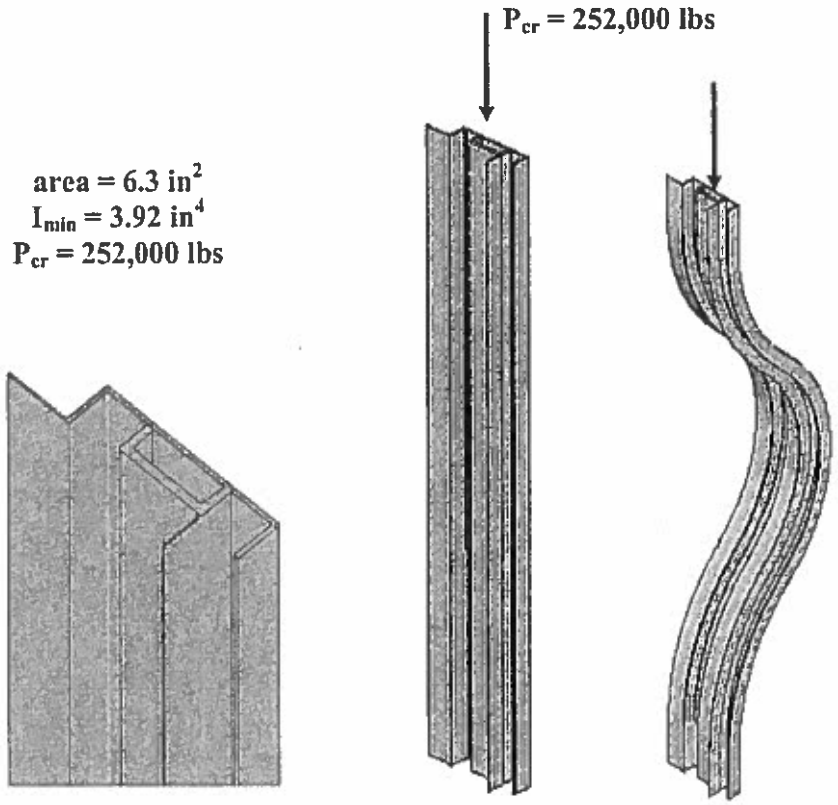


Figure 3. Corner Post from Fig. 2(a) showing increase in buckling strength due to participation of wall

Corner Fittings

The corner fittings shown in Figure 1 are an integral part of the load-bearing column in the container. ISO 1161-1984(E)[4] states "Corner fittings for Series 1 freight containers shall be capable of withstanding the loads calculated in accordance with the requirements of ISO 1496/1 for Series 1 containers." This means that the bottom corner fitting of the bottom container in a stack must withstand the weight of the containers stacked above it, plus the weight of the bottom container itself. The maximum load which a single corner fitting must take is then

$$P_{tot} = 190{,}480 + (52{,}800/4) = 203{,}680 \text{ lbs}$$

A typical corner fitting is shown in Fig. 4.. The cross sectional area of this fitting is shown in Fig. 5. The total cross sectional area available for compression is 10.15 in^2. This results in an average compressive stress under maximum load of 20,067 psi.

Corner fittings are typically cast and machined from A-216 steel, which has a minimum specified yield stress of 40,000 psi. Therefore, under maximum load, a corner fitting of the cross section shown below operates with a safety factor on yield of nearly 2.0

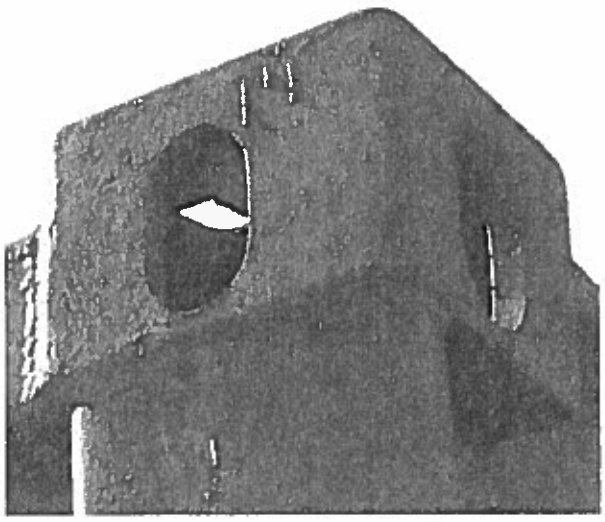


Figure 4. Corner Fitting

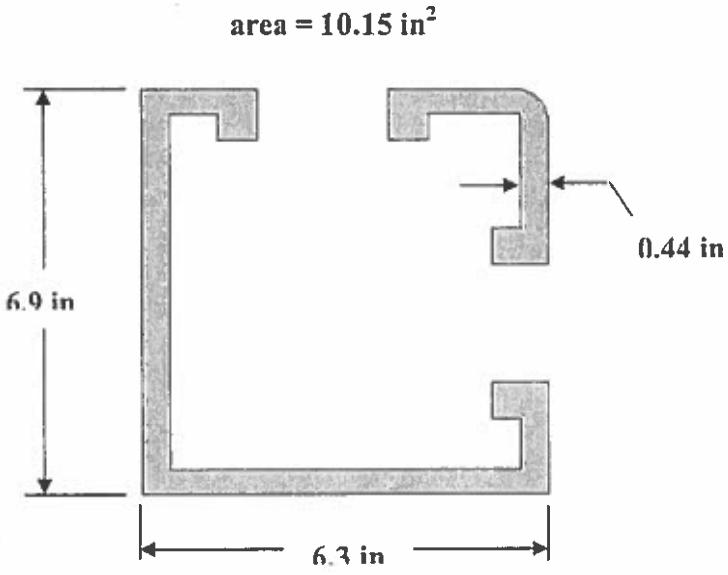


Figure 5. Fitting Cross Section

Safety Factor for Stacking Containers on Land

A safety factor for the corner posts in the bottom container of a stack can be defined as

$$SF = F_{cp\text{-}fail}/F_{cp\text{-}act}$$

where SF = safety factor
$F_{cp\text{-}act}$ = actual operating load on corner post
$F_{cp\text{-}fail}$ = failure load of corner post

The ISO Standard, however, does not define a force $F_{cp\text{-}fail}$; rather, it specifies the load that each corner post must withstand *without* failure. In this sense, the specified load is a *proof* load, F_{cp_proof}, which is simply a load which each corner post must be shown capable of resisting. For the purposes of calculating a safety factor, the specified test load can be thought of as an absolute lower limit on the failure load. Any safety factor calculated with $F_{cp\text{-}fail} = F_{cp\_proof}$ will be smaller than the actual safety factor, since F_{cp_proof} is always smaller than $F_{cp\text{-}fail}$.

Using the expression above, the safety factor of an 8-on-1 stack of containers on land is at least 1.8 . Safety factors in engineering commonly range from 1.25 to 2.0 or greater, depending on the amount of confidence the designer has in material performance and load characterization. The AISC Steel Construction Code[5], for example, uses a safety factor of 2 for column loading; however, conservative design in civil structures is necessary because there is typically no load-testing of the parts; they are designed, manufactured, and set in place with only the calculation and fabrication standards serving as proof of merit. Aircraft design, however, uses safety factors closer to 1.25, due to the great penalties incurred by excess weight. The extremely rigorous materials and testing programs common in the aviation industry justify these smaller safety factors.

Because the corner posts of all containers are known to have been tested to the load stipulated by ISO 1496 with no failures occurring at a load that is less than the test load, a safety factor of about 1.5 is adequate for a stack of containers on land. Table I shows the safety factor on the corner post loading of the bottom container in a stack, for stacks of various heights. This table is based on the application of the equation for safety factor, with $F_{cp\text{-}fail} = F_{cp\text{-}proof} = 190{,}480$ lbs, and containers of 52,910 lbs gross weight:

Table I. Safety Factors on Land for Various Stack Heights on Land with Container Corner Post Capacity of 190,480 lbs (86,400 kg)

Number of Containers Stacked on One	Total Height of Stack	Safety Factor on Corner Post Loading
8	9	1.80
9	10	1.60
10	11	1.44
11	12	1.31

The table shows that we can stack 9-on-1 on land, and maintain a safety factor of greater than 1.5.

Possible Modifications

For a final detector design, good engineering practice would require that the corner posts of several containers be loaded to failure to more precisely determine F_{cp_fail}, from which more accurate stacking safety factors could be calculated. Some advantage might be taken of the fact that while $F_{cp\text{-}fail}$ is not known, it is certainly higher than 190,480 lbs (86,400 kg). If the measured failure load is just 4% higher than the test (proof) load, the safety factor on a 10-on-1 stack becomes 1.5, and stacking to that height becomes defensible.

Some vendors advertise containers with a higher capacity[(6)] than the ISO Series 1 standard, and advantage could be taken of the greater payload, as well as the higher post strength, in configuring the detector array. The typical higher post rating quoted is 214,290 lbs (97,400 kg), allowing exactly 9 on 1 stacking of 52,910 lb (24,000 kg) containers at sea and therefore allowing 10 on 1 on land with a safety factor of (9/8)*(1.44) = 1.62.

Similarly, if the Off-Axis detector density is small enough that our standard gross weight container is less than 52,910 lbs (24,000 kg), then even higher stacks could be supported. Table II shows the stack heights possible when the higher strength containers are used. A container volume of 33.2 m^3 is assumed with a tare weight of 2,250 kg and four different detector gross weights of 22,150 kg, 24,000 kg, 26,000 kg and 30,480 kg. The 30,480 kg number is the vendor quoted maximum gross weight for the higher strength containers. Comparing Tables I and II shows that the higher strength posts lead to the same height stacks as the lower strength posts for containers of density 0.75 gm/cc vs. 0.66 gm/cc.

Table II. Stack Heights on Land forVarious Detector Densities with Container Corner Post Capacity of 214,290 lbs (97,400 kg)

Number of Containers Stacked on One	Total Height of Stack (m)	Safety Factor on Corner Post Loading			
		with payload density = **0.60 g/cc** (22,150 kg gross)	with payload density = **0.66 g/cc** (24,000 kg gross)	with payload density = **0.75 g/cc** (27,150 kg gross)	with payload density = **0.85 g/cc** (30,480 kg gross)
8 on 1	23.3	2.20	2.03	1.80	1.60
9 on 1	25.9	1.95	1.80	1.59	1.42
10 on 1	28.5	1.76	1.62	1.43	1.28
11 on 1	31.1	1.60	1.48	1.30	1.16

Conclusion

Stacking ISO containers 10 high on land is reasonable, and stacks as high as 12 may be possible depending on the type of container purchased and on the loading of the container with Off-Axis detector elements. For a final detector design, good engineering practice would require that the corner posts of the selected containers be loaded to failure to more accurately determine the safety factor of the stacked array.

References

1. ISO 1496-1:1990 *Series 1 freight containers – Specification and testing – Part 1: General cargo containers for general purposes*

2. ISO/TR 15070:1996(E) *Series 1 freight containers – Rationale for structural test criteria*

3. "Commentary on the Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", Section 1.8, American Institute of Steel Construction, 1978

4. ISO 1161-1984(E) *Series 1 freight containers – Corner fittings – Specification*

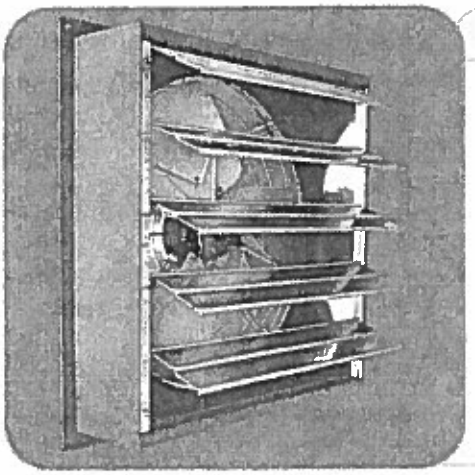
5. "Commentary on the Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", Section 1.5.1.3, American Institute of Steel Construction, 1978

6. We have several specification documents from container vendors that stipulate a higher load capacity, but no details on just how this is accomplished by any container manufacturer via changes in the post configuration. We suspect that these vendors may just be taking advantage of a specification requiring a higher measured failure load as discussed in the preceding paragraph. After all, our post calculations for Figures 2(b) and Figure 3 indicate that these "standard" posts should easily pass a failure load test at 214,290 lbs vs. the original ISO test at 190,480 lbs.

STANDARD FANS

Efficient • Low Maintenance • Easy Installation

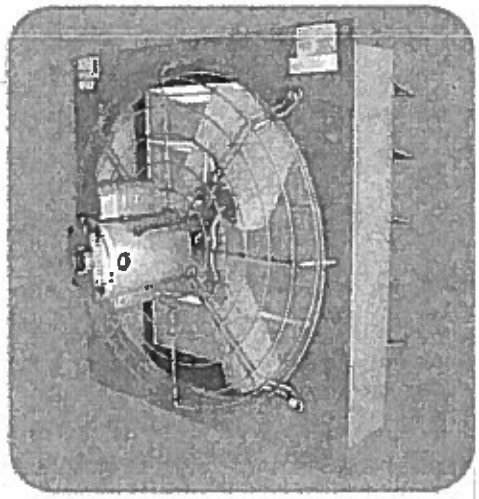
Canarm's Standard Fans follow a tradition of quality in design, materials and construction.



Features

- Available in 8" to 36" sizes.
- Single, two and variable speed models are available.
- All fans use a totally enclosed, ball bearing motor with thermal overload protection.
- The motor mount is manufactured with heavy welded rods and has a powder coated finish.
- The fan blades are well-balanced, heavy gauge aluminum.
- The rugged steel welded box housing has a durable powder coated finish.
- Aluminum louver shutters are supported by long life nylon bushings (30" and 36" have PVC louvers).
- All fans are shipped completely assembled.

General Information



Canarm's Standard Fans follow a tradition of quality in design, materials and construction. All our Standard Fans are developed to be efficient and economically priced. All variable speed Standard Fans use an energy efficient variable speed, dual voltage motor and blade combination.

To determine the proper Canarm Fan for your applications, use the following formula.

Number of cubic feet in room / Number of minutes per air change = Required C.F.M. Capacity

*****Example*****

A general office, (see chart) which requires an air change every ten minutes, would require the following fan capacity. If office is 100' x 40' x 10' = 40,000 cubic feet

40,000 cubic feet / 10 minutes per air change = 4000 Required C.F.M.

From the "Performance Data" section on the back of this page, you would select a fan that is rated at 4000 C.F.M. at 1/8" S.P. (Static Pressure)

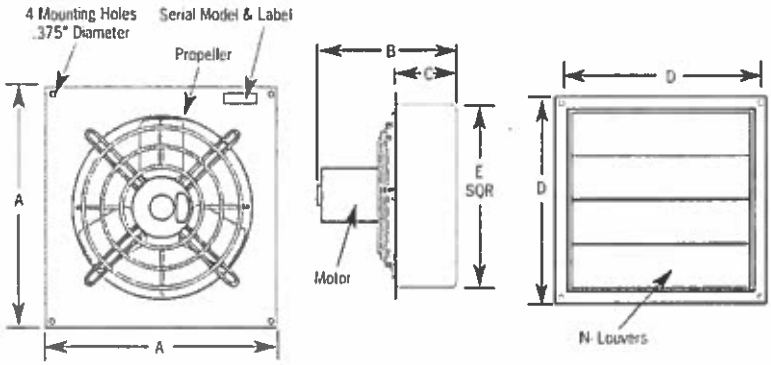
Fan Selection Chart

Application	Minutes per Air Change	Application	Minutes per Air Change	Application	Minutes per Air Change
Assembly Hall	7	Department Store	6	Plating Room	3
Auditorium	10	Dry Cleaning	5	Pressing Room	1
Bakery	3	Engine Room	6	Projection Booth	2
Barber Shop	6	Forge Room	3	Restaurant	6
Basement	8	Foundry	4	School	7
Battery Room	4	Garage	5	Summer Cooling	1
Boiler Room	1	General Office	10	Store	8
Bowling Alley	5	Gymnasium	8	Tavern	3
Church	15	Hospital	8	Toilet	3
Cocktail Bar	3	Kitchen	2	Transformer Room	1
Corridor	10	Laundry	2	Warehouse	12
Dairy	4	Locker Room	3	Welding Shop	2
		Machine Shop	8		

STANDARD FANS

Fan Dimensions

Fan Auto	A	B	C	D (c/c)	E	N
8"	13 1/4"	10"	4"	12"	10 3/4"	2
10"	15 1/4"	10"	4"	14"	12 3/4"	2
12"	17 1/4"	14"	6"	16"	14 3/4"	3
14"	19 1/4"	14"	6"	18"	16 3/4"	3
16"	21 1/4"	14"	6"	20"	18 3/4"	4
18"	23 1/4"	15"	6"	22"	20 3/4"	4
20"	25 1/4"	16"	6"	24"	22 3/4"	5
24"	29 1/4"	16"	6"	28"	26 3/4"	5
30"	35 1/4"	19"	6"	34"	32 3/4"	16
36"	41 1/4"	16"	6"	40"	38 3/4"	20



Performance Data & Specifications

Model Number	Fan Size	Motor HP	Operation Speed	Fan RPM	Current Load Amps @ 115V	Current Load Amps @230V	Input Watts	Airflow Capacity - CFM 0" S.P.	.10" S.P.	.125" S.P.	.25" S.P.	CFM Watts	Sound Level Decibel (A)	Framing Dimensions	Shipping Weight Lbs.
S8-B2	8"	1/20	Two	High 1550 Low 1300	0.95 0.45	- -	109	360 300	270 150	230 110	0 0	2.5	48 43	11" x 11"	12
S10-B2	10"	1/20	Two	High 1550 Low 1300	1.2 0.7	- -	125	690 580	590 460	570 390	0 0	4.72	56 50	13" x 13"	13
S12-E1	12"	1/4	Single	1750	3.5	-	245	1,640	1,540	1,510	1,390	6.00	63	15" x 15"	28
S12-E2			Two	High 1760 Low 1180	3.4 2.3	- -	230 132	1,650 1,090	1,550 950	1,520 930	1,390 -	6.74 7.31	64 50		32
SD12-EV			Variable	Max 1625 Min 600	2.2	1.1	205	1,650 560	1,540 440	1,510 420	1,390 -	7.50	60 -		32
S14-E1	14"	1/4	Single	1740	3.6	-	257	2,170	2,070	2,030	1,860	8.05	67	17" x 17"	30
S14-E2			Two	High 1740 Low 1170	3.8 2.2	- -	253 137	2,180 1,350	2,080 1,190	2,060 1,160	1,890 -	8.22 8.69	65 53		34
S16-E1	16"	1/4	Single	1740	3.7	-	274	2,370	2,270	2,210	2,060	8.28	68	19" x 19"	33
S16-E2			Two	High 1740 Low 1170	3.7 2.3	- -	270 152	2,380 1,640	2,280 1,490	2,230 1,430	2,070 -	8.44 9.80	69 55		36
SD16-EV			Variable	Max 1625 Min 450	2.6	1.3	248	2,370 610	2,270 580	2,210 570	2,063 -	9.15	63 -		36
S18-F1	18"	1/3	Single	1700	4.8	-	448	3,200	3,090	3,040	2,920	6.89	73	21" x 21"	37
S18-F2			Two	High 1700 Low 1140	5.7 3.1	- -	446 250	3,200 2,100	3,090 1,890	3,040 1,820	2,920 -	6.93 7.56	74 64		43
SD18-FV			Variable	Max 1625 Min 390	3..7	1.9	378	3,150 700	3,050 650	2,980 630	2,860 -	8.07	74 -		45
S20-F1	20"	1/3	Single	1735	4.8	-	322	3,420	3,220	3,170	2,920	10.00	77	23" x 23"	41
S20-F2			Two	High 1745 Low 1165	4.3 2.6	- -	315 190	3,440 2,300	3,240 2,000	3,180 1,950	2,930 -	10.20 10.52	77 67		45
SD24-F1	24"	1/3	Single	1075	4.3	-	370	5,000	4,500	4,300	3,600	12.80	70	27" x 27"	46
SD24-GV		1/2	Variable	Max 1100 Min 310	4.2	2.1	290	5,050 800	4,940 710	4,810 650	4,400 -	13.2	72 -		56
SD30-G1D	30"	1/2	Single	1075	4.6	2.3	600	8,000	7,000	6,000	5,000	11.5	82	33" x 33"	72
SD36-G1D	36"	1/2	Single	850	6.0	3.0	660	12,000	11,000	10,500	9,500	13.0	72	39" x 39"	88

NOTE: RPM Min (Minimum) is determined when louvers are opened one inch

Note: Wind has a significant effect on exhaust fans. A 10 mph wind creates a 0.05" pressure against the fan. A 20 mph wind creates 0.20" pressure and 30 mph a 0.45" pressure. These pressures are in addition to the static pressure in the building. Wind blocks or hoods should be included in all designs where fans will be subjected to winds above 10 mph.

Warranty

- 1 year on all components

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Code No. LIT-1927010
Issued February 1, 2009

A19 Series

Remote Bulb Control

Description

The A19 Series are single-stage temperature controls that incorporate environmentally friendly liquid-filled sensing elements.

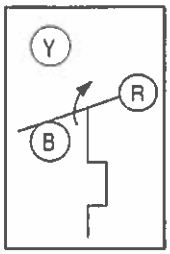
Features

- wide temperature ranges available
- constant differential throughout the entire range
- compact enclosure
- fixed or adjustable differential available
- variety of sensing element styles
- unaffected by cross-ambient conditions

Applications

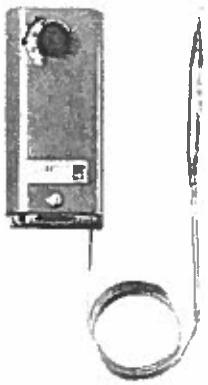
The A19 is suitable for temperature control in heating, ventilating, air conditioning, and refrigeration.

A19 Series



Action on increase of Temperature

A19 Series
Terminal Arrangement for SPDT



A19ABC-24

Selection Charts

A19 Series Remote Bulb Control[1]

Code Number	Switch Action	Range °F (°C)	Diff F° (C°)	Bulb and Capillary	Bulb Well No. (order separately)	Range Adjuster	Max. Bulb Temp. °F (°C)
Adjustable Differential (Wide Range)							
A19ABA-40C [2]	SPST Open Low	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver Slot	140 (60)
A19ABC-4C	SPDT	50 to 130 (10 to 55)	3 1/2 to 14 (1.9 to 8)	3/8 in. x 5 in., 8 ft. Cap.	WEL14A-603R	Knob	170 (77)
A19ABC-24C [3]	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 8 ft. Cap.	WEL14A-602R	Convertible	140 (60)
A19ABC-36C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 20 ft. Cap.	WEL14A-602R	Convertible	140 (60)
A19ABC-37C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 10 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ABC-74C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
Fixed Differential							
A19AAF-12C	SPDT	25 to 225 (-4 to 107)	3 1/2 (1.9)	3/8 in. x 3 in., 10 ft. Cap.	WEL14A-602R	Screwdriver slot	275 (135)
Fixed Differential (Case Compensated)							
A19AAC-4C	SPDT	0 to 80 (-18 to 27)	5 (2.8)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19AAD-12C	SPST Open Low	-30 to 50 (-34 to 10)	2 1/2 (1.4)	3/8 in. x 4 in., 7 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
Fixed Differential (Close)							
A19AAD-5C [4]	SPST Open Low	30 to 50 (-1 to 10) (Bulk Milk Cooler)	2 1/2 (1.4)	3/8 in. x 2 5/8 in., 6 ft. Cap.	WEL16A-601R	Screwdriver slot	190 (88)
A19AAF-20C	SPDT	-30 to 100 (-34 to 38)	2 1/2 (1.4)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19AAF-21C	SPDT	40 to 90 (4 to 32)	1 1/2 (0.8)	3/8 in. x 5 3/4 in., 6 ft. Cap.	WEL14A-603R	Screwdriver slot	140 (60)
Manual Reset							
A19ACA-14C	SPST Open Low	-30 to 100 (-34 to 38)	Manual Reset	3/8 in. x 4 in. 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ACA-15C	SPST Open Low	-30 to 100 (-34 to 38)	Manual Reset	3/8 in. x 4 in. 10 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ADB-1C	SPST Open High	100 to 240 (38 to 116)	Manual Reset	3/8 in. x 3 1/2 in. 6 ft. Cap.	WEL14A-602R	Knob	290 (143)
A19ADN-1C	SPST Open High	100 to 240 (38 to 116)	Manual Reset	3/8 in. x 4 in. 6 ft. Cap.	WEL14A-602R	Screwdriver slot	290 (143)

1. Specify the control model code number, packing nut code number (if required), and bulb well code number (if required).
2. Replaces White-Rodgers 1609-101
3. Replaces White-Rodgers 1609-12, -13, Ranco 010-1408, -1409, - 1410, -1490, 060-110, Honeywell L6018C-1006, L6021A-1005, T675A-1011, -1508, -1516, -1821, T4301A-1008, T6031A-1011, T6031A-1029
4. Case-Compensated

Remote Bulb Control (Continued)

Selection Charts (Continued)

Replacement Parts

Code Number	Description
CVR28A-617R	Concealed adjustment cover
CVR28A-618R	Visible scale cover
KNB20A-602R	Replacement Knob Kit

Accessories

A packing nut is available for closed tank application.
Specify the part number **FTG13A-600R**.

Bulb wells (WEL14A Series) are available for liquid immersion applications.
Refer to the selection chart or to *Bulb Wells Catalog Page, LIT-1922135.*

Technical Specifications

Electrical Ratings

Motor Ratings VAC	120	208	240
Wide Range – Adjustable Differential			
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A [1]	22 A, 120 to 277 VAC		
Pilot Duty – 125 VA, 24 to 600 VAC			
Fixed Differential and Close Differential			
AC Full Load A	6.0	3.4	3.0
AC Locked Rotor A	36.0	20.4	18.0
Non-Inductive A	10 A, 24 to 277 VAC		
Pilot Duty – 125 VA, 24 to 277 VAC			
Case Compensated – Fixed Differential A19AAC-4			
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A [1]	22 A, 120 to 277 VAC		
Pilot Duty – 125 VA, 24 to 600 VAC			
A19AAD-12			
AC Full Load A	6.0	3.4	3.0
AC Locked Rotor A	36.0	20.4	18.0
Non-Inductive A	10 A, 24 to 277 VAC		
Pilot Duty – 125 VA, 24 to 277 VAC			
Manual Reset			
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A	16.0	9.2	8.0
Pilot Duty – 125 VA, 24 to 600 VAC			

1. SPST and N.O. contact of SPDT control.
SPDT N.C. contact- 16 amps 120 to 277 VAC

Features

The 460's universal range from 190-480VAC, 50/60 Hz provides the versatility needed to handle global applications.

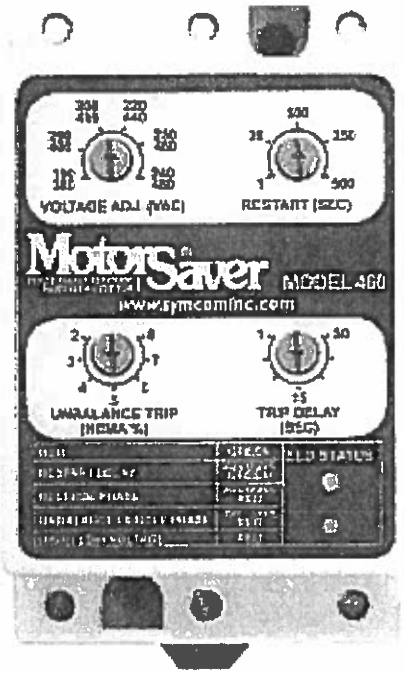
Four adjustment pots provide versatility for a variety of applications.

Diagnostic LEDs indicate trip status and provide simple troubleshooting.

Microcontroller-based circuitry provides better accuracy and higher reliability than analog designs.

Single-phase conditions are detected regardless of regenerated voltages.

Transient protection meets IEEE and IEC standards and permits operation under tough conditions.



MotorSaver
THREE-PHASE ELECTRONIC MOTOR PROTECTOR

Model 460

Three-Phase Voltage Monitor

•

Engineered Protection

•

Microcontroller Based

Protects 3-Phase Motors from:

- Loss of any phase
- Low voltage
- High voltage
- Voltage unbalance
- Phase reversal
- Rapid cycling

Additional Features:

- Compact design
- UL and cUL listed
- CE compliant
- Finger-safe terminals
- 5-year warranty
- Made in USA
- Standard surface or DIN rail mountable
- Standard 1-500 sec. variable restart delay
- Standard 2-8% variable voltage unbalance
- Standard 1-30 sec. variable trip delay
- One 10 amp general purpose Form C relay
- Optional manual reset

The **Model 460** is designed to protect 3-phase motors from damaging power conditions. The 460's wide operating range combined with UL and CE compliance enables quick access to domestic and global markets.

A unique microcontroller-based voltage and phase-sensing circuit constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level for a specified amount of time (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

The Model 460 automatically senses whether it is connected to a 190-240V, 60Hz system, a 440-480V, 60Hz system, or a 380-416V, 50Hz system. An adjustment is provided to set the nominal line voltage from 190-240 or 380-480VAC. Other adjustments include a 1-30 second trip delay, 1-500 second restart delay, and 2-8% voltage unbalance trip point.

SymCom Inc
Motor Protection & Controls Since 1974

2880 North Plaza Drive • Rapid City, SD 57702
(800) 843-8848 • (605) 348-5580 • FAX (605) 348-5685
www.symcominc.com • email: sales@symcominc.com

10/05

MotorSaver®
THREE-PHASE ELECTRIC MOTOR PROTECTOR

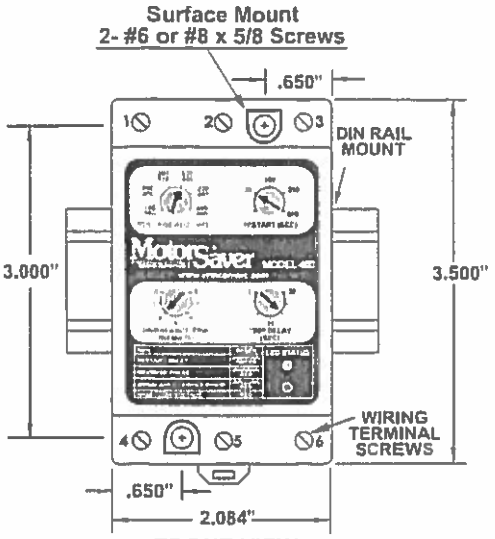
Specifications
•
Operating Points
•
Special Options

Model 460
Three-Phase Voltage Monitor

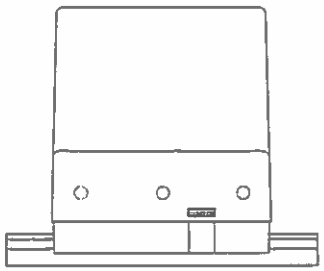
Specifications

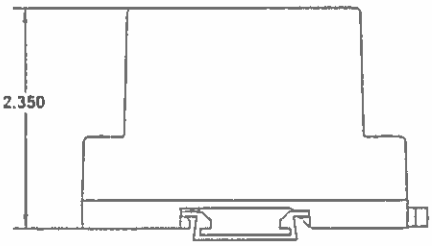
3-Phase Line Voltage	190-480VAC (475-600VAC optional) (95-120VAC optional)
Frequency	50*/60Hz
Low Voltage (% of setpoint)	
•Trip	90% ±1%
•Reset	93% ±1%
High Voltage (% of setpoint)	
•Trip	110% ±1%
•Reset	107% ±1%
Voltage Unbalance (NEMA)	
•Trip	2-8% adjustable
•Reset	Trip setting minus 1% (5 - 8%) Trip setting minus .5% (2 - 4%)
Trip Delay Time	
•Low, High and Unbalanced Voltage	1-30 seconds adjustable
•Single-Phasing Faults	1 second fixed
Restart Delay Time	
•After a Fault	1-500 seconds adjustable
•After a Complete Power Loss	1-500 seconds adjustable
Output Contact Rating	
•1-Form C	10A General Purpose @ 240VAC Pilot Duty 480VA @ 240VAC, B300
Power Consumption	6 Watts (max.)
Weight	14 oz
Enclosure	Polycarbonate
Terminal Torque	6 in.-lbs.
Wire Type	Stranded or solid 12-20 AWG, one per terminal
Safety Marks	
•UL	UL508
•CE	IEC 60947-6-2
Standards Passed	
•Electrostatic Discharge (ESD)	IEC 1000-4-2, Level 3, 6kV contact, 8kV air
•Radio Frequency Immunity, Radiated	150 MHz, 10V/m
•Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5kV input power & controls
Surge	
•IEC	IEC 1000-4-5, Level 3, 4kV line-to-line, Level 4, 4kV line-to-ground
•ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
•Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Environmental	
Temperature Range	Ambient Operating: -20° to 70° C (-4° to 158°F) Ambient Storage: -40° to 80° C (-40° to 176°F)
Class of Protection	IP20, NEMA 1 (FINGER SAFE)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Special Options	
Manual Reset	External momentary pushbutton required

*Note: 50 Hz will increase all delay timers by 20%

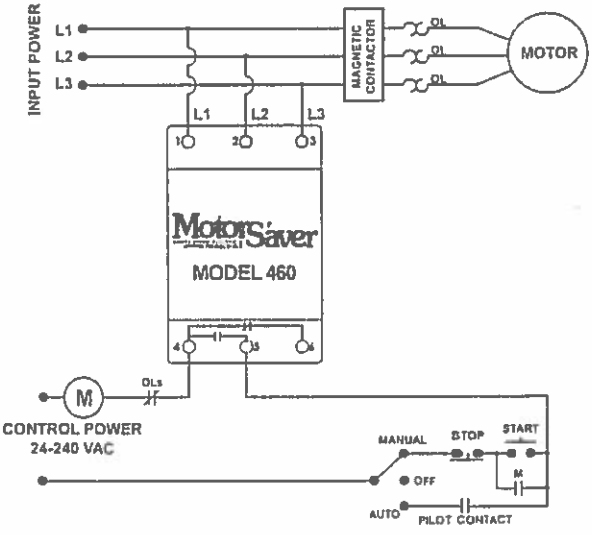


FRONT VIEW


BOTTOM VIEW



SIDE VIEW



TYPICAL WIRING DIAGRAM

SymCom Inc
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Manual Document List

PMProjNum **RTS151**

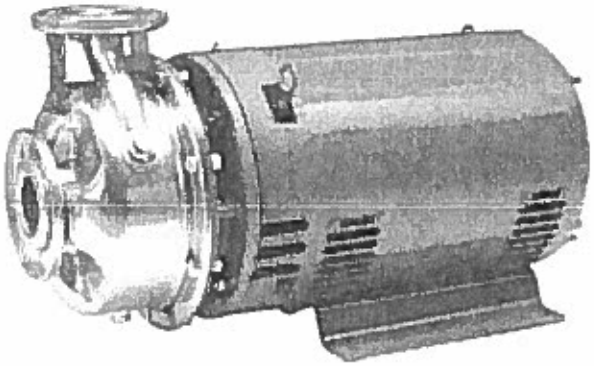
WTS, 150gpm, OWS-24, Carbon, 40' Container

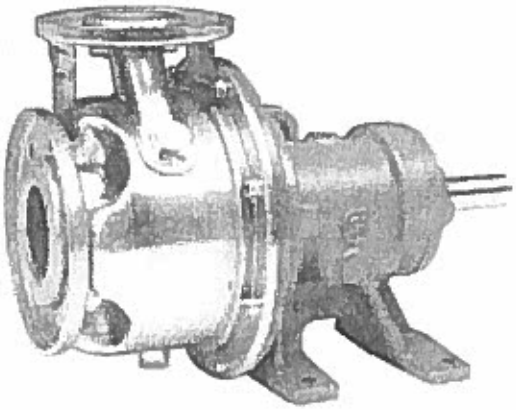
Tag	Part Number	Part Description		
Module:		*4900*		
P-4901	21028	Pump, Suction, Goulds, SSH Series, 4SH2K	Manucturer:	Goulds
			ManDoc:	#N:\Library\Goulds\Manuals\Goulds_Pu
Module:		*8200*		
8200	18396	Motor Saver, 460 w/Diagnostic 3ph	Manucturer:	Symcom
			ManDoc:	N:\Library\Symcom\Manuals\Motor Sav

G&L Pumps

Installation, Operation and Maintenance Instructions

Models SSH-C and SSH-F





Owner's Information

Please fill in data from your pump nameplate.
Warranty information is on page 28.

Pump Model: _____

Serial Number: _____

Dealer: _____

Dealer's Phone Number: _____

Date of Purchase: _____

Installation Date: _____

Table of Contents

Goulds Pumps

ITT Industries

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a SAFETY ALERT SYMBOL. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that WILL cause serious personal injury, death or major property damage.

⚠WARNING Warns of hazards that CAN cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that CAN cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠WARNING

UNIT NOT DESIGNED FOR USE WITH HAZARDOUS LIQUIDS OR FLAMMABLE GASES. THESE FLUIDS MAY BE PRESENT IN CONTAINMENT AREAS.

NOTICE: INSPECT UNIT FOR DAMAGE AND REPORT ALL DAMAGE TO THE CARRIER OR DEALER IMMEDIATELY.

1. Important Instructions

1. Inspect unit for damage. Report damage to carrier immediately.
2. Electrical supply must be a separate branch circuit with fuses or circuit breakers, wire sizes, etc., per National and Local electrical codes. Install an all-leg disconnect switch near pump.

⚠WARNING

ALWAYS DISCONNECT ELECTRICAL POWER WHEN HANDLING PUMP OR CONTROLS.

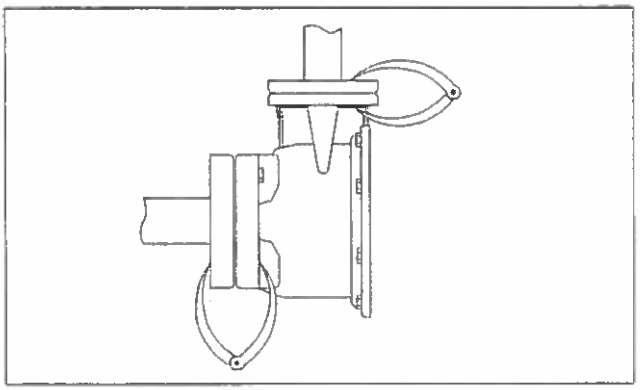
3. Motors must be wired for proper voltage (check nameplate). Wire size must limit maximum voltage drop to 10% of nameplate voltage at motor terminals, or motor life and pump performance will be lowered.
4. Single-Phase: Thermal protection for single-phase units is sometimes built-in (Check nameplate). If no built-in protection is provided, use a contactor with proper overload. Fusing is permissible if properly fused.
5. Three-Phase: Provide three-leg protection with proper size magnetic starter and thermal overloads.
6. Maximum Liquid Temperatures:
   212°F (100°C) with standard seal.
   250°F (120°C) with optional high-temperature seal.
7. Maximum allowable operating pressure: 230 PSI (15 bars).
8. Maximum number of starts per hour: 20, evenly distributed.
9. Regular Inspection and Maintenance will increase service life. Base schedule on operating time.

2. Installation

1. Close-coupled units may be installed inclined or vertical.

⚠ CAUTION DO NOT INSTALL WITH MOTOR BELOW PUMP. CONDENSATION WILL BUILD UP IN MOTOR.

2. Locate pump as near liquid source as possible (below level of liquid for automatic operation).
3. Protect from freezing or floods.
4. Allow adequate space for servicing and ventilation.
5. For close-coupled pumps, the foundation must be flat and substantial to eliminate strain when tightening bolts. Use rubber mounts to minimize noise and vibration. Tighten motor hold-down bolts before connecting piping to pump.
6. For frame-mounted pumps, permanent and solid foundation is required for smooth operation. Bedplate must be grouted to a foundation with solid footing.
7. Place unit in position on wedges located at four points (Two below approximate center of driver and two below approximate center of pump). Adjust wedges to level unit, bringing coupling halves into reasonable alignment. Level or plumb suction and discharge flanges.
8. Make sure bedplate is not distorted and final coupling alignment can be made within the limits of movement of motor and by shimming if necessary.
9. Tighten foundation bolts finger tight and build dam around foundation. Pour grout under bedplate making sure the areas under pump and motor feet are filled solid. Allow grout to harden 48 hours before further tightening foundation bolts.
10. All piping must be supported independently of the pump, and must "line-up" naturally. Never draw piping into place by forcing the pump suction and discharge connections!
11. Angular alignment of the flanges can best be accomplished using calipers at bolt locations (See illustration).



12. On frame-mounted units, tighten foundation, pump and driver hold-down bolts before connecting piping to pump.
13. Avoid unnecessary fittings. Select sizes to keep friction losses low.
14. After completing piping, rotate unit by hand to check for binding. **Note:** A screwdriver slot or flats are provided in end of motor shaft.

3. Alignment

1. No field alignment is necessary on close-coupled pumps.
2. Even though the pump-motor unit may have a factory alignment, in transit this alignment could be disturbed and must be checked prior to running.
3. Check the tightness of all hold-down bolts before checking the alignment.
4. If re-alignment is necessary, always move the motor. Shim as required.
5. Final alignment is achieved when parallel and angular requirements are achieved with both pump and motor hold down bolts tight.

⚠CAUTION ALWAYS RECHECK BOTH ALIGNMENTS AFTER MAKING ADJUSTMENTS.

6. Parallel misalignment exists when the shafts are not concentric. Place dial indicator on one hub and rotate this hub 360° while taking readings on the outside diameter of the other hub. Parallel alignment occurs when Total Indicator Reading is .005" or less.
7. Angular misalignment exists when the shafts are not parallel. Place dial indicator on one hub and rotate this hub 360° while taking readings on the face of the other hub. Angular alignment is achieved when Total Indicator Reading is .005" or less.

4. Suction Piping

1. Low static lift and short, direct suction piping is desired. For suction lift over 15 feet, consult pump performance curve for *Net Positive Suction Head Required.*
2. Suction pipe size must be at least equal to suction connection of pump.
3. If larger pipe is used, an eccentric pipe reducer (with straight side up) must be used at the pump.
4. Installation with pump below source of supply:
   4.1. Install isolation valve in piping for inspection and maintenance.
   4.2. Do not use suction isolation valve to throttle pump!
5. Installation with pump above source of supply:
   5.1. To avoid air pockets, no part of piping should be higher than pump suction connection. Slope piping upwards from liquid source.
   5.2. All joints must be airtight.
   5.3. Foot valve to be used only if necessary for priming, or to hold prime on intermittent service.
   5.4. Suction strainer open area must be at least triple the pipe area.
6. Size of inlet from liquid source, and minimum submergence over inlet, must be sufficient to prevent air entering pump.

5. Discharge Piping

1. Arrangement must include a check valve located between a gate valve and the pump. The gate valve is for regulation of capacity, or inspection of pump or check valve.
2. If reducer is required, place between check valve and pump.

6. Rotation

⚠WARNING

DO NOT PLACE HANDS IN PUMP WHILE CHECKING MOTOR ROTATION. TO DO SO WILL CAUSE SEVERE PERSONAL INJURY.

1. Pumps are right-hand rotation (Clockwise when viewed from the driver end). Switch power on and off. Observe shaft rotation. On frame-mounted units, check rotation before coupling pump to motor.
2. Single-Phase: Refer to wiring diagram on motor if rotation must be changed.
3. Three-Phase: Interchange any two power supply leads to change rotation.

7. Operation

1. Before starting, pump must be primed (free of air and suction pipe full of liquid) and discharge valve partially open.

⚠CAUTION PUMPED LIQUID PROVIDES LUBRICATION. IF PUMP IS RUN DRY, ROTATING PARTS WILL SEIZE AND MECHANICAL SEAL WILL BE DAMAGED.

2. Make complete check after unit is run under operating conditions and temperature has stabilized. Check for expansion of piping. Check coupling alignment.
3. Do not operate at or near zero flow. Energy imparted to the liquid is converted into heat. Liquid may flash to vapor. Rotating parts require liquid to prevent scoring or seizing.

8. Maintenance

⚠WARNING
Hazardous voltage

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING ANY MAINTENANCE CAN CAUSE SHOCK, BURNS OR DEATH.

1. Bearings are located in and are part of the motor. For lubrication procedure, refer to manufacturer's instructions.
2. On frame-mounted units, regrease at 2,000 hours use or after 3 months. Use #2 Sodium or Lithium grease and fill until grease comes out of the relief fitting.

9. Disassembly

1. Always turn power off.
2. Drain system. Flush if necessary.
3. Remove motor hold-down bolts on close-coupled or disconnect coupling and remove spacer.
4. Remove casing bolts and pump hold-down bolts.
5. Remove motor and rotating element from casing.
6. Unscrew impeller bolt with a socket wrench. Do not insert screwdriver between impeller vanes to prevent rotation. It may be necessary to use a strap wrench around the impeller if impacting the socket wrench will not loosen the impeller bolt.
7. Remove impeller o-ring.
8. Insert two pry bars (180° apart) between impeller and seal housing. Pry off impeller.
9. Remove shaft sleeve, seal spring, cupwasher, seal rotary and impeller key.
10. Remove seal housing.
11. Place seal housing on flat surface. Press out stationary seal parts.
12. Remove deflector from shaft on frame-mounted units.
13. Remove bolts holding bearing cover to frame and remove bearing cover (frame-mount).
14. Remove lip seals from bearing frame and bearing cover (frame-mount).
15. Remove shaft and bearings from frame (frame-mount).
16. Remove bearing retaining ring (frame-mount).
17. Use bearing puller or arbor press to remove ball bearings (frame-mount).
18. Remove wear ring if excessively worn. Use pry bar and/or vicegrips.

10. Reassembly

1. All parts should be cleaned before assembly.
2. Refer to parts list to identify required replacement items.
3. Reassembly is the reverse of the disassembly procedure.
4. Replace lip seals if worn or damaged (frame-mount only).
5. Replace ball bearings if loose, rough or noisy when rotated (frame-mount only).
6. Check shaft for maximum runout of .005" TIR. Bearing seats and lip seal areas must be smooth and free of scratches or grooves. Replace if necessary (frame-mount only).
7. All mechanical seal components must be in good condition or leakage may result. Replacement of complete seal assembly, whenever seal has been removed, is good standard practice.
8. If wear ring is being replaced, do not use lubricants on the metal-to-metal fit when pressing in the replacement.
9. If the impeller is removed, as for example to effect a mechanical seal change, this procedure must be followed: Old impeller bolt and impeller o-ring cannot be reused.
10. Install the mechanical seal stationary seat in the seal housing, using soapy water as a lubricant to ease insertion.
11. S-Group – Install the mechanical seal spring retainer, spring and rotary assembly on the shaft sleeve using soapy water to lubricate. Slide the shaft sleeve over the pump shaft, be sure that a new shaft sleeve o-ring is used.

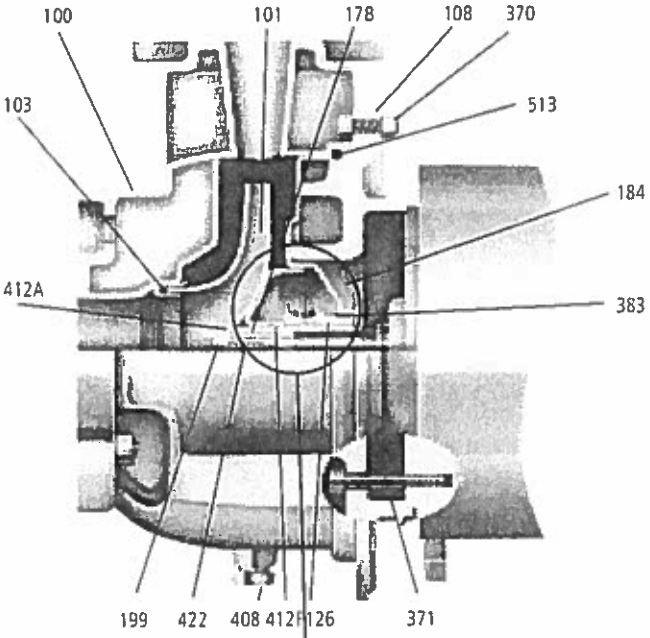
NOTE: THE SHAFT SLEEVE O-RING AND IMPELLER WASHER O-RING ARE ALMOST IDENTICAL IN DIAMETER. BE SURE TO USE THE SQUARE CROSS-SECTION O-RING IN THE IMPELLER WASHER. THE ROUND CROSS-SECTION O-RING IS USED IN THE SHAFT SLEEVE.

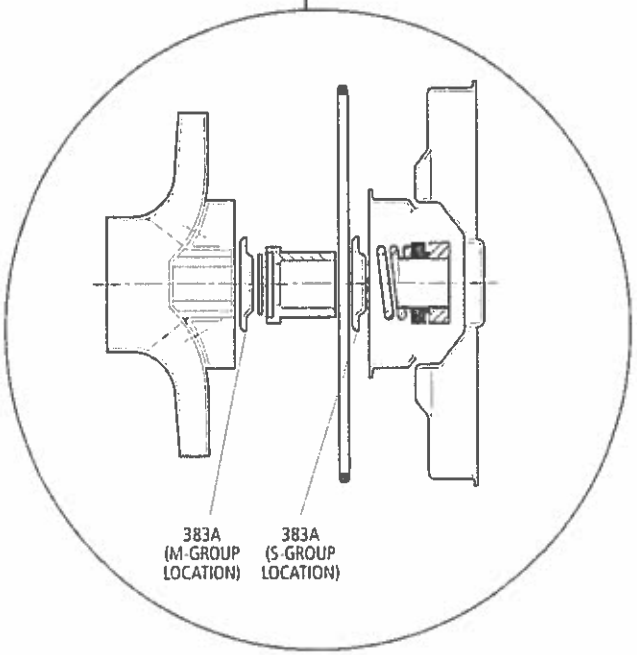
11. M-Group – Install the mechanical seal spring and rotary on the shaft sleeve using soapy water to lubricate. Slide the shaft sleeve over the pump shaft. Be sure that a new shaft sleeve o-ring is used. Place the mechanical seal spring retainer over the impeller hub.
12. Place the impeller key into the shaft keyway and slide the impeller in place. Install the impeller stud and impeller washer. Be sure that a new impeller o-ring is used. Tighten S-Group (⅜" thread) to 17 lb.ft. and M-Group (½" thread) to 38 lb.ft.

11. Troubleshooting

1. Motor does not start, and no noise or vibration occurs:
   1.1. Power supply not connected.
   1.2. Fuses or protection device tripped or defective.
   1.3. Loose or broken electrical connections.
2. Motor will not start, but generates noise and vibration:
   2.1. Motor not wired as directed on diagram.
   2.2. Shaft locked due to mechanical obstructions in motor or pump.
   2.3. Low voltage or phase loss on three phase supply.
3. Pump does not deliver rated capacity:
   3.1. Pump not filled and primed.
   3.2. Pump has lost prime due to leaks in suction line.
   3.3. Direction of rotation incorrect. See Rotation.
   3.4. Head required is higher than that originally specified. (Valve may be partially closed.)
   3.5. Foot valve clogged.
   3.6. Suction lift too high.
   3.7. Suction pipe diameter too small.
4. Protection trips as unit starts:
   4.1. Phase loss on three-phase supply.
   4.2. Protection device may be defective.
   4.3. Loose or broken electrical connections.
   4.4. Check motor resistance and insulation to ground.
5. Protection device trips too often:
   5.1. Protection may be set to a value lower than motor full load.
   5.2. Phase loss due to faulty contacts or supply cable.
   5.3. Liquid is viscous or its specific gravity is too high.
   5.4. Rubbing occurs between rotating and stationary parts.
6. Shaft spins with difficulty:
   6.1. Check for obstructions in the motor or the pump.
   6.2. Rubbing occurs between rotating and stationary parts.
   6.3. Check bearings for proper conditions.
7. Pump vibrates, runs noisily, and flow rate is uneven:
   7.1. Pump runs beyond rated capacity.
   7.2. Pump or piping not properly secured.
   7.3. Suction lift too high.
   7.4. Suction pipe diameter too small.
   7.5. Cavitation caused by insufficient liquid supply or excessive suction losses.
   7.6. Impeller blockage.
8. When stopped, unit turns slowly in the reverse direction:
   8.1. Leaks on air locks in suction pipe.
   8.2. Partial blockage in check valve.
9. In pressure boosting applications, the unit starts and stops too often:
   9.1. Pressure switch settings are incorrect.
   9.2. Tank size may be incorrect.
10. In pressure boosting applications, the unit does not stop:
    10.1. Pressure switch maximum setting is higher than was specified.
    10.2. Direction of rotation incorrect. See Rotation.

SSH-C Components





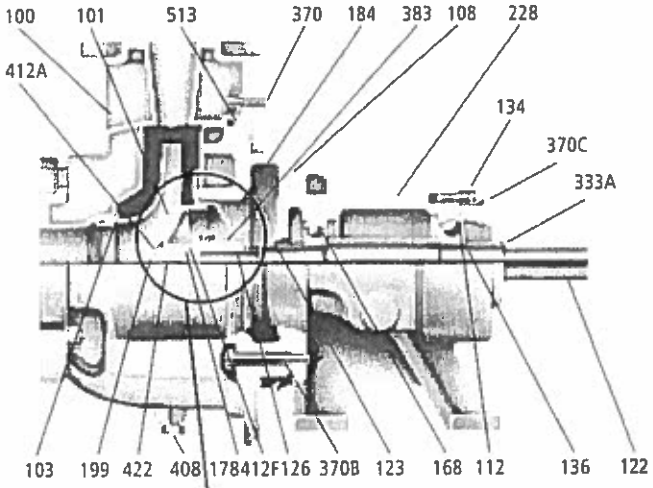
MATERIALS OF CONSTRUCTION

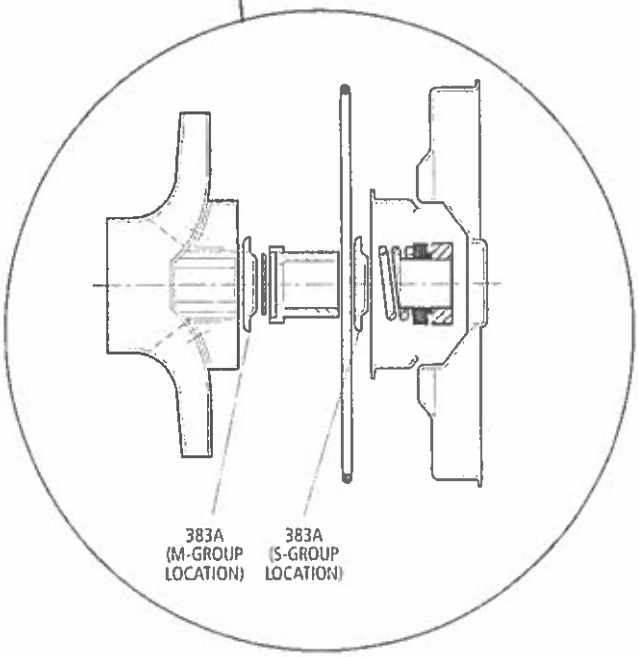
Item	Description	Material
100 101 103 184 370	Casing Impeller Wear Ring Seal Housing Socket Head Cap Screw (Casing to Adapter)	AISI TYPE 316L Stainless Steel
408	Drain Plug — ¾ NPT	AISI TYPE 316 SS
126	Shaft Sleeve	316 SS
178	Impeller Key	Steel
422	Impeller Stud	Steel
199	Impeller Washer	316 SS
108	Adapter	Cast Iron ASTM A48CL20
371	Hex Head Cap Screw (Adapter to Motor)	Steel
412A	O-ring, impeller	BUNA-N
412F	O-ring, shaft sleeve	BUNA-N
513	O-Ring	BUNA-N
383	Mechanical Seal Part No. 10K13	Carbon/Ceramic Buna Elastomers 316 SS Metal Parts
383A	Spring Retainer	AISI Type 316 SS

OPTIONAL MECHANICAL SEALS

John Crane Type 21 Mechanical Seals						
Item	Part No.	Rotary	Stationary	Elastomers	Metal Parts	Intended Duty
383 Options	10K19	Carbon	Ni-Resist	EPR	316 SS	Hi-Temperature
	10K25		Ni-Resist	Viton		Chemical
	10K27		Tungsten Carbide	EPR		Hi-Temperature Mild Abrasive

SSH-F Components





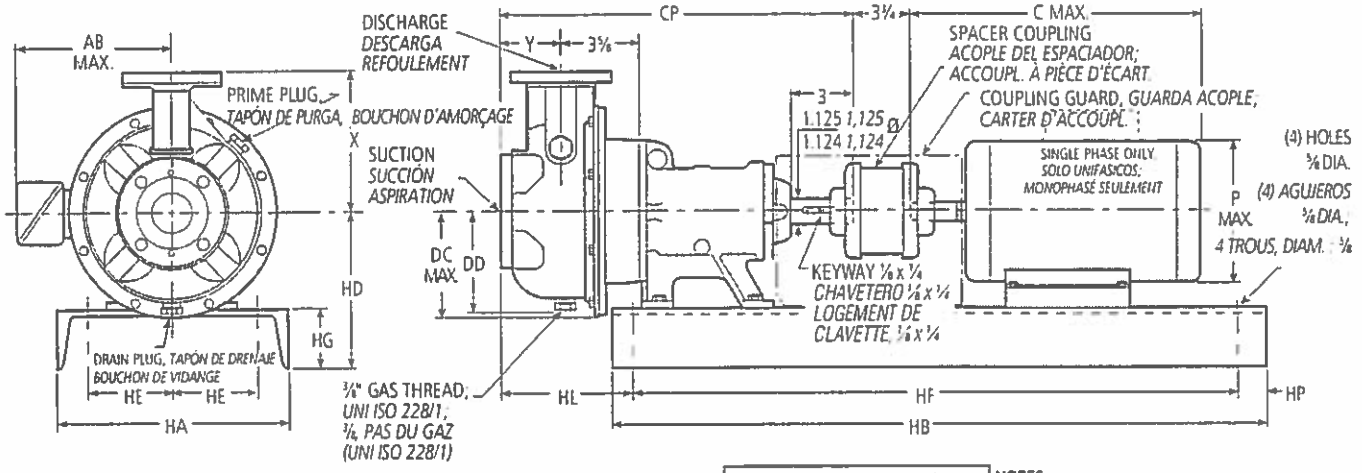
MATERIALS OF CONSTRUCTION

Item		Description	Material
Pump End Components	100 101 103 184 370	Casing Impeller Wear Ring Seal Housing Socket Head Cap Screw	AISI TYPE 316L Stainless Steel
	408	Drain plug – ¼ NPT	AISI TYPE 316 SS
	126	Shaft Sleeve	316 SS
	178	Impeller Key	Steel
	422	Impeller Stud	Steel
	199	Impeller Washer	316 SS
	412A	O-ring, impeller	BUNA-N
	412F	O-ring, shaft sleeve	BUNA-N
	513	O-Ring	BUNA-N
	383	Mechanical Seal Standard Part No. 10K13	Carbon/Ceramic BUNA-N Elastomers 316 SS Metal Parts
	383A	Spring Retainer	AISI Type 316SS
Power End Components	108 228 134	Adapter Bearing Frame Bearing Cover	Cast Iron ASTM A48 CL20
	122 168 112 136 370B 370C	Pump Shaft Ball Bearing (Inboard) Ball Bearing (Outboard) Retaining Ring Hex Head Cap Screw (Adapter to Bearing Frame) Hex Head Cap Screw (Bearing Frame to Cover)	Steel
	333A	Lip Seal	BUNA-N
	193	Grease Fitting	Steel
	123	V-Ring Deflector	BUNA-N

OPTIONAL MECHANICAL SEALS

John Crane Type 21 Mechanical Seals						
Item	Part No.	Rotary	Stationary	Elastomers	Metal Parts	Intended Duty
383 Options	10K19	Carbon	Ni-Resist	EPR	316 SS	Hi-Temperature
	10K25		Ni-Resist	Viton		Chemical
	10K27		Tungsten Carbide	EPR		Hi-Temperature Mild Abrasive

Channel Steel Bedplate, Clockwise Rotation Viewed from Drive End;
Fundación de Acero, Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor;
Plaque de base profilée en U et rotation en sens horaire (vue de l'extrémité du moteur)



Dimensions and Weights – Determined by Pump,
Dimensiones y Pesos – Determinados por la Bomba;
Dimensions et poids – pompe

Pump, *Bomba, Pompe*		Suction ① *Succión ① Aspir.*	Discharge ① *Descarga ① Refoul.*	CP	DC Max., *DC Máx. DC max.*	DD	X	Y	Wt. (lbs.), *Peso (lib.) Poids*	Dimension "HL" Determined by Pump and Bedplate, *Dimensión "HL" determinada la bomba y el motor, Dimensions HL – pompe et plaque de base* Motor Frame Size, *Tamaño del bastidor del motor, Carcasse de moteur* 143/145	183/184	213/215	254/256	284/286
9SH	1 X 2–6	2	1	16⅜	5	4¼	6⅛	3¼	56	9⅛		7⅛		3⅛
10SH	1 X 2–8				5⅛	5⅛	7⅛		64					
11SH	1 X 2–10			17¼	6⅛	6⅛	8⅛		86	10		8½		4½
4SH	1½ X 2½–6	2½	1½	16½	5	4¼	6⅛	3¼	57	9¼		7¼		4
7SH	1½ X 2½–8			17¼	5⅛	5⅛	7⅛	4	66	10		8½		4¼
5SH	2 X 2½–6		2		5	4¼			57					
8SH	2 X 2½–8				6	5¼	7¹⁵⁄₁₆		68					
6SH	2½ X 3–6	3	2½						59					

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTES:
1. All pumps shipped in vertical discharge position. May be rotated in 90° increments. Tighten ⅛ – 16 casing bolts to 12 ft./lbs. torque.
2. Dimensions in inches.
3. Motor dimensions may vary with motor manufacturer.
4. Not to be used for construction purposes.

NOTAS:
1. Todas las bombas transportadas en posición de descarga vertical. Pueden rotarse en aumentos de 90°. Apretar ⅛ – 16 tornillos de carcasa a 12 pies/libras potencia.
2. Las dimensiones en pulgadas.
3. Las dimensiones puede que varíen con los fabricantes.
4. No para propósitos de construcción.

NOTA :
1. L'orifice de refoulement est orienté vers le haut. On peut le tourner de 90° en 90°. Serrer les vis ⅛ - 16 du corps de pompe à 12 lbf pi.
2. Les dimensions sont en pouces, et le poids en livres.
3. Les dimensions et le poids du moteur peuvent varier selon le fabricant.
4. Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.

Available Motor and Bedplate Dimensions and Weights,
Pesos y Dimensiones Disponibles de la Fundación y del Motor
Dimensions et poids – moteur et plaque de base

Motor Frame, *Armazón del Motor, Carcasse de moteur*	HP @ 3500 RPM, *HP a 3500 RPM, hp à 3 500 trimin*				HP @ 1750 RPM, *HP a 1750 RPM, hp à 1 750 trimin*				AB Max., *AB Máx., AB max.*	C Max., *C Máx., C max.*	P Max., *P Máx., P max.*	Wt. Max., *Peso Máx., Poids max.*	Bedplate Data, *Datos de la Fundación, Plaque de base*								
	Single Phase, *Monofásicos, 1 Ø*		Three Phase, *Trifásicas, 3 Ø*		Single Phase, *Monofásicos, 1 Ø*		Three Phase, *Trifásicas, 3 Ø*						HA	HB	HD*	HE	HF	HG	HP*	Wt. (lbs.), *Peso (libras), Poids*	Motor Shim, *Plancha de relleno del motor Cale de moteur*	Bearing Frame Shim *Plancha de relleno del bastidor del cojinete, Cale de palier*
	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC														
143T					1	1	1	1	5¼	13⅜	6⅛	45	10	28	8	3¾	24	2¾	¼	48	1¼	–
145T	2	2	2 or ou 3	2	1½	1½	1½ or ou 2	1½ or ou 2		14½		53										
182T	3	3	5	3	2	2	3	3	5⅛	16⅛	7⅛	74										
184T	5	5	7½	5	3 or ou 5	3	5	3		18⅛		95										
213T			10	7½					7⅛	18	9⅛	116	12	31	8¼	4¼	29	3	1	65	–	–
215T			15	10						19¼		136										
254T			20	15					10⅛	21⅜	13	266	13	42	9¼	5¼	38½	4	1¼	110	–	1
256T			25	20						23¾		264										
284TS			30	25					12⅝	24¼	15	392	15	44	10½	5¾	40½	3½		124	–	1¾
286TS			40	30						26¼		432										

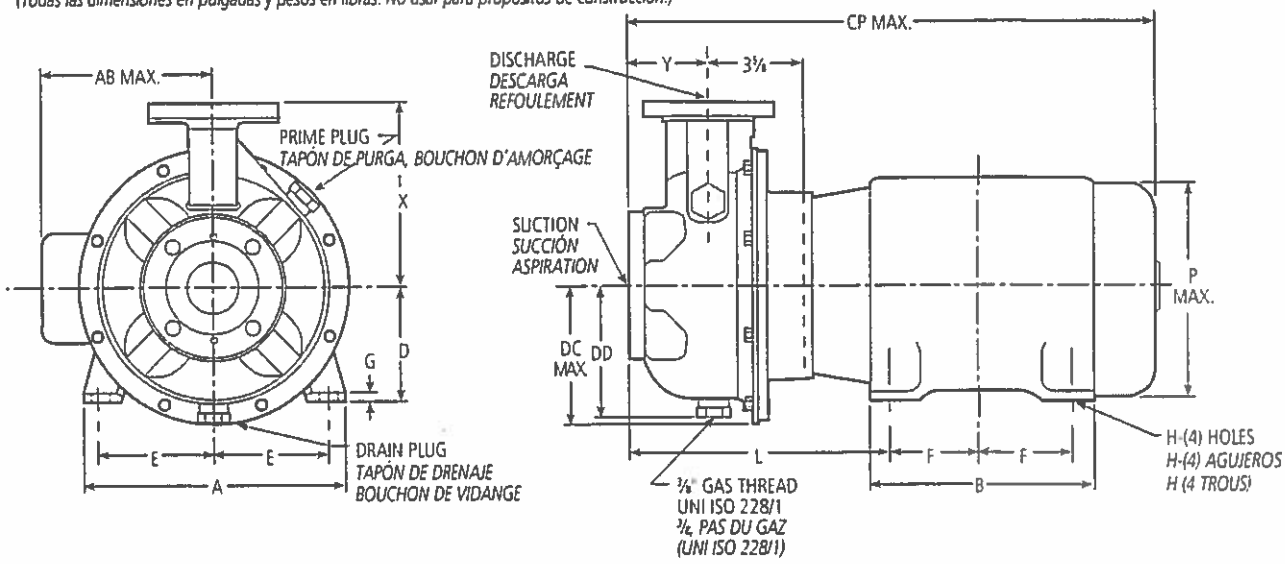
Dimensions and weights vary with manufacturers. Dimensions in inches and weights in lbs.
"HP" Dimensions at motor end only.
* "HD" Dimension for 254T/256T motor frame on 1 x 2-10 only is 11", A ¾" motor shim and a 1¼" bearing frame shim are required.

Dimensiones y pesos varían con los fabricantes. Dimensiones en pulgadas y pesos en libras.
Dimensiones "HP" sólo en el extremo del motor.
** La dimensión "HD" para el bastidor del motor 254T/256T de 1 x 2 - 10 es sólo 11", se requieren una cuña del motor de ¾" y una cuña del bastidor de apoyo de 1¼".*

ODP = carcasse abritée (à ouvertures de ventilation protégées) , TEFC = carcasse fermée autoventilée.
**Dimensions HP à l'extrémité du moteur seulement. La dimension HD pour la carcasse 254T ou 256T, version 1X2-10 seulement, est de 11 po ; une cale de moteur de ¾ po et une cale de palier de 1¼ po sont requises.*

SSH S-Group Close Coupled – Dimensions and Weights, *SSH Acople Cerrado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur moteur, groupe S*

(All dimensions in inches and weights in lbs. Do not use for construction purposes.)
(Todas las dimensiones en pulgadas y pesos en libras. No usar para propósitos de construcción.)



Dimensions "L" Determined by Pump and Motor, *Dimensiones "L" Determinadas por la Bomba y el Motor, Dimensions L – pompe et moteur*													
Pump, *Bomba, Pompe*		150 lb. Flange, *Brida de 150 lib., Bride, 150 lbfpo²*		CP Max., *CP Máx., CP max.*	DC Max., *DC Máx., DC max.*	DD	X	Y	Motor Frame Size, *Tamaño del Armazón del Motor, Carcasse de moteur*				Wt. (lbs.), *Pesos (libras), Poids*
		Suct. ① *Succ. ① Aspir.*	Disch. ① *Desc. ① Refoul.*						143/145	182/184	213/215	254/256	
9SH	1 x 2 – 6	2	1	25¾	5	4¼	6⅜	3⅛	9⅛	10¼	11¼	—	24
10SH	1 x 2 – 8				5⅜	5⅛	7⅛						32
11SH	1 x 2 – 10			27⅛	6¼	6⅜	8⅛	4	10½	11⅛	12⅛	12⅜	54
4SH	1½ x 2½ – 6	2½	1½	25½	5	4¾	6⅛	3¼	9¼	10⅜	11⅜	—	25
7SH	1½ x 2½ – 8			27⅞	5⅜	5⅛	7⅛	4	10½	11⅛	12⅛	12¾	34
5SH	2 x 2½ – 6		2		5	4¼	6⅛						25
8SH	2 x 2½ – 8				6	4¾	7 15/16						36
6SH	2½ x 3 – 6	3	2½										27

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTE:
1. Pumps shipped in vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ¾ – 16 bolts to 12 ft./lbs., ⅞ – 14 bolts to 20 ft./lbs.
2. ALL dimensions in inches.
3. Motor dimensions may vary with motor manufacturer.
4. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán en descarga vertical como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posicion deseada, y apretar ¾ – 16 tornillos a 12 pies/libras, ⅞ – 14 tornillos a 20 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *Las dimensiones puede que varíen con los fabricantes.*
4. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ¾ - 16 à 12 lbf pi et ⅞ - 14 à 20 lbf pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Dimensions Determined by JM Motor Frame, *Dimensiones Determinadas por el Armazón del Motor JM, Dimensions – carcasse de moteur JM*

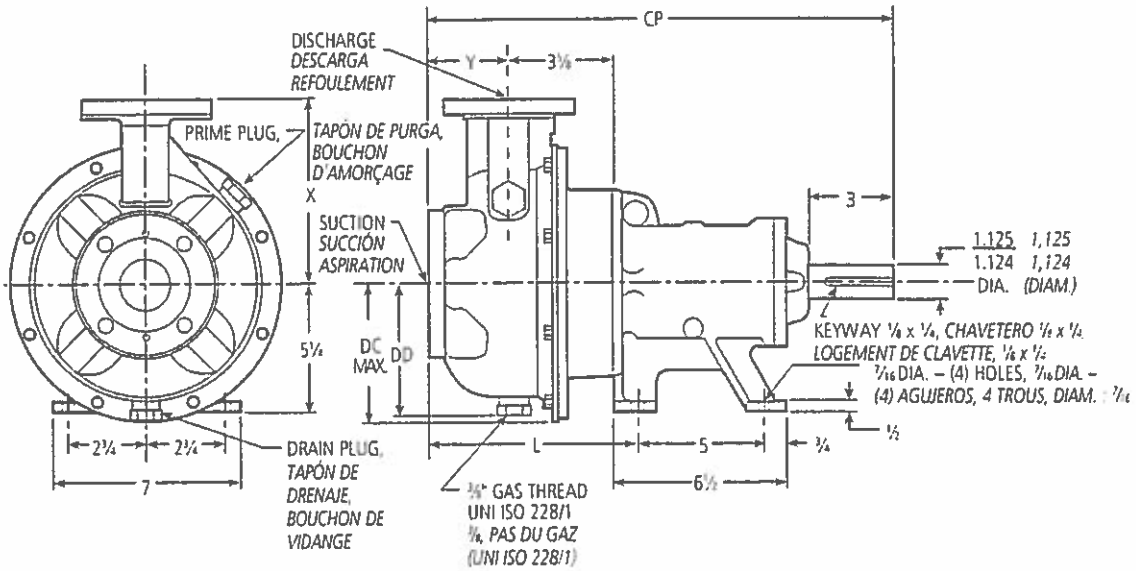
JM Frame, *JM Armazón, Carcasse*	A	AB	B	D	E	F	G	H Dia., *H Diám., H (diam.)*	P Max., *P Máx., P max.*	Motor Wt. (lbs.) *Peso Motor (lib.), Poids du moteur*
143JM	6½	5¼	6	3½	2¾	2	⅛	11/32	6⅝	41
145JM						2½				57
182JM	8½	5⅛	6½	4½	3¾	2¼	3/16	13/32	7⅛	77
184JM						2¼				97
213JM	9½	7⅛	8	5¼	4¼	2¼	7/32		9⅝	122
215JM						3½				155
254TCZ	11¼	9	9½	6¼	5	4⅛	¼	17/32	11½	265
256TCZ			11¼			5				320

Motor Frame Selections, *Selecciones del Armazón del Motor, Choix de carcasses de moteur*

Motor Frame, *Armazón del Motor, Carcasse*	Motor Horsepower, *Potencia del Motor, Puissance (hp)*							
	3500 RPM, *3500 RPM, 3 500 trimin*				1750 RPM, *1750 RPM, 1750 trimin*			
	1Ø, *Monofásicos 1 Ø*		3Ø, *Trifásicos 3 Ø*		1Ø, *Monofásicos 1 Ø*		3Ø, *Trifásicos 3 Ø*	
	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC
143JM	–	–	–	–	–	–	1	1
145JM	2	2	2-3	2	1-1½	1-1½	1½-2	1½-2
182JM	3	3	5	3	2	2-3	3	3
184JM	5	5	7½	5	3	–	5	5
213JM	7½	–	10	7½	5	–	7½	7½
215JM	10	–	15	10-15	–	–	–	–
254TCZ	–	–	20	–	–	–	–	–
256TCZ	–	–	25	20-25	–	–	–	–

ODP = carcasse abritée (à ouvertures de ventilation protégées),
TEFC = carcasse fermée autoventilée.

SSH S-Group Frame-Mounted – Dimensions and Weights, *SSH Armazón Montado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur palier, groupe S*



Dimensions and Weights – Bare Pump Only,
Dimensiones y Pesos – Solamente Bomba,
Dimensions et poids – pompe nue seulement

Pump, *Bomba, Pompe*		150 lb. Flange, *Brida de 150 lib., Bride, 150 lb/po²*		DC Max., *DC Máx., DC max.*	DD	CP Max., *CP Máx., CP max.*	L	X	Y	Wt. (lbs.), *Peso (libras), Poids*
		Suction ① *Succión ① Aspir.*	Discharge *Descarga ① Refoul.*							
9SH	1 x 2 – 6	2	1	5	4¾	16¾	7¾	6⅛	3¼	56
10SH	1 x 2 – 8			5⅛	5⅛			7⅛		64
11SH	1 x 2 – 10			6⅛	6⅛	17¼	8½	8⅛	4	86
4SH	1½ x 2½ – 6	2½	1½	5	4¾	16½	7¾	6⅛	3¼	56
7SH	1½ x 2½ – 8			5⅛	5⅛	16½	8½	7⅛	4	64
5SH	2 x 2½ – 6		2	5	4¾					57
8SH	2 x 2½ – 8			6	5¼			6⅛		66
6SH	2½ x 3 – 6	3	2½							57

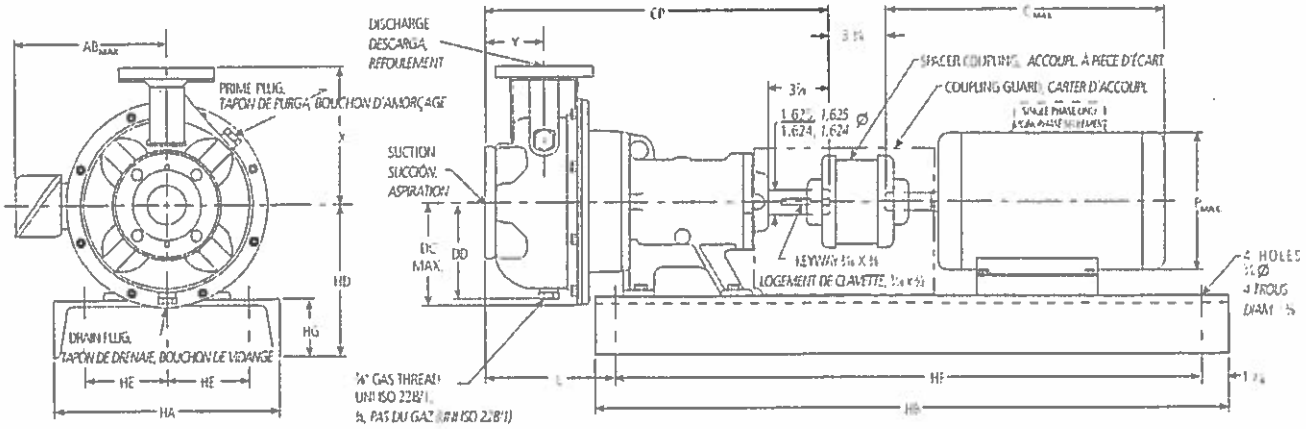
① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTE:
1. Pumps will be shipped with top vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ⅜ –16 bolts to 12 ft./lbs., 7/16 – 14 bolts to 20 ft./lbs.
2. ALL dimensions in inches.
3. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras, 7/16 – 14 tornillos a 20 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ – 16 à 12 lbf·pi et 7/16 – 14 à 20 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Channel Steel Bedplate, Clockwise Rotation Viewed from Drive End;
Fundación de Acero, Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor;
Plaque de base profilée en U et rotation en sens horaire (vue de l'extrémité du moteur)



Dimensions and Weights – Determined by Pump,
Dimensiones y Pesos – Determinados por la Bomba,
Dimensions et poids – pompe

Pump, *Bomba, Pompe*	Pump Size, *Tamaño de la Bomba, Dimensions*	① Suction *Succión Aspir.*	① Discharge *Descarga Refoul.*	CP	DC Max., *DC Máx., DC max.*	DD	L	X	Y	Wt. (lbs.), *Peso (libras), Poids*
24SH	1½ x 2 ½-10	2½	1½	23	6⅞	6⅛	10⅛	8¹⁵⁄₁₆	4	125
25SH	2 x 2½-10		2							125
22SH	2½ x 3-8	3	2½		6⅛	5⅞				125
27SH	2½ x 3-10				6⅞	6⅛		9¹⁵⁄₁₆		134
23SH	3 x 4-8	4	3	24			11⅛		5	136
28SH	3 x 4-10				7⅝	7⅛		11⅛		148

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTE:
1. Pumps will be shipped with top vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position and tighten ⅜ – 16 bolts to 12 ft./lbs.
2. ALL dimensions in inches.
3. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ - 16 à 12 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Available Motor and Bedplate Dimensions and Weights,
Pesos y Dimensiones Disponibles de la Fundación y del Motor,
Dimensions et poids – moteur et plaque de base

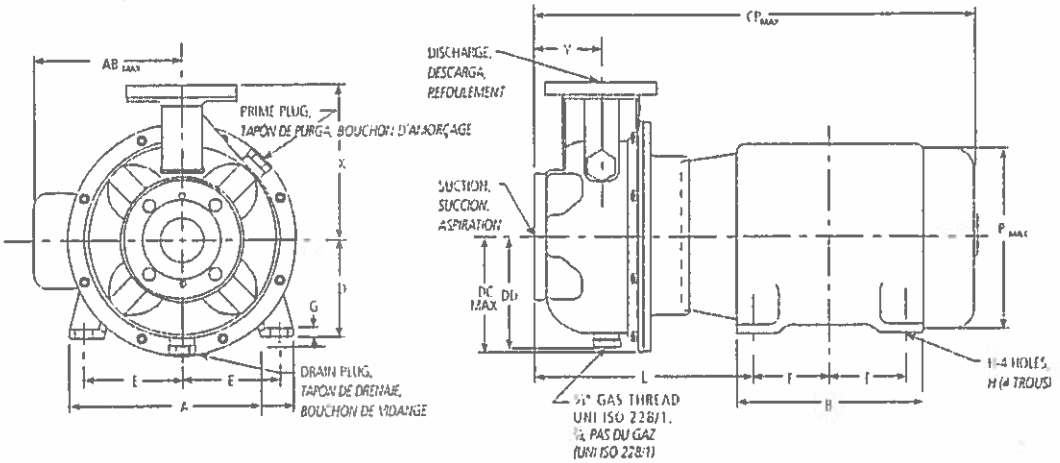
Motor Frame, *Armazón del Motor, Carcasse de moteur*	HP @ 3500 RPM, *hp à 3 500 tr/min*		HP @ 1750 RPM – T-Frame Only *hp à 1 750 tr/min – carc. T seulem.*				AB Max., *AB Máx., AB max.*	C Max., *C Máx., C max.*	P Max., *P Máx., P max.*	Wt. Max., *Peso Máx., Poids max.*	Bedplate Data, *Datos de la Fundación, Plaque de base*						
	Three Phase, *Trifásicos, 3 Ø*		Single Phase, *Monofásicos, 1 Ø*		Three Phase, *Trifásicos, 3 Ø*						HA	HB	HD	HE	HF	HG	Wt. (lbs.), *Peso (libras), Poids*
	ODP	TEFC	ODP	TEFC	ODP	TEFC											
184T			3 or ou 5	3	5	5	5⅞	18⅛	7⅛	95	13	42	10¼	5¼	38½	4	111
213T					7½	7½	7⅜	18	9⅝	116							
215T	15				10	10		19⅛		136							
254T	20	15			15	15	9½	21⅝	13	266							
256T	25	20			20	20		23⅜		264							
284TS/T	30	25			25	25	12⅝	24⅞	15	392	15	44	10½	5¾	40½	3½	124
286TS/T	40	30						26⅝		422							
324TS/T	50	40					14⅛	28¾	17⅜	592	18	48	12	7¼	44½	4	183
326TS/T	60	50						30¼		634							
364TS/T	75	60					15⅞	31⅝	18⅞	834			13				
365TS/T	100	75						32⅝		1000							
405TS/T		100					18	36¼	20½	1060	22	56	14	7¼	52½	4	214

Dimensions and weights vary with manufacturers. Dimensions in inches and weights in lbs
Dimensiones y pesos varían con los fabricantes. Dimensiones en pulgadas y pesos en libras.

ODP = carcasse abritée (à ouvertures de ventilation protégées) ; TEFC = carcasse fermée autoventilée.

SSH M-Group Close Coupled – Dimensions and Weights, *SSH Acople Cerrado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur moteur, groupe M*

(All dimensions in inches and weights in lbs. Do not use for construction purposes.)
(Todas las dimensiones en pulgadas y pesos en libras. No usar para propósitos de construcción.)



Dimensions "L" Determined by Pump and Motor, *Dimensiones "L" Determinadas por la Bomba y el Motor, Dimensions L – pompe et moteur*																
Pump, *Bomba, Pompe*	Pump Size, *Tamaño de la Bomba, Dimensions*	① Suction *Succión Aspir.*	① Discharge *Descarga Refoul.*	CP Max., *CP Máx., CP max.*	DC Max., *DC Máx., DC max.*	DD	X	Y	Wt. (lbs.), *Peso (libras), Poids*	Motor Frame Size, *Tamaño del Armazón del Motor, Carcasse de moteur*						
										140	180	210	250	280	320	360
24SH	1½ x 2 ½-10	2½	1½	34½	6⅞	6⅝	8 15/16	4	75	10½	11⅛	12⅛	13⅜		14⅜	-
25SH	2 x 2½-10		2	36					75							15
22SH	2½ x 3-8	3	2½		6⅛	5⅞			72	-						
27SH	2½ x 3-10				6⅞	6⅝	9 15/16		84	-	-					
23SH	3 x 4-8	4	3	37				5	86	11½	12⅛	13⅜	14⅞		15⅜	16
28SH	3 x 4-10				7⅛	7⅜	11⅛		98	-	-					

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTES:
1. Pumps shipped in vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ⅜ – 16 bolts to 12 ft./lbs., ⅞ – 14 bolts to 20 ft./lbs., ½ – 13 bolts to 35 ft./lbs.
2. Motor dimensions may vary with motor manufacturer.
3. Not for construction purposes.

NOTAS:
1. *Las bombas se transportarán en descarga vertical como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras, ⅞ – 14 tornillos a 20 pies/libras, ½ – 13 tornillos a 35 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ - 16 à 12 lbf·pi, ⅞ - 14 à 20 lbf·pi et ½ - 13 à 35 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Dimensions Determined by JM Motor Frame, *Dimensiones Determinadas por el Armazón del Motor JM, Dimensions – carcasse de moteur JM*

Frame, *Armazón, Carcasse*	A	AB Max., *AB max.*	B	D	E	F	G	H	P Max., *P Máx., P max.*
145JM	6½	5¼	6	3½	2¼	2½	⅛	11/32	7 5/16
182JM	8½	5⅞	6½	4½	3¾	2¼	3/16	13/32	8½
184JM						2¾			
213JM	9½	7⅜	8	5¼	4¼	3½	7/32		10 3/16
215JM									
254JM	11¼	9	11¾	6¼	5	4⅛	¼	17/32	13¼
256JM						5			
284JM	12¼	12¼	12¼	7	5½	4¾			15
286JM						5½			
324JM	14	13¼	14	8	6¼	5½	5/16	21/32	16 5/16
326JM						5½			
364TCZ	17¾	15½	15½	9	7	5⅝	1		19
365TCZ						6⅛			

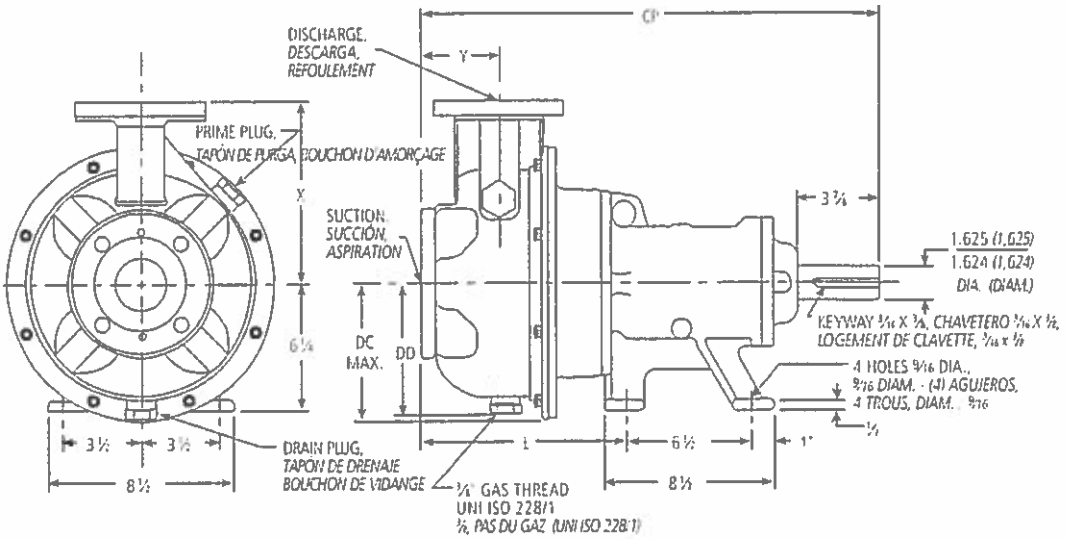
364TCZ and 365TCZ frames are built with 326JM shaft extensions.
Dimensions may vary with manufacturer.;
Los armazones 364TCZ y 365TCZ se construyen con extensiones del eje 326JM.
Las dimensiones puede que varíen con los fabricantes.;
Les carcasses 364TCZ et 365TCZ possèdent la rallonge d'arbre de la 326JM.

Motor Frame Selections, *Selecciones del Armazón del Motor, Choix de carcasses de moteur*

Frame, *Armazón, Carcasse*	Motor Horsepower, *Potencia del Motor, Puissance (hp)*						Wt. Max., *Peso Máx., Poids max.*
	3500 RPM, *3500 r/min*		1750 RPM, *1750 r/min*				
	3 PH, *Trifásicos, 3 Ø*		1 PH, *Monofásicos, 1 Ø*		3 PH, *Trifásicos, 3Ø*		
	ODP	TEFC	ODP	TEFC	ODP	TEFC	
145JM	–	–	–	–	2	2	57
182JM	–	–	2	2, 3	3	3	77
184JM	–	–	3	–	5	5	97
213JM	10	–	5	–	7½	7½	141
215JM	15	10	–	–	10	10	155
254JM	20	15	–	–	15	15	265
256JM	25	20	–	–	20	20	320
284JM	30	25	–	–	25	25	419
286JM	40	30	–	–	–	–	422
324JM	50	40	–	–	–	–	562
326JM	60	50	–	–	–	–	625
364TCZ	75	60	–	–	–	–	775
365TCZ	100	75, 100	–	–	–	–	905

364TCZ and 365TCZ frames are built with 326JM shaft extensions.
Los armazones 364TCZ y 365TCZ se construyen con extensiones del eje 326JM.
ODP = carcasse abritée (à ouvertures de ventilation protégées) ; TEFC = carcasse fermée autoventilée. Les carcasses 364TCZ et 365TCZ possèdent la rallonge d'arbre de la 326JM.

SSH M-Group Frame Mounted – Dimensions and Weights, *SSH Armazón Montado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur palier, groupe M*



Dimensions and Weights – Bare Pump Only,
Dimensiones y Pesos – Solamente Bomba
Dimensions et poids – pompe nue seulement

Pump, *Bomba, Pompe*	Pump Size, *Tamaño de la Bomba, Dimensions*	① Suction *Succión Aspir.*	① Discharge *Descarga Refoul.*	CP	DC Max., *DC Máx., DC max.*	DD	L	X	Y	Wt. (lbs.), *Peso (libras), Poids*
24SH	1½ x 2 ½-10	2½	1½	23	6⅞	6⅝	10½	8 15/16	4	125
25SH	2 x 2½-10		2							125
22SH	2½ x 3-8	3	2½		6⅛	5⅞				125
27SH	2½ x 3-10									134
23SH	3 x 4-8	4	3	24	6⅜	6½	11½	9 15/16	5	136
28SH	3 x 4-10				7⅛	7⅜		11⅛		148

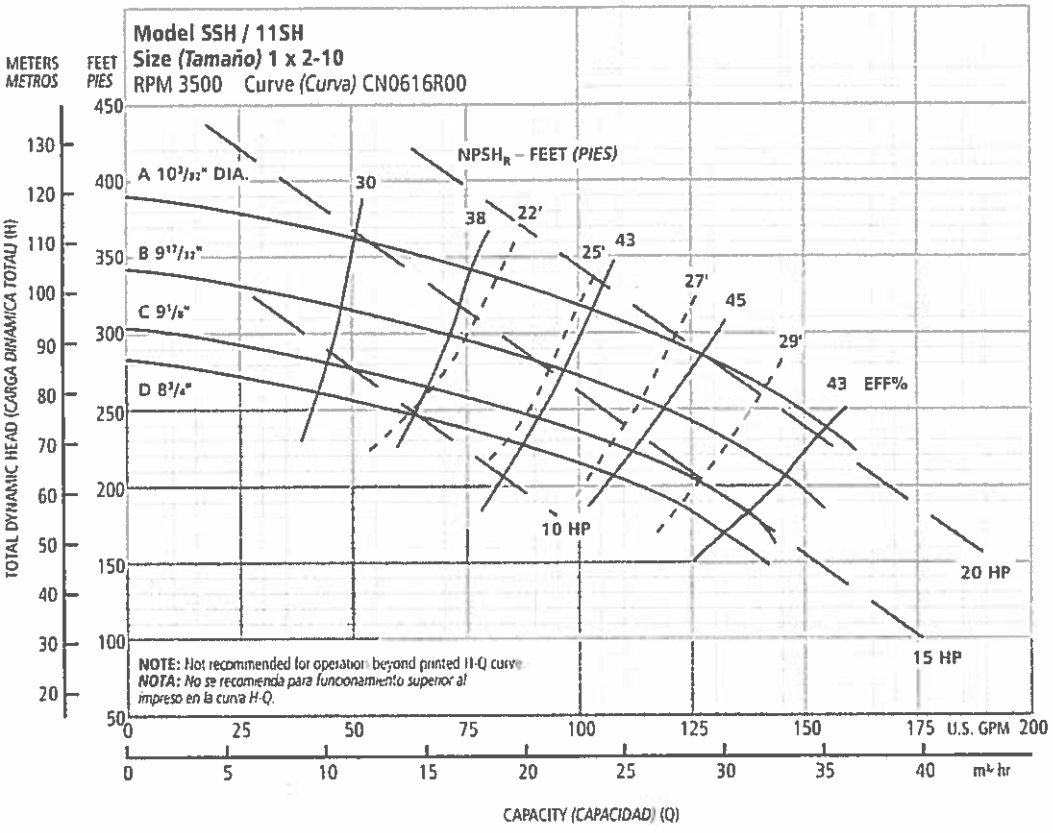
① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTES:
1. Pumps will be shipped with top vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, replace and tighten ⅜–16 bolts to 12 ft./lbs.
2. Motor dimensions may vary with motor manufacturer.
3. Not for construction purposes.

NOTAS:
1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ – 16 à 12 lbf pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

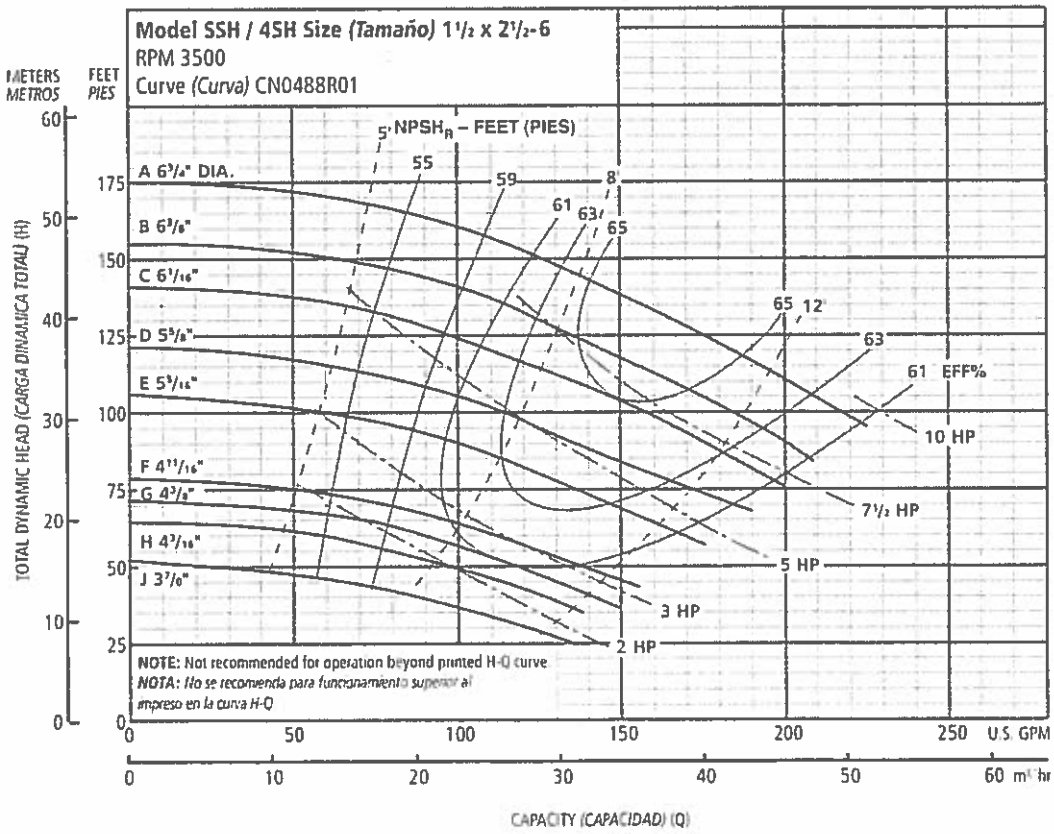
Performance Curves – 60 Hz, 3500 RPM
Curvas de Funcionamiento – 60 Hz, 3500 RPM



Optional Impeller, *Impulsor Opcional*		
Impeller Code, *Código del Impulsor*	Dia., *Diá.*	Standard HP Rating, *Estándar HP Potencia*
A	10 3/32"	20
B	9 17/32	15
C	9 1/8	15
D	8 3/4	15

NOTE: Pump will pass a sphere to 1/4" diameter.

NOTA: La bomba pasará una esfera a 1/4" diámetro.



Optional Impeller, *Impulsor Opcional*		
Impeller Code, *Código del Impulsor*	Dia., *Diá.*	Standard HP Rating, *Estándar HP Potencia*
A	6 3/4"	10
B	6 3/8	7 1/2
C	6 1/16	7 1/2
D	5 5/8	5
E	5 5/16	5
F	4 11/16	3
G	4 3/8	3
H	4 3/16	2
J	3 7/8	2

NOTE: Pump will pass a sphere to 3/16" diameter.

NOTA: La bomba pasará una esfera a 3/16" diámetro.

GOULDS PUMPS

Wastewater Pumps
Dewatering, Effluent and Sewage
Installation and Operation Manual

Owner's Information

Pump Model Number: _____

Pump Serial Number: _____

Control Model Number: _____

Dealer: _____

Dealer Phone No. _____

Date of Purchase: _____ Installation: _____

Current Readings at Startup:

1Ø	3Ø	L1-2	L2-3	L3-1
Amps: _____	Amps: _____	_____	_____	_____
Volts: _____	Volts: _____	_____	_____	_____

Table of Contents

Goulds Pumps

ITT Industries

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a SAFETY ALERT SYMBOL. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that WILL cause serious personal injury, death or major property damage.

⚠ WARNING Warns of hazards that CAN cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that CAN cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠ WARNING All electrical work must be performed by a qualified technician. Always follow the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes. Code questions should be directed to your local electrical inspector. Failure to follow electrical codes and OSHA safety standards may result in personal injury or equipment damage. Failure to follow manufacturer's installation instructions may result in electrical shock, fire hazard, personal injury or death, damaged equipment, provide unsatisfactory performance, and may void manufacturer's warranty.

⚠ WARNING Standard units are not designed for use in swimming pools, open bodies of water, hazardous liquids, or where flammable gases exist. These fluids and gases may be present in containment areas. Tank or wetwell must be vented per local codes.

Only pumps specifically Listed for Class 1, Division 1 are allowable in hazardous liquids and where flammable gases may exist. *See specific pump catalog bulletins or pump nameplate for all agency Listings.*

⚠ WARNING Disconnect and lockout electrical power before installing or servicing any electrical equipment. Many pumps are equipped with automatic thermal overload protection which may allow an overheated pump to restart unexpectedly.

⚠ CAUTION All three phase (3Ø) control panels for submersible pumps must provide Class 10, quick-trip, overload protection.

PRE-INSTALLATION CHECKS

Open all cartons and inspect for shipping damage. Report any damage to your supplier or shipping carrier immediately.

Important: Always verify that the pump nameplate Amps, Voltage, Phase, and HP ratings match your control panel and power supply.

Many of our sewage pumps are oil-filled. If there are any signs of oil leakage or if the unit has been stored for an extended period check the oil level in the motor dome and the seal housing, if so equipped.

Check the motor cover oil level through the pipe plug on top of the unit. The motor chamber oil should just cover the motor. Do not overfill, leave room for expansion!

To check the seal housing oil level, where used, lay the unit on its side with the fill plug at 12 o'clock. Remove the plug. The oil should be within ½" (13mm) of the top. If low, refill with an ASTM 150 turbine oil. Replace the plug.

Oil is available in 5 gallon cans through our distributors. You can also source oil locally at motor repair shops. Typical oil brands are: Shell Turbo 32, Sunoco Sunvis 932, Texaco Regal R&O 32, Exxon Nuto 32 and Mobil DTE Light.

Check the strain relief nut on power cable strain assemblies. Power cables should be torqued to 75 in. lbs. for #16 cables and 80 in. lbs. for all other cable assemblies. Seal/heat sensor cables, where used, should be torqued to 75 in. lbs.

Warranty does not cover damage caused by connecting pumps and controls to an incorrect power source (voltage/phase supply).

Record the model numbers and serial numbers from the pumps and control panel on the front of this instruction manual for future reference. Give it to the owner or affix it to the control panel when finished with the installation.

LIFTING OF PUMP

⚠ WARNING

DO NOT LIFT, CARRY OR HANG PUMP BY THE ELECTRICAL CABLES. DAMAGE TO THE ELECTRICAL CABLES CAN CAUSE SHOCK, BURNS OR DEATH.

Lift the pump with an adequately sized chain or cable attached to the lifting eye bolt. DO NOT damage electrical and sensor cables while raising and lowering unit.

OPTIONAL GUIDE RAIL OR LIFT-OUT SYSTEM

In many effluent and sewage basins or lift stations it is advisable to install the pump on a guide rail system or on a lift-out adapter to facilitate installation and removal for inspection and/or service. Most codes do not allow personnel to enter a wetwell without the correct protective equipment and training. Guide rails are designed to allow easy removal of the pump without the need for entry into the wetwell or need to disturb piping. The guide rail or lift-out adapter should locate the pump opposite the influent

opening preventing stagnate areas where solids can settle. The basin or pit must be capable of supporting the weight of the pump and guide rail. The pit floor must be flat.

NOTICE: FOLLOW THE INSTRUCTIONS THAT ARE PROVIDED WITH THE GUIDE RAIL ASSEMBLY.

PIPING

Discharge piping should be no smaller than the pump discharge diameter and kept as short as possible, avoiding unnecessary fittings to minimize friction losses.

Install an adequately sized check valve matched to the solids handling capability of the pump to prevent fluid backflow. Backflow can allow the pump to "turbine" backwards and may cause premature seal and/or bearing wear. If the pump is turning backwards when it is called on to start the increased torque may cause damage to the pump motor and/or motor shaft and some single-phase pumps may actually run backwards.

Install an adequately sized gate valve AFTER the check valve for pump, plumbing and check valve maintenance.

Important – Before pump installation. Drill a 3/16" (4.8mm) relief hole in the discharge pipe. It should be located within the wetwell, 2" (51mm) above the pump discharge but below the check valve. The relief hole allows any air to escape from the casing. Allowing liquid into the casing will insure that the pump can start when the liquid level rises. Unless a relief hole is provided, a bottom intake pump could "air lock" and will not pump water even though the impeller turns.

All piping must be adequately supported, so as not to impart any piping strain or loads on the pump.

The pit access cover must be of sufficient size to allow for inspection, maintenance and crane or hoist service.

WIRING AND GROUNDING

Important notice: Read Safety Instructions before proceeding with any wiring.

⚠ Use only stranded copper wire to pump/motor and ground. The ground wire must be at least as large as the power supply wires. Wires should be color coded for ease of maintenance and troubleshooting.

⚠ Install wire and ground according to the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes.

⚠ Install an all leg disconnect switch where required by code.

⚠ Disconnect and lockout electrical power before performing any service or installation.

⚠ The electrical supply voltage and phase must match all equipment requirements. Incorrect voltage or phase can cause fire, motor and control damage, and voids the warranty.

⚠ All splices must be waterproof. If using splice kits follow manufacturer's instructions.

⚠ WARNING Select the correct type and NEMA grade junction box for the application and location. The junction box must insure dry, safe wiring connections.

⚠ WARNING Seal all controls from gases present which may damage electrical components.

⚠ WARNING Hazardous voltage

FAILURE TO PERMANENTLY GROUND THE PUMP, MOTOR AND CONTROLS BEFORE CONNECTING TO POWER CAN CAUSE SHOCK, BURNS OR DEATH.

SELECTING AND WIRING PUMP CONTROL PANELS AND SWITCHES

FLOAT SWITCH TYPES

There are two basic float switch designs; single-action and wide-angle. Single-action switches operate over a range of 15° so they open and close quickly. Wide-angle floats operate over a 90° swing with the tether length between the float body and the pivot point controlling the On-Off range. The design determines how many floats are required with different systems or controls.

Floats may be normally open (NO) for pump down applications or to empty a tank. Normally closed (NC) switches are used to pump up or to fill a tank.

A single-action control switch may be used only with a control panel, never direct connected to a pump.

The wide-angle, pump down switches may be used as direct connected pump switches or as control switches.

SETTING THE FLOAT SWITCHES

There are no absolute rules for where to set the float switches, it varies from job to job.

Suggested Rules to Follow:
All floats should be set below the Inlet pipe!

Off Float: Best: set so the water level is always above the top of the pump (motor dome). **Next Best:** set so the water level is not more than 6" below the top of the pump.

On Float: set so the volume of water between the On and Off floats allows pumps of 1½ HP and under to operate for 1 minute minimum. Two (2) HP and larger pumps should run a minimum of 2 minutes. Basin literature states the gallons of storage per inch of basin height.

Lag/Alarm Float(s): should be staggered above the Off and On floats. Try to use most of the available storage provided by the basin, save some space for reserve storage capacity. *See Diagrams and Charts in Float Switch Chart Section.*

PANEL WIRING DIAGRAMS

Our control panels are shipped with instructions and wiring diagrams. Use those instructions in conjunction with this IOM. Electrical installation should be performed only by qualified technicians. Any problem or questions pertaining to another brand control must be referred to that control supplier or manufacturer. Our technical people have no technical schematics or trouble shooting information for other companies' controls.

ALARMS

We recommend the installation of an alarm on all Wastewater pump installations. Many standard control panels come equipped with alarm circuits. If a control panel is not used, a stand alone high liquid level alarm is available. The alarm alerts the owner of a high liquid level in the system so they can contact the appropriate service personnel to investigate the situation.

SINGLE PHASE PUMPS

Single phase (1Ø) pumps may be operated using a piggyback or hard wired float switch, a contactor, or a Simplex or Duplex control panel. *See Figures 1, 2 and 5.*

All 1/3 and 1/2 HP, 115 or 230 volt pumps, and some 3/4 and 1 HP pumps, are supplied with plug style power cords. They may be plugged into piggyback float switches for simple installations. It is allowable to remove the plugs in order to hardwire or connect to a Simplex or Duplex controller. Removing the plug neither voids the warranty nor violates the agency Listings. *See Figure 5.*

PLUG-CONNECTED UNITS MUST BE CONNECTED TO A PROPERLY GROUNDED, GROUNDING TYPE RECEPTACLE.

ON NON-PLUG UNITS, DO NOT REMOVE CORD AND STRAIN RELIEF. DO NOT CONNECT CONDUIT TO PUMP.

Pumps with bare lead power cords can be hard-wired to a float switch, wired to a 1Ø contactor, a Simplex controller or a Duplex controller. Always verify that the float switch is rated for the maximum run amperage, maximum starting amperage, and the HP rating on the pump. Single-phase wastewater pumps contain on-winding overloads, unless noted on the pump nameplate. *See Figures 1 and 2.*

THREE PHASE PUMPS:

As a Minimum a 3Ø pump requires a 3 pole circuit breaker/fused circuit, an across the line magnetic starter rated for the pump HP, and ambient compensated Quick Trip Class 10 overloads.

SINGLE AND THREE PHASE CONTROL PANELS:

Control panels are available as Simplex (controls 1 pump) or Duplex (controls 2 pumps). Our standard SES Series Panels are available with many standard features and can be built with our most popular options. We also custom build panels which offer many more design options than the SES panels. Custom control panels are available in many different configurations. Custom panel quote requests may be forwarded to Customer Service through any authorized distributor.

Our "SES" Duplex panels feature a solid-state printed circuit board design with standard high level alarm circuits. Other standard features are: an auxiliary dry alarm contact for signaling a remote alarm and float switch position indicator lights. Our 3Ø panels have built-in, adjustable, Class 10 overloads. The adjustable overloads on all our 3Ø panels mean less labor for the installer and no need to order specific overloads. Most SES panels are in stock for immediate delivery.

On pumps equipped with seal fail and/or heat (high temperature) sensors it is recommended that you use our control panel with the appropriate options. The pump sensors do not function without a seal fail relay or terminal connection in the control panel and a warning device such as a bell, horn or light.

Seal Failure Circuit - Some dual seal pumps are equipped with a standard, built-in seal failure circuit, which may also be called a moisture detection circuit. This circuit must be connected to a control panel with an optional seal fail relay. The panel must be special ordered with the seal fail relay and alarm. There are also stand alone seal fail panels such as the A4-3 or A4-4 available as standard items. The pumps can be identified by an extra control cable exiting the motor cover. The cable contains two wires, a black wire, connects to panel "terminal" going to "probe"; and a white wire, connects to the panel "terminal" going to the relay ground. Do not connect to the panel ground screw. Follow the wiring instructions supplied with the panel.

Heat Sensor and Seal Failure Circuit - Some pumps are equipped with a seal fail and normally closed, on-winding high temperature thermostats (heat sensors). The pumps have a control cable with four (4) leads, black (probe) and green (relay ground) for the seal fail circuit and red and white for the high temperature circuit. Connect the high temperature (heat sensor) circuit to the panel terminal strip as indicated on the panel drawing using the red and white wires. The high temperature panel circuit is also an optional item which you must specifically order when you order your control panel. The high temperature circuit is different from the Class 10 overloads which are always required on three phase pumps. *Follow the wiring instructions supplied with the panel.*

INSTALLATION

Connect the pump(s) to the guide rail pump adapters or to the discharge piping. Slide rail bases should be anchored to the wetwell floor.

Complete all wiring per the control panel wiring diagrams and NEC, Canadian, state, provincial and/or local codes. This a good time to check for proper rotation of the motors/impellers.

DO NOT PLACE HANDS IN PUMP SUCTION WHILE CHECKING MOTOR ROTATION. TO DO SO WILL CAUSE SEVERE PERSONAL INJURY.

Always verify correct rotation. Correct rotation is indicated on the pump casing. Three phase motors are reversible. It is allowable to bump or jog the motor for a few seconds to check impeller rotation. It is easier to check rotation before installing the pump. Switch any two power leads to reverse rotation.

Lower the pump(s) into the wetwell.

Check to insure that the floats will operate freely and not contact the piping.

OPERATION

Once the piping connections are made and checked you can run the pumps.

Piggyback Switch Operation – Plug the piggyback switch into a dedicated grounded outlet and then plug the pump into the switch. Test the pump by filling the wetwell until the pump goes On. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Check the operating range to insure a minimum one minute run time and that the pump goes Off in the correct position.

Control Panel Operation – Fill the wetwell with clear water.

Use the pump H-O-A (Hand-Off-Automatic) switches in Hand to test the pumps. If they operate well in Hand proceed to test Automatic operation. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Place Control Panel switch(es) in Automatic position and thoroughly test the operation of the ON, OFF, and Alarm floats by filling the wetwell with clear water. **Important:** Failure to provide a Neutral from the power supply to a 10, 230 volt Control Panel will not allow the panel control circuit to operate. The Neutral is necessary to complete the 115 volt control circuit.

Check voltage and amperage and record the data on the front of this manual for future reference. Compare the amperage readings to the pump nameplate maximum amperage. If higher than nameplate amperage investigate cause. Operating the pump off the curve, i.e. with too little head or with high or low voltage will increase amperage. The motor will operate properly with voltage not more than 10% above or below pump nameplate ratings. Performance within this range will not necessarily be the same as the published performance at the exact rated nameplate frequency and voltage. Correct the problem before proceeding. Three phase unbalance is also a possible cause. *See Three Phase Power Unbalance and follow the instructions.*

Reset the Alarm circuit, place pump switch(es) in the Automatic position and Control Switch in ON position. The system is now ready for automatic operation.

Explain the operation of the pumps, controls and alarms to the end user. Leave the paperwork with the owner or at the control panel if in a dry, secure location.

FLOAT SWITCH AND PANEL CHART

The purpose of this chart is to show the required switch quantities and the function of each switch in a typical wastewater system. The quantities required vary depending on the switch type, single-action or wide-angle. Switch quantities also vary by panel type: simplex with and without alarms, and duplex with alarms.

Duplex Panels using single-action switches:

Three Float Panel Wiring

SW1	Bottom	Pumps Off
SW2	Middle	1st Pump On
SW3	Top	2nd Pump & Alarm On

Four Float Panel Wiring ②

SW1	Bottom	Pumps Off
SW2	2nd	1st Pump On
SW3	3rd	2nd Pump On
SW4	Top	Alarm On

Duplex Panels using wide-angle switches:

Three Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Top	2nd Pump & Alarm On

Four Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Middle	2nd Pump On
SW3	Top	Alarm On

Simplex Panel using single-action switches:

Simplex Panel with Alarm ①

SW1	Bottom	Pump Off
SW2	Middle	Pump On
SW3	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Bottom	Pump Off
SW2	Top	Pump On

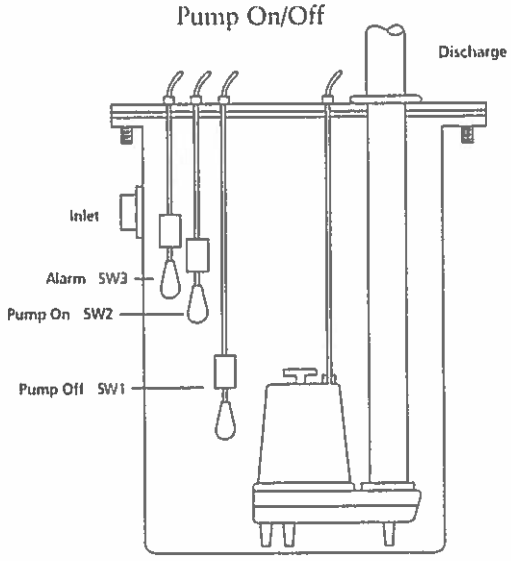
Simplex Panel using wide-angle switches:

Simplex Panel with Alarm

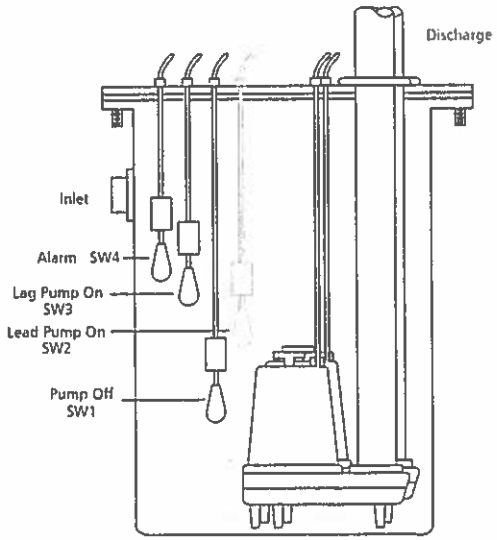
SW1	Bottom	Pump On/Off
SW2	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Pump On/Off



Simplex ①



Duplex ②

THREE PHASE POWER UNBALANCE

A full three phase supply consisting of three individual transformers or one three phase transformer is recommended. "Open" delta or wye connections using only two transformers can be used, but are more likely to cause poor performance, overload tripping or early motor failure due to current unbalance.

Check the current in each of the three motor leads and calculate the current unbalance as explained below.

If the current unbalance is 2% or less, leave the leads as connected.

If the current unbalance is more than 2%, current readings should be checked on each leg using each of the three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.

To calculate percent of current unbalance:

A. Add the three line amp values together.

B. Divide the sum by three, yielding average current.

C. Pick the amp value which is furthest from the average current (either high or low).

D. Determine the difference between this amp value (furthest from average) and the average.

E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance.

Current unbalance should not exceed 5% at service factor load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source.

Contact your local power company to resolve the imbalance.

	Hookup 1			Hookup 2			Hookup 3		
Starter Terminals	L1	L2	L3	L1	L2	L3	L1	L2	L3
	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T
Motor Leads	R	B	W	W	R	B	B	W	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Example:

T3-R = 51 amps	T2-W = 50 amps	T1-B = 50 amps
T1-B = 46 amps	T3-R = 48 amps	T2-W = 49 amps
T2-W = 53 amps	T1-B = 52 amps	T3-R = 51 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
÷ 3 = 50 amps	÷ 3 = 50 amps	÷ 3 = 50 amps
— 46 = 4 amps	— 48 = 2 amps	— 49 = 1 amps
4 ÷ 50 = .08 or 8%	2 ÷ 50 = .04 or 4%	1 ÷ 50 = .02 or 2%

INSULATION RESISTANCE READINGS

Normal Ohm and Megohm Values between all leads and ground

Condition of Motor and Leads	Ohm Value	Megohm Value
A new motor (without drop cable).	20,000,000 (or more)	20 (or more)
A used motor which can be reinstalled in well.	10,000,000 (or more)	10 (or more)
Motor in well. Readings are for drop cable plus motor.		
New motor.	2,000,000 (or more)	2 (or more)
Motor in good condition.	500,000 - 2,000,000	.5 - 2
Insulation damage, locate and repair.	Less than 500,000	Less than .5

Insulation resistance varies very little with rating. Motors of all HP, voltage and phase ratings have similar values of insulation resistance.

Insulation resistance values above are based on readings taken with a megohmmeter with a 500V DC output. Readings may vary using a lower voltage ohmmeter, consult factory if readings are in question.

This table was reprinted through the courtesy of Franklin Electric.

Engineering data for specific models may be found in your catalog and on our website (address is on the cover).

Control panel wiring diagrams are shipped with the control panels. Please use the control panel drawings in conjunction with this instruction manual to complete the wiring.

PUMP CONSTRUCTION	
Minimum Submergence	
Continuous Duty	Fully Submerged
Intermittent Duty	6" Below Top of Motor

Maximum Fluid Temperature	
Continuous Operation	104° F 40° C
Intermittent Operation	140° F 60° C

Pumpmaster and Pumpmaster Plus - Hard Wired

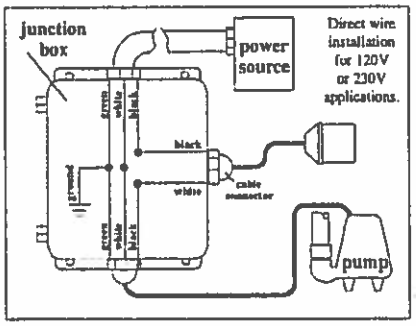


Fig. 1

Single-Action Float Switch "Typical" Installation

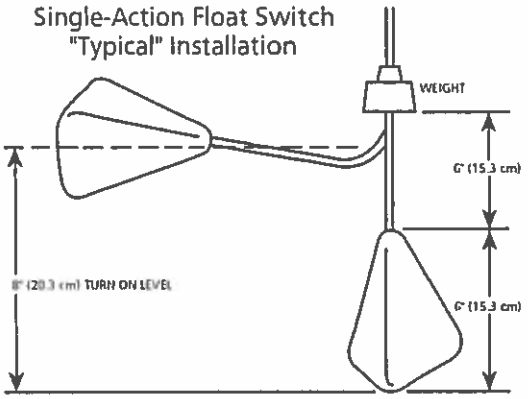


Fig. 4

Double Float - Hard Wired

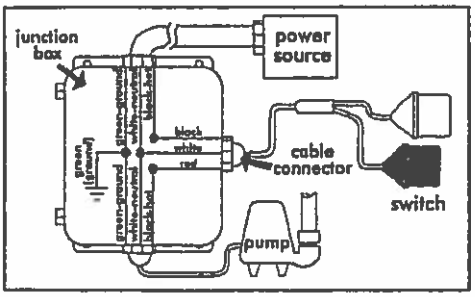


Fig. 2

Wide-Angle Float Switch

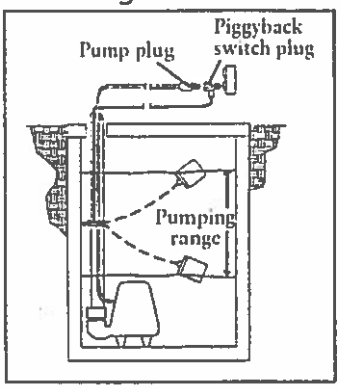


Fig. 5

Determining Pumping Range

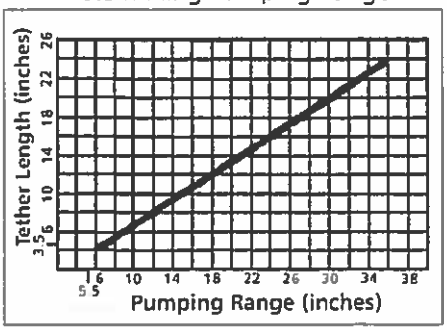


Fig. 3

Three Phase Connection Diagram

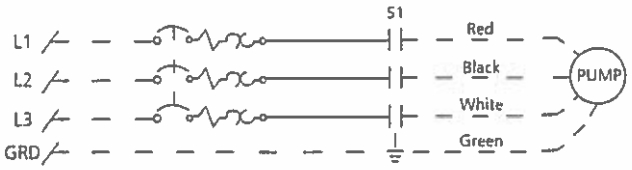
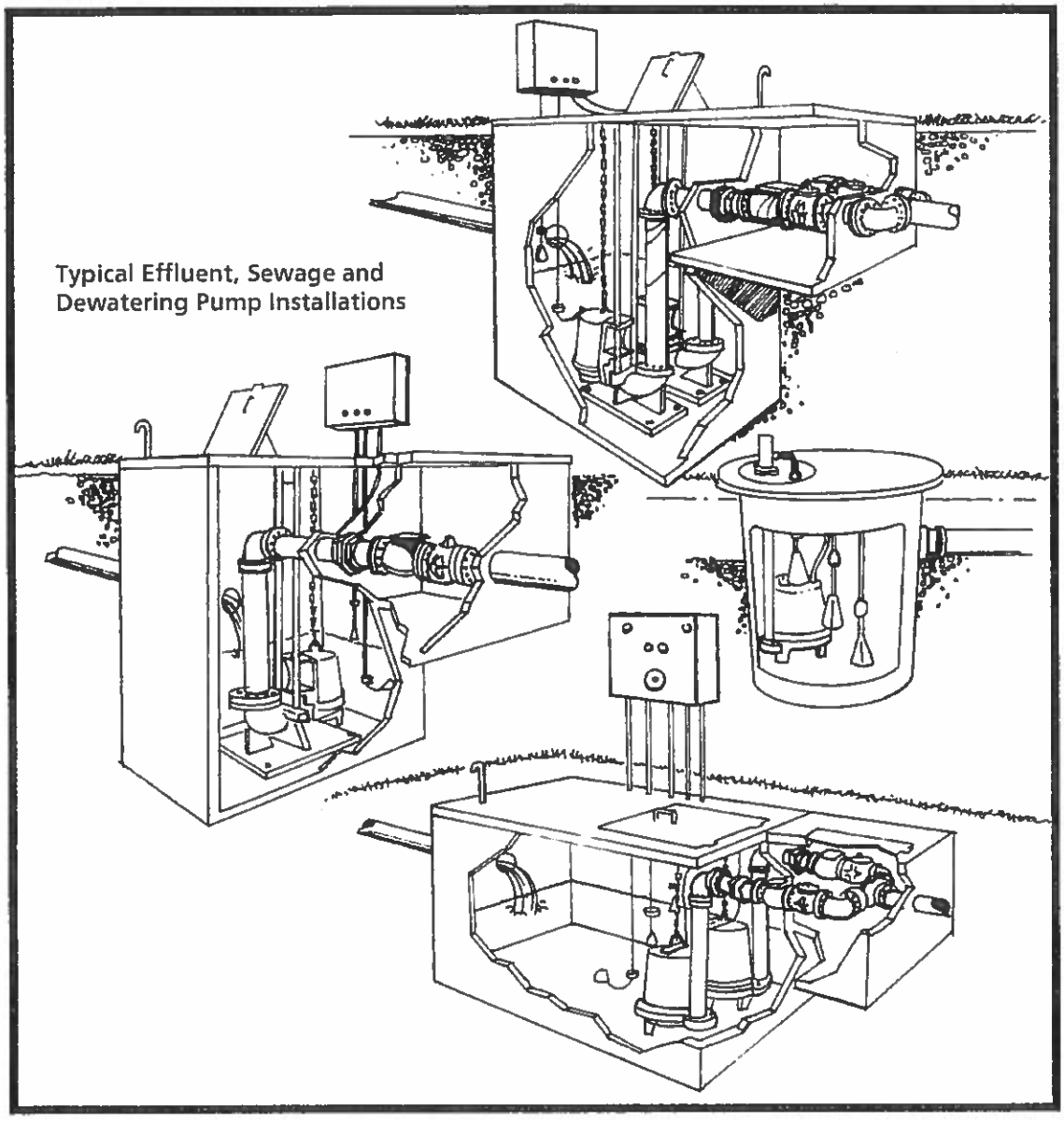


Fig. 6


Typical Effluent, Sewage and
Dewatering Pump Installations

⚠WARNING
Hazardous voltage

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING ANY SERVICE CAN CAUSE SHOCK, BURNS OR DEATH.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
MOTOR NOT RUNNING NOTE: If circuit breaker "OPENS" repeatedly, DO NOT reset. Call qualified electrician.	Motor thermal protector tripped.	Allow motor to cool. Insure minimum pump submergence. Clear debris from casing and impeller.
	Open circuit breaker or blown fuse.	Determine cause, call a qualified electrician.
	Pump impeller binding or jammed.	Check motor amp draw. If two or more times higher than listed on pump nameplate, impeller is locked, motor bearings or shaft is damaged. Clear debris from casing and impeller, consult with dealer.
a) Manual operation	Power cable is damaged.	
	Inadequate electrical connection in control panel.	
b) Automatic operation	No neutral wire connected to control panel.	Resistance between power leads and ground should read infinity. If any reading is incorrect, call a qualified electrician.
	Inadequate electrical connection in control panel.	Inspect control panel wiring. Call a qualified electrician.
NOTE: Check the pump in manual mode first to confirm operation. If pump operates, the automatic control or wiring is at fault. If pump does not operate, see above.	Defective liquid level switch.	With switch disconnected, check continuity while activating liquid level switch. Replace switch, as required.
	Insufficient liquid level to activate controls.	Allow liquid level to rise 3" to 4" (76 mm - 101 mm) above turn-on level.
	Liquid level cords tangled.	Untangle cords and insure free operation.
PUMP WILL NOT TURN OFF	Liquid level cords tangled.	Untangle cords and insure free operation.
	Pump is air locked.	Shut off pump for approximately one minute, then restart. Repeat until air lock clears. If air locking persists in a system with a check valve, a 3/16" (4.8 mm) hole may be drilled in the discharge pipe approximately 2" (51 mm) above the discharge connection.
	Influent flow is matching pump's discharge capacity.	Larger pump may be required.
LITTLE OR NO LIQUID DELIVERED BY PUMP	Check valve installed backwards, plugged or stuck closed.	Check flow arrow on valve and check valve operation.
	Excessive system head.	Consult with dealer.
	Pump inlet plugged.	Inspect and clear as required.
	Improper voltage or wired incorrectly.	Check pump rotation, voltage and wiring. Consult with qualified electrician.
	Pump is air locked.	See recommended action, above.
	Impeller is worn or damaged.	Inspect impeller, replace as required.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
PUMP CYCLES CONSTANTLY	Discharge check valve inoperative.	Inspect, repair or replace as required.
	Sewage containment area too small.	Consult with dealer.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
	Influent excessive for this size pump.	Consult with dealer.

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;
(b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment;
(d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

Printed in U.S.A.

Goulds Pumps
ITT Industries

ITT

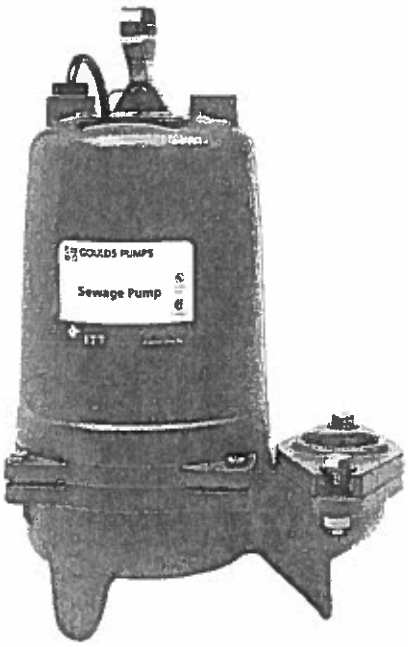
Wastewater

Goulds Pumps

WS_BHF Series Model 3887BHF

Submersible Sewage Pump

Prosurance available for residential applications.



FEATURES

- **Impeller:** Cast iron, enclosed, non-clog, dynamically balanced with pump out vanes for mechanical seal protection.
- **Casing:** Cast iron flanged volute type for maximum efficiency. Designed for easy installation on A10-20 slide rail or base elbow rail systems.
- **Mechanical Seal:** Silicon Carbide vs. Silicon Carbide sealing faces for superior abrasive resistance, stainless steel metal parts, BUNA-N elastomers.
- **Shaft:** Corrosion resistant, 300 series stainless steel. Threaded design. Locknut on all models to guard against component damage on accidental reverse rotation.
- **Fasteners:** 300 series stainless steel.
- Capable of running dry without damage to components.
- Designed for continuous operation, when fully submerged.

GOULDS PUMPS

AGENCY LISTINGS

Tested to UL 778 and CSA 22.2 108 Standards
By Canadian Standards Association — File #LR38549

Goulds Pumps is ISO 9001 Registered.

Goulds Pumps is a brand of ITT Corporation.

www.goulds.com

Engineered for life

APPLICATIONS

Specifically designed for the following uses:

- Homes
- Sewage systems
- Dewatering/Effluent
- Water transfer
- Light industrial
- Commercial applications

Anywhere waste or drainage must be disposed of quickly, quietly and efficiently.

SPECIFICATIONS

Pump

- Solids handling capabilities: 2" maximum.
- Capacities: up to 220 GPM.
- Total heads: up to 81 feet TDH.
- Discharge size: 2" NPT threaded companion flange as standard. 3" option available but must be ordered separately. (Order no. A1-3)
- Temperature: 104°F (40°C) continuous
  140°F (60°C) intermittent.

MOTORS

- Fully submerged in high grade turbine oil for lubrication and efficient heat transfer. All ratings are within the working limits of the motor.
- Class B insulation on ⅓-1½ HP models.
- Class F insulation on 2 HP models.

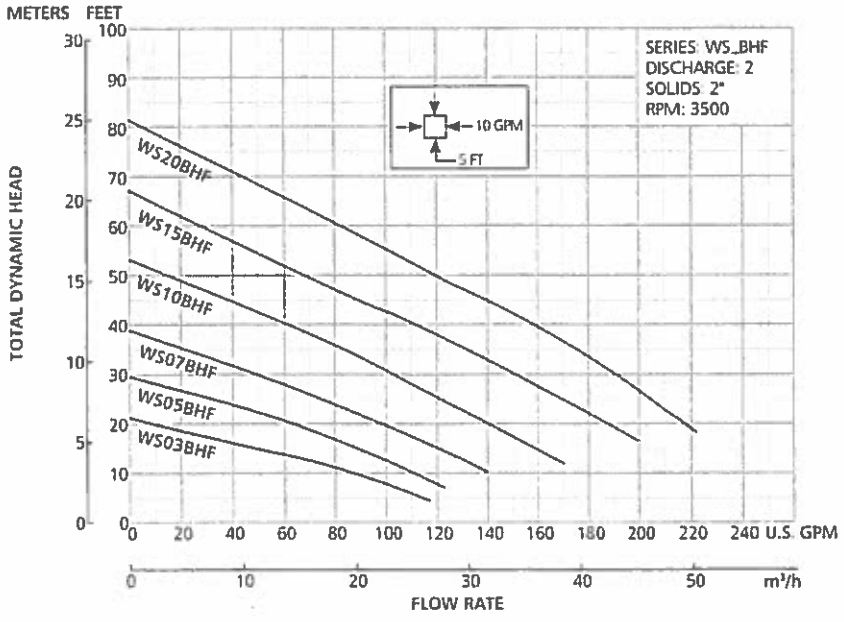
Single phase (60 Hz):

- Capacitor start motors for maximum starting torque.
- Built-in overload with automatic reset.
- SJTOW or STOW severe duty oil and water resistant power cords.
- ⅓ – 1 HP models have NEMA three prong grounding plugs.
- 1½ HP and larger units have bare lead cord ends.

Three phase (60 Hz):

- Class 10 overload protection must be provided in separately ordered starter unit.
- STOW power cords all have bare lead cord ends.

- **Designed for Continous Operation:** Pump ratings are within the motor manufacturer's recommended working limits, can be operated continuously without damage when fully submerged.
- **Bearings:** Upper and lower heavy duty ball bearing construction.
- **Power Cable:** Severe duty rated, oil and water resistant. Epoxy seal on motor end provides secondary moisture barrier in case of outer jacket damage and to prevent oil wicking. Standard cord is 20'. Optional lengths are available.
- **Motor Cover O-ring:** Assures positive sealing against contaminant and oil leakage.

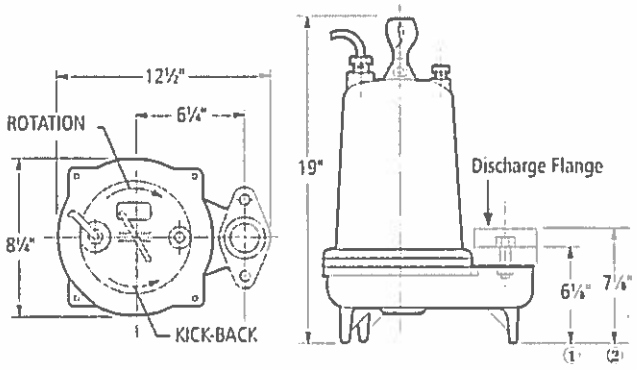


MOTOR AND MODEL INFORMATION

ORDER NUMBER	HP	PHASE	VOLTS	RPM	IMPELLER DIA. (IN.)	MAX. AMPS	LOCKED ROTOR AMPS	KVA CODE	FULL LOAD MOTOR EFF. %	RESISTANCE	
										START	LINE-LINE
WS0311BHF	0.33	1	115	3500	2.94	12.4	46.0	M	54	7.5	1.0
WS0318BHF	0.33	1	208			6.8	31.0	K	68	9.7	2.4
WS0312BHF	0.33	1	230			6.2	34.5	M	53	9.6	4.0
WS0511BHF	0.5	1	115		3.19	14.5	46.0	M	54	7.5	1.0
WS0518BHF	0.5	1	208			8.4	31.0	K	68	9.7	2.4
WS0512BHF	0.5	1	230			7.6	34.5	M	53	9.6	4.0
WS0538BHF	0.5	3	200			4.9	22.6	R	68	–	3.8
WS0532BHF	0.5	3	230			3.6	18.8	R	70	–	5.8
WS0534BHF	0.5	3	460			1.8	9.4	R	70	–	23.2
WS0537BHF	0.5	3	575			1.5	7.5	R	62	–	35.3
WS0718BHF	0.75	1	208		3.44	11.0	31.0	K	68	9.7	2.4
WS0712BHF	0.75	1	230			10.0	27.5	J	65	12.2	2.7
WS0738BHF	0.75	3	200			6.2	20.6	L	64	–	5.7
WS0732BHF	0.75	3	230			5.4	15.7	K	68	–	8.6
WS0734BHF	0.75	3	460			2.7	7.9	K	68	–	34.2
WS0737BHF	0.75	3	575			2.2	9.9	L	78	–	26.5
WS1018BHF	1	1	208		3.75	14.5	59.0	K	68	9.3	1.1
WS1012BHF	1	1	230			13.0	36.2	J	69	10.3	2.1
WS1038BHF	1	3	200			8.6	27.6	M	77	–	2.7
WS1032BHF	1	3	230			7.5	24.1	L	79	–	4.1
WS1034BHF	1	3	460			3.8	12.1	L	79	–	16.2
WS1037BHF	1	3	575			3.1	9.9	L	78	–	26.5
WS1512BHF	1.5	1	230		4.00	18.0	52.0	J	67	2.76	0.53
WS1538BHF	1.5	3	200			10.0	42.4	K	78	–	1.7
WS1532BHF	1.5	3	230			9.6	42.4	K	78	–	1.7
WS1534BHF	1.5	3	460			4.8	21.2	K	78	–	6.6
WS1537BHF	1.5	3	575			3.9	16.3	L	78	–	10.5
WS2012BHF	2	1	230		4.44	18.0	49.6	F	78	3.2	1.1
WS2038BHF	2	3	200			12.0	42.4	K	78	–	1.7
WS2032BHF	2	3	230			11.6	42.4	K	78	–	1.7
WS2034BHF	2	3	460			5.8	21.2	K	78	–	6.6
.WS2037BHF	2	3	575			4.7	16.3	L	78	–	10.5

DIMENSIONS

(All dimensions are in inches. Do not use for construction purposes.)



Discharge Flange:

① 2" NPT standard

② 3" NPT optional (order an A1-3)

ITT

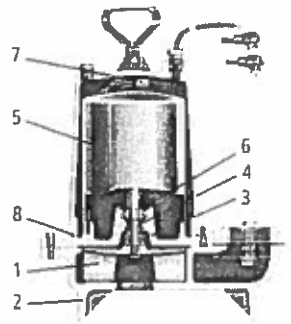
Wastewater

PERFORMANCE RATINGS (gallons per minute)

Order No.		WS03BHF	WS05BHF	WS07BHF	WS10BHF	WS15BHF	WS20BHF
HP ▶		1/3	1/2	3/4	1	1 1/2	2
RPM ▶		3500	3500	3500	3500	3500	3500
Total Head Feet of Water	10 ▶	86	110	140	–	–	–
	15	48	88	120	158	–	–
	20	–	62	98	139	186	217
	25	–	32	74	120	170	204
	30	–	–	49	101	150	190
	35	–	–	21	82	130	175
	40	–	–	–	60	110	159
	45	–	–	–	38	88	140
	50	–	–	–	–	67	120
	55	–	–	–	–	47	100
	60	–	–	–	–	29	80
	65	–	–	–	–	–	62
	70	–	–	–	–	–	43
	75	–	–	–	–	–	23

COMPONENTS *(for reference only)*

Item No.	Description
1	Impeller
2	Casing
3	Mechanical Seal
4	Motor Shaft
5	Motor
6	Ball Bearings
7	Power Cable
8	Casing O-Ring



** For repair parts, reference repair parts book.*

GOULDS PUMPS

B3887BHF April, 2007

Engineered for life

MotorSaver®
THREE-PHASE ELECTRIC MOTOR PROTECTOR

INSTALLATION INSTRUCTIONS FOR SYMCOM'S MOTORSAVER®
MODEL 460

DANGER!

HAZARDOUS VOLTAGES MAY BE PRESENT DURING INSTALLATION.
Electrical shock can cause death or serious injury.
Installation should be done by qualified personnel following all national, state and local electrical codes.

BE SURE POWER IS DISCONNECTED PRIOR TO INSALLATION!
FOLLOW NATIONAL, STATE, AND LOCAL CODES!
READ THESE INSTRUCTIONS ENTIRELY BEFORE INSTALLATION!

! WARNING !

UNEXPECTED OUTPUT ACTUATION CAN OCCUR.
Use hard-wired safety interlocks where personnel and/or equipment hazards exist.
Failure to follow this instruction can result in death, injury or equipment damage.

The Model 460 MotorSaver® is an auto ranging voltage monitor designed to protect three-phase motors regardless of size. The MotorSaver® is used on 190-480 VAC, 50 to 60 Hz motors to protect from damage caused by single phasing, low voltage, high voltage, phase reversal, and voltage unbalance.

CONNECTIONS

1. Mount the MotorSaver® in a convenient location in or near the motor control panel. If the location is wet or dusty, the MotorSaver® should be mounted in a NEMA 4 or 12 enclosure. The MotorSaver® can be mounted to a back panel using two #6 or #8 x 5/8 screws or can be snapped onto a DIN rail.
2. Connect L1, L2 and L3 on the MotorSaver's terminal strip to the LINE SIDE of the motor starter. (See Figure No. 1).
3. Connect the output relay to the circuitry to be controlled. For motor control, connect the normally open contact in series with the magnetic coil of the motor starter as shown in Figure No. 1. For alarm operation, connect the normally closed contact in series with the control circuit as shown in Figure No. 2.

SymCom inc
Motor Protection & Controls Since 1974
2880 North Plaza Drive, Rapid City, SD 57702 • (800) 843-8848

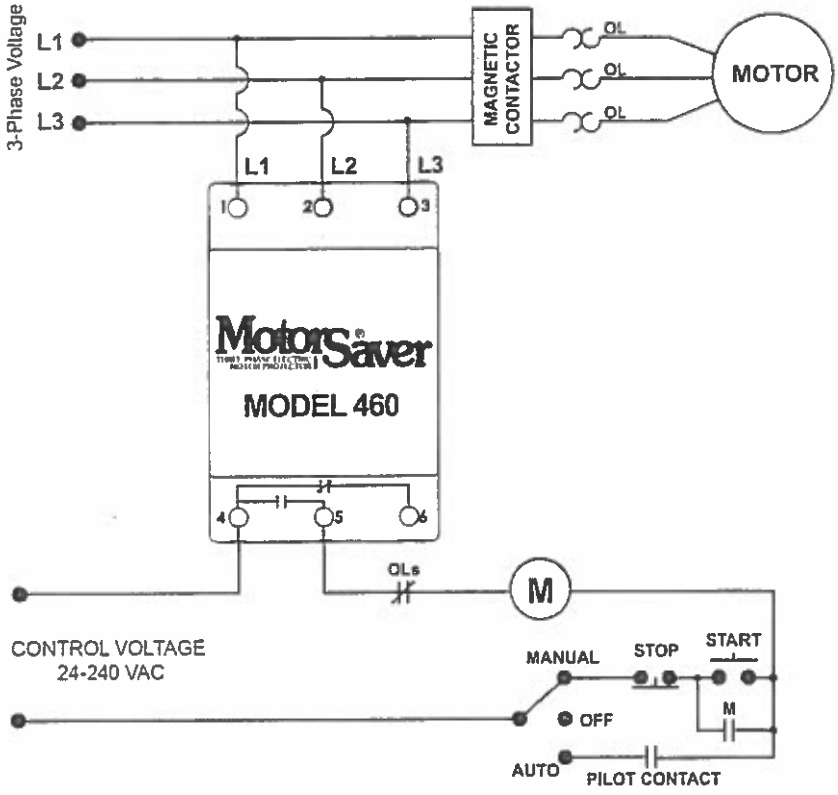


FIGURE NO. 1: CONTROL WIRING DIAGRAM

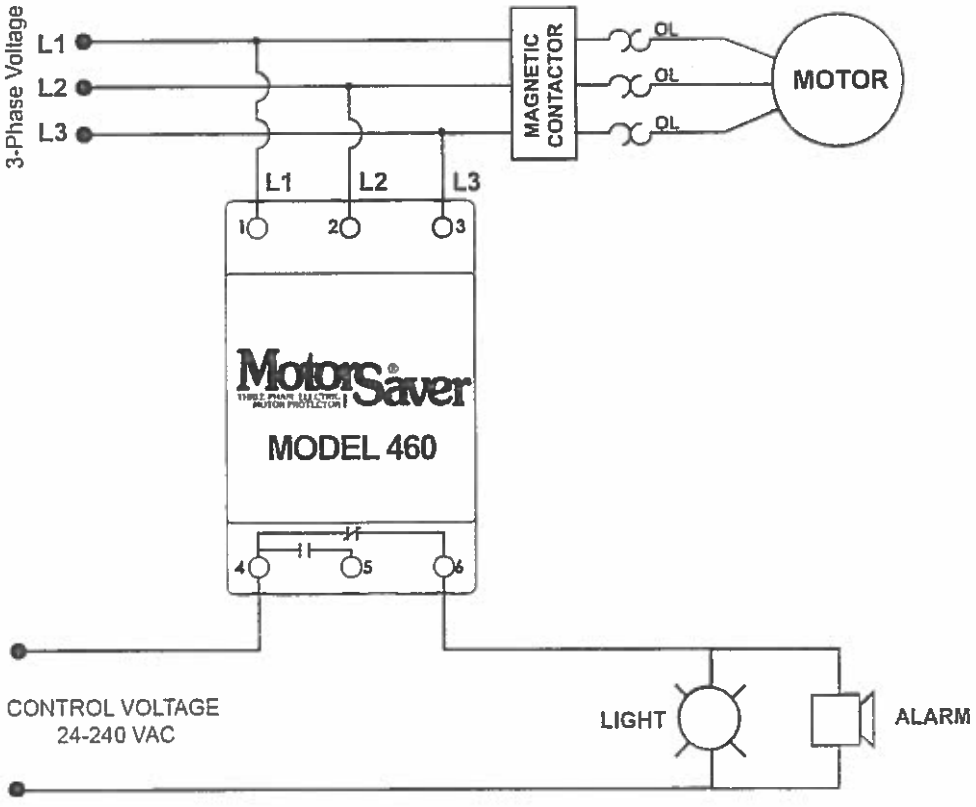
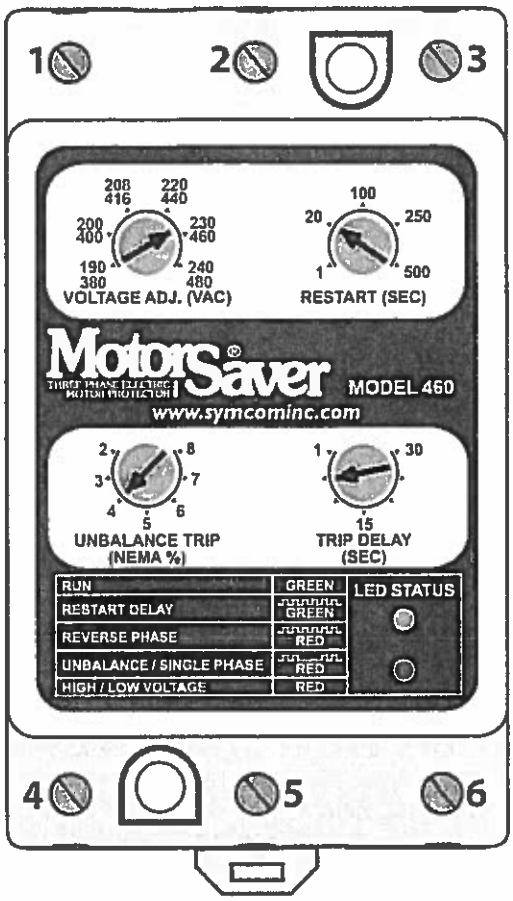


FIGURE NO. 2: ALARM WIRING DIAGRAM

SETTINGS



1. Line voltage adjustment: Rotate the **"VOLTAGE ADJ. (VAC)"** to the nominal three-phase line voltage feeding the motor to be protected.
2. Restart delay adjustment: Rotate the **"RESTART (SEC)"** adjustment to the desired position. The restart delay is the time between MotorSaver® seeing acceptable voltage and the MotorSaver® closing its output contacts. For compressor applications, the restart delay should be set for the approximate time it takes for the head pressure to bleed off of the compressor. For other applications, the restart delay is typically set between 2 and 10 seconds.
3. Trip delay adjustment: Rotate the **"TRIP DELAY (SEC)"** adjustment to the desired setting. This adjustment does not affect the trip delay on phasing faults. Typically, the trip delay adjustment is set between 1 and 5 seconds. In areas where voltage fluctuations are frequent, the trip delay adjustment may be set greater than 10 seconds.
4. Voltage unbalance adjustment: Rotate the **"UNBALANCE TRIP (NEMA%)"** adjustment to the desired unbalance trip level. The NEMA MG1 standard does not recommend operating a motor above 1% voltage unbalance without derating the motor. The NEMA MG1 standard also recommends against operating a motor above a 5% voltage unbalance under any circumstances. SymCom recommends consulting the motor manufacturer for specific tolerances.

$$\text{Percent Unbalance} = \frac{\text{Maximum Deviation from the Average}}{\text{Average}} \times 100$$

Example: The measured line-to-line voltages are 203, 210, and 212.

$$\text{Average} = \frac{203 + 210 + 212}{3} = 208.3$$

The maximum deviation from the average is the largest difference between the average voltage (208.3) and any one voltage reading.

208.3 - 203 = 5.3 210 - 208.3 = 1.7 212 - 208.3 = 3.7

The maximum deviation from the average is 5.3.

$$\frac{5.3}{208.3} \times 100 = 2.5\% \text{ Unbalance}$$

POWER-UP

Turn on the 3∅ power to the motor. The MotorSaver's green RUN light will blink during the RESTART delay. After the RESTART delay, the MotorSaver® will energize its output contacts and the green RUN light will illuminate. If the contacts do not energize and the RUN light does not illuminate, see the TROUBLESHOOTING section.

DIAGNOSTIC INDICATOR LIGHTS	
RUN	GREEN
RESTART DELAY	 GREEN
REVERSE PHASE	 RED
UNBALANCE / SINGLE PHASE	 RED
HIGH / LOW VOLTAGE	RED

CONGRATULATIONS!!
YOU HAVE JUST INSTALLED THE FINEST MOTOR PROTECTION AVAILABLE!!

TROUBLESHOOTING

SYMPTOM	LIGHT PATTERN	SOLUTION
No lights are on. The unit seems completely dead.	N / A	Measure the three line-to-line voltages. If any of the voltages are below 150 VAC, the MotorSaver® does not have enough power to operate its internal electronics. This may occur on a single-phased system. If the voltages are correct, call SymCom at 1-800-843-8848 or 1-605-348-5580.
Red light is blinking (on initial power up).	 RED	Turn off the three-phase power. Swap any two leads powering the MotorSaver® (L1, L2, or L3). There is a 50-50 chance of connecting L1, L2, and L3 correctly the first time. Re-apply the three-phase power.
Red light is blinking (after the motor has been previously running).	 RED	The incoming lines have been reverse phased. The MotorSaver® is preventing the motor from running backwards. Correct the phase sequence.
Red light is blinking in this pattern.	 RED	The voltage is unbalanced or single-phased. Measure the incoming line voltages and calculate the % unbalance. If the voltage unbalance does not exceed the % unbalance reset value, call SymCom at 1-800-843-8848 or 1-605-348-5580.
Red light is on steady.	RED	The voltage is out of tolerance. Measure the three line-to-line voltages. Calculate the average of the three voltages. If the average is 7% above or below the nominal voltage as selected by the LINE VOLTAGE ADJUST, the MotorSaver® is functioning properly. If the voltage is within ±7% of the selected line voltage, call SymCom at 1-800-843-8848 or 1-605-348-5580.
Green light blinks and motor is not running.	 GREEN	The MotorSaver® is in restart delay.
Green light is on steady, but motor does not start.	GREEN	The MotorSaver® is in run mode. Ensure other control devices are allowing the motor to start. Check control circuit for loose wires or malfunctioning switches.

Any questions or comments call SymCom at 1-800-843-8848 or 1-605-348-5580

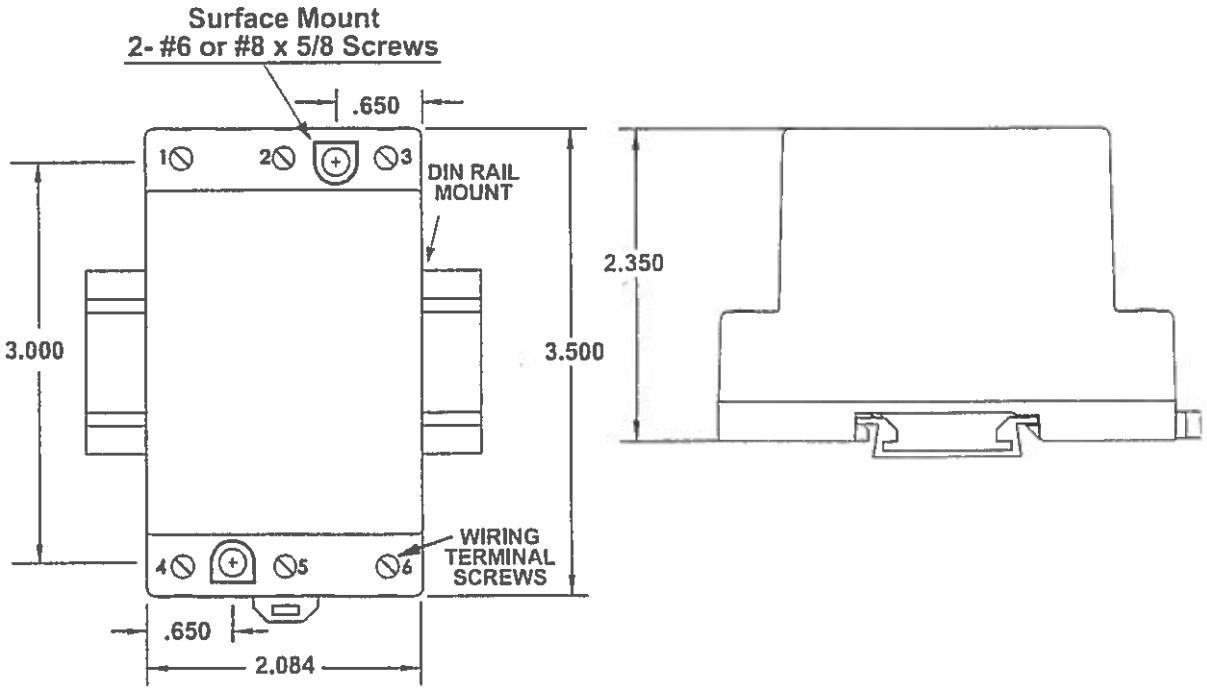
SPECIFICATIONS

3 - Phase Line Voltage	190 - 480 VAC
Frequency	50* - 60 Hz
Low Voltage (% of setpoint)	
Trip	90% ± 1%
Reset	93% ± 1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Voltage Unbalance (NEMA)	
Trip	2 - 8% Adjustable
Reset	Trip Setting minus 1% (5 - 8%)
	Trip Setting minus 0.5% (2 - 4%)
Trip Delay Time	
Low, High, and Unbalanced Voltage	1 - 30 Seconds Adjustable
Single-phasing faults (>25% UB)	1 Second Fixed
Restart Delay Time	
After a fault or complete power loss	1 - 500 Seconds Adjustable
Output Contact Rating - SPDT	
Pilot Duty	480 VA @ 240 VAC
General Purpose	10 A @ 240 VAC
Power Consumption	6 Watts (maximum)
Weight	14 oz
Enclosure	Polycarbonate
Terminal	
Torque	6 Inch-Pounds Max.
Wire AWG	12 - 20 AWG
Safety Marks	
UL	UL508 (File # E68520)
CE	IEC 60947-6-2
Standards Passed	
Electrostatic Discharge (ESD)	IEC 1000-4-2, Level 3, 6 kv contact, 8 kv air
Radio Frequency Immunity, Radiated	159 MHz, 10 V/m
Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5 kv input power and controls

*NOTE: 50 Hz will increase all delay timers by 20%

Surge	
IEC	IEC 1000-4-5, Level 3, 4kv line-to-line; Level 4, 4kv line-to-ground
ANSI / IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kv line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Environmental	
Temperature Range	Ambient Operating: -20° - 70° C (-4° - 158°F) Ambient Storage: -40° - 80° C (-40° - 176°F)
Class of Protection	IP20, NEMA 1 (Finger Safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

DIMENSIONS



SymCom warrants its microcontroller based products against defects in material or workmanship for a period of five (5) years* from the date of manufacture. All other products manufactured by SymCom shall be warranted against defects in material and workmanship for a period of two (2) years from the date of manufacture. For complete information on warranty, liability, terms, and conditions, please refer to the SymCom Terms and Conditions of Sale document.

Visit our website at www.symcominc.com for our complete catalog and new product listings!

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Motor Protection & Controls Since 1974

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FAX: (605) 348-5685

Warning: This document does not replace the manufacturer's recommended maintenance schedules as referenced in the OM manual provided by the equipment manufacturer. It is provided as a quick guide to required OM activities for this project.

Section1: General Maintenance Activities
Section2: Cross Reference Maintenance Code to Parts
Section3: Maintenance Schedule by Hours

General Maintenance Activities

Daily

- Check the control panel for running status.
- Contact the system remotely to check system operation for:
  - Alarms
  - Operating Conditions

Weekly

- Check for Leaks.
- Check the volume of consumables. i.e. Chemicals, oil etc
- Check for excessive noise of various components.
- Check for Alarms.
- Check and record Flow Rates, Vacuums, Pressures, Temperatures, pH.
- Check for excessive moisture inside the control panels and transducer wiring boxes.
- Check for corrosion and grease the moving parts if required to reduce corrosion.

Monthly

- Test critical inputs for proper shutdown capacity.
- Test the operation of the overloads.
- Test building sump switch if it is present.

Yearly

- Test each input.
- Test alarm conditions.
- Test the operation of each output device.

Parts Listing per Maintenance Code

Fan

	Part		Qty	Module
F-7901	10329	Fan, Building, 24", 1/3hp, 1625rpm, 120/230V, 1ph, XPF	1	Building, Trailer or Skid
F-7903	M1072	Fan, Building, 12", 1/4hp, 1750rpm, 120V, 1ph, TEFC	1	Building, Trailer or Skid

Flow Meter (Liquid)

	Part		Qty	Module
FQI,FT-7001	15499	Meter, Water, 2", US Gal, w/ pulse, Turbine, DLJ	1	Liquid Phase Carbon

Gauge, Pressure

	Part		Qty	Module
PI-7001	16203	Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60	2	Liquid Phase Carbon
P-4901	16203	Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60	1	Oil/Water Separator

Oil Water Separator

	Part		Qty	Module
OWS-4901	16263	Oil Water Separator, OWS-24, Stainless	1	Oil/Water Separator

Pump, Discharge

	Part		Qty	Module
P-4901	21028	Pump, Suction, Goulds, SSH Series, 4SH2K52C0	1	Oil/Water Separator

Strainer

	Part		Qty	Module
P-4901	M1523	Strainer, Wye, Brass, 3"	1	Oil/Water Separator

Vertical Level Switch (Almeg)

	Part		Qty	Module
LSHH-5201	12351	Switch, Level, Almeg, Vertical, ATB3-48B	1	Product Storage Tank

EVERY 200 OPERATING HOURS

Strainer

Remove strainer basket. Inspect strainer and empty if necessary.

EVERY 800 OPERATING HOURS

Pump, Discharge

Close-Coupled Unit
Ball bearings are located in and are part of the motor. They are permanently lubricated. No greasing required.

Frame-Mounted Units
Regrease frame with a #2 sodium or lithium based grease. Fill until grease comes out of relief fittings, or lip seal. Then wipe off excess. Follow motor and coupling manufacturers' lubrication instructions.

Note: Alignment must be rechecked after any maintenance work involving any disturbance of the unit.

Fan

1) Check the fan outlet pressure.
2) Check to ensure nothing is obstructing the air intake.
3) Check the fan wheel for corrosion.
4) Check the fan wheel alignment and positioning.

Flow Meter (Liquid)

Test the operation of the flow meter. Disassemble and clean the internal components if dirt or particles are preventing the meter from working properly.

Vertical Level Switch (Almeg)

1) Test the operation of the switch.
2) Remove the switch and check for debris buildup that can potentially cause a failure of normal operation.

EVERY **4000** OPERATING HOURS

Gauge, Pressure

1) Check accuracy of gauges.
2) Zero gauge if required.

Oil Water Separator

After the first 6 months of operation, the inlet should be inspected and cleaned as follows:
1) Stop the flow of influent to the separator.
2) Remove separator cover.
3) Dispose of separated oil per regular procedures.
4) Remove water from separator through drain or hose. Measure and record the depth of the solids. Use this measurement as the timing basis for the next solids inspection and clean out. Consult OWS drawing for depth of sludge baffle. Solids should not exceed this depth.
5) The HD Q-PAC plates can be either cleaned in place or removed and cleaned.
6) Examine the tank interior for damage and repair any damage to internal coating.
7) To restart separator, install HD Q-PAC plate packs and polishing pack in original position. Make sure that both are securely in place so that they do not float when unit is operational.

WINTER OPERATION AND STORAGE IN COLD CLIMATES

GENERAL

Systems operating in climates where seasonal temperatures regularly fall below freezing may need to be winterized. Depending on the equipment in the system, different steps must be taken to prepare for winter operation.

If the system is going to be shut down and stored for the winter, additional measures should be taken above and beyond normal maintenance practices for an extended shut down.

SYSTEMS OPERATING THOUGH THE WINTER

- Confirm that the enclosure heater is working. This can be done by adjusting the set point on the low temperature switch (TSL) to a setting above the ambient temperature inside the enclosure. Verify that the heater has turned on before adjusting the setting on the low temperature switch to a point above 32℉. If the heater is controlled by a temperature transmitter (TT), the set point can be adjusted through the HMI.
- Confirm that the control panel heater is working by adjusting the thermostat inside the panel – follow the procedure above.
- If the enclosure has a sump with a high level switch, ensure the sump is free of water to prevent ice from forming and potentially disabling the switch.
- If the system has a heat exchanger or rotary screw compressor, provisions may be included to prevent cycling cold air through the system. Depending on the design of the system, the following options may be available for winter operation:
    - Systems where the heat exchanger/compressor is recessed from the wall or ceiling, by removing the hood and withdrawing the insert, the discharge port can be fully or partially boarded up to allow warm air to be re-circulated back into the enclosure. See Figure 1.
    - The hood provided on the exterior of the enclosure may have been designed to allow air to be re-circulated back into the container through a duct on the wall above the heat exchanger/compressor or through the roof. See Figure 2.

Note: Depending on the parameters of the system, the above mentioned options may need to be fine-tuned onsite to optimize performance of the system. While these methods are good for maintaining the temperature inside the enclosure above freezing, there are some situations where too much air is being re-circulated and the heat exchanger is not able to cool the process air sufficiently. This will cause the high temperature switch on the discharge of the heat exchanger to trip and send the system into alarm.

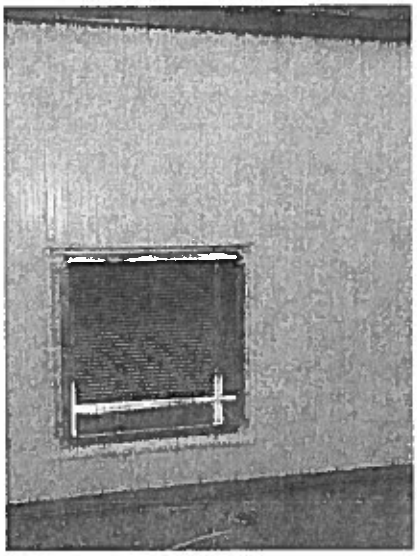

Figure 1: Recessed Heat Exchanger

Figure 2: Re-circulating Hood

SYSTEMS BEING STORED THROUGH THE WINTER

- All water must be drained from the system where possible.
- Valves should be left open to allow ice to expand in the event residual water was left in the system without damaging piping or equipment.
- Additional O&M as required for long-term system shutdowns.

WINTERIZING PROCEDURE

Progressive Cavity Pumps (Moyno)

- Remove bolts from pump end and ensure all water is removed.

Centrifugal Pumps (Goulds)

- Remove drain plug on the bottom of the outer steel body. Keep in mind water inside lines will also drain through these plugs depending on elevations.

Inlet Manifolds

- Drain all water from SVE and ground water extraction manifolds.

Vapor/Liquid Separators

- Drain all water from VLS.

Bag Filter Housings

- Drain all water and remove bag filter from housing.
- Pour antifreeze into bottom of housing ensuing drain valve is closed.

Oil/Water Separators

- Pour antifreeze in bottom of OWS, filling 1 to 2" from the bottom, ensuring drain lines are filled with antifreeze.

Air Strippers

- Sump should be drained and trays disassembled.
- Pour antifreeze in bottom of stripper and ensure drain lines are filled with antifreeze.

Air Compressors

- Drain receiver tank of any condensate.

Water Flow Meters (Paddlewheels and Rotameters)

- Remove via unions and drain. Store for the winter.

CAUTION

Freezing water poses a serious threat to the equipment in a system. Pipes, vessels and pumps can be severely damaged by freezing water.

Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
Electrical Motor		
Motor will not start and there is no noise.	Motor may not be receiving the proper power.	Check fuses and power distribution between power lines to motor.
	Overload is tripped.	Reset overload.
	Main power may be off.	Check main power.
	Contactor may not be closing because motor is in manual position.	Switch motor to Auto position.
	Contactor may not be closing because PLC is not telling output to be on.	Check PLC operating sequence to determine if a start requirement is not met.
Motor will not start but makes a humming noise.	One of the phases of power is not getting to the Motor as a result of a blown fuse.	Change fuse.
	One of the phases of power is not getting to the Motor as a result of a poor wire connection.	Check wiring for a loose wire or a poor connection.
	The driven component (i.e. pump) will not spin and could be seized up.	Disassemble driven component, check clearances and clean internal components and replace any damaged components.
	Bearing on drive shaft of motor or driven component may be seized up.	Replace bearings.
Overloads trip immediately after startup.	Check for short circuit in motor windings.	Re-wind motor.
	One of the phases of power is not getting to the motor as a result of a blown fuse.	Change fuse.
	Motor power wires may be shorting out to ground.	Search for wiring short and replace wiring if required.
	Motor may have too much load or backpressure as a result of operating the driven component outside of its operating capabilities.	Check operating capabilities of driven component. I.e. Ensure positive displacement pump is not over pressured or that centrifugal pump is not operating at too high a flow rate.
Motors amps are above the allowable value on the nameplate.	Motor may be designed to operate on the upper limit.	Calculate maximum allowable amps. Name plate amps x safety factor.
	Driven component may have scale build up inside.	Clean internal components of driven component.

	Driven component may be rotating in the wrong direction.	Check direction of rotation and switch rotation of motor if it is incorrect.
	Check voltage of power. Low voltage results in high amps.	Adjust overloads for higher amps if the difference is only slight, otherwise change power or motor.
Centrifugal Pumps		
Pump does not produce sufficient pressure/vacuum.	Pump is not primed.	Prime pump.
	Pump is rotating in wrong direction.	Check and change rotation if required.
	Vacuum or pressure gauge is faulty.	Replace gauge.
	Pump is not operating at required RPM.	Check and replace motor if required.
	Pump has wrong sized impeller.	Check impeller and replace if required.
	Pump pressure or vacuum is lost due to an obstruction located between the pump and gauge.	Check for flow restrictions and clean strainers or piping if required.
	Pump is not turned on.	Turn pump on.
	Coupling between pump and motor is no longer connected preventing the pump from rotating with the motor.	Reconnect and realign motor and pump.
Pump is leaking.	Gaskets are worn or faulty.	Replace gaskets.
	Mechanical seal has been overheated. This is often a result of operating the pump without any water.	Replace mechanical seal.
	Fittings are leaking on or around pump.	Tighten fittings.
	Water may be coming from another location.	Check for leaks around pump.
Pump flow rate is too low.	Backpressure is too high for pump.	Reduce backpressure.
	Pump may not be sized correctly for process.	Replace pump.
	Pump impeller is too small.	Change pump impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter.	Replace filter and clean line.

Pump is making excessive noise during operation.	Manually rotate pump impeller and listen for clearance problems.	Disassemble pump and fix clearance problems.
	Alignment of pump may be off causing the flexible coupling to degrade.	Check alignment and reset alignment if needed. Replace flexible coupling if it is degraded.
Liquid Ring Pump		
Pump does not produce enough vacuum.	Pump is not primed.	Prime pump and start under vacuum.
	Service fluid is to low in seal oil tank.	Add seal oil.
	No restriction on inlet of pump.	Close valves to create suction.
	Dilution valve is open.	Close dilution valve.
	Service fluid is not flowing into the pump.	Check for flow restrictions in service fluid lines. Check strainer.
	Pump is rotating in the wrong direction.	Check and change direction if required.
	Vacuum gauge is not working correctly.	Replace vacuum gauge.
	Pump seals may be allowing air into the pump.	Check for leaking and replace seals if required.
	Pump is too small for application.	Replace pump.
	Vacuum relief valve is set too low.	Replace or reset vacuum relief valve.
	Air may be leaking into vapor lines.	Check for air leaks in vapor lines.
	Pump internal components are damaged.	Disassemble pump and replace components if required.
Pump is making a growling noise.	Cavitation is occurring.	Decrease the vacuum.
	Insufficient seal fluid flow or excessive seal fluid flow.	Increase/decrease seal fluid flow rate.
Pump is leaking.	Gaskets are faulty.	Replace gaskets.
	Mechanical seal has been overheated or is faulty.	Replace mechanical seal.
	Oil may be leaking from 1/8" vacuum relief valves in pump housing.	Remove valves and install plugs.
Pump is running too hot.	Seal fluid strainer is plugged restricting seal fluid.	Clean out strainer.
	LRP is not providing enough suction to draw sufficient seal fluid.	Increase seal oil suction. Pipe seal fluid into a higher vacuum port of pump.

	Seal fluid flow rate is too low.	Open seal fluid control valve to allow more seal fluid to enter the pump.
	Seal fluid heat exchanger is not working properly.	Check heat exchanger.
Excessive discharge pressure built up in seal oil tank.	Demister filter is plugged and requires replacement.	Replace demister.
	Seal oil is not being drawn out of demister filter through scavenger line.	Increase vacuum of LRP to allow oil to be sucked through scavenger line. Ensure that scavenger line has sufficient vacuum to draw oil out of the demister filter.
Seal Oil Low Level Alarm	Seal oil temperature may be operating too high causing the oil to evaporate.	Check seal oil operating temperature and increase seal oil flow.
	Seal oil suction line may be plugged causing seal oil to collect in bottom of demister filter.	Check for plugging of seal oil return line and clean or replace if required.
Air to Air and Air to Fluid Heat Exchangers		
Heat exchanger fan is drawing too many amps.	See troubleshooting for motors.	
	Fan blade pitch and diameter may be wrong.	Change fan blade.
	Motor may be operating at wrong RPM for fan blade.	Replace motor or fan blade.
	Check clearance of fan blade.	Make adjustments if blade is making contact.
Phase Separator		
Water will not pump out of phase separator.	Base of separator may be plugged with sand.	Flush sand and debris out of separator.
Electric Solenoid Valve		
Valve will not completely shut.	May have dirt or rocks preventing it from shutting properly.	Disassemble and clean out internal components.
Valve will not open	Check for power to solenoid.	Trace power lines and determine why power is not going to valve.
	PLC may not be telling it to open.	Check start requirements in manual.
	Coil may be damaged or faulty.	Replace coil.
Level Switches		
Level switch is staying closed when water in tank drops below switch.	Level switch is upside down or on its side.	Check orientation of level switch. Level switch may be designed as normally closed and therefore will be upside down.

	Sight glass is plugged giving a false level in the tank.	Clean sight glass.
	Level switch has dirt or film causing it to stick up.	Remove level switch, clean and test for normal operation using a millimeter.
	Level switch may be damaged or faulty and failed closed regardless of the switch position.	Replace switch.
	Wiring to level switch may be shorting out to ground causing the switch to appear closed at all times.	Disconnect switch from system wiring and separate system wires so they are not in contact with each other or any metal. If the input is still on, the input wiring is being grounded somewhere. Find short and replace or fix wiring.
	IS barrier is shorted out internally.	Switch IS barrier with working barrier and if problem goes away then the barrier may be faulty and should be changed.
	Input wiring is loose in terminal strip.	Tighten terminal strip where field wiring is brought into panel.
	Level switch is wired incorrectly.	Consult input wiring diagram and inspect wiring of level switch. Change if required.
Level switch stays open when water in tank is above the switch.	Level switch is upside down or on its side.	Check orientation of level switch. Level switch may be designed as normally closed and therefore will be upside down.
	Sight glass is plugged giving a false level in the tank.	Clean sight glass.
	Level switch has dirt or film causing it to stick down.	Remove level switch, clean and test for normal operation using a millimeter.
	Level switch may be damaged or faulty and failed open regardless of the switch position.	Replace switch.
	IS barrier is blown preventing the level switch signal from crossing the barrier.	Switch IS barrier with working barrier and if problem goes away then the barrier may be blown. If barrier is blown, the input wire on the right side of the barrier will have 24 V DC and the wire on the opposite side will have 0V DC.
	Level switch is wired incorrectly.	Consult input wiring diagram and inspect wiring of level switch. Change if required.

Regenerative Blowers		
Blower does not produce sufficient pressure/vacuum.	Blower is not turned on.	Turn on blower.
	Wrong direction of rotation.	Check and change rotation if required.
	Vacuum or pressure gauge is faulty.	Replace gauge.
	Blower is not operating at required RPM.	Check and replace motor if required.
	Blower has wrong sized impeller.	Check impeller and replace if required.
	Pressure or vacuum is lost due to obstruction located between blower and gauge.	Check for flow restrictions and clean strainers or piping if required.
Blower is leaking.	Fittings are leaking on or around blower.	Tighten fittings.
Blower flow rate is too low.	Backpressure is too high for blower.	Reduce backpressure.
	Blower may not be sized correctly for process.	Replace blower.
	Blower impeller is too small.	Change blower impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter.	Replace filter and clean line.
Air Stripper		
Stripper leaks.	Gaskets are leaking.	Apply silicon grease to gaskets and close up stripper. If they cannot be fixed the gaskets may need to be replaced.
Pressure or vacuum is building up in stripper.	Stripper is being fouled by mineral precipitates.	Clean stripper with acid to dissolve precipitates.
	Airflow rate through stripper has risen or is above the design value.	Decrease airflow rate.
Stripper is not cleaning contaminants sufficiently.	Inlet concentrations are higher than the design values.	Decrease water flow rate to obtain required stripping capacity.
	Flow rate of water through stripper is too high.	Decrease flow rate allowing longer residence time in stripper.
	Water temperature is lower than the design (below 60°F).	Increase water temperature or slow down water flow rate or increase airflow rate.
	Airflow rate is not high enough.	Increase airflow rate or decrease water flow rate.

	Products that are not easily strippable may be in higher concentrations than originally planned.	Consult manufacturer with test results of discharge contaminants.
	Stripper may have been shut down manually causing the contaminated water in the trays to fall into the sump without being cleaned.	Allow stripper to go through proper shutdown cycle when stopping the unit.
	Stripper may be setup wrong allowing the water to bypass trays.	Check orientation of trays to ensure water will flow through each tray properly.
	Some contaminants may be present that are affecting the ability to strip other contaminants.	Consult manufacturer with test results of intake and discharge contaminants.
	Increase in pressure causes a decrease in airflow resulting in a decrease of contaminant concentrations.	See pressure rise in stripper troubleshooting above.
Water is collecting in discharge piping of stripper.	Air leaving the stripper is very humid and will condense some water in the pipelines.	Install a knockout drum in discharge line before air is piped to another section of the process.
	The stripper causes foaming of the water which results in water collecting in the discharge lines.	Test for foaming contaminants such as soaps and install antifoaming dosing system to prevent foaming.
	Airflow rate is higher than the design value causing water to be carried over into the discharge lines.	Decrease flow rate to within design range.
Stripper often shuts down on a high stripper sump alarm.	Transfer pump is flowing faster than the discharge pump.	Slow transfer pump or speed up discharge pump.
	Discharge pump is not working properly.	Troubleshoot discharge pump.
Moyno Pumps		
Pump does not produce sufficient pressure/vacuum.	Pump is not primed.	Prime pump.
	Wrong direction of rotation.	Check and change rotation if required.
	Vacuum or pressure gauge is faulty.	Replace gauge.
	Pump is not operating at required RPM.	Check and replace motor if required.
	Pump has wrong sized impeller.	Check impeller and replace if required.
	Pump pressure or vacuum is lost due to obstruction located between pump and gauge.	Check for flow restrictions and clean strainers or piping if required.

	Pump is not turned on.	Turn pump on.
	Coupling between pump and motor is no longer connected preventing the pump from rotating with the motor.	Reconnect and realign motor and pump.
Pump is leaking.	Gaskets are worn or faulty.	Replace gaskets.
	Mechanical seal has been overheated. This is often a result of operating the pump without any water.	Replace mechanical seal.
	Fittings are leaking on or around pump.	Tighten fittings.
	Water may be coming from another location.	Check for leaks around pump.
	Pump was run in reverse allowing the rotor to spin off of the pump shaft.	Disassemble pump and screw rotor back onto shaft (See manufacturer's manual).
Pump flow rate is too low.	Backpressure is too high for pump.	Reduce backpressure.
	Pump may not be sized correctly for process.	Replace pump.
	Pump impeller is too small.	Change pump impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter.	Replace filter and clean line.
Pump is making excessive noise during operation.	Manually rotate pump impeller and listen for clearance problems.	Disassemble pump and fix clearance problems.
	Alignment of pump may be off causing the flexible coupling to degrade.	Check alignment and reset alignment if needed. Replace flexible coupling if it is degraded.
Pressure Switch/Vacuum Switch		
Switch is not reacting at desired set point.	Switch is out of adjustment.	Change set point to desired value.
Switch is not working.	Switch may be faulty.	Remove input wires and test switch at desired pressure. If it does not trigger, it should be replaced.
Flow meter		
Flow meter is not rotating.	Dirt could have caused meter internals to jam up.	Disassemble flow meter and clean internal components.
Flow meter is rotating but pulse input is not working.	Switch on meter may be faulty.	Remove wiring and test contacts on meter to ensure that they are opening and closing. If not meter head needs to be replaced.

	Input wiring may be grounding out preventing the signal from opening and closing.	Test input wiring by isolating input wires and checking if input is on. If so you have a grounded input wire.
	Input to PLC is not working.	Simulate rotating meter by contacting input wires together and check for a detected flow rate and change in totalized flow.
Belt Driven Assemblies		
Squealing noise occurs on startup.	Belt is too loose.	Check tension of belt and tighten if required.
Excessive wear on bearings.	Belt is too tight.	Loosen belt tension.
Belt is wearing excessively.	Check orientation of blower and motor.	Adjust orientation if required.
Carbon Vessel		
Vessel is operating over pressure.	Silt may have collected in water phase vessel.	Remove lid and check for silt. Remove top layer of silt or replace vessel.
Vessel is breaking through earlier than expected.	Flow rate through vessel may be too high. Check design specifications.	Decrease flow rate.
	Air contaminant concentrations are higher than expected.	Test inlet concentrations.
	Check piping orientation to ensure that water is going in the top of water phase vessels and air is going in the bottom of air phase vessels.	Repipe vessel if piping is wrong.
	Ensure that there is not a large trapped air gap in the top of the water phase carbon vessel allowing the water to bypass a portion of the carbon.	Release air gap if present.
Bag Filter		
Vessel is operating over pressure.	Bag filter may be full of dirt and silt.	Remove cover and check for dirt buildup in the bag. Replace filter element if required.
	Equipment down stream of bag filter may be plugging.	Check for pressure buildup down stream of filter and fix pressure buildup downstream if found.
Water will not flow through filter fast enough.	Pump may not be able to supply enough pressure.	Check pressure output of pump with pump curve. Replace pump if needed.
Filters are plugging too fast	Filter element micron size may be too low.	Install larger micron filter element.

	Filter pressure switch setpoint may be too low.	Increase high pressure shutdown setpoint.
Oil Water Separator		
Water is collecting in product tank	Oil water separator may not be level causing water to spill into the skimmer tube.	Check level of oil water separator and adjust if necessary.
	Skimmer tube is not adjusted properly.	Check position of skimmer tube ensure that tube is rotated so the skimming slot allows at least 1-2" of oil to collect before spilling over into the oil tank.
	Skimmer tube is cracked or leaking.	Check that skimmer tube is not cracked, replace if necessary.
	Separator can be full of sludge on the bottom restricting water flow through to the clean water reservoir.	Check for dirt buildup in bottom. Drain and clean separator if necessary.
Oil is collecting on the clean water side	Oil water separator may be operating outside of design parameters.	Check that specific gravity of product and flow rate of separator match site-specific design print out for oil water separator. This can be found in the oil water separator section of your **newterra** manual or submittal package.
	Oil water separator was not primed with clean water on startup and large amounts of product were initially pumped into separator contaminating the clean water sections.	Drain separator, clean separator and media, and fill with clean water before proceeding.
	Silt can build up in the bottom of the separator restricting volume capacity and flow through media.	Inspect bottom of separator and inside of media. Drain and clean separator and clean or replace media if plugged or restricted.
	Inlet side of separator can have excessive amounts of oil on the top layer. This will reduce effective capacity of oil water separator.	Check level of oil collected in inlet side of separator. Adjust skimmer if required. Re-prime separator so only 1-2" of product remains on the top of the separator.
	Biological bacteria is suspending product in high-density mucus like collections that are passing through the separator.	Check for signs of bacteria in the inlet side of the separator. Contact **newterra** to discuss solutions to eliminating biological suspension.
	Product may be made up of two different components. The component breaking through may have a different density from what the separator was designed for.	Collect a sample of what is breaking through and confirm that it has the same properties as the product collecting on the inlet side.

	Oil storage tank may be full and high-level alarm not working properly. This will back the product up and fill the inlet side of the separator with product until the product passes under the lower weir and collects in the clean-water side.	Check product storage tank and ensure that level switch is working properly and that tank has not overfilled.
Oil and water is building up on inlet side but is not passing through separator and collecting in the clean water side.	Sludge and dirt may have built up on floor of separator preventing the water from passing by the lower weir.	Check for dirt buildup on bottom of separator. Drain and clean if necessary.
	Oil Water interface may be too low indicating that the separator has insufficient water to properly separate.	Fill the separator with clean water allowing water to collect in the inlet side forcing the oil water interface level to rise up too about 1" - 2" below the skimmer level.
	Only product is being pumped into inlet of separator.	If water is not present in sample entering the separator then it will not collect in the clean water side.
Water is in the oil outlet.	Skimmer opening is below the oil/water interface.	Adjust skimmer alignment to allow more oil to collect before skimming.
Oil is making its way to the outlet.	Water flow rate is too high.	Reduce flow rate through system.
	Filter media is plugged.	Replace or clean media.
	Oil discharge is plugged backing up OWS.	Drain oil down stream of skimmer.
Sand Filter		
Vessel is operating over pressure.	Sand filter may be full of dirt and silt.	Remove cover and check for dirt buildup on top of filter. Backwash filter.
	Equipment down stream of sand filter may be plugging.	Check for pressure buildup down stream of filter and fix pressure buildup downstream if found.
Water will not flow through filter fast enough.	Pump may not be able to supply enough pressure.	Check pressure output of pump with pump curve. Replace pump if required.
Filters are plugging too fast.	Filter was not backwashed properly.	Backwash filter vessel as per manufacturer's instructions.
	Filter pressure switch setpoint may be too low.	Increase high-pressure shutdown setpoint.
	Filter sand has solidified with calcification.	Replace sand in filter.

	Process water flow rate is operating above the design flow rate for the sand filter.	Check process flow rate and compare with design flow rate listed on manufacturer's literature or on the component sheet of the sand filter section of your **newterra** Manual.
Rotary Screw Compressor Package		
Compressor not starting.	Motor Overload.	Reset overload. Check compressor output pressure. Oil separator may be dirty, replace if needed. Check supply voltage.
	Stopped by compressed air temperature relay.	Oil level is too low. Not enough cooling air flow. Wrong compressor oil. Ambient temperature too high. Cooler dirty.
Insufficient air output.	Clogged intake filter.	Check condition of the filter and replace if needed.
	Clogged oil separator element.	Check condition of the oil separator element and replace if needed.
	Pressure switch is not working.	Check pressure switch adjustment. Repair or replace if switch is faulty.
	Receiver blow down valve open.	Disassemble and clean out internal components.
	Too high air consumption.	Check network for leaks and air powered devices.
	Drive belt slipping.	Check tension of belt and tighten if required. Replace belt if worn.
Compressor overheating.	Insufficient amount of oil.	Add more oil.
	Clogged oil filter.	Check condition of the filter and replace if needed.
	Cooler dirty.	Clean.
	Ambient temperature too high.	Check temperature and air circulation.
High oil consumption.	Oil return tube or its orifice is blocked.	Open and clean all internal components.
	Oil separator or sealing damaged or loosened.	Check seals and repair if needed.
	Oil separator dirty.	Replace.
	Wrong compressor oil.	Change oil. Use the correct oil as specified in the manufacturer's instructions.
	Output air temperature too high.	Check output temperature correct if it is too high.

	Faulty non-return valve of oil return pipe.	Check operation and replace valve if needed.
	Too much oil.	Drain extra oil out.
Network pressure rises over set valve.	Pressure switch is not working or damaged.	Check operation of switch.
	Output valve leaking.	Replace seal.
	Loose wire connections.	Check for loose wires and correct as needed.
Compressor doesn't restart automatically.	Pressure switch damaged.	Replace pressure switch.
	Output valve leaks.	Replace seals of output valve.
	Loose wires.	Check for loose wires and correct as needed.
Compressor doesn't stop automatically.	Output valve leaks.	Replace seals of output valve.
	Pressure Switch Damaged.	Replace pressure switch.
Refrigerated Dryer		
Water down stream of dryer.	Residual air in piping.	Blow out system with dry air.
	Air bypass system is open.	Check the bypass valve position.
	Inlet and Outlet conditions are reversed.	Check for correct connection.
	Air temperature on outlet of dryer may be too low.	Add heat trace to piping.
	Automatic drain mechanism is not working.	Replace drain mechanism.
	Dryer overloaded.	Check flow rate and inlet temperature.
High pressure drop across dryer.	Inlet air strainer clogged.	Clean inlet air strainer.
	Excessive air flow.	Check flow rate and reduce if needed.
	Separator filter clogged.	Replace filter sleeve.
	Freezing of moisture in evaporator.	Shut down dryer until system thaws.
Fault Alarm.	Dryer overloaded resulting in high air outlet temperature.	Check operating conditions.
	High outlet air temperature.	Correct high temperature.
	Thermostat switch is malfunctioning or not securely mounted.	Replace thermostat switch.
Refrigeration system not functioning properly in on position.	Power failure.	Check power.
	Line disconnect switch is open.	Check disconnect.

	Fuses blown, breaker blown.	Check fuses or breaker.
	Loose or faulty wiring.	Check wiring.
Refrigeration system cycles on and off.	High or low ambient conditions.	Check min/max temperature ranges.
	Air filter clogged.	Clean filter.
	Condenser fins clogged.	Clean fins.
	Fan motor or control switch not working.	Replace fan motor or switch.

Analog 4-20mA Transmitters		
Transmitter is sending a signal that is not accurate.	There may be water in the air sampling lines that is throwing off the readings.	Drain any moisture out of the air sampling lines.
	Transmitter may be out of calibration.	Refer to transmitter specification sheets on how to calibrate the transmitter. Note if transmitter is more than 10-25% out of calibration it will likely require factory recalibration.
Transmitter is sending 0-2 mA to the PLC input.	Transmitter may not be wired properly or one or more wire connections may be loose.	Check wiring with device specification sheet and newterra drawing. Check wiring for loose connections.
	Transmitter may be damaged or not working properly.	If you have a similar transmitter installed in another location on the system, switch them around to determine if the faulty transmitter works in another location. If the transmitter works you know the transmitter is not the problem. If the transmitter does not work in the other location then it is likely the transmitter. If the good transmitter does not work in the faulty location the problem is likely the wiring at that location or the input into the PLC.
Transmitter is sending over 20 mA to the PLC.	Transmitter is likely damaged.	Send back to manufacturer for re-calibration.
PLCs		
Power is on, Lights are on but PLC is not running the logic. Run light is not on.	PLC may not be in run mode. If the power has been off to the panel for an extended period of time, the PLC will switch out of run mode and stop running the logic.	Use external switch on PLC to switch from "term" to "run" then back to "term". This will force the PLC back into run mode. The run light should now indicate that the PLC is in run mode.
Power is on to panel but PLC lights are not on.	Fuse for PLC is pulled out or blown.	Test PLC fuse and replace if necessary. This is in the "PLC" fuse holder.

APPENDIX B –

OWS COMMISSIONING JOB HAZARD ANALYSIS (JHA)

Job Hazard Analysis Form

PROJECT/TASK: Commissioning Mobile OWS		CONTRACTOR: BIM				JOB No.:			
SUPERVISOR:		LOCATION:				DATE:			
JOB STEP Break the job into steps. Listing work which may be hazardous.	**HAZARDS** List the hazard or type of harm identified with each step.	**Inherent**			**CONTROL MEASURE** List the necessary control measures to be followed to eliminate/reduce the identified hazards.	**Residual**			**ACTION** Person who will ensure this happens
		Consequence	Likelihood	Risk Ranking		Consequence	Likelihood	Risk Ranking	
Opening Media canisters	Potential built up gases				Technicians will use appropriate PPE and wear Gas Tester alarm systems while opening GAC canisters and opening vent ports.				
Vacuum Media from OWS	Vacuum line inside OWS area				Operators/technician will open valve and ensure system is operating properly before working inside OWS canisters				
	Potential for inhalation of carcinogenic particulate being disturbed				Respirators will be worn while disturbing spent bentonite and GAC to avoid inhalation of particulate				
	Working from a ladder or raised platform				Work platform or ladder will be tested for stability before working with vacuum line to remove media				
Discharge or Vacuum to/from an open vessel	Working with pressurized hoses				When completing discharge, pressure is released, 3” opened, and the line will be vacuumed out.				
					Open end must always be controlled –				

					braced by operator, or in a bracket.				
	Potential for inhalation of carcinogenic particulate being disturbed				Respirators will be worn while disturbing spent bentonite and GAC to avoid inhalation of particulate				
Installing new media	Working from heights				Scaffolding will be present to ensure platform and railing to prevent falling.				
	Heavy lifting at heights				Telehandler will need to be used to remove pallets of media from Sea Cans and onto OWS roof so bags of media are within reach of the scaffolding and railing system				
	Potential for inhalation of carcinogenic particulate being disturbed				Respirators will need to be worn while pouring media through roof ports into canisters to prevent inhalation of particulate				
Commissioning new media	Working with pressurized hoses				A water truck operator will need to hook up line to tanks and fill through influent port in first media canister until fresh water comes out the effluent line into the berm.				

Job Hazard Analysis Attendees:

	Name	Signature	Date
Written by:			
Reviewed by:			

Score	*TABLE OF CONSEQUENCE*		
	People	**Plant**	**Environment**
5 – Very High/ Catastrophic	Multiple Fatalities.	Greater than $10 Million Loss	Catastrophe, destruction of sensitive environment, worldwide attention. Likely EPA prosecution. More than 30 days delay.
4 – High/ Major	Fatality or Permanent Disabilities.	$1 Million to $10 Million Loss	Disaster, high levels of media attention, high cost of clean up. Offsite environmental harm; more than 10 days delay.
3 – Moderate	Major Injuries – Incapacitations or requiring time of work.	$100 Thousand to $1 Million Loss	Major spills, onsite release, substantial environmental nuisance, more than 1day delay. (Leads to an additional resources call out i.e. SES).
2 – Low/ Minor	Significant Injuries – Medical Treatments, non-permanent injury.	$10 Thousand to $100 Thousand Loss	Significant spills. (Leads to a call out of Site Emergency Response Group).
1 – Very Low/ Insignificant	Minor Injuries – First Aid Treatments (cuts/bruises).	Less than $10 Thousand Loss	Low environmental impact. Minor Spills less than 80 Litres.

Score	*LIKELIHOOD*
5 – Almost Certain	The event is expected to occur in most circumstances. Likely to occur frequently - More than 1 per year.
4 – Likely/ Probable	The event will probably occur in most circumstances. Likely to occur several times – 1 per year.
3 – Moderate/ Occasional	The event should occur at some time. Likely to occur some time – 1 per 5 years.
2 – Remote/ Unlikely	The event could occur at some time. Unlikely but possible. 1 per 10 years.
1 – Rare/ Very Unlikely	The event may occur only in exceptional circumstances. Assumed it may not be experienced. 1 per 100 years.

Risk Rating = Consequence + Likelihood

Consequence	Risk Rating				
5	**6**	**7**	**8**	**9**	**10**
4	**5**	**6**	**7**	**8**	**9**
3	**4**	**5**	**6**	**7**	**8**
2	**3**	**4**	**5**	**6**	**7**
1	**2**	**3**	**4**	**5**	**6**
	1	**2**	**3**	**4**	**5**
	Likelihood				

Risk Rating - Definitions

Risk Rating	Definitions	*Action Required*
8 - 10	Intolerable	Task not to start till the risk is eliminated or reduced. Bring to the immediate attention of management. Formal assessment required. MUST reduce the risk as a matter of priority.
7	High	Bring to the immediate attention of management. Task not to start till the risk is eliminated or reduced. Further Assessment required. MUST reduce the risk as a matter of priority.
6	Significant Risk	Bring to the attention of supervision. Review risks and ensure that they are reduced to as low as reasonably practicable. To be dealt with as soon as possible, preferably before the task commences. Introduce some form of hardware to control risk.
5	Moderate Risk	Needs to be controlled but not necessarily immediately, an action plan to control the risk should be drawn up. Review effectiveness of controls. Ensure responsibilities for control are specified.
2-4	Low Risk	If practical reduce the risk. Ensure personnel are competent to do the task. Manage by routing procedure. Monitor for change

A JHA considers a variety of activities/tasks involved in a job scope and analyses the key hazards (sources of harm) and their consequences (types of harm) eg. Sources of harm – lifting a heavy pipe - manual handling. Types of harm – Back strain.

Main Points – On how to write a JHA.

1. Define the task – what is to be done.
2. Review previous JHA if any – have we done it before?
3. Identify the steps – what is to be done.
4. Identify the hazards of each step.
5. Identify who or what could be harmed.
6. Give the task a risk rating – Consequence + Frequency
7. Develop solutions to eliminate or control hazards in each step.
8. Review the risk rating after the control system has been implemented.
9. If risk rating unacceptable review the solutions till risk rating acceptable.
10. Agree who will implement the control system.
11. Document the JHA and discuss with the relevant personnel.

Hierarchy of Hazard Management – Control Measures

These steps outline what should be planned for when deciding what control measures are to be put in place. Whenever possible the highest step should be used first and then progress down the list.

1. Eliminate the hazard.
2. Substitution.
3. Reducing the frequency of a hazardous task.
4. Enclosing the hazard.
5. Additional procedures.
6. Additional supervision.
7. Additional training.
8. Instructions / information.
9. Some personal protective equipment.

APPENDIX C –

OWS OPERATIONS JOB HAZARD ANALYSIS

Job Hazard Analysis Form

PROJECT/TASK: Operating OWS		CONTRACTOR: BIM				JOB No.:			
SUPERVISOR:		LOCATION:				DATE:			
JOB STEP Break the job into steps. Listing work which may be hazardous.	**HAZARDS** List the hazard or type of harm identified with each step.	**Inherent**			**CONTROL MEASURE** List the necessary control measures to be followed to eliminate/reduce the identified hazards.	**Residual**			**ACTION** Person who will ensure this happens
		Consequence	**Likelihood**	**Risk Ranking**		**Consequence**	**Likelihood**	**Risk Ranking**	
Starting System	Leaks of fuel or contaminated water				Operator will address all active alarms.				
	Energized equipment failure				Pre inspection of all electrical equipment and pumps.				
	Skin contact with contaminated water				Wear hip waiters and rubber gloves when installing sump in berm				
Operating system	Exceeding maximum pressure in pumps and tanks				Operators/technician monitor all pressure valves and shut down system if any exceedances occur.				
	Leaks of fuel or contaminated water				Continuously monitor all lines and fittings to make sure they are secured properly				

	Slips, trips and falls Congested work area				Proper footwear, be aware of surroundings Communicate with other occupants, be aware of all valves and hoses when walking through seacan				

Job Hazard Analysis Attendees:

	Name	Signature	Date
Written by:			
Reviewed by:			

Score	*TABLE OF CONSEQUENCE*		
	People	**Plant**	**Environment**
5 – Very High/ Catastrophic	Multiple Fatalities.	Greater than $10 Million Loss	Catastrophe, destruction of sensitive environment, worldwide attention. Likely EPA prosecution. More than 30 days delay.
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3	**4**	**5**	**6**	**7**	**8**
2	**3**	**4**	**5**	**6**	**7**
1	**2**	**3**	**4**	**5**	**6**
	1	**2**	**3**	**4**	**5**
	Likelihood				

Risk Rating - Definitions

Risk Rating	Definitions	*Action Required*
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5. Identify who or what could be harmed.
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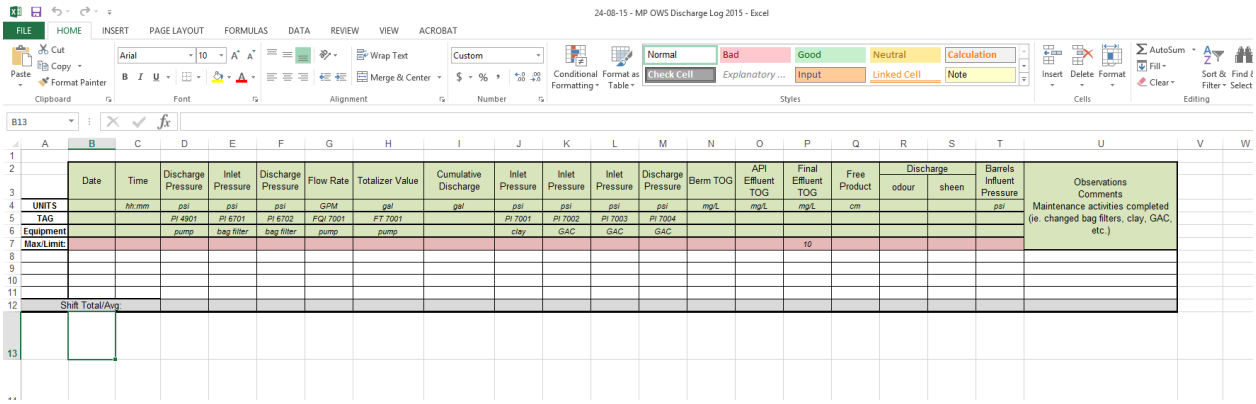
4. Enclosing the hazard.
5. Additional procedures.
6. Additional supervision.
7. Additional training.
8. Instructions / information.
9. Some personal protective equipment.

APPENDIX D –

OWS DISCHARGE LOG - DAILY LOG SHEET



Electronic file located on Mine Site Environmental Server:

FINAL File System\2.0 ENV MANAGEMENT, MONITORING PLANS (BIM INTERNAL)\2.08 Oily Water Separators

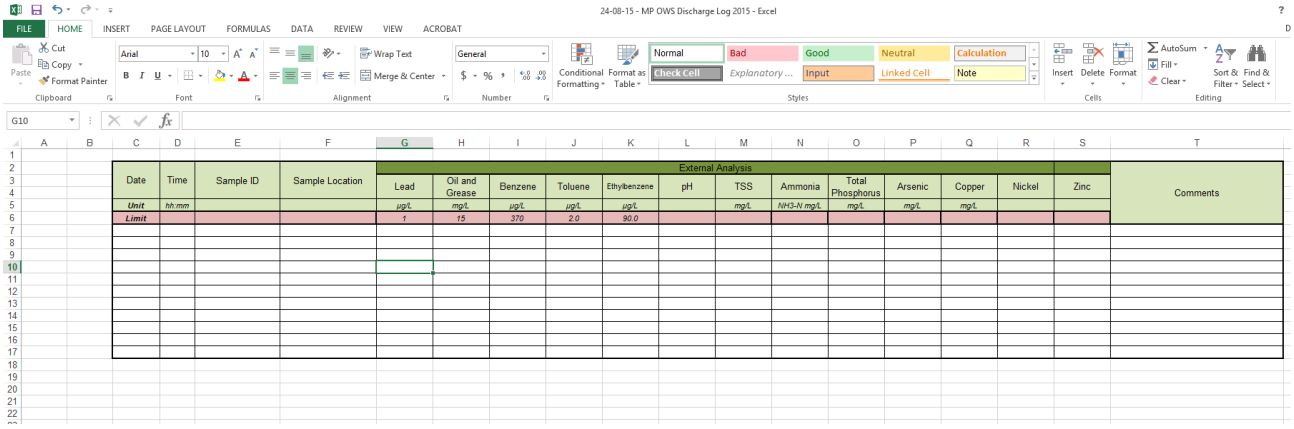
APPENDIX E –

BOTTLE SET REQUIREMENTS FOR SAMPLING STATIONS

Monitoring Group	Station			Parameters	Bottles	Total Bottles	Notes
Group 1	All water taking and discharge			Water withdrawal/discharge volumes in cubic meters			Daily
Group 2	MS-01 MS-01a	MP-01 MP-01a	SP-01 SP-01a	pH, TSS alkalinity, BOD TKN, N-NH3, TP, COD O&G Faecal coliforms (effluent only)	1 x 1L Plastic or glass for on site analysis of pH and TSS 1 x 1L Plastic for alkalinity, BOD 1 x 250mL glass with H2SO4 preservative for NH3, TKN, TP, COD 2 x 500mL glass with HCL preservative for Oil & Grease 1 x 300mL sterile PET with sodium thiosulfate filled to shoulder for feacal coliforms	6 Effluent 5 Influent	On Site
Group 3	MS-01 MS-01a MS-MRY-04 MS-MRY-04a MS-06+ MS-07 MS-08 MS-09 MS-MRY-09 MS-MRY-10 MQ-C	MP-01 MP-01a MP-Q1	SP-01 SP-01a SP-03 SP-07	Acute Toxicity	1 x 20L pail a. Acute lethality to Rainbow Trout, *Oncorhynchus mykiss* (as per Environment Canada's Environmentla Protection Series Biological Test Method EPS/1/RM/13) b. Acute lethality to *Daphnia magna* (as per Environment Canada's Environmentla Protection Series Biological Test Method EPS/1/RM/14)	1	Sterile Aquatox Pail
Group 4	MS-02	MP-02 MP-03	SP-02	pH, TSS, TDS N-NH3, TP benzene, ehtylbenzene, toluene O&G total metals: As, Cu, Pb, Ni, Zn	1 X 1L plastic or glass for on site lab analysis of pH and TSS 1 X 250ml glass bottle with H2SO4 preservative for NH3 3 X 40ml septa vials with no headspace for benzene, ethylbenzene and toluene 2 X 500ml glass with HCL preservatives for oil and grease 1 X 125ml HDPE with HNO3 preservative	8	On Site
Group 5	MS-03 MS-04 MS-05 (add TSS) MS-MRY-6	MP-03 MP-04 (add TSS)	SP-04 SP-05 SP-06 (add TSS)	pH, TSS benzene, ethylbenzene, toluene Total Lead (Pb) O&G total petroleum hydrocarbons (TPH)	1 x 1L plastic or glass for on-site lab analysis of pH and TSS 3 X 40ml septa vials with no headspace and sodium bisulfate preservative for BTE, TPH (F1) 1 X 125ml HDPE with HNO3 preservative for total lead 2 X 500ml glass bottles with HCL preservative for Oil & Grease 2 X 500ml amber glass bottles with sodium bisulfate preservative for TPH (F2-F4)	9	On Site
Group 6	MS-MRY-13A MS-MRY-13B		SP-08	pH, TSS, TDS alkalinity, conductivity, DOC O&G phenols, TOC total petroleum hydrocarbons (TPH - F1) total petroleum hydrocarbons (TPH - F2-F4) total full list of metals total mercury	1 X 1L plastic or glass for on site analysis of pH and TSS, turbidity, TDS 1 X 1L Plastic for alkalinity conductivity, DOC 2 X 500ml glass with HCL preservative for oil & grease 1 X 250ml glass with H2SO4 preservative for phenols(4AAP), TOC 3 X 40ml septa vials with no headspace and sodium bisulfate preservative for TPH (F1) 2 X 500ml amber glass bottles with sodium bisulfate preservative for TPH (F2-F4) 1 X 125ml HDPE with HNO3 preservative for total metals 1 X 120ml square glass with HCL preaservative for total mercury.	12	On Site
Group 7	MS-06+ MS-07 MS-09 MS-MRY-09 MS-MRY-10 MS-MRY-11 MS-08 MS-08-US MS-MRY-10a	MP-07?	SP-07	pH, TSS, TDS, turbidity alkalinity, hardness, DOC, sulphate, fluoride, chloride TKN, N-NH3, N-NO3, TOC, TP Total Full List Metals Dissolved Full List Metals Total mecury Dissolved mercury	1 X 1L plastic or glass for on site analysis of pH and TSS, turbidity, TDS 1 X 1L Plastic for alkalinity, anions, DOC 1 X 250ml glass with H2SO4 preservative for tkn,nh3,toc, TP 1 X 125ml HDPE with HNO3 for total metals 1 X 125ml HDPE field filtered and preserved with HNO3 preservative for dissolved metals 1 X 120ml square glass with HCL for total mercury 1 X 120ml glass field filtered and preserved with HCL for dissolved mercury	7	On Site
Group 7a	MS-MRY-10a MS-08-US MS-08						
Group 8	MS-C MQ-C	MP-C MP-Q1		N-NH3 N-NO3, conductivity pH, TSS O&G	1 X 1L plastic or glass for on site analysis of pH and TSS, turbidity 1 X 250ml glass with H2SO4 preservative for NH3 1 X 1L plastic or glass for NO3, conductivity 2 X 500ml glass with HCL preservative for oil & grease.	5	On SIte

APPENDIX F –

OWS DISCHARGE LOG - EXTERNAL RESULTS SHEET



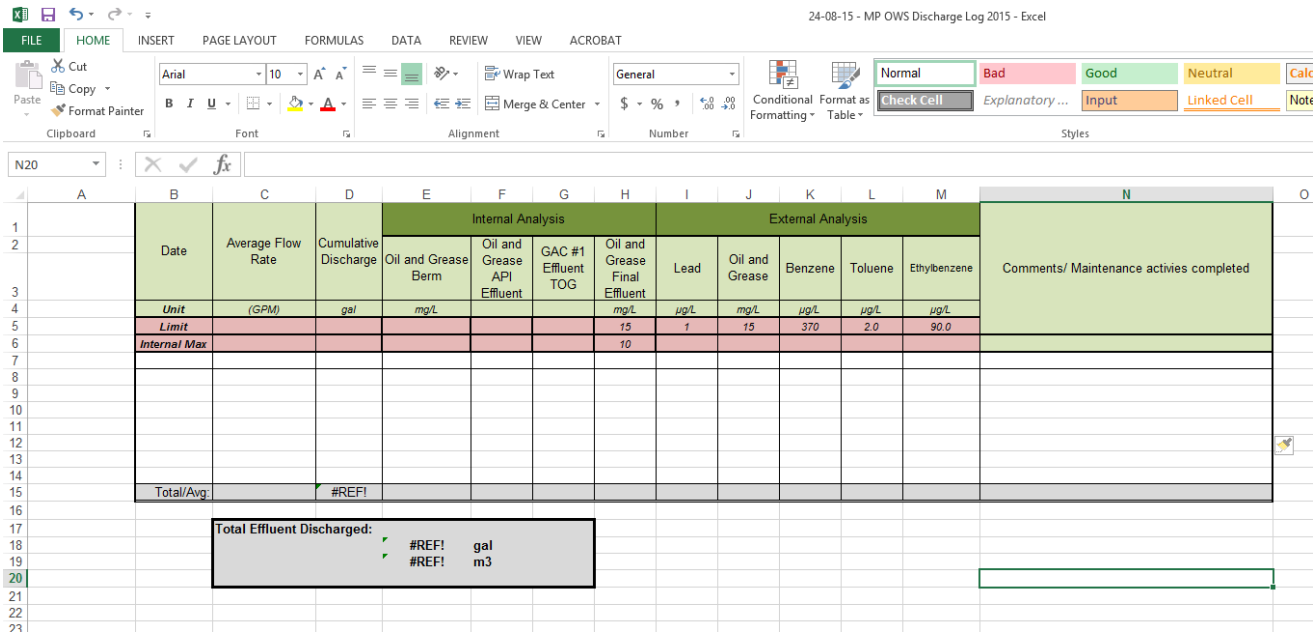
Date	Time	Sample ID	Sample Location	External Analysis													Comments
				Lead	Oil and Grease	Benzene	Toluene	Ethylbenzene	pH	TSS	Ammonia	Total Phosphorus	Arsenic	Copper	Nickel	Zinc	
Unit	*hh:mm*			*µg/L*	*mg/L*	*µg/L*	*µg/L*	*µg/L*		*mg/L*	*NH3-N mg/L*	*mg/L*	*mg/L*	*mg/L*			
Limit				*1*	*15*	*370*	*2.0*	*90.0*									

Electronic file located on Mine Site Environmental Server:

FINAL File System\2.0 ENV MANAGEMENT, MONITORING PLANS (BIM INTERNAL)\2.08 Oily Water Separators

APPENDIX G –

OWS DISCHARGE LOG – SUMMARY SHEET



Electronic file located on Mine Site Environmental Server:

FINAL File System\2.0 ENV MANAGEMENT, MONITORING PLANS (BIM INTERNAL)\2.08 Oily Water Separators