POST-REMEDIAL OPERATION AND MAINTENANCE PLAN
DOLLINGER CORPORATION, SITE NO. 828078

by:

H&A of New York
Rochester, New York

for

American Filtrona Corp.
Richmond, Virginia

File No. 70007-044
November 1994

Geotechnical Engineers &
Environmental Consultants

21 November 1994
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Division of Hazardous Waste Remediation
Room 222
NYSDEC
50 Wolf Road
Albany, New York 12233-7010

Attention: Mr. Amar Nagi

Subject: Post-remedial Operation and Maintenance Plan
Dollinger Corporation, Site No. 828078

Dear Mr. Nagi:

H&A of New York is pleased to provide, on behalf of American Filtrona Corporation, the enclosed Post-remedial Operation and Maintenance Plan for the Dollinger facility in Brighton, New York. Included with this report is a set of "as-built" engineering drawings.

Please note that a portion of the 2-Phase Extraction system operating at this site is patented and may only be designed, installed, and operated by entities licensed by the patent holder. Appendix B contains proprietary information relative to this process which, if made publicly available, would adversely affect the license and patent holder. Appendix B to this report is being provided in the copy submitted to the NYSDEC project manager Mr. Amar Nagi. Because of the confidential nature of the proprietary information provided in the Appendix, other distribution copies of this report will not contain this Appendix. Furthermore, it is requested that this information not be released to Department personnel not directly involved in review of this document, nor to the public domain under the Freedom of Information Act, but remain confidential as provided in the Act.

Thank you for your continued input on this project.

Sincerely yours,
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I. INTRODUCTION

1-01. INTRODUCTION

The intent of the Post-remedial Operation and Maintenance Plan is to:

- provide detailed "as-built" drawings of the system and its components,
- describe the in place remedial system and its operation,
- list the remediation goals and means of attaining such goals,
- provide detailed operating instructions,
- give maintenance and servicing information and schedules,
- provide system performance monitoring procedures,
- provide system effectiveness monitoring procedures,
- and provide the site specific health and safety plan for the site and its operations.

1-02. 2-PHASE EXTRACTION DESCRIPTION

2-Phase Extraction is a remedial process developed and patented by Xerox Corporation that combines soil vapor extraction with groundwater recovery under high vacuum (>25 inches Hg at the source). The 2-Phase Extraction process was developed for remediation of volatile organic compounds (VOCs) from low permeability soils. The process utilizes skid mounted equipment for the extraction of a vapor-liquid mixture from the subsurface through a series of wells and trenches. The well or trench acts as an in-situ air stripper where induced vacuum actually strips the majority of VOC's from the entrained groundwater; thereby transferring the contaminant mass from the liquid to the vapor phase.

The 2-Phase Extraction system consists of a liquid-ring vacuum pump with oil seal system; recovered liquid system; vapor conditioning system; wells, trenches and collection piping system; liquid treatment system; and vapor treatment system. Descriptions of each of these systems are detailed in later sections.

1-03. PRE START-UP MONITORING, PROCEDURES, AND RESULTS

Prior to the start-up of the 2-Phase Extraction system, a series of samples were collected in order to establish an understanding of baseline site conditions. These samples consisted of two soil samples from the boreholes for each newly installed vacuum extraction well, and two samples from each of the newly installed trenches. A groundwater sample was also collected from each of the new extraction wells, trenches, and from each of the 13 nearby observation wells. Each of these samples was analyzed using USEPA Method 8010/8020 for select site volatile compounds. Results from these analyses are provided on Table I.

Three pre-start-up tests were conducted on the AFC-Dollinger 2-Phase Extraction system. The tests were studied separately based on time of installation completion. The three test groups studied and the test dates were as follows: Group 1, wells VE-3,4,5,7,8,9,10,11,12, and 13 tested on 24-26 May 1994; Group 2, wells VE-1,2, and 6 on 22 June 1994; and Group 3, trenches VTR-1,2, and 3 tested on 9 August 1994. The three test groups were studied using the same procedures, as follows:

1. Operate the 2-Phase Extraction system with each test group on line (turned on) for a minimum of 18 hours in order to determine the baseline VOC concentration levels being removed in the water and vapor.

2. Analyze vapor samples using portable Photovac (photoionization detector) gas chromatograph hourly to establish a baseline concentration for each member of the study group (well or trench).

3. Turn off each individual member, collect a vapor sample, and record the vapor flow rate.

4. Once all members of a test group are off, collect groundwater level measurements, and shield point vacuum readings to determine the group's area of influence.

By following this procedure, the mass removal concentration and extraction rate of VOCs were determined for each well and trench. From that information, the optimal wells and trenches for vapor extraction were identified, and have been selected for initial utilization during initial startup. Drawing C-1, and Figures 1 and 2 show the location of these wells and trenches.

It is anticipated that those wells and trenches performing the best in terms of removal of VOCs and efficiency of operation, will be operated first. Once the performance of these wells and trenches begins to level off, alternate or additional wells and trenches will be connected to the system.

The VOC concentration on 26 May 1994, for the first test group (wells VE 3-5, and 7-13) was 552 ug/L or an extraction rate of 2.5 lbs/day. On 26 May, when well VE-13 was off, the vapor was analyzed at 309 ug/L or an extraction rate of 1.4 lb/day. Therefore, approximately half of all VOC concentrations was being extracted through VE-13. When well VE-4 was shut off, a sample of the vapor phase was analyzed, and indicated that 247 ug/L or 1.4 lb/day were being extracted. Therefore, it also appears VE-4 is responsible for removal of approximately half of all VOCs within this group. The remaining wells in this group were responsible for only a small percentage of VOCs extracted. Groundwater levels indicated that the 2-Phase Extraction system was lowering the local groundwater table, however, the test was too brief to show an overall impact across the site. The shield point data indicated that the site had started to de-water, and vacuum had begun to penetrate the formation. The data also indicated, as with the groundwater data, that the test had been too short in duration to result in an overall vacuum influence in the formation.

VOCs extracted on 22 June 1994, when the second test group (wells VE-1,2, and 6) was on, was 285 ug/L or a contaminant extraction rate of 1.7 lb/day. VE-1 was shut off and the contaminant concentration dropped to 168 ug/L, or an extraction rate of 1.0 lb/day, indicating that approximately half of the VOCs were extracted by VE-1. VE-2 was shut off line and the contaminant concentration dropped slightly to 273 ug/L. VE-6 was shut off and the system vacuum increased indicting that VE-6 had vented clean air, and was removing VOCs from the formation. The test indicated that well

VE-1 was responsible for the majority of VOCs removed from the formation. Since VE-6 had vented during the test, it had little to no influence on the baseline VOC concentrations; well VE-2 showed minor VOC removal during the test.

The VOC vapor-phase extraction rate during the third test group (VTR-1,2, and 3) start-up was approximately 10 ug/L. When VTR-2 and VTR-3 were shut off, the flow rate decreased, the system vacuum increased, and VOCs increased more than five-fold. The results of the test indicate that VTR-2 and VTR-3 vented atmospheric air and had little effect on VOC removal from the subsurface. When VTR-1 was operated alone, it had an extracted VOC concentration of 55 ug/L.

As of mid-November 1994, wells VE-1, VE-3, VE-4, VE-7, VE-8, and VE-13 are on.

1-04. GOALS OF REMEDIATION, OPERATING APPROACH, AND MEANS OF MEASURING PROGRESS TOWARDS THESE GOALS

Remediation goals of the 2-Phase Extraction system consist of reaching the soil clean up objectives presented on Table II. The schedule for sampling and analysis to evaluate progress towards these goals is presented on Table III and described in greater detail in Section V.

The effectiveness of the 2-Phase Extraction effort will be measured by several means. During operation of each system, the equipment will be monitored; during and after system operation, site sampling will be used to measure the change in concentrations of site compounds of concern in selected media; and after the remediation is completed, the site will be monitored for a period of time in order to track the concentrations of site compounds.

To evaluate the effectiveness of the 2-Phase Extraction, soil vapor will be analyzed monthly, and groundwater will be semi-annually sampled and analyzed. Soil vapor samples will be collected from the extraction wells and/or shield points in-place around the wells. Groundwater samples will be collected from the observation well network. The results will be used to determine what level of remediation effort is to be continued. Once remediation is achieved, as determined by asymptotic conditions exhibited in soil vapor results, confirmational soil samples will be collected. Three soil sampling locations will be selected (based on input from NYSDEC) in both the former degreaser area and the former drum storage area. Samples at these locations, down to the specified remediation depths (3.5 feet [or 6 inches deeper than the trench, whichever is deeper] in the drum storage area, and 14 feet in the degreaser room area), will be collected and analyzed for VOCs. Soil samples containing the highest concentration of the VOCs, based on field screening, will be analyzed. If operational data indicates additional soil sampling is needed in other areas, it will be considered and locations will be selected based on AFC's opinion and NYSDEC's input. Groundwater from wells within or immediately adjacent to the remediation areas, will also be samples. When acceptable concentrations are measured at the agreed upon soil sampling locations, locations at the perimeter of the remediation area will also be sampled. The combination of reaching asymptotic soil vapor concentration conditions, and soil sample results below the criteria shown on Table II will be the indication that site remediation may have occurred.

Once the 2-Phase Extraction system is in place and running, the system effectiveness will be measured by periodic sampling and analysis of the groundwater and air removed from the subsurface. These samples will be taken from the extraction wells and from the pre- and post-treatment discharges. The schedule for this sampling is included on Table III.

The long-term sampling and analysis of surface water consists of a sample to be collected and analyzed after the 2-Phase Extraction system has been turned off. This is described on Table III.

While this section of the Post-remedial Operation and Maintenance Plan deals primarily with what the remediation goals are, Section V contains additional information or specific sampling schedules and their purpose. The information presented both here and in Section V is summarized on Table III.

II. REMEDIAL SYSTEM OPERATION

2-01. OPERATING LICENSES

The installed 2-Phase Extraction system is patented by Xerox Corporation and its operation is restricted by the patent-holder to only those entities holding a license to operate issued by the patent holder. H&A of New York is the licensed operator of the system.

2-02. OPERATOR SKILLS

The operator of the 2-Phase Extraction system must have a basic working knowledge of vapor and liquid handling mechanical systems. Even though the extraction system is relatively simple, it is a mechanical system which will need periodic maintenance and adjustments. This document, which includes manufacturer's recommendations, identifies the periodic maintenance required on the "skid" and the remainder of the system.

1. Required Skills/Training

   - 40-Hour Health and Safety Training Course for Hazardous Waste Operations and Emergency Response in accordance with OSHA Standards, plus required 8-hour annual refresher training as required under OSHA 29CFR 1910.120.
   - Mechanical Background

2. Recommended Knowledge and Experience

   - A knowledge and understanding of vacuum systems
   - Experience in the installation of piping systems, i.e. PVC solvent piping, threaded steel piping, etc...
   - Experience in the maintenance and operation of pumps, i.e. vacuum pumps, centrifugal pumps, progressing cavity pumps, etc...
   - A knowledge and understanding of system controls

3. Health and Safety Requirements

Appendix A contains a copy of the site specific Health & Safety Plan. All site personnel are required to follow this plan. The plan includes the 2-Phase Extraction system operation, maintenance, and monitoring activities described herein. These activities, and the health and safety measures required while performing them, are included in Appendix A.

2-03. Description of Operation

The primary tasks associated with the operation and maintenance (O&M) of the remedial systems includes evaluating operating parameters and performing preventative maintenance.

System operating parameters are to be monitored and recorded during routine inspections on the 2-Phase Extraction system, and the Vapor and Liquid Treatment Systems. The individual components that will be monitored during routine inspections are described below. Examples of log sheets used for recording data are included in Table IV.

Refer to, as-built drawing P-1, for the process and instrumentation diagrams (P&IDs) for the 2-Phase Extraction system and the Treatment Systems.

2.3.1 2-Phase Extraction System

Information pertaining to the Operation of the 2-Phase Extraction system is confidential. Refer to Appendix B.

2.3.2. Vapor Treatment

The treatment used for the extracted vapor stream from the 2-Phase Extraction system is carbon adsorption. There are two (2) 2000 lb. granular activated carbon (GAC) vessels installed in series. The primary vessel adsorbs the majority of the contamination, with the secondary vessel acting as a "polish". The effluent of the carbon vessels is discharged through the roof to the atmosphere. Prior to the carbon vessels, a vapor flow totalizing meter is installed.

There is associated instrumentation with the Vapor Treatment System that must be monitored on a periodic basis in order to assess the performance of the system. Following is a brief description of the instrumentation monitored, refer to the log sheets in Table IV.

- Inlet Vapor Temperature Gauge to Primary GAC measures the temperature of the vapor stream prior to entering the primary carbon vessel. This is also used to monitor the conditioning of the vapor stream from the 2-Phase "skid".

- Inlet Vapor Temperature Gauge to Secondary GAC measures the temperature of the vapor stream prior to entering the secondary carbon vessel. This is also used to determine that the vapor stream has been properly conditioned.

- Discharge Vapor Flow Meter reads the current vapor mass discharge from the system and is used to assess extraction performance. The vapor flow meter measures rate and total flow in cubic feet per minute.

2.3.3 Liquid Treatment

The treatment used for the recovered groundwater from the 2-Phase Extraction system is carbon adsorption. There are two (2) 200 lbs. GAC vessels installed in series. The majority of groundwater contamination has been "stripped" by the vapor stream within the system.

These vessels act as a "polish" prior to discharge to the Monroe County Pure Waters (MCPW) sanitary sewer and local publicly owned treatment works (POTW). A totalizing water flow meter has been installed to monitor groundwater discharge. Following is a brief description of the instrumentation monitored, refer to the log sheets in Table IV.

- Inlet Pressure Gauge to Primary Carbon Vessel reads the inlet pressure to the primary carbon vessel.

- Inlet Pressure Gauge to Secondary Carbon Vessel measures the outlet pressure from the primary carbon and the inlet pressure to the secondary carbon. This can be used to determine the pressure drop across the primary carbon. Pressure drop can be an indication of biological and/or sediment fouling.

- Outlet Pressure Gauge from Secondary Carbon Vessel measures the outlet pressure from the secondary carbon. This can be used to determine the pressure drop across the secondary carbon. Pressure drop can be an indication of biological and/or sediment fouling.

- Water Discharge Total Flow Meter measures total groundwater production being recovered from the wells.

2-04. OPERATION INSTRUCTIONS

These operating instructions are intended to provide standard guidelines for normal operation of the 2-Phase Extraction system. This document provides normal start-up, shut-down and routine operating conditions. The instructions are intended to supplement the individual component information provided by the extraction unit manufacturer included in this document (Appendix C). Please refer to the Manufacturer's recommendations for routine servicing of equipment components.

2.4.1 Pre Start-up Commissioning

Prior to initial unit start-up, all components in the system were checked to confirm the unit was ready for service. The following checks were performed prior to initial operation:

a. If any components were disassembled for shipment, recheck the assembly with the drawings provided, perform leak testing on all field assembled piping components and systems.

b. Make sure the system is level and anchored to the floor.

c. There are four main external connection to be made to the system:

- 2-Phase piping to the Inlet Separator from the wells and trenches,
- Vapor piping from the Reheat Exchanger to Vapor Treatment,
- Liquid discharge piping from Filter Assembly to Liquid Treatment,

- Main (480V) power supply to the control panel.

d. Check all power supply connections to confirm proper voltage and overload protection is in place.

e. Check rotation on all driven equipment to confirm proper power phasing.

f. Verify final alignments of all driven equipment.

g. Physically check and verify proper operation of all system interlocks and alarms including components not physically located on the unit (i.e. ventilation, etc.).

h. Confirm that all fluid levels are in normal operating range (i.e. seal oil).

i. Confirm that all system isolation valves are installed and in normal operating position.

2.4.2 Normal Start-up

The extraction unit has been designed for automatic unattended operation. High groundwater recovery rates are normal during initial extraction which may require operator attention to prevent unit shutdown. We recommend the unit be observed after any start-up operation to confirm stable conditions have been achieved and the system is performing properly. Refer to Figure 3 for control panel layout and Table IV for log sheet. The normal start-up procedures are as follows:

a. Confirm all system valves are in normal operating position and all extraction well isolation valves are closed.

b. Confirm all system fluid levels are in normal operating range.

c. Close Main Circuit Breaker/Disconnect to energize unit. The following should occur:

- Inlet Separator and High Temperature alarms should be illuminated.
- System vapor flow meter output should read zero.
- System liquid flow totalizer should read zero, if not, record flow total on log sheet prior to start-up.

d. Depress the Main Reset button to clear Inlet Separator alarm.

e. Depress the High Temperature Reset button to clear High Temperature alarm.

f. Set extraction pump "hand-off-auto" selector to "auto" position.

g. Set after-cooler "off-on" selector to "on" position.

h. Open system vent valve partially to provide air flow through unit.

i. System is ready to start.

j. Depress System Start button. Vacuum pump, seal circulating pump and air cooler fans should start. System vacuum indicator lamp (green) should be illuminated.

k. Confirm normal operating pressures and temperatures.

l. Slowly open valve(s) to extraction wells and observe changes in system operating conditions.

m. Observe inlet separator level and confirm extraction pump start/stop at set levels.

n. When all extraction wells are on line or as needed, slowly close vent valve to increase system vacuum to desired level.

o. Record operating conditions on system log sheets for future reference.

2.4.3 Normal Operation Checks

The extraction unit is designed for unattended operation. Routine operating checks are necessary to confirm proper operation and perform preventative maintenance. Refer to Table IV for log sheets. Routine operating checks include the following:

a. Record operating data on log sheets.

b. Observe system strainers (oil and conical in vapor stream) and filter assembly, pressure/vacuum gauges to determine if cleaning/changeout is necessary.

c. Set system vacuum (using vacuum breaker) to achieve target levels.

d. Observe vacuum pump discharge temperature. Adjust the seal oil temperature control valve to the vacuum pump as necessary to hold 190°F at the vacuum pump discharge.

e. Observe vapor phase outlet temperature from the unit. Adjust the seal oil temperature control valve to the reheat exchanger as necessary to hold target temperatures for treatment (approx. 100°F).

f. Check condensate receiver for recovered liquids, other than water. Drain to approved container as needed.

2.4.4 Normal Shutdown

a. Press the System Stop button. Unit should stop.

b. Position the extraction pump "hand-off-auto" selector to the "hand" position to pump away accumulated groundwater in the inlet separator. Place selector in "off" position when the pump stops.

c. Close all inlet valves from the extraction wells and close the vapor discharge valve from the unit to isolate the system from the well field and treatment system.

d. Open the circuit breaker/disconnect to de-energize the unit.

The preceding information is intended to be used as a guide only by qualified operators in developing specific operating procedures for each system application. In the event additional information is required, contact the system designer and/or manufacturer.

2.4.5 Re-starting After Shutdown

The 2-Phase Extraction system has alarms and shutdowns installed within the controls and instrumentation of the "skid". If the system shuts down due to an alarm condition, determine the cause of the alarm, correct the condition, reset the alarm and proceed with normal start-up procedures.

2-05. EFFLUENT TREATMENT AND DISCHARGE

2.5.1 Description of Vapor Treatment

The majority of contaminant mass from the 2-Phase Extraction process is contained in the vapor phase. The treatment of the vapor phase utilizes GAC. There are two 2000-pound carbon vessels piped in series. The primary vessel adsorbs the majority of contaminants depending on loading, mass removal and specific contaminant. The secondary vessel acts as a polish prior to discharge to the atmosphere.

To evaluate for compliance with the air permit, weekly vapor samples are collected. A copy of the air permit is included in Appendix D. Pre-, mid-, and post-carbon samples are analyzed. Data, along with operating hours and vapor flow rates are used to determine contaminant break-thru of carbon vessels, contaminant loading on the carbon, and mass removal from the subsurface.

2.5.2 Description of Liquid Treatment

The treatment of the recovered groundwater discharged from the 2-Phase Extraction system also utilizes GAC. There are two 200-pound carbon drums piped in series. The primary canister adsorbs the majority of contaminants and the secondary vessel acts as a polish prior to discharge to the sanitary sewer.

To maintain compliance with the local wastewater treatment facility, monthly liquid samples are collected and analyzed. Similar data is collected and generated as for the vapor stream, but the carbon loading and mass removal is insignificant compared to that of the vapor phase.

2-06. DISPOSAL OF USED MATERIALS AND WASTE

2.6.1 Generated Waste

The majority of waste generated from the 2-Phase Extraction system consists of the water phase particulate filters used to filter water prior to entering the liquid phase carbon treatment vessels. On an annual basis, the seal oil (approximately 10 gallons) will be changed out. These wastes will be analyzed as necessary for disposal purposes and sent to an approved disposal facility or incinerator with appropriate documentation. This documentation will be maintained and referenced in the required periodic reporting during operation of the 2-Phase SVE system.

2.6.2 Carbon Regeneration/Disposal

The contaminant mass removed during remediation will be adsorbed on the vapor and liquid carbon. Based on analytical data, the carbon will be regenerated by an approved facility with all appropriate documentation. The frequency of regeneration will be based on mass removal rates and carbon loading.

III. REMEDIAL SYSTEM MAINTENANCE

3-01. INSPECTION

Periodic inspections and site visits will be performed on the remedial system. Bi-weekly (twice per week) visits are currently being performed, due to initial start-up and system optimization activities. During initial start-up, more frequent visits are necessary for filter changes and to determine "normal" operation of the system (ie. mass removal, operating temperatures, etc.).

System operating parameters are recorded on the log sheets (Table IV) at each site visit. This data can be used to evaluate trends in the operating parameters, determine maintenance items to be addressed, and changes in the system performance.

There are numerous items to be periodically inspected or checked. The manufacturer of the 2-Phase skid recommends maintenance schedules for the various components of the skid in their manual (Appendix C). There are several items that should be checked at each site visit.

The items to be periodically checked associated with the skid are presented in Appendix B and C.

The following is a list of items to be checked periodically within the remedial system:

- Visually check the integrity of all piping and control systems and verify all equipment is operational.
- Check and record the liquid carbon vessel pressures.
- Check for liquid within the secondary containment vessel.
- Weekly (at start-up) water level measurements of selected monitoring wells on site to be recorded on Water Level Data sheet, included in Table IV.
- Weekly (at start-up) soil vapor vacuum measurements of all shield points on site to be recorded on Shield Point Data sheet, included in Table IV.
- Weekly samples (vapor and liquid) collected.

3-02. MAINTENANCE

3.2.1 2-Phase Extraction Skid

This data is proprietary and can be found in Appendix B.

3.2.2 Liquid Treatment System

The liquid treatment carbon vessels shall be changed out based on the analytical data indicating "break-thru". "Break-thru" is when contaminants are detected on the discharge side of the vessel. The primary carbon will be removed, the secondary carbon will become the primary and the new carbon will be placed in-line as the secondary vessel.

All new liquid carbon vessels must be degassed prior to operation to prevent vapor lock. To degas a carbon drum, clean water is added to the outlet port of the vessel until it is full, allow to stand for a minimum of 24 hours, and water is added as necessary.

Liquid carbon vessels have a pressure rating of 10 psig. If the pressure on the vessels increases, this could indicate sediment fouling of the carbon and change-out must be performed. If this persists, the particle filters may need to be changed to a smaller micron filter cartridge.

3.2.3 Vapor Treatment System

The vapor treatment vessels shall be changed out based on analytical data indicating "break-thru". "Break-thru" is when contaminants are detected on the discharge side of the vessel. The primary carbon vessel will be removed, the secondary carbon will become the primary and the new carbon will be placed in-line as the secondary vessel.

3-03. MONITORING

Periodic (daily to weekly) monitoring of the 2-Phase Extraction system is necessary to ensure proper operation of the remedial system. Record the data on the Log sheet (Table IV) at each site visit. This data can be utilized to determine trends in operation and maintenance items to be addressed.

The items that need to be monitored at least once a week are as follows:

- Replace particulate filter cartridges as necessary.
- Oil Scavenger Line Sight Glass - should be wetted, not full; this shows that the oil mist eliminator within the oil reservoir is operating properly.
- Clean dirt, sediment, or sludge from the inlet separator and\or the capacitance probe; this is to ensure proper operation of the level probe and transfer pump.
- Drain water from Oil Reservoir.
- Drain accumulated product/seal oil from condensate separator.
- Clean Y-strainer on seal oil piping.
- Replace seal oil filter as necessary.
- Replace/clean the seal oil cooler filter.
- Replace seal oil annually.
- Replace oil mist eliminator annually.
- Check transfer pump flow rate.

These are some of the major items to be checked and monitored. The frequency will depend on operation. Skid manufacturer recommendations are included in Appendix C.

3-04. ALARM CONDITIONS

The 2-Phase Extraction skid is equipped with internal alarms to protect the system. More information, some of which is proprietary, is included in Appendix B. The skid has a control panel with all alarm conditions lighted. See Figure 3 for a pictorial of the control panel. The following is a list of the alarms with possible causes and actions required.

- High Temperature Reset: Excessive discharge temperature from the vacuum pump or power interruption to the skid panel.

  Lower set temperature by modulating regulator valve.
  Change filter on seal oil cooler.

- Vacuum Pump Overload: Vacuum pump motor overworking, possibly caused by low vacuum, high vapor flow.

  Change high vapor flow conditions.

  Reset motor starter within skid control panel.

- Inlet Separator High Level: High liquid-flow rate above separator capacity or transfer pump failure.

  Action:
  1. Check all valves in loop for proper operation and positioning.
  2. Check capacitance probe operation.
  3. Throttle flow rate down by shutting off wells as required.

- Inlet Separator Low Level: Transfer pump discharging in "hand" mode below set level or power interruption to skid.

  Action:
  1. Allow liquid to accumulate in inlet separator, push alarm reset.

- High Carbon Pressure: Spare alarm - Not in operation

- Oil Reservoir High Level: Water in oil separator or dig circulation pump failure.

  Action:
  1. Drain water from reservoir
  2. Check demister Element in inlet separator for proper operation
  3. Check circulation pump discharge temperature
  4. Troubleshoot pump

- Oil Reservoir Low Level: Low oil level.

  Action:
  1. Check scavenger lines for blockage
  2. Check oil separator demister element for proper operation
  3. Check oil carry over

- Circ. Pump Overload: High oil flow.

  Action:
  1. Check all valves in loop for proper operation and positioning
  2. Check oil filter and change if pressure drop is greater than 15-20 psig across filter
  3. Check oil Y strainer
  4. Reset motor starter in skid control panel

- Exhaust Fan Cr (Circuit Relay): Exhaust/Booster fan failure or power interruption to fan.

  Action:
  1. Troubleshoot fan if required
  2. If power failure push alarm reset

- Transfer Pump Overload: Deadheading of pump (no flow), or pump failure

  Action:
  1. Check all valves in loop for proper operation and positioning
  2. Check particle filters for loading
  3. Troubleshoot pump if required
  4. Reset motor starter in skid control panel

- Condensate High Level: High liquid level in condensate separator

  Action:
  1. Check operation of ball float trap

- Back Pressure: High vapor flow (low vacuum on vacuum pump)

  Action:
  1. Check vacuum breaker position
  2. Throttle flow rate down by shutting off wells as required
  3. Check all valve in loop for proper operation and positioning
  4. Check for obstruction in vapor discharge piping
  5. Check demister element in inlet separator

- Aftercooler overload: Overload of blower motor

  Action:
  1. Troubleshoot motor and aftercooler system

- High Liquid Back Pressure: High pressure at transfer pump discharge

  Action:
  1. Change particle filters
  2. Check all valves in loop for proper operation and positioning
  3. Carbon fouling/silt build up

IV. SYSTEM PERFORMANCE MONITORING

The AFC-Dollinger site remediation program includes the sampling and analysis of the on-site extracted groundwater, groundwater treatment effluent, in-situ soil vapor, and treated vapor effluent as described below:

- Weekly sampling and analysis of the post-carbon, mid-carbon, and precarbon treatment systems (water and vapor) at the designated sampling ports. See as-built drawings for the port locations. Analyses are conducted in-house (by H&A of New York) on a Hewlett Packard (PID) Gas Chromatograph (GC). Note that these screening level analyses are to provide system management data and are not intended to provide regulatory compliance information.

- Recording of the system vacuum and flow rates at the time of sampling. Flow rates are read from the vortex meter for vapor flow rate, and the inlet separator sight glass for the water flow rate (1-inch on the sight glass = 1.1 gallons of water/time).

- In-house analyses are performed using the direct-injection technique, for vapor phase analyses, and purge and trap technique for water analyses. Analyte concentrations and mass removal rates are then calculated.

- Monthly post-liquid-carbon samples are submitted to General Testing Corporation for method 601/602 analysis as required by the Monroe County Pure Waters water discharge permit.

Daily to weekly monitoring and routine inspection of the individual 2-Phase Extraction system components, includes recording temperature, vacuum, and pressure gauge readings. The data must be recorded on the appropriate Log Sheets and incident report forms. An example of the log sheets and forms is provided in Table IV.

Weekly groundwater elevation measurements are being conducted at this time to evaluate the groundwater capture zone. An example of the groundwater elevation form is provided in Table IV. Well locations and elevations are on as-built Drawing C-1. Monthly measurements are required and it is anticipated that monitoring will go to that schedule.

Weekly subsurface vacuum monitoring is being conducted at this time to evaluate optimum well and trench operating conditions. These shield point locations are shown on as-built Drawing C-1. This monitoring is to evaluate vacuum influence only; it is not required.

V. SYSTEM EFFECTIVENESS MONITORING, REPORTING, AND RECORDS

The type of reporting during operation of the 2-Phase Extraction system will be written quarterly reports documenting the activities of the previous quarter. The reports will be formatted to include a text discussion of activities and any associated laboratory reports, tables, figures or graphs describing the required monitoring and its results.

As with the previously provided monthly reports, the quarterly reports will be provided to the project manager at NYSDEC, Division of Hazardous Waste Remediation, Bureau of Construction Services. At this time that person is Amar Nagi.

Table III lists the sampling and analysis to be performed during 2-Phase Extraction system operation, and is briefly discussed below.

To evaluate the effectiveness of the 2-Phase Extraction system vacuum extraction trenches on the site shallow groundwater upgradient of the pond, the pond will be sampled semi-annually and analyzed for volatiles and semi-volatiles. This sampling, to occur where the pond discharges into the adjacent stream, will continue until two successive samples are below the surface water cleanup goals which are 0.011 parts per million for trichloroethene and less than 0.02 parts per million for all other site VOCs combined. Following final shutdown of the 2-Phase system, a final pond water sample will be collected to confirm that there has not been a relapse of site environmental conditions.

Groundwater, soil and air monitoring are proposed for a variety of schedules, to track 2-Phase Extraction system progress. These are:

- Monthly groundwater elevation measurements at the 13 selected site wells (201-D, 104-D, 205, 106-S, 106-D, 103-S, 103-D, 102-S, 102-D, 204-S, 204-D, 203-S, and 203-D) to evaluate vacuum influence (drawdown).

- Monthly analysis of discharge water by an analytical laboratory using USEPA Method 601/602 to evaluate for sewer discharge permit compliance.

- Semi-annual analysis of the 13 site wells listed above for site specific volatiles to track the progress of the 2-Phase system.

- Monthly evaluation of system air discharge to assist with permit compliance.

- Monthly evaluation of soil vapor samples for selected site volatiles, to track 2-Phase Extraction system progress.

- Two semi-annual soil samples, one each from the former TCE degreaser room area and the former drum storage area. These samples, to be analyzed for select site volatiles, will aid in tracking 2-Phase Extraction system progress and, once the soil vapor results show asymptotic conditions have been reached, 6 soil samples will be collected (3 from each remediation area)

and analyzed for selected site volatiles. If the sample results are below the criteria for this, and three successive quarterly sampling efforts the 2-Phase effort is completed. If any of the samples exceeds the soil cleanup criteria (Table II) then the 2-Phase Extraction system will be re-started and run for 4 more months. At this time the four quarters of soil sampling will begin again.

Any of the above sampling and analysis which occurs or which is reported during a quarter will be described in that quarterly report.

Other than the monitoring work described above, other information that will be provided in the quarterly reports will include records regarding site maintenance, filter changes and disposal/regeneration, shut-down time and reasons, wells and trenches operating, and system performance adjustments.

70007044\report2.wp

TABLE I

PRE–STARTUP SAMPLING
SOIL RESULTS

AFC–DOLLINGER SITE
BRIGHTON, NEW YORK

		COMPOUNDS						
LOCATION	DATE	MeCl	1,2–DCE	TCE	PERC	Tol	EBnz	Xyl
VE–2–S1	2/23/94	0.0015 B	---	0.0024	---	---	---	---
VE–2–S5	2/23/94	0.0012 B	---	0.014	---	---	---	---
VE–3–S5	2/23/94	0.0084 B	---	0.520	---	---	---	---
VE–3–S8	2/23/94	0.0024 B	---	---	---	---	---	---
VE–4–S2	2/22/94	0.0017 B	0.0015	0.041	---	---	---	---
VE–4–S6	2/22/94	1.700 B	---	21.000	---	---	---	---
VE–5–S2	3/03/94	0.0012 B	---	0.0021	---	---	---	---
VE–5–S5	3/03/94	0.0035 B	---	---	---	---	---	---
VE–6–S3	2/24/94	---	---	0.0090	---	---	---	---
VE–6–S6	2/24/94	---	---	0.043	---	---	---	---
VE–7–S4	3/02/94	---	0.190	0.810	---	---	---	---
VE–7–S7	3/02/94	---	---	---	---	---	---	---
VE–8–S1	3/02/94	0.0022 B	0.073	0.120	---	---	---	---
VE–8–S5	3/02/94	---	0.140	1.500	---	---	---	---
VE–9–S4	3/04/94	---	0.055	0.130	---	---	---	---
VE–9–S7	3/04/94	---	---	---	---	---	---	---
VE–10–S5	2/24/94	---	0.0034	0.098	0.0052	---	---	---
VE–10–S8	2/24/94	0.0031	---	---	---	---	---	---
VE–11–S1	3/03/94	---	0.0045	0.130	0.0098	---	---	---
VE–11–S6	3/03/94	0.0065 B	0.087	1.200	0.027	---	---	---
VE–12–S2	3/04/94	0.0013 B	---	0.0027	---	---	---	---
VE–12–S4	3/04/94	0.0038 B	---	---	---	---	---	---
VE–13–S1	3/01/94	0.0013 B	---	0.0055	---	---	---	---
VE–13–S3	3/01/94	0.0066 B	0.220	1.500	0.0067	0.033	0.025	0.110
VTR–2–S1	5/03/94	0.0029 B	0.0023	0.0075	---	---	---	---
VTR–2–S2	5/03/94	0.0026 B	---	---	---	---	0.0046	0.025
VTR–3–S1	5/03/94	0.0030 B	---	0.0016	---	---	---	---
VTR–3–S2	5/03/94	0.0030 B	---	---	---	---	---	---

Notes:

1. ND = Not Detected
2. B = Detected in blank also
3. All results in parts per billion (ppb).
4. Compounds are abbreviated as follows:

   MeCl = methylene chloride

   1,2–DCE = 1,2–dichloroethene

   TCE = trichloroethene

   PERC = tetrachloroethene

   Tol = Toluene

   EBnz = ethylbenzene

   Xyl = xylene

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TABLE I (Cont.)

PRE–STARTUP SAMPLING
GROUNDWATER RESULTS

AFC–DOLLINGER SITE
BRIGHTON, NEW YORK

		COMPOUNDS									
LOCATION	DATE	VC	MeCl	1,1–DCE	1,2–DCE	1,1,1–TCA	TCE	PERC	Bnz	Tol	Xyl
VE–1	6/15/94	---	---	---	17.000	---	160.000	---	---	---	---
VE–2	4/05/94	---	---	---	0.590	---	15.000	---	---	---	---
VE–3	4/05/94	---	---	---	5.500	---	26.000	---	---	---	---
VE–4	4/05/94	---	---	---	2.200	---	150.000	---	---	---	---
VE–5	4/05/94	0.028	0.0013	---	0.079	---	0.027	---	---	0.0031	---
VE–6	4/05/94	---	---	---	0.190	---	1.400	---	---	---	---
VE–7	4/05/94	0.100	---	---	1.600	---	5.500	---	---	---	---
VE–8	4/05/94	---	0.130	---	0.280	---	1.000	---	---	---	---
VE–9	4/05/94	0.063	---	---	1.000	---	2.100	---	---	---	---
VE–10	4/05/94	---	---	---	0.240	---	0.700	0.0079	---	---	---
VE–11	4/05/94	---	---	---	0.600	---	3.400	---	---	---	---
VE–12	4/05/94	---	---	---	---	---	---	---	---	---	---
VE–13	4/05/94	---	---	---	47.000	---	190.000	---	---	---	---
VTR–1	6/15/94	---	0.0031	---	0.230	---	0.360	---	---	---	---
VTR–2	6/15/94	0.060	---	---	0.740	---	0.250	---	0.016	---	---
VTR–3	6/15/94	0.0036	---	---	0.034	---	0.041	---		---	---
OW–102S	6/15/94	---	---	---	---	---	0.860	---	---	---	---
OW–102D	6/15/94	---	---	---	---	---	0.014	---	---	---	---
OW–103S	6/15/94	0.080	---	0.0013	0.078	---	0.0093	---	---	---	---
OW–103D	6/15/94	---	---	---	0.0056	---	0.063	---	---	---	---
OW–104S	6/15/94	0.370	---	0.0085	0.440	---	0.035	---	---	---	0.019
OW–104D	6/15/94	---	0.024	---	0.048	---	2.200	---	---	---	---
OW–106S	6/15/94	---	---	---	---	---	---	---	---	---	---
OW–106D	6/15/94	---	---	---	---	---	---	---	---	---	---
OW–201S	6/15/94	---	---	---	1.400	---	1.200	---	---	---	---
OW–201D	6/15/94	---	---	---	2.200	---	5.000	---	---	---	---
OW–203S	6/15/94	---	---	---	---	---	0.0036	---	---	---	---
OW–203D	6/15/94	---	---	---	---	---	---	---	---	---	---
OW–204S	6/15/94	---	---	---	---	---	0.0022	---	---	---	---
OW–204D	6/15/94	---	---	---	---	0.0010	---	---	---	---	---
OW–205	6/15/94	---	---	---	---	---	---	---	---	---	---

Notes:

1. ND = Not Detected
2. B = Detected in blank also
3. All results in parts per billion (ppb).
4. Compounds are abbreviated as follows:

VC = Vinyl Chloride
MeCl = methylene chloride
1,1–DCE = 1,1–dichloroethene
1,2–DCE = 1,2–dichloroethene
1,1,1–TCA = 1,1,1–trichloroethane
TCE = trichloroethene
PERC = tetrachloroethene
Bnz = Benzene
Tol = Toluene
Xyl = xylene

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TABLE II

SOIL CLEANUP CRITERIA

AFC-DOLLINGER
BRIGHTON, NEW YORK

CONTAMINANT	RECOMMENDED SOIL CLEANUP OBJECTIVE
xylenes	1.2
trichloroethene	1.0
1,2-dichloroethenes	0.5
vinyl chloride	0.15
benzo(a)pyrene	0.330 or MDL
benzo(a)anthracene	0.330 or MDL

NOTES:

1. MDL = Method Detection Limits

2. All concentrations are listed in parts per million (ppm).

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TABLE III

SITE OPERATION & MAINTENANCE SAMPLING

AFC-DOLLINGER SITE
BRIGHTON, NEW YORK

Remediation Effort	Sample Purpose	Sample Type (Media)	Number/Time of Sampling	Analytical Procedure	Comments
Surface Water Monitoring	Continued evaluation	Surface Water	Semi-annually until two successive clean samples	Volatiles & semi-Volatiles	Sampling will be done once more after the VES effort is completed.
Surface Water Monitoring	Final evaluation	Surface Water	One-after VES completed	Volatiles	Sample to confirm volatiles were not released by VES.
VES	Monitor System influence	Groundwater	Monthly Measurement	Groundwater Elevation	Evaluate influence of VES system on groundwater elevations at 13 selected wells.
VES	Monitor Groundwater	Groundwater	Semi-annually	Select site volatiles	Groundwater collected from cleanup areas to track progress of VES.
VES	Monitor water discharge	Water	Monthly sampling	Select site voltiles	Evaluate water (after carbon) being released to POTW. Possibly do at H&A with GC.
VES	Monitor soil cleanup	Soil Vapor	Monthly	Select site volatiles	Soil vapor collected from cleanup areas to track progress of VES.
VES	Monitor air discharge	Air	Monthly	Select site volatiles	Evaluate air (post carbon) at H&A with GC; also used to check carbon use.
VES	Monitor initial soil concentrations at wells/trench	Soil	Two per well/trench	Select site volatiles	Two soil samples from each new extraction well to get starting concentrations. Will select high and low sample based on field screening.
VES	Monitor groundwater at wells/trench	Groundwater	One per well/trench	Select site volatiles	GW sample from new extraction wells to get starting concentrations.
VES	Monitor SVE progress	Soil	Semi-annually, one per remediation area	Select site volatiles	One soil sample from each of the two selected remediation areas to measure VOC reduction.
VES	evaluate shut-down conditions	Soil	Sample upon reaching soil vapor asymptote; if below criteria, perform three more quarters, if above then restart SVE and run for four months.	Select site volatiles	Three soil samples from each of the two remediation areas at locations agreed upon by Dollinger and NYSDEC.
OVERALL	Semi-annually monitoring	Groundwater	Each of 13 wells (see text for well numbers)	Select site volatiles	Monitor groundwater levels and concentrations.

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TABLE IV

2-Phase Extraction System Data Recording Sheets

AFC–DOLLINGER, BRIGHTON, NEW YORK
ENVIRONMENTAL REMEDIATION SYSTEM
OPERATIONS LOG SHEET

DATE:							
TIME:							
BY:							

DESCRIPTION	ID#	RANGE	NORMAL	DATA	DATA	DATA	DATA	DATA
2–PHASE EXTRACTION SYSTEM:								
VACUUM PUMP HOUR METER	HM–101	HOURS	READ					
VACUUM BREAKER POSITION	VB–101	0–9	READ					
INLET PRESSURE TO VACUUM PUMP (P–100)	PI–101	15–30"Hg	READ					
INLET SEAL OIL PRESSURE TO VACUUM PUMP (P–100)	PI–203	5"– 5 PSIG	0					
INLET SEAL OIL TEMPERATURE TO VACUUM PUMP (P–100)	TI–200	100–160 F	140 F					
INLET VAPOR TEMPERATURE TO AIR COOLER (HX–100)	TI–102	130–160 F	150 F					
OUTLET VAPOR TEMPERATURE FROM AIR COOLER (HX–100)	TI–103	60–100 F	80 F					
DISCHARGE TEMPERATURE OF VACUUM PUMP (P–100)	TI–101	170–205 F	190 F					
OUTLET VAPOR PRESSURE OF SEAL OIL RESERVOIR (S–200)	PI–200	0–2 PSIG	0 PSIG					
SEAL OIL RESERVOIR LEVEL (S–200)	LG–200	4–7"	6"					
TEMPERATURE AT INLET SEPARATOR (S–300)	TI–100	40–70 F	55 F					
PRESSURE AT INLET SEPARATOR (S–300)	PI–100	15–30"Hg	READ					
OUTLET PRESSURE OF CIRCULATION PUMP (P–200)	PI–201	15–40 PSIG	25 PSIG					
OUTLET PRESSURE OF SEAL OIL FILTER (F–200)	PI–202	15–40 PSIG	25 PSIG					
OUTLET PRESSURE FROM TRANSFER PUMP (P–300)	PI–301	0–50 PSIG	15 PSIG					
OUTLET PRESSURE FROM PARTICLE FILTER (F–300)	PI–302	0–50 PSIG	15 PSIG					
OUTLET PRESSURE FROM PARTICLE FILTER (F–301)	PI–303	0–50 PSIG	15 PSIG					
OUTLET VAPOR PRESSURE	PI–102	0–2 PSIG	0 PSIG					
OUTLET TEMPERATURE OF CONDENSATE COOLER (HX–110)	TI–104	55–70 F	65 F					

AFC–DOLLINGER, BRIGHTON, NEW YORK
ENVIRONMENTAL REMEDIATION SYSTEM
OPERATIONS LOG SHEET

DATE:							
TIME:							
BY:							

DESCRIPTION	ID#	RANGE	NORMAL	DATA	DATA	DATA	DATA	DATA
2–PHASE EXTRACTION SYSTEM (CON'T):								
OUTLET VAPOR TEMPERATURE	TI–107	90–125 F	110 F					
INLET WATER TEMPERATURE TO CONDENSATE COOLER (HX–110)	TI–106	50–65 F	55 F					
OUTLET WATER TEMPERATURE FROM CONDENSATE COOLER (HX–110)	TI–105	50–70 F	60 F					
CARBON SYSTEM:								
INLET VAPOR TEMPERATURE TO PRIMARY CARBON (F–110)	TI–108	70–150 F	< 100 F					
INLET VAPOR TEMPERATURE TO SECONDARY CARBON (F–111)	TI–109	70–150 F	< 100 F					
DISCHARGE VAPOR FLOW METER – TOTALIZER	FM–100	SCF	READ					
DISCHARGE VAPOR FLOW METER – FLOW RATE	FM–100	SCFM	READ					
INLET PRESSURE TO PRIMARY LIQUID CARBON (F–310)	PI–304	0–8 PSIG	0 PSIG					
INLET PRESSURE TO SECONDARY LIQUID CARBON (F–310)	PI–305	0–8 PSIG	0 PSIG					
OUTLET PRESSURE FROM SECONDARY LIQUID CARBON (F–310)	PI–306	0–8 PSIG	0 PSIG					
WATER DISCHARGE FLOW METER	FM–300	GALLONS	READ					

REMARKS:

AFC–DOLLINGER, BRIGHTON, NEW YORK
ENVIRONMENTAL REMEDIATION SYSTEM
OPERATIONS LOG SHEET

DATE:							
TIME:							
BY:							

DESCRIPTION	ID#	RANGE	NORMAL	DATA	DATA	DATA	DATA	DATA
EXTRACTION WELLS:								
VE–1 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–2 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–3 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–4 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–5 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–6 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–7 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–8 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–9 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–10 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–11 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–12 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VE–13 WELL PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VTR–1 TRENCH PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VTR–2 TRENCH PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					
VTR–3 TRENCH PRESSURE: @HEAD / @WELL BORE	PI	15–30"Hg	READ					

REMARKS:

AFC – DOLLINGER, BRIGHTON, NEW YORK
ENVIRONMENTAL REMEDIATION SYSTEM
OPERATIONS SHUTDOWN INCIDENT REPORT

DATE:
TIME:
BY:

SYSTEM NAME: _____

ESTIMATED TIME OF SHUTDOWN: _____

HOUR METER (IF APPLICABLE): _____

REASON FOR SHUTDOWN: _____

_____

_____

ACTION TAKEN: _____

_____

_____

_____

_____

START–UP TIME: _____

START–UP DATE: _____

COMMENTS/SUGGESTIONS:

_____

_____

_____

_____

H&A OF NEW YORK NOTIFICATION: YES ☐ NO ☐

(716–232–7386)

AFC–DOLLINGER, BRIGHTON, NEW YORK
ENVIRONMENTAL REMEDIATION SYSTEM
SHIELD POINT VACUUM DATA

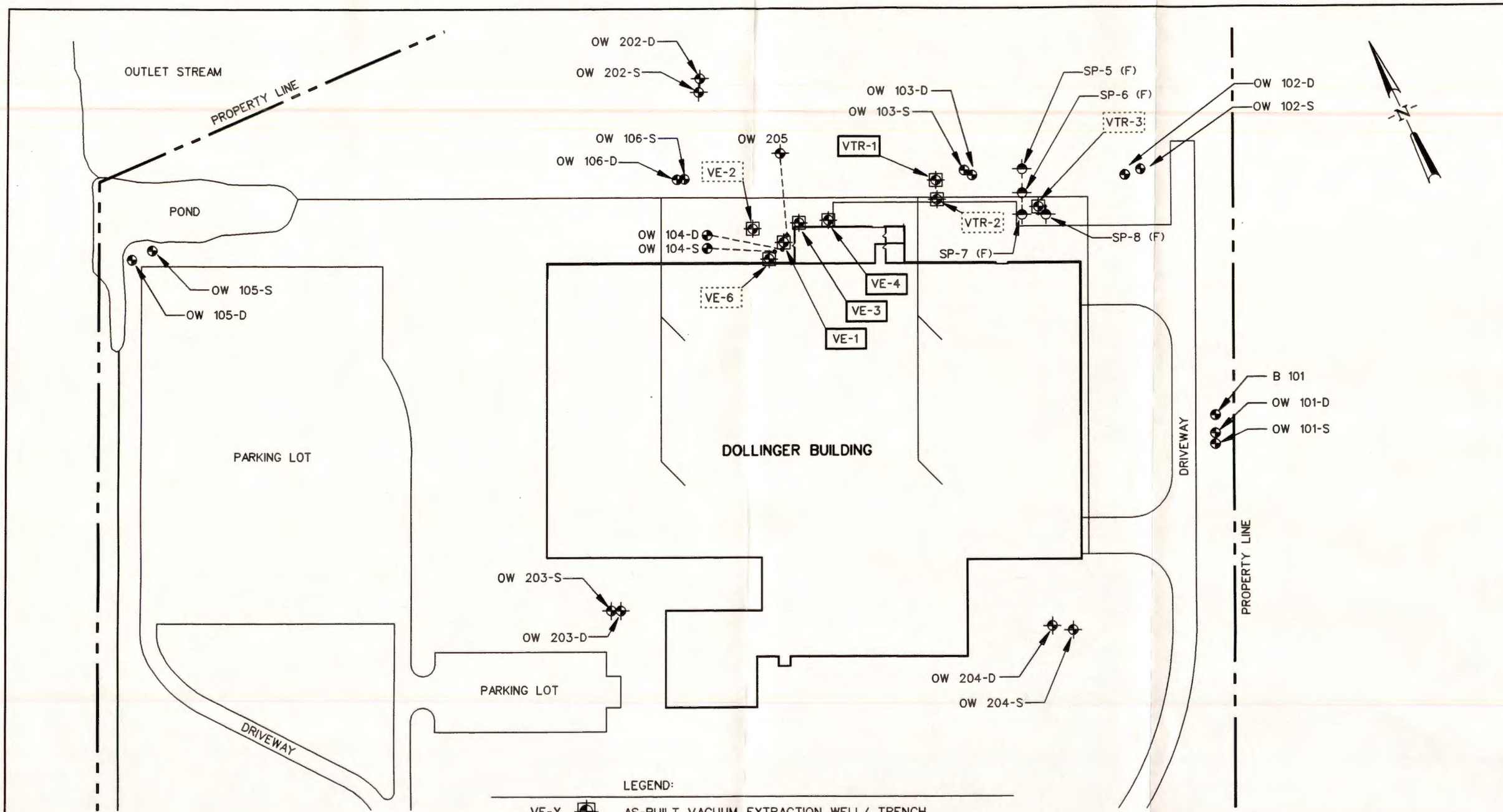
	DATE:							
	TIME:							
	BY:							
SHIELD POINT NO.	SCREEN DEPTH	VACUUM	VACUUM	VACUUM	VACUUM	VACUUM	VACUUM	VACUUM	VACUUM
SP–1S	2.5–3.5								
SP–1D	5.5–6.5								
SP–2S	2.5–3.5								
SP–2D	5.5–6.5								
SP–3S	2.5–3.5								
SP–3D	5.5–6.5								
SP–4S	2.5–3.5								
SP–4D	5.5–6.5								
SP–5									
SP–6									
SP–7									
SP–8									
SP–9S	1.8–2.8								
SP–9D	4.8–5.8								
SP–10D	4.5–5.5								
SP–11S	2.0–3.0								
SP–11D	5.0–6.0								
SP–12S	2.0–3.0								
SP–13S	2.0–3.0								
SP–14S	1.5–2.5								

REMARKS: DEPTH (FEET); VACUUM (IN.W.C.)

AFC–DOLLINGER, BRIGHTON, NEW YORK
ENVIRONMENTAL REMEDIATION SYSTEM
WATER LEVEL DATA

			DATE:						
			TIME:						
			BY:						
WELL NO.	G.S. ELEVATION	T.O.C. ELEVATION	T.O.R. ELEVATION	DEPTH TO WATER	WATER ELEVATION	DEPTH TO WATER	WATER ELEVATION	DEPTH TO WATER	WATER ELEVATION
OW101–S									
OW101–D									
OW102–S	541.1	543.9	543.7						
OW102–D	540.8	543.3	543.1						
OW103–S	541.5	543.7	543.5						
OW103–D	541.6	543.7	543.5						
OW104–S	542.7	545.1	544.9						
OW104–D	542.7	545.8	545.6						
OW105–S									
OW105–D									
OW106–S	542.2	544.7	544.5						
OW106–D	542.0	544.7	544.5						
OW201–S	542.9	542.9	542.6						
OW201–D	542.9	542.9	542.6						
OW202–S									
OW202–D									
OW203–S	542.5	542.7	542.4						
OW203–D	542.4	542.5	542.2						
OW204–S	540.6	543.6	543.5						
OW204–D	539.5	542.5	542.3						
OW205	542.7	545.0	544.8						

REMARKS: ALL UNITS (FEET)



LEGEND:

VE-X	AS-BUILT VACUUM EXTRACTION WELL/ TRENCH
SP-X (F)	SHIELD POINT - FUTURE INSTALLATION
OW 10X-X	PREVIOUS TEST BORING/ OBSERVATION WELL
OW 20X-X	REMEDIAL INVESTIGATION TEST BORING/ OBSERVATION WELL
VE-X / VTR-X	ON-LINE VACUUM EXTRACTION WELL/ TRENCH
VE-X / VTR-X	OFF-LINE VACUUM EXTRACTION WELL/ TRENCH

FILE No. 70007-044

H & A OF NEW YORK

Geotechnical Engineers & Environmental Consultants

AFC-DOLLINGER
BRIGHTON, NEW YORK

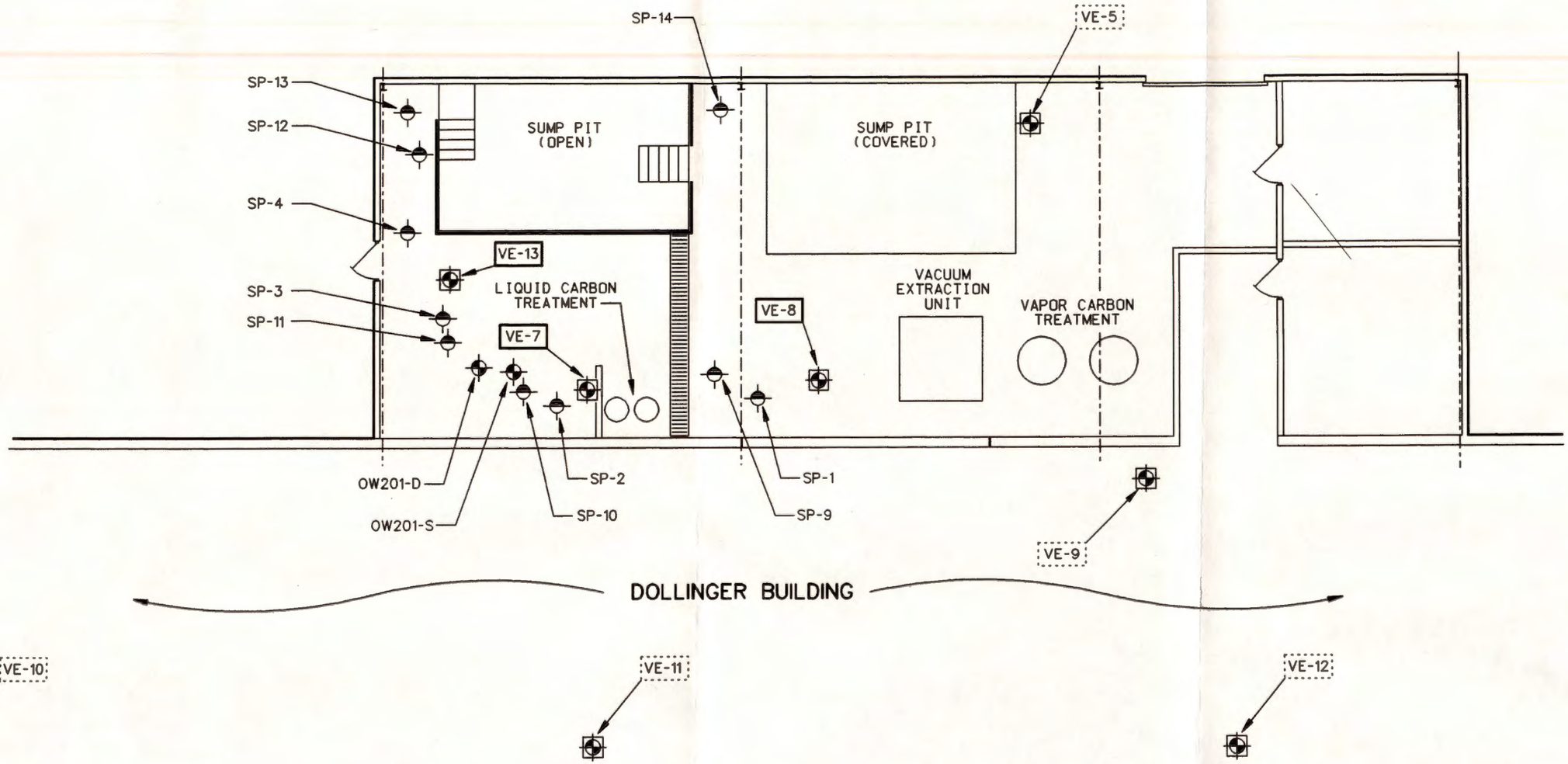
WELL & SHIELD POINT LOCATIONS BUILDING EXTERIOR – SITE

SCALE: 1"=80'

NOVEMBER 1994

FILENAME: 70007-044:OMW012B.DGN

FIGURE 1



LEGEND:

VE-X	⊕	AS-BUILT VACUUM EXTRACTION WELL
SP-X	⊕	AS-BUILT SHIELD POINT
OW 201-X	⊕	REMEDIAL INVESTIGATION TEST BORING/ OBSERVATION WELL
[VE-X]		ON-LINE VACUUM EXTRACTION WELLS
(VE-X)		OFF-LINE VACUUM EXTRACTION WELLS

H & A OF NEW YORK

Geotechnical Engineers & Environmental Consultants

AFC-DOLLINGER
BRIGHTON, NEW YORK

WELL & SHIELD POINT LOCATIONS BUILDING INTERIOR

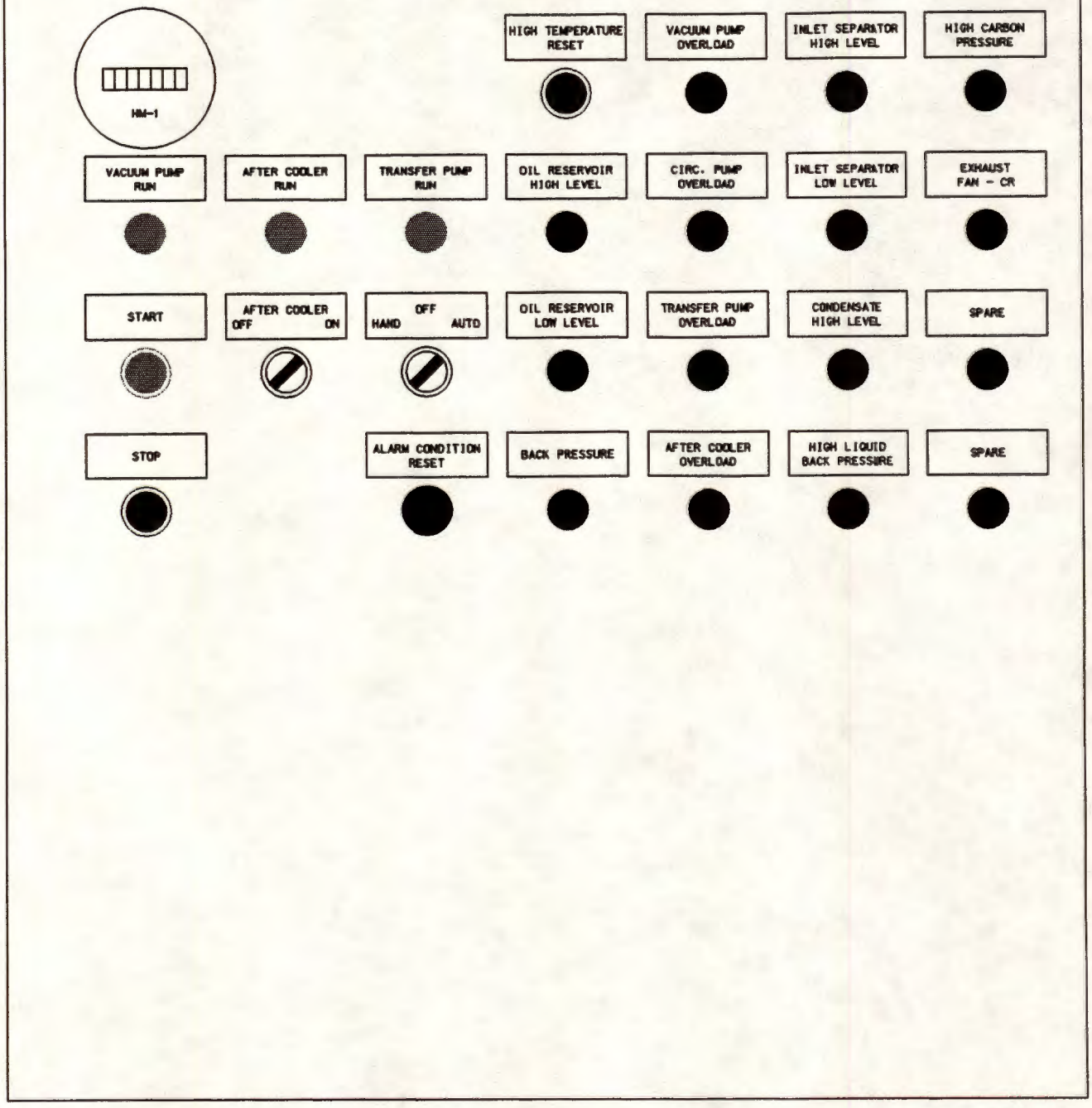
SCALE: 1"=10'

NOVEMBER 1994

FILENAME: 70007-044:OMW011B.DGN

FIGURE 2

FILE No. 70007-044



FILE No. 70007-044

H & A OF NEW YORK

Geotechnical Engineers & Environmental Consultants

AFC-DOLLINGER
BRIGHTON, NEW YORK

CONTROL PANEL DIAGRAM
VACUUM EXTRACTION SKID

SCALE: NONE

NOVEMBER 1994

FILENAME: 70007-044:OME013A.DGN

FIGURE 3

APPENDIX A

Health & Safety Plan

APPENDIX A

HEALTH AND SAFETY PLAN

INTRODUCTION

This Health and Safety plan addresses health and safety personnel involved in site investigation and remediation activities at the American Filtrona Corporation Dollinger facility. These detailed health and safety procedures will help to prevent injury, illness and accidents by avoiding unnecessary risks while maintaining an efficient work environment.

This health and safety plan was developed for the American Filtrona Corporation-Dollinger Site and is intended for use during field investigations and remediation actions including water and soil sampling, soil and sediment removal, and installation and operation of the vapor extraction system (VES). All contractors working on the site are required to adopt their own Health and Safety Plans which must, as a minimum, contain the requirements of this plan.

Site activities proposed for the remedial effort include the following:

- installation of wells inside and outside the building,
- excavation of a trench for vapor extraction piping,
- excavation of soil and sediment,
- installation of vapor extraction equipment,
- monitoring/sampling groundwater, surface water, soil, sediment, water treated and released by the VES, and vapor treated and released by the VES.
- excavation for and placement of bentonite collars around the storm sewer pipe,
- monitoring and changing VES system components such as filters and carbon units for the vapor and water streams.

OBJECTIVES

The objectives of the Health and Safety Plan are:

- To establish levels of personal protection and equipment requirements for all scheduled activities and to develop contingency plans.
- To assign on-site health and safety responsibilities.
- To outline mandatory operating procedures.

The provisions of this plan are mandatory for all personnel assigned to the activities described in the respective work plans. The Health and Safety Procedures contained in this plan have been developed for the specific activities intended for the Dollinger site remedial investigation and remedial activities and will be periodically reviewed and revised as necessary to keep them current and technically correct.

SITE ACCESS

The Dollinger site is the location of the former manufacture and assembly of industrial filtration devices. The site is approximately 18.5 acres in size consisting of one building with drainage ditches, storm sewers and a "detention" pond.

Access to investigation activities where exposure to contaminated soil or water may be likely, such as during excavation and soil/rock borings, will be controlled by temporary fencing placed around each exploration location. Entrance to the exploration area will be controlled by the Contractor Coordinator designated for the particular site activity (see section 4-06 - Assignment of Responsibilities). Entrance will be allowed only to individuals directly involved with exploration tasks or oversight, who have agreed to follow the site Health and Safety Plan, and are wearing appropriate protective wear.

Water and electrical power for site activities, and a phone for emergencies are available at the Dollinger building. The emergency services may include emergency medical response and ambulance, and fire services.

POTENTIAL HAZARDS

The potential hazards at the site consist of the presence of organic solvents in the soil and groundwater underlying the site vicinity, and work activities involving the use of drilling rigs, excavation equipment and other machinery necessary for field investigations and remedial actions.

The following solvents have been identified by soil and water sampling in the site vicinity:

benzene
carbon tetrachloride
chloroform
chloromethane
1,2-Dichloroethylene
ethylbenzene
methylene chloride
tetrachloroethylene
toluene
1,1,1-trichloroethane
trichloroethylene
vinyl chloride
xylene

The potential routes of exposure for these chemicals include inhalation, skin absorption, ingestion and skin/eye contact. The potential for exposure through any one of these routes will depend on the activity conducted. Most likely routes of exposure for the activities to be conducted at the site include:

Activity	Potential Routes of Exposure
Drilling and Soil Sampling	INH, ABS, CON
Soil Vapor Sampling	INH, ABS, CON
Hydrogeologic Testing	INH, ABS, CON
Excavation of Contaminated Soil/Sediment	INH, ABS, CON
Water Quality Sampling	INH, ABS, CON
Installation and Operation of the VES	INH, ABS, CON

NOTE:

INH = Inhalation
ABS = Skin absorption
CON = Skin/eye contact

Table 1 lists the solvent found on site, possible exposure routes, odor thresholds or limits of perception, and the solvent's ionization potential. Table 2 lists potential exposure rates and associated acute and chronic health effects.

Inorganics (arsenic, chromium, copper, lead, nickel and zinc) have also been detected on site in the pond sediment. Protection measures described herein have been established to protect against exposure to these inorganics as well as the organics. Table 2A lists the exposure limits and health effects of the site inorganics.

The greatest risk to workers will occur when the work directly exposes personnel to high concentrations of solvents in contaminated soil, extracted vapors, or groundwater. The activities most likely to expose workers to these conditions would include the excavation of VES trenches, the excavation of contaminated soil/sediment, drilling, VES vapor, water stream, and soil sampling in the vicinity of the potential contaminant source area.

The risk associated with the soil vapor sampling program and VES equipment installation should be less than for the drilling activities because penetration of the ground surface is limited to a small diameter (1/2 in.) hole advanced to shallow depths below ground surface. Workers performing the soil vapor sampling can potentially be exposed by direct contact with contaminants retained on the sampling equipment.

Hydrogeologic testing potentially exposes workers to risks at two different levels, depending on the activity conducted. Water quality sampling from wells and the falling head permeability tests conducted on monitoring wells may expose workers to vapors emanating from the boreholes or to contaminants introduced onto sampling or water level measurement devices. Most of the wells are located in open areas with ample air circulation. Vapor concentrations are expected to be undetectable in the breathing zone. Wells will also be installed inside the site building which may have a decreased air circulation compared to the outside. Engineering controls to address vapor buildup, such as fans, will be evaluated if needed. Exhaust from the drilling rig will be vented to the outside. An exhaust fan has been proposed for the former degreaser room to ventilate the VES.

GENERAL HEALTH AND SAFETY

Protective clothing and respiratory protection help prevent workers from coming in contact with potential hazards. Personnel protective equipment must be appropriate to protect against the anticipated hazards for each of the activities outlined above.

AIR MONITORING

At the initiation of the site work activities H&A will survey ambient air at the work area, upwind at the property line using an Hnu (11.7 lamp) or flame ionization detector (OVA). If organic vapors are detected, samples will be collected and analyzed with the H&A portable 10S70 gas chromatograph.

Air monitoring will be performed during the activities for which inhalation has been identified as a potential exposure route.

Volatiles

Monitoring shall be conducted with a photoionization detector equipped with an 11.7 eV lamp or a flame ionization detector. These instruments are capable of detecting all of the chemical compounds identified in Section 4-04 above to an approximate detection limit of 1 ppm. The Threshold Limit Values (TLV's) established by OSHA for an eight hour work day, for all of the compounds listed in the attached table, are above the detection limit of the proposed equipment. The rapid response of the instrument allows for quick determination of potential contaminants in the air, and changes in safety procedures can be implemented if needed.

Air Particulates

Air particulates at the site will be monitored with a MDA P-5 digital dust indicator (or similar). Air particulate monitoring will performed continuously during the mass soil excavation activities. Monitoring will be conducted adjacent to excavation activities, and at the downwind site perimeter as defined in Section 4-07. If dust levels exceed 150 ug/m^3 or are 100 ug/m^3 above upwind background, necessary measures such as water misting of the soils will be implemented. A steam cleaner or hand held sprayer is capable of providing a sufficient mist to moisten soils and suppress dust without saturating the excavation. If the action level of 150 ug/m^3 is exceeded, the Division of Air Resources will be notified in writing within five working days; the notification will include a description of the control measures implemented.

PERSONNEL PROTECTIVE EQUIPMENT

The minimum level of personnel protection to be implemented at the site will be Level D as described in "Standard Operating Safety Guidelines" (USEPA November 1984). The required equipment includes:

- Leather or chemical resistant boots/shoes.
- Hard hat.
- Safety glasses.
- Chemical resistant gloves (inner vinyl and outer Bayprene for sampling activities).

For the drilling, soil vapor, soil sampling, and soil/sediment removal or other activities which may potentially expose workers to contaminated soil, the Level D program will be modified to include, in addition to the items listed above, the following:

- Chemical resistant clothing (Tyvex or Saranex suit).
- Respirator availability.

Hearing protection will be included in noisy environments.

Respiratory Protection

The decision to don respirators during a particular activity will be based on the results of the continuous air monitoring performed during the site activity. Detection of organic vapors in excess of 1 part per million (ppm) above background concentrations monitored in the breathing zone during the site activity will trigger further vapor evaluation using draeger tubes and/or the portable gas chromatograph to identify the chemicals present. If vinyl chloride or benzene are identified, work will be stopped until a decision can be made to upgrade the level of personnel protection to Level C and/or additional engineering controls implemented to prevent vapors from building up in the breathing zone. If vapors are not benzene or vinyl chloride, a 3 ppm vapor concentration action level will be used to determine the need to either don air purifying respirators (APR) or immediately evacuate the work area as defined in Section 4-07. Table 3 lists hazard guidelines and action response levels.

If APR's are required, work activities will continue after upgrading to Level C unless organic vapor concentrations are detected in excess of 50 ppm above background levels in the breathing zone. If this level of organic vapors is reached in the breathing zone during the site activities, the exploration area will be secured and immediate evacuation of the work area will be required. Work will resume once the health and safety plan has been modified to provide the level of protection necessary to protect the health and safety of the workers.

Contingency Plan

If concentrations of non-benzene or vinyl chloride organic vapors above 50 ppm are detected in the breathing zone, the Health and Safety Plan will be modified to provide the level of protection necessary to protect the health and safety of the workers prior to the resumption of site activities. Such conditions may necessitate a modification of the investigation procedure in progress, or increase the level of protection to Level B health and safety requirements, which would include the use of positive pressure self contained breathing apparatus. The final decision to modify will be made on a case by case basis. NYSDEC will be advised of any necessary changes.

BUILDING TENANT PLAN

Since it is understood that the Dollinger Building may be occupied during the site work, it is necessary to include notification measures for changes in air quality due to work conducted inside the building. The site owner and site tenant representative will be notified if work is upgraded to Level C or B. The site tenant will be notified when VES maintenance that has a potential to result in a vapor, or water release is being done.

COMMUNITY AIR MONITORING PLAN

In addition to the continuous monitoring performed at the work zone during all intrusive site work, real-time air monitoring for volatile organic compounds will also be conducted at the downwind site perimeter (Exclusion Zone as described in Section 4-07), daily at a minimum of (2) hour intervals during excavation activities. If total organic vapor concentrations in the breathing zone, attributable to excavation or drilling activities conducted at the Dollinger site, exceed 5 ppm above background, work activity must be halted and monitoring continued under the provision of the Vapor Emissions Response Plan. If the sustained organic vapor concentrations in the breathing zone levels equal or exceed 5 ppm at the site perimeter or in the rest of the site building, work activities will be halted and air samples taken to determine the chemical species present. The air samples will be analyzed with the H&A gas chromatograph. Work activities at the site will proceed only after the following conditions are met:

- Sustained organic vapor levels fall below 5 ppm at the site perimeter, or
- More frequent intervals of monitoring, as directed by the Safety Officer, are conducted.

If organic vapor concentrations are above 5 ppm at the perimeter of the Exclusion Zone and are attributable to the borehole, excavation or other site work, work activities must shutdown. When work shutdown occurs, downwind air monitoring as directed by the Safety Officer will be implemented to ensure the vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the major vapor emission section below.

Major Vapor Emission

If any organic concentrations greater than 5 ppm over background, attributed directly to excavation or drilling activities conducted at the Dollinger site, are identified 200 feet downwind from the survey site, half the distance to the nearest residential or commercial

property, or in the remainder of the site building as measured adjacent to the degreaser room, all excavation must be halted.

Efforts shall be undertaken to abate the breathing zone vapor concentrations such as capping the borehole or backfilling the excavation.

If, following the cessation of the excavation activities, or as the result of an emergency, organic levels persist above 5 ppm above background 200 feet downwind, half the distance to the nearest residential or commercial property from the Exclusion Zone or in the remainder of the site building, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20 Foot Zone) or in the building immediately adjacent to the former degreaser room.

The Major Vapor Emissions Response Plan will be automatically placed into effect if organic vapor concentrations, attributed to excavation or drilling activities conducted at the Dollinger site, exceed 10 ppm in the 20 foot zone for more than 30 minutes.

Major Vapor Emission Response Plan

Upon activation, the following activities will be undertaken:

a. The local police authorities, the MCHD, and NYSDEC will immediately be contacted by the Safety Officer and advised of the situation.

b. Frequent air monitoring will be conducted at 30 minute intervals within the 20 Foot Zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the Safety Officer.

c. Site personnel will assist local police authorities as necessary to identify wind direction and potentially affected areas that may require excavation.

ASSIGNMENT OF RESPONSIBILITIES

To coordinate the health and safety aspects of the project, the following individuals are necessary:

- H&A Project Manager

The H&A Project Manager (Suzanne B. Wheatcraft - (716) 232-7386, alternate - Vincent B. Dick) is responsible for project management and communicating site requirements to H&A personnel, contacting the appropriate medical, fire and emergency personnel, and coordinating with contractors.

- Contractor Site Coordinator

  The Site Coordinator (E. Quinn Lewis - H&A (716) 232-7386, alternate - Suzanne B. Wheatcraft) will be responsible for the day to day implementation of the Health and Safety Plan during the various field activities. The responsibilities of the Site Coordinator will include:

  - Observe that the appropriate personnel protective equipment and monitoring equipment is available and is properly utilized.
  - Monitor the safety performance of all field personnel.
  - Bring any observed work practices or conditions that may result in injury or exposure to hazardous substances to the attention of workers and the H&A Project Manager, and (if applicable) the contractor's project manager. This does not relieve contractors of their responsibility for health and safety of contractors' personnel.
  - Prepare and submit accident/incident reports.

- Health & Safety Representatives

  Each contractor working on site will be required to identify a Health & Safety Representative who will be responsible for preparation and oversight of each company's respective Health & Safety plan.

- Field Personnel

  The personnel needed to perform the activities outlined above will be briefed on the anticipated hazards and trained on available respirator equipment, safety practices, emergency procedures and communication pathways. Training will be accomplished in a health and safety briefing prior to starting site work and attendance will be required for all personnel.

WORK AREAS

Work areas for the above outlined activities shall include a minimum 50 ft. radius around drilling and soil sampling operations (Exclusion Zone). All workers and personnel within the 50 ft. work area radius shall be required to comply with site health and safety procedures. The work areas associated with the soil vapor sampling, water quality sampling and hydrogeologic testing activities shall include a minimum 25 ft. radius of the site activity.

Access to the site is controlled by the site owner, Wilray. Access to all work areas within the site shall be controlled by the Contractor Coordinator. When respirator use is required in a work area, access shall be restricted by means of barricades or fencing. Any excavation or drilling rig activity shall be barricaded during periods of non-activity. Regardless of organic vapor concentrations, OSHA regulations governing excavations and other aspects of construction shall be observed. Continuous air monitoring will be conducted within a 20 foot zone.

PERSONNEL DECONTAMINATION

Personnel decontamination activities will be conducted during all site activities to reduce the potential for contamination of personnel and/or transmission of contaminants off site.

Disposable personal protective clothing such as tyvex suits, outer gloves or other material used on the site that has come in contact with hazardous materials at the site shall be placed in 55-gallon drums and disposed of as a hazardous waste.

If respirators are required during site activities, the organic vapor cartridges shall be replaced after each day's operations, or more frequently, if needed. The cartridges shall be disposed as previously described.

EQUIPMENT DECONTAMINATION PROCEDURES

A project decontamination area will be located on the east side of the Dollinger building as approved by the site owner and/or tenant.

All drilling rigs and backhoes which will come in contact with contaminated soil or ground water shall be required to be steam cleaned prior to arriving at the site. Prior to leaving the site and between exploration locations, the steam cleaning shall be conducted in the decontamination area.

Hollow stem augers will be cleaned with steam between each exploration. All split spoons and soil sampling equipment which will come in contact with contaminated soil or groundwater shall be decontaminated between each exploration location by the following sequence of cleaning solutions: alconox detergent wash, and tap water rinse. In addition, all soil sampling equipment shall be decontaminated between each soil sample with the same sequence of cleaning solutions.

All equipment decontamination rinses will be collected and drummed for appropriate disposal.

MEDICAL EMERGENCY PLAN

During site activities, unpredictable events such as physical injury, chemical exposure, fire or explosions may occur. The emergency plan is described in order to provide prompt responses to emergency situations. The emergency plan provides information concerning Dollinger site phone and first aid locations, emergency contacts, a map of the site area showing access routes for ambulance response and contacts for medical and fire emergencies.

PERSONNEL INJURY

In case of personnel injury at the site the following procedures shall be followed:

- Field team members trained in first aid should administer care to the injured worker.
- Dial 911 (Ambulance) for emergency assistance.
- Injured personnel should be transported to the nearest medical center (Strong Memorial Hospital) as directed by the Site Coordinator.

- The Site Coordinator will assist the H&A Project Manager in preparation and submittal of an Accident Report.

FIRST AID AND EMERGENCY FIRE EQUIPMENT

First aid kits are maintained in H&A of New York field vans and on the drilling rigs. Emergency fire equipment is maintained on the drilling rigs and will be available at the majority of site excavations.

CHEMICAL EXPOSURE

If a member of the field crew is exposed to chemicals, the procedure outlined below should be followed:

- Another team member, outfitted in upgraded protection, should remove the individual from the immediate area of contamination.

- Precautions should be taken to avoid exposure of other workers to the chemical.

- If the chemical is on the individual's clothing, the clothing should be removed if it is safe to do so.

- If the chemical has contacted the skin, the skin should be washed with copious amounts of water, preferably under a shower. In case of eye contact, emergency eye wash should be used. Eyes should be washed for at least 15 minutes. Skin wash and emergency eye wash can be made available by transporting the injured personnel to the Dollinger building.

- If necessary, the victim should be transported to the nearest hospital or medical center (Strong Memorial Hospital). If necessary, an ambulance should be called to transport the victim.

- All chemical exposure incidents will be reported in writing by the On-Site Coordinator. The Contractor Coordinator shall assist the H&A Project Manager in completing an Accident Report for all chemical exposure incidents that occur.

WEATHER RELATED CONDITIONS

Since the site activity may be conducted during the winter and summer months, precautions should be taken by the workers to prevent frostbite and heatstroke.

Frostbite

Frostbite can be categorized into:

- Frostnip or incipient frostbite characterized by sudden blanching or whitening of the skin.

- Superficial frostbite - skin has a waxy or white appearance is firm to the touch but tissue beneath is resilient.

- Deep frostbite - tissues are cold and hard indicating an extremely serious injury.

First aid for frostbite will include bringing the victim indoors and rewarming affected areas quickly with warm (not hot) water according to first aid procedures. Medical help should be called immediately.

Frostbite can be prevented by the use of insulated gloves, socks and other protective clothing. All protective clothing should be chosen so that it is compatible with the chemical resistant clothing required for certain site activities.

Heatstroke

Heatstroke is characterized by:

- Reduction in perspiration and clammy skin.

- Disorientation and/or incoherence.

Heatstroke can be treated by removing the affected individual to a shaded area and removing protective clothing. For extreme heat stroke, the individual's body temperature should be lowered artificially with ice packs and/or cold water applied in accordance with standard first aid practices.

FIRST AID AND DECONTAMINATION

There is a possibility that decontamination procedures may interfere with medical treatment or cause more serious health effects in an emergency situation. If prompt lifesaving first aid and medical treatment is required, decontamination procedures may be modified by the onsite health and safety representative on a case by case basis. All emergency and response personnel will be advised of the contamination/ decontamination status. If emergency site evacuation is required for health and safety reasons, decontamination of personnel protective clothing and equipment may be delayed until it is safe to do so.

HEALTH AND SAFETY TRAINING

All personnel involved in site activities shall be required to have been trained and met the minimum Health & Safety requirements established by OSHA for hazardous waste site work. In addition, all field personnel should participate in a Medical Monitoring Program including, at a minimum:

- Medical and Occupation History Form
- Physical examination
- Blood analysis
- Urine analysis
- Chest X-ray
- Pulmonary function test
- Audiogram

In addition to the health and safety training and medical monitoring programs, at least one individual on site during a site activity shall have completed and be currently certified in Multimedia First Aid and Cardiopulmonary Resuscitation.

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HEALTH & SAFETY PLAN
TABLE 1

EXPOSURE LIMITS AND RECOGNITION QUALITIES

Compound	OSHA Permissible Exposure Limit (ppm)	ACGIH TWATLV	IDLH (ppm)	Odor	Odor Warning Concentration (ppm)	LEL	UEL	Ionization Potential (ev)	Maximum Concentration Identified	
									Groundwater (ppm)	Soil (ppm)
Benzene	1	10	Ca	Aromatic	82	1.3	7.1	9.25	0.0006	0.47
Carbon Tetrachloride	2	5	Ca	Ether	340	NC	NC	---	---	1.03
Chloroform	2	10	Ca	Sweet	50-307 fatigue (<4096)	NC	NC	11.42	0.0006	2.5
Chloromethane	50	50	Ca	Sweet	10-maybe	7.6	19	---	---	---
1,2-Dichloroethene (1,2-DCE)	200	200	4000	Ether	0.085-500	9.7	12.8	9.65	11.0	40.6
Ethylbenzene	100	100	2000	Ether	0.09-0.6	1.0	6.7	8.76	---	8.1
Methylene Chloride	500	50	5000 (Ca)	Chloroform	160	1.2	19	11.35	0.011	0.23
Tetrachloroethene	25	50	500 (Ca)	Sweet	---	---	---	9.32	0.008	0.25
Toluene	100	100	2000	Aromatic	40	0.9	9.5	8.82	0.012	303.0
1,1,1-Trichloroethane	350	350	1000	Sweet	390	7	16	10.2	0.16	1.1
Trichloroethylene (TCE)	50	50	1000	Sweet	21.4-400	11	41	9.47	50.0	291.0
Vinyl Chloride	1 5(15 min. Ceil)	5	Ca	Sweet	260	3.6	33	9.995	0.16	0.48
Xylene	100	100	1000	Aromatic	0.4-20	1	6	8.44	---	451.0

HEALTH & SAFETY

TABLE 2

ACUTE AND CHRONIC EFFECTS
AND FIRST AID TREATMENT

Compound	Routes of Entry	Eye Irritant	Acute Effects	Chronic Effects
Benzene	Con, Ing, Inh	Yes	Dizzy, weak, Euphoria, headache, nausea/vomit, skin irritation, tight chest	Loss of appetite, drowsy, nervous, pallor, anemia, petechiae leukemia, abdominal bleeding
Carbon Tetrachloride	Con, Ing, Inh	Yes	Headache, Intox, narcotic, liver/kidney damage, skin damage	Anemia, blurred vision, tremors, liver damage, potential carcinogen
Chloroform	Con, Ing, Inh	Yes	Dizziness, mental dullness, nausea, headache, fatigue	Liver, kidneys, heart, eyes, skin
Chloromethane	Con, Ing, Inh	Yes	Dizzy, vomit abdominal pain, convulsions, unconsciousness, liver/kidney/blood damage	Dizzy, headache, mental confusion, blurred vision, narcotic
1,2-DCE	Con, Ing, Inh	Yes	Irritates respiratory system, CNS depression	CNS, respiratory system, eyes
Ethylbenzene	Con, Ing, Inh	Yes	Weak, dizzy, drowsy, narcotic	Skin rash, inflammation
Methylene Chloride	Con, Ing, Inh	Yes	Mental confusion, nausea/vomit, headache, stagger, heart palpitation	Skin irritation, potential carcinogen
1,1,1-Trichloroethene	Con, Ing, Inh	Yes	Irritation of eyes, skin, mucous membranes, incoordination, nausea, confusion, loss of consciousness	Dermatitis, liver/kidney damage
TCE	Con, Ing, Inh	Yes	Headache, vertigo, tremors, nausea, vomiting	CNS, respiratory system, heart, liver, kidneys, potential human carcinogen
Tetrachloroethene	Con, Ing, Inh	Yes	Headache, drowsiness, incoordination, unconscious, irritation of eyes, nose, throat, flushing of face, neck	Dermatitis, liver, kidney damage, CNS effects
Toluene	Con, Ing, Inh	Yes	Fatigue, weak, vision disturb, anemia, narcotic	Dry/cracking skin, fatty degeneration of heart, liver, anemia
Vinyl chloride	Inh	No	Weak, abdominal pain, GI bleeding	CNS, liver, blood, respiratory system
Xylene	Con, Ing, Inh	Yes	Dizzy, headache, cough, nausea/vomit, abdominal cramps	Possible liver/kidney damage pulmonary congestion

Explanation

Con - Skin Contact
Ing - Ingestion
Inh - Inhalation
CNS - Central Nervous System

General First Aid Treatment (a first-aid kit will be kept in the site vehicle).

Eye	Irrigate immediately (a portable eye-wash unit will be kept in the site vehicle.)
Skin	Soap wash promptly.
Inhalation	Move to fresh air.
Ingestion	Get medical attention.

HEALTH & SAFETY PLAN
TABLE 2A

EXPOSURE LIMITS, RECOGNITION QUALITIES,
AND HEALTH EFFECTS OF SITE METALS

Metal	OSHA Permissible Exposure Limit (mg/m^3)	ACGIH TWA/TLV	IDLH	Maximum Concentration Identified in Sediment (ppm)	Route of Entry	Eye Irritant	Acute Effects	Chronic Effects
Aresenic	0.01	0.002	100	12.0	INH, ABS, CON, ING	Yes	Ulceration of nasal septum, dermatitis, gastro-intestinal disturbances, respiratory irritant, hyperpigmentation of skin.	Lymphatic system, liver, kidneys, skin, and lung damage.
Chromium	1.0	NA	NE	70.0	INH, ING	Yes	Histologic fibrosis of lungs.	Respiratory system damage.
Copper	1.0	NA	NE	174.0	INH, ING, CON	Yes	Irritant to the nasal membranes, pharynx and nasal perforation, eye irritant, dermititis.	Respiratory system, skin, liver, and kidney damage.
lead	0.05	0.1	700	137.0	INH, ING, CON	Yes	Weakness, insomnia, facial pallor, malnutrition, constipation, colic, abdominal pain, anemia, hypotension, irritated eyes, encephalopathy, nephropathy.	Gastiointestinal tract, central nervous system, kidneys, blood, and gingival tissue damage.
Nickel	1.0	0.015	NE	93.0	ING, ING	Yes	Vertigo, headache, nausea, vomiting, epigastric pain, substernal pain, cough, weakness, convulsions.	Central nervous system, lungs, and paranasal sinus damage.
Zinc	5.0	NA	NE	2890.0	INH	Yes	Dry throat, cough, chills, fever, tight chest, reduced pulmonary function, headache, blurred vision, muscle cramps, low back pain, nausea, vomiting, fatigue.	Respiratory system damage.

Explanation

Con - Skin and/or eye contact
Ing - Ingestion
Inh - Inhalation
ABS - Skin absorption
CNS - Central Nervous System
NA - Not Available
NE - Not Established

General First Aid Treatment

Eye	Irrigate immediately
Skin	Soap wash promptly
Inhalation	Move to fresh air
Ingestion	Get medical attention

All of the metals listed are odorless solids that are not explosive (LEL and UEL values do nto apply) and not ionized by detection equipmenent (no ionization potential).

HEALTH & SAFETY PLAN
TABLE 3

MONITORING METHOD, ACTION LEVELS AND PROTECTIVE MEASURES

Type of Instrument	Type of Hazard	Action Response Level[1]	Action Response
Respirable Dust Monitor	Contaminated Particulates	> .05 mg/m^3	Upgrade to Level C protection immediately or evacuate site
OVA Hnu Photoionizer[2]	Organic Vapors/Gases	Background 3 ppm over background or the lowest recorded OSHA permissible exposure limit, whichever is lower 50 ppm over background unless lower values are dictated by respirator protection factors	Level D Upgrade to Level C protection immediately or evacuate site. Upgrade from Level C to Level B protection immediately[3]
Combustible Gas Indicator[4]	Explosive Atmosphere	10% scale reading 10-15% scale reading Greater than 15% scale reading	Proceed with work. Monitor with extreme caution. Evacuate from work zone immediately.
Oxygen Meter[5]	Oxygen Deficient Atmosphere	19.5% O_2 by volume 19.5-25% O_2 by volume Less than 19.5% O_2 Greater than 25% O_2 by volume	Monitor with caution. Continue investigation with caution. Terminate work O_2 deficient atmosphere. Terminate work; fire hazard.

Type of Instrument	Type of Hazard	Action Response Level[1]	Action Response
Radiation Survey Meter [6]	Ionizing Radiation	0.1 mR/hr. 1 mR/hr. or greater	If radiation is detected above this level, radiation sources may be present [7]. Potential radiation hazard; evacuate site immediately.
Colormetric Tubes	Organic and Inorganic Vapors/Gases especially vinyl chloride	Depends on species	Consult standard reference manuals for air concentration/toxicity data. Use Draeger tubes to distinguish vinyl chloride if organic vapors detected in breathing zone.
Tedlar Bag-Chromatograph Analysis	Compound Specific	3 ppm over background or the lowest recorded OSHA permissible exposure limit, whichever is lower	If VC suspected use tedlar bag to obtain air sample analyze for VC in lab.

Notes:

1. Monitored in breathing zone.
2. Some inorganic species can also be ionized with this analyzer.
3. Positive pressure demand self-contained breathing units are required (+SCBA).
4. LEL - Lower explosive limit where the (scale) range is 0-100%. The LEL for most gases is between 1-15%.
5. 0_2 - Normal atmospheric oxygen concentration at sea level is approximately 20% oxygen by volume.
6. mR/hr. - Milliroentgen per hour where normal background gamma radiation is approximately 0.01-0.02 mR/hr.
7. Contact H&A Health & Safety Staff immediately.

HEALTH & SAFETY PLAN
TABLE 4

AMERICAN FILTRONA CORPORATION - DOLLINGER SITE
HEALTH AND SAFETY PLAN
COMMUNITY AIR MONITORING PLAN SUMMARY

	Condition	Response
o	5 ppm or greater at site perimeter (attributed to Dollinger boring, well installation or excavation)	- halt work, notify Health and Safety officer - take air sample, analyze with GC - resume work if levels fall below 5 ppm and compounds identified fall below TLV's - increased perimeter monitoring to be initiated - monitoring will be initiated 200 feet downwind from the survey site or half the distance to the nearest downwind residential/commercial property
o	5 ppm or greater 200 feet downwind of work site, or half the distance to the nearest residential/commercial property (attributed to Dollinger site boring, well installation or excavation).	- all drilling/excavation to halt - if levels persist above 5 ppm air quality must be monitored within 20 feet of nearest downwind Residential/Commercial Structure. (20 foot zone) - take air sample, analyze with GC.
o	5 ppm for 30 minutes or exceeding 10 ppm, measured at the 20 foot zone. (attributed to Dollinger site boring, well installation or excavation).	- initiate Major Vapor Emission Plan. - Health and Safety Officer to contact local police - Monitor 20 foot zone at 30 minute intervals or less. - take air sample, analyze with portable GC.
o	2 successive monitoring readings (20 foot zone) below 5 ppm	- initiate reduced air monitoring as per Health and Safety Officer.

HEALTH & SAFETY PLAN
TABLE 5

EMERGENCY PHONE NUMBERS

Monroe County Emergency Services	
Ambulance Service	911
Fire Department	911
Police Department	911
H&A of New York Project Manager Suzanne Wheatcraft	232-7386
H&A of New York Health & Safety Representative Margaret Bonn	232-7386
New York State Department of Environmental Conservation David Crosby, Project Manager	(518) 457-3373
Town of Brighton Engineer Tim Keef	473-8800
Hospital - Strong Memorial Hospital 601 Elmwood Avenue Rochester, New York Emergency Room	275-4551
Monroe County Health Department Richard Elliott	274-6904
New York State Department of Health David Napier	(716) 423-8071
Poison Control	275-5151
New York State Department of Environmental Conservation - Region 8	226-2466

NAME _____ DATE _____

EMPLOYER _____

ACKNOWLEDGMENT

TO BE SIGNED AND RETURNED TO

H&A OF NEW YORK SITE SAFETY OFFICER

I have received and carefully read the Site Health and Safety Plan. I agree to abide by these safety rules, regulations, and guidelines while working on the site, and understand that any violation of these rules will result in my removal from the facility.

I have completed and understand the training program and have checked below those subjects addressed during the course of site specific training.

- o Work Rules and Safety Requirements
- o Personal Protective Equipment (PPE)
- o Potentially Hazardous Chemicals
- o Emergency Equipment
- o Reporting of Injuries and Illnesses
- o Emergency Procedures
- o Job Assignment
- o Personal Hygiene
- o Motor Vehicle Equipment
- o Standard Operating Procedures

I further affirm that at a minimum, a respirator qualitative fit test has been performed and a respirator of the same type has been assigned for my use.

Signature _____

Print Name _____

This individual has received training in all aspects of this Health and Safety Plan and has indicated he/she is knowledgeable in the use and care of personal protective equipment.

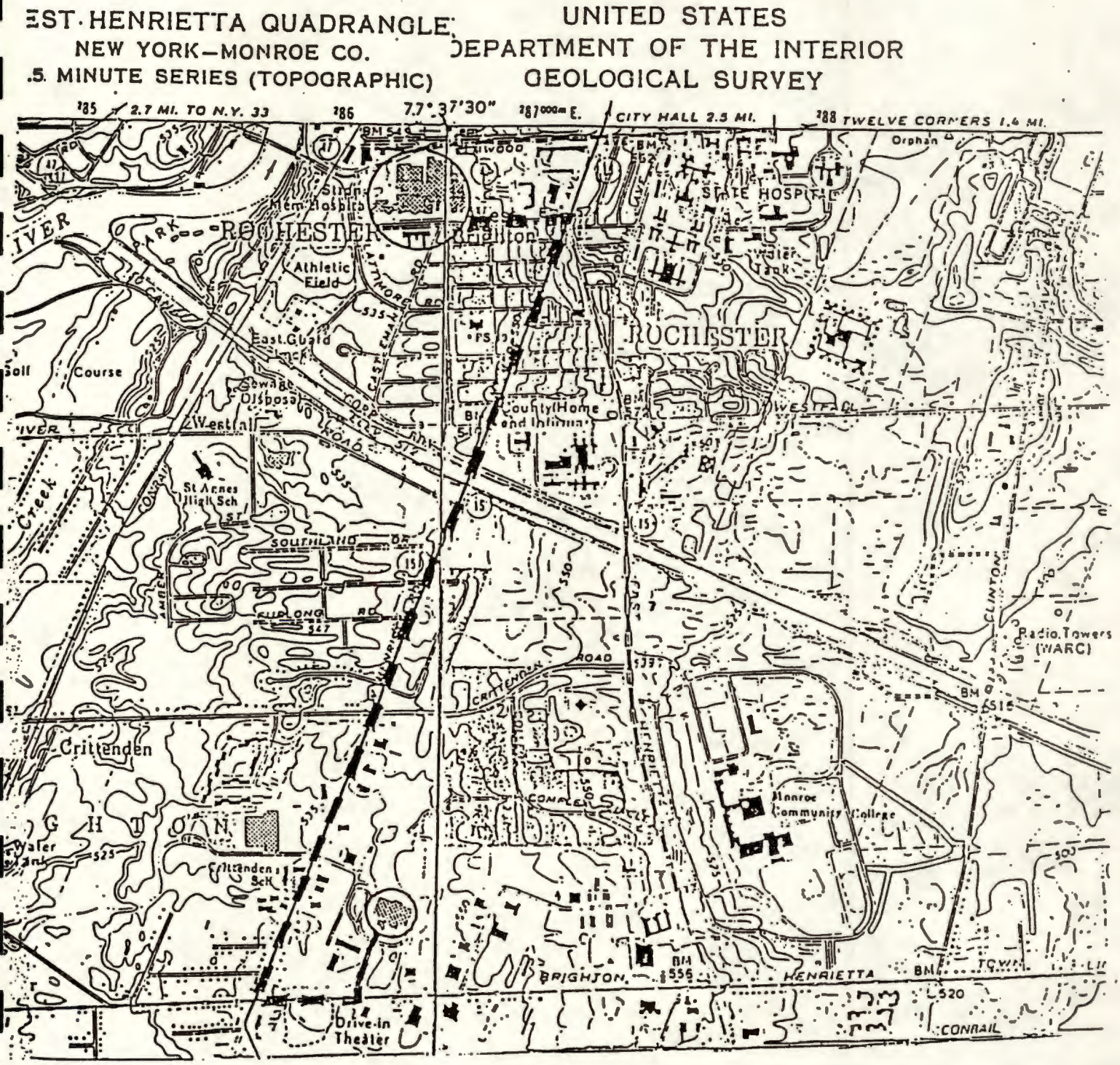
SAFETY OFFICER

Signature _____ Date _____

Print Name _____

ROUTE TO STRONG HOSPITAL

- From Townline Circle turn Right onto Brighton-Henrietta Townline Road
- At traffice light turn right onto Route 15 (West Henrietta Road)
- Turn left onto Crittendon, go approximately two blocks
- The hospital and emergency room entrance will be on your right.



APPENDIX B

2-Phase Extraction System-Confidential Information

APPENDIX C

Manufacturer's Information

WINTEK CORPORATION

Intervac/Wintek Soil Vapor Extraction System (SVES)

System Data Sheet

System Serial Number	93112759
System Model Number	KO-CSO-500/2-1A-C
Application:	Xerox 2-Phase Soil Vacuum Extraction
Customer/End User:	Dollinger Corporation Dollinger Building 1 Town Line Circle Rochester, NY 14618
Rated Capacity:	440 ACFM @ 25"HgV
Vacuum Pump model:	TRH 80-750/C-F
Vacuum Pump HP:	50 HP - TEFC Enclosed
System Voltage:	460 V
Vacuum Pump Sealant Fluid:	Intervac 75211
Starter:	NEMA 4, 460V
Engineer	H & A 189 North Water Street Rochester, NY 14604 1-716-232-7386
Manufacturer	Intervac Corporation 125 Rawson Road Victor, NY 14564 1-716-924-7080
Service Mgr:	Floyd Hockenberry
Technical Representative	Paul M.Winter Wintek Corporation 7 Lime Rock Lane Califon, NJ 07830 1-908-832-9477

NOTICE

To keep the warranty in effect use INTERVAC SEALANT part number 75211-000 only

WINTEK CORPORATION

Intervac/Wintek Soil Vapor Extraction System (SVES)

TABLE OF CONTENTS

SECTION A - SVES OPERATION MATERIALS

Section B - Intervac CSO Oil Sealed Vacuum System Information

7 Lime Rock Lane, Califon, NJ 07830 * (908) 832-9477 * FAX: (908) 832-9768

Section C - Individual Components

The **Intervac/Wintek Soil Vapor Extraction System** (SVES) is used for groundwater remediation in conjunction with the Xerox 2-Phase Extraction process. The Xerox 2-Phase Extraction Process is patented under U.S.A. law, Patents 5,050,676 and 5,172,764 as licensed by Xerox Environmental.

For information on the 2-Phase Extraction process, contact either Xerox or their licensed consulting engineers.

The Intervac/Wintek SVES is a self contained, skid mounted system which:

1) separates the liquid from the vapors for treatment,
2) creates the deep vacuum required for the 2-Phase process, and
3) adjusts the humidity of the process vapors for optimum efficiency of vapor phase carbon treatment.

1. VAPOR-LIQUID SEPARATION

Skid Isolation Butterfly Valve

Inlet Separator/Knock-Out-Pot - Separates vapors from groundwater. This tank is carbon steel with an epoxy coating.

Features:

Demister Pad - Acts as an inlet filter to remove entrained droplets and solids preventing ingestion into the vacuum pump. The Intervac vacuum pump can handle liquid slugs without damage, however, it would cause operational problems.

Vacuum Gauge with isolation valve - for proper reading of process vacuum.

Level Glass - Indicates level of groundwater in the inlet separator tank.

Capacitance probe - Located in the clear level glass, Electronically transmits adjustable level conditions. High-High, High, Low, Low-Low Conditions

High-High: When groundwater rises to this level, the skid shuts down and activates the "Inlet High Level" light on the control panel.

High: When groundwater rises to this level, the water transfer pump turns on to pump the groundwater to the water treatment carbon system.

Low: When groundwater drops to this level, transfer pump turns off.

Low-Low: When groundwater reaches this level, the entire system shuts down, and activates the "Inlet Level Low" light on the panel.

Clean out port- The bottom of the inlet separator should be cleaned periodically to remove sand, dirt, and any floating organics which may accumulate. Failure to clean the separator could result in damage to the transfer pump from ingesting any of these.

Drain piping/Probe isolation valves

A. Path of Groundwater - Separated from process vapors in KOP

Y-Strainer This strainer keeps particulate material out of the transfer pump. It is extremely important to keep this strainer clean or damage to the transfer pump will occur. After initial start-up of the system, the strainer should be cleaned daily.

"Tee"s: For future installation of a backup Transfer Pump.

Transfer Pump- This is a low NPSH Teflon gear pump which removes groundwater from the inlet separator tank. The pump operates in "Hand-Off-Automatic" (HOA) operation. In "Hand" mode, the pump will operate until reaching the low shut-off point on the separator tank level probe. In "Automatic" mode, the pump turns on when the separator level reaches the "HLS" switch point on the separator probe, and turns off when the water drops to the "LLS" switch point. Pump performance is monitored by a PI on the discharge.

Transfer Pump High Pressure Switch (PS-2): Indicates a plugged discharge, set for 45-55 psig, will shut down Transfer Pump, but not the entire system.

Filters, PI, Check Valve - The transfer pump pumps the groundwater through a pair of particulate filters to prevent clogging of the discharge carbon filters. These filters can be monitored by comparing the pressure gauges on each side.

Diverted Piping: The cool groundwater can be used as the cooling medium for the aftercondenser. Five (5) ball valves are arraigned so the user can choose between the filtered groundwater or water from another source. Temperature gauges are included on the aftercondenser's coolant inlet and discharge.

B. Path of Contaminated Process Vapors

- After leaving the inlet separator, process vapors are drawn through Intervac's SynSeal vacuum system and Humidity adjustment treatment.

2. INTERVAC SYNSEAL VACUUM SYSTEM

This system features an Intervac air-cooled Liquidring vacuum pump (cast iron housing, ductile iron impellers, 420 SS shaft) with carbon face mechanical seals and PTFE elastomers.

Suction Line Accessories Include:

Vacuum Breaker with silencer - This manual vent valve w/ silencer is used to set the operating vacuum level, should the vacuum level pull down deeper than desired. This valve also prevents cavatation of the pump by bleeding air into the pump inlet. Without this, the pump would pull down to a blank-off point and start cavitating.

Inlet check valve - After the pump shuts down, the pressure difference between the atmospheric discharge and the evacuated inlet will cause the sealant fluid to push up into the vacuum line. The check valve is mounted on the suction housing of the vacuum pump, and will prevent the sealant from backing up any further.

Vacuum gauge - Reads the system's deepest vacuum point, located at the suction housing of the liquidring vacuum pump.

Interstage Relief Valve: At operating pressures lower than 20-22"HgV, the second stage of the vacuum pump may reach positive pressure. The Interstage Relief will relieve the pressure into the separator tank. A check valve is included to be sure that the pump interstage is otherwise isolated.

Sealant Fluid Recirculation System:

High temperature switch on pump discharge (Set at 200°F) Due to the close-machined clearances of the liquidring pump, great care must be taken against seizure of the pump due to thermal expansion. Under no circumstances should the pump operate at temperatures higher than 200°F. This temperature switch will shut-down the SVES and turn on the "High Temperature Light" on the control panel.

Temperature gauge

Separator/reservoir, manufactured in carbon steel, complete with:

- **Multistage coalescing type exhaust mist eliminator arrangement (OME)** and removable top cover. To separate exhaust mist from process vapors.
- **Oil-suck back line (one per stage)** - A scavenger line piped directly to a negative pressure point on the vacuum pump which will suck accumulated sealant off of the OME. Consists of tubing, a sight glass and an orifice. Sight glass should be wetted, not full of oil. If deep enough vacuum is not reached (20"HgV minimum), the oil may be retained in the OME, thus reducing its effectiveness.
- **Back-pressure indicator** - Indicates when OME is clogged.
- **High Level Switch (HLS-5)** - Will shut down the SVES and turn on panel light.
- **Low Level Switch (LLS-6)** - Will shut down the SVES and turn on panel light.
- **(2) Drain Valves** - One aligned at pump centerline for draining off accumulated water in the sealant tank; other for total draining of separator/reservoir for a sealant change.
- **Cleanout Port**

Y-strainer, Oil Filter (with stop valves for total isolation), collects small solids which may have entered the sealant loop. Oil filter contains a differential pressure indicator.

Circulation pump, circulates the sealant fluid. Performance monitored by pressure ind. on Circulation Pump.

Temperature Control Valve (TCV-A) - Diverts hot sealant out of recirculation loop for use as heating medium in process vapor discharge reheater. Senses temperature of process vapors leaving SVES on the way to carbon beds.

Sealant Heat Exchanger (HX), air-cooled, fin tube, to cool the vacuum pump.

Temperature Control Valve (TCV-B) - Regulates heat exchanger bypass to control vacuum pump operating temperature.

Temperature Gauge - should indicate 160°F-180°F pump operating temperature. Senses Vacuum Pump discharge temperature.

Sealant Fluid Recirculation System (con't):

Regulating Valve, to regulate the proper sealant fluid (when vacuum pump is at 25"HgV, regulate this valve until compound gauge reads 5-10"HgV.

Compound Gauge, used to regulate the sealant flow to the vacuum pump. Should read 5-10"HgV when the vacuum pump is operating at 25"HgV.

3. HUMIDITY ADJUSTMENT SECTION

After-Cooler - Cools down the discharged process vapors from vacuum system, includes drip leg.

After-Condenser - Condenses any residual moisture out of the process vapor stream.

Condensate Separator - Separates any condensate out of the process vapors. A water level is maintained in this separator because it is common for condensed ground contaminants to collect at this point and congeal to a "SPOOGE". The spooge typically will float on the water level and must be periodically drained through the tank's side drain valve. This separator also consists of:

- **Demister pad** - A final mist-eliminator.
- **Drain trap** - when float is activated, atmospheric pressure forces condensate through drain into the Inlet separator.
- **High Level Switch (HLS-7)** - When high condensate level is sensed, vacuum pump will shut down and an alarm condition will occur.

Reheater - Reheats the process vapors up to a proper temperature to drop the relative humidity in anticipation of carbon treatment beds. Uses hot, discharged vacuum sealant as heating medium.

Temperature Gauge - Reads temperature of the vapor stream leaving the unit.

Pressure Switch (PS-1) - Set at 2 psig, indicates a carbon treatment high pressure condition. This indicates that there is either a closed discharge valve or a plugged carbon bed. When engaged, vacuum pump will shut down and turn on panel light.

4. CARBON TREATMENT SYSTEM

Treats process vapors, supplied by others.

By Components - NOTE: Soil Vacuum Extraction has many variables which affect the maintenance schedules of the various components of the system. The following schedule is typical. For the 1st six months of operation, maintenance frequency should be twice that as shown below, or until operation has demonstrated a longer time between service is acceptable.

Inlet Separator

Check water level cycle points

Check operating vacuum level

Clean-out bottom to remove sand/dirt:

Weekly - stop and vent system, drain through bottom valve

Bi-Monthly (every 2 months) - stop system, vent, open manway to clean bottom and any floating sludge

New well added - Two weeks after new well added : stop system, vent, open manway to clean bottom and any floating sludge

Transfer Pump

Check transfer pump flow rate

Check water filter pressure readings

Clean suction strainer - Daily - clean suction screen

Water filters - As necessary, when pressure drop increases to 20 psig

(***Note: if well water is very hard, then additional servicing /deliming will be required.***)

Vacuum Pump:

Check vacuum level, oil level, operating temperature,

Check for unusual noises

Oil Separator

Weekly - drain water from bottom drain until partly oil;

As necessary if oil level increases - drain water from bottom, adjust operating temp.

Six months - Change sealant oil (see attached instructions)

Yearly - Change mist eliminator

Sealant line strainer: Monthly - clean strainer

Sealant line Oil Filter: As needed

Condensate separator:

Check water level

Weekly - Drain floating sludge (Spooge) using side drain

Air-coolers - Monthly - blow off dust/dirt from fins with compressed air

Discharge - Check discharge temperature

Check discharge pressure

By Time Intervals - NOTE: Soil Vacuum Extraction has many variables which affect the maintenance schedules of the various components of the system. The following schedule is typical. For the 1st six months of operation, maintenance frequency should be twice that as shown below, or until operation has demonstrated a longer time between service is acceptable.

AS NECESSARY

Water filters: when pressure drop increases to 20 psig

New Well added: Two weeks after new well added, do full clean-out of inlet separator

Oil separator when oil level increases: Drain water and adjust operating temperature

Hard water conditions: additional servicing will be required

Oil Filter: as needed

DAILY:

Inlet Separator:	- Check water level cycle points
	- Check operating vacuum level
Transfer Pump:	- Check transfer pump flow rate
	- Check water filter pressure readings - Service at 20 psig pressure drop.
	- Clean suction strainer - Daily - clean suction screen
Vacuum Pump:	- Check vacuum level - Should be 24-28"HgV
	- Check oil level - Should be at pump centerline.
	- Check operating temperature - Range 140°F - 180°F
	- Check for unusual noises
	- Check oil separator discharge pressure - Change demister element at 2 psig backpressure
	- Check oil suck-back line sight gauge. Should be wetted, not full of oil. Vacuum level must be at least 22"HgV for suck-back line to work properly
Condensate Sep:	- Check water level
Discharge:	- Check discharge temperature
	- Check discharge pressure

WEEKLY

Inlet Separator:	- Clean dirt from bottom by venting and drain through bottom valve.
Oil Separator:	- Drain water from bottom until partly oil
Condensate Sep:	- Remove floating sludge (Spooge) using side drain

MONTHLY

Vacuum pump:	- Clean sealant oil's Y-strainer
Air-coolers:	- Blow off dust/dirt with compressed air

BI-MONTHLY (every 2 months)

Inlet separator: - Full clean-out through manway to remove floating sludge and settled solids.

SIX MONTHS

Vacuum pump: - Change sealant oil (see attached instructions)

YEARLY

Vacuum pump: - Change discharge mist eliminator

The quality of the vacuum pump's sealant determines performance and reliability of the system. As the oil becomes contaminated with whatever is sucked into the vacuum pump, the quality will decrease and eventually, the oil must be changed. We recommend changing the oil every 6 months, however, severe operating conditions will necessitate more frequent changes. The proper procedure for changing the oil is as follows:

1. Run vacuum system to normal operating temperature.

2. Turn vacuum skid off.

3. Close sealant isolation valve at Y-strainer.

4. Run vacuum pump for ten (10) seconds, then shut off system again. Most of the skid's oil should now be in the separator tank.

5. Drain oil from separator tank.

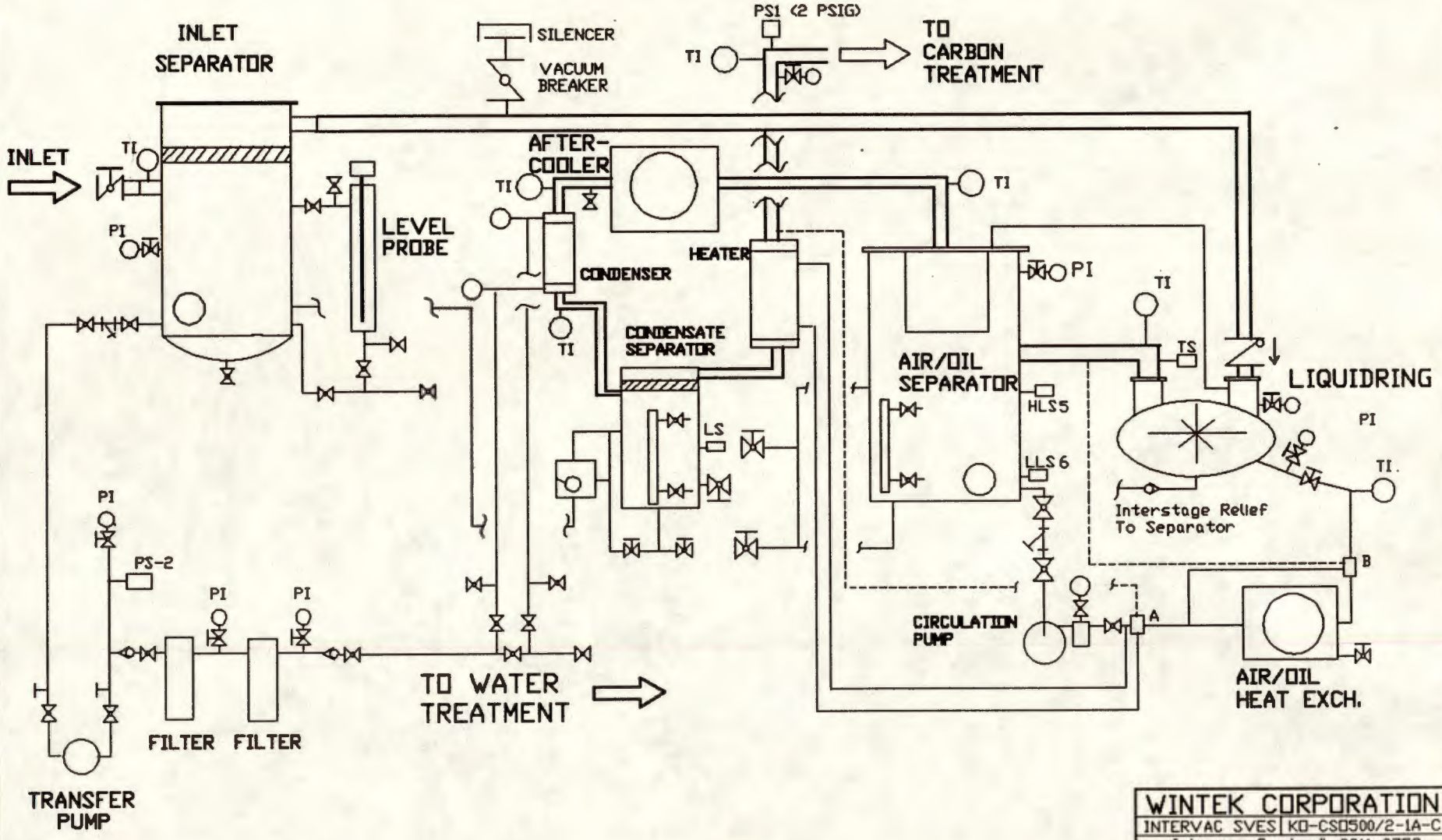
6. Remove and clean Y-strainers and/or basket strainer.
   NOTE: If system strainer shows large amounts of deposits, you may consider flushing the system with diesel fuel and repeat steps 1-7.

7. Open sealant inlet isolation valve, charge system with new oil to proper level. Run system for five (5) minutes and shut off. Recheck sealant level. Add more if necessary.
   NOTE: Oil level not to exceed center line of shaft in vacuum pump.

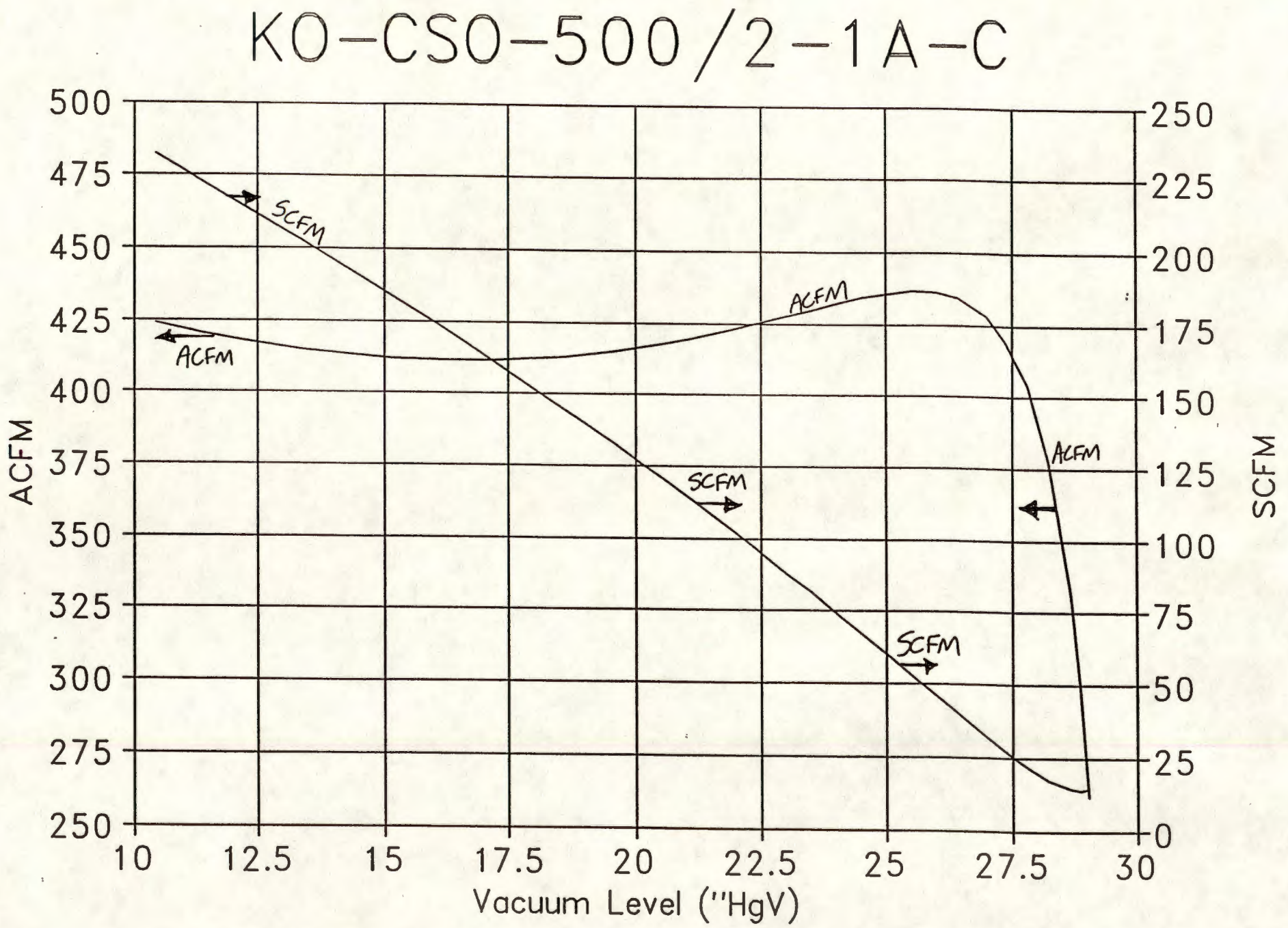
8. Wintek/Intervac is not responsible for disposal of used sealant.

Your system's performance is optimized by using Intervac's CP series sealant. This sealant is synthetically designed for compatibility with a large number of substances that may be present in contaminated soil. Typical oil would rapidly degrade in the presence of many organic pollutants. To keep your warranty in effect, please contact Wintek for additional sealant. Wintek Corporation will also be glad to assist you in any of your maintenance or troubleshooting concerns.

INTERVAC SOIL VAPOR EXTRACTION SYSTEM



WINTEK CORPORATION	
INTERVAC SVES	KD-CSD500/2-1A-C
Intervac System# 9311-2759	
3-11-94	RAC


KO-CSO-500/2-1A-C
500
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275
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ACFM
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225
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175
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125
100
75
50
25
0
SCFM
SCFM
ACFM
ACFM
SCFM
ACFM
SCFM
10
12.5
15
17.5
20
22.5
25
27.5
30
Vacuum Level (''HgV)

INTERVAC®
Vacuum System Specialists

125 RAWSON ROAD
VICTOR, NY 14564
1-800-433-8487

03-07-94

RECOMMENDED SPAREPARTS LIST

We are pleased that you have chosen Intervac to meet your vacuum system requirements.

We support our equipment with a nationwide network of representatives and large inventory of parts in our factory.

We recommend a PM program be set up for your Intervac vacuum system. The recommended procedures are detailed in the parts and service manual.

SYSTEM MODEL NUMBER: SYSTEM #93062759

QTY	PART NUMBER	DESCRIPTION
1	00021221-042	COUPLING HUB - PUMP 10S, 42mm
1	00021221-000	COUPLING HUB - MOTOR 10S 2-1/8"
1	00022210-000	COUPLING ELEMENT
1	00067005-100	SEPARATOR ELEMENT
1	00067009-100	SEPARATOR ELEMENT (NESTED)
1	00053112-000	VACUUM GUAGE 0-30"HgV
1	00053114-000	COMPOUND GAUGE 30Psi-0-30HgV
1	00053114-100	COMPOUND GAUGE 30Psi-0-100HgV
1	00053016-000	PRESSURE GAUGE 0-15 Psi
1	00053116-000	PRESSURE GAUGE 0-60 PSI
1	00045020-000	TEMPERATURE GAUGE 20-240F
1	00045058-140	TEMPERATURE GAUGE 0-140F
1	00044018-001	TEMPERATURE CONTROL VALVE 135F-195F
1	00044018-002	TEMPERATURE CONTROL VALVE 80F-140F
1	00059330-000	LEVEL SWITCH
1	00046120-000	HIGH TEMPERATURE SWITCH 225F
1	836T-T-251J	PRESSURE SWITCH SET@3Psi
1	836T-T-253J	PRESSURE SWITCH SET@50Psi
1	00058103-024	SIGHT GLASS 24"
1	00058103-018	SIGHT GLASS 18"
40	00075211-000	SEALANT OIL (GALLONS)
2	00067050-000	DEMISTER ELEMENT 4"
1	303023.5x27	AIR FILTER

PARTS FOR VACUUM PUMP MODEL NO: TRH 80/750C-F
PUMP SERIAL # :

2	942055750603	LIP SEAL
2	950055SAC915	MECHANICAL SEAL
2	961006310000	BALL BEARING
1	GUAB7901000M	GASKET SET

INTERVAC®
Vacuum System Specialists

125 RAWSON ROAD
VICTOR, NY 14564
1-800-433-8487

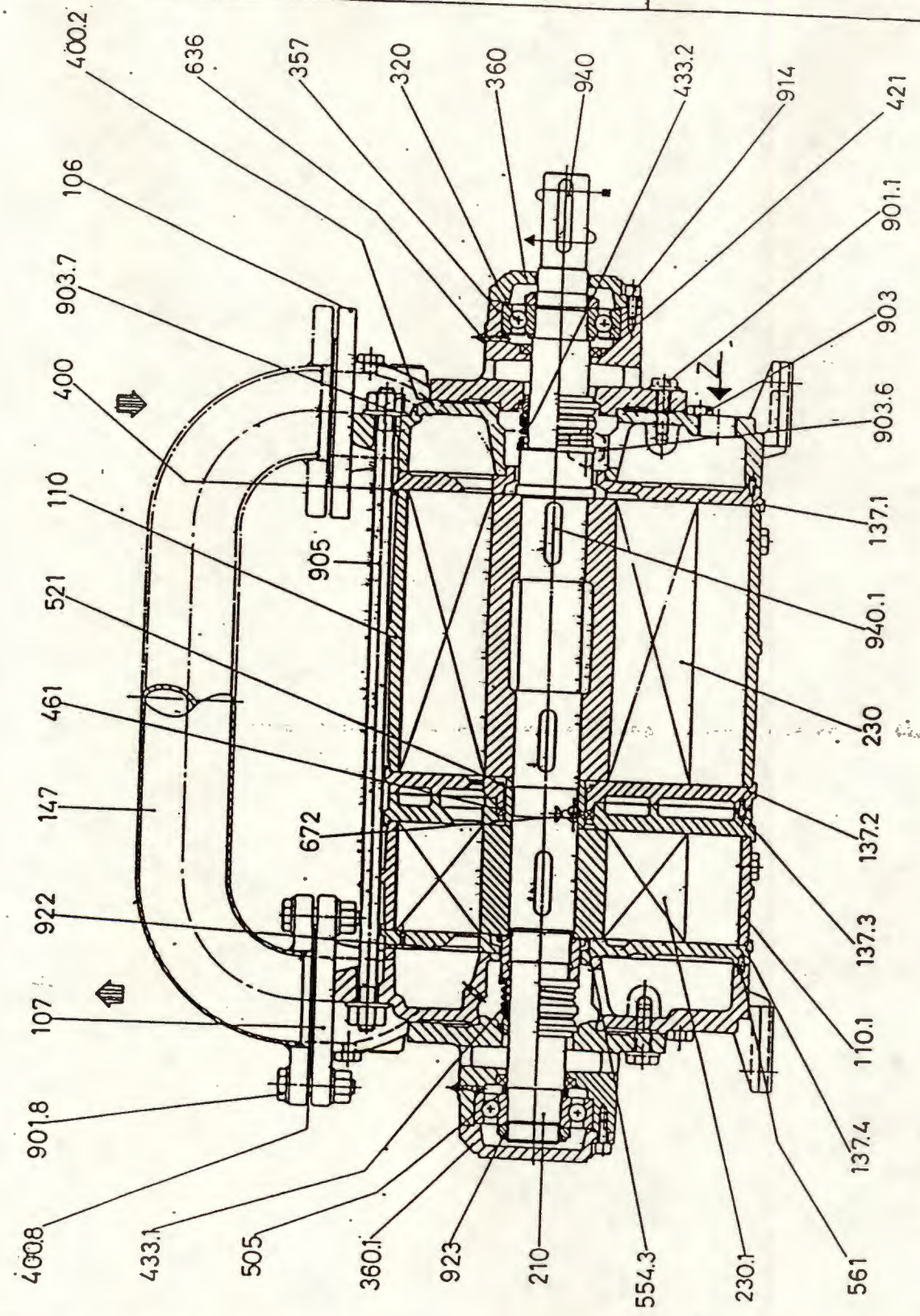
PUMP PARTS LIST
PUMP MODEL: TRH 80-750/C-F

ITEM NO.	QTY	DESCRIPTION	PART NUMBER
106	1	SUCTION COVER	306 62 100 001
107	1	DISCHARGE COVER	306 63 100 001
110	1	CENTER BODY ASSY.	306 84 100 001
110.1	1	CENTER BODY ASSY.	306 82 100 001
137.1	1	SIDE ELEMENT	306 72 100 001
137.2	1	SIDE ELEMENT	306 74 100 001
137.3	1	SIDE ELEMENT	306 73 100 001
137.4	1	SIDE ELEMENT	306 73 100 001
147	1	MANIFOLD	306 171 200 001
210.G	1	SHAFT ASSEMBLY	ALB B79 012 040
230	1	IMPELLER	306 921 100 002
230.1	1	IMPELLER	306 941 100 002
320	1	BALL BEARING	961 006 310 000
322	1	ROLLER BEARING	963 NUO 310 000
357	2	BEARING HOUSING	062 14 102 001
360	1	BEARING COVER	001 11 100 001
360.1	1	BEARING COVER	001 010 100 001
400.G	1	GASKET SET	GUA B79 010 00M
421	2	LIP SEAL	942 055 750 603
433	2	MECH. SEAL (DE. & NDE.)	950 055 SAC 915
461	1	GLAND PACKING	943 008 010 784
521	1	SPACER SLEEVE	966 062 764 032
905	5	TIEBOLT	914 016 605 034
922	1	IMPELLER NUT	+031 43 100 037
923	2	BEARING NUT	920 050 015 075
940	1	SHAFT KEY (DE)	930 070 128 044

INTERVAC
System Specification Specialists

SECTIONAL DRAWING

Pumps type TRH 80-600/C
TRH 80-750/C



Ref.:

Date: September 89

Replaces : 6570-6571.3L1.301.01

N.: 6570-6571.3L1.301.02

INTERVAC
System Specification Specialists

COMPONENTS

PUMPS SERIES TRH TRS TRV

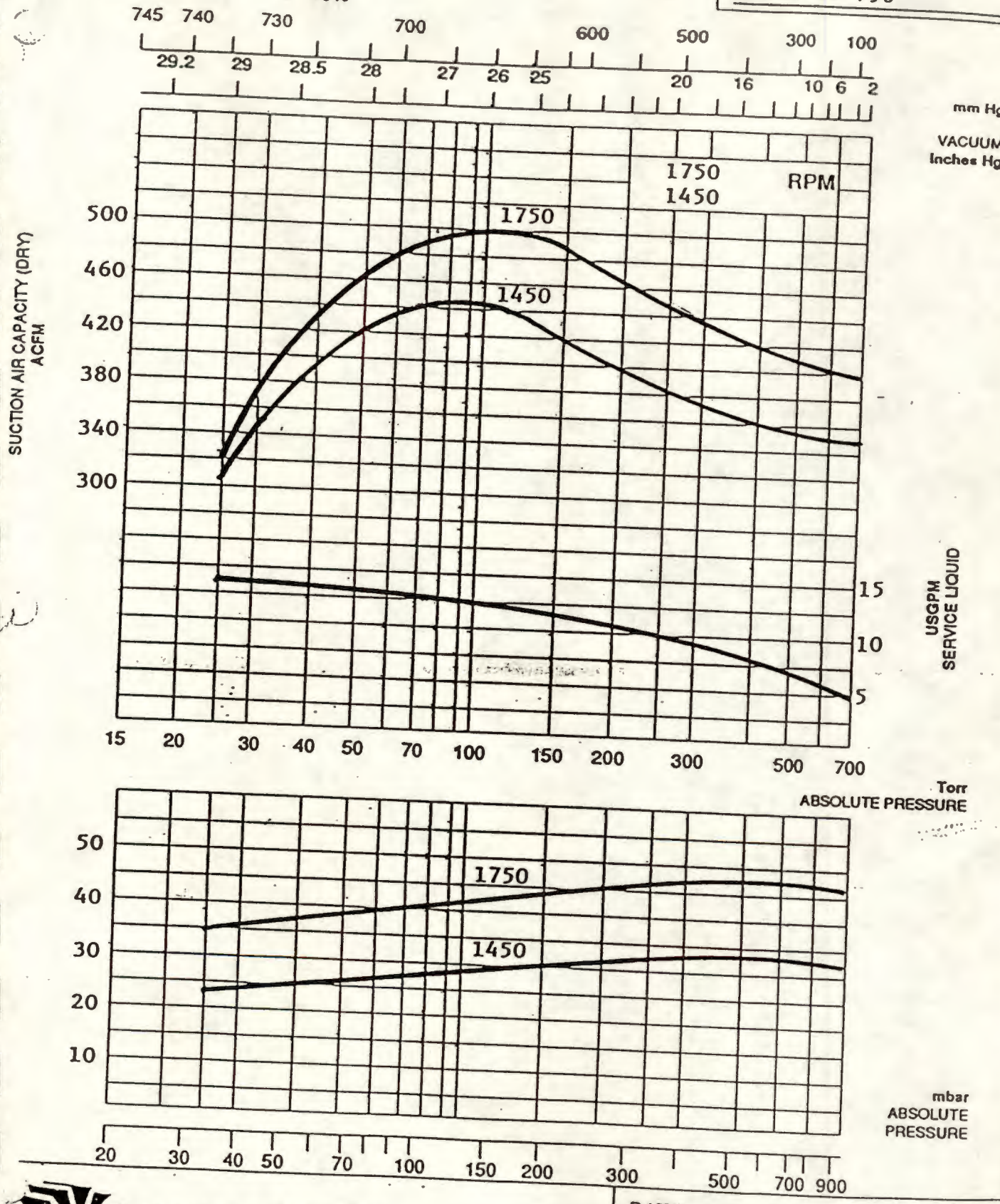
REF.N.	DESIGNATION
106	Suction casing
107	Delivery casing
109	Suction element
110	Impeller casing
110.1	Impeller casing
114	Delivery element
120	Rear casing
137.1	Side element
137.2	Side element
137.3	Side element
137.4	Side element
140	Intermediate suction plate
140.1	Intermediate suction plate
147	Manifold
180.5	Valve plate
183	Lantern foot
185	Flange with feet
210	Shaft
230	Impeller
230.1	Impeller
310	Bearing bush
310.1	Side element bush
320	Ball bearing
322	Roller bearing
341	Lantern bracket
350	Bearing housing
357	Bearing and mech.seal housing
357.1	Bearing and mech.seal housing
360	Bearing cover
360.1	Bearing cover
365	Bearing cover
365.1	Bearing cover
400	Gasket
400.1	Gasket
400.2	Gasket
400.3	Gasket
400.5	Gasket
400.8	Gasket
400.9	Flat valve
421	Radial seal ring
433.1	Mechanical seal c.c.w.
433.2	Mechanical seal c.w.
450	Stuffing box bush
451	Stuffing box housing
452	Gland
458	Lantern ring
461	Packing ring
461.1	Packing ring
471	Mechanical seal cover
485	Mechanical seal locking ring
485.1	Mechanical seal locking ring
504	Shoulder ring
505	Shoulder ring
505.1	Shoulder ring
507	Thrower
521	Impeller spacer sleeve
524	Shaft sleeve
542	Seal bush
550	Junk ring
554	Washer
561	Cylinder pin
562	Cylinder pin
636	Grease cup
672	Cock

REF.N.	DESIGNATION
721	Liquid supply inlet flange
722	Taper piece flanged
723	Counter flange
724	Blank flange
730	Fitting
731.3	Fitting
731.4	Fitting
731.5	Fitting
731.6	Fitting
734	Fitting
735	Fitting
736	Fitting
801	Flanged motor
861	Half coupling
861.1	Half coupling
861.2	Half coupling
867	Coupling dowel
901	Screw
901.1	Screw
901.2	Screw
901.8	Bolt
901.9	Bolt
902	Stud
902.1	Stud
902.3	Stud
902.4	Stud
903	Plug
903.1	Plug
903.3	Plug
903.5	Plug
903.6	Plug
903.7	Plug
903.9	Plug
905	Tie-bolt
914	Screw
914.1	Screw
914.2	Screw
920	Nut
922	Nut
922.1	Nut
923	Nut
923.1	Nut
932	Circlip
932.3	Circlip
935	Elastic ring
940	Key
940.1	Key
940.2	Key
940.3	Key
Z	Liquid supply inlet

DATA BASED ON:

Suction dry air : 70 deg. F
Discharge Pressure : 29.92" Hg - 760 Torr
Sealing Liquid : Water @ 60 deg. F
Tolerance : 10%

PERFORMANCE DATA
LIQUID RING VACUUM PUMP
PUMP MODEL:
IRH 80-750



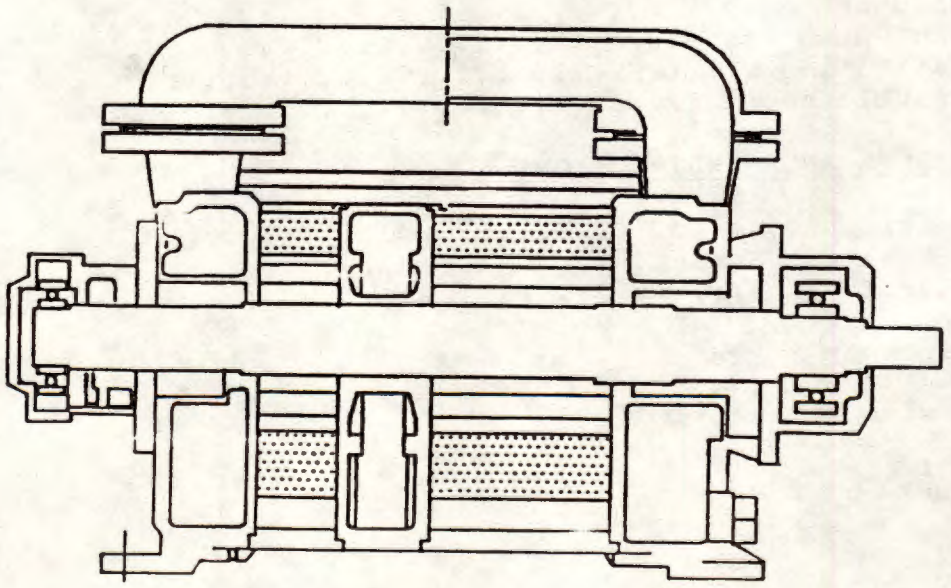
INTERVAC
System Specification Specialists

DATE: OCTOBER 1990

PAGE NO.

GENERAL INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

CLOSED LOOP OIL SEALED SYSTEMS



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INSTALLATION, OPERATION AND MAINTENANCE MANUAL

INTRODUCTION

This manual contains instructions for the installation, operation and maintenance of your Intervac liquid ring vacuum pump system. It has been designed to provide safe and reliable service. However, since it is a piece of rotating equipment, the operator must exercise good judgement and proper safety practices to avoid damage to the equipment or personal injury. The instructions in this manual are intended for personnel with general training in operation and maintenance of vacuum pumps.

SAFETY

It is assumed that your safety department has established a program based upon a thorough analysis of industrial hazards.

It is important that due consideration be given to these hazards which arise from the presence of electrical power, hot oil, or other liquids and toxic gases. Proper installation and care of protective devices is essential.

In the following safety procedures you will encounter the words **WARNING, CAUTION,** and **NOTE**. They are intended to emphasize certain areas in the interest of personal safety and satisfactory pump operation and maintenance. The definitions of these words are as follows:

WARNING: An operation procedure, practice, etc. which, if not correctly followed, could result in personal injury or loss of life.

CAUTION: An operating procedure, practice, etc. which, if not strictly observed, could result in damage or destruction of equipment.

NOTE: An operating procedure, condition, etc. which is essential to highlight.

These safety procedures are to be used in conjunction with the installation, operation and maintenance instructions contained in the system manual.

INSTALLATION

NOTE: The design of plant piping systems, foundations, and other areas of system design is the responsibility of others, not Intervac Corporation or its representatives. Data and comments are offered as an aid, but Intervac cannot assume responsibility for the design and operation.

We recommend that ... a specialist skilled in the design of foundation, piping, and equipment location so as to supplement and interpret Intervac Corporation's information and to insure a successful installation.

WARNING: Install, ground, and maintain equipment in accordance with the National Electric Code and all applicable federal, state, and local codes.

CHECK UPON ARRIVAL

The unit should be inspected immediately upon arrival, and any irregularities arising due to shipment should be reported to the carrier.

PREPARATION

Read this manual and other literature provided. If questions arise, consult the distributor or the factory.

Verify that the proper utility services required to operate the equipment are available. Among these are the electrical supply, voltage, current, number of phases, the water supply temperature, flow capacity and quality, and drain size and capacity.

LOCATION

Install the vacuum system in an accessible place, as close as possible to the vacuum use area. Allow adequate space for operation as well as for maintenance operations involving dismantling and inspection of parts.

Consideration must be given to environment. Proper ventilation is necessary, and extremes of dampness or temperature should be avoided.

GENERAL DESCRIPTION AND PRINCIPLE OF OPERATION

GENERAL DESCRIPTION

Liquid Ring Type Vacuum Pumps

The rotary impeller is located eccentrically within the pump casing. The liquid ring, therefore, acts as a piston. Both single and two stage pumps are available in a wide range of sizes.

The operating ranges, when using oil at (150-190 degrees F.) as the seal liquid, are:

- Single stage pumps: down to 26" Hg. vacuum (99 TORR suction pressure)
- Two stage pumps: down to 29 1/2" Hg. vacuum (10 TORR suction pressure)

The standard materials of construction are suitable for handling air and other non-corrosive gases using oil as the seal liquid. Other materials can be substituted for special applications.

PRINCIPLE OF OPERATION

Figure # 1 shows a cross section of a liquid ring vacuum pump. The impeller is cylindrical in shape with a mulitiude of blades and is located eccentrically in the impeller housing which is partially filled with the sealing liquid, normally water. A portplate with suction and discharge openings is located on each side of the impeller cell.

As the impeller rotates the centrifugal force flings the sealing liquid outwards where it forms a liquid ring which follows the contour of the impeller housing. Start at point "A" the impeller cell is completely filled with the sealing liquid.

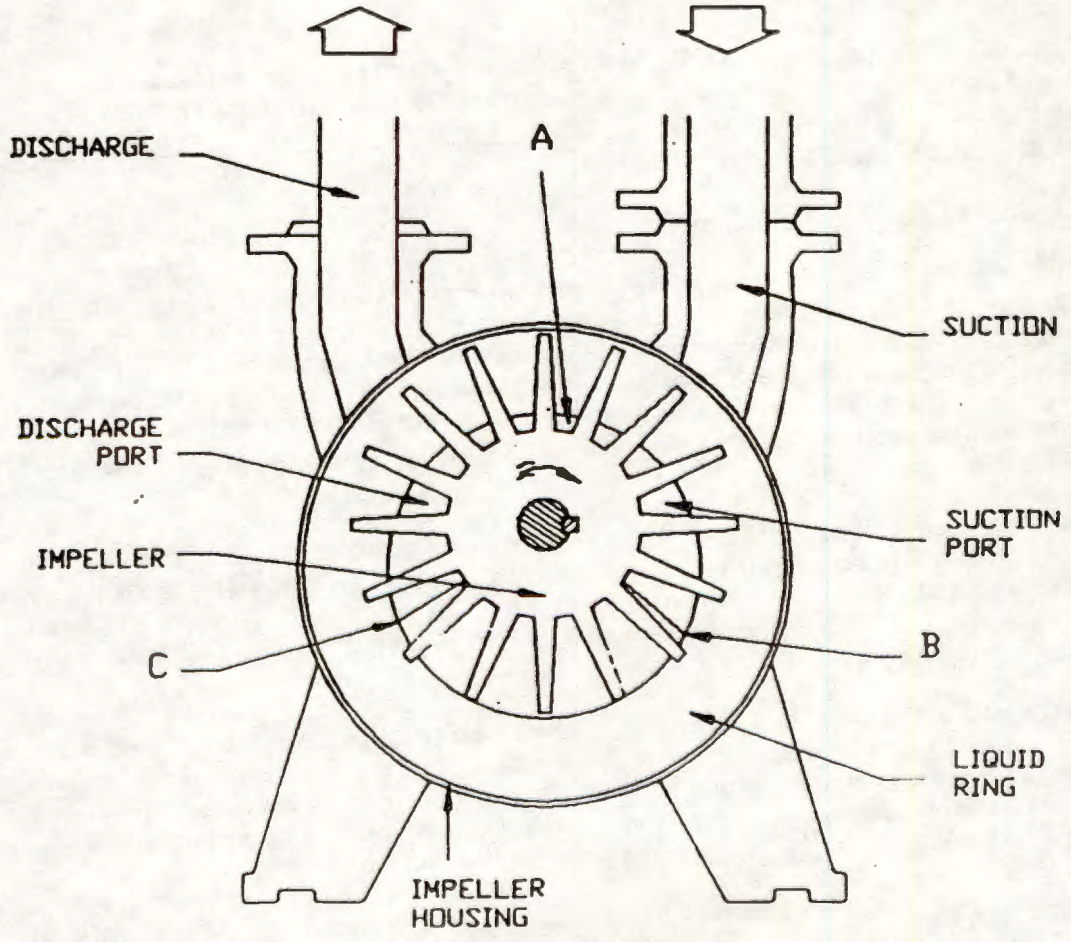
As the impeller advances, the liquid in the cell recedes and creates a vacuum in the empty space, which draws in the air or gas through the suction port. Continued rotation increases the gas volume in the impeller cell until the end of the suction cycle at point "B".

From point "B" onwards, the liquid is gradually forced back into the impeller cell, compressing the gas trapped in between, until at point "C" the compressed gas is expelled through the discharge port together with part of the sealing liquid.

The complete cycle can be compared with a piston in a cylinder where the piston is the liquid ring and the impeller cell is the cylinder. The heat generated by the pump during the compression cycle is dissipated into the liquid ring.

A fresh supply of cool liquids is continuously introduced into the pump through a separate sealing liquid supply opening. The amount of cooling liquid added is synonymus with that discharged through the discharge port together with the compressed gas.

Figure 1



PUMP INSTALLATION INSTRUCTIONS

Carefully unpack the pump, taking care not to damage or misalign the pump. For pump and motor units mounted on a baseplate, lift by the baseplate only. Do not attach slings or hooks to the pump or motor. This can cause misalignment. Do not attempt to run the pump until the installation work is complete as detailed in this manual. DO NOT run pump without sealant liquid.

A. Preservation Procedures

Systems are shipped with oil in the closed loop system. The location of the installation or storage of the unit should be in a dry environment.

B. Foundation

The foundation should be sufficiently rigid and substantial enough to absorb any system vibration and to permanently support the base at all points. It should be strong enough to support one and a half times the weight of the unit.

Leveling the Baseplate

Place the unit on the foundation and level the baseplate. Use a machinist's level to determine the levelness.

Pull the foundation bolts down so they are snug and re-check with level. Adjust if needed.

Grouting

NOTE: Do not grout until the unit has been leveled.

Build a dam around the baseplate and push or squeeze grout under the frame with a trowel.

It is recommended that the baseplate be completely grouted.

C. Direct Coupled Units

Correct alignment of the pump and motor is of the utmost importance. Pump/motor combinations are aligned at the factory, but baseplates may be distorted in shipment, and misalignment may occur due to unequal tightening of the foundation bolts or pipe strain. It is, therefore, essential that alignment is checked before the unit is put into service.

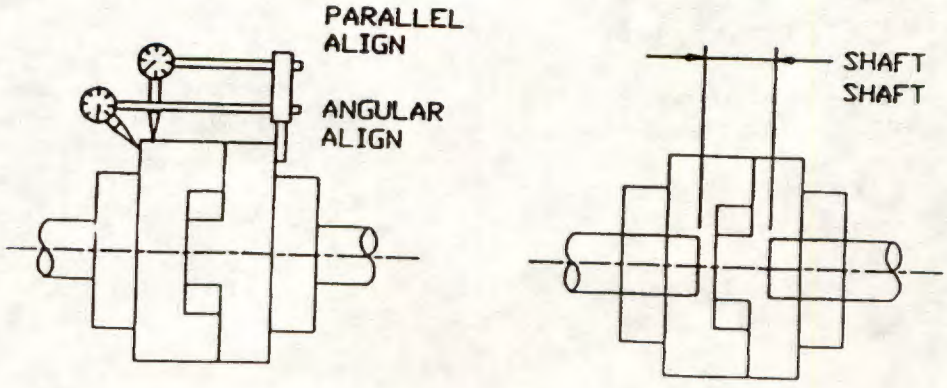
Both angular and parallel alignments should be within .005 inch, total indicator runout. Monoblock units do not require field alignment.

Drive Coupling

Drive coupling hubs should be checked and maintained for tightness of set screws and proper spacing. The flexible element must be allowed approximately 1/16" of free axial movement.

FIGURE 2

LOVEJOY COUPLING SIZE	PARALLEL X	ANGULAR Y	SHAFT/SHAFT
	INCH	INCH	INCH
AL-095	.005	.005	1/2"
AL-100	.005	.005	3/4"
AL-110	.005	.005	7/8"
AL-150	.005	.005	1"



D. V-Belt Coupled Units

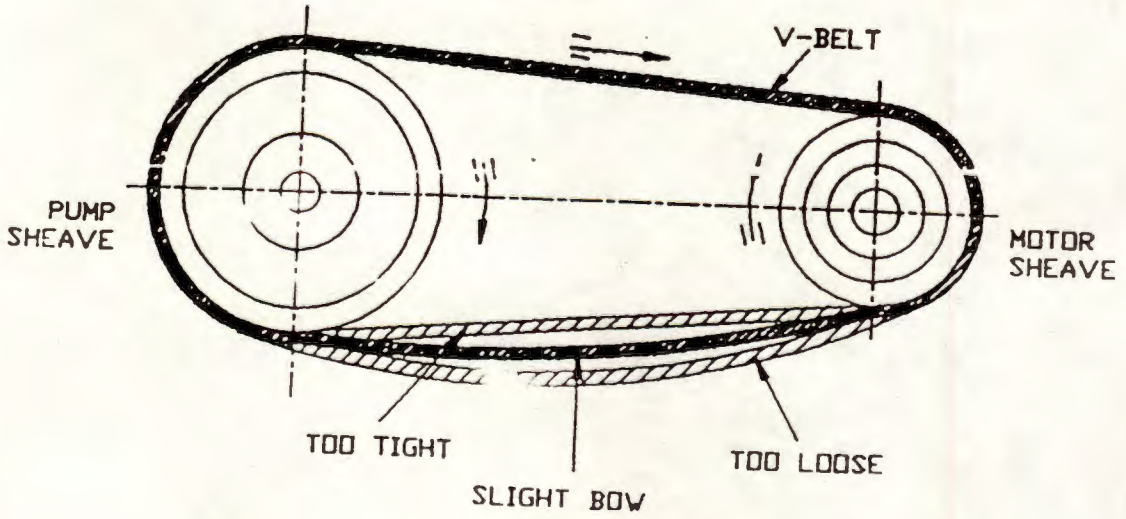
For the pumps utilizing V-belt drives, make sure the sheaves are properly installed and aligned before attempting to tension the drive. The V-belts should be placed over the sheaves and in the grooves without forcing them over the sides of the grooves. The tensioning steps 1,2, and 3 can be used for all types of V-belts, all cross sections and number of belts, and all types of construction.

1. With all belts in their grooves, adjust centers to take up the slack until they are fairly taut.

2. Start the drive and continue to adjust until the belts have only a slight bow on the slack side while operating <u>with load conditions.</u>

3. After several days of operation, the belts will seat themselves in the sheave grooves. Further tensioning may be necessary, such that the drive shows a slight bow in the slack side. Insufficient tension is often evidenced by slipping (squealing) at start-up. If the unit is idle for an extended period of time, the tension on belts should be removed. Excessive heat (140 degrees and higher) should be avoided, as belt life is shortened since the rubber is overcured. Belts should never be mixed or switched from one groove to another on the sheaves and <u>belt dressing never should</u> be used. <u>Belts should be replaced with a matched set.</u> Sheaves should remain free of oil and grease. Consult the drive manufacturer for more specific information.

<u>FIGURE 3</u>



E. SEAL LIQUID PIPING ARRANGEMENTS

The working principle of the liquid ring pump is dependent upon a continuous supply of clean seal liquid. The seal liquid enters the pump through a connection on the casing and is discharged from the pump, along with the gas. The basic seal liquid arrangement that can be used for vacuum pump applications.

The arrangement has four basic elements:

1. Source of seal liquid (from reservoir).
2. Regulating device to control flow of liquid.
3. Means of stopping flow when pump is shut off. (Systems with elevated reservoirs.)
4. A means of separating the gas-liquid exhaust mixture.

1. Seal Liquid: Full Recovery of the oil seal liquid (Arrangements are shown on Figure 4)

VACUUM PUMPS (CSO Closed Loop Oil Sealed Systems)

This arrangement provides the total recirculation of the seal liquid. A heat exchanger is added to the system to remove the heat of compression, friction, and condensation from the seal liquid before it is re-introduced back into the pump. This heat exchanger may be of the shell and tube, or plate and frame design. A circulating pump is normally installed for prolonged operation at suction pressures above 300 TORR or when suction pressure varies during cycling operations.

CSO oil sealed systems use a low vapor pressure fluid (normally oil) as the sealing liquid for durability and long pumping life.

Because the seal fluid has a much lower vapor pressure than water, the maximum vacuum obtainable is no longer limited by seal fluid temperature and, in addition, the pump efficiency is enhanced.

CSO systems operate at elevated temperature (150-190 degrees F). Heat removal is therefore more efficient and less costly, and provides a choice of air cooled or water cooled design.

The system operating temperature on air cooled systems is controlled by a temperature switch fitted in the vacuum pump discharge which in turn cycles the cooling fan of the oil cooler. On water cooled systems the temperature can be controlled by a thermostatic valve mounted in the cooling water outlet of the heat exchanger. In addition, the vacuum pump is provided with a high temperature cut-out switch which will shut down the system in case of insufficient cooling or low sealing liquid flow.

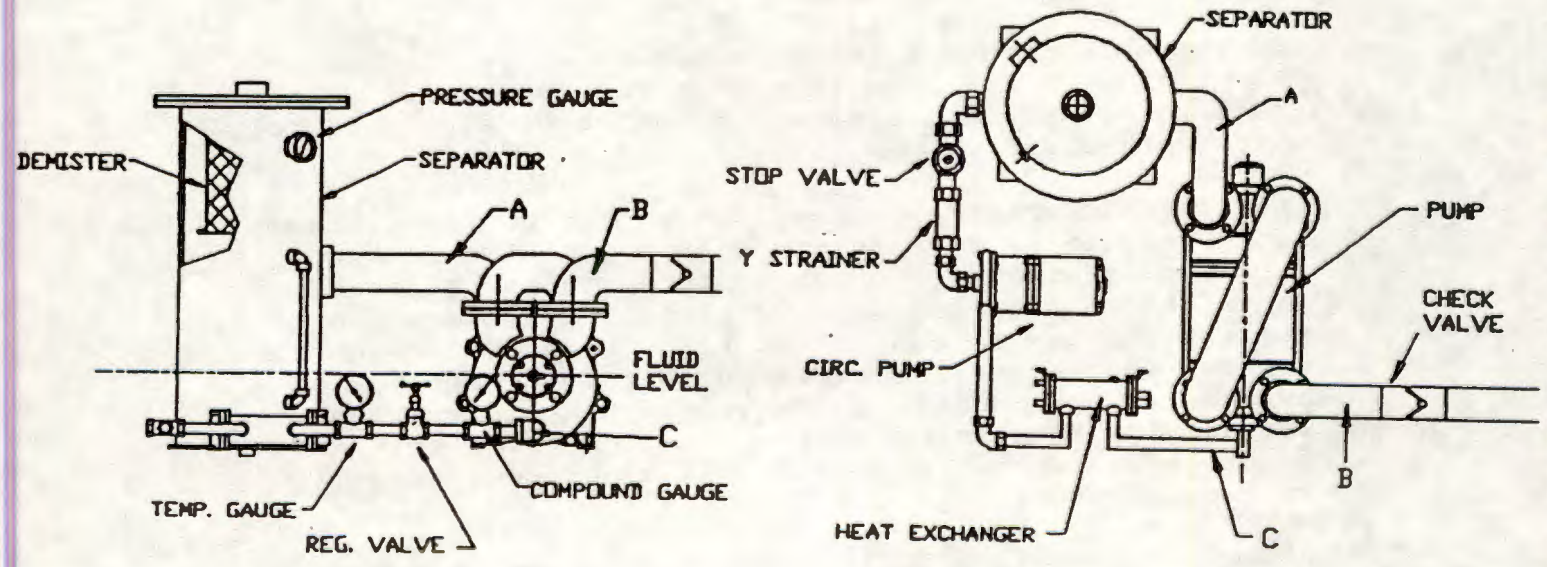
Efficient operation of the liquid ring vacuum pump is dependent upon a supply of the correct amount of sealing liquid. The sealing liquid circulating pump fitted in the system is sized correctly for each particular model vacuum pump.

The seal liquid level in the separator/recirculation tank should be at, or slightly below, the centerline of the pump shaft.

Any solids or contaminants carried over into the vacuum pump will ultimately collect in the seling liquid reservoir, but part will stay in suspension in the sealing liquid and will cause excess wear to the internal parts of the vacuum pump and circulating pump, in addition, it can cause blockage of the heat exchanger. Therefore, included is a liquid filter/strainer in the return line between the reservoir and circulating pump. It is essential at start-up, especially in new installations, to clean this filter regularly to avoid blockage of the liquid supply to the pumps. INSUFFICIENT SEAL LIQUID FLOW WILL CAUSE THE VACUUM PUMP AND CIRCULATION PUMP TO OVERHEAT.

In those installations where a high carry-over of solids can be expected, we recommend the installation of an inlet filter properly sized for the pump capacity. Contact your nearest distributor or the factory for details.

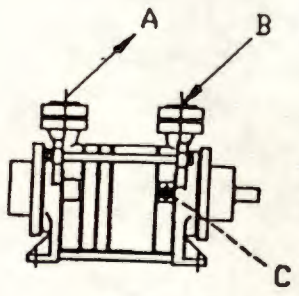
FIGURE 4



A = Connect to pump discharge
B = Connect to pump suction
C = Connect to pump service liquid
(Refer to Fig. 5 for specific location of pump connection)

VARIOUS PUMP CONFIGURATIONS

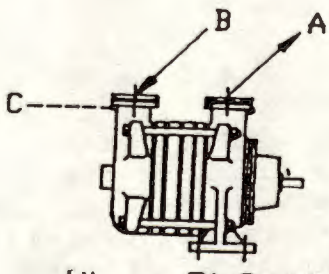
FIGURE 5



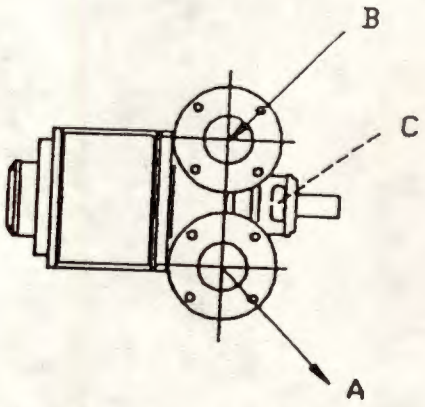
PLT - PLTC 3103/1
PLT - PLTC 3106/1
PLT - PLTC 3203/1
PLT - PLTC 3206/1

PLM - PLMC 31/5
PLM - PLMC 32/5
PLM - PLMC 33/5

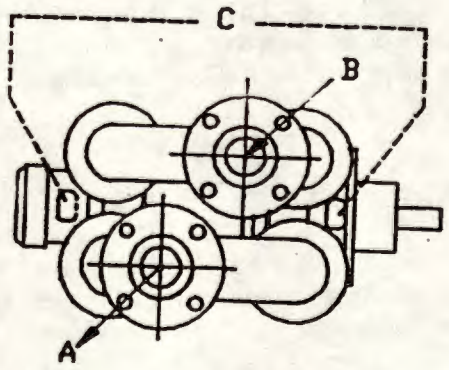
P - PLC 31/5
- PLC 32/5



PL - PLC 10/1

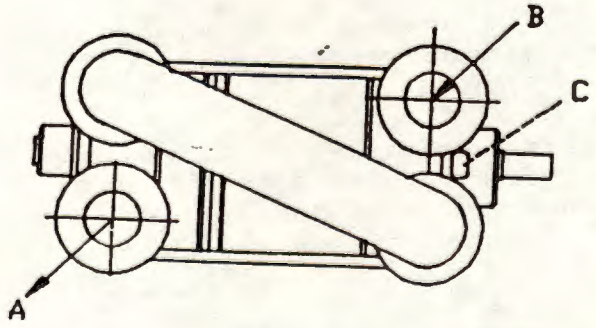


PLM - PLMC 52/2



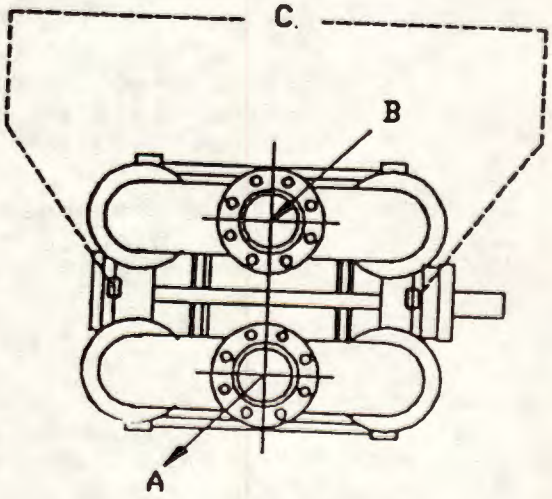
PLM - PLMC 42/5

A=Connect to pump discharge
B=Connect to pump suction
C=Connect to pump service fluid



PL 41/5
PL 42/5
PL 51/2
PL 52/5
PL 53/2

PL 61/2
PL 62/2
PL 71/5
PL 72/5
PL 73/5



PLM - PLMC 53/2
PLM - PLMC 53A/2
PLM - PLMC 61/2
PLM - PLMC 62/2
PLM - PLMC 72/5
PLM - PLMC 73/5

F. Pump Draining

When pumps are properly installed, as indicated in section E, the oil level within the pump itself should be automatically set at shaft centerline or below every time the pump stops.

However, Intervac Vacuum Pumps are provided with additional connections at about the shaft centerline which may be fitted with an automatic drain valve; also the two stage pumps are fitted with a manual drain valve (or air bleeding valve depending upon use). All pumps are also fitted with casing draining plugs which would allow complete drainage of the pump.

G. Shaft Seals

Intervac Pumps do not require additional liquid control for the shaft sealing. The pump is fitted with mechanical seals and a suitable liquid supply is provided to the seals via the pump internal passages.

H. Piping

1. SUCTION AND DISCHARGE

Prior to installation, check that all protective inserts fitted in the gas and service liquid connections of the pump are removed.

Piping connected to the pump must be installed without imposing any strain on the pump. Improperly installed piping can result in misalignment, rubbing of internal parts, etc. Use flexible connectors when necessary.

Piping should be cleaned properly before installation and at least of the same size as the corresponding pump connections.

It is recommended that a temporary screen be installed in the inlet to the pump unit at first start-up to protect the unit against carry-over of pipe debris and welding slag. This screen can be removed after the initial run in period.

If the possibility exists that the pump inlet can become closed during operation, it will be essential to install some type of vacuum relief so that air can enter the system. NEVER RUN A PUMP WITH SUCTION CLOSED. A check valve suitable for vacuum service and providing a minimum of resistance must be installed in the suction line as close to the pump as possible, to prevent backflow of the process gas and sealing liquid into the system when the pump is stopped.

The discharge piping from the pump must be sized and installed in such a way that no back pressure is created. It is recommended to limit the vertical height of the discharge piping to a maximum of 24" above the pump flange prior to separating the gas and sealing liquid.

NOTE: The discharge line from the separator/reservoir must be vented outside the building, to avoid any contamination of the ambient inside air by any toxic gasses drawn into the system and discharged through the discharge opening on the separator.

2. SEALING LIQUID SUPPLY

The principle of the liquid ring vacuum pump is dependent upon a continous supply of cool, clean sealing liquid, which enters the pump through the sealing liquid inlet connection on the suction side of the pump and is discharged together with the compressed gas. The sealing liquid entering and leaving the pump also serves to carry away the heat of compression imparted to the liquid ring during the working cycle. With the proper quantity of sealing liquid supplied to the pump and no additional heat load from condensation of process vapors; the temperature rise across the vacuum pump will usually be limited to approximately 7 degrees Farenheit.

For optimum pump efficiency, it is important to supply the correct amount of sealing liquid to the pump. Refer to the individual pump performance curves and tables for the correct quantity.

Pump performance data (as published) is based on the use of 60 degree Farenheit (15 degree C) water as the sealing liquid. When operating with oil, an increase in capacity can be expected.

When supplied as a system from Intervac, the sealing liquid supply line components may be arranged in a number of ways. Refer to the schematic supplementing this manual, which pertains to your particular model.

If you have purchased a bare shaft pump and/or intend to use a sealing fluid other than water or one supplied by Intervac, consult your local distributor or Intervac for the recommended components and arrangement.

I. Electrical Requirements

Standard induction motors are suitable for driving Intervac Liquid Ring Pumps. Starting loads are low so that an across the line starter is normally employed for motors up to 100 horsepower. On larger motors, reduced voltage starting may be used, especially where the plant power supply is limited.

It is recommended that a motor controller with overcurrent protection of the heater or fuse type be used. The full load current rating, stamped on the motor nameplate, should be used in making the selection for protection rating. A disconnect switch should also be installed between the motor controller and plant power.

After the electrical work is completed the motor should be started to check rotation. First, turn the pump by hand to see that it rotates freely. The direction of rotation is marked by an arrow on the pump. Fill the pump casing halfway with seal liquid and then switch on the motor to check for rotation. If the direction is wrong, reverse any two of the three motor leads and recheck.

It is recommended that 115 volts, single phase supply be used for control circuits. Items such as solenoid valves, vacuum pressure switches, level controllers, alarms, etc. should be supplied with only 115 volts to comply with electrical safety code requirements.

J. Accessory Items

There are many accessory items associated with Liquid Ring Pumps. These can be supplied with the pump from the factory or by others in the field. The particular application requirements, model of operation, and type of control scheme desired, dictate the necessity of the various items, however, the following list covers some of the more commonly used accessory items.

! Check Valve - Used to prevent backflow of gas and seal liquid to process when the pump is stopped. Swing-check type or equal valve must be installed horizontally. An inlet elbow can be provided to adapt vertical pump inlet to accept horizontal inlet check valve.

2. Inlet Vacuum Relief Valve - Used to protect the pump from cavitation and to control suction pressure to a certain degree. When the pump capacity exceeds the system's flow requirements at a predetermined vacuum level, then the valve will open and bleed in atmospheric air or process gas (if connected back to pump discharge side).

3. Flexible Connector - Used for slight misalignment between pump and process or if a minimal amount of expansion is anticipated.

4. Inlet Vacuum Control Valve - Used to control system by bleeding in atmospheric air or process gas (recirculated back from pump discharge). Pneumatically operated diaphram valves are required to achieve fine degree of control.

5. Inlet Vacuum Gauge - Used to indicate vacuum at pump inlet. Normally it is mounted directly ahead of pump suction.

6. Sealant Shut-off Valve - Used to manually stop flow of sealant to pump.

7. Strainer - Used to filter out solid particles from sealant.

8. Sealant Flow Control Valve - Used to control sealant flow rate to the pump. Normally a globe valve is used, but other types of flow control valves can be used.

9. Compound Pressure Gauge - Used to indicate pressure at inlet connection of sealant piping to pump. Approximate flow rates can be established by maintaining proper pressure at sealant connection to pump. (See Operating Instruction Section).

10. Discharge Separator Tank - Used to separate sealant liquid from discharged gas stream coming out of pump. This separator tank will be base plate mounted with the pump for a total recovery system.

11. Solenoid Valve - May be used to automatically stop-start flow of seal liquid to pump. (For elevated tank systems.)

12. Sealant Circulating Pump - Used to recirculate sealant in total recovery systems. It is required when the pump operates for prolonged periods above 300 TORR or when suction pressure varies during cycling operations.

13. Heat Exchanger - Used to remove heat from recirculated sealant.

14. Atmospheric Air Ejector - Used to provide a suction pressure lower than pump is capable of operating alone. May be added to a two stage pump to provide an inlet pressure as low as 3 TORR. The operation of the air ejector is similar to that of steam ejectors. Atmospheric air or recycled gas from separator discharge is used as the motive force for compressing the process gas from system design pressure up to the inlet pressure of the liquid ring pump. To inhance pumping capacity above 30 TORR, a motive air shut-off valve can be added. To achieve full pump capacity above 30 TORR, a bypass can also be added.

OPERATING INSTRUCTIONS

A. SEAL LIQUID

1. **FLOW RATES** - Depend upon the type of sealant arrangement used, size of pump, and allowable temperature rise through the pump. Flow rates of water at 60 degrees F. for standard pumps at standard conditions are given on the Liquid Ring Vacuum Pump performance curve insert sheet.

Standard flow rates result in approximately 10 degrees F. rise in temperature for a single stage, and 12 degrees F. rise for a two stage through the pump when handling dry air. Condensible vapors in the gas stream add heat to the seal liquid. This will result in a slightly higher temperature rise through the pump.

Sealant flow rates and the temperature rise are important because of the effect on pump performance. Too much sealant will result in excessive horsepower requirements.

2. **FLOW CONTROL** - A regulating valve is used to control flow of sealant to the pump. A compound gauge is installed between the regulating valve and pump. The regulating valve should be set so that the reading on the compound gauge will be within 5" to 10" Hg. Vacuum for two stage pumps. On single stage pumps it is necessary to adjust the regulating valve to obtain approximately 3 to 5 PSIG supply pressure to the pump casing.

Another procedure that can be used to establish the minimum seal flow required is with the pump operating at the desired vacuum on process, slowly reduce the flow of seal liquid until the suction pressure begins to fluctuate and then gradually increase the flow until the suction pressure again stabilizes. This setting can be used as long as the temperature rise through the pump remains reasonable (40 to 50 degrees F. maximum) and all other operating conditions remain constant.

B. Start-Up Procedures

WARNING: The unit must not be operated unless coupling guard is in place. Failure to observe this warning could result in personal injury.

WARNING: DO NOT attempt any maintenance, inspection, repair or cleaning in the vicinity of rotating equipment. Such action could result in personal injury.

INITIAL START UP PROCEDURE

1. Verify that the electrical power to the equipment is off.

2. Check the drive coupling alignment. (See Section C page 6). Adjust the driver if necessary. On monoblock units the alignment is preset.

3. Check the drive coupling hub spacing. The flexible element should be allowed approximately 1/16" of free axial movement. Adjust if necessary. Tighten setscrews.

4. Rotate the pump by hand to ensure that it turns freely. During the time between manufacture and start-up, a slight film of rust may form on the port plates, causing the pump to be hard to turn.

5. Assure the pump has clean sealing liquid up to the shaft level. Do not start the pump when the liquid level is above the shaft level, as the increased starting torque can cause damage to the pump internals and/or the driver.

6. It is recommended that a temporary screen be installed in the suction line of the pump for the first several hours of operation to remove any foreign assembly material, pipe scale, slag, etc.

7. Reinstall any safety guards or covers that may have been removed.

8. Ensure that discharge from separator/reservoir is not blocked and that discharge line is vented outside building.

9. Open valve in suction line. Never start a pump with a closed inlet.

10. Verify that all valves required for operation are open (sealing liquid, cooling water, etc.)

11. Turn on the electrical power to the equipment. Verify that all phases are energized, and that the voltage is correct.

12. Check the driver rotation by jogging it for a period of less than one second. Correct direction of rotation is indicated by an arrow on the pump casing. Normal direction is clockwise facing shaft.

13. Start the driver and if necessary, adjust the sealing liquid flow for optimum performance. Units fitted with a compound gauge and a manual regulation valve should have the valve adjusted so that the gauge reads per Section (2) on Page (17).

14. Check the temperature of areas such as the bearing housings, pump and motor casings, and discharge piping for unusually hot spots.

15. Check that the motor current draw is within specifications.

MAINTENANCE

Intervac liquid ring vacuum pumps require very little attention or maintenance provided the units are installed properly.

MAINTENANCE SCHEDULE

AT FIRST 50 HOURS OF OPERATION

1. Clean any filters/strainers associated with the system to remove any foreign assembly material, pipe scale, etc. Remove temporary inlet screen fitted at start-up.

2. Check sealing liquid level in reservoir.

AT EVERY 1000 HOURS

1. Clean filters and strainers.

2. Check sealing liquid level in reservoir.

AT EVERY 3000 HOURS

1. On those vacuum pumps with grease fittings, grease the bearings. Use a moisture resistant lithium based grease of number 2 consistency. Typical products are Texaco Premium RB, Chevron SR1 # 2, and Esso Ronex MP. DO NOT OVERGREASE.

2. Check condition of drive coupling. Service if necessary.

3. On vacuum pumps fitted with external seal flush tubing, check the tubing and related porting for restriction. Clean/replace if necessary.

4. Check back pressure indicator on separator/reservoir to check condition of demister element. Pressure should not exceed 2.5 PSIG when unit is operating under vacuum conditions. Pressure gauge might show a higher pressure when pump is started at 0" Hg. If high pressure is indicated at operating vacuum, the element should be replaced.

EVERY 6000 HOURS OR EVERY YEAR

1. Under normal operating conditions, change oil every 6000 hours or once a year whichever is sooner.

C. Shut-Down Procedures

1. Stop motor drive.

2. Close all suction and discharge valves.

3. Protect pump from freezing. If this is not possible, drain pump completely or fill with anti-freeze. (If other than oil)

D. Cavitation

Cavitation is recognized by a characteristic matallic or grinding noise inside the pump. It is caused when the pump suction pressure is too close to the vapor pressure of the seal liquid. If the seal liquid temperature rises such that the corresponding vapor pressure closely approaches the total suction pressure, then cavitation will occur.

When cavitation takes place, vapor bubbles form and collapse within the liquid ring. This is detrimental to the surfaces of the impeller, side plate, and casing. The cavitation shock force causes erosion by tearing away metal particles and deforming soft materials. Damage can be especially severe in a corrosive condition.

Cavitation is prevented by bleeding air into the pump casing. Vacuum relief valves can be fitted in the suction piping for this purpose. For two stage pumps, there is a manual attenuation valve between stages, which can be used to decrease the cavitation when opened.

If the problem is not a low flow of non-condensible gases, then the seal liquid temperature should be checked. With the proper temperature, the operating vacuum can be increased. Ultimately, the vacuum at which the pump can be operated is governed by the vapor pressure of the seal liquid.

E. Trouble-Shooting

Intervac pumps are simple in design and are ruggedly constructed. This provides for excellent reliability and long life when installed and operated properly. However, should you have difficulty in trying to resolve problems, refer to the following chart for suggestions to correct the problem. If the problem persists do not hesitate to contact your representative.

TROUBLE-SHOOTING CHART

Problem	List if items to be checked
a) Reduced Capacity	1,2,3,4
b) Excessive Noise	5,6,7,8
c) High Power Consumption	6,7,9,10,11,12
d) Overheating	3,4,6,7,11,12
e) Vibration	6,12,13
f) Excessive Gland Leakage	14,15
g) Abnormal Bearing Wear	6,16,17
h) Mechanical Seal "Squeal"	18
i) Shaft Will Not Turn or Partially Seizes	12,19,20

Reason	Solution
1. Speed to low	Check voltage and belt tension
2. Leak in suction line	Repair
3. Seal liquid temperature too high	Check coolant flow and heat exchanger
4. Insufficient seal liquid	Provide correct flow rate
5. Excessive or insufficient seal liquid	Provide correct flow rate
6. Coupling misalignment	Realign coupling
7. Defective bearing	Replace bearing
8. Cavitation	Open attenuation valve or reset vacuum relief for lower vacuum
9. Excessive seal liquid	Reduce flow rate
10. Excessive back pressure	Correct as necessary
11. Gland ring too tight	Loosen gland
12. Improperly mounted pump	Make sure surface is level and all feet are touching surfaces using shims, if necessary.

13.	Pump not properly anchored	Anchor
14.	Worn packing	Replace packing
15.	Gland cooling liquid pressure too high	Reduce pressure
16.	Strain on pump casing from connecting pipe work	Support connecting pipe work
17.	Shaft finger missing	Replace finger
18.	Insufficient lubrication	Check flow of coolant to seals
19.	Scale from hard water	Descale pump
20.	Foreign object in pump	Dismantle pump and remove

MAINTENANCE INSTRUCTION

A. Bearings

During assembly the bearings are pre-packed with high quality grease. The two shaft bearings should be lubricated after each 3000 hours running time using good quality bearing grease. The temperature of the bearings should not exceed 140 degrees F. (60 degrees C.). Overheating may be due to too much grease, misalignment of coupling, or a bad bearing. Replacement bearings can be obtained from your local distributor.

TABLE 1

PUMP SERIES	BEARINGS: DIRECT COUPLED	BEARINGS: BELT DRIVE	MECHANICAL SEAL
30	(x2)00012012-000	(x1)00012012-000 (x1)00012010-000	V=(x2)00011282-000
40	(x2)00012013-000	N/A	V=(x2)00011352-000 B=(x2)00011351-000
50	(x2)00012015-000	N/A	V=(x2)00011432-000 B=(x2)00011431-000
60	(x2)00012016-000	(x1)00012016-000 (x1)00012018-000	V=(x2)00011552-000 B=(x2)00011551-000
70	(x2)00012017-000	N/A	V=(x1)00011752-000 DE V=(x1)00011753-000NDE B=(x1)00011750-000 DE B=(x1)00011751-000NDE
3000	(x2)00012011-000	N/A	V=(x2)00011222-000 B=(x2)00011221-000

( )= QTY
V = Viton
B = Buna
DE = Drive End
NDE = Non-Drive End

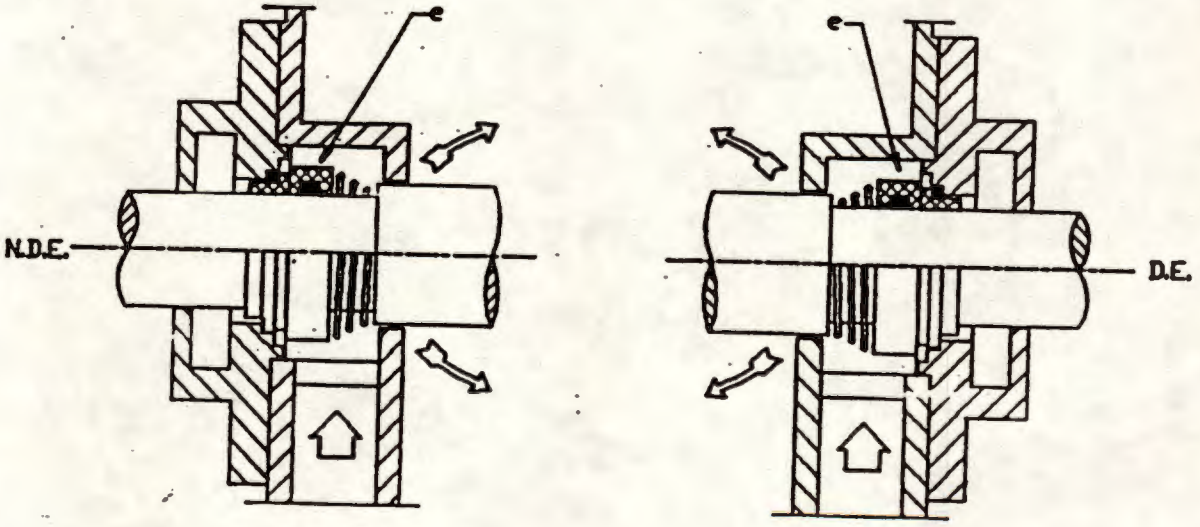
B. Mechanical Seals

This section pertains to pumps fitted with mechanical seals. Mechenical seals usually do not require maintenance unless there is visual leakage to the outside.

Seal replacement or repair is addressed in the "Disassembly and Assembly Instructions" for a specific pump series.

When handling mechanical seals always make sure that the working seal faces are well protected and clean from particles which may scratch these surfaces. Prior to installing the mechanical seals thoroughly clean the shaft surface edges, moisten shaft and seal o-ring elements with water, alcohol, or other clean liquids, to facilitate fitting of the seal over the shaft and in the seal housing.
CAUTION: NEVER RUN THE SEALS DRY.

(e: Mechanical seal)



C. Storage

The pump and/ or system is protected against corrosion for the period of shipment and installation only.

If the unit is not to be installed at once, find a clean, dry location for storage.

For long term storage, the pump should be flushed with a water soluable rust preventative, or in the case of the oil sealed units, rotate shaft once a month.

APPENDIX

INTERVAC CORPORATION
CSO/BSO RECOMMENDED OIL CHANGE PROCEDURE

1. Run vacuum system to normal operating temperature.

2. Turn vacuum system off.

3. Close sealant inlet isolation valve from separator tank.

4. Jog vacuum pump for ten (10) seconds, then shut off system again.

5. Drain oil from separator tank.

6. Remove 1/4" drain plugs (up to 5 depending on size of pump).
   - 2 each on suction housing.
   - 2 each on discharge housing.
   - 1 in bottom of pump.

7. Remove and clean separator Y-strainer and/or basket strainer.
   NOTE: If system strainer shows large amount of deposit you may consider flushing system with diesel fuel and then repeat steps 1-7.

8. Open sealant inlet isolation valve, charge system with new oil to proper level. Run system for five (5) minutes and shut off then re-check level.
   NOTE: Oil level not to exceed center line of shaft in vacuum pump.

km
1/90

2/93

INTERVAC®
System Specification Specialists

WARRANTY AND LIMITATION OF LIABILITY

Subject to the terms and conditions set forth in General Terms of Sale, Intervac Corporation (the Seller) warrants products and parts of its manufacture, when shipped, and its work (including installation and start-up) when performed, will be of good quality and will be free from defects in material and workmanship. This warranty applies only to Seller's equipment, under use and service in accordance with Seller's written instructions, operating, maintenance and service of products, for a period of five (5) years on the pump and two (2) years on the balance of the system, and ninety (90) days on mechanical seals after date of shipment for all new products, and six (6) months for all rebuilt or remanufactured products which are not supplied under standard situations.

On warranty repairs, the warranty period will be either whatever time was left on the original warranty at time of removal or three (3) months, whichever is greater. Because of varying conditions of installations and operation, all guarantees of performance are subject to plus or minus 10% variation.

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

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

All claims for defective product, parts, or work under this warranty must be made in writing immediately upon discovery and in any event within five (5) years on the pump and two (2) years on the system from the date of shipment thereof by the Seller. Unless done with prior written consent of Seller's equipment shall void warranty. Installation and transportation costs are not included and defective items must be held for Seller's inspection and returned to Seller's facility upon request.

Seller's warranty does not cover damage due to one or more of the following:

1. Abnormal wear and tear.
2. Abuse and unreasonable use.
3. Misuse or neglect.
4. Damage caused by equipment or system for which the product is used.
5. Damage caused by modification or repair not made or authorized by the seller.

INTERVAC®
System Specification Specialists

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

After buyer's submission of a claim as provided above and its approval, Seller shall at its option either repair or replace its product, part, or work at a facility of its choice, or refund an equitable portion of the purchase price.

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

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

No employee or representative of Seller other than an officer of the Company is authorized to change this warranty in any way or grant any other warranty.

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

TERMS AND CONDITIONS

1. Prices - All prices are f.o.b. shipping point. Quotations are firm for 60 days and thereafter are subject to review and revision. All excise, sales, use and other similar taxes applicable to this order and required to be collected by the seller shall be added to the invoice unless appropriate exception certificate is received.

2. Acceptance and Cancellation of Orders - No contract between the seller and buyer shall be deemed in existence until buyer's order has been accepted and acknowledged in writing by seller. Order placed may be cancelled, and shipment of goods made up or in process extended beyond the original delivery date, only with the seller's written consent, and upon terms which will equitably indemnify the seller.

3. Terms of Payment - The standard terms of payment are net cash 30 days from date of invoice.

4. Title - Title to all products and parts ordered and risk of loss shall pass to buyer upon their delivery to a carrier for shipment. Any claims for shortages or damages suffered in transit shall be submitted by the buyer directly to carrier.

5. Delays - Seller shall not be responsible for any defaults, damages, or delays in filling order caused by conditions beyond seller's control, including but not limited to Acts of God, strike, lock-out, boycott or other labor troubles, war, riot, flood, government regulation or delays of seller sub-contractors, or suppliers in furnishing materials or supplies due to one or more of the foregoing causes.

6. Warranty - Seller warrants products furnished hereunder to be free from defects in material and workmanship under normal use and service for a period of two years after the sale of the product by the seller. Seller's sole obligation under this warranty shall be to repair or replace any defective product or part thereof which is returned to seller's factory transportation charge prepaid within the period mentioned above, and which upon examination is proven to seller's satisfaction to be so defective. The warranty shall not apply to any product or part which has been subject to misuse, negligence, or accident. Seller shall not be responsible for any special, incidental or consequential damages and the warranty as set forth is in lieu of all other warranties either expressed or implied. Components purchased by seller are warranted by the original manufacturer, and the seller neither offers nor assumes responsibilities for the warranty of these components beyond that offered by the original manufacturer. Seller specifically excludes and and all warranties of merchantibility and of fitness for a particular purpose. Any alterations or repairs made without seller's written approval relieves seller of all responsibility. Mechanical shaft seals are warranted for 90 days from date of start-up or 12 months from date of shipment.

7. Patent Liability - Seller agrees to hold buyer and its customer harmless only against infringement of patents covering the material or part in the form sold by seller provided buyer or its customer, as the case may be, promptly notifies the seller of any claim or litigation and tenders the defense thereof to the seller. Buyer agrees to hold seller harmless for any liability of seller for infringement of patents by reason of manufacture according to design or by reason of incorporation of said part in a more comprehensive assembly than sold by the seller provided seller promptly notifies buyer of any claim or litigation and tenders the defense thereof to the buyer. Seller grants no license, expressed or implied, other than the right of the buyer to use the specific material or part in form delivered by seller.

8. Rejections and Returned Material - Claims for incorrect material must be filed in writing within 10 days from delivery at buyer's place of business. No material may be returned without first obtaining approval from the seller and no claim will be allowed or credit given for material returned without such written approval.

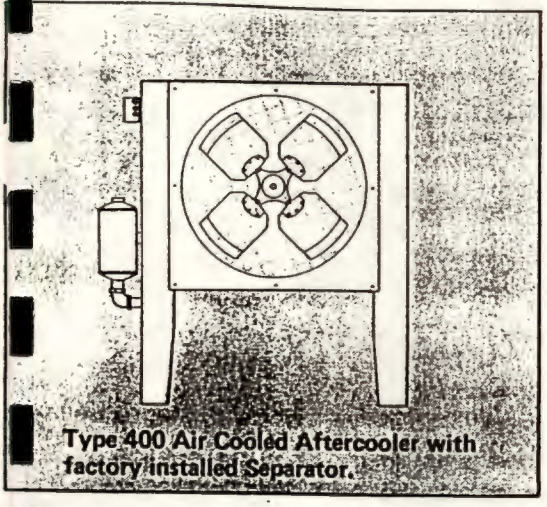
9. Service Calls - The services of seller's representatives performed outside seller's plants are available when specifically covered by a separate service contract.

10. Buyer agrees to indemnify seller for, and hold seller harmless from, all costs and expenses incurred by seller, including, without limitation, costs of investigation, attorneys' fees, and amount paid in settlement or satisfaction of claims, proceedings, or judgments, in connection with all claims and proceedings against seller based upon claimed defects in design in design in any item or items manufactured for buyer by seller to buyer's design and/or specifications.

11. Inspection - Buyer will inspect all goods purchased prior to or upon their delivery f.o.b. carrier; seller, including, without limitation, costs of investigation, attorneys' fees, and amounts paid in settlement or satisfaction of claims, proceedings, or judgments, in connection with all claims and proceedings against seller based upon claimed defects in design in any item or items manufactured for buyer by seller to buyer's design and/or specifications.

12. Tools, Fixtures - Tools, fixtures, jigs, dies, etc. needed to provide the goods or services ordered are seller's property unless specifically purchased by buyer.

13. This sale is conditioned on the buyer's agreement that the terms and conditions set forth above shall be applicable to all orders accepted by seller, and shall cancel and supersede any terms and conditions whether oral or by purchase order forms submitted by the buyer. These terms and conditions are subject to modification only by the actual agreement of the buyer and seller expressed in writing and shall be construed under the laws of the State of New York.



Type 400 Air Cooled Aftercooler with factory installed Separator.

Air Cooled Aftercoolers Type 400

- Rugged Construction
- Optional Installed Separator Reduces Installation Cost
- 200 PSIG Standard Operating Pressure
- Shipped Assembled — Ready To Run

Sizes, Ratings, Dimensions, Weights

Catalog No.	Model No.*	SCFM Capacity at 15° TD 100-125 PSIG			Physical Dimensions				Air In/Out	Motor HP	Fan CFM	Recommended Options	
		1 Stg.	2 Stg.	Rotary	L	W	H	WT.				Separators	Flexible Metal Hose
AF2940AC	401	18	25	35	22	15	34	80	1" FPT	1/15*	750	QF2410	CF1603
AF2942AC	402	32	48	58	22	15	34	85	1" FPT	1/15*	750	QF2410	CF1603
AF2944AC	403	60	80	100	28	19	41	100	1½" FPT	1/15*	1080	QF2410	CF1605
AF2946AC	404	100	125	150	34	23	45	110	2" FPT	1/4*	2000	QF2415	CF1606
AF2948AC	406	141	185	240	37	23	48	120	2" FPT	1/4*	2000	QF2415	CF1606
AF2950AG	407	209	260	365	37	23	48	125	2" FPT	1/2	3960	QF2415	CF1606
AF2952AG	408	260	365	490	43	23	54	200	2" FPT	1/2	5700	QF2415	CF1606
AF2954AG	409	390	560	650	46	29	54	225	2½" FPT	3/4	6000	QF2420	CF1607
AF2956AG	411	540	650	760	46	29	54	238	2½" FPT	1	6650	QF2420	CF1607
AF2958AG	412	660	750	960	52	36	62	300	2½" FPT	1	9000	QF2425	CF1608
AF2960AG	413	740	900	1150	52	36	62	320	2½" FPT	1	9000	QF2425	CF1608
AF2962AG	414	870	1050	1300	55	38	58	340	3" FPT	2	13300	QF2425	CF1608
AF2964AG	416	1005	1460	1560	65	41	61	370	3" FPT	3	19600	QF2425	CF1608
AF2966AG	417	1330	1800	2150	73	43	64	390	4" FPT	3	19600	QF2430	CF1610
AF2968AG	418	2020	2500	3100	122	62	66	1100	6"† FLG	4-½***	21000	**QF2435	CF1610
AF2970AG	419	2230	3000	3500	122	62	66	1200	6"† FLG	4-½***	26000	**QF2440	— —
AF2972AG	421	2650	3500	4200	122	62	66	1350	8"† FLG	6-½***	33000	**QF2440	— —
AF2974AG	422	3220	4200	4800	160	76	74	1450	8"† FLG	6-½***	38000	**QF2440	— —

*115 Volt, 60 Cycle. All other 230/460 volt, 3 Phase, 60 Cycle. *** Multiple Fans. ** Separator Not Installed
†ASA 150 lb. Flange Connections.
Maximum operating pressure on all units — 200 PSIG.

Optional Equipment

A. TEFC Motor (standard, model 407 up)
B. Explosion Proof Motor
C. Air Motor
D. Air Controls
E. Electronically Timed Automatic Drain
F. Manual Float Drain
G. Low Temp. Control
H. 300 PSIG, 500 PSIG
I. Mounted Separator
J. Wall Mounted
K. Stainless Steel Coils

GUARANTEE

All products manufactured by seller are warranted to be free from defects in material and workmanship under normal use and service for a period of twelve (12) months unless otherwise stated in writing from date of shipment by seller. In all cases, seller must be given a reasonable opportunity to make an investigation of any asserted defects and the buyer shall return any alleged defective material to the seller's plant at the buyer's expense. In no event shall seller be liable for consequential or special damages.

DISTRIBUTED BY:

PIONEER

AN INNOVATIVE COMPANY

INDUSTRIAL PROCESS CHILLERS

CAPACITY ½ TON TO 1,000 TON

TYPICAL PAYBACK — ONE YEAR

Optional & standard features

NO.	DESCRIPTION	RC60-120	RC180	RC240-720	RC900-1200	RC1800 & UP
1.	Refrigerant analyzer gauge	S	S	S	S	S
2.	Power on light	S	S	S	S	S
3.	On/off switch	S	S	S	S	S
4.	Outlet temperature guage	S	S	S	S	S
5.	Refrigerant discharge guage	O	O	O	O	O
6.	Compressor over load	S	S	S	S	S
7.	Hot gas by pass (temperature control)	S	S	S	S	S
8.	Tank & pump	O	O	O	O	O
9.	*No flow shut down	S	S	S	S	S
10.	Low level shut down	O	O	O	O	O
11.	Auto fill	O	O	O	O	O
12.	Casters	O	O	O	O	O
13.	Enclosure	S	S	S	O	O
14.	Crank case heater	N	S	S	S	S
15.	Hi pressure shut down (refrigerant)	O	S	S	S	S
16.	Low ambient control	O	O	S	S	S
17.	NEMA 7 or JIC elec	O	O	O	O	O
18.	NEMA 4 or 12	O	O	O	O	O
19.	Water in temperature gauge	O	O	O	O	O
20.	Water in pressure gauge	O	O	O	O	O
21.	Water out pressure gauge	O	O	O	O	S
22.	Freeze protection (temperature control)	S	S	S	S	S
23.	Heater(s) for freeze protection and/or temperature control	O	O	O	O	O
24.	Open loop design	O	O	O	O	O
25.	Closed loop design	S	S	S	S	S
26.	Capacity control-compressor unloading	N	N	N	N	S**
27.	Cleanable 'Y' strainer	O	O	O	O	O
28.	Filter and filter by pass	O	O	O	O	O
29.	Precision temperature controller	O	O	O	O	O

*Standard with pump S - Standard O - Optional N - Not available or applicable **On RC3000 and up

Table 5

KLEEN-WATER Filters

Clean and cool water improves performance and reliability of the equipment to be cooled as well as that of the cooling equipment. For longevity and dependability, we recommend KLEEN-WATER Filters which are 99.0% efficient down to 1 micron. For points of installations see Figure 1. All *PIONEER* Filters are equipped with read easy ΔP gauge. This dual dial gauge can be read from the front and the back.

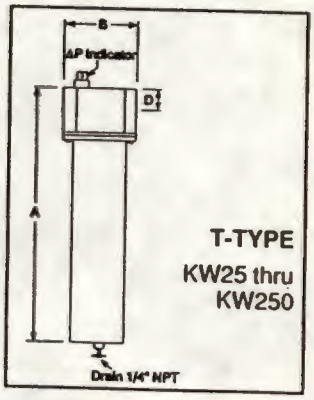


Figure 1

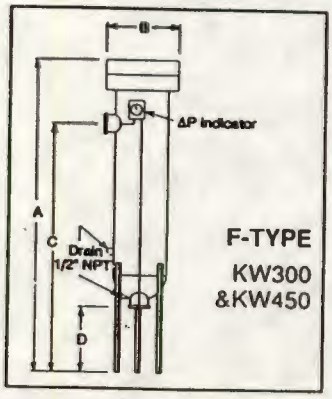


Figure 2

KLEEN-WATER Filters Model	Port Size NPT-In.	Max. Press. PSIG	Max. GPM	Max. Temp. °F	Dimensions Inches A (in.)	B (in.)	C (in.)	D (in.)	Approx. Shipping Wt. (lbs.)	Type
KW25	1	300	25	225	16¼	4½	-	15/16	15	T
KW50	1½	300	50	225	17¼	5 7/16	-	1¼	20	T
KW100	2½	300	100	225	24¼	6⅞	-	1¾	35	T
KW150	2½	300	150	225	34	6⅞	-	1¾	50	T
KW200	3	300	200	225	34½	7⅝	-	2⅛	65	T
KW250	3	300	250	225	40½	7⅝	-	2⅛	69	T
KW300	4 FLG.	225	300	225	60	22	46	18	370	F
KW450	6 FLG.	225	450	225	70	22	56	18	506	F

NOTES: 1. Filters come with initial element(s).
2. To order spare element, add 'E' before filter Model Number.

OPTIONS: 1. Flange Connections, where not standard.
2. Pressure Differential Lights/Contacts.
3. Multi-Filter Assemblies with By-Pass valving.

Table 6

Over size Chillers by 20% or more to allow for variations in operating conditions and loss of cooling in piping, tank, etc.

MODEL	OPTIONAL—PUMP & TANK[1] COMP. HP	PUMP HP	CAPACITY GPM@ FT. HEAD	TANK GALS.	FILTER (OPT.)	CAPACITY—BTUH[2] CHILLER DISCHARGE TEMP. 40°F	50°F	60°F	LxWxH-INS.	IN/OUT DIM. NPT INS.	INS. VOLTAGE[3]	APP. SHPG. WT. LBS.
RC60A/W[4]	½	⅓	20@40'	4	KW25	4,300	5,400	6,000	32x22x28	¾	115/1/60	150
RC90A/W	¾	⅓	20@40'	4	KW25	7,000	8,200	9,500	32x22x28	¾	or 230/1/60	250
RC120A/W	1	½	22@50'	4	KW25	8,900	10,780	11,800	32x22x28	¾	230/1/60	275
RC180A/W	1½	½	22@50'	4	KW25	13,600	16,200	18,600	32x22x28	¾		450
RC240A/W	2	½	22@50'	6	KW50	19,500	23,200	27,000	43x26x35	1		600
RC360A/W	3	½	22@50'	6	KW50	25,800	31,300	37,200	43x26x35	1		800
RC480A/W	4	½	22@50'	8	KW50	41,500	49,200	56,000	57x33x52	1½		1200
RC600A/W	5	¾	31@61'	8	KW50	50,000	60,000	70,000	57x33x52	1½		1400
RC720A/W	6	¾	31@61'	8	KW50	55,000	67,000	80,000	57x33x52	1½		1500
RC900A/W	7½	1	37@70'	10	KW50	68,000	86,500	104,000	50x37x52	1½		1700
RC1200A/W	10	1	37@70'	10	KW50	91,100	110,800	133,400	50x37x56	1½		1800
RC1800A	7½+7½	1½	48@83'	10	KW100	124,500	156,100	189,900	103x64x58	2		2500
RC1800W	7½+7½	1½	48@83'	10	KW100	133,900	165,000	204,400	67x40x45	2	230/3/60	2100
RC2400A	10+10	2	63@87'	10	KW100	152,100	193,600	238,300	103x64x58	2	or	3000
RC2400W	10+10	2	63@87'	10	KW100	167,800	209,200	255,900	56x40x45	2	460/3/60	2500
RC3000A	25	3	72@103'	15	KW150	164,900	244,700	304,600	103x64x60	2	or	3900
RC3000W	25	3	72@103'	15	KW150	211,100	266,900	333,000	65x40x45	2	575/3/60	3300
RC3600A	30	5	140@103'	15	KW150	207,300	270,100	329,000	139x64x60	2		4300
RC3600W	30	5	140@103'	15	KW150	238,100	298,200	360,700	72x40x45	2		3600
RC4200A	35	5	140@103'	15	KW150	301,600	371,300	449,600	133x89x60	3		4600
RC4200W	35	5	140@103'	15	KW150	322,800	399,200	485,900	89x40x45	3		3900
RC4800A	40	5	140@103'	15	KW150	322,500	403,200	505,300	133x89x60	3		4800
RC4800W	40	5	140@103'	15	KW150	349,200	441,100	543,400	89x40x45	3		4200
RC6000A	25+25	5	140@103'	15	KW200	389,800	489,400	609,200	133x89x63	4 FLG.		7800
RC6000W	25+25	5	140@103'	15	KW200	422,200	533,800	666,000	105x52x63	4 FLG.		6600
RC7200A	30+30	7.5	168@128'	21	KW200	414,600	540,200	658,000	184x89x63	4 FLG.		8500
RC7200W	30+30	7.5	168@128'	21	KW200	476,200	596,400	721,400	130X52X63	4 FLG.		7200
RC8400A	35+35	10.0	218@120'	21	KW250	603,200	742,600	899,100	184x89x63	4 FLG.		9200
RC8400W	35+35	10.0	218@120'	21	KW250	645,600	798,300	971,700	164x52x63	4 FLG.		9800
RC9600A	40+40	10.0	218@120'	21	KW300	645,000	806,300	1,010,500	184x89x63	4 FLG.		10,000
RC9600W	40+40	10.0	218@120'	21	KW300	698,300	882,200	1,066,800	164x89x63	4 FLG.		9600
LARGER SIZES			CONSULT FACTORY									

Table 4

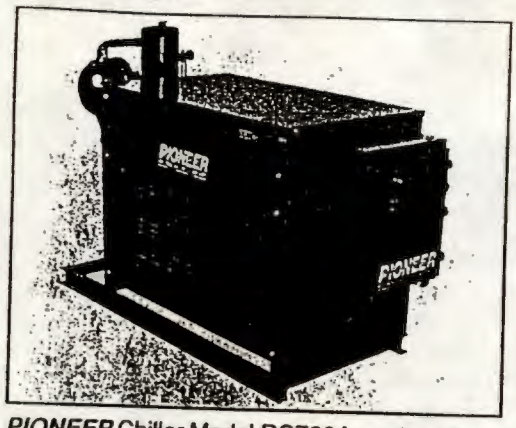
NOTES:

1. May select larger pump and tank.
2. Capacity is based on 90°F ambient temp. or 85°F cooling water temperature.
3. Voltages other than standard are available.
4. Add 7% to capacity for water-cooled units.
5. Enclosure is standard in sizes through RC 720A/W. Open frame is standard in larger sizes. The dimensions for units with optional cabinets may vary.
6. Dimensions subject to change without notice.
7. NEMA 1 electrical is standard.
8. NEMA 3R, 4, 4X, 7, 12, 13 & JIC are available.
9. Standard Ton of Refrigeration corresponds to 12,000 BTUH. In a typical air conditioning application 1.0 HP refrigeration produces roughly 12,000 BTUH of cooling or provides approximately one ton of cooling capacity. Therefore, one HP of refrigeration is often equated to one ton capacity. However, the actual capacity of a Chiller depends upon the working conditions. To avoid problems, the capacity and the heat load shall be described for a set of specific conditions. The questionnaire on page 3 will be helpful in determining the conditions and the size. If in doubt, please feel free to contact your *PIONEER* representative or the factory.

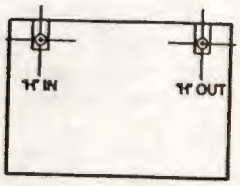
10. Energy savings and capacity control: Models RC3000A/W and up are equipped with internal capacity control to reduce capacity and power consumption.

For example, a RC4800A/W when 66% unloaded saves 64% on energy costs.

Multiple compressor systems are especially suitable for compressor cycling. When two or more compressors are used, some or all of the compressors can be cycled on need basis, providing even greater savings.



PIONEER Chiller Model RC720A equipped with optional 60-gallon tank and auto-fill.



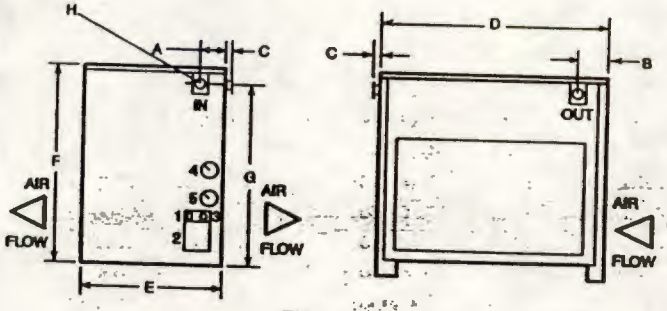


Figure 3

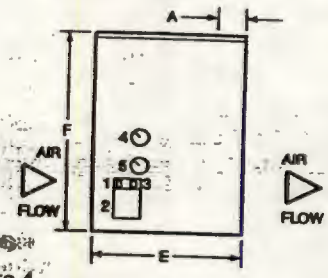


Figure 4

NOTES:

1. On/Off switch & power on light
2. Electrical access cover
3. Electrical conduit hole
4. Refrigerant analyzer gauge
5. Temperature out gauge
6. Enclosure is standard thru RC720A/W, optional on larger sizes.

Heat recovery

Recover 12,000 to 15,000 BTUH/HP.

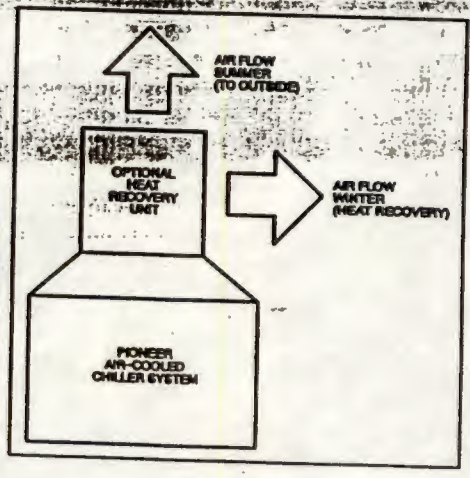


Figure 6

Dimensional details

MODEL NO.	A	B	C	D	E	F	G	H IN/OUT	FIG. NO.
RC60A/W thru RC180A/W	3¼"	3½"	1½"	32"	22"	28"	26¼"	¾" NPT	3
RC240A/W & RC360A/W	2⅞"	5"	2½"	43"	26"	35"	30½"	1" NPT	4
RC480A/W	11⅜"	3¾"	4⅜"	57"	33"	52"	–	1" NPT	4
RC600A/W & RC720A/W	11⅜"	3¾"	4⅜"	57"	33"	52"	–	1½" NPT	4

Table 7

PIONEER
AN INNOVATIVE COMPANY

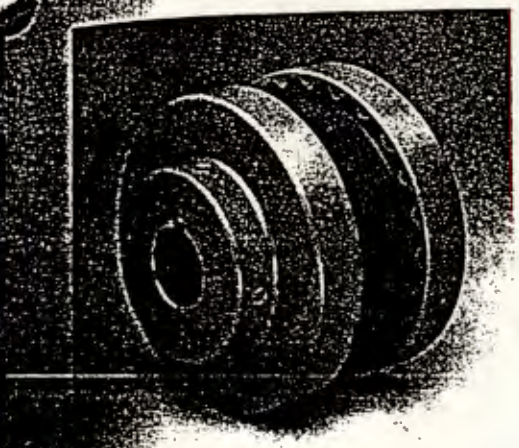
The United States Patent Office has assigned the following patents to:

PIONEER AIR SYSTEMS, INC.

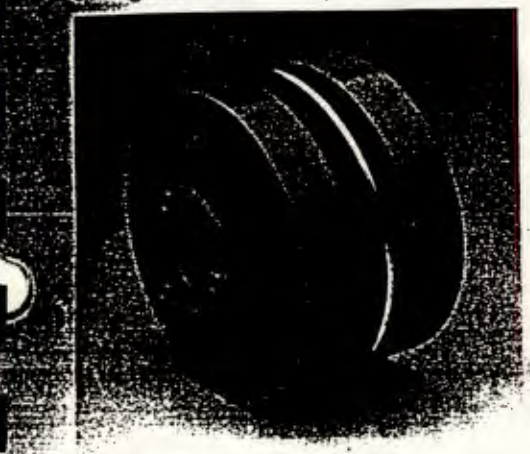
U.S. Patent No. 4,761,968
U.S. Patent No. 4,638,852
U.S. Patent No. 4,499,033

PIONEER AIR SYSTEMS INC. • FLATFORK ROAD • P.O. BOX 130 • WARTBURG, TN 37887-0130 • TEL (615) 346-6693 • FAX (615) 346-3865

S-Flex
Rubber In Shear Type



J Flange/JE Sleeve



B Flange/E Sleeve

S-Flex Nomenclature

Flanges	
Flange Type	Description
J	Die Cast, Bored-to-size*
S	Cast Iron, Bored-to-size
B	Cast Iron, Bushed for QD
SC	Cast Iron, spacer type

*Sizes 5J and 6J are made of cast iron.

Sleeves	
Sleeve Type	Description
JE	EPDM—1-piece solid
JES	EPDM—1-piece split
JN	Neoprene—1-piece solid
JNS	Neoprene—1-piece split
E	EPDM—2-piece w/retaining ring
N	Neoprene—2-piece w/retaining ring

Hubs for SC (Spacer) Type Coupling	
H	Standard length, powdered metal or cast iron
HS	Short length, powdered metal or cast iron

Note: hub material may vary depending on size.

The Size & Model That's Right For You
With S-Flex couplings you have your choice of several models of flanges and sleeves which can be assembled to suit your specific application. Ten sizes are available with torque capabilities that range up to 7,200 in.-lbs. (200 HP @ 1750 RPM).

Coupling flanges should be ordered by indicating the basic coupling size, the flange type, and then the bore size required.

Example No. 1 for Type S Flange:
6S x 1⅛ (6 = size, S = flange type, 1⅛ = bore size with standard keyway and 2 setscrews. If no keyway dimension is specified, standard will be supplied.). See standard keyway chart page 28

Example No. 2 for Type B Flange:
If flanges with QD bushings are required, specify as 8B x SH. The SH bushing with required bore should be specified separately.

Example No. 3 for Sleeves:
S-Flex coupling sleeves are specified as: 8JE (8 = size, JE = EPDM material, 1-piece construction); 8E (8 = size, E = EPDM material, 2-piece construction), etc.

Example No. 4 for Complete Coupling:
When it is desirable to specify a complete S-Flex coupling with one number, do so as follows:

Example A: 6S ⅞ x 1 with JE sleeve
Example B: 10B SK x SK with E sleeve (Bored for QD bushing, size SK, both flanges. Order bushings with bore size(s) separately.)

Example No. 5 for Complete SC (Spacer) Type Coupling:
A complete SC coupling can be specified as follows:
1 6E Sleeve
2 6SC35 Flanges (for 3½" dropout)
1 6SC-Hx1 Hub (for 1" bore)
1 6SC-Hx1⅜ Hub (for 1⅜" bore)

Flexible sleeves for Lovejoy S-Flex couplings are available in two elastomeric materials: EPDM rubber (JE, JES & E) and Neoprene (JN, JNS & N). Torque is transmitted through shear loading of the elastomer. It is the highly elastomeric qualities of the sleeve which permits the S-Flex coupling to protect connected equipment from harmful shock, vibration, and shaft misalignment.

The sleeves are not affected by abrasives, dirt, moisture, or most commonly used chemicals, so you are ensured of rugged, dependable, and long-lasting performance. See SLEEVE CHEMICAL RESISTANCE chart on page 26 for specific conditions.

EPDM
Unless otherwise specified, S-Flex couplings are supplied with EPDM flexible sleeves. This sleeve is intended for general use and operates within the temperature range of -30° to +275°F (-34° to +135°C).

Neoprene®
Neoprene flexible sleeves offer higher oil resistance than EPDM, and operate within a temperature range from 0° to +200°F (-18°to +93°C).

S-Flex

Selection/Ratings

S-Flex Coupling Selection

It is important to select the correct coupling size for the application, because using a size that is too small or too large may adversely affect the life of the coupling.

When the driver is a standard speed electric motor:

Step 1—Determine Load Symbol from chart on page 24.

Step 2—Knowing Load Symbol, determine the proper Service Factor from chart below.

Step 3—Knowing Service Factor, refer to chart below and the section of the chart that applies to the RPM of the motor used. Find the correct coupling size on the line that intersects the HP of the motor and the service factor.

Selection example: A coupling is needed to connect a 20 HP, 1750 RPM standard electric motor to a centrifugal pump.

Step 1—Load Symbol: L

Step 2—Service Factor: 1.25

Step 3—Coupling Size: 8 with EPDM or Neoprene Sleeve. Select flanges, pages 27-28.

When the driver is other than an electric motor or the speeds are different than those shown in the selection charts on page 24.

Step 1—Determine Load Symbol and Service Factor.

Step 2—Calculate HP at 100 RPM

$$\text{HP at 100 RPM} = \frac{\text{HP x Service Factor x 100}}{\text{coupling RPM}}$$

Step 3—Refer to the Coupling Ratings chart page 24. In the column showing the ratings at 100 RPM, locate the nearest higher rating and find the recommended coupling size to the left.

Selection example: A bucket elevator is to be operated with a motor/reducer drive that requires a coupling to transmit 14 HP @ 1300 RPM.

Step 1—Load Symbol: M, Service Factor: 1.5

Step 2—

$$\text{HP at 100 RPM} = \frac{14 \times 1.5 \times 100}{1300} = 1.61 \text{ HP/100 RPM}$$

Step 3—Refer to coupling rating chart page 24, under 100 RPM column Size 7 coupling is rated at 1.2 HP at 100 RPM, Size 8 is rated at 1.8 HP per 100 RPM. Proper selection is size 8, with EPDM sleeve (Neoprene sleeve if conditions require). Review bore sizes and dimensional parameters on pages 27 and 28.

S-Flex Couplings Service Factors*

Load Symbol	Electric Motor Standard Torque	Electric Motor High Torque	Internal Combustion Engines	Reciprocating Engines
L (Light)	1.25	1.5	1.0	1.5
M (Medium)	1.5	2.0	1.25	2.0
H (Heavy)	2.0	2.5	1.5	2.5

*On applications involving varying torque loads, make selection based on conditions at maximum load. Then determine the resulting service factor at minimum condition. If this value is greater than 4.0, special coupling alignment will be required.

Selection Chart—S-Flex Couplings EPDM or Neoprene Sleeves

HP	3450 RPM Motors Service Factor 1.0	1.25	1.5	1.75	2.0	1750 RPM Motors Service Factor 1.0	1.25	1.5	1.75	2.0	1160 RPM Motors Service Factor 1.0	1.25	1.5	1.75	2.0	870 RPM Motors Service Factor 1.0	1.25	1.5	1.75	2.0
½	3	3	3	4	4	3	3	3	3	4	3	3	3	3	3	...	...	...	...	...
¾	3	4	4	4	5	3	3	4	4	4	3	3	3	3	4	3	3	3	3	3
1	4	4	4	5	5	3	4	4	4	5	3	3	3	4	4	3	3	3	3	3
1½	4	5	5	5	6	4	4	5	5	5	3	4	4	4	5	3	3	3	3	4
2	5	5	5	6	6	4	5	5	5	6	4	4	4	5	5	3	3	3	4	4
3	5	6	6	6	7	5	5	6	6	6	4	5	5	5	6	3	4	4	4	5
5	6	6	7	7	8	6	6	6	7	7	5	5	6	6	6	4	4	5	5	5
7½	7	7	8	8	9	6	7	7	8	8	6	6	6	7	7	5	5	5	6	6
10	7	8	8	9	9	7	7	8	8	9	6	6	7	7	8	5	5	6	6	6
15	8	9	9	10	10	8	8	9	9	10	7	7	8	8	9	6	6	6	7	7
20	9	9	10	10	11	8	9	9	10	10	7	8	8	9	9	6	6	7	7	8
25	9	10	10	11	11	9	9	10	10	11	8	8	9	9	10	6	7	7	8	8
30	10	10	11	11	12	9	10	10	11	11	8	9	9	10	10	7	7	8	8	9
40	10	11	11	12	12	10	10	11	11	12	9	9	10	10	11	7	8	8	9	9
50	11	11	12	12	...	10	11	11	12	12	9	10	10	11	11	8	8	9	9	10
60	11	12	12	...	...	11	11	12	12	...	10	10	11	11	12	8	9	9	10	10
75	12	12	...	...	...	11	12	12	...	...	10	11	11	12	12	9	9	10	10	11
100	12	...	...	...	...	12	12	...	...	...	11	11	12	12	...	9	10	10	11	11
125	...	...	...	...	...	12	...	...	...	...	11	12	12	...	...	10	10	11	11	...
150	...	...	...	...	...	...	...	...	...	...	12	12	...	...	...	10	11	11	...	...
200	...	...	...	...	...	...	...	...	...	...	12	...	...	...	...	11	11	...	...	...
250	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11	...	...	...	...

Caution: Applications involving reciprocating engines and reciprocating driven devices are subject to critical rotational speeds which may damage the coupling and/or connected equipment. Contact Lovejoy Engineering with specific requirements

S-Flex

Selection/Ratings

Coupling Ratings

Coupling Size	Sleeve Construction	Basic HP Ratings @ RPM 100	860	1160	1750	3500	Rated Torque (in.-lbs.)	Torsional Stiffness Factor (in.-lb./radians)
3	EPDM & Neoprene	.10	.80	1.1	1.7	3.3	60	229
4	EPDM & Neoprene	.19	1.6	2.2	3.3	6.7	120	458
5	EPDM & Neoprene	.38	3.3	4.4	6.7	13	240	916
6	EPDM & Neoprene	.71	6.1	8.3	12.5	25	450	1718
7	EPDM & Neoprene	1.2	10	13	20	40	725	2769
8	EPDM & Neoprene	1.8	16	20	32	63	1135	4335
9	EPDM & Neoprene	2.8	25	33	50	100	1800	6875
10	EPDM & Neoprene	4.6	39	53	80	160	2875	10980
11	EPDM & Neoprene	7.2	62	83	126	252	4530	17300
12	EPDM & Neoprene	11.4	98	132	200	...	7200	27500

*Values shown are for an ambient temperature of 75°F.

Maximum RPM and Allowable Misalignment

Max. Allowable Misalignment (inches) Parallel	Angular	Maximum RPM	Max. Bore w/std. Kwy ■	Max. Bore Shallow Kwy ■
.010	.035	9200	7/8	NA
.010	.043	7600	1	NA
.015	.056	7600	1 3/16	1 1/4
.015	.070	6000	1 7/16	1 7/8
.020	.081	5250	1 5/8	1 7/8
.020	.094	4500	1 15/16	2 3/8
.025	.109	3750	2 3/8	2 7/8
.025	.128	3600	2 3/4	3 3/8
.032	.151	3600	3 3/8	3 7/8
.032	.175	2800	3 7/8	3 15/16

**Note: Values shown apply if the actual torque transmitted is more than 1/4 the coupling rating. For lesser torque, reduce above values by 1/2.

■ See standard and shallow keyway chart page 28.

LOAD SYMBOLS (For S-Flex Couplings Only)

Application	Load Symbol
AGITATORS—Paddle, Propeller, Screw	L
BAND RESAW (lumber)	M
BARGE HAUL PULLER	M
BARKING (lumber)	H
BAR SCREEN (sewage)	H
BATCHES (textile)	L
BEATER AND PULPER (paper)	M
BENDING ROLL (metal)	M
BLEACHER (paper)	M
BLOWERS	L
Centrifugal, Vane	L
Lobe	M
BOTTLING MACHINERY	L
BREW KETTLES (distilling)	L
BUCKET ELEVATOR OR CONVEYOR	M
CALENDERS	
Calender (paper)	M
Calender-super (paper), Calender (rubber)	H
CANE KNIVES (sugar)	M
CARD MACHINE (textile)	H
CAR DUMPERS	H
CAR PULLERS	M
CEMENT KILN	H
CENTRIFUGAL BLOWERS, COMPRESSORS, FANS, or PUMPS	L
CHEMICAL FEEDERS (sewage)	L
CHILLER (oil)	M
CHIPPER (paper)	H
CIRCULAR RESAW (lumber)	M
CLARIFIER or CLASSIFIER	L
CLAY WORKING MACHINERY	M
COLLECTORS (sewage)	L
COMPRESSORS	
Centrifugal	L
Reciprocating	*
Screw, Lobe	L
CONCRETE MIXERS	M
CONVERTING MACHINE (paper)	M
CONVEYORS	
Apron, Assembly Belt, Flight, Oven, Screw, Bucket	L
COOKERS—Brewing, Distilling, Food	M
COOLING TOWER FANS	L
COUCH (paper)	H
CRANES and HOISTS	M
Heavy Duty Mine	M
CRUSHERS—Cane (sugar), Stone, or Ore	H
CUTTER—Paper	H
CYLINDER (paper)	H
DEWATERING SCREEN (sewage)	M
DISC FEEDER	L
DOUGH MIXER	M
DRAW BENCH CONVEYOR and MAIN DRIVE	H
DREDGES	
Cable Reel, Pumps	M
Cutter Head Drive, Jig Drive, Screen Drive	H
Maneuvering and Utility Winch, Stacker	M
DYNAMOMETER	L
DRYERS (rotary)	M
EDGER (lumber)	H
ELEVATORS	
Bucket	M
Escalator	L
Freight, Passenger, Service, Man Lift	H
ESCALATORS	L
EXTRUDER (metal)	H
FANS	
Centrifugal	L
Cooling Tower	H
Forced Draft, Large Industrial, or Mine	M
FEEDERS	
Apron, Belt, Disc	L
Reciprocating	H
Screw	M
FILTER, PRESS-OIL	M
GENERATORS	
Uniform load	L
Varying load, Hoist	M
Welders	H
GRIT COLLECTOR (sewage)	L
GRIZZLY	H
HAMMERMILL	
Light Duty, Intermittent	M
Heavy Duty, Continuous	H
HOISTS	
Heavy Duty	H
Medium Duty	M
JORDAN (paper)	H
KILN, ROTARY	H
LAUNDRY WASHER or TUMBLER	H
LINE SHAFTS	L
LOG HAUL (lumber)	H
LOOM (textile)	M
MACHINE TOOLS, MAIN DRIVE	M
MANGLE (textile)	L
MASH TUBS (distilling)	L
MEAT GRINDER	M
METAL FORMING MACHINES	
MILLS	
Ball, Pebble, Rod, Tube, Rubber, Tumbling	H
Dryer and Cooler	M
MIXERS	
Concrete, Muller	M
Banbury	H
ORE CRUSHER	H
OVEN CONVEYOR	L
PLANER (metal or wood)	M
PRESSES	
Brick, Briquette Machine	H
Notching, Paper, Punch, Printing	M
PUG MILL	M
PULP GRINDER (paper)	H
PULVERIZERS	
Hammermill—light duty, Roller	M
Hammermill—heavy duty, Hog	H
PUMPS	
Centrifugal, Axial	L
Gear, Lobe, Vane	M
Reciprocating—sgl. or dbl. acting, cylinder	*
REEL, REWINDER (paper) CABLE	M
ROD MILL	H
SAWDUST CONVEYOR	L
SCREENS	
Air Washing, Water	L
Rotary for coal or sand	M
Vibrating	H
SCREW CONVEYOR	L
SLAB CONVEYOR (lumber)	M
SLITTERS (metal)	M
SOAPERS (textile)	L
SORTING TABLE (lumber)	M
SPINNER (textile)	M
STOKER	L
SUCTION ROLL (paper)	M
TENTER FRAMES (textile)	M
TIRE BUILDING MACHINES	H
TIRE & TUBE PRESS OPENER	L
TUMBLING BARRELS	H
WASHER and THICKENER (paper)	M
WINCHES	M
WINDERS, Paper, Textile, Wire	M
WINDLASS	M
WIRE	
Drawing	H
Winding	M
WOODWORKING MACHINERY	L

*Consult Lovejoy Engineering

Armstrong Guided Free Floating Lever Liquid Drainers

For loads to 50,000 lbs/hr . . . pressures to 1000 psig

Armstrong Guided Free Floating Lever Liquid Drainers use the mass produced bodies, caps, lever mechanisms, valves and seats of Armstrong inverted bucket steam traps that have been proved in years of service.

Elliptical floats and high leverage make it possible to open large orifices to provide large capacity for drainer size and weight. The hemispherical valve, seat, and leverage are identical in design, materials, and workmanship to those for saturated steam service up to 1000 psig, with the exception of the addition of a guide post to assure positive leaktight valve closing under all operating conditions.

Table A-4—Maximum operating pressures for handling different specific gravity liquids with orifices available in guided free floating lever drainers. (See pages 2 and 3.)

Drainer No.	Sp. Gr.	1.00	.95	.90	.85	.80	.75	.70	.65	.60	.55	.50
	Orifice	Maximum Operating Pressure, psi										
1-LD	#38	170	150	135	115	100	80	65				
	5/64	300	260	225	190	155	130	110				
11-LD	#38	275	256	232	207	184	160	136	113	90		
	5/64"	400	400	400	400	371	323	273	228	182		
2-LD	5/16"	18	17	15	14	12	10	9	7			
	1/4"	30	28	26	23	20	17	14	12			
	3/16"	70	60	55	50	45	40	30	25			
	5/32"	125	110	100	90	80	65	55	45			
	1/8"	210	190	175	160	140	120	100	80			
	7/64"	250	250	230	200	175	150	130	105			
32-LD Forged Steel	5/16"	32	29	26	23	21	18	16	13	11	8	6
	1/4"	55	48	44	39	35	31	26	22	18	14	9
	3/16"	115	100	91	81	73	64	55	46	38	29	20
	5/32"	210	186	169	153	137	121	104	88	72	55	35
	1/8"	375	326	297	267	238	209	180	151	121	92	63
	7/64"	500	434	394	355	306	278	239	200	161	127	84
3-LD* Cast Iron and 33-LD Forged Steel	1/2"	15	13	12	10	9	8	7	6	5	3	2
	3/8"	30	28	26	23	21	18	15	13	10	8	5
	5/16"	55	49	45	40	36	31	27	22	18	13	9
	9/32"	70	64	58	53	47	41	35	29	24	18	12
	1/4"	110	97	88	79	70	61	52	43	34	25	16
	7/32"	140	125	114	102	91	77	66	54	43	31	20
	3/16"	225	204	186	168	150	132	113	95	75	56	35
	5/32"	350	303	276	249	222	191	164	138	110	82	52
	1/8"	800	722	657	585	523	457	390	330	264	197	125
	7/64"	900	773	702	628	560	490	420	354	283	212	135
6-LD Cast Iron	1 1/16"	20	17	16	14	13	12	11	9	8	7	6
	7/8"	30	28	25	23	21	19	17	15	13	11	9
	3/4"	45	39	36	33	30	28	25	22	19	16	13
	5/8"	70	62	57	53	48	43	39	34	30	25	21
	9/16"	95	84	76	70	64	58	52	46	40	33	27
	1/2"	127	118	109	100	92	84	75	66	57	48	40
	7/16"	177	165	153	141	129	117	104	92	80	68	56
	3/8"	250	250	242	223	204	185	166	146	127	107	88
	11/32"	250	250	250	250	238	216	193	170	148	125	103
	5/16"	250	250	250	250	250	250	244	215	187	158	130
	9/32"	250	250	250	250	250	250	250	250	250	225	185
	1/4"	250	250	250	250	250	250	250	250	250	250	250
36-LD Forged Steel	1 1/16"	15	13	12	11	9	8	7	5	4	3	1
	7/8"	25	22	20	18	16	13	11	9	7	5	3
	3/4"	35	32	28	26	22	19	16	13	10	7	4
	5/8"	53	49	44	40	35	30	26	21	16	11	6
	9/16"	72	66	58	53	47	40	35	28	21	15	9
	1/2"	103	94	82	76	67	58	49	40	31	22	12
	7/16"	145	132	116	107	95	81	70	56	44	31	18
	3/8"	232	211	190	171	151	130	111	90	70	50	29
	11/32"	262	239	215	194	170	147	126	102	78	56	32
	5/16"	352	320	290	260	228	197	169	137	105	75	44
	9/32"	510	463	420	377	331	285	244	198	153	109	63
	1/4"	712	647	585	527	463	399	341	277	213	152	89
	7/32"	1000	912	820	742	652	562	481	391	301	214	125
	3/16"	1000	1000	1000	1000	1000	930	800	650	500	355	210

NOTE: If specific gravity falls between those shown above, use the next lower gravity. For example, if specific gravity is 0.73, use 0.70 gravity data.

**All pressures above 250 psi are applicable ONLY to model 33-LD.*

TABLE B-4—List of Materials

Drainer No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket
1-LD, 2-LD, 3-LD, 6-LD	Hardened Chrome Steel	Stainless Steel	Stainless Steel	Cast Iron ASTM A-278, Cl.30	Compressed Asbestos-free
11-LD	Hardened Chrome Steel	Stainless Steel	Stainless Steel	Sealed Stainless Steel, 304-L	—
32-LD 33-LD 36-LD	Hardened Chrome Steel	Stainless Steel	Stainless Steel	Forged Steel ASTM A-105	Compressed Asbestos-free

For information on special materials, consult the Armstrong Application Engineering Department.

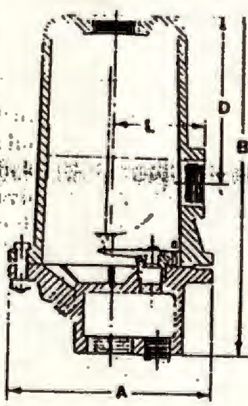


Fig. 4-1—No. 2-LD, 3-LD and 6-LD cast iron guided lever drainers. No. 1-LD is similar.

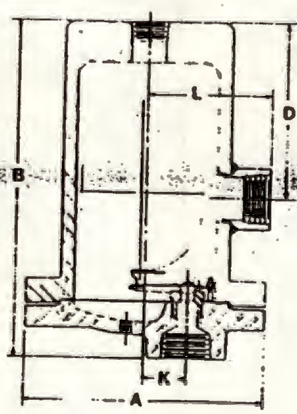


Fig. 4-2—No. 32-LD, 33-LD and 36-LD forged steel guided lever drainers. Socket weld or flanged connections are also available.

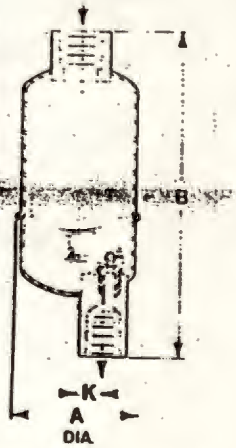


Fig. 4-3—No. 11-LD stainless steel guided lever liquid drainer with sealed, tamper-proof construction.

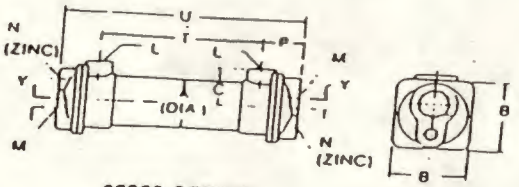
Table C-4—Physical Data, Armstrong Guided Lever Liquid Drainers.

	Cast Iron				Stainless Steel	Forged Steel		
Model Number	1-LD	2-LD	3-LD†	6-LD†	11-LD	32-LD†	33-LD†	36-LD
Pipe Connections	[illegible]	[illegible]	[illegible] or 1"	1" [illegible] or 2"	[illegible]	[illegible]	[illegible] or 1"	[illegible]
Dimension, "A"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8"	11"
"B"	[illegible]	8"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
"D"	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]	9"
"K"	[illegible]	—	—	—	[illegible]	[illegible]	[illegible]	[illegible]
"L"	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	3"	[illegible]
Approx. Wt., Lbs.	4	13	22	80	[illegible]	31	49	163
Vessel Design Limitations, psig	[illegible]	250 [illegible] 450 F	250 [illegible] 450 F	250 [illegible] 450 F	400 (500°F) —	750 (100 F) 500 (750 F)	1000 (100 F) 600 (750 F)	1000 (100 F) 600 (750 F)

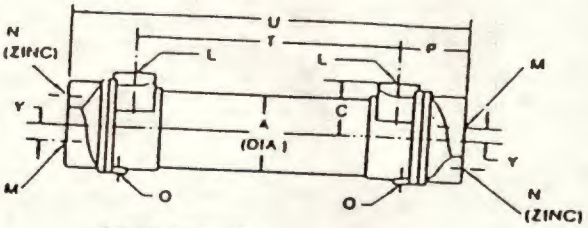
[illegible] outlet [illegible] outlet †This model is also available with a cast 316 stainless steel body and all stainless steel internals. Consult factory.

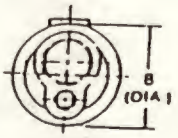
Pipe size of vent connection is same as that of inlet and outlet connections.

NOTE: All dimensions and weights are approximate. Use certified print for exact dimensions.

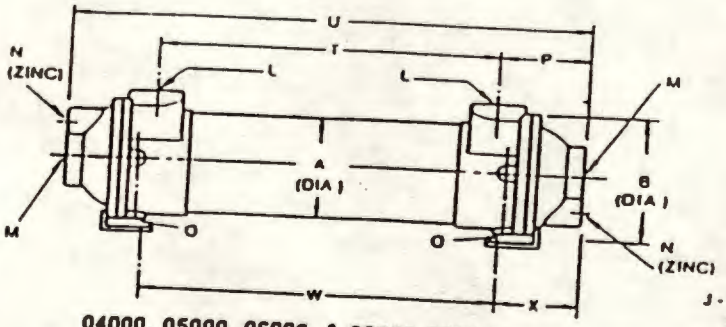


02000 SERIES

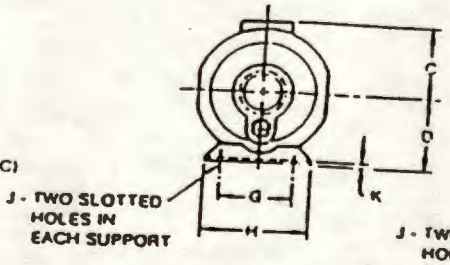


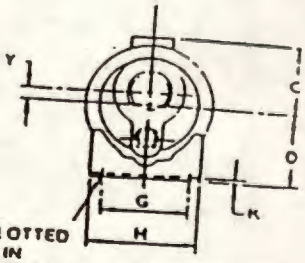


03000 SERIES



04000, 05000, 06000, & 08000 SERIES





J - TWO SLOTTED HOLES IN EACH SUPPORT

04000 SERIES ONLY

NOTE:
04000, 05000, 06000, and 08000 Series mo
feet may be rotated 90° in either direction fro
shown on illustration.

DESIGN	W.P.	T.P.	TEM
SHELL SIDE	300 PSI	350 PSI	300°
TUBE SIDE	150 PSI	225 PSI	300°

STANDARD SINGLE PASS TYPE BCF EXCHANGER DIMENSIONS

All dimensions are in inches unless otherwise indicated. Dimensions are not guaranteed unless certified. All connections are NPT.

SIZE	A	B	C	D	G	H	J	K	L	M	N	O	P	T	U	W	X	Y
02008	2⅛	2⅜	1 1/16						1	1/4	⅜		2⅛	6¼	11			3⅛
03008 03014 03024	3⅛	4 3/16	2 1/16						1	1½	⅜	¼	2 9/16	6 ⅛ 12⅛ 22⅛	11¼ 17¼ 27¼			3⅛
04014 04024 04036	4⅛	5⅛	3¼	3⅛	3⅛	4⅛	⅛ x 1⅛	5/16	1⅛	2	⅝	⅜	3 3/16	11⅛ 21⅛ 33⅛	18 28 40	12⅛ 22⅛ 34⅛	2⅛	⅛
05014 05024 05036	5⅛	6½	3⅜	3½	4	5	½ x ⅛	7/16	1½	2½	⅜	¼	3 11/16	11⅛ 21⅛ 33⅛	18½ 28½ 40½	11¼ 21⅛ 33¾	3⅛	
06024 06036 06048 06060	6⅛	7½	4¼	4⅛	5	6	½ x ⅛	7/16	2	3	½	¼	4¼	20½ 32½ 44½ 56½	29 41 53 65	21½ 33½ 45½ 57½	3¾	
08024 08036 08048 08060 08072	8⅛	9¼	5⅜	5⅛	7	8¼	⅛ x 1⅛	7/16	3	3	½	¼	6	19 31 43 55 67	31 43 55 67 79	20½ 32½ 44½ 56½ 68½	5¼	

OUR ORDER

AMERICAN STANDARD FACTORY ORDER NO

PART NO.:

BY:

DATE:

STANDARD TYPE BCF
EXCHANGERS
SINGLE PASS

HEAT TRANSFER DIVISION
AMERICAN-STANDARD

TYPE FIXED TUBESHEET, NON REMOVABLE BUNDLE EXCHANGERS

Note: Before placing this equipment in operation, environment and service conditions should be checked for compatibility with materials of construction. Contact your nearest ITT Standard Representative if you are not sure what the actual materials of construction are.

INSTALLATION

(a) As a cooler, the preferred arrangement is with the hot medium through the shell and the cooling medium through the tubes. When the hot fluid is dirty or fouling, it is better to put it through the tubes because they are easier to clean. With single pass units be sure the shell inlet is on the same end as the tube side outlet. In two pass units, the shell inlet should be at the inlet-outlet bonnet end. It is customary for the cooling medium to enter the lower bonnet connection, although this can be reversed if necessary.

(b) As a heater, the hot medium, usually steam or hot water, must be in the shell. If it is steam, either of the shell connections, or both, can be used, dependent on actual entering velocities.

(c) For the above applications and for temperatures above 150ºF, the higher temperature fluid should be circulated through the shell side of the exchanger and precaution should be taken to avoid shock from abrupt changes in fluid circulation temperatures.

OPERATION

A heat exchanger is a pressure vessel designed for operation at certain specific limits of pressure and temperature, and the system must be safeguarded with safety valves and controls so that these design conditions are not exceeded and that all operating personnel are alerted.

Before placing the exchanger in operation initially, or after service or inspection, be sure that both sides are clean, carefully vented and full of fluid. The most frequent cause of nonperformance is improper venting and fouling.

Be sure all parts of the system are clean and in proper operating condition. An exchanger cannot perform properly unless all connected equipment is functioning properly, yet, the exchanger is frequently blamed for non-performance when the actual trouble is elsewhere in the system.

Observe the following precautions to obtain maximum performance:

1. Exchanger must be full of liquid in both shell and tube sides. Not for steam.
2. Provide periodic venting if air tends to accumulate in system.
3. Maintain rated flow of both fluids.
4. Avoid excessive flow of cooling water in exchangers used as coolers. It is a frequent cause of tube failure through erosion, and may decrease cooling efficiency, especially with heavy oils.
5. Inspect exchanger periodically and clean thoroughly when necessary, especially the inside of the tubes.

Many heat exchangers process fluids which are irritating or dangerous to the human system and could cause problems if bolted or threaded joints are not maintained in a leak tight condition at operating pressures, temperatures and no flow, ambient conditions.

If fluids are not irritating or dangerous a leak will at least cause a slippery situation on the floor below.

Since one fluid in the heat exchanger is at higher temperatures, any leaks might cause burns.

INSPECTION

A heat exchanger needs little attention, but to insure continued satisfactory performance it should be inspected periodically.

1. Remove the bonnets. Inspect all tubes carefully for possible erosion, corrosion, or foreign material.
2. Inspect all anodes to be sure they are neither excessively corroded nor insulated with scale. Scrape to a bright surface.
3. Inspect filters in the system to prevent foreign matter from entering the exchanger.

RECOMMENDED START-UP AND SHUT-DOWN PROCEDURES

Caution: Every effort should be made to avoid subjecting the unit to thermal shock, overpressure, and/or hydraulic hammer, since these conditions may impose stresses that exceed the mechanical strength of the unit or the system in which it is installed which may result in leaks and/or other damage to the unit and/or system.

Heat Exchanger Type of Construction	Fluid Location & Relative Temp.				Start-Up Procedure	Shut-Down Procedure
	Shell side		Tube side			
	Type of Fluid	Rel. Temp.	Type of Fluid	Rel. Temp.		
Fixed Tubesheet (Non-Removable Bundle)	Liquid	Hot	Liquid	Cold	Start both fluids gradually at the same time	Shut down both fluids gradually at the same time
	Condensing Gas (i.e., Steam)	Hot	Liquid or Gas	Cold	Start hot fluid first, then slowly start cold fluid. Avoid temperature shock (1)	Shut down cold fluid first, then hot fluid
	Gas	Hot	Liquid	Cold	Start cold fluid first, then hot fluid	Shut down cold fluid gradually, then hot fluid
	Liquid	Cold	Liquid	Hot	Start both flows gradually at the same time	Shut down both fluids gradually at the same time
	Liquid	Cold	Gas	Hot	Start cold fluid first, then hot fluid.	Shut down hot fluid first, then cold fluid

General Comments:

1) In all start-up and shut-down operations, fluid flows should be regulated so as to avoid thermal shocking the unit regardless of whether the unit is of either a removable or non-removable type construction.

2) For fixed tubesheet (non-removable bundle) type units where the tube side fluid cannot be shut down, it is recommended that (1) A bypass arrangement be incorporated in the system, and (2) The tube side fluid be bypassed before the shell side fluid is shut down.

3) Extreme caution should be taken on insulated units where fluid flows are terminated and then restarted. Since the metal parts could remain at high temperatures for an extended period, severe thermal shock could occur.

CLEANING

The interior of the tubes may be flushed by directing a stream of water through them. More stubborn deposits may require brushes, rods, or other cleaning tools. Rubber plugs may be forced through the tubes if the special water or air gun required is available.

The shell side, or the exterior of the tubes (and the interior of the tubes, as well) can be cleaned by circulating a cleaning solution through the exchanger. For most conditions a mild alkaline solution, such as Oakite or equal, is satisfactory. For hard scales it may be necessary to use a weak solution of inhibited hycrochloric acid. Circulate the solution through the shell or tubes (or both) until clean. Be sure to wash out all chemicals thoroughly before returning the exchanger to service.

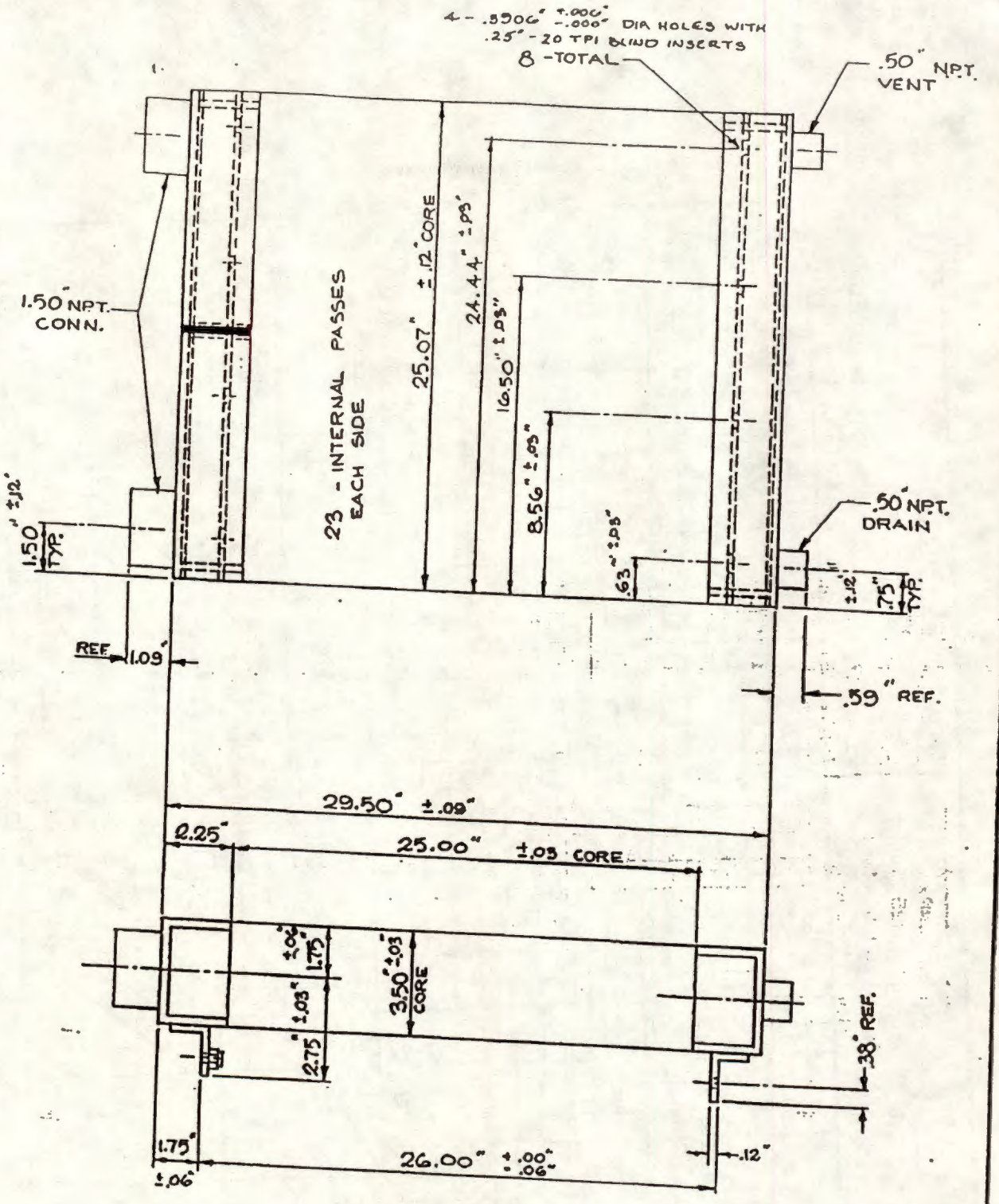
When the heat exchanger is cleaned, it is important that full characteristics of the fouling material and the cleaning agent be known and care exercised in handling them according to instructions.

Since the heat exchangers in the larger sizes are too heavy for men to handle care must be used to take this weight with proper rigging to avoid injury.

ANODES

Some exchangers may be equipped with renewable anodes. The purpose of the anodes is to inhibit electrolytic corrosion. In order to remain active the anodes must be kept free of scale or other surfaces coatings.

On some applications where electrolytic corrosion is not a problem, pipe plugs maybe substituted for the anode. The pipe plug material selected should be softer than the base part to avoid pipe thread damage.



DESIGN PRESS. 150# AIR
TEMP. 250 °F

Face square Footage = 4.34 ft²

Intervac Part # 40725-008

CROWLEY COMPANY
P.O. BOX 425
BURTON OHIO 44021
(216) 834-9400

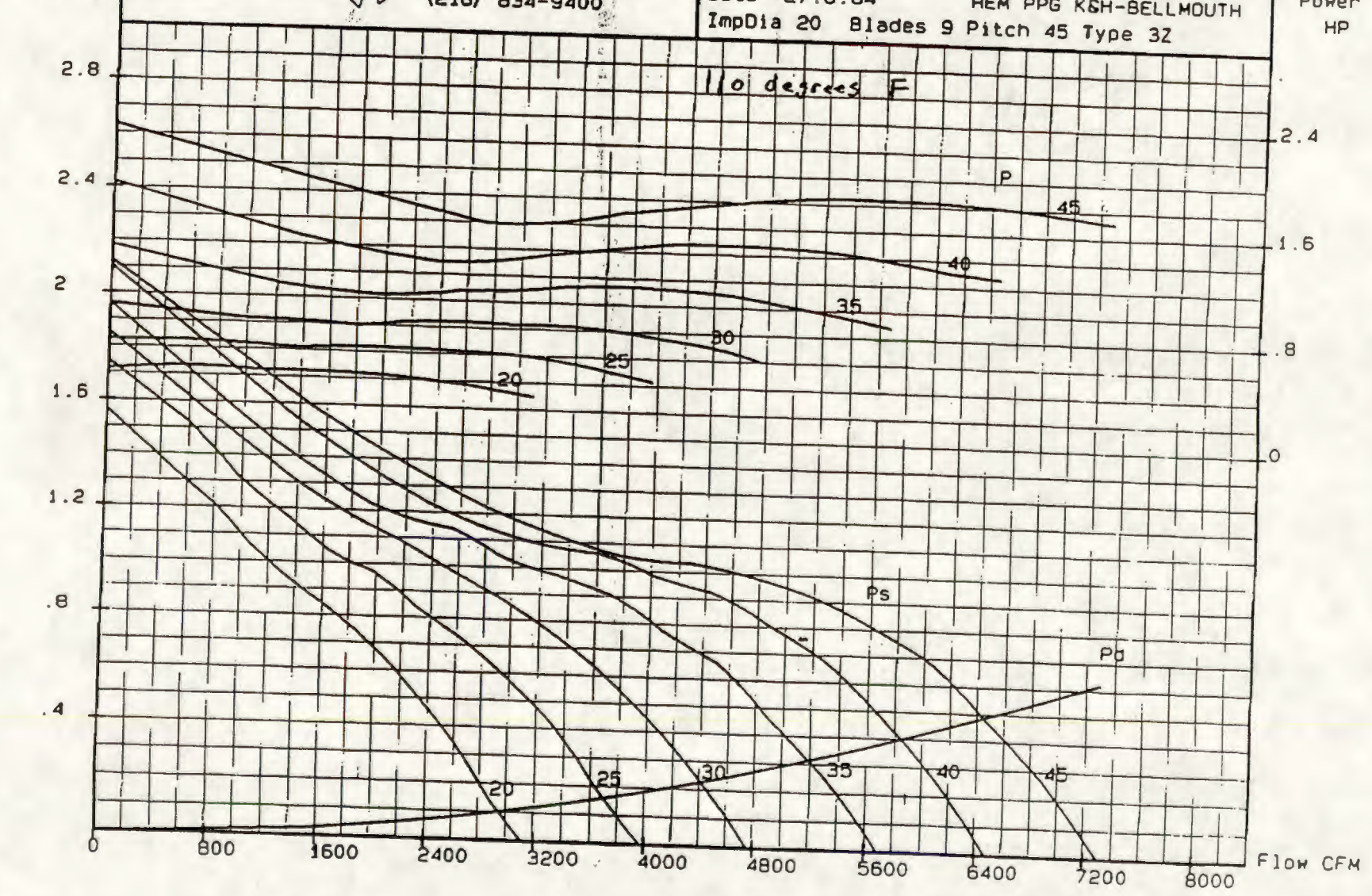
MULTI-WING

Impeller 20-9-3Z S737.1

RPM 1750 Density .07 lb/ft3

Date 27.6.84 AEM PPG K&H-BELLMOUTH

ImpDia 20 Blades 9 Pitch 45 Type 3Z



Sales Bulletin

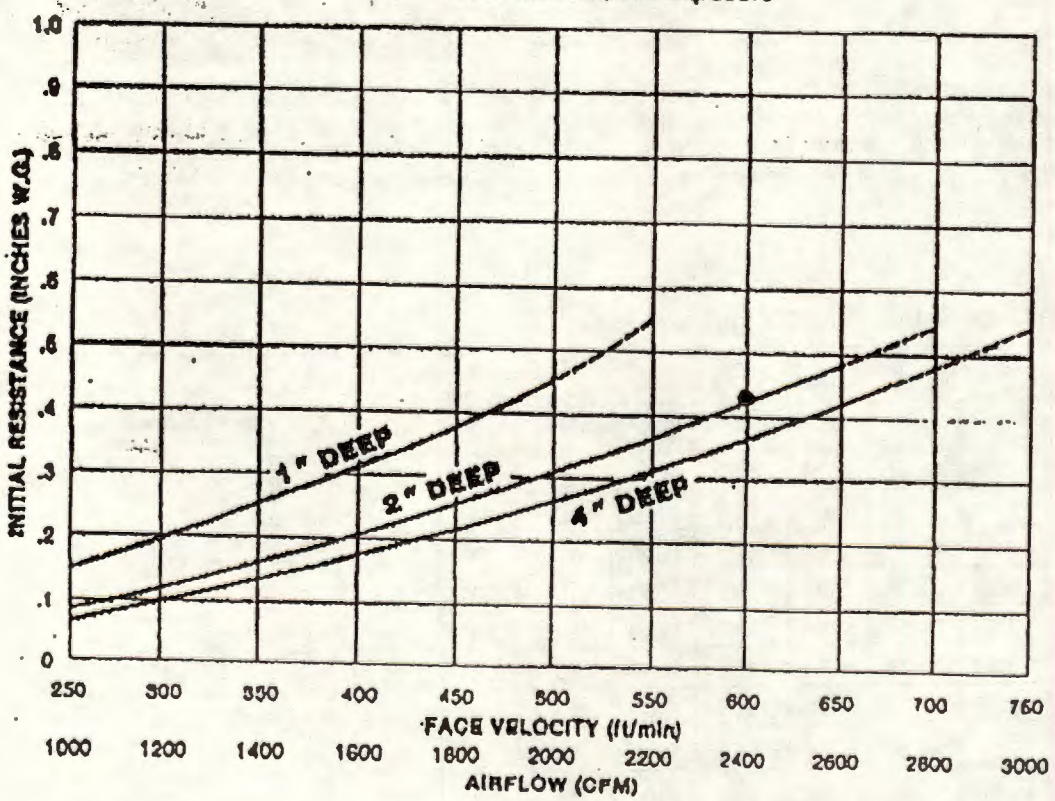
Bulletin No. A-1305-5A

30/30

Initial Resistance vs Airflow

24" x 24"

Final (Maximum Recommended) Resistance is .9" w.g.
NOTE: Consult factory before operating in dotted line region
Temperature limitations — 180° Continuous Exposure
200° Intermittent Exposure



Introducing the Farr U.L. Class 1 30/30 filter

THE CLASS 1 30/30 FILTER was specifically developed for applications requiring stringent Underwriters' Laboratories Class 1 rating.

In the past, the application of Class 1 filters has resulted from local fire code or ordinance requirements. In certain applications, insurance underwriters offer lower rates when Class 1 filters are utilized.

Farr Company foresees increasing usage of Class 1 type filters, particularly in high occupancy facilities, such as hospitals, schools and buildings with public assembly areas.

NEW OR EXISTING SYSTEMS can be upgraded by incorporating the Farr 30/30 Class 1. Its high dust holding capacity extends replacement intervals and considerably lengthens the service life of any other secondary filters.

Farr 30/30 Class 1 filters may be installed in built-up banks, Farr Glide/Pack side access housings and OEM air handling units.

A wide range of conversion fasteners and clips are available to adapt the Farr 30/30 to almost any existing built-up filter bank.

How To Specify

FILTER MEDIA shall be of high density glass micro fibers laminated to all glass woven mesh backing. The filter media shall have an average efficiency of 25-30% on ASHRAE Standard 52-76.

It shall have an average arrestance of 94-96% in accordance with that test standard.

The Farr 30/30 Class 1 is categorized as a 30% efficiency filter. Average efficiencies may vary 5 points. These variances are typical of filters in the medium efficiency category when tested in accordance with the ASHRAE 52-76 Standard. The filter shall be listed by Underwriters' Laboratories as Class 1.

MEDIA SUPPORT GRID shall be a welded wire grid with an effective open area of not less than 96%.

The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull away.

The media support grid shall be formed in such a manner that it affects a radial pleat design, allowing total use of filter media.

ENCLOSING FRAME is constructed of non-flammable board and meets requirements for Underwriters' Laboratories Class 1 rating. The enclosing frame has diagonal support members bonded to the air entering and air exiting side of each pleat, to ensure pleat stability. The inside periphery of the enclosing frame shall be bonded to the filter pack, thus, eliminating the possibility of air bypass.

U.L. CLASS 1 30/30 PERFORMANCE
Farr Class 1 30/30 filters are rated on ASHRAE Standard 52-76 at 25-30% efficiency, arrestance is 94-96%.

CAPACITY AND RESISTANCE — U.L. CLASS 1 30/30

Filter Depth	Nominal Size (Inches)	Actual Size (inches)			Capacities (CFM)		Resistance @ Capacity (inches w.g.)			Media Area - Square Feet	
		Width	Height	Depth	Medium	High	Medium	High	Final*	Total	Media Area Per Sq. Ft. of Face Area
4"	12x24x4	11.38	23.38	3.88	500	1000	.10	.33	1.00	13.8	7.0 11 pleats per linear foot
	16x20x4	15.38	19.38	3.88	550	1100	.10	.33	1.00	15.6	
	20x20x4	19.38	19.38	3.88	695	1390	.10	.33	1.00	18.6	
	16x25x4	15.38	24.38	3.88	695	1390	.10	.33	1.00	19.6	
	20x25x4	19.38	24.38	3.88	870	1740	.10	.33	1.00	23.6	
	24x24x4	23.38	23.38	3.88	1000	2000	.10	.33	1.00	27.5	
2"	12x24x2	11.38	23.38	1.88	500	1000	.13	.38	1.00	8.5	15 pleats per linear foot
	16x20x2	15.50	19.50	1.88	550	1100	.13	.38	1.00	10.1	
	20x20x2	19.50	19.50	1.88	695	1390	.13	.38	1.00	12.1	
	16x25x2	15.50	24.50	1.88	695	1390	.13	.38	1.00	12.7	
	20x25x2	19.50	24.50	1.88	870	1740	.13	.38	1.00	15.3	
	24x24x2	23.38	23.38	1.88	1000	2000	.13	.38	1.00	17.6	

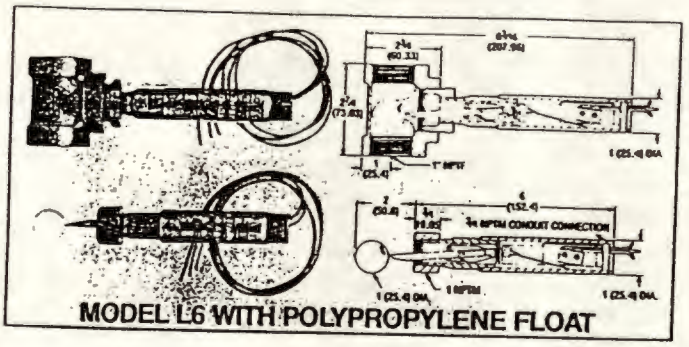
* *Recommended final resistance. System design may dictate a lower changeout point.*

See Performance Data regarding U.L. Class 2 30/30 filters on the following pages.

Model L6

FLOTECT™ Liquid Level Switch

Explosion-proof. Easy in-wall or external installation.
Small size; up to 2000 PSIG operating pressure.



Explosion-Proof; U.L. and C.S.A. Listed –
Class I, Groups A, B, C, D
Class II, Groups E, F, G.
CENELEC: EExd IIC T6 (T amb = 75°C)

PHYSICAL DATA

Temperature Limits: 220°F (105°C) max

Operating Pressure: (Polypropylene float) to 2000 PSIG (140KG/CM²) (304SS float) to 350 PSIG (25KG/CM²).

Electrical Rating: One (or two) SPDT snap action micro-switch. 5 amp 125/250 VAC.

Wiring Connections: 18" (460MM) leads. 18 gauge.

Minimum Specific Gravity: (Polypropylene float) 0.9 S.G. (round SS float) 0.7 S.G. (cylindrical SS float) 0.5 S.G.

Wetted Materials: Style B-S-3-0. Brass 301SS, Polypropylene, Ceramic. Style B-S-3-A, Style B-S-3C; Brass 301SS. 304SS Ceramic. Style S-S-3-0; 303SS. 301SS, Polypropylene, Ceramic. Style S-S-3-A, S-S-3-C; 303SS. 301SS, 304SS, Ceramic.

Switch Body: Brass ¾" NPT conduit conn. For S.S. switch housing change model number to L6EPS.

Piping Connection: 1" NPT

Installation: Horizontal w/index arrow pointing down.

Weight: Appx. 1 lb. (.5KG); appx. 1¾ lb. (.8KG) w/external chamber.

Model L6 FLOTECT Level Switches

MODEL NO.	BODY	INSTALLATION	FLOAT	PRESSURE RATING, PSI (KG/CM²)	MINIMUM SPECIFIC GRAVITY
L6EPB-B-S-3-0	Brass	Side Wall Mounting	Solid Polypropylene	2000 (140)	0.9
L6EPB-B-S-3-A	Brass	Side Wall Mounting	Stainless Steel Cylindrical	200 (14)	0.5
L6EPB-B-S-3-C	Brass	Side Wall Mounting	Stainless Steel Round	350 (25)	0.7
L6EPB-B-S-3-B	Brass	With External Float Chamber	Solid Polypropylene	250 (18)	0.9
L6EPB-B-S-3-H	Brass	With External Float Chamber	Stainless Steel Round	250 (18)	0.7
L6EPB-S-S-3-0	Stainless Steel	Sidewall Mounting	Solid Polypropylene	2000 (140)	0.9
L6EPB-S-S-3-A	Stainless Steel	Sidewall Mounting	Stainless Steel Cylindrical	200 (14)	0.5
L6EPB-S-S-3-C	Stainless Steel	Sidewall Mounting	Stainless Steel Round	350 (25)	0.7
L6EPB-S-S-3-B	Stainless Steel	With External Float Chamber	Solid Polypropylene	2000 (140)	0.9
L6EPB-S-S-3-H	Stainless Steel	With External Float Chamber	Stainless Steel Round	350 (25)	0.7

*For C.S.A. Listed switch (includes junction box) add suffix CSA to model number.
*For CENELEC Certified switch (includes junction box) add suffix CN to model number (with stainless steel floats only).
For DPDT switch change seventh character in model to D.
MT option. High temperature [400°F (205°C) construction] available on all models with stainless steel floats.
MV option. Gold contact for dry circuits. Rated 0.1A @ 125 VAC (not U.L. Listed).

The compact Flotect Model L6 Level Switch is designed and built for years of trouble-free service in a wide variety of process liquid level applications. Machined from brass or stainless steel bar stock, the body is leak proof, eliminating the possibility of the process media entering the switch housing. The float lever pivoted within the body moves when the process liquid displaces the solid polypropylene or stainless steel float. A magnet on the opposite end of the float lever controls a second magnet on the switch actuating lever located in the switch housing. Maintenance is easy since the electrical assembly can be removed for inspection or replacement without removing the entire switch. The stainless steel float lever arm and the polypropylene or stainless steel float are compatible with most process fluids.

The Flotect Model L6 is sensitive to level changes of less than ½" (12MM) and is U.L./C.S.A. Listed for explosion-proof service – Class I, Groups A, B, C & D and Class II, Groups E, F, & G. C.S.A. model furnished with optional junction box.

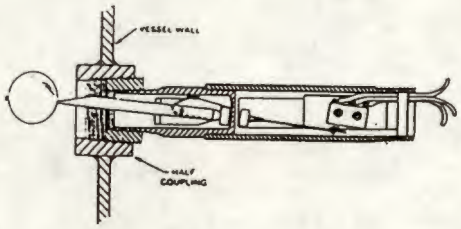
Suggested Specification:

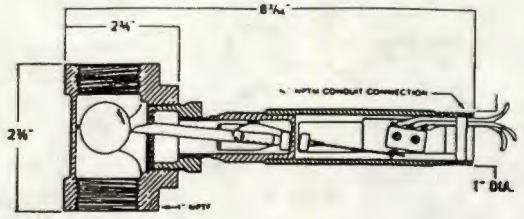
Automatic explosion-proof level switches shall be operated by a (solid polypropylene) (stainless steel) float actuating one (two) single pole, double throw switch(es) rated at 5 amps, 125/250 VAC. Motion of the float shall actuate switch by action of a magnet which controls the switch inside the one-piece switch body. Switches shall be W.E. Anderson model no. L6 ____ .

W.E. Anderson
Div. of Dwyer Instr., Inc.

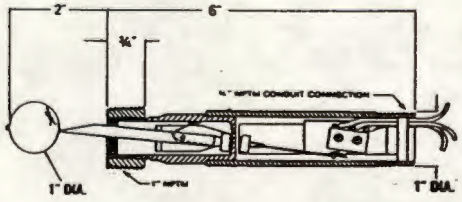
FLOTECT® Model L6 Level Switch

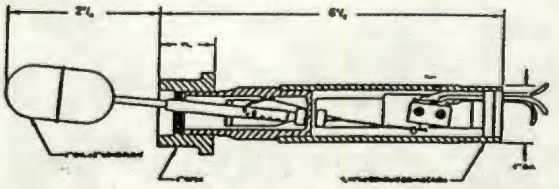
INSTALLATION AND OPERATING INSTRUCTIONS





L-6 WITH EXTERNAL FLOAT CHAMBER





L-6 FOR THRU—WALL INSTALLATION

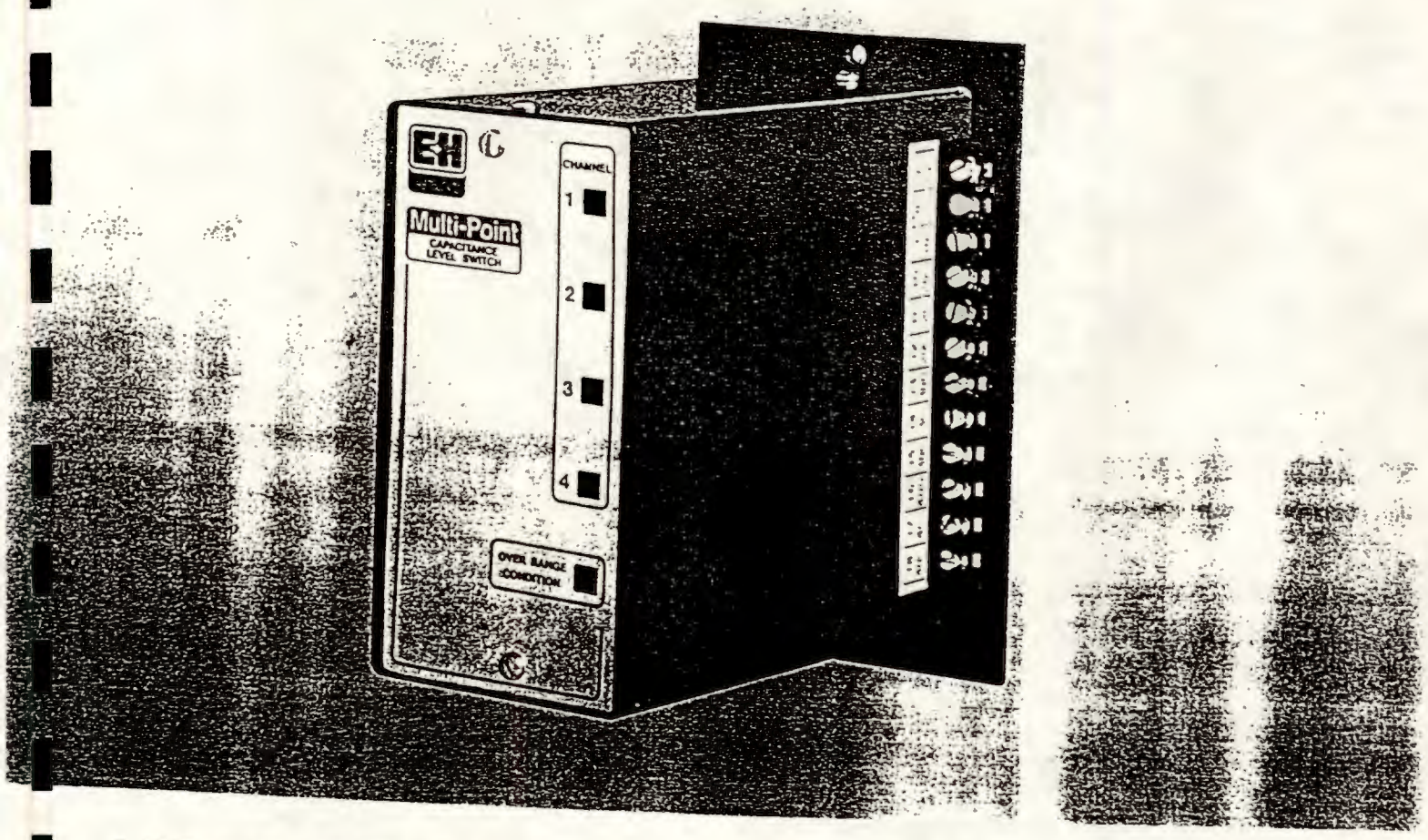
INSTALLATION

1. Carefully unpack switch, making sure to remove any packing from inside float chamber and/or lower housing.
2. Switch must be indexed during installation, so that the arrow on the side of the switch points down.
3. If switch is installed "thru-wall", a 1" half-coupling must be welded in the vessel wall as shown above. Half-couplings must extend through the wall as shown above. Do not attempt to use thredolets, full couplings or other types of fittings.
4. Pass the connecting wires through external conduit and connect. Switch is deactivated and contacts are in normal condition when level is below switch.

   Black - Common
   Blue - N. O.
   Red - N. C.

   Note: Double pole, double throw switches have dual black, blue and red leads. These are connected in the same manner as single pole double throw switches as described above.
5. Make sure conduit and wiring meet appropriate codes for hazardous areas. Make sure conduit is properly sealed. Care must be taken in hot/cold or outdoor installations to prevent condensation inside conduit. Electrical components must be kept free of moisture at all times. CAUTION: To prevent ignition of hazardous atmosphere, disconnect the device from the supply circuit before opening. Keep assembly tightly closed when in operation.
6. Inspect and clean wetted parts at regular intervals.

W.E. ANDERSON DIV., DWYER INSTRUMENTS, INC., 320 W. 80th ST., KANSAS CITY, MO 64114 816-333-9882



LSC 1135 SERIES

Multi-Point Capacitance (RF) Level Switch

The LSC 1135 Multi-Point is an advanced state-of-the-art capacitance level switch offering four level switches in a single unit. Using one controller and probe, the LSC 1135 Multi-Point provides four independent setpoints, each having a SPDT relay output to accommodate a variety of control actions. Individual channels can be specified with time delay or deadband.

The LSC 1135 Multi-Point Series can be used with most liquid and solid applications. The End-A-Coat™ function insures immunity to buildup, guards against false signaling and inaccuracies.

Enclosed in a surface or flush panel mount enclosure, the LSC 1135 is simple to install and requires no maintenance. There are no moving parts to wear, break, or fail. Other features include: field-selectable failsafe; 115 VAC power; .5pF sensitivity; 10-2000pF initial capacitance zeroing range; LED indication of relay status.

The LSC 1135 Multi-Point is available from stock with probes to meet virtually any application requirement.

FEATURES

- Four level switches in a single unit
- Uses a single probe
- Independent and non-interacting setpoints
- 5A SPDT control output relay for each point
- Individual channels with time delay or deadband
- Field-changeable modular channel boards
- Field-selectable failsafe mode
- Field-selectable time delay: ON, OFF, BOTH ON and OFF, and NO DELAY
- Immunity to buildup
- Application versatility
- Cost savings
- Simple calibration

The LSC 1135 Multi-Point Series

The LSC 1135 Multi-Point Series is offered in five models.

The distinction among the various models is for individual channel designations with time delay or deadband. All other features remain the same. The chart indicates which time delay and deadband combinations are available.

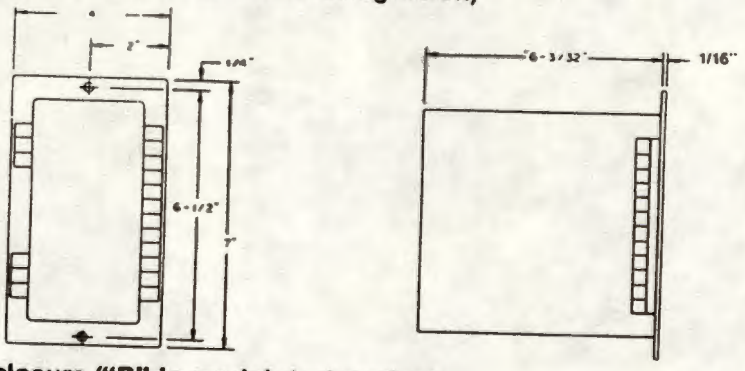
UNIT	TIME DELAY	DEADBAND
LSC 1135	4 Channels	None
LSC 1136	3 Channels	1 Channel
LSC 1137	2 Channels	2 Channels
LSC 1138	1 Channel	3 Channels
LSC 1139	None	4 Channels

PRINCIPLE OF OPERATION

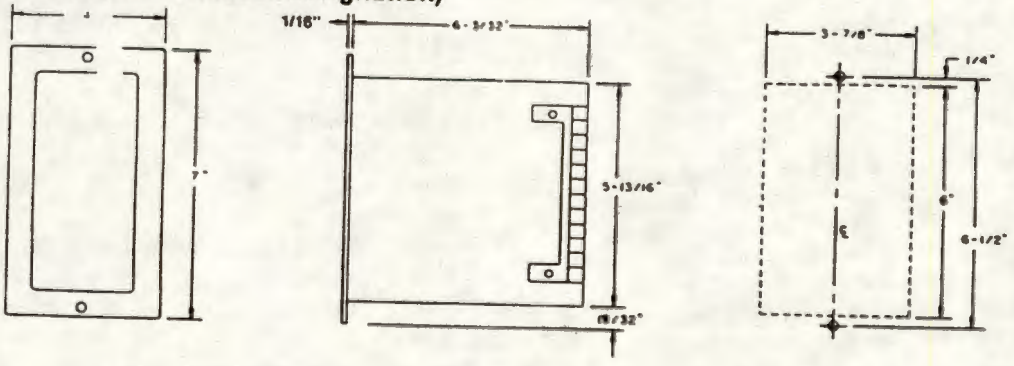
The LSC 1135 applies a low voltage, high frequency signal to the sensing probe thus causing a minute current to flow from the probe to the ground plane. The LSC 1135 is calibrated to ignore the initial current which flows when the probe is uncovered. When material contacts the probe, additional current—which is sensed and amplified by the LSC 1135—flows to ground. The amplified signal is input to a programmable comparator which drives the output relays.

OUTLINE DIMENSIONS

Surface mount enclosure ("A" in model designation)



Flush mount enclosure ("B" in model designation)



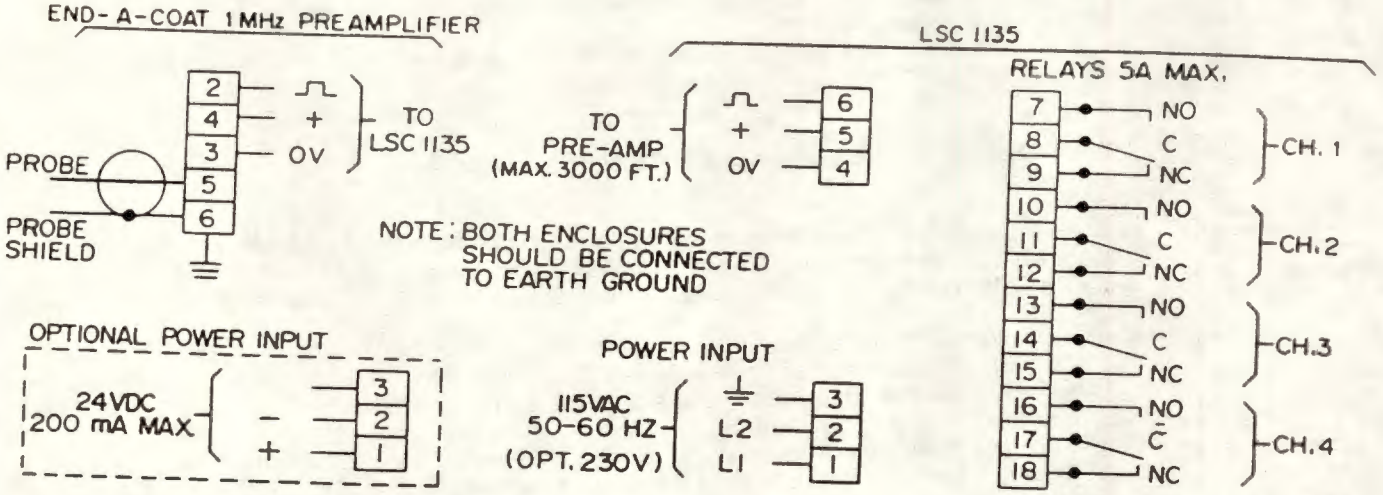
SPECIFICATIONS

Enclosure: aluminum, surface or flush panel mount
Power input: 115 VAC, ± 10%, 50/60 Hz (other voltages available; consult factory)
Power: 3VA
Output relay; SPDT for each channel; potential-free rated 5A, 115VAC or 28VDC
Status indication: LED lighted if relay is energized.
Operating temperature for LSC 1135 Series controller: 0° to 140°F (-20° to + 60°C)
Operating temperature for 1 MHz Preamplifier (within probe enclosure): 0° to 212°F (-20° to + 100°C)
Operating principle: High frequency (RF) capacitance
Operating frequency: 1 MHz
Initial capacitance zeroing capability: Range I: 10pF to 300 pF; Range II: 10pF to 2000pF
Sensitivity: Range I: 0.5pF; Range II: 3pF
Time delay: 0-25 seconds infinitely adjustable; field-selectable for ON, OFF, BOTH or NO DELAY
Deadband: Range I: 10-300pF; Range II: 50-2000pF
Temperature drift: 0.01pF/°C
Failsafe: Maximum or minimum, field-selectable
Probe: All Endress + Hauser capacitance probes

A COMPLETE MEASURING SYSTEM

A complete LSC 1135 Multi-Point Series system consists of 1) an LSC 1135 Series controller; 2) a 1MHz preamplifier (located within the probe enclosure); and 3) an E•H capacitance probe

WIRING



DEFINITIONS: Time Delay, Deadband, and Failsafe

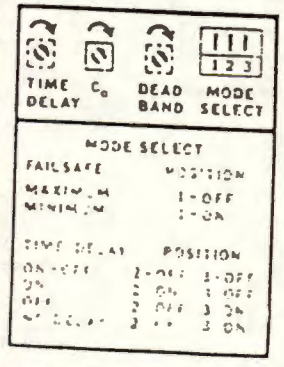
Time delay: Time delay is defined as the pre-selected time interval between detection of material presence (ON DELAY) or absence of material (OFF DELAY) and the changing state of the output relay. Time delay is used frequently to eliminate false indications caused by wave action or incoming material intermittently contacting the sensing probe.

Deadband: Deadband (or adjustable hysteresis) is defined as the adjustable differential of product levels at which the switching relay coil is energized and de-energized. A common deadband application is to turn a pump on (or off) at one material level and to maintain that state until another specific level of the material is reached.

Failsafe: In the maximum (high) failsafe mode, the relay coil is de-energized when sufficient material is present to cause a high level indication. In the minimum (low) failsafe mode, the relay coil is de-energized when the material level falls below the calibrated switchpoint of the probe, thus causing a low level indication. If there is a power failure, the system will indicate the alarm condition required under normal condition.

CALIBRATION

General: 1. Before calibrating, insure the LSC 1135 is connected to the End-A-Coat, 1MHz preamplifier and the power input as shown above. Figures 1-4 are the Mode Selection label which is located on the reverse side of the front panel. To obtain access to the label, remove the two mounting screws on the front panel.



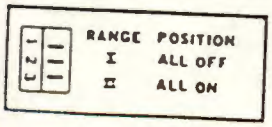


FIGURE 1

2. Place all range selection switches in the OFF position to insure the unit is in Range I. See Figure 1.

3. Place all channels in the maximum failsafe mode by putting "mode select" switch #1 in the OFF potition. See Figure 2.

4. **Note:** If at any time during calibration the "over-range" lamp illuminates, refer to procedures listed in the OVER-RANGE Section, Page 4.

5. **Note:** To minimize calibration time, first adjust the channel which will be used for the highest switchpoint

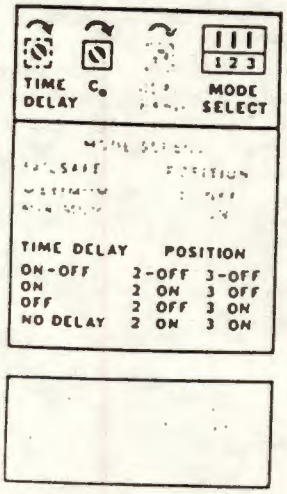


FIGURE 2

Initial Capacitance

1. Probe must be covered to the desired level for that particular channel
2. Turn "Time Delay" and "Co" adjustment controls to the extreme counterclockwise (CCW) position—at least 20 turns. The appropriate LED should be off.
3. Turn the "Co" control clockwise (CW) until the LED illuminates.
4. Slowly turn the "Co" control counterclockwise (CCW) until the LED goes off.
5. Repeat steps 3 and 4 until the switchpoint is achieved

Time Delay Mode Selection And Adjustment

1. Position "mode select" switches #2 and #3 to set the desired time delay functions (ON and OFF, ON only, OFF only, or NO time delay). See Figure 2.
2. The maximum time delay is 25 seconds. Turning the time delay control clockwise (CW) will lengthen the duration; counterclockwise (CCW) turning will decrease the duration.

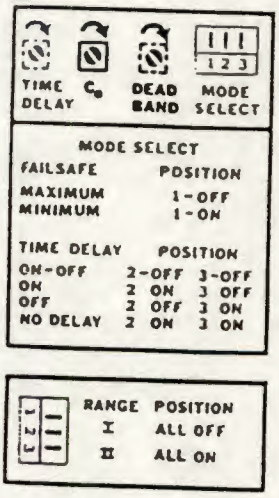


FIGURE 3

ADJUSTMENT OF DEADBAND ΔS CHANNELS (Complete the same procedure for each channel.)

Note: Unlike time delay channels which can be completely switched off, a deadband channel function cannot be eliminated. Deadband channel calibration MUST still be performed even if that channel is used for a non-deadband function.

Method 1: Vessel filled to maximum level

1. Turn the "Co" control to the extreme clockwise (CW) position (minimum 20 turns). Turn the "deadband" control to the extreme counterclockwise (CCW) position. The appropriate LED should be off.
2. Turn the "deadband" control clockwise (CW) until the LED illuminates.
3. Slowly turn the "deadband" control counterclockwise (CCW) until the LED goes off.
4. Steps 2 and 3 can be repeated until the desired switchpoint is achieved. (Stop here for non-deadband function.)
5. Turn the "Co" control to the extreme counterclockwise (CCW) position.
6. Drain the vessel to the desired minimum level.
7. Slowly turn the "Co" control clockwise (CW) until the LED illuminates. If the control is turned beyond the desired point, repeat the complete ΔS calibration method 1 or proceed with the optional calibration method 2.

Method 2: Vessel at minimum level.

1. Turn the "Co" and "deadband" controls to the extreme counterclockwise (CCW) position (minimum 20 turns). The appropriate LED should go out.
2. Turn the "deadband" control to the extreme clockwise (CW) position.
3. Slowly turn the "Co" control clockwise (CW) until the LED lights. If the control is turned beyond the desired switchpoint, return to steps 1 and 2.
4. Fill the vessel to the desired maximum level.
5. Slowly turn the "deadband" control counterclockwise (CCW) until the LED goes off. If the control is turned beyond the desired point, repeat the complete ΔS calibration using either method.

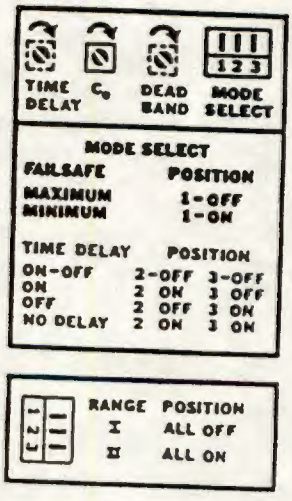


FIGURE 4

FAILSAFE MODE SELECTION

When switchpoint calibrations have been completed, select the failsafe mode. Set "mode select" #1 in the OFF position for the maximum failsafe mode; in the ON position for the minimum failsafe mode. See Figure 4.

OVER-RANGE COMPENSATION

1. If the over-range condition occurs during calibration, set the range selection dip switces for Range II. See Figure 1.
   (Over-range condition is indicated by illuminated LED on the front panel.)
2. Repeat calibration procedures for all channels.
3. If the over-range condition occurs while in Range II, consult the factory.

Endress + Hauser, Inc.
2350 Endress Place
P.O. Box 246, Greenwood, IN 46142
Phone: 317/535-7138
Telex: 27-2195 (Level Grwd)
Cable: LEVEL Greenwood
Call Toll Free: 800-428-4344
Telefax: 317/535-7223

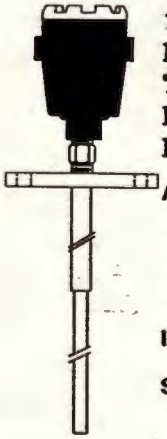
Standard Probe Configurations

1320
Rod Probe, Fully TFE Insulated*

Applications: Switch and transmitter compatible; liquids or solids; top or side mount
Initial Capacitance: Approx. 25 pF plus 1.6 pF/ft L1
Spanned Capacitance: Water — approx. 120 pF/ft
Temperature: 500°F at 0 psig
Pressure: 3,000 psig at 70°F
Vacuum rated

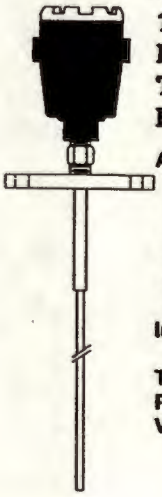
1321
Rod Probe, Fully TFE Insulated with Ground Tube*

Applications: To increase measuring capacitance in low dielectric materials or to linearize capacitance and level; normally used with transmitter; liquids only; top mount
Initial Capacitance: Approx. 25 pF plus 15 pF/ft L1
Spanned Capacitance: Water — 120 pF/ft; oil — 25 pF/ft
Temperature: 500°F at 0 psig
Pressure: 3,000 psig at 70°F
Vacuum rated



1328I
Rod Probe, Fully TFE Insulated with Inactive Section and Flange*

Applications: To minimize influence of heavy coating near tank top or wall; liquids or solids; top or side mount; switch and transmitter compatible
Initial Capacitance: Approx. 25 pF plus 1.6 pF/ft L1
Spanned Capacitance: Water — approx. 120 pF/ft along active section
Temperature: 500°F at 0 psig
Pressure: 3,000 psig at 70°F
Vacuum rated



1332
Rod Probe, Partially TFE Insulated with Flange*

Applications: Dry materials or other low dielectric materials; increased sensitivity; tip-sensitive switch; liquids or solids; top or side mount; switch and transmitter compatible
Initial Capacitance: Approx. 25 pF plus 1.6 pF/ft L1
Temperature: 500°F at 0 psig
Pressure: 3,000 psig at 70°F
Vacuum rated

1337D
Rod Probe, Partially TFE Insulated with Dead Section*

Applications: To completely shield probe from influence of coatings, where raised C_0 is tolerable; liquids or solids; switch or transmitter compatible
Initial Capacitance: Approx. 25 pF plus 1.6 pF/ft LAS plus 80 pF/ft LDS
Temperature: 500°F at 0 psig
Pressure: 3,000 psig at 70°F
Vacuum rated

1357
Rod Probe, Partially Ceramic Insulated with Dead Section*

Applications: High-temperature use; switch or transmitter in dry or non-conductive materials; switch only in conductive materials
Initial Capacitance: Approx. 25 pF plus 2 pF/ft LAS plus 90 pF/ft LDS
Temperature: 1,600°F at 0 psig
Pressure: 4,000 psig at 70°F; 3,000 psig at 900°F

2120
Cable Probe with Fully Insulated Weight*

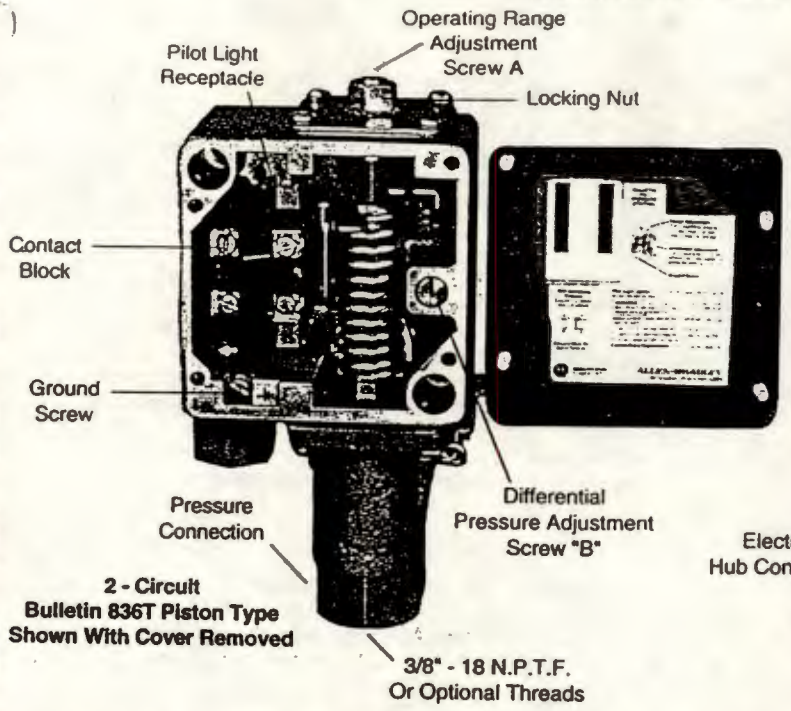
Applications: For insertion lengths of >12 ft.; where headroom for installation is limited; liquids only; top mount; switch and transmitter compatible
Initial Capacitance: Approx. 25 pF plus 2.2 pF/ft L1
Spanned Capacitance: Water — approx. 85 pF/ft
Temperature: 450°F at 0 psig
Pressure: 750 psig at 70°F

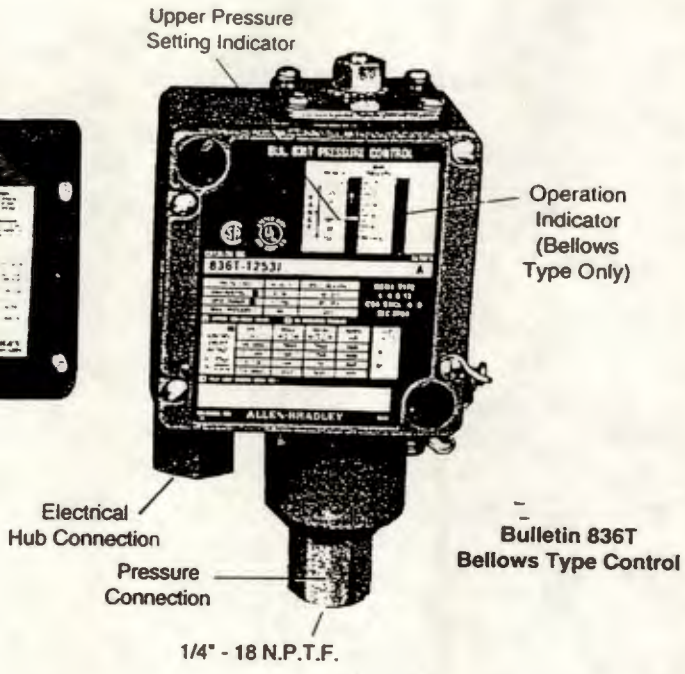
2800
Heavy-Duty Cable Probe with Fully Insulated Weight

Applications: For insertion lengths of >12 ft.; where headroom for installation is limited; solids only; top mount; switch and transmitter compatible
Initial Capacitance: Approx. 30 pF plus 10 pF/ft L1
Temperature: 200°F at 0 psig
Pressure: 150 psig at 70°F

*Compatible with Factory Mutual System **Approved** electronics

PRESSURE CONTROLS





DESCRIPTION - Bulletin 836T, NEMA Type 4,13 oiltight pressure controls are designed for use on machine tool applications where a stream of water may flow over the enclosure. Other applications would include areas where it is desirable to resist the entrance of lint, dust, and dirt into enclosure.

The operating range pressure and differential are adjustable. The operating range pressure is adjustable externally. The differential adjustment is internal and the front cover must be removed to change this setting.

A diaphragm type device is used for the vacuum control. Bellows type devices are available for pressures up to 650 psi.

CAUTION: Copper alloy bellows may be used on water or air, and other liquids or gases not corrosive to this alloy. Type 316 stainless steel bellows are available and are used for the more corrosive liquids and gases.

Piston type devices are available for pressures up to 5000 psi.

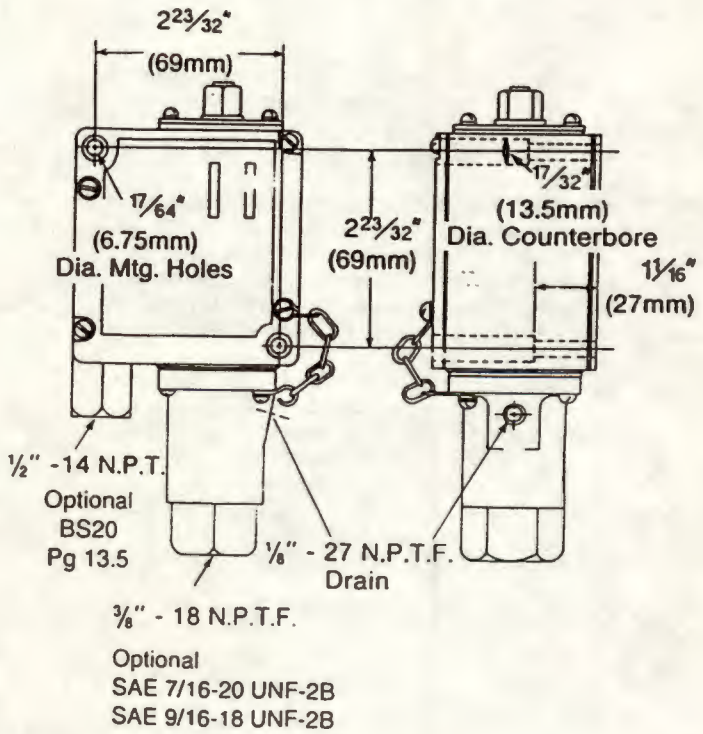
CAUTION: Piston type controls are designed for use on oil only and must not be used on air or gases, water or liquids that will rust cast iron.

The 2 - Circuit contact block has one set of normally open and one set of normally closed contacts. These contacts may be arranged for single pole double-throw operation or separate circuit operation having the same polarity.

A 4 - Circuit contact block assembly with two normally open and two normally closed contacts is also available. An isolated terminal is furnished to provide a termination point when an optional power source is used. These contacts may be arranged for double pole double-throw operation or two isolated single pole double-throw, electrically isolated circuits. Circuits must be of the same polarity.

MOUNTING - The pressure control should be mounted securely to a firm base using two mounting screws. The mounting holes (see sketch) are easily accessible without removing the front cover assembly.

CAUTION : The control should not be supported by only the electrical and pressure connections. A support wrench should be used when tightening the electrical hub and pressure connections.



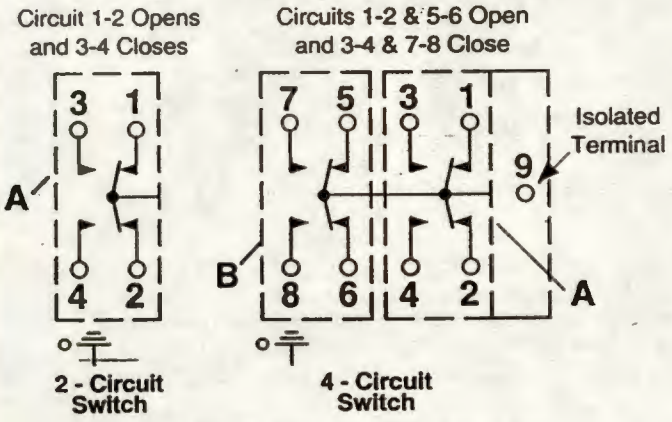
Piston Type Shown

OPERATION - A toggle mechanism operates the snap action switch at a predetermined pressure setting. For the 2 - Circuit snap switch the pressure causes the normally closed circuit 1-2 to open and normally open circuit 3-4 to close. This is known as the trip pressure. When the pressure returns to a lower predetermined setting, the circuit 1-2 will close and circuit 3-4 will open. This is known as the reset pressure. The difference between "trip" and "reset" pressure is the differential.
Similarly, for the 4 - Circuit snap switch, both normally closed circuits, 1-2 & 5-6 would open and both normally open circuits, 3-4 & 7-8 would close on increasing pressure. On decreasing pressure, the contacts would return to their original state at a predetermined setting.

Catalog number 836T-T250J is a vacuum control. At a higher vacuum setting (lower pressure toward 30" Hg) the 2 - Circuit switch contacts 1-2 will be closed and 3-4 open. At a lower vacuum (higher pressure toward 0 psi) circuit 1-2 will open and circuit 3-4 will close.

EXAMPLE: Vacuum control set to close contacts at 15" Hg vacuum, open at 5" Hg vacuum. For the 2 - Circuit switch, circuit 1-2 would be used. For the 4 - Circuit switch, circuits 1-2 or 5-6 would be used.

CONTACT BLOCK WIRING SYMBOL
(Increasing Pressure Operation)



A or B circuits must be the same polarity.

ADJUSTMENT - Generally, unless otherwise specified, controls shipped from the factory are set at the maximum operating range pressure and minimum differential.

The following procedure should be used to set the control to a particular requirement.

OPERATING RANGE ADJUSTMENT: Turn lock nut on adjustment screw "A" counterclockwise to loosen. Turn range adjustment screw "A" clockwise to raise upper and lower pressure settings. To decrease the upper and lower settings, turn screw "A" counterclockwise. The approximate upper pressure setting is shown by an indicator in the left window between the calibration scales on the nameplate. When the proper setting is reached, tighten the lock nut on screw "A" clockwise.

DIFFERENTIAL ADJUSTMENT: Remove the front cover. When the differential screw "B" is flush with the enclosure base, the control will function at minimum differential. To increase the differential, turn adjustment screw "B" clockwise. This will decrease the lower setting only. The higher setting will not change. Similarly, to decrease the differential turn the differential adjustment screw "B" counterclockwise. This will raise the lower setting only.

Condensed instructions can be found on the inside of the front cover.

NOTE: The use of a pressure gauge is desirable when setting the control.

CAUTION - The adjustment screw "A" should not be forced beyond the range of the control indicated on the calibrated scale. The adjustment screw "B" should never extend above the base of the enclosure nor be adjusted beyond the maximum specified differential of the control.

After the desired setting has been accomplished, mount the cover and tighten the four cover screws 6-8 in. lbs. thereby compressing the gasket seal.

Operating variables in a system may cause changing pressure requirements. It is recommended that a periodic inspection of the gauge pressure be made and the pressure control adjusted to compensate when necessary for these changes.

PISTON TYPE APPLICATIONS -

CAUTION: All pistons are provided with a 1/8 inch threaded drain opening which should be connected to an oil return line leading to an oil reservoir which is vented to atmosphere. This reservoir may be at a higher level of elevation than the control. The controls with seal rings usually do not require return lines. However, the 1/8 inch threaded drain opening should never be plugged on either type of piston control. This also includes the shipping plug which must be removed upon installation. Filters should be used to reduce contamination of hydraulic fluid.

PILOT LIGHT OPTION - A high intensity neon glow pilot light is available for 120 volt, 60 hertz applications and can be installed at the factory or in the field. To order pilot light kit specify catalog number of existing control and add N9 to this number. Optional pilot lights are available on special orders.

WARNING - To prevent electrical shock, disconnect from power source before installing or servicing.

The pilot light is wired to the contact block as follows:

A. **2 - Circuit**
Always connect lamp wires to same set of terminals used for the load. To light on increasing pressure connect across 1-2. To light on decreasing pressure connect across 3-4.

B. **4 - Circuit**
Consists of 2 electrically isolated single pole-double throw circuits. Connect lamp wires to same set of terminals used for load. To light on increasing pressure connect across 1-2 or 5-6. To light on decreasing pressure connect across 3-4 or 7-8.

(or)

An isolated terminal, 9, is provided as a termination point when an optional power source is used. This provides a convenient means for various circuit connections when separation of the load and pilot light is required. Circuits must be the same polarity for pilot light connections and switching of auxiliary equipment.

PAINTING - Standard controls are supplied with a removable paint mask on the nameplate. Remove the mask on final installation.

CONTACT BLOCK REPLACEMENT - To order Bulletin 836T Contact Block 2 - Circuit (SPDT-DB) Replacement Kit specify Catalog Number 836T-N1. For the 4 - Circuit (DPDT-DB) Contact Block Replacement Kit specify Catalog Number 836T-N2.

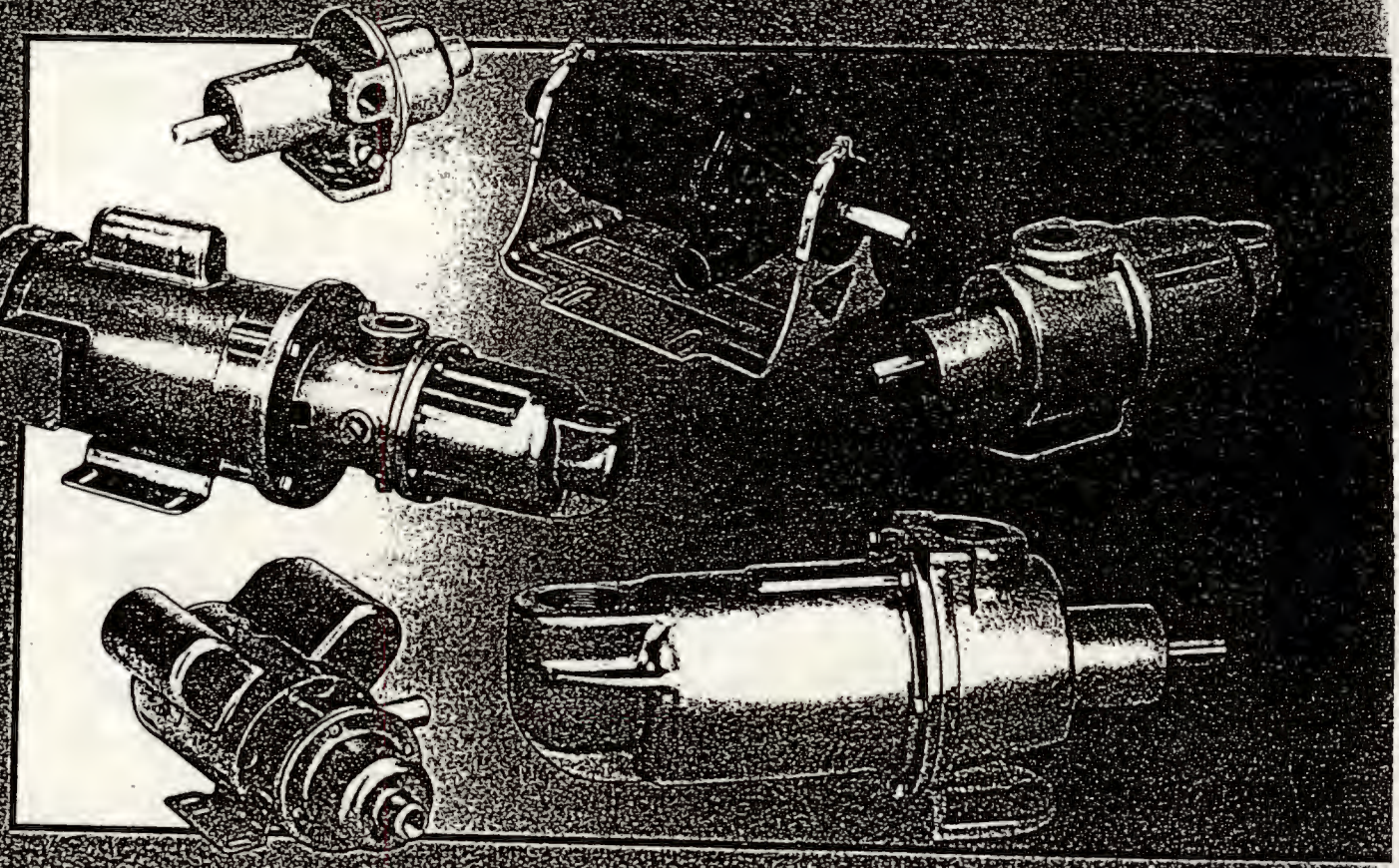
REPAIRS - Due to the integral construction of the Bulletin 836T Pressure Control, it is recommended it be returned to the factory for repairs (excluding contact block replacement). The control will be adjusted for optimum performance and tested to specifications.

40060-229-01(E)
PRINTED IN U.S.A.

ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

Moyno® SP Pumps

Utility + Plus In Commercial Applications



Bulletin 90

ROBBINS & MYERS

200 Series

Housing	Aluminum	316 SS	Aluminum	316 SS	Phenolic	316 SS
Rotor	Phenolic	316 SS	416 SS/CP	316 SS/CP	Phenolic	316 SS
Stator	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM
Motor Data	n/a	n/a	n/a	n/a	1/8 HP, 1 PH, 115 VAC, 50/60 HZ, 1725 RPM	
Weight	3	5	3	6	10	13

300 Series

[illegible]	Phenolic	Cast Iron	316 SS	Nylon	Cast Iron	Cast Iron	Cast Iron	Cast Iron	316 SS	Cast Iron	Cast Iron	Cast Iron
[illegible]	Phenolic	416 SS/CP	316 SS/CP	416 SS/CP	416 SS/CP	416 SS/CP	416 SS/CP	416 SS/CP	316 SS/CP	416 SS/CP	416 SS/CP	416 SS/CP
[illegible]	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM	NBR EPDM FPM
[illegible]	n/a	n/a	n/a	n/a	n/a	1/2 HP, 1 PH 115/230 VAC 60 Hz TEFC****	1/2 HP 3 PH 208/230/ 460 VAC 60 Hz TEFC***	n/a	n/a	n/a	1 HP 3 PH 208/230/ 460 VAC 60 Hz TEFC	2 HP, 3 PH 208/230/ 460 VAC 60 Hz TEFC
[illegible]	7	16	16	8	16	41	41	37 / 40	37 / 40	54	68	115

[illegible]

Stator materials:
NBR = Nitrile
EPDM = Ethylene Propylene Diene Monomer
[illegible]

[illegible]

Robbins & Myers, Inc.
Fluids Handling Group
P.O. Box 960
Springfield, Ohio [illegible] U.S.A.
Telephone [illegible]-327-3553
Telex [illegible] RMSPG UW
Facsimile [illegible] 327-3572

Robbins & Myers Canada, Ltd.
8032 Torbram Road
Brampton, Ontario, Canada L6T 3T2
Telephone 416-793-6800
Facsimile 416-793-9434

Robbins & Myers Limited
2 West Links
Tollgate
Chandler's Ford, [illegible]
England
Telephone [illegible]
Facsimile [illegible]

Robbins & Myers (FHG) Europe
Manufacturing Plant
Avenue du Parc [illegible]
Zoning Industriel de Paul Rechain
B-4650 Chaineux, Belgium
Telephone [illegible]
Telex [illegible]
Facsimile [illegible]

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Your Moyno Authorized Distributor is:

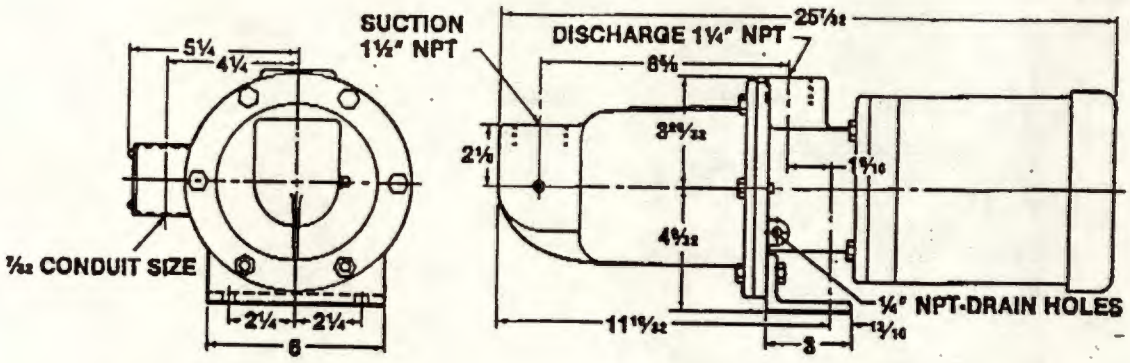
ROBBINS MYERS

NOTE: Information contained herein is subject to change without notice. Before making a final product selection, please contact a Robbins & Myers [illegible]

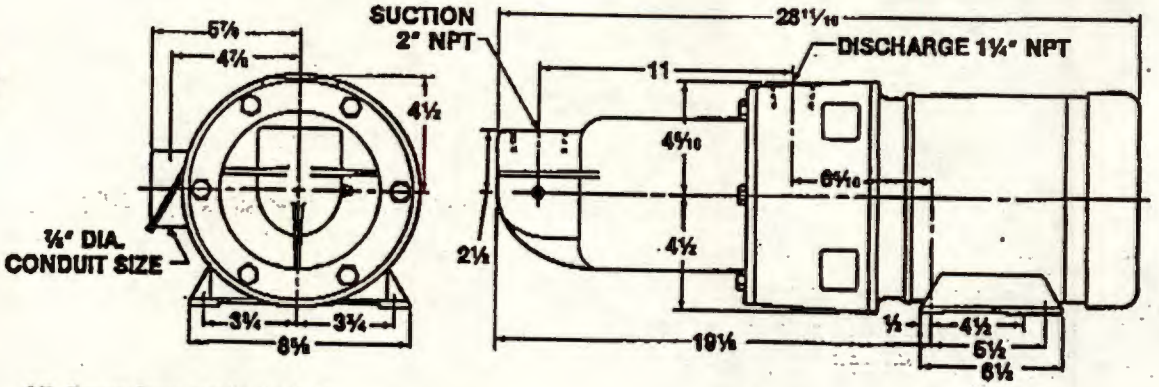
356 AND 367 MODELS

DIMENSIONS

Model 35651



Model 36751



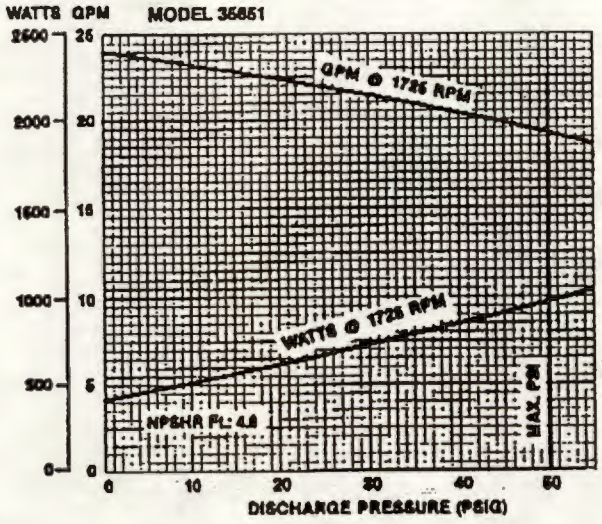
All dimensions are in inches.
Specifications subject to change without notice.

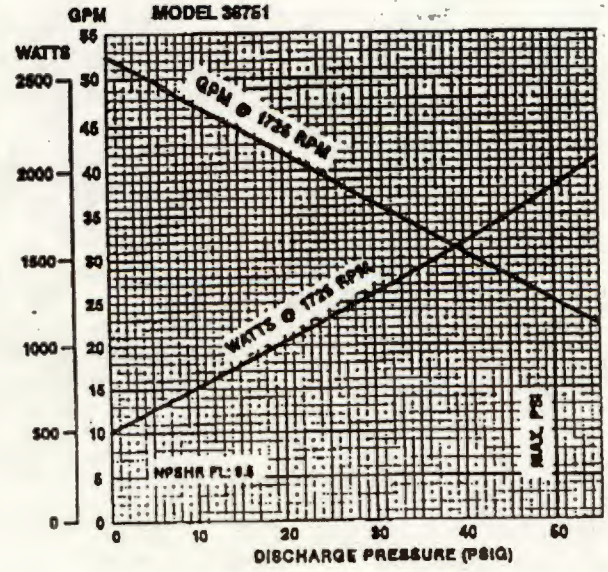
MATERIALS OF CONSTRUCTION

COMPONENT	MODELS	
	35651	36751
Housing Rotor Stator	Cast Iron 416 SS/CP NBR (Nitrile)	Cast Iron 416 SS/CP NBR (Nitrile)
Motor Data	1 HP, 3 PH 208/230/440 VAC 60 HZ TEFC	2 HP, 3 PH 230/440 VAC 60 HZ TEFC
Weight (lbs)	68	115

CP = Chrome plated

PERFORMANCE (Water at 70°F)





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

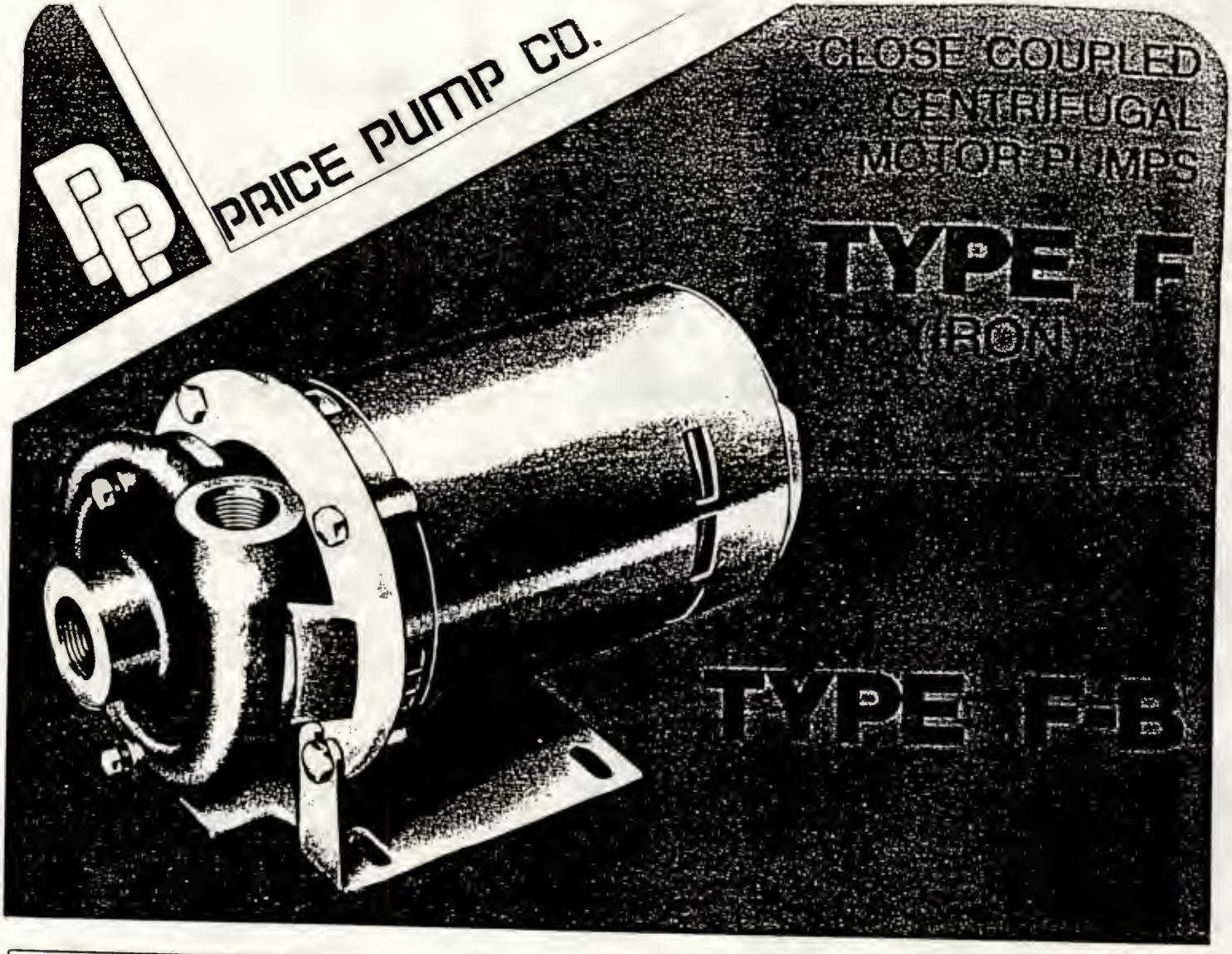
Springfield, Ohio 45501

2M PPI 1/92

PRICE PUMP CO.

CLOSE COUPLED CENTRIFUGAL MOTOR PUMPS

TYPE F (IRON)



APPLICATIONS ..... ■ Air conditioning, Washing Machines, Carpet Cleaners, bilge pumps, wash down, circulating pumps, coolant pumps, brine circulation.

FEATURES .....
- Cast Iron or Cast Bronze (85-5-5-5) volute, impeller and bracket.
- Impeller screwed to motor shaft.
- Stationary mechanical seat with rotating ceramic seat (6A).
- Standard 56J (threaded shaft) motors of popular make (sleeve-ball standard; ball-ball optional).
- Available as unassembled kit to volume purchasers.
- Close coupled with minimum overall length.
- Easily serviced without disturbing volute.

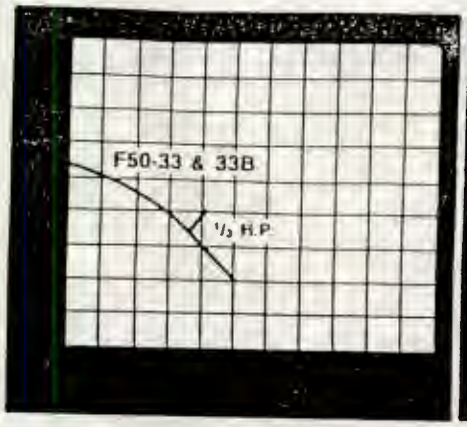
PERFORMANCE TABLE — 3450 RPM

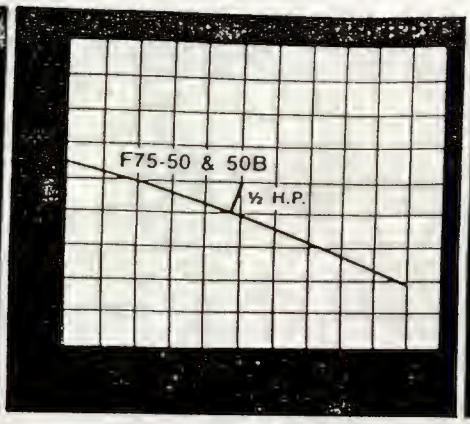
Maximum suction lift 20 feet.

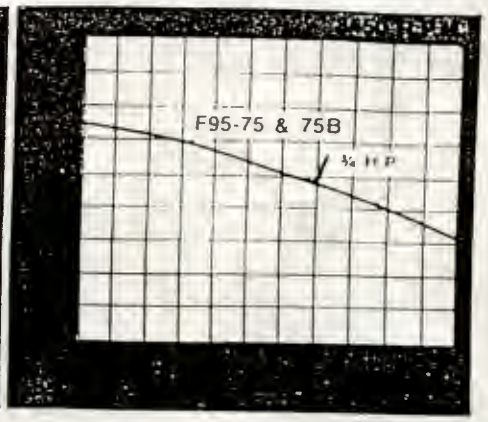
Model No.	H.P.	Suc.	Dis.	Heads	Gallons per minute at heads shown								
					20	25	30	35	40	45	50	60	Shutoff
F50-33 & 33B	⅓	¾"	½"		25	23	20	18	15	12	5	0	54
*F75-50 & 50B	½	1"	¾"		50	45	40	35	27	20	10	0	55
*F95-75 & 75B	¾	1¼"	1"				60	55	49	43	35	15	64

All ratings are based on water at 60°F. For other liquids, determine H.P. by multiplying water rated H.P. by specific gravity (e.g. — 1.5 S.G. X 1 BHP = 1.5 BHP). For PSI rating, multiply head in feet by .433 and multiply by specific gravity of liquid being pumped (e.g. — 30 TDH X .433 X 1.5 S.G. = 19.49 PSI). *Special Order Only.

PERFORMANCE CURVES



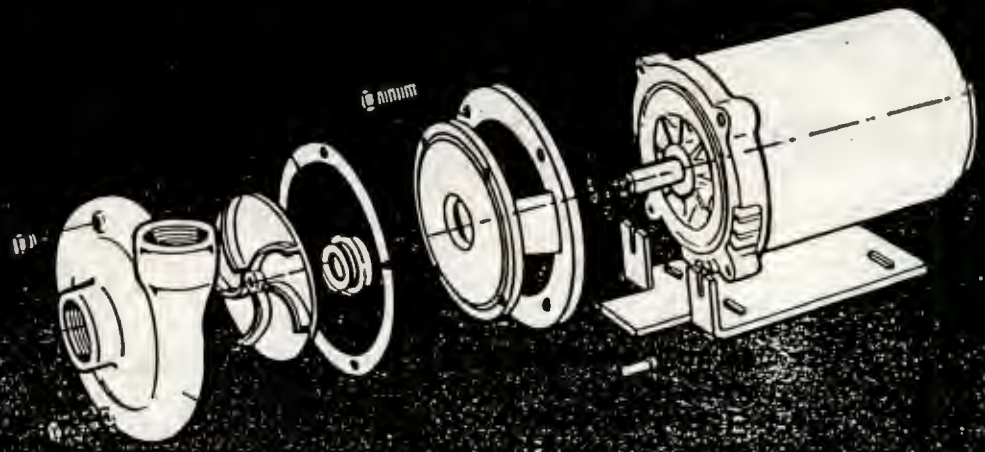




NOTE: Hash marks show HP required on 1.0 SG Liquid. Pumps with enclosed motors will be supplied with the next size motor.

Model No.	Y	C	D	L	X
F50-33 & 33B	1⅛"	3½"	4¼"	4⅜"	2⅝"
F75-50 & 50B	1⅜"	3¾"	4¼"	4⅜"	3¼"
F95-75 & 75B	1⅜"	3¾"	4¼"	4⅜"	3¼"

Note: Dimension AG, contact factory. Width will vary by motor make and model. Motor is major diameter.



PRICE PUMP CO.
19672 - 8th Street East
P.O. Box Q
Sonoma, California 95476
Tel: (707) 938-8441
FAX: (707) 938-0764

POWERS
PROCESS CONTROLS
A UNIT OF MARK CONTROLS CORPORATION

Installation Instructions
FORM 63B
February 1987

HOW TO INSTALL POWERS No. 11 REGULATORS

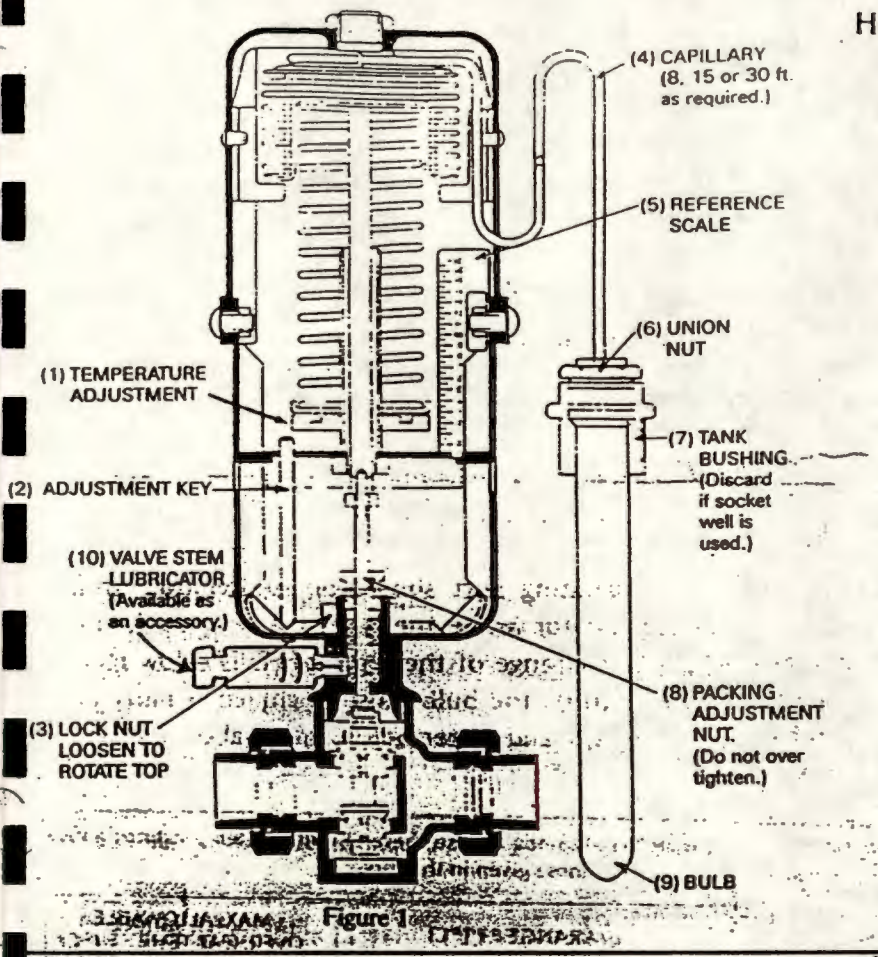


Figure 1

HOW IT WORKS

Bulb is placed in tank, vat, or pipe line where temperature is to be controlled. Control valve is placed in pipe line supplying heating or cooling medium. A temperature change at the bulb varies the pressure of the volatile fluid in the bulb. This pressure is transmitted through the capillary tubing to the diaphragm bellows, which operates the valve in a gradual manner and holds the process under control at a constant temperature. HEATING VALVES close with a temperature rise at the bulb. COOLING VALVES open with a temperature rise at the bulb. WATER MIX VALVES are used for mixing. A temperature rise at the bulb causes the valve disc to move toward the lower (hot) seat and toward the upper (cold) seat on a fall in temperature.

PIPING IN THE VALVE

Blow out and flush line thoroughly to get rid of all scale and dirt. Then set valve in line, noting carefully the inlet markings on valve body. For best results install valve in a horizontal line with bellows head above valve. Never install valve upside down.

THERMOSTATIC BULB (Item 9)

(NOTE: Bulb must be placed in position as stated on tag attached to capillary tubing.)

(1) Place thermostatic bulb in medium, the temperature of which is to be controlled.

(2) If regulator is to control temperature of a storage type hot water heater, place bulb in tapped opening in end of tank nearest hot water outlet not less than 6 inches (152mm) above top of steam oil, this tapped opening to be same size as thermostatic bulb bushing. Remove bushing from bulb and screw it into tank; then insert thermostatic bulb through bushing and make up union nut.

(3) If air temperatures are being controlled, locate bulb at point of greatest air movement.

(4) If regulator is of the Water Mix type, install thermostatic bulb in outlet line close to valve, using a reducing tee.

(5) When a cooling regulator controls the flow of a medium which also passes over the bulb, provision must be made by means of a by-pass around the valve to insure a small flow over the bulb at all times.

TEMPERATURE ADJUSTMENT

The temperature setting can be raised by increasing the tension of the adjustment spring and lowered by decreasing the tension. Use adjustment key to rotate the adjustment nut as necessary. Reference scale may be used to return setting to original point after temporary change.

POWERS
PROCESS CONTROLS
A UNIT OF MARK CONTROLS CORPORATION
3400 Oakton St., Skokie, IL 60076
Phone: (312) 673-6700 Telex: 72-4357
1200 Courtney Pk. Dr. E., Mississauga, Ontario L5T 1S2
Phone: (416) 673-0133 Telex: 06-983575

VALVE STEM LUBRICATOR (Item 10) (Available as an accessory only)

This feature is available as an accessory on all types of Powers No. 11 Regulators. The lubricant is SILICONE grease, suitable for valves handling steam, hot water, cold water, air, natural gas, gasoline, dilute and some concentrated acids, and alkalis, vegetable and mineral oils, and fuel oils. It can be used for applications where the temperature of the fluid in the valve is between the limits of minus 40°F to plus 450°F (4 to 232°C). It contributes to greater accuracy and minimizes packing gland service.

Order Part Number 590-184A.

CAUTIONS

Do not twist the capillary tubing or bend it unnecessarily. Do not disconnect tubing either from thermostatic bulb or valve top.

If regulator is of the combination type with dial thermometer, do not attempt to rotate thermometer head. Loosen yoke lock nut (3) which secures the upper works to valve body, and rotate upper works to desired position.

To prolong life of regulator and prevent temperature variations due to dirt or sediment lodging between plugs and seats, install a Powers self-cleaning strainer in steam supply line to valve.

If steam carries an excessive amount of entrained moisture, install a steam trap just ahead of regulator.

Tighten nut (8) on packing box of valve stem by hand only. Lubricate valve stem occasionally.

The operating part should not be removed from the regulator while the thermostatic bulb is hot. Where the range of the regulator falls below room temperature, the bulb must be chilled in a mixture of ice, salt and water before removal of operating head.

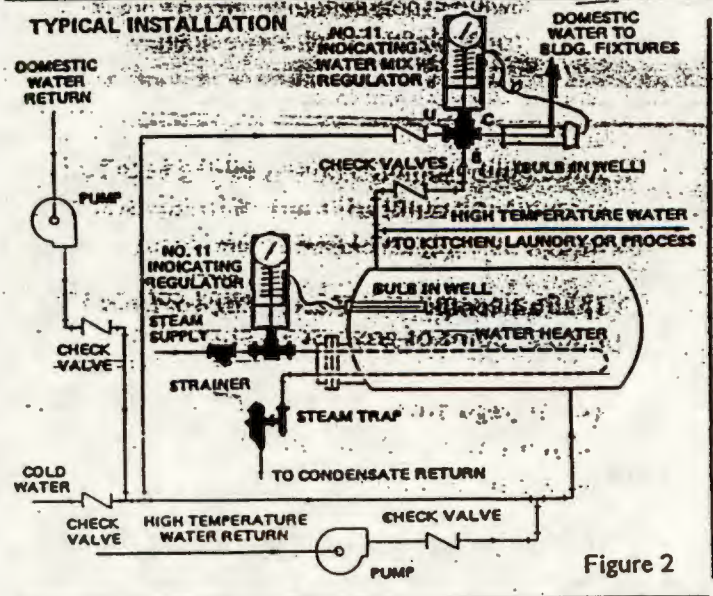


Figure 2

WARNING—Do not expose thermal bulbs to temperatures above those given in this table.

RANGE °F (°C)	MAX. ALLOWABLE OVERHEAT TEMP. °F (°C)
10-70 (12-21)	100 (38)
55-115 (13-46) 45-105 (7-41)	145 (63)
85-145 (29-63) 70-130 (21-54)	170 (77)
90-150 (32-66)	195 (91)
110-170 (43-77) 110-150 (43-66)	195 (91)
130-190 (54-88)	215 (102)
140-200 (60-93) 120-180 (49-82)	225 (107)
170-230 (77-110) 150-210 (66-99)	255 (124)
200-250 (93-121)	275 (135)
230-290 (110-143) 220-280 (104-138)	320 (160)
270-330 (132-166) 255-315 (124-157)	355 (179)

FAILURE TO OBSERVE THIS CAN RESULT IN DAMAGE

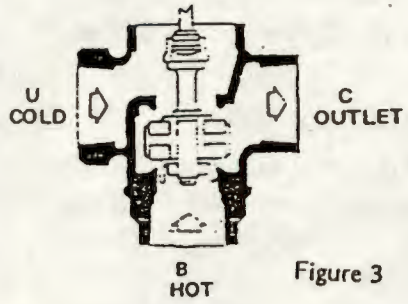


Figure 3

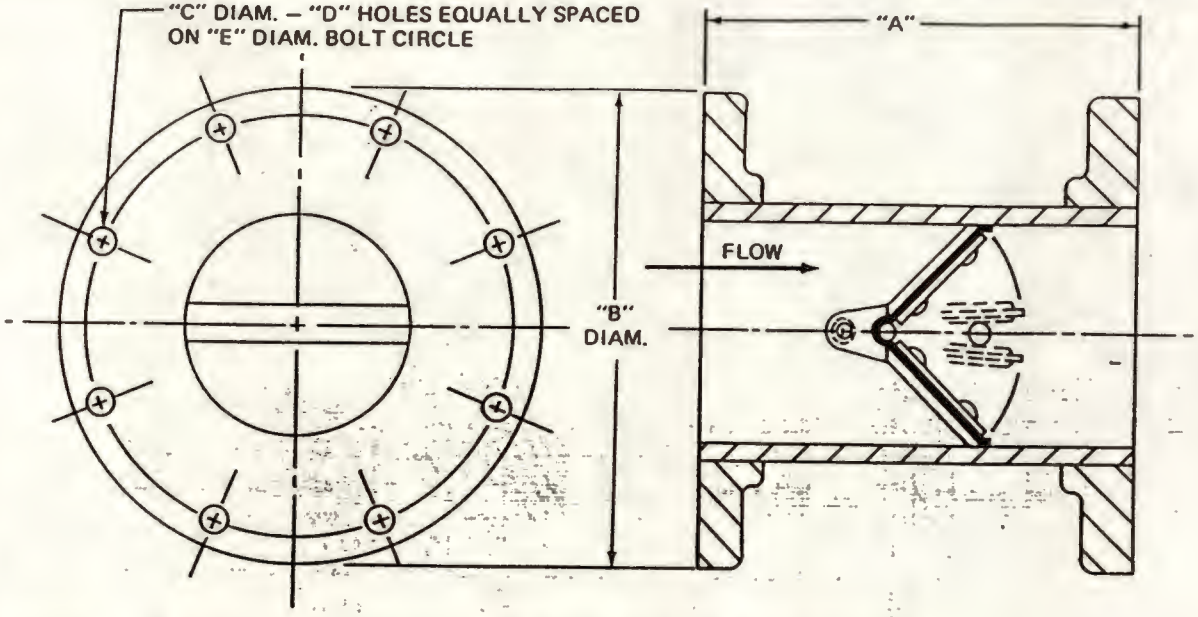
Piping Connections for Water Mix Valves

Pipe as shown in Figure 3. Connect hot line to bottom Port "B" and cold line to side upper Port "U." Side center Port "C" is the outlet for the mixed liquid. IMPORTANT: WATER MIX VALVES SHOULD BE INSTALLED WITH CIRCULATION RETURN OR RETURNS PIPED AS ILLUSTRATED ABOVE. FOR FURTHER INFORMATION, CONSULT NEAREST POWERS REPRESENTATIVE.

Printed in U.S.A.

TECHNOCHECK
FULL FLANGED
125# CLASS

STYLE 5102



GENERAL DIMENSIONS FOR STYLE 5102

VALVE SIZE	"A"	"B"	"C"	"D"	"E"	VALVE SIZE	"A"	"B"	"C"	"D"	"E"
3	5	7-1/2	3/4	4	6	14	15	21	1-1/8	12	18-3/4
4	5-1/2	9	3/4	8	7-1/2	16	17	23-1/2	1-1/8	16	21-1/4
5	6	10	7/8	8	8-1/2	18	19	25	1-1/4	16	22-3/4
6	7	11	7/8	8	9-1/2	20	21	27-1/2	1-1/4	20	25
8	9	13-1/2	7/8	8	11-3/4	24	25	32	1-3/8	20	29-1/2
10	11	16	1	12	14-1/4	30	31	38-3/4	1-3/8	28	36
12	13	19	1	12	17	36	37	46	1-5/8	32	42-3/4

ALL DIMENSIONS IN INCHES

STANDARD MATERIALS

STYLE	BODY	INTERNALS	ELASTOMER	PSI C.W.P.
5102	STEEL LIGHTWEIGHT	ALUMINUM	BUNA-N	150

OPTIONAL MATERIAL SELECTION

INTERNAL MATERIALS

- Aluminum
- Bronze
- 304 Stainless Steel
- 316 Stainless Steel
- Cadmium Plated Steel
- Electroless Nickel Plated Steel or Aluminum
- Monel*
- Titanium*
- Hastelloy*

*Non stock item – Available upon request.

SPRING MATERIALS

- 304 Stainless Steel
- 316 Stainless Steel

Monel and Inconel springs available upon request.

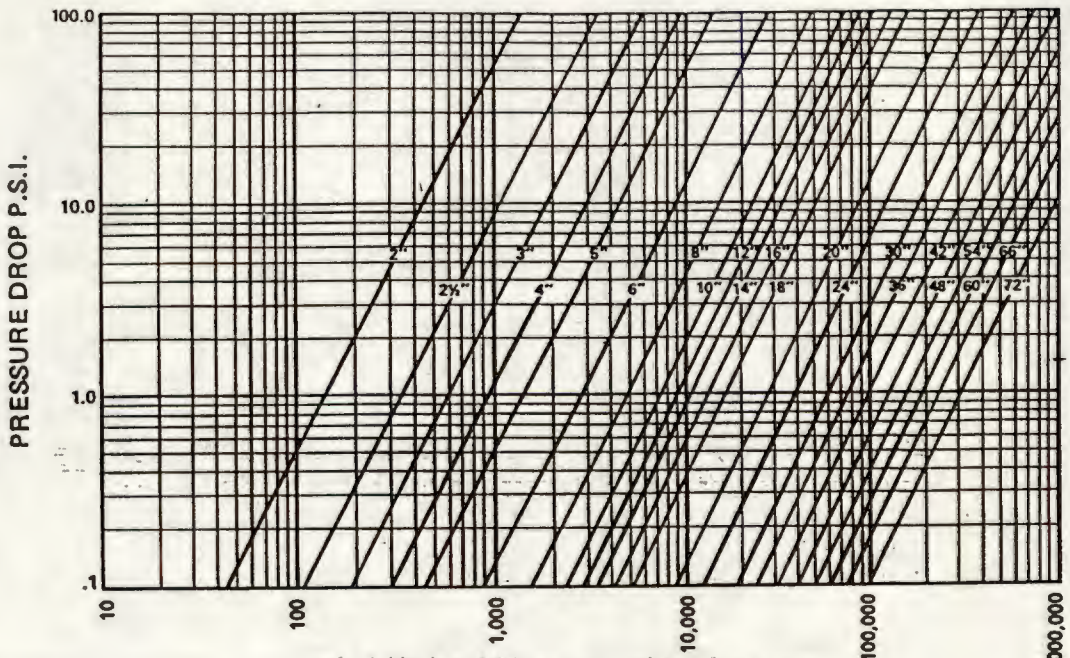
SEALING MEMBER MATERIALS

MATERIAL	*TEMPERATURE RANGE
• Buna-N	–60 to 225° F
• Neoprene	–40 to 225° F
• Butyl	–65 to 300° F
• Hypalon	–20 to 300° F
• EPDM	–40 to 300° F
• Viton	–20 to 400° F
• Teflon	–20 to 450° F
• Silicone	–100 to 500° F
• FDA Approved White Neoprene	–40 to 225° F

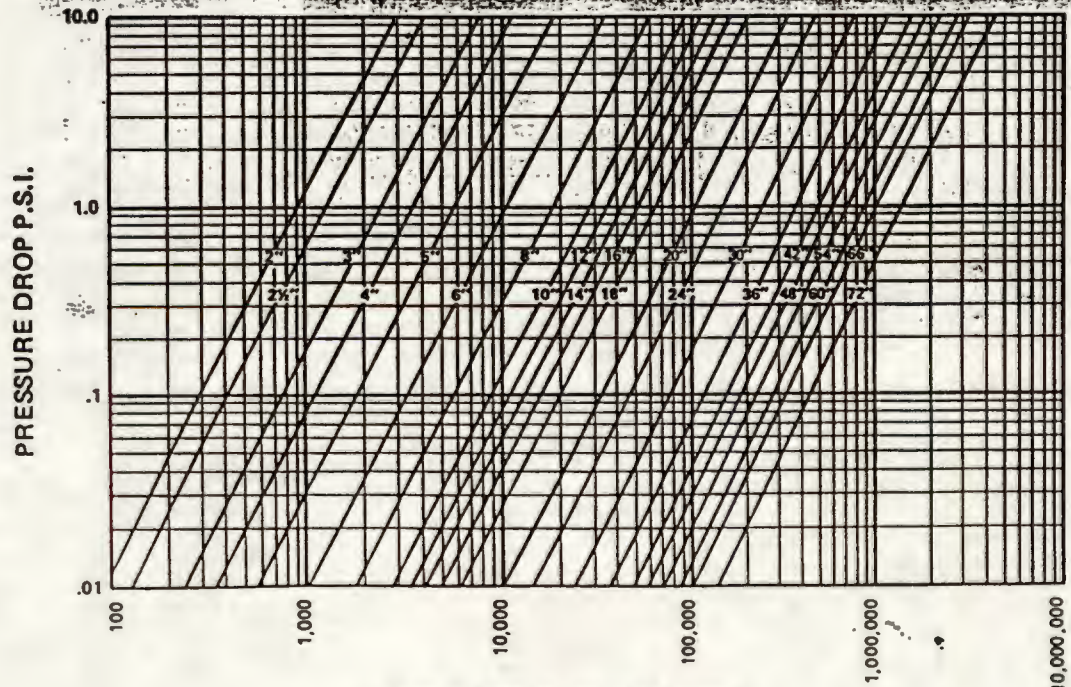
*This temperature range is for general guidance. The figures may vary with application.

CONSULT FACTORY FOR MATERIALS, SIZES AND PRESSURE RATINGS NOT SHOWN.

PRESSURE DROP CHARTS
FOR WATER AND AIR SERVICE



FLOW OF WATER @ 70° IN G.P.M.



AIR FLOW @ 70° IN S.C.F.M.

TECHNO CORPORATION
2709 WEST 10th ST.
P.O. BOX 1416
ERIE, PA. 16512
PHONE: 814 838-4561
TWX: TECHNO ERIE 510 696 6616

BRONZE

"Y" type, screwed end connections

27 Series 1/8" thru 1/2"

777 Series 1/2" thru 4"

27, 777 Series

For liquid or steam service, bronze body construction

No. 777

No. 27

777 Series For Water Service

This "Y" type strainer series has 20 mesh stainless steel screen*, (except 3" supplied with 3/64" perf. screen and 4" with 1/8" perf. screen)†, cast bronze body, solid retainer cap with straight thread and gasket. WWP 250 PSI at 210°F.

777S Series For Steam & Water Service

Same as the 777 Series except furnished with a standard industry tapped retainer cap for a closure plug (closure plug not supplied). S.W.P. 125 lbs. at 400°F.

*OPTIONAL: #40 MESH - #60, #80, #100 wire mesh liners. Wire mesh liners are inserted inside a standard screen.
†OPTIONAL: 1/16" or 1/8" perf. on 2½" and 3" size only. For other screens consult factory.

No.	Size	Dimensions A	Dimensions B	777S Only Tapping Retainer Cap	Weight (lbs)
777 or 777S	½"	3 13/32"	3¾"	⅜" NPT	1½
777 or 777S	¾"	3¾"	3¼"	½" NPT	1⅝
777 or 777S	1"	4 9/16"	3⅞"	¾" NPT	2½
777 or 777S	1¼"	4¾"	4 1/16"	¾" NPT	2¾
777 or 777S	1½"	5 11/16"	4⅝"	1" NPT	4
777 or 777S	2"	6 11/16"	5⅝"	1¼" NPT	7⅞
777 or 777S	2½"	8.16	6.58	1¼" NPT	12¼
777 or 777S	3"	10.16	8.28	1½" NPT	24
777 or 777S	4"	13.00	10.58	1½" NPT	41

27 Series Compact Strainers

These "Y" type strainers are popularly used on Beverage Dispensers, Ice Cube Machines, Dental Equipment, Instrument Control Systems. Cast bronze body, brass retainer cap, gasket. Up to 300 lbs. pressure.

PERFORMANCE DATA

Chart shows flow through strainer in gallons per minute based on pressure drop across strainer.

	PRESSURE DROP ACROSS VALVE				
	2 lbs.	4 lbs.	6 lbs.	8 lbs.	10 lbs.
⅛"	1.5	2.5	3	3.5	4
¼"	3	3.5	4.5	5	6
⅜"	5	7	8	10	11
½"	10	12	14	15	16

No.	Size	Dimensions A	Dimensions B	Weight	Std. Screen Mesh	Optional Mesh Sizes
27	⅛"	1¾"	1 7/16"	⅜ lb.	40	20, 30, 40, 60 80, 100
27	¼"	2 1/16"	1 11/16"	¾ lb.	30	
27	⅜"	2½"	2 3/16"	¾ lb.	24	
27	½"	2¾"	2⅝"	1 lb.	24	

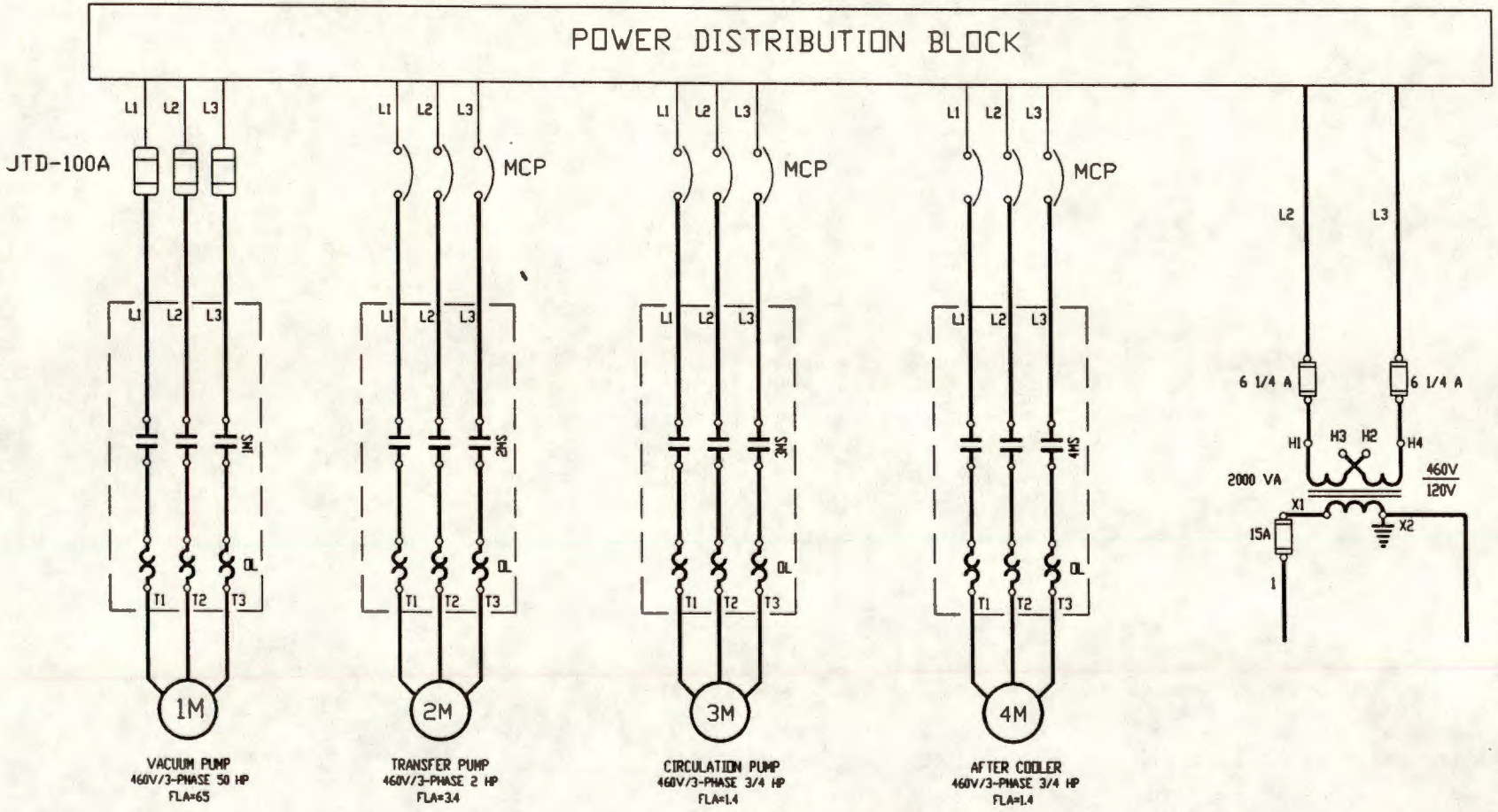
For other screens consult factory.

PERFORMANCE

Table shows pressure drop (PSID) through 777 Series strainers at various flow rates using standardly furnished 20 mesh screens.

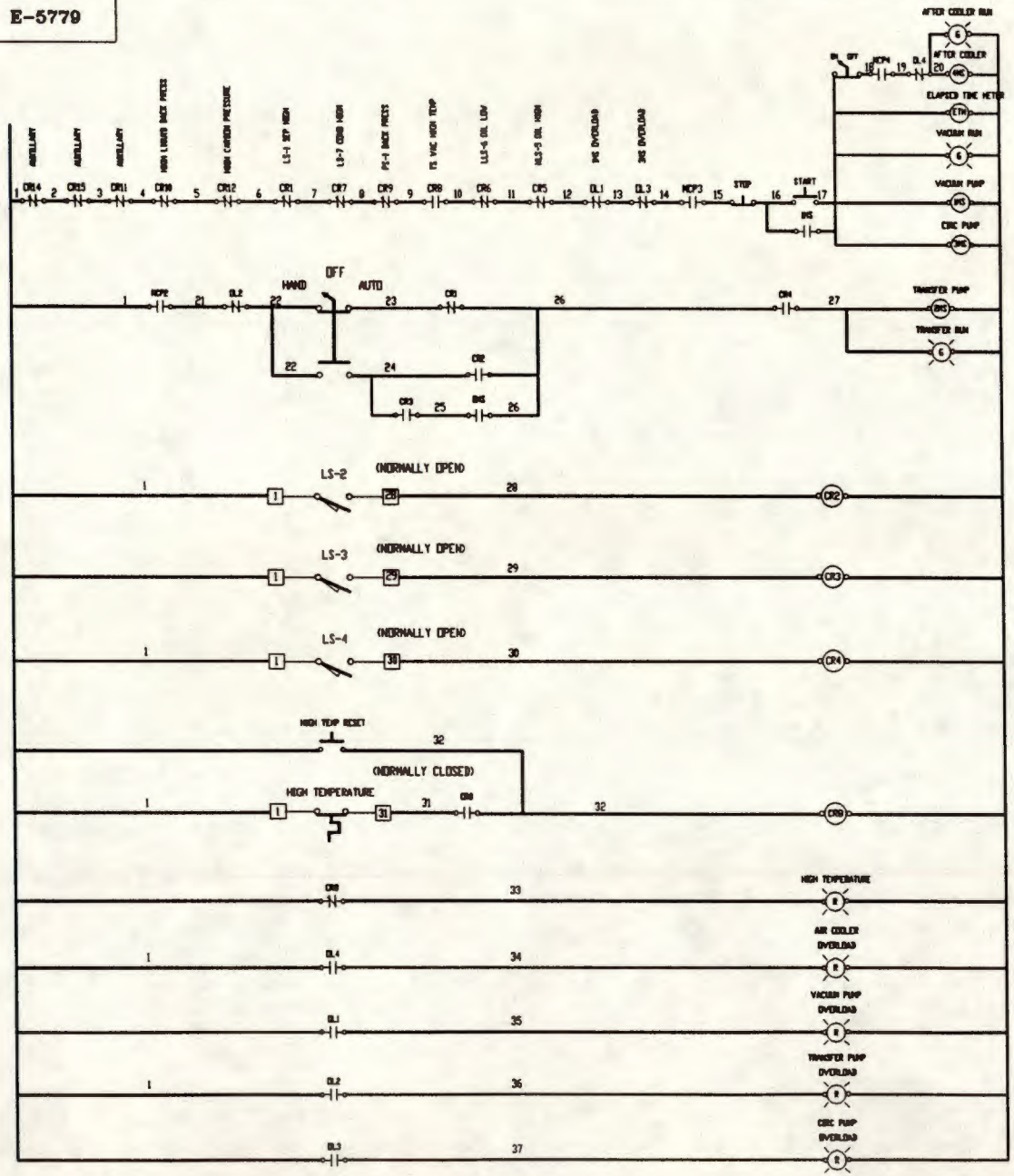
FLOW GPM	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"
10	1.4	.4	.1	.1	.1	.1	.1	.1	.1
20	5.5	2.1	.4	.3	.2	.1	.1	.1	.1
30	13.3	4.3	1.3	.5	.3	.1	.1	.1	.1
40		7.5	2.3	1.0	.5	.2	.1	.1	.1
50		10.0	3.5	1.7	.9	.3	.2	.15	.1
60		12.0	4.0	2.5	1.5	.5	.25	.2	.1
70			4.6	3.2	2.0	.7	.3	.25	.1
80			8.0	4.4	2.5	1.0	.4	.3	.1
90			12.0	5.7	3.5	1.5	.45	.4	.1
100				7.7	4.1	2.0	.5	.45	.13
120				10.0	6.0	2.5	.6	.5	.15
140				13.0	8.0	3.4	.9	.6	.18
160					10.0	4.5	.95	.7	.25
180					12.0	5.0	1.0	.8	.35
200					14.0	6.5	1.2	.95	.5
225						8.0	1.5	1.1	.6
250						9.5	1.8	1.3	.7
300						11.0	2.5	1.6	1
400							4.3	3.0	1.7
500							6.1	4.0	2.7
600							8.5	5.5	4.0

E-5780



REV	DATE	POWER WIRING
THIS PRINT IS THE PROPERTY OF INTERVAC CORPORATION AND MAY NOT BE COPIED OR GIVEN TO ANY OTHER CONCERN WITHOUT THE CONSENT OF INTERVAC CORPORATION		INTERVAC CORPORATION VICTOR, NEW YORK 14564
		VACUUM SOIL EXTRACTION
DO NOT SCALE	SCALE:	DATE: 1/19/94 DRAWN BY: D.BODZIEN
	SYSTEM #2759	E-5780

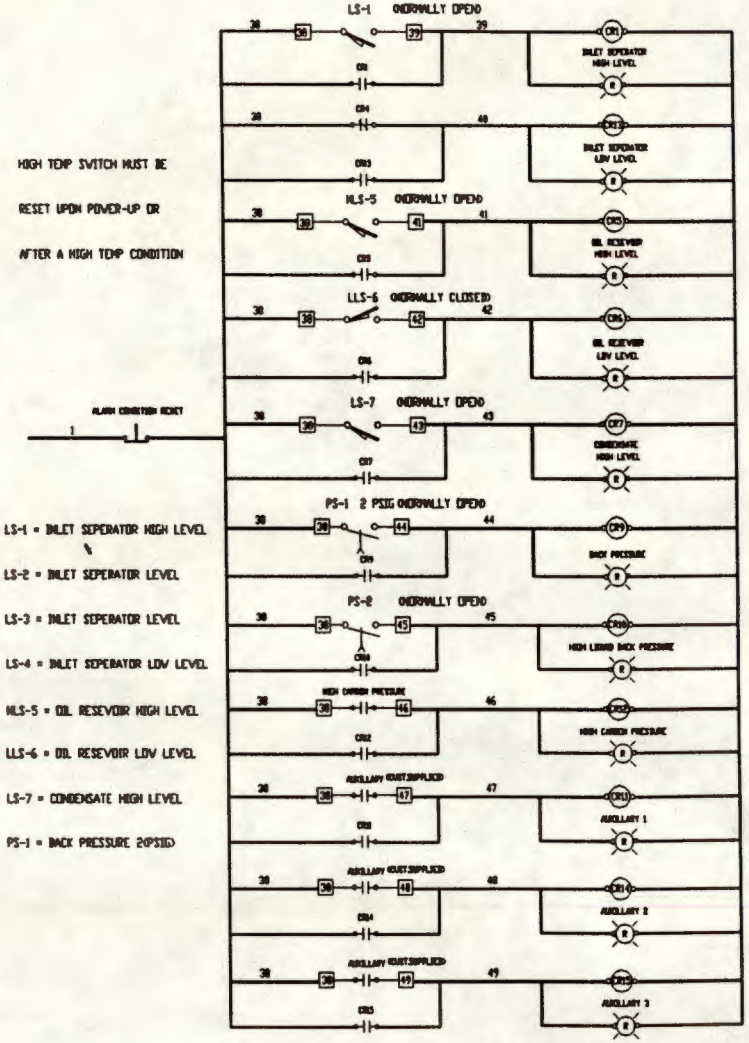
E-5779



HIGH TEMP SWITCH MUST BE

RESET UPON POWER-UP OR

AFTER A HIGH TEMP CONDITION



LS-1 = INLET SEPERATOR HIGH LEVEL

LS-2 = INLET SEPERATOR LEVEL

LS-3 = INLET SEPERATOR LEVEL

LS-4 = INLET SEPERATOR LOW LEVEL

NLS-5 = OIL RESEVOIR HIGH LEVEL

LLS-6 = OIL RESEVOIR LOW LEVEL

LS-7 = CONDENSATE HIGH LEVEL

PS-1 = BACK PRESSURE 2(PSID)

REV	DATE	ELECTRICAL SCHEMATIC
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		VACUUM SOIL EXTRACTION
DO NOT SCALE	SCALE:	DATE: 1/19/94 DRAWN BY: B. BOBZIEN
	SYSTEM #2759	E-5779

IV 0772

INTERVAC CORPORATION
FARMINGTON, N.Y.

DATE: 5/10/94 WARRANTY: ____ / ✓ FOLLOW-UP REQ'D: ____ / ____
YES / NO YES / NO

SYSTEM M/N: KO/CSO-500/2-1 CUSTOMER: Dallinger Corporation

SYSTEM S/N: 93112759 LOCATION: 2 Tower Lind E Circle
Rochester Way 14618

PUMP M/N: TRH-80-750/F

PUMP S/N: H-0511 CONTACT: Mark Ramsdell of HHA. Bob Beyer TEL: ____

PROBLEMS: Start up Vacuum System
Align motor Coupling Check operation of system

DATE OF START-UP: 5-10-94 OPERATING HOURS: 00134 ~~3267~~

MOTOR HP: 50 RPM: 1760 VOLTS: 480 FRAME: 326T

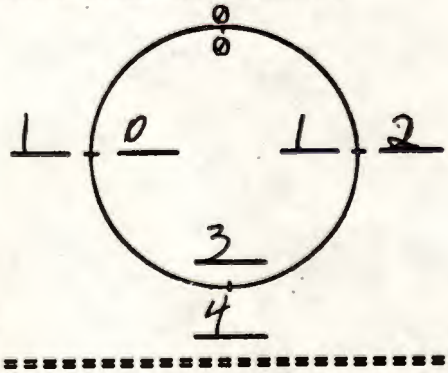
46 AMPS @ 26 IN. HG DRIVE TYPE: DD with dampers open 145 COOLING: ✓ AIR 170 ____ WATER

SEAL FLUID: ____ GPM TEMPERATURES(F): 170 SEAL FLUID 190 DISCHARGE 68 AMBIENT

FINDINGS: Start up Ductwork may be to small - Damper Malfunction
runs at 170 With dampers open, room at 190 ambient

PARTS REQUIRED:

PART #	DESCRIPTION	QTY
	DIAL INDICATOR COUPLING ALIGNMENT	1



I HAVE READ THE ABOVE REPORT AND ACCEPT THE FINDINGS.

SIGNED: M M Ramsdell (HHA)
CUSTOMER
5/10/94

IT'S 0775

INTERVAC CORPORATION
FARMINGTON, N.Y.

DATE: 5/23/54 WARRANTY: ____ YES / ✓ NO FOLLOW-UP REQ'D: ____ YES / ✓ NO

SYSTEM M/N: CS 0-500/2-14 CUSTOMER: Dollinger Corperation

SYSTEM S/N: 93112759 LOCATION: 1 Town Line Circle

PUMP M/N: TRH-80-750/F Rochester N.Y. 14618

PUMP S/N: H-0511 CONTACT: _____ TEL: _____

PROBLEMS: Re install Fan to Heat exchange
Check and & repair oil leaks.

==========

DATE OF START-UP: _____ OPERATING HOURS: 00157

MOTOR HP: 50 RPM: 1760 VOLTS: 480 FRAME: 324T

____ AMPS @ ____ IN. HG DRIVE TYPE: DD COOLING: ✓ AIR ____ WATER

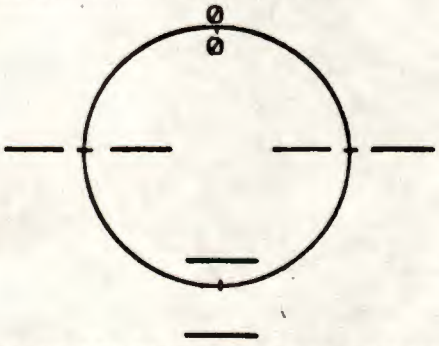
SEAL FLUID: ____ GPM TEMPERATURES (F): 165 SEAL FLUID 180 DISCHARGE 70 AMBIENT

==========

FINDINGS: Install New Fan add 3/8 Safty Bolt so Fan can
Not be sucked off Shaft By Exturtel Fan

PARTS REQUIRED:	PART #	DESCRIPTION	QTY
		Shaft Ex	1
		Fan	1

DIAL INDICATOR
COUPLING ALIGNMENT



==========

I HAVE READ THE ABOVE REPORT AND ACCEPT THE FINDINGS.

Mark Needs # For New oil Filter SIGNED: Mark Ramsdell (H&A)
CUSTOMER

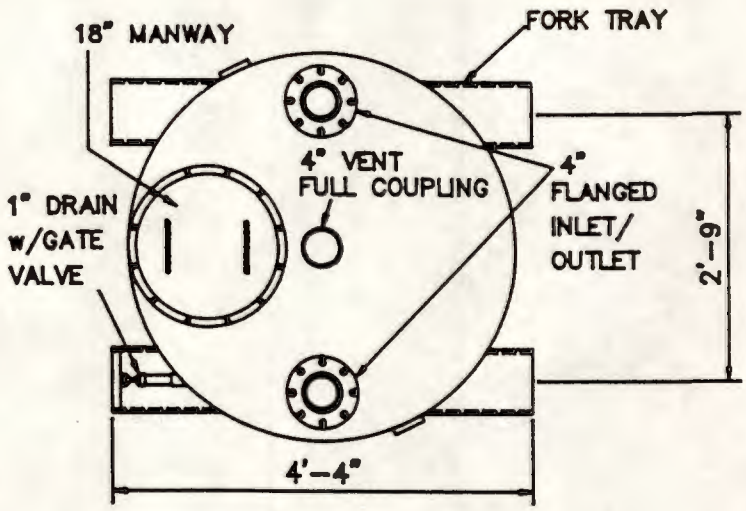
On Job From 8.15 to 1.45

VP-2000

Vapor Phase Adsorber

SPECIFICATIONS:

Carbon Fill (lbs.)	1800-2000
Flow Rate (CFM, Max.)	1000
Temperature (°F)	120
Pressure (PSIG, Max.)	15
Tare Weight (lbs.)	1350



***MATERIALS OF CONSTRUCTION:**

Vessel: Mild Carbon Steel

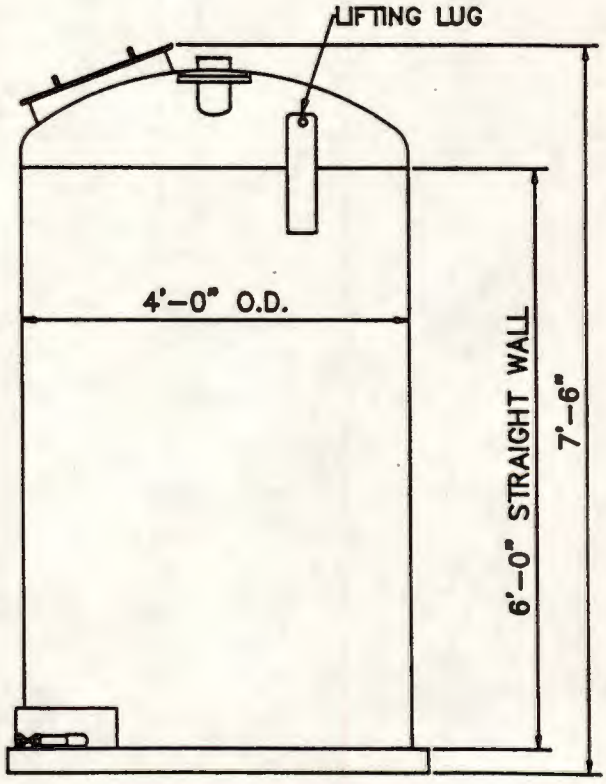
Couplings: 316 Stainless Steel

Interior Lining: Epoxy Paint

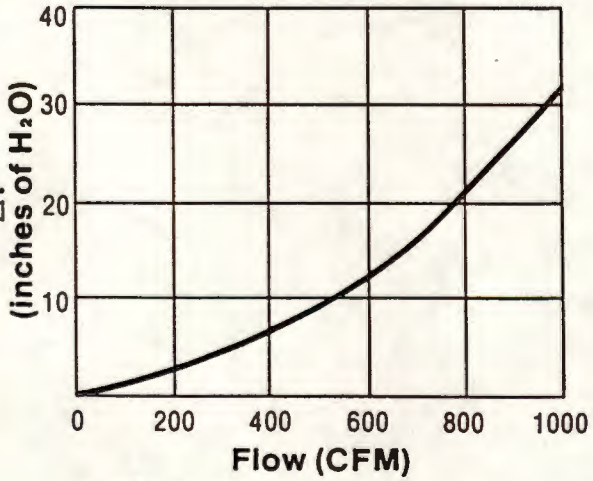
Exterior Lining: Industrial Enamel

Internal Piping: Schedule 40 PVC

*All materials can be changed to meet your requirements.



PRESSURE DROP

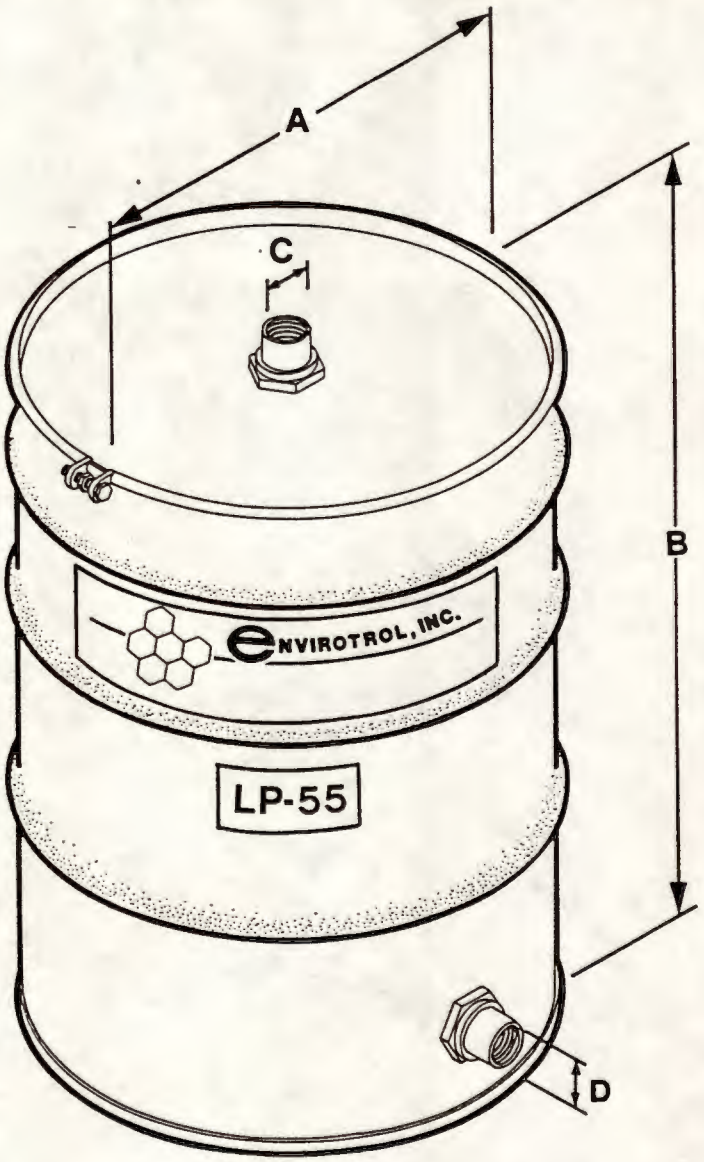


ENVIROTROL, INC.

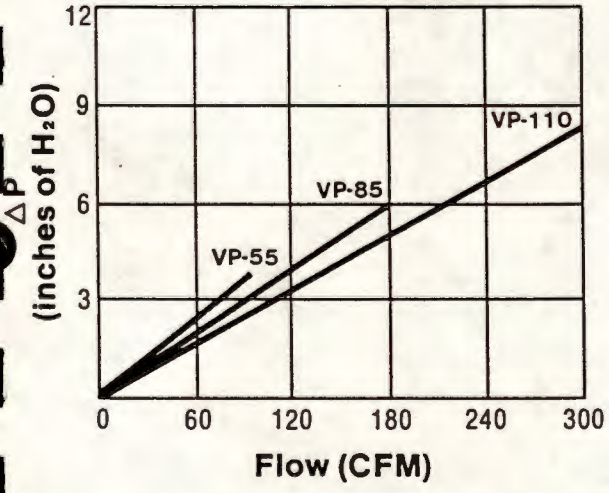
432 Green Street, P.O. Box 61 • Sewickley, Pennsylvania 15143-0061
(412) 741-2030 • FAX 412-741-2670

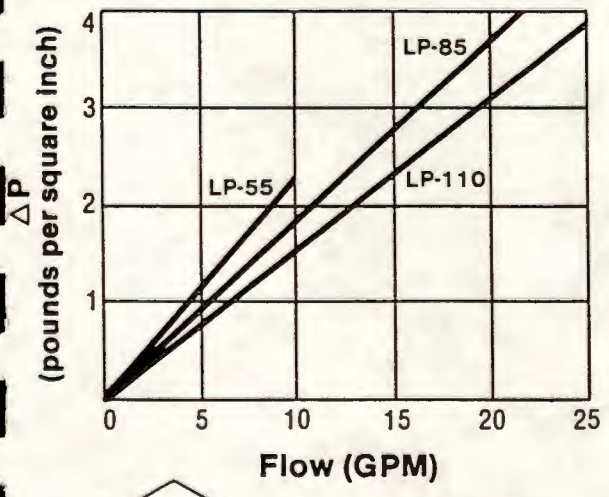
DRUM ADSORBERS

Envirotrol's drum adsorbers are designed to remove contaminants from air and water at low flow rates and at an economical price. These units are engineered to be easily recycled. Envirotrol provides a complete turn-key service to handle the reactivation and recycling of drum adsorbers. Drum adsorbers can be purchased with a top-top or top-side inlet/outlet configuration to suit your piping requirements. Please contact your sales engineer concerning delivery, pricing, and return.



PRESSURE DROP





DIMENSIONS:

Adsorber	(Inches) A	B	C	D	Carbon Fill (lbs.)
LP-55	24	34	1	1	180
VP-55	24	34	2	2	180
LP-85	26	37	1	1	300
VP-85	26	37	3	3	300
LP-110	32	43	1	1	400
VP-110	32	43	3	3	400

ENVIROTROL, INC.

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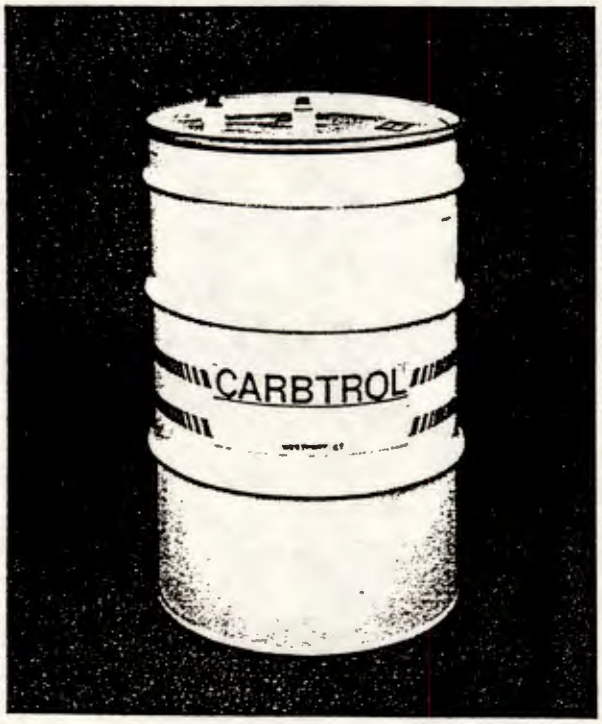
CARBTROL®

WATER PURIFICATION CANISTER 200 POUND ACTIVATED CARBON

L-1

1545



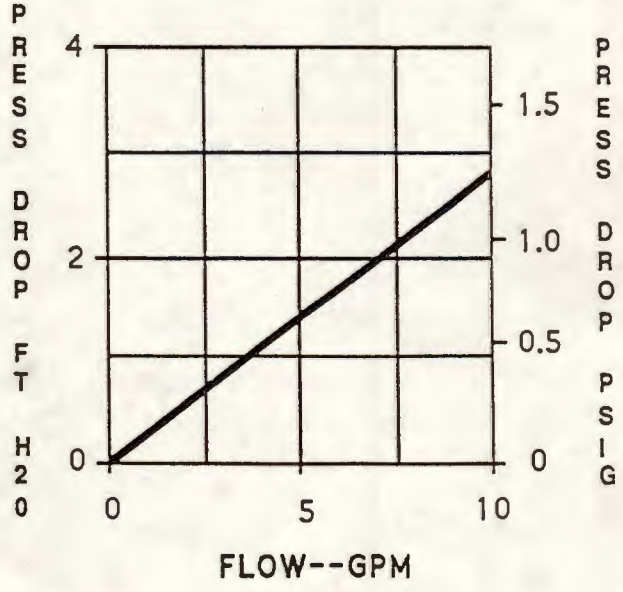
The CARBTROL L-1 (liquid) Canister handles up to 10 gpm.

FEATURES

- 200 pounds of high activity carbon.
- Large 1 1/4" internal piping.Low pressure drop allows operation of three canisters in series.
- Standard FPT couplings for easy installation - saves time and money.
- Special "no leak" lid gasket.
- Heavy duty steel drums, DOT 17C, suitable for shipment of spent hazardous carbon.
- Piping design eliminates channeling.

SPECIFICATIONS

DRUM	24" Ø x 34" high, mild steel, epoxy phenolic internal coating, with polyethylene liner.
CARBON	200 lbs.
SHIPPING WEIGHT	250 lbs.
INLET	1 1/4" FPT, steel
OUTLET	1 1/4" FPT, steel
INTERNAL PIPING	1 1/4" PVC
DRAIN	3/4" bung
PRESSURE DROP	1.25 psi @ 10 gpm
MAX. OPERATING PRESSURE	10 psi



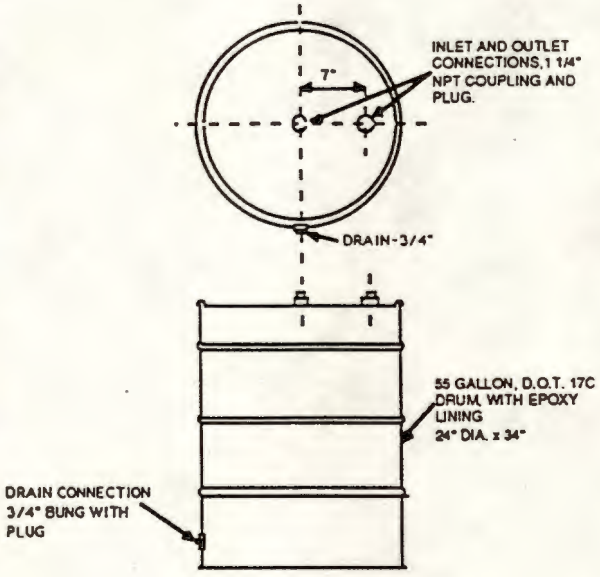
CARBTROL® CORPORATION
39 Riverside Avenue, Westport, CT 06880 • 1-800-242-1150 • (203) 226-5642

 AT-100/#2

CARBTROL®

WATER PURIFICATION CANISTER
200 POUND ACTIVATED CARBON

L-1



OPTIONS

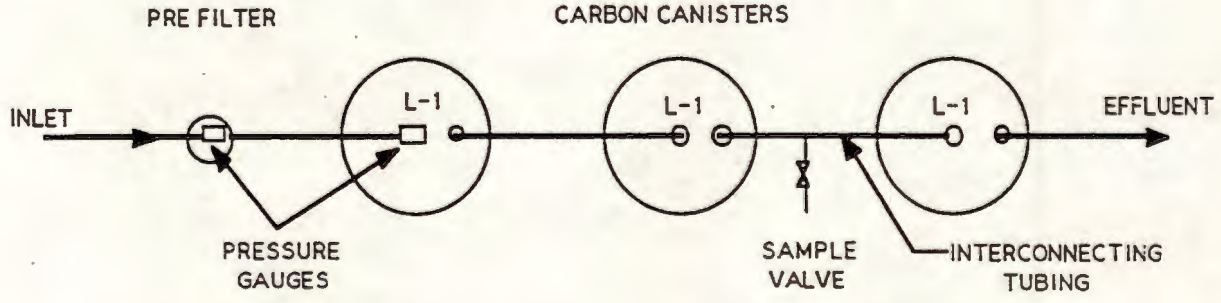
Interconnecting Piping Kit

Flexible 1 1/4" diameter PVC tubing with hose clamps. Includes inlet pressure gauge and intermediate sample valve.

Pre-filter For Suspended Solids Removal

Pre-filter consisting of a basket filter piped and mounted on support frame. Filter is of carbon steel construction.

ARRANGEMENT (3) L-1 Canisters in series for 10 gpm flow (contact time @ 10 gpm - 15 minutes)



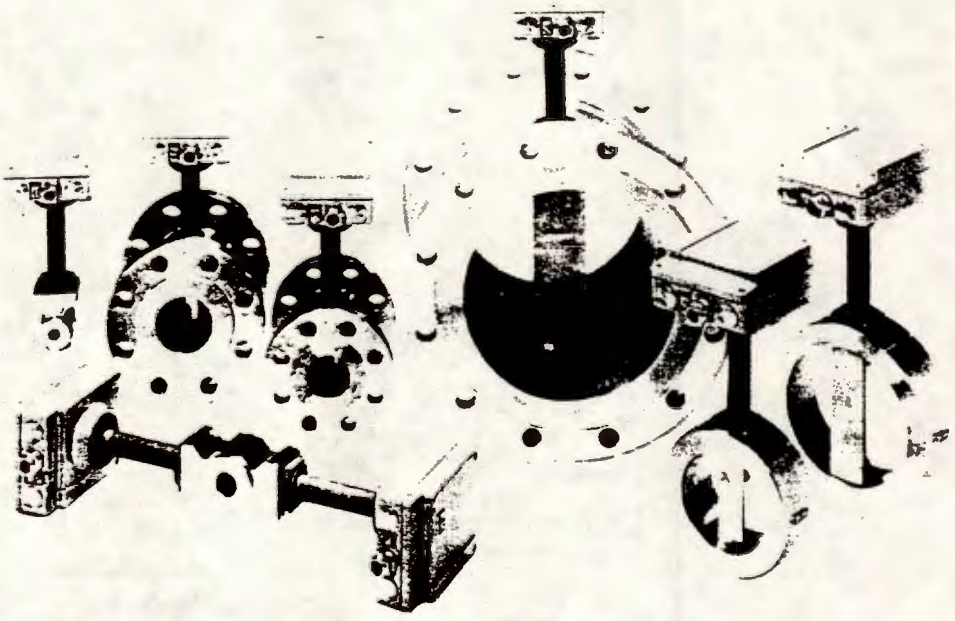
TYPICAL INSTALLATION

CARBTROL® CORPORATION
39 Riverside Avenue, Westport, CT 06880 • 1-800-242-1150 • (203) 226-5642

Technical Information
TI 063D/01/ae

Vortex Flow Measurement
swingwirl II

For measuring gas, steam and liquids



Measuring Principle
The operating principle is based on the Karman Vortex Street. When a fluid flows past a delta-shaped bluff body, vortices are alternately formed on the sides of that body and are detached or shed by the flow. The frequency of vortex shedding (with a Reynolds number above 20,000) is proportional to the mean flow velocity and therefore the volumetric flow.

Alternating pressure changes caused by the vortices are transmitted via lateral port holes in the bluff body. The DSC (Differential Switched Capacitor) sensor detects these pressure pulses and converts them into an electrical signal. The sensor is located within the bluff body, well protected from water hammer, temperature or pressure shocks.

The preamplifier processes the sinusoidal sensor signal into flow proportional square wave pulses. The same sensor and preamplifier are used for all nominal diameters and for all media. The sensor signal is galvanically isolated from the preamplifier output signal.

Applications
- Chemical
  - In-line / continuous metering.
  - High temperature chemical flow monitoring.
  - Off gas measurement.
- Power Plants
  - Steam distribution.
  - Fuel usage.
  - Cooling water metering.
- Food and Dairy Production
  - CIP fluid flow monitoring.
  - High pressure steam distribution.
  - CO_2 flow metering.
- General Industrial Manufacturing
  - Plant air distribution.
  - Steam flow usage.
  - Interdepartmental billing.

Endress+Hauser
Nothing beats know-how

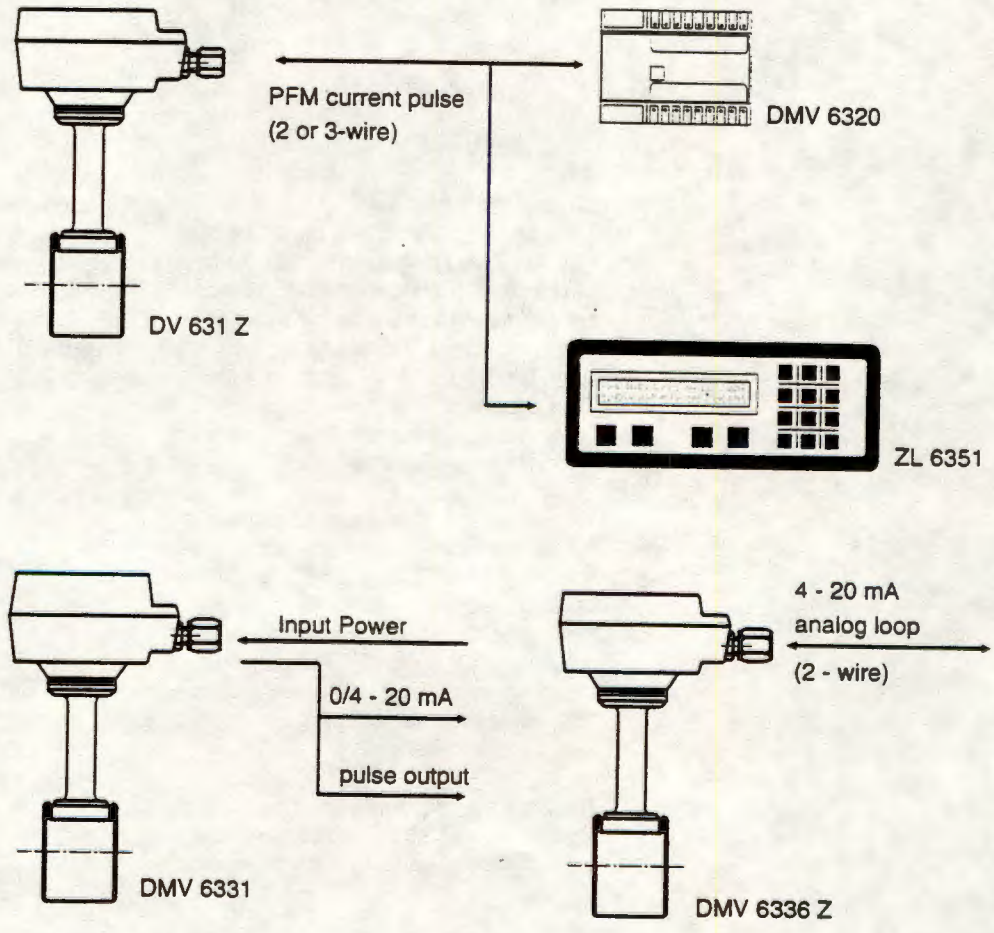
Measuring System

The measuring system can be configured according to the application and process requirements (Figure 1):

- Steam, gas and liquid
  - Sensor DV 631Z with the ZL 6351 flow computer (single channel).
- Liquids
  - Sensor DV 631Z with the separate DMV 6320 transmitter.
  - Sensor and transmitter in a compact version DMV 6331 (with integral power supply).
  - Sensor DMV 6336Z as a 2-wire, 4 to 20 mA transmitter.

Features

- FM approved Class I, Div 1, Groups A through G.
- Full range of sizes from 1/2" to 12", available in wafer (1/2" to 6") and flanged (1/2" to 12") process connections.
- Handles fluid temperature ranges from -330°F to +750°F.
- Maintenance free design, no moving parts.
- High accuracy of ± 1.0% of actual rate for gas or steam, ± 0.75% for liquids
- Repeatability typically better than 0.2% of rate.
- Wide turndown ratio, typically:
  - 24 : 1 for steam or gas
  - 50 : 1 for liquids
- Universal sensor and electronics for all sizes and applications, reduces spare parts requirements.
- Low in-line pressure loss.
- Optional flow computer for mass, thermal, or standardized volumetric flow.



Measuring System
Figure 1

Theory of Operation

The DSC Sensor

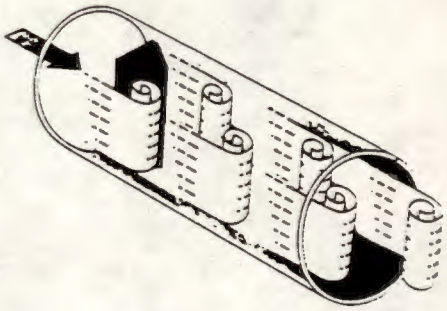
The DSC (Differential Switched Capacitor) sensor detects the vortices shed by the bluff body. Electrodes inside the sensor detect capacitance changes resulting from minute deflections of the sensor's outer shell which are caused by the vortex shedding action. The unique sensor design enables the Swingwirl II Vortex Flowmeter to measure a wider range of flow rates than ever before possible with other vortex type sensors. The sensor can handle fluid temperatures ranging from + 750°F superheated steam down to – 330°F cryogenic liquids, and it can not be damaged by thermal shock.

Engineered using computer aided design techniques, the sensor can ignore pipe vibration which is a major source of measurement error for most other vortex flowmeters. Plus, this rugged sensor has overspeed protection to 2 times the maximum specified flow rate.

Spare parts requirements have been drastically reduced; all size flowmeters use the same sensor, a one-piece machined part with no weld seams to break or fatigue (Figure 2). If a sensor ever needs to be replaced, it can be done without removing the flowmeter from the process piping. The electronics are universal for all sizes and all applications. There is no need to order different electronics for liquids, gas or steam measurement. The DSC sensor has proven its ruggedness in thousands of applications.

Swingwirl II Vortex Operation

The Swingwirl II Flowmeter measures flow rate using the vortex shedding principle. As fluid flows past a bluff body, vortices are produced on alternate sides of the bluff body (Figure 3). The frequency at which these vortices are produced (or shed) is directly proportional to the flow rate and is independent of the fluid density, viscosity, pressure or temperature.



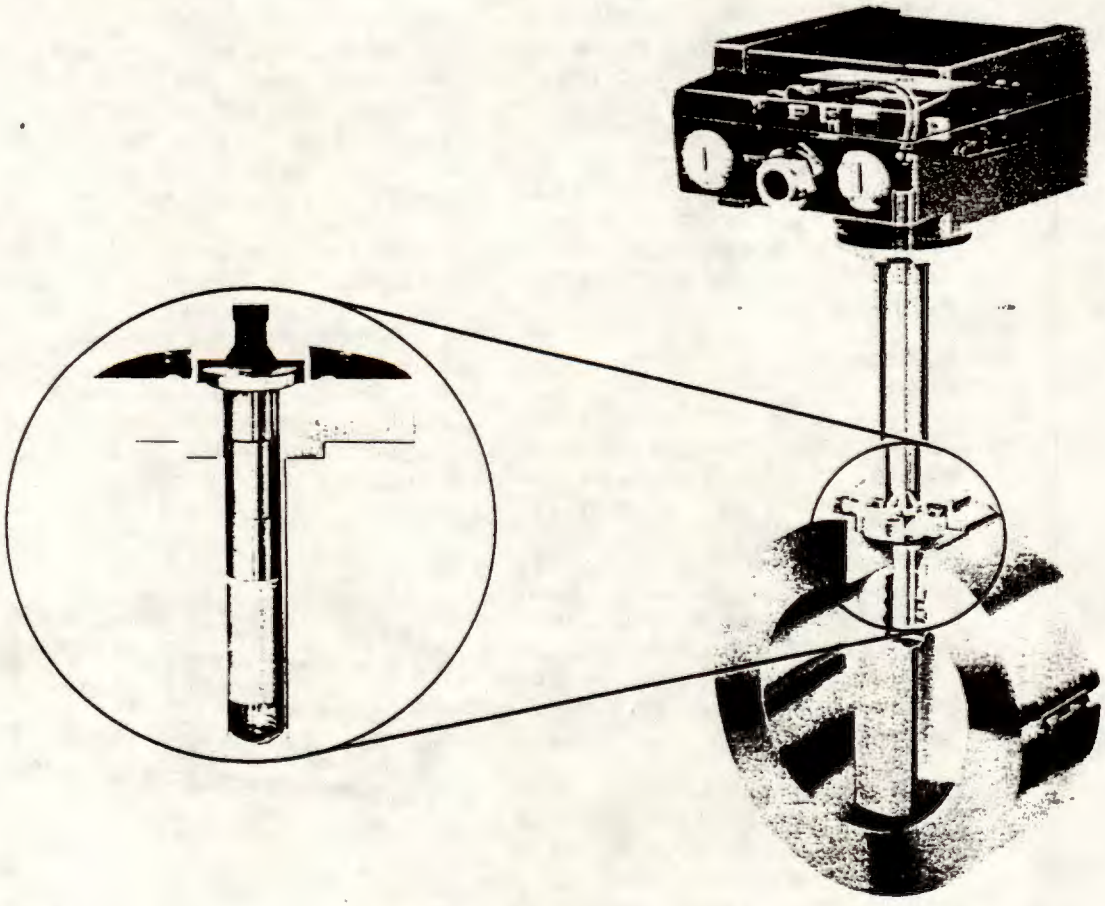
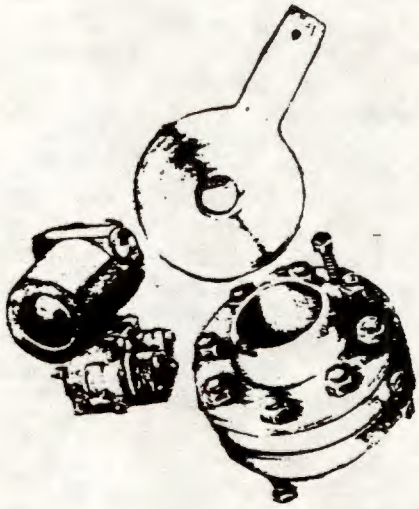


Figure 2

Complete Measuring System

Figure 4



The Preferred Alternative to Orifice Plates

The Swingwirl II Flowmeter is the ideal replacement for orifice plate systems to measure the flow of steam, gas and liquids in closed pipes. Its wide turndown of 24:1 for steam and 50:1 for water far surpass the typical 3:1 turndown of an orifice plate, enabling the user to measure accurately over a much wider range of flow rates.

The Swingwirl II meter does not suffer the large accuracy degradation experienced when an orifice plate's sharp edge wears down over time. Your pumps will have less of a burden as well, since the pressure loss is much lower. The installed cost is lower because there is no need for orifice flanges, separate transmitter mounting, pressure lines, purge lines, valves or square root extractors. Compare the components required for measurement as shown in Figure 4.

Four Systems to Suit Your Steam, Gas and Liquid Flowmeter Applications

The Swingwirl II Flowmeter is an extremely flexible flowmetering system which can be tailored to your specific needs and offers four basic systems from which to choose.

DMV 6336 Z Loop-Powered System

The lowest priced flowmeter system with convenient 2-wire operation provides a 4 to 20 mA flow rate output signal on the same wires that power the unit from a user-supplied 24 VDC power supply. The full scale flow rate is easily rescaled via BCD switches as your measurement requirements change. The ideal choice for simple volumetric flow rate measurement (refer to Figure 4).

DMV 6331 Self-Contained, Dual Output System

A compact system that provides two outputs; a 4 to 20 mA volumetric flow rate signal, plus a 24 VDC or open collector pulse signal for totalized flow. The system operates on 115 VAC (or optional 230 VAC) and has separate terminals for the output signals. The full scale flow rate and pulse weight are easily rescaled via BCD switches — no field calibration equipment is needed. This unit is an ideal choice for simple volumetric flow rate and totalized flow measurement.

DMV 6320 Transmitter
Figure 5

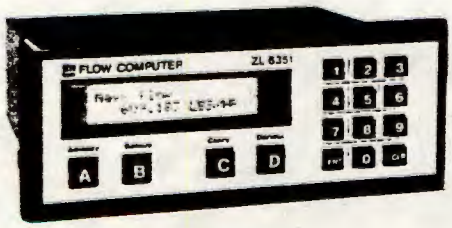
DMV 6320 Remote Transmitter

When the flow sensor will be located in an inaccessible area, this system enables you to mount the transmitter up to 3000 feet away. The DV 631 Z sensor is powered by the transmitter; an additional power source is not required. Sensor and transmitter are connected using inexpensive 2-wire instrument cable. The PFM (Pulse Frequency Modulated) transmission signal is highly immune to noise.

The DMV 6320 standard tranmsitter (Figure 5) provides the same two volumetric flow rate and totalized flow output signals as the DMV 6331. Full scale flow rate and pulse weight are easily rescaled via BCD switches located in the transmitter. Field calibration equipment is not required.

ZL 6351 Flow Computer

The ZL 6351 Flow Computer is a reliable, economical system for the measurement of mass, heat, or standard volumetric flow (Figure 6). This microprocessor-based flow computer calculates the flow rates using inputs from pressure and/or temperature sensors to compensate the volumetric flow rate measured by the DV 631 Z sensor.



ZL 6351 Flow Computer
Figure 6

Measuring Ranges and Size Selection

Flowmeter Size Selection
Tables for saturated steam and the diagram showing measuring ranges for superheated steam, gas and liquids are shown on pages 6 and 7. Swingwirl II vortex flowmeters measure the volumetric flow (ACFM) at operating conditions (i.e., the actual volume which is dependent on pressure and temperature). Since gas quantities are usually stated at standard conditions (14.7 PSIA at 60°F) and steam quantities in pounds, the volumetric flow limits at operating conditions are found by using the formulas and table values below.

Flow Limits (Wafer, 1/2" to 6"; Flanged, 8" to 12")
The maximum flow velocity for steam and gases = 246 fps (75 m/s). 1/2" = 151 fps (46 m/s). For liquids, 30 fps (9 m/s).

The minimum flow velocity, q_{min}, is dependent on three criteria:

1. Sensitivity (start of measurement depends on the liquid density)
2. Linearity from Re > 3800
3. Minimum vortex frequency of 1 Hz.

Criteria #1 should be followed for all applications, #2 for liquids, and #3 for larger diameters.

1" to 12": $q_{min}\ (fps) = \frac{20}{\sqrt{\rho}}$

1/2" (liquids): $q_{min}\ (fps) = \frac{40}{\sqrt{\rho}}$

(gas/steam): $q_{min}\ (fps) = \frac{50}{\sqrt{\rho}}$

Flow Limits (Flanged 1/2" to 6")
Minimum flow velocity:

$$q_{min}\ (ACFM) \geq \frac{ID^2 \times 1.61}{\sqrt{\rho}}$$

$$q_{min}\ (GPM) \geq \frac{ID^2 \times 12}{\sqrt{\rho}}$$

Maximum flow velocity:

for $0.06 \leq \rho \leq 0.75$ lb/ft^3

$$q_{max}\ (ACFM) \leq ID^2 \times 80.65$$

for $\rho > 0.75$ lb/ft^3

$$q_{max}\ (ACFM) \leq \frac{ID^2 \times 70.7}{\sqrt{\rho}}$$

$$q_{max}\ (GPM) \leq \frac{ID^2 \times 529.4}{\sqrt{\rho}}$$

Where ρ = density (lb/ft^3) and meter ID value as listed below:

Size	I.D	Size	I.D
1/2"	0.547"	3"	2.902"
1"	0.957"	4"	3.819"
1-1/2"	1.50"	6"	5.760"
2"	1.937"		

Table 1

Pressure (PSIG)

Dia. (In.)		10	20	30	40	50	60	80	100	150	200	250	300	350	400	500	600	700	800	900
0.5	min	10	12	13	15	16	16	17	19	21	25	28	31	34	36	39	40	46	51	57	63
	max	55	75	95	115	134	154	193	231	328	421	516	610	707	803	997	1197	1401	1611	1826
1	min	30	36	40	44	48	51	57	63	75	86	94	102	110	117	130	143	154	166	178
	max	322	442	560	677	792	907	1140	1360	1920	2490	3040	3600	4170	4740	5880	6440	6970	7470	7960
1.5	min	72	84	96	104	113	121	135	148	178	200	221	241	259	276	308	337	365	391	417
	max	761	1040	1320	1600	1870	2150	2690	3220	4550	5880	7190	9510	9850	11,200	13,900	16,200	16,500	17,700	18,800
2	min	119	136	156	172	186	199	223	244	290	330	365	397	427	455	507	556	601	645	686
	max	1250	1720	2180	2640	3080	3530	4420	6310	7480	9680	11,800	14,000	16,200	18,500	22,900	25,100	27,100	29,100	31,000
3	min	261	306	344	379	410	439	491	537	639	726	803	873	940	1000	1120	1220	1320	1420	1510
	max	2760	3790	4800	5800	6800	7789	9740	11,700	16,500	21,300	26,100	30,800	35,800	40,800	50,400	55,200	59,800	64,100	68,200
4	min	460	528	594	663	707	766	846	927	1100	1250	1390	1510	1620	1730	1930	2110	2280	2480	2610
	max	4760	6530	8280	10,000	11,700	13,400	16,800	20,200	28,500	36,800	45,000	53,200	61,700	70,100	86,900	96,200	103,000	110,000	118,000
6	min	1020	1200	1360	1480	1600	1720	1920	2100	2500	2840	3140	3420	3680	3920	4370	4780	5180	5550	5910
	max	10,800	14,800	18,800	22,700	26,600	30,500	38,100	45,700	64,800	83,400	102,000	121,000	140,000	159,000	197,000	216,000	234,000	251,000	267,000
8	min	1780	2080	2340	2570	2780	2980	3340	3650	4340	4930	5460	5940	6470	7120	8370	9800	10,800	12,000	13,200
	max	18,800	25,700	32,600	39,400	46,200	52,900	66,200	79,400	112,000	145,000	177,000	210,000	243,000	276,000	343,000	376,000	409,000	436,000	464,000
10	min	2750	3230	3630	3990	4320	4630	5180	5670	6740	7660	8470	9210	10,000	11,000	13,000	14,900	16,800	18,600	20,600
	max	29,100	39,900	50,600	61,200	71,700	82,100	103,000	123,000	174,000	225,000	275,000	326,000	377,000	429,000	532,000	582,000	630,000	676,000	720,000
12	min	3970	4660	5240	5760	6240	6670	7270	8180	9720	11,000	12,200	13,300	14,000	15,900	18,700	21,500	24,200	26,900	29,500
	max	42,000	57,600	73,000	88,300	103,000	118,000	148,000	178,000	251,000	324,000	397,000	470,000	544,000	618,000	767,000	840,000	909,000	975,000	1,040,000
Temp.$_{sat}$	°F	239	259	274	287	298	307	323	338	366	388	406	422	436	448	470	489	506	520	534
Density$_{sat}$	lb/ft^3	0.061	0.083	0.108	0.128	0.150	0.171	0.214	0.257	0.363	0.469	0.574	0.679	0.787	0.894	1.11	1.33	1.56	1.79	2.03

lb/hr

Saturated Steam Flow
Minimum and maximum flow rates by meter size are shown in Table 1.
Example: What is the measuring range for 150 PSIG saturated steam in a 4" line?

1. From Table 1, scan across the 4" row and read the measuring range under the 150 PSIG column (1100 to 28,500 lb/hr).
2. The saturation temperature is 366°F and the density is 0.363 lb/ft^3 (last two lines of Table 1).

Table 2
Density

PSIG	Temperature (degrees F)					
	300	400	500	600	700	750
10	0.056	0.049	0.044	0.039	0.036	0.034
20	0.078	0.069	0.061	0.055	0.050	0.048
30	0.102	0.089	0.079	0.071	0.065	0.062
40	0.125	0.109	0.097	0.087	0.080	0.076
50	0.149	0.129	0.115	0.103	0.094	0.090
60		0.150	0.133	0.120	0.109	0.105
80		0.192	0.169	0.152	0.139	0.133
100		0.234	0.206	0.185	0.168	0.161
150		0.344	0.300	0.267	0.243	0.233
200		0.459	0.396	0.351	0.318	0.305
250			0.495	0.437	0.395	0.379
300			0.597	0.523	0.471	0.451
350			0.703	0.612	0.550	0.526
400			0.814	0.703	0.630	0.602
500			1.046	0.890	0.790	0.754
600			1.300	1.086	0.956	0.910
700				1.293	1.126	1.070
800				1.512	1.302	1.233
900				1.745	1.485	1.401

Superheated Steam Flow

1. Read the density from Table 2 based on operating temperature and pressure (interpolation may be required).
2. If flow rate is known only in lb/hr, convert to volumetric flow rate using the formula below.

$$q = \frac{m}{(60)(\rho)}$$ Where:

q = volumetric flow rate in ACFM
m = mass flow rate in lb/hr
ρ = density in lb/ft^3

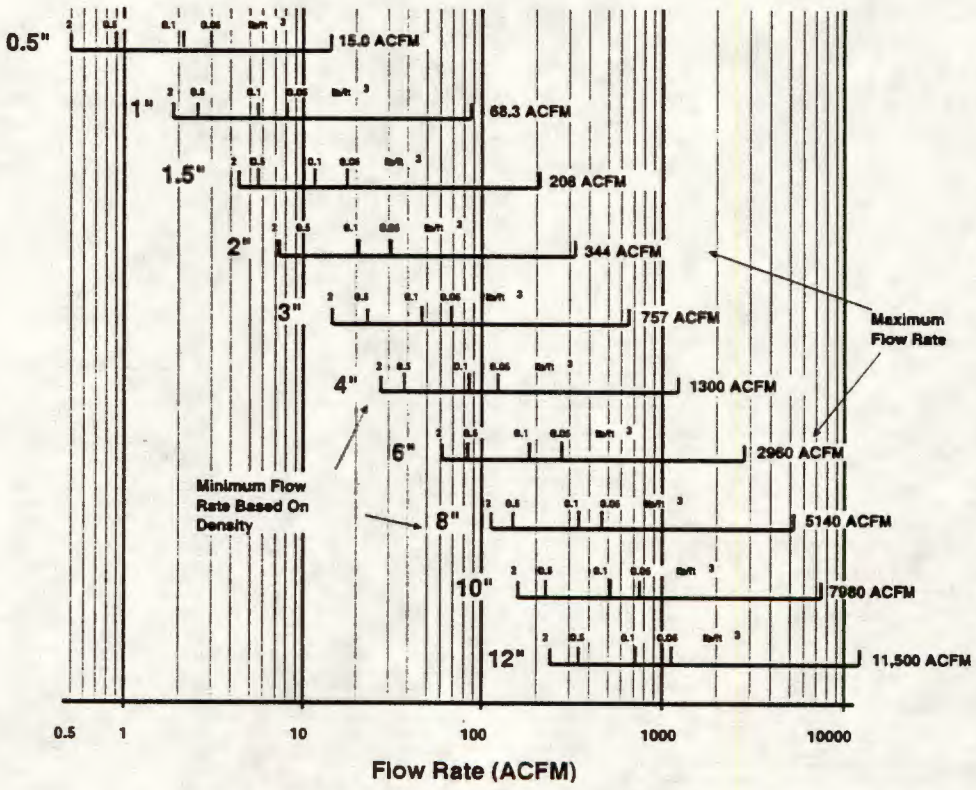
3. Refer to the Measuring Range for Steam and Gas (Figure 7) to determine minimum / maximum flow rates by meter size.

Example: Determine the proper line size and measuring range for superheated steam at 500°F and 200 PSIG, flowing at 20,000 lb/hr.

1. From Table 2, the steam density is 0.396 lb/ft^3.
2. $q = \frac{20,000}{(60)(0.396)} = 842$ ACFM
3. From Figure 7, a 4" meter would be a good choice, offering a 17.5:1 turndown.

The measuring range for a steam density of 0.396 lb/ft^3 is 48 to 1300 ACFM (1150 to 31,000 lb/hr).

Measuring Range for Steam and Gas



NOTE: For extremely dense gases, the maximum flow may be less than shown. Gases with extremely low densities (eg hydrogen, helium) may not be measureable
Figure 7

Gas Flow

1. If the flow rate is only known in SCFM, convert to ACFM using the following formula.

$$q_A = \frac{(q_S)(T)}{(35.4)(p)}$$ Where:

q_A = Actual volumetric flow in ACFM
q_S = Volumetric flow rate at standard conditions (60°F, 14.7 PSIA)
T = Actual process temperature in °R (°F + 460)

2. Determine the actual gas density. Standard densities of some common gases are shown in Table 3. Calculate actual density as:

$$\rho_A = \frac{(\rho s)(p)(35.4)}{(T)}$$ Where:

ρ_A = Actual density in lb/ft^3
ρs = Density at standard conditions (60°F, 14.7 PSIA) in lb/ft^3
p = Actual process pressure in PSIA
T = Actual process temperature in °R (°F + 460)

3. If the density is unknown, it can be determined from the molecular weight

or

specific gravity of the gas as:

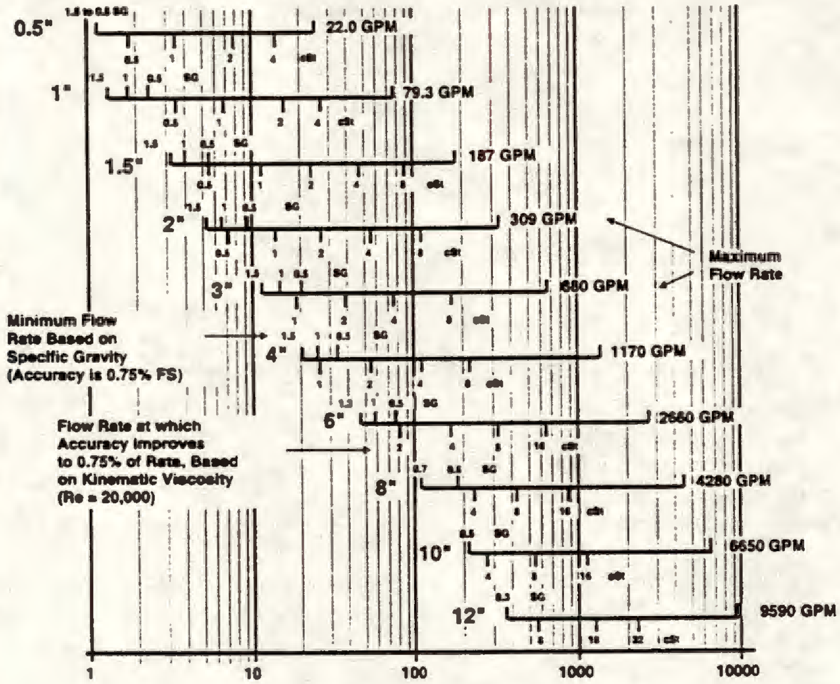
$$\rho s = \frac{M}{381} = \frac{G}{13.1}$$ Where:

ρs = Density at standard conditions (60°F, 14.7 PSIA) in lb/ft^3
M = Molecular weight of the gas
G = Specific gravity of the gas.

OTES: Minimum flow rates for sizes [illegible] reflect the [illegible] minimum vortex shedding frequency criteria.

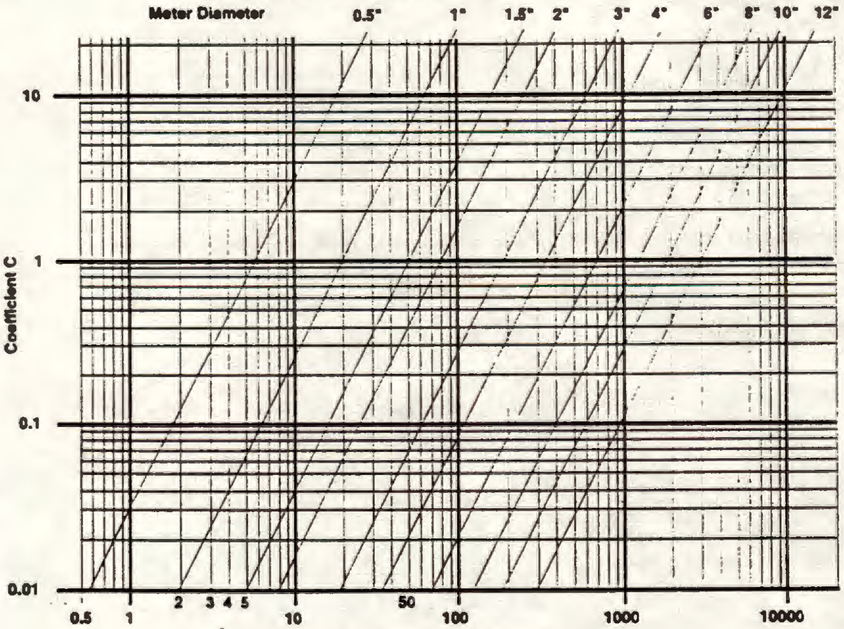
Minimum flow rates for [illegible] may be higher than shown [illegible]

Measuring Range for Liquids (S.G. = 1.0, Viscosity = 1 cSt)



Flow Rate (GPM)

Pressure Loss for Steam, Gas and Liquids



Flow Rate
(ACFM for Steam and Gas, GPM for Liquids)

Figure 9

4. Refer to Figure 7 for minimum/maximum flow rates by meter size.

Example: Determine the proper line size and measuring range for air at 70°F and 100 PSIG, flowing at 5000 SCFM.

1. Converting from SCFM to ACFM

$$q_S = \frac{(5000)(70-460)}{(35.4)(100+14.7)} = 653 \text{ ACFM}$$

2. Actual gas density:

$$\rho_A = \frac{(0.0761)(100+14.7)(35.4)}{(70+460)} = 0.583 \text{ lb/ft}^3$$

3. From Figure 7, a 4" meter would be a good choice, offering a 16:1 turndown. The measuring range for a gas density of 0.583 lb/ft^3 is 40 to 1300 ACFM.

Table 3

Gas	Standard Density *	Gas	Standard Density *
Air (dry)	0.0761	N-Hexane	0.2266
Ammonia	0.0448	Hydrogen	0.0053
Argon	0.1051	Hydrogen Sulfide	0.0896
Benzene	0.2054	Isobutane	0.1528
N-Butane	0.1528	Isopentane	0.1897
1-Butene	0.1475	Methane	0.0422
Carbon Dioxide	0.1158	Methyl Fluoride	0.0895
Carbon Monoxide	0.0736	Neon	0.0531
N-Deuterium	0.0106	Nitric Oxide	0.0789
Ethane	0.0790	Nitrogen	0.0736
Ethylene	0.0737	Oxygen	0.0841
Ethyl Ester	0.1949	N-Pentane	0.1897
Helium	0.0105	Propane	0.1180
N-Heptane	0.2634	Porpene	0.1107

* Standard conditions are 60 degrees F, 14.7 PSIA.

Liquid Flow

Minimum and maximum flow rates for liquids are shown in Figure 8.

Example: Determine the proper line size and measuring range for a liquid with a Specific Gravity (S.G.) of 1.2 and a Kinematic Viscosity of 2 Centistokes (cSt), flowing at 800 gallons per minute (GPM).

From Figure 8, a 4" meter would be a good choice with 800 GPM offering a 31:1 turndown. Maximum flow rate is 1170 GPM. Minimum flow rate at 1.2 S.G. is 26 GPM. Measurement accuracy: 0.75% of rate at 51 to 1170 GPM, 1% of full scale at 26 to 51 GPM.

Pressure Loss

Pressure loss is extremely low for the Swingwirl II Flowmeter. To determine the pressure loss:

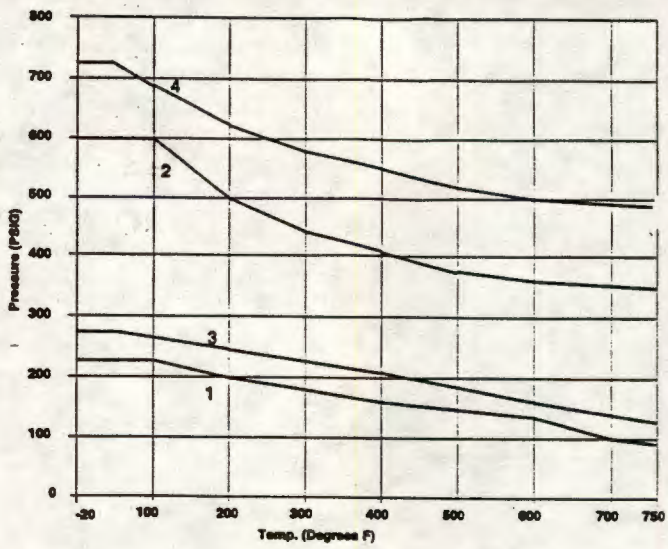
1. Use Figure 9 to find a coefficient value (C) based on flow rate and meter diameter. For steam and gas, read the flow on the horizontal axis in units of ACFM. For liquids, read the flow rate in units of "GPM".
2. Calculate the pressure loss as:
   A. Steam and gas, $\Delta p = (C)(\rho)$
   B. Liquids, $\Delta p = (C)(SG)$
   Where:
   Δp = pressure loss in PSI
   C = Coefficient from Figure 4
   ρ = Density in lb/ft^3
   SG = Specific Gravity

Example: Determine the pressure loss for a liquid with a Specific Gravity of 0.9 flowing through a 6" meter at 600 GPM.

1. From Figure 9, the Coefficient (C) for 600 GPM flow through a 6" meter is 0.7.
2. $\Delta p = (0.7)(0.9) = 0.63$ PSI

Pressure/Temperature Limitations

Certain application limits for the flanged and wafer designed sensors are dependent on pressure and temperature. Figure 10 illustrates the working ranges for the flanged sensors. Ranges for wafer sensors are in accordance with B16.5 for A105 Carbon Steel.



Line 1 — 150# flanged style 8, 10 and 12"
Line 2 — 300# flanged style 8, 10, and 12"
Line 3 — 150# flanged style 1/2" to 6"
Line 4 — 300# flanged style 1/2" to 6"
Figure 10

Installation Guidelines

Location and Orientation

Installation location and orientation of the Swingwirl II sensor must be considered for proper operation of the measurement system. The recommended inlet and outlet section distance is a multiple of the pipe nominal diameter as shown in Figure 11. Valves and other restrictions should be downstream from the sensor whenever possible. If there is not enough distance between the sensor and an upstream device, a flow straightener may be installed between the device and the flow sensor. The flow straightener can reduce the inlet section length.

Example: A control valve requires 50 X D. Installing a flow straightener reduces the recommended distance to 25 X D. The minimum straight inlet including the flow straightener must be 12 X D.

NOTE: ID of process pipe and measuring sensor should be equal. Wafer 1" to 6" and flanged 1/2" to 12" are Schedule 40, standard. Wafer 1/2" is Schedule 80, standard.

Inlet distance for other standard devices are as follows:

1. Ball valve, fully open, requires 23 X D.
2. Expansion section requires 18 X D (same pipe size as the installed sensor).
3. Shut-off valve, fully open, requires 14 X D.
4. Inlet distances listed are for maximum performance. Distance may be shortened, please consult factory.

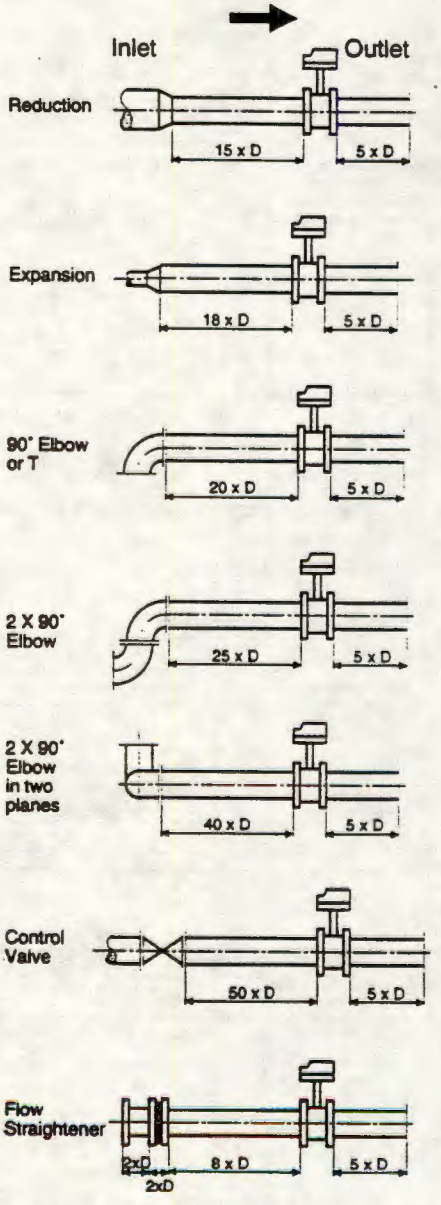


Figure 11

Wafer designed sensors (1/2" to 6") incluce a mounting kit wnich consists of two centering rings, two gaskets and mounting hardware (Figure 12). Long sections of pipe with a tendency to vibrate should be rigidly supported upstream and downstream of the vortex sensor.

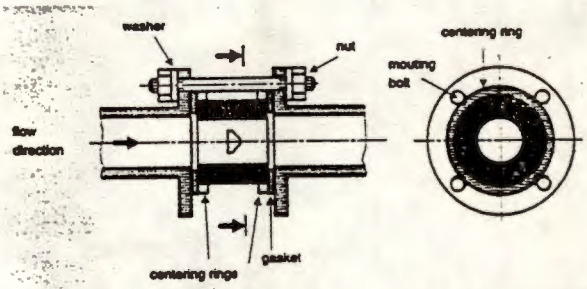
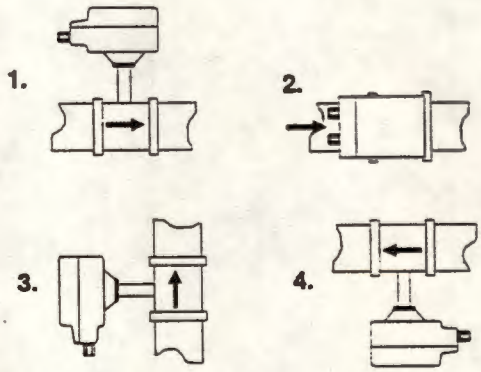


Figure 12

Mounting Orientation

Recommended mounting orientation of the vortex sensor is shown in Figure 13. In liquid applications, vertical installation with the liquid flowing upwards is recommended to ensure a full pipe (#3, Figure 13).

For high temperature applications, the sensor electronics housing should project horizontally, laterally or downwards to prevent heat build-up inside the electronics (#2, #3 and #4, Figure 13). For cryogenic liquids, sensor orientation should be per #1, Figure 13.

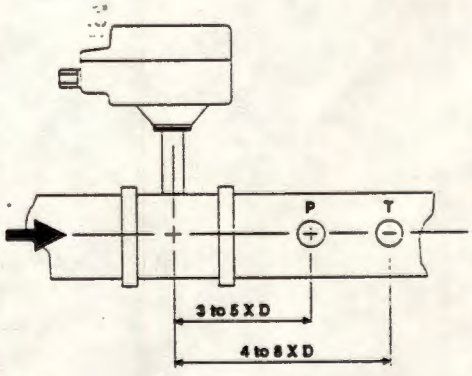


Pressure / Temperature Sensors

Whenever a ZL 6351 Flow Computer is specified, a user-supplied pressure and temperature sensor for input signals is mounted in the outlet section from the sensor according to Figure 14.

Steam Applications

In steam applications where the pipe and meter body must be insulated, maintain a 2" clearance between the electronics housing and the insulation to prevent over heating of the electronics (Figure 15). When mounting the sensor in a horizontal pipe, the electronics should face downwards (refer to figure 13, #4).



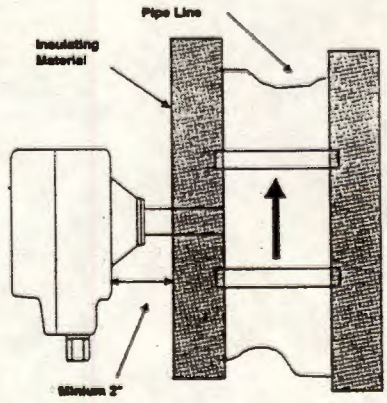


Figure 15

Sensor Technical Data

General Sensor Specifications

Accuracy:	Reynolds Number ≥ 20,000: ± 1% of rate for steam and gas. ± 0.75% of rate for liquids. Reynolds Number between 3800 and 20,000: ± 1% of full scale for steam and gas. ± 0.75% of full scale for liquids
Repeatability:	± 0.2% of rate.
Voltage Fluctuation:	± 0.05% full scale, 10% fluctuation.
Sensor Gasket:	Graphite, standard. Kalrez, optional.
Process Fluids:	Liquids, steam (including saturated and superheated) and gas.
Process Pressure Limits:	In accordance with ANSI standard B16.5. 740 PSIG maximum pressure for FM approved wafer meters. See graph (Figure 10, page 8) for flanged meters.
Process Temp. Limits:	– 330°F to + 750°F, (– 5°F to + 465°F with Kalrez sensor gasket). Maximum liquid temperature for the DMV 6331 is + 570°F.
Wetted Parts:	Sensor 316 L. Wafer body (1/2" to 6") or flanged body (8" to 12") 316L stainless steel. Flanged body (1/2" to 6") A351 CF 8C cast stainless steel.
Dimensions:	1/2" to 1" wafer and flanged, Figure 16; 1-1/2" to 6" wafer and flanged, Figure 17; 8" to 12" flanged, Figure 18.
Mounting:	1/2" to 6" wafer design, fits between 150#, 300# or 600# ANSI flanges and includes mounting kit. Kit includes centering rings, nuts, bolts, washers (4140 carbon steel, zinc plated) and Victopac 69 (non-asbestos) gaskets. 1/2" to 12" flanged design, mates to 150# or 300# ANSI flanges. Process connection type must be specified when ordered.
System Approvals:	DV 631 Z, DMV 6336 Z: FM approved Intrinsically Safe, Class I, II and III; Division 1; Groups A through G. Dust Ignition-proof, Class I and II; Division 1; Groups E through G; Outdoor locations (NEMA 4). Non-Incendive, Class I; Division 2, Groups A through D.

ATTENTION: Transmitters specified with the DV 631 Z sensor (DMV 6320 or ZL 6351) must be mounted in a safe area. Only the sensor is approved for hazardous locations.

DV 631 Z Remote Powered Sensor

Ambient Temp. Limits:	– 13°F to + 140°F
Power Input:	From DMV 6320 transmitter or ZL 6351 flow computer. 12.5 to 36 VDC.
Electronics Housing:	Epoxy coated die-cast aluminum.
Housing Protection:	NEMA 4.
Power Consumption:	0.5 Watt.
Electrical Connection:	2-conductor instrument cable, 3000 feet maximum.

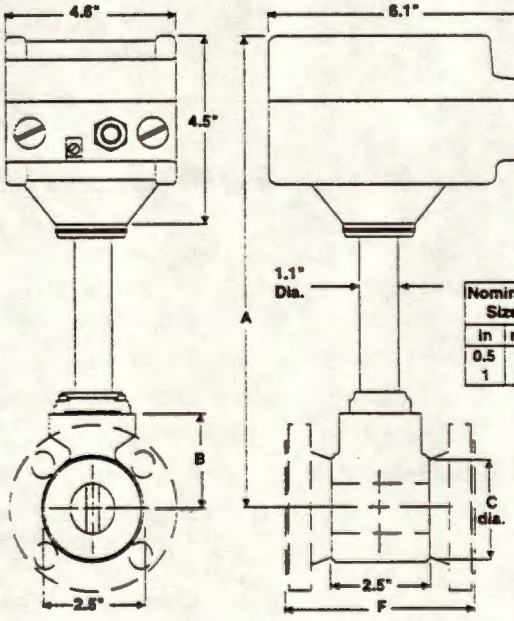
DMV 6336 Z Loop-Powered Sensor

Specifications same as DV 631 Z, except:

Power Consumption:	< 0.5 Watt (< 1.0 Watt with optional analog display).
Flow Rate Output:	4 to 20 mA into 600 Ohms maximum load at 24 VDC supply voltage. Scaling locally via BCD switches.
Response Time:	2.5 seconds.

DMV 6331 Self-Contained Sensor
Specifications same as DV 631 Z, except:

Power Input:	115 VAC, + 10%, – 15%, 50/60 Hz, standard. Optional 220 VAC.
Power Consumption:	2.5 VA
Process Temp. Limit:	+ 570°F maximum.
Ambient Temp. Limits:	+ 14°F to + 122°F.
Flow Rate Output:	4 to 20 mA (0 to 20) into 800 Ohms maximum load, isolated.
Totalized Flow Output:	Scaled pulse, 24 V peak, 150 Ohms minimum load, 25 ms pulse duration, $f_{max} \leq 2$ Hz, isolated. OR Open collector, 50 mA maximum load, $f_{max} \leq 20$ Hz, isolated.

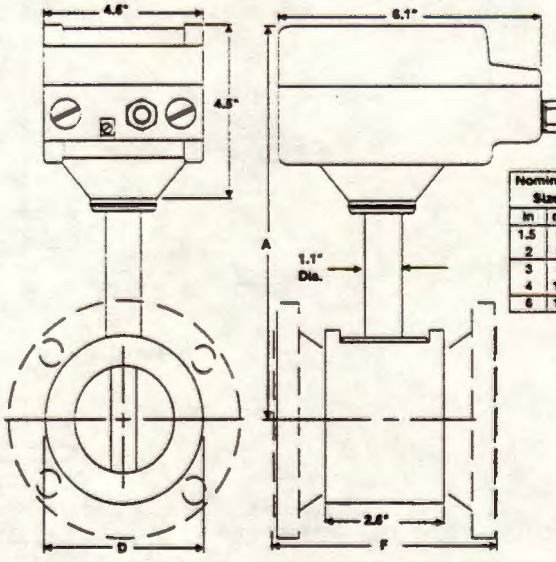


Nominal Size					Flanged Units
in	mm	A (in.)	B (in.)	C (in.)	F (in)
0.5	15	12.2	2.1	1.8	7.8
1	25	12.3	2.4	2.5	7.8

Weights (lbs)		
	Wafer	Flanged
0.5	7.5	11.0
1	8.5	17.5

DMV 6336 Z, DMV 6331, DV 631 Z Sensor Dimensions 1/2" and 1" Nominal Sizes.

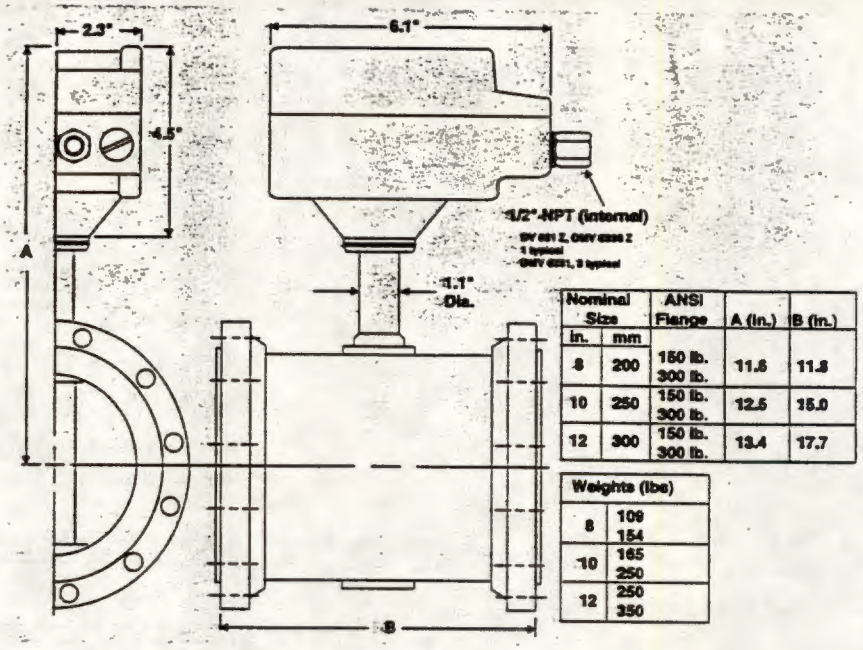
Figure 16



Nominal Size				Flanged Units	Weights (lbs)	
in	mm	D (in.)	A (in.)	F (in.)	Wafer	Flanged
1.5	40	3.2	10.6	7.8	11.0	24.0
2	50	3.6	10.8	7.8	11.0	29.0
3	80	5.0	11.6	7.8	13.0	44.0
4	100	6.2	12.2	9.8	20.0	80.0
6	150	8.5	13.4	11.8	37.0	121.0

DMV 6336 Z, DMV 6331, DV 631 Z Sensor Dimensions 1-1/2" to 6" Nominal Sizes.

Figure 17



Nominal Size		ANSI Flange	A (in.)	B (in.)
in.	mm			
8	200	150 lb. 300 lb.	11.6	11.8
10	250	150 lb. 300 lb.	12.5	15.0
12	300	150 lb. 300 lb.	13.4	17.7

Weights (lbs)	
8	109 154
10	165 250
12	250 350

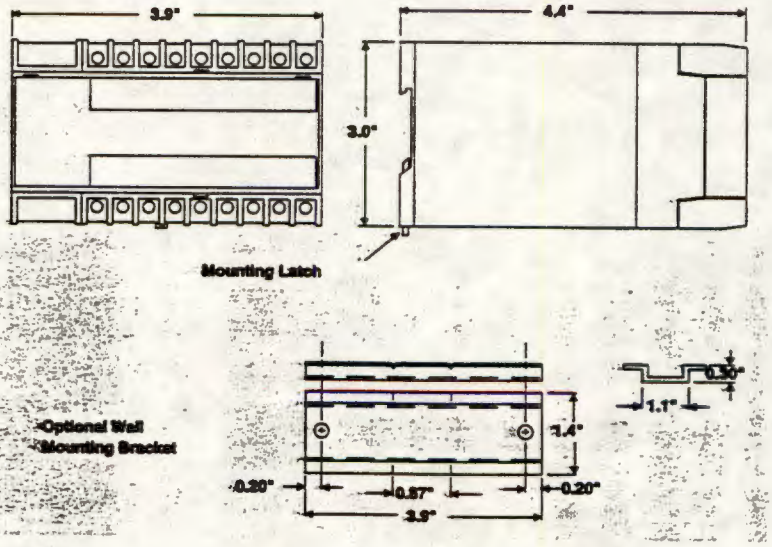
DMV 6336 Z, DMV 6331, DV 631 Z Sensor Dimensions 8" to 12" Nominal Sizes.

Figure 18

Transmitter Technical Data

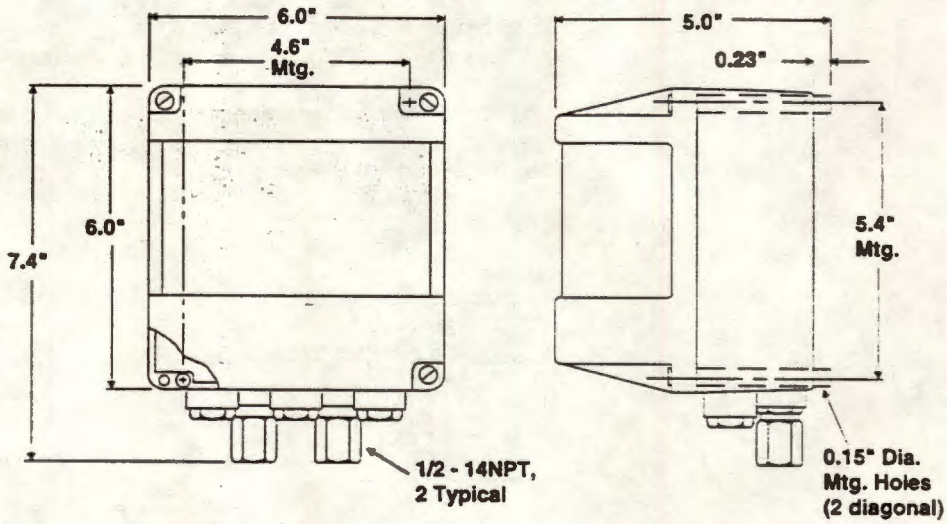
DMV 6320 Transmitter (Remote, control room mounting)

Housing:	ABS plastic.
Protection Rating:	NEMA 1
Power Input:	115 VAC +15%, – 10%, 50/60 Hz ± 5%, standard. 230 VAC optional.
Power Consumption:	2.5 VA
Output Scaling:	Locally via BCD switches.
Response Time:	2.5 seconds.
Flow Rate Output:	4 to 20 mA (0 to 20) into 800 Ohms maximum load, isolated.
Totalized Flow Output:	Scaled pulse, 24 V peak, 180 Ohms minimum load, 25 ms pulse duration, $f_{max} \leq 2$ Hz, isolated. OR Open collector, 50 mA maximum load, $f_{max} \leq 20$ Hz, isolated.
Ambient Temp. Limits:	+ 14°F to + 122°F.
Dimensions:	Refer to Figure 19.
Mounting:	Rail-mounted, standard. Wall mounting bracket, optional. Wall-mount NEMA 4X plastic enclosure, optional (refer to Figure 20 for wall mount unit).



DMV 6320 Transmitter

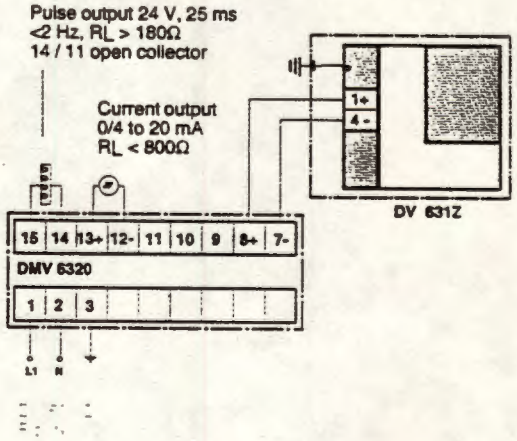
Figure 19



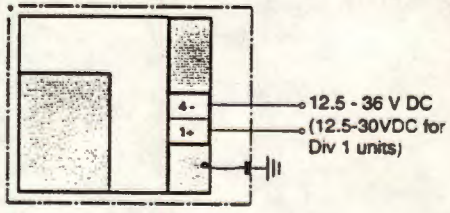
Optional Wall Mount Enclosure
Figure 20

Wiring

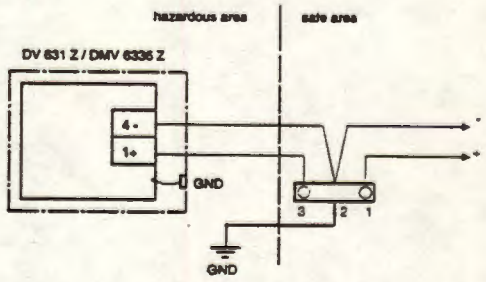
DV 631 Z
Basic version (20 mA current pulse, 2-wire), for connection to either a DMV 6320 transmitter or ZL 6351 Flow Computer (Figure 21).
Pulse width 260 µs, ± 20%
Maximum output frequency, 3000 Hz.



DMV 6336 Z
Loop powered 2-wire transmitter (4 to 20 mA) with preamplifier (same as the DV 631 Z) and current output board (Figure 22).



DV 631 Z / DMV 6336 Z
(FM Div 1 installations)
For applications in FM Class I, Division 1 areas, the DV 631 Z and DMV 6336 Z must be used in conjunction with an approved zener barrier (e.g. Stahl 8901/31-280/110/00). V_{max} = 30 VDC, I_{max} = 245 mA, Ci = 0 and Li = 0 (0.25 mH if equipped with optional analog meter). Refer to Figure 23.

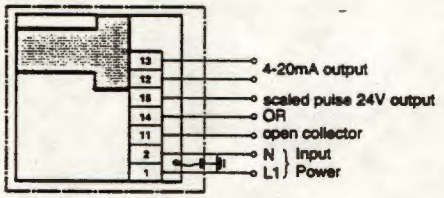


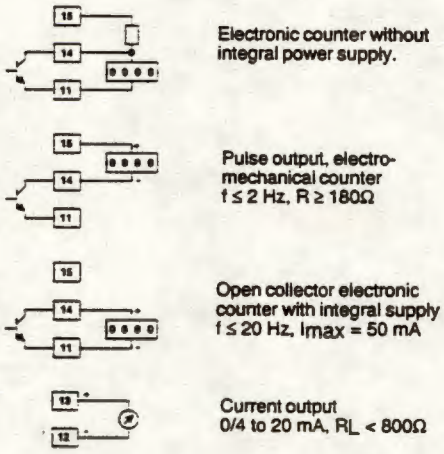
DV 631 Z / DMV 6336 Z
Figure 23

DMV 6331 (Compact Transmitter)
The DMV 6331 remote transmitter is wired according to Figure 24. The DMV 6331 is not available in an FM approved version.

The various wiring connections for pulse, open collector, current and electronic counter are shown in Figure 24.

DMV 6331

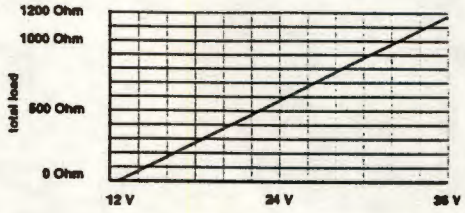




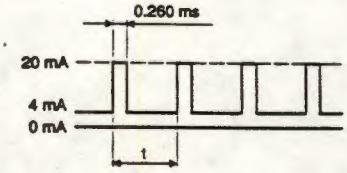
DMV 6331
Figure 24

Load Diagram (DV 631 Z / DMV 6336 Z)
Figure 25 illustrates maximum load according to input voltage. Shielded cable for the power supply is recommended.

A pulse wave diagram for the DV 631Z is shown in Figure 26.



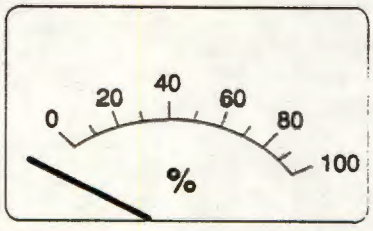
Load Diagram
Figure 25



DV 631 Z Pulse Wave
Figure 26

Accessories

Local Display
An analog display allows an immediate on-site indication of flow (Figure 27). The display is connected into the 4 to 20 mA circuit of the DMV 6336 Z using a connector to the upper PC board. A viewing window is provided in the electronics housing cover.



Analog Display
Figure 27

"Applicator" Software for Optimum Sizing
Application software for sizing and range selections is available. The Applicator program simplifies the following calculations:

- Converting actual volume to standard volume for gas.
- Converting to mass flow with steam, allowing for temperature and/or pressure.
- Determining minimum and maximum flow limits.
- Calculating pressure loss at the measuring point.
- Simultaneous display of other nominal diameters, etc.

The Applicator runs on all PC's (IBM AT/XT or compatibles). Please contact Endress + Hauser for a free copy or for sizing assistance.

Ordering Code, Swingwirl II

Swingwirl II [ ][ ]–[ ][ ][ ][ ][ ][ ]0 0 2

DV631 Z (requires DMV 6320 transmitter or ZL 6351 flow computer). S10
DMV 6331 self-contained, dual output (not FM Approved). S31
DMV 6332 Z Two-wire loop powered system. S36

Nominal Size
1/2" 015
1.0" 025
1.5" 040
2.0" 050
3.0" 080
4.0" 100
6.0" 150
8.0" 200
10.0" 250
12.0" 300

Process Connection Class
Wafer, 150 / 300 / 600 lb ANSI, Sch. 40, 1/2" to 6" 6
Flange, 150 lb ANSI, Sch. 40, 8" to 12" 7
Flange, 300, lb ANSI, Sch. 40, 8" to 12" 8
Flange, 150 lb ANSI, Sch. 40, 1/2" to 6" . . . . . T
Flange, 300 lb ANSI, Sch. 40, 1/2" to 6" . . . . . U
Flange, 150 lb ANSI, Sch 80, 1/2" to 6" V
Flange, 300 lb ANSI, Sch 80, 1/2" to 6" . . . . . W

Electrical Classification
General purpose, safe area only, DMV 6331. 0
FM Approved I.S. Class I, II and III; Div. 1; Grp A to G (DV 631 Z and DMV 6336 Z). 3

Power Supply
220 VAC, 50/60 Hz (DMV 6331 only). 0
115 VAC, 50/60 Hz (DMV 6331 only). 2
External power supply for DMV 6336 Z, 12.5 to 36 VDC (FM, 12.5 to 30 VDC). 6
Power supply with DV 631 Z, 12.5 to 36 VDC (FM, 12.5 to 30 VDC). 8

Signal Outputs
Current output, 4 to 20 mA / pulse output, DMV 6331 only. 1
Current output, 4 to 20 mA, no display, with DMV 6336 Z only. . . . 2
Current output, 4 to 20 mA with analog display, DMV 6336 Z only. . 3
Pulse frequency output for connecting to transmitter, 2-wire / unscaled, DV 631 Z only. 5

Sensor Body Materials
316L Stainless Steel, wafer 1/2" to 6", flanged 8" to 12" 0
ASTM A 351 Grade CF8C Stainless Steel (flanged 1/2" to 6") . . . A

Sensor Gasket
Graphite 0
Kalrez 3

Meter Body Certification
Meter body without material certificate 0

DSC Sensor Material
316L Stainless Steel 0

Conduit Connection
1/2" NPT cable entry 2

Ordering Code
DMV 6320 Transmitter

DMV 6320 – [ ] – [ ]

Power Input	
115 VAC, 50/60 Hz, standard	3
230 VAC, 50/60 Hz	9

Enclosure	
Track mount (minipac) enclosure, NEMA 1; standard	MP
Minipac enclosure with wall mounting bracket	BR
Wall mount plastic enclosure, NEMA 4X	WE

Ordering Information

1. Construct model number by selecting one code from each category.
2. Specify full scale flow rate in GPM (liquids) or ACFM (gas and steam) for 20 mA output.
3. Specify desired pulse weight in gal/pulse (liquids) or actual cubic feet per pulse for scaled pulse output.
4. Supply the following application information:
   a. Process fluid name.
   b. Process fluid temperature, minimum and maximum.
   c. Process working pressure, minimum and maximum..
   d. Process fluid density and viscosity (state reference temperature and pressure).
5. If the DMV 6320 is to be used with an DV 631 Z which is already in the field, please specify the following information from the DV 631 Z nameplate:
   a. K-factor (pul/ft^3).
   b. Nominal sensor size.
6. To order the ZL 6351 Flow Computer, request TSF 6351 for technical information.

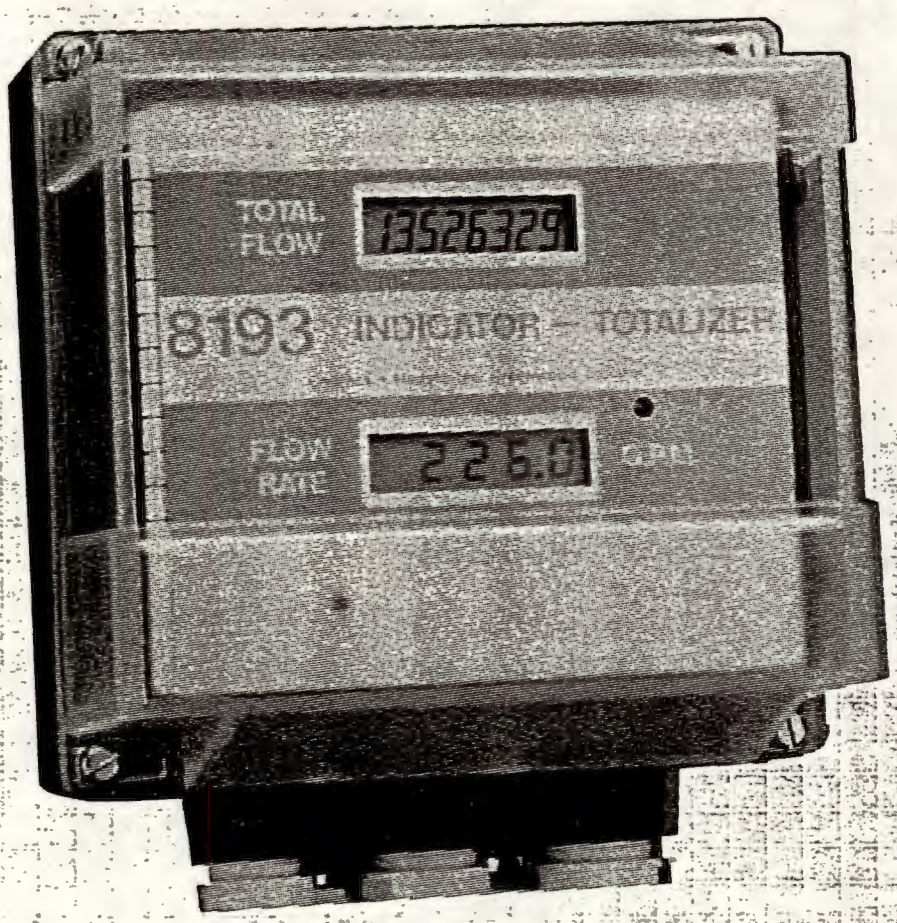
Special options are available, please consult factory.

Endress + Hauser, Inc.
2350 Endress Place
Greenwood, Indiana 46143
Phone: 1-317-535-7138
1-800-428-4344
FAX: 1-317-535-8498

Regional Office
Endress + Hauser
Houston, TX
Phone: 1-713-999-1991
FAX: 1-713-999-1891

Endress+Hauser
Nothing beats know-how

TI 063D/01/ae/12.93



Technical Specifications — Flow Measurement

8190 Series

Remote Indicator / Totalizer

System Features

- Available as 3-1/2 digit LCD indicator or 8 digit LCD totalizer or both
- Engineering units indication available at no additional cost
- Rugged NEMA 4X corrosion resistant enclosure
- Loop powered, no separate power connections required

Indicator:

- Selectable dummy zero to provide 4-1/2 digit display
- Selectable decimal point
- 4-20 mA signal input

Totalizer:

- Includes dry contact remote reset as standard
- 4-24 VDC pulse input
- Battery powered with 8 year life

Application Versatility

The Endress + Hauser 8190 Series Indicator/Totalizer gives the user a choice of 3 models to fit virtually any requirement.

Model 8191 - Indicator only

Model 8192 - Totalizer only

Model 8193 - Indicator/totalizer combination

Each model is housed in a wall mounted enclosure and does not require separate power connections.

For indication, the unit receives flow rate data as a 4-20 mA signal proportional to flow and provides a digital LCD readout.

Full scale flow rates (at 20 mA) can be set to read up to 1999 (19,990 with dummy zero activated). Indication is standardly in G.P.M.; other engineering units available at no additional cost. Decimal point selection is provided using simple dip switches.

The totalizer receives a scaled pulse input that is counted and displayed as total flow. When total flow exceeds 99,999,999 the counter recycles to zero and starts over; or, can be remotely reset at any time using the dry contact reset terminals. A built-in lithium battery powers the totalizer for up to 8 years.

Specifications

Enclosure:

Mounting base is constructed of ABS plastic, corrosion and stain resistant.

Front cover is impact resistant plexiglass, matte finish, with transparent viewing window.

Housing is rated NEMA 4X.

Ambient temperature limits, – 4°F to +122°F.

Totalizer:

LCD 8 digit display, 0.315" character height. Remote reset, via external dry contact closure.

Totalizer is powered by lithium battery, 8 year life.

Maximum input frequency, 5kHz.

Pulse "on" state, 3 to 24 VDC +10%, –15%; pulse "off" state, maximum 0.7 V.

Minimum pulse width, 100 µs.

Input current minimum at 3V, 250 µA; maximum at 24 V, 5mA.

Indicator:

LCD 3-1/2 digit display, 0.35" character height.

Selectable decimal point via dip switches including a dummy zero selection for 4-1/2 digit indication.

Indicator is 2-wire loop powered.

Maximum input resistance is 300 ohms.

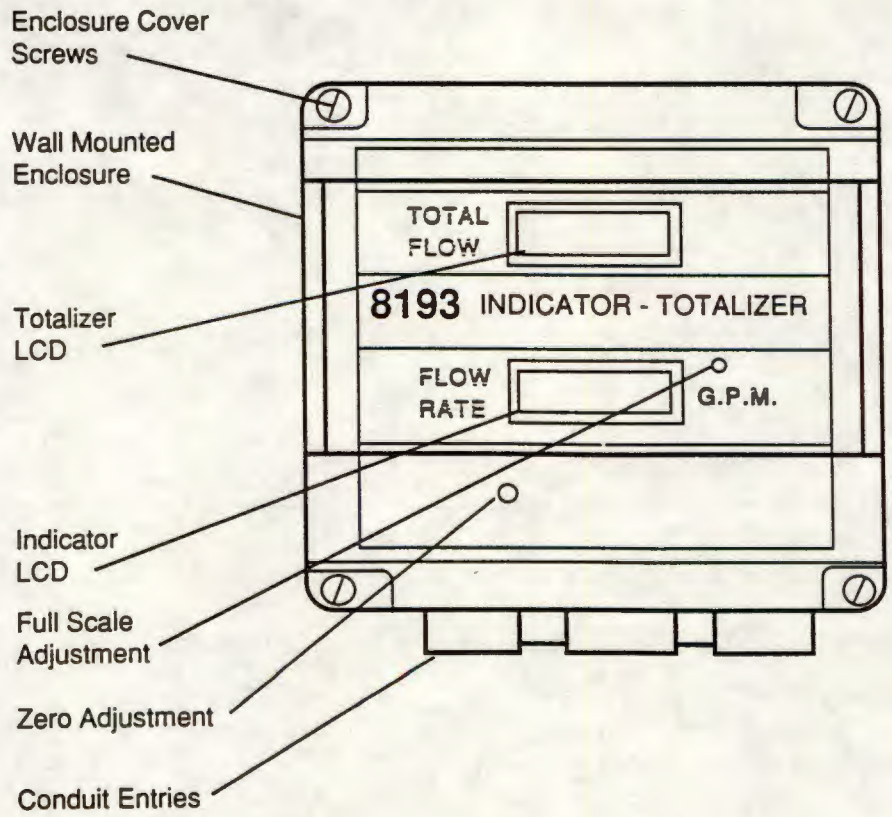
Zero and full scale settings are user adjustable via front panel potentiometers.

Zero range, – 500 to + 480 counts at 4 mA.

Full scale range, 200 to 1999 counts at 20 mA.

Accuracy, ±0.05%.

Linearity, ±1 digit.

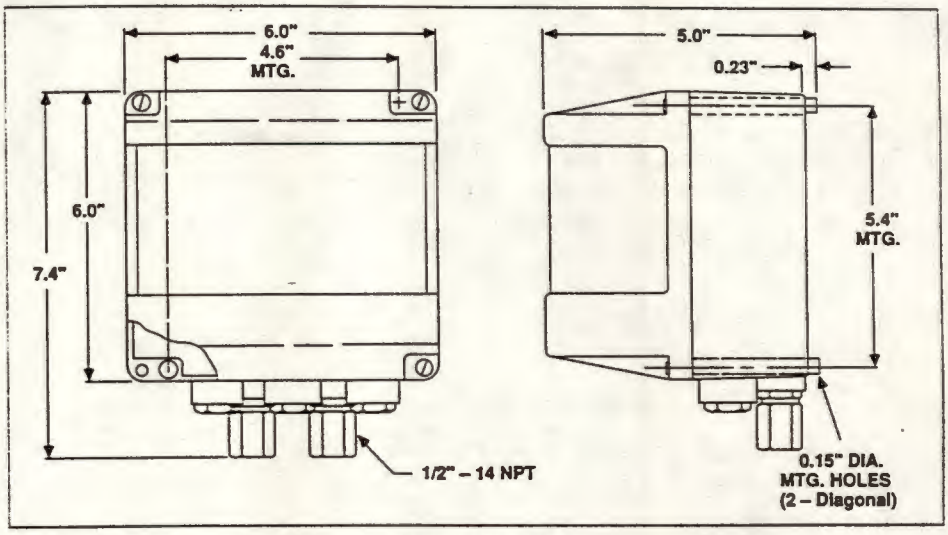


Installation

1. Locate housing per requirements, refering to mounting dimensions.
2. Remove clear housing cover, mount housing base to wall.
3. Locate and remove two panel screws, open hinged panel.
4. Insert wires through conduit entries, connect to terminals as required.

NOTE: Number of terminals provided depends on Model specified.

NOTE: Care should be taken to avoid ingress of moisture through conduit. Drip loops or conduit runs which slope down from enclosure are suggested, in conjunction with sealing of conduit entries.



DIMENSIONS

Adjustments

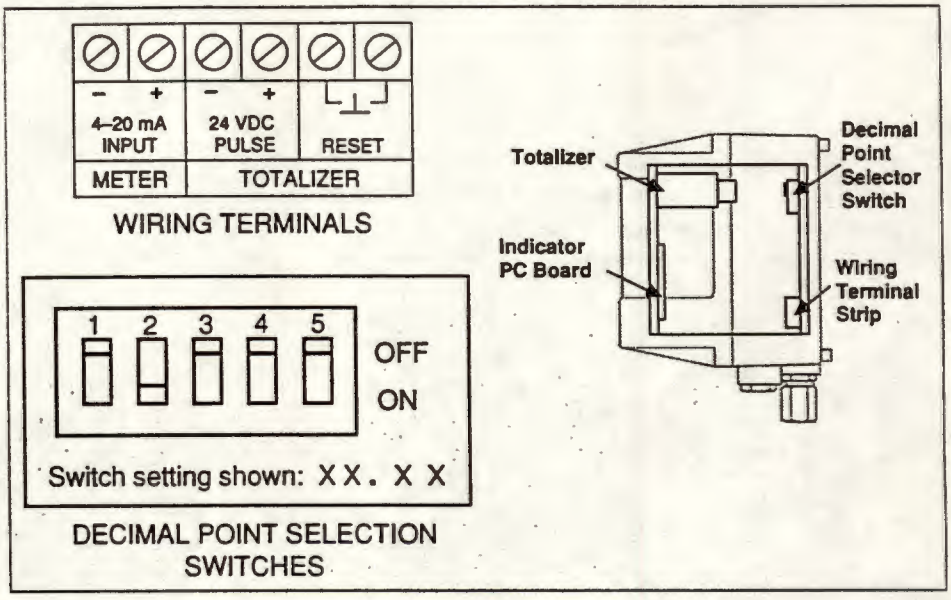
(Models with indicator only)

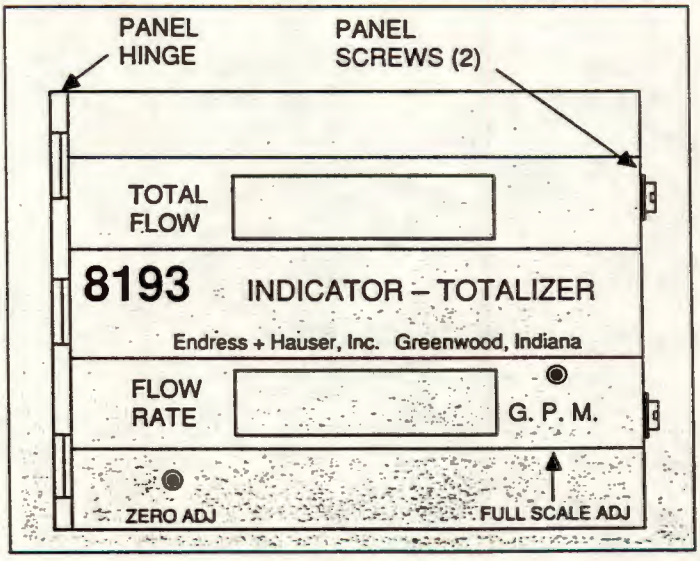
Decimal point select:

1. Locate dip switch block on back PC board behind display panel. Refer to Decimal Point Select chart. (Only one switch is "ON" unless user requires dummy zero activated)

Selector Switch	Decimal Location
1 ON	X.XXX
2 ON	XX.XX
3 ON	XXX.X
4 ON	XXXX (no decimal)
5 ON	Dummy zero active

2. Close panel cover, tighten screws.
3. Adjust indicator zero and full scale with pots located on display panel. (refer to Display Panel diagram)
   a. Connect 4 mA source to meter terminals, adjust zero to desired value. (CW rotation increases value)
   b. Connect 20 mA source to meter terminals, adjust full scale to desired value. (CW rotation increases value)
4. With adjustments complete, re-install housing cover, tighten screws.





DISPLAY PANEL

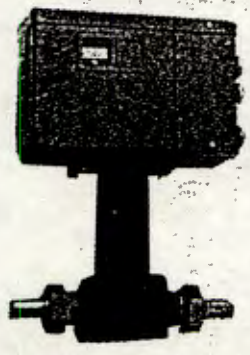
Ordering Information

819 □

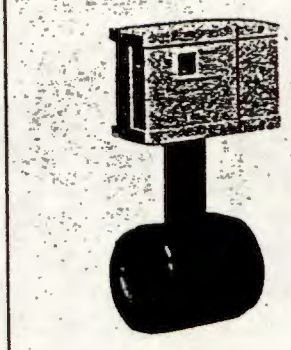
1 – Loop powered indicator, 4–20 mA input, with NEMA 4X wallmount enclosure *
2 – Totalizer with NEMA 4X wall mount enclosure
3 – Indicator / totalizer combination with NEMA 4X wall mount enclosure *

* Specify the desired indicator readings at 4 mA and 20 mA inputs for factory calibration.

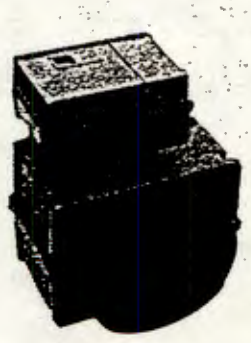
The 8190 Series Indicator/Totalizer is compatible with the flow systems pictured below or any Endress + Hauser flow system where remote indication is needed.



FTI 1941 PICOMAG®



FTI 1942 DISCOMAG®



FTI 1943 VARIOMAX

DSC VORTEX

Measurement and Automation
Level • Flow • Moisture

Endress + Hauser

Endress + Hauser Instruments
2350 Endress Place
Greenwood IN 46143
Phone: 317/535–7138
Telex: 27–2195 (Level Grwd)
Cable: LEVEL Greenwood
Telefax: 317/535–7223
Call Toll Free: 800–428–4344

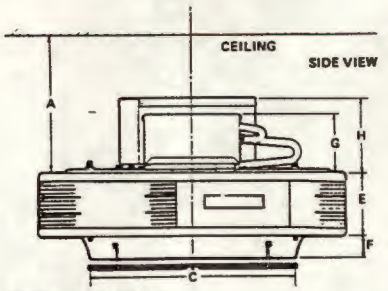
TSF8190B0888

vertical delivery unit heaters (VE series)

These unit heaters deliver air downward. Heat can be beamed, flooded, or gently diffused by selecting the proper air deflector designed to produce the desired heat throw or heat spread pattern. Mounting height, heat throw, and heat spread should be thoroughly evaluated prior to selecting the right air deflector especially if worker comfort is a primary consideration. Heat throw and spread patterns included on the facing page should be used in connection with the accompanying performance table when making a selection of an air deflector.

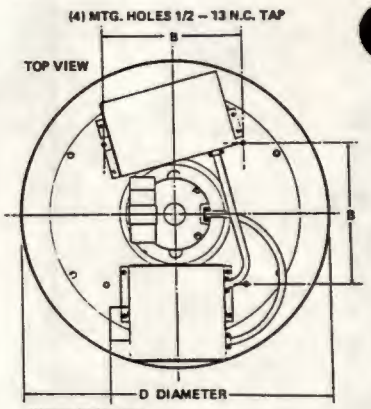
Air deflectors are optional. Please refer to pages 12-13 for optional controls and accessory equipment.

dimensions of unit heaters



MINIMUM CLEARANCES:
AT LEAST 18 IN. FROM CEILING
AND 24 IN. HORIZONTALLY
FROM NEAREST ENCLOSURE.

MODELS VE50 THRU VE250 SHOWN

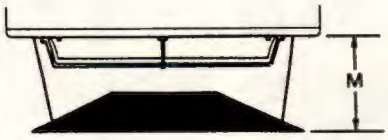


KNOCKOUTS FOR
POWER SUPPLY AND
CONTROL WIRES.

dimensions in inches

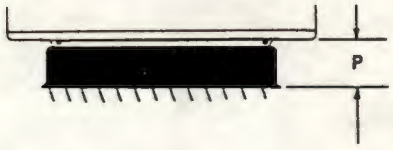
Model	Min. A	B	C	D	E	F	G	H	Fan Dia.	Approx. Ship. Wt. Lbs.
VE50	18	11⅜	14½	24⅞	4¼	3½	4¾	6¼	14	62
VE75	18	11⅜	14½	24⅞	4¼	3½	4¾	6¼	14	64
VE100	18	11⅜	14½	24⅞	5	3½	4¾	6¼	14	66
VE150	18	11⅜	14½	24⅞	5	3½	4¾	6¼	14	70
VE200	18	11⅜	14½	24⅞	5	3½	4¾	6¼	14	72
VE250	18	11⅜	14½	24⅞	5	3½	4¾	6¼	14	73
VE300	18	18⅜	19½	34⅞	8⅝	2¼	4¾	6¼	19	122
VE400	18	18⅜	19½	34⅞	8⅝	2¼	4¾	6¼	19	125
VE500	18	18⅜	19½	34⅞	8⅝	2¼	4¾	6¼	19	129

unit with truncone



unit with cone-jet

unit with louvers



dimensions in inches

Model No.	Truncone M	Cone-Jet L	Louvers P
VE50 - VE250	12½	6½	6½
VE300 - VE500	12½	7½	7½

motor specifications

Model	HP	Volt	Phase	Amp.	Hertz	RPM	Motor Type w/Tol	Bearing Type
VE50-100	1/15	208-230	1	1.28	60	1050	Totally Enclosed Shaded Pole	Sleeve
VE150-250	1/8	208-230	1	1.00	60	1725	Totally Enclosed PSC	Ball
VE300-500	1/6	208-230	1	1.54	60	1075	Totally Enclosed PSC	Ball

performance ratings of unit heaters

Model No.	Heating Data		Electrical Data				Air Data*		
	KW	BTU/HR	Power Code	Supply Volts	Phase	Total Amps	Outlet CFM	Discharge Velocity FPM	Temp. Rise °F
VE50	5.0	17,100	12 31 32 33	240 208 240 480	1 3 3 3	21.4 14.5 12.7 6.7	800	700	21
VE75	7.5	25,600	12 31 32 33	240 208 240 480	1 3 3 3	31.9 21.4 18.6 9.7	800	700	31
VE100	10.0	34,100	12 31 32 33	240 208 240 480	1 3 3 3	42.3 28.3 24.6 12.7	940	820	36
VE150	15.0	51,200	31 32 33	208 240 480	3 3 3	42.5 37.0 19.0	1340	1170	38
VE200	19.0	64,900	32 33	240 480	3 3	46.6 23.8	1600	1400	41
VE250	25.0	85,400	33	480	3	31.0	1600	1400	55
VE300 1-Stage 2-Stage	15.0 30.0	51,200 102,000	33 33	480 480	3 3	19.5 37.6	2575	1240	40
VE400 1-Stage 2-Stage	20.0 40.0	68,300 137,000	33 33	480 480	3 3	25.5 49.6	2575	1240	54
VE500 1-Stage 2-Stage	25.0 50.0	85,400 171,000	33 33	480 480	3 3	31.5 61.5	2575	1240	70

*With 70°F ambient air and heating at full capacity

heat spread and mounting height, with and without deflectors*

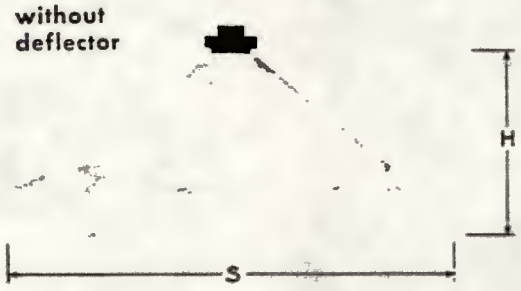
Model No.	With No Deflector		With Deflector							
			Truncone		Cone-Jet		Louvers			
					Blades Open		Blades Open		45° Blades	
	Max. Height (H)	Spread (S)	H	S	H	S	H	S	H	S
VE50	13	20	9	24	18	23	15	13	8	23
VE75	11	17	8	20	15	20	13	11	8	20
VE100	12	18	8	22	17	22	14	12	8	22
VE150	17	26	11	30	23	30	20	17	10	30
VE200	20	30	13	36	27	35	23	20	12	35
VE250	17	26	11	31	23	31	20	18	10	31
VE300	20	31	15	36	28	36	24	21	12	36
VE400	18	27	13	32	24	32	21	18	11	32
VE500	16	24	12	29	22	29	19	16	10	29

With 70°F ambient air and heating at full capacity

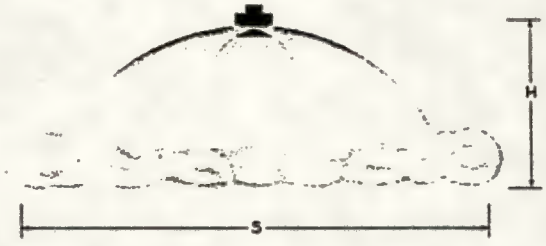
heat spread and mounting height

Refer to the performance table at the bottom of this page for the recommended mounting heights and accompanying heat spread of vertical units without air deflector and with the three air deflectors offered.

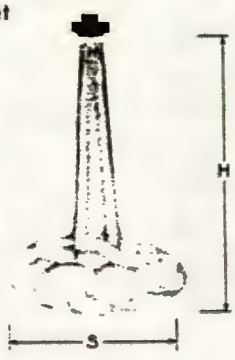
without deflector



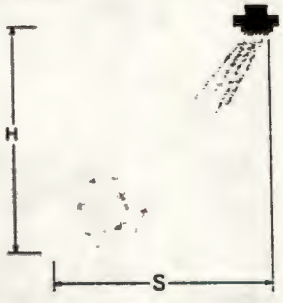
with Truncone



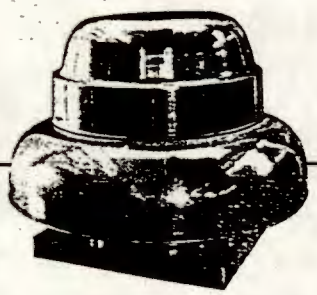
with cone-jet



with louvers



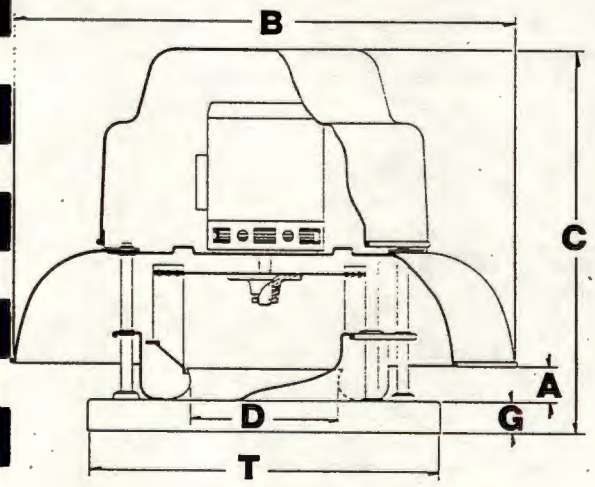
ACE



CENTRIFUGAL ROOF VENTILATOR
Direct and Belt Drive

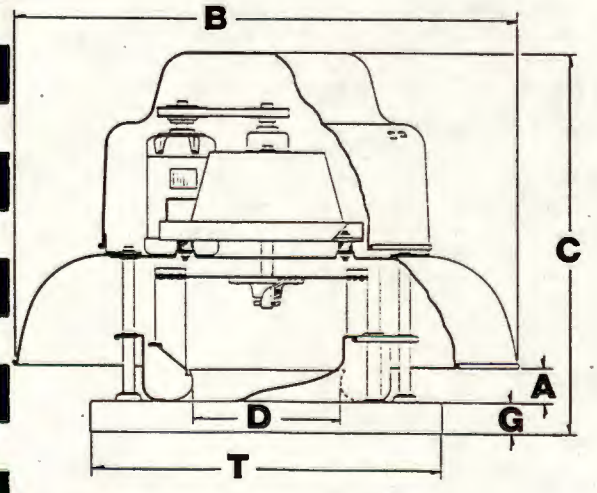
The Type ACE-D and ACE-B roof ventilators are available in either direct or belt drive. All spun parts are of heavy gauge aluminum with a rolled bead for added strength. These units feature an aluminum backward inclined, non-overloading centrifugal wheel. The motor and drives are enclosed in a weathertight compartment, separate from the exhaust airstream and cooled by way of an air passage free of contaminated fumes. These ventilators are AMCA certified for air and sound.

When ventilators require a reinforced wheel you must consult factory for availability.



ACE-D DIMENSIONAL DATA

Size	A	B	C	D	G	T-Sq.	App'x. Ship'g. Wt.
70	2-3/16	13-1/2	13-5/8	5-1/8	2	18	20
90	1-11/16	18-5/8	16-3/8	7-1/4	2	18	28
100	1-11/16	18-5/8	16-3/8	7-1/4	2	18	30
120	2-1/8	28-7/16	23-7/16	8	2	20	67
135	2-7/16	28-7/16	24-3/16	9	2	20	72
150	3-1/2	32-15/16	28-9/16	10	2	24	87
165	3-7/8	32-15/16	30-3/8	11	2	24	90
180	4-3/8	37-13/16	30-3/4	12	3	30	102



ACE-B DIMENSIONAL DATA

Size	A	B	C	D	G	T-Sq.	Ship'g. Wt.-Less Motor
100	2-9/16	23-7/16	19-11/16	6-5/8	2	18	30
120	2-1/8	28-7/16	23-15/16	8	2	20	55
135	2-7/16	28-7/16	24-1/4	9	2	20	60
150	3-1/2	32-15/16	29-1/16	10	2	24	70
165	3-7/8	32-15/16	28-15/16	11	2	24	75
180	4-3/8	37-13/16	31-3/8	12	3	30	90
195	4-5/8	37-13/16	31-5/8	13	3	30	100
210	4-3/4	43-7/16	34-1/4	14	3	30	200
225	4-3/4	43-7/16	34-1/4	15	3	30	220
245	5-11/16	47-1/2	36-12	16-3/8	3	30	240
270	6-1/8	47-1/2	36-13/16	18	3	36	260
300	6-15/16	52-1/2	44-3/8	20	3	36	300
330	7-3/16	52-1/2	44-13/16	22	3	42	365
365	7-15/16	62-1/2	48-3/8	24-3/8	3	42	380
402	9-5/8	62-1/2	50-1/8	27	3	48	440
445	9-7/16	75	54	29-7/8	3	54	500
490	11-3/16	75	55-5/8	32-7/8	3	54	650

LR15267

E35337

The type ACE-D, ACE-B Roof Ventilators are available as Underwriters' Laboratories' listed models. When listed models are required, specify Type ACEDU or ACEBU.

Loren Cook Company certifies that the ACE-D, ACE-B shown hereon are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

The sound ratings shown are loudness values in fan sones at 5 ft. (1.5m) in a hemispherical free field calculated per AMCA Standard 301. Values shown are for installation Type A free inlet fan sone levels.

TYPE ACE-B CENTRIFUGAL ROOF VENTILATOR CAPACITY CHART BELT DRIVE

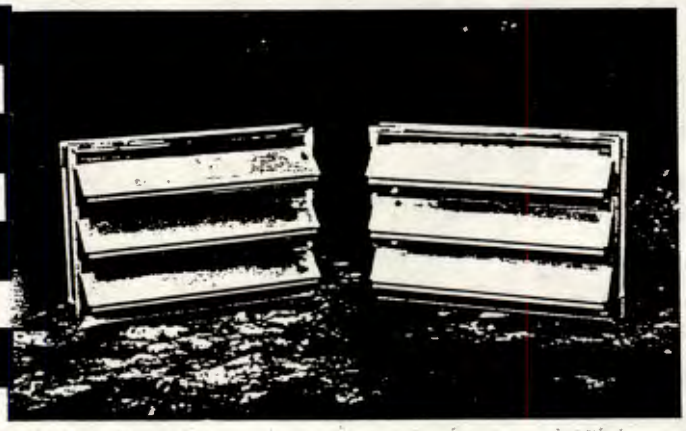
Catalog Number	Motor HP	Fan RPM	Tip Speed	FA Sones	0 SP		1/8 SP		1/4 SP		3/8 SP		1/2 SP		5/8 SP		3/4 SP		7/8 SP		1 SP		1-1/4 SP		1-1/2 SP		2 SP		Mtr. & Dr. Wt.
					CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	
180C8B	1½	1305	6147	23.0	4805	1.11	4716	1.13	4625	1.15	4533	1.13	4436	1.16	4335	1.19	4223	1.24	4085	1.25	3902	1.27	3567	1.27	2949	1.22			38
		1425	6712	26.0	5247	1.45	5166	1.44	5083	1.45	4998	1.49	4912	1.53	4824	1.57	4730	1.55	4628	1.58	4508	1.63	4191	1.65	3881	1.65	1545	.94	38
180C9B	2	1470	6924	28.0	5412	1.59	5334	1.58	5254	1.60	5172	1.64	5089	1.68	5004	1.66	4914	1.71	4819	1.75	4713	1.77	4419	1.81	4130	1.81	2110	1.21	50
		1565	7371	31.0	5762	1.92	5689	1.91	5613	1.94	5537	1.99	5460	1.96	5381	2.02	5300	2.08	5215	2.05	5125	2.11	4907	2.16	4611	2.19	3931	2.15	50
195C2B	1/6	500	2575	5.6	2341	.09	2068	.10	1515	.10																			15
		595	3064	7.6	2785	.15	2566	.16	2243	.18	1611	.17																	15
195C3B	1/4	625	3219	8.1	2926	.18	2718	.19	2441	.20	1992	.20																	15
		685	3528	9.4	3207	.24	3019	.25	2803	.26	2467	.27	1809	.25															15
195C4B	1/3	705	3631	10.0	3300	.26	3118	.26	2914	.28	2596	.29	2118	.29															19
		755	3888	11.3	3534	.32	3365	.33	3182	.34	2919	.36	2595	.36	1315	.24													19
195C5B	1/2	790	4069	12.1	3698	.36	3537	.38	3364	.39	3147	.41	2843	.42	2389	.41	564	.16											23
		865	4455	14.0	4049	.48	3903	.50	3748	.50	3577	.52	3325	.55	3055	.55	2612	.53	1085	.29									23
195C6B	3/4	905	4661	15.2	4236	.56	4097	.55	3950	.58	3792	.61	3589	.62	3319	.63	3017	.62	2352	.59									31
		985	5073	17.6	4611	.71	4483	.72	4350	.72	4210	.77	4055	.77	3838	.81	3595	.81	3323	.80	2845	.78	1330	.47					31
195C7B	1	1020	5253	18.5	4775	.79	4651	.80	4524	.81	4391	.86	4245	.87	4063	.89	3817	.90	3590	.90	3247	.89	734	.35					36
		1090	5614	21.0	5102	.96	4987	.98	4868	.99	4745	1.01	4616	1.03	4470	1.08	4277	1.09	4049	1.10	3835	1.10	3012	1.05					36
195C8B	1½	1140	5871	22.0	5336	1.10	5226	1.12	5113	1.14	4997	1.17	4875	1.19	4744	1.21	4587	1.25	4370	1.26	4168	1.26	3627	1.24	1587	.72			38
		1245	6412	25.0	5828	1.44	5728	1.43	5625	1.44	5519	1.47	5411	1.51	5298	1.55	5176	1.58	5036	1.60	4848	1.64	4467	1.64	3934	1.62			38
195C9B	2	1285	6618	26.0	6015	1.58	5918	1.57	5818	1.59	5717	1.62	5612	1.67	5505	1.71	5391	1.75	5263	1.77	5108	1.80	4726	1.81	4310	1.79			50
		1370	7056	28.0	6413	1.92	6322	1.91	6229	1.93	6134	1.98	6038	2.04	5938	2.01	5835	2.07	5726	2.11	5605	2.14	5273	2.19	4934	2.19	3618	2.04	50
210C2B	1/6	435	2392	4.9	2543	.08	2193	.10	809	.06																			15
		530	2915	7.1	3099	.16	2832	.17	2423	.18	936	.11																	15
210C3B	1/4	555	3053	7.8	3245	.18	2992	.19	2621	.21	1927	.20																	15
		605	3328	8.9	3537	.24	3307	.25	3025	.27	2585	.27	860	.14															15
210C4B	1/3	625	3438	9.5	3654	.26	3432	.28	3172	.29	2758	.30	1322	.19															19
		665	3658	10.4	3888	.31	3681	.32	3449	.34	3093	.36	2602	.35															19
210C5B	1/2	695	3823	11.3	4063	.36	3865	.37	3650	.38	3335	.41	2950	.41	1408	.26													23
		765	4208	13.3	4473	.48	4294	.50	4104	.52	3882	.54	3549	.55	3171	.55	1611	.35											23
210C6B	3/4	800	4400	14.1	4677	.55	4507	.57	4327	.58	4127	.60	3830	.63	3514	.63	2982	.61	1122	.33									31
		870	4785	16.4	5087	.71	4930	.71	4767	.75	4594	.76	4386	.80	4084	.81	3792	.81	3307	.79	1618	.49							31
210C7B	1	900	4950	17.6	5262	.79	5111	.79	4954	.83	4788	.85	4600	.88	4328	.90	4050	.90	3693	.89	2986	.86							36
		960	5280	19.1	5613	.95	5472	.97	5326	.98	5174	.99	5009	1.05	4809	1.08	4529	1.09	4274	1.09	3923	1.08	1504	.57					36
210C8B	1½	1005	5528	21.0	5876	1.10	5741	1.11	5602	1.13	5459	1.15	5307	1.17	5134	1.22	4901	1.25	4639	1.25	4383	1.25	3285	1.17					38
		1100	6050	25.0	6431	1.44	6309	1.46	6183	1.49	6054	1.53	5920	1.50	5779	1.53	5618	1.61	5412	1.63	5162	1.64	4675	1.64	3559	1.55			38
210C9B	2	1135	6243	25.0	6636	1.58	6517	1.61	6396	1.64	6271	1.61	6142	1.65	6007	1.69	5860	1.73	5684	1.78	5446	1.80	5003	1.80	4271	1.76			50
		1210	6655	28.0	7074	1.92	6963	1.90	6849	1.92	6733	1.97	6614	2.02	6492	2.07	6363	2.04	6222	2.09	6051	2.16	5614	2.18	5171	2.18	1721	1.13	50
225C3B	1/4	440	2592	6.1	3205	.14	2748	.15	2268	.15																			15
		530	3122	8.6	3861	.24	3505	.26	3078	.27	2517	.26																	15
225C4B	1/3	545	3210	8.9	3970	.26	3626	.28	3202	.29	2870	.29																	19
		585	3446	9.9	4261	.33	3945	.35	3555	.36	3284	.36																	19
225C5B	1/2	610	3593	10.7	4443	.37	4141	.39	3778	.41	3473	.41	2981	.40															23
		665	3917	12.4	4844	.48	4570	.51	4257	.52	3901	.54	3706	.53	2841	.48													23
225C6B	3/4	695	4094	13.1	5062	.55	4801	.58	4508	.60	4162	.61	3941	.61	3574	.60													31
		760	4477	15.5	5536	.73	5298	.75	5041	.77	4742	.79	4437	.80	4278	.80	3893	.79											31
225C7B	1	785	4624	16.2	5718	.80	5489	.82	5242	.85	4960	.87	4651	.88	4465	.89	4244	.88	3283	.79									36
		840	4948	18.0	6119	.98	5905	1.01	5679	1.03	5428	1.06	5141	1.08	4883	1.09	4743	1.09	4487	1.07	3544	.97							36
225C8B	1½	880	5184	19.4	6410	1.13	6207	1.16	5992	1.18	5761	1.21	5497	1.23	5221	1.25	5039	1.25	4905	1.25	4536	1.23							38
		965	5684	23.0	7029	1.49	6845	1.52	6652	1.55	6448	1.58	6226	1.60	5978	1.63	5728	1.64	5552	1.65	5440	1.65	4725	1.59					38
225C9B	2	990	5832	24.0	7211	1.61	7032	1.64	6845	1.67	6648	1.70	6435	1.73	6199	1.75	5949	1.77	5747	1.78	5627	1.78	5167	1.75					50
		1060	6244	26.0	7721	1.98	7554	2.01	7380	2.04	7200	2.07	7009	2.10	6803	2.13	6575	2.16	6343	2.18	6156	2.19	5931	2.18	5234	2.12			50
245C3B	1/4	375	2404	5.1	3526	.14	3008	.15	1131	.09																			15
		450	2885	7.1	4231	.25	3818	.26	3236	.27																			15
245C4B	1/3	465	2981	7.5	4372	.27	3973	.29	3432	.30	2023	.25																	19
		490	3141	8.5	4608	.32	4230	.33	3750	.35	2960	.34																	19
245C5B	1/2	515	3301	9.1	4843	.37	4484	.38	4064	.40	3451	.41																	23
		565	3622	11.1	5313	.50	4986	.51	4644	.53	4145	.54	3395	.53															23
245C6B	3/4	590	3782	11.5	5548	.56	5236	.57	4912	.60	4465	.61	3910	.61	1592	.35													31
		645	4134	13.3	6065	.73	5780	.75	5488	.77	5155	.79	4690	.80	4111	.79	1648	.44											31
245C7B	1	670	4295	14.4	6300	.82	6026	.84	5746	.87	5446	.89	5013	.89	4535	.90	3347	.80											36
		715	4583	15.7	6723	1.00	6467	1.00	6206	1.03	5936	1.06	5580	1.09	5162	1.09	4661	1.09	3306	.96									36
245C8B	1½	750	4808	17.3	7052	1.15	6808	1.16	6560	1.20	6306	1.23	6015	1.25	5616	1.26	5203	1.27	4564	1.23	2262	.78							38
		820	5256	19.5	7711	1.51	7487	1.52	7261	1.53	7032	1.59	6794	1.60	6498	1.64	6132	1.64	5758	1.65	5279	1.65							38
245C9B	2	845	5416	21.0	7946	1.65	7729	1.67	7510	1.68	7288	1.70	7060	1.76	6802	1.79	6448	1.80	6095	1.81	5698	1.81	3196	1.39					50
		900	5769	23.0	8463	2.00	8259	2.02	8054	2.04	7847	2.07	7636	2.10	7415	2.15	7140	2.17	6805	2.18	6472	2.18	5546	2.16	1498	.97			50
270C3B	1/4	335	2368	5.1	4216	.16	3567	.18																					15
		385	2722	6.5	4845	.25	4310	.27	3493	.27																			15
270C4B	1/3	395	2793	6.9	4971	.27	4451	.28	3687	.30																			19
		420	2969	7.6	5286	.33	4798	.34	4135	.36	2136	.27																	19
270C5B	1/2	440	3111	8.2	5538	.38	5074	.39	4476	.41	3397	.39																	23
		480	3394	9.8	6041	.49	5617	.51	5146	.53	4444	.54																	23
270C6B	3/4	505	3570	11.1	6356	.57	5953	.59	5528	.61	4900	.62	3765	.59															31
		550	3889	12.7	6922	.74	6553	.75	6173	.79	5669	.80	5050	.81	3476	.70													31
270C7B	1	570	4030	13.5	7174	.82	6818	.84	6453	.86	6006	.89	5424	.90	4477	.87													36
		605	4277	14.8	7614	.98	7279	1.01	6938	1.04	6569	1.06	6037	1.07	5447	1.08	3926	.95											36
270C8B	1½	635	4489	16.0	7992	1.14	7673	1.17	7349	1.17	7011	1.23	6545	1.24	6023	1.25	5295	1.23	2427	.74									38
		695	4914	17.9	8747	1.49	8456	1.50	8161	1.55	7861	1.56	7531	1.62	7065	1.62	6586	1.64	5973	1.63	4362	1.43							38

For additional capacities see Catalog AC-July 1991.

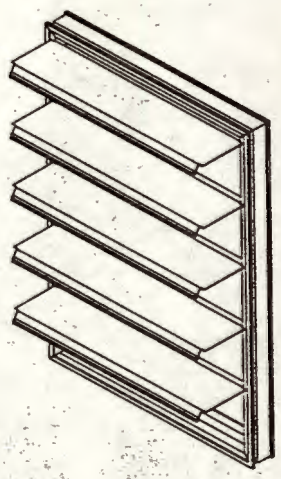
BHP does not include drive loss.

Extruded Aluminum
BD2/A1 and BD2/A2 Backdraft Dampers
Standard Performance

Extruded aluminum construction highlights these products, developed for light backdraft duty in commercial applications.



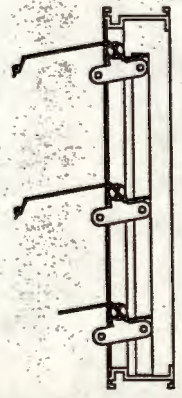
BD2/A1, BD2/A2



BD2A1/A2

Specification (BD2/A1 and BD2/A2)

Furnish and install, at locations shown on plans, or in accordance with schedules, backdraft dampers that meet the following minimum construction standards: frame shall be .090" (2.3) 6063-T5 extruded aluminum wall thickness with mitered corners. Blades shall be (specify) .025" (.6) formed aluminum with extruded vinyl edge seals or .050" (1.3) 6063-T5 extruded aluminum with extruded vinyl edge seals. Blade edge seals shall be mechanically locked into blade edge; adhesive type seals are unacceptable. Bearings shall be corrosion resistant synthetic and linkage shall be concealed in frame for low pressure drop and noise. Damper shall be in all respects equivalent to Ruskin Model (specify) BD2/A1 or BD2/A2.



SPECIFICATIONS

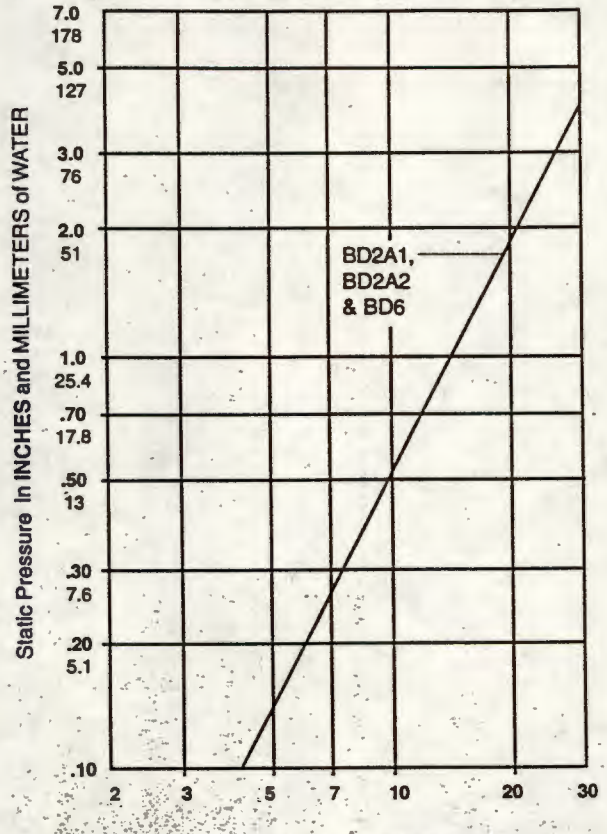
DAMPER TYPE	BLADE MATL. (NOM.)	FRAME MATL. (NOM.)	LINKAGE	BEARINGS	TEMP. LIMITS	MIN. SIZE	MAX. SIZE	MAX. SPOT VELOCITY
BD2/A1	.025" (.6) formed alum.	.090" (2.3) 6063-T5 ext. alum.	Concealed in frame	Synthetic	-40°F to +200°F (-40°C to +93°C)	6" x 6" (152 x 152)	40" x 48" (1016 x 1219)	1500 FPM
BD2/A2	.050" (1.2) 6063-T5 ext. alum.	.090" (2.3) 6063-T5 ext. alum.	Concealed in frame	Synthetic	-40°F to +200°F (-40°C to +93°C)	6" x 6" (152 x 152)	40" x 48" (1016 x 1219)	2500 FPM

See page 59 for BD2/A1 and BD2/A2 performance data.

Dimensions in parentheses ( ) indicate millimeters.

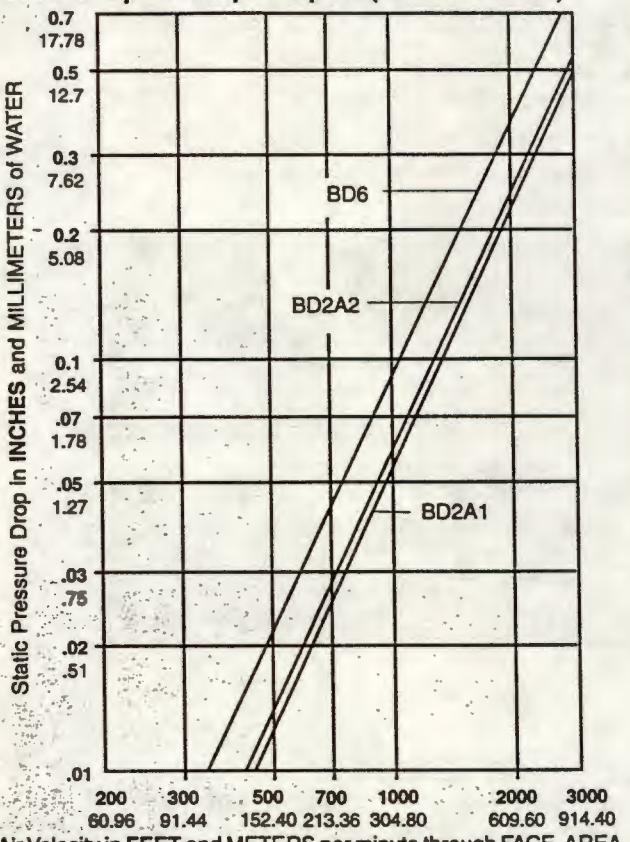
Performance Data

Air Leakage - Damper Closed (Max width)



Air Leakage in **CFM/Sq. Ft.** through FACE AREA.
Tested per AMCA Std. 500, Fig. 5.5, plenum mounted.

Pressure Drop - Damper Open (24" x 24" size)



Air Velocity in **FEET** and METERS per minute through FACE AREA.
Tested per AMCA Std. 500, Fig. 5.5, plenum mounted.

BD2/A1 PERFORMANCE DATA

DAMPER WIDTH INCHES (MM)	MAXIMUM BACK PRESSURE (External wind vel.)	MAXIMUM SYSTEM VELOCITY	LEAKAGE*		BLADES START TO OPEN	BLADES FULLY OPEN
			Percent of Max. Flow	CFM/Sq. Ft.		
40" (1016)	55 mph/1.5" w.g.	1000 FPM	1.5%	15	.03" w.g.	.10" w.g.
36" (914)	70 mph/2.5" w.g.	1000 FPM	1.5%	15		
24" (610)	85 mph/3.5" w.g.	1000 FPM	2.0%	20		
12" (305)	95 mph/4.5" w.g.	1000 FPM	4.0%	40		

BD2/A2 PERFORMANCE DATA

DAMPER WIDTH INCHES (MM)	MAXIMUM BACK PRESSURE (External wind vel.)	MAXIMUM SYSTEM VELOCITY	LEAKAGE*		BLADES START TO OPEN	BLADES FULLY OPEN
			Percent of Max. Flow	CFM/Sq. Ft.		
40" (1016)	75 mph/3.0" w.g.	1500 FPM	1.0%	15	.10" w.g.	.15" w.g.
36" (914)	90 mph/4.0" w.g.	1500 FPM	1.0%	15		
24" (610)	100 mph/5.0" w.g.	1500 FPM	1.2%	17.5		
12" (305)	110 mph/6.0" w.g.	1500 FPM	2.7%	40		

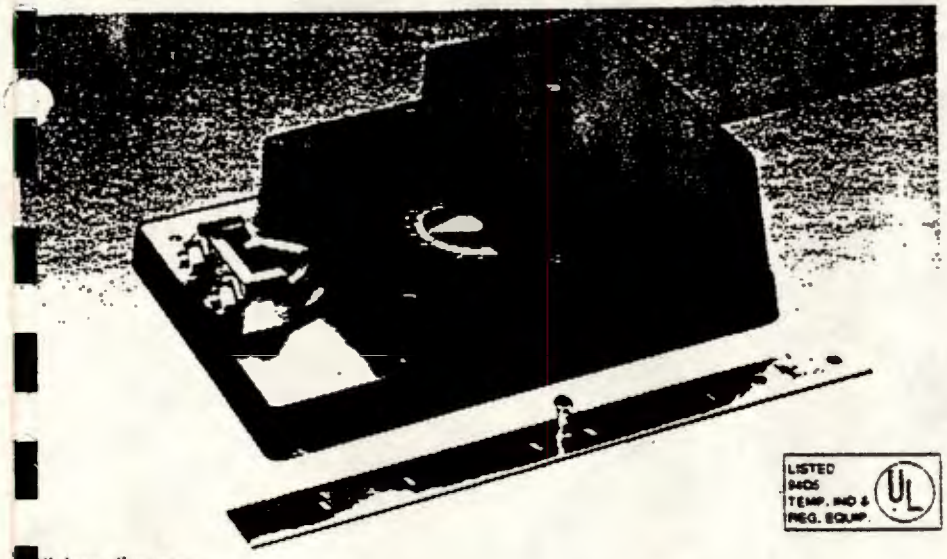
BD6 PERFORMANCE DATA

DAMPER WIDTH INCHES (MM)	MAXIMUM BACK PRESSURE (External wind vel.)	MAXIMUM SYSTEM VELOCITY	LEAKAGE*		BLADES START TO OPEN	BLADES FULLY OPEN
			Percent of Max. Flow	CFM/Sq. Ft.		
48" (1219)	4.0" w.g.	2500 FPM	.6%	15	.12" w.g.	.20" w.g.
36" (914)	8.0" w.g.	2500 FPM	.6%	15		
24" (610)	12.0" w.g.	2500 FPM	.7%	17.5		
12" (305)	16.0" w.g.	2500 FPM	1%	25		

* Leakage information based on pressure differential of 1" w.g. tested per AMCA Std. 500.

Direct coupled damper actuator SMC 24-SR

Proportional damper actuator 24 V for 0 . . . 10 VDC, 0 . . . 20 V phasecut and 4 . . . 20 mA control signal. Output signal of 2 . . . 10 VDC for position indication.



Torque min. 88 in-lb, for control of damper surface up to 24 ft². UL listed.

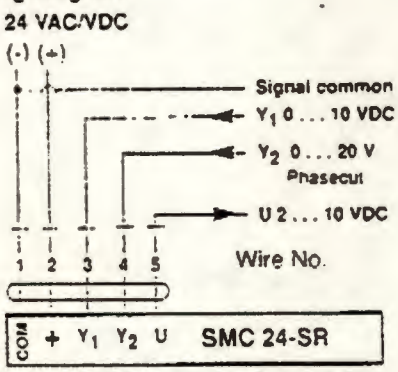
Application

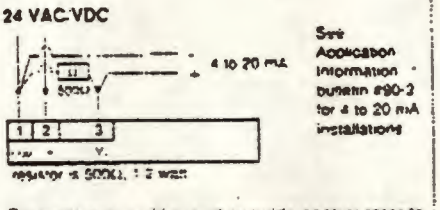
For modulating control of dampers up to approximately 24 ft² [2 m²] (based on 4 in-lb per sq. ft.). Actual actuator sizing should be done in accordance with the damper manufacturer's specifications.
The damper actuator has a built-in position signal output.
Control is with a 0 . . . 10 VDC. 0 . . . 20 V phasecut or, with the addition of a 500Ω resistor, a 4 . . . 20mA control signal from either an electronic controller or positioner.
The measuring voltage 'U' allows either an electrical 0 . . . 100% indication or alternatively a master-slave control of several SMC 24-SR actuators.

Operation

The actuator is, by means of a special clamp, directly mounted onto the damper shaft.
The universal mounting bracket supplied with the actuator will prevent lateral movement of the actuator. The damper actuator is not provided with and does not require any limiting switches, but is protected against overloading. The angle of rotation is mechanically limited to 95°. When reaching the damper or actuator end position, the motor stops automatically. The gears can be manually disengaged by simply pressing down the spring loaded button on the actuator cover.
When this button is pressed down, the damper blades can be adjusted by hand.
The position of the actuator is indicated by means of a scale reading 0 . . . 10.

Wiring diagram





For minimum position and override control refer to the SM24-SR literature or consult the controls companies' literature.

Parallel connection of several actuators possible. Power consumption must be observed.

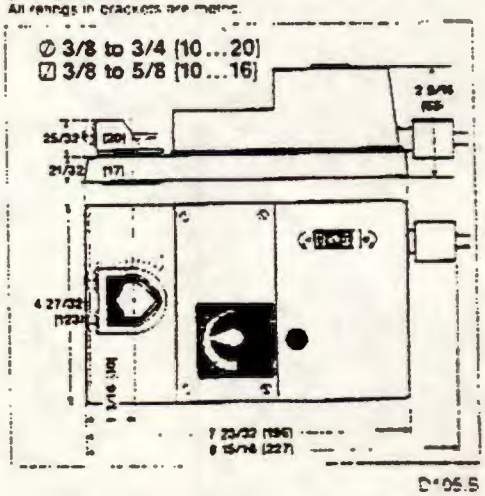
Technical Data	SMC 24-SR		
Power supply	24 VAC ± 20% 50/60 Hz 24 VDC ± 10%		
Power consumption	2 W		
Transformer sizing	5 VA		
Electrical connection	3 ft. 18 GA cable, 1/2" conduit connector		
Control signal Y	Y_1 0 . . . 10 VDC	Y_2 0 . . . 20 V phasecut	4 . . . 20 mA
Input impedance	100kΩ (0.1 mA)	8kΩ (50 mW)	500Ω
Operating range	2 . . . 10 VDC	2 . . . 10 V phasecut	4 . . . 20 mA
Parallel running	± 5%		
Measuring voltage 'U'	2 . . . 10 VDC (max. 0.5 mA) for 0 . . . 100%		
Angle of rotation	mechanically limited to 95°		
Torque at rated voltage	min. 88 in-lb [10Nm], max. 120 in-lb [13.5 Nm]		
Direction of rotation	reversible with switch A/B with Y= 0 volt A=0 stop ↶ B= 10 ↷		
Position indication	0 . . . 10 (0= stop ↶) and reversible indicator		
Running time	55 . . . 110 sec for 0 to 88 in-lb [0 to 10 Nm]		
Humidity	5 to 95% RH noncondensing		
Ambient temperature	-22°F to +122°F [-30°C to +50°C]		
Storage temperature	-40°F to +176°F [-40°C to +80°C]		
Housing type	NEMA type 2		
Housing material rating	UL 94 - VØ (flammability rating)		
Noise level	max. 45 dB (A)		
Servicing	maintenance free		
Weight	3.2 lbs. [1.46 kg]		

Accessories

S1, S2	Auxiliary switches
P. . .	Feedback potentiometer
ZG-SM2	Accessory for connecting damper linkage
ZDB	Angle of rotation limiter
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-H2	Actuator operator handle
ZS-100	Weather shield

Dimensions

All ratings in brackets are metric.



D-05.5

Model INDUSTRIAL RCDL

Nutating Disc Meter

Technical Brief

General

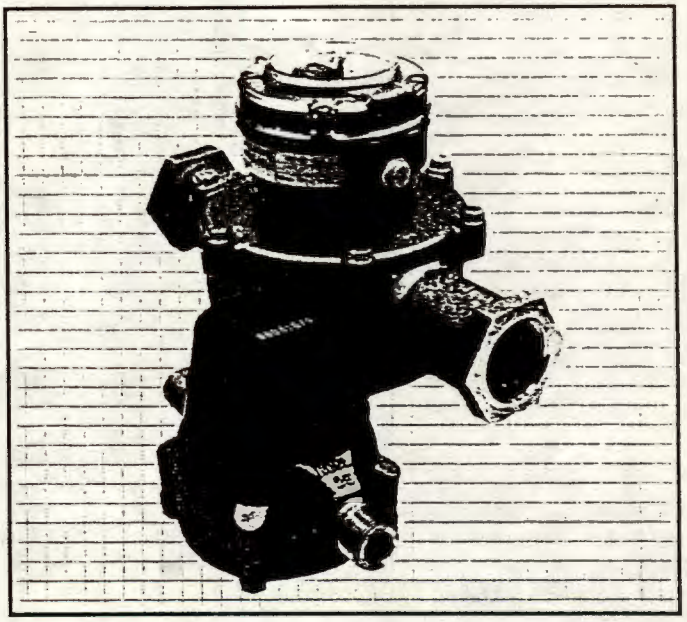
Badger's RCDL positive displacement meters are one of the most cost effective methods in metering industrial fluids. The RCDL meter's simple but efficient design assures high accuracy and repeatability over the entire meter flow range.

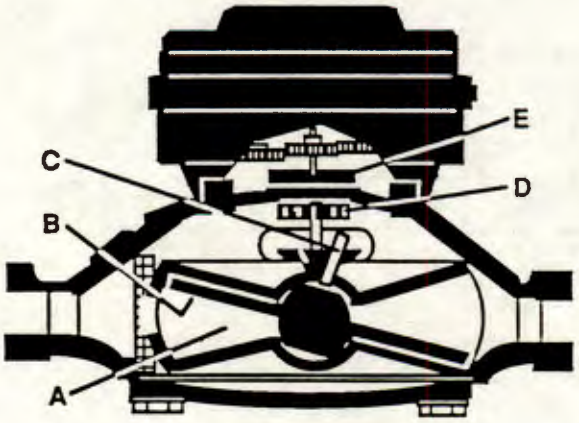
Made in five sizes, 1/2" thru 2" for flows up to 160 GPM, these meters are extremely rugged and reliable. With only three internal moving parts, maintenance is seldom required. If necessary, it takes but a few minutes. All parts are designed and built of materials to meet your application, providing you with long life and a trouble-free, precision flow meter.

To complement the RCDL meter line, Badger offers a complete line of accessories that includes totalizers, electromechanical and electronic transmitters, rate of flow indicators and batch/process controllers.

Operation

The metering principle, known as positive displacement, is based on the continuous filling and discharging of the measuring chamber. Controlled clearances between the disc and the chamber insure minimum leakage for precise measurement of each volume cycle. As the disc nutates, the center spindle rotates a magnet, whose movement is sensed through the meter wall by a follower magnet or by electronic sensors. Each revolution of the magnet is equivalent to a fixed volume of fluid, which is converted to any engineering unit of measure for totalization, indication or process control.





Liquid flowing through the meter chamber **(A)** causes a disc **(B)** to nutate or wobble. This motion, in turn, results in the rotation of a spindle **(C)** and drive magnet **(D)**. Rotation is transmitted through the wall of the meter to a second magnet **(E)** which operates the transmitter.

Main Features

Accuracy: ±1.5% (Over full range)

Repeatability: ± 0.5%

Extended 50:1 flow range.

Operating temperature: 32° to 120° F
(M-25 Bronze only): 32° to 250° F

Rugged bronze housing.

Wide range of compatible accessories.

Easily maintained without removing from line.

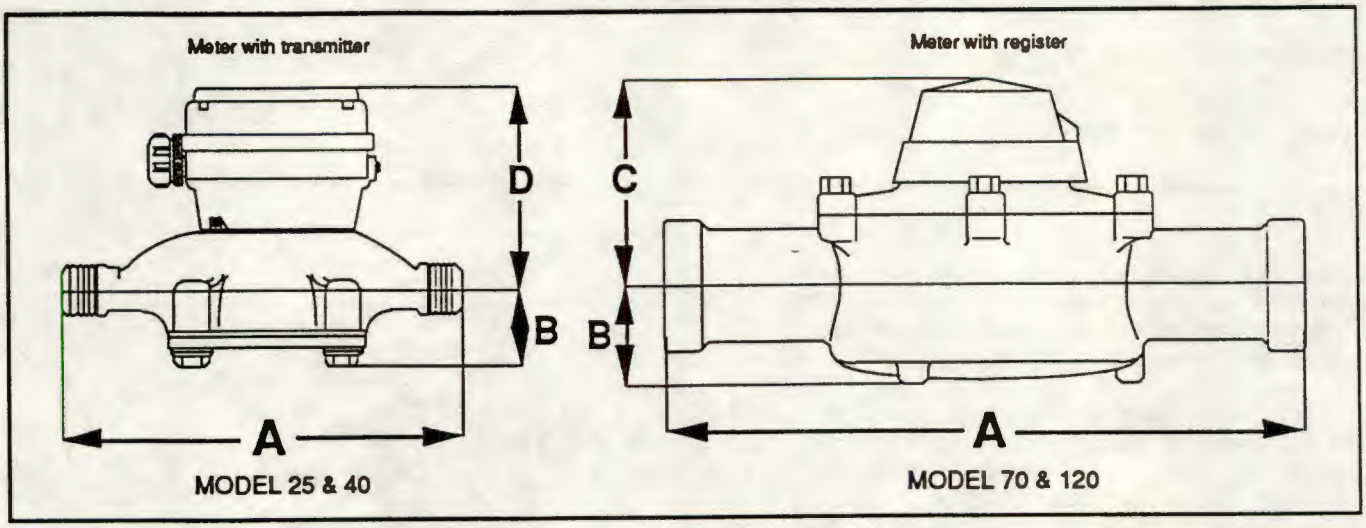
Durable components for minimal maintenance.

Direct replacement for SC-ER.

BadgerMeter,Inc. Industrial Division
4545 W. Brown Deer Road, P.O. Box 23099, Milwaukee, WI 53223-0099

(414) 355-0400 Fax: (414) 355-7499 Telex: WU 2-6757 — RCA 201313

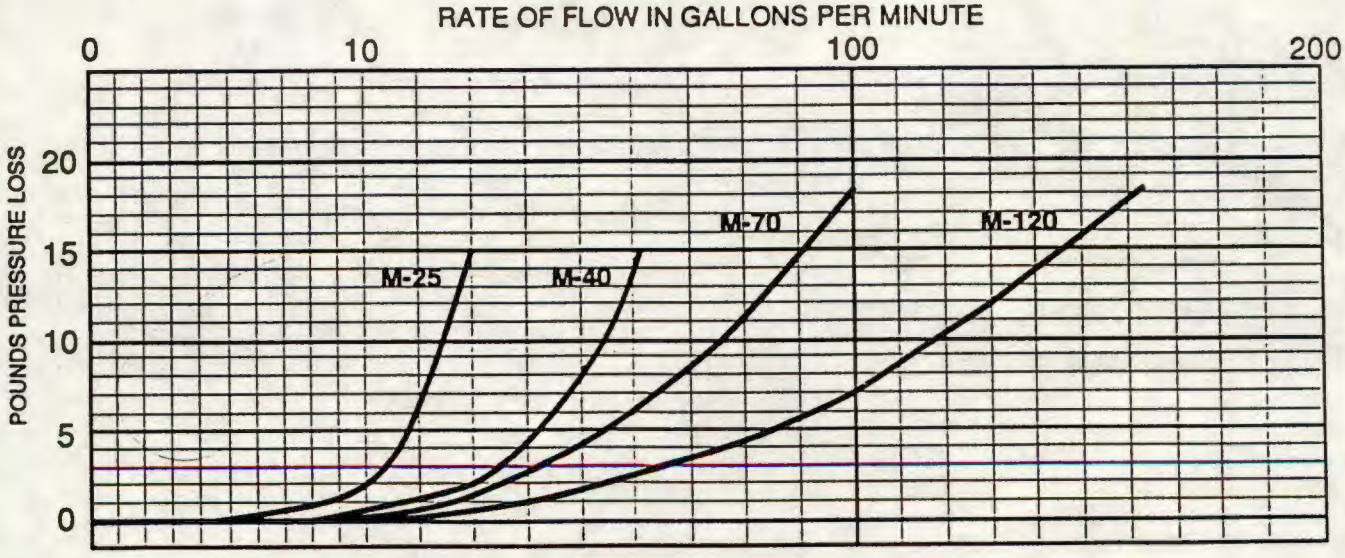
INSTALLATION DIMENSIONS



METER SPECIFICATIONS

				Dimensions Inches					
Meter Model	Meter Size Inches	Flow Range GPM	End Connections	Laying Length A	Centerline To Base B	Register Height C	Transmitter Height D	Maximun Pressure Loss-PSI	Approx. Weight Pounds
M-25	5/8	1/2-25	NPT - Male	7.50	1.69	3.30	4.40	15	5
M-25	3/4	1/2-30	NPT - Male	7.50	1.69	3.30	4.40	15	5
M-40	1	3/4-50	NPT - Male	10.75	1.94	3.75	4.75	15	12
M-70	1 1/2	11/4-100	NPT - Female	12.62	2.06	4.94	5.94	15	24
M-120	2	21/4-160	NPT - Female	15.25	2.38	7.38	8.38	19	35

PRESSURE LOSS CHART
INDUSTRIAL DISC METERS



How to use the SPILLBLOCKER™

PROTECTIVE BARRIER TO CONFINE, DIVERT, OR BLOCK LIQUIDS WITHOUT ABSORBING THEM

Follow these easy steps to assure maximum effectiveness:

1. Deploying the SPILLBLOCKER™ Dike.

NOTE: The SPILLBLOCKER™ Dike performs best when used on a smooth surface.

A. Use the SPILLBLOCKER™ Dike as desired with the widest base down, making sure no debris interferes with a proper floor seal.

If longer lengths are needed, deploy the additional SPILLBLOCKER™ Dike(s) end-to-end using the SPILLBLOCKER™ Dike Connector at the joints to ensure a proper connection.

2. Always wash the SPILLBLOCKER™ Dike before reuse or storage.

Wash the SPILLBLOCKER™ Dike and Connector using warm water with a non-abrasive detergent or petroleum solvent cleaner.

B. Dry the SPILLBLOCKER™ Dike and Connector before storage.

To repackage the SPILLBLOCKER™ Dike in its response box, start at the center, placing the Dike on its side with the widest base facing inward. Allow the Dike to fully relax while repackaging. Also store the Connector in a corner of the response box to ensure preparedness.

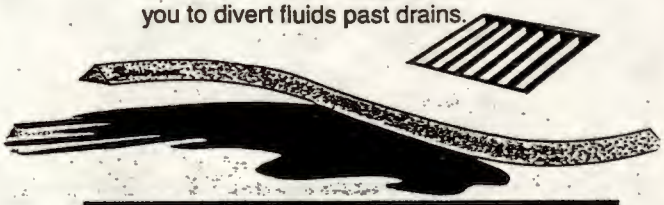
D. Store the SPILLBLOCKER™ Dike out of direct sunlight and at room temperature. Always lay the box flat.

A

Confine liquids at the source of the spill for easy cleanup with absorbents, vacuum, or other means.

B

SPILLBLOCKER™ Dike allows you to divert fluids past drains.



IMPORTANT NOTES:

1. **Never allow the SPILLBLOCKER™ Dike to touch itself for long periods of time.**
2. **The SPILLBLOCKER™ Dike will become less flexible if stored in cold temperatures.**

If the SPILLBLOCKER™ Dike comes into contact with hazardous chemicals, always follow your state and local regulations regarding proper decontamination and waste handling procedures.

These chemicals are compatible for use with SPILLBLOCKER™ Dike:

Aluminum Salts	Kerosene
Barium Salts	Methanol
Butanol	Mineral Oil
Boric Acid	Naphtha
Calcium Chloride	Propylene Glycol
Cupric Chloride	Sodium Hydroxide (50%)
Formaldehyde	Tetrachloroethylene
Gasoline	Triethylamine
Glycol Ether	Turpentine
Hexane	Water
Jet Fuel (JP-5)	

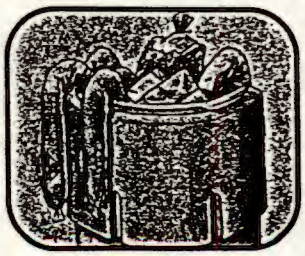
Call 1-800-HOT-HOGS (468-4647) for a complete Chemical Compatibility Guide.

Other PIG® products for you

For aggressive spills:

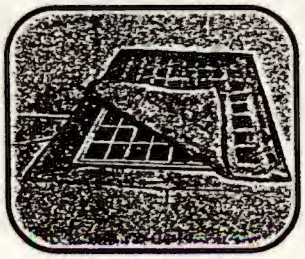
HAZ-MAT PIG® Sock and HAZ-MAT PIG® Pillows

Contingency Planners' Dream:



Spill Kit for accidental spills

Blocks drains from contamination:



DRAINBLOCKER™ Drain Plug

You want to know more about these products? Great! Just call our toll-free number and we'll send you a FREE Pigalog®, a catalog filled with information on all PIG® products.

TOLL-FREE ORDERING OR TECHNICAL ASSISTANCE:

***Call* 1-800-HOT-HOGS** (468-4647)
***Fax 24 hrs.* 1-800-621-PIGS** (7447)

NEW PIG CORPORATION
One Pork Avenue
Tipton, PA 16684-0304

Material Safety Data Sheet

Product Identification: ™ ***SpillBlocker dike*, #PLR204 and ™ *SpillBlocker connector*, #PLR205**
Product Description: Designed to contain or divert liquids on a smooth or semi-smooth surface, also longer lengths can be obtained using the connector unit.

I. Manufacturer Identification

Manufacturer's Name: New Pig Corporation
Address: One Pork Avenue
Tipton, PA 16684-0304
Emergency Telephone Number: (800) 468-4647
Telephone Number for Information: (800) 468-4647
(Above numbers during the hours of 8 a.m. - 5 p.m. ET)
Date Prepared: 04-30-92 (1)

II. Ingredients/Identity Information

Component: (100%): Polyurethane Elastomer.

NFPA Rating:
- Health 0
- Flammability 1
- Reactivity 0

(Component considered non-hazardous.)

III. Physical/Chemical Characteristics

Boiling Point: N/A
Vapor Pressure (mm Hg.): N/A
Vapor Density (AIR = 1): N/A
Solubility in Water: Insoluble
Specific Gravity (H2O = 1): 1.05 - 1.26
Melting Point: Melts 380°F-450°F. Will degrade above 300°F (150°C)
Evaporation Rate: (Butyl Acetate = 1): N/A
Appearance and Odor: Rubber-like substance in a dike form, yellow in color. No odor.

IV. Fire and Explosion Hazard Data

Flash Point: N/A
Flammable Limits: N/A LEL: N/A UEL: N/A
Extinguishing Media: Water, chemical foam, dry chemical or CO_2.
Special Fire Fighting Procedures: Firefighters should use self contained breathing apparatus. Avoid breathing smoke, fumes, and decomposition products. Use water spray to drench smoldering elastomer. Product may melt after ignition to form flammable liquids. Burning produces intense heat, dense smoke, and toxic gases such as carbon monoxide, oxides of nitrogen and traces of hydrogen cyanide.
Unusual Fire and Explosion Hazards: N/A

V. Reactivity Data

Stability: Unstable ____ Stable X
Conditions to Avoid: N/A
Incompatibility (Materials to avoid): Product may be affected by strong acids or bases. (See chemical compatible sheet.)
Hazardous Decomposition or Byproducts: Decomposition through burning produces fumes consisting of organic particulates, gaseous hydrocarbons, carbon dioxide, carbon monoxide, and may contain traces of Toluene Diisocyanate or Diphenylmethane Diisocyanate, Hydrogen cyanide, Acrolein and oxides of nitrogen
Hazardous Polymerization: Will not occur.

VI. Health Hazard Data

Route(s) of Entry: Inhalation? No Skin? No
Ingestion? No toxic effects are expected.
Health Hazards (Acute and Chronic): N/A
Carcinogenicity: NTP? No IARC? No
OSHA Regulated? No
Signs/Symptoms of Exposure: N/A
Medical Conditions Generally Aggravated by Exposure: None
Emergency and First Aid Procedures: N/A

VII. Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled: Pick up and handle as any other inert solid material.
Waste Disposal Method: Not considered a hazardous material. Dispose of material according to federal, state, and local laws.
Precautions to Be Taken in Handling and Storing: During use or storage, never allow the ™ ***SpillBlocker dike*** to touch itself for long periods of time. After use, always decontaminate the ™ ***SpillBlocker dike.*** When not in use ™ ***SpillBlocker dike*** should be stored in a sheltered compartment (i.e.: out of sunlight).
Other Precautions: ™ ***SpillBlocker dike*** should be stored flat in the supplied storage box.

VIII. Control Measures

Respiratory Protection: N/A
Ventilation: Local Exhaust? None Mechanical? None
Special? None Other? None
Protective Gloves: None required
Eye Protection: None required
Other Protective Clothing or Equipment: None required
Work/Hygienic Practices: None required

N/A - Not Applicable; N/E - Not Evaluated
The following is in lieu of all warranties, expressed or implied: All information provided is based on testing and data believed to be accurate.

printed on recycled paper

Hayward®
Temporary Strainers

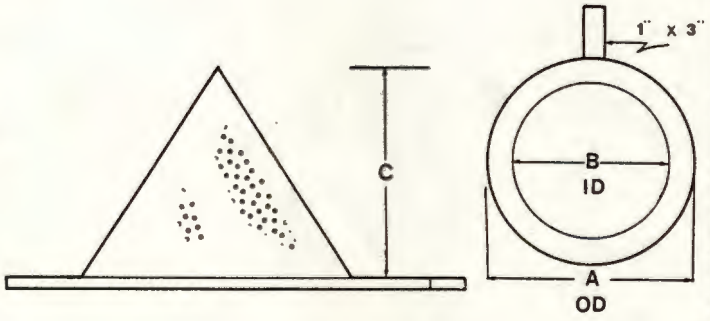
Model 92

Sizes from 2" to 24" — As Standard
Larger Sizes — Available on request
Available in Carbon, Stainless Steel and Monel
Flanged ANSI Class 150, 300 and 600 — As Standard
Perforations 1/32" to 1/2" Diameter
20, 40, 60, 80 and 100 Mesh Linings

Cone and Basket Strainers are best suited for:

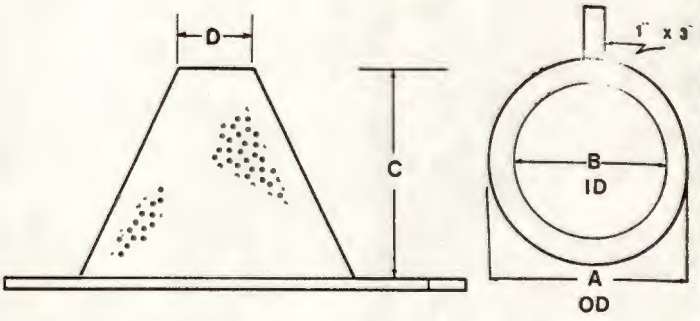
- New pipeline start-up service.
- Systems where solid contaminants are not prevalent but where protection of piping system components is desirable.

Cone-Type



Cone Type					
Pipe Size	A			B	C
	Class 150	Class 300	Class 600		
2	3⅞	3⅞	4⅛	1¾	6
2½	4⅝	4⅝	4⅞	2¼	7
3	5⅛	5⅛	5⅜	2¾	9
4	6⅝	6⅝	6⅞	3½	12
5	7½	7½	9¼	4⅜	14
6	8½	8½	10¼	5½	17
8	10¾	10¾	12⅜	7⅛	23
10	13⅛	13⅛	15½	9	27
12	15⅞	15⅞	17⅜	10⅞	32
14	17½	17½	19⅛	12⅝	33
16	20	20	22	14½	39
18	21⅜	21⅜	23⅞	16⅜	44
20	23⅝	23⅝	26⅛	18⅜	49
24	28	28	30⅞	20⅜	58

Basket-Type



Basket Type						
Pipe Size	A			B	C	D
	Class 150	Class 300	Class 600			
2	3⅞	3⅞	4⅛	1¾	3½	1
2½	4⅛	4⅝	4⅞	2¼	4	1
3	5⅛	5⅛	5⅜	2¾	4½	1
4	6⅝	6⅝	6⅞	3½	6	2
5	7½	7½	9¼	4⅜	7½	2
6	8½	8½	10¼	5½	9	2
8	10¾	10¾	12⅜	7⅛	12	2
10	13⅛	13⅛	15½	9	14	3
12	15⅞	15⅞	17⅜	10⅞	16½	3
14	17½	17½	19⅛	12⅝	17	4
16	20	20	22	14½	19	4
18	21⅜	21⅜	23⅞	16⅜	21	6
20	23⅝	23⅝	26⅛	18⅜	24	6
24	28	28	30⅞	22⅜	28	10

These dimensions are for reference only. For installation purposes, request certified drawings.

Dimensions are in inch

Hayward® The Strainer Company

GENERAL ELECTRIC
CONTRACTOR EQUIPMENT

TRANSMITTAL

DATE 02-23-94

JOB NAME		REV NO.
DOLLINGER BUILDING		
CUSTOMER ORDER NUMBER	G.E. REQUISITION NUMBER	FACTORY ORDER NUMBER
225RB6774	G13 - 11279P	-
FACTORY ADDRESS		

SOLD TO

GRAYBAR ELEC CO 2387561
175 DEWEY AVE
ROCHESTER NY 14603

CONTRACTOR

DRAWINGS ARE FOR --> APPROVAL ___ RECORD X ___

APPROVAL DRAWINGS ARE ATTACHED. COMPLETE DETAILS WERE AVAILABLE AND WE HAVE ASSUMED APPROVAL WITHOUT CHANGE. MANUFACTURING INSTRUCTIONS ARE BEING PREPARED AND WE WILL SCHEDULE OUR MANUFACTURE UPON RECEIPT OF APPROVED DRAWINGS. PRESENT MANUFACTURE SCHEDULES AFTER RECEIPT OF APPROVED DRAWINGS ARE SHOWN BELOW.

APPROVAL DRAWINGS ARE ATTACHED. DETAILS ARE MISSING WHICH MUST BE FURNISHED TO PROCEED WITH THIS ORDER. RELEASE FOR MANUFACTURE WILL BE EXPEDITED BY FURNISHING THE DETAILS REQUESTED AND RETURNING THE DRAWINGS "APPROVED" OR "APPROVED AS NOTED". PRESENT RELEASE PLUS MANUFACTURE SCHEDULES AFTER RECEIPT OF APPROVED DRAWINGS ARE SHOWN BELOW.

716-442-7880
CALL 24HR BEFORE DELIVERY

PANELBOARDS __ WKS. SWITCHBOARDS 00 WKS. SWITCHGEAR __ WKS. BUSWAY __ WKS.

TYPICAL DRAWINGS ATTATCHED:

DRAWING SCHEDULE

MAIL DRAWINGS AS FOLLOWS (ONE COPY IF THIS TRANS FOR CUST. SERVICE)

CUSTOMER DRAWINGS

CONTRACTOR DRAWINGS

OFF CODE SALESMAN DWGS

OFF CODE SERVICEMAN DWGS

CUSTOMER SERVICE

DATE : 02/15/94 PAGE : 1
TIME : 16:53:13

IN[illegible]ON PLACE
, SUITE 30
TER, NY 14623
TELEPHONE: (716) 272-7983
FAX: 716-272-9146

F [illegible]ATERIAL: DOLLINGERS PROF: 613-60284

SANDY WAITE

PO # 6774

PLEASED TO QUOTE AS FOLLOWS:
[illegible]ecifically refered to, no addendums are included

QTY CAT #/NAME	DESCRIPTION
1 LP-1	Panelboard, Type AQ 101 Surface Mount Top Feed 3P4W 120/208V 125A MLO 10 KAIC 12 Cir 1 60 Amp 3 Pole THQB 2 20 Amp 1 Pole THQB-GF 3 20 Amp 1 Pole THQB 1 15 Amp 1 Pole THQB 1 Nameplate 1 1000A PSI Copper BusBar 3 Ground Bar (TGL2)
1 PP-1	Spectra Panelboard 101 Surface Mount Top Feed 3P4W 277/480V 400A SGHA4 Main 25 KAIC 2 70 Amp 3 Pole THED6 1 175 Amp 3 Pole THFK 1 15 Amp 1 Pole THED 1 30 Amp 3 Pole THED6 4 100 Amp 3 Pole THED6 SPACE 1 Nameplate 1 Copper Bus 1 Bonded Gnd Bar w/Main Lug
9T23O3571	Transformer, QL 3Phs 66 115C Rise 15 KVA 3 Ph 480 TO 208Y/120 6 Taps Indoor
1 THN3364	Safety Switch, HD 131 200A no fuse 3 pole 3 wire 600 volt Indoor
2 THN3363	Safety Switch, HD 131 100A no fuse 3 pole 3 wire 600 volt Indoor

TL. Dave Horning

DATE : 02/15/94
PAGE : 2

: DOLLINGERS
: 60294

Y	CAT #/NAME	DESCRIPTION
1	CR308C1042RANTDA	Enclsd NEMA Starter 10G1 Comb FVNR Magnetic Starter Disconnect Switch Three Phase, 60 Hertz NEMA Size 1 NEMA Type 1 CPT Forms Control Circuit 480/120V Coil 10 HP 27 Amps Class R Clips 30A - 600V 2NO-2NC Aux Contacts Standard Overload Relay CPT With 2 PRI Fuses\1 SEC Fuse HOA Sw
1	THN3361R	Safety Switch, ND 131 30A no fuse 3 pole 3 wire 600 volt Outdoor

D H Wessels

ESSELS

ES ENGINEER

Add 400amp enclosure w/breaker
1 - TJ400S enclosure
1 - TJJ436400WL breaker
1 - TNI400 neutral

D: 2/15/2

DEM - 1301

GE Panelboards

Submittal Data — "A" Series Panels Only

ITEM NO. 1 QTY. 1 ☐ NAMEPLATE

PANELBOARD MARKING LP1

PANELBOARD TYPE AQ

SERVICE VOLTAGE 120/208

MAIN: ☑ MAIN LUGS ONLY

☐ MAIN CIRCUIT BREAKER TYPE _____

MAIN RATING 125 AMPERES

FOR _____ – _____ CABLE(S) PER LEG

LOCATED TOP ☑ BOTTOM ☐

☐ SERVICE ENTRANCE LABEL

☑ EQ. GROUND BAR

BUS MATERIAL CU ☑ ALUM ☐

ENCLOSURE: ☑ NEMA 1 ☐ NEMA 3R/12

MOUNTING: ☑ SURFACE ☐ FLUSH

DIMENSIONS: H 25.5 W 20" D 5.78"

SPECIAL FEATURES/NOTES _____

SHORT CIRCUIT CURRENT RATING

_____ **RMS SYMMETRICAL AMPERES**

☐ FULLY RATED ☐ SERIES RATED

Standards

All GE panelboards are designed to meet the following applicable industry standards, except where noted:

1. Underwriter's Laboratories, Inc.
   a. Panelboards: UL 67
   b. Cabinets and boxes: UL 50
   NOTE: Only panelboards containing UL listed devices can be UL labeled.
2. National Electrical Code
3. NEMA Standards: PB 1
4. Federal Specifications
   a. Panelboards: W-P-115b
   b. Molded case breakers W-C 375a,b
   c. Switches: W-S-865c

See standard specification sheet for specific panelboard type for general construction details.

BRANCH CIRCUITS

QTY.	TYPE	AMP RATING	NO. POLES	
1	THQB	60	3	
2	THQB-GF	20	1	
3	THQB	20	1	
1	THQB	15	1	

PANEL INTERIOR BRANCH CIRCUIT ARRANGEMENT
(If Required)

CKT. No.	TYPE	POLES	AMPS
1			
3			
5			
7			
9			
11			
13			
15			
17			
19			
21			
23			
25			
27			
29			
31			
33			
35			
37			
39			
41			

TYPE	POLES	AMPS	CKT. NO.
			2
			4
			6
			8
			10
			12
			14
			16
			18
			20
			22
			24
			26
			28
			30
			32
			34
			36
			38
			40
			42

JOB NAME: Dellinger Bldg

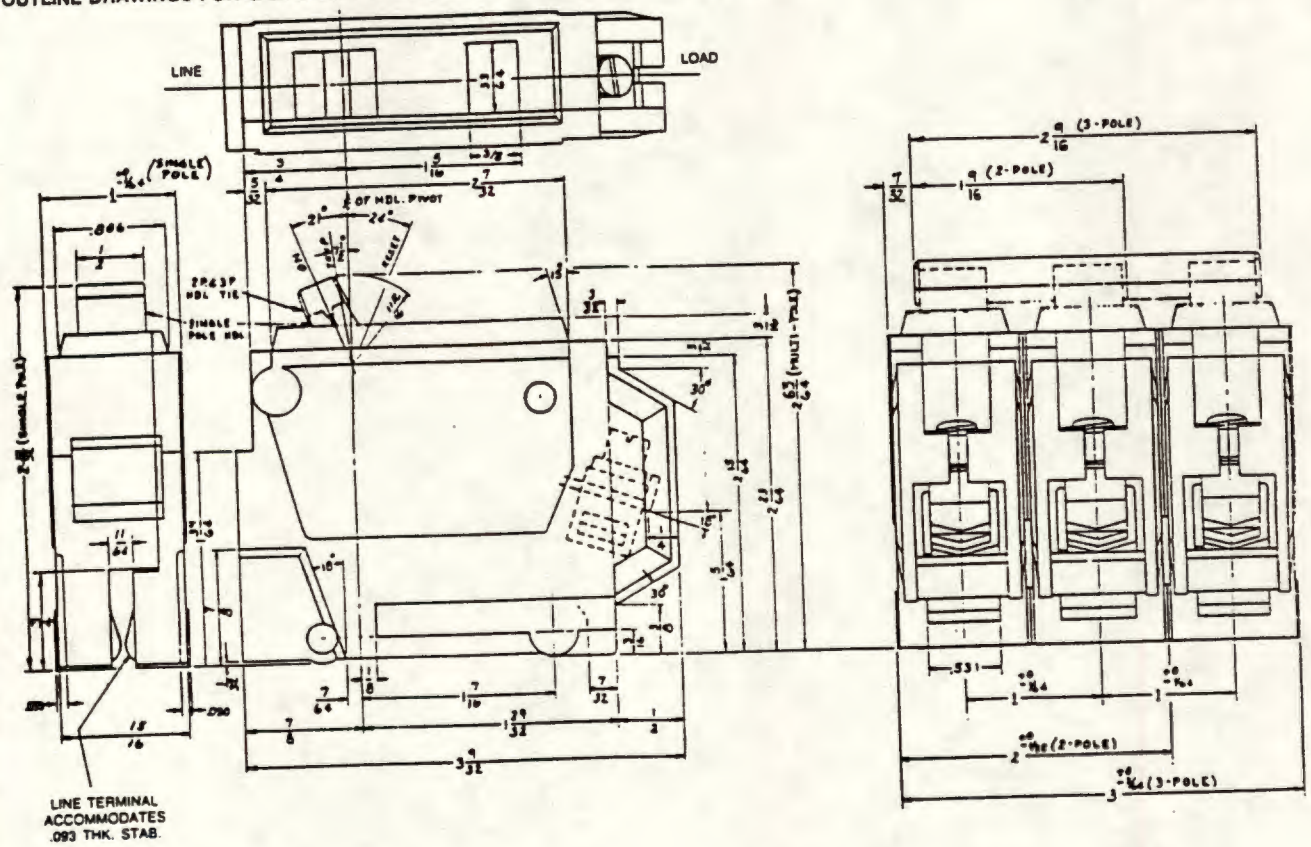
DEM - 1302

GE Panelboards

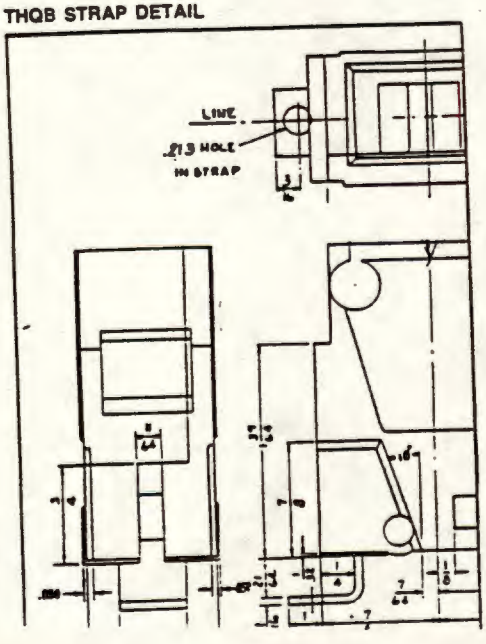
Typical Type AL, AQ Panelboard

(Replaces Types NLTQ, NLAB)

OUTLINE DRAWINGS FOR Q-LINE BREAKERS (SEE BELOW FOR THQB STRAP DETAIL)



THQB STRAP DETAIL



Q-LINE BRANCH BREAKER TRIP RANGE IN AMPERES

		1 pole	2 pole		3 pole
Type	Frame	120/240 Volts	120/240 Volts	240 Volts	240 Volts
Plug in for Panel Type AL	THQL	15-70	15-100	15-100	15-100
	THQL-GF	15-30	15-30		
	THQL-HID	15-20	15-20		
	THHQL	15-70	15-100	15-100	15-100
	THHQL-GF	15-30			
	THHQL-HID	15-20	15-20		
	TXQL	15-30	15-30		
Bolt on for Panel Type AQ	THQB	15-70	15-100	15-100	15-100
	THQB-GF	15-30	15-30		
	THQB-HID	15-20	15-20		
	THHQB	15-70	15-100	15-100	15-100
	THHQB-GF	15-30			
	THHQB-HID	15-20	15-20		
	TXQB	15-30	15-30		

NOTES:

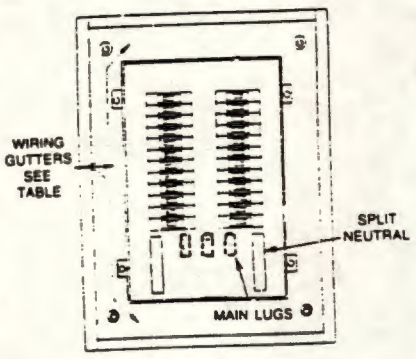
DEM - 1304

GE Panelboards

Typical Type AL, AQ Panelboard

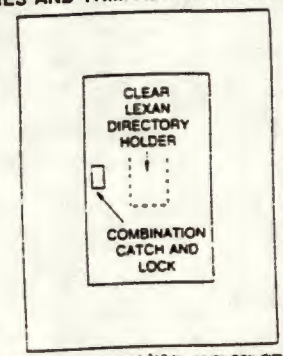
(Replaces Types NLTQ, NLAB)

TYPICAL PANELBOARD



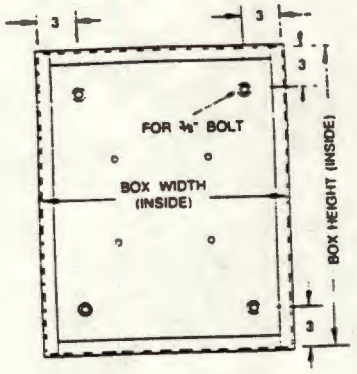
Front View with trim removed

TYPICAL FRONT W/CONCEALED HINGES AND TRIM ADJUSTING SCREWS



Surface mounting — add ⅛" to inside box dimensions
Flush mounting — add 1½" to inside box dimensions

TYPICAL BOX



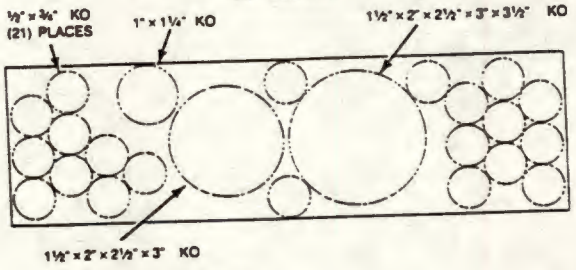
MINIMUM WIRING SPACE—FROM END OF LUG TO WALL OF BOX IN INCHES

Main Rating In Amps	Main Lugs Only: To End Wall: Phase Lug	Main Lugs Only: To End Wall: Neutral Lug	Main Circuit Breaker: Frame Type	Main Circuit Breaker: Mounting	Main Circuit Breaker: Phase Lug: To Side Wall (20" Wide Box)	Main Circuit Breaker: Phase Lug: To End Wall	Main Circuit Breaker: Neutral Lug
125A Main Lug 100A Main Bkr	6	6	THOB, THHOB	Horizontal	6½		6
			TEY	Horizontal	5		
			TEL, THLC*	Vertical		6	
225	12	12	TQD, THQD	Horiz	5½		12
			TLB2, THLC2	Vert		12	
400	15	11①	TJD, TLB4, THLC4	Vert		15	11①
600	15	11①					

①To Side Wall

KNOCKOUT DIAGRAM

(20" Wide Box)



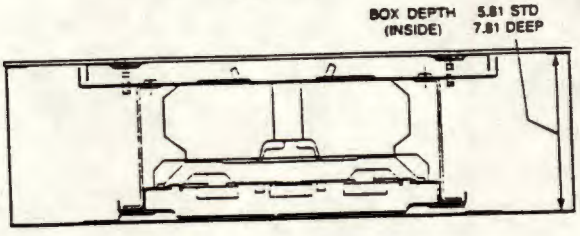
Note: Blank end wall also available

WIRING SPACE–BRANCH CIRCUIT BREAKERS

Branch Circuit Devices	Frame	No. of Poles	Wiring Space to Side Wall: 20" W Box
Q-Line Breakers (Double-branch Mounting)	THQL, THHQL, TXQL, TXQB, THQB, THHQB,	①	6½"
Sub-feed Breakers Single Branch Mounting (6 poles max)	TQD, THQD	2, 3	5½

①See "Q" Line Breaker Trip Range in ampere table on back page

END VIEW



SPECIFICATIONS

General

- A-Series panelboards and branch breakers meet or exceed the following standards and specifications
  - —UL50, cabinets & boxes
  - —UL67, panelboards
  - —UL489, circuit breaker
  - —NEMA AB-1, circuit breakers
  - —NEMA PB-1, panelboards
  - —US Federal Spec W-P-115b Panelboards
  - —US Federal Spec W-C375b Gen circuit breakers
- Metal gages in accordance with U L and NEMA standards
- Panelboards are of dead front construction

Boxes

- Boxes are of galvanneal G20 steel
- Endwalls furnished with KO's as standard. Blank endwalls available when specified

Panels

- Panelboard interiors are factory assembled on rigid steel frames.
- Solderless, anti-turn main lugs suitable for copper or aluminum wire are front removable
- Solderless, anti-turn main lugs suitable for copper or aluminum wire are front removable and branch straps will be silver plated copper fully rated at 100 amperes.
- Main bus will be aluminum with copper branch connections unless otherwise specified.
- Main disconnect device is identified when supplied, and numbers are provided for branch circuits.
- Interior base assemblies will be of Noryl* and provide breaker mounting and bus bar insulation.
- Unless otherwise specified, branch circuits will be arranged as follows:
  1. 3 pole devices and specified spaces will be placed closest to the main in descending order of ampere rating. The higher rated device will be on the right
  2. 2 pole devices are mounted next, also in descending order of ampacity, followed by

DEM - 1303

GE Panelboards

Typical Type AL, AQ Panelboard

(Replaces Types NLTQ, NLAB)

INTERRUPTING RATINGS—MOLDED CASE CIRCUIT BREAKERS

Molded Case Circuit Breakers						Federal Specs C/B Class W-C-375B	UL Listed Interrupting Ratings In Thousand Amps				
				Rated Volts			RMS Symmetrical ac Volts				
Construction	Frame	Trip Range (Amps)	Pole	ac	dc		120	120/240	240	277	480Y/277
HQ Frames	THQB THQL	15-70	1	120/240		12a	10	10			
		15-125	2	120/240		12a		10			
		15-100	2, 3	240		12b			10		
HHQ Frames	THHQL THHQB	15-70	1	120/240		14a	22	22			
		15-125	2	120/240		14a		22			
		15-100	2	240		14b			22		
		15-100	3	240		14b			22		
XQ Frames	TXQB	15-30	1, 2	120/240		15a		65			
		15-30	3	240		15b			65		
Standard Frames	TEY	15-100	1	480Y/277	250	13a			65	14	
		15-100	2, 3	480Y/277	250	13b			65		14
	TQD	125-225	2, 3	240		12b			10		
	TJD	250-400	2, 3	240	250 ①	14b			22		
Hi-Break® Frames	THQD	125-225	2, 3	240		N/A			22		
Hi-Interrupting Circuit Breakers	TLB1	15-150	3	480					85		50
	TLB2	125-225	3	480					85		50
	TLB4	225-400	3	480					85		50
Current Limiting Circuit Breakers	THLC1	15-150	3	480					200		150
	THLC2	125-225	3	480					200		150
	THLC4	225-400	3	480					200		150

① 3-pole devices are not DC rated

PANELBOARD SHORT-CIRCUIT RATING:

The short-circuit rating of a panelboard is limited to the interrupting rating of the lowest rated device or to the applicable UL listed series rating when proper main and branch device combinations are used. The short-circuit current available at the incoming line terminals should not exceed this value.

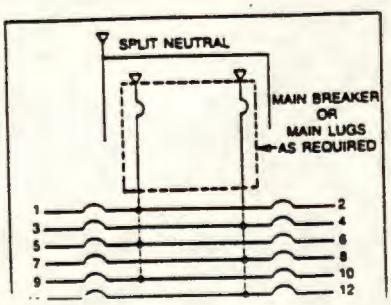
When a panelboard is applied within its short-circuit rating, bus bar bracing is adequate to withstand the forces exerted by the let-through current.

MOLDED CASE CIRCUIT BREAKERS

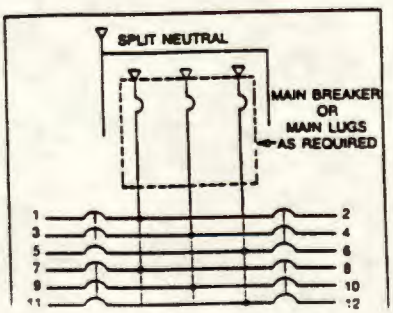
Circuit Breaker Frame					Terminal Lugs (Cu-Al)				
								Wire—Cu-Al (Unless otherwise noted)	
Standard	Hi-Break®	Current Limiting	High Interrupting	Poles	No. Per Pole	Cat. No.	Per Lug	Range
THQL	TXQL, THHQL			1	1	Fixed to Breaker Terminal	1	(15-30A) #14-10 CU or #12-8 AL (35-60A) #14-4 CU or #12-3 AL (70-100) #6-1 CU, #4-1/0 AL
THQL	TXQL, THHQL			2-3				
THQB	TXQB, THHQB			1, 2, 3				
TEY				1, 2, 3	1		1	(15-20A) #14-#12 CU, #10-#12 AL (30-60A) #10-#6 CU, #8-#4 AL (70-100A) #4-#1 CU, #2-1/0 AL
TED4				2-3	1	TCAL12A	1	(70-110A) #6-2/0 CU, #4-2/0 AL
TQD	THQD			2-3	1	TCAL25	1	#1-300MCM
TJD				2-3	1	TCAL43	1	#6-600MCM or 2-(2/0-250MCM)
		THLC1	TLB1	3	1	TCAL12 TCAL12A TCAL15	1	(15-60A, TCAL12) #14-#3 CU or #12-#1 AL (70-110A, TCAL12A) #6-2/0 CU or #4-2/0 AL (125-150A, TCAL15) #1-2/0 CU or 1/0-3/0 AL
		THLC2	TLB2	3	1	TCAL27	1	(125-225A, TCAL27) #4-300MCM
		THLC4	TLB4	3	1	TCLK43①		3/0-500MCM or 2 (3/0-250MCM)

① Three-pole lug assembly suitable for line or load end

NOTES:



1Ø 3W 240-120 VAC

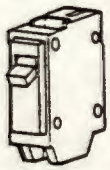


3Ø 4W 208Y/120 VAC
③ 3Ø 4W 240-120 VAC Mid Tap Delta
3Ø 3W 240 VAC Ungrounded Delta
(Do not connect neutral)
③ 1 pole devices cannot be connected to BQ
2 pole devices connected to BQ must be 240V rated

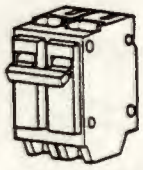
DEM - 0410

GE Molded Case Circuit Breakers

Q Line Circuit Breakers



THQL1120



THQL2140

Types TQL, THQL, TQB, THQB, TQC, THQC

5-125 Amps
10,000 Amps IC

Ampere Rating	TQL, THQL Plug-in			TQC, THQC Lug-lug①			TQB, THQB Bolt-on		
	Item No.	Qty.	Catalog Number	Item No.	Qty.	Catalog Number	Item No	Qty	Catalog Number
Single-pole, 120/240 Volts ac③									
10②			TQL1110			TQC1110WL			TQB1110
15⑤			THQL1115			THQC1115WL			THQB1115
20⑤			THQL1120			THQC1120WL			THQB1120
25			THQL1125			THQC1125WL			THQB1125
30			THQL1130			THQC1130WL			THQB1130
35			THQL1135			THQC1135WL			THQB1135
40			THQL1140			THQC1140WL			THQB1140
45			THQL1145			THQC1145WL			THQB1145
50			THQL1150			THQC1150WL			THQB1150
60			THQL1160			THQC1160WL			THQB1160
70			THQL1170			THQC1170WL			THQB1170
Two-pole, 120/240 Volts ac③									
10②			TQL2110			TQC2110WL			TQB2110
15			THQL2115			THQC2115WL			THQB2115
20			THQL2120			THQC2120WL			THQB2120
25			THQL2125			THQC2125WL			THQB2125
30			THQL2130			THQC2130WL			THQB2130
35			THQL2135			THQC2135WL			THQB2135
40			THQL2140			THQC2140WL			THQB2140
45			THQL2145			THQC2145WL			THQB2145
50			THQL2150			THQC2150WL			
60			THQL2160			THQC2160WL			THQB2160
70			THQL2170			THQC2170WL			THQB2170
80			THQL2180			THQC2180WL			THQB2180
90			THQL2190			THQC2190WL			THQB2190
100			THQL21100			THQC21100WL			THQB21100
110			THQL21110			—			—
125			THQL21125④			—			—
Two-pole, 240 Volts ac③									
10②			TQL22010			TQC22010WL			TQB22010
15			THQL22015			THQC22015WL			THQB22015
20			THQL22020			THQC22020WL			THQB22020
25			THQL22025			THQC22025WL			THQB22025
30			THQL22030			THQC22030WL			THQB22030
35			THQL22035			THQC22035WL			THQB22035
40			THQL22040			THQC22040WL			THQB22040
45			THQL22045			THQC22045WL			THQB22045
50			THQL22050			THQC22050WL			THQB22050
60			THQL22060			THQC22060WL			THQB22060
70			THQL22070			THQC22070WL			THQB22070
80			THQL22080			THQC22080WL			THQB22080
90			THQL22090			THQC22090WL			THQB22090
100			THQL22100			THQC22100WL			THQB22100
Three-pole, 240 Volts ac③									
10③			TQL32010			TQC32010WL⑥			TQB32010⑥
15			THQL32015			THQC32015WL			THQB32015
20			THQL32020			THQC32020WL			THQB32020
25			THQL32025			THQC32025WL			THQB32025
30			THQL32030			THQC32030WL			THQB32030
35			THQL32035			THQC32035WL			THQB32035
40			THQL32040			THQC32040WL			THQB32040
45			THQL32045			THQC32045WL			THQB32045
50			THQL32050			THQC32050WL			THQB32050
60			THQL32060			THQC32060WL			THQB32060
70			THQL32070			THQC32070WL			THQB32070
80			THQL32080			THQC32080WL			THQB32080
90			THQL32090			THQC32090WL			THQB32090
100			THQL32100			THQC32100WL			THQB32100

① Requires mounting plate.
② 5000 AIC.
③ UL Listed as HACR.
④ Recommended for use as main or sub-main breaker only.
⑤ UL Listed as SWD (Switching Duty) rated. Suitable for switching 120-volt ac fluorescent lighting loads.
⑥ Not UL Listed.

NOTES:

DEM - 0415

GE Molded Case Circuit Breakers

Q Line Circuit Breakers

CB3® Ground Fault Circuit Interrupters (GFCI)

5 mA Trip Level

THQL1120GF

Plug-in Types THQL, THHQL

Ampere Rating	10,000 AIC			22,000 AIC			Packing Quantity	
	Item No.	Qty.	Type THQL Catalog Number	Item No.	Qty.	Type THHQL Catalog Number	Carton	Multi Pak
Single-pole, 120 Volts ac								
15			THQL1115GF			THHQL1115GF	1	10
20			THQL1120GF			THHQL1120GF		
30			THQL1130GF			THHQL1130GF		
Two-pole, 120/240 Volts ac								
15			THQL2115GF			—	1	10
20			THQL2120GF			—		
30			THQL2130GF			—		

Bolt-on Types THQB, THHQB

Ampere Rating	10,000 AIC			22,000 AIC			Packing Quantity	
	Item No.	Qty.	Type THQL Catalog Number	Item No.	Qty	Type THHQL Catalog Number	Carton	Multi Pak
Single-pole, 120 Volts ac								
15			THQB1115GF			THHQB1115GF	1	10
20			THQB1120GF			THHQB1120GF		
30			THQB1130GF			THHQB1130GF		
Two-pole, 120/240 Volts ac								
15			THQB2115GF			—	1	10
20			THQB2120GF			—		
30			THQB2130GF			—		

Lug-lug Type THQC①

Ampere Rating	10,000 AIC		
	Item No.	Qty.	Type THQC Catalog Number
Single-pole, 120 Volts ac			
15			THQC1115GF
20			THQC1120GF
30			THQC1130GF

① Requires mounting plate.

NOTES:

DATE : 02/15/94 PAGE : 1
TIME : 16:53:13
TELEPHONE: (716) 272-7983
FAX: 716-272-9146

N. PLACE
, SUITE 30
ER, NY 14623

TERIAL: DOLLINGERS PROP: 613-60284

SIGN WAVE

PO # 6774

PLEASED TO QUOTE AS FOLLOWS:
Specifically refered to, no addendums are included

TY	CAT #/NAME	DESCRIPTION
1	LP-1	Panelboard, Type AQ 101 Surface Mount Top Feed 3P4W 120/208V 125A MLO 10 KAIC 12 Cir 1 60 Amp 3 Pole THQB 2 20 Amp 1 Pole THQB-GF 3 20 Amp 1 Pole THQB 1 15 Amp 1 Pole THQB 1 Nameplate 1 1000A PSI Copper BusBar 3 Ground Bar (TGL2)
1	PP-1	Spectra Panelboard 101 Surface Mount Top Feed 3P4W 277/480V 400A SGHA4 Main 25 KAIC 2 70 Amp 3 Pole THED6 1 175 Amp 3 Pole THFK 1 15 Amp 1 Pole THED 1 30 Amp 3 Pole THED6 4 100 Amp 3 Pole THED6 SPACE 1 Nameplate 1 Copper Bus 1 Bonded Gnd Bar w/Main Lug
	9T23G3571	Transformer, QL 3Phs 66 115C Rise 15 KVA 3 Ph 480 TO 208Y/120 6 Taps Indoor
	THN3364	Safety Switch, HD 131 200A no fuse 3 pole 3 wire 600 volt Indoor
	THN3363	Safety Switch, HD 131 100A no fuse 3 pole 3 wire 600 volt Indoor

T. Doug Herring

DATE : 02/15/94
PAGE : 2

: DOLLINGERS
: 60294

Y	CAT #/NAME	DESCRIPTION
1	CR308C1042RANTDA	Enclsd NEMA Starter 10G1 Comb FVNR Magnetic Starter Disconnect Switch Three Phase, 60 Hertz NEMA Size 1 NEMA Type 1 CPT Forms Control Circuit 480/120V Coil 10 HP 27 Amps Class R Clips 30A - 600V 2NO-2NC Aux Contacts Standard Overload Relay CPT With 2 PRI Fuses\1 SEC Fuse HOA Sw
1	THN3361R	Safety Switch, HD 131 30A no fuse 3 pole 3 wire 600 volt Outdoor

DH

Wessels

ESSELS

ES ENGINEER

Add 400amp enclosure w/breaker
1 - TJ400S enclosure
1 - TJJ436400WL breaker
1 - TNI400 neutral

Dr 2402

GENERAL ELECTRIC
ELECTRICAL DISTRIBUTION & CONTROL

PANELBOARD DRAWING

FACTORY ORDER NO	JOB NAME	REV	DATE	PAGE
	DOLLINGER BUILDING		02-23-94	1

REQUISITION NO	PROPOSITION NO	FRONT DATE	BOX DATE	INTERIOR DATE
GE 11279P	613 NONE			

ITEM 2 PP-1 PRINT SEQ # 2

QTY 1 SPECTRA POWER PANEL 3P4W 480Y/277V AC

COPPER BUS, 25,000 AMPS. RMS SYM SC FULLY RATED

MAIN 400AMP 3P SGHA4 CB LOC TOP

1-LUG/PH 1-CABLE/LUG #6 -600 MCM

ACCESS GROUND BAR - MOUNTED IN BOX 0

DEV CAT

1	SGHA36AT0400+ SRPG400A400	1TCLK365
1	THFK236175	
1	AMC3FJ	
2	THED136070	
2	AMC6EB	
1	THED136030	
1	THED113015	
1	AMC3GM	

BRANCHES

1 -	175A	3P	THFK	
4 -	100A	3P	THED6	SPACE
2 -	70A	3P	THED6	
1 -	30A	3P	THED6	
1 -	15A	1P	THED	

OPTIONS NAMEPLATES

SPEC. BUS CURRENT DENSITY-CU 1000

X VALUES	PANEL	MAIN	BRANCH	FEATURE	FILLER
	23	4	15	0	4

BOX APB2765B H 64.63 W 27.00 D 14.25

FRONT APF6523S SURFACE MOUNTING

INTERIOR APN2304FB4

KIT 1 AEG10 GROUND BAR, BOX MOUNTED FIELD-INSTALLED

DEM - 1323

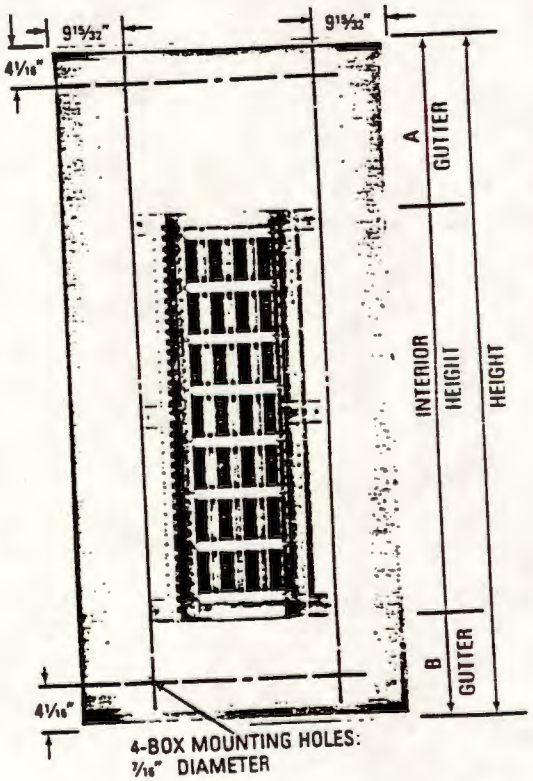
GE Panelboards

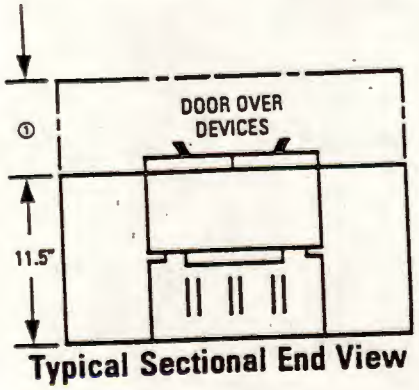
Spectra Series™ Power Panelboards

Circuit Breaker Mains and Feeders

Enclosures

Spectra Series Panelboard Enclosures come in eight standard sizes. Enclosure heights are determined by two criteria: interior height and main device rating (to provide adequate wire-bending space). Enclosure widths are determined by the largest main/branch device.





Typical Sectional End View

①36" and 44" wide enclosures are 11½" deep (NEMA1) and 14" deep (NEMA 3R/12). 27" wide enclosures are 14.5" deep.

When doors are required over devices in 36" and 44" wide enclosures, en- ... door as a standard feature for 27" wide

36" & 44" Wide Enclosures

Main Amp Rating	Interior Height		Gutter Inches		Enclosure Dimensions	
	X-Height	Inches	A	B	Height Inches	Width Inches
250	18X	24.75	19.94	19.94	64.63	36
	28X	38.50	19.94	6.25	64.63	36
	38X	52.25	22.75	14.25	89.25	36
	53X	72.88	17.00	6.25	96.13	36
400	18X	24.75	19.94	19.94	64.63	36/44
	28X	38.50	22.75	14.25	75.50	36/44
	38X	52.25	22.75	14.25	89.25	36/44
	48X	66.00	19.94	10.25	96.13	36/44
600	23X	31.63	19.94	13.13	64.63	36/44
	38X	52.25	22.75	14.25	89.25	36/44
	48X	66.00	19.94	10.25	96.13	36/44
800	23X	31.63	22.75	21.25	75.50	36/44
	38X	52.25	22.75	14.25	89.25①	36/44
	43X	59.13	22.75	14.25	96.13	36/44
1200	28X	38.50	22.75	14.25	75.50	36/44
	38X	52.25	22.75	14.25	89.25①	36/44
	43X	59.13	22.75	14.25	96.13	36/44

①Height is 96.13" if dual main or feed through lugs and neutral are provided.

27" Wide Enclosures

Main Amp Rating	Interior Height		Gutter Inches		Enclosure Dimensions	
	X-Height	Inches	A	B	Height Inches	Width Inches
250	18X	24.75	19.94	19.94	64.63	27
	28X	38.50	18.50	7.62	64.63	27
	38X	52.25	18.50	18.50	89.25	27
400	18X	24.75	19.94	19.94	64.63	27
	28X	38.50	18.50	18.50	75.50	27
	38X	52.25	18.50	18.50	89.25	27
600	23X	31.63	18.50	14.50	64.63	27
	38X	52.25	18.50	18.50	89.25	27

Branch Molded Case Circuit Breaker Units

	Poles	Double Branch: Maximum Poles	Double Branch: Minimum Enclosure Width	Double Branch: Maximum # Poles Blank Option	Single Branch: Maximum Poles	Single Branch: Minimum Enclosure Width	Module X-Height
TEL	3	6	27"	3	—	—	3X
THQB	1/2/3	6		5	—		3X
TEY	1/2/3	6		5	—		3X
TEB/TED/THED	1/2	4		2	—		2X
TEB/TED/THED	1/2/3	6		3	—		3X
TQD/THQD	2	4		2	—		2X
TQD/THQD	3	6		3	—		3X
TFJ	2/3	6	36"	3	3	27"	3X
TFL/THFK	2/3	6		3	3		3X
②TFL/THLC1	3	6		3	3		3X
THLC2	3	6		3	3		5X
TJD	2/3	6	44"	3	3	27"	6X
TJJ/TJK/THJK	2/3	6		3	3		6X
TJ4V/TH4V/TJL4V	3	6		3	3		6X
TLB4	3	6		3	3		6X
THLC4	3	6		3	3		5X
TKM/THKM	2/3	—	—	—	3	44"	6X
TK4V/TKQL4V	3	—		—	3		6X
SEDA/SEHA	2	4	27"	2	—	—	3X
SELA/SEPA②	3	6	27"	3	—	—	
SFHA/SFLA/SFPA②	2/3	6	36"	3	3	27"	3X
SKHA/SKLA/SKPA②	2/3	—	—	—	3	44"	6X

②When TFL is interlocked with fusible devices—X-Height is 4X.

DEM - 1324

GE Panelboards

Spectra Series™ Power Panelboards

Circuit Breaker Mains and Feeders

Molded-Case Circuit Breakers Interrupting Ratings

Molded Case Circuit Breakers					Maximum UL Listed Interrupting Ratings in Thousand Amps								
					rms Symmetrical ac Volts							dc Volts	
Construction	Frame	Trip Range (Amps)	No. Poles	Federal Specs C/B Class W-C-375B	120	120/240	240	277	480Y/277	480	600	125	250
HQ Frames	THQB	15-70	1	12a	10	10	—	—	—	—	—	—	—
		15-125	2	12a	—	10	—	—	—	—	—	—	—
		15-100	2,3	12b	—	—	10	—	—	—	—	—	—
HHQ Frames	THHQB	15-70	1	14a	22	22	—	—	—	—	—	—	—
		15-125	2	14a	—	22	—	—	—	—	—	—	—
		15-100	2,3	14b	—	—	22	—	—	—	—	—	—
XQ Frames	TXQB	15-30	1,2	15a	—	65	—	—	—	—	—	—	—
		15-30	3	15b	—	—	65	—	—	—	—	—	—
Standard Frames	TEY	15-100	1	—	—	—	65	14	—	—	—	10	—
		15-100	2,3	—	—	—	65	—	14	—	—	—	10
	TEB	15-100	1	12a	10	10	—	—	—	—	—	5	—
	TEB	15-100	2	12b	—	—	10	—	—	—	—	—	5
		15-100	3	12b	—	—	10	—	—	—	—	—	—
	TED	15-100	1	13a	—	—	—	14	—	—	—	10	—
	TED4	15-50①	1	13b	—	—	—	14	—	14	—	—	—
	TED4	15-100	2	13b	—	—	18	—	—	14	—	—	10
	TED4	15-150	3	13b	—	—	18	—	—	14	—	—	10
	TED6	15-100	3	18a	—	—	18	—	—	14	14	—	—
	TED6	110-150	3	N/A	—	—	18	—	—	14	14	—	—
	TQD	125-225	2,3	12b	—	—	10	—	—	—	—	—	—
	TFJ	70-225	2	20a	—	—	25	—	—	22	—	—	10
	TFK	70-225	2	20a	—	—	25	—	—	22	—	—	10
	TFJ	70-225	3	20a	—	—	25	—	—	22	18	—	—
	TFK	70-225	3	20a	—	—	25	—	—	22	18	—	—
	TJD	250-400	2,3	14b	—	—	22	—	—	—	—	—	10
	TJJ	125-400	2,3	21a	—	—	42	—	—	30	22	—	10
	TJK4	125-400	2,3	21a	—	—	42	—	—	30	22	—	10
	TJK6	250-600	2,3	21a	—	—	42	—	—	30	22	—	10
	TKM8	300-800	2,3	21a	—	—	42	—	—	30	22	—	10
	TKM12	600-1200	2,3	21a	—	—	42	—	—	30	22	—	—
Hi-Break® Frames	THED	15-30	1	13a	—	—	—	65	—	—	—	20②	—
	THED4	15-100	2	22a	—	—	65	—	—	25	—	—	20②
	THED4	110-150	3	—	—	—	42	—	—	25	—	—	—
	THED6	15-100	3	22a	—	—	65	—	—	25	18	—	—
	THED6	110-150	3	N/A	—	—	42	—	—	25	18	—	—
	THQD	125-225	2,3	N/A	—	—	22	—	—	—	—	—	—
	THFK	70-225	2,3	20a	—	—	65	—	—	25	18	—	20②
	THJK4	125-400	2,3	23a	—	—	65	—	—	35	25	—	20②
	THJK6	250-600	2,3	23a	—	—	65	—	—	35	25	—	20②
	THKM8	300-800	2,3	23a	—	—	65	—	—	35	25	—	20②
	THKM12	600-1200	2,3	23a	—	—	65	—	—	35	25	—	—
Hi-Interrupting Circuit Breakers	TEL	15-150	3	—	—	—	100	—	—	65	25	—	—
	TFL	70-225	3	—	—	—	100	—	—	65	25	—	—
	TLB4	225-400	3	—	—	—	85	—	—	65	—	—	—
Current Limiting Circuit Breakers	THLC1	15-150	3	—	—	—	200	—	—	150	—	—	—
	THLC2	125-225	3	—	—	—	200	—	—	150	—	—	—
	THLC4	225-400	3	—	—	—	200	—	—	150	—	—	—
Molded Case Circuit Breakers w/Micro Versa Trip® 4-Function	TJ4V	150-600	3	21a	—	—	42	—	—	30	22	—	—
	TK4V	800-1200	3	21a	—	—	42	—	—	30	22	—	—
	THJ4V	150-600	3	23a	—	—	65	—	—	35	25	—	—
	TJL4V	150-600	3	23a	—	—	100	—	—	65	42	—	—
	TKL4V	800-1200	3	23a	—	—	100	—	—	65	42	—	—
SE150	SEDA	15-150	2,3	—	—	—	18	—	—	14	10	—	—
	SEHA	15-150	2,3	—	—	—	65	—	—	25	18	—	—
	SELA	15-150	2,3	—	—	—	100	—	—	65	25	—	—
	SEPA	15-150	2,3	—	—	—	200	—	—	100	25	—	—
SF250	SFHA	70-250	2,3	—	—	—	65	—	—	25	18	—	—
	SFLA	70-250	2,3	—	—	—	100	—	—	65	25	—	—
	SFPA	70-250	2,3	—	—	—	200	—	—	100	25	—	—
SG600	SGDA	125-600	2,3	—	—	—	65	—	—	—	—	—	—
	SGHA	125-600	2,3	—	—	—	65	—	—	35	25	—	—
	SGLA	125-600	2,3	—	—	—	100	—	—	65	65	—	—
	SGPA	125-600	2,3	—	—	—	200	—	—	100	65	—	—
SK1200	SKHA	300-1200	2,3	—	—	—	65	—	—	50	25	—	—
	SKLA	300-1200	2,3	—	—	—	100	—	—	65	42	—	—
	SKPA	300-1200	2,3	—	—	—	200	—	—	100	65	—	—

①UL Listed for only 100,000 AIC when internally mounted accessories are used. ②DC ratings above 10,000 AIC are not UL Listed. ③3-pole devices are not dc rated.

NOTES:

DEM - 1325

GE Panelboards

Spectra Series™ Power Panelboards

Circuit Breaker Mains and Feeders

Termination Information

Standard Main Lug Module Terminations (CU/AL Mechanical)

Amp Rating	Wire Size (CU/AL)	# Wires Per Leg	# Lugs Per Phase-Single	# Lugs Per Phase-Dual
250	#6-350 MCM	1	1	2
400	#2-500 MCM	2	1	2
600	#2-500 MCM	2	1	2
800	#2-500 MCM	2	2	4
1200	#2-500 MCM	2	2	4

Standard Neutral Lug Terminations (CU/AL Mechanical)

Amp Rating	ADS Type	Wire Quantity	Wire Size (CU/AL)
250	Main	1	①#6-350 MCM
	Branch	8	#14-#4
	Branch	16	#14-2/0
	Branch	5	#4-300 MCM
400	Main	2	①#2-500 MCM
	Branch	8	#14-#8
	Branch	6	#14-#4
	Branch	16	#14-2/0
	Branch	5	#4-300 MCM
	Branch	2	①#2-500 MCM
600	Main	2	①#2-500 MCM
	Branch	8	#14-2/0
	Branch	10	#4-300 MCM
	Branch	4	①#2-500 MCM
800	Main	4	①#2-500 MCM
	Branch	8	#14-2/0
	Branch	10	#4-300 MCM
	Branch	6	①#2-500 MCM
1200	Main	4	①#2-500 MCM
	Branch	8	#14-2/0
	Branch	10	#4-300 MCM
	Branch	6	①#2-500 MCM

①The #6-350 MCM and the #2-500 MCM lug can be field-replaced with a #2-600 MCM or #3/0-750 MCM mechanical lug, which is available in kit form.

Ground lugs are available in kit form for field installation. Catalog numbers are included here for references.

Ground Lug Terminations (CU/AL Mechanical)

Lug Quantity	Wire Size	Catalog Number	Insulated/ Insulated
10	#6-2/0 CU/AL	AEG 10	No
12	#14-#8 CU / #12-#8 AL — Solid; or #12-#8 CU / #12-#6 AL — Stranded	AEG 21	No
9	#14-#8 CU / #12-#6 AL — Solid; or #10-#4 CU / #10-#4 AL — Stranded	AEG 21	No
12	Identical lug offering as listed above for Cat. #AEG 21	AEG 21S	Yes
9	Identical lug offering as listed above for Cat. #AEG 21	AEG 21S	Yes
12	Identical lug offering as listed for AEG 21	AEG 31S	Yes
9	Identical lug offering as listed for AEG 21	AEG 31S	Yes
10	#6-2/0 CU/AL	AEG 31S	Yes

Standard Circuit Breaker Module Terminations (CU/AL Mechanical)

Circuit Breaker Frame					Terminal Lugs (CU-AL)			
							Wire—CU-AL (Unless otherwise noted)	
Standard	Ni-Break®	Current Limiting	High Interrupting	Poles	No. Per Pole	Catalog Number	Per Lug	Range
THQB	THHQB	—	—	1,2,3	1	Fixed to Breaker Terminal	1	(15-30A) #14-4 CU or #12-4 AL (35-100A) #14-1/0 CU or #12-1/0 AL
TEY	—	—	—	1,2,3	1		1	(15-20A) #14-#12 CU or #12-#1 AL (30-60A) #10-#6 CU or #8-#4 AL (70-100A) #4-#1 CU or #2-1/0 AL
TEB	—	—	—	1,2,3	1	TCAL14 TCAL12 TCAL12A TCAL15	1	(15-30A, TCAL14) #14-8 (30-60A, TCAL 12) #14-3 CU #12-1 AL (70-110A, TCAL 12A) #6-2/0 CU #4-2/0 AL (110-150A, TCAL 15) #2-3/0
TED	THED①	—	—	1				
TED4	—	—	—	2-3				
TED6	THED	—	—	2-3				
TQD	THQD	—	—	2-3	1	TCAL25	1	#1-300MCM
TFJ, TFK	THFK	—	TFL	2-3	1	TCAL24,25	1	#4-300MCM
TJJ, TJK4	THJK4	—	—	2-3	1	TCAL43	1	#6-600MCM or 2-(2/0-250MCM)
TJ0	—	—	—	2-3	1	TCAL43	1	#6-600MCM or 2-(2/0-250MCM)
TJK5 TJ4V	THJK5 THJ4V	—	TJL4V	2-3	1	TCAL43	1	#6-600MCM or 2-(2/0-250MCM)
					1	TCAL63	2	250-350MCM, CU or 350-500MCM, AL
—	—	—	—	3	1	TCAL61	2	2/0-500MCM
TKM8	THKM8	—	TKL4V SK1200 LOAD END	2-3	1	TCAL41	1	#4-600MCM or 2-(1/0-250MCM)
					1	TCAL61	2	2/0-500MCM
					1	TCAL81	3	300-500MCM
—	—	—		—	1	TCAL91	3	250-500MCM
—	—	—	—	3	1	TCAL81	3	300-500MCM
TKM12 TK4V	THKM12	—	TKL4V SK1200 LOAD END	2-3	1	TCAL81	3	250-500MCM
					1	TCAL121	4	250-300MCM CU or 350-500MCM AL
—	—	—			1	TCAL131	4	250-300MCM CU or 350-500MCM AL
—	—	THLC1	TEL	3	1	TCAL12 TCAL12A TCAL15	1	(15-60A, TCAL 12) #14-#3 CU or #12-#1 AL (70-110A, TCAL12A) #6-2/0 CU or #4-2/0 AL (125-150A, TCAL 15) #1-2/0 CU or 1/0-3/0 AL
—	—	THLC2	—	3	1	TCAL27	1	(125-225A, TCAL 27) #4-300MCM
—	—	THLC4	TLB4	3	1	TCLK43②		3/0-500MCM or 2-(3/0-250MCM)
SE150	—	—	—	2,3	1	TCAL14	1	(15-40A) #14-#8
						TCAL18	1	(15-150A) #14-3/0 CU or #12-3/0 AL
SF250	—	—	—	2,3	1	TCAL29	1	#8-350MCM
SG800	—	—	—	2,3	1	TCLK36	1	Copper #6-600MCM or 2-#2/0-400MCM
								AL #6-600MCM or 2-#2/0-500MCM

①One-pole THED frame available only in 15-30 amp trip. ②Three-pole lug assembly suitable for line or load end.

GENERAL:

- Panelboards are listed and labeled by Underwriters Laboratories, Inc. in accordance with UL Standards 50 and 67, and shall conform to the latest requirements of the National Electrical Code and NEMA standard PB.1.
- The panelboard will meet service entrance requirements when specified.
- Federal specifications: panelboards, W-P-115a; fusible switches, W-S-865c.
- Boxes are corrosion-resistant galvanealed (zinc finished) sheet steel with removable end walls. Boxes are furnished without knockouts. Panel fronts are cold-rolled steel, coated with a phosphatized rust inhibitor and then finish coated with ANSI 61 light gray enamel.
- A four-piece front is furnished to provide ease of wiring access. All screw fasteners are zinc coated to retard corrosion.
- Main and branch circuit breakers shall be quick-make, quick-break, and trip-indicating. All two and three pole breaker switches less than 800A) are mounted onto the bus bar with positive gripping jaw assemblies and locked pressure connections. The circuit-protective module can be removed or replaced without removing the main bus or branch circuit connections.
- Bus bars are current density rated and meet UL67 temperature rise limits thru actual tests. All bus bars are silver plated aluminum unless otherwise stated on the drawing.
- Bus bars are sequenced-phased, and rigidly supported by high-impact resistant, insulated bus supporting assemblies to prevent vibration and resulting damage when subjected to stress, vibration or short circuits. All solderless terminations are suitable for either copper or aluminum UL Listed wire or cable and have been tested and listed in conjunction with appropriate UL standards.
- Panelboards are so designed to permit the oncoming line conductors to enter either the top or bottom of the enclosure.

DATE : 02/15/94 PAGE : 1
TIME : 16:53:13

N. PLACE
, SUITE 30
ER, NY 14623

TELEPHONE: (716) 272-7983
FAX: 716-272-9146

TERIAL: DOLLINGERS PROP: 613-60284

~~Sandy Wahl~~

PO # 6774

PLEASED TO QUOTE AS FOLLOWS:
cifically refered to, no addendums are included

TY	CAT #/NAME	DESCRIPTION
1	LP-1	Panelboard, Type AQ 101 Surface Mount Top Feed 3P4W 120/208V 125A MLO 10 KAIC 12 Cir 1 60 Amp 3 Pole THQB 2 20 Amp 1 Pole THQB-GF 3 20 Amp 1 Pole THQB 1 15 Amp 1 Pole THQB 1 Nameplate 1 1000A PSI Copper BusBar 3 Ground Bar (TGL2)
1	PP-1	Spectra Panelboard 101 Surface Mount Top Feed 3P4W 277/480V 400A SGHA4 Main 25 KAIC 2 70 Amp 3 Pole THED6 1 175 Amp 3 Pole THFK 1 15 Amp 1 Pole THED 1 30 Amp 3 Pole THED6 4 100 Amp 3 Pole THED6 SPACE 1 Nameplate 1 Copper Bus 1 Bonded Gnd Bar w/Main Lug
	9T23Q3571	Transformer, QL 3Phs 66 115C Rise 15 KVA 3 Ph 480 TO 208Y/120 6 Taps Indoor
	THN3364	Safety Switch, HD 131 200A no fuse 3 pole 3 wire 600 volt Indoor
2	THN3363	Safety Switch, HD 131 100A no fuse 3 pole 3 wire 600 volt Indoor

A. Dave Horning

DATE : 02/15/94
PAGE : 2

: DOLLINGERS
: 60294

Y	CAT #/NAME	DESCRIPTION
1	CR308C1042RANTDA	Enclsd NEMA Starter 10G1 Comb FVNR Magnetic Starter Disconnect Switch Three Phase, 60 Hertz NEMA Size 1 NEMA Type 1 CPT Forms Control Circuit 480/120V Coil 10 HP 27 Amps Class R Clips 30A - 600V 2NO-2NC Aux Contacts Standard Overload Relay CPT With 2 PRI Fuses\1 SEC Fuse HOA Sw
1	THN3361R	Safety Switch, HD 131 30A no fuse 3 pole 3 wire 600 volt Outdoor

D H Wessels

NESSELS

S ENGINEER

Add 400amp enclosure w/breaker
1 - TJ400S enclosure
1 - TJJ436400WL breaker
1 - TNI400 neutral

Dr 2402

DEM - 1018

GE Specialty Transformers

Dry Type General Purpose Transformers

Low Temperature Rise

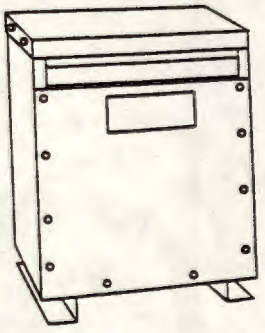
Description

These low temperature rise transformers utilize a UL recognized 220°C insulation system featuring either 80°C or 115°C temperature rise. They provide inherent overload capability and longer life than standard type QL designs.

Available in both single- and three-phase ratings, GE Type QL low temperature rise transformers are UL Listed, File E79145.

Application

Type QL low temperature rise transformers can help cut operating expenses for systems requiring unit loading at 80 to 100 percent of nameplate rating, 24 hours a day, or where load growth is expected. Units with 115°C temperature rise can be operated continuously at 15 percent above nameplate rating without loss of transformer life. Units with 80°C temperature rise offer loading capability at 30 percent above nameplate rating.



Type QL low temperature rise transformer (closed view)

NOTES:

Single-phase Indoor②, Type QL, 60 Hertz UL Listed

kVA	Item No.	Qty.	Catalog Number	480 Volts Delta Primary Secondary 208Y/120 Volts — Dimensions (Inches) Height	Width	Depth	① Taps	Wiring Diagram No. DEM-1007	Approx. Net Wt. (Lbs.)
115°C Rise									
15			9T23L2670	25	16⅛	15¼	6	9	185
25			9T23L2671	34⅛	20¼	22⅛	6	9	285
37.5			9T23L2672	37½	20¼	22⅛	6	4	385
50			9T23L2673	38⅛	22½	27½	6	4	550
75			9T23L2674	44½	26½	28¼	6	4	685
100			9T23L2675	51¾	29	33¾	6	4	1130
80°C Rise									
15			9T23L3670	34⅛	20¼	22⅛	6	9	285
25			9T23L3670G81	37½	20¼	22⅛	6	4	385
37.5			9T23L3672	38⅛	22½	27½	6	4	550
50			9T23L3673	44½	26½	28¼	6	4	685
75			9T23L3674	51¾	29	33¾	6	4	1130
100			9T23L3675	51¾	29	33¾	6	4	1130

Three-phase Indoor②, Type QL, 60 Hertz UL Listed, CSA Certified

kVA	Item No.	Qty.	Catalog Number	480 Volts Delta Primary Secondary 208Y/120 Volts — Dimensions (Inches) Height	Width	Depth	① Taps	Wiring Diagram No. DEM-1007	Approx. Net Wt. (Lbs.)
115°C Rise									
15			9T23Q3571	27⅜	19	16⁹/₁₆	6	18	185
30			9T23Q3572	32¼	24	18⁹/₁₆	6	18	325
45			9T23Q3573	35¾	32	23¹⁵/₁₆	6	18	465
50			9T23Q3564	35¾	32	23¹⁵/₁₆	6	18	465
75			9T23Q3574	40	32	23¹⁵/₁₆	6	18	605
112.5			9T23Q3575	46	35	23¹⁵/₁₆	6	18	775
150			9T23Q3576	48	38½	28¹⁵/₁₆	6	18	1030
225			9T23Q3577	51¾	42½	30¼	6	18	1370
300			9T23L1578	58⅜	47½	34¾	6	18	1900
400			9T23L1566	58⅜	47½	34¾	6	18	2100
500			9T23L1579	76	60	50	▲	21	3450
80°C Rise									
			[illegible]	32¼	24	18⁹/₁₆	6	18	275

N ON PLACE
SUITE 30
ER, NY 14623

DATE : 02/15/94 PAGE : 1
TIME : 16:53:13
TELEPHONE: (716) 272-7983
FAX: 716-272-9146

PROF: 613-60284

ATERIAL: DOLLINGERS

SIMON WARE

PO # 6774

LEASED TO QUOTE AS FOLLOWS:
pecifically refered to, no addendums are included

T	CAT #/NAME	DESCRIPTION
1	LP-1	Panelboard, Type AQ 101 Surface Mount Top Feed 3P4W 120/208V 125A MLO 10 KAIC 12 Cir 1 60 Amp 3 Pole THQB 2 20 Amp 1 Pole THQB-GF 3 20 Amp 1 Pole THQB 1 15 Amp 1 Pole THQB 1 Nameplate 1 1000A PSI Copper BusBar 3 Ground Bar (TGL2)
1	PP-1	Spectra Panelboard 101 Surface Mount Top Feed 3P4W 277/480V 400A SGHA4 Main 25 KAIC 2 70 Amp 3 Pole THED6 1 175 Amp 3 Pole THFK 1 15 Amp 1 Pole THED 1 30 Amp 3 Pole THED6 4 100 Amp 3 Pole THED6 SPACE 1 Nameplate 1 Copper Bus 1 Bonded Gnd Bar w/Main Lug
1	9T23G3571	Transformer, QL 3Phs 66 115C Rise 15 KVA 3 Ph 480 TO 208Y/120 6 Taps Indoor
1	THN3364	Safety Switch, HD 131 200A no fuse 3 pole 3 wire 600 volt Indoor
2	THN3363	Safety Switch, HD 131 100A no fuse 3 pole 3 wire 600 volt Indoor

T. Dave Herring

DATE : 02/15/94
PAGE : 2

: DOLLINGERS
: 60294

Y	CAT #/NAME	DESCRIPTION
1	CR3D8C1042RANTDA	Encled NEMA Starter 10G1 Comb FVNR Magnetic Starter Disconnect Switch Three Phase, 60 Hertz NEMA Size 1 NEMA Type 1 CPT Forms Control Circuit 480/120V Coil 10 HP 27 Amps Class R Clips 30A - 600V 2NO-2NC Aux Contacts Standard Overload Relay CPT With 2 PRI Fuses\1 SEC Fuse HOA Sw
1	THN3361R	Safety Switch, HD 131 30A no fuse 3 pole 3 wire 600 volt Outdoor

DH

Wessels

WESSELS

ES ENGINEER

Add 400amp enclosure w/breaker
1 - TJ400S enclosure
1 - TJJ436400WL breaker
1 - TNI400 neutral

Dr 2 of 2

DEM - 0204

GE Safety Switches

Spec-Setter™ Safety Switches, Heavy Duty Type TH

30-1200 Amperes
480 and 600 Volts ac.
600 Volts dc

Schematic Diagram	Max. Ampere Rating	Indoor Type 1① Item No.	Qty.	Catalog Number	Outdoor Type 3R② Item No.	Qty.	Catalog Number	Water- and Dust-tight Types 4/4X Stainless Steel Item No.	Qty.	Catalog Number	Drip- and Dust-tight Type 5, 12 and JIC Without Knockouts Item No.	Qty.	Catalog Number	Horsepower Ratings ac NEC Std 480V 3-ph	NEC Std 600V 3-ph	Time Delay 480V 3-ph	Time Delay 600V 3-ph	dc 125 Volts	dc 250 Volts	dc 600 Volts
600 Volts—Fusible																				
Two-pole, 600 Volts dc																				
	30			TH2261DC			TH2261RDC			TH2261SSDC			TH2261JDC	—	—	—	—	—	—	15
	60			TH2262DC			TH2262RDC			TH2262SSDC			TH2262JDC	—	—	—	—	—	—	25
	100			TH2263DC			TH2263RDC			TH2263SSDC			TH2263JDC	—	—	—	—	—	—	25
Three-pole, 480, 480Y/277④ and 600 Volts ac—250 Volts dc																				
	30			TH3361			TH3361R			TH3361SS			TH3361J	5	7½	15	20	—	5	—
	60			TH3362			TH3362R			TH3362SS			TH3362J	15	15	30	50	—	10	—
	100			TH3363			TH3363R			TH3363SS			TH3363J	25	30	60	75	—	20	—
	200			TH3364			TH3364R			TH3364SS			TH3364J	50	60	125	150	—	40	—
	400			TH3365			TH3365R			TH3365SS			TH3365J	100	125	250	350	—	50	—
	600			TH3366			TH3366R			TH3366SS			TH3366J	150	200	400	500	—	50	—
	800③			TC72367			TC72367R⑤			—			—	—	—	—	—	—	—	—
	1200③			TC72368			TC72368R⑤			—			—	—	—	—	—	—	—	—
														2-ph	2-ph	2-ph	2-ph			
Four-pole, 480 and 600 Volts ac																				
	30			TH6661			TH6661			—			TH6661	7½	10	20	25	—	5	—
	60			TH6662			TH6662			—			TH6662	15	20	40	50	—	10	—
	100			TH6663			TH6663			—			TH6663	25	30	50	50	—	20	—
	200			TH6664			TH6664			—			TH6664	50	50	—	—	—	40	—
600 Volts—No Fuse														240V 1-ph	240V 3-ph	480V 3-ph	600V 3-ph			
Two-pole, 600 Volts dc																				
	30			THN2261DC			THN2261RDC			THN2261SSDC			THN2261JDC	—	—	—	—	—	—	15
	60			THN2262DC			THN2262RDC			THN2262SSDC			THN2262JDC	—	—	—	—	—	—	25
	100			THN2263DC			THN2263RDC			THN2263SSDC			THN2263JDC	—	—	—	—	—	—	25
Three-pole, 480 and 600 volts ac—250 Volts dc or Two-pole with Switching Neutral																				
	30			THN3321⑥			THN3361B			—			—	3	10	—	—	3	5	—
	30			THN3361			THN3362R			THN3361SS			THN3361J	3	10	20	30	3	5	—
	60			THN3362			THN3363R			THN3362SS			THN3362J	10	20	50	60	5	10	—
	100			THN3363			THN3364R			THN3363SS			THN3363J	20	40	75	100	—	20	—
	200			THN3364			THN3365R			THN3364SS			THN3364J	30	60	125	150	—	40	—
	400			THN3365			THN3366R			THN3365SS			THN3365J	—	125	250	350	—	50	—
	600			THN3366			⑦			THN3366SS			THN3366J	—	200	400	500	—	50	—
	800③			TC36367			⑦			—			—	—	—	—	—	—	—	—
	1200③			TC36368						—			—	—	—	—	—	—	—	—
															2-ph	2-ph	2-ph			
Four-pole, 480 and 600 Volts ac⑧ ⑨																				
	30			THN6661			THN6661			—			THN6661	—	10	20	25	—	5	—
	60			THN6662			THN6662			—			THN6662	—	20	40	50	—	10	—
	100			THN6663			THN6663			—			THN6663	—	30	50	50	—	20	—
	200			THN6664			THN6664			—			THN6664	—	50	—	—	—	40	—

① 200-600 amp devices available factory reversed for bottom feed. Add "B" suffix to Catalog Number (e.g., TH3365B). UL Listed.
② 30-200 amp devices have removable closing cap. Larger ampere devices require field cut openings. Order hubs separately.
③ Type TH electrical performance does not apply to Type TC switches. Class "L" fuses are ac only.
⑤ Not CSA Certified.
⑥ 250 volts ac or 250 volts dc only. Compact enclosure.
⑦ Use molded case switch in circuit breaker enclosure.
⑧ Use four poles of six-pole switch.
⑨ Not CSA Certified.

NOTES:

DEM - 0213

GE Safety Switches

Spec-Setter™ Safety Switches, Dimensions

TG and TH, Type 1 and 3R Enclosures

Type 1 Enclosures
Approximate Dimensions In inches

Switch Catalog Number	W	H	D	W2	KO Fig. No. See DEM-0214

TG — Figure 1

TG3221 TG3222 TG3223 TG3224 TG3225 TG3226	6½ 8½ 9½ 13¾ 22 23¼	10⅜ 13⅞ 21⅜ 29¼ 49½ 50	3⁹⁄₁₆ 4 5 5½ 9 9¼	7 9 10 14 23 23¾	1 15 3 4 5 6
TG3325 TG3326	22 23¼	49½ 50	9 9¼	23 23¾	7 6
TG4321 TG4322 TG4323 TG4324 TG4325 TG4326	6½ 8½ 9½ 13¾ 22 23¼	10⅜ 13⅞ 21⅜ 29¼ 49½ 50	3⁹⁄₁₆ 4 5 5½ 9 9¼	7 9 10 14 23 23¾	1 15 3 4 7 6
TGN3321 TGN3322 TGN3323 TGN3324 TGN3325 TGN3326	6½ 8½ 9½ 13¾ 22 23¼	10⅜ 13⅞ 21⅜ 29¼ 49½ 50	3⁹⁄₁₆ 4 5 5½ 9 9¼	7 9 10 14 23 23¾	1 15 3 4 7 6

TH — Figure 2

TH3221 TH3222 TH3223 TH3224 TH3225 TH3226	6½ 9½ 9½ 13⅝ 23¼ 23¼	10⅜ 17⅜ 21⅜ 31⅜ 50⅞ 50⅞	3⅜ 5 5 5¼ 8⅜ 8⅜	7⅛ 10½ 10⅛ 14½ 24¼ 24¼	1 3 3 4 6 6
TH3325 TH3326	23¼ 23¼	50⅞ 50⅞	8⅜ 8⅜	24¼ 24¼	6 6
TH4321 TH4322 TH4323 TH4324 TH4325 TH4326	6½ 9½ 9½ 13⅝ 23¼ 23¼	10⅜ 17⅜ 21⅜ 31⅜ 50⅞ 50⅞	3⅜ 5 5 5¼ 8⅜ 8⅜	7⅛ 10⅛ 10½ 14½ 24¼ 24¼	1 3 3 4 6 6
TH2261DC TH2262DC TH2263DC	8⅜ 9½ 9½	12⅝ 21⅜ 22¾	4 5 5	9½ 10⅛ 10⅛	15 3 14
TH3361 TH3362 TH3363 TH3364 TH3365 TH3366	8⅜ 9½ 9½ 13⅝ 23¼ 23¼	12⅝ 21⅜ 22¾ 31⅜ 54 54	4 5 5 5¼ 8⅜ 8⅜	9½ 10⅛ 10⅛ 14½ 24½ 24½	15 3 14 4 6 6
THN2261DC THN2262DC THN2263DC	8½ 9½ 9½	10⁹⁄₁₆ 17⅝ 17⅝	4 5 5	9¼ 10⅛ 10⅛	15 3 3
THN3321 THN3361 THN3362 THN3363 THN3364 THN3365 THN3366	6½ 8½ 9½ 9½ 13⅝ 23¼ 23¼	10⅜ 10⁹⁄₁₆ 17⅝ 17⅝ 31⅜ 42½ 42½	3⅜ 4 5 5 5¼ 8⅜ 8⅜	7⅛ 9¼ 10⅛ 10⅛ 14½ 24½ 24½	1 15 3 3 4 6 6

Type 3R Enclosures
Approximate Dimensions In inches

Switch Catalog Number	W	H	D	W2	KO Fig. No. See DEM-0214

TG — Figure 3

TG3221R TG3222R TG3223R TG3224R TG3225R TG3226R	6⅞ 8¾ 9⅞ 14 22¼ 23⅝	9⅞ 13¾ 21¼ 29 49½ 50	3⁹⁄₁₆ 4 5 5⅞ 9 9¼	7¼ 9¼ 10 14¼ 22½ 23¾	8 19 10 11 12 13
TG3325R TG3326R	22¼ 23⅝	49½ 50	9 9¼	22½ 23¾	12 13
TG4321R TG4322R TG4323R TG4324R	6⅞ 8¾ 9⅞ 14	9⅞ 13¾ 21¼ 29	3⁹⁄₁₆ 4 5 5⅞	7¼ 9¼ 10 14¼	8 19 10 11
TGN3321R TGN3322R TGN3323R TGN3324R	6⅞ 8¾ 9⅞ 14	9⅞ 13¾ 15¾ 29	3⁹⁄₁₆ 4 5 5⅞	7¼ 9¼ 10 14¼	8 19 10 11

TH — Figure 4

TH3221R TH3222R TH3223R TH3224R TH3225R TH3226R	6⅞ 9⅞ 9⅞ 14 23½ 23½	10⅜ 17½ 22¼ 31½ 49⅛ 53¼	3⁵⁄₁₆ 5 5 5⁹⁄₁₆ 8⅜ 8⅜	7⅛ 10⅛ 10⅜ 14⅛ 24¼ 24¼	8 10 10 11 18 18
TH3325R TH3326R	23½ 23½	49⅛ 53¼	8⅜ 8⅜	24¼ 24¼	18 18
TH4321R TH4322R TH4323R TH4324R	6⅞ 9⅞ 9⅞ 14	10⅜ 17½ 22¼ 31½	3⁵⁄₁₆ 5 5 5⁹⁄₁₆	7⅛ 10⅛ 10⅜ 14⅛	8 10 10 11
TH2261RDC TH2262RDC TH2263RDC	8⅞ 9⅞ 9⅞	13¼ 22¼ 22¼	4 5 5	9½ 10⅜ 10⅜	19 10 10
TH3361R TH3362R TH3363R TH3364R TH3365R TH3366R	8⅞ 9⅞ 9⅞ 14 23½ 23½	13¼ 22¼ 22¼ 31½ 53¼ 53¼	4 5 5 5⁹⁄₁₆ 8⅜ 8⅜	9½ 10⅜ 10⅜ 14⅛ 24¼ 24¼	19 10 10 11 18 18
THN2261RDC THN2262RDC THN2263RDC	8⅞ 9⅞ 9⅞	13¼ 17½ 17½	4 5 5	9½ 10⅛ 10⅛	19 10 10
THN3361R THN3362R THN3363R THN3364R THN3365R THN3366R	8⅞ 9⅞ 9⅞ 14 23½ 23½	13¼ 17½ 17½ 31½ 49⅛ 53¼	4 5 5 5⁹⁄₁₆ 8⅜ 8⅜	9½ 10⅛ 10⅛ 14⅛ 24¼ 24¼	19 10 10 11 18 18

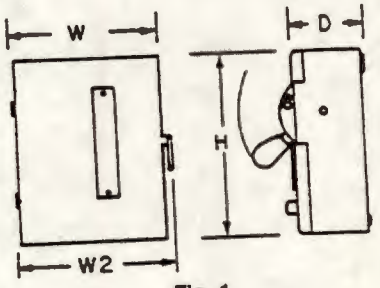


Fig. 1

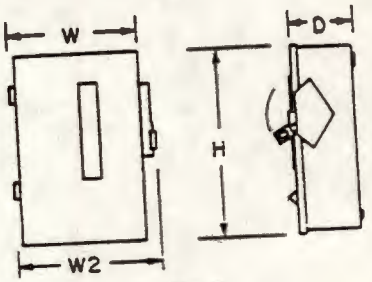


Fig. 2

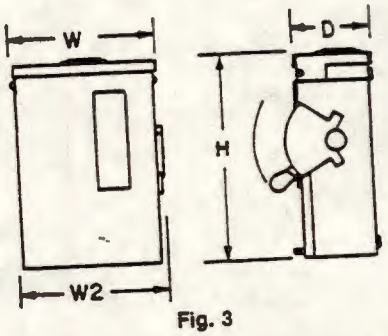


Fig. 3

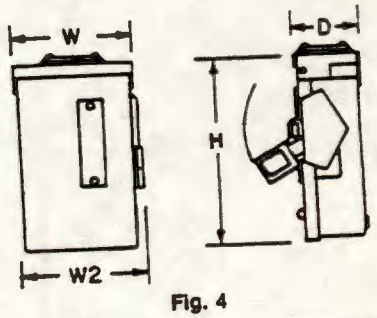


Fig. 4

NOTES:

DEM - 0214

GE Safety Switches

Spec-Setter™ Safety Switches, Knockouts

TG and TH, Type 1 and 3R Enclosures

Dimensions—Knockouts

Sym-bol	A	B	C	D	E	F	G	H	J	K	L	M	N
Conduit Size (inches)	9/32	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1	1	2	2	2 1/2
	—	—	3/4	3/4	3/4	3/4	1	1	1 1/4	1 1/2	2 1/2	2 1/2	3
	—	—	—	1	1	1	—	1 1/4	1 1/2	2	3	3	—
	—	—	—	—	1 1/4	1 1/2	—	1 1/2	2	2 1/2	—	3 1/2	—

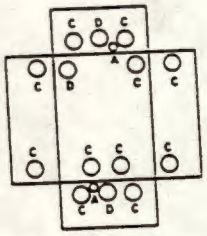


Fig. 1

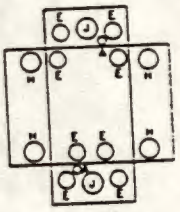


Fig. 2

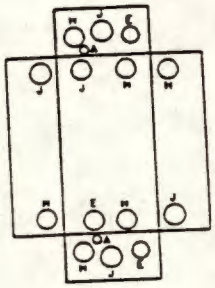


Fig. 3

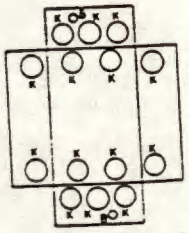
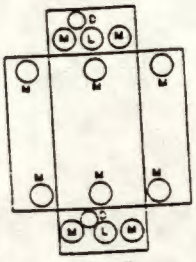


Fig. 4



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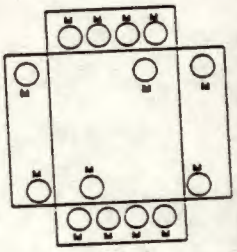

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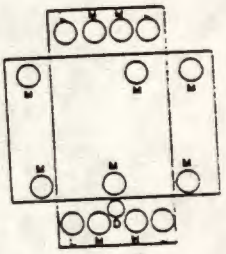
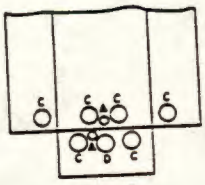


Fig. 7



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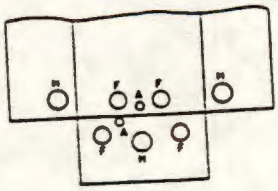

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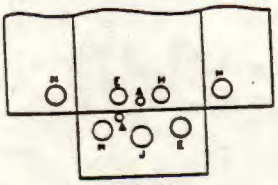


Fig. 10

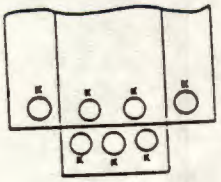
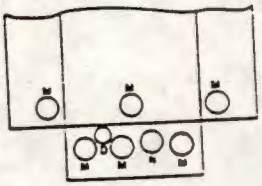


Fig. 11



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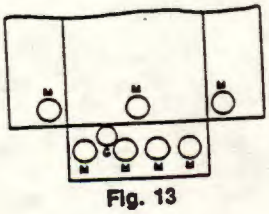

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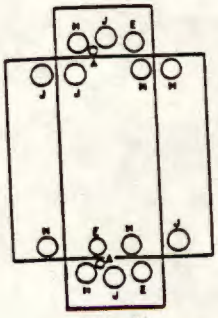


Fig. 14

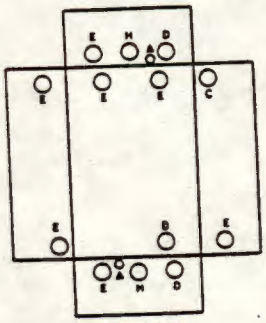


Fig. 15

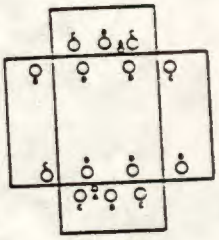


Fig. 16

NOTES:

DATE : 02/15/94 PAGE : 1
TIME : 16:53:13
TELEPHONE: (716) 272-7983
FAX: 716-272-9146

I ON PLACE
, SUITE 30
TER, NY 14623

F MATERIAL: DOLLINGERS PROP: 613-60294

~~SANDY WAHL~~

PO # 6774

E PLEASED TO QUOTE AS FOLLOWS:
5 pecifically refered to, no addendums are included

QT	CAT #/NAME	DESCRIPTION
1	LP-1	Panelboard, Type AQ 101 Surface Mount Top Feed 3P4W 120/208V 125A MLO 10 KAIC 12 Cir 1 60 Amp 3 Pole THQB 2 20 Amp 1 Pole THQB-GF 3 20 Amp 1 Pole THQB 1 15 Amp 1 Pole THQB 1 Nameplate 1 1000A PSI Copper BusBar 3 Ground Bar (TGL2)
1	PP-1	Spectra Panelboard 101 Surface Mount Top Feed 3P4W 277/480V 400A SGHA4 Main 25 KAIC 2 70 Amp 3 Pole THED6 1 175 Amp 3 Pole THFK 1 15 Amp 1 Pole THED 1 30 Amp 3 Pole THED6 4 100 Amp 3 Pole THED6 SPACE 1 Nameplate 1 Copper Bus 1 Bonded Gnd Bar w/Main Lug
1	9T23Q3571	Transformer, QL 3Phs 66 115C Rise 15 KVA 3 Ph 480 TO 208Y/120 6 Taps Indoor
1	THN3364	Safety Switch, HD 131 200A no fuse 3 pole 3 wire 600 volt Indoor
2	THN3363	Safety Switch, HD 131 100A no fuse 3 pole 3 wire 600 volt Indoor

A. Dave Horning

DATE : 02/15/94
PAGE : 2

: DOLLINGERS
: 60294

TY	CAT #/NAME	DESCRIPTION
1	CR3D8C1042RANTDA	Enclsd NEMA Starter 10G1 Comb FVNR Magnetic Starter Disconnect Switch Three Phase, 60 Hertz NEMA Size 1 NEMA Type 1 CPT Forms Control Circuit 480/120V Coil 10 HP 27 Amps Class R Clips 30A - 600V 2NO-2NC Aux Contacts Standard Overload Relay CPT With 2 PRI Fuses\1 SEC Fuse HOA Sw
1	THN3361R	Safety Switch, HD 131 30A no fuse 3 pole 3 wire 600 volt Outdoor

Wessels

WESSELS

LES ENGINEER

Add 400amp enclosure w/breaker
1 - TJ400S enclosure
1 - TJJ436400WL breaker
1 - TNI400 neutral

2/15/94

GE Electrical Distribution & Control

G1311279 Sandy IT.6

55-178488

CONT ON SHEET FL. 2 SH NO. 1

REV NO.

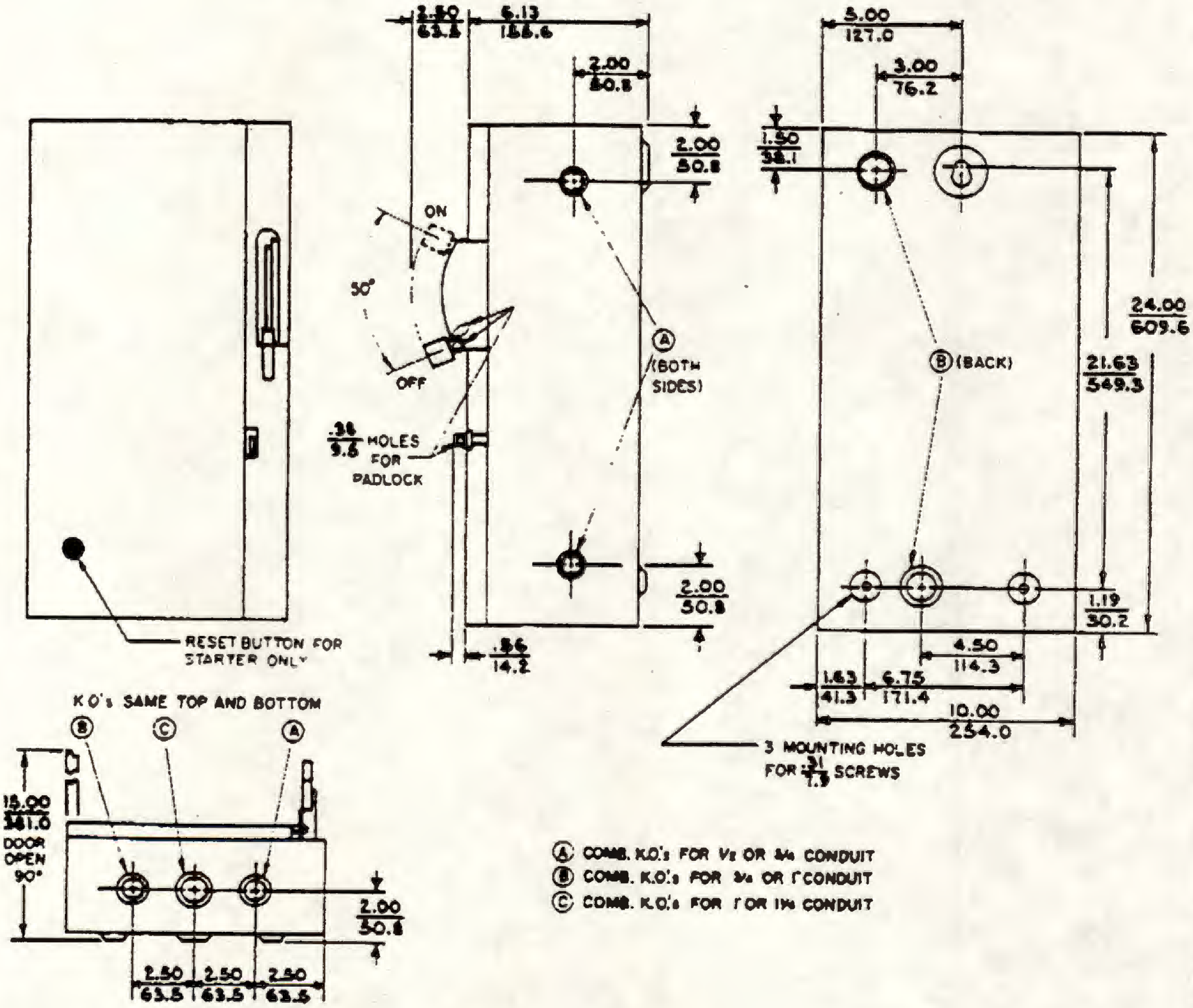
CONT ON SHEET SH NO.

TITLE

OUTLINE

FIRST MADE FOR CR307-308 B,C&D

REVISION



308C1042RANTDA
600 LINE SIZE 1 COMBINATION STARTER
THREE FULL RATED POLES PLUS INTERLOCK
30A, 600V CLASS R FUSE CLIPS
FUSIBLE DISCONNECT SWITCH
TYPE 1 GENERAL PURPOSE ENCLOSURE
480/120V 60HZ STD CAP CPT (50VA)
WITH TWO CPT PRIMARY FUSES
WITH ONE CPT SECONDARY FUSE
2 NO - 2 NC EXTRA AUX CONTACTS
MANUAL RESET OVERLOAD RELAY
THREE LEG OVERLOAD PROTECTION
NON-COMP RELAY - 1NC CONTACT
TYPE 1 HAND-OFF-AUTO SELECTOR SWITCH KIT

DUAL DIMENSIONS = INCHES / MILLIMETERS

2 May 20, 1981 Patt. ANSI 1981 RE-ISSUED

622

812

WP

FT

PRINTS TO

MADE BY C. DE VISSER JULY 17, 1968

APPROVALS

GENERAL PURPOSE CONTROL

55-178488

GE Electrical Distribution & Control

Sandy *G/3 11279* *IT.6*

55-179677

CONT ON SHEET *2* SH NO. *2*

REV NO.

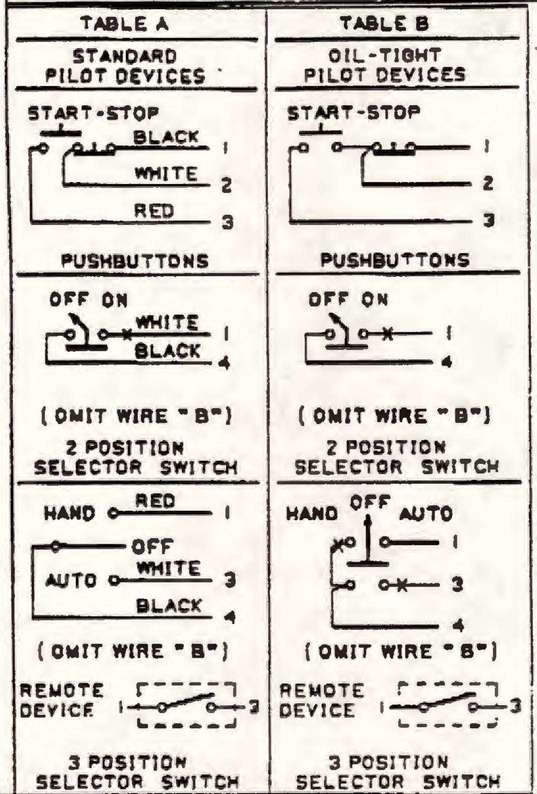
CONT ON SHEET | SH NO.

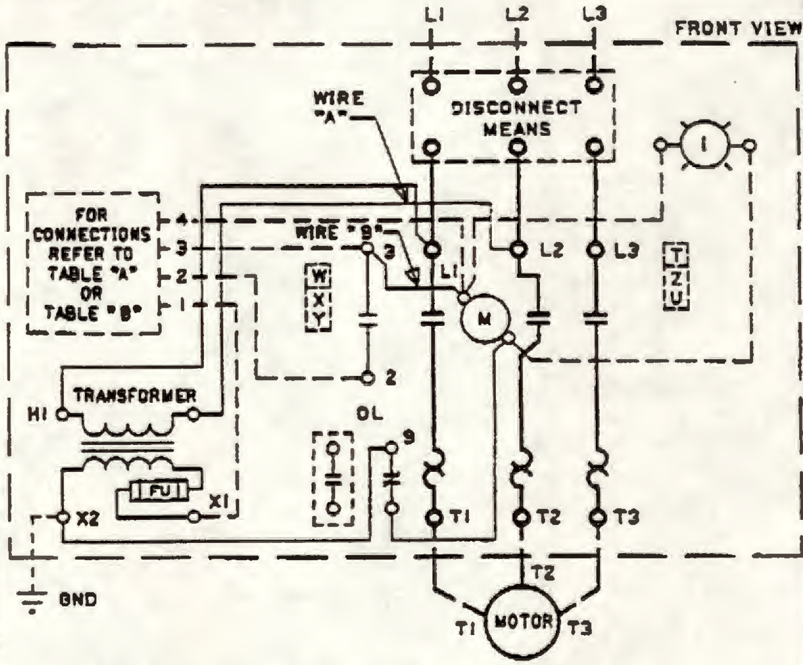
TITLE

WIRING INSTRUCTIONS FOR:
CR 306, 307, 308 & 387 FULL VOLTAGE, NON-REVERSING
MAGNETIC STARTERS WITH CONTROL TRANSFORMER

FIRST MADE FOR NEMA SIZE 00, 0 & 1

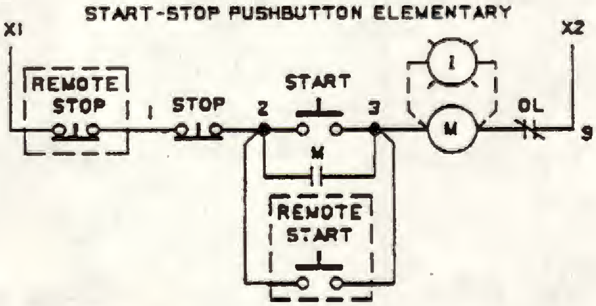
REVISIONS





		LINE	LOAD
TORQUE LINE AND LOAD TERMINALS AS SHOWN AT RIGHT	CR306	20 LB-IN	20 LB-IN
	CR307	AS MARKED	20 LB-IN
	CR308	35 LB-IN	20 LB-IN
	CR387	AS MARKED	20 LB-[illegible]

START-STOP PUSHBUTTON ELEMENTARY

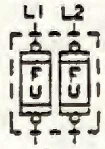


USE 75°C. COPPER CONDUCTORS ONLY.
FOR FIELD WIRING.

-NOMENCLATURE-

M-LINE CONTACTOR
OL-THERMAL OVERLOAD RELAY
I-INDICATING LIGHT
FU-FUSE
X-INDICATES CONTACT CLOSED

CONTROL CIRCUIT FUSING



EXTRA SECONDARY FUSE

FOR CSA - GND. KIT
1/2 IN. CONDUIT 55-2134038001
3/4 IN. CONDUIT 55-2134038002

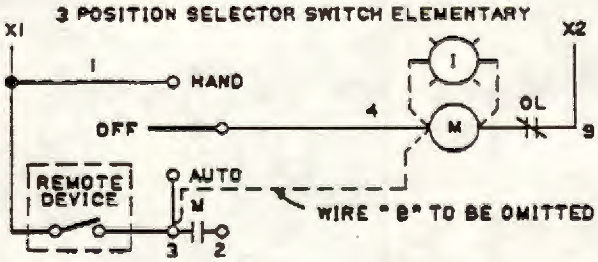
NOTE: REFER TO THE NATIONAL ELECTRICAL CODE. ADDITIONAL CONTROL CIRCUIT OVER-CURRENT PROTECTION MAY BE REQUIRED.

FOR 1-PHASE OPERATION-CHANGE CONNECTION OF WIRE "A" FROM L2 TO L3. CONNECT LINE TO L1 AND L3 AND LOAD TO T1 AND T3.

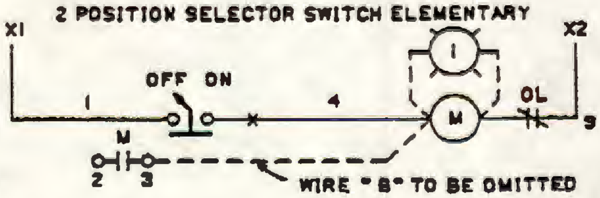
FOR STARTER WITHOUT DISCONNECT MEANS-WIRE LINE DIRECT TO L1, L2 AND L3 ON STARTER.

FOR EXTRA AUXILARY CONTACTS- A MAXIMUM OF 4 CONTACTS MAY BE ADDED AT POSITIONS T,U,W,X,Y,& Z FOR SIZE 0 & 1 ONLY.

3 POSITION SELECTOR SWITCH ELEMENTARY



2 POSITION SELECTOR SWITCH ELEMENTARY



Sept. 29, 1983 *C. Lehman AW83-1637* *Aug. 29, 1983*

6
7
F7
622
WP
813

E.DIA.55-179677.PLOT

PRINTS T

DATE : 02/15/94 PAGE : 1
TIME : 16:53:13

N ON PLACE
, SUITE 30
ER, NY 14623

TELEPHONE: (716) 272-7983
FAX: 716-272-9146

ATERIAL: DOLLINGERS PROF: 613-60204

~~SANDY WAHL~~

PO # 6774

PLEASED TO QUOTE AS FOLLOWS:
ecifically refered to, no addendums are included

TY	CAT #/NAME	DESCRIPTION
1	LP-1	Panelboard, Type AQ 101 Surface Mount Top Feed 3P4W 120/208V 125A MLO 10 KAIC 12 Cir 1 60 Amp 3 Pole THQB 2 20 Amp 1 Pole THQB-GF 3 20 Amp 1 Pole THQB 1 15 Amp 1 Pole THQB 1 Nameplate 1 1000A PSI Copper BusBar 3 Ground Bar (TGL2)
1	PP-1	Spectra Panelboard 101 Surface Mount Top Feed 3P4W 277/480V 400A SGHA4 Main 25 KAIC 2 70 Amp 3 Pole THED6 1 175 Amp 3 Pole THFK 1 15 Amp 1 Pole THED 1 30 Amp 3 Pole THED6 4 100 Amp 3 Pole THED6 SPACE 1 Nameplate 1 Copper Bus 1 Bonded Gnd Bar w/Main Lug
1	9T23035?1	Transformer, QL 3Phs 66 115C Rise 15 KVA 3 Ph 480 TO 208Y/120 6 Taps Indoor
1	THN3364	Safety Switch, HD 131 200A no fuse 3 pole 3 wire 600 volt Indoor
2	THN3363	Safety Switch, HD 131 100A no fuse 3 pole 3 wire 600 volt Indoor

A. Dave Horning

DATE : 02/15/94
PAGE : 2

: DOLLINGERS
: 60294

Y	CAT #/NAME	DESCRIPTION
1	CR308C1042RANTDA	Enclsd NEMA Starter 10G1 Comb FVNR Magnetic Starter Disconnect Switch Three Phase, 60 Hertz NEMA Size 1 NEMA Type 1 CPT Forms Control Circuit 480/120V Coil 10 HP 27 Amps Class R Clips 30A - 600V 2NO-2NC Aux Contacts Standard Overload Relay CPT With 2 PRI Fuses\1 SEC Fuse HOA Sw
1	THN3361R	Safety Switch, HD 131 30A no fuse 3 pole 3 wire 600 volt Outdoor

D H Wassels

ESSELS

S ENGINEER

Add 400amp enclosure w/breaker
1 - TJ400S enclosure
1 - TJJ436400WL breaker
1 - TNI400 neutral

D: 2402

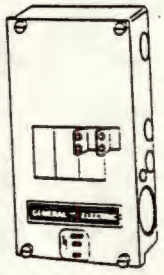
DEM - 0301

GE Circuit Breaker Enclosures

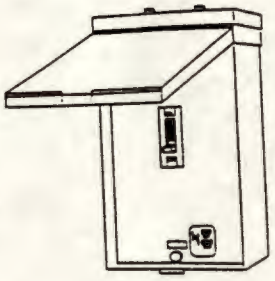
Circuit Breaker Enclosures

70-1200 Amperes
240-600 Volts ac.
125-250 Volts dc (except Spectra RMS™ breakers which have ac ratings only)

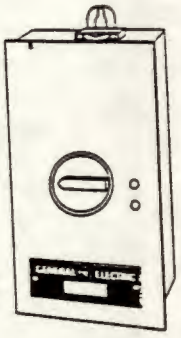
UL Listed.
Suitable for use as service equipment.
60°C/75°C conductor ratings.
Short circuit ratings are equal to the rating of the installed breaker.



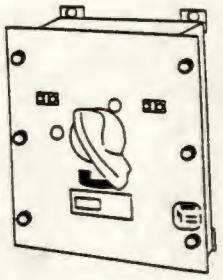
Type 1, indoor surface or flush mounting



Type 3R outdoor, raintight



Types 12K and 12 rotary handle integral with breaker



Types 4/4X stainless steel, watertight, dust tight

Breaker Type	Max. Amp Rating	Poles	Item No	Qty	Type 1① Indoor Cat. No.	Item No	Qty.	Type 3R② Outdoor Cat. No.	Item No	Qty	Type 12③ Oil-tight/ Dust-tight Cat. No	Item No.	Qty.	Type 4/4X Stainless Steel④ Cat. No	Item No	Qty	Neutral Catalog Number	Item No	Qty	Neutral for Ground Fault Cat. No	Item No.	Qty	Current Trans for Gd. Fault Cat. No
THQL, THQL-FG, TXQL	70	1,2,3			TQL70F TQL70S			TQL70R			–			–			included			–			–
	100	1,2,3			TQL100F TQL100S			TQL100R															
	125⑤	1,2			TPL212C			TPL212R															
THQC, THHQC, TXQC, THQE	100	1,2,3			TQC100F TQC100S			TQC100R			–			–			included			–			–
TEB, TED, THED	100	2,3			TE100F TE100S			TE100R			TE100D⑥ TE100J⑥			TE100CS⑥			included			–			
SE150	100	2,3			TE100F TE100S			TE100R			SE100D SE100J			SE100CS⑥			included			–			
TED, THED	150	2,3			TE150F TE150S			TE150R			–			–			included			–			–
SE150	150	2,3			TE150F TE150S			TE150R			–			–			included			–			–
TB1	100	3			–			–			TB100J			–			included			–			–
TQD, THQD	225	2			–			TQD225NR⑦			–			–									
		2,3			TQD225F TQD225S			TQD225R															
TFJ, TFL, TFK, THFK	225	2,3			TF225F TF225S			TF225R			TF225D TF225J			TF225CS			TNIA225			–			–
SF250	250⑧	2,3			TF225F TF225S			TF225R			SF250D SF250J			SF250CS			TNIA225			–			–
TJD, TJJ, TJK, THJK	400 ⑨	2,3			TJ400F TJ400S			TJ400R			TJ400D TJ400J			TJ400CS			TNIA400			–			–
TB4	400	2,3			–			–			TB400J			–			TNIA400			–			–
TJK, THJK	600	2,3			TJ600F TJ600S			TJ600R			TJ600J			TJ600CS			TNIA400⑦ TNIA600			TNIA400VG TNIA600VG			TSRG201 TSRG202 TSRG203 TSRG204 TSRG205 TSRG206
TJ4V, THJ4V, TJL4V	600	3			TJ4V600F TJ4V600S			TJ4V600R			TJ4V600J			TJ4V600CS									
TJH, TJL	600	3			TJ9V600F TJ9V600S			TJ9V600R			TJ9V600J			–									
SG400	400	2,3			SG400F SG400S			SG400R			SG400D SG400J			SG400CS			TNIA400			TNIA400VG			TSRG201 TSRG202 TSRG203 TSRG204
SG600	600	2,3			SG600F SG600S			SG600R			SG600J			–			TNIA600			TNIA600VG			TSRG205 TSRG206
TB6	600	3			–			–			TB600J			–			TNIA400 TNIA600			–			–
TB8	800	3			–			–			TB800J			–			TNIA400 TNIA600 TNIA800			–			–
TKMA, THKMA	1200	2,3			TK4V1200F TK4V1200S			TK4V1200R			TK1200J			–			TNIA400⑧ TNIA600⑧ TNIA800 TNIA1200 TNIAC1200			– TNIA800G TNIA1200G			– – TSKG408 TSKG410 TSKG412
TKL4V, TK4V	1200	3			TK4V1200F TK4V1200S			TK4V1200R			TK4V1200J			–									
TKH, TKL	1200	3			–			–			TK9V1200J⑧			–									
SK1200	1200	2,3			TK4V1200F TK4V1200S			TK4V1200R			SK1200J			–			TNIA400 TNIA600 TNIA800 TNIA1200 TNIAC1200			TNIA800G TNIA1200G			TSKG408 TSKG410 TSKG412

...able for parallel 250 MCM

NOTES:

DEM - 0303

GE Circuit Breaker Enclosures

Dimensions

Type 1

See Fig. 1

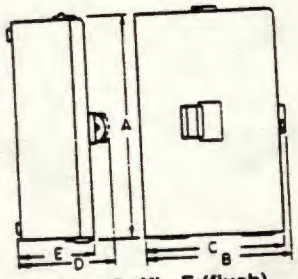


Fig. 1 Suffix F (flush)
Suffix S (surface)

Catalog Number	Dimensions in Inches A①	B①	C①	D	E	Outline Drawing Number
TE100F.S	17	—	7 7/8	5 1/2	4 3/4	139C5651 Sh 1
TE150F.S	26 7/16	8 1/8	8 1/8	6 3/16	5 1/2	139C5497 Sh 1
TF225F.S	29 1/8	8 1/8	8 1/8	6 3/16	5 1/2	139C5497 Sh 2
SG400F	31 3/8	—	15 21/32	7 3/16	6 3/8	208C2891 Sh 1
SG400S	30 9/16	—	14 1/8	7 3/16	6 3/8	208C2891 Sh 1
TJ400F.S②	27 1/16	15 1/16	15 1/16	7 1/8	6 7/16	139C5497 Sh 3
SG600F	44	—	18 3/16	9	8 3/8	208C2891 Sh 2
SG600S	42 3/4	—	17 1/8	9	8 3/8	208C2891 Sh 2
TJ4V600F.S	46 5/8	17 3/16	17 3/16	9 1/16	8 1/8	139C5497 Sh 4
TJ600F.S	46 5/8	17 3/16	17 3/16	9 1/16	8 1/8	139C5497 Sh 4
TJ9V600F.S	46 5/8	17 3/16	17 3/16	9 1/16	8 3/8	139C5497 Sh 4
TK4V1200F.S	48 1/8	21 15/16	21 15/16	9 9/16	8 11/16	139C5497 Sh 5
TPL212C	9 1/32	7 1/2	7 1/2	3 9/16	3 9/16	—
TQC100F.S	15 1/4	—	6 7/8	4 3/4	4	139C5651 Sh 1
TQD225F.S	26 7/16	8 1/8	8 1/8	6 3/16	5 1/2	139C5497 Sh 1
TQL70F.S	11 1/8	—	5 1/8	4	3 1/4	139C5651 Sh 1
TQL100F.S	15 1/4	—	6 7/8	4 3/4	4	139C5651 Sh 1

Type 3R

See Fig. 2

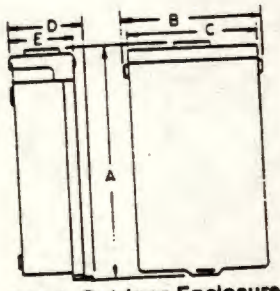


Fig 2. Outdoor Enclosure

Catalog Number	Dimensions in Inches A	B	C	D	E	Outline Drawing Number
TE100R	18 1/8	7 7/8	7 1/2	5 11/16	5 3/8	139C5652 Sh 1
TE150R	27 7/16	10 1/4	10	6 1/4	5 1/2	139C5498 Sh 1
TF225R	30 13/16	10 1/4	10	7	6 1/4	139C5498 Sh 2
SG400R	30 12/16	14 15/16	14 3/8	9 1/8	8	208C2837 Sh 1
SG600R	43	18 1/8	18 1/16	8 13/16	7 11/16	208C2838 Sh 1
TJ400R②	27 9/16	15 7/8	15 11/16	8 11/16	8	139C5498 Sh 4
TJ4V600R	46 7/16	18 1/16	18 1/16	8 3/16	7 3/8	139C5519 Sh 1
TJ600R	46 7/16	18 1/16	18 1/16	8 3/16	7 3/8	139C5519 Sh 1
TJ9V600R	46 7/16	18 1/16	18 1/16	8 3/16	7 3/8	139C5519 Sh 1
TK4V1200R	47 3/4	23 3/8	22 9/16	9 7/16	8 3/16	139C5520 Sh 1
TPL212R	9 1/32	7 1/2	7 1/2	3 9/16	3 9/16	—
TQC100R	15 3/4	7 7/8	7 1/2	5 11/16	5 3/8	139C5652 Sh 1
TQD225NR	26 13/16	7 13/16	7 3/8	5 1/8	4 7/16	139C5498 Sh 3
TQD225R	26 3/8	10 1/4	10	6 1/4	5 1/2	139C5498 Sh 1
TQL70R/100R	17	7 1/4	6 7/8	6	5	139C5652 Sh 1

Type 4/4X

See Fig. 3

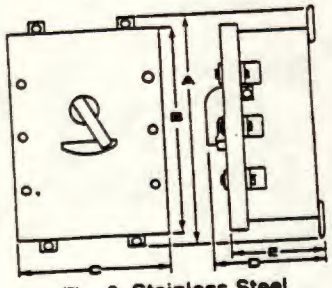


Fig. 3. Stainless Steel

Catalog Number	Dimensions in Inches A	B	C	D	E	Outline Drawing Number
SE100CS	19 1/4	18 1/2	8 1/2	7	5	139C5654 Sh 1
TE100CS	19 1/4	17 1/4	8 1/2	7	5	139C5654 Sh 1
TF225CS	31 3/4	30	10 7/16	9 1/16	7 1/8	139C5496 Sh 1
SF250CS	36 1/2	35 3/8	10 3/8	7 15/16	6 1/16	208C2887 Sh 1
TJ400CS②	29 1/4	27 1/2	16 1/4	9 1/16	7 1/8	139C5496 Sh 2
TJ4V600CS	46 1/4	45 1/2	19 1/8	9 1/16	7 1/8	139C5496 Sh 3
SG400CS	32	31 1/4	14 1/8	9 5/16	7 7/16	208C2888 Sh 1
TJ600CS	46 1/4	45 1/2	19 1/8	9 1/16	7 1/8	139C5496 Sh 3

Type 12 and 12K

See Fig. 4

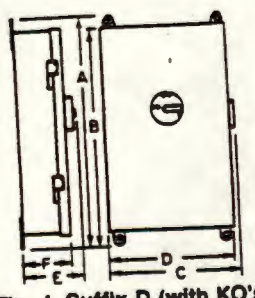


Fig. 4. Suffix D (with KO's)
Suffix J (without KO's)

Catalog Number	Dimensions in Inches A	B	C	D	E	F	Outline Drawing Number
TB100J	23 1/8	21 1/8	9	8	5 3/4	4 3/8	139C5653 Sh 1
TB400J	48 7/16	46 15/16	17 3/4	17 3/16	9 3/4	8 3/8	139C5682 Sh 5
TB800J	56 9/16	54 13/16	22 1/16	22	10 7/16	8 11/16	139C5682 Sh 6
SE100DJ	19 1/4	17 9/16	9	8	5 3/8	4 1/8	139C5653 Sh 1
TE100D	19 1/4	17 9/16	9	8	5 3/4	4 1/8	139C5653 Sh 1
TE100J	19 1/4	17 9/16	9	8	5 3/4	4 1/8	139C5653 Sh 1
SF250DJ	36 1/2	35 3/8	9 13/16	9 3/16	7 9/16	6 1/2	208C2884 Sh 1, Sh 2
TF225D	31 3/4	30 1/4	9 1/2	9	7 9/16	6 7/16	139C5682 Sh 1
TF225J	31 3/4	30 1/4	9 1/2	9	7 9/16	6 7/16	139C5682 Sh 2
SG400DJ	31 3/8	30 1/2	16 9/16	15 11/16	7 7/8	6 9/16	208C2885 Sh 1, Sh 2
TJ400D②	29 9/16	27 13/16	14 1/4	13 3/16	7 7/8	6 7/16	139C5682 Sh 3
TJ400J②	29 9/16	27 13/16	14 1/4	13 3/16	7 7/8	6 7/16	139C5682 Sh 4
TJ4V600J	48 7/16	46 15/16	17 3/4	17 3/16	9 3/4	8 3/8	139C5682 Sh 5
SG600J	44 7/8	44	18	17 3/8	9 9/16	8 3/8	208C2886 Sh 2
TJ600J	48 7/16	46 15/16	17 3/4	17 3/16	9 3/4	8 3/8	139C5682 Sh 5
TJ9V600J	48 7/16	46 15/16	17 3/4	17 3/16	9 3/4	8 3/8	139C5682 Sh 5
SK1200J	56 9/16	55 1/16	22 11/16	22	10 7/16	8 11/16	139C5682 Sh 5
TK4V1200J	56 9/16	54 13/16	22 11/16	22	10 7/16	8 11/16	139C5682 Sh 6
							139C5682 Sh 6

NOTES:

Knockouts

Dimensions-Knockouts

Symbol	A	⊕	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z
Conduit Size (Inches)	9/32	—	3/8	—	—	—	—	—	—	3/8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	1/2	1/2	1/2	—	1/2	—	1/2	—	1/2	—	—	—	—	—	3/4	—	—	—	—	—	3/4	—	—	—	—
	—	—	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	—	—	—	—	1	1	—	—	—	—	1	—	—	—	—
	—	—	—	—	—	1	1	1	1	1	1	1	—	1	—	1	1	—	—	1¼	—	1¼	—	—	—	—
	—	—	—	—	—	—	—	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½	1½	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	—	—	—	2	2	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	2	2	2	2	2	2	—	2½	—	—	2½
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2½	2½	2½	2½	2½	2½	—	3	3	3	3
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	3	3	—	3½	3½	3½	3½
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Circuit Breaker Enclosures	
Catalog Number	KO Fig. No. (also see DEM-0305)
TE100D, SE100D	2
TE100F,S	3
TE100R	16
TE150F,S	7
TE150R	12
TF225D, SF250D	-
TF225F,S	-
TF225R	12
TJ400D, SG400D	10
TJ400F,S, SG400F,S	9
TJ400R, SG400R	11
TJ4V600F,S, SG600F,S	6
TJ4V600R, SG600R	15
TJ600F,S	6
TJ600R	15
TJ9V600F,S	6
TJ9V600R	15
TK4V1200F,S	No KO
TK4V1200R	No KO
TPL212C	5
TPL212R	14
TQC100F,S	4
TQC100R	16
TQD225F,S	7
TQD225NR	13
TQD225R	12
TQL70F,S	8
TQL70R	16
TQL100F,S	4
TQL100R	16

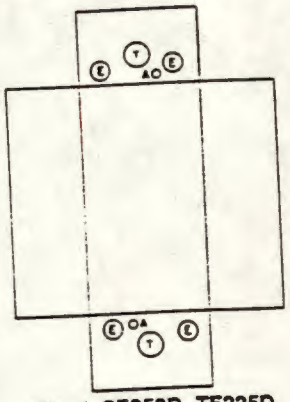


Fig. 1. SF250D, TF225D

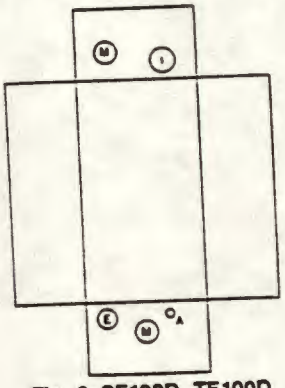


Fig. 2. SE100D, TE100D

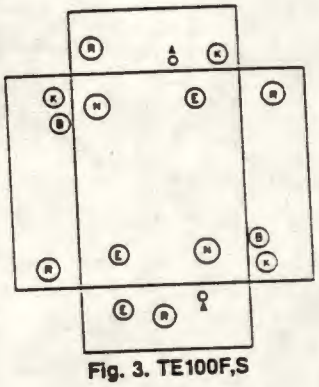


Fig. 3. TE100F,S

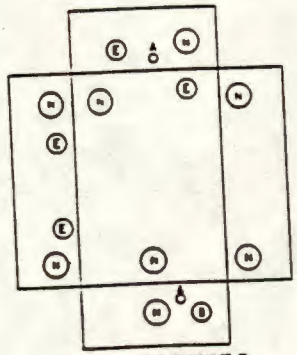


Fig. 4. TQC100F,S TQL100F,S

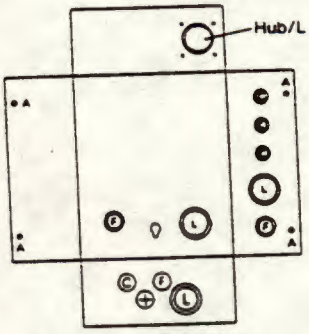


Fig. 5. TPL212C

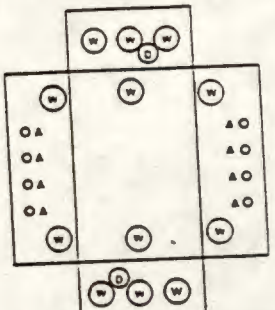
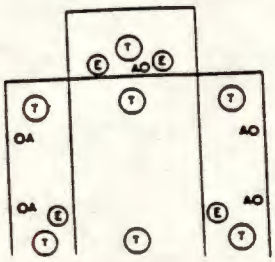
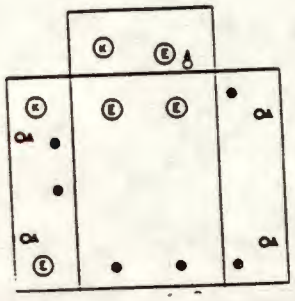
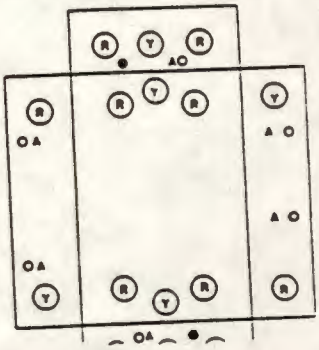


Fig. 6. SG600F,S, TJ4V600F,S TJ600F,S TJ9V600F,S

NOTES:







Dimensions

Knockouts

Dimensions-Knockouts

Symbol	A	⊕	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z
Conduit Size (Inches)	9/32	—	3/8	—	—	—	—	—	—	3/8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	1/2	1/2	1/2	—	1/2	—	1/2	—	1/2	—	—	—	—	—	—	—	—	—	—	—	3/4	—	—	—	—
	—	—	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	—	—	—	—	3/4	—	—	—	—	—	1	—	—	—	—
	—	—	—	—	—	1	1	1	1	1	1	1	—	1	—	1	1	—	—	—	—	1¼	—	—	—	—
	—	—	—	—	—	—	—	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	—	—	1¼	—	—	1¼	—	—	—	—
	—	—	—	—	—	—	—	—	—	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	2	2	2	2	2	2	—	2	2	—	2
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2½	2½	2½	2½	2½	2½	—	2½	—	—	2½
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	3	3	—	3	3	3	3
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3½	3½	3½	3½	3½
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
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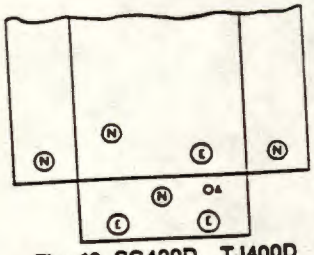


Fig. 10. SG400D TJ400D

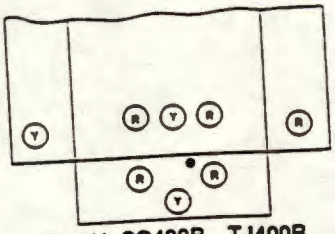


Fig. 11. SG400R TJ400R

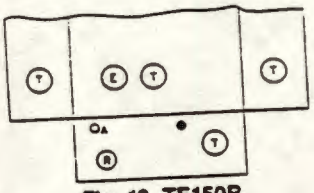


Fig. 12. TE150R
TF225R TQD225R

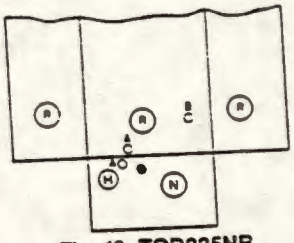


Fig. 13. TQD225NR

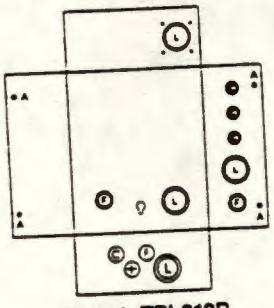


Fig. 14. TPL212R

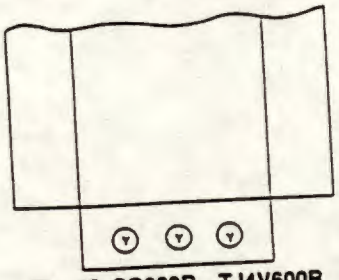


Fig. 15. SG600R TJ4V600R
TJ600R TJ9V600R

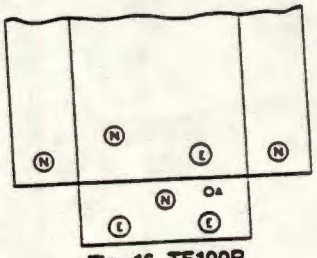


Fig. 16. TE100R
TQC100R TQL100R
TQL70R

NOTES:

DEM - 0422

GE Molded Case Circuit Breakers

J600 Line Circuit Breakers

125-600 Amperes
600 Volts ac
250 Volts dc

Type TJJ Non-interchangeable Trip (Includes Line and Load Lugs)

Ampere Rating	Adjustable Trip Range Amp Lo	Adjustable Trip Range Amp Hi	2-pole, 400-amp Frame 600V ac, 250V dc Item No.	2-pole, 400-amp Frame 600V ac, 250V dc Qty.	2-pole, 400-amp Frame 600V ac, 250V dc Catalog Number	3-pole, 400-amp Frame 600 Volts ac Item No	3-pole, 400-amp Frame 600 Volts ac Qty	3-pole, 400-amp Frame 600 Volts ac Catalog Number	Copper/Aluminum Lugs	Wire Size
125	375	1250			TJJ426125WL			TJJ436125WL	TCAL43 included in price of breaker	(1)6-600 MCM (2)Hi-250 MCM
150	450	1500			TJJ426150WL			TJJ436150WL		
175	525	1750			TJJ426175WL			TJJ436175WL		
200	600	2000			TJJ426200WL			TJJ436200WL		
225	675	2250			TJJ426225WL			TJJ436225WL		
250	750	2500			TJJ426250WL			TJJ436250WL		
300	900	3000			TJJ426300WL			TJJ436300WL		
350	1050	3500			TJJ426350WL			TJJ436350WL		
400	1200	4000			TJJ426400WL			TJJ436400WL		
400NA	—	—			TJJ426Y400①②			TJJ436Y400①②		

NOTES:

Types TJK, THJK Interchangeable Trip

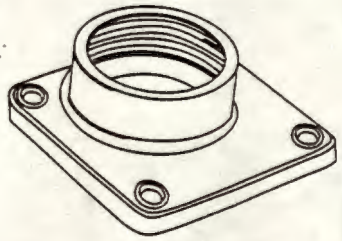
Ampere Rating	Adjustable Trip Range Amp Lo	Adjustable Trip Range Amp Hi	Complete Circuit Breaker (includes line and load lugs) Standard Item No	Standard Qty	Standard Catalog Number	Hi-Break® Item No	Hi-Break® Qty	Hi-Break® Catalog Number	Frame Only Item No.	Frame Only Qty.	Frame Only Catalog Number	Trip Unit Only Item No.	Trip Unit Only Qty.	Trip Unit Only Use with Standard and Hi-Break Frames	Terminal Lugs for Front Connection (Copper/Aluminum) Item No.	Terminal Lugs for Front Connection (Copper/Aluminum) Qty	Terminal Lugs for Front Connection (Copper/Aluminum) Catalog Number (Order 2 per Pole)	Terminal Lugs for Front Connection (Copper/Aluminum) Wire Size
400-amp Frame																		
Two-pole																		
125	375	1250			TJK426125WL			THJK426125WL			TJK426F000 Standard Frame			TJK436T125			TCAL43③	(1) 6-600 MCM or Twin 2/0-250
150	450	1500			TJK426150WL			THJK426150WL						TJK436T150				
175	525	1750			TJK426175WL			THJK426175WL						TJK436T175				
200	600	2000			TJK426200WL			THJK426200WL						TJK436T200				
225	675	2250			TJK426225WL			THJK426225WL						TJK436T225				
250	750	2500			TJK426250WL			THJK426250WL						TJK436T250				
300	900	3000			TJK426300WL			THJK426300WL			THJK426F000 Hi-Break			TJK436T300				
350	1050	3500			TJK426350WL			THJK426350WL						TJK436T350				
400	1200	4000			TJK426400WL			THJK426400WL						TJK436T400				
400NA	—	—			TJK426Y400①②			—						TJKY3②				
Three-pole																		
125	375	1250			TJK436125WL			THJK436125WL			TJK436F000 Standard Frame			TJK436T125			TCAL43③	(1) 6-600 MCM or Twin 2/0-250 MCM
150	450	1500			TJK436150WL			THJK436150WL						TJK436T150				
175	525	1750			TJK436175WL			THJK436175WL						TJK436T175				
200	600	2000			TJK436200WL			THJK436200WL						TJK436T200				
225	675	2250			TJK436225WL			THJK436225WL						TJK436T225				
250	750	2500			TJK436250WL			THJK436250WL						TJK436T250				
300	900	3000			TJK436300WL			THJK436300WL			THJK436F000 Hi-Break Frame			TJK436T300				
350	1050	3500			TJK436350WL			THJK436350WL						TJK436T350				
400	1200	4000			TJK436400WL			THJK436400WL						TJK436T400				
400A Mag Only	600	2000			—			—						TJK436TM1400④				
	1200	4000			—			—						TJK436TM2400④				
	350	1000			—			—						TJK436TM3400④				
400NA	—	—			TJK436Y400①③			—						TJKY3②				
600-amp Frame																		
Two-pole																		
250	750	2500			TJK626250WL			THJK626250WL			TJK626F000 Standard Frame			TJK636T250			TCAL43③	(1) 6-600 MCM or Twin 2/0-250 MCM
300	900	3000			TJK626300WL			THJK626300WL						TJK636T300				
350	1050	3500			TJK626350WL			THJK626350WL						TJK636T350				
400	1200	4000			TJK626400WL			THJK626400WL						TJK636T400				
450	1350	4500			TJK626450WL			THJK626450WL			THJK626F000 Hi-Break Frame			TJK636T450			TCAL63	Twin 4/0-350 MCM-Cu or Twin 300-500 MCM-Al
500	1500	5000			TJK626500WL			THJK626500WL						TJK636T500				
600	1600	6000			TJK626600WL			THJK626600WL						TJK636T600				
600NA	—	—			TJK626Y600①②			—						TJKY36②				
Three-pole																		
250	750	2500			TJK636250WL			THJK636250WL			TJK636F000 Standard Frame			TJK636T250			TCAL43③	(1) 6-600 MCM or Twin 2/0-250 MCM
300	900	3000			TJK636300WL			THJK636300WL						TJK636T300				
350	1050	3500			TJK636350WL			THJK636350WL						TJK636T350				
400	1200	4000			TJK636400WL			THJK636400WL						TJK636T400				
450	1350	4500			TJK636450WL			THJK636450WL			THJK636F000 Hi-Break Frame			TJK636T450			TCAL63	Twin 4/0-350 MCM-Cu or Twin 300-500 MCM-Al
500	1500	5000			TJK636500WL			THJK636500WL						TJK636T500				
600	1800	6000			TJK636600WL			THJK636600WL						TJK636T600				
600A Mag Only	600	2000			—			—						TJK636TM1600④				
	1600	6000			—			—						TJK636TM2600④				
600NA	—	—			TJK636Y600①②			—						TJKY36②				

① ... necessary installation ③ Alternate lug for 750 MCM

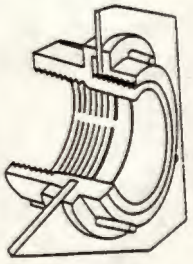
DEM - 0302

GE Circuit Breaker Enclosures

Hubs and Other Accessories



TC150



343L647G21

Universal Raintight Hubs

For outdoor enclosures that have removable closing caps.

Nominal Conduit Diameter in Inches	Aluminum Hub			Standard Pkg.
	Item No.	Qty.	Catalog Number	
¾			TC75	10
1			TC100	
1¼			TC125	
1½			TC150	
2			TC200	
2½			TC250	
Closing Cap			TCCP	

Myers Scru-Tite Hubs

For outdoor enclosures that require field cut openings.

Nominal Conduit Diameter in Inches	Zinc Hub			Chrome Plated Zinc Hub			Std Pkg
	Item No.	Qty.	Catalog Number	Item No.	Qty.	Catalog Number	
½			343L647G3			343L647G17	1
¾			343L647G4			343L647G18	
1			343L647G5			343L647G19	
1¼			343L647G6			343L647G20	
1½			343L647G7			343L647G21	
2			343L647G8			343L647G22	
2½			343L647G9			343L647G23	
3			343L647G10			343L647G24	
3½			343L647G11			343L647G25	
4			343L647G12			343L647G26	

Insulated Groundable Neutrals Only

Item No.	Qty.	Neutral Catalog Number	Max. Ampere Rating	Lug Wire Size (CU-AL) AWG/MCM	Std. Pkg.
		TNI100	100	14-1/0 CU 12-1/0 AL	1
		TNIA225	225	1-300	
		TNIA400 TNIA400VG	400	(2) 1/0-250 or (1) 4-600	
		TNIA600 TNIA600VG	600	(2) 2/0-500	
		TNIA800	800	(3) 250-500	
		TNIA800G	800	(3) 250-350 CU or (3) 250-500 AL	
		TNIA1200 TNIA1200G	1200	(4) 250-350 CU or (4) 250-500 AL	
		TNIAC1200	1200	(4) 250-400 CU Only	

Stainless Steel Cover Only

For flush mounted Type 1 circuit breaker enclosures, field installed only.

Enclosure Catalog Number	Stainless Steel Cover		
	Item No.	Qty.	Catalog Number
TE100F			TE100FSS
TF225F TJ400F TJ600F			Order by Description

Special Phenolic Nameplates

For circuit breaker enclosures, 15 letters maximum.

Item No	Qty.	Quantity (same words)
		1-5 6-10

Ground Kits

For Enclosure	Item No.	Qty.	Catalog Number
70-125 Amp			Included
225-400 Amp			(1) TGL1 plus (1) TGL20
600-1200 Amp			TGL6

Key Interlocks

Available for circuit breaker enclosures on special factory order on Type 1, only. Order by description. Locks supplied. Complete coordination (lock scheme) required with order.

NOTES:

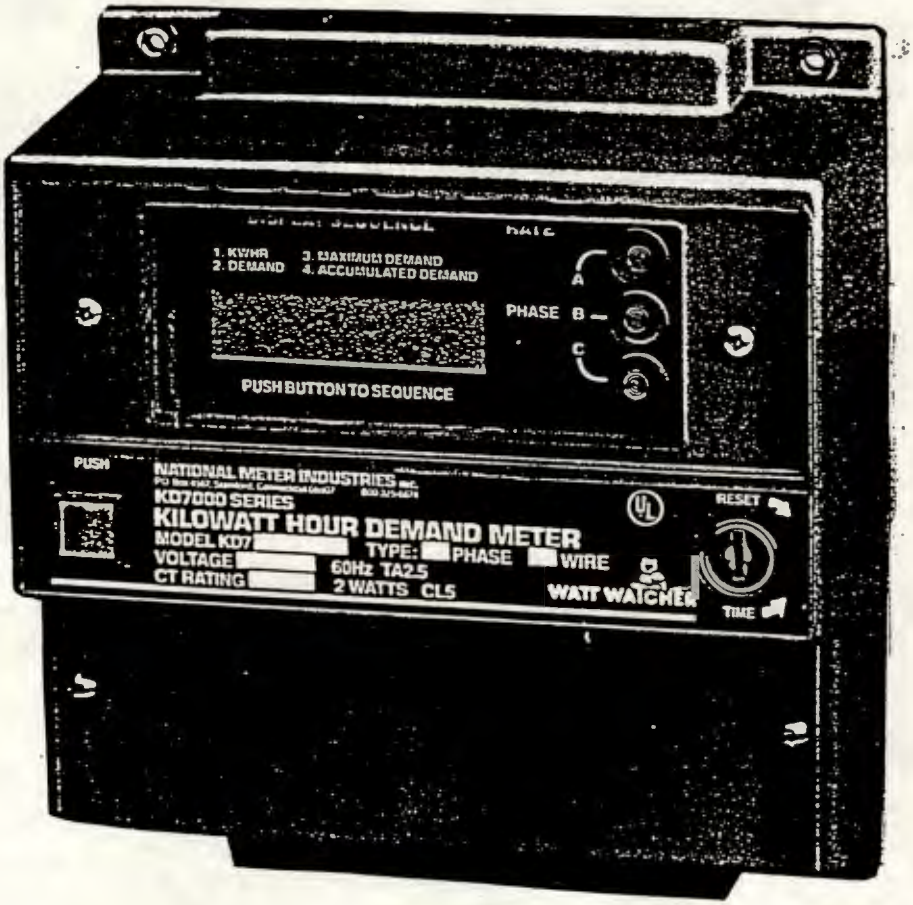
SERIES 7000

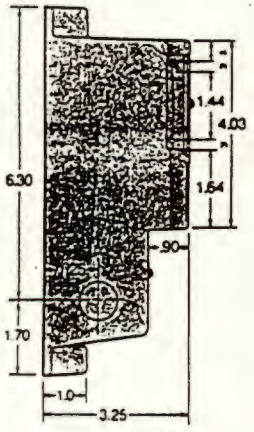
KILOWATT HOUR DEMAND METER

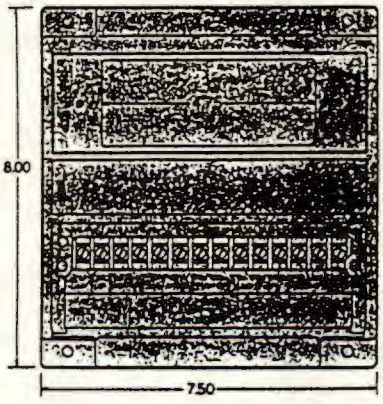
Made in U.S.A.

WATT WATCHER™

User Manual







UNDERWRITERS LABORATORIES INC

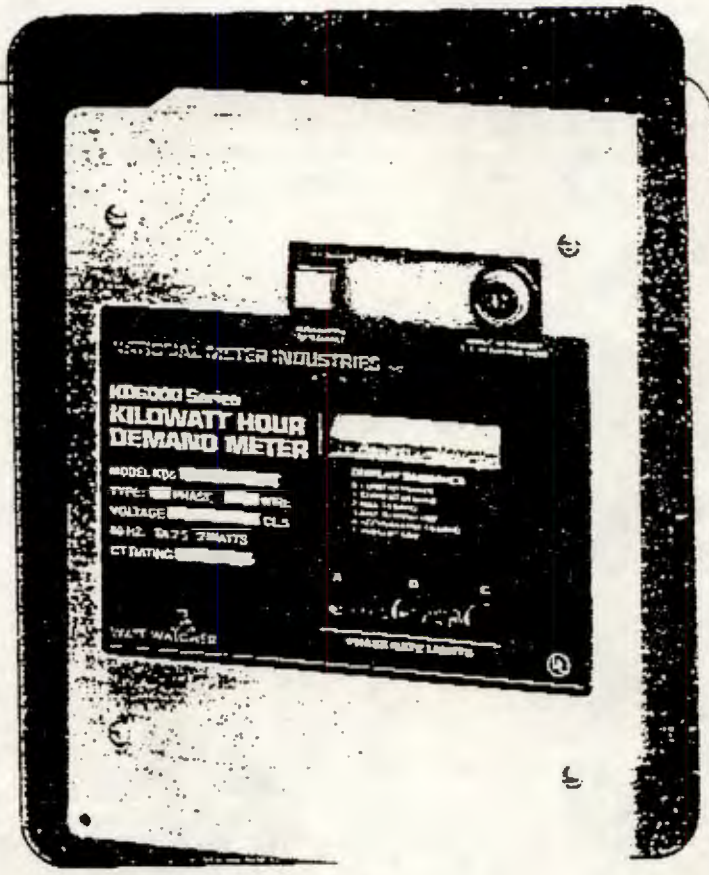
NATIONAL METER INDUSTRIES

SERIES 6000

KILOWATT HOUR DEMAND METER - PANEL MOUNT

WATT WATCHER

Made in *U.S.A.*



ELECTRICAL SUBMETERING

APPLICATION - THREE PHASE LOADS

- OFFICE BUILDINGS • MALLS • HOSPITALS
- COLLEGES • INDUSTRIAL
- MILITARY BASES • DSM VERIFICATION

FEATURES

- REMOTE CT OPERATED
- NO MULTIPLIERS FOR READINGS
- PHASE LIGHT INDICATORS
- SHIELDED ELECTRONICS
- NON-VOLATILE MEMORY
- MICROPROCESSOR BASED TECHNOLOGY
- COMPUTER COMPATIBLE (OPTIONAL)
- ALPHA NUMERIC SCREEN • KEY RESET

SPECIFICATIONS

- REFER TO SPECIFICATION BULLETIN
- OPTO OUTPUT PULSE (STANDARD)
  - RATING: 80 VDC / 80 ma. MAX
  - PULSE ON TIME 1/40 TO 1 SEC.
  - MAX PULSES PER/SEC 20

ORDERING INFORMATION

CATALOG#	VOLTAGE	ELEMENT	WIRE	CTs REQ.
KD6234	120/208	3	4	3
KD6834	277/480	3	4	3
KD6833	480	3	3	3
KD6433	240	3	3	3
KD6432C	120/240	3	4	3
KD6233PT	120	3	3	3

OPTIONS

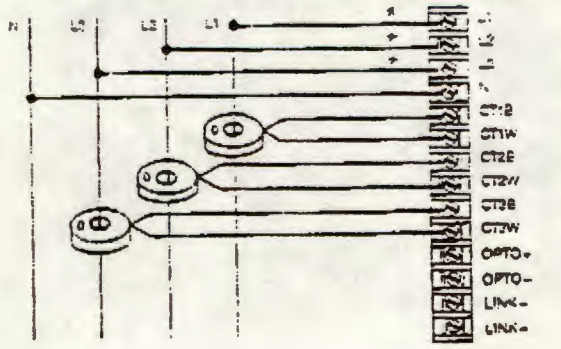
- SPLIT CORE CTs • SMART LINK OUTPUT
- 120 VAC, .5 a. RATED PULSE RELAY

SCREEN DISPLAYS

- CURRENT KW=R
- CURRENT DEMAND
- MAX DEMAND
- MAX DEMAND DATE, HR MIN
- ACCUMULATIVE DEMAND
- CLOCK, DATE

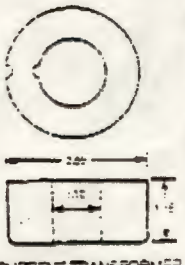
Standard System Includes: Meter • Appropriate Number of 200:5 CTs • OPTO Output

• TYPICAL WIRING DIAGRAM •



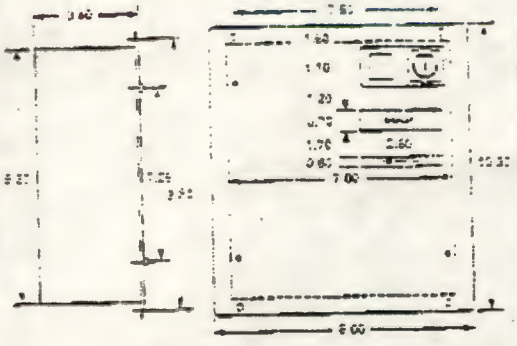
*5 amp in Line Fuse Protection Recommended

• CT DIMENSIONS •



CURRENT TRANSFORMER
200:5 ±1% ACCURACY
WIRE LEAD 36" #16 AWG 105°C
HOUSING UL94V0 ABS

• METER DIMENSIONS •



P.O. Box 4567 • Stamford • CT • 06907 800 • 325 • 6674 • Fax 203 • 975 • 0093

METER

INSTALLATION

Please read through this entire instruction manual before attempting this installation. These are highly accurate, microprocessor based instruments and care must be given to proper wiring. This will be a credit to both of us.

WARNING: DANGEROUS SHOCK HAZARD

All electricity must be turned off before connections are made to meter with either potential or current transformer wires. This equipment must be installed by a qualified licensed Electrician.

UNPACKING AND/OR RETURNING GOODS

Upon receipt of equipment, please check for shipping damage. If damage has occurred, then the shipper must be notified immediately. If there is any reason that the equipment has to be sent back to the factory, please call to discuss the problem with our service department. A return authorization number must be marked on the outside of all packages.

APPLICATION NOTES

The Series 7000 panel mount kilowatt hour demand meters are often installed in commercial office buildings to bill tenants for electricity and demand KW used in their space. This meter is often used in hospitals, military bases, college campuses and various industrial applications to define the cost of electricity for internal budgeting. The use of remote current transformers and it's unique design contributes to an easy installation.

INSTALLATION

Series 7000 meters are designed for surface mounting. Four #8 screws are recommended, one through each hole. This will secure the meter to the surface. The meter has a 3/4" conduit knockout provided on the left-hand side for voltage and current transformer wiring. Voltage and current transformer wires can be mixed in the same conduit for a short distance if wires are twisted independently and all are 600 volt rated. If low voltage outputs are used, keep wiring separated and maintain same voltage rating on the wire's insulation.

WIRING INSTRUCTIONS

1) All wiring must comply with NEC 70 or any local codes having jurisdiction over electrical equipment.
2) Potential line wires can be #16 AWG 600 volt rated.
3) Recommended fusing (by others)can be 5 amp in line fuses, one per phase or a circuit breaker with locking HWD. (contractors choice)
4) The CT and the line feed must come from the same phase. Example: If phase A is connected to L1 on the terminal board, then the current transformer (CT) on that phase must be attached to CT1W (white) and CT1B (black). The same follows true for the remaining phases to be

CURRENT TRANSFORMERS

The current transformers have a standard 5 amp output which is utility standard. Other amperage and voltage outputs are also available. The rating on a current transformer tells you the amount of burden (ohms) you can add to the length of wire leads and still stay within the accuracy stated on the current transformer.

Since current transformers are usually installed in panel boards when room is available the current transformer wires are usually too short to reach the meters and need to be lengthened. We recommend splicing the wires together with insulated butt crimp connectors. Wire size to be added to the standard 3 foot leads are as follows: (Consult factory for information on longer runs)

WIRE-SIZE AWG	MAXIMUM LEAD WIRE LENGTH (FT.)
14	20
12	30
10	50

NOTE: The white dot (or H1) mark always faces the line side. Shunt the black and white wires on the current transformer if they are installed on an energized circuit before the meter(s) are connected.

METER OPERATION

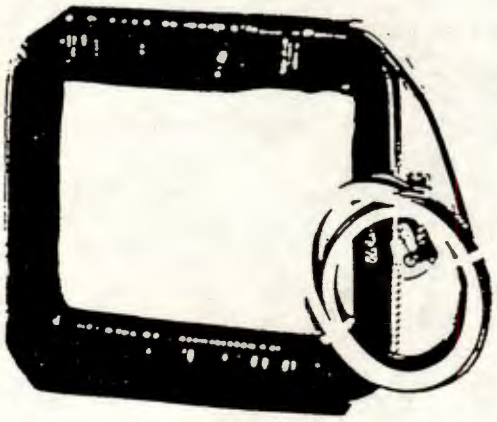
When meter is wired correctly and the circuit being monitored is energized with a load, you will notice the rate (LED) lights blink. Each phase is monitored separately and the blinking light will indicate applied load. The longer duration ON time, of the LED indicates a larger load. A load of 90% or greater will make the LED stay on constantly. If the lights do not work, please refer to trouble shooting tips on last page. The mechanical counter will

SPLIT CORE CURRENT TRANSFORMERS

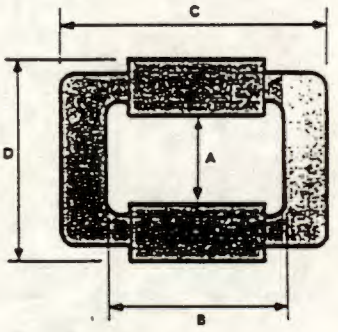
Cable split core (non-insulated): 200 to 3000 amps. Insulated buss-type split core transformers are also available. Contact Sales Department.

Split core transformers are used when disconnecting insulated wires is difficult or impossible. The black and white wire on the current transformers must be shunted on energized circuits. The white dot or H1 faces line side. Split core transformers are usually 1% to 3% accurate. Because of the butting ends in the current transformers, a field of eddy currents will cause a small degree of inaccuracy.

TYPE A: Cable split core (non-insulated) 200 to 3000 amps



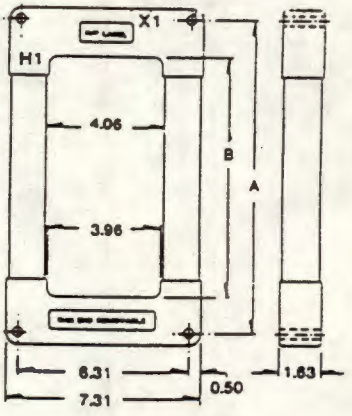
AMPERAGE RATE	DIMENSIONS
200:5	A = 2.25"
400:5	B = 3.50"
600:5	C = 5.00"
	D = 4.25"
800:5	A = 4.00"
1000:5	B = 5.50"
1200:5	C = 7.00"
1600:5	D = 6.00"
1800:5	A = 4.25"
2000:5	B = 8.00"
2500:5	C = 9.00"
3000:5	D = 6.00"



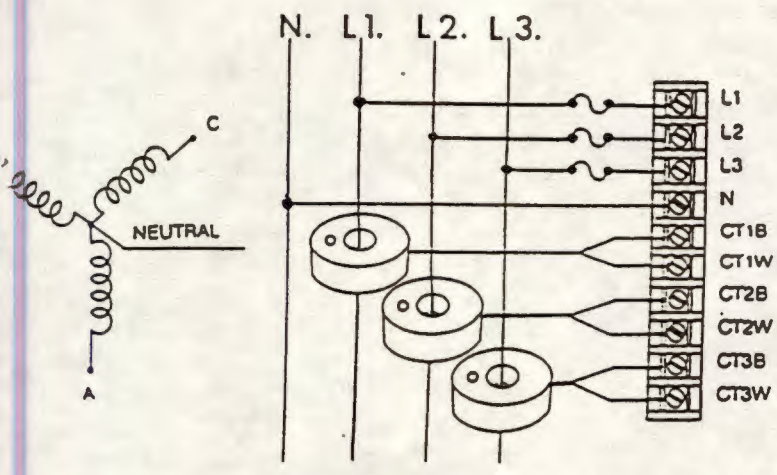
TYPE B: Insulated buss type split core, rectangular or square current transformers must be confirmed by factory for size, pricing and delivery.

Shown with end removed

	MODEL 500	MODEL 501
A	10.25	14.75
B	7.50	12.00



THREE PHASE FOUR WIRE



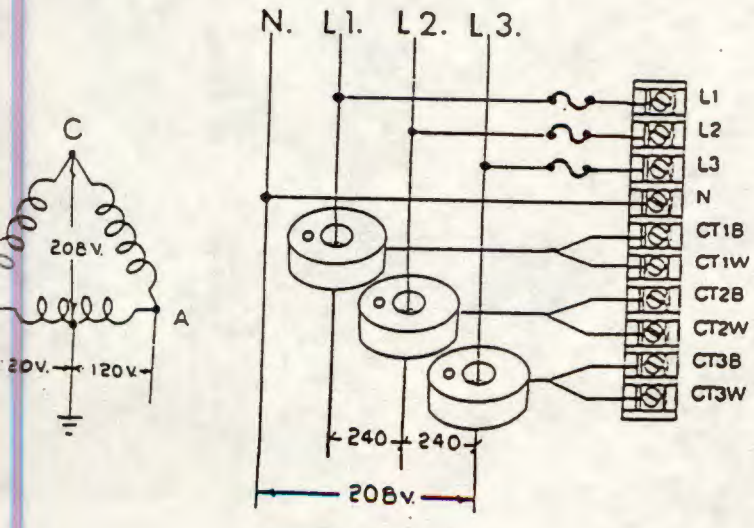
TYPICAL APPLICATIONS:

Monitoring three phase four wire industrial and commercial branch circuits or main service.

WIRING INSTRUCTIONS:

Three phase four wire circuits require three (3) current transformers. CT1 is installed around the same phase as L1. The same holds true for CT2 and L2 and CT3 and L3. The system's neutral wire is connected to NEUT. terminal on meter. White dot or H1 on current transformer must face toward line/source side of service. The meter has no phase rotation, each phase independently totals.

THREE PHASE FOUR WIRE HIGH LEG



TYPICAL APPLICATIONS:

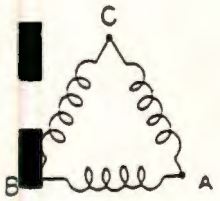
Monitoring industrial loads where there are heavy three phase and lighter single phase loads.

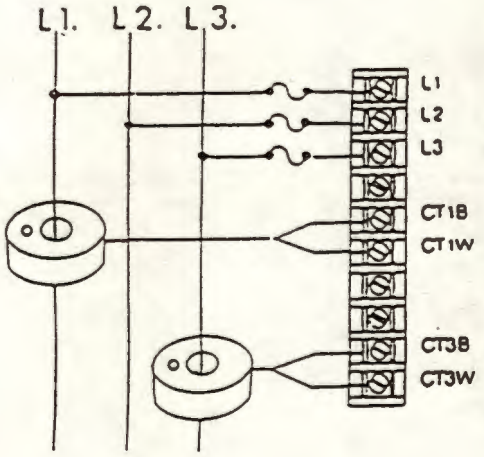
CAUTION: A ground delta service has a high leg of 208 volts to neutral.. This leg must be installed on L3 of the meter.

WIRING INSTRUCTIONS:
A three phase four wire circuit requires three current transformers. CT1 is installed around the same phase as L1. The same holds true for CT2 and L2. CT3 must be around the high leg and the high leg must be on L3. There is no phase rotation. The white dot or H1 mark must face toward the line/source side.

WIRING DIAGRAMS

THREE PHASE THREE WIRE





TYPICAL APPLICATION:

Monitoring industrial or heavy commercial motor loads. "Floating" or underground delta services are most often found in chemical or refinery plants.

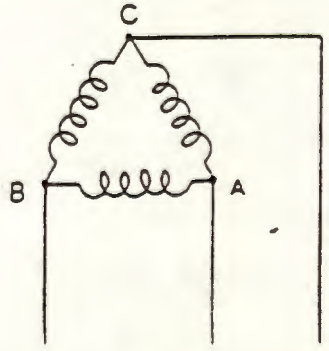
WIRING INSTRUCTIONS:

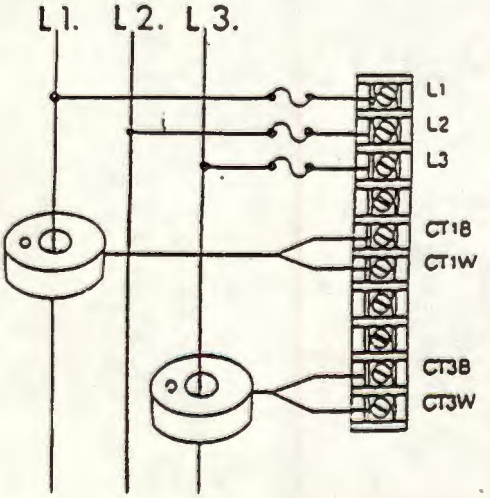
A three-phase three-wire circuit requires only two current transformers. CT1 is installed around the same phase as L1. Phase B or L2 has no current transformer on it. Feed wire connects to L2. CT3 is installed on L3. The white dot or H1 mark faces the line/source side. There is no phase rotation. See Figure 2.3
IMPORTANT: DO NOT GROUND CT'S IF YOUR ON A FLOATING SYSTEM

GROUNDED THREE PHASE THREE WIRE

IMPORTANT:
Many of the 3 phase 3 wire services have one phase connected to the building ground system. To determine if one of the phases is connected to ground, refer to the following procedure.

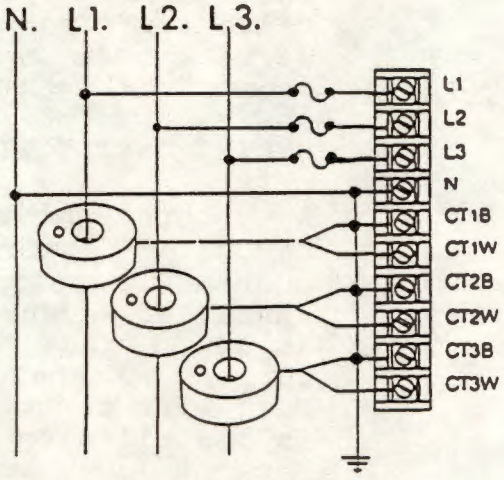
Use a voltmeter to test for voltage between each phase and building ground. If there is a phase connected to ground, then the voltmeter will indicate 0, or nearly 0, volts between building ground and grounded phase. Install grounded phase on L2 of meter. The two current transformers are installed on L1 and L3. Our meters do not have rotation requirements





SPECIAL INSTRUCTIONS:

GROUNDING THE CT's (CUSTOMER OPTION)



THE "B" TERMINAL ON THE CT's IS COMMON TO THE "N" TERMINAL.

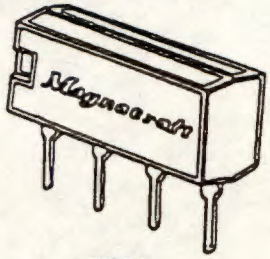
Note: The B terminal is common to NEUT
Delta meter the B is common to line 2 term

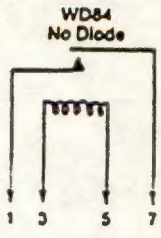
OPTO-SWITCHING RELAY (OPTIONAL)

Specifications:

130 VAC
.5 AMP switching
1.5 AMP carry

CLASS 117 SIP 4-PIN RELAYS





These epoxy-molded reed relays are ideal in circuits requiring high density pack-

OPTO OUTPUT

The OPTO output is an OPTO isolated switching transistor. This switch is used in conjunction with load management, or monitoring systems. The rating is 80 V DC and 80 MA max. The pulse is set at 1KWH unless specified when ordered. Pulse rates of one (1), ten (10), one hundred (100). or 1 KWH are available. Sixty (60) pulses per second is maximum.

ABSOLUTE MAXIMUM RATINGS (T_a = 25 °C)

		(PS2501-1)	(PS2501-2, PS2501-3, PS2501-4)	
Diode				
Reverse Voltage	V_R	6.0	6.0	V
Forward Current (DC)	I_F	80	80	mA
Power Dissipation	P_D	150	120	mW/Unit
Peak Forward Current (100 μs, 1 % Duty Cycle)	$I_{F(peak)}$	1	1	A
Transistor				
Collector to Emitter Voltage	V_{CEO}	80	80	V
Emitter to Collector Voltage	V_{ECO}	7	7	V
Collector Current	I_C	80	80	mA
Power Dissipation	P_C	150	120	mW/Unit
Isolation Voltage *1	BV	5000	5000	V_{ac}
Storage Temperature	T_{stg}	−55 to +150	−55 to +150	°C
Operating Temperature	T_{opt}	−55 to +100	−55 to +100	°C
Lead Temperature (Soldering 10 s)	T_{sol}	260	260	°C
Total Power Dissipation	P_T	250	200	mW/Unit

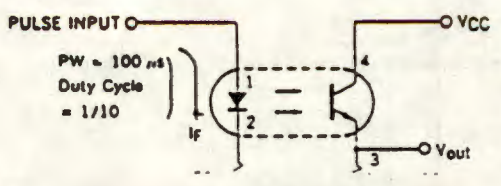
ELECTRICAL CHARACTERISTICS (T_a = 25 °C)

	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Diode	Forward Voltage	V_F		1.1	1.4	V	I_F = 10 mA
	Reverse Current	I_R			5	μA	V_R = 5 V
	Junction Capacitance	C		50		pF	V = 0, f = 1.0 MHz
Transistor	Collector to Emitter Dark Current	I_{CEO}			100	nA	V_{CE} = 40 V, I_F = 0
	Collector to Emitter Breakdown Voltage	BV_{CEO}	40	60		V	I_C = 1 mA, I_B = 0
	Emitter to Collector Breakdown Voltage	BV_{ECO}	7	9		V	I_E = 100 μA, I_B = 0
Coupled	Current Transfer Ratio *2	CTR(I_C/I_F)	80	300	600	%	I_F = 5 mA, V_{CE} = 5.0 V
	Collector Saturation Voltage	$V_{CE(sat)}$			0.3	V	I_F = 10 mA, I_C = 2.0 mA
	Isolation Resistance	R_{1-2}	10^{11}			Ω	V_{in-out} = 1.0 kV
	Isolation Capacitance	C_{1-2}		0.5		pF	V = 0, f = 1.0 MHz
	Rise Time *3	t_r		3		μs	V_{CC} = 10 V, I_C = 2 mA, R_L = 100 Ω
	Fall Time *3	t_f		5		μs	V_{CC} = 10 V, I_C = 2 mA, R_L = 100 Ω

*1 AC voltage for 1 minute at T_a = 25 °C
RH = 60 %

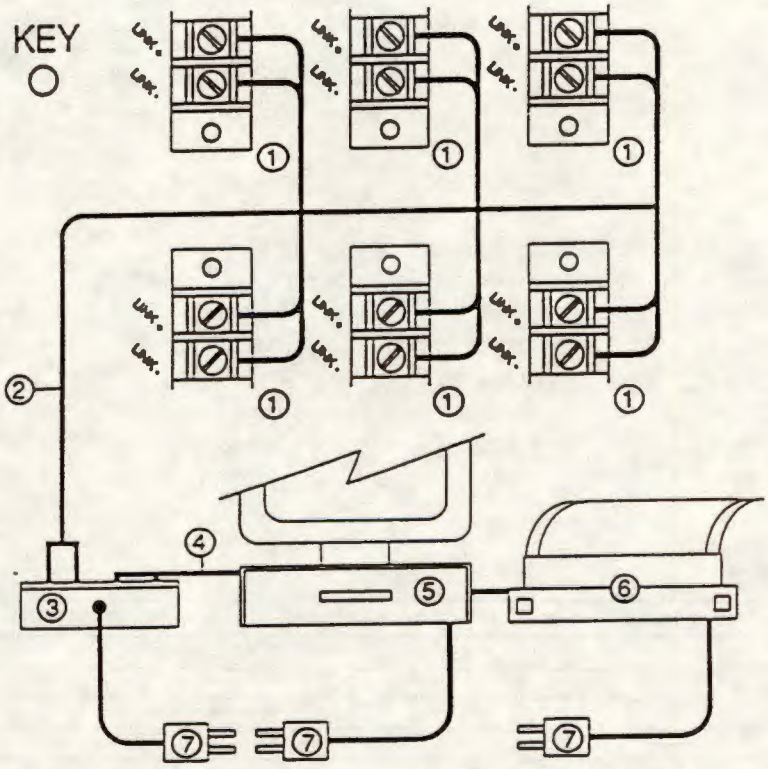
*2 CTR rank (Only PS2501-1)
KA: 300 to 600 (%)
LA: 200 to 400 (%)
MA 80 to 240 (%)
DA 100 to 300 (%)

*3 Test Circuit for Switching Time



COMMUNICATIONS

SMART LINK PLUS AND MINUS OUTPUTS:
The link plus + and link minus - is a propriety system. Communication is possible through the link port in each meter. This two wire 12 VDC port enables our software driven RS232 interface module to communicate via an IBM or compatible computer. Each meter has been programmed withaseven (7) digit protocol. There can be up to 200 meters installed on a parallel two wire circuit. Each meter applies a load of 2 ma. on this circuit. Normally a #14 AWG twisted shielded wire can handle 200 meters up to 2000 feet.



>>>> COMPONENTS REQUIRED <<<<

KEY

① SMART LINK OUTPUT
Communication components built into meter.

② COMMUNICATIONS CABLE
Up to 200 meters at a distance of 2000' would typically use 2C #14 gage twisted with shield.

③ SMART LINK INTERFACE MODULE

⑤ IBM or EQUAL (MS DOS)
MS DOS operated 640K with 3.5" Disk drive and 40 megabyte hard drive

⑥ DOT MATRIX PRINTER

SPECIFICATIONS

CONSTRUCTION: 94 VO rated A.B.S. Injection molded plastic

WIRE TERMINALS: Wire gage number 20-12 UL rated to 600 volts.

TEMPERATURE RANGE: -20 deg. C to +40 deg. C with accuracy within ANSI C-12.1.

DIELECTRIC WITHSTAND: 1200 Volts 1 minute.

TRANSIENT WITHSTAND: ANSI C37-90.1, 1989, including output terminals.

ACCURACY: Complies with ANSI C12.1, 1988 performance tables 5.1.8. Complies with part 15 of FCC Rules for Class A computing devices.

HUMIDITY: 0 - 95%

OVER VOLTAGE: Plus 20% Continuous.

UNDER VOLTAGE: Minus 40% Continuous.

POWER FACTOR: .5 to unity.

OPERATING FREQUENCY: 50 TO 60 Hz.

NORMAL OPERATING CURRENT: 5 Amps (Current Transformer secondary).

OVER CURRENT RATING: 150% Continuous.

OPTO PULSES COUNT: Standard 1 per KWH (can be per watt hour if requested and it doesn't exceed 60 per second).

RATE LED: 1 second off with on duration contingent to load (each phase's independent).

METER BURDEN: 0.3 VA.

CURRENT TRANSFORMER BURDEN: 1.00 VA at 5 amps.

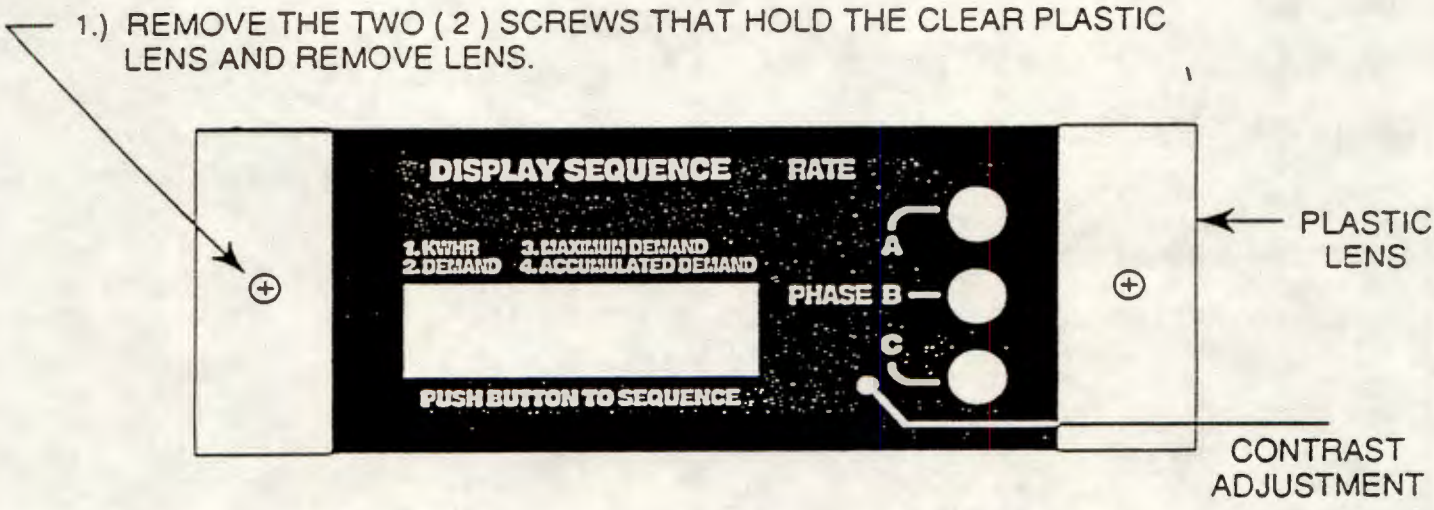
FACTORY PROGRAMED DEMAND INTERVALS:

15 min. window averages every 30 seconds
30 min. window averages every 1 minute
60 min. window averages every 2 minutes

BATTERY: The battery is projected to last approximately 7-8 years. The battery must be replaced by qualified technician or the meter sent back to the factory for replacement. Call service department for return number.

ADJUSTING THE LCD CONTRAST (IF REQUIRED)

LCD screens are sensitive to temperature. Cold temperatures will cause the screen to lighten and hot temperatures will darken the background. We adjust in a room temperature of 70 degrees F, so there is a good chance the contrast will be OK. In case of temperature extremes an adjustment can be made. Follow steps below:



1) Meter must be energized for LCD to work.

2) This plate is located behind the main cover.

3) Be extremely careful not to touch the LCD screen. The LCD screen is sensitive to static electricity.

4) Use a 1/16" screwdriver and insert it carefully into the slot of the adjusting put. Turn right or left until desired contrast is reached.

METER OPERATION

Make sure the meter is installed according to the wiring instructions in Section I. If there is a load on the wires being monitored, the rate lights will blink. If there is a ninety percent (90%) or greater load, the rate lights will stay on continuously. The LCD window will automatically cycle to "Kilowatt Hours" and will start registering as soon as the meter is turned on. Demand timing will begin when the set time mode has been initiated.

INIATIATE METER

KEY POSITION AND OPERATION

OFF POSITION
Insert and remove key in this position.

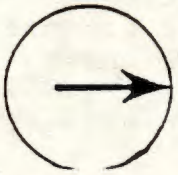
SET TIME

1. To set meter, insert key and turn to left (CCW)
   Set Time Window will appear with cursor under year.
2. Push button on left until correct year appears.
   Return key to Off position.
3. Turn key again to the left and cursor will appear under month.
4. Push button on left again until correct month appears.
   Return key to Off position.
5. Repeat above for setting Day, Hour, and Minute.
   Return key to Off position.

Current KWHR screen will appear when this step is complete.

Daily, Weekly, or Monthly Operation
To Reset MAX DEMAND, this usually occurs once per month for billing. You can reset every 24 hrs for daily peak

RESET DEMAND



Insert key and turn to right (CW).
Push button on left and all zeros (0000) will appear under the MAX DEMAND title.
The meter is now reset.

EXPLANATION OF WINDOWS

WINDOW 0: CURRENT KWHR
This window will always appear after a 1 minute time cycle from previous selection. Unless indicated, there are no multipliers. If "BAT" appears, or "OSC" appears in the right hand corner, call Customer Service.

WINDOW 1: CURRENT DEMAND
The current demand window numbers represent the current demand segment listed below.

Demand Intervals:
- 15 minute interval is calculated every 30 seconds.
- 30 minute interval is calculated every 1 minute.
- 1 Hour interval is calculated every 2 minutes.

WINDOW 2: MAX DEMAND
This window displays the max demand achieved since the last reset. This is a rolling window similar to those in utility meters.

The last minute is subtracted from the first segment and is now the first minute of the second segment.
NOTE: This window resets to 0 when the Key Switch is turned to the right (clockwise) and the yellow button is pushed.

WINDOW 3: MAX DEMAND TIME
This window displays the month, day, hour and minute that the max demand occurred since the last reset.

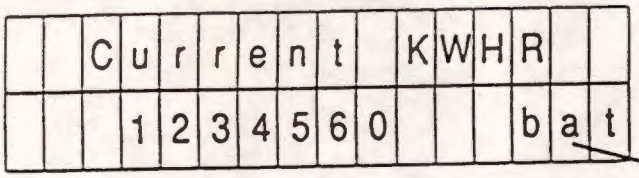
WINDOW 4: ACCUMULATIVE DEMAND
Each time you reset the meter, the maximum demand is added to the accumulative demand window. This file cannot be reset except at factory. Recording the accumulative demand each month secures the fact that the meter **HAS NOT** been reset if number has not changed.

Example:	**Month 1**	
	Maximum demand	75KW
	Accumulative demand	0

Example:	**Month 2**	
	Maximum demand	50 KW
	Accumulative demand	75 KW

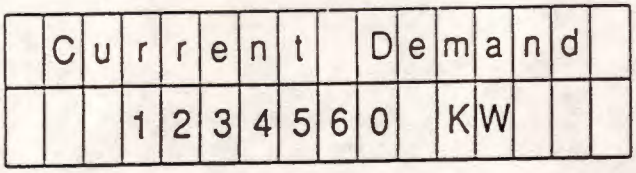
WINDOW 5: PRESENT TIME
This window allows you to monitor the meter's time sequence by keeping the clock accurate. Prolonged power outage will cause the clock to slow down. If this occurs, reset clock by turning the Key Switch CCW (counter clock wise) toward "TIME" to bring up the "SET TIME" window. Follow steps 1 through 5.

DEMAND METER SCREEN LAYOUTS

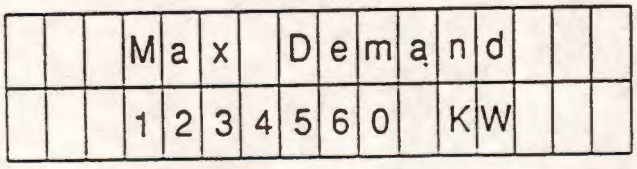


Window Number: 0
Window Timeout: none
Next Window: 1

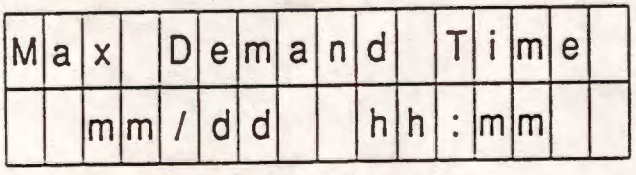
bat will appear when battery is low. Consult Factory.



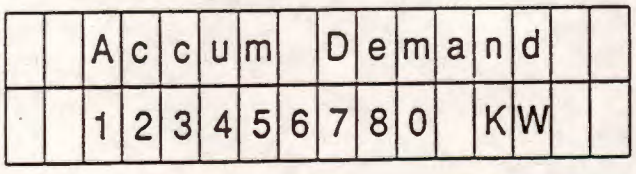
Window Number: 1
Window Timeout: 60 sec.
Next Window: 2



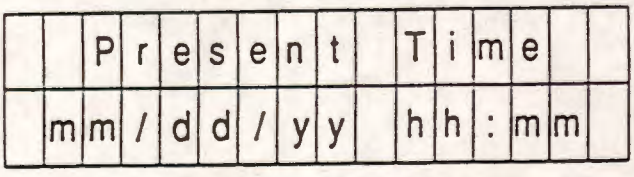
Window Number: 2
Window Timeout: 60 sec.
Next Window: 3



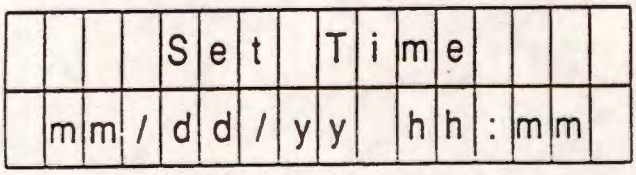
Window Number: 3
Window Timeout: 60 sec.
Next Window: 4



Window Number: 4
Window Timeout: 60 sec.
Next Window: 5



Window Number: 5
Window Timeout: 60 sec.
Next Window: 0



This window will only APPEAR WHEN KEY IS TURNED CCW TO SET OR RESET TIME.

TROUBLE SHOOTING

SYMPTOM	CHECK	REMEDY
One or all of the rate lights do not blink.	CT white dot (or H1) should be facing the line side (towards breaker).	Reverse CT or reverse the black and white wires on the CT terminals.
CT's are installed properly, but lights still do not work.	CT and line must be correlated. Example: L1 and CT1 must be on the same phase wire.	Swap either the line wires or the CT wires.
No lights blink.	With Voltage Meter, check all phases for voltage. Check current with an Amp Meter. LED's will not blink with voltage only.	Restore voltage or turn on load.
One LED blinks faster than the other.	If Load is not balanced the lights will blink differently.	The meter is working properly.

WARRANTY

National Meter Industries, Inc. warrants their meters to be free of any and all defects in materials and workmanship and will give satisfactory service for a period of 24 (twenty-four) months from date of purchase. If the meter should malfunction, a call must be made to our Customer Service Department, 1-800-325-6674 for verification. After verifying a meter malfunction, an Authorized Return Number (ARN) will be issued. Freight is to be prepaid with the (ARN) written on the Packing Slip.

After examination of the returned meter by N.M.I. Technicians proves the meter to be a warranteed failure, the meter will be repaired or replaced without charge.

This warranty is null and void if the meter shows evidence of having been tampered with, abused, connected to the wrong voltage or if our specifications were exceeded. (SEE SPECIFICATION BULLETIN) The customer will be notified by phone of any charges before repairs are made.

10 YEAR CALIBRATION CHECK

N.M.I. will, without charge, check and recalibrate (if necessary), any meter for a period of 10 (ten) years. These meters must be sent back to N.M.I. Factory using corresponding ARN, with freight and handling paid by customer in both directions.

Field Calibration Check is available. Consult Customer Service for charges. N.M.I. is not responsible for any damage or monetary losses, whether direct, indirect, incidental or consequential. Every precaution has been taken in the preparation of our manuals. N.M.I. takes no responsibility for errors or omissions in the installation of it's meters. All installations must be made by qualified electricians and follow all local and national codes that are applicable.

When Installing or Removing a Meter, De-energize All Voltage Circuits. If CT's are Installed Without Meter, Shunt Black and White Wires.

NATIONAL METER INDUSTRIES INC.

P.O. Box 4567, Stamford, Connecticut 06907 800-325-6674

BULLETIN #2

EFFECTIVE DATE 10-1-92

MODEL	DESCRIPTION	TRADE
	SERIES 1000 WATT HOUR TRANSDUCER	
K1212	120 VOLT 1 PHASE 2 WIRE WITH PULSE	$235.00
K1223	120/208/240 VOLT 1 PHASE 3 WIRE WITH PULSE	255.00
	SERIES 2000 WATT HOUR TRANSDUCER	
K2234	120/208 VOLT 3 PHASE 4 WIRE WITH PULSE	490.00
K2433	240 VOLT 3 PHASE 3 WIRE DELTA WITH PULSE	490.00
K2633	480 VOLT 3 PHASE 3 WIRE DELTA WITH PULSE	490.00
K2834	277/480 VOLT 3 PHASE 4 WIRE WITH PULSE	510.00
K2432G	120/240 VOLT 3 PHASE 4 WIRE GR. DELTA WITH PULSE	510.00
K2133PT	120 VOLT 3 PHASE 3 WIRE OR 4 WIRE WITH PULSE	510.00
K2812	480 VOLT 1 PHASE 2 WIRE WITH PULSE	490.00
	SERIES 3000 KILOWATT HOUR METER (FLUSH OR SURFACE MOUNT)	
K3212	120 VOLT 1 PHASE 2 WIRE W/COUNTER OUTPUT	301.50
K3213	120/240 1 PHASE 3 WIRE W/COUNTER OUTPUT	321.00
K3223	120/208 VOLT 1 PHASE 3 WIRE W/COUNTER OUTPUT	321.00
K3272	277 VOLT 1 PHASE 2 WIRE W/COUNTER OUTPUT	360.00
	SERIES 4000 KILOWATT HOUR (SURFACE MOUNT)	
K4234	120/208 3 PHASE 4 WIRE WITH PULSE	495.00
K4834	277/480 3 PHASE 4 WIRE WITH PULSE	550.00
K4833	480 VOLT 3 PHASE 3 WIRE WITH PULSE	550.00
K4433	240 VOLT 3 PHASE 3 WIRE WITH PULSE	495.00
K4432G	120/240 3 PHASE 4 WIRE GR. DELTA WITH PULSE	550.00
K4233PT	120 VOLT 3 PHASE 3 WIRE OR 4 WIRE WITH PULSE	495.00
	SERIES 5000 KILOWATT HOUR METER (FLUSH MOUNT)	
K5234	120/208 VOLT 3 PHASE 4 WIRE WITH PULSE	565.00
K5634	277/480 3 PHASE 4 WIRE WITH PULSE	620.00
K5633	480 VOLT 3 PHASE 3 WIRE WITH PULSE	620.00
K5433	240 VOLT 3 PHASE 3 WIRE WITH PULSE	565.00
K5432G	120/240 VOLT 3 PHASE 4 WIRE WITH PULSE	565.00
K5233PT	120 VOLT 3 PHASE 3 WIRE OR 4 WIRE WITH PULSE	565.00
	SERIES 6000 KILOWATT HOUR/DEMAND METER (FLUSH MOUNT)	
KD6234	120/208 VOLT 3 PHASE 4 WIRE WITH PULSE	850.00
KD6834	277/480 VOLT 3 PHASE 4 WIRE WITH PULSE	905.00
KD6833	480 VOLT 3 PHASE 3 WIRE WITH PULSE	905.00
KD6433	240 VOLT 3 PHASE 3 WIRE WITH PULSE	850.00
KD6432G	120/240 VOLT 3 PHASE 4 WIRE GR. DELTA WITH PULSE	850.00
KD6233PT	120 VOLT 3 PHASE 3 WIRE OR 4 WIRE WITH PULSE	850.00
	SERIES 7000 KILOWATT HOUR/DEMAND METER (SURFACE MOUNT)	
KD7234	120/208 VOLT 3 PHASE 4 WIRE WITH PULSE	715.00
KD7834	277/480 VOLT 3 PHASE 4 WIRE WITH PULSE	795.00
KD7833	480 VOLT 3 PHASE 3 WIRE WITH PULSE	795.00
KD7433	240 VOLT 3 PHASE 3 WIRE WITH PULSE	715.00
KD7432G	120/240 3 PHASE 4 WIRE GR. DELTA	715.00
KD7233PT	120 VOLT 3 PHASE 3 WIRE OR 4 WIRE WITH PULSE	715.00
	SERIES 8000 PORTABLE ANALYZERS	
8400	KILOWATT HOUR INSERT	1050.00
8700	KILOWATT HOUR/DEMAND INSERT	1350.00

FACTORY FOR PRICING

NATIONAL METER INDUSTRIES INC.

P.O. Box 4567, Stamford, Connecticut 06907 800-325-6674

EFFECTIVE DATE 10-1-92 BULLETIN #2

MODEL	DESCRIPTION	TRADE
	CLAMP-ON PROBES	
NM-177	5-125 AMPS ± 3% ACCURACY	139.00
NM-165	1-100 AMPS ± 1% ACCURACY	150.00
NMI 1200	20-500 AMPS ± 1% ACCURACY	236.00
NMI 1600	10-600 AMPS ± 1% ACCURACY	525.00
NM-4200	400-2000 AMPS ± 2% ACCURACY	525.00
NM-6300	200-3000 AMPS ± 2% ACCURACY	775.00
	SOLID CORE CURRENT TRANSFORMERS	
SX-100	100:1 SOLID CORE CT	$ 23.50
LX-200	200:5 SOLID CORE CT	25.00
LX-400	400:5 SOLID CORE CT	25.00
	SPLIT CORE CURRENT TRANSFORMERS	
SNMS200	200:5 SPLIT CORE CT	65.00
SNMS400	400:5 SPLIT CORE CT	70.00
SNMS600	600:5 SPLIT CORE CT	75.00
SNMS800	800:5 SPLIT CORE CT	80.00
SNMS1000	1000:5 SPLIT CORE CT	90.00
SNMS1200	1200:5 SPLIT CORE CT	95.00
SNMS1600	1600:5 SPLIT CORE CT	105.00
SNMS1800	1800:5 SPLIT CORE CT	120.00
SNMS2000	2000:5 SPLIT CORE CT	140.00
SNMS2500	2500:5 SPLIT CORE CT	150.00
SNMS3000	3000:5 SPLIT CORE CT	175.00
	OPTO-SWITCHING RELAY	50.00
	COUNTERS	
-3/16PM-00	PANEL MOUNT COUNTER 3/16"	18.50
-3/16SP-00	SNAP IN COUNTER 3/16"	18.50
	LED INDICATORS	
-8062V2-22	2 VOLT RED LED INDICATOR	7.50
	REMOTE METER READING ACCESSORIES	
SMLK-OUT	SMART LINK OUTPUT	35.00
SMLK-INTER	SMART LINK INTERFACE MODULE	960.00
RMDS-MARINA	WATT WATCHER MARINA SOFTWARE	CALL
RMDS-COMMER	WATT WATCHER COMMERCIAL SOFTWARE	CALL
RMDS-DEMAND	WATT WATCHER KWH/DEMAND SOFTWARE	CALL
	CUSTOM GANG METER BOXES AVAILABLE	*

*CALL FACTORY FOR PRICING

MONTAGE- UND BETRIEBSANLEITUNG

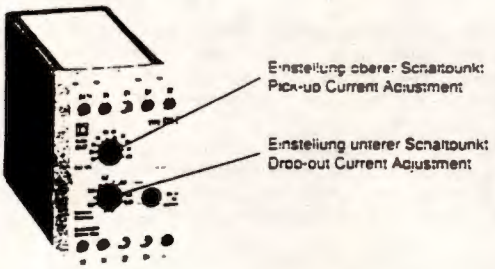
INSTRUCTION SHEET

Klasse / Class } 8430

Type / Type } DIA

Stromwächter für Wechsel- und Gleichstrom

AC/DC Current Relay



— — — — — — — — ACHTUNG — — — — — — — —

Gefährliche Spannungen können zu Stromschlägen oder Verbrennungen führen. Vor dem Arbeiten am Gerät Spannung abschalten! Vor dem Wiedereinschalten vergewissern, daß das Gehäuse fest verschlossen ist.

— — — — — — — — WARNING — — — — — — — —

~~Hazardous voltage can~~ shock or burn. Turn off all power supplying this equipment before working on it. Be sure enclosure is closed securely before reapplying power.

ANWENDUNG:

Der Stromwächter DIA dient zur Überwachung von Wechsel- und Gleichströmen. Übersteigt der Meßstrom einen am Gerät eingestellten Grenzwert, zieht das Ausgangsrelais an. Sinkt der Strom unter einen einstellbaren prozentualen Wert des Anzugsstroms ab, fällt das Ausgangsrelais zurück.

APPLICATION:

The AC/DC current relay is designed for monitoring of either AC or DC currents. If the current exceeds a current limit set within the range of the device, the relay will energize. When the current drops below a value that is a percentage of the pick-up current, the relay will drop out.

EINGANG:

Anschlußspannung: siehe Gerätebeschriftung

Nennfrequenz: 50-60 Hz

Nennverbrauch: ca. 4 VA

INPUT:

Supply Voltage: see label on device

Rated Frequency: 50-60 Hz

Power Consumption: Approximately 4 VA

AUSGANG:

Kontaktbestückung: Ein einpoliger Wechslerkontakt standardmäßig. Ebenfalls mit zweipoligen Wechslerkontakten erhältlich, gekennzeichnet durch den Typzusatz "W" hinter der Relais-Bezeichnung.

OUTPUT:

Contact Arrangement: One single pole double throw contact is standard.
Also available with double pole double throw contacts indicated by the type addition "W" to the relay designation.

Kontaktmaterial: Hartsilber, vergoldet.

Contact material: Hard silver, gold-plated

Maximale elektrische Kontaktbelastung

Anzahl der Umschaltkontakte (Wechsler)	Spannung	AC-Nennleistungen, Last induktiv, cos φ = 0.4		
		Einschaltvermögen VA	Ausschaltvermögen VA	Dauerstrom I_{th} A
1 Wechsler	380V AC	2200	660	10
2 Wechsler	250V AC	1100	250	6

Maximum electrical contact ratings

Number of Double Throw Contacts	Volts	AC RATINGS, Inductive, cos φ = 0.4		
		Make VA	Break VA	Continuous Amps
1 contact	380V AC	2200	660	10
2 contacts	250V AC	1100	250	6

Umgebungstemperatur: –10 °C bis +55 °C

Ambient temperature: –10 °C to +55 °C

Überspannungsfestigkeitsklasse: 2 (VDE 0160)

Monitored Frequency Range: 0-1000 Hz

Überwachter Frequenzbereich: 0 -1000 Hz

Einstellungspunkte:
Oberer Schaltpunkt I Ein = 0.1 bis 1,0 x I Bereich max.
Unterer Schaltpunkt I Aus = 0.5 bis 0.95 x I Ein

Range of Set Points:
Pick up Current: 0.1 to 1.0 x max. minitored current
Drop out Current: 50% to 95% of pick up current

Ansprechverzögerung: 50 ms

Response Time: 50 ms

Ansprechgenauigkeit: max. Abweichung 0.5%

Response Accuracy: max. deviation 0.5 %

Eingangswiderstand:

DIA 1	25 Ω
DIA 2	5 Ω
DIA 3	0.05 Ω
DIA 4	0.01 Ω
DIA 5	0.01 Ω

Eingangswiderstand:

DIA 1	25 Ω
DIA 2	5 Ω
DIA 3	0.05 Ω
DIA 4	0.01 Ω
DIA 5	0.01 Ω

Typen-Auswahltabelle

Klasse 8430 Type	Überwachter Strombereich	Max. zulässiger Strom	Überlaststrom (max. 1 min.)
DIA 1	2-20 mA	40 mA	120 mA
DIA 2	10-100 mA	200 mA	600 mA
DIA 3	0.1-1 A	6 A	15 A
DIA 4	0.5-5 A	8 A	25 A
DIA 5	1-10 A	12 A	25.0 A

Selection Table

Class 8430 Type	Monitored Curent Range	Maximum Permissible Current	Overload Current (max. 1 min.
DIA 1	2-20 mA	40 mA	120 mA
DIA 2	10-100 mA	200 mA	600 mA
DIA 3	0.1-1 A	6 A	15 A
DIA 4	0.5-5 A	8 A	25 A
DIA 5	1-10 A	12 A	25.0 A

FUNKTIONSWEISE:

Eine der Nennspannung des Gerätes entsprechende Wechsel- oder Gleichspannung wird an die Klemme A1 und A2 gelegt. Der Meßstrom wird über die Klemme B1 und B2 dem Gerät zugeführt.

Liegt der zu überwachende Strom über dem am Gerät eingestellten Wert, zieht das Ausgangsrelais an.

Der überwachte Strom darf bis auf den in der Auswahltabelle angegebenen max. zulässigen Stromwert ansteigen. Der in der Auswahltabelle genannte Überlaststrom darf für max. eine Minute an das Relais angelegt werden. Ströme, die über diesen Wert hinausgehen oder längere Zeit anstehen, können zur Zerstörung des Gerätes führen.

Das Ausgangsrelais bleibt solange angezogen, bis der Meßstrom den am Gerät eingestellten Ausschaltpunkt unterschreitet. Der Ausschaltpunkt kann über ein Potentiometer auf der Vorderseite des Gerätes von 50% bis 95% des Ansprechwertes eingestellt werden.

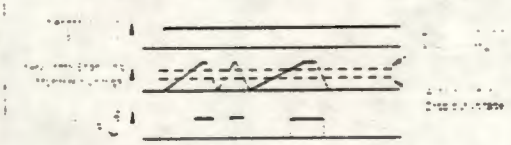
METHOD OF OPERATION:

An AC supply voltage equal to the supply voltage rating of the device is applied to terminals A1 und A2. The monitored current is applied to terminals B1 and B2. When the monitored current is above the pick up value which is set on the device within the range specified in the selection table, the double throw contact(s) will change state.

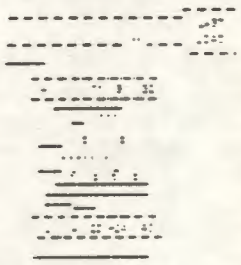
The monitored current can now rise to the maximum permissible current level indicated in the selection table and the relay will remain in the energized state. Overload current as indicated in the selection table can be applied to the relay for a period of one minute. Currents above this level or for longer periods of time will innibit the correct operation of the relay in the future.

The relay will remain energized until the current drops to the drop out value which is set on the relay. At this time, the contact(s) will return to their de-energized state. The drop out current is set by an adjustment on the face of the relay to a percentage within the range of 50% to 95% of the pick up current.

FUNKTIONSDIAGRAMM/LOGIC DIAGRAM:

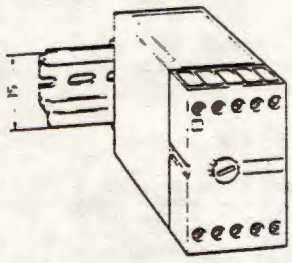


ANSCHLUßSCHEMA/WIRING DIAGRAM:



Tragschienenmontage
Rail Mounting

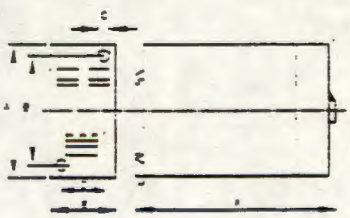
Aufrasten
Installation



Montage: Schnellbefestigung auf 35 mm DIN Schiene oder Schraubbefestigung mittels beigefügter Adapter-Platte.

Mounting: Relays are designed for direct mounting to a 35 mm DIN rail or may be directly mounted in any position to a panel through the use of a snap-on base plate mounting adaptor supplied with the relay. The DIN mounting rail is available as Class 8501 Type NT-13.

MAßE/DIMENSIONS:



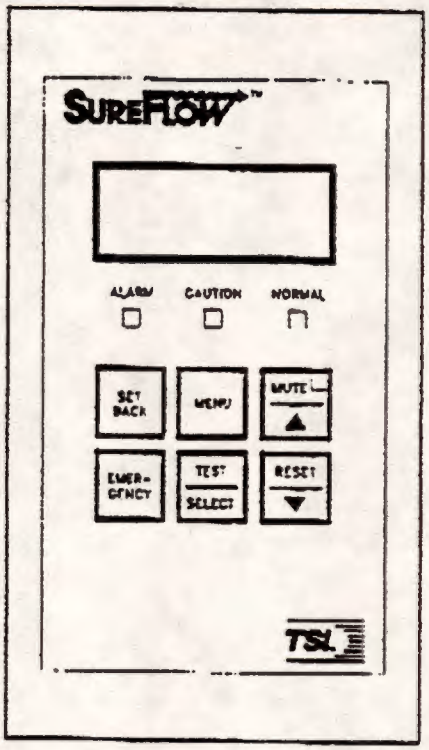
Maße Dimensions	A	B	C	D	E	F
mm	70	60	5	35	45	109.5
inches	2.76	2.36	.20	1.38	1.77	4.31

Anmerkung: Tiefenmaß mit Adapter-Platte + 1,5 mm (0.06 in.)

Note: Add. 1.5 mm (0.06 in.) in depth when using adaptor plate

MODEL 8670
SUREFLOW ROOM PRESSURE CONTROLLER

CD-105



System Component List

Part Number	Description
800242 ✓	Pressure Controller
~~800118~~	~~Electric Actuator~~
800199 ✓	Controller Output Cable
~~800119~~	~~Electric to Pneumatic Interface~~
800321 ✓	Pressure Sensor
800325 ✓	Sensor Cable
800414 ✓	Transformer Cable
800420 ✓	Transformer
~~800116~~	~~Pneumatic Actuator~~

TSI INCORPORATED
INDUSTRIAL TEST INSTRUMENTS GROUP

MAIL TO:
PO BOX 64394
ST. PAUL, MN 55164

SHIP TO:
500 CARDIGAN ROAD
SHOREVIEW, MN 55126

TELEPHONE: 612-490-2888 FAX: 612-490-2874

ENGINEER:

SOLD TO:

PROJECT:

JOB NO.: DWG NO.:

REP: DATE:

APPENDIX D

Air Permit

H & A OF NEW YORK

Geotechnical Engineers &
Environmental Consultants

31 March 1994
File No. 70007-43

New York State Department of
Environmental Conservation
Air Division
6274 East Avon - Lima Road
Avon, New York 14414

Attention: Mr. Dan Walsh

Subject: Spill Cleanup/Remediation Air Emission
Permit Application

Gentlemen:

Enclosed please find the above-referenced permit application for emissions to be generated by a vapor extraction system (VES) at the former Dollinger building in Brighton, New York. This VES is part of site remediation activities for NYSDEC Inactive Hazardous Waste Site, Site No. 828078, and is described in the Remedial Design Document dated 17 February 1994, submitted to Mr. Amar Nagi, NYSDEC project manager (Division of Hazardous Waste Remediation).

The information used to calculate actual emissions, short term impact, and annual impact, was derived from a short duration pilot study performed in June 1993. The air discharge permit application for the pilot study was submitted to the Air Division on 20 April and 4 May 1993, and signed by a representative of your Division on 13 May 1993. The pilot study permit contained predicted air discharge concentrations, and provided additional background information on previous site investigations and activities. The enclosed application is based on actual results of the pilot study. As shown on the enclosed application, it is anticipated that the carbon control devices will reduce concentrations in air to below applicable regulatory levels (AGC).

It is our understanding, based on conversations with you, that we may begin operating the VES immediately upon submittal of this application as long as emissions remain below calculated impact levels. Please contact us by phone if this is not the case, as we intend to begin start-up testing of the VES within the month.

189 North Water Street
Rochester, New York
716-[illegible]

Affiliate:
Haley & Aldrich Inc.
Cambridge, Massachusetts
Glastonbury, Connecticut
Marlborough, Mass.
Bedford, New Hampshire

Thank you for your continued assistance.

Sincerely yours,
H&A OF NEW YORK

Suzanne B. Wheatcraft
Senior Hydrogeologist

Vincent B. Dick
Vice President

SBW:VBD:gmc
ldwals23.wp

Attachment:
Spill Cleanup/Remediation Air Emission Permit Application

xc: A. Nagi, NYSDEC

NON PETROLEUM
Spill Cleanup/Remediation Air Emission Permit Application
New York State Department of Environmental Conservation
Region 8, 6274 E. Avon-Lima Rd., Avon, NY 14414
5/14/93 DEW

Source: Air Stripper __ Soil Vent __ Other (specify) Vapor Extraction System

Facility Name: American Filtrona Corporation - Dollinger

Facility Address: 1 Townline Circle
Brighton, New York 14618

Startup Date approx. 15 April 1994 Shutdown Date approx. April 1999

Stack Height: 24.0 FT
Stack Exit Inside Dimensions: 0.25 FT
Stack Exit Temperature: 110 F
Stack Exit Flow Rate: (max) 220 SCFM

Contaminant Name	CAS #	Emission Rate Potential (lbs/hr)	Percent Control	Actual Emissions (lbs/hr)
1,2-dichloroethene	540-59-0	0.39	90%	.04
trichloroethene	79-01-6	1.73	95%	.09
vinyl chloride	75-01-4	2.48×10^{-3}	90%	2.48×10^{-4}
toluene	108-88-3	0.31	90%	.03

Use Air Guide 1 (Draft 1991 Edition) screening equations on p. B-9 to estimate ambient impact. Compare impact estimate to AGC and SGC from tables in the back of Air Guide 1. See Air Guide 1, p. 8-9 for compounds not listed. Impact levels must be below guideline concentrations if air pollution control is not used.

	CAS #	Short Term Impact (ug/m3)	SGC (ug/m3)	Annual Impact (ug/m3)	AGC (ug/m3)
1,2-DCE	540-59-0	1.98×10^{8}	190,000.0	0.18	1,900.0
TCE	79-01-6	8.83×10^{8}	33,000.0	0.40	0.45
vinyl chloride	75-01-4	1.26×10^{6}	1,300.0	1.09×10^{-3}	0.02
Toluene	108-88-3	1.58×10^{8}	89,000.0	0.13	2,000.0

Air Pollution Control Equipment:

_____ Not Needed Based on Analysis of Design Conditions
_____ Not Needed Based on Analysis of Operating Conditions
__x__ Described Below

Air Pollution Control Type:

____ None
__x__ Activated Bed Adsorber
__x__ Other, Explain: Liquid Carbon, Vapor Carbon

____ Thermal Afterburner
____ Catalytic Unit

Manufacturers's Name: Carbtrol
Model Number: Model L-1, 200# 55 gallon drum (liquid carbon treatment)
Model G-5, 2000* Canister (vapor carbon treatment)

Disposal of Collected Contaminants:

____ Landfill Off-Site
____ Recylced in the Process
____ Recycled On-Site
__x__ Other, Explain: Recycled off-site

requency of stack emission monitoring/testing Monthly
onitoring/testing method Post carbon air will be evaluated by H&A of New York using a Hewlett-Packard II Gas Chromatograph.

am of DEC Spill/Remediation Project Manager Amar Nagi, P.E.
Phone # (518) 457-9280

hi is not a permit until signed and dated by the Division of Regulatory ff irs below. All specifications and limits stated above and contained in ny attached materials submitted with this application will become binding nd enforcable conditions of the permit.

certify this system will be operated in accordance with the pecifications stated above and in compliance with all existing laws, rules nd regulations.

Signature of Responsible Party — President — Title — 4 April 1994 — Date

Signature: _____ Date: _____
Division of Air Resources

Signature: _____ Date: _____
Division of Regulatory Affairs

c: DEC Project Manager

5/14/93 DEW

CALCULATIONS FOR SPILL CLEANUP/REMEDIATION
AIR EMISSION PERMIT APPLICATION

AFC-DOLLINGER
BRIGHTON, NEW YORK

EMISSION RATE POTENTIAL (lbs/hr) CALCULATION

Anticipated maximum stack exit flow rate = 220 SCFM
Maximum concentration, in air, measured during pilot test:

1,2-dichloroethene	470.6 ug/l
trichloroethene	2101.95 ug/l (average of all measurements)
vinyl chloride	3.0 ug/l
toluene	376.5 ug/l

Emission Rate Potential (lbs/hr) = (ug/l in air)(FLOW IN SCFM)(3.75×10^{-6})

1,2-dichloroethene	0.39 lbs/hr
trichloroethene	1.73 lbs/hr
vinyl chloride	2.48×10^{-3} lbs/hr
toluene	0.31 lbs/hr

Once Emission Rate Potential has been determined, and the Percent Control of control devices to be used (carbon drums) is known, then the Annual Emissions, representing that percent of the Emission Rate Potential remaining after the control device, is used.

SHORT TERM IMPACT (ug/m^3) CALCULATION

Cst = Short Term Impact (ug/m^3)
Cp = Potential Annual Impact (ug/m^3)

$$Cst = Cp \times 420$$

Cp = measured concentration in air (ug/l) (1000)

Cp 1,2 dichloroethene	$= 4.71 \times 10^5$
Cp trichloroethene	$= 2.10 \times 10^6$
Cp vinyl chloride	$= 3.00 \times 10^3$
Cp toluene	$= 3.76 \times 10^5$

$$Cst = Cp \times 420$$

Cst 1,2-dichloroethene	$= 1.98 \times 10^8$
Cst trichloroethene	$= 8.83 \times 10^8$
Cst vinyl chloride	$= 1.26 \times 10^6$
Cst toluene	$= 1.58 \times 10^8$

ANNUAL IMPACT (ug/m^3) CALCULATION

$$Ca = \frac{0.482\ Qa}{h_e\ 2.16}$$

where:

Ca = Annual Impact (ug/m^3)
Qa = Actual Emission (lbs/year)
h_e = Stack Height from Permit (24 ft.)

First, convert Actual Emissions from lbs/hr to lbs/year:

Qa = (0.04 lbs/hr)(24 hrs/day)(365 days/yr) = lbs/yr
Qa 1,2-dichloroethene = 350.4 lbs/yr
Qa trichloroethene = 788.4 lbs/yr
Qa vinyl chloride = 2.17 lbs/yr
Qa toluene = 262.8 lbs/yr

Then, solve for Ca:

Ca 1,2-dichloroethene = 0.18 ug/m^3
Ca trichloroethene = 0.40 ug/m^3
Ca vinyl chloride = 1.09×10^{-3} ug/m^3
Ca toluene = 0.13 ug/m^3

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