Operations and Maintenance Manual

Byron Barrel & Drum Site
(Area 2)
6065 Transit Road
Byron NY

March 2004

Prepared for:

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Eagan, Minnesota

and

Garlock Sealing Technologies
Palmyra, New York

Prepared by:

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23 Grand Avenue
Farmingdale, New York

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Site Background

The Byron Barrel and Drum Area 2 Site is located at 6065 Transit Road, in Byron Township, Genesee County, NY. The Site is set back approximately 1,000 feet from the east side of Transit Road. In 1982, two drum disposal locations were discovered at the Byron Barrel and Drum site. New York State Department of Environmental Conservation's (DEC) subsequent investigation led to the site's inclusion on the Superfund National Priorities List (April 1984).

A remedial investigation and feasibility study (RI/FS) was conducted, which identified three areas of concern at the site. Based on the findings of the RI, it was concluded that further action in two of the areas, Area 1 and Area 3, was not warranted. However, the RI detected volatile organic compounds (VOCs); including trichloroethene (TCE) and 1,1,1-trichloroethane (TCA) in groundwater samples collected from locations in Area 2.

The remedial activities discussed in this report include only activities for Area 2. The selected remedy for Area 2 was in-situ soil flushing and groundwater pumping, treatment, and recharge. The Remedial Action construction was performed during the summer of 2001. The implementation of the Remedial Design included excavation and characterization of potentially contaminated soil, installation of two groundwater pumping wells (PWs), installation of a ground water treatment system, and installation of an infiltration gallery.

1.0 Overview

The major functions of the remediation operation include:

- Operations;
- Monitoring;
- Analytical/record keeping; and
- Maintenance.

The specific managerial responsibilities for the operation and maintenance of the remediation tasks are outlined in the following list:

- Maintain adequate remediation operational and management records.
- Establish staff requirements and assign personnel, as appropriate.
- Prepare an appropriate budget and ensure that costs associated with operation and maintenance of the remediation stay within that budget.
- Make employees aware of the importance of proper Plant performance.
- Make periodic inspections of the Plant and associated facilities to discuss mutual problems with the operations personnel and to observe operation practices.
- Create an atmosphere that will make operational personnel feel that they can bring special problems to management's attention.
- Maintain good public relations.
- Submit required reports to USEPA/NYSDEC in a timely manner.
- Plan for the future Plant needs.

The specific responsibilities of the Plant Operation are outlined in the following list:

- Exercise direct authority over any subordinate personnel and subcontractors in accordance with approved policies and procedures. Provide training as required.
- Establish work priorities for Plant personnel, and when necessary, authorize work orders to obtain the services of outside contractors.
- Schedule and oversee all Site maintenance including preventative maintenance and lubrication.
- Direct and supervise the preparation of operating logs and reports, maintenance and repair schedules and reports, requests for contract to work, purchase requisitions, equipment files and accident reports.
- Provide good working conditions, proper tools and safety equipment for the operational personnel.

- Analyze and evaluate operation, maintenance and monitoring activities; initiate or recommend new or improved practices.
- Schedule and implement all residuals disposal and complete associated paperwork.
- Inspect all facilities regularly.
- Ensure a safe working environment. Formulate advance planning and take steps to prevent employee injuries and equipment damage; anticipate hazards in new procedures and materials and develop procedures for controller such hazards. Provide leadership and motivation in a continuing safety program.
- Implement and enforce all Plant health and safety requirements.
- Provide regular safety training.
- Be responsible for all Plant security. Ensure that fences around are intact to prevent unauthorized access to the Plant.
- Perform monitoring, sampling, and analysis as required or scheduled. Review and perform QA/QC of all laboratory work. Sampling will include ground water recovery system and treatment systems.
- Review and approve all process data collected and maintain process data records.
- Prepare, or review and approve, operation and progress reports.
- Prepare status reports for USEPA/NYSDEC.
- Operate and maintain the Plant equipment.
- Observe variations in operating conditions and interpret monitoring equipment output and analytic results to determine processing requirements.
- Maintain all record and reporting forms included in this manual (including maintenance records).
- Assist in the startup of new equipment.
- Perform custodial and grounds keeping chores and any maintenance work or repairs required.
- Perform general maintenance and repair tasks on the building, equipment and grounds.

2.0 System Operations

The treatment process consists of first passing the extracted groundwater from PW1, PW2, and PW3 through a bag filter. After the bag filter, the groundwater is routed through a low-profile air stripping unit. The air stripping operation removes the VOCs from the groundwater and is sized to treat the contaminants of concern at a flowrate of twenty GPM with an airflow of 150 SCFM. Following air stripping, the groundwater is discharged to surface water. **Figure 1** illustrates the PW locations and the Groundwater Treatment System. A Flow Diagram of the Groundwater Treatment System equipment and process piping is presented in **Figure 2**.

2.1 Routine visits

Scheduled O&M activities include weekly site visits by the local Chief Operator, Mr. Steve Rodland, and the Assistant Operator, Mr. Ken Marble. The Operators are the first responders to autodialer alarms from the site. The autodialer also contacts John Maddox at the ECOR office in Farmingdale , NY. Site status may be checked remotely by telephoning the autodialer. .

Weekly site visits include performing an overall site inspection, GWTP system inspection, including checking the bag filter for loading, gauging air flow through the stripper, and noting flow rates and totalized flow. Preventive maintenance items performed by the operator include monthly inspections of the air stripper blower, and air stripper trays are inspected for sediment and mal deposits. It is anticipated that the trays will be cleaned on a quarterly basis as a preventative maintenance and system operation performance item.

The GWTP is sized for the contaminants of concern and is rated for 20 gpm through the air stripper with an air flow of 150 SCFM. Total flowrates from the three Pumping Wells can be expected to vary from a minimum of 8 gpm to a maximum of 15 gpm. PW-1 recharges continually at an extraction rate of 8 gpm,

thus has a 100% duty cycle. PW-2 and PW-3 have less yield; 30% duty cycles at 3 gpm. The system has been optimized to establish cones of depression at the pumping wells in order to capture the highest yield in contaminants.

2.2 System Data Readings

Totalizer and flowrate data are taken from the Influent Totalizer, as well as from PW-1, PW-2, and PW-3 totalizers. The sum of PW totalizer values should approximate the Influent Totalizer value. On the discharge side, totalizer and flow data are taken from the Infiltration Galley and Ditch (Outfall 001). The sum of these Effluent discharge points should approximate the Influent Totalizer value.

Readings are taken from the Hour Meter, which is in parallel with the air stripper blower, and the time of day of the reading, so that a real-time comparison may be made to the calculated run time.

Record the bag filter influent and effluent pressures. The inlet pressure will vary according to the volume of water, i.e. the number of Pumping Wells on; the pressure drop across the bag filter is an indication of sediment loading. A 20% pressure drop is a rough indication for a filter changeout.

Applied Vacuum and Differential Pressure data for the air stripper are recorded. Under operating conditions, the applied vacuum at the air stripper is typically 15" Water Column. A higher value would indicate a restriction in the flow path, a characteristic of sediment loading. A lower value would indicate a loss of blower efficiency or a gross leak in the stripper. The Differential Pressure (DP) is typically 0.10", or 150 scfm at 60° F. The DP is the difference between Static Pressure (low) and Applied Pressure (high), which yields air velocity. The volume of airflow as shown on **Table 1** is derived from the air velocity through the

six-inch diameter pipe of the air stripper. The chart also gives corrections for temperature. **Table 2** is the site visit data sheet for these parameters.

2.3 System Maintenance

Documentation received with each piece of equipment including installation and maintenance instructions, model numbers, troubleshooting and performance curves are included in **Appendix A**.

- The blower and pump motors have sealed bearings, thus require no lubrication. Motor performance can be evaluated by measuring the amperage draw under load and comparing that value to that on the motor nameplate.
- Excessive loading of the stripper sump pump motor may be an indication of mineral buildup on the pump. A further indication of mineral buildup in the system is a rise in the applied vacuum at the stripper. A cleaning of the pump and stripper trays would be in order.
- Similarly, amperage draw on the groundwater pump motors is an indicator of increased loading, although minerals will not drop out of solution as readily without aeration, as in the stripper.
- Reduced yield as indicated by slower recharge of the Recovery Wells would indicate a need for well redevelopment. The six-inch diameter wells would require a truck mounted rig for re-development.
- The discharge plumbing line has been replaced with tubing in order to facilitate periodic replacement as the discharge line becomes fouled with minerals.

Table 3 is a *Monthly Maintenance Chart* which itemizes these issues for system performance tracking and as preventative maintenance measures.
Table 4 is an *Emergency Contact List* for local Police, Sheriff, Fire, and Medical, as well as ECOR Solutions, Unisys, Garlock, EPA, and NYSDEC. A Site Health

and Safety Plan is onsite and has been previously submitted. A ten pound ABC rated fire extinguisher, first aide kit, and emergency eye wash are onsite.

3.0 System Sampling

The Treatment System sampling schedule was reduced to quarterly during the third quarter 2002. Effluent sampling coincides with the quarterly sampling of the groundwater monitoring wells and Pumping Wells.

The remedial action is considered exempt from NYSDEC State Pollutant Discharge Elimination System (SPDES) permitting, but not the associated operating, monitoring, and reporting requirements.

Monitoring Requirements for the site's discharge are summarized below:

Constituent	Maximum Daily Limit, (ug/l)
Toluene	5
1,1,1-Trichloroethane	10
Trichloroethene	10
1,1 Dichloroethane	10
1,1 Dichloroethene	10
Cis, 1-2 Dichloroethene	10
Methylene chloride	10
Vinyl Chloride	10
pH:	6.5 to 8.5 S.U.
Total Suspended Solids (TSS)	20.0 mg/l

3.1 Sample Designation

Sample bottles (including those containing preservatives, where necessary), labels, shipping containers, trip blanks, and field blank water will be provided by the

laboratory. During collection of field samples, the sample container will be labeled with the following information:

- ECOR project number;
- Location identifier;
- Sample type (media) identification code (see below);
- Analysis identifier;
- Date and time of collection; and
- Type of preservative added (if applicable).
- Each sample shall have a corresponding notebook entry which includes:

  - Sample ID number
  - Sample location and number
  - Date and time
  - Analysis for which sample was collected
  - Additional comments as necessary
  - Samplers' name

- Each sample must have a corresponding entry on a chain-of-custody form.
- The entry for sampling at any one location is to be completed before sampling is initiated at any other location by the same sampling team.
- In cases where the samples leave the immediate control of the sampling team (i.e., shipment via common carrier) the shipping container must be sealed.

Each sample collected shall be designated by an alphanumeric code that shall identify the type of sampling location, the specific location, the matrix sampled, and a specific sample designation (identifier). "GW" is the indicator for groundwater; sampling events shall be numbered in a sequence beginning with "01", which corresponds to the round of sampling.

3.2 Treatment System Influent

Samples of treatment system influent will be collected from the combined influent force main which is located inside the treatment system building. The sample tap is located in the force main pipe downstream of the individual pumping well force main connections to the influent force main, and upstream of the influent bag filter. Influent samples will be collected when all operable wells are pumping.

3.3 Treatment System Effluent

Samples of effluent of the treatment system will be collected from the sample valve in the treatment system's discharge force main, which is located inside the treatment building. Effluent samples will be collected from the effluent sample valve located in the force main downstream of the system discharge pump, and upstream of the flow control valves. The flow control valves can be used to distribute a fraction of the effluent to the groundwater reinjection system, and most of the flow to the surface water discharge point. Therefore, the effluent sample location will provide a representative sample of the discharge to the reinjection system as well as to the surface water discharge.

3.4 Field Sampling Procedures

Chain-of Custody records will be completed at the time of sample collection and will be placed inside the cooler with the samples for shipment to the selected laboratory.

Samples will be placed in an insulated cooler for shipment to the Laboratory within the specified holding times. A temperature blank, consisting of a sample container filled with nonpreserved water (potable or distilled), will be included in each cooler containing samples (soil and aqueous) being sent for analysis. The temperature blank container will be labeled as "USEPA COOLER TEMPERATURE INDICATOR" and dated.

A custody seal will be affixed to the sample cooler prior to shipment to the selected laboratory.

3.5 Analytical Methods

Compliance sampling for Effluent water quality consists of TCL VOAs for the eight compounds described in the QAPP; 1,1-DCA, 1,1-DCE, MeCl, TCA, TCE, toluene, VC and cis-1,2-dichloroethene. Effluent pH is measured with a meter accurate to +/- 0.1 with a resolution of 0.1. A two point calibration of the meter is performed prior to measurements. Although not required, Influent samples for the same compounds as well as TSS are also taken in order to track system performance.

The three Pumping Wells are analyzed for twenty project specific compounds in accordance with USEPA Method 8260B. These are 1,1-dichloroethane; 1,1-dichloroethene; MeCl; toluene; 1,1,1-trichloroethane; trichloroethene; VC; benzene; total xylenes; chlorobenzene; 1,1,2-trichloroethane; 1,2-dichloroethane; tetrachloroethene; chloroform; bromodichloromethane; dibromochloromethane; 2-butanone; carbon tetrachloride; 1,2-dichlorobenzene; and 1,4-dichlorobenzene.

Tables

Table 1
Byron Barrel Drum GWTP
Induced Draft Stripper Airflow

K=	*0.71*	*for 6" pipe*
Diameter (inches), D =	5.709	6" sch 40
Operating Pressure (in. w.c.)	-14.5	
Static Pressure (psia), P =	14.17655	

Flow (cfm) Based Upon Temperature and Pitot Tube Reading

Temperature (deg F) ==>	20	40	50	60	80	100
ΔP (inches w.c.)						
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.01	51.22	50.19	49.69	49.21	48.29	47.42
0.02	72.44	70.98	70.28	69.60	68.30	67.07
0.03	88.72	86.93	86.07	85.24	83.65	82.14
0.04	102.44	100.37	99.39	98.43	96.59	94.85
0.05	114.54	112.22	111.12	110.04	107.99	106.04
0.06	125.47	122.93	121.72	120.55	118.29	116.16
0.07	135.52	132.78	131.48	130.20	127.77	125.47
0.08	144.88	141.95	140.55	139.19	136.59	134.13
Target flowrate = 150 scfm **0.09**	**153.67**	**150.56**	**149.08**	**147.64**	144.88	142.27
0.10	161.98	158.71	157.14	**155.62**	**152.72**	**149.96**
0.11	169.89	166.45	164.81	163.22	160.17	157.28
0.12	177.44	173.85	172.14	170.48	167.29	164.28
0.13	184.68	180.95	179.17	177.44	174.12	170.98
0.14	191.66	187.78	185.93	184.14	180.70	177.44
0.15	198.38	194.37	192.46	190.60	187.04	183.67
0.16	204.89	200.75	198.77	196.85	193.17	189.69
0.17	211.19	206.93	204.89	202.91	199.12	195.53
0.18	217.32	212.93	210.83	208.79	204.89	201.20
0.19	223.27	218.76	216.61	214.51	210.50	206.71
0.20	229.07	224.44	222.23	220.09	215.97	212.08
0.21	234.73	229.99	227.72	225.52	221.31	217.32
0.22	240.25	235.40	233.08	230.83	226.51	222.43
0.23	245.65	240.69	238.32	236.02	231.60	227.43
0.24	250.94	245.87	243.44	241.09	236.59	232.32
0.25	256.11	250.94	248.46	246.06	241.46	237.11
0.26	261.18	255.91	253.39	250.94	246.25	241.81
0.27	266.16	260.78	258.21	255.72	250.94	246.42
0.28	271.04	265.57	262.95	260.41	255.54	250.94
0.29	275.84	270.27	267.60	265.02	260.06	255.38
0.30	280.56	274.89	272.18	269.55	264.51	259.74

Table 2
Byron Barrel and Drum
Weekly Site Visit Data Sheet

Byron GWTS Data

FAX completed sheet to John Maddox (631) 420-5922

Operator: _____ Date: _____

	Flowrate		Totalizer	
Influent (Badger)	_____	gpm	_____	gal
PW1	_____	gpm	_____	gal
PW2	_____	gpm	_____	gal
PW3	_____	gpm	_____	gal
Infiltration Effl.	_____	gpm	_____	gal
Ditch Effl.	_____	gpm	_____	gal

Hour meter _____ taken at _____ (time of day)

Electric meter _____

Take during sampling event:

Influent pH _____

Effluent pH _____ (6.5-8.5)

Influent Temp _____ °F

Bag Filter Infl. Pressure _____ psi

Bag Filter Effl. Pressure _____ psi

Applied Vacuum _____ "WC

Differential Pressure _____ "WC

= _____ scfm

Samples taken? _____ Any alarm condition? _____

Site secure? Note signs of intrusion. _____

Notes:

Table 3
Byron Barrel and Drum
Monthly Maintenance Form

Byron GWTS Monthly Maintenance

FAX completed sheet to John Maddox (631) 420-5922

Operator: _____ Date: _____

Amperage draw on process motors (single phase 220 VAC):

	L1	L2	Notes:
PW-1			
PW-2			
PW-3			
Stripper blower			
Sump pump			

For the groundwater and sump pump motors, if amperage values are higher than nameplate and historical numbers, the pumps may be loading with minerals or sediment. Pull pumps and inspect.

If the sump pump motor shows an increase in amperage across all legs and the pump shows lack of throughput, remove the wet end of the pump and inspect for mineral buildup. Descale.

Applied vacuum at stripper, "WC: _____

If > 18" WC, clean the stripper trays of mineral buildup. _____

Inspect stripper trays for mineral buildup: _____

_____

Discharge Pressure of stripper sump pump, psi: _____

If > 10 psi, inspect discharge line for mineral buildup. _____

Notes:

Table 4
Byron Barrel and Drum Emergency Contact List

Byron Barrel and Drum Site
6065 Transit Rd.
Byron NY 14422
(585) 548-7573

ECOR Solutions

John Maddox and Mark Gouch
23 Grand Avenue
Farmingdale NY 11735
(631) 424-4972

Steve Rodland, Site Operator
1060 Cohocton Rd.
Corfu NY 14036
(585) 230-0521

Ken Marble, Site Operator
8974 Upton Rd.
Batavia NY 14020
(585) 762-8033

Elba Fire Department
Main St.
Elba NY 14058
(585) 757-9011

Garlock Sealing Technologies
Christopher Rockwell
1666 Division St.
Palmyra NY 14522
(315) 597-3101

Genesee County Sheriff
14 W. Main St.
Batavia NY 14020-2097
(585) 345-3000

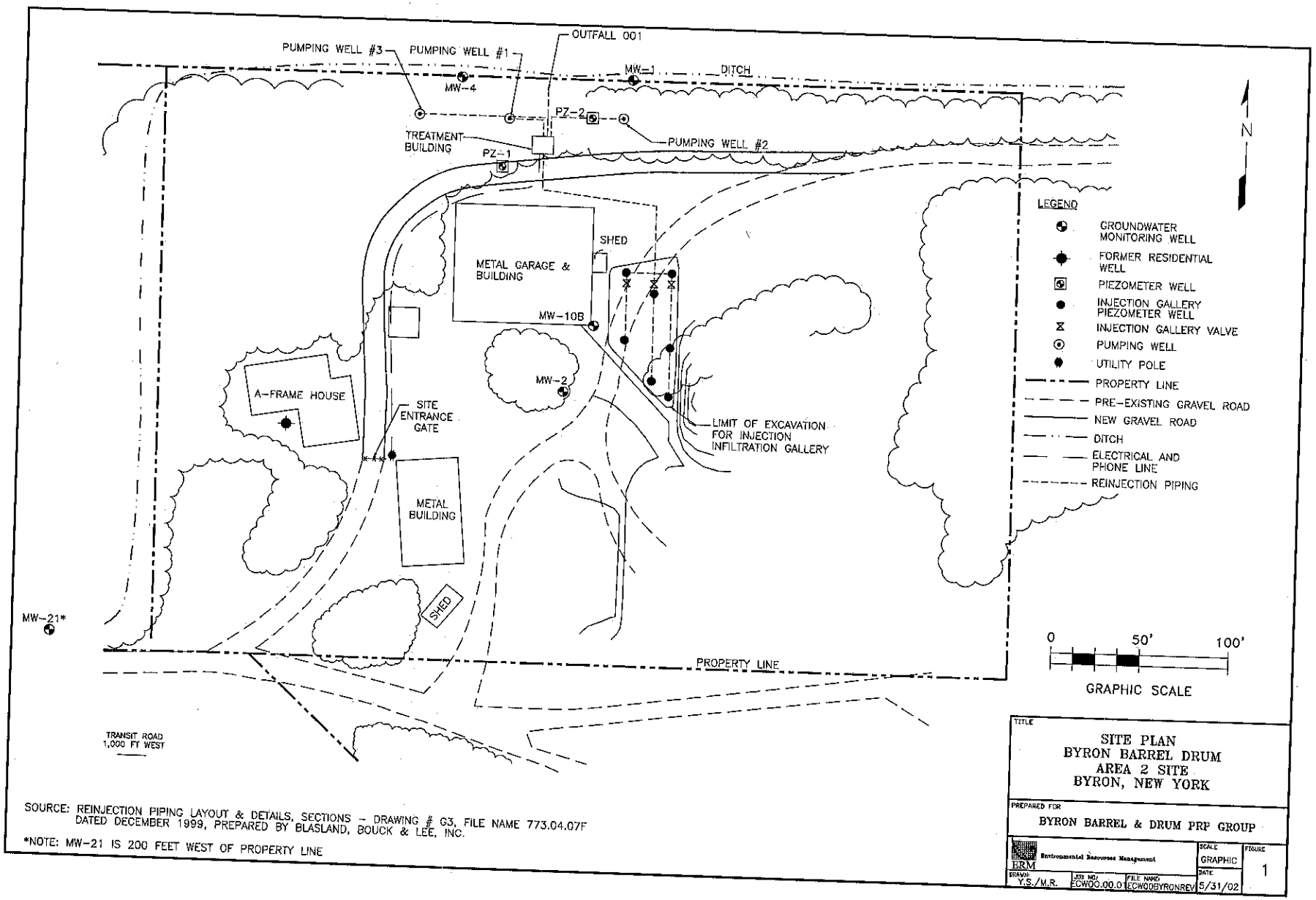
NYSDEC
John Grathwol
625 Broadway, 12th Floor
Albany NY 12233-7013
(518) 402-9812

State Police Department
4525 W. Saile Dr.
Batavia NY 14020-1046
(585) 343-2200

Unisys Corporation
Terry Etter
3199 Pilot Knob Rd.
Eagan MN 55121-1328
(651) 687-2881

USEPA Region 2
George Jacob
290 Broadway, 20th Floor
New York, New York 10007-1866
(212) 637-4266

Figures



SOURCE: REINJECTION PIPING LAYOUT & DETAILS, SECTIONS - DRAWING # G3, FILE NAME 773.04.07F DATED DECEMBER 1999, PREPARED BY BLASLAND, BOUCK & LEE, INC.

*NOTE: MW-21 IS 200 FEET WEST OF PROPERTY LINE

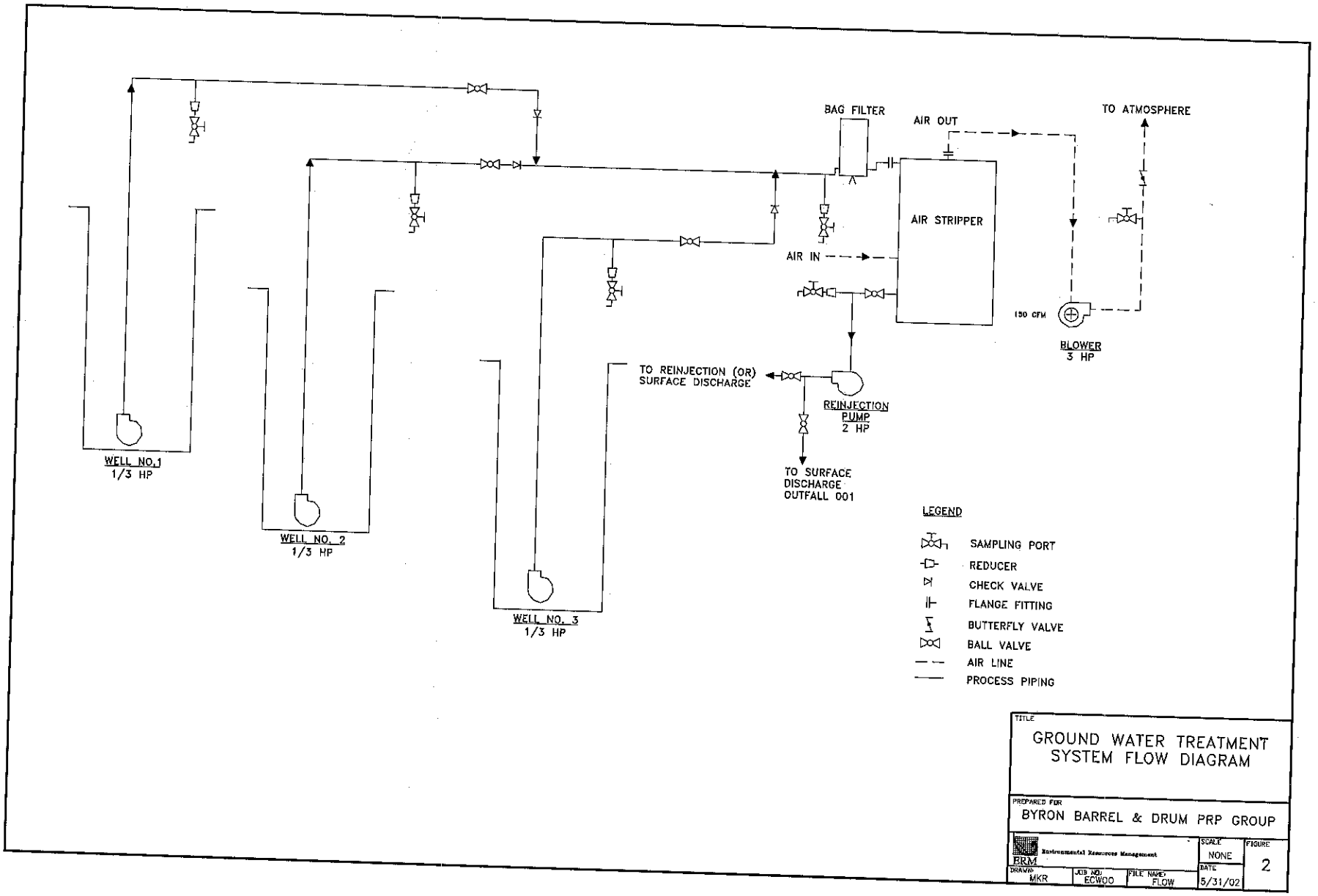
TITLE

SITE PLAN
BYRON BARREL DRUM
AREA 2 SITE
BYRON, NEW YORK

PREPARED FOR

BYRON BARREL & DRUM PRP GROUP

ERM Environmental Resources Management		SCALE: GRAPHIC	FIGURE: 1
DRAWN: Y.S./M.R.	JOB NO.: ECW00.00.0	FILE NAME: ECW00BYRONREV	DATE: 5/31/02



TITLE

GROUND WATER TREATMENT SYSTEM FLOW DIAGRAM

PREPARED FOR

BYRON BARREL & DRUM PRP GROUP

ERM — Environmental Resources Management

SCALE	FIGURE
NONE	2

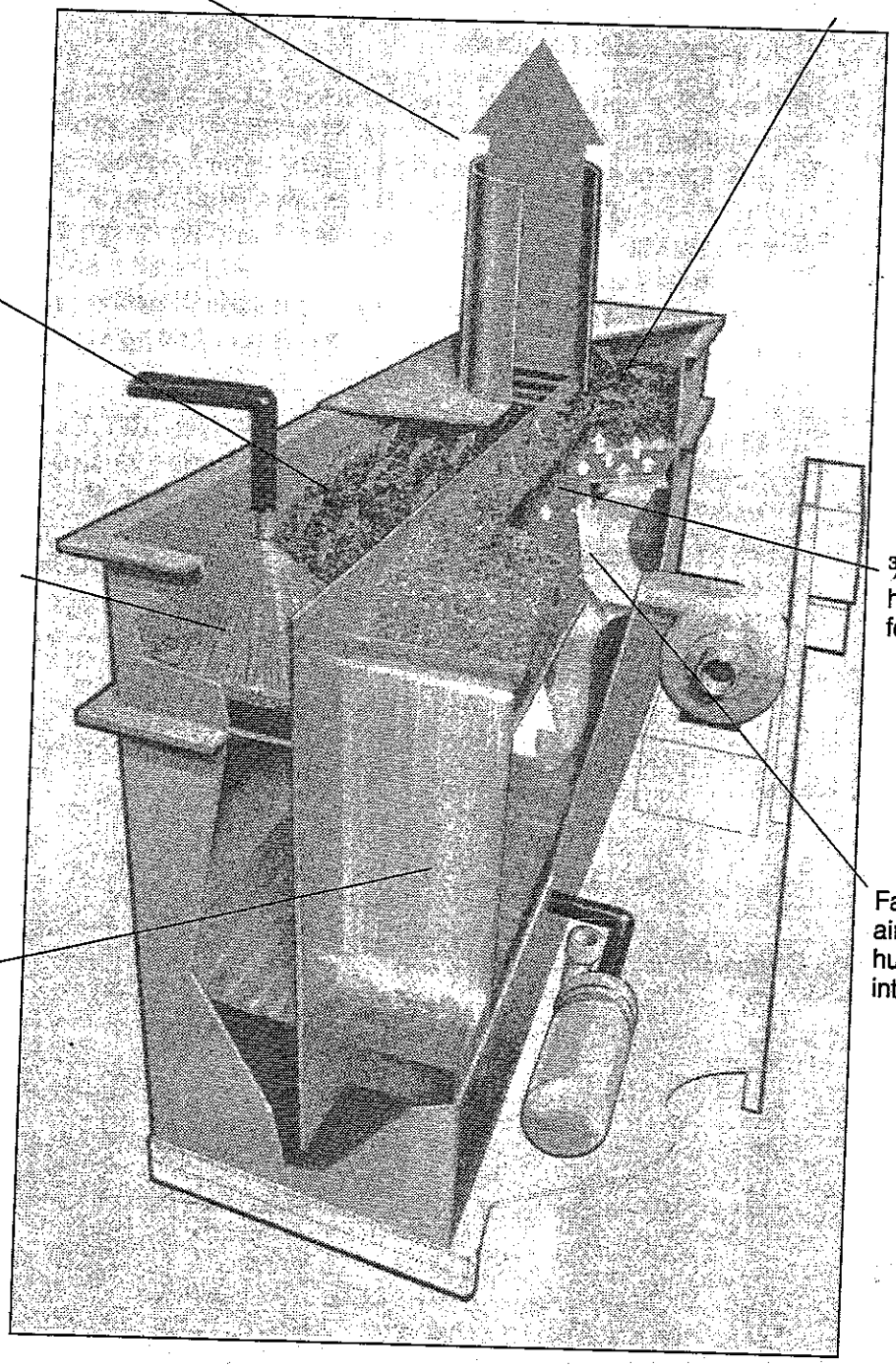
DRAWN	JOB NO.	FILE NAME	DATE
MKR	ECW00	FLOW	5/31/02

Appendix A

The ShallowTray Process

Air is vented to the atmosphere or to vapor phase treatment of choice.

Water travels around the full length of the baffled tray, becoming progressively cleaner.



Turbulent frothing maximizes volatilization and scours the stripper tray.

Contaminated water inlet.

3/16" (4.8mm) holes resist fouling.

Fan blows fresh air up through hundreds of holes into the water.

Treated water falls into holding tank.

THE SHALLOWTRAY PROCESS

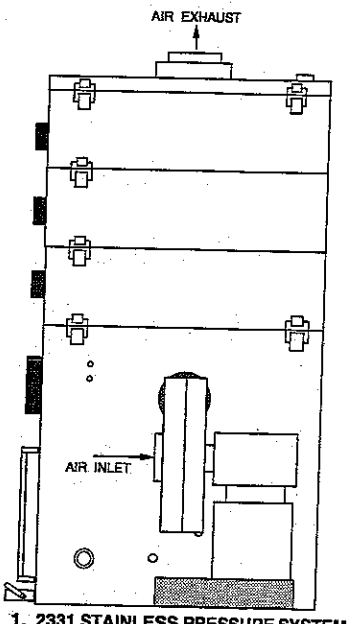
The Treatment Process

The purpose of air stripping is to treat contaminated groundwater for the removal of certain dissolved volatile organic compounds (VOC). The ShallowTray low profile air stripper is a compact, low-maintenance solution to groundwater treatment.

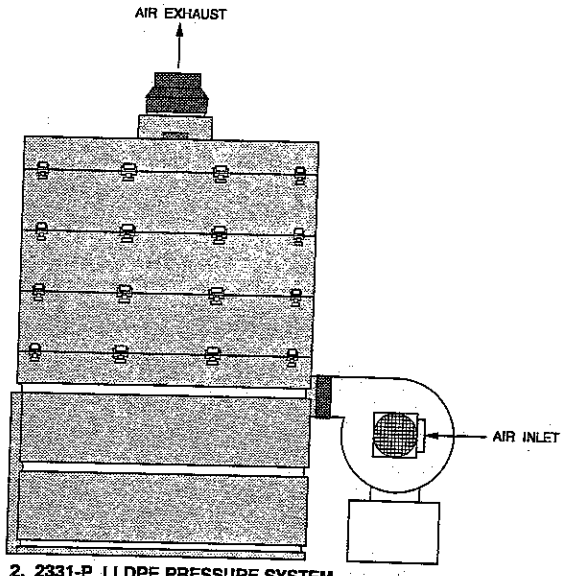
The active components of a ShallowTray low profile air stripper are patent-protected tray-type stripper trays. (The ShallowTray process is protected under U.S. Patent #5,045,215 and 5,240,595; other international patents pending.) Fresh air is blown up through hundreds of 3/16" (5mm) diameter holes in each stripper tray. The air forms a froth of bubbles approximately six inches deep on the stripper tray, generating a large mass transfer surface area where the contaminants are volatilized. The necessary contact or residence time to reach required volatilization is achieved through model size, addition of trays, and flow rate selection.

Typically constructed of corrosion resistant type 304L stainless steel or polyethylene, the tray unit utilizes countercurrent air and water flow through an array of baffled stripper trays. Sizing and design of a ShallowTray low profile air stripper are determined by a variety of factors that include water flow rate, contaminant concentration, temperature, required removal efficiency, and the physical/chemical properties of the contaminants that govern their solubility in water.

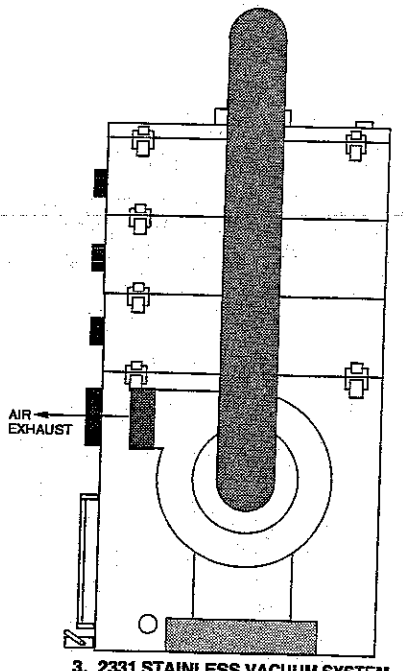
The ShallowTray Basic System



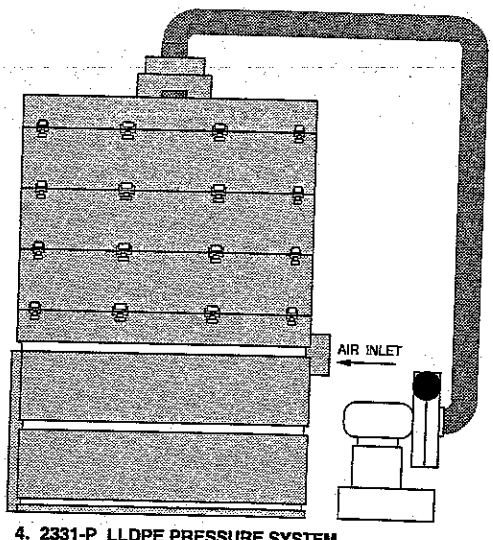
1. 2331 STAINLESS PRESSURE SYSTEM (FORCED DRAFT)



2. 2331-P LLDPE PRESSURE SYSTEM (FORCED DRAFT)



3. 2331 STAINLESS VACUUM SYSTEM (INDUCED DRAFT)



4. 2331-P LLDPE PRESSURE SYSTEM (INDUCED DRAFT)

BASIC SYSTEM

ShallowTray systems are fabricated from rugged 304L stainless steel, 316L stainless steel, or molded polyethylene, and are typically supplied with all the components listed in this section. Read through each component description for a better understanding of its function.

Pressure Versus Vacuum Set-up

There are two versions of the basic system referred to in this manual. They are defined as follows:

1. Pressure System – The blower is installed so that the stripper tank and stripper trays are pressurized. This arrangement can be used when the maximum total system pressure (air stripper plus other downstream air equipment) does not exceed 26 inches (56cm) water column (W.C.) pressure or vacuum for plastic strippers, and 32 inches (82cm) W.C. for stainless steel strippers.

2. Vacuum System – The blower is installed so that the stripper cover and stripper trays are under a vacuum. Removal efficiency is the same as for a pressure system. This is the proper arrangement when total system pressure exceeds the values listed above. In this setup, the blower induces the required vacuum on the stripper, and also provides the required additional pressure for downstream air equipment.

High Water Flow Versus Low Water Flow Systems

There are two water flow range options for the basic system. They are referred to in this manual as **Low Flow** and **High Flow** systems. The high flow system requires a blower that produces an additional 4 inches (10.2cm) W.C. pressure/vacuum compared to the low flow system blower. The low and high water flow ranges for each ShallowTray series are listed in the table below:

ShallowTray Series	Low Water Flow Range	High Water Flow Range
1300P	0.5 - 15 gpm	N/A
1300	0.5 - 15 gpm	16 - 24 gpm
2300P	1 - 30 gpm	31 - 50 gpm
2300	1 - 30 gpm	31 - 45 gpm
2600	2 - 60 gpm	61 - 115 gpm
3600	3 - 90 gpm	91 - 160 gpm
31200	4 - 150 gpm	151 - 425 gpm
41200	6 - 200 gpm	201 - 550 gpm

Basic System Components

Component manufacturer information sheets ("cutsheets") are included in the Components Information Section (Section 7) at the back of this manual.

Blower

The blowers on the ShallowTray low profile air stripper units are typically type B spark resistant with a cast aluminum wheel, direct driven @ 3450 rpm with motor options of Totally Enclosed Fan Cooled (TEFC) or Explosion Proof (EXP). Each blower is selected by our engineering staff to exceed the minimum cubic feet per minute (CFM) air flow requirements at the nominal working pressure (inches of W.C.) of each system. It is critical that the blower damper be opened wide enough to provide the unit with the designated minimum fresh air flow.

It is also critical that water does not enter the blower housing while the blower is in operation; this will damage your blower and void the warranty. The high water level alarm switch prevents this from happening. Make sure it is installed properly.

The motor horsepower is selected to provide a reasonable operating range. However, there is potential for the blower motor to overload if it is not working against sufficient pressure drop. Therefore, the blower must be protected with a thermal overload switch. Also, the blower damper should be set so that the blower produces at least the minimum air flow requirement (see table below), and does not exceed the nameplate amperage limit of the motor.

Damper

There is a damper on the blower, used to make air flow rate (SCFM) adjustments to your system. Open the damper to increase air flow rate, and close the damper to decrease air flow rate. Note that air pressure may vary as the air flow rate is changed.

To get the most accurate air flow measurement, we recommend installing an air flow meter in the air piping.

If this is not possible, then an estimated air flow can be obtained by measuring the stripper pressure or vacuum. For initial start-up, simply adjust the damper until the air pressure is at least the minimum required for your system. (Refer to the pressure gauge description for minimum pressure readings).

The table below gives the minimum, recommended, and maximum required air flow rates for each ShallowTray series.

ShallowTray Model	Requirements Air Flow Minimum		Recommended	Maximum
1300 & 1300P	150 cfm	(250m³/hr)	195	225
2300 & 2300P	300 cfm	(500m³/hr)	390	450
2600	600 cfm	(1020m³/hr)	780	900
3600	900 cfm	(1530m³/hr)	1170	1350
31200	1800 cfm	(3060m³/hr)	2340	2700
41200	2400 cfm	(4080m³/hr)	3120	3600

Beware when making damper adjustments after initial start-up. Fouling may occur in the system which may reduce the air flow rate, and may increase the air pressure reading.

Demister

A wire mesh mist eliminator pad is installed beneath the air exhaust port, located on the top cover of the unit. The purpose of the mist eliminator pad is to remove water droplets that would have blown through the vent line. It is possible, though unlikely, that the mist eliminator pad may become plugged or fouled. If this occurs the mist eliminator pad is easily removed for cleaning. Disconnect the vent line, take off the top cover, and remove the retaining plates on the bottom side of the cover. The mist eliminator pad can be cleaned with a pressure washer, or replaced with a new one.

Gasket

A black nitrile (or neoprene on the 2300P) sponge gasket is used to form an airtight/watertight seal around the sump tank and stripper trays. If there are any problems with the gaskets, please contact North East Environmental Products. A replacement gasket can be glued to the sealing flange using an industrial contact adhesive. We recommend using Rubatex adhesive # R-27780. Please contact North East Environmental Products prior to making any gasket repairs or adjustments.

Sight Tube

The sight tube provides a means of easily viewing the water level in the sump tank. Make sure the valve to the sight tube is open during stripper operation.

Spray Nozzle

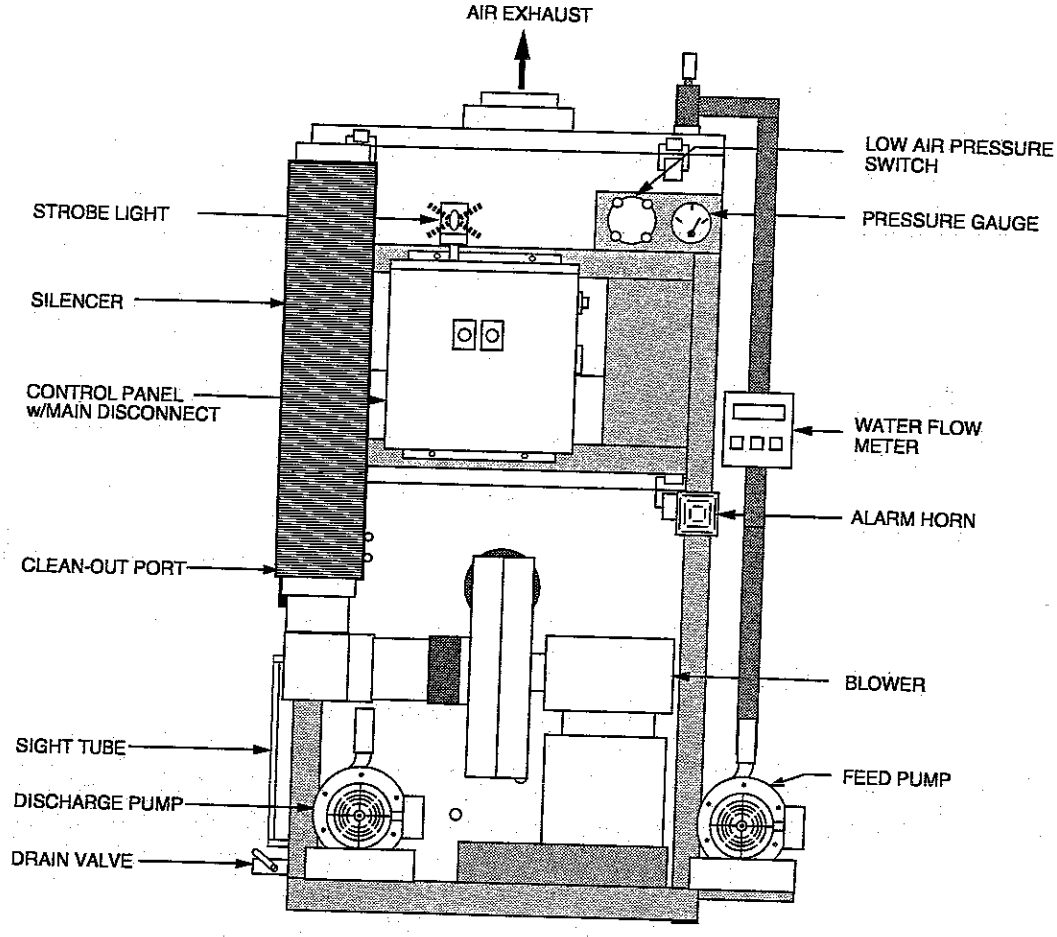
A spray nozzle is installed in all units except those with a gravity feed option. The nozzle directs the contaminated water to the first inlet chamber and begins the volatilization process. The nozzle is typically rated for 15 psig at the system's maximum water flow rate.

It is recommended that a strainer be installed somewhere in the inlet process water line, especially during initial start-up, to prevent sediment from plugging the nozzle.

If the nozzle becomes plugged, it is easily removed by first removing the top cover and then unscrewing the nozzle from the inlet piping. Clean it with a wire brush or a pipe cleaner. If the nozzle causes too much back pressure or becomes plugged too often, it can be removed without any serious effects on the system's performance. Units that have a gravity feed system should not use a spray nozzle – it causes too much back pressure. In these cases, the inlet piping should extend below the water level of the inlet chamber to provide a water seal.

Note: System performance is based on ShallowTray operation without a nozzle, and warranty is valid whether a nozzle is installed or not.

ShallowTray System Options



2331 STAINLESS PRESSURE SYSTEM WITH OPTIONS

NOT ALL OPTIONS SHOWN

SHALLOWTRAY OPTIONS

ShallowTray System Options

ShallowTray low profile air strippers are custom built to meet site and project specifications. Please refer to the components list insert (Section 1) to see which options were selected for your system. Component information cutsheets are included in Section 7 of this manual.

Air Blower Silencer

The air blower silencer reduces the dynamic noise level of the blower. The size of the silencer and the type of connection used to mount are dictated by the size of the blower, and whether the silencer is mounted horizontally or vertically. Silencers should be supported to avoid over-stressing the connections, and should be secured if exposed to high wind loads.

Air Flow Meter

The air flow meter measures the amount of air flowing through the system. It consists of a pitot tube mounted in the air line and a differential pressure gauge. The measured velocity pressure is then converted to an air flow rate. The pitot tube must be located at least 8½ pipe diameters of straight pipe after any pipe fitting or transition, and at least 1½ diameters of straight pipe before the end of the pipe or any elbow. The best pitot tube location is before the stripper because the air is less humid and the gauge hose is less likely to fill with condensate.

The air flow meter typically gives readings in inches of water column (W.C.), which is then converted to feet per minute (FPM) using the provided chart. You then multiply the feet per minute by the interior cross sectional area (square feet) of the vent line. This gives cubic feet per minute (CFM). As stated in the damper section, the air flow meter in conjunction with the pressure gauge provides the most accurate damper adjustments, especially after initial start-up.

The table below lists the minimum, recommended, and maximum flows for each stripper model, and the minimum exhaust pipe diameters. Note that the airflow must be at least the minimum for proper stripping efficiency.

Stripper Model	Minimum	Required Air Flow Recommended	Max.	Recommended Exhaust Pipe Diameter
1300	150 cfm (250m³/hr)	195 cfm (330m³/hr)	300 cfm (510m³/hr)	6 in.(16cm)
2300	300 cfm (510m³/hr)	390 cfm (660m³/hr)	600 cfm (1020m³/hr)	6 in.(16cm)
2600	600 cfm (1020m³/hr)	780 cfm (1320m³/hr)	1200 cfm (2040m³/hr)	8 in.(20cm)
3600	900 cfm (1530m³/hr)	1170 cfm (1990m³/hr)	1350 cfm (2290m³/hr)	10 in.(25cm)
31200	1800 cfm (3060m³/hr)	2340 cfm (3980m³/hr)	2700 cfm (4590m³/hr)	16 in.(40cm)
41200	2400 cfm (4080m³/hr)	3210 cfm (5450m³/hr)	3600 cfm (6120m³/hr)	18 in.(45cm)

Note: Low airflow is the most common reason for poor removal efficiencies. Thus, an airflow meter is highly recommended to help ensure adequate air flow.

Air Pressure Gauge

The air pressure gauge reads the pressure differential in inches of water column (W.C.) between the point of highest pressure in the air stripper and the atmosphere. The gauge is connected to the system via an air hose that attaches to a pressure port on the system. Instructions to connect the gauge for the two types of systems are as follows:

Pressure System – Using tubing, connect the "High" pressure port on the gauge to the 1/8" (3mm) shutoff valve/hose barb located on the air stripper sump tank. The matching "Low" pressure port is to be open to the atmosphere. Highest pressure is in the sump tank.

Vacuum System – Using tubing, connect the "Low" pressure port on the gauge to the hose barb located on the exhaust vent line of the air stripper. The matching "High" pressure port is to be open to the atmosphere. Highest vacuum is in the cover air exhaust pipe.

Note: There are two pairs of pressure ports on the gauge. One pair should be used to measure the differential pressure, and the other set must be plugged.

At initial start-up, the pressure gauge can be used to make proper blower damper adjustments. Adjustments should be made according to the following nominal air pressure/vacuum table:

	Nominal Air Pressure/Vacuum	
Number of trays	**Low Water Flow System**	**High Water Flow System**
1 tray system	4 - 6 inches W.C. (10 - 15cm)	7 - 10 inches W.C. (18 - 25cm)
2 tray system	7 - 10 inches W.C. (18 - 25cm)	11 - 14 inches W.C. (28 - 36cm)
3 tray system	11 - 14 inches W.C. (28 - 36cm)	16 - 18 inches W.C. (40 - 46cm)
4 tray system	16 - 18 inches W.C. (40 - 46cm)	20 - 22 inches W.C. (50 - 56cm)
5 tray system	20 - 22 inches W.C. (50 - 56cm)	24 - 26 inches W.C. (60 - 66cm)

Note: The nominal pressures or vacuums shown are for the air stripper only, and do not include additional air stream equipment pressure requirements. Fouling may occur in the system, which may increase the nominal air pressure reading, and may decrease the air flow rate.

Control Panel

The control panel serves two basic functions required for the safe operation of the system. The first is to provide the required electrical safety components for each motor (blowers and pumps) per NEC standards. These components consist of fuses, motor starters, and overload relays.

The second function is to provide the required process control and alarm components. The alarm circuit monitors the low air pressure switch and the high water level alarm switch. If either of these alarms occur, then the alarm contacts will shut off the incoming water source (feed or well pumps) if the appropriate connections have been made. Other alarm options are also available.

Control Panel Intrinsically Safe Components

ShallowTray low profile air stripper systems that operate in or near potentially explosive concentrations of vapors may require intrinsically safe (IS) signals to all electrical components housed in non-explosion proof enclosures. The IS signal is not capable of creating a spark or a temperature rise great enough to ignite any concentration of any NEC classified explosive vapor. Typical components that need IS signals are the float switches and well probes. Determination of when IS signals are required is generally the responsibility of the groundwater remediation engineer who is specifying a system.

Digital Water Flow Indicator

The digital water flow indicator, typically installed in the water feed piping to the stripper, reads the rate of flow (gpm) and the totalized flow (gallons). The flow meter is selected to exceed the maximum flow of your system while providing a wide working range. The digital face plate is battery operated and intrinsically safe (typically Halliburton brand). The only moving meter component is the turbine rotor, which spins around a shaft axial to the flow of water.

It is possible to plug the turbine rotor with particles and sediment. An ⅛" (3mm) screen filter should be installed somewhere in the incoming process water line prior to the meter. If the meter becomes plugged it can be disassembled and cleaned. Please disassemble per the manufacturer's instructions, if necessary.

Feed and Discharge Pumps

The pumps on each system have been selected by our engineering staff to meet the appropriate flow and pressure requirements. The pumps are typically cast iron and bronze, with either EXP or TEFC motors. The pumps are not self-priming. Prior to initial start-up, the pumps must be primed by filling the pump impeller housing with clean water. Throttle valves are typically installed on the discharge lines. If the pump is running wide open and it is not pumping against the required head, the pump may cavitate. This is the nature of centrifugal pumps; they must be throttled back if they are not pumping against the required head. Also, the valve should be throttled back until the motor draws less than the nameplate amps current rating.

If the pump is wired by someone other than North East Environmental Products, please **double check the rotation**. A pump rotating in the wrong direction could cause the pump impeller to spin off, causing serious damage to the pump.

Systems using pumps should have the flow rates tuned so that the discharge flow rate is greater than the inlet flow rate. This will prevent blower flooding.

High Water Level Float Alarm Switch

The high water level float alarm switch is one of the alarm interlocks that must be properly connected, by a licensed electrician, prior to the system's initial start-up. Please see *Special Cautions* at the beginning of Operating Instructions section for more information. The purpose of the high water level float alarm switch is to prevent water from flooding the system. It does this by shutting off the incoming contaminated water once clean water has reached a designated level in the sump tank. The high water level float switch will send an alarm signal when it rises approximately 3½ inches (9cm) above the coupling it is installed in.

Line Sampling Ports

The line sampling ports provide a quick and easy way to take water samples of both incoming contaminated water and outgoing clean water. The sampling ports are the typically ½" (1cm) ball valves located on both the inlet and outlet piping.

When taking a water sample, open the valve and let the water flow for at least 1 minute prior to bottling the sample. This purges the sample port of any stagnant water.

When purging the sample ports be sure to capture the water and properly dispose of it. When starting the unit for the first time double check that the valves on the sample ports are closed.

Low Air Pressure/Vacuum Alarm Switch

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

Should the blower fail, the low air pressure switch should be wired to shut off all incoming water. Using tubing, connect the switch to the hose barb on the tank (pressure system) or in the cover exhaust pipe (vacuum system).

Pressure system – The air hose is connected from the sump tank ⅛" (3mm) hose barb (without valve) to the "high" pressure port on the switch using the provided hose barb. The "low" pressure port must be open to the atmosphere. The switch measures the differential pressure between the sump tank and the atmosphere.

Vacuum system – The air hose is connected from the exhaust piping ⅛" (3mm) hose barb to the "low" pressure port on the switch using the provided hose barb. The "high" pressure port must be open to the atmosphere.The switch measures the differential pressure between the top tray and the atmosphere.

Periodically inspect the air hose for water build-up which will affect the switch's operation. The tubing must remain open at all times.

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

High Air Pressure/Vacuum Alarm Switch

The high air pressure/vacuum alarm switch prevents the system from exceeding its highest rated pressure/vacuum value. If the blower has the ability to produce pressure/vacuum higher than 32 inches (82cm) W.C. for stainless units or 26 inches (56cm) W.C. for plastic units then it should have a high pressure/vacuum alarm switch. Be sure to check that the setpoint for alarm shutdown is at the proper setting for the system.

Main Disconnect Switch

The main disconnect switch removes power from the ShallowTray low profile air stripper. A disconnect is required by the National Electric Code (NEC) and must be installed. North East Environmental Product's panels typically contain a disconnect integral with the control panel to remove power, but may also use disconnects external to the control panel depending on the situation. Make sure a qualified licensed electrician installs the power line into the disconnect switch. Be sure to ground the switch to the main service ground.

Water Temperature Gauge

Water temperature gauges can be installed on both the inlet and outlet piping. Influent water temperature is an important variable affecting the system's removal efficiency.

Water Pressure Gauge

Water pressure gauges can be installed on both the inlet and outlet water piping. Excessively high readings could signal that something in the piping system is plugged. Large pressure fluctuations could be a sign that the water flow rate is varying.

Special Cautions!

The following operations must be carried out prior to initial system start-up:

Step 1

Connect the Interlock Switches.

1. To avoid damaging the blower and flooding the equipment with contaminated feed water, install the high water level and low air pressure/vacuum interlock switches.

It is important that a qualified licensed electrician perform these installations.

High water level interlock

If the water level in the sump tank rises beyond the maximum level, it could flood the blower. This may damage the blower and void the warranty. The high water level interlock switch will also shut off the feed water pump in an emergency situation.

Low Air Pressure/ Vacuum Interlock

If the blower fails, untreated water could flow directly to the discharge line. The low air pressure/vacuum interlock switch will shut off the feed water pump to prevent this from occurring.

High Air Pressure/ Vacuum Interlock

If a system has a blower capable of producing more than 32 inches (82cm) W.C. for stainless units or 26 inches (56cm) W.C. for polyethylene units then it requires a high pressure/vacuum switch. If a unit fouls or pressure increases due to off-gas treatment, it may exceed the maximum pressure rating of the system and cause damage to the gaskets, sump, or trays.

Note: These recommended interlock options might not have been provided as part of North East Environmental Product's scope of supply.

Step 2

Fill the Sump Tank and each tray's Inlet Chamber.

On initial start-up, the sump tank must be filled with **clean water** to a height of about 5 inches (13cm). Make sure the valve to the sight tube is open. The sump tank can be filled via the clean-out ports on the end of the stainless units, or through the inlet water port located on the cover. The inlet chamber on each tray (referred to as seal pots) can be filled manually by pouring **clean water** through the 1 inch (3cm) inlet chamber filling ports or the 4 inches (10cm) clean out ports located on the ends of the stainless units, or by disassembling the plastic units and filling the seal pots as you reassemble. The seal pots on both the plastic and stainless systems can also be filled at initial start-up by connecting a **clean water** line to the inlet water port and running the system for ten minutes with the blower on and the damper 1/4 open. For complete instructions on this method, please follow initial Start-up procedures later in this section.

Do Not Run Free-Product Through the ShallowTray Air Stripper.

Free product will contaminate the unit by coating the sidewalls with a film of free-product. ShallowTray units are designed to remove dissolved VOCs only.

Always provide fresh, clean air for the system air intake. Air that is heavily contaminated with VOC's will significantly reduce the Shallow Tray's performance.

Equipment Set-up

Drawings

Drawings referred to in the following sections are located in Section 6.

Please follow codes.

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

Protect critical items from the environment.

In areas that could be below freezing, the stripper should be installed in a heated building. Plastic units, control panels, and motors should be protected from direct sun. Explosion proof motors should be protected from rain due to the absence of motor gaskets.

Install adequate supports.

Since **none** of the external piping associated with the ShallowTray unit is designed to support process water lines or air piping, adequate supports must be installed.

Assemble Unit.

All ShallowTray units are assembled and hydraulically tested at the factory. However, to safeguard the units from shipping damage, some components are removed prior to shipping and will require re-assembling. Follow all relevent steps in this section to properly set-up your ShallowTray unit.

Check for loose fittings.

Shipping your system to the site may have caused piping joints or assembly hardware to loosen. Please re-tighten as necessary.

Step 1

Bolt your unit together.

For shipping purposes, the ShallowTray unit may come in two sections; the blower frame assembly and the sump and tray assembly. Bolt the base frames together using the bolts and spacers provided. (This step is done at the factory for the 1300 and 2300 series.)

Step 2

Connect Blower.

For positive pressure systems install the rubber coupling provided from the blower outlet to the air inlet nozzle on the sump tank. (See Section 6 coupling layout drawing for air inlet nozzle location.) For vacuum systems, install a vent line from the stripper air exhaust located on the top cover to the blower intake. North East Environmental Products may not have provided this piping. Make sure the

pipe diameter is large enough to maintain the required air flow without adding a pressure drop, and be sure the pipe has a suitable vacuum rating to prevent collapse.

Caution: Blower must draw clean air. Do not vent storage tanks that contain substances that will contaminate the air in the same room the blower draws air from. Do not duct intake air from an area that has contaminated air. Contaminated air will contaminate the water.

Step 3

Assemble trays and level the ShallowTray unit.

Some of the larger units may have the top tray and cover shipped separately. Install trays shipped separately by lining up the arrows and numbers on the trays and cover. To prevent damaging the gasket, do not drag the trays or cover across the gasket during assembly. Fasten all latches properly. The tray being installed must have the downcomer line up with the sealpot on the tray below it. Check all the trays to make sure they are installed correctly, and not backwards. If the system is not set up properly the water could bypass a tray allowing water to miss a large portion of the treatment path. Refer to the "base subassembly" exploded view drawing in Section 6.

Level the ShallowTray unit. This is a critical step in the proper assembly of the equipment. If not level, the water depth on the trays will be uneven, causing the water to seep through the tray holes untreated.

Step 4

For a gravity discharge unit

Install the outlet pipe.

For a gravity discharge unit (no discharge pump): Refer to the Section 6 outlet piping drawings to assemble the plumbing components, which are typically shipped in a separate carton. Positive pressure systems require a riser pipe to compensate for the pressure generated by the blower. It is important that the riser pipe height is adjusted to create a 5 inch (13cm) water depth in the sump tank during normal operating conditions. The provided vacuum relief valve must be installed to prevent the sump from siphoning below the 5 inch depth.

It is essential that the riser pipe be mounted in the vertical direction, and that it be properly supported.

Note: Some systems have an internal trap. Please refer to the plumbing drawing.

The purpose of having the 5 inch (13cm) water depth in the sump tank is twofold. First, it is to keep the downcomer (from the bottom tray) and the water discharge port (which elbows down internally) submerged. Both are set to a height of 2 inches (5cm) from the bottom of the sump. Keeping them submerged forms a water seal which prevents air from escaping up the downcomer pipe or out the discharge trap.

Second, the 5 inch (13cm) depth is low enough to allow our high water level switch to reset. The switch, located in its typical position, has an approximate reset deadband of six inches, meaning the water level must drop 6 inches (15cm) below the alarm trip point before it resets. Consult with North East Environmental Products for additional options or questions about float switch location or normal operating water depth.

Use proper pipe sealant and PVC cement when needed. We recommend running the system and adjusting the riser pipe before permanently bonding the fitting.

Caution: The vertical height of the trap should create a 5 inch (13cm) water depth in the sump tank during normal operating conditions. Depths lower than 5 inches (13cm) may allow air to escape through the water discharge line or up through the downcomer. This may result in untreated water falling into the sump tank.

Step 5

For a unit with a discharge pump

Install the outlet pipe.

For a pumped discharge unit: Refer to the Section 6 outlet piping drawing to assemble the water line from the sump tank to the pump suction, using components supplied in a separate carton.

Install outlet piping to the pump's discharge port. A ball valve is typically provided and should be used to adjust flow and prevent the pump from cavitating. Use proper pipe sealant and PVC cement when needed. To reduce pressure losses, it is recommended that the connected pipe size remain at least as large as the fitting provided.

Prime the pump. Pour clean water in the pump's inlet port until it has filled the entire pump chamber. A check valve is supplied to keep the pump primed. Remove the top air bleed plug on the pump housing to let air bleed out, then replace plug tightly.

Step 6

Install the inlet piping manifold.

Install the inlet piping manifold (typically shipped in a separate carton). Follow the Section 6 inlet piping diagram for proper installation. The spray nozzles are installed on the inside of the cover, or may have been shipped separately. The nozzles are typically selected to produce a 15 psig pressure drop at the highest anticipated water flow rate.

During start-up, a strainer should be installed in the water inlet line to prevent the spray nozzle and process water line components from plugging with sand and sediment. If necessary, the strainer can be permanently installed.

Use proper pipe sealant and PVC cement when needed.

Caution: For all systems other than 31200 and 41200, there are two inlet port locations on the cover; one is plugged, the other is used. The 31200 and 41200 series, have three and four ports respectively, and all are used. *You must use the port located above the sealpot of the top tray.* Otherwise contaminated water will bypass the treatment path of the first tray and fall directly into the downcomer to the next tray. This will result in poor removal efficiency.

Step 7

Install the sump drain valve and the sight tube.

Install the sump drain valve and the sight tube. Refer to the Section 6 coupling layout drawing for port locations. Be sure to open the valve to the sight tube during start-up and operation. The valve should be closed only to replace a damaged sight tube.

Step 8

Connect the water lines.

If the seal pots have not yet been filled with *clean water*, connect a *clean water* line to the inlet port or piping manifold and fill the seal pots according to the steps outlined in the initial start-up section.

If the seal pots are filled with clean water, connect the process water line to the inlet piping manifold.

Connect the discharge water line.

Firmly support the process water lines to prevent stress on the piping and ports. **The system is not designed to support the weight of the process water lines.**

Use proper pipe sealant and PVC cement when needed.

Step 9

Connect the tubing.

Connect the tubing from the ShallowTray to the optional low air pressure/ vacuum switch, optional high air pressure/vacuum switch, and the optional pressure/vacuum gauge. Read the component descriptions on each for detailed connection information, and also refer to the Section 6 drawings. For the air pressure gauge, be sure to install the tubing to the 1/8" (3mm) shutoff valve. Open the valve only when a reading is required. This will reduce condensation build-up in the gauge. The air pressure switch tubing should always be open for continuous sensing. The switch is designed to drain excess condensation.

Step 10

Connect the air discharge line.

Connect an air vent line on the top of the unit.

Caution: Do not use a vent line with a smaller diameter than the air exhaust port. A smaller diameter may cause a pressure drop larger than the blower was designed for, resulting in low air flow and poor removal efficiency.

Connect the air vent line to the exhaust port using the flexible rubber coupling provided. Support the vent line independently of the air stripper so that it can be easily disconnected when the cover is removed for maintenance purposes.

Step 11

Wire the electrical components.

Have a qualified licensed electrician wire the electrical components in compliance with local, state, and national codes.

Make sure the safety interlocks, described in the Special Cautions section, are connected properly!

(If North East Environmental Products is supplying your control panel, see Section 6 wiring diagrams.)

Step 12

Install optional items.

Air flow meter

Mount the pitot tube on the vent line per Dwyer bulletin # H-11 (located in the separate shipping box) or per the Section 6 air flow meter assembly drawings using the mounting hardware provided. Connect pitot tube to the 0-0.5 or 0-1.0 inches W.C. air pressure gauge using the tubing provided. (See pitot tube mounting diagram in Section 6.) There are two air hoses required, one connects to the high pressure port on the gauge and on the pitot tube, and measures internal static pressure plus velocity pressure. The other connects to the low pressure ports on the gauge and on the pitot tube, and measures the internal static pressure only. The optimum pitot tube location is before the stripper, because the air is less humid and the tubing will be less prone to filling with condensate.

Air blower silencer

Pressure systems – Install the silencer on the inlet side of the blower.

If the silencer is to be in the vertical position, install the piping and elbow as shown on the Section 6 silencer diagram.

If the silencer is in the horizontal position, attach it directly to the blower inlet using a rubber coupling.

Vacuum systems – Install the silencer on the blower. The standard silencer's maximum pressure/vacuum rating is 20 inches (50cm) W.C. Be sure not to exceed the silencer's limit.

Water flow meter

Install the water flow meter into the inlet piping per the Section 6 water inlet piping diagrams.

The flow meter owner's manual was sent with the unit. Be sure to refer to it when installing the meter.

Please install an 1/8" (3mm) strainer in the incoming process water line prior to the water flow meter. This will prevent rotor jamming.

Note: There may be other optional equipment that requires installation or assembly. Please refer to the Section 6 specification sheet and drawings for more information.

Initial Start Up

Upon completion of the equipment set-up and mechanical/electrical installation, proceed with the following steps:

Step 1

Check all connections, and close drain and sample valves.

Double check that all electrical, water, and vent connections are properly made. Close drain and sample valves.

Note: Be sure that the sight tube valve is open.

Step 2

With other switches 'OFF', turn 'ON' the main power disconnect switch.

Turn all panel control switches to the 'OFF' position, then turn 'ON' the main power disconnect switch.

Note: Turn all panel control switches to the 'OFF' position before applying power. Systems with intermittent operation will show an alarm condition (low air pressure) five seconds after power is applied because the blower is not operating. Once the blower is supplying proper pressure, the alarm low air pressure condition will reset. Some systems may require pushing an 'Alarm Reset' button.

Step 3

Check the blower rotation.

Check the blower rotation by momentarily switching 'ON' (bumping) the blower switch and observing whether the blades turn in the direction of the arrow on the blower casing. You can also observe the motor's cooling fan blades for proper rotation.

Note: If system panel has the intermittent operation feature, the blower motor must be bumped in the 'HAND' position. Refer to the Routine Operation Section for a description of "intermittent operation".

Step 4

Attach clean water line to the inlet.

If you did not fill the seal pots on each tray manually, please fill them now by attaching a (clean) water line to the water inlet piping manifold or port, and then follow Step 5.

If you have filled the seal pots manually, please skip Step 5 and go to Step 6.

Step 5

Fill the seal pots (inlet chamber) with clean water.

***Special Caution*: Make sure to use *clean water* when filling the seal pots. If contaminated water is used it will go through the system untreated.**

To fill the seal pots (inlet chambers), set the blower damper to ¼ open, and start the blower and the clean water flow to the unit. Let the blower and clean water run for about five to ten minutes, then shut them off. Setting the damper at ¼ open reduces the air flow enough to allow the water to flow through the downcomers and into the seal pots.

Note: If your system has the intermittent operation feature, you must start the blower in the 'HAND' position for this procedure.

If you have trouble filling the seal pots by this method you can fill them manually, either by using the one inch sealpot filling ports (if provided), or by spraying a stream of clean water through the clean-out ports (not provided on plastic systems). The stream of water must be directed into the sealpot on the far side of the unit, until the sealpot is full.

For plastic systems and older model stainless systems, you must remove the trays and fill the sealpots manually.

Step 6

Connect contaminated feed water line.

Connect contaminated feed line. Install all piping to allow for future removal for maintenance or repair. Make sure it is supported independently of the ShallowTray. Start system with the blower damper ½ open.

Note: For systems with intermittent operation, you must turn 'OFF' the power at the main disconnect, turn all control switches to the auto position, and then reapply main power. All motors will start automatically based on control functions.

Note: Each control panel is custom designed for each site. Become familiar with the panel logic and proper operation before attempting to start the system. The panel might have been provided by a panel manufacturer other than North East Environmental Products.

Step 7

Check the air pressure readings and set damper.

Run the unit for 5 minutes, and then adjust the blower damper setting to produce the required air pressure/vacuum reading on the pressure gauge. Since the blowers provided by NEEP are selected and tested to exceed the minimum flow requirements of the system, you can use the following table to set the damper during initial start-up.

	Nominal Air Pressure/Vacuum	
Number of trays	**Low Water Flow System**	**High Water Flow System**
1 tray system	4 - 6 inches W.C. (10 - 15cm)	7 - 10 inches W.C. (18 - 25cm)
2 tray system	7 - 10 inches W.C. (18 - 25cm)	11 - 14 inches W.C. (28 - 36cm)
3 tray system	11 - 14 inches W.C. (28 - 36cm)	16 - 18 inches W.C. (40 - 46cm)
4 tray system	16 - 18 inches W.C. (40 - 46cm)	20 - 22 inches W.C. (50 - 56cm)
5 tray system	20 - 22 inches W.C. (50 - 56cm)	24 - 26 inches W.C. (60 - 66cm)

Note: Double check pressure reading after system has been running for about ½ hour. Adjust damper again if needed. Also check the airflow meter for proper airflow rate.

Pressure readings may vary somewhat depending on your venting system. See the components list in Section 1 for the minimum air flow requirements for your system.

The system is ready for operation.

The system is now ready for normal operation. It is not necessary to perform initial start-up procedures each time the system is shut down.

However, note that anytime water is completely removed from the seal pots or sump tank, the initial start-up procedure must be done again. For example, after the system has been taken apart for cleaning, or after an extended shutdown where the water may have evaporated from the tank or seal pots.

Routine Operation

Air Flow

The table below lists the minimum, recommended, and maximum airflow for each stripper model and the minimum exhaust pipe diameters.

Note: The airflow must be at least the minimum shown for proper stripping efficiency.

Stripper Model	Minimum	Required Air Flow Recommended	Maximum	Minimum Air Pipe Diameter
1300	150 cfm	195 cfm	300 cfm	6 in. (15cm)
2300	300 cfm	390 cfm	600 cfm	6 in. (15cm)
2600	600 cfm	780 cfm	1200 cfm	8 in. (20cm)
3600	900 cfm	1170 cfm	1350 cfm	10 in. (25cm)
31200	1800 cfm	2340 cfm	2700 cfm	16 in. (40cm)
41200	2400 cfm	3210 cfm	3600 cfm	18 in. (46cm)

Adjust water flow rate by setting the water throttle valves.

Now that the system has been primed per the initial start-up procedures, it is ready for fine tuning. Adjust throttle valves on inlet and outlet piping to obtain the desired water flow rates. Refer to the Section 6 specification sheet for your system's design and maximum water flow rates. To prevent a high water level alarm, it is critical that the discharge pump flow rate exceed the influent water flow rate.

Pumps provided by NEEP have throttle valves on the discharge side of the pump. Once the desired water flow rate is achieved, check the amp draw of the motor.
It must not exceed the pump nameplate amp draw. If the pump is cavitating, it is not pumping against the required head, and should be throttled back.

Alarm switches

High water level switch – The switch is typically installed in the middle of three half inch switch ports located on the front of the unit (refer to the Section 6 coupling layout drawings). If more sump capacity is required, the high level float switch can be moved to the top port location.

Caution: If the float is moved to the higher port and the discharge line plugs or the discharge pump fails, the water level could rise above the air inlet port, allowing water to drain into the blower housing or onto the floor. The blower may become damaged if it is running while water is in the blower housing. Be sure to check that the 1/8" (3mm) hole in the bottom of the blower housing is open to allow for drainage of water that may get into the housing.

Intermittent Operation

If continuous blower operation is a concern, ShallowTray low profile air stripper systems can be designed to run intermittently. When the feed water is flowing into the system, the blower will be in operation and the outlet pump (if provided) will maintain proper sump tank levels. When the feed water is shut down, the blower will run for an additional five minutes to treat the water already in the trays, then it will also shut down. When the feed water is restored, the blower will automatically start up to treat the new batch of water.

If there is an alarm condition that lasts longer than five minutes the blower will shut down and the alarm circuit light will remain on. Once the blower shuts off, the system will sense a low air pressure condition. To reset the alarm circuit or light once the blower has shut off, you must disconnect power at the main disconnect. Some systems may also have a "reset" push button on the control panel door.

System Shut Down

Shut feed water off.

Shut off the water feed to the system.

Wait 5 minutes, then shut off the blower.

Wait 5 minutes to allow the water in the stripper trays to be completely treated, then shut off the blower. Treated water in the trays will drain into the sump tank, so it is important to keep the outlet pump in "auto" to remove this extra water.

Shut main power off.

Shut off the power at the main disconnect switch if the shutdown is more than temporary.

Caution: If proper shut down procedures are not followed, contaminated water will drain into the sump tank. This will contaminate the water that has been collected in the tank. Therefore, always allow the blower to run an additional 5 minutes after the feed water is shut-off.

MAINTENANCE

Equipment Maintenance Instructions

Cleaning Instructions

Minerals dissolved in high concentrations tend to precipitate out of groundwater during air stripping processes. These minerals form insoluble deposits commonly referred to as 'fouling.' Although the ShallowTray low profile air stripper system is designed to be fouling resistant, proper steps must be taken when treating water with high mineral concentrations. Deposits from iron-rich feed water can be reduced by pre-treating it with **sequestering agents.** For more information, please call Remede Products, Inc., 802-365-7200. The recommended cleaning procedure is pressure washing. Please follow the detailed instructions in this section.

Equipment Required

Pressure Washer

2 gpm minimum flow at 900 psig minimum. Equipment rental companies can usually supply such a unit on a daily rental basis.

Washer Wand

Washer wand with spray nozzle, (obtainable from North East Environmental Products as an option) and an adapter to connect the wand to the pressure washer hose end. All washer wand connections are ¼" (6mm) NPT.

Clean Water Supply

Clean water supply with a capacity of at least 2 gpm at 20 psig. Connect to the pressure washer using an ordinary garden hose.

Cleaning the Unit

Step 1

Turn off equipment.

Turn off the feed water to the stripper.

Step 2

Provide for waste disposal.

Make provisions for disposing of the sludge and waste generated during cleaning. A wet/dry vacuum may be required, or possibly the outlet pump (if provided) can pump out to a storage tank. Be aware that large pieces of debris might possibly clog the outlet pump or check valve.

Step 3

Remove cleanout port covers.

Remove all cleanout port covers.

Step 4

Turn on water and pressure washer.

Turn on the water supply to the pressure washer. Then, turn on the pressure washer. Wear protective goggles or face shield while spraying.

Step 5

Insert wand and start pressure washer water flow.

Insert the wand all the way into the 8" (20cm) cleanout port on the sump tank. Have the spray nozzle pointed up toward the bottom of the lowest tray. Holding the wand tightly, pull the trigger to start the pressurized water flow. Expect the wand to kick back as flow starts.

Step 6

Move wand side to side.

Move the wand side to side at a rate of about 1 inch (3cm) per second. Be sure to cover the entire tray bottom area. Recommended cleaning times for one side of one tray are given below:

Model 1300	2 min
Model 2300	4 min
Model 2600	8 min
Model 3600	12 min
Model 31200	24 min
Model 41200	32 min

Step 7

Inspect cleaned area.

Periodically stop the cleaning operation and inspect the cleaned area by shining a light into the unit. The area is clean when there are no deposits in or around the stripper tray holes.

Caution: Check the water level in the sump tank periodically, and drain it when necessary.

Step 8

Clean top side of tray.

When the bottom surface appears clean, move the wand to the top side of the same tray by inserting it in the next highest cleanout port. Continue spraying with the nozzle pointed down onto the top surface of the tray. Remove all visible deposits from the tray baffles and the walls of the unit.

Step 9

Repeat for all trays.

Repeat the procedure for the bottom of the next higher tray, etc., working up to the top tray.

Step 10

Rinse.

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

Step 11

Remove the top cover, flip it over, and wash the bottom side. Inspect spray nozzle and the wire mesh mist eliminator pad for fouling.

Clean the spray nozzle.

If the spray nozzle shows evidence of deposits, it should be removed and cleaned with a wire brush. Some systems have more than one spray nozzle.

Check the mist eliminator pad.

Clean the mist eliminator pad.

Use the pressure sprayer to remove debris, deposits, and gummy residues on the mist eliminator pad.

Replace the mist eliminator pad.

Mist eliminator pads that are excessively plugged should be replaced. The old pad is removed by loosening the retainer plates on the corners of the pad. Reinstall the new pad in the same orientation as the old one.

Caution: A competent electrician should perform any work inside the electrical control panel. Do not perform troubleshooting if you are not familiar with the procedures or the equipment.

Problem — Blower Won't Start Or Run

No power to blower

Check that all switches are in "ON" or "AUTO" position.

Position main disconnect switch to "ON" position. Turn control switches to "ON" or "AUTO."

Blown Fuse

Check to see if fuses are ok. Check fuses in main disconnect switch and in control panel.

If blown, replace with fuse of the same size and rating to avoid the risk of fire or electrical shock.

Overload relay trips

Locate reset button on blower overload relay.

Push reset button in. Reasons for tripping: incorrect line voltage, motor wired incorrectly, inadequate ventilation, worn bearings.

Tubing to air pressure switch plugged with water or debris.

Remove tubing from air pressure switch and blow into it towards tank.

Clean or replace tubing if plugged or kinked.

Blower does not rotate freely.

TURN OFF ALL power to the system. Try to spin wheel by hand. Wheel should rotate freely.

If not, call North East Environmental Products.

Problem **Outlet Pump Won't Shut Off**

Suction or discharge piping for pump is clogged.

Check water flow from discharge pipe. Piping should be clean inside. Look for narrowing caused by scale or iron accumulation.

Remove piping. Inspect, clean, or replace as necessary.

Float switch in tank is stuck in down position.

Remove 8 inch (20cm) inspection cap and check that all floats are floating on the water.

Clean all deposits from float. Replace float if necessary.

Normal Operation – Water level in sump is OK.

Pump will stop when water level reaches pre-determined height in tank.

Allow water level to decrease until pump turns off.

Let water level reach predetermined lower level, which will cause outlet pump to turn off. Water level may be just below the bottom of clear sight tube before pump shuts off – this is normal.

Problem — Outlet Pump Won't Run Or Pump Water

No power to pump

Check that all switches are in "ON" or "AUTO" position.

Position main disconnect switch to "ON" position. Turn control switches to "ON" or "AUTO."

Blown fuse.

Check to see if fuses are ok. Check fuses in main disconnect switch and in control panel.

If blown, replace with fuse of the same size and rating to avoid the risk of fire or electrical shock.

Overload relay trips.

Locate reset button on pump overload relay.

Push reset button in. Reasons for tripping: incorrect line voltage, motor wired incorrectly, inadequate ventilation, worn bearings.

Normal operation – Water level in sump is OK.

Pump will start when water level reaches predetermined height in tank.

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

Let water level reach predetermined upper level, which will cause outlet pump to turn on.

Level switch in tank is wired incorrectly in control panel.

Check wiring circuit against diagram. See that all connections are tight and no short circuits exist because of worn insulation, crossed wires, etc.

Rewire any incorrect circuits. Tighten connections, replace defective wires.

Pump does not rotate freely.

TURN OFF ALL POWER TO THE SYSTEM. Try to turn impeller by hand.

If impeller won't turn, remove housing and locate source of binding. It could be due to impeller, seal, or bearing damage, or excessive fouling.

Impeller or check valve is fouled.

TURN OFF POWER.

Remove pump outer housing and inspect impeller for blocked openings. Be sure to have a new housing gasket kit available before removing housing. Remove check valve from line and inspect for stuck or fouled valve. Clean or replace impeller or check valve as necessary.

Problem — Low Air Pressure/Vacuum In Stripper Tank

Blower damper closed.

Visually check position of damper on inlet of blower.

Open damper to get proper reading on pressure gauge. Firmly tighten damper set screw.

Motor rotation backwards.

Watch rotation of blower wheel at slow speed. It must match direction of the rotation arrow on the blower housing.

Reconnect wiring for proper rotation as per motor diagram.

Gravity discharge trap installed incorrectly.

Trap should be positioned vertically, as an "upside down U."

Install discharge trap per outlet plumbing drawings located in Section 6.

Inlet chamber (sealpot) in each tray is not full of water.

Remove "4 inch" (10cm) rubber caps or slide tray aside and look at water level in chambers.

Remove 4 inch (10cm) rubber caps on end of trays. Fill up inlet chambers with a hose. Or, follow the sealpot fill procedure as described in the Initial Start Up section.

Rubber clean out caps not in place.

All cleanout ports must have a rubber cap installed.

Tighten clamp on all rubber caps.

Tubing to pressure gauge plugged with water or debris.

Remove tubing from pressure gauge and blow into it towards tank.

Clean or replace tubing if plugged or kinked.

Unit has gravity feed, and inlet pipe on inside of ShallowTray cover is not submerged in inlet chamber water.

Remove cover and measure length of piping hanging from inside of cover. Length is to be about 10½ inches (27cm) from cover surface.

Adjust length of inlet pipe on inside of cover until total length is about 10½ inches (27cm). DO NOT INSTALL NOZZLE ON A GRAVITY FEED UNIT.

Debris blocking blower intake.

Look at blower intake screen.

Remove debris from screen.

Normal operation for automatic unit.

When inlet pump starts, the blower will start and air pressure will increase to required operational level.

No action necessary.

Problem High Pressure/Vacuum In Stripper

Air exhaust piping is restricted.

Check vent piping for bird nests or other obstructions. Check that vent pipe diameter does not decrease.

Intake or exhaust air pipe diameter must be at least as big as the cover vent or blower intake diameters.

Air holes in bottom of trays are plugged.

Remove inspection and cleanout caps and visually inspect aeration holes.

For iron fouling, clean out the unit with a pressure washer. For scaling, scrape or bang the scale from all surfaces, then use a pressure washer to open the 3/16 inch (5mm) diameter holes. Consider using a sequestering agent to prevent scaling.

Mist eliminator pad is plugged.

Remove cover from ShallowTray and inspect the bottom of the mist eliminator pad in the cover.

Remove mist eliminator pad from cover and clean. If fouled, replace with a new mist eliminator.

Problem — Water Won't Flow Into Unit

Inlet/well pump functioning properly.

Allow water level to rise in well pump, which will turn on the inlet pump and start water flow to system.

No action necessary.

Stripper Sump Tank air pressure is low. System is in alarm condition.

Read sump tank air pressure from pressure gauge. System should be in alarm condition if pressure is below about 2 inches (5cm) W.C.

Check that blower is operating properly, and has correct rotation. Check that all rubber caps are in place on end of trays.

Spray nozzle or inlet piping is plugged.

Remove cover and inspect nozzle and piping for debris and buildup.

Clean or replace clogged parts.

Problem Iron Fouling Is A Problem

Iron precipitates out of water when treated with an air stripper, causing iron build up in unit.

Remove cleanout caps and inspect inside of tray for buildup/fouling.

- Clean out unit with pressure washer on a routine basis.
- Pretreat incoming water to reduce fouling problems in stripper.
- Meter a sequestering agent into the inlet water.

Problem VOC Removal Is Less Than Expected

There are many possible reasons for poor stripper efficiency. Please review the following list of questions to determine what the problem might be.

1. Have the trays been taken apart? Are they put back together as supplied from the factory, i.e., nozzle over sealpot, downcomers from each tray underwater in the sealpot of the tray below?
2. What is the sump tank air pressure reading? Is it steady, slowly changing over time, or rapidly fluctuating?
3. What is the air flow rate through the stripper? How is it measured? Where is the sensor mounted?
4. What is the air intake and exhaust piping design (size of ducts, number of elbows, length of pipe run, GAC, heaters, other restrictions)?
5. Are sample ports installed on each tray to verify per-tray removal efficiency?
6. Is sump tank contaminated? Where are effluent samples taken from?
7. Are sample ports purged for 30 seconds-1minute before taking sample?
8. Are samples being taken, stored, and tested per approved methods?
9. Are seal pots on each tray full of water?
10. Does the sump tank have at least 4 inches (10cm) of water at all times?
11. Is the water suction elbow in the tank pointing down and always underwater?
12. What is the inlet water temperature?
13. What else is in the water besides the contaminants in question?
14. Are there occasional slugs of free product, or much higher than normal contaminant concentrations that could enter the stripper?

15. Is inlet water supplied as a continuous stream (as from an electric pump), or is the flow pulsed (as from a pneumatic pump)?
16. Are there surfactants, detergents, greases, fats, etc. in the water that are causing foaming in the stripper?
17. Is there equipment near the blower intake that could be contaminating the air?
18. Has the air entering the blower been tested for VOCs?
19. How far away from each other are the air intake and air exhaust points? Is the air intake downwind or upwind from the exhaust? Is it possible for contaminated air to be sucked back into the stripper air intake?
20. Is the blower spinning in the correct direction (top of blower wheel spinning towards tank)? Watch wheel when it is almost stopped.
21. Is there air coming out of the discharge piping?
22. Is outlet piping siphoning all water out of the sump tank, until it sucks air from tank?
23. What is the outlet plumbing design (gravity discharge, pumped discharge, uphill, downhill, other equipment in-line, size of piping, etc.)?
24. What do the bubbles look like in each tray? Install view ports to see.
25. Are the undersides of the trays free of drips and drizzles?
26. Are tray holes closed or plugged? Is there any scaling or fouling on the trays?
27. Is the system level?
28. When shutting system down, is inlet water shut off, blower allowed to operate for an additional 5 minutes, then blower shut off?

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AMERICAN FAN CO. INSTALLATION, OPERATION, AND MAINTENANCE MANUAL SM 844

This general manual has been prepared to assist you in installing and maintaining your American Fan equipment. By following the general instructions presented, you will prolong the life of the equipment, while preventing unexpected downtime.

The scope of this manual covers our standard product line and is not intended to cover specially engineered equipment.

INDEX

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DESIGNERS / MANUFACTURERS OF HIGH EFFICIENCY
INDUSTRIAL FANS / BLOWERS / DUST COLLECTORS

SECTION I

RECEIVING

All shipments are F.O.B. factory, Fairfield, Ohio. It is, therefore, in the interest of the buyer to carefully inspect all shipments before they are accepted from the freight carrier. Upon delivery, be sure that all items listed on the bill of lading and packing list (inserted in the plastic envelope attached to the shipment) have been received. Partial shipments are sometimes made.

Units are usually completely assembled except when specifications call for unit less motor. They are then skidded, boxed or crated to fully comply with rail or trucking requirements for shipment.

Accessories are sometimes shipped separately due to handling and space requirements.

Even though all equipment is carefully inspected and prepared for shipment at the factory, rough handling enroute may cause damage to fan and/or drive parts.

Any shortage, breakage or damage noticed at time of delivery should be indicated to the carrier's representative. Damage noticed after delivery should be reported to the carrier at once. Request their inspection of the shipment and fill out a concealed damage inspection report.

EXTENDED STORAGE

Units shipped to customer which will be held in storage for a period of up to two years should have special provisions so operation-readiness can be maintained. Motors should be equipped with internal space heaters kept on continuously. Units should be crated and covered with polyethylene film. In addition, impellers should be hand-rotated once a month. For best results, keep units sheltered in a cool, dry location.

HANDLING

Small units should be handled carefully and lifted only by the base, never by the shaft, coupling, motor or housing. Larger units should also be lifted by the base or by lifting eyes, if provided. Precaution should be taken to avoid dropping or jarring equipment as this can cause damage to the shaft or wheel which is not visibly noticeable, but can cause vibration problems.

INSTALLATION

Fans and motors should be mounted on structurally sound foundations. Concrete is the best, however, other types designed properly are acceptable. Equipment should be leveled on the foundation and be shimmed or grouted in place. This will prevent putting the fan structure into a bind by bolting down on an uneven surface.

As a general rule, if vibration isolators are used, the fan should first be bolted to a structural steel base and the isolation take place between the structural steel base and the foundation. This prevents the fan base from "floating" due to uneven weight distribution and/or drive forces when mounted directly to vibration isolators.

SECTION II

BEFORE START-UP

1. Fasteners - all foundation bolts, wheel hub set screws, wheel locking bolts and bearing locking collars must be tight.
2. Bearings - check bearing alignment and make certain they are properly lubricated.
3. Fan Wheel - turn over rotating assembly by hand to see that it runs free and does not bind or strike fan housing. If wheel strikes housing, the wheel may have to be moved on the shaft or the bearing pillow blocks moved and reshimmed.
4. Motor - check electrical wiring to motor. The current characteristics of the supply line must agree with the motor nameplate rating. Motor should be wired and fused in accordance with the National Electric Code and local codes.
5. V-belt drive must be in alignment with belts at proper tension.
6. Duct Connections (if required) from fan to duct work must not be distorted. Ducts should never be supported by the fan. Expansion joints between duct connections should be used where expansion is likely to occur or where fan is mounted on vibration isolators. All duct joints should be sealed to prevent air leaks. All debris should be removed from ductwork and fan.

START UP

1. "Jog" the motor to check for proper wheel rotation. The motor should be started in accordance with the manufacturer's recommendations. Arrows on fan indicate the proper direction of rotation and air flow.
2. Fan may now be brought up to speed. Watch for anything unusual such as vibration, overheating of bearings and motors, etc. Check fan speed on V-belt driven units and adjust motor sheave (on adjustable drives) to give desired RPM.
3. Check motor amperage against nameplate amperage to make sure motor is not overloading.

START-UP OF HIGH TEMPERATURE CONSTRUCTION FANS AND BLOWERS

In addition to normal start-up procedure described above, certain measures must be taken against thermal expansion deformation.

1. Fan or blower should be brought to speed between 50°F and 120°F. It may be necessary to throttle back air entering fan or blower and slowly bleeding in heated air to accomplish this. (Note: if motor horsepower is sized for high temperature operating condition and not cold start-up, throttling inlet air will be mandatory to prevent motor overloading. It is recommended motor amperage be monitored during this procedure.)
2. The maximum rate of temperature rise allowable is 15°F per minute.
3. The reverse situation of fan or blower shut-off also applies. That is, the temperature must be lowered slowly before turning fan or blower off to prevent damage.

SECTION III

GENERAL MAINTENANCE

1. A definite time schedule for inspecting all rotating parts and accessories should be established. The frequency of inspection depends on the severity of operation and the locality. Inspections might be weekly at first in order to set up the schedule.
2. Alignment - shaft must not be cocked in the bearings. Misalignment can cause overheating, wear to dust seals, bearing failure and unbalance.
3. Hardware - check tightness of all bolts and set screws.
4. Lubrication - check fan and motor bearings and add lubricant if necessary. Be careful not to overgrease as this can damage bearing seals.
5. Air flow - make sure there are no obstructions to air flow in outlet or inlet ductwork.
6. Bearings on high speed fans tend to run hot. Therefore, do not replace a bearing because it feels hot to the touch. Place a pyrometer or contact thermometer against the pillow block and check the temperature.

   Ball pillow blocks can have total running temperatures of 165°F (74°C) before the cause of overheating be investigated.
7. Wheel - inspect wheel blades for accumulation of dust and dirt. Clean thoroughly with stream of water jet, compressed air or a wire brush. This will help prevent an unbalanced condition. If blades are aluminum, be careful not to damage them. Cover the bearings so water won't enter the pillow block. The wheel should be centered to prevent the blades from striking the housing. Make sure wheel is rotating in proper direction. Never run the fan at a higher speed than it was designed for unless you check with American Fan first.

FAN BEARING MAINTENANCE

For most applications, a lithium base grease conforming to a NLGI grade 2 consistency should be used. This type of grease inhibits rust, is water resistant, and has a temperature range of -30°F to 200°F with intermittent highs of 250°F.

Because oil lubricated bearings are usually used on high-speed or high-temperature applications, refer to American Fan for the type of oil you should use in your particular application.

When greasing bearings it is important not to overgrease. This is especially true if the bearings are equipped with extended grease lines and the bearings are not visible. In this case, more bearing failures occur due to overgreasing than undergreasing. It is best to give the bearing just one "shot" of grease periodically, when the bearings are not visible. When the bearings are visible, pump in grease until a small bead of grease forms around the bearing seals. It is very important that fan bearing greasing take place while the fan is operating. Caution should be taken while working on and near rotating equipment to avoid personal injury.

When oiling oil-lubricated bearings, oil should be poured into cup at top of bearing until it reaches the overflow point at the lower oil cup.

MOTOR MAINTENANCE

Lubricate motor bearings to the manufacturer's recommendations. Lubrication recommendations are printed on tags attached to the motor. Should these tags be missing, the following will apply:

A. Fractional Horsepower Sleeve Bearing Motors:
Under normal operation at ordinary temperatures and clean surroundings, these motors will operate for three years without relubrication. Then lubricate annually with electric motor oil or SAE 10 oil. Under continuous operation at higher temperatures (but not to exceed 104°F ambient) relubricate annually.

B. Fractional Horsepower Ball Bearing Motors:
Under normal conditions, ball bearing motors will operate for five years without relubrication. Under continuous operation at higher temperatures (but not to exceed 104°F ambient) relubricate after one year. To relubricate where motors are not equipped with pressure fittings, disassemble motor and clean the bearings thoroughly. Repack each bearing one-third full with ball bearing grease.

C. Integral Horsepower Ball Bearing Motors:
Motors having pipe plugs or grease fittings should be relubricated while warm and at stand-still. Replace one pipe plug on each end shield with grease fitting. Remove other plug for grease relief. On low pressure, grease, run and lubricate until new grease appears at grease relief. Allow motor to run for ten minutes to expel excess grease. Replace pipe plugs. Motors not having pipe plugs or grease fittings can be relubricated by removing end shields, cleaning grease cavity and refilling three-fourths of circumference of cavity.

Recommended relubrication intervals-general guide only.

H.P. Range	Standard Duty 8 Hr./Day	Severe Duty 24 Hr./Day Dirty-Dusty	Extreme Duty Very Dirty High Ambients
1½-7½	5 Yrs.	3 Yrs.	9 Mos.
10-40	3 Yrs.	1 Yrs.	4 Mos.
50-150	1 Yrs.	9 Mos.	4 Mos.

These ball bearing greases or their equivalents are satisfactory for ambients from -15°F. For Motors:

Mobilplex EP#1—Socony Mobil Oil Company
Alvania Grease #2—Shell Oil Company
Andox B Grease—Esso Standard Oil Company
Prestige #42 Grease—Sun Oil Company

V-BELT DRIVE MAINTENANCE

If belts squeal at start-up, they are too loose and should be tightened. Periodically, check belt and sheave wear, alignment, and tension. When belts show wear, replace all belts at once with a new matched set of belts. New belts will not work properly in conjunction with used belts due to difference in length. Belts and sheaves should be clean and free from grease. After installing new belts, check tension midway between sheaves. Belts should deflect about 1/64" per inch of span length with approx. 20 lb. force. Allow unit to run for 4-6 hours, then it will be necessary to re-tighten belts again because new belts tend to stretch initially.

SECTION IV

PROBLEM TROUBLESHOOTING

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

1. CAPACITY OR PRESSURE RATING
   - A. Total resistance of system higher than anticipated.
   - B. Speed too low.
   - C. Dampers or variable inlet vanes not properly adjusted.
   - D. Poor fan inlet or outlet conditions.
   - E. Air leaks in system.
   - F. Damaged wheel.
   - G. Incorrect direction of rotation.
   - H. Wheel mounted backwards on shaft.

2. VIBRATION & NOISE
   - A. Misalignment of bearings, couplings, wheel, or V-belt drive.
   - B. Unstable foundation, fan bolted to uneven foundation, not shimmed or grouted.
   - C. Foreign material in fan causing unbalance.
   - D. Worn bearings.
   - E. Damaged wheel or motor.
   - F. Broken or loose bolts and set screws.
   - G. Bent shaft.
   - H. Worn coupling.
   - I. Fan wheel or driver unbalanced.
   - J. 120 cycle magnetic hum due to electrical input. Check for high or unbalanced voltage.
   - K. Fan delivering more than rated capacity.
   - L. Loose dampers or variable inlet vanes.
   - M. Speed too high or fan rotation in wrong direction.
   - N. Vibration transmitted to fan from some other source.

3. OVERHEATED BEARINGS
   - A. Too much grease.
   - B. Poor alignment.
   - C. Damaged wheel or driver.
   - D. Bent shaft.
   - E. Abnormal end thrust.
   - F. Dirt in bearings.
   - G. Excessive belt tension.

ORDERING SPARE PARTS

Contact the local American Fan representative or the factory and supply the following information:

1. Fan serial number stamped on nameplate.
2. Fan code and model stamped on nameplate.
3. Fan arrangement.
4. Description of part required.
5. Part number if part is a casting.
6. Special paints or coatings.

WHEEL—Be sure to indicate direction of rotation as viewed from drive side, type of wheel and the operating speed.

SHAFT—Length and diameter.

MOTORS—The name of the motor manufacturer and the motor model number from the motor nameplate must be supplied to the factory for repairs or replacement.

BEARINGS—The following information should be indicated when ordering various types of bearings:

ANTI-FRICTION BEARINGS
1. State whether ball or roller.
2. Manufacturer
3. Size and number
4. Fixed or floating

RECOMMENDED SPARES:
1. V-belts on V-belt driven fans
2. Fan bearings
3. Wheel (s)
4. Motor (if blower is critical to your operation.)

SECTION V

AMERICAN FAN COMPANY WARRANTY

1) "The Seller hereby warrants the equipment to be free from defects in materials and workmanship under normal use and service, the obligations hereunder being limited to making good at Seller's plant F.O.B. any part or parts thereof manufactured by Seller which shall within twelve (12) months from the date of shipment to the original purchaser be returned to Seller with transportation charges prepaid and which on examination by Seller shall disclose to Seller's satisfaction defects. This warranty shall be the only warranty by Seller covering this equipment or the parts thereof and shall be in lieu of all other warranties either expressed or implied. Buyer waives all claims for defects in material and workmanship unless said claim be made in writing and received by Seller within ten (10) days after the discovery thereof. This warranty shall cover only the cost of correcting defects in the equipment or parts thereof and Seller shall not be responsible for damages either proximate or consequential arising out of use, operation or possesion of said equipment or the parts thereof by Buyer or any other parties. The Seller shall not be responsible for work done, equipment or parts furnished or repairs made by others, for any loss or expense arising from such work, equipment parts or other repairs unless the same is done or furnished with the prior written consent and approval of the Seller. Seller shall under no circumstances be liable for the cost of raw materials used or lost in testing or experimental operations of any equipment sold or other such testing or experimentation to be done under the supervision of a representative of the Seller or of any employee or other representative of the Buyer."

2) Warranties on purchased material are limited to terms of warranty furnished by our suppliers.

3) We do not guarantee against abrasion, corrosion or erosion.

Quality design and construction features

Bezel provides flange for flush mounting in panel.

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

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

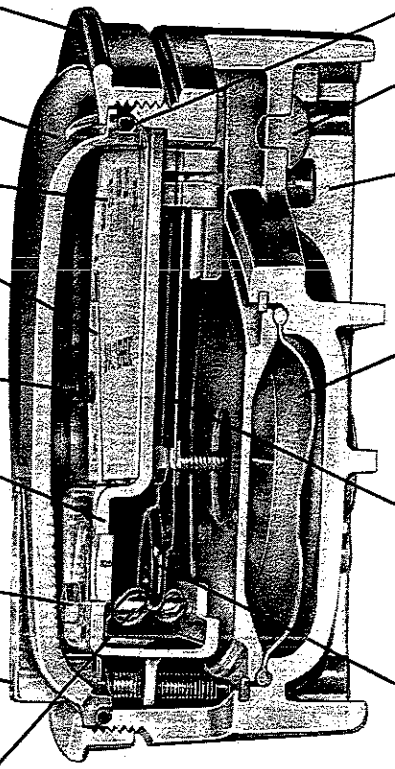
Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on helix shaft.

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

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

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

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



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

Blowout plug of silicone rubber protects against overpressure on 15 PSIG rated models. Opens at approximately 25 PSIG.

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

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

Calibrated range spring is a flat leaf of Swedish spring steel in temperature compensated design. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

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

Helix is precision milled from an alloy of high magnetic permeability, deburred and annealed in a hydrogen atmosphere for best magnetic qualities. Mounted in jeweled bearings, it turns freely to align with magnetic field of magnet to transmit pressure indication to pointer.

SERIES 2000 MAGNEHELIC® — MODELS AND RANGES

The models below will fulfill most requirements. Page 5 also shows examples of special models built for OEM customers. For special scales furnished in ounces per square inch, inches of mercury, metric units, etc., contact the factory.

Model Number	Range, Inches of Water	Minor Div.
2000-00†	0-.25	.005
2000-0†	0-.50	.01
2001	0-1.0	.02
2002	0-2.0	.05
2003	0-3.0	.10
2004	0-4.0	.10
2005	0-5.0	.10
2006	0-6.0	.20
2008	0-8.0	.20
2010	0-10	.20
2015	0-15	.50
2020	0-20	.50
2025	0-25	.50
2030	0-30	1.0
2040	0-40	1.0
2050	0-50	1.0
2060	0-60	2.0
2080	0-80	2.0
2100	0-100	2.0
2150	0-150	5.0

Model Number	Range, Zero Center Inches of Water	Minor Div.
2300-0†	.25-0-.25	.01
2301	.5-0-.5	.02
2302	1-0-1	.05
2304	2-0-2	.10
2310	5-0-5	.20
2320	10-0-10	.50
2330	15-0-15	1.0

Model Number	Range, PSI	Minor Div.
2201	0-1	.02
2202	0-2	.05
2203	0-3	.10
2204	0-4	.10
2205	0-5	.10
2210*	0-10	.20
2215*	0-15	.50
2220**	0-20	.50
2230**	0-30	1.0

*MP option standard
**HP option standard

Dual Scale Air Velocity Units

Model Number	Range, Inches of Water	Range, Air Velocity F.P.M.
2000-00AV†	0-.25	300-2000
2000-0AV†	0-.50	500-2800
2001AV	0-1.0	500-4000
2002AV	0-2.0	1000-5600
2010AV	0-10	2000-12500

For use with pitot tube

Model Number	Range, MM of Water	Minor Div.
2000-6MM†	0-6	.20
2000-10MM†	0-10	.20
2000-25MM	0-25	.50
2000-50MM	0-50	1.0
2000-80MM	0-80	2.0
2000-100MM	0-100	2.0
Zero Center Range		
2300-20MM†	10-0-10	.50

Model Number	Range, CM of Water	Minor Div.
2000-15CM	0-15	.50
2000-20CM	0-20	.50
2000-25CM	0-25	.50
2000-50CM	0-50	1.0
2000-80CM	0-80	2.0
2000-100CM	0-100	2.0
2000-150CM	0-150	5.0
2000-200CM	0-200	5.0
2000-250CM	0-250	5.0
2000-300CM	0-300	10.0
Zero Center Ranges		
2300-4CM	2-0-2	.10
2300-10CM	5-0-5	.20
2300-30CM	15-0-15	1.0

†These ranges calibrated for vertical scale position.

Model Number	Range, Pascals	Minor Div.
2000-60 Pa†	0-60	2.0
2000-125 Pa†	0-125	5.0
2000-250 Pa	0-250	5.0
2000-500 Pa	0-500	10.0
2000-750 Pa	0-750	25.0
Zero Center Ranges		
2300-250 Pa	125-0-125	5.0
2300-500 Pa	250-0-250	10.0

Model Number	Range, Kilopascals	Minor Div.
2000-1 kPa	0-1	.02
2000-1.5 kPa	0-1.5	.05
2000-2 kPa	0-2	.05
2000-3 kPa	0-3	.10
2000-4 kPa	0-4	.10
2000-5 kPa	0-5	.10
2000-8 kPa	0-8	.20
2000-10 kPa	0-10	.20
2000-15 kPa	0-15	.50
2000-20 kPa	0-20	.50
2000-25 kPa	0-25	.50
2000-30 kPa	0-30	1.0
Zero Center Ranges		
2300-1 kPa	.5-0-.5	.02
2300-3 kPa	1.5-0-1.5	.10

Suggested Specifications

A differential pressure gage for measuring (state purpose) shall be installed. Gage shall be the diaphragm-actuated dial type 4¾" O.D. with white dial, black figures and graduations and pointer zero adjustment. Gage shall be Dwyer Instruments, Inc., Magnehelic®, Catalog No. _____ reading to _____" water column, in _____" divisions.

Special Purpose Ranges

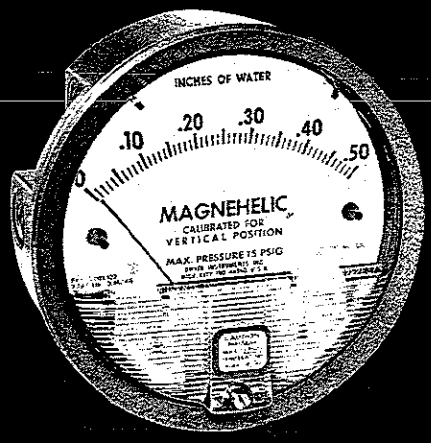
Scale No. 2401 Square Root, Specify Range

Scale No. 2402 Blank Scale, Specify Range

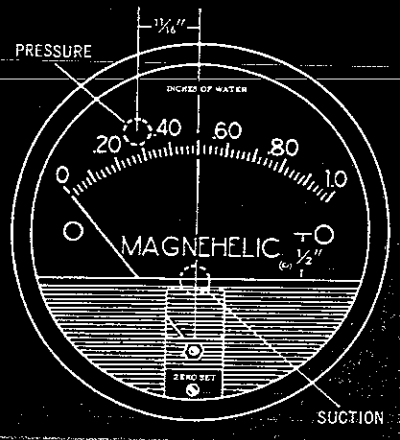
Model 2000-00N, Range — .05 to +.20" W.C. For room pressure monitoring.

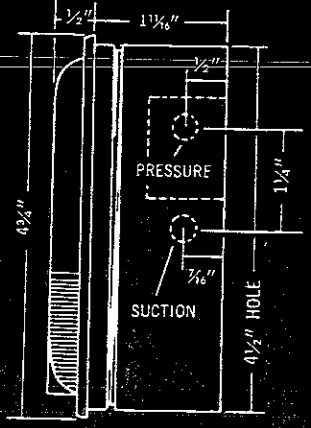
Dwyer

SERIES 2000 Magnehelic® Differential Pressure Gages



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

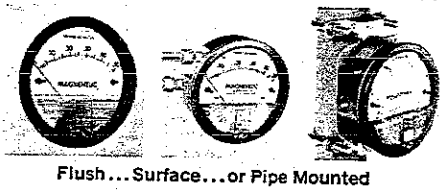




Dimensions, Standard Series 2000 Magnehelic® Pressure Gages. (Slightly different on medium and high pressure models)

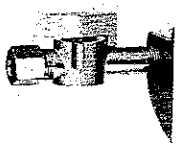
Select the Dwyer Magnehelic® gage for high accuracy – guaranteed within 2% of full scale – and for the wide choice of 81 ranges available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® movement, it quickly indicates low air or non-corrosive gas pressures – either positive,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

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



Flush... Surface... or Pipe Mounted

Mounting. A single case size is used for most ranges of Magnehelic gages. They can be flush or surface mounted with standard hardware supplied. With the optional A-610 Pipe Mounting Kit they may be conveniently installed on horizontal or vertical 1¼"-2" pipe. Although calibrated for vertical position, many ranges above 1 inch may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic gages ideal for both stationary and portable applications. A 4½" hole is required for flush panel mounting. Complete mounting and connection fittings plus instructions are furnished with each instrument.



Vent valves

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

HIGH AND MEDIUM PRESSURE MODELS

Installation is similar to standard gages except that a 4¾" hole is needed for flush mounting. The medium pressure construction is rated for internal pressures up to 35 psig and the high pressure up to 80 psig. Available in all ranges. Because of larger case, will not fit in portable case. Weight 1 lb., 10 oz. (Installation of the A-321 safety relief valve on standard Magnehelic gages often provides adequate protection against infrequent overpressure; see Bulletin S-101).

PHYSICAL DATA

Ambient temperature range: 20° to 140° F.*

Rated total pressure: −20" Hg. to 15 psig.†

Overpressure: Relief plug designed to open at 25 psig.

Connections: ⅛" NPT female high and low pressure taps, duplicated – one pair side and one pair back.

Housing: Die cast aluminum. Case and aluminum parts Iridite-dipped to withstand 168 hour salt spray test. Exterior finish is baked dark gray hammerloid.

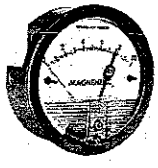
Accuracy: Plus or minus 2% of full scale (3% on −0 and 4% on −00 ranges), throughout range at 70°F.

Standard accessories: Two ⅛" NPT plugs for duplicate pressure taps, two ⅛" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws. (Mounting ring and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)

Weight: 1 lb. 2 oz.

*Low temperature models available as special option.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

OPTIONS AND ACCESSORIES

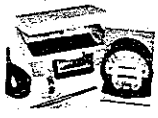


Transparent overlays

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

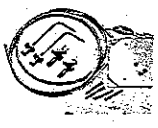
Adjustable signal flag

Integral with plastic gage cover; has external reset screw. Available for all ranges (not high pressure). Can be ordered with gage or separately.



Portable units

Combine carrying case with any Magnehelic gage of standard range (not high pressure). Includes 9 ft. of ¾" I.D. rubber tubing, stand-hang bracket, and terminal tube with holder.



Air filter gage accessory package

Adapts any standard Magnehelic for use as an air filter gage. Includes aluminum surface-mounting bracket with screws, two 5 ft. lengths of ¼" aluminum tubing, two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

1002640

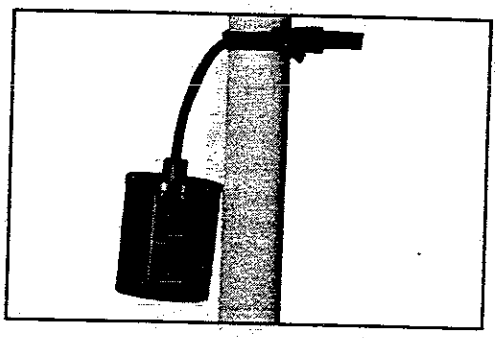
SJE PUMPMASTER® pump switch

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

APPLICATIONS

This mechanically-activated, wide-angle pump switch provides automatic control of pumps in non-potable water and sewage applications.

The SJE PumpMaster® pump switch is not sensitive to rotation or turbulence allowing it to be used in both calm and turbulent applications.



U.S. Patent Nos. 5,087,801 & 5,142,108
Canadian Patent Pending

FEATURES

- Heavy-duty contacts
- Controls pumps up to 1/2 HP at 120 VAC and 1 HP at 230 VAC
- Adjustable pumping range of 7 to 36 inches (18 to 91 cm)
- Includes standard mounting strap and boxed packaging
- UL Listed for use in non-potable water and sewage
- CSA Certified
- Two-year limited warranty

LISTED
83N2

LR54245

SPECIFICATIONS

Cable: flexible 16 gauge, 2 conductor (UL, CSA) SJOW, water-resistant (CPE)

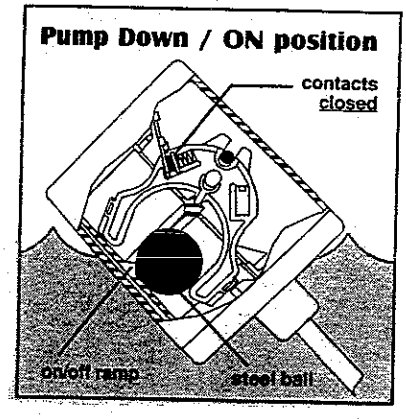
Float: 3.05 inch diameter x 3.56 inch long (7.75 x 9.04 cm), high impact, corrosion resistant, PVC housing for use in sewage and non-potable water up to 140°F (60°C)

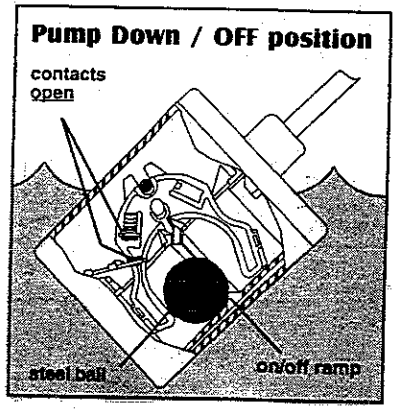
Electrical:

120 VAC 50/60Hz Single Phase:
Maximum Pump Running Current:
13 amps
Maximum Pump Starting Current:
85 amps
Recommended Pump HP:
1/2 HP or less

230 VAC 50/60Hz Single Phase:
Maximum Pump Running Current:
13 amps
Maximum Pump Starting Current:
85 amps
Recommended Pump HP:
1 HP or less

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





OPTIONS

This switch is available:

- for pump down or pump up applications
- with a 120 VAC or 230 VAC piggy-back plug
- without a plug for direct wiring in 120 VAC or 230 VAC applications
- in standard cable lengths of 10, 15, 20, or 30 feet and 1, 2, 3, 5, 6, or 10 meters (longer lengths available)

SJE Rhombus CONTROLS
SJ Electro Systems, Inc.

SJE PumpMaster® pump switch installation instructions

⚠WARNING **ELECTRICAL SHOCK HAZARD**
Disconnect power before installing or servicing this product. A qualified service person must install and service this product according to applicable electrical and plumbing codes.

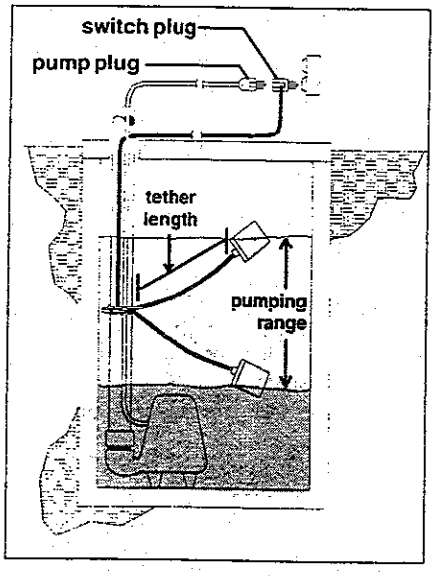
⚠WARNING **EXPLOSION OR FIRE HAZARD**
Do not use this product with flammable liquids. Do not install in hazardous locations as defined by National Electrical Code, ANSI/NFPA 70.

■ Failure to follow these precautions could result in serious injury or death. ■ Replace product immediately if switch cable becomes damaged or severed. ■ Keep these instructions with warranty after installation. ■ This product must be installed in accordance with National Electric Code, ANSI/NFPA 70 so as to prevent moisture from entering or accumulating within boxes, conduit bodies, fittings, float housing, or cable. ■

MOUNTING THE SWITCH

1. Determine pumping range for installation (see Figures A and B). Do not tether less than 3.5 inches (9 cm) from pipe.
2. Tighten strap around discharge pipe keeping switch cable between strap and pipe to prevent slippage.
3. Space small ties at least 1 inch (2.5 cm) apart (see Figure C). To re-adjust ties, press small tie tabs down.
4. To lock releasable tab, run remaining strap between tab and head. Tuck strap back through head (see Figure C).

Figure A



PIGGY-BACK PLUG INSTALL

■ Electrical outlet must not be located in pump chamber.
■ Electrical outlet voltage, piggy-back plug voltage, and pump voltage must match.

1. Follow steps 1 through 4 of "Mounting The Switch."
2. Insert switch's piggy-back plug into outlet.
3. Plug pump into piggy-back plug (see Figure A).
4. Check installation. Allow system to cycle to insure proper operation.

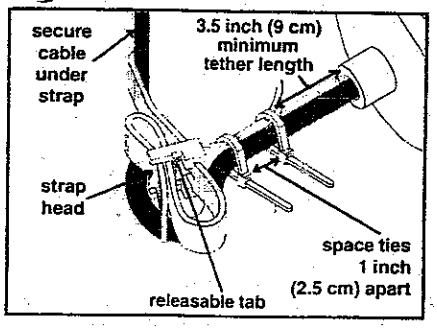
Figure B

Determining Pumping Range In Inches (1 inch = 2.5 cm)

tether length	3.5	6	10	14	18	22	24	
pumping range	7	10	16	22	28	33	36	

Use only as a guide. Pumping ranges are based on testing in non-turbulent conditions. Range may vary due to water temperature and cord shape. Note: As the tether length increases, so does the variance of the pumping range.

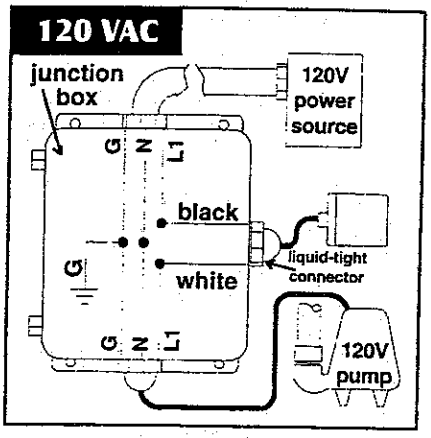
Figure C



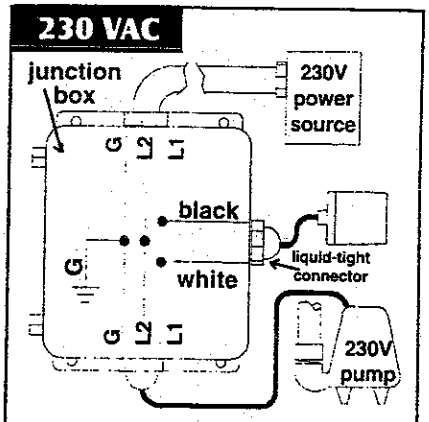
DIRECT WIRE INSTALL

1. Follow steps 1 through 4 of "Mounting The Switch."
2. Wire switch as shown below.
3. Check installation. Allow system to cycle to insure proper operation.

120 VAC



230 VAC



⚠WARNING In 230 VAC pump installations, one side of the line going to the pump is always HOT. This condition exists if the switch is on or off. Install double pole disconnect on all 230 VAC pump circuits.

CONTROLS SJE-Rhombus
SJ ELECTRO SYSTEMS, INC.

P.O. Box 1708 ■ County Rd 6 ■ Detroit Lakes, Minnesota 56502 USA
1-888-DIAL-SJE (342-5753) ■ Phone: 218-847-1317 ■ Fax: 218-847-4617

Instl. Instr. PN 1002627K
Cat. Page PN 1004164D

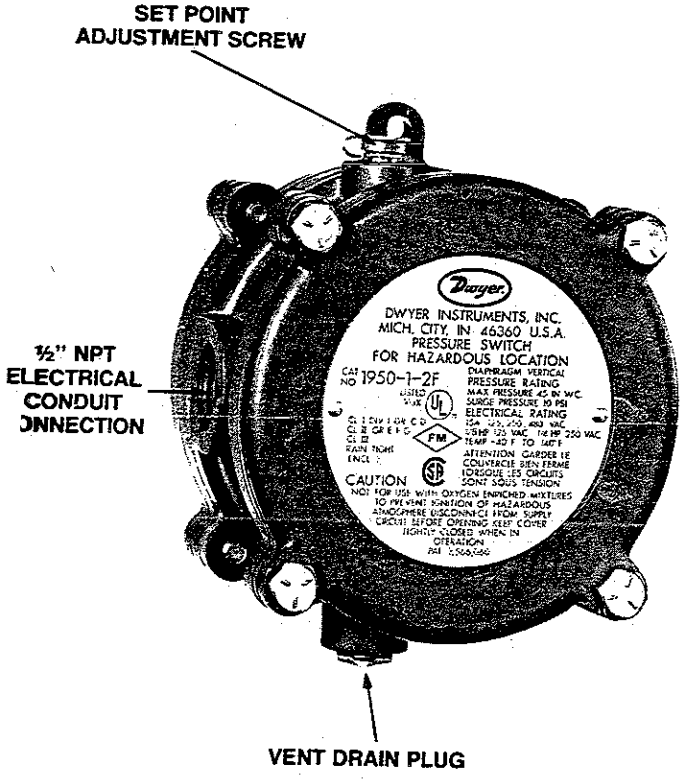
Printed in USA 0997

Dwyer

SERIES 1950

INTEGRAL EXPLOSION-PROOF PRESSURE SWITCHES

Specifications - Installation and Operating Instructions



UL and CSA Listed, FM Approved For
CL. I GR. C,D – CL. II GR. E,F,G – CL. III

Model 1950 Switches: Operating ranges and dead bands.

To order specify Model Number	Operating Range Inches, W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1950-04	0.03 to 0.35	0.02	0.09
1950-00	0.07 to 0.15	0.04	0.05
1950-0	0.15 to 0.5	0.10	0.15
1950-1	0.4 to 1.6	0.15	0.20
1950-5	1.4 to 5.5	0.3	0.4
1950-10	3.0 to 11.0	0.4	0.5
1950-20	4.0 to 20.0	0.4	0.6
Model Number	**Operating Range PSI**	**Approximate Dead Band**	
		Min. Set Point	**Max. Set Point**
1950P-2	.5 to 2.0	0.3 PSI	0.3 PSI
1950P-8	1.5 to 8.0	1.0 PSI	1.0 PSI
1950P-15	3.0 to 15.0	0.9 PSI	0.9 PSI
1950P-25	4.0 to 25.0	0.7 PSI	0.7 PSI
1950P-50	15.0 to 50	1.0 PSI	1.5 PSI

PHYSICAL DATA

Temperature limits: —40°F to 140°F. 0°F to 140°F for 1950P-8, 15, 25, and 50.
Rated Pressure: 1950 — 45 IN. W.C., 1950P — 35 PSI, 1950P-50 only — 70 PSI.
Maximum surge pressure: 1950 — 10 PSI, 1950P — 50 PSI, 1950P-50 only — 90 PSI.
Pressure Connections: 1/8" NPT.
Electrical Rating: 15 amps, 125, 250,480 volts, 60 Hz. A.C. Resistive 1/8 H.P. @ 125 volts, 1/4 H.P. @ 250 volts, 60 Hz. A.C.
Wiring connections: 3 screw type; common, norm. open and norm. closed.
Conduit connections: 1/2" NPT.
Set point adjustment: Screw type on top of housing. Field adjustable.
Housing: Anodized cast aluminum.
Diaphragm: Molded fluorosilicone rubber. 04 model, silicone on nylon.
Calibration Spring: Stainless Steel.
Installation: Mount with diaphragm in vertical position.
Weight: 3 1/4 lbs. 04 model, 4 lbs., 7 oz.

The New Model 1950 Explosion-Proof Switch combines the best features of the popular Dwyer Series 1900 Pressure Switch with a compact explosion-proof housing.

The unit is U.L. and CSA listed, FM approved for use in Class I, Groups C & D, Class II, Groups E, F, & G and Class III atmospheres. It is also totally rain-tight for outdoor installations. Twelve models allow set-points from .03 to 20 inches W.C. and from .5 to 50 PSI.

Easy access to the SPDT switch for electrical hook-up is provided by removing the top plate of the three-part aluminum housing. Adjustment to the set point of the switch can be made without disassembly of the housing. The unit is very compact, about half the weight and bulk of equivalent conventional explosion-proof switches.

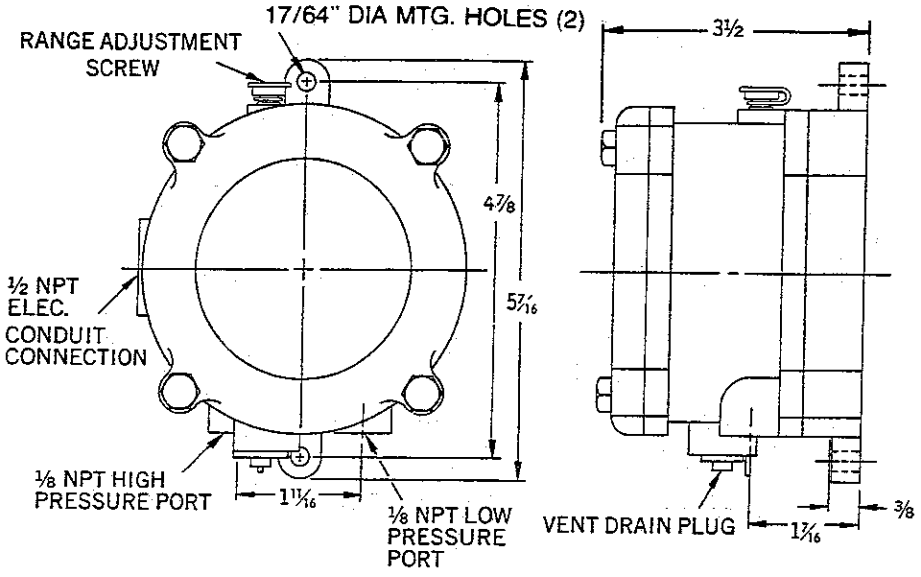
CAUTION: Use of the Model 1950 switch with explosive media connected to the **low** pressure port (including differential pressure applications in such media) is not recommended. Switch contact arcing can cause an explosion inside the switch housing which, while contained, may render the switch inoperative. If switch is being used to sense a single positive pressure relative to atmosphere, run a line from the low pressure port to a non-hazardous area free of combustible gases.

Response Time: Because of restrictive effect of flame arrestors, switch response time may be as much as 10-15 seconds where applied pressures are near set point.

NOTE: The last number-letter combination in the 1950 model number identifies the switch electrical rating (number) and diaphragm material (letter). The 2F combination is standard as described in the physical data above. In the case of special models, a number 1 rating is the same as 2; a number 3 or 4 rating is 10A 125, 250, 480 VAC - 1/8 HP 125 VAC, 1/4 HP 250 VAC; and a number 5 or 6 rating is 1A 125 VAC. A letter B indicates a Buna-N diaphragm, N; Neoprene, S; Silicone, and V; Viton.

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46360, U.S.A.
Telephone 219/879-8000
Fax 219/872-9057 Telex 25916

SERIES 1950
INTEGRAL EXPLOSION-PROOF PRESSURE SWITCHES
Installation and Operating Instructions



NOTE: For dimensions of Model 1950-04, request drawing 28-700175-00.

1950 SWITCH OUTLINE DIMENSIONS

INSTALLATION

1. Select a location that is free from excessive vibration, corrosive atmosphere and where the ambient temperature is between -40° and +140°F. Switch may be installed outdoors or in areas where the hazard of explosion exists. (See pg. 1 for specific types of hazardous service).
2. Mount standard switches with the diaphragm in a vertical plane and with switch lettering and Dwyer nameplate in an upright position. Some switches are position sensitive and may not reset properly unless they are mounted with the diaphragm vertical. (Special units can be furnished for other than vertical mounting arrangements if required.)
3. Connect switch to source of pressure, vacuum or differential pressure. Metal tubing with ¼" O.D. is recommended, but any tubing which will not restrict the air flow can be used. Connect to the two ⅛" NPT female pressure ports as noted below:
   A. Differential pressures - connect pipes or tubes from source of greater pressure to high pressure port marked HIGH PRESS. and from source of lower pressure to low pressure port marked LOW PRESS.
   B. Pressure only (above atmospheric) - connect tube from source of pressure to high pressure port. The low pressure port is left open to atmosphere.
   C. Vacuum only (below atmospheric pressure) - connect tube from source of vacuum to low pressure port. The high pressure port is left open to atmosphere.
4. To make electrical connections, remove the three hex head screws from the cover and, after loosening the fourth captive screw, swing the cover aside. Electrical connections to the standard single pole, double throw snap switch are provided by means of screw terminals marked "common", "norm open", and "norm closed". The normally open contacts close and the normally closed contacts open when pressure increases beyond the set point. Switch loads for standard models should not exceed the maximum specified current rating of 15 amps resistive. Remember that switch capabilities decrease with an increase in ambient temperature, load inductance, or cycling rate. Whenever an application involves one or more of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonging switch life.

ADJUSTMENT

To change the set point:

A. Remove the plastic cap and turn the slotted Adjustment Screw at the top of the housing clockwise to raise the set point pressure and counter-clockwise to lower the set point. After calibration, replace the plastic cap.

B. The recommended procedure for calibrating or checking calibration is to use a "T" assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point very slowly. Note that manometer and pressure switch will have different response times due to different internal volumes, lengths of tubing, fluid drainage, etc. Be certain the switch is checked in the position it will assume in use, i.e. with diaphragm in a vertical plane and switch lettering and Dwyer nameplate in an upright position.

C. For highly critical applications it is a good idea to check the set point adjustment and reset it as necessary once or twice in the first few months of operation. This will compensate for any change in initial tension which may occur in the spring and diaphragm. For most applications this change will not be significant and no resetting will be required.

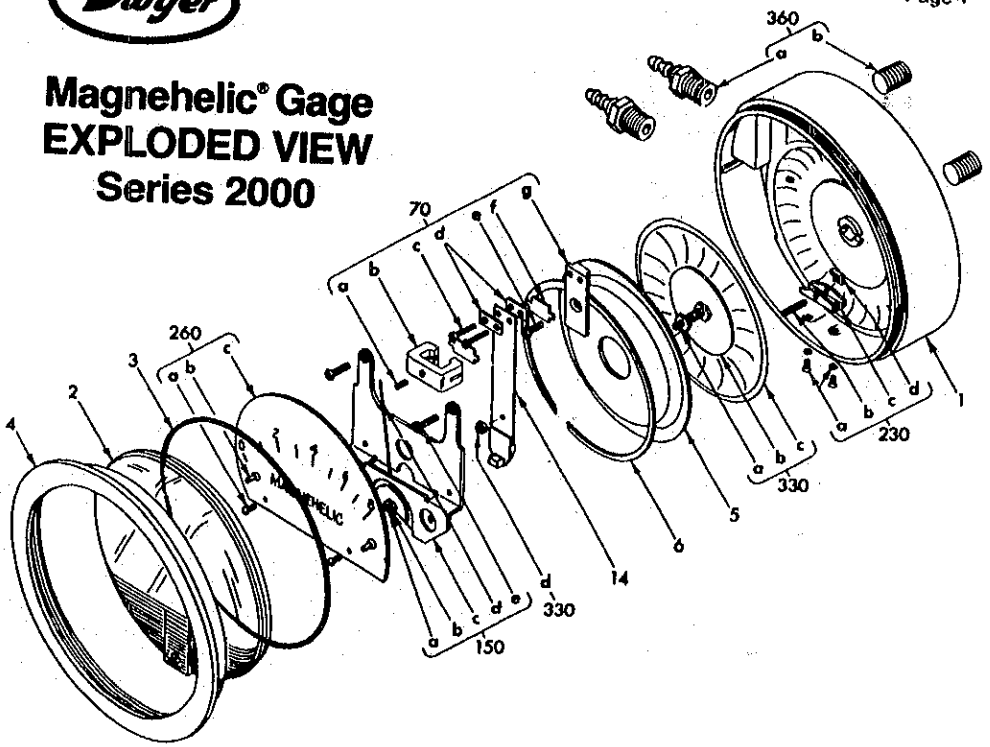
MAINTENANCE

The moving parts of these switches need no maintenance or lubrication. The only adjustment is that of the set point. Care should be taken to keep the switch reasonably clean. Periodically the vent drain plug should be rotated one turn clockwise then returned to its original position. This will dislodge deposits which could accumulate in applications where there is excessive condensation within the switch.

Litho in U.S.A. 2/89

DWYER INSTRUMENTS, INC.
P.O. Box 373, Michigan City, Indiana 46360, U.S.A.
Phone: 219/879-8000 Telex: 25916 Fax: 219/872-9057

Magnehelic® Gage EXPLODED VIEW Series 2000



1. Case
2. Cover with zero adjust assy.
3. "O" ring seal
4. Bezel
5. Diaphragm sealing plate
6. Retaining ring
70. Range Spring assembly
   a. Clamp set screw
   b. Clamp
   c. Mounting screws (2 req'd)
   d. Clamping shoe (2 req'd)
   e. Clamp plate screw
   f. Spacer (2 req'd)
   g. Clamp plate
14. Range Spring with magnet
150. Wishbone Assembly – consists of:
   a. Front jewel
   b. Locking nut
   c. Wishbone
   d. Pointer
   e. Mounting screws (2 req'd)
   f. Helix assembly (not shown)
   g. Pivots (2 req'd) (not shown)
   h. Rear jewel (not shown)
230. Zero adjust assembly – consists of:
   a. Foot screws with washers (2 req'd)
   b. Adjust screw
   c. Foot
   d. Finger
260. Scale Assembly – consists of:
   a. Mounting screws (2 req'd)
   b. Bumper pointer stop (2 req'd)
   c. Scale
330. Diaphragm Assembly – consists of:
   (Arbor press needed to install)
   a. Linkage assy., complete
   b. Front plate
   c. Diaphragm
   d. Rear plate (not shown)
   e. Plate washer (not shown)
360. Mounting Hardware Kit
   a. Adapter – pipe plug ⅛" NPT to rubber tubing – (2 req'd)
   b. Pipe plug ⅛" NPT – (2 req'd)
   c. Mounting lug (3 req'd)
   d. Long screw (3 req'd)
   e. Short screw (3 req'd)

Ordering Instructions:

When corresponding with the factory regarding Magnehelic® gage problems, refer to the call-out numbers in this view. Be sure to include model number, pressure range, and any special options. Field repair is not recommended; contact the factory for repair service information.

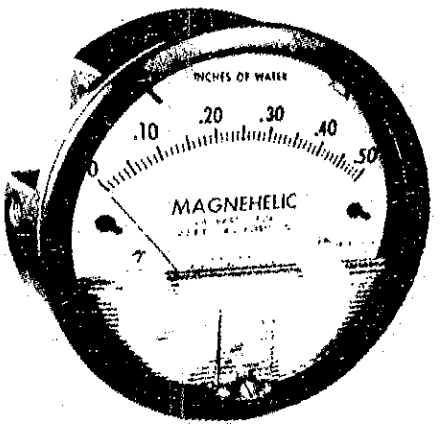
Litho in U.S.A. 9/89

12-440212-04

BULLETIN NO. A-27

OPERATING INSTRUCTIONS and PARTS LIST

Magnehelic® Differential Pressure Gage



SPECIFICATIONS

Dimensions: 4-3/4" dia. X 2-3/16" deep.

Weight: 1 lb. 2 oz.

Finish: Baked dark gray enamel.

Connections: 1/8 N.P.T. high and low pressure taps, duplicated, one pair side and one pair back.

Accuracy: Plus or minus 2% of full scale, at 70°F (Model 2000-0, 3%; 2000-00, 4%).

Pressure Rating: 15 PSI.

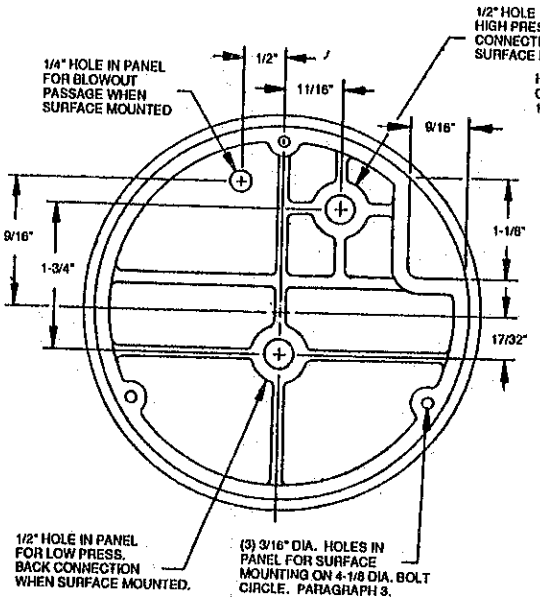
Ambient Temperature Range: 20° to 140°F

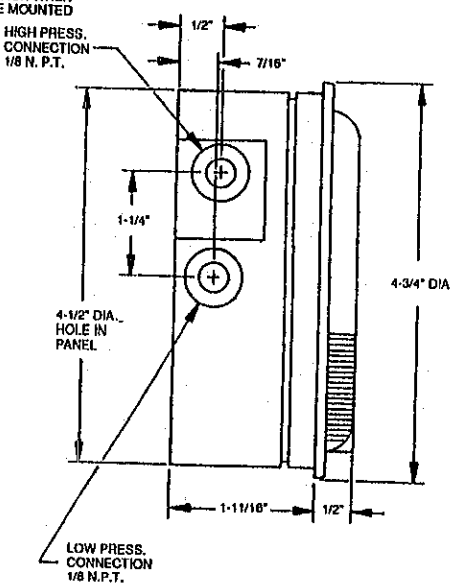
Standard gage accessories include two 1/8" N.P.T. plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws.

Caution: For use with air or compatible gases only.

For repeated over-ranging or high cycle rates, contact factory.

Hydrogen Gas Precautionary Note: The rectangular rare earth magnet used in the standard gage may not be suitable for use with hydrogen gas since a toxic and explosive gas may form. For hydrogen service, consult the factory for an alternate gage construction.





DWYER INSTRUMENTS, INC.
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Telex 25016

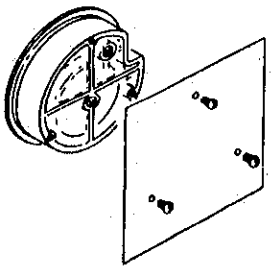
MAGNEHELIC® INSTALLATION

Overpressure Protection: Standard Magnehelic gages are rated for a maximum pressure of 15 psig and should not be used where that limit can be exceeded. Newer models employ a rubber plug on the rear which will unseat and vent the gage at approximately 25 psig. When surface mounting units with this feature, provide a vent hole, as indicated on the dimension drawing, or allow a minimum 1/8" clearance when flush mounting.

1. Select a location free from excessive vibration and where the ambient temperature will not exceed 140°F. Also, avoid direct sunlight which accelerates discoloration of the clear plastic cover. Sensing lines may be run any necessary distance. Long tubing lengths will not affect accuracy but will increase response time slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult the factory for ways to provide additional damping.

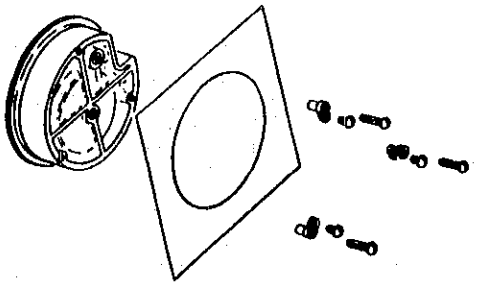
2. All standard Magnehelic gages are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If gages are to be used in other than vertical position, this should be specified on the order. Many higher range gages will perform within tolerance in other positions with only rezeroing. Low range Model 2000-00 and metric equivalents must be used in the vertical position only.

3. Surface Mounting



Locate mounting holes, 120° apart on a 4-1/8" dia. circle. Use No. 6-32 machine screws of appropriate length.

4. Flush Mounting



Provide a 4½" dia. opening in panel. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with adaptors, Part No. 360c, firmly secured in place. To mount gage on 1¼"-2" pipe, order optional A-610 pipe mounting kit.

5. To zero the gage after installation

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

Operation

Positive Pressure: Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.

Negative Pressure: Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.

Differential Pressure: Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.

When one side of gage is vented in a dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

a. For portable use or temporary installation, use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with rubber or Tygon tubing.

b. For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended. See accessory bulletin S-101 for fittings.

MAINTENANCE

Maintenance: No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves, (bulletin S-101), should be used in permanent installations.

Calibration Check: Select a second gage or manometer of known accuracy and in an appropriate range. Using short lengths of rubber or vinyl tubing, connect the high pressure side of the Magnehelic gage and the test gage to two legs of a tee. Very slowly apply pressure through the third leg. Allow a few seconds for pressure to equalize, fluid to drain, etc., and compare readings. If accuracy unacceptable, gage may be returned to factory for recalibration. To calibrate in the field, use the following procedure.

Calibration:

1. With gage case, P/N 1, held firmly, loosen bezel, P/N 4 by turning counterclockwise. To avoid damage, a canvas strap wrench or similar tool should be used.
2. Lift out plastic cover and "O" ring.
3. Remove scale screws and scale assembly. Be careful not to damage pointer.
4. The calibration is changed by moving the clamp, P/N. 70-b. Loosen the clamp screw(s) and move slightly toward the helix if gage is reading high, and away if reading low. Tighten clamp screw and install scale assembly.
5. Place cover and 0-ring in position. Make sure the hex shaft on inside of cover is properly engaged in zero adjust screw, P/N 230-b.
6. Secure cover in place by screwing bezel down snug. Note that the area under the cover is pressurized in operation and therefore gage will leak if not properly tightened.
7. Zero gage and compare to test instrument. Make further adjustments as necessary.

Caution: If bezel binds when installing, lubricate threads sparingly with light oil or molybdenum disulphide compound.

Warning: Attempted field repair may void your warranty. Recalibration or repair by the user is not recommended. For best results, return gage to the factory. Ship prepaid to:

Dwyer Instruments, Inc.
Attn. Repair Department
55 Ward Street
Wakarusa, IN 46573

Trouble Shooting Tips:

• *Gage won't indicate or is sluggish.*

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O" ring damaged, missing.
5. Pressure sensors, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F, order gage with low temperature, (LT) option.

• *Pointer stuck-gage can't be zeroed.*

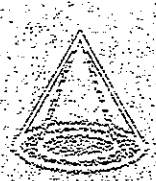
1. Scale touching pointer.
2. Spring/magnet assembly shifted and touching helix.
3. Metallic particles clinging to magnet and interfering with helix movement.
4. Cover zero adjust shaft broken or not properly engaged in P/N 230-b adjusting screw.

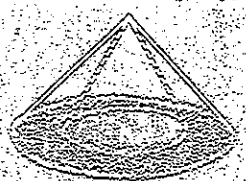
We generally recommend that gages needing repair be returned to the factory. Parts used in various sub-assemblies vary from one range of gage to another, and use of incorrect components may cause improper operation or failure. Gages repaired at the factory are carefully calibrated and tested to assure "like-new" operation. After receipt and inspection, we will be happy to quote repair costs before proceeding.

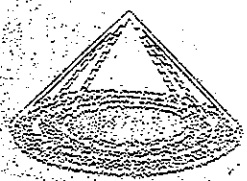
Consult factory for assistance on unusual applications or conditions.

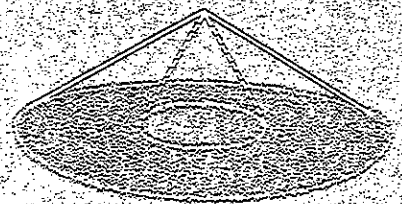
Use with air or compatible gases only.

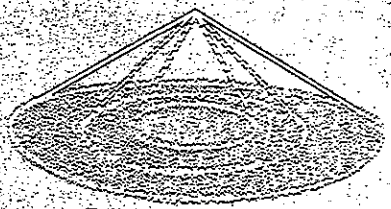
Standard Line
Wide Range of Flows, Angles and Materials
Full and Hollow Cone


Full Cone 60° NN


Full Cone 90° FCN


Full Cone 90° FFCN


Full Cone 120° FC


Full Cone 120° FFC

DESIGN
Unique Bete spiral nozzles
solve many difficult spray problems
HIGH ENERGY EFFICIENCY
One piece - no internal parts
Clog-free performance
High discharge velocity

SPRAY CHARACTERISTICS
Wide range of flow rates and spray angles
Fine atomization
Spray patterns - full and hollow cone
Spray angles - 50° to 120°
Flow rates - .7 to 3350 gpm
Higher flow rates available

FULL CONE 60° Full Cone available in metals only.

Spray Angle	Male Pipe Size	Nozzle Number	Orifice Dia.	Free Passage Dia.	Overall Length	Hex. or Round Dia.	Weight Plastic Oz.	Weight Metal Oz.	GALLONS PER MINUTE @ PSI 10	20	30	40	50	60	80	100	200*	400*
60°	1/4	TF6NN	3/32	3/32	1 7/8	3/4		1	.7	1.0	1.2	1.4	1.6	1.7	2.0	2.2	3.1	4.4
		TF8NN	1/8	1/8	1 7/8	3/4		1	1.3	1.9	2.3	2.6	2.9	3.2	3.8	4.1	6.0	8.2
		TF10NN	5/32	1/8	1 7/8	3/4		1	2.0	2.9	3.5	4.0	4.5	5.0	5.9	6.5	9.2	13.0
	3/8	TF6NN	3/32	3/32	1 7/8	3/4		1	.7	1.0	1.2	1.4	1.6	1.7	2.0	2.2	3.1	4.4
		TF8NN	1/8	1/8	1 7/8	3/4		1	1.3	1.9	2.3	2.6	2.9	3.2	3.8	4.1	6.0	8.2
		TF10NN	5/32	1/8	1 7/8	3/4		1	2.0	2.9	3.5	4.0	4.5	5.0	5.9	6.5	9.2	13.0
		TF12NN	3/16	1/8	1 7/8	3/4		1 1/2	3.0	4.2	5.2	6.0	6.7	7.4	8.5	9.5	13.4	19
		TF14NN	7/32	1/8	1 7/8	3/4		1 1/2	4.0	5.7	7.0	8.1	9.0	10.0	11.4	12.5	18	25
		TF16NN	1/4	1/8	1 7/8	3/4		1 1/2	5.3	7.5	9.2	10.6	11.8	13.0	15.0	16.7	24	33
		TF20NN	5/16	1/8	1 7/8	3/4		1 1/2	8.2	11.7	14.3	16.5	18.4	20.0	23.3	26.1	36	52
	1/2	TF24NN	3/8	3/16	2 1/2	7/8		2 3/4	12.0	17.0	20.8	24.1	26.8	29.4	34	38	54	76
		TF28NN	7/16	3/16	2 1/2	7/8		2 3/4	16.4	23	28	33	37	40	46	52	74	104
	3/4	TF32NN	1/2	3/16	2 3/4 †	1 1/8		4 1/2	21	30	37	42	47	52	60	67	94	134
	1	TF40NN	5/8	1/4	3 5/8 ‡	1 3/8		7 1/2	34	48	57	67	74	81	94	105	148	210
		TF48NN	3/4	1/4	3 5/8 ‡	1 3/8		7 1/2	47	67	83	95	107	117	135	151	214	302
	1 1/2	TF56NN	7/8	5/16	4 3/8	2		21	64	93	112	129	145	159	184	205	290	410
		TF64NN	1	5/16	4 3/8	2		21	84	120	147	169	190	208	240	268	380	536
		TF72NN	1 1/8	5/16	4 3/8	2		21	96	137	165	192	213	235	270	302	426	604
90°	1/8	TF6FCN	3/32	3/32	1 11/16	3/4	1/2	1	.7	1.0	1.2	1.4	1.6	1.7	2.0	2.2	3.1	4.4
		TF8FCN	1/8	1/8	1 11/16	3/4	1/2	1	1.3	1.9	2.3	2.6	2.9	3.2	3.8	4.1	6.0	8.2
	1/4	TF6FCN	3/32	3/32	1 7/8	3/4	1/2	1	.7	1.0	1.2	1.4	1.6	1.7	2.0	2.2	3.1	4.4
		TF8FCN	1/8	1/8	1 7/8	3/4	1/2	1	1.3	1.9	2.3	2.6	2.9	3.2	3.8	4.1	6.0	8.2
		TF10FCN	5/32	1/8	1 7/8	3/4	1/2	1	2.0	2.9	3.5	4.0	4.5	5.0	5.9	6.5	9.2	13.0
	3/8	TF12FCN	3/16	1/8	1 7/8	3/4	3/4	1 1/2	3.0	4.2	5.2	6.0	6.7	7.4	8.5	9.5	13.4	19
		TF14FCN	7/32	1/8	1 7/8	3/4	3/4	1 1/2	4.0	5.7	7.0	8.1	9.0	10.0	11.4	12.5	18	25
		TF16FCN	1/4	1/8	1 7/8	3/4	3/4	1 1/2	5.3	7.5	9.2	10.6	11.8	13.0	15.0	16.7	24	33
		TF20FCN	5/16	1/8	1 7/8	3/4	3/4	1 1/2	8.2	11.7	14.3	16.5	18.4	20.0	23.3	26.1	36	52
	1/2	TF24FCN	3/8	3/16	2 1/2	7/8	1	2 3/4	12.0	17.0	20.8	24.1	26.8	29.4	34	38	54	76
		TF28FCN	7/16	3/16	2 1/2	7/8	1	2 3/4	16.4	23	28	33	37	40	46	52	74	104
	3/4	TF32FCN	1/2	3/16	2 3/4 †	1 1/8	1 1/2	4 1/2	21	30	37	42	47	52	60	67	94	134
	1	TF40FCN	5/8	1/4	3 5/8 ‡	1 3/8	2 1/2	7 1/2	34	48	57	67	74	81	94	105	148	210
		TF48FCN	3/4	1/4	3 5/8 ‡	1 3/8	2 1/2	7 1/2	47	67	83	95	107	117	135	151	214	302
	1 1/2	TF56FCN	7/8	5/16	4 3/8	2	5 1/2	21	64	93	112	129	145	159	184	205	290	410
		TF64FCN	1	5/16	4 3/8	2	5 1/2	21	84	120	147	169	190	208	240	268	380	536
		TF72FCN	1 1/8	5/16	4 3/8	2	5 1/2	21	96	137	165	192	213	235	270	302	426	604
	2	TF88FCN	1 3/8	7/16	5 7/8	2 1/2	6 1/2	26	140	198	240	280	310	340	395	438	620	876
		TF96FFCN	1 1/2	7/16	6 7/8	2 1/2	7 1/2	32	178	250	310	355	395	430	505	560	790	1120
	3	TF112FFCN	1 3/4	9/16	8	3 1/2	26	104	256	362	448	516	580	636	736	810	1160	1720
		TF128FFCN	2	9/16	8	3 1/2	26	104	336	480	588	676	760	832	960	1072	1520	2140
	4	TF160FFCN	2 1/2	5/8	9	4 1/2	40	160	525	750	920	1058	1188	1300	1500	1675	2370	3350

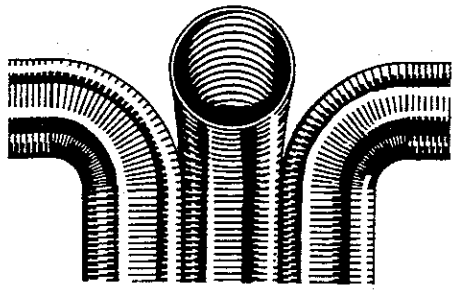
*High pressure operation recommended for metal nozzles only.
†Plastic length: 3 5/8" ‡Plastic length: 4 3/8"

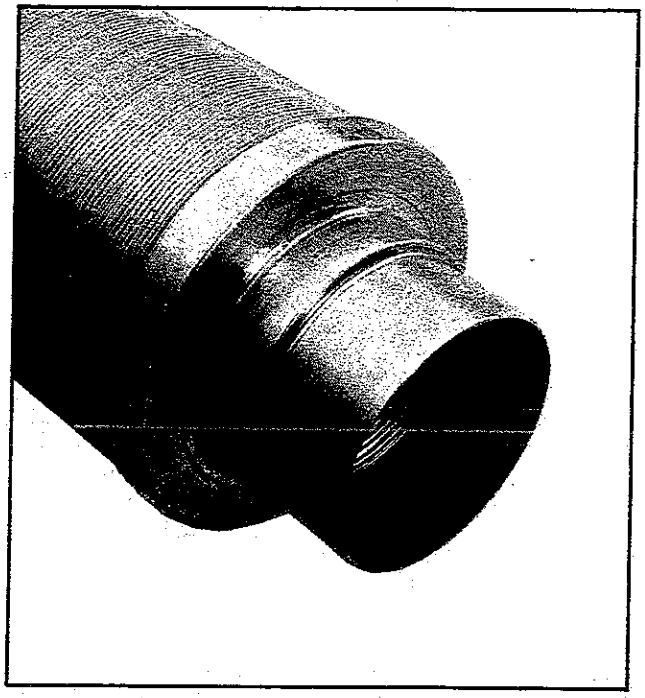
For adapters and bushings, refer to Accessories page

TO ORDER: Specify Spray Angle, Pipe Size, Nozzle Number and Material

CLEVAFLEX

HIGH VELOCITY ATTENUATOR





CONSTRUCTION:

Inner Liner consists of Clevaflex Type S single-ply aluminum perforated flexible duct.

This Inner Core is covered by 1" thick fiberglass of one pound density.

Outer Liner consists of Clevaflex Type 12 two-ply bonded aluminum with inlet and outlet collars.

UNDERWRITERS LABORATORY LISTED

PHYSICAL DATA

Nominal Diameter—Inches	4	5	6	7	8	10	12	14
Inside Diameter—Inches	← NOMINAL—EXACT →							
Outside Diameter—Inches	6	7	8	9	10	12	14	16
Standard Length	← FIVE FEET—CUSTOM DESIGN AVAILABLE →							
Operating Temperature Range	← 0°—350° →							
Working Pressure—Inches of Water	← 20" POSITIVE OR NEGATIVE →							

SPECIFICATIONS

High velocity attenuator, where indicated, shall be a double wall product with a perforated inner liner of single-ply aluminum with a minimum of seven mechanically formed corrugations per joint, covered by a one inch thick by one pound density, fiberglass blanket. The outer liner shall be a bonded two-ply laminate, closely corrugated for strength and air-tightness, capable of 20" of positive or negative pressure. Spun aluminum inlet and outlet collars shall be factory sealed to the inner and outer liners. This unit shall be tested by a recognized, independent acoustical laboratory in accordance with Air Diffusion Council standards for acoustics FD 72-R_1. High Velocity Acoustical Attenuator shall be manufactured by Clevaflex, Inc., Cleveland, Ohio 44135.

Clevaflex, Inc.

4081 West 150th Street
Cleveland, Ohio 44135
Telephone (216) 941-6505
Fax (216) 941-8742

CLEVAFLEX HIGH VELOCITY ATTENUATOR

8″ ø CLEVAFLEX DUCT RADIATED NOISE REDUCTION IN dB

OCTAVE BAND NO.	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CENTER FREQ. Hz	125	250	500	1000	2000	4000	8000
NOISE REDUCTION @ 0 FLOW	19	24	38	36	36	29	24
NOISE REDUCTION @ 2500 fpm	17	23	36	35	35	29	24

Note: Radiated noise reduction does not vary substantially with diameter. All values shown are available for diameters 4″-14″.

SOUND ATTENUATION WITH AND WITHOUT AIR FLOW

STRAIGHT ATTENUATOR INSERTION LOSS (I.L.) IN DB

OCTAVE BAND NO.	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CENTER FREQUENCY (Hz)	125	250	500	1000	2000	4000	8000
I.L. @ 0 FLOW							
4″ Attenuator	12	15	30	40	42	28	18
6″ Attenuator	9	10	21	30	35	18	12
8″ Attenuator	6	7	19	26	25	13	11
14″ Attenuator	4	6	18	22	20	10	9
I.L. @ 2500FPM							
4″ Attenuator	11	14	29	38	42	27	18
6″ Attenuator	8	9	20	28	32	17	12
8″ Attenuator	4	6	17	25	24	13	11
14″ Attenuator	3	5	15	21	19	10	9

ELBOW ATTENUATOR LOSS (I.L.) IN dB

OCTAVE BAND NO.	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CENTER FREQUENCY (Hz)	125	250	500	1000	2000	4000	8000
I.L. @ 0 FLOW							
4″ Attenuator	5	13	29	41	35	38	6
6″ Attenuator	2	4	17	32	34	15	7
8″ Attenuator	5	4	16	28	31	11	6
14″ Attenuator	5	4	15	26	29	9	7
I.L. @ 2500 FPM							
4″ Attenuator	4	13	29	36	33	19	6
6″ Attenuator	2	4	17	33	33	14	7
8″ Attenuator	5	3	16	28	30	12	6
14″ Attenuator	5	4	15	26	29	10	7

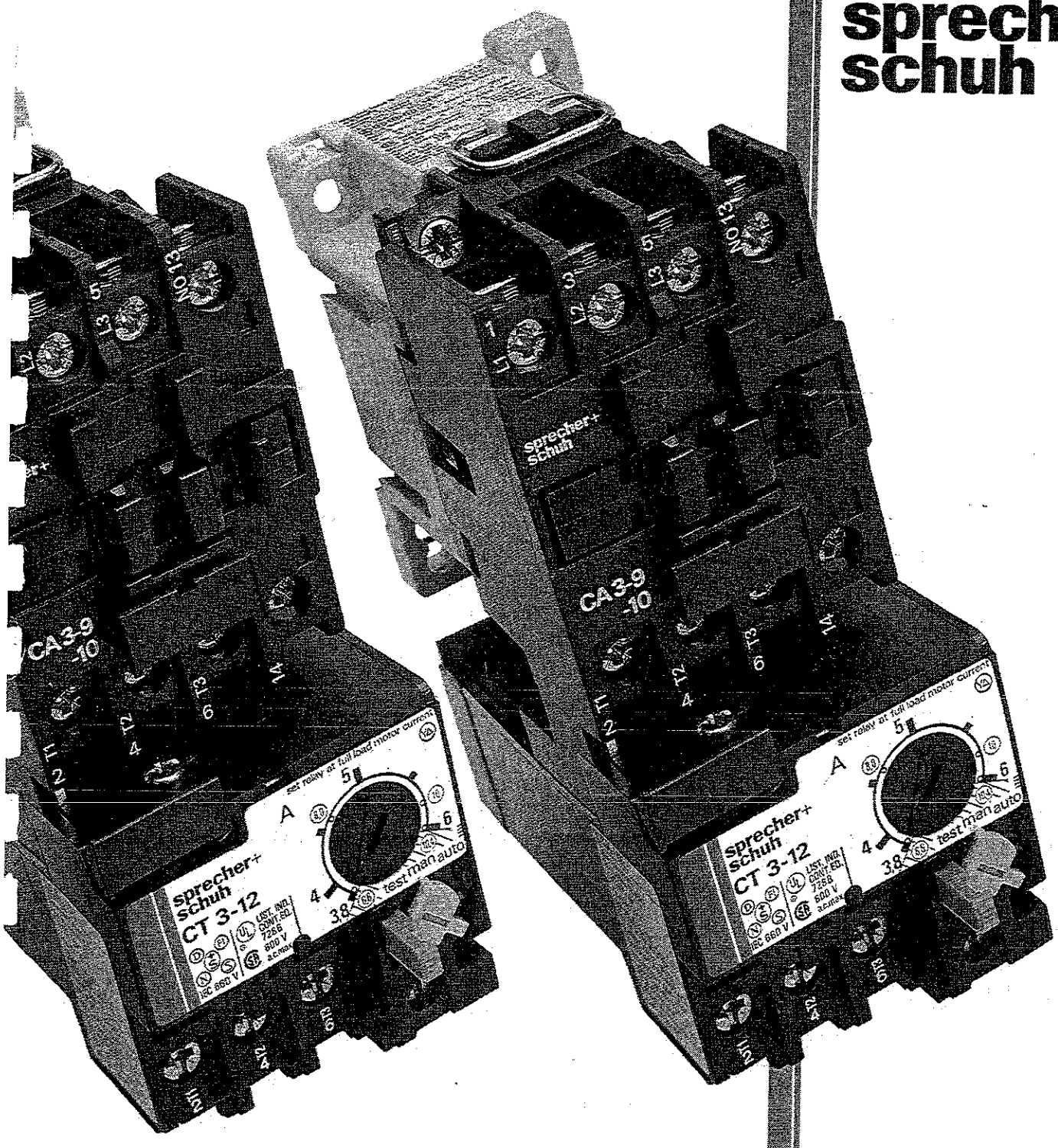
As tested by Kodaras Acoustical Laboratories, Division Electrical Testing Laboratories, Inc. Aug. 31-Sept. 2, 1979

Note: Insertion Loss values should not be directly compared with similar data for single wall flexible duct. Single wall data includes the effect of noise transmitted through the wall into the surrounding space.

While the herein published data is the result of performance under accurate laboratory conditions, Clevaflex cannot be responsible for exact reproduction of performance characteristics in the field due to the many outside variables associated with any installation.

Test Procedures: A smooth, straight empty metal duct equal in diameter and length (5 feet) of Clevaflex High Velocity Attenuator is installed in a duct system. Test signals are generated at one end of the duct and then measured in a reverberation room at the other end. The empty metal duct is removed and replaced with a Clevaflex High Velocity Attenuator and the test repeated. These procedures are followed for different air flows as well as for both straight and "elbowed" (90°) flex.

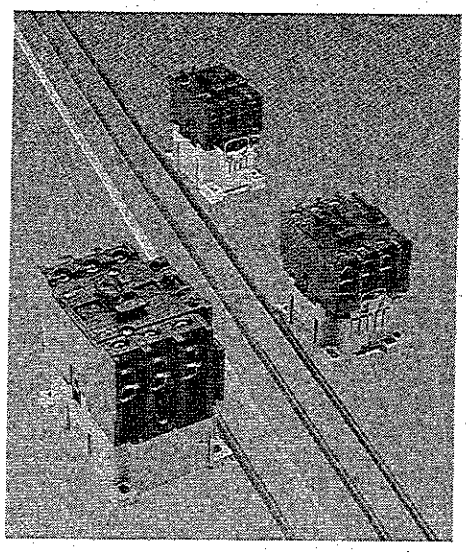
sprecher+
schuh



CA3 Contactor/Starter Series

Proven contactors and motor protection for applications up to 50HP

The powerful contactor system with decisive advantages



The CA3 series is Sprecher + Schuh's most popular line of contactors and starters. This versatile series was developed to meet the demand for smaller size devices without reducing reliability or performance. On average, every CA3 device is over 40% smaller than traditional contactors in this size class.

A perfect match

A wide selection of ten contactors is available in only three different frame sizes covering the range from 5 to 50 HP (@460V). This broad selection provides a contactor size for virtually every horsepower increment, allowing you to precisely match your motor with the appropriate CA3 starter.

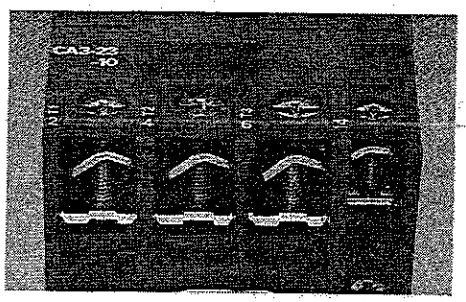
Rugged performance

Where traditional contactors rely on physical size, Sprecher + Schuh's CA3 series achieves rugged performance through a number of special design features. "Bounce free" contacts and high contact pressure allow the devices to handle high inrush currents with no effect on performance.

Due to their enclosed design, CA3 components are not affected by unfavorable climatic conditions. They also operate reliably under vibration and shock conditions such as those found in vehicles and ships.

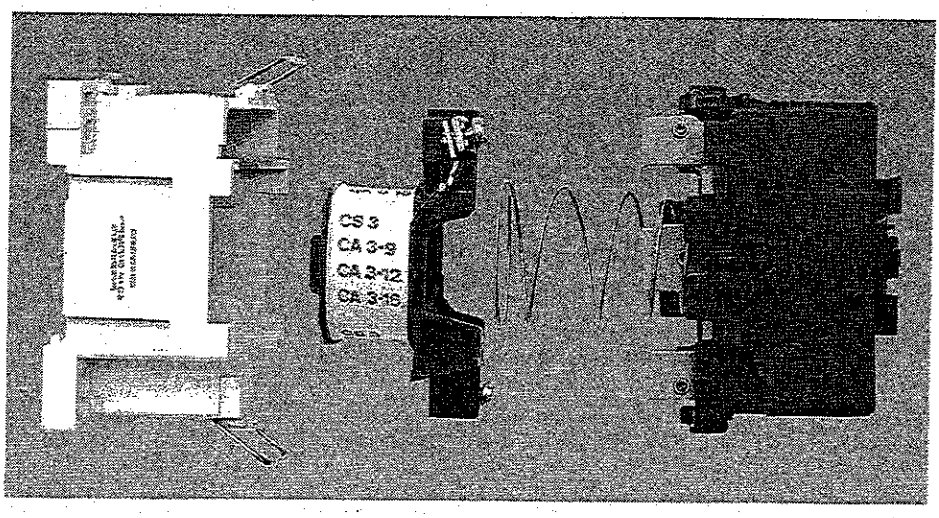
Maximum convenience

The CA3 line is completely modular for fast and trouble free installation and maintenance. Most contactors are DIN-rail mountable so they can be installed, moved or replaced quickly. All terminals are "captive" and are shipped in the raised position, saving you an operation. The universal terminal screws can be tightened with conventional, slot or posidrive screwdrivers and a limit stop prevents the conductor from being pushed into the contact chamber when wiring.



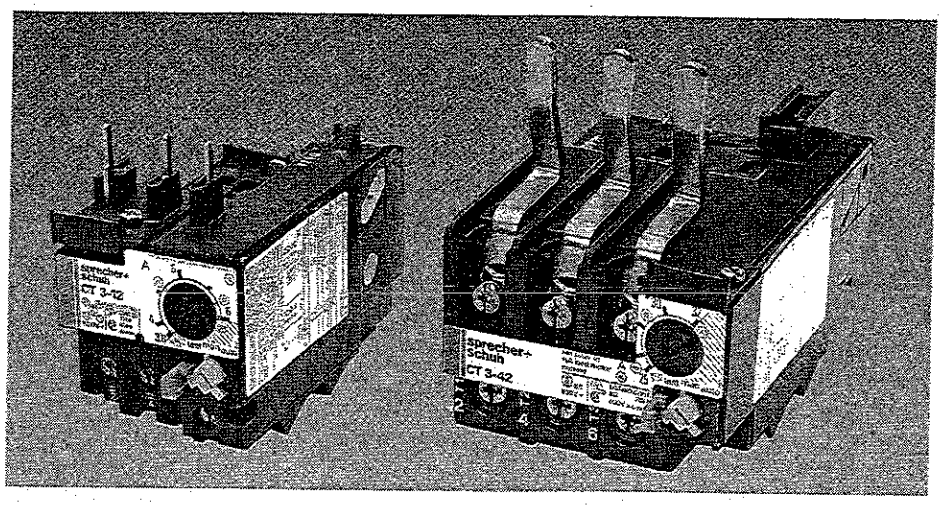
Easy coil changes

Simple and rapid coil changes are possible without tools on the CA3-9 through CA3-30, while only two screws must be loosened on the largest frame size. Reset solenoids and latch coils are also easily changed with no loose or small components to fumble with.



Exceptional motor protection is assured with CT3 overload relays

Sprecher + Schuh has always paid particular attention to the subject of motor protection. This concern is reflected in our CT3 line of thermal overload relays which include many standard features not available with traditional overload protection devices. Only two CT3 frame sizes cover the entire CA3 contactor range.



Superior "Class 10" characteristics

Today's T-Frame motors have less copper and iron than the old U-Frame motors that were popular when traditional "Class 20" overload relays were designed. For this reason, faster "Class 10" overloads like the CT3, have been recognized by many motor manufacturers as the ideal type to assure optimum motor protection.

Protection from single phase conditions

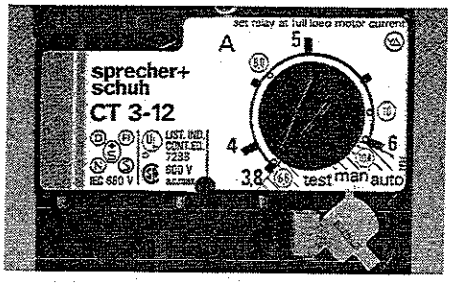
A unique feature not found in traditional thermal overload relays provides accelerated tripping under single phase conditions. This is accomplished with a special "differential tripping" mechanism built into every CT3 device (see diagram).

Ambient temperature compensation

Automatic ambient temperature compensation is another important feature standard with the CT3 series. The overload continually adjusts to surrounding temperatures between –25°C and +70°C so that trip times remain constant. This is especially important in cold climates where the trip times of uncompensated overloads can increase far beyond the safe limit for the motor.

Convenient dial adjustment of motor FLA

Rather than changing "heaters" to set the overload to the motor's FLA, CT3 relays have a dial adjustment on the faceplate. This convenience offers a wide range of FLA settings and allows you to accurately set or reset the overload in seconds.



Other standard features

CT3 overloads feature a fail-safe "trip free" design which prevents the device from being held closed during an overload. In addition, a selectable reset button permits any one of three reset options to be chosen: test, manual or automatic modes.

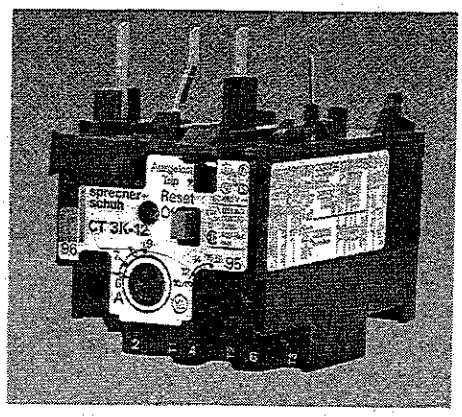
A separate NO signal contact is also provided which is isolated from the NC trip contact. This permits the use of a trip signal voltage different than that of the control voltage.

The CT3K Excellence and economy

The economic CT3K thermal overload relay also provides excellent "Class 10" protection that is accurate and consistent. Although CT3K's possess no differential tripping mechanism, they nevertheless trip under single phase conditions at a maximum of 1.25 x set current. This is achieved by a direct current calibration procedure performed on *every* device before it leaves the factory.

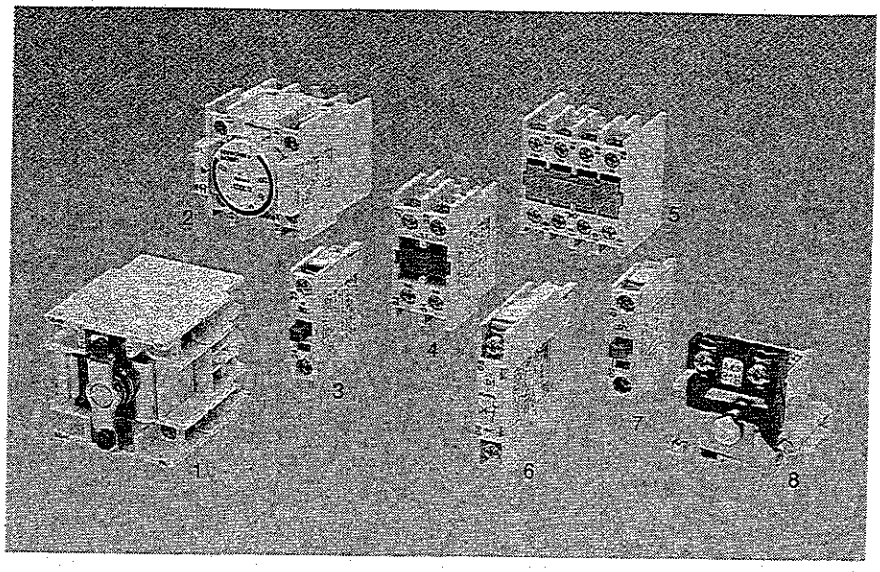
The CT3K also features permanently installed bimetal elements and a dial adjustment to accurately set the motor's FLA.

An auxiliary NO contact block is offered as an available option which snaps onto the top of any CT3K. This isolated auxiliary contact can be used as an alarm contact, for example.



Modular accessories provide more performance in less space

A comprehensive selection of modular accessories allows limitless contactor and starter configurations. All accessory modules have a standard coupling system that quickly snaps to the top or side of any CA3 contactor, requiring little or no additional panel space.



1 Mechanical latch – Holds the contactor closed so voltage can be removed from the coil.

2 Timing element – Provides on-delay or off-delay of the contactor (3 to 180 seconds).

3 Auxiliary contact block (1 pole).

4 Auxiliary contact block (2 pole).

5 Auxiliary contact block (4 pole).

6 Auxiliary contact block (1 pole - 40ms delay).

7 Auxiliary contact block (1 pole - late break).

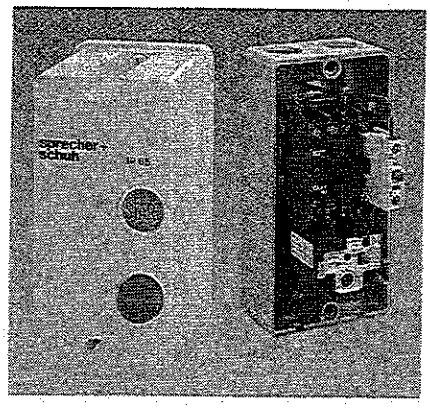
8 Reset module – For remote reset of CT3 overload relay.

Other accessories include:
Mechanical interlocks
RC links and neutral links
Reset extension rods
Various terminals and bridges
Terminal protection covers
Labeling and marking options

Enclosed starters for any application

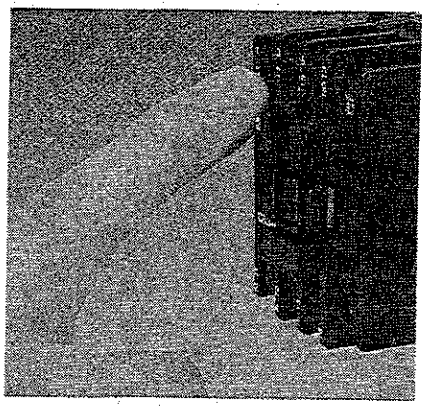
The entire CA3 contactor/starter line is available in all configurations, including combination and reduced voltage starters, pump panels and others.

A *pre-assembled* compact starter is also available for motors up to 20HP (@ 460V). This cost effective space-saving unit comes in a high impact watertight enclosure with built-in START/STOP push-buttons for speedy installation.



Safety in mind

The setting of timing elements or resetting of overload relays inside enclosures is often performed on live installations and is the most frequent cause of electrical accidents. For this reason, all CA3 contactors and accessories, as well as CT3 overload relays, offer finger and back of hand protection in accordance with the strictest international standards.

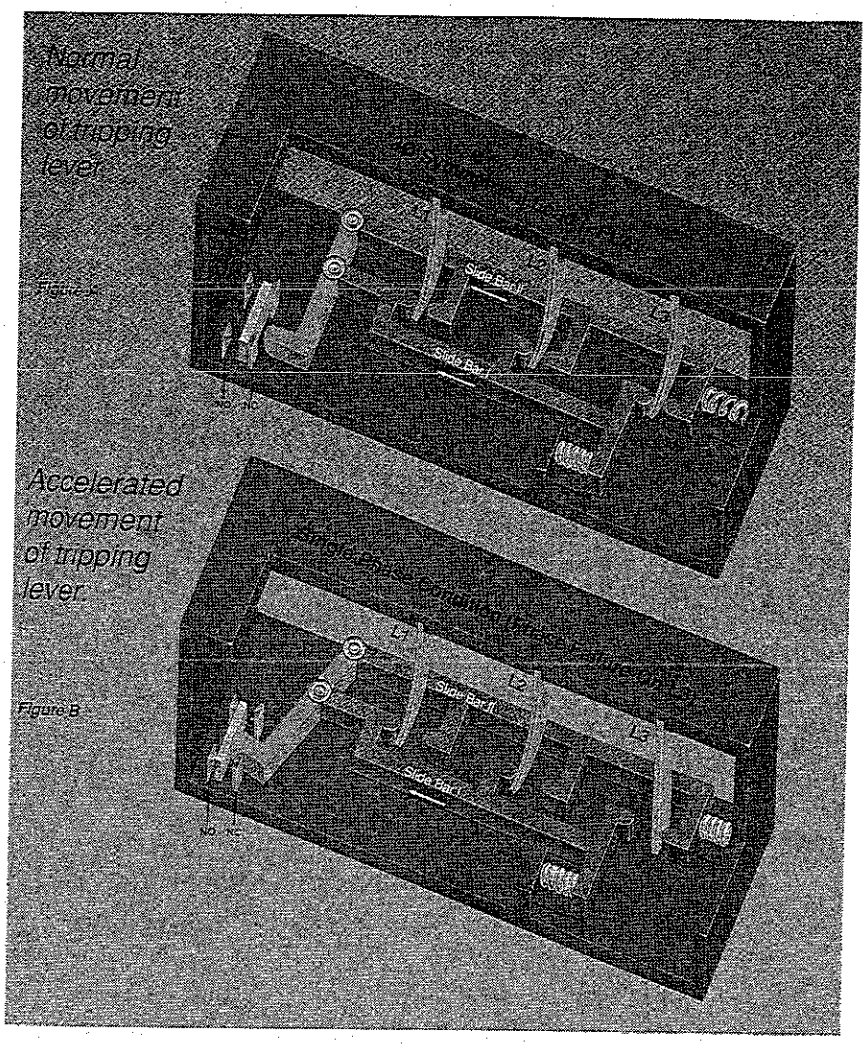


Differential Tripping – It sets us apart

Unique to IEC-style overload relays is their ability to provide *accelerated* tripping under single phase conditions. This concept is made possible by an ingenious double slide bar assembly called a "differential tripping" mechanism.

In Figure A, Slide Bar I is spring loaded to the right while Slide Bar II is spring loaded to the left. Hinge points connect the two slide bars to the tripping lever. Under a three phase symmetrical load (<FLA) the bimetal elements bend simultaneously. This causes the two slide bars to act as a single unit, positioning the tripping lever just short of tripping the normally closed contact. A three phase symmetrical overload (>FLA), however, would bend the bimetals even more, causing the tripping lever to trip the device.

The purpose of the two slide bars becomes quite evident during a single phase condition. In Figure B, if one of the phases is lost (L3 in this example), the cold bimetal element holds Slide Bar II in the same position while the additional current passing through the two remaining bimetal elements shifts Slide Bar I. This action produces a cantilever effect, accelerating the movement of the tripping lever toward the trip contacts. Any unbalanced loading of one or more of the three bimetal elements will cause this differential shift between the slide bars; thus the name "Differential Tripping."

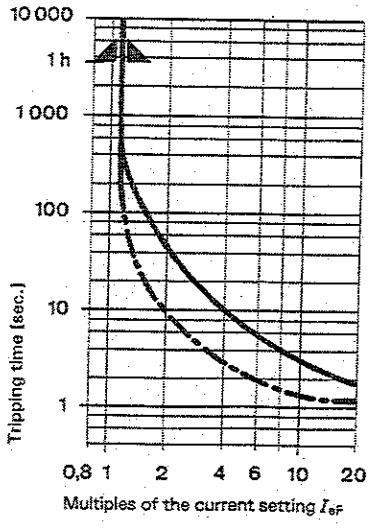


Accurate, reliable and consistant thermal overload protection

Thermal overload relays must have a high degree of tripping accuracy and consistency to protect motors. To achieve this, CT3 overload relays utilize permanently installed bimetal elements rather than interchangeable "heaters". This enables us to precisely calibrate every CT3 at the factory *as one unit*, eliminating inaccurate tripping characteristics often caused when combining parts in the field. Factory sealed calibration of every CT3 device assures a faithful reproduction of the published time/current tripping curve. This guarantees reliable and exact motor protection... every time.

Thermal response curve

The solid curve shows the mean trip times of a CT3-12 device at 20°C ambient temperature starting from a cold state. The dashed line shows mean trip times for an operationally warm device. Different models may have slightly different time/current characteristics.

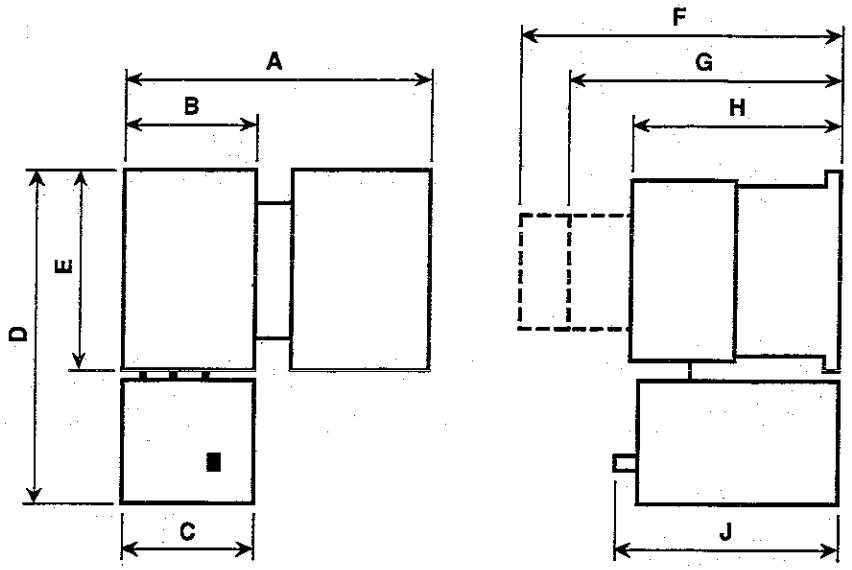


CA3 Selection Guide ①

Contactor	Continuous Amp Rating		Maximum Horsepower						Equivalent NEMA Ratings
			Single Phase		Three Phase				
	Open	Encl.	115V	230V	200V	230V	460V	575V	
CA3-9	25	24	1/3	1	2	2	5	7 1/2	NEMA Size 00
			1/3	1	1 1/2	1 1/2	2	2	
CA3-12	25	24	1/2	2	3	3	7 1/2	10	② Size 00+
CA3-16	25	24	1	3	5	5	10	15	NEMA Size 0
			1	2	3	3	5	5	
CA3-23A	40	36	1 1/2	3	5	5	10	15	② Size 0+
CA3-23	40	36	2	3	7 1/2	7 1/2	15	20	NEMA Size 1
			2	3	7 1/2	7 1/2	10	10	
CA3-30	40	36	2	5	10	10	20	25	② Size 1 1/2
CA3-37	50	45	3	5	10	10	25	30	② Size 1 3/4
CA3-43	50	45	3	7 1/2	10	15	30	40	NEMA Size 2
			3	7 1/2	10	15	25	25	
CA3-60	80	72	5	10	15	20	40	50	② Size 2 1/2
CA3-72	80	72	5	10	20	20	50	60	② Size 2 3/4

① Sprecher + Schuh ratings are in **Black Type.** NEMA equivalent ratings are in **White Type.**
② Sprecher + Schuh intermediate ratings.

Dimensions mm (inches)



Code	Description	Contactor Series		
		CA3-9, 12 & 16	CA3-23A, 23 & 30	CA3-37, 43, 60 & 72
A	Width - 2 contactors w/ mech interlock	104.5 (4.11)	124.5 (4.90)	159 (6.26)
B	Width - contactor only	44.5 (1.75)	54.5 (2.15)	74 (2.91)
C	Width - CT3 O/L relay only	① 49 (1.93)	49 (1.93)	69.5 (2.74)
D	Heigth - contactor & CT3 O/L relay	119 (4.68)	128 (5.04)	188 (7.40)
E	Heigth - contactor only	70 (2.75)	75 (2.95)	114 (4.49)
F	Depth - contactor w/ latch or timer	② 129.5 (5.10)	134 (5.27)	152 (5.98)
G	Depth - contactor w/aux contact block	② 108 (4.25)	114 (4.49)	131 (5.16)
H	Depth - contactor only	② 79 (3.11)	84 (3.31)	104 (4.07)
J	Depth - CT3 O/L relay only	③ 92 (3.62)	92 (3.62)	110 (4.33)

① For CT3K O/L relay the dimensions are 43 (1.69).
② For device with DC coil add 24 (0.94).
③ For CT3K O/L relay the dimensions are 85 (3.35).

Specifications

Standards
UL, CSA, SEV, DEMKO, SEMKO, NEMKO, RINA, Bureau Veritas, CEBEC, Lloyds Reg of Shipping, Seti, Germanischer Lloyd, USSR Reg

Rated Insulation Voltage
UL, NEMA, CSA 600V
IEC, AS, BS, SEV, VDE 660V

Test Voltage ..... 3000 volts (1 minute)

Maximum Coil Voltage ..... 110% of rated voltage

Pull-in Voltage
CA3-9 thru CA3-16 ..... 80% of rated voltage
CA3-23A thru CA3-30 ..... 85% of rated voltage
CA3-37 thru CA3-72 ..... 80% of rated voltage

Drop-out Voltage
AC coil
CA3-9 thru CA3-30 ..... 35-65% of rated voltage
CA3-37 thru CA3-72 ..... 35-55% of rated voltage
DC coil ..... 10-25% of rated voltage

Coil Burden
AC inrush VA (W)
CA3-9 thru 16 ..... 59 (46)
CA3-23A thru 30 ..... 90 (65)
CA3-37 thru 72 ..... 190 (103)
AC sealed VA (W)
CA3-9 thru 16 ..... 7.2 (2.2)
CA3-23A thru 30 ..... 8.6 (2.5)
CA3-37 thru 72 ..... 17 (4.9)
DC inrush VA
CA3-9 thru 16 ..... 7.4
CA3-23A thru 30 150
CA3-37 thru 72 350
DC sealed VA
CA3-9 thru 16 ..... 7.4
CA3-23A thru 30 ..... 3.8
CA3-37 thru 72 ..... 5.5

Switching Delay
Closing
CA3-9 thru CA3-16 ..... 10-20ms AC/20-60ms DC
CA3-23A thru CA3-30 ..... 10-20ms
CA3-37 thru CA3-72 ..... 12-22ms
Opening
CA3-9 thru CA3-72 ..... 8-18ms

Ambient Temperature
100% rated current ..... -25°C to +60°C
85% rated current ..... -25°C to +70°C

Auxiliary Contacts
Standard
CA3-9 thru 16 ..... 1 NO (NC available)
CA3-23A thru 30 ..... 1 NO (NC available)
CA3-37 thru 72 ..... 1 NO & 1 NC
Additional maximum (any combination of NO or NC)
CA3-9 thru 16 ..... 4 (for a total of 5)
CA3-23A thru 30 ..... 5 (for a total of 6)
CA3-37 thru 72 ..... 5 (for a total of 7)

sprecher+schuh

Sprecher + Schuh, Inc.
Corporate Headquarters
15503 W. Hardy St.
Houston, TX 77060
(713) 931-7000

PS 1019 – 3/91

Installation Instructions

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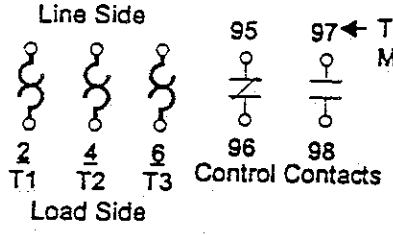
Overload Relays - Series CT3

Installation Precautions

- Be sure overload relay is properly rated for the load. (See chart at right.)
- Use wire sizes in accordance with code and rating label.
- Check that terminations are properly torqued in accordance with label.
- Insure that overload relay has not been opened or tampered with in any way.
- Be sure that overload is protected by properly sized backup fuse in accordance with label.
- Use the function selector "TEST" position for checking circuitry and operation.
- Before energizing motor be sure overload relay is adjusted properly in accordance with instructions below.

Overload Relay Wiring Diagram

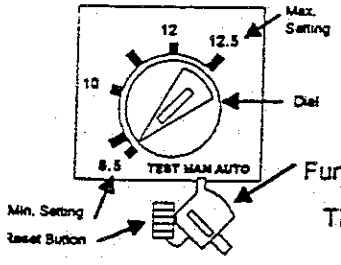


Overload Relay Ratings

Catalog Number	Setting Range (Amperes)
CT3-0.16	0.10-0.16
CT3-0.24	0.15-0.24
CT3-0.38	0.24-0.38
CT3-0.62	0.38-0.62
CT3-1.0	0 62-1.0
CT3-1.6	1.0-1.6
CT3-2.5	1.6-2.5
CT3-4.0	2.5-4.0
CT3-6.0	3.8-6.0
CT3-9.5	6.0-9.5
CT3-12.5	8.5-12.5
CT3-17.5	12.0-17.5
CT3-23	16.0-23.0
CT3-32	23.0-32.0
CT3-42-32	25.0-32.0
CT3-42-42	32.0-42.0
CT3-52	40.0-52.0
CT3-63	52.0-63.0
CT3-72.5	58.0-72.5

Setting Overload Relay

For motors with a service factor equal to or greater than 1.15, set dial at motor nameplate full load current. For motors with a service factor below 1.15 or a temperature rise greater than 40° C, the current setting should be adjusted lower. For example, set overload to .9 times full load current for 1.0 service factor (or 50° C rise) motors.



- Caution -
Do not use "AUTO" position if automatic restarting of equipment could be hazardous to personnel

Function Selector Settings:

TEST - Pressing reset button simulates tripping of overload relay.

MAN - After trip, overload relay must be manually reset by pressing reset button after cool down period.

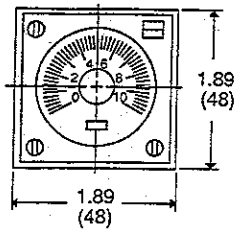
AUTO - After trip, overload relay will automatically reset after cool down

The information contained herein does not include all details or variations in equipment, nor does it provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired, or should particular problems or questions arise which are not covered sufficiently for the purchasers purpose, the matter should be referred to the nearest Sprecher + Schuh office shown at right.

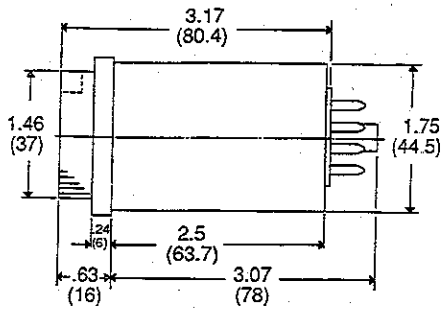
Sprecher + Schuh Regional Offices:

- Port Chester, NY Tel: (914) 937-0400
- Brookfield, WI Tel: (414) 785-9960
- Houston, TX Tel: (713) 847-2000
- Temecula, CA Tel: (714) 699-5091

INSTALLATION



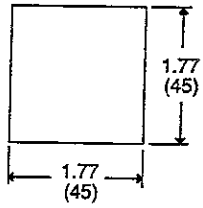
INSTALLATION MONTAGE



INSTALACION INSTALAÇÃO

PANEL CUTOUT
DÉCOUPE DU PANNEAU
SCHALTTAFEL-AUSSCHNITT
CORTE DEL PANEL
CORTE DE PAINEL

FLUSH MOUNT WITH ADAPTER
MONTAGE ENCASTRÉ AVEC ADAPTATEUR
VERSENKTER EINBAU MITTELS ADAPTER
MONTAJE AL RAS CON ADAPTADOR
MONTAGIM NIVELADA COM ADAPTADOR



WARNING:
CAUTION:

- To prevent electrical shock, disconnect from power source before installing or servicing.
- Do not remove timer from housing. This will invalidate product warranty.
- Remove power before changing timing range, unit or mode selection.
- The 700-HR timer utilizes a transformerless power supply. Do not touch the input terminals when power is applied.
- External input devices used to control the timer should be equipped with an isolation transformer and an ungrounded output.
- When 2 or more timers are controlled by the same input contact or transistor, connect the #2 terminals of the timers together.
- Recommendations for external input signal lines:
  - Use shielded wire.
  - Keep wire as short as possible.
  - Separate input signal wires from power supply for the timer and from other voltage or power lines.

AVERTISSEMENT:
ATTENTION:

- Préalablement à l'installation et aux opérations de service, couper l'alimentation secteur pour empêcher tous chocs électriques.
- Ne pas retirer le temporisateur de son compartiment sous peine d'annuler la garantie.
- Couper le courant avant de changer la gamme de temporisation, la sélection de l'unité ou le mode.
- Le temporisateur 700-HR utilise une alimentation électrique sans transformateur. Ne pas toucher les bornes d'entrée pendant la mise sous tension.
- Les appareils d'entrées externes utilisés pour contrôler le temporisateur doivent être équipés d'un transformateur d'isolation et d'une sortie non mise à la masse.
- Lorsque 2 temporisateurs ou plus sont contrôlés par le même contact ou transistor d'entrée, connecter les bornes #2 des temporisateurs ensemble.
- Recommandations au sujet des lignes de signaux d'entrée externes:
  - Utiliser un câble blindé.
  - Le câble doit être le plus court possible.
  - Séparer les câbles des signaux d'entrée de l'alimentation électrique pour le temporisateur mais aussi des autres tensions ou lignes électriques.

WARNUNG:
VORSICHT:

- Vor Installation oder Servicearbeiten Stromversorgung zur Vermeidung von elektrischem Schlag unterbrechen.
- Das Zeitrelais nicht aus dem Gehäuse entfernen. Die Garantie für das Produkt wird dadurch ungültig gemacht.
- Vor Veränderungen im Zeitregelungsbereich, Auswahl einer Einheit oder Betriebsart, die Stromzufuhr unterbrechen.
- Das 700-HR Zeitrelais nutzt transformatorlose Stromversorgung. Die Eingangsklemmen nicht berühren, wenn Strom zugeführt wird.
- Die externen Eingangsgeräte, die zur Kontrolle des Zeitrelais benutzt werden, sollten mit einem Trenntrafo und einem nichtgeerdeten Ausgang ausgestattet sein.
- Wenn zwei oder mehrere Zeitrelais durch dieselben Eingangskontakte oder den Transistor kontrolliert werden, Klemmen Nr. 2 der Zeitrelais verbinden.
- Empfehlungen für die externen Eingangssignal-Leitungen:
  - Abgeschirmten Draht benutzen.
  - Den Draht so kurz wie möglich halten.
  - Eingangssignal-Leitungen vom Netzanschluss für das Zeitrelais und von anderen Spannungs- oder Stromleitungen getrennt halten.

ADVERTENCIA:
PRECAUCION:

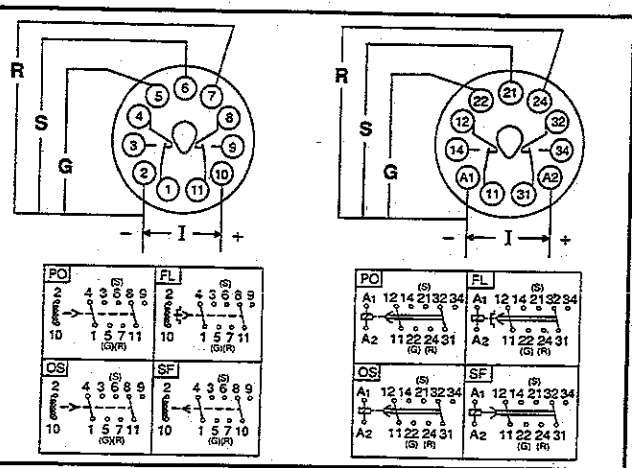
- Desconecte la corriente eléctrica antes de la instalación o servicio para evitar descargas eléctricas.
- No saque el temporizador de su recinto. Esto invalidará la garantía del producto.
- Desconecte la energía antes de cambiar el rango de temporización, la selección de modalidad o de la unidad.
- El temporizador 700-HR usa un suministro eléctrico sin transformador. No toque los bornes de entrada cuando la energía esté conectada.
- Los dispositivos de entrada externos usados para controlar el temporizador deben estar equipados con un transformador aislador y una salida sin conexión a tierra.
- Cuando 2 o más temporizadores estén controlados por el mismo transistor o contacto de salida, conecte los bornes #2 de los temporizadores juntos.
- Recomendaciones para líneas externas de señal de entrada:
  - Use cable blindado.
  - Mantega el cable tan corto como sea posible.
  - Separe los cables de señal de entrada de los del suministro eléctrico para el temporizador y los de otros voltajes o líneas eléctricas.

ADVERTÊNCIA:
ATENÇÃO:

- Para evitar choques, desligar a corrente elétrica antes de iniciar a instalação.
- Não remova temporizador da embalagem. Isto invalidará a garantia do produto.
- Desligar energia antes de alterar a temporização, a seleção de modalidade e da unidade.
- O temporizador 700-HR utiliza um transformador para a energia. Não toque os terminais da entrada quando energia é ativada.
- Os dispositivos de entrada externa devem ser equipados com transformador isolante e saída sem conexão terra.
- Quando 2 ou mais temporizadores são controlados pelo mesmo contato de entrada ou transistor, conectar, juntos, os terminais #2 dos temporizadores.
- Recomendação para linhas externas de sinal de entrada:
  - Use fio encapado.
  - Mantenha o fio tão curto o quanto for possível.
  - Separe os fios de sinal de entrada dos elétricos do temporizador e dos outros elétricos ou de voltagem diferentes.

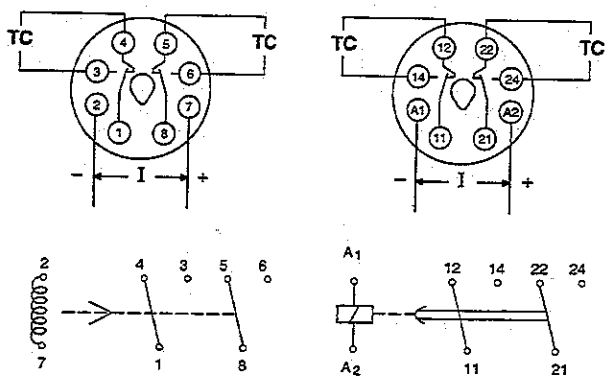
WIRING DIAGRAMS | **SCHÉMAS ÉLECTRIQUES** | **SCHALTPLÄNE** | **DIAGRAMAS DEL CABLEADO** | **DIAGRAMAS DE CABOS**

HR



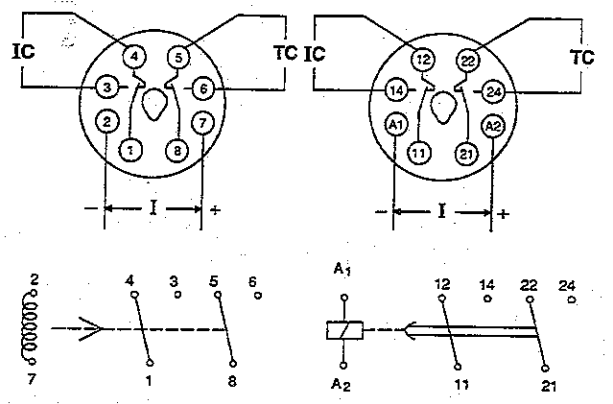
- CONTACT INPUTS (R, S, G)
  FOR OPTIMUM RELIABILITY USE EXTERNAL SWITCHES THAT ARE DESIGNED FOR LOW LEVEL SWITCHING. (700-HC54 – –)
- ENTRÉES CONTACTS (R, S, G)
  POUR UNE FIABILITÉ MAXIMUM, UTILISEZ DES COMMUTATEURS EXTERNES PRÉVUS POUR UN BAS NIVEAU DE COMMUTATION. (700-HC54 – –)
- KONTAKT-EINGÄNGE (R, S, G)
  FÜR OPTIMALE ZUVERLÄSSIGKEIT WIRD DIE BENUTZUNG VON EXTERNEN SCHALTERN, DIE FÜR SCHWACHSTROMSCHALTUNGEN KONSTRUIERT WURDEN, EMPFOHLEN. (700-HC54 – –)
- ENTRADAS DE CONTACTO (R, S, G)
  PARA UNA OPTIMA CONFIABILIDAD USE CONMUTADORES EXTERNOS QUE ESTEN DISEÑADOS PARA UN BAJO NIVEL DE CONMUTACION. (700-HC54 – –)
- ENTRADAS DE CONTATO (R, S, G)
  PARA PERFEITA CONFIABILIDADE USE TOMADAS EXTERNAS QUE SÃO CONCEBIDAS PARA BAIXAS ALTERAÇÕES. (700-HC54 – –)

HRM



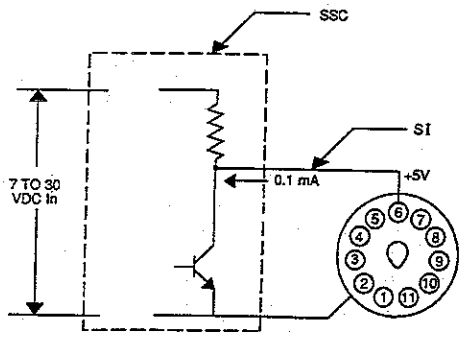
- SOLID STATE SIGNAL INPUTS (R, S, G)
  TRANSISTOR OPEN COLLECTOR: ①
  PROXIMITY SWITCH, PHOTOELECTRIC SWITCH, ETC.: ②
- ENTRÉES DE SIGNAUX À SEMI-CONDUCTEURS (R, S, G)
  COLLECTEUR OUVERT DU TRANSISTOR: ①
  COMMUTATEUR DE PROXIMITÉ, COMMUTATEUR PHOTOÉLECTRIQUE ETC.: ②
- FESTKÖRPER-SIGNAL-EINGÄNGE (R, S, G)
  OFFENER TRANSISTORKOLLEKTOR: ①
  NÄHERUNGSSCHALTER, PHOTOELEKTRISCHER SCHALTER, ETC.: ②
- ENTRADAS DE SEÑAL TRANSISTORIZADAS (R, S, G)
  COLECTOR ABIERTO DEL TRANSISTOR: ①
  CONMUTADOR DE PROXIMIDAD, CONMUTADOR FOTOELECTRICO, ETC.: ②
- ENTRADAS DE SINAL TRANSISTORIZADOS (R, S, G)
  COLETA ABERTO DE TRANSISTOR: ①
  TOMADA DE PROXIMIDADE, TOMADA FOTOELÉTRICA, ETC.: ②

HRC



① V_{CEO} = 20 V min $V_{CE(S)}$ = 1 Vmax,
I_C = 50mA min, I_{CBO} = 0.5uA max.

②



WIRING DIAGRAM KEY / CODE SCHÉMAS ÉLECTRIQUES / SCHALTPLANSCHLÜSSEL / CODIGO DE LOS DIAGRAMAS DEL CABLEADO / CÓDIGO DIAGRAMA DE CABOS

R = RESET SIGNAL
SIGNAL DE RÉARMEMENT
RÜCKSETZSIGNAL
SEÑAL DE REPOSICION
SINAL DE REARMAMENTO

S = START SIGNAL
SIGNAL DE DÉMARRAGE
STARTSIGNAL
SEÑAL DE ARRANQUE
SINAL DE INÍCIO

G = GATE SIGNAL (PAUSE)
SIGNAL GATE (PAUSE)
GATE SIGNAL (PAUSE)
SEÑAL DE COMPUERTA (PAUSA)
SINAL DE COMPORTA (PAUSA)

I = INPUT
ENTRÉE
EINGANG
ENTRADA
ENTRADA

IC = INSTANTANEOUS CONTACTS
CONTACTS INSTANTANÉS
SOFORT ANSPRECHENDE KONTAKTE
CONTACTOS INSTANTANEOS
CONTACTOS INSTANTÂNEOS

TC = TIMED CONTACTS
CONTACTS TEMPORISÉS
ZEITGESTEUERTE KONTAKTE
CONTACTOS TEMPORIZADOS
CONTATOS TEMPORIZADOS

SSC = SOLID STATE CIRCUIT (PROXIMITY SWITCH, PHOTOELECTRIC SWITCH, ETC.)
CIRCUIT TRANSISTORISÉ (COMMUTATEUR PHOTOÉLECTRIQUE, ETC.)
FESTKÖRPERSCHALTKREIS (NÄHERUNGSSCHALTER, PHOTOELEKTRISCHER SCHALTER, ETC.)
CIRCUITO TRANSISTORIZADO (CONMUTADOR DE PROXIMIDAD, CONMUTADOR FOTOELECTRICO, ETC.)
CIRCUITO TRANSISTORIZADO (TOMADA DE PROXIMIDADE, TOMADA FOTOELÉTRICA, ETC.)

SI = START INPUT (TIMER STARTS AT LOW LEVEL OF THIS SIGNAL)
ENTRÉE DÉMARRAGE (LE TEMPORISATEUR DÉMARRE À BAS NIVEAU DE CE SIGNAL)
STARTEINGANG (ZEITRELAIS BEGINNT BEI KLEINSIGNAL)
ENTRADA DE ARRANQUE (EL TEMPORIZADOR ARRANCA A UN BAJO NIVEL DE ESTA SEÑAL).
ENTRADA DE INIZIO (O TEMPORIZADOR INICIA À BAIXO NÍVEL NO SINAL)

TIMING CHARTS	TABLEAUX DE TEMPORISATION	ZEITREGELUNGS-BEREICH-TABELLEN	GRAFICAS DE TEMPORIZACION	GRAFICOS DE TEMPORIZAÇÃO

TYPE HR:

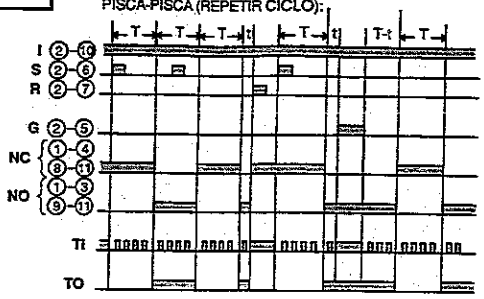
PO

(SIGNAL) ON DELAY:
SIGNAL DE DÉBUT DE TEMPORISATION:
(SIGNAL) EINSCHALTVERZÖGERUNG:
RETARDO AL CONECTARSE (SEÑAL):
(SINAL) COM RETARDAMENTO:

T>t

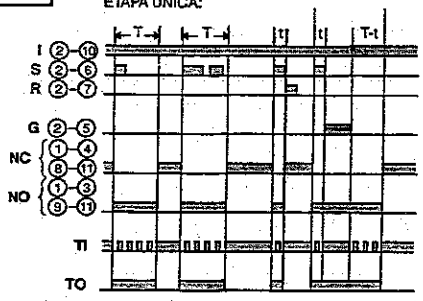
FL

FLICKER (REPEAT CYCLE):
CLIGNOTEMENT (RÉPÉTER CYCLE):
FLACKER (WIEDERHOLZYKLUS):
CENTELLEO (REPETIR EL CICLO):
PISCA-PISCA (REPETIR CICLO):



OS

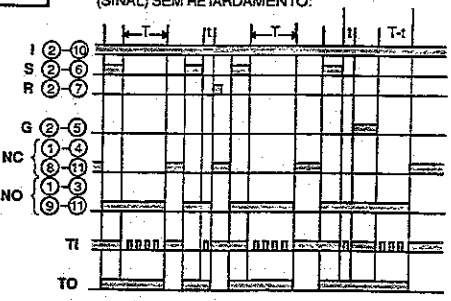
ONE SHOT:
UN COUP:
EINZELSCHRITT:
ETAPA UNICA:
ETAPA UNICA:



T>t

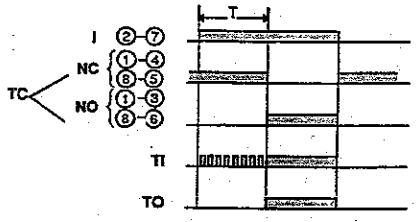
SF

(SIGNAL) OFF DELAY:
SIGNAL D'ARRÊT DE TEMPORISATION:
(SIGNAL) AUSSCHALTVERZÖGERUNG:
RETARDO AL DESCONECTARSE (SEÑAL):
(SINAL) SEM RETARDAMENTO:



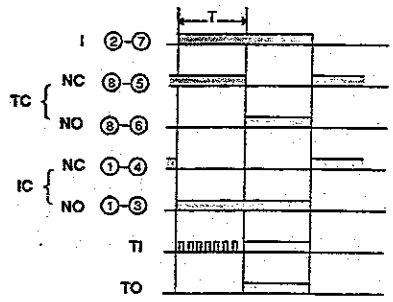
TYPE HRM:

ON DELAY
DÉBUT TEMPORISATION
EINSCHALTVERZÖGERUNG
DE RETARDO AL CONECTARSE
COM RETARDAMENTO



TYPE HRC:

ON DELAY
DÉBUT TEMPORISATION
EINSCHALTVERZÖGERUNG
DE RETARDO AL CONECTARSE
COM RETARDAMENTO



TIMING CHART KEY	CODE TABLEAU DE TEMPORISATION	SCHLÜSSEL FÜR ZEITREGELUNGSTABELLE	CODIGO DEL GRAFICO DE TEMPORIZACION	CÓDIGO DA GRÁFICO DE TEMPORIZAÇÃO

I = INPUT / ENTRÉE / EINGANG / ENTRADA / ENTRADA

S = START SIGNAL / SIGNAL DE DÉMARRAGE / STARTSIGNAL / SEÑAL DE ARRANQUE / SINAL DE INÍCIO

R = RESET SIGNAL / SIGNAL DE RÉARMEMENT / RÜCKSETZSIGNAL / SEÑAL DE REPOSICION / SINAL DE REARMAMENTO

G = GATE SIGNAL (PAUSE) / SIGNAL GATE (PAUSE) / GATE SIGNAL (PAUSE) / SEÑAL DE COMPUERTA (PAUSA) / SINAL DE COMPORTA (PAUSA)

NC = OUTPUT (NC) / SORTIE (NF) / AUSGANG (RUHEKONTAKT) / SALIDA (NC) / SAÍDA (NC)

NO = OUTPUT (NO) / SORTIE (NO) / AUSGANG (ARBEITSKONTAKT) / SALIDA (NA) / SAÍDA (NO)

TI = POWER / TIMING INDICATOR / INDICATEUR DE PUISSANCE/TEMPORISATION / STROM / ZEITREGELUNGS-ANZEIGE / INDICADOR DE TEMPORIZACION/ENERGIA / INDICADOR DE ENERGIA/TEMPORIZAÇÃO

TO = TIMED OUT INDICATOR / INDICATEUR DE DÉPASSEMENT / ZEITABLAUF-ANZEIGE / INDICADOR DE TERMINACION DEL PERIODO DE TEMPORIZACION / INDICADOR DO TÉRMINO DA TEMPORIZAÇÃO

TC = TIMED CONTACTS / CONTACTS TEMPORISÉS / ZEITGESTEUERTE KONTAKTE / CONTACTOS TEMPORIZADOS / CONTATOS TEMPORIZADOS

IC = INSTANTANEOUS CONTACTS / CONTACTS INSTANTANÉS / SOFORT ANSPRECHENDE KONTAKTE / CONTACTOS INSTANTANEOS / CONTACTOS INSTANTÂNEOS

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A ROCKWELL INTERNATIONAL COMPANY

FORM 270-B

WARRICK CONTROLS

Installation

INSTALLATION OF WARRICK SERIES 27 — INTRINSICALLY SAFE SENSING CIRCUIT

This bulletin should be used by experienced personnel as a guide to the installation of the Series 27. Selection or installation of equipment should always be accomplished by competent technical assistance. We encourage you to contact Warrick or its local representative if further information is required.

IMPORTANT: BEFORE PROCEEDING TO INSTALL AND WIRE THE CONTROL, READ AND THOROUGHLY UNDERSTAND THESE INSTRUCTIONS.

When installed according to these instructions, this device provides an intrinsically safe output for interface into Class I and II, Division I, Groups A, B, C, D, E, F, and G Hazardous locations. Electrical equipment connected to associated apparatus should not exceed maximum voltage marked on product.

LOCATION: The control must be situated in a non-hazardous area where an explosive atmosphere will not exist at any time unless it is mounted in a suitable U.L. approved explosion-proof enclosure with suitable U.L. approved explosion-proof seals.

WIRING:

1. Intrinsically safe wiring must be kept separate from non-intrinsically safe wiring.
2. Intrinsically safe and non-intrinsically safe wiring may occupy the same enclosure or raceway if they are at least 2 inches (50mm) apart and separately tied down. Inside panels, field wiring terminals for intrinsically safe circuits must be separated by at least 2 inches (50mm) from non-intrinsically safe terminals.
3. Wire the control device(s) to the Series 27 relay as shown in the specific application wiring diagram on reverse side. A separate rigid metallic conduit should be used to enclose the conductors of the intrinsically safe control circuit.
4. An approved seal should be used at the point where the intrinsically safe control circuit wiring enters the hazardous area.

For intrinsically safe output wiring use #14 or #16 AWG type MTW or THHN wire. By using these wire types in conjunction with the following distance recommendations, you will not exceed the maximum capacitance for field wiring.

Use the following chart as a guide for maximum wire runs for differential level service (3 wire) field wiring.

Model	Max. Sensitivity (K OHMS)	Distance (Ft.)
27XXDO	3	4,000
27XXEO	10	900
27XXGO	100	75

GROUNDING: Both mounting tabs of the Series 27 provide an electrical connection for earth grounding between the control's internal solid state circuitry and the enclosure chassis. To insure proper grounding, use only metal screws and lock washers when mounting this control.

One of the two ground terminals provided on the intrinsically safe output terminal strip must be connected as reference to the same conductive media presented to terminals "H" and "L" (see applicable wiring diagram on reverse side).

Terminal G1 on the supply line/load side terminal strip is a redundant system ground terminal and should be connected to the earth ground buss of the control's AC supply line feeder.

NOTE:

1. Intrinsically safe terminals can be connected to any non-energy generating or storing switch device such as a pushbutton, limit or float type switch or any Warrick electrode and fitting assembly.
2. To prevent electrical shock from supply line/load side powered connections, the Series 27 should be mounted in a tool accessible enclosure of proper NEMA rated integrity.
3. For additional guidance on "Hazardous Location Installations" and "Intrinsically Safe Devices", consult ANSI/ISA standard RP 12-6 or NEC articles 500 through 516.

MODEL NUMBER DESIGNATION:

SERIES 27 X X X X

- **Enclosure:** 0 – open (no enclosure); 1 – NEMA 1 Enclosure
- **Sensitivity (ohms):** D-3,000; E-10,000; G-100,000
- **Primary AC Supply:** 1 - 120 VAC; 2 - 240 VAC (50/60 Hz)
- **Mode of Operation:** A - Direct; B -Inverse
- **Control Series**

SPECIFICATIONS

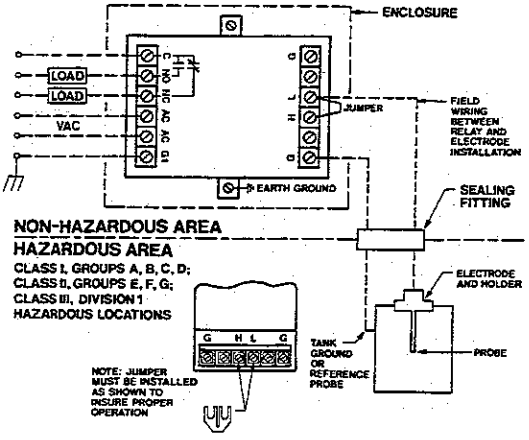
CONTACT DESIGN: SPDT (1 form C), one normally open (N.O.) and one normally closed (N.C.)
CONTACT RATING: 8 Amps - 250 VAC, 8 Amps - 30 VDC. Resistive.
CONTACT LIFE: Electrical @ rated load = 100,000 cycles minimum. Mechanical = 10,000,000 cycles.
ELECTRONICS MODULE: Solid state components epoxy encapsulated in a black nylon shell.
SENSITIVITY RANGE: 0-100,000 Ohms maximum specific resistance.
TEMPERATURE RANGE: (minus) -40 deg F. to (plus) + 150 deg F.
PRIMARY AC SUPPLY LINE: A) Voltage — (120, and 240 VAC) (plus) + 10%, (minus) — 10%. B) Frequency — 50/60 Hertz. C) Power — (Relay energized) 1.7 VA.
SECONDARY CIRCUIT: Nominal 11 Volts, AC, RMS, Current: 2.3 Milliampere, RMS.
TERMINALS: Size 6 pan head screws with captivated wire clamping plate.

WARRICK CONTROLS

INSTALLATION OF WARRICK SERIES 27 — INTRINSICALLY SAFE SENSING CIRCUIT

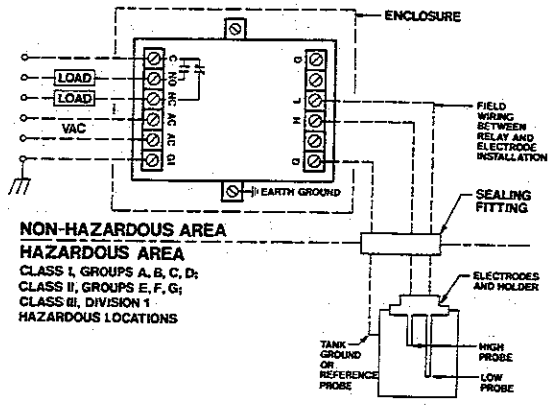
SINGLE LEVEL SERVICE — CONDUCTANCE ACTUATED:

Connect incoming AC (120, 240 VAC) supply to AC terminals:
Incoming earth ground to terminal G1.
Install metallic jumper between terminals H-L.
Connect terminal L to the electrode.
Terminal G must be grounded to the tank if metallic. When the tank is non-metallic, terminal G must be connected to an additional electrode of length equal to the longest electrode.
NOTE: Jumper must be installed as shown to insure proper operation. Wire contacts (C-NO) normally open and (C-NC) normally closed into load circuit as required.



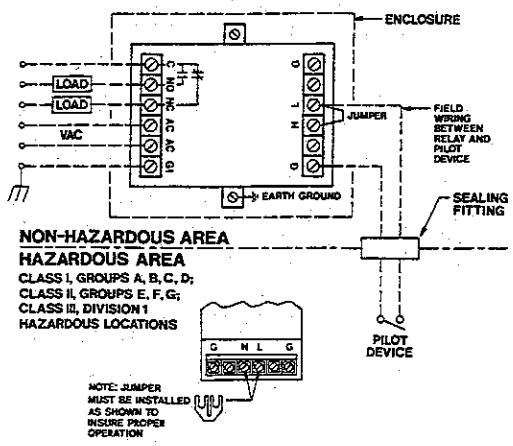
DIFFERENTIAL LEVEL SERVICE — CONDUCTANCE ACTUATED:

Connect incoming AC (120, 240 VAC) supply to AC terminals:
Incoming earth ground to terminal G1.
Connect terminal H to high electrode and terminal L to low electrode.
Terminal G must be grounded to the tank if metallic. When the tank is non-metallic, terminal G must be connected on an additional electrode of length equal to the longest electrode.
Wire contacts (C-NO) normally open and (C-NC) normally closed into load circuit as required.



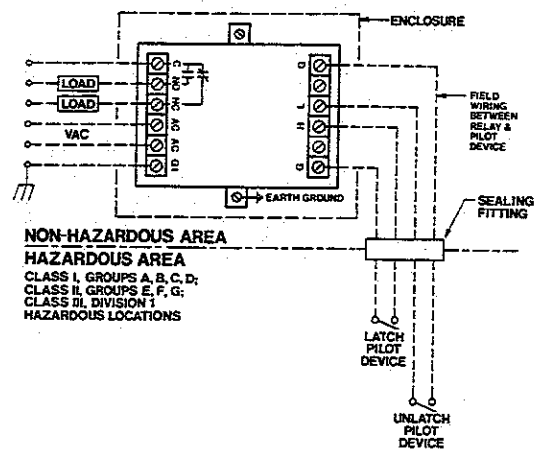
SINGLE INPUT (NON-LATCHING) - PILOT CONTACT ACTUATED:

Connect incoming AC (120, 240 VAC) supply to AC terminals:
Incoming earth ground to terminal G1.
Install metallic jumper between terminals H-L.
Wire contacts (C-NO) normally open and (C-NC) normally closed into load circuits as required.
Connect the pilot contact to terminals G-L.
NOTE: Jumper must be installed as shown to insure proper operation.



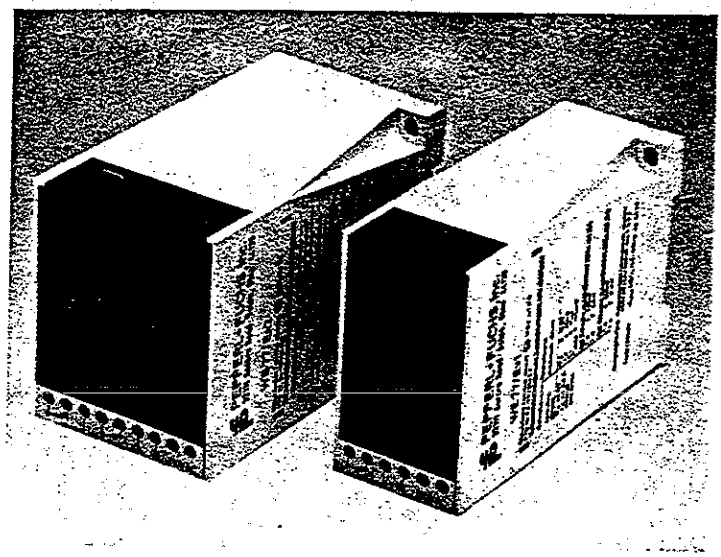
DUAL INPUT (LATCHING) - PILOT CONTACT ACTUATED:

Connect incoming AC (120, 240 VAC) supply to AC terminals:
Incoming earth ground to terminal G1.
Wire contacts (C-NO) normally open and (C-NC) normally closed into load circuits as required.
Connect the latch pilot contact to terminals G-H and the unlatch pilot contact to terminals G-L.



Intrinsically Safe

Switch Isolator



2 Models

WE77/Ex1-UL

Single Channel, SPDT Relay Output
Housing Style A

WE77/Ex2-UL

Dual Channel, SPDT Relay Output
Housing Style B

Description

This device is a transformer isolated intrinsic safety barrier with a built-in amplifier that isolates and transfers discrete signals from a potentially explosive area to a safe area. The following discrete inputs may be used:

- Dry Contact Closures
- P+F NAMUR Output Proximity Sensors
- Open Collector (Potential Free) Transistors

It may also be used to act as an amplifier/interface for discrete signals in non-explosive applications.

Operation

The output changes state when the input signal changes state depending upon the mode of operation selected (see functional diagram).

Approval

UL LISTED

General Specifications

HOUSING STYLES	A & B (See Dimension Page)
OPERATING TEMP. RANGE	-13°F to +140°F
MAXIMUM WIRE SIZE	(2) #16 AWG
HOUSING MATERIAL	NORYL SE O
WEIGHT	
WE77/Ex1-UL	13.5 oz.
WE77/Ex2-UL	14.5 oz.
APPROVED FOR	Class I, II, III; Division 1 and 2; Groups A-G Hazardous Locations

Technical Data

SUPPLY VOLTAGE	120VAC,-15%+10%/45-60Hz*
The supply is isolated from the input and output	
POWER CONSUMPTION	approximately 3.5VA
INPUT	Intrinsically Safe follows FM Approval Standard No. 3610 and all European Standards
The input is isolated from the output and supply	
OPEN CIRCUIT VOLTAGE	approximately 8VDC
SHORT CIRCUIT CURRENT	approximately 8mA
SWITCHING POINT (S)	1.2mA≤S≤2.1mA (1.7mA typical)
RELAY OUTPUT	SPDT
The output is isolated from the supply and input	
AC RATING	Max. Voltage ≤240VAC Max. Current ≤4A Max. Power ≤500VA/cos ϕ ≥.75
DC RATING	110V/0.2A 60V/0.5A 24V/1.0A
MAX. SWITCHING FREQUENCY	10Hz
RESPONSE TIME	Energize approximately 20mS De-energize approximately 10mS

**Other voltages available upon request.*

Operation

Mode Condition

Standard pre-set A-mode: Output energizes with input resistance low.

R-mode option: Output energizes with input resistance high.

RS-mode option: R-mode with lead breakage monitoring of the input.

Lead Breakage Monitor

Additional circuitry monitors the input current.

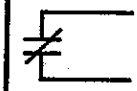
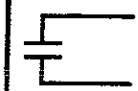
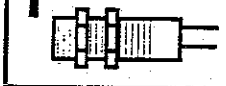
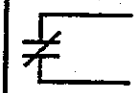
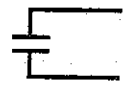
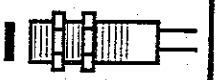
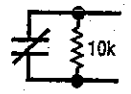
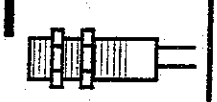
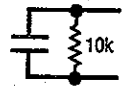
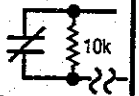
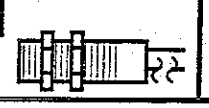
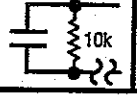
Output de-energizes if current falls below 150μA.

Changing the Mode of Operation

	Single Channel	Dual Channel
Mode of Operation	Jumper at Terminals	Jumper at Terminals
A-mode	3 and 4	2 and 3, 7 and 8
R-mode	4 and 5	3 and 4, 6 and 7
RS-mode	no jumper	no jumper

Functional Diagram

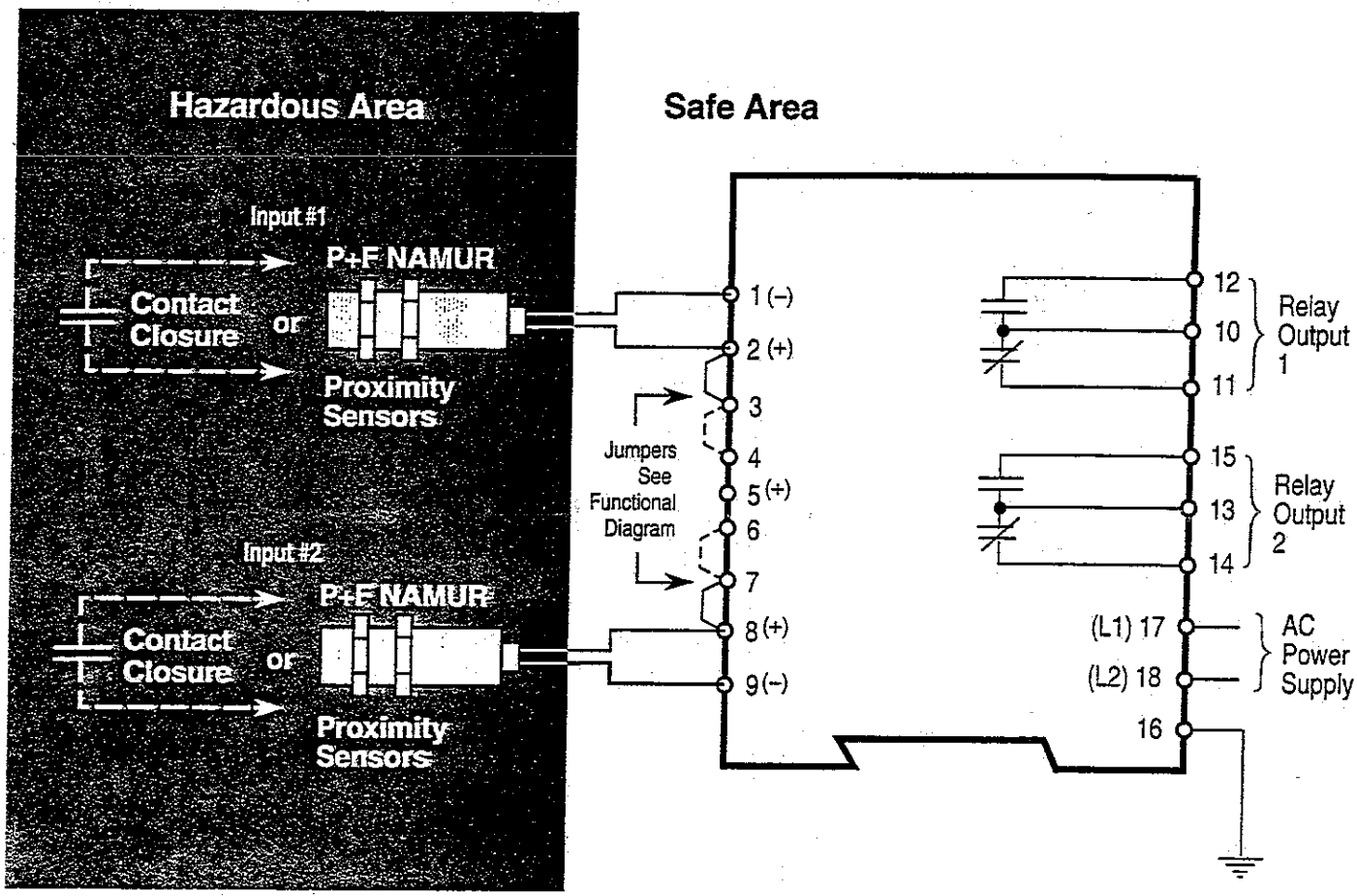
A, R and RS mode
(comparison between NAMUR inductive,
NAMUR capacitive sensor and contact closure).

INPUT			Mode of Operation	Output	LED
NAMUR Inductive Sensor	NAMUR Capacitive Sensor	Contact Closure			
			A	*ON*	*ON*
			A	OFF	OFF
			R	OFF	OFF
			R	*ON*	*ON*
			RS regular operation	OFF	OFF
			RS regular operation	*ON*	*ON*
			RS lead breakage	OFF	OFF
			RS lead breakage	OFF	OFF

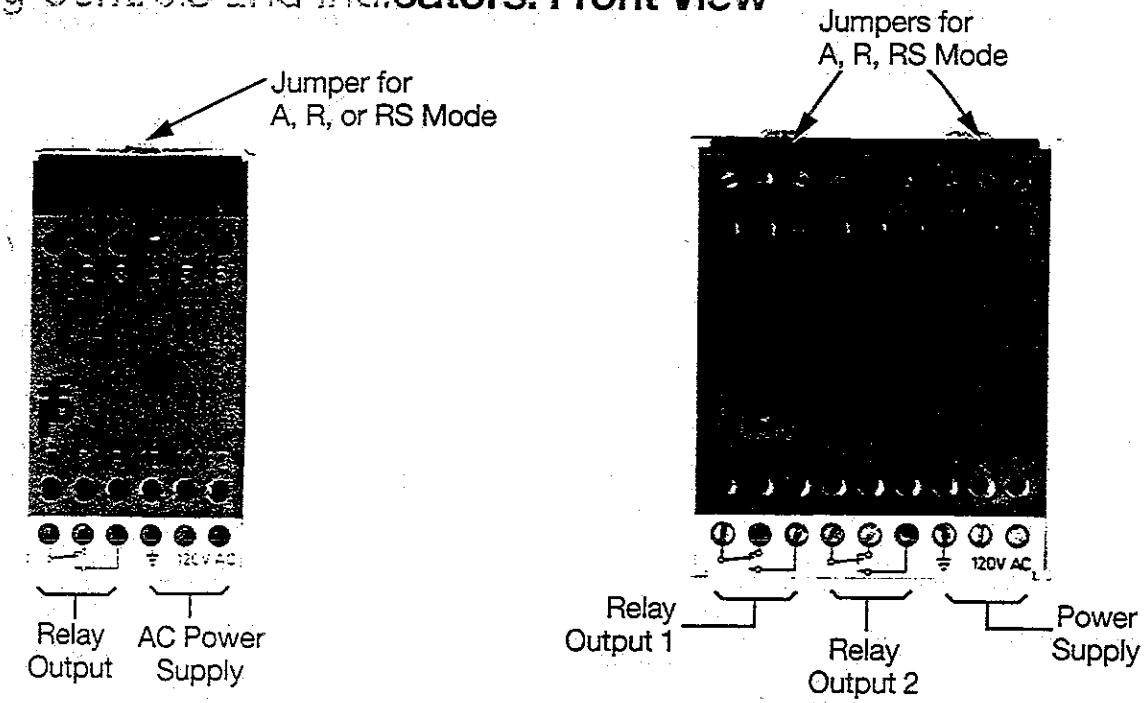
When lead breakage monitoring of a contact closure is desired, the resistor shown **must** be connected at the contact closure for proper results.

Connection Diagram

WE77/Ex2-UL

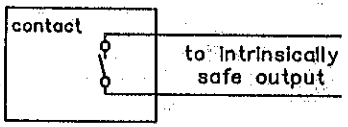


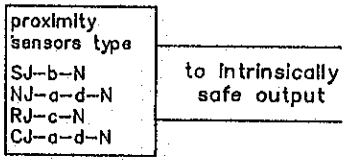
Operating Controls and Indicators: Front View



HAZARDOUS LOCATION

CLASS I, DIVISION 1, GROUPS A, B, C, D AND
CLASS II, DIVISION 1, GROUPS E, F & G
CLASS III





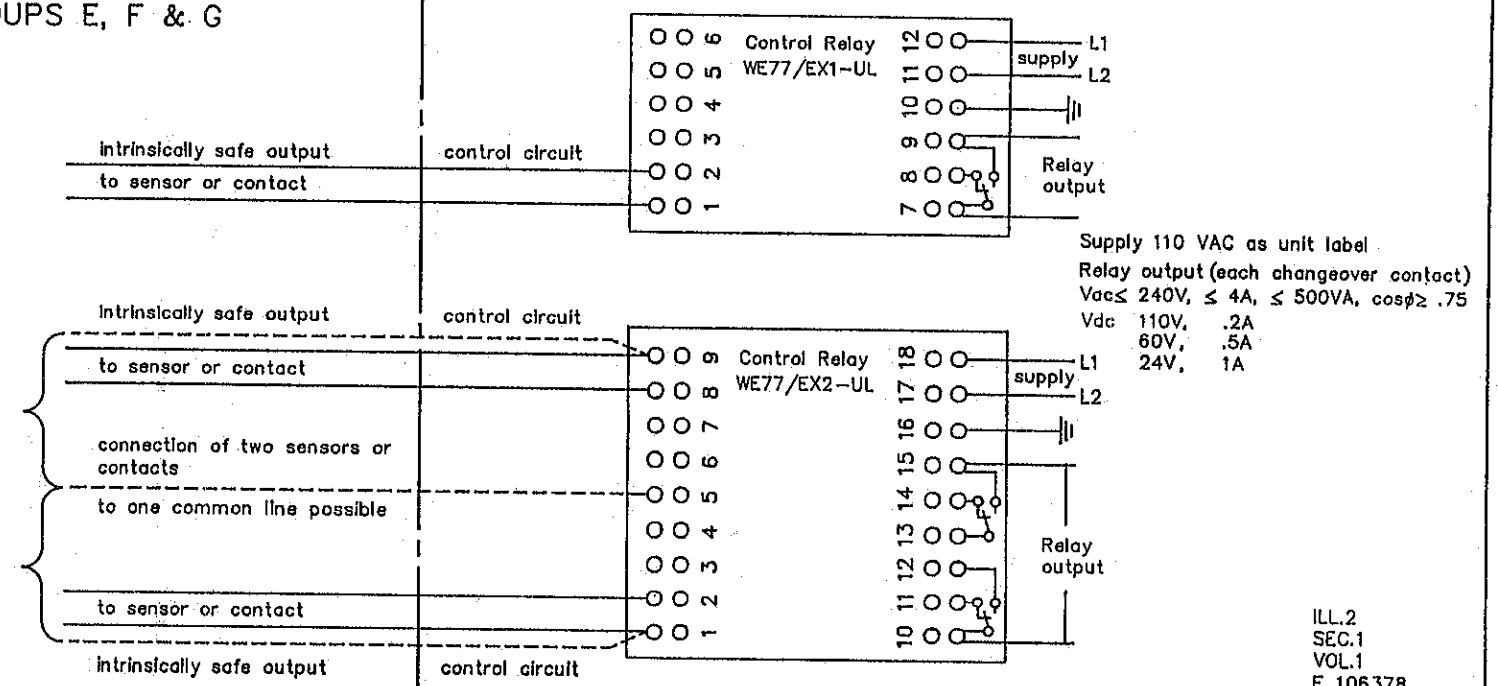
a– sensing range (mm)
b– slot width (mm)
c– ring diameter (mm)
d– mechanical form

Maximum capacitance of each sensor 0.4 microfarads, maximum inductance of each sensor 1.0 millihenry.

* The total series inductance and the shunt capacitance for the field device and cable must be restricted to the following max. values (per terminal pair)

Control Relay	Groups	Max. Inductance, * (millihenries) in series w/Terminals				Max. Capacitance, * (microfarads) across Terminals			
		1&2	8&9	1&5	5&9	1&2	8&9	1&5	5&9
WE77/EX1-UL	A and B	175	—	—	—	4.15	—	—	—
	C	525	—	—	—	18.45	—	—	—
	D	1400	—	—	—	35.1	—	—	—
WE77/EX2-UL	A and B	96	96	96	96	4.15	4.15	4.15	4.15
	C	288	288	288	288	18.45	18.45	18.45	18.45
	D	768	768	768	768	35.1	35.1	35.1	35.1

NON HAZARDOUS LOCATION



Supply 110 VAC as unit label
Relay output (each changeover contact)
Vac≤ 240V, ≤ 4A, ≤ 500VA, cosφ≥ .75
Vdc 110V, .2A
60V, .5A
24V, 1A

ILL.2
SEC.1
VOL.1
E 106378

No changes without prior UL approval

NOTE: Proximity sensors are not a part of the UL listed system

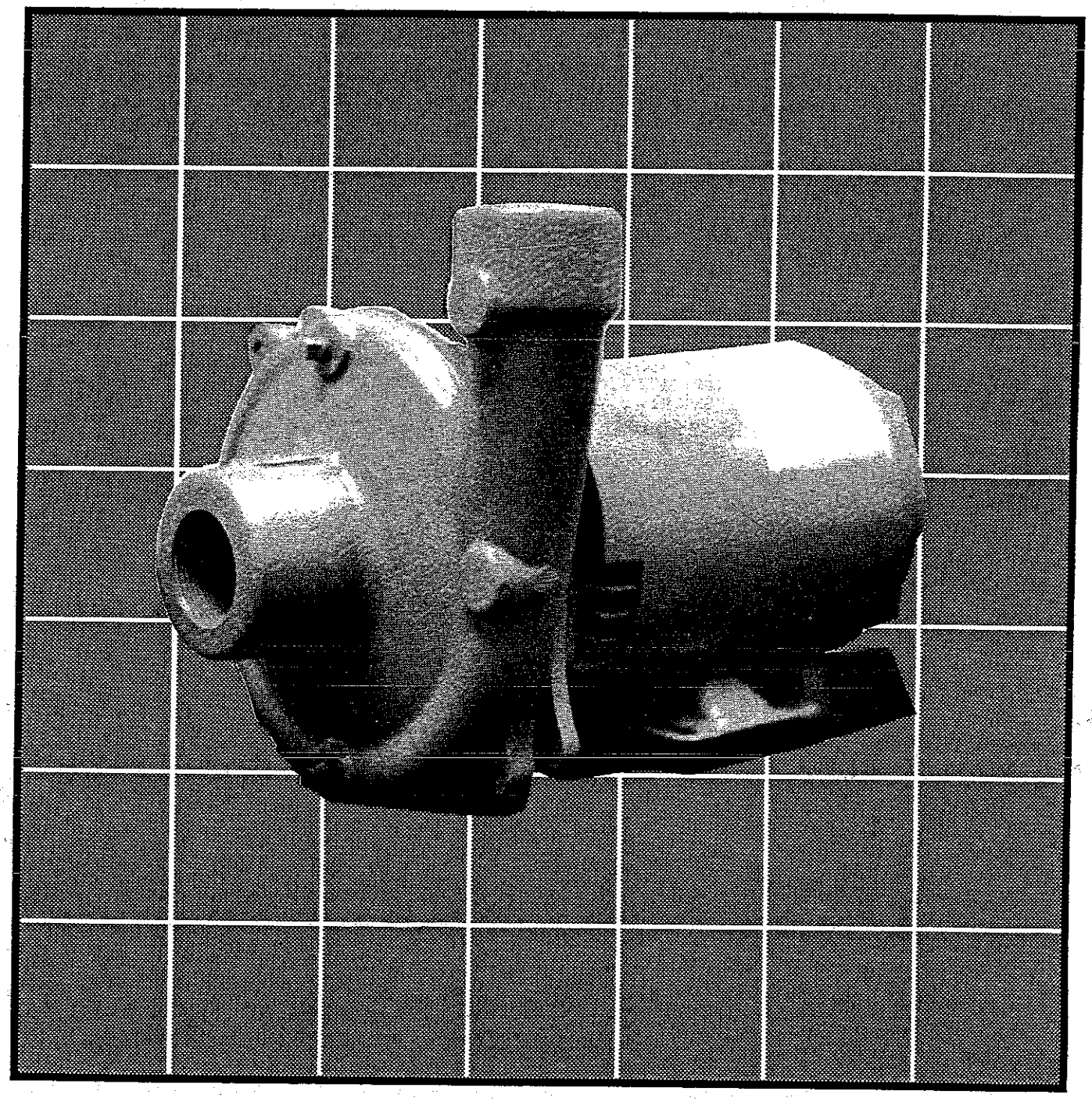
a		Added –UL to all model numbers
	Change from	Change into

In.	Date	Cons.	Resp.	Sale	Appr.
a	4-18-89	m.gl.	CA	DS	
0	2-1-89				

Scale –
Vendor
Dimens –
Title INSTALLATION DWG. FOR CONTROL RELAYS WE77/EX1–UL, WE77/EX2–UL
Draw. No. ID–15a
Part list no.
Pepperl+Fuchs® Inc.
Twinsburg, OH 44087–2202
Repl. for
Sh. 1 of 1

Form 3628

Centrifugal Pump, Type R5 1", R5 1-1/4", & R6 1-1/4"
Installation, Operation and Maintenance Instructions



DUNHAM-BUSH®
DUNHAM DIVISION

NOMENCLATURE

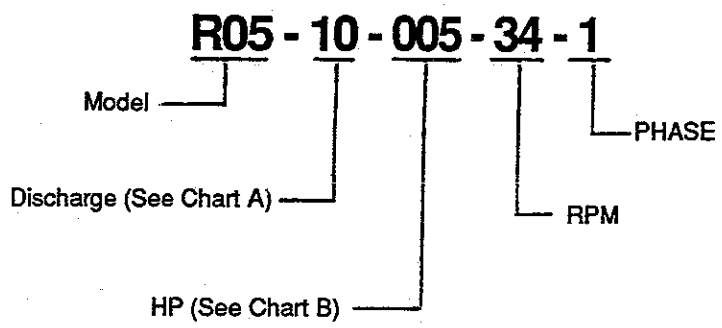


CHART A
10 = 1"
12 = 1-1/4"
15 = 1-1/2"
20 = 2"

CHART B
003 = 1/3 HP
005 = 1/2 HP
007 = 3/4 HP
010 = 1 HP
015 = 1-1/2 HP
020 = 2 HP
030 = 3 HP

ORDERING PROCEDURE

1) Complete part number and description is required when ordering.

2) When a part number is not known or shown in the parts catalog, the complete model and serial number of the unit on which the part is to be used must be given.

3) Send all orders to: Dunham-Bush, Inc., Dunham Division Parts Department,

   P.O. Box 498, 811 E. Main Street, Marshalltown, IA 50158, FAX: (515) 753-0496 or TELE: (515) 752-4291

4) Prices can be found in the latest revision of Form 17448 and are for one item or kit as applicable.

5) Minimum billing is $50.00.

6) All prices are subject to federal, state, local or other taxes which may be applicable.

7) When order requires special handling (emergency order) contact factory for rate and delivery.

8) Dunham-Bush reserves the right to substitute parts if they are interchangeable with those ordered. The invoice will reflect the cost of the actual part shipped.

9) Refer to the latest revision of Form 1278 (located on back of price sheet) for terms of sale.

INTRODUCTION

The Dunham-Bush Type R5 and R6 are radially split, single stage, motor mounted centrifugal pumps. These pumps are supplied with an end face mechanical shaft seal installed, which is especially selected for reliability and life on the particular pump application. All pumps are supplied as complete units including motor.

SECTION 1 - PUMP INSTALLATION

A) LOCATION

1. For satisfactory operation of any centrifugal pump it is necessary that adequate "Net Positive Suction Head" (NPSH) be available at the pump suction connection (NPSH is the total head in feet absolute, less the vapor pressure of the liquid in feet absolute, available to the pump). For this reason the pump should be located as close to the liquid source as possible.

2. Adequate head room should be provided for the us of installing equipment.

3. Adequate space should be allowed for inspection during pump operation.

B) FOUNDATION

1. The foundation must be solid and substantial enough to absorb mechanical vibration. In general concrete foundations are the most satisfactory and when used, bolts should be supplied which are imbedded for pump footing. Bolts should be long enough to insure proper tightening (minimum of six (6) threads

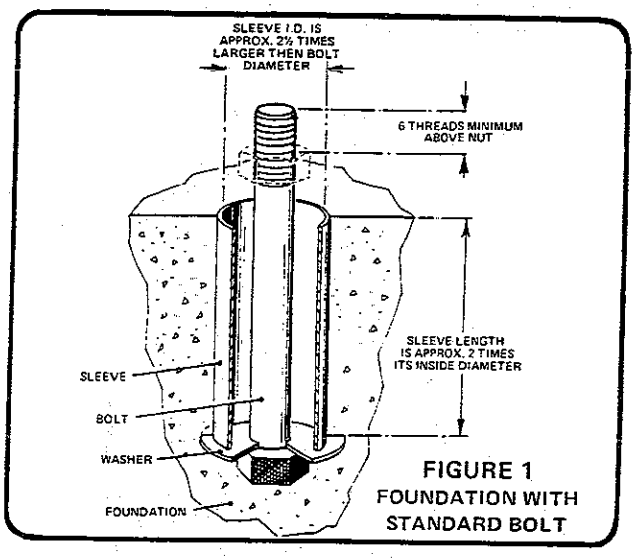


FIGURE 1
FOUNDATION WITH STANDARD BOLT

should protrude beyond nut), and it is recommended that each bolt (standard or "J" type) be fitted with a pipe sleeve that is approximately 2-1/2 times the bolt diameter of the sleeve. When using a standard bolt (figure 1) a washer should be used to support the head of the bolt in the sleeve. After the concrete foundation has been poured, the pipe sleeve remains in place allowing for alignment with the holes in the motor feet.

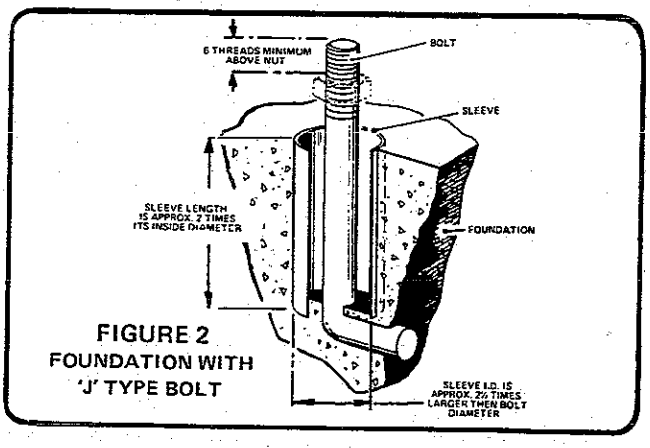


FIGURE 2
FOUNDATION WITH 'J' TYPE BOLT

2. When "J" type bolts (figure 2) are used the same procedure is used except that no washer is needed.

3. If the foundation has been laid, holes may be drilled and expansion bolts used to anchor the pump to the foundation.

C) MOUNTING PUMP - Foot Mounted

1. Uncrate the pump leaving all instructions attached and install at its' place of operation.

2. Locate the leveling plates and shims at each foundation bolt.

3. Level the motor perpendicular to shaft, shimming as necessary.

4. Level the motor parallel to shaft and tighten the nuts on the foundation bolts evenly.

C) MOUNTING PUMP - Pipe Mounted

1. Horizontal Lines - Normally the pump is mounted with the motor perpendicular to the ground with the motor end up. The piping must be adequate to support both the piping and pump.

2. Vertical Lines - The motor will be parallel to the floor and may require additional support other than that offered by the piping.

D) PIPING

1. Both suction and discharge piping should be as short and as direct as possible. There should be as few fittings and bends as possible. Bends, where used should be of the long radius variety.

2. Piping should be supported near the pump to prevent strains from being transmitted to the pump, and piping at the pump suction and discharge should be as large or larger than the openings in the pump.

3. Gate valves and pressure gauges should be installed in both the suction and discharge line to facilitate pump maintenance and performance checks.

E) SUCTION PIPING

1. Suction piping must be free of vapor trapping pockets.

2. In horizontal piping leading to the pump only eccentric-reducers should be used (see figures 3 & 4).

3. The suction pipe must be free from the expansion of hot lines.

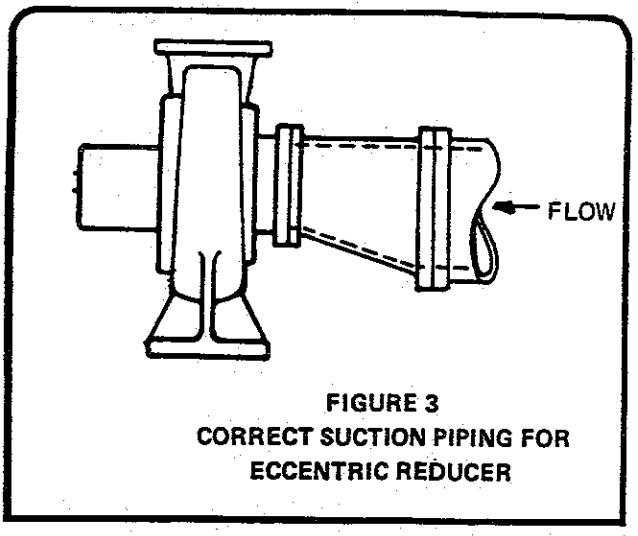


FIGURE 3
CORRECT SUCTION PIPING FOR ECCENTRIC REDUCER

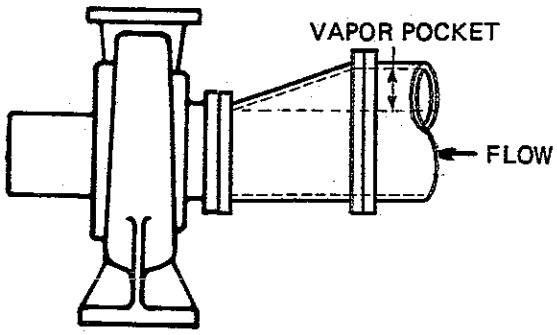


FIGURE 4
INCORRECT SUCTION PIPING FOR ECCENTRIC REDUCER

4. It is recommended that a strainer be installed near the pump suction inlet to catch scale or other foreign material. A pressure gauge installed on each side of the strainer can be used for measuring the pressure drop across the strainer.

5. If a strainer or foot valve is to be used on the inlet end of the suction line, the free area through the strainer or valve should be approximately 2-1/2 to 4 times the area of the suction pipe.

F) DISCHARGE PIPING

1. On some installations, a check valve and balancing cock in addition to a gate valve may be required in the discharge piping. The check valve would be used to prevent liquid from running back through the pump in case of failure of the motor. The balancing cock is used to control the pumps' operating capacity by providing a changeable control in the piping system. The gate valve would be used in priming, starting and shutting down the pump.

2. When valves are required in the discharge line, they should be located as near as possible to the pump.

3. In some applications when the pump may be operated with zero flow, provisions should be made for recirculating a portion of the liquid from the discharge to the suction of the pump to reduce the possibility of overheating.

G) PIPING FOR SPARE PUMPS

1. Spare pumps in high temperature service should be piped so that hot liquid from the discharge of the operating pump circulates continuously through a by-pass to the spare pump and back to the suction of the operating pump. This can greatly reduce thermal shock when the spare pump is started.

H) INSTALLING PUMP

1. Make up the piping to the suction and discharge connections of the pump. All piping must be properly supported by hangers and not by the pump.

2. Wire the pump motor for the voltage required as specified on the wiring diagram located on the motor nameplate, or in cover of the motor terminal box. All wiring must be in accordance with local regulations. If the motor is damaged due to improper wiring, the guarantee is void.

SECTION 2 - PUMP OPERATION

A) Starting Pump

1. Open the suction and discharge valves to the pump. <u>These pumps have a mechanical seal and must NOT be run dry.</u> Open the cock at the top of the pump case to vent out any air.

<u>NOTE:</u> a. If the pump is above the level of the liquid to be pumped, close the discharge valve. If the pump is below the level of the liquid, open the discharge valve 1-1/2 to 2 turns.

b. Prime the pump. All air and vapor must be removed. The pump case and suction pipe must be filled with liquid before the pump is started.

2. Rotate the pump shaft by hand (if possible) to be sure the pump is not binding. On some models the end of the motor shaft has a screwdriver slot. It may be used to turn the shaft. A check for sticking of the shaft should also be made after a prolonged pump shutdown. Close discharge valve, then open slightly.

3. Start the pump and check for correct rotation according to the arrow on the case. If it is running in the wrong direction on three phase current, change any two leads to the motor. You must disconnect the power before changing the wiring.

4. Lack of capacity and head may indicate the passageways of the pump impeller have become clogged with foreign matter or that the motor speed is low. If speed of the motor is low, the wiring connections at the motor should be checked for miswiring or looseness. If the pump is wired for 460 volt current, but is actually operating on 230 volt current, the motor will never come up to proper speed and may burn out. If low voltage occurs, notify local power company. Slugging of air is another cause of low capacity and head on a closed system. Be sure the system is properly vented of all air - see further notes under Trouble Shooting - Section IV.

<u>**WARNING - DO NOT ATTEMPT TO OPERATE PUMP WITH SUCTION VALVE CLOSED!**</u>

5. As soon as the pump is up to full speed, slowly open the discharge valve until it is completely open. Do not let the pump run with the discharge valve closed.

6. Check the pressure gauges on each side of the strainer in the suction line. A pressure drop across the strainer indicates it is becoming clogged with dirt or scale. In this case, the pump should be shut down and the strainer screen cleaned or replaced. A clogged strainer can cause damage to the pump.

7. The pump should be shut down if motor bearings overheat, if there is undue vibration or noise, or if it fails to develop its rated discharge pressure at operating speed.

B) OPERATING AT REDUCED CAPACITY

1. If the pump is connected to a constant speed driver or motor, the capacity of the pump can be reduced by throttling the discharge. When throttling the discharge, a by-pass connection may be used to by-pass sufficient liquid back to the suction inlet to prevent overheating.

C) OPERATING ROUTINE

1. Check the bearing temperatures periodically. If there is overheating, check the motor to insure adequate lubrication. Normal inspection consists of periodic checks of motor lubrication.

2. Lubricating the pump motor should be done in accordance with manufacturer's recommendations.

3. Check all seals for leakage.

4. Check the suction and discharge pressure gauges. If the differential pressure drops critically, shut down the pump at once.

D) STOPPING

1. The pump should be shut down rapidly to keep liquid in the pump and to prevent the parts from seizing. After stopping the driver, close the discharge valve and then the inlet valve, in that order. Sometimes it is necessary to close the discharge valve immediately after stopping the driver to prevent reverse rotation. If the pumps are to remain idle under freezing conditions, precautions, such as draining the case, should be taken to avoid damage.

SECTION 3 - MAINTENANCE INSTRUCTIONS

A) R5 & R6 PUMP DISASSEMBLY AND ASSEMBLY
(Refer to Figures 5 & 6)

1. Disconnect the power to pump.

2. Close the valves in suction and discharge lines or drain the system.

3. Remove the 4 hex head screws (7), holding the adapter (2), to the case (1). Disassemble the adapter (2), from the case (1), by sliding the motor back.

4. Remove the case O-Ring (5) and clean the O-Ring surfaces on the case (1), and adapter (2).

5. Remove the plug covering the shaft end in motor.

6. Hold motor shaft from turning by using a large blade screwdriver in slot of motor shaft end and remove the impeller by turning it counter clockwise. Three phase pumps require heat on shaft to loosen.

7. Remove the adapter (2), and mechanical seal (4), from the shaft by first removing 4 hex cap screws (6), and then pulling the adapter (2), from the motor (9).

8. Remove stationary mechanical seal cup and mating ring from the adapter (2).

9. Clean the motor shaft and seal bore on adapter with solvent and inspect for scrapes, nicks and scratches.

Lightly polish the shaft to remove blemishes.

continued next page

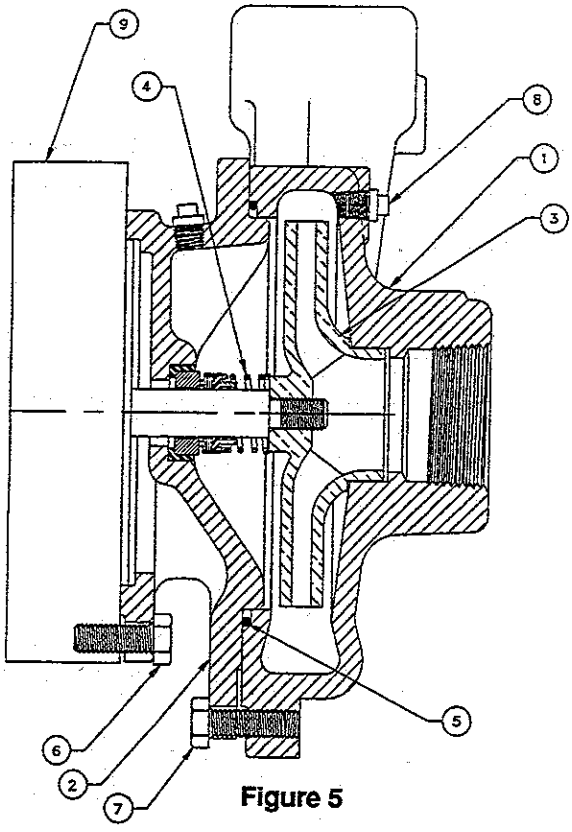
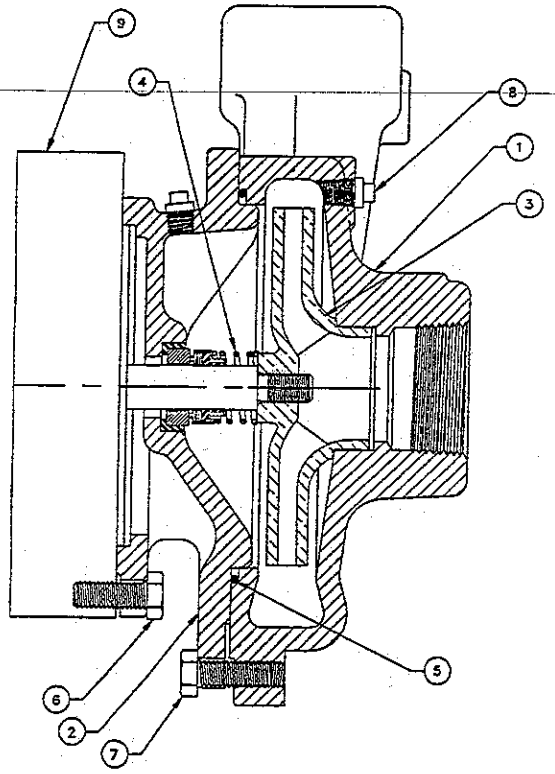


Figure 5

10. Lightly lubricate the O.D. of the stationary member of the new seal. With the seal seat towards the impeller, press the seal firmly into the adapter recess. Make sure that the seat is level and square. **NOTE: EXTREME CAUTION MUST BE EXERCISED NOT TO SCRATCH, GOUGE OR OTHERWISE MAR THE SEALING SURFACE OF THE MECHANICAL SEAL OR LEAKAGE WILL LIKELY RESULT. DO NOT LUBRICATE EPT SEALS WITH OIL OR VASOLINE.**

Figure 5



11. Mount the adapter (2), on the motor (9), by using four hex head cap screws (6).

12. To assemble mechanical seal rotating element (4), onto the shaft; Lightly lubricate the I.D. of new bellows and slide it over shaft with the carbon seal face towards the stationary seal face until seal faces meet.

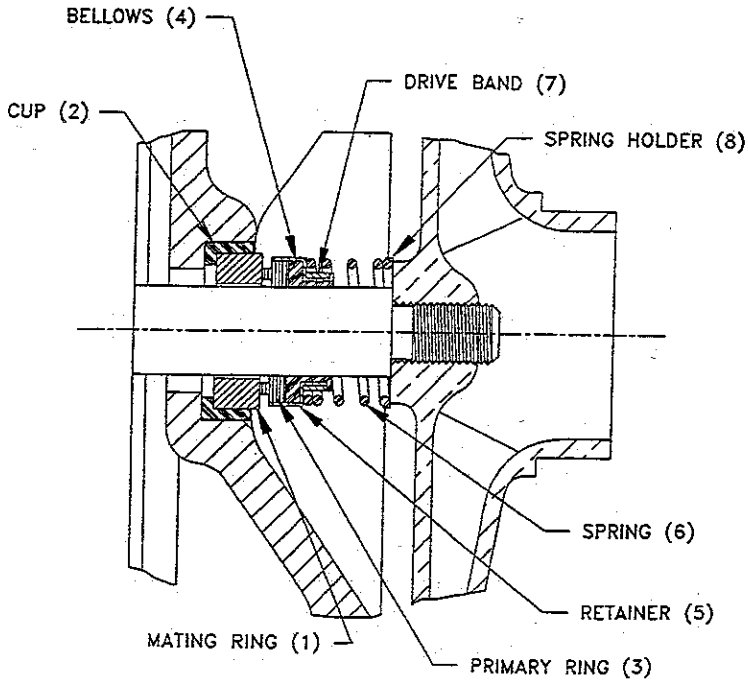
Place spring (6), on the rotating member retainer so it seats properly against the shoulder.

Place spring holder (8), against the spring. Be sure the rolled edge faces toward the spring.

13. Screw the impeller (3), onto the shaft while holding shaft stationary with screwdriver placed in motor shaft slot. Make sure impeller is snugged up tight. Use a screwdriver to pry the spring holder (8), away from the impeller to be sure that the retainer isn't caught between the shaft shoulder and impeller.

14. Place the O-Ring (5), in the case and assemble pump and motor to case (1), using 4 hex head cap screws (7).

Figure 6



15. Remount motor to base.

16. Open valve to pump and refill the system and check for leaks.

17. Reconnect power to pump.

PARTS

ITEM	PART #	DESCRIPTION
1	C2-4407	CASE R5-1" CAST IRON
1	C2-4403	CASE R5-1-1/4" CAST IRON
1	C2-4395	CASE R6-1-1/4" CAST IRON
1	C2-4477	CASE R5-1 BRONZE
1	C2-4478	CASE R5-1-1/4" BRONZE
1	C2-4476	CASE R6-1-1/4" BRONZE
2	C2-4375	ADAPTER R5 CAST IRON
2	C2-4396	ADAPTER R6 CAST IRON
2	C2-4475	ADAPTER R5 BRONZE
2	C2-4474	ADAPTER R5 BRONZE
2	B2-5272	IMPELLER R5 1" BRONZE
3	B2-5264	IMPELLER R5 1-1/4" BRONZE
3	B2-5239	IMPELLER R6 1-1/4" BRONZE
3	B2-5283	IMPELLER R5 1" CAST IRON
3	B2-5281	IMPELLER R5 1-1/4" CAST IRON

(parts continued next page)

ITEM	PART #	DESCRIPTION
3	B2-5282	IMPELLER R6 1-1/4" CAST IRON
3	472	SEAL BUNA-N
3	2944	SEAL EPT
4	2143	SEAL VITON
4	4837	O-RING R5 BUNA-N
5	4901	O-RING R5 EPT
5	4902	O-RING R5 VITON
5	4831	O-RING R6 BUNA-N
5	4893	O-RING R6 EPT
5	4894	O-RING R6 VITON
6	753CO2A2	CAP SCREW
7	753CO2A3	CAP SCREW
8	4837	PIPE PLUG
8	459	1/3 HP ODP SINGLE PHASE MOTOR
8	460	1/2 HP ODP SINGLE PHASE MOTOR
8	461	3/4 HP ODP SINGLE PHASE MOTOR
8	462	1 HP ODP SINGLE PHASE MOTOR
9	463	1-1/2 HP ODP SINGLE PHS. MOTOR
9	464	2 HP ODP SINGLE PHASE MOTOR

ITEM	PART #	DESCRIPTION
9	2770	1/3 HP ODP THREE PHASE MOTOR
9	2771	1/2 HP ODP THREE PHASE MOTOR
9	2772	3/4 HP ODP THREE PHASE MOTOR
9	2773	1 HP ODP THREE PHASE MOTOR
9	2774	1-1/2" HP ODP THREE PHS. MOTOR
9	2775	2 HP ODP THREE PHASE MOTOR
9	4551	3 HP ODP THREE PHASE MOTOR
9	459E	1/3 HP TEFC SINGLE PHS. MOTOR
9	460E	1/2 HP TEFC SINGLE PHS. MOTOR
9	461E	3/4 HP TEFC SINGLE PHS. MOTOR
9	462E	1 HP TEFC SINGLE PHS. MOTOR
9	463E	1-1/2 HP TEFC SINGLE MOTOR
9	464E	2 HP TEFC SINGLE PHS. MOTOR
9	2770E	1/3 HP TEFC THREE PHS. MOTOR
9	2771E	1/2 HP TEFC THREE PHS. MOTOR
9	2772E	3/4 HP TEFC THREE PHS. MOTOR
9	2773E	1 HP TEFC THREE PHASE MOTOR
9	2774E	1-1/2 HP TEFC 3-PHASE MOTOR
9	2775E	2 HP TEFC 3-PHASE MOTOR
9	4551E	3 HP TEFC 3-PHASE MOTOR

SECTION IV - TROUBLE SHOOTING

Operating troubles and their probable causes are as follows:

A) INSUFFICIENT OR NO DISCHARGE PRESSURE

1. Wrong direction of rotation.
2. Pump not primed.
3. Air or vapor in suction line.
4. Suction pipe not submerged enough.
5. Available NPSH not sufficient.
6. Pump not up to rated speed.
7. Too much system head.

B) INSUFFICIENT PRESSURE

1. Wrong direction of rotation.
2. Air or vapor in suction line.
3. Air leaks in suction line.
4. Suction line not submerged enough.
5. Available NPSH not sufficient.
6. Pump not up to rated speed.
7. Mechanical defects; Impeller damaged, or internal leakage (clearances).

C) CAVITATION OR NOISE

1. Air or gas in liquid.
2. Suction line not filled with liquid.
3. Suction line not submerged enough.
4. Available NPSH not sufficient.

D) PUMP LOSES SUCTION AFTER STARTING

1. Air leaks in suction line.
2. Air or vapor in suction line.
3. Suction line not submerged enough.
4. Available NPSH not sufficient.

E) EXCESSIVE POWER CONSUMPTION

1. Speed too high.

2. Insufficient back pressure.

3. Mechanical Defects; shaft bent, rotating element dragging, piping improperly supported.

F) VIBRATION

1. Air or vapor in suction line.

2. Worn or loose motor bearings.

3. Rotating element out of balance.

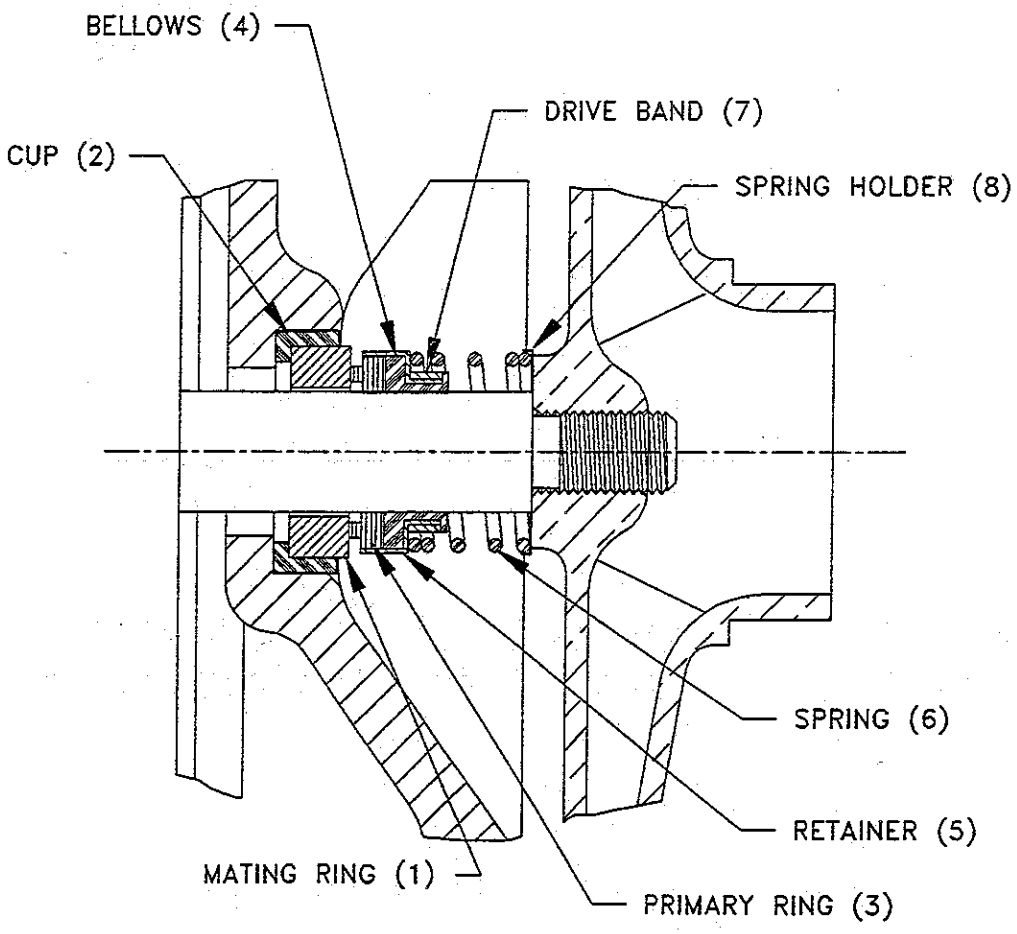
4. Shaft bent.

5. Foundation not rigid.

6. Vibration in the driver.

7. Wrong location of control valve.

8. Piping improperly supported



GRUNDFOS®

GRUNDFOS PUMPS MANUFACTURING CORPORATION
5900 E. Shields Avenue
Fresno, CA 93727

Telephone: (559) 292-8000
Voicemail: (559) 292-1865
Admin. Fax: (559) 292-2353
MRQ Purch. Fax: (559) 292-2891
PROD. Purch. Fax: (559) 292-1578

June 20, 2001

MORRIS INDUSTRIES INC
P.O. BOX 278
POMPTON PLAINS, NJ 07444-0278

RE: **Verified Performance Test**
Morris Industries Inc. P/O 20955
Grundfos Order No. 671028663, Co. GPU

Enclosed you will find the requested: VERIFIED PERFORMANCE/TEST DATA FOR:

TEST NO.	GRUNDFOS PUMP MODEL NO.	PUMP PRODUCT NO.
01-06-20A	7S03-8	03004Z08

If you have any questions, please feel free to contact me.

Kind regards,

GRUNDFOS PUMPS MANUFACTURING CORPORATION

Richard Frias

Mr. Richard Frias,
Engineering Lab Technician

I:ENGN\LABTEST\VER&HYD\2000\000711.DOC

GRUNDFOS®

VERIFIED PERFORMANCE TEST - GROUNDWATER PRODUCTS

Verified Test No.: 01-06-20A
Date: June 20, 2001

Model No.: 7S03-8
Serial No.: P1 0125 US
Grundfos Co. No.: GPU
Grundfos Order No.: 671028663

Product No.: 03004Z08
Customer Name: MORRIS INDUSTRIES INC
Customer No.: 600000487
Customer P.O.: 20955

Motor:
HP: 1/3 **PH:** 1
RPM: 3450 **HZ:** 60
Serial No.: 01B1828-2958
Date Code: ---
Manufacturer: FRANKLIN

Volts: 230
Amps: 4.0
S.F. Amps: 4.6
S.F.: 1.75
Model/Cat. No.: 2445039004
Part No.: 337443920
Encl.: ----

FLOW	DIFF. HEAD	AMPS	TEST VOLTAGE
GPM	FEET	L1	L1
0.0	217.1	3.5	230.4
1.0	212.5	3.6	230.9
3.0	200.9	3.8	230.6
5.0	173.2	4.1	230.7
7.0	142.0	4.3	230.9
9.0	94.7	4.4	230.5

Tested By: Richard Frias

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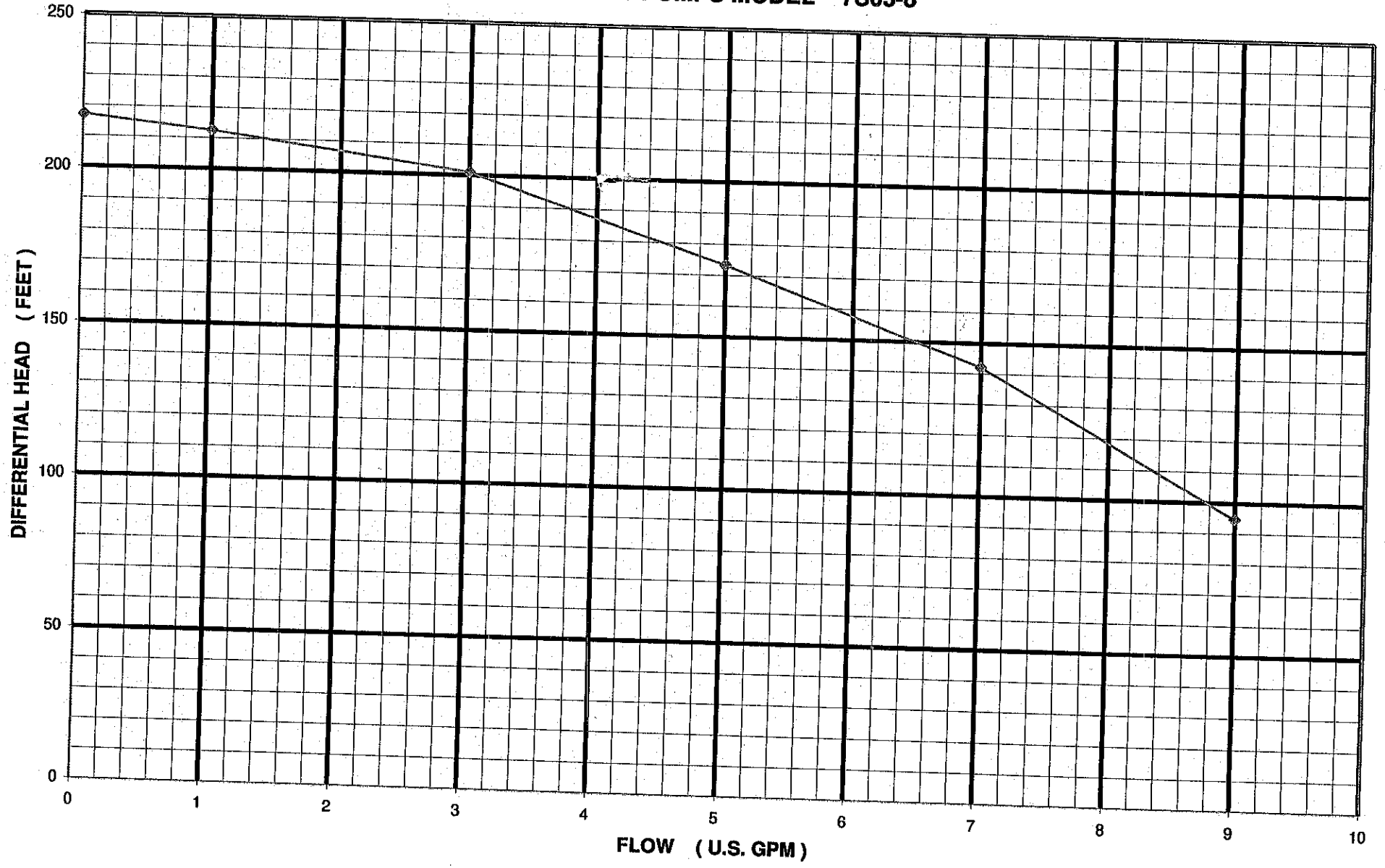
VERIFIED PERFORMANCE TEST 01-06-20A
GRUNDFOS PUMPS MODEL 7S03-8



RICHARD FRIAS
6/20/01

GRUNDFOS®

GRUNDFOS PUMPS MANUFACTURING CORPORATION
5900 E. Shields Avenue
Fresno, CA 93727

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Voicemail: (559) 292-1865
Admin. Fax: (559) 292-2353
MRQ Purch. Fax: (559) 292-2891
PROD. Purch. Fax: (559) 292-1578

June 20, 2001

MORRIS INDUSTRIES INC
P.O. BOX 278
POMPTON PLAINS, NJ 07444-0278

RE: **Verified Performance Test**
Morris Industries Inc. P/O 20955
Grundfos Order No. 671028663, Co. GPU

Enclosed you will find the requested: VERIFIED PERFORMANCE/TEST DATA FOR:

TEST NO.	GRUNDFOS PUMP MODEL NO.	PUMP PRODUCT NO.
01-06-20C	7S03-8	03004Z08

If you have any questions, please feel free to contact me.

Kind regards,

GRUNDFOS PUMPS MANUFACTURING CORPORATION

Richard Frias

Mr. Richard Frias,
Engineering Lab Technician

I:ENGN\LABTEST\VER&HYD\2000\000711l.DOC

GRUNDFOS®

VERIFIED PERFORMANCE TEST - GROUNDWATER PRODUCTS

Verified Test No.: 01-06-20C
Date: June 20, 2001

Model No.: 7S03-8
Serial No.: P1 0125 US
Grundfos Co. No.: GPU
Grundfos Order No.: 671028663

Product No.: 03004Z08
Customer Name: MORRIS INDUSTRIES INC
Customer No.: 600000487
Customer P.O.: 20955

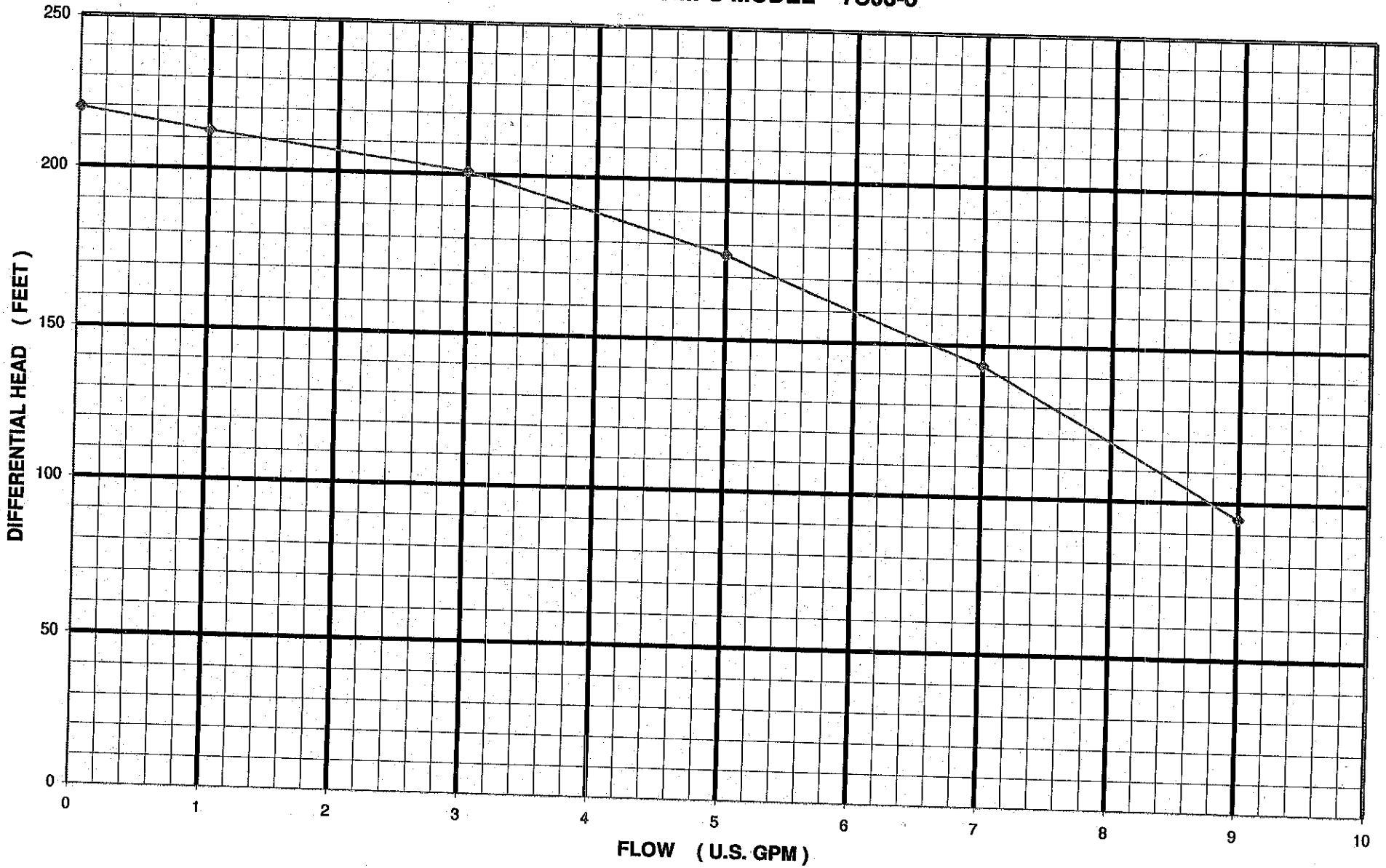
Motor:
HP: 1/3 **PH:** 1
RPM: 3450 **HZ:** 60
Serial No.: 01B1828-2928
Date Code: ---
Manufacturer: FRANKLIN

Volts: 230
Amps: 4.0
S.F. Amps: 4.6
S.F.: 1.75
Model/Cat. No.: 2445039004
Part No.: 337443920
Encl.: ----

FLOW	DIFF. HEAD	AMPS	TEST VOLTAGE
GPM	FEET	L1	L1
0.0	219.4	3.5	230.9
1.0	212.5	3.6	230.8
3.0	200.9	3.9	230.7
5.0	176.7	4.2	230.6
7.0	143.2	4.4	230.4
9.0	94.7	4.4	230.3

Tested By: Richard Frias

VERIFIED PERFORMANCE TEST 01-06-20C
GRUNDFOS PUMPS MODEL 7S03-8



RICHARD FRIAS
6/20/01

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June 20, 2001

MORRIS INDUSTRIES INC
P.O. BOX 278
POMPTON PLAINS, NJ 07444-0278

RE: **Verified Performance Test**
Morris Industries Inc. P/O 20955
Grundfos Order No. 671028663, Co. GPU

Enclosed you will find the requested: VERIFIED PERFORMANCE/TEST DATA FOR:

TEST NO.	GRUNDFOS PUMP MODEL NO.	PUMP PRODUCT NO.
01-06-20B	7S03-8	03004Z08

If you have any questions, please feel free to contact me.

Kind regards,

GRUNDFOS PUMPS MANUFACTURING CORPORATION

Richard Frias

Mr. Richard Frias,
Engineering Lab Technician

I:ENGN\LABTEST\VER&HYD\2000\000711l.DOC

GRUNDFOS®

VERIFIED PERFORMANCE TEST - GROUNDWATER PRODUCTS

Verified Test No.: 01-06-20B
Date: June 20, 2001

Model No.: 7S03-8
Serial No.: P1 0125 US
Grundfos Co. No.: GPU
Grundfos Order No.: 671028663

Product No.: 03004Z08
Customer Name: MORRIS INDUSTRIES INC
Customer No.: 600000487
Customer P.O.: 20955

Motor:
HP: 1/3 **PH:** 1
RPM: 3450 **HZ:** 60
Serial No.: 01B1828-3008
Date Code: ---
Manufacturer: FRANKLIN

Volts: 230
Amps: 4.0
S.F. Amps: 4.6
S.F.: 1.75
Model/Cat. No.: 2445039004
Part No.: 337443920
Encl.: ----

FLOW GPM	DIFF. HEAD FEET	AMPS L1	TEST VOLTAGE L1
0.0	217.1	3.6	230.7
1.0	212.5	3.7	230.8
3.0	199.8	3.9	230.8
5.0	175.5	4.2	230.0
7.0	142.0	4.4	230.0
9.0	95.8	4.6	230.2

Tested By: Richard Frias

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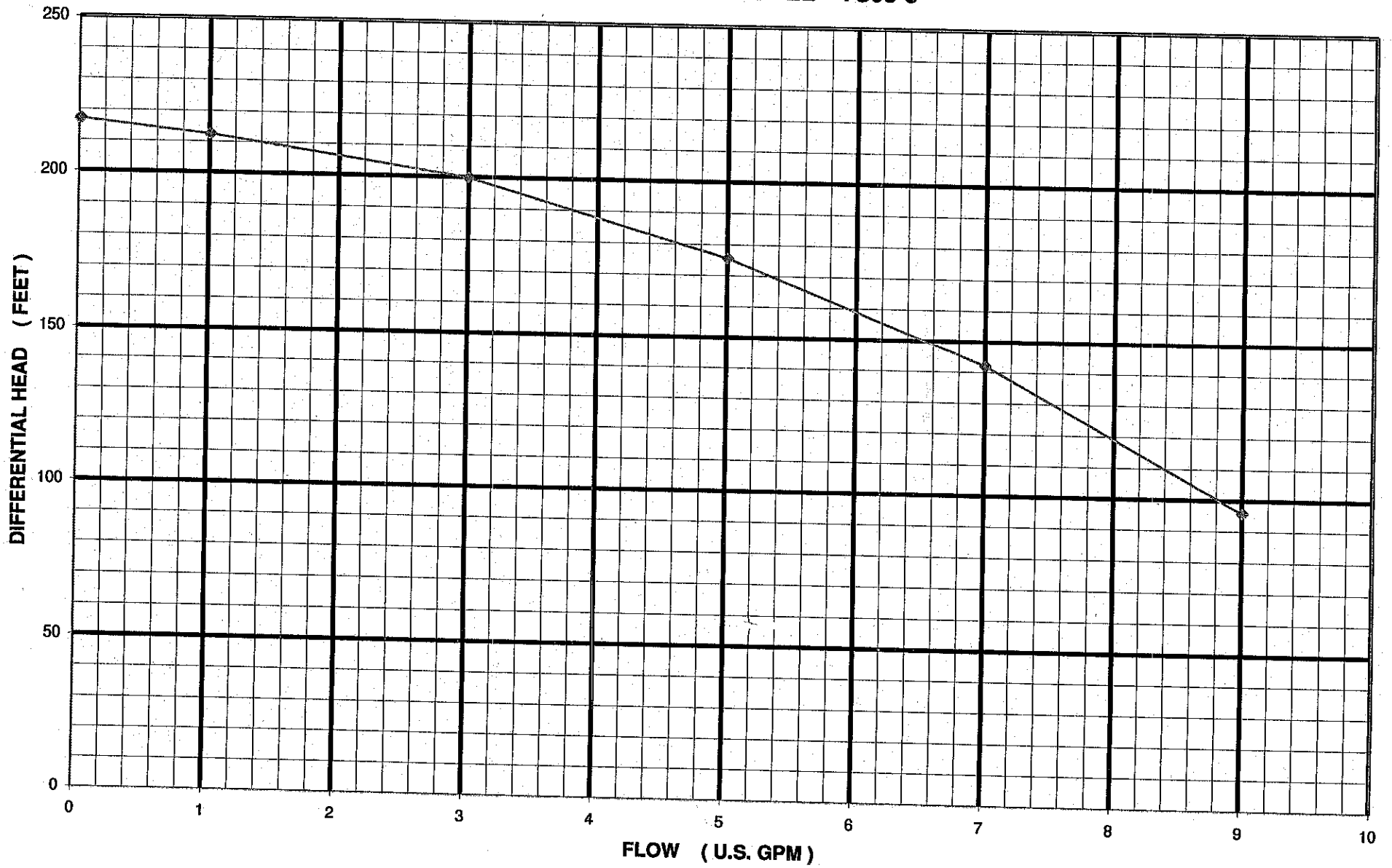
VTF 0001 A | LRD 061697

VERIFIED PERFORMANCE TEST 01-06-20B
GRUNDFOS PUMPS MODEL 7S03-8



RICHARD FRIAS
6/20/01

FILTER EQUIPMENT CO., INC.
P.O. BOX 1452
WALL, NJ 07719
(732) 938-7440

ATLANTA, GA
NAPLES, FL
(800) 445-9775

Installation, Operating and Safety Manual for Liquid Filter Housings and Filter Bags

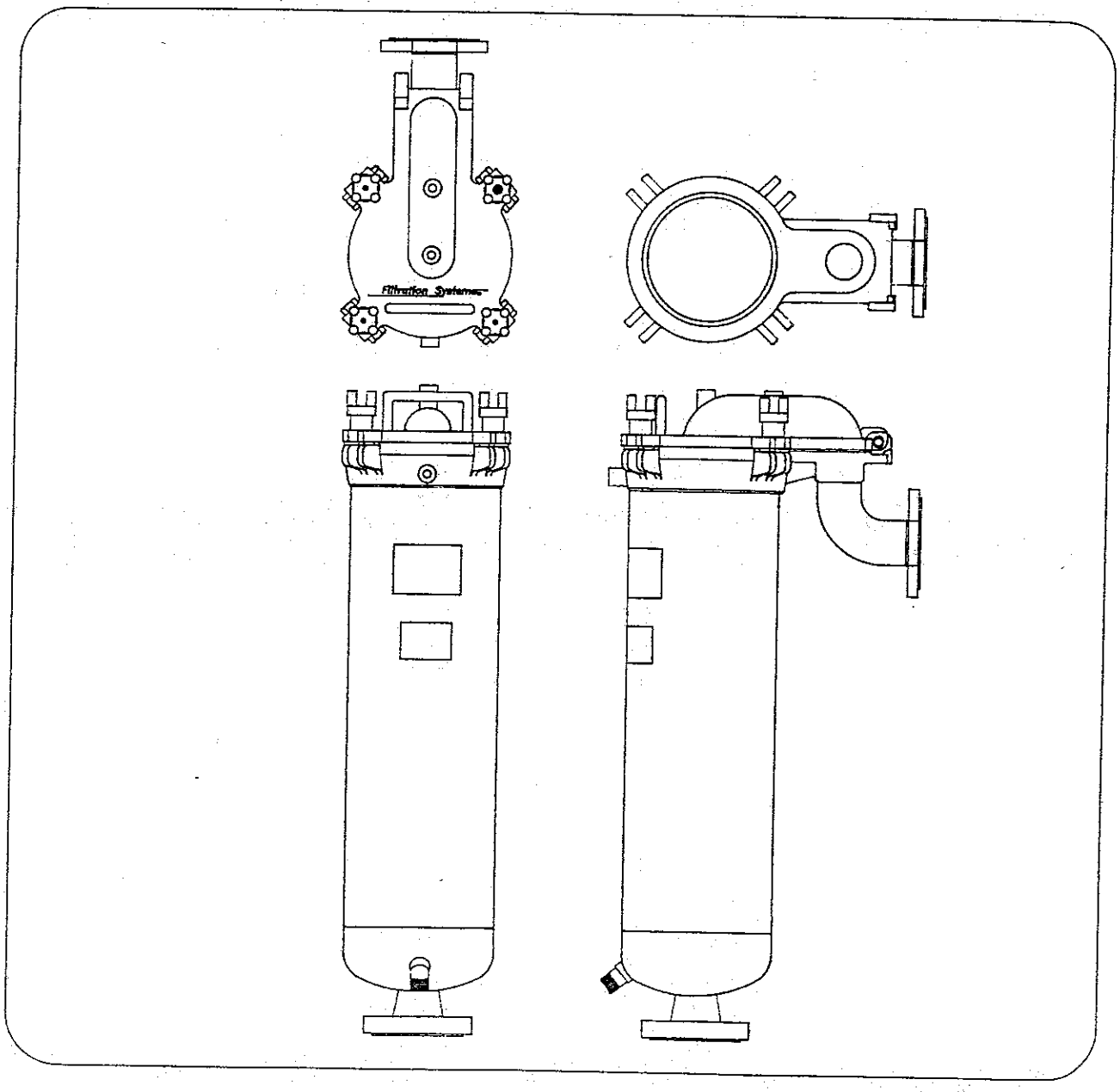


TABLE OF CONTENTS

Introduction and Background

Filtration Systems is glad that you have selected our products for your liquid filtration requirements. Our products have the most advanced design features to achieve excellent results for straining, filtering and liquid clarification applications. By familiarizing yourself with this booklet, most of your questions about this equipment will be answered.

Our design integrates an over-the-top inlet and hinged closure which provides a 360 degree positive seal to eliminate bypass of unfiltered liquid around the filter bag. More importantly, since the filter bag is situated at the top of the overflow rim in the vessel, no contamination reaches the downstream side, even during filter bag changes. Contamination collected in the filter bag is then easier to dispose of without cleaning the vessel.

NOTE: *A filter bag that has been used with a hazardous liquid may contain residual amounts of this material and should be handled with the same safeguards that would be used in handling any hazardous and/or toxic materials i.e., gloves, respirators, protective eyewear, etc. Filter bags used for such applications should be disposed of in accordance with federal, state or local laws and requirements.*

FEATURES

Over-The-Top Inlet
360 degree Hinged Closure with Lid Handle
"O" Rings in Lid
Investment Casting for Consistent Quality
Lid Stop
Taps for Gauges (Upstream & Downstream)
Vent Valve Tap
Tap for Drain
Glass Bead Blasting for Uniform Finish
T-316 S/S Baskets with Longitudinal Taper

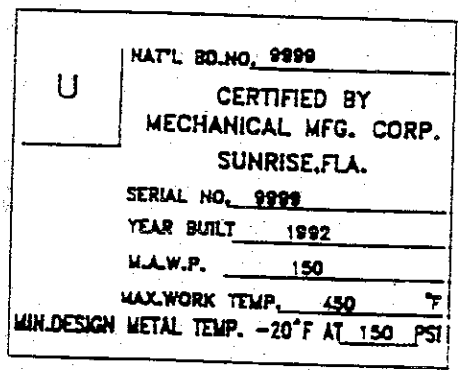
OUR VESSELS ACCOMMODATE STANDARD SIZE FILTER BAGS AS WELL AS HIGH EFFICIENCY FILTER BAGS AND CARTRIDGES MANUFACTURED BY EITHER 3M COMPANY OR PALL CORPORATION AND OTHERS.

Product Identification

All products are stamped with a unique serial number and can be identified by our factory. Below are samples of the possible nameplates that are permanently affixed to the filter housings.

NOTE: *The removal of the nameplate voids the product of any warranty and eliminates future identification of the product.*

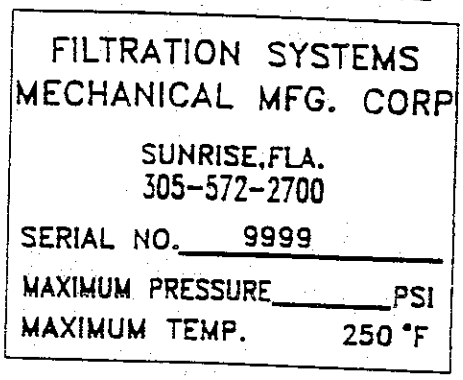
ASME CODE NAMEPLATE



Identifies both the National Board Number and the Serial Number of the vessel. It also designates the working pressures and temperatures of the vessel within safe limits. A "U" stamp indicates that the vessel has been designed and manufactured in accordance within the guidelines of ASME Code Section 8, Division 1.

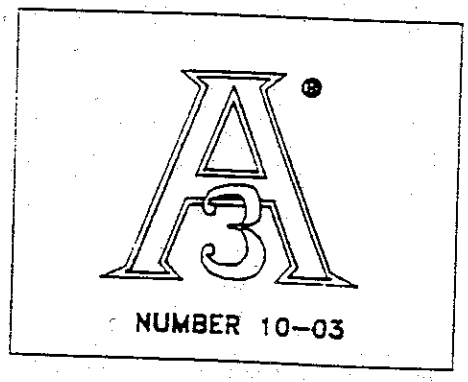
NOTE: *Any repair or modification of housings with an ASME code plate will void the housing of its ASME code status and may cause an unsafe condition in the usage of this vessel.*

NON-CODE NAMEPLATE



Identifies the serial number of the vessel as well as the working pressures and temperatures of the vessel within safe limits.

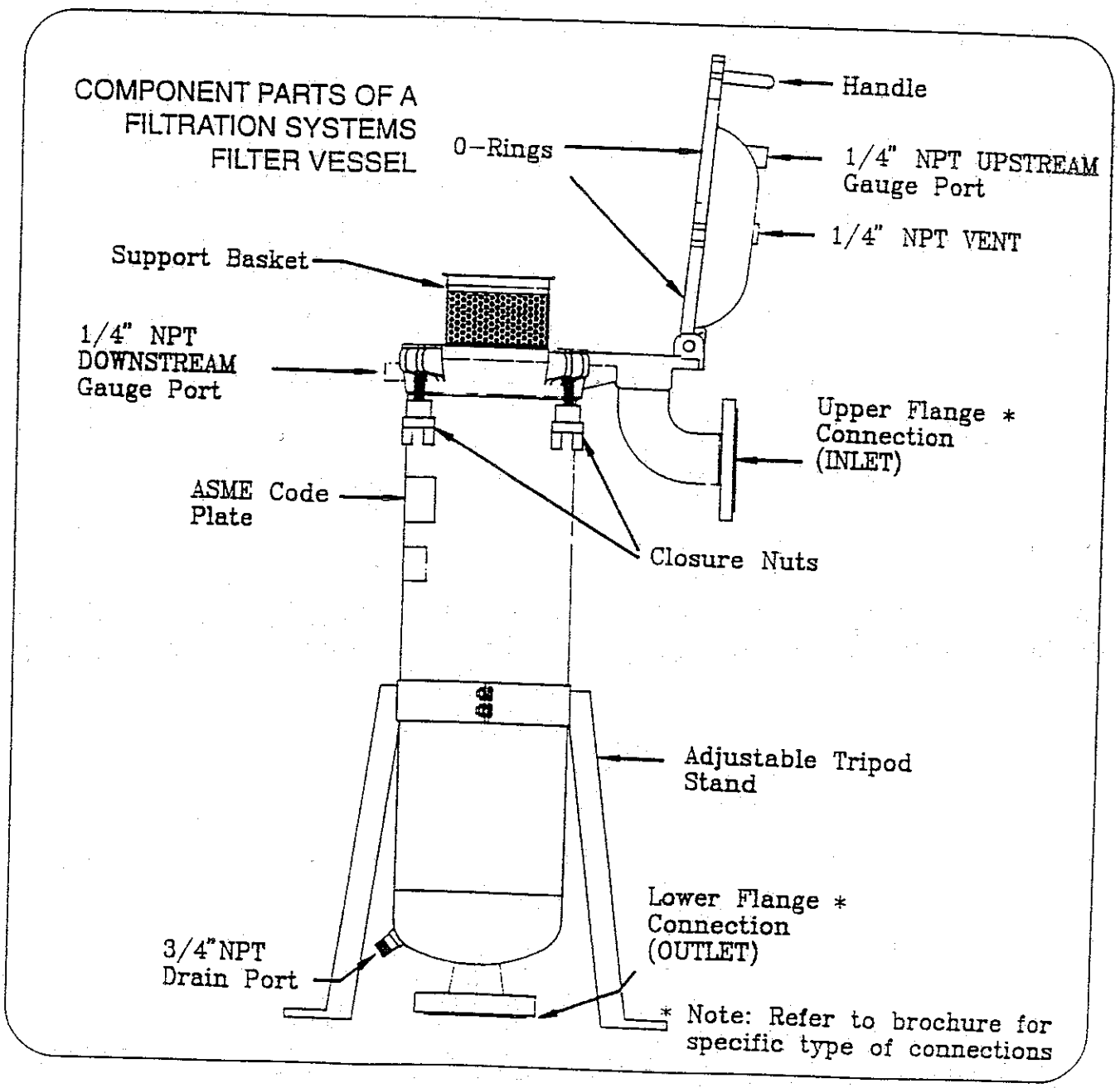
3-A SANITARY SYMBOL PLATE



Identifies the vessel as having been designed and built in accordance with 3-A Sanitary Standards, establishing design and fabrication criteria for cleanability of product contact surfaces for dairy quality products.

If it is <u>not</u> an Over-The-Top Inlet,

It is <u>not</u> Filtration™...



Filtration Systems ™

Division of Mechanical Mfg. Corporation

Operating Instructions

1) Anchor the adjustable tripod stand to the floor or a base. Be certain to save additional literature that has been included with the unit for safekeeping and future reference.

2) The direction of liquid flow is from the top (inlet) through the bottom (outlet). NOTE: When making piping connections be certain not to bend the filter vessel in any way, or leaks will occur out the back of the filter vessel "O" Ring.

3) A shut off valve should be installed before and after the filter vessel to allow the filter bags, cartridges or filter baskets to be changed.

NOTE: *Valved, modular filter systems allow for individual housings to be isolated so that there is no disruption of continuous service. Filter bags may be replaced one at a time, while the other housing(s) are filtering.*

4) Flow rates for filter bags vary by manufacturer. Determining the number of vessels for use depends upon how many filter bags will be used simultaneously. Flow rates for our filter housings may be found in the individual brochures.

NOTE: *Flow rate information is based on the filter housing without the filter bag.*

5) Connections: A pressure gauge should be installed in the 1/4" NPT gauge port on the cover. The second pressure gauge should be installed in either the downstream pipeline or in the 1/4" downstream NPT gauge port on the filter vessel body. The difference between the two gauges indicates the "pressure differential" across the filter bag, signaling "blinding" and the need for filter bag replacement.

A vent valve should be installed in the 1/4" NPT vent port on the cover. As liquid enters the vessel, air is allowed to escape through the vent valve to avoid an air pocket.

GENERAL RULES

Initial operating pressure with a clean filter bag installed in the vessel will remain constant until the filter is approximately 80% "blinded".

When the pressure differential increases by approximately 15-25psi, the filter bag should be changed. This figure can vary with the manufacturer of the filter bag. Actual pressure differential, pressure drops, and the frequency of filter bag changes can only be determined by experience in each individual application.

Operating Instructions

FILTER BAG INSERTION

Insert the filter bag into the support basket installed in the housing and form the bag to the contours of the support basket, making sure to fully extend it to the bottom. Care should be taken to make sure the filter bag collar will firmly seat when the machined face of the cover makes contact with the filter bag.

It is the action of the machined face of the cover that compresses and seals the filter bag into the housing, providing a quality seal and preventing bypass around the filter bag.

LID CLOSING PROCEDURE

Close the cover of the housing, being careful not to drop it.

Bring all the hold-down bolts into position and hand tighten the rear bolts on the cover. Hand tighten the front bolts on the cover.

Final torque should be done by repeating these steps until the cover is tightly and evenly closed. This procedure should be followed to insure complete sealing. We recommend approximately 30-50 ft. lbs. of torque on the hold-down bolts.

STARTING TO FILTER

We recommend opening the upstream valve (shut-off valve) before the downstream valve (shut-off valve) to prevent any back flow from occurring.

Vent any air from the housing by using the vent valve installed in the cover and then slowly increase the pressure in the system.

FILTER BAG REMOVAL

A) Shut off the pressure to the system

B) Open the drain

Slowly open the 3/4" drain located in the bottom head of the filter vessel and capture the liquid in an appropriate container (i.e., suitable for the filtered material that you are evacuating). Safeguards should be taken in wearing the same type of protective clothing suitable for the material that is being handled.

C) Open the vent valve

NOTE: *If a filter bag is not changed on a timely basis it will not drain; if this happens, remove the filter bag and pour its contents into the new filter bag, installed in the vessel, and filter it!*

Troubleshooting

Housing Leaks.... A new filter housing will not leak. All Filtration Systems' vessels are hydrostatically pretested at our factory to eliminate any problems in the field. If a housing does leak:

I) Check "O" Rings for dirt, cuts or swelling; if so, replace the "O" Rings.

2) Check the procedure for closing the lid and apply the recommended torque pressure and reseal the filter housing.

3) Check that both shut-off valves on either side of the system are open for filtering (Upstream and Downstream).

4) Check all threaded connections and redo these threaded connections with a "leak lock" product.

5) Check to see if the filter bag is dirty and "blinded".

6) Check to see if the casting body is bent; apply a straight edge over the entire machined face of the vessel body to see if during piping it was bent out of line.

Poor Filtration Results....

I) Check the position of the filter bag in the support basket to make sure it is seated flat and flush at the top of the vessel to attain a good seal.

2) Check if the filter bag has been ripped or torn to cause bypass.

3) If there is abnormally short filter bag life you may need to increase the filter housing to a larger system. Our equipment is designed for expansion if required; also valved multi-housing systems are available to obtain longer life from a filter bag and eliminate downtime.

IF YOU HAVE ANY QUESTIONS OR NEED ASSISTANCE PLEASE DO NOT HESITATE TO CALL US (305) 572-2700

Notes on Safety

Our filter vessels are designed to be used safely to filter liquids under pressure in accordance with temperature and pressure restrictions as stamped on the name plate affixed to the product.

NOTE: **Improper use of a filter vessel may result in injury or property damage. Any misuse or modification of these products will void both the manufacturer's warranty as well as the ASME certification, if it is an ASME Code vessel.**

Filtration Systems' vessels are not designed for lethal service. "Lethal Service" refers to vessels containing lethal substances, poisonous gases or liquids of such a nature that a very small amount of the gas or vapor of the liquid (mixed or unmixed) is dangerous to life when inhaled. In addition, substances of this nature which are stored under pressure or may generate a pressure, if stored in a closed vessel are also considered lethal.

The following steps must be taken before using this equipment...

Notes on Safety

1) Follow the instructions in the installation and operations manual.
2) Before pressurizing a filter vessel, always make sure the connections and lid hardware are securely fastened. Be certain that the pressure rating of the filter vessel is greater than the possible limit you may have when the filter vessel is "blinded" with a dirty filter bag. (If the operating pressure can exceed the pressure restriction stamped on the affixed plate, a pressure relieving device must be installed.)
3) Wear protective garments, splash protection, eye protection and respirators, if necessary. Hot liquids that splash or spray can cause burns. Wear protective clothing and eyewear to prevent contact with a hot liquid or surface and when changing a filter bag. (If the liquid to be filtered emits fumes or gases, we further recommend a fume hood over the filter vessel.)
4) "O" rings (gaskets) are subject to wear and should be checked each time the filter bag is changed for dirt, cuts, abrasion or swelling. Replacement of the gaskets should be done prior to pressurization of the filter system. (Be certain that the fluid to be filtered is chemically and thermally compatible with the filter vessel, "O" ring material, and the filter bag material. Fluid compatibility includes all materials in contact with the liquid under elevated temperature and pressure.)
5) Always relieve the pressure to the filter system before loosening lid hardware, opening up a lid or removing a filter bag or cartridge.
6) Dispose of filter bags property. A filter bag that has been used with a hazardous liquid may contain residual amounts of this material and should be handled with the same safeguards that would be used in handling any hazardous and/or toxic material; i.e., gloves, respirators, protective eyewear, protective clothing, etc... Filter bags used for such applications should be disposed of in accordance with federal, state or local laws and requirements.

1) Siga las instrucciones de instalacion y las del manual de operacion.
2) Antes de presurizar el filtro, asegurese siempre que las conecciones, tuberia y tapas, esten bien selladas y apretadas. Asegurese que la capacidad de presion del filtro sea mayor que la del limite maximo posible cuando el filtro este "obstruido" debido al sucio acumulado en la bolsa o cartucho usada para filtrar. (Si la presion de operacion excede la presion de restricion estampada en la placa, debe ser instalada una valvula de seguridad).
3) Use equipo protectivo, proteccion anti-salpique, anteojos de seguridad y equipo respiratiorio si fuese necesario. Los liquidos calientes que salpican o se esparcen, pueden causar quemaduras. Use ropa protectiva y protecion para los ojos, previniendo asi contacto con el liquido o la superficie caliente, cuando vaya a cambiar la bolsa para filtrar. (Si el liquido que ha de ser filtrado emite humos o gases, peligrosos o toxicos, nosotros recomendamos usar ademas una cubierta protectiva sobre el filtro.)
4) Los empaques ("O" rings) estan sujetos a deterioro y siempre deben ser revisados completamente, cada vez que se cambie la bolsa o cartucho, en busca de mugre, grietas, cortadas, abrasion o engrandecimiento. El reemplazo de los empaques, debe ser hecho antes de presurizar el sistema de filtro. (Esté completamente seguro que el liquido que va a ser filtrado, es quimica y termalmente compatible con el tipo de filtro usado, los empaques y el material de las bolsas o cartuchos usados.) La compatibilidad de los liquidos con el equipo, se refiere a todos los materiales y componentes que esten en contacto con el liquido incluso cuando sean sometidos a alta temperature y presion.
5) Siempre descomprima el sistema de filtro antes de levantar una tapa, aflojar cualquier componente, o remover una bolsa o cartucho.
6) Deshagase de las bolsas y cartuchos usados en forma apropiada. Una bolsa o cartucho que ha sido usado con materiales peligrosos o toxicos, pueden contener residuous de este material, y por lo tanto deben ser tratados con el mismo cuidado con que serian tratados aquellos materiales peligrosos y toxicos, por ejemplo usando guantes, proteccion para los ojos, ropa protectiva, etcetera. Las bolsas de filtrado usadas en tal aplicacion, deben ser deshechas de acuerdo con las leyes federales, estatales o locales, y de acuerdo con todos los requisitos.