Operation and Maintenance Manual: Sub-Slab Depressurization System ð Building C Lockheed Martin Middle River Complex 2323 Eastern Boulevard Middle River, Maryland

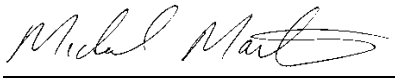
Prepared for:

Lockheed Martin Corporation

Prepared by:

Tetra Tech, Inc.

September 2013



Michael Martin, P.G.
Regional Manager

Peter A. Rich, P.E.
Principal Engineer

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

APPENDICES

LIST OF TABLES

ACRONYMS

CFM	cubic feet per minute
CFR	*Code of Federal Regulations*
ÜF	degrees Fahrenheit
GAC	granular activated-carbon
HOA	HAND/OFF/AUTO
HP	horsepower
hr	hour
$KMnO_4$	potassium permanganate
lbs	pounds
lbs/day	pounds per day
lbs/hr	pounds per hour
LCD	liquid crystal display
L/min	liters per minute
Lockheed Martin	Lockheed Martin Corporation
MDE	Maryland Department of the Environment
Õg/m^3	microgram(s) per cubic meter
MRC	Middle River Complex
PVC	polyvinyl chloride
PPZ	potassium permanganate zeolite
psi	pound(s) per square inch
PVC	polyvinyl chloride
RPM	revolutions per minute
SSD	sub-slab depressurization
SSDS	sub-slab depressurization system
SCFM	standard cubic feet per minute
SPCC	spill prevention, control, and countermeasure
SV	sub-slab vapor
TCE	trichloroethene (also known as trichloroethylene)
TEFC	totally enclosed, fan cooled
Tetra Tech	Tetra Tech, Inc.
USEPA	United States Environmental Protection Agency
VMP	vapor monitoring point
VOC	volatile organic compound
WC	water column

Section 1
Introduction

1.1 BACKGROUND

Since its installation in March 2008, the sub-slab depressurization system (SSDS) in the Building C basement at the Lockheed Martin Middle River Complex (MRC) in Middle River, Maryland has applied a vacuum under the concrete foundation where elevated concentrations of volatile organic compounds (VOCs) are known to be present. Sub-slab sampling in the Building C basement in February 2012 (Tetra Tech, 2012a) indicated trichloroethene (TCE; also known as trichloroethylene) concentrations above 880 micrograms per cubic meter (Õg/m^3) (i.e., the trigger level identified in the *Vapor-Intrusion Management Plan* [Tetra Tech, 2012b]) in multiple locations, and a vinyl chloride concentration of 82,000 Õg/m^3 at one monitoring point (vinyl chloride was not detected at any other monitoring point).

The first-phase expansion of the sub-slab depressurization system was completed in October 2012 to address the middle area of the Building C basement and to continue to address the southern portion of the basement. The first-phase expansion installed four additional vapor-extraction wells, replacing the granular activated-carbon (GAC) units with larger vessels (and associated piping, fittings, and appurtenances), and installed one potassium permanganate zeolite (PPZ) unit. The second-phase system expansion was completed in May 2013 to better address the middle area of Building C, based on sampling results from an expanded sampling area over time and the lessons learned from the first-phase expansion. The second-phase expansion installed five additional vapor-extraction wells, replaced and relocated the blower skid, added a heat exchanger and post-heat-exchanger moisture separator, installed a mist-eliminator pad in the exhaust stack, and relocated the vapor treatment units to the approved indoor location. As-built drawings showing the location of the sub-slab depressurization system and the layout of the system components are in Appendix A.

1.2 PURPOSE

The sub-slab depressurization system is designed to maintain a negative pressure of 0.01 inches water column (WC) under the sub-slab in the target area to prevent potential vapor migration that could affect indoor air quality. This manual provides guidance for the safe operation, maintenance, and monitoring of the sub-slab depressurization system. The major components of the system, the required maintenance for each piece of equipment, and instructions on system startup, shutdown, and operation are outlined in the following sections. Instructions for monitoring the system to maintain zero or minimal VOC emissions to the building interior and verify successful system operation are also provided. Refer to the latest version of the sub-slab depressurization-system health and safety plan (HASP) for safety precautions and procedures to follow during sub-slab depressurization-system operation and maintenance. The health and safety plan includes an emergency response plan and a remediation contingency plan for the sub-slab depressurization system, as well as information on safe work practices.

1.3 OPERATIONAL OBJECTIVES AND VAPOR EFFLUENT LIMITATIONS

1.3.1 Operational Objectives

The objective of the sub-slab depressurization system is to prevent migration of volatile organic compounds to indoor air by maintaining induced-vacuum influence in areas with elevated sub-slab volatile organic compound levels. Achievement of this objective will be determined by evaluating the vacuum gauge readings at monitoring points and by evaluating the data generated from the collection and laboratory analysis of extracted air samples, air samples collected at monitoring points, and indoor air samples.

1.3.2 Vapor Effluent Limitations

The system is operated with emissions treatment using two 400-pound granular activated-carbon units and one 600-pound potassium permanganate zeolite unit connected in series. Even without granular activated carbon and potassium permanganate treatment, the system emission rates are below Maryland Department of the Environment (MDE) guidance for Title 5 emissions (25 tons of volatile organic compounds per year) found in *Code of Maryland Regulations* (COMAR) 26.11.02.01C. Telephone communication with the MDE Air Quality Permits Division when the existing sub-slab depressurization system was proposed in November 2007 indicated that no air

permit is required for the estimated emission rates (MDE, 2007). This was re-confirmed via telephone communication on August 2, 2012 with Mr. George Beerli of the Maryland Department of the Environment Air Quality Permits section (MDE, 2012).

1.4 MANUAL ORGANIZATION

This manual is organized as follows:

Section 2ð System Processes and Components: Describes the sub-slab depressurization system and its individual components with associated operation and maintenance information, including manufacturer, model number, vendor, and required maintenance.

Section 3ð System Operation: Details sub-slab depressurization-system operation, emergency procedures, and monitoring requirements.

Section 4ð System Startup and Shutdown Procedures: Outlines system startup and shutdown procedures.

Section 5ð Troubleshooting: Contains general troubleshooting information for the sub-slab depressurization system.

Section 6ð Lock-Out/Tag-Out Procedures: Contains lock-out/tag-out procedures to be followed when working on system equipment.

Section 7ð Reporting: Details reporting requirements.

Section 8ð References: Lists the references used in this report.

As-built drawings, system-check forms, material safety data sheets, and equipment manufacturer manuals are in the appendices.

Section 2
System Processes and Components

2.1 SYSTEM DESCRIPTION

2.1.1 Extraction System

Sub-slab vapor is continuously extracted with balanced flows across 11 vapor extraction wells: SV-21-C, SV-23-C, SV-26-C, SV-27-C, SV-28-C, SV-29-C, SV-30-C, SV-31-C, SV-32-C, SV-33-C, and SV-34-C (see Drawings G1 and G2 in Appendix A). The original extraction wells installed in March 2008 (SV-21-C and SV-23-C) are connected by polyvinyl chloride (PVC) piping to a three-inch-diameter PVC header and lead to the main vapor-influent six-inch-diameter header, which connects to the sub-slab depressurization system (SSDS) equipment skid. Four extraction wells (SV-26-C, SV-27-C, SV-28-C, and SV-29-C) installed in October 2012, and five more (SV-30-C, SV-31-C, SV-32-C, SV-33-C, and SV-34-C) installed in April 2013, are connected to the six-inch-diameter PVC header line that runs along the basement ceiling to the SSDS equipment skid. Each vapor extraction well is individually valved, as shown in the systemôs process and instrumentation diagram (Drawing G4 in Appendix A). All well extraction piping is labeled with green ñvacuumò self-sticking vinyl pipe markers.

Sub-slab vapors are extracted using one AMETEK^{È} 7.5 horsepower (HP) HP Rotron^{È} regenerative blower (model DR858) installed on the systemôs equipment skid. The blower can achieve a suction flow rate of 220 standard cubic feet per minute (SCFM) at 55 inches of water column (WC). Before entering the blower, extracted vapors pass through a 30-gallon Gasho, Inc. (model GX-90) moisture separator to remove entrained condensation from the vapor stream. The effluent from the moisture separator passes through an air filter to remove foreign matter in the air stream before it enters the blower. Extracted vapors then pass through the blower. A silencer on the blower effluent reduces noise from air exiting the blower.

From the blower, extracted vapors pass through a heat exchanger (Xchanger, Inc. model AA-250) rated to reduce the temperature of a 250-SCFM air stream from 200 degrees Fahrenheit (ÜF) to approximately 125ÜF. From the heat exchanger, vapors pass through a second 30-gallon (Gasho, Inc. model GX-90) moisture separator to remove any entrained condensate before entering the vapor treatment units. Following vapor treatment, any remaining condensate in the vapor stream is collected in the exhaust-stack sump and the mist-eliminator pad installed on the exhaust stack. The treated vapor stream is then released through the exhaust stack.

Fail-safe switches are installed on the SSDS, tied into the control panel, and programmed into an eight-channel auto-dialer. The fail-safe switches shut down the blower in the event any of the following occurs:

- high pressure at the effluent of the blower
- high temperature at the effluent of the blower
- high temperature at the effluent of the heat exchanger
- the pre-blower moisture separator becomes full
- the post-heat-exchanger moisture separator becomes full
- low vacuum, which could indicate pipe damage

All alarms are normally closed. The temperature switch before the heat exchanger is set at 215ÜF and protects the blower; the post-heat-exchanger temperature switch is set at 140ÜF and protects the downstream granular activated-carbon (GAC) units. Schematics of the blower skid components are in Appendix D. Two-inch-diameter hollow steel-pipe bollards protect the blower/equipment skid from traffic. Soundproofing rubber curtains, installed on a nine-foot-tall frame constructed with three-inch-diameter galvanized steel corner posts and wood, surround the equipment skid to insulate the sound from the blower and heat exchanger.

2.1.2 Vapor Treatment System

Extracted vapors are treated to remove volatile organic compounds (VOCs) using two Vent-Scrub^{È} VSC400 vapor-phase GAC units and one Vent-Scrub^{È} VSC400 potassium permanganate zeolite (PPZ) unit connected in series. The Vent-Scrub^{È} VSC400 vapor-phase adsorbers are capable of a maximum flow of 300 SCFM and are piped for up-flow. Each GAC unit contains 400 pounds of

virgin, pelletized coconut-shell carbon; the PPZ unit is filled with 600 pounds of potassium permanganate ($KMnO_4$)-impregnated media (KMN2000 by Siemens Industry, Inc.). Material safety data sheets (MSDS) for GAC and PPZ are in Appendix C. After passing through GAC units, extracted vapors are treated to remove vinyl chloride using $KMnO_4$ media. The PPZ units (one active [in-line] and one spare) are positioned on a spill-containment platform with drain.

Treated vapors are discharged to the atmosphere via the systemôs PVC exhaust stack, which extends above the building roof. The exhaust stack is tied into the header line at the former skid location, as shown in Drawing G3 in Appendix A. As indicated previously, following vapor treatment, any remaining condensate in the vapor stream is collected in the exhaust stack sump (located near Q35) via a 10-inch-diameter mist-eliminating polypropylene-mesh pad installed on the exhaust stack. The treated vapor stream is then discharged to the atmosphere.

2.2 MAJOR EQUIPMENT OPERATION AND MAINTENANCE

2.2.1 Extraction Wells

The SSDS vapor extraction wells (SV-21-C, SV-23-C, SV-26-C, SV-27-C, SV-28-C, SV-29-C, SV-30--C, SV-31-C, SV-32-C, SV-33-C, and SV-34-C) draw air through the sub-slab zone to stimulate volatilization of adsorbed-phase trichloroethene (TCE; also known as trichloroethylene) and other VOCs in the Building C basement. The wells were installed by Tetra Tech, Inc. (Tetra Tech) using two-inch-diameter 0.020-inch-slot Schedule 40 PVC pipe (12ï 18 inches long) in four-inch-diameter boreholes with clean pea-gravel filling the annular space. A bentonite grout seal was placed above the screen and gravel to prevent short-circuiting. The original extraction wells (SV-21-C and SV-23-C, installed in March 2008) are connected to a three-inch-diameter PVC header line that runs along the ceiling to the blower skid location and connects to the six-inch-diameter system influent PVC header line. Extraction wells SV-26-C, SV-27-C, SV-28-C, and SV-29-C (installed in October 2012) and SV-30-C, SV-31-C, SV-32-C, SV-33-C, and SV-34-C (installed in April 2013) are connected to the six-inch-diameter PVC header line that runs along the basement ceiling to the blower skid.

The riser pipe for each extraction well has a measuring point for sampling, flow, and vacuum monitoring, and a lockable diaphragm valve for throttling or shutting off flow. All extraction piping is level or sloped back toward the extraction points, or toward the header-pipe-condensate

sumps, to prevent condensate accumulation in low points in pipe runs. Table 2-1 summarizes the extraction well details. The extraction wells require no routine maintenance.

2.2.2 Moisture Separators

A 30-gallon moisture separator (Gasho model GX-90) is installed immediately downstream of the vapor extraction manifold, before the blower, to remove condensate from extracted vapors. A second identical moisture separator is installed following the heat exchanger to remove entrained condensate droplets, thereby reducing the chance of both vapor line fouling and the possibility of saturating the GAC units. A high-level switch is installed in each unit and wired to the control panel to enable shutdown of the blower if either moisture separator fills up with condensate. Moisture separator details are in Table 2-2.

2.2.3 Blower

A 7.5 HP AMETEK® Rotron® regenerative blower capable of achieving a suction flow rate of 220 standard cubic feet per minute (SCFM) at 55 inches of water column (WC) draws sub-slab vapor from the extraction wells. The header line from wells SV-21-C and SV-23-C connects to the six-inch-diameter influent line from wells SV-26-C, SV-27-C, SV-28-C, SV-29-C, SV-30-C, SV-31-C, SV-32-C, SV-33-C, and SV-34-C, which connect to the vacuum side of the blower. Blower details are in Table 2-2.

2.2.4 Heat Exchanger

A 1 HP heat exchanger (Xchanger, Inc. model AA-250) is installed immediately following the blower to reduce the effluent temperature (of an air stream flowing at 250 SCFM) from approximately 200°F to approximately 125°F. Cooling the extracted vapor protects the GAC units from temperatures in excess of their maximum (140°F) temperature limit. A Hand/Auto/Off switch for the heat exchanger on the control panel door allows the system to operate with or without the heat exchanger.

2.2.5 Granular Activated Carbon Units

Vapor-phase GAC removes VOCs from the vapor stream via adsorption. VOCs adsorb to the carbon granules as vapor moves through the carbon. Carbon life is limited by the amount of VOCs it adsorbs. Once the adsorption capacity is achieved, VOCs will begin to pass through the carbon drums. VOC concentrations in the influent to the carbon and the flow rate of the vapor

stream are monitored to estimate when the adsorption capacity will be exceeded, so change-out of the carbon can be scheduled in advance.

Tetra Tech will change out the carbon drums using the lead-lag method whenever 50% or higher breakthrough is observed in the midpoint air sample or at Tetra Tech's discretion with concurrence from Lockheed Martin Corporation (Lockheed Martin), to minimize total VOC discharge. Analytical lab results will be based on monthly samples taken from sampling ports (double-valved quick-disconnect-tube couplings). Preliminary analytical results will be provided to Lockheed Martin as soon as they are issued by the laboratory (usually within seven business days); written results will be provided within three weeks of sampling.

The GAC drums are connected with a neoprene-coated fiberglass hose that connects to the system by cam-lock fittings secured against tampering by plastic zip-ties. The operator will change out the lead GAC unit when instructed by the project manager, following these steps:

1. Shut system down and remove the lead GAC unit from the cam-lock fittings
2. Restore (screw back on) the caps on the influent and effluent ports of the lead GAC unit
3. Connect the neoprene hose with cam-locks from the system to the former lag GAC unit (the second of the two) so that it becomes the lead GAC unit
4. Connect the hose on the effluent port of the new lead GAC unit to a previously unused GAC drum
5. Attach the exit cam-lock fitting on the new (lag) GAC drum to the hose connected to the PPZ unit
6. Attach new plastic zip-ties to secure the hose between the SSDS and the new lead GAC unit and restart the SSDS

After each GAC change-out, spent carbon will be handled in accordance with the latest version of the Lockheed Martin waste management plan for the Middle River Complex (MRC). GAC unit details are in Table 2-2.

2.2.6 Potassium Permanganate Zeolite Unit

Similar to the GAC, the potassium-permanganate-impregnated medium removes vinyl chloride from the vapor stream via adsorption. Manufacturer information indicates that 100 pounds of $KMnO_4$ media will oxidize 0.3 pounds of vinyl chloride. Once the adsorption capacity has been achieved, vinyl chloride will begin to pass through the PPZ drum. VOC concentrations in the

effluent of the lead GAC unit and the flow rate of the vapor stream are then monitored to estimate when the adsorption capacity of the PPZ will be exceeded. Tetra Tech will change out the PPZ drum when 10% or higher vinyl chloride breakthrough is detected by laboratory analysis in the PPZ effluent air sample (i.e., when the PPZ effluent vinyl chloride concentration is 10% or greater of the lead GAC unit vinyl chloride effluent concentration).

The influent and effluent ports on the PPZ unit are connected to the lag GAC unit and SSDS exhaust stack, respectively, with neoprene-coated fiberglass hoses that connect by cam-lock fittings (secured against tampering with plastic zip-ties). The operator will change out the PPZ unit when instructed to do so by the project manager, following these steps:

1. Shut system down and remove the PPZ unit from the cam-lock fittings
2. Restore (screw back on) the caps on the influent and effluent ports of the PPZ unit
3. Connect the neoprene hose with cam-locks from the lag GAC unit (the second of the two) to the influent port of the new PPZ unit
4. Connect the hose on the effluent port of the new PPZ unit to the SSDS stack
5. Attach new plastic zip-ties to secure the hoses between the PPZ and GAC and SSDS exhaust stack

The spent PPZ unit will be handled in accordance with the latest version of the Lockheed Martin MRC waste management plan. PPZ unit details are in Table 2-2. The in-line PPZ unit and spare unit are both positioned on a 120-gallon, eight-drum-capacity spill platform.

2.2.7 Gauges, Switches, and Miscellaneous Equipment

A number of gauges, meters, and valves monitor and control SSDS operation. Table 2-3 lists pertinent information and maintenance for each of these pieces of equipment.

Table 2-1

Sub-Slab-Vapor Extraction-Well Construction Specifications
Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland

Extraction well	Diameter (inches)	Total depth (inches)	Screen length (inches)	Construction material	Backfill
SV-21-C	2	26.3	12	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-23-C	2	32.5	18	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-26-C	2	23.5	13	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-27-C	2	22.0	12	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-28-C	2	26.5	15	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-29-C	2	23.0	12	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-30-C	2	24.0	15.5	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-31-C	2	15.75	7.75	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-32-C	2	26	16	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-33-C	2	27	15.75	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole
SV-34-C	2	28	16	0.020-inch slot PVC	Pea gravel in annular space of four-inch-diameter borehole

PVCð polyvinyl chloride

Table 2-2
Major System Equipment Component Details
Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland
Page 1 of 3

Equipment	Manufacturer	Supplier	Model	Specification/ set point	Required maintenance
Moisture separators	J. E. Gasho 460 West Gay Street West Chester, PA 19380 Tel: 610-692-565	J. E. Gasho 460 West Gay Street West Chester, PA 19380 Tel: 610-692-5650	GX90	Capacity: 30 gallons Rated flow: 1,200 SCFM	*Every two weeks:* • Check for condensate and drain as necessary. • Refer to the water handling procedures (Section 3.4.3). • Check unit and surrounding piping for leaks. *Quarterly:* • Check moisture separator for corrosion and wear. • Test high-level switch for proper operation.
Blower	AMETEK Rotron 627 Lake Street Kent, OH 44240 Tel: 330-673-3452	J. E. Gasho 460 West Gay Street West Chester, PA 19380 Tel: 610-692-5650	DR858AY 72W	7.5HP 460-Volt 3-phase 220 SCFM at 55 inches WC	*Every two weeks:* • Check and record operating temperature. *Quarterly:* • Inspect general condition of blower and surrounding piping for leaks. • Measure and record amperage draw.
Heat exchanger	XChanger, Inc. 1401 7th Street South Hopkins, MN 55343 Tel: 952-933-2559	J. E. Gasho 460 West Gay Street West Chester, PA 19380 Tel: 610-692-5650	AA-250	1 HP TEFC motor Design temp: 200ÜF Design pressure: 15lb/in^2 12-inch fan 3450 RPM	*Every two weeks:* • Check unit and drain condensate that may have formed on the outside of the fins using the IJ-inch female drain coupling in the bottom of the housing.

Table 2-2
Major System Equipment Component Details
Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland
Page 2 of 3

Equipment	Manufacturer	Supplier	Model	Specification/ set point	Required maintenance
Granular activated-carbon	Siemens Industry, Inc. 663 Dowd Avenue Elizabeth, NJ 07201 Tel: 908-353-7400	Siemens Industry, Inc. 663 Dowd Avenue Elizabeth, NJ 07201 Tel: 908-353-7400	VOCarb® 48C (carbon media) and Vent-Scrub® VSC400 (canister)	400 pounds of virgin, pelletized coconut-shell carbon Rated flow: 300 CFM	*Every two weeks:* • Check units and surrounding piping for damage or leaks. • Check cam locks and zip-ties for possible tampering. • Change lead carbon drum with lag carbon drum when midpoint concentration is 50% or greater of influent concentration, or as instructed by the project manager. Replace lag carbon drum with new carbon drum. • Check for water in flex hose. *Quarterly:* • Check units and surrounding piping for damage or leaks. • Check condition of sampling ports. *Other* • Check unit condition before placing it in service. • Take monthly samples for laboratory analysis from pre- and mid-GAC sampling ports. • Replace connecting hoses after five years of service, or sooner if damaged or showing signs of deterioration.

Table 2-2
Major System Equipment Component Details
Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland
Page 3 of 3

Equipment	Manufacturer	Supplier	Model	Specification/ set point	Required maintenance
Potassium permanganate zeolite	Siemens Industry, Inc. 663 Dowd Avenue Elizabeth, NJ 07201 Tel: 908-353-7400	Siemens Industry, Inc. 663 Dowd Avenue Elizabeth, NJ 07201 Tel: 908-353-7400	KMN2000 (potassium permanganate media) and Vent-Scrub^{È} VSC400 (canister)	600 pounds of potassium permanganate media Rated flow: 300 CFM	*Every two weeks:* • Check unit and surrounding piping for damage or leaks. • Check cam-locks and zip-ties for possible tampering. • Change unit when the PPZ effluent air sample vinyl chloride concentration is 10% or greater of the lead GAC unit vinyl chloride effluent concentration, or as instructed by the project manager. • Check for water in the exhaust stack. *Quarterly:* • Check unit and surrounding piping for damage or leaks. • Check condition of sample port. *Other* • Check unit condition before placing it in service. • Take monthly samples for laboratory analysis from post-PPZ sampling port. • Replace connecting hoses after five years of service, or sooner if damaged or showing signs of deterioration.

Abbreviations:

CFMð	cubic feet per minute	HPð	horsepower	SCFMð	standard cubic feet per minute
ÜFð	degrees Fahrenheit	lbs/in^{2}ð	pounds per square inch	TEFCð	totally enclosed, fan cooled
GACð	granular activated-carbon	PPZð	potassium permanganate zeolite	VOCð	volatile organic compound
		RPMð	revolutions per minute	WCð	water column

Table 2-3
Gauges, Switches, and Miscellaneous Equipment Information, Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland
Page 1 of 3

Equipment	Manufacturer	Supplier	Model	Specification/ set point	Required maintenance
High-pressure switch	Dwyer Instruments Michigan City, IN Tel: 219-879-8000	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	1950P-2-2F	60 inches WC	*Quarterly*: • Test for proper operation. • Replace if necessary.
Low-vacuum switch	Dwyer Instruments Michigan City, IN Tel: 219-879-8000	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	1950-20-2F	¯10.0 inches WC	*Quarterly*: • Test for proper operation. • Inspect tubing to ensure no fouling or breakthroughs have occurred.
Flow meter	AMETEK Rotron 75 North Street Saugerties, NY 12477 Tel: 914-246-3401	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	550606	70ï 350 SCFM	*Every two weeks:* • Check that flow gauge falls to zero when system is off. • Replace if necessary.
Level switch	Dwyer Instruments Michigan City, IN Tel: 219-879-8000	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	L6-EPB-B-S-3-0	30 gallons	*Quarterly:* • Test for proper operation. • Remove switch from moisture separator. • Clean, repair, or replace as needed.
Vacuum gauges	Dwyer Instruments Michigan City, IN Tel: 219-879-8000	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	Various	Various	*Every two weeks:* • Check that vacuum gauges fall to zero when system is off. • Replace if necessary.
Pressure gauges	Dwyer Instruments Michigan City, IN Tel: 219-879-8000	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	Various	Various	*Every two weeks:* • Check that pressure gauge falls to zero when system is off. • Replace if necessary.

Table 2-3
Gauges, Switches, and Miscellaneous Equipment Information, Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland
Page 2 of 3

Equipment	Manufacturer	Supplier	Model	Specification/ set point	Required maintenance
Spill platform for PPZ units	Eagle Manufacturing Company 2400 Charles Street Wellsburg, WV 26070 Tel: 304-737-3171	Grainger 2100 Haines Street Baltimore, MD 21230 Tel: 410-234-0184 http:\\www.grainger.com	1688D	120-gallon spill capacity 10,000-lb load capacity Meets USEPA 40 CFR 264.175 and SPCC plans	*Every two weeks:* • Check unit for damage and presence of condensate collection. If condensate is present, drain into storage drum containing condensate from system moisture separators. • Check that drain is closed. • Replace if necessary.
Vacuum relief valve	Fisher 3809 South Center St. Marshalltown, IA 50158 Tel: 641-753-5557	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	289H3	90 inches WC	*Every two weeks:* • Ensure valve is closed. *Quarterly:* • Visually inspect valve and filter element.
Temperature switch (TS-1)	Ashcroft 210 Old Gate Lane Milford, CT 06460 Tel: 800-328-8258	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	T424-TO5-030-XRS-150ï 260; 150 ÜFï 260ÜF	215ÜF	*Quarterly:* • Check for proper operation and adjust as needed. • Replace if necessary.
Temperature switch (TS-2)	Ashcroft 210 Old Gate Lane Milford, CT 06460 Tel: 800-328-8258	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	T424-TO5-030-XRS-75ï 205; 75 ÜFï 205ÜF	140ÜF	*Quarterly:* • Check for proper operation and adjust as needed. • Replace if necessary.
Bi-metal thermometer	Noshok 1010 W. Bagley Road Berea, OH 44017 Tel: 440-243-0888	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	30.110.025	0ï 250ÜF	*Every two weeks:* • Check that temperature drops when system is off. • Replace if necessary.

Table 2-3
Gauges, Switches, and Miscellaneous Equipment Information, Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland
Page 3 of 3

Equipment	Manufacturer	Supplier	Model	Specification/ set point	Required maintenance
Air filter	Solberg 1151 Ardmore Ave. Itasca, IL 60143 Tel: 630-773-1363	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	CSL-239-300C	3ò	*Every two weeks:* • Evaluate pressure difference pre- and post-filter (ΔP) to ensure less than 25-inch difference. • Replace when ΔP=25 in. WC or greater. *Quarterly:* • Inspect general condition of filter and filter element. • Clean or replace as necessary.
Auto-dialer	Sensaphone 901 Tryens Road Aston, PA 19014 Tel: 610-558-2700	J. E. Gasho 460 West Gay Street West Chester, Penn. 19380 Tel: 610-692-5650	FGD-800	8 channels	*Quarterly:* • Check that auto-dialer calls out for each alarm. *Other:* • Replace battery as needed.
Soundproof curtains	Sound Seal 50 H.P. Algrem Drive Agawam, MA 01001 Tel: 413.789.1770		Sound Seal B-10R (reinforced loaded-vinyl noise barrier)	54"Ĭ 60' roll; gray; 1 lb per square foot	*Quarterly*: • Inspect for integrity.

Abbreviations:

ΔP— pressure difference pre- and post-filter
CFRð *Code of Federal Regulations*
CFMð cubic feet per minute
ÜFð degrees Fahrenheit
lbð pound
SPCCð Spill Prevention, Control, and Countermeasure
USEPAð United States Environmental Protection Agency
WCð water column

Section 3
System Operation

Sub-slab depressurization system (SSDS) operating procedures must be in accordance with the latest version of the SSDS health and safety plan.

3.1 INITIAL OPERATION

Extraction wells will be open to allow approximately 20 standard cubic feet per minute (SCFM) airflow each, for a combined flow rate of 220 SCFM. Data will be regularly evaluated to determine if operational adjustments are warranted. Targeted or pulsed operations are potentially feasible and will be evaluated.

3.2 EMERGENCY OPERATION AND FAIL-SAFE FEATURES

3.2.1 Power Failure

The sub-slab depressurization system (SSDS) will shut down completely in the event of a power failure. The low-vacuum switch will alarm upon shutdown, and the auto-dialer will call the system operator. When power to the control panel is restored, the SSDS will not automatically restart because of the low-vacuum alarm.

3.2.2 Fail-Safe Features

Fail-safe features and/or alarms are provided with the SSDS to shut down the system in the event of a potentially unsafe condition. The system is wired to shut down for the alarm conditions listed in Table 3-1. The SSDS also has a vacuum-relief valve set to allow air into the blower if the vacuum exceeds 85 inches water column (WC). The low-vacuum switch has a time delay set at 10 seconds to allow system startup.

Triggering of any of the fail-safes listed above will also result in the system auto-dialer calling the system operator and up to three backup personnel until the alarm has been acknowledged. Tetra Tech, Inc. (Tetra Tech) will respond to the alarm and restart the system within four hours of notification, if reasonably possible. Lockheed Martin Corporation (Lockheed Martin) will be notified within 24 hours if the system remains shut down for more than three days and will be

given a description of the cause(s) and actions taken to address the condition and restart the system (at times of high precipitation, the system may not operate up to two days until water levels decrease). The SSDS auto-dialer can also be called by Tetra Tech personnel at 443-510-1487. Calling this number will provide the status of alarm conditions, power, battery, and sound.

3.3 SYSTEM MONITORING

Tetra Tech will collect monthly air samples from the influent to the granular activated-carbon (GAC) units, from the effluent of the lead GAC unit, and from the effluent of the potassium permanganate zeolite (PPZ) unit. These samples will be collected in one-liter Summa^{È} canisters. TestAmerica Laboratories, Inc. will analyze the samples for volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method TO-15. The SSDS will be inspected every two weeks; the field forms in Appendix B will be filled out during each monitoring visit to record system data. SSDS monitoring will include the biweekly, monthly, quarterly, annual, and other tasks listed in Table 3-2, which incorporate the maintenance requirements in the equipment manuals (see Appendix D). System-check forms are in Appendix B.

Tetra Tech will conduct monthly 24-hour vacuum monitoring to verify system radius-of-influence and quantify differential pressure changes over daily cycles. Dwyer MS-121 Magnesense^{È} differential-pressure transmitters (low-range 4ï 20 output with liquid crystal display [LCD]) displays and 0.0-0.5-inch WC range [accuracy to 0.005-inch WC]) and Dwyer DW-USB programmable data-loggers set at five-minute sampling rates will be deployed at three selected vapor monitoring points (VMPs) in the south basement area and three selected VMPs in the middle basement area for each event. The VMPs are listed in Table 3-3 and will be alternated so that all VMPs with differential pressure readings up to 0.5-inches WC are monitored regularly. After 24 continuous hours of data collection, the equipment will be retrieved and the data downloaded and graphed for analysis.

3.4 SYSTEM OPERATION AND MAINTENANCE PROCEDURES

The following procedures detail the methods for testing system components and other aspects of system operation and maintenance. Table 3-2 includes tasks associated with SSDS operation and maintenance.

3.4.1 Testing Temperature Switch Operation

While the system is in the OFF position, remove the temperature-switch bulb and the scaled thermometer from the discharge piping. Plug the piping and restart the system. Using an electric heat gun, heat the switch bulb and thermometer until the temperature-switch alarm trips and shuts down the system. Verify that the switch trips at the correct temperature or adjust the setting and repeat. Reinstall equipment and restart the system.

3.4.2 Testing Auto-Dialer Alarms

When testing each alarm (moisture separator high-level, high pressure, high temperature, low pressure, low vacuum), check that the system shuts down; also check that the auto-dialer calls out properly to the listed numbers with the proper alarm annunciation.

3.4.3 Water Handling Procedures

If a drainable amount of water is found during each system check in the header pipe, sumps, exhaust stack sump, or moisture separators, the system will be shut down and the water drained by opening the corresponding drain valve. When draining the moisture separators, the hand pump installed for each unit will be used. If water accumulates in an extraction well, the water will be removed with a disposable hand bailer. All water will be collected in five-gallon buckets. When approximately three gallons have accumulated in the buckets, the drain valve or extraction well cap will be closed and bucket lids will be placed on the buckets. The buckets will then be immediately transported to the drum storage area adjacent to the exhaust stack and drained into a labeled drum. Once drained, the system will be restarted.

Condensate drums will be inspected during each system check to ensure they are in good condition and properly labeled. The drums will be shipped for off-site disposal to a Lockheed Martin-approved facility within 90 days of the date that the drum became full. The condensate will be sampled once a year for waste characterization purposes, as required by the disposal facility. To date, analytical results have indicated that the condensate is non-hazardous. Copies of shipping documents will be maintained in the project files; the corresponding Lockheed Martin generator copies will be provided directly to the Middle River Complex by the disposal facility.

3.4.4 Inspection of Vapor Treatment Units

The GAC and PPZ drums will be inspected for general condition, including properly sealed rims, upon delivery to the site and before being placed into service. Damaged GAC and PPZ drums will not be placed into service; they will be returned to the vendor. The spill platform for the PPZ drums will also be inspected for general condition, including accumulated liquid level (if any) and drain cap.

Table 3-1
System Alarm Conditions
Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland

Alarm	Alarm zone	Alarm description
High liquid level (MS-1)	Zone 1	The pre-blower moisture separator is full of condensate.
High liquid level (MS-2)	Zone 2	The post-heat-exchanger moisture separator is full of condensate.
High pressure	Zone 3	The pressure influent to the vapor-phase-carbon drum is higher than 60 inches of water column.
High temperature (TS-1)	Zone 4	The temperature of the vapor-stream from the blower is 215 degrees Fahrenheit (ºF) or higher.
High temperature (TS-2)	Zone 5	The temperature of the vapor-stream discharge from the heat exchanger (before entering the vapor treatment units) is 140ºF or higher.
Low vacuum	Zone 6	The vacuum before the pre-blower moisture separator is lower than 10 inches of water column.

Table 3-2
System Monitoring and Maintenance Tasks
Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland
Page 1 of 2

Every two weeks
1. Record: Å vacuum pre-air filter Å vacuum post-air filter Å post-blower pressure Å differential pressure (difference between pre-filter separator and post-filter <25 in. water column[WC]) Å post-blower temperature Å post-heat-exchanger temperature Å system flow
2. Record differential pressure across filters and replace filter when difference is 25 in. WC or greater.
3. Record the vacuum and flow velocity from each extraction point and adjust as needed.
4. Record the induced vacuum at all vapor monitoring points.
5. Ensure that vacuum relief valves are closed.
6. Check all extraction points and associated piping and header pipe sumps for water accumulation; drain as necessary. Refer to the water handling procedures in Section 3.4.3.
7. Turn system off. Check that flow meter, vacuum, and pressure gauges fall to zero. Check that temperature gauge falls; replace gauges if necessary.
8. Inspect the granular activated-carbon (GAC) and potassium permanganate zeolite (PPZ) units and surrounding pipes/fittings for leaks, corrosion, and signs of heat stress.
9. Check cam-locks and zip-ties on GAC and PPZ unit fittings.
10. Change lead GAC drum when midpoint concentration is 50% or greater of influent concentration.
11. Change PPZ unit when its effluent vinyl chloride concentration is 10% or greater of the lead GAC unit vinyl chloride effluent concentration.
12. Empty moisture separators and sumps into properly labeled transportable container, as needed. Refer to the water handling procedures in Section 3.4.3.
13. Record the number of spare GAC and PPZ units on-site; ensure that two spare GAC units are on-site.
14. Record the number of spare PPZ units on-site; ensure that one spare PPZ unit is maintained on-site.
15. Record the number of empty, partially full, and full wastewater drums on-site.

Table 3-2
System Monitoring and Maintenance Tasks
Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland

Monthly
1. Collect air samples from the influent and effluent of the lead GAC unit and from the effluent of the PPZ unit using one liter Summa® canisters and submit to TestAmerica Laboratories, Inc. for volatile organic compound (VOC) analysis by USEPA Method TO 15.
2. Record induced vacuum at three monitoring points each in the south target zone and central target zone for a continuous 24-hour period. Rotate monitoring points monthly among the vapor monitoring points (VMPs) at the outer extent of the induced vacuum radius. Set up Dwyer Magnesense® MS121 differential-pressure transmitters with 0ï 0.5 inch WC range (accuracy to 0.005 inches WC) and Dwyer DW-USB programmable data-loggers set at five-minute sampling rates to record the induced vacuum at the selected VMPs for 24 hours. Collect the equipment the following day. Download and graph the data for analysis and inclusion in system reports.
Quarterly
1. Measure and record amperage draw from the blower.
2. Visually inspect the air filter and replace if necessary.
3. Check the condition of the moisture separators, blower, heat exchanger, and surrounding pipes for corrosion and wear.
4. Inspect the GAC and PPZ units for corrosion and leakage.
5. Test alarms using checklist (see Appendix B). Ensure that the auto-dialer calls out for all alarms.
6. Check vacuum-relief valve operation and visually inspect filter element.
7. Inspect liquid-level switches. Clean, repair, or replace if necessary.
8. Check for proper operation to ensure that system shutdown occurs upon activation.
9. For the moisture-separator-level switches, fill the units with water to check their operation rather than lifting the switches. Refer to Section 3.4 for specific procedures and methods.
As needed
Change auto-dialer batteries
Every five years
Change GAC hoses in 2017 (since hoses were changed in October 2012; sooner if damaged)

Abbreviations:
GACð granular activated-carbon
PPZð potassium permanganate zeolite
USEPAð United States Environmental Protection Agency
VMPð vapor monitoring point
VOCð volatile organic compound
WCð water column

Table 3-3
Vacuum Influence Monitoringð Vapor Monitoring Points
Building C Sub-slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland

Basement area	Vapor extraction point	Associated vapor monitoring points	Monitoring frequency	Basement area	Vapor extraction point	Associated vapor monitoring points	Monitoring frequency
South basement area	SV-21-C and SV-23-C	001-C-SV, SSD-3-C, SSD-4-C, SSD-2C, SSD-22-C, SSD-24-C, SSD-25-C, SSD-1-C	Biweekly/monthly	Middle basement area	SV-30-C	135-C, 044-C, 143-C	Biweekly/monthly
Middle basement area	SV-26-C	088-C, 113-C, 135-C	Biweekly/monthly		SV-31-C	087-C, 113-C, 134-C	Biweekly/monthly
	SV-27-C	087-C, 113-C, 133-C, 134-C	Biweekly/monthly		SV-32-C	133-C, 111-C, 132-C	Biweekly/monthly
	SV-28-C	060-C, 111-C, 132-C, 127-C	Biweekly/monthly		SV-33-C	141-C, 050-C, 127-C	Biweekly/monthly
	SV-29-C	050-C, 126-C, 127-C	Biweekly/monthly		SV-34-C	050-C, 126-C, 141-C	Biweekly/monthly

Notes:

1. Biweekly monitoring: Instantaneous vacuum readings are to be taken at the listed vapor monitoring points during the biweekly system checks.
2. Monthly monitoring: three points in the south basement area and three points in the middle basement area are to be selected and alternated monthly for 24-hour vacuum monitoring.
3. Monitoring points will be removed from the program if they are not useful. Existing or new points will be proposed and added as needed to define the area of induced vacuum.

Section 4
System Startup and Shutdown Procedures

Startup and shutdown procedures must be in accordance with the latest version of the Building C sub-slab depressurization-system health and safety plan.

In case of an emergency related to system operation, refer to the *Remediation Contingency/Emergency Response Plan Sub-Slab Depressurization Systems in Buildings A and C* (Tetra Tech, December 2012)

4.1 STARTUP PROCEDURE

1. Check all manual valves to ensure that they are in the correct positions, with the valve to at least one extraction point open.

2. Turn main electrical disconnect to the ON position. Turn main disconnect switch on the main control panel to the ON position.

3. Turn the HAND/OFF/AUTO (HOA) switch for the blower to the AUTO position.

4. Turn the HOA switch for the heat exchanger to the AUTO position.

5. *Note:* As soon as the blower switch is turned to the AUTO position, the blower and heat exchanger will turn on. If the blower and heat exchanger do not turn on, refer to the troubleshooting section. If the blower and heat exchanger turn on, proceed to the next step.

6. Verify that the system airflow is above 150 standard cubic feet per minute (SCFM) for the blower. If not, recheck valves and piping. Shut the system down if flow rate is not achieved.

7. Verify that the pressure at the system discharge is below 60 inches of water column (WC). If not, recheck valves and piping. Shut system down if high pressure persists.

4.2 SHUTDOWN PROCEDURE FOR SHORT-TERM PERIODS (LESS THAN 24 HOURS)

1. Turn the HOA switches for the blower and heat exchanger and the main disconnect switch on the main control panel to the OFF position.

2. Drain any condensate from the moisture separators, if present. Put all condensate in a properly labeled transportable container. Refer to water handling procedures in Section 3.4.3.

4.3 SHUTDOWN PROCEDURE FOR LONG-TERM PERIODS (MORE THAN 24 HOURS)

1. Turn the HOA switches for the blower, heat exchanger, and control panel to the OFF position. Turn the wall-mounted electrical disconnect switch to the OFF position. Disconnect the auto-dialer phone line and battery.

2. Drain any condensate, if present, from the moisture separator. Refer to Section 3.4.3 for water handling procedures.

3. Close all valves on the extraction points.

4.4 SHUTDOWN PROCEDURE FOR EMERGENCIES

1. Turn the control panel HOA switch to the OFF position. Turn the wall-mounted electrical disconnect switch to the OFF position.

2. Call the Tetra Tech, Inc. (Tetra Tech) project manager or the program manager if the project manager cannot be reached. Contact telephone numbers are listed in Table 1 of the latest version of the *Remediation Contingency/Emergency Response Plan for Sub-Slab Depressurization Systems in Buildings A and C* (Tetra Tech, 2012b). If the Tetra Tech project or program manager cannot be reached, contact the Lockheed Martin Corporation and CDM Smith personnel shown in bold text in Table 1 of the remediation contingency/emergency response plan, in the order they appear in the table.

3. Refer to the *2012 Remediation Contingency/Emergency Response Plan for Sub Slab Depressurization Systems in Buildings A and C* (Tetra Tech, 2012b) for emergency procedures related to SSDS operation.

Section 5
Troubleshooting

Troubleshooting procedures must be in accordance with the latest version of the Building C sub-slab depressurization-system health and safety plan.

Follow all lock-out/tag-out procedures before servicing equipment (see Section 6.0). Table 5-1 lists possible scenarios, along with probable causes and remedies.

Table 5-1
Troubleshooting Matrix
Building C Sub-Slab Depressurization-System Expansion
Lockheed Martin Middle River Complex, Middle River, Maryland

Symptom	Probable causes	Possible remedies
Blower will not operate	• Breaker in service panel is in OFF position	• Turn breaker to ON position
	• High condensate in moisture separator	• Drain condensate
	• Faulty level switch	• Repair or replace level switch
	• Faulty pressure switch	• Repair or replace pressure switch
	• Faulty temperature switch	• Repair or replace temperature switch
High-temperature light ON (TS-1, TS-2)	• Clogged air filter or line	• Change filter or clear obstruction
	• Low airflow	• Reduce pressure differential across blower. Reduce applied vacuum by opening the ambient air valve
	• Faulty temperature switch	• Check temperature switch; clean, adjust, or replace if necessary
High-level light ON (MS-1, MS-2)	• Moisture separator is full of condensate.	• Drain moisture separator
	• Faulty level switch	• Check level switch; clean or replace if necessary
High-pressure light ON	• Vapor-phase-carbon drums are clogged	• Replace carbon drum
	• Faulty pressure switch	• Check pressure switch. Adjust, clean or replace if necessary
Low vacuum switch ON	• Low or no flow	• Check blower
	• Faulty switch	• Repair or replace switch
	• Pipe or hose disconnected or broken	• Repair pipe or hose

Section 6

Lock-Out/Tag-Out Procedures

Lock-out/tag-out procedures must be in accordance with the latest version of the Building C sub-slab depressurization-system health and safety plan.

Follow lock out/tag out procedures before any equipment repair. The location of both electrical and mechanical lock-out points is listed below in Table 6-1.

ONLY QUALIFIED PERSONNEL SHALL PERFORM LOCK-OUT/TAG-OUT TASKS

Table 6-1
Lock-Out/Tag-Out Procedures
Building C Sub-Slab Depressurization System
Lockheed Martin Middle River Complex, Middle River, Maryland

Equipment/device	Electrical lock-out
Moisture separators	Main disconnect switch on control panel
High level switches for moisture separators	Main disconnect switch on control panel
Particulate filter	Main disconnect switch on control panel
Vapor extraction blower	Main disconnect switch on control panel
Temperature switches	Main disconnect switch on control panel
High pressure switch	Main disconnect switch on control panel
Low vacuum switch	Main disconnect switch on control panel
GAC and PPZ drums	Turn HOA switches for the blower and heat exchanger to OFF position, close extraction-point valves, disconnect quick-connect couplings
Main control panel	Wall-mounted disconnect
Wall-mounted disconnect	Breaker panel

Abbreviations:
GACð granular activated-carbon
HOAð HAND/OFF/AUTO
PPZð potassium permanganate zeolite

Section 7
Reporting

Quarterly and semiannual progress reports will be submitted to Lockheed Martin Corporation. These reports will include:

- mass-removal data for the monitoring period and cumulative mass-removal data to date
- individual extraction-point flow rates and operating vacuums
- summary of activities performed during the reporting period
- field notes/daily activity logs
- system down-times
- laboratory sample analytical results (full data packages only in the semiannual reports)
- figure(s), tables and/or graphs showing induced vacuum at vapor monitoring points associated with each extraction well, including comparison to design criteria (24-hour monitoring data only in the semiannual reports)
- recommendations for continued operations

Section 8
References

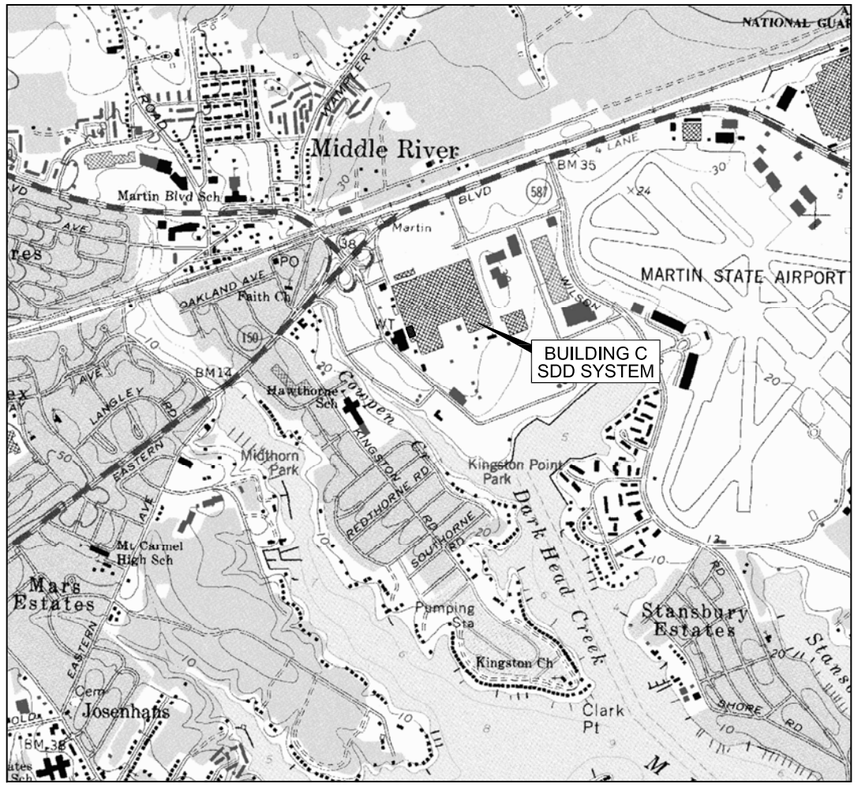
1. Maryland Department of the Environment (MDE), 2007. Telephone communication between Mr. Dave Mummert of Air Quality Permits section and Tetra Tech, Inc. regarding the anticipated volume of emissions at site not requiring an air permit. November.

2. Maryland Department of the Environment (MDE), 2012. Telephone communication between Mr. George Beerli of Air Quality Permits section and Tetra Tech, Inc. regarding the anticipated volume of emissions at site not requiring an air permit.

3. Tetra Tech (Tetra Tech, Inc.), 2012a. *Vapor Intrusion Investigation and Sub-Slab Depressurization System Operation, February 2012 Monitoring Report, Lockheed Martin Middle River Complex, 2323 Eastern Boulevard Middle River, Maryland*. July

4. Tetra Tech Inc. (Tetra Tech), 2012b. *Remediation Contingency/Emergency Response Plan, Sub-Slab Depressurization Systems in Buildings A and C, Lockheed Martin Middle River Complex, 2323 Eastern Boulevard Middle River, Maryland.* December.

APPENDIX Að AS-BUILT DRAWINGS



SITE LOCATION MAP

LEGEND

- SUBSLAB VAPOR EXTRACTION POINT INSTALLED MARCH 2008
- GROUNDWATER MONITORING WELL
- SUBSLAB VAPOR MONITORING POINT
- MONITORING POINT INSTALLED JANUARY 2010
- PROPOSED SUBSLAB VAPOR EXTRACTION POINT
- TARGET OF OPPORTUNITY
- INDOOR AIR SAMPLE
- ABANDONED WELL BORING
- SUBSLAB VAPOR EXTRACTION POINT INSTALLED OCTOBER 2012

SSD SUBSLAB DEPRESSURIZATION

SYSTEM PIPING

PROPOSED PIPE EXTENSION (OVERHEAD)

TARGET AREA FOR INDUCED VACUUM

APPROVED BY:

DATE	REVISION	APRVD.

TITLE:

AS-BUILT
BUILDING C BASEMENT SSD SYSTEM SECOND-PHASE EXPANSION PLAN

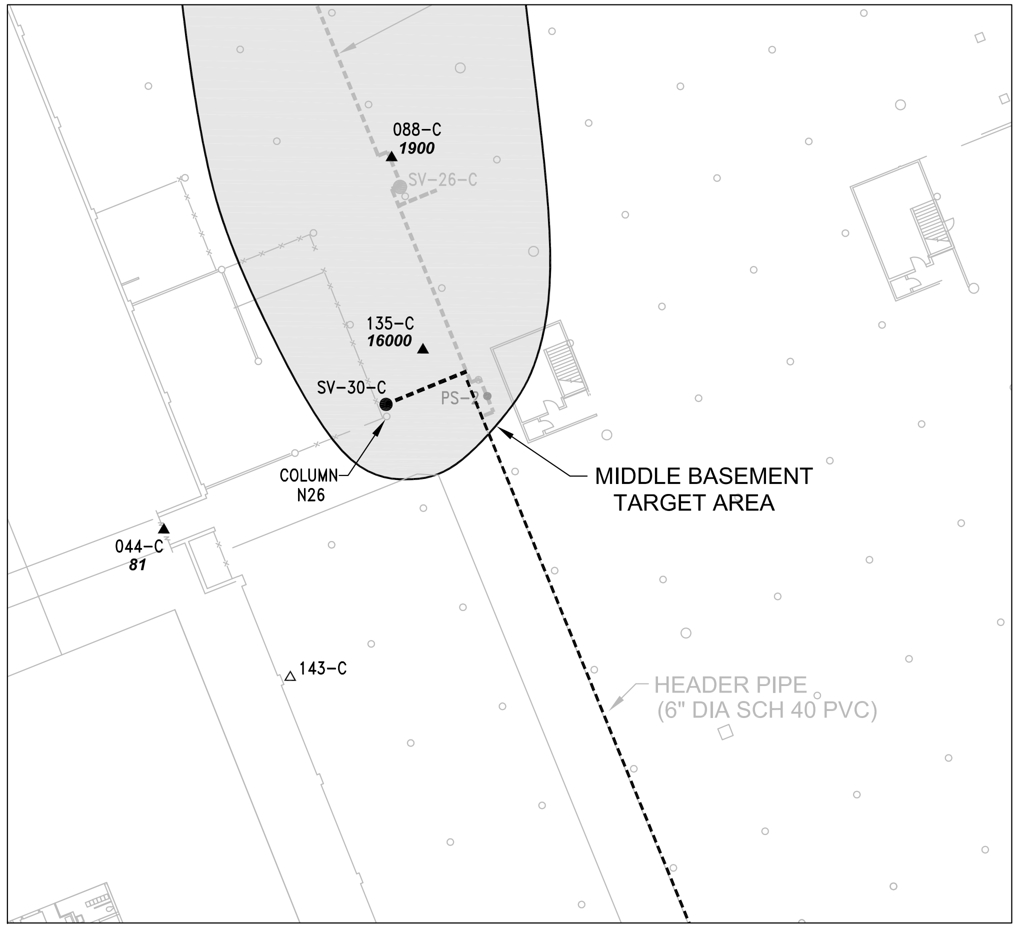
LOCATION:

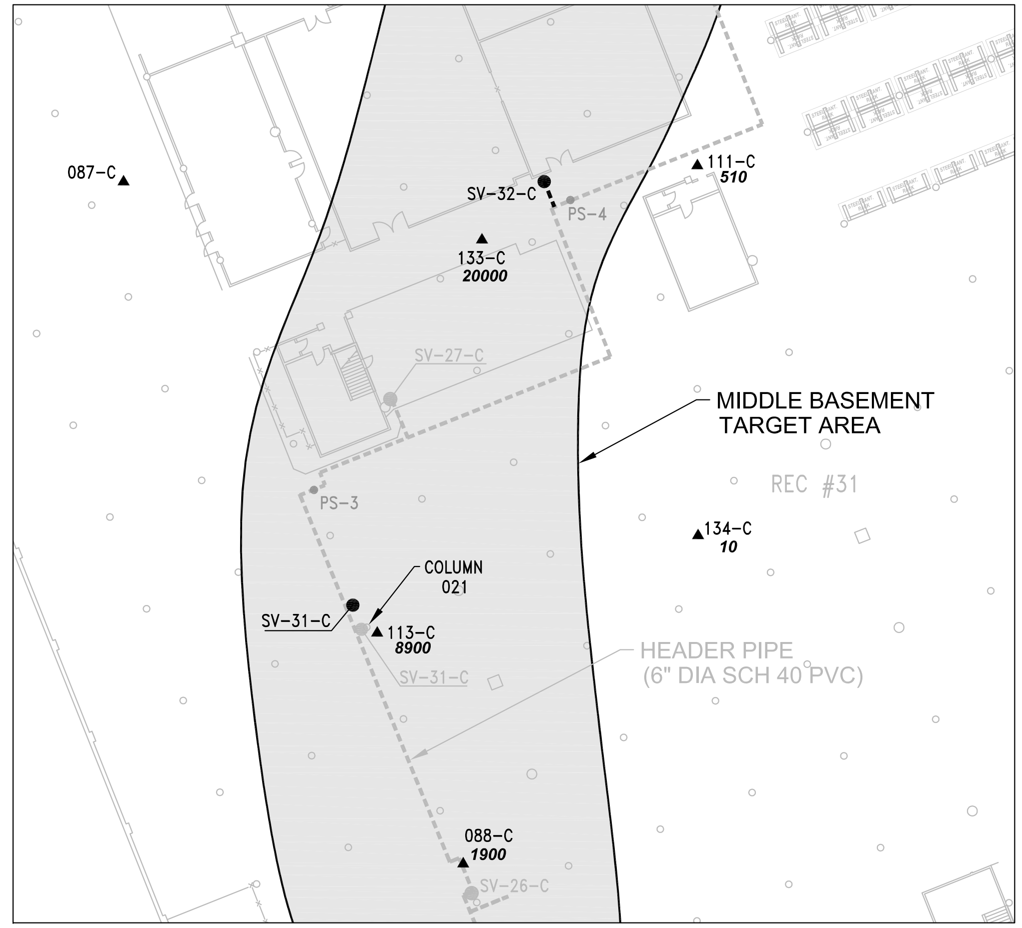
Middle River, Maryland

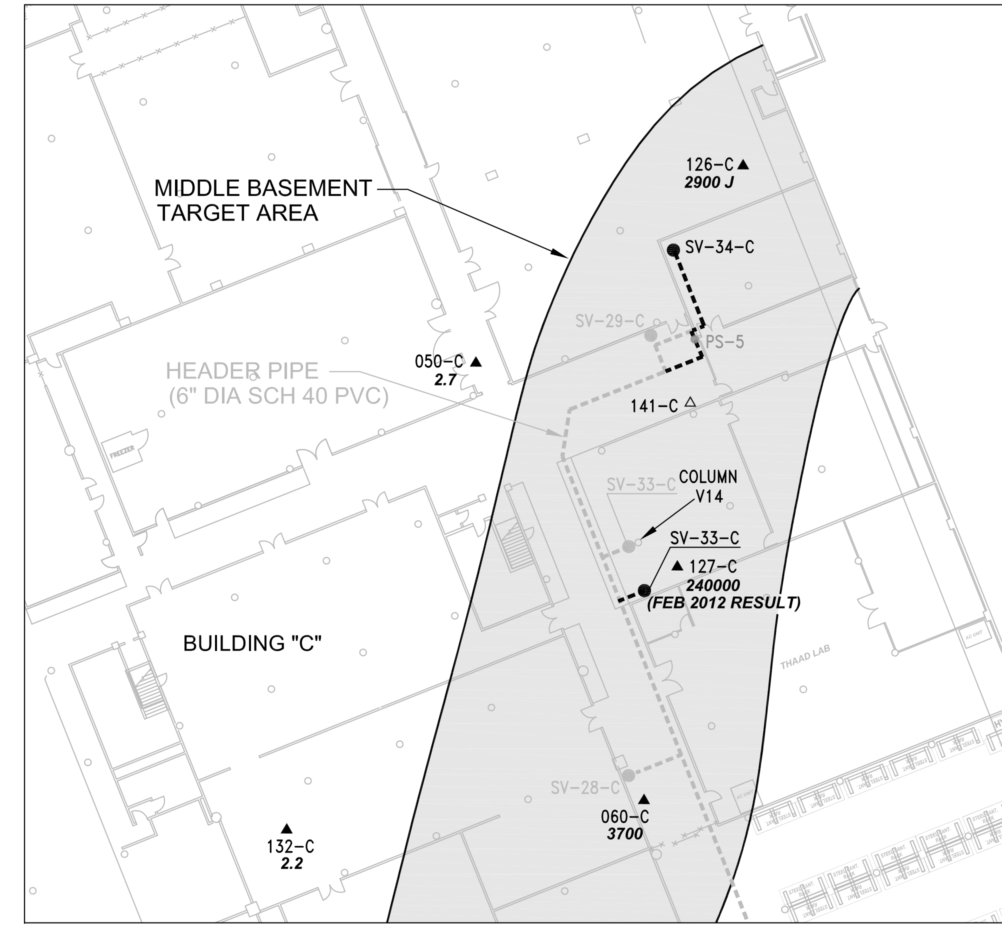
TETRA TECH

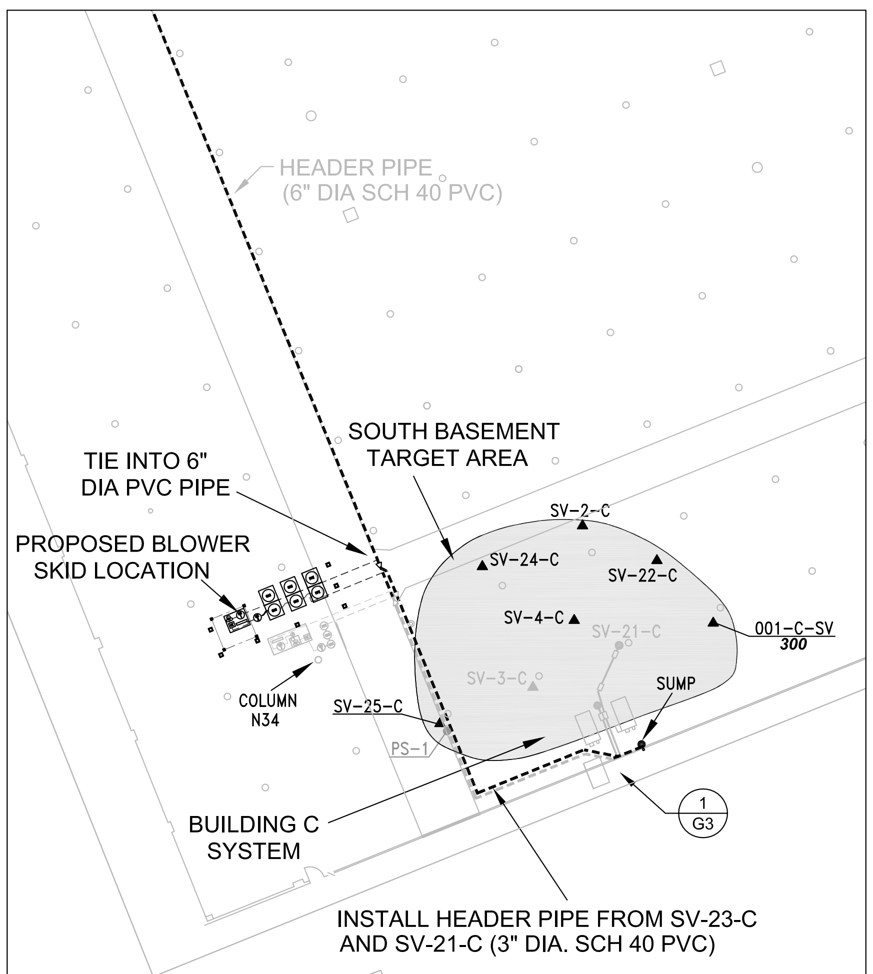
APPROVED	PAR
DRAFTED	CMP
PROJECT#	117-0507537
DATE	5-14-13

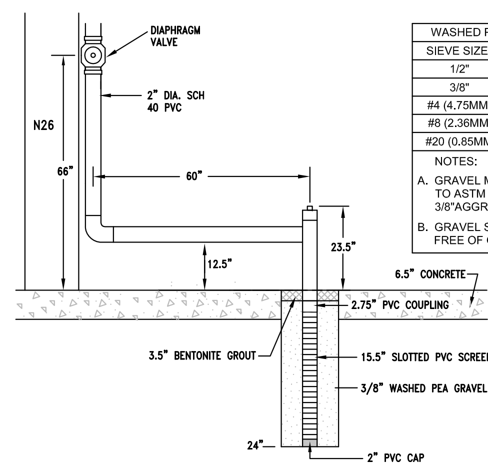
DRAWING: G1











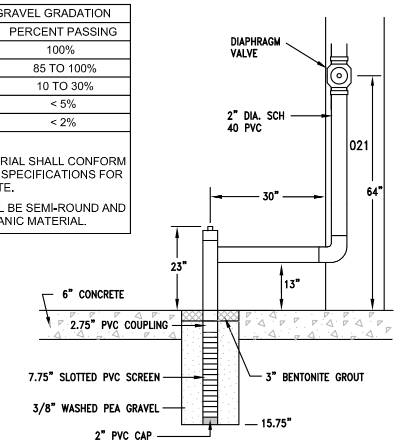
SSD EXTRACTION POINT DETAIL SV-30-C
NOT TO SCALE

WASHED PEA GRAVEL GRADATION	
SIEVE SIZE	PERCENT PASSING
1/2"	100%
3/8"	85 TO 100%
#4 (4.75MM)	10 TO 30%
#8 (2.36MM)	< 5%
#20 (0.85MM)	< 2%

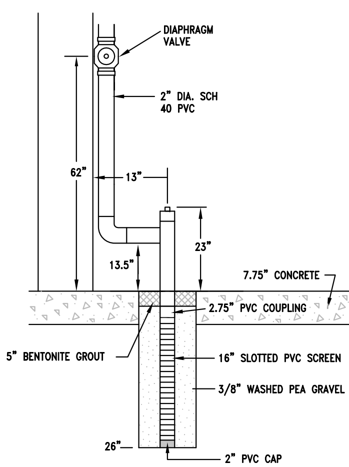
NOTES:

A. GRAVEL MATERIAL SHALL CONFORM TO ASTM C-33 SPECIFICATIONS FOR 3/8"AGGREGATE.

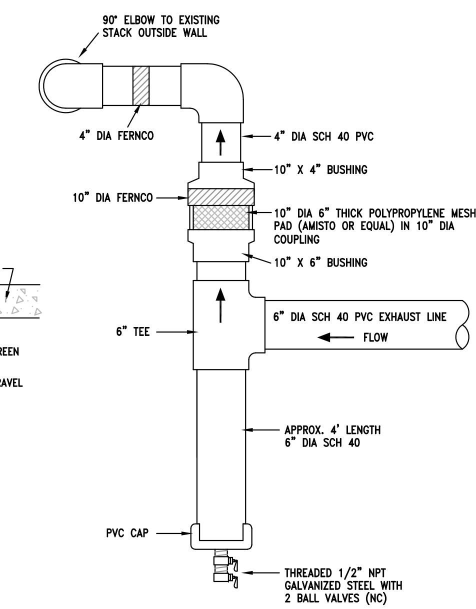
B. GRAVEL SHALL BE SEMI-ROUND AND FREE OF ORGANIC MATERIAL.



SSD EXTRACTION POINT DETAIL SV-31-C
NOT TO SCALE



SSD EXTRACTION POINT DETAIL SV-32-C
NOT TO SCALE

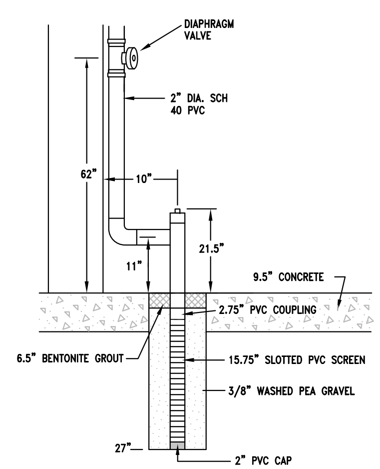


SUMP AND DEMISTER AT STACK BASE DETAIL
NOT TO SCALE

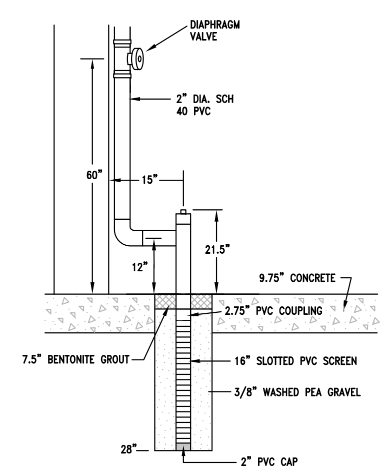
LEGEND

- GROUNDWATER MONITORING WELL
- SUBSLAB VAPOR MONITORING POINT
- MONITORING POINT TO BE INSTALLED FEBRUARY 2013
- PROPOSED SUBSLAB VAPOR EXTRACTION POINT
- SUBSLAB VAPOR EXTRACTION POINT
- PS-1 PIPE SUMP
- HEADER PIPE (6" DIA. SCH 40)
- PROPOSED PIPE EXTENSION (2", 3", 4" OR 6" DIA. SCH 40)
- 5700 TCE CONCENTRATION ($\mu g/m^3$) FROM AUGUST 2012
- 2900 J ESTIMATED TCE CONCENTRATION
- SSD SUBSLAB DEPRESSURIZATION

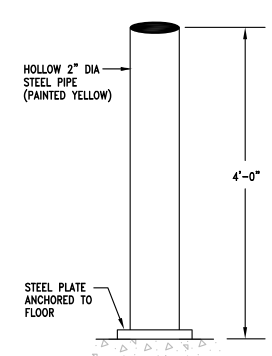
NOTE:
PIPE HANGERS PLACED NEXT TO EXISTING SUPPORT BRACKETS FOR STEEL PIPING IN CEILING APPROX. 6-12 FT APART.



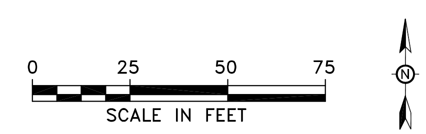
SSD EXTRACTION POINT DETAIL SV-33-C
NOT TO SCALE

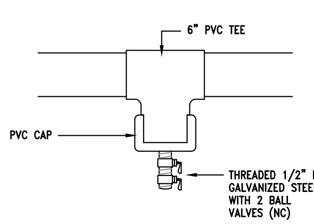


SSD EXTRACTION POINT DETAIL SV-34-C
NOT TO SCALE



PIPE BOLLARD DETAIL
NOT TO SCALE





NOTE: INSTALL AT PIPING LOW POINT AS NEEDED. SUMP DEPTH KEPT TO A MINIMUM DUE TO FACILITY HEIGHT CLEARANCE REQUIREMENTS.

PIPE SUMP AND DRAIN DETAIL
NOT TO SCALE

NOTE: EXTRACTION POINT PIPING SUPPORTED ON WALL OR COLUMN WITH PIPE SUPPORTS.

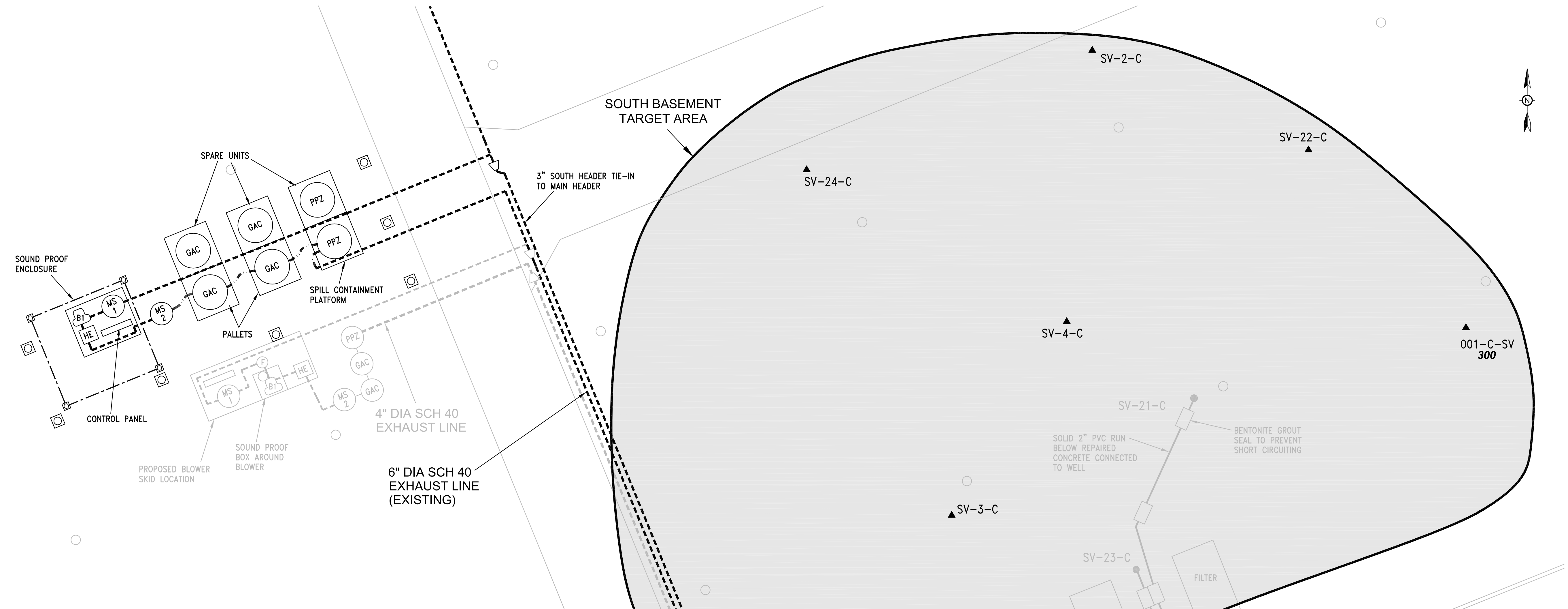
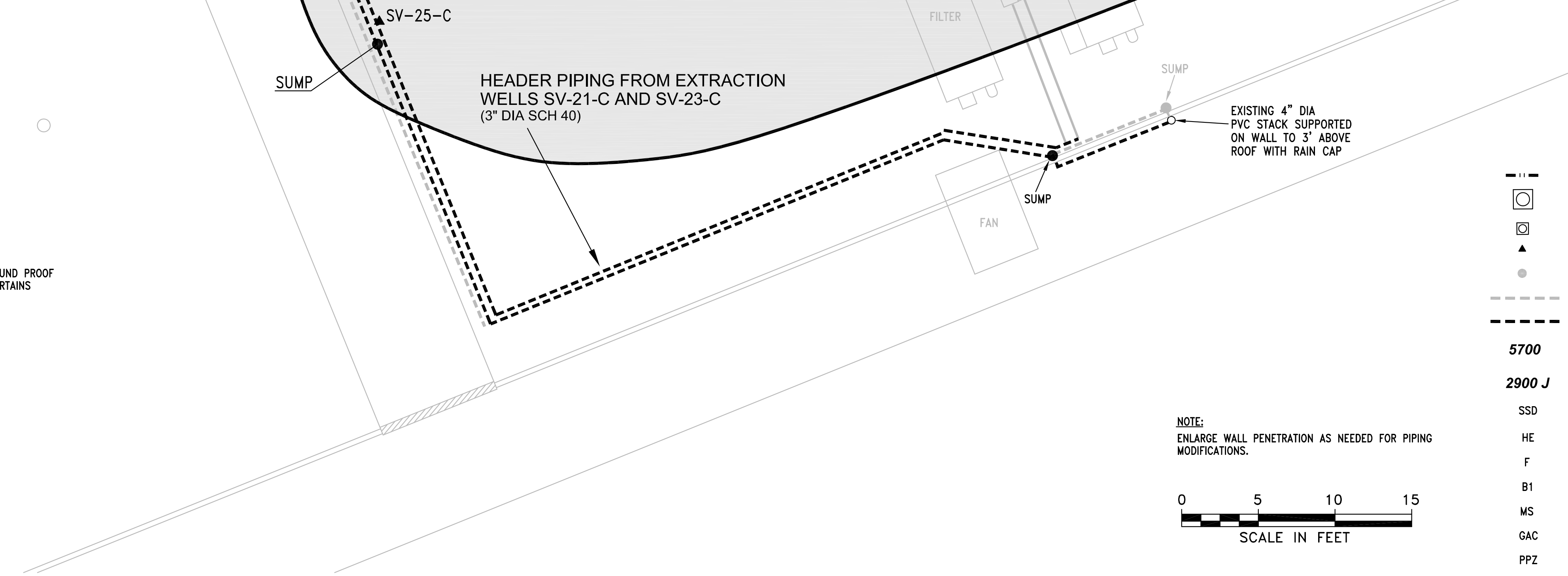
APPROVED BY:	DATE	REVISION	APPRVD.

TITLE:
AS-BUILT
BUILDING C BASEMENT SSD
SYSTEM SECOND-PHASE EXPANSION LAYOUT AND DETAILS

LOCATION:
Middle River, Maryland

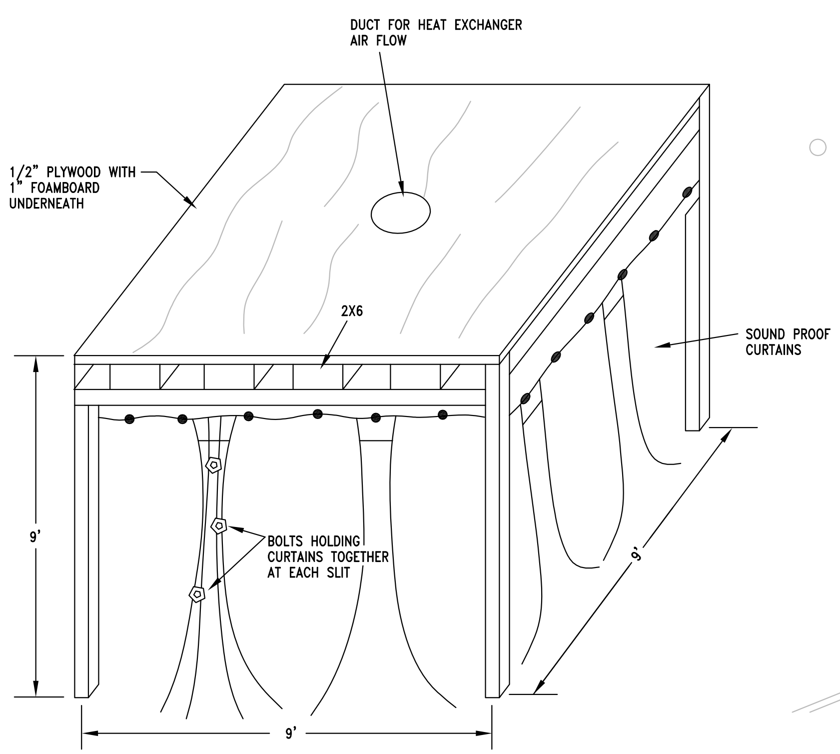
TETRA TECH

APPROVED	PAR	DRAWING:
DRAFTED	CMP	G2
PROJECT#	117-0507537	
DATE	5-14-13	

BUILDING C SSD SYSTEM LAYOUT (1/G3)

NOT TO SCALE



SOUND PROOF ENCLOSURE

NOT TO SCALE

NOTES:

1. CURTAINS OVERLAPPED BY ~4 INCHES
2. 6 IN FOAMBOARD TRIM AROUND INSIDE TOP OF WALLS.

NOTE:

ENLARGE WALL PENETRATION AS NEEDED FOR PIPING MODIFICATIONS.

0 5 10 15

SCALE IN FEET

LEGEND

Symbol	Description
(dash-dot line)	4" DIA. FLEX HOSE
(large square with circle)	CORNER POST FOR SOUND CURTAIN
(small square with circle)	BOLLARD
▲	SUBSLAB VAPOR MONITORING POINT
●	SUBSLAB VAPOR EXTRACTION POINT
(grey dashed line)	ORIGINALLY PROPOSED HEADER PIPE
(black dashed line)	AS-BUILT HEADER PIPE (3", 4", OR 6" DIA. SCH 40)
5700	TCE CONCENTRATION ($\mu g/m^3$) FROM AUGUST 2012
2900 J	ESTIMATED TCE CONCENTRATION
SSD	SUBSLAB DEPRESSURIZATION
HE	HEAT EXCHANGER
F	INLET AIR FILTER
B1	BLOWER
MS	MOISTURE SEPARATOR
GAC	GRANULAR ACTIVATED CARBON
PPZ	POTASSIUM PERMANGANATE ZEOLITE

APPROVED BY:

DATE	REVISION	APRVD.

TITLE:

AS-BUILT
BUILDING C BASEMENT SSD SYSTEM SECOND-PHASE EXPANSION LAYOUT

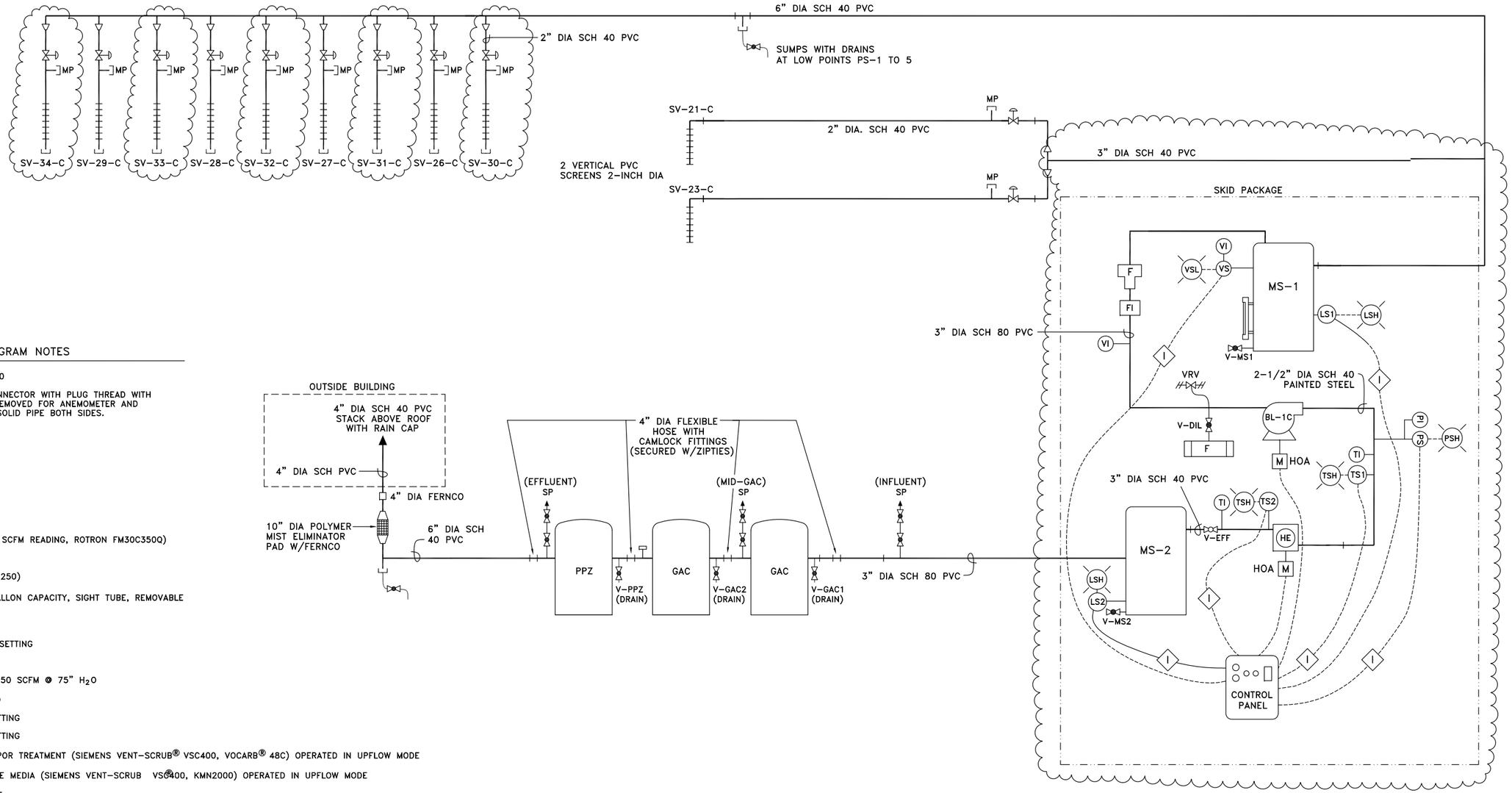
LOCATION:

Middle River, Maryland

TETRA TECH

APPROVED	PAR
DRAFTED	CMP
PROJECT#	117-0507537
DATE	5-14-13

DRAWING: G3



PROCESS AND INSTRUMENTATION DIAGRAM NOTES

VI	VACUUM INDICATOR – 0–160" H_2O
MP	MEASURING POINT 1/4" MALE CONNECTOR WITH PLUG THREAD WITH TEFLON TAPE. FITTING MAY BE REMOVED FOR ANEMOMETER AND VACUUM READINGS PROVIDE 20" SOLID PIPE BOTH SIDES.
▽	REDUCER
–▷◁–	BALL VALVE – NORMALLY OPEN
–▶◀–	BALL VALVE – NORMALLY CLOSED
⧖	DIAPHRAGM VALVE (LOCKABLE)
⩘	CHECK VALVE
FI	FLOW INDICATOR (DIRECT 70–350 SCFM READING, ROTRON FM30C350Q)
F	INLET AIR FILTER
HE	HEAT EXCHANGER (XCHANGER AA–250)
MS	MOISTURE SEPARATOR WITH 30 GALLON CAPACITY, SIGHT TUBE, REMOVABLE TOP, DRAIN VALVE
LS	LEVEL SWITCH
VRV	VACUUM RELIEF VALVE, 85" H_2O SETTING
SP	SAMPLE PORT 1/4" DIAMETER
BL	ROTRON DR858, 7.5 HP MOTOR, 150 SCFM @ 75" H_2O
PI	PRESSURE INDICATOR 0–160" H_2O
TS1	TEMPERATURE SWITCH, 215° F SETTING
TS2	TEMPERATURE SWITCH, 140° F SETTING
GAC	GRANULAR ACTIVATED CARBON VAPOR TREATMENT (SIEMENS VENT-SCRUB® VSC400, VOCARB® 48C) OPERATED IN UPFLOW MODE
PPZ	POTASSIUM PERMANGANATE ZEOLITE MEDIA (SIEMENS VENT-SCRUB VSC®400, KMN2000) OPERATED IN UPFLOW MODE
TI	TEMPERATURE INDICATOR 0–250° F
PS	PRESSURE SWITCH (HIGH)
VS	VACUUM SWITCH (LOW)
V-MS1	PROCESS VALVE LABELS
HOA	PANEL MOUNTED HAND/OFF/AUTO SWITCH
◇I	INTERLOCK BLOWER SHUTDOWN
○	LOCALLY MOUNTED INSTRUMENT
⊗	PANEL ALARM LIGHT
H	HIGH
L	LOW
M	MOTOR
⊤	TAP PLUG

CONNECT FIVE (5) NEW SUBSLAB VAPOR EXTRACTION POINTS. REPLACE EXISTING BLOWER SKID WITH NEW SKID WITH LARGER BLOWER, MOISTURE SEPARATOR, HEAT EXCHANGER, AND CONTROL PANEL. RELOCATE BLOWER SKID AND VAPOR TREATMENT (GAC AND PPZ) UNITS. ADD EXHAUST SIDE MOISTURE SEPARATOR (RE-USE EXISTING SEPARATOR). TIE IN CONTROLS.

APPROVED BY:

DATE	REVISION	APRVD.

TITLE: **AS-BUILT**

BUILDING C BASEMENT SSD SYSTEM SECOND-PHASE EXPANSION PROCESS AND INSTRUMENTATION DIAGRAM

LOCATION: **MIddle RIver, Maryland**

TETRA TECH

APPROVED	PAR
DRAFTED	CMP
PROJECT#	117-0507537
DATE	5-14-13

DRAWING: **G4**

APPENDIX Bð SYSTEM-CHECK FORMS

SSD SYSTEM CHECK - BUILDING C

LMC Middle River Complex, Middle River, Maryland

Date: _____ **Time:** _____ **Personnel:** _____

1. Was the system running upon arrival?
YES NO

2. Where there any alarm conditions upon arrival?
YES NO

Comment: _____

3. Is the blower ambient air valve open?
YES NO

4. Are there any leaks or damage to system hoses?
YES NO

5. Is there any damage to system components?
YES NO

6. Are all locks and zip-ties secure?
YES NO

7. Do the these fall to zero when system is turned off?

Flow Gauge	YES	NO
Pressure Gauges	YES	NO
Vacuum Gauges	YES	NO

8. Was there a GAC change out?
YES NO

9. Was there a $KMnO_4$ change out?
YES NO

10. How many GAC units are at this location?
NEW _____ SPENT _____

11. How many $KMnO_4$ units are at this location?
NEW _____ SPENT _____

12. How many water drums are on-site?
EMPTY _____ PART FULL _____ FULL _____

GENERAL SYSTEM MONITORING

Time	Vacuum pre-Filter (in. H_2O)	Vacuum post-Filter (in. H_2O)	Diff Pressure of Filters (in. H_2O)*	Flow (scfm)	Pressure post-Blower (in. H_2O)	Temp post-Blower (ÜF)	Temp post-HE (ÜF)

* Replace filter if >25 in. H_2O

13. How many hours are displayed on the time counter? _____

EXTRACTION WELL VACUUM AND VELOCITY MONITORING

Location	Time	Vacuum (in. H_2O)	Velocity (ft/min)	Flow (scfm)**	Vacuum/Flow Adjustment	Comments
SV-21-C						
SV-23-C						
SV-30-C						
SV-26-C						
SV-31-C						
SV-27-C						
SV-32-C						
SV-28-C						
SV-33-C						
SV-29-C						
SV-34-C						

** Flow = Velocity x 0.0218

SSD SYSTEM CHECK - BUILDING C

LMC Middle River Complex, Middle River, Maryland

VMP VACUUM MONITORING							
VMP	**Time**	**Vacuum (in. H_2O)**	**Comments**	**VMP**	**Time**	**Vacuum (in. H_2O)**	**Comments**
001-C-SV				SV-087-C			
SV-22-C				SV-133-C			
SV-2-C				SV-134-C			
SV-24-C				SV-111-C			
SV-25-C				SV-060-C			
SV-3-C				SV-127-C			
SV-4-C				SV-141-C			
SV-135-C				SV-050-C			
SV-088-C				SV-126-C			
SV-113-C							

MOISTURE SEPARATOR, SUMP, AND DRAIN MONITORING							
Location	**Contains Water?**		**Water Drained?**		**Volume Drained**	**Valves Closed?**	
Moisture Separators							
MS-1	YES	NO	YES	NO		YES	NO
MS-2	YES	NO	YES	NO		YES	NO
Pipe Sumps							
PS-1	YES	NO	YES	NO		YES	NO
PS-2	YES	NO	YES	NO		YES	NO
PS-3	YES	NO	YES	NO		YES	NO
PS-4	YES	NO	YES	NO		YES	NO
PS-5	YES	NO	YES	NO		YES	NO
System Sumps							
Exhaust Stack Sump	YES	NO	YES	NO		YES	NO
GAC and PPZ Drains							
Lead GAC	YES	NO	YES	NO		YES	NO
Lag GAC	YES	NO	YES	NO		YES	NO
PPZ	YES	NO	YES	NO		YES	NO

MONTHLY VAPOR SAMPLING			
Location	**Time**	**Canister ID**	**Comments**
C-INFLUENT			
C-MID GAC			
C-EFFLUENT			

ADDITIONAL COMMENTS:

FIELD REP. SIGNATURE: _____ **Time:** _____

APPENDIX Cð MATERIAL SAFETY DATA SHEETS

Envirotrol Inc.®
P.O. Box 61
432 Green St.
Sewickley, PA 15143
Phone: 412.741.2030 Fax: 412.741.2670

Emergency Phone Number:
724.827.8181

MSDS Date: 5/14/2003

Material Safety Data Sheet

Section 1 – Product Identification

Chemical Name:	Carbon	Trade Name:	Activated/Reactivated Carbon (Granular, Pelletized or Powdered)
Formula:	C	Common Name:	Carbon
CAS Number:	7440-44-0	Chemical Family:	Element, Group IV-A

Section 2 – Ingredients (Typical Values)

Carbon	----------	90-100%
Inert Ingredients	----------	0-10%

Section 3 - Physical And Chemical Data

● Boiling Point:	8721° F, 4827° C (Approx.)	● Vapor Pressure:	N/A
● Vapor Density:	N/A	● Solubility in Water:	Insoluble
● Specific Gravity:	0.2 – 0.75	● Percent, Volatile by Volume:	N/A
● Appearance:	Black, Odorless, Pelletized, Powder	● Evaporation Rate:	N/A

Section 4 - Fire And Explosion Hazard Data

- Flash Point: N/A
- Ignition Point: 500-800° F
- Extinguishing Media: Dry Chemical, Water Fog, Foam
- Special Fire Fighting Procedures: Wear positive pressure self-contained breathing apparatus if fire occurs in enclosed space. Oxygen starved fires may result in the release of carbon monoxide.
- Unusual Fires And Explosion Hazards: Avoid producing suspensions of dust during handling, and avoid exposure of suspensions to sources of ignition. Suspensions of -40 mesh powdered activated carbon may explode if exposed to strong sources of ignition

Section 5 - Health Hazard Data

- Eye: Carbon particles may cause physical irritation if not removed.
- Skin Contact: Constant prolonged exposure may cause dryness or chapping of exposed area
- Skin Adsorption: Not adsorbed by skin.
- Ingestion: No adverse affect unless quantity ingested causes physical discomfort.
- Inhalation: No toxic affect caused by dust. As with any dust, excessive exposure should be avoided. OSHA "Nuisance Dust" limitations should be observed
- Systemic And Other Effects: None

Envirotrol Inc.®
P.O. Box 61
432 Green St.
Sewickley, PA 15143
Phone: 412.741.2030 Fax: 412.741.2670

Emergency Phone Number:
724.827.8181

MSDS Date: 5/14/2003

Section 5 - Health Hazard Data *(continued)*

- Eyes: Irrigate with water immediately. Repeat as needed to flush particle from eye. If irritation persists, consult medical personnel.
- Skin: Wash with soap and water to avoid skin drying or chapping.
- Ingestion: N/A
- Inhalation: N/A

Section 6 - Reactivity Data Compatibility Data

- Stability: Avoid contact with strong oxidizing chemicals, such as ozone, perchloric acid, permanganate, sodium chlorite, etc. Exposure to hydrocarbons and vegetable oils may cause slow oxidation until ignition point is reached--contact should be avoided.
- Incompatibility: Strong oxidizing materials.
- Hazardous Decomposition Products: Oxygen starved combustion may yield carbon monoxide.
- Hazardous Polymerization: Will not occur.

Section 7 - Storage Handling And Use

- Action To Take For Spills: Shovel and sweep material into appropriate container. If necessary wash area with water.
- Disposal Method: Reactivation, landfill or incineration, in accordance with applicable regulations.

Section 8 - Personnel Protection

- Ventilation: Local exhaust recommended minimizing dust exposure.
- Respiratory Protection: Approved "nuisance dust" dust masks should be worn in dust exposure areas.
- Protective Clothing: Protective gloves can be worn.
- Eye Protection: Safety glasses with side shields should be worn and eye wash capabilities should be available.

Section 9 - Special Precautions And Additional Information

Precautions to be taken in handling and storage: keep dry; wet carbon will adsorb oxygen and may reduce oxygen levels in confined spaces to dangerous levels. Adequate ventilation and precautions should be employed whenever closed tanks, receptacles or other enclosed spaces containing carbon are accessed. Suspensions of dust should be avoided and exposure of suspensions of dust to sources of ignition should be avoided.

HYDROSIL
INTERNATIONAL LTD.

1180 St. Charles Street
Elgin, IL 60120

Phone: 1-800-787-7531
Emergency Phone: 1-847-741-1600
Telex*: 1-847-741-1616

Hydrosil HS-600

Identity (Trade Name As Used On Label)

MSDS Number*

CAS Number*

January 1, 2012 to December 31, 2012

Date Prepared

William J. Waldschmidt

Prepared By*

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

SECTION 1 - MATERIAL IDENTIFICATION AND INFORMATION

COMPONENTS - Chemical Name & Common Names (Hazardous Components 1% or greater; Carcinogens 0.1% or greater)	%*	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
hydrated potassium permanganate forming ionic	6-8%	5 mg/m^3	5 mg/m^3	None
potassium hydroxide (CAS # 1310-58-3) and				
ionic manganese tetraoxide (CAS # 1317-35-7)				
Non-Hazardous Ingredients molecular sieve/moisture	92-94%			
TOTAL	**100**			

SECTION 2 - PHYSICAL / CHEMICAL CHARACTERISTICS

Boiling Point: N/A

Specfic Gravity (H_2O = 1): Density 59-61 #/ft^3

Vapor Pressure (mm Hg and Temperature): N/A

Melting Point: N/A

Vapor Density (Air = 1): N/A

Evaporation Rate (_____ = 1): N/A

Solubility in Water: $KMnO_4$ - yes, molecular sieve - no

Water Reactive: N/A

Appearance and Odor: purple granules, odorless

SECTION 3 - FIRE AND EXPLOSION HAZARD DATA

Flash Point and Method Used	Auto-Ignition Temperature	Flammability Limits in Air % by Volume	LEL	UEL
N/A	N/A	N/A	N/A	N/A

Extinguisher Media: None

Special Fire Fighting Procedures: None

Unusual Fire and Explosion Hazards: None

SECTION 4 - REACTIVITY HAZARD DATA

STABILITY
■ Stable
☐ Unstable

Conditions To Avoid: Protect in containers against puncture and physical damage, keep in a dry area, avoid exposure to water

Incompatability (Materials to Avoid): None

Hazardous Decomposition Products: None

HAZARDOUS POLYMERIZATION
☐ May Occur
■ Will Not Occur

Conditions To Avoid: None

SECTION 5 - HEALTH HAZARD DATA

PRIMARY ROUTES OF ENTRY
☐ Inhalation ☐ Ingestion
☐ Skin Absorption ■ Not Hazardous

CARCINOGEN LISTED IN
☐ NTP ☐ OSHA
☐ IARC Monograph ■ Not Listed

HEALTH HAZARDS

Acute: May be irritating to body tissue upon contact

Chronic: None

Signs and Symptoms of Exposure: May stain body tissue

Medical Conditions Generally Aggravated by Exposure: Open wounds, burns, and mucous membranes

EMERGENCY FIRST AID PROCEDURES - Seek medical assistance for further treatment, observation and support if necessary

Eye Contact: Immediately flush with large amounts of water for 15 minutes

Skin Contact: Immediately flush with soap and water

Inhalation: Leave contaminated area

Ingestion: Drink several glasses of water or milk. Seek medical attention.

SECTION 6 - CONTROL AND PROTECTIVE MEASURES

Respiratory Protection (Specify Type): Treat as low level nuisance dust, Use NIOSH/MSA #TC-21C-132

Protective Gloves: Rubber or plastic gloves

Eye Protection: Safety glasses

VENTILATION TO BE USED
☐ Local Exhaust ■ Mechanical (general) ☐ Special
☐ Other (specify)

Other Protective Clothing and Equipment: Regular work clothing

Hygienic Work Practices: Wash your hands before eating. Wash contaminated clothing.

SECTION 7 - PRECAUTIONS FOR SAFE HANDLING AND USE/ LEAK PROCEDURES

Steps to be Taken If Material is Spilled Or Released: Sweep up granules and dispose of in accordance with local, state, and federal regulations.

Waste Disposal Methods: Reduce potassium permanganate with hypo (10% sodium thiosulfate) solution and deposit in permitted landfill.

Precautions to be Taken in Handling and Storage: Protect containers against physical damage. Store in a cool dry area in closed containers.

Other Precautions and/or Special Hazards: Avoid exposure to water and contaminated air, otherwise the media is rendered useless

NFPA Rating* Health _____ Flammability _____ Reactivity _____ Special _____

HMIS Rating* Health _____ Flammability _____ Reactivity _____ Special _____

* Optional

APPENDIX Dð EQUIPMENT MANUFACTURER MANUALS

Gasho SINCE 1982
The Leader in Blower & Vacuum Solutions

Gasho, Inc.

BLOWER PACKAGE TEST DOCUMENTATION

Customer / Job #: 2 [illegible] 2
Blower Model and Serial #: 028 58/A472W
Motor size and Voltage: 460

Date: 12 April 2013
Start Time: 8:15
Stop Time: 3:30

Design Flow:
Design Press./Vac.:
Relief Valve Setting: 85" H_2O ✓

Ambient Temp:
VOLTAGE: 526 ✓

CHECK ALL OF THE FOLLOWING AND INITIAL:

- ______ Ensure ALL Components are securely fastened
- ______ Inspect Paint
- N/A Ensure Lubrication is Complete
- N/A Check sheaves in accordance with sizing sheet

Location of Noise Testing Points:
A = Discharge end
B = Blower end
C = Belt guard side (front)
D = Back side
[ ] With Enclosure
[ ] Without Enclosure

PRESS Switch 60" H_2O set ✓
Vacuum set at 10" [illegible]

Run under 3 Conditions: Record the following information:

1 NO LOAD - 0 psig/vac
AMP DRAW
LINE 1 - 7.2
LINE 2 - 6.7
LINE 3 - 6.7

Noise Level (dba) 3 feet from unit
Location A - 85
Location B - 83
Location C - 84
Location D - 85

Discharge Temp.:
Blower Discharge Temp:

2 HALF LOAD - 30 1" H_2O ~~psig~~/vac
AMP DRAW
LINE 1 - 7.6
LINE 2 - 7.4
LINE 3 - 8.2

Noise Level (dba) 3 feet from unit
Location A - 78
Location B - 77
Location C - 78
Location D - 79

Discharge Temp:
Blower Discharge Temp: 110 F

3 FULL LOAD - 60 " H_2O ~~psig~~ /vac
AMP DRAW
LINE 1 - 8.8
LINE 2 - 8.7
LINE 3 - 9.4

Noise Level (dba) 3 feet from unit
Location A - 84
Location B - 80
Location C - 86
Location D - 86

Discharge Temp:
Blower Discharge Temp: 125 F

VIBRATION LEVELS: (inch/sec)

	NO LOAD	FULL LOAD
Blower:		
Vertical:		
Horizontal:		
Axial:		
Motor:		
Vertical:		
Horizontal:		
Axial:		
Base:		
Vertical:		
Horizontal:		
Axial:		

Additional comments:

Check and inspection performed by: [signature]
REQUIRED PANEL [illegible] Add T2 & [illegible] contacts

2/2/2010 INSPECT 1-26-10.xls

Gasho
SINCE 1982
The Leader in Blower & Vacuum Solutions

460 West Gay Street
West Chester, PA 19380

Tetra Tech Geo

51 Franklin Street
Suite 400
Annapolis, MD 21401

Operation and Maintenance Manual

Gasho Custom Package Utilizing Model #DR858AY72W, 3" Inline Filter, 2" VRV, Gauges, Valve, GX-90, HEX AA-250 & Nema 4 Control Panel all Mounted on a Skid

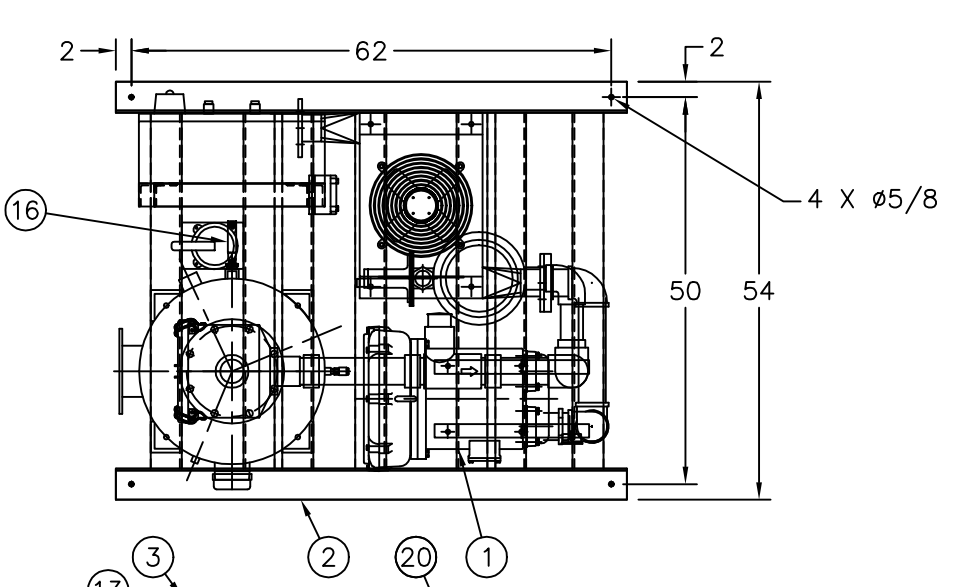
JG13B-2692

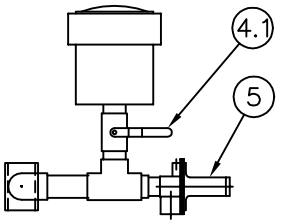
April 3, 2013

Gasho, Inc.
Blower Package
JG13B-2692

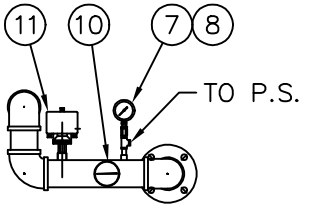
Description	Date	Revision

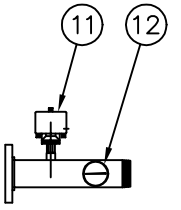
Item	Qty.	Supplier	Description	Part Number	Misc ID	Weight
1	1	Ametek Rotron	Regenerative Blower	DR858AY72W	38738	
2	1	Gasho	Base Weldment			
3	1	Solberg Mfg.	3" Inline filter	CSL-239-300C		
4	1	Universal	2 1/2" Dilution Valve	CCS-2 1/2		
4.01	1	Apollo	2 1/2" Ball Valve	64-109-01		
5	1	Fisher	2" Relief Valve	289H-3	set @ 85" H2O	
6	2	Gasho	Vacuum Gauges	25.0.012.HG.160.IWC		
7	1	Gasho	Pressure Gauge	25.0.006.PSI.160.IWC		
8	3	SMC Specialties	Isolation Valves	VA BRS 025-4F4M-BT		
9	1	Dwyer Instruments	Discharge Pressure Switch	1950P-2-2F	set @ 60" WC incr	
9.1	1	Dwyer Instruments	Low Vacuum Switch	1950-20-2F	set @ 10" WC decreasing	
10	2	Noshok	Bi-Thermometer	30.110.025.0/250 deg F		
11	1	Ashcroft	Nema 4 Temperature Switch	T424-T05-030-XRS-150-2(	set @ 215 deg. F	
11.1	1	Ashcroft	Nema 4 Temperature Switch	T424-T05-030-XRS-75-20!	set @ 140 deg. F	
11.2	2	Koenig Pretempco	1/2" thermowell	KP602081A		
12	1	Noshok	Bi-Metal Thermometer	30.110.025.0/250 deg F		
13	1	Gasho	Moisture Separator	GX-90		
13.1	1	Gasho	Basket			12
13.2	1	Gasho	Cover Plate	1500-C-0507-4	4" Female	14
13.3	1	Gasho	Jaegger Demister Material			1
13.4	1	Cooney	4" Clean out cap			2
14	1	Oil Rite	Sight Gauge	B1559-1-12		1
14.1	2	Oil Rite	Adapters	B1656-4		1
15	1	Grainger	Manual Sludge Pump	400H		2
16	1	Dwyer Instruments	Liquid Level Switch	L6-EPB-B-3-S-0		3
17	1	Apollo	Drain Valve	64-104-01		1
18	1	Xchanger	Air Cooled Heat Exchanger	AA-250 with 3" flanges	1 Hp, TEFC, 230/460	
19	1	International Control	Nema 4 Control Panel	Gasho86		
20	1	Ametek Rotron	Direct Read Flow Meter	550606		
900	1	Dwyer Instruments	Liquid Level Switch	L6-EPB-B-3-S-0		
					Weight	37



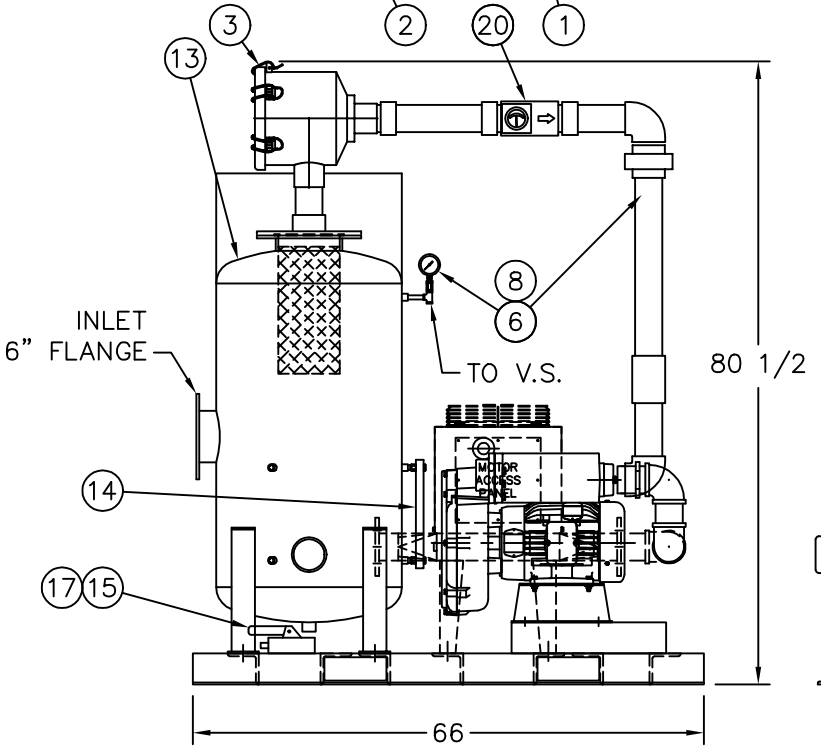


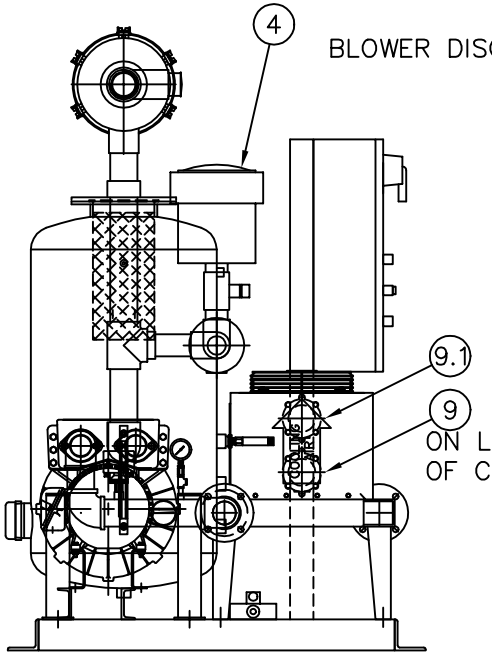
DILUTION VALVE



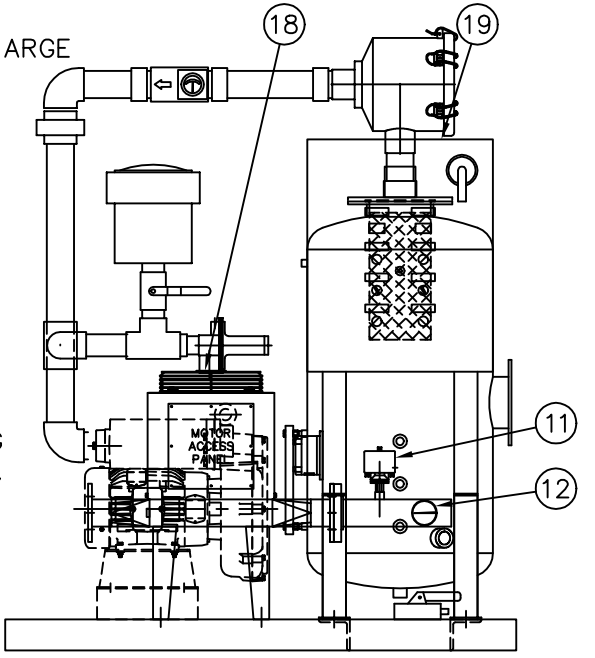


HEAT EXCHANGER DISCHARGE





BLOWER DISCHARGE



REV.	DATE	DESCRIPTION
B	4-10 2013	MOVED FILTERS
A	3-26 2013	MISC. REVS.

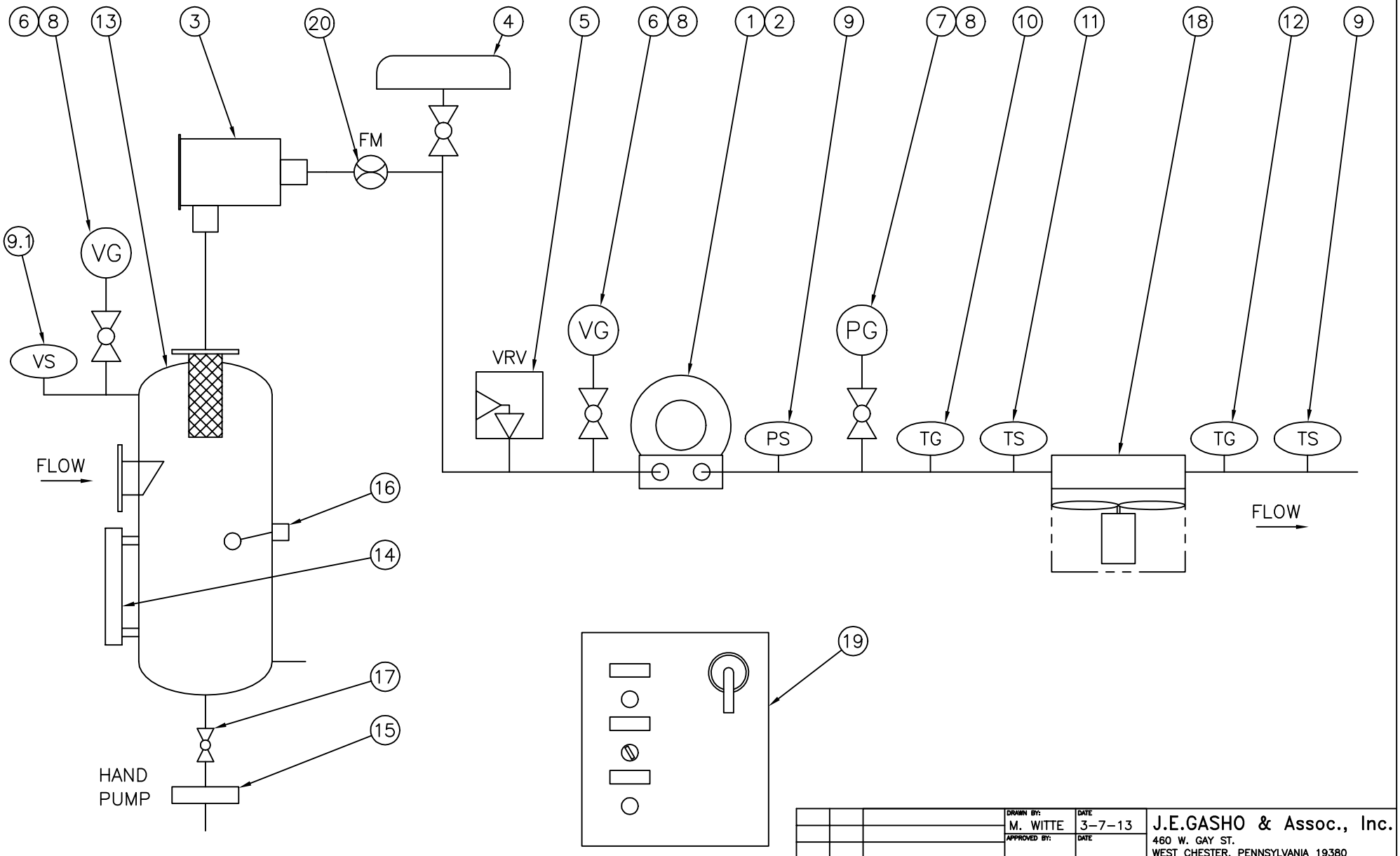
DRAWN BY: M. WITTE — DATE: 3-7-13
APPROVED BY: — DATE:
DIMENSIONS IN INCHES
SCALE:
TOLERANCE: — ANGULAR TOLERANCE:
MATERIAL: — WEIGHT:
SHEET 1 OF 1

J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

BLOWER PACKAGE
DR858 GX90

JG13-B-2692 | B

2692B DR858 GX90.dwg 04/10/13 18:56



REV.	DATE	DESCRIPTION
B	4-10 2013	MOVED F.M.
A	3-26 2013	ADDED LOW V.S.

DRAWN BY: M. WITTE DATE: 3-7-13
APPROVED BY: DATE:
DIMENSIONS IN INCHES
SCALE:
TOLERANCE: ANGULAR TOLERANCE:
MATERIAL: WEIGHT:
SHEET 1 OF 1

J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

PIPING & INSTRUMENT DIAGRAM
REGEN VACUUM PKG.

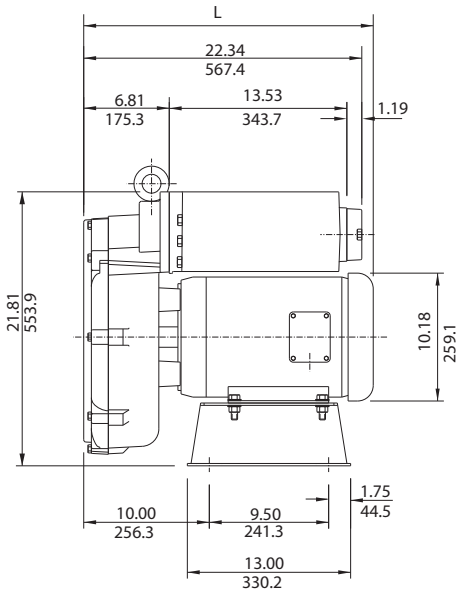
JG13-B-2692 | B

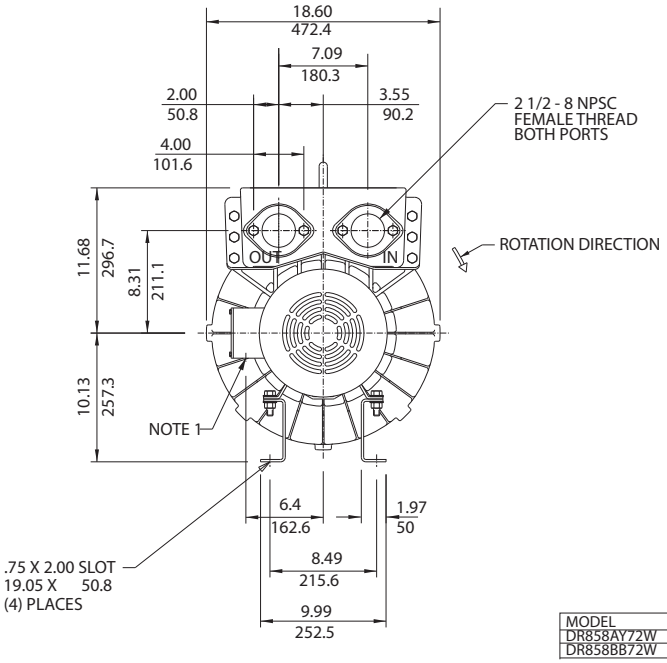
2692B DR858 GX90 PID.dwg 04/10/13 19:09

DR 858 & CP 858

ROTRON®

7.5 / 10.0 HP Regenerative Blower





IN
MM

NOTES
1. TERMINAL BOX CONNECTOR HOLE 1.06 (26.9) DIA.
2. DRAWING NOT TO SCALE, CONTACT FACTORY FOR SCALE CAD DRAWING.
3. CONTACT FACTORY FOR BLOWER MODEL LENGTHS NOT SHOWN.

MODEL	L (IN/MM)
DR858AY72W	23.06/585.7
DR858BB72W	23.19/589

		Part/Model Number				
		DR858BB72W	DR858BB86W	DR858AY72W	CP858FH72WLR	HiE858BB72W
Specification	Units	038740	038742	038738	038749	038743
Motor Enclosure - Shaft Mtl.	-	TEFC-CS	TEFC-CS	TEFC-CS	Chem TEFC-SS	TEFC-CS
Horsepower	-	10	10	7.5	10	10
Voltage	AC	230/460	575	230/460	230/460	230/460
Phase - Frequency	-	Three-60 hz	Three-60 hz	Three-60 hz	Three-60 hz	Three-60 hz
Insulation Class	-	F	F	F	F	F
NEMA Rated Motor Amps	Amps (A)	26/13	10.5	17.8/8.9	26/13	26/13
Service Factor	-	1.15	1.15	1.15	1.15	1.15
Max. Blower Amps	Amps (A)	28/14	12	28/14	28/14	28/14
Locked Rotor Amps	Amps (A)	162/81	65	120/60	162/81	162/81
NEMA Starter Size	-	2/1	1	1/1	2/1	2/1
Shipping Weight	Lbs	280	280	264	280	280
	Kg	127	127	119.7	127	127
Model (Base Mount)	-	DR858BB72X	DR858BB86X	DR858AY72X		
Part Number (Base Mount)	-	038735	038737	038736		

Voltage - ROTRON motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

Operating Temperatures - Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

Maximum Blower Amps - Corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

AMETEK TECHNICAL & INDUSTRIAL PRODUCTS
75 North Street, Saugerties, NY 12477
USA: +1 215-256-6601 - Europe: +44 (0) 845 366 9664 - Asia: +86 21 5763 1258
Customer Service Fax: +1 215.256.1338
www.ametektip.com

AMETEK®
TECHNICAL & INDUSTRIAL PRODUCTS

DR 858 & CP 858

ROTRON®

7.5 / 10.0 HP Regenerative Blower

FEATURES

- Manufactured in the USA - ISO 9001 and NAFTA compliant
- CE compliant - Declaration of Conformity on file
- Maximum flow: 380 SCFM
- Maximum pressure: 125 IWG
- Maximum vacuum: 104.8 IWG
- Standard motor: 10 HP, TEFC
- Cast aluminum blower housing, impeller & cover; cast iron flanges (threaded)
- UL & CSA approved motor with permanently sealed ball bearings
- Inlet & outlet internal muffling
- Quiet operation within OSHA standards

MOTOR OPTIONS

- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

BLOWER OPTIONS

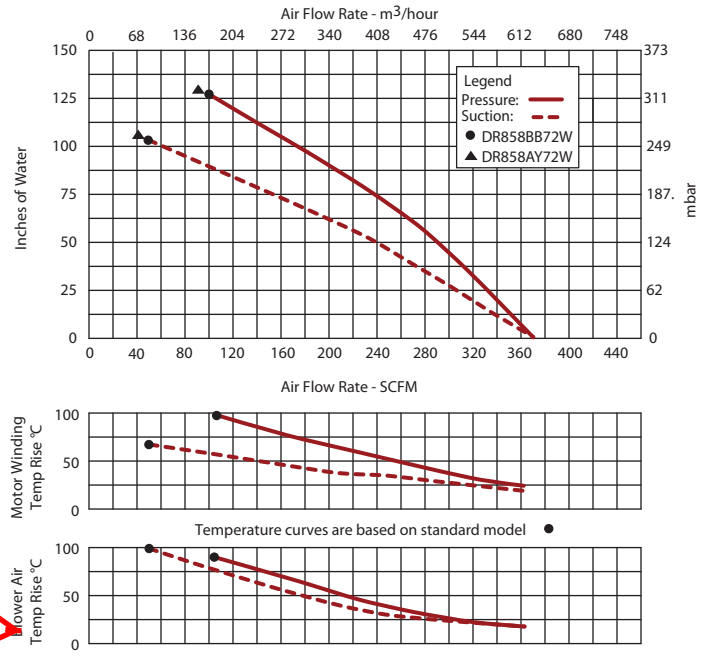
- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

ACCESSORIES

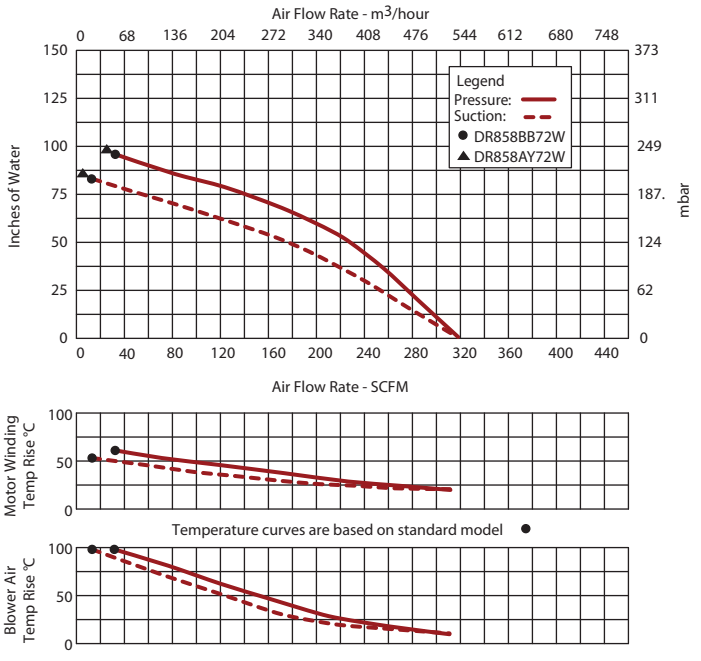
- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges, & relief valves
- Switches - air flow, pressure, vacuum, or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

Blower Performance at Standard Conditions

60 Hz



50 Hz



AMETEK TECHNICAL & INDUSTRIAL PRODUCTS
75 North Street, Saugerties, NY 12477
USA: +1 215-256-6601 - Europe: +44 (0) 845 366 9664 - Asia: +86 21 5763 1258
Customer Service Fax: +1 215.256.1338
www.ametektip.com

AMETEK®
TECHNICAL & INDUSTRIAL PRODUCTS

SERVICE AND PARTS MANUAL
FOR
BLOWER MODEL

DR6, 858, 909, 979, 14

DIRECT DRIVE REGENERATIVE BLOWER

Technical & Industrial Products
627 Lake Street, Kent, Ohio 44240 U.S.A.
Telephone: 330-673-3452 Fax: 330-677-3306
e-mail: rotronindustrial@ametek.com
internet: www.ametektip.com

Your Choice. Our Commitment.™

WARRANTY, INSTALLATION, MAINTENANCE AND TROUBLESHOOTING INSTRUCTIONS

TECHNICAL AND INDUSTRIAL PRODUCTS
627 Lake Street, Kent, Ohio 44240 USA
Telephone: 330-673-3452 Fax: 330-677-3306
e-mail: rotronindustrial@ametek.com web site: www.ametektip.com

1. AMETEK Rotron DR, EN and HiE regenerative direct drive blowers are guaranteed for one full year from the date of installation (limited to 18 months from the date of shipment) to the original purchaser only. Should the blower fail we will evaluate the failure If failure is determined to be workmanship or material defect related, we will at our option repair or replace the blower.

2. AMETEK Rotron Minispiral, Revaflow, Multiflow, Nautilair, remote drive blowers, moisture separators, packaged units, CP blowers, Nasty Gas™ models and special built (EO) products are guaranteed for one full year from date of shipment for workmanship and material defect to the original purchaser only. Should the blower fail, If failure is determined to be workmanship or material defect related, we will at our option repair or replace the blower.

3. **Parts Policy** - AMETEK Rotron spare parts and accessories are guaranteed for three months from date of shipment for workmanship and material defect to the original purchaser only. If failure is determined to be workmanship or material defect related we will at our option repair or replace the part.

Corrective Action - A written report will be provided indicating reason(s) for failure, with suggestions for corrective action. Subsequent customer failures due to abuse, misuse, misapplication or repeat offense will not be covered. AMETEK Rotron will then notify you of your options. Any failed unit that is tampered with by attempting repair or diagnosis will void the warranty, unless authorized by the factory.

Terms and Conditions - Our warranty covers repairs or replacement of regenerative blowers only, and will not cover labor for installation, outbound and inbound shipping costs, accessories or other items not considered integral blower parts. Charges may be incurred on products returned for reasons other than failures covered by their appropriate warranty. Out-of-warranty product and in warranty product returned for failures determined to be caused by abuse, misuse, or repeat offense will be subject to an evaluation charge. Maximum liability will in no case exceed the value of the product purchased. Damage resulting from mishandling during shipment is not covered by this warranty. It is the responsibility of the purchaser to file claims with the carrier. Other terms and conditions of sale are stated on the back of the order acknowledgement.

Installation Instructions for SL, DR, EN, CP, and HiE Series Blowers

1. **Bolt It Down** - Any blower must be secured against movement prior to starting or testing to prevent injury or damage. The blower does not vibrate much more than a standard electric motor.

2. **Filtration** - All blowers should be filtered prior to starting. Care must be taken so that no foreign material enters the blower. If foreign material does enter the blower, it could cause internal damage or may exit at extremely high velocity.

   Should excessive amounts of material pass through the blower, it is suggested that the cover(s) and impeller(s) be removed periodically and cleaned to avoid impeller imbalance. Impeller

imbalance greatly speeds bearing wear, thus reducing blower life. Disassembling the blower will void warranty, so contact the factory for cleaning authorization.

3. **Support the Piping** - The blower flanges and nozzles are designed as connection points only and are not designed to be support members.

   Caution: Plastic piping should not be used on blowers larger than 1 HP that are operating near their maximum pressure or suction point. Blower housing and nearby piping temperatures can exceed 200ºF. Access by personnel to the blower or nearby piping should be limited, guarded, or marked, to prevent danger of burns.

4. **Wiring** - Blowers must be wired and protected/fused in accordance with local and national electrical codes. All blowers must be grounded to prevent electrical shock. Slo-Blo or time delay fuses should be used to bypass the first second of start-up amperage.

5. **Pressure/Suction Maximums** - The maximum pressure and/or suction listed on the model label should not be exceeded. This can be monitored by means of a pressure or suction gage (available from Rotron), installed in the piping at the blower outlet or inlet. Also, if problems do arise, the Rotron Field representative will need to know the operating pressure/suction to properly diagnose the problem.

6. **Excess Air** - Bleed excess air off. DO NOT throttle to reduce flow. When bleeding off excess air, the blower draws less power and runs cooler.

   Note: Remote Drive (Motorless) Blowers - Properly designed and installed guards should be used on all belts, pulleys, couplings, etc. Observe maximum remote drive speed allowable. Due to the range of uses, drive guards are the responsibility of the customer or user. Belts should be tensioned using belt gauge.

Maintenance Procedure

When properly piped, filtered, and applied, little or no routine maintenance is required. Keep the filter clean. Also, all standard models in the DR, EN, CP, and HiE series have sealed bearings that require no maintenance. Bearing should be changed after 15,000 to 20,000 hours, on average. Replacement bearing information is specified on the chart below.

Bearing Part Number	Size	Seal Material	Grease	Heat Stabilized
510217 510218 510219	205 206 207	Polyacrylic	Nye Rheotemp 500 30% +/- 5% Fill	Yes – 325 F
510449 516440 516648	203 202 307	Buna N	Exxon Polyrex Grease	NO
516840 516841 516842 516843 516844 516845 516846 516847	206 207 208 210 309 310 311 313	Buna N	Exxon Polyrex Grease	NO

Troubleshooting

		POSSIBLE CAUSE	OUT OF WARRANTY REMEDY ***
IMPELLER DOES NOT TURN	Humming Sound	1. * One phase of power line not connected 2. * One phase of stator winding open 3. Bearings defective 4. Impeller jammed by foreign material 5. Impeller jammed against housing or cover 6. ** Capacitor open	1. Connect 2. Rewind or buy new motor 3. Change bearings 4. Clean and add filter 5. Adjust 6. Change capacitor
	No Sound	1. * Two phases of power line not connected 2. * Two phases of stator winding open	1. Connect 2. Rewind or buy new motor
IMPELLER TURNS	Blown Fuse	1. Insufficient fuse capacity 2. Short circuit	1. Use time delay fuse of proper rating 2. Repair
	Motor Overheated Or Protector Trips	1. High or low voltage 2. * Operating in single phase condition 3. Bearings defective 4. Impeller rubbing against housing or cover 5. Impeller or air passage clogged by foreign material 6. Unit operating beyond performance range 7. Capacitor shorted 8. * One phase of stator winding short circuited	1. Check input voltage 2. Check connections 3. Check bearings 4. Adjust 5. Clean and add filter 6. Reduce system pressure/vacuum 7. Change capacitor 8. Rewind or buy new motor
	Abnormal Sound	1. Impeller rubbing against housing or cover 2. Impeller or air passages clogged by foreign material 3. Bearings defective	1. Adjust 2. Clean and add filter 3. Change bearings
	Performance Below Standard	1. Leak in piping 2. Piping and air passages clogged 3. Impeller rotation reversed 4. Leak in blower 5. Low voltage	1. Tighten 2. Clean 3. Check wiring 4. Tighten cover, flange 5. Check input voltage

*** 3 phase units**

**** 1 phase units**

***** Disassembly and repair of new blowers or motors will void the Rotron warranty. Factory should be contacted prior to any attempt to field repair an in-warranty unit.**

Blower Disassembly:

WARNING: Attempting to repair or diagnose a blower may void Rotron's warranty. It may also be difficult to successfully disassemble and reassemble the unit.

1) Disconnect the power leads. **CAUTION:** Be sure the power is disconnected before doing any work whatsoever on the unit.

2) Remove or separate piping and/or mufflers and filters from the unit.

3) Remove the cover bolts and then the cover. **NOTE:** Some units are equipped with seals. It is mandatory that these seals be replaced once the unit has been opened.

4) Remove the impeller bolt and washers and then remove the impeller. **NOTE:** Never pry on the edges of the impeller. Use a puller as necessary.

5) Carefully note the number and location of the shims. Remove and set them aside. NOTE: If the disassembly was for inspection and cleaning the unit may now be reassembled by reversing the above steps. If motor servicing or replacement and/or impeller replacement is required the same shims may not be used. It will be necessary to re-shim the impeller according to the procedure explained under assembly.

6) Remove the housing bolts and remove the motor assembly (arbor/.housing on remote drive models).

7) Arbor disassembly (Applicable on remote drive models only):
   a) Slide the bearing retraining sleeve off the shaft at the blower end.
   b) Remove the four (4) screws and the bearing retaining plate from the blower end.
   c) Lift the shaft assembly far enough out of the arbor to allow removal of the blower end snap ring.
   d) Remove the shaft assembly from the arbor.
   e) If necessary, remove the shaft dust seal from the pulley end of the arbor.

Muffler Material Replacement:

1) Remove the manifold cover bolts and them manifold cover.

2) The muffler material can now be removed and replaced if necessary. On blowers with fiberglass acoustical wrap the tubular retaining screens with the fiberglass matting before sliding the muffler pads over the screens.

3) Reassemble by reversing the procedure.

NOTE: On DR068 models with tubular mufflers it is necessary to remove the cover and impeller accessing the muffler material from the housing cavity.

Blower Reassembly:

1) Place the assembled motor (assembled arbor assembly for remote drive models) against the rear of the housing and fasten with the bolts and washer.

2) To ensure the impeller is centered within the housing cavity re-shim the impeller according to the procedure outlined below.

3) If blower had a seal replace the seal with a new one.

4) Place the impeller onto the shaft making sure the shaft key is in place and fasten with the bolt, washer and spacer as applicable. Torque the impeller bolt per the table below. Once fastened carefully rotate the impeller to be sure it turns freely.

5) Replace the cover and fasten with bolts.

6) Reconnect the power leads to the motor per the motor nameplate.

Bolt Size	**Torque** **Pound-Force-Foot**
1/4-20	**6.25 +/- 0.25**
5/16-18	**11.5 +/- 0.25**
3/8-16	**20.0 +/- 0.5**
½-13	**49.0 +/- 1**
5/8 –11	**90.0 +/- 2**

Impeller Shimming Procedure:

WARNING: This unit may be difficult to shim. Extreme care may be exercised.

Tools Needed: Machinist's Parallel Bar
Vernier Caliper with depth measuring capability
Feeler gauges or depth gauge

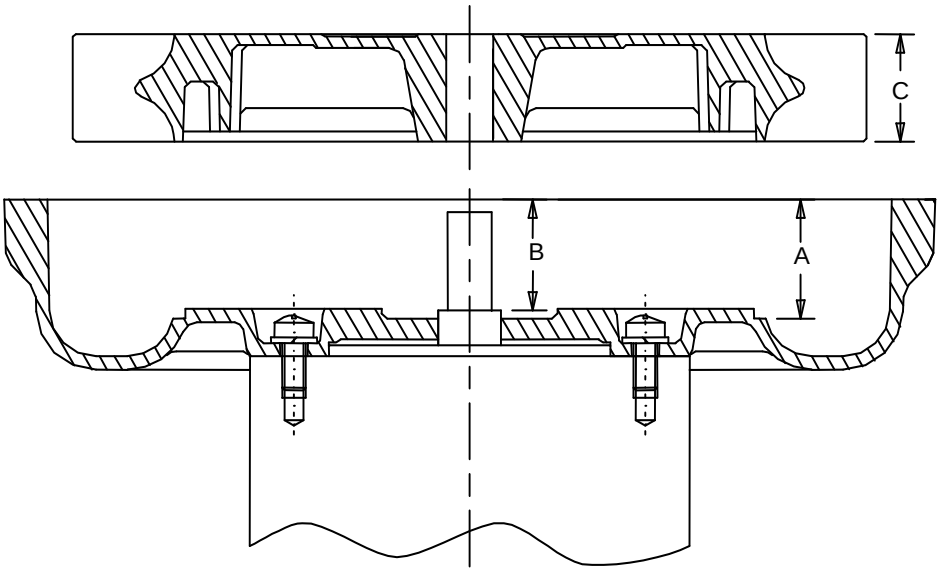
Measure the Following:

Distance from the flange face to the housing (A)
Distance from the flange face to the motor shaft shoulder (B)
Impeller Thickness (C)

Measurements (A) and (B) are made by laying the parallel bar across the housing flange face and measuring to the proper points. Each measurement should be made at three points, and the average of the readings should be used.

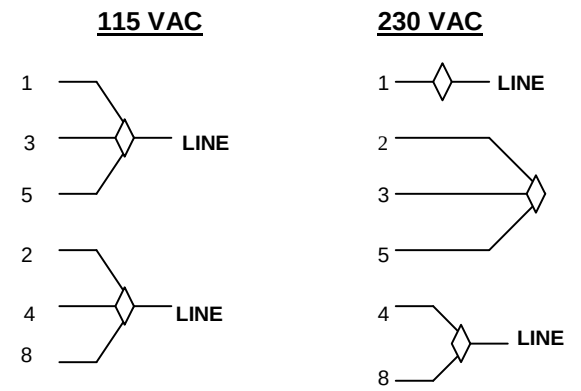
Shim Thickness = B – (A+C)/2

After the impeller installation (step #4 above) the impeller/cover clearance can be checked with feeler gauges, laying the parallel bar across the housing flange face. This clearance should nominally be (A-C)/2.



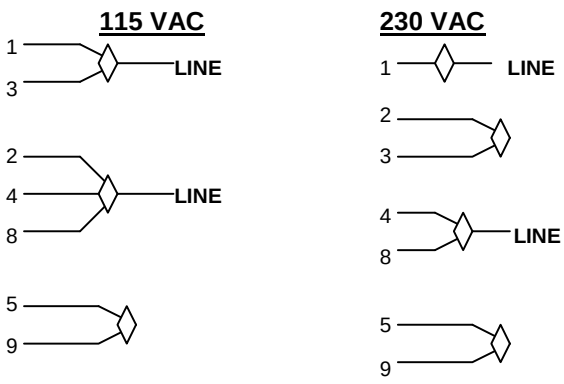
WIRING DIAGRAMS, TEFC and ODP MOTORS

A. 1Ø, 6 WIRE



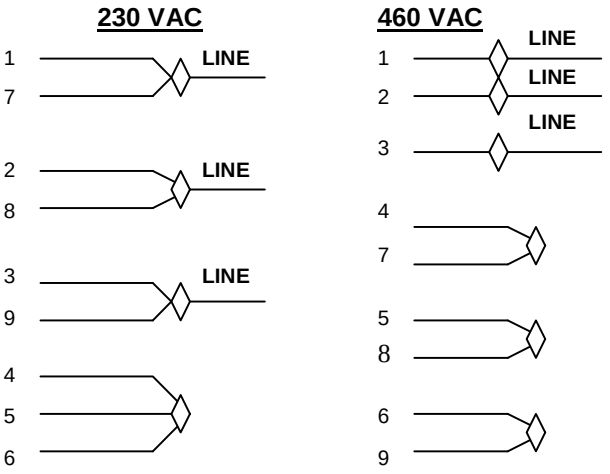
INTERCHANGE LEADWIRES 5 & 8 to REVERSE ROTATION

B. 1Ø, 7 WIRE



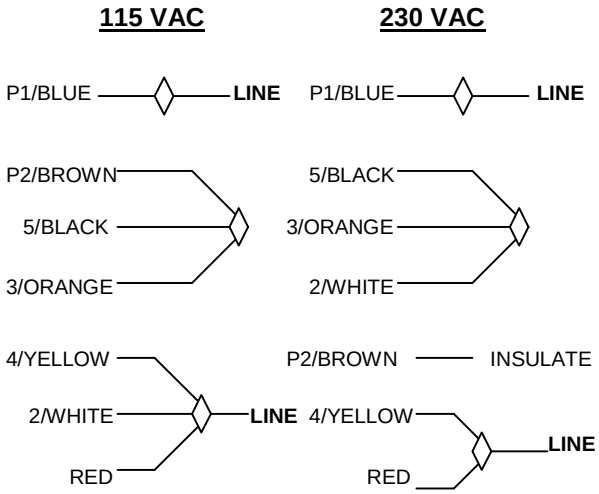
INTERCHANGE LEADWIRES 5 & 8 to REVERSE ROTATION

C. 3Ø, 9 WIRE



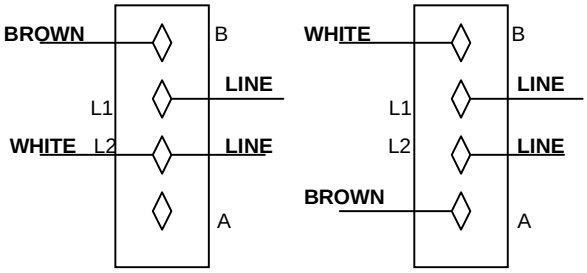
INTERCHANGE ANY TWO LEAD LINES TO REVERSE ROTATION

D. 1Ø, EMERSON 1/8 HP MOTOR



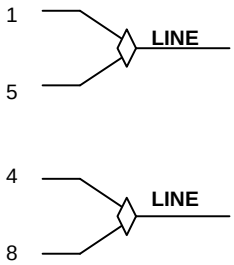
INTERCHANGE RED AND BLACK TO REVERSE ROTATION

E. 1Ø, SPA DUTY WITH TERMINAL STRIPS



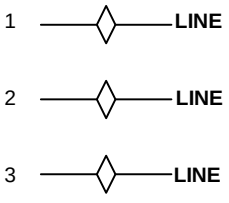
F. 1Ø, 230 VAC

SINGLE VOLTAGE



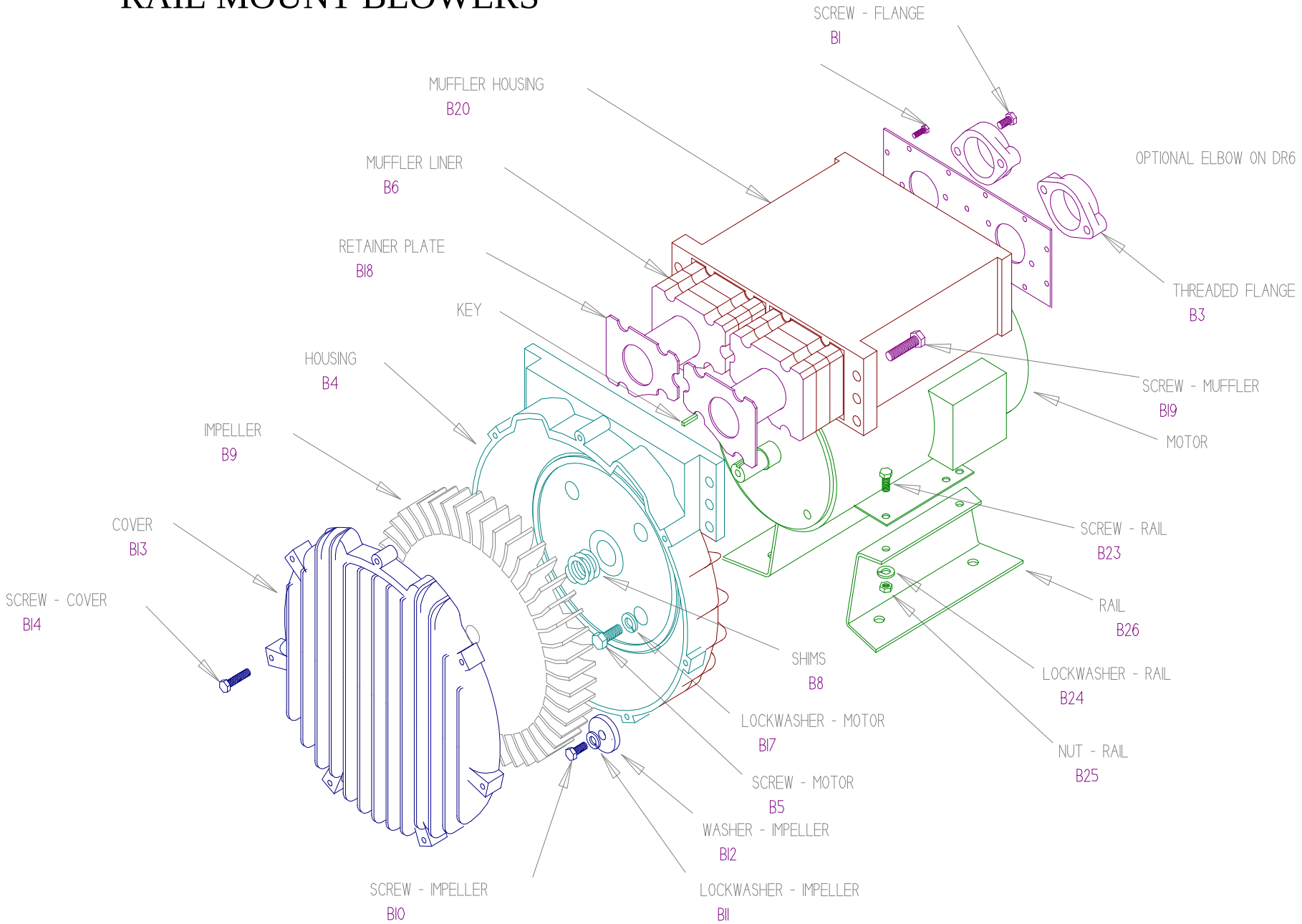
INTERCHANGE LEAD WIRES 5 & 8 TO REVERSE ROTATION

G. 3Ø, 575 VAC

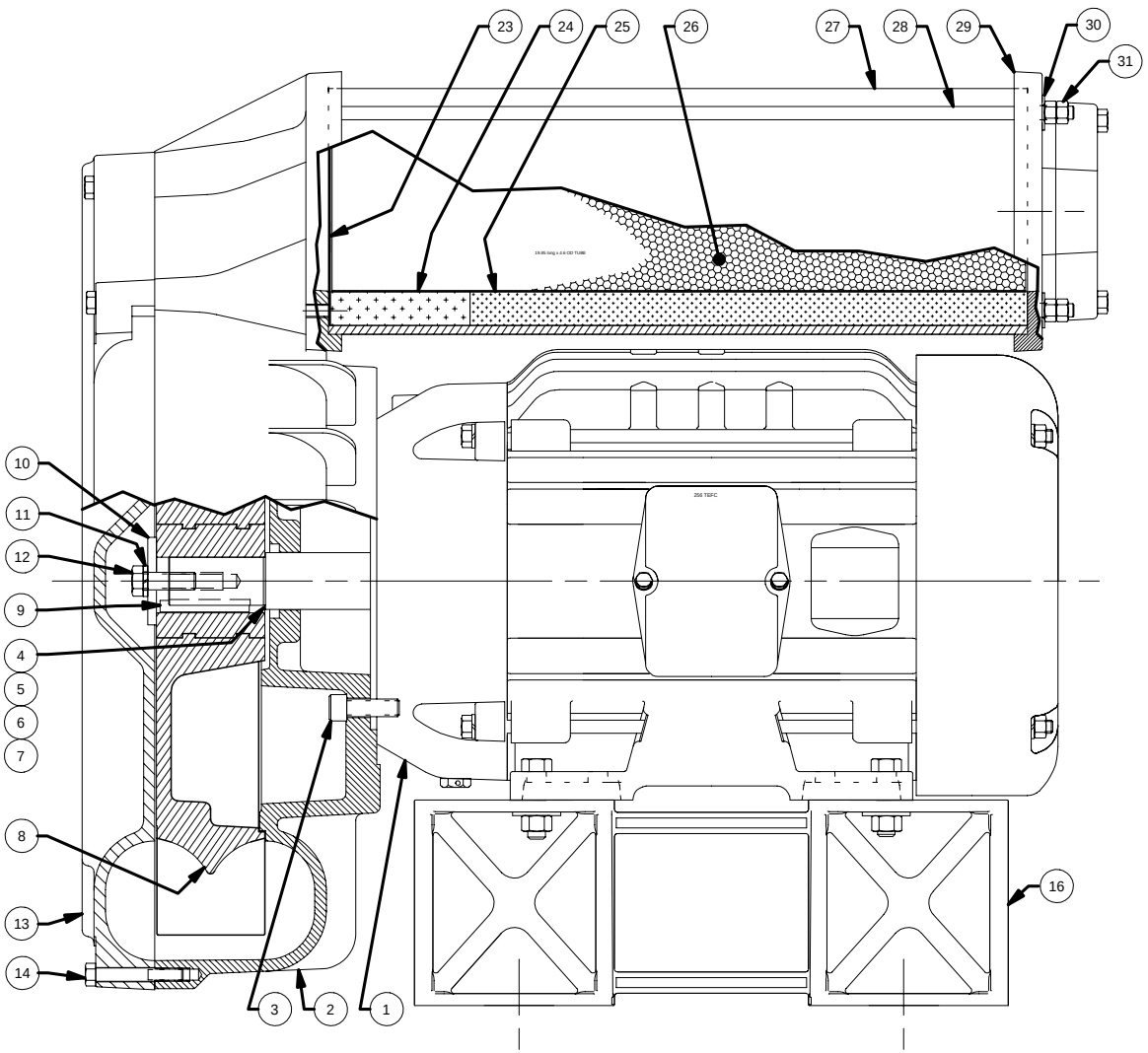


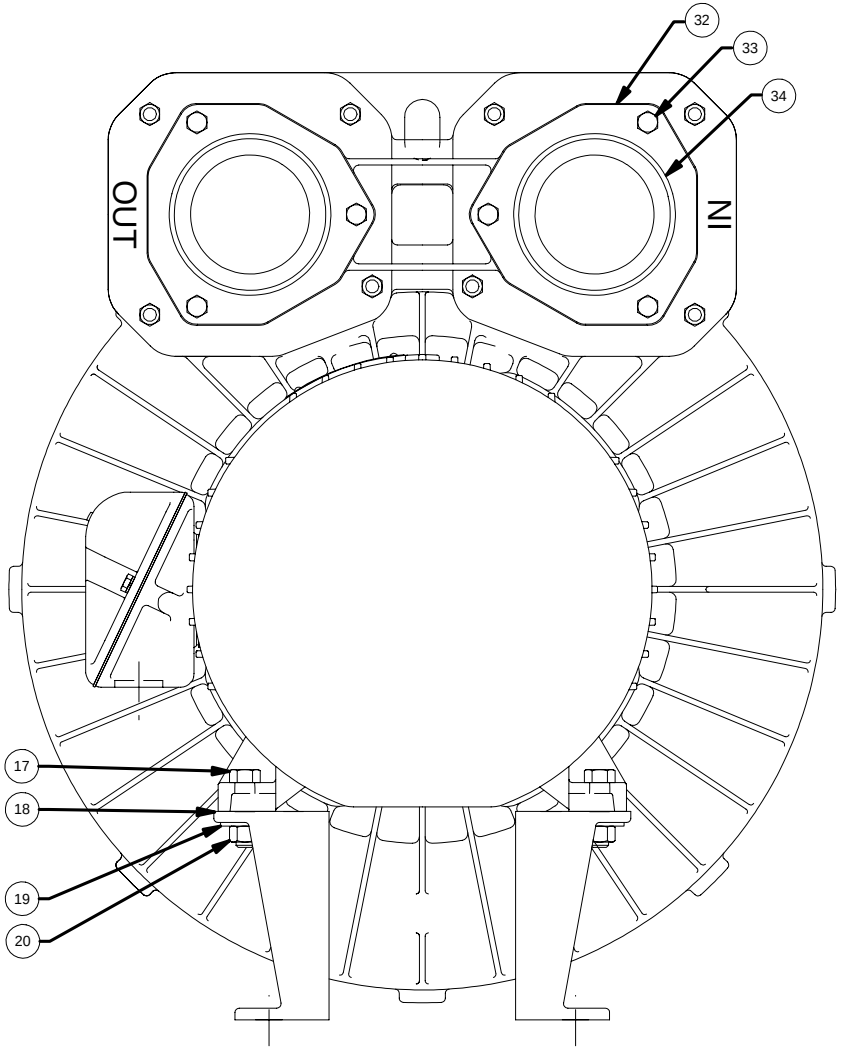
INTERCHANGE ANY TWO LEAD LINES TO REVERSE ROTATION

ASSEMBLY DIAGRAM
DR6 DR858 DR909 DR979 DR14
RAIL MOUNT BLOWERS



ASSEMBLY DIAGRAM "B"





Parts Breakdown

Item No.	Qty. Req'd	Description	DR6	DR858 - Rail	DR858 - Base	DR909 - Rail	DR909 - Base	DR909 - Rail	DR979	DR14
		Model:								
		Part No.:	027578	038738	038735	038620	038622	081737	080702	038750
			027579	038740	038736	038621	038623	081739	080704	038751
			027600	038742	038737	038625	038626	081738	080632	038759
			036212	038743	080173	080300	080183	081744	080718	080451
			038071	080172		038633				080612
						OBSOLETE		NEW		OBSOLETE
M3	1	Key Motor Shaft	510212	511532	511532	511532	511532	511532	551570	155066
B1	6	Screw, Flange	(4 pcs) 120065	(4 pcs) 155067	(4 pcs) 155067	140016	140016	140016	140016	140016
B3	2	Flange	478341	511614	511614	529912	529912	529912	529912	529912
	2	Screen, Flange Guard	511479	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
		Elbow 90º	See Next Page	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B4	1	Housing	515497	515410	515410	515356	515356	552409	See Next Page	515975
B5	4	Screw, Hsg /Motor	251792	155034	155034	140014	140014	155025	120205	120205
B6	28	Muffler Material	Not Used	(7 pcs) 551736	(7 pcs) 551736	(10 pcs) 551738	(10 pcs) 551738	(2 pcs) 552477	(8 pcs) 551571	(12 pcs) 551740
	2	Muffler Material		(2 pcs) 551737	(2 pcs) 551737	(2 pcs) 551739	(2 pcs) 551739	552483	Not Used	(2 pcs) 551741
	2	Muffler Screen guard	Not Used	Not Used	Not Used	551730	551730	Not Used	Not Used	551744
B8	*	Shim .002"	272703	511547	511547	511547	511547	511547	511547	515991
	*	Shim .005"	272704	511548	511548	511548	511548	511548	511548	515992
	*	Shim .010"	272705	511549	511549	511549	511549	511549	511549	515993
	*	Shim .020"	272706	511550	511550	511550	511550	511550	511550	515994
B9	1	Impeller	515484	515249	515249	552544	552544	552431	551566	515509
B10	1	Bolt, Impeller	251791	120210	120210	140015	140015	140015	140015	155068
B11	1	Lockwasher, Impeller	251787	251788	251788	251788	251788	251788	251788	251788
B12	1	Washer, Impeller	Not Used	511529	511529	Not Used	Not Used	Not Used	Not Used	Not Used
B13	1	Cover	515488	515247	515247	515359	515359	515359	551409	515910
B14	8	Screw, Cover	155170	140016	140016	140016	140016	140016	155512	155069
B15	1	Eye Bolt	Not Used	140019	Not Used	140019	Not Used	Not Used	See Next Page	140019
B16	1	Spacer, Impeller Bolt	478336	515555	515555	511529	511529	511529	511529	515990
		Shaft Sleeve	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B17	4	Lockwasher, Housing	251788	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B18	2	Screen, Muffler	Not Used	551723	551723	551725	551725	552479	551611	551727
	2	Finger guard	Not Used	Not Used	Not Used	551730	551730	Not Used	Not Used	Not Used
B19	6	Bolt, Muffler Hsg/Hsg	Not Used	155025	155025	155025	155025	(4) 120210	155512	155067
B19A	4	Bolt, Muffler Hsg/Hsg	Not Used	120214	Not Used	120214	Not Used	(4) 120205	Not Used	120214
B20	1	Muffler Housing	Not Used	550019	550017	529932	529933	552428	See Next Page	550039
	1	Muffler Discrete	522948	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
	2	Bolt, Motor/Muffler	Not Used	Not Used	Not Used	Not Used	120214	Not Used	Not Used	Not Used
	2	Lockwasher, Motor/Mu	Not Used	Not Used	Not Used	Not Used	120203	Not Used	Not Used	Not Used
	2	Washer, Motor/Muffler	Not Used	Not Used	Not Used	Not Used	155029	Not Used	Not Used	Not Used
B23	4	Bolt, Rail	251791	120007	Not Used	See Next Page	Not Used	140016	See Next Page	120256

*As needed **Viewed looking atinlet/outlet ports

B24	4	Lockwasher Rail	251787	251787	Not Used	251787	Not Used	251787	See Next Page	251788
	8	Washer Rail/Motor	Not Used	Not Used	Not Used	See Next Page	Not Used	155091	See Next Page	Not Used
B25	4	Nut, Rail	251789	251789	Not Used	251789	Not Used	251789	See Next Page	155070
B26	2	Rail Mounting	478338	595301	Not Used	See Next Page	Not Used	595301	See Next Page	551658

Model	Part #	Motor	Wiring Diagram	Specific Parts	Bearing, Rear (M1)	Bearing, Impeller End (M2)
DR6D89	027578	500291	C	Elbow - not used	510217	510218
DR6D86	027579	500292	G			
DR6K72	027600	500293	C			
DR6D5	036212	510459	A	Elbow - (1 pc) 120153		
HiE6D89	038071	529325	C			
DR858AY72W	038738	511570	C		516840	516844
DR858AY86W	080172	515568	G			
DR858AY86X	080173	515568	G			
DR858BB72W	038740	511571	C			
DR858BB86W	038742	515567	G			
HiE858BB72W	038743	529600	C			
DR858BB72X	038735	511571	C			
DR858AY72X	038736	511570	C			
DR858BB86X	038737	515567	G			
DR909BE72W	038620	511572	C	B23 (4 pcs) 140016 (16 pcs) 155091 B26 (2 pcs) 595301		
DR909BB72W	038621	511571	C			
DR909BE86W	038625	511601	G			
DR909BB86W	080300	515567	G			
HiE909BE72W	038633	529601	C	B23 (4 pcs) 120256 (8 pcs) 155091 B26 (2 pcs) 516242		
DR909BE72X	038622	511572	C			
DR909BB72X	038623	511571	C			
DR909BE86X	038626	511601	G			
DR909BB86X	080183	515567	G			
DR909BE72W	081737	511572	C			
DR909BB72W	081738	511571	C			
DR909BE86W	081739	511601	G			
DR909BB86W	081744	515567	G			
DR979BE86W	080702	551605	G	B4 = 551383, B15 = 140019 B19A = Not used, B23 = 155095, B26 = 595301 B24 = (4pcs) 251787 & (8 pcs) 155091, B25 =595301, B20 = 551422		
DR979BE72W	080704	551604	C			
DR979BE72W	080632	551603	C			
DR979BH72W	080718	551635	C	B4 = 551560 B15 = Not used B19A = 155070, B23 = 120256 B26 = 551658 B24= (4 pcs) 251788 & (8 pcs) 120211, (8) 155091, B20 = 551422 B25 = 155070		
DR14DW72MW	038750	516096	C		516844	516846
DR14DW86MW	038751	516097	G			
DR14BH72MW	038752	510463	C		516842	516844
DR14BH86MW	038753	511511	G			

*As needed **Viewed looking atinlet/outlet ports

Model	Part #	Motor	Wiring Diagram	Specific Parts	Bearing, Rear (M1)	Bearing, Impeller End (M2)
DR14DT72MW	080451	551037	C		516844	516846
DR14DT86MW	080612	516100	G			
HiE14DW72MW	038759	529603	C			

*As needed **Viewed looking atinlet/outlet ports

Use Assembly Diagram "B" for non obsolete DR14

DR 14
Service and Parts Manual

Parts Breakdown

			Model:	**DR14**	**DR14**				**DR14**
			Part No.:	**081476**	**081480**				**038752**
				081479	**081484**				**038753**
				081483					
				081497					**OBSOLETE**
REF #	**QTY**	**Description**							
1	1	Motor		See Below	See Below	M3	1	Key Motor Shaft	511532
2	1	Housing		552309	552304	B1	6	Screw, Flange	140016
3	4	Housing to mtr bolts		120256	120205	B3	2	Flange	529912
4	*	Shim		515991	511547		2	Screen, Flange Guard	Not Used
5	*	Shim		515992	511548			Elbow 90º	Not Used
6	*	Shim		515993	511549	B4	1	Housing	515983
7	*	Shim		515994	511550	B5	4	Screw, Hsg /Motor	120205
8	1	Impeller		515509	515683	B6	28	Muffler Material	(12 pcs) 551740
9	1	Mtr shaft Key		155066	511532		2	Muffler Material	(2 pcs) 551741
10	1	Impeller washer		515990	515990		2	Muffler Screen guard	551744
11	1	Impeller lockwasher		251788	251788	B8	*	Shim .002"	511547
12	1	Impeller bolt		155068	120251		*	Shim .005"	511548
13	1	Cover		515910	515910		*	Shim .010"	511549
14	8	Cover screws		155069	155069		*	Shim .020"	511550
15		Not used		Not used	Not used	B9	1	Impeller	515683
16	2	Mounting Rails		551658	551658	B10	1	Bolt, Impeller	120251
17	4	Rail Bolts		120205	120205	B11	1	Lockwasher, Impeller	251788
18	4	Rail spacers		Not used	Not used	B12	1	Washer, Impeller	Not Used
19	4	Rail lockwashers		251788	251788	B13	1	Cover	515910
20	4	Rail -Nuts		155070	155070	B14	8	Screw, Cover	155069
21	4	Rail washers		155091	155091	B15	1	Eye Bolt	140019
22		Not used		Not used	Not used	B16	1	Spacer, Impeller Bolt	515990
23	2	Finger guard screen		552322	552322			Shaft Sleeve	Not Used
24	2	Muffler foam (hi temp)		552328	552328	B17	4	Lockwasher, Housing	Not Used
25	2	Muffler foam (regular)		552327	552327	B18	2	Screen, Muffler Retaining, Right	551727
26	2	Retainer		552332	552332		2	Finger guard	Not Used
27	2	Muffler tube		552324	552324	B19	6	Bolt, Muffler Hsg/Hsg	155067
28	8	Muffler Tie Rod		552325	552325	B19A	4	Bolt, Muffler Hsg/Hsg	120214
29	1	Connector plate		552298	552298	B20	1	Muffler Housing	550039
30	8	Muffler washer		155091	155091		1	Muffler Discrete	Not Used
31	16	Muffler tie rod nuts		251789	251789		2	Bolt, Motor/Muffler	Not Used

*As needed **Viewed looking atinlet/outlet ports

32	2	Flange	529912	529912		2	Lockwasher, Motor/Muffler	Not Used	
33	6	Flange bolts	140016	140016		2	Washer, Motor/Muffler	Not Used	
34		Flange Cap.	Not used	Not used	B23	4	Bolt, Rail	155025	
35		Not used	Not used	Not used	B24	4	Lockwasher Rail	251788	
36		Nameplate- Blower	Not used	Not used		8	Washer Rail/Motor	Not Used	
37		Rotation Sticker	Not used	Not used	B25	4	Nut, Rail	155070	
38		Not used	Not used	Not used	B26	2	Rail Mounting	551658	
39									
40									
41									
42									

Model	Part #	Motor	Wiring Diagram	Specific Parts	Bearing, Rear (M1)	Bearing, Impeller End (M2)
DR14DW72MW	081476	516096	C		516844	516846
DR14DW86MW	081479	516097	G			
DR14BH72MW	081480	510463	C		516842	516844
DR14BH86MW	081481	511511	G			
DR14DT72MW	081483	551037	C		516844	516846
DR14DT86MW	081484	516100	G			
HiE14DW72MW	081497	529603	C			

Small Compact Inlet Vacuum Filters

"CSL" Series 3/8" - 3" FPT

APPLICATIONS & EQUIPMENT

- Vacuum Pumps & Systems – P.D., Side Channel, Rotary Vane, Screw, Piston
- Vacuum Packaging Equipment
- Vacuum Lifters
- Blowers - Side Channel & P.D.
- Intake Suction Filters
- Pneumatic Conveying Systems
- Soil Venting/Remediation
- Remote Installations for Piston & Screw Compressors
- Printing Industry
- Factory Automation Equip
- Leak Detection Systems
- Woodworking
- Medical Industry

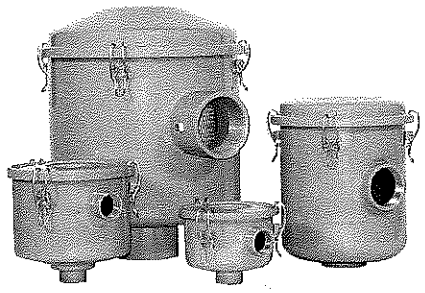
FEATURES & SPECIFICATIONS

- **Vacuum level**: Typically $1x10^{-3}$ mmHg ($1.3x10^{-3}$ mbar)
- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron
- Brazed fittings for **High** vacuum duty
- Stainless steel torsion clips for durability
- Low pressure drop
- Positive engagement O-ring seal system
- Seamless drawn housings
- **Large** dirt holding capacity and **Easy** field cleaning, especially when mounted horizontally or inverted
- Rugged all steel construction w/baked enamel finish
- Various media
- Temp (continuous): min -15°F (-26°C) max 220°F (104°C)
- Filter change out differential: 10" - 15" H_2O over initial delta P
- Pressure drop graphs available upon request

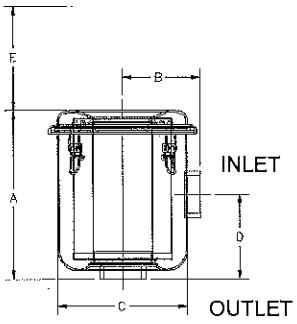
OPTIONS (Inquiries Encouraged)

- Vacuum gauge available
- Dome hood for high holding capacity
- Available in ***Stainless Steel***
- Epoxy coated housings
- Activated carbon prefilter for odor
- Support brackets
- Alternate top-to-canister fastening system for low pressure or pulsating systems

CONFIGURATION



DRAWING



Dimension tolerance ± 1/4"

I = Industrial Duty S = Severe Duty

	with Polyester Element	with Paper Element	FPT Inlet & Outlet	DIMENSIONS - inches A	B	C	D	E	Rated Flow SCFM Nominal Rating	Element Rating	Approx. Wt. lbs
I	CSL-825-039HC	CSL-824-039HC	3/8"	3 5/8	2 1/4	3 3/4	1 7/8	3	18	25	0.88
I	CSL-825-050HC	CSL-824-050HC	1/2"	3 5/8	2 1/4	3 3/4	1 7/8	3	18	25	0.88
I	CSL-843-050HC	CSL-842-050HC	1/2"	4 3/8	3	5 7/8	2 1/2	3 1/4	20	55	3
I	CSL-825-075HC	CSL-824-075HC	3/4"	3 3/4	2 1/4	3 3/4	1 7/8	3	24	25	0.88
S	CSL-843-075HC	CSL-842-075HC	3/4"	4 3/8	3	5 7/8	2 1/2	3 1/4	25	55	3
I	CSL-843-100HC	CSL-842-100HC	1"	4 3/8	3 1/4	5 7/8	2 5/8	3 1/4	35	55	3
S	CSL-849-100HC	CSL-848-100HC	1"	6 3/4	4 1/8	7 5/16	4 1/2	5 1/4	40	115	5
I	CSL-843-125HC	CSL-842-125HC	1 1/4"	4 3/8	3 1/4	5 7/8	2 5/8	3 1/4	55	55	3
S	CSL-849-125HC	CSL-848-125HC	1 1/4"	6 3/4	4 1/8	7 5/16	4 1/2	5 1/4	60	115	5
I	CSL-849-150HC	CSL-848-150HC	1 1/2"	6 3/4	4 1/8	7 5/16	4 1/2	5 1/4	80	115	5
I	CSL-851-200HC	CSL-850-200HC	2"	10 1/4	4 9/16	8 3/4	5	9 1/4	175	290	15
I	CSL-851-250HC	CSL-850-250HC	2 1/2"	10 1/2	5 1/8	8 3/4	5 1/2	9 1/4	210	290	15
I	CSL-239-300C*	CSL-238-300C*	3"	15 3/4	8 7/8	13 1/4	8 3/4	11	300	570	33

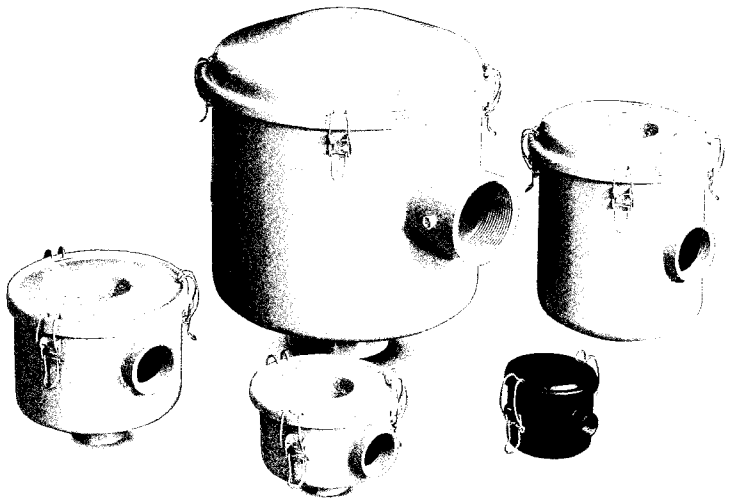
*1/4" taps standard on inlet and outlet

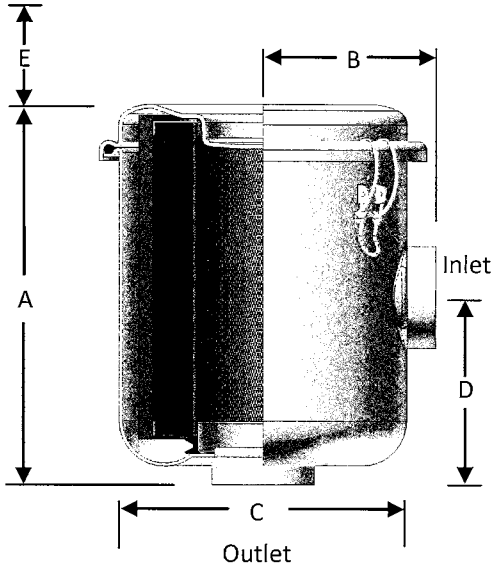
Note: Model offerings and design parameters may change without notice.

1151 Ardmore Ave. • Itasca, IL 60143 USA
Sales/Service: 630.773.1363 • Fax: 630.773.0727
E-mail: sales@solbergmfg.com • Web Site: www.solbergmfg.com

"L" Style Vacuum Filters
CSL Series 3/8" - 3" FPT

SOLBERG®





Features

- Seamless drawn housings
- Brazed fittings for high vacuum duty
- Stainless steel torsion clips for durability
- Positive engagement O-ring seal system
- Rugged all steel construction with baked enamel finish

Benefits

- Large dirt holding capacity and easy field cleaning, especially when mounted horizontally or inverted
- Designed to handle high vacuum applications
- Low pressure design

Technical Specifications

- Vacuum Rating: Gas tight o-ring seal
- Temp (continuous): min -15°F (-26°C) max 220°F (104°C)
- Filter change out differential: 15-20" H_2O over initial Δ P
- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron

Options

- Vacuum gauge
- Dome hood for high holding capacity
- Material/Finishes: stainless steel, epoxy coating
- Support brackets
- Alternative top-to-canister fastening system for low pressure or pulsating systems

FPT Outlet Connections

FPT Inlet/ Outlet	Assembly SCFM Rating	Assembly Part Number		Dimensions - inches				Suggested Service HT.	Approx.	Replacement Element Part No.		Element SCFM
		Polyester	Paper	A	B	C	D	E	Wt. lbs	Polyester	Paper	Rating
3/8"	18	CSL-825-039HC	CSL-824-039HC	3 5/8	2 1/4	3 3/4	1 7/8	3	0.88	825	824	25
1/2"	18	CSL-825-050HC	CSL-824-050HC	3 5/8	2 1/4	3 3/4	1 7/8	3	0.88	825	824	25
1/2"	20	CSL-843-050HC	CSL-842-050HC	4 3/8	3	5 7/8	2 1/2	3	3	843	842	55
3/4"	24	CSL-825-075HC	CSL-824-075HC	3 3/4	2 1/4	3 3/4	1 7/8	3	0.88	825	824	25
3/4"	25	CSL-843-075HC	CSL-842-075HC	4 3/8	3	5 7/8	2 1/2	3	3	843	842	55
1"	35	CSL-843-100HC	CSL-842-100HC	4 3/8	3 1/4	5 7/8	2 5/8	3	3	843	842	55
1"	40	CSL-849-100HC	CSL-848-100HC	6 3/4	4 1/8	7 1/3	4 1/2	5	5	849	848	115
1 1/4"	55	CSL-843-125HC	CSL-842-125HC	4 3/8	3 1/4	5 7/8	2 5/8	3	3	843	842	55
1 1/4"	60	CSL-849-125HC	CSL-848-125HC	6 3/4	4 1/8	7 5/16	4 1/2	5	5	849	848	115
1 1/2"	80	CSL-849-150HC	CSL-848-150HC	6 3/4	4 1/8	7 5/16	4 1/2	5	5	849	848	115
2"	175	CSL-851-200HC	CSL-850-200HC	10 1/4	4 9/16	8 3/4	5	9	15	851	850	290
2 1/2"	210	CSL-851-250HC	CSL-850-250HC	10 1/2	5 1/8	8 3/4	5 1/2	9	15	851	850	290
3"	300	CSL-239-300HC	CSL-238-300HC	15 3/4	8 7/8	13 1/4	8 3/4	11	33	239	238	570

See Vacuum Filter Technical Data section for sizing guidelines.

Dimension tolerance ± 1/4"

Note: Model offerings and design parameters may change without notice. See www.solbergmfg.com for most current offering.

www.solbergmfg.com • sales@solbergmfg.com • Sales: 630.773.1363 • Fax: 630.773.0727

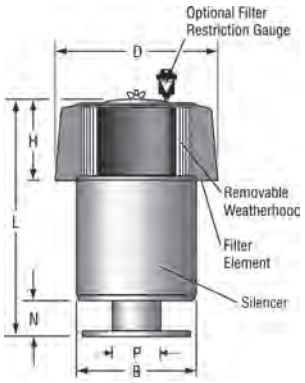
CCS/CS Series

Filter-Silencers

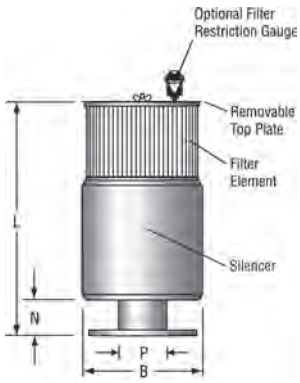
CCF/CF Series

Filters

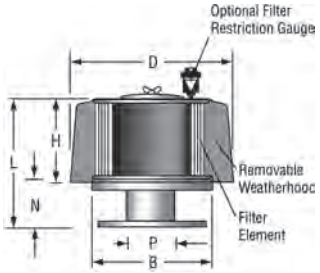
CCS Series (with weatherhood)



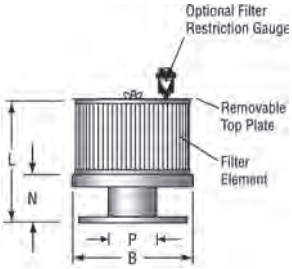
CS Series (with top plate)



CCF Series (with weatherhood)



CF Series (with top plate)



Part Numbers

Pipe Size	CCS	CS	CCF	CF
.5	34-K50-TT*	34-M50-TT*		
.75	34-K70-TT*	34-M70-TT*	*Sizes .5"–1" Use CCS or CS Series*	
1	34-K01-TT*	34-M01-TT*		
1.25	34-K21-TT*	34-M21-TT*	34-L21-TT*	34-N21-TT*
1.5	34-K15-TT*	34-M15-TT*	34-L15-TT*	34-N15-TT*
2	34-K02-TT*	34-M02-TT*	34-L02-TT*	34-N02-TT*
2.5	34-K25-TT*	34-M25-TT*	34-L25-TT*	34-N25-TT*
3	34-K03-TT*	34-M03-TT*	34-L03-TT*	34-N03-TT*
3.5	34-K35-TT*	34-M35-TT*	34-L35-TT*	34-N35-TT*
4	34-K04-TT*	34-M04-TT*	34-L04-TT*	34-N04-TT*
4	34-K04-AA*	34-M04-AA*	34-L04-AA*	34-N04-AA*
5	34-K05-TT*	34-M05-TT*	34-L05-TT*	34-N05-TT*
5	34-K05-AA*	34-M05-AA*	34-L05-AA*	34-N05-AA*
6	34-K06-AA*	34-M06-AA*	34-L06-AA*	34-N06-AA*
8	34-K08-AA*	34-M08-AA*	34-L08-AA*	34-N08-AA*
10	34-K10-AA*	34-M10-AA*	34-L10-AA*	34-N10-AA*
12	34-K12-AA*	34-M12-AA*	34-L12-AA*	34-N12-AA*
14	34-K14-AA*	34-M14-AA*	34-L14-AA*	34-N14-AA*
16	34-K16-AA*	34-M16-AA*	34-L16-AA*	34-N16-AA*

*Specify "P" at end of part number for unit with pleated paper elements, "F" for pleated felt or "W" for wire mesh.
Refer to page 11 for filter element details.

Universal's cartridge filters and filter-silencers offer high-performance filtration and silencing in a convenient, economical cartridge configuration. Choose from four standard models for pipe sizes ranging from .5" to 16" and for flow capacities ranging from 15 to 7,700 CFM. Three types of filter element media—pleated paper, pleated felt, or wire mesh—are available to suit your application.

The CCF and CF series filters are high-quality air filters without a silencing section. The CCF has a removable weatherhood, and the CF has a removable top plate. Our CCS and CS intake filter-silencers have a built-in silencing section. The CCS features a removable weatherhood, and the CS has a removable top plate for easy access to the filter element.

Performance Benefits

- **Durability**
  Weatherhoods for CCF and CCS sizes 2.5" through 5" are rugged blue ABS composite material that may be painted. All other components are carbon steel construction with a high-quality semi-gloss enamel finish.
- **High Performance**
  Unique design options, combined with the latest manufacturing techniques, ensure optimum performance and long life even under demanding conditions.
- **Functional**
  Choice of filter only or filter-silencer.
- **Easy to Maintain**
  Removable lightweight weatherhood (CCS and CCF) or removable top plate (CS and CF) for easy access to the filter element.
- **Versatile**
  Interchangeable element options for desired filtration characteristics in the same housing.

Toll-Free: 1-888-300-4272
www.universalAET.com
94-1553 Rev 0

CCS/CS Series

Filter-Silencers

CCF/CF Series

Filters

Noise Attenuation, CCS/CS

Attenuation, dB	Octave Band Center Frequency, Hz
5	63
8	125
10	250
12	500
14	1,000
14	2,000
14	4,000
14	8,000

Pressure Drop, All Models

Pressure Drop (in. of H_2O)	Percentage of Rated Flow
0.7	50%
1.6	75%
2.8	100%
4.4	125%
6.3	150%

P (size)	Rated Flow Cap. (CFM)	D	H	B	N				L				Approx. Weight with Paper Elements			
					CCF	CCS	CF	CS	CCF	CCS	CF	CS	CCF	CCS	CF	CS
.5	15	8.00	3.13	6.00	Use	—	Use	—	Use	6.50	Use	6.50	Use	7	Use	7
.75	22	8.00	3.13	6.00	CCS	—	CS	—	CCS	6.50	CS	6.50	CCS	7	CS	7
1	35	8.00	3.13	6.00	Series	—	Series	—	Series	6.50	Series	6.50	Series	7	Series	7
1.25	60	9.00	3.50	6.50	—	—	—	—	3.50	7.88	3.50	7.88	9	10	5	9
1.5	75	9.00	3.50	6.50	—	—	—	—	3.50	7.88	3.50	7.88	9	10	5	9
2	120	9.00	3.50	6.50	—	—	—	—	3.50	7.88	3.50	7.88	8	10	5	8
2.5	190	13.44	6.75	10.00	1.00	1.00	1.00	1.00	7.50	17.69	7.13	17.31	11	19	10	18
3	275	13.44	6.75	10.00	1.00	1.00	1.00	1.00	7.50	17.69	7.13	17.31	10	18	9	17
3.5	375	13.44	6.75	10.00	1.13	1.13	1.13	1.13	7.63	17.69	7.25	17.31	13	20	12	19
4 (NPT)	500	13.44	6.75	10.00	1.13	1.13	1.13	1.13	7.63	17.69	7.25	17.31	12	19	11	18
4 (flanged)	500	13.44	6.75	10.00	4.00	3.00	4.00	3.00	10.50	19.63	10.13	19.25	14	21	13	20
5 (NPT)	750	13.44	6.75	10.00	1.81	1.81	1.81	1.81	8.38	18.25	8.00	17.88	12	19	11	18
5 (flanged)	750	13.44	6.75	10.00	4.00	3.00	4.00	3.00	10.50	19.56	10.13	19.13	16	23	15	22
6	1,100	18.00	9.50	14.00	4.00	3.00	4.00	3.00	13.31	25.25	12.75	24.75	31	43	23	35
8	2,200	20.00	18.00	14.00	4.00	3.00	4.00	3.00	21.88	33.88	21.38	33.38	43	56	30	43
10	3,000	24.00	11.50	18.00	4.00	3.00	4.00	3.00	15.38	29.25	14.19	28.13	52	83	41	67
12	4,300	24.00	11.50	18.00	4.00	3.00	4.00	3.00	15.38	29.25	14.19	28.13	64	91	48	75
14	5,900	30.00	15.44	24.00	4.00	3.00	4.00	3.00	19.38	36.25	18.25	35.06	97	143	75	121
16	7,700	30.00	15.44	24.00	4.00	3.00	4.00	3.00	19.38	36.25	18.25	35.06	101	145	79	123

All models have a .125" FNPT tap for installation of a gauge or manometer to monitor pressure drop. Sizes **.5" through 3.5"** are standard with female pipe thread connection (FNPT). Sizes **4" and 5"** are available with female threads or flanges. Please specify "threaded" or "flanged" when you order 4" and 5" sizes. Sizes **6" through 16"** are standard with 150# ANSI drilled plate flanges. Rated capacity is based upon exit velocity of approximately 5,500 ft/min. If pressure drop allowance permits, capacity may be increased by as much as 50%.

Toll-Free: 1-888-300-4272
www.universalAET.com
94-1553 Rev 0

CCS/CS/CCF/CF Filter Elements

Three types of filter elements are available for Universal's cartridge filters and filter-silencers. Pleated paper elements provide the highest efficiency and are considered standard. Pleated felt and wire mesh elements are available for less demanding service with respect to efficiency. The three types of elements are completely interchangeable and will fit all CCS, CS, CF or CCF filter housings.

Pleated Paper Element

Specifications

- High-quality industrial grade filter paper—pleated and oven-cured during production.
- Oven-cured plastisol end caps with molded sealing beads.
- Media efficiency: 99.5% on 2 microns; 97% on 1 micron.
- Maximum operating temperature: 200°F for units with .5" through 16" pipe sizes.
- Collapse Strength: 25" WC

Service Instructions

Because of the low cost of the paper element, it is generally treated as a consumable and replaced when dirty. However, depending on customer preference, the paper element may be cleaned with compressed air and reused.

Compressed Air Cleaning

Carefully direct compressed air (100 PSI maximum) through the dry element, opposite the normal direction of flow. After cleaning, inspect carefully for holes or cracks. If damaged, replace element.

Pleated Felt Element

Specifications

- Durable polyester felt media—pleated.
- Oven-cured plastisol end caps with molded sealing beads (larger elements for pipe sizes 10", 12", 14", and 16" have metal end caps with closed cell rubber gaskets).
- Media efficiency: 99% on 10 microns.
- Maximum operating temperature: 200°F for units with .5" through 8" pipe sizes, 250°F for units with 10" through 18" pipe sizes using elements with metal end caps.
- Collapse Strength: 25" WC

Service Instructions

Pleated felt elements may be cleaned with compressed air (as described for paper elements) or water and reused.

Water Cleaning

Rap gently to dislodge accumulated dirt, soak thoroughly approximately 15 minutes in warm water and mild detergent. Rinse thoroughly under low pressure water. Air dry—do not dry with compressed air. After cleaning, inspect carefully for holes or cracks. If damaged, replace element.

Wire Mesh Element

Specifications

- Galvanized wire-mesh media—corrugated construction.
- May be cleaned and reused indefinitely.
- Wire mesh elements are considered "roughing" filters and are not recommended for applications which require efficient filtration of fine particles.
- Approximate efficiency: 93% on 10 microns. Efficiency will vary with element oil or adhesive coverage.
- Maximum operating temperature: 200°F for .5" through 16" with oil-free adhesive (flash point of adhesive is 235°F) and 300°F for .5" through 16" without adhesive.

Service Instructions

New elements are delivered pre-treated with Universal's oil-free adhesive. See the back page for details. For best efficiency, wire mesh elements must be retreated after each cleaning. Spray the element on both sides with Universal Oil-Free Adhesive, P/N 81-0323, following the directions on the container. For oil treatment, dip the element in SAE 30–50 motor oil and drain thoroughly before using.

Cleaning

To clean wire mesh elements, wash in solvent or warm water and detergent in a container large enough for complete immersion of element. Rinse completely, drain, and either air dry or use compressed air. After cleaning and drying, retreat the element with oil-free adhesive or oil as described.

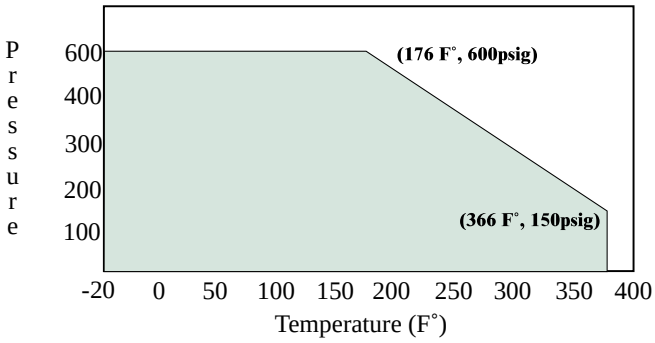
P (Nom.)	Replacement Element Part Number		
	Paper	Felt	Wire Mesh
.5	81-0470	81-1202	81-1035
.75	81-0470	81-1202	81-1035
1	81-0470	81-1202	81-1035
1.25	81-0471	81-1203	81-1036
1.5	81-0471	81-1203	81-1036
2	81-0471	81-1203	81-1036
2.5	81-1063, 81-0472 (old)	81-1205, 81-1204 (old)	81-1038, 81-1037 (old)
3	81-1063, 81-0472 (old)	81-1205, 81-1204 (old)	81-1038, 81-1037 (old)
3.5	81-1063	81-1205	81-1038
4	81-1063	81-1205	81-1038
5	81-1063, 81-0474 (old)	81-1205, 81-1206 (old)	81-1038, 81-1039 (old)
6	81-0475	81-1207	81-1040
8	81-0475 (2)	81-1207 (2)	81-1040, (2) 81-1199 (old)
10	81-1163	81-1209	81-1200
12	81-1163	81-1209	81-1200
14	81-1164	81-1210	81-1201
16	81-1164	81-1210	81-1201

Toll-Free: 1-888-300-4272
www.universalAET.com
94-1553 Rev 0

Standards Compliance

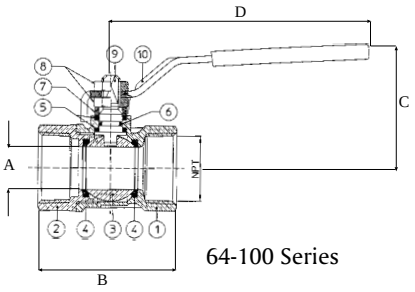
IPG's 64 series brass ball valves comply with the latest editions of these published standards:

- AGA Z21.15.CGA9.1
- AGA No. 3-88
- ANSI B1.20.1
- ANSI B16.18
- CAN/CGA-3.16-M88
- ASME/ANSI B16.33
- ASME/ANSI B16.38
- MSS SP-110
- UL Guide YSDT
- UL Guide YRPV
- UL Guide VQGU
- FM APPROVED

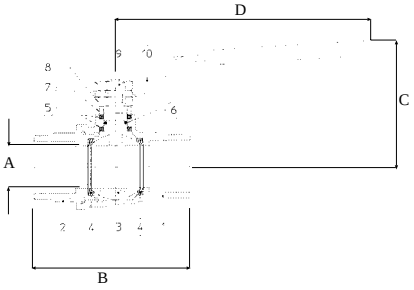


Materials of Construction

Description	Materials
1. Body	Brass UNI 5705-65
2. Retainer	Brass UNI 5705-65
3. Ball	Brass UNI 5705-65
4. Seats	PTFE
5. Stem Seals	PTFE
6. O-Ring	NBR 75 Shore A
7. Packing Gland	Brass UNI 5705-65
8. Nut	Plated Steel
9. Stem	Brass UNI 5705-65 Cr Plated
10. Lever Handle	Plated Steel 1/4" - 2" Models Aluminum 2 1/2" - 4" Models



64-100 Series



Optional Kits

Valve Size	Locking Handle	Stem Extensions	Balancing Stops
1/4", 3/8" & 1/2"	78-1659-01	78-1501-0	78-1506-01
3/4" & 1"	78-1660-01	78-1502-0	78-1507-01
1-1/4" & 1-1/2"	78-1661-01	78-1503-0	78-1508-01
2"	78-1662-01	78-1504-0	78-1509-01
2-1/2" & 3"	-	78-1505-0	78-1510-01

NOTE: Specify (-07) suffix for T-Handle i.e. 64-105-07.

64-100 Dimensional Data

Size	Part No.	A	B	C	D	(Cv)
1/4" NPT	64-101-01	0.39	2.02	1.75	3.85	6
3/8" NPT	64-102-01	0.39	2.02	1.75	3.85	7
1/2" NPT	64-103-01	0.59	2.44	1.88	3.85	19
3/4" NPT	64-104-01	0.78	2.71	2.28	4.80	34
1" NPT	64-105-01	0.98	3.07	2.44	4.80	50
1-1/4" NPT	64-106-01	1.25	3.42	3.07	6.02	104
1-1/2" NPT	64-107-01	1.57	3.89	3.34	6.02	268
2" NPT	64-108-01	1.96	4.33	3.79	6.37	309
2-1/2" NPT	64-109-01	2.56	5.59	5.02	8.07	629
3" NPT	64-100-01	3.15	6.45	5.45	8.07	1018
4" NPT	64-10A-01	3.94	7.60	6.34	10.23	1622

64-200 Dimensional Data

Size	Part No.	A	B	C	D	(Cv)
1/2"	64-203-01	0.59	2.53	1.88	3.85	19
3/4"	64-204-01	0.78	2.99	2.28	4.80	34
1"	64-205-01	0.98	3.58	2.44	4.80	50
1-1/4"	64-206-01	1.25	4.09	3.07	6.02	104
1-1/2"	64-207-01	1.57	4.56	3.34	6.02	268
2"	64-208-01	1.96	5.43	3.79	6.37	309
2-1/2"	64-209-01	2.56	6.93	5.02	8.07	629
3"	64-200-01	3.15	8.09	5.45	8.07	1018

APOLLO INTERNATIONAL
A Division of Conbraco Industires, Inc.

P.O. Box 247
Matthews, NC 28106

(704) 841-6000
Fax: (704) 841-6020
http://www.conbraco.com

Your local Conbraco distributor is:

PHFL64S 4/02
CG 7.5M

February 2012

289 Series Spring-Loaded Relief Valves

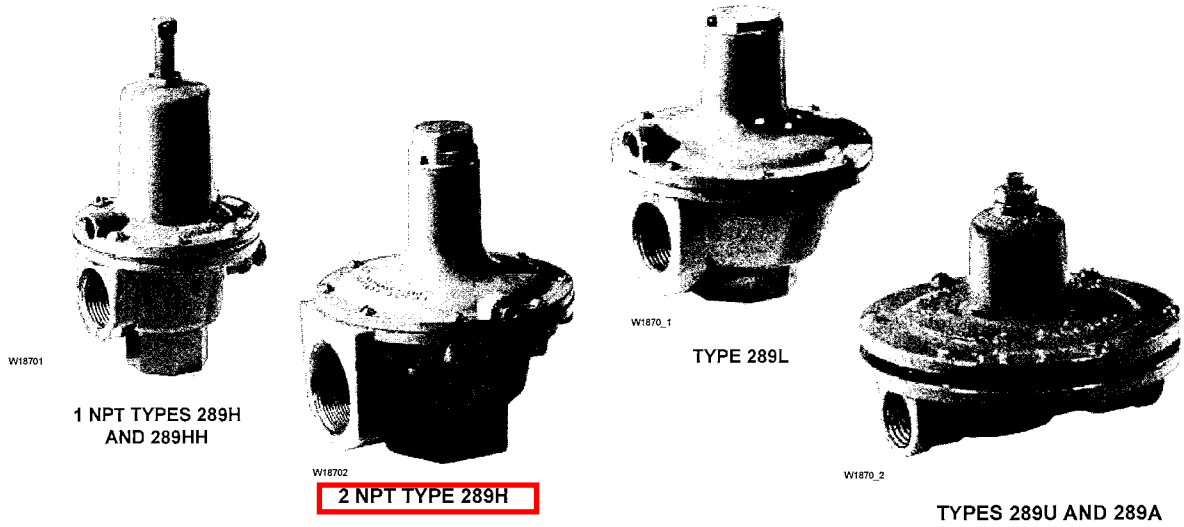


Figure 1. *Types 289H, 289L, and 289U Relief Valves*

Introduction

The 289 Series relief valve is a throttling relief valve used downstream of pressure regulators to protect the downstream system from overpressure. A smooth throttling action minimizes pressure surges in the system during emergency operation. These relief valves are available in 1/4, 3/4, 1, or 2 NPT sizes with spring ranges (relief pressure settings) from 5-inches w.c. to 75 psig / 12 mbar to 5.2 bar.

All sizes above 1/4 NPT feature a pitot tube booster (Figure 1) for achieving the highest possible relief capacity with a minimum buildup of system pressure. When the valve is opening, high gas velocity through the orifice creates an area of relatively low pressure near the end of the pitot tube. This pitot tube effect forms a partial vacuum above the diaphragm which helps to open the valve.

The relief valve diaphragm functions as a valve disk to control flow in all types except the Types 289H and 289HH, which use O-ring seats. The Nitrile (NBR) or Neoprene (CR) seating surfaces provide tight shutoff. The 289 Series relief valves are ideal for low-pressure settings due to the increased sensitivity provided by the large diaphragm area.

Features

- **Throttling Type Relief**—Smooth, sensitive throttling action minimizes pressure surges.
- **High Flow Rates**—As shown by the Figure 3 capacity curves, high flow rates can be achieved with minimum pressure buildup due to the boosting system which increases the relief valve opening.
- **Small Size**—The 289 Series relief valves are small and compact, making them suitable for areas limited in space.
- **Reliability Due to Simplicity**—A single internal assembly decreases the possibility of mechanical failure.

D100154X012

Specifications

Available Configurations

Type 289A: 1/4 NPT spring-loaded relief valve for relief pressure settings of 3 to 22 psig / 0.21 to 1.5 bar, two spring ranges

Type 289H: 1 or 2 NPT spring-loaded relief valve for relief pressure settings of 1 to 50 psig / 0.07 to 3.4 bar four spring ranges, in the 1 NPT and of 7-inches w.c. to 10 psig / 17 mbar to 0.69 bar, four spring ranges, in the 2 NPT

Type 289HH: 1 NPT spring-loaded relief valve for relief pressure settings of 45 to 75 psig / 3.1 to 5.2 bar

Type 289L: 3/4 or 1 NPT spring-loaded relief valve for relief pressure settings of 10 to 40-inches w.c. / 25 to 99 mbar, two spring ranges

Type 289U: 1/4 NPT spring-loaded relief valve for relief pressure settings of 5-inches w.c. to 3 psig / 12 mbar to 0.21 bar, two spring ranges

Inlet Connections

Type 289L: 3/4 or 1 NPT

Types 289A and 289U: 1/4 NPT

Type 289H: 1 or 2 NPT

Type 289HH: 1 NPT

Outlet (Vent) Connections

Same size as inlet connection

Maximum Allowable Relief (Inlet) Pressure[1] and Maximum Relief Set Pressure

See Table 1

Capacity Data

See Figure 3

Standard Construction Materials

Valve Body and Spring Case

Types 289A and 289U: Zinc
Types 289H (1 NPT), 289HH, and 289L: Aluminum
Type 289H (2 NPT): Cast iron body with Aluminum spring case

Diaphragm

Type 289A: Neoprene (CR)
Types 289H and 289HH: Nitrile (NBR) or Fluorocarbon (FKM)
Types 289L and 289U: Nitrile (NBR)

Standard Construction Materials (continued)

Orifice

Types 289A and 289L: Aluminum
Type 289H (2 NPT Only): Brass or Stainless steel

O-Ring Seat (Types 289H and 289HH Only):

Nitrile (NBR) or Fluorocarbon (FKM)[2]

O-Ring Seat Holder and Washer (1 NPT Types 289H and 289HH Only):

Aluminum

Seat Washer (2 NPT Type 289H Only):

Stainless steel

Pitot Tube

Types 289H, 289HH (1 NPT), and 289L: Aluminum*Type 289H (2 NPT):* Brass or Stainless steel

Gaskets

Type 289L: Neoprene (CR)
All Others: Composition

Spring: Zinc-plated steel

Diaphragm Plate

Types 289A and 289U: Zinc
All Others: Zinc-plated steel

Closing Cap

Type 289L: Plastic, Aluminum, or Zinc
Type 289H (2 NPT): Zinc

Temperature Capabilities[1]

With Nitrile (NBR) and Neoprene (CR) Elastomer:
-20° to 150°F / -29° to 66°C

With Fluorocarbon (FKM):
20° to 300°F / -7° to 149°C
Available with Types 289H and 289HH only

Approximate Weights

Types 289A and 289U: 0.75 pounds / 0.3 kg

Type 289H

1 NPT: 4 pounds / 2 kg
2 NPT: 15 pounds / 7 kg

Type 289HH: 4 pounds / 2 kg

Type 289L: 15 pounds / 7 kg

Options

- Polytetrafluoroethylene (PTFE) diaphragm protector (Types 289A and 289U only)
- Wire-seal on closing cap (1 NPT Type 289L only)

1. The pressure/temperature limits in this Bulletin and any applicable standard limitation should not be exceeded.
2. Bubble-tight shutoff cannot be attained at settings below 5 psig / 0.35 bar with Fluorocarbon (FKM) O-ring seat.

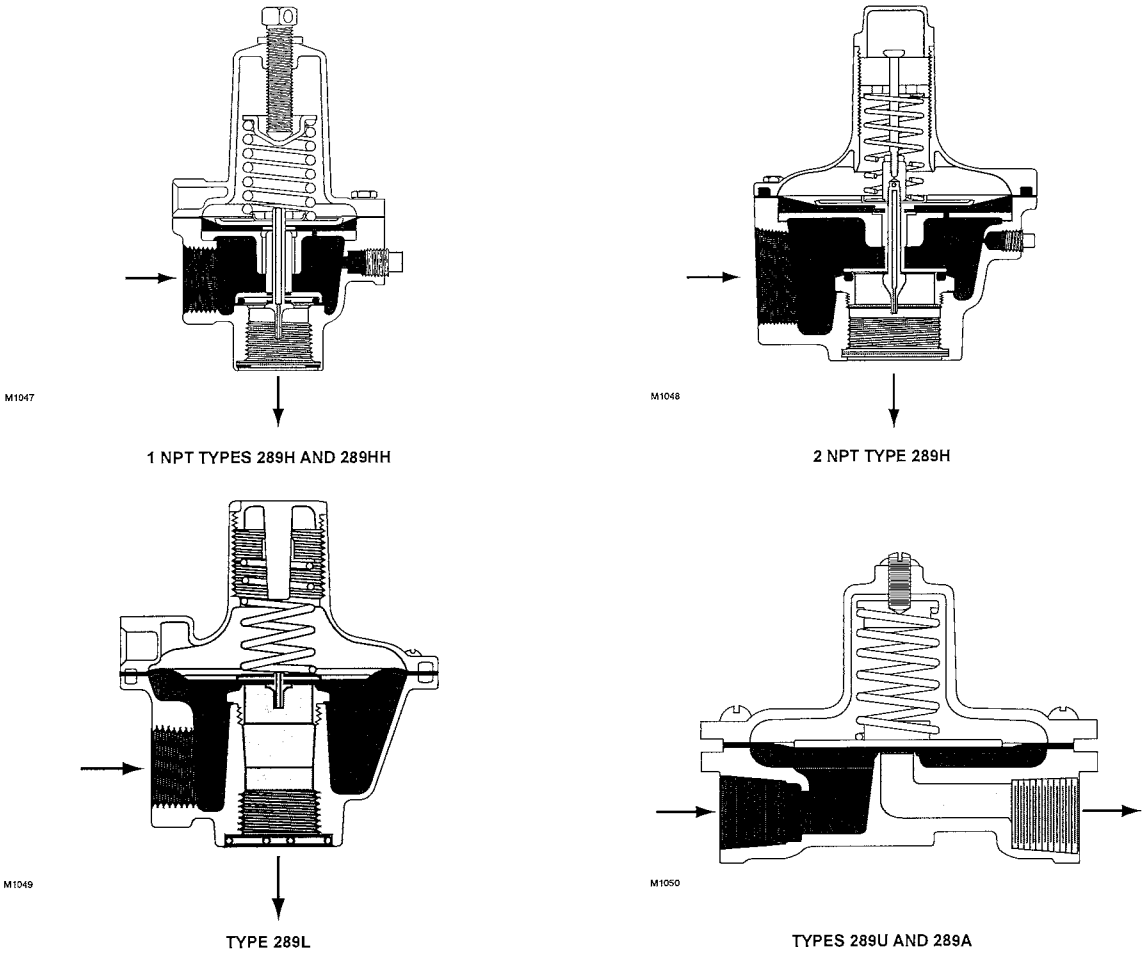
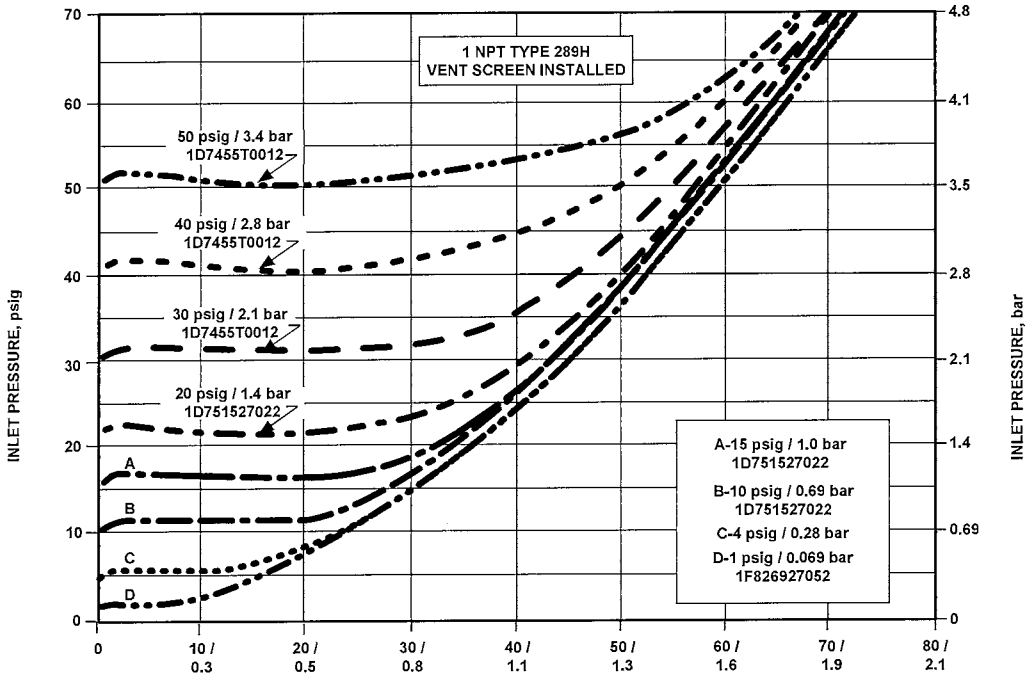


Figure 2. *Types 289H, 289L, and 289U Operational Schematics*

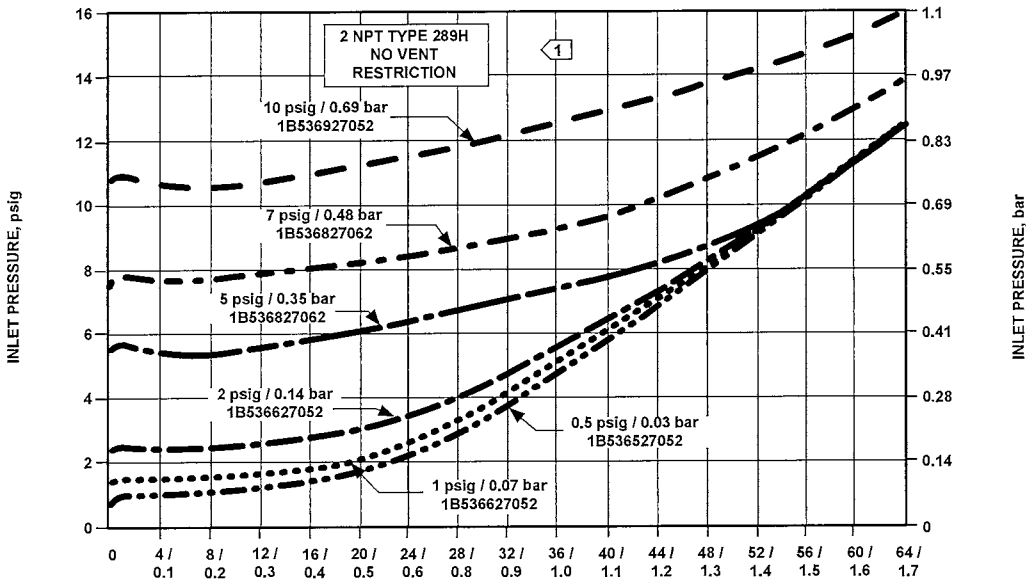
Table 1. *Maximum Allowable Relief (Inlet) Pressure*

AVAILABLE CONFIGURATION	BODY SIZE, NPT	SPRING PART NUMBER	COLOR CODE	SPRING RANGE (RELIEF PRESSURE SETTINGS)		MAXIMUM ALLOWABLE RELIEF (INLET) PRESSURE[1]	
Type 289A	1/4	0Z056327022 1B268227022	Silver Silver	3 to 13 psig 11 to 22 psig	0.21 to 0.90 bar 0.76 to 1.5 bar	45 psig	3.1 bar
Type 289H	1	1F826927052 1D892327022 1D751527022 1D7455T0012	Pink Red Silver Green	1 to 4.5 psig 4 to 15 psig 10 to 20 psig 15 to 50 psig	0.07 to 0.31 bar 0.28 to 1.0 bar 0.69 to 1.4 bar 1.0 to 3.5 bar	100 psig	6.9 bar
	2	1B536527052 1B536627052 1B536827062 1B536927052	Dark Blue Gray Dark Green Red Stripe	7 to 18-inches w.c. 0.5 to 2.25 psig 1.75 to 7 psig 4 to 10 psig	17 to 45 mbar 0.03 to 0.16 bar 0.12 to 0.48 bar 0.28 to 0.69 bar	25 psig	1.7 bar
Type 289HH	1	1D7455T0012	Green	45 to 75 psig	3.1 to 5.2 bar	100 psig	6.9 bar
Type 289L	3/4 or 1	13A7917X012 13A7916X012	Silver Red Stripe	10 to 18-inches w.c. 12 to 40-inches w.c.	25 to 45 mbar 30 to 99 mbar	7 psig	0.48 bar
Type 289U	1/4	0V060227022 0F058227022	Silver Silver	5 to 25-inches w.c. 20-inches w.c. to 3 psig	12 to 62 mbar 50 to 207 mbar	10 psig	0.69 bar

1. This value indicates the relief pressure setting plus pressure build-up.



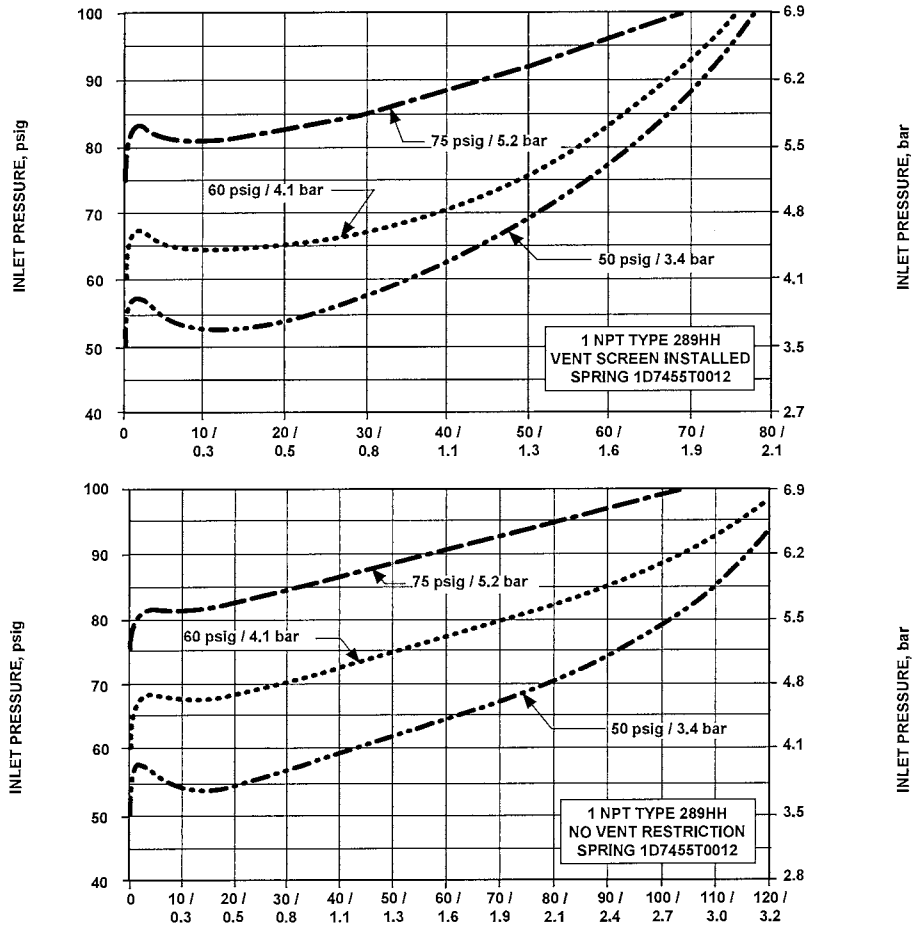
CAPACITIES IN THOUSANDS OF SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS AT 14.7 psia AT 60°F / 1.01325 bar AT 0°C



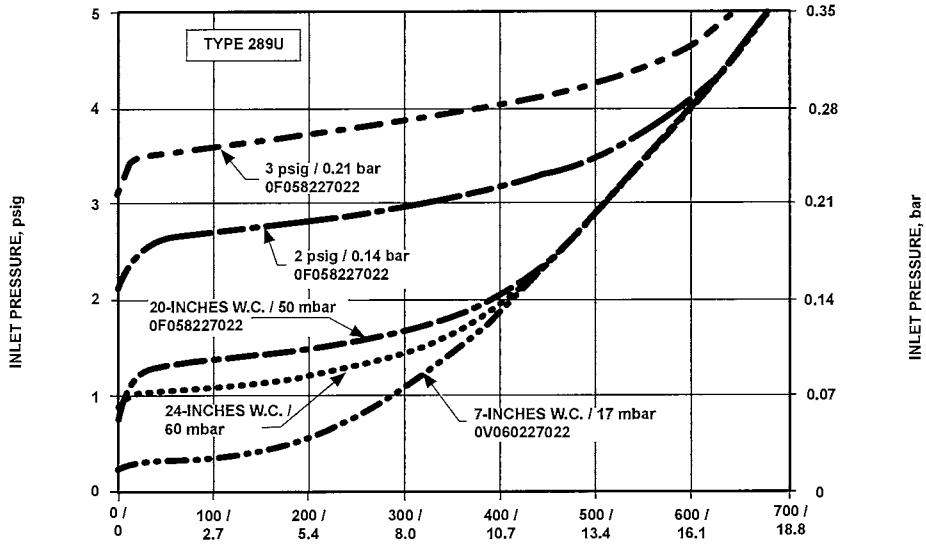
CAPACITIES IN THOUSANDS OF SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS AT 14.7 psia AT 60°F / 1.01325 bar AT 0°C

NOTE:
1. LESS THAN A 5% CAPACITY LOSS CAN BE EXPECTED WITH THE VENT SCREEN INSTALLED ON THE 2 NPT TYPE 289H AT MAXIMUM FLOW.
2. WHEN SELECTING ANY RELIEF VALVE FOR INSTALLATION DOWNSTREAM OF THE REGULATOR, THE CAPACITY OF THE RELIEF VALVE SHOULD BE COMPARED WITH THE WIDE-OPEN CAPACITY OF THE REGULATOR.
3. BUBBLE POINT RELIEF SETTING AND SPRING PART NUMBER ARE NOTED ON EACH CURVE.
4. TO CONVERT TO EQUIVALENT CAPACITIES OF OTHER GASES, MULTIPLY VALUES OBTAINED FROM CURVE BY THE FOLLOWING FACTORS: AIR–0.78, PROPANE–0.628, BUTANE–0.548, NITROGEN–0.789.

Figure 3. *Capacity Curves*



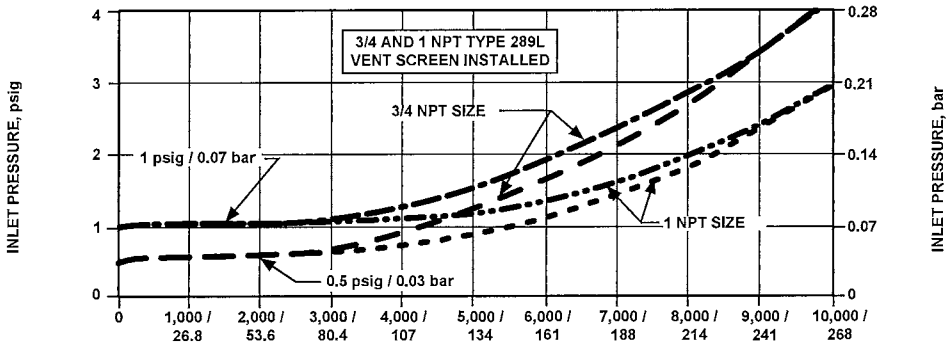
CAPACITIES IN THOUSANDS OF SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS AT 14.7 psia AT 60°F / 1.01325 bar AT 0°C



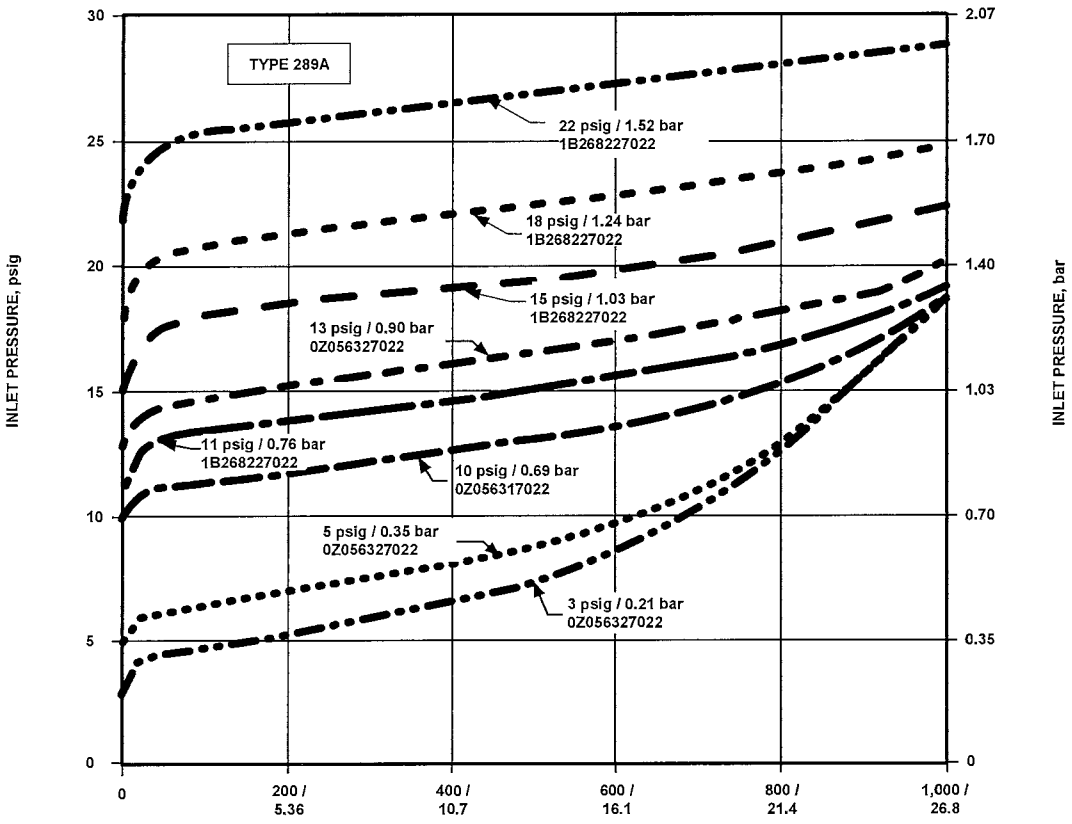
CAPACITIES IN 0.6 SPECIFIC GRAVITY GAS —
CUBIC FEET PER HOUR / Nm³/h—14.7 psia AT 60°F / 1.01325 bar AT 0°C

NOTE:
1. WHEN SELECTING ANY RELIEF VALVE FOR INSTALLATION DOWNSTREAM OF THE REGULATOR, THE CAPACITY OF THE RELIEF VALVE SHOULD BE COMPARED WITH THE WIDE-OPEN CAPACITY OF THE REGULATOR.
2. BUBBLE POINT RELIEF SETTING AND SPRING PART NUMBER ARE NOTED ON EACH CURVE.
3. TO CONVERT TO EQUIVALENT CAPACITIES OF OTHER GASES, MULTIPLY VALUES OBTAINED FROM CURVE BY THE FOLLOWING FACTORS: AIR–0.78, PROPANE–0.628, BUTANE–0.548, NITROGEN–0.789.

Figure 3. *Capacity Curves (continued)*



CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS AT 14.7 PSIA AT 60°F / 1.01325 bar AT 0°C



CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS AT 14.7 psia AT 60°F / 1.01325 bar AT 0°C

NOTE:
1. WHEN SELECTING ANY RELIEF VALVE FOR INSTALLATION DOWNSTREAM OF THE REGULATOR, THE CAPACITY OF THE RELIEF VALVE SHOULD BE COMPARED WITH THE WIDE-OPEN CAPACITY OF THE REGULATOR.
2. BUBBLE POINT RELIEF SETTING IS NOTED ON EACH CURVE.
3. TO CONVERT TO EQUIVALENT CAPACITIES OF OTHER GASES, MULTIPLY VALUES OBTAINED FROM CURVE BY THE FOLLOWING FACTORS: AIR–0.78, PROPANE–0.628, BUTANE–0.548, NITROGEN–0.789.

Figure 3. *Capacity Curves (continued)*

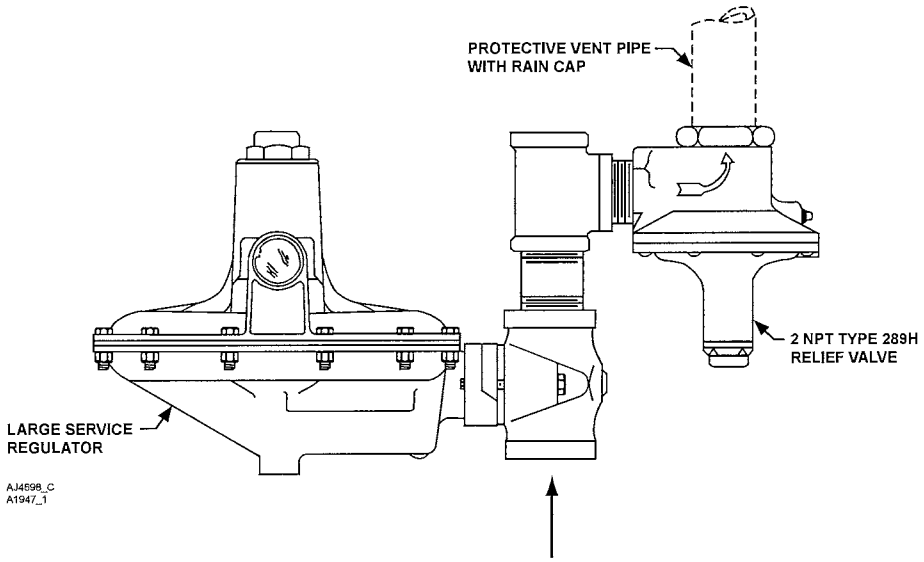


Figure 4. *Typical Installation of a 289 Series Relief Valve*

Installation

The 289 Series relief valves may be installed in any position. However, the outlet connection must be protected against the entrance of rain, snow, insects, or any other foreign material that may plug the outlet or affect the opening and closing of the valve (see Figure 4). If it is necessary to pipe away the outlet, remove the outlet screen (if one is present).

Flow through the valve must be as indicated by the flow direction arrow on the body (inlet connection is marked on some sizes).

The spring case vent on the 2 NPT Type 289H is tapped and plugged. This vent opening must remain plugged to allow the pitot tube booster to function.

Overpressure

Overpressure conditions in a regulating system may cause personal injury or equipment damage due to bursting of pressure-containing parts or explosion of accumulated gas. Check the system for damage if any of the maximum allowable relief (inlet) pressure ratings in Table 1 are exceeded.

Ordering Information

When ordering, specify:

1. Type number and size
2. Relief pressure range and setting desired
3. Type of gas (natural gas, air, etc.); list any factors such as impurities in the gas that may affect compatibility of the gas with valve trim parts
4. Temperature and specific gravity of the gas
5. Maximum relief (inlet) pressure and flow rate desired
6. Line size and end connection size of adjacent piping
7. For Types 289H and 289HH, specify material of diaphragm and O-ring seat; for 2 NPT Type 289H, specify material of orifice and pitot tube
8. Options desired, if any

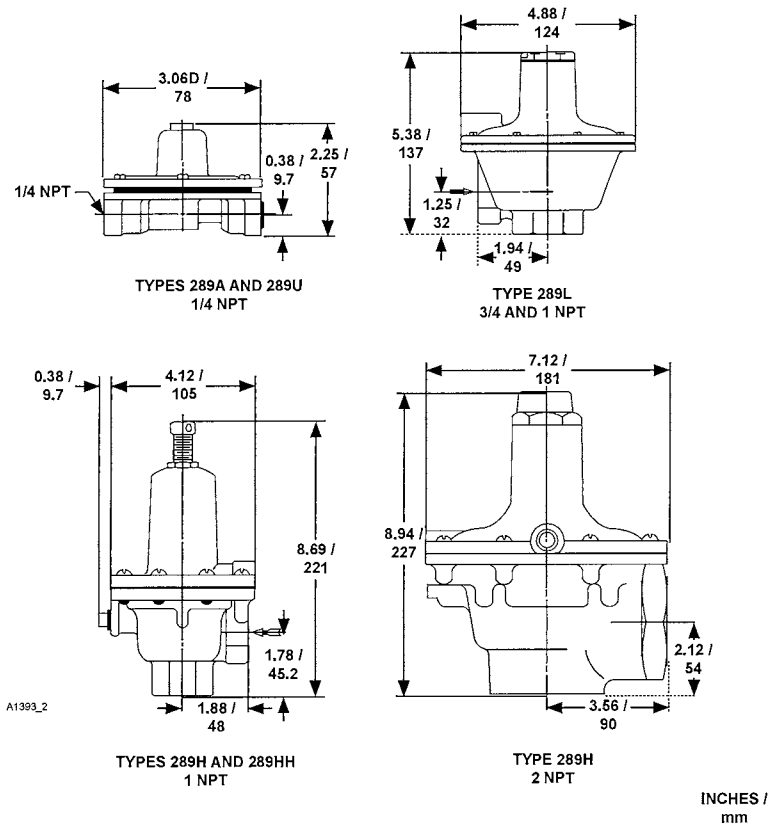


Figure 5. *Dimensions*

Industrial Regulators

Emerson Process Management
Regulator Technologies, Inc.

USA - Headquarters
McKinney, Texas 75069-1872, USA
Tel: +1 800 558 5853
Outside U.S. +1 972 548 3574

Asia-Pacific
Shanghai 201206, China
Tel: +86 21 2892 9000

Europe
Bologna 40013, Italy
Tel: +39 051 419 0611

Middle East and Africa
Dubai, United Arab Emirates
Tel: +971 4811 8100

Natural Gas Technologies

Emerson Process Management
Regulator Technologies, Inc.

USA - Headquarters
McKinney, Texas 75069-1872, USA
Tel: +1 800 558 5853
Outside U.S. +1 972 548 3574

Asia-Pacific
Singapore 128461, Singapore
Tel: +65 6770 8337

Europe
Bologna 40013, Italy
Tel: +39 051 419 0611
Gallardon 28320, France
Tel: +33 2 37 33 47 00

TESCOM

Emerson Process Management
Tescom Corporation

USA - Headquarters
Elk River, Minnesota 55330-2445, USA
Tels: +1 763 241 3238
+1 800 447 1250

Europe
Selmsdorf 23923, Germany
Tel: +49 38823 31 287

Asia-Pacific
Shanghai 201206, China
Tel: +86 21 2892 9499

For further information visit www.emersonprocess.com/regulators

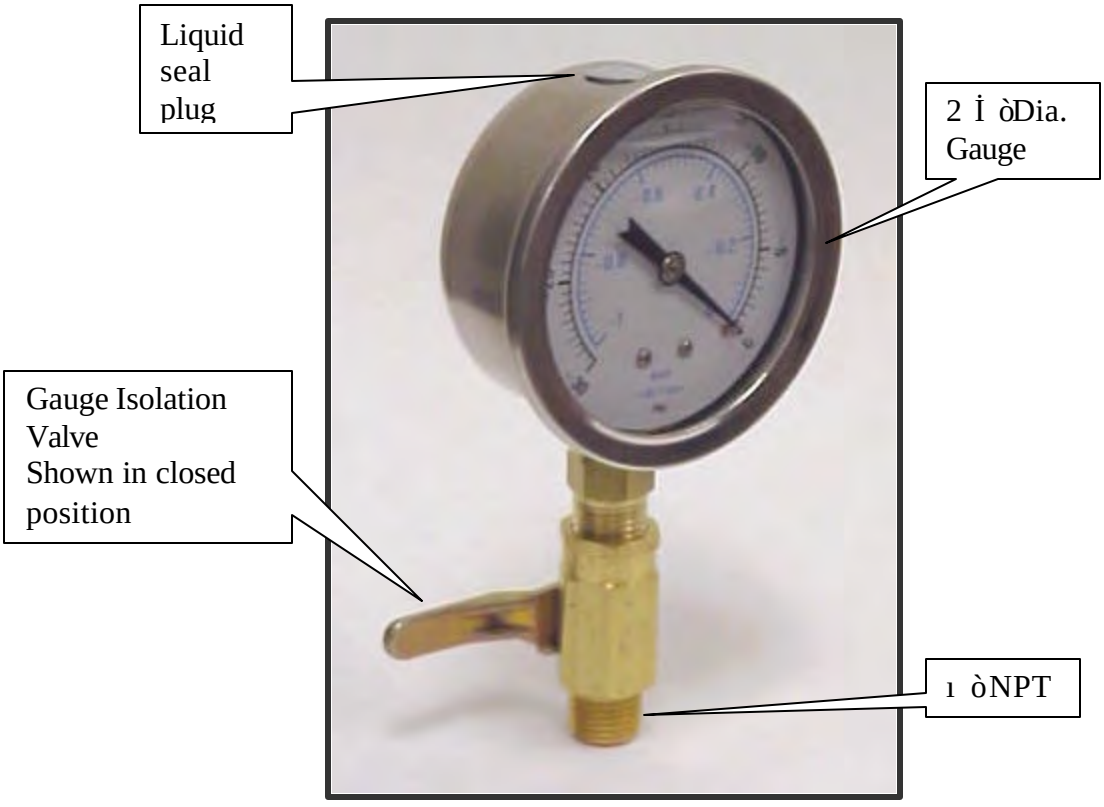
J. E. GASHO & ASSOCIATES, INC.

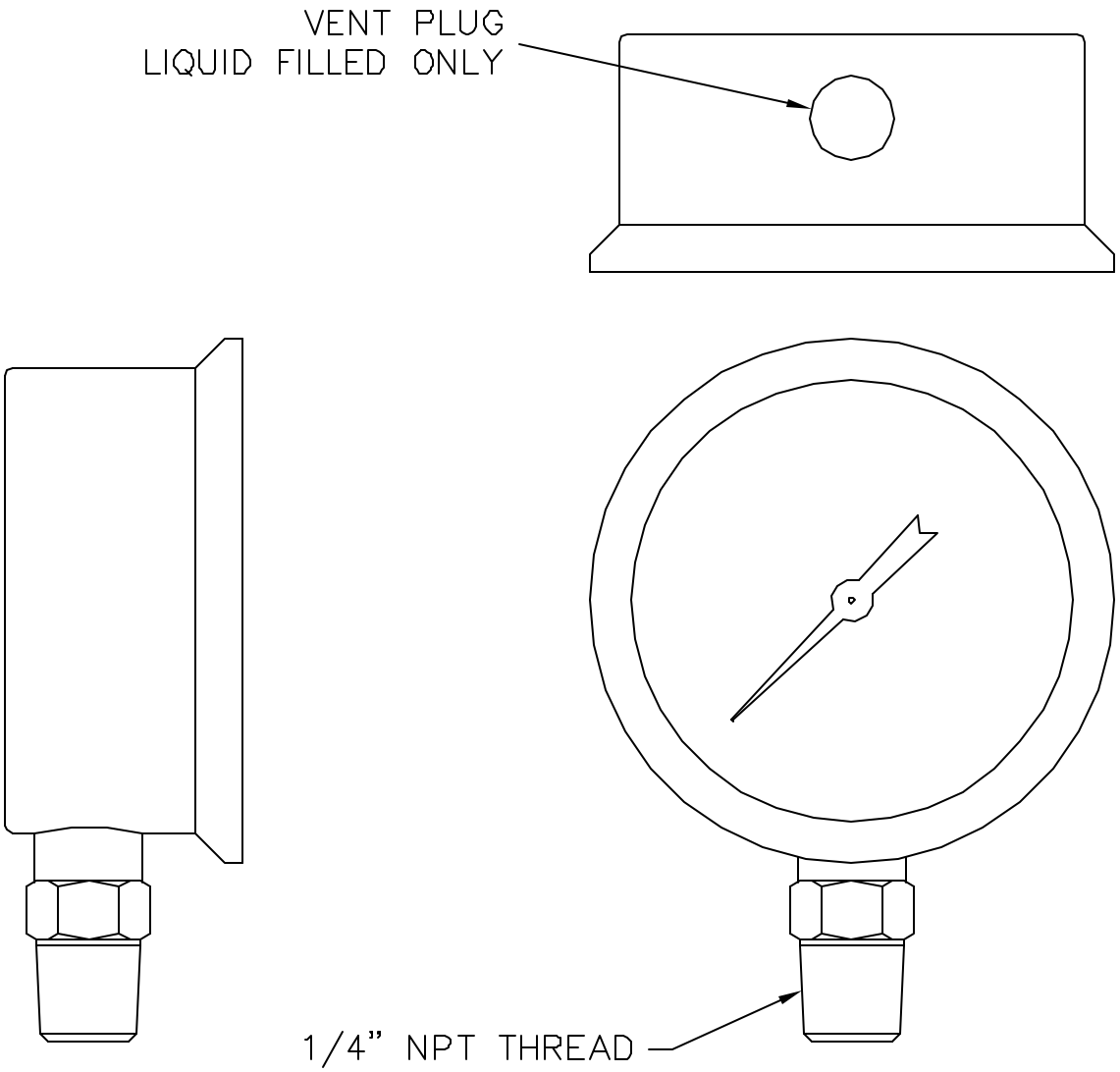
Authorized Manufacturer's Representative
Air / Gas Moving Equipment
460 W. GAY STREET
WEST CHESTER, PA 19380
PHONE: 610-692-5650 FAX: 610-692-5837

Pressure and Vacuum Gauges

We use both standard gauges and liquid filled gauges from a variety of manufacturers. Gauges are installed on our packages with gauge isolation valves (gauge cocks) part number BRS-VA-025-4F4M-BT. The gauge isolation valve can be used as a snubber while reading the gauge by opening it slightly. To protect gauges from damage due to shocks or pulsations in the system, gauge isolation valves should be closed except when the gauge is being read.

Liquid filled gauges may display incorrect readings due to variations in atmospheric pressure. To determine if a gauge is subject to this condition, the liquid filled cavity should be temporarily vented to atmosphere. Most liquid filled gauges have a seal plug in the liquid filled cavity. Remove this plug to allow the cavity to be vented to atmosphere. In some instances the case can be lightly squeezed to burp it. Replace the plug.





25.0.015PSI

NOMINAL SIZE
- 25 = 2.5in
- 40 = 4.0 in.

TYPE
- 0 = NON-FILLED
- 1 = LIQUID FILLED

RANGE

NOTES:
1. WE USE BOTH STANDARD GAUGES & LIQUID FILLED GAUGES FROM A VARIETY OF MANUFACTURERS
2. STANDARD RANGES:
   - PRESSURE: 0-6 PSI & 0-160 IWC
     0-15 PSI
     0-30 PSI
   - VACUUM: 0-12 IN. HG. & 0-160 IWC
     0-30 IN., HG.

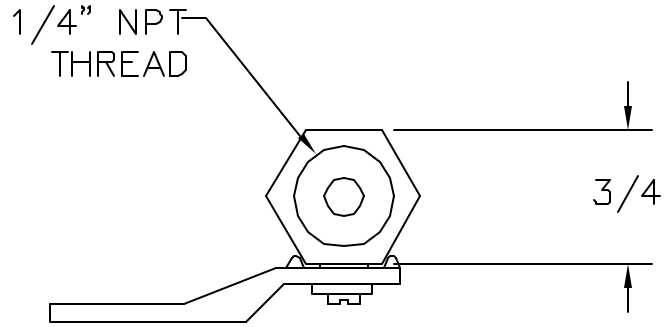
REV.	DATE	DESCRIPTION

DRAWN BY: M. WITTE | DATE: 8-18-00
APPROVED BY: | DATE:
DIMENSIONS IN INCHES
SCALE | TOLERANCE | ANGULAR TOLERANCE | MATERIAL | WEIGHT
SHEET 1 OF 1

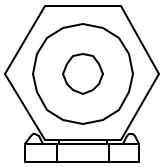
J. E. GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

PRESSURE GAUGE NUMBERING SYSTEM

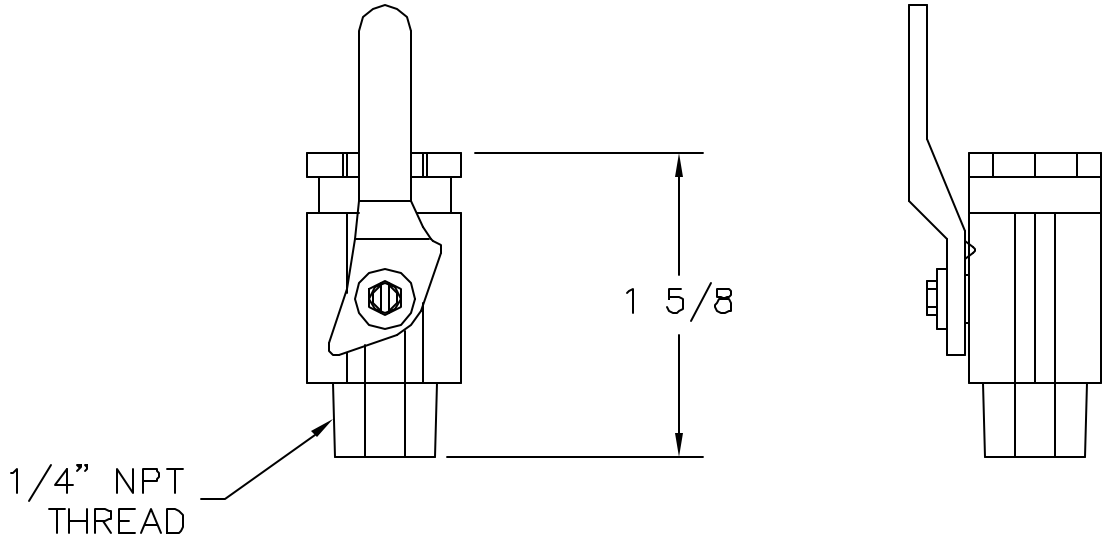
—



PLAN VIEW – CLOSED



PLAN VIEW – OPEN



			DRAWN BY: M. WITTE	DATE 8–17–00	J. E. GASHO & Assoc., Inc. 460 W. GAY ST. WEST CHESTER, PENNSYLVANIA 19380
			APPROVED BY:	DATE	
			DIMENSIONS IN INCHES		GAUGE ISOLATION VALVE SMC VA BRS 025–4F4M–BT
			SCALE		
			TOLERANCE	ANGULAR TOLERANCE	
			MATERIAL	WEIGHT	
REV.	DATE	DESCRIPTION	SHEET 1 OF 1		—

025 SERIES BALL VALVE

Maximum Operating Pressure - 500 psi
Maximum Operating Temperature - 180 Degrees F
Ball Through Hole Diameter - .218

025 One-Way Ball Valve Design Considerations

The 025 Series One-Way Ball Valve compact design promotes multiple configurations to fit the exact end use application. The 025 Ball Valve Series is rated to 500 psi and will support flow and pressure only in the flow direction. The 025 Series has a one-piece body construction, stamped with directional flow arrows, to cover 1/4" NPT end configuration applications. The Zinc Die Cast Lever Handle is standard. Handles can be ordered Reversed - to lie over the outlet when the valve is in the open position. UL configurations are available and rated to 250 psi. UR configurations are available and rated to 500 psi.

Example:	Inlet End	Outlet End	Seal	Handle	Plating
	1/4 FNPT	1/4 MNPT	Buna-N	Steel	ENP

SMC Part Number: 025-4F4M-B,SH,ENP

The handle will lie over the Inlet port when the valve is in the open position. SMC Part Numbers are a description of the valve as read left to right, Inlet to Outlet.
Example: 025-4F4M-B,SH,ENP = 1/4 FNPT Inlet x 1/4 MNPT Outlet

025 Series Options

Material Options Brass Body, Nickel Plated Brass Ball, Teflon® Seats, Stainless Handle Screw

Seal Options Buna-N, Ethylene Propylene, Fluoroelastomer (Viton®), Neoprene

Body Options

- 1/4 Female x 1/4 Female NPT
- 1/4 Female x 1/4 Male NPT
- 1/4 Female x 1/8 Female NPT
- 1/4 Female x 1/8 Male NPT
- 1/4 Female x 1/4 Hose Barb
- 1/4 Female x 11/16-16 Male
- 1/4 Female x 7/16-24 Female
- 1/4 Female x 1/4 Female Flare
- 1/4 Female x 3/8 Compression

Handle Options Zinc Die Cast Lever (Standard), Zinc Die Cast Lever with Red Vinyl Sleeve, Steel Lever, Steel Lever, Round Handle, Steel Lever, Steel Lever with Red Vinyl Sleeve, Round Zinc Die Cast Handle, Black Nylon T-Handle, Blue Nylon Knob, .312 x 1" Stem, Screw Slot Headed Ball

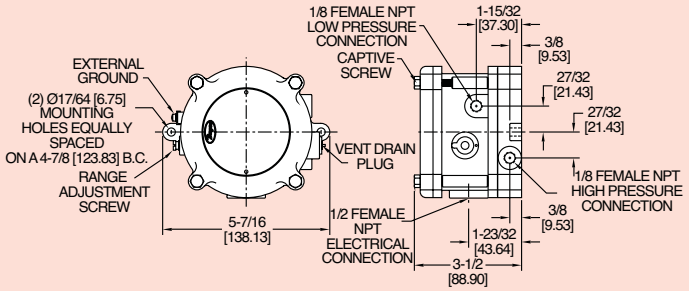
Plating Options Electroless Nickel, Black Zinc

SMC will quote alternate materials or customize our standard products when quantities ensure competitive pricing.
Contact Customer Service at (651) 653-0599, FAX - (651) 653-0989, E-Mail - info@specialtymfg.com

Series 1950

Explosion-proof Differential Pressure Switches

Compact, Low Cost, Explosion-proof and Weatherproof



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

SPECIFICATIONS

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

SERIES 1950 SWITCHES - MODELS, OPERATING RANGES AND DEAD BANDS

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

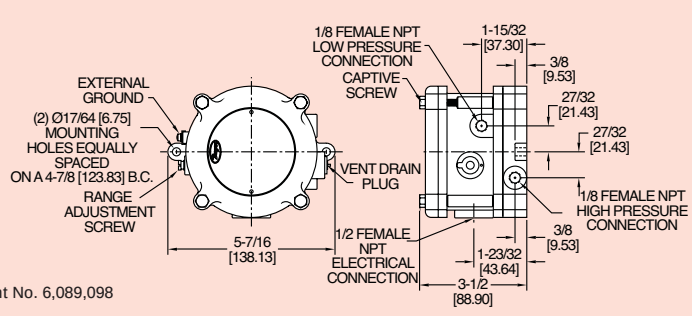
Model* Number	Range, PSID	Approximate Dead Band at	
		Min. Set Point	Max. Set Point
1950P-2-2F	0.5 to 2	.3	.3
1950P-8-2F	1.5 to 8	1.0	1.0
1950P-15-2F	3 to 15	.9	.9
1950P-25-2F	4 to 25	.7	.7
1950P-50-2F	15 to 50	1.0	1.5

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

Series 1950G

Explosion-proof Differential Pressure Switch

Explosion-proof, Weatherproof, Compatible with Natural Gases



Patent No. 6,089,098

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

SPECIFICATIONS

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

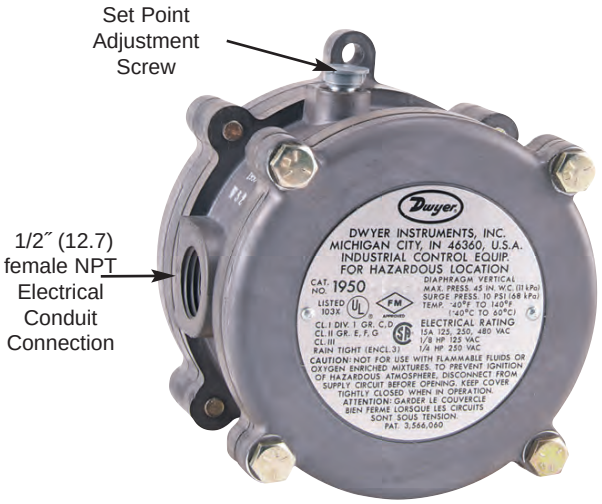
MODELS

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

[1]Note: For alternate supply voltages change 24 to 120 or 240. Example: 1950G-00-B-120. For ATEX approved models remove"-NA".

Series 1950 Explosion-Proof Differential Pressure Switches

Specifications - Installation and Operating Instructions



Series 1950 Explosion-Proof Differential Pressure Switches combine the best features of the Dwyer Series 1900 Pressure Switch with an integral explosion-proof and weather-proof housing. Each unit is UL & CSA listed; FM approved for use in Class I, Groups C & D; Class II, Groups E, F, & G; and Class III atmospheres (NEMA 7 & 9). They are totally rain-tight for outdoor installations. Twelve models allow set-points from .03 to 20 inches w.c. and from .5 to 50 psi (3.4 to 345 kPa).

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 disassembling the housing. The unit is very compact, about half the weight and bulk of equivalent conventional explosion-proof switches.

CAUTION

For use only with air or compatible gases. 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. This may increase response time on -0 and -00 models.

NOTE: The last number-letter combination in the model number identifies the switch's electrical rating (number) and diaphragm material (letter). The 2F combination is standard as described in the physical data above. In 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 H.P. 125 VAC; 1/4 H.P. 250 VAC; a number 5 or 6 rating is 1A 125 VAC. Letter B indicates a Buna-N diaphragm; N = Neoprene; S = Silicone; and V = Viton®.

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

Series 1950 Switches
Operating ranges and deadbands

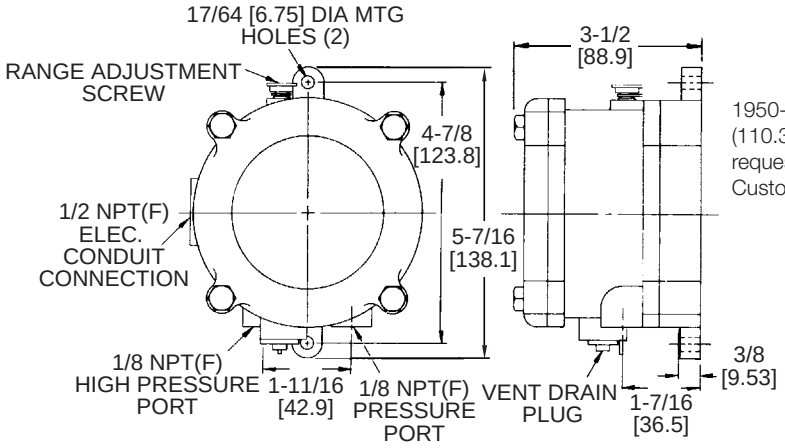
To order specify Model Number	Operating Range: Inches, W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1950-02-2S	0.03 to 0.10	0.025	0.05
1950-00-2F	0.07 to 0.15	0.04	0.05
1950-0-2F	0.15 to 0.5	0.10	0.15
1950-1-2F	0.4 to 1.6	0.15	0.20
1950-5-2F	1.4 to 5.5	0.3	0.4
1950-10-2F	3.0 to 11.0	0.4	0.5
1950-20-2F	4.0 to 20.0	0.4	0.6
Model Number	**Operating Range: PSI**	**Approximate Dead Band**	
		Min. Set Point	Max. Set Point
1950P-2-2F	0.5 to 2.0	0.3 psi	0.3 psi
1950P-8-2F	1.5 to 8.0	1.0 psi	1.0 psi
1950P-15-2F	3.0 to 15.0	0.9 psi	0.9 psi
1950P-25-2F	4.0 to 25.0	0.7 psi	0.7 psi
1950P-50-2F	15.0 to 50	1.0 psi	1.5 psi

SPECIFICATIONS

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

RESPONSE TIME: Because of restrictive effect of flame arrestors, switch response time may be as much as 10-25 seconds where applied pressures are near set point.

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000 **www.dwyer-inst.com**
Fax: 219/872-9057 **e-mail: info@dwyer-inst.com**



1950-02: 7-3/4″ (196.9) dia. x 4-11/32″ (110.3) depth. For complete dimensions request drawing 28-700175-00 from our Customer Service Department

1950 Switch Outline Dimensions

INSTALLATION

1. Select a location free from excess vibration and corrosive atmospheres where temperatures will be within the limits noted under Specifications on reverse. Switch may be installed outdoors or in areas where the hazard of explosion exists. See reverse 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.

3. Connect switch to source of pressure, vacuum or differential pressure. Metal tubing with 1/4″ O.D. is recommended, but any tubing which will not restrict the air flow can be used. Connect to the two 1/8″ female NPT pressure ports as noted below:

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 pressure) - 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 terminals marked “COM” (common), “NO” (norm open), “NC” (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. 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

1. Remove the plastic cap and turn the slotted Adjust-ment 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 and re-check the set point.

2. 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.

3. For highly critical applications check the set point adjustment and if necessary, reset it as noted in step A.

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, then returned to its original position. This will dislodge deposits which could accumulate in applications where there is excessive condensation within the switch. The Series 1950 Explosion-Proof Differential Pressure Switch is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

Printed in U.S.A. 3/05 FR# 26-440332-00 Rev. 10

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000 **www.dwyer-inst.com**
Fax: 219/872-9057 **e-mail: info@dwyer-inst.com**

Select A Model 110 Dial Size

20-110
2 Inch

30-110
3 Inch

3 Inch Dial Size

Size & Model Number: 30-110
NPT Connection Size & Type: 1/2" NPT Back Connection
Model Specifications: Stock Model Specifications
Standard Ranges Dual Scale: -100 ÁF to 150 ÁF through 200ÁF to 1000 ÁF -70 ÁC to 70 ÁC through 100 ÁC to 540 ÁC
Dial Configurations: Dual Scale Fahrenheit / Celsius
Options & Accessories: Regularly Stocked Options & Accessories
Special Ordering: Contact Us for Details on Custom Thermometers
Standard Stem Length 2 1/2 in through 24 in

STANDARD TEMPERATURE RANGES

Dual Scale Dial Units

Outer Scale Options: **Fahrenheit**

Inner Scale Options: **Celsius**

Standard Ranges

RANGE - FAHRENHEIT	FIG. INT.	DIV.	RANGE - CELSIUS	FIG. INT.	DIV.
-100 ÁF to 150 ÁF	20 ÁF	2 ÁF	-70 ÁC to 70 ÁC	10 ÁC	1 ÁC
-40 ÁF to 120 ÁF	20 ÁF	2 ÁF	-40 ÁC to 50 ÁC	10 ÁC	1 ÁC
25 ÁF to 125 ÁF	10 ÁF	1 ÁF	-5 ÁC to 50 ÁC	5 ÁC	1/2 ÁC
0 ÁF to 140 ÁF	10 ÁF	1 ÁF	5 ÁC to 50 ÁC	5 ÁC	1/2 ÁC
0 ÁF to 200 ÁF	20 ÁF	2 ÁF	-15 to 90 ÁC	10 ÁC	1 ÁC
0 ÁF to 250 ÁF	20 ÁF	2 ÁF	-20 ÁC to 120 ÁC	10 ÁC	1 ÁC
20 ÁF to 240 ÁF	20 ÁF	2 ÁF	-5 ÁC to 115 ÁC	10 ÁC	1 ÁC
50 ÁF to 300 ÁF	20 ÁF	2 ÁF	10 ÁC to 150 ÁC	10 ÁC	1 ÁC
50 ÁF to 500 ÁF	50 ÁF	5 ÁF	10 ÁC to 260 ÁC	20 ÁC	2 ÁC
150 ÁF to 750 ÁF	100 ÁF	10 ÁF	65 ÁC to 400 ÁC	50 ÁC	5 ÁC
200 ÁF to 1000 ÁF	100 ÁF	10 ÁF	100 ÁC to 540 ÁC	50 ÁC	5 ÁC

30.110 STOCK MODEL SPECIFICATIONS

Case	304 Stainless Steel
Connection	1/2" NPT Brass Center Back Connection
Bezel	304 Stainless Steel Electropolished
Crystal	Instrument Glass
Stem	304 Stainless Steel
Accuracy	Ñ2% Low Point - Ñ1% Midpoint - Ñ2% High Point
Pointer	Black Finish
Dial	Aluminum, White Background, Dual Scale, Black Celsius Scale and Black Fahrenheit Scale

STANDARD STEM LENGTHS

Length	MM	63.5	101.6	152.4	225.6	304.8	381.0	451.2	690.6
	Inches	2 1/2	4	6	9	12	15	18	24
ORDER CODE		025	040	060	090	120	150	180	240

OPTIONS AND ACCESSORIES

Connections:	In addition to our standard 1/4" or 1/2" NPT connection, 3/8' NPT is available. If a special connection is required then Contact Us for Details on Custom Connections.
Special Dials	Special ranges and dials with company names, company logs, part numbers, telephone numbers or almost any custom layout is available. Single scale ÁF or ÁC available upon request. Check for availability.
Crystals	Laminated safety glass crystals are available on all 3" & 5" NOSHOK Bimetal Thermometers. Plexiglas crystals are available on all NOSHOK Bimetal Thermometers, however, they should not be used where case temperature exceeds 300 ÁF (150 ÁC)

B-Series Switches – Pressure, Differential Pressure, Temperature & Hydraulic

FEATURES

B-Series switches have proven reliable in such harsh environments as:

- ***Offshore oil rigs***
- ***Chemical and petrochemical plants***
- ***Pulp and paper mills***
- ***Steel mills***
- ***Power plants***
- ***Water and sewage-treatment plants***
- ***Other corrosive environments***

Ashcroft Inc. supplies highly reliable Ashcroft® switches and controls for industrial and process applications. We begin with rock-solid designs, matching the most appropriate technology with the safety and reliability requirements of the applications. The materials of construction are specified to Ashcroft's exacting standards, and product is built to last in the toughest applications. Our modern, responsive manufacturing facility is supported by an extensive network of stocking distributors and factory sales offices located in virtually every part of the world. Special application assistance is always just a telephone call away.

The Ashcroft B-Series switch line is designed to satisfy most switch requirements. Materials of construction have been selected for long life. A wide variety of precision switch elements are available to meet every application requirement, including hermetically sealed contacts for added reliability and safety. The actuators we use have been proven in more than 20 years of service in the world's plants and mills. Special designs are available for fire safety, NACE, limit control and other more stringent requirements. Simplicity and ease of use are stressed to improve reliability of the installation.

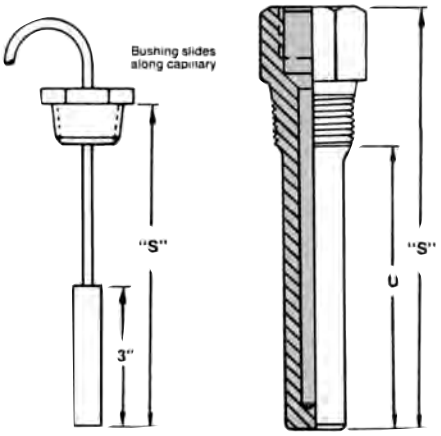
Applications include: pumps, compressors, washers, filters, degreasers, evaporators, recovery systems, food processing, ground support equipment, reverse osmosis systems, heat exchangers, hydraulic systems, lubrication systems, marine equipment, textile machinery, heating and air conditioning equipment.

Thermowells

Thermowells must be used on any application where the stem of the temperature switch may be exposed to pressure, corrosive fluids or high velocity. Additionally, the use of a thermowell permits instrument interchange or calibration check without disturbing or closing down the process.

Ashcroft temperature switches have bulb diameters to match ⅜″ nominal bore thermowells. The bulbs have a sensitive portion length of 2″ which can be used with 2½″ "U" dimensioned thermowells or longer. For maximum accuracy, a thermowell's "U" dimension should be selected to permit complete immersion of the sensitive portion plus 1″ when measuring the temperature of liquids; an extra 3″ should be allowed when measuring the temperature of gases.

Thermowell bushings should be used with remote mount temperature switches. We recommend the standard 3″ bulb and code 69 Series bushings for use with any thermowell "U" dimension. A split rubber grommet allows easy installation and "S" dimension adjustment.



ISO 9001
REGISTERED FIRM

Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

B-Series Switches – Pressure, Differential Pressure, Temperature & Hydraulic

Temperature Switches

B-Series temperature switches feature a SAMA Class II vapor pressure thermal system. This system provides quick, accurate response to process temperature changes with negligible ambient temperature effects. This is inherent in the design due to the precise relationship that exists between temperature and pressure according to the vapor pressure laws. A wide selection of sensing bulb and armored capillary lengths is available. The vapor pressure system design features small bulb sizes, making installation easy and cost-effective.

All models feature ±1.0% percent of span setpoint repeatability with very high overtemperature ratings.

These standard designs perform well in applications where shock and vibration could be a problem and should be used with Ashcroft thermowells for bulb protection and ease of installation and maintenance.

STANDARD TEMPERATURE RANGE SELECTION

Nominal Range(1)		Maximum Temperature	Approximate Deadband(1) Switch Element				
°F	°C	°F	20, 26, 27	21, 24, 31	50	22	32, 42
–40 to 60	–40 to 16	400	1.0-2.0	3.0-8.0	1.5-5.5	1.4-6.0	8.0-16.0
0 to 100	–20 to 40	400	1.5-3.0	5.0-12.0	2.2-8.5	1.5-7.5	9.0-20.0
75 to 205	20 to 95	400	1.5-3.5	8.0-16.0	2.5-12.0	2.0-9.0	10.0-24.0
150 to 260	65 to 125	400	1.5-3.0	5.0-12.0	2.2-8.5	2.0-9.0	10.0-24.0
235 to 375	110 to 190	500	1.5-3.5	5.0-12.0	2.5-8.5	2.0-9.0	10.0-24.0
350 to 525(3)	175 to 275	700	2.0-4.5	8.0-16.0	3.2-12.0	2.5-10.0	15.0-34.0
500 to 750(2)	260 to 400	900	4.0-8.0	16.0-30.0	7.2-24.0	5.0-23.0	30.0-50.0

NOTES:

1 All deadbands given in °F.
2 Available with remote mount thermal systems only.
3 Not available with 2¾″ stem.
4 Dual switch element multiply single switch element value by 1.6 for approximate deadband.
5 Set and reset points must fall within the adjustable range.

Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

B-Series Switches – Pressure, Differential Pressure, Temperature & Hydraulic

B-SERIES TEMPERATURE SWITCH MODEL NUMBER:

To specify the exact switch desired, select entries from appropriate tables as shown in example below.

1	2	3	4	5	6
T4	20	T05	030	XNH	150° to 260°F

1 – ENCLOSURE

T4	Temperature switch, Type 400, watertight enclosure meets NEMA 3, 4, 4X, 13 and IP66 requirements.
T7	Temperature switch, Type 700, explosion-proof enclosure meets Div. 1 & 2, NEMA 7, 9 and IP66 requirements.

2 – SWITCH ELEMENT SELECTION

Order Code	Switch Elements UL/CSA Listed SPDT	
20[7]	Narrow deadband ac	15A, 125/250 Vac
21	Ammonia service	5A, 125/250 Vac
22[6]	Hermetically sealed switch, narrow deadband	5A, 125/250 Vac
23	Heavy duty ac	22A, 125/250 Vac
24[1]	General purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc; 6A, 30 Vdc
25	Heavy duty dc	10A, 125 Vac or dc, ⅛ HP, 125 Vac or dc
26[7]	Sealed environment proof	15A, 125/250 Vac
27	High temperature 300°F	15A, 125/250 Vac
28[5]	Manual reset trip on increasing	15A, 125/250 Vac
29[5]	Manual reset trip on decreasing	15A, 125/250 Vac
31	Low level (gold) contacts	1A, 125 Vac
32	Hermetically sealed switch, general purpose	11A, 125/250 Vac 5A, 30 Vdc
42	Hermetically sealed gold contacts	1A, 125 Vac
50	Variable deadband	15A, 125/250 Vac
UL/CSA Listed Dual (2 SPDT)		
61[7]	Dual narrow deadband	15A, 125/250 Vac
62[7]	Dual sealed environment proof	15A, 125/250 Vac
63	Dual high temp. 300°F	15A, 125/250 Vac
64	Dual general purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc
65	Dual ammonia service	5A, 125/250 Vac
67[4,6]	Dual hermetically sealed switch, narrow deadband	5A, 125/250 Vac
68[4]	Dual hermetically sealed switch, general purpose	11A, 125/250 Vac 5A, 30 Vdc
70	Dual low level gold contacts	1A, 125 Vac
71[4]	Dual hermetically sealed switch, gold contacts	1A, 125 Vac

3 – THERMAL SYSTEM SELECTION

Direct Mount

Order Code	System Material	Style
TS	3l6 SS	Rigid

Remote Mount

Order Code	System Material	Line Length	Style[9]
T05	316 SS	5′	Capillary with 302 SS Spring Armor
T10	316 SS	10′	
T15	316 SS	15′	
T20	316 SS	20′	
T25	316 SS	25′	

4 – BULB LENGTH SELECTION

Direct Mount

Order Code	"S" Dimension	Minimum Thermowell "U" Dimension
027[8]	2¾″	–
040	4″	2½″
060	6″	4½″
090	9″	7½″
120	12″	10½″
Remote Mount		
030[9]	3″	2½″

5 – OPTIONS

Use table on page 7

6 – STANDARD TEMPERATURE RANGE SELECTION

Adjustable Range

°F	°C
–40 to 60	–40 to 16
0 to 100	–40 to 40
75 to 205	20 to 95
150 to 260	65 to 125
235 to 375	110 to 190
350 to 525	175 to 275
500 to 750[2]	260 to 400

NOTES:

1 Standard switch.
2 Available with remote mount thermal systems only.
3 Dual switches are 2 SPDT snap-action switches, not independently adjustable.
4 Wires cannot be terminated inside T400 switch enclosure.
5 Not available with Type 700 enclosure.
6 Estimated dc rating, 2.5A, 28 Vdc (not UL listed).
7 Estimated dc rating, 0.4A, 120 Vdc (not UL listed).
8 Not available on 350 to 525°F.
9 Consult factory on remote mount for bulb lengths other than 3″.

Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

B-Series Switches – Pressure, Differential Pressure, Temperature & Hydraulic

OPTIONAL FEATURES AND ACCESSORIES

B-SERIES SWITCH OPTIONS								
		Appicable Switch Series						
		Pressure		Differential Pressure		Temp-erature	H	
Code	Description	(psi)	(in. H_2O)	(psi)	(in. H_2O)	All Ranges		Notes
XBP	Wall Mounting Bracket in. H_2O		•		•			
XBX	½″ Male NPT Bushing					•		
XCH	Chained Cover	•	•	•	•	•	•	
XC8	CSA Approval	•	•	•	•	•		11
XCN	ATEX Directive 94/9/EC EEx d IIC T6	•	•	•	•	•		
XFM	FM Approval – Single Element	•	•	•	•			17
	FM Approval – Dual Element	•	•	•	•			17
XFP	Fungus Proofing	•	•	•	•	•	•	
XFS	Factory Adjusted Setpoint	•	•	•	•	•	•	2
XG3	Belleville Actuator	•						16,17
XG5	UL Limit Control to 150″ H_2O				•			1, 17
XG6	UL Limit Control to 600 psi	•						1, 17
XG7	Secondary Chamber with Vent	•						13
XG8	Steam Limit Control to 300 psi	•						7
XG9	Fire Safe Welded Actuator	•						7
XHS	High Static Differential Pressure			•				15
XHX	High Pressure, 40 psi, (static) d/p only 160 psi (proof) d/p only 100 psi (proof) pressure only (″ H_2O)		•		•			
XJK	Left Conduit Connection	•	•	•	•	•	•	9
XJL	¾″ to ½″ Reducing Bushing	•	•	•	•	•	•	
XJM	Metric Electrical Conduit Connection M20 x 1.5	•	•	•	•	•	•	
XK3	Terminal Block (700 Series only)	•	•	•	•	•		6
XLE	6 foot Leads on the Micro Switch	•	•	•	•	•	•	
XNH	Tagging Stainless Steel	•	•	•	•	•	•	
XNN	Paper Tag	•	•	•	•	•	•	
XPK	Pilot Light(s) Top Mounted	•	•	•	•	•	•	4
XPM	¾″ Sealed Conduit Connection with 16″ Lead Wires	•	•	•	•	•	•	
XTA	316 Stainless Steel Pressure Connection for in. H_2O Range		•		•			
XTM	2″ Pipe Mounting Bracket	•	•	•	•	•		
XUD	316 Stainless Steel Pressure Conn.			•				
X06	Pressure Connection: ½ NPT Male, ¼ NPT Female 316 Stainless Steel (Combination)	•	•	•	•			5
X07	½ NPTF Press. Conn., 316 SS	•	•	•	•			10
X6B	Cleaned for Oxygen Service	•	•	•				3
	Diaphragm Seal	•	•	•	•			

NOTES:

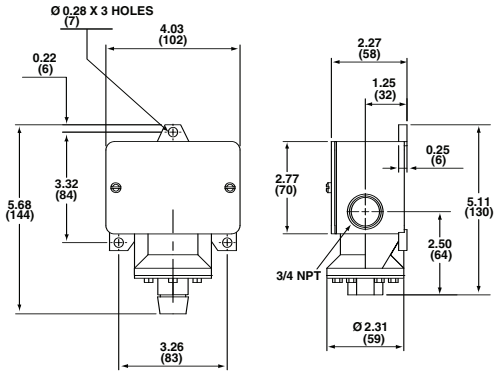
1 Buna N and Viton diaphragm.
2 Advise static or working pressure for differential pressure switches.
3 Buna N cannot be cleaned for oxygen service.
4 N/A on 700 Series.
5 Standard with 1000 and 3000 psi ranges. Bottom connection only on DP in H_2O ranges.
6 Terminal Blocks standard with 700 dual switches.
7 Stainless steel diaphragm only.
8 Pressure connection ¼ NPTF.
9 Standard on 700 Series. N/A with DPDT element on 400 Series.
10 N/A with Monel diaphragm.
11 Standard on 400 Series.
12 N/A on 3000 psi range. Available with Teflon diaphragm only.
13 SS diaphragm required. Teflon diaphragm is the backup. NEMA 7 only.
14 Available in ranges vacuum to 600 psi. Not available with stainless steel or Monel diaphragm.
15 Buna N and Viton diaphragm – 15#D & 30#D only.
16 24, 32, 64 or 68 element only.
17 N/A on all combinations.
18 700 Series only.

Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

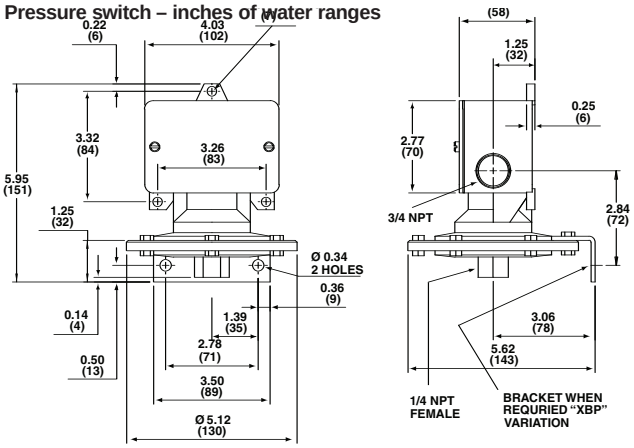
B-Series Switches – Pressure, Differential Pressure, Temperature & Hydraulic

Dimensions – 400 Series

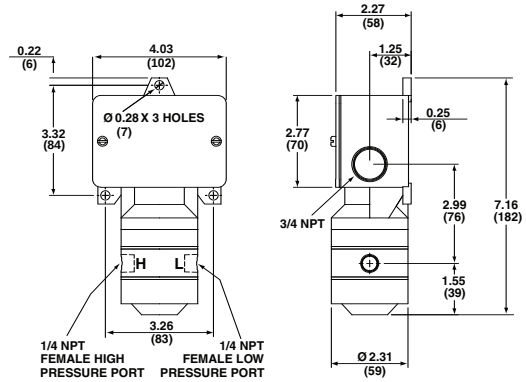
Pressure switch – psi ranges



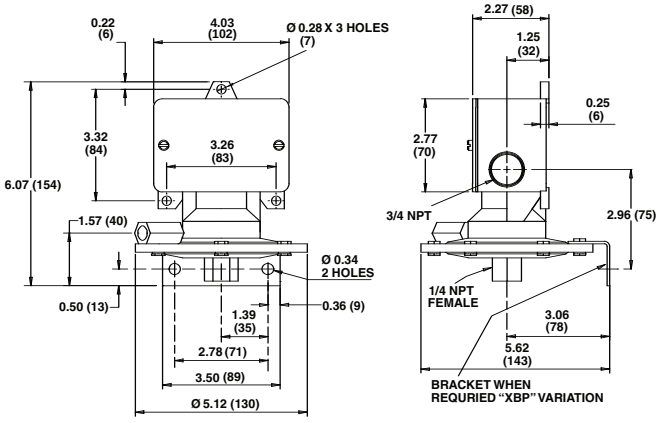
Pressure switch – inches of water ranges



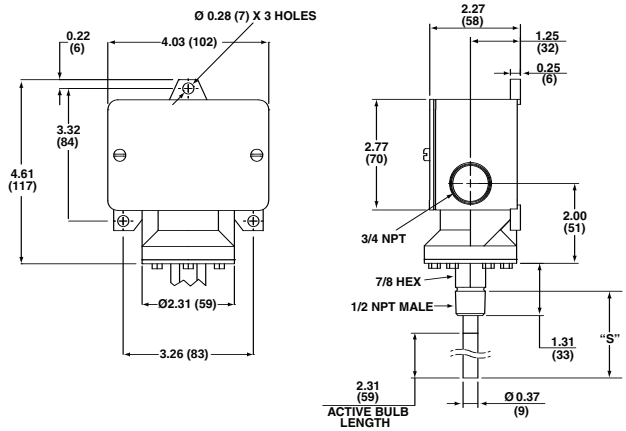
Differential pressure switch – psi differential ranges



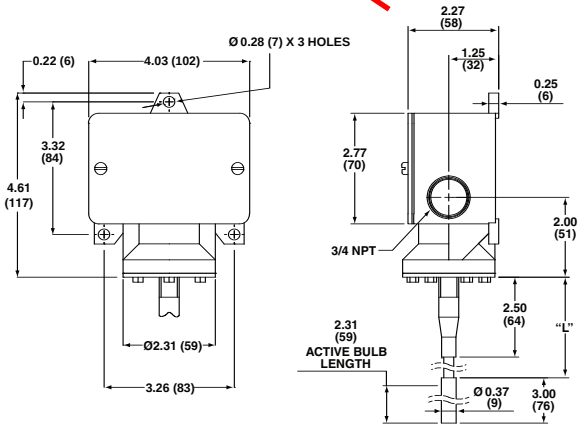
Differential pressure switch – inches of water ranges



Temperature switch – direct mount



Temperature switch – remote mount

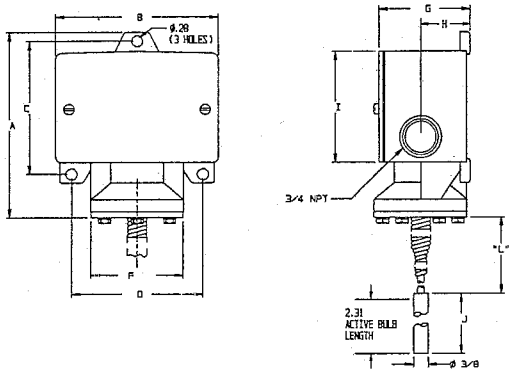


Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

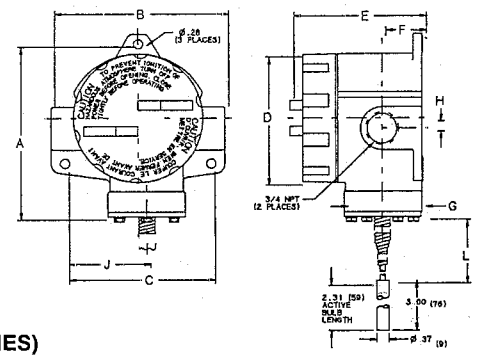
INSTALLATION AND MAINTENANCE T400 AND T700 SERIES ASHCROFT® SNAP ACTION SWITCHES FOR TEMPERATURE CONTROL

TEMPERATURE SWITCH - REMOTE MOUNT

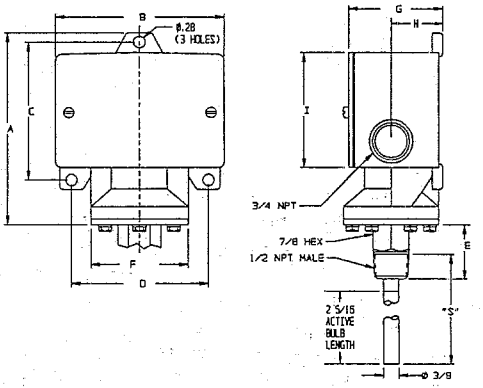
T400

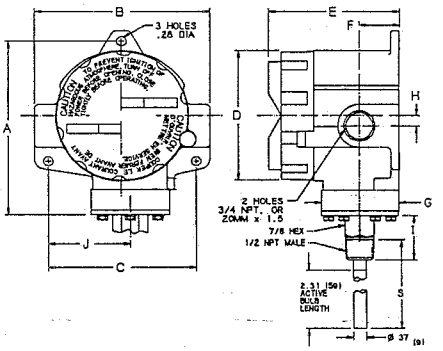


T700



TEMPERATURE SWITCH - DIRECT MOUNT





Dimensions (INCHES)

	A	B	C	D	E	F	G	H	I
T400	4.6	4.0	3.31	3.25	1.30	2.31	2.27	1.19	2.75
T700	5.23	5.20	4.38	3.88	3.58	1.22	2.31	.312	1.30

Stem Length - inches

S	2.75	4.0	6.0	9.0	12.0

Line Length - feet

L	5.0	10.0	15.0	20.0	25.0

INTRODUCTION

The Ashcroft® temperature switch is a precision built U.L. and C.S.A. approved control device which features a mechanical snap action switch. Controllers are available for operation on temperature with fixed or variable differential. Also, manual reset types are available for operation on increasing or decreasing temperature. The manual reset types remain tripped until reset by pressing a button on the top of the enclosure. The standard electrical switch is SPDT and is available with various electrical characteristics. Two SPDT switch elements mounted together are available except on variable deadband and manual reset types.
Bulb materials are either stainless steel or copper.

The Ashcroft snap action temperature switch is furnished in the standard NEMA 4/4x and explosion proof NEMA 7 and 9 enclosure styles. Both enclosures are epoxy coated aluminum castings.

INSTALLATION

These controls are precision instruments and should never be left with internal components exposed. During installation insure that covers are in place and conduit openings are closed except when actually working on the control. Good piping practice requires the use of a thermowell for installation where pressure may be applied to the thermal system. The thermowell provides protection against physical damage as well as corrosive effects of media flow. Use of a thermowell also facilitates removal of the bulb from the process line without disturbing the process. Standard thermowell materials include brass, steel and stainless steel; other materials are available upon request. Selection should be based on corrosion resistance requirements and process pressure.

INSTRUMENT DIVISION DRESSER
CONTROL INSTRUMENT OPERATION
210 OLD GATE LANE
MILFORD, CT 06460

250-2230-G.DOC
Rev. 01/30/98

PRINTED IN U.S.A.

MOUNTING T400 AND T700 SERIES

There are three holes external to the enclosure for surface mounting. Location of these holes is shown on the general dimension drawing.

A. Direct - Mounted Controls

These controls have a 1/2 NPT threaded adapter and may be attached directly or indirectly by means of a thermowell to equipment to be controlled.

When installing or removing control always use the wrench flats or hex above the threads. Do not twist the housing.

B. Remote Mounted Controls

Two types of union bushings are available to install a remote mounted bulb into a thermowell or other 1/2 NPT threaded hole. A non-pressure tight type consists of a bushing, split grommet and compression nut. To use this, the bulb is inserted through the nut and the split grommet is slipped into the capillary between the compression nut and the bushing. After positioning the bulb as desired tighten the nut to the bushing. This will lock the capillary at the desired location. The pressure tight type is clamped to the bulb after insertion by tightening the compression nut. To use this, the union bushing is screwed into the 1/2 NPT threaded hole. The compression nut and sleeve are slipped onto the bulb which is then inserted into the union bushing. The bulb is then positioned and the compression nut is hand tightened pus 2 1/4 turns. This will lock the capillary at the desired location.

ELECTRICAL CONNECTIONS

Remove cover

T400 Series - two screws hold cover to enclosure

T700 Series - cover unscrews

CONDUIT CONNECTIONS

Note - It is recommended that Teflon® tape or other sealant be used on conduit, bushing or plug threads to ensure integrity of the enclosure.

T400 series standard - one 3/4 NPT conduit hole right side.

T700 series standard - two 3/4 NPT conduit holes with one permanent plug. NEMA 7 & 9 enclosures require proper conduit seals and breathers as per the National Electrical Code.

T400 & WT700 series - XJL variation - 3/4 to 1/2 NPT reducing bushing supplied.

T400 series - XJK variation - two 3/4 NPT conduit holes.

T400 SERIES

SPDT - Wire directly to the switch according to circuit requirements. On controls with pilot lights wire lights according to circuit diagram on inside of cover. See special wiring instruction tag for single switches with two pilot lights and dual switches with one or more lights.

2-SPDT - Dual switching elements consist of two SPDT switches mounted together in a bracket. Switches are calibrated to have simultaneous operation within 1% of range either on increasing or decreasing pressure but not in both directions. Wire directly to the front and rear switch according to circuit requirements. Leads are provided on rear switch color coded as follows:

Common	- White
Normally Closed	- Red
Normally Open	- Blue

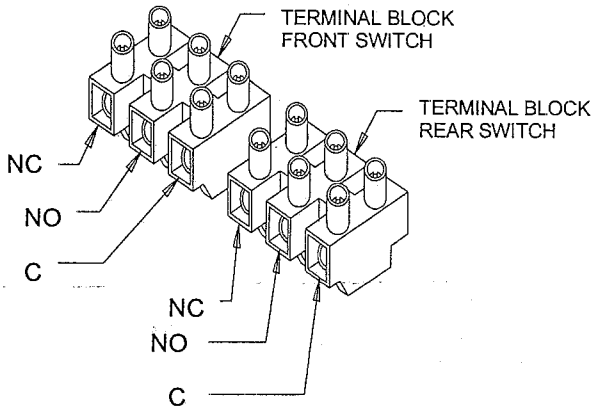
When hermetically sealed switch element (s) are supplied, the lead color coding is as follows:

Common	- White
Normally Closed	- Red
Normally Open	- Blue

T700 SERIES

SPDT - Wire directly to the switch according to circuit requirements.

2-SPDT - Wire to front switch terminal block (left) and rear switch terminal block (right) as marked. Strip insulation 5/16", insert in proper terminal connector and tighten clamping screw to secure.



ADJUSTMENT OF SETPOINT

T400 & T700 Series - A single setpoint adjustment nut (7/8") is located centrally at the bottom on the inside of the enclosure.

The bulb of the control should be immersed in a bath at the desired set point temperature. Optimum performance will be obtained if the bulb is fully immersed. Allow five minutes for initial stabilization.

As received, the temperature switch will normally be set to approximately 90% of the indicated range. After stabilization, turn the adjustment nut until switch changes mode. Direction of turning is indicated on a label affixed to the inside of the control enclosure. When set point has been achieved raise and lower temperature to insure that the set point is correct.

After installation of the control replace cover to insure electrical safety and to protect internal parts from the environment.

T450 and T750 VARIABLE DEADBAND SWITCHES

Deadband is varied by rotating the wheel on the precision switch. When viewed from the front of the enclosure, rotation to the left increases deadband - rotation to the right decreased deadband. Letters on the wheel may be used as a reference. Deadbands obtainable will vary from 0.5% to 9% of pressure range depending on range segment and type of diaphragm.

ADJUSTMENT OF SETPOINT

As received, the temperature switch will normally be set to approximately 90% of range. Rotate the wheel on the MICRO SWITCH all the way to the right; this will provide smallest deadband. Increase bath temperature to the required set point and turn the adjustment nut until the switch changes mode. Lower the bath temperature to reset the switch. Rotate the wheel on the MICRO SWITCH until the desired deadband is obtained. The upper set point will be changing upward with this adjustment. Lower the bath temperature to reset the switch. Raise the bath temperature to the desired set point and turn the adjusting nut until the switch changes mode. Lower the bath temperature and check reset point and deadband.

T428 & T429 MANUAL RESET SWITCHES

Dress wire leads from switch terminals so as not to interfere with or touch reset button.

Note- As indicated above, adjustment of set point is made by use of 7/8" nut. Precision switch element mounting screws and bracket adjusting screw are factory sealed and should not be tampered with.

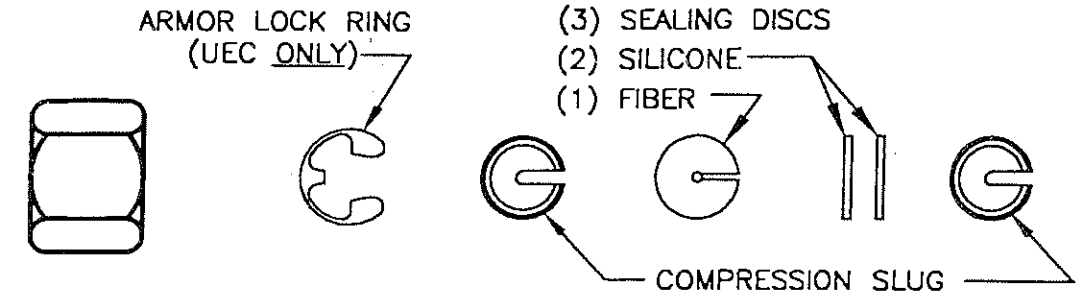
KOENIG-PRETEMPCO INC.

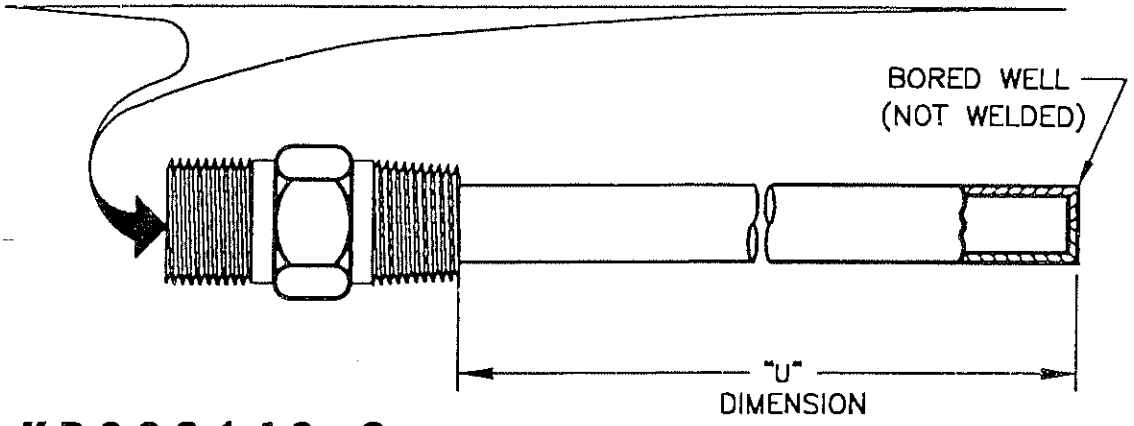
P.O. BOX 4459 BETHLEHEM, PA 18018-4459

PH. 610-433-6061 or 800-542-9393 FAX 610-770-1995

"SERVING THE INDUSTRY FOR NEARLY 50 YEARS!"

SEPARABLE THERMOWELLS





KP602142-C

MATERIAL
- A – BRASS
- B – CARBON STL.
- C – 304 STAINLESS

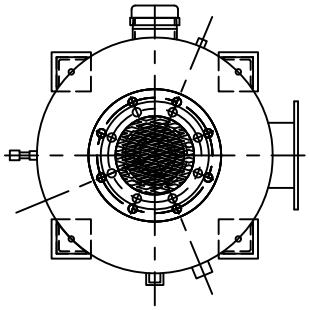
PROCESS CONNECTION
- 1 – 1/2" MNPT
- 2 – 3/4" MNPT

"U" DIMENSION (BELOW THREADS)
IN .5" INCREMENTS
(EXAMPLE: 08 = 4" BELOW THREADS
14 = 7" BELOW THREADS

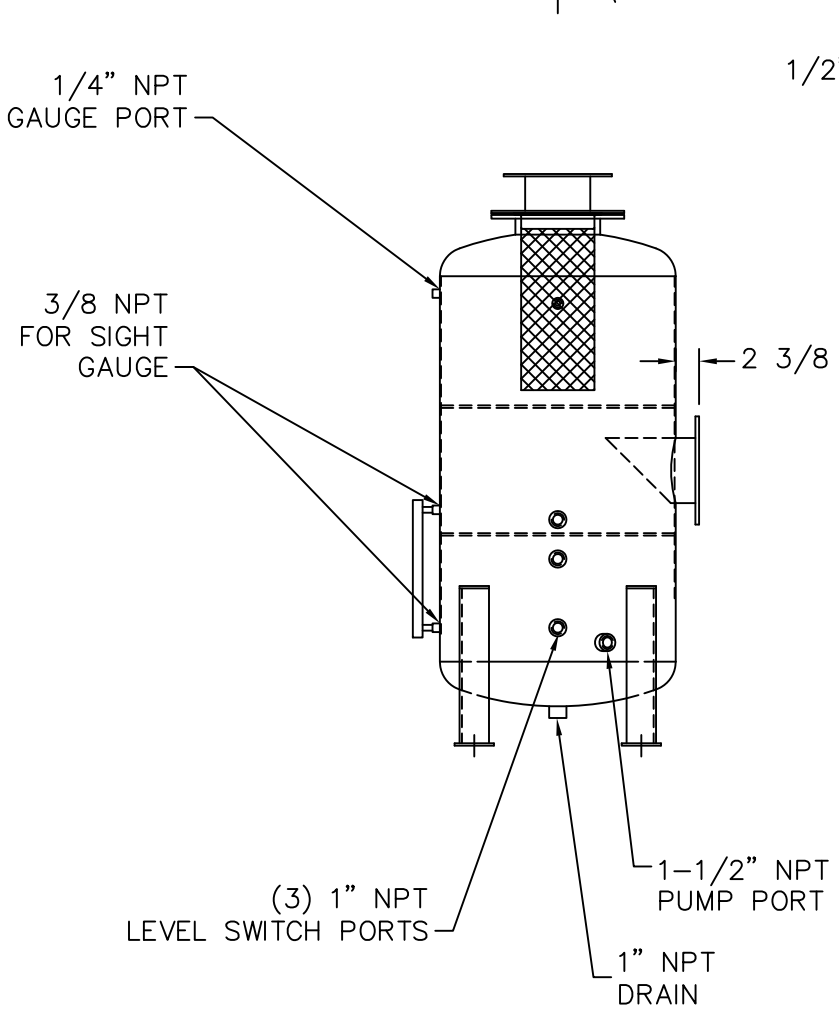
INTEGRAL UNION CONNECTOR
- . LESS THREADED CONNECTIONS
- . SHORTER OVERALL LENGTH

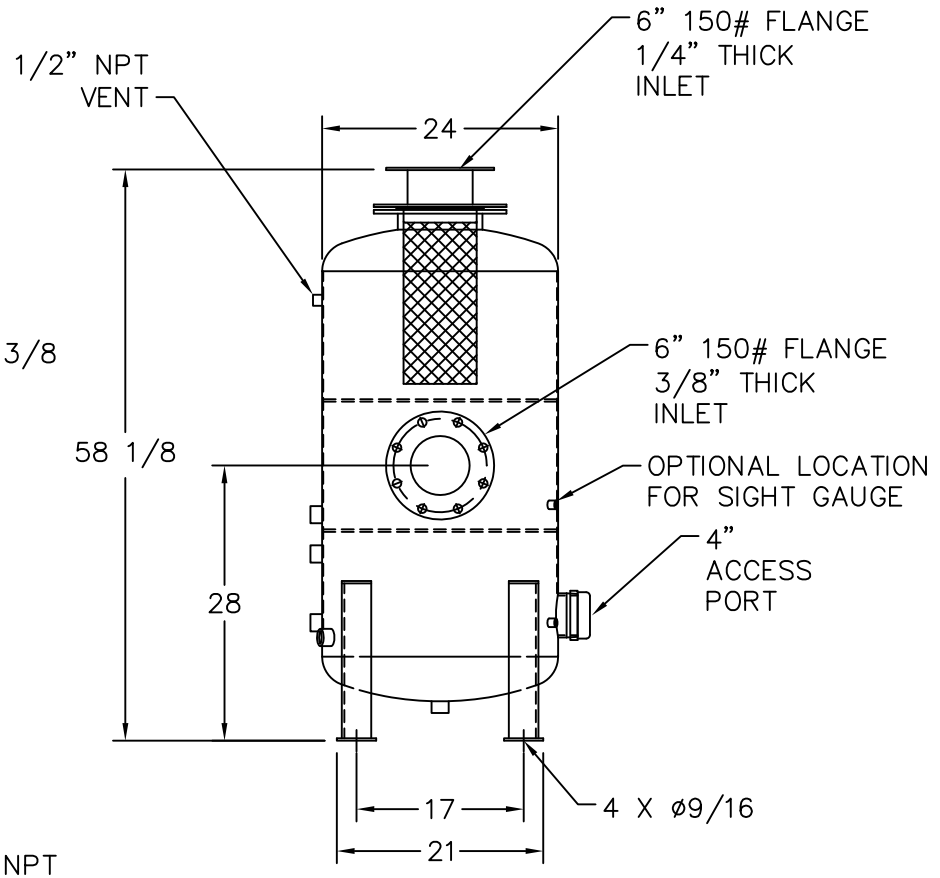
KOENIG -- PRETEMPCO, INC

CUSTOM SIZES AND LENGTHS MADE TO ORDER.



NOTES:
1. FINISH: GRAY ENAMEL
2. ALL PORTS ARE FEMALE EXCEPT 4"





REV.	DATE	DESCRIPTION

DRAWN BY: M. WITTE — DATE: 7-12-02
APPROVED BY: — DATE:
DIMENSIONS IN INCHES
SCALE:
TOLERANCE — ANGULAR TOLERANCE
MATERIAL: STEEL — WEIGHT: 220
SHEET 1 OF 1

J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

MOISTURE SEPARATOR
GX-90V HIGH VACUUM
30 GALLON LIQUID

1500-C-0598 | -

GX-90V.dwg 07/07/03 11:36

Gasho
SINCE 1982
The Leader in Blower & Vacuum Solutions
460 West Gay Street
West Chester, PA 19380
610-692-5650 Fax 610-692-5837
cs@gasho.org

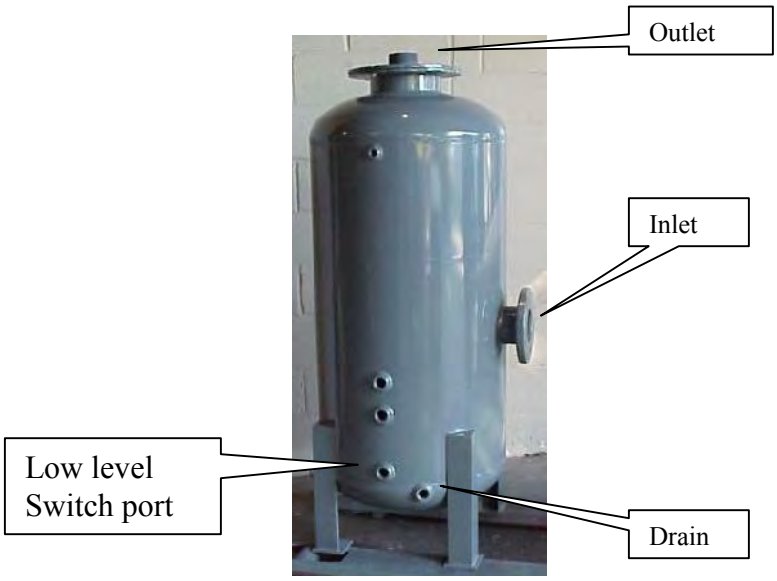
Moisture Separators

Moisture separators are used to remove water and other liquids from air streams. They are typically used on the inlet of vacuum systems to remove water and other contaminants before they enter the vacuum pump. The air volume of the moisture separator reduces the velocity of the air stream to allow liquids to precipitate. Up to 95% water removal is possible. The models GX-30 & GX-60 are rated for full vacuum. Other moisture separators are rated to 18 in. Hg. higher vacuum ratings available.

Standard accessories include a sight gauge, drain valve, and a hand operated sludge pump. Inside the top of the separators is a basket with "tri-packs" demister material to promote condensation of vapors.

Options include: 1 to 3 level switches, automatic pump down systems, heat tracing, vacuum gauges, and thermometers.

Model Number	Nominal Flow Rate	Liquid Capacity	Diameter (inches)	Height (inches)	Inlet Size	Discharge Size	Cleanout Size	Weight (Pounds)
GX-30	250	8	16	47	3"	3"	4"	125
GX-60	500	22	20	57	4"	4"	4"	175
GX-90	1200	30	24	57	6" Flange	6" Flange	4"	240
GX-120	2000	40	24	70	8" Flange	8" Flange	4"	260
GX-200	2000	95	30	85	8" Flange	8" Flange	4"	350



J. E. Gasho and Associates, Inc.
460 West Gay Street, West Chester, PA 19380
ph 610.692.5650 fax 610.692.5837

Moisture Separator
Operating and Maintenance Instructions

Operation:

The moisture separator is a static vessel with no moving parts. It removes moisture by reducing the flow rate of incoming air and allowing the entrained moisture to coalesce and precipitate.

Maintenance:

The moisture separator has been designed to require minimal maintenance.
During normal operation a layer of sludge may build up on the bottom of the separator. Open isolating ball valve to drain the sludge. If the unit is furnished with a sludge pump, operate pump until the sludge is removed and only liquid is being removed.
The moisture separator is provided with a clean out port that can be removed and the inside cleaned with water.
Check sight gauge, clean if needed.
Demister material is included in the throat of the moisture separator. It can be inspected and washed through the top opening of the moisture separator.

If there are accessories attached to the moisture separator follow the operating and maintenance instructions for those items

Jaeger Tri-Packs®

TABLE OF CONTENTS

Features

- Jaeger Tri-Packs® are hollow, spherical packings made of injection molded plastic, available in four diameters: 1”, 1 ¼”, 2”, and 3 ½”.
- Symmetrical geometry made from a unique network of ribs, struts, and drip rods.
- High active surface areas.
- Extremely low pressure drops.
- Extremely high operating capacities.

Benefits

- High mass and heat transfer rates.
- Excellent gas and liquid dispersion characteristics.
- Resist nesting, making removal easy.
- Installs to packed position - no settling.
- Available in a wide variety of plastics.
- Predictable performance.

Jaeger Tri-Packs®-PP are NSF Certified to ANSI/NSF Standard 61 when made in polypropylene.

Specifications & Physical Properties

Materials.

Twelve standard, injection moldable plastics are available:

- Polypropylene (PP)
- Polyethylene (PE)
- Polypropylene Glass-Filled (PPG)
- Noryl® (PPO)
- Polyvinylchloride (PVC)
- Corzan™ (CPVC)
- TopEx® (LCP)
- Kynar® (PVDF)
- Halar® (ECTFE)
- Teflon® (PFA)
- Tefzel® (ETFE)
- Tefzel® Glass-Filled (ETFE-G)

Other plastics are available on request.

IMPORTANT NOTE:
Design data presented in this bulletin are for preliminary calculations only. Contact Jaeger before finalizing calculations.

Properties Table

Size (in.)	1	1 1/4	2	3 1/2
Geometric Surface Area (ft^2/ft^3)	85	70	48	38
Packing Factor (1/ft)	28	25	16	12
Void Space (%)	90	92	93.5	95
Bulk Density (lb/ft^3) (PP)	6.2	5.6	4.2	3.3

Maximum Operating Temperatures for Plastic Jaeger Tri-Packs®

Jaeger Tri-Packs® are available in a variety of injection-molded plastics for different applications. The maximum operating temperatures for these different resins vary from material to material and are also affected by specific process variables. The data presented below correspond to maximum continuous operating temperatures at atmospheric pressure and systems that are essentially air and water. The presence of solvents, acids, free radicals, and oxidants needs to be considered. Furthermore, these temperatures correspond to the maximum recommended bed depth for each packing size and material. These maximum bed depths are different depending on the application. Consult with Jaeger in respect to the maximum bed depth for your particular application.

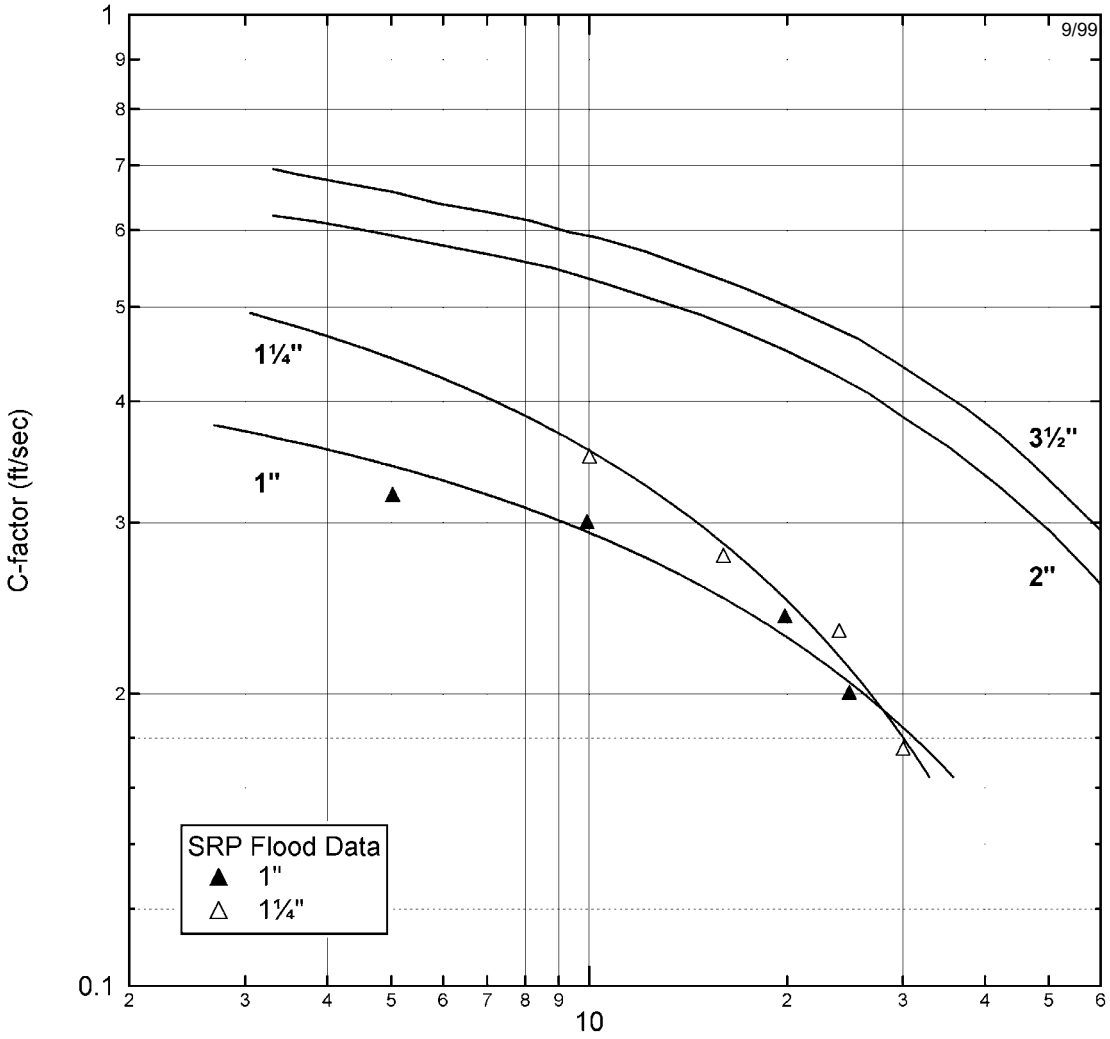
Material	Maximum Temperature (Deg. F) (1 atm, air/water, at max. recommended depth)	Bulk Density Factor
Polyvinyl Chloride (PVC)	140	1.50
Polyethylene (PE)	160	1.02
Polypropylene (PP)	180	1.00
Corzan™ (CPVC)	230	1.74
Chlorinated Polyvinyl Chloride (CPVC)	210	1.74
Polypropylene - Glass-Filled (10-30%) (PP-G)	210-230*	1.17-1.38*
Noryl® (PPO)	230	1.24
Kynar® (PVDF)	280	1.98
Halar® (ECTFE)	290	1.86
Tefzel® (ETFE)	350	1.93
Teflon® (PFA)	400	2.45
Tefzel® - Glass Filled (25% Glass) (ETFE-G)	410	2.2

*Depending on glass content.

Generalized Flooding Curves

Plastic Jaeger Tri-Packs®

Ambient Air-Water Systems at 1 atm, 70°F



C-Factor = $V_s[(\rho_V)/(\rho_L - \rho_V)]^{1/2}$ where
V_s = Superficial Vapor Velocity in ft/sec
ρ_L and ρ_V = Density of Liquid and Vapor in lb/ft³

For Air/Water systems at 70°F & 1 atm: C-Factor x 7776.2 = lb/hr-ft²; gpm/ft² x 499.7 = lb/hr-ft²

SRP - Separations Research Program, University of Texas at Austin.

JAEGER
1611 Peachleaf St., Houston, Texas 77039 800-678-0345 Phone: 281-449-9500 Fax: 281-449-9400 www.jaeger.com

Conversion Factors

FROM	TO	MULTIPLY BY	ADD OFFSET
mg/ml	ppm_W	1.0	
1/ft	1/m	3.2808	
atm	psia	14.696	
atm	psig	14.696	-14.696
atm	torr	760	
C	F	1.8	32
C	K	1	273.15
C-factor (air/water @70°F) ft/se	lb/hr ft^2	7776.2	
F	K	.5556	255.3722
ft	cm	30.48	
ft	m	.3048	
ft^2/ft^3	m^2/m^3	3.2808	
ft^3	gal (US)	7.4805	
ft^3	m^3	.0283	
g/cm^3	lb/ft^3	62.428	
gm/cm^3	kg/m^3	1000	
gpm/ft^2	lb/hr ft^2 (water @ 70°F)	499.7	
hr	sec	3600	
in	m	.0254	
in wc/ft	$dyne/cm^3$	81.5617	
in wc/ft	Pa/m	815.6168	
kg	gm	1000	
kg	lb	2.2046	
kg/m^2*sec	lb/ft^2*hr	737.3402	
kg/sec	lb/hr	7936.6829	
kg mole/m^2*sec	lbmole/ft^2*hr	737.3402	
kW	hp	1.341	
lb	gm	453.59	
m^2	cm^2	10000	
m^2	ft^2	10.7639	
m^2/m^3	cm^2/cm^3	.01	
m^3	liters	1000	
mg/l	ppm_W	1.0	
Millions of Gallons/Day	gpm	694.46	
min	sec	60	
ppm_W	ppb_W	1000	

Oil-Rite Corporation
4325 Clipper Drive, P.O. Box 1207, Manitowoc, WI. 54221-1207
Telephone: (920) 682-6173 Fax: (920) 682-7699
E-Mail: sales@oilrite.com Web site: www.oilrite.com

Item # B-1559-1, Level Gages Flush Channel - Steel

larger image

Level Gages Flush Channel - Steel

Level Gages Flush Channel - Steel can be mounted flush against the outside surface of a reservoir with only a small amount of protrusion. Liquid level gages for flush mounting are used for a multitude of applications, such as on tanks, reservoirs, packaged hydraulic equipment, large steel mill pumps, hydraulic presses, and for any other application where it is desirable to indicate fluid levels. These level gages are used to determine the liquid level inside a metal reservoir by visual observation of the level in a transparent sight. The clarity and condition of the liquid can also be checked. Models with a thermometer will show the temperature of the liquid as well. Extremely sturdy and rigid, these gages come with glass sights mounted inside the steel channel shield to provide maximum protection against breakage. Visibility of the liquid level is excellent through the large sight opening. A reflector enhances the visibility of the liquid level. Liquid level markings can be added on request. Back mounting gages are used on tanks permitting access to the inside, in order to fasten the nuts on the mounting studs inserted in drilled holes in reservoirs. Front mounting gages are used on reservoirs which do NOT permit access to the inside, therefore, the tanks must have two tapped holes, 1/2 - 20 N.F., to receive the mounting studs, which are fastened from the outside.

Specifications

Style	Plain
Pressure	125 P.S.I. Max.
Temperature	225° F. Max.
Centerline Distance Between Mtg. Holes	3" to 60"
Body	Steel, Plated (Optional Material Available)
Sight	Red Line Gage Glass
Seals	Buna-N
Mounting Shanks	Steel, Plated 1/2-20 N.F.

Print Back

Oil-Rite Corporation
4325 Clipper Drive, P.O. Box 1207
Manitowoc, WI. 54221-1207
Phone: (920) 682-6173 • **Fax:** (920) 682-7699
Email: sales@oilrite.com • **Web Address:** www.oilrite.com

Item # B1656-4, 3/8” Male NPT Adapter for Steel Liquid Level Gages with 1/2"-20 Straight Thread

larger image

3/8” Male NPT Adapter for Steel Liquid Level Gages with 1/2"-20 Straight Thread
This steel 3/8” male NPT adapter is suitable for use with liquid level gages with 1/2”-20 mounting. Each gage requires two adapters (one for each bolt).

Specifications

Feature	3/8" Male NPT Adapter
Material	Steel

Print Back

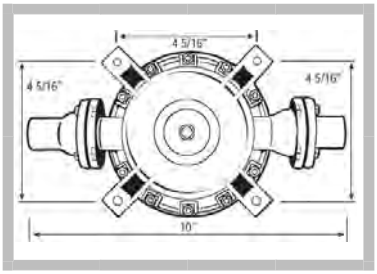
GUZZLER® 400 HAND PUMP

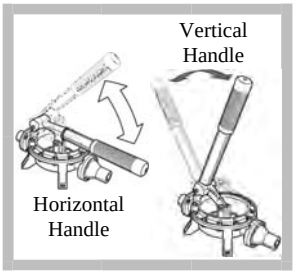
Model GH-400

Description Hand pump for use with 1/2" to 1 1/4" hose. Available with either horizontal or vertical handle.

Features

- Lightweight, economical
- Durable – tough Delrin® plastic
- Clamp ring adjusts to 12 different handle orientations
- Can be configured with either vertical or horizontal handle





Performance

	per Stroke	per Minute (@ 90 cycles/min)
Flow Rate	0.44 Qt 0.42 L	10 Gals 37.9 L
Max Pressure	20 psi	1.4 kg/cm^2
Max Head	12 ft	3.7 m
Max Lift	12 ft	3.7 m

Available Materials

Pump Body	Delrin (Gray)
Clamp Ring	Delrin, Epoxy-coated Aluminum
Diaphragm	Buna Nitrile (Buna N), Buna N Double Sided, Buna-N 3-Ply, Neoprene, Viton, EPDM, Urethane, Silicone
Valves	Buna N, Neoprene, Viton, EPDM, Silicone *(Silicone only available with umbrella valve)*

Inlet & Outlet Ends & Sizes

in	cm	Hose (Smooth)	N.P.T. Female (Tapped Inside)	N.P.T. Male (Threaded Outside)	Male (Threaded Outside) Garden Hose	Barbed
1/2	1.27		●			
3/4	1.91	●	●	●	●	●
1	2.54	S		●		
1 1/8	2.86	●				●
1 1/4	3.18	●				

(**S**: standard ●: optional)

Dimensions

	Length			Width	Height	
	Body	incl. H. Handle	incl. V. Handle		incl. H. Handle Up	incl. V. Handle Up
in	10 1/4	12 3/4	12	5 1/2	12	13 5/8
cm	26.0	32.39	30.48	13.97	30.48	34.61

Mounting Holes	4		
Mounting Hole Diameter	1/4 in	0.64 cm	**Weight**
Bolt Circle Diameter	6 1/8 in	15.56 cm	1.70 lb 0.77 kg
Hole-to-Hole Distance	4 5/16 in	10.95 cm	

Other Options

Item	Standard	Optional	
Valves	Flapper	Duckbill	Umbrella
Handle Style	Horizontal (H)	Vertical (V) (removable)	
Other		Thru Deck Mounting Kit *(only for vertical handle)*	
		Internal Spring	

Consult factory for other options.

930 Waterman Avenue East Providence, Rhode Island 02914
Ph: 888-438-1110 Fax: 401-438-2713 Web: www.thebosworthco.com

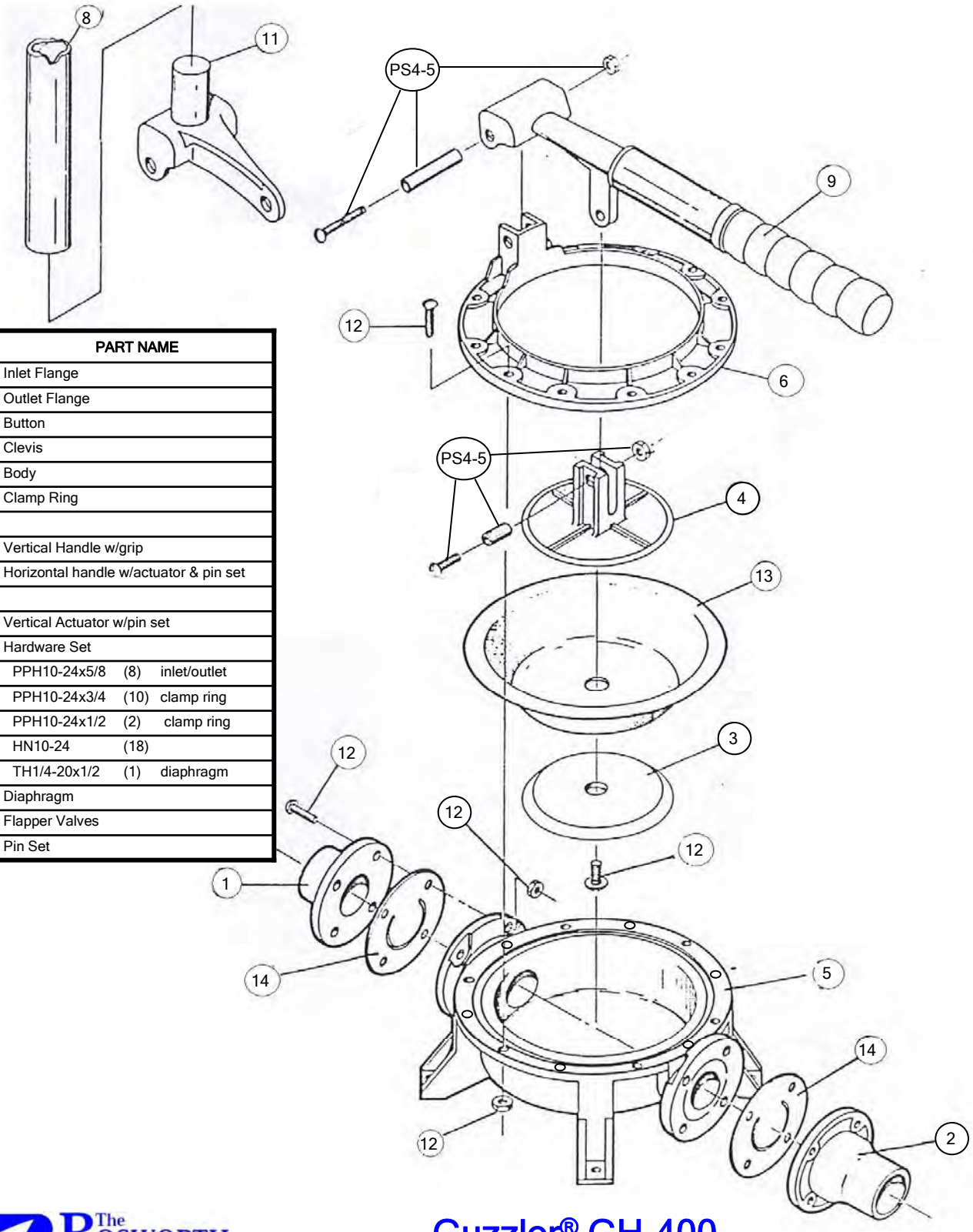
Hand-Operated Diaphragm Pumps

A little elbow grease is all these pumps need to do their job. All pumps have a Delrin housing. Intake and discharge connections are unthreaded male slip-on style. All pumps have check valves, are self-priming, and can be run dry. Not for use with solids. Maximum discharge pressure is 12 feet of head (5 psi). Maximum viscosity is 100,000 centipoise (similar to toothpaste). Temperature range is 33° to 140° F.

Common Compatible Chemicals

Deionized Water, Diesel Fuel, Glycol, Kerosene, Methanol, Mineral Spirits, Salt Water, Water

Diaphragm Material	Flow Rate, oz/stroke	For Hose ID	Overall Size, Ht. x Wd. x Dp.	
Buna-N	14.08	1"	4 1/2" x 5 1/2" x 12 3/4"	4**332K17**
Buna-N	21.44	1 1/2"	4 1/2" x 5 1/2" x 13 3/8"	4332K18
Silicone	14.08	1"	4 1/2" x 5 1/2" x 12 3/4"	4332K37



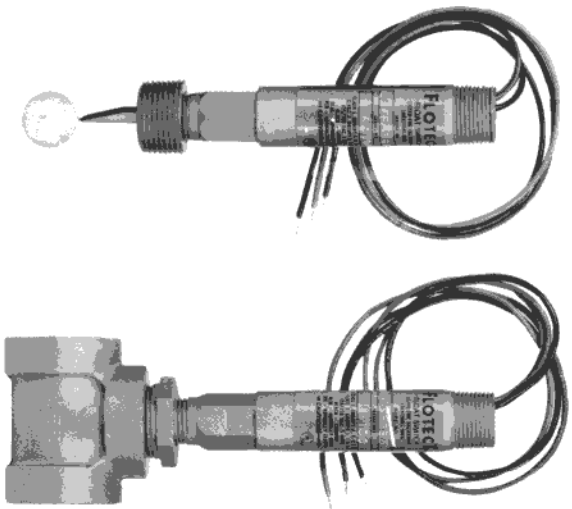
ITEM	PART NAME
1	Inlet Flange
2	Outlet Flange
3	Button
4	Clevis
5	Body
6	Clamp Ring
7	
8	Vertical Handle w/grip
9	Horizontal handle w/actuator & pin set
10	
11	Vertical Actuator w/pin set
12	Hardware Set
	PPH10-24x5/8 (8) inlet/outlet
	PPH10-24x3/4 (10) clamp ring
	PPH10-24x1/2 (2) clamp ring
	HN10-24 (18)
	TH1/4-20x1/2 (1) diaphragm
13	Diaphragm
14	Flapper Valves
PS4-5	Pin Set

Guzzler® GH-400

The Bosworth Company
930 Waterman Avenue East Providence, RI 02914
Ph: 401-438-1110 888-438-1110 Fax: 401-438-2713
www.thebosworthco.com

FLOTECT™ MODEL L-6 FLOAT SWITCH

Installation and Operating Instructions



Explosion-Proof; U.L. and C.S.A. Listed -
Class I, Groups *A, B, C & D
Class II, Groups E, F & G
CENELEC: EExd IIC T6 (T amb=75ºC)
*(Group A, stainless steel body only)

PHYSICAL DATA

Temperature Limit: 220ºF (105ºC) maximum
Maximum Pressure: See chart below
Switches: One or two SPDT snap switches
Electrical Rating: U.L.: 5A @ 125/250 VAC.
C.S.A. and CENELEC: 5A @ 125/250 VAC, 5A resistive, 3A inductive @ 30 VDC.
Optional ratings: MV option—Gold contacts for dry circuits. Rated 0.1A @ 125 VAC MT option: 400ºF (205ºC) 5A @ 125/250 VAC (not listed).
Wiring Connections: 3-18" (460mm) wire leads, 18 ga.
CENELEC models only: push-in type terminal blocks
Black = common, blue = N.O., red = N.C.
Minimum Specific Gravity:
Polypropylene float - 0.9
Round SS float - 0.7
Cylindrical SS float - 0.5
Switch Body: Brass 3/4" NPT conduit connection.
For SS switch body, change model no. to L6EPS.
Piping/Mounting Connection: 1" NPT
Installation: Horizontal, index arrow pointing down.
Weight: 1 lb. (.5 KG); w/external chamber 1-3/4 lb. (.8 KG)

WETTED MATERIALS CHART

Model	Brass	Bronze	Ceramic	Polypropylene	301SS	303SS	304SS
B-S-3-A	X		X		X		X
B-S-3-B	X	X	X	X	X		
B-S-3-C	X		X		X		X
B-S-3-H	X	X	X		X		X
B-S-3-O	X		X	X	X		
S-S-3-A			X	X	X		X
S-S-3-C			X		X	X	X
S-S-3-L			X		X	X	X
S-S-3-O			X	X	X	X	
S-S-3-S			X	X	X	X	

MAXIMUM PRESSURE CHART

Model Number	Float	Pressure Rating PSIG (KG/CM²)
L6EPB-B-S-3-A	Cylindrical SS	200 (14)
L6EPB-B-S-3-B	Polypropylene	250 (18)
L6EPB-B-S-3-C	Round SS	350 (25)
L6EPB-B-S-3-H	Round SS	250 (18)
L6EPB-B-S-3-O	Polypropylene	1000 (70)
L6EPB-S-S-3-A	Cylindrical SS	200 (14)
L6EPB-S-S-3-C	Round SS	350 (25)
L6EPB-S-S-3-L	Round SS	350 (25)
L6EPB-S-S-3-O	Polypropylene	2000 (140)
L6EPB-S-S-3-S	Polypropylene	2000 (140)

INSTALLATION:

Unpack switch and remove any packing material found inside lower housing or float chamber.

Switch must be installed with body in a horizontal plane and arrow on side pointing down.

If switch has an external float chamber (tee), connect it to vertical sections of 1" NPT pipe installed outside vessel walls at appropriate levels. If unit has no external float chamber, it must be mounted in a 1" NPT half coupling welded to the vessel wall. The coupling must extend through the wall.

Inspect and clean wetted parts at regular intervals.

ELECTRICAL CONNECTIONS:

Connect wire leads in accordance with local electrical codes and switch action required. N.O. contacts will close and N.C. contacts will open when liquid level causes float to rise. They will return to "normal" condition on decreasing liquid level. Black = common, Blue = N.O. and Red = N.C.

For units supplied with both internal and external grounds, the ground screw inside the housing must be used to ground the control. The external ground screw is for supplementary bonding when allowed or required by local code. Some CSA listed models are furnished with a separate green ground wire. Such units must be equipped with a junction box, not supplied but available on special order.

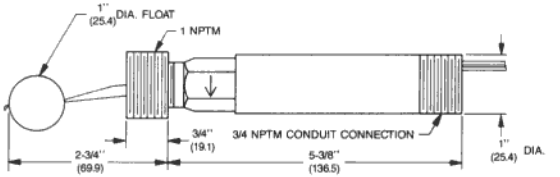
CENELEC certified models include a junction box. Cable should enter enclosure through an approved EX cable gland, not supplied. Push stripped and tinned leads into appropriate openings in terminal block(s). To connect fine stranded leads or to remove any wire, depress spring release with small screwdriver first.

All wiring, conduit and enclosures must meet applicable codes for hazardous areas. Conduits and enclosures must be properly sealed. For outdoor or other locations where temperatures vary widely, precautions should be taken to prevent condensation inside switch or enclosure. Electrical components must be kept dry at all times. **CAUTION:** To prevent ignition of hazardous atmospheres, disconnect the device from the supply circuit before opening. Keep assembly tightly closed when in use.

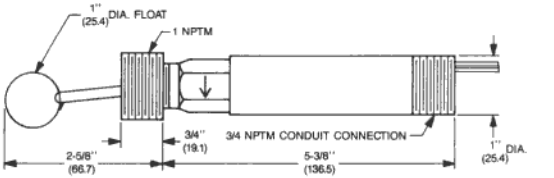
Dimensions on reverse

W.E. ANDERSON DIV., DWYER INSTRUMENTS, INC.
P. O. BOX 358 • MICHIGAN CITY, INDIANA 46360, U.S.A.
Telephone 219/879-8000
Fax 219/872-9057

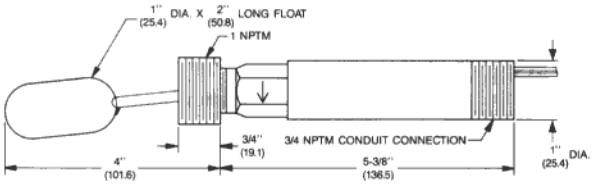
FLOTECT™ MODEL L-6 FLOAT SWITCH — DIMENSION DRAWINGS



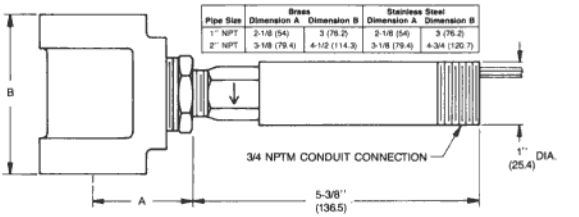
Polypropylene Float



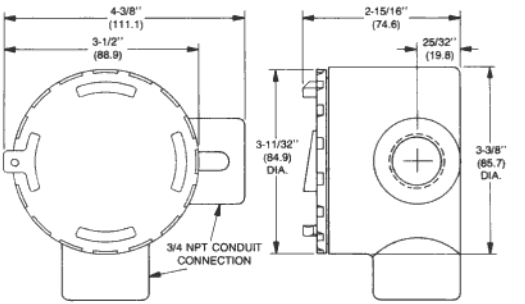
Round Stainless Steel Float



Cylindrical Stainless Steel Float



With External Float Chamber (Tee)



CSA, CENELEC Conduit Enclosure

Limited Warranty: The Seller warrants all Dwyer instruments and equipment to be free from defects in workmanship or material under normal use and service for a period of one year from date of shipment. Liability under this warranty is limited to repair or replacement F.O.B. factory of any parts which prove to be defective within that time or repayment of the purchase price at the Seller's opinion provided the instruments have been returned, transportation prepaid, within one year from the date of purchase. All technical advice, recommendations and services are based on technical data and information which the Seller believes to be reliable and are intended for use by persons having skill and knowledge of the business, at their own discretion. In no case is Seller liable beyond replacement of equipment F.O.B. factory or the full purchase price. This warranty does not apply if the maximum ratings label is removed or if the instrument or equipment is abused, altered, used at ratings above the maximum specified, or otherwise misused in any way.

THIS EXPRESS LIMITED WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER REPRESENTATIONS MADE BY ADVERTISEMENTS OR BY AGENTS AND ALL OTHER WARRANTIES, BOTH EXPRESS AND IMPLIED. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE FOR GOODS COVERED HEREUNDER.

Buyers Remedies: THE BUYER'S EXCLUSIVE AND SOLE REMEDY ON ACCOUNT OF OR IN RESPECT TO THE FURNISHING OF NONCONFORMING OR DEFECTIVE MATERIAL SHALL BE TO SECURE REPLACEMENT THEREOF AS AFORESAID. THE SELLER SHALL NOT IN ANY EVENT BE LIABLE FOR THE COST OF ANY LABOR EXPENDED ON ANY SUCH MATERIAL OR FOR ANY SPECIAL, DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES TO ANYONE BY REASON OF THE FACT THAT IT SHALL HAVE BEEN NON-CONFORMING OR DEFECTIVE.

W.E. ANDERSON DIV., DWYER INSTRUMENTS, INC.
P.O. Box 358
Michigan City, IN 46360
Phone: 219/879-8000
Fax: 219/872-9057

FR 82-440726-00
Printed in U.S.A. 10/93

Xchanger, Inc. **Rating for Model AA-250 ref #110744**

Engineer: David Wangensteen November 1, 2012

Prepared for:

J.E. Gasho & Associates, Inc.

Gary Rowe

PERFORMANCE	**PROCESS AIR**	**AMBIENT AIR**
Fluid Circulated	Air	Air
Volumetric Flow Rate	250 Std. ft^3/min	1,632 Std. ft^3/min
Total Fluid Entering	1,125 lb/hr	7,342 lb/hr
Liquid		
Vapor		
Non-Condensibles	1,125 lb/hr	7,342 lb/hr
Vaporized or (Cond.)		
Temperature In	180 °F	90 °F
Temperature Out	103 °F	102 °F
Inlet Pressure (Absolute)	15.2 lb/in^2	14.7 lb/in^2
Velocity (Standard)	2,126 ft/min	1,770 ft/min
Pressure Loss	4.3 in. water	1.1 in. water
Fouling Factor	0.0001 ft^2-°F-hr/BTU	0.0001 ft^2-°F-hr/BTU

Total Heat Exchanged: 20,667 BTU/hr

PROPERTIES		
Thermal Conductivity	0.017 BTU/hr-ft-°F	0.015 BTU/hr-ft-°F
Specific Heat	0.240 BTU/lb-°F	0.240 BTU/lb-°F
Viscosity	0.049 lb/ft-hr	0.046 lb/ft-hr
Molar Weight	29.0	29.0
Latent Heat of Vapor		

CONSTRUCTION		
Design Temperature	200 °F	Not Applicable
Design Pressure (Gauge)	15 lb/in^2	Not Applicable
Test Pressure (Gauge)	15 lb/in^2	Not Applicable
Cyclic Pressure	No	Not Applicable
Flow Direction	Right Hand Horizontal	Vertical Up - Pull Through
Coating	None	None

Plate-Fin Core	: Aluminum	Fan Hood	: Galvanized Steel
Fan Guard	: Coated Carbon Steel	Venturi Frame	: Coated Carbon Steel
Drawing Number	:	Weight	: 135 lb

CONNECTIONS

Process Inlet : 3 inch dia. tube stub

Process Outlet : 3 inch dia. tube stub

Instrument :

MECHANICAL EQUIPMENT

Fan Diameter	: 12 inch	Motor	: 1.00 HP TEFC
Fan Qty/Speed	: 1 / 3450 RPM	Motor Qty/Speed	: 1 / 3450 RPM
Fan Type	: 4 Blade Mill Galv. St	Motor Electrical	: 208-230/460/3/60

NOTES

Approximate unit dimensions (inches): A = 33, B = 32, C = 24, D = 14

Construction material suitability must be determined by customer.

The process flow must be uniform, smooth and free of pulsation.

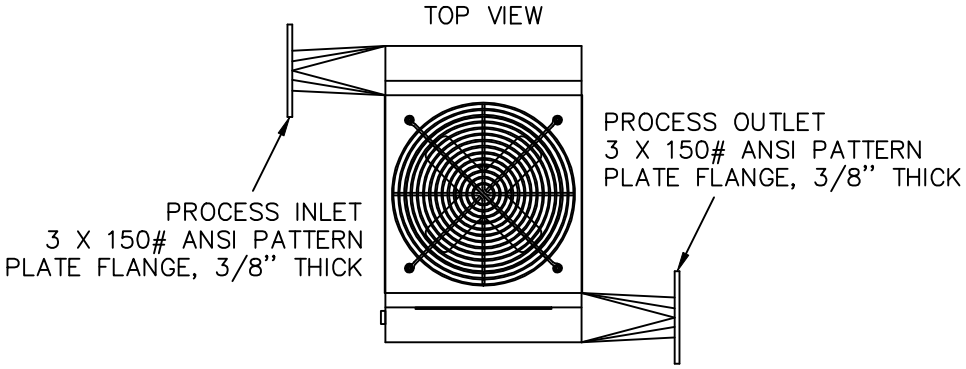
This unit is not designed for cycling process gas pressure.

A motor access panel is included in the fan hood.

CERTIFIED
DRAWING
Date: 03/19/13

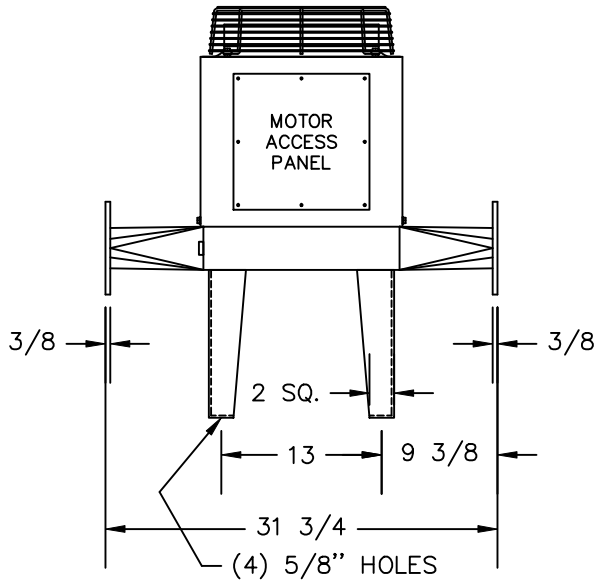
49430

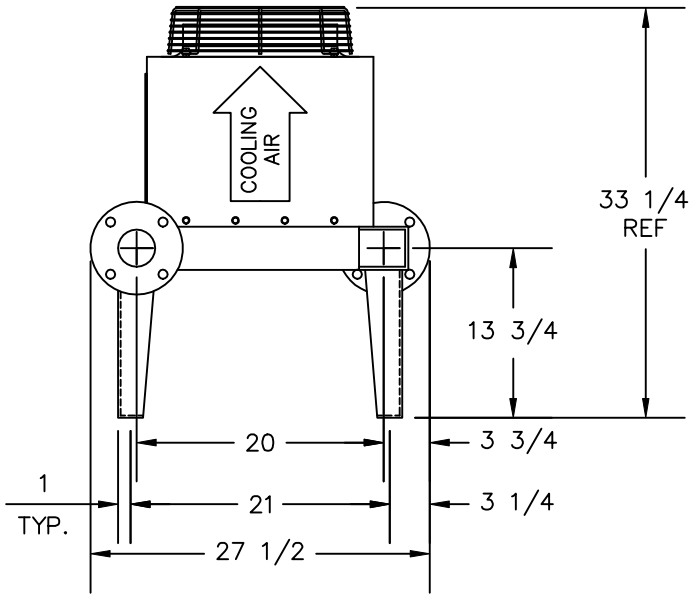
PERFORMANCE AND CONSTRUCTION PER DATA SHEET #110744A
QUANTITY OF – 1 – REQUIRED



Xchanger Inc.
Hopkins, Minnesota

CUSTOMER P.O.:	1303056–2692
J.E. Gasho & Associates, Inc.	
MODEL NUMBER:	AA–250 P/N: 49430
SERIAL NUMBER:	0313–B13601





TOLERANCES (UNLESS OTHERWISE NOTED)	Xchanger Inc. 1401 SOUTH 7TH ST HOPKINS, MN 55343	MODEL AA–250 HEAT EXCHANGER ASSEMBLY				
DECIMAL ± .25	FRACTIONAL ± 1/4	DRAWN BY: DWW APPROVED BY:	SCALE: NONE DATE: 03/14/13	JOB NUMBER B13601	SHEET 1 OF 1	DRAWING NUMBER 49430	REV.

Xchanger, Inc.

Certificate of Compliance

Xchanger job: B-13601
Manufactured for: J.E. Gasho & Associates, Inc.
on purchase order: 1303056-2692

This is to certify that the following heat exchanger(s) have been successfully pressure tested as indicated on the data sheet and have been inspected and found to be in compliance with the purchase order, certified drawing and our manufacturing procedures.

Part No	Description
49430	AA-250, Heat Exchanger, Ref #110744A

David W Wangensteen

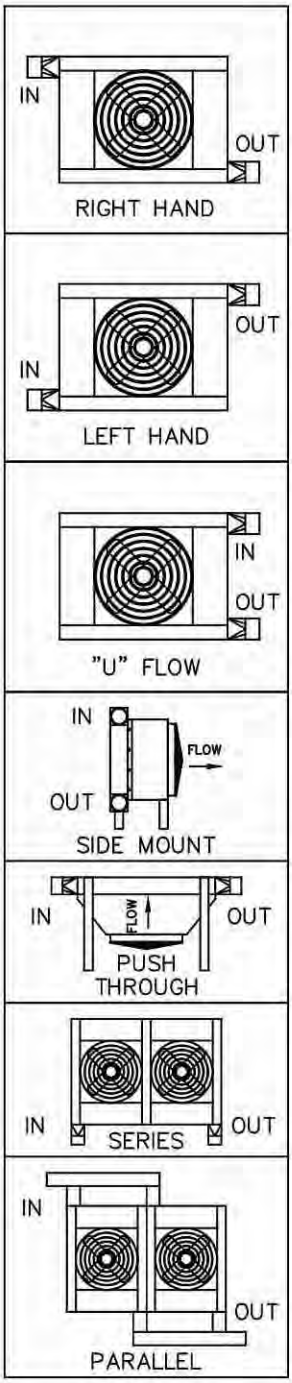
by David Wangensteen Date 3/29/13

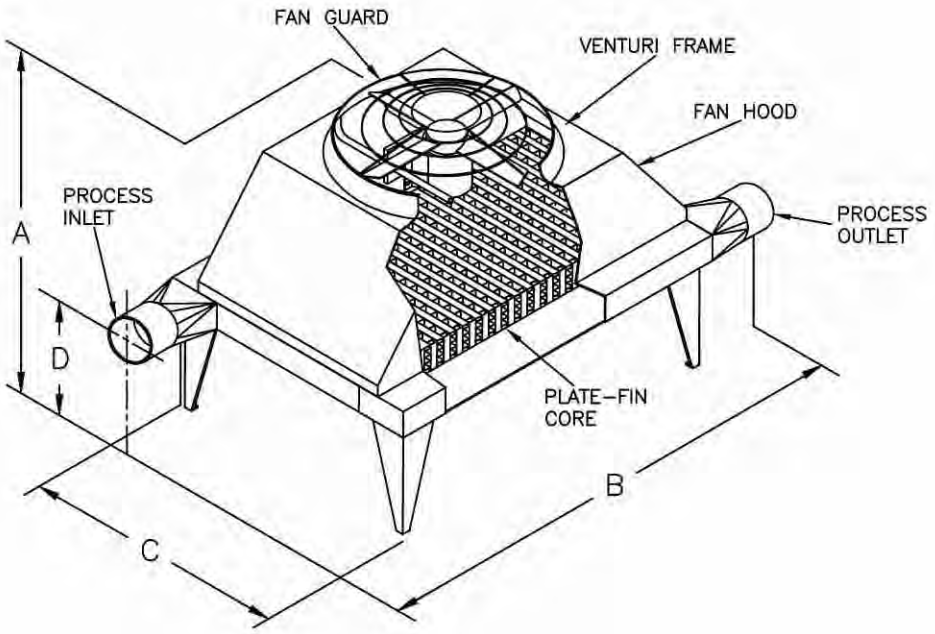
1401 South 7th Street Hopkins, MN 55343 ph:(952) 933-2559 fax:(952) 933-5647 email: info@xchanger.com

INDUSTRIAL HEAT EXCHANGERS
XCHANGER
1401 7th STREET S.
HOPKINS, MN 55343
952-933-2559
XCHANGER.COM

AA Series Heat Exchanger

AA Series exchangers cool low pressure air streams using fan-drafted ambient air. Air flows to 3,500 CFM from vacuum to 75 PSI can be cooled near ambient, with under 0.2 PSI pressure loss. AA Series exchangers are ideal for installation outdoors where cooling water is unavailable or undesirable due to freezing temperatures. Indoor installations should be well ventilated. The process air should be filtered and pulsating flow, such as that produced by rotary lobe blowers, should be dampened by a chambered silencer prior to entering the heat exchanger.





SEE LINE #54 OF DATA SHEET FOR APPROXIMATE DIMENSIONS

Design Options:

- Connection types: tube, pipe, flange, NPT, ferrule, etc
- Materials of construction:
  Core: aluminum (others available with our LC series)
  Propeller, venturi, and shroud: aluminum, painted, galvanized, or stainless steel
- Motors: any available
- Epoxy phenolic coating for corrosion protection of the core
- Units can be built to required dimensions
- Multiple cores combined together to make a single unit

Accessories:

• Instrument Coupling	$ 60
• Thermometer (Includes Coupling)	$ 90
• Differential Pressure Gauge	$ 280
• Service side filters	Ask
• Others available upon request	

INDUSTRIAL HEAT EXCHANGERS
XCHANGER

1401 7th STREET S.
HOPKINS, MN 55343
952-933-2559
XCHANGER.COM

Heat Exchangers

Installation

Operation

Maintenance

The information supplied in this manual is based on many years of field experience with our heat exchangers. Following the instructions of this manual will extend the service life of your heat exchanger.

Please note that all heat exchangers will eventually fail, even if they have been properly installed and well maintained. Our experience shows that some of the most common reasons for failure are: over-pressurization, water hammer, freezing, corrosion, and vibration induced metal fatigue.

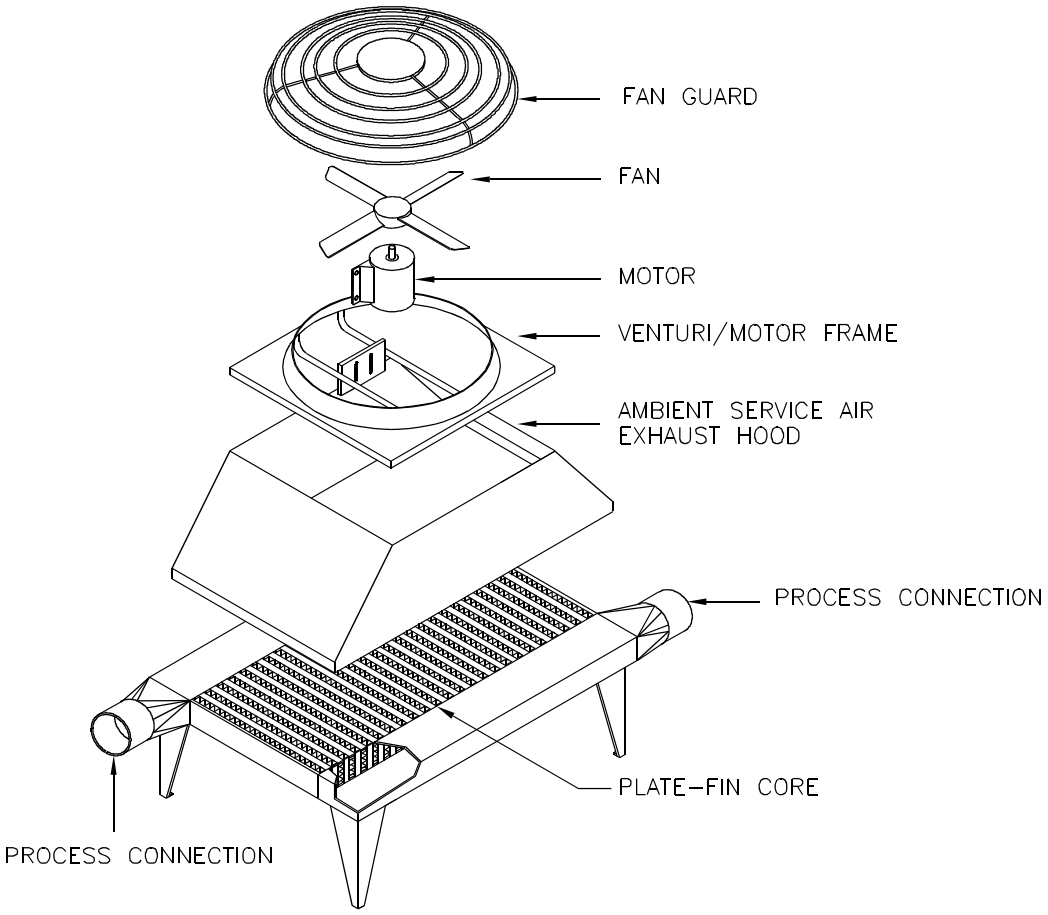
When a heat exchanger fails, the likely result is contamination of the process and/or service fluids. If this would be a serious problem for your system, steps should be taken to protect your system to eliminate or reduce the impact of such contamination. Depending on the type of failure, it is also possible that one or both fluids could leak into the atmosphere.

TABLE OF CONTENTS

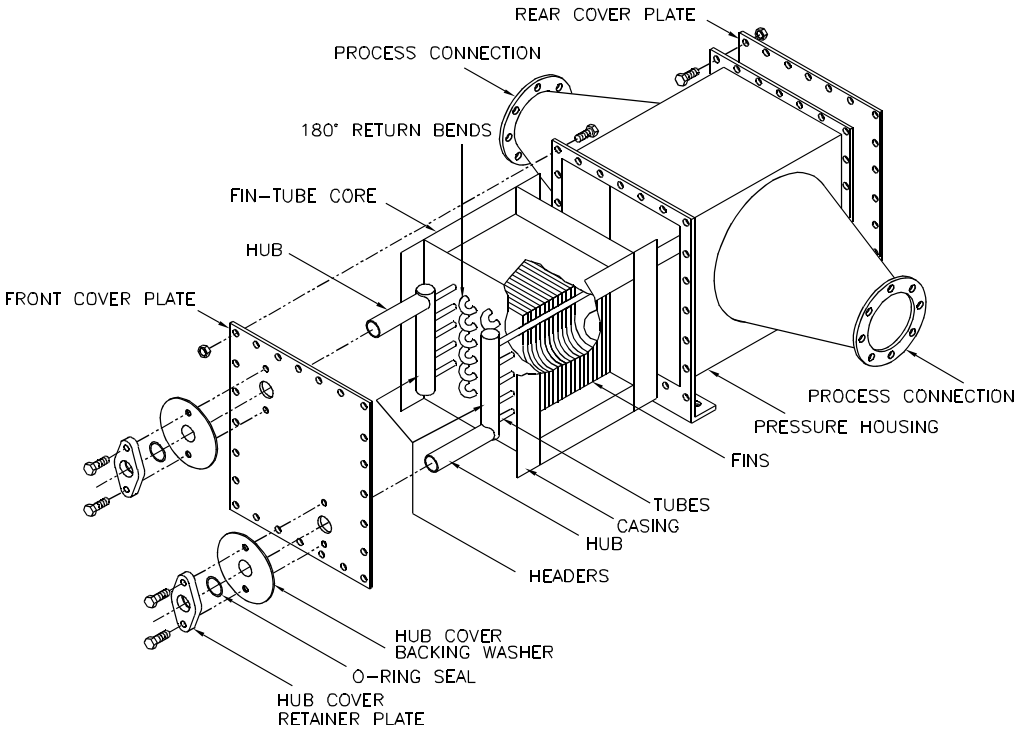
1.0 SCOPE OF THIS MANUAL

This manual describes the appropriate procedures for the use and care of Xchanger AA, C, HP, HR, LC, and TV Series heat exchangers. Warranty and service contact information is also included.

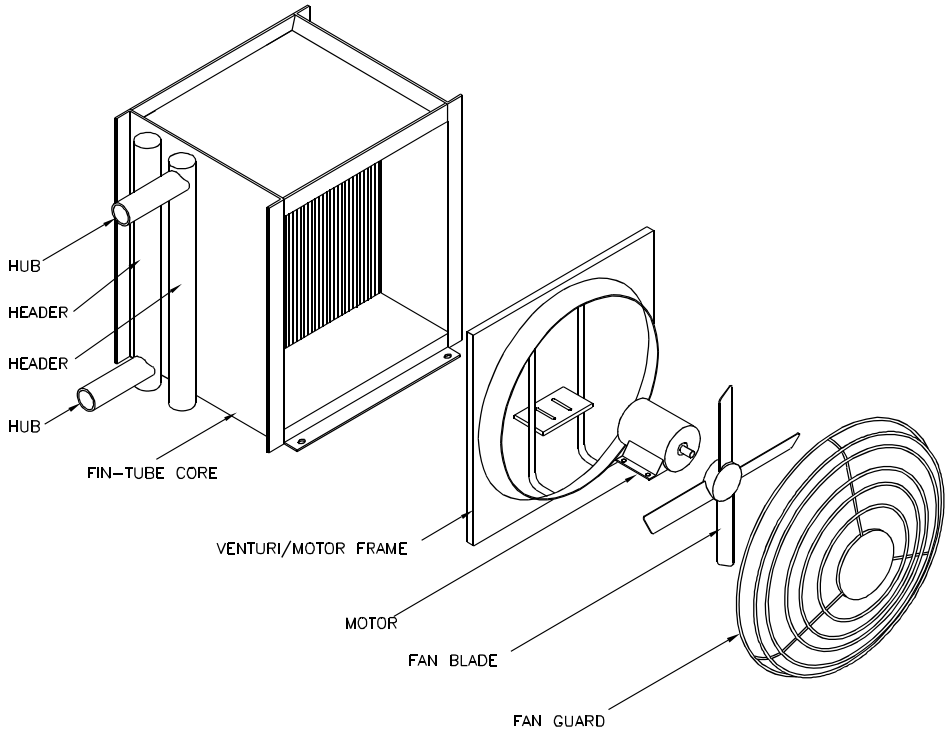
Due to the custom nature of all Xchanger heat exchangers, this manual discusses the characteristics and procedures that are common to all exchangers. Unit specific information not included in this manual will be shown on or included with the data sheet and certified drawing that characterize each distinct exchanger design. Information about any accessories provided with an exchanger would also be separate from this manual.



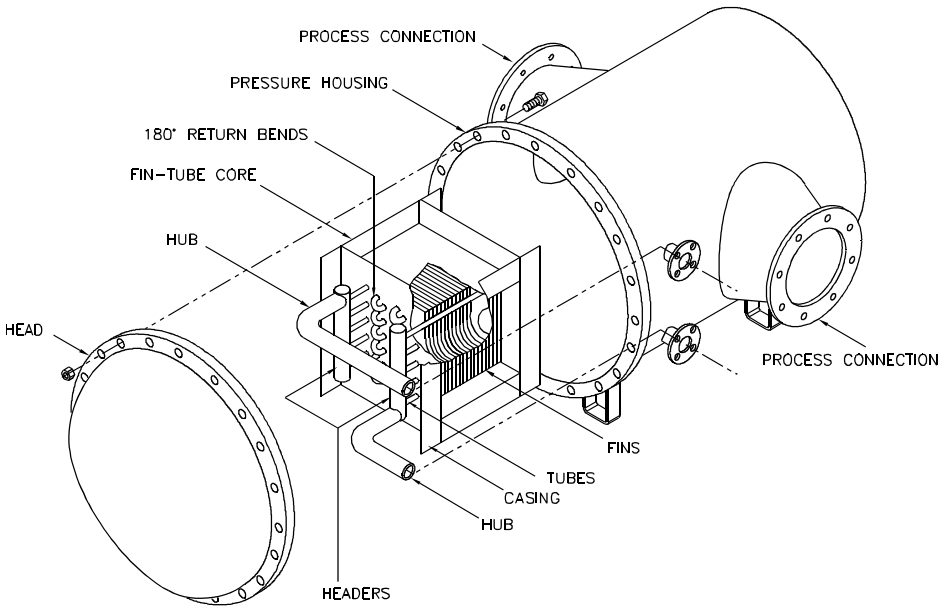
AA Series Heat Exchangers



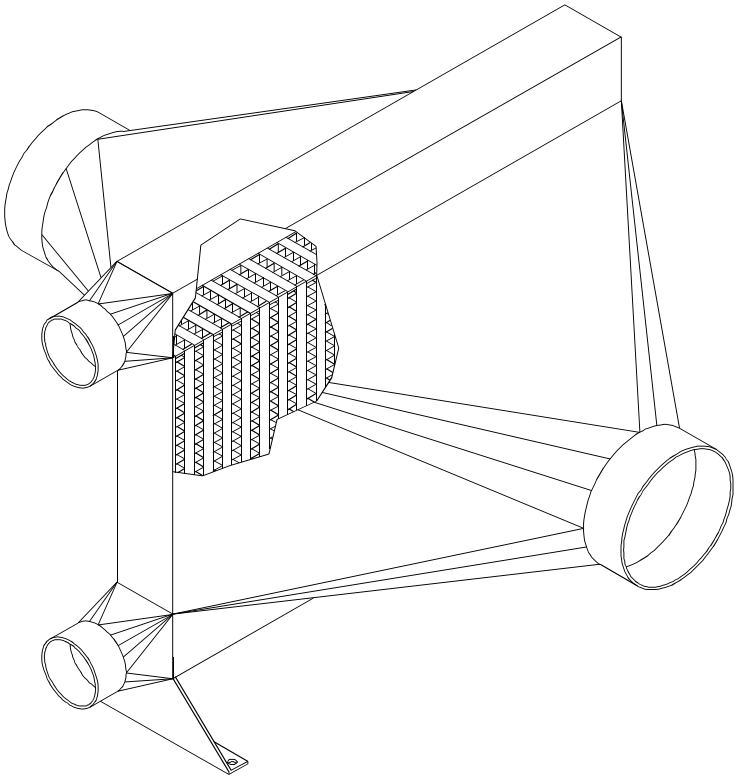
C/TV Series Heat Exchangers



LC Series Heat Exchangers



HP Series Heat Exchangers



HR Series Heat Exchangers

2.0 RECEIVING THE HEAT EXCHANGER

The unit should be examined thoroughly upon receipt. The unit should have no cracks, dents or deformations.

Damage to either the unit or its crating should be immediately noted on the freight receipt. If the shipment was made F.O.B. our factory, damage claims should be filed with the responsible carrier.

Accessories are sometimes shipped loose on the same skid as the exchanger. If so, the Bill of Lading and/or Packing Slip would reflect the loose parts. Check for any accessories before discarding the skid.

2.1 STORAGE

If the unit will not be placed into operation for an extended period of time, it should be left on the shipping skid. Store in a clean, dry, and protected area. All openings should be covered to protect interior surfaces. Unprotected carbon steel should be sprayed with a light coating of a rust inhibitor.

3.0 MOUNTING LOCATION

If the heat exchanger is located at the inlet or discharge of a blower with a pulsating flow, such as a Roots type rotary lobe blower, the heat exchanger must be protected from the pulsation by a chambered silencer.

The heat exchanger must be isolated from system vibrations using flexible piping connections and isolation pads on the mounting feet. Vibration can cause work-hardening, and failure of the heat exchanger.

The process gas stream should be free of particulate. If there is a possibility of particulate passing through the heat exchanger, a filter should be installed upstream of the heat exchanger.

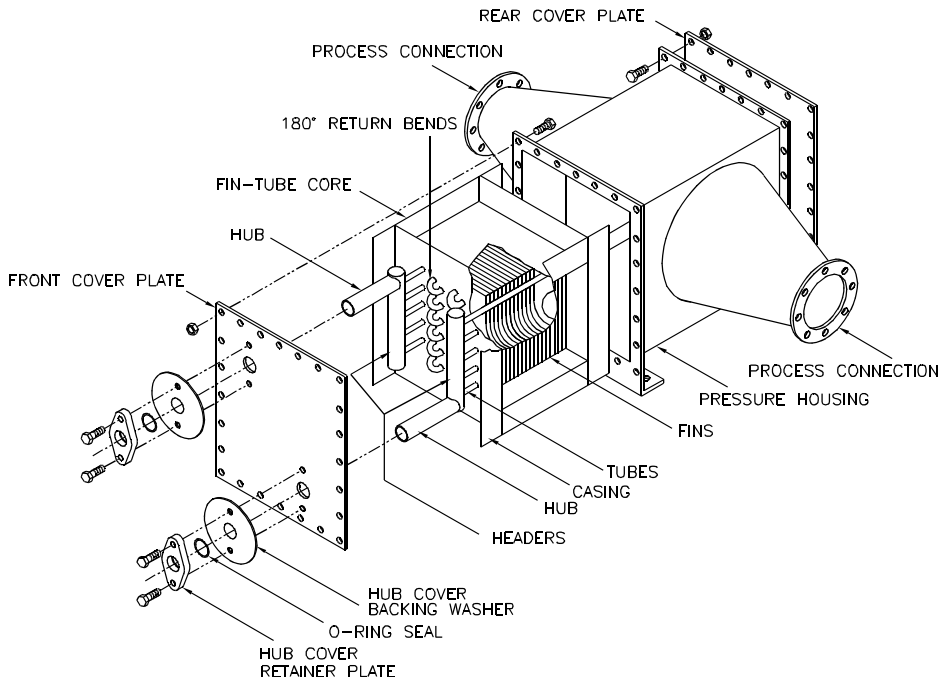
Ample space should be provided on all sides to allow servicing when required.

3.1 C/HP/TV SERIES

To facilitate servicing a unit with a removable core, provide enough clear space to remove the core through the bolted access panel.

For cooling applications where vapors may condense from the gas stream, a proper drain trap arrangement is necessary (see section 4.1.5 titled C/HP/TV SERIES Housing Drain Trap for more information).

The service fluid must not be allowed to freeze or damage to the core will result (see section 6.4 titled FREEZING PROTECTION - C/HP/TV SERIES for more information). Heating of the service fluid beyond its boiling point may also damage the core.



3.2 AA/LC SERIES

The heat exchanger should be mounted in a well ventilated area, preferably outdoors, as these units dissipate heat to the ambient air. If the unit is installed indoors and ducting of the service air is required, a booster fan should be used to convey the air through the duct.

A minimum clearance of 2 feet around the heat exchanger base is essential for proper cooling air flow.

3.3 HR SERIES

If installed in a very warm or very cool location, the ambient conditions could interfere with the intended heat transfer. The effects of the ambient conditions can be minimized by insulating the exchanger after installation.

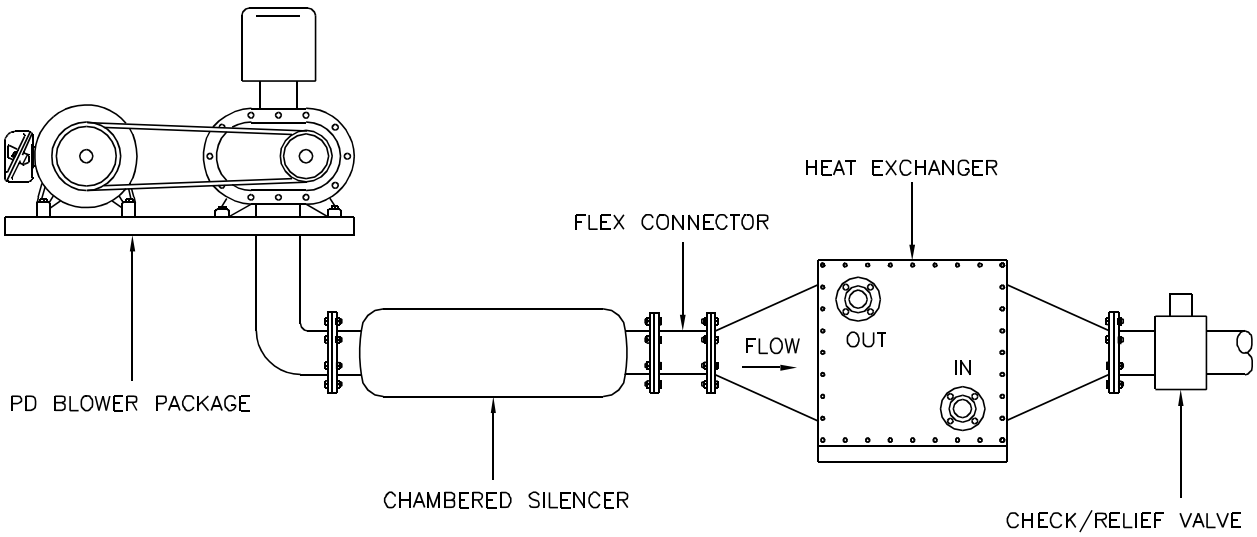
4.0 INSTALLATION

The heat exchanger should be supported and secured by the mounting feet. All piping should be supported independently of the heat exchanger, and any flex connectors present should not add loads or moments to the heat exchanger process connections. Any debris in the piping should be removed before the heat exchanger is installed, as the core of the exchanger could trap any particles, causing reduced performance or damage to the core.

The unit is equipped with labels indicating gas flow direction and service fluid inlets and outlets. Connections must be installed as labeled. The certified drawing also indicates the flow direction, and should be consulted during installation.

If the gas flow through the unit is pulsating and/or vibrations are present in the system piping, a chambered silencer and/or flexible connections should be used. If vibrations may pass through the mounting skid, isolation pads should be used between the skid and the mounting feet of the heat exchanger. Pulsation and/or vibration can cause metal fatigue, and lead to failure of the heat exchanger.

If the heat exchanger is used in a pneumatic conveying system, a check valve should be placed between the air lock and the heat exchanger. This will help to prevent clogging the heat exchanger with the product being conveyed.



4.1 C/HP/TV SERIES

The orientation for which the heat exchanger is designed is noted on the certified drawing. A unit that is designed for horizontal gas flow may not perform to specification if it is installed in a vertical flow orientation.

Attachment to the service connections should be made using industry standard practices. If special valves, controls, traps, etc., are provided by Xchanger, separate instructions may be attached. If shut off valves are installed on both of the service lines, a pressure relief valve should be installed on the heat exchanger side of one of the shut off valves to prevent over pressurizing the unit. A pressure relief valve similar to a domestic water heater valve is usually adequate.

On standard heat exchangers, there is a 3/4 inch female NPT drain coupling in the bottom of the housing. Condensate that forms on the outside of the fins can be drained though this coupling to a drain leg or trap.

4.1.1 Drainable Tube Circuits

These units should be installed with a slight slope toward the service connection side of the exchanger.

4.1.2 Steam Piping

Proper installation, piping, and trapping is necessary to insure satisfactory operation and prevent damage under normal operating conditions. These installation recommendations must be followed to assure trouble free operation:

- Provide swing joints or flexible fittings in all piping connections adjacent to the heat exchanger. This absorbs the thermal expansion and contraction of the piping.
- Condensate must flow freely from the heat exchanger at all times to prevent physical damage to the core caused by water hammer, unequal thermal stresses, freeze-up, or corrosion.
- Do not pitch the heat exchanger. The mounting position should be level.
- Control each heat exchanger core separately when installing multiple cores.
- Do not modulate systems with overhead or pressurized returns unless the condensate is drained by gravity to a receiver, vented to atmosphere, and returned to the steam main by a condensate pump.
- Pitch all supply and return piping down a minimum of 1 inch per 10 feet in the direction of steam flow.
- Do not drain steam mains or take-offs through the heat exchanger. Drain steam mains ahead of the heat exchanger through a steam trap into the steam return line.

- Do not bush or reduce the steam condensate return piping smaller than the heat exchanger connection. Run return pipe full size to a steam trap (except for a short nipple screwed directly into the condensate connection of the steam trap).

- Overhead steam return lines require 1 PSIG pressure at the steam trap discharge for each 2 feet of elevation to assure continuous condensate removal.

- When an overhead steam return line is installed, provisions should be incorporated into the piping system to allow condensate to drain from the heat exchanger during down time.

- The end of the steam supply main must be trapped.

- A vacuum breaker must be installed if there is any possibility that the heat exchanger will see a vacuum resulting from a fast acting valve operation.

4.1.3 Steam Trap Selection

Proper steam trap selection and installation is necessary for satisfactory heat exchanger performance and service life:

- Select a steam trap based on the maximum possible condensate flow rate along with the recommended load factors.

- Locate the steam trap discharge at least 12 inches below the heat exchanger condensate return connection. This will provide sufficient hydrostatic head pressure to overcome trap losses and assure complete removal of the condensate from the heat exchanger.

- Float and thermostatic type steam traps are preferred because of their gravity drain and continuous discharge operation.

- Use a float and thermostatic type steam trap with gravity condensate return and automatic controls where there is a possibility of a low pressure steam supply.

- Use bucket traps only when steam supply is not modulated and is over 25 PSIG.

- When installed for series airflow, size steam traps for each heat exchanger core using the capacity of the first heat exchanger core (in airflow direction).

- Trap each heat exchanger separately. This will prevent condensate holdup in the heat exchanger cores.

- Install strainers as close as possible to the inlet side of a steam trap.

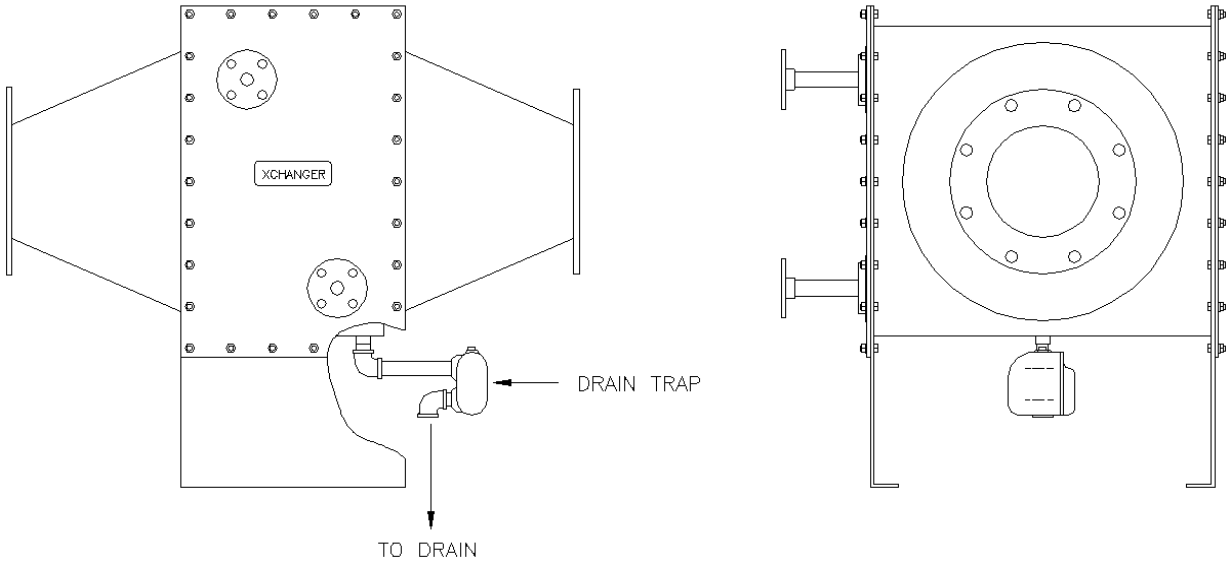
4.1.4 Refrigerant Circuit

Direct expansion refrigerant circuits are shipped open and uncharged. They must be evacuated and charged. If you need assistance, contact a local refrigeration contractor.

4.1.5 Housing Drain Trap

In applications where vapors are expected to condense from a horizontal gas flow, an automatic drain trap should be installed. Approximately 12 inches total clearance under the housing box is required, or 9 inches below the standard mounting feet.

For installations where the gas flow is vertical, any condensed vapors will fall out of the low side transition, due to gravity.



4.2 AA/LC SERIES

The electric motor must be wired on site. On many air cooled heat exchangers, the electrical service must be brought through the exhaust hood. Any holes in the exhaust hood should be sealed to prevent air that has not passed through the core from entering, thereby short-circuiting the core. Refer to the motor name plate for electrical requirements.

5.0 START-UP

After carefully observing all the points listed under Section 4.0 INSTALLATION, the unit is ready for start-up. After the process/service fluids have been directed to the unit, check for leaks.

5.1 C/HP/TV SERIES STEAM HEATERS

Steam should be turned on full for at least ten minutes before the airflow is started to prevent water hammer, freezing, and excessive thermal stresses on the heat exchanger.

5.2 AA/LC SERIES

Before starting the electric fan, the following checklist should be used:

- The propeller hub should be secure on the motor shaft.
- The propeller should rotate freely.
- Electrical wiring should be safely secured.
- The air flow path should be open (i.e. packing material removed).

After starting the motor, verify that the propeller is rotating in the proper direction. The data sheet and certified drawing should state the design flow direction for the ambient air.

6.0 MAINTENANCE

Depending on the model, and your operating environment, the maintenance requirements may vary.

6.1 LUBRICATION

6.1.1 C/HP/HR/TV SERIES

No lubrication is required for the heat exchangers. Accessories may require lubrication, per their manuals.

6.1.2 AA/LC SERIES

Refer to the maintenance instructions provided with the motor(s).

6.2 C/HP/TV SERIES CORE REMOVAL AND INSTALLATION

It may be necessary to occasionally remove the fin-tube core from the housing for inspection or cleaning.

For units with removable cores, the following steps describe the procedure for removing the fin-tube core from the heat exchanger housing. Units which are all-welded will need to be returned to the factory for service. [See page 2 & 3 for reference to terminology.]

6.2.1 C/TV SERIES Core Removal

1. Disconnect service fluid and remove any connections from the service hubs (i.e. sweat on bronze flanges, screwed on threaded flanges, etc.). If the core and cover are welded together, the flanges do not need to be removed, as the cover will remain with the core.
2. Remove the bolts securing the hub plate assemblies to the front cover.
3. Remove the hub plate assembly (hub plate, O-ring, and backing washer). Some prying with a screwdriver or similar tool may be required to break the bond of the sealant.
4. Remove the bolts securing the front and rear housing covers to the housing.
5. Remove the front and rear covers. Some prying with a screwdriver or similar tool may be required to break the bond of the sealant.
6. Remove the bolts securing the core to the housing. Check both sides.
7. Remove the core from the housing by pulling evenly on the headers or the casing and/or pushing evenly on the 180° tube return bends on the back side of the core. Take care not to damage the headers or return bends.

6.2.2 HP SERIES Core Removal

1. Remove the flange bolts around the removable dished head cover.
2. Disconnect the core connections from the internal service connections.
3. Remove the bolts holding the core to the side of the housing.
4. Remove the core from the housing.

6.2.3 C/HP/TV SERIES Core Installation

Install the core in the reverse order of removal, noting the following:

1. Slide the core into the housing and attach the casing to the side of the housing.

   For replacement cores, the holes in the casing which hold the core against the side of the housing may not match the holes on the original core. If not, new holes will need to be drilled as follows:

   a. Slide the core into the housing such that the core face is centered in the transition opening.
   b. Mark the locations of the housing holes on the casing.
   c. Remove the core and drill the holes where marked. When drilling the holes, place a wooden block behind the casing to prevent damage to the core's tubing.
   d. Reinstall the core into the housing.

2. For HP Series exchangers, the internal service connections will need to be reattached.

3. Clean the sealing surfaces on the covers and housing flanges with solvent to remove any oils or residue.

4. Apply new gasket material to the housing flange. Refer to the data sheet supplied at the time of purchase for proper gasket material selection.

5. Install covers, cover bolts-washers-nuts and for C/TV Series exchanger, the hub cover assemblies. To facilitate installing the hub cover assemblies, do not tighten the cover bolts until after the hub cover assemblies are installed. All bolts should be finger tight at this point.

   For C/TV Series replacement cores, the hub locations may not be identical to those of the original core. To check for proper alignment, install the front cover with the four corner bolts. Slide on the hub cover assemblies to check for alignment over the hubs of the replacement core. If the hub and cover bolt holes do not match, new holes must be drilled and tapped into the cover. The hub covers may be rotated such that the old air holes will not interfere with the new holes. Fill in the old holes to prevent gas leakage.

6. Tighten the front and, if applicable, rear cover bolts.

7. Tighten the hub cover assembly bolts.

6.3 CLEANING

Xchanger heat exchangers perform best when clean. It is recommended that they be prevented from becoming fouled since their design is such that once plugged or coated, it may not be possible to fully clean them. The sections below offer suggestions, where applicable, if cleaning is attempted.

6.3.1 AA/HR SERIES Internal Gas Passages

The internal process gas passages in these heat exchangers are not cleanable. Filtered air is absolutely required for these units. If plugging does occur, core replacement is recommended.

6.3.2 AA/HR/LC SERIES Service Gas Passages

For dirt/dust contamination, a soap and water wash is usually adequate to clean the service side of these units. If not, the use of an appropriate solvent or compressed air is recommended. Pressure washers can damage the fins, and should not be used.

6.3.3 C/HP/TV SERIES Gas Passages

These heat exchangers may require disassembly for cleaning. See Section 6.2 for disassembly instructions. Once access is obtained, the cleaning options described in Section 6.3.2 can be used.

6.3.4 C/HP/LC/TV SERIES Fluid Passages

The tube interior can become coated with sediment. This coating will reduce the thermal capacity of the heat exchanger. To try to restore a fouled heat exchanger to the original capacity, an appropriate solvent or cleaner compatible with the tube material can be circulated through the circuit to clean the tube interior.

6.4 FREEZING PROTECTION - C/HP/LC/TV SERIES

6.4.1 Drainable Circuits

If the heat exchanger is equipped with a drainable tube circuit, the tubes can be drained by simply opening the service and outlet to atmosphere. These units should be installed with a slight slope toward the service connection end to facilitate complete drainage.

6.4.2 Non-trapped Circuits

These tube circuits run horizontally and downward across the exchanger. If the exchanger is installed level, when the service inlet and outlet are opened to atmosphere, the service fluid may drain out of the low connection sufficiently to prevent freezing damage. If the exchanger is installed out of level, some service fluid will hang up in the now trapped points of the core. In this case, antifreeze should be added as discussed below.

6.4.3 Trapped Circuits

These circuits run downward and upward, like the trap under a sink, and therefore are not drainable. Antifreeze should be added as discussed below.

Antifreeze should be added to the core to provide freezing protection, per the following procedure.

1. Open the water inlet and outlet to atmosphere and allow the core to drain as completely as possible.

2. Add antifreeze to the core and circulate the solution through the core for approximately fifteen minutes.

3. Check the concentration for adequate freeze protection for your area. If the concentration is not sufficient, repeat steps 1 & 2 as necessary.

7.0 SPARE PARTS

7.1 C/HP/TV SERIES

Normally, no spare parts are recommended. If a specific exchanger includes special parts or accessories that could be a spare part, or if an accessory itself uses spare parts, they would be noted on the data sheet, certified drawing, or on accompanying documentation.

Please note that the manufacturing and shipping time for replacement cores is often 6 weeks. If this length of downtime would present a significant problem, it may be advisable to stock a spare core.

7.2 AA/LC SERIES

A spare electric motor is recommended.

7.3 HR SERIES

Normally, no spare parts are recommended. Similar to the C/HP/TV Series above, any special parts would be noted on a case by case basis.

8.0 GUARANTEE

8.1 DURATION

The sooner of either:

- 12 months from date of start-up.
- 18 months from date of shipment from Xchanger.

8.2 TERMS

Xchanger will replace or repair any part or parts free of charge, F.O.B. our factory, provided our examination shows the item to be defective by reason of inferior materials or workmanship.

The part or parts must have been used as intended and in accordance with our instructions. No allowance will be made for repairs or alterations made without our written consent.

8.3 EXCLUSIONS

This Guarantee does not cover damages resulting from misuse, neglect, alteration, or accident, specifically including operating at temperatures or pressures in excess of those for which the equipment was specified and furnished.

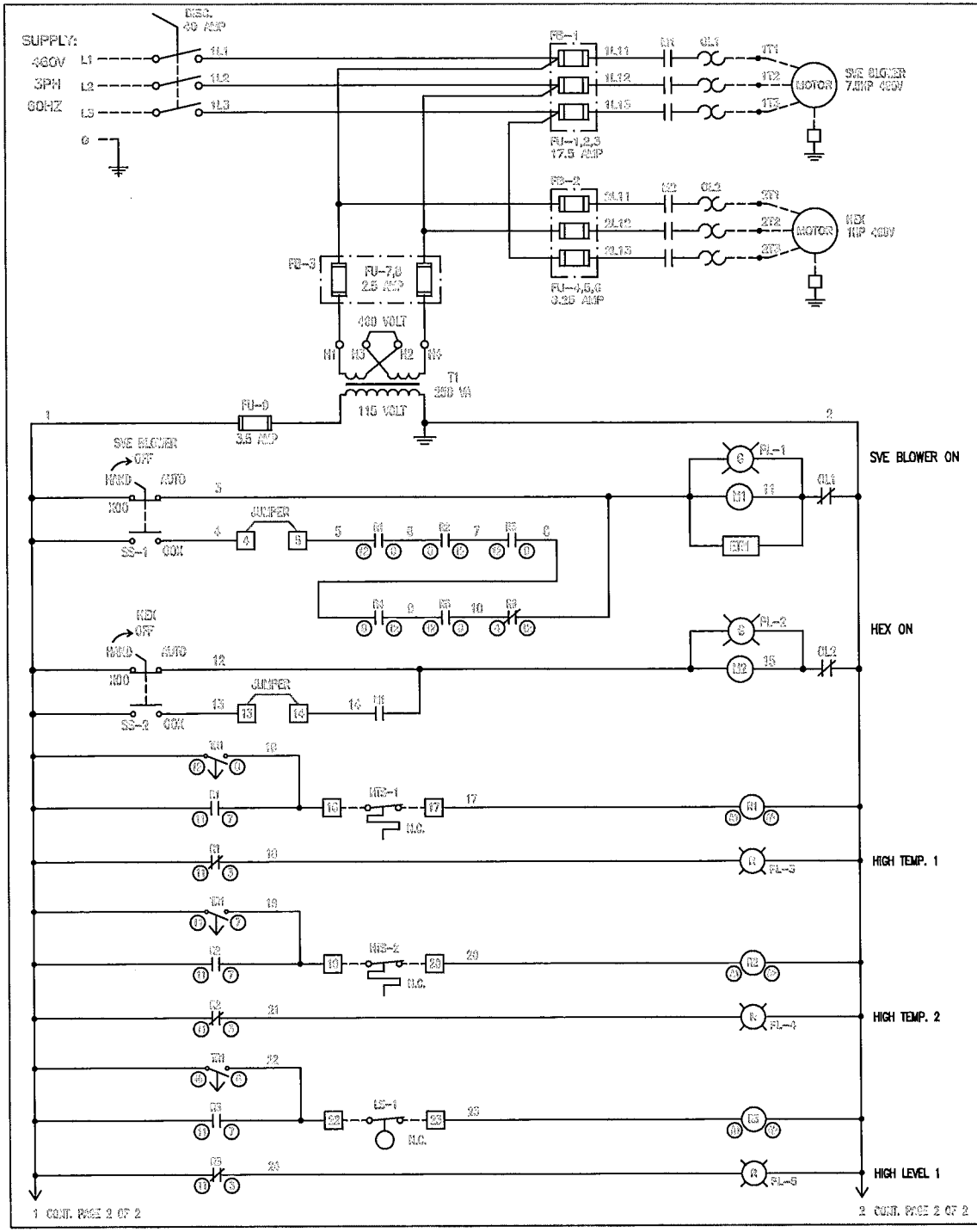
The liability of Xchanger is limited to our option of the repair or replacement at our factory of any part which has been found defective by our examination. Such repair or replacement shall constitute the extent of our obligation. Xchanger shall not be liable for any incidental or consequential damages resulting from the resolution of the warranty issue, or otherwise.

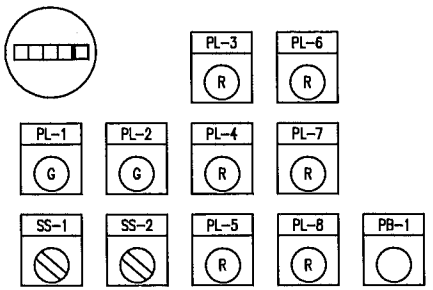
Motors, controls and other purchased parts are warranted by their original manufacturers. Such warranties will be carried out in accordance with the usual terms thereof.

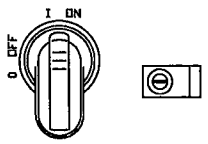
9.0 SERVICE

Should assistance in installation, demonstration, or repair of any equipment be required, please contact Xchanger at:

Mail: 1401 South 7th Street
Hopkins, MN 55343 USA
Ph: 952-933-2559
Fax: 952-933-5647
E-mail: info@xchanger.com







PL-1 – SVE BLOWER ON
PL-2 – HEX ON
PL-3 – HIGH TEMP. 1
PL-4 – HIGH TEMP. 2
PL-5 – HIGH LEVEL 1
PL-6 – HIGH LEVEL 2
PL-7 – HIGH PRESSURE
PL-8 – LOW VACUUM
SS-1 – SVE HAND–OFF–AUTO
SS-2 – HEX HAND–OFF–AUTO
PB-1 – ALARM CONDITION RESET

NOTES:
1. ☐ INDICATES TERMINAL BLOCK
2. ○ INDICATES COMPONENT TERMINAL POINT
3. USE COPPER WIRE ONLY
4. REPLACE WITH LIKE FUSES ONLY
5. HTS – INDICATES TEMPERATURE SWITCH
6. LS – INDICATES LEVEL SWITCH
7. ALL CONTACTS SHOWN WITH POWER OFF

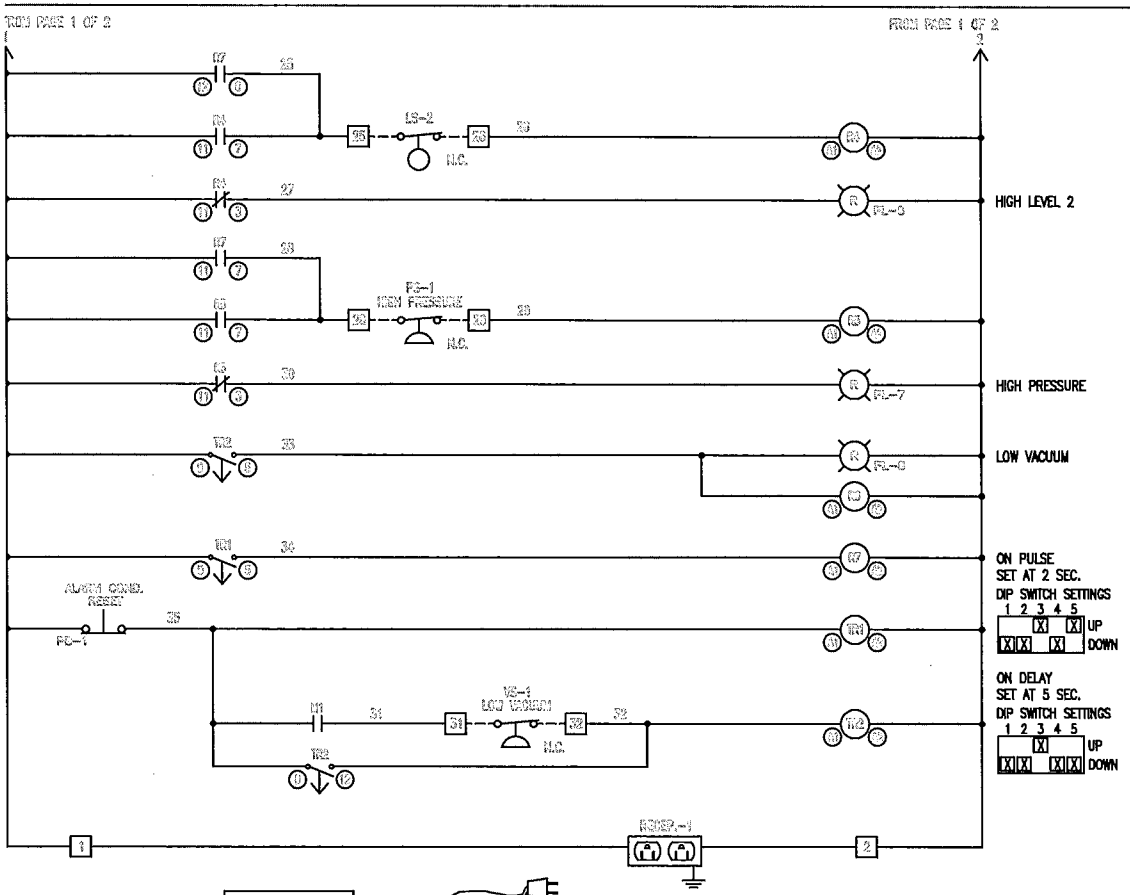
REVISIONS				
REV.	DATE	BY	CHKD.	DESCRIPTION
A	3/28/13	S.G.	R.M.	ADD 2ND CONTACTS
B	4/10/13	S.G.	R.M.	ADDED LS-1 TO CIRCUIT

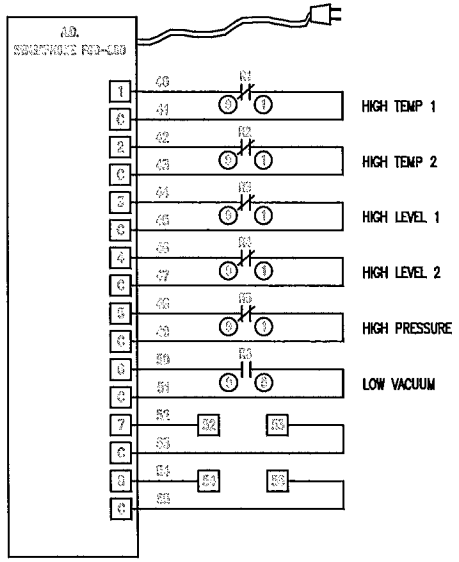
J.E. GASHO & ASSOCIATES
PO# 11303057-2892
ICP S.O.# XXX
HP SEE DWG
VOLTAGE 460

TITLE: SVE CONTROL PANEL

DATE	PAGE	DWG NO.
3/5/13	1 OF 2	CASHO66

INTERNATIONAL CONTROL PRODUCTS, INC.





BILL OF MATERIALS

ITEM	QTY	ITEM LABEL	MFG.	DESCRIPTION	PART NUMBER
1	1	ENCL	RITTAL	30x24x8 NEMA 4 ENCLOSURE	AE1076.500
2	2	ENCL	RITTAL	SCREWDRIVER INSERT	SZ2464
3	1	DISC.	ABB	3P 40 AMP NON-FUSED DISC.	OT40F3
4	1	DISC.	ABB	NEMA 4 DISCONNECT HANDLE	OHB65L6
5	1	DISC.	ABB	DISCONNECT SHAFT	OXP6X210
6	1	FB-1	MERSEN	3P 30A CLASS J FUSE BLOCK	60308SJ
7	3	FU-1,2,3	MERSEN	17.5 AMP CLASS J FUSE	AJT-17 1/2
8	1	FB-2	MERSEN	3P 30A CLASS CC FUSE BLOCK	30323R
9	3	FU-4,5,6	MERSEN	6.25 AMP CLASS CC FUSE	ATDR-6 1/4
10	1	M1	SIEMENS	17 AMP IEC CONTACTOR	3RT1025-1AK60
11	2	M1	SIEMENS	1 N.O. AUX. CONTACT	3RH1921-1CA10
12	1	OL1	SIEMENS	OVERLOAD RELAY (9-12.5 FLA)	3RU1126-1KB0
13	1	M2	SIEMENS	7 AMP IEC CONTACTOR	3RT1015-1AK61
14	1	OL2	SIEMENS	OVERLOAD RELAY (1.8-2.5 FLA)	3RU1116-1CB0
15	2	SS-2	ABB	3 POS. S.S. SPRG. RET. L TO C (2 N.O.)	M3SS7-30B-20
16	2	PL-1,2	ABB	GREEN F.V. PILOT LIGHT - 120V	CL-100G
17	6	PL-3-->8	ABB	RED F.V. PILOT LIGHT - 120V	CL-100R
18	1	PB-1	ABB	BLACK FLUSH P.B. (1 N.C.)	MP1-30B-01
19	1	ETM	ENM	ELAPSED TIME METER	T50B2-12
20	2	FU-7,8	EDISON	2 1/2 AMP CLASS CC FUSE	HCTR-2.5
21	1	FB-3	MERSEN	2P 30A CLASS CC FUSSE BLOCK	30322R
22	1	1T	SIEMESN	250VA CONTROL TRANSFORMER	MT0250A
23	1	FU-12	EDISON	3 1/2 AMP TIME DELAY FUSE	MEN-3.5
24	1	TR1	FINDER	4 POLE TIMER - 115V	85.04.0.125.0000
25	1	TR1	FINDER	4 POLE TIMER SOCKET	94.74
26	1	TR2	FINDER	2 POLE TIMER - 115V	85.02.0.125.0000
27	1	TR2	FINDER	2 POLE TIMER SOCKET	94.82
28	7	R1,2,3,4,5,6,7	FINDER	4 POLE RELAY - 115V	56.34.8.120.0040
29	7	R1,2,3,4,5,6,7	FINDER	4 POLE RELAY SOCKET	96.74
30	1	RECEP.	RED DOT	DUPLEX RECEPTACLE BOX	RIH31LM
31	1	RECEP.	LEVITON	DUPLEX RECEPTACLE	7899-3W
32	1	A.D.	SENSAPHONE	8 CHANNEL AUTO DIALER	FGD-800
33	24	T.B.'S	PHOENIX	TERMINAL BLOCK	3004362
34	1	T.B.'S	PHOENIX	TERMINAL BLOCK END COVER	3003020
35	2	T.B.'S	PHOENIX	DIN RAIL END RETAINER	0800886
36	2	GROUND	BURNDY	14-2 AWG GROUND LUG	DLA2

REVISIONS				
REV.	DATE	BY	CHKD.	DESCRIPTION
A	3/20/13	S.G.	G.A.	PRE-PRO CHANGES
B	4/12/13	S.G.	R.M.	ADDITIONAL LOW VAC. ALARM

J.E. CASHO & ASSOCIATES
PO# 11303057-2692
ICP S.O.# XXX
HP SEE DWG
VOLTAGE 460

TITLE: SVE CONTROL PANEL

DATE	PAGE	DWG NO.	
3/5/13	1 OF 2	CASH006	INTERNATIONAL CONTROL PRODUCTS, INC.

Measurement - Air Flow Meter

ROTRON®

FEATURES

- Direct reading in SCFM
- Low pressure drop (2-4" typical) across the flow meter
- Non-clogging, low impedance air stream
- Light weight aluminum
- No moving parts
- Large easy-to-read dial
- Accurate within 2% at standard conditions
- Good repeatability
- Available in 2", 3" and 4" sizes
- Factory configured for quick installation
- .048" Allen key supplied for gauge adjustment

OPTIONS

- Corrosion-resistant version with Chem-Tough ™ or in stainless steel
- FDA-approved Food Tough™ surface conversion

BENEFITS

- OPTIMIZE SYSTEM EFFICIENCY
  Measuring the correct air flow can assist you in fine-tuning to your system's optimal efficiency.
- BALANCE MULTI-PIPING SYSTEMS
  When evacuating CFM from more than one pipe, different run lengths or end system impedance can cause one pipe to handle more CFM than the other. With an accurate CFM reading, piping can be balanced by bleeding air in/out or by creating an extra impedance.
- DETECT CHANNELING OR PLUGGING
  For systems in which channeling or plugging can occur, a change in the CFM measured can help indicate the unseen changes in your system.

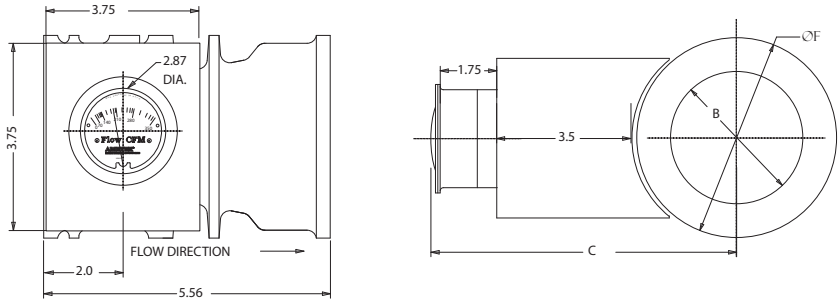
		Part/Model Number					
		FM20C030Q	FM20C045Q	FM20C065Q	FM20C125Q	FM20C175Q	FM20C225Q
Specification	Units	550599	550600	550601	550602	550603	550604
Flow Rate	CFM	2	2	2	2	2	2
	m3/hr	3.4	3.4	3.4	3.4	3.4	3.4
Threads B	-	6-30	9-45	13-65	25-125	35-175	45-225
Dimension C	Inches	7.18	7.18	7.18	7.18	7.18	7.18
	mm	182.4	182.4	182.4	182.4	182.4	182.4
Dimension D	Inches	7.0	7.0	7.0	5.8	5.8	5.8
	mm	177.8	177.8	177.8	147.3	147.3	147.3
Dimension E	Inches	2.0	2.0	2.0	2.0	2.0	2.0
	mm	50.8	50.8	50.8	50.8	50.8	50.8
Dimension F	Inches	3.75	3.75	3.75	3.75	3.75	3.75
	mm	95.3	95.3	95.3	95.3	95.3	95.3

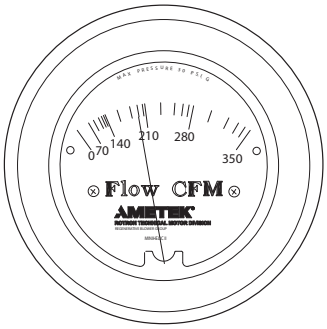
		Part/Model Number					
		FM30C250Q	FM30C350Q	FM30C475Q	FM40C450Q	FM40C600Q	FM40C850Q
Specification	Units	550605	550606	550607	550608	550609	550610
Flow Rate	CFM	2	2	2	2	2	2
	m3/hr	3.4	3.4	3.4	3.4	3.4	3.4
Threads B	-	50-250	70-350	95-475	90-450	120-600	170-850
Dimension C	Inches	7.18	7.18	7.18	7.18	7.18	7.18
	mm	182.4	182.4	182.4	182.4	182.4	182.4
Dimension D	Inches	7.0	7.0	7.0	5.8	5.8	5.8
	mm	177.8	177.8	177.8	147.3	147.3	147.3
Dimension E	Inches	2.0	2.0	2.0	2.0	2.0	2.0
	mm	50.8	50.8	50.8	50.8	50.8	50.8
Dimension F	Inches	3.75	3.75	3.75	3.75	3.75	3.75
	mm	95.3	95.3	95.3	95.3	95.3	95.3

AMETEK TECHNICAL & INDUSTRIAL PRODUCTS
75 North Street, Saugerties, NY 12477
USA: +1 215-256-6601 - Europe: +44 (0) 845 366 9664 - Asia: +86 21 5763 1258
Customer Service Fax: +1 215.256.1338
www.ametektip.com

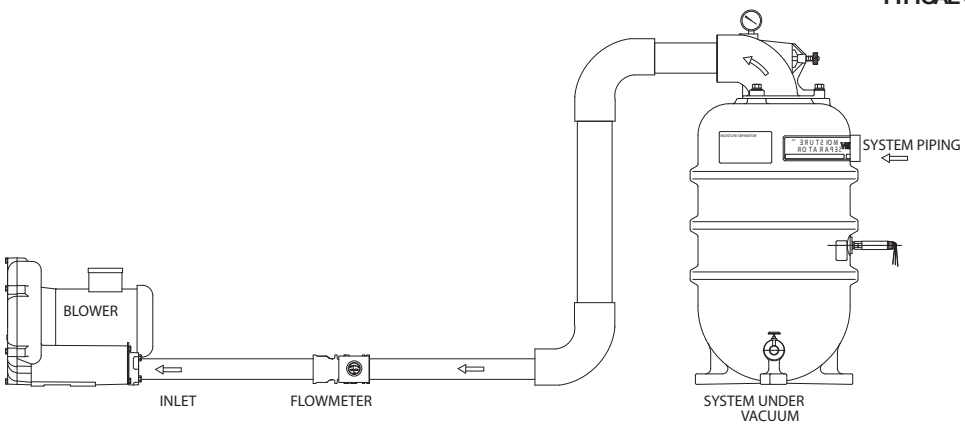
ROTRON®

TYPICAL FLOW METER ARRANGEMENT





TYPICAL GAUGE FACE



HIGH TEMPERATURE/PRESSURE CORRECTION

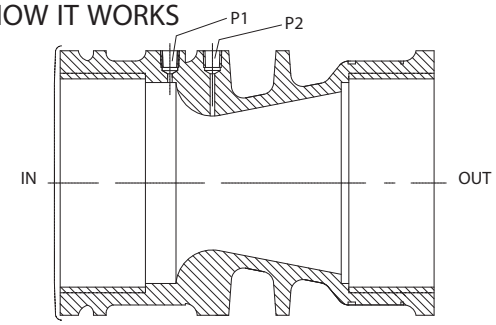
$$SCFM_2 = \frac{SCFM_1}{\sqrt{\left(\frac{14.7}{Pf_2}\right) \times \left(\frac{530}{Tf_2 + 460}\right)}}$$

Pf_2 = Absolute Pressure in PSIA

Tf_2 = Temperature in °F

- Use on inlet to limit need to correct for high pressure or elevated outlet temperature
- Standard model limits = 140°F and 30 PSIG

HOW IT WORKS



ROTRON'S flow meter is a venturi style design. After air enters the inlet, the pressure is measured in the P1 tap. The second tap, P2, measures the pressure at the throat. The differential between P1 and P2 registers across a special calibrated CFM gauge to provide accurate readings. The throat is then expanded back to the original size to keep pressure loss to under 2-4 IWG.

AMETEK TECHNICAL & INDUSTRIAL PRODUCTS
75 North Street, Saugerties, NY 12477
USA: +1 215-256-6601 - Europe: +44 (0) 845 366 9664 - Asia: +86 21 5763 1258
Customer Service Fax: +1 215.256.1338
www.ametektip.com

AMETEK® TECHNICAL & INDUSTRIAL PRODUCTS

AMETEK®
ROTRON TECHNICAL MOTOR DIVISION
REGENERATIVE BLOWER GROUP

75 North Street
Saugerties, New York 12477
Phone: (914) 246-3401
Fax: (914) 246-3802

OPERATION & MAINTENANCE MANUAL

Air Flow Meter

Thank you for purchasing an AMETEK Rotron Flow Meter. When matched with the correct Rotron blower, and properly installed and maintained, this meter will quickly and accurately measure the pipe flow. To ensure good results, please take the time to read these instructions before starting the installation of your air flow meter.

Sizing for Optimal Efficiency

CURRENT MODELS		MODELS FOR RELEASE JUNE '97		FLOW RANGE (SCFM)	THREADS	LENGTH	WIDTH	GAUGE PART #	BODY STYLE
MODEL	PART #	MODEL	PART #						
FM20A030Q	550312	FM20C030Q	550599	6-30	2.0" 11.5 NPSC	6.94"	5.49"	550321	A
FM20A045Q	550313	FM20C045Q	550600	9-45				550322	
FM20A065Q	550314	FM20C065Q	550601	13-65				550323	
FM20A125Q	550256	FM20C125Q	550602	25-125		5.34"		550290	B
FM20A175Q	550255	FM20C175Q	550603	35-175				550291	
FM20A225Q	550254	FM20C225Q	550604	45-225				550292	
FM30A250Q	550259	FM30C250Q	550605	50-250	3.0" 8.0 NPSC	7.38"	7.62"	550293	C
FM30A350Q	550258	FM30C350Q	550606	70-350				550294	
FM30A475Q	550257	FM30C475Q	550607	95-475				550295	
FM40A450Q	550262	FM40C450Q	550608	90-450	4.0" 8.0 NPSC	7.68"	8.62"	550296	D
FM40A600Q	550261	FM40C600Q	550609	120-600				550297	
FM40A850Q	550260	FM40C850Q	550610	170-850				550298	

Installation

1. **Unpacking** -- Open box carefully. Do not cut box open. Lift top packing material off. The air flow meter is placed between the two foam materials for protection.

2. **Piping** – The flow meter should be installed horizontally on the inlet side of the blower. Since this device is directional, please observe the flow direction arrow. Rotron suggests using a length of straight pipe equivalent to three to five pipe diameters prior to the meter for any elbows, valves, etc., unless there is a tee. If there is a tee, the suggested equivalent length is eight to ten pipe diameters. The flow meter should have two pipe diameters of straight pipe after the flow exits the meter before any elbows, tees, valves, etc.

3. **Continuous Service** – Moisture and debris should not be allowed to enter the tubes leading into the gauge, as it may affect the gauge. Orient the gauge between 10 o'clock and 2 o'clock when viewed from end. (See Figure 1).

   If the gauge does not read zero, gently press down on gauge cover while turning counterclockwise to remove cover. Zero the gauge with the allen wrench and reattach cover.

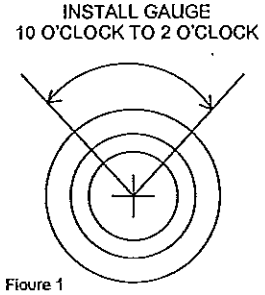
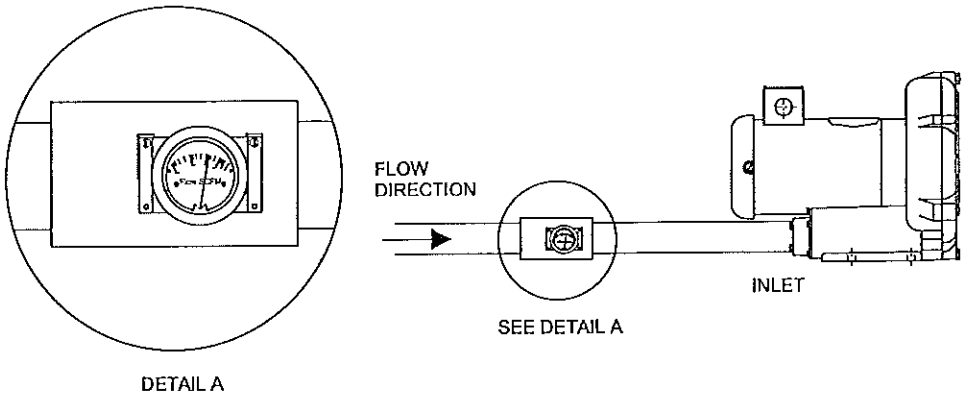


Figure 1

4. **Interchangeability** – Gauges are interchangeable within body styles, e.g., gauge 550321 and 550323. Gauges from different body styles are not interchangeable, e.g., gauge 550321 and 550290 or 550321 and 550293. Note the proper hose connections as shown in detail B.

Typical Arrangement



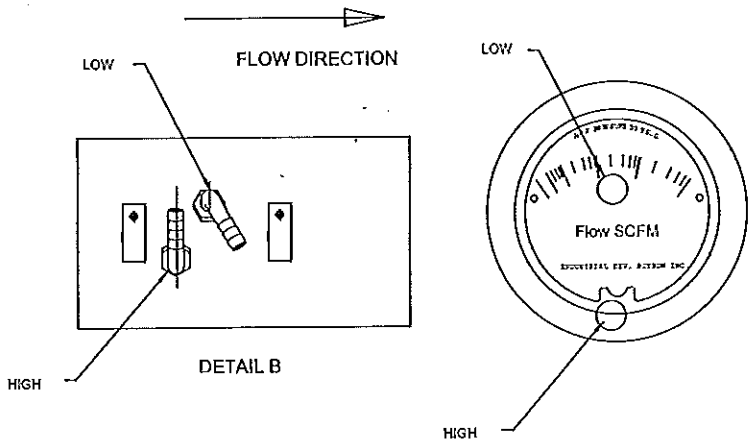
Operation

Rotron's Flow Meter is a venturi style design. After air enters the inlet, the pressure is measured in the high pressure tap. The second tap measures the pressure at the throat. The differential between the taps registers across a specially calibrated gauge to provide accurate readings. The throat is then expanded back to the original size to keep pressure loss to under 2-4 IWG.

Maintenance

This air flow meter has been designed to require minimal maintenance. During normal operation, little maintenance is required. Care should be taken to ensure no debris enters the meter.

If the tubes become plugged, remove and clean. Do not switch the low and high hoses. Note proper orientation of hoses.

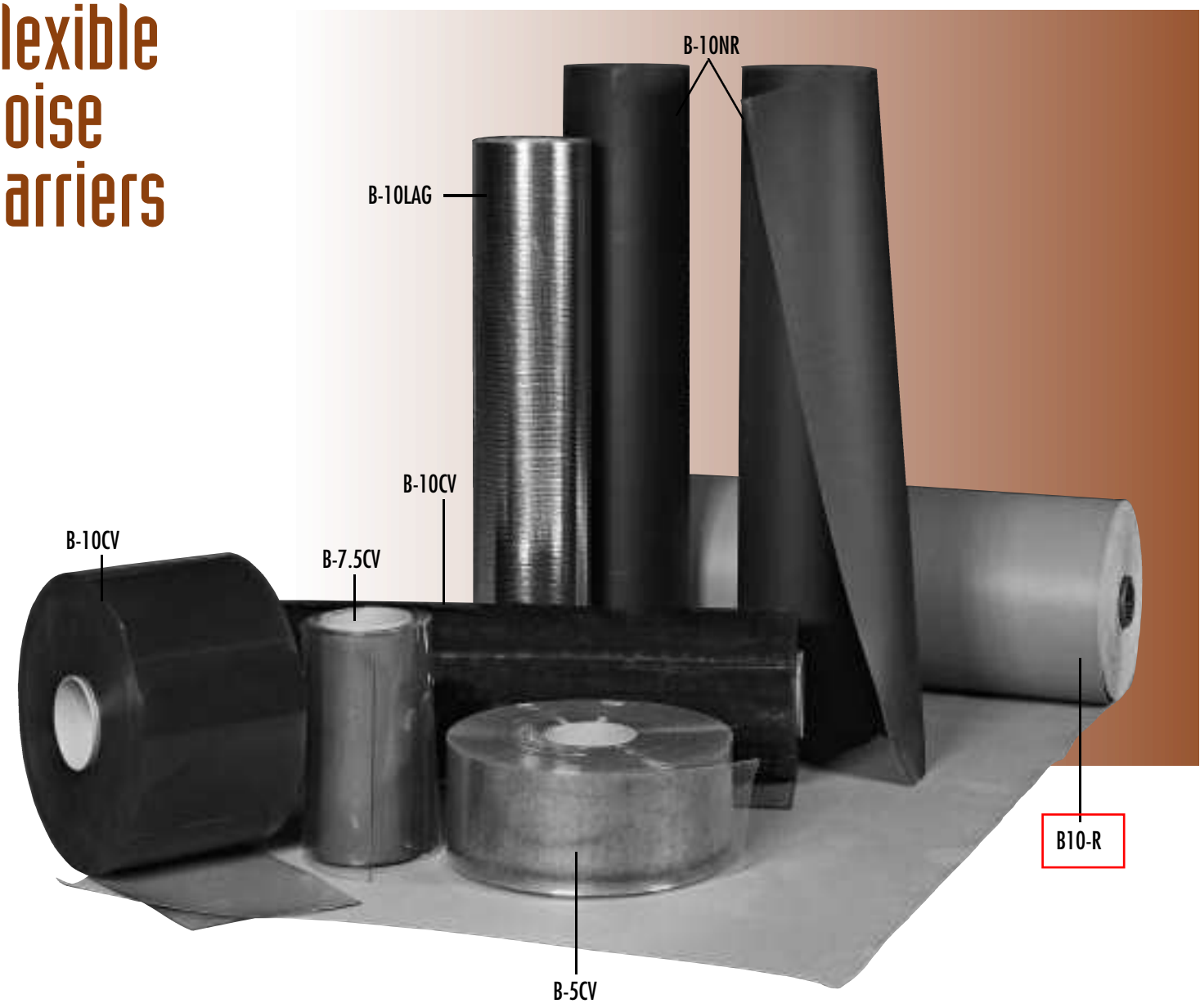


If you have any questions regarding this product, contact your local sales representative or our Application Engineering Department at the factory.

Barricade™
NOISE CONTROL PRODUCTS

Bulletin
SS-104

Flexible Noise Barriers



FEATURES:

- ✦ Loaded vinyl noise barriers
- ✦ Reinforced, non-reinforced, transparent and foil-faced lag styles
- ✦ Mass loaded barriers from 1/2 lb. to 2 lbs. per sq. ft.
- ✦ Acoustical ratings: STC-20 thru STC-31
- ✦ Limp, flexible, formable, versatile
- ✦ High tear and tensile strength
- ✦ For industrial, construction, commercial, residential and OEM applications

SOUND SEAL®

Barricade™ Flexible Noise Barriers are available in a variety of styles to meet a multitude of applications.

Non-Reinforced Barriers:

B-10NR

- 1 lb. PSF **non-reinforced** loaded vinyl noise barrier
- Low-cost, often used between dry wall and stud construction to substantially improve transmission loss between rooms (see photo)
- Used as the barrier septum material in acoustical curtain and foam composites
- An economic acoustical pipe or duct wrap
- Utilized as a rooftop equipment noise barrier
- Used as a noise barrier ceiling tile (typically in conjunction with a fiberglass decoupler) above standard suspended ceiling systems
- Used underneath carpeting to improve transmission loss of floor

B-5NR

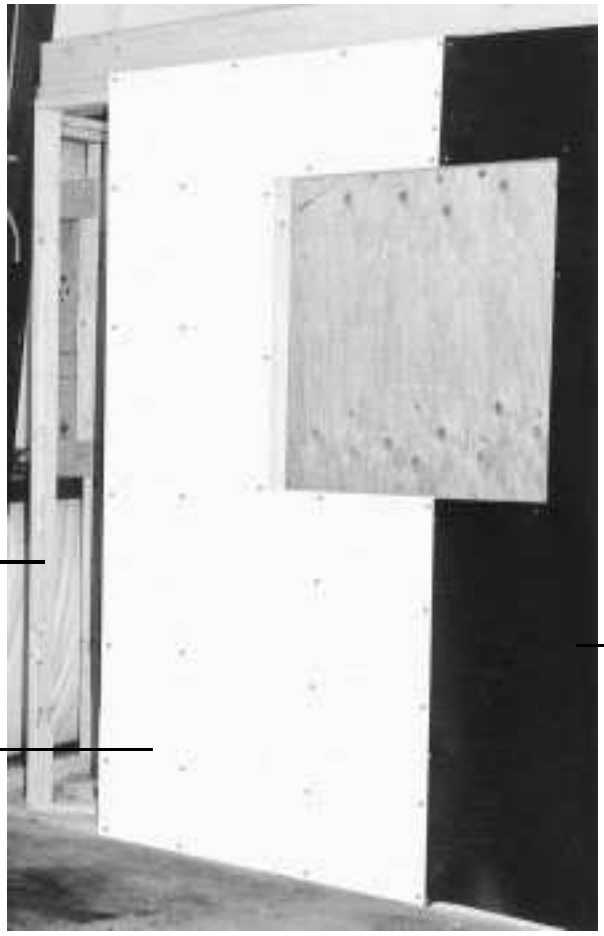
- 1/2 lb. PSF version of the above
- Used where weight restrictions require a lighter weight barrier

B-20NR

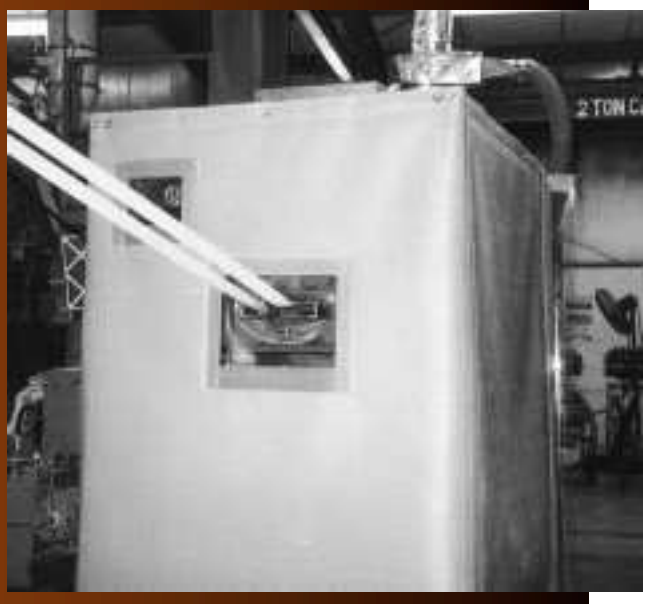
- 2 lb. PSF version of the above
- For applications requiring greater noise reduction, especially at lower frequencies

B-10CLA

- 1 lb. PSF non-reinforced flexible loaded vinyl noise barrier
- **Class A (1) flammability rating per ASTM E-84 (surface burning characteristics of building materials)**
- For commercial, construction, in-plant, residential or OEM requirements



B-10 NR attached to studs before drywall is installed will significantly reduce noise transmission between rooms.



B-10R Flexible Noise Barrier material fabricated into Acoustical Curtain Panels with grommets at top and hook and loop fasteners sewn along each edge.

Reinforced Barriers:

B-10R

- 1 lb. PSF **reinforced** loaded vinyl noise barrier
- High-strength polyester fabric reinforcement is utilized in the center of the barrier to dramatically improve its durability, tear and hanging strength
- Excellent outdoor UV and weather resistance
- Can serve as accordion fold access door
- Used as a free hanging acoustical curtain panel, typically with grommets at the top and hook and loop fasteners along each edge (see photo)
- When used in combination with a Quilted Fiberglass Sound Absorber, (BBC-13, BBC-13-2"F) can offer STC Ratings up to 32 (See Bulletin SS101)
- Standard color is gray. Tan and blue are also available

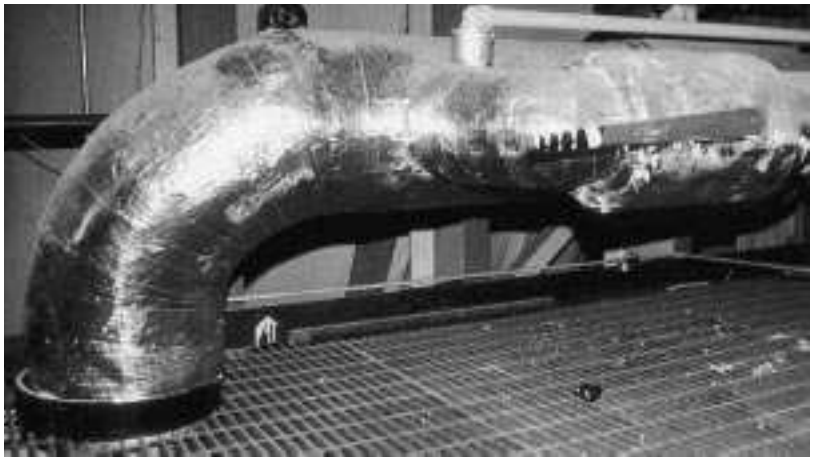
B-5R

- 1/2 lb. PSF **reinforced** loaded vinyl
- Same properties as above, utilized where weight restriction require a lighter weight material

Pipe and Duct Lagging:

B-10 LAG

- 1 lb. PSF reinforced-**foil faced** loaded vinyl noise barrier
- Acoustical wrap for noisy pipes, duct work, valves, heat exchangers
- Easy to cut, wrap and install with matching lag tape
- May be combined with quilted fiberglass decoupler to improve acoustical performance, thermal conductivity and lower installation costs
- **Class A flammability rating requirements per ASTM E-84**
- Durable reinforced foil facing serves as protective jacket as well as readily accepts matching tape



B-10 LAG/QFA-3 Acoustical Pipe Lag installed on 12" diameter pipe with matching lag tape. See Sound Seal bulletin SS-105 for additional information.

Clear vinyl strip installed on loading dock door allows easy access while offering thermal protection and noise reduction.

Transparent Barriers:

- Flexible **transparent** barrier materials offer significant noise reduction while allowing for visibility and easy access
- Also utilized to reduce heat and cold loss between areas
- Sheet material is often utilized as a view window in Sound Seal Acoustical Curtain Panels
- CV strip doors are often incorporated into Acoustical Curtain Enclosures for easy access
- Mounting angles and hardware are also available.
- Furnished in three standard products:

B-10 CV

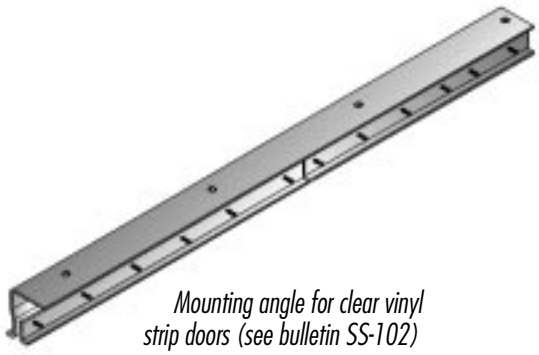
- 1 lb. PSF
- 16" wide strips
- 48" wide sheets
- Curtain panels with grommets at top and velcro edges
- Custom-sized window covers

B-7.5 CV

- 3/4 lb. PSF
- 12" wide strips
- 48" wide sheets
- Custom-sized fabrications

B-5 CV

- 1/2 lb. PSF
- 8" wide strips
- 48" wide sheets
- Custom-sized fabrications



Mounting angle for clear vinyl strip doors (see bulletin SS-102)

Specialty Barriers:

B-10MB

- 1 lb. PSF barrier material with a woven-fiberglass cloth facing
- Typically referred to as **"marine barrier"**
- Superior fire ratings when installed against bulkheads, etc.

B-10L

- 1 lb. PSF **lead** sheet
- Commonly used as a septum product in acoustical composites
- Utilized where radiation or RF resistance are required in addition to noise reduction

Flexible Barriers

Noise Transmission Loss

Barriers	Noise Transmission Loss (dB) Per Octave Band (HZ)						STC
	125	250	500	1000	2000	4000	
2 lb. PSF	16	22	26	32	35	40	31
1 lb. PSF	13	17	22	26	32	37	26
3/4 lb. PSF	11	16	20	25	30	34	23
1/2 lb. PSF	8	13	17	22	27	31	20

Per ASTM: E 90 (90A)

Physical Properties

Product	Nom. Thickness (in.)	Nom. Weight lb/sq. ft.	Description	Roll Size	Additional Details
B-10 NR	.107	1.0	Non-Reinforced	54" W x 60' L	See Bulletin SS101
B-5 NR	.042	.5			
B-20 NR	.225	2.0			
B-10 R	.090	1.0	Reinforced		
B-5 R	.050	.5			
B-10 LAG	.090	1.0	Foil Faced	48" W x 60' L	See Bulletin SS105
B-10 CV	.160	1.0	Transparent	16" W x 100' L & 48" W x 60' L	Mounting Hardware Details See Bulletin SS102
B-7.5 CV	.120	7.5		12" W x 200' L & 48" W x 60' L	
B-5 CV	.080	.5		8" W x 300' L & 48" W x 60' L	
B-10 CLA	.109	1.0	Class A	54" W x 60' L	SS104
B-10 L	.020	1.0	Lead Sheet	48" W x 25' L	
B-10MB	.100	1.0	Marine Barrier	38" W x 45' L	

Additional information on tensile, breaking and tear strengths, elongation, chemical resistance, flammability, etc. available upon request.

The test results reported were obtained using standard laboratory procedures recognized by the technical community. The data is valid as a measurement of the material under specific controlled test conditions. However, this data does not represent an accurate indicator of the performance of the material or of the hazards which may exist under actual field conditions.

Distributed By

For OEM Applications see Sound Seal Bulletin SS-203

SOUND SEAL®
50 H. P. Almgren Drive
Agawam, MA 01001
TEL: 413.789.1770
FAX: 413.789.2248
e-mail: sales@soundseal.com
www.soundseal.com