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

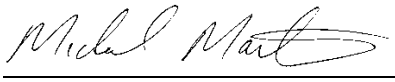
Prepared for:

Lockheed Martin Corporation

Prepared by:

Tetra Tech, Inc.

September 2013



Michael Martin, P.G.
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APPENDICES

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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 microgram[illegible]

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 al

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 (Vem

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 streatst vä

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^{È} Rotron^{È} 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 200ÜF to approximately 125ÜF. Cooling the extracted vapor protects the GAC units from temperatures in excess of their maximum (140ÜF) temperature limit. A Hand map(o ppr
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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 Techôs 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 thee

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

Table 2-2
Major System Equipment Component Details
Building C Sub-Slab Depressurization System
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Equipment	Manufacturer	Supplier	Model	

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

Section 3
System Operation

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

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 (GA@Jti,t T rl 3.wolatt cs rl 3.w

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

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^{È} 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^{È} 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.

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

eme area	Vapor extraction point	Associated vapor monitoring points	Monitoring frequency	Basement area	Vapor extraction point	Associated vapor monitoring points	Monitoring frequency
n ment	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

Section 4

System Startup and Shutdown Procedures

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 b i a ȯŎC c rsitiĕ ne he

Section 5
Troubleshooting

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 fod` ATU

X

X

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.

APPENDIX Að AS-BUILT DRAWINGS

APPENDIX Bð SYSTEM-CHECK FORMS

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

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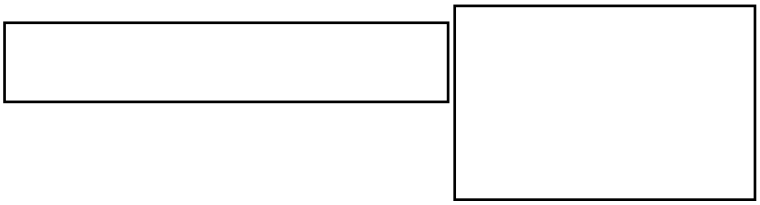


SECTION 4 - REACTIVITY HAZARD DATA

STABILITY
☐ Stable
☐ Unstable

Conditions
To Avoid

Incompatability
(Materials to Avoid)

Hazardous
Decomposition Products

HAZARDOUS POLYMERIZATION
☐ May Occur
☐ Will Not Occur

Conditions
To Avoid

SECTION 5 - HEALTH HAZARD DATA

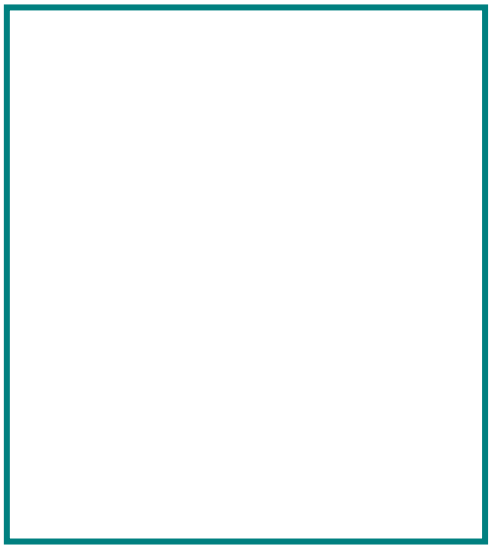
PRIMARY ROUTES OF ENTRY

☐ Inhalation ☐ Ingestion ☐ NTP ☐ OSHA
☐ Skin Absorption ☐ Not Hazardous ☐ IARC Monograph ☐ Not Listed

HEALTH HAZARDS

Signs and Symptoms

460 West Gay Street
West Chester, PA 19380



Tetra Tech Geo

51 Franklin Street
Suite 400
Annapolis, MD 21401

Operation and Maintenance Manual

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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			

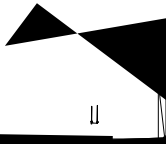
DIMEN

SCALE

TOLERANCE ANGULAR TOLERANCE

MATERIAL WEIGHT

REV. DATE DESCRIPTION SHEET OF



REV. DATE

Industrial / Chemical Processing Blowers

DR 858 & CP 858

7.5 / 10.0 HP Regenerative Blower

Industrial / Chemical Processing Blowers

DR 858 & CP 858

7.5 / 10.0 HP Regenerative Blower

ROTRON

SERVICE AND PARTS MANUAL
FOR
BLOWER MODEL

DR6, 858, 909, 979, 14

DIRECT DRIVE REGENERATIVE BLOWER

AMETEK

Your Choice. Our Commitment.™

WARRANTY, INSTALLATION, MAINTENANCE AND TROUBLESHOOTING INSTRUCTIONS

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

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

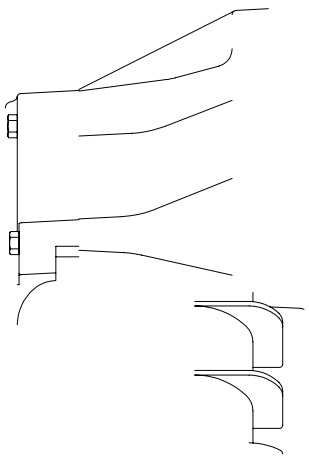
7) Arbor disassembly (Applicable on remote drive models only):
   a) Slide the bearing retraining sleeve off the shaft at the blower end.
   b) Remove the four (4) screws and the bearing retaining plate from the blower end.
   c) Lift the shaft assembly far enough out of the arbor to allow removal of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

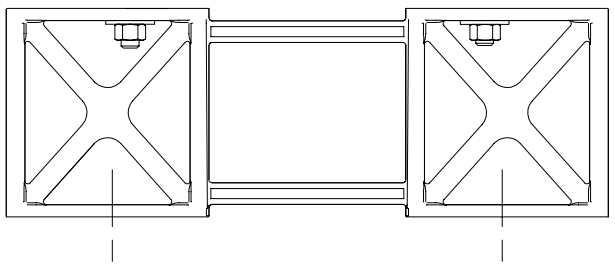
Impeller Shimming Procedure:

A. **1Ø, 6 WIRE**

	115 VAC		**230 VAC**	
1		1	**LINE**	
3	**LINE**	2		
5		3		
2		5		
4	**LINE**	4		**LINE**
8		8		

INTERCHANGE LEADWIRES 5 & 8 to REVERSE ROTATION





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			

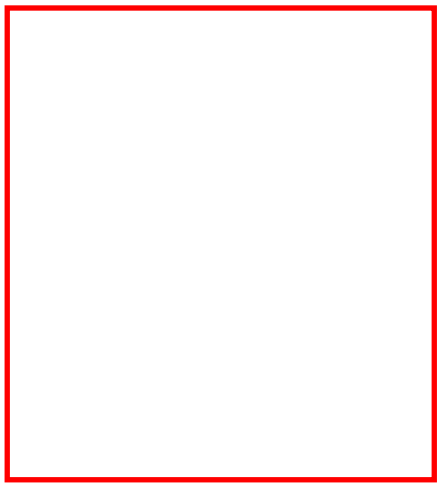
*As needed **Viewed looking atinlet/outlet ports

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			

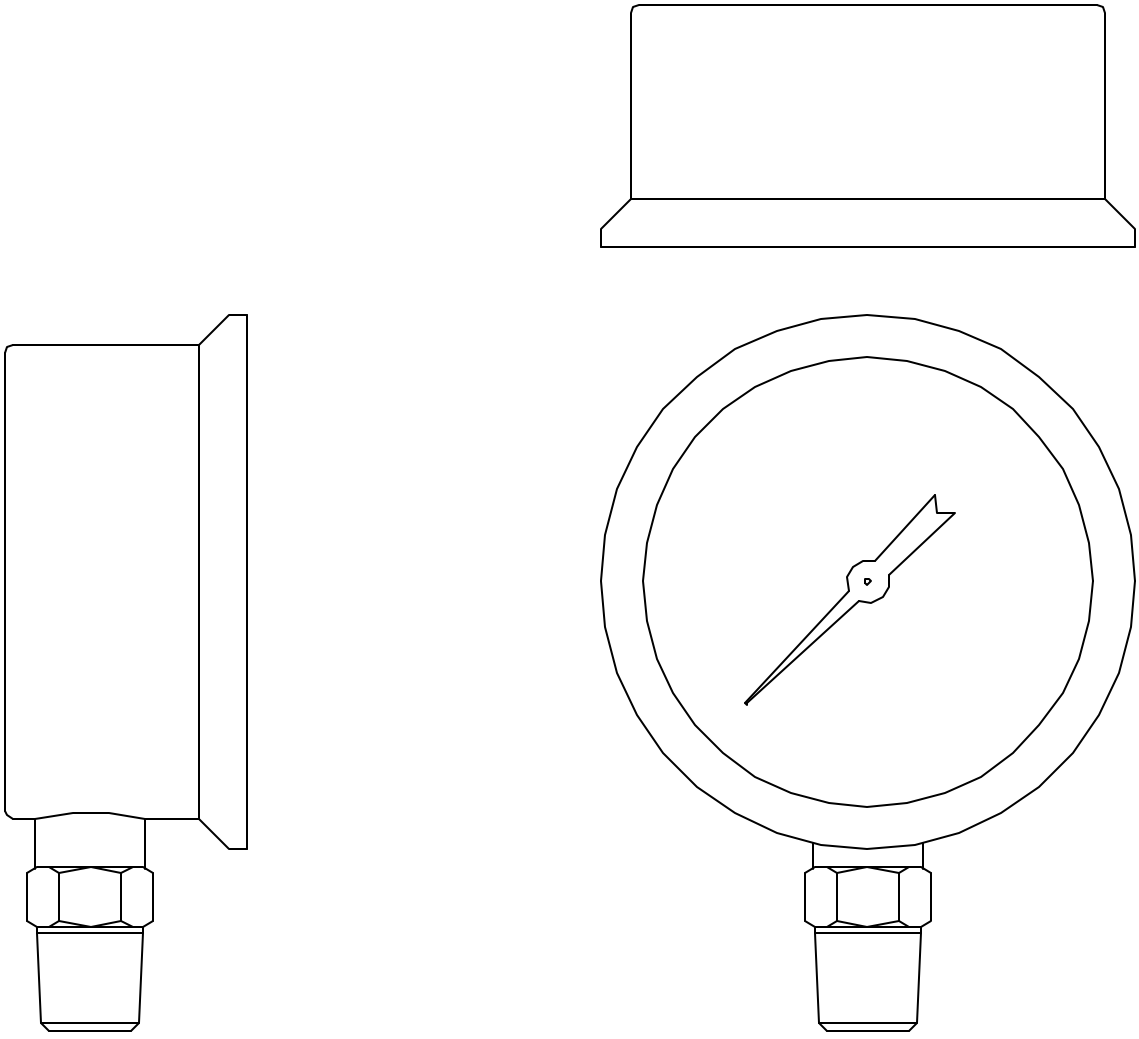
*As needed **Viewed looking atinlet/outlet ports

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			



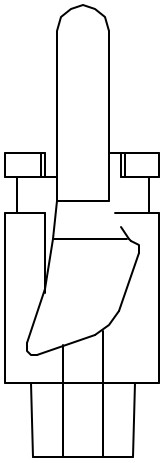
IPG’s 64 series brass ball valves comply with the latest

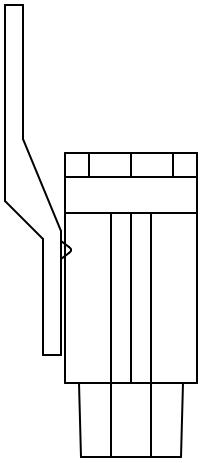


DIMENSIONS IN INCH

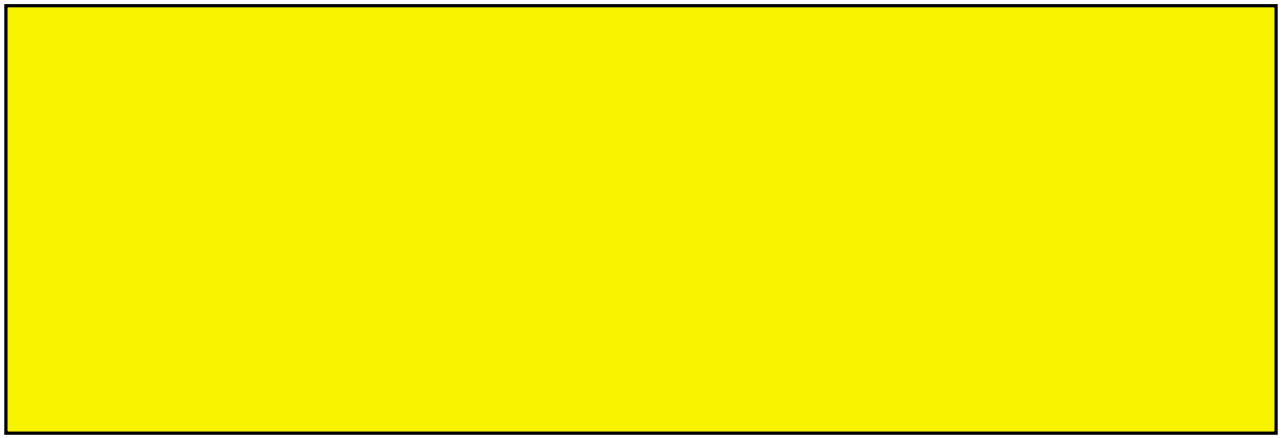
J. E. GASHO & Assoc., Inc.

WEST CHESTER, PENNSYLVANIA 19380





025 SERIES BALL/4 vLHxTd(Body Options)Tj/T



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

At Min. Set Point
0.025
0.04
0.10
0.15
0.3
0.4
0.4

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.

Select A Model 110 Dial Size

20-110
2 Inch

30-110
3 Inch

3 Inch Dial Size

Size & Model Number:
NPT Connection Size & Type:

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	

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 e

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

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

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Ashcroft Inc. st n tr t tr tfor C A
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Ashcroft Inc. [illegible] A
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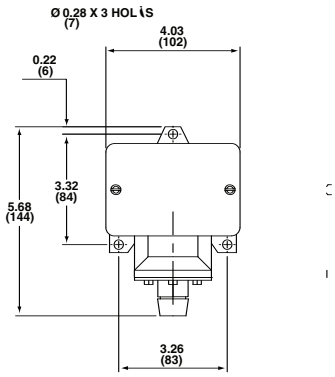
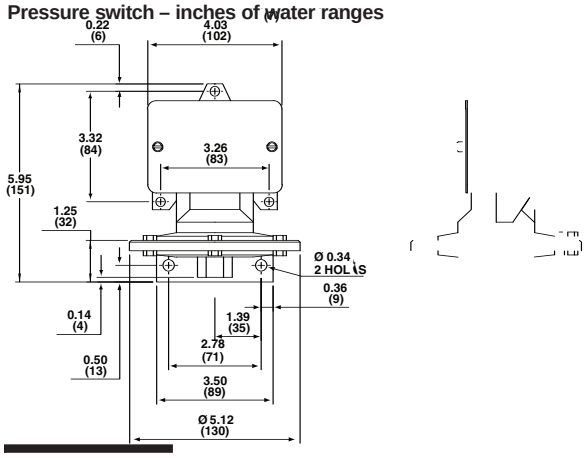
B-Series Switches – Pressure, Differential Pressure, Temperature & Hydraulic

Dimensions – 400 Series

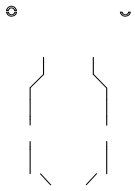
Pressure switch – psi ranges



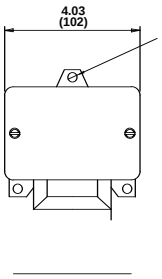
Pressure switch – inches of water ranges



Differential pressure switch – psi differential ranges



Differential pressure switch – inches of water ranges



Temperature switch – direct mount

Temperature switch – remote mount

All specifications are subject to change without notice.
All sales are subject to standard terms and conditions.
Ashcroft Inc. 2012

Ashcroft Inc. 250 East Main Street Stratford, CT 06614-5145 USA
T (203) 378-8281 F (203) 385-0408
Email: info@ashcroft.com www.ashcroft.com

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3 6;<. 86;<6: 1- #+%'"
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5;, 74;89!9:7

4 GBKLM> 6>H: J: LGJK

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7 A>P : J> LPHB<: LDD MK>= GF LA> BFD>LG?N <MME KPKL>E KLG J>E GN> O: L>J : F= GLA>J
<GFL: E BF: FLK; >?GJ> LA>P >FL>J LA> N <MME HME H#7 A> : BJ NGLME > G? LA> E GBKLM>
K<H: J: LGJ J>=M<>KLA> N>LDG<BP G? LA> : BJ KLJ>: E LG: LDDO LBK MB=KLG HJ><B=HB: L>#8 HLG-)
O: L>J J>E GN DBKHGKKB, D#7 A> E G=>LK0 9 "(% 0 9 "*%: J> J: L>= ?GJ ?MDDN <MME #5 LA>J
E GBKLM> K<H: J: LGJK: J> J: L>= LG &; BF#1 @#ABG@A>J N <MME J: LBF@K: N BD; D#
6L: F=: J= : <<>KKGJB>KBF<DM=>: KBG@AL@M@! =J: BF N LD>! : F= : A: F= GH>J: L>= KDM=@>
HME H#2FKB=> LA> LGHG? LA> K<H: J: LGJKBK: ; : KC>LOBLA QJB'H: <CKR=>E BKL>J E : L>JB DLG
HJGE GL> <GF=>FK: LBGF G? N HGJK#
5 HLBGFKBF<DM=>. &LG(D>N>DKOBL<A>K : MLGE : LB< HME H=GOF KPKL>E K A>: LLJ: <BF@
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4 F>?C 5 FD BE; C 3B+LB> . B;D ?K?I 1 ?B@AK 2EC?K . B=A; I@? - C?; EFLK 9 ?B@AK

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.

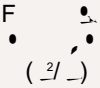
If there are accessories attached to the moisture separator follow the operating and maintenance instructions for those items

Features

1 , 1 ¼”, 2 , ½”.

Benefits

Properties Table

(_ .)	1	1 1/4	2	3 1/2
F  (_²/ _)		0		
 (1/ _)	2	2	1	12

Generalized Flooding Curves

Plastic Jaeger Tri-Packs®

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/ft^3

Conversion Factors

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

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

*) (+ 3 GBGG@H4 HBK@ 9 $B $2 FM' (&-
6 =EBFL F>" < 5$+* ((' # (&-
/ (&! , . (#, ' -) N / (&! , . (# , / /
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C HA@HBD =A@

Lightweight, economical

Durable – tough Delrin® plastic

Chtwei

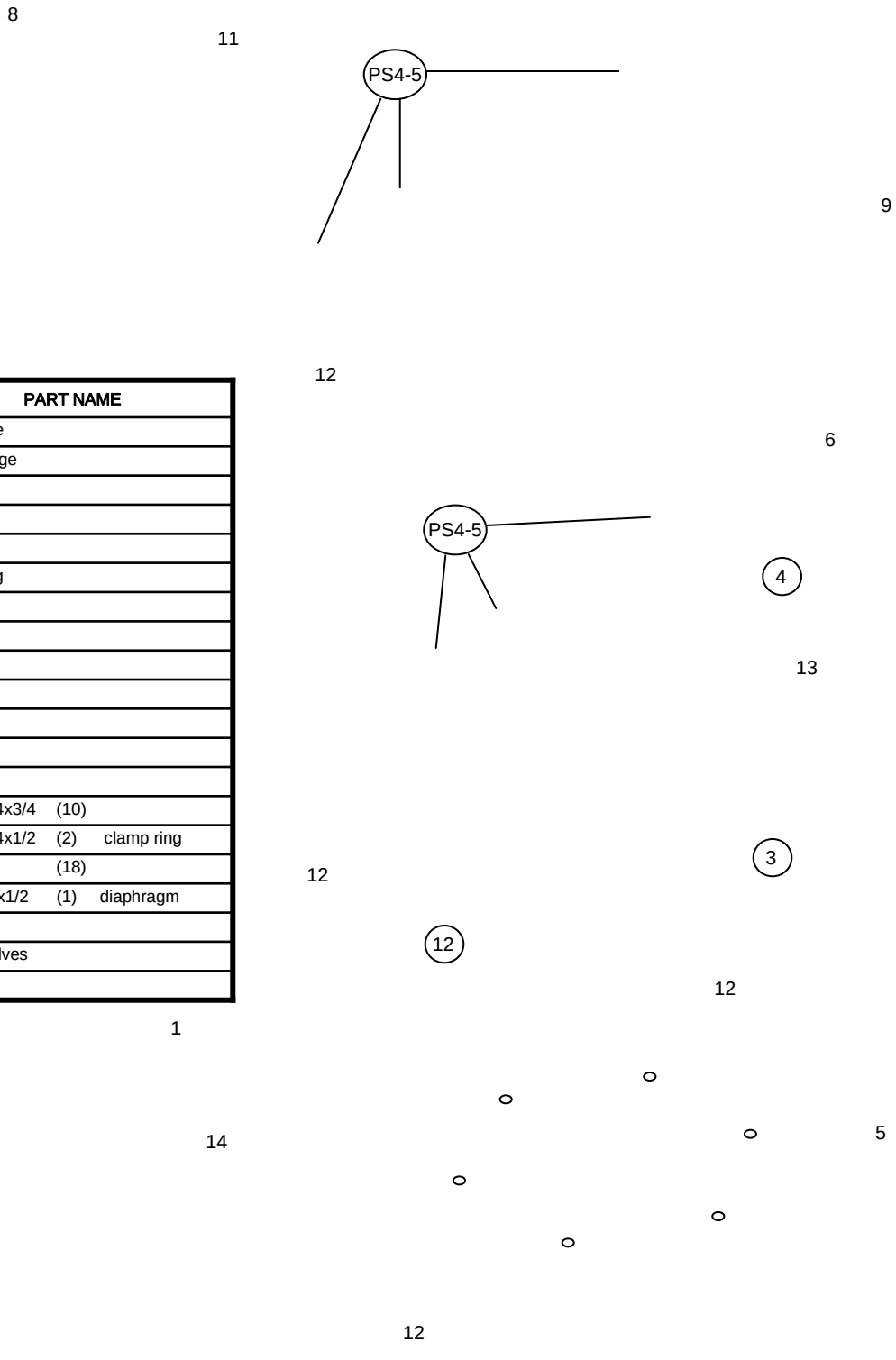
Hand-Operated Diaphragm Pumps

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	
	PPH10-24x3/4 (10)
	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

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

ass I, Groups *A, B, C & D
ass II, Groups E, F & G
ENELEC: EExd IIC T6 (T amb=75ºC)
Group A, stainless steel body only)

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).

CENELEC models only: push-in type terminal blocks

Round SS float –0.7
Cylindrical SS float – 0.5

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		

Model Number	Float	Pressure Rating PSIG (KG/CM²)
L6EPB-B-S-3-A	Cylindrical SS	200 (14)

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

ound screw is for supplementary bonding when allowed or
y local code. Some CSA listed models are furnished with a
reen ground wire. Such units must be equipped with a junc-

external gr
required by
separate gr

onduit and enclosures must meet applicable codes for

through the wall.

Inspect and clean wetted parts at regular intervals.

All wiring, c

ICAL CONNECTIONS

Blue = N.C. and red

Dimensions on reverse

screw inside the housing must be used to ground the control. The

MODEL L-6 FLOAT SWITCH — DIMENSION DRAWINGS

Xchanger, Inc.	**Rating for Model AA-250 ref #110744**		**Page 1 of 1**
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	

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

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.

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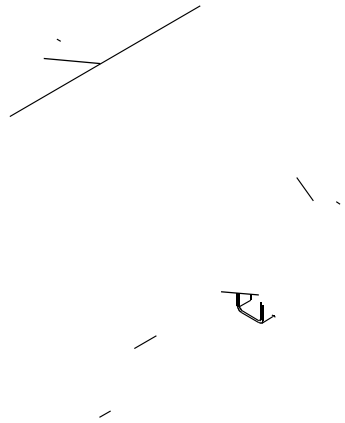


2.0 RECEIVING THE HEAT EXCHANGER

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.

3.2 AA/LC SERIES

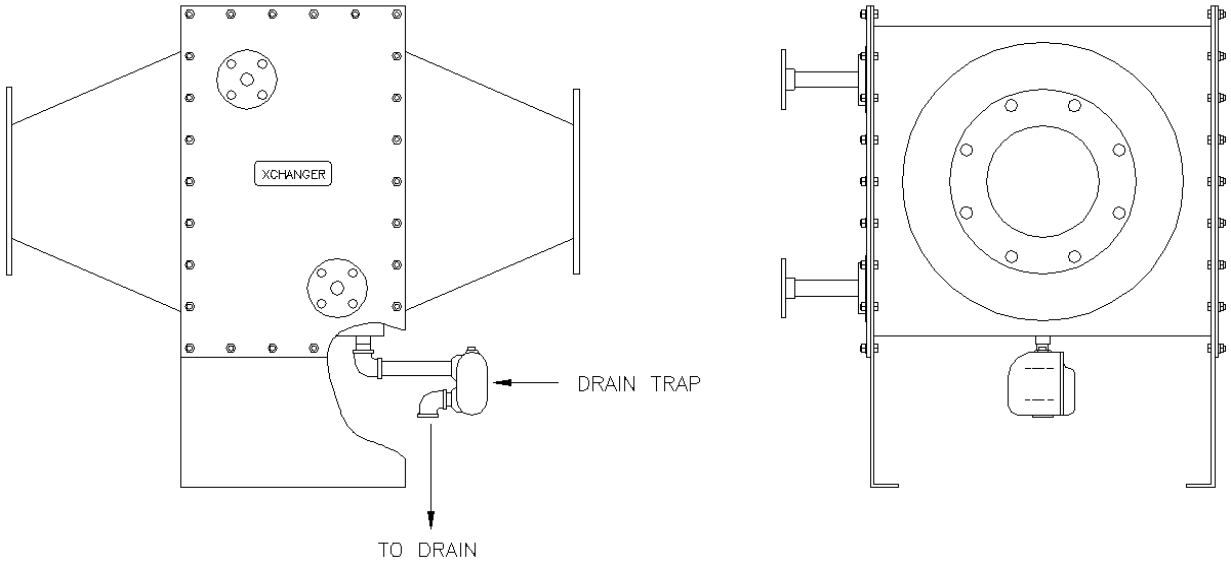
The heat exchanger should be mounted in a well ventilated area, preferably outdoors, as these units dissipate heat to the ambient air. If the unit is installed indoors and ducting of

- 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).
-

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

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

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

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

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.

PA E PA

C HP E IE

Nor a y, no spare parts are reco ended If a spec f c exch anger nc udes spec a parts or accessor es th at cou d be a spare part, or f an accessory tse f uses spare parts, th ey wou d be noted on th e data sh eet, cert f ed draw ng, or on acco pany ng docu entat on

P ease note th at th e anufactur ng and sh pp ng t e for rep ace ent cores s often wee s If th s engt h of downt e wou d present a s gn f cant prob e , t ay be adv sab e to stoc a spare core

AA LC E IE

A spare e ectr c otor s reco ended

H E IE

Nor a y, no spare parts are reco ended ar to th e C HP er es above, any spec a parts wou d be noted on a case by case bas s

8.0 GUARANTEE

8. DURATION

The sooner of either:

- months from date of start-up.
- 8 months from date of shipment from Xchanger.

8. 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. 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 wilE

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

Accessories

Measurement - Air Flow Meter

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

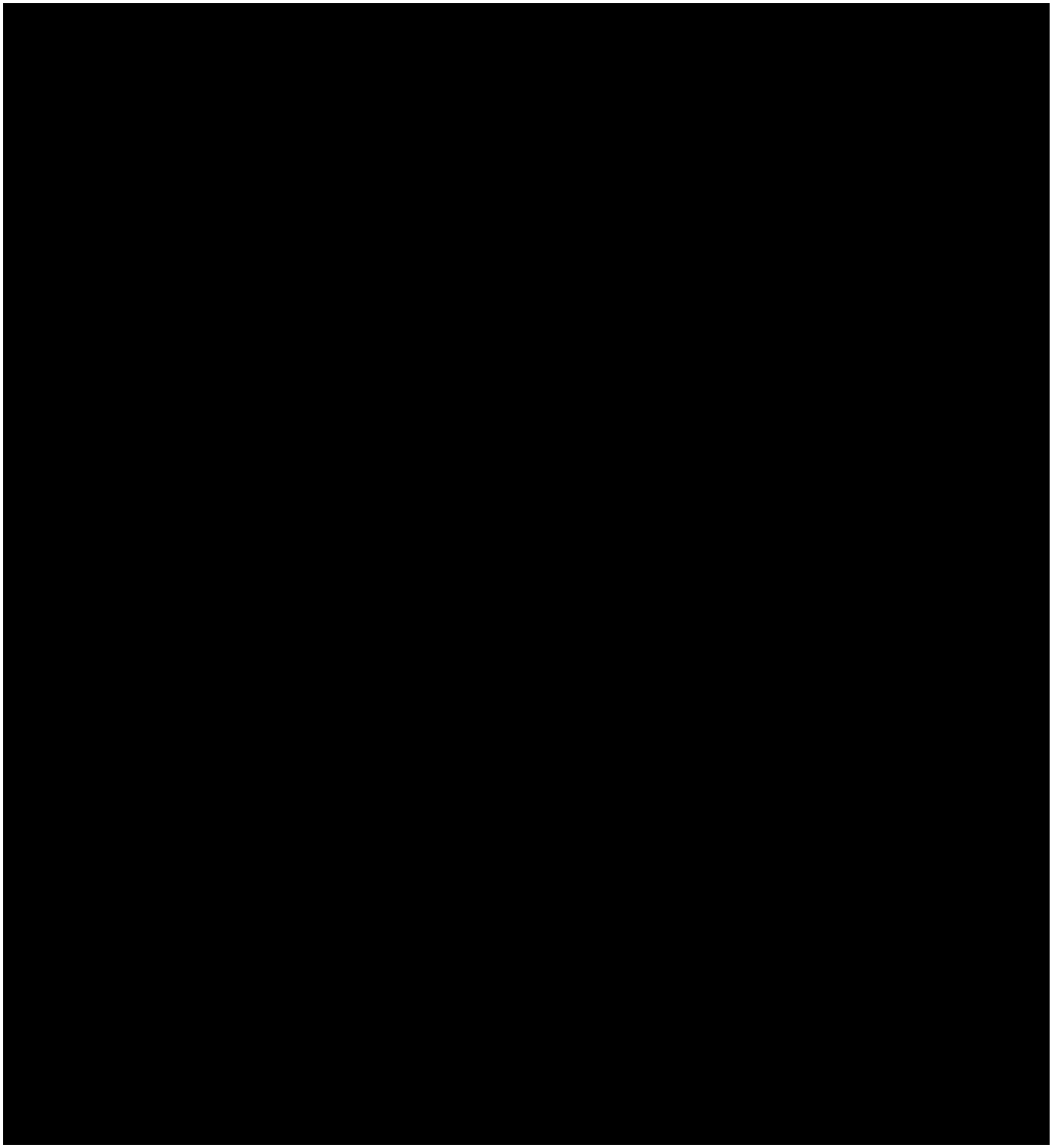
BENEFITS

- 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	
					2.0	2.0	2.0
				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				
						2	2
						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		
	mm	182.4	182.4	182.4			

Measurement - Air Flow Meter



This document is for informational purposes only and should not be considered as a binding description of the products or their performance in all applications. The performance data on this page depicts typical performance under controlled laboratory conditions. AMETEK is not responsible for blowers driven beyond factory specified speed, temperature, pressure, flow or without proper alignment. Actual performance will vary depending on the operating environment and application. AMETEK products are not designed for and should not be used in medical life support applications. AMETEK reserves the right to revise its products without notification. The above characteristics represent standard products. For product designed to meet specific applications, contact AMETEK Technical & Industrial Products Sales department.

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