HAPMAN
Ideas that move

Vacuum Conveyor

Installation, Operation and Maintenance Manual

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All owners and operators should read this manual and/or be instructed on safe operating and maintenance procedures before attempting to uncrate, install, operate, adjust or service this equipment

Following are symbols used in this manual along with a description of their meanings:

DANGER
Indicates an imminently hazardous situation which, if not avoided, will result in death or severe injury.

WARNING
Indicates a potentially hazardous situation which, if not avoided, will result in death or severe injury

CAUTION
Indicates a potentially hazardous situation which, if not avoided, may result in minor/moderate injury and/or damage to equipment.

HAPMAN

MiniVac™ PNEUMATIC CONVEYOR

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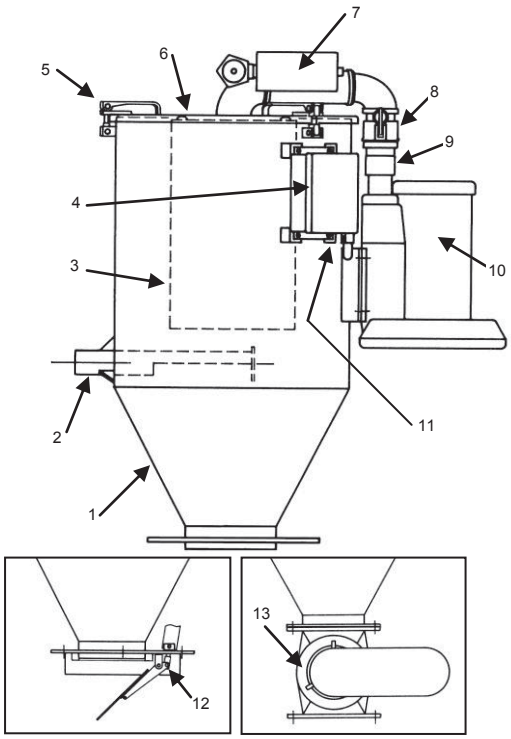
9. Vacuum Breaker (If Required)
10. Regenerative Blower
11. 80 PSI (Dry) Air Connection
12. Discharge Gate
13. Rotary Valve

NOTE: The marker numerical designations listed in this illustration are for reference purposes only within this manual.



1.0 Warranty

Equipment manufactured by Hapman is warranted to be free of defective material and workmanship under the use and service quoted for a period of one year after date of shipment. This warranty is void if serviced by anyone other than Hapman service personnel.

Hapman agrees to replace or repair any defective parts it has manufactured as covered under this warranty. F.O.B. our plant, subject to inspection of the part in question by Hapman's personnel. No article may be returned to Hapman without Hapman's written consent.

Parts supplied but not manufactured by Hapman are subject to the warranties extended to Hapman by its suppliers. Hapman's liability is limited to such adjustment as the respective manufacturer makes to the seller.

In no event shall Hapman be liable for costs incurred due to equipment malfunction such as consequential damages, lost production or the expenses or losses incurred due to geographical location or fault of the product, difficulty of access to the product as installed, or time urgency on the part of the user and/or buyer of the equipment.

NOTICE:
While all information in this manual has been checked for accuracy, changes in design or specifications may occur at any time in HAPMAN's continuing program of product improvement. HAPMAN cannot assume responsibility for errors in the production of this manual, or for unsafe operating practice of those employing HAPMAN equipment.

WARNING

BEFORE INSTALLING, OPERATING OR MAINTAINING ANY EQUIPMENT, THE CONTENTS OF THIS MANUAL SHOULD BE THOROUGHLY REVIEWED AND UNDERSTOOD.

Statements and instructions set forth herein are based upon the best information and practices known to HAPMAN, but this may not be construed to suggest that every conceivable safety precaution is contained herein. As a matter of practicality, HAPMAN cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of all hazards and thus assumes no liability for accidents which may occur.

For further information regarding installation, operation and maintenance please contact the factory service department.

HAPMAN Customer Service
5944 East N Avenue, Kalamazoo, MI 49048-2321 (US/Can): 800.427.6260
Phone: 269.343.1675, Fax: 269.382.8266 E-mail: service@hapman.com

2.0 Safety Instructions

CAUTION

All Hapman furnished equipment must be installed, operated and maintained in accordance with service instructions. Failure to follow these instructions may result in serious personal injury or property damage.

2.1 Once the pneumatic conveyor (sometimes referred to as the MiniVac™) has been properly positioned in the desired location, it must be securely fastened (anchored) to approved structural supporting beams or equipment before connecting the electric and air utilities.

2.2 Installation, operation and maintenance of electrical machinery must be performed only by qualified, trained and experienced personnel. Make sure that the motor and conveyor body is effectively grounded in accordance with OSHA safety and health standards, the National Electric Code and local codes.

2.3 Avoid physical contact in and around the pneumatically operated discharge gate because it can cause injury to the operator when it closes. The gate can severely pinch fingers and hands when it is activated.

2.4 Likewise, when a rotary valve is used for controlled discharge of product, it too can present a significant “pinch-point” hazard.

2.5 Keep clothing, hair, hands and other body parts away from the rotary valve and receiving pickup wand when the unit is operational.

2.6 Do not manually override or electrically bypass any protective device.

2.7 Periodically inspect the bolts and welds of the frame to ensure their continued integrity and tightness.

WARNING

2.8 Do not attempt to open, work on, clean, service, remove any protective cover, guard, or maintenance panel on the pneumatic conveyor until the **POWER IS TURNED OFF AND LOCKED OUT.**

2.9 Use extreme care and caution when handling combustible dusts, powders, and vapors because such conditions can introduce a potential fire/explosive hazard which may be caused by sparks (electrical, electrostatic, metal against metal) in the filter receiver or transport pipe.

Pneumatic filter receivers do not contain extinguishing or suppression equipment.

Should combustible dusts or explosive vapors be introduced to the conveyed material, consult NFPA (National Fire Prevention Association) guideline for recommended explosion relief (vent) devices and/or fire extinguishing equipment. Hapman conveyor equipment hoppers, filter/receivers and dust collectors do not contain explosion relief vents, except on special order.

2.10 Any equipment which is used in the processing or transporting of explosive materials in hazardous environments requires an evaluation on the part of the user and operator or proper and adequate equipment enclosures. Do not use your equipment in hazardous environments unless it has been properly equipped for the hazard.

2.11 Protective gloves, breathing masks, and other protective clothing required for the material being conveyed must be worn when using the pickup wand and when changing the cartridge filter to prevent over exposure to the material.

2.12 It is ultimately the operator's responsibility to implement the above-listed precautions and ensure proper use of the equipment. Keep these instructions and list of warnings with your machines at all times. **WORK SAFELY AT ALL TIMES**.

3.0 General Description and Installation

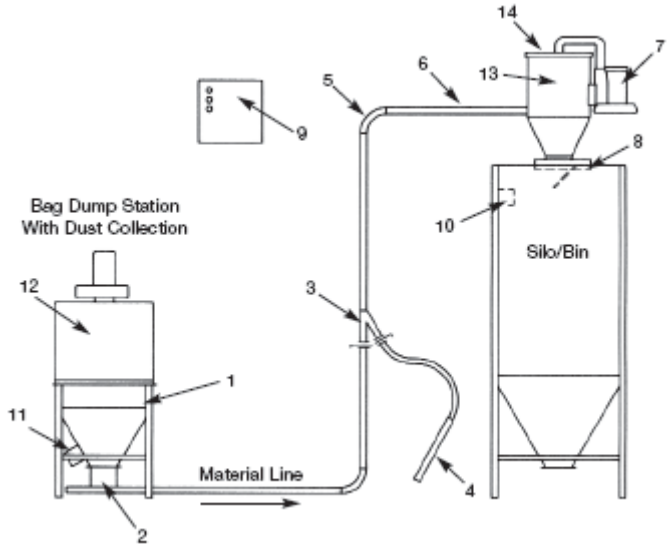
Designed for in-plant handling of most dry solids and powders, Hapman Mini-Vacuum conveyors deliver high performance, ultra-compact size, and cost effectiveness. Operating under negative pressure, or "vacuum"; material is drawn directly into the conveying line by airflow via pick up nozzle or hopper. Product loss and dusting is minimal as accidental leakage is drawn inward, providing maximum safety in handling toxic products.

The Hapman Mini-Vacuum system is particularly adaptable to providing material pick up from single or multiple hoppers, or open containers and delivering to one discharge point. Material laden air is transported through the line by induced air flow created by a positive-displacement blower or regenerative centrifugal fan. Material/air separation and discharge is accomplished by Hapman's compact receiver unit. The Hapman receiver provides highly-efficient final filtration through application of cartridge-type filtration technology.

Available in both standard and custom arrangements, each Hapman pneumatic conveyor system is designed for your specific application. The success of your conveyor installation will be dependent on understanding the operation of each component and its operation.

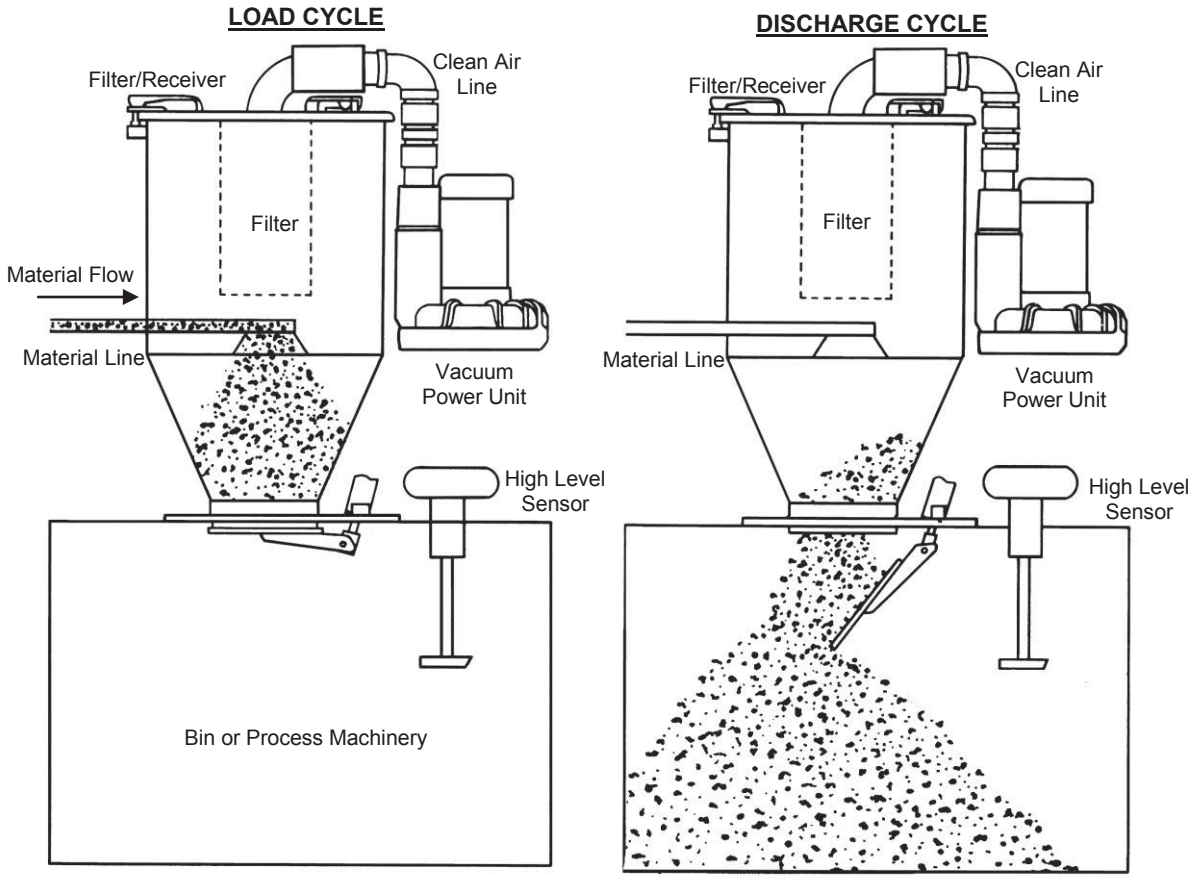
Please review the following guidelines when installing your pneumatic conveyor system. In addition, carefully review specific construction drawings that have been prepared by Hapman engineers for your applications.

TYPICAL SYSTEM COMPONENTS
Figure 7



1. Air Intake
2. Self-Feeding Material Intake
3. Y Branch
4. Pick-Up Wand
5. Elbow
6. Transport Pipe
7. Regenerative Blower
8. Discharge Gate
9. Control Panel
10. High Level Sensor-Silo
11. Low Level Probe-Material Inlet
12. Bag Dump Station
13. Filter Receiver
14. Receiver Lid

4.0 Hapman Pneumatic Conveyor Equipment



Hapman's miniature filter receiver units provide efficient separation and collection of air-borne solids that have been introduced into the conveying system. The air/material mixture enters the receiver plenum chamber and immediately begins to decelerate. Larger particles quickly fall from the air stream and collect in the receiver. Smaller particles remain entrained in the air flow, migrating upward and collecting on the filter media. The filtered air passes up through the receiver "lid" and continues to the vacuum blower inlet.

Collected dust begins to densify on the filter membrane. A solid state timer periodically energizes a solenoid operated air valve resulting in a burst of compressed air directed into the inside of the cartridge filter. The compressed air expands inside the filter and provides a momentary reverse air flow across the filter membrane. This dislodges the collected dust which falls into the receiver. The filter is now clean and resumes collecting dust from the conveying air stream.

NOTE: The filter cartridge, when reversed pulsed, may contain a significant amount of the material being conveyed. This material accumulates within the filter pleats and on end-caps. It is normal for the cartridge to look "dirty" as the material buildup densifies. This buildup of densified conveyed material actually aids in the air/material separation. The Hapman MiniVac™ receiver includes a side access door for filter access and ease of cleaning. See Major Features Index on Page 4.

Note: When preparing to clean the filter receiver, use extreme care when removing the filter from the filter receiver. Do not rest the filter cartridge on the edge of the receiver housing. The cartridge's delicate filter membrane will be damaged by the exposed receiver housing edge.

4.1 Major Components of Filter/Receiver Unit Include:

Discharge Gate

Standard filter receivers are equipped with a cylinder operated "dump" gate to periodically empty the filter plenum of collected material.

During normal operation, the discharge gate is in the closed position, sealing the receiver chamber. Once closed, a vacuum develops inside the receiver causing the material/air to flow through the transport line. At the beginning of the cycle, a solid state timer (located in the operators control station) energizes. This timer is adjustable; however, the factory setting is 4 seconds.

When the timer de-energizes, two events simultaneously occur. First, the vacuum breaker valve (located on blower inlet) opens and relieves the vacuum from the receiver chamber. In the absence of vacuum, material ceases to flow through the transport line. Next, the discharge gate is signaled to open allowing collected material to discharge from the receiver. After 4 seconds, the discharge gate is signaled to close and prepare for the next conveying cycle. The vacuum breaker valve is held open by a delay timer for a short time period to allow the dump gate to fully close. When the delay timer de-energizes, the vacuum breaker valve is closed and the convey cycle is repeated.

Solenoid Cabinet (Dump Gate model only)

The discharge gate and vacuum breaker valve are cylinder operated and controlled via electrically operated solenoids (110VAC). These solenoids, as well as the filter cleaning pilot solenoid, are mounted and wired inside a NEMA 4 enclosure mounted to the filter/receiver housing. Field wiring and compressed air connections are furnished for ease of installation.

NOTE: Solenoids are equipped with flow control fittings to control the Speed of the cylinder operated discharge gate.

Rotary Discharge Valve

An optional rotary discharge valve may be installed in lieu of a cylinder operated dump valve. This effectively increases the net conveyor capacity by eliminating the delay period necessary for dump gate discharge. The application of a rotary valve is usually limited to fine, free-flowing materials.

The rotary discharge valve provides an airlock seal between the interior of the filter/receiver chamber (under vacuum) and the discharge chute or hopper vessel (ambient pressure).

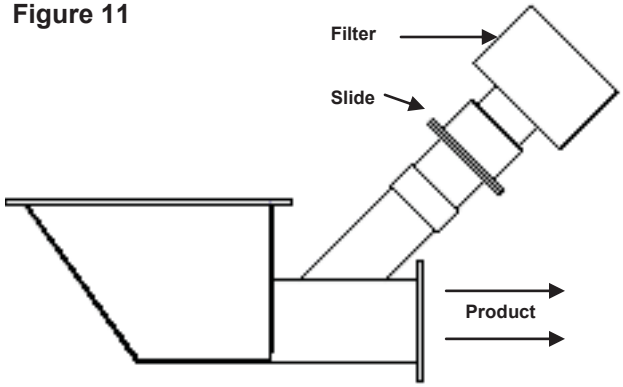
Rotary valves are normally supplied with 1/2 HP gear motor arrangement including shear-pin overload.

5.0 Material Feed Devices

5.1 Flooded Well Inlet

The Hapman flooded well inlet provides a controllable means of introducing most free-flowing solids into the conveying air stream. The inlet is attached to the discharge of material supply hoppers and can be fitted with a cylinder or manually operated shut-off gate to allow several feed points to be arranged on a single vacuum conveyor line.

Figure 11



Its design directs material to the bottom of the pneumatic conveyor line where it is swept away by the conveying air stream. Volumetric feeding is achieved by the natural angle of repose of the material. Adjustable flow rates are achieved by a movable slide. See Figure 11.

5.2 Rotary Inlet Valve (Figure 12)

Rotary valves are often utilized to provide more positive feed control into pneumatic conveyors. This type of valve more readily controls fluid material and prevents surging or flooding the conveyor line. See Figure 12.

5.3 Manual Pickup Wand (Figure 13)

Material can be unloaded from open containers using a hand-held pick-up lance or wand. The wand is constructed of concentric steel tubes which maintain infeed air flow when the wand top is buried deep into the material container. The wand can be adjusted to provide optimum material-to-air ratios to increase or decrease conveying rates as required. See Figure 13.

Figure 12
ROTARY INLET VALVE

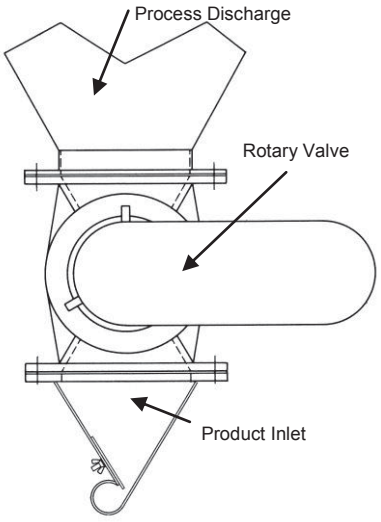
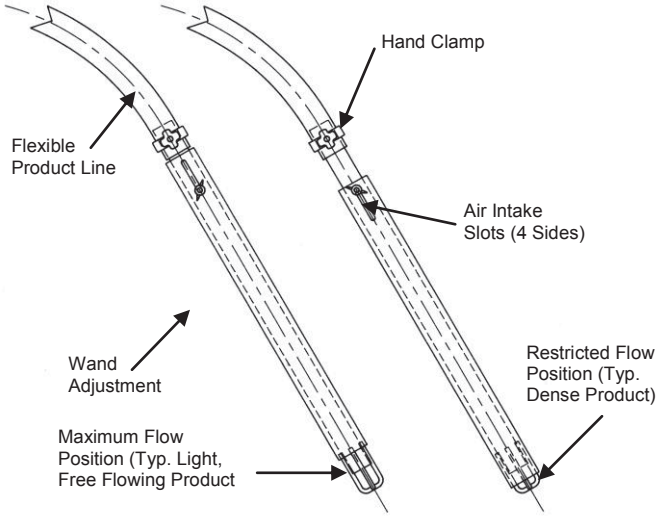


Figure 13
PICKUP WAND



6.0 Blower Packages

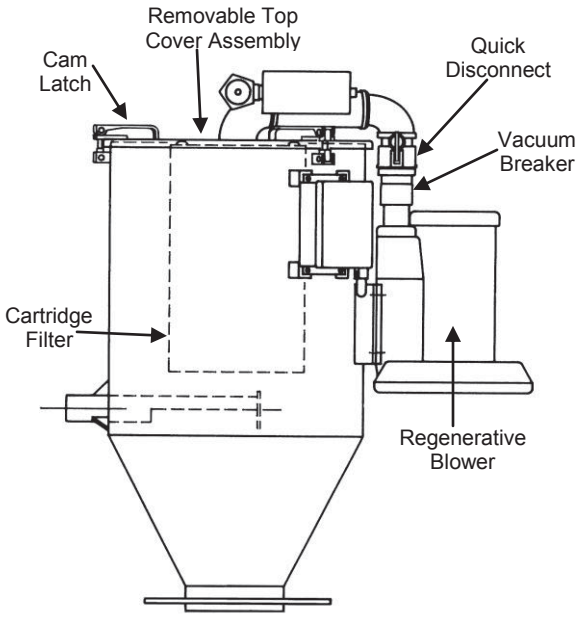
6.1 Regenerative

The regenerative blower utilizes a motor driven impeller that draws in air from the inlet port and then by centrifugal force, accelerates the air out through the discharge.

The regenerative blower works in principle by utilizing an annular shaped housing that turns air back to the base of the following blades where it is again hurled outward. Each regeneration imparts additional pressure to the air until it reaches the discharge where air is then diverted out of the blower.

Each blower is assembled as an integral part of the pneumatic receiver. A quick disconnect-cam/lever type coupling is furnished on the blower inlet. This coupling allows the vacuum line-top cover assembly to be easily removed for inspection of the filter cartridge. See Figure 14.

Figure 14



NOTE: Blower motor must be wired for clockwise rotation and should be verified before running the unit.

6.2 Positive Displacement

A positive displacement system utilizes a rotary blower that is either belt driven or direct coupled to the drive motor. The blower has two impellers rotating in opposite directions. As each impeller lobe passes the blower inlet, air is trapped and routed around the case and to the blower outlet.

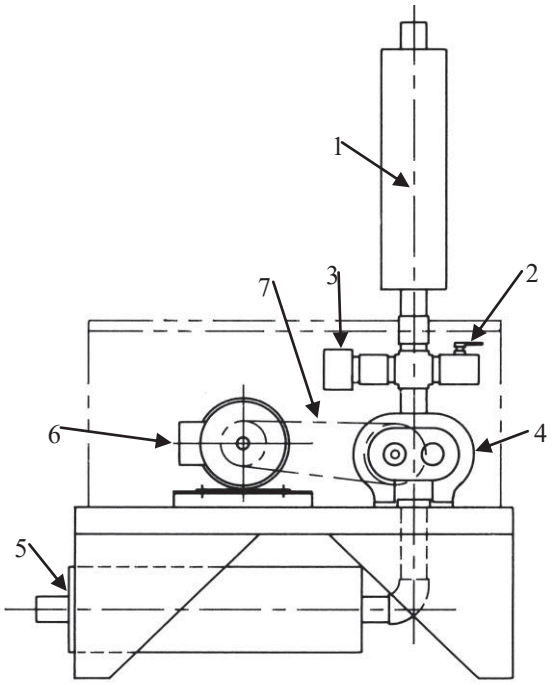
Positive displacement blower systems are normally furnished with inlet and discharge silencers and a foam lined enclosure that will effectively dampen the noise level. A spring loaded vacuum relief valve is furnished in the clean air-vacuum line. The relief valve is factory set at a predetermined value.

The blower system may also be furnished with an auxiliary air inlet valve (manual ball valve). This valve can be used to bleed air into the clean air side of the receiver thus reducing both vacuum and system capacity.

A positive displacement blower system is normally located remote from the pneumatic receiver. Clean air-vacuum piping is furnished either in random lengths or cut to length as dictated by job requirements. A quick disconnect cam/lever type coupling is furnished at the filter receiver-top cover assembly. This coupling allows the vacuum line-top cover to be easily removed for inspection of the filter cartridge. See Figure 16.

Figure 16
POSITIVE DISPLACEMENT SYSTEM

1. Inlet Silencer
2. Auxiliary Air Inlet Valve
3. Vacuum Relief Valve
4. Positive Displacement Blower
5. Discharge Silencer
6. Drive Motor
7. V-Belt



7.0 Electronic Control Systems (Figure 17)

Inlet Rotary Timer:
Delays the starting of the inlet rotary valve after the pneumatic conveyor has started.
Typical setting = 5 seconds

Conveyor Delay Timer:
Delays the starting of the conveyor if a rotary valve is located on the discharge
Typical setting = 3 Seconds

Fill Timer:
When a dump gate is purchased this timer is used to set the fill time in between dumps.
Typical setting = 30 seconds

Dump Timer:
When a dump gate is purchased this timer is used to set the dump duration time.
Typical setting = 4 seconds

Vacuum Break Timer:
Used to set the amount of time the vacuum is vented to atmosphere.
Typical setting is 2 seconds longer then dump timer setting.

Pulse#1 on Timer:
Sets the duration of time an air pulse is delivered to clean filter#1.
Typical setting = 0.5 seconds

Pulse#1 off Timer:
Sets the amount of off time between each pulse for filter#1.
Typical setting = 30 seconds

Pulse#2 on Timer:
Sets the duration of time an air pulse is delivered to clean filter#2.
Typical setting = 0.5 seconds

Pulse#2 off Timer:
Sets the amount of off time between each pulse for filter#2.
Typical setting = 30 seconds

Pulse#3 on Timer:
Sets the duration of time an air pulse is delivered to clean filter#3.
Typical setting = 0.5 seconds

Pulse#3 off Timer:
Sets the amount of off time between each pulse for filter#3.
Typical setting = 30 seconds

Pulse#4 on Timer:
Sets the duration of time an air pulse is delivered to clean filter#4.
Typical setting = 0.5 seconds

Pulse#4 off Timer:
Sets the amount of off time between each pulse for filter#4.
Typical setting = 30 seconds

High level discharge Timer:
This timer is used when there is a high level sensor located at the discharge and when product falls below the high level this timer will start and once expired will restart the pneumatic conveyor
Typical setting = varies per receiver.

Discharge off delay Timer:
When a discharge rotary valve is purchased this timer is used to set the amount of time the discharge rotary valve continues to run after the pneumatic conveyor shuts off allowing the receiver to be emptied
Typical setting = 5 seconds

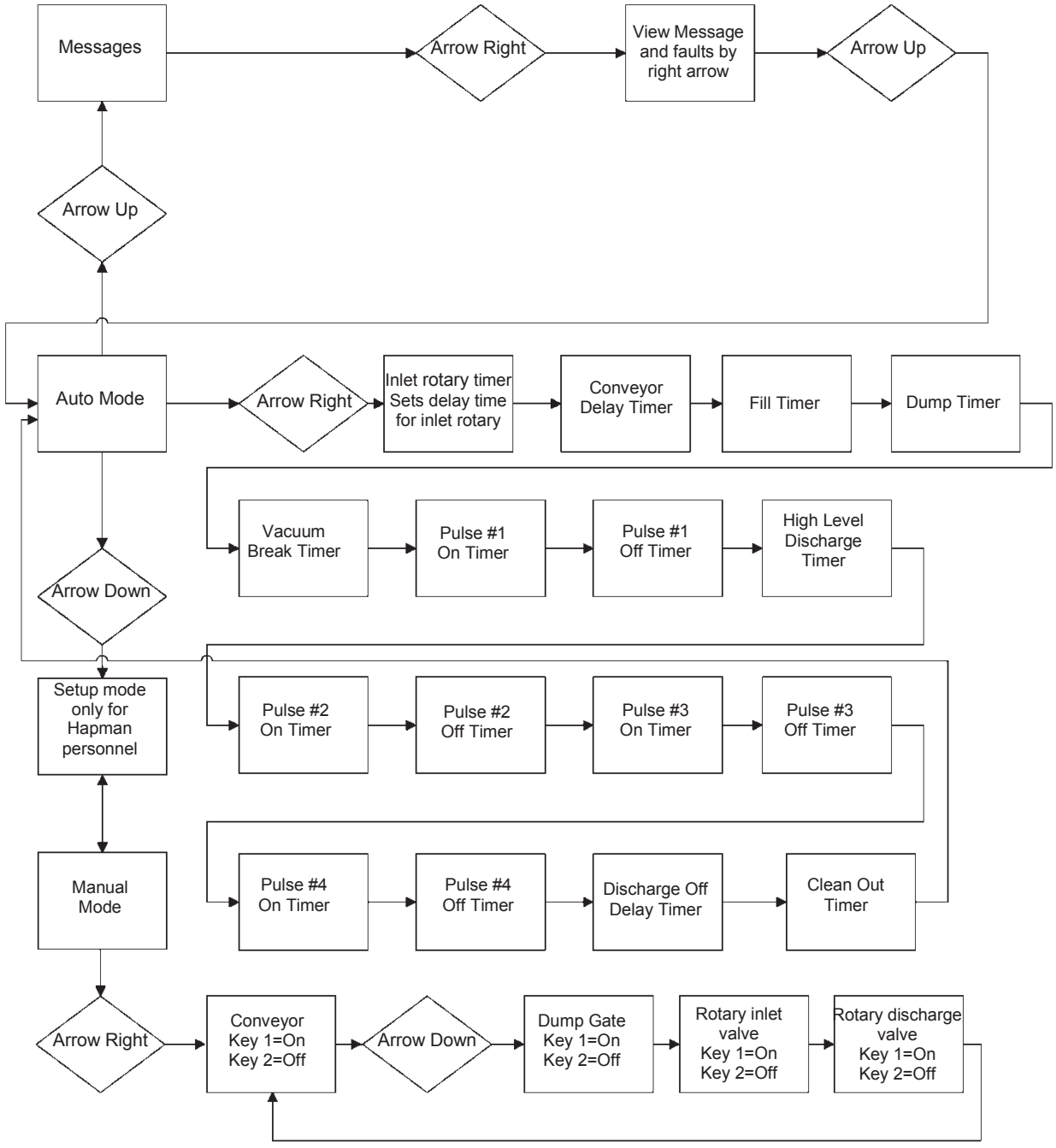
Clean out Timer:
When a dump gate is purchased this timer is used to clean out the pneumatic conveyors pipes in between dumping the product. This timer is only needed when there is long vertical drops.
Typical setting = 5 seconds.

Note:
Depending on options purchased only some of these 1imers will be visible when shipped to the end user.

How to enter values into a Timer:
When the auto mode is showing press right arrow to first Timer then press the 0 key until desired digit then enter correct value. If there is a Timer that you do not want to adjust then just press the enter key then the right arrow.

Isolate and lock power source prior to inspecting control panel wiring. Inspect control panel wiring for tightness

FIGURE 17
PNEUMATIC RECEIVER PLC FLOW DIAGRAM



8.0 Installation Instructions

8.1 Refer to Hapman general arrangement drawings when installing air-handling piping. The material handling capacity of your conveyor system has been calculated based upon a pre-determined number of straight lengths and bends of piping. Deviations or additions to the layout may impact the performance and capacity of the conveyor system. Piping runs should be kept in a horizontal and vertical axis at all times. Avoid sloped routing (upward or downward).

8.2 Inspect your equipment for loosening and breakage that may occur during shipment.
a. Inspect compressed air connections on the filter/receiver for tightness.
b. Check the tightness of the cartridge filter in the filter/receiver chamber.

8.3 Compressed air requirements:
a. Install 1/2" (minimum) air supply line to filter/receiver unit.
b. Compressed air should be 60-80 PSI; the filter/receiver will consume 2-3 SCFM of air (per unit maximum).

NOTE: Install regulator should plant air exceed 90 PSI.

c. Compressed air should be free from water, oil and solids. Oil will eventually plug the filter media and solids may cause solenoid malfunctions.

NOTE: Install a mist eliminator if the plant air quality is poor.

d. If pneumatic conveyor is installed outdoors or in unheated areas, the compressed air must be dried to appropriate dew point to prevent air lines from freezing.

8.4 Control System:

Isolate and lock power source prior to inspecting control panel wiring. Inspect control panel wiring for tightness. Verify timer settings (see illustrations for correct settings), and reinsert timers and relays that may have loosened during shipment.

8.5 Motor-Driven Devices: Check for correct rotation as indicated by the "rotation" arrow on housings of vacuum blower, fan or rotary valve.

8.6 Re-inspect conveyor piping for tightness, rigidly and leaks. Be sure that all piping connections have static grounding straps correctly installed.

8.7 Adjust, if necessary, flow control valves controlling speed of cylinder operated discharge gate. Gate should not slam open or closed.

8.8 Check lubrication levels, motor driven devices such as gearboxes and positive displacement blowers. Follow suggested lubrication inspection and replenishment according to manufacturer's instructions.

9.0 General Maintenance

An air conveying system that has been properly engineered, checked out, and adjusted for start-up is subject to little trouble. A regular maintenance schedule will help prevent malfunctions.

9.1 Weekly

1. Inspect blower discharge air for presence of dust, indicating filter failure.
2. Inspect compressed air line filter/oil separators for accumulation of oil, water and debris.
3. Check for smooth operation of air operated devices such as slide gates, discharge gates and vacuum breakers.

9.2 Monthly

1. Remove receiver lid and inspect for cartridge filter wear and excessive product buildup on filter media.
   Remove excess product buildup as necessary.
2. Check lubrication levels of positive displacement blower and gear boxes.
   Consult Appendix for further lubrication information.
3. Inspect conveyor piping for leaks and wear.
4. Energize pulse timer circuit (with blower off) and observe operation of the filter cleaning mechanism.

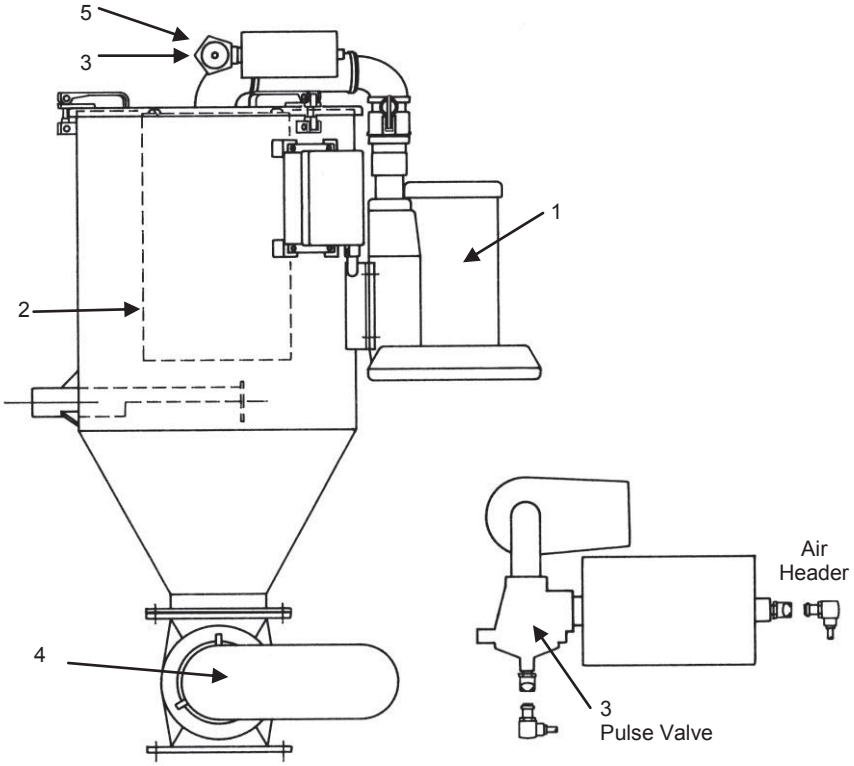
10.0 Replacement Parts for Receiver with Rotary Discharge Valve

When calling or writing for replacement parts, please reference the equipment serial number embossed on the Hapman nameplate affixed to equipment. See back of this manual for phone number and address of Hapman Service.

Hapman Filter Receivers – Rotary Discharge Valve Model "R"					
Item No.	Description	Model			
		16R/20R/24R	30R	36R	42R
1	Blower Assembly	1	1	1	1
2	Filter Cartridge	1	2	3	4
3	Pulse Air Valve	1	2	3	4
4	Rotary Valve	1	1	1	1
5	Solenoid NC 2-Way (Pulse)	1	2	3	4

NOTE: For Replacement Parts and Service for the Filter Receiver Discharge Gate See Page 18

Figure 27
PARTS DIAGRAM FILTER RECEIVER WITH ROTARY DISCHARGE VALVE



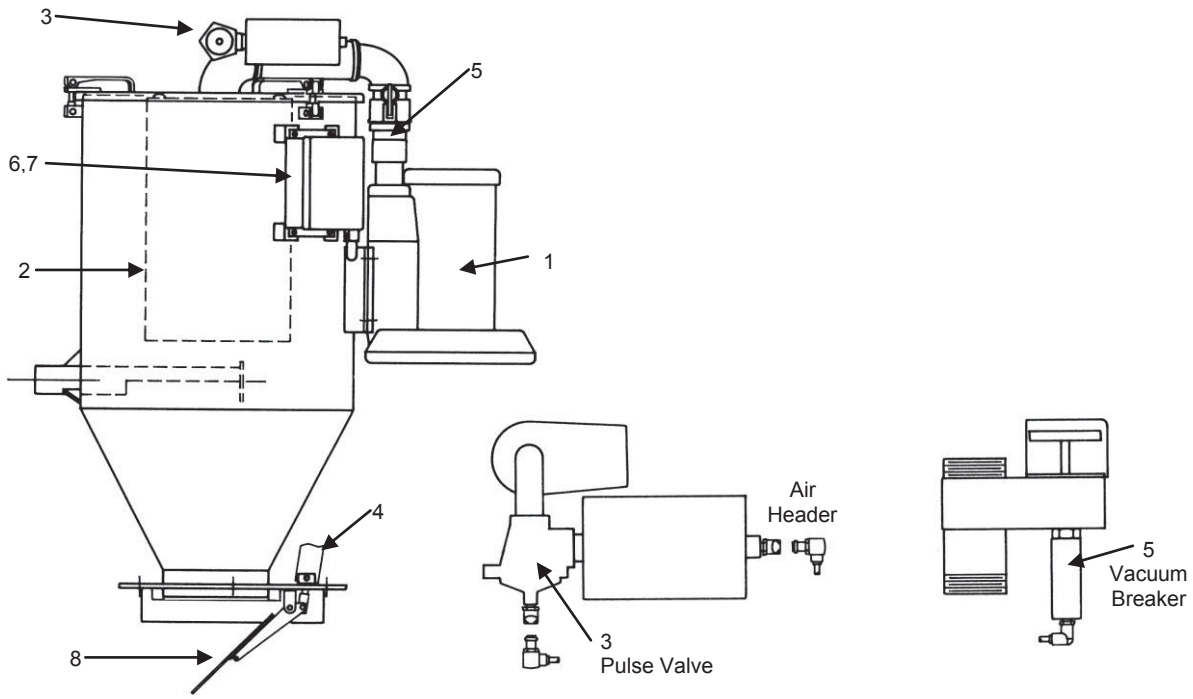
Replacem

When calling or writing for replacement parts, please reference the equipment serial number embossed on the Hapman nameplate affixed to equipment. See back of this manual for phone number and address of Hapman Service.

Hapman Filter Receivers –Discharge Gate Model "D"					
Item No.	Description	Model			
		16D / 20D / 24D	30D	36D	42D
1	Blower Assembly	1	1	1	1
2	Filter Cartridge	1	2	3	4
3	Pulse Air Valve	1	2	3	4
4	Discharge Gate Cylinder	1	1	1	1
5	Vacuum Breaker Cylinder	1	1	1	1
6	Solenoid NC 3-Way (Dump gate, vacuum break)	3	3	3	3
7	Solenoid NC 2-Way (Pulse)	1	2	3	4
8	Discharge Gate	1	1	1	1

Note:
For Replacement Parts and Service for the Filter Receiver Rotary Discharge Valve See Page 17

Figure 28 - PARTS DIAGRAM FILTER RECEIVER WITH DISCHARGE GATE



Record of Important Information for This Machine

Serial Number_____

Model Number_____

For Operational Information in This Plant Contact

Name_____

Department / Phone Number_____

Notes

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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Spencer® Vortex® Regenerative Blowers

Serial No: _____

Model No: _____

Installation, Operation and Maintenance Instructions

VB-007

VB-055

Important

Read and become familiar with this manual prior to uncrating and installing your Spencer Vortex Blower. Following the instructions detailed here will help you realize its full potential of efficient service and extended lifespan. Damage resulting from failure to follow correct procedure will void the warranty.

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VI. Troubleshooting Guide 18

I. General

Scope
Information contained in this manual relates to Vortex Blowers standard and explosion-proof motor models VB-001S, VB-001, VB-002S, VB-002, VB-003S, VB-003, VB-004S, VB-004, VB-007S, VB-007, VB-019S, VB-019, VB-030S, VB-030, VB-037S, VB-037,VB-055, VB-075, and VB-110.

Limited Warranty
We warrant that this product will be free from defects in material and workmanship for a period of 18 months from date of shipment or 12 months from date of startup, whichever comes first. Within the warranty period, we shall repair or replace F.O.B. our Factory such products that are determined by us to be defective.

This warranty will not apply to any product which has been subjected to misuse, negligence, or accident, or misapplied or improperly installed. This warranty will not apply to any product which has been disassembled, repaired, or otherwise altered by any persons not authorized by the Spencer Vortex Service Department.

On units which include thermal protection, the thermal protection must be connected as recommended.

The guarantee of the motor and control manufacturers will govern the extent of our guarantee on such equipment. Warranty work on motors and controls must be authorized by Spencer and must be performed in an authorized shop as designated by the manufacturers.

The Spencer Turbine Company reserves the right to invoice all expenses incurred when repairs are made in the field at the specific request of the customer.

No assemblies or parts of assemblies will be accepted for repair or replacement under this warranty without prior authorization by The Spencer Turbine Company. For complete warranty information, obtain Spencer's Form 706, "Terms and Conditions of Sales."

Safety Precautions
Power sources, protective devices, and grounding provisions must be in accordance with wiring instructions provided in this manual.

Blower becomes hot during operation and may cause burns if touched.

Do not operate the blower under load conditions which exceed the rated full-load amps on the nameplate.

Do not install the blower in any area which may have an explosive atmosphere or which may contain flammable gases or liquids. Always provide proper ventilation. Do not install in any area which may subject the blower to corrosive liquids. Excessive moisture may cause electrical failure; install the blower in areas free from water or rain. Do not operate blower without motor cooling fan cover, or without impeller end cover.

Before installing blowers with explosion-proof motors, the buyer must check federal, state and local codes to see if such motors are appropriate for the intended application environment. It is the buyer's responsibility to determine the suitability of any product for a particular purpose.

Storage
If machine is to be stored for an extended period of time, it must be carefully protected from dampness and dirt.

II. Installation

Locating, Mounting, Connecting
Ambient temperature at the installed location should not be less than -5˚ F or greater than 104˚ F. Relative humidity should not exceed 80%.

Mount the blower in a horizontal or vertical position as shown in Figure 1. For models VB-055, VB-075 and VB-110, it is recommended to mount in the horizontal position only. Check with factory *prior* to mounting these models vertically.

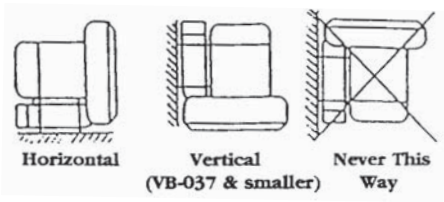


Fig. 1 Mounting Positions

Remove protective coverings, such as vinyl tape or plastic plugs, from the inlet and outlet ports. For models VB-004 and larger, attach to system piping using threaded connection as provided. Avoid excessive stress caused by pipe connector tightening or by misaligned pipe on the inlet and outlet ports. Support piping by brackets or other means. Models VB-001, VB-002 and

VB-003 are supplied with a patented (U.S. Patent 5,791,870) reversible flange with threaded pipe or tubing connections.

In the event the blower is located where dust, fibers, drops of water, or other particulates may be in the airstream, use a filter on the suction side of the piping. If foreign matter enters the impeller, it may clog, jam, or otherwise impair the blower performance.

Wiring

Caution: Confirm that the power source is the same as that indicated on the unit's nameplate. Application of incorrect voltage or improper phase connection may cause motor failure or other damage.

Use conductors and devices (such as the circuit breakers, starters, and switches shown in Figure 3) that are suitable for the applications shown in Tables 1 and 2 and are in compliance with the National Electric Code and applicable local codes and regulations. Motor terminal connections are shown below Table 1.

Provide protection from overheating of the motor windings. Some models are equipped with built-in thermal protectors (see Table 1). Where applicable, connect the leads from the pilot-duty thermal protector to the magnetic starter as shown in Fig. 3.

Check the direction of rotation of the blower.
To reverse the direction or rotation:

1) **for a single-phase motor, interchange motor leads 5 and 8.**
2) **for a three-phase motor, interchange any two of the three line connections.**

Caution: Install a properly-sized overload device and disconnect in accordance with local codes and regulations and dedicated only to the Vortex Blower.

Furnish the Vortex Blower and all associated electrical devices with a proper ground in accordance with all local codes and regulations.

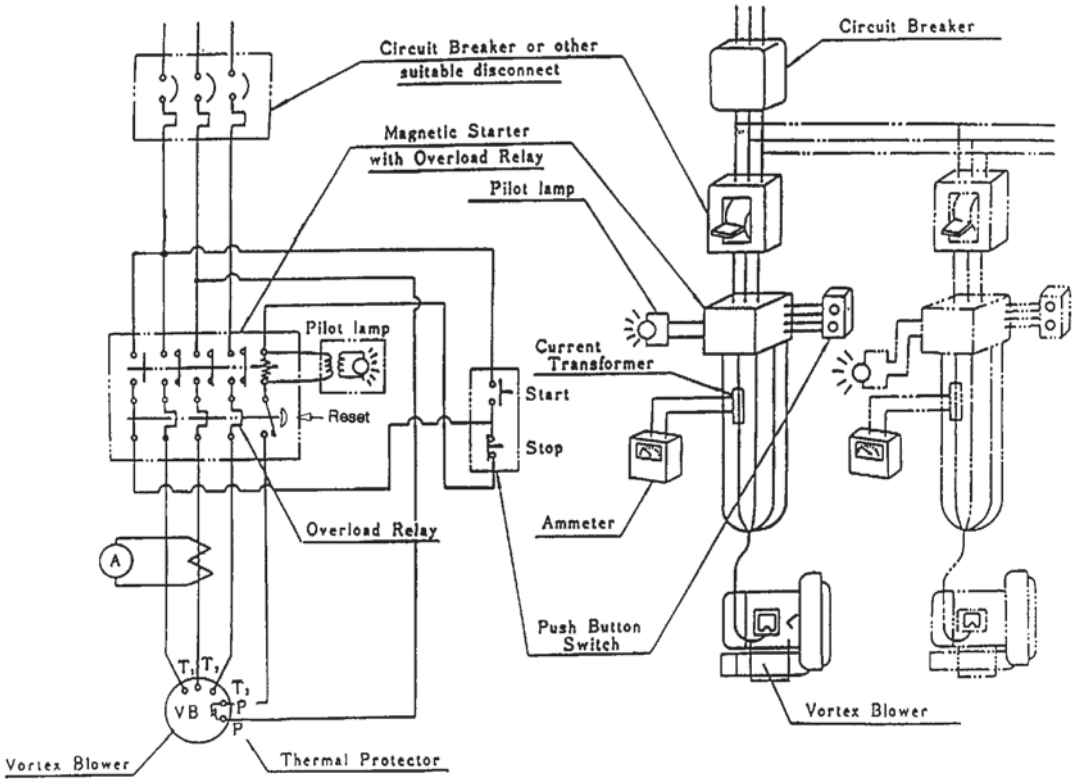


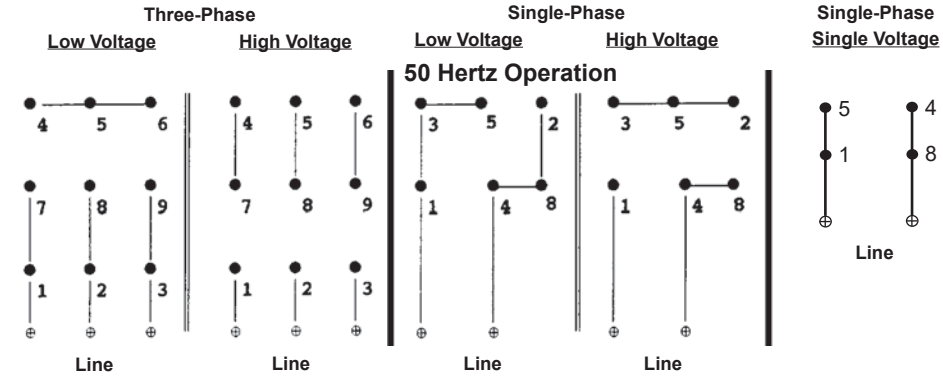
Fig. 3 Typical Wiring Diagram

Table 1 Three-Phase Motor Data - Typical Values

60 Hertz Operation						
Model No.	**VB-001**	**VB-002**	**VB-003**	**VB-004**	**VB-007**	**VB-019**
Power (hp)	0.13	0.25	0.5	0.75	1	2.5
Voltage (V)	200-230/460	200-230/460	208-230/460	200-230/460	200-230/460	200-230/460
FL Amp (A)	.5-.48/.24	.86-.73/.37	1.8-1.6/.8	2.3-2.4/1.2	2.7-2.8/1.4	7.2-6.6/3.3
Voltage (V)		575	575	575	575	575
FL Amp (A)		.4	0.8	0.96	1.4	2.1
Model No.	**VB-030**	**VB-037**	**VB-055**	**VB-075**	**VB-110**	—
Power (hp)	4	5	7.5	10	15	—
Voltage (V)	200-230/460	200-230/460	200-230/460	200-230/460	200-230/460	—
FL Amp (A)	10.6-10.2/5.1	13.2-12/6	19.8-17.2/8.6	27.5-27.2/13.6	39-37/18.5	—
Voltage (V)	575	575	575	575	575	—
FL Amp (A)	3	4.8	7	9.6	13.5	—
50 Hertz Operation						
Model No.	**VB-001**	**VB-002**	**VB-003**	**VB-004**	**VB-007**	**VB-019**
Power (hp)	0.13	0.21	0.5	0.63	.83	2.1
Voltage (V)	190-220/380-415	190-220/380-415	190/380-415	190/380-415	190/380-415	190/380-415
FL Amp (A)	.5-.52/.25-.26	.74-.66/.37-.34	2/1-.9	2.4/1.2-1.3	2.8/1.4-1.5	6.6/3.3-3.1
Model No.	**VB-030**	**VB-037**	**VB-055**	**VB-075**	**VB-110**	—
Power (hp)	3.4	4.2	6.25	8.33	12.5	—
Voltage (V)	190/380-415	190/380-415	190/380-415	190/380-415	190/380-415	—
FL Amp (A)	10.2/5.2-5.1	11.8/5.9-5.6	17.6/8.8-8.2	27/13.5-14.5	36/18-17	—

NOTE: Thermostats are provided on the VB-004 and larger models.

MOTOR WIRING



NOTES: (1) For three-phase, interchange any two line connections to reverse shaft rotation
(2) For single-phase, interchange motor leads 5 and 8 to reverse shaft rotation

THERMOSTATS VB-004 AND LARGER

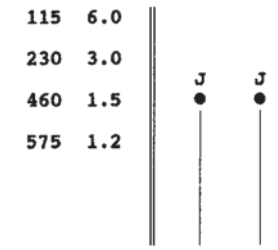


Table 2 Single-Phase Motor Data - Typical Values

60 Hertz Operation								
Model No.	**VB-001S**	**VB-002S**	**VB-003S**	**VB-004S**	**VB-007S**	**VB-019S**	**VB-030S**	**VB-037S**
Power (hp)	0.13	0.25	0.5	0.75	1	2.5	4	5
Voltage (V)	115/230	115/230	115/230	115/208-230	115/208-230	115/208-230	115/208-230	230
FL Amps (A)	1.25/.63	2.3/1.15	5.2/2.6	9.6/5-4.8	12.4/6.5-6.2	22/11.5-11	34.8/18.5-17.4	20.8
Model No.	**VB-001S**	**VB-002S**	**VB-003S**	**VB-004S**	**VB-007S**	**VB-019S**	**VB-030S**	**VB-037S**
Power (hp)	0.13	0.21	0.5	0.63	1	2.1	3.3	4.2
Voltage (V)	110/220	110/220	110/220	100-110/220	100-110/220	100-110/220	100-110/220	220
FL Amps (A)	1.34/.67	2.1/1.05	5.6/2.8	9.9-11.6/5.8	12.7-12.4/6.2	22-21/10.5	42-38.6/19.3	19

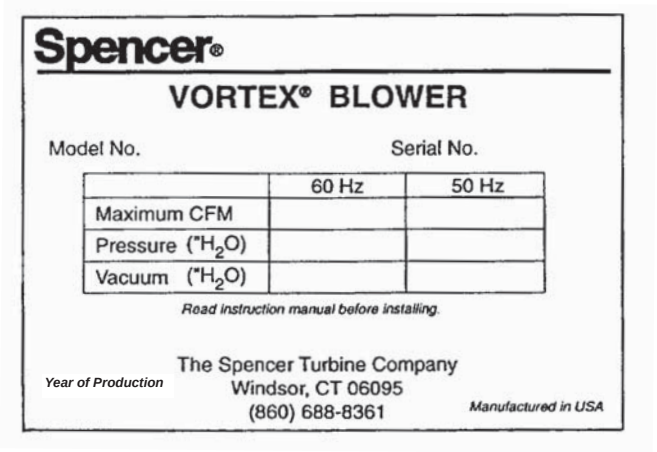


Fig. 4 Typical Nameplate

III. Operation

Limits of Operation

Operation at flows less than those indicated by the solid line on the applicable performance curve will cause overheating of the unit and is to be avoided. Throttling suction or discharge piping to reduce air volume increases differential pressure resulting in elevated temperature and increased power consumption. Use of pressure and/or vacuum relief valve recommended.

Maximum pressure and vacuum are indicated on the nameplate (see Fig. 4). These represent conditions at which the minimum allowable airflow (CFM) occurs. Check the operating pressure or vacuum to assure that the pressure or vacuum remains less than maximum.

For continuous operation at low air volume (on the dotted portion of the performance curve), provide a bypass in the piping and operate at a lower pressure than maximum operating pressure. See Performance Curves, Section V.

Caution: Low flow conditions may produce heat levels which may cause burns. Do not touch the blower in operation.

Temperature Rise

A NEMA Class F insulation system is used in the motor. Maximum allowable winding temperature is 265˚F. If a thermal protector or thermal relay activates because the temperature rise of the motor is higher than usual, investigate and correct the problem. Explosion-proof motors use a NEMA Class B insulation. Typical causes of motor overheating are given in Section VI, Troubleshooting Guide.

IV. Disassembly and Reassembly

A. General

1. Precautions should be taken when disassembling or reassembling the blower. See Warranty Terms.
2. Keep all parts clean.
3. Do not overtighten bolts and screws.

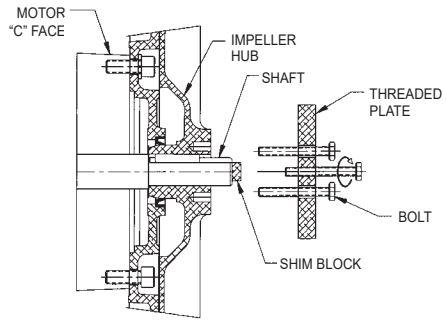


Fig. 5 Impeller Puller

B. Disassembly Procedure (Reassembly is performed in reverse order)

Caution: Shims are used to adjust the gap between the impeller and casing. When disassembling, take care to note the quantity of shims and their thickness. The shim stack replacement must be the correct thickness to assure proper clearance and to avoid degradation of performance.

1. Remove impeller cover; remove screws, pull cover away from case.
2. Unfasten lock washer; remove nut and washer.
3. Remove impeller from shaft by one of the following methods:
   a. manually pull the impeller outward, OR
   b. screw two bolts into tapped holes and pull on the bolts, OR (if the fit is tight)
   c. use a puller assembly (not furnished) as shown in Fig. 5.
4. Remove motor shaft key.
5. Remove case from motor; if necessary remove screws holding case to base and motor to case.
6. Remove shims from motor shaft if necessary; do not discard them. See Note above.

Caution: Motors are heavy. Lift motor on models larger than VB002 by the eyebolt on the motor with an aid from a lifting device.

C. Reassembly Guidance

1. The gap between the impeller and case is essential for proper performance of the unit. The shims between the shaft collar and impeller hub establish the spacing of this gap. In reassembly, before installing the impeller cover, check the gap between the impeller and case to assure that the measurement conforms to the gap specification on the assembly drawing (on the following pages) for your unit.

2. For models VB001, VB002 and VB003, gap clearance between impeller and unibody case should be checked around entire periphery of the impeller in accordance with Item 18, impeller to case gap specification prior to securing impeller.

3 On models VB004 thru VB110 remove Item 23 Plug located on bottom of the case and check impeller gap with a feeler gauge. Remove impeller and adjust shims to meet gap specification. With adjustments and gap check complete, replace plug tightly to prevent air leakage.

4. Fasten impellers using lockwashers and locknuts. Torgue locknut to recommended torque values in Table 3. Bend a lockwasher tab down into a lockwasher slot.

5. Reattach the impeller cover.

Catalog No.	Recommended Torque (Ft-Lb)
VB001, VB001S, VB002 VB002S, VB003, VB003S	22
VB004, VB004S	31
VB007, VB007S	36
VB019, VB019S	36
VB030, VB030S	44
VB037, VB037S	44
VB055	77
VB075	90
VB110	90

Table 3 Locknut Torque

V. Vortex Blower Data

Pages 7 through 17 present information about the various blower models. This information is important in understanding your blower's performance, in using the blower in the proper operating range, and in ordering parts that might be needed.

A. Assembly Diagrams
At the top of each page is an assembly diagram of the unit. Items are identified by circled numbers around the diagram. Above each diagram is the gap specification.

B. Parts Lists
At the lower left of each diagram is a table giving the item number (shown on the Assembly Diagram), the Part No. for that item and the corresponding part description. In ordering parts, provide the model number, the part number and the description.

C. Performance Curves
At the lower right of each diagram are performance curves for 50Hz and 60Hz operation. The curves present the following information:

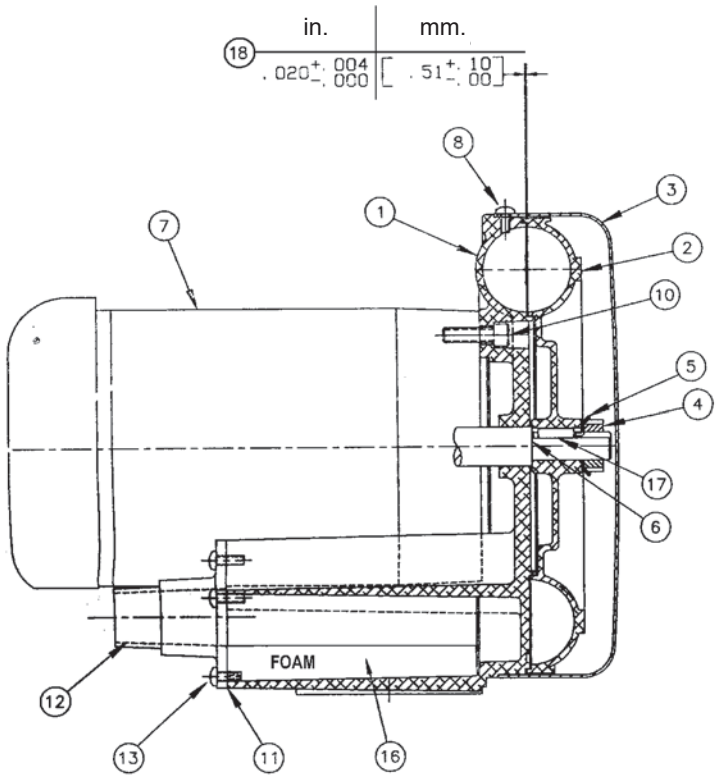
The upper line of each curve is pressure performance while the lower line is vacuum performance. The dashed portion at the left end of some of the curves indicates an intermittent-only operating area. See **Operation** Section on page 5.

D. Estimated Acoustical Noise Level at 1.5M, 60Hz

Model	dba
VB001S	62
VB001	61
VB002S	61
VB002	61
VB003S	66
VB003	66
VB004S	63
VB004	63
VB007S	70
VB007	64
VB019S	70
VB019	73
VB030S	71
VB030	73
VB037S	74
VB037	76
VB055	82
VB075	81
VB110	80

Spencer® Vortex® Regenerative Blowers
VB001S, VB001

Assembly Diagram

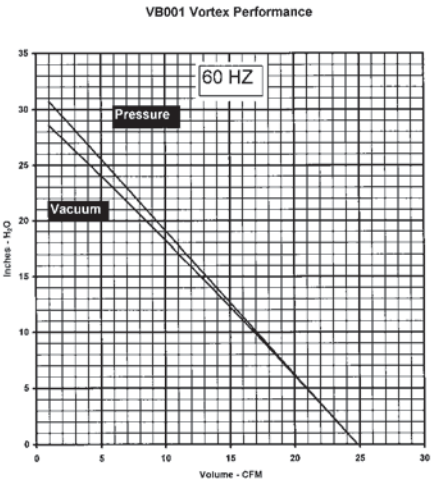


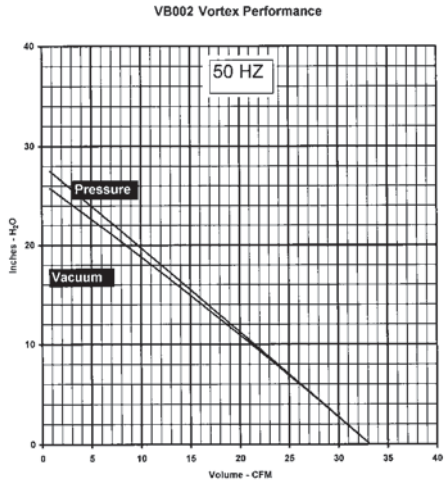
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB001S & VB001			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90101	Case, Unibody	1
2	VBI90101	Impeller	1
3	VBE90101	Cover, Impeller	1
4	NUT90219	Locknut, Shaft	1
5	WSH90184	Lockwasher, Shaft	1
6	WSH90185	Shim, Shaft to Impeller (as required)	1
7	MOT90210	Motor 42C, 1/8 HP, 1PH, 50/60Hz	1
7A	MOT90215	Motor 42C, 1/8 HP, 3PH, 50/60Hz	1
8	SCR90901	M4 x 0.7 Pan Head Phillips Screw x .31 [8] Long	4
10	SCR90307	1/4-20 x .625" Long Socket Cap Screw	4
11	GSK90168	Gasket, Flange	1
12	FLC90013	Flange	1
13	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] long	6
16	INS90014	Absorber	2
17	KEY90083	Key	1
18	N/A	Impeller to case gap specification	N/A

VB001S, VB001

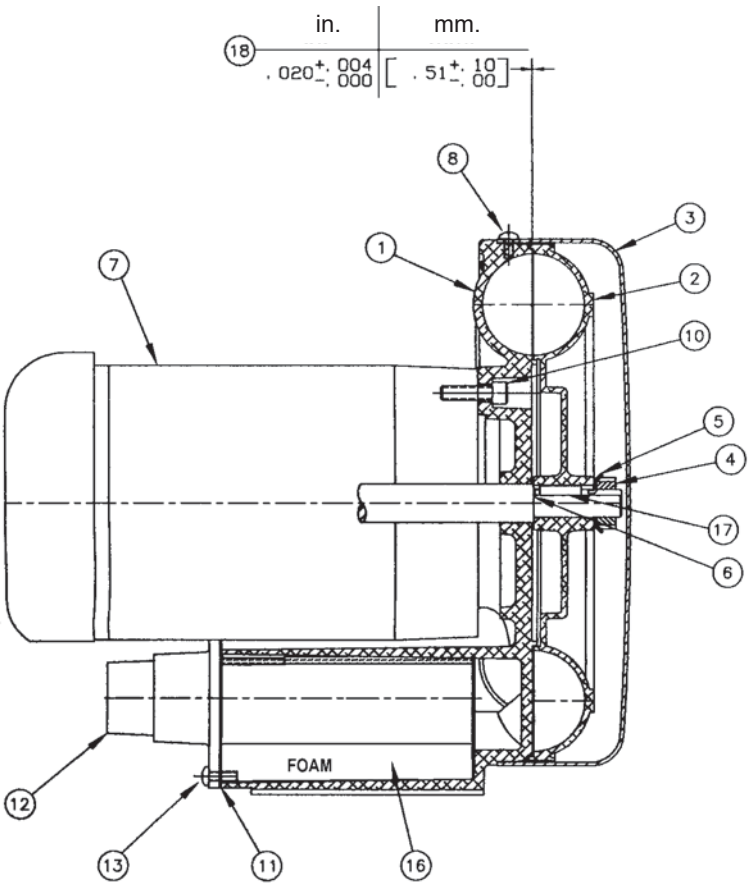
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB002S, VB002

Assembly Diagram

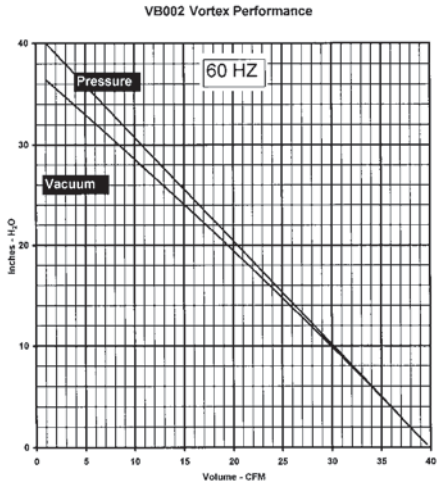


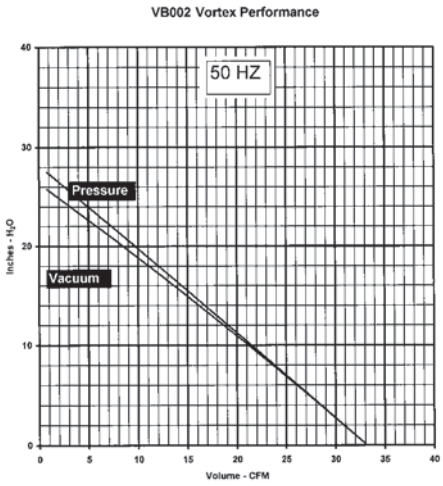
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB002S & VB002			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90201	Case, Unibody	1
2	VBI90201	Impeller	1
3	VBE90201	Cover, Impeller	1
4	NUT90219	Locknut, Shaft	1
5	WSH90184	Lockwasher, Shaft	1
6	WSH90185	Shim, Shaft to Impeller (as required)	1
7	MOT90211	Motor 42C, 1/4 HP, 1PH, 50/60Hz	1
7A	MOT90212	Motor 42C, 1/4 HP, 3PH, 50/60Hz	1
8	SCR90901	M4 x 0.7 Pan Head Phillips Screw x .31 [8] Long	4
10	SCR90307	1/4-20 x .625" Long Socket Cap Screws	4
11	GSK90169	Gasket, Flange	1
12	FLC90014	Flange	1
13	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] Long	6
16	INS90015	Absorber	2
17	KEY90085	Key	1
18	N/A	Impeller to case gap specification	N/A

VB002S, VB002

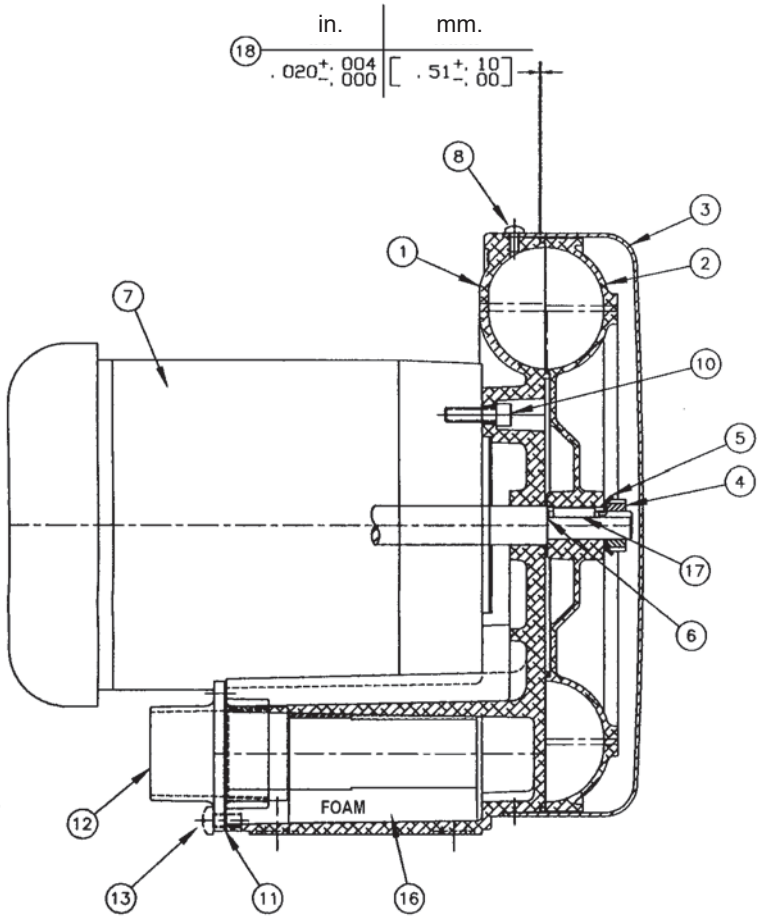
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB003S, VB003

Assembly Diagram

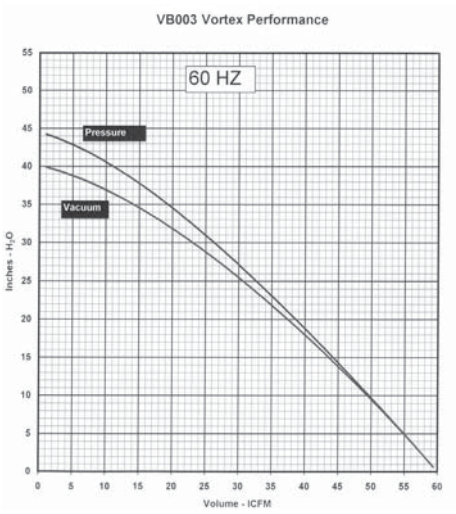


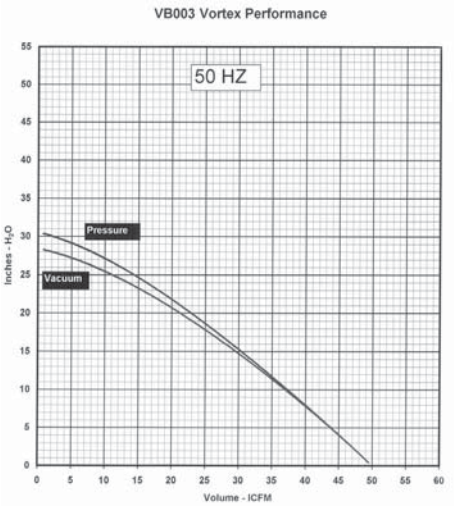
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB003S & VB003			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90301	Case, Unibody	1
2	VBI90301	Impeller	1
3	VBE90301	Cover, Impeller	1
4	NUT90219	Locknut, Shaft	1
5	WSH90184	Lockwasher, Shaft	1
6	WSH90185	Shim, Shaft to Impeller (as required)	1
7	MOT90213	Motor 48C, 1/2 HP, 1PH, 50/60Hz	1
7A	MOT90214	Motor 48C, 1/2 HP, 3PH, 50/60Hz	1
7B	MOT90229	Motor 48C, 1/2 HP, 3PH, 575 Volt, 50/60Hz	1
7C	MOT90470	Motor 48C, 1/2 HP, 3PH, 60Hz	1
7D	MOT90469	Motor 48C, 1/2 HP, 1PH, 60Hz	1
8	SCR90901	M4 x 0.7 Pan Head Phillips Screw x .31 [8] Long	4
10	SCR90307	1/4-20 x .625" Long Socket Cap Screw	4
11	GSK90170	Gasket, Flange	1
12	FLC90015	Flange	1
13	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] Long	6
16	INS90016	Absorber	2
17	KEY90085	Key	1
18	N/A	Impeller to case gap specification	N/A

VB003S, VB003

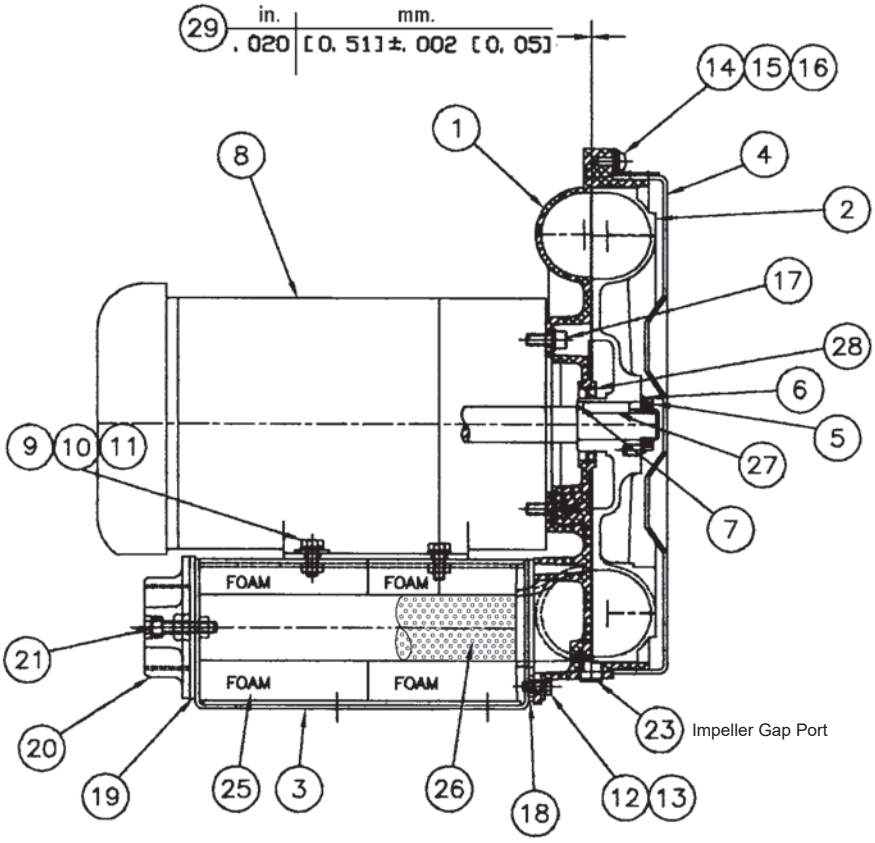
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB004S, VB004

Assembly Diagram

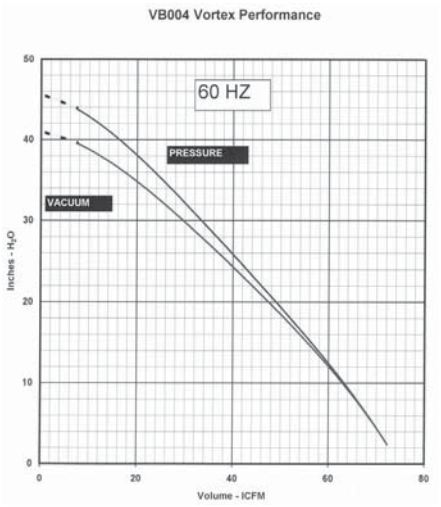


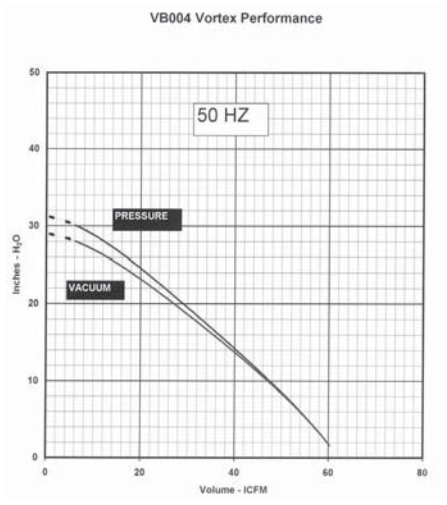
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB004S & VB004			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90401	Case	1
2	VBI90401	Impeller	1
3	VBB90401	Base	1
4	VBE90401	Cover, Impeller	1
5	NUT90212	Locknut, Shaft	1
6	WSH90170	Lockwasher, Shaft	1
7	WSH90177	Shim, Shaft to Impeller (as required)	1
8	MOT90193	Motor 48C, 3/4 HP, 1PH, 50/60Hz	1
8A	MOT90192	Motor 48C, 3/4 HP, 3PH, 50/60Hz	1
8B	MOT90230	Motor 48C, 3/4 HP, 3PH, 575 Volt, 50/60Hz	1
8C	MOT90471	Motor 48C, 3/4 HP, 3PH, 60Hz	1
8D	MOT90472	Motor 48C, 3/4 HP, 1PH, 60Hz	1
9	SCR90887	M6 x 1.0 Hex Head Bolt x .63 [16] Long	4
10	WSH90142	Lock washer, M5	4
11	WSH90166	Flat Washer, M5	4
12	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] Long	2
13	WSH90181	Flat Washer, M5	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90307	1/4-20 x .625" Long Socket Cap screw	4
18	GSK90165	Gasket, Case	1
19	GSK90163	Gasket, Flange	2
20	FLC90007	Flange	2
21	SCR90931	M6 x 1.0 S.H.C.S. x .98 [25] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90017	Absorber	4
26	SCN90065	Screen	2
27	KEY90076	Key	1
28	SEL90108	Lip Seal	1
29	N/A	Impeller to case gap specification	N/A

VB004S, VB004

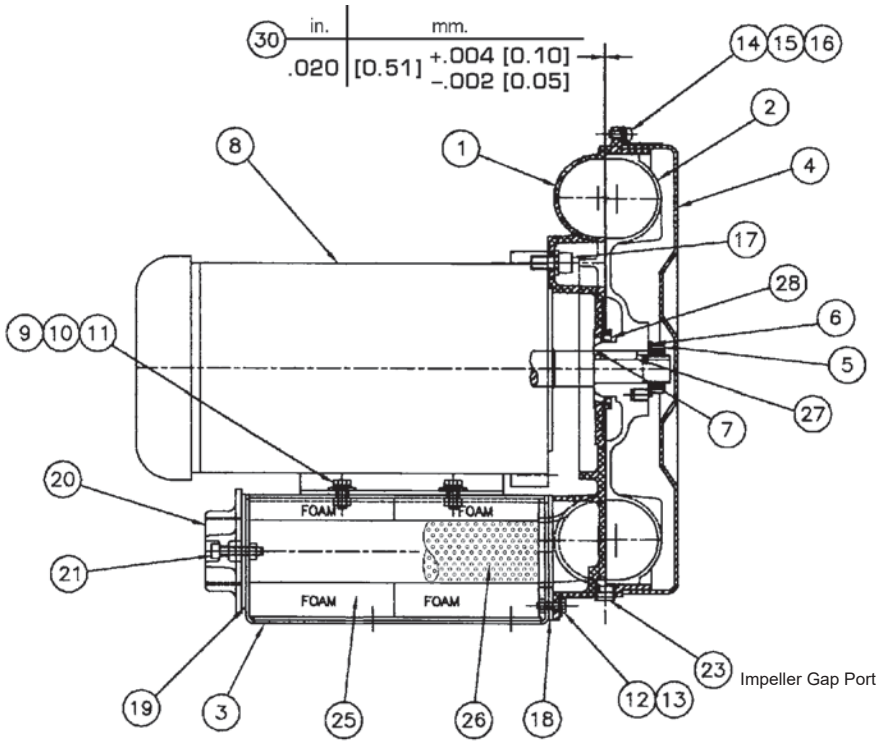
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB007S, VB007, VB007SXP, VB007XP

Assembly Diagram



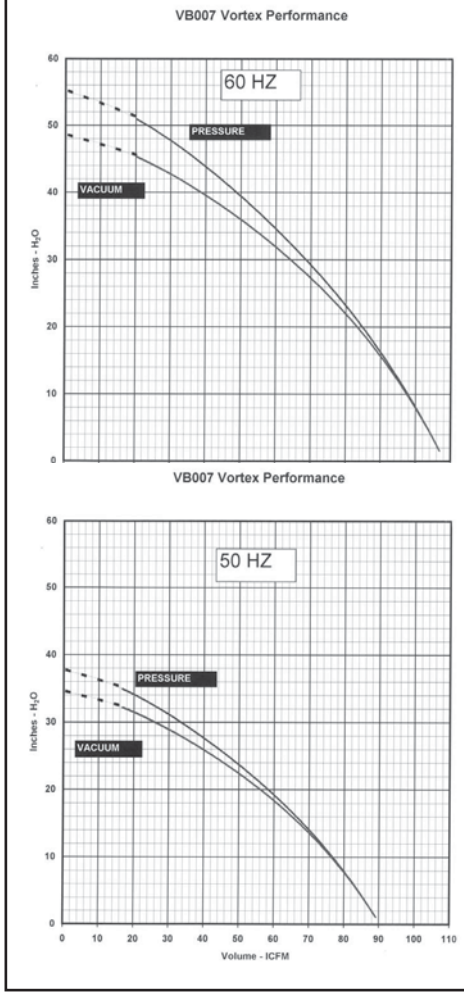
(See Bulletin 417, pages 34 and 35 for specifics on models with explosion-proof motors.)

Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB007S, VB007, VB007SXP, VB007XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90701	Case	1
2	VBI90701	Impeller	1
3	VBB90701	Base	1
4	VBE90701	Cover, Impeller	1
5	NUT90210	Locknut, Shaft	1
6	WSH90171	Lockwasher, Shaft	1
7	WSH90160	Shim, Shaft to Impeller (as required)	1
8C	MOT90225	Motor, 56C, 1-1/2 HP, 3PH, XP, 50/60Hz	1
8D	MOT90358	Motor, 56C, 1-1/2 HP, 1PH, XP, 50/60Hz	1
8G	MOT90248	Motor, 56C, 1-1/2 HP, 3PH, 50/60Hz	1
8H	MOT90253	Motor, 56C, 1-1/2 HP, 1PH, 50/60Hz	1
8I	MOT90485	Motor, 56C, 1-1/2 HP, 3PH, 60Hz	1
8J	MOT90484	Motor, 56C, 1-1/2 HP, 1PH, 60Hz	1
9	SCR90887	M6 x 1.0 Hex Head Bolt x .63 [16] Long	4
10	WSH90142	Lockwasher, M6	4
11	WSH90166	Flat Washer, M6	4
12	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] Long	2
13	WSH90181	Washer, Flat M5	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90867	3/8-16 x .75" Long Socket Cap Screw	4
18	GSK90164	Gasket, Case	1
19	GSK90163	Gasket, Flange	2
20	FLC90008	Flange, 1 1/2 FNPT	2
21	SCR90931	M6 x 1.0 S.H.C.S. x .98 [25] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90018	Absorber	4
26	SCN90064	Screen	2
27	KEY90076	Key	1
28	SEL90107	Lip Seal	1
30	N/A	Impeller to case gap specification	N/A

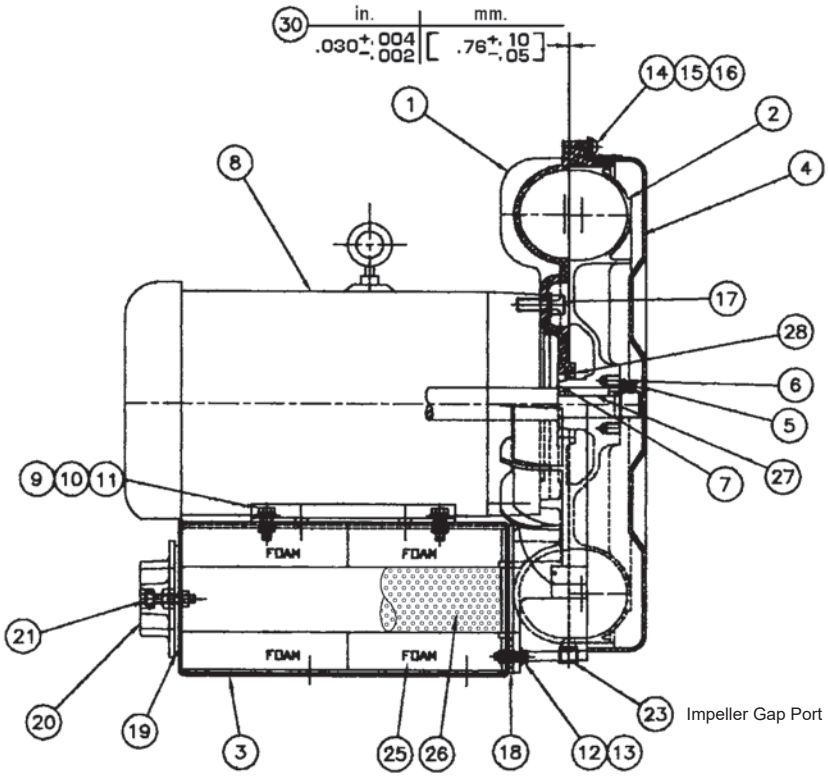
VB007S, VB007

Performance Curves



Spencer® Vortex® Regenerative Blowers
VB019S, VB019, VB019SXP, VB019XP

Assembly Diagram



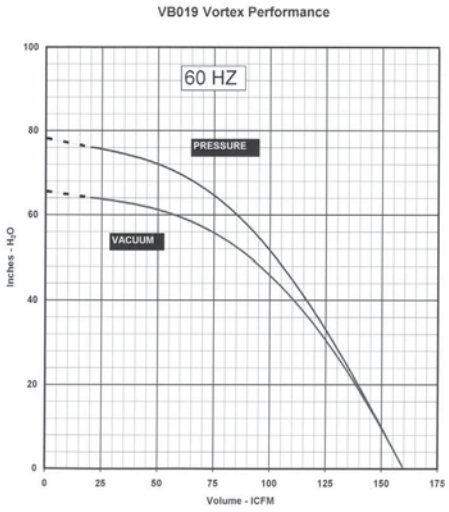
(See Bulletin 417, pages 36 and 37 for specifics on models with explosion-proof motors.)

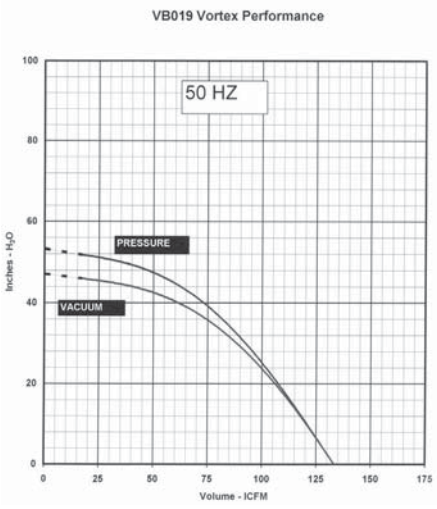
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB019S, VB019, VB019SXP, VB019XP			
ITEM	PART NO.	DESPCRIPTION	QTY.
1	VBC91901	Case	1
2	VBI91901	Impeller	1
3	VBB91901	Base	1
4	VBE91901	Cover, Impeller	1
5	NUT90210	Locknut, Shaft	1
6	WSH90171	Lockwasher, Shaft	1
7	WSH90160	Shim, Shaft to Impeller (as required)	1
8	MOT90254	Motor, 145TC, 2-1/2 HP, 1PH, 50/60Hz	1
8A	MOT90249	Motor, 145TC, 2-1/2 HP, 3PH, 50/60Hz	1
8B	MOT90347	Motor, 145TC, 2-1/2 HP, 3PH, 575 Volt, 50/60Hz	1
8C	MOT90224	Motor, 145TC, 2-1/2 HP, 3PH, XP, 50/60Hz	1
8D	MOT90359	Motor, 145TC, 2-1/2 HP, 1PH, XP, 50/60Hz	1
8E	MOT90476	Motor, 145TC, 2-1/2 HP, 3PH, 60Hz	1
8F	MOT90475	Motor, 145TC, 2-1/2 HP, 1PH, 60Hz	1
9	SCR90887	M6 x 1.0 Hex Head Bolt x .63 [16] Long	4
9ALT	SCR90876	M6. x 1.0 Hex Head Bolt x .98 [25] Long (Cast Motor)	4
10	WSH90142	Lockwasher, M6	4
11	WSH90166	Flat Washer, M6	4
12	SCR90943	M5 x 0.8 Hex Head Bolt x .79 [20] Long	2
13	WSH90181	Flat Washer, M5	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90867	3/8-16 x .75" Long Socket Cap Screw	4
18	GSK90162	Gasket, Case	1
19	GSK90163	Gasket, Flange	2
20	FLC90008	Flange, 1 1/2 FNPT	2
21	SCR90931	M6 x 1.0 S.H.C.S. x .98 [25] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90019	Absorber	4
26	SCN90063	Screen	2
27	KEY90077	Key	1
28	SEL90107	Lip Seal	1
30	N/A	Impeller to case gap specification	N/A

VB019S, VB019

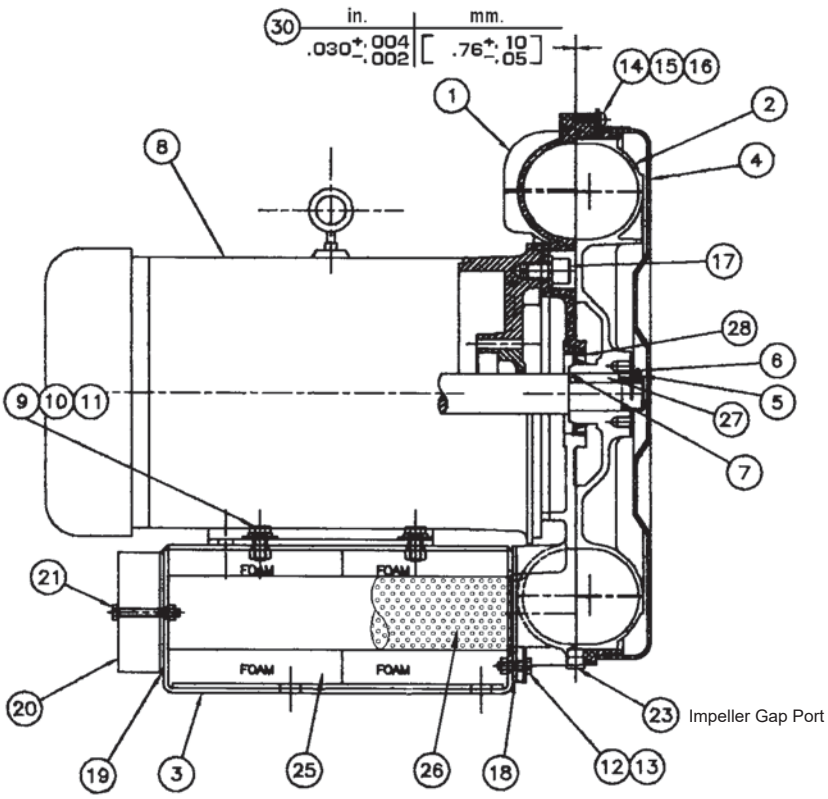
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB030S, VB030, VB030XP

Assembly Diagram



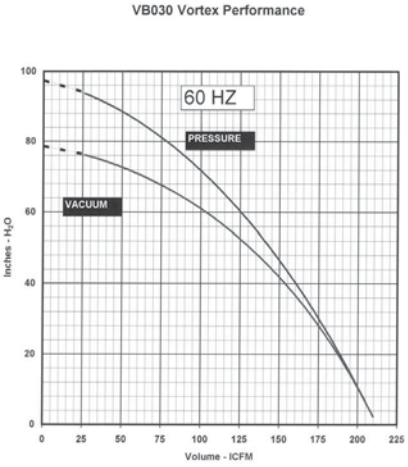
(See Bulletin 417, pages 38 and 39 for specifics on models with explosion-proof motors.)

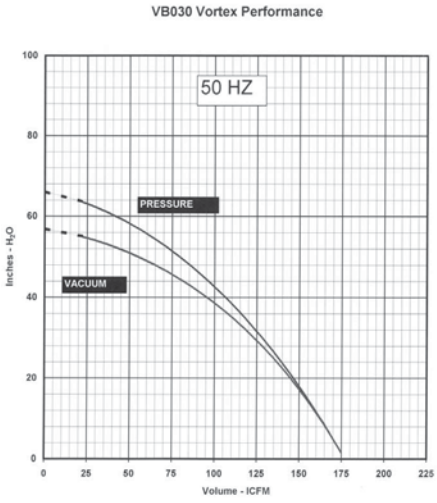
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB030S, VB030, VB030XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC93001	Case	1
2	VBI93001	Impeller	1
3	VBB93001	Base	1
4	VBE93001	Cover, Impeller	1
5	NUT90209	Locknut, Shaft	1
6	WSH90172	Lockwasher, Shaft	1
7	WSH90157	Shim, Shaft to Impeller (as required)	1
8	MOT90370	Motor, 184TC, 4 HP, 1PH, 50/60Hz	1
8A	MOT90250	Motor, 182TC, 4 HP, 3PH, 50/60Hz	1
8B	MOT90348	Motor, 182TC, 4 HP, 3PH, 575 Volt, 50/60Hz	1
8C	MOT90223	Motor, 182TC, 4 HP, 3PH, XP, 50/60Hz	1
8D	MOT90478	Motor, 182TC, 4 HP, 3PH, 60Hz	1
8E	MOT90477	Motor, 182TC, 4 HP, 1PH, 60Hz	1
9	SCR90879	M8 x 1.25 Hex Head Bolt x .98 [25] Long	4
10	WSH90148	Lockwasher, M8	4
11	WSH90182	Flat Washer, M8	4
12	SCR90876	M6 x 1.0 Hex Head Bolt x .98 [25] Long	2
13	WSH90166	Flat Washer, M6	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90335	1/2 -13 x 1.0 Long Socket Cap Screw	4
18	GSK90161	Gasket, Case	1
19	GSK90155	Gasket, Flange	2
20	FLC90009	Flange, 2 FNPT	2
21	SCR90878	M6 x 1.0 Hex Head Bolt x 1.57 [40] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90020	Absorber	4
26	SCN90062	Screen	2
27	KEY90078	Key	1
28	SEL90104	Lip Seal	1
30	N/A	Impeller to case gap specification	N/A

VB030S, VB030

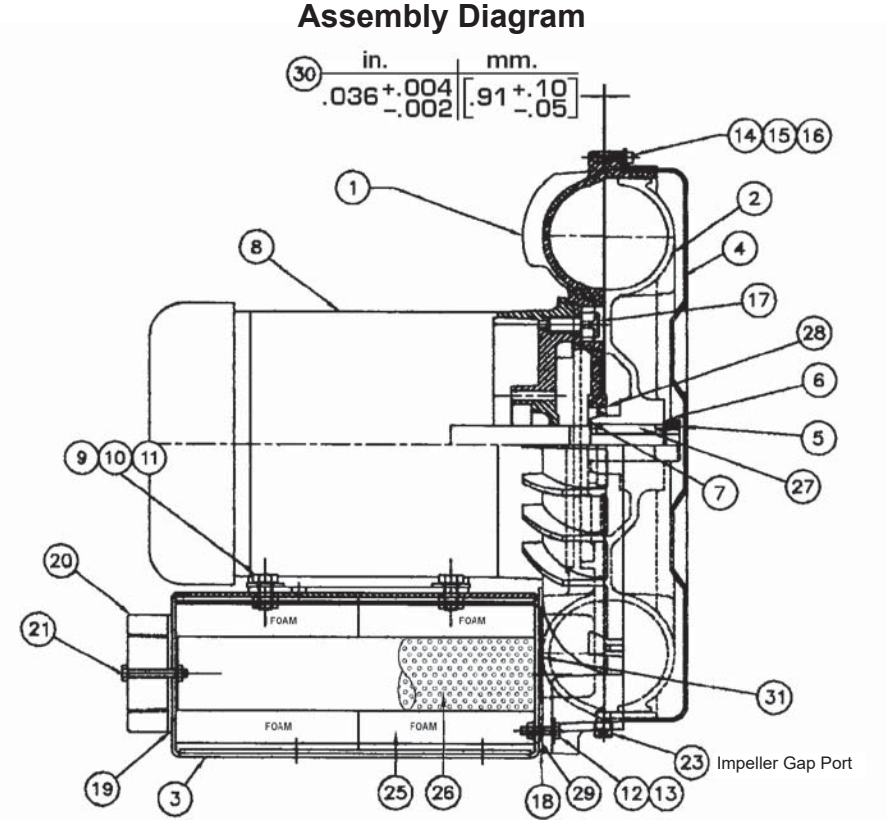
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB037S, VB037, VB037XP

Assembly Diagram



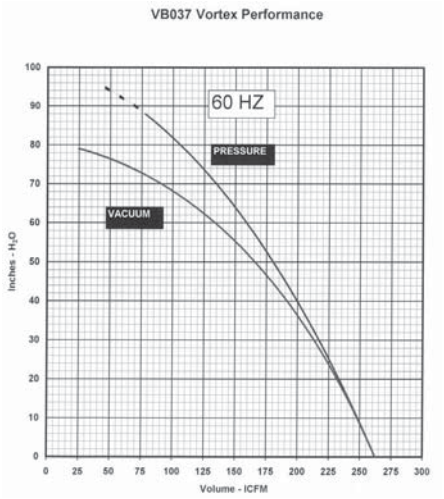
(See Bulletin 417, pages 40 and 41 for specifics on models with explosion-proof motors.)

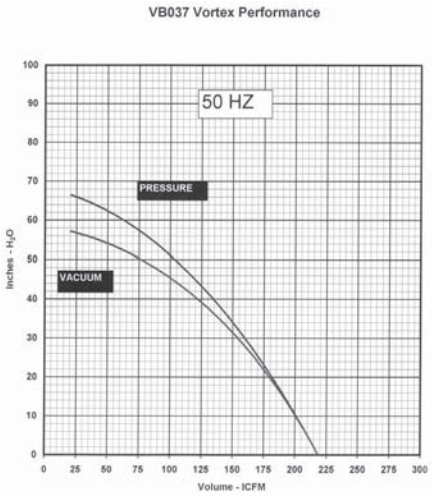
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB037S, VB037, VB037XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC93701	Case	1
2	VBI93702	Impeller	1
3	VBB93700	Base	1
4	VBE93701	Cover, Impeller	1
5	NUT90209	Locknut, Shaft	1
6	WSH90172	Lockwasher, Shaft	1
7	WSH90157	Shim, Shaft to Impeller (as required)	1
8	MOT90361	Motor, 184TC, 5 HP, 1PH, 50/60Hz	1
8A	MOT90181	Motor, 184TC, 5 HP, 3PH, 50/60Hz	1
8B	MOT90234	Motor, 184TC, 5 HP, 3PH, 575 Volt, 50/60Hz	1
8C	MOT90222	Motor, 184TC, 5 HP, 3PH, XP, 50/60Hz	1
8D	MOT90480	Motor, 184TC, 5 HP, 3PH, 60Hz	1
8E	MOT90479	Motor, 184TC, 5 HP, 1PH, 60Hz	1
9	SCR90879	M8 x 1.25 Hex Head Bolt x .98 [25] Long	4
10	WSH90148	Lockwash, M8	4
11	WSH90182	Flat Washer, M8	4
12	SCR90878	M6 x 1.0 Hex Head Bolt x 1.57 [40] Long	2
13	WSH90166	Flat Washer, M6	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90335	1/2-13 x 1.0 Long Socket Cap Screw	4
18	GSK90154	Gasket, Case	1
19	GSK90155	Gasket, Flange	2
20	FLC90009	Flange, 2 FNPT	2
21	SCR90878	M6 x 1.0 Hex Head Bolt x 1.57 [40] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90021	Absorber	4
26	SCN90056	Absorber Screen	2
27	KEY90079	Key	1
28	SEL90104	Lip Seal	1
29	SPR90088	Spacer, Washer (Case to Base)	2
30	N/A	Impeller to case gap specification	N/A
31	PLC90027	Plate, Case	1

VB037S, VB037

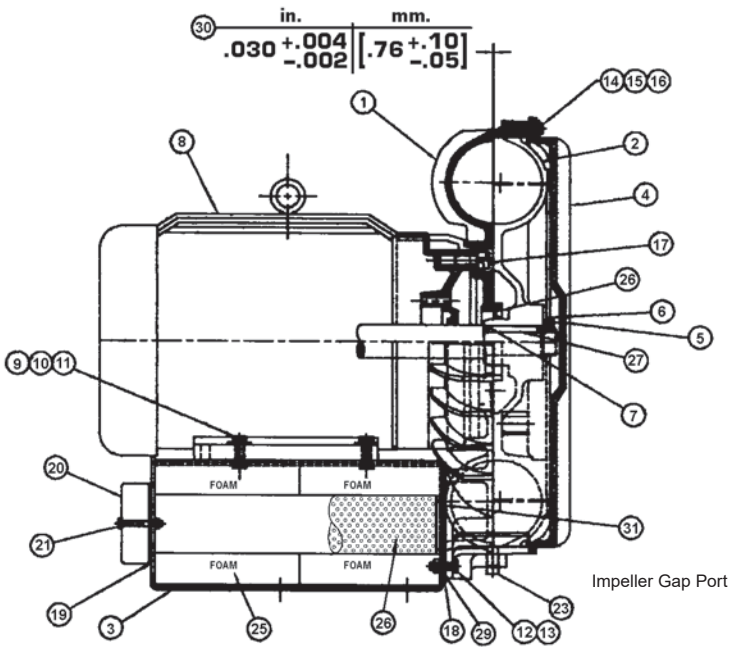
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB055, VB055XP

Assembly Diagram



Impeller Gap Port

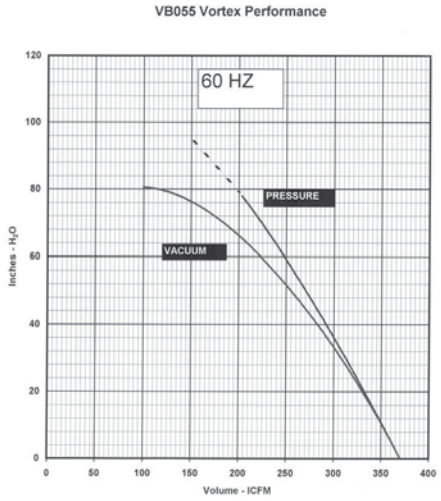
(See Bulletin 417, pages 42 and 43 for specifics on models with explosion-proof motors.)

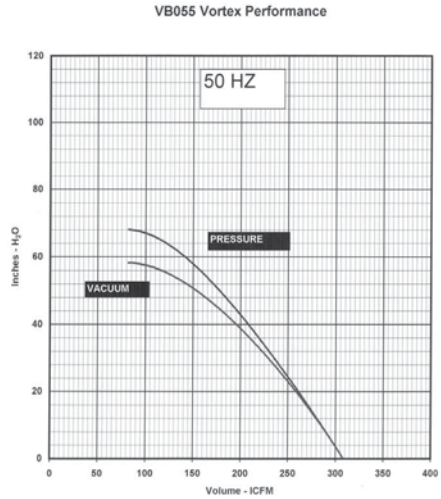
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB055, VB055XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC95501	Case	1
2	VBI95502	Impeller	1
3	VBB95501	Base	1
4	VBE95501	Cover, Impeller	1
5	NUT90211	Locknut, Shaft	1
6	WSH90173	Lockwasher, Shaft	1
7	WSH90154	Shim, Shaft to Impeller (as required)	1
8	MOT90182	Motor, 213TC, 7-1/2 HP, 3PH, 50/60Hz	1
8A	MOT90205	Motor, 213TC, 7-1/2 HP, 3PH, 575 Volt, 50/60Hz	1
8B	MOT90221	Motor, 213TC, 7-1/2 HP, 3PH, XP, 50/60Hz	1
8C	MOT90481	Motor, 213TC, 7-1/2 HP, 3PH, 60Hz	1
9	SCR90881	M8 x 1.25 Hex Head Bolt x 1.18 [30] Long	4
10	WSH90148	Lockwasher, M8	4
11	WSH90182	Flat Washer, M8	4
12	SCR90895	M8 x 1.25 Hex Head Bolt x 1.57 [40] Long	2
13	WSH90182	Flat Washer, M8	2
14	SCR90876	M6 x 1.0 Hex Head Screw x .98 [25] Long	8
15	WSH90143	Lockwasher, M6	8
16	WSH90142	Washer, Flat M6	8
17	SCR90335	1/2-13 x 1.0 Long Socket Cap Screw	4
18	GSK90156	Gasket, Case	1
19	GSK90157	Gasket, Flange	2
20	FLC90010	Flange, 2-1/2 FNPT	2
21	SCR90878	M6 x 1.0 Hex Head Bolt x 1.57 [40] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90022	Absorber	4
26	SCN90057	Absorber Screen	2
27	KEY90080	Key	1
28	SEL90105	Lip Seal	1
30	N/A	Impeller to case gap specification	N/A
31	PLC90028	Case Plate	1

VB055

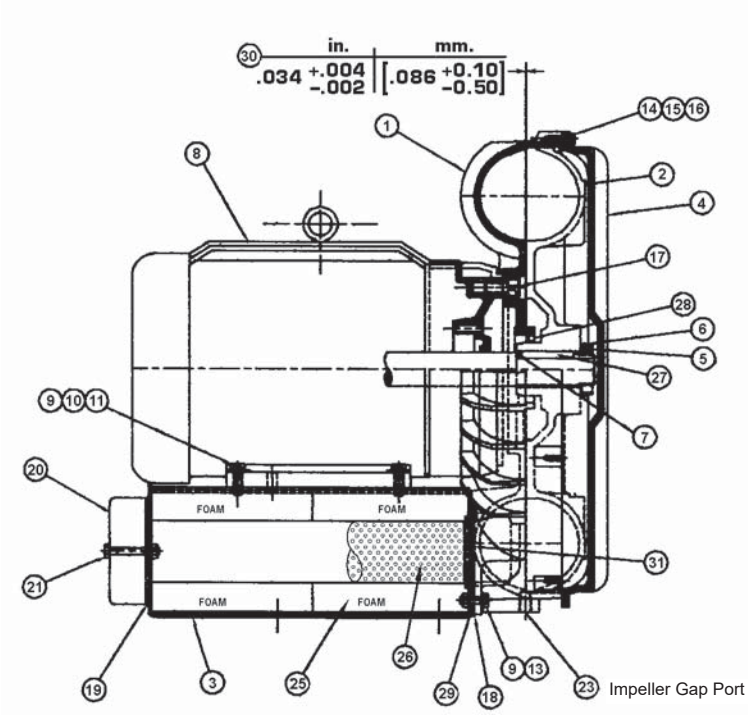
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB075, VB075XP

Assembly Diagram



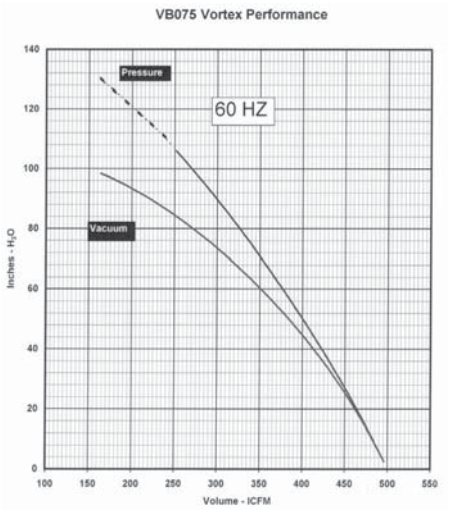
(Contact factory for specifics on models with explosion-proof motor.)

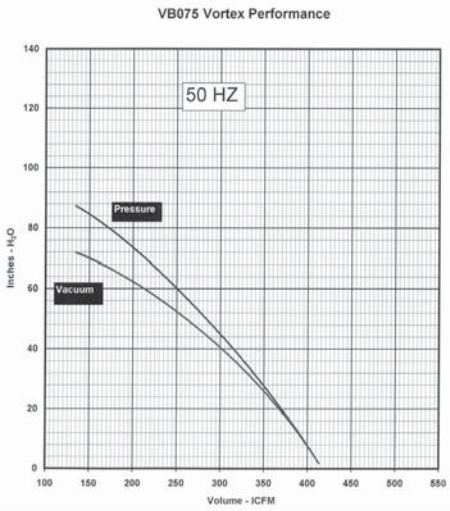
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB075, VB075XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC97501	Case	1
2	VBI97502	Impeller	1
3	VBB97501	Base	1
4	VBE97501	Cover, Impeller	1
5	NUT90213	Locknut, Shaft	1
6	WSH90174	Lockwasher, Shaft	1
7	WSH90179	Shim, Shaft to Impeller (as required)	1
8	MOT90199	Motor, 215TC, 10 HP, 3PH, 50/60Hz	1
8A	MOT90235	Motor, 215TC, 10 HP, 3PH, 575 Volt, 50/60Hz	1
8B	MOT90220	Motor, 215TC, 10 HP, 3PH, XP, 50/60Hz	1
8C	MOT90482	Motor, 215TC, 10 HP, 3PH, 60Hz	1
9	SCR90881	M8 x 1.25 Hex Head Bolt x 1.18 [30] Long	4
10	WSH90148	Lockwasher, M8	4
11	WSH90182	Flat Washer M8	4
12	SCR90881	M8 x 1.25 Hex Head Bolt x 1.18 [30] Long	2
13	WSH90182	Flat Washer M8	2
14	SCR90876	M6 x 1.0 Hex Head Screw x .98 [25] Long	8
15	WSH90143	Lockwasher, M6	8
16	WSH90142	Flat Washer M6	8
17	SCR90335	1/2-13 x 1.0 Long Socket Cap Screw	4
18	GSK90158	Gasket, Case	1
19	GSK90159	Gasket, Flange	2
20	FLC90011	Flange, 3 FNPT	2
21	SCR90883	M8 x 1.25 Hex Head Bolt x 2.165 [55] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90023	Absorber	4
26	SCN90058	Absorber Screen	2
27	KEY90081	Key	1
28	SEL90106	Lip Seal	1
29	SPR90089	Spacer, Washer (Case to Base)	2
30	N/A	Impeller to case gap specification	N/A
31	PLC90029	Case Plate	1

VB075

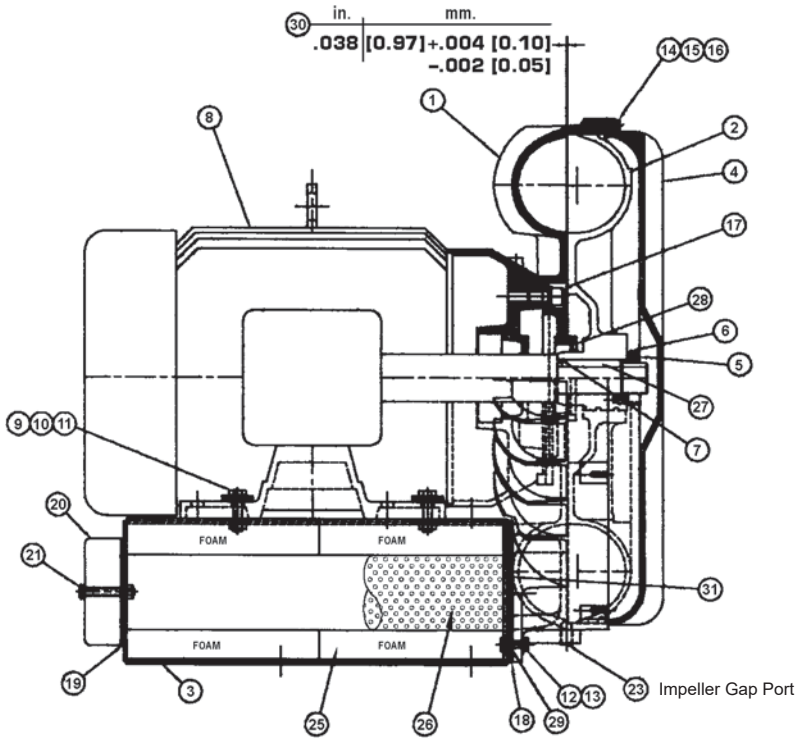
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB110, VB110XP

Assembly Diagram



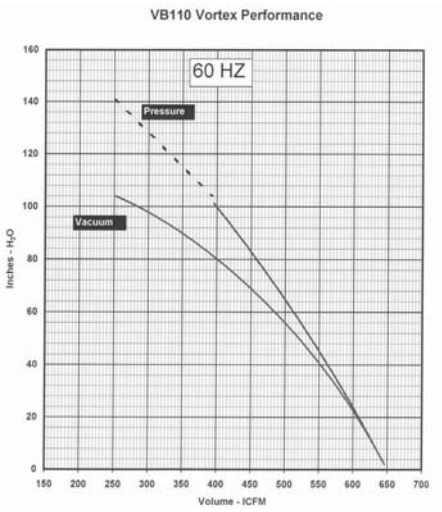
(Contact factory for specifics on models with explosion-proof motor.)

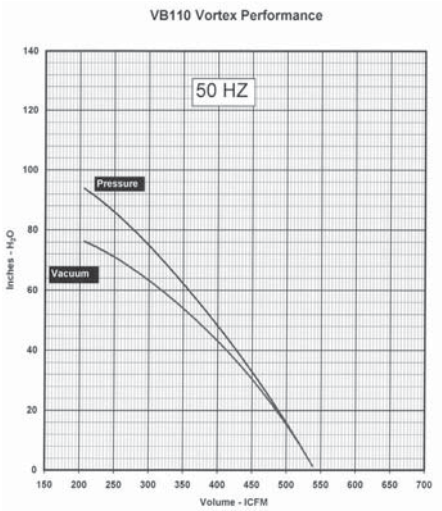
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB110, VB110XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC91101	Case	1
2	VBI91102	Impeller	1
3	VBB91101	Base	1
4	VBE91101	Cover, Impeller	1
5	NUT90213	Locknut, Shaft	1
6	WSH90174	Lockwasher, Shaft	1
7	WSH90179	Shim, Shaft to Impeller (as required)	1
8	MOT90200	Motor, 254-6TC, 15 HP, 3PH, 50/60Hz	1
8A	MOT90236	Motor, 254-6TC, 15 HP, 3PH, 575 Volt, 50/60Hz	1
8B	MOT90219	Motor, 254TC, 15 HP, 3PH, XP, 50/60Hz	1
8C	MOT90483	Motor, 254TC, 15 HP, 3PH, 60Hz	1
9	SCR90882	M10 x 1.5 Hex Head Bolt x 1.57 [40] Long	4
10	WSH90137	Lockwasher, M10	4
11	WSH90183	Flat Washer M10	4
12	SCR90881	M8 x 1.25 Hex Head Bolt x 1.18 [30] Long	2
13	WSH90182	Flat Washer M8	2
14	SCR90876	M6 x 1.0 Hex Head Screw x .98 [25] Long	8
15	WSH90143	Lockwasher, M6	8
16	WSH90142	Flat Washer M6	8
17	SCR90335	1/2-13 x 1.0 Long Socket Cap Screw	4
18	GSK90160	Gasket, Case	1
19	GSK90159	Gasket, Flange	2
20	FLC90011	Flange, 3 FNPT	2
21	SCR90883	M8 x 1.25 Hex Head Bolt x 2.16 [55] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90024	Absorber	4
26	SCN90061	Absorber Screen	2
27	KEY90082	Key	1
28	SEL90106	Lip Seal	1
29	SPR90089	Spacer, Washer (Case to Base)	2
30	N/A	Impeller to case gap specification	N/A
31	PLC90030	Case Plate	1

VB110

Performance Curves





VI. Troubleshooting Guide

Trouble	Possible Cause	Corrective Action
Blower Does Not Turn and there is -		
A Humming Sound	– One phase of power line disconnected	Connect power leads properly
	– One phase of stator line open	Contact factory
	– Bearing(s) defective	Change defective bearing(s)
	– Impeller jammed by foreign material	Clean impeller
	– Impeller jammed against casing or side cover	Adjust gap
	– Rubbing of rotor core and stator core	Contact factory
	– Capacitor open (single-phase models)	Change capacitor
No Sound	– Two phases of power line disconnected	Connect power leads properly
	– Two phases of stator winding open	Contact factory
	– Faulty switch connection	Change switch
	– Fuse blown	Change fuse
Blower Turns, but -		
Fuse Blows	– Fuse capacity insufficient, wiring fault	Inspect wiring
	– Short circuit	Repair
	– Terminals shorted	Improve insulation and check connections
	– Excessive load	Increase air flow
Overheats or Thermal Protector Activates	– Power source unbalance; possible voltage drop	Check voltage; phases must be balanced within 5% and voltage must be within 10% of rated
	– Operating in single-phase condition	Check connections
	– Excessive friction due to defective bearings	Replace bearings
	– Impeller contaminated by foreign material	Clean impeller
	– Impeller rubbing against casing or side cover	Adjust gap
	– Operation at less than minimum rated flow	Increase air flow
Makes Abnormal Sound	– Impeller rubbing against casing or side cover	Adjust gap
	– Impeller rubbed by foreign material	Clean impeller
	– Bearing(s) defective	Replace bearings
	– There is a leak or air passages are clogged	Repair or clean
	– Loose cap screw	Tighten screw

Customer Maintenance Log

DATE	PROCEDURE	COMMENTS	INITIALS

Spencer®

Products & Services

Industrially rated products offering effective solutions for air and gas handling problems:

- Multistage centrifugal blowers
- Single stage centrifugal blowers
- Gas boosters and hermetic gas boosters
- Regenerative blowers
- Modular central vacuum systems
- Mobile or stationary integrated vacuum units
- Separators and dust collectors
- Custom-engineered products with special materials for extreme temperatures and pressures

Complementary accessories with single source convenience and compatibility:

- Standard and custom electrical control panels – UL, CUL Listed and C.E. Compliant available
- Valves, gauges, couplings, shrink sleeves, vibration isolators and other system components
- Comprehensive selection of tubing, fittings, vacuum hoses, valves and tools

Comprehensive engineering and other customer support services:

- The industry's largest complement of technical specialists in air and gas handling technology
- Worldwide parts and service organization
- Application research and testing facility

Worldwide organization of sales representatives and distributors offering:

- Product selection, installation and operation assistance
- Comprehensive system design services
- Follow-up services and troubleshooting

For the name and telephone number of your local Spencer Representative, call 800-232-4321 or email marketing@spencer-air.com

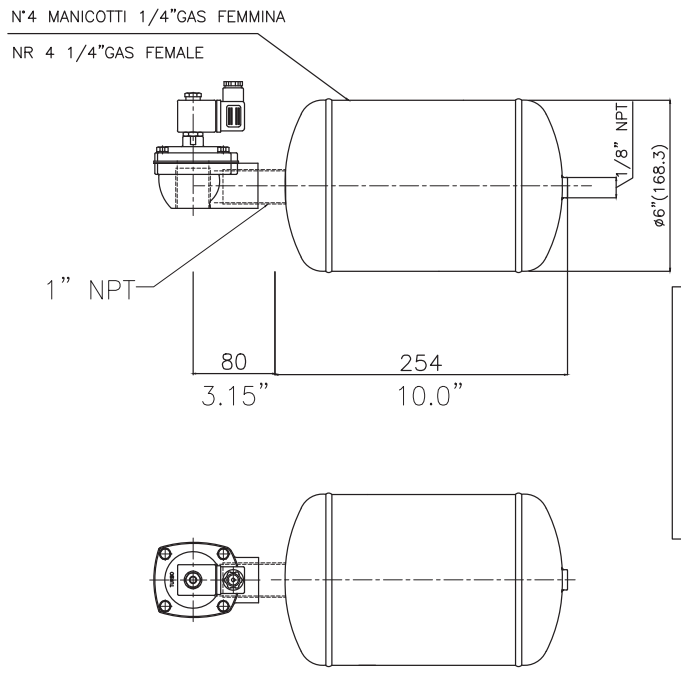
Blowers & Vacuum Systems with an Engineering Edge

The Spencer Turbine Company, 600 Day Hill Road, Windsor, CT 06095-4706

TEL 800-232-4321 ◆ 860-688-8361 ◆ FAX 860-688-0098 ◆ www.spencerturbine.com

SUFFIX	VOLTAGE	ROYAL #
01	24VDC	FP25/G NPT24
00	110VAC	FP25/G NPT110

LET	REVISION	DATE	DRAWN
A	ADD SUFFIX FOR 24VDC	4/15/13	EAD



VALVOLA DA 1" NPT
TUBO ACCIAIO INOX 304 SS
TRONCHETTO FILETTATO DA 1" NPT
MANICOTTO FILETTATO FEMMINA DA 3/8"NPT
TRATTAMENTO : (EXCEPT AS NOTED BELOW) MANDARE A LUCIDARE PRIMA DEL MONTAGGIO

HAPMAN CONVEYOR NOTES FROM ORIG QUOTE DATED OCTOBER 14, 2004:

304L STAINLESS

BRUSHED FINISH TANK WITH NON-ANODIZED (NO BLACK ANODIZATION) VALVE ON END

REVISIONE/REV	DATA/DATE	DESCRIZIONE MODIFICA/REVISION DESCRIPTION	DIS/DRAWN	CONTR/CHK	APPR/APPROVED

CODICE SERBATOIO/ TANK CODE TF6P25N1PxxxBG	VALVOLA/VALVE: FP25/G NPT[redacted]
CAPACITA'/LITRES: LT 6	COLORE/COLOUR: RAL NO
PRESSIONE DI ESERCIZIO/WORKING PRESSURE: 8 BAR MAX	WORKING TEMPERATURE: −10°C +55°C
TURBO srl VIA SAN CARLO 88 20031 CESANO MADERNO (MI) TEL.: ++39 0362 574024 FAX.: ++39 0362 574092 e-mail: turbocontrols@tin.it www.turbocontrols.it	CLIENTE/CUSTOMER: ROYAL/HAPMAN RIF.CLIENTE/REFERENCE DISEGNO/DWG: DP3699A
DISEGNATO DRAWN: MF CONTROLLATO CHECKED APPROVATO APPROVED DATA/DATE SCALA/SCALE	REVISIONE REVISION

Q:STDHAP\PNEU\09155010.DWG

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE ENGLISH (FEET AND/OR INCHES)
TOLERANCES

DECIMALS	INCHES	FEET	ANGLES
.X ±.030 .XX ±.015 .XXX ±.005	X"= ±1/16"	X'−X"=±1/4" UP TO 20 FEET X'−X"=±1/2" OVER 20 FEET	±1°

DO NOT SCALE DWG.
BREAK ALL SHARP EDGES

MATERIAL: 304L SS

FINISH: BRUSH FINISH

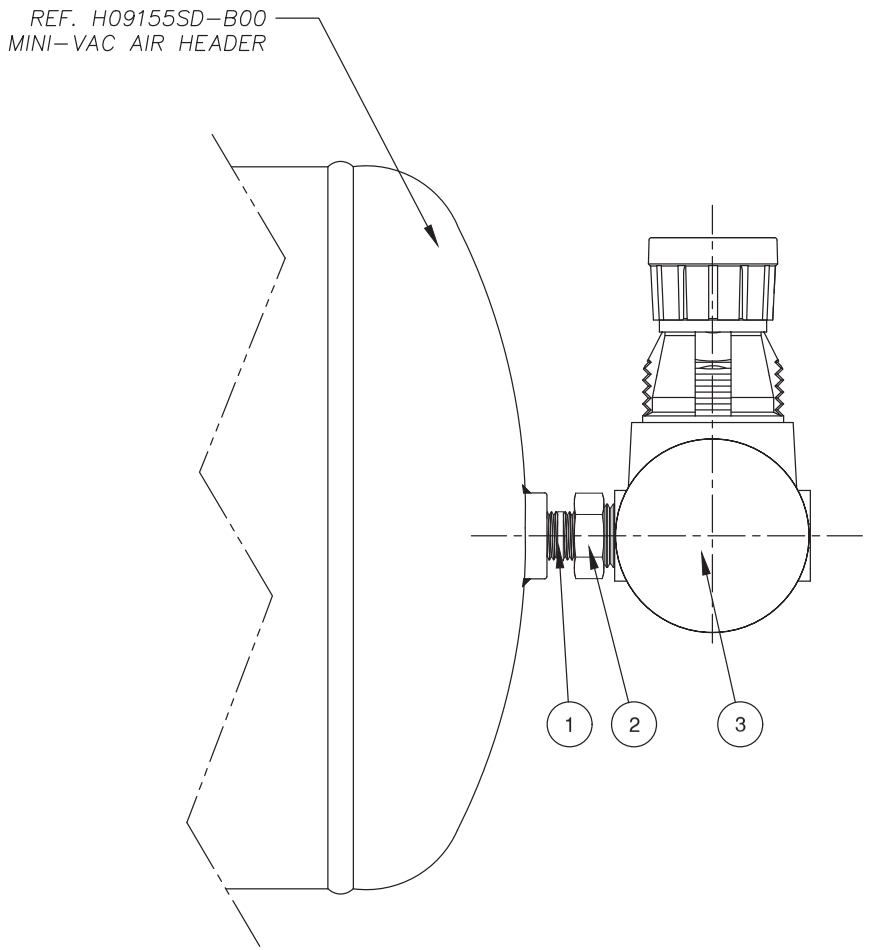
HAPMAN

Hapman Conveyors
6002 EAST KILGORE ROAD
KALAMAZOO, MICHIGAN 49003
AREA CODE 616/343-1675
TEXEX 224468

NAME: AIR HEADER, 6" DIA X 10" LG W/VALVE 304L SS

DRAWN	DATE	SCALE	REV. DATE
MH	1/10/05	2"=1"	4/15/13

SHEET OF	DWG. NO.	REV.
1 1	H09155SD−B__	A



	REV.	SUF.	ITEM NO.	DRAWING/PART NO.	DESCRIPTION	QTY	UOM
B00	A		1		CLOSE NIPPLE- 1/8 NPT, PLATED	1	--
	A		2		REDUCING HEX- 1/4 NPT TO 1/8 NPT, PLATED	1	--
			3	14R116FC	REGULATOR W/GAUGE, 0-60 PSI, 1/4 NPT	1	--
							--
B01	A		1		CLOSE NIPPLE- 1/8 NPT, S.S.	1	--
	A		2		REDUCING HEX- 1/4 NPT TO 1/8 NPT, S.S.	1	--
			3	14R116FC	REGULATOR W/GAUGE, 0-60 PSI, 1/4 NPT	1	--

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE ENGLISH (FEET AND/OR INCHES)

TOLERANCES

DECIMALS	INCHES	FEET	ANGLES
.X ±.030" .XX ±.015" .XXX ±.005"	X"= ±1/16"	X'-X"=±1/4"UP TO 20 FEET X'-X"=±1/2" OVER 20 FEET	±1°

DO NOT SCALE DRAWING | REMOVE ALL SHARP EDGES

REV	REVISION DESCRIPTION	DATE	BY
A	SEPERATED THE BOM BY THE ASSEMBLY SUFFIX NUMBER	4/30/13	CJC

HAPMAN
Ideas that move
P.O. BOX 2321
6002 E. KILGORE ROAD, KALAMAZOO, MICHIGAN 49048
PHONE (269) 343-1675 FAX (269) 349-2477

DATE	8/25/11	JOB NO.	DRAWN E. DZIERFZYC
SCALE	NONE		BOM = 0 DWG = 1

Q:\HAPMAN\LIBRARY\9535B

TITLE

REGULATOR ASSEMBLY FOR MINI-VAC AIR HEADER

CUST.

SHEET	OF	DWG. NO.	REV.
1	1	9535-B__	A

SUFFEX	MATERIAL OF CONSTRUCTION
01	304 STAINLESS STEEL CONSTRUCTION
00	CARBON STEEL CONSTRUCTION

LET	REVISION	DATE	DRAWN
A	UPDATED VENDOR DATA	11/05/07	MAV
B	REMOVED VENDOR SPECIFIC INFORMATION	01/21/16	JAF

FILTER 7.875 O.D X 3.56" I.D X 16"Lg.
STAINLESS STEEL END CAPS
GALVANIZED INNER CORE
MEDIA- "PTFE POLYESTER"/16OZ. POLYESTER FELT
FILTER AREA - 13 SQ FT.
NO OF PLEATS - 30
POTTING - WHITE FOOD GRADE SILICONE
GASKET - WHITE SILICONE
FDA APPROVED MATERIALS
OPEN TOP, CLOSED BOTTOM WITH 9/16" HOLE
MAXIMUM OPERATING TEMP - 240° F
MAXIMUM OPERATING DIFFERENTIAL PRESSURE - 25" WG
TYPICAL USES - BAG DUMP DUST COLLECTOR, MODEL 20 PNEU.
RECEIVERS

HAPMAN
ideas that move
P.O. BOX 2321
6002 E. KILGORE ROAD, KALAMAZOO, MICHIGAN 49048
PHONE (269) 343-1675 FAX (269) 349-2477

NAME
AIR FILTRATION CARTRIDGE

DRAWN	DATE	SCALE
DRB	3/16/93	NONE

DWG. NO.
104909-B

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Description

When it comes to machine safety, Rockwell Automation knows that protection of personnel and equipment is your main concern. At the same time, flexibility and productivity are points that must also be considered as you design your safety system. Optimize all of these with the new Allen-Bradley SensaGuard family of noncontact switches.

Featuring the latest generation of RFID technology for coding and Inductive technology for sensing, SensaGuard's large sensing range and tolerance to misalignment is a cost-effective solution that is ideally suited for a wide range of industrial safety applications.

The SensaGuard product line is a Category 4 /SIL 3 rated switch per EN954-1, TÜV functional safety approved to IEC 61508.

Features

- Switches can be connect to a standard safety relay, for example, the MSR126, MSR127, MSR200/300 Family, SmartGuard and Safety I/O Blocks
- Multiple actuator sizes for large sensing distance
- IP 69K environmental rating
- Short-circuit and over-voltage protection
- Led located on the switch for door status and troubleshooting

Benefits

- No dedicated controller required
- Cat 4/SIL 3 rating maintained even with multiple units connected in series
- Switches can be connected in series with other devices (light curtain, E-stops, key interlock switches)
- Extended diagnostics for easy troubleshooting
- Large sensing distances
- Tolerance to misalignment
- Multiple sensing directions
- Stainless steel version suitable for use in harsh environments
- Use standard proximity brackets

Specifications

Category	Cat. 4/SIL3		
Certifications	TÜV, CE, cULus (UL 508)		
Standards	IEC 60947-5-3, IEC 61508, EN 954		
PFHd	1.119...10^{-9}		
Operating Characteristics			
Sensing Distance (Target)	**18 mm Plastic**	**30 mm Plastic**	**18 mm SS**
Operating Distance, Make—mm (in)	Assured: 15 (0.59)	Assured: 25 (0.98)	Assured: 10 (0.39)
Case Material	Valox® DR 48		304 Stainless Steel
Actuator Material	Valox® DR 48		304 Stainless Steel
Typical Misalignment	See misalignment curve.		
Repeat Accuracy	10% of Sensing Range		
Output Current, Max.	200 mA (all outputs)		
Switching Current @ Voltage, Max.	24V DC +10%/-15%		
Operating Voltage/Supply Current	24V DC, +10%/-15% Class 2 SELV power supply		
Frequency of Operating Cycle	1 Hz		
Response Time (Off)	54 ms		
Outputs (Guard Door Closed, Actuator in Place)			
Safety Outputs	2 x PNP, 0.2 A, max.; Status: ON (+24V DC)		
Auxiliary Outputs	1 x PNP, 0.2 A max.; Status: OFF (0V DC)		
Environmental			
Operating Temperature—C (F)	-10...+55° (+14...+131°)		
Relative Humidity	5...95%		
Enclosure Type Rating	NEMA 3, 4X, 12, 13, IP 69K		
Shock	IEC68-2-27 30 g, 11 ms		
Vibration	IEC 68-2-6 10...55 Hz		
Radio Frequency	IEC 61000-4-3, IEC 61000-4-6		
Protection			
Protection Type	Short Circuit, Current Limitation, Overload, False Pulse, Transient Noise, Reverse Polarity, Overvoltage (inc. load dump), Thermal Shutdown with restart, Loss of GND and Vdd		
Loss of GND and Vdd protection	Incorporated		
Electrical Life	10 x 10^6		

Noncontact Switches

SensaGuard™ 18 mm Barrel

Product Selection

Description	Operating Voltage/ Input Current	Safety Outputs	Auxiliary Outputs	Actuator Type	Assured Sensing Distance	Connection	Cat. No.
18 mm Plastic Barrel	24V DC, +10%/-15%/ 50 mA max.	2 Solid State outputs	1 Solid State output	18 mm	15 mm (0.59 in)	6 in Pigtail, 8-Pin Micro (M12)	440N-Z21S16H
						3 m Cable	440N-Z21S16A
						10 m Cable	440N-Z21S16B
				30 mm	25 mm (0.98 in)	6 in Pigtail, 8-Pin Micro (M12)	440N-Z21S26H
						3 m Cable	440N-Z21S26A
						10 m Cable	440N-Z21S26B
18 mm Stainless Steel Barrel				18 mm	10 mm (0.39 in)	6 in Pigtail, 8-Pin Micro (M12)	440N-Z21S17H
						3 m Cable	440N-Z21S17A
						10 m Cable	440N-Z21S17B

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Pg. No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable Screw	Monitored Manual	24V AC/DC	—	440R-N23135
MSR127TP	3 N.O.	1 N.C.	Removable Screw	Automatic/Manual	24V AC/DC	—	440R-N23132
Modular Safety Relays							
MSR211P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Automatic/Manual Monitored Manual	24V DC	—	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	—	440R-H23178
MSR310P Base	—	3 PNP Solid State	Removable	Automatic/Manual Monitored Manual	24V DC	—	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC	—	440R-W23218

Note: For additional Safety Relays connectivity, see the Logic section of this catalog.
For additional Safety I/O connectivity, see the Safety I/O section of this catalog.
For Application and wiring diagrams, see the Applications section of this catalog.

Connection Systems

Description	Cat. No.
Cordset	889D-F8AB-*

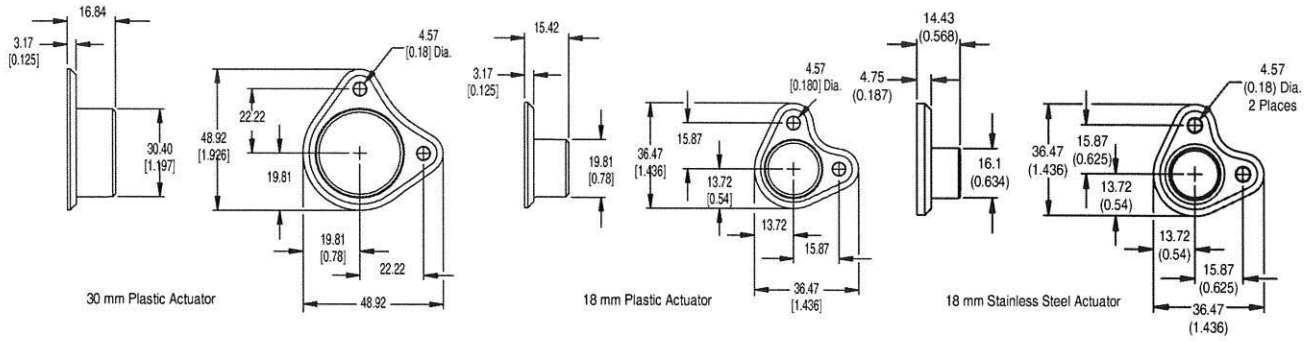
* Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.

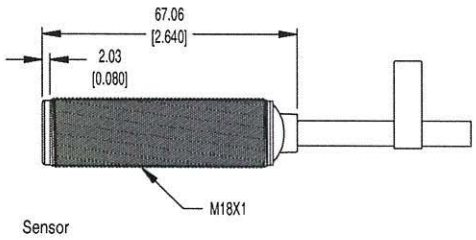
Accessories

	Description	Dimensions	Cat. No.
	18 mm Plastic Actuator	—	440N-Z18PT
	30 mm Plastic Actuator	—	440N-Z30PT
	18 mm Stainless Steel Actuator	—	440N-Z18SST
	Mounting Bracket for Tubular Sensors—Right Angle Style	—	871A-BRS18
	Mounting Bracket for Tubular Sensors—Clamp Style	—	871A-BP18
	Snap Clamp Mounting Bracket	—	871A-SCBP18
	Swivel/Tilt bracket allows ±10° vertical and 360° rotation adjustment.	—	60-2649

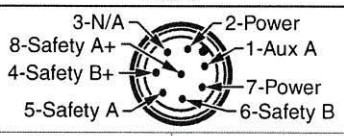
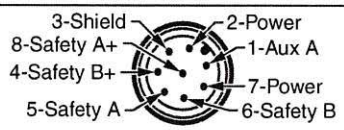
Approximate Dimensions—mm (inches)

Dimensions are not intended to be used for installation purposes.





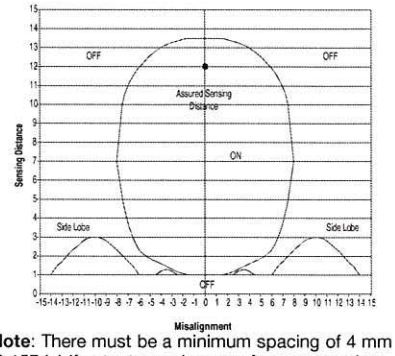
Typical Wiring Diagrams

Description		Plastic		Stainless Steel	
8-Pin Micro (M12)					
8-Pin Cordset 889D-F8AB-*	Grey	OSSD 1	Safety A	OSSD 1	Safety A
	Red	OSSD 1+		OSSD 1+	
	Pink	OSSD 2	Safety B	OSSD 2	Safety B
	Yellow	OSSD 2+		OSSD 2+	
	White	Aux A		Aux A	
	Brown	24V DC	Unit Power	24V DC	Unit Power
	Blue	Gnd		Gnd	
	Green	NA		Shield	

* Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

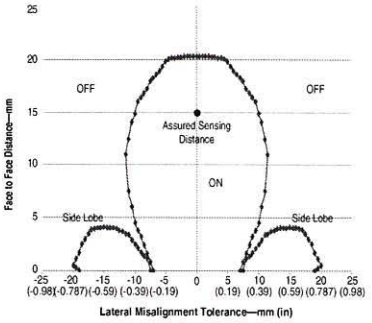
Misalignment Curve

18 mm Stainless Steel Barrel



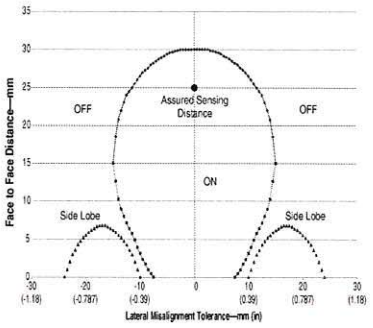
Note: There must be a minimum spacing of 4 mm (0.157 in) if actuator and sensor face approaches laterally. This will prevent false triggering due to the side lobe areas.

18 mm Plastic Barrel



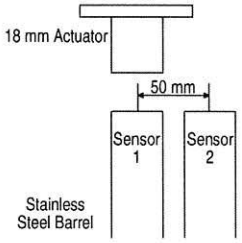
Note: There must be a minimum spacing of 4 mm (0.157 in) if actuator and sensor face approaches laterally. This will prevent false triggering due to the side lobe areas.

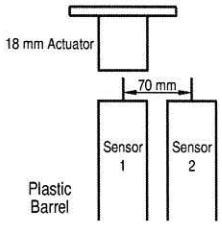
30 mm Plastic Barrel

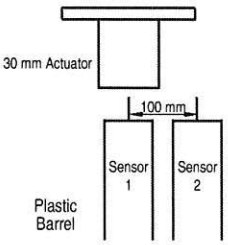


Note: There must be a minimum spacing of 7 mm (0.275 in) if actuator and sensor face approaches laterally. This will prevent false triggering due to the side lobe areas.

Minimum Distance Between Sensors







Diagnostic

Unit Indicators (per IEC 60073)

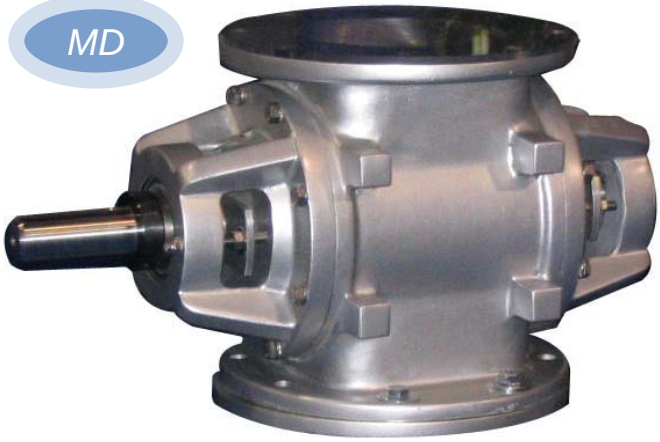
	State	Status	Troubleshooting
Device Output LED	Off	Not Powered	NA
	Red	Not Safe, OSSD Not Active	NA
	Green	Safe, OSSD Active	NA
	Green Flash	Power Up Test or OSSD Inputs Not Valid	Check 24V DC on OSSD Inputs (yellow and red wire)
	Red Flash	1 Hz Flash Recoverable Fault 4 Hz Flash Nonrecoverable Fault	Recoverable Fault: Check OSSD Outputs Are Not Shorted to GND, 24V DC or Each Other. Cycle Power.

ACS VALVES

EQUIPMENT INSTRUCTION MANUAL
ACS Rotary Airlock Valve/Feeders

DR-S

MD



CI

Heavy Duty Extra Tough

611 Argyle St. N. Caledonia, Ontario N3W 1M1 TEL: (800) 655-3447 FAX: (800) 955-4991
Email: sales@acsvalves.com Website: www.acsvalves.com

ACS VALVES
ANCASTER CONVEYING SYSTEMS

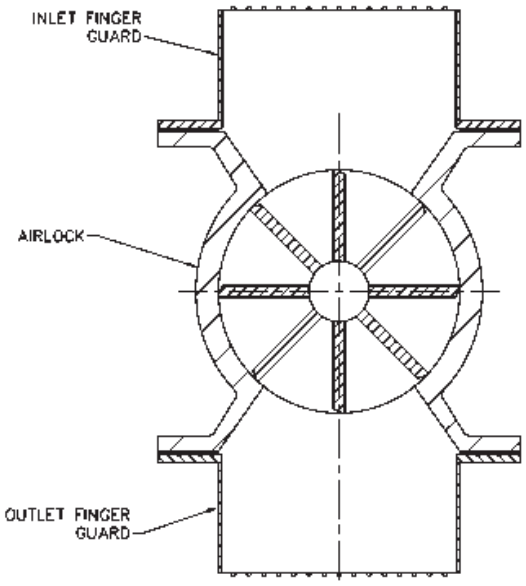
611 Argyle St. N. Caledonia, Ontario N3W 1M1 TEL: (800) 655-3447 FAX: (800) 955-4991
Email: sales@acsvalves.com Website: www.acsvalves.com

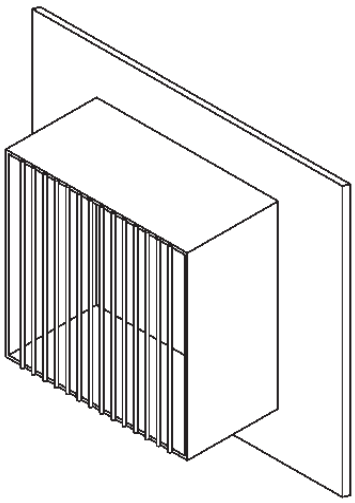
SAFETY FIRST

WARNING/CAUTION

DO NOT INSTALL ROTARY AIRLOCK VALVES & FEEDERS IN AN APPLICATION, WHICH LEAVES THE INLET OR THE OUTLET FLANGE OPENING EXPOSED.

INLET & OUTLET FLANGE GUARDS ARE MANDATORY IF EITHER THE INLET OR OUTLET FLANGES ARE EXPOSED.
THESE FLANGE GUARDS ARE AVAILABLE APON REQUEST





611 Argyle St. N. Caledonia, Ontario N3W 1M1 **TEL: (800) 655-3447** **FAX: (800) 955-4991**
Email: sales@acsvalves.com **Website:** www.acsvalves.com

Congratulations on your selection of an **"ACS"** Rotary airlock. The unit will require very little attention to keep it in good operating condition.

Safety Precautions

This Safety alert symbol is used to call your attention to an important safety message on equipment, safety decals and in manuals, to warn you of possible danger to your personal safety. When you see this symbol, be alert; your personal safety or the safety of the other persons is involved. Follow the instructions in the safety message.

The following definitions for identifying hazard levels are:

DANGER (RED) **–** Danger is used to indicate the presence of a hazard that WILL cause SEVERE personal injury, death, or substantial property damage of the warning is ignored.

WARNING (ORANGE) – Warning is used to indicate the presence of a hazard that CAN cause SEVERE personal injury, death, or substantial property damage if the warning is ignored.

CAUTION (YELLOW) – Caution is used to indicate the presence of a hazard that WILL or CAN cause MINOR personal injury or property damage if the warning is ignored.

WARNING: All owners and operators should read this manual, or be instructed in safe operating and maintenance procedures, before attempting to uncrate, install, operate, adjusts, or service this equipment.

611 Argyle St. N. Caledonia, Ontario N3W 1M1 TEL: (800) 655-3447 FAX: (800) 955-4991
Email: sales@acsvalves.com Website: www.acsvalves.com

RECEIVING YOUR AIRLOCK

As soon as the equipment is received, it should be carefully inspected to make certain the unit is in good condition and all items listed on the packing list are received. Even though the equipment is mounted on heavy shipping skids at our plant, it is possible for it to be damaged in shipment. All damages or shortages should be noted on the Bill of Lading. Purchaser should take immediate steps to file reports and damage claims with the carrier. All damages incurred to the units in transit are the responsibilities of the common carrier since it is the manufacturer's policy to make shipment F.O.B. its factory: i.e., Ownership passes to purchaser when the unit is loaded and accepted by trucker. Any claims for in transit damage or shortage must be brought against the carrier by the Purchaser.

If the unit is not going to be installed soon after arrival, it should be stored in a warm, dry location to protect from corrosion to the machined surfaces.

CAUTION: Read All Instructions contained in this manual before installing and operating this equipment.

WARNING

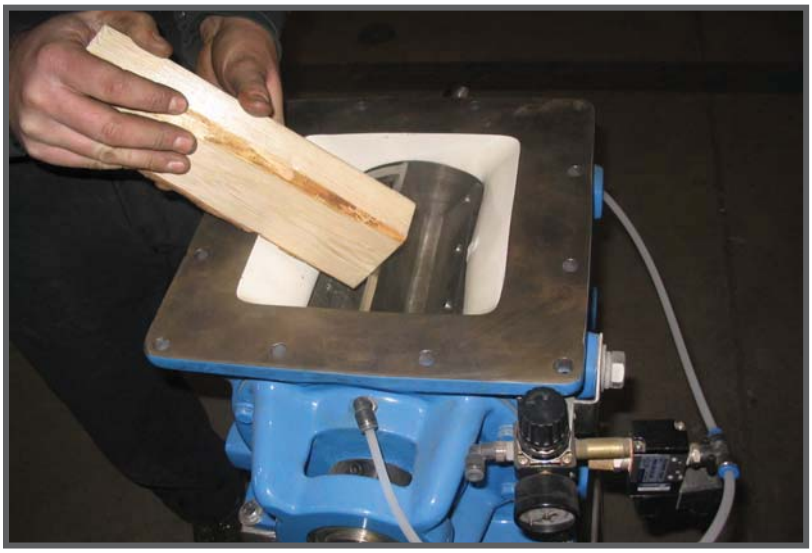


FIGURE 1

ONCE PROTECTIVE FLANGE COVER IS REMOVED FROM VALVE, DO NOT PLACE HANDS OR FEET IN THE VALVE OR ATTEMPT TO TURN ROTOR ASSEMBLY BY HAND. TO TEST ROTATE THE ROTOR, USE A SOFT PUSH BAR (2 x 4) AS SHOWN IN FIGURE 1. WE RECOMMEND ALL OWNERS AND/OR OPERATORS OF THIS EQUIPMENT READ THIS MANUAL. FOLLOW SAFE OPERATING & MAINTENANCE PROCEDURES. SAFETY COMES FIRST!

611 Argyle St. N. Caledonia, Ontario N3W 1M1 TEL: (800) 655-3447 FAX: (800) 955-4991
Email: sales@acsvalves.com Website: www.acsvalves.com

OPERATING INSTRUCTIONS FOR ACS ROTARY AIRLOCK PACKAGE

Rotary Airlocks

The Rotary Airlock is one of the most important units in your material handling system. The function of the airlock is to hold pressure or vacuum in a pneumatic system, and also to meter products into conveying lines, or storage areas, (bins, tanks, hopper, etc.)

The airlock operates by filling each rotor pocket with material at the high point of rotation and then empties into conveying lines or storage areas at the low point of rotation.

In the case of conveying line, a blow-thru is used to allow the velocity of the air to move the material through the conveying line. After each rotor pocket has emptied into the blow-thru it still contains pressurized air. With some products, this air is allowed to escape up through the bulk material as soon as the edge of the rotor blade passes the edge of the inlet opening. The release of this pressurized air assists in maintaining a continuous flow of product to the airlock inlet. With some products, this air must be vented to atmosphere or to a dust collector, as it tends to hinder rather than help the flow of material into the airlock.
*The above procedure is endlessly repeated to produce a continuous flow of material at the discharge end of the conveying line.

The airlock rotor is precision machined to obtain the desired high degree of accuracy and close tolerance. Rotors may be supplied either with fixed or adjustable tips.

The airlock rotor is mounted on bearings at each end of the rotor shaft. Rotor clearance is small to prevent excessive air leakage back to the product inlet.

Installation of Airlock Packages

After airlock packages are uncrated, disconnect the chain drive and rotate the airlock with a soft push bar, the rotor should be able to rotate freely without binding.

Check clearance between rotor tips and valve housing. Clearance should not be greater than that specified on the invoice. If adjustable tips are provided and have shifted out of adjustment during shipping, re-adjust as per instructions found in maintenance section of this manual.

If airlock clearances and rotations are correct, replace chain drive, position an anchor package.

See Figure 1

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Numerous types of bulk materials feeding devices can be connected to the inlet opening of an airlock. Bins, hoppers, mixers, sifters, screw conveyors, etc. all can be adapted for attachment to the airlock. In all cases, except sifters, rigidly attach the feeding device to the airlock flange, using silicone caulk to obtain an air-tight connection. Be sure all seams in the feeding device are air-tight.

If the airlock package is to be hung from a hopper, storage tank, etc. it may be necessary for some type of structural steel support. However, in most cases, the hopper or tank flange will have sufficient strength to support the weight of the airlock package.

Normally, it is not good practice to use the airlock to support equipment loads either in compression on the top flange or in tension from the bottom flange. Excessive loads will cause the housing to distort, which will result in the loss of precise clearances. Loss of clearance between the rotor and housing can result in excessive noise, binding and galling.

Flanges of components, which attach to the airlock must be flat and "square" with the airlock flanges. The machines flanges of cast airlock housing must not be forced or conform to warped or twisted fabricated flanges. This practice can result in broken airlock housing or loss of clearance as noted above.

If the airlock is to be installed with either the **inlet or discharge exposed, a guard must be mounted to the appropriate flange** in order to reduce the risk of personal injury to operators, maintenance personnel, or others who may be near the equipment. Any object placed in the inlet area or discharge area of the airlock will be sheared off. Inlet and discharge guards are available from **Ancaster Conveying Systems**.

Air Purge Kit - Optional

The optional air Purge Kit may be used to provide compressed air the shaft seal area on airlocks with either open or closed end rotors. This kit may also be used to provide compressed air to the end plate cavity on the airlocks with closed end rotors.

The Air Purge Kit should included a Filter/Regulator, 0-30 psi pressure gauge, tubing and miscellaneous fittings. Depending on the airlock model and what ports are to be purged, certain fittings supplied in the kit may not be required.

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Air Purge Pressure Adjustment

Shut off the compressed air supply and bleed off air pressure before attempting to install or service the air purge assembly.

After installation is complete and while the filter/regulator is shut off completely, the air supply should be turned on.

After verifying that all connections are tight the regulator should be adjusted to provide the appropriate purge pressure to the airlock using the following guidelines.

1. Initial setting, prior to conveying product through the airlock or system should be 5 psig.
2. If the airlock is either receiving product from or discharging product to a pressure system the regulator should be set at 5 psig above the system conveying pressure.
3. If the airlock is used in a gravity flow application or is receiving or discharging only to a vacuum system the regulator should remain set at 5 psig.

Air Purge Assembly For Airlocks
With Open or Closed End Rotors

ITEM	P/N	QTY	DESCRIPTION
1	128961	1	Filter/Regulator with gauge & bracket
2	128937	1	3/8” Male Branch Tee Poly-Flo fitting
3	128929	4 ft.	3/8” O.D. Nylo-Seal Tubing
*4	120022	2	3/8” Poly-flo to 1/8” MNPT Connector
5	112895	1	0-30 PSI, 2” Face, ¼” CTR Back Gauge
°6	128945	2	3/8” Poly-flo to 3/8” MNPT Connector
°7	102733	2	3/8” Poly-Flo Union Tee
°8	125539	2	¾ x 3/8 Hex Bushing
	400726	1	Air Purge Kit (includes items 1 thru 8)

Please Note: *** Fittings for purging shaft seal**
° Fittings for purging end plate cavity

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Airlock Maintenance And Adjustment

Airlock maintenance is just as important as the unit is to the system. Type "CI" airlocks are assembled with sealed bearings, therefore requiring no lubrication.

Blade clearance should be checked as part of the maintenance program. Blade clearance should be within the allowable clearance range of the appropriate service. (See table). Each airlock is built to a standard, which is determined by its size and design operating conditions. The appropriate standard established for any airlock can be determined by checking the order acknowledgement.

Fixed tip airlocks obviously have no adjustment at tips, but should be checked to determine if the airlock is functioning in the system properly. Airlocks equipped with adjustable tips have a definite advantage. If clearances do not fall within rotor clearance range for the airlock, the tips can easily be adjusted. Adjusting tips of an airlock should be done as follows after electrical power is turned off.

Disconnect all electrical power to airlock before performing any maintenance.

1. Disconnect drive chain.
2. Access through either inlet or outlet.
3. Mark blades one through eight (assuming it is an 8-vane rotor).
4. Loosen bolts on number one blade.
5. Using two feeler gauges, insert between blade and housing, one at each end.
6. Push blade up tight against feeler gauges and tighten bolts.
7. Rotate blade and measure clearance on both sides of housing. This will determine which is tight side of housing.
8. Repeat steps 4, 5, &6 on all blades settings them against tight side of housing.

NOTE: As each blade is adjusted, make sure clearance is held uniformly by spinning rotor 360 degrees after completing steps 4, 5 & 6, and also by re-measuring with feeler gauge.

Disassembly of an airlock can be done quickly and efficiently by following the proper procedures.

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Remove Rotor:

1. Determine which side rotor is to be pulled from. Normally clearance permitting, drive side is pulled to avoid dismantling of sprocket and re-alignment.
2. Disconnect drive chain
3. Loosen and remove bearing lock-collar at bearing opposite the drive side.
    a) Remove allen set screw from collar and peen down groove formed by set screw using a small flat punch.
    b) Loosen collar by rotating collar in the same direction as the shaft rotation. Use drift pin in the plain hole (not threaded set screw hole) and tap with hammer to rotate collar.
    c) Slide collar off shaft.
4. Airlocks with packing gland seals, loosen the packing gland bolts (2 ea.) opposite the drive side.
5. On type “CI” Airlocks loosen the shaft seal collar, located within the end plate bearing port.
6. Remove the bolts on end cover (side to be pulled).
7. On all models place wheel puller at end opposite the drive end, hooking it at back of bearing port. Place puller bolt at the shaft and push rotor through until it slides freely.
8. Remove rotor from housing gently to keep from forming burrs on rotor or housing.

Replacing Rotor

1. Carefully check to see if rotor or housing have burrs. (Blade tips, shrouds, and housing matching surfaces). If burrs are found, file them smooth using a fine file and then polish with emery paper.
2. Check rotor shaft, file and sue emery paper on any rough surface found.
3. Blow off rotor and shaft to clean any foreign material. Also check end cover to see that matching edges to housing are clean.
4. Gently slide rotor into housing. Rotor normally will not slide the last few inches easily. Use a large rubber hammer to pound rotor far enough to start end cover bolts, and tighten evenly.
5. Make sure rotor is centred in housing. If not, loosen bearing lock collars, and centre with rubber mallet by tapping end of shaft.
6. Tighten bearing lock collars in the direction opposite to shaft rotation.
7. Tighten packing gland bolts evenly or tighten shaft seal collar.
   Note: If rotor does not turn freely, loosen end cover bolts. Centre rotor with feeler gauges and retighten bolts evenly.
8. Turn rotor by hand. Check clearances and see that rotor turns freely in housing.

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Removing End Covers

1. Remove bolts that attach end cover to housing
2. Loosen and remove bearing lock collar
   a) Remove allen set screw from collar and peen down groove formed by set screw using a small flat punch.
   b) Loosen collar by rotating collar in direction opposite shaft rotation. Use drift pin in the plain hole (not threaded set screw hole) and tap with hammer to rotate collar.
   c) Slide collar off shaft.
3. Loosen packing gland bolts or shaft seal collar, if applicable.
4. Attach wheel puller.
5. Tighten slowly until cover slides off shaft. If cover tends to bind on shaft, tap puller bolt with rubber mallet as you tighten.

Remove Press-Fit Bearings

1. Remove end cover.
2. Press bearing in the appropriate direction to remove from end plate.

Replacing Press-Fit Bearings

1. Align bearing with machined hole in end cover.
2. Be sure the eccentrically machined end of the inner bearing ring will be at the outer face of the endplate so that matching bearing lock collar can be properly installed.
3. Press the bearing in place.

Installing Press-Fit Bearing Lock Collar

1. Check to see that bearing has been pressed into endplate with eccentrically machined face of inner bearing ring facing outward toward the end of the shaft.
2. Slide collar on shaft with eccentrically machined, recessed face against the inner bearing ring. Rotate the collar in the opposite direction of shaft rotation until eccentric faces of collar and inner bearing ring engage.
3. Continue to rotate the collar in the opposite direction of shaft rotation until snug. Complete tightening by inserting pin in drift pin hole of the collar and tap with lightweight hammer.
4. Tighten allen set screw.

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Chain Drive Adjustment and Maintenance

Airlock drive chain tension. Check tension of airlock drive chain every 200 hours as follows:

A. Remove chain guard. Airlock drive chain should have no noticeable sag between gearmotor and valve sprockets. However, chain should be loose enough to allow a slight up and down motion with hand pressure applied midway between sprockets.
B. To adjust airlock drive chain, loosen two bolts securing gearmotor and change position of gearmotor to obtain desired degree of tightness. Tighten mounting parts and reinstall chain guard.
C. Clean and re-grease chain every 500 hours.

Inspection and Repair

Inspection and repair procedures given below provide sufficient information for restoring the package to peak operation. In most cases, repair simply consists of component replacement.

A. If airlock is not operating efficiently or satisfactory, remove from system, inspect and repair in accordance with preceding information.
B. Inspect airlock drive chain and sprockets for wear, loose links, and damage. Replace chain and sprockets if damage is noted. Be sure the same size sprockets are replacements for original sprockets.
C. Inspect base structure, chain guard, and brackets, for damage and deformation. Replace defective parts.
D. Check all accessory equipment to assure proper operation. Replace any components found to be defective.

When requesting service assistance, please have the following information at hand prior to calling system engineer.

1. Blower speed.
2. Vacuum or pressure gauge reading.
3. Pressure switch setting.
4. Blower motor amperage reading.
5. Airlock speed.
6. Method of feeding the valve.
7. Gearmotor amperage reading
8. Conveying line length
   a) Horizontal run
   b) Vertical run
   c) Number of elbows

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Airlock Rotor Clearances

Model & Size	Standard Temperature Application	High Temperature Application
CI 6 x 6 CI 8 x 8 CI 10 x 10 CI 12 x 12	.004" - .007"	.007"-.010"
CI 14 x 14	.004" - .007"	.007" .010"
CI 16 x 16	.007" - .010"	.012" - .016"
CI 18 x 18 CI 22 x 22	.012" - .016" .012" - .016"	.012" - .016" .024" - .035"
CI 26 x 26	On Application	On Application
CI 30 x 30	On Application	On Application
MD 6 MD 8 MD 10 MD 12	.004" - .007"	.007" - .010"
MD 14 MD 16	-- .007" - .010"	--- .012" - .016"
AF-A AF-B	.004" - .007" .004" - .007"	.007" - .010" .007" - .010"
AF-C AF-D	.004" - .007" ---	--- ---
CDC-CI 6" CDC-CI 8" CDC-CI 10" CDC-CI 12"	.004" - .007"	.007" - .010"

BEST TO CONSULT FACTORY FOR CLEARANCES BEST SUITED TO YOUR SIZE ROTARY VALVE & APPLICATION.

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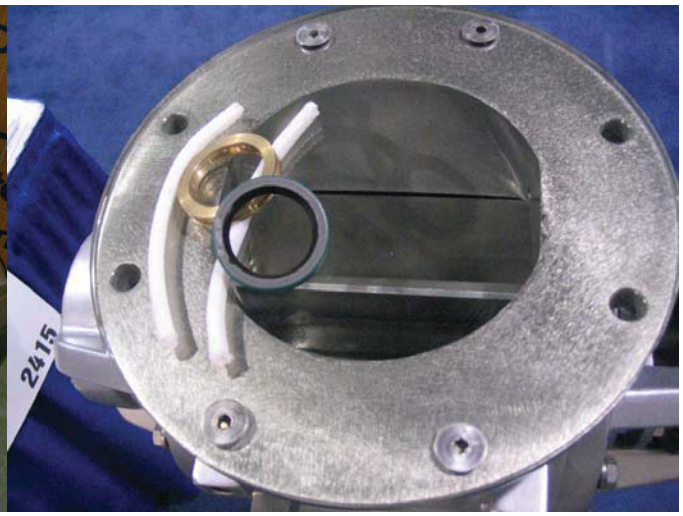
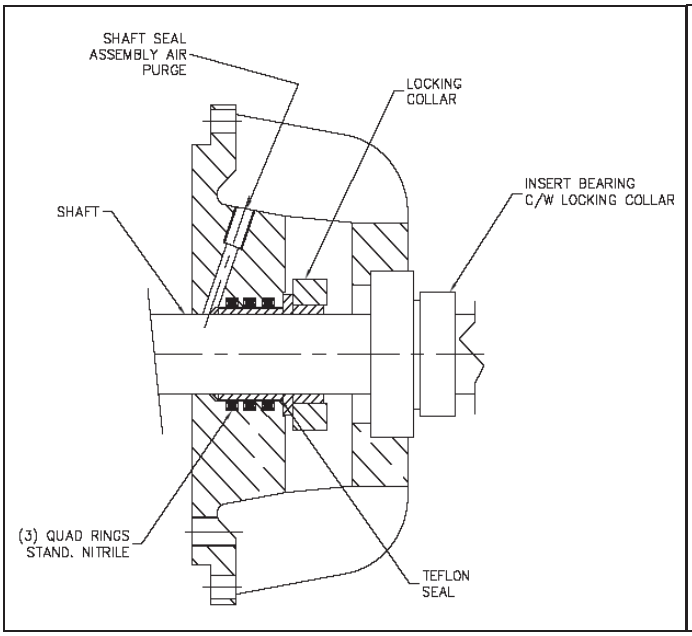
Shaft Seals

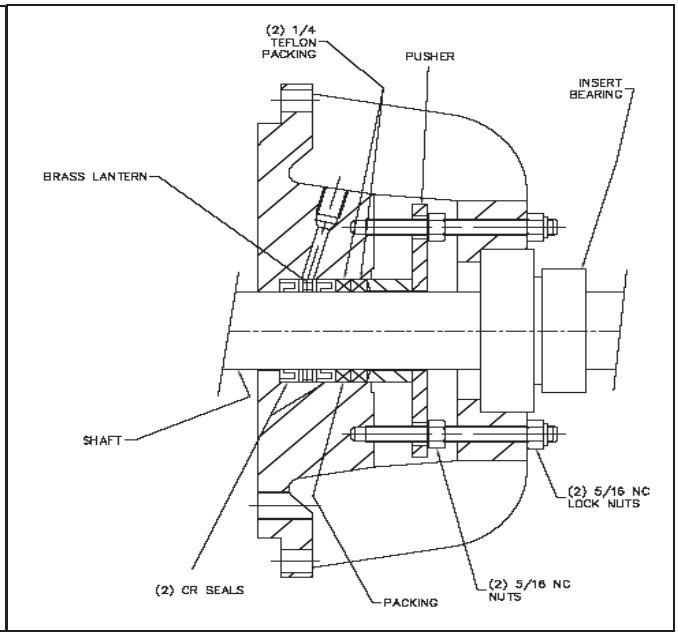
- ACST-4 shaft seals are used on both ends of the rotor shaft for superior sealing
- Each shaft seal assembly consists of one virgin teflon sleeve and three quad rings, which fit snuggly over the teflon sleeve
- The teflon sleeve has a smooth self lubricated surface creating a tight seal with the quad rings
- Also available in a packing gland style shaft seal air purge assembly consisting of a lantern ring, 2 lip seals, lot teflon packing and a adjusting pusher plate
- Air purge seals connection option for severe applications

ACST-4 Shaft Seal

ACS Packing Gland Style Shaft Seal with Lantern Ring







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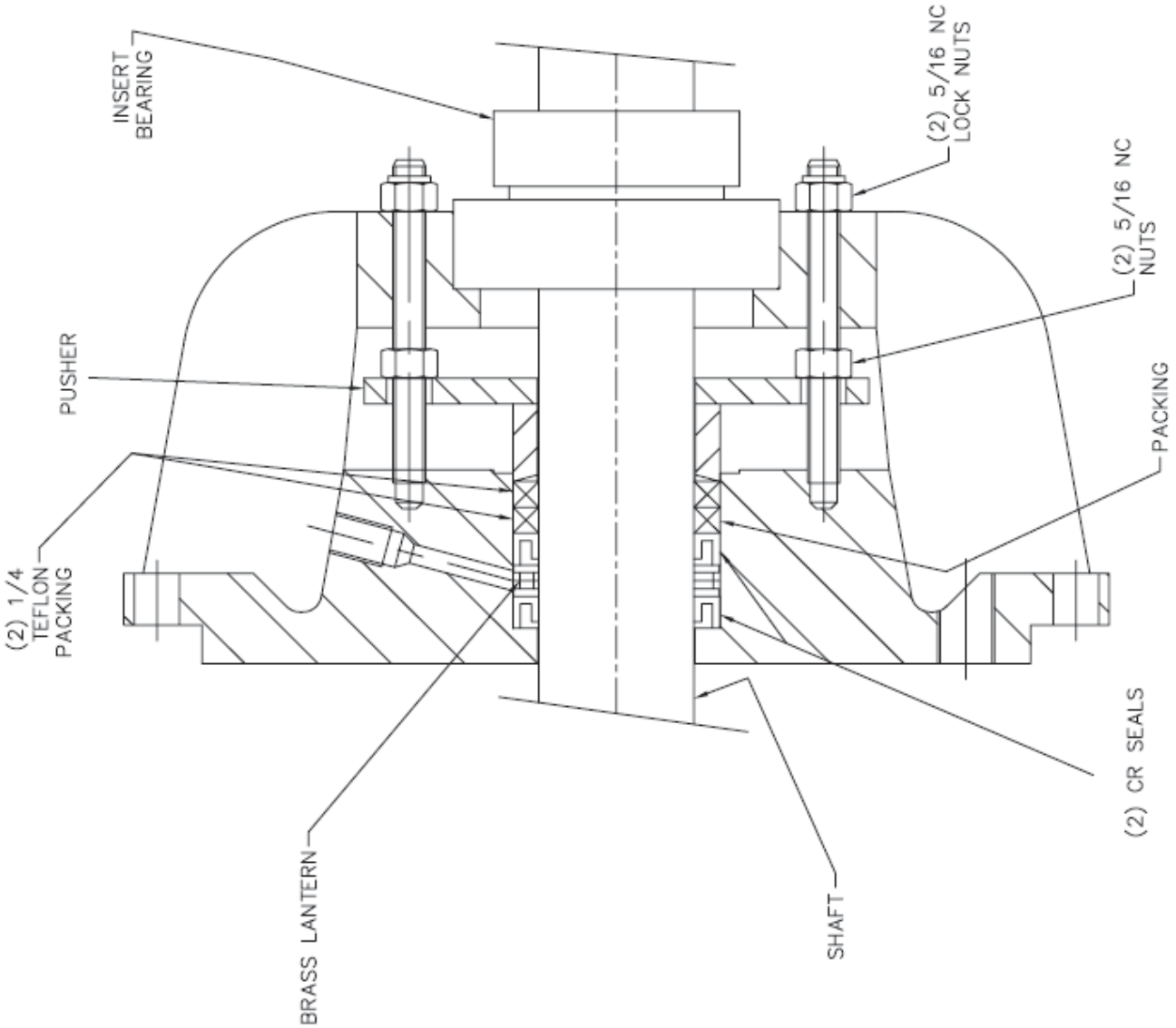
Packing Gland Shaft Seal Assembly



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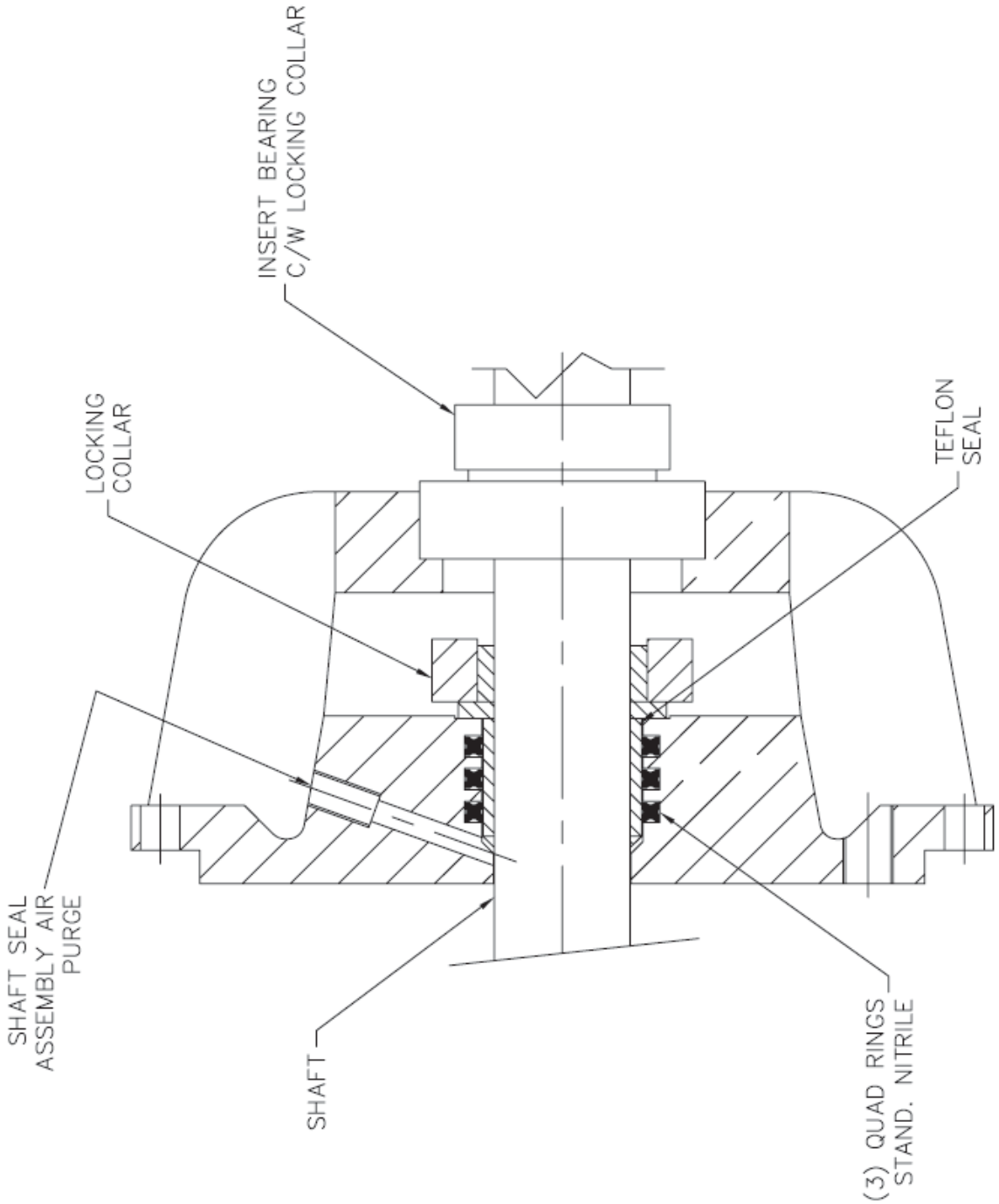
ACST-4 Shaft Seal Assembly



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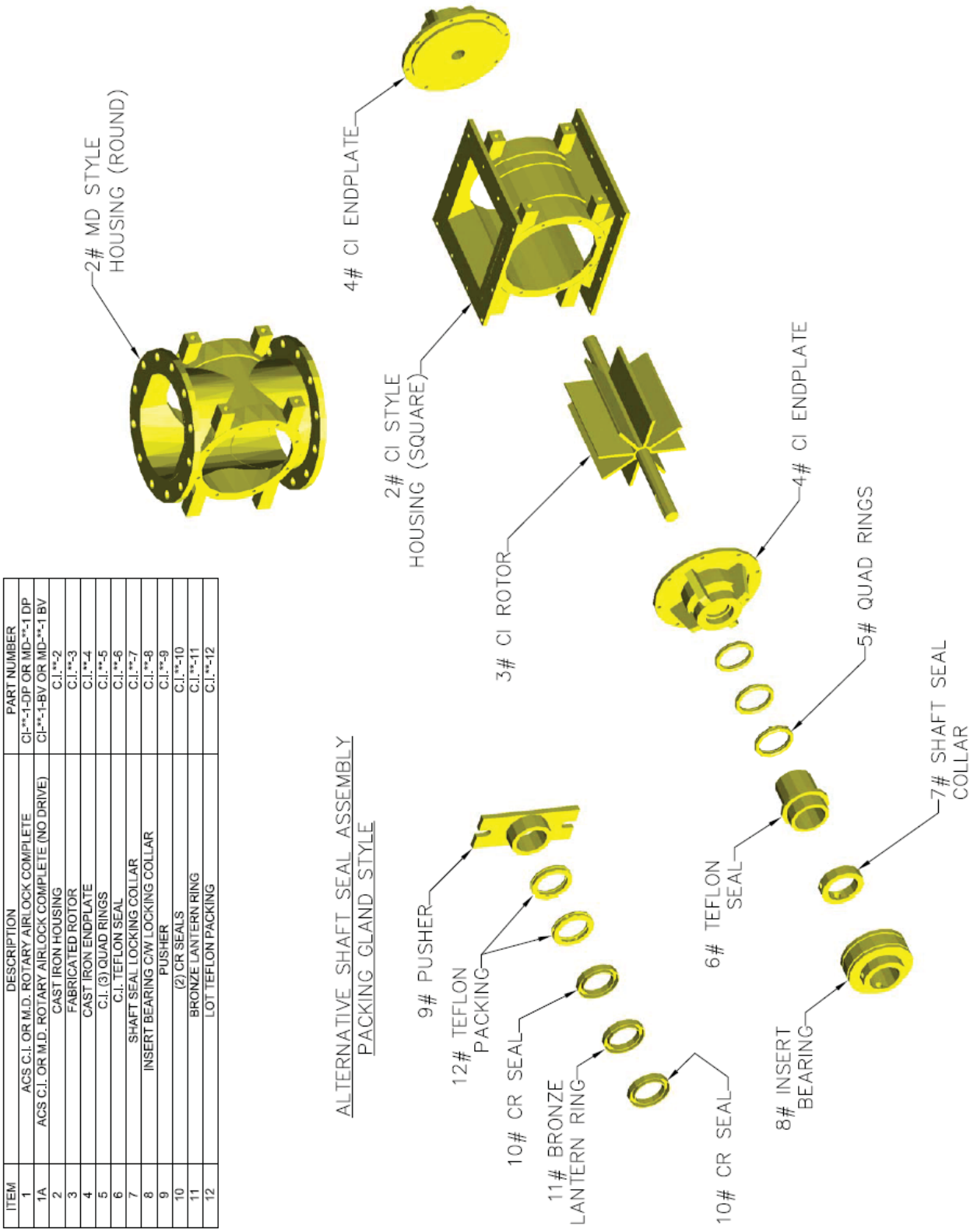

ITEM	DESCRIPTION	PART NUMBER
1	ACS C.I. OR M.D. ROTARY AIRLOCK COMPLETE	CI-**-1-DP OR MD-**-1 DP
1A	ACS C.I. OR M.D. ROTARY AIRLOCK COMPLETE (NO DRIVE)	CI-**-1-BV OR MD-**-1 BV
2	CAST IRON HOUSING	C.I.**-2
3	FABRICATED ROTOR	C.I.**-3
4	CAST IRON ENDPLATE	C.I.**-4
5	C.I. (3) QUAD RINGS	C.I.**-5
6	C.I. TEFLON SEAL	C.I.**-6
7	SHAFT SEAL LOCKING COLLAR	C.I.**-7
8	INSERT BEARING C/W LOCKING COLLAR	C.I.**-8
9	PUSHER	C.I.**-9
10	(2) CR SEALS	C.I.**-10
11	BRONZE LANTERN RING	C.I.**-11
12	LOT TEFLON PACKING	C.I.**-12

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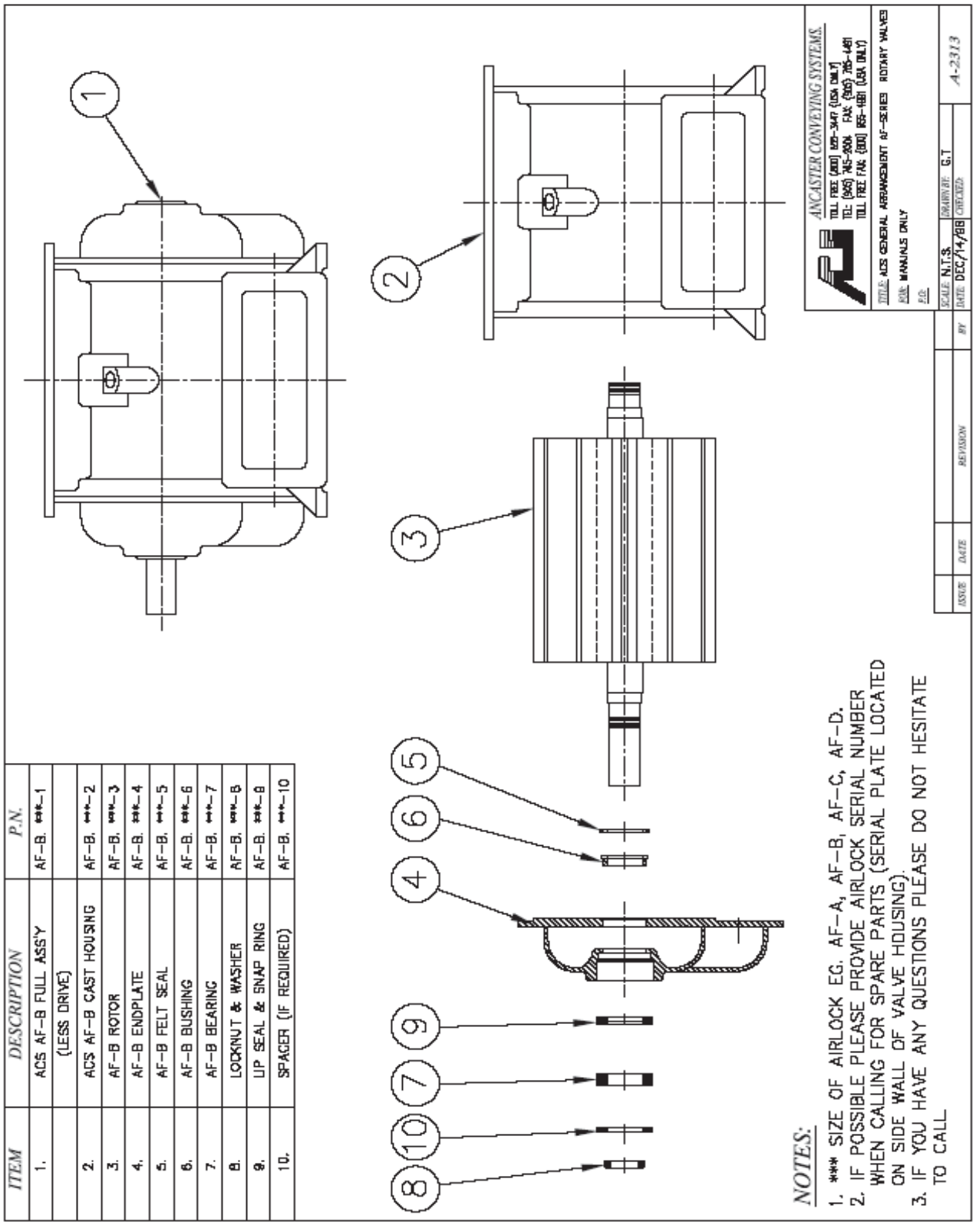

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Terms and Conditions of Sale

These General Conditions of Sale are and shall be applicable to all sales of products and services of Ancaster Conveying Systems ("ACS"). No other or inconsistent conditions of sale shall be binding upon ACS unless specifically agreed to in writing by an authorized official of ACS. ACS' distributors and sales representatives are not authorized officials of ACS for purposes of this provision. Any failure by ACS to object to any inconsistent condition or other communication from a buyer of production or services from ACS shall not be construed as an acceptance of such other inconsistent provision or as a waiver of these General Conditions of Sales

PRICES: Published prices on standard products and services are subject to change without notice. Verbal quotations on custom productions or special services expire at the close of the business day they were made, if not first accepted in writing or withdrawn. Written quotations for custom productions or special services expire 30 days from the date which they bear, unless earlier withdrawn or unless the quotation specifically provides another expiration date.

OFFICIAL CORRESPONDANCE: All official correspondence to include, but not limited to Purchase orders, Specifications, Samples, Construction Drawings, Approval Documentations, Shipping Status, Reports, Shortages of Incorrect Equipment Claims and/or Warranty Claims must be made and addressed to ACS at its principal office in Caledonia, Ontario.

ACCEPTANCE: No purchase order shall be valid and/or binding upon ACS unless first accepted by ACS at its principal office in Caledonia, Ontario.
TERMS OF PAYMENT: Unless otherwise agreed to in writing, payment is due:

a) Net within 30 days from the date of invoice from buyers whose credit has been approved by ACS.
b) Upon delivery for all other buyers. ACS with charge a 1 ½ % per month service and carrying charge with respect to all balances which are not paid when due. If a shipment of ACS' products is delayed by the acts of omissions of a buyer, payment shall become due at the time such products would have been shipped and the products will thereafter be stored by ACS at the buyer's expense and risk.

CONFIDENTIALITY: All proposals and price quotations, including any drawings prepared by ACS are confidential and remain the property of ACS. Transmission of all or any part of such information to others, or the use of any such information for the purpose other than considering the purchase of the products described, is prohibited.

TAXES: Any federal, state, provincial or local tax, tariff or charge of duty levied on the sale by ACS of any product or service or on the use or possession of any product after shipment by ACS shall be borne by and paid for by the buyer. If ACS is required by law to collect any such tax, tariff, charge or duty, the buyer will pay the amount thereof to ACS on demand or provide to ACS at the time the purchase order, any applicable exemption certificate or additional documentation.

RESPONSIBILITY FOR DOCUMENTS: Any documents, drawings or samples submitted with a purchase must be picked up by the buyer within a 30-day period. ACS shall no longer be responsible for any such items and may discard them.

ESCALATION: Any price quoted by ACS is calculated on the basis of wage and materials cost in effect at the date of the quotation and may be subject to increase to reflect increases in wage and/or materials cost accordingly.
CHANGES IN SPECIFICATIONS: No specification change shall be valid unless in writing, signed by ACS and the buyer of the product.
LOCAL CONDITIONS: ACS shall not be responsible for determining whether products furnished to any buyer comply with local conditions, codes or interpretations. The buyers of the product shall have the sole responsibility for assuring such compliance.

SHIPPING: Shipping dates are approximate and are dependant upon availability of materials and the cooperation of the buyers. ACS shall not be subject to any liability because of delay in shipping resulting from strike, accident, weather, fire or other conditions beyond ACS' control. ACS shall not be responsible for damage or loss in transit, and the buyer of any product shall have the sole responsibility to pursue any claims against a carrier.

SHORTAGES OR INCORRECT EQUIPMENT: Claims by a buyer of products from ACS for shortages or incorrect products must be made in writing within 10 days after receipt of the shipment by the recipient. Failure to give such written notice to ACS shall constitute in an unqualified acceptance of the shipped products and waiver of any claim by the buyer.

INSTALLATION: Installation of the Products shall be at the expense of the buyer. ACS can provide installation and start-up service.
In any case where ACS is utilized, the buyer shall nevertheless be obligated to furnish all necessary skilled and unskilled labor, tools, rigging and appliances with respect to the erection of a Product, without responsibility or liability of ACS.
If a Product is installed without ACS' assistance, ACS warranties contained in these general conditions shall not be applicable in the event of any claim of damage which, in ACS opinion, results from inadequate or faulty installation.

WARRANTY: ACS warrants its Products on the following terms and conditions only. THESE EXPRESSED WARRANTIES ARE IN LIEU OF ANY OTHER OBILGATION OR WARRANTY, WHETHER EXPRESSED OR IMPLIED OR ARISING BY OPERATION OF LAW.

a) ACS warrants that each of its Products shall be free of defects in workmanship and materials for a period up to one year from the date of installation (but not to exceed 18 months from the date of shipment by ACS from its factory)
b) ACS warrants that any of its custom Products which are manufactured in accordance with specifications, drawings, plans and designs set forth in writing by the buyer shall reasonably conform to all such written specifications, drawings, plans and designs.
c) The warranties set forth in (a) and (b) above are subject to and limited by the following:
    I. ACS' warranty with respect to a component of a Product supplied by another shall not exceed the warranty of the other supplier in terms or conditions.
    II. ACS' warranties shall be inapplicable if in the opinion of ACS, the Product has been mechanically, electrically or environmentally abused or altered, or if the Product was improperly installed.

III. ACS' warranties are applicable only within the continental boundaries of the United States, Hawaii, Canada and Alaska.
IV. ACS' warranties are limited to the supply of replacements for the defective part(s), FOB factory.

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GOVERNING LAW: Ontario law shall be applicable with respect to, and interpretation of these General Conditions of Sale.
RETURNS/CANCELLATIONS BY BUYER: Unilateral cancellation of a purchase order to ACS shall constitute a breach of contract and shall be subject to a cancellation/restocking charge. This charge shall be a minimum of 30% of the purchase order value and a maximum charge of the selling price of all materials and labor, purchased or expended by ACS to compensate for the disruptions in scheduling, planned productions and other direct costs. No approval shall be granted for the return of Goods under any circumstances where the original invoice date for such Goods is more than one-hundred eighty (180) days prior to the date that a request is made to ACS for such approval. No credit will be issued for returned Goods where the net amount involved is less than $100.00, except when an error made by ACS is to be corrected.

Start with a top-to-bottom equipment inspection and save year after year.

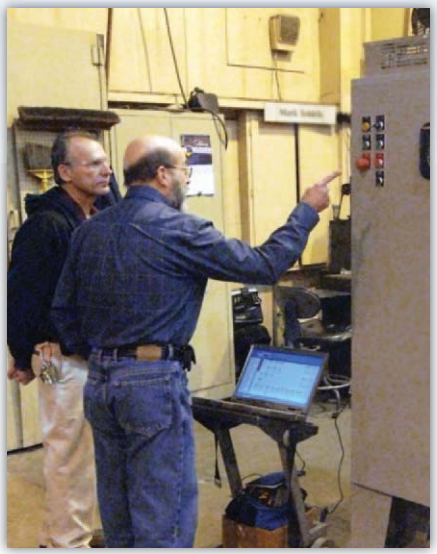
Proactively prevent component failures, major repairs and unplanned downtime.

Initial inspection puts you back on track. Your Hapman equipment was robustly engineered to run trouble-free for years. But you must properly maintain it to reap the savings – and it's too easy to fall behind. To keep maintenance on track, start with a top-to-bottom inspection of your Hapman equipment. One of our skilled technicians will conduct the 4-8 hour inspection. You'll get a detailed report with early warnings of part wear and/or impending component failures. We'll also evaluate your maintenance program and provide a 30-minute consultation so you can learn how to make cost-saving improvements. Fee: only $600 plus expenses.

Customized Managed Maintenance Program (MMP) minimizes "surprise" expenses. Included in your initial inspection will be a no-obligation MMP based on the level of maintenance assistance you want:

- Regularly scheduled equipment inspections by a Hapman technician
- Shared maintenance responsibilities between Hapman and your staff, or
- Full maintenance performed by Hapman

All three levels will improve your machine uptime, reliability, performance and longevity. And that's how you'll keep saving year after year.



YOUR INITIAL INSPECTION INCLUDES:

- Maintenance baseline for your Hapman equipment.
- Detailed inspection report pinpointing maintenance/repair needs.
- One-on-one consultation on how to maximize equipment longevity.
- No-obligation MMP to safeguard your equipment investment.

EXCLUSIVE SAVINGS

When you sign on for the Hapman MMP:

- Save 10% on Hapman service call rates.
- Save 10% on list price of all MMP-covered parts purchases.

TO LEARN MORE WAYS TO SAVE WITH MMP OR TO SCHEDULE AN INSPECTION, CONTACT US TODAY:

800-427-6260 (US/Can) or 269-343-1675
fax 269-382-8266

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Ideas that move™

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KOFLO

MODEL 1.5-40C-4-6-2, STATIC MIXER
MODEL 2-40C-4-6-2, STATIC MIXER

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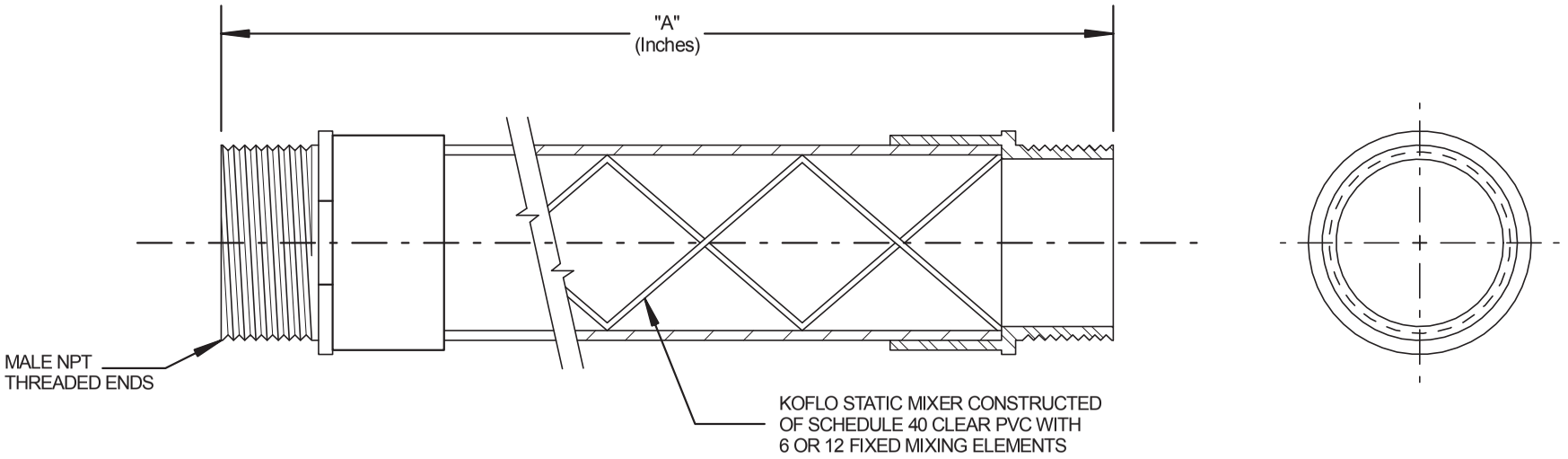

Size	6 Element Model Number	"A" 6 Element	12 Element Model Number	"A" 12 Element
3/8"	3/8-40C-4-6-2	6-1/2	3/8-40C-4-12-2	11
1/2"	1/2-40C-4-6-2	7	1/2-40C-4-12-2	12
3/4"	3/4-40C-4-6-2	9	3/4-40C-4-12-2	15
1"	1-40C-4-6-2	11	1-40C-4-12-2	18
1-1/4"	1.25-40C-4-6-2	14	1.25-40C-4-12-2	25
1-1/2"	1.5-40C-4-6-2	15	1.5-40C-4-12-2	28
2"	2-40C-4-6-2	19	2-40C-4-12-2	35

Koflo Corporation
309 CARY POINT DR.
CARY, IL 60013

SCALE: NONE	APPROVED BY JJT	DRAWN BY NJF
DATE: 1/18/94		REVISED 10/15/01
CUSTOMER:		REVISED 5/22/08
		REVISED 6/12/09
MODEL NO: CLEAR PVC SCHEDULE 40 MIXER		DRAWING NUMBER: KD-993

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MANUFACTURER INSTALLATION OPERATION AND MAINTENANCE MANUAL

AMARUQ WTP – NUNAVUT

VEOLIA PROJECT: 5000 218 009

Mc LANAHAN

MODEL M3H-CR 3/3, MICROSAND RECIRCULATION PUMP (P2-011/012/021/022)

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McLanahan®
585 Airport Road, Gallatin, TN 37066 USA Tel: +1 (615) 451 4440 Fax: +1 (615) 451 4461 mclanahan.com

May 11, 2018
VEOLIA WATER TECHNOLOGIES
3901 RUE SARTELON
VILLE ST LAURENT QC H4S 2A6
CANADA

Thank you for your recent purchase of the following McLanahan equipment with your Purchase Order 18000630 HD referencing our Sales Order 113957.

This document contains important information regarding the installation & operations of your new equipment. Having recommended spare parts at your plant will assure minimum down time in order to perform periodic maintenance and will also eliminate the expense of air freight of critical parts. They are available for immediate shipment from our inventory.

When ordering parts, you will be required to provide the equipment's serial number.

- (4) 3X3 DG NITRILE PUMP ASM W/ 15 HP DRIVE
  S/N: **20182093- 20182096**

We suggest you become familiar with the enclosed literature to ensure the proper installation of this equipment.

Should you have any questions regarding the installation and/or operation of the equipment you have purchased, please contact our Process Equipment Department at (615) 451-4440.

Sincerely,

McLanahan Corporation

Product SUPPORT ★★★★★ Customer SERVICE

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INSTALLATION, OPERATION & MAINTENANCE MANUAL

(4) 3X3 DG NITRILE PUMP ASM W/ 15 HP DRIVE

PROJECT ID #20182093- 20182096

McLanahan®

WORLD HEADQUARTERS	200 Wall Street, Hollidaysburg, PA 16648 USA	Ph: +1 (814) 695 9807	Fax: +1 (814) 695 6684
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IOWA	800 First Avenue N.W., Cedar Rapids, IA 52405 USA	Ph: +1 (319) 365 0441	Fax: +1 (319) 369 5440
AUSTRALIA	16 Callistemon Close, Warabrook, NSW 2304 Australia	Ph: +02 49 248 248	Fax: +02 4926 2514
UNITED KINGDOM	Unit 15, Newman Lane, Alton, Hampshire, GU34 2QR, UK	Ph: +44 (0) 1420 542489	

mclanahan.com

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INSTALLATION, OPERATION & MAINTENANCE MANUAL

PUMP ASSEMBLY MANUAL

TAG INFO: ITEM #1 P2-011 PID 20182093

TAG ITEM #2 P2-012 20182094

TAG ITEM #3 P2-021 20182095

TAG ITEM #4 P2-022 20182096

McLanahan®

WORLD HEADQUARTERS 200 Wall Street, Hollidaysburg, PA 16648 USA Tel: +1 814-695-9807 Fax: +1 814-695-6684

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Safety Precautions

Overview

READ THIS MANUAL IN ITS ENTIRETY BEFORE BEGINNING OPERATION.

- **DO NOT** install, operate or service this equipment (or any portion thereof) without fully understanding the information contained herein.
- **DO NOT** operate this equipment in any manner other than that for which it has been designed or approved.

NOTE: A copy of this manual **must** be provided to the operator of this equipment and **must** be kept with the equipment at all times.

The safety instructions presented throughout this manual do not supersede any other directives or practices associated with this equipment or its operation. Rather, they are to be used in addition to any other applicable guidelines set forth by governing bodies (ANSI, ISO, OSHA, MSHA, etc.), plant administrators, signs, tags or placards, etc. (Refer to the **TAGS** section of this manual for information regarding safety and instructional tags provided with the equipment.) In the event of conflicting information, **always use the guidelines providing the highest degree of protection/safety.**

The safety instructions used throughout this manual and on the equipment contain a "signal word" (CAUTION, WARNING or DANGER) that indicates the seriousness of the hazard as described below.

DANGER *indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.*

WARNING *indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.*

CAUTION *indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury.*

CAUTION *(used without the safety alert symbol) indicates a potentially hazardous situation, which, if not avoided, may result in property damage.*

The safety instructions listed below are general guidelines. Additional safety instructions are listed throughout this manual as required. **All** safety instructions **must** be followed at all times to ensure personal safety and to prevent equipment damage.

Verify that all personnel are clear of any/all moving or rotating parts (or parts that are subject to movement or rotation) before installing, operating or servicing this equipment or any portion thereof.

Verify that all guards and safety devices are in place, secured and functional before operating this equipment or any portion of it. **DO NOT** circumvent or disable any safety devices.

Lockout/Tagout all controls and secure all applicable components to prevent unexpected movement before performing any maintenance, repairs or adjustments on this equipment or any portion thereof.

Lockout/Tagout power at the source before accessing any electrical panels or devices on this equipment or before performing any maintenance or repairs to the power line(s) feeding this equipment.

Wear appropriate personal protective equipment at all times.

Obey all safety tags and signs and replace any that are illegible or missing.

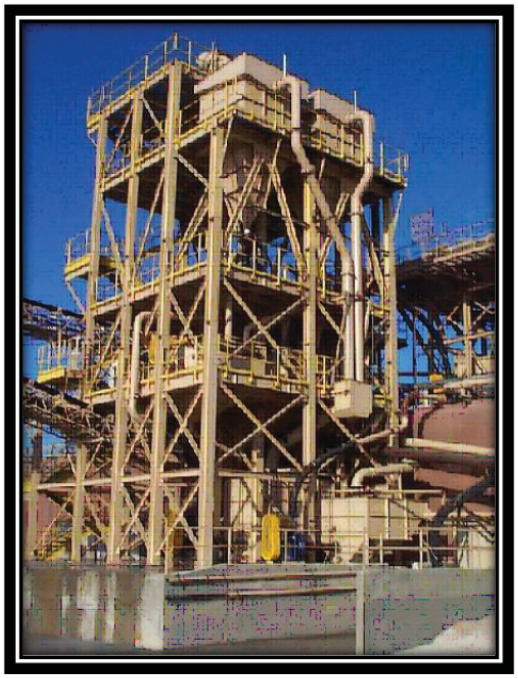
If any questions arise concerning the safe operation of this equipment, or if clarification of any information is required, cease operation and contact **McLanahan Corporation** immediately.

The McLanahan Pump

Introduction

The Aggregate Processing Division of McLanahan is a major manufacturer of process plants for the minerals industry. The McLanahan Model lllr is the latest generation of successful abrasion/corrosion-resistant slurry handling pumps.

This manual should be carefully read before attempting to install or operate this McLanahan Model lllr Pump.



Service, Selection and Support

Total Service

From design to installation and beyond, McLanahan engineers are available to give advice on your slurry pumping needs and solutions for your problems.

The McLanahan Model lllr range has been designed to offer a wide choice of pump sizes to suit most slurry pumping applications. A standard questionnaire is available to ensure that the most complex installation, as well as the more straightforward pumping application, receives individual consideration.

McLanahan can also advise on the ancillary components within the pumping system. The provision of low head loss valves, gland feed pumps, priming devices and flexible bends, all incorporating application specific linings for trouble-free life, are an important aspect of ensuring a totally successful pump installation.

Design Specifications and Options

The McLanahan Model lllr standard casing is designed for a maximum working pressure of 88psi (6 bar). A high pressure casing is available, rated at 272psi (18.5 bar). Please contact McLanahan for pressures higher than this.

The pump units in the McLanahan Model lllr range are designated by the size of suction and discharge ports. Units up to 4” (100mm) have equal size suction and discharge; above this, the Model lllr has a larger suction than discharge. Size is given in inches i.e. 8”/6” (200/150mm) Model lllr has an 8” (200mm) suction port and a 6” (150mm) discharge port.

Suction and discharge flanges are universal and, as a standard, are available in ASA150 drilling patterns. Other drilling patterns (metric & BS4504) are available to special order. Orientation of discharge to 4 positions according to installation requirements.

The McLanahan Model lllr pump components are designed and manufactured in accordance with appropriate International Quality Standards, such as ISO9000.

"Pumptec" Computer Software

Many complex calculations are needed in order to

- Size a pump
- Establish the optimum pipeline carrying velocity
- De-rate the pump for a slurry duty
- Calculate pipeline friction head losses
- Calculate power absorbed
- Analyze the system head

McLanahan Corporation uses unique software, **Pumptec,** to perform these calculations.

The pump is able to adapt to a change of V-belt sheave ratios and different speeds. However, it is **crucial** to recalculate duty parameters and check motor and drives to guarantee that they are not overloaded under any normal operating condition.

Please consult McLanahan Corporation before making any changes to your pump system to ensure the correct combination of speed and power is selected.

Input criteria required:

- Volume to be pumped
- Percent solids
- Gradation of solids (top size & 50% passing size)
- Specific Gravity of Solids
- Specific Gravity of Liquid
- Temperature of Liquid
- Elevation above sea level
- Height of liquid level in tank (**if negative suction**, height from liquid surface to center line of pump inlet)
- Vertical height from pump inlet to discharge point
- Pressure required at delivery point
- Pipe diameter (inside diameter important)
- Pipe material
- Pipe fittings – type and quantity

Pumptec: Computer Aided Support

To complement and facilitate optimum selection of your slurry system, McLanahan uses **Pumptec.**

This unique computer program:

- Analyzes the effects of changing slurry density
- Calculates the P_{50} particle size from a sieve analysis
- Calculates settling velocities and select pump sizes
- Calculates pipeline frictional losses in various pipe materials and pipe fittings
- Calculates the pump duty and selects a pump and drive based on input parameters
- Prints full application and selection data including NPSH, BEP, RPM, HP, etc.

Troubleshooting is made easier using **Pumptec** Software to evaluate different scenarios.

Maska Pulleys Inc.
180, Boul. Gagnon, Ste-Claire
,Qc, Canada G0R 2V0
Tel:(418)883-3322 Fax:(418)883-5015
www.maskapulleys.com

Selection Parameters

Family: Classic & Narrow belts drives

Shaft diameter Driver: 1-5/8 Inch
Shaft diameter Driven: 45MM
Service Factor: 1.2
Driver power: 15 hp
Rpm Driver: 1760
Rpm Driven: 1318 **Tolerance:** -3% +3%
Center distance : Minimum: 16.5 Inch
Maximum: 18 Inch
Belts: BX,5V,5VX

Max. Hub Load: 9999
Rim Speed min.: 900 FPM
Rim Speed max.: 6500 FPM
Nbr of Grooves min.: 2
Nbr of Grooves max.: 15

Pitch Diameter (Inch)

	Min.	Max.
Driver	0.50	71.00
Driven	0.50	71.00

Actual Drive Values

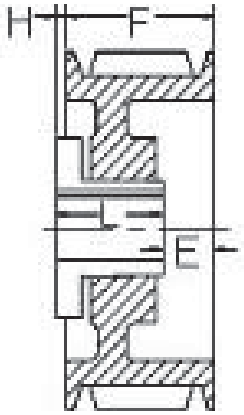
Maximum number of results: 20

Rpm: 1326
Service Factor: 1.54
BeltSpeed (fpm): 3384
List Price: 298.32

Center distance (Inch): 17.0
Power/Belt (hp): 11.5

Deflection (inch): 0.26
Deflection Force (lbs): 5.0
Hub Loads (lbs): 263

Driver Sheave: 2B70

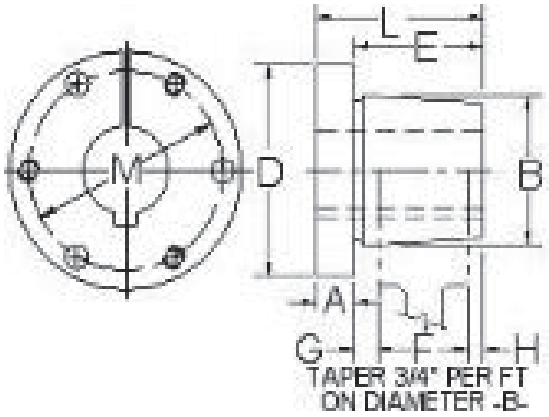


List Price: 72.00
Weight: 9.30 lbs

D.D. A or 4L Belt: 6.60"
D.D. B or 5L Belt: 7.00"
E: 1/4"
F: 1 3/4"
H: 3/8"
L: 1 7/8"
O.D.: 7.35"

Constuction type: Web

Driver Bushing: SKX1-5/8

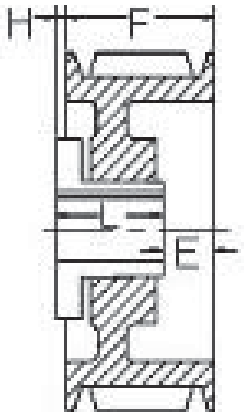


List Price: 26.80
Weight: 2.75 lbs

A: 1/2"
B: 2 13/16"
D: 3 7/8"
E: 1 3/8"
F: 1 1/4"
G: 5/16"
H: 3/16"
Keyseat: 3/8 x 3/16"
L: 1 7/8"
M: 3 5/16"

Product specifications: Standard with set screw over keyway.
Set screw - Dimensions: 1/4-20 UNC x 1/4
Hex bolt: 3=5/16-18UNC X 2

Driven Sheave: 2B94

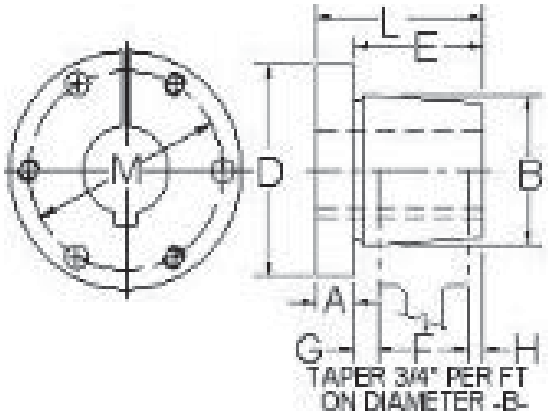


List Price: 78.00
Weight: 13.30 lbs

D.D. A or 4L Belt: 9.00"
D.D. B or 5L Belt: 9.40"
E: 1/4"
F: 1 3/4"
H: 3/8"
L: 1 7/8"
O.D.: 9.75"

Constuction type: Arms

Driven Bushing: SKX45MM

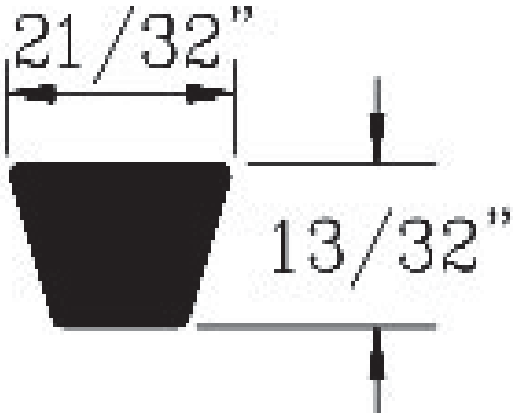


List Price: 26.80
Weight: 2.55 lbs

A: 1/2"
B: 2 13/16"
D: 3 7/8"
E: 1 3/8"
F: 1 1/4"
G: 5/16"
H: 3/16"
Key: 14 x 9"
L: 1 7/8"
M: 3 5/16"

Product specifications: Standard with set screw over keyway.
Hex bolt: 3=5/16-18UNC X 2
Set screw - Dimensions: 1/4-20 UNC x 1/4

Belts: VBBX58 (Qty:2)



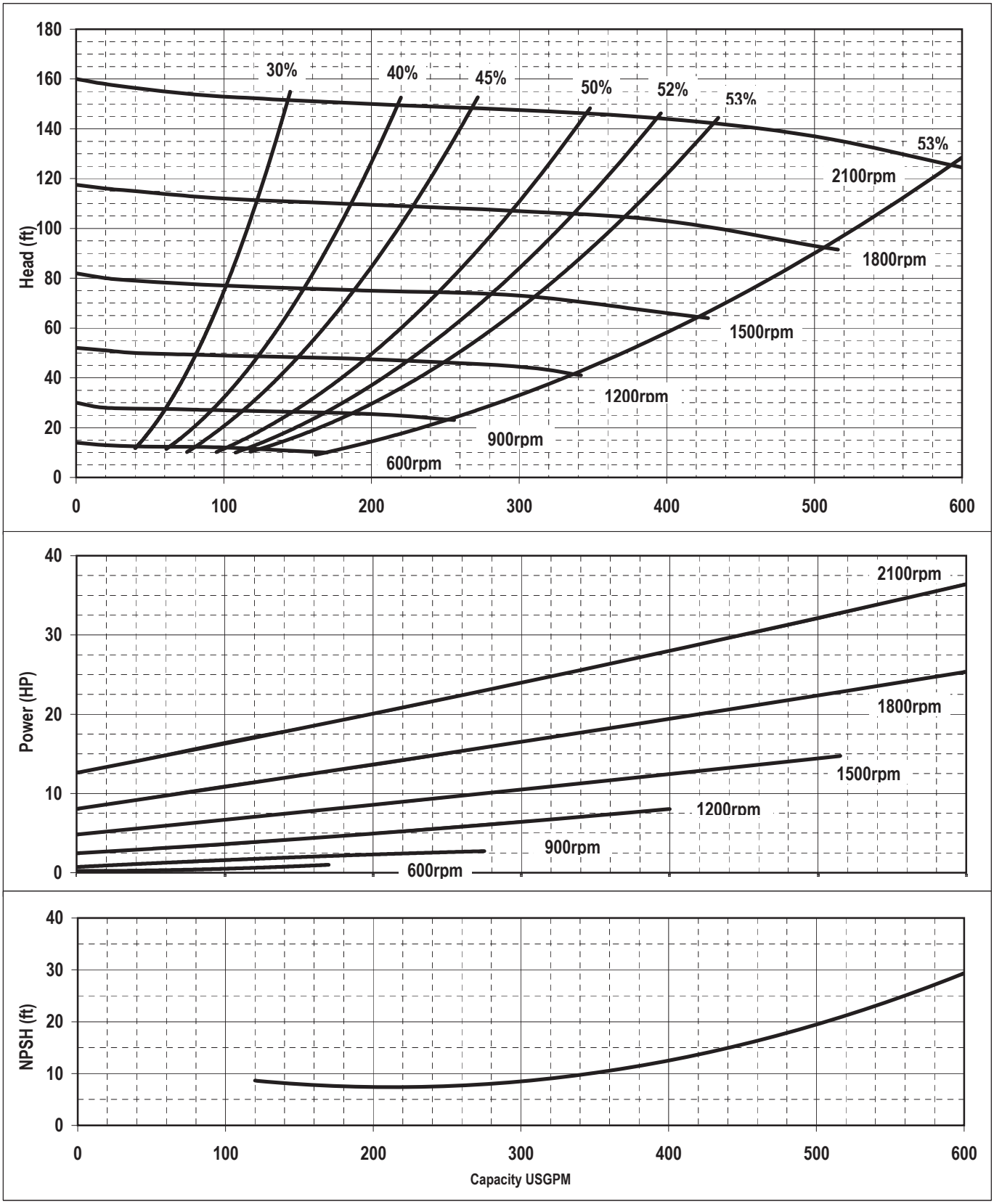
List Price: 47.36
Weight: 0.64 lbs

McLanahan
AGGREGATE PROCESSING DIVISION

Standard Pump Curve

Linapump model 3/3 LPIIIr

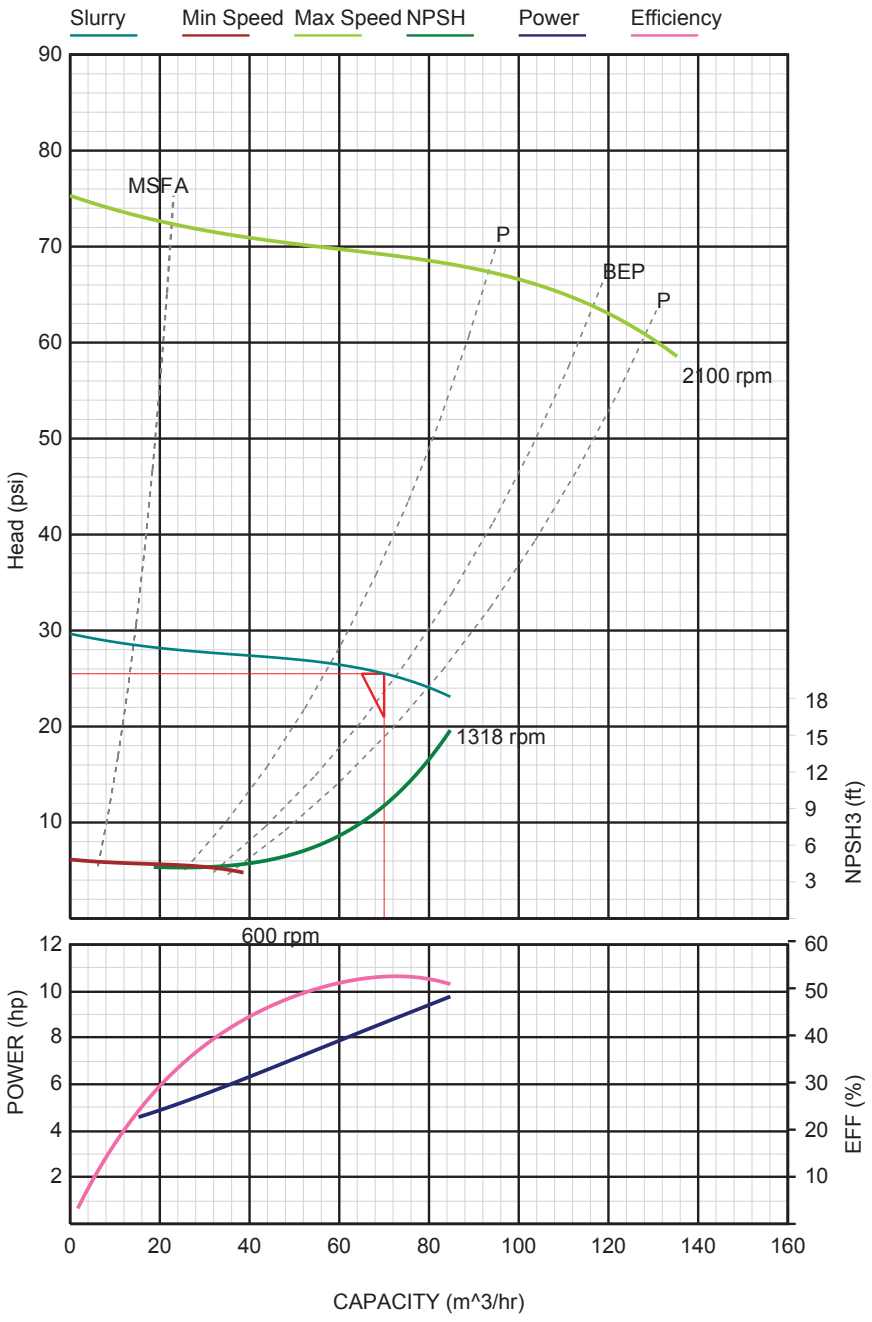
Impellar Diameter	10"	Maximum Speed	2100rpm	Max. Solids size	5/8"	Curve No	080/01.96
No. of Vanes	4	Maximum Power	60hp	Model	3/3	date	02-Apr-97



JMI - Agnico Eagle-Amaruk /

Q20180320-01, March 20, 2018

M3H-CR 3/3 , 1318 rpm, 15 hp



Pump model: M3H-CR 3/3

Pump	
Pump range	-CR
Speed	1318 rpm
Max Speed	2100 rpm
Efficiency @ BEP	53.13 %

Duty Point	
Flow	70 m^3/hr
Static Head	0 psi
Total Head	25.5 psi
Efficiency	53.15 %
NPSH required	7.664 ft
% of BEP	96.51 %
Power absorbed - @ Duty	8.635 hp
Motor size	15 hp
Tip Speed	57.03 ft/s
Impeller Diameter	10 in
Speed Head	25.97 psi

Slurry Data	
Solid flow rate	12.98 Tons/hr
Solid SG	2.7
Slurry SG	1.104
% Comp. by Weight	15 %
% comp. by Volume	6.135 %
Ave. Particle size (D50)	100 microns
Max Particle Size	300 microns
Head Ratio	0.982

Engineer's Notes

JMI - Agnico Eagle-Amaruk /
Q20180320-01, March 20, 2018
M3H-CR 3/3 , 1318 rpm, 15 hp

Pump Details	
Pump Model	M3H-CR 3/3
Rated Flow	70 m^3/hr
Rated Head	25.5 psi
Efficiency	53.15 %
QBEP	96.51 %
Impeller Diameter	10 in
Pump Speed	1318 rpm
Minimum Speed	600 rpm
Maximum Speed	2100 rpm
Tip speed	57.03 ft/s
NPSH required	9.421 ft

Selection Details	
Required Flow	70 m^3/hr
Required Head	25.5 psi
Static Head	0 psi
Friction Head	25.5 psi
Suction Height	0 psi
Discharge Height	0 psi
Discharge Pressure	0 kPa
Head Ratio	0.982
NPSH Available	0 psi

Slurry Details	
Solid flow rate	12.98 Tonnes/hr
Slurry flow rate	70 m^3/hr
SG solid	2.7
SG liquid	1
SG slurry	1.104
% comp. by weight	15 %
% comp by volume	6.135 %
Ave. particle size	100 microns
Max particle size	300 microns
Widely graded particles	False
Froth factor	0
Set ER & HR manually	False
Efficiency ratio	0.982
Head ratio	0.982

Electrical Driver Details	
Motor	15 hp
Power absorbed by pump	9 hp
Power required	8.049 hp
Frame size	160M
Temperature rise	0
Insulation class	
Bearing size D/E	
Bearing size N/D/E	
Weight	0
Shaft size	0

Specific Information About Your Pump

Company Name:		
Address:		Tel:
		Fax:
Supplier:	Type of Industry:	
	Pump Model:	Size:
	Serial No:	Flange Type:
Contact Person:	Gland Size:	Drive Style:
Start-up date/remarks:		

Design Condition (To be filled in by distributor or owner)

The following data should be completed as a record of the duty for which the pump was originally sold. During its lifetime the pumping requirements may change; if so, the new speed and operating conditions must be carefully engineered. McLanahan engineers are able to assist you in doing this. U.S. units are used, unless otherwise noted.

Details of Solids

Description of Solids: _____

Specific Gravity Solids: S=_____ Quantity of Solids M: _____ dry tons/hr

Particle Size: Topsize= _____mesh (mm). 50% passing size= _____mesh (mm).

Details of Liquor

Description of Liquor: _____

Specific Gravity of Liquor: Sl = _____

Details of Slurry

Specific Gravity of Slurry: Sm = _____

Percent (%) of solids by volume in slurry: Cv=_____

Percent (%) of solids by weight in slurry: Cm = _____

Flow rate of slurry: Q=_____gpm (l/s, m^3/Hr).

Calculated Design Data

Total Head: _____ft (m). Maximum working Head: _____ft (m).
NPSHa: _____ft (m). NPSHr: _____ft (m).
Pump Speed on Slurry: _____rpm. Derate factor for Slurry: _____

Motor Data

Motor Power rating: _____HP (kW).
Motor Frame size: _____
Motor Speed: _____rpm.
Motor Shaft Size: _____in (mm).

Vee-Belt Drive Data

Motor pulley O.D. _____in (mm). Pump pulley O.D.: _____in (mm).
Taper lock Bush No: _____ Taper lock Bush No: _____
Vee-belt: _____No off_____ No of grooves/pulley: _____

Gland Water Requirements (H and P glands only)

Quantity: _____gpm (l/s)
Pressure: _____psi (m)

Technical Data

Pump Mass: _____lbs (kg).
Motor Mass: _____lbs (kg).
Pump Shaft Size: _____mm
Noise Level: _____db (A)

Gland Options

Gland Seals

The **gland** is usually the weakest point on any **pump**; therefore, it requires the most attention and maintenance. All glands need cooling and lubrication between the sliding surfaces, so **a leisurely drip from the glands is normal**. **NOTE: DO NOT PREVENT DRIP.** All glands must be finally adjusted while the pump is running.

The McLanahan Glands have been developed to minimize the attention and service needed; Pressure of the fluid being pumped, the size and shape of the solid particles and the concentration of the solid particles in the liquid all affect wear and tear on pumps. Three unique seal arrangements have been developed and McLanahan engineers can give advice regarding the optimum selection for a specific duty.

"H" and "P" Glands

The slurry pressure at the gland is reduced by back pump out vanes on the impeller. The rubber axial expeller, which is a stretch fit on the shaft of the "H" and "P" glands, is used to avert waste.

The solids are restrained by the outward centrifugal swirl behind the impeller, the axial expeller and the restricted path to the seal interface.

With the "H" Gland, the adjusting gland must be eased **outward** to increase the sealing pressure. The geometric shape of the **gland seal** is carefully designed to provide a flawless seal while limiting the amount of "digging" onto the gland sleeve.

The gland sealing water must be as clean as possible and at a pressure of about 3-5psi (2-4m water gauge) above the discharge pressure. A high-flushing water pressure results in greater water use and greater dilution of the pumped slurry without any benefit to the seal.

“D” Gland

This is a unique type of mechanical seal. The **face seal** runs against the **hard wearing face**.

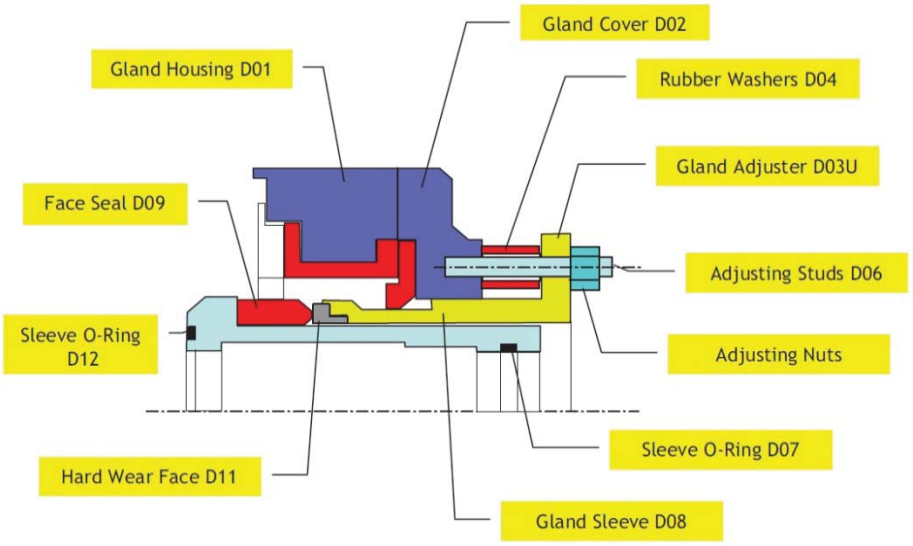
The **face seal** acts as a spring and if any grit particles get between the rotating rubber and stationary **wear face** it is pressed into the rubber. The **face seal** is a stretch fit on the **shaft sleeve**. As the gland pressure increases, the rubber extends axially and increases the pressure at the rubbing interface. Be sure not to over-tighten the adjusting sleeve.

When the pump is first started, ensure that the adjusting nuts are finger tight. While the pump runs, adjust the gland nuts so there are approximately five (5) drops per minute from the gland. This should reduce to one (1) occasional drop and run satisfactorily for up to a year without further attention in a good application.

Dry Gland

Also known as "D" type gland
This gland has a unique proprietary design and is unlike conventional mechanical seals. A rotating rubber **face seal** is adjusted against a static **hard wearing face**; it is **self-lubricating -** pressure from inside the pump head forces small amounts of liquid between the surfaces for lubrication.

Note: The gland needs no external water source to lubricate the gland; both small amounts of water and the fines do exit the pump, accumulating at its base, hence the term **dry gland**.

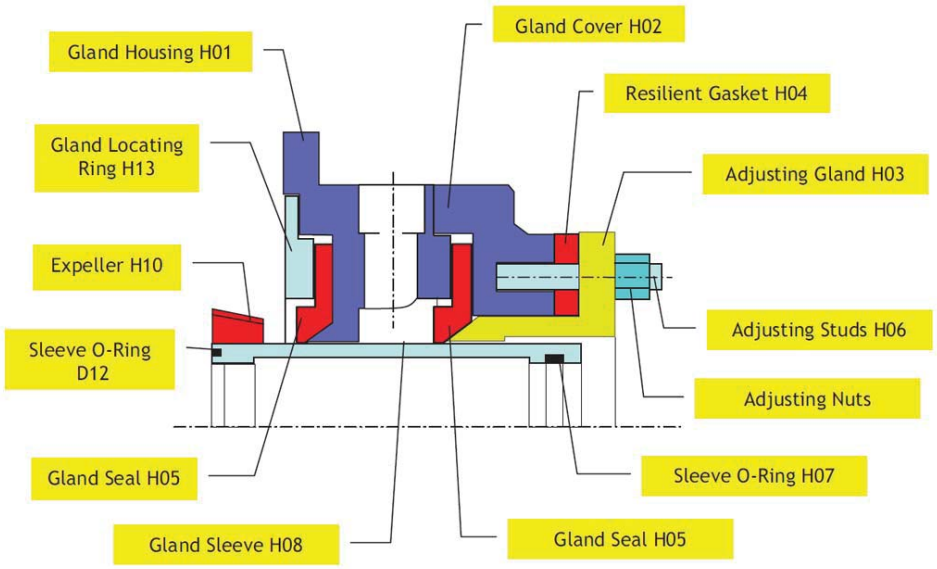


The **face seal** acts as a spring; if any grit particles get between the rotating rubber and **stationary wear face**, it is pressed into the rubber. The **face seal** is a stretch fit on the shaft sleeve. As the gland pressure increases, the rubber extends axially and increases the pressure at the rubbing interface.

While the pump is running, adjust the gland nuts so there are approximately five (5) drops per minute from the gland. This should reduce to one (1) occasional drop and run satisfactorily for up to one year without further attention in a typical application.

Hydrostatic Gland

Also known as "H" type gland
This gland has a unique proprietary design with the lowest maintenance and longest life. The unique rubber gland seal is designed to deflect inwards to provide an effective seal. The **slurry pressure** at the gland is reduced by back pump out vanes on the impeller; when fitted, it is reduced by the **rubber axial expeller**, which is a stretch fit on the shaft of the "H" gland sleeve.



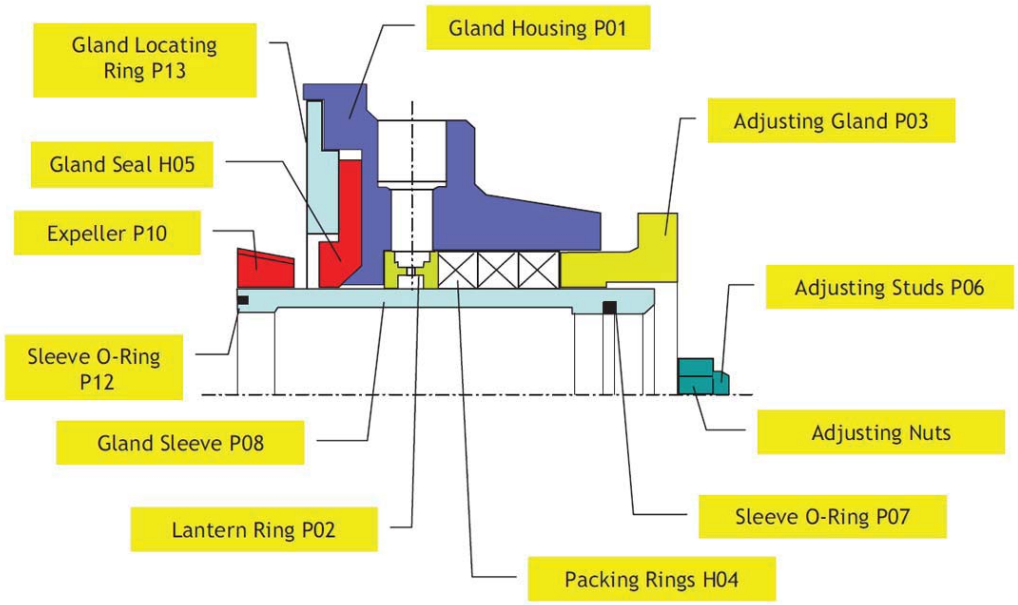
The solids are restrained by the outward centrifugal swirl behind the impeller, the axial expeller and the restricted path to the seal interface.

With the H Gland, the adjusting gland must be eased outwards to increase the sealing pressure. The geometric shape of the **gland seal** is carefully designed to give a good seal while limiting the amount of "digging" onto the gland sleeve.

The gland sealing water must be as clean as possible at a pressure of about 5psi (4m water gauge) above the discharge pressure and at a volume of between 1 to 5 gpm depending on pump size. A high-flushing water pressure results in greater water use and greater dilution of the pumped slurry without any benefit to the seal.

Packed Gland

“P” Type Gland
In a classic “stuffing box” design, sealing is obtained by compressing the gland packing rings onto the shaft sleeve. The gland offers the capacity to seal the pump even at high pressures, for instance, in series pumping.



The solids are restrained by the outward centrifugal swirl behind the impeller, the axial expeller and the restricted path to the seal interface.

With the “P” gland, the adjusting gland must face inwards to increase the sealing pressure. The geometric shape of the **gland seal** is carefully designed to give a good seal while limiting the amount of “digging” onto the gland sleeve.

The gland sealing water must be as clean as possible at a pressure of about 5psi (4m water gauge) above the discharge pressure and at a volume of between 1 to 5 gpm depending on pump size. A high flushing water pressure results in greater water use and greater dilution of the pumped slurry without any benefit to the seal.

A pressure-fed grease supply can be used with the “P” gland; be sure to use synthetic rubber parts (special order).