Preventative Maintenance

&

Standard Operating Procedures

Class For

Oil Flooded Rotary Vane Vacuum Pumps

Total Maintenance Solutions

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1.0 Installation

1.1 Inspect the pumps for any signs of damage. Pumps are shipped from the factory & your service center **Without Oil.**

1.2 Location

The pump must be installed in a **horizontal position on a level surface** so that the pump is evenly supported on its rubber feet. Allow at least one foot (five feet on larger pumps) of air space between the pump and any walls or other obstructions to flow of cooling air.

Also, adequate ventilation must be provided for the fans on the pump & motor (i.e. do not locate the pump in a stagnant location)

When moving the pump from one location to another drain the oil prior to shipping to avoid breakage of vanes.

Do Not Tip The Pump Over If Filled With Oil!!!

1.3 Power Requirements

Check for proper voltage & that motor is connected for that voltage. 2nd, check for proper pump rotation.

Caution: Prolong running of the motor in the wrong direction of rotation will damage the pump.

1.4 Vacuum Connections

Use a line size to the vacuum system which is at least as large as that of the pump inlet! Smaller lines can result in slower pumping speeds than the rated values.

If more than one vacuum pump is connected to a common mainline, each pump should have its own manual or automatic operated shut-off valve or positive action check valve. The built-in anti-suck back valve should not be used as a shut-off valve for the vacuum system.

Pump Inlet Size:

Pump Type	Line Size
0010-0016	¾"
0012-0021	1"
0025-0100	1 ¼"
0160-0250	2"
0400-0630	3"
1000/1600	6"

Caution: Choose an appropriate inlet filter to prevent foreign particles (5 Micron rating or less) from entering the pump.

Note: All threaded fittings should have epoxy applied to the threads before they are fitted together. Soft sealing materials like silicone, pipe paste & Teflon tape should not be used. (If you can move it, bend it or stretch it vacuum can too!) All vacuum hoses, inlet assemblies & all exhaust box covers should be applied to a dry surface with gaskets.

2.0 Oil Filling

Caution: After level installation & after correct rotation has been established. Fill the pump with the recommended oil between the ¾ & the full position @ the oil sight glass. Start the pump (After starting the pump, immediately close off the inlet) let run for a few minutes & check again. Add oil only when pump is Shut Off to the ¾ to full mark on the oil sight glass. (see page 6)

Approximate quantities of oil required for each pump

Pump Type:	Oil Capacity (Qt.)
0010-0016	0.5
0012-0021	0.5
0025-0040	1.0
0063-0100	2.0
0160-0250	7.0
0400	16
0630	18
1000	42
1600	44

Caution: Do not add/fill pump with oil while the pump is running or through the exhaust /inlet ports.

On pumps with one sight glass & with **the pump shut off** the oil level should be between the ¾ & full mark on the oil sight glass.

On pumps with two sight glasses on top of each other & with the pump shut off the oil level should be visible in the upper oil sight glass between the ¾ and full mark

Oil should only be added while the pump is shut off and the circulating oil has had sufficient time to return to the oil sump. (see page 6)

3.0 Maintenance

3.1.1 Oil Level

With the pump shut off check the oil daily and make sure there is a sufficient amount of clean oil in the pump. Replenish oil if it drops below the ¼ mark on the oil sight glass.

All oil readings should be done only when the pump has been running for at least 5- 10 minutes then shut off for 2-3 minutes & the oil has had sufficient time to return to the oil sump. (see page 6)

Under normal circumstances it should not be necessary to add or drain oil from the pump between the recommend oil changes.

3.1.2 Oil & Filter Change

When using synthetic oil it is recommended that oil changes are every six (6) months or 1000 hrs of operation which ever comes first.

When using a 30 wt. hydrocarbon Vacuum Pump oil it is recommended that oil changes are every four (4) months or 750 hrs of operation which ever comes first.

When using a SAE 30 wt. motor oil it is recommended that oil changes are every three (3) months or 500 hrs of operation which ever comes first.

When changing the oil it is recommended that the oil spin-on filter also be changed. It is also recommended that a spin-on oil filter that is designed for vacuum pumps be used (there is difference between a vacuum pump filter & an auto filter).

3.2 Exhaust Filters

Every nine (9) to eighteen (18) months or as necessary replace the exhaust filter elements.

3.3 Inlet Filters

Check & clean if necessary on a weekly basis.

3.4 Maintenance Chart

Daily:	Visually Check Oil Level
Weekly:	Inspect Inlet Filter
Every 3-6 Months or 500-1000 hrs:	Change Oil & filter
Every 9-18 months:	Change Exhaust Filters

Note: The maintenance schedule mentioned above is for the ideal working environment. Most food processing plants must use a more aggressive maintenance schedule. Careful consideration, proper planning & an understanding of the pumps environment should be taken into account when determining a proper maintenance schedule.

4.0 Gas Ballast Valve:

Most oil flooded rotary vane pumps from the 0100 & up are equipped with a gas ballast valve. The 0100 models have a permanent open gas ballast valve that cannot be shut off, unless it is capped or removed and the orifice plugged. Pump models 0160 and larger are equipped with an adjustable gas ballast valve.

The gas ballast valve should normally be left open. Its primary function is to prevent water vapor from condensing in the pump, which then causes emulsification of the oil resulting in the loss of lubricity and possible rotor seizure. When the gas ballast valve is open the pump may lose a small amount of performance however, it is recommended that the valve be left open at all times if possible.

Proper Oil Change Procedures For **Oerlikon leybold/Busch** Rotary Vane Pumps

Step 1.

Prior to any oil change make sure that the pump has been running for a minimum of 15 minutes, so that the oil is warm. Turn the pump off, remove the oil drain plug and drain the oil.

Step 2.

When the oil slows down screw the oil drain plug back in. **Briefly** turn the pump back on (10 Sec Max) Jog pump 2-3 times, remove the drain plug again & drain remaining oil.

Caution: When changing the oil and filters, it may be necessary to flush the pump to remove any build up of degraded oil from the sump, oil lines, radiator ect to ensure the proper oil flow through the pump. Reduced oil flow, especially through the radiator & cooling coils can cause mechanical damage or extreme overheating which could cause the oil vapor to ignite.

Step 3.

Tighten the oil drain plug, install a new automotive style oil filter & tighten. Fill the pump with fresh oil through the oil filling port between the ¾ & Full mark on the oil sight glass. Replace the oil fill plug with a properly working exhaust pressure gauge.

Caution: Insufficient oil quantity in the pump has the potential, under certain conditions to lead to self-ignition of the remaining oil in the pump.

Step 4.

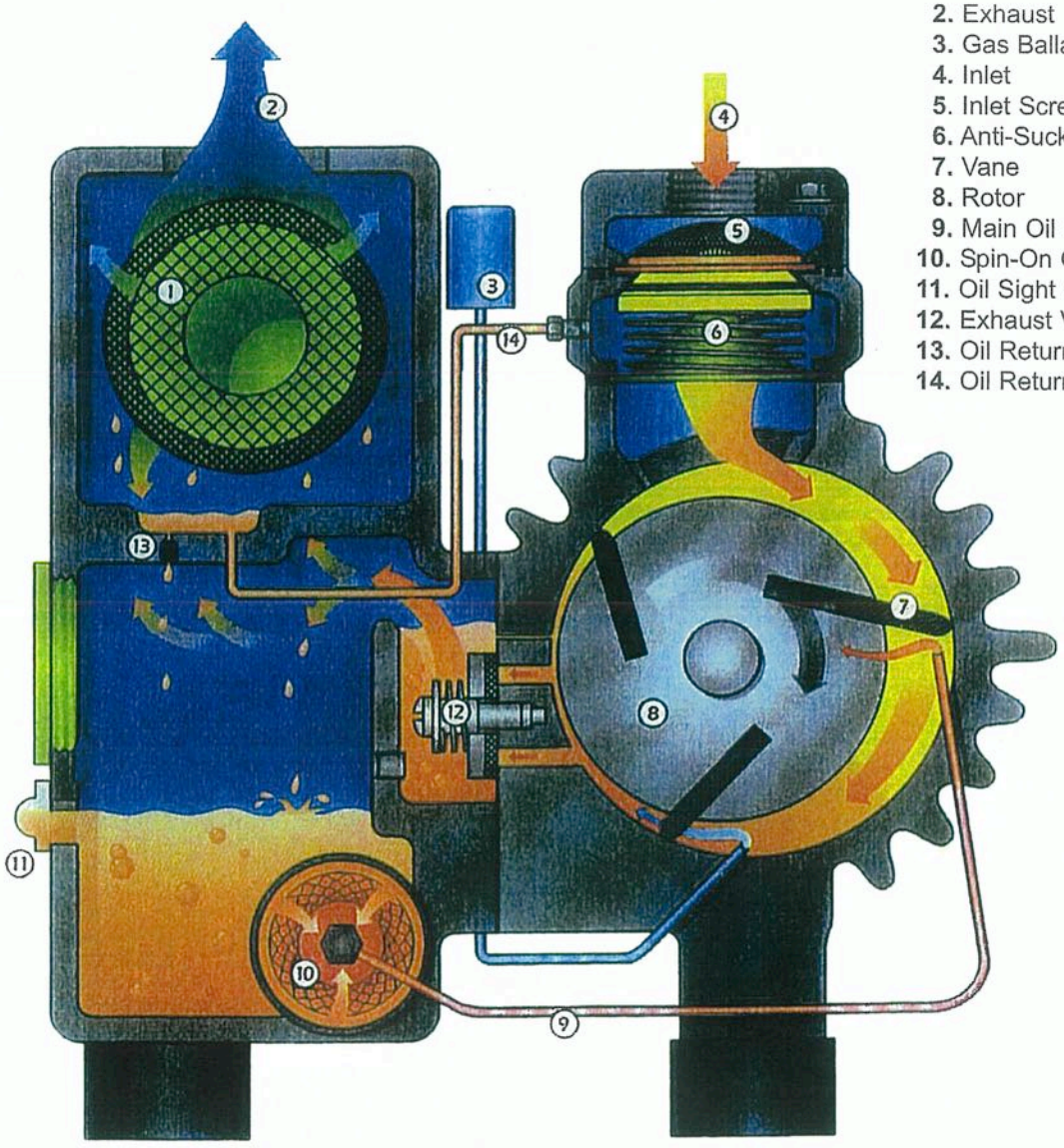
Start the pump & **immediately close off the inlet**. Run the pump for a few minutes (5-10 min) shut the pump off wait 2-3 minutes before checking oil level. Fill with oil to the ¾ to full mark on the oil sight glass.

Note: With the pump shut off, on pumps with one sight glass the oil level should be visible in the oil sight glass between the ¾ and full mark. On pumps with two sight glasses on top of each other and with the pump shut off, the oil should be visible in the upper oil sight glass between the ¾ & full mark.

Add oil if necessary, pump oil should only be added when the pump is shut off and the circulating oil has had sufficient time to return to the oil sump. Under normal circumstances it should not be necessary to add oil between oil changes.

OPERATING PRINCIPLE

Rotation of the pump rotor, which is mounted eccentrically in the pump cylinder, traps entering vapor between rotor vane segments. As rotation continues, vapor is compressed and discharged into the exhaust box. Vapors then pass through several stages of internal oil and mist eliminators to remove 99.9% of lubricating oil from the exhaust. Oil is then returned to the oil reservoir. Additional features include an automotive type spin-on filter, and a built-in inlet anti-suckback valve that prevents the pump from rotating backwards. A built-in gas ballast is available on the H-version, which permits pumping with high water vapor loads.



1. Oil Mist Eliminator
2. Exhaust
3. Gas Ballast
4. Inlet
5. Inlet Screen
6. Anti-Suckback Valve
7. Vane
8. Rotor
9. Main Oil Feed Line
10. Spin-On Oil Filter
11. Oil Sight Glass
12. Exhaust Valve
13. Oil Return Valve
14. Oil Return Line

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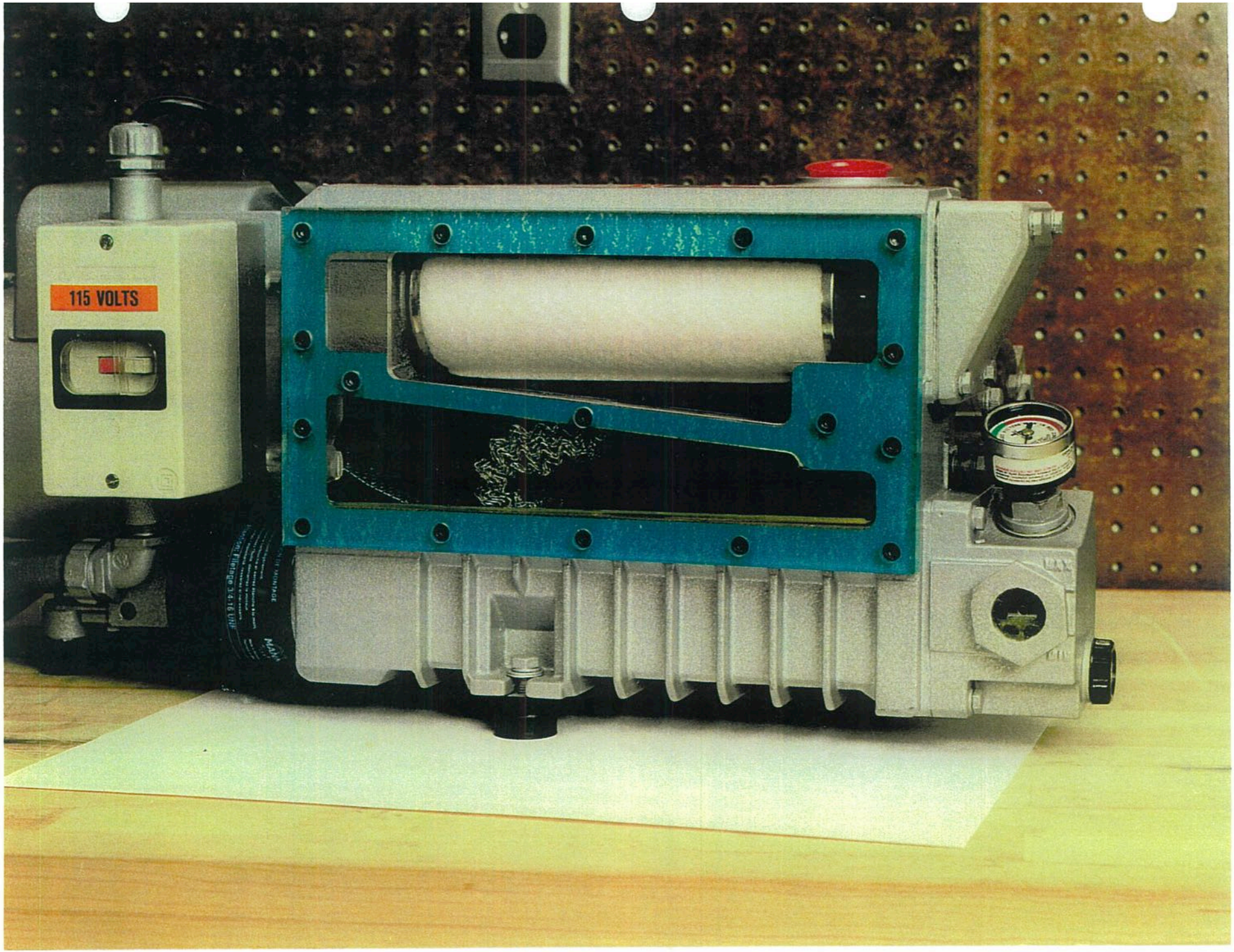

115 VOLTS

Trouble Shooting Rotary Vane Vacuum Pumps:

4.1 Trouble:

Pump does not reach "Blank-Off" pressure which is the lowest absolute pressure (best Vacuum) when running with the inlet closed via a blank flange or a valve; or pump takes too long to evacuate the system. The "Blank-Off" pressure can be measured by using a good quality capsule gauge.

4.1.1 Possible Cause:

Contaminated oil is by far the most common cause of not reaching the ultimate pressure.

Remedy:

Shut off the pump, after operating temperature has been reached, drain the warm oil from the pump and exchange automotive type oil filter (where applicable) if necessary. Fill with new oil and take new "blank-off" measurement after operating temperature is reached (at least 20-30 minutes).

4.1.2 Possible Cause:

Vacuum System or vacuum piping not leak-tight.

Remedy:

Check hose & pipe connections for possible leak.

4.1.3 Possible Cause:

Wire mesh inlet screen plugged.

Remedy:

Clean wire mesh inlet screen. Install inlet filter if problem repeats frequently.

4.1.4 Possible Cause:

No oil or not enough oil in oil reservoir.

Remedy:

Shut off the pump, drain balance of oil from the pump, exchange automotive oil filter and refill with fresh oil.

4.1.5 Possible Cause:

Automotive type oil filter is dirty or clogged.

Remedy:

Replace automotive type oil filter, exchange oil if necessary, refill with fresh oil.

4.1.6 Possible Cause:

Inlet valve plate stuck in the closed or partially open position due to contamination.

Remedy:

Disassemble inlet valve and screen, clean as required.

4.1.7 Possible Cause:

Oil tubing defect and /or leaking. Oil return line broken on RC model.

Remedy:

Replace or retighten oil fittings or oil tubing. Replace only with same size tubing, call Valley Pump for assistance.

4.1.8 Possible Cause:
Shaft seal leaking.
Remedy:
Replace shaft seal following disassembly and assembly steps outlined in Maintenance and Repair Manual. Call valley Pump for seal kit & proper instructions. Check that shaft seal has a spring installed inside around the shaft sealing lip.
4.1.9 Possible Cause:
Exhaust valves not properly seated or partially stuck open.
Remedy:
Replace valves. Call Valley Pump for proper instructions & new valve kit.
4.1.10 Possible Cause:
Vanes blocked in rotor or otherwise damaged.
Remedy:
Free vanes or replace with new ones following disassembly and assembly steps outlined by Valley Pump. If vanes are damaged call Valley Pump for a new vane kit and assistance.
4.1.11 Possible Cause:
Radial clearance between rotor and cylinder no longer adequate.
Remedy:
Follow disassembly and assembly steps per Valley Pump & Supply on resetting radial clearance correctly.
4.1.12 Possible Cause:
Internal parts worn or damaged.
Remedy:
Follow disassembly and assembly steps per Valley Pump & Supply and replace all worn parts.
4.1.13 Possible Cause:
The oil return line is connected directly to atmospheric pressure in the exhaust area. On small model pumps therefore a fairly large amount of air is sucked through the oil return line and it may not be possible to reach 15 Torr or 29.4 inches Hg blank-off on the inlet of the pump under these conditions.
Blank-off of 29.4 inches Hg or 15 Torr can be reached by temporarily disconnecting and closing the oil return line. Also by squirting oil through the exhaust opening into the exhaust filter area. The oil will be sucked into the oil return line and no air will reach the inlet thus affecting the "blank-off" pressure.

4.2 Trouble:

Pump will not start.
4.2.1 Possible Cause:
Motor does not have proper supply voltage or is overloaded, motor starter overload settings are too low or wrong setting, fuse are burned, wire size is too small or too long causing a voltage drop at the pump.

Remedy:
Check correct supply voltage, check overload settings in motor starter for size and settings according to motor nameplate data, check fuses, install proper size wire. If ambient temperature is high, use next larger size overloads or adjust setting 5% above nominal motor nameplate value.

4.2.2 Possible Cause
Pump or motor is blocked.

Remedy:
Remove fan cover and try to turn pump and motor by hand. If frozen, remove motor from pump and check motor and pump separately. If pump is frozen, disassemble completely per Maintenance and Repair Manual and remove foreign objects in pump and replace broken vanes.

4.3 Trouble:

Pump starts, but labors and draws a very high current.

4.3.1 Possible Cause
Oil too heavy (viscosity too high) or ambient temperature below 5 degrees C (41 degrees F).

Remedy:
Change to a 10W40 multi-purpose motor oil--only use when necessary since continued use may clog filter elements prematurely.

4.3.2 Possible Cause
Pump runs in the wrong direction.

Remedy:
Check for correct rotation which is counter clockwise when looking at the motor from the motor's fan side.

4.3.3
Pump is overfilled with oil or wrong kind of oil is used.

Remedy:
Correct oil level and quality per Section 1.5 and use only recommended motor oil.

4.3.4 Possible Cause
Exhaust filters in exhaust are clogged and burned black with pump oil.

Remedy:
Replace exhaust filters, maintain proper oil condition, oil level and use recommended non-detergent motor oil.

4.3.5 Possible Cause
Exhaust filter is clogged due to process material.

Remedy:
Contact factory for recommendation or proper filter cartridge.

4.3.6 Possible Cause
Loose connection in motor terminal box, not all motors coils are properly connected. Motor operates on two phases only.

Remedy:
Check motor wiring diagram for proper hook-up, especially on motors with 6 internal motor windings, tighten and/or replace loose connections.

4.3.7 Possible Cause

Foreign particle in pump, vanes broken. bearing seizing.

Remedy:

Follow disassembly and assembly steps outlined in Maintenance and Repair Manual and remove foreign parts, replace vanes and bearings.

4.4 Trouble:

Pump smokes at the exhaust side or expels oil droplets from the exhaust.

4.4.1 Possible Cause

Exhaust filter not properly seated with O-ring (Pos. 121) in filter base or filter material cracked.

Remedy:

Check condition and placement of exhaust filters in filter base. Replace if necessary.

4.4.2 Possible Cause

Exhaust filter clogged with foreign particles.

Remedy:

Replace exhaust filter. Install other factory recommended filter cartridges if pump application requires other filter cartridges.

4.4.3 Possible Cause

Oil recirculation valve (Pos. 275) not properly working or clogged. Proper function is, that when blowing into check valve, it should close. When sucking on it, check valve should open.

WARNING: Do not inhale through or allow your mouth to come in direct contact with the oil recirculation valve.

Remedy:

Free or replace oil recirculation check valve.

4.4.4 Possible Cause

If Super Series vacuum pumps run continuously over 10 hours without ever being shut down, it may be possible that oil accumulates behind the exhaust box cover (Pos. 64) to the extent that oil is blown out of the exhaust with the exhaust gas.

Remedy:

Shut pump down during break periods or install additional oil return line assembly. Check that oil recirculation valve (Pos. 275) is free and drains oil back into pump when Super Series pump is stopped.

4.4.5 Possible Cause

Oil return line (Pos. 290) on RC, 118/138/218/338 Standard pumps clogged or broken.

Remedy:

Free clogged line, replace broken line, but only with proper size, and check that oil is pumped out of oil sump while vacuum pump is operating.

NOTE: An oil filling plug with pressure gauge is available for all R5 series pumps, so that the pressure in front of exhaust filters can be monitored. The green field (0 through 0.6 bar) is between 0 and 9 psi and indicates that the filters are still effective. Any back pressure close to 9 psi requires immediate change of the exhaust filter (Pos. 120).

4.5 Trouble:

Pumps runs very noisy

4.5.1 Possible Cause

Coupling insert worn.

Remedy:

Replace coupling insert in motor/pump coupling.

4.5.2 Possible Cause

Bearing noise.

Remedy:

Follow disassembly and assembly steps outlined in Maintenance and Repair Manual and replace bearings. Contact Valley Pump for Bearing kit and assistance.

4.5.3 Possible Cause

Vanes stuck.

Remedy:

Follow disassembly and assembly steps outlined in Maintenance and Repair Manual and replace vanes. Use only recommended motor oil and change oil more frequently.

4.6 Trouble:

Pump runs very hot.

See **7.0 TECHNICAL DATA** for typical oil sump temperature.

4.6.1 Possible Cause

Not enough air ventilation to pump.

Remedy:

Clean motor and pump air grills. Do not install pump in enclosed cabinet unless sufficient amount of fresh air is supplied to pump. On pumps with oil cooling coils clean outside fin assembly. Consult (Valley Pump & Supply) for recommendation.

4.6.2 Possible Cause

Automotive type oil filter clogged and pump does not receive enough oil. (not applicable on 0010, 0012, 0016 or 0021)

Remedy:

Change automotive oil filter.

4.6.3 Possible Cause

Not enough oil in oil reservoir or badly burned oil is used in pump lubrication.

Remedy:

Drain and refill only with non-detergent oil, increase oil change intervals.

Note: On some high temperature applications it may be necessary to change to a high temperature oil. Contact Valley Pump & Supply for recommendations.

4.7 Trouble:

Pump is seized.

4.7.1 Possible Cause

Pump operated without oil and vanes broke.

Remedy:
Disassemble and exchange vanes as outlined in Maintenance and Repair Manual. Call Valley Pump for a vane kit and assistance.

4.7.2 Possible Cause
Pump was operated for an extended period of time in the wrong rotation.

Remedy:
Inspect vanes and replace if necessary.

4.7.3 Possible Cause
Liquid carryover into pump cylinder broke vanes while pump was running or oil broke vanes on start-up.

Remedy:
a) Install condensate trap on inlet of pump.
b) Pump was overfilled with oil in oil reservoir. Follow oil filling procedure (see section 1.5) and do not overfill.
c) Built-in anti-suck back valve (Pos. 250 through 255) leaking while pump was shut down and vacuum was left in manifold. Clean valve seat and check that anti-suck back valve holds vacuum on inlet when pump is shut down.
d) Two pumps on same main line. Install a manual or automatic valve in front of each pump, if more than one vacuum pump is pumping on the same main line.

4.8 Trouble:

Automotive type oil filter (Pos. 100) does not get warm within 2-5 minutes when cold pump is started. (Not applicable on 0010, 0012, 0016, 0021).

4.8.1 Possible Cause
Automotive type oil filter is clogged.

Remedy:
Replace automotive type filter per section 3.2 and exchange oil per section 1.5.

4.8.2 Possible Cause
Wrong automotive type filter is used and/or oil lines leading to pump are clogged.

Remedy:
Use only automotive filter as listed in section 3.2 and blow lines free.

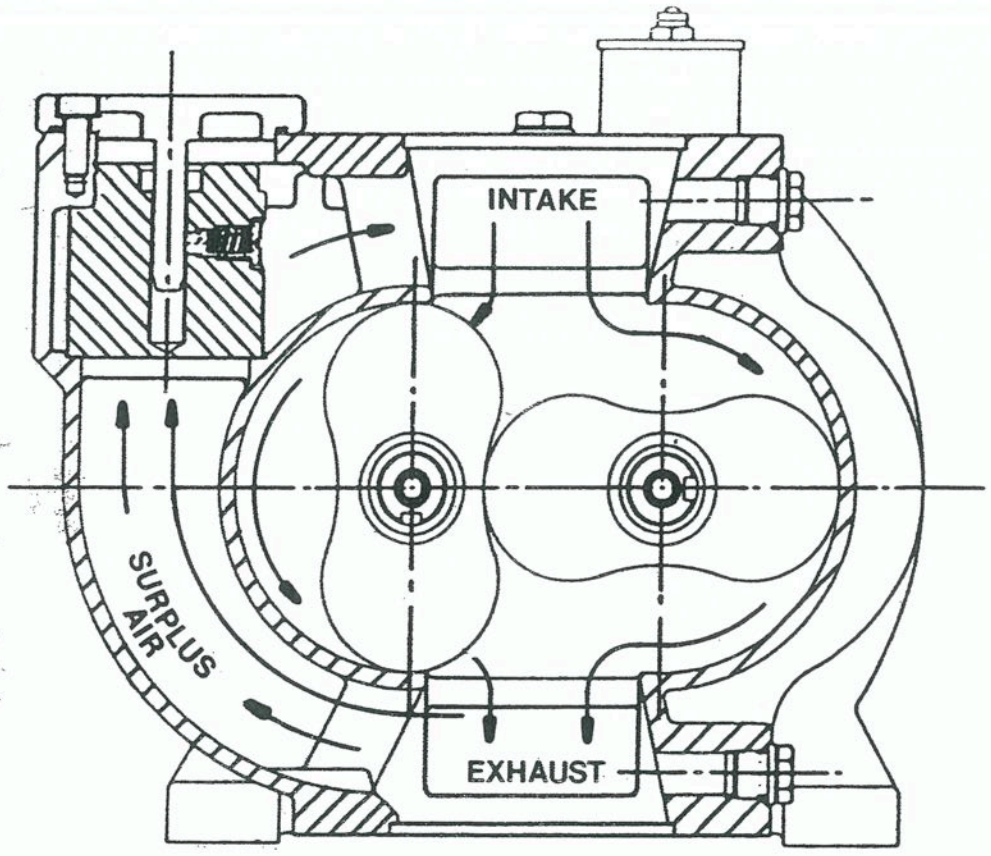
opening and retain with socket head cap screws (Ref. 168).

54. Make sure all the oil plugs are tight. Oil plugs are sealed via an O-ring which can be replaced if necessary. Add oil to both ends of the blower until the oil level is 3/4 way up on the sight glass. Use Fomblin® oil, if required. Fill the oil cup until it remains at the 3/4 full level.

8.0 TECHNICAL DATA

Model	WV0500	WV1000	WV2000
CFM displacement	350	765	1520
Motor size (HP/kW)	3/2.2	5/4	10/7.5
Rotational speed (RPM) (Synchronous)	3600	3600	3600
Maixmum leak rate (Torr - CFM)	2.8×10^{-2}	2.8×10^{-2}	2.8×10^{-2}
Maximum differential pressure (Torr)	40	32	32
Oil capacity (qt.)	1.25	3.2	5
Weight (lbs.)	315	520	1200
Seal material	Viton	Viton	Viton
Inlet flange	3" ASA	4" ASA	6" ASA
Outlet flange	3" ASA	4" ASA	4" ASA

CROSS SECTION ILLUSTRATING INTERNAL AIR FLOW



Troubleshooting Rotary Lobe Blowers:

5.1 Trouble:

Rapid increase in temperature and high Amp-erage draw; also an increase in noise.

5.1.1 Possible Cause:

(a) Lost clearance between lobes.
(b) Deposits on the housing or lobes.
(c) Mounting or piping distorted the housing.
(d) Bypass valve stuck.
(e) Flex line collapsed & or blockage between blower & backing pump.

Remedy:

(a) Stop the blower, disassemble and re-set the timing gears.
(b) Clean housing & lobes.
(c) Remove the stress condition & check the clearances.
(d) Disassemble the bypass valve & repair.
(e) Replace flex line, remove blockage in line (Inlet screen?)

5.2 Trouble:

Rattling noise from the bypass valve.

5.2.1 Possible Cause:

Spring guide inside bypass valve worn.

Remedy:

Disassemble the bypass valve & replace the spring guide.

5.3 Trouble:

The oil cup is losing more oil than normal and/or the gear side oil cavity requires filling more than normal.

5.3.1 Possible Cause:

The shaft seals are leaking and the labyrinth seals are worn.

Remedy:

(a) Shut down the system & vent the blower. Remove the threaded plugs, the cavity should be free of oil. If oil does exist in this cavity, it means oil has leaked past the labyrinth seals. Replace the seals in the motor mounting bracket. Call Valley Pump for Assistance.

(b) Shut down the system & inspect the blower half of the motor coupling for oil leaks. Replace the seals in the motor mounting bracket. Call Valley Pump for Assistance.

7.0 TECHNICAL DATA

Type		0010	0012	0016	0021	0025	0040	0063	0100	0160	0250	0400	0630	1000	1600
Theoretical Displacement	CFM	6	7.5	8	15	20	28	41	63	117	174	300	430	704	1130
*Typical oil sump temperature	—	—	—	—	—	184°F	—	198°F	241°F	214°F	251°F	225°F	215°F	—	—
Guaranteed vacuum without gas ballast - RA Models	in Hg.	29.9	29.8	29.8	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9
RC (Standard) Models	in Hg.	29.4	29.3	29.4	29.3	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4
Water vapor tolerance - R5 Super, with gas ballast	in Hg.	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7
Maximum sound level one meter from pump	dBA	69	68	70	62	68	69	70	71	79	82	83	85	84	85
Motor size for 3 phase	HP	0.75	0.75	0.75	1	1.5	2	3	5	7.5	10	20	25	40	50
Motor size for 1 phase	HP	1.0	0.75	1.0	1.25	1.5	2	3	5	N/A	N/A	N/A	N/A	N/A	N/A
Pump rotational speed	RPM	1710	1725	1710	3450	1700	1745	1710	1710	1740	1745	1150	1150	1200	1200
Oil Capacity Busch R530 (R580 on 0021 & R590 on 1000/1600)	Qt.	0.5	0.5	0.5	0.5	1	1	2	2	7	7	16	18	42	44
Inlet connection - male NPT	inch	3/4	1 hose	3/4	1 hose	1-1/4	1-1/4	1-1/4	1-1/4	2	2	3	3	150#ASA 6" flange	150#ASA 6" flange
Weight of pump	lbs.	49	42	60	42	109	129	154	214	416	496	1152	1461	1914	2816
Shipping weight (approximate)	lbs.	58	49	64	49	154	161	198	226	515	555	1269	1739	2300	3000
Ordering Information- Catalog Number															
R5 Super (except 0012 and 0021 Plus)		RA0010	RB0012	RA0016	RB0021	RA0025	RA0040	RA0063	RA0100	RA0160	RA0250	RA0400	RA0630	RA1000	RA1600
R5 Standard		RC0010	RC0012	RC0016	RC0021	RC0025	RC0040	RC0063	RC0100	RC0160	RC0250	RC0400	RC0630	RC1000	RC1600

We reserve right of alteration.

*Maximum oil temperature with 100°F ambient temperature and no supplemental oil cooling.

For example, insufficient ventilation or high ambient temperatures cause the winding resistance to increase, reducing motor efficiency, and potentially resulting in overheating. Excess temperatures also may be due to poor maintenance or misapplication, and likewise will reduce motor operating life and increase energy consumption.

Friction may also gradually increase within the driven machine. This could be caused by dirt buildup on a fan, an impeller rubbing on a pump, worn parts, misaligned couplings or sheaves, or inadequate lubrication.

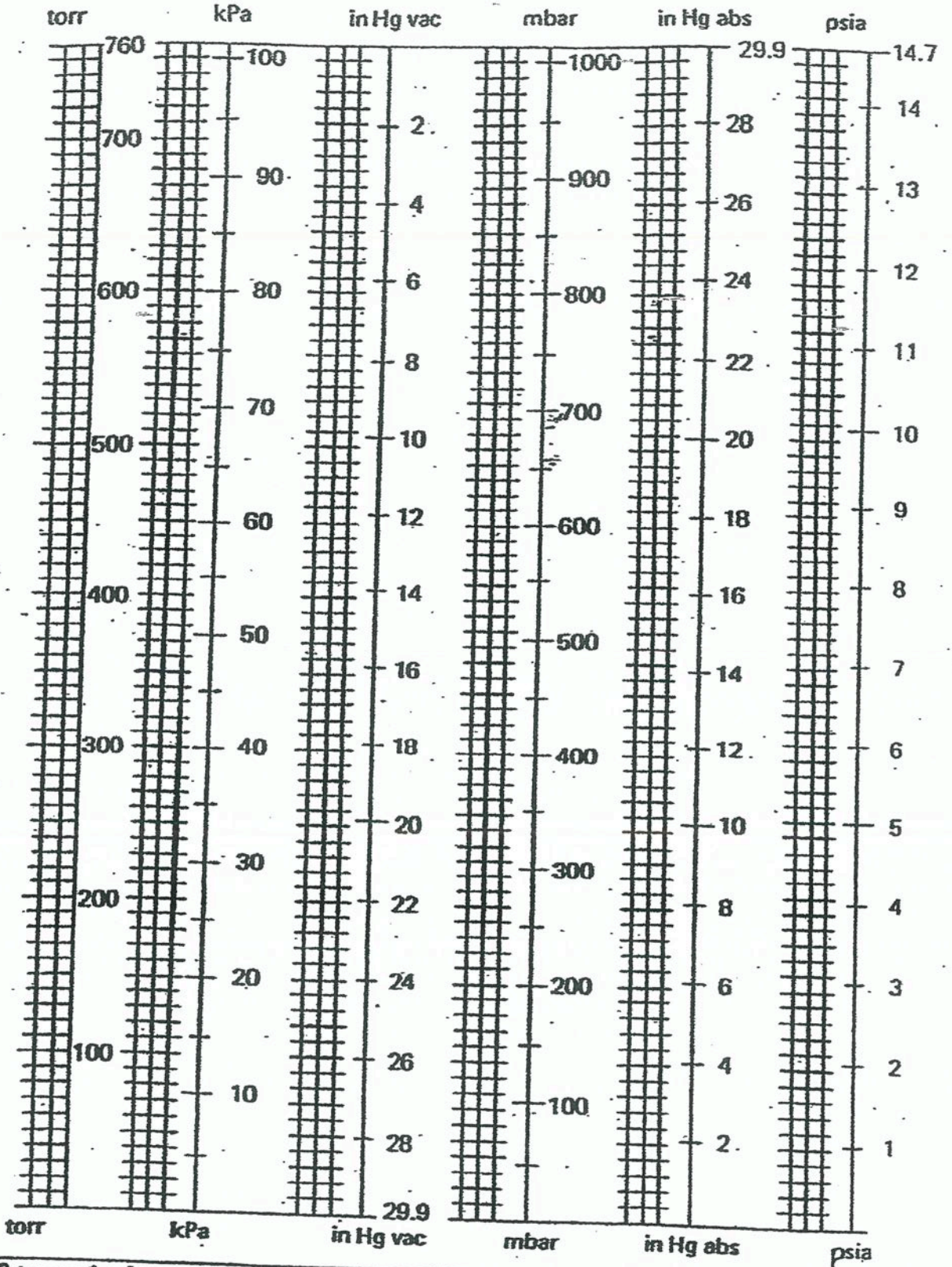
■ **Lubrication.** Too much lubricant is a major cause of premature motor failure. If too much grease is applied, it is eventually forced out of the bearing housings and begins dripping on the motor windings, resulting in early winding failure. Overlubrication also can reduce bearing life and motor efficiency.

To lubricate standard-duty motors, follow the original manufacturer's specifications. Begin by cleaning the grease fitting and removing the drain plug. After adding the new grease, run the motor for about an hour before reinstalling the drain plug. This purges excess grease without damaging the windings. If the motor manufacturer's lubrication specifications are not available, use the following.

Table 1. Lubrication Guide

RPM	Frame Range	Type Of Service	
		8 Hours/Day	24 Hours/Day
3600	143T-256T	*ALL BLOWERS	*
	284TS-286TS	6 months	2 months
	324TS-587US	4 months	2 months
1800	143T-256T	* 250/160	*
	284T-326T	4 years	18 months
	364T-365T	1 year	4 months
	404T-449T	9 months	3 months
	505U-587U	6 months	2 months
1200 and below	143T-256T	*	*
	284T-326T	4 years	18 months
	364T-449T —	1 year 630	4 months
	505U-587U	9 months	3 months

* These motors often do not have bearings that can be relubricated. Their bearings should be replaced at least every 5 years for 8 hour/day service, or every 2 years for 24 hour/day service.



0.0010 torr = 1 micron (μmHg)	25.40 torr = 1 in mercury (in Hg)
0.0075 torr = 1 pascal (Pa)	51.71 torr = 1 lb/in² (psi)
0.7501 torr = 1 millibar (mbar)	735.6 torr = 1 tech. atmosphere (at)
1.000 torr = 1 mm mercury (mmHg)	750.1 torr = 1 bar
1.868 torr = 1 in water @ 4°C (in H_2O)	760.0 torr = 1 stand. atmosphere (atm)

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TECHSOUTH

RELATIVE VACUUM TABLE

mbar	Pascal	Torr	bar	atm	at	%vac	inches of Hg	mm of water
1013	101,300	760.00	1.010	1.000	1.030	0	0	10,300
1000	100,000	750.00	1.000	0.987	1.020	1.300	0.3900	10,200
981	98,100	735.75	0.981	0.968	1.000	3.200	0.9600	10,000
900	90,000	675.00	0.900	0.888	0.918	11.100	3.3300	9,180
800	80,000	600.00	0.800	0.789	0.816	21.000	6.3000	8,160
700	70,000	525.00	0.700	0.691	0.714	30.900	9.2700	7,140
600	60,000	450.00	0.600	0.592	0.612	40.800	12.2400	6,120
500	50,000	375.00	0.500	0.494	0.510	50.600	15.1800	5,100
400	40,000	300.00	0.400	0.395	0.408	60.500	18.1500	4,080
300	30,000	225.00	0.300	0.296	0.306	70.400	21.1200	3,060
200	20,000	150.00	0.200	0.197	0.204	80.200	24.0600	2,040
100	10,000	75.000	0.100	0.099	0.102	90.100	27.0300	1,020
90	9,000	67.500	0.090	0.089	0.092	91.100	27.3300	918
80	8,000	60.000	0.080	0.079	0.082	92.100	27.6300	816
70	7,000	52.500	0.070	0.069	0.071	93.100	27.9300	714
60	6,000	45.000	0.060	0.059	0.061	94.100	28.2300	612
50	5,000	37.500	0.050	0.049	0.051	95.100	28.5300	510
40	4,000	30.000	0.040	0.040	0.041	96.100	28.8300	408
30	3,000	22.500	0.030	0.030	0.031	97.000	29.1000	306
20	2,000	15.000	0.020	0.020	0.020	98.000	29.4000	204
10	1,000	7.5000	0.010	0.010	0.010	99.000	29.7000	102
5	500	3.7500	0.005	0.005	0.005	99.500	29.8500	51
1	100	0.7500	0.001	0.001	0.001	99.900	29.9700	10
0.5	50	0.3750	0.0005	0.0005	0.0005	99.900	29.9700	5
0.1	10	0.0750	0.0001	0.0001	0.0001	99.900	29.9970	1
0.01	1	0.0075	0.00001	0.00001	0.00001	99.900	29.9970	0.1

1 torr = 1 mmHg 1 atm = standard atmosphere 1 at = 1 technical atmosphere
mbar = millibar

GLOSSARY

ABSOLUTE PRESSURE	The pressure measured from absolute zero, i.e. from absolutely perfect vacuum.
ATMOSPHERIC PRESSURE	The pressure exerted by the total weight of the earth's atmosphere . At sea level, this is 14.7 pounds per square inch, also equal to 1 Bar.
BAR	One bar is the pressure exerted by the earth's atmosphere. One Bar is equal to 760; one millibar is equal to 1/1,000th of a Bar. The expression "millibar" is commonly used in meteorology to express atmospheric pressure
BLOWER/BOOSTER	This is a type of vacuum booster constructed of two rotating interweaving lobe structures. The lobes are coupled by timing gears. These were first constructed by Roots brothers; hence the name Roots blower. They are used in conjunction with various vacuum pumps as a booster to enhance and increase the pumping speed at low pressures. Some models contain a bypass valve, which permits starting up at atmosphere.
BOURDON GAUGE	A type of vacuum gauge whose pressure reference is the ambient atmospheric pressure. Therefore the gauge is sensitive to altitude.
BTU	The unit of measure of heat energy. One BTU is the quantity of heat required to raise one pound of water one degree Fahrenheit.
CAVITATION	Erosion of a pump and impeller caused by the formation and sudden collapse of vapor bubbles in a liquid. This occurs when a liquid ring pump is operated below the vapor pressure of the coolant/sealant.
COMPRESSION RATIO	The ratio of discharge pressure to the inlet pressure for the pump.
CONDUCTANCE	The ratio of throughput under steady state conditions to the pressure differential between two specified cross sections of a pumping system.

CFM	Cubic feet per minute; method of measuring the vacuum pumping speed of a vacuum pump. It is also a unit of measure of conductance.
DIAPHRAGM GAUGE	A type of vacuum gauge where the indication of the gauge is a direct measure of the difference in pressure relative to a sealed high vacuum capsule. This gauge reads in absolute pressure units and is independent of altitude.
DISPLACEMENT	The volume swept per unit time by the impeller or pistons of a pump.
END PRESSURE	Also known as blank-off pressure of a vacuum pump and is the maximum obtainable vacuum when the inlet of the pump is closed off.
EQUIVALENT LENGTH	The equivalent length in a manifold piping system is the length of constant diameter pipe that has the same conductance as some other piping connections such as a tee, valve, elbow, change in diameter, etc.
INCHES OF MERCURY	One of the pressure units used in measuring a vacuum. When a system has a pressure of one inch of mercury, it will support a column of mercury one inch high when compared to a perfect vacuum. Similarly, millimeters of mercury are defined. One inch of mercury is approximately 25 Torr. One millimeter of mercury is exactly 1 Torr.
LEAK	A hole, porosity, or permeable element through which leakage may occur, as a result of a pressure difference.
LITER	A unit of measure of volume. It is equal to 1,000 cubic centimeters (milliliter)
PISTON PUMP	A type of vacuum pump where the gas being pumped is trapped behind a piston, and as the pump rotates, the piston compresses the gas and discharges it, one cycle at a time.
PRESSURE	The summation of the forces of gas molecules against the walls of a closed volume. In the strictest sense, pressure is a relative measurement, i.e., the measurement of the difference between the forces on the walls of an encol0sed volume and some other reference location.

PUMP	In this context, a pump is a mechanical device that takes gas in at one pressure and discharges it at another pressure. Common types of pumps are rotary vane pumps, rotary piston pumps, liquid ring pumps, and Roots boosters.
SEAL	A joint or closure between two elements of a vacuum system that is effective in maintaining leakage at or below a required level.
TEMPERATURE	A means of measuring the degree of molecular activity in a gas. On the absolute scale, the units are typically degrees Rankine (460° Rankine equals 32° Fabrenheit).
TEMPERATURE RISE COEFFICIENT	This is an experimentally derived constant for the rise in gas temperature which occurs when gas is compressed across a Roots-type booster.
THROUGHPUT	The quantity of gas in pressure volume units at a specified temperature flowing across a specified open cross section.
VACUUM	The condition of a gaseous environment in which gas pressure is below atmospheric pressure.
VANE PUMP	A type of vacuum pump where a cylindrical rotor is mounted eccentrically in a cylindrical cylinder. Vane slots in the rotor trap the gas at the inlet port. This trapped volume of gas is then compressed as the rotor rotates to the close clearance position. The gas is then discharged typically through an exhaust valve.
VAPOR PRESSURE	The vapor pressure of a liquid is the pressure at which the liquid freely turns to vapor, i.e., it boils at constant temperature.