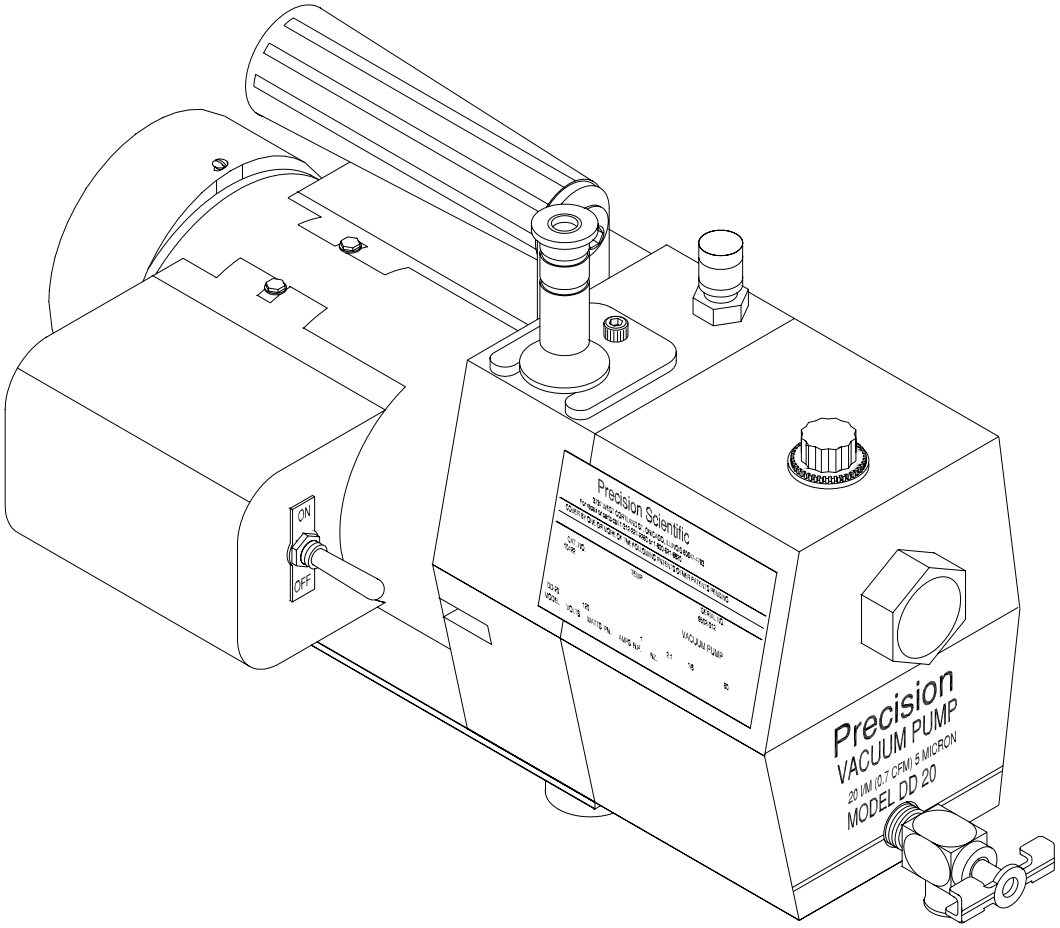
Thermo
ELECTRON CORPORATION

Instruction Manual

Vacuum Pump DD-20

Catalog No. 3178711 & 3178712 (6838 & 6839)



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REVISION STATUS

INDEX	DATE	AMENDED PAGES	NOTES
A	9/99		Initial release
B	7/05	36000002 (10422AZ-3)	new manual #, manufacture location

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Introduction

Your satisfaction and safety are important to Thermo and a complete understanding of this unit is necessary to attain these objectives.

As the ultimate user of this apparatus, you have the responsibility to understand its proper function and operational characteristics. This instruction manual should be thoroughly read and all operators given adequate training before attempting to place this unit in service. Awareness of the stated cautions and warnings, and compliance with recommended operating parameters — together with maintenance requirements — are important for safe and satisfactory operation. The unit should be used for its intended application; **alterations or modifications will void the warranty.**

WARNING

AS A ROUTINE LABORATORY PRECAUTION, ALWAYS WEAR SAFETY GLASSES WHEN WORKING WITH THIS APPARATUS.

This product is not intended, nor can it be used, as a sterile or patient connected device. In addition, this apparatus is not designed for use in Class I, II, or III locations as defined by the National Electrical Code.

Unpacking and Damage

This product was carefully packed and thoroughly inspected before leaving our factory. Save all packing material if apparatus is received damaged.

Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment; therefore, claims for loss or damage sustained in transit must be made upon the carrier by the recipient as follows:

Visible Loss or Damage: Note any external evidence of loss or damage on the freight bill or express receipt, and have it signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusing to honor your claim. The form required to file such claim will be supplied by the carrier.

Concealed Loss or Damage: Concealed loss or damage is any loss or damage which does not become apparent until the merchandise has been unpacked and inspected. Should either occur, make a written request for inspection by carrier's agent within 15 days of the delivery date; then file a claim with the carrier.

If you follow the above instructions carefully, Thermo will guarantee our full support of your claim to be compensated for loss or damage in transit.

DO NOT — for any reason — return this unit to Thermo without first obtaining return authorization. In any correspondence with Thermo, please supply the nameplate data, including catalog number and serial number.

General Information

Model Number	DD-20	
Catalog Number	3178712	3178711
Electrical Service	115V 60 Hz. (Open)	230V 50 Hz. (TEFC)

These instructions encompass the Direct Drive Vacuum Pumps listed below with their specific electrical characteristics.
For identification purposes an exploded view and parts list are provided.

WARNING

DO NOT USE THESE PUMPS FOR OXYGEN SERVICE. HYDROCARBON OIL AND SEALS ARE NOT COMPATIBLE FOR THIS APPLICATION, AND AN EXPLOSIVE CONDITION WILL RESULT.

These pumps are two-stage oil sealed rotary vane design. They are equipped with a gas ballast valve to help prevent the condensation of contaminant vapors within the pump, thereby protecting the pump from corrosive action of these condensed vapors. Air is bled into the pump via the adjustable valve on top of the pump just before the gas is exhausted through the oil.

With the gas ballast open, the pump will not reach its rated vacuum. The pump will also run warmer with the gas ballast valve open because of the greater amount of gas (air) it is handling.

When all traces of the contaminant vapors have disappeared from the system and oil, the gas ballast valve may be closed to permit the pump to attain its ultimate vacuum.

NOTE

THE GAS BALLAST VALVE HAS BEEN SEALED INTO THE PUMP WITH GLYPTAL.

Exercise care to prevent this seal from being broken. One counterclockwise turn will open the valve. To obtain a leak-tight closure, finger-tight in a clockwise direction will assure a snug fit. Do not overtighten or you will lose your vacuum seal.

Other standard features include drain cock, quick-release intake fitting anti-backstreaming baffle, oil sight glass, carrying handle, and air intake strainer to trap gross particulates from entering the pump which could cause internal damage.

Technical Specifications

Free air displacement: ..... 20 L/m (0.7 CFM) at 3450 RPM

Pumping speed at high vacuum: ..... 10 L/m @ 100 Microns Hg

Efficiency factor: ..... 50% @ 100 Microns Hg

Ultimate vacuum (McLeod gauge): ..... 5×10^{-3} Torr* (5 microns) = 29.79" Hg
.667 Pa
.00665 mbar

* 1 Torr = 1 mm of Hg = 1,000 microns of Hg.

10^{-1} Torr = 100 microns Hg
10^{-3} Torr = 1 micron Hg
10^{-4} Torr = 0.1 microns Hg

Weight, Lbs. (Kg): 16 (7.7)

Motor, 1/8 HP ..... 3450 RPM

Exterior dimensions:
Width, Length, Height, Inches (mm):
Cat. 3178712 ..... 6.3 x 10 x 7.7 (160 x 254 x 195.6)
Cat. 3178711 ..... 6.3 x 11.1 x 7.4 (160 x 282 x 188)

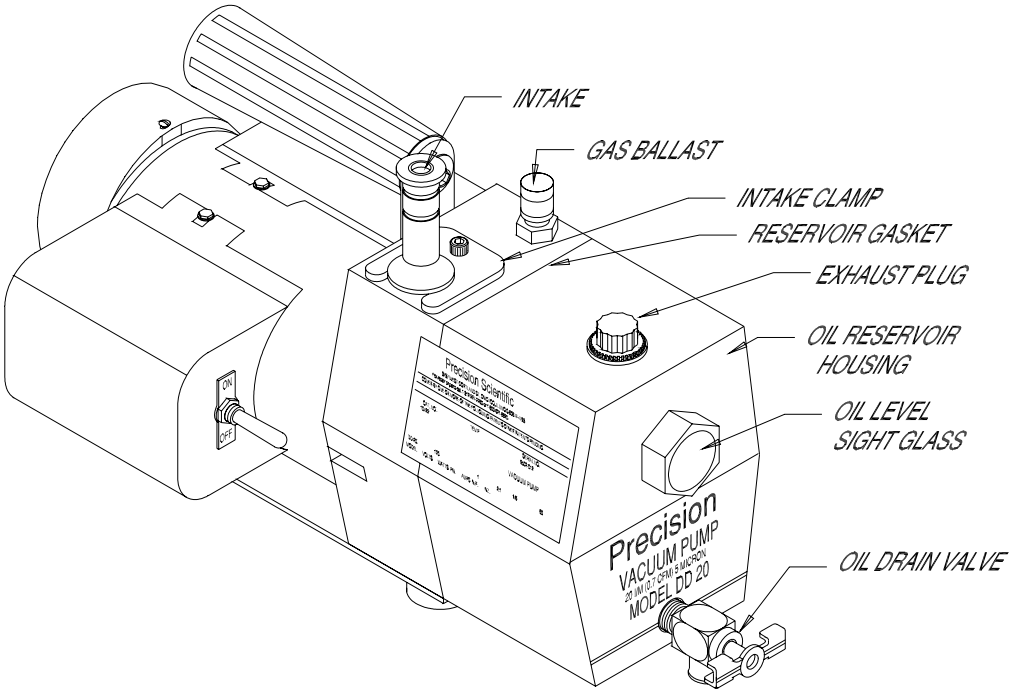
Oil capacity, Qt. (Liter): ..... .25 (240 ml)

Intake Fitting, inches (mm): Cat. 3178712 ..... 3/8 I.D.(9.5), 1/2 O.D. (12.7)
Cat. 3178711 ..... Pneurop Fitting, No. KF-10

Discharge Fittings, inches (mm): Cat. 3178712 ..... 3/8 NPT
Cat. 3178711 ..... 3/8 NPT, Pneurop Fitting, No. KF-16

Temperature rise, °C: ..... 45, ±5

Sound level in db 2 ft from pump: ..... 72 db (Scale A)



Installation/Operation

Electrical Connections: Important (Please Read Carefully.)

WARNING

FOR PERSONAL SAFETY, THIS APPARATUS MUST BE PROPERLY GROUNDED.

The power cord of Catalog Number 3178712 is equipped with a three-prong (grounding) plug which mates with a standard three-prong (grounding) wall receptacle to minimize the possibility of electric shock hazard from this apparatus. The user should have the wall receptacle and circuit checked by a qualified electrician to make sure the receptacle is properly grounded. Where a two-prong receptacle is encountered, it is the personal responsibility and obligation of the user to have it replaced with a properly grounded three-prong wall receptacle.

WARNING

DO NOT, UNDER ANY CIRCUMSTANCE, CUT OR REMOVE THE THIRD (GROUND) PRONG FROM THE POWER CORD. DO NOT USE A TWO-PRONG ADAPTER PLUG.

Catalog Number 3178711 is supplied with a 3 wire power cord and without plug. A suitable plug can be attached to meet local specifications. This plug should be attached by a qualified electrician.

Determine the total amount of current presently being used by other apparatus connected to the circuit that will be used for this unit. It is critical that the added current demand and other equipment on the circuit not exceed the rating of the fuse or circuit breaker in use.

CAUTION

BE SURE THE POWER SUPPLY IS OF THE SAME VOLTAGE AS SPECIFIED ON THE NAMEPLATE.

When possible, it is suggested that a vacuum pump be connected to a separate fused circuit, free of other devices that may occasionally start simultaneously and take away needed power. The voltage specified is that which is needed at the motor. When pumps slow down or fail to start under vacuum, many times it can be traced directly to low voltage at the motor.

Oil Level and Shipping Plugs: Before shipment, each pump is filled to the proper oil level, ready for installation. The correct oil level can be determined by observing the oil level sight glass located on the front of the pump housing. The oil level in the sight glass should be three-quarters full when the pump is in operation.

CAUTION

DO NOT OPERATE THE PUMP UNTIL BOTH SHIPPING PLUGS ARE REMOVED.

Remove the shipping plug from the intake nipple. Remove the threaded shipping plug and "O" ring from the exhaust port, and insert the exhaust plug which is provided in a separate bag.

CAUTION

INSPECT THE PLASTIC EXHAUST PLUG (ITEM NO. 46) TO MAKE CERTAIN EACH OF THE SIX HOLES AT THE TOP OF THE PLUG ARE FREE OF OBSTRUCTION OR DEBRIS.
DO NOT OPERATE THE PUMP IF THIS PLUG, WHEN INSTALLED, OBSTRUCTS THE AIRFLOW FROM THE EXHAUST PORT. CONTACT THE TECHNICAL SERVICES DEPARTMENT FOR REPLACEMENT, IF NECESSARY.

Test the pump: This procedure will check for proper oil level and operation.

- Place a large rubber stopper over pump intake nipple.
- Close gas ballast valve if open (knurled knob on top of pump).
- Switch power On.
- After 5 minutes or less, the pump should no longer gurgle. A consistent gurgling sound indicates one or more of the following conditions: insufficient oil, the gas ballast is not closed completely, or the intake is not completely stoppered.
- If oil level appears low (less than 3/4 in the sight glass), add oil slowly through the intake until gurgling stops. Do not fill above the sight level; excess oil may spit from the discharge.

Vacuum Connection: On catalog number 3178712, the intake nipple is designed to accept 1/2 I.D. vacuum tubing. Export models (50 Hz.) are supplied with Pneurop (KF-16) fitting. Intake fittings are quick release fittings held in place by a press-down flange and a hex nut. The simplest, most efficient system has a pump connected directly to the vessel to be evacuated. Speed of evacuation is a function of pump capacity, vessel size, type, length, diameter, and bends in the connecting tubing.

Keep vacuum lines as short as possible and of adequate diameter. The time required to evacuate a system will increase in direct proportion to the length of pipe; it will decrease in direct proportion to the cube of the inside diameter of the connecting line. Reducing pipe length by one half (while retaining diameter) can increase pumping speed to 67% of rated pumping speed. More important, doubling line diameter (while retaining length) increases effective speed to 90% of rated pumping speed.

The most common deterrent to maximum pumping speed is the use of small diameter vacuum lines. If the vessel outlet is smaller than the pump inlet, the connecting line should be sized for the pump inlet. Reduction should be made at the vessel, not at the pump.

Traps (see below) will usually reduce effective pumping speed by approximately 50%.

Do not use high vacuum pumps to “control the pressure level of a vacuum system. Operating these pumps continuously above 100 microns will cause excessive overheating and an added load on the motor.

Traps—protecting the vacuum system: All mechanical, oil-filled vacuum pumps allow oil molecules to migrate backward toward the system under vacuum. To reduce “backstreaming” install a Precision trap at the pump inlet. This self-contained cartridge is filled with Linde molecular sieves (13X). Glass bead cartridges are available as an additional accessory and they will further prevent “backstreaming. Both types can be regenerated. The Precision trap has quick-connect fittings.

All vacuum pumps should be trapped to prevent internal damage. A trap is simply a capture device between the pump inlet and the system under vacuum.

The Precision trap (Linde 13X) serves as a particle filter and absorbs molecules with diameters up to 13 angstroms. Traps can also be made from vacuum-tight metal containers or pyrex glass suitable for vacuum service. These devices can be filled with continuous strand glass wool (particle traps), or they can be submerged in cold liquid (dry ice and acetone, liquid nitrogen, etc.) to condense volatile materials. In many cases, silica gel can be used to absorb water vapor.

Shutdown procedure: A pump that is allowed to run continuously under vacuum will last longer and remain cleaner. Never cycle a pump on and off. When desired vacuum has been achieved in a system, isolate the pump from the system with a shutoff valve, and allow the pump to continue operating at low pressure. This will improve “wear in of moving parts and reduce the possibility of corrosion which is more likely to occur in an idle pump. When a task is completed and the pump removed from service, bleed air into the system, allowing the pump to come to atmospheric pressure, and turn the pump off. Prior to storage, drain, flush, and refill the pump with new Precision vacuum oil. Stopper the inlet and exhaust openings.

Vacuum oil: Vacuum oils must perform other important functions, in addition to lubricating internal parts of the pump. Vacuum pump oil must be specially formulated to resist oxidation degradation, lubricate precision fitting rotating parts, have low vapor pressure at pump operating temperature, and provide a seal against gas leakage during the compression/expansion cycles. Precision vacuum oils are premium grade, containing no additives.

When and How to Change Oil:

WARNING

USE EXTREME CARE IN CHANGING OIL. USED OIL IN THE PUMP MAY CONTAIN HAZARDOUS OR TOXIC SUBSTANCES FROM PREVIOUS USE.

Contaminated oil is the most common cause of pump failure and unsatisfactory performance. If water or acid vapors have passed through the pump and the oil is allowed to stand for any length of time, severe corrosion and damage to any pump may occur.

The simplest guide for indicating the need for an oil change is to connect a McLeod gauge directly to the pump and determine if the rated ultimate vacuum can be attained. Refer to section, Vacuum Gauges,” for information on the various levels of vacuum and limitations to expect from different types of gauges.

An odor may indicate the presence of solvent, or a cloudy color may indicate water contamination. When in doubt, change the oil.

If the pump is used occasionally or loaned to another operator, it is good practice to drain and refill the pump with fresh oil before the pump is placed in temporary storage. For convenience, many users attach a tag recording dates of oil change. New oil costs a fraction of repair charges for a corroded pump. Keep a supply of Precision vacuum oil on hand.

Draining procedure is simple. Close the vacuum intake, and run the pump until the oil is warm. Open the vacuum intake to atmosphere, shut power off, and open the drain valve. If possible, tip the pump to assure complete drainage. When flow has stopped, turn power on for a few seconds to clear any oil remaining in stator cavities. Sufficient oil coating remains to protect moving parts. Remember, any contaminated oil left in the pump will degrade new oil.

Filling:

1. Turn pump "off".
2. Fill the pump by slowly pouring Precision vacuum oil through the exhaust port.
3. The proper oil level is indicated when the oil is observed 1/2 way up the oil level sight glass.
4. Turn the pump ON and operate for 15 minutes allowing the oil to reach operating temperature.

Troubleshooting

Overheating: Pump operating temperature is related to ambient temperature. Under normal conditions when operating at low pressures, pump oil temperatures may be expected to rise approximately 45° + 5°C above ambient temperature. Operation is satisfactory if oil temperature does not exceed 80°C. Most frequently, overheating is caused by handling too large a volume of air for prolonged periods or operating with contaminated oil. A pump should never be used as a control to regulate a specific vacuum. If allowed to cycle on and off frequently, the motor will probably overheat and fail to start because the motor thermotector will prevent the motor from operating. Other causes of failure:

- Oil level is low. Add oil.
- Oil is gummy. Drain, flush, and refill with new oil.
- Gas ballast is open. Close ballast valve.
- Abrasive particles have entered the pump. Disassemble, clean, and replace any scored parts.
- Pump is binding mechanically due to parts misaligned during shipping.

Noisy Pump: Noise, of course, is relative. When evaluating the sound level of a new pump, be sure comparison is with another pump of comparable performance with regard to free air displacement. Also, be sure that the pump is not on a platform that amplifies normal operating sound, and evaluate with the intake closed.

Sound should be analyzed for probable origin with respect to the following points:

- Low oil level. Refer to section on proper filling procedure and add oil.
- Load is too large for the pump, causing prolonged operation at intermediate pressures, which results in a normal but noisier pumping sound. Add smoke eliminator accessory, or select a larger pump.
- System has pronounced leaks, causing prolonged operation at intermediate pressures, resulting in noisier than normal pumping sound. Locate and seal leaks.
- Damaged or corroded exhaust valve. Replace.
- Internal damage or corrosion. Replace malfunctioning components or return pump to factory for refurbishing.
- Check exhaust valve for proper alignment. The exhaust hole must be covered by the valve.

Pump Does Not Produce Expected Vacuum: Pumps are tested at the factory with a McLeod gauge. Other types of gauges give higher readings. Refer to section, "Vacuum Gauges." When a pump is connected to a system, the rated ultimate may not be achieved due to the configuration of the system. Always check to see that oil in the mechanical pump is at the proper level. Leaks are always possible, and a complete check should be made, preferably with a leak detector. Quite frequently volatile materials in the system will be releasing vapor at such a rate (outgassing) that a higher than expected vacuum will be experienced. Water vapor in the air is a prime example. If a pump's performance is to be evaluated, remove the pump from the system and gauge the pump alone directly at the intake. The following points may also be investigated:

- Gas ballast is open. Close completely.
- Plain grease instead of high vacuum silicone grease was used at slip joints or seals. (Only a very thin film of vacuum grease is necessary at joints. Remove any excess.)
- Oil is contaminated, or improper oil used. Drain, flush, and refill.
- Check gauge calibration.

Under vacuum, most liquids turn to vapors. Many tables show vapor pressure of a liquid relative to temperature. As soon as a particular pressure is reached, equilibrium shifts to the vapor phase. Water, the most common liquid, has a vapor pressure of about 17 mm of mercury at room temperature. This means that as long as water is present, no vacuum pump can achieve a vacuum greater than 17 mm of mercury. The same phenomenon is true for all other volatiles. However, water is almost always present to some degree in the atmosphere as humidity, and may be absorbed in solids. If water vapor is present in the gas entering the pump in such quantities that it cannot be handled by the gas ballast, it will emulsify with oil, requiring an oil change.

Running the pump with the gas ballast open will separate water from the oil and exhaust it as a vapor. The pump cannot reach ultimate pressure until water or other volatiles are removed from the oil. Contaminated oil should be replaced promptly. This speeds attainment of an ultimate vacuum and removes the risk of corrosion damage. A suitable trap prevents vapors from entering the pump.

Gases adhere to surfaces and are occluded in most solids. Gases are also present in liquids. Gases in a vacuum leave the surfaces and depths of solids and liquids including vacuum pump oil during normal operation. This outgassing increases the amount of gas a pump must handle. Therefore, a pump may evacuate a system at a slower rate than anticipated. Heating or baking the components will speed release of gas, but will increase pump load during such heating.

Pump Won't Start: Occasionally a vacuum pump may be found that is difficult to start. This rarely indicates a defective pump, and several considerations may cause the condition. Very often, it reflects the particular application, and hard starts can be common to pumps of any manufacture. Proper sizing of the pump to the task insures a fairly rapid pumpdown and prevents motor overload. Trapping strongly reactive agents that would turn high vacuum oil into a gummy substance will avoid seizure. If condensable vapors are continually drawn through any pump, vapor accumulation will distort oil level. If the pump is cold—below 5°C (40°F), it should be warmed to 10°C (50°F) before attempting restart. The following points can also be checked:

- Check fuse, line cord, and switch.
- Check voltage at motor for excessive line loss.
- If the pump has been abused with frequent on-off cycling, check that the motor has not overheated and that the malfunction is not a result of normal thermotector cutout protection.
- Drain a small amount of oil and examine for increased viscosity.
- Return for repair.

Pumping Speed Is Too Slow: The variety of pump applications is impossible to anticipate. Therefore, speed curves for all vacuum pumps are plotted to standards of the American Vacuum Society. Pumping speed is reduced by each bend and any restriction in connecting tube, and by any valve or trap in the line. These factors, as well as length/diameter of connecting tubing, should be considered when calculating evacuation speed and selecting proper pump size. Additional considerations are:

- Gas load is too great for the pump. Use larger pump.
- Leaks in system. Locate and seal.
- Oil is contaminated. Drain, flush, and refill.
- Material in system is outgassing. Heat material if possible.

Pump Smokes: Some oil is continuously exhausted with gas during normal operation of any vacuum pump. At intermediate pressures, this mist is commonly referred to as smoke. If operation is to be continued at intermediate pressures, add a smoke eliminator. The smoke eliminator for the DD-20 is Catalog No. 3160970. Note: Pumps built prior to 1987 may require an adapter (ref P/N 3164980). A smoking condition may also indicate low oil level. Small quantities of oil can be added slowly to the pump while operating until the sight gauge shows 3/4 full.

Pump Ejects Oil From Exhaust Port: Oil level is too high. Drain oil to proper level. Oil expands with heat after the pump is started. If the pump was overfilled slightly while cold, oil may spit at operating temperature. Also, other liquids or condensed vapor may have entered the pump from the system and raised the oil level.

Pump Leaks Oil: Do not confuse an accumulation of condensed oil vapors with a leak. When in doubt, wipe off pump and isolate the source (see below).

- Spitting or overfill. See earlier paragraph and drain oil partially.
- Loose or defective drain valve. Tighten or replace.
- Housing gasket. Tighten screws or replace.
- Shaft seal. Replace.

Vacuum Gauges

Pump performance is measured by gauges, and a brief discussion on the more popular types should be helpful. First, the gauge must be properly located. It should be placed near the pump.

All gauges, except McLeod, measure total pressure exerted by both gases and vapors; and different gases give different readings at the same pressure. The McLeod gauge is the primary standard used to test all mechanical vacuum pumps. Other types of gauges will read higher pressures because they indicate both gas and vapor. Absolute values of pressure levels, therefore, depend on the gases and vapors present and calibration of the gauge. Selection of a gauge should be made based on the necessity to read absolute or relative vacuum levels, ease of operation, and the desired investment.

BOURDON TUBE gauges are simple mechanical types generally used to measure pressure. As a vacuum gauge they are usually used only to indicate the condition of the system. They are not suitable for high vacuum measurements.

"U" TUBE MANOMETERS can be read more accurately than Bourdon Tube gauges in the range of O to 10 mm of mercury. With modification, such as using an auxiliary pump and measuring the differential pressure, or by inclining the “U” tube, their accuracy can be improved in this range. Usually used only to 0.5 mm of mercury.

McLEOD GAUGE is the primary standard for absolute measurement of pressure. A chamber (part of the gauge) of known volume is evacuated and filled with mercury. This chamber terminates in a sealed capillary calibrated in microns of mercury. As mercury fills the chamber, gas is compressed to approximately atmospheric pressure, and trapped vapors are liquefied, and have no significant volume. In other words, this gauge does not measure pressure caused by any vapors present.

Its reading represents only the total pressure of gases. A cold trap is sometimes employed with this gauge to prevent transfer of vapors from the pump to the gauge, or from the gauge to the pump. These gauges, while accurate to approximately 10^{-5} mm of mercury, are not considered suitable for common use because they do not read continuously and are usually fragile.

PIRANI GAUGE measures the pressure of a gas by indicating the ability of gas to conduct heat away from a hot filament. The greater the density (or pressure) of a gas, the greater the conduction of heat from the filament. As the filament temperature varies, so does its ability to carry current. A Wheatstone Bridge circuit is usually employed with a microammeter calibrated to read in microns of mercury.

Thus pressure is read based upon the current flowing through the filament which is a function of filament temperature. Since heat is conducted away from the filament by vapors as well as gases, these gauges measure the presence of vapors. Also, different gases have different thermal conductivities. Used in the same system, a Pirani gauge will yield a higher reading than a McLeod gauge, which measures only the pressure caused by gases. Pirani gauges are usually used in the pressure range of 1 micron to 1 mm of mercury.

THERMOCOUPLE GAUGE is similar to a Pirani gauge in many ways. The basic difference is that a thermocouple measures filament temperature, and thermocouple output is shown on a meter calibrated in microns of mercury. A Thermocouple gauge will also give a different reading for the same pressure of different gases and vapors. This gauge is more rugged, smaller, and sightly less sensitive than the Pirani. Range is approximately the same, micron to 1 mm of mercury.

IONIZATION GAUGES are more sophisticated, sensitive, and fragile than Pirani and Thermocouple types. Ionization gauges are usually used to measure beyond the range of simpler gauges—up to 10-14 mm of mercury—dispensing upon specific type and design. These gauges form ions of the gas molecules present. The amount of current carried by this ionized gas depends upon the amount of gas present, and this is the density or pressure of the gas. Ionization gauges are in two basic types—the thermionic, which forms gas ions by electrons emitted from a hot filament—and the cold cathode. The Bynard-Alpert type is a common example of thermionic design. Penning or Philips are the most common examples of cold cathode design. These gauges also give different readings for different gases of vapors at the same pressure.

OTHER TYPES of gauges use radio activity viscosity, discharge tubes, and radiometer principles to measure pressure.

Parts Replacement

In case of pump malfunction, check the "Troubleshooting" section for probable cause and corrective action. Pump disassemble may be necessary for thorough cleaning and inspection of internal parts.

WARNING

HANDLE PARTS WITH EXTREME CARE TO AVOID PERSONAL INJURY OR EQUIPMENT DAMAGE PART SURFACES ARE PRECISION GROUND; EDGES ARE BURR-FREE BUT VERY SHARP.

Parts should be cleaned with a soft brush dipped in Butyl Base Alkaline cleaner with Rust inhibitor and blown dry.

CAUTION

WITH PARTS REMAINING IN SEQUENTIAL ORDER, CLEAN EACH PART WITH A SOFT BRUSH DIPPED IN A CLEANER AS DESCRIBED ABOVE. THE CLEANER SHOULD NOT CONTACT SEALS, GASKETS, OR OTHER ELASTOMERS. COMPRESSED AIR IS RECOMMENDED FOR DRYING PARTS. DO NOT USE RAGS. USE VACUUM OIL TO LUBRICATE ALL PARTS PRIOR TO REASSEMBLY.

Gasket replacement: The DD-20 oil reservoir gasket is readily replaced by removing the oil reservoir housing from the intake housing. First, drain oil. Remove four (4) trap bolts. Brace oil reservoir housing with one hand, firmly strike top of housing with wooden or rubber mallet (do not use a metal hammer). This will free housing. Peel gasket off (carefully scrape, if necessary).

Exhaust valve replacement: Drain oil and remove oil reservoir housing. The exhaust valve is a rectangular spring metal piece and is easily replaced by removing a screw that holds the valve in place.

Intake Strainer Cleaning or Replacement: The strainer is located under the intake nipple. Remove the socket head cap screw and clamp that fasten the intake nipple to the top of the pump. Remove strainer and clean with soft brush dipped in Alkaline cleaner with rust inhibitors to remove any residue. Replace strainer and/or intake O-ring if necessary. Refer to Fig. 2 on page 9.

Exhaust Mesh Cleaning or Replacement: Drain oil and remove oil reservoir housing. The mesh is packed in the upper cavity of the housing. Remove the mesh and clean by soaking in alkaline cleaner with rust inhibitors to remove any residue. Replace, if necessary. Refer to Exploded View on page 13.

Pump Disassembly

1. Refer to Exploded View (Page, 10)-
2. Dismantle Oil Reservoir Housing (43) by removing 4 allen head screws (21).
3. Tap reservoir with rubber or wooden mallet to break the reservoir from the Trap (22).
4. If the Gasket (42) is damaged replace when reassembling pump.
5. Remove 3 pan head screws (39) and (40) with (3) washers (38) and this will release End Plate (37).
6. Remove 2 machine screws (36) and this will release the Exhaust Stator (35), Center Plate (32), and Intake Stator (28) from the Intake End Place (23). Be careful not to lose ball and spring (33) & (34) located between Center Plate & Exhaust Stator.
7. Remove (4) Vane, (27) from rotor slots (26).
8. If Rotor (26) has to be removed, Tap out drive pin (25) carefully.
9. Do not remove Intake End Plate (23) unless badly scored or if the seal (19) has to be replaced.
10. There are two seals (19) one in the Intake End Plate (23) and one in the Trap (22). They are both pressed In .
11. If the seal in the trap has to be replaced remove the motor from the trap. Remove 3 sheet metal screws to remove fan cover. Then remove 2 bolts that will release the trap from the motor.
12. Clean all parts with a Butyl Base Alkaline Cleaner with rust inhibitors.
13. Handle all parts with care as not to damage any of the machine surfaces.
14. Check all parts for damage, scratches, sharp edges or deep gouges. Do not confuse scratches with wear marks. All worn or scratched parts must be replaced in order for vacuum pump to perform satisfactorily.
15. If in doubt about any part being defective replace or call Technical Services.

Reassembly

1. Before starting assembly, coat all parts with Precision Vacuum Pump Oil.
2. The assembly is just in reverse of disassembly with some added precautions.
3. When reassembling the pump be very careful to make sure that the Rotor (26) and Stators (28) and (35) make proper contact. If Rotor (26) does not touch the entire arc in the Stators (28) and (35) the pump will not achieve ultimate vacuum and will be noisy. Use a .001 feeler gauge to check the correct alignment. The feeler gauge should not enter the arc of the stator where the rotor makes contact. Refer to Fig. 3.
4. Before tightening machine screws (36) apply slight pressure to both Stators (28 and 35) where they make contact with the Rotor. Make a final check with the feeler gauge so that the Stator did not pull away from the Rotor.
5. Before assembling the End Plate (37) to pump pour some pump oil between the Rotor (26) and Stator (35).
6. When pump is completely assembled turn the pump On and run pump for at least 24 hours to eliminate all gases from the pump oil. If all of the above steps were very carefully performed and defective parts replaced the vacuum pump should perform satisfactorily.

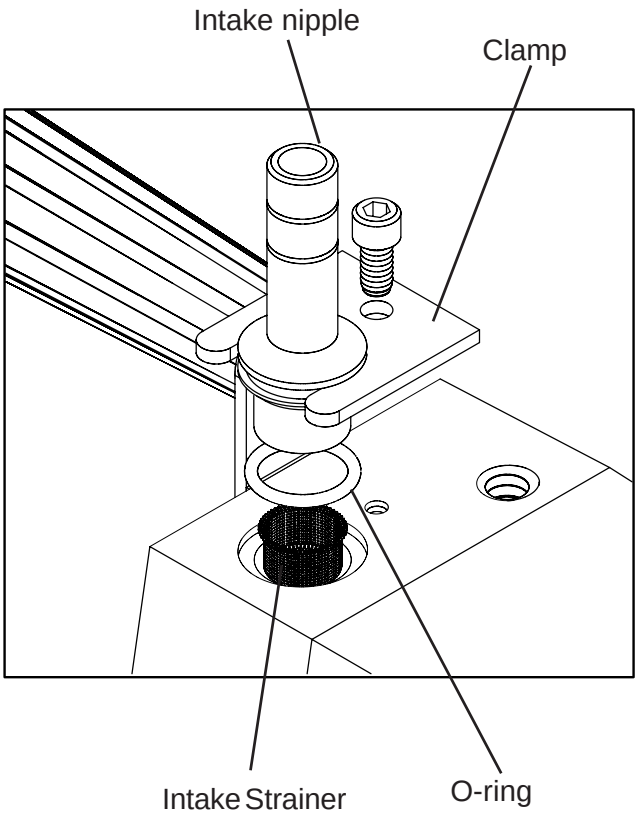


Figure 2

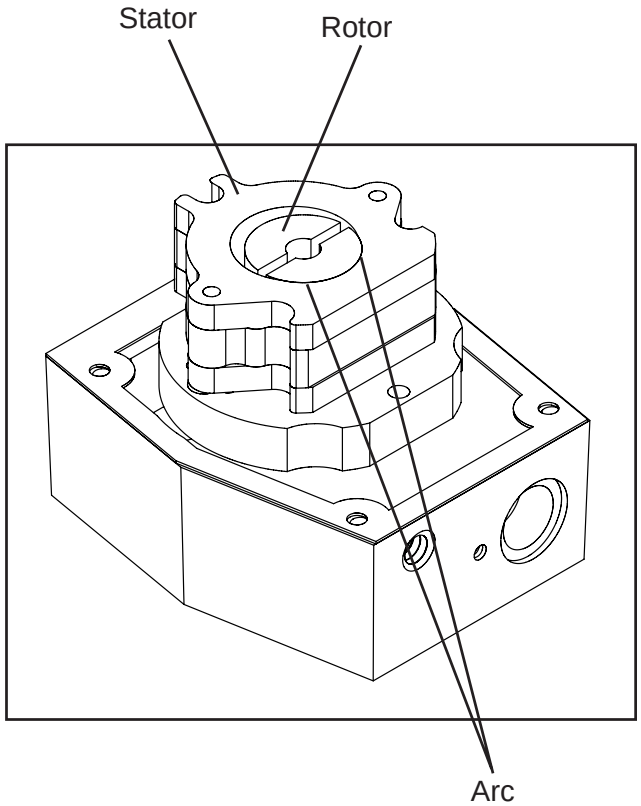
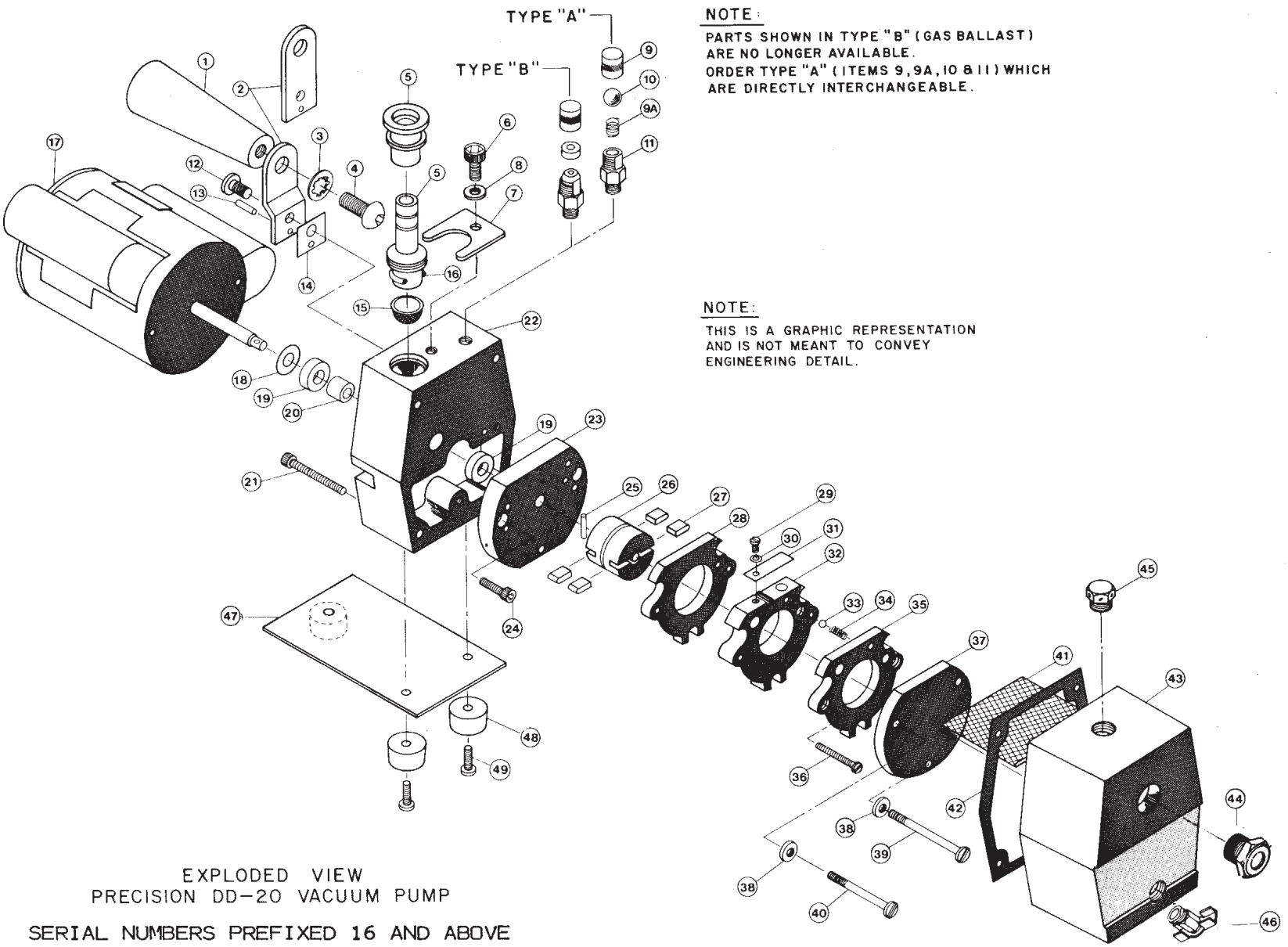


Figure 3



EXPLODED VIEW
PRECISION DD-20 VACUUM PUMP

SERIAL NUMBERS PREFIXED 16 AND ABOVE

PARTS LIST FOR EXPLODED VIEW OF MODEL DD-20		
Item #	**Description**	**Qty.**
1	Handle	1
2	Bracket, Handle	1
3	3/8 Internal Lockwasher, Handle	1
4	3/8-16 x 3/4 Button Head Mach. Screw	1
5	Nipple, Intake	1
6	1/4-20 x 1/2 socket Head Cap Screw	1
7	Clamp, Intake Nipple	1
8	1/4 Stainless Steel Washer	1
9	Cap, Quick Seal	1
9A	Spring	1
10	Ball, Viton 3/8 Dia.	1
11	Gas Ballast Body	1
12	1/4-20 x 1/2 Hex Head Mach. Screw	1
13	Groove Pin, 1/8" x 7/16"	1
14	Spacer, Insulating	1
15	Strainer, Intake	1
16	"O" Ring, Intake Nipple	1
17	Motor	1
18	Washer, Thrust	1
19	Seal, Oil	2
20	Bushing, 5/16" I.D. x 1/2" O.D. x 1/2"	1
21	No. 10-32 x 2 Socket Head Cap Screw	4
22	Trap	1
23	End Plate, Intake	1
24	No. 10-32 x 3/4 Socket Head Cap Screw	2
25	Drive Pin	1
26	Rotor	1

PARTS LIST FOREXPLODED VIEW OF MODEL DD-20 (CONTINUED)		
Item #	**Description**	**Qty.**
27	Vane	1
28	Stator, Intake	1
29	No. 6-32x1/4 Pan Head Stainless Steel Mach. Screw	1
30	No. 6 Stainless Steel Washer	1
31	Valve, Flutter	1
32	Center Plate	1
33	Ball, Steel 1/4" dia.	1
34	Spring	1
35	Stator, Exhaust	
36	No. 6-32x1-3/8 Pan Head Stainless Steel Mach. Screw	2
37	End Plate, Exhaust	1
38	No. 10 Steel Washer	3
39	No. 10-32 x 2-1/2 Pan Head Stainless Steel Mach. Screw	1
40	No. 10-32 x 2 Pan Head Stainless Steel Mach. Screw	2
41	Mesh, Exhaust	1
42	Gasket, Housing	1
43	Housing	1
44	Sight glass, Oil Level	1
45	Plug, Exhaust (Plastic), 3//8 NPT	1
46	Valve, Drain	1
47	Base Plate Assembly	1
48	Bumper	2
49	No. 10-32 x 3/4 Pan Head Stainless Steel Mach. Screw	2

PUMP ACCESSORIES	
Catalog No.	**Description**
3160970	Smoke Eliminator (for Cat. No.'s 3178712 and 3178711)
VACUUM OIL	
	Precision B+ **Premium Grade, double distilled, high purity, low vapor pressure oil for both direct drive and belt drive pumps.**
3177864	Quart, 6/case
3174013	Gallon, 4/case
3174014	5-gallon container

VACUUM TUBING, RED GUM RUBBER		
Part No.	**Inner Diameter**	**Wall Thickness**
3174664	1/4"	3/8"
3174666	3/8"	3/8"
3174668	1/2"	3/8"
3174670	3/4"	3/8"
3174671	1"	3/8"
3175623	Adjustable tubing clamp for 3174670 and 3174671	
3175631	Adjustable tubing clamp for 3174666, 3174664 and 3174668	
3166196	Vacuum Gauge Assembly	

Maintenance and Repair Kits	
MINOR KIT includes gaskets and O-rings . MAJOR KIT includes the contents of MINOR KIT plus vanes, spring, gas ballast valves, drain valve and sight glass.	
Minor	**Major**
3166931	3167068

THERMO ELECTRON CORPORATION STANDARD PRODUCT WARRANTY

The Warranty Period starts two weeks from the date your equipment is shipped from our facility. This allows for shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner during the first year warranty period.

During the first year, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, labor included. Installation and calibration are not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, glass, filters and gaskets are excluded from this warranty.

Replacement or repair of components parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any components or equipment. At Thermo's option, all non-conforming parts must be returned to Thermo Electron Corporation postage paid and replacement parts are shipped FOB destination.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED. NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY. Thermo shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products.

Your local Thermo Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed instruction manuals carefully detail equipment installation, operation and preventive maintenance.

If equipment service is required, please call your Technical Services Office at 1-888-213-1790 (USA and Canada) or 1-740-373-4763. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special application. Outside the USA, contact your local distributor for warranty information.

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