Snap-on.Tools
CORPORATION
KENOSHA, WI 53140

MADE IN U.S.A.

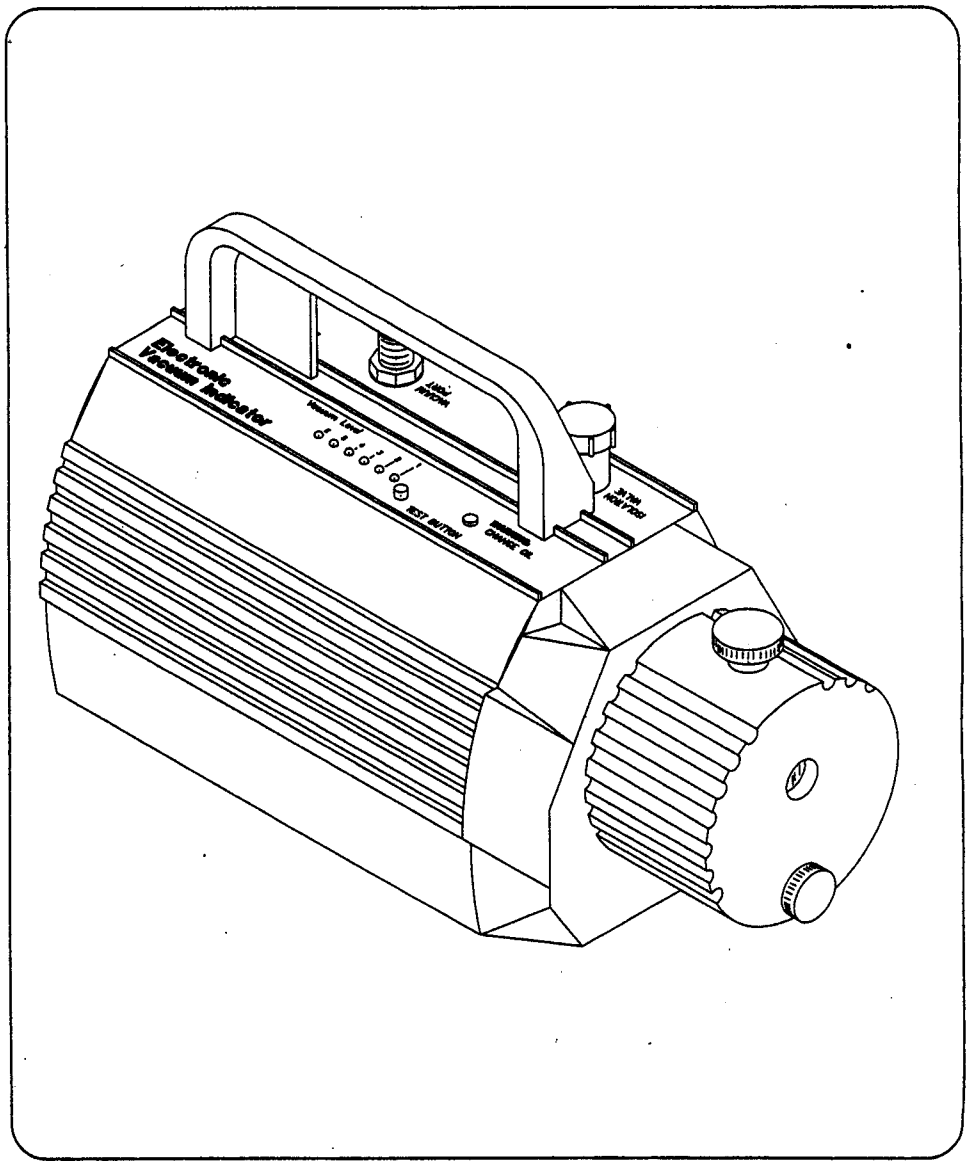
PATENT #: 5,136,885

PM068ASOT 11/92

Snap-on®

ACT9100 or ACTR9200
ELECTRONIC VACUUM SYSTEM

Owner's Manual



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INTRODUCTION

Thank you for purchasing the new Snap-On Electronic Vacuum System. More than just a vacuum pump, this unit is a complete diagnostic system for refrigerant evacuation. It has been designed and produced to the highest quality standards and is warranteed for one full year from date of purchase. The biggest advantage of this Vacuum system is that it provides the technician with the ability to detect minute changes in vacuum pressure. In the past attempts were made to measure deep vacuum through the use of deep vacuum gauges. These gauges worked on the heat sensing principle and resulted in a slow response to vacuum changes. This slow response time often created difficulty for the technician when trying to differentiate between the vacuum change caused by a system leak or a change caused by moisture in the system. The technician was forced to operate without the information required to quickly diagnose and repair the problem.

The unit incorporates a built-in vacuum indicator gauge which allows the technician to differentiate between slow changes in vacuum, caused by moisture, and fast changes in vacuum, caused by leaks. For the first time the technician will know exactly what is happening DURING the evacuation process. This system does what no other pump can do. It takes all the guesswork out of system evacuation; providing the service technician with a single tool that quickly and efficiently gets the job done and eliminates the need for expensive gauge accessories.

NOTE: For best results please read this instruction manual carefully before operating your new ACT9100 or ACTR9200 Electronic Vacuum System. If you should require assistance please call our Customer Service Department at this toll free number: 1-800-327-5060.

Each unit is "burned-in", or test run, at our facility before shipment. For this reason some residual oil may be present in the reservoir and around the plugs when the unit is unpacked; and is no cause for concern.

FEATURES

- ELECTRONIC VACUUM SENSOR WITH LED INDICATORS
- OIL CONTAMINATION SENSOR AND WARNING LIGHT
- BUILT-IN ISOLATION VALVE FOR LEAK CHECKING
- AUTOMATIC PURGE TO PREVENT ROTOR LOCK-UP
- DIAGNOSTIC TEST BUTTON
- OFFSET ROTARY VANE PUMP DESIGN
- VACUUM SENSOR/INDICATOR NEEDS NO CALIBRATION AND IS UNAFFECTED BY TEMPERATURE
- OIL LEVEL WINDOW
- EXTRUDED ALUMINUM AND ABS HOUSING
- ONE YEAR WARRANTY
- MADE IN THE USA

WARNINGS

This unit is intended for use only by trained and qualified professional service personnel. This unit should only be used on Air Conditioning and Refrigeration systems utilizing halogenated refrigerants (e.g. R-12, R-22, R-502, R-134a). The same unit should never be used for both CFC (R-12, 22, 502) and HFC (R-134a) evacuation due to the possibility of cross contamination. Use ACT9100 for CFC/HCFC applications and ACTR9200 for HFC (R134a) applications. Always take adequate precautions and wear safety goggles when working with such systems. A manifold gauge set should be used in conjunction with this unit. Any misuse or improper application of this unit will automatically void the warranty.

PRECAUTIONS

- Connect only to 110-130 VAC/60Hz (or 220-250 VAC/50Hz for International versions) Do not defeat the ground by removing or cutting the ground pin.
- If an extension cord is necessary, use only a three wire cord of at least 16 gauge (16/3).
- Do not operate unit without the proper amount of the correct grade oil. Use of an improper grade oil may reduce performance and will void the warranty.
- Never operate the unit with the shipping plug installed (see page 8).
- Use only on A/C or Refrigeration systems utilizing halogenated refrigerants. Do not use on ammonia or other such systems.
- Do not evacuate full systems or systems which still contain refrigerant. Refrigerant should be recovered with an approved recovery unit and ONLY empty systems should be evacuated.
- Keep cap on vacuum port when not in use to prevent dirt and moisture from entering unit.

LOCATION OF PARTS & CONTROLS

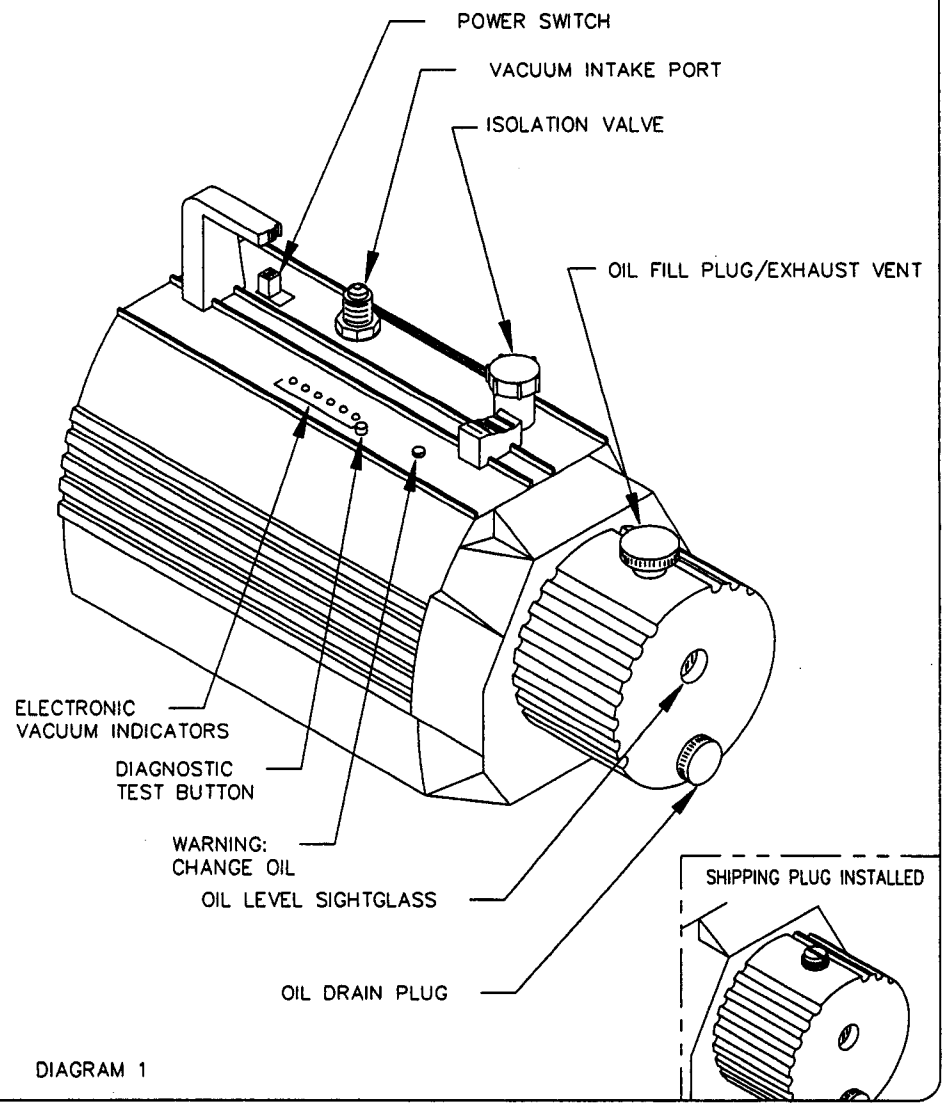


DIAGRAM 1

DESCRIPTION OF PARTS & CONTROLS

■ POWER SWITCH & AUTO PURGE FEATURE

The power switch is used to turn the unit ON and OFF (see diagram 2). It should only be operated when the unit is plugged into the correct power supply. When switched to the OFF position an automatic purge feature is activiated and vacuum is released from the pump module. If the isolation valve (page 6) is closed, the system vacuum will not be lost; only released from the module as shown in diagram number 16.

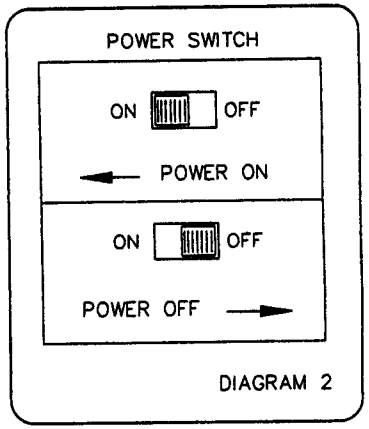


DIAGRAM 2

■ WARNING - CHANGE OIL LIGHT

(OIL CONTAMINATION INDICATOR)
This oil warning light will constantly illuminate when the pump oil needs to be changed. It is possible that this light may flash on and off during initial evacuation. If this occurs please disregard. If the warning light is on CONSTANTLY the oil must then be changed. (see diagram 3)

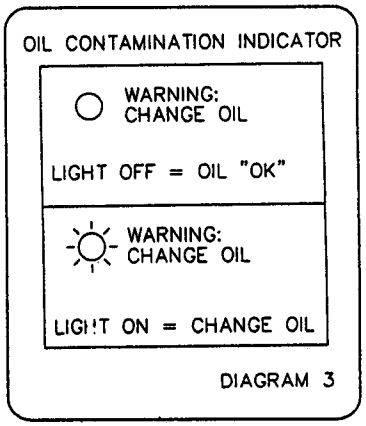


DIAGRAM 3

■ DIAGNOSTIC TEST BUTTON

This button will operate only when the unit is plugged into the correct power supply. It will allow one to verify the proper operation of the electronic circuit and test the LED indicators. All Vacuum Indicator LEDs should be lit when the button is depressed; if all LEDs do not light, please consult the Troubleshooting Guide. (see diagram 4).

■ ELECTRONIC VACUUM INDICATOR

The vacuum indicator is connected to a unique electronic sensing element that instantly detects changes in vacuum. A series of six color coded LEDs will illuminate to indicate vacuum level; The two red LEDs will light first, then the two yellow and finally the two green LEDs. The red LEDs indicate a moderate vacuum is being pulled, the last green LED will come on when the vacuum level is sufficient to boil moisture. (see diagram 4)

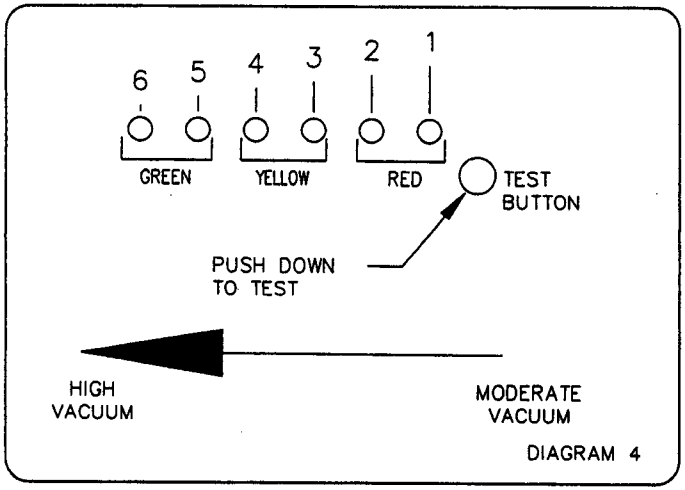
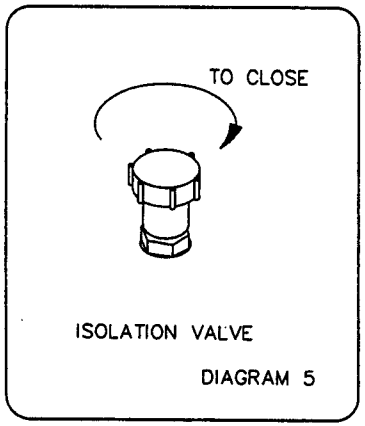


DIAGRAM 4

■ ISOLATION VALVE

This valve allows the user to separate the rotary vane pump from the system being evacuated. Because the valve forms an air tight seal between the vacuum indicators and the pump module it will allow you to leak check by isolating the evacuated system. Turn the valve clockwise to close and counter-clockwise to open. (see diagram 5)



ISOLATION VALVE

DIAGRAM 5

■ VACUUM PORT

This is the intake of the unit; 1/4" MFL on the ACT9100 and 1/2" ACME on the ACTR9200. Connect the vacuum hose (usually black or yellow) from a manifold gauge set to this port. Use the cap provided when not in operation or when performing the initial test. The port includes a fine mesh screen to prevent external contaminants from entering the unit. From time to time, check the port to verify free passage as described in the Maintenance section. (see diagram 6)

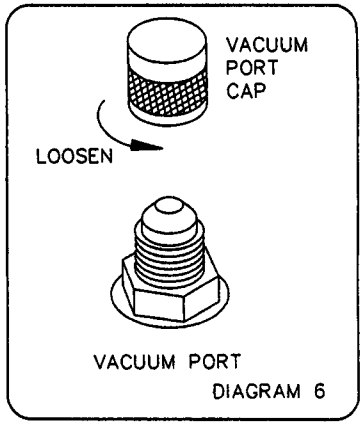


DIAGRAM 6

■ FILL PLUG/EXHAUST VENT AND SHIPPING PLUG

The shipping plug is installed after assembly to keep the reservoir clean. Make certain to remove the shipping plug and replace it with the fill plug after unpacking.

Warning: Never operate the unit with the shipping plug installed. Such action will void the warranty and may result in explosion, damage and/or possible injury.

Remove the fill plug to fill the oil reservoir (turn counter-clockwise to remove and clockwise, till finger tight, to insert). Never operate the unit without this plug properly installed. This plug has been cross-drilled to provide an exhaust for the evacuated gases. (see diagram 7)

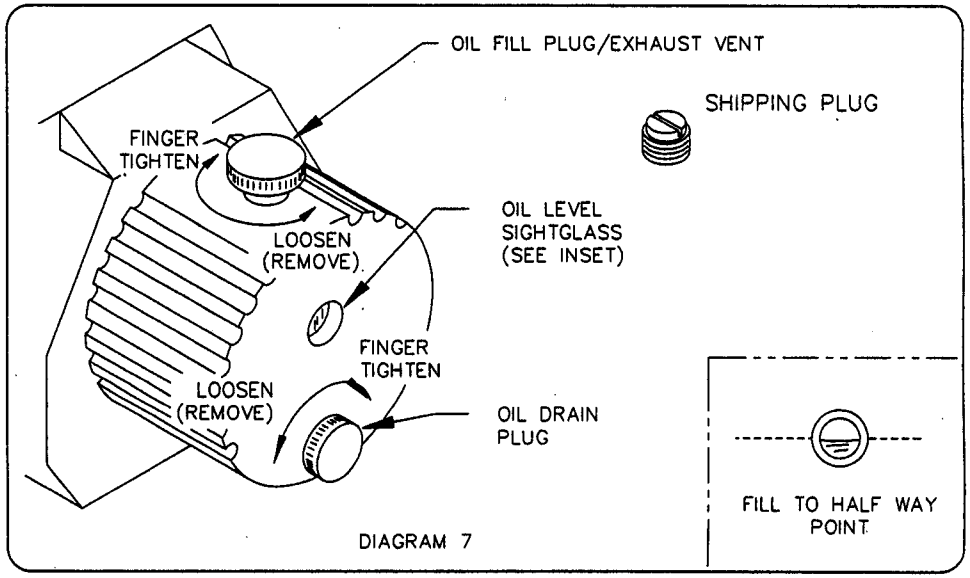


DIAGRAM 7

Note: Water vapor will be released during evacuation and may appear in the form of steam; this vapor is completely harmless.

■ DRAIN PLUG

Remove this plug to drain the oil (turn counter-clockwise to remove and clockwise to insert). Replace plug before refilling reservoir; always verify that the plug is tightened finger tight before attempting to operate unit. (see diagram 7)

■ OIL LEVEL WINDOW

This sightglass is provided in order to view the oil level. When the reservoir is full the oil level should be half way up the sightglass. Do not over-fill. Oil will be expelled through the fill plug/vent if the reservoir is over-filled. Performance may be impaired and pump life shortened if the unit is operated with a low oil level. (see diagram 7)

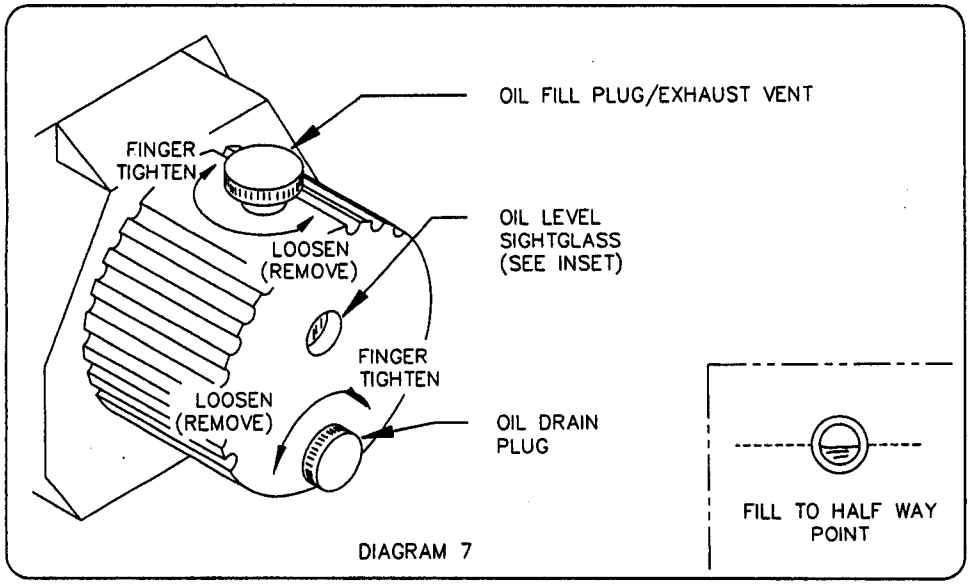


DIAGRAM 7

PREPARATION & SET-UP

■ OIL FILL

After unpacking, and before using, your unit the oil reservoir must be properly filled. Included with your unit is a bottle of Premium Vacuum Pump Oil which contains the exact amount of oil necessary for one complete fill. (see diagram 8)

- Remove the Shipping Plug and make sure the Drain Plug is finger tight.
- Remove the cap from the oil bottle and slowly pour the entire contents into the reservoir.
- Wipe up any oil that may have been spilled.
- Insert the Fill Plug and tighten finger tight.

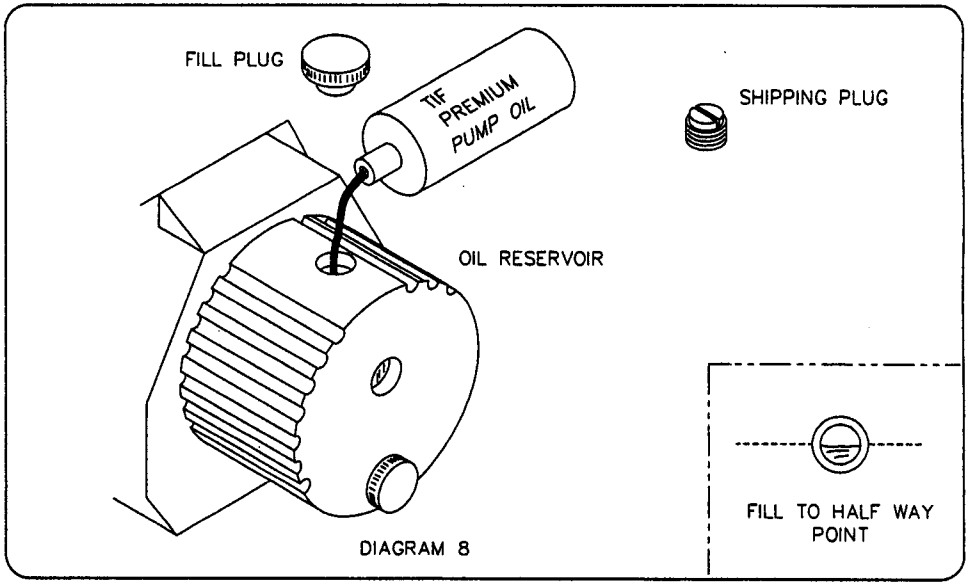


DIAGRAM 8

Caution: When transporting the unit with a full reservoir it is best to remove the Fill Plug and replace it with the Shipping Plug. This will prevent any oil from spilling during transport. REMEMBER to replace the Fill Plug before operating.

Note: Please refer to the maintenance section for detailed information regarding refills and replacement parts.

■ TEST PROCEDURES

A short test before each evacuation will enable you to properly test all functions of your Electronic Vacuum System. Follow the instructions below to test the electronic circuit, vacuum indicator and oil warning light.

ELECTRONICS TEST

- Connect Power Cord to 115VAC. Note precautions on pg.3. (see diagram 9)
- Depress Diagnostic Test Button All LEDs should illuminate when the test button is depressed. If so, the electronic circuit and vacuum indicator are functioning properly; proceed with test. (see diagram 10)
- If all LEDs do not light consult the Trouble Shooting Guide.

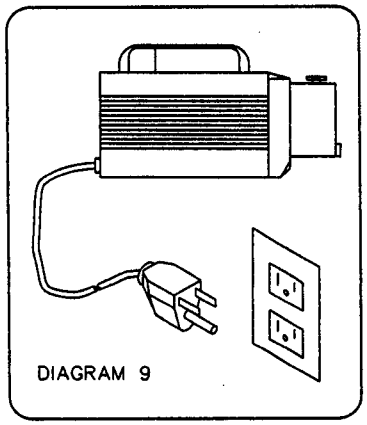


DIAGRAM 9

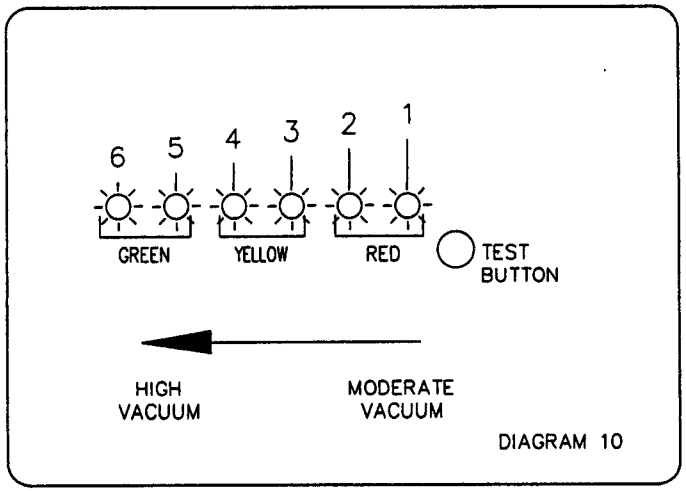


DIAGRAM 10

OIL QUALITY TEST

Monitor the Warning Change Oil Light: if light is CONSTANTLY ON the pump oil should be changed before proceeding; refer to the maintenance section. If light remains OFF the oil quality is OK, proceed with sensor test.

VACUUM SENSOR TEST

(see diagram 11)

1. Seal vacuum port with cap provided. Make sure the O-ring is properly seated at the bottom of the cap.
2. With power cord connected, turn unit on.
3. Open isolation valve (counter-clockwise).

4A. The LED vacuum indicators should begin to light after a few seconds. Run until all LEDs are lit. If all indicators light, the vacuum sensor is OK.

4B. If any or all indicators do not light, check the following: Isolation Valve open; Vacuum Port sealed; Warning Change Oil light off. If any of the indicators do not light after performing these checks then the Vacuum Sensor must be replaced. Refer to the maintenance section of this manual for detailed instructions.

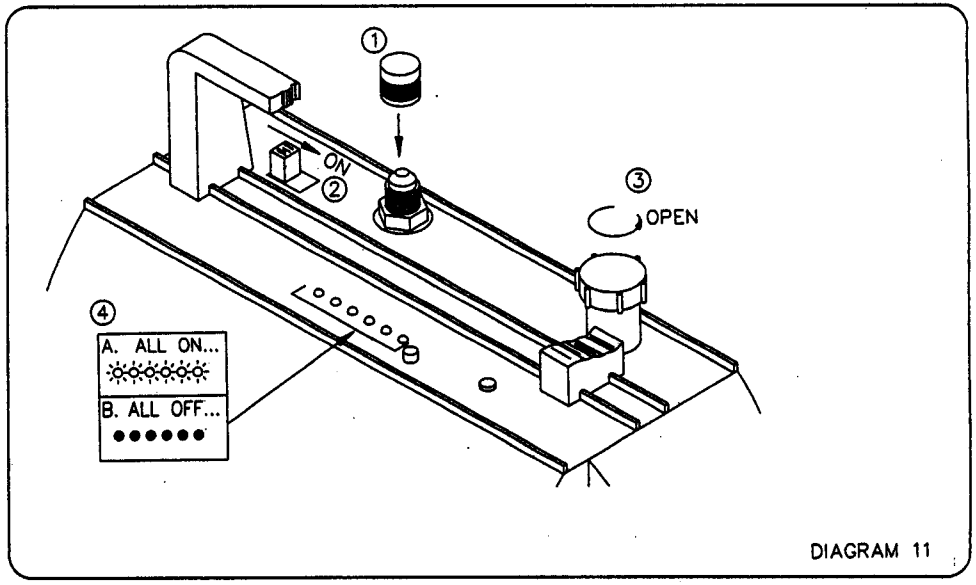


DIAGRAM 11

OPERATION

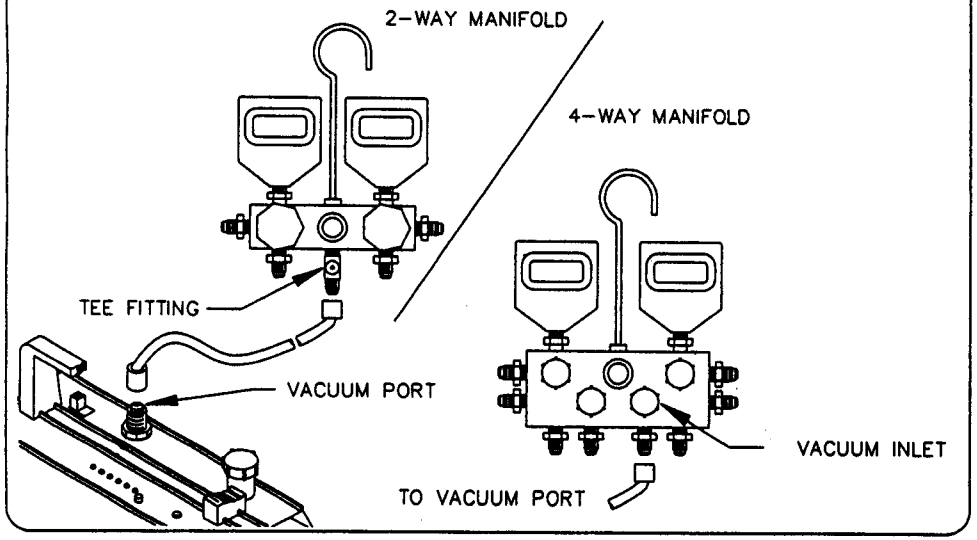
NOTE: The unit should only be connected to EMPTY Air Conditioning or Refrigeration systems. Always hook-up via a manifold gauge set. Evacuating a system that contains refrigerant will vent harmful gases into the atmosphere and is illegal in some areas. In addition, the evacuation of refrigerant through the unit will rapidly reduce oil quality and performance.

■ CONNECTIONS

- Connect the unit to Manifold Gauge Set as shown (see diagram 12). Connect hose to Vacuum Port, ensuring that hose seal is in good condition.

- If connecting to a 2-way manifold, hook-up to bottom of Tee fitting. If connecting to a 4-way manifold, hook-up to vacuum inlet.

DIAGRAM 12



NOTE: Some newer "shut-off" valves or "anti-blowback" fittings on hoses will not be properly opened by the vaccum port. It is best to use a designated vacuum hose, without a shut-off fitting.

- Before proceeding, test manifold and hoses for leaks (see diagram 13). Connect low and high side hoses from their respective inlet ports to blind ports on manifold (ensure that hose seals are in good condition).If using a 2-way manifold, open both valves; if using a 4-way manifold, open low side, high side and vacuum port valves (keep charging port valve closed).

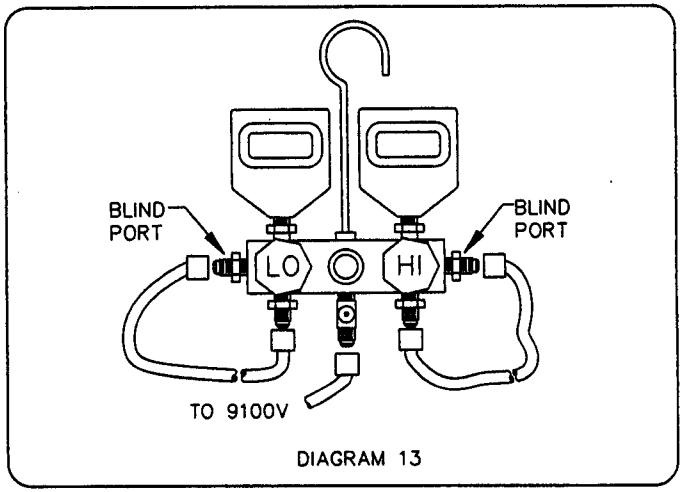


DIAGRAM 13

- Connect unit to 115VAC (or 230VAC for International versions) power supply. Open isolation valve (counter-clockwise) and turn unit on. Run until all vacuum indicators are lit. If all lights will not illuminate (and the unit has been checked OK per Test Procedures Section) a leak is present in either the connections, hoses or manifold; locate, repair and re-test. After all LEDs are lit, close isolation valve (clockwise). If any of the LEDs go out a leak is present in either the connections, hoses or manifold; locate, repair and re-test.

- After manifold and hoses have passed the leak test, turn unit off, close all manifold valves and connect hoses to A/C or Refrigeration system. Connect low side hose (blue) to low side service port of system; connect high side hose (red) to high side service port of system. If applicable, open service valves. If using a 4-way manifold, connect refrigerant supply hose from refrigerant cylinder to manifold so that it will also be evacuated, make certain refrigerant tank valve is closed. (see diagram 14)

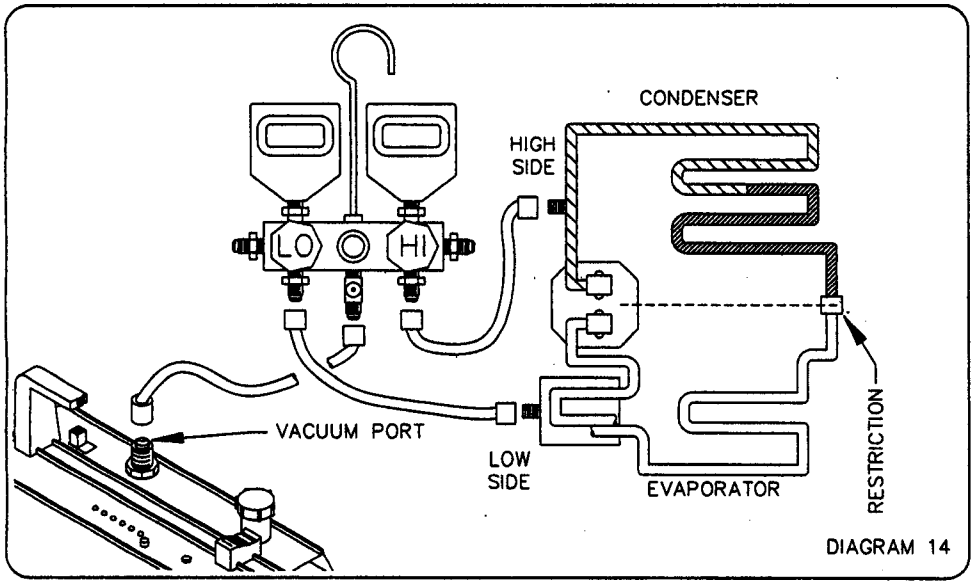


DIAGRAM 14

■ EVACUATION

- After all connections have been made evacuation may begin.
- Make certain all manifold valves are closed.
- Make sure oil level in reservoir is correct. Open isolation valve (counter-clockwise) and switch unit on.
- Open both the low side (blue) and high side (red) valves on the manifold; if using a 4-way manifold, also open the vacuum port valve.
- Evacuation is now underway. Simply monitor the Electronic Vacuum indicator for evacuation status as described in the following section.

■ MONITORING VACUUM

- The Electronic Vacuum Indicator is designed to allow the user to monitor the vacuum level and determine evacuation status. (see diagram 15)
- Six color coded LEDs light in sequence as the vacuum increases. Each light represents a level from 1 to 6. Levels 1 and 2 (red LEDs) indicate that a vacuum is being pulled on the system. Levels 3 and 4 (yellow LEDs) indicate a good vacuum level. Levels 5 and 6 (green LEDs) indicate a high vacuum within the system. Level 6 indicates sufficient vacuum to boil all moisture at normal ambient temperatures.
- Run the unit until vacuum level 6 is reached, indicated by the illumination of the last green LED. Any moisture that may be in the system is now being boiled. Leave the unit running for approximately five (5) minutes AFTER level 6 is reached. If working on very large systems this time may need to be increased; if unsure of status check for remaining moisture as described in the following section, condition B. If any or all LEDs do not light, consult the Troubleshooting Guide.

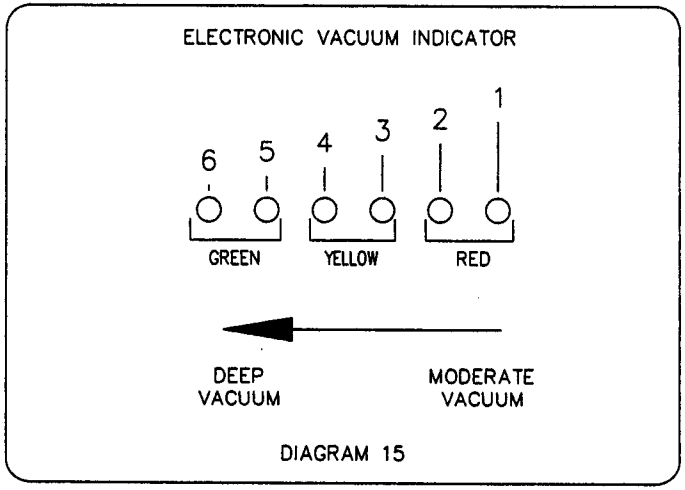
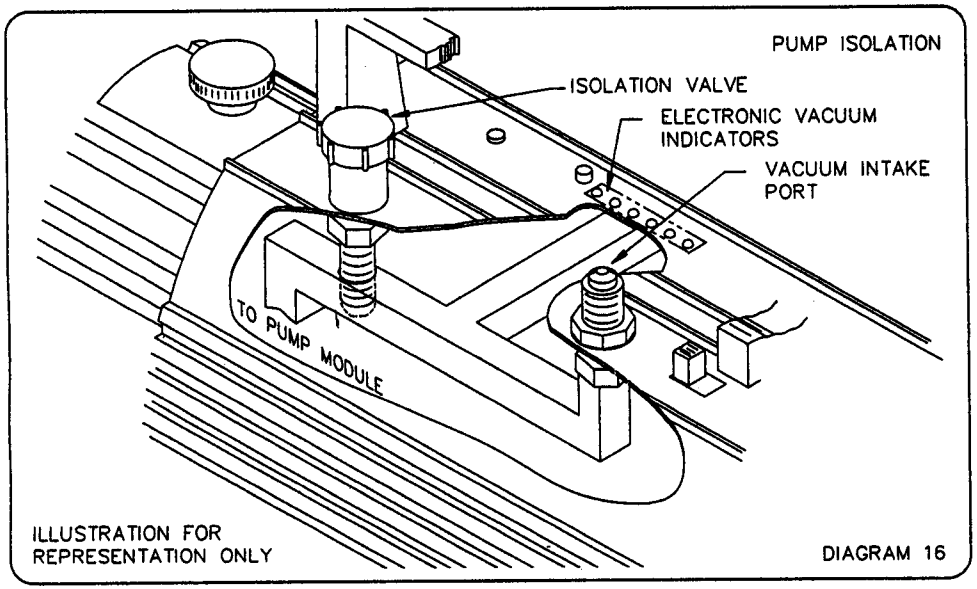


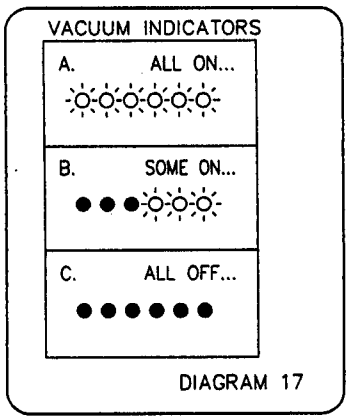
DIAGRAM 15

■ VACUUM STATUS/LEAK CHECK

- The isolation valve allows the user to check the vacuum status and to check for leaks.
- Maintain vacuum at level six for five minutes.
- Isolate the pump from the vacuum indicators and refrigerant system by closing the isolation valve in a clockwise direction (see diagram 16).



- Monitor the vacuum indicators for five minutes, this allows vacuum to equalize throughout the entire system; three possibilities may exist: (see diagram 17)



A) ALL INDICATORS REMAIN ON: Evacuation is complete, a deep vacuum has been maintained and no moisture or leaks are present.
B) SOME INDICATORS SLOWLY GO OUT, ONE OR SOME STAY ON: Moisture remains in the system. Open isolation valve and resume evacuation following steps outlined above.
C) ALL INDICATORS GO OUT: A leak is present in the refrigerant system. Identify leak location, repair and repeat procedure.

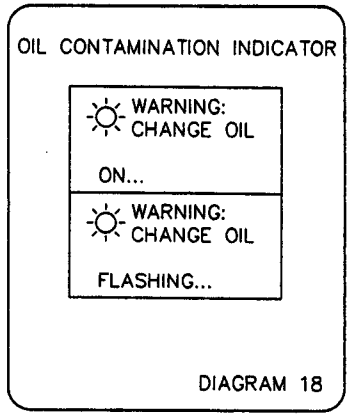
- Evacuation is complete when all indicators remain on for several minutes, as described in condition A, above. Close all manifold valves, disconnect hose from vacuum port and make sure the Vacuum System is switched off.

CAUTION: If the Vacuum System is switched OFF while the isolation valve is open, the system vacuum will be lost because of the unit's automatic vent.

- Any system can be checked to see if moisture remains once the vacuum indicators have been illuminated. **With the unit running,** close the isolation valve (clockwise) and monitor the indicators. If any lights slowly go out, moisture remains in the system. Open isolation valve and continue evacuation. Repeat check after 5-10 minutes.

■ OIL CONTAMINATION INDICATOR

- Oil contamination from moisture and or sludge will affect pumping efficiency and performance. Pump life will be reduced by continued operation with contaminated oil. (see diagram 18)



- The Warning Change Oil light will remain CONSTANTLY ON when the sensor detects contaminated oil.
- During initial evacuation the Warning Change Oil light may flash on and off as air bubbles disrupt the infrared sensor. This is not an indication of contaminated oil and should be disregarded.
- If the Warning Change Oil light remains CONSTANTLY ON the pump oil should be changed (see Maintenance section). It may not be possible to light all vacuum indicators when the oil contamination indicator is constantly on, due to reduced pumping efficiency. If this condition exists, seal the refrigerant system via the manifold; disconnect and turn off Vacuum System and change the oil as described in the Maintenance section. Re-connect and resume evacuation after oil change.
- If a flashing indicator causes uncertainty the oil quality can be checked at any point. With the unit running, close the isolation valve, and watch the Warning Change Oil light. If it is CONTINUOUSLY lit the oil should be changed; if the light is off the oil quality is OK.

MAINTENANCE

■ OIL CHANGES

For optimum performance, change the oil after each evacuation. The oil should be changed whenever the Warning Change Oil light is CONSTANTLY ON. Failure to do so will reduce efficiency and decrease the performance life of the unit.

NOTE: Use only oil designed specifically for vacuum pumps. Use of an improper grade oil may affect performance and will automatically void the warranty.

TO DRAIN THE OIL RESERVOIR (see diagram 19):

1) Place an appropriate container beneath the drain plug and oil reservoir.
2) Remove the fill plug by turning counter-clockwise.
3) Remove the drain plug and allow oil to drain from the reservoir. It will be necessary to tilt the back of the unit in order for all oil to flow out.
4) Clean any sludge away from, and out of, drain hole.
5) Clean and replace drain plug, turn clockwise until finger tight.

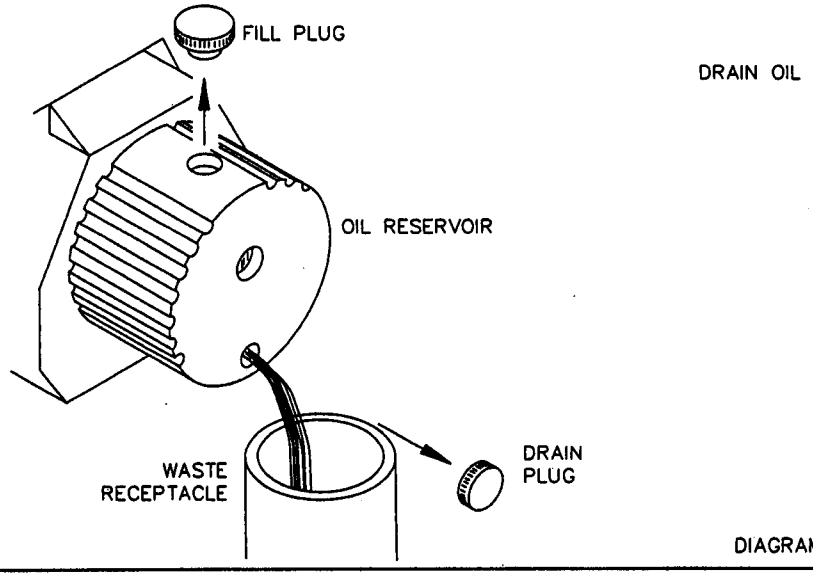


DIAGRAM 19

TO REFILL THE OIL RESERVOIR (see diagram 20):

1) Refill ONLY with Premium Vacuum Pump Oil or equivalent.
2) With the fill plug removed and drain plug installed finger tight, slowly pour oil into the top of the reservoir until the oil level is half way up the sightglass. Do not over-fill.
3) Replace fill plug, cap vacuum port and open isolation valve.
4) Plug unit into correct power supply and switch on. Allow unit to run for approximately thirty (30) seconds, then switch off. This will circulate the oil throughout the pump.
5) Re-check the oil level in the sightglass. If it is below the half way point, remove the fill plug and top up to the correct level.

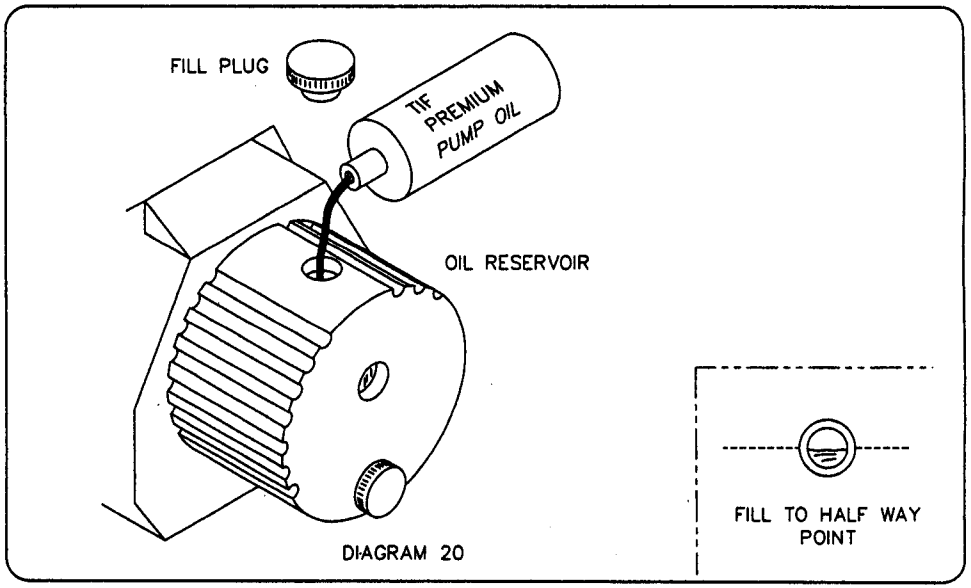


DIAGRAM 20

■ VACUUM SENSOR REPLACEMENT

If the vacuum sensor has been diagnosed as defective (see Test Procedures section) it may be replaced by the user in the field by ordering a Vacuum Sensor Replacement Kit (part# 9101).

Replace the sensor ONLY when the ALL of the following conditions exist:

A) Vacuum indicator LEDs have been tested OK with diagnostic test button.
B) Vacuum indicator LEDs do not light when pump is on, isolation valve is open and vacuum port is capped.
C) Warning Change Oil light is off.
D) Suction is present at vacuum port.

- Make certain you have a Replacement Kit (part # 9101) before proceeding. DO NOT operate the unit without the vacuum sensor.
- Two common tools will be needed; a 1/4" open ended wrench and a medium size phillips screwdriver.

TO REPLACE SENSOR:

CAUTION: Make Sure Unit Is Unplugged.

1) Remove the eight (8) screws (see diagram 21) securing the back cover on the unit to expose the sensor (see diagram 22)

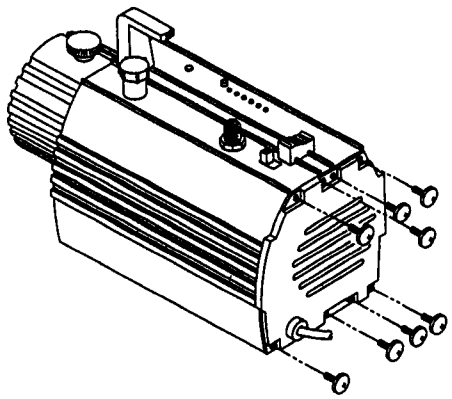
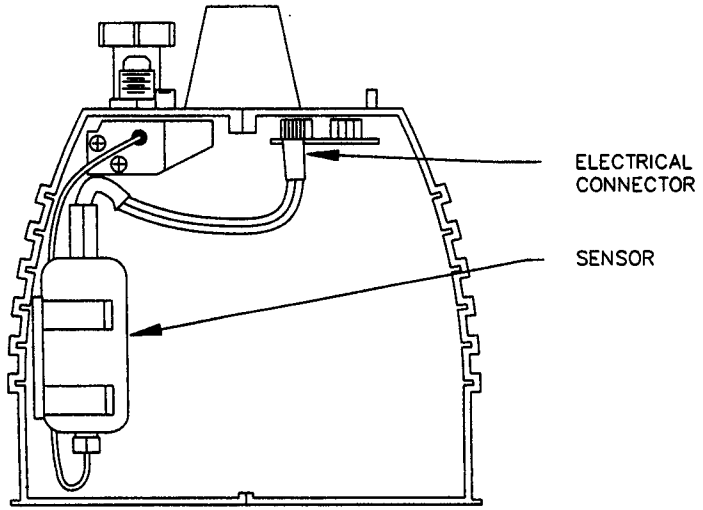


DIAGRAM 21

DIAGRAM 22



2) Disconnect the electrical wires attached to the sensor from the PC Board. (see diagram 23)
a. Grasp white plug with forefinger and thumb.
b. Gently pull away from board.

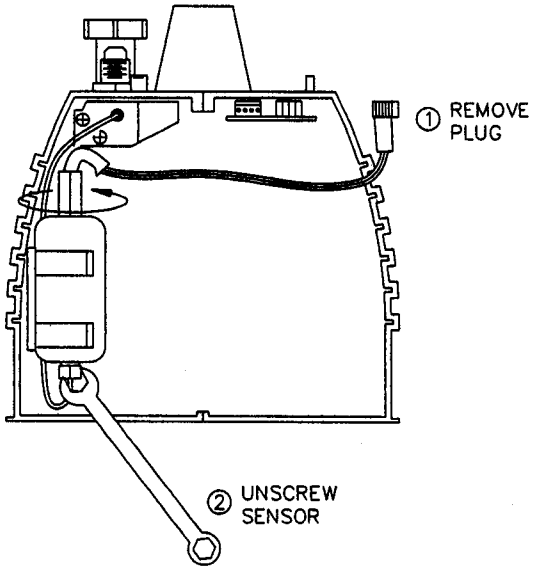


DIAGRAM 23

3) Pull the sensor from its retaining clips.
4) Hold the plastic nut below the sensor with the open ended wrench and unscrew the sensor with forefinger and thumb by turning counter-clockwise.
5) Locate replacement sensor in 9101 kit and install by screwing clockwise onto plastic fitting while holding nut with wrench. Tighten finger tight, then push back into retaining clips.

CAUTION: Make certain clear vinyl tube to sensor is routed clear of cooling fan.

6) Re-connect electrical wires by gently pushing white plug onto the PC Board, make certain the pins line up with the holes in the plug.
7) Re-install the back cover with the eight phillips head screws removed earlier. Before operating, test the sensor as described in the Test Procedures Section.

INTAKE FILTER MAINTENANCE

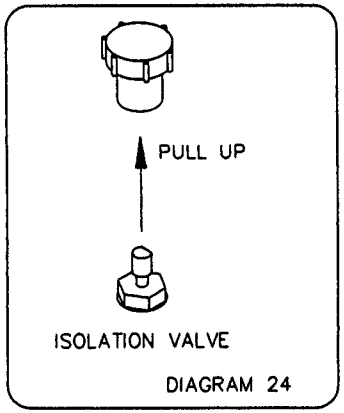
A fine mesh filter is attached to the bottom of the vacuum port in order to keep any contaminants from entering the pump mechanism.
From time to time it is advisable to check that adequate suction is being maintained through the port. Simply switch the unit on and cover the port with a finger to determine if there is a strong vacuum (make certain the isolation valve is open).

If necessary, remove the vacuum port with a 9/16" open ended wrench and clean the filter screen with a solvent or compressed air. Check the "O"-ring for wear by unscrewing in a counter-clockwise direction and replace if necessary. The "O"-ring should be kept clean of dirt and grit to ensure a snug seal. Reinstall by screwing in clockwise; tighten finger tight and then snug up with a wrench.

ISOLATION VALVE REPLACEMENT

If the Isolation Valve has been diganosed as faulty, it can be repaired in the field. Make certain that you have a repair kit before proceeding.

- Fullly open Isolation Valve
- Remove the Valve knob by grasping firmly and pulling upwards off the valve stem. (see diagram 24)
- Use an open ended wrench on the mounting nut and unscrew the valve in a counter-clockwise direction and remove.
- Remove the old "O"-ring from its groove in the valve mounting hole. Remove any dirt or grit that may be present. (see diagram 25 next page)



ISOLATION VALVE

DIAGRAM 24

- Locate the new "O"-ring in the repair kit and lightly coat it with pump oil. Position new "O"-ring into the groove and make sure that it is properly seated.
- Replace valve with the new one found in repair kit. Discard old valve.
- Lightly coat new valve seal with pump oil and re-insert valve into the unit. Tighten untill finger tight and then gently snug up with an open ended wrench.

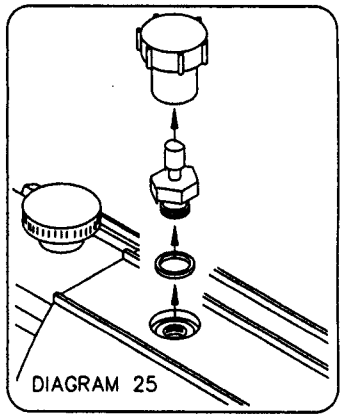


DIAGRAM 25

REPLACEMENT PARTS

TIF9101...VACUUM SENSOR REPLACEMENT KIT
TIF9102...FILL PLUG
TIF9103...ISOLATION VALVE KNOB
TIF9104...DRAIN PLUG
TIF9105...PREMIUM VACUUM PUMP OIL, QUART
TIF9106...ISOLATION VALVE REPAIR KIT
TIF9107...INTAKE VALVE REPAIR KIT

SPECIFICATIONS

PUMP TYPE: OFFSET ROTARY VANE
POWER SUPPLY: 115VAC 60Hz (230VAC 50Hz for International)
DRIVE: Direct
MOTOR SIZE: 1/5 HP
FREE AIR DISPLACEMENT: 1.3 CFM
NUMBER OF STAGES: One
PUMP WEIGHT: 15 POUNDS
DIMENSIONS: 12 1/2 X 7 X 6"
MOTOR SPEED: 3450 RPM (UNLOADED)
OIL CAPACITY: 8.1 OZ (240ML)
FACTORY MICRON RATING: 200 Microns
INTAKE FITTING: 1/4" MFL, ACT9100; 1/2" ACME, ACTR9200
VACUUM INDICATOR: LEDS INDICATE LEVELS 1 THROUGH 6
WARNING CHANGE OIL LIGHT: GOOD/BAD OIL CONDITION
AMBIENT OPERATING TEMPERATURES: 32 F TO 130 F
PUMP OPERATING TEMPERATURE: LESS THAN 150 F

TROUBLE SHOOTING GUIDE

If you encounter a problem with the unit, check the possible causes listed below and/or call Customer Service TOLL FREE at 1-800-327-5060 before returning the unit.

Problem	Cause	Solution
Unit will not run	• Not plugged into live outlet • Thermal overload on motor triggered	• Check plug connection • Check outlet • Wait 15 minutes and try again.
Vacuum Indicators do not light when diagnostic test button is depressed	• Unit not plugged into live outlet • Faulty PCB or LEDs	• Check plug • Check outlet • Return for repair
No Vacuum Indicators light during evacutation but test "OK" with diagnostic test button.	• Isolation valve closed. • Large leaks in connections/ system • Faulty vacuum sensor	• Open valve • Leak check as described on pg.15, if tests "OK", there is a leak in refrigeration system; repair. • Verify sensor fault by testing as described on pg.11 . Replace with 9101 kit if necessary.
Some indicators will not light during evacuation	• Contaminated oil • Moisture laden refrigerant system • Low oil level	• Check oil warning light, if on, change oil. • Close isolation valve and verify moisture presence as described on pp.15,16 . Continue evacuation and check until moisture is removed. • Check level and fill, if necessary.
All Vacuum Indicator Lights go out when Isolation Valve is closed	• Leak in connections • Leak in Refrigerant System	• Test as described p.13 , and repair if necessary. • Locate and Repair
Some lights slowly go out when Isolation Valve is closed	• Moisture remains in system	• Open Isolation Valve and continue evacuation

TROUBLE SHOOTING GUIDE

Problem	Cause	Solution
WARNING: CHANGE OIL light flashes on/off during vacuum	• Air bubbles disrupting IR sensor	• Disregard
WARNING: CHANGE OIL light remains constantly on	• Contaminated oil	• Change oil as described on pg.18.
WARNING: CHANGE OIL light remains on after oil has been changed	• Moisture contaminated oil • Faulty oil sensor	• Run unit with vac port capped for 10 minutes & recheck. • Return for repair
WARNING: CHANGE OIL light does not come on even when oil is very dirty	• Faulty oil sensor • PC board fault	• Return for repair • Return for repair
Unit very slow to start up, in cold conditions.	• Isolation Valve closed, causing air lock.	• Open Isolation Valve
Unit runs but creates very little suction at vacuum port.	• Isolation Valve partially closed • Vacuum port filter clogged. • Worn or damaged pump mechanism	• Open valve completely • Remove port and clear filter as described, pg. 22. • Return for repair
Isolation Valve leaks	• Faulty seal or "0" ring	• Repair as described on pg.22.
Motor shuts off during evacuation, however vacuum indicators remain on	• Thermal overload activated	• Wait 15 minutes and attempt to restart
Vacuum Indicator LEDs suddenly go out during evacuation, but motor remains running	• Vacuum sensor failure.	• Verify sensor fault through test procedures, p.11 and replace if necessary.

WARRANTY

This unit is designed and produced to provide unlimited service. Should it become inoperative after performing the recommended maintenance, a no charge replacement will be made to the original purchaser within one year from date of purchase.
This warranty applies to all repairable units and components (except as noted below) which have not been tampered with, misused or damaged.
This warranty does not cover filters or sensors which are subject to contamination or normal wear pumping components, plugs and/or seals.

BEFORE RETURNING THE UNIT FOR REPLACEMENT OR SERVICE

1. TAKE THE FOLLOWING STEPS TO MAKE SURE THAT UNIT RETURN IS REALLY NECESSARY:
   A) Read the operating instructions to make sure the unit is being operated properly.
   B) Consult the Troubleshooting Guide to determine if the problem can be easily resolved.
   C) Verify suspected faults by following the prescribed test procedure.
   D) Contact Customer Service via the Toll Free number at 1-800-327-5060.
   E) Follow instructions outlined by Customer Service Representative.

2. PREPARE UNIT FOR RETURN SERVICING:
   A) Drain ALL oil from the pump reservoir.
   B) Pack the unit in the original shipping carton or a secure equivalent and contact your local dealer for return instructions.

PRINCIPLES OF DEEP VACUUM EVACUATION

Why Do It?

The main reason for pulling a vacuum on a system is to rid it of unwanted gases, mainly air and water vapor.
Air, being a noncondensible, will get trapped in the high side of a refrigeration system because of the condenser's liquid seal (subcooled liquid) at its bottom prevents the air's passage.
The system's head pressure, discharge temperature and compression ratio will elevate, causing unwanted inefficiencies due to the reduced condensing surface area. At these elevated temperatures, oxygen in the air will react with the refrigeration oil to form organic solids.
This reaction usually occurs at the discharge valve; it is the hottest part of the refrigeration system. Removing air or other noncondensible gases from the system with a vacuum pump is called "degassing" a system. Removing water vapor from a system is called "dehydration". The process of removing both air and water vapor is called "evacuation".

DEGASSING + DEHYDRATION = EVACUATION

Water Vapor

Water, the universal solvent, is considered a relatively harmless liquid. But it can be a service technician's nightmare if not handled properly.
Water vapor will cause more serious problems to systems. As we know, all air contains water vapor. So, if air gets into the system, water vapor will also be present.
Water vapor can cause freeze-ups at expansion devices. Sludging due to acid formation can cause even more serious system problems due to the presence of water vapor.
Water vapor in atmospheric air is commonly measured in terms of specific or relative humidity. It can enter a refrigeration system either through a leak or poor service practices , or be generated from oil, refrigerant and excessive heat.
Refrigerant transports moisture through the system until it experiences a sudden pressure drop at the expansion device. This is where the water will crystallize, gradually building frozen layers until the expansion device is restricted enough to stop refrigerant flow ("freeze-up"), thus causing a reduction or complete loss of cooling.
This restriction causes the low-pressure control or other protection device to open and interrupt power to the cooling unit. Once the unit has cycled off, the ice layers will melt. The cooling unit will cycle back on and start a short cycling routine until the problem is corrected. Clearly, short-cycling is not good for motors or controls. Whether or not freeze-up occurs depends on the amount of water vapor present and the ice crystal sizes. However, even if freeze-up doesn't occur, corrosion, acids and sludges from the mixture of water vapor, excessive heat, oil and refrigerant can seriously damage a cooling system,
When moisture, heat and refrigerant are present in a refrigeration system, you can bet that, after a short time acids will form.
Refrigerants (CFC's) such as R-12 and R-22 contain chlorine; they will hydrolize with water, forming hydrochloric acid and more water. Once acid is formed, corrosion of most metals in the system will occur.
Heat is the catalyst in this complex chemical reaction; as more heat is generated, hydrochloric acid formations are accelerated. When this acid is carried through the system and mixes with the system's oil, globules of sludge will form, along with organic acids and oil decomposition products. Sludge is nothing more than a tightly bound mixture of water, acid and oil.

MOISTURE + ACID + OIL = SLUDGE

One point that must be understood is that refrigeration oil has a high affinity for water vapor and refrigerant due to the oil's low vapor pressure.This means refrigerant and water vapor will

be attracted to the oil; all three will mix and be soluble in one another.

Sludge can exist as minute slimy or sticky solids, powdery solids or thick, slimy and oily liquids. Sludge will break the oil down and reduce its lubricating abilities, causing severe mechanical damage to the system. If any mechanical parts have corroded from the hydrochloric acid, small particles from the corroded parts will be carried in the sludge.

These sludges and solids tend to build up at the hottest point in the system, where the discharge valve seats. The valves will no longer seat properly, and "wiredrawing" occurs. (Wiredrawing is vapor being forced through a very small orifice at a very high speed, creating friction and elevating temperature up to 1000°F.)

Technicians must realize that, to avoid corrosion and sludging problems in cooling systems, moisture must be kept out through good service practices and effective preventative maintenance.

Sludging and corrosion will cause expansion devices, filter driers and strainers to plug up and malfunction. So, once moisture is in a cooling system, the only sure way to rid the system of its presence is with good evacuation procedures using a high vacuum pump.

Once sludge is formed, standard cleanup procedures must be followed using over-size driers specified for removing solids. Vacuum pumps are just not designed to remove those. Assuredly, deep vacuum procedures will not take the place of liquid line or suction line driers, because the vacuum pump can't remove solids.

Deep Vacuums ■■■■■■■■■■■■■

Many service technicians believe that a vacuum pump actually sucks out "liquid" moisture particles from the system. This is incorrect. Even if there was moisture in the cooling system that existed as both liquid and vapor, the vacuum still couldn't draw out liquid water.

What actually happens with a vacuum pump is that the system's pressure is reduced to the boiling point of water at normal temperatures. For example, water boils at 212°at an atmospheric pressure of 14.696 psia (0 psig). So, to vaporize any liquid moisture from the cooling system at atmospheric pressure, the system would have to be at 212°, which is not considered normal temperature.

To vaporize (boil) water at lower temperatures, the cooling system's internal pressure must be lowered. If it can be lowered significantly, any liquid water will be vaporized and, thus, drawn through the vacuum pump and expelled into the atmosphere.

The lower the internal pressure, the lower the moisture's boiling point. By referring to the Boiling Point Chart, a technician can see that, if the system's internal pressure is lowered to 1.006 psia (27.75 in. Hg.) water in the system will boil at 104°. But the system still must be exposed to 104° temperatures for vaporization to occur.

Now, if the internal system pressure was brought down further to 28.67 in. Hg. any moisture in the system would vaporize at 86°- a more reasonable temperature, since it would not require artificial heat.

Once all moisture has been vaporized from the system, the vapor pressure and the heat dissipation rate will decrease; thus, the measurement will decrease. **This low measurement, not the time on a wristwatch, will tell the service technician when evacuation is complete.**

The more vaporization of water, or degassing of unwanted gases, the more time it takes to reach a deep vacuum level (when using the same size vacuum pump). Vacuum pump capacity is measured in cubic feet per minute (CFM).

Vacuum pump capacity has little to do with evacuation, because of internal restrictions innate to cooling systems. Metering devices, length of tubing, return bends and service valve orifices all offer restrictions during evacuation.

The only way to increase flow through a fixed orifice is to increase the pressure difference across that orifice. However, when evacuating a system, the pressure source in and out of the system on a 3/16 in. gauge orifice isn't much to work with.

For this reason, vacuum pumps in the 1 to 3 CFM range should handle 95% of the work. Reducing the system's pressure drop will, though, decrease the evacuation time. This can be accomplished by pulling a vacuum through the system's high and low sides, provided the connecting hoses and manifold are not too restrictive.

The deep vacuum method of evacuation lets the technician know for certain that a cooling system is ready for charging. In these days of rising refrigerant costs and ozone depletion panic, we can't afford to guess whether or not the system is properly dehydrated and degassed.

Boiling point of water at various vacuum levels

Temperature •F	Microns	Inches of Hg vacuum	Pressure psia
212	759,968	00.00	14.696
205	535,000	4.92	12.279
194	525,526	9.23	10.162
176	355,092	15.94	6.866
158	233,680	20.72	4.519
140	149,352	24.04	2.888
122	92,456	26.28	1.788
104	55,118	27.75	1.066
86	31,750	28.67	.614
80	25,400	28.92	.491
76	22,860	29.02	.442
72	20,320	29.12	.393
69	17,780	29.22	.344
64	15,240	29.32	.295
59	12,700	29.42	.246
53	10,160	29.52	.196
45	7,620	29.62	.147
32	4,572	29.74	.088
21	2,540	29.82	.049
6	1,270	29.87	.0245
-24	254	29.91	.0049
-35	127	29.915	.00245
-60	25.4	29.919	.00049
-70	12.7	29.9195	.00024
-90	2.54	29.9199	.000049
	0.00	29.9200	.000000

NOTE: We would like to extend our sincere thanks and gratitude to John A Tomczyk for allowing us to include excerpts from his article; "System Evacuation Using the Deep Vacuum Method"