GARDNER DENVER®

13–10–606
4th Edition
May, 1999

ELECTRA–SAVER®

STATIONARY BASE–MOUNTED

COMPRESSORS

WITH CONSTANT SPEED OR AUTOMATIC START/TIMED STOP CONTROL – 50/60 HZ

MODELS
EAY99F
350, 400 & 500 HP

OPERATING AND SERVICE MANUAL

Gardner Denver

MAINTAIN COMPRESSOR RELIABILITY AND PERFORMANCE WITH GENUINE GARDNER DENVER® COMPRESSOR PARTS AND SUPPORT SERVICES

Gardner Denver® Compressor genuine parts, manufactured to design tolerances, are developed for optimum dependability —— specifically for Gardner Denver compressor systems. Design and material innovations are the result of years of experience with hundreds of different compressor applications. Reliability in materials and quality assurance are incorporated in our genuine replacement parts.

Your authorized Gardner Denver® Compressor distributor offers all the backup you'll need. A worldwide network of authorized distributors provides the finest product support in the air compressor industry. Your local authorized distributor maintains a large inventory of genuine parts and he is backed up for emergency parts by direct access to the Gardner Denver Master Distribution Center (MDC) in Memphis, Tennessee.

Your authorized distributor can support your Gardner Denver® air compressor with these services:

1. Trained parts specialists to assist you in selecting the correct replacement parts.
2. Factory warranted new and remanufactured rotary screw air ends. Most popular model remanufactured air ends are maintained in stock at MDC for purchase on an exchange basis with liberal core credit available for the replacement unit.
3. A full line of factory tested AEON™ compressor lubricants specifically formulated for use in Gardner Denver compressors.
4. Repair and maintenance kits designed with the necessary parts to simplify servicing your compressor.

Authorized distributor service technicians are factory–trained and skilled in compressor maintenance and repair. They are ready to respond and assist you by providing fast, expert maintenance and repair services.

For the location of your local authorized Gardner Denver Air Compressor distributor refer to the yellow pages of your phone directory or contact:

Distribution Center:
Gardner Denver
Master Distribution Center
5585 East Shelby Drive
Memphis, TN 38141
Phone: (901) 542–6100
(800) 245–4946
Fax: (901) 542–6159

Factory:
Gardner Denver
1800 Gardner Expressway
Quincy, IL 62301
Phone: (217) 222–5400
Fax: (217) 224–7814

REMANUFACTURED AIR ENDS

Whenever an air end requires replacement or repair, Gardner Denver offers an industry unique, factory remanufactured air end exchange program. From its modern Remanufacturing Center in Indianapolis, IN, Gardner Denver is committed to supplying you with the highest quality, factory remanufactured air ends that are guaranteed to save you time, aggravation and money.

Immediately Available

Repair downtime costs you money, which is why there are over 200 remanufactured units in inventory at all times, ready for immediate delivery.

Skilled Craftsmen

Our Remanufacturing assembly technicians average over 20 years experience with air compression products.

Precision Remanufacturing

All potentially usable parts are thoroughly cleaned, inspected and analyzed. Only those parts that can be brought back to original factory specifications are remanufactured. Every remanufactured air end receives a new overhaul kit: bearings, gears, seals, sleeves and gaskets.

Extensive Testing

Gardner Denver performs testing that repair houses just don't do. Magnaflux and ultrasonic inspection spot cracked or stressed castings, monochromatic light analysis exposes oil leaks, and coordinate measurement machine inspects to +/– .0001", insuring that all remanufactured air ends meet factory performance specifications.

Warranty

Gardner Denver backs up every remanufactured air end with a new warranty . . . 18 months from purchase, 12 months from service.

Gardner Denver remanufactured air ends deliver *quality without question . . . year in and year out.*

Call Gardner Denver for information on the air end exchange program and the name of your authorized distributor.

Phone Number: 800–245–4946 or
FAX: 901–542–6159

FOREWARD

Gardner Denver Rotary Screw compressors are the result of advanced engineering and skilled manufacturing. To be assured of receiving maximum service from this machine the owner must exercise care in its operation and maintenance. This book is written to give the operator and maintenance department essential information for day-to-day operation, maintenance and adjustment. Careful adherence to these instructions will result in economical operation and minimum downtime.

⚠ DANGER

Danger is used to indicate the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ WARNING

Warning is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ CAUTION

Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.

NOTICE

Notice is used to notify people of installation, operation or maintenence information which is important but not hazard-related.

This book covers the following models:

HP	PSIG	Air Cooled	Water Cooled	Parts List
350	100, 125 150	EAYQSF	EAYSSF	13-10-504
400	100, 125 150	EAYQTF	EAYSTF	13-10-504
500	100, 125 150	EAYQVF	EAYSVF	13-10-504

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ILLUSTRATIONS

SECTION 1
GENERAL INFORMATION

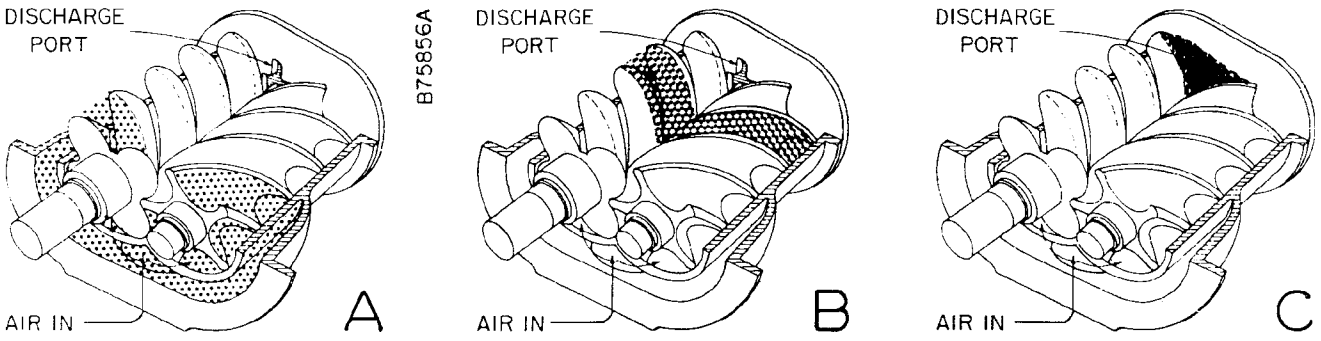


FIGURE 1-1 - COMPRESSION CYCLE

COMPRESSOR - The Gardner-Denver Electra-Saver compressor is a single-stage, positive displacement rotary machine using meshing helical rotors to effect compression. The input drive shaft and helical drive gear are supported in the gear case by high capacity tapered roller bearings. The drive gear meshes with a driven gear mounted on the main rotor shaft to drive the rotors. Both rotors are supported between large capacity anti-friction bearings located outside the compression chamber. Single-width cylindrical roller bearings are used at the inlet end of the rotors. Early models used two (2) heavy-duty, single-row, angular contact ball bearings at the discharge end to locate each rotor axially and carry all thrust loads; later models use tapered roller bearings in this location.

COMPRESSION PRINCIPLE (Figure 1-1) - Compression is accomplished by the main and secondary rotors synchronously meshing in a one-piece cylinder. The main rotor has four (4) helical lobes 90° apart. The secondary rotor has five (5) matching helical grooves 72° apart to allow meshing with main rotor lobes.

The air inlet port is located on top of the compressor near the center. The discharge port is near the bottom at the opposite end of the compressor cylinder. Figure 1-1 is an inverted view to show inlet and discharge ports. The compression cycle begins as rotors unmesh at the inlet port and air is drawn into the cavity between the main rotor lobes and secondary rotor grooves (A). When the rotors pass the inlet port cutoff, air is trapped in the interlobe cavity and flows axially with the meshing rotors (B). As the meshing continues, more of the main rotor lobe enters the secondary rotor groove, normal volume is reduced and pressure increases. Oil is injected into the cylinder to remove the heat of compression and seal internal clearances. Volume reduction and pressure increase continues until the air/oil mixture trapped in the interlobe cavity by the rotors passes the discharge port and is released to the oil reservoir (C). Each rotor cavity follows the save "fill-compress-discharge" cycle in rapid succession to produce a discharge air flow that is continuous, smooth, and shock-free.

AIR FLOW (Figure 5-1, Section 5, page 1) - Air enters the air filter and passes through the inlet unloader valve to the compressor. After compression, the air/oil mixture passes into the oil reservoir where most of the entrained oil is removed by velocity change and impingement and drops back into the reservoir. The air and remaining oil then passes through the oil separator; the separated oil is returned to the system through tubing connecting the separator and compressor. The air passes through the reservoir discharge manifold, discharge check valve, minimum pressure valve and the customer furnished unit shutoff globe valve to the plant air lines.

LUBRICATION, COOLING, AND SEALING - Oil is forced by air pressure from the oil reservoir through the oil cooler, thermal control (thermostatic mixing) valve and oil filter and discharges into the compressor main oil gallery. A portion of the oil is directed through internal passages to the bearings, gears, and shaft oil seal. The balance of the oil is injected directly into the compression chamber to remove the heat of compression, seal internal clearances, and lubricate the rotors.

TURN VALVE - The turn valve is a rotary helical valve located on the discharge side of the cylinder toward the inlet end. The valve opens and closes ports in the cylinder which communicates with the inlet passage. This varies the compressor rotor volume to match the demand for air, thus reducing the part-load power requirement.

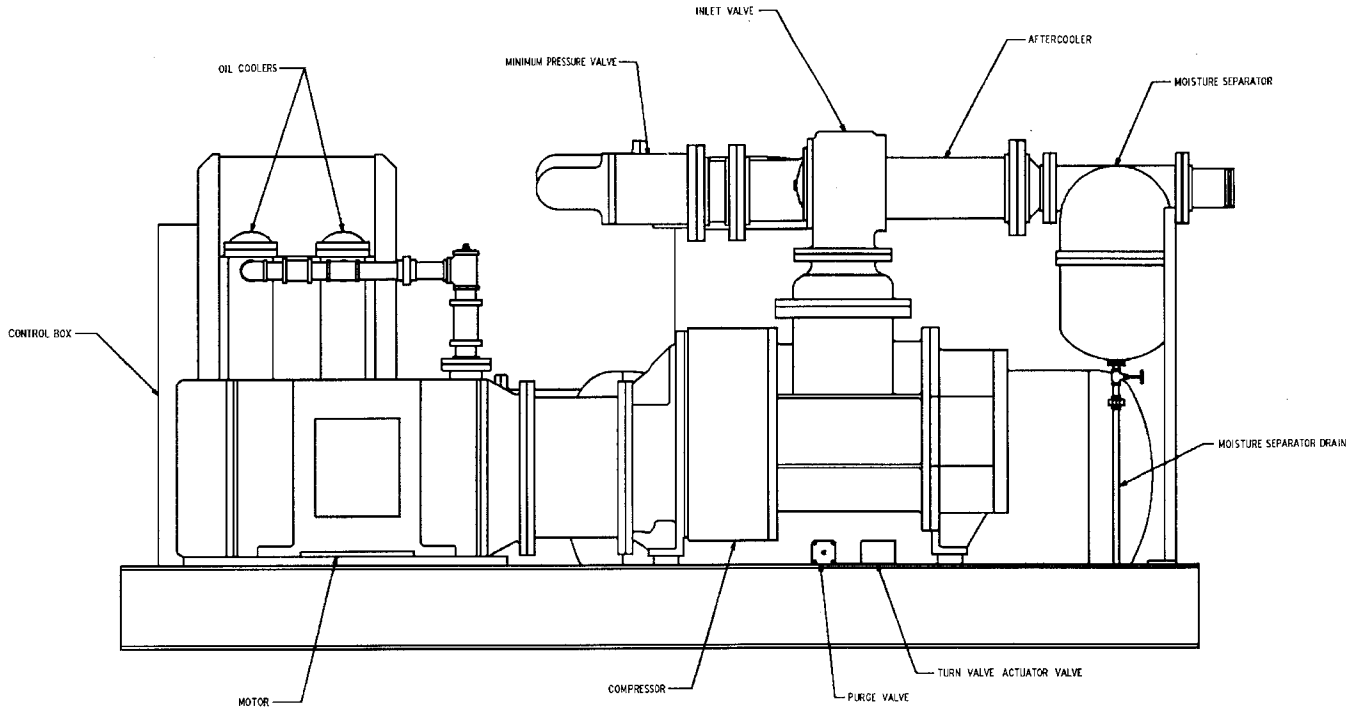


FIGURE 1-2 - VIEW OF WATER COOLED UNIT WITH AFTERCOOLER (LESS ENCLOSURE) COMPRESSOR - MOTOR SIDE

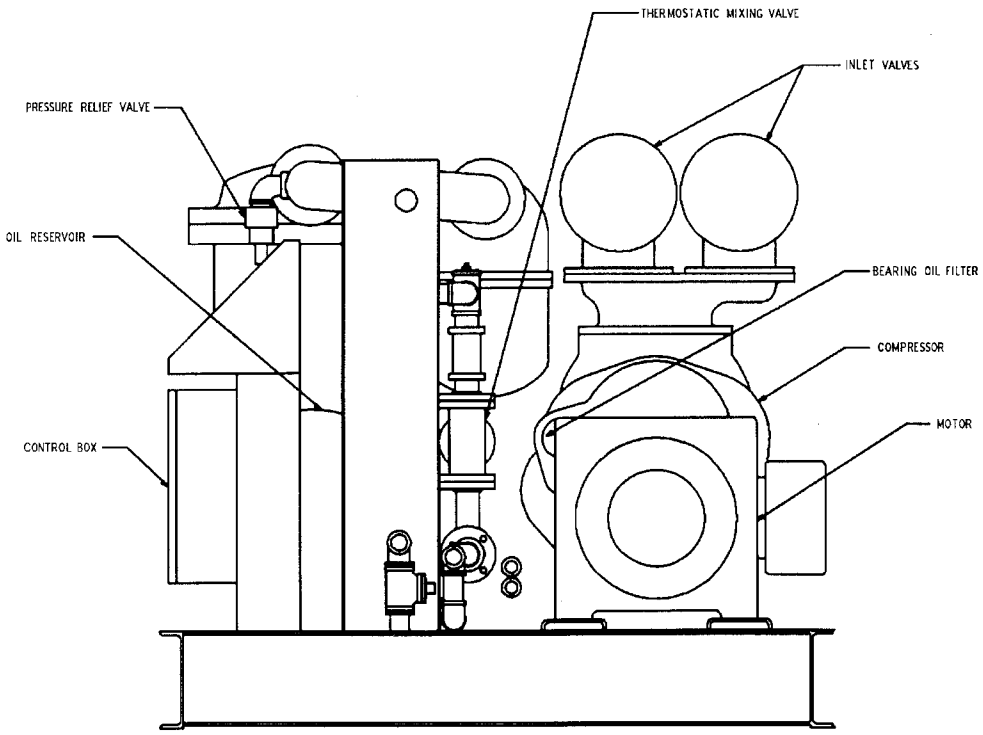


FIGURE 1-3 - VIEW OF WATER COOLED UNIT WITH AFTERCOOLER (LESS ENCLOSURE) MOTOR END

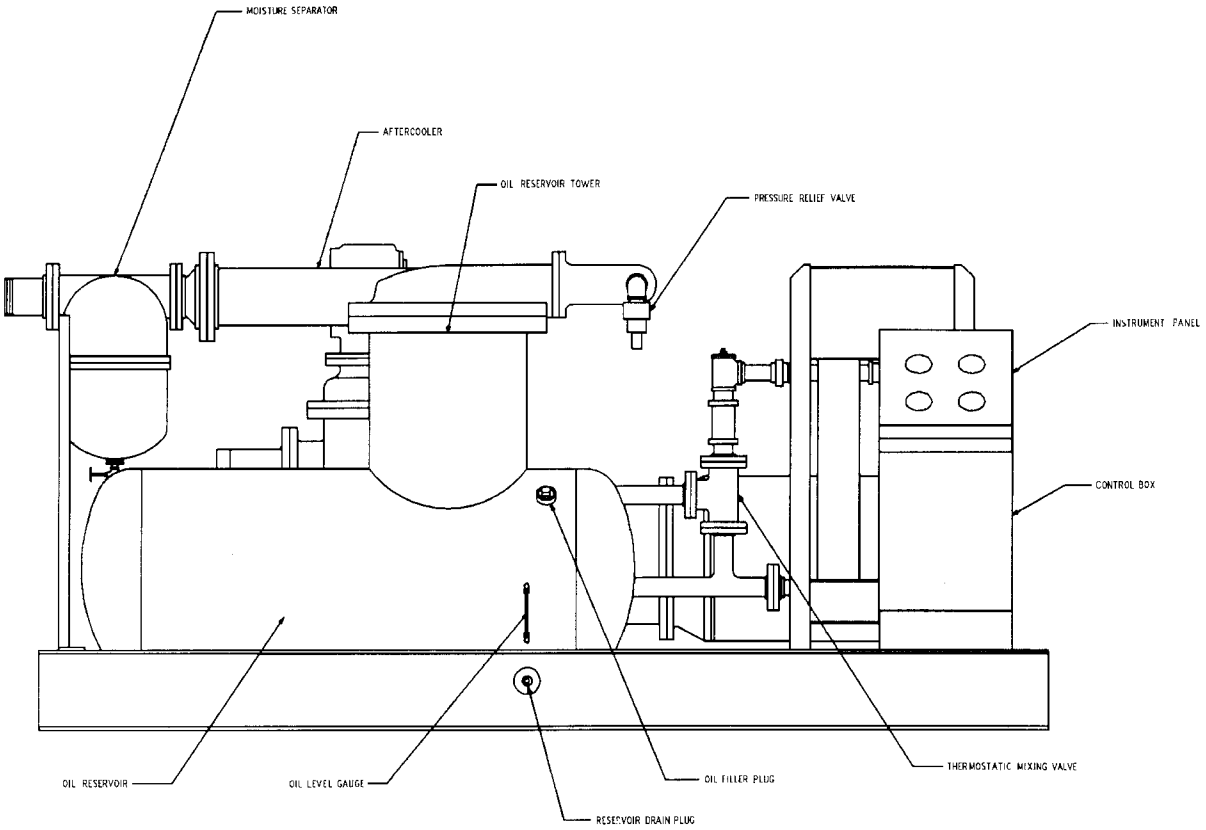


FIGURE 1-4 - VIEW OF WATER COOLED UNIT WITH AFTERCOOLER (LESS ENCLOSURE) COMPRESSOR - RESERVOIR END

SAFETY PRECAUTIONS

Safety is everybody's business and is based on your use of good common sense. All situations or circumstances cannot always be predicted and covered by established rules. Therefore, use your past experience, watch out for safety hazards, and be careful.

Some general safety precautions are given below:

⚠ DANGER

Failure to observe these notices could result in injury to or death of personnel.

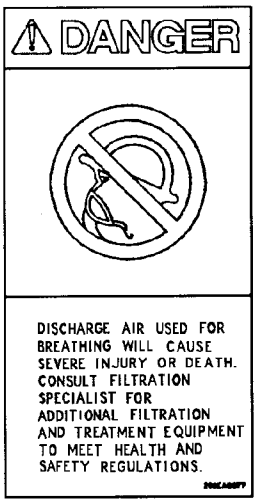
- **Keep fingers and clothing away from revolving fan, drive coupling, etc.**
- **Do not use the air discharge from this unit for breathing - not suitable for human consumption.**
- **Do not loosen or remove the oil filler plug, drain plugs, covers, the thermostatic mixing valve or break any connections, etc. in the compressor air or oil system until the unit is shut down and the air pressure has been relieved.**
- **Electrical shock can and may be fatal.**
- **Compressor unit must be grounded in accordance with the National Electrical Code. A ground jumper equal in size to the equipment ground conductor must be used to connect the compressor motor base to the unit base.**
- **Fan motors must remain grounded to the main base through the starter mounting panel in accordance with the National Electrical Code.**
- **Open main disconnect switch, tag and lockout before working on the control.**
- **Disconnect the compressor unit from its power source, tag and lockout before working on the unit - this machine is automatically controlled and may start at any time.**

⚠ WARNING

Failure to observe these notices could result in damage to equipment.

- **Stop the unit if any repairs or adjustments on or around the compressor are required.**
- **Disconnect the compressor unit from its power source, tag and lockout before working on the unit - this machine is automatically controlled and may start at any time.**
- **An Excess Flow Valve should be on all compressed air supply hoses exceeding 1/2 inch inside diameter. (OSHA Regulation, Section 1926.302)**
- **Do not exceed the rated maximum pressure values shown on the nameplate.**
- **Do not operate unit if safety devices are not operating properly. Check periodically. Never bypass safety devices.**

DECALS



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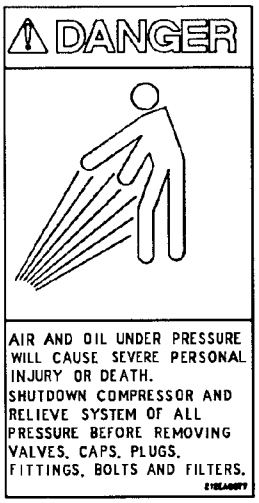

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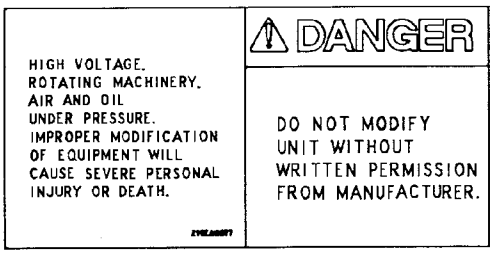

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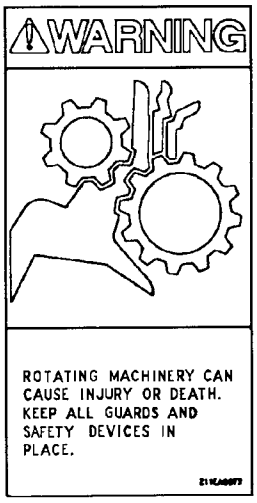

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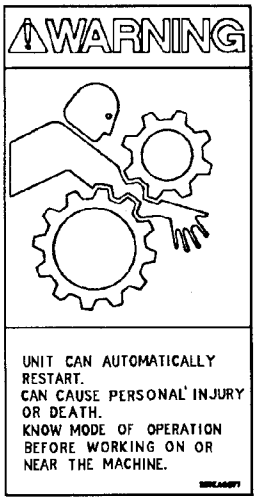

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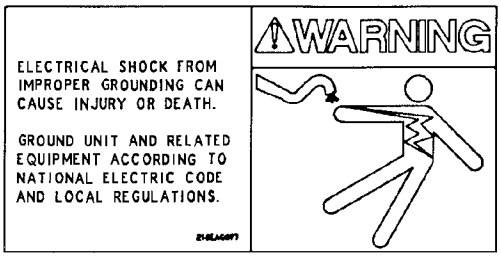

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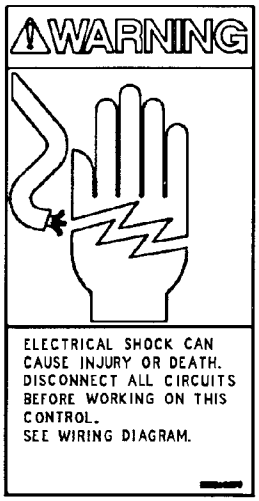

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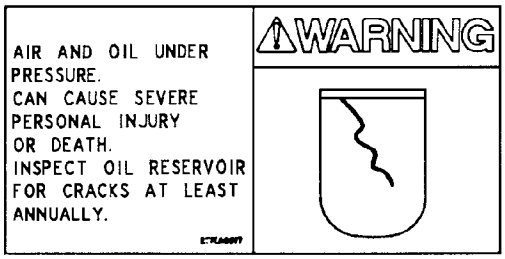

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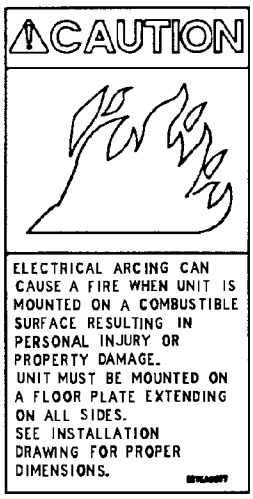

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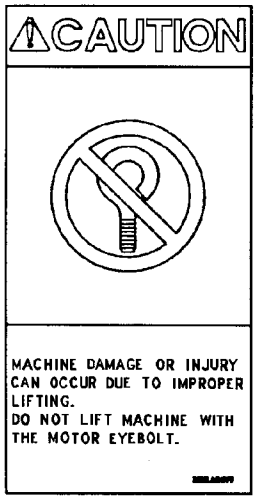

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SECTION 2
INSTALLATION

GENERAL - On receipt of the unit, check for any damage that may have been incurred during transit. Report any damage or missing parts as soon as possible.

⚠ CAUTION

Do not electric weld on the compressor or base; bearings can be damaged by passage of current.

LIFTING UNIT:

⚠ CAUTION

Lift compressor unit by base only. Do not use other places such as motor, compressor or discharge manifold piping as lifting points.

⚠ DANGER

The eyebolts or lugs provided on the motor are for lifting the motor only and should not be used to lift any additional weight. All eyebolts must be securely tightened. When lifting the motor the lifting angle must not exceed 15 degrees. Failure to observe this warning may result in damage to equipment or personal injury.

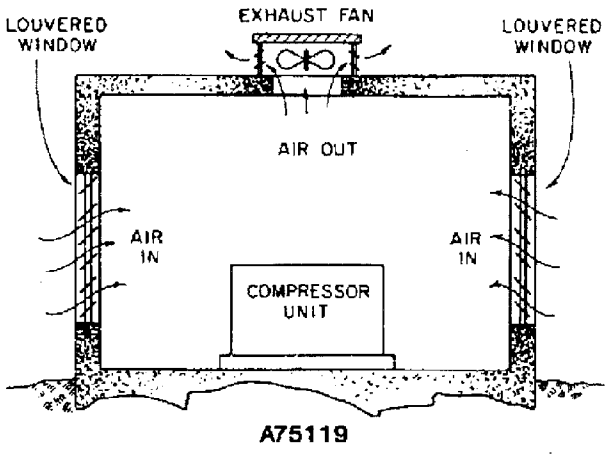


FIGURE 2-1 - TYPICAL COMPRESSOR ROOM

LOCATION - The compressor should be installed in a clean, well-lighted, well-ventilated area with ample space all around for maintenance. Select a location that provides a cool, clean, dry source of air. In some cases it may be necessary to install the air filter at some distance from the compressor to obtain a proper air supply.

The compressor unit requires electric motor cooling air as well as air to the compressor inlet. Proper ventilation MUST be provided (Figure 2-2); hot air must be exhausted from the compressor operating area. A typical inlet-outlet air flow arrangement is show in Figure 2-1.

If the air-cooled oil cooler module is to be installed at a location remote from the compressor unit, be sure that adequate ventilation is provided, Figure 2-2. Hot air must be exhausted from the oil cooler area.

Do not block the air flow to and from the unit. Allow 3-1/2 feet to the nearest obstruction on the control box side of the unit and 3 feet on all other sides.

Size	Open Compressor Unit	Aftercooler and Oil Cooler Module	Open Unit With Aftercooler & Oil Cooler Module Discharge In Same Room
350 HP	12,600	31,500	44,100
400 HP	14,400	31,500	45,900
500 HP	18,000	31,500**	59,500**

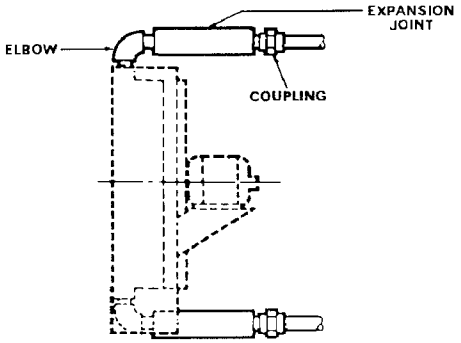
* 80° F Inlet Air

** If unit is supplied less aftercooler, add 8,250 cubic feet per minute.

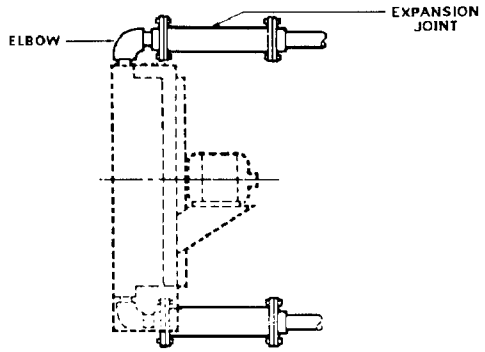
FIGURE 2-2 - MINIMUM AIR* FLOW FOR COMPRESSION AND COOLING (Cubic Feet/Minute)

VENTILATION - The unit, whether air- or water-cooled, requires sufficient air flow, Figure 2-2, for electric motor cooling. Air is drawn into the back and front of the motor and is discharged out the sides. Do not block air flow to and from the unit.

FOUNDATION - The Electra-Saver® compressor requires no special foundation but should be mounted on a smooth, solid surface of sufficient strength to support the weight of the unit. Whenever possible, install the unit near level. Temporary installation may be made at a maximum of 10° angle lengthwise or 30° sidewise.



PIPING SCHEMATIC OF COOLER WITH SCREWED CONNECTIONS



PIPING SCHEMATIC OF COOLER WITH FLANGED CONNECTIONS

FIGURE 2-3 - PIPING SCHEMATIC

Mounting bolts are not normally required. However, installation conditions such as piping rigidity, angle of tilt, or danger of shifting from outside vibrations or moving vehicles may require the use of mounting bolts to the foundation.

OIL RESERVOIR DRAIN (Figure 1-5, Section 1, page 3) - The oil reservoir drain valve is located near the center of the oil reservoir just below the separator tower. The drain valve is approximately five (5) inches from the floor level. If this height is not sufficient to conveniently drain the oil, some other methods of providing oil drain are:

1. Elevate the compressor unit on the foundation to obtain the desired drain height.
2. Construct an oil sump or trough below the floor level and pump or bail the drained oil.
3. Pump oil from the reservoir filler opening or reservoir drain to a container.

ACOUSTIC ENCLOSURE - The Electra-Saver unit is furnished with an acoustic enclosure over the compressor only, as standard equipment. The enclosure reduces the normal operating sound of the unit to 90 DBA or below in free field conditions.

AIR-COOLED OIL COOLER MODULE - The air-cooled oil cooler is a separate module and may be mounted remote to the compressor unit.

Ventilation - The oil cooler requires adequate cooling air flow. Proper ventilation MUST be provided, with hot air exhausted away from the cooler; take care that hot air is not recirculated from the exhaust to the inlet side of the cooler. Cooling air flow direction is from the motor side through the grille side of the oil cooler. Do not obstruct the air flow to or from the cooler. Allow two (2) feet clearance on all sides of the cooler module. See Figure 2-2, previous page, for cooling air flow requirements.

Low Oil Pressure Protection - The standard factory-installed low oil pressure shutdown switch in the control box will prevent start-up or shut the unit down if oil pressure is not established or maintained due to malfunction in the oil cooler system.

Oil Cooler - Location and General Piping - The oil cooler module can be mounted in any of several remote locations: close coupled but not joined to the compressor unit; horizontal remote, located on the same level as the compressor unit, but some distance away; or overhead remote, located above level of the compressor unit, as on a roof.

⚠ WARNING

The machine cannot be run blown down with remote overhead oil cooler. These units require special wiring diagram - check with factory. Running the machine blown down with an overhead cooler could result in damage to compressor.

All piping and wiring between the compressor unit and the remote oil cooler is to be supplied by the user. **THE DESIGN OF THE REMOTE OIL COOLER MODULE SYSTEM MUST BE APPROVED BY THE FACTORY BEFORE INSTALLATION**. The design information to be submitted for approval includes:

1. Location of oil cooler module - inside or outdoors.
2. Range of operating ambient temperatures at the oil cooler location.
3. Elevation of the oil cooler above the compressor unit.

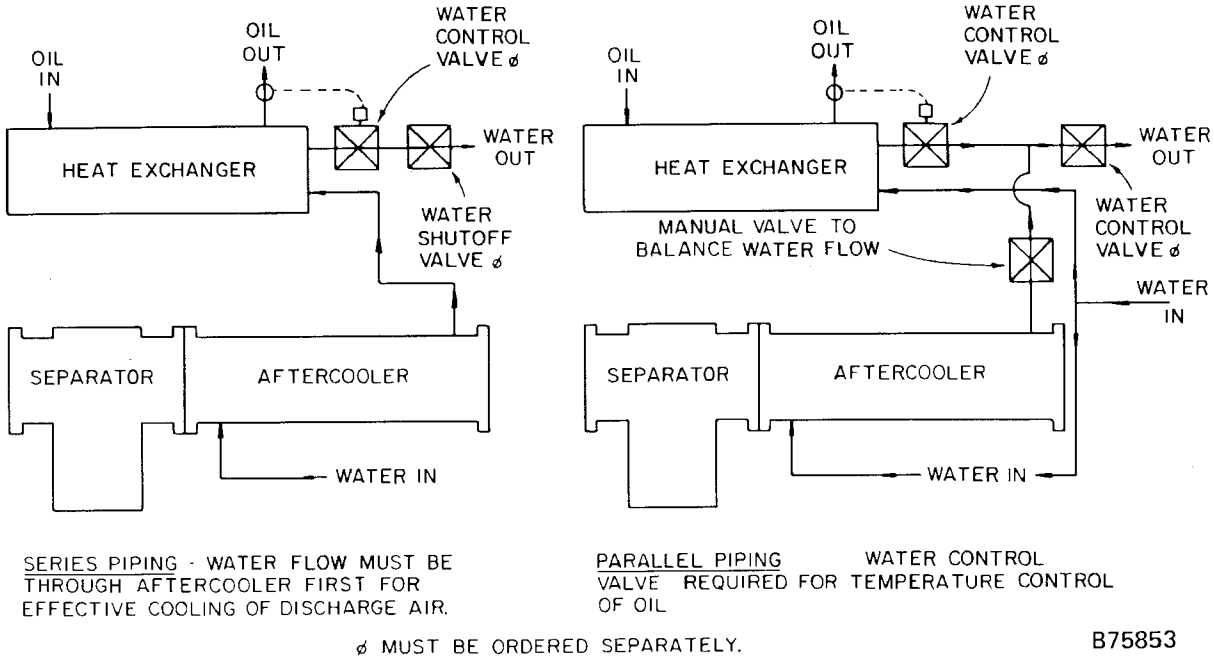


FIGURE 2-4 - PIPING DIAGRAM FOR AFTERCOOLER AND HEAT EXCHANGER

4. Pipe type and size(s) to be used to connect the oil cooler and the compressor unit. Minimum pipe size is 2-1/2" NPT.
5. Horizontal and vertical lengths of the pipe run. If more than one pipe size is used, list length of each size and total length.
6. Number and size of elbows, tees, unions, reducers, and valves to be used in the pipe run.
7. A dimensional sketch of the proposed piping system showing location of the compressor unit, oil cooler, and pipe and fittings of 3 through 6 above.

All remote piping should be of adequate size to insure the minimum pressure loss. Number 4 above lists the pipe size at the compressor unit oil inlet and outlet connections and is the minimum pipe size to be used. Long runs of pipe and the use of valves and fittings require larger than the minimum pipe sizes in the system to keep the pressure loss low. All pipe and fittings used in a remote oil cooler system should be galvanized or treated internally to prevent rust, and all valves are to be of a nonferrous construction to prevent corrosion and fouling.

The remote cooler should be placed so that the fan air flow through the cooler (air flow is from motor side through core) and the prevailing winds are in the same direction. A baffle should be provided on the exhaust side of the cooler for protection against occasional wind shifts.

When the oil cooler is mounted above the compressor unit, a check valve is to be mounted on the compressor unit in the line to the oil cooler; see Figure 5-4, Section 5, page 6. A pneumatic pilot-operated normally-closed valve is to be mounted at the oil filter inlet on the compressor unit line from the oil cooler; see Figure 5-4, Section 5, page 6. The check valve permits oil flow to the oil cooler during operation, but prevents return oil flow from the cooler when the unit is shut down. The pilot valve is held open by air pressure from the unit oil reservoir during operation and closes under spring load when the unit is shut down to prevent return oil flow from the oil cooler.

An oil filler stand pipe and plug must be located in the piping on the oil cooler module for ease of filling of a remote oil cooler, see Figure 5-4, Section 5, page 6.

Oil Cooler - Installation - Inspect unit upon arrival. In case of damage, report immediately to transportation company. Before installation, check rating plate on motor to verify that power input and motor specification requirements match available electric power at point of installation.

1. Set the unit level on a firm, solid foundation. The larger oil cooler models have lifting holes to facilitate unit hoisting.
2. Allow for linear expansion and contraction of piping in the direction away from the oil cooler. Use flexible connectors or suitable expansion joints on all oil cooler inlet and outlet piping. See Figure 2-3, page 2, this section, for typical schematics.

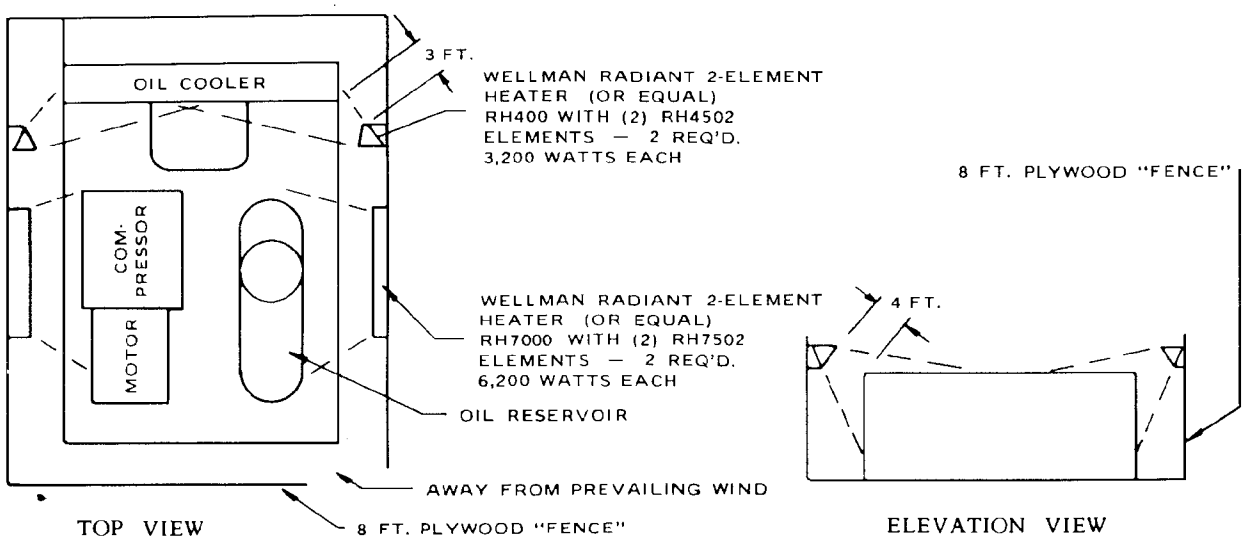


FIGURE 2-5 - COLD WEATHER INSTALLATION

3. Select properly tensioned and aligned piping support clamps or hangers and position them to relieve any piping stress at the oil cooler inlet and outlet ports. Do not support from flexible connectors.
4. Service - For continuous efficiency, oil cooler cores must be periodically cleaned with either vacuum or compressed air. If wet cleaning is required, shield motor and spray on a mild soap solution and flush with clear water.

AUXILIARY AIR RECEIVER - The unit requires an auxiliary air receiver unless the piping system is large and provides sufficient storage capacity to prevent rapid cycling. When used, an air receiver should be of adequate size, provided with a relief valve of proper setting, a pressure gauge, and a means of draining condensate.

AFTERCOOLER (Figures 1-2 and 1-5, Section 1, pages 2 and 3) - An aftercooler will provide control of moisture entering the shop air lines while reducing the normal low discharge temperature of about 180° F at 100 PSIG discharge pressure to near inlet air temperature, or cooling water temperature.

Air-Cooled Machines - When an aftercooler is furnished on an air-cooled machine, the aftercooler is installed on the oil cooler module between the fan and the oil cooler. The moisture separator is furnished by Gardner-Denver but must be mounted by the customer between the aftercooler and the auxiliary air receiver with a condensate drain provided at the bottom. All air piping from the compressor discharge to aftercooler to auxiliary air receiver is to be furnished and mounted by customer. **The design of the aftercooler piping must be approved by the factory before installation.** Design information to be submitted for approval includes:

1. Location of aftercooler module - inside or outdoors.
2. Range of operating ambient temperatures at the aftercooler location.
3. Pipe type and size(s) to be used to connect the aftercooler, separator, and compressor unit - minimum pipe size is 5" NPT.
4. Lengths of the pipe run. If more than one pipe size is used, list length of each size and total length.
5. Number and size of elbows, tees, unions, reducers, and valves to be used in the pipe run.
6. A dimensional sketch of the proposed piping system showing location of the compressor unit, aftercooler, separator and auxiliary air receiver, pipe and fittings of 3 through 5 above.

Water-Cooled Machines (Figure 2-4, page 3, this section) - On water-cooled machines with aftercooler, the moisture separator and condensate drain are shipped loose and must be installed by customer. Customer must furnish and install all water piping required.

INSTALLATION FOR COLD WEATHER OPERATION - It is recommended that whenever possible the unit be installed inside a shelter that will be heated to temperatures above freezing (32° F, 0° C). This will eliminate many of the problems associated with operating the units outside in cold climates where freezing rain, drifting snow, freezing condensate, and bitter cold temperatures are encountered.

Refer to Engineering Data Sheet 13-9-411 for the advantages of using the heat recovered from rotary compressors. This heat recovery could easily pay for an adequate shelter for the unit.

When an outside installation must be made, the precautions required will depend on how severe the environment will get. Following are general guidelines for outside installations:

Cold Weather (Down To +10° F)

1. Be sure all control lines, drains, and traps are heated to avoid freezing of condensate. Heat tape with thermostat control is generally satisfactory for this purpose and can be obtained at various local plumbing or hardware outlets.
2. If an air-cooled aftercooler is to be used, provisions to bypass the aftercooler should be made. Since cold air contains very little moisture, successful operation can be achieved without the aftercooler. Successful operation down to +15° F can be accomplished by reversing fan flow, but cooler bypass should still be provided should it be required.
3. Provide at least some simple shelter such as a plywood windbreak to protect against drifting snow.
4. Use only Gardner Denver AEON 9000 SP Lubricating Coolant.
5. Monitor unit carefully during start-up and operation to be sure it is functioning normally.
6. Use NEMA 4 enclosure for electrical devices.

Extreme Cold Weather Operation (Down To -40° F.) - In addition to recommendation for +10° F. installations, the following should be provided:

1. A temperature switch to control the fan should be provided for better starting and quicker warm-up. This switch can be provided from the factory and will delay fan start-up until discharge temperature reaches approximately 150-160° F.
2. It will probably be necessary to provide shutters or to block off part of the cooler in some manner since the cooler is greatly oversized for operation in these low temperatures. Shutters are not a factory option.
3. Coolers should be located as close to the unit as possible. Long lines to and from the cooler only further complicate the circulation of oil flow on cold starts. Heat tape and insulation may be required on oil lines.
4. Some means of providing heat to the oil reservoir and cooler during shutdown should be provided. There are various methods to accomplish this, but since openings are not provided for sump heaters, the use of radiant heaters is recommended. The heaters should be sized to provide at least a +10° F. environment for the coolers, motor, and sump. Figure 2-5, previous page, shows how these might be located in a typical installation and sizes required.

Remember unsheltered (outside) installations should be avoided where possible. Installation next to a heated building where enough heat can be used to keep the compressor room above freezing will save many complications in the operation and installation of the unit.

CONTROL PIPING - Control piping is not necessary since the Electra-Saver® unit is factory-wired and piped for the control system specified.

INLET LINE - Where an inlet line is used between the air filter and the compressor, it must be thoroughly cleaned on the inside to prevent dirt or scale from entering the compressor. **If welded construction is used, the line must be shot blasted and cleaned to remove welding scale.** In either case, the inlet line must be coated internally by galvanizing or painting with a moisture and oil-proof sealing lacquer. The inlet line should be the full size of the inlet opening on the compressor. If an extra-long line is necessary, the pipe size should be increased. See table below.

Accessibility for inlet air filter servicing must be considered when relocating the filters from the unit to at remote location.

DISCHARGE SERVICE LINE - The discharge service line connection on water-cooled units with aftercooler is made at the moisture separator. On air-cooled units and water-cooled without aftercooler, the connection is made at the pipe nipple located behind the instrument panel. When manifolding two or more Electra-Saver units on the same line, each unit is isolated by the check

INLET LINE LENGTHS

Length of Inlet Line	Diameter of Pipe Size
0 to 10 Feet	Same as Compressor Inlet Opening
10 to 17 Feet	One Size Larger Than Inlet Opening
17 to 38 Feet	Two Sizes Larger Than Inlet Opening

HEAT EXCHANGER							
Size	Rated Pressure PSIG	Water Temperature To Heat Exchanger				Maximum Water Flow	Approx. Water Pressure Drop @ Maximum Flow (PSI)
		60°F.	70°F.	80°F.	90°F.		
350 HP	ALL	33	42	56	83	120	21.0
400 HP	ALL	38	48	64	95	120	21.0
500 HP	ALL	48	60	80	119	130	17.0

The maximum water flow shown is allowable through the heat exchanger.

FIGURE 2-6 - HEAT EXCHANGER (OIL COOLER) APPROXIMATE WATER FLOW (U.S. Gallons/Minute)

AFTERCOOLER							
Size	Rated Pressure PSIG	Water Temperature To Aftercooler				Maximum Water Flow	Approx. Water Pressure Drop @ Maximum Flow (PSI)
		60°F.	70°F.	80°F.	90°F.		
350 HP	ALL	8.4	10.5	14.0	21.6	100.0	10.0
400 HP	ALL	9.4	11.7	15.6	23.5	100.0	10.0
500 HP	ALL	11.3	14.1	18.8	29.0	100.0	10.0

Water flow rates (gpm) are based on 110° F water temperature out of cooler. Maximum water flow shown is the maximum allowable flow through aftercooler.

FIGURE 2-7 - AFTERCOOLER APPROXIMATE WATER FLOW (U.S. Gallons/Minute)

valve in the unit discharge line. Additional check valves are not necessary and may cause multi-unit operational problems.

If an Electra-Saver unit is manifolded to another compressor, be sure the other compressor has a check valve in the line between the machine and the manifold.

If an Electra-Saver and a reciprocating compressor are manifolded together, an air receiver must be located between the two units.

⚠ DANGER

Do not use the air discharged from this unit for breathing - it is not suitable for human consumption. Use of this air for breathing may result in personal injury or death.

WATER PIPING (Water-Cooled Heat Exchanger Models Only) - On machines equipped with a water-cooled heat exchanger, pipe water to the inlet of the heat exchanger. Pipe outlet water from the outlet or magnetic water shutoff valve to a sump or drain. The thermal bulb of the water flow control valve is inserted in the heat exchanger oil outlet line; refer to the unit outline drawing for location.

The water source should be capable of supplying up to the maximum flow shown in Figure 2-6 at a minimum pressure of 40 PSIG; maximum allowable water pressure is 150 PSIG. The water flow rates shown in Figure 2-6 are approximate and a guide to sizing piping, cooling tower and other water system equipment.

The heat exchanger is designed to operate with water inlet temperatures from 60° F. to 90° F., and a water outlet temperature not to exceed 110° F. If water cooler than 60° F is used, high water outlet temperatures (over 110° F.) will be experienced along with shortened heat exchanger life caused by tube fouling and corrosion. If water warmer than 90° F. is used, higher compressor oil temperatures and high water usage will result.

Most water systems will require control of impurities: filtration, softening, or other treatment. See "Compressor Oil Cooler - Water-Cooled Heat Exchanger" for more information on the water system.

Aftercooler - Heat Exchanger Water Piping (Figure 2-4, page 3, and Figures 2-6 and 2-7, page 6, this section) - If an aftercooler is used and piped in series with the heat exchanger, install the water flow control valve and magnetic water shutoff valve, if used, downstream of the exchanger. Pipe the aftercooler water outlet to the heat exchanger water inlet on the compressor unit.

If the aftercooler is piped in parallel with the heat exchanger, provide a manual valve between aftercooler outlet and heat exchanger outlet after the water control valve to adjust aftercooler water flow for discharge temperature required and most economical water use; separate water inlet lines are piped to the aftercooler and heat exchanger.

If the standard factory built-in aftercooler is used, the maximum allowable water flow through the aftercooler is 100 gallons per minute on all 350 - 500 HP units and the maximum water inlet pressure is 150 PSIG. If another aftercooler is used, consult the manufacturer for operating limits.

⚠ CAUTION

When an aftercooler is piped in series with the oil cooler, the maximum allowable water flow rate through the oil/aftercooler system is the maximum allowed by the aftercooler. If the oil cooler requires more water flow than the maximum allowed by the aftercooler, a parallel water piping system must be used.

The water control valve MUST be used to maintain discharge temperatures approximately 10° F. over the dew point for expected ambient (Figure 5-7, Section 5, page 8). See Section 5 for adjustment instructions and maximum allowable oil temperature.

ELECTRICAL WIRING - The Electra-Saver® unit is furnished with the compressor motor enclosure as specified by the user. If unit has an air-cooled oil cooler, this fan motor is a totally enclosed "air-over" or "fan-cooled type" and is complete with starter and enclosure as specified by the user. Allow 42" deep by 30" wide clear space to the nearest obstruction in accordance with Article 110-16(a), National Electric Code.

It is necessary to connect the compressor unit (and oil cooler, if used) to a main starter of the correct size, power characteristics, and enclosure for the application. See Section 4 for typical wiring diagrams; however, use only the wiring diagrams supplied with the unit for final connections.

Starter - The main starter is to be mounted at a location selected by the user at the time of installation. The first three feet of line from the motor conduit box to the starter must be of flexible conduit to maintain effective vibration isolation. Electrical connections to other parts of the unit (instrument panel, fan motor, etc.) from the starter do not require flexible conduit since the compressor and motor are already isolated from these parts. See Table 110-16(a) National Electrical Code for correct working clearance.

⚠ WARNING

Electrical shock can cause injury or death. Open main disconnect switch, tag and lockout before working on starter/control box.

GROUNDING - Equipment must be grounded in accordance with Table 250-95 of the National Electric Code.

⚠ WARNING

Failure to properly ground the compressor package could result in controller malfunction.

MOTOR LUBRICATION - Long time satisfactory operation of an electric motor depends in large measure on the bearings and timely lubrication. The following charts show recommended grease qualities and regreasing intervals for motors supplied with ball bearings. For additional information refer to the motor manufacturers instructions.

The following procedure should be used in regreasing:

1. Stop the unit.
2. Disconnect, tag and lockout the unit from the power supply.
3. Remove the relief plug and free the hole of hardened grease.
4. Wipe the lubrication fitting clean and add grease with a hand-operated grease gun.

5. Leave the relief plug temporarily off. Reconnect the unit and run for about 20 minutes to expel the excess grease.

6. Stop the unit. Replace the relief plug.

7. Restart the unit.

⚠ WARNING

Rotating machinery can cause injury or death. Open main disconnect, tag and lockout power supply to the starter before working on the electric motor.

ELECTRIC MOTOR GREASE RECOMMENDATIONS

	Standard Service	High Temperature
Worked Penetration	265-296	220-240
Viscosity, SSU At 100°F (38° C)	400-550	475-525
Soap Type	Lithium	Lithium
N-H Bomb, Min. Hours For 20 PSI (1.4 Bar) Drop at 210°F (99°C)	750	1000
Bleeding, Maximum Weight % In 500 Hours 212°F (100°C)	10	3
Rust Inhibiting	Yes	Yes

ELECTRIC MOTOR REGREASING INTERVAL

Type of Service	Typical Examples	Rating	Relubrication Interval
Standard	One- or Two-Shift Operation	Over 150 HP	12 Months
Severe	Continuous Operation	Over 150 HP	6 Months
Very Severe	Dirty Locations, High Ambient Temperature	Over 150 HP	2 Months

SECTION 3
STARTING & OPERATING PROCEDURES

PRESTART-UP INSTRUCTIONS - A new unit as received from the factory has been tested and then prepared for shipping. Do not attempt to operate the unit until checked and serviced as follows:

1. **Compressor Oil** - Check oil level in the reservoir. Add oil only if the oil level gauge reads in the red "ADD OIL" range. Do not mix different type oils. Unit is shipped filled with Gardner-Denver® AEON™ 4000 Lubricating Coolant which is suitable for the first 6000 hours under normal operating conditions.

   REPLACE OIL FILTER EVERY 1000 HOURS.

   Initial fill, or filling after a complete draining of the system, may show the oil level in the yellow "EXCESS OIL" range. After start-up, the oil will fall into the green operating range as system components are filled. If necessary, add oil to bring the level to the top of the green range as read when the unit is operating at full load and normal pressure. See Figure 5-2, page 3, Section 5.

NOTICE

Regular maintenance and replacement at required intervals of the oil filter, air filter and air-oil separator is necessary to achieve maximum service and extended drain intervals of AEON 4000 lubricant. Use only genuine Gardner-Denver filters designed and specified for this compressor.

⚠ DANGER

Always stop the unit and release air pressure before removing oil filler plug. Failure to release pressure may result in personal injury or death.

   During unloaded operation and after shutdown, the system will partially drain back into the oil reservoir and the oil level may read higher than when operating on load. DO NOT DRAIN OIL TO CORRECT; on the next loaded cycle or start, oil will again fill the system and the gauge will indicate the operating level.

2. **Air Filter** - Inspect the air filter to be sure it is clean and tightly assembled. Refer to Section 6, "Air Filter," for complete servicing instructions. Be sure the inlet line, if used, is tight and clean.

3. **Coupling** - Check all bolts and cap screws for tightness. See Section 7.

4. **Piping** - Refer to Section 2, "Installation," and make sure piping meets all recommendations.

5. **Moisture Separator Trap** - The trap is constructed of cast iron with side inlet and outlet connections and inverted bucket design. A stainless steel internal strainer is used in the trap; it should be checked periodically for clogging and replaced if necessary. Repair parts are available for trap cap, retainer gasket and strainer. See package outlines for mounting dimensions of moisture separator trap.

   The moisture trap must be primed by filling with clean water prior to initial start-up of unit.

6. **Electrical** - Check the wiring diagrams furnished with the unit to be sure it is properly wired. See Section 4, "Controls and Instruments," for general wiring diagrams and Section 2 for installation instructions.

7. **Grounding** - Equipment must be grounded in accordance with Table 250-95 of the National Electrical Code.

⚠ WARNING

Failure to properly ground the compressor package could result in controller malfunction.

8. **Rotation** - Check for correct motor rotation by momentarily starting the motor. Compressor drive shaft rotation must be clockwise standing facing the compressor coupling.

⚠ WARNING

Operation with incorrect motor rotation can damage equipment and cause oil eruption from the compressor inlet. When checking motor rotation, induce minimum rotation (less than one revolution if possible). Never allow motor to reach full speed.

9. **Operating Light Test** - Observe the operating lights on the ON-OFF switch when jogging the motor in Step 8. Be sure all lamps are operative.

10. **System Pressure** - Set the controls to the desired unload pressure and differential. DO NOT EXCEED MAXIMUM OPERATING PRESSURE ON COMPRESSOR NAMEPLATE. See Section 4, "Controls and Instruments," for procedure.

⚠ WARNING

Operation at excessive discharge air pressure can cause personal injury or damage to equipment. Do not adjust the full discharge air pressure above the maximum stamped on the unit nameplate.

11. **Operating Mode** - Refer to Section 4 for detailed information on the control system.

12. **Enclosure** - Check for damaged panels or doors. Check all screws and latches for tightness. Be sure doors are closed and latched.

STARTING THE UNIT - OBSERVE UNIT COLD OR HOT STARTING PROCEDURES.

Unit Cold - If the unit is a water-cooled heat exchanger model, open any manual water inlet valves wide open. Start the unit by pushing either the "CONSTANT RUN" button or one of the "AUTO" buttons. Since the unit is equipped with a minimum (65 psig) pressure discharge valve, no special procedure to maintain unit reservoir pressure is required.

Unit Hot - No warm-up period is required. If the unit is a water-cooled heat exchanger model, open any manual water inlet valves wide open. Start the unit by pushing either the "CONSTANT RUN" button or one of the "AUTO" buttons.

DAILY CHECK - Refer to Section 8, "Maintenance Schedule."

STOPPING THE UNIT - Press "STOP-RESET" button. The oil reservoir will automatically blow down as the motor stops. If the unit is a water-cooled heat exchanger type, close any manual water inlet valves.

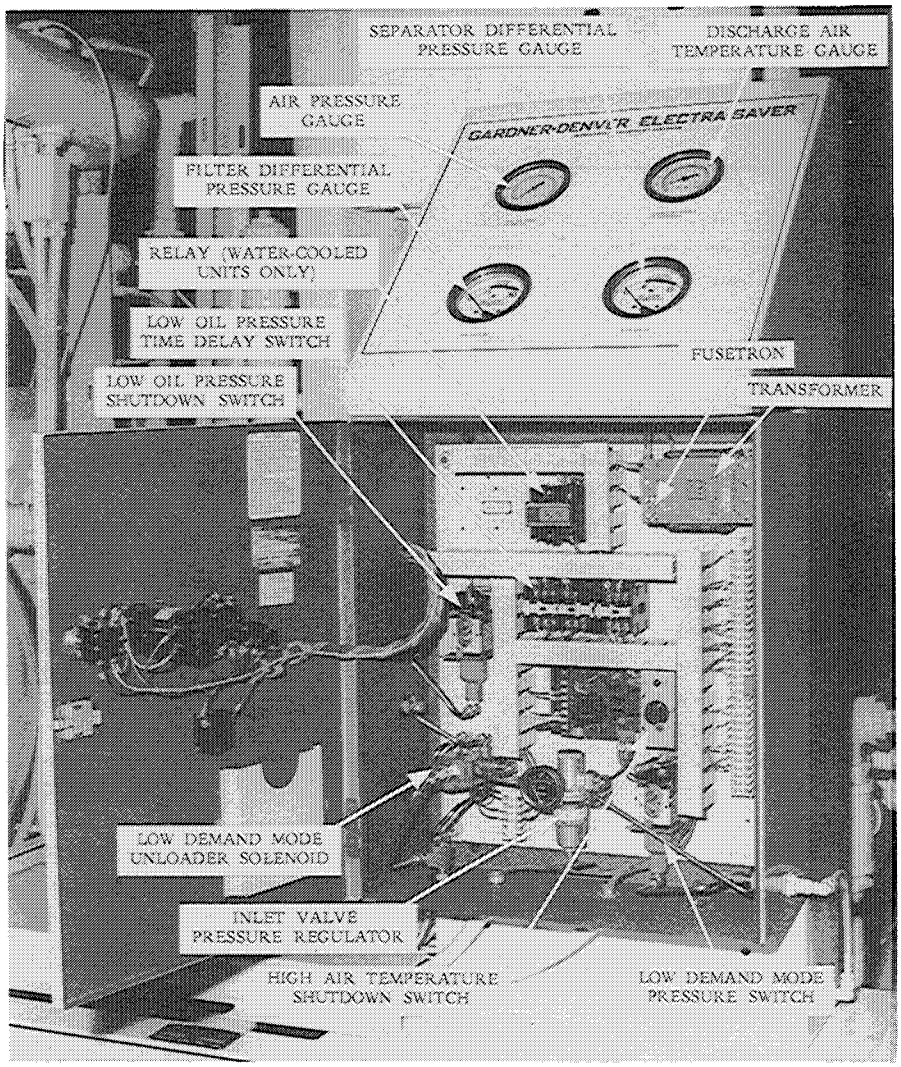


FIGURE 4-1 - INSTRUMENT PANEL AND CONTROL BOX INTERIOR

GENERAL - The Gardner Denver® Electra-Saver® compressor units are available with two different control systems:

Constant Speed With Low Demand Mode
Automatic Start/Timed Stop With Low Demand Mode

The standard Electra-Saver unit consists of the compressor, oil reservoir and cooler, air and oil filters, the control system specified, and open drip-proof motor, and a dust resistant control enclosure/instrument panel all mounted on a steel base. The compressor is isolated in an acoustic enclosure. The unit is factory wired for the voltage specified; electrical connection to a main starter, connection to the shop air line, shop water line or oil lines to air-cooled oil cooler are to be made by the user.

CONTROL VOLTAGE - The control voltage for the start-stop push button, hourmeter, pressure switch, high discharge temperature shutdown switch, and other electrical control devices is 115 volts regardless of power supply voltage. On standard units, the transformer in the control enclosure is connected to change the specified user's power supply voltage to 115 volt control voltage.

RESET - The Reset Button must be pushed whenever power is interrupted or turned off. For circuit interruption, see the paragraph relating to the specific safety device.

⚠ CAUTION

Do not continue to reset the manual reset if the same malfunction occurs within a short period of time. Find and correct the trouble before resuming operation.

Start-Stop/Reset Switch - Later model Constant Speed units with Low Demand switch using the two-probe high discharge temperature switch have a two-button Start-Stop/Reset switch in the control box door. The indicating pilot light is separately mounted adjacent to the switch.

On-Off-Reset Switch - Later model Automatic Start/Timed Stop units with Low Demand switch that use the two-probe high discharge temperature switch have a three-button On-Off-Reset switch in the control box door. The indicating pilot light is separately mounted adjacent to the switch.

Pilot Light - Later model units with either Constant Speed or Automatic Start/Timed Stop control system and the two-probe high discharge temperature switch have an indicating pilot light mounted in the control box door. The amber lighted ON indicates compressor running under Constant Speed Control. Under Automatic Start/Timed Stop, the compressor may be stopped with the amber light ON indicating power on. The blue lighted LOAD indicates compressor is loaded.

To replace the bulbs in the pilot light (replacement bulb number is Sylvania 120 PSB or equal):

1. Turn power off at main breaker panel, tag and lockout.
2. Open control panel.
3. Turn slotted locking screw on upper side of pilot light body counterclockwise 1/4 turn and remove the body from the lens holder.
4. Remove old bulb located in the body and insert the new bulb.
5. Reassemble body to lens holder and secure by turning locking screw 1/4 turn clockwise.
6. Restore power to the unit.

ON-OFF SWITCH (Figure 1-2, Section 1, page 2) - Early model Constant Speed units with Low Demand Mode switch and the units with Automatic Start/Timed Stop with Low Demand Mode have an ON-OFF push button with an amber lighted section to indicate ON (compressor running) and a green lighted section to indicate LOAD (compressor loaded). The red bar on the bottom of the ON-OFF switch is the OFF and RESET on the Constant Speed unit with Low Demand Mode. The black bar on the bottom of the Automatic Start/Timed Stop ON-OFF switch is the RESET.

To replace the bulb (Sylvania 120 PSB or equal) in any of the switches:

1. Turn the power off at the main breaker panel, tag and lockout.
2. Open the control panel.
3. Turn the slotted locking screw on the upper side of the switch body counterclockwise 1/4 turn and remove the switch body from the switch operator.
4. Remove the old bulb located in the stem of the switch body and insert the new bulb.
5. Reassemble the switch body to the operator and lock in place by turning the locking screw 1/4 turn clockwise.
6. Restore power to the unit.

LOW DEMAND MODE SWITCH (Figure 1-2, Section 1, page 2) - The low demand mode switch, when turned to the ON position, will blow the reservoir down when the compressor unloads. When switch is turned to OFF, unit will retain pressure in reservoir when unloaded.

⚠ WARNING

The low demand feature requires an adequately sized air receiver and/or piping loop system to prevent a too rapid cycle time and oil carryover.

⚠ CAUTION

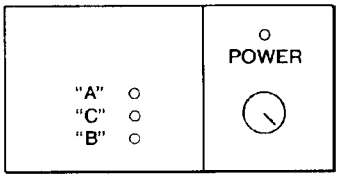
The low demand mode switch cannot be used with remote elevated oil coolers. These units require special wiring diagrams - check with factory. Use of low demand switch with elevated cooler could result in damage to compressor.

SAFETY DEVICES - Both control systems incorporate these safety devices:

Motor Protection Devices - Overload heaters are furnished for the air-cooled oil cooler fan motor starter in the voltage range specified. There are three (3) overloads of proper size for the starter and its enclosure. When replacing or changing overloads, be sure to select them from a 3-overload heater table, since the use of a

HIGH DISCHARGE TEMPERATURE SWITCH CONDITION CHART

"A" indicates Temperature Condition at Compressor Discharge.
"B" indicates Temperature Condition at Oil Separator.
"C" indicates Probe Condition.



CONDITION	POWER ON	"A"	"B"	"C"
POWER OFF	OFF	OFF	OFF	OFF
NORMAL TEMPERATURE	RED	RED	RED	OFF
COMPRESSOR HIGH TEMPERATURE	RED	OFF	RED	OFF
SEPARATOR HIGH TEMPERATURE	RED	RED	OFF	OFF
COMPRESSOR PROBE OPEN	RED	OFF	RED	GREEN
SEPARATOR PROBE OPEN	RED	RED	OFF	GREEN
COMPRESSOR PROBE SHORTED	RED	OFF	RED	RED
SEPARATOR PROBE SHORTED	RED	RED	OFF	RED
COMPRESSOR PROBE SHORTED/ SEPARATOR PROBE OPEN	RED	OFF	OFF	ORANGE
COMPRESSOR PROBE OPEN/ SEPARATOR PROBE SHORTED	RED	OFF	OFF	ORANGE

FIGURE 4-2 - TEMPERATURE SWITCH CONDITION CHART

third overload derates each overload for a given enclosure due to the extra heat. An overload from a 2-overload heater table would be undersize.

The overload heaters are in a common overload block in the starter and have a single common percentage adjustment knob with a 90 to 110% range. The knob is set at the factory on the 100% mark.

Main unit starter should be adequately fused and provided with overload heaters suitable for the application to provide protection for the unit drive motor.

High Discharge Temperature Switch - Later Models - Later models of the compressor unit are protected from high discharge temperature by a two-probe adjustable switch. One probe is located in the discharge pipe between the compressor and oil reservoir to sense compressor discharge air/oil mixture temperature. The second probe is located in the final discharge manifold and senses temperature of the air at the oil separators. The switch is located inside the control box (Figure 1-2, Section 1, page 2); the shutdown temperature is set on the adjustable dial. If the temperature of the air at either of the probes exceeds the temperature set on the dial, the switch will stop the unit. Press reset button of the Start/Stop (On-Off) switch, then the Start (On) button to restart the unit.

⚠ CAUTION

This adjustable switch dial must not be set higher than 225° F.

Do not continue to reset the circuit if the same malfunction occurs within a short period of time. Find and correct the trouble before resuming operation.

In addition to protecting the unit from damage or failure resulting from high air temperature, the switch also incorporates four (4) indicator lights which show the point of high temperature and/or the condition of the temperature probes. This information is shown on the decal inside the control box and in the Temperature Switch Condition Chart, Figure 4-2.

The High Air Temperature Switch may be checked periodically to assure proper operation. To check with the unit running, turn the dial on the switch to the temperature indicated by the discharge temperature gauge. The unit should shutdown. If it does not, check the temperature gauge accuracy and indicator lights - refer to the condition decal on the control box door for the malfunc-

tion. After operational check, always reset the switch dial to the proper setting (225° F.).

High Air Temperature Shutdown - Early Models - Early models of the compressor were protected from high discharge temperature by a temperature switch, with a single probe located in the discharge pipe between the compressor discharge and the oil reservoir. This switch is wired into the motor control circuit and will shut the unit down if the discharge temperature exceeds 225° F. The reset button must be pressed any time the unit is shut down due to high air discharge temperature.

⚠ CAUTION

This adjustable switch dial must not be set higher than 225° F.

Do not continue to reset the circuit if the same malfunction occurs within a short period of time. Find and correct the trouble before resuming operation.

This switch should be checked periodically to assure proper operation. To check with the unit running, reset the switch to the discharge temperature indicated by the discharge temperature gauge. The unit should shut down - if not, switch is inoperative and should be replaced. Always reset switch to proper setting after check (225° F.).

Automatic Blowdown Valve - A pilot operated valve piped into the oil reservoir final discharge manifold ahead of the check valve and connected to the unloader solenoid valve which is wired into the motor control circuit, will release pressure from the oil reservoir each time the unit is unloaded with low demand mode switch ON or when unit is shut down. The blowdown line is equipped with a muffler to reduce air discharge noise.

Relief Valve (Figures 1-2 & 1-3, Section 1, page 2) - A pressure relief valve is installed in the final discharge manifold and set at the factory to approximately 120% of the specified operating pressure for protection against overpressure. Periodic checks should be made to insure its proper operation. Never operate the unit without a proper relief valve setting.

The relief valves should be tested for proper operation at least once every year. To test the relief valve, raise the system operating pressure to 75% of relief valve set pressure and manually open the valve with the hand lever. Hold the valve open for a few seconds and allow it to snap shut.

⚠ WARNING

When the relief valve opens, a stream of high velocity air is released, resulting in a high noise level and possible discharge of accumulated dirt or other debris. Always wear eye and ear protection and stand clear of the discharge port when testing the relief valve to prevent injury.

⚠ CAUTION

Never paint, lubricate or alter a relief valve. Do not plug vent or restrict discharge.

⚠ WARNING

Operation of unit with improper relief valve setting can result in severe personal injury or machine damage.

Insure properly set valves are installed and maintained.

Low Demand Mode Pressure Switch (Figure 4-1, page 1, this section) - The low demand mode switch when turned ON will cause the low demand mode pressure switch to de-energize the low demand mode solenoid valve when the discharge pressure reaches the set point. This switch should be set approximately 5 PSI above full load pressure with an 8-12 PSI differential.

Low Demand Mode Unloader Solenoid (Figure 4-1, page 1, this section) - The low demand mode solenoid valve when energized supplies an air signal to close blowdown valve. When de-energized, it supplies an air signal to close compressor inlet valve and exhausts air to open blowdown valve.

Pressure Regulator (Figure 4-1, page 1, this section) - The pressure regulator must be set 15-20 PSIG to prevent inlet valve "slam".

Reservoir Pressure Switch (Figure 4-1, page 1, this section) - A pressure switch is connected to the discharge manifold and wired to the motor control circuit to prevent attempted starting of the unit when there is more than 5 PSIG pressure in the oil reservoir. This protects the unit from starting against load when the oil

reservoir has not had enough time to blowdown. Blowdown time is usually about 45 seconds.

⚠ WARNING

Do not set the switch higher than 5 PSIG or render the switch inoperative; severe damage to the motor can occur if started with pressure in the oil reservoir.

Low Oil Pressure Shutdown (Figure 4-1, page 1, this section) - Units are provided with a pressure switch piped to the compressor oil sump and wired into the motor control circuit to protect the unit against operation at too low an oil pressure and against complete lubrication failure due to an oil line restriction or sudden loss of oil pressure. The pressure switch is set 10-15 PSIG and will stop the unit if the oil pressure falls below this pressure any time during operation, and will prevent the unit being started if the oil pressure does not rise to 10-15 PSIG within 10 seconds of starting.

The pressure switch is set at 10-15 PSIG at the factory. If resetting is necessary:

1. Adjust the upper limit pressure to 15 PSIG by turning the slotted screw (pressure) near the top of the switch. Clockwise movement of the screw raises the pressure; counterclockwise lowers the pressure. Note approximate pressure setting is indicated on the range scale on the left face of the switch.

2. Adjust the lower limit pressure to 10 PSIG by turning the slotted screw (differential) near the bottom of the switch until the cam-shaped calibrated dial under the pressure setting screw indicates about 1/4 of full scale reading from lowest setting. Clockwise movement of the screw reduces the differential; counterclockwise increases differential. Note differential range (1-18 PSI) is indicated by marks on the cam-shaped dial.

If a unit with Constant Speed with Low Demand Mode Switch shuts down from low oil pressure, pressing the ON button will restart the unit. Since the Automatic Start/Timed Stop control is an automatic starting type, a reset relay is used as a positive means to interrupt the circuit on either a low oil pressure shutdown or high discharge air temperature shutdown; to restart these units, press the black bar marked RESET and then press the ON button.

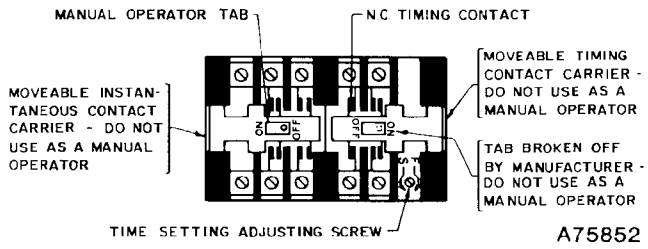


FIGURE 4-3 - LOW OIL PRESSURE TIME DELAY SWITCH

⚠ CAUTION

Do not continue to restart unit if the same malfunction occurs within a short period of time. Find and correct the trouble before resuming operation.

This switch should be checked periodically to assure proper operation. To check, disconnect the timed-opening instantaneous-closing time delay relay from the system at point 10 (see wiring diagram). Try to start unit - unit should not run - if it does, switch is inoperative and should be replaced. Be sure to reconnect the time delay after checking.

Low Oil Pressure Time Delay Switch (Figure 4-1, page 1, this section, and Figure 4-3, above) located in the control panel enclosure, is wired into the control circuit to provide the 10-second delay required for the compressor oil pressure to rise to 10-15 PSIG and energize the low oil pressure switch circuit.

To check the time delay switch setting:

1. Pull the main breaker switch, tag and lockout power.

2. Move the black timer tab located on the left half of the relay block to the ON position and hold. Timer will begin to run for set time.

3. Observe the action of the right hand set of contacts on the right half of the relay block; the contacts will open when the preset time runs out.

4. Adjustment of time delay setting is made by turning screw on lower right face of relay block to a faster (F) or slower (S) setting. Recheck setting of relay as in NO. 2 and 3 above each time screw is turned.

5. Restore power to the unit.

⚠ WARNING

Timer is factory set at 10 seconds. Never attempt to adjust the timing relay for more than 15 seconds delay - serious compressor damage may result from operation without lubrication for even a short period.

⚠ CAUTION

Never disconnect safety devices that protect the unit.

INSTRUMENTS & GAUGES (Figures 1-3, Section 1, page 2 & 4-1, page 1, this section) - Both control system instrument panels incorporate the following:

Hourmeter - A continuous reading (non-reset) type hourmeter displays the accumulated operating time of the unit and provides a convenient means for scheduling changes of oil supply and servicing of filters, separators, and other devices.

Air Pressure Gauge - A direct reading air pressure gauge indicates final discharge air pressure at the discharge manifold.

Discharge Air Temperature Gauge - A direct reading temperature gauge indicates compressor discharge air temperature.

Pressure Differential Gauge - This gauge reads the pressure differential across the oil separators providing continuous monitoring of their condition and indicated when changing of the elements is required.

Air Filter Indicator - An air filter indicator is located on the instrument panel and indicates when the air filter requires servicing.

Oil Filter Differential Gauge - This gauge reads the pressure differential across the oil filter providing a continuous monitoring of its condition and indicates when changing of elements is required.

MINIMUM DISCHARGE PRESSURE/CHECK VALVE (Figures 1-2, Section 1, page 2, & 4-4, above) - An internal spring-loaded minimum pressure valve is used in the final discharge line to provide a positive pressure on the oil system of the compressor even when the air service valve is fully open. A renewable seat swing type check valve in the final discharge manifold prevents backflow of air from shop air line when the unit stops, unloads, or is shut down.

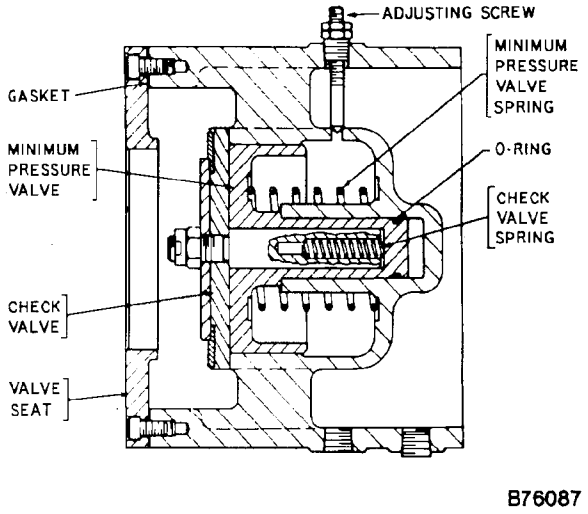


FIGURE 4-4 - MINIMUM DISCHARGE PRESSURE/CHECK VALVE

The valve incorporates an orifice which, when air is flowing through it, maintains approximately 65 PSIG in the oil reservoir. A spring-loaded piston valve senses air pressure on the downstream (shop air line side) of the valve. When system pressure rises above 65 PSIG, the spring is overridden and the valve opens to full porting.

The valve does not require maintenance or adjustment. If the valve fails to function, check the valve stem O-rings for sealing, valve orifices for restriction, or valve and valve seat for burrs and dirt.

The valve is adjustable within a small range. It is adjusted by a set screw secured by a locknut on the side of the valve body. The minimum pressure can be adjusted as follows:

1. Start the compressor.
2. Reduce pressure downstream of minimum pressure valve to below desired minimum pressure. DO NOT REDUCE DOWNSTREAM PRESSURE OR ADJUST VALVE BELOW 65 PSIG.
3. Loosen locknut on adjusting screw.
4. Turn set screw in to increase, or out to decrease minimum pressure to be held.
5. Hold set screw at the desired point and tighten locknut.

COMPRESSOR CAPACITY CONTROL - The capacity of the compressor is controlled by the action of the Turn Valve and the Compressor Inlet Valve.

The turn valve reduces compressor capacity down to approximately 40% and the inlet valve then throttles the compressor from 40% to approximately 20% compressor capacity.

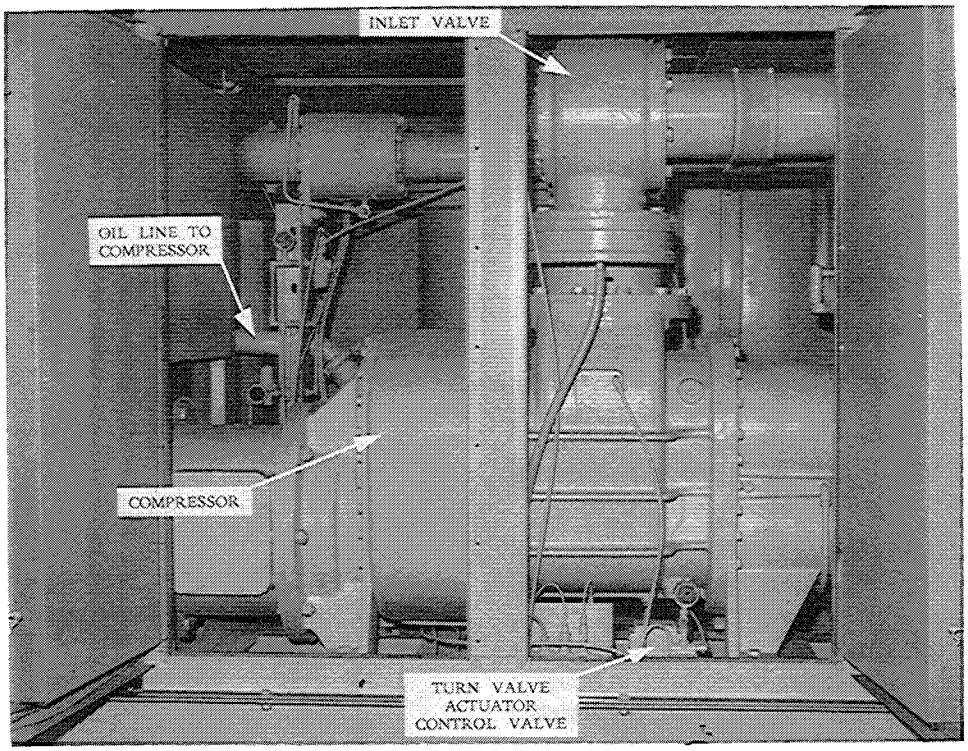


FIGURE 4-5 - VIEW INSIDE COMPRESSOR ENCLOSURE

On Constant Speed Control with low demand mode switch in the ON position, the reservoir will blow down at below 20% compressor capacity. On Automatic Start/Timed Stop Control with low demand mode switch in the ON position, at below 20% capacity, the reservoir will blow down and the timer will start timing. The unit will stop if air demand does not increase before the timer runs out.

On Constant Speed Control and Automatic Start/Timed Stop Control systems with the low demand mode switch in the OFF position, at 20% compressor capacity, the unit will partially unload and continue to run.

Example with normal setting of 100 PSIG:

Compressor	Inlet Valve	Turn Valve	Discharge Manifold Pressure
Full Capacity	Open	Closed	100 PSI
70% Capacity	Open	50% Open	100 PSI
40% Capacity	Open	Full Open	100 PSI
30% Capacity	Closing	Full Open	103 PSI
20% Capacity	Closing	Full Open	105 PSI
0% Capacity	Closed	Full Open	110 PSI

The capacity control system pilots and actuator control valve are protected from moisture and dirt by manually drained line filters located just upstream from the turn valve pilot and the inlet valve pilot. The filter should be drained periodically to prevent moisture buildup and carryover into the control lines.

TURN VALVE (Figure 4-5) - The turn valve is located on the side and between the two compressor rotors and is an integral part of the compressor. The valve is mounted on two large tapered roller bearings. Rotation of the turn valve opens or closes ports cast in the cylinder. Excess air in rotor pockets returns to the suction, thus reducing amount of air to be compressed. Rotation of this valve is controlled by the turn valve actuator. The tubing connecting the turn valve system is shown in Figure 4-11, page 11, this section.

TURN VALVE ACTUATOR (Figure 4-6, page 8, this section) - The turn valve actuator is a double-acting hydraulic-operated rack and pinion type rotary actuator with approximately 270° rotation.

There are timing marks on the rack and pinion which must be lined up before actuator is assembled.

Adjustment is required only when compressor is disassembled. The adjusting screw on the top adjusts the

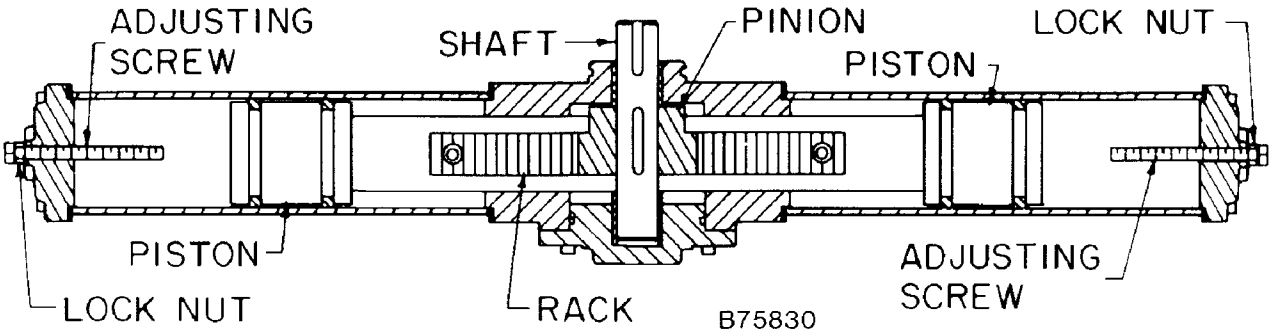


FIGURE 4-6 - TURN VALVE ACTUATOR

open position of the turn valve; the bottom adjusting screw adjusts the full closed position of the valve.

TURN VALVE ACTUATOR CONTROL VALVE (Figure 4-7) - This valve is a pneumatic pilot-actuated 4-way spring-loaded valve with all ports blocked in the centered position. When discharge pressure is below set point, spring pressure returns or holds valve in position to allow oil to flow to the turn valve actuator which rotates turn valve to maximum compressor capacity. When discharge pressure is at the set point, the control valve shifts to centered position blocking oil flow and the turn valve actuator is held in that position.

When discharge pressure is over the set point, the control valve shifts further to allow oil to flow in the opposite direction to the actuator which rotates the turn valve to a reduced capacity position.

TURN VALVE SUBTRACTIVE PILOT (Figure 1-2, Section 1, page 2) - The turn valve subtractive pilot is a spring-loaded diaphragm-actuated valve that regulates air pressure from the discharge manifold to the pilot port on the turn valve actuator control valve. As the discharge manifold pressure increases, the pilot pressure also increases on the spool valve, moving it toward the center position. At the full load unload pressure, the spool is in the center position. As the discharge manifold pressure raises slightly, the spool will shift rotating the turn valve to open, which unloads the compressor. When the discharge pressure falls, the valve will shift to rotate the turn valve closed. The pilot can be adjusted from 65 to 150 PSIG. This pilot will have a pressure gauge located on the top port.

INLET VALVE (Figure 4-8, page 9, this section) - On these units there are two (2) inlet valves operating in parallel. The inlet valve is a piston-actuated device which controls the compressor inlet and operates on air pressure from the inlet valve subtractive pilot. The valve is closed when full pressure is on the system and changes degree of opening in direct response to system pressure changes.

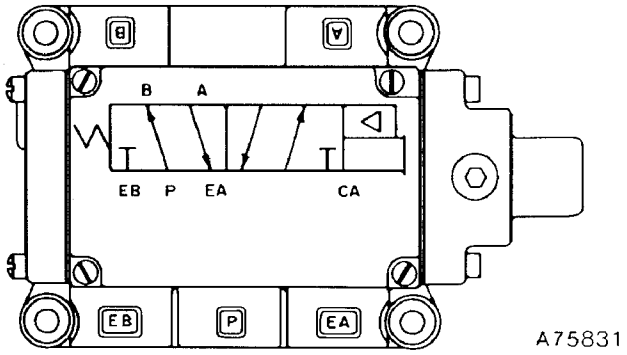


FIGURE 4-7 - TURN VALVE ACTUATOR CONTROL VALVE

The inlet valve contains piston spring which returns the unloader piston and allows the inlet valve to open as pressure decreases, and valve spring which returns the inlet valve to a closed position on shutdown of the compressor and prevents oil backflow from the compressor to the air filter.

The inlet valve piston is lubricated by a separate line which introduces oil from the compressor oil system.

BLEED AIR VALVE - A pilot-operated bleed air valve is provided in the inlet valve system to admit air to the compressor to scavenge oil during the unloaded cycle. The inlet valve subtractive pilot admits air to the bleed air valve piston at the same time as air is being admitted to the inlet valve piston at the beginning of the unloaded cycle. The bleed air valve piston shifts, allowing air to pass from the oil reservoir to the inlet valve behind the closed inlet valve, providing scavenging air as long as the compressor remains unloaded with low demand mode switch OFF.

INLET VALVE SUBTRACTIVE PILOT (Figure 4-8) is the same type that is used on the turn valve actuator control

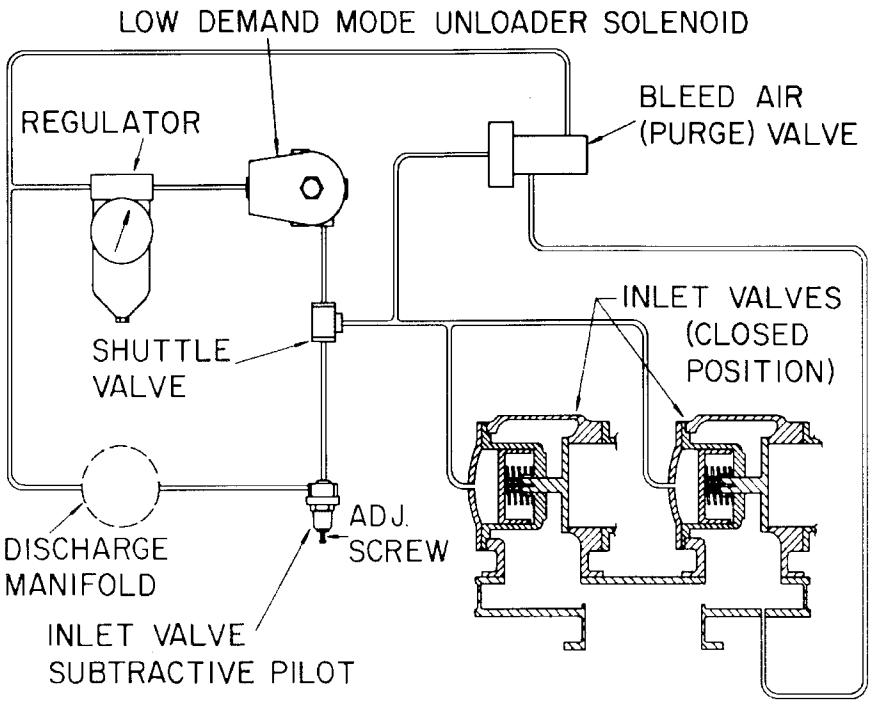


FIGURE 4-8 - INLET VALVE AND CONTROLS

valve. The pilot admits air to the inlet valve piston when a discharge manifold pressure equal to the pilot low setting is reached. The air begins to pass through the pilot to the piston, and the inlet valve begins to close. As the discharge manifold pressure increases the pilot pressure also increases on the inlet valve piston, closing the inlet valve. At full manifold pressure (pilot unload setting), the pilot is exerting full differential pressure on the inlet valve piston and the inlet valve is fully closed. As the discharge manifold pressure falls, the pilot exerts proportionally less pressure on the inlet piston allowing the inlet piston spring to return the piston and the inlet valve to open. The pilot can be adjusted from 65 to 150 PSIG. The differential range of approximately 15 PSI cannot be changed. In order to obtain full capacity at the maximum operating pressure, the pilot should be set to unload **with the inlet valve fully closed** at approximately 10 PSIG above maximum operating pressure.

COMPRESSOR CAPACITY AND PRESSURE ADJUSTMENTS - Any adjustment made affecting the compressor capacity and pressure must be made with care. This is a finely balanced control system and must be handled as such if the optimum performance is to be obtained from the unit.

Turn Valve Operational Check and Adjustment - Adjustment should be required only when the compressor has been disassembled for repairs. The turn valve should be adjusted so that it blocks all of the cylinder ports (windows) when it is in the closed (full load) position, and the ports should be open when it is in the open (unloaded) position.

⚠ DANGER

Do not remove any plugs or fittings when the compressor is operating or the reservoir is pressurized. Stop the compressor by pulling the main disconnect, tag and lockout power supply to the starter, and bleed all air from the oil reservoir by manually opening the pressure relief valve.

The full load position of the actuator may be checked by removing the adjusting screw at the unloaded end of the actuator (left side) and using a rod to push the pistons to the full load position. The rod must be clean and free of burrs and scale. Take care not to scrape the cylinder walls when moving the pistons.

⚠ WARNING

Do not use auxiliary air pressure to move the actuator. Excessive or sudden application of air pressure can result in breakage of the turn valve shaft.

With the turn valve in the full load position, remove the 1/2" pipe plug located on the side of the turn valve casting (on the right side, facing the discharge end). Note -- several quarts of oil will usually come out of this opening. The straight side land of the valve should be tangent to the edge of the hole when the turn valve is fully closed and properly adjusted.

Disassembly of the rack and pinion mechanism will result in loss of timing and should not be performed in the field except by factory service personnel.

Operating Air Pressure Adjustment - Turn low demand mode switch OFF. Start the unit. Close the air service line valve (furnished by customer), allow the unit to build to full pressure and unload, and proceed as follows:

A. **INLET VALVE SETTING** - Should be 10 PSI above compressor rating.

Pressure Too High:

1. Loosen the inlet valve subtractive pilot locknut. Back the adjusting screw out about one turn.
2. Open the air service line valve and bleed air from the unit so that compressor loads again. Close valve and allow compressor to unload.
3. Repeat Steps 1 and 2 until the proper pressure is obtained. Tighten the locknut.

Pressure Too Low:

1. Loosen the inlet valve subtractive pilot locknut.
2. Turn the adjusting screw in until the proper pressure is obtained.
3. Tighten the locknut.

B. **TURN VALVE SETTING** - With low demand mode switch in the OFF position, compressor running and unloaded (the turn valve pilot gauge should read approximately 20 PSIG), SLOWLY open the air service line valve and allow pressure to drop until pressure stabilizes - this point is the turn valve pressure setting.

Pressure Too High:

1. Loosen the turn valve subtractive pilot locknut. Back the adjusting screw out until correct pressure is reached.
2. Tighten locknut.

Pressure Too Low:

1. Loosen the turn valve subtractive pilot locknut.
2. Turn the adjusting screw in until the proper pressure is obtained.
3. Tighten the locknut.

C. **SET RESERVOIR BLOWDOWN AND COMPRESSOR UNLOAD.**

1. Turn the upper adjusting screw on the low demand mode pressure switch until the pointer on the left edge indicates the desired pressure.
2. Adjust the service valve until the unit is operating at full load set point.
3. Turn the low demand mode switch "ON".
4. Close the service valve. Note the air pressure when unit blows down. If it is not the pressure desired, repeat Steps 1, 2, and 3 until proper unload pressure is obtained.

D. **SET COMPRESSOR LOAD POINT.**

1. With the unit running, the air receiver at full pressure and the shop air line valve closed, and the low demand mode switch in the "ON" position, set the lower (differential) adjusting screw on the low demand mode pressure switch near the desired pressure. Full receiver pressure minus the differential is the compressor load point. The differential range is approximately 2-18 PSIG on the circular scale above the adjusting screw. It should be set approximately 10 PSIG.
2. Bleed air from the air receiver and note the pressure on the receiver gauge at which the compressor loads.
3. Repeat Steps 1 and 2 until desired low receiver pressure point is obtained.

⚠ CAUTION

Do not adjust the operating air pressure and/or full pressure (motor stop) higher than the maximum stamped on the unit nameplate. Minimum operating pressure is 65 PSIG.

LOW DEMAND MODE CONTROL SYSTEM - The low demand mode control system is suitable for use only on water-cooled or air-cooled units which have the oil cooler module close coupled but not joined or having horizontal remote (located on same level with the compressor but at some distance away) mounting from the compressor unit main base.

> **⚠ WARNING**
>
> **Low demand mode control system cannot be used with a remote overhead mounted oil cooler. Use of low demand switch with overhead cooler could result in damage to compressor.**

CONSTANT SPEED CONTROL SYSTEM WITH LOW DEMAND MODE - This control system is used where there is a demand for air with no long periods of non-usage.

With compressor running with the low demand mode switch in the "ON" position, the compressor will build to the set pressure and unload, and the air in the oil reservoir will blow down.

During the time the compressor is unloaded with the motor running, the unit draws only about 20% of the power required on load at 100 PSIG.

With the low demand mode switch in the OFF position, the compressor oil reservoir will not blow down when the compressor unloads.

Electrical Wiring - Figures 4-13 and 4-14, pages 13 and 14, this section, are the wiring diagrams for the units with Constant Speed Control System.

AUTOMATIC START/TIMED STOP CONTROL SYSTEM WITH LOW DEMAND MODE - This control system is used where the air requirements vary widely, change in frequency of demand, and where it is desirable to have some degree of control over the length of time the motor will run after the compressor unloads.

The Automatic Start/Timed Stop Control System offers three modes of operation controlled by turning the low demand mode switch and/or the timer: Constant Speed, and Automatic Start/Timed Stop both with or without low demand mode.

Constant Speed Operation: When the low demand mode switch is in the OFF position, the compressor will build to full pressure and unload and continue to run unloaded.

Automatic Start/Timed Stop Operation: When the low demand mode switch is in the ON position and the timer is set between 0 and 30, the unit will start and the inlet valve open when the pressure in the receiver falls to the pressure switch low setting. When the pressure rises to the pressure switch high setting, the unit will unload (LOAD light off), the inlet valve will close, the motor will continue to run, and the oil reservoir will blow down. If the system pressure does not fall to the pressure switch low setting within the time set on the timer, the unit will stop. The ON indicator light will remain on as long as the On-Off switch ON push button is depressed. When air is again required, the unit will start, the timer will reset and the loaded-unloaded-stop cycle will repeat.

MINIMUM RUN TIME SETTING FOR AUTOMATIC START/TIMED STOP CONTROL	
Size	Time (Minutes)
All	15

The timer must never be set at a time less than that indicated by the minimum run time caution plate on the instrument panel. Use of less time of run interval will allow excessive motor starts and cause shortened motor life or failure.

When the low demand mode switch is in the ON position and timer is positioned so the letter "N" in "MINUTE" is opposite the green arrow mark on the faceplate, the compressor will build to full pressure, unload, and blow down. At this setting, the motor will not time out and stop.

Electrical Wiring - Figures 4-15 and 4-16, pages 16 and 17, this section, are the wiring diagrams for the units with Automatic Start/Timed Stop Control System.

VIBRATION SWITCH (Optional Equipment) - The optional vibration shutdown switch, mounted on the compressor coupling cover, detects an increase in vibration that could be an indication of impending damage to the unit. The switch actuates when the selected level of vibration is exceeded.

The switch MUST BE ADJUSTED when the unit is first installed.

AUXILIARY AIR RECEIVER - An auxiliary air receiver with adequate volume must be used with both control systems to prevent rapid cycling of the unit. Occasionally shop air line are of such a length as to provide adequate volume, but this should be carefully checked before using the unit without an auxiliary air receiver.

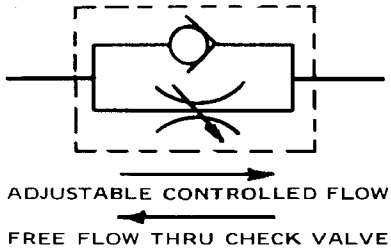


FIGURE 4-9 - FLOW CONTROL/CHECK VALVE

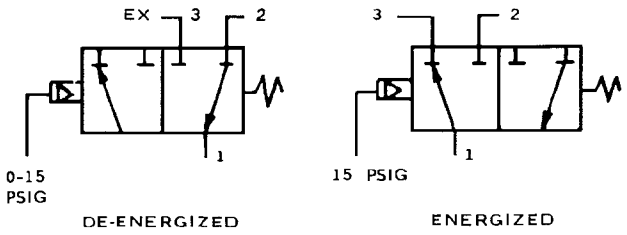


FIGURE 4-10 - THREE-WAY VALVE

LOW STARTING TORQUE (Unloaded Start) CONTROL (Optional Equipment) - When a reduced voltage closed transition starter is used, problems may arise as the torque required by the compressor may exceed that available from the compressor drive motor during and just after the starting cycle. This is especially true when a unit uses full motor horsepower at some pressure lower than 100 PSIG. The Low Starting Torque Control holds the compressor inlet valve closed for a short period while the motor is starting and reduces internal air loads and the compressor torque.

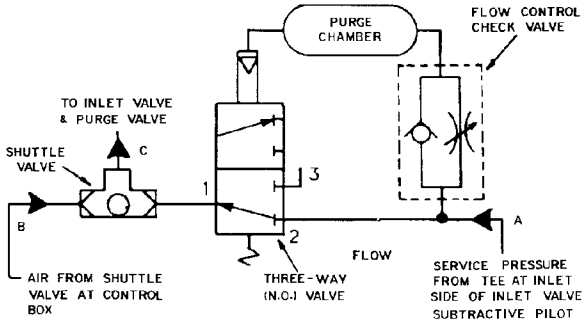
⚠ CAUTION

This control will function properly only when the low demand switch is off. If the low demand switch is on, the low torque control will react to all demands for air as initial start-up and delay buildup in air pressure for the time delay built into the system.

The control allows the compressor to build up a pressure of approximately 15 PSIG in the oil reservoir which is directed to the pilot on the inlet valve to close the valve and unload the compressor while the motor reaches full load speed. A pneumatic timing circuit then bleeds the pressure off the inlet valve pilot after approximately 10-15 seconds, allowing the compressor to load up and operate normally.

The control consists of a flow control-check valve, a small surge chamber, a normally open three-way air valve, and a shuttle valve.

The **Flow Control-Check Valve** consists of a check valve and an adjustable orifice in one body; see Figure 4-9.



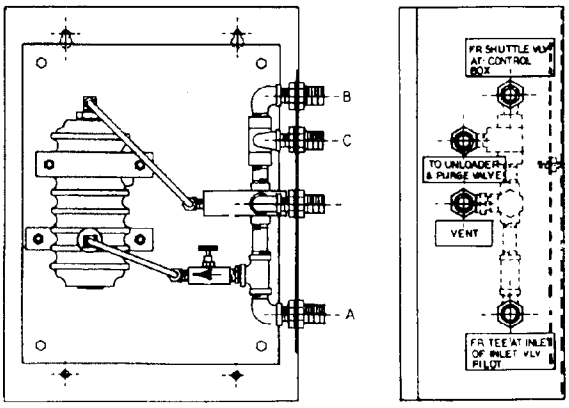


FIGURE 4-11 - SCHEMATIC AND OUTLINE - LOW STARTING TORQUE CONTROL

The **Three-Way Valve** (Figure 4-10) requires 15 PSIG control pressure to shift the valve.

In operation (Figure 4-11), the adjustable orifice in the flow control check valve controls the rate at which pressure will build in the surge chamber; the unloaded starting time is proportional to the pressure buildup time. When the pressure in the surge chamber reaches 15 PSIG, the three-way valve will shift, bleed control pres-

sure from the inlet valve and purge valve, and allow the compressor to load. See Figure 4-11, for the complete Low Starting Torque Control Assembly. Figure 4-12, page 14, this section, is the unit tubing diagram with control in place.

RESERVOIR PRESSURE SWITCH - The reservoir pressure switch will prevent motor damage if an attempt to start motor is made before the reservoir is completely blown down. The pressure switch will not allow the motor to be restarted after the unit has stopped until the pressure in the reservoir is below 5 PSIG. The switch pressure is sensed at the separator tower section of the oil reservoir.

The switch is factory set at 5 PSIG with an adjustable range of 3 - 30 PSIG.

⚠ WARNING

Do not set switch to pressure above 5 PSI or render the switch inoperative. Severe damage to motor can occur if started with pressure in oil reservoir.

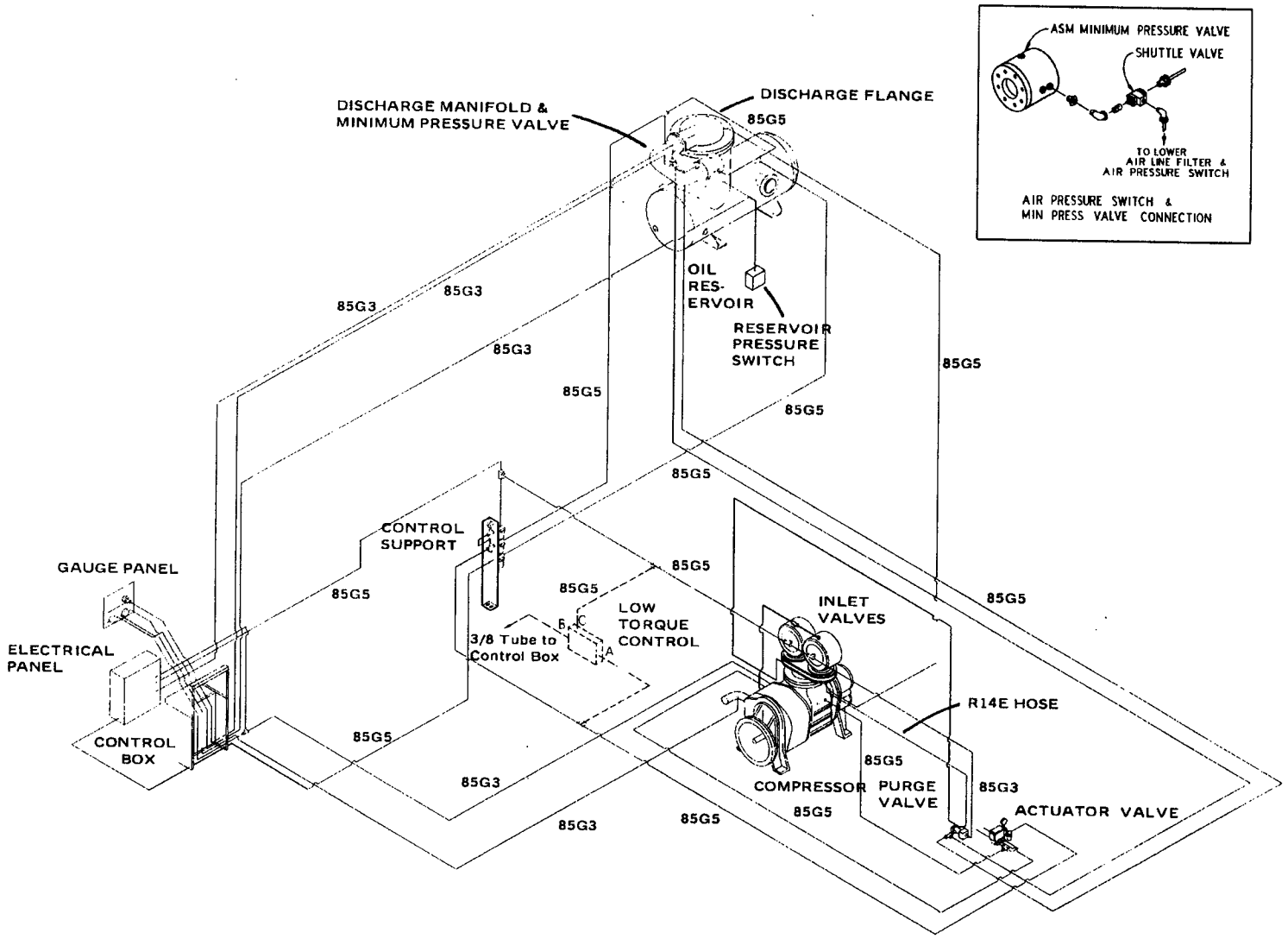
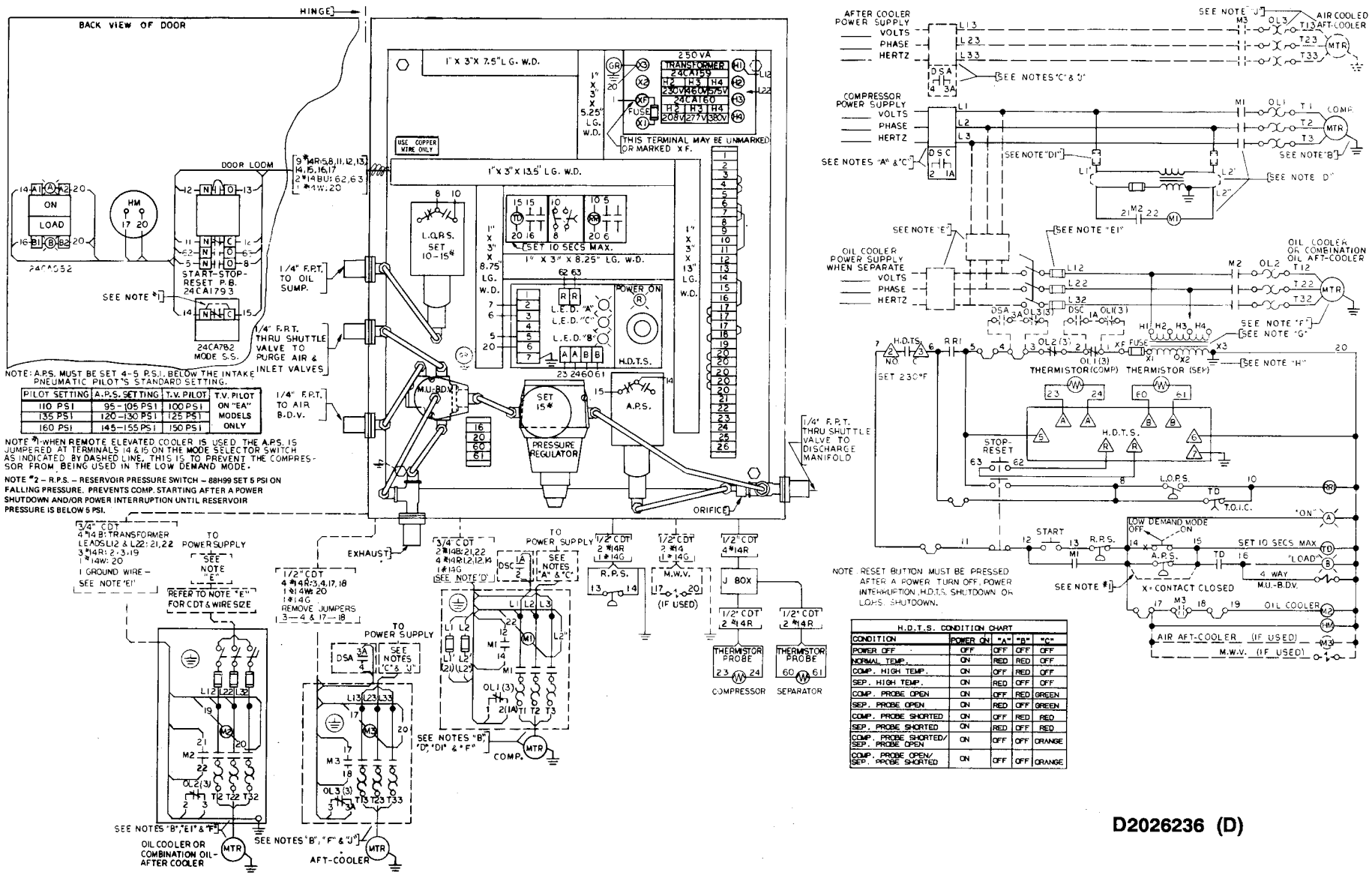


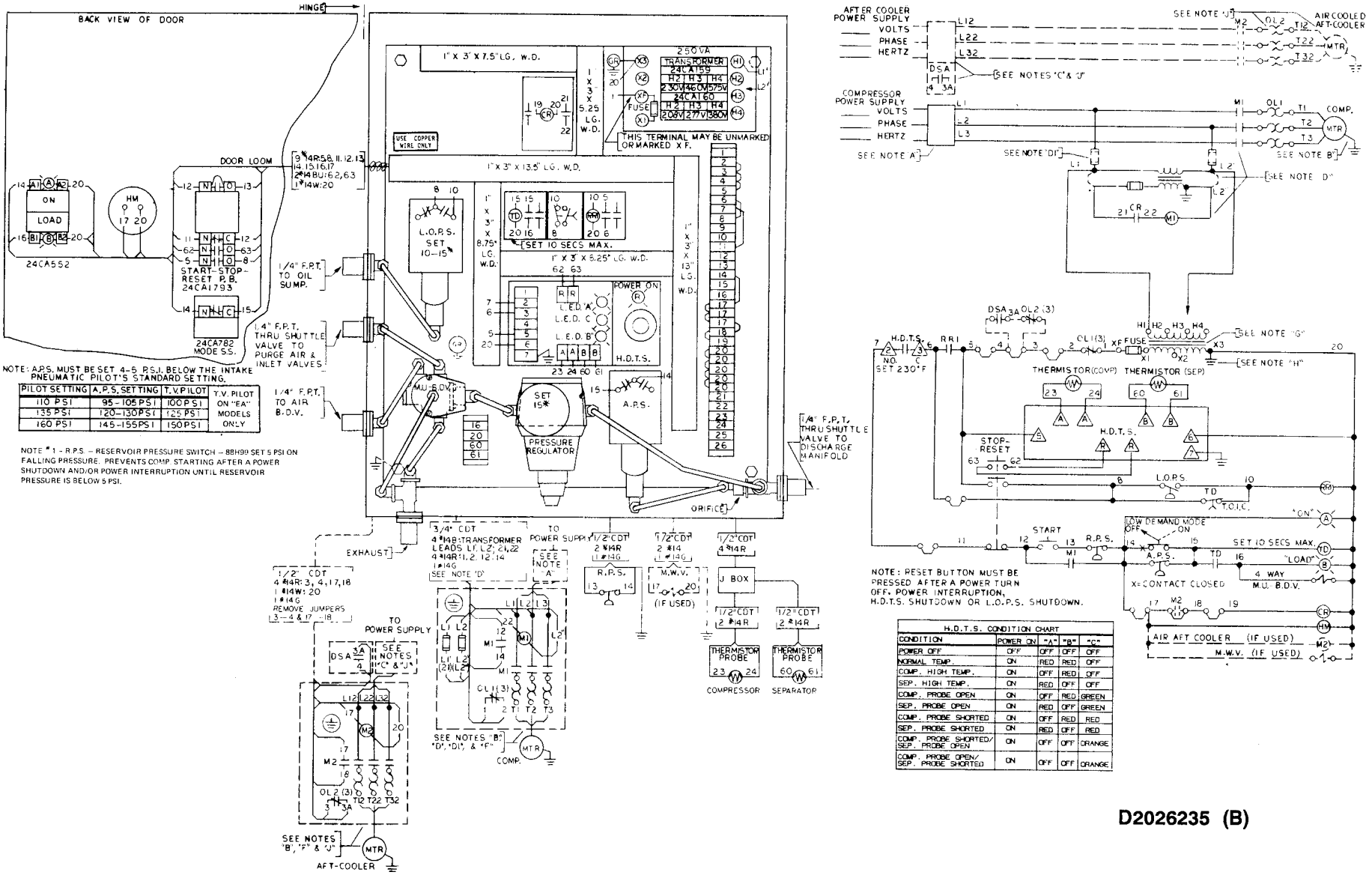
FIGURE 4-12 - CONTROL TUBING WITH LOW STARTING TORQUE CONTROL



D2026236 (D)

FIGURE 4-13 - WIRING DIAGRAM - AIR-COOLED UNITS - CONSTANT SPEED WITH LOW DEMAND MODE SWITCH

(FOR NOTES SEE SECTION 4, PAGES 19 - 22)



D2026235 (B)

FIGURE 4-14 - WIRING DIAGRAM - WATER-COOLED UNITS - CONSTANT SPEED WITH LOW DEMAND MODE SWITCH

(FOR NOTES SEE SECTION 4, PAGES 19 - 22)

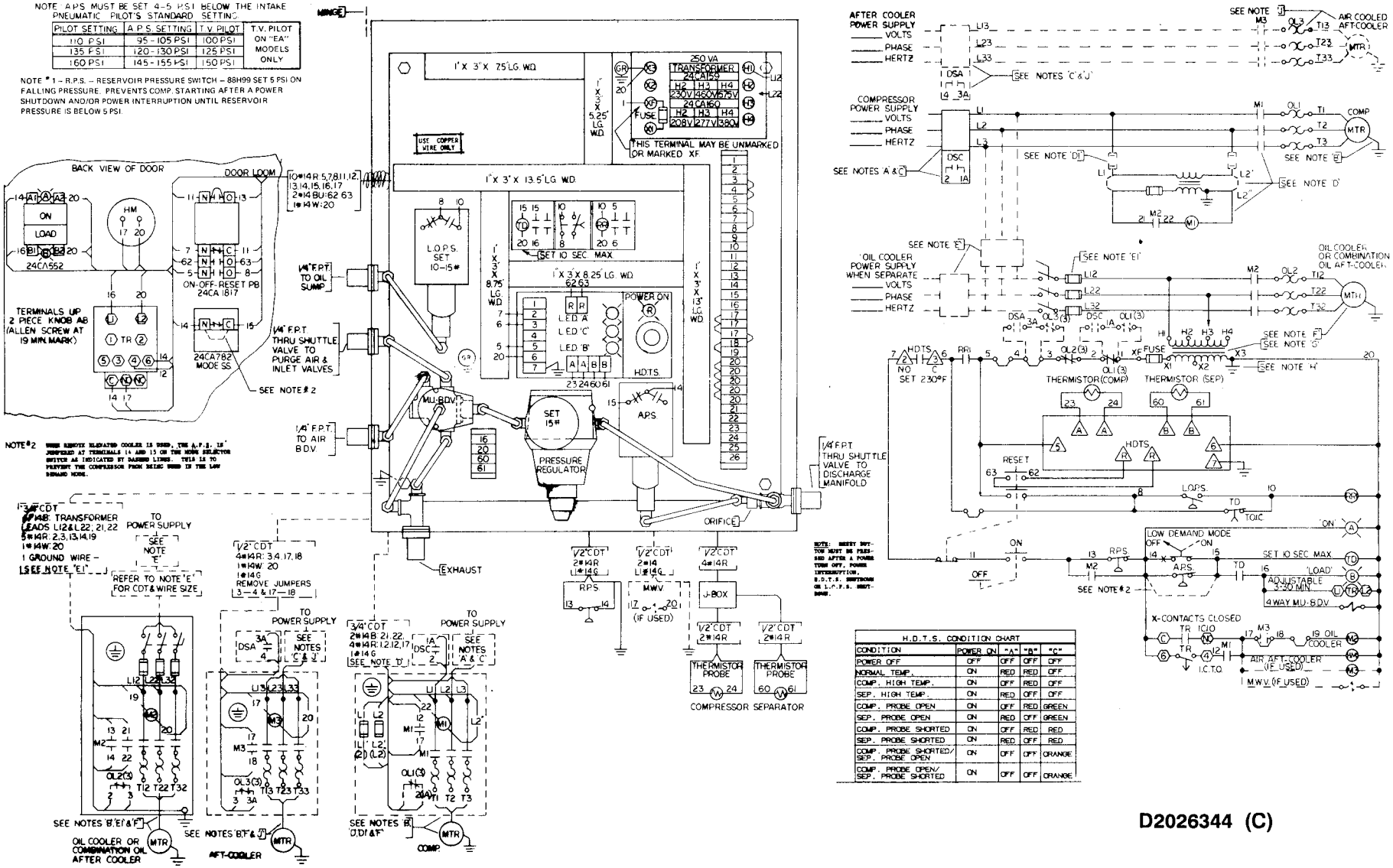
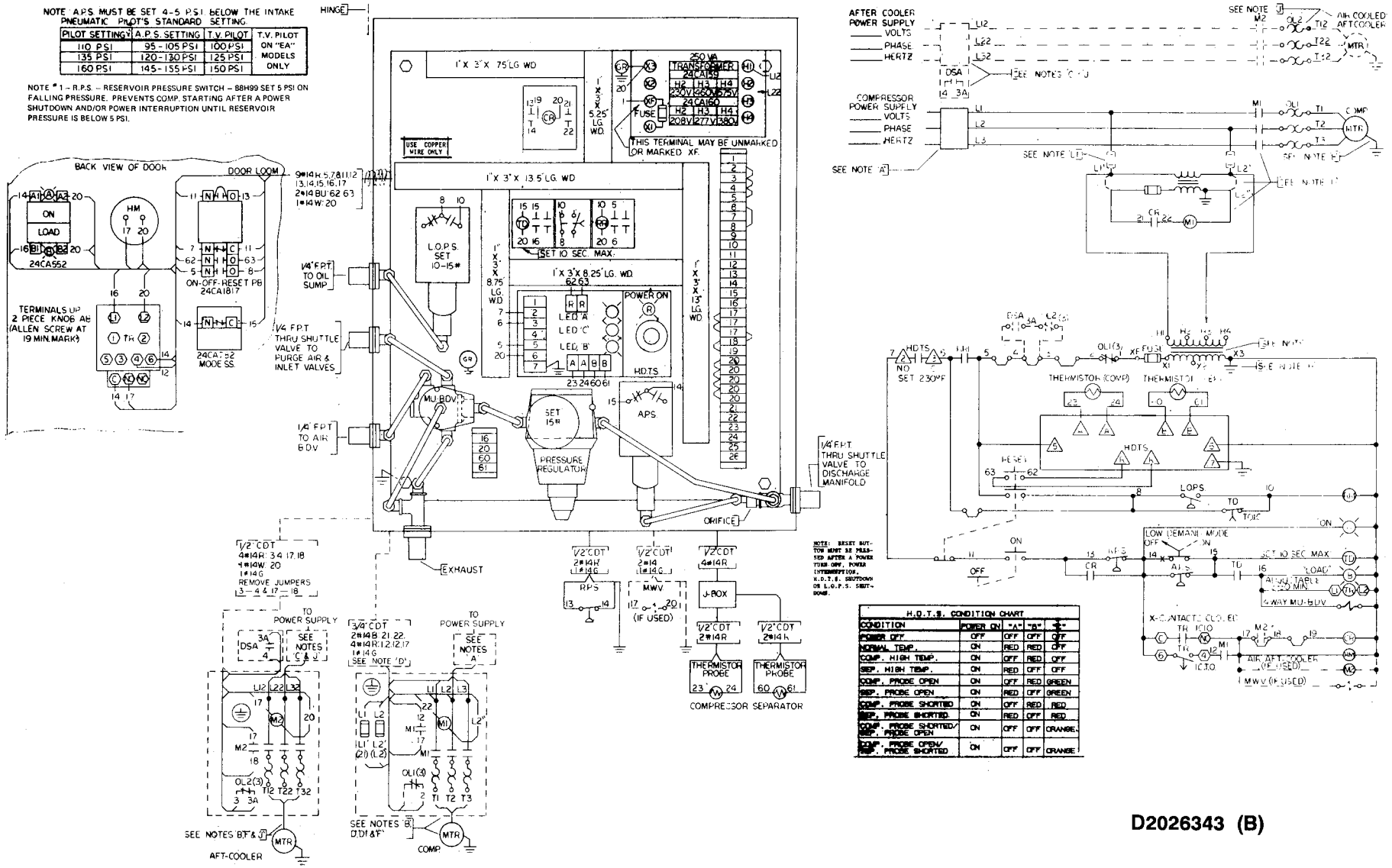


FIGURE 4-15 - WIRING DIAGRAM - AIR-COOLED UNITS - AUTOMATIC START/TIMED STOP WITH LOW DEMAND MODE SWITCH

(FOR NOTES SEE SECTION 4, PAGES 19 - 22)



D2026343 (B)

FIGURE 4-16 - WIRING DIAGRAM - WATER-COOLED UNITS - AUTOMATIC START/TIMED STOP WITH LOW DEMAND MODE SWITCH

(FOR NOTES SEE SECTION 4, PAGES 19 - 33)

NOTES FOR WIRING DIAGRAMS
(FIGURES 4-13 THRU 4-16)

ALL NOTES ARE NOT APPLICABLE TO ALL WIRING DIAGRAMS - READ CAREFULLY AND COMPLETELY FOR WIRING INSTRUCTIONS.

All equipment must be connected and phased exactly as shown. All piping, wiring, and other equipment not specified on order is to be supplied by other than Gardner-Denver.

"A" - Compressor power supply disconnecting means - Fused Switch or Circuit Breaker (not furnished as a standard item - if ordered, it must be remote mounted and wired by customer).

"B" - Equipment must be grounded in accordance with Table 250-95 of the National Electrical Code.

⚠ WARNING

An equipment ground jumper, equal in size to the equipment ground conductor, must be used to connect the compressor motor base to the main base because the bases are isolated from each other by vibration mounts. Failure to observe this notice could result in injury to or death of personnel.

The oil cooler motor (when used) is grounded to the starter as shown. The ground conductor for this motor is compatible to the motor short circuit protection.

"C" - When the control circuit voltage is from a separate power (voltage) source and is not controlled by the motor power supply disconnecting means, a disconnect switch (DS) interlock (not furnished) shall be mounted immediately adjacent to the motor power supply disconnecting means and wired by the customer as shown in the Schematic Wiring Diagram and per the data shown for that starter and its disconnecting means.

This interlocking device (DS) may be an Auxiliary (Aux.) or Electrical Interlock (E.I.) contact operated by the handle of the motor power supply disconnecting means.

When this disconnect switch (DS) interlock is a separate device, it shall be used to turn the control circuit "OFF" before operating the motor supply disconnecting means. See Article 430-74 of the National Electrical Code.

"D" - The compressor motor starter is remote mounted and wired by the customer.

All reduced voltage (current inrush) starters, manual and magnetic, are also remote mounted and wired by the customer. See reduced voltage starter note on page 19.

The compressor motor starter coil voltage shall be the same as the motor voltage, i.e., 200, 230, 460 volts, etc., unless the starter is ordered with its own fused control transformer. The contact (relay or fan-oil cooler starter interlock) from the compressor control panel to the remote mounted starter control circuit is rated 600 volts.

Remote mounted magnetic compressor starter control circuits are to be connected for TWO (2) WIRE Control.

The remote compressor starter control wiring shall be interlocked with the rest of the control wiring as shown in the Schematic Wiring Diagram and per the wiring data shown for the remote starter. The internal wiring shown is typical only. For exact wiring, see diagram on inside of starter or diagram supplied with starter.

"D1" - Motor control circuits must be fused in accordance with Article 430-72 of the National Electrical Code. Control circuits shall have short circuit protection (fuses, etc.) in all instances because the control circuit wiring leaves the starter enclosure to go to the external devices.

An ESG66459 Electrical Group will be furnished in addition to starter control fuses for water-cooled compressors with remote mounted manual reduced voltage starters.

Customer is to mount and wire fuses using the following mounting data: Fuse Block Mounting Data - Approximate area 2-1/2" L x 3" H - Mounting centers 2.1" No. 29 Drill (.1360) two holes for No. 8 self-tapping screws furnished with fuse block and fuses.

"D2" - An air break manual starter is shown. The undervoltage (latch) coil circuit for the oil break manual starters is to be similarly reconnected and interlocked as shown with the compressor control wiring.

"E" - Oil Cooler power supply disconnecting means - Fused Switch or Circuit breaker. NOT FURNISHED - and is remote mounted and wired by customer. Wire and conduit in the following table is sized for S.F. T.E.A.O. motors when used. This table may also be used for T.E.F.C. motors or refer to N.E.C. for T.E.F.C. motors.

HP	Voltage	Wire Size	Conduit
3	200 V	No. 12 TW	1/2"
3	230-575 V	No. 14 TW	1/2"
5	200 V	No. 10 TW	1/2"
5	230 V	No. 12 TW	1/2"
5	460-575 V	No. 14 TW	1/2"
7-1/2	200 V	No. 8 TW	3/4"
7-1/2	230 V	No. 10 TW	1/2"
7-1/2	460-575 V	No. 14 TW	1/2"
10	200 V	No. 6 TW	1"
10	230 V	No. 8 TW	3/4"
10	460-575 V	No. 12 TW	1/2"

HP	Voltage	Ground Wire
3	200 V	No. 12
3	230-575 V	No. 14
5	200-230 V	No. 12
5	460-575 V	No. 14
7-1/2	200-230 V	No. 10
7-1/2	460 V	No. 12
7-1/2	575 V	No. 14
10	200-230 V	No. 10
10	460 V	No. 12
10	575 V	No. 14

"E1" - Fused combination starter mounted on separate oil cooler module in NEMA 1 enclosure unless specified NEMA 4 for outdoor usage.

The oil cooler module is remote from the compressor and the interconnecting wiring is not furnished. This interconnecting wiring (by customer) is to be interlocked with the rest of the control wiring as shown in the Schematic Wiring Diagram and per the wiring data shown for oil cooler starter. The remote oil cooler equipment ground wire must be connected to the main control panel as shown. Use the Interconnecting Equipment Ground Table to determine ground wire size. Fuses are sized for HP and voltage.

"F" - Since most AC motors are wound for dual voltage, be certain leads are connected per the motor nameplate for the correct voltage.

"G" - Control transformers are sized for the components shown in the Schematic Wiring Diagram on 115 volts and not for any remote mounted compressor starter controls. Transformer part number is shown on the wiring diagrams.

"H" - Control circuit ground. A green ground wire is connected from the terminal shown on the wiring diagram to the control panel.

"J" - Air-cooled aftercooler with its starter and its power supply disconnecting means (Fused Switch or Circuit Breaker) with disconnect switch (DS) interlock - see Note "C" - (Not furnished as standard item - if ordered, it is remote mounted and wired by customer.)

The aftercooler (when sized for an individual compressor) starter coil is 120 volts and is wired and interlocked with the rest of the control wiring as shown in the Schematic Wiring Diagram and per the wiring data shown for the aftercooler starter with its disconnecting means. When the aftercooler is sized for more than one compressor, see instructions for aftercooler starter coil on the special wiring diagram or sketch.

THE FOLLOWING COMPONENTS ARE NOT USED ON ALL UNITS

(See Wiring Diagram For Usage)

A.P.S. - Air Pressure Switch - 2009006 - Set and/or Reset per table on Wiring Diagram.

The "Low Demand Switch" is furnished to provide low unloaded horsepower when the requirement for air is low. Turning the switch to "ON" switches the A.P.S. into the control circuit.

It is necessary to make sure the unload-load cycle time is greater then 45 seconds or else oil mist will be carried into the air lines. The unload-load cycle time can be increased in the same manner described below for excessive starts.

Excessive starting of motor can and will cause premature motor failure. Too frequent starting causes excessive heat which deteriorates the motor insulation. Excessive starting may be reduced by lowering the A.P.S. cut-in point (increasing differential) or by adding additional receivers to increase the system air storage capacity or both. The elimination of air leaks will also reduce the number of motor starts.

B.D.V. - 1" - 2-Way Normally Open - 2W.N.O. Air Operated Valve - 90AR114.

B.D.V.'s are sized to blow down oil reservoir in approximately 45 seconds. If the compressor is started or loads up (low unloaded HP only) before the reservoir is blown down, the compressor may be starting under load which may cause motor failure and/or oil mist will be carried over into the air lines.

BOOT - 24CA281 - Transparent for PB's when NEMA 4.

C.R. - Control Relay -24CA771 - 110/120 V - 50/60 Hz Coil - 2S.P.N.O. Convertible 600 Volt Contacts.

D.S.A. - Disconnect Switch Interlock - Aftercooler.

D.S.C. - Disconnect Switch Interlock - Compressor.

FUSE - See applicable wiring diagram for correct fuse information.

H.D.T.S. - High Discharge Temperature Switch - Set 230° F - 24CA779 Thermistor Probe 24CA780.

△ - Terminals on Temperature Switch

H.M. - Hourmeter - 2009369 - 120 V - 60 Hz (Alternate 2009370 - 110 V - 50 Hz).

I.C.I.O. - Instant Closing - Instant Opening.

I.C.T.O. - Instant Closing - Timed Opening.

I.O.I.C. - Instant Opening - Instant Closing.

I.O.T.C. - Instant Opening - Timed Closing.

L.O.P.S. - Low Oil Pressure Switch - 88A301 Set 10-15 PSI.

NOTICE

When starting unit for first time at final installation, loosen tube fitting on bottom of pressure switch. After compressor is started and oil appears at fitting, tighten fitting. If compressor shuts down on low oil pressure on first start, wait until all the air has been bled off through the blowdown valve before pressing reset button and restarting compressor.

M. - Motor Starter Coil, Contacts, etc. Those starters furnished as standard equipment for low voltage control have 110/120 V - 50/60 Hz coils.

M.U.-B.D.V. - Magnetic Unloader - Blowdown Solenoid Valve - 110/120 V - 50/60 Hz - Four Way - 91B34.

The LOW DEMAND MODE switch should be in the "OFF" position when starting the unit to keep the compressor from cycling rapidly if service valve is closed.

M.W.V. - Magnetic Water Valve -110/120 V - 50/60 Hz - Two-Way Normally Closed - 2W.N.C.

WATER-COOLED OIL COOLER *	
NEMA 1	NEMA 4
91B3 - 1-1/2"	91B24 - 1-1/2"

* Valves have manual override.

M.W.V.'s are also shown on Wiring Diagrams for Water-Cooled Aftercoolers (when used) and are to be sized for the aftercooler (if used).

O.L. - Overload - Heater-  Contacts

R.P.S. - Reservoir Pressure Switch (not standard on early models) - 88H99. Set 5 PSI falling pressure. Prevents compressor starting after a power shutdown and/or power interruption until reservoir is below 5 PSI.

R.R. 1 - Reset Relay - 24CA541 - 110/120 V - 50/60 Hz Coil - 2S.P.N.O. Convertible 300 Volt Contacts. Used with all automatic start controls which have low oil pressure shutdown. This relay gives LOW VOLTAGE PROTECTION which means a manual reset is required after every power turnoff or interruption. See the appropriate control wiring diagram for additional control switch components and resetting instructions.

T.C.I.O. - Timed Closing - Instant Opening.

T.D. - Time Delay Relay - 24CA285 - 110/120 V - 50/60 Hz Coil - is set for a maximum of 10 seconds to establish oil pressure after each start-up. If the TD timing coil fails, the compressor will not load when started and will unload if running when control is constant speed. If the TD timing relay fails on auto-start time-stop control, the compressor will not start; if running, unit will unload and continue running unloaded for the time setting of TR.

T.O.I.C. - Timed Opening - Instant Closing.

V.R. - Voltage Relay -

200 Volts - 60 Hz - 24CA772
230 Volts - 60 Hz - 24CA773
380/460 Volts - 50/60 Hz - 24CA774
575 Volts - 60 Hz - 24CA775

 - Jumpers On Terminal Blocks (T.B.).

 - Indicating Light - 24CA40

ADDITIONAL COMPONENTS WHEN COMPRESSOR CONTROL IS OTHER THAN CONSTANT SPEED

(See Wiring Diagram Title For Type of Compressor Control)

T.R. - Timing Relay (Auto-Start/Timed Stop Only) - 24A482 (Thru Door Mounting) - 110/120 V - 50/60 Hz Coil - 24A515 (Inside Panel Mounting) - 110/120 V - 50/60 Hz Coil.

DO NOT SET TIMER DIAL BETWEEN THE 0 AND 6 MINUTES.

See remarks following A.P.S. If compressor remains unloaded for time set on timer dial head (adjustable to 30 minutes), compressor will stop and then start up when needed.

To make the compressor run Constant Speed, set timer dial head so the letter "N" in "Minute" is opposite the green arrow mark on the escutcheon. When the timer dial is set for Constant Speed operation and compressor is not running, the compressor will not start until air is required (A.P.S. closes).

 - Terminals on T.R. Timing Relay.

REDUCED VOLTAGE STARTER NOTE

1. Two extra Normally Open Auxiliary contacts are required on most magnetic autotransformer reduced voltage starters. These contacts are required to interlock the compressor starter back to the 115 volt compressor control.

   To determine whether or not these N.O. Aux. contacts are required, look at the typical wiring diagram shown in most starter manufacturers' control handbook, digest, catalog, etc. If the typical wiring diagram shows two or more contacts paralleling the start push button, then these Aux. contacts are required.

   If the typical wiring diagram shows a control (timing relay, with or without control transformer, then the additional contacts are not required.

   Generally, these Aux. contacts are to be ordered for the start and run contactors. If these Aux. contacts are not ordered with the starter, then the starter manufacturers' field installation kits for Aux. contacts will have to be ordered and used.

   These two N.O. Aux. contacts, when required, will be supplied if Quincy orders the starters.

2. STARTING (All Types Reduced Voltage Starters)

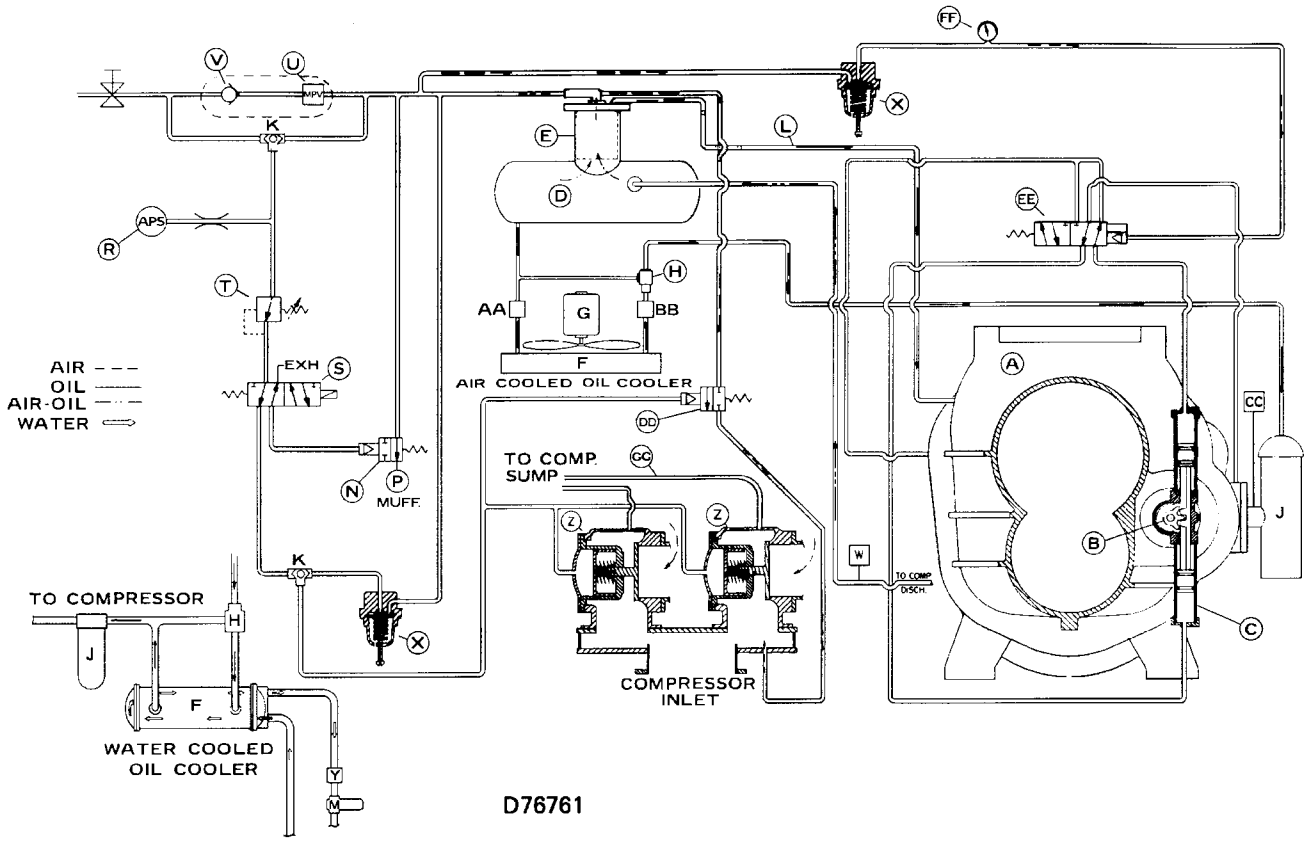
   The first point acceleration time should not be longer than 4-5 seconds. This is in order that the pressure buildup in the compressor will not bog down or stall the motor when the starter goes from the start to the run mode.

NOTICE
First point acceleration time may be limited to 2-3 seconds on some part winding motors.

   On magnetic reduced voltage starters, set the starter timer for 4-5 seconds. If the starter is of the manual type, then do not hold the handle in the start position longer than 4-5 seconds.

Special Notes, Components, Part Numbers and Description, etc. will be shown on Wiring Diagrams requiring the special notes and/or components.

SECTION 5
LUBRICATION,
OIL COOLER, OIL FILTER & SEPARATOR



A - Compressor
B - Turn Valve
C - Turn Valve Actuator
D - Oil Reservoir
E - Oil Separator
F - Oil Cooler
G - Fan and Motor
H - Thermal Control (Thermostatic Mixing) Valve
J - Oil Filter
K - Shuttle Valve
L - Separator to Cylinder Oil Return Line
M - Water Flow Control Valve
N - Pneumatic Blowdown Valve
P - Blowdown Muffler
R - Operating Air Pressure Switch
S - Magnetic Unloader
T - Pressure Regulator
U - Minimum Discharge Pressure Valve
V - Discharge Check Valve
W - High Discharge Temperature Shutdown Switch
X - Subtractive Pilot
Y - Magnetic Water Shutoff Valve
Z - Compressor Inlet Valve
AA - Oil Line Check Valve (Remote Overhead Oil Cooler Only)
BB - Oil Stop Valve (Remote Overhead Oil Cooler Only
CC - Low Oil Pressure Switch
DD - Purge Valve
EE - Turn Valve Directional Valve
FF - Air Pressure Gauge
GG - Inlet Valve Piston Lubrication Line

FIGURE 5-1 - FLOW DIAGRAM - AIR-OIL SYSTEM

COMPRESSOR OIL SYSTEM (Figures 5-1) cools the compressor, lubricates moving parts and seals internal clearances in the compression chamber.

The oil inlet line is connected at the bottom of the oil reservoir. Air pressure in the oil reservoir forces oil through the oil cooler, thermostatic mixing valve, oil filter and into the compressor main oil gallery.

The oil passes through internal passages for lubrication, cooling and sealing. The air-oil mixture is then discharged to the oil reservoir where a large part of the entrained oil drops out of the air stream; the air then passes through the final oil separator where most of the remaining oil is removed. The separated oil is returned to the compressor and the air passes to the final discharge line.

RECOMMENDED LUBRICANT - Gardner Denver compressors are factory filled with AEON™ lubricants. These lubricants are formulated to the highest quality standards and are factory authorized, tested and approved for use in rotary screw compressors. AEON™ lubricants

are available through your authorized Gardner Denver compressor distributor.

OIL SPECIFICATIONS - The recommended compressor lubricant is Gardner Denver AEON™ 4000 Lubricating Coolant which can be used for year-round operation except as noted in the "High Temperature Operation" paragraph below, or low temperature, see "Installation for Cold Weather," Section 2, page 4. AEON™ 4000 Lubricating Coolant is a superior petroleum base lubricant formulated and containing additives for use in Gardner Denver compressors.

⚠ CAUTION

Use of improper lubricants will cause damage to equipment. Do not mix different types of lubricants or use inferior lubricants.

HIGH TEMPERATURE OPERATION - If the discharge temperature is sustained between 200-210°F for a period of more than four (4) hours due to continuing high ambient air temperature, use Gardner-Denver® AEON 9000 SP Lubricating Coolant which is a superior synthetic lubricant. Short periods of up to four (4) hours of sustained discharge temperatures up to 210°F do not require a change from the recommended year-round lubricant AEON™ 4000.

LUBRICANT CHANGE PROCEDURE - Upgrading to a longer life lubricant is essentially a very worthwhile practice. Following are the primary steps to be completed when upgrading or changing the type of lubricant.

1. Thoroughly drain system:
   - Drain oil from air end and cooler while hot.
   - Break low point connections and drain oil from pipe runs.
   - Dump Oil from filter and reinstall used filter.
2. Fill system with a 50 percent charge of the new lubricant:
   - Start machine and stay there to observe.
   - Allow machine to run about five minutes at temperature, or until temperature stabilizes, then shut down.
3. Thoroughly drain machine.
4. Change to new filter and separator.
5. Fill system with full charge of the new lubricant.
6. Replace the drain plug before restoring power.
7. Machine should then be run normally, however, total run time after the initial changeout should be 50 percent of normal anticipated service life of the new lubricant.
   - Drain all lubricant from system, change filter and separator, and replace with full charge of the new lubricant.
8. Subsequent lubricant changouts should be at normal intervals. (See chart, page 3, this section.)

⚠ CAUTION

Improper equipment maintenance with use of synthetic lubricants will damage equipment. Oil filter and oil separator change intervals remain the same as for AEON™ 4000 -- See maintenance schedule, Section 8.

⚠ DANGER

Oil under pressure will cause severe personal injury or death. Shut down compressor and relieve system of all pressure, disconnect, tag and lockout power supply to starter before removing valves, caps, plugs, fittings, bolts and filters.

⚠ WARNING

High temperature operation can cause damage to equipment or personal injury. Do not repeatedly restart after high temperature stops operation. Find and correct the malfunction before resuming operation.

⚠ WARNING

All materials used in Gardner-Denver compressor units are compatible with AEON™ 9000 SP Lubricating Coolant. Use caution when selecting downstream components such as air line lubricating bowls, gaskets and valve trim.

AEON™ 9000 SP Synthetic Lubricant is not compatible with low nitrile Buna N or acrylic paints. AEON™ 9000 SP is compatible with most air system down stream components.

Material Safety Data Sheets (MSDS) are available for all AEON lubricants from your authorized Gardner-Denver distributor or by calling the factory at 217-222-5400.

COLD AMBIENT OPERATION - See "Installation for Cold Weather Operation," Section 2, page 4.

ADDITION OF OIL BETWEEN CHANGES must be made when the oil level is below the center of the lower sight gauge as read while the unit is running fully loaded and not cycling on and off. (Alternate method is when unit is completely off and blown down.)

1. Be sure the unit is completely off and that no air pressure is in the oil reservoir.
2. Disconnect, tag and lockout the power supply to the starter.
3. Wipe away all dirt around the oil filler plug .
4. Remove the oil filler plug and add oil as required to return the oil level to the center of the RUN range when the unit is operating.
5. Replace the oil filler plug BEFORE restoring the power.

DO NOT OVERFILL as oil carryover will result. The quantity required to raise the oil level from the top of the ADD range to the centerline of the RUN range is shown in Figure 5-2.

Repeated addition of oil between oil changes may indicate excessive oil carry-over and should be investigated.

⚠ DANGER

Air/oil under pressure will cause severe personal injury or death. Shut down compressor, relieve system of all pressure, disconnect, tag and lockout power supply to starter before removing valves, caps, plugs, fittings, bolts, and filters.

⚠ CAUTION

Excessive oil carry-over can damage equipment. Never fill oil reservoir above "FULL" marker.

Size	Approximate System Capacity (Initial Fill)	Oil Reservoir Capacity** (Refill)	Qty. - Top of ADD to Centerline of RUN
350 HP	Air Cld* - 61 Water Cld - 59	55	11
400 HP	Air Cld* - 61 Water Cld - 59	55	11
500 HP	Air Cld* - 61 Water Cld - 59	55	11

* System capacity shown is for the initial fill of the compressor unit and oil cooler module ONLY - remotely mounted oil coolers will require additional oil to fill the piping between the compressor unit and the oil cooler.

** The oil reservoir refill quantity shown is measured at the centerline of the oil level gauge RUN range or approximately 3.5 inches below the centerline of the oil reservoir.

FIGURE 5-2 - OIL SYSTEM CAPACITIES (APPROXIMATE) - U.S. GALLONS

OIL LEVEL GAUGE (Figure 1-5, Section 1, page 3) indicate the amount of oil in the oil reservoir. When the unit is stopped, the oil level will be higher in the RUN range than when operating on load. When the unit is operating, the oil level should be near the center of the RUN range. In normal operation, the oil level will fluctuate slightly as the compressor loads and unloads. Add oil only when the oil level gauge indicated in the ADD OIL range when the compressor is loaded. Drain oil only when the oil level gauge indicates EXCESS OIL when the compressor is loaded.

MOISTURE IN THE OIL SYSTEM - In normal humidity and with normal operating temperatures and pressures, the thermal mixing valve controls the oil temperature and prevents moisture contamination of the oil. Unusual cooling of the oil reservoir, short loaded cycle in high humidity, malfunctions of the thermal valve or cooling water system may result in moisture in the oil system which is detrimental to compressor lubrication and could cause oil carryover. If moisture is observed in the oil reservoir, drain the moisture and correct the condition causing the accumulation. See "Compressor Oil System Check" and "Thermal Control (Thermostatic Mixing) Valve" in this section.

OIL CHANGE INTERVAL - Recommended oil change intervals are based on oil temperature.

Refer to the following chart for the change interval for the type of oil use in the unit:

Discharge Temperature	AEON 4000 Change Interval	AEON 9000 SP Change Interval
Up to 180°F	6000 hrs.	8000 hrs.
180 to 190°F	4500 hrs.	6000 hrs.
190 to 200°F	3000 hrs.	4000 hrs.
200 +	1500 hrs.	2000 hrs.

When operating conditions are severe (very dusty, high humidity) it will be necessary to change the oil more frequently. Operating conditions and the appearance of the drained oil must be surveyed and the oil change intervals planned accordingly by the user. A good lubricant analysis program is helpful in planning the change interval.

⚠ CAUTION

Change the oil filter every 1000 hours.

DRAINING AND CLEANING OIL SYSTEM -

⚠ DANGER

Air/oil under pressure will cause severe personal injury or death. Shut down compressor, relieve system of all pressure, disconnect, tag and lockout power supply to starter before removing valves, caps, plugs, fittings, bolts, and filters.

Always drain the complete system. Draining when the oil is hot will help to prevent varnish deposits and carry away impurities. To drain the system, use one of the following methods:

If the unit is not elevated high enough to use the oil reservoir drain line to drain oil, a small hand, electric or air operated pump should be used to drain reservoir through the oil filler opening or from the drain valve.

If the unit is elevated so that the oil reservoir drain can be used, empty the oil reservoir through the drain valve to a suitable container or sump.

If the drained oil and/or the oil filter element are contaminated with dirt, flush the entire system: reservoir, oil cooler, mixing valve and lines. Inspect the oil separator elements for dirt accumulation; replace if necessary. If a varnish deposit exists, contact the factory for recommendations for removal of the deposit and prevention of varnish.

FILLING OIL RESERVOIR -

⚠ DANGER

Air/oil under pressure will cause severe personal injury or death. Shut down compressor, relieve system of all pressure, disconnect, tag and lockout power supply to starter before removing valves, caps, plugs, fittings, bolts, and filters.

1. Be sure the unit is completely off and that no air pressure is in the oil reservoir.
2. Disconnect, tag and lockout the power supply to the starter.
3. Wipe away all dirt around the oil filler plug.
4. Remove the oil filler plug and add oil as required to return the oil level to the RUN range. (Refer to Figure 5-2, page 3, for the oil quantity required to fill the compressor oil system. This amount may bring the oil level into the EXCESS OIL range on the gauge. Install the oil filler plug. After a short time of operation, the oil level will drop into the RUN range as oil fills other areas of the system.)
5. Shut down unit, allowing the oil to settle, and be certain all pressure is relieved.
6. Add oil, if necessary, to bring the level to the RUN range.

On unloaded operation and after shutdown some of the oil will drain back into the oil reservoir and the oil level gauge may read in the EXCESS OIL range. DO NOT DRAIN OIL TO CORRECT! On the next start, oil will again fill the system and the gauge will indicate the operating oil level.

COMPRESSOR MAIN OIL FILTER (Figure 5-3, page 5) - This replaceable element filter is a vital part in maintaining a trouble-free compressor since it removes dirt and abrasives from the circulated oil. The filter is equipped with a relief valve that opens in the event the element becomes dirty enough to block the flow of oil.

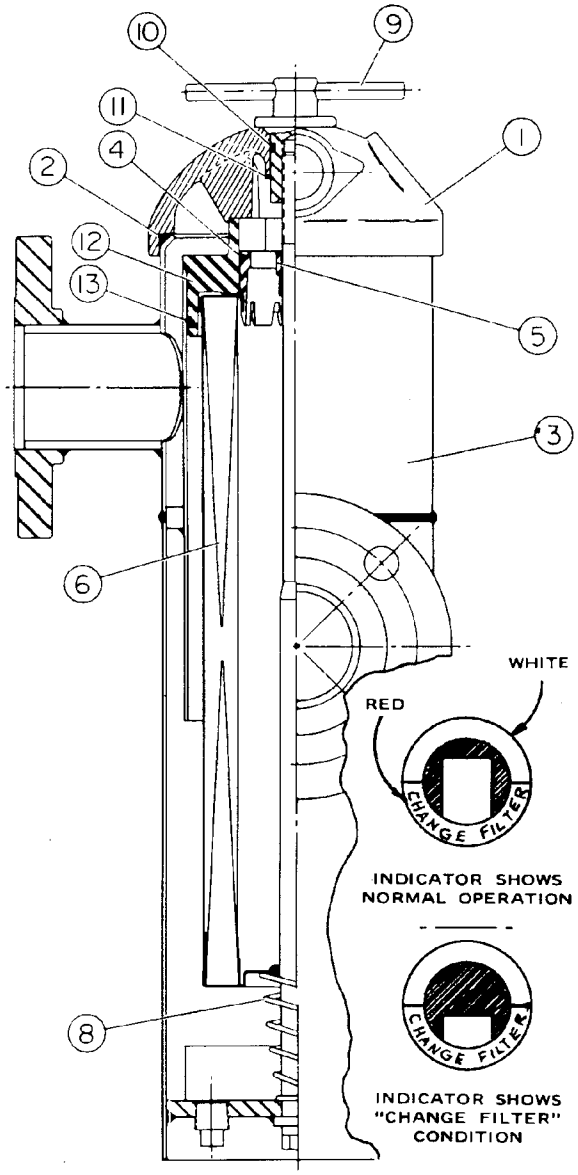


FIGURE 5-3 - COMPRESSOR OIL FILTER

⚠ CAUTION

Element must be replaced every 1000 hours or sooner, or when the top of the indicator on the filter is in the red CHANGE FILTER half of the window. Unit must be running and warmed up for the indicator to read accurately. Check with a light to be certain of the indicator position - some lubricants will obscure the indicator.

Use only the replacement element shown on the filter tag or refer to the parts list for the part number. Use the following procedure to replace the filter element. Do not disturb the piping.

⚠ DANGER

Air/oil under pressure will cause severe personal injury or death. Shut down compressor, relieve system of all pressure, disconnect, tag and lockout power supply to starter before removing valves, caps, plugs, fittings, bolts, and filters.

Compressor Main Oil Filter Instructions (Refer to Figure 5-3):

1. Stop the unit and be sure no air pressure is in the oil reservoir. Disconnect, tag and lockout power supply to the starter.
2. To remove head assembly, rotate tee handle (9) counterclockwise until head assembly (1) is free of housing (3).
3. Holding baffle (12) down, push down on indicator assembly (5) to insure that it moves up and down freely within the baffle. Remove baffle (12) and check its inside bore for burrs or deep scratches and carefully smooth out if required. Check seal (13) for cuts and excess wear.
4. Remove element (6) from housing assembly (3). Remove indicator assembly (5) from element (6) by inserting screwdriver between indicator assembly and element cap and carefully prying downward. Inspect indicator O-ring (4) for cuts or excessive wear and discard element (6).
5. Remove O-ring from head assembly (1) and inspect for cuts or excessive wear. Wipe O-ring area of head (1) with clean cloth and after covering O-ring (2) with oil, reinstall in head assembly.
6. Reinstall indicator assembly (5) into new element (6). Place element into cannister (3), making sure that large diameter of spring (8) contacts the new element, and install baffle (12).
7. Place head assembly (1) onto housing assembly (3) and rotate tee handle (9) clockwise until hand tight; do not exceed 20 foot-pound torque if tools are used.
8. Reconnect starter to power source.

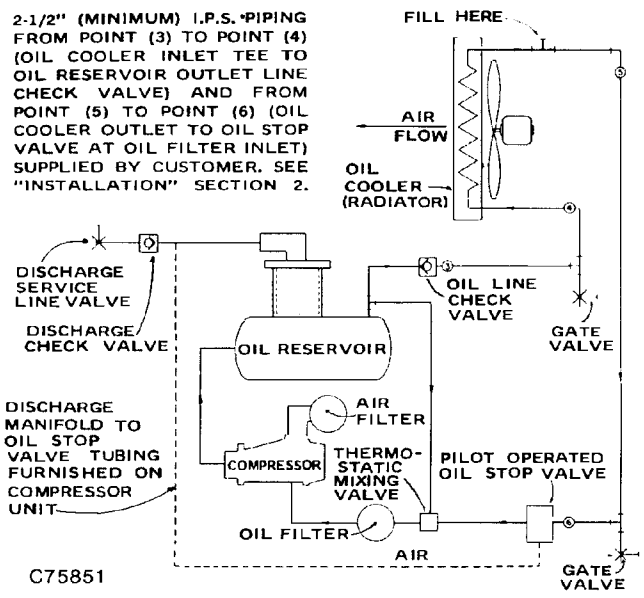


FIGURE 5-4 - OIL FLOW DIAGRAM - REMOTE OVERHEAD MOUNTED OIL COOLER

9. If leakage appears at the top of the cannister, replace O-ring (2). If this does not stop the leakage, the cannister may be nicked or distorted by over-torquing, and should be repaired or replaced.

   If leakage appears around tee handle (9) remove snap ring (11) and remove tee handle (9) from head assembly (1). Remove O-ring (10) and inspect for nicks or cuts and replace if necessary. Wipe tee handle (9) and O-ring groove. Then oil and replace O-ring (10), insert tee handle (9) into head assembly (1) and replace snap ring (11).

BEARING OIL FILTER - An oil filter of the spin-on type is used. This filter is a vital part in maintaining a trouble-free compressor, since it removes dirt and abrasives from the circulated oil before it reaches the bearings. The filter is the disposable type and is equipped with a relief valve that opens in the event the element becomes dirty enough to block the flow of oil. **The filter must be replaced each time the main oil filter element is replaced**. When changing this filter between oil changes, add one (1) quart of lubricant to the system to replace that retained in the old filter. Use only the replacement filter shown in the parts list, as others may not have sufficient burst pressure strength.

To replace filter, stop the unit and be sure no air pressure is in the oil reservoir. Disconnect, tag and lockout power supply to the starter. Spin off the old filter and discard, then spin on the new filter by hand, tightening firmly enough to prevent leaks.

COMPRESSOR OIL COOLER (RADIATOR TYPE) - (Figure 5-4) The air-cooled oil cooler module is remote mounted. The oil cooler requires pipe and electrical connection to the main compressor unit. Connecting piping and wiring are furnished by the user. See "Installation", Section 2.

Do not obstruct the air flow to and from the oil cooler. Allow two (2) feet clearance on all sides of the oil cooler. See Figure 2-2, Section 2, page 1, for cooling air flow requirements. Keep both faces of the oil cooler core clean for efficient cooling of the compressor oil. Oil cooler malfunctions may be traced by checking oil pressure drop through the cooler; check by installing pressure gauges at fittings in the inlet and outlet oil piping near the end of the cooler. At normal operating air service pressures (65 to 150 psig), with the unit warm, a pressure drop of 2 to 25 psig can be expected between the inlet and outlet side of the cooler. The controller will show the reservoir temperature which is the air temperature in the reservoir and the approximate oil temperature into the thermal mixing valve.

An oil filler stand pipe and plug must be located in the piping on the oil cooler module for ease of filling the oil cooler when it is mounted at a distance from the compressor unit. When filling a remotely mounted oil cooler, be sure all lines to and from the compressor unit are also filled to prevent excessive drawdown of the oil supply in the oil reservoir. A vent line should be installed between the oil cooler and compressor oil reservoir as an aid in filling and to prevent siphoning.

⚠ WARNING

Failure to remove condensate from an idle cooler in freezing temperatures will cause permanent cooler damage. Drain condensate after system shutdown. It is the owner/operator's responsibility to ensure that condensate has been drained and cooler dried out to prevent cooler damage.

HEAT EXCHANGER (OIL) PIPING - All remote elevated cooler applications must be sent through Engineering for approval and for recommending the pipe size. A special control group will be mounted on the package at the factory.This group controls the oil stop valve as well as not allowing the machine to run unloaded.

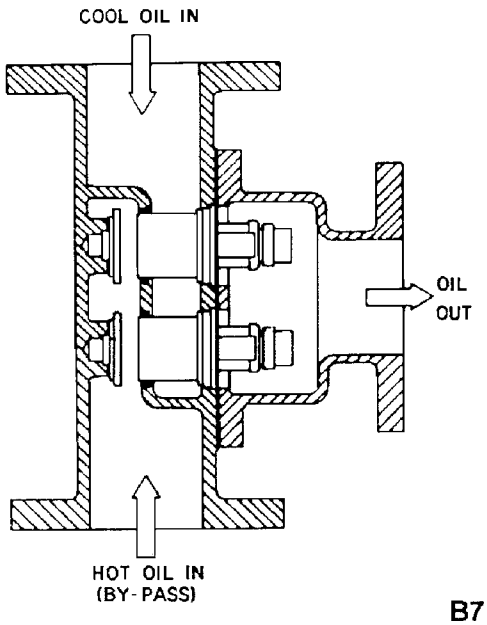


FIGURE 5-5 - THERMAL CONTROL (THERMOSTATIC MIXING) VALVE

NOTICE

Remote mounted elevated coolers have a maximum pipe length of 30 feet (each way) and a maximum height of 20 feet with a minimum of fittings. Engineering will review all remote elevated cooler applications and recommend pipe size on an individual basis. Customer Service should include the engineering recommendation in the special order sent to Engineering.

Kit number EAU68133 includes the oil stop valve, check valve and flanges and must be installed on all remote elevated coolers per Figure 5-4, and the following instructions.

1. Mount the check valve (90J113).
2. Mount the drain valves in the lowest section of the pipe on each side of the cooler connections.
3. Mount the oil stop valve (90AR243) in the line after the thermal mixing valve as shown.

Modifications to the control lines will be made at the factory to control the oil stop valve. Air to the oil stop valve must come from the dry side of the reservoir cover, then through the 3-way pneumatic valve. Control air to the valve must come from the line between the tee and the orifice in the blowdown muffler line. When the machine blows down, it will activate the pneumatic valve which will shut off the air and vent the line between the pneumatic control valve and the oil stop valve to the atmosphere. This will shut the oil stop valve and prevent excessive oil from running into the reservoir. Failure to install these parts could result in high oil carryover and cause the machine to shutdown on high discharge temperature.

THERMAL CONTROL (THERMOSTATIC MIXING) VALVE (Figure 5-5) on current units is installed in the system as shown in Figure 5-1, page 1, this section. This valve is used to control temperature of the oil in both radiator and tube type oil cooler systems. The element is so designed that a portion of the oil can flow through the oil cooler at all times. On start-up with the unit cold, the element is open to bypass, allowing oil to pass directly from the reservoir to the compressor during warm-up. As oil warms, the element gradually closes to the bypass allowing more of the oil from the cooler to mix with oil from the bypass. After the unit is warmed up, the mixing valve maintains oil injected into the compressor at a minimum of 150° F. (On early units compressor discharge temperature is maintained at a minimum of 70° F. above ambient temperature.) This system provides proper compressor warm-up and prevents moisture contamination of the oil.

To check element, heat in oil - it should be fully extended at 150° F. (180° F. for early units). If the unit shuts down due to high air discharge temperature, the cause may be that the element is stuck open to the bypass, in which case lines 1 and 2 (Figure 5-1, page 1, this section) will be hot to touch and lines 3 and 4 much cooler. When flushing the oil system, remove mixing valve and clean all parts thoroughly.

COMPRESSOR OIL COOLER - WATER COOLED HEAT EXCHANGER (Figure 1-2, Section 1, page 2) - The heat exchanger oil cooler is a multiple pass type, with water in the tubes and oil in the shell. The oil temperature is controlled by the thermal control (thermostatic mixing) valve. The optional water control valve may be used to conserve water.

Oil cooler malfunction may be traced by checking pressure at oil inlet and outlet. Fittings in the oil cooler at these locations are equipped with a pipe tap for a gauge. At normal operating air service pressure (65 to 150 PSIG) with unit warm, a pressure drop of 2 to 25 PSI can be expected between the oil inlet and the oil outlet.

Water pressure drop from water inlet to outlet will vary with the inlet pressure and amount of water flowing. A normal pressure drop may range from 5 to 40 PSI. Any

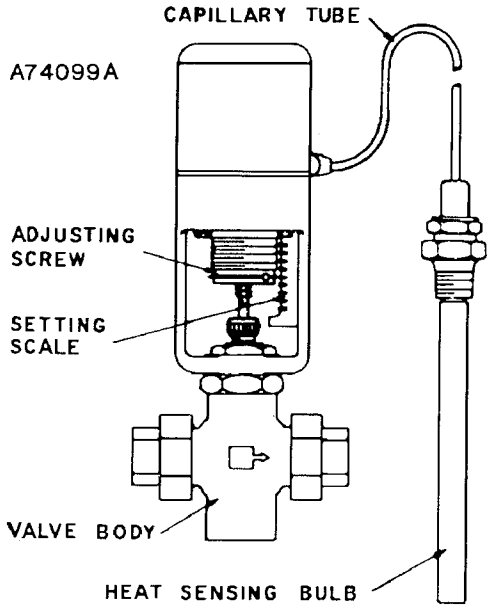


FIGURE 5-6 - WATER CONTROL VALVE

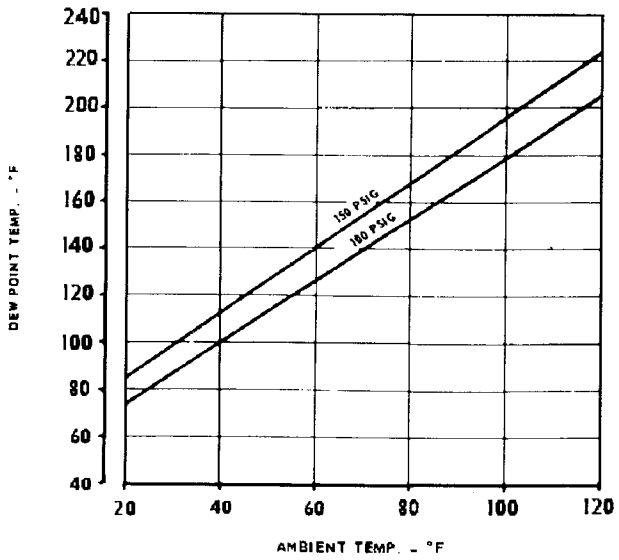


FIGURE 5-7 - DEW POINT TEMPERATURE VS. AMBIENT TEMPERATURE (100% RELATIVE HUMIDITY)

change in the pressure drop from that normally held may indicate tube leakage or fouling and should be investigated.

In many instances, the cooling water supply for the heat exchanger will contain impurities dissolved in solution and/or in suspension. These substances can cause scale formations, corrosion and fouling (plugging) of any water-cooled heat exchanger equipment. Disregarding the possibility that one or more of these conditions exists may result in increased maintenance and operation expense, reduced equipment life and emergency shutdown. It is strongly recommended that a reputable, local water treatment concern be engaged to establish the corrosion, scale-forming and fouling tendency of the cooling water and take steps necessary to remedy the situation if a problem does exist. The need for water treatment may only involve filtration (screening) to remove debris, sand and/or silt in the cooling water supply. However, chemical treatment methods may be necessary in certain instances to inhibit corrosion and/or remove suspended solids to alter the water's tendency to form scale deposits, or prevent growth of microorganisms. The normal maintenance program for the unit should include periodic cleaning on the tube side (water side) of the heat exchanger to remove deposits which enhance fouling and corrosion.

Hex head zinc anodes are used in the return bonnet (opposite end to the water pipe connections) of heat exchangers to provide internal water system corrosion protection. These anodes should be inspected periodically and replaced when the zinc has been reduced to about 1/2 inch in length.

WATER FLOW CONTROL VALVE FOR HEAT EXCHANGER (Optional Equipment) - Recommended To Conserve Water Where Appropriate - (Figures 5-6 and 5-7) The water flow control valve is adjustable to compensate for varying water inlet temperatures and pressures (thermal control valve prevents settings below approximate 180° F.). Use the discharge air temperature gauge on the instrument panel to set flow control valve for minimum water usage to maintain discharge temperature at a minimum of 10° F. above dew point at the maximum anticipated ambient; refer to Figure 5-7 for the dew point temperature at your operating pressure and ambient temperatures.

To decrease water flow (increase compressor discharge air temperature) turn the adjusting screw from left to right, increasing spring tension. **To increase water flow** (decrease compressor discharge air temperature) turn the adjusting screw in the opposite direction. The groove at the lower edge of the adjusting screw is an index line for use with the index scale 0 to 8 in obtaining a desired setting.

These valves must be handled with care and proper tools and techniques must be used when working on the valve. Care must be used when handling the capillary tube; a kink or break in the tubing or connections will make the valve inoperative. Never attempt to change capillary length. Excess capillary tube should be carefully coiled and placed so that damage will not occur in normal maintenance or traffic past the unit.

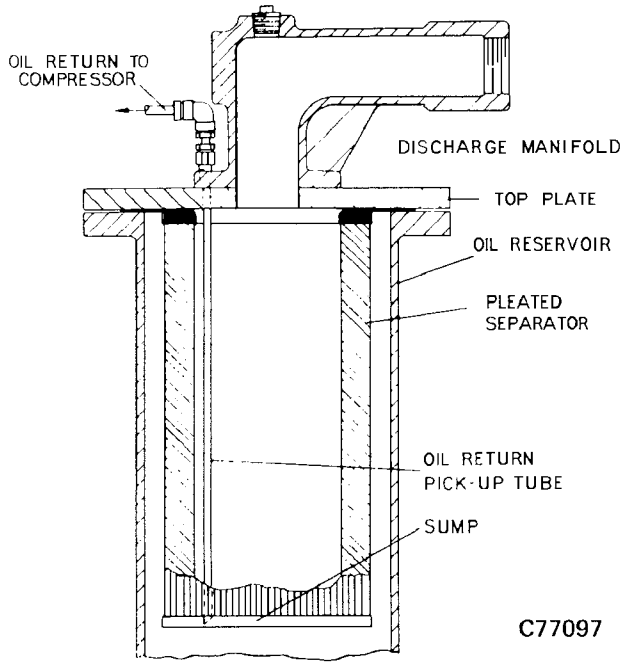


FIGURE 5-8 - SINGLE ELEMENT OIL SEPARATOR

If a leak developes through the packing, tighten the packing gland nut firmly with a wrench to reseat the packing around the valve stem, then back off the nut until loose, and finally retighten the nut finger tight. Tightening the packing nut too tight may cause erratic operation. An occasional drop of oil on the valve stem at the packing nut will prolong packing life.

If the valve malfunctions, check for bent or binding (paint or corrosion, etc.) valve stem, foreign material in the valve, erosion, or thermal system (capillary) failure. If foreign material or scale is likely, the use of a strainer in the inlet water line is recommended.

WATER SHUTOFF VALVE - WATER-COOLED HEAT EXCHANGER (Optional Equipment But Recommended) (Figure 5-1, page 1, this section) - A magnetic solenoid-operated water shutoff valve rated at 150 PSIG water pressure should be mounted in the water inlet line ahead of the oil cooler. The valve should be wired into the compressor control circuit in such a manner that the valve opens to allow water to flow any time the ON-OFF push button is ON and the compressor is running. When the compressor stops under automatic control, or is shut off manually, the valve should close, stopping water flow through the system.

OIL RESERVOIR - The oil reservoir-separator combines multiple functions into one vessel. The horizontal section is the oil reservoir, providing oil storage capacity for the system and a primary oil separation means. The vertical section contains the final oil separator and has the discharge line mounted on the upper flange. The reservoir provides limited air storage for control and gauge actuation.

COMPRESSOR OIL SEPARATOR located in the vertical section of the oil reservoir consists of a single high efficiency, pleated element and provides the final removal of oil from the air stream. Oil from inside the separator elements is returned through tubing to the compressor cylinder. Refer to Figure 5-8.

Oil carry-over through the service lines may be caused by a faulty oil separator, faulty minimum pressure valve, overfilling of the oil reservoir, oil that foams, oil return line malfunction or water condensate in the oil. If oil carryover occurs, inspect the separators only after it is determined that the oil level is not too high, the oil is not foaming excessively, the oil return line from the separator housing to the compressor cylinder is not clogged or pinched off, the return tube inside the separator is not loose or broken, the check valve in the oil return line is functioning properly, and there is not water or an oil/air emulsion in the oil.

Oil carry-over malfunctions of the oil separator are usually due to using elements too long, heavy dirt or varnish deposits caused by inadequate air filter service, use of improper oil or using oil too long for existing conditions. A ruptured or collapsed separator element is usually due to heavy dirt or varnish buildup in the filtering material. Excessive tilt angle of the unit will also hamper separation and cause oil carry-over.

Oil separator element life cannot be predicted; it will vary greatly depending on the conditions of operation, the quality of the oil used, and the maintenance of the oil and air filters. The condition of the separator can be determined by pressure differential or by inspection.

Pressure Differential Gauges - Gauges mounted on the instrument panel continuously monitor the pressure differential across the oil separators and main oil filter and indicate the condition of these components.

The oil separator should be changed when the gauge indicates a pressure differential of 8 PSI with the unit on full load at rated service pressure. See "Compressor Oil Separator" above.

The main oil filter and bearing oil filter should be changed when the gauge indicates a pressure differential of 15 PSI with the unit on full load at rated service pressure or 1000 hours of operation, whichever occurs first. See Compressor Main Oil Filter, page 4, and Bearing Oil Filter, page 6, this section.

⚠ CAUTION

Using an oil separator element at excessive pressure differential can cause damage to equipment. Replace separator when there is a pressure differential of 8 psi with the unit at full load at rated service pressure.

NOTICE

A sudden drop of zero pressure differential or sudden heavy oil carryover may indicate a ruptured element.

Inspection - After removal of separator element, shine a light inside the element to reveal areas of heavy dirt or varnish deposits or breaks (ruptures) in the element media.

Removal Of Oil Separator For Inspection Or Replacement: (Figure 5-8)

⚠ DANGER

Air/oil under pressure will cause severe personal injury or death. Shut down compressor, relieve system of all pressure, disconnect, tag and lockout power supply to starter before removing valves, caps, plugs, fittings, bolts, and filters.

1. Be certain unit is completely off and that no air pressure is in the oil reservoir.
2. Disconnect, tag and lockout power supply to the starter.
3. Disconnect oil return to compressor tubing at tube elbow near the discharge manifold flange on the top plate.
4. Loosen the nut on fitting at manifold flange and completely withdraw the tubing through the fitting.
5. Disconnect all other tubing from discharge manifold.
6. Disconnect discharge manifold pipe union.
7. Remove screws holding the top plate to the oil reservoir. Lift the top plate from the oil reservoir.

Ambient Temp. (° F.)		80	90	100
350 HP 400 HP 500 HP	Discharge Temperature ° F.	171 175 184	181 185 194	191 195 204*

* For temperatures above 200° F. see "High Temperature Operation".

FIGURE 5-9 - AMBIENT TEMPERATURES

8. Lift the separator from the oil reservoir.
9. Inspect and/or replace the separator as necessary. Before installing (or reinstalling) any separator be sure gaskets bonded to the separator flanges are not damaged. Remove the gasket material adhering to the top plate or reservoir flange from the old separator.
10. Lower the separator into the oil reservoir.
11. Seat the top plate to the oil reservoir flange; install and tighten all cap screws.
12. Reconnect the discharge manifold pipe union and all tubing.
13. Install original oil return by slipping tube through the fitting at the discharge manifold flange until ferrule bottoms in the fitting. If a new fitting and return tube are used, slip the tube through the fitting until it touches the bottom of the separator, then raise the tube about 1/4 inch off the bottom and tighten the fitting nut securely. Connect the other end of the tube to the compressor oil return tube elbow. Do not bend tube or raise tube further than 1/4"-1/2" from the bottom of the separator.
14. Reconnect compressor oil return tube to tube elbow.

COMPRESSOR OIL SYSTEM CHECK - The compressor should be at operating temperature at the time of the checks. One-half hour of loaded operation is usually sufficient to reach level-out operating temperatures. The data shown below is for an oil system in good condition.

If the unit will operate at discharge temperatures over 200° F. for more than 4 consecutive hours, refer to the "High Temperature Operation" paragraph and select a lubricant for the service. Regardless of level of sustained discharge temperature, the high discharge air temperature switch must never be set higher than 225° F. shutdown temperature.

Air and Oil Discharge Temperature - Check with a thermometer in the tapped opening on top of the compressor discharge pipe to the oil reservoir.

For **Air Cooled Oil Systems**, Figure 5-9, page 10, this section, shows the normal upper limit of discharge temperatures for varying ambient temperatures beginning at the system design point of 80° F. At ambient temperatures below 80° F., the mixing valve will hold the discharge temperature at the 80° F. ambient temperature point. Above 80° F., the oil cooler is fully used and the discharge temperature varies degree for degree with the ambient temperature.

For **Water Cooled Oil Systems**, the water flows at various temperatures outlined in Section 2 will hold the discharge temperature below the 80° F. ambient temperature level of Figure 5-9, page 10, this section. Small variations in specific water flows or temperatures will not be noted in the discharge temperature since the water control valve will tend to hold a constant oil temperature. A significant change in the discharge temperature is cause to check for a change in water flow or temperature.

Oil Inlet Pressure - Check at the fitting in the line near the compressor oil inlet. With air receiver pressure at 100 psi, oil inlet pressure should be 75-85 psig.

Oil Cooler Oil Pressure Differential (Air-Cooled Radiator) - 2 to 25 PSI (65 to 150 PSIG Receiver Pressure) - Check at the fitting in the inlet and outlet lines of the oil cooler.

Oil Cooler Oil Pressure Differential (Water-Cooled Heat Exchanger) - 2 to 25 PSI (65 to 250 PSIG Receiver Pressure) - Check at the heat exchanger oil inlet and outlet fittings.

Oil Cooler Temperature Differential (Air-Cooled Radiator) - The oil temperature differential depends on the temperature of the air at the oil cooler fan and cleanliness of the core faces. As ambient temperatures and core restrictions increase, the oil cooler outlet temperature will increase. The inlet oil temperature may be checked at the fittings in the oil inlet line on the oil cooler module. The outlet oil temperatures may be checked at the fitting in the oil outlet line.

Oil Cooler Temperature Differential (Water-Cooled Heat Exchanger) - The oil temperature differential depends on the inlet water temperature and the water flow rate permitted by the water flow control valve setting. The oil inlet temperature is approximately the same as air discharge temperature - see the gauge on the instrument panel. The oil outlet temperature may be checked at the compressor oil inlet line fitting.

Oil Cooler Water Pressure Differential (Water-Cooled Heat Exchanger) - The water pressure differential through the heat exchanger will depend on supply pressure, flow rate, cooler tube cleanliness and outlet pressure. The inlet and outlet water pressures may be checked at pipe fittings supplied by the customer.

SECTION 6
AIR FILTERS

AIR FILTER - The air filter furnished as standard equipment is a panel type washable filter. The filter must receive proper maintenance if maximum service is to be obtained from the unit. Establishing adequate and timely filter service is MOST IMPORTANT. With wide variation of dust conditions encountered, only experience can determine the proper time element for servicing filters. Although a paper filter element is normally considered expendable, proper and careful cleaning can extend its original life several times.

Filter Element - Service the air filter element when indicated by the service indicator or when inspection indicates a heavy accumulation of dirt on the outside of the element. Clean every 50 to 250 operating hours depending on dust conditions. Inspect every few days until experience determines the proper time for servicing. Higher than normal current use by the motor or loss of compressor delivery may indicate a need for servicing the filter element.

To Service:

Remove louvered filter cover and filter element by removing the six (6) cover to enclosure screws.

Two methods of cleaning are recommended. Use of compressed air is effective when the major contaminant is dust. Washing is effective on carbon, soot, and oil laden elements.

DO NOT ATTEMPT TO CLEAN ELEMENTS BY BEATING OR RAPPING.

When air is used, direct a jet of air (100 PSI maximum) against the clean air side of the element in the opposite direction of normal air flow. Move the air jet up and down the pleat, slowly moving across the face of the element. Nozzle must be kept at least one inch away from element. Take care the paper is not ruptured by the nozzle or air jet.

When cleaning by washing, use a good non-sudsing detergent and water. Soak the element in a solution of two (2) ounces of detergent per gallon of water (140° F. maximum) for at least 15 minutes. Swish the element around in the solution (2 minutes) to help remove dirt. Warm solution gives best results. Rinse the element with a stream of water (40 PSI maximum) opposite to normal air flow until rinse water is clear. DRY THE ELEMENT THOROUGHLY BEFORE USING. DO NOT USE LIGHT BULBS FOR DRYING. Warm air (160° F. or less) must be circulated as high surface temperatures can burn or scorch the filter paper.

After cleaning, thoroughly inspect element for dirt on clean air side, holes or damage by looking through the element toward a bright light. Do not reuse damaged elements.

Filter Element Life - The element should be replaced after six (6) cleanings or if:

1. Visual inspection indicates a rupture, crack or pin hole in the pleated media. Inspection should be done by placing a bright light inside the element.
2. Pressure drop through a filter with a freshly cleaned element is below 3 inches of water with compressor running at full load - this would indicate a rupture or crack.

NOTICE

Use only genuine Gardner Denver air filter elements on Gardner Denver compressor units. Genuine parts are available through your authorized Gardner Denver distributor.

⚠ WARNING

Do not oil this element. Do not wash in inflammable cleaning fluids. Do not use solvents other than water. Improper cleaning may damage element.

⚠ CAUTION

Never operate unit without filter element. Never use elements that are damaged, ruptured or wet. Never use gaskets that won't seal. Keep spare elements and gaskets on hand to reduce downtime. Store elements in a protected area free from damage, dirt and moisture. Handle all parts with care.

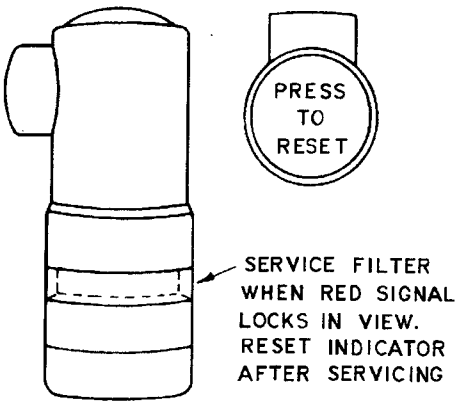


FIGURE 6-1 - AIR FILTER SERVICE INDICATOR

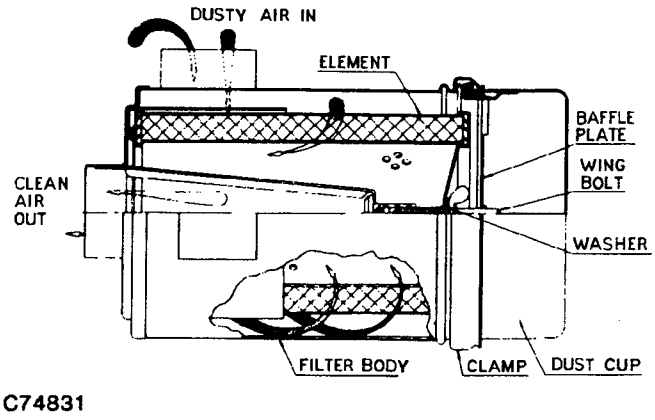


FIGURE 6-2 - HEAVY DUTY AIR FILTER

AIR FILTER SERVICE INDICATOR (Figure 6-1) - This indicator signals time to change or service the air filter. The flag in the window gradually rises as the filter element loads with dirt. When the pressure drop across the filter reaches the preset restriction (equivalent of 20 inches of water), the flag reaches the top and locks in position, indicating the need for filter servicing. After servicing, reset the indicator by pushing the reset button all the way in, then release.

⚠ WARNING

The air filter service indicator is an effective device only as long as the inlet system vacuum is maintained. If the vacuum is broken because of a defective filter gasket or ruptured element, the indicator will not function. It is wise, therefore, to periodically inspect the air filter for excessive dust buildup.

HEAVY-DUTY AIR FILTER - 350 & 400 HP UNITS (Figure 6-1) - When heavy-duty air filters are specified for the 350 & 400 HP units, they will be a two-stage dry type. When the unit has been so equipped, service the filters as follows:

Dust Cup - Service every 4 to 120 hours depending on dust conditions. To service, loosen the retaining band clamp and remove the dust cup. Do not wash the dust cup - wipe clean with a clean dry cloth. Do not bend the edge of the cup by striking on a hard surface. When installing the dust cup, make sure the clamp is securely tightened to prevent leakage.

Filter Element - Service the air filter element when indicated by the service indicator or when inspection indicates a heavy accumulation of dirt on the outside of the element. Clean every 50 to 250 operating hours depending on dust conditions. Inspect every few days until experience determines the proper time for servicing. Higher than normal current use by the motor or loss of compressor delivery may indicate a need for servicing the filter element.

To Service:

1. Loosen the retaining band clamp and remove the dust cup from the body of the filter.
2. Visually inspect the element in place. If cleaning is not necessary, reinstall the dust cup on the filter. If the element requires cleaning, unscrew the wing bolt and withdraw the element from the body.
3. Wash the element by soaking about 15 minutes in warm water with a mild detergent. Rinse the element thoroughly with clean water; a hose may be used if the water pressure does not exceed 40 PSIG.
4. Inspect the element for ruptures or cracks in the pleated media; replace the element if any are found. Inspect the gasket on the bottom (outlet end) of the element; replace the entire element if the gasket is damaged.
5. Allow the element to air dry COMPLETELY. Do not expose the element to heat over 150° F. Install the element in the filter body and fasten securely with the wing bolt. Reinstall the dust cup and retaining band clamp. Make sure the clamp is tightened securely to prevent leakage.

Filter Element Life - The element should be replaced after six (6) cleanings or if:

1. Visual inspection indicates a rupture, crack or pin hole in the pleated media. Inspection should be done by placing a bright light inside the element.
2. Pressure drop through a filter with a freshly cleaned element is below 3 inches of water with compressor running at full load - this would indicate a rupture or crack.

Inlet Tube - Inspect the inlet screen and tube for dirt accumulation each time the filter is serviced. Clean the tube when required by ramming a clean dry cloth through the tube. Wipe the inside of the filter body to remove any dirt falling from the inlet tube before reinstalling the element.

Causes of short element life include:

- Severe dust conditions
- Infrequent servicing
- Improper cleaning
- Contamination by oil or chemical fumes.

NOTICE

Use only genuine Gardner Denver air filter elements on Gardner Denver compressor units. Genuine parts are available through your authorized Gardner Denver distributor.

⚠ WARNING

Do not oil this element. Do not wash in inflammable cleaning fluids. Do not use solvents other than water. Improper cleaning may damage element.

⚠ CAUTION

Never operate unit without filter element. Never use elements that are damaged, ruptured or wet. Never use gaskets that won't seal. Keep spare elements and gaskets on hand to reduce downtime. Store elements in a protected area free from damage, dirt and moisture. Handle all parts with care.

SECTION 7
COUPLING

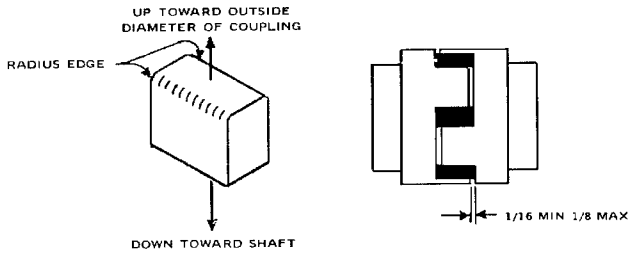


FIGURE 7-1 - INSTALLATION OF STYLE "A" COUPLING CUSHION

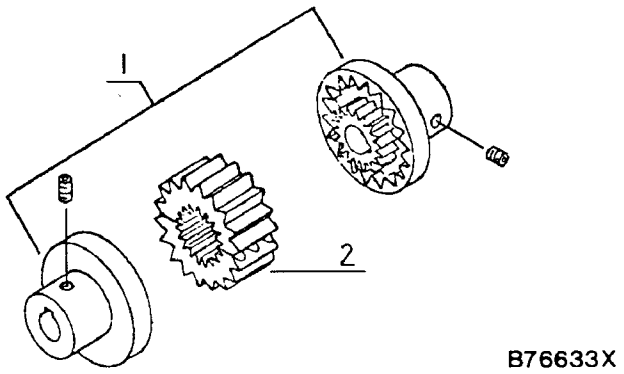


FIGURE 7-2 - INSTALLATION OF COUPLING - STYLE "B"

Coupling - The motor and compressor are direct connected by a flexible coupling. Style "A" coupling has several individual cushions, Figure 7-1. Style "B" has a two piece split sleeve, Figure 7-2.

⚠ DANGER

Rotating machinery can cause personal injury or death. Turn the unit completely off, open main disconnect, tag and lockout before servicing coupling.

If maintenance on mating parts is required, reassemble the coupling as follows:

1. Slide coupling halves over shaft extensions. Be sure collar on Style "A" coupling is installed on shaft behind one coupling body.
2. Assemble the motor to the compressor.
3. FOR STYLE "A" COUPLING:
   a. Working through the cover plate opening, center coupling halves over the gap between the shafts, maintaining gap as shown in Figure 7-1 between the ends of the jaws on one coupling body and the flange on the opposite coupling body. Tighten set screws in each coupling body.
   b. Insert individual cushions as shown in Figure 7-1 and slide the collar over the cushions and secure with cap screws. Reinstall the cover plate.

FOR STYLE "B" COUPLING:

⚠ DANGER

Rotating machinery can cause personal injury or death. Do not operate unit with either coupling guard or collar removed. All bolts and screws must be properly tightened.

a. Working through cover plate opening, center coupling halves over the gap in the shafts. Secure short hub half of coupling to the shaft by tightening the set screws over the shaft key and 90° to the key.
b. Assemble halves of split sleeve into the teeth of the short hub half of the coupling.
c. Slide the long hub over the split sleeve teeth until the sleeve is bottomed in both hubs; back long hub off 1/16 inch.
d. Secure the long hub in position by tightening the socket head cap screw through the split section of the hub; tighten the set screw over the shaft key.

Alignment - The coupling is permanently aligned by the flanges on the compressor and motor.

SECTION 8
MAINTENANCE SCHEDULE

SERVICE CHECK LIST

Air Filter - Operating conditions determine frequency of service; refer to "Air Filters" Section 6 and plan maintenance accordingly.

Oil Separator - Change the oil separator element when the pressure differential gauge indicates an 8 PSI differential.

Refer to "Compressor Oil Separator," Section 5, page 8, for further details.

Motor Lubrication - See Section 2, page 8 .

Every 8 Hours Operation

1. Check the reservoir oil level - add oil if the oil level is in the ADD range with the compressor on load. If oil consumption is high, refer to "Compressor Oil Separator" in Section 5, page 8, and "Excessive Oil Consumption" in Section 9, page 1.
2. Observe if the unit loads and unloads properly.
3. Check discharge pressure and temperature.
4. Drain the moisture traps on turn valve and inlet valve pilots and on separate air receiver and moisture separator, if used.
5. If moisture is noted in the oil level gauge, drain accumulated moisture and see Section 5, page 3, "Moisture in the Oil System".

Every 125 Hours Operation

1. Check for dirt accumulation on oil cooler and aftercooler core faces and the fan and fan motor. If cleaning is required, clean the exterior fin surfaces of the cores by blowing compressed air carrying a non-flammable safety solvent in a direction opposite that of the cooling fan air flow. This cleaning operation will keep the exterior cooling surfaces clean and ensure effective heat dissipation.

Every 1000 Hours Operation

1. Change oil filter element every 1000 hours or sooner, or when top of indicator on filter is in the red "Change Filter" half of window. Unit must be running and warmed up for indicator to read accurately. Check with light to be certain of indicator position - some lubricants will obscure indicator.

Every 6000 Hours Operation

1. Change the compressor lubricant. UNDER ADVERSE CONDITIONS, CHANGE MORE FREQUENTLY (refer to "Oil Change Interval," Section 5, page 3). Flush system if required.

Every Year

1. Check the relief valve for proper operation. See Section 4, page 4.

MAINTENANCE SCHEDULE (See detail notes above)

Maintenance Action	As Indicated By Pressure Differential	Every 8 Hours	Every 125 Hours	Every 1000 Hours	Every 6000 Hours	Every Year
Change Air Filter	●					
Check/Change Oil Separator	●					
Check Reservoir Oil Level		●				
Check For Proper Load/Unload		●				
Check Discharge Pressure/Temp.		●				
Check Dirt Accumulation on Cooler			●			
Change Oil Filter Element				●		
Change Compressor Lubricant (AEON 4000)*					●	
Check Relief Valve						●

* See Oil Change Interval Chart, Section 5, page 4, for specific lubricant life.

SECTION 9
TROUBLE SHOOTING

IF UNIT FAILS TO START, check:

1. Wiring system for wrong lead connections.
2. Temperature and/or pressure shutdown reset on control panel and/or reset relay in control box.
3. Fuses in control enclosure or starter enclosure.
4. Compressor motor starter overload heaters and adjusting knob.
5. Oil cooler fan motor overload heaters and adjusting knob.
6. Low oil pressure or faulty low oil pressure switch.
7. Contacts of timing relay for low oil pressure shutdown stuck open.
8. Faulty timing relay.
9. Reduced voltage starter only - starting phase time set too long.
10. Reservoir pressure switch setting.

UNIT STARTS BUT STOPS AFTER A SHORT RUN, check:

1. High air discharge temperature caused by:
   (a) Low compressor oil level.
   (b) Clogged oil cooler or oil filters.
   (c) Thermal control (thermostatic mixing) valve inoperative.
   (d) Accumulation of grease, oil, or dirt on exterior fin surfaces of oil cooler (refer to maintenance schedule for cleaning procedure).
   (e) Poor ventilation of unit and/or oil cooler.
   (f) Water control valve inoperative.
   (g) Water inlet temperature too high.
   (h) Water shutoff valve inoperative.
   (i) On remote oil cooler unit, pilot-operated valve or check valve in piping to oil cooler inoperative.
   (j) Reservoir pressure switch setting.
2. Fuses in control panel enclosure or starter enclosure.
3. Compressor motor starter overloads and adjusting knob.
4. Oil cooler fan motor overload heaters and adjusting knob.
5. Low oil pressure or faulty low oil pressure shutdown switch.
6. Time delay on timing relay for low oil pressure shutdown set too short a time. MAXIMUM DELAY SETTING IS 15 SECONDS.
7. Timing relay setting screw not engaged.
8. (a) Faulty or intermittent HDTS or probe.
   (b) Incorrect HDTS setting (225° F. is maximum).
9. Faulty timing relay.

COMPRESSOR DOES NOT UNLOAD, check:

1. Magnetic unloader or pressure switch for malfunction.
2. Control lines for restriction.
3. Air leaks in control system.
4. Inlet valve stuck open due to corrosion.
5. Inlet valve disc not sealing.
6. Broken inlet valve stem spring.
7. Pilot(s) or pressure switch adjustment.
8. Pilot(s) or pressure switch for dirt or leaking diaphragm.

PNEUMATIC BLOWDOWN VALVE CONTINUES TO PASS AIR, check for:

1. Loose or broken air line to blowdown valve pilot.
2. Loose wiring to the blowdown valve actuator solenoid.
3. Coil failure on the blowdown valve actuator solenoid.
4. Pressure regulator not set to correct pressure.

EXCESSIVE OIL CONSUMPTION, check for:

1. Oil carry-over through discharge line caused by:
   (a) Overfilling the reservoir.
   (b) Clogged, broken, or loose oil return lines.

EXCESSIVE OIL CONSUMPTION, (Continued) check for:

(c) Ruptured oil separator elements.

(d) Loose assembly.

(e) Incorrect oil causing foam.

(f) Inoperative minimum pressure valve.

2. Oil leaks at all fittings and gaskets.
3. Oil leaking into water system of oil cooler.

COMPRESSOR LOW ON DELIVERY AND PRESSURE, check for:

1. Clogged air filter.
2. Restricted inlet valve.
3. Corrosion in inlet valve causing sticking.
4. Broken inlet valve stem spring.
5. Binding inlet valve piston.
6. Incorrect motor speed.
7. Turn valve and/or inlet valve pilot adjustment and/or malfunction.
8. 4-way valve malfunction.
9. Pressure gauge faulty.

NOTICE

Gardner Denver factory remanufactured replacement compressor air end units are available from your authorized distributor, on an exchange basis, for all rotary screw compressor units.

Gardner Denver

WARRANTY
ROTARY SCREW COMPRESSORS
AND VACUUM PACKAGES
OIL INJECTED – OIL FREE

GENERAL PROVISIONS AND LIMITATIONS
Gardner Denver (the "Company") warrants to each original retail purchaser ("Purchaser") of its new products from the Company or its authorized distributor that such products are, at the time of delivery to the Purchaser, made with good material and workmanship. No warranty is made with respect to:

1. Any product which has been repaired or altered in such a way, in the Company's judgment, as to affect the product adversely.

2. Any product which has, in the Company's judgment been subject to negligence, accident, improper storage, or improper installation or application.

3. Any product which has not been operated or maintained in accordance with the recommendations of the Company.

4. Components or accessories manufactured, warranted and serviced by others.

5. Any reconditioned or prior owned product.

Claims for items described in (4) above should be submitted directly to the manufacturer.

WARRANTY PERIOD
The Company's obligation under this warranty is limited to repairing or, at its option, replacing, during normal business hours at an authorized service facility of the Company, and part which in its judgment proved not to be as warranted within the applicable Warranty Period as follows.

AIRENDS
Airends, consisting of all parts within and including the cylinder and gear housing, are warranted for 24 months from date of initial use or 27 months from date of shipment to the purchaser, whichever occurs first.

Any disassembly or partial disassembly of the airend, or failure to return the "unopened" airend per Company instructions, will be cause for denial of warranty.

MAJOR PACKAGE COMPONENTS
The drive motor, air or water cooled coolers and the auto Sentry ES+, RS2000 or VS2000 Controller are warranted for 24 months from date of initial use or 27 months from date of shipment to the first purchaser, whichever occurs first.

OTHER COMPONENTS
All other components are warranted for 12 months from date of initial use or 15 months from date of shipment to first purchaser, whichever occurs first.

LABOR TRANSPORTATION AND INSPECTION
The Company will provide labor, by Company representative or authorized service personnel, for repair or replacement of any product or part thereof which in the Company's judgment is proved not to be as warranted. Labor shall be limited to the amount specified in the Company's labor rate schedule.

Labor costs in excess of the Company rate schedule amounts or labor provided by unauthorized service personnel is not provided for by this warranty.

All costs of transportation of product, labor or parts claimed not to be as warranted and, of repaired or replacement parts to or from such service facilities shall be borne by the Purchaser. The Company may require the return of any part claimed not to be as warranted to one of its facilities as designated by Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

Replacement parts provided under the terms of the warranty are warranted for the remainder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components.

DISCLAIMER
THE FOREGOING WARRANTY IS EXCLUSIVE AND IT IS EXPRESSLY AGREED THAT, EXCEPT AS TO TITLE, THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES. UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative, or employee of the Company which is not contained in this Warranty will be binding upon the Company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented within 30 days after the date upon which the product is claimed not to have been as warranted. Any action for breach of this warranty must be commenced within one year after the date upon which the cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.

Gardner Denver

For additional information contact your local representative or
Gardner Denver, Customer Service Department,
1800 Gardner Expressway, Quincy, Illinois 62301
Telephone: (800) 682–9868 FAX: (217) 224–7814

Sales and Service in all major cities.

For parts information, contact Gardner Denver,
Master Distribution Center, Memphis, TN
Telephone: (800) 245–4946 FAX: (901) 542–6159

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