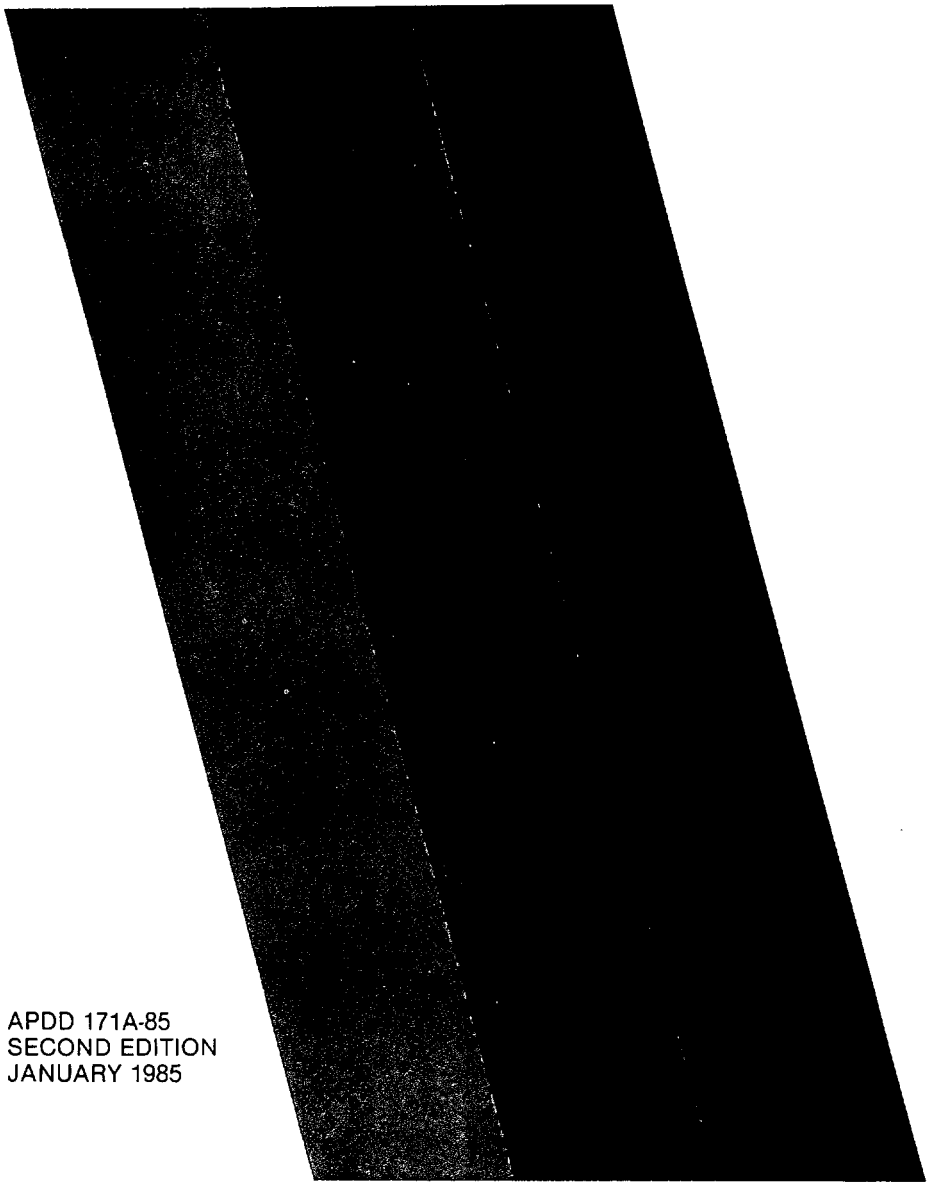
SSR 75/100 H.P., 55/75 KW. OPERATORS MANUAL INSTALLATION MAINTENANCE INCLUDES NEMA 4/12

INGERSOLL-RAND®
AIR COMPRESSORS

SSR



APDD 171A-85
SECOND EDITION
JANUARY 1985

OPERATORS MANUAL
ALL SSR MODELS
ROTARY SCREW AIR COMPRESSOR

This unit was purchased from

_____

_____

_____

Ingersoll-Rand Company reserves the right to make changes or add improvements without notice and without incurring any obligation to make such changes or add such improvements to products sold previously.

Model: _____

No. of units on order: _____

Customer order No.: _____

Ingersoll-Rand Co. Order No.: _____

For ready reference:
Record the serial number and model number of your unit here.

Serial number: _____

Model number: _____

△ WARNING △

Failure to adhere to these recommendations can result in mechanical failure, property damage and serious injury or death.

"All air and water inlet, and air and water discharge pipework to and from the inlet and discharge port connections must take into account vibration, pulsations, temperature, maximum pressure applied, corrosion and chemical resistance. In addition, it should also be noted that lubricated compressors will discharge some oil into the air stream; therefore, compatability between discharge piping, system accessories, and software must be assured.

"For the foregoing reasons, the use of plastic piping, soldered copper fittings, and rubber hose as discharge piping is not recommended. In addition, flexible joints and/or flex lines can only be considered for such purposes if their specifications fit the operating parameters of the system.

It is the responsibility of the installer and owner to provide the appropriate service pipework to and from the machine."

APDD 171A-85
JANUARY 1985

SAFETY PRECAUTIONS

READ CAREFULLY BEFORE INSTALLING THE COMPRESSOR.

WARNING

COMPRESSED AIR AND ELECTRICITY ARE DANGEROUS.

BEFORE DOING ANY WORK ON THIS UNIT, BE SURE THE ELECTRICAL SUPPLY HAS BEEN CUT OFF AND THE ENTIRE COMPRESSOR SYSTEM HAS BEEN VENTED OF ALL PRESSURE.

SAFETY PRECAUTIONS

1. Do not remove the covers or loosen or remove any fittings, connections or devices when this unit is in operation. Hot liquid and air under pressure that are contained within this unit can cause severe injury.

2. The compressor has high and dangerous voltage in both the motor, the starter, and control box. All installations must be in accordance with recognized electrical codes. Before working on the electrical system, be sure to remove voltage from the system by use of a manual-disconnect-switch. A circuit breaker or fused safety switch must be provided in the electrical supply line leading to the compressor.

Those responsible for installation of this equipment must provide suitable grounds, maintenance clearance and lightning arrestors for all electrical components as stipulated in O.S.H.A. 1910.308 through 1910.329.

3. Do not operate the compressor at higher discharge pressures than those specified on the Compressor Nameplate, or motor overload will occur. This condition will result in motor and compressor shutdown.

4. Use only safety solvent for cleaning the compressor and auxiliary equipment.

5. Install a manual shut off valve (isolation type) in the discharge line as close to the compressor as possible.

6. A safety valve is located on the receiver-separator. Whenever pressure is released through this valve, it is due to excessive pressure in the system. The cause for the excessive pressure should be investigated immediately.

7. Before doing any mechanical work on the compressor:

a.) Shut the unit down.

b.) Electrically isolate the compressor by use of the manual disconnect switch in the power line to the unit. Lock and tag the switch so that it cannot be operated.

c.) Make sure the unit has blown down, and close the unit isolation valve to prevent possible backflow into the unit from the air system.

8. There can be bad effects if compressor lubricants are allowed to enter plant air systems.

Air line separators, properly selected and installed, can reduce any liquid carryover close to zero.

The use of plastic bowls on line filters without metal guards can be hazardous. Their safety can be affected by either synthetic lubricants, or the additives used in mineral oils. From a safety standpoint, metal bowls should be used on any pressurized system. Review of your plant air line system is recommended.

9. When a receiver is installed, it is recommended that occupational safety and health standards as covered in the Federal Register, volume 36 number 105 Part II paragraph 1910.169 be adhered to in the installation and maintenance of this receiver.

10. Before starting the compressor, its maintenance instructions should be thoroughly read and understood.

FAILURE TO HEED THIS WARNING MAY RESULT IN AN ACCIDENT CAUSING PERSONAL INJURY OR PROPERTY DAMAGE.

FOREWORD

The SSR data plate on the enclosed unit is affixed to the compressor housing inside the cabinet.

It lists the rated operating pressure and the maximum discharge pressure along with the compressor capacity, the electric motor characteristics and power.

Information has been prepared in this manual to assist an operator to understand, maintain and operate this compressor within the power limits shown on the data plate.

Before installation or starting the compressor for the first time, this manual should be studied carefully to obtain a clear knowledge of the unit and the duties to be performed.

Take pride in your compressor—keep it clean and in good mechanical condition.

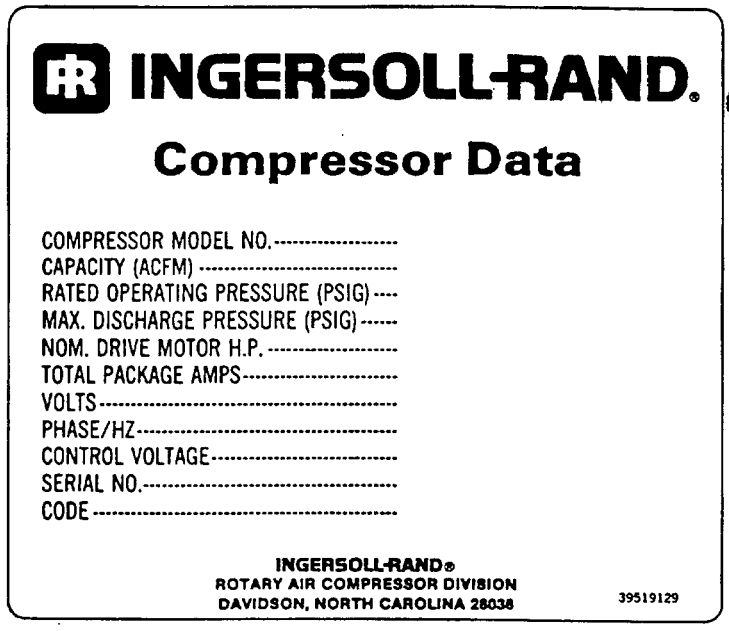


Figure 1
Compressor Data

WARNING

STATEMENT CONCERNING THE USE OF THIS EQUIPMENT FOR BREATHING AIR AND/OR AQUA LUNG SERVICE

If the model number on this air compressor contains the letters "BAP", the compressor is suitable for use in breathing air services. In the absence of such a designation, the compressor is NOT considered as capable of producing air of breathing quality. For a compressor to be capable of use in breathing air services, it must be fitted with additional specialized equipment to properly filter and/or purify the air to meet all applicable federal, state and local laws, rules, regulations and codes, such as, but not limited to, OSHA 29 CFR 1910.134, Compressed Gas Association Commodity Specification G-7.1-1966, Grade D Breathing Air, and/or Canadian Standards Association. Should the Purchaser and/or User fail to add such specialized equipment and proceeds to use the compressor for breathing air service, the Purchaser/User assumes all liability resulting therefrom without any responsibility or liability being assumed by Ingersoll-Rand Company.

The Purchaser is urged to include the above provision in any agreement for any resale of this compressor.

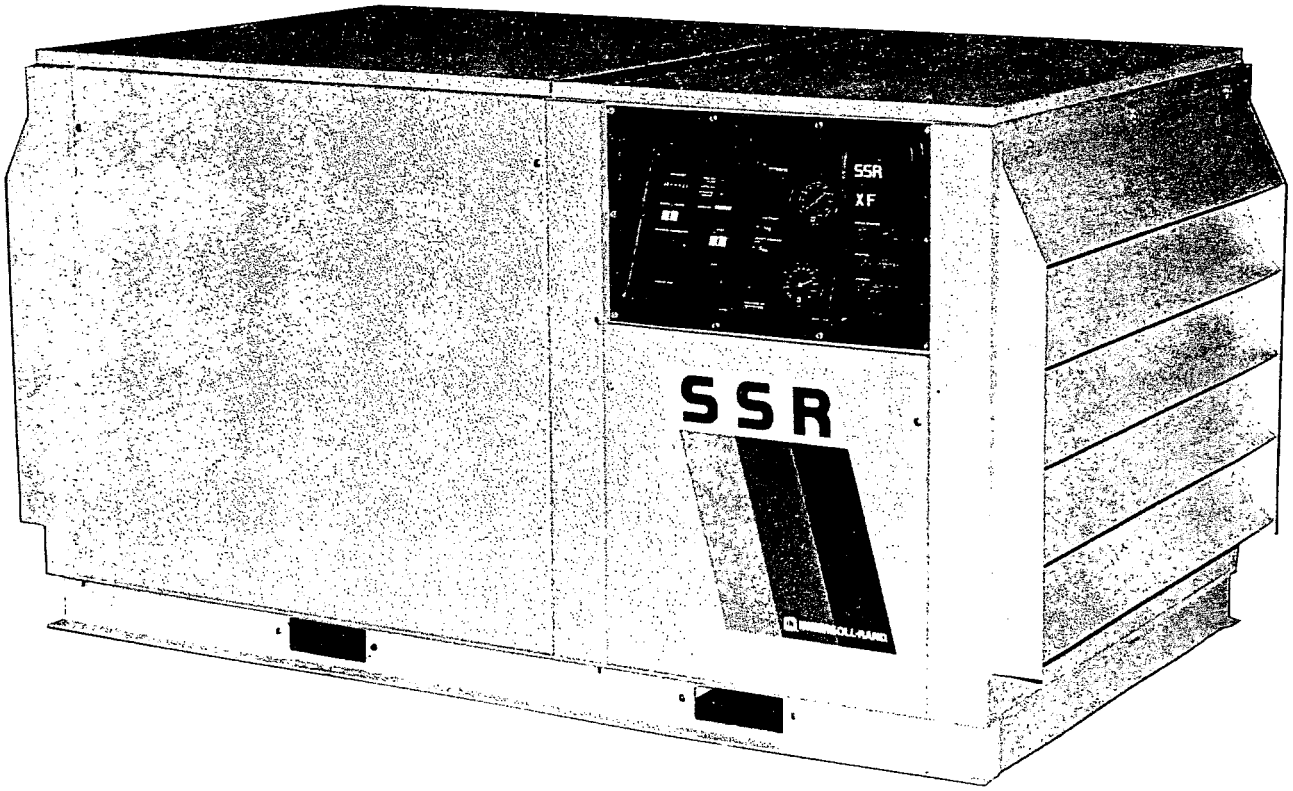


Figure 2
Typical SSR Compressor

Figure 2A
Typical SSR Nema 4/12 Compressor

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WARNINGS and CAUTIONS in this manual —

WARNINGS: Explicit instructions advising that failure to heed these instructions may result in bodily injury or death.

CAUTIONS: Failure to follow these explicit directions may result in equipment damage or premature parts failure.

CAUTION

THE USE OF REPAIR PARTS OTHER THAN THOSE INCLUDED WITHIN THE INGERSOLL-RAND COMPANY APPROVED PARTS LIST MAY CREATE HAZARDOUS CONDITIONS OVER WHICH THE INGERSOLL-RAND COMPANY HAS NO CONTROL. SUCH HAZARDOUS CONDITIONS CAN LEAD TO ACCIDENTS THAT MAY BE LIFE-THREATENING, CAUSE SUBSTANTIAL BODILY INJURY, OR RESULT IN DAMAGE TO THE EQUIPMENT. THEREFORE, INGERSOLL-RAND COMPANY CAN BEAR NO RESPONSIBILITY FOR EQUIPMENT IN WHICH NON-APPROVED REPAIR PARTS ARE INSTALLED.

GENERAL INFORMATION

The SSR compressor is an electric motor driven, single stage, screw compressor — complete with accessories piped, wired and baseplate mounted. It is a totally self-contained air compressor package.

A standard compressor is composed of the following:

Inlet air filtration
Compressor and motor assembly
Pressurized lubricant system
with cooler
Separation system
Load control system
Motor starting control system
Instrumentation
Safety provisions
Air cooled aftercooler
(Moisture separator and drain trap)

Compression in the screw-type air compressor is created by the meshing of two helical rotors (male and female) on parallel shafts, enclosed in a heavy-duty cast iron housing, with air inlet and outlet ports located on opposite ends. The grooves of the female rotor mesh with, and are driven by, the male rotor. Tapered roller bearings at the discharge end prevent axial movement of the rotors.

The air-lubrication mixture discharges from the compressor into the separation system. This system, self-contained in the receiver tank, removes all but a few PPM of the lubricant from the discharge air. The lubricant is returned to the system and the air passes to the aftercooler.

The aftercooling system consists of a heat exchanger, a condensate separator, and a drain trap. By cooling the discharge air, much of the water vapor naturally contained in the air is condensed and eliminated from the downstream plant-piping and equipment.

The compressor capacity is governed by the load control system. In the standard control mode, the compressor can operate "On-Off Line." The compressor will operate to maintain discharge line pressure at or slightly above the rated pressure.

Optional accessories can provide for such things as upper range modulation and automatic starting and stopping. This may be desirable in a plant where the air demand varies widely.

The field proven control system is basically solid state for long term, trouble-free operation.

The lubricant system consists of a sump, a cooler, thermostatic lubricant control valve and a filter. When the unit is operating the lubricant is pressurized and forced to the compressor bearings.

Panel instrumentation is provided to indicate the compressor operating conditions, control power availability, load control mode, a start-stop station and optionally, a shut down annunciator section. Safety of operation is provided for excessive discharge temperature and electrical overload by causing the compressor to shut down.

Effective lubricant filtration is provided by use of a heavy duty hydraulic type filter.

All of the above features are described in greater detail and discussed in the pertinent sections of this manual.

COMPRESSION

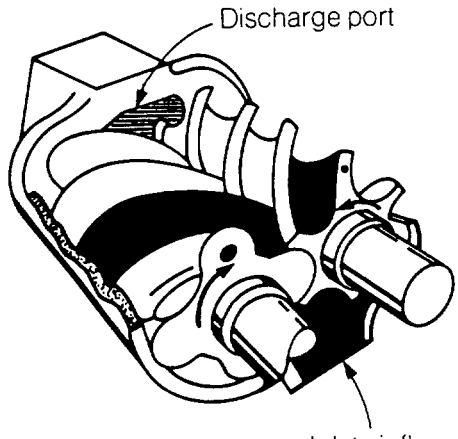
If one thinks of the female rotor grooves and the compressor housing acting as a conventional cylinder, and the sliding action of the male rotor lobe as a piston, the positive displacement nature of a rotary screw compressor becomes apparent.

As rotation of the compressor begins, air is drawn into the pockets opened between the male rotor lobes and the female rotor grooves at the intake end of the compressor. This is illustrated in Figure 3-1. (A mating male-lobe and female-groove are marked with dots to show the relative positions of the rotors.)

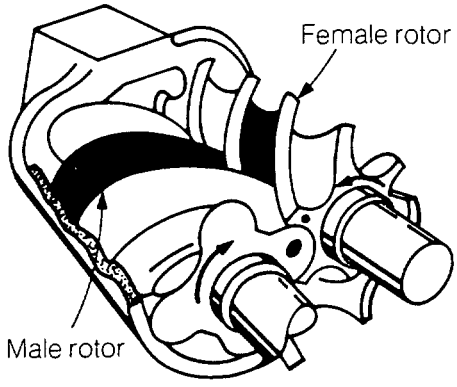
With further rotation, the leading strip of the male lobe reaches the contour of the female groove, and traps the air in the pocket previously formed. This air is moved down the female rotor groove and is compressed.

Coolant-lubricant is injected during the compression phase and takes up heat of compression, lubricates the rotors, and seals the rotor-clearances against leakage. This phase is illustrated in Figure 3-2.

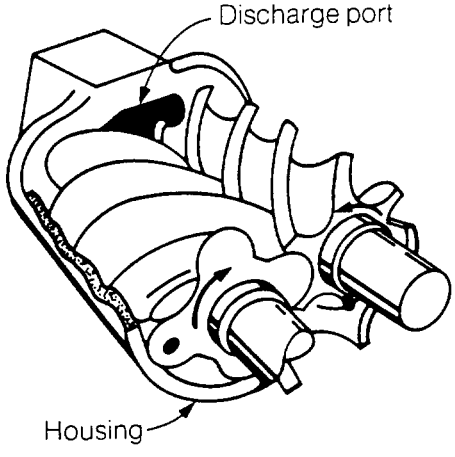
When the male rotor lobe reaches the end of the groove, the trapped air is discharged along with the coolant. Figure 3-3. The mixture is piped through a check valve to the receiver. In the receiver, the coolant will be separated from the air and returned to the system. The air will flow to the aftercooler and then to the plant system.



1 — Intake



2 — Compression



3 — Discharge

Figure 3
Rotor Compression

LUBRICANT CIRCULATION SYSTEM

Refer to Figure 4 for the Aircooled Circulation System Schematic.

Lubricant is forced by pressure from the receiver-separator to the inlet port of the lubricant cooler and the bypass port of the thermostatic control valve.

The thermostatic oil control valve controls the quantity of lubricant necessary to provide a suitable compressor injection temperature. When the compressor starts cold, part of the lubricant will by-pass the cooler. As the system temperature rises above the valve setting, the lubricant will be directed to the cooler. During periods of operation in higher ambient temperatures, all the lubricant flow will be directed through the cooler.

The compressor-injection minimum temperature is controlled to preclude the possibility of water vapor condensing in the receiver. By injecting lubricant at a sufficiently high temperature, temperature of the discharge air and lubricant mixture will be kept above the dew point.

The controlled-temperature lubricant passes through a filter to the air end under constant pressure.

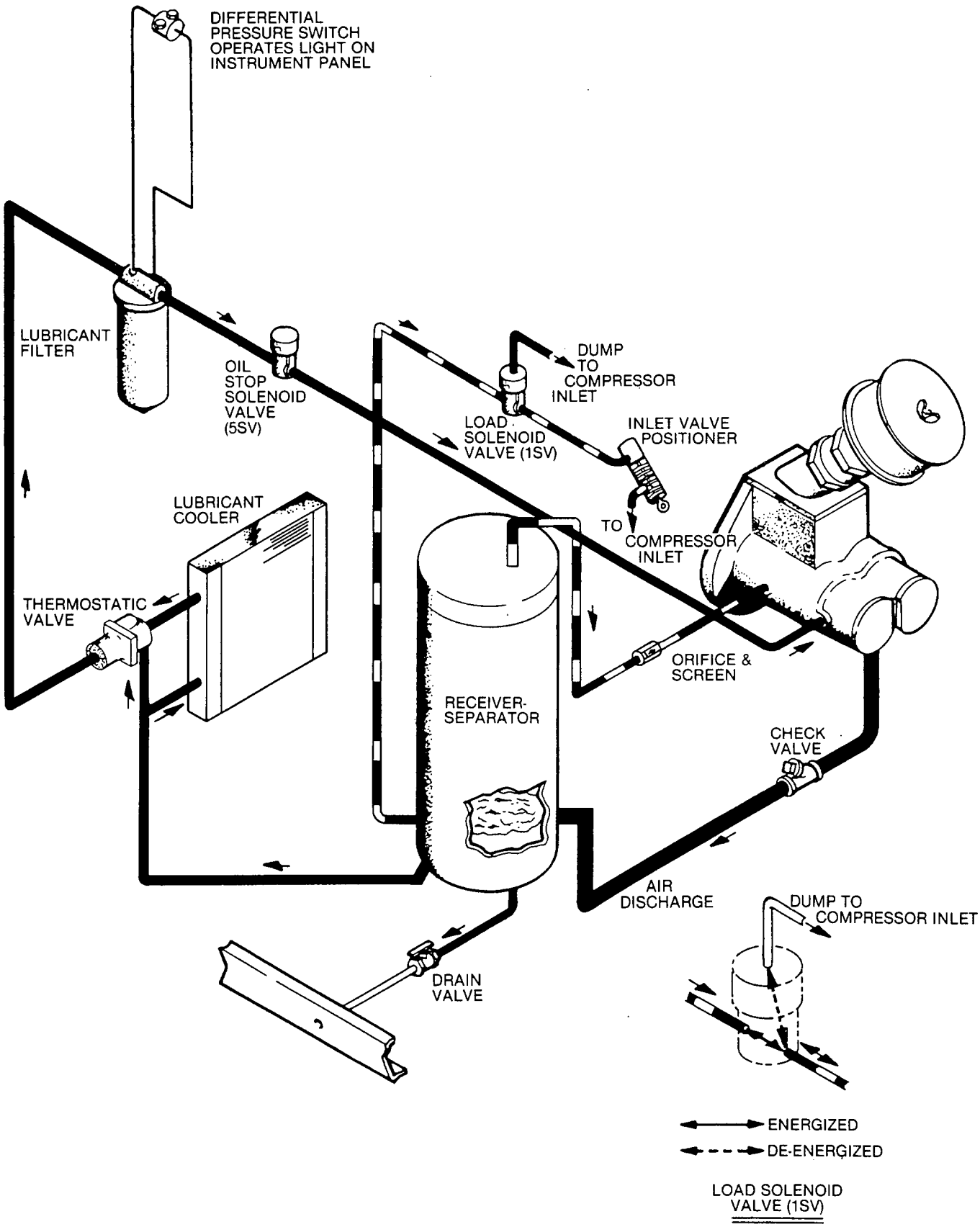


Figure 4
Coolant-Lubricant Circulation System
Aircooled

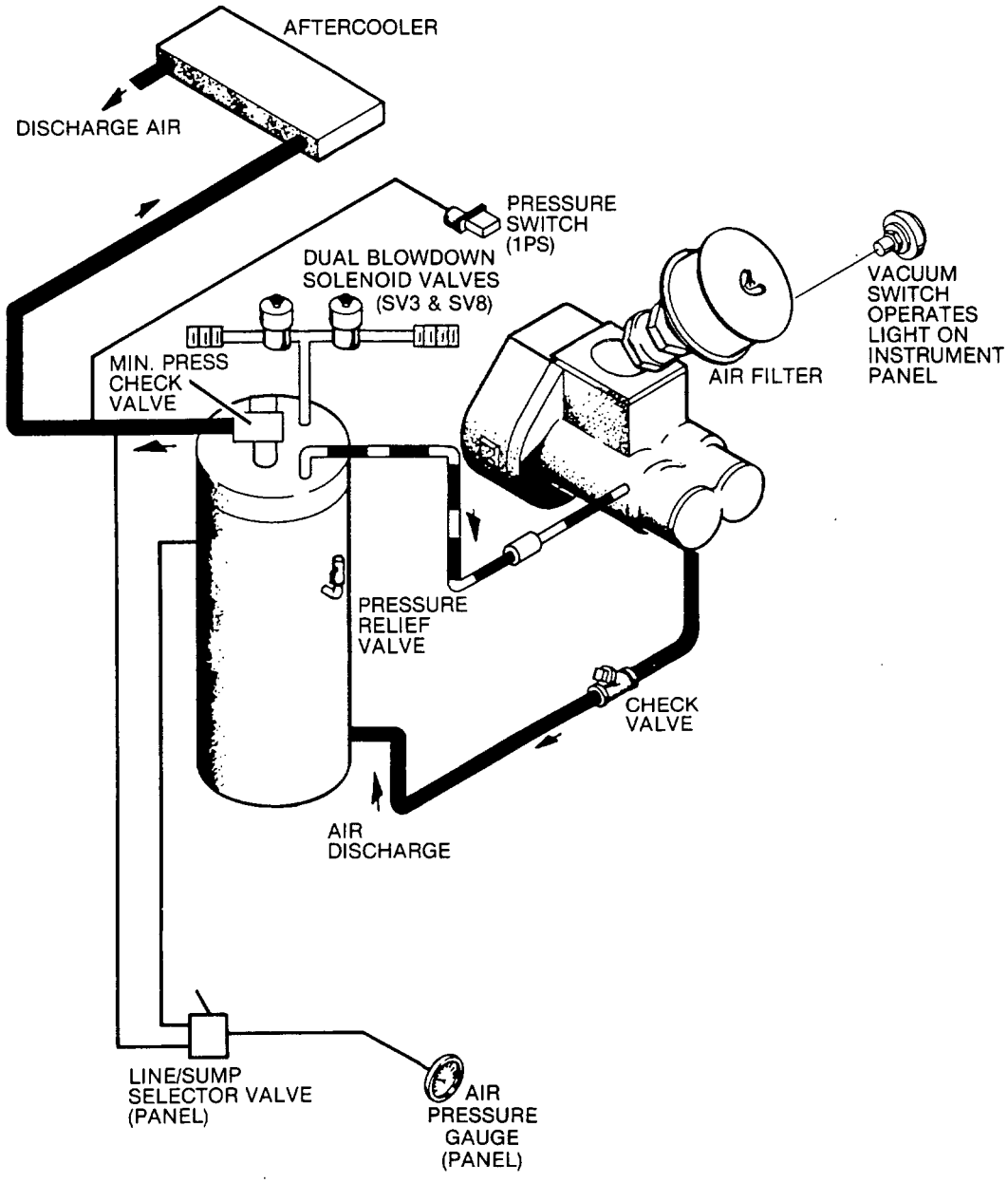


Figure 5
Air Flow System
With Aircooled Aftercooler

LUBRICANT/ AIR SEPARATION SYSTEM

The lubricant/air-separation-system is composed of a receiver with specially designed internals, a two-stage, coalescing-type separator-element, and provision for return of the separated fluid back to the compressor.

OPERATION

The lubricant and air discharging from the compressor flow into the receiver through a tangential-discharge-outlet. This outlet directs the mixture along the inner circumference of the receiver, allowing the coolant stream to collect and drop to the receiver sump.

Internal baffles maintain the circumferential flow of remaining coolant droplets and air. In an almost continuous change of direction of flow, more and more droplets are removed from the air by inertial action and then returned to the sump.

The air stream, now essentially a very fine mist, is directed to the separator element.

The separator element is constructed with two concentric-cylindrical-sections of closely-packed fibers, each held in steel mesh. It is flange-mounted at the receiver-outlet-cover.

The air stream enters the separator element radially and the mist coalesces to form droplets. The droplets collected on the outer first stage fall to the receiver sump. Those collected on the inner second stage collect near the outlet of the element, and are drawn back to the compressor inlet through a filter-screen and orifice-fitting installed in the separator scavenge line.

The air stream, now essentially free of lubricant, flows from the separator to the aftercooler, then to the condensate separator, and on to the plant air system.

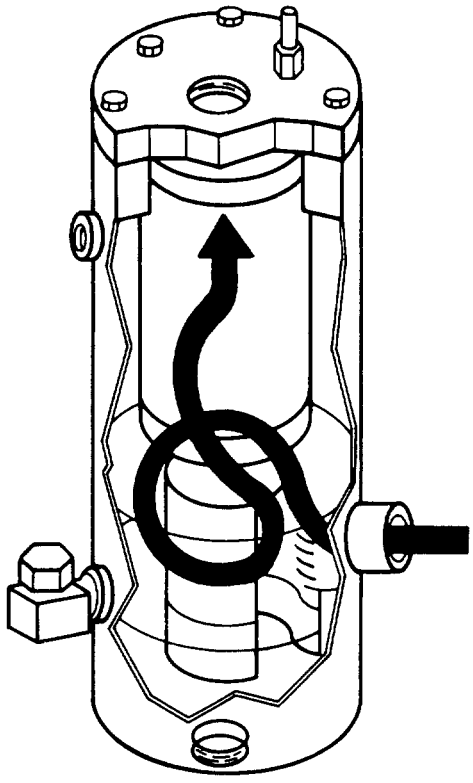


Figure 6
Separator Tank Internals

AIRCOOLED COMPRESSORS

DESIGN TEMPERATURES

The standard compressor is designed for operation in an ambient range of 35°F. to 100°F. (1.7°C. to 38°C.). If the compressors are to operate in ambient temperatures above 100°F. for periods of more than one hour or two per day, it is assumed that they will have been ordered with optional-higher-temperature-rated coolers, and possibly drive motors. When conditions other than the design levels described are encountered, we recommend you contact your nearest Ingersoll-Rand representative for additional information.

The standard maximum temperature (100°F.) is applicable up to an elevation of 7500 ft. (2300 meters) above sea level. Above this altitude, significant reductions in ambient temperature are required if a standard drive motor is to be used.

LUBRICANT COOLERS

The cooler is an integral assembly of core, fan and fan-motor, all mounted in the end section of the compressor enclosure. The cooling air flows in through the right end of the enclosure, through the vertically-mounted-cooler-core, and discharges through the left end of the enclosure.

COOLING FAN MOTOR

In a standard compressor, the cooling-fan-motors are wired at the factory. They are three-phase-motors. Each is protected by a suitable circuit breaker and/or fuses and overload relay. The fan motor is energized at the same time the compressor drive motor is energized. The fan-motor-overload is wired in series with the compressor-drive-motor-overload. If an overload occurs in the fan-motor-circuit, both the fan motor and compressor drive motor will stop.

AFTERCOOLER

The discharge air aftercooling system consists of a heat exchanger (located at the cooling air entrance of the machine), a condensate separator, and an automatic drain trap.

By cooling the discharge air, much of the water vapor naturally contained in the air is condensed and eliminated from the downstream plant-piping and equipment.

WATERCOOLED COMPRESSORS

DESIGN TEMPERATURES

The standard comrpessor is designed for operation in a temperature range of 35°F. to 100°F. (1.7°C. to 38°C.).

The standard shell and tube coolers (Fig. 7-1) are designed to use clean fresh cooling water at temperatures up to 90°F. (32°C.).

The optional high temperature cooling water system (Fig. 7-2) is designed with shell and tube coolers, sized to use fresh cooling water at temperatures up to 115°F. (46°C.).

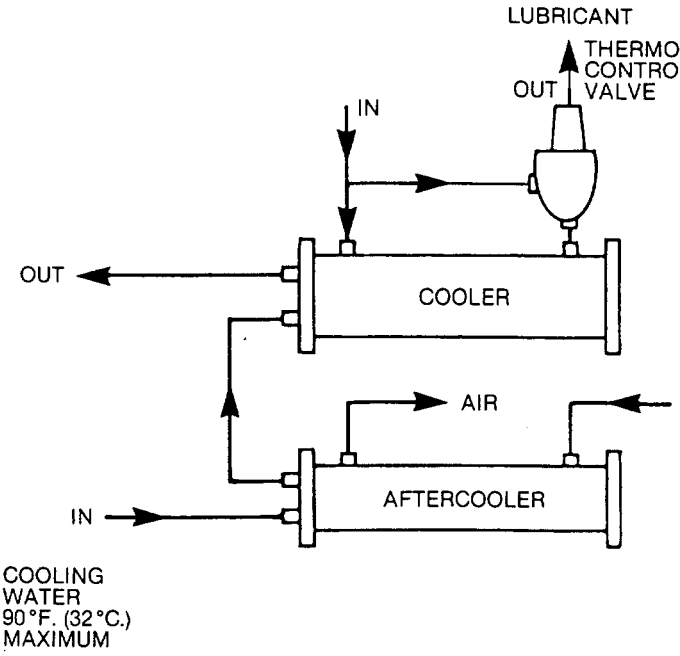
AFTERCOOLING

To reduce or eliminate downstream condensation of water vapor, an aftercooler is furnished as standard equipment. It is shell and tube construction, with the water flowing through the tubes.

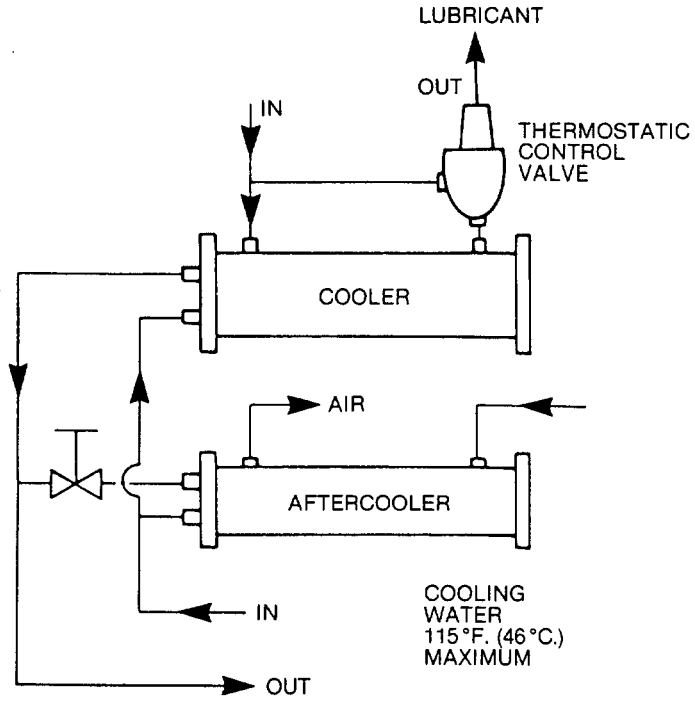
In a standard compressor, the cooling water flows to the aftercooler, and then to the lubricant cooler. This "series" flow brings the cooling water to the aftercooler first, and lower temperature air is discharged to the plant system. See Figure 7-1.

When the cooling water availabe is at temperatures between the standard requirement of 90°F. (32°C.), and up to the maximum of 115°F. (46°C.), the optional high temperature cooling water system is available, with cooling water flow in a "parallel" arrangement. A throttling valve is installed in the aftercooler circuit to balance the water flows. See Figure 7-2.

The standard cooling-water system and the option high-water-temperature-systems are shown in Figure 7.



1 - STANDARD COOLING WATER SYSTEM



2 - OPTIONAL HIGH TEMPERATURE COOLING WATER SYSTEM

Figure 7
Cooling Water Flow

INSTALLATION DETAILS

GENERAL

The condition of the arriving compressor should be carefully inspected. Any indication of careless handling by the carrier should be noted on the delivery receipt especially if the compressor will not be immediately uncrated. Obtaining the delivery man's signed agreement to any noted damages will facilitate any future insurance claims.

UNPACKING AND HANDLING

The compressor package has been mounted on a skid type frame to facilitate handling during shipment. The shipping crate has been marked to show the safe and correct sides that forklifts can be used. Care in positioning the forklifts is important because the location of the center of gravity is strongly affected by the inline assembly of the compressor airend and drive motor.

Slings can be used to lift the crates but spreader bars must be used to prevent the slings from exerting a force against the sides of the crates. After uncrating, the above handling precautions should still be observed. Forklift holes are furnished in the steel base but lifting should ONLY be on the compressor airend and drive motor side. If slings are used, spreader bars must be used. Placing protective material between the slings and the compressor enclosure should not be attempted.

FOUNDATION REQUIREMENTS

Refer to the foundation plan for the particular model compressor to be installed. Foundation plans for all models are furnished as part of the service-literature-package sent with each compressor, in additon to other normal drawing-handling-procedures.

Note that all piping connections are made at the rear, which is the side opposite to the instrument panel of the compressor.

The compressor can be installed on any level floor that is capable of supporting it. Compressor weights are listed on the foundation plans.

When sound transmission is of particular importance, it is often helpful to install a sheet of rubber-fabric-matting, or cork under the compressor to reduce the possibility of resonant sounds being transmitted or amplified through the floor.

LOCATION IN PLANT

The compressor should be installed in a dry, well-ventilated area where the air is as clean as possible. We recommend the compressor unit with enclosure have three feet of clearance on the intake and exhaust ends of the unit. Air cooled units, in particular, require a free flow of cooling air. Cooling air enters at the right end of the enclosure and exits at the left end. The possibility of excessive recycling of cooling air must be avoided.

Consideration must be given to the need for clearances around the compressor for ease of maintenance. The foundation plan shows the minimum clearances required.

CAUTION

Screw type compressors should not be installed in air systems with reciprocating compressors without a means of isolation, such as a common receiver tank. We recommend both types of compressor units be piped to a common receiver utilizing individual air lines.

DISCHARGE PIPING

Discharge piping should be at least as large as the discharge connection at the compressor enclosure. All piping and fittings should be suitably rated for the discharge pressure.

It is essential in installing a new compressor to review the total plant air system. This is to insure a safe and effective total system. One item which must be considered is liquid carryover into the plant air line. Installation of aftercoolers, air dryers and line separators is always good practice and these added safety features are recommended.

Water condensation can affect the operation of pneumatic devices. Aftercoolers and the addition of air dryers can eliminate this hazard.

Air line separators, properly selected and installed, can reduce any liquid carryover close to zero.

A. Compressors With Aftercooler

The built-in aftercooler reduces the discharge air temperature well below the dew point (for most ambient conditions), therefore, considerable water vapor is condensed. To remove this condensation, each compressor with built-in aftercooler is furnished with a combination condensate separator/trap.

The separator/trap must be installed as shown in Figure 9. A dripleg assembly, condensate separator/trap, and isolation valve should be mounted near the compressor discharge.

Important: The drain line must slope downward from the trap to work properly.

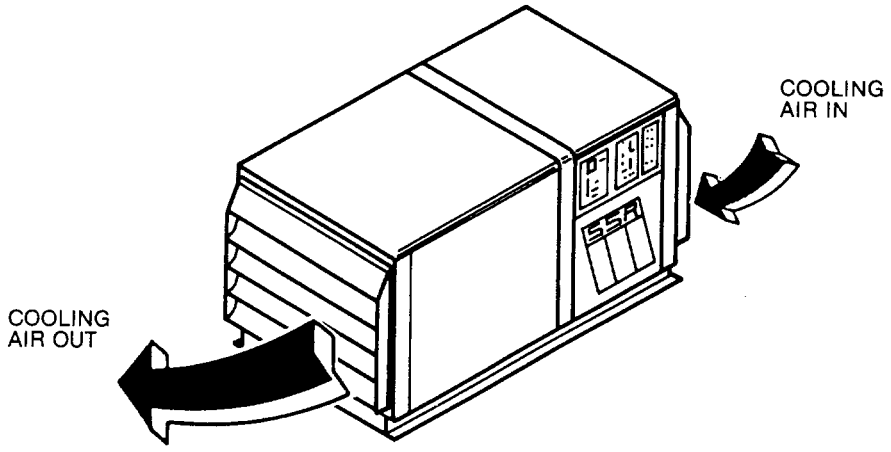


Figure 8
Cooling Air Flow

For ease of inspection of the automatic drain trap operation, the drain piping should include an open funnel.

It is possible that additional condensation can occur if the downstream piping cools the air even further, and low points in the piping system should be provided with driplegs and traps.

B. Compressors Without Aftercooler

When the compressor is furnished without a built-in aftercooler, a dripleg assembly and isolation valve must be mounted near the compressor discharge (refer to Figure 10).

The dripleg must be installed. It is essential that the condensate not be allowed to collect in the discharge piping at the compressor. Additional condensation will occur in the piping downstream from the discharge isolation valve and it is recommended that other driplegs be installed at the low points of the system.

CAUTION

The use of plastic bowls on line filters without metal guards can be hazardous. Their safety can be affected by either synthetic lubricants, or the additives used in mineral oils. From a safety standpoint, metal bowls should be used on any pressurized system. Review of your plant air line system is recommended.

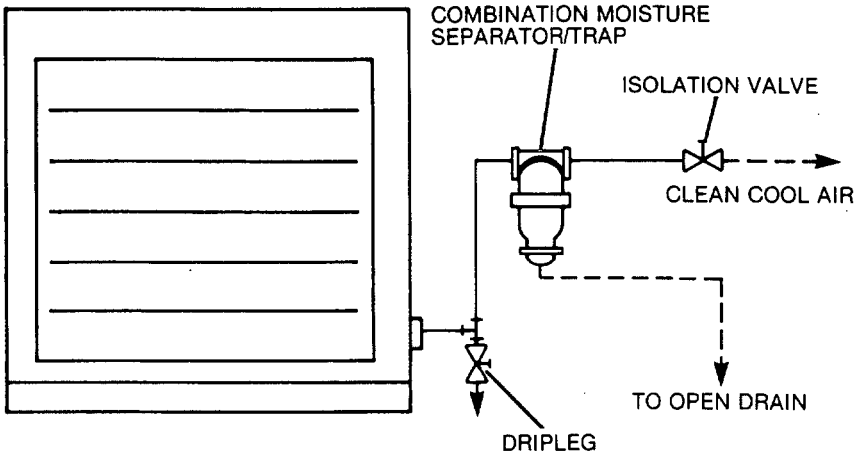


Figure 9
Discharge Piping With Aftercooler

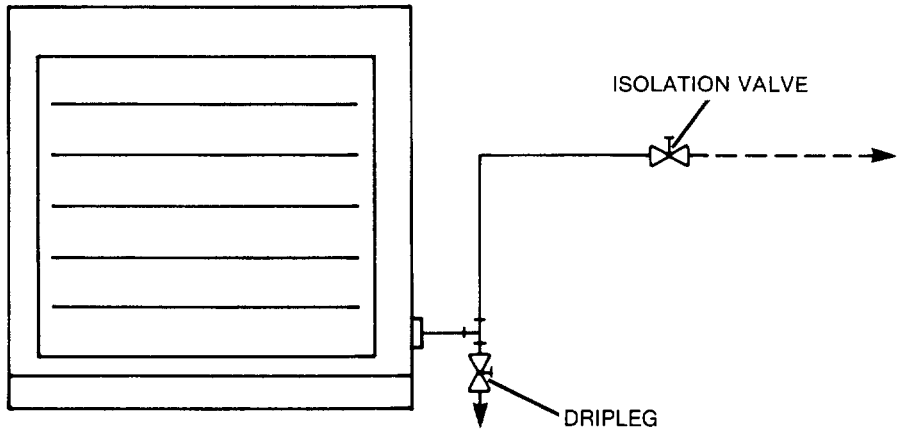


Figure 10
Discharge Piping Without Aftercooler

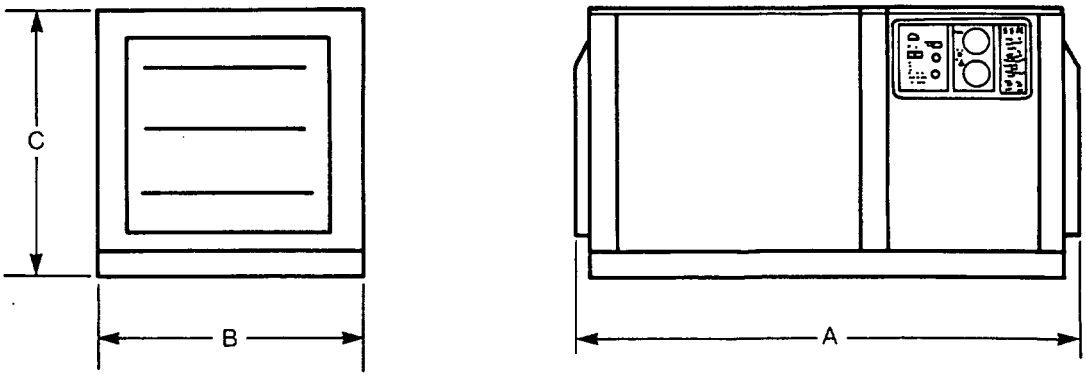


Figure 11
Standard Enclosure

OVERALL UNIT DIMENSIONS — STANDARD ENCLOSURE
International and Domestic Units (50 Hz and 60 Hz)
(See Foundation Plans for specific details on connections, etc.)

Unit Designations	Dimensions In Inches		
	A	B	C
60 HERTZ MODELS SSR-XF75, XF100 SSR-EP75, EP100 SSR-HP75, HP100	99.0	52.0	53.5
50 HERTZ MODELS SSR-ML55, ML75 SSR-MM55, MM75 SSR-MH55, MH75	99.0	52.0	53.5

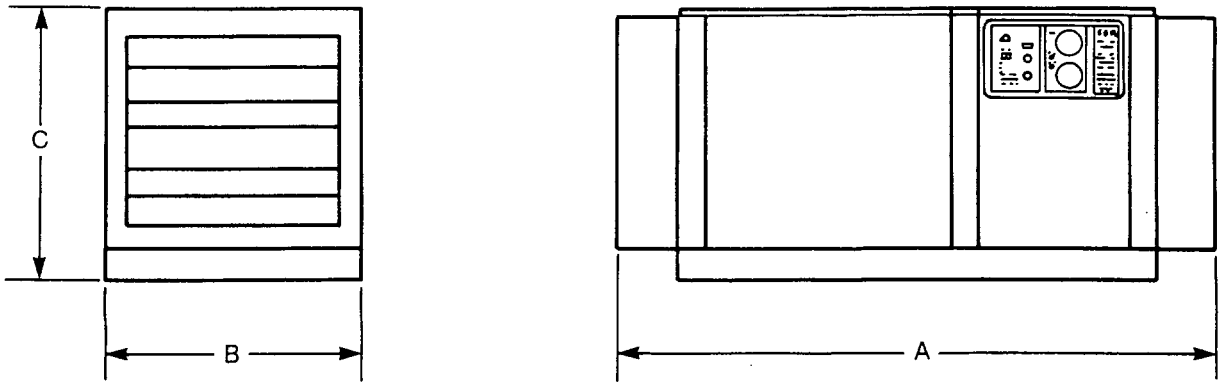


Figure 12
Low Sound Enclosure

OVERALL UNIT DIMENSIONS — LOW SOUND ENCLOSURE
International and Domestic Units (50 Hz and 60 Hz)
(See Foundation Plans for specific details on connections, etc.)

Unit Designations	Dimensions In Inches		
	A	B	C
60 HERTZ MODELS SSR-XF75, XF100 SSR-EP75, EP100 SSR-HP75, HP100	119.0	52.0	53.5
50 HERTZ MODELS SSR-ML55, ML75 SSR-MM55, MM75 SSR-MH55, MH75	119.0	52.0	53.5

ELECTRICAL SYSTEM

GENERAL

The electrical system of each SSR compressor is built with solid state components and printed circuits as its base. Plug-in modules and relays allow variations and additions to the standard control circuit.

The standard electrical components, enclosed in a readily accessible, but lockable, sheet metal box are:

1. The Compressor Motor Starter, with auxiliary contacts and overload relays.
2. The Cooling Fan Motor overload relays and circuit breaker or fuses.
3. The main printed circuit board, with Plug-in Power Control Module.
4. The Control Relay.
5. The Control Transformer and Fuse.

Modifications to the capacity control system are made by plugging in solid state modules which contain the necessary special circuitry.

AUTOMATIC UNLOADED START CONTROL

To provide a manual and/or automatic unloaded compressor start, the following components have been coordinated into the starting system.

a. A Normal-Unload Selector Switch

An unloaded start is achieved by preventing the inlet valve positioner from opening the inlet valve before the compressor has come up to full speed.

The Normal-Unload Selector Switch mounted on the compressor panel performs this function. For manual starting, placing the switch in the unload position de-energized the load solenoid valve circuit and stops pressure from being transmitted to the inlet valve positioner thus preventing the compressor from loading.

When the discharge temperature reaches 100°F. (38°C.), set the selector switch on the compressor panel to the normal position and allow the compressor to load.

b. Star Delta Time Delay Unloading. (Star Delta Starter Only)

The use of the interlocking switch (2Ma) in the Star Delta Starter provides for an automatic unloaded start. The switch is connected to insure that during the starting cycle of the Star Delta Starter, the load solenoid valve is shut. When the starter transfers to the run position, the switch contacts close; arming the load solenoid valve circuit. The compressor will now load; provided the Normal-Unload Selector Switch is in the normal position on the compressor panel.

FULL VOLTAGE TYPE STARTER (ACROSS THE LINE, MAGNETIC)

Refer to the electrical schematic, Figure 17. The starter coil is controlled by the normally open contacts of the control relay (1CR). Note that if all protective temperature switches and motor overload relays are closed, the control relay (1CR) will be energized when the start switch (2PB) is closed.

When the start switch (2PB) is closed, the following sequence takes place:

Control voltage is placed across the starter coil (1M). The compressor motor will start and the Normal-Unload Selector Switch should then be moved from the Unload position to the Normal position and the compressor will load.

STAR-DELTA TYPE STARTERS

By use of the Star-Delta type starter, the compressor motor can be started and accelerated using a greatly reduced "inrush" electric current. The starter is completely automatic and controlled by a start-stop switch mounted in the compressor panel.

Refer to the electrical schematic, Figure 18 and note that the starter coils and time delay relay are controlled by the normally open contacts of the control relay (1CR). If all protective temperature switches and motor overload relays are closed, the control relay (1CR) will be energized when the start switch (2PB) is closed.

When start switch (2PB) is closed the following sequence takes place automatically in the Star-Delta Type Starter:

1. Control voltage is available across the starter contactor coil (1S) because the timer contact (1TR) and auxiliary contact (2Mb) are both closed. The start contactor coil (1S) will be energized and auxiliary contacts (1Sa) will close and (1Sb) will open.
2. The action of auxiliary contacts (1Sa) and (1Sb) will put control voltage across the start-run contactor coil (1M), and will prevent the run contactor coil (2M) from being energized. Auxiliary contacts (1Ma) will then close to provide an interlock to hold the coil (1M) in an energized state. The time delay relay (1TR) will be energized and begin to time out. Contactors (1S) and (1M) are now energized and the compressor motor will start and run in the "star connected" mode.
3. When the time delay relay (1TR) runs out its time, which is adjustable and usually set to about 12-15 seconds, its contact (1TR) opens. This breaks the circuit to the start contactor (1S), and energizes the run contactor coil (2M) through the auxiliary contact (1Sb). Contactors (1M) and (2M) are now energized and the compressor is running in the "delta" mode and the auxiliary contacts (2Ma), (used as the unloaded start automatic control) are closed permitting the compressor to be loaded.
4. A mechanical interlock exists between contactors (1S) and (2M), which prevents both these contactors "pulling in" at the same time. An additional interlock, electrical, exists; auxiliary contact, (2Mb), when contactor (2M) is energized. This auxiliary contact opens, preventing any possible energizing of the start contactors (1S).
5. The time delay relay (1TR) is a solid state module plugged into the main printed circuit board. A light, (7LT) mounted on the module face, is lit when the time delay relay is timing and can be used to check the timer adjustment.

CAUTION

Care should be exercised during any such checks because of the electrical hazards that will be present when the electrical box is open.

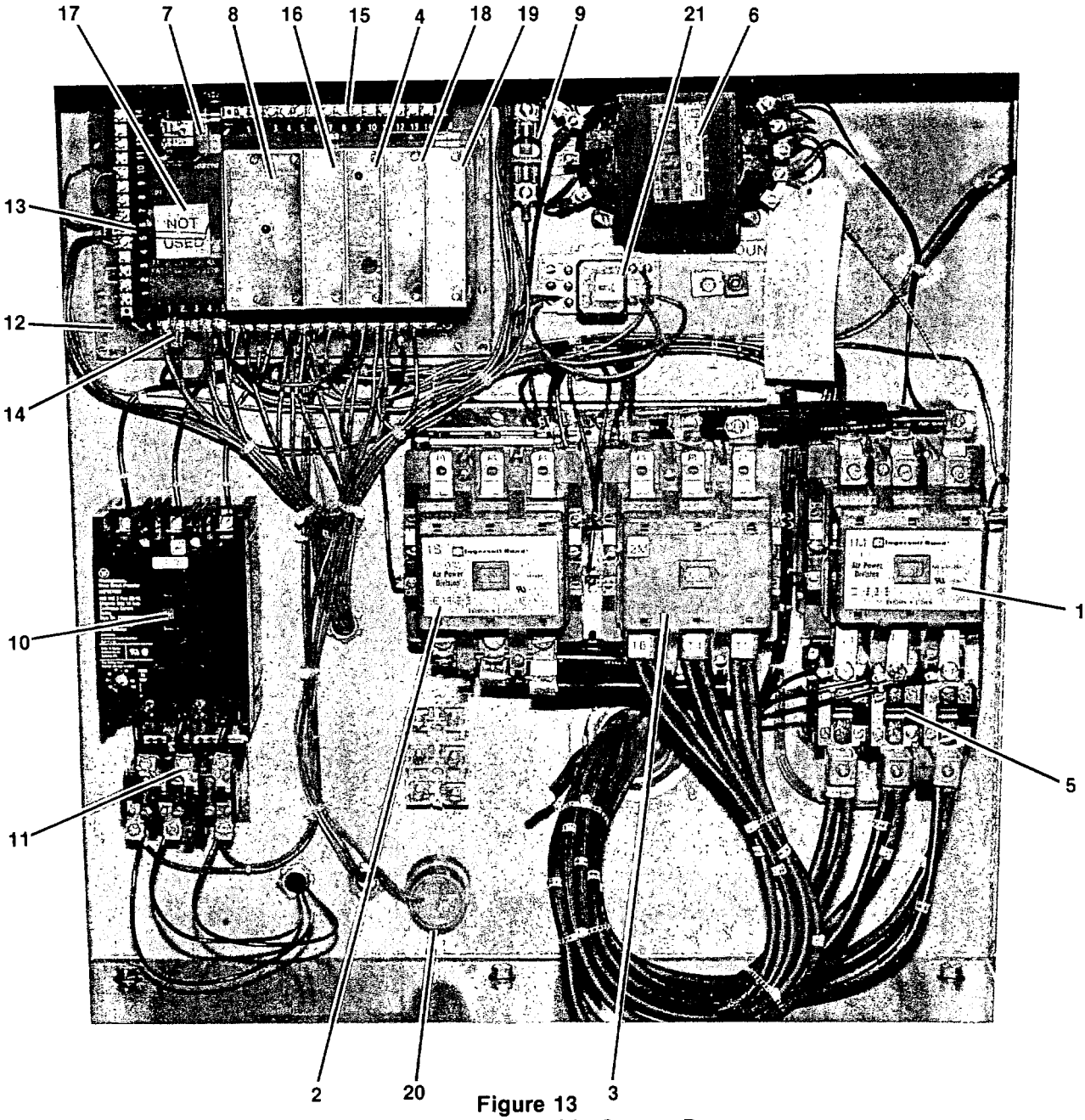


Figure 13
Components Located in Starter Box

1. Start-run contactor (1M)
2. Start contactor (1S)
3. Run-contactor (2M)
4. Star-Delta timer module (1TR)
5. Overload relay (10L)
6. Control transformer (T)
7. Control relay (1CR)
8. Power control module
9. Fuse (1FU)
10. Fan motor circuit breaker (1CB)

*Optional

11. Overload relay (20L)
12. Main board assembly
13. Terminal strip (1TB)
14. Terminal strip (2TB)
15. Terminal strip (3TB)
16. Auto stop-start module (3TR)*
17. Auto stop-start relay (3TR)*
18. Shutdown annunciatior module (1SA)*
19. A.C.S. System module (4TR)*
20. Vacuum Switch
21. Cold Start Relay (4CR)

SHUTDOWN ANNUNCIATOR (OPTIONAL)

The SSR Compressor can be furnished with a plug in module solid state annunciator which indicates any one of (4) reasons for a compressor shutdown. These are,

1. High discharge air temperature
2. Compressor motor overcurrent
3. Cooling fan motor overcurrent
4. High bearing scavenge temperature

The indication of shutdown cause is shown on the compressor control panel by lights and identification. Only the reason for shutdown is indicated if a shutdown occurs — no other lights are lit.

Also available as an option is a warning indication of high aftercooler temperature. This indication is shown on the compressor control panel by a light and identification.

STAR-DELTA STARTER AUXILIARY CONTACTS

The auxiliary contacts which control the starter sequencing are located on the upper rear section of the contactor which bears its number. The auxiliary contacts on a standard star-delta starter are shown in Figure 14.

CONTROL TRANSFORMER

The control transformer, mounted in the electrical control box, is a universal type. It is suitable for use with various primary voltages and frequencies and is connected according to the rated voltage of the compressor.

For correct connections refer to the compressor control connection data plate located inside the starter box.

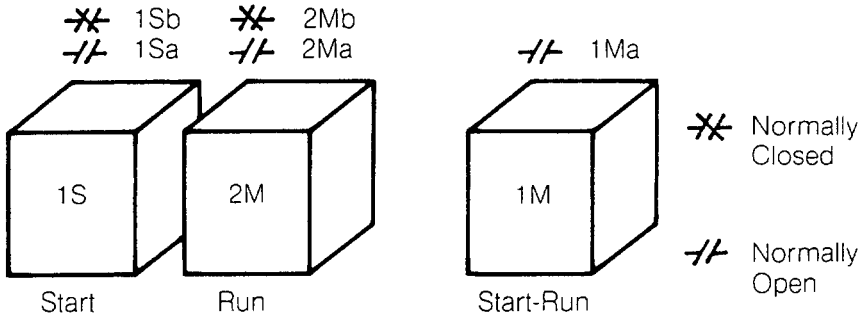
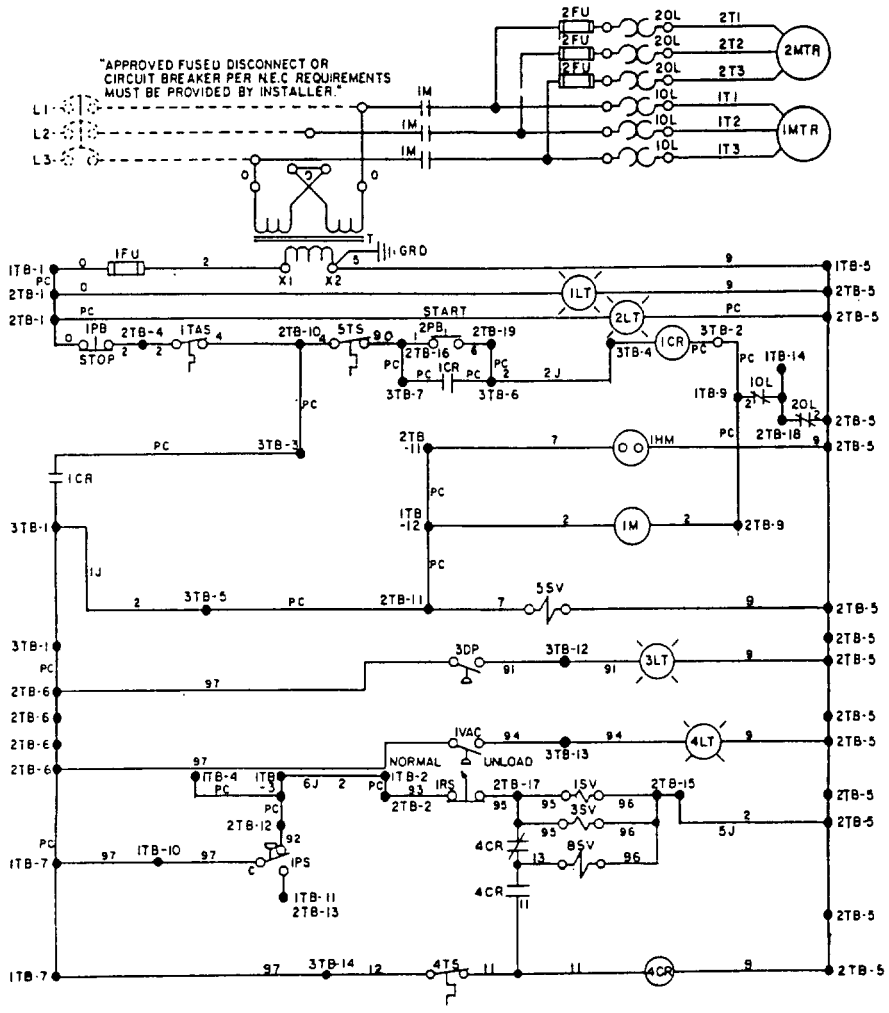


Figure 14
Star-Delta Contactors



LEGEND

J	JUMPER WIRE
PC	PRINTED CIRCUIT
1MTR	COMPRESSOR MOTOR
1M	1MTR START-CONTACTOR COIL
1OL	1MTR OVERCURRENT RELAY
1CR	CONTROL RELAY
T	CONTROL TRANSFORMER
1FU	FUSE
GRD	GROUND
1HM	HOURMETER
1PB	STOP BUTTON
2PB	START BUTTON
1TAS	HIGH AIR TEMPERATURE SWITCH
4TS	COLD START TEMPERATURE SWITCH
5TS	HIGH BEARING SCAVENGE TEMPERATURE SWITCH
1PS	LINE PRESSURE SWITCH
1SV	LOAD SOLENOID VALVE
5SV	OIL STOP SOLENOID VALVE
3SV	BLOWDOWN SOLENOID VALVE
1RS	NORMAL-NO LOAD SELECTOR
8SV	COLD START BLOWDOWN SOL. VALVE
1VAC	FOULED AIR FILTER SWITCH
3DP	FOULED COOLANT FILTER SWITCH
4CR	COLD START CONTROL RELAY

INDICATING LIGHTS

1LT	POWER ON — WHITE
2LT*	POWER ON — RED
3LT	FOULED COOLANT FILTER — AMBER
4LT	FOULED AIR FILTER — AMBER

COOLER CIRCUIT

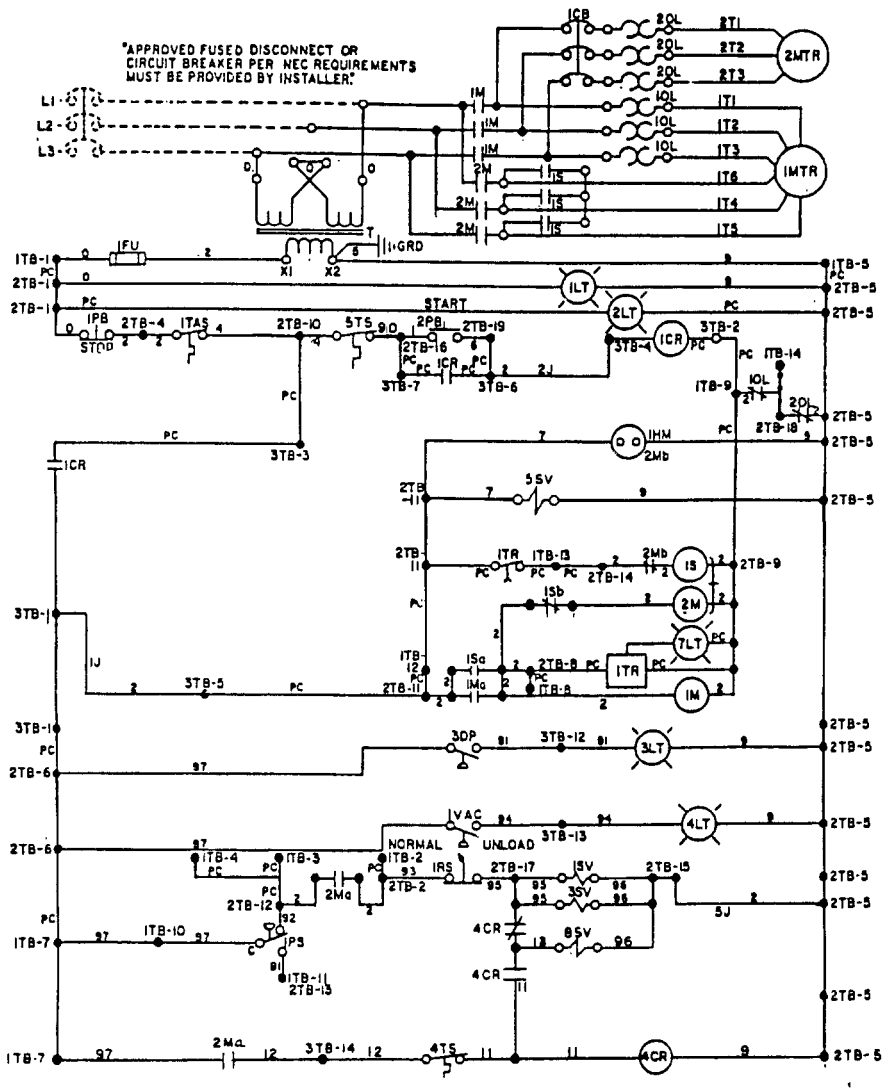
2MTR	FAN MOTOR
2OL	2MTR OVERCURRENT RELAY
2FU	FUSE

OPTIONAL EQUIPMENT

1SA	SHUTDOWN ANNUNCIATOR MODULE — WITH LIGHTS
8LT	HIGH AIR TEMPERATURE — RED
9LT	HIGH BEARING SCAVENGE TEMPERATURE — RED
10LT	1MTR OVERCURRENT RELAY — RED
11LT	2MTR OVERCURRENT RELAY — RED
3PB	RESET — TEST BUTTON
2RS	CONTROL MODE SELECTOR
2SV	CONTROL MODE SOLENOID VALVE
3TR	AUTOMATIC START-STOP TIMER MODULE
13LT*	AUTOMATIC START-STOP TIMER — RED
14LT	STOPPED-AUTO RESTART — AMBER
4TR	AUTO CONTROL SELECTOR (A.C.S.) TIMER MODULE
15LT*	A.C.S.-MODULATE MODE — RED
4SV	WATER SHUTOFF SOLENOID VALVE

* LOCATED IN STARTER BOX

Figure 15
Full Voltage Wiring Schematic



LEGEND

J	JUMPER WIRE
PC	PRINTED CIRCUIT
1MTR	COMPRESSOR MOTOR
1M	1MTR START-RUN CONTACTOR
2M	1MTR RUN CONTACTOR
1S	1MTR START CONTACTOR
1Ma	AUXILIARY CONTACTS
2Ma,b	AUXILIARY CONTACTS
1Sa,b	AUXILIARY CONTACTS
10L	1MTR OVERCURRENT RELAY
1CR	CONTROL RELAY
T	CONTROL TRANSFORMER
1FU	FUSE
GRD	GROUND
1HM	HOURMETER
1PB	STOP BUTTON
2PB	START BUTTON
1TAS	HIGH AIR TEMPERATURE SWITCH
4TS	COLD START TEMPERATURE SWITCH
5TS	HIGH BEARING SCAVENGE TEMPERATURE SWITCH
1PS	LINE PRESSURE SWITCH
1SV	LOAD SOLENOID VALVE
5SV	OIL STOP SOLENOID VALVE
3SV	BLOWDOWN SOLENOID VALVE
1RS	NORMAL-NO LOAD SELECTOR
8SV	COLD START BLOWDOWN SOL. VALVE
1TR	STARTER TIME DELAY RELAY
1VAC	FOULED AIR FILTER SWITCH
3DP	FOULED COOLANT FILTER SWITCH
4CR	COLD START CONTROL RELAY

INDICATING LIGHTS

1LT	POWER ON — WHITE
2LT*	POWER ON — RED
3LT	FOULED COOLANT FILTER — AMBER
4LT	FOULED AIR FILTER — AMBER.
7LT*	STARTER TIMER ENERGIZED — RED

COOLER CIRCUIT

2MTR	FAN MOTOR
2OL	2MTR OVERCURRENT RELAY
1CB	CIRCUIT BREAKER

OPTIONAL EQUIPMENT

1SA	SHUTDOWN ANNUNCIATOR MODULE — WITH LIGHTS
8LT	HIGH AIR TEMPERATURE — RED
9LT	HIGH BEARING SCAVENGE TEMPERATURE — RED
10LT	1MTR OVERCURRENT RELAY — RED
11LT	2MTR OVERCURRENT RELAY — RED
3PB	RESET — TEST BUTTON
3TR	AUTOMATIC START-STOP TIMER MODULE
13LT*	AUTOMATIC START-STOP TIMER — RED
14LT	STOPPED-AUTO RESTART — AMBER
4TR	AUTO CONTROL SELECTOR (A.C.S.) TIMER MODULE
15LT*	A.C.S.-MODULATE MODE — RED
4SV	WATER SHUTOFF SOLENOID VALVE

* LOCATED IN STARTER BOX

Figure 16
Star Delta Wiring Schematic

INSTRUMENTATION

CONTROL PANEL

Discharge Temperature Gauge - indicates temperature of air leaving the compressor. The temperature sensing bulb is located in the receiver tank in line with the discharge air flow.

Air Pressure Gauge - reads receiver (sump) pressure or line pressure, depending on the position of the selector valve.

Line/Sump Selector - directs the desired pressure to the air pressure gauge. By reading the pressure on either side of the air-coolant separator, the differential shows the conditions of the separator element. Differential pressure readings should be taken when the compressor is operating at rated capacity and pressure.

The differential pressure should be recorded when the unit is first started or after a replacement element is installed. This base reading can then be used to determine the proper change period. (See maintenance section.)

Power On Light - indicates that control voltage is available to the control circuit and that the line voltage is available at the motor-starter main-contacts.

WARNING

The power on light must never be used as a positive indication that power has been shut off. A burned out bulb can give a false indication.

Start-Stop Switches - energize or de-energize the control relay (1CR) to start or stop the compressor.

Hour Meter - reads the total time of operation of the compressor. It runs only when the motor starter coils are energized. It should be used to schedule maintenance functions such as coolant, and coolant-filter changes.

Normal-Unload Selector - controls the ability of the compressor to "load up". When the selector is in the Normal mode, the Load-Solenoid-Valve can be energized, and the Inlet Valve Positioner can open the Inlet Valve. When the selector is in the Unload mode, the Load-Solenoid-Valve cannot be energized. This selector position is used when the compressor is started manually.

On Line-Off Line/Modulate A.C.S. Selector (Optional) - chooses the type of compressor-capacity-control. Refer to the capacity-control section for an explanation of the different modes of control. Each is designed for varying plant needs.

Coolant Filter Maintenance Indicator Light - Mounted on the coolant filter, a differential pressure switch senses the pressure drop across the filter, and switches on the panel mounted Coolant Filter light indicating that the filter element should be replaced. However, the indicator coming on when the compressor starts cold is a normal condition. After operating for a short period of time, the indicator must extinquish. Refer to the lubrication section for specific details.

Air Filter Maintenance Indicator - Mounted in the starter box, a vacuum switch senses the pressure drop across the air filter element. As the filter element traps dust, the pressure drop increases causing the vacuum switch to switch on the panel mounted Air Filter Light indicating that the filter element should be replaced.

In addition to the pressure and temperature indicators and other instruments on the control panel, each compressor is equipped with a High-Pressure Relief-Valve which is mounted on the receiver-separator. It is set to open at the maximum working pressure stamped on the tank.

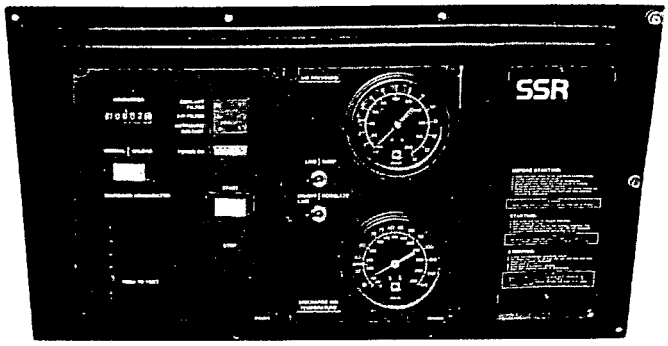


Figure 17
Standard
Instrument Panel

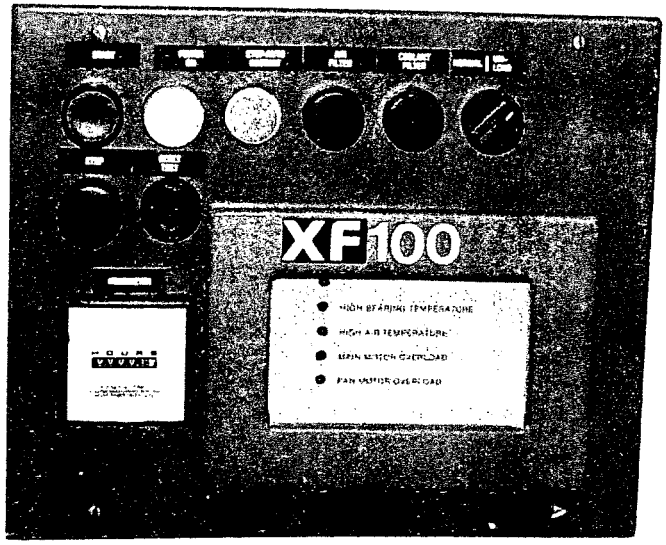


Figure 17A
Nema 4/12
Instrument Panel

DUAL BLOWDOWN VALVE SYSTEM

The SSR Compressor package includes a dual blowdown valve system, designed to maintain the proper lubricant flow to the compressor during all phases of machine operation.

The system includes the main blowdown valve, the cold start blowdown valve, the cold start temperature switch, and control relay.

The main blowdown valve (3SV); is an electrically operated, normally open solenoid valve, controlled by the normal/unload switch (1RS), or the pressure switch (1PS).

The cold start blowdown valve (8SV) is an electrically operated, normally open solenoid valve, controlled by the normal/unload switch (1RS), the pressure switch (1PS), or the cold start temperature switch (4TS).

During initial cold, unloaded starting of the machine, the cold start blowdown valve (8SV) remains closed as long as the lubricant injection temperature is less than 120°F. (49°C) and the main blowdown valve (3SV) is open. This results in an elevated receiver (sump) pressure, approximately 50 psig (3.4 BAR), to provide adequate lubricant flow until the compressor has reached the 120°F minimum warm-up temperature.

As the injected lubricant temperature rises to 120°F (49°C), the normally closed, cold start temperature switch (4TS) opens, de-energizing and opening the cold start blowdown valve (8SV), allowing the receiver pressure to decrease to the normal unloaded level, approximately 25 psig (1.7 BAR).

The main and cold start blowdown valves operate simultaniously once the injection temperature reaches the 120°F (49°C) minimum warm-up temperature.

CAPACITY CONTROL

The SSR compressor is equipped with two types of capacity control — each designed to suit the individual plant requirements.

These controls are:

A. On Line-Off Line (Standard, Figure 18).

B. On Line-Off Line with Upper Range Modulation (Optional, Figure 19)...and either is available by operation of the selector switch on the compressor panel.

ON LINE-OFF LINE CONTROL

For those plants which have a widely varying air demand, the On Line-Off Line control will deliver air at full capacity, (the compressor maximum efficiency condition) or will operate at zero capacity with low receiver pressure (the compressor minimum power condition).

The operating mode of the compressor is controlled by the pressure switch (1PS) responding to changes in plant air pressure. This switch energizes the Load Solenoid Valve (1SV) and the Blowdown Solenoid Valves (3SV & 8SV) whenever the plant air pressure drops below the lower set point of (1PS) and keeps these solenoid valves energized until the upper set point is reached.

When these solenoid valves are energized, pressurized coolant is fed to the inlet valve positioner through the Load Solenoid Valve (1SV) forcing the inlet valve to open fully. The Blowdown Solenoid Valves close off the atmospheric vents.

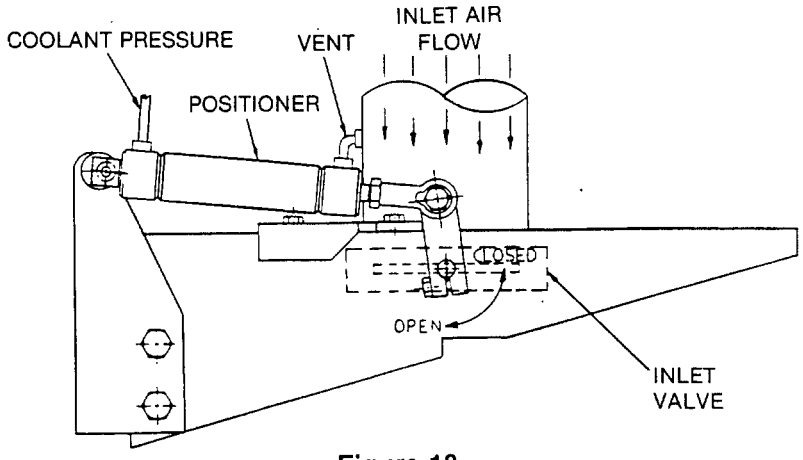


Figure 18
On Line-Off Line Control

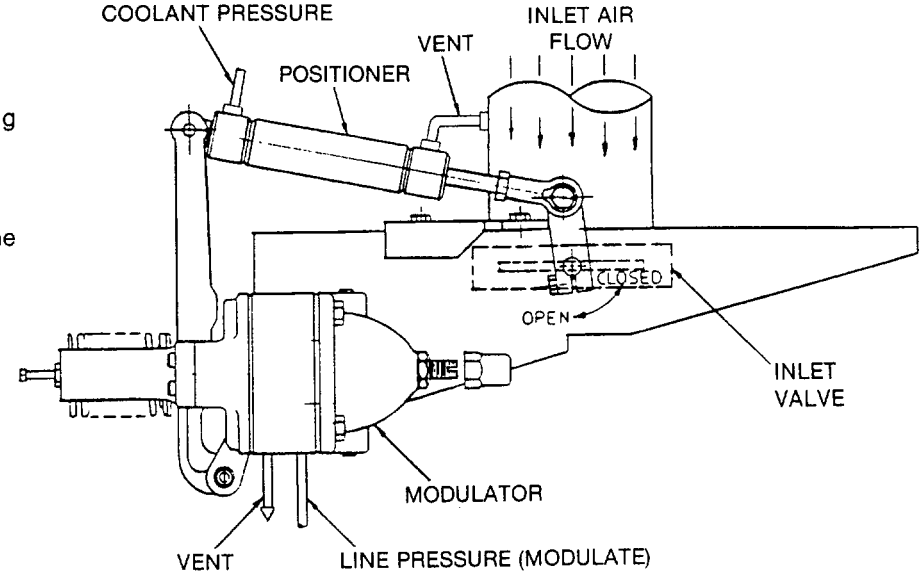


Figure 19
On Line-Off Line with Upper Range Modulation Control (Optional)

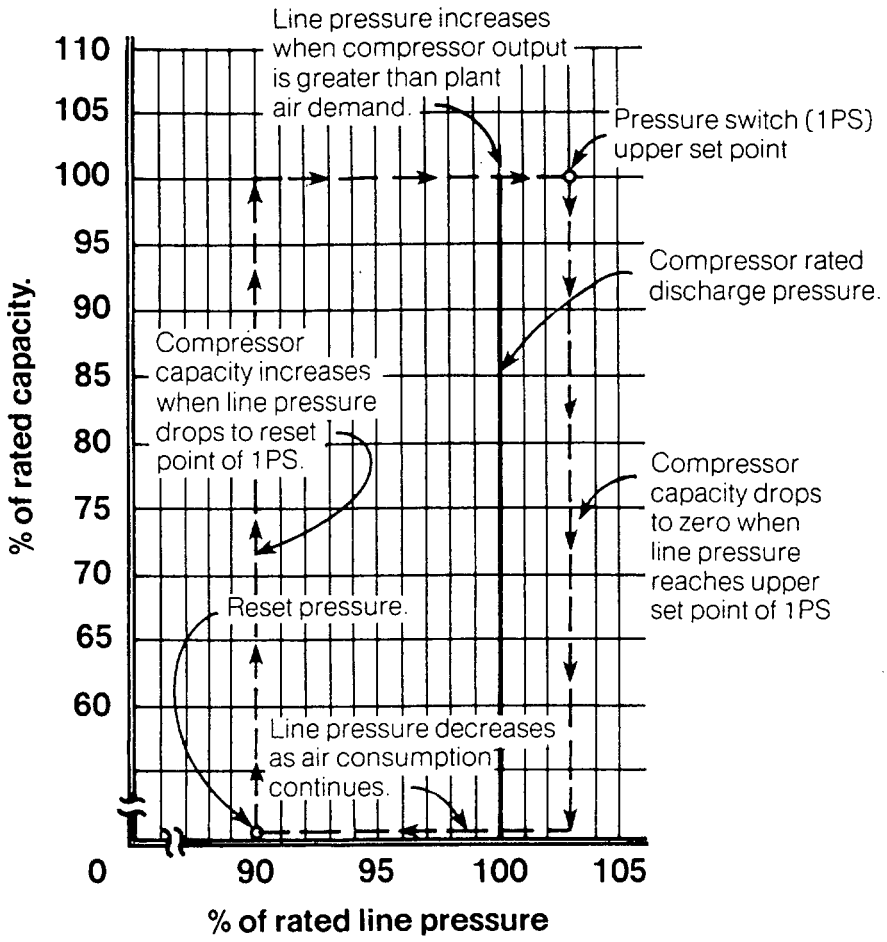


Figure 20
Operating Sequence
Using On Line-Off Line Control

The compressor will then operate to deliver full capacity air to the plant system. If the plant air system pressure rises to that of the pressure switch upper set point, all solenoids will be de-energized.

The Load-Solenoid-Valve will shut off the flow of pressured coolant to the inlet valve positioner, allowing the inlet valve to close.

The Blowdown-Solenoid-Valves (3SV & 8SV) will open the receiver-vent-line, and allow the receiver pressure to drop.

The compressor will continue to run, but since most pressure has been relieved, it will do so with a minimum power draw.

The Pressure Switch (1PS) has a 12 psi (0.83 BAR) range between its upper and lower set-point pressures. The upper set-point pressure is factory set at slightly above the compressor rated discharge pressure. The correct upper-set-point pressures are listed in Regulation Adjustment Section of this manual and, also, on decals affixed to the compressor.

A graph indicating the relationships between the compressor output, the line pressure, and the pressure switch (1PS) setting is shown in Figure 20.

ON LINE-OFF LINE WITH UPPER RANGE MODULATION CONTROL (OPTIONAL)

For those plants which have relatively high and constant air demand, relative to the compressor capacity, the recommended control mode is Upper Range Modulation (URM).

The URM control system retains the features of the On line-Off line control, but provides for throttling of the inlet air flow as the line pressure rises to the upper set point of the pressure switch (1PS).

By applying line pressure to a spring loaded diaphragm valve, that is, the Modulator, the throttling position of the inlet valve is controlled. The inlet valve positioner is part of the linkage, but does not act other than to move the inlet valve to the open position, allowing the modulator to "trim" the inlet valve position as dictated by the line pressure.

The modulating pressure range is about 7 psi (0.5 BAR) and the modulator is factory set to straddle the compressor rated pressure. Modulation begins when the line pressure reaches about 96 percent of the compressor rated pressure and continues as/if the line pressure rises. Modulation becomes stable when the compressor output equals the plant air demand. When the modulation is at the factory setting the maximum capacity reduction will be down to approximately 60 percent of the compressor rated capacity.

If the air demand has decreased to a level below the 60 percent modulated output, the line pressure will increase slightly to actuate the pressure switch (1PS). The compressor will then shift to the off line control position, and operate at unload with the receiver vented.

It is sometimes desirable to begin modulation at a higher pressure than the standard factory setting thereby increasing the modulated capacity at the time the pressure switch (1PS) is actuated. Reference to Figure 21 will indicate the typical modulated capacities available when this is done.

AUTOMATIC START-STOP CONTROL (OPTION)

For those plants which have a widely varying plant air demand, large air storage capacity and/or want automatically available standby air capacity, Automatic Start-Stop Control by solid state module addition is available.

During periods of low demand, if the line pressure rises to the upper set point of pressure switch (1PS), a time delay relay (3TR) is energized and begins to time out. The timer, mounted on the main board in the starter box, is adjustable in a 0-15 minute range. The timer will continue to operate as long as the plant line-pressure remains above the lower set-point of the pressure swtich.

If the timer continues to operate for as long as its adjusted time setting, a relay contact in the timer module opens to de-energize the compressor motor and fan motor coils. At the same time, an amber light (14LT) on the instrument panel is lit to indicate that the compressor has shut down automatically and will restart automatically.

The automatic restart will take place when the line pressure drops to the lower set point of pressure switch (1PS).

An indicating light, red (13LT), is lit when the timer is running. This light can be used to confirm the timer setting and can be of assistance if electrical checks are being considered. It is mounted on the face of the Automatic Start-Stop module.

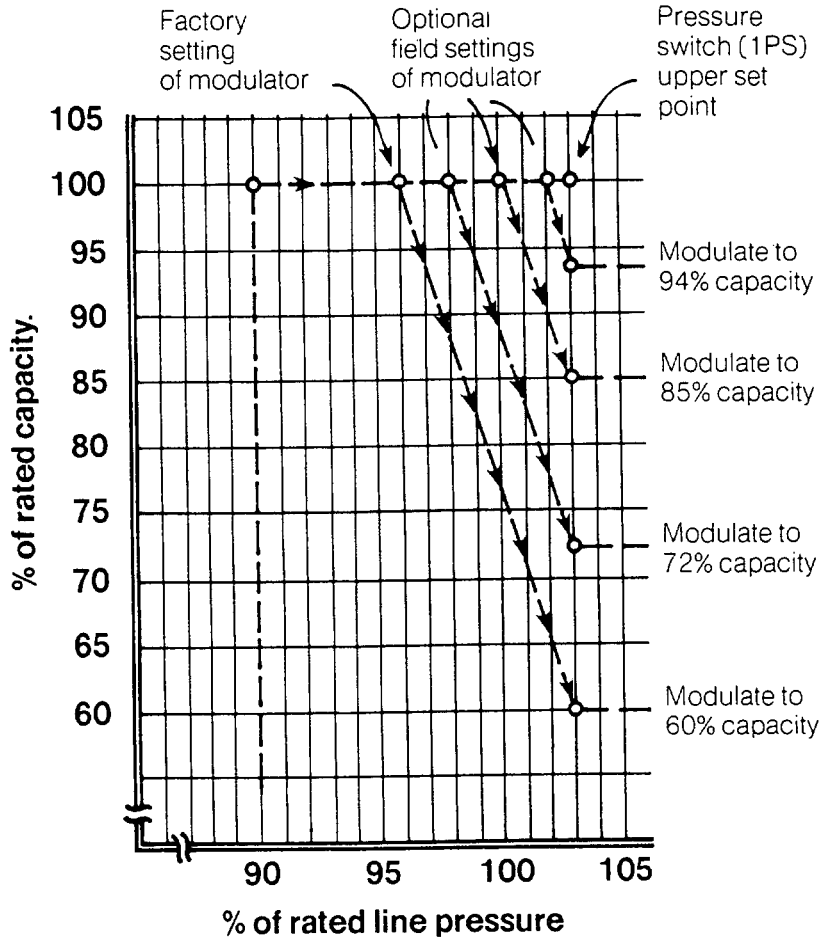


Figure 21
Modulation Capacity

AUTOMATIC CONTROL SELECTOR (ACS) (OPTIONAL)

The automatic control selector (ACS) is designed to continously monitor the plant air demand and select either the on line-off line, or the modulate control mode, whichever is most desirable at any time during an operating day.

It allows the compressor to operate in its most efficient mode without attendance, thereby reducing power costs to a minimum.

When the compressor operates in the On Line-Off Line control mode, the length of time the compressor remains in the "off line" condition is an indication of the plant air demand. The compressor switch (1PS) is sensing and awaiting a sufficient line pressure decrease before signaling a shift to the on line mode. If the "off line" time period is relatively short, thereby indicating a high demand for air, it is preferable to shift the control system to the upper range modulation.

The ACS control does this, and does it automatically.

If later, the plant demand decreases, and even under modulate control the line pressure reaches the setting of the pressure switch (1PS) and the control shifts to the "off line" mode, the time in this mode will still be monitored. A long "off line" time-period indicates a low plant air demand, indicating the desirability of operating in the On Line-Off Line mode.

The ACS control then does this, and does it automatically.

The ACS control is a solid state module addition to the standard compressor control system. It can operate independently. It can add additional usefulness to an automatic start-stop control system.

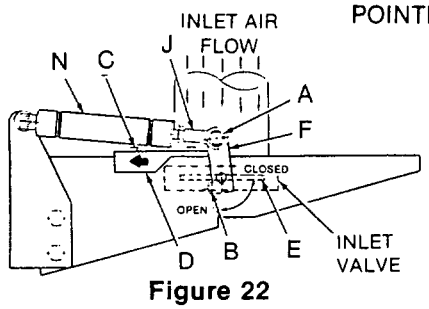


Figure 22
Inlet Control Valve

REGULATION ADJUSTMENT INSTRUCTIONS

IF PROPER ADJUSTMENT IS LOST, PROCEED AS FOLLOWS TO RE-ESTABLISH CORRECT SETTING:

ON LINE-OFF LINE CONTROL

A. Setting the inlet control valve

1. Remove bolt (A). Loosen clamp screw (B). Slide the travel stop (D) in the direction of the arrow in Figure 22 until it stops.
2. Rotate the inlet air control valve shaft counterclockwise until the valve plate (E) is in the closed position. While assuring the valve plate (E) is closed, position the lever arm (F) against the travel stop (D) as shown in Figure 22. Tighten the clamp screw (B).

B. Setting the inlet valve positioner linkage

1. Adjust the length of the inlet valve positioner linkage (G) until the lever end bolt (A) threads easily into lever (F) while the lever is held against the travel stop (D). Tighten bolt (A).

C. Setting the pressure switch

Note: The compressor is shipped from the factory pre-set as indicated in table 1 below. If adjustment is required, refer to illustration shown in Figure A.

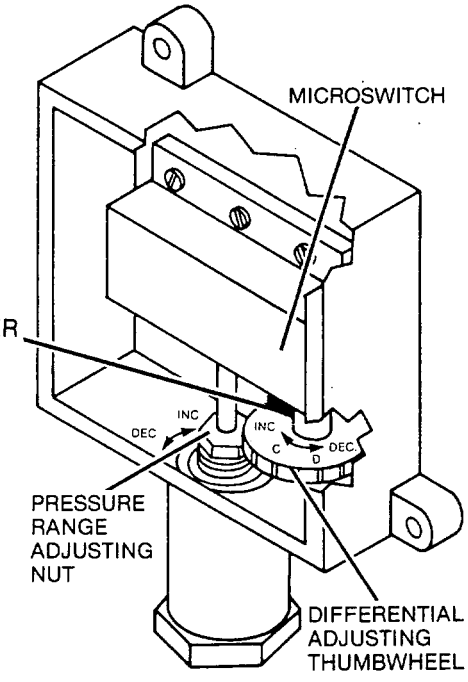


Figure A. Pressure Switch (1PS)

1. Open isolation valve, allowing control system to sense "Line" pressure.
2. Place rocker switch (1RS) in the "unload" position and the optional control selector in the "On/Off-Line" position.
3. Remove cover from pressure switch (1PS) and, referring to Figure A, set the switch differential at its midpoint by turning white differential adjusting wheel until the letter "B" on flat face of the wheel is under the black pointer on the microswitch.
4. Start the compressor and place rocker switch (1RS) in the "Normal" position. The compressor should load if the Line pressure is lower than the switch reset (lower pressure) setting. It may be necessary to vent air from customer system to load unit.
5. Slowly close the isolation valve, allowing Line pressure to rise to the Maximum Discharge Pressure or "Trip" setting of the pressure switch as shown below:

TABLE I

Model	Maximum Discharge Pressure
XF	103 psig
EP	128 psig
HP	150 psig
ML	7.7 BAR
MM	8.7 BAR
MH	10.0 BAR

6. Carefully adjust Pressure Range Adjusting Nut until the unit unloads. When the pressure switch trips, the compressor will unload, venting receiver/separator tank.
7. With switch differential set at mid-point, switch will reset approximately 12 psig lower than the maximum discharge pressure.
8. Vent air from customer system to confirm switch operation is satisfactory.
9. If a narrower differential (<12 psig) is needed, turn differential wheel as shown in Figure A to decrease differential. This provides a narrower differential but also decreases the Maximum Discharge Pressure or Trip setting. Repeat steps 5 and 6 to set maximum discharge pressure.

10. If a wider differential (>12 psig) is needed, turn differential wheel as shown in Figure A to increase differential. This provides a wider differential but also increases the Maximum Discharge Pressure or Trip setting. Repeat steps 5 and 6 to set maximum discharge pressure.

CAUTION

When adjusting differential, adjust switch so that maximum discharge pressure does not exceed value listed in Table 1.

11. Cycle unit by venting air from customer system to confirm proper switch operation.
12. Reinstall switch cover.

D. Setting receiver pressure

1. Turn the Normal/Unload switch to "Unload." Allow receiver-separator tank to blow down fully. Check to insure air is exiting from both blowdown valves.
2. Turn the Line/Sump selector to the "Sump" position.
3. Close the isolation valve.
4. Rotate the lever arm (F) until 25-30 psig or (1.7-2.0 BARS for 50 Hz Units) is read on the air pressure gauge.
5. Loosen travel stop bolts (C). Slide travel stop (D) until it touches the lever arm (F). Tighten the travel stop bolts (C).
6. Adjustment is now complete.

ON LINE/OFF LINE WITH UPPER RANGE MODULATION CONTROL (Optional)

A. Setting the inlet control valve

1. Remove bolt (A). Loosen clamp screw (B). Loosen travel stop bolts (C). Slide the travel stop (D) in the direction of the arrow in Figure 23 until it stops.
2. Rotate the inlet air control valve shaft counterclockwise until the valve plate (E) is in the closed position. While assuring the valve plate (E) is closed, position the lever arm (F) against the travel stop (D) as shown in Figure 23. Tighten the clamp screw (B).

B. Setting the inlet valve positioner linkage

1. While being sure that the lever arm (G) of the modulator (H) is against its full open stop (I), adjust the length of the inlet valve positioner linkage (J) until the lever end bolt (A) threads easily into lever (F) while the lever is held against the travel stop (D). Tighten bolt (A).

C. Setting the modulator

1. Remove the acorn nut (K) from the modulator (H), loosen locknut (L), and run adjusting screw (M) in a few turns.
2. Start the compressor with the Normal/Unload selector switch in the "Unload" position and the On/Off Line/Modulate selector in the "On/Off Line" position. Allow the unit to reach operating temperature.
3. Turn the Normal/Unload selector switch to the "Normal" position. This allows the positioner (N) to be actuated, opening the inlet control valve (E) loading the compressor. Turn Line/Sump selector to the "Line" position.
4. Insure that the pressure switch (1PS) is operating properly by closing the isolation valve located on the discharge line of the compressor. Watch the pressure gauge to insure that the pressure switch (1PS) opens at the correct **maximum discharge pressure** for the model being adjusted. These maximum discharge pressures or upper trip settings of the line pressure switch (1PS) are as follows:

	60 HZ UNITS	50 HZ UNITS
Model "XF" compressors	103 psig	
Model "EP" compressors	128 psig	
Model "HP" compressors	150 psig	
Model "ML" compressors		7.7 BAR
Model "MM" compressors		8.7 BAR
Model "MH" compressors		10.0 BAR

5. After confirming the upper trip setting of the pressure switch (1PS), open the isolation valve and set the discharge pressure 4 psi (0.3 BAR) below the **rated operating pressure listed on the compressor data plate.**
6. After adjusting the discharge pressure with the isolation valve, confirm that the inlet air valve is fully open.
7. Turn the compressor control selector to the "Modulate" position.
8. Airflow should be sensed coming from the orifice located in the bottom of the modulator body (H).
9. Turn the modulator adjusting screw (M) until lever (G) begins to move off stop (I).

   NOTE: Confirm line pressure has held steady and the inlet valve is still fully open.
10. While holding adjusting screw (M) firm, tighten locknut (L). Replace acorn nut (K).
11. Raise the line pressure by the use of the isolation valve to just below the upper trip setting of the line pressure switch (1PS). Set adjustment lock bolt (O) so that it just contacts lever (G). Tighten locknut on bolt.

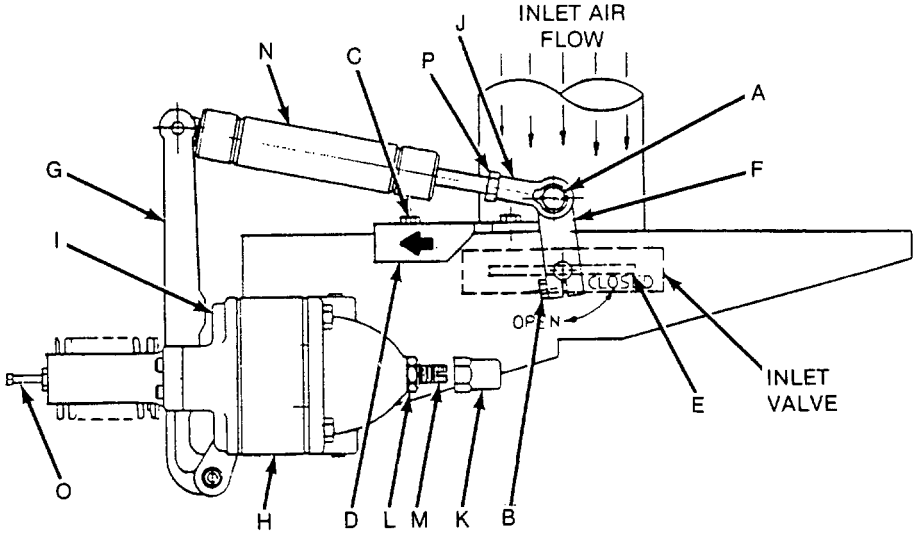


Figure 23. Inlet Control Valve With Modulator

D. Setting receiver pressure

1. Turn the Normal/Unload switch to "Unload," and compressor control selector to "On/Off Line." Allow unit to blowdown fully with *both* blowdown valves exhausting.
2. Turn the Line/Sump selector to the "Sump" position.
3. Close the isolation valve.
4. Rotate the lever arm (F) until 25-30 psig or (1.7-2.0 BARS for 50 Hz Units) is read on the air pressure gauge.
5. Loosen travel stop bolts (C). Slide travel stop (D) until it touches the lever arm (F). Tighten the travel stop bolts (C).
6. Adjustment is now complete.

OPERATION

INITIAL PREPARATIONS AND START-UP

1. Inspect and confirm that all piping and electrical work is tight and that the main disconnect switch is in the OFF position.
2. Confirm that line voltage and compressor nameplate voltage are the same. Confirm that the control transformer is connected correctly. Refer to the electrical section of this manual for transformer hook-up.
3. The unit will normally be prefilled with Ingersoll-Rand coolant-lubricant and it is only necessary to check the level gauge before and immediately after start-up. Add two quarts of coolant through the compressor inlet.
4. Remove the panel section in the enclosed unit to expose the compressor motor. Inspect the motor and control wiring for tightness and safety.
5. Place the main disconnect switch in the ON position. Note whether the white "power on" light on the panel is lit, indicating control voltage is available to the control circuit.
6. Place the Normal/Unload selector switch in the Unload position, the control selector in the "On/Off Line" position, and the Line/Sump selector in the "Sump" position.
7. Look through the compressor-motor cooling-air-access and, with a flashlight, observe a blade of the compressor motor cooling fan. Have an assistant jog the compressor motor and note the direction of rotation of the motor. The rotation must be in accordance with the directional-arrow-decal affixed to the motor.

   Note: The correct motor rotation is clockwise when the motor is viewed from the end opposite the drive end.

CAUTION

For the motor rotation check, the motor jogging must be for as short a time as possible. After depressing the start switch, immediately depress the stop switch.

WARNING

If main motor rotation is not correct, disconnect the main power, and interchange any two line connections (L1, L2, or L3) at the starter.

8. For air cooled units, or cabinet vented units, when the compressor rotation is correct, the cooling or venting fan motors will also be correct. In each case, cooling air should be exiting from the enclosure. If, for some reason, this is not so, the fan motor rotation should be reversed. Put the main disconnect in the "OFF" position, and interchange any two fan motor leads (2T1, 2T2, or 2T3) at the fan motor overload relay (2OL).
9. Check to determine that the lubricant level is at the mid-point of the sight glass provided.
10. If the compressor is watercooled, turn on the cooling water. Close the discharge isolation valve. Start the compressor.
11. Check for tightness of all fittings, particularly in the coolant system. After a few minutes operation, shut the unit down and check the coolant level in the receiver.
12. Because some lubricant will remain in the piping and accessories, it may be necessary to add lubricant to bring the level back to the mid-point of the sight glass. Tighten the fill plug securely.
13. Start the compressor and let it warm up while operating in the "Unload" and "On/Off Line" control modes.
14. When operating the compressor in the "Unload" mode, observe the pointer on the Air Pressure Gauge with the Line/Sump selector in the "Sump" position. This pointer indicates sump pressure and should not fall below 25 psig (1.7 BAR). If so, please refer to section D of Regulation Adjustment Instruction elsewhere in this manual.
15. When the discharge temperature reaches about 100°F (38°C), switch the load control to "Normal."
16. Set the Line/Sump selector to the "Line" position.
17. SLOWLY open the discharge isolation valve to put the compressor on the line.
18. If the compressor is discharging into a non-pressurized system, it is good practice to use the isolation valve to develop a back pressure of about 5 psig (0.4 BAR) below the compressor rated pressure. When the system is pressurized, open the isolation valve completely, and allow the unit to operate normally.
19. For air cooled units, the discharge temperature should rise to near 190°F. (88°C.) and may rise to as high as 210°F. (99°C.) at full load if the ambient cooling air is as high as 100°F. (38°C.).

LUBRICATION

COOLANT-LUBRICANT

Note: Ingersoll-Rand has available two synthetic coolants. SSR Coolant and Ultracoolant both of which meet these performance standards.

Rotary screw compressor fluids have a triple function to perform. They lubricate the bearings and contacting surfaces of the rotors; they seal internal clearances within the rotor chamber; and they provide for the cooling of the compression process. The bulk of the fluid is actually used for cooling with only small amounts used for lubrication and sealing.

The coolant-lubricant used in the SSR compressor has been specially blended and formulated to perform the above three functions exceptionally well. Its lubricating qualities exceed those of standard petroleum oils as well as those of previously available synthetic-lubricants. Its viscosity characteristics are such as to provide excellent sealing of internal clearances over broad ranges of operating temperatures. In fact, the viscosity change with temperature is small enough to permit the coolant-lubricant to be used over the entire range of ambients from 20°F. (−7°C.) to 115°F. (46°C.) without significant loss of its qualities. When conditions other than the design levels described are encountered, we recommend you contact your nearest Ingersoll-Rand representative for additional information.

Most important is the performance of the fluid as a coolant. In this function the SSR Coolant demonstrates its outstanding abilities. It has exceptional oxidation-stability at system-operating-temperatures so as to provide long life. Advanced-rust-inhibitors assure clean piping, clean cooler tubes, and clean separator tanks.

Due to the large volume of coolant circulated and its direct contact with the air being compressed, foaming at blowdown or other pressure change conditions is often a problem with rotary compressors. The SSR Coolant has quick air release characteristics and minimal air-entrainment, such that foaming has been largely eliminated as an operating concern.

In addition, the SSR Coolant has little affinity for water as well as quick, effective water release at shutdown. These characteristics provide for maximum bearing lubrication integrity, as even small amounts of water in the lubricant can be highly detrimental. These factors also provide for easy draining of condensation from the vertical-separator-receiver-tank.

Each SSR compressor will normally be filled, tested, and shipped with a complete charge of Ingersoll-Rand SSR Coolant. This fluid, with its characteristic blue color, is to be changed each 8000 hours of operation or once a year, whichever comes first. While operation far beyond this time frame is possible under favorable conditions, change-out at the recommended times will assure maximum unit protection and operating life for all installations. Filter change-periods should be strictly adhered to for proper fluid maintenance. See the Filtration Section for specific filter change recommendations.

Readily available but normally ordered and shipped with the unit is a service kit which includes air and coolant-lubricant filter elements and make-up coolant-lubricant for approximately one year's operation.

If a situation arises where, for some reason, this fluid cannot be used, consult Ingersoll-Rand for specifications and recommendations on possible substitutes.

COOLANT/LUBRICANT FILTRATION

Each compressor has a hydraulic-type full-flow-filter with a single replaceable element.

The filter is mounted downstream of the cooler and the thermostatic control valve.

It is rated at 10 microns.

It has a differential-pressure-bypass-valve set to open in the event that the pressure drop across the filter element rises to as high as 15 psi, which indicates an excessively fouled element, as well as poor maintenance practice.

To eliminate this latter possibility, a maintenance indicator consisting of a filter mounted differential pressure switch and a panel mounted indicating light, is provided. This indicator will signal that a differential pressure of 15 psi has been reached and the filter element should be replaced.

During some start-ups, if the coolant is cold, the indicator may light up. This is normal. If the filter element is serviceable, the indicator will extinguish as the compressor temperature rises.

COOLANT FILTER INDICATOR

However, regardless of the maintenance indicator reading, the filter element should be changed after the first 150 hours of operation and again after each 2000 hours of operation. If the compessor operates less than 2000 hours per year, the element should be replaced when the annual coolant change is made.

The procedure for renewing the filter element is outlined in the maintenance section of this manual. Spare elements and gaskets should be kept in stock at the installation to facilitate regular replacement.

The procedure for change out of the coolant-lubricant is outlined in the maintenance section. Make-up coolant for use between annual changes should also be kept in plant stock.

SAFETY SHUTDOWN CHECKS

HIGH AIR TEMPERATURE

A high air temperature shutdown switch is located at the discharge port of the compressor.

This switch should be checked at regular intervals; about once a month is recommended.

The switch can be checked for proper operation by either:

1. Shutting down the cooling fan on an air cooled unit by opening the disconnect switch on the fan motor circuit breaker, or,
2. Shutting off the cooling water on a watercooled unit.

In either case, the discharge temperature will rise at a fairly rapid rate. Shutdown should occur at about 230°F. (110°C.). If shutdown does not occur, replace switch.

The temperature at which the shutdown occurs should be recorded for comparison with similar future test results.

HIGH BEARING SCAVENGE TEMPERATURE

A high bearing scavenge lubricant temperature switch is located in the compressor rear bearing scavenge manifold piping.

This switch will open and shut the unit down at a bearing scavenge temperature of about 230°F. (110°C.).

TROUBLE INVESTIGATION

COMPRESSOR FAILS TO START

1. If the main disconnect switch is closed and the "power on" light bulb is good but does not light up, the control voltage is probably not available. Check the transformer secondary for control voltage and check the fuse (1FU) for continuity. If the fuse is blown, check for the fault.
2. If "power on" light (1LT) is lit and starter button is depressed, check the voltage across the hour meter terminals (2TB-11) and (2TB-5). If full control voltage exists across the hour meter, the trouble is in the motor starter. If full voltage does not exist across the hour meter, check the protective control circuit from (1TB-1) to (2TB-5) for an open temperature switch, an open overload relay, an open "stop" push button or a defective control relay (1CR).

   If the trouble is in the motor starter control circuit, check across terminals (2TB-11) and (1TB-13) to confirm that the time delay relay contacts (1TR) are closed. If they are open, the time delay relay solid state module should be replaced.

COMPRESSOR WILL NOT BUILD UP RATED PRESSURE

The air demand may be too high. Check for plant air leaks or open service valves.

The pressure switch (1PS) may be set too low. Check the pressure setting and the on line-off line control mode when the unit is operating in "Normal." If the pressure setting is increased, it must not be set higher than the upper set point pressure listed on the Compressor Data Plate.

COMPRESSOR FAILS TO DELIVER RATED CAPACITY

A fouled inlet air-filter will reduce the actual weight flow of air which will show up as reduced capacity of the compressor. The filter element should be changed when the panel-mounted indicator light comes on.

A faulty adjustment of the capacity regulation system could cause modulation of capacity at incorrect pressures. Check the inlet valve positioner and the modulator.

A defective modulator needle and seat could cause modulation at lower than intended line pressures. Inspection of the inlet valve position during modulation will indicate this condition. The inlet-valve should be in a throttle position consistent with the curves shown in the "Upper Range Modulation Control" section of this manual.

COMPRESSOR OVERTEMPERATURE SHUTDOWN

Insufficient coolant being circulated.

Check coolant level in receiver sump.

Insufficient cooling of coolant-lubricant.

Check injection temperature by inserting a dial type thermometer in the specially provided port in the manifold block. The proper injection temperature, for test purposes, is in the 130°F. to 150°F. (55°C. to 65°C.) range.

Insufficient cooling can be caused by fouled coolers, usually external fouling on aircooled units, and tubside fouling on watercooled units.

Operating air cooled units in excessively high ambient air. Insufficient ventilation could be a cause.

Overtemperature can result if thermostatic valves become defective. This would show up if the injection coolant temperatures are higher than normal.

Operating above rated discharge pressure can cause overtemperature. It also shortens motor insulation life because of the overload the motor must carry.

EXCESSIVE COOLANT-LUBRICANT CONSUMPTION

A ruptured or fouled separator element or a blocked scavenge orifice-screen assembly will increase coolant-lubricant consumption. The orifice-screen assembly should be checked regularly.

An increase in pressure differential across the separator is the indication of a fouled separator.

A decrease of pressure differential from the previous reading should indicate a ruptured separator.

Differential pressure should be noted and recorded. It should be taken when the compressor is operating at rated capacity and pressure.

CAUTION

Hoses should be checked every three months for signs of deterioration. Hairline cracks and hardening are two signs to look for; replace hoses as required. A service life of two to four years is normal.

EXCESSIVE LINE CURRENT

If shutdown occurs because of electrical overload, a trip indicator projects from an opening in the lower portion of the overload relay.

Overload relays can trip if line voltage is excessively low. This condition causes the motor to draw higher current. Unbalanced electrical phase can contribute to this problem.

Operating at pressures above the rated pressure will cause higher motor currents.

All starter contacts must be in good condition. The contacts can be inspected by removing the arc box from the front of the starter.

WATER CARRYOVER TO DISCHARGE LINES

A fouled or defective condensate trap that does not drain condensate will allow the condensate to be carried to the plant system. The trap operation must be checked regularly.

Condensate should flow whenever the aftercooler lowers the discharge air temperature below the dew point. Under atmospheric conditions of very low humidity, it is possible that no water vapor is condensed and therefore there will be no flow from the condensate trap.

The use of an open funnel in the drain line has been recommended to make a visual inspection easier.

LAMP TEST PROCEDURE

Periodic maintenance of the compressor should include checks of the safety shutdown devices, and problem warning lights. Each of the four lamps on the instrument panel may be tested by using a short test jumper wire with a clip on one end and a test probe on the other.

CAUTION

Care should be exercised during these lamp checks because of the electrical hazards that will be present when the electrical box is open.

By applying main power to the compressor the control transformer will be energized to supply proper voltage for testing the lamps. Provided the 1FU is not open, the Power On (1LT) lamp will light as soon as power is applied to the transformer.

By connecting the test wire clip to (1TB-1) carefully touch the probe to (3TB-12). This applies power to the Coolant Filter Lamp (3LT). If the lamp is good it will light up.

Leaving the clip connnected to (1TB-1), move the probe to (3TB-13). This applies power to the Air Filter Warning Lamp (4LT). If the lamp is good it will light up.

Still leaving the clip connected to (1TB-1), move the probe to (3TB-8). This applies power to the Automatic Restart Lamp (14LT). If the lamp is good it will light up.

COOLANT LEVEL CHECK

With the unit not running, coolant should appear in the sight glass.

With the unit running unloaded and the coolant at operating temperature, the coolant level should be at mid-range in the sight glass.

MAINTENANCE

GENERAL

The SSR Compressor requires a minimum of maintenance. The major concerns are the air cleanliness, the quality of the lubricant and the lubrication of the electric motors. Over relatively long periods of time, other system accessories will require replacement; items such as the air separator element.

The procedures to follow when servicing the compressor or replacing major accessories are described in the following paragraphs.

COOLANT FILTER ELEMENT

Time of Change - after first 150 hours and every 2000 hours thereafter, or when the filter indicator shows the need for element change, or when the coolant is being changed.

WARNING

Confirm all pressure is relieved from the compressor system and that the main electric disconnect switch is open and tagged to remain open.

Procedure (Cartridge Type) —

Place a suitable container under the filter housing drain valve which is located near the bottom of the housing.

Remove the bolt at the bottom of the housing. This will free the housing and element from the filter head. Remove the "O" ring gasket.

Inspect the element and housing for foreign particles which have been trapped in the element and also for general overall condition - then discard the element and clean the housing.

Reassemble the filter using a new element and "O" ring. Each replacement element is furnished with replacement gaskets -including one which fits under the bolt head.

Torque the bolt to 20 Lb.-Ft.

AIR FILTER ELEMENT

Time of change - when the panel mounted indicator lights up, or annually, when the coolant is changed. Indicator should be observed at full load.

Procedure —

Shut down the compressor.

Loosen wing nut on top of inlet filter housing. Lift cover up and away to expose element.

Carefully remove the old element to prevent dirt from entering the inlet valve. Discard old element.

Thoroughly clean the element housing and wipe all surfaces.

Install new element and inspect to insure that it has seated properly.

Install top of inlet filter housing.

Inspect the rubber seal on the retainer wing nut and replace seal if required.

Tighten wing nut.

Place unit in service.

LUBRICANT CHANGE TIME

AFTER EVERY 8000 HOURS OR ANNUALLY (SSR COOLANT)

PROCEDURE AND COMMENTS

There is a lubricant drainage point on each compressor. It is located on the bottom of the separator tank.

> **WARNING**
>
> **No drainage points should be opened until the compressor has been isolated electrically and all air pressure has been removed from the system.**

The lubricant should be drained soon after the compressor has been shut down. When the lubricant is hot, the drainage will be more complete and any particles in suspension in the lubricant will be carried out with the lubricant.

> **WARNING**
>
> **Extreme care should be exercised when draining the hot lubricant so that no possibility of injury to personnel exists.**

After the unit is drained and a new filter element is installed, refill the system with fresh lubricant.

CAPACITY	75HP/55KW	9 Gal.
CAPACITY	100HP/75KW	8 Gal.

Bring the receiver level of lubricant up to the mid-point of the gauge glass. Replace the fill cap.

Start the compressor and run it for a short while. Shut it down and check the lubricant level in the receiver. Add enough lubricant so that it appears in the sight glass.

COOLANT-LUBRICANT SEPARATOR ELEMENT

Time of Change - when the differential pressure across the element reaches three times the initial pressure drop or a maximum of 15 psi at full load.

NOTE: A drop to zero differential also indicates a failing or by passing element that must be replaced.

Procedure —

> **CAUTION**
>
> **Shut down the compressor, close the service air line isolation valve and open the main electrical disconnect switch. Confirm all air pressure is relieved from receiver.**

Disconnect the scavenge tube at the airend.

Loosen the fitting that holds the scavenge tube into the tank and withdraw the tube assembly.

Disconnect the piping from the receiver cover. Tag the lines if required.

Use a suitable wrench and remove the bolts that hold the tank cover in position. Remove cover by lifting up and away.

Carefully lift the separator element up and out of the tank. Discard the faulty element.

Clean the gasket surface on both the tank and its cover. Exercise care to prevent pieces of the old gasket from falling down into the tank.

Check the tank to be absolutely certain that no foreign objects such as rags or tools have been allowed to fall into the tank. Install replacement element down into the tank after checking the new element gaskets for possible damage. Center the element up within the tank.

Place the tank cover in its correct position and install bolts. Tighten the bolts in a cross-pattern to prevent over-tightening one side of the cover. An improperly tightened cover will likely result in a leak.

Install scavenge tube down into the tank until the tube just touches the separator element. Tighten fittings.

Install the regulation lines in their original position.

Start unit, check for leaks, place in service.

DRIVE MOTOR LUBRICATION

The induction-type squirrel cage motor have anti-friction ball or roller bearings front and rear. At extended intervals they require relubrication.

The periods between re-greasings of the motor bearings can vary, primarily with the severity of the service conditions under which the motor operates. As a general rule the following would apply:

Frequency of Lubrication-Normal Environments

Type of Enclosure	Insulation	Frame Size
Open DP	F	364T to 449T 9 Mo. (or 3000 Hours)
Enclosed - FC	F	6 Mo. (or 2000 Hours)

NOTE: For severe duty - Dusty locations
- High Ambients

Reduce time intervals in table above to 1/3 the listed value.

LUBRICATION: BALL OR ROLLER BEARINGS

Grease lubricated bearings as furnished are adequate for a long period of operation without relubrication. A good maintenance schedule for regreasing will vary widely depending on motor size, speed, duty and environment.

Procedure for Relubrication —

> **CAUTION**
>
> **Grease should only be added when the motor is stopped and power disconnected.**

When regreasing, stop motor and remove inlet and outlet plugs. Inlet grease gun fittings and spring-loaded outlets are arranged at each end on the motor housing. Use a hand lever type grease gun. Determine in advance the quantity of grease delivered with each stroke of the lever. Add grease in the following quantity:

3/4 cu. in. or 0.6 oz.
(13.0 c.c. or 18 grams)

Do not expect grease to appear at the outlet, but if it does discontinue greasing at once.

Run for about ten minutes before replacing outlet plug. Certain TEFC motors have a spring relief outlet fitting on the fan end. If the outlet plug is not accessible at surface of hood, it is the spring relief type and need not be removed when regreasing.

A major cause of motor bearing failure is overgreasing. The quantity of grease added should be carefully controlled. The smaller motors must be greased with a lesser amount of grease than the larger motors.

> **CAUTION**
>
> **Overgreasing is a major cause of bearing and motor failure. Make sure dirt and contaminants are not introduced when adding grease.**

Recommended Motor Greases
(or equals)

Chevron SRI	Standard Oil of California
Premium RB	Texaco
Unirex N2	Exxon
Dolium R	Shell
Rykon Premium	American Oil

DRIVE MOTOR BEARING MAINTENANCE - STORED UNITS

GENERAL

To ensure that complete contact is maintained between the motor bearings and the bearing grease on units to be placed in storage for extended intervals, the following motor maintenance procedures should be adhered to:

284T THROUGH 449TDZ FRAME DRIVE MOTORS

1. Prior to placing a unit in storage, rotate the drive motor several revolutions by hand in the proper direction of rotation. This can be accomplished by carefully turning the rotor with the fan blades located at each end of the rotor.

2. Thereafter, rotate the motor as described in Step 1 at three month intervals until such time as the unit is placed in service.

3. If the storage time should exceed a total of six (6) months duration, re-grease the motor using the amount and type of grease described in the Operator's Manual covering the specific unit to be stored.

   After re-greasing, continue to rotate the motor at three (3) month intervals as previously described.

LONG TERM STORAGE

GENERAL

The factory upon special request prepares compressor units for long term storage. In such cases, the following guidelines and recommendations apply.

> **CAUTION**
>
> **VAPOR SPACE INHIBITORS**
>
> **Before actual start up of the compressor, the unit must be drained of coolant containing vapor space inhibitors.**

REFER TO THE OPERATION section of this Manual for initial preparation and start up instructions. However, before putting the unit into operation, the Vapor Space Inhibitors must be drained and replaced with new coolant.

Procedure and Comments

1. There are two points of coolant drainage on each compressor. 1) A valved drain in the base, 2) drain cock in the filter housing.

   Both of these drainage points should be used to obtain maximum drainage of the used coolant.

> **CAUTION**
>
> **No drainage points should be opened until the compressor has been isolated electricaly and all air pressure has been relieved from the system.**

2. A hand operated transfer pump, connected to the base drain coupling will be a convenient way to remove the used coolant.

3. The coolant should be drained soon after the compressor has been shut down. When the coolant is hot, the drainage will be more complete and any particles in suspension in the coolant will be carried out with the coolant.

> **WARNING**
>
> **Extreme care should be excercised when draining the hot coolant so that no possibility of injury to personnel exists.**

4. After the unit is drained, close all drain valves and refill the system with fresh coolant. Add two quarts of coolant to the compressor through the air inlet piping while holding the inlet valve open. Bring the receiver level of coolant up to the midpoint of the gauge glass.

5. Start the compressor and run it for a short while. Shut it down and check the coolant level in the receiver. Add enough coolant to bring the level back to the gauge midpoint.

NOTES