THIS MANUAL COVERS THE FOLLOWING SULLAIR REFRIGERATION COMPRESSOR PACKAGES.

A12 PACKAGES AFTER 1985
CB12 PARTS PRIOR TO 1985

THERE HAS BEEN ADDITIONAL INFORMATION ADDED ALONG WITH SOME CORRECTION OF ORIGINAL MANUAL ERRORS

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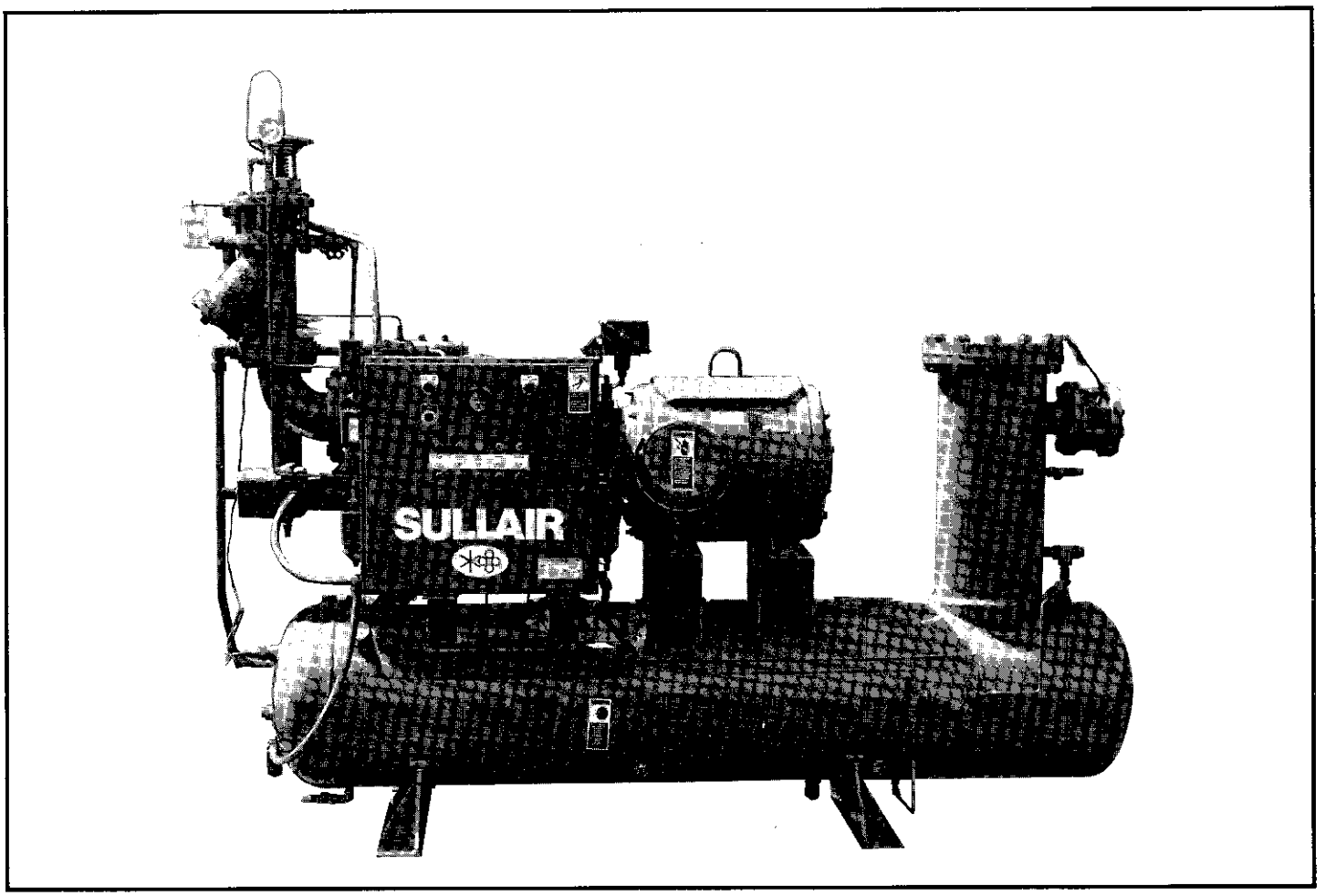
May 2010

Operators Manual and Parts List

SULLAIR®
Refrigeration Compressor

A12 SERIES



PRICE $50.00

STATEMENT OF WARRANTY

Sullair Corporation ("Sullair") warrants that, under normal use and service, if properly stored, handled, operated and maintained, its bare refrigeration air end for a period of thirty (30) months from the date of shipment of the package or twenty-four (24) months from date of start-up, whichever occurs first; be free of defects in design and workmanship; whereas, repair of defects appearing in the package components shall be limited to eighteen (18) months from the date of shipment of the package or twelve (12) months from the date of start-up, whichever occurs first. This warranty does not extend to any prime mover or other component which is covered by the original equipment manufacturer's warranty or may be furnished by the customer. Should any such defect become apparent within such time, and written notice of each and every such defect is promptly provided to Sullair, and Sullair reasonably determines that any such product is defective in material or workmanship, Sullair will, at its option, replace or repair such product. Sullair's obligation with respect to such product shall be limited to repair or replacement, F.O.B. Sullair's place of business, without any further expense to Sullair, and except as expressly provided herein, Sullair shall not in any event be liable for any other labor, transportation, installation, adjustment or other expenses which may arise in connection with such product. Any misuse or abuse of the products(s) voids this limited warranty.

The Sullair warranty does not extend to products not assembled by Sullair. As to such Products assembled by others including the driver (whether engine, turbine or electric motor), Purchaser shall be entitled to proceed only upon the terms of that particular manufacturer's warranty. Warranty does not apply to defects in materials provided by Purchaser or design stipulated by Purchaser.

Used products, and products not assembled by Sullair, are sold AS IS with no representation or warranty, and ALL WARRANTIES OF QUALITY, WRITTEN, ORAL OR IMPLIED, other than may be expressly agreed to by Sullair in writing, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS, ARE HEREBY DISCLAIMED.

IN NO EVENT SHALL SULLAIR BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES however arising whether in warranty, strict liability, contract, tort, negligence or otherwise, including but not limited to loss of profits of revenue, loss of total or partial use of the Products, facilities or services, downtime costs, or claims of Purchaser for such or other damages whether on account of Products furnished hereunder or delays in delivery thereof of services performed upon or with respect to such Products. Sullair's liability on any claim whether in warranty, strict liability, contract, tort, negligence or otherwise for any loss or damage arising out of, connected with, or resulting from this contract or the performance or breach thereof, or from the design, manufacture, sale delivery, resale, repair, replacement, installation, technical direction of installation, inspection, servicing, operation or use of any Product covered by or furnished under this contract shall in no case exceed the purchase price allowable to the Product or part thereof which give rise to the claim. Notice of claims against Sullair hereunder for any reason, including breach of warranty, must be made to Sullair in writing within forty-eight (48) hours of discovery to afford Sullair an opportunity to make a prompt investigation of surrounding facts and mitigate any damage which might ensue, should it be determined to be Sullair's responsibility. Failure to give such notice to Sullair shall constitute a waiver by Purchaser of any right later to assert such a claim.

Any cause of action against Sullair arising out of or relating to the contract or the performance hereof shall expire unless brought within one (1) year of the time of accrual thereof.

THE FOREGOING LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

SULLAIR CORPORATION
A Subsidiary Of Sundstrand Corporation
Michigan City, Indiana 46360

Sullair Corporation
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Phone 219-879-5451
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PRODUCT SAFETY POLICY

May 15, 1984

It is Sullair Corporation's policy to produce and market the best product available commensurate with the safety and health needs of the customer.

Sullair's objective is to furnish a product that is safe for it's designed and intended use. It is Sullair's corporate desire that no Sullair product be the direct cause of an accident when used for its intended application.

Product safety shall be assured through systematic application of sound engineering and management principles in the conception, design, development, testing, manufacturing, sale and servicing of all products.

Adequate instructions and cautionary labels shall be utilized.

This is a reaffirmation of a policy existing at Sullair since its origin.

R. T. Bloomberg

Robert T. Bloomberg
President and Chief
Executive Officer

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Section 6

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ILLUSTRATIONS AND PARTS LIST

1.1 INTRODUCTION

Your new Sullair Refrigeration Screw compressor will provide you with improved reliability and reduced maintenance if installed, started, operated, and serviced according to this manual. As with all industrial compressors, only trained and authorized personnel should install, operate and maintain the Sullair compressor. Take special note of items marked "important", "danger", or "warning", as overlooking these can lead to machine damage and/or hazardous situations. Should you have any questions which are not answered in this manual, contact Sullair Refrigeration Service Department or their agents for assistance.

To ensure correct application the compressor package must be connected to a system designed and installed in accordance with good industrial practices such as described in the ASHRAE (American Society of Heating, Refrigerating, and Air Conditioning Engineers) "Systems Handbook", and the IIAR (International Institute of Ammonia Refrigeration) "Equipment Design and Installation of Ammonia Mechanical Refrigeration System". System valves and controls should be installed according to the recommendations of the manufacturers or suppliers.

Immediately on arrival of your new Sullair compressor, unpack all the crates and boxes and check the items against shipping lists for any possible shortages. Examine the compressor, package components and loose items for possible damage in transit. Notify the carrier of any shortages or damages and enter the appropriate claim with them.

Prior to proceeding any further, familiarize yourself with the compressor package components with the aid of Figures 1-1 and 1-2.

Figure 1-1 Sullair Model A12 Water-Cooled Rotary Screw Refrigeration Compressor

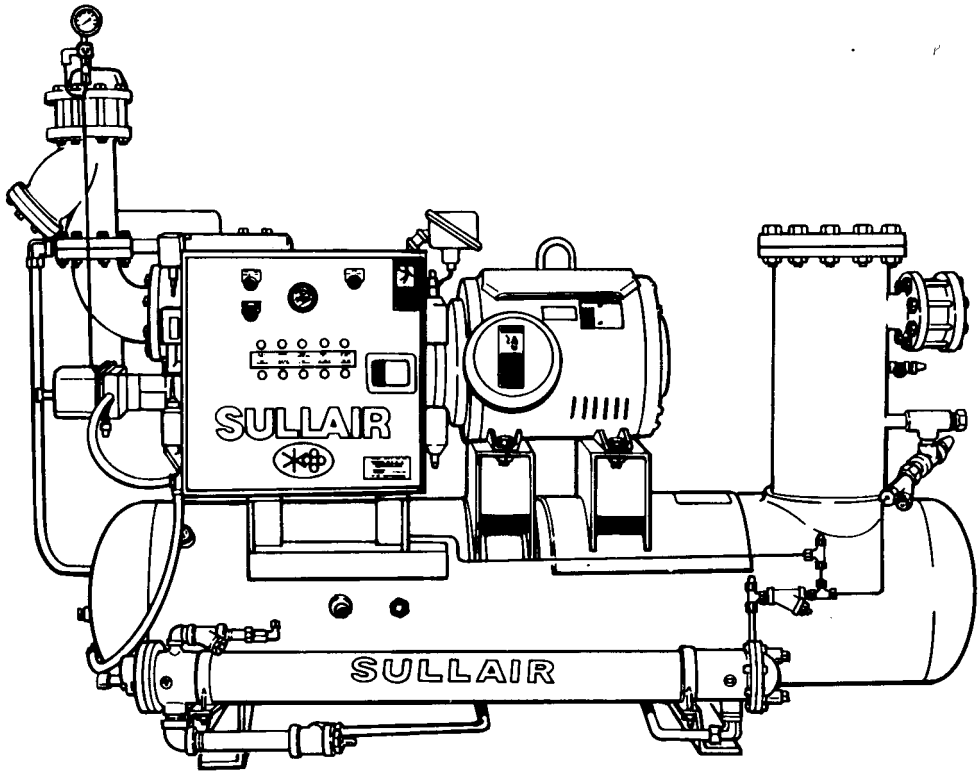
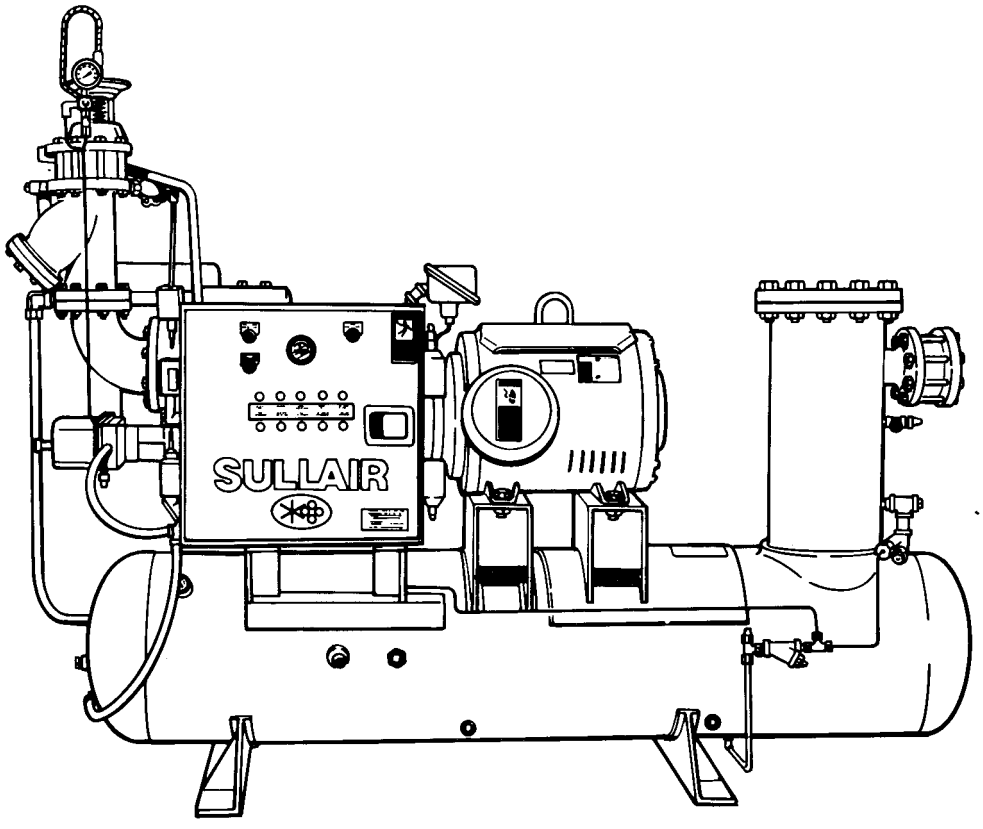


Figure 1-2 Sullair Model A12 Liquid Injection Cooled Rotary Screw Refrigeration Compressor



1.2 THE PACKAGE

The compressor package is factory assembled and includes the following equipment:

- Sullair screw compressor unit
- Electric motor
- Lubrication system with oil separator with either a shell and tube water-cooled oil cooler, shell and tube thermosiphon oil cooler, or a high pressure liquid refrigerant injection oil cooling system.
- Suction strainer, suction check valve, and discharge check valve.
- Electrical Control System
- Oil pump

Refer to Figures 1-1 and 1-2 for arrangement.

1.3 THE COMPRESSOR

The U.S. made Sullair Refrigeration screw compressor is an advanced design incorporating many years of experience in the screw compressor field. The single stage, positive displacement, pulse-free compressor includes the following design features:

- Non-symmetrical rotor profile
- 300 PSI (2.1 MPa) design casting
- Flange for direct mounting to the NEMA C flanged motor
- Anti-friction bearings
- Oil flooded, carbon face shaft seal

Oil is injected into the compressor unit and mixes directly with the refrigerant as the rotors turn compressing the gas. The oil has three functions:

- As a coolant, it controls the rise of the gas temperature associated with the heat of compression.
- As a sealant, it seals the leakage paths between each rotor and the stator and also between the two rotors.
- As a lubricant, it acts as a lubricating film between the rotors allowing the male rotor to directly drive the female rotor.

After the refrigerant/oil mixture is discharged from the compressor unit, the oil is separated from the refrigerant in the oil separator which also serves as the oil receiver. The refrigerant passes into the system and the oil is returned to the compressor.

The compressor capacity is varied by rotating a hollow cylindrical valve with openings distributed along its length so that the openings progressively correspond to ports in the stator, allowing the gas to return to suction rather than be compressed.

1.4 THE LUBRICATION SYSTEM

Figures 1-3 thru 1-26 show the lubrication schematic for the A12L package. Oil for bearings and injection is circulated by differential pressure between suction and discharge or by an

oil pump, when the differential pressures between suction and discharge pressure is too low to adequately circulate oil. Oil is passed through a 15 micron fine filter then routed to the oil injection ports, shaft seal, balance pistons, bearings and gear box on applicable units. Female injection oil is routed thru a 100 mesh strainer on high stage only. On booster compressors all oil is circulated by a continuously running oil pump. The gas/oil mixture leaving the compressor discharge enters the oil separator/sump where the oil is separated. Sight glasses are installed in the sump portion of the separator to indicate oil level.

A thermostatically controlled oil heater is installed in the oil separator to maintain oil temperature when the compressor is not running. Oil cooling is accomplished by a shell and tube oil cooler for water and thermosiphon cooling or by direct injection of high pressure liquid refrigerant.

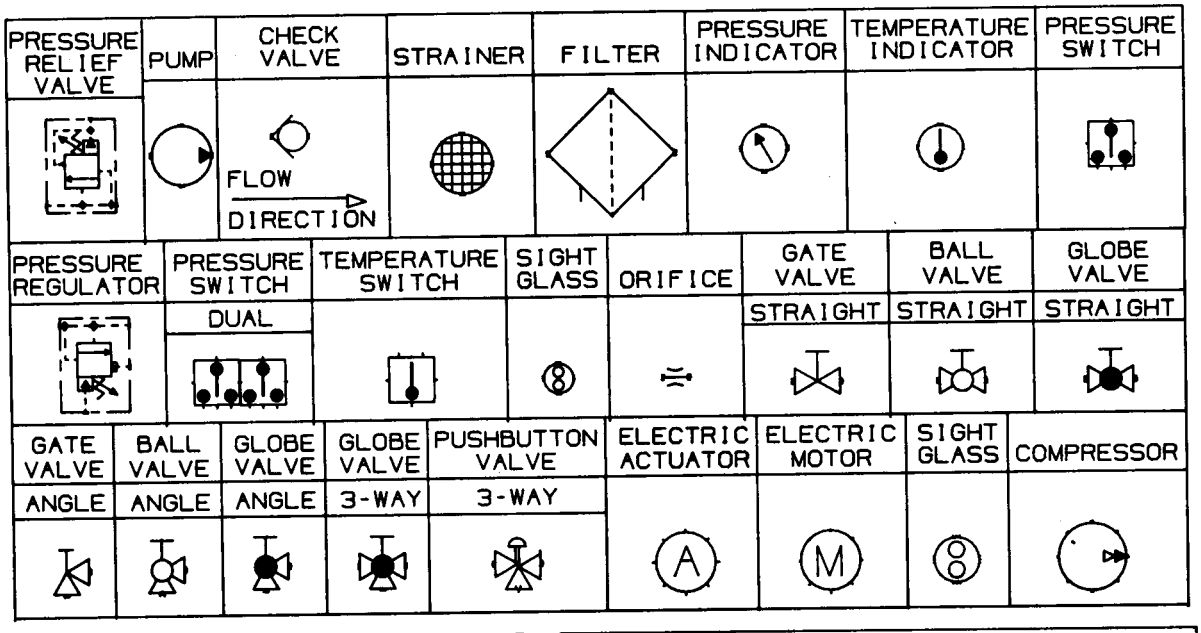
The water-cooled oil cooling system is furnished with a water regulation valve (shipped loose) which senses oil temperature.

The thermosiphon oil cooling system is furnished with a 3-way thermostatically actuated control valve which bypasses hot oil around the cooler to maintain oil temperature.

The liquid injection cooling system includes a strainer, low discharge temperature switch, solenoid valve and temperature control valve. Refrigerant is injected directly into the compressor near the discharge port. The low discharge temperature sensor is included to stop refrigerant flow at low discharge temperatures and to prevent refrigerant overfeed. The following additional optional system components are available:

- Dual filters
- Panel mounted pressure and temperature gauges
- Suction and discharge stop valves
- Load limit relay
- MICRO Processor Control Panel
- Hydraulic Valve Actuator
- Sullistage Economizer

Figure 1-3 Legends For Figures 1-4 Thru 1-9 Direct Drive With Electric Valve Actuator (EVA)



SYMBOLS	
	GAS TUBING
	GAS PIPING
	OIL TUBING
	OIL PIPING
	CONTROL LINE
	ELECTRICAL LINE
	COOLANT LINE
	CAPILLARY LINE

NO.	PORT DESCRIPTION
X1	LIQUID INJECTION OR SULLISTAGE
X2	OIL SUPPLY TO DISCHARGE BEARINGS
X3	N/A
X4	OIL SUPPLY TO INLET BEARINGS
X5	OIL INJECTION TO FEMALE ROTOR
X6	OIL RETURN FROM BEARING DRAIN
X7	N/A
X8	CONNECTION TO DISCHARGE PRESSURE
X9	DISCHARGE BEARING OIL DRAIN
X10	N/A
X11	N/A
X12	N/A
X13	N/A
X14	GAS FEED TO STATOR
X15	INLET PRESSURE PICKUP (PLUGGED)
X16	OIL RETURN TO MALE ROTOR FACE
X17	SHAFT SEAL DRAIN

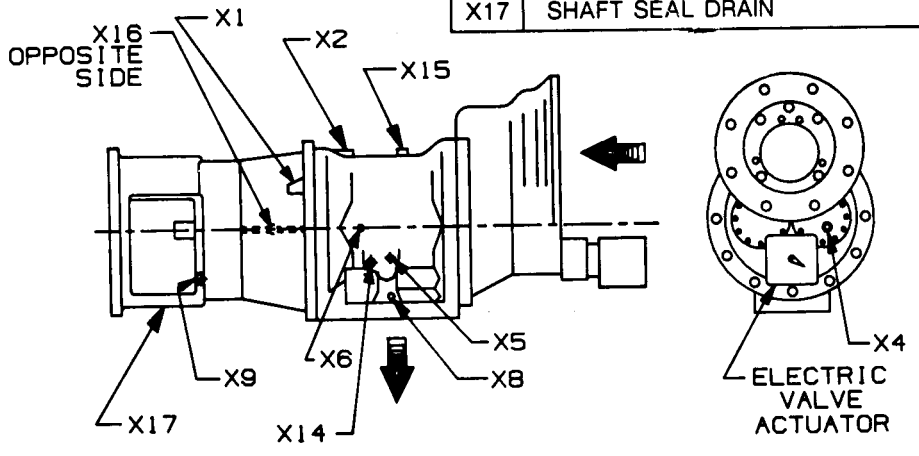


Figure 1-4 Water Cooled High Stage Direct Drive With Electric Valve Actuator

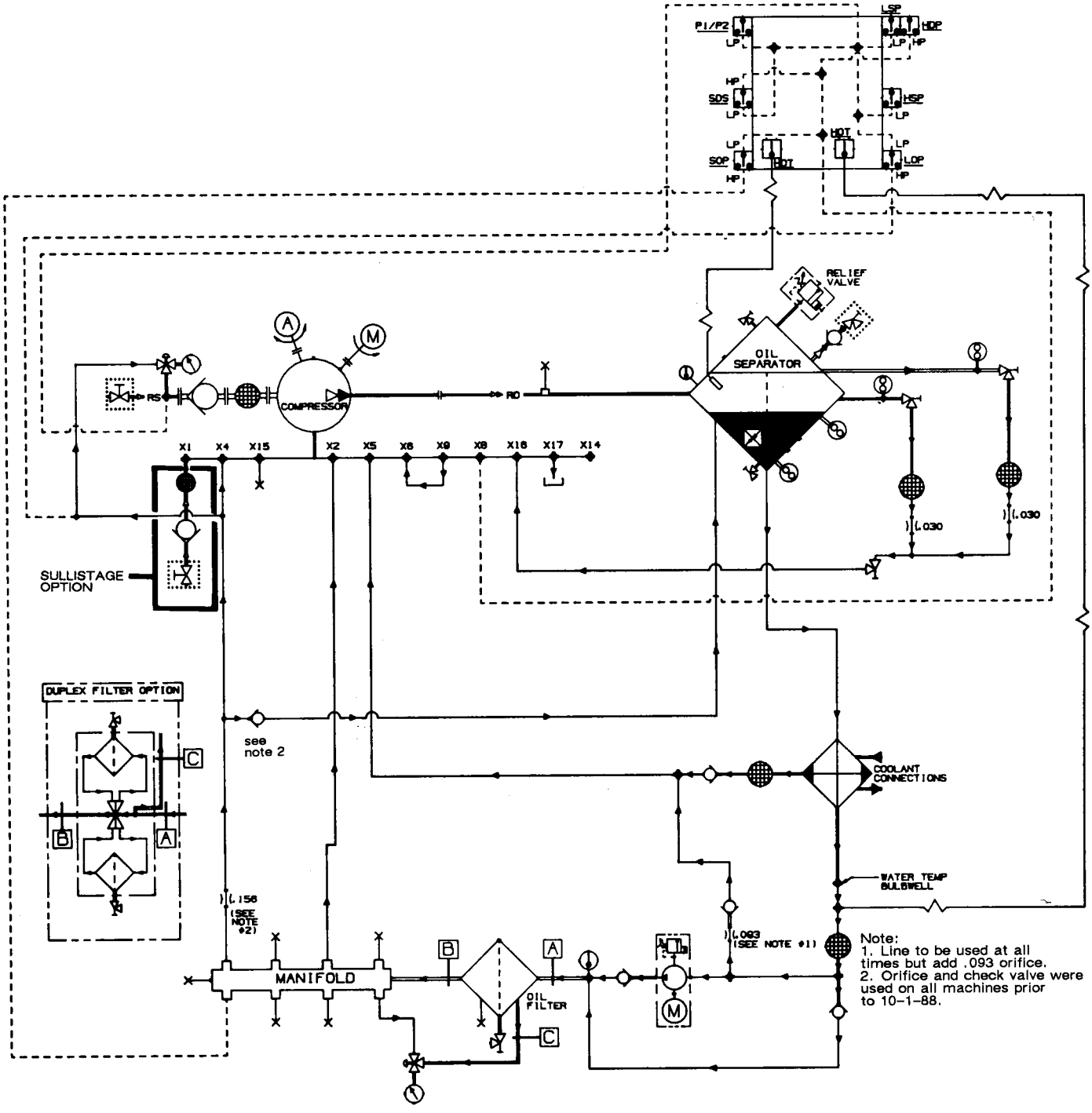


Figure 1-5 Water Cooled Booster Direct Drive With Electric Valve Actuator

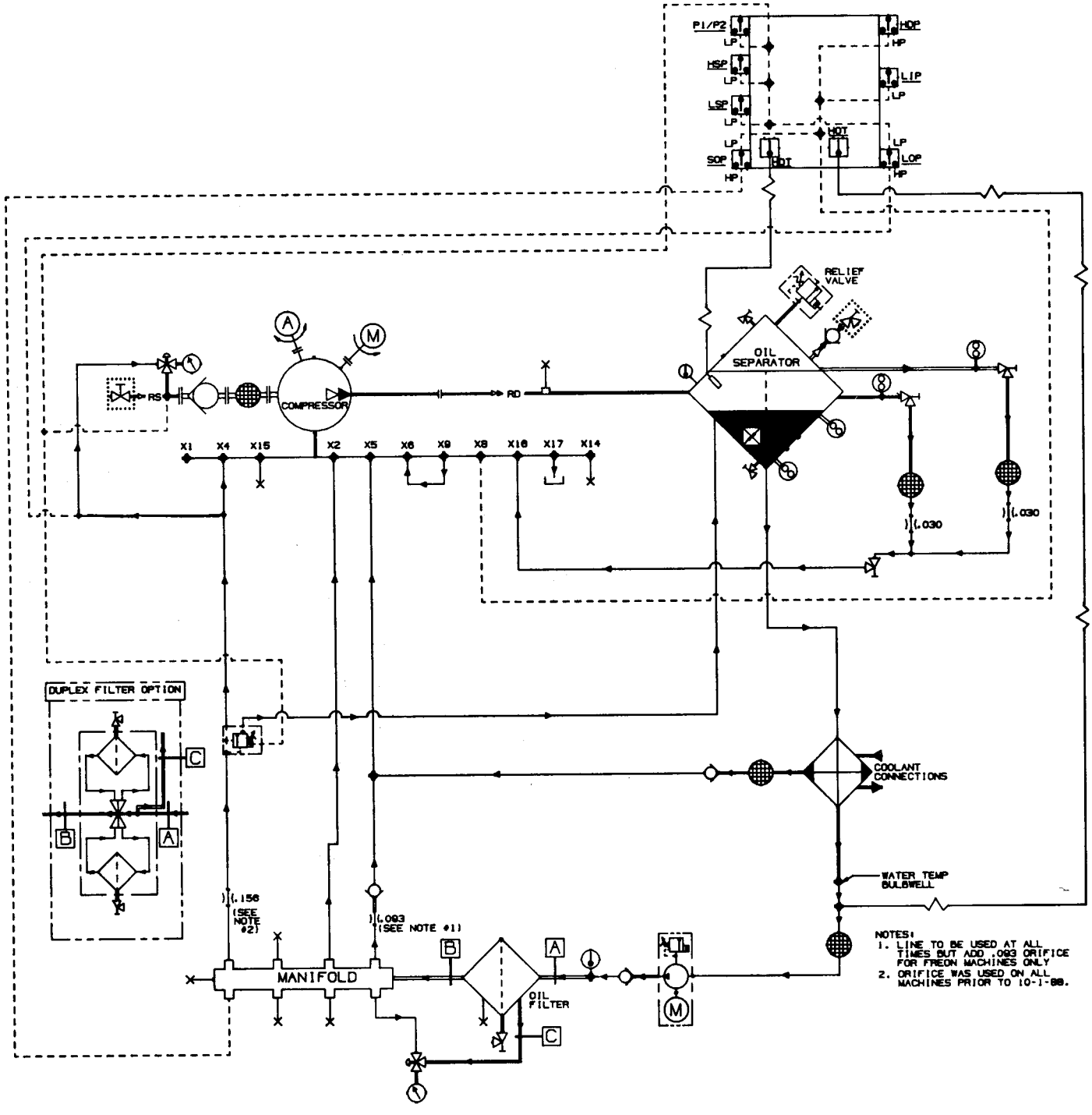


Figure 1-6 Thermosiphon High Stage Direct Drive With Electric Valve Actuator

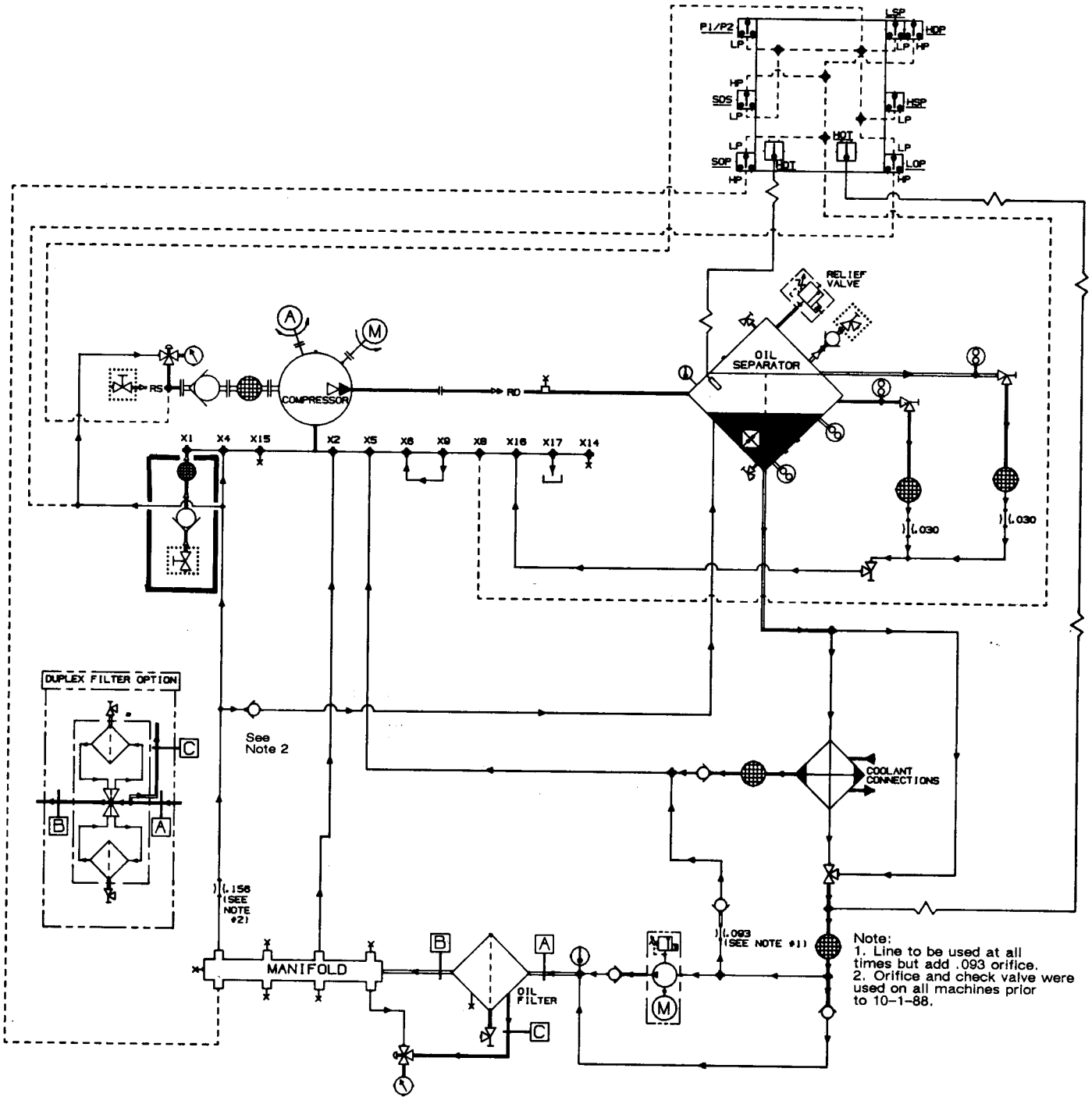


Figure 1-7 Thermosiphon Booster Direct Drive With Electric Valve Actuator

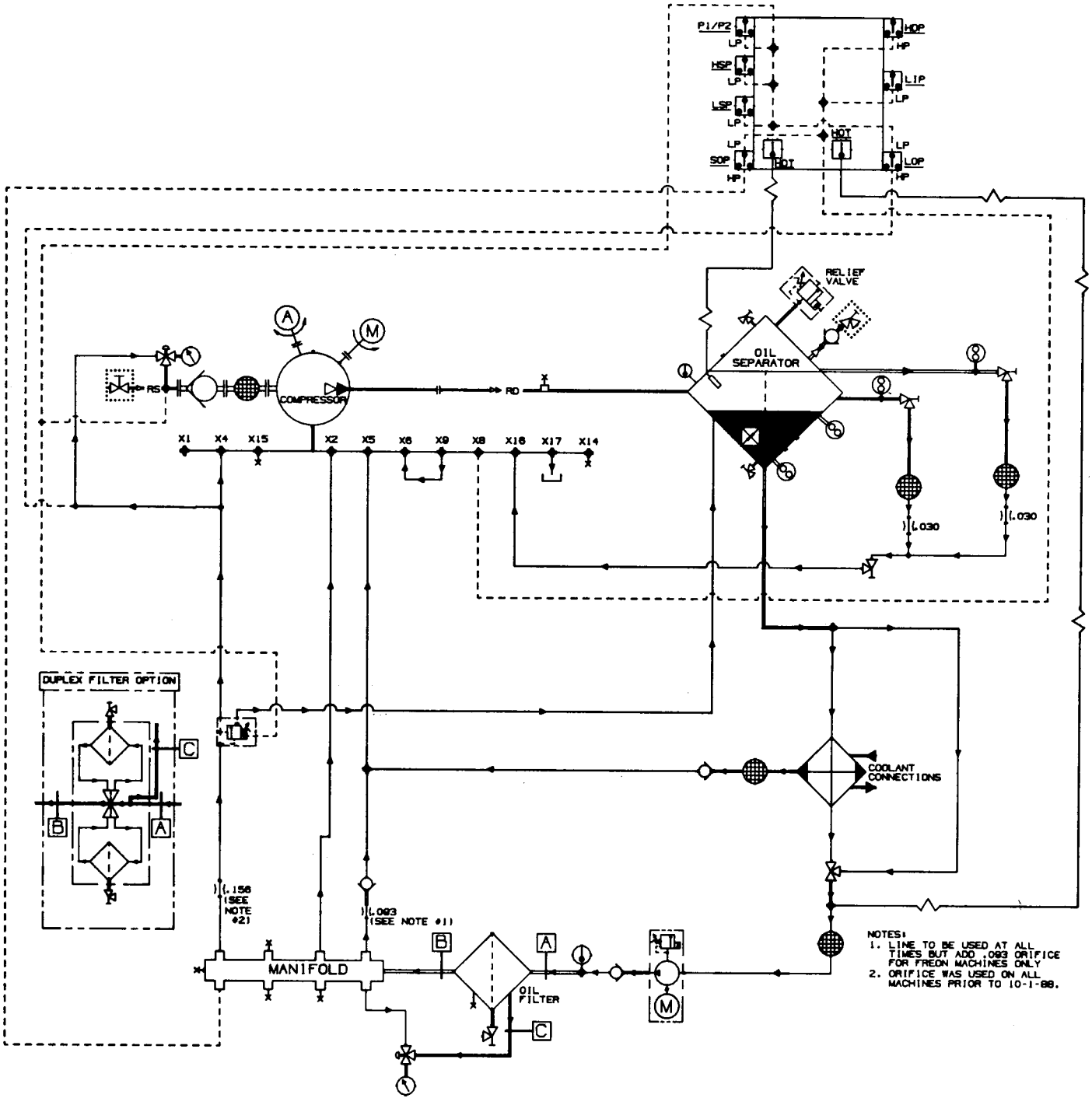


Figure 1-8 Liquid Injection High Stage Direct Drive With Electric Valve Actuator

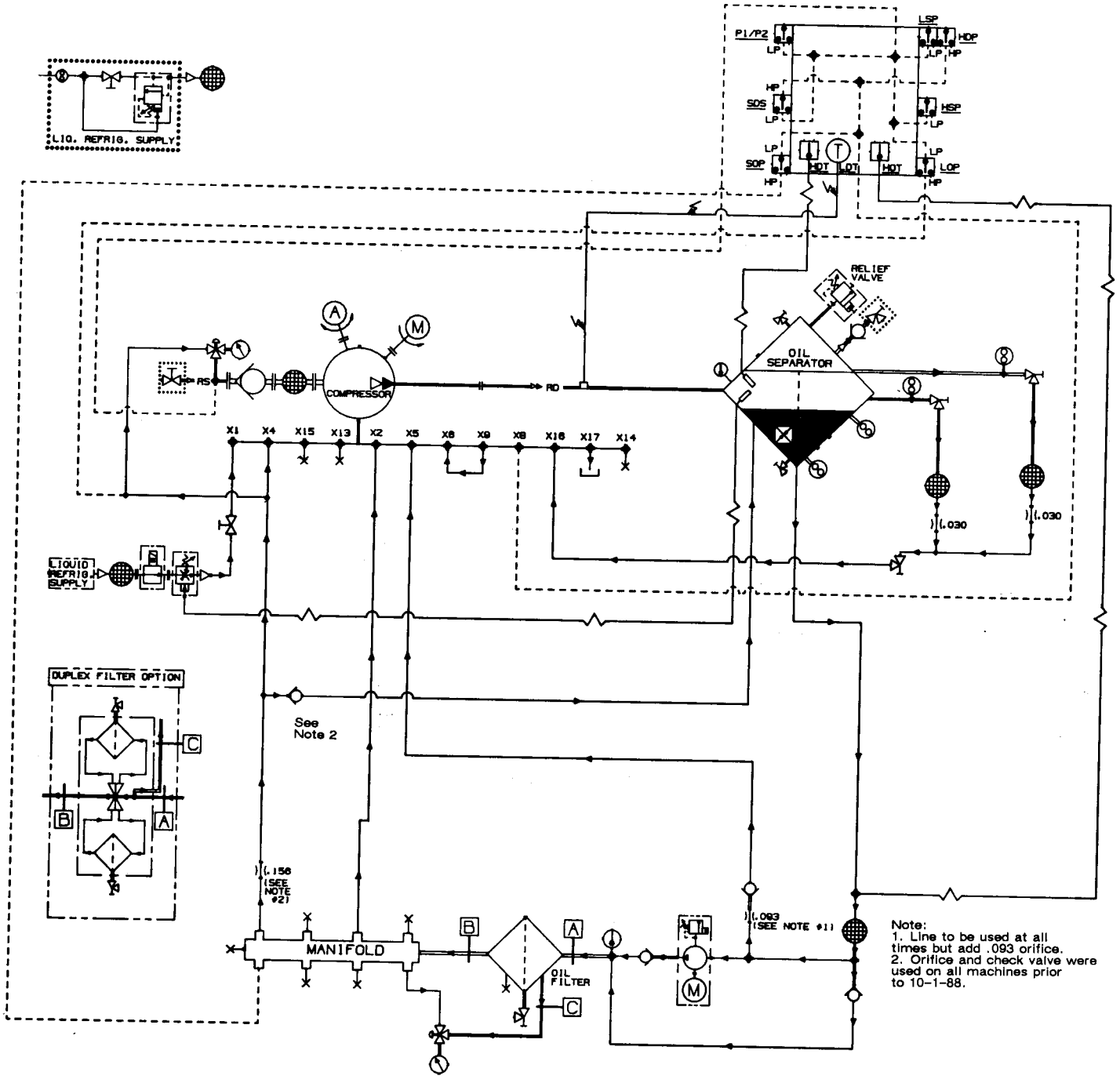


Figure 1-9 Liquid Injection Booster Direct Drive With Electric Valve Actuator

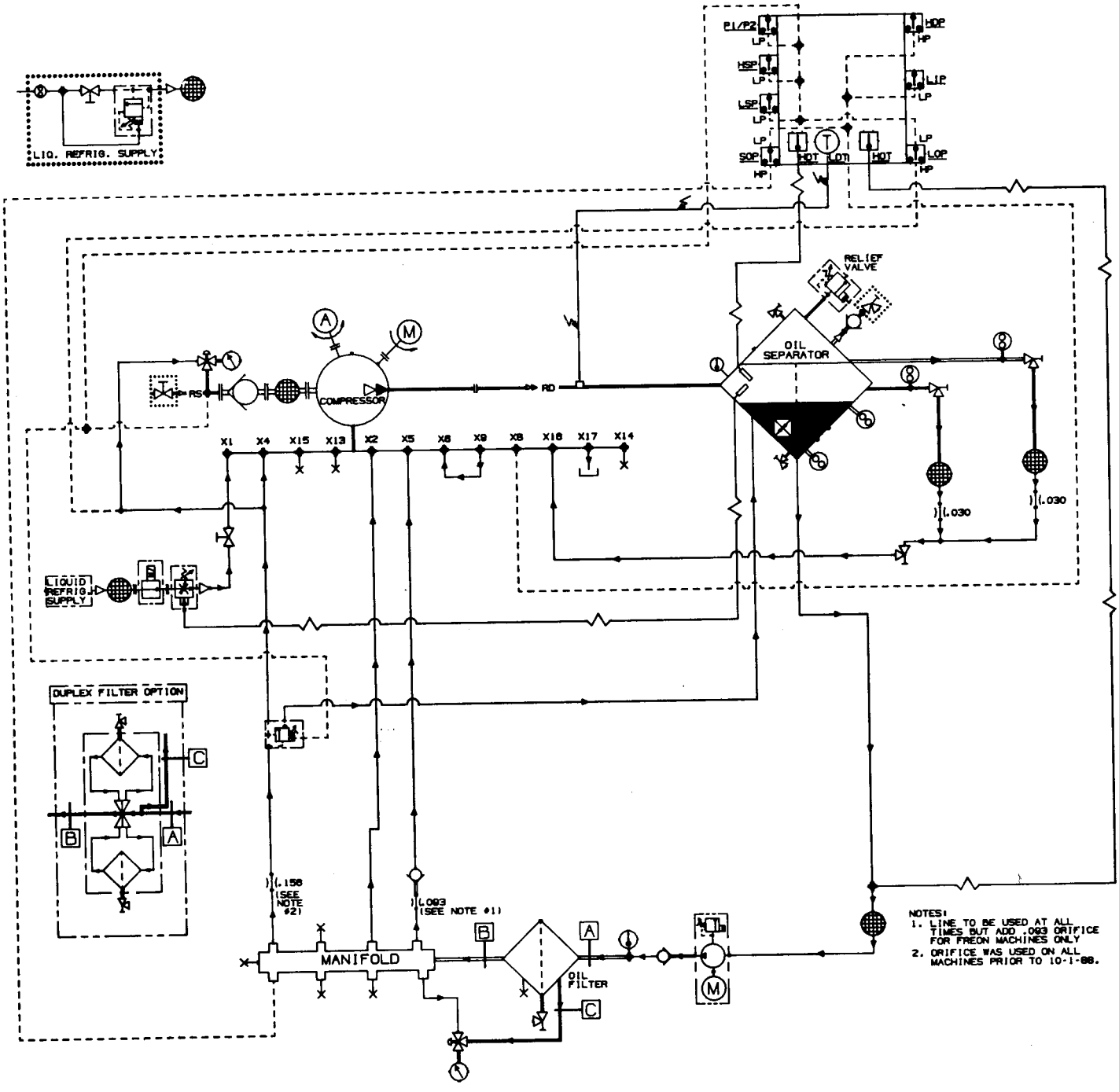
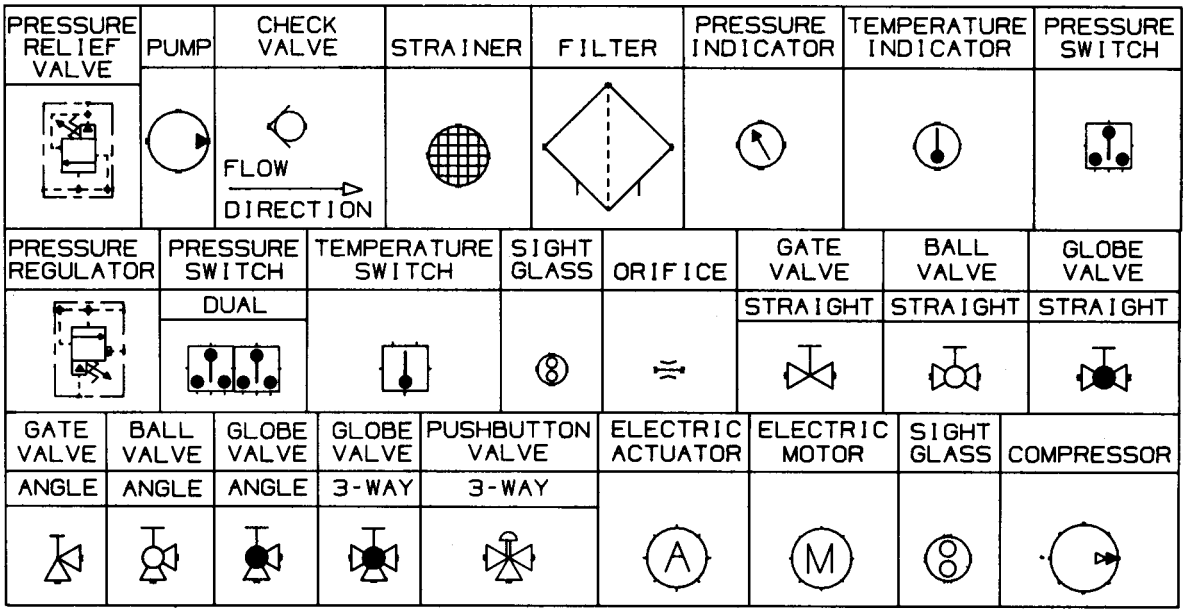


Figure 1-10 Legends For Figures 1-11 Thru 1-16 Gear Driven With Electric Valve Actuator (EVA)



SYMBOLS	
	GAS TUBING
	GAS PIPING
	OIL TUBING
	OIL PIPING
	CONTROL LINE
	ELECTRICAL LINE
	COOLANT LINE
	CAPILLARY LINE

NO.	PORT DESCRIPTION
X1	LIQUID INJECTION OR SULLISTAGE
X2	OIL SUPPLY TO DISCHARGE BEARINGS
X3	N/A
X4	OIL SUPPLY TO INLET BEARINGS
X5	OIL INJECTION TO FEMALE ROTOR
X6	OIL RETURN FROM BEARING DRAIN
X7	N/A
X8	CONNECTION TO DISCHARGE PRESSURE
X9	DISCHARGE BEARING OIL DRAIN
X10	N/A
X11	N/A
X12	N/A
X13	OIL SUPPLY TO GEARBOX AND SEAL
X14	GAS FEED TO STATOR
X15	INLET PRESSURE PICKUP (PLUGGED)
X16	OIL RETURN TO MALE ROTOR FACE
X17	SHAFT SEAL DRAIN

DOTTED SQUARES INDICATE CUSTOMER SUPPLIED

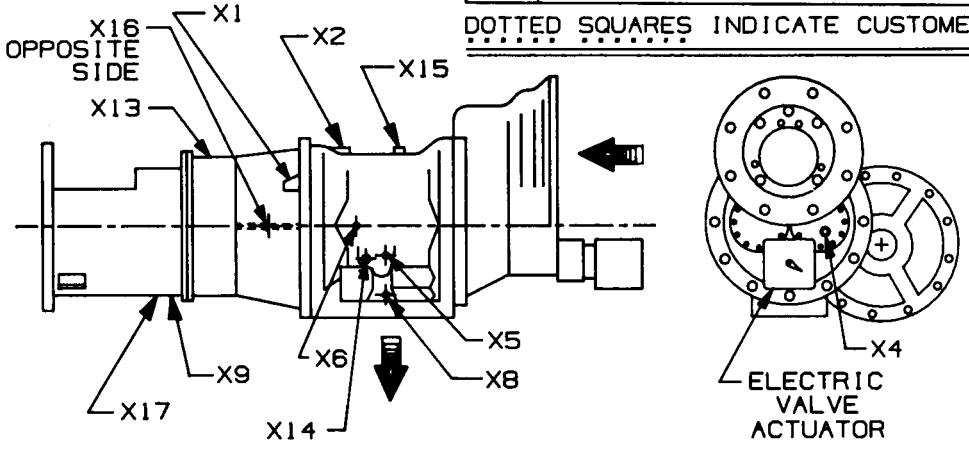


Figure 1-11 Water Cooled High Stage Gear Drive With Electric Valve Actuator

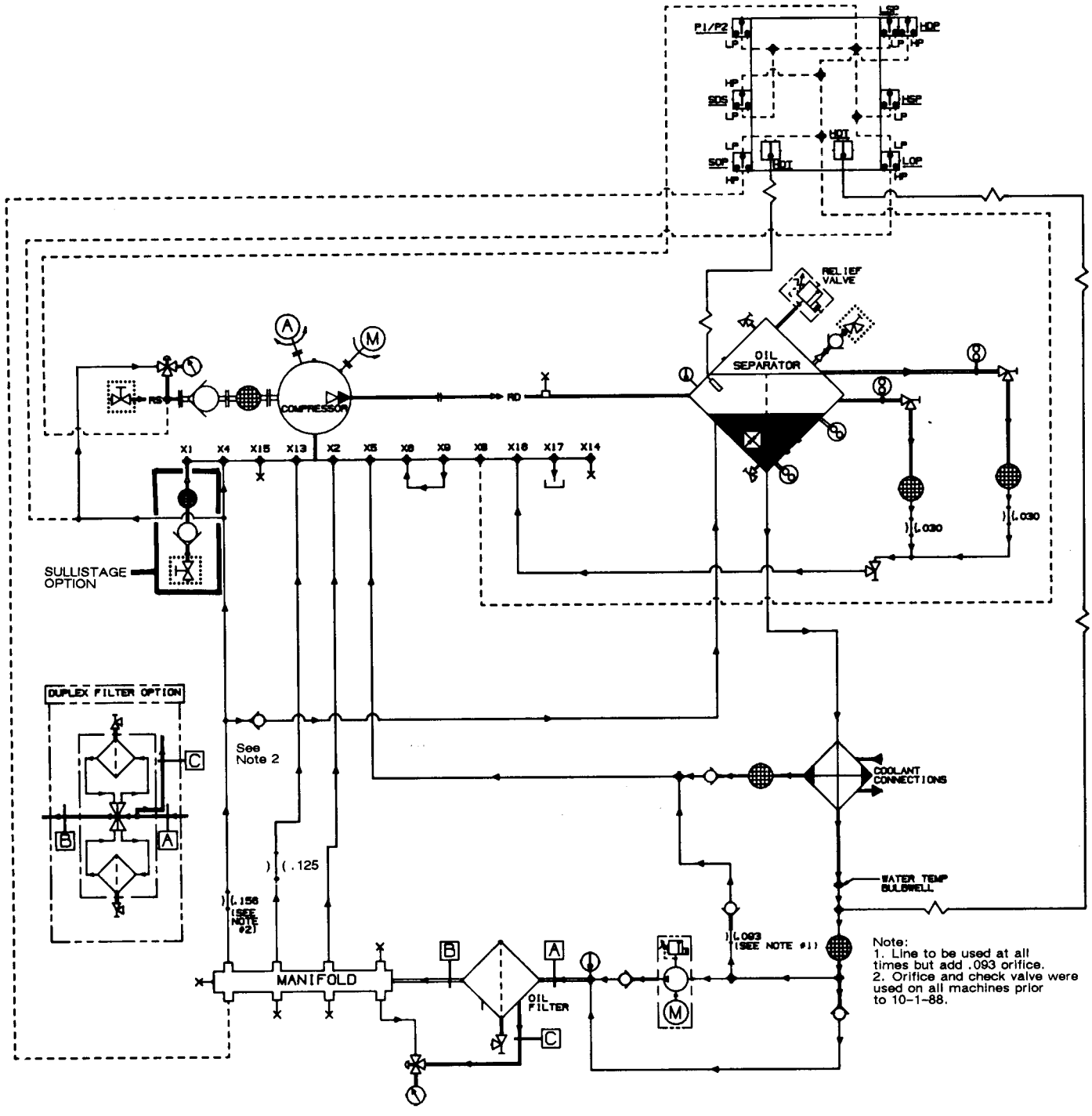


Figure 1-12 Water Cooled Booster Gear Drive With Electric Valve Actuator

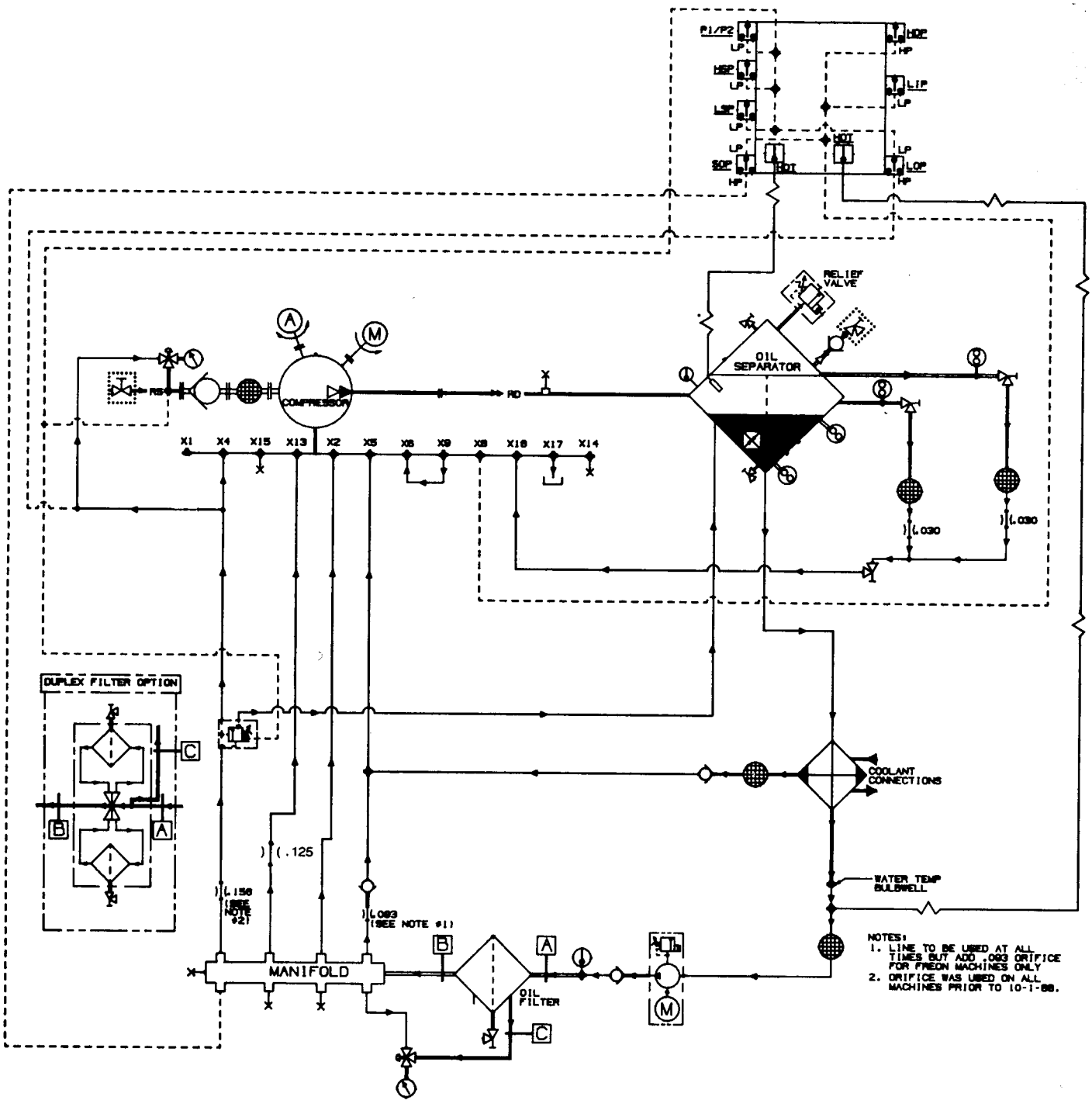


Figure 1-13 Thermosiphon High Stage Gear Drive With Electric Valve Actuator

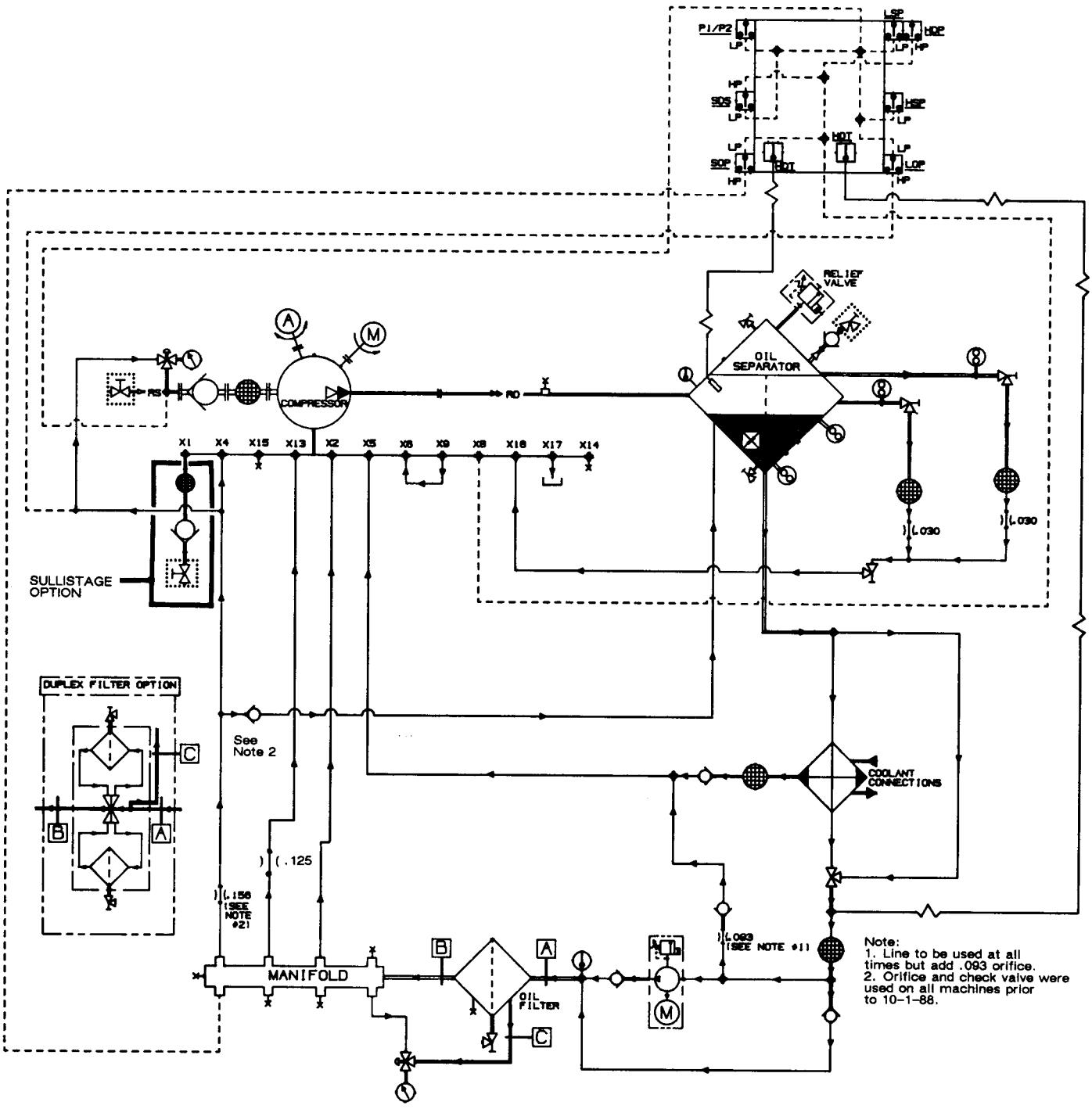


Figure 1-14 Thermosiphon Booster Gear Drive With Electric Valve Actuator

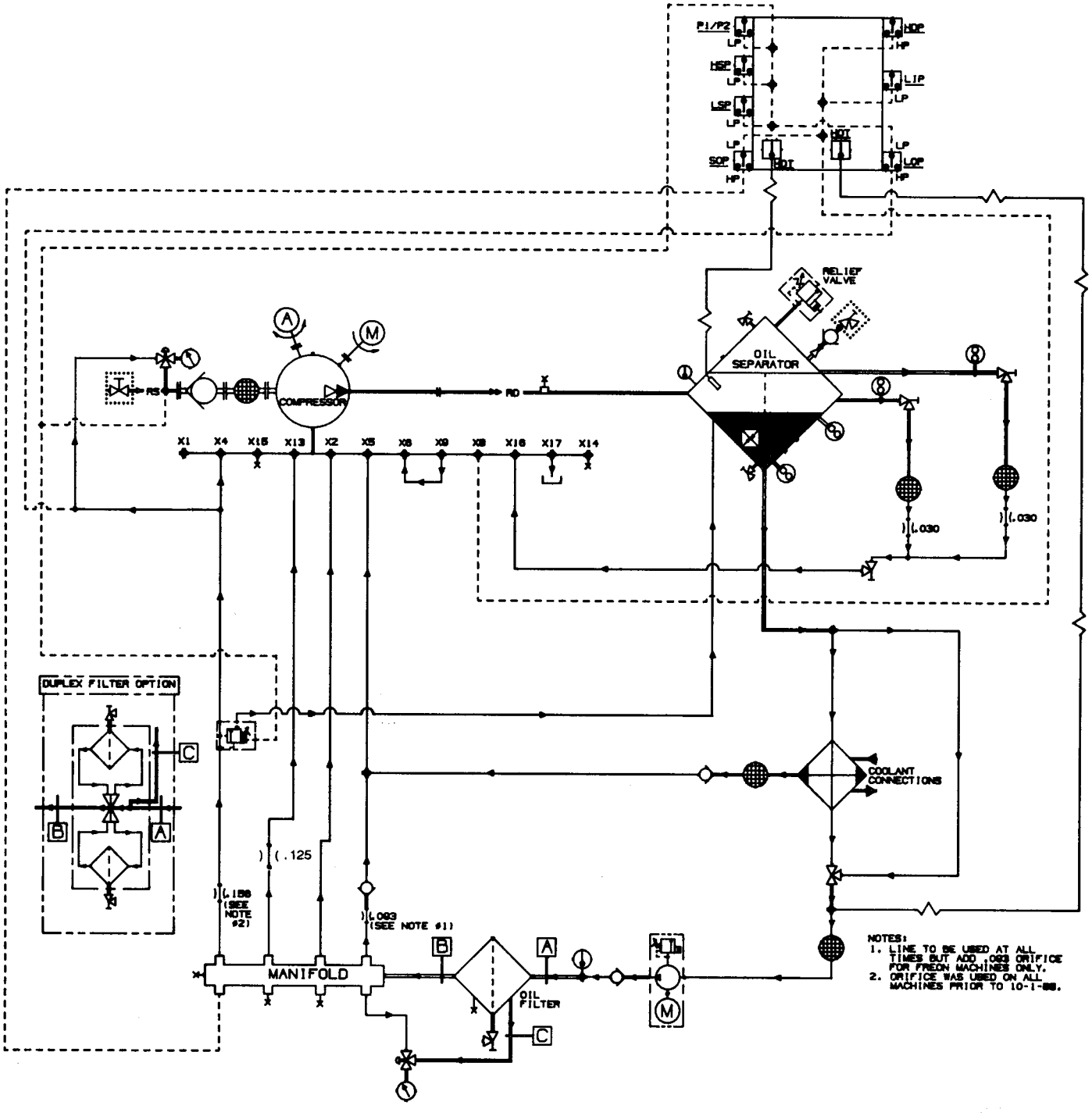


Figure 1-15 Liquid Injection High Stage Gear Drive With Electric Valve Actuator

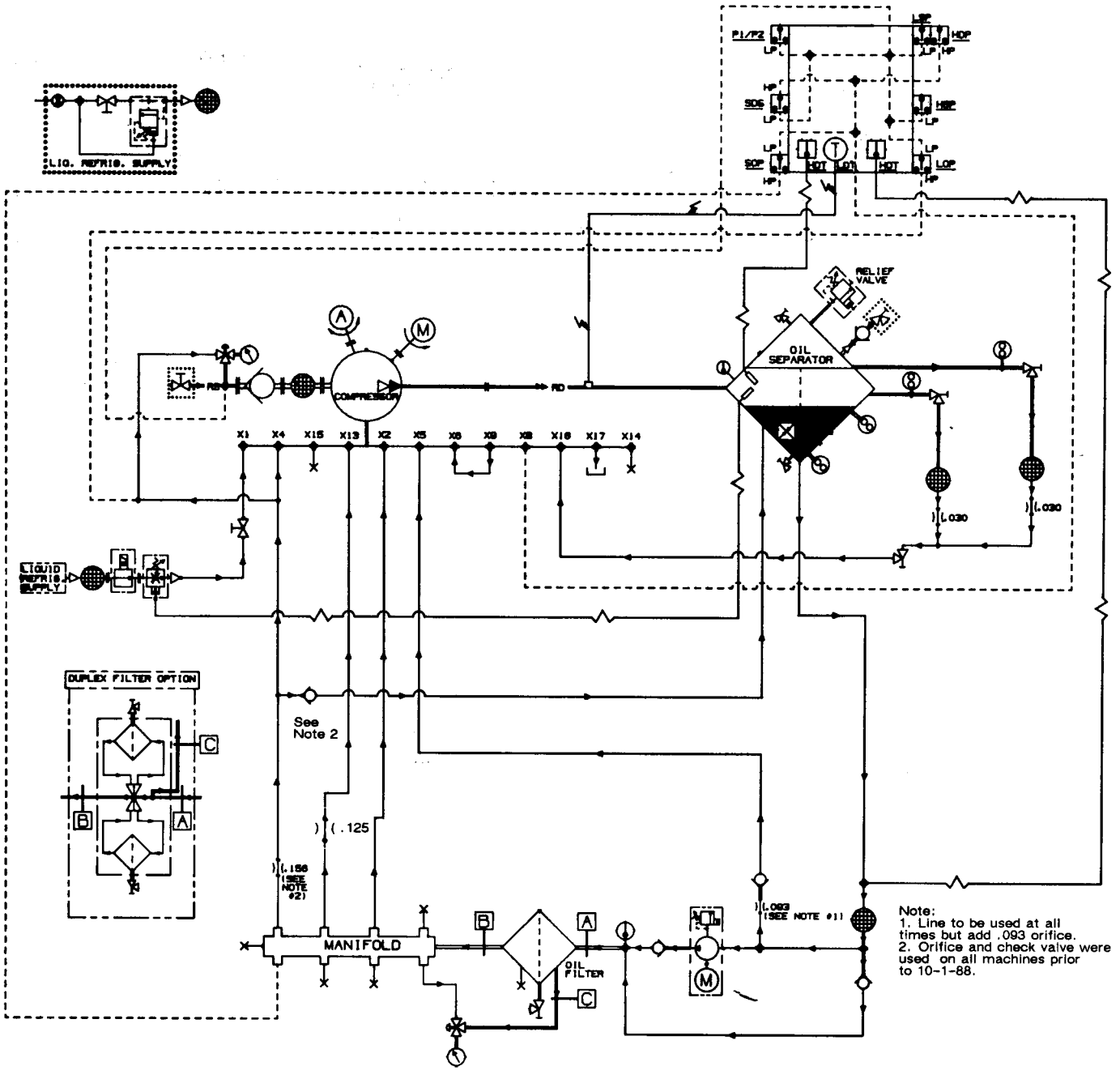
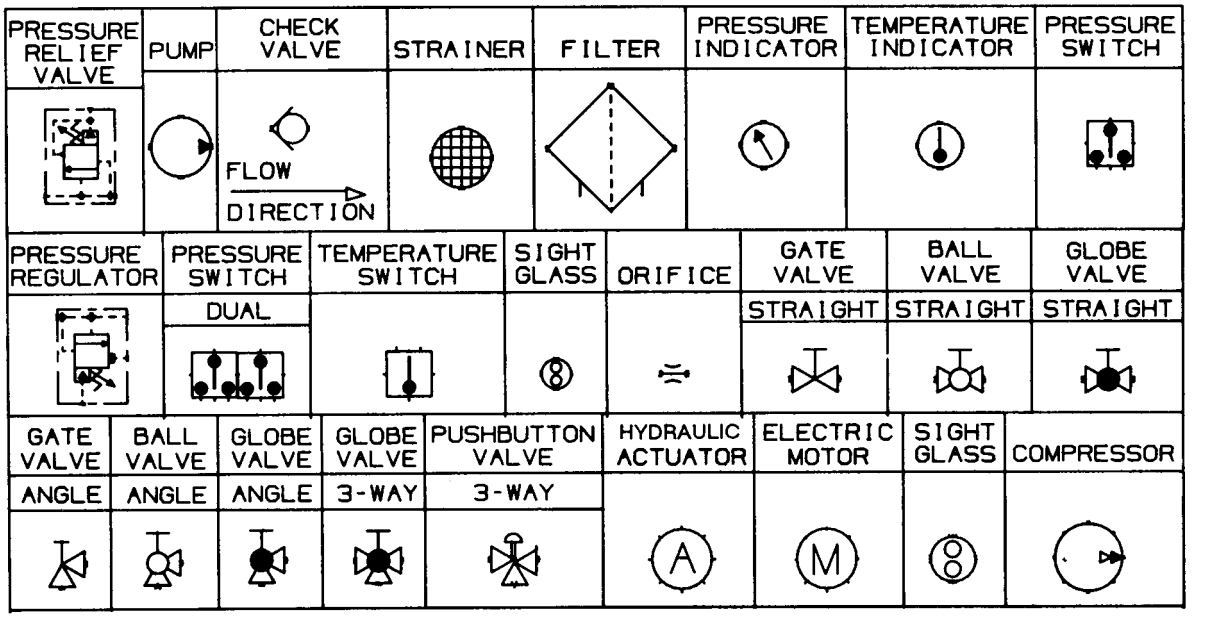


Figure 1-17 Legends For Figures 1-18 Thru 1-21 Direct Drive With Hydraulic Valve Actuator



SYMBOLS	
	GAS TUBING
	GAS PIPING
	OIL TUBING
	OIL PIPING
	CONTROL LINE
	ELECTRICAL LINE
	COOLANT LINE
	CAPILLARY LINE

NO.	PORT DESCRIPTION
X1	LIQUID INJECTION OR SULLISTAGE
X2	OIL SUPPLY TO DISCHARGE BEARINGS
X3	N/A
X4	OIL SUPPLY TO INLET BEARINGS
X5	OIL INJECTION TO FEMALE ROTOR
X6	OIL RETURN FROM BEARING DRAIN
X7	N/A
X8	CONNECTION TO DISCHARGE PRESSURE
X9	DISCHARGE BEARING OIL DRAIN
X10	OIL TO UNLOAD SIDE OF VALVE ACTUATOR
X11	OIL TO LOAD SIDE OF VALVE ACTUATOR
X12	N/A
X13	N/A
X14	GAS FEED TO STATOR
X15	INLET PRESSURE PICKUP (PLUGGED)
X16	OIL RETURN TO MALE ROTOR FACE
X17	SHAFT SEAL DRAIN

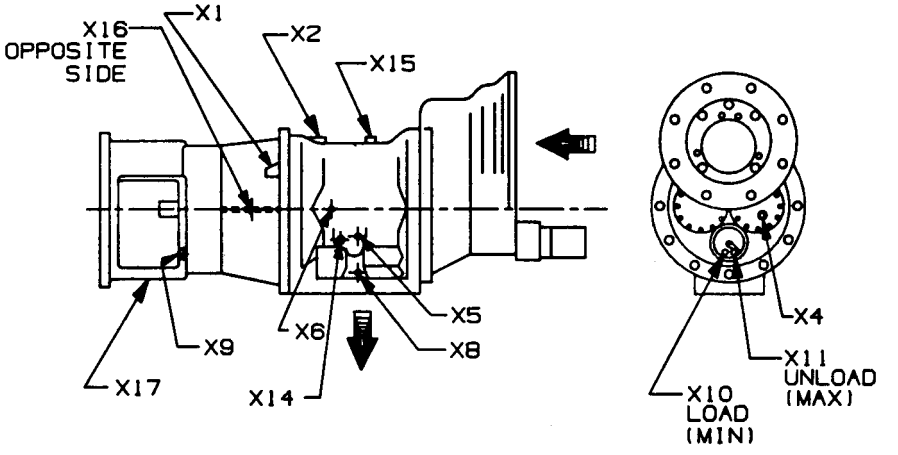


Figure 1-18 Water Cooled High Stage Direct Drive With Hydraulic Valve Actuator

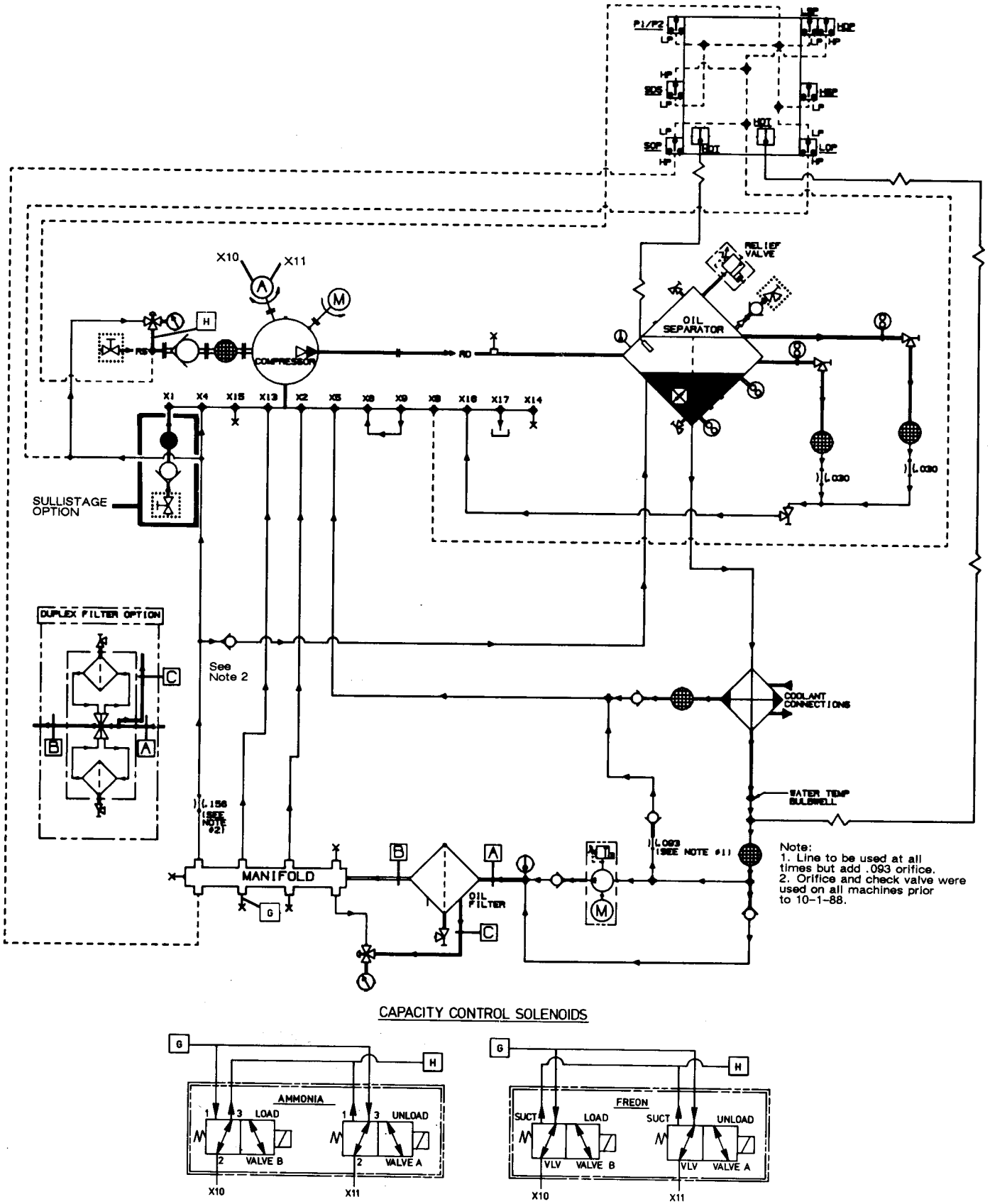


Figure 1-19 Water Cooled Booster Direct Drive With Hydraulic Valve Actuator

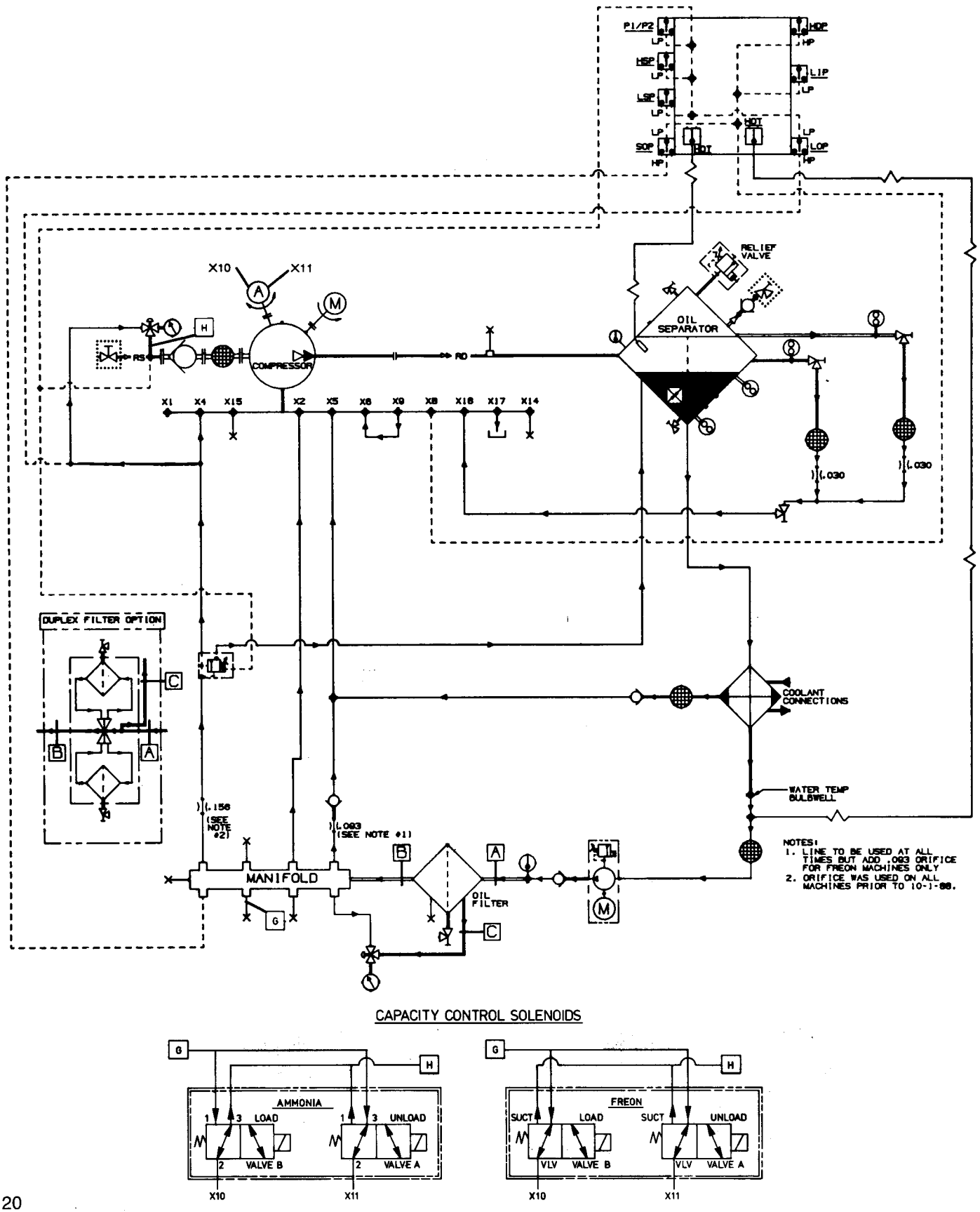


Figure 1-20 Liquid Injection High Stage Direct Drive With Hydraulic Valve Actuator

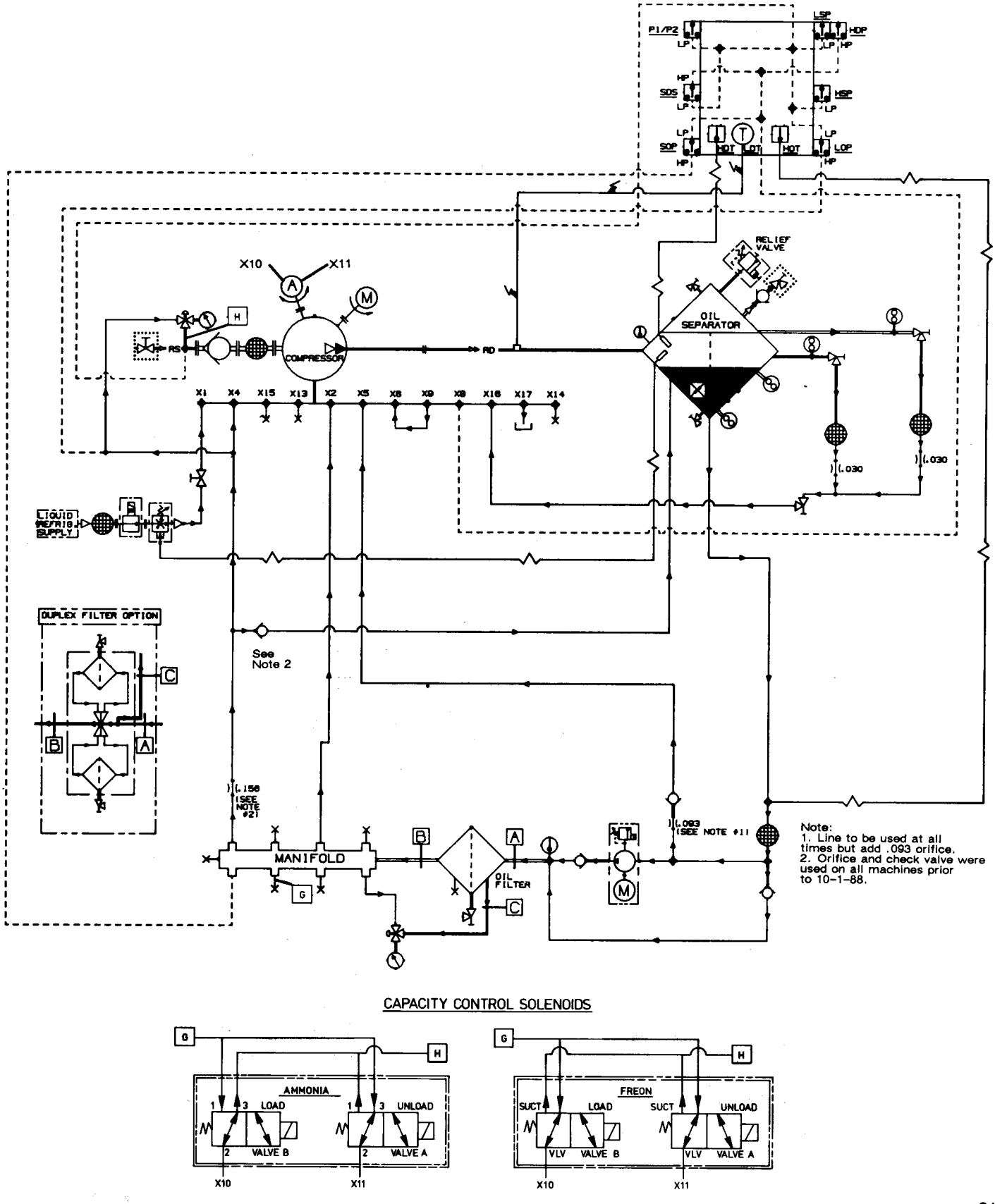


Figure 1-21 Liquid Injection Booster Direct Drive With Hydraulic Valve Actuator

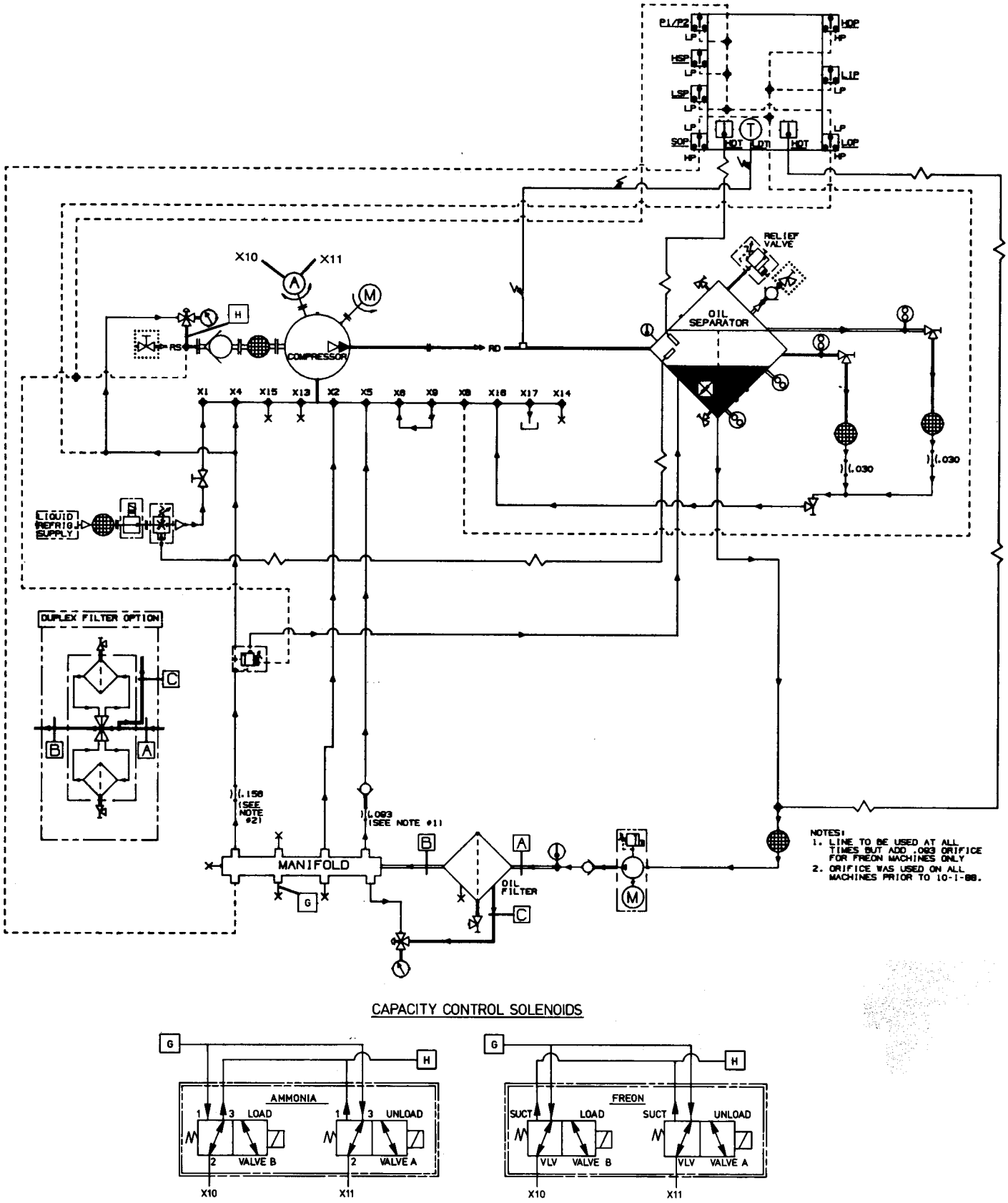
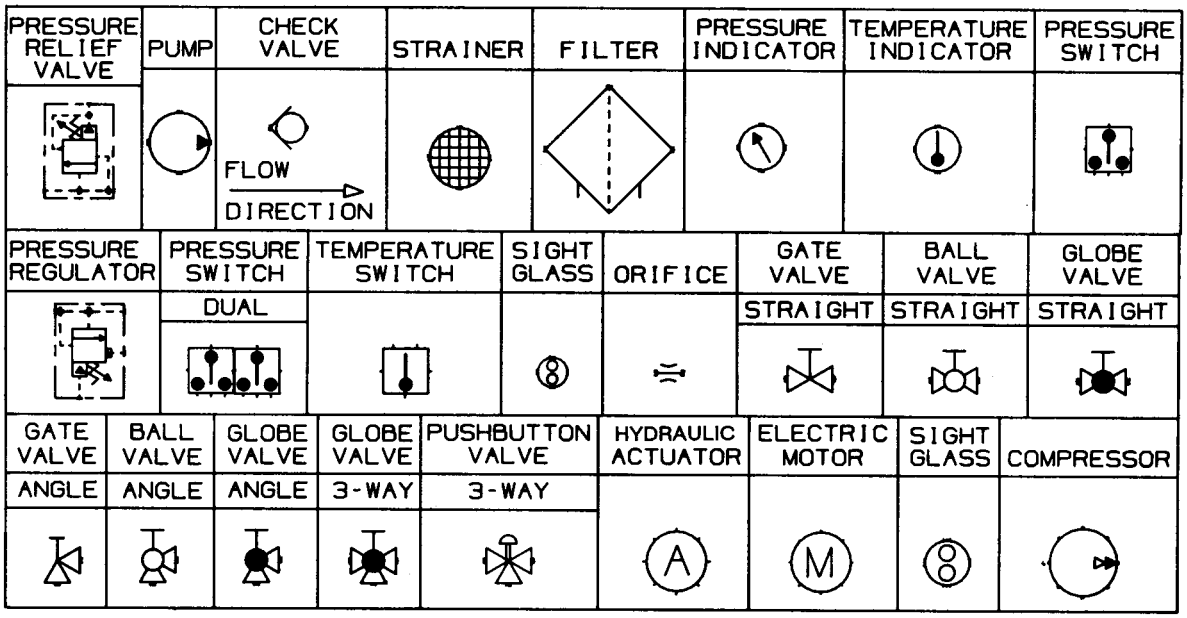


Figure 1-22 Legends For Figures 1-23 Thru 1-26 Gear Driven With Hydraulic Valve Actuator



SYMBOLS	
	GAS TUBING
	GAS PIPING
	OIL TUBING
	OIL PIPING
	CONTROL LINE
	ELECTRICAL LINE
	COOLANT LINE
	CAPILLARY LINE

NO.	PORT DESCRIPTION
X1	LIQUID INJECTION OR SULLISTAGE
X2	OIL SUPPLY TO DISCHARGE BEARINGS
X3	N/A
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X5	OIL INJECTION TO FEMALE ROTOR
X6	OIL RETURN FROM BEARING DRAIN
X7	N/A
X8	CONNECTION TO DISCHARGE PRESSURE
X9	DISCHARGE BEARING OIL DRAIN
X10	OIL TO UNLOAD SIDE OF VALVE ACTUATOR
X11	OIL TO LOAD SIDE OF VALVE ACTUATOR
X12	N/A
X13	OIL SUPPLY TO GEARBOX AND SEAL
X14	GAS FEED TO STATOR
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X16	OIL RETURN TO MALE ROTOR FACE
X17	SHAFT SEAL DRAIN

DOTTED SQUARES INDICATE CUSTOMER SUPPLIED

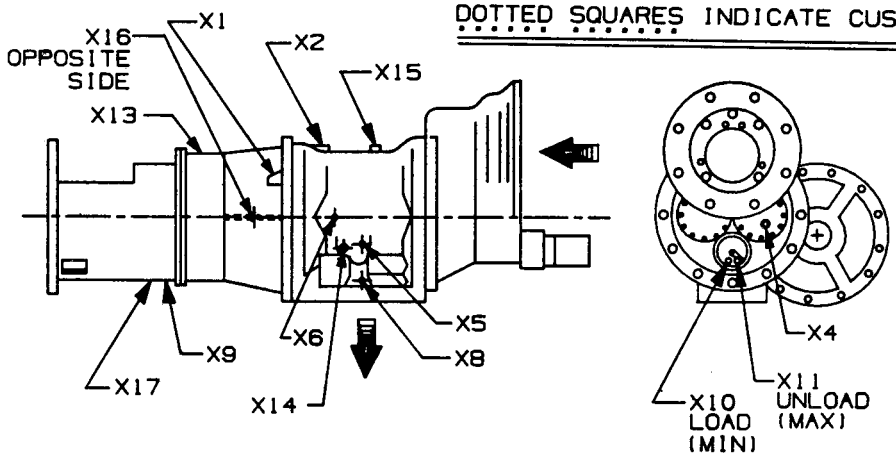


Figure 1-23 Water Cooled High Stage Gear Driven With Hydraulic Valve Actuator

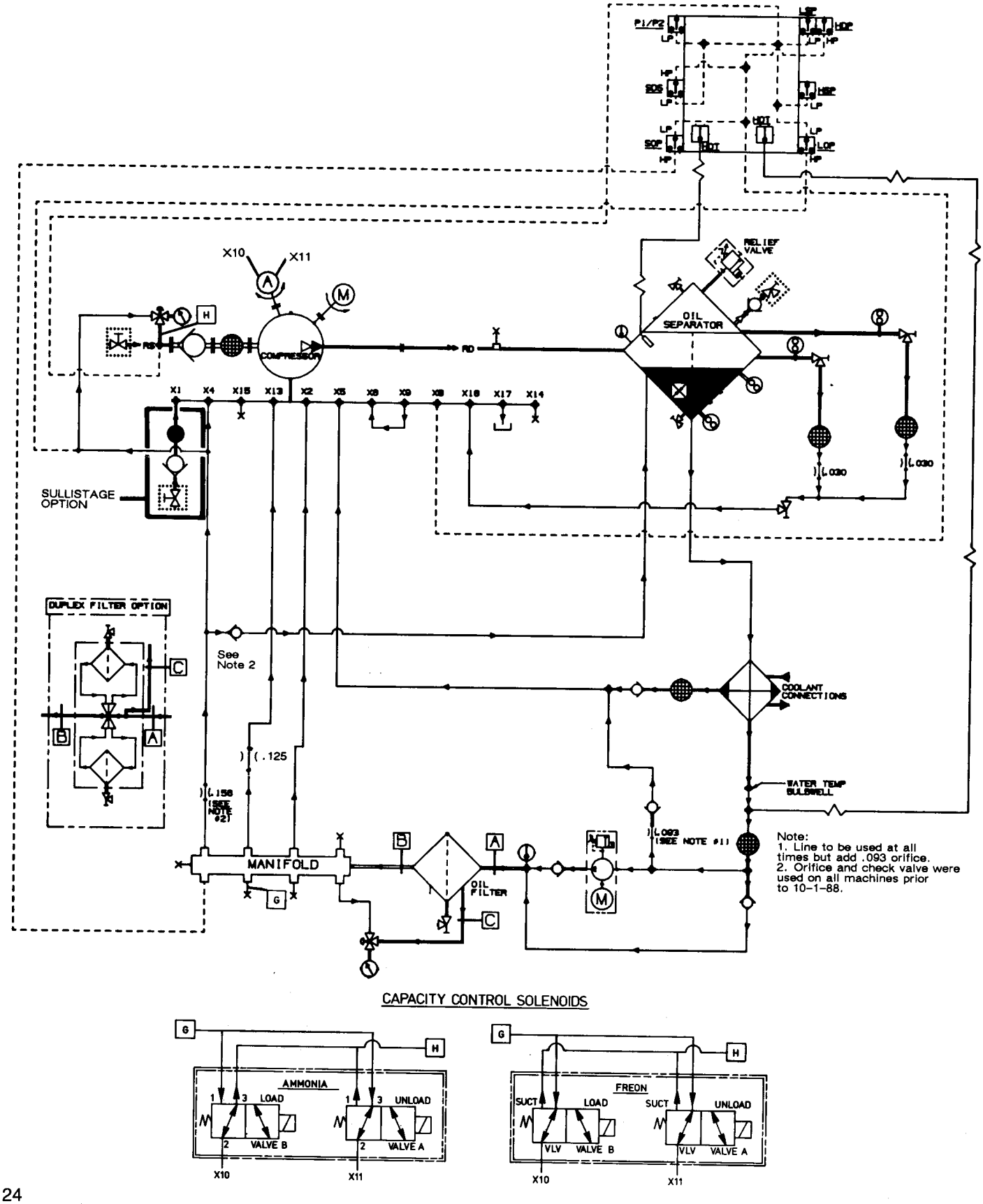


Figure 1-24 Water Cooled Booster Gear Driven With Hydraulic Valve Actuator

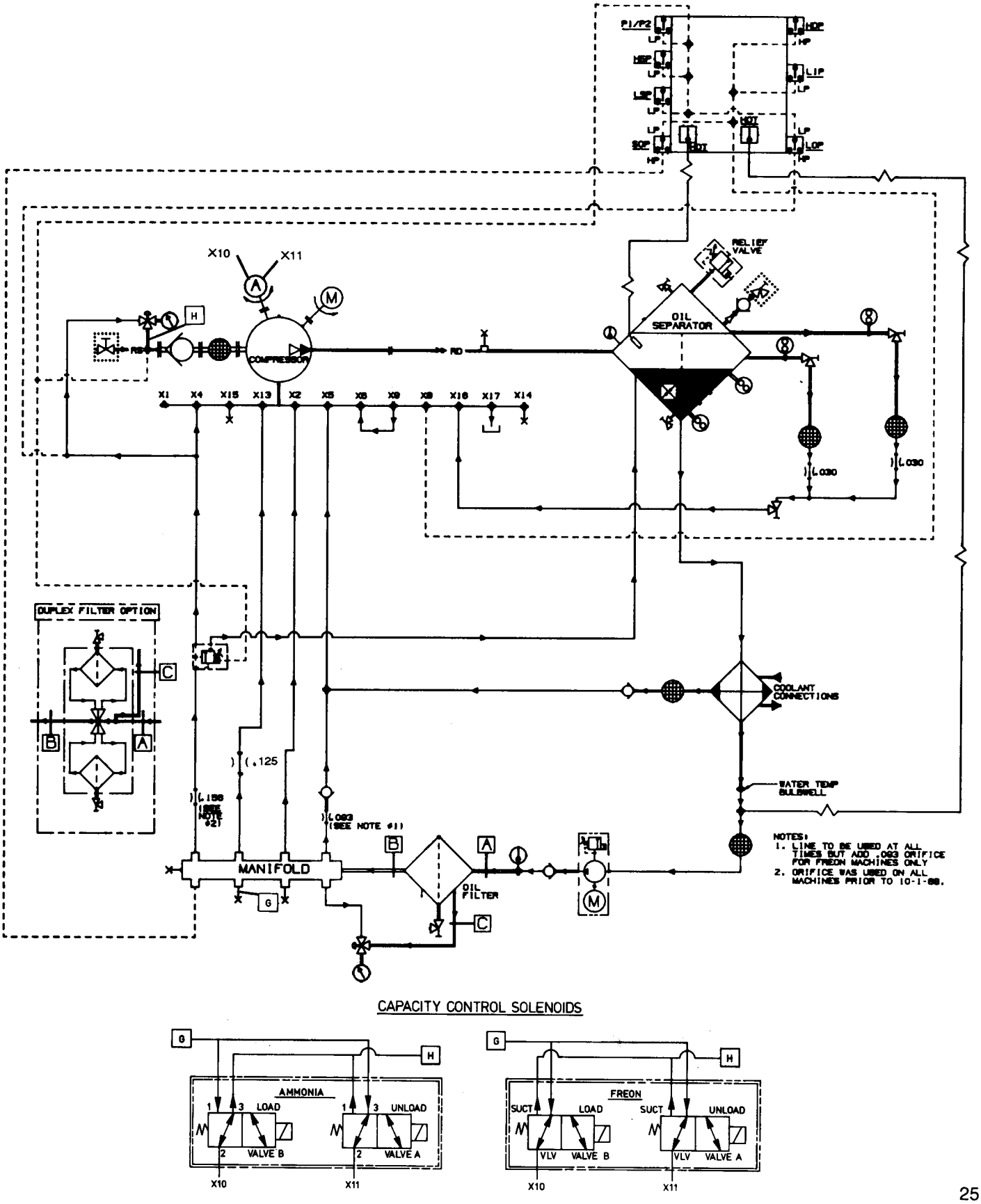


Figure 1-25 Liquid Injection High Stage Gear Driven With Hydraulic Valve Actuator

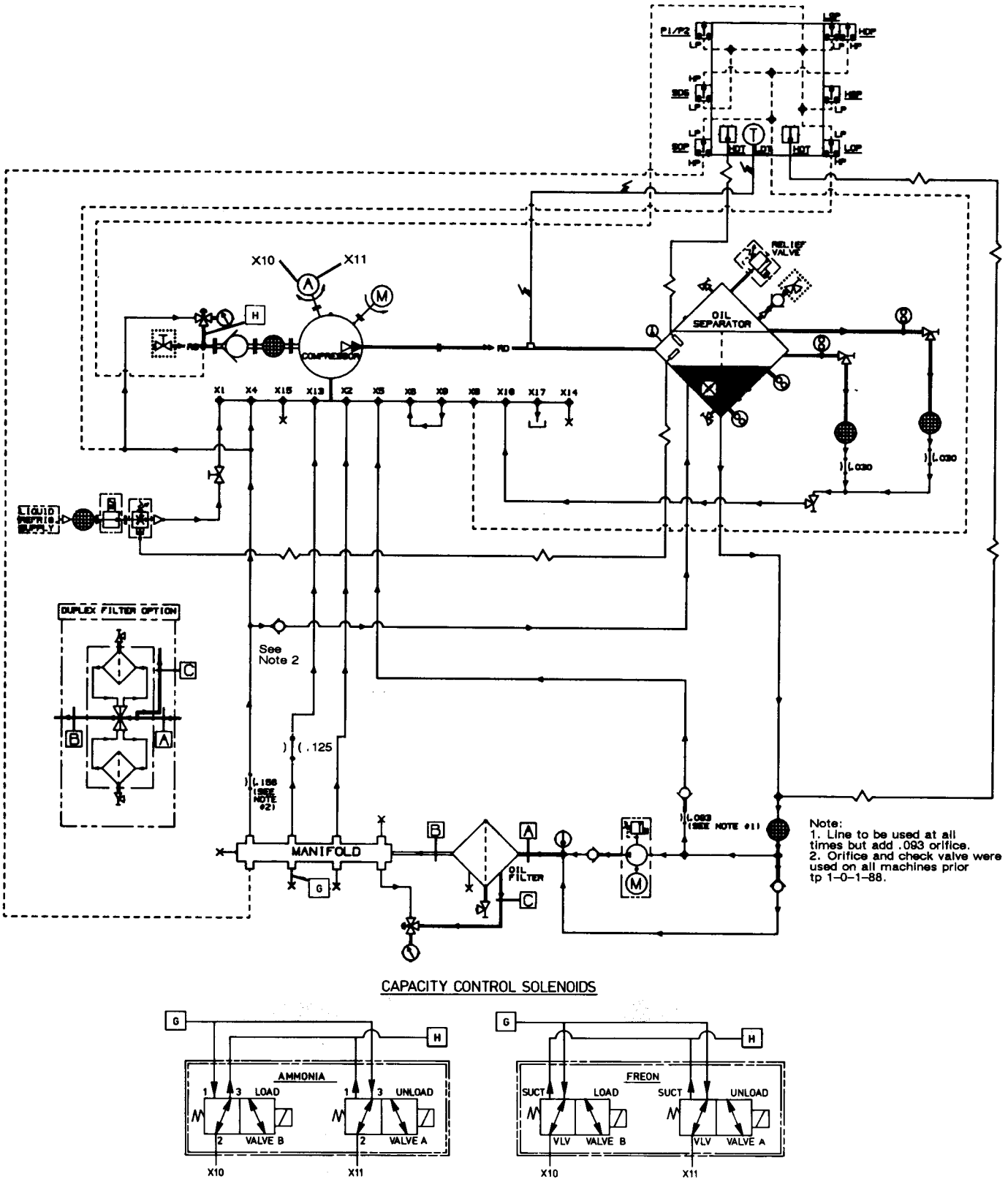


Figure 1-26 Liquid Injection Booster Gear Driven With Hydraulic Valve Actuator

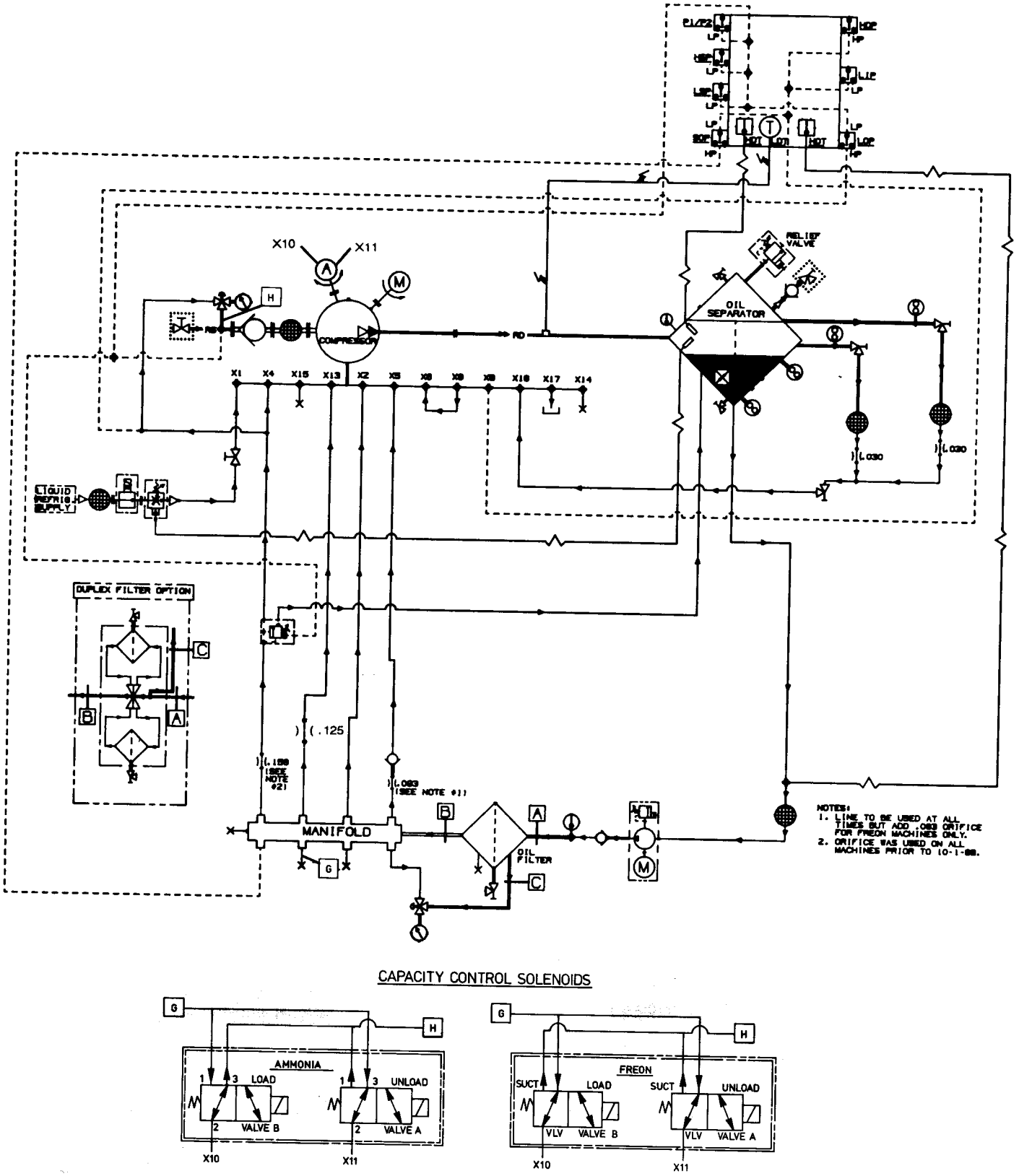


TABLE 1

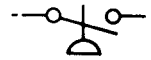
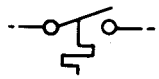
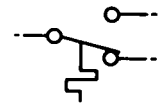
TERMINOLOGY OF PRESSURE AND TEMPERATURE SWITCHES

First Letter: Function (high, low system etc.)
Second Letter: Sensed Point (suction, discharge, oil etc.)
Third Letter: Pressure, Temperature

LSP	Low Suction Pressure Shutdown (manual/reset)
HSP	High Suction Pressure Start/Stop (auto/reset)
HDP	High Discharge Pressure Shutdown (manual/reset)
HDP/LSP	High Discharge Pressure Shutdown or Low Suction Pressure Shutdown (manual/reset)
LOP	Low Oil Pressure Shutdown (manual/reset)
SOP	Start-up Oil Pressure - Enables Compressor Start (auto/reset)
LDT	Low Discharge Temperature (auto/reset)
HOT	High Oil Temperature Shutdown (manual/reset)
HDT	High Discharge Temperature Shutdown (manual/reset)
SDS	System Differential Pressure Switch (auto/reset)
P1/P2	Capacity Control Pressure Switch (auto/reset)

TABLE 2

GRAPHICS OF PRESSURE AND TEMPERATURE SWITCHES

 N.O.*	No Pressure Applied or Pressure Lower Than Set Point. Switch is Reset. (Special Case for HDP/LSP Switch Pressure Higher Than Lo Set Point *and* Lower Than Hi Set Point).
 N.C.**	
 N.O.	Pressure Applied Higher Than Set Point. Switch is Tripped. (Special Case for HDP/LSP Switch Pressure Higher Than Hi Set Point *or* Lower Than Lo Set Point.)
 N.C.	
 N.C.	Temperature Lower Than Set Point. Switch is Reset.
 N.C.	Temperature Higher Than Set Point. Switch is Tripped.
 N.O. N.C.	Some Switches Have A Common With A Double Contact.
 N.O. N.C.	

* N.O. = Normally open contact
** N.C. = Normally closed contact

NOTES FOR FIGURES 1-27 THRU 1-32

1 - Field Wiring Shown in Dotted Lines.
2 - Contacts Shown with Relay De-energized, Equalized Pressures, Normal Temperatures.
3 - *Optional Liquid Injection Cooling.
4. - For ammonia machines, capacity control loads when both valves A and B are on, unloads when both A and B are off, and maintains position when B is on and A is off.
5. - For freon machines, capacity control loads when valve A is on and B is off. Unloads when A is off and B is on, and maintains position when both A and B are off.
6. - Optional Load Limiting. Jumper 40 to 41 if Not Used. Field Wired Unless Machine has Factory Mounted and Wired Starter.
7. - Jumpers 13 to 14 and 14 to 15 are for Field Wiring to Remote Protect Shutdowns Such as High Liquid Level.

1.5 THE ELECTRICAL CONTROL SYSTEM

The package is supplied with a complete electrical control system. All normal running, protective controls and capacity controls are included.

The control system is completely wired, tubed, and mounted to the package in a Nema1 control cabinet. The controls operate on 115V, 1 phase, 60 Hz power supply of 2.5 kVA capacity. See the standard wiring diagram (Figures 1-27 thru 1-32) for additional details and keys to the description below. These diagrams are only typical; see the wiring diagram for your machine for specific details.

All Sullair Refrigeration wiring diagrams are drawn with relays de-energized and with 115V power supplied. The motor overload and the optional ampere relay have to be field wired and this is shown in dashed lines.

The terminology and graphics of the pressure switches and temperature switches are given in Tables 1 and 2.

The labeled wire numbers are shown on the wiring diagrams. The numbers on the far right hand side of the wiring diagrams refer to the line numbers where the contacts function. If the number is underlined, it refers to a normally closed contact.

Figure 1-27 Wiring Diagram A12 High Stage Water Cooled Or Thermosiphon With Electric Valve Actuator
(See Notes 1, 2, 3 & 5 on Page 28)

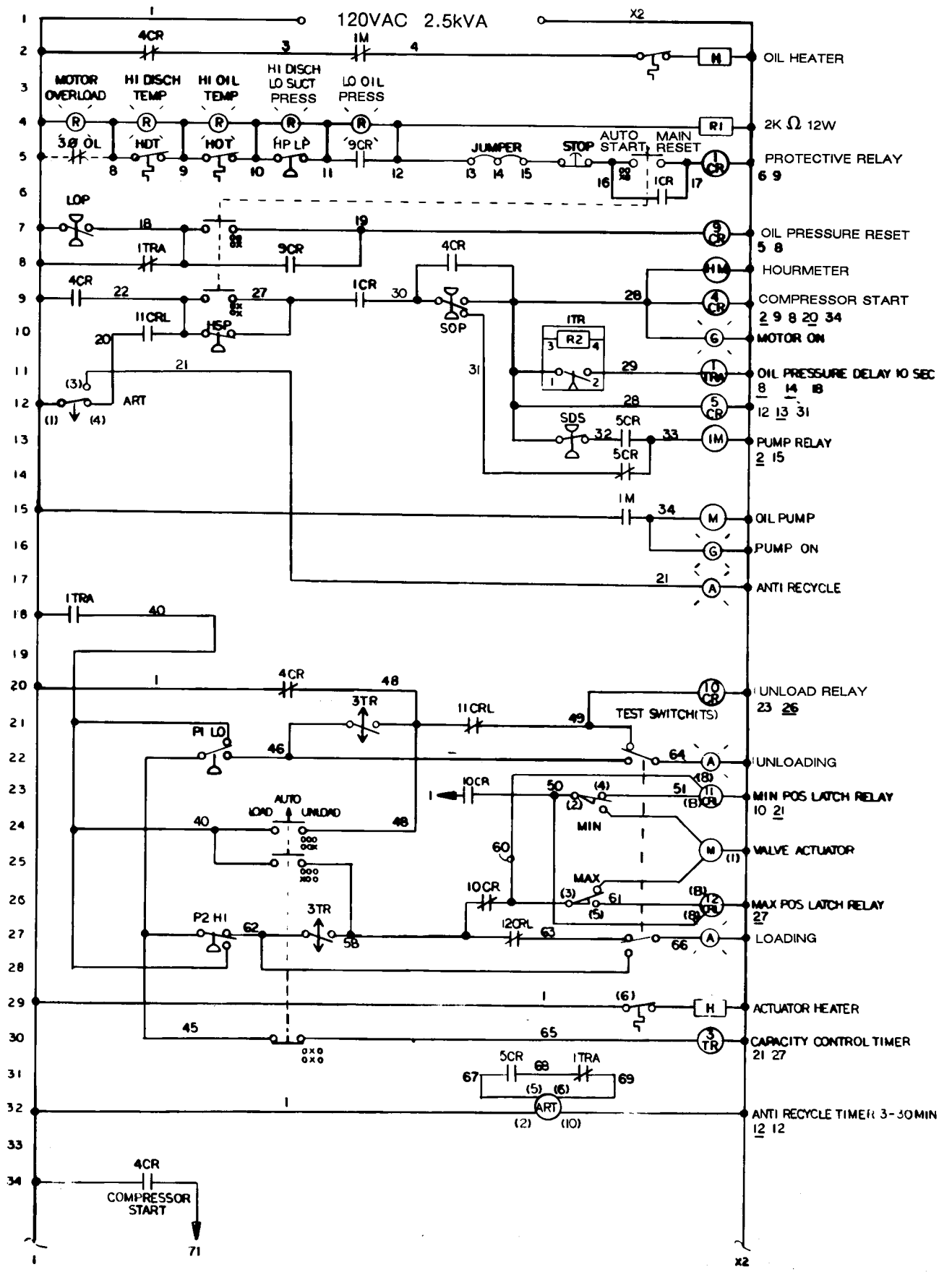


Figure 1-28 Wiring Diagram A12 Booster Water Cooled Or Thermosiphon With Electric Valve Actuator (See Notes 1, 2, 3 & 5 on Page 28)

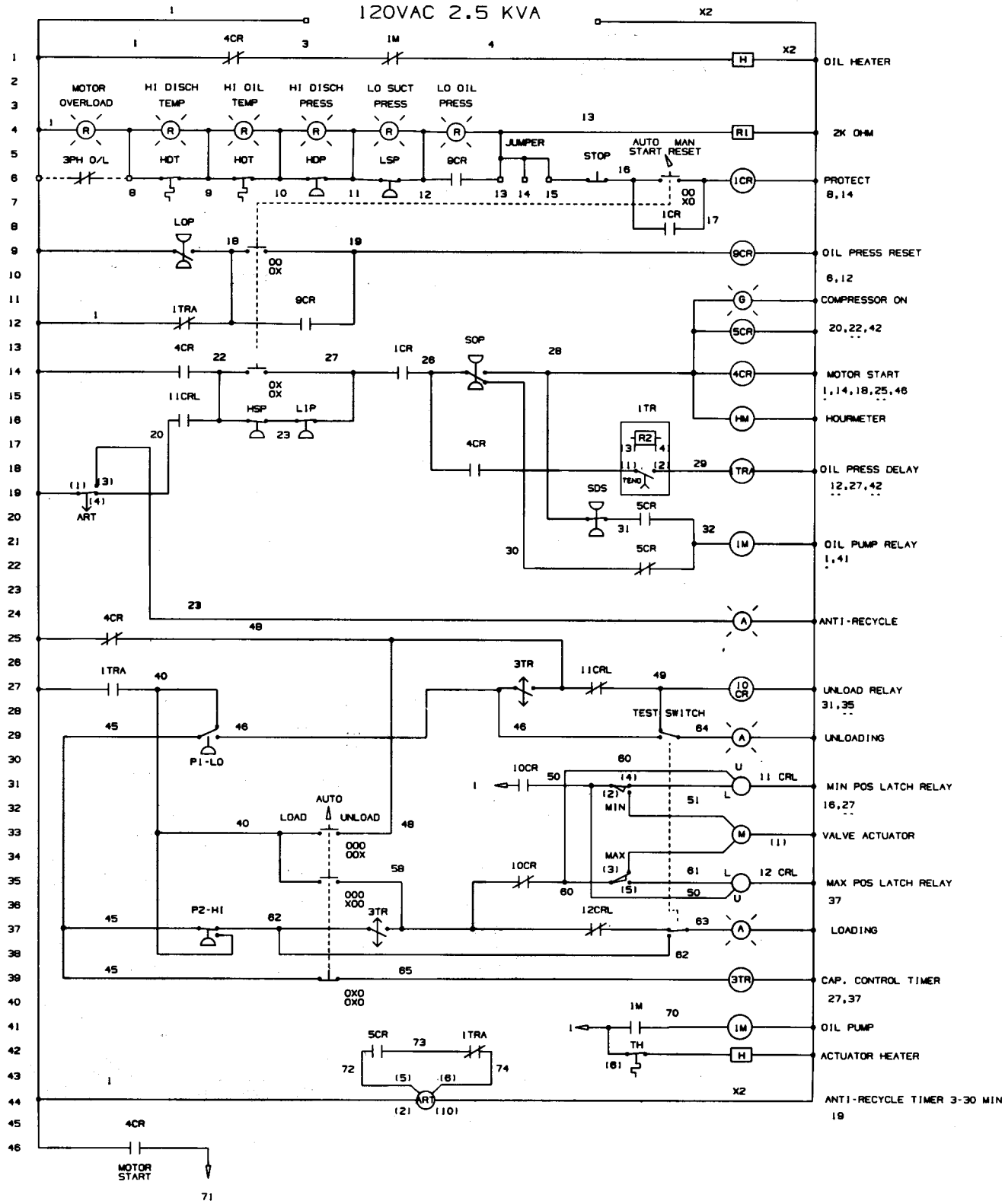


Figure 1-29 Wiring Diagram A12 High Stage Liquid Injection With Electric Valve Actuator
(See Notes 1, 2, 3 & 5 on Page 28)

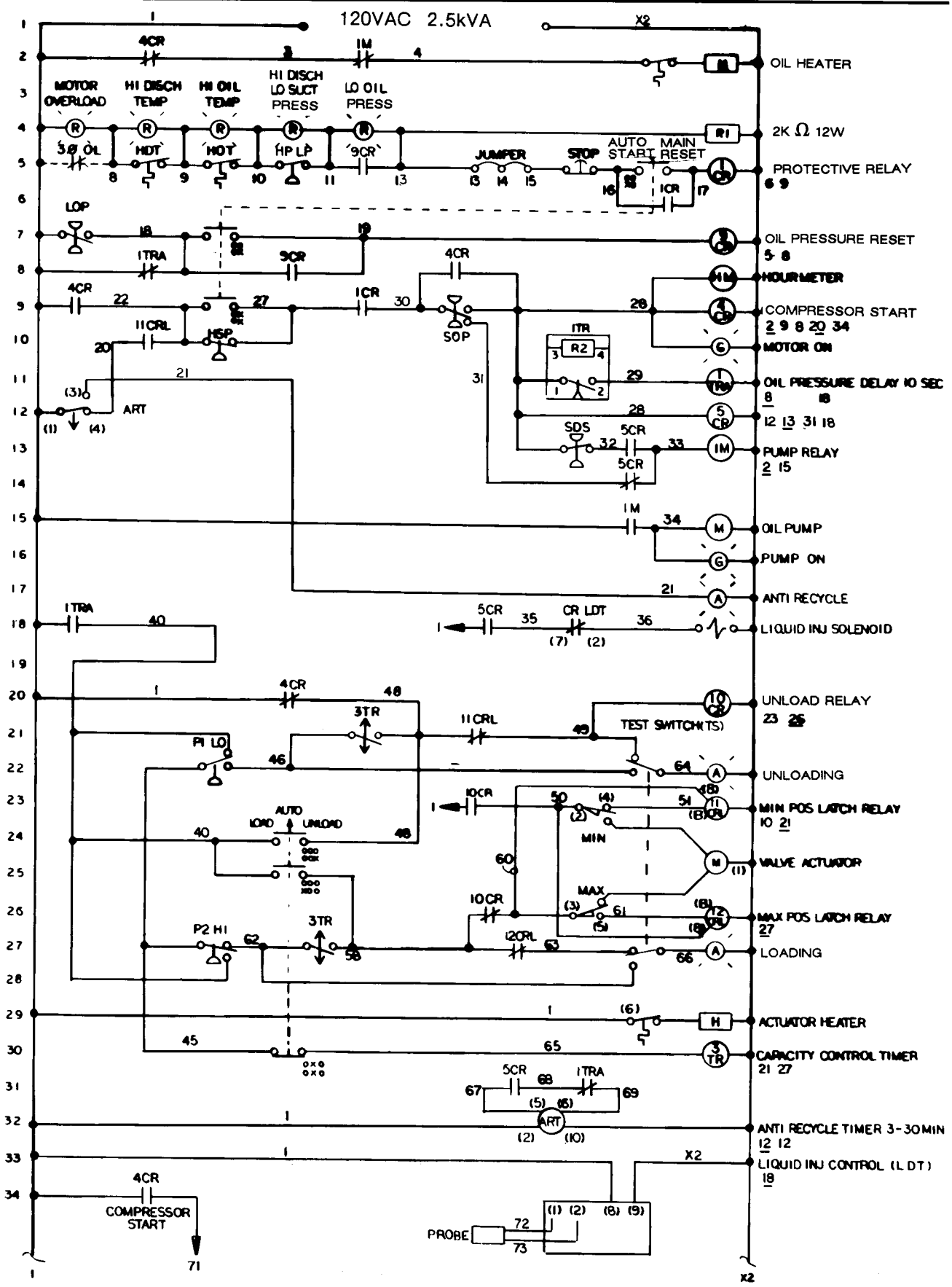


Figure 1-30 Wiring Diagram A12 Booster Liquid Injection With Electric Valve Actuator
(See Notes 1, 2, 3 & 5 on Page 28)

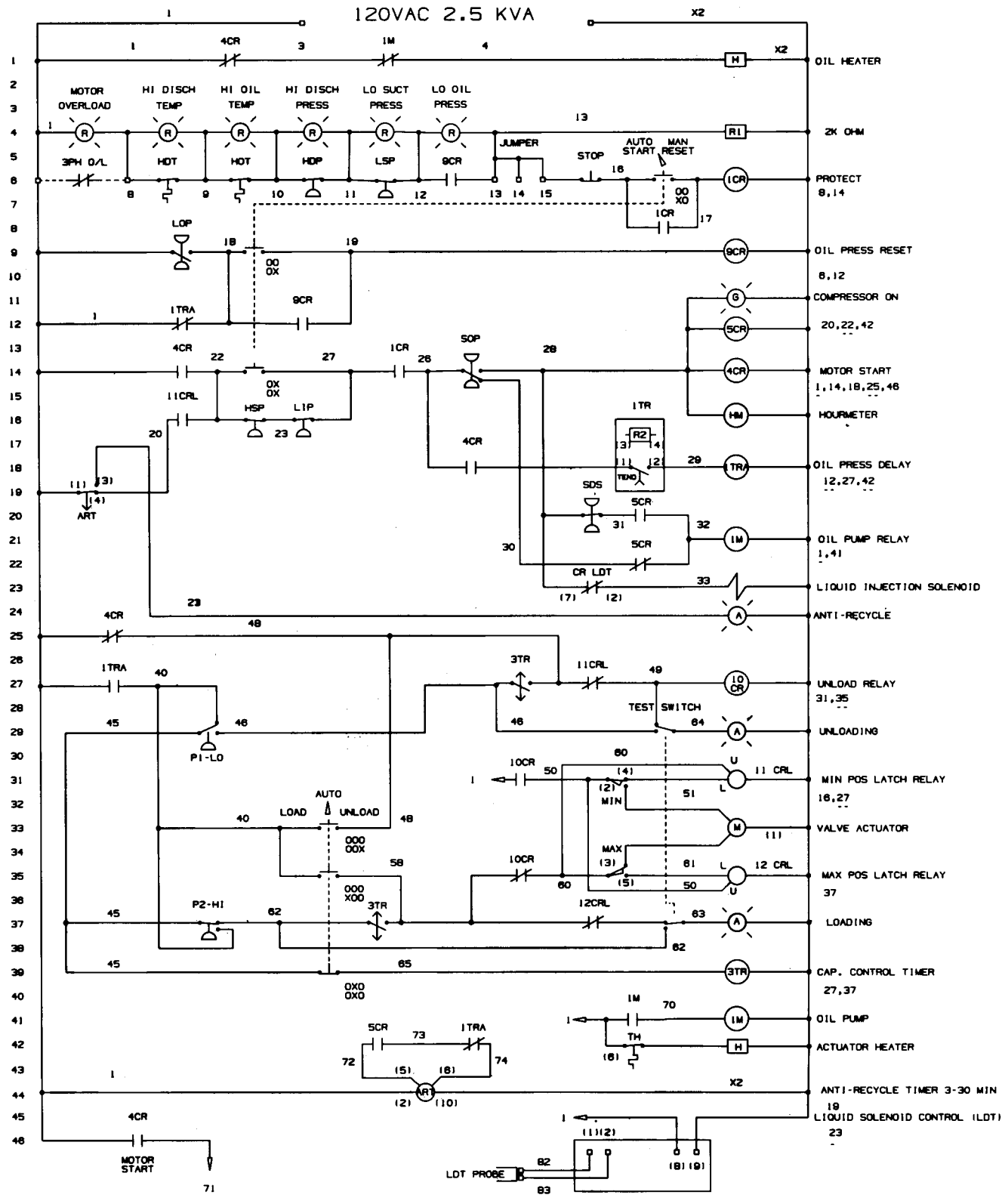
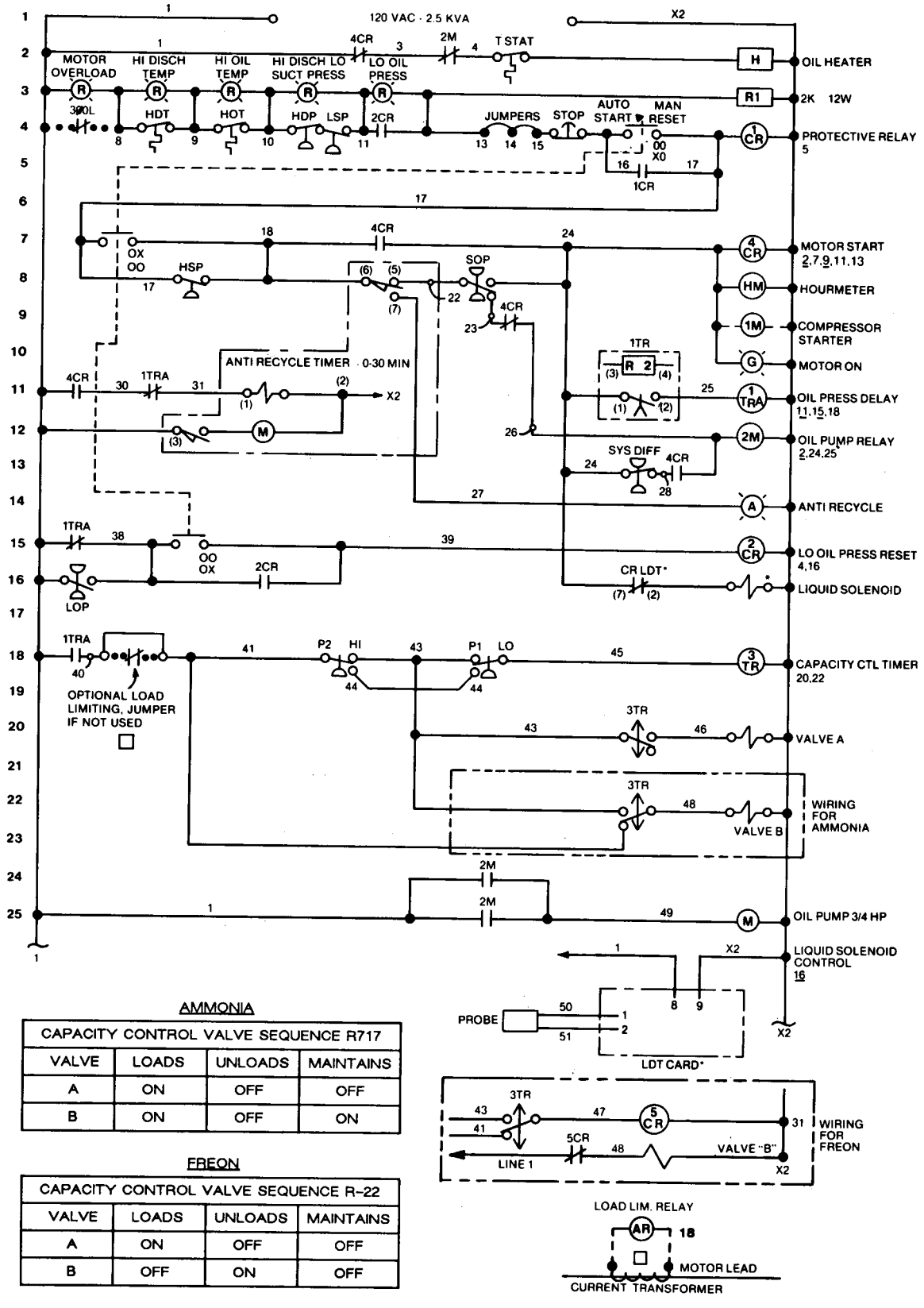


Figure 1-31 Wiring Diagram A12 High Stage With Hydraulic Actuator
(See Notes 1, 2, 3, 4 & 5 on Page 28)



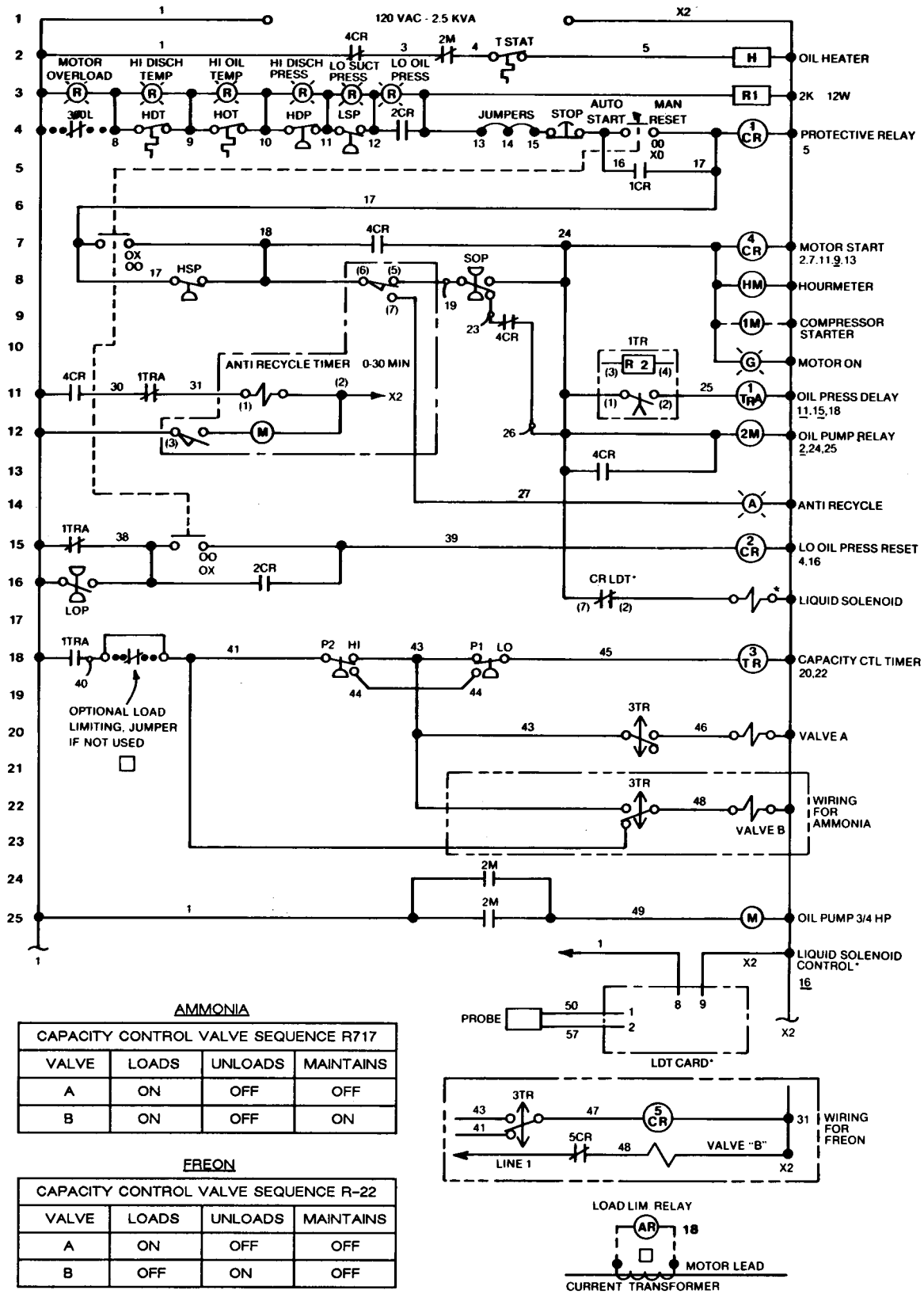
AMMONIA

CAPACITY CONTROL VALVE SEQUENCE R717			
VALVE	LOADS	UNLOADS	MAINTAINS
A	ON	OFF	OFF
B	ON	OFF	ON

FREON

CAPACITY CONTROL VALVE SEQUENCE R-22			
VALVE	LOADS	UNLOADS	MAINTAINS
A	ON	OFF	OFF
B	OFF	ON	OFF

Figure 1-32 Wiring Diagram A12 Boosters With Hydraulic Actuator
(See Notes 1, 2, 3, 4 & 5 on Page 28)



AMMONIA

CAPACITY CONTROL VALVE SEQUENCE R717			
VALVE	LOADS	UNLOADS	MAINTAINS
A	ON	OFF	OFF
B	ON	OFF	ON

FREON

CAPACITY CONTROL VALVE SEQUENCE R-22			
VALVE	LOADS	UNLOADS	MAINTAINS
A	ON	OFF	OFF
B	OFF	ON	OFF

The "auto/start" / "manual/reset" selector switch is a four function switch. In the wiring diagram, the position of the contacts is represented as "O" (open) and as "X" (closed) just below the contacts. The top row represents the contacts with the switch in the left hand and right hand position without the button being depressed. The bottom row represents the contacts with the pushbutton depressed.

As of mid-1987, the panel will also include a load-auto-unload selector switch. With the switch in auto, the compressor will load and unload off of P1/P2. In the load or unload position, the compressor will load or unload only when the pushbutton is pushed and maintain capacity if left in the load or unload position.

RUNNING CONTROLS

START SWITCH

The START pushbutton is a multi-function switch allowing the compressor to operate in manual or automatic starting modes and also serving as a protective switch reset.

To start the compressor manually, the pushbutton is rotated to the "auto/start" position and pushed. The compressor will then start and stop in the automatic mode via the HSP switch. If manual operation is desired after the START button has been pushed, the pushbutton is rotated to the "manual/reset" position. In the "manual" position, the compressor will load and unload as the load/auto/unload switch requires, but start-up and shutdown must be manually initiated.

In automatic, the compressor will automatically start whenever the suction pressure rises above an adjustable high setpoint on the "stop/start" pressure switch (HSP).

The compressor can then load and unload as required and will automatically shutdown whenever the suction pressure falls below the lower adjustable setpoint on the HSP switch. If the suction pressure rises again, above the higher set-point, automatic restart will be initiated. Auto restart will not occur when the compressor shuts down for a protective function, power interruption or if the STOP button is pushed.

After a protective switch shutdown or whenever the control power is interrupted, resetting the control system is accomplished by rotating the START button to the "manual/reset" position and depressing the button. The compressor can then be started again as described above.

STOP BUTTON

The stop button is a red pushbutton which will shutdown the compressor in any mode of operation.

HIGH SUCTION PRESSURE START/STOP SWITCH

The dual setpoint high suction pressure switch (HSP) allows automatic starting and stopping of the compressor at set cut-in and cut-out suction pressures. The HSP is wired such that the protective circuit and the protective relay, 1CR remains energized during HSP cut-out.

LOW DISCHARGE TEMPERATURE SWITCH

On refrigerant liquid injection cooled, machines only, the low discharge temperature switch (LDT) prevents over feed of refrigerant to the oil cooling system. If the discharge temperature drops below the setpoint on the low discharge temperature switch, the main liquid line solenoid valve closes and stops the refrigerant flow to the compressor.

PROTECTIVE CONTROLS

LOW OIL PRESSURE SWITCH

The low oil pressure switch (LOP) functions consists of a pressure switch and a 10 second delay timer (1TR). During start-up, the low oil pressure switch is bypassed for ten seconds to allow the machine to build-up sufficient oil pressure to close the low oil pressure protective switch controls. The oil pressure relay (2CR) is energized during normal operation. If the oil pressure falls below the set limit, after the 10 second override by 1TR, the LOP shuts down the compressor immediately and lights up the red indicating light. The LOP is reset by resetting the protective circuit with the manual RESET pushbutton.

A power failure will also result in a low oil pressure indication which must be reset when power is restored.

This switch senses the oil pressure above suction pressure and must be field set to set points listed in Section 2.1.

HIGH DISCHARGE TEMPERATURE, HIGH OIL TEMPERATURE, HIGH DISCHARGE PRESSURE AND LOW SUCTION PRESSURE

These protective devices are connected in series with the protective relay, 1CR. If the setpoint is exceeded on any switch, the compressor will immediately shut down and light up the red pilot light indicating the malfunction. Each must be manually reset on the respective switch after the protect conditions has been cleared and then the protective circuit must be manually reset as described under Start Switch description. Refer to Section 3.13 for adjustment.

MOTOR THERMAL OVERLOAD

A normally closed overload contact from the starter may be wired in series with the 1CR protective relay to shut down the compressor in a motor overload situation, if this protect function is incorporated into the circuit per the appropriate wiring diagram. If the contacts are opened, the protective circuit must be manually reset and described under Start Switch description.

ANTI-RECYCLE TIMER

The adjustable 0 to 30 minute timer prevents the motor from overheating by limiting the number of motor starts in a given period. It is energized every time the compressor starts and the compressor cannot be restarted until it has timed out. If the START switch or HSP calls for a restart before the timer has timed out, the circuit will be in a standby condition and the compressor will automatically start when the set time has elapsed. An amber indicator light shows whenever the ART is timing.

The absence of control power will not allow the timer to time out. Control power must be restored to allow the timer to operate. If the machine has been off for a period of time exceeding the time set on the timer, the timer may be reset to zero to allow immediate start-up but it should be returned to the previous setting immediately.

After July 1987, the Eagle Signal timer was replaced by a Magnecraft plug-in timer. This timer has a range of 2 to 30 min. and will automatically reset on power failure. All other functions perform as above

REMAINING CONTROLS AND OPTIONAL CONTROLS

OIL HEATER

The oil heater and thermostat are connected through contacts of the starting relays (4CR and 2M) such that the oil heater circuit will be energized whenever the compressor and oil pump are shutdown and the control power is on. The heater is controlled by an intergral thermostat. This heater prevents refrigerant from condensing in the oil and raises oil temperature for start-up. For operations outdoors or in unheated engine rooms, additional heat and/or insulation may be required.

PILOT LIGHTS

Pilot indicating lights are provided for the following:

1. Motor run (green)
2. Anti-recycle (amber)
3. Motor overload (red)
4. High discharge temperature (red)
5. High oil temperature (red)
6. High discharge pressure/low suction pressure (red) (two separate lights on booster)
7. Low oil pressure (red)

Starting in mid-1987, the control panel will normally also include:

8. Pump On (green)
9. Load (amber)
10. Unload (amber)

Protective device pilot lights are connected in parallel with each device and in series with resistor R1. An open contact causes a voltage difference across the pilot light which causes the light to come on.

HOURMETER

An hourmeter is supplied to record machine running time. Since the hourmeter is connected across relay 4CR the recorded time advances only when the motor is running.

OPTIONAL LOAD LIMIT RELAY

An optional load limit relay is available which will unload the compressor should the motor draw more than the current setpoint on the load limit relay. The load limit relay and current transformer are to be mounted in the motor starter.

OPTIONAL AMMETER AND/OR AMMETER RELAY

An optional ammeter and/or ammeter relay is available to be mounted in the starter or control panel. The ammeter indicates motor current in one phase of the motor power supply, and the ammeter relay performs the same function as the load limit relay.

MULTIPLE MACHINE SEQUENCING

Multiple machine sequencing is accomplished by sequential settings of the HSP switch, a separate programmable controller or a separate electro-mechanical sequence panel.

AREA CLASSIFICATION

Optional electrical equipment is available for water tight NEMA 4 and hazardous locations NEMA 7 (Class 1, Group D, Division 1 or 2) area classifications.

1.6 THE CAPACITY CONTROL SYSTEM

Before a compressor can be started, the capacity control valve must be at minimum position for maximum bypassing of gas to suction. Whenever the compressor is shut down for any reason other than power failure, the capacity control valve automatically returns to the minimum position.

The capacity control system is connected through a timer (1TR) such that the machine cannot load during the initial 10 seconds of running. Once the initial time delay is complete after the initial start, the compressor may load or increase capacity on demand.

The compressor capacity is normally controlled automatically from the suction pressure by a dual setpoint adjustable pressure switch (P1/P2). At the desired suction pressure which is midway between the two switch settings (or in the dead band) no control action occurs and the compressor remains in a constant capacity position. This adjustable dead band is approximately 2 PSI (15kPa).

Above the high suction pressure setpoint, P2, the compressor loads. Below the low suction pressure setpoint, P1, the compressor unloads. Refer to Section 4.6 for adjustment of these two pressure settings.

For ammonia machines with hydraulic valve actuators, the controls operate so that the machine will increase capacity or load when both solenoids A and B are on. When both solenoids are off, the machine will decrease capacity or unload. In the condition of stable load i.e., the machine neither loads nor unloads solenoid B is on, solenoid A is off.

For freon machines with hydraulic valve actuators, the controls operate so that the machine will increase capacity or load when solenoid A is on and B is off. When solenoid A is off and B is on, the machine will decrease capacity or unload. When both solenoids are off, the machine will neither load nor unload.

On machines with an electric valve actuator, this P1/P2 switch operates an AC motor to turn the capacity control valve.

An automatic interrupter (3TR) slows down the valve action so that the speed of response can be set to match individual system characteristics.

This dual adjustment timer, 3TR, controls the "on" and "off" time of the capacity control actuator when there is either a load or unload signal. The actuator moves in a step wise fashion such that the "on" time adjustment varies the length or percent capacity of each step and the "off" time adjustment varies the number of steps in a given amount of time. Refer to Section 4.6 for adjustment of this timer.

An indicator/lever is provided which can be used to vary the capacity control position manually.

Other types of remote pressure or temperature controllers may be adapted to the capacity control system provided the same contact function as described above for P1/P2 is maintained.

Section 2
SPECIFICATIONS

2.1 OPERATING LIMITS AND SWITCH SETTINGS

** Anti-Recycle Timer - Minimum (ART) ..... 15 minutes

* Oil Pressure Delay Timer (ITR) ..... 10 seconds

OIL PRESSURE - HIGH STAGE COMPRESSORS

Normal ..... 10-20 PSI Below discharge pressure.

** Minimum (LOP) ..... 60 PSI (415kPa) over suction. For discharge pressures above 250 PSIG (1.75mPa) set at 70 PSI (480kPa) over suction.

OIL PRESSURE - BOOSTER COMPRESSORS

Normal ..... 25 PSI (175kPa) to 30 PSI (210kPa) over suction pressure.

Minimum (LOP) ..... 15 PSI (105kPa) over suction pressure

Oil Pressure Drop Across Filter - Maximum ..... 30 PSI (210kPa)

OIL TEMPERATURE

Normal, Water cooled or thermosiphon ..... 105°F (40°C) to 115°F (46°C)

Normal, Liquid Injection Cooled ..... Same or slightly less than discharge temperature

Absolute Minimum Before Starting ..... 68°F (20°C) or 10°F (5.5°C) above saturation temperature of package pressure whichever is higher

Ideal Minimum Before Starting ..... 80°F (27°C) to 100°F (38°C)

** Maximum (HOT) ..... 130°F (54°C)

Oil Heater Thermostat (TH) ..... 105°F (40°C) or 10°F (6°C) above condensing temperature which ever is higher. Standard heater is non-adjustable

DISCHARGE PRESSURE

Liquid Injection Cooled - Minimum (High Stage Only) ..... 100 PSIG (690kPa)

Water cooled - Maximum Operating ..... 255 PSIG (1.8 mPa)

Liquid Injection Cooled - Maximum Operating ..... 210 PSIG (1.5 mPam)

** Maximum (HDP) ..... 10% below system relief valve

DISCHARGE TEMPERATURE

** Low, Liquid Injection Cooled (LDT) ..... 105°F (40°C) or 10°F (5.5°C) above condensing temperature whichever is higher

**Water-cooled (HDT) - Maximum ..... 195°F (90°C)

Liquid Injection Cooled
(HDT) - Maximum ..... 150°F (60°C)
- Normal ..... 118°F (48°C) to 122°F (50°C) or 10°F (5°C) above saturated temperature at discharge pressure whichever is higher

SUCTION PRESSURE

P1 Unload, Below Desired Suction Pressure ..... 1 PSI (7kPa) to 2 PSI (14kPa)

P2 Load, Above Desired Suction Pressure ..... 1 PSI (7kPa) to 2 PSI (14kPa)

Low (compressor stop or cut-out), Below P1 Pressure (HSP) (minimum) ..... 5 PSI (35kPa)

High (compressor start or cut-in), Above P2 Pressure (HSP) (minimum) ..... 2 PSI (14kPa)

** Below Low Suction Pressure (LSP) - Minimum ..... 2 PSI (14kPa)

Maximum ..... See Table 5

SUCTION TEMPERATURE

Maximum Superheat, Ammonia R12 or R22 ..... 20°F (11°C)

Suction/Discharge Differential Pressure Maximum ..... 275 PSI (1.9 mPa)

Minimum ..... 100 PSI (700kPa) without oil pump

WATER TEMPERATURE, MAXIMUM INLET DESIGN ..... 85°F (30°C)

AMBIENT MACHINE ROOM TEMPERATURE

*** Minimum ..... 50°F (10°C)

**** Maximum ..... 104°F (40°C)

* This is factory preset and sealed to the above setting. Tampering with this device constitutes abuse of the compressor under the terms of the warranty.

** Set all protective devices and control switches to the above values. When using synthetic oils, consult the Sullair Refrigeration Service Department.

*** If the machine is to be operated in an unheated machine room of 50°F (10°C) or lower, special modifications may be required (consult Sullair Refrigeration Service Department).

**** If the machine is to be operated in a machine room of 104°F (40°C) or higher, a motor having a higher class of insulation than Class B (standard) may be required (consult Sullair Refrigeration Service Department).

For halocarbon or hydrocarbon systems or other special systems, special operating points may be required. Consult Sullair Refrigeration Service Department.

TABLE 3

MAXIMUM INLET OPERATIVE PRESSURES

MAXIMUM INLET OPERATING PRESSURE								
Volume Ratio	2.2		2.6		3.5		5.0	
	PSIG	kPa	PSIG	kPa	PSIG	kPa	PSIG	kPa
Ammonia	-	-	100	690	65	450	40	275
R-22	120	830	110	750	75	520	47	325

2.2 OIL SPECIFICATIONS

The oil specified for use in Sullair Ammonia Refrigeration screw compressors is a refrigeration oil with a low pour point having a kinematic viscosity of 300 Saybolt Universal Seconds (SSU) at 100°F which is equivalent to 68 centistokes (cSt) at 40°C. The oil shall not contain anti-wear additives. Sullair Refrigeration Service Department maintains a list of approved oils. For halo-carbon or hydrocarbon applications the oil will become diluted with the refrigerant. Therefore, oil selection must be verified with Sullair Refrigeration Service Department.

⚠CAUTION

Used or filtered oil should never be added to a refrigeration screw compressor under any circumstances. Use only new oil from an oil manufacturer (any of the major oil companies or their approved dealers).

The oil must be changed every three months or 2000 hours unless the oil quality is assured by a qualified oil laboratory, or a synthetic oil is used with an approved extended life. See Section 5.4 for further details of oil analysis.

Should you have other types of compressors in your system, it is recommended that you investigate changing their oil grade to that of the screw compressor. The screw compressor oil is usually satisfactory in other types of compressors, but the compressor manufacturer must be consulted for approval. This will minimize any possibility of incorrect grade being added to the compressor.

Sullair Refrigeration assumes no responsibility for the quality, performance, availability, viscosity or pour point of the recommended oil products.

3.1 GENERAL

This Section contains instructions for the proper installation of Sullair A Series Refrigeration Screw compressors. All items in this section must be completed by those with installation responsibility before the Sullair Refrigeration representative arrives for start-up. For answers to any specific questions about installation procedures, please contact Sullair Refrigeration Service Department.

3.2 START-UP SERVICE OUTLINE

The following items are tasks that must be completed before the Sullair Refrigeration representative arrives at the job site.

1. The compressor is to be leveled, securely anchored to the foundation.
2. All refrigeration piping is to be completed. Relief valves are to be properly vented.
3. All piping is to be supported so that it does not exert loads on the compressor or separator.
4. The water piping is to be completed with the water valve installed for water cooled machines.
5. The refrigerant piping is to be completed for the refrigerant-cooled liquid injection machines.
6. The system and the compressor package are to be pressure tested for leaks.
7. The system is to be evacuated to remove air and moisture.
8. The coupling does not require alignment since it is flange mounted to the motor.
9. The electrical wiring is to be completed as per wiring diagrams. DO NOT energize the compressor control panel until oil is added or the oil heater is disconnected.
10. The compressor is to be filled with the correct type (Section 2.2) and amount of lubricating oil (see Section 3.11).
11. The oil is to be warmed up per Section 2.1.
12. The control panel is to be energized to check the protective switches.
13. The direction of rotation of the motor and pump are to be checked (see Section 3.14).

The Sullair Refrigeration representative will supervise the following with customer supplied labor:

1. Check the general installation.
2. Check all electrical protective controls.
3. Start the compressor for the first time and adjust all the package valves and controls.
4. Set capacity control actuator adjustment.
5. Explain compressor operation to the operating personnel.

3.3 STORAGE

The compressor package should be stored at all times in a dry location to prevent corrosion damage. The suction and discharge lines are covered for shipment and short term storage. If the unit is to be stored for a prolonged period of time, the unit should be checked occasionally and a holding charge of dry nitrogen must be installed to 4 or 5 PSI (28kPa or 35kPa) above atmospheric pressure. This will prevent corrosion from any moisture that might enter the compressor package.

3.4 FOUNDATION AND RIGGING

The compressor package can be mounted and secured to any hard rigid and level surface which is adequate to support the weight of the package. Since the screw compressor is a relatively vibration free rotary machine, it does not have to be mounted on an inertia block or pad.

Check the foundation anchor bolt spacings with the hole spacings in the package base.

Lift the package by placing slings under each end of the complete assembly. Use spreader bars or timber under the slings to prevent damage to the piping and components. DO NOT sling from the pipework, the suction strainer or the eyebolt holes in the motor. Eyebolts have been provided for lifting component pieces only and not the entire package, DO NOT fork lift the package without taking precautions against tipping as the package is top heavy.

If the mounting surface is not level, use shims under the feet to level in both directions to distribute the weight evenly over the entire feet. Any gross distortion of the feet when the anchor bolts are tightened will cause stresses to the compressor separator and the piping.

In locations with excessive floor vibration, it may be necessary to mount the package on an inertia block or pad and isolate the package and pad from the floor.

Vibration isolation equipment can be effectively used only if flexible connectors are used in the piping and electrical conduit.

3.5 REFRIGERANT PIPING

All piping must conform to federal, state and local codes and good industrial practice (e.g. ANSI 31.5 and ASHRAE Systems Handbook).

The size and location of the package piping connections can be found on the general dimensions drawing of the package. Back-up weld rings should be used in all joints in the suction and discharge lines to minimize the amount of weld slag inside the system pipes. All steel lines (especially suction, Sullistage, and liquid injection lines) should be thoroughly cleaned, for example by power rotary wire brushing and blowing out with compressed air.

DO NOT ground through the compressor when arc welding.

The suction line and discharge line should be installed and supported such that there is no load exerted on the compressor frame.

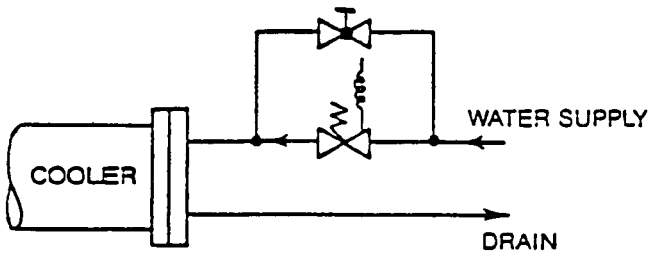
3.6 COOLING WATER SUPPLY REQUIREMENTS

⚠CAUTION

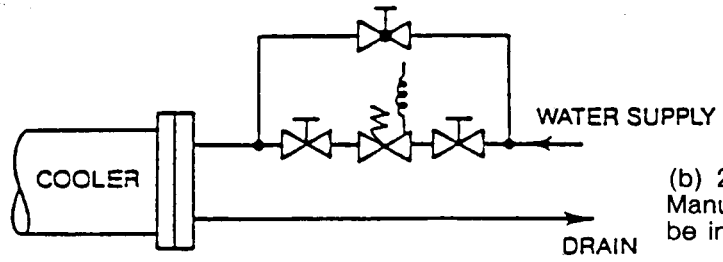
A water supply temperature of 85°F (30°C) or lower is required unless special design considerations have been made. The Sullair Selection Guide gives the procedure for calculating the required water flow rate. To design the water piping and select the pump, allow a minimum pressure drop through the oil cooler and the two way valve of 20 PSI (140kPa) unless checked by Sullair Refrigeration.

The oil cooler will require water supply and drain lines with a control valve that will regulate the water flow to maintain the oil temperature. Figure 3-1 shows typical piping arrangements for two-way and three-way water valves for the oil cooler systems.

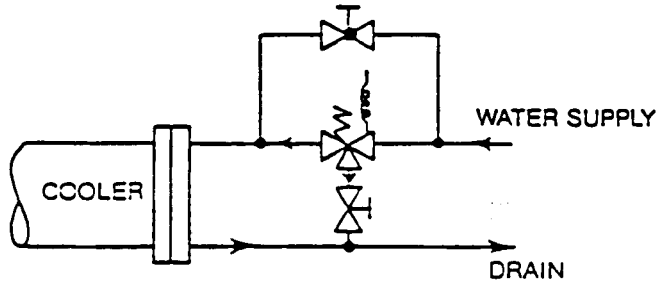
Figure 3-1 Recommended Water Piping Schematics for the Oil Cooler System



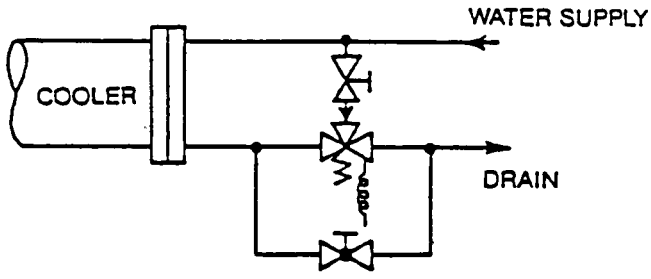
(a) 2-way Valve With Manual bypass Valve



(b) 2-Way Valve With Maintenance Stop Valves And Manual Bypass Valve (Maintenance Stop Valves may also be included in Figures 3-1(c), 3-1(d).



(c) 3-Way Diverting Valve With Balancing Valve And Manual Bypass Valve.



(d) 3-Way Mixing Valve With Balancing Valve And Manual Bypass Valve.

⚠CAUTION

To properly vent the cooler and prevent air buildup in the cooler, the water inlet should be piped into the lowest connection in the cooler head.

The two-way water regulating valve supplied with the machine should be installed on the inlet side of the cooler with the temperature sensing bulb inserted into the bulbwell in the oil line leaving the oil cooler. Three-way regulating valves must be installed per valve manufacturer's recommendations.

⚠CAUTION

The bulb should be coated with aluminum paste or heat transfer grease before inserting it into the bulbwell to improve heat transfer between the bulb and the bulbwell.

Manual bypass valves are recommended to allow for water supply to the cooler in case the water regulating valve becomes inoperative. A water solenoid valve is also recommended to stop the water flow upon shutdown.

Optional three-way water regulating valves are available. If a three-way valve is used, a manual pressure balancing valve is recommended in addition to a manual bypass valve and a water solenoid valve.

The water supply to the cooler should be treated to minimize fouling of the oil cooler due to scale, corrosion, algae growth, dirt, etc. Additives, filtering and bleed-off should be used where necessary. If the water supply will not be reasonably treated, special consideration must be given to the oil cooler design (contact Sullair Refrigeration) and the water piping should be designed to maintain a high water velocity of approximately 10ft./sec. (3 m/s) to minimize fouling.

The alternative sources of cooling water for water cooled machines are outlined below:

OPEN CIRCUIT RECIRCULATED EVAPORATIVE CONDENSER PAN WATER

The most common source of cooling water for the oil cooler is from the evaporative condenser pan or a cooling tower pan. In most applications, the condenser size is the same as a comparable sized reciprocating compressor. Contact Sullair Refrigeration or your condenser (or cooling tower) supplier for specific recommendations on loads and sizing.

This source of cooling water has the advantages of the lowest operating cost and simplicity.

The disadvantages of this method are that the cooling water is contaminated with dissolved or suspended air-born particles and pollution which causes excessive scale and fouls the oil cooler tubes and the potential for winter freeze up is great in the colder climates.

CLOSED CIRCUIT RECIRCULATED EVAPORATIVE COOLING

By using a circuit of the evaporative condenser and circulating a captive charge of coolant to the oil cooler, scale build up and fouling of the tubes is minimized and the winter freeze hazard can be eliminated.

The disadvantage of this method is the expense of the evaporative cooler and the possibility of an oversized oil cooler.

ONCE THROUGH WELL OR CITY WATER

If a low cost source of water is available, it is possible to cool the oil and return the warm water to a drain. Special consideration must be given to the oil cooler design if the water will not be treated and cleaned.

3.7 COOLING REFRIGERANT SUPPLY REQUIREMENTS

Figure 3-2 is a schematic of direct liquid injection oil cooling and the components and connection supplied with the Sullair package. For refrigerant cooling of Sullair Refrigeration compressors by direct liquid injection, a reliable source of high pressure liquid must be supplied to the compressor by the owner. The system must be such that the cooling liquid supply is always available to the compressor whether or not liquid is present in the high pressure receiver. A minimum of a five minute supply of liquid should be available to the compressor cooling system after the high pressure receiver is empty for any reason.

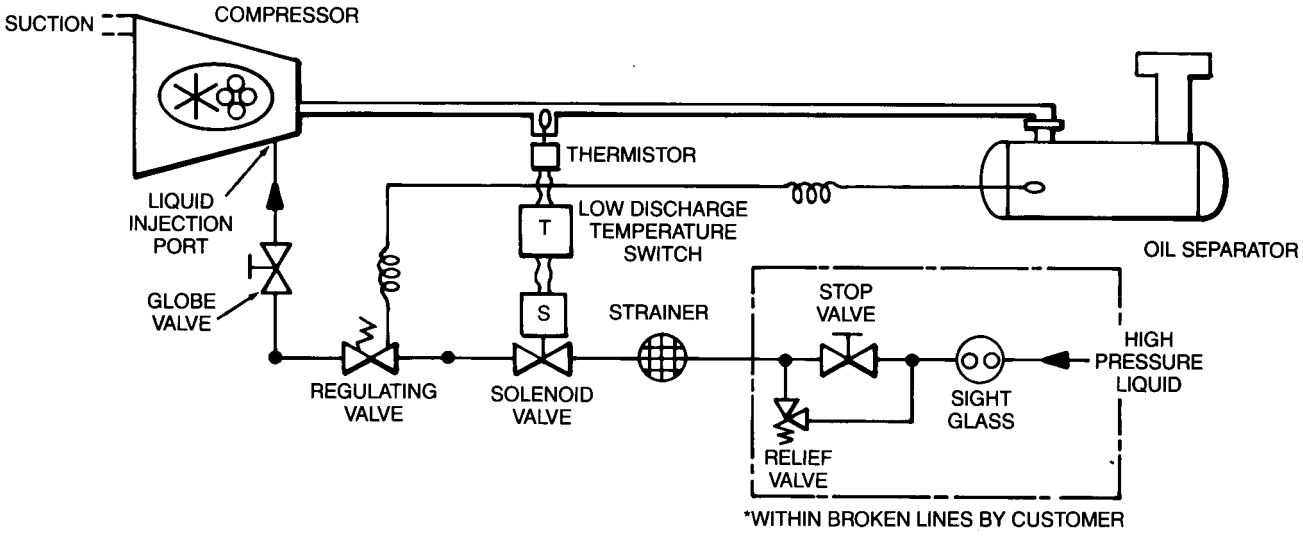
Line lengths from the high pressure receiver to the compressor should be as short as possible to insure an adequate liquid supply at start-up. The piping must allow free venting of any vapor that may be created on shutdown.

To minimize evaporation of liquid in the supply line with consequent reduction in liquid flow through the refrigerant regulating valve, the line should be insulated if it passes through an area where the temperature is higher than the condensing temperature (e.g., in the open, under the hot sun, or inside warm rooms in cold climates).

Three methods are shown in Figure 3-3.

System "A" consists of modifying the existing high pressure receiver or modifying the design of a new high pressure receiver such that two liquid supply lines are available; one to the evaporator and one for the cooling liquid supply. The connection must be situated such that the liquid will stop flowing to the evaporator before it stops flowing to the compressor. Again, a minimum of five minutes supply must be available to the compressor.

Figure 3-2 Liquid Injection Piping



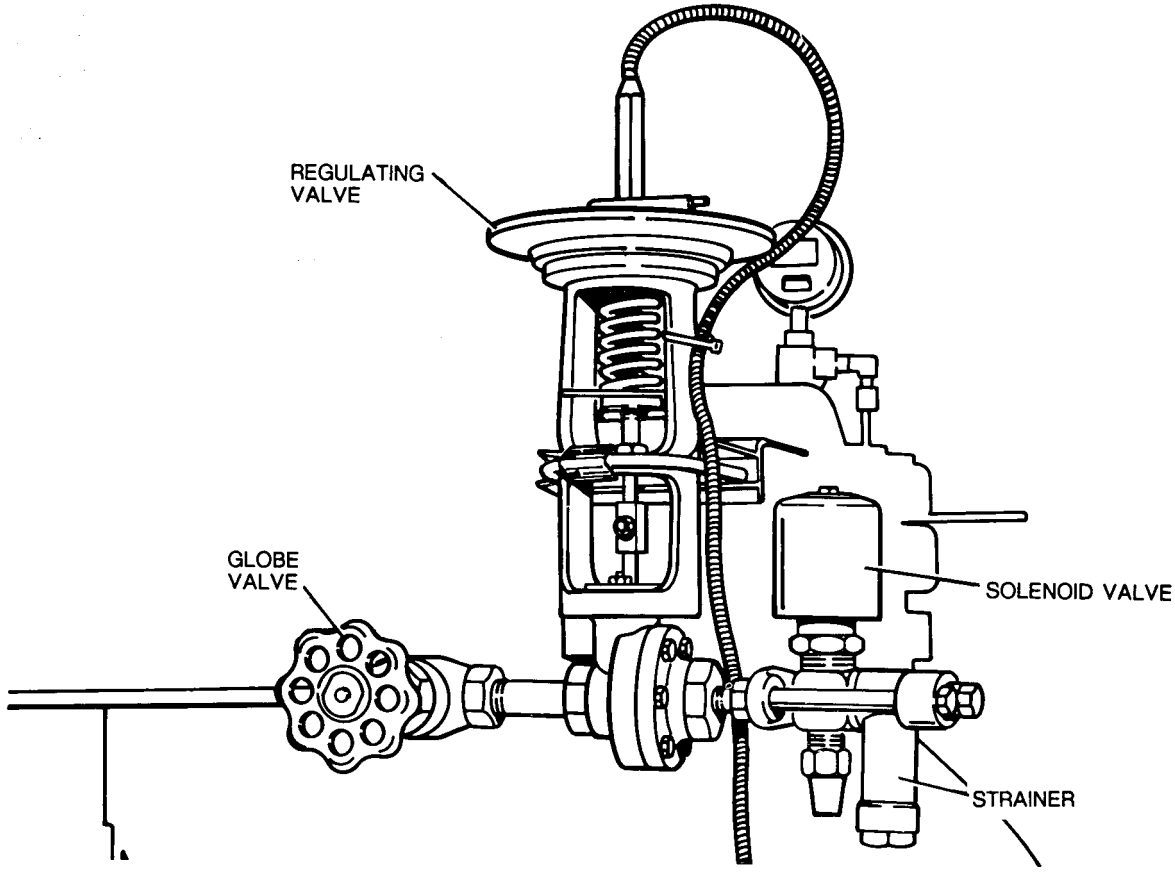
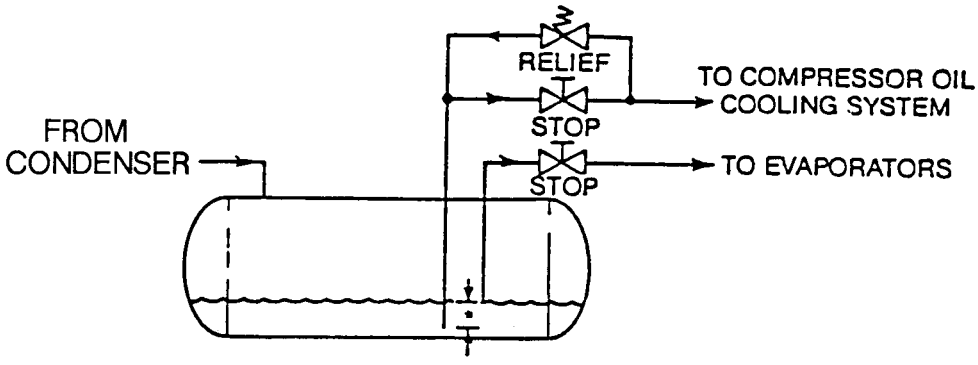
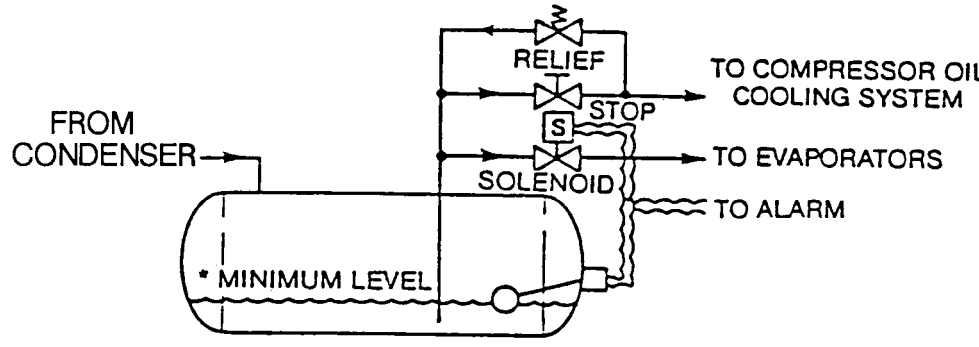


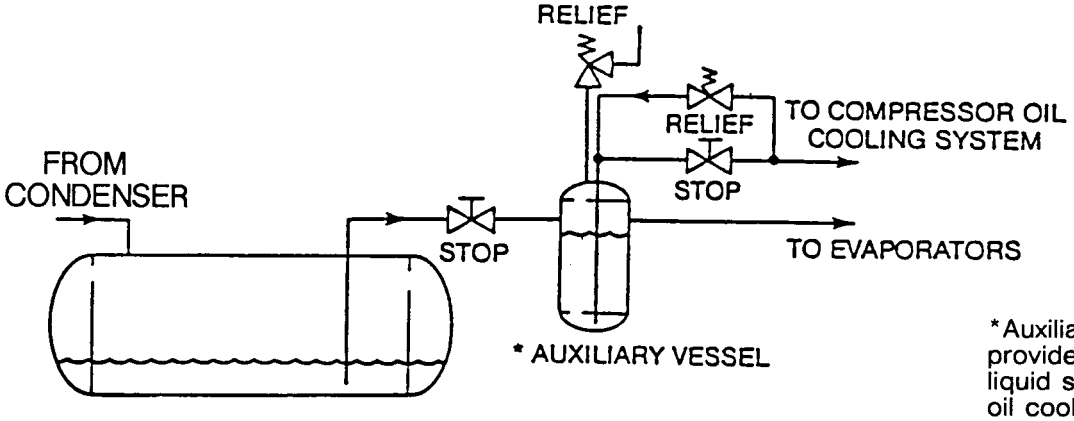
Figure 3-3 Refrigerant Supply Methods



(A) Modified High Pressure Liquid Receiver Method



(B) Level Control And Solenoid Valve Method



(C) Auxiliary Vessel Method

System "B" consists of a solenoid valve connected to the liquid supply line from the high pressure receiver to the evaporator. The solenoid valve is controlled by a level switch installed in the high pressure receiver and set such that the solenoid valve will close when the liquid level in the tank drops to a point where slightly more than five minutes of liquid remains in the tank.

System "C" consists of installing a small auxiliary high pressure vessel, sized to hold the five minute liquid supply.

3.8 PRESSURE TEST

The Sullair Refrigeration package components have all been pressure tested prior to leaving the factory to the "Safety Code for Mechanical Refrigeration" ANSI B9.1, 1977. The compressor unit should, however, be leak checked at the job site to detect leaks which may be present due to rough handling during shipment.

This test should be done simultaneously with the system pressure test and system leak check.

DO NOT add oil to the package prior to pressure testing.

⚠CAUTION

Whenever the compressor package is colder than the condensing temperature, admit only enough high pressure refrigerant to bring the package up to the test pressure given in Table 4 and then close the inlet valve. This minimizes the amount of liquid condensing in the package which could damage the compressor on start-up.

Before the system pressure test, check that the oil separator elements are seated correctly and that the gaskets are in the correct position. When the package is under pressure, tighten the oil separator flange cover.

In the absence of an established pressure testing procedure, the following is a guide to good practice.

1. Open all interconnecting valves between the low and high pressure sides. Open solenoid valve, pressure regulating valves, check valves and other control valves by means of their manual lifting stems.
2. Pressure test the entire system with dry nitrogen or dry air to the low side pressure given in Table 4 or the setting of the pressure relief device protecting the low side.

⚠CAUTION

If using an air compressor, a drier must be used to reduce the moisture content.

3. Blow down the system and repair any leaks.
4. Again pressure test the entire system to the low side pressure as in Step 2 but add 1% of the system refrigerant charge to aid leak detection.
5. If no leaks are found, record the pressure and the ambient temperature and hold the system pressurized for 12 hours (overnight). Note the system pressure and the ambient temperature after 12 hours. Correct the pretest pressure for temperature variation (as the absolute pressure is proportional to the absolute temperature) as in the example. If the pretest temperature corrected pressure has not decreased by more than 0.5% of the test pressure the low side system can be considered leak free for refrigeration purposes.

For example, consider a low side ammonia system where the pretest pressure was 150 PSIG (1034kPa) at an ambient temperature of 81°F (27°C) and the test pressure reduced to 144 PSIG (992kPa) at an ambient temperature of 61°F (16°C). The pretest pressure is corrected for the temperature variation as follows:

$$Pc = \frac{(61 + 459)}{(81 + 459)} \times (150 + 14.7)$$

$$= 159 \text{ PSIA (1096kPa)}$$
$$= 144 \text{ PSIG (992kPa)}$$

TABLE 4

MINIMUM DESIGN AND TEST PRESSURES

REFRIGERANT	LOW SIDE		HIGH SIDE			
			WATER-COOLED		AIR-COOLED	
	PSIG	kPa	PSIG	kPa	PSIG	kPa
R12	100	700	150	1000	200	1400
R22	150	1000	300	2000	300	2000
R717	150	1000	250	1700	300	2000

The minimum pressure of an acceptable leak free system is 99.5% of Pc which is 143 PSIG (985kPa). As the system test pressure was 144 PSIG (992kPa) the low side is acceptable (see step 10 below for an SI unit example).

This assumes that the system air is at the same temperature as the ambient temperature and that the test mixture of air and refrigerant is a perfect gas.

6. Isolate the low side from the high side by closing all the interconnecting valves.
7. Pressure test the high side of the system with dry nitrogen or dry air and 1% of the system refrigerant charge to the high side pressure given in Table 4 or the setting of the pressure relief device protecting the high side.
8. If leaks are found then blow down the high side and repair any leaks, otherwise go to Step 10.
9. Again pressure test the high side to the high side pressure as in Step 7.
10. If no leaks are found, record the pressure and the ambient temperature and hold the high side of the system pressurized for 12 hours (overnight). Note the system pressure and the ambient temperature after12 hours and if the pressure has not decreased by more than 0.5% of the pretest temperature corrected pressure the high side can be considered leak free for refrigeration purposes.

For example, consider a high side ammonia system where the pretest pressure was 1700kPa at an ambient temperature of 27° C and test pressure reduced to 1635kPa at an ambient temperature of 17° C. The pretest pressure is corrected for the temperature variation as follows:

$$Pc = \frac{(17 + 273)}{(27 + 273)} \times (1700 + 101)$$

$$= 1741\text{kPa}$$
$$= 1640\text{kPa}$$

The minimum pressure of an acceptable leak free system is 99.5% of Pc which is 1632kPa. As the system test pressure was 1635kPa the high side is acceptable (see Step 5 above for an English unit example).

3.9 SYSTEM EVACUATION

The system must be evacuated to remove both air and moisture according to good refrigeration practice. Any free moisture and air in a system will mix with the refrigerant and oil to form harmful organic contaminants in resinous sludge and wax like forms which will plug the oil filters and strainers and damage the compressor.

This evacuation can be done with a high vacuum pump capable of reducing the absolute pressure to 1000 microns (1000 um = 1mm) of mercury or less. As the internal pressure is reduced, the temperature at which the water boils (saturation temperature) is also reduced. As the water boiling temperature is lowered below the external ambient temperature, heat is transferred into the system and vaporizes the water which is removed by the vacuum pump. With high ambient temperatures, dehydration occurs more quickly (see Table 5).

DO NOT evacuate with oil in the separator as the oil prevents any trapped moisture from boiling off.

The following procedure is recommended:

1. Ensure all leaks have been corrected by pressure testing as in Section 3.8.
2. Blow the system down to atmospheric pressure.
3. As many commercial vacuum pumps contain brass which is attacked by ammonia in the presence of moisture, remove any ammonia remaining in the system from the pressure test by adding dry nitrogen to a pressure of about 10 PSIG (70kPa). Again blow the system down to atmospheric pressure.
4. Open all the interconnecting valves between the low and high pressure sides.
5. Install a vacuum gauge at the oil filter drain valve or some other convenient system connection. Open the drain valve.
6. Attach the vacuum pump by hose to the blowdown valve on the oil separator.
7. Open the blowdown valve.

TABLE 5

PRESSURE - BOILING TEMPERATURE RELATION FOR WATER

Microm (um) of mercury	ABSOLUTE PRESSURE PSI	ABSOLUTE PRESSURE in of mercury	BOILING TEMPERATURE Pa	BOILING TEMPERATURE F°	BOILING TEMPERATURE C°
100	0.00193	0.004	13.3	−40	−40
200	0.00385	0.008	26.6	−28	−33
500	0.00964	0.020	66.4	−12	−24
1000	0.0193	0.039	132.9	1	−17
2000	0.0385	0.078	265.8	+14	−10
5000	0.0964	0.197	664	+34	+1
10000	0.193	0.393	1329	+52	+11

8. Start the vacuum pump and evacuate the system to 1000 microns of mercury absolute pressure 0.0193 PSIA (133 Paa). Depending on the internal volume of the system, the amount of air and water present, the ambient temperature and the size of the vacuum pump this may take from half an hour to ten hours. Should the ambient temperature be less than 32°F (0°C), evacuate the system to 200 microns of mercury absolute pressure 0.00385 PSIA (27Pa).
9. Close the blowdown valve.
10. Stop the vacuum pump.
11. Record the system absolute pressure.
12. Wait two hours and repeat steps 6, 7, 8, 9, 10 and 11.
13. Wait two hours and read the system absolute pressure again. If the pressure has not increased, dehydration is complete. If the pressure has increased, repeat steps 6, 7, 8, 9, 10 and 11.
14. If the vacuum fails to hold after several dehydration attempts, check the system for leaks and again repeat steps 6, 7, 8, 9, 10 and 11.
15. Close the blowdown valve and the vacuum gauge valve.
16. Charge the system with refrigerant at the charging valve.

Even with the above procedure, small amounts of moisture located a long way from the vacuum pump may be difficult to remove. A filter-drier (preferably with a replaceable element) should be installed in halocarbon systems in the liquid line downstream of the charging valve to remove this residual water. The circulating refrigerant brings the residual moisture to the drier. The filter drier element may have to be changed several times before the correct degree of dryness (as shown by a moisture indicator installed in the liquid line downstream of the filter-drier) is obtained.

3.10 ELECTRICAL CONNECTIONS

The package is supplied with a completely wired electrical control system which requires a 115 volt, single phase, 60 hertz power supply of 2.5 KVA capacity and some field connections at the terminal strip. For compressors with MCS panels, the power supply is 1.0KVA and a separate source of 2.0KVA must be supplied for the pump. All electrical connections are to be made according to the wiring diagrams for your specific machine. Make sure that electrical interfacing with the compressor complies with local, state and federal codes.

⚠WARNING

Local codes may require a warning sign for automatically starting and stopping equipment.

⚠CAUTION

DO NOT supply power to the compressor control panel until oil has been charged into the oil reservoir. Failure to observe this caution will result in a burned out oil heater.

3.11 INITIAL OIL CHARGE

⚠CAUTION

Used or filtered oil should never be added to a refrigeration screw compressor under any circumstances. Use only new oil from an oil manufacturer (any of the major oil companies or their approved dealers).

Sufficient oil should be charged into the oil separator reservoir to establish a level in the upper sight glass. This will be approximately 40 gallons (150 liters).

An additional gallon (4 liters) of oil should be pumped into the filter through the valve in the bottom of the filter canister to assure adequate lubrication during the initial start-up.

See Section 2.2 for oil requirements.

3.12 INITIAL OIL WARM-UP

After installing the initial oil charge, connect the oil heater and supply power to the compressor panel before the arrival of the Sullair Refrigeration Service Representative. This will allow the oil in the oil reservoir to warm to operating temperature and will help facilitate a smooth start-up.

3.13 ELECTRICAL CHECK

Before attempting to start the compressor, the electrical control system protective switches and capacity controls must be checked in a simulated operating condition. Be sure there is oil in the separator so the oil heater will not burn out. For compressors with MCS controls, the Sullair Refrigeration Service Representative will perform the electrical check. A separate manual is available for servicing the MCS.

The simplest and most reliable method of checking the electrical system is to feed the power supply to the control panel with the main drive motor power disconnected. This can be accomplished by disconnecting the motor power at the main power disconnect. If the control power is also supplied from the main disconnect, a separate temporary 115 volt, single phase, 60 hertz source should be obtained or the motor starter coil should be disconnected.

⚠CAUTION

The electrical check must be made with the main motor disconnected.

PROTECTIVE SWITCH CHECK

All switches are to be adjusted to values shown in Section 2.1.

LOW OIL PRESSURE PROTECTIVE SWITCH

With panel power on, simulate a start by pushing the START button to energize the main control relay, 4CR. After ten seconds, the time delay (1TR) will time out, de-energizing the main relay and causing the low oil pressure circuit to light up the pilot light on the control panel.

HIGH DISCHARGE PRESSURE/LOW SUCTION PRESSURE, HIGH DISCHARGE TEMPERATURE AND HIGH OIL TEMPERATURE PROTECTIVE SWITCHES

To check the remaining protective switches, jumper the low oil pressure switch, then readjust or manually manipulate each protective switch after simulating a start and note whether the main control relay 4CR drops out. Also, check that the appropriate pilot light on the panel door lights up.

CAPACITY CONTROL CHECK

The capacity control system will be checked after the compressor is running and during the setting of the capacity control pressure switches. Before starting, carefully remove the 3TR timer from its socket. This will hold the capacity control system in the unloaded or minimum position. Also, before start-up, check to see that the capacity control actuator moves freely by manipulation of the capacity control valve. Movement should be firm, but not sticking or binding.

Compressors supplied with electric valve actuators (EVA), may have mechanical stops built in. In order to check for mechanical stops, pull out the knob on the EVA and rotate the knob counterclockwise a maximum of 270 or until a mechanical stop is encountered. If a mechanical stop is encountered, set the minimum and maximum limit switches per Section 6.13. If a mechanical stop is not encountered, EVA must be set while compressor is running.

Move the capacity control actuator counterclockwise to the minimum position for low starting torque.

3.14 MOTOR ROTATION CHECK

Supply power to the motor starter and rotate the START button to the "auto/start" position. Bump the motor by pushing the START button then pushing the STOP button. Verify the motor rotation by observing the coupling.

⚠CAUTION

The compressor shaft will rotate counterclockwise (direct driven) and clockwise (gear driven) when facing the compressor shaft end when motor rotation is correct.

If the motor rotates in the wrong direction, disconnect the power supply to the starter at the circuit breaker and reverse two of the three phases by interchanging two of the three electrical lines at the starter or at the motor terminal box.

⚠CAUTION

DO NOT run the compressor in the reverse direction more than a few seconds. Failure to observe this caution could result in serious damage to the compressor.

Rotate the starting switch to the "manual/reset" position. Disconnect power from the motor starter.

Section 4
OPERATION

4.1 START-UP

After all the installation functions covered in Section 3 have been completed, it will be possible for the Sullair Refrigeration Service representative to perform start-up service. The Sullair Refrigeration Service Department should be notified a minimum of two weeks before a scheduled start-up to assure timely arrival of the Sullair Refrigeration Service representative. It is necessary that key operating personnel be available to go through the start-up, since a great deal of knowledge can be obtained in this manner. The operations covered in this section will be performed at start-up under the supervision of a Sullair Refrigeration Service representative.

⚠CAUTION

See Section 3.2 before scheduling the start-up.

4.2 PRE-START CHECK LIST

The following section covers only the initial start of the compressor and not the remainder of the refrigeration system. Be sure that all necessary system valves are open and that the refrigeration system is ready for start-up. Use the following check list to guarantee that no items of importance regarding the compressor package have been overlooked.

1. Motor starter breaker disconnected from the electric supply line.
2. Low oil pressure protective switch reconnected.
3. Protective switches set to values in Section 2.1.
4. All protective switches verified for correct operation.
5. Oil temperature above 68°F (20°C) or 10°F (5°C) above the saturation temperature of the package pressure whichever is higher, ideally 80°F to 100°F (27°C to 38°C).
6. Oil level established in upper sight glass.
7. One gallon (4 liters) of oil pumped into filter to prelubricate the compressor bearings.
8. Cooling water to oil cooler turned on if water cooled.
9. Liquid refrigerant supply to compressor turned on if refrigerant cooled.
10. Stop valves to the pressure gauges are open.
11. Suction and discharge valves open.
12. Timer 3TR removed from socket.
13. Direction of motor rotation checked.
14. Motor bearings lubricated per manufacturer's specification.
15. Capacity control actuator indicator at minimum.
16. Capacity control limit switches set if required (Section 3.13).
17. Starting switch in the "manual/reset" position.

When the above items are verified, the compressor is ready for the initial start.

4.3 INITIAL START-UP PROCEDURE

Connect the starter to the electric supply line at the main breaker. With one hand over the STOP button and someone standing by the main breaker (in case the starter contacts fail to disengage), energize the protective circuit by rotating the start switch to the "manual/reset" position. Push the button to reset LOP, rotate the start switch to the "auto/start" position and push the button. The compressor will start automatically provided the suction pressure is above the "cut in" pressure on the unadjusted "start/stop" pressure switch (HSP). After starting, rotate this switch to the "manual/reset" position so the compressor will not automatically stop and start. If the suction pressure is below the "cut in" pressure, start the compressor by rotating the start switch to the "manual/reset" position. Check rotation direction, oil pressure, noise and vibration, and if any of these items are abnormal, immediately stop the machine.

4.4 OIL PRESSURE SWITCHES

The low oil pressure switch (LOP) must be set per Section 2.1. The SOP switch should be set at 5 PSI (34kPa) over compressor discharge pressure.

4.5 OIL TEMPERATURE ADJUSTMENT

WATER COOLED MACHINES

The normal operating oil temperature of 110°F (43°C) must be achieved by adjusting the water regulating valve. For Penn water valves, turn the spindle counterclockwise when viewed from above to increase spring loading on the diaphragm and increase the temperature. Allow a few minutes after each water valve adjustment to allow the oil temperature to stabilize. Note that the final temperature at stable operating conditions can be 105°F to 115°F (40°C to 46°C).

LIQUID INJECTION COOLED MACHINES

Refrigerant injection cooled machines require adjustment of both the low discharge temperature protective switch (controlling the refrigerant liquid feed solenoid valve) and the refrigerant regulating valve. Below the low discharge temperature of 105°F (40°C), the liquid solenoid valve is closed or de-energized and no refrigerant enters the compressor. When the low discharge temperature is exceeded, the solenoid valve opens and feeds liquid refrigerant to the refrigerant regulating valve. This regulating valve senses the oil temperature in the discharge pipe and varies the flow of refrigerant injected into the compressor discharge to maintain a constant discharge temperature of 118°F to 122°F (48°C to 50 °C) or 10°F (5°C) above condensing temperature.

The low discharge temperature switch (LDT) also prevents refrigerant overfeed by sensing the low discharge temperature caused by cold oil at start-up or the unevaporated overfed liquid and immediately closes the solenoid valve which shuts off the supply of liquid refrigerant.

Adjustment of the low discharge temperature switch (LDT) is accomplished by adjusting the low temperature switch located in the control panel to 105°F (40°C). Verify the calibration of the adjustment with the discharge temperature gauge when the machine is warming up and operating at the set point value.

The oil and discharge temperature is sensed in the oil separator by the bulb of the self contained refrigerant regulating valve. As the oil temperature increases, a portion of the liquid in the sensing bulb is vaporized which increases the pressure on both the diaphragm and the adjustment spring to open the regulating valve and admit more refrigerant.

⚠CAUTION

The bulb of the refrigerant regulating valve should be coated with aluminum paste or heat transfer grease to improve heat transfer and must be installed with the "top" marking on the bulb in the up position.

Adjustment of the refrigerant regulating valve involves turning the adjusting wheel on the valve with the key supplied with the valve. Each quarter turn on the valve will cause a change in the valve control point temperature of approximately 1°F (0.5°C). The adjusting spring acts to close the valve.

Turning the collar to the right (or up, or counterclockwise when viewed from above) increases the temperature setpoint.

The recommended setting procedure for the liquid injection system is as follows:

1. Start the compressor and leave in manual capacity control and in minimum position (pull 3TR timer).
2. Close the hand globe valve (in the liquid line adjacent to the liquid injection port) and crack it open a quarter turn.
3. Turn the regulating valve adjusting wheel fully down (clockwise) to the jam nut so that the valve is wide open.
4. When the discharge temperature gauge (on the oil separator) is reading 104°F to 105°F (40°C), adjust the low discharge temperature switch (in the control panel) to open the liquid feed solenoid valve.
5. Open the globe valve very slowly and regulate to obtain 120°F (49°C) so that expansion occurs at the globe valve. Allow time for temperatures to stabilize after each adjustment. Note that changes in suction or discharge pressure will vary the heat of compression and the discharge temperature.
6. Adjust the regulating valve adjusting wheel up (counterclockwise) again allowing for temperatures to stabilize until the discharge temperature rises above 120°F (49°C). When this occurs, the expansion is occurring at the regulating valve rather than the globe valve. Stabilize the discharge temperature at 118°F to 122°F (48°C to 50°C) or 10°F (5°C) above condensing temperature whichever is higher.
7. Open the globe valve fully so that the regulating valve takes full control.

This must be done very slowly.

After the adjustments are made, check to see that the discharge temperature is being controlled by the refrigerant regulating valve and not by the low temperature switch. This condition will occur if the refrigerant regulating valve setpoint is lower than specified or if the low temperature switch is set too high. Once the operation is verified and the machine is allowed to operate for twenty to thirty minutes, a slight readjustment may be necessary. A further check should be made when the machine is running at full load. The discharge temperature should always be more than 10°F (5°C) above the condensing temperature. Note that the final discharge temperature at stable operating conditions can be 118°F to 122°F (48°C to 50°C) or 10°F (5°C) above the condensing temperature, whichever is higher.

During a start, the discharge temperature will rise to near the limits before the refrigerant regulating valve will respond. This is normal and should occur only on start-up.

THERMOSIPHON COOLED MACHINES

Before starting the compressor, make sure that there is a good supply of liquid refrigerant to the tube side of the cooler. When the compressor is started, the oil will completely bypass the oil cooler through the 3-way temperature control valve until the oil temperature approaches the setpoint of the valve.

The valve will gradually open mixing hot oil from the separator with cold oil from the oil cooler. There are no adjustments to be made at start-up.

4.6 CAPACITY CONTROL ADJUSTMENT

The P1/P2 pressure controller consists of a single adjustment, dual pressure switch assembly with a factory set dead band of approximately 2 PSI (15kPa). This dead band is satisfactory for the majority of refrigeration systems.

To set the controller to the desired system suction pressure, carry out the procedure as in Steps 1 to 9 inclusive below (see Figures 1-27 thru 1-32 for wire termination).

COMPRESSORS WITH HYDRAULIC ACTUATORS

1. Obtain a voltmeter or two 120V neon pilot lights with pigtails. The procedure is easier with the lights as they can remain connected throughout the setting procedure.
2. Remove the timer 3TR from its socket to place the capacity control system in the manual mode. Remove the cover from the P1/P2 switch.
3. To keep the capacity control valve stable in the same position:
   A. For ammonia machines jumper wire No. 48 to wire No. 41 on the 3TR socket to keep solenoid B on (solenoid A is already off because 3TR is removed).
   B. For freon machines jumper wire No. 47 to wire No. 41 on the 3TR socket to keep solenoid B off (solenoid A is already off because 3TR is removed).
4. Connect one pilot light to terminal 43 on the 3TR socket and to X2 on the other side of the socket. Connect the other pilot light to terminal 45 on the 3TR socket and to X2. See the wiring diagram in Figure 1-31 or 1-32.
5. Vary the compressor capacity manually with the indicator handle on the end of the actuator until the desired suction pressure is obtained. In some systems, it may be necessary to throttle the suction valve to achieve the desired pressure.
6. When the desired suction pressure is reached and remains stable, adjust the P1/P2 controller by turning the control adjustment screw in the appropriate direction so that both pilot lights are off. If both lights are on, turn the adjustment screw clockwise (from above). If the light connected to terminal 43 is off while the light connected to terminal 45 is on, turn the adjustment screw counterclockwise (from above).
7. To widen the dead band, lower the pressure switch P1 (turn the adjusting threaded insert counterclockwise from above) and raise the high pressure switch P2 (turn the adjusting threaded insert clockwise from above). Widen the band evenly about the control point by making equal adjustments to both P1 and P2. Conversely, the band can be narrowed by raising the low pressure switch P1 and lowering the high pressure switch P2.
8. Remove the jumper wire between 41 and 47 or 48.
9. Plug the 3TR timer into its socket. The capacity control system is now in the automatic mode.

COMPRESSORS WITH ELECTRIC VALVE ACTUATORS

The P1/P2 pressure controller consists of a single adjustment, dual pressure switch assembly with a factory set dead band of approximately 2 PSI (15kPa). This dead band is satisfactory for the majority of refrigeration systems.

To set the controller to the desired system suction pressure, carry out the procedure as in Steps 1 to 7 below.

1. Utilize the test switch in the control panel to connect the load/unload pilot lights to the pressure switch (P1/P2) and remove the on/off timer (3TR) so that the capacity control actuator cannot operate automatically.
2. To set the controller to the desired system control pressure, place the capacity control in the manual mode (load or unload).
3. With the manual load/unload switch, vary the compressor capacity until the desired suction pressure is obtained. In some systems, it may be necessary to throttle the suction valve to achieve the desired pressure.
4. When the desired suction pressure is reached and remains stable, adjust the P1/P2 controller by turning the center adjustment screw in the appropriate direction so that neither the loading nor unloading lights are on. If the load light is on, turn the adjustment screw clockwise (from above). If the unload light is on, turn the adjustment screw counterclockwise (from above).
5. To widen the dead band, lower the low pressure switch P1 (turn the adjusting threaded insert below the switch counterclockwise from above) and raise the high pressure switch P2 (turn the adjusting threaded insert below the switch clockwise from above). Widen the band evenly about the control point by making equal adjustments to both P1 and P2. Conversely, the band can be narrowed by raising the low pressure switch P1 and lowering the high pressure switch P2.
6. Return the test switch to its original position so the pilot lights indicate when the capacity controller is loading or unloading. Reinstall 3TR.
7. Place the compressor in the automatic capacity control mode. It will then modulate capacity as required to maintain the desired control suction pressure.
The response time of the capacity control system is adjusted by the settings on the dual recycling timer 3TR.

The red center knob controls the "on" time, adjustable from 0.6 to 30 seconds and the black outer knob controls the "off' time, adjustable from 1.2 to 120 seconds. Both increase time when turned clockwise. For adjustment, turn the black control fully clockwise and the red fully counterclockwise. Turn the red knob clockwise until the actuator moves a desirable distance. The longer the "on" time, the further the actuator will move (i.e. the increment or percentage load change at each movement will increase). The actuator moves in a stepwise fashion. The longer the "on" time, the greater percentage change per step.

Turn the black knob counterclockwise until the desired time from full load to minimum is achieved after several steps. The "off' time determines the number of steps in a given amount of time.

Experience has shown that on large refrigeration systems, the smoothest operation and best control is achieved with slow machine response (e.g. a short "on" time of 1 to 2 seconds and long "off" time of 120 seconds). Also, the best way to speed up the response is to slightly shorten the "off"time rather than increase the "on" time.

4.7 AUTOMATIC START/STOP PRESSURE SWITCH ADJUSTMENT (HSP)

After stable automatic capacity control is achieved, the automatic "start/stop" switch or high suction pressure switch (HSP) may be adjusted to allow automatic starting and stopping of the compressor at set "cut-in" and "cut-out" pressures.

Set the "cut-in" pressure adjustment to the pressure where it is desired to have the compressor automatically start. This pressure may be set above the pressure at which the capacity control calls for loading, usually 2 PSI to 5 PSI (15kPa to 35kPa) above P2 setting.

Set the "cut-out" pressure adjustment at the pressure where it is desired to have the compressor automatically stop. This pressure should be set sufficiently below the pressure at which the capacity control calls for unloading, usually 5 PSI to 15 PSI (35kPa to 100kPa) below P1 setting. If short cycling or frequent starts and stops occur at low conditions, this "cut-out" setting may have to be lowered.

Rotate the start switch to the "auto/start" position so that the compressor starts and stops automatically.

4.8 SYSTEM DIFFERENTIAL PRESSURE SWITCHES (SDS)

On initial start-up this switch should be jumpered out (wires 24 and 28) so that the oil pump will run continuously. After system has run steady this switch should be adjusted to turn on the oil pump when discharge pressure is less than 100 PSI (689kPa) over suction pressure. This switch is not used on boosters.

4.9 OPTIONAL LOAD LIMIT RELAY ADJUSTMENT

Make sure that the high discharge pressure switch is set before adjusting the load limit relay.

The transformer current which activates the relay can be calculated by dividing full load current by the turns ratio of the current transformer. Set the load limit relay scale to this transformer current.

Artificially impose a high load on the motor until the motor ammeter indicates full load motor nameplate current by turning off condenser fans and water pumps one at a time. DO NOT THROTTLE THE DISCHARGE STOP VALVE. Adjust the setting on the load limit relay until the unloading pilot light comes on. Check that the load limit relay at full motor load unloads the compressor until the excessive motor current is eliminated.

Set the 0 to 3 minute adjustable Allen Bradley timer, 4TR to approximately 3 minutes by turning the little white wheel to the maximum time position and then backing it off two full turns. This timer prevents the compressor loading until the time setting has elapsed. DO NOT leave the timer in the maximum position as this effectively prevents the timer from timing out. An amber load limiting light shows whenever the load limiting timer is timing.

After July 1987 the Allen Bradley timer was replaced by an IDEC Timer. This is a 0 to 100 sec. timer.Set the dial to maximum position. This timer will time out when set at maximum position. The amber load limiting light shows only while the timer is timing and a load signal is present.

4.10 START-UP DATA RECORD

After the compressor has run fully automatically for an hour and the pressures and temperatures have remained stable

for 15 minutes, fill out the start-up data record (Figure 4-1). Send a copy to the Sullair Refrigeration Service Department for the permanent file which the Sullair Refrigeration Service Department maintains on your machine.

⚠CAUTION

Whenever the compressor stops, it runs in the reverse direction for several revolutions. After the discharge check valve closes, the high pressure refrigerant in the oil separator expands back through the compressor to the closed suction check valve which causes the compressor to run in reverse. It is a completely normal action and is no cause for alarm. Continued back spin for more than 5 seconds indicates excess leakage through the suction check valve. Consult Sullair Refrigeration Service Department.

4.11 AFTER START-UP MAINTENANCE

After the compressor has run for 24 hours, clean the suction strainer, oil strainers and change the oil filter if its pressure drop exceeds 30 PSI (210kPa).

Figure 4-1 Start-Up Data Record

START-UP DATA RECORD

Customer _____ Contractor _____

_____ _____

_____ _____

Persons Contacted _____ Persons Contacted _____

_____ _____

Phone _____ Phone _____

_____

TELEX _____ TELEX _____

_____

IDENTIFICATION

Package Model No. _____ _____

Package Serial No. _____ _____

Compressor Serial No. _____ _____

Wiring Diagram No. _____ _____

Oil Cooling: Liquid Injection/Water/DX/Thermosiphon Sullistage: Yes/No

PROTECTIVE SWITCH SETTINGS

Anti Recycle Timer _____ Min.

Low Oil Pressure 25 PSI (175kPa)
(Factory Set)

High Oil Temperature _____ F/C
(Manuel Reset)

Low Discharge Temp. _____ F/C

High Discharge Temp. _____ F/C

Low Suction Pressure _____
(Manual Reset) PSIG/in HG/kPa

High Disch. Pressure _____ PSIG/kPa

CONTROL SWITCH SETTINGS

Suction Pressure: Cut In _____ PSIG/in Hg/kPa

Cut Out _____ PSIG/in Hg/kPa

Capacity Control Presure: P1 Unload _____ PSIG/in Hg/kPa

P2 Load _____ PSIG/in Hg/kPa

Oil Heater Thermostat _____ °F/°C

Ampere Relay Unload* _____ Amps

Current Transformer Ratio _____

Oil Pressure Delay, 1TR _____ Seconds

Capacity Control, 3TR ON _____ Seconds

OFF _____ Seconds

Load Limiting, 4TR* _____ Minutes

Auto, Restart* _____ Minutes

Sequencing Delay* _____ Minutes

Start-Up Oil Pump Shutdown, 7TR _____ Minutes

* Optional Components

ELECTRICAL EQUIPMENT

Motor Manufacture _____ Sullair Supplied: Yes/No

Motor Serial Number _____

Frame _____

Motor Rated Power _____ HP/kw

Full Load Current _____ Amp

Electric Supply _____ **Volts** _____ Hertz _____ Phase

Starter Manufacturer _____ Type _____

Type _____ Sullair Supplied: Yes/No

Starter Rated Power _____ HP/kw

Motor Overload _____ Amps

Circuit Breaker _____ Amps

OPERATIONAL DATA

Refrigerant _____

Suction Pressure _____ PSIG/in Hg/kPa

Suction Temperature _____ °F/°C

Sullistage Pressure _____ PSIG/in Hg/kPa

Sullistage Temperature _____ °F/°C

Discharge Pressure _____ PSIG/kPa

Discharge Temperature _____ °F/°C

Oil Pressure _____ PSIG/kPa

Oil Temperature _____ °F/°C

Oil Filter Pressure Drop _____ PSI/kPa

Oil Type _____

Water Temperature: Inlet _____ °F/°C Outlet _____ °°F/°C

Water Supply: Condenser/Cooling Tower/
Treated/Untreated/Mains/Well/Other _____

Current _____ Amps at Above Condition
Capacity Control at _____ %

Comments _____

Sullair Representative Signature _____ Date _____

5.1 GENERAL

Although the maintenance for your Sullair Refrigeration compressor is minimal, it must be carried out for long compressor life. The instrumentation and indicators provided will alert you of the first sign of a maintenance requirement. Observe these instruments and indicators at regular intervals and be certain that the machine is performing properly. Become familiar with the normal operating sound of the compressor and if something does not sound just right, shut down the machine. Excessive vibration is a good indication that something is wrong. This precaution may save the cost of a major repair.

⚠WARNING

Before commencing work on any item on the package, carry out the shutdown procedure in Section 6.2 for your own personal protection.

Keep the compressor package clean to minimize dirt entering the compressor whenever components are opened during routine maintenance.

Before cleaning a component with a solvent to remove gum or resin like deposits, remove all the O-rings, as they can be chemically attacked.

Alternatively, check the compatibility of the solvent with the O-rings which are neoprene or Buna-N. Unfortunately, those solvents which most readily remove carbon deposits (e.g. trichlorethylene) rapidly attack both neoprene and Buna-N.

To ensure no traces of solvent will be left to react with the oil and refrigerant, thoroughly dry the component.

5.2 DAILY OPERATION

After a routine start has been made, be sure the gauges indicate the correct reading for that particular phase of operation.

After the machine has warmed up, check the overall compressor and instrument panel to make sure it is running properly. Particular attention should be given to the following:

- Oil Pressure Gauge
- Oil Temperature Gauge
- Discharge Temperature Gauge

Also check the setting of the suction, oil and discharge pressure protective switches. A log of the operating temperatures, pressures and service requirements can be invaluable in troubleshooting. It is strongly recommended that a log be kept of all readings at least every 8 hours as in Table 6.

While the compressor is running, each sight glass contains slowly churning oil and small vapor bubbles. When clear vapor appears in the top sight glass, the oil level may be low. The oil level can be accurately checked when the compressor has stopped and the oil has settled in the separator sump for about 10 minutes. The oil level should be visible in the bottom of the top sight glass.

⚠CAUTION

Used or filtered oil should never be added to a refrigeration screw compressor under any circumstance. Use only new oil (as in Section 2.2) from an oil manufacturer.

TABLE 6 COMPRESSOR LOG EXAMPLE

PLANT NAME _____ MODEL _____ SERIAL NO. _____

DATE _____ LOGGED BY _____ TIME RUN (HOURS) _____

ITEM	SYMBOLS	UNITS	NORMAL RANGE FROM	NORMAL RANGE TO	TIME 8am	TIME 4pm	TIME 12pm	NOTES
Suction Pressure	Ps	PSIG/in Hg/kPa						
Suction Temperature	Tx	F/C						
Discharge Pressure	Pd	PSIG/kPa						
Discharge Temperature	Td	F/C						
Oil Pressure (at manifold)	Po	PSIG/kPa						
Oil Temperature (at manifold)	To	F/C						
Oil Pressure (at Filter Inlet)	Pf	PSIG/kPa						
Oil Filter Pressure Drop	Pf-Po	PSI/kPa						
Water Temperature (at Cooler Inlet)	Ti	F/C						
Water Temperature (at Cooler Outlet)	To	F/C						
Oil Level	—							
Oil Added	—	Gal/L						
Capacity	—	%						
Motor Current	1	Amp						
Receiver Liquid Level		ft/m						
Refrigerant Added		lb/kg						
Machine Room Temp.		F/C						
Outside Temperature		F/C						
Outside Wet Bulb Temperature		F/C						

Oil should preferably be added after the compressor has stopped or been shut down. Add sufficient oil into the oil separator to bring the oil level to the bottom of the top sight glass with a hand or electric pump capable of pumping oil against a pressure of 100 PSI (700kPa). When the compressor is running, use a hand or electric pump to add oil through a 100 mesh strainer into the normally plugged connection on top of stator at the suction end (port X15 of Figure 1-3 thru 1-26).

If the addition of oil becomes too frequent, a problem may have developed causing this excessive loss. See Troubleshooting (Section 5.6) under High Oil Consumption for a probable cause and remedy.

5.3 MAINTENANCE AFTER THE INITIAL 200 HOURS OF OPERATION

After the initial 200 hours of operation, a few maintenance tasks are necessary to rid the system of foreign materials which may have accumulated during assembly and installation. Other procedures, stated below are required to ensure that the initial operation of the machine is correct.

1. Change the oil.
2. Replace the oil filter element.
3. Clean all oil strainers.
4. Clean the gas suction strainer.
5. Check the settings of the capacity control valve pressure switch (P1/P2).
6. Check the pressure gauge calibration (0 PSIG or 0kPag) when open to atmosphere.
7. Tighten all bolts, especially motor and compressor mounting bolts.
8. Check compressor shaft seals for excessive leakage over 10 drops per minute. A small oil loss of 1 to 2 drops per minute is normal.
9. Check low oil pressure protective switch.
10. Check high oil temperature protective switch.
11. Check high discharge temperature protective switch.
12. Check start-up oil pressure switch and system differential switch.
13. Restart and check all operating temperatures and pressures.

5.4 OIL ANALYSIS PROGRAM

The oil injection screw compressor has proven to be a most reliable and successful compressor, but because of the washing action of the oil, the oil quality must be checked closely for maximum compressor life. Since it is impossible to look at the oil and determine its quality, chemical analysis by a qualified concern signifies when to change the oil. Oil analysis has proven to be of great value in preventing lubrication problems by diagnosing poor quality or contamination before significant damage has been done.

WHAT CAUSES THE OIL CONTAMINATION AND BREAKDOWN

Why oil breaks down or becomes contaminated is chemically complex and often cannot be easily evaluated. Several of the problems are:

1. AMMONIA SALTS - These are formed with water from oil cooler leaks and condenser leaks during low head pressure operation or system shutdown or from low side leaks.

2. EXTERNAL DIRT FINS OR LIQUIDS - Dirt comes from improperly cleaned new systems or old systems that contain used oil from reciprocating compressors.

3. POOR OIL QUALITY - Several systems have had problems with excessive oil breakdown, oil discoloration and/or incorrect oil viscosity. To avoid poor oil quality, purchase one of the oils suggested in Section 2.2 directly from one of the major oil companies or their approved dealers.

⚠CAUTION

Used or filtered oil should never be added to a refrigeration screw compressor under any circumstances. Use only new oil.

4. HIGH OIL VISCOSITY - During normal operation, a small amount of oil will be lost from the compressor since the separator cannot be 100% efficient. The oil that escapes, tends to be the more volatile constituents resulting in increased viscosity in the remaining oil and improper bearing lubrication.

5. LOW OIL VISCOSITY - If the system has other compressors using lower viscosity oils, the returning oil dilutes the oil and lowers its viscosity.

6. OXYGEN - The air which is drawn in through valve glands, pinhole leaks in low temperature systems where the evaporating pressure is less than atmospheric pressure, or from air entering after servicing the system components, forms oxygenated organic compounds. These are a constituent of varnish.

WHAT AN OIL ANALYSIS CHECKS

A proper analysis will check the following basic properties of the oil:

1. Viscosity
2. Quantity of particle contamination
3. Moisture content
4. Acid level
5. Chemical analysis of metal contamination including tin, sodium and other reactive metal ions.

Sullair Refrigeration strongly recommends an oil analysis for a new compressor after its initial operation to assist in evaluating potential problems during the early stages of its life. The initial oil analysis and follow up check have resulted in an early warning for many customers of oil contamination, breakdown and changes in viscosity, all of which can affect the lubricating quality of the oil and thus the machine life.

In order to have this service work carried out most efficiently and effectively, Sullair Refrigeration has designated a laboratory to perform the oil analysis. Sullair Refrigeration Service Department will submit an evaluation of the analysis to you.

INSTRUCTIONS FOR SULLAIR'S OIL ANALYSIS SERVICE

Refer to Figures 5-1, 5-2, and 5-3.

1. Issue an order to Sullair Refrigeration Parts Department for three (3) oil analysis service kits (P/N 013214).
2. Oil samples are to be drawn from the oil drain valve on the oil separator sump while the oil is warm. Some oil should be allowed to flow to a waste container before the sample bottle is filled to ensure a representative sampling.
3. A label on the cap of the sample bottle has been provided for sample identification. This label must be properly filled out and attached to the sample bottle cap for the oil sample to be quickly processed (See Figure 5-1).
4. Fill out the "Sullair Fluid Sample" Form as in Figure 5-2. Note that the package serial number from the control nameplate is important and must be included. Remove the backing paper from this tag and attach to sample bottle.
5. Fill out the "Oil Sample Information Sheet" as in Figure 5-3.

Figure 5-1 Oil Sample Bottle Cap

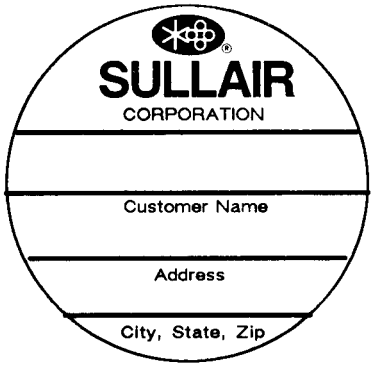


Figure 5-2 Compressor Identification Record

SULLAIR FLUID SAMPLE

MACHINE S/N:

HOURMETER READING:

HOURS ON FLUID:

DATE SAMPLED:

FLUID ADDED:

FLUID TYPE:

Figure 5-3 Oil Sample Data Sheet

(Return this portion with Oil Sample)

OIL SAMPLE INFORMATION

CUSTOMER NAME _____

ADDRESS _____

CITY & STATE _____ ZIP _____

ATTN: _____ PHONE _____

SERIAL# _____ MODEL# _____

HOURMETER _____ HOURS _____

HOURS SINCE LAST OIL DRAIN _____

FLUID TYPE _____

DATE SAMPLE TAKEN _____

6. Draw the initial oil sample at 150 hours of compressor operation. A new oil sample from your unused stock should be taken at the same time to evaluate the quality of the new oil.
7. Place the 150 hour used sample and the new oil sample in the mailers provide along with the Sullair Fluid Sample Form and the Oil Sample Information Sheet and mail them First Class directly to the laboratory for prompt analysis.
8. You will receive by mail from Sullair Refrigeration Service Department a summary of the laboratory analysis of your 150 hour oil sample.

⚠CAUTION

Regardless of the findings of the 150 hour analysis, the oil must be changed after the initial 200 hours as described in Section 5.3.

9. Draw the second oil sample at 1000 hours of compressor operation.
10. The 1000 hour sample should be accompanied by a filled out Oil Sample Information Sheet and again mailed First Class directly to the laboratory for prompt analysis.
11. You will again receive by mail from Sullair Refrigeration Service Department, a summary of the laboratory analysis of your oil. With the summary of your 1000 hour analysis, will come a recommendation on the time interval for future oil checks.

INSTRUCTIONS FOR CONTINUATION OF OIL ANALYSIS SERVICE

After the two initial oil analysis have been completed, Sullair Refrigeration recommends that this oil analysis program be continued as part of a routine maintenance program. After the 150 hour and 1000 hour oil analyses, the following schedule is recommended for oil sample analyses:

1. Every 1000 hours of operation for the first 6000 hours.
2. Every 2000 hours thereafter or any time an unusual problem of discoloration, filter plugging or oil contamination occurs.

The cost of these oil analyses is insignificant when the value of a compressor is considered. It is recommended that your oil analysis program be continued with our designated lab to provide uniformity to the oil analysis, the oil analysis report and Sullair's interpretation of the analysis report. However, if you have had good experience with another laboratory or prefer dealing with your oil supplier, you can continue your oil analysis program with them. Be sure to send reports made by other labs to Sullair Refrigeration Service Department so we may assist you in analyzing the results of the test.

5.5 MAINTENANCE SCHEDULE

Table 7 is intended as a minimum maintenance schedule. Abnormal conditions may require more frequent action as determined by your daily log readings.

TABLE 7

MAINTENANCE SCHEDULE

OPERATION	SCHEDULING TIME PERIOD
1. Check all operating indicators per Section 2.1 operating limits and switch settings.	
Net Oil Pressure (equals oil pressure gauge reading minus suction pressure gauge reading)	DAILY
Oil Temperature	DAILY
Discharge Pressure	DAILY
Discharge Temperature	DAILY
Suction Pressure	DAILY
Oil Filter Pressure Drop	DAILY
Oil Level	DAILY
Motor Current	DAILY
2. Test all protective controls per 2.1 operating limits and switch settings and 3.13 electrical check.	
Low Oil Pressure Protective Switch	MONTHLY
High Oil Temperature Protective Switch	MONTHLY
High Discharge Temperature Protective Switch	MONTHLY
High Discharge Pressure/Low Suction Pressure Protective Switch	MONTHLY
Anti-recycle Timer Setting	MONTHLY
Oil Heater Thermostat Setting	MONTHLY
Capacity Control Timer	MONTHLY
Refrigerant Relief Valve Leakage	MONTHLY
EVA Cam Switch Settings	MONTHLY
3. Maintain oil quality per 5.4 oil analysis program.	
Sample Oil to Check Appearance and Run Oil Analysis	Every 1000 hours for first 6000 hours and every 2000 hours thereafter.
Change Oil	Every 3 months or 2000 hours unless using oil analysis. Maximum time is 6 months.
Change Oil Filter Element	Whenever oil is changed or when pressure drop across the filter exceeds 25 PSI (172.4kPa) or is less than 4 PSI (27.6kPa).
Clean All Oil and Gas Strainers	Whenever oil is changed.
4. General Maintenance	
Check Noise Level	DAILY
Check Electric Motor Bearings Temperature	MONTHLY or as recommended by motor manufacturer
Lubricate Electric Motor Bearing	YEARLY or as recommended by motor manufacturer
Inspect Oil Cooler Cleanliness	Every 3 months until required cleaning frequency is established. Intervals between cleaning depend on contamination in cooling water.

5.6 TROUBLESHOOTING

The information contained in the Troubleshooting chart has been compiled from data gathered from field service reports and factory experience. It contains symptoms and usual causes for the service problems described, however, DO NOT assume that these are the only problems that may occur. All available data concerning the trouble should be systematically analyzed before undertaking any repairs or component replacement procedures.

With any problem, make a detailed visual inspection and look for heat damaged electrical parts (apparent by discoloration or burned odor), loose wiring and damaged piping. Then analyze the problem logically step by step with the aid of the Troubleshooting chart.

Should your problem persist after making the recommended checks, consult the Sullair Refrigeration Service Department.

TROUBLESHOOTING

SYMPTOM	*PROBABLE CAUSE AND REMEDY*
1. Compressor will not start.	1. One of the protective switches tripped; remove cause. Check setting and reset. 2. Recycle timer activated; wait for timer to time out. 3. No power supply to control circuit; check power supply. 4. Oil pump defective; check if motor is running in correct direction and repair. 5. Plugged oil strainer in oil pump suction line; clean. 6. Start-up oil pressure switch out of adjustment or defective; adjust or repair if necessary. 7. Compressor not at minimum position (EVA only).
2. Compressor shuts down immediately after starting.	1. Low oil pressure; see symptom No. 3. 2. High discharge pressure; open discharge stop valves and check condenser fan, condenser water pump and purge noncondensables from refrigerant in condenser. 3. Low suction pressure; open suction valves. Check capacity control to see if it unloads automatically. 4. High oil or discharge temperature; see Symptoms No. 6 and 7.
3. Low oil pressure.	1. Plugged oil strainer; clean screen 2. Plugged oil filter; replace filter element. DO NOT clean. 3. Low oil charge; check oil level with compressor shut down. 4. Liquid refrigerant in oil. a. Stop liquid carryover. b. Check oil heater. c. On liquid injection machines, check and adjust refrigerant regulating valve, solenoid valve, and low discharge temperature protection switch. For refrigerant regulating valve see Symptom No. 11; causes 1 thru 16. **WARNING:** Do not restart more than two (2) times without pumping 1 gallon (4 liters) of oil into the oil filter to prelubricate the compressor bearings. 5. Water in oil; change or install filter drier. 6. Low oil viscosity; change oil. Investigate lower viscosity oils in other compressors on common system and change to screw compressor grade. 7. Vapor in oil cooler; check vent line from top of cooler. 8. Leaking check valve on the pump discharge and/or pump bypass; repair or replace check valve.
4. High oil pressure	1. Oil temperature too low; see Symptom No. 5.

5. Low oil temperature.	1. Water regulating valve or refrigerant regulating valve out of adjustment or defective; adjust or repair if necessary. 2. Liquid refrigerant in oil. a. Check oil heater and evaporator controls. b. On liquid injection machines, check and adjust refrigerant regulating valve, solenoid valve the low discharge temperature protective switch. For refrigerant regulating valve see Symptom No. 11, Causes 1 thru 16.
6. High oil temperature.	1. Water regulating valve or refrigerant regulating valve out of adjustment or defective or the wrong plate seat (Cv); adjust or repair if necessary. a. The water regulating valve and the refrigerant regulating valve are self contained temperature sensing valves that have a hermetically sealed thermal system. If the charge is lost, the valve will not open. b. Install a new thermal system. 2. Inadequate water supply; clean strainers and check pump. 3. Dirty oil cooler. a. Clean tubes. b. Check water treatment. 4. Refrigerant supply low (liquid injection machines); check liquid supply, installation and stop valves fully open (see Symptom No. 11). 5. Oil in liquid refrigerant supply; drain oil from liquid receiver and check oil carryover from compressors (see Symptom No. 12).
7. High discharge temperature. (water-cooled only)	1. High oil temperature; see symptom No. 6. 2. Plugged oil strainer; clean strainer. 3. Abnormal operating condition (abnormally high suction pressure, high suction superheat or high discharge pressure); check system.
8. Low suction pressure.	1. Excessive suction line pressure drop; check system valves are open and clean suction strainer. 2. Capacity control not modulating; see Symptom No. 10. 3. Refrigerant charge low; add refrigerant. 4. Evaporators starving of refrigerant. a. Plugged liquid feed strainers; clean.
9. High suction pressure.	1. Additional refrigeration load added; check heat loads. 2. Capacity control not modulating; See Symptom No. 10. 3. Excessive refrigerant in evaporators; check liquid feed valves for wear and repair. 4. Liquid refrigerant in suction vapor; check evaporator controls. If problem persists, consider installation of suction liquid trap.

10. Capacity control not operating	1. Pressure switch P1/P2 out of adjustment or defective; adjust or replace if necessary. 2. Timer 3TR out of adjustment or defective; adjust or replace if necessary. 3. Capacity control actuator out of adjustment or defective; adjust or repair if necessary. 4. Hydraulic actuator. a. No power at terminal 41 on wiring diagram. (1) 1TRA contact on line 25 open. (2) Relay 1TRA or timer 1TRX defective; replace. b. Solenoid valves defective. (1) Coil burned out. (2) Dirt under seat. (3) Seats worn; clean, repair or replace if necessary. 5. Electric valve actuator. a. Motor burned out. b. Capacitor bad. c. Limit switches bad or out of adjustment. d. No power to motor. 6. Loose electrical connection.
11. Erratic oil temperature. (liquid injection cooled only)	1. Erratic liquid refrigerant pressure or supply. a. Install sight glass and pressure gauge. b. Add refrigerant or check for improper installation. c. Check stop valves fully open. 2. Oil in liquid refrigerant supply. a. Drain oil from liquid receiver. b. Check oil carryover from compressors (see Symptom No. 12). 3. Low condensing pressure; turn off condenser fan or water pump. 4. Liquid solenoid defective; check coil and valve seat and repair or replace if necessary. 5. Plugged solenoid strainer; clean. 6. "Top" of refrigerant regulating valve bulb not in vertical up ("top" stamped on end of bulb outside of bulb well); reinstall correctly. 7. Refrigerant regulating valve bulb not in good thermal contact with bulbwell; remove bulb and apply heat transfer grease or aluminum paste. 8. Defective refrigerant regulating valve thermal system; replace. 9. Crushed, kinked or twisted capillary; repair or replace entire thermal system. 10. Foreign matter in valve seat; clean. 11. Valve stroke out of adjustment; adjust. 12. Oversized port in valve; check with Sullair Refrigeration Service Department. 13. Valve plate and sliding disc upside down in valve; turn both 180 (disc arrow to point toward scribe mark). 14. Low discharge temperature switch controlling discharge temperature instead of regulating valve; adjust. 15. Liquid refrigerant carryover entering compressor suction. a. Remove cause for carry over. b. Verify by placing liquid injection under hand globe valve control with refrigerant regulating valve cranked down to lowest control temperature. c. If discharge temperature fluctuates under stable suction pressure conditions, liquid carryover is probable. 16. Packing too tight on regulating valve; replace and reset.

12. High oil consumption.	1. Oil not returning to compressor from final stage of oil separator. a. Check oil return sight glass at oil separator. b. If abnormal level shows, clean orifice and/or strainer. 2. Oil separator element and gaskets are incorrectly seated and sealed or defective; reseat and seal or replace if necessary. 3. Excessive oil charge; check oil level with compressor off and drain excess oil. 4. Liquid refrigerant in suction vapor; check evaporator controls. If problem persists, consider installation of suction liquid trap. 5. Oil sump heater defective allowing refrigerant to condense during an off cycle; replace heater. 6. Suction check valve defective (e.g. broken spring); repair or replace if necessary (piston should just close under its own weight). 7. Economizer check valve defective, repair or replace if necessary. 8. Blocked oil return orifices and/or strainers from dry sump and/or element.
13. Motor runs hot.	1. Too many starts in a short period; adjust and check the anti-recycle timer. Replace if defective. 2. Excessive current draw; check ampere unloading relay and thermal overload. Replace if defective. 3. Low voltage; check voltage at the motor starter and the plant supply. a. Check with power supply utilities (the voltage at the motor should never be less than 90% of the nameplate rating at the normal full load motor speed). 4. Unequal phase voltages; check at the motor starter and the plant supply. a. Check with power supply utilities. 5. Blocked ventilation ports; clean. 6. High ambient temperature above 105°F (40°C); reduce machine room temperature. 7. Motor internal centrifugal fan backwards; contact motor supplier. 8. Insufficient or excessive grease in bearings; add or remove grease. 9. Bearings defective; replace or contact motor supplier.
14. Compressor vibrating or noisy.	1. Liquid refrigerant in suction vapor; check evaporator controls. If problem persists, consider installation of suction liquid trap. 2. Rotor end play excessive; contact Sullair Refrigeration Service Department. 3. Motor fan hitting stator; tighten motor end bolts. Contact Sullair Refrigeration Service Department. 4. Any other persistent vibration or noise; contact Sullair Refrigeration Service Department.

5.7 SEASONAL OR LONG TERM SHUTDOWN

To shut down a compressor for four months or longer, tightly shut both the suction and discharge stop valves, the liquid injection globe valve (if liquid injection cooled) and the Sullistage stop valve (if fitted with Sullistage) enclosing refrigerant at low pressure along with the used oil. Disconnect the power source from the compressor drive motor and the electrical control panel.

Place a moisture absorbing compound (e.g. a desiccant such as silica gel) inside the control panel. If water cooled, close the cooling water supply valves and drain the water from the oil cooler.

Place warning tags on the electrical system and all closed stop valves. Those who do not know the machine is shut down for a long term must not attempt to start the compressor until it is ready for normal operation.

Install nitrogen holding charge.

Every month while the compressor is shut down, turn the compressor and motor over several turns.

Prior to starting up after a shutdown, change the oil and pump down the compressor. Before pushing the START button, check items in Section 4.2 noting Items 5 and 7.

5. The oil in the separator sump is above 68°F (20°C) or 10°F (5°C) above the saturation temperature of the package pressure whichever is higher, ideally 80°F to 100°F (27°C to 38°C).
6. One gallon (4 liters) of oil pumped into the filter to prelubricate the compressor bearings.

6.1 GENERAL

The following paragraphs outline the various servicing procedures for the Sullair Refrigeration A Series compressors.

For assistance with any detail of service or servicing of an item not covered by this manual, please consult Sullair Refrigeration Service Department or their agents. Sullair Service Technicians are available from Sullair Refrigeration who will assist on any servicing procedure.

To prevent needless downtime, have available on site, all parts that may be needed to carry out the repair before commencing any work.

To prevent dirt from entering opened components, keep the surroundings clean and cover the exposed working areas with plastic whenever possible.

Before cleaning a component with a solvent to remove gum or resin like deposits, remove all the O-rings as they can be chemically attacked. Alternatively check the compatibility of the solvent with the O-rings which are neoprene or Buna-N. Unfortunately, those solvents which most readily remove carbon deposits (e.g. trichlorethylene) rapidly attack both neoprene and Buna-N. To ensure no traces of solvent will be left to react with the oil and refrigerant, thoroughly dry the component.

6.2 SHUTDOWN PROCEDURE

⚠WARNING

DO NOT remove caps, plugs or other components when compressor is running or pressurized. Stop the compressor and relieve all internal pressure before removing caps, plugs or other components.

⚠WARNING

Before commencing work on any item on the package, ensure that the following are carried out for your own personal protection.

1. Whenever the compressor is to be shut down for service, place warning tags on the electrical system and the line valves. Others who do not know the machine may be faulty or is being repaired must not attempt to start the compressor until the servicing is complete and it is ready for normal operation. Exposed electrical wiring must always carry a warning tag even though it is disconnected from the power supply.
2. Stop the compressor with the STOP button on the control panel.
3. Disconnect the starter from the power supply and lock out the disconnect.
4. Disconnect and lockout the control power from the 115V power supply.
5. Close compressor suction stop valve and discharge stop valve.
6. If the compressor is liquid injection cooled and fitted with a relief valve (between the main solenoid valve and the stop valve, relieving to the inlet of the stop valve), close the liquid feed stop valve. Do not trap liquid refrigerant between valves in a liquid line. If it is not fitted with a relief valve, than make sure liquid refrigerant is bled from the pipe by manually opening the solenoid valve and/or breaking the flanges.
7. If the compressor is fitted with Sullistage port, close the Sullistage stop valve.
8. Relieve the gas pressure in the package by opening the blowdown valve on the oil separator to either a pump out compressor or to the atmosphere. If using a pump out compressor, pull the package pressure to atmospheric pressure (15 PSIG/105kPa on the suction pressure gauge) and open the blowdown valve on the separator to the atmosphere.
9. Leave the blowdown valve open to the atmosphere all the time while working on the package.

6.3 BOLT TIGHTENING TORQUES

The tightening torques for servicing the various screws used in the package are given in Table 9. All fasteners (e.g. the ferryhead screw) used in the compressor unit, are high tensile Grade 8 only and they must always be torqued to Condition B when the compressor is serviced. The fasteners on the package (e.g. flange screws) are medium tensile Grade 5 and the tightening torques in Table 9 may be used as a guide.

Screws of different grades may be distinguished by the number of slashes on the hexagonal head, (e.g. Grade 5 screws have three slashes and Grade 8 screws have six slashes per Table 9). All ferryhead screws are Grade 8.

When a torque wrench is not available, it is possible to approximate these values by using an ordinary wrench or piece of pipe on wrench. For example, to obtain 100 ft./lbs. wrench torque, pull 100 pounds at 1 foot distance from center of pull to center of screw, or pull 50 pounds at a 2 feet distance, etc., in a direction perpendicular to the line connecting the center of the screw and the center of pull.

TABLE 9 TIGHTENING TORQUES FOR THREADED BOLTS

FASTNER		TIGHTENING TORQUES: lb$_f$ft in top line / N.m in bottom line									
DIAMETER	PITCH	GRADE 5					GRADE 8				
	THREAD	*CONDITION					*CONDITION				
INCH	INCH	A	B	C	D	E	A	B	C	D	E
1/4	20	8.0 10.8	6.0 8.1	5.5 7.5	4.0 5.4	7.2 9.8	12 16.3	9.0 12.2	8.0 10.8	6.0 8.1	11 14.9
5/16	18	17 23	13 17.6	11.5 15.6	8.5 11.5	15.3 21	25 34	18 24	17 23	12.5 16.9	22.5 31
3/8	16	30 41	23 31	20 27	15 20	27 37	45 61	35 47	31 42	22.5 31	40 54
1/2	13	75 102	55 75	50 68	38 52	68 92	110 149	80 108	74 100	55 75	99 134
5/8	11	150 203	110 149	100 136	75 102	135 183	220 298	170 230	147 199	110 149	198 268
3/4	10	260 353	200 271	174 236	130 176	234 317	380 515	280 380	255 346	190 258	342 464
7/8	9	430 583	320 434	288 390	215 291	387 525	600 813	460 624	402 545	300 407	540 732
1	8	640 868	480 650	429 582	320 434	576 781	900 1220	680 922	603 818	450 610	810 1098

GRADE	IDENTIFICATION MARK	TENSILE STRENGTH		YIELD STRENGTH		DIAMETER
		PSI	MPa	PSI	MPa	inch
5		105,000	725	81,000	560	ALL SIZES
8		150,000	1035	130,000	900	ALL SIZES

*CONDITIONS
A) Non-lubricated solvent-cleaned and dry.
B) Lubricated with rust preventative or cadmium or zinc plated.
C) Lubricated with oil or grease.
D) Lubricated with dry lube film or graphite/oil mixture.
E) Lubricated with loctite or sealants.

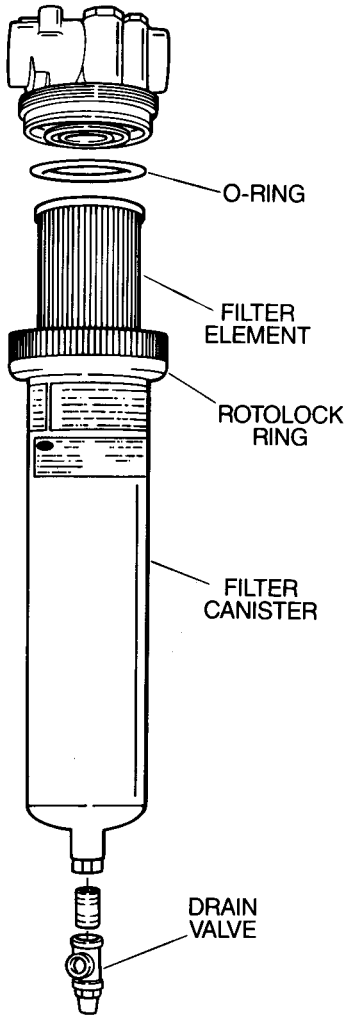
6.4 OIL FILTER ELEMENT REPLACEMENT

Refer to Figure 6-1. Whenever the oil pressure drop over the filter exceeds 25 PSI (170kPa), the old oil filter element should be discarded (not cleaned) and replaced with a new filter element.

SINGLE FILTER REMOVAL

1. Carry out the shut down procedure in Section 6.2.
2. Open the drain valve on the bottom of the filter to drain the filter oil and reduce pressure to atmospheric.
3. Loosen the filter canister by turning the rotolock ring. This can normally be turned by hand when the pressure inside the filter has been reduced to atmospheric pressure.
4. As the rotolock ring is turned, it will pry off the filter canister and the ejection spring will loosen the filter element.
5. Discard filter element and clean the filter canister.

Figure 6-1 Oil Filter



SINGLE FILTER INSTALLATION

⚠CAUTION

Ensure that the replacement element is Sullair P/N 250008-955 and is labeled.

1. Replace large O-ring.
2. Assemble the filter element into the filter canister with opening in filter element up. Make sure small O-ring is installed properly in the filter element.
3. Set assembly up to the filter manifold and make sure that filter element pushes ejector ring up as rotolock ring is tightened. Hand tighten rotolock ring only.
4. Pump one (1) gallon (4 liters) of oil through the oil drain valve into the oil filter to replenish the filter chamber.
5. Shut the oil drain valve.
6. Open the compressor suction and discharge stop valves.
7. If the compressor is liquid injection cooled, open the liquid refrigerant stop valve.
8. If the compressor is fitted with a Sullistage port, open the Sullistage stop valve.
9. Reconnect the control panel to the 115V supply line.
10. Reconnect the starter to the electrical supply line.
11. Start the compressor.

DUAL FILTER (Optional)

Refer to Figure 6-2. If your compressor is equipped with the optional dual filter, the filter canister can be replaced while the compressor is running.

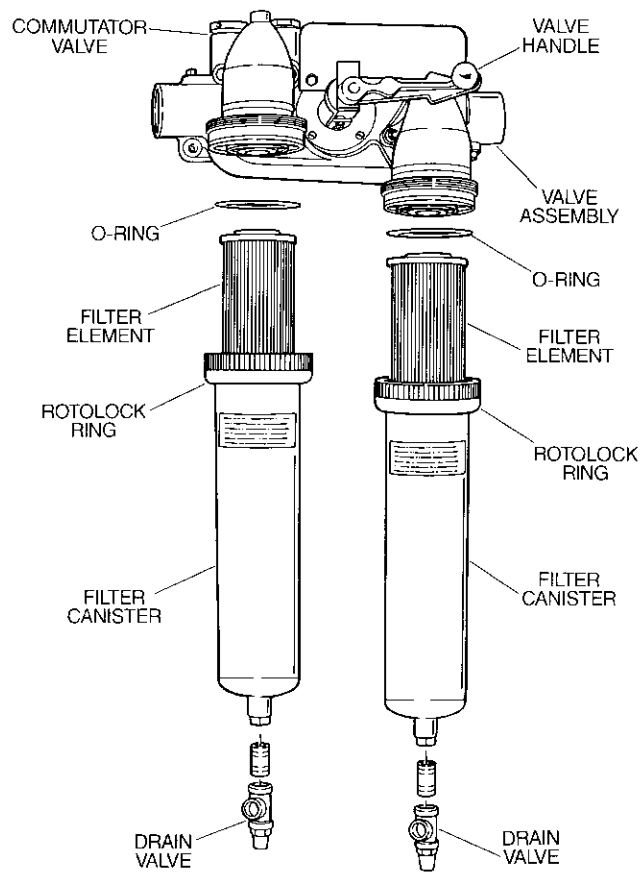
⚠CAUTION

As compressor is pressurized, all steps must be performed with extreme caution in the event of leakage around the filter seals, and the resultant possibility of high pressure gas being present.

REMOVAL

1. Make sure commutator valve is open.
2. Slowly rotate valve handle to point to clean filter.
3. Close commutator valve.
4. Open the drain valve on the bottom of the dirty filter to drain the oil and reduce canister pressure to atmospheric.
5. Loosen the filter canister by turning the rotolock ring. This can normally be turned by hand when the pressure inside the filter has been reduced to atmospheric pressure.
6. As the rotolock is turned, it will pry off the filter canister and the ejector spring will loosen the filter element.
7. Discard the filter element and clean the filter canister.

Figure 6-2 Dual Filter



INSTALLATION

⚠CAUTION

Make sure that the replacement element is Sullair P/N 250008-955 and is labeled.

1. Replace large O-ring.
2. Assemble the filter element into the filter canister with opening in the filter element up. Make sure that the small O-ring is installed properly in the filter element.
3. Set the assembly up to the filter manifold and make sure that the filter element pushes the ejector ring up as the rotolock ring is tightened. Hand tighten the rotolock ring only.
4. Close the oil drain valve.
5. Slowly open the commutator valve to allow clean oil into the filter.

⚠CAUTION

If the compressor is shut down when the filter elements are changed then follow the installation procedure for a single filter.

6.5 SHAFT SEAL REPLACEMENT

Carry out the shutdown procedure in Section 6.2. When shaft seal replacement is necessary, use replacement per recommended spare parts (Section 7.1) and follow the procedures supplied with the shaft seal kit or explained in the following paragraphs.

6.6 DIRECT DRIVE COMPRESSOR (A12LA200 or A12LB200)

Refer to Figure 6-3.

DISASSEMBLY

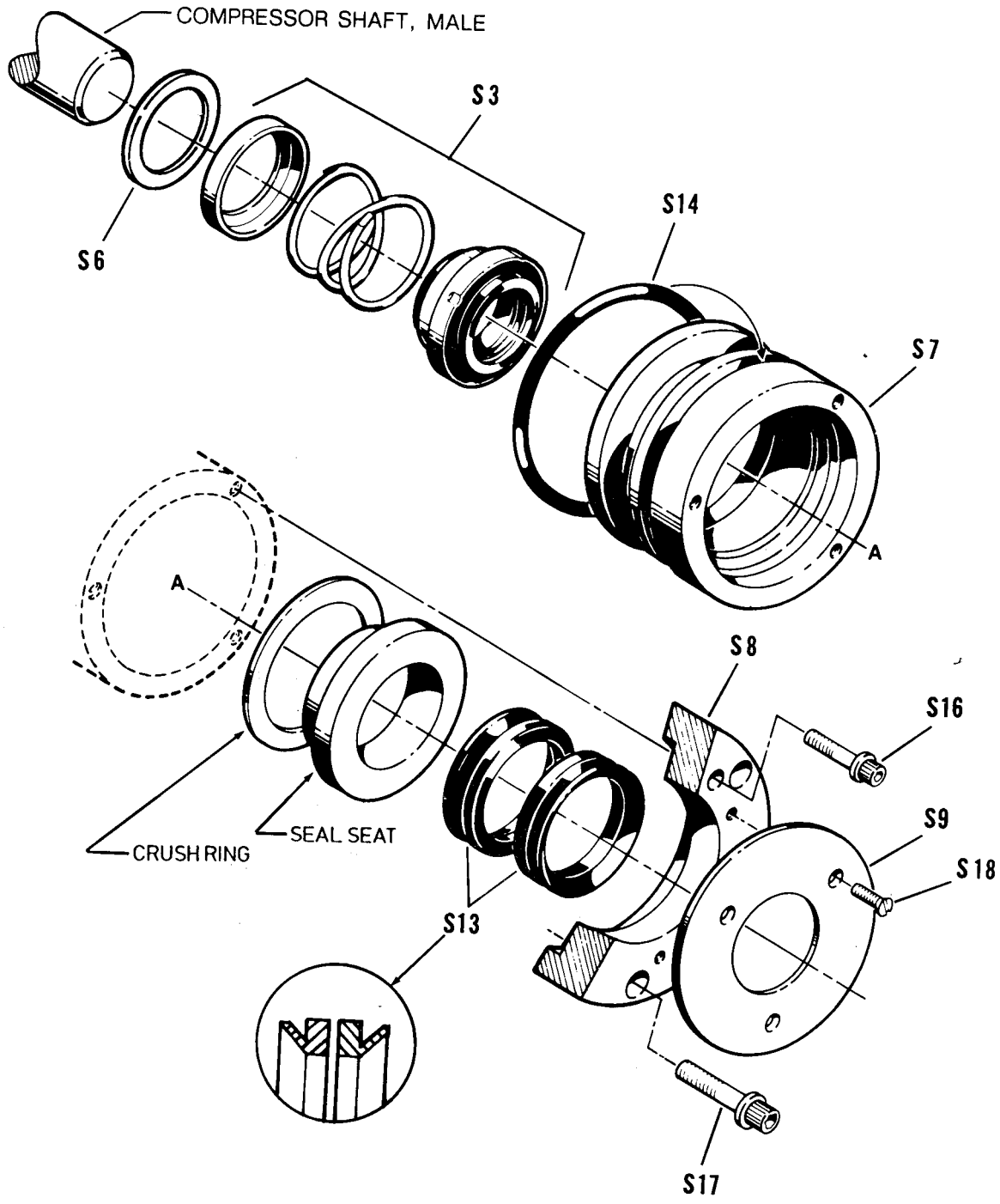
1. Remove the three (3) screws (S18) which hold the V-ring cover (S9) up against the seat retainer (S8). Remove the V-ring cover (S9).
2. Remove both rubber V-rings (S13).
3. Remove the seven (7) screws (S17) which hold the seat retainer (S8) and remove the retainer assembly (S7, S8, S16, seal seat and crush ring).
4. Disassemble the retainer assembly by removing the three (3) screws (S16) from the seat retainer (S8).
5. Remove the seal seat and crush ring from the seal housing (S7).
6. Remove the O-ring (S14) from the seal housing (S7).
7. Remove the seal (S3) from the shaft. The rubber bellows is bonded to the shaft and has to be broken loose by pushing the whole seal further down the shaft. If tools are used, care should be taken that the shaft is not scratched or damaged in any way.

⚠WARNING

The seal spacer (S6) and shim set (not shown) behind the spacer must not be removed.

Figure 6-3 Direct Driven Units

SHAFT SEAL ASSEMBLY



INSPECTION AND PREPARATION FOR SEAL ASSEMBLY

1. Clean all parts thoroughly and scrape off any debris or material on the parts.
2. Check the bore edges of the seat retainer (S8) and seal housing (S7) for burrs and break any sharp edges. Make sure oil supply orifice in housing (S7) is open and clean.
3. Remove all burrs and break all sharp edges on the shaft.

⚠WARNING

New seal must slide over the shaft and any sharp edges will cut the seal. Therefore, the sharp edges on the shaft must be rounded off or broken.

4. Clean the shaft thoroughly with fine emery cloth to remove any dirt, metal particles, etc.

ASSEMBLE THE RETAINER ASSEMBLY

⚠WARNING

The finish of the lapped surface is easily damaged and must be handled carefully. The lapped face can be identified by its highly polished surface. Fingers should not come in direct contact with the lapped surface. Coat the lapped surface of the seal seat with lubricant provided in the shaft seal kit.

1. Unwrap the seat.
2. Install the crush ring and seal seat in the seal housing (S7) with the lapped surface facing the inside of the compressor. Check to make sure the seat is evenly seated.
3. Attach the seat retainer (S8) to the seal housing (S7) with the three (3) screws (S16). Torque the screws to 9 ft./lbs.

NOTE

The bolt pattern is irregular and the parts will only fit together one way.

4. Install the O-ring (S14) in the groove of the seal housing (S7).

INSTALLATION OF SEAL

1. Coat the shaft with lubricant provided in the shaft seal kit.
2. Unwrap the seal assembly. Coat the lapped surface of the carbon face with lubricant provided in the shaft seal kit.

⚠WARNING

The carbon is easily damaged and must be handled carefully. Fingers should not come in direct contact with the lapped surface of the carbon face.

3. Install the seal assembly (S3) on the shaft with the carbon surface facing out, just far enough to assure that the tail section is past the shaft chamfer.

⚠WARNING

This seal assembly must be started squarely over the shaft by hand force against the carbon face and protecting the face with cardboard. If the seal assembly becomes locked on the shaft, remove it and start over. Excessive force should not be necessary. Extreme caution must be exercised not to damage the carbon surface and to keep it clean.

4. Install the retainer assembly over the shaft and line up the bolt holes.

NOTE

The bolt pattern is irregular and the retainer will only bolt on one way.

Push down squarely and slowly against the seal assembly until the seat retainer (S8) contacts the housing. The seal will then be at proper operating height. Hold the retainer assembly in position with one hand while installing any two screws (S17) opposite each other. Torque the screws to 35 ft./lbs.
5. Once the two (2) screws (S17) are in place, install the remaining five (5) screws and torque them to 35 ft./lbs.

INSTALLATION OF V-RINGS

1. Coat the shaft and I.D. of V-rings (S13) with the lubricant provided in shaft seal kit.
2. Install the V-rings (S13) on the shaft to the dimension specified with the lips facing as shown.
3. Install the V-ring cover (S9) with the three (3) screws (S18).

6.7 GEAR DRIVE UNITS (A12LA231, A12LA251, A12LA276)

Refer to Figure 6-4.

DISASSEMBLY

1. Remove the six (6) screws (S19) which hold the oil seal retainer (S5) in place.
2. Remove the retaining ring (S17) and seal seat from the oil seal retainer. If the spring pin (S15) in the oil seal retainer is sheared or bent, remove it.
3. Remove the O-ring (S14) from the oil seal retainer (S5).
4. Remove the seal (S12) from the shaft. The rubber bellows is bonded to the shaft and has to be broken loose by pushing the whole seal further down the shaft. If tools are used, care should be taken that the shaft is not scratched or damaged in any way. Remove the oil seal spacer (S1). If the pin (S15) located in the oil seal spacer is sheared or bent, remove it. If not, replace the spacer on the shaft.

INSPECTION AND PREPARATION FOR SEAL ASSEMBLY

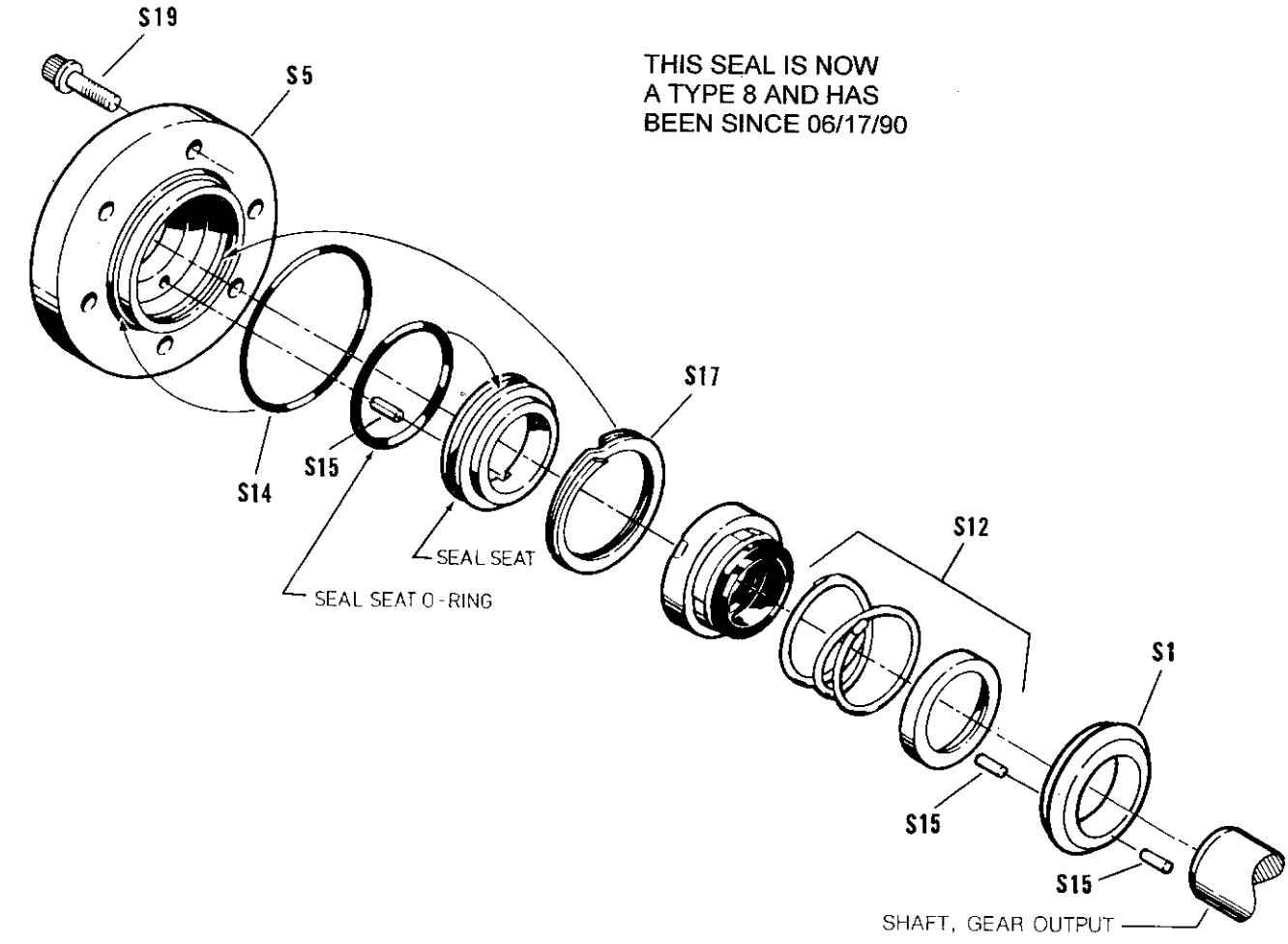
1. Clean all parts thoroughly and scrape off any debris or material on the parts.
2. Check the bore edges of the seal retainer (S5) and the adaptor housing for burrs and break any sharp edges. Make sure the oil supply orifice in the adaptor housing is open and clean.
3. Remove all burrs and break all sharp edges on the shaft.

⚠WARNING

New seals must slide over the shaft and any sharp edges will cut the seal. Therefore, the sharp edges on the shaft must be rounded off or broken.

Figure 6-4 Gear Drive Units

SHAFT SEAL ASSEMBLY



4. Clean the shaft thoroughly with fine emery cloth to remove any dirt, metal particles, etc.

ASSEMBLE THE OIL SEAL RETAINER ASSEMBLY

1. If a new pin (S15) is required in the oil seal retainer (S5), install it at this time.
2. Lightly coat the bore of the seal retainer (S5) with lubricant provided in the shaft seal kit.
3. Unwrap the seat.

⚠WARNING

The finish of the lapped surface is easily damaged and must be handled carefully. The lapped face can be identified by its highly polished surface. Fingers should not come in direct contact with the lapped surface. Coat the lapped surface of the seal seat with lubricant provided in the shaft seal kit.

4. Install the seal seat and seal seat O-ring in the oil seal retainer (S5) with the lapped surface facing the inside of the compressor. Check to make sure that the seat is evenly seated.
5. Install the retaining ring (S17).
6. Install the O-ring (S14) in the groove of the oil seal retainer (S5).

INSTALLATION OF SEAL

If the oil seal spacer (S1) was removed, continue with Step 1. If it was not removed, go on to Step #2.

1. If a new pin (S15) is needed, install it in the oil seal spacer (S1).
2. Slide the spacer (S1) over the shaft until the pin (S15) on the back side of the spacer lines up with the slot in the input shaft. The spacer should fit flat against the shaft shoulder.
3. Coat the shaft with lubricant provided in the shaft seal kit.
4. Unwrap the seal assembly.

⚠WARNING

The carbon is easily damaged and must be handled carefully. Fingers should not come in direct contact with the lapped surface of the carbon face. Coat the lapped surface of the carbon face with lubricant provided in the shaft seal kit.

5. Install the seal assembly (S12) on the shaft, with the carbon surface out, just far enough to assure that the tail section is past the shaft chamfer.

⚠WARNING

This seal assembly must be started squarely over the shaft by hand force against the carbon face and protecting the face with cardboard. If the seal assembly becomes locked on the shaft, remove it and start over. Excessive force should not be necessary. Extreme caution must be exercised not to damage the carbon surface and to keep it clean.

6. Coat the carbon surface of the seal and the lapped surface of the seat in the oil seal retainer assembly with lubricant provided in the shaft seal kit. Install the seal retainer (S5) over the shaft and line up the bolt holes.

NOTE

The bolt pattern is irregular and the retainer will only bolt on one way.

Push down squarely and slowly against the seal assembly until the seal retainer (S5) contacts the housing. The seal will then be at proper operating height. Hold the retainer assembly in position with one hand while installing any two (2) screws (S19) opposite each other. Torque the screws to 35 ft./lbs.

⚠WARNING

The retainer assembly must be held in position until the two (2) screws (S19) are installed since releasing the assembly may not allow the spring to exert the correct pressure between the lapped faces of the seat and carbon. This will result in seal failure within a short period of time.

7. Once the two screws (S19) are in place, install the remaining four (4) screws and torque them to 35 ft./lbs.

6.8 WATER COOLED OIL COOLER CLEANING

The internal diameter of the ⅜" (9.5mm) tubes in the standard cooler is 0.300" (7.6mm).

1. Disconnect the starter from the electric supply line and lockout the disconnect.
2. Disconnect the control panel from the 115V electric supply line.
3. Close water supply and return stop valves.
4. Remove the connecting water pipework from the cooler head(s).
5. If mechanical tube cleaning is desired, proceed to Steps 7, 8, 9, 10 and 11.
6. Fit the necessary hose and fittings to the cooler head and flush through a proprietary chemical according to the manufacturer's instructions. Alternately flush through a mild 4% sulfamic acid solution for 15 minutes or until no more scale exists in the outlet acid. As a last resort use a very weak 2% sulfuric acid solution with care as tube damage may result.
7. Remove the cooler heads from each end.

⚠CAUTION

To retain the correct angular orientation of the cooler heads make two marks adjacent to each other on the cooler head and the cooler with a punch or file.

8. With a rotary wire brush mechanically brush each tube in turn ensuring that the brush reaches the far end. Make sure all tubes are cleaned, otherwise the flow may be partially blocked in some tubes causing overheating or cooling which results in severe expansion stresses, loosened tube joints and fractured tubes.
9. Clean the heat exchanger and cooler heads.
10. Mount both cooler heads with new gaskets.
11. Thoroughly flush the cooler with clean water and dispose

of this effluent properly.
12. Reconnect the water pipework to the cooler head.
13. Open the water supply and return stop valves.
14. Reconnect the control panel to the 115V electric supply.
15. Reconnect the starter to the electric supply line.
16. Start the compressor.
17. After running for 15 minutes adjust the water regulating valve if necessary to achieve an operating oil temperature per Section 2.1.

6.9 OIL STRAINER SERVICING

OIL STRAINER SERVICING

The strainers in standard packages are shown per the schematics (Figures 1-3 thru 1-26).

1. Carry out the shutdown procedure as in Section 6.2.

⚠CAUTION

If a pump out compressor is used to evacuate refrigerant from the package, do not lower the package pressure to less than atmospheric and be sure to open the blowdown valve on the separator to the atmosphere. If this is not done, when the strainer plugs are removed, the sudden inrush of air to break the vacuum will backflush the foreign matter from the strainers into the lines. After reassembling the apparently clean strainers and running the compressor, the strainers will again plug up.

2. Loosen the hexagonal screwed plug in the end of the strainer until the plug is held by about two threads.
3. Place a receptacle underneath the strainer to catch oil.
4. Unscrew the plug by hand, quickly remove the strainer screen from the recess in the plug and screw the plug about two threads into the empty strainer body.

⚠CAUTION

Be careful to avoid being burned by the hot oil. Use rags or waste cloths for protection.

5. Remove any foreign matter from inside the strainer screen (e.g. fibers) and clean the strainer screen with a light solvent (e.g. mineral spirits).
6. Again unscrew the plug by hand, and quickly insert the strainer screen into the plug recess. Renew the plug gasket, if necessary, and screw the plug into the strainer body. Tighten the plug.
7. While the compressor package is blown down, clean all of the oil strainers as in Steps 2 thru 6.
8. Close the blowdown valve.
9. Open the suction stop valve slowly to prevent compressor shaft rotation and then open discharge stop valve.
10. With the package pressurized, check that none of the strainers are leaking and, if necessary, tighten the plug(s) further.
11. If the compressor is liquid injection cooled, open the liquid refrigerant stop valve.
12. If the compressor is fitted with Sullistage port, open the Sullistage stop valve.
13. Reconnect the control panel to the 115V supply line.
14. Reconnect the starter to the electric supply line.
15. Start the compressor.

6.10 OIL SEPARATOR ELEMENT SERVICING

Refer to Figure 6-5.

INSPECTION

1. Carry out the shut down procedure as in Section 6.2.
2. Remove access cover on the top of the separator.
3. Inspect the element gaskets (2) for tightness. If the gaskets are blown on either end, they must be replaced. If the gaskets had been replaced recently and they are blown again, the element is dirty and the gaskets and elements have to be replaced.

REMOVAL

1. Remove double nut, flat washer and cover plate.
2. Remove element.
3. Scrape old gaskets from both ends of the element if the elements are to be reused.

⚠CAUTION

DO NOT clean element screens with air blast or solvents of any kind.

4. Thoroughly clean the gasket surfaces, cover plate and the bulkhead in the separator.

INSTALLATION

1. Cement new gaskets to the element using Loctite 404 (available from Sullair Refrigeration).
2. Replace element, cover plate, flat washer and double nut.
3. Tighten nuts on the cover plate.
4. Replace the access cover on the oil separator using a new gasket if necessary.
5. Close the blowdown valve.
6. Open the suction stop valve slowly to prevent compressor shaft rotation and discharge stop valve.
7. If the compressor is liquid injection cooled, open the liquid refrigerant stop valve.
8. If the compressor is fitted with a Sullistage port, open the Sullistage stop valve.
9. Reconnect the control panel to the 115V supply line.
10. Reconnect the starter to the electric supply line.
11. Start the compressor.

Figure 6-5 Oil Separator Element

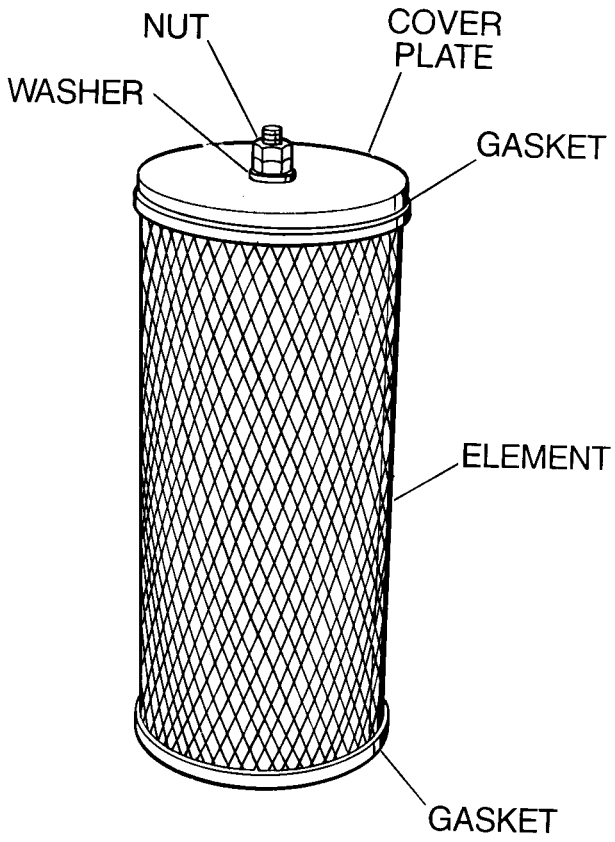
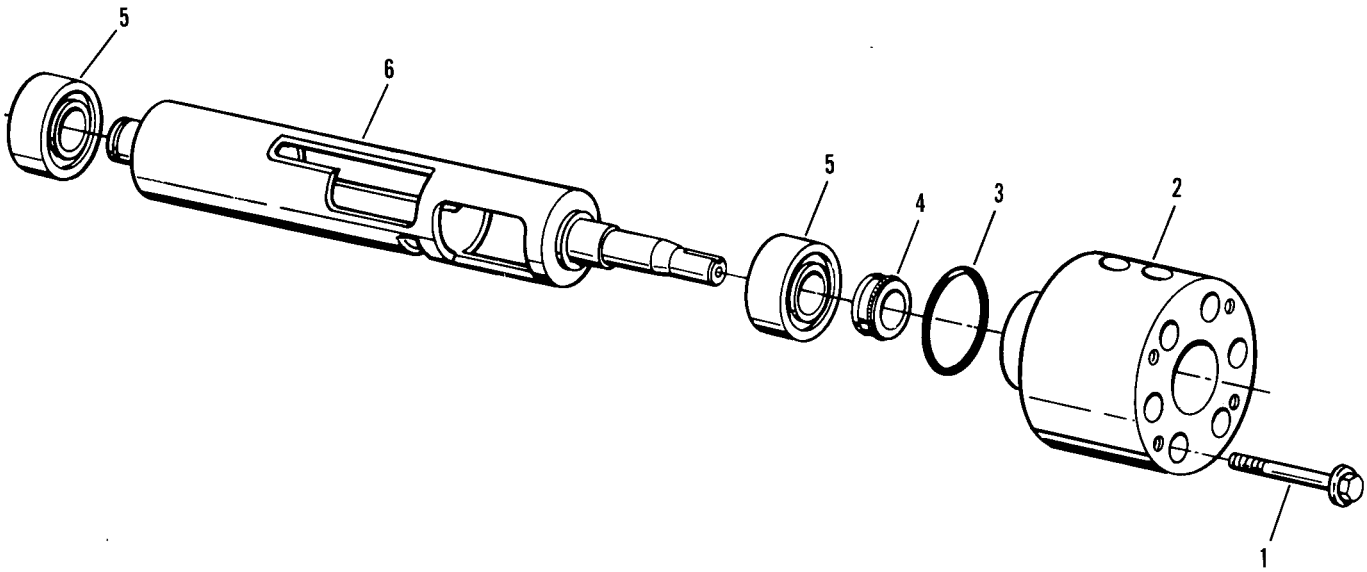


Figure 6-6 Capacity Control Valve



6.11 CAPACITY CONTROL VALVE SERVICING

Should it be necessary to replace the seals on the capacity control shaft, refer to Figure 6-6 for component identification.

DISASSEMBLY

1. Carry out the shut down procedure as in Section 6.2.
2. Disconnect the actuator per Section 6.12 or 6.13.
3. Loosen the six (6) mounting screws (1) from the actuator adaptor (2).
4. Remove the actuator adaptor (2) from the compressor.
5. Remove the turn valve and bearing assembly (5, and 6). Inspect seal area and clean with emery cloth.
6. Remove seal (4) and O-ring (3) from the actuator adaptor.
7. Clean all parts.

ASSEMBLY

1. Coat turn valve and bearings (5, and 6) with refrigerant oil and reinsert into the compressor.
2. Coat the O-ring (3) and seal (4) with refrigerant oil and assemble to the actuator adaptor (2) (Figure 6-6).
3. Install the actuator adaptor (2) back into the compressor and replace the six (6) screws (1).
4. Reinstall the actuator per Section 6.12 or 6.13.

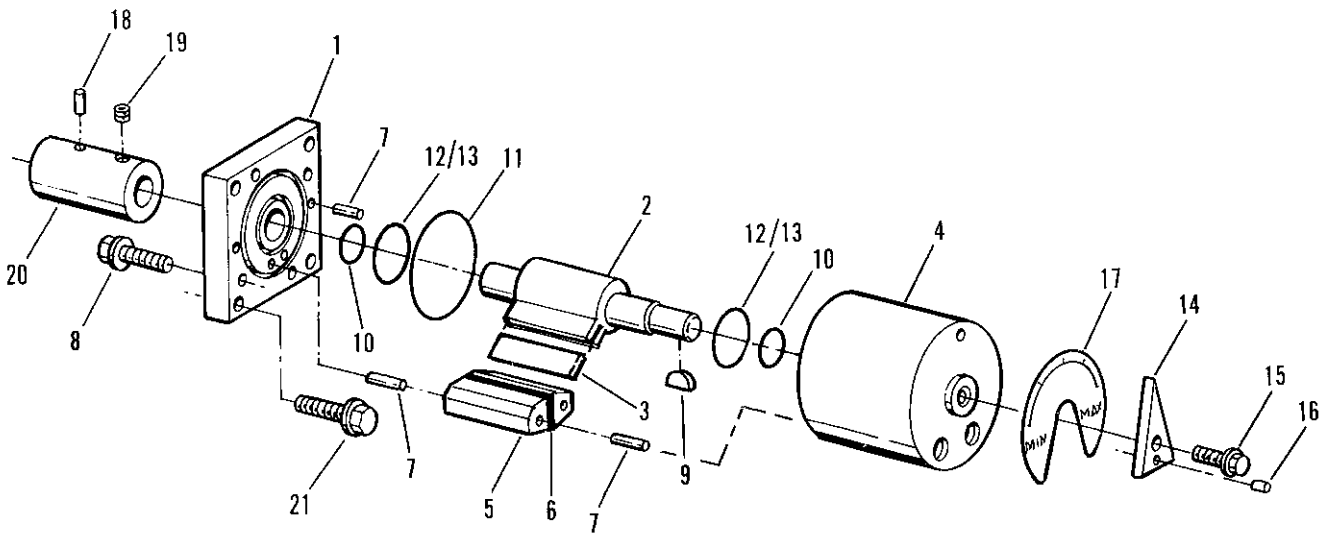
6.12 HYDRAULIC CAPACITY CONTROL ACTUATOR SERVICING

Refer to Figure 6-7.

REMOVAL

1. Carry out the shut down procedure as in Section 6.2.
2. Disconnect fluid lines and drain the oil.
3. Remove the complete actuator by removing the four (4) screws (21) and removing from the compressor.
4. Remove the set screw (19) and coupling (20).

Figure 6-7 Hydraulic Capacity Control Actuator



DISASSEMBLY

1. Remove all burrs from shaft assembly extension.
2. Remove four screws (8) and indicator screw (15) and remove indicator (14).
3. Strike end of shaft opposite loosened head (1) with plastic mallet to free it from dowels (7).
4. Remove head (1), shaft assembly (2), and shoe (5) from body (4).
5. Remove all seals (and dowels if necessary for repair).

INSPECTION AND REPAIR

1. Inspect inside of actuator; presence of foreign material may indicate the need to inspect and clean the filter.
2. Inspect all internal surfaces for excessive scoring or galling which could cause seal damage or internal leakage.
3. Minor score marks can be polished out with fine emery cloth or equivalent. Score marks in any part in excess of .005 (0.12mm) require replacement of that part.
4. Check dowel holes in head (1) and body (4) for elongation. Excessive elongation requires replacement of that part.
5. Place short end of shaft (2) through bearing area in body (4), and shake to determine the condition of the shaft bearing area. Repeat procedure using long end of shaft (2) through head (1). If excessively worn, replacement of the head (1) and/or body (4) is necessary.

REASSEMBLY

1. Thoroughly wash all parts to remove any foreign material that might cause damage and remove any burrs. DO NOT break the corners of the body (4) bore or the corners of the large diameter of the shaft.
2. Lubricate all seals and internal parts with refrigerant oil.
3. Replace and install shaft seal (10) in its groove in the head (1) and in the body (4).
4. Replace and install shoulder seal cushion (13) in its groove in the head (1) and in the body (4).
5. Replace and install shoulder seal cap (12) with radiused corners toward cushion.

NOTE

Corner radii are very small. A magnifying glass may be necessary to determine proper seal orientation.

6. Replace and install head seal (11) in its groove in the head (1).
7. Replace and install shoe seal (6) in its groove around shoe (5).

NOTE

Replacement shoe must be aluminum or steel. No plastic acceptable.

8. Place vane seal (3) in its groove around vane (2).
9. Insert dowel pins (7) into body (4).
10. Install shoe (5) into body (4). Leave approximately 1/8" (3.18mm) between end of shoe (5) and body (4).
11. To assemble shaft (2), tuck in corners of seal (3). DO NOT TWIST. Push straight in until shaft (2) is seated against end of body (4).
12. Complete shoe (5) installation by seating shoe (5) against end of body (4).
13. Press corners of shoe seal (6) and vane seal (3) below end surface of body (4).
14. Install head (1) on body (4), pull down evenly and secure with screws (8) and torque to 35 in./lbs. (4Nm).
15. Reinstall the decal (17), if required, indicator (14) and indicator screw (15). DO NOT tighten.

ADJUSTMENT

1. Install tube fittings into body (4) if removed.
2. Rotate actuator shaft (2) counterclockwise until actuator vane hits the shoe (5).
3. Rotate indicator (14) clockwise until it hits the tube fitting in maximum position.
4. Using pilot hole in indicator (14), drill a 1/8" (3.18mm) diameter hole in shaft (2) approximately 5/16" (7.94mm) deep (this is not required on factory adjusted units).
5. Insert spring pin (16) in hole flush with indicator (14). Tighten indicator screw (15).
6. Install coupling (20), set screw (19) and rollpin (18).
7. Install complete actuator in unit.
8. Install and tighten screws (21).
9. Reconnect tubing.
10. Reverse the shut down procedure as in Section 6.2.

6.13 ELECTRIC VALVE ACTUATOR SERVICING

Refer to Figure 6-8.

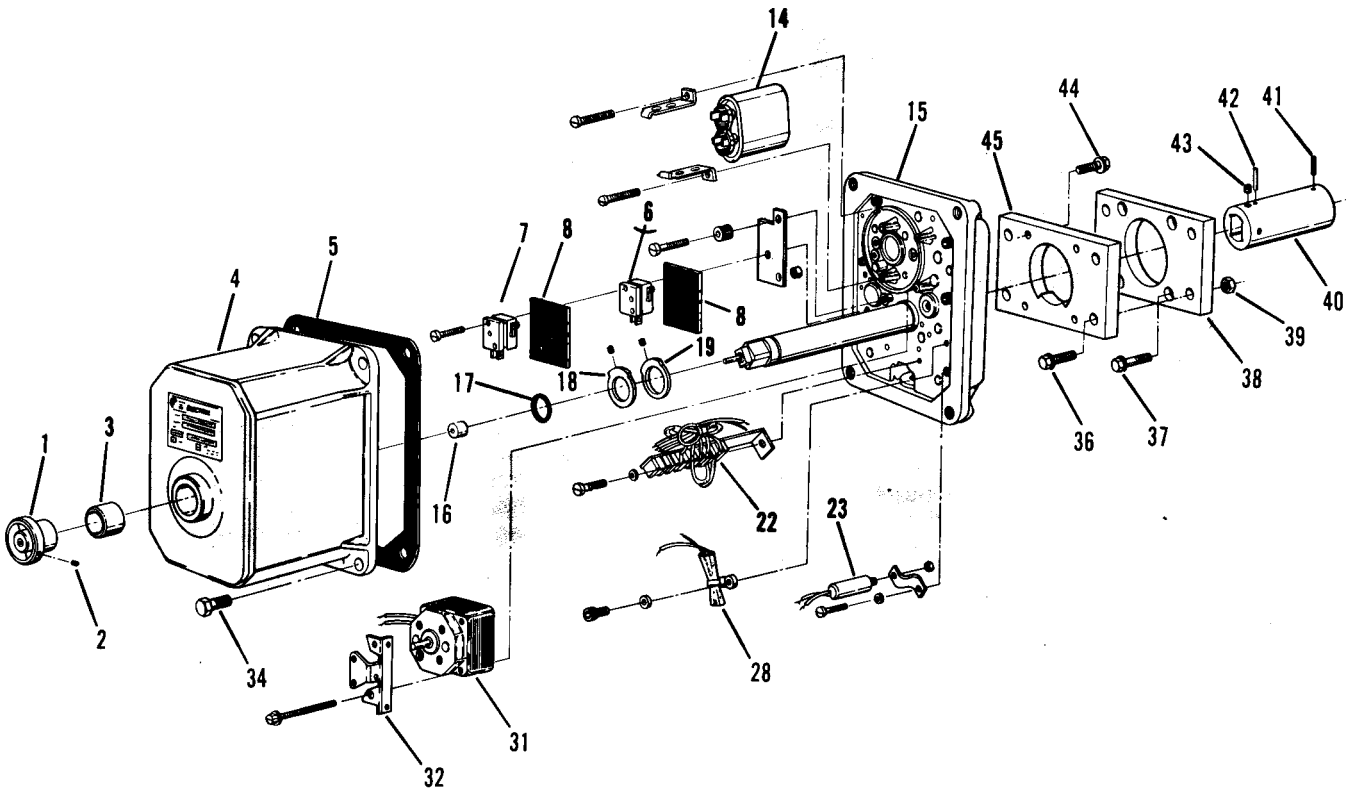
REMOVAL

1. Carry out the shutdown procedure in Section 6.2.
2. If actuator is to be removed from the package or work is to be performed inside the actuator. proceed with Steps 3 to 6, otherwise skip to Step 7.
3. Remove setscrew (2) and handle (1).
4. Remove four (4) screws (34) from cover.
5. Remove cover (4) and gasket (5).
6. Disconnect control panel wiring from terminal strip and remove wires from actuator (only if actuator is to be removed from the compressor package).
7. Remove four (4) bolts (36) and nuts (39) from adaptor plates (38, 45).
8. Remove actuator from compressor.
9. If capacity control valve seal is to be replaced, remove four (4) screws (37) and adaptor plate (38) from the compressor.
10. If actuator is to be replaced, remove four (4) screws (36) and adaptor plate (45).

ADJUSTMENT

1. If adjustment is to be made, leave actuator mounted or remount actuator.
2. Remove cover (4) and gasket (5) as in Steps 3, 4 and 5 from above. Leave wiring connected.
3. Reinstall handle (1) and setscrew (2) to actuator shaft.
4. Pull handle (1) out and turn handle (1) clockwise until mechanical stop is reached. If actuator does not have a mechanical stop proceed to Step 8. Rotate handle (1) a couple of degrees counterclockwise.
5. Locate maximum position switch (7) and rotate cam (18) until switch (7) will trip as shaft rotates to maximum position. Tighten setscrew in cam (18).
6. Rotate handle (1) counterclockwise until mechanical stop is reached. Rotate handle (1) a couple of degrees clockwise.

Figure 6-8 Electric Valve Actuator



7. Locate minimum position switch (6) and rotate its cam (19) so that switch will trip as the shaft rotates to minimum position. Tighten setscrew in cam (19).
Skip Steps 8 thru 12.
8. On compressors built prior to June, 1987, the actuator did not have a mechanical stop. The maximum and minimum position must be set with the compressor running.

⚠CAUTION

All electrical wires will be hot. Caution must be observed to avoid electrical shock. Only qualified personnel must attempt to do this work and the compressor must not be left unattended until cover is replaced. Cover must be removed or replaced with control power turned off.

9. Pull the handle (1) out and slowly rotate the handle (1) clockwise until the motor amps drop indicating that the actuator has gone past the maximum position and rotated to minimum. Rotate the handle (1) counterclockwise until motor amps increase and then start to decrease.
10. Locate the maximum position switch (7) and rotate cam (18) so that the switch (7) will trip as the shaft rotates to maximum position. Tighten the setscrew in cam (18).
11. Rotate the handle (1) clockwise until the motor amps drop.
12. Locate the minimum position switch (6) and rotate its cam (19) so that the switch will trip as the shaft rotates counterclockwise to this position.
Tighten setscrew in cam (19).
13. Rotate handle (1) from minimum to maximum and watch motor amps to verify correct switch settings.

REASSEMBLY

1. After all repairs and adjustments are made, the actuator can be reassembled by reversing steps in Removal section above.

6.14 ELECTRICAL CONTROLS SERVICING

Use the wiring diagram for your specific machine to assist in locating a defective electrical component (the wiring diagram number is on the Sullair logo inside the electrical control panel). Replace defective controls with the new standard industrial controls.

Do not attempt to repair electrical components.

6.15 COMPRESSOR UNIT REPLACEMENT

Should replacement of the Sullair compressor unit be necessary, the following procedures will ensure correct replacement and minimize down time. It is recommended that

Sullair Refrigeration Service Department be involved in the decision to change compressor units.

They will also assist in the ordering of the new unit and scheduling of Sullair Service technician if required.

REMOVAL

1. Carry out the shut down procedure in Section 6.2.
2. Remove tubing in large subassemblies. This will save time and confusion when installing the new unit. Avoid bending the tubing assemblies. In most cases, the assemblies will fit the new unit.
3. When removing the old unit, install temporary pipe hangers to facilitate installation of the new unit.
4. Return the old unit to Sullair Corporation in the same crate in which the replacement was shipped.

INSTALLATION

1. Change the oil filter element and thoroughly clean every oil strainer.
2. Thoroughly clean all tubing and piping with solvent and brush before refitting to compressor.
3. Reconnect the tubing and piping as in a standard unit.
4. Follow the pressure test procedure as in Section 3.8.
5. Follow the evacuation procedure as in Section 3.9.
6. Drain and discard all the oil from the package, by opening the drain valve on the bottom of the oil separator, and then removing the drain plug from the bottom of the oil cooler (if water cooled) or loosening the oil tubing whichever allows draining of low spots in oil piping.
7. Flush the package with clean oil through the discharge temperature connection on the oil separator.
8. Replace the drain plugs, close the oil separator drain valve and charge the system with new oil as in Section 3.11.
9. Warm the oil as in Section 3.12.
10. Check the electrical system as in Section 3.13.
11. Check the protective switches as in Section 3.13.
12. Check the capacity control as in Section 3.13.
13. Follow the pre-start check list as in Section 4.2.
14. Follow the initial start-up procedure as in Section 4.3.
15. Follow the initial maintenance procedures as for a new machine as in Sections 5.2 and 5.3.

NOTES

PROCEDURE FOR ORDERING PARTS

Parts should be ordered from the nearest contractor from whom the machine was purchased. If for any reason parts cannot be obtained in this manner, contact the factory directly at the address below.

When ordering parts always indicate the Serial Number and model number of the machine. This can be obtained from the Bill of Lading for the machine or from the Serial Number Plate located on the instrument panel.

Standard fasteners (capscrews, nuts, washers, etc.) tubing and fittings plus other standard hardware have not been included in the Parts List. These are items which can be obtained more quickly and economically from local sources.

SULLAIR CORPORATION
Subsidiary of Sundstrand Corporation
3700 East Michigan Boulevard
Michigan City, Indiana 46360

Telephone: (219) 879-5451
Telex: 4946922

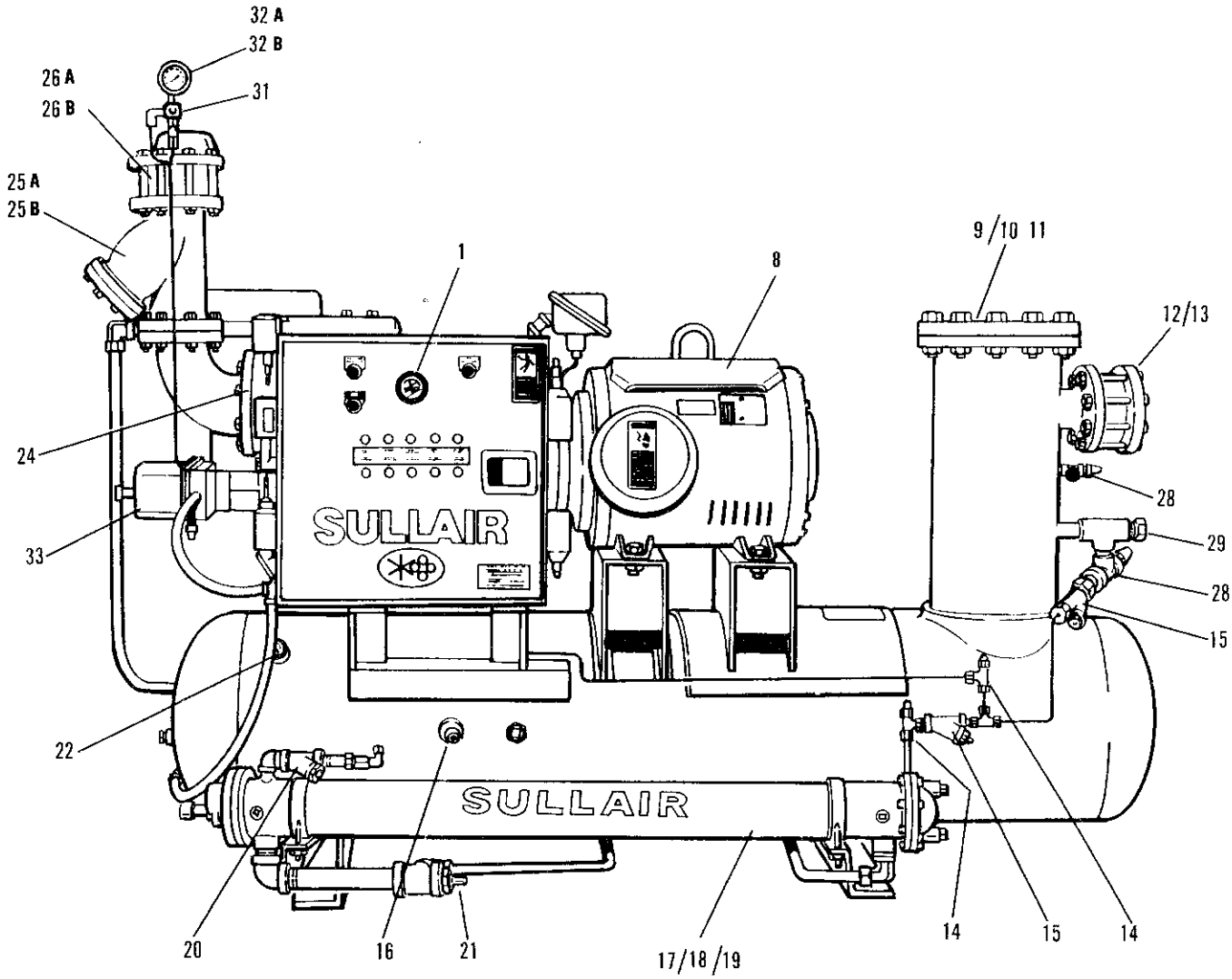
SULLAIR CORPORATION
Parts Distribution Division
1625 E. Second Street
Michigan City, Indiana 46360

Telephone: (219) 879-5451 or
1-800-348-2722 (U.S. except Indiana)
1-800-225-6226 (Indiana)
1-800-525-5506 (Canada)
Telex: 4320147
FAX: 1-219-874-1835

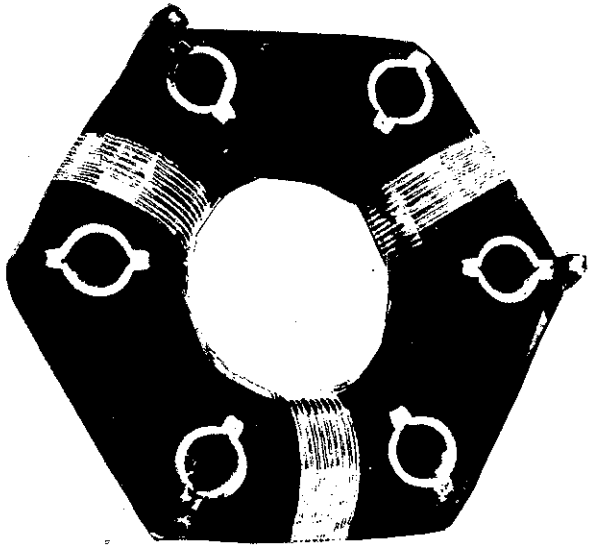
7.1 RECOMMENDED SPARE PARTS LIST

DESCRIPTION	PART NUMBER	QTY
gasket, water cooled oil cooler - return head	044221	1
gasket, water cooled oil cooler-inlet outlet head	044220	1
cartridge, oil filter	250008-955	1
O-ring, oil filter - neoprene	826202-153	1
screen, oil strainer 1″	240281	1
screen, oil strainer ⅜″	044056	2
gasket, oil strainer screen cap 1″	240280	1
gasket, oil strainer screen cap ⅜″	044060	2
gasket, suction strainer screen cap 4″	240247	1
gasket, suction strainer screen cap 3″	240245	1
gasket, oil separator element access: bolt circle - 13½″	250009-530	1
• bolt circle - 13⅞″	2500017-859	1
• bolt circle - 17¾″	248357	1
gasket, oil separator element	026427	2
element, oil separator 20″	044038	1
adhesive, element gasket	240179	1
lamp, pilot light	043386	6
valve, solenoid - capacity control freon - R22	240785	1
• ammonia - NH3	047287	1
repair kit, control valve actuator hydraulic	240601-004	1
seal, shaft - capacity control	250002-758	1
repair kit, compressor shaft seal direct drive	001919C	1
• gear drive	001812B	1
motor, pump	050484	1
motor, EVA 120V	250014-494	1
switch, EVA position	250014-509	1
capacitor, EVA	242324	1
pump, assembly	045625	1
pump, shaft seal	252317	1
pump, only	240870	1
switch, temperature (HOT or HDT)	045417	1
switch, pressure P1/P2	047607	1
switch, pressure HSP	042888	1
switch, low oil pressure	042464	1
start-up oil pressure		
switch, system pressure differential	410095	1
relay	045496	4
relay, 1TR	47090	1
relay, 3TR	047087	1
timer, anti-recycle (ART)	250023-402	1
relay, min/max position latching	047734	1
relay, oil pump motor start	046175	1

7.2 FRONT VIEW



BELOW IS SHOWN
A12 AND CB12 COUPLING ELEMENT
PART NUMBER 250018-551



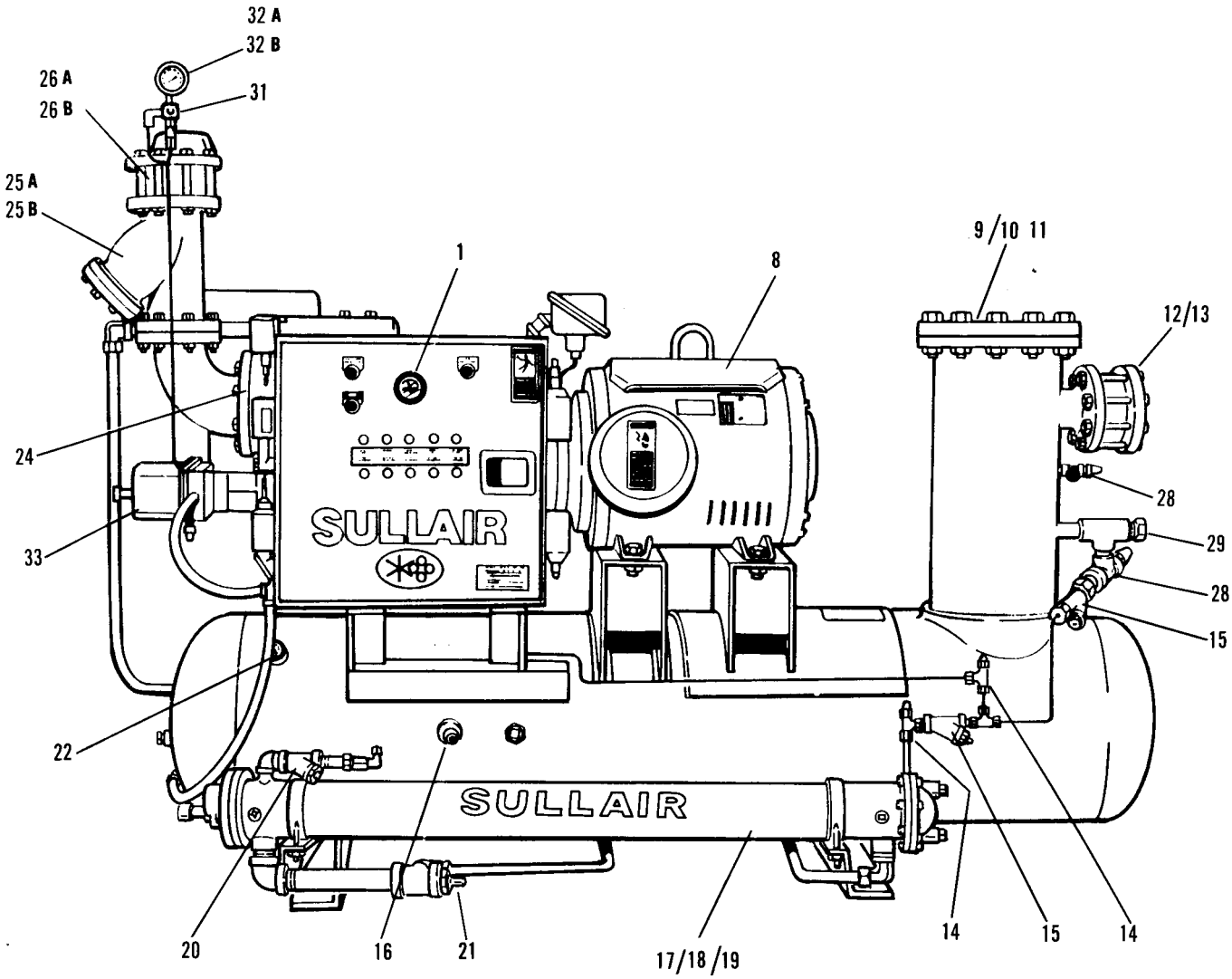
7.2 FRONT VIEW

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	panel, control		
2	compressor unit (not shown)		
3	seal, shaft - compressor (not shown)		
	direct driven	001919C	1
	gear driven	001812B	1
4A	coupling, drive 1⅞" complete (not shown) - bushing not included	240187	1
	coupling, element (no hardware)	250018-551	1
	coupling, hub motor drive (straight bore)	240188	1
	coupling, hub compressor drive	240189	1
4B	coupling, drive 2⅛" complete (not shown) - bushing not included	240225	1
	coupling, element (no hardware)	250018-551	1
	coupling, hub motor drive (straight bore)	240224	1
	coupling, hub compressor drive	240189	1
4C	coupling, drive 2⅜" complete (not shown) - bushing not included	240749	1
	coupling, element (no hardware)	250018-551	1
	coupling, hub motor drive (straight bore)	047271	1
	coupling, hub compressor drive	240189	1
4D	coupling, drive 1⅝" complete (not shown) - taperlock bushings not included	250014-624	1
	coupling, element (no hardware)	250018-551	1
	coupling, hub motor drive (taper bore)	240189	1
	coupling, hub compressor drive	240189	1
5	bushing, taperlock (not shown)		
	direct drive 1½"	041683	1
	gear drive 1⅝"	049389	1
	motor, 1⅝"	049389	1
6	strainer, Sullistage complete (not shown)	240278	1
	screen, strainer	240281	1
	gasket, strainer	240280	1
7	valve, Sullistage check (not shown)	250016-852	1
8	motor, standard 3600RPM 460V ODP		
	75HP	050191	1
	100HP	050192	1
	125 HP	050193	1
	150 HP	050351	1
9	gasket, separator bolt circle diameter 13½"	250009-530	1
	bolt circle diameter 13⅞"	250017-859	1
	bolt circle diameter 17¾"	240621-15	1
10	element, oil separator (not shown)	044038	1
11	gasket, oil separator element (not shown)	026427	2
12	valve, discharge check 3"	250016-156	1
13	gasket, 3"	044998	2
14	valve, shutoff ¼"	044996	3

* There is an exchange program whereby a reconditioned compressor unit can be obtained from Sullair distributors or the factory at less cost than the owner could repair the unit. For information regarding the unit exchange program, contact your nearest Sullair representative or the Sullair Corporation.

The shaft seal is not considered part of the compressor unit in regard to the 2 year warranty. The normal Sullair parts warranty applies.

7.2 FRONT VIEW



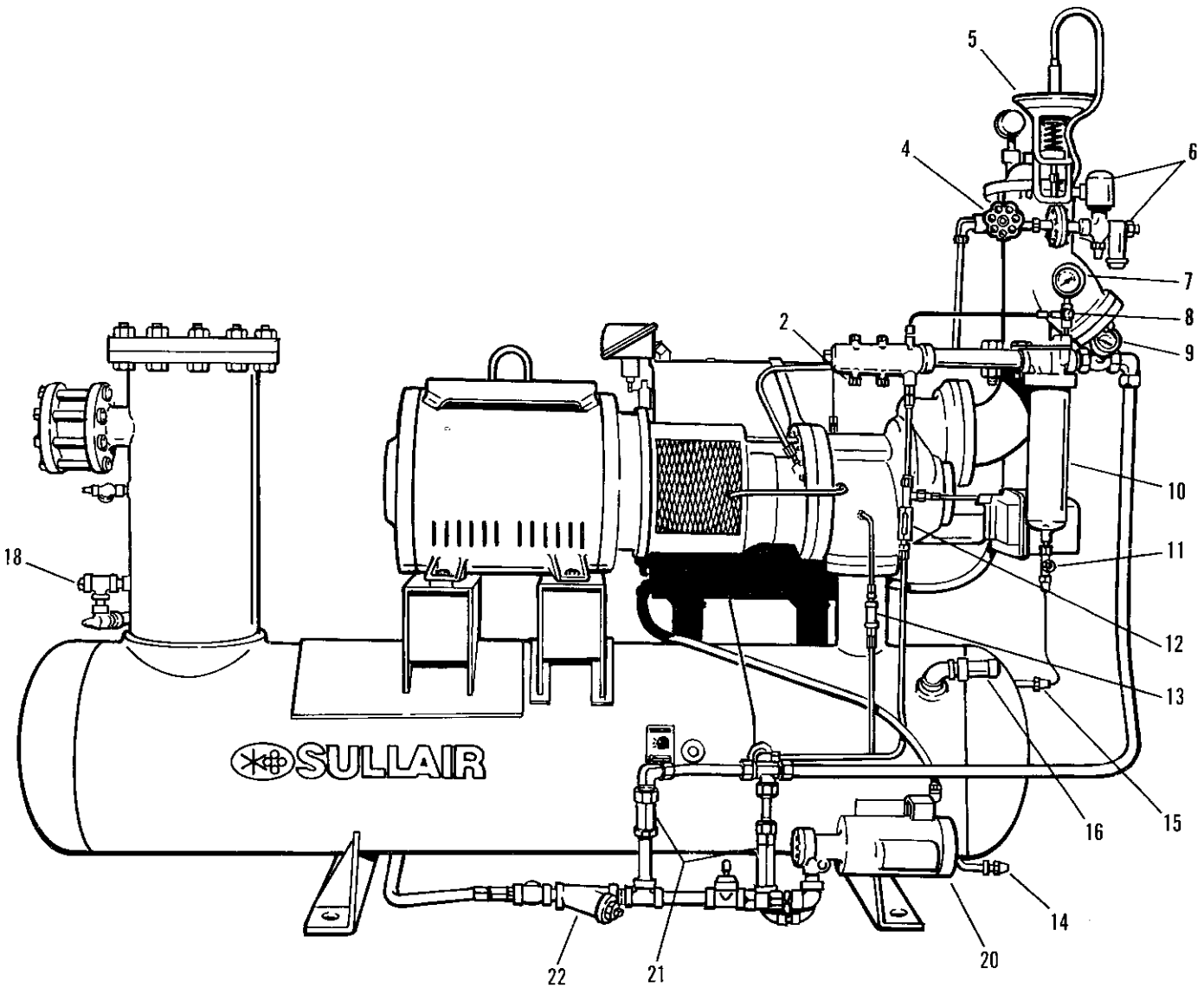
7.2 FRONT VIEW (continued)

15	strainer, oil complete 3/8"	043325	3
	screen, oil strainer	044056	3
	gasket, oil strainer	044060	3
16	bulbwell, high discharge temperature	042883	1
17	cooler, oil standard water cooled*	043932	1
18	gasket, oil cooler return head*	044221	1
18A	bonnet, return head*	045466	1
19	gasket, oil cooler in/out head*	044220	1
19A	bonnet, in/out head*	045447	1
20	strainer, oil cooler vent*	043325	1
	screen oil strainer	044055	1
	gasket, oil strainer	044060	1
21	bulbwell, Penn water regulator*	043474	1)
22	thermometer, discharge	240054	1
23	gasket, compressor discharge (not shown)	240171	1
24	gasket, compressor inlet	240705	1
25-A	strainer, 3" complete	240163	1
	screen, strainer	240825-004	1
	gasket, strainer		1
25-B	strainer, 4" complete	241082	1
	screen, strainer	240825-006	1
	gasket, strainer		1
26-A	valve, inlet check 3"	250016-156	1
26-B	valve, inlet check 4"	250016-157	1
27-A	gasket, 3" (not shown)	044998	3
27-B	gasket, 4" (not shown)	044999	3
28	valve, shutoff 3/8"	044997	1
29	glass, sight 3/4"	250014-037	1
30	orifice 0.030" (not shown)	027935	2
31	valve, 3 way prior to 1-1-89	241239	1
32A	gauge - NH3 - suction	249747	1
32B	gauge - R22 - suction	249748	1
33	electric valve actuator	410360	1

* Applies to standard 3/8" water cooled oil cooler only. Consult factory for special oil coolers such as helium and thermosyphon.

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.3 BACK SIDE



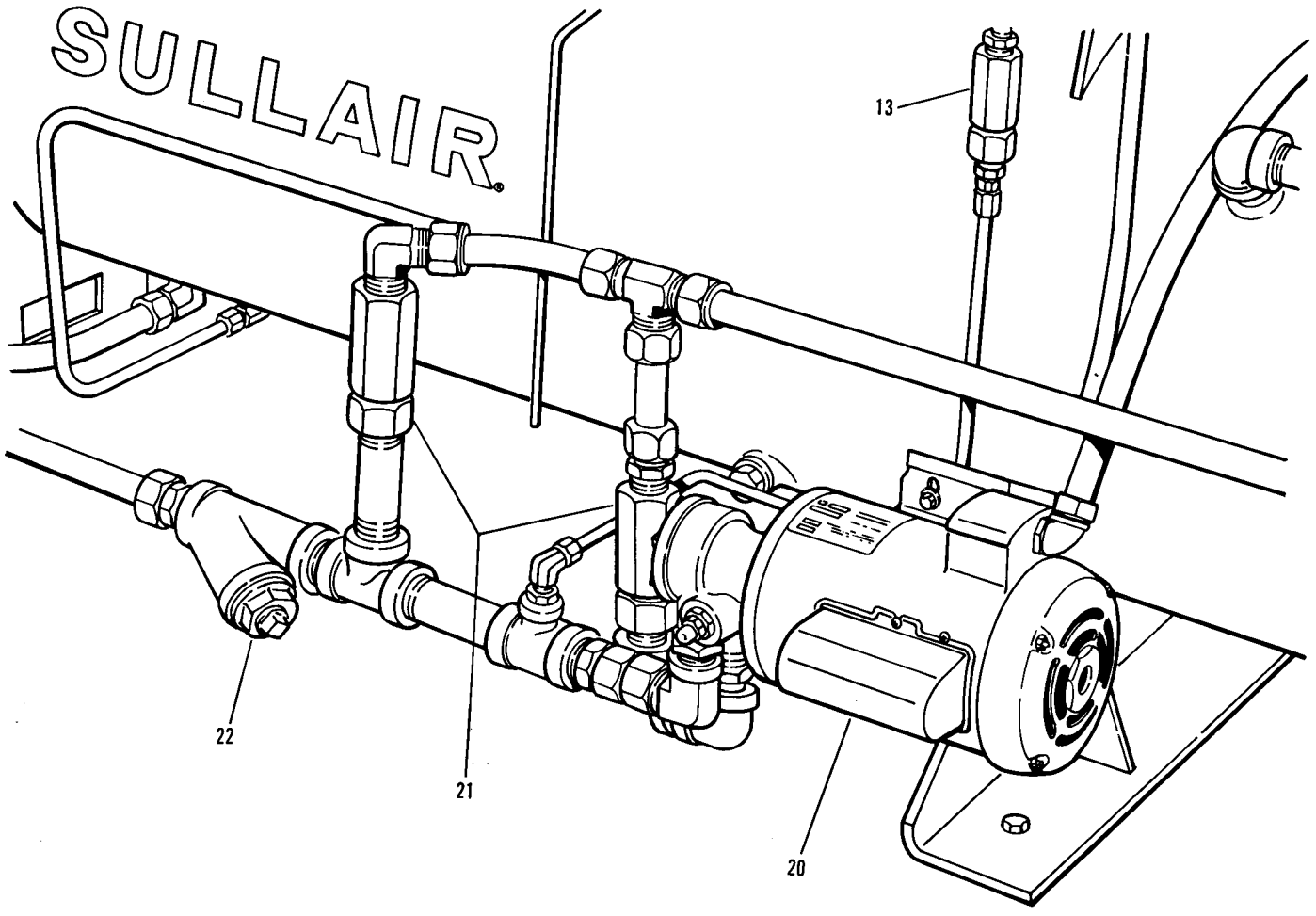
7.3 BACK SIDE

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	bulbwell, high oil temperature (not shown)	042883	1
2	orifice, gear box (.125)	250002-535	1
3	orifice, inlet bearings (.156) prior to 10-10-88	250004-363	1
4	valve, shutoff liquid injection	045626	1
5A	valve, temperature regulator liquid injection - high stage	240227	1
	replacement seats (.21″)	240786	1
	thermal system	240782	1
	packing	240710	1 set
5B	valve, temperature regulator liquid injection - booster	241521	1
	valve seat - replacement (.08″)	241522	1
	thermal system	240782	1
	packing	240710	1
6	valve, solenoid & strainer assembly	410047-001	1
	valve, solenoid - liquids injection (complete)	240228	1
	coil, solenoid	407306	1
	strainer, liquid injection (complete)	240226	1
	gasket	248013-003	1
	screen	248014-003	1
7	gauge, oil filter pressure ammonia	249747	1
	• freon	249748	1
8	valve, 3-way oil filter	241239	1
9	thermometer, oil	240054	1
10-A	filter, assembly, oil - single (complete)	250008-954	1
	element, oil filter	250008-955	2
	O-ring, oil filter	826202-153	2
10-B	filter, oil dual (complete)	250008-953	1
	element, oil filter	250008-955	2
	O-ring, oil filter	826202-153	2
11	valve, oil filter drain ¼″ npt		
	single	044996	1
	dual	044996	2
12	valve, oil check ½″ npt	250016-851	1
13	valve, oil check ⅜″ npt	250016-850	1
14	valve, oil drain-separator ⅜″ npt	044997	1
15	bulbwell, liquid injection	240027	1
16	valve, pressure relief		
	300 PSI (2067kPa) setting	250004-385	1
	150 PSI (1034kPa) setting	250008-376	1
17	glass, oil level sight 1″ npt (not shown)	041327	2
18	glass, oil level sight ¾″ npt	250014-037	1
19	heater, oil (not shown)*		
	300W oil heater	240067	1
	thermostat for oil heater	042589	1
	500W oil heater with built in thermostat	250001-301	1
20	pump, assembly, oil ¾HP (complete)	045625	1
	pump	240870	1
	motor	050484	1
	seal, shaft	242317	1
21	valve, oil check - lube pump 1″		
	high stage	250016-852	2
	booster	250016-852	1
22	strainer, oil (complete)	240278	1
	screen	240281	1
	gasket	240280	1

* 300 watt oil heater with separate thermostat was used up to approximately Jan. 1987 only, 500 watt heater used there after.

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.3 BACK SIDE (continued)



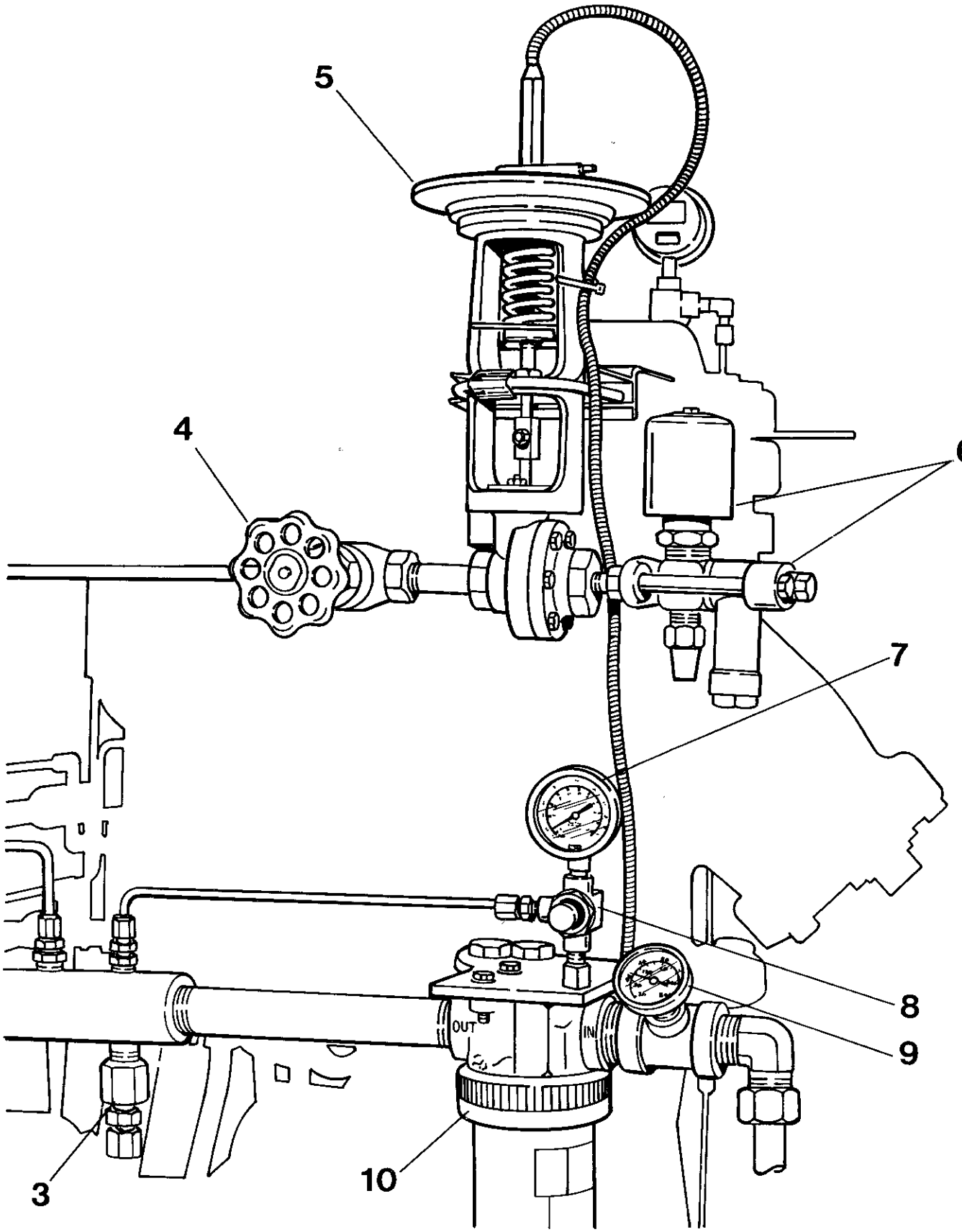
7.3 BACK SIDE

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	bulbwell, high oil temperature (not shown)	042883	1
2	orifice, gear box (.125)	250002-535	1
3	orifice, inlet bearings (.156) prior to 10-10-88	250004-363	1
4	valve, shutoff liquid injection	045626	1
5A	valve, temperature regulator liquid injection - high stage	240227	1
	replacement seats (.21″)	240786	1
	thermal system	240782	1
	packing	240710	1 set
5B	valve, temperature regulator liquid injection - booster	241521	1
	valve seat - replacement (.08″)	241522	1
	thermal system	240782	1
	packing	240710	1
6	valve, solenoid & strainer assembly	410047-001	1
	valve, solenoid - liquids injection (complete)	240228	1
	coil, solenoid	407306	1
	strainer, liquid injection (complete)	240226	1
	gasket	248013-003	1
	screen	248014-003	1
7	gauge, oil filter pressure ammonia	249747	1
	• freon	249748	1
8	valve, 3-way oil filter	241239	1
9	thermometer, oil	240054	1
10-A	filter, assembly, oil - single (complete)	250008-954	1
	element, oil filter	250008-955	2
	O-ring, oil filter	826202-153	2
10-B	filter, oil dual (complete)	250008-953	1
	element, oil filter	250008-955	2
	O-ring, oil filter	826202-153	2
11	valve, oil filter drain ¼″ npt		
	single	044996	1
	dual	044996	2
12	valve, oil check ½″ npt	250016-851	1
13	valve, oil check ⅜″ npt	250016-850	1
14	valve, oil drain-separator ⅜″ npt	044997	1
15	bulbwell, liquid injection	240027	1
16	valve, pressure relief		
	300 PSI (2067kPa) setting	250004-385	1
	150 PSI (1034kPa) setting	250008-376	1
17	glass, oil level sight 1″ npt (not shown)	041327	2
18	glass, oil level sight ¾″ npt	250014-037	1
19	heater, oil (not shown)*		
	300W oil heater	240067	1
	thermostat for oil heater	042589	1
	500W oil heater with built in thermostat	250001-301	1
20	pump, assembly, oil ¾HP (complete)	045625	1
	pump	240870	1
	motor	050484	1
	seal, shaft	242317	1
21	valve, oil check - lube pump 1″		
	high stage	250016-852	2
	booster	250016-852	1
22	strainer, oil (complete)	240278	1
	screen	240281	1
	gasket	240280	1

* 300 watt oil heater with separate thermostat was used up to approximately Jan. 1987 only, 500 watt heater used there after.

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.3 BACK SIDE (continued)



7.3 BACK SIDE

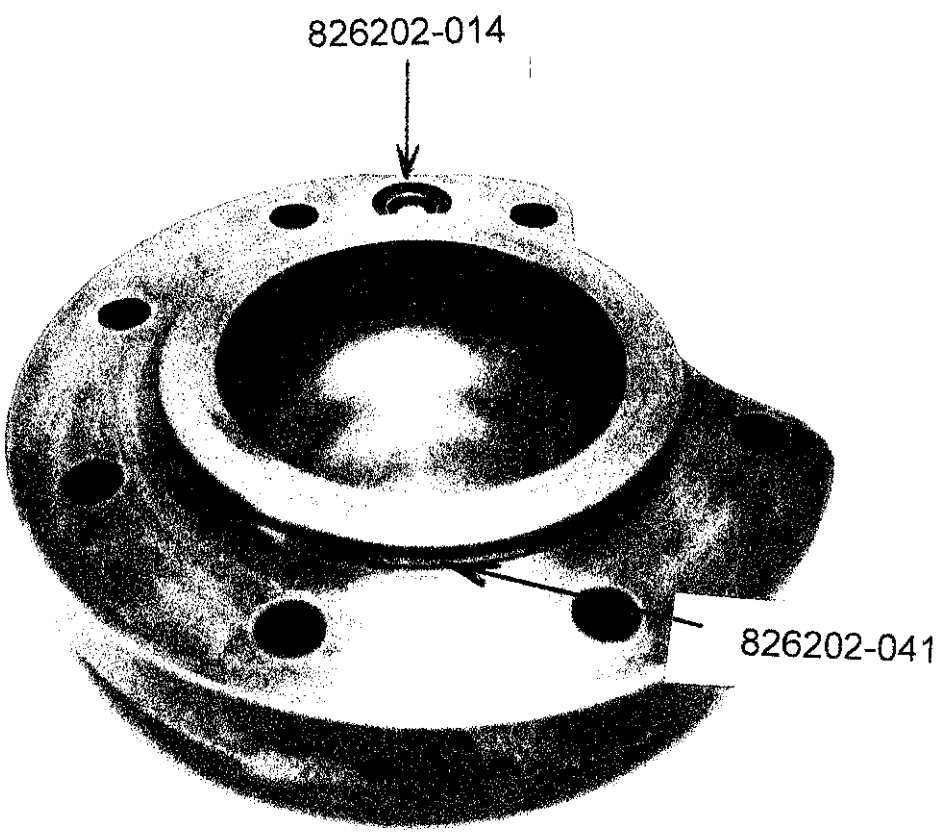
KEY NO	DESCRIPTION	PART NUMBER	QTY
1	bulbwell, high oil temperature (not shown)	042883	1
2	orifice, gear box (.125)	250002-535	1
3	orifice, inlet bearings (.156) prior to 10-10-88	250004-363	1
4	valve, shutoff liquid injection	045626	1
5A	valve, temperature regulator liquid injection - high stage	240227	1
	replacement seats (.21")	240786	1
	thermal system	240782	1
	packing	240710	1 set
5B	valve, temperature regulator liquid injection - booster	241521	1
	valve seat - replacement (.08")	241522	1
	thermal system	240282	1
	packing	240710	1
6	valve, solenoid & strainer assembly	410047-001	1
	valve, solenoid - liquids injection (complete)	240228	1
	coil, solenoid	407306	1
	strainer, liquid injection (complete)	240226	1
	gasket	248013-003	1
	screen	248014-003	1
7	gauge, oil filter pressure ammonia	249747	1
	• freon	249748	1
8	valve, 3-way oil filter	241239	1
9	thermometer, oil	240054	1
10-A	filter, assembly, oil - single (complete)	250008-954	1
	element, oil filter	250008-955	2
	O-ring, oil filter	826202-153	2
10-B	filter, oil dual (complete)	250008-953	1
	element, oil filter	250008-955	2
	O-ring, oil filter	826202-153	2
11	valve, oil filter drain ¼" npt		
	single	044996	1
	dual	044996	2
12	valve, oil check ½" npt	250016-851	1
13	valve, oil check ⅜" npt	250016-850	1
14	valve, oil drain-separator ⅜" npt	044997	1
15	bulbwell, liquid injection	240027	1
16	valve, pressure relief		
	300 PSI (2067kPa) setting	250004-385	1
	150 PSI (1034kPa) setting	250008-376	1
17	glass, oil level sight 1" npt (not shown)	041327	2
18	glass, oil level sight ¾" npt	250014-037	1
19	heater, oil (not shown)*		
	300W oil heater	240067	1
	thermostat for oil heater	042589	1
	500W oil heater with built in thermostat	250001-301	1
20	pump, assembly, oil ¾HP (complete)	045625	1
	pump	240870	1
	motor	050484	1
	seal, shaft	242317	1
21	valve, oil check - lube pump 1"		
	high stage	250016-852	2
	booster	250016-852	1
22	strainer, oil (complete)	240278	1
	screen	240281	1
	gasket	240280	1

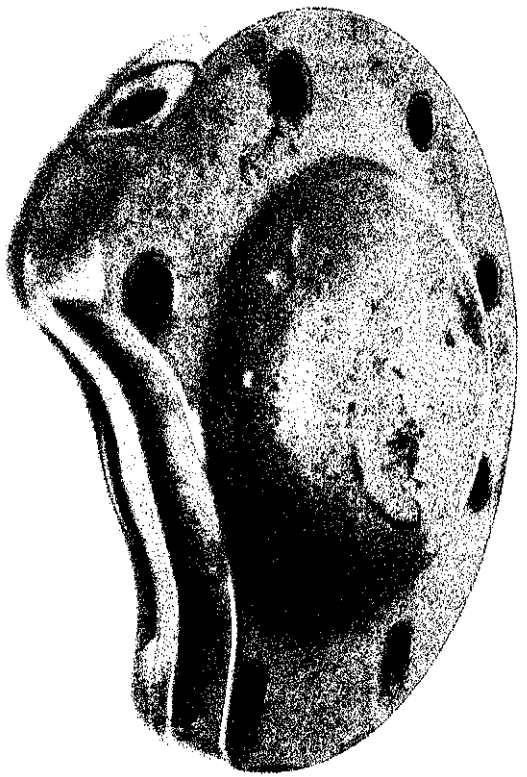
* 300 watt oil heater with separate thermostat was used up to approximately Jan. 1987 only, 500 watt heater used there after.

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

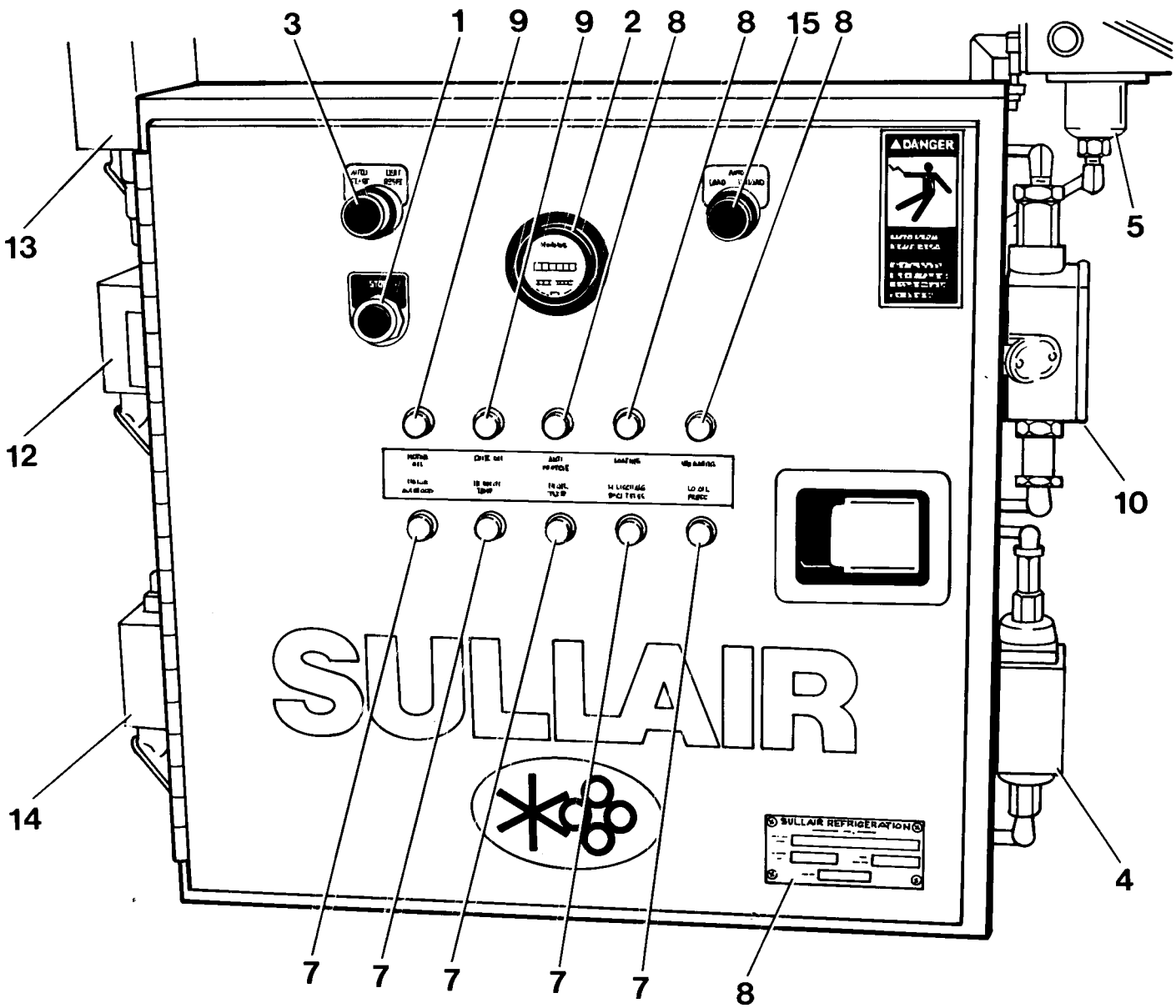
A12 GEAR DRIVE INPUT SHAFT COVER

O-RING 826202-014
O-RING 826202-041





7.4 ELECTRIC CONTROL PANEL ELECTRICAL VALVE ACTUATOR



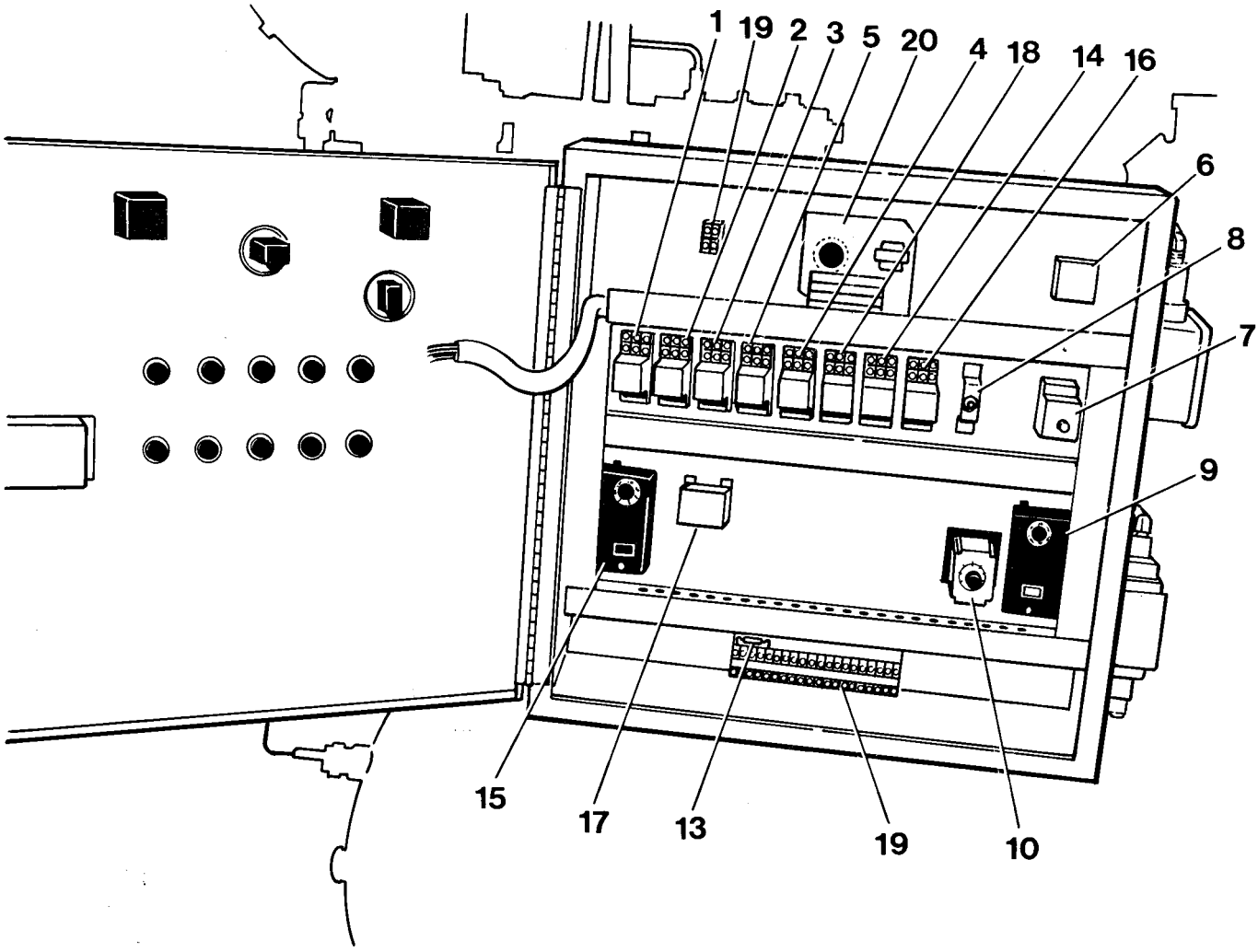
7.4 ELECTRIC PANEL WITH ELECTRICAL VALVE ACTUATOR (FRONT OF PANEL)

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	switch, stop	045494	1
2	hourmeter	042988	1
3	switch, auto/manual/start/reset	047097	1
4	switch, pressure start-up oil pressure (SOP)	042464	1
5	switch, pressure P1/P2	047607	1
6	serial plate	N/A	
7	lens, pilot light protective (red)	043384	5
8	lens, pilot light (amber)	047016	3
9	lens, pilot light (green)	043385	2
10	switch, pressure system differential (SDS)	410095	1
11	bulb, 120V PSB	043386	10
12	switch, pressure HSP	042888	1
13	switch, pressure LSP/HDP*	042465	1
14	switch, pressure low oil pressure (LOP)	042464	1
15	switch, load/auto/unload	047088	1

* For booster compressors, the LSP/HDP switch is replaced by a LSP switch No. 047138 and a separate HDP switch No. 408788.

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.4 ELECTRICAL CONTROL PANEL



7.4 ELECTRICAL PANEL WITH ELECTRICAL VALVE ACTUATOR (INSIDE)

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	relay, protective circuit control 1CR	045496	1
2	relay, LOP delay control 1TRA	045496	1
3	relay, motor start control 4CR	045496	1
4	relay, LOP control 9CR	045496	1
5	relay, pump oil start interlock	045496	1
6	relay, delay timing 1TR	046176	1
	w/resistor ¼ watt	047090	1
7	relay, capacity control timing 3TR	047087	1
8	switch, test	042531	1
9	switch, protective HOT	045417	1
10	timer, anti-cycle (ART)**	250023-402	1
11	relay, load limiting timing 4TR (not shown)* and **	250023-403	1
13	resistor, 12W 2000 Ohm	044846	1
14	relay, minimum position latching	047734	1
15	switch, HDT protective	045417	1
16	relay, maximum position latching	047734	1
17	relay, oil pump motor start	046175	1
18	relay, unload 10CR	045496	1
19	terminal block and track	041493	14
20	control, liquid solenoid (LDT)	046546	1
21	probe thermistor (not shown)	046521	1

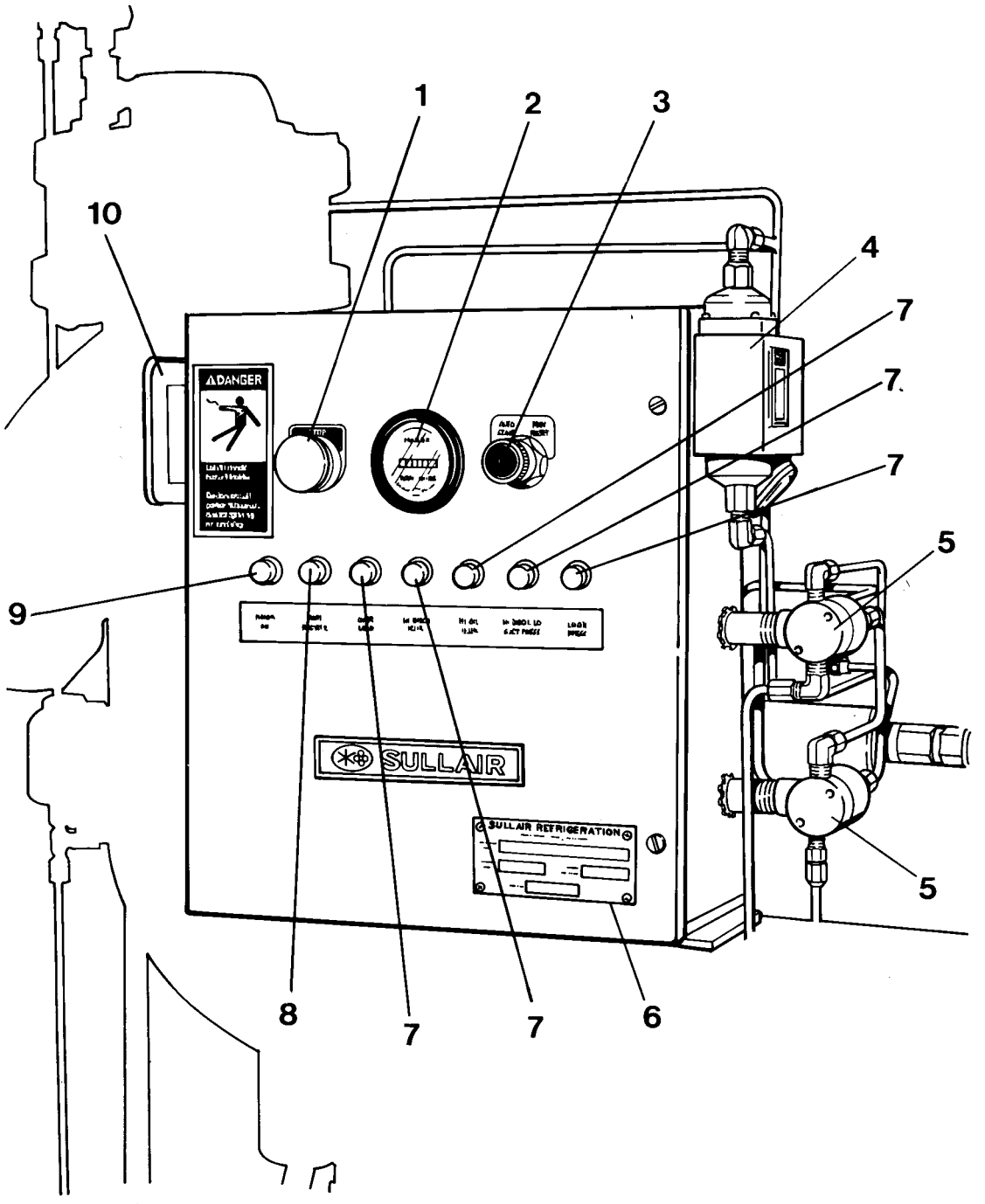
*Optional equipment

**Prior to July, 1987 ART (Key –10) was P/N 046177 and 4TR (Key –11) was P/Ns 045437 and 045362. Changes in wiring will be required if switched either relays.

NOTE: Special ordered compressors may cause variations in components, locations and quantities.

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.5 ELECTRIC CONTROL PANEL WITH HYDRAULIC ACTUATOR

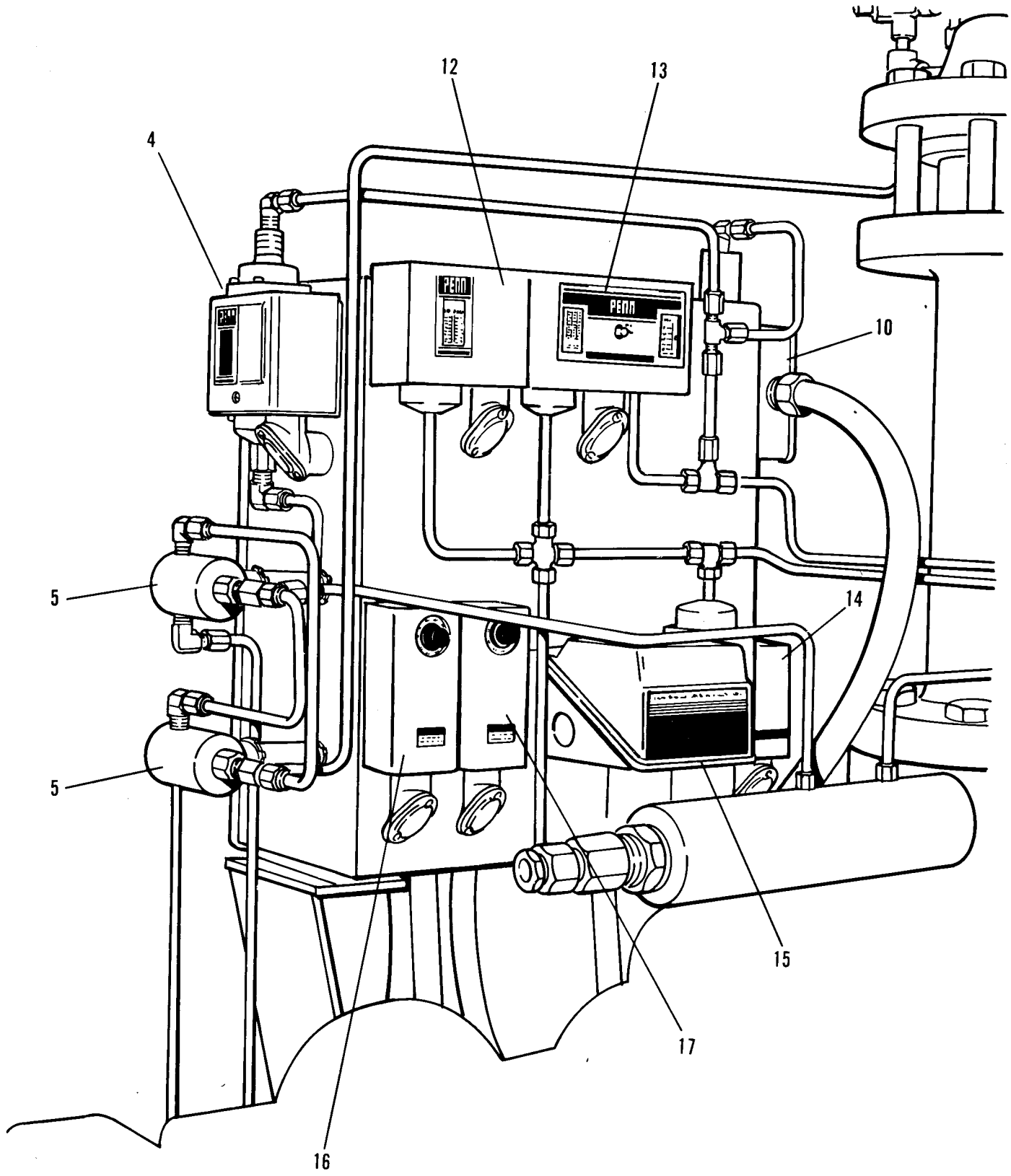


7.5 ELECTRIC CONTROL PANEL WITH HYDRAULIC ACTUATOR

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	switch, stop	045494	1
2	hourmeter	042988	1
3	switch, auto/manual/start/reset	047097	1
4	switch, pressure start-up oil pressure	042464	1
5	solenoid, capacity control		
	ammonia	047287	2
	freon	240785	2
6	nameplate, serial number	N/A	
7	lens, pilot light protective - red	043384	5
8	lens, pilot light anti-recycle - amber	047016	1
9	lens, pilot light motor on - green	043385	1
10	switch, pressure system differential	410095	1
12	switch, pressure HSP	042888	1
13	switch, pressure LSP/HDP	042465	1
14	switch, pressure low oil pressure	042464	1
15	switch, pressure P1/P2	047607	1
16	switch, temperature	045417	1
17	switch, temperature	045417	1
18	relay, 1CR	046175	1
19	relay, 1TRA	046175	1
20	relay, 2CR	046175	1
21	relay, 4CR	046175	1
22	relay, 5CR - freon only (not shown)	046175	1
23	timer, anti-recycle (ART)	046177	1
24	control, low discharge temperature	046546	1
24	probe (not shown)	046521	1
25	timer, capacity control (3TR)	047087	1
26	relay, oil pump	045496	1
27	resistor, for 1TR	047090	1
28	pilot light, lamp holder	043383	1
29	pilot light, lamp (not shown)	043386	1
30	timer, 1TR	046176	1

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.5 ELECTRIC CONTROL PANEL WITH HYDRAULIC ACTUATOR (continued)

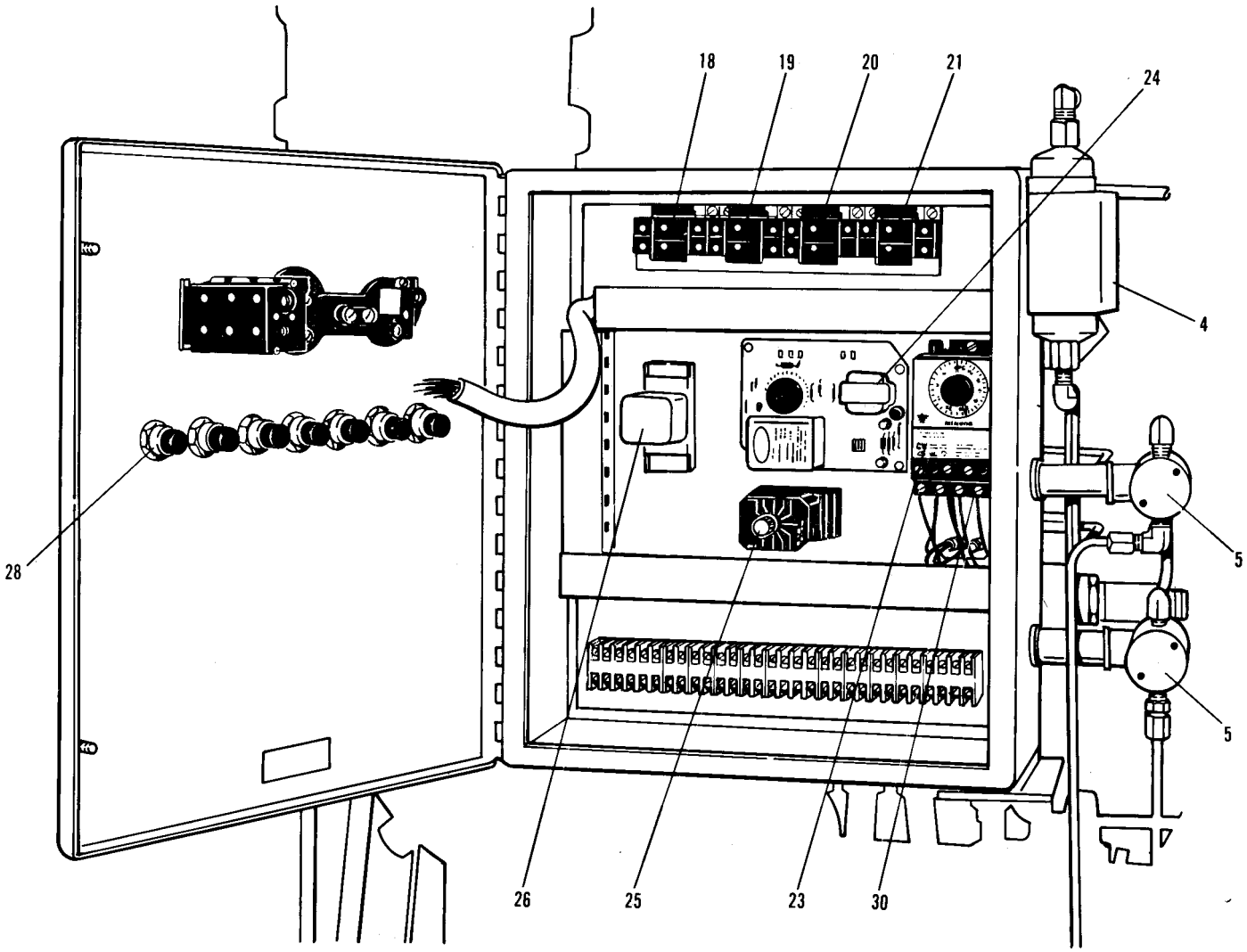


7.5 ELECTRIC CONTROL PANEL WITH HYDRAULIC ACTUATOR (continued)

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	switch, stop	045494	1
2	hourmeter	042988	1
3	switch, auto/manual/start/reset	047097	1
4	switch, pressure start-up oil pressure	042464	1
5	solenoid, capacity control		
	ammonia	047287	2
	freon	240785	2
6	nameplate, serial number	N/A	
7	lens, pilot light protective - red	043384	5
8	lens, pilot light anti-recycle - amber	047016	1
9	lens, pilot light motor on - green	043385	1
10	switch, pressure system differential	410095	1
12	switch, pressure HSP	042888	1
13	switch, pressure LSP/HDP	042465	1
14	switch, pressure low oil pressure	042464	1
15	switch, pressure P1/P2	047607	1
16	switch, temperature	045417	1
17	switch, temperature	045417	1
18	relay, 1CR	046175	1
19	relay, 1TRA	046175	1
20	relay, 2CR	046175	1
21	relay, 4CR	046175	1
22	relay, 5CR - freon only (not shown)	046175	1
23	timer, anti-recycle (ART)	046177	1
24	control, low discharge temperature	046546	1
24	probe (not shown)	046521	1
25	timer, capacity control (3TR)	047087	1
26	relay, oil pump	045496	1
27	resistor, for 1TR	047090	1
28	pilot light, lamp holder	043383	1
29	pilot light, lamp (not shown)	043386	1
30	timer, 1TR	046176	1

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.5 ELECTRIC CONTROL PANEL WITH HYDRAULIC ACTUATOR (continued)

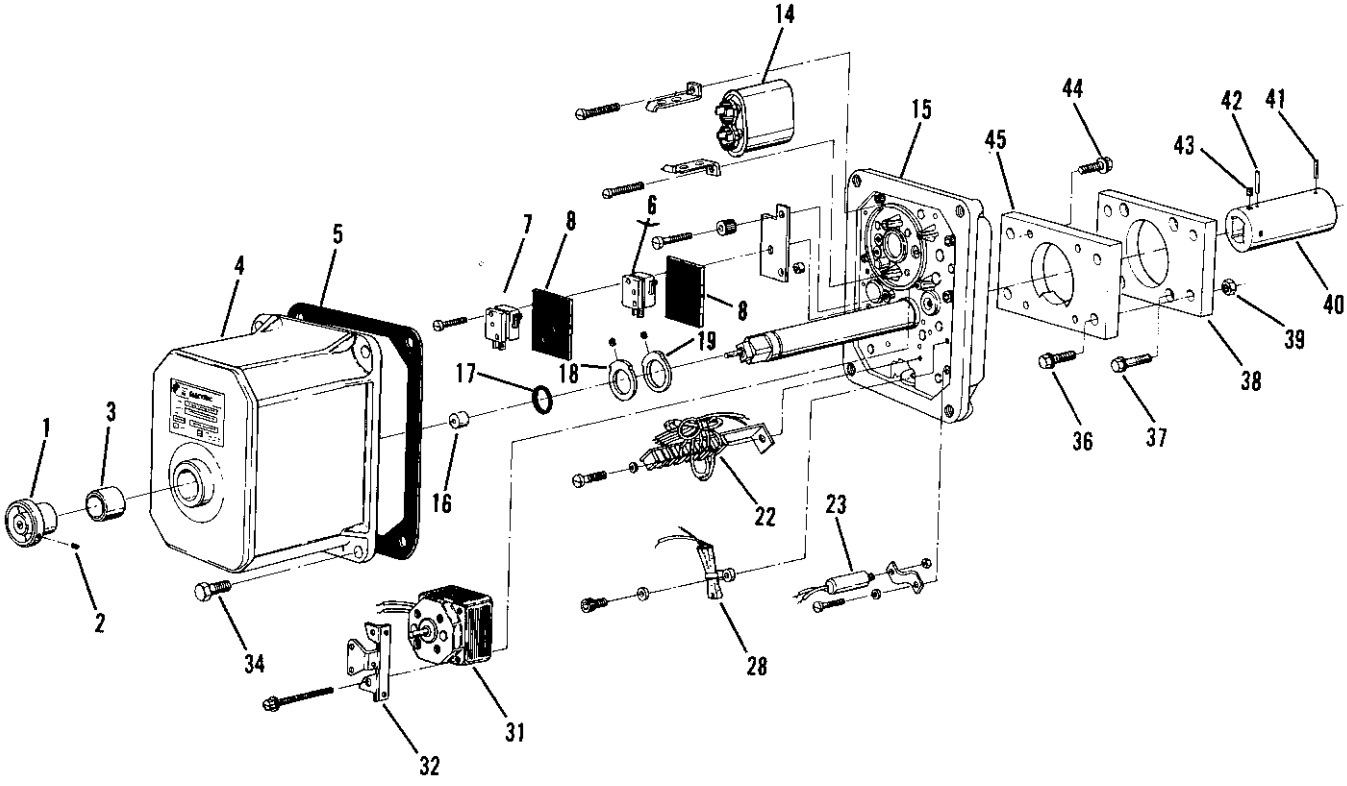


7.5 ELECTRIC CONTROL PANEL WITH HYDRAULIC ACTUATOR (continued)

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	switch, stop	045494	1
2	hourmeter	042988	1
3	switch, auto/manual/start/reset	047097	1
4	switch, pressure start-up oil pressure	042464	1
5	solenoid, capacity control		
	ammonia	047287	2
	freon	240785	2
6	nameplate, serial number	N/A	
7	lens, pilot light protective - red	043384	5
8	lens, pilot light anti-recycle - amber	047016	1
9	lens, pilot light motor on - green	043385	1
10	switch, pressure system differential	410095	1
12	switch, pressure HSP	042888	1
13	switch, pressure LSP/HDP	042465	1
14	switch, pressure low oil pressure	042464	1
15	switch, pressure P1/P2	047607	1
16	switch, temperature	045417	1
17	switch, temperature	045417	1
18	relay, 1CR	046175	1
19	relay, 1TRA	046175	1
20	relay, 2CR	046175	1
21	relay, 4CR	046175	1
22	relay, 5CR - freon only (not shown)	046175	1
23	timer, anti-recycle (ART)	046177	1
24	control, low discharge temperature	046546	1
24	probe (not shown)	046521	1
25	timer, capacity control (3TR)	047087	1
26	relay, oil pump	045496	1
27	resistor, for 1TR	047090	1
28	pilot light, lamp holder	043383	1
29	pilot light, lamp (not shown)	043386	1
30	timer, 1TR	046176	1

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.6 ELECTRIC VALVE ACTUATOR

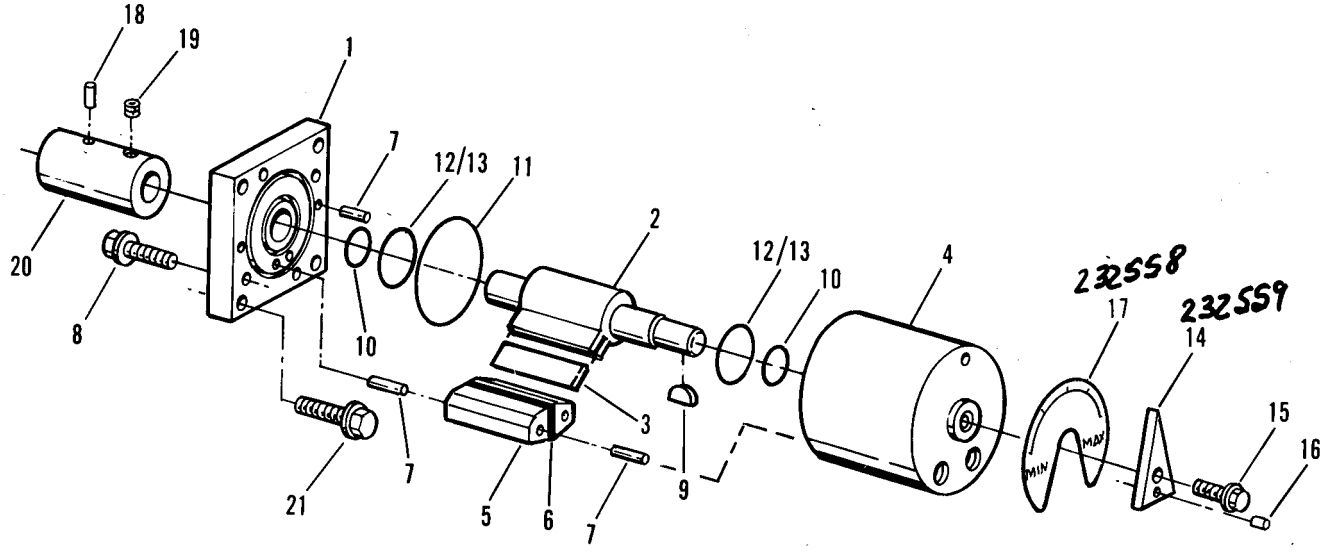


7.6 ELECTRIC VALVE ACTUATOR

KEY NO	DESCRIPTION	PART NUMBER	QTY
1 thru 34	complete assembly	410360	1
1	handle	250014-493	1
2	setscrew		
5	gasket, cover	250014-509	1
6	switch, position minimum	250014-230	1
7-A	switch, position maximum	250014-230	1
7-B	switch, position intermediate (not shown)	250014-230	1
14	capacitor	242324	1
16	spacer		
17	O-ring, shaft	250014-510	1
18A	cam, position maximum	250024-472	1
18B	cam, position intermediate (not shown)	250005-576	1
19	cam, position minimum	250024-472	1
22	terminal, 6 point block	250014-496	1
23, 28	heater, thermostat	250024-473	1
31	motor, EVA 120V	250014-494	1
36	hex screw		
37	ferry head screw		
38	plate, adaptor to compressor	234650	1
40	coupling, EVA to compressor	250023-968	1
45	plate, adaptor, to EVA	250023-967	1

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.7 HYDRAULIC VALVE ACTUATOR



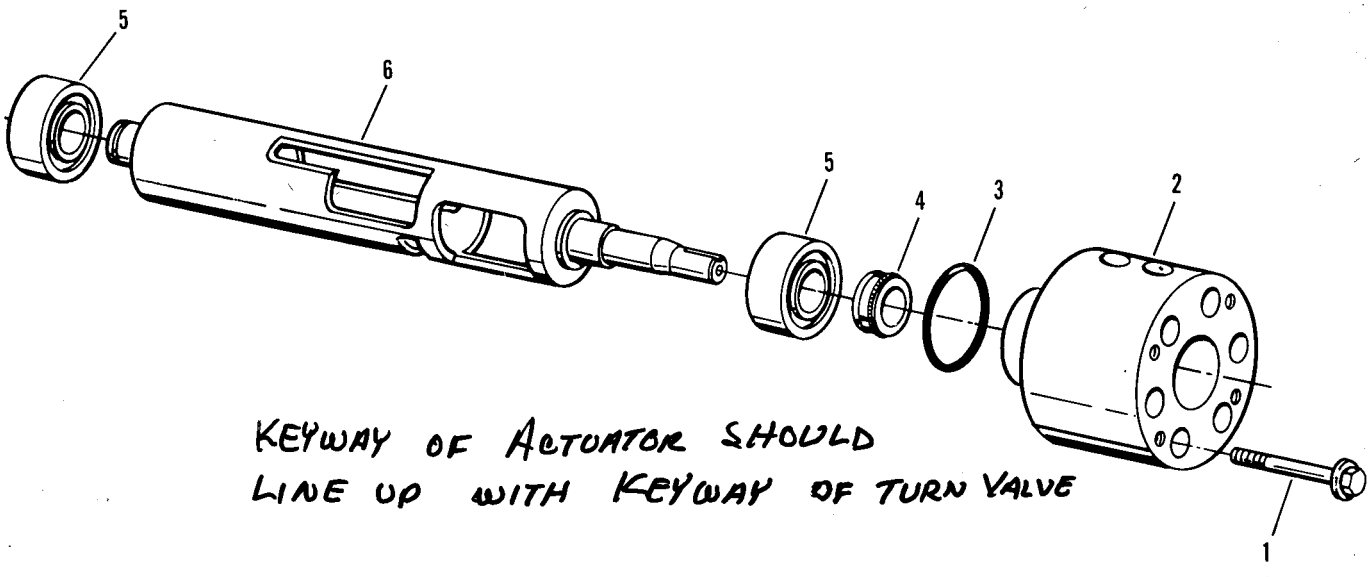
7.7 HYDRAULIC VALVE ACTUATOR

KEY NO	DESCRIPTION	PART NUMBER	QTY
1 thru 17	complete actuator	250027-554	1
*	repair kit	240601-004	1
1	head		1
2	shaft assembly		1
3	vane seal		1
4	body		1
5	shoe*		1
6	shoe seal*		2
7	dowel pin*		4
8	screw		4
9	key		1
10	shaft seal*		1
11	head seal*		1
12	seal cap*		1
13	seal cushion*		2
14	indicator 232559		1
15	screw		1
16	indicator pin		1
17	decal	232558	1
18	roll pin 1/8" x 1/2"	827902-050	1
19	set cup screw 1/4"-20 x 5/16"	832204-031	1
20	coupling	232561	1
21	ferry capscrew 1/4"-20 x 1 1/4"	828404-125	1

* Items are supplied with repair kit.

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.8 CAPACITY CONTROL SYSTEM

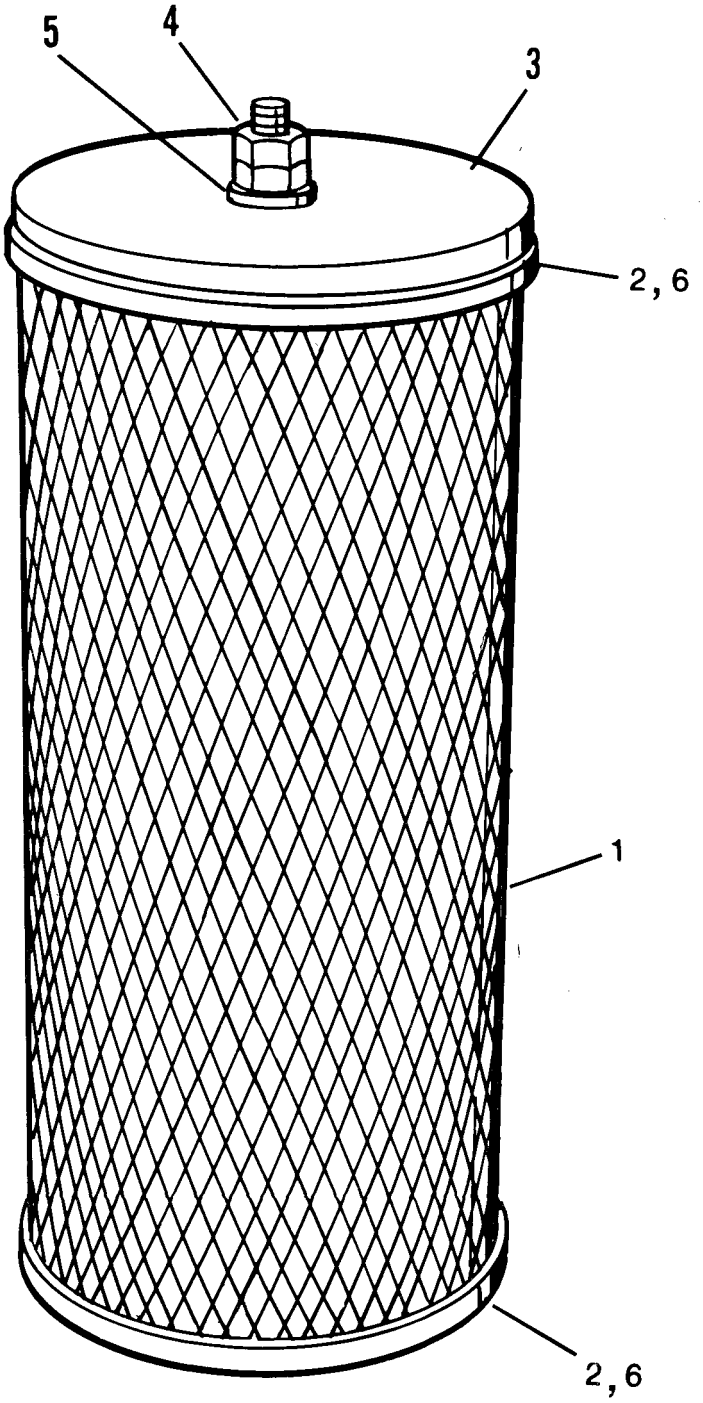


7.8 CAPACITY CONTROL VALVE COMPLETE ACTUATOR P/N 250027-554*

KEY NO	DESCRIPTION	PART NUMBER	QTY
1A	capscrew	828406-250	4
1B	capscrew	828406-400	2
2	actuator adaptor	232557	1
3	neoprene O-ring	826202-133	1
4	seal, 0.75	250002-758	1
5	bearing	499072-525	2
6	capacity control valve	017224	1

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.9 GAS/OIL SEPARATOR ELEMENT ASSEMBLY



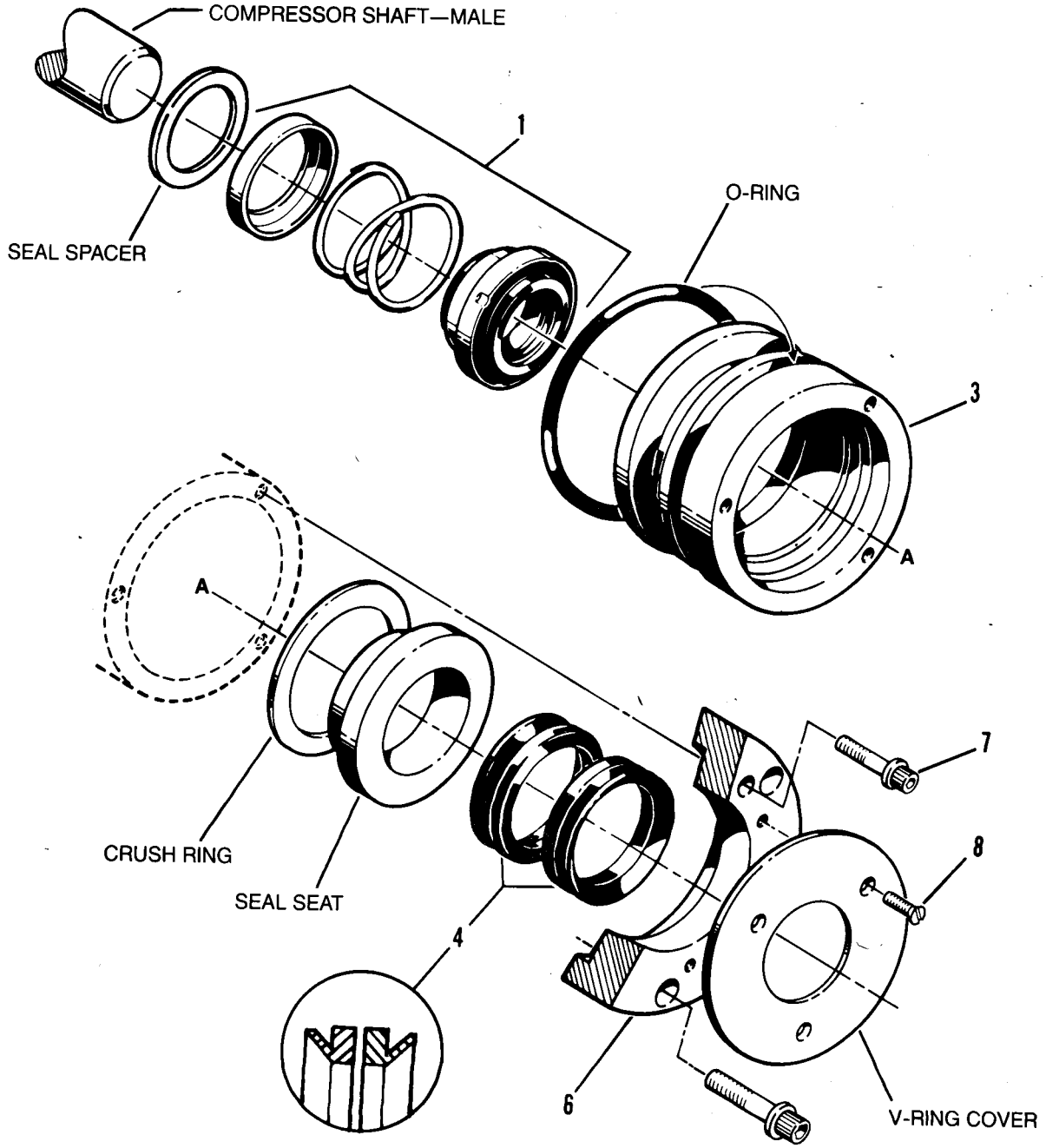
7.9 GAS/OIL SEPARATOR ELEMENT ASSEMBLY

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	element, gas/oil separator	044038	1
2	gasket**	026427	2
3	plate, cover	024371	1
4	nut, hex ½"-13 UNC	824208-448	2
5	washer, flat ½"*	837208-112	1
6	adhesive, gasket***	240179	1

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.10 SHAFT SEAL ASSEMBLY, DIRECT DRIVE

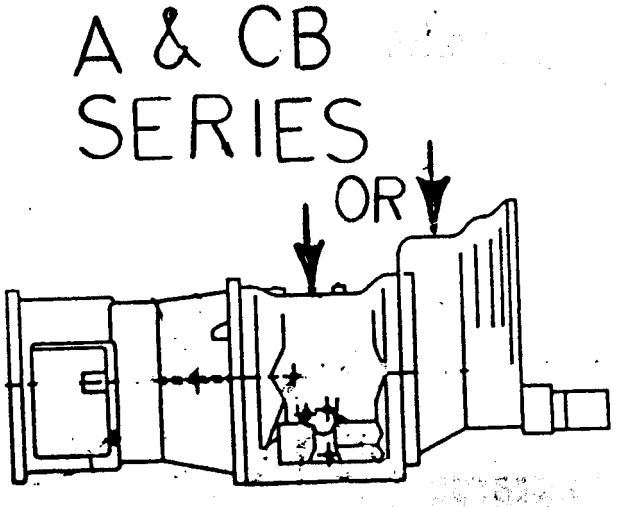
SHAFT SEAL ASSEMBLY



SULLAIR A12/CB12 SHAFT SEAL KITS BY UNIT PART NUMBER

UNIT PART NUMBER	STYLE	USE KIT NUMBER	UNIT MODEL #
008432-001,004	GEAR DRIVE	001812B	C
008453-001,003,004	GEAR DRIVE	001812B	C
008573-011	GEAR DRIVE	001812B	C
008574-001,004	GEAR DRIVE	001812B	C
008578-001	GEAR DRIVE	001812B	C
008579-001,004	GEAR DRIVE	001812B	C
008724-001,004	GEAR DRIVE	001812B	C
02250064-160	GEAR DRIVE	02250047-688	
060564-1	DIRECT DRIVE	001812A	A
063048-100	DIRECT DRIVE	001812A	B
065067-100	DIRECT DRIVE	001812A	B
065096-300,310,320	DIRECT DRIVE	001919C	C
065453-300,310,320	GEAR DRIVE	001812B	C
065454-300,320	GEAR DRIVE	001812B	C
065455-300,320	GEAR DRIVE	001812B	C
066347-300,310,320	GEAR DRIVE	001812B	C
066348-300,310,320	GEAR DRIVE	001812B	C
066349-300,310,320	GEAR DRIVE	001812B	C
066351-300,310,320	DIRECT DRIVE	001919C	C
066570-300,310,320	DIRECT DRIVE	001919C	C
069571-100	DIRECT DRIVE	001812A	A
069698-200	GEAR DRIVE	001812B	B
069699-200	GEAR DRIVE	001812B	

AS OF DECEMBER 2004, 001812B & 001919C ARE TYPE 8 SEALS
AS OF DECEMBER 2004, 001812A IS A TYPE 21 SEAL



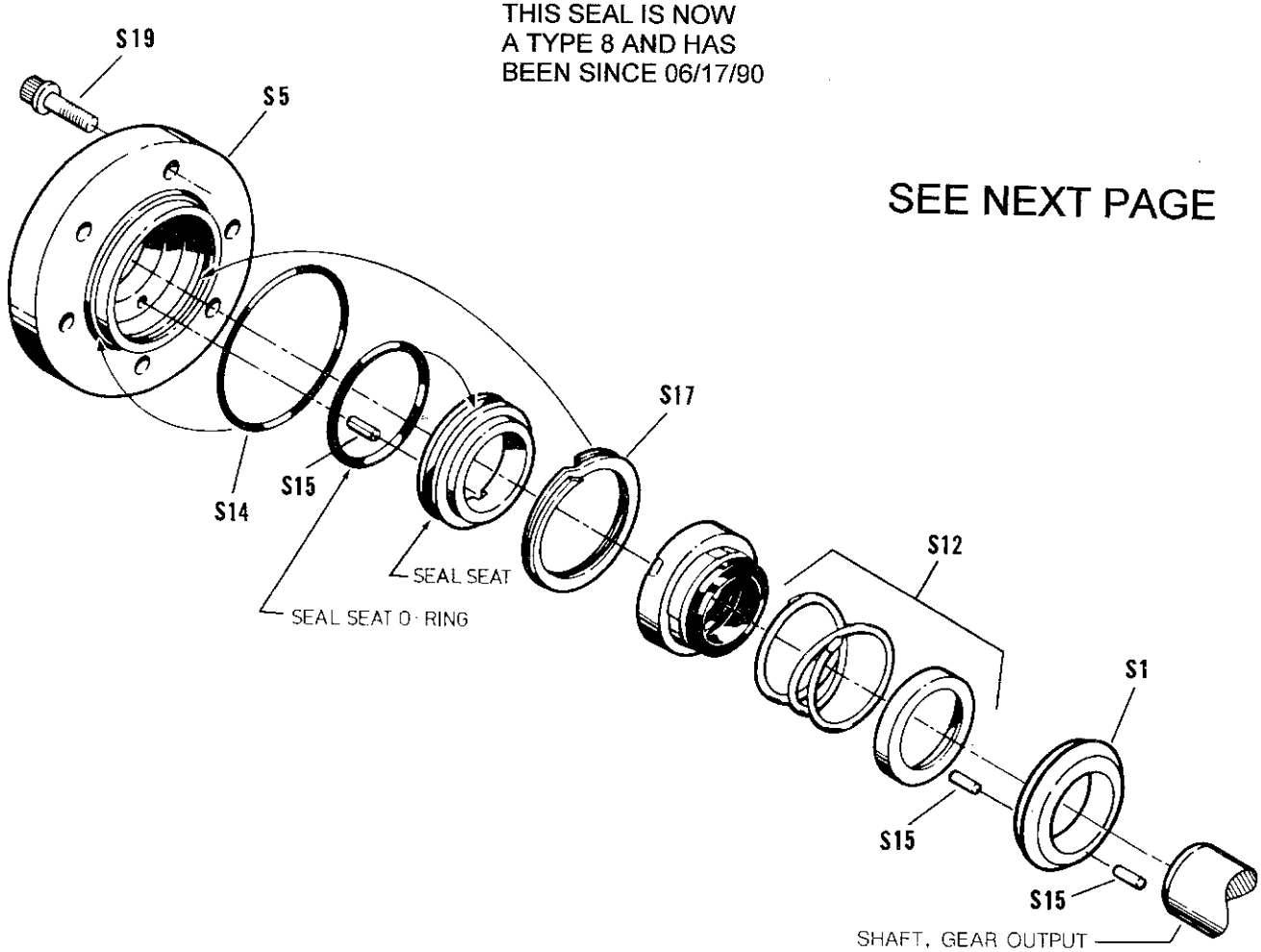
7.10 SHAFT ASSEMBLY, DIRECT DRIVE

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	seal, shaft w/seat NOT CORRECT SEE TABLE	496618	1
2	housing, O-ring seal	826202-238	1
3	housing, shaft seal	232598 5	1
4	seals, "V" secondary	499044-040	2
5	retainer, shaft seal	232596	1
6	retainer, "V" ring	232597	1
7	capscrew	828404-062	3
8	screw, machine flat head FLAT HD SOCKET 8-32 X 1/2"	499074-205	3
9	replacement kit, shaft seal (includes Items 1, 2, 4)	001919C	1

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

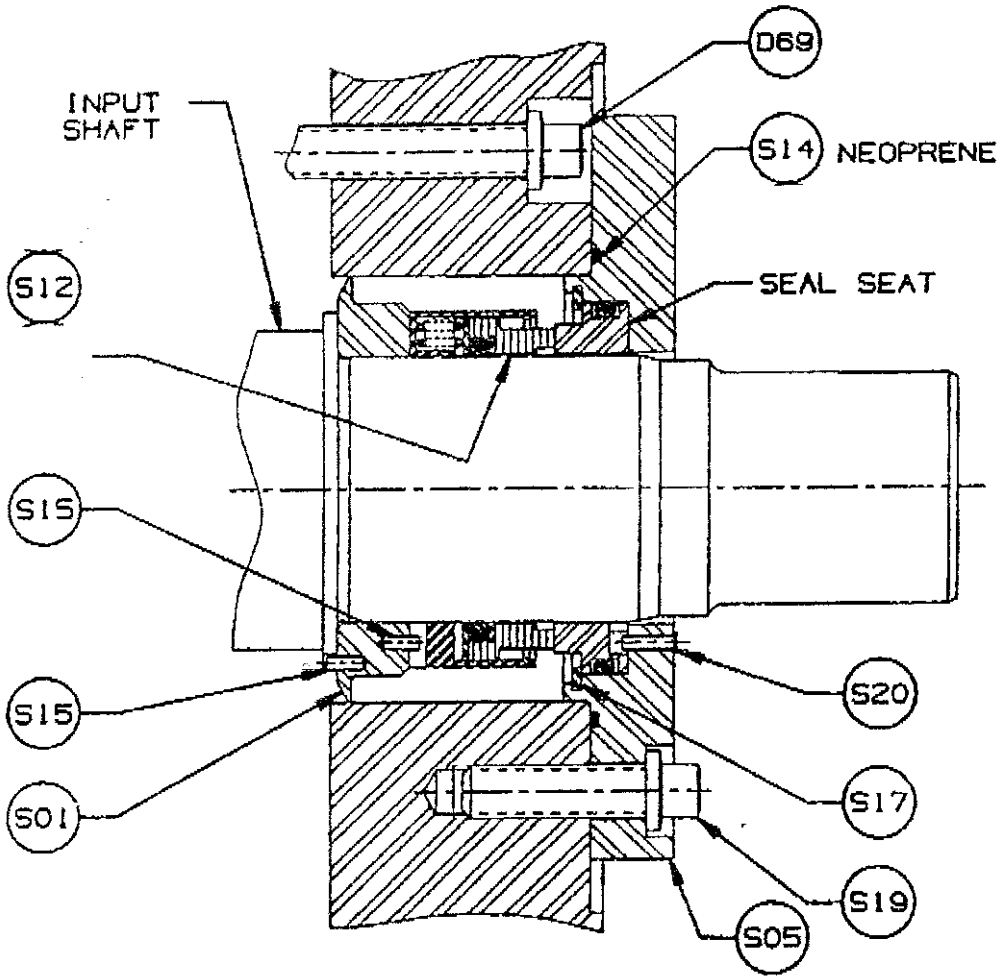
7.11 SHAFT SEAL ASSEMBLY, GEAR DRIVE

SHAFT SEAL ASSEMBLY



GEAR DRIVE -- TYPE 8 SEAL

1812B

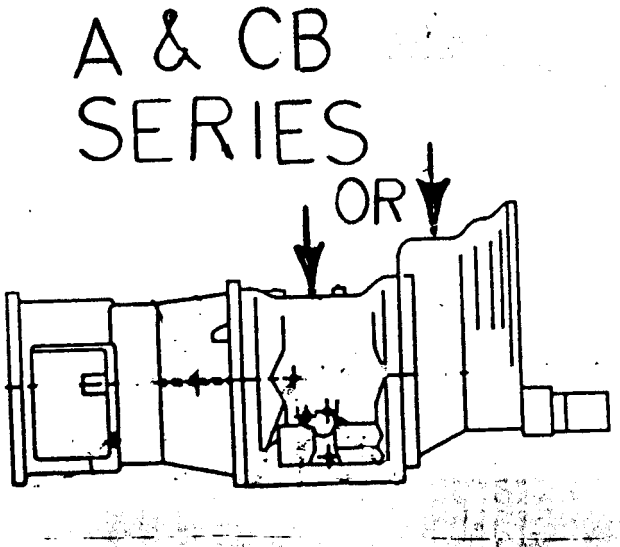


Item Number	Description
D69	Screw, Ferry 3/8-16 UNC-2A
S01	Disc, Oil Blocking
S05	Cover, Shaft Seal
S12	Seal, Type 8 Neoprene Ni-Resist
S14	O-Ring, Neoprene
S15	Pin, Spring 3/32 Diameter
S17	Ring, Retaining - Internal
S19	Screw, Ferry 3/8-16 UNC-2A
S20	Pin, Spiral Head 3/32 Diameter

SULLAIR A12/CB12 SHAFT SEAL KITS BY UNIT PART NUMBER

UNIT PART NUMBER	STYLE	USE KIT NUMBER	UNIT MODEL #
008432-001,004	GEAR DRIVE	001812B	C
008453-001,003,004	GEAR DRIVE	001812B	C
008573-011	GEAR DRIVE	001812B	C
008574-001,004	GEAR DRIVE	001812B	C
008578-001	GEAR DRIVE	001812B	C
008579-001,004	GEAR DRIVE	001812B	C
008724-001,004	GEAR DRIVE	001812B	C
02250064-160	GEAR DRIVE	02250047-688	
060564-1	DIRECT DRIVE	001812A	A
063048-100	DIRECT DRIVE	001812A	B
065067-100	DIRECT DRIVE	001812A	B
065096-300,310,320	DIRECT DRIVE	001919C	C
065453-300,310,320	GEAR DRIVE	001812B	C
065454-300,320	GEAR DRIVE	001812B	C
065455-300,320	GEAR DRIVE	001812B	C
066347-300,310,320	GEAR DRIVE	001812B	C
066348-300,310,320	GEAR DRIVE	001812B	C
066349-300,310,320	GEAR DRIVE	001812B	C
066351-300,310,320	DIRECT DRIVE	001919C	C
066570-300,310,320	DIRECT DRIVE	001919C	C
069571-100	DIRECT DRIVE	001812A	A
069698-200	GEAR DRIVE	001812B	B
069699-200	GEAR DRIVE	001812B	

AS OF DECEMBER 2004, 001812B & 001919C ARE TYPE 8 SEALS
AS OF DECEMBER 2004, 001812A IS A TYPE 21 SEAL

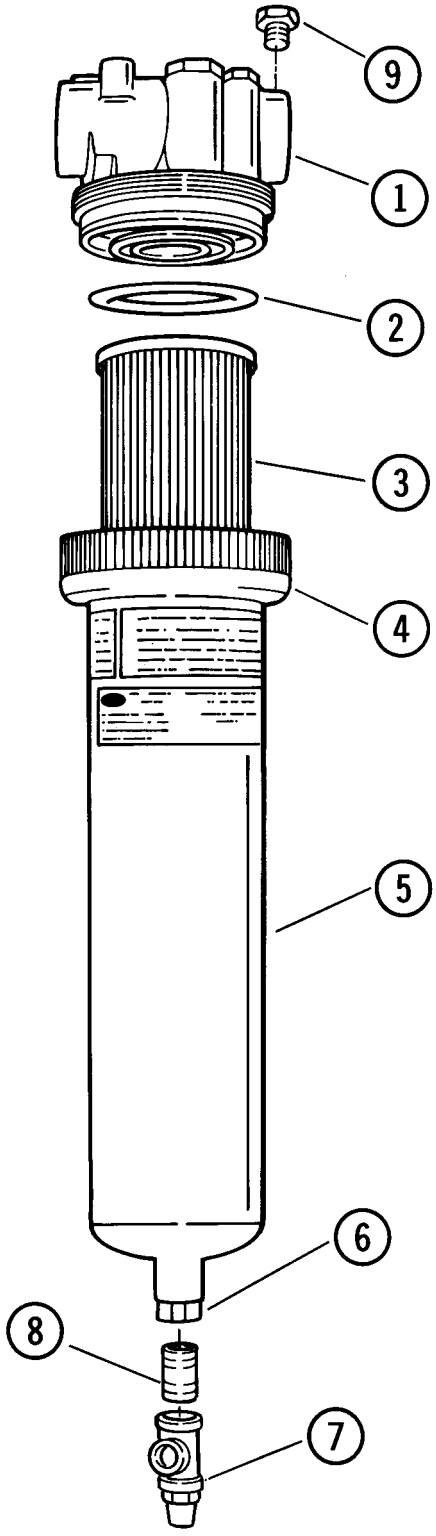


7.11 SHAFT SEAL ASSEMBLY, GEAR DRIVE

KEY NO	DESCRIPTION	PART NUMBER	QTY
S12	seal, shaft with seat NOT CORRECT SEE TABLE	240627	1
S14	seal, O-ring retainer	826202-042	1
S5	seat, shaft retainer	220436	1
4	capscrew	828405-100	6
5	spring, pin (not shown)	827501-025	2
S17	ring, retaining shaft seal seat	043438	1
7	kit, replacement shaft seal (includes Items 1, 2, 5, 6)	001812B	1

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.12 SINGLE FILTER ASSEMBLY

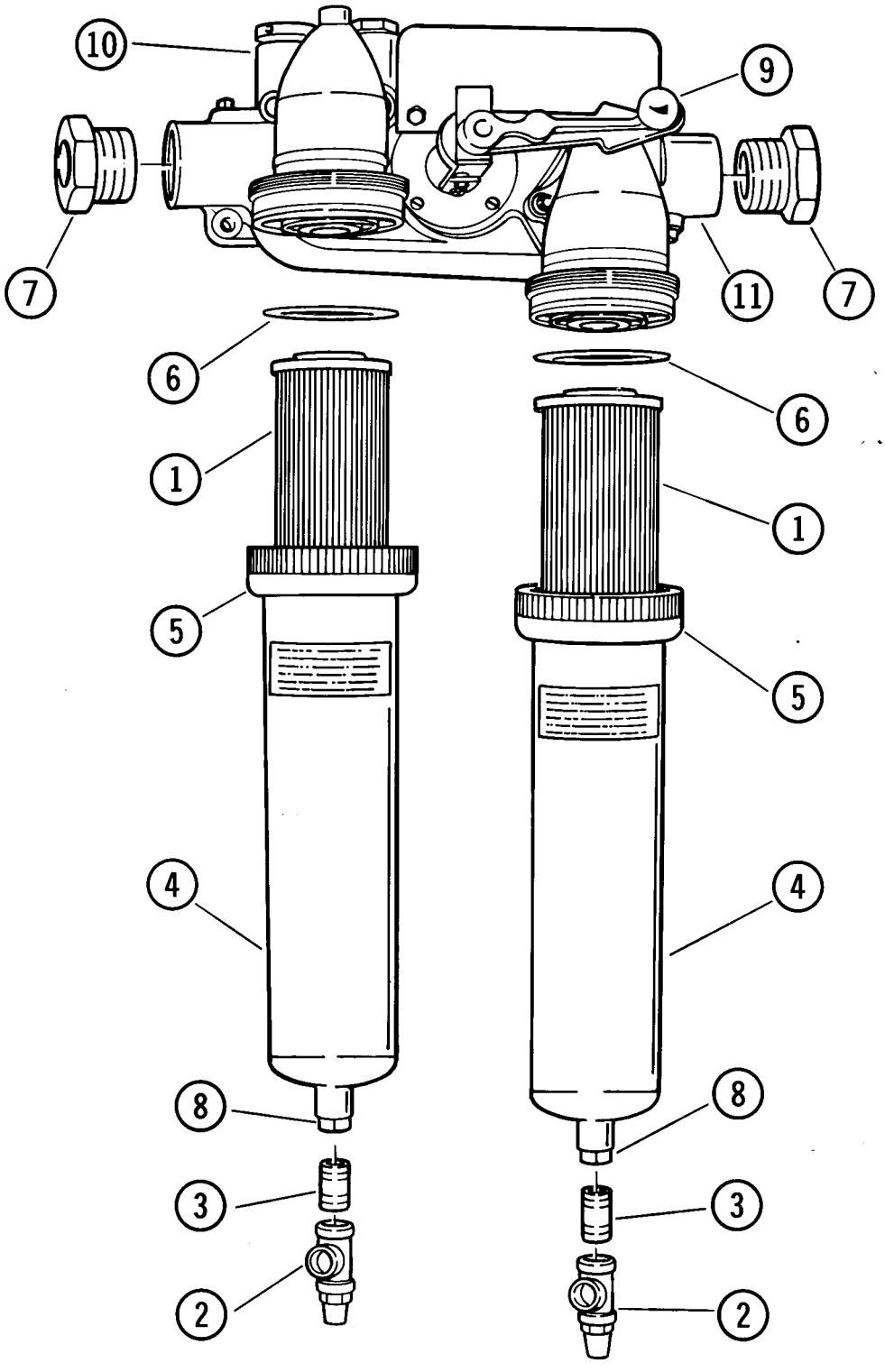


7.12 SINGLE FILTER ASSEMBLY

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	filter assembly (complete)	250008-954	1
2	o-ring, oil filter	826202-153	1
3	element, oil filter	250008-955	1
4	ring, rotolock-oil filter		1
5	canister, oil filter		1
6	adaptor, oil filter drain 3/8" x 1/4"	250009-865	1
7	valve, oil filter drain 1/4"	044996	1
8	nipple, pipe-oil filter 1/4"	822204-000	1
9	adaptor, oil filter pressure port	250009-864	1

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

7.13 DUPLEX FILTER ASSEMBLY



7.13 DUPLEX FILTER ASSEMBLY

KEY NO	DESCRIPTION	PART NUMBER	QTY
1	duplex filter assembly (complete)	250008-953	1
2	valve, oil filter drain ¼"	044996	2
3	nipple, pipe-oil filter ¼"	822204-000	2
4	canister, oil filter		2
5	ring, rotolock-oil filter		2
6	o-ring, oil filter	826202-153	2
7	adaptor, oil filter	250009-872	2
8	adaptor, oil filter drain	250009-865	2
9	handle, duplex filter valve		1
10	valve, commutator		1
11	element, oil filter	250008-955	2

WHEN ORDERING PARTS, INDICATE SERIAL NUMBER OF COMPRESSOR

WORLDWIDE SALES AND SERVICE

SULLAIR CORPORATION

A SUBSIDIARY OF SUNDSTRAND CORPORATION

3700 E. Michigan Blvd. Michigan City, Indiana 46360-9990
Telephone (219) 879-5451 Telex 4946922

Part Number

252852

Printed in U.S.A. Effective 9/89 TSP

Specifications Subject To
Change Without Prior Notice

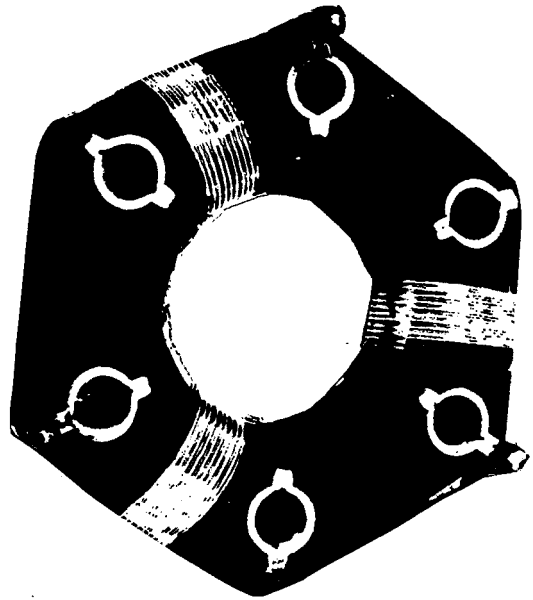
Part No. 252852

THE FOLLOWING PAGES ARE FROM THE PARTS SECTION OF THE OLD CB12 MANUAL

SOME OF THE PART NUMBERS COULD BE OBSOLETE AND SOME COULD BE CONVERTED TO CURRENT PART NUMBERS

PLEASE PROVIDE PACKAGE MODEL AND SERIAL NUMBERS ALONG WITH UNIT PART AND SERIAL NUMBERS WHEN REQUESTING INFORMATION OR PARTS

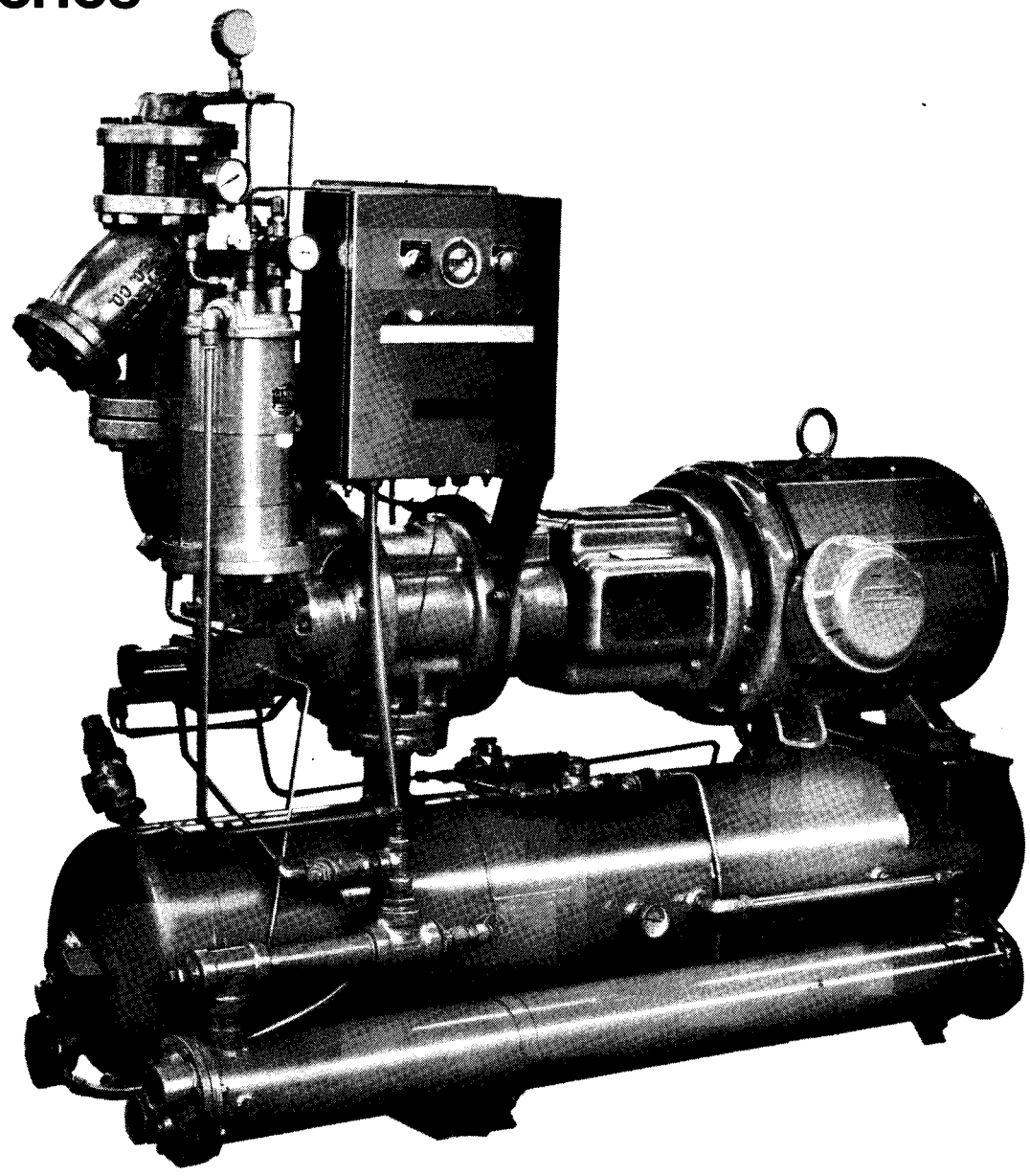
BELOW IS SHOWN
A12 AND CB12 COUPLING ELEMENT
PART NUMBER 250018-551



Operators Manual and Parts List

Sullair
Refrigeration Compressor

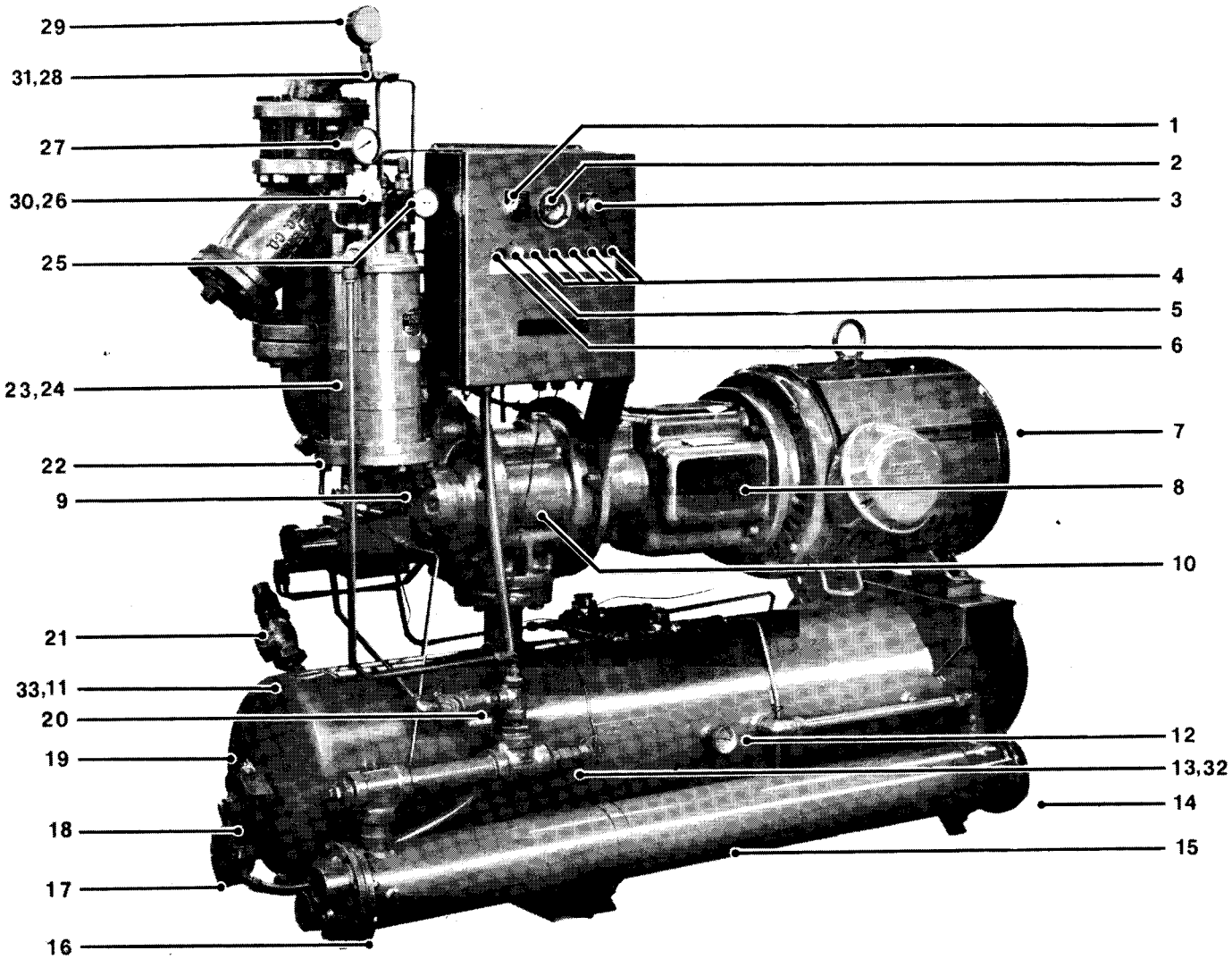
CB Series



Price $25

ILLUSTRATIONS AND PARTS LISTS

FIGURE 7.2 GENERAL (PANEL SIDE)



key number	*description*	*part number*	*quantity*
1	start switch	47097	1
2	hour meter	42988	1
3	stop switch	45494	1
4	pilot light lens - protective switches (red)	43384	5
5	pilot light lens - run (green)	43385	1
6	pilot light lens - anti recycle (amber)	47016	1
7	motor 75hp 460/220 volt/3/60	50191	1
	motor 100hp 460/220 volt/3/60	50192	1
	motor 125hp 460/220 volt/3/60	50193	1
8	drive coupling 75hp and 100hp (not shown)	240187	1
	drive coupling 125hp (not shown)	240225	1

7.2 GENERAL (PANEL SIDE) (Continued)

key number	description	part number	quantity
9	gasket, suction elbow	240705	1
10	compressor unit*	**	1
11	bulbwell, control valve (not shown)	240027	1
12	discharge temperature gauge	240054	1
13	bulbwell	42883	1
14	oil cooler gasket - return head	43912	1
15	oil cooler	43932	1
16	oil cooler gasket - in/out head	43906	1
17	oil heater	240067	1
18	oil heater thermostat	42589	1
19	oil separator/sump	18035	1
20	oil strainer	43325	1
	oil strainer screen	44055	1
	oil strainer gasket	44060	1
21	relief valve	44991	1
22	oil filter O ring (not shown)	826202-259	1
23	oil filter	42463	1
24	oil filter cartridge (not shown)	42712	1
25	oil temperature gauge	240054	1
26	three-way valve, filter pressure drop	241239	1
27	filter pressure drop gauge	240055	1
28	three way valve, suction pressure/oil pres	241239	1
29	suction pressure/oil pressure gauge	240055	1
30	nameplate, filter check	241325	1
31	nameplate, suction/oil pressure	241324	1
32	shield, capillary (temp.)	26356	2
33	shield, capillary (liq. inj.)	222195	1

R22 Gauges 240274

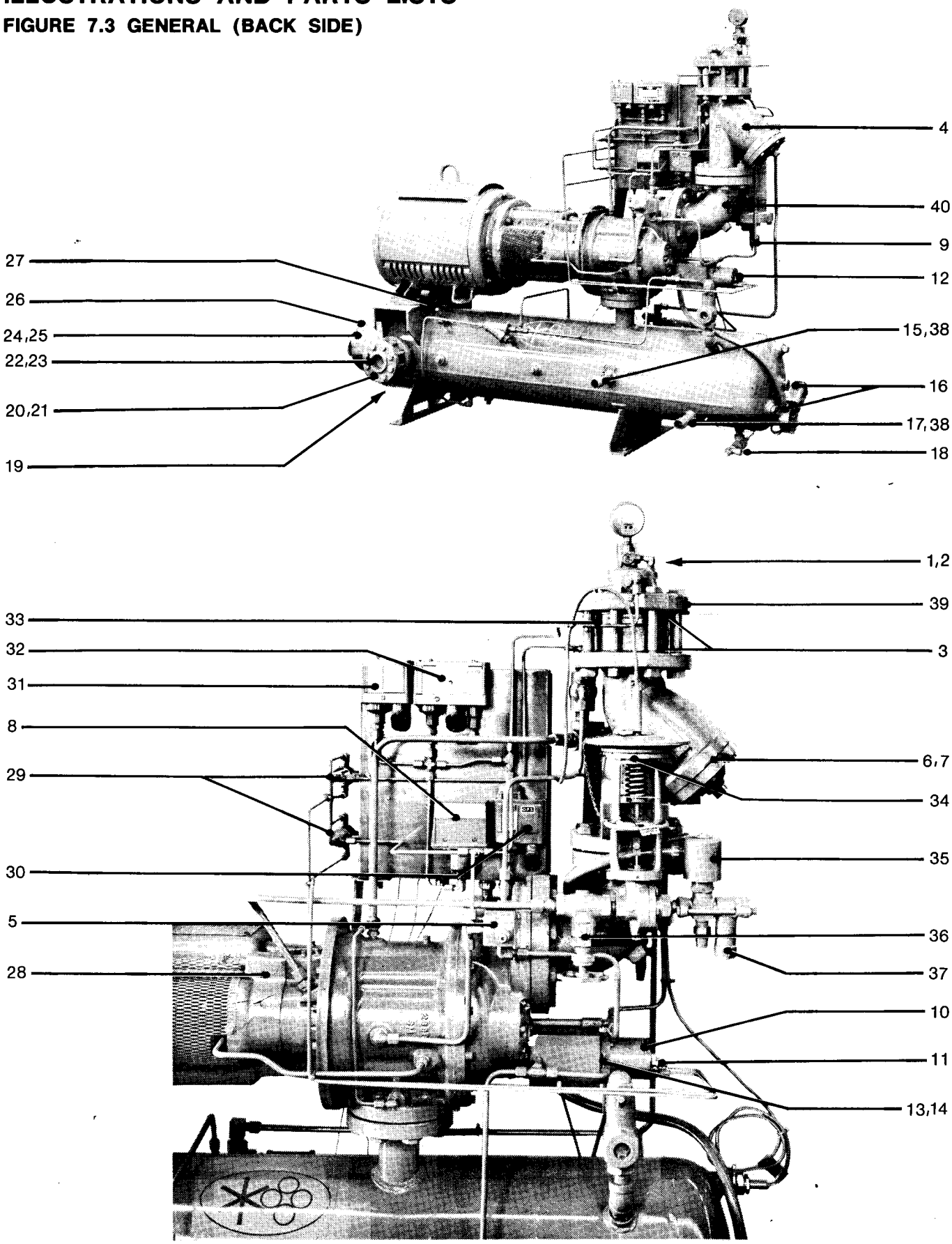
* See compressor unit serial no. nameplate.

** The shaft seal or capacity control valve is the only spare part which can be purchased for the compressor unit. Any other part replacement must be made at the factory. Tampering with internal parts other than the shaft seal or capacity control valve constitutes abuse of the compressor under the terms of the warranty. There is an exchange program whereby a reconditioned (warranteed) compressor unit can be obtained from the factory at the price of reconditioning your unit.

Section 7

ILLUSTRATIONS AND PARTS LISTS

FIGURE 7.3 GENERAL (BACK SIDE)



7.3 GENERAL (BACK SIDE)

key number	description	part number	quantity
1	suction stp valve, 3" st with flanges (not shown)	44578	1
2	gasket	43678	2
3	gasket (not shown)	44998	3
4	suction strainer	240163	1
5	oil pressure regulator**	42475	1
6	suction strainer screen (not shown)	240234	1
7	gasket (not shown)	240245	1
8	capacity control pressure switch (P1/P2)	47607	1
9	filter valve	44996	1
10	capacity control indicator	220225	1
11	capacity control actuator	240218	1
12	capacity decal (not shown)	240219	1
13	capacity control actuator coupling (not shown)	220224	1
14	capacity control actuator coupling key (not	*	1
15	bulbwell shown)	42883	1
16	oil level sight glass	41327	2
17	bulbwell	42883	1
18	oil drain valve	44997	1
19	discharge pressure gauge (not shown, shipped loose)	240055	1
20	discharge stop valve, 2" globe w/flanges (not	240065	1
21	gasket shown)	43676	2
22	discharge check valve, 2" (not shown, shipped loose)	240056	1
23	gasket (not shown)	240170	2
24	oil separator element (not shown)***	240158	1
25	oil separator element gasket (not shown)	240229	2
26	oil separator access cover gasket (not shown)	240172	1
27	blow down valve	44997	1
28	shaft seal (not shown)	240012	1
29	capacity control solenoid valve***	47287	2
30	low oil pressure protective switch	42464	1
31	suction pressure auto start-stop control	42888	1
32	high discharge/low suction pressure control	42465	1
33	suction check valve	240058	1
34	refrigerant regulating valve	240227	1
a.	refrigerant regulating valve replacement seats	240786	1
b.	refrigerant regulating valve thermal system	240882	1
c.	refrigerant regulating valve packing	240710	1
35	main solenoid valve	240228	1
36	liquid injection line manual valve	45626	1
37	strainer	240226	1
38	shield, capillary (temp.)	26356	2
39	suction flange	18125	1
40	suction elbow	221592	1

* Standard hardware item, purchase locally.

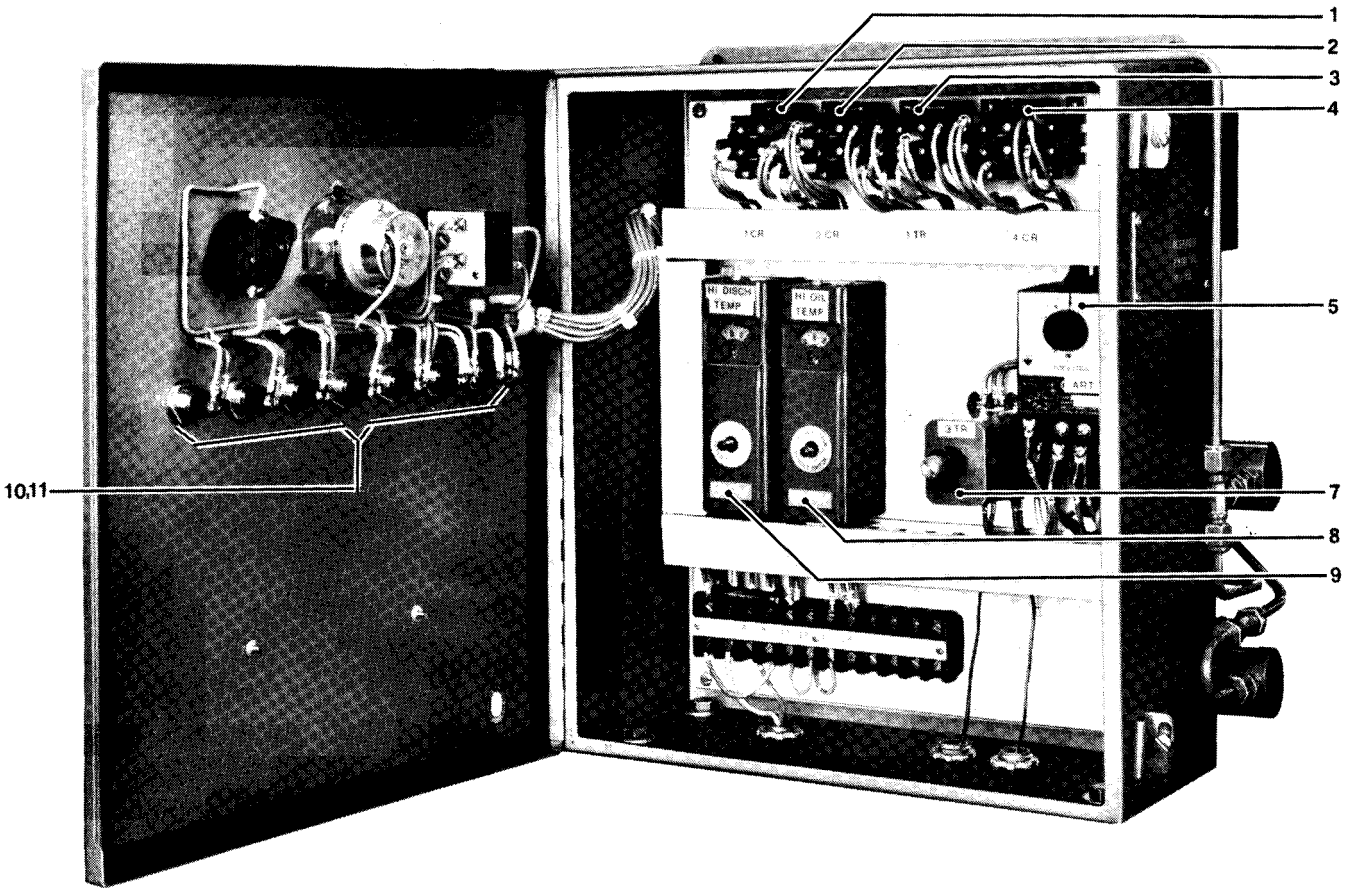
** Earlier machines equippped with "Fulflo" regulator #240066 - request conversion kit.

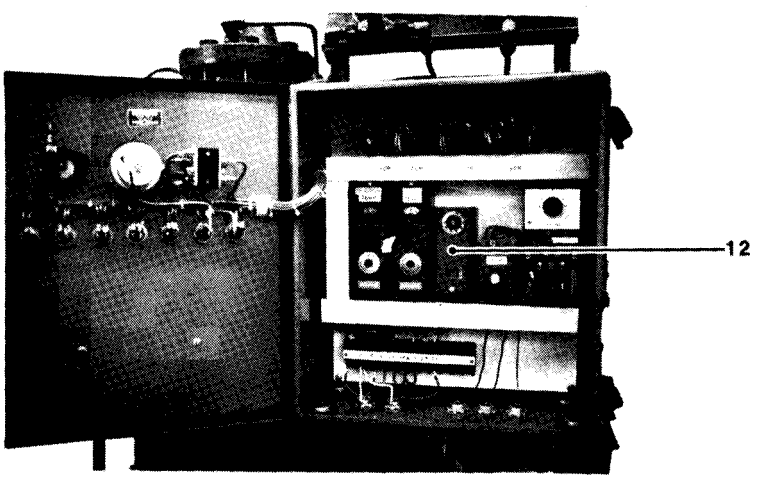
*** Freon machines use element #240812 & solenoid #240785.

Section 7

ILLUSTRATIONS AND PARTS LISTS

FIGURE 7.4 ELECTRICAL PARTS





7.4 ELECTRICAL PARTS

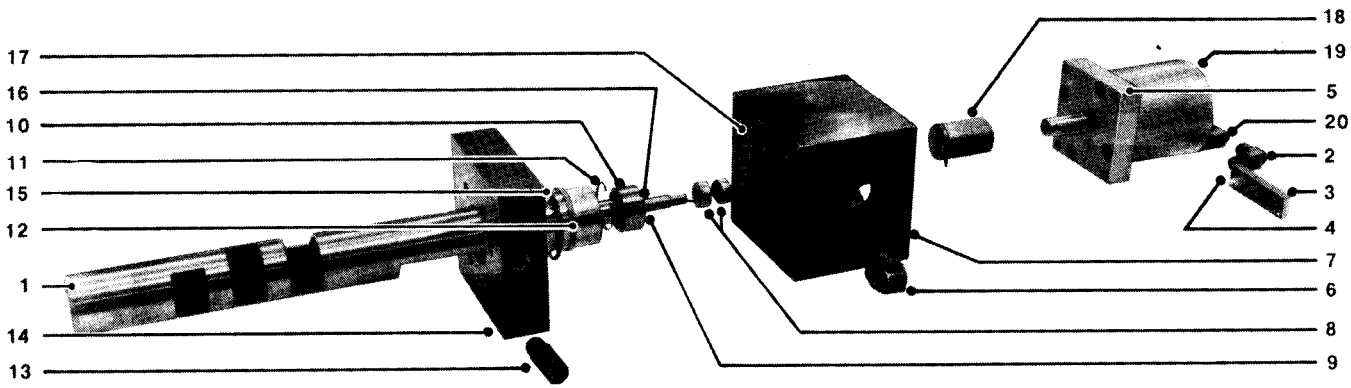
key number	*description*	*part number*	*quantity*
1	protective relay (1cr)	46175	1
2	low oil pressure relay (2cr)	46175	1
3	oil pressure delay timer (1tr)	46176	1
4	motor run relay (4cr)	46175	1
5	anti-recycle timer (art)	46177	1
6	solenoid relay (freon only) not shown	45496	1
7	capacity control timer (3tr)	47087	1
8	high oil temperature control	45417	1
9	high discharge temperature control	45417	1
10	pilot light, lamp holder	43383	7
11	pilot lamp (not shown)	43386	7
12	low discharge temperature control	42589	1

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

ILLUSTRATIONS AND PARTS LISTS

FIGURE 7.5 CAPACITY CONTROL VALVE

DECAL 240219
MAX MIN



7.5 CAPACITY CONTROL VALVE

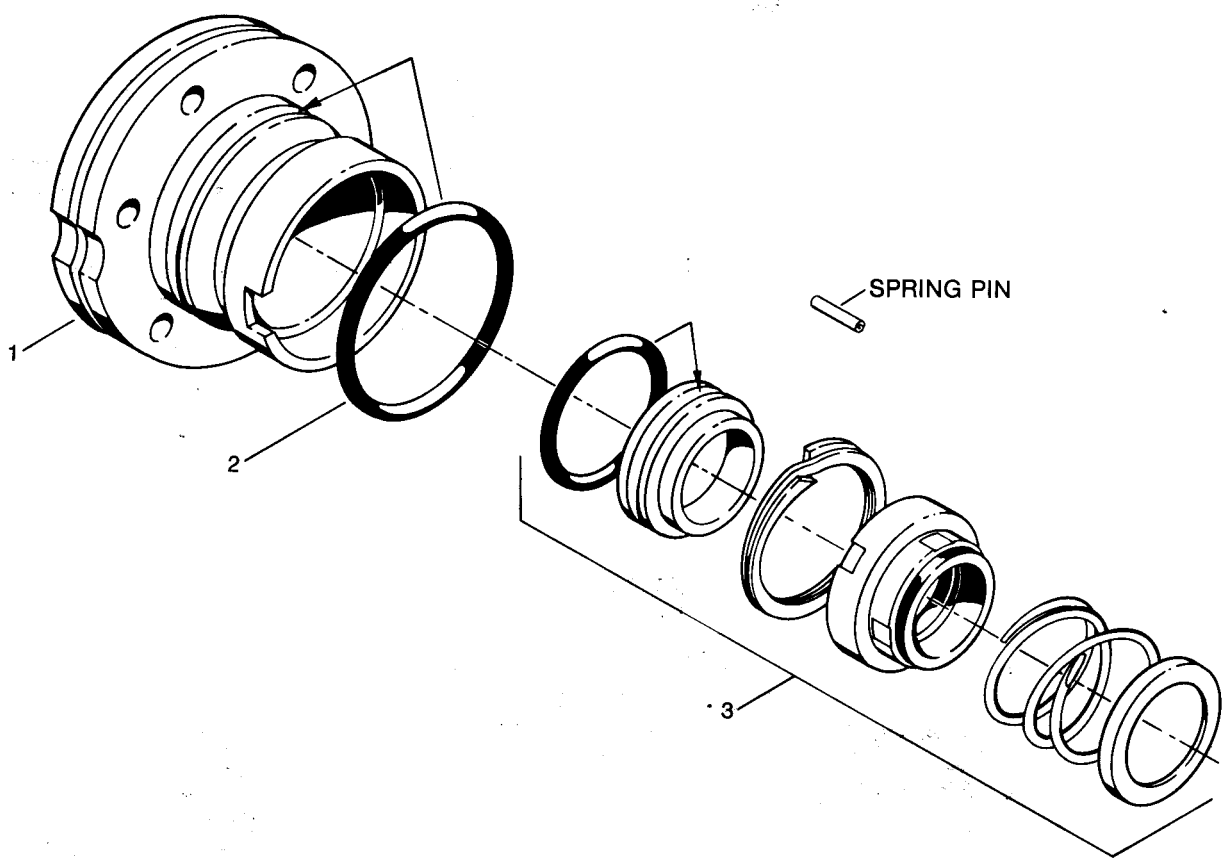
key number	*description*	*part number*	*quantity*
1	capacity control valve		
	• high volume ratio	18112	1
	• low volume ratio	18107	1
2	elbow, tube 1/4"pipe x 1/2"tube	*	1
3	indicator	220225	1
4	pin, spiral 1/8" x 1/2"	*	1
5	actuator**	240218	1
6	plug, pipe 3/4"	*	1
7	adapter, mounting	220223	1
8	seal, oil	42874	2
9	ring, retaining	836251-046	1
10	bearing	42681	1
11	ring, retaining	836150-125	1
12	O ring	826202-224	1
13	connector, 1/4"pipe x 1/4"tube	*	1
14	adapter	220222	1
15	ring, glide	240195	1
16	ring, support	22939	1
17	O ring	826202-043	1
18	coupling	220224	1
19	decal	240219	1
20	elbow, tube 1/4"pipe x 1/4"tube	*	1

* Standard hardware item, purchase locally.

** For repair kit order no. 1804A (Does not include actuator 240218).

ILLUSTRATIONS AND PARTS LISTS

FIGURE 7.6 SHAFT SEAL ASSEMBLY



key number	*description*	*part number*	*quantity*
1	retainer, oil seal	220101	1
2	O ring	826202-238	1
3	seal, oil (neoprene)	240012	1

SULLAIR A12/CB12 SHAFT SEAL KITS BY UNIT PART NUMBER

UNIT PART NUMBER	STYLE	USE KIT NUMBER	UNIT MODEL #
008432-001,004	GEAR DRIVE	001812B	C
008453-001,003,004	GEAR DRIVE	001812B	C
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008724-001,004	GEAR DRIVE	001812B	C
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AS OF DECEMBER 2004, 001812B & 001919C ARE TYPE 8 SEALS
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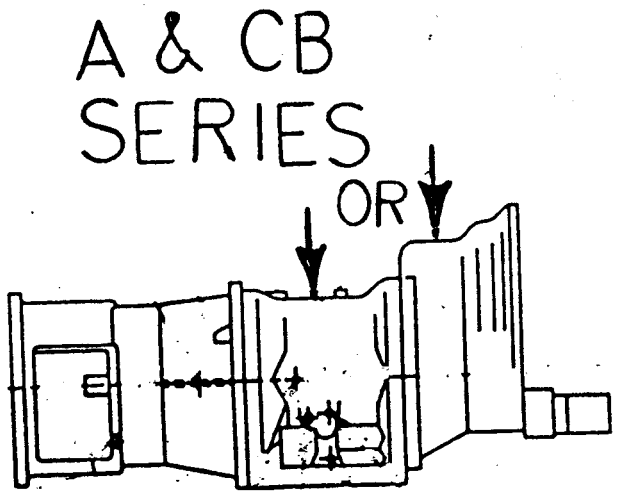
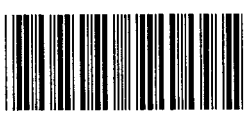


Worldwide Sales and Service

SULLAIR REFRIGERATION, INC.

Mailing Address: 3700 East Michigan Blvd. Michigan City, Indiana 46360
Shipping Address: 1625 E. Second Street, Michigan City, Indiana 46360
Phone: (219) 879-5451 Telex: 276103

Part Number



253769

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Specifications subject to change
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