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Operation and Maintenance Manuals
Bachelors Enlisted Quarters
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R & W Construction Co.
620 Richlands Hwy.
Jacksonville, NC 28540
Ph. (919) 455-1830

R & W CONSTRUCTION COMPANY

Welding & Fabrication — Certified Pipe & Structural Steel

620 Richlands Highway — Jacksonville, North Carolina 28540

Russell Pierce
455-1830

Wayne Pierce
455-1830

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R & W CONSTRUCTION COMPANY

Welding & Fabrication — Certified Pipe & Structural Steel

620 Richlands Highway — Jacksonville, North Carolina 28540

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Local Suppliers List

Manhole drainers

Jacksonville Mechanical Supply, Inc.
620 Richlands Hwy.
Jacksonville, NC 28540
Ph. (919) 455-8328

Sewage Pumps

Davis Meter & Supply
3321 Hobby Court
Raleigh, NC 27604
Ph. 800-662-7414

Water Heaters

Heat Transfer Sales, Inc.
1005 Cedar Hurst
Raleigh, NC 27609
Ph. (919) 876-3846

Pumps

McKenzie Supply Co.
PO Box 1166
Wilmington, NC 28402
Ph. (919) 791-4994

Terminal Air Blenders
Air Handling Units
Fan Coil Units
Water Chillers
Unit Heaters
Exhaust Fans

Hoffman Hoffman, Inc.
6120 St. Giles St.
Raleigh, NC 27612
Ph. (919) 781-8011

Pumps

Heat Transfer Sales, Inc.
1005 Cedar Hurst
Raleigh, NC 27609
Ph. (919) 876-3846

Temperature Controls

Universal Controls Division
PO Box 1667
Chesapeake, VA 23320
Ph. (804) 420-4672

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and

Model 2R-SL Steam Operated Sump Pump

INSTALLATION INSTRUCTIONS

(1) Sump should be at least 16" diameter.

(2) Pump must be placed on hard level surface. Use bricks or other suitable support in bottom of open tile sumps, never place drainer directly on clay or earth surface.

(3) Choose a location which will allow discharge piping to be routed with the least elevation, the least number of turns, and the least total length of pipe.

(4) Do not use pipe size smaller than the pump connections.

(5) Inlet piping should be equipped with the special strainer union supplied with your pump. This strainer will protect the valve and nozzle from pipe scale and dirt.

(6) Install a swing type check valve in discharge line to prevent backflow when pump stops. (1" size for Model 1R, 1¼" size for Models 2R and 2R-SL).

(7) Flush out inlet line before making final connections to pump.

(8) These pumps are factory set to operate at 10 to 60 PSI motive pressure (water for Models 1R & 2R, steam for Model 2R-SI) for higher pressures — up to 150 PSI, hanger should be set at corresponding number on valve lever arm.

(9) Open inlet supply valve and leave it open.

(10) To check installation, gradually fill sump with water. Pump valve will open when water level reaches about ¾" below float rim. Drainer will pump water until level drops sufficiently for float to pull valve shut.

OPERATING INSTRUCTIONS

(1) Check operation of pump a few times each year by adding water to sump, especially before normal heavy operating period.

(2) Remove debris from sump periodically.

(3) Clean suction screen if it appears to be covered with lint or other material.

(4) Clean inlet union strainer periodically.

(5) Do not allow pump to handle cement, mortar, plaster, gravel or mud.

SERVICE INSTRUCTIONS

IF PUMP FAILS TO OPERATE:

(1) Check to be sure float is free to move up and down.

(2) Check for leaky or damaged float.

(3) Check for clogged inlet line or jets.

IF PUMP FAILS TO EMPTY SUMP:

(1) Check for sticking check valve or restriction in outlet flow.

(2) Check for excessive inflow into sump.

(3) Check to be sure you have sufficient water or steam pressure available. (IMPORTANT: Total elevation from bottom of sump to top of discharge line not to exceed 1 foot for each 4 PSI of motive pressure.)

(4) Check for clogged strainer.

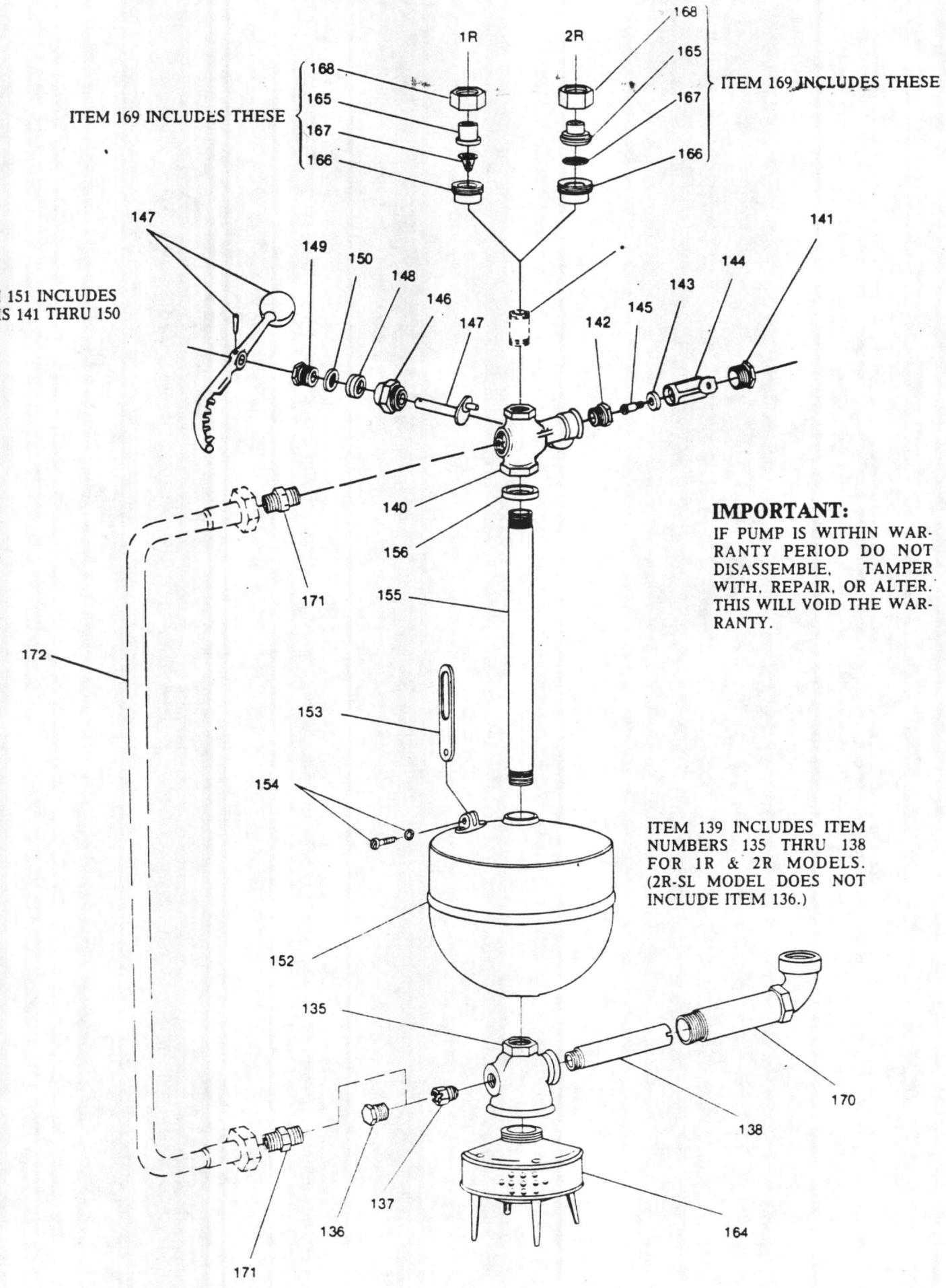
IF VALVE WILL NOT SHUT OFF:

(1) Check to be sure float is free to move.

(2) If valve is sticking, disassemble and clean out, or loosen packing gland until valve works freely.

PENBERTHY HOUDAILLE

#11642-009 P.O. Box 112 Prophetstown, Illinois 61277



IMPORTANT:
IF PUMP IS WITHIN WARRANTY PERIOD DO NOT DISASSEMBLE, TAMPER WITH, REPAIR, OR ALTER. THIS WILL VOID THE WARRANTY.

ITEM 139 INCLUDES ITEM NUMBERS 135 THRU 138 FOR 1R & 2R MODELS. (2R-SL MODEL DOES NOT INCLUDE ITEM 136.)

*SUPPLIED BY CUSTOMER

PARTS & MATERIALS LIST

Key No.	Part Description	1R		2R		2R-SL	
		Part No.	Material	Part No.	Material	Part No.	Materia
135	Ejector Body	40928-002	Bronze	40928-002	Bronze	40928-002	Bronze
136	Ejector Body Plug	40614-002	Brass	40614-002	Brass		
137	Water Jet	40927-002	Brass	40616-002	Brass		
137	Steam Jet					42312-002	S.S.
138	Delivery Jet	40617-002	Brass	40618-002	Brass	42313-002	S.S.
139	Ejector Assembly	40615-001		40616-001		42310-001	
140	Valve Body (Includes Seat)	40633-002	Bonze	40636-002	Bronze	42314-002	Bronze
141	Valve Body Plug	40614-002	Brass	40614-002	Brass	40614-002	Brass
142	Valve Body Seat	40640-002	Brass	40640-002	Brass	40640-002	Brass
143	Valve Disc	12691-010	Rubber	12691-010	Rubber	12691-020	Teflon
144	Valve Disc Holder	40639-002	Bronze	40639-002	Bronze	40639-002	Bronze
145	Valve Disc Screw	40638-002	Brass	40638-002	Brass	40638-002	Brass
146	Valve Bonnet	40603-002	Brass	40603-002	Brass	40603-002	Brass
147	Valve Stem, Lever & Pin	40607-001	Bronze & Brass	40607-001	Bronze & Brass	42335-001	Bronze & Br
148	Valve Packing (2 Required)	40606-002	Graphite Asbestos	40606-002	Graphite Asbestos	40606-002	Graphite Asbestos
149	Valve Packing Gland	40604-002	Brass	40604-002	Brass	40604-002	Brass
150	Valve Packing Gland Washer	40605-002	Brass	40605-002	Brass	40605-002	Brass
151	Valve Assembly	40921-001		40922-001		42314-001	
152	Float	40611-001	Copper	40611-001	Copper	40611-001	Copper
153	Hanger	40608-002	Brass	40608-002	Brass	42336-002	Brass
154	Hanger Screw & Lock Washer	40609-001		40609-001		40609-001	
155	Float Guide Tube	40613-002	Brass	40613-002	Brass	42310-002	Brass
156	Guide Tube Washer	40601-002	Rubber	40601-002	Rubber	40601-002	Rubber
164	Strainer Assembly	40598-001	Brass	40598-001	Brass	40598-001	Brass
165	Strainer Union — Male Seat	40642-002	Brass	40622-002	Bronze	40622-002	Bronze
166	Strainer Union— Female Seat	42337-002	Bronze	40623-002	Bronze	40623-002	Bronze
167	Strainer Union Screen	40643-002	Monel	40625-002	Brass	40625-002	Brass
168	Strainer Union— Coupling Nut	51180-002	Brass	40624-002	Bronze	40624-002	Bronze
169	Strainer Union Assembly	40642-001		40622-001		40622-001	
170	Discharge Elbow	40619-002	Bronze	40620-002	Bronze	40620-002	Bronze
171	Adaptor					42311-002	Brass
172	Tube Assembly					42315-001	Brass

DISASSEMBLY - REASSEMBLY INSTRUCTIONS

DISASSEMBLY

STRAINER UNION ASSEMBLY

(1) Disconnect cellar drainer at inlet and outlet unions.

(2) Remove cellar drainer from sump.

(3) Remove inlet strainer union assembly (item 169) which includes coupling nut (item 168), union male seat (item 165), union strainer screen (item 167), and union female seat (item 166).

(4) Remove any inlet and outlet pipes.

STEAM LOOP

(1) On 2R-SL Model, loosen coupling nuts of tube assembly (item 172) and remove tube assembly.

(2) Remove both adaptors (item 171).

WATER AND DELIVERY JETS

(1) On 1R and 2R Models remove plug (item 136) and water jet (item 137) from ejector body (item 135).

(2) On 2R-SL Models remove steam jet (item 137) from ejector body (item 135).

(3) Remove discharge elbow (item 170) and delivery jet (item 138) from ejector body.

STRAINER

(1) Remove strainer assembly (item 164) from ejector body.

(2) Strainer parts are riveted together; if disassembly is required, drill out rivets and use brass screws to reassemble.

FLOAT

(1) Hanger (item 153) may be removed from float (item 152) by unfastening hanger screw and lock washer (item 154).

(2) Loosen float guide tube (item 155) from valve body (item 140) and remove the tube washer (item 156).

(3) Slide float (item 152) off of tube (item 155).

(4) Loosen tube from ejector body (item 135).

(5) Remove hanger (item 153) from valve lever (item 147).

VALVE

(1) Remove valve body plug (item 141) for 1R and 2R Models and adapter (item 171) for 2R-SL Model from valve body.

(2) Loosen and remove valve bonnet (item 146).

(3) Valve disc holder (item 144) may be removed at this time. Valve disc (item 143) and screw (item 145) may be taken off at this time.

(4) To disassemble valve packing remove pin (item 147) from lever (item 147) and slide lever off stem. Loosen valve packing gland (item 149) from valve bonnet, and remove. Valve packing (item 148) and gland washer (item 150) may be pulled out from valve bonnet.

(5) Valve seat (item 142) may now be unscrewed from valve body.

REASSEMBLY

WATER AND DELIVERY JETS

(1) Fasten ejector body to strainer assembly.

(2) Replace delivery jet and discharge elbow onto ejector body.

(3) Water jet and plug may be replaced on 1R and 2R Models to the ejector body.

(4) Fasten steam jet onto ejector body on 2R-Sl Model.

(5) Replace the adaptor onto ejector body.

FLOAT

(1) Tighten tube to ejector body, and slide float onto tube.

(2) Connect hanger to float by tightening hanger screw and lock washer.

VALVE

(1) Replace valve body and tube washer to tube.

(2) Replace valve body seat.

(3) Reassemble valve disc onto holder using screw. Then insert holder in valve body. Take valve stem and valve bonnet, and replace into valve body making certain that peg on stem slides into holder. Tighten valve bonnet.

(4) Slide two valve packings, and one packing washer on stem; then replace packing gland. Tighten moderately.

(5) Slide lever on stem and replace pin.

(6) Slide float hanger on lever.

STEAM LOOP

(1) On 2R-Sl Models attach steam loop tube assembly to valve body and ejector body.

STRAINER UNION ASSEMBLY

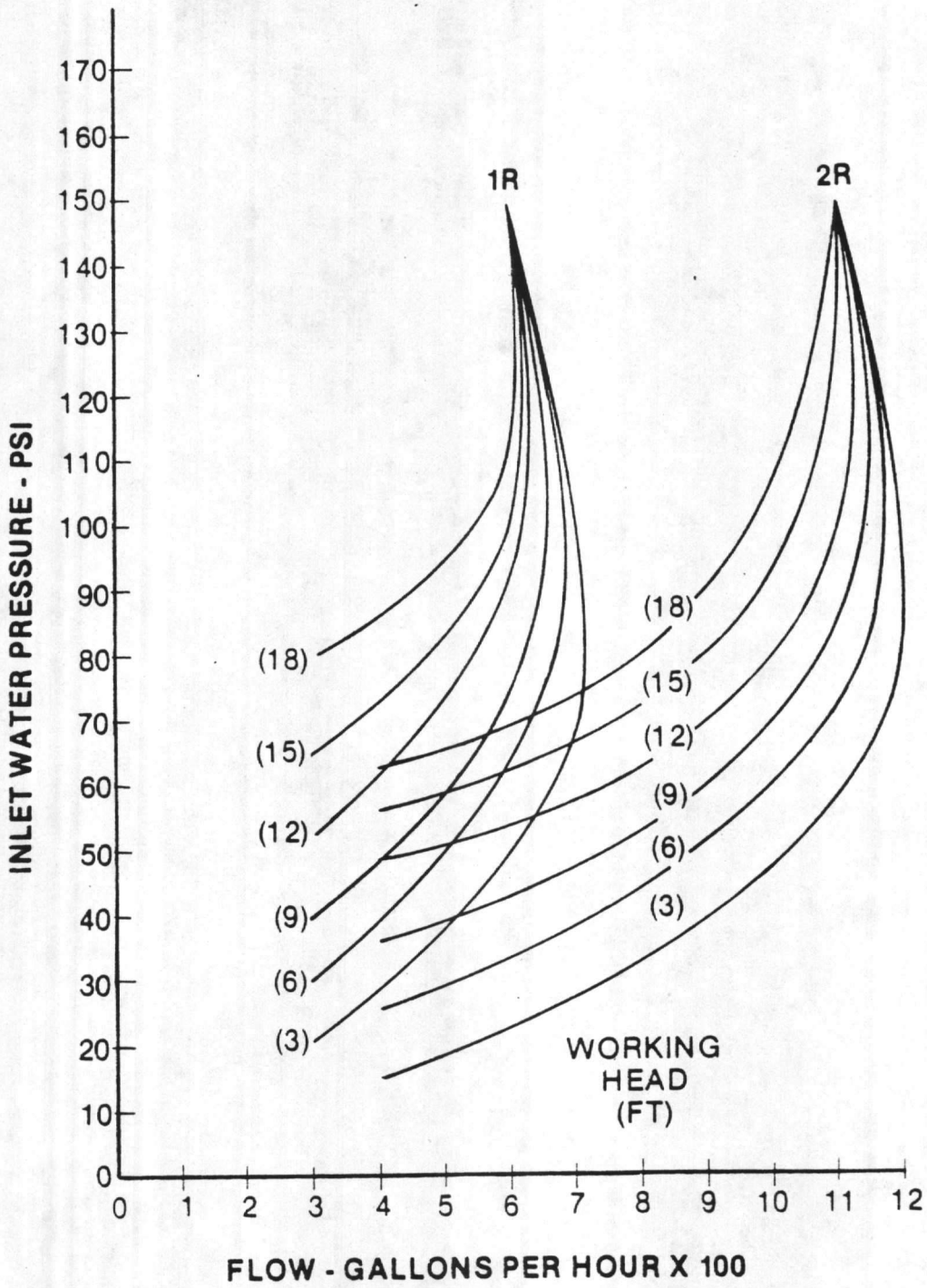
(1) Replace any inlet and outlet pipes.

(2) Replace inlet strainer union assembly, including coupling nut, union male seat, union strainer screen, and union female seat.

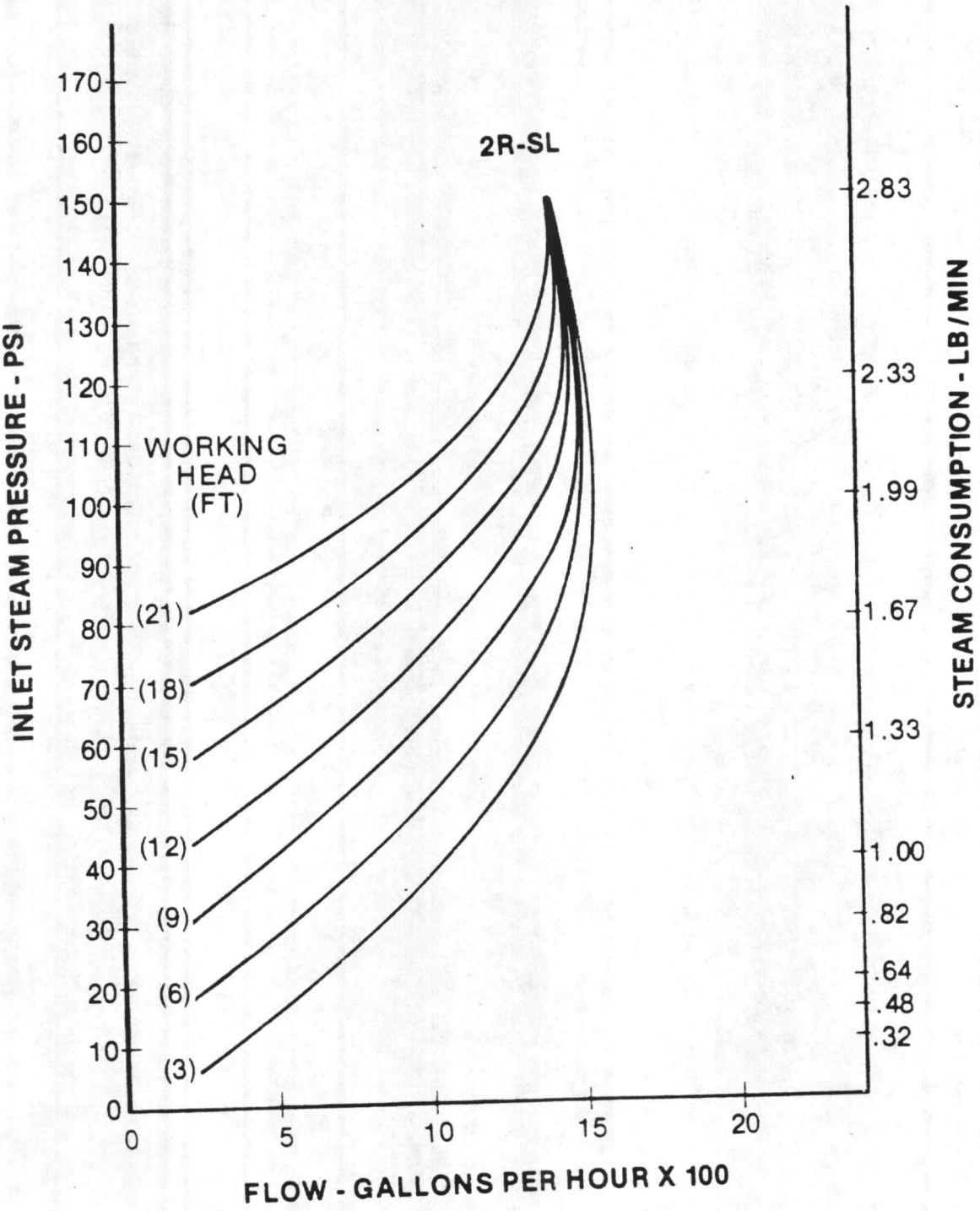
(3) Attach cellar drainer to inlet and outlet unions.

PERFORMANCE

MODEL 1R & 2R

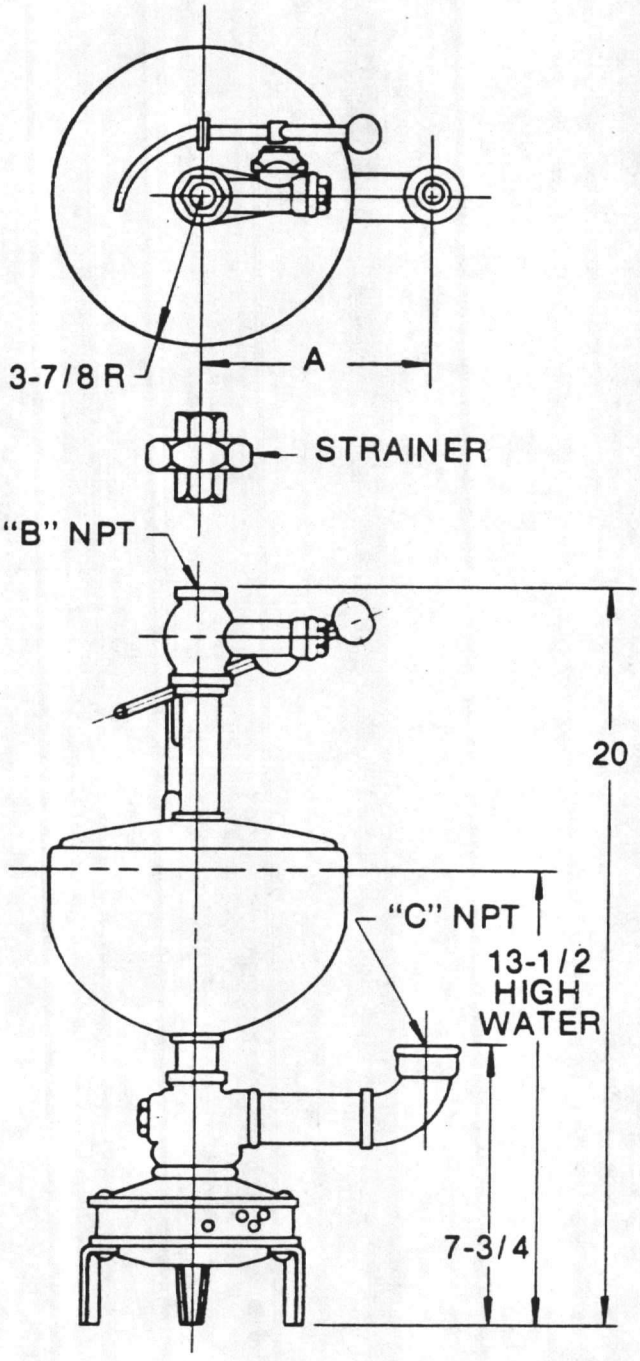


MODEL 2R-SL


2R-SL
INLET STEAM PRESSURE - PSI
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
WORKING HEAD (FT)
(21)
(18)
(15)
(12)
(9)
(6)
(3)
0
5
10
15
20
FLOW - GALLONS PER HOUR X 100
STEAM CONSUMPTION - LB/MIN
2.83
2.33
1.99
1.67
1.33
1.00
.82
.64
.48
.32

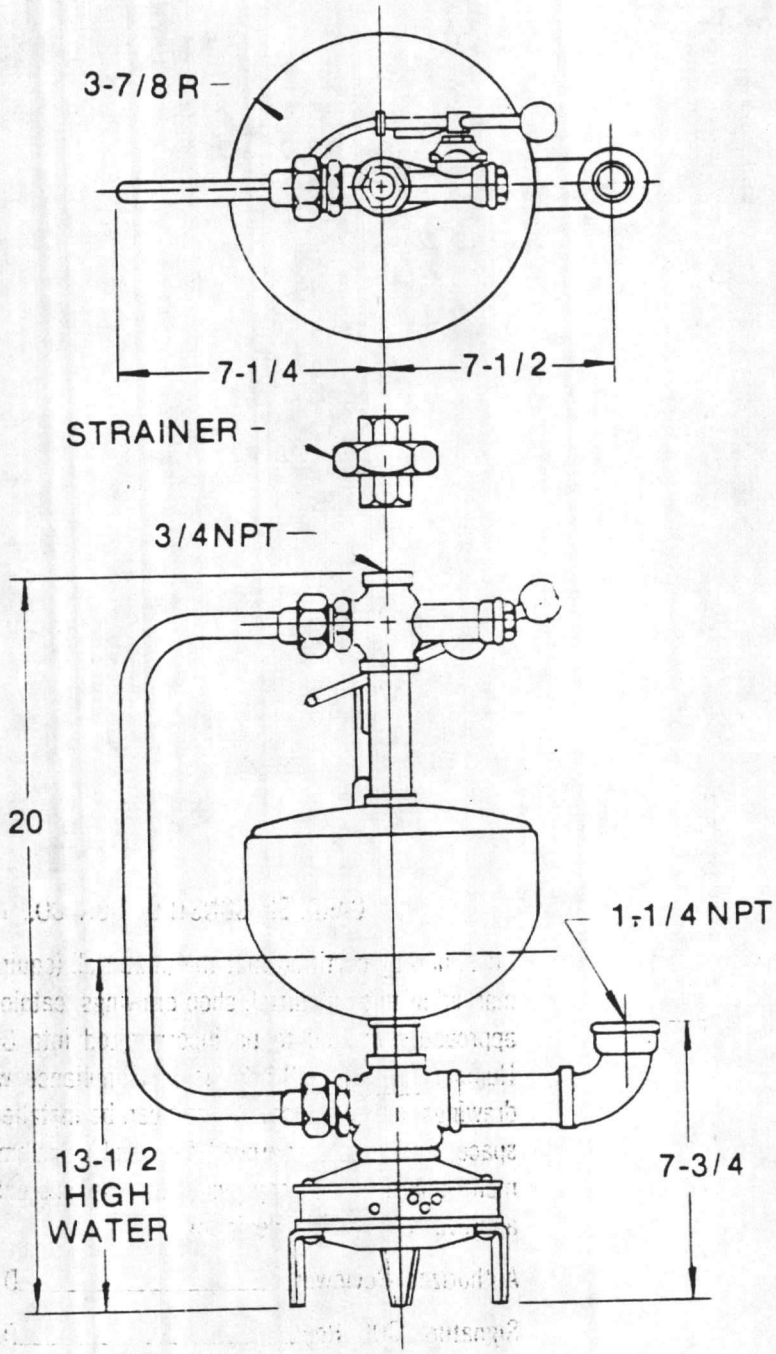
DIMENSIONS

MODEL 1R & 2R



MODEL	A	B	C
1R	6	1/2	1

MODEL 2R-SL



MODEL	A	B	C
2R	7-1/2	3/4	1-1/4

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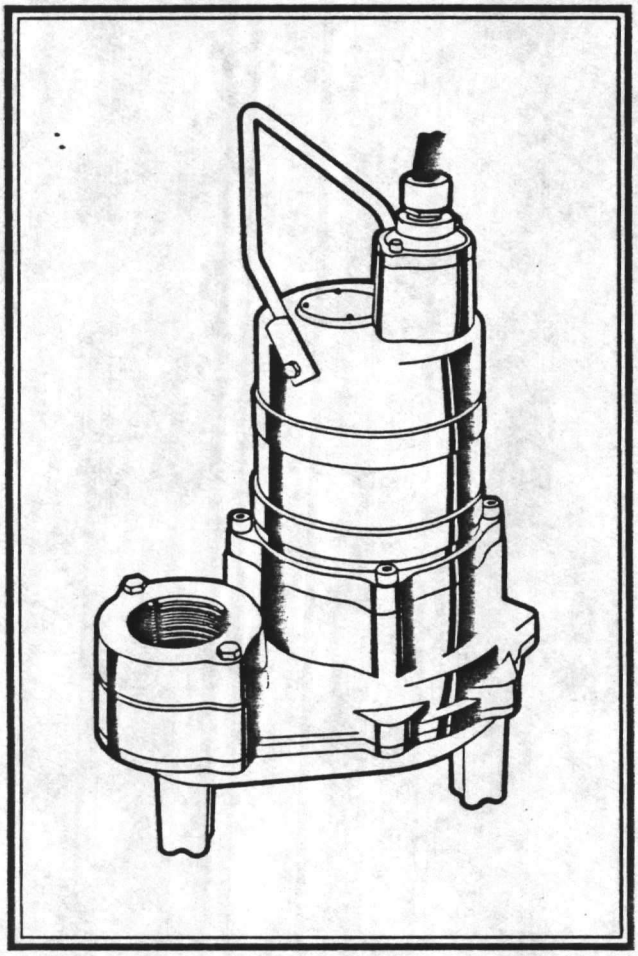


Installation and Service Manual

Models:
S4F, S4HX, S4HRC, S3HRC

HYDROMATIC PUMPS
A Marley Pump Company

WARNING: Before handling these pumps and controls, always disconnect the power first.
Do not smoke or use sparkable electrical devices or flames in a septic (gaseous) or possible septic sump.

Before operation — Read the following instructions carefully. Reasonable care and safe methods should be practiced. Check local codes and requirements before installation.

CONTENTS

GENERAL INFORMATION

SHIPPING

When unpacking unit check for concealed damage. CLAIM FOR DAMAGE MUST BE MADE AT THE RECEIVING END THROUGH THE DELIVERING CARRIER. DAMAGE CANNOT BE PROCESSED FROM THE FACTORY.

SEAL FAILURE — OPTIONAL

An electrode probe is installed in the seal chamber so if any water enters the chamber through the first seal the electrode will be energized and a signal will be transmitted to the sensing unit at ground surface causing an alarm function to energize.

In operation the seal failure unit indicates only that there is some water in the seal chamber. The pump will continue to operate without damage but the seal should be checked within 30 days after failure is indicated.

PUMP

The S, SH, S3HRC and S4HRC submersible pumps are supplied for 1 and 3 phase and for 208, 230, 460 or 575 volts. Pump is supplied with 15 feet of power cord and/or 15 feet of auxiliary control cord. Longer cable lengths can be furnished but must be specified at time of order. Power cable is 4 wire with the green wire for ground. Be sure green wire is connected to a good ground such as a water pipe or ground stake. The auxiliary cable for seal failure and heat sensors is also 4 wire color coded.

HEAT SENSORS — OPTIONAL

All motors have heat sensor units embedded in the motor winding to detect excessive heat. The heat sensors are set to trip at 105° C. so will operate if dangerous heat occurs. The sensors automatically reset when motor cools to safe temperature.

The sensors are connected in series with the motor starter coil so that the starter is tripped if heat sensor opens. The motor starter is equipped with overload heaters so all normal overloads are protected by the starter.

IMPORTANT

If Hydromatic electrical starting equipment is not supplied the heat sensor circuit must be connected in series with the starter coil or warranty on motor is void. Connection diagram is included in this manual.

SUMP LEVEL CONTROL

Sump level is controlled by Hydromatic 3900 mercury switch controls. The 3900 control is a mercury tube switch sealed in a solid polyurethane float. The float is held in position in the sump by a weight attached to the power cord above the float. The cord supports the float and is adjusted for height from the surface.

Typical duplex systems use three controls: one set at turn-off, one set at turn-on for one pump, and one set for turn-on for two pumps. Pumps alternate operation on each successive cycle.

Two pumps operate together only if sump level rises to the third or override control. The override control also brings on the second pump in case of failure of the first pump. Extra floats with appropriate controls can be supplied for alarm functions. Triplex systems use four controls: one set at turn-off, one set at turn-on for one pump, one set at turn-on for two pumps, and one set at turn-on for three pumps. Pumps alternate each successive cycle.

Three pumps operate together only if sump level rises to the fourth control (second override). This control also brings on the third pump in case of failure of either or both of the first two pumps.

ALARM CONTROLS

The alarm level is usually set above the override level so the alarm will signal only if the override level is exceeded. However, some engineers prefer to have the alarm level set below the override level as it is possible for one pump to fail and the other pump to operate on the override level with the sump level never reaching the alarm level. This is particularly true in cases of low inflow capacity.

ELECTRICAL CONTROL PANEL

It is recommended that the HYDROMATIC control panel be used with all pumps as proper starter heaters and connections for heat sensor wires are furnished.

IMPORTANT

If HYDROMATIC electrical controls are not used and the motor fails because of improper components or if the heat sensors are not properly connected the motor guarantee is void.

HYDROMATIC electrical equipment is installed in a weatherproof NEMA 3R enclosure. The electrical equipment includes a main circuit breaker for each pump, a magnetic starter with overload protection for each pump, a H-O-A switch and run light for each pump, an electric alternator and a transformer to provide appropriate control for control circuit and alarms.

OVERLOAD HEATERS

If the HYDROMATIC electrical panel is not used, starters with 3 leg overload protection must be supplied. On 3 phase pumps the heaters must be sized in accordance with the nameplate amps on the motor housing. The amp draw on these submersible motors is slightly higher than a corresponding horsepower surface motor so heaters must be sized by the nameplate rating.

Single phase pumps with capacitor start have a run and a start winding each drawing a different current. To adequately protect these windings with the appropriate heaters consult the factory.

IMPORTANT

If other than HYDROMATIC starters are used be sure the heat sensor wires are connected in series with the starter coil circuit. Typical wiring diagrams are included.

HYDR-O-RAIL

If the pump or pumps are to be used with HYDR-O-RAIL system the pumps will be equipped with guide brackets and hydraulic sealing flange.

SERVICING INSTRUCTIONS

IMPORTANT—READ ALL DIRECTIONS BEFORE REPLACING ANY PARTS.

WARNING: BEFORE HANDLING THESE PUMPS AND CONTROLS, ALWAYS DISCONNECT THE POWER FIRST.

DO NOT SMOKE OR USE SPARKABLE ELECTRICAL DEVICES OR FLAMES IN A SEPTIC (GASEOUS) OR POSSIBLE SEPTIC SUMP.

FIELD SERVICE ON MOTOR

All submersible motors can be serviced (out of warranty) in the field by any reliable motor service shop. Any pump (in warranty) must be returned to the factory for service or repaired in an authorized HYDROMATIC service shop. Charges will not be allowed if (in warranty) pump is taken to a motor repair shop that is not authorized.

When field service is performed on a pump these instructions should be carefully followed.

REPLACING STATOR

If motor winding is burned or shortened it can be rewound or replaced with new factory wound stator. Refer to sectional drawing of pump and motor and use following steps to remove and replace stator.

1. If stator only is damaged it may not be necessary to completely dismantle pump as stator and housing can be lifted from pump without disturbing seals or bearings.
2. Drain all oil from upper housing, remove from upper housing, remove drain plug in bottom of stator housing and remove plug in top of housing to allow air to enter.
3. After chamber is drained, remove hold down bolts and lift off. Use care in lifting as the seal failure connecting wire must be disconnected before housing is completely removed. See sectional drawing.

4. Set assembly on bench and remove connection box. When box is lifted off connection wires to motor will be exposed. These wires will probably be burned but each wire is tagged with a metal marker giving wire number. Cut the wires.

   If the leads to the connection box are burned, a complete new connection box with new wire must be used. The wires are potted in with sealing compound and a new unit must be obtained from the factory.
5. The stator is held in the housing with a bolted-in clamp ring.
6. After ring is removed turn housing upright and bump on hardwood blocks. This should jar the stator loose and allow it to drop out.
7. Thoroughly clean housing before replacing new stator. Replace stator and make all wire connections to connection box before replacing housing on pump. This is important as leads must be tucked behind the windings by using hands up through rotor core.

IMPORTANT

Use only compression type insulated connectors on the wires.

DO NOT TAPE LEADS AS OIL WILL DETERIORATE THE TAPE AND CAUSE DAMAGE TO STATOR AND BEARINGS.

8. Drain oil from seal chamber. If oil is clean and no water is present, seals can be considered satisfactory to reuse.
9. Check top bearing. If clean and does not turn rough, bearings can be reused and it is not necessary to completely dismantle pump to change bearings. If bearings are damaged with dirt or heat they must be replaced. See additional instructions on replacing seals and bearings. Remember to reinstall the upper bearing load spring.
10. Replace stator housing onto seal chamber and bolt in place. **BE SURE SEAL FAILURE WIRE IS CONNECTED BEFORE HOUSING IS ASSEMBLED.**

    Be sure O-ring seal has been replaced. If O-ring is nicked or cut replace with new rings. This applies to all O-rings used in assembly.
11. After all leads are reconnected in the connection box make a high voltage ground test on each wire. The only wire that should show ground is the green power lead and the ground lead in the auxiliary control cable.
12. For safety, complete pump should be air checked under water for leaks. If seals were O.K. refill seal chamber with oil. Lay pump on side for this oil filling with oil fill hole upright. Do not completely fill, leave oil about 1 inch below plug hole. Use only #10 Non-detergent automobile oil or regular HYDROMATIC submersible oil in this chamber. Replace plug, use permatex on threads. Install air valve in top plug opening of motor housing and charge housing with about 10 PSI of air. Be sure air is dry. Do not use air line where water may be trapped in the line. Submerge complete unit under water and check for leaks.
13. Refill motor chamber with oil. Use high grade transformer oil or HYDROMATIC special submersible oil. Fill chamber until oil covers top of windings. Leave air space in top for expansion. Use permatex on plug threads.

REPLACING SEALS AND BEARINGS

1. Drain all oil from motor chamber and seal chamber as described.
2. Remove motor housing as described.
3. Remove bolts that hold seal chamber to pumphousing. Use back off screws to break loose. With hard wood block, tap end of impeller to loosen from shaft. When free, remove impeller from shaft.
4. Lift rotating assembly (rotor, shaft and impeller) from pump case and place horizontally on bench.
5. **Impeller removal**
   Hold motor and remove bolt and washer from impeller end of shaft. Impeller is threaded to the shaft so tap face of impeller with hard wood block to free threads. Holding rotor, turn impeller counter-clockwise as thread is right hand.
6. Shaft sleeves are not used.
7. Remove lower seal spring and pry out seal with screwdriver.
8. To remove seal housing, take out socket head bolts and using bolts in back of holes, pry plates loose. This will force out lower seal if not already removed.
9. Remove snap ring that holds upper seal. Pull seal if it is free. If not free, it can be forced off when shaft is removed.
10. Remove 4 bolts that hold bearing housing in place. Set assembly in upright position and bump end of shaft on hardwood block. This will push the bearing from housing and will force upper seal from shaft.
11. Use bearing puller to remove bearings. Replace with new bearings. Press only on inner race of bearing when replacing. Pressing on outer race can damage the bearing. Bearings are standard size that can be obtained from any bearing supply house or can be obtained from HYDROMATIC factory.
12. **IMPORTANT — DO NOT USE ANY OF THE OLD SEAL PARTS. REPLACE WITH ALL NEW SEALS.**
13. Thoroughly clean all castings before replacing seals. One grain of dirt between the seal faces can cause failure.
14. Be sure seal washers are replaced under heads of 4 bolts that hold bearing cap in place. Examine all O-rings for nicks before reusing.
15. Be sure key is in place in notch of shaft sleeve to prevent sleeve from turning.
16. Use Locktite on socket head locking screw in end of shaft.
17. Before refilling chamber with oil, air test as described above.
18. Refill both chambers with oil as described above.
19. Always check all leads with high voltage or with megger for grounds before operating the pump.

INSTALLATION INSTRUCTIONS

INSTALLING PUMP IN SUMP

Before installing pump in sump lay it on side and turn impeller with fingers. Impeller may be slightly stuck due to factory test water so it must be broken loose with small bar or screw driver in edge of vanes. The impeller should turn freely.

Clean all trash and sticks from sump and connect pump to piping.

A check valve must be installed on each pump. A gate or plug valve in each pump discharge line is also recommended. This valve should be installed on the discharge side of the check valve so if necessary to service the check valve the line pressure can be cut off. Single pump systems are sometimes installed without a check valve where it is desirable to self-drain the discharge line to prevent freezing. This can be done only with short discharge lines otherwise water will return to the sump and cause short cycling of the pump.

POWER CORD

If power cord and auxiliary control cord are not long enough due to an error in ordering, the cords can be spliced. If a spliced joint is made all connections must be thoroughly taped to make a waterproof connection. Splicing is only a last resort in an emergency. We recommend that proper cable length be ordered from the factory. The cords are potted into the conneciton box cap with sealing compound so if longer cord is necessary, the connection box cap must be furnished. The original connection box cap and cord can be returned to the factory for credit.

NEMA 4 JUNCTION BOX

If electrical control panel is to be set remote from the pump sump a NEMA 4 junction box should be used to make power and control connections. The HYDROMATIC Nema 4 junction box is provided with compression connectors for sealing all wires. No sealing compound is needed to make connections waterproof. A terminal block is provided giving numbers for all power and control wires.

Wiring diagrams are provided with panel for making connections. An extra set of diagrams are included so that one set can be used in the sump when making connections. The size wire to use from panel to sump depends on motor size and distance in feet.

Be sure each wire is checked out so that wrong connection will not be made. An ohmmeter or Megger can be used to check wire continuity. Attach one side of meter to ground and other side to one side at control panel then have man in sump touch one wire to ground. If wire is correct meter will show reading. If some distance exists between sump and panel a Walkie-Talkie radio is useful. (See Fig. 1)

INSTALLING 3900 MERCURY SWITCH CONTROLS

The controls are supported by a mounting bracket that is attached to sump wall or cover or to the NEMA 4 junction box.

Cord snubbers are used to hold the cord in place. Control lever can be changed at any time by loosening the snubber and re-adjusting cord length.

In either simplex or duplex system the lower or turn-off control is set just above the top of volute so the the volute will always be submerged during the pumping cycle. The second or turn-on control is set about 24 inches above the lower turn-off control.

More distance between turn-on and turn-off controls can be used but sewage may become septic and excessive solids may collect for the pump to handle. A frequent pumping cycle is recommended for best operation.

If an alarm system is used this control is usually set about 6 inches above the override control.

Some engineers as described previously prefer to have the alarm control set below the override control.

MAKING ELECTRICAL CONNECTIONS

All electrical wiring must be in accordance with local code, and only competent electricians should make the installations. A set of prints is included for use in making the installation. All wires should be checked for grounds with an ohmmeter or Megger after the connections are made. **THIS IS IMPORTANT, AS ONE GROUNDED WIRE CAN CAUSE CONSIDERABLE TROUBLE.** (See Fig. 2)

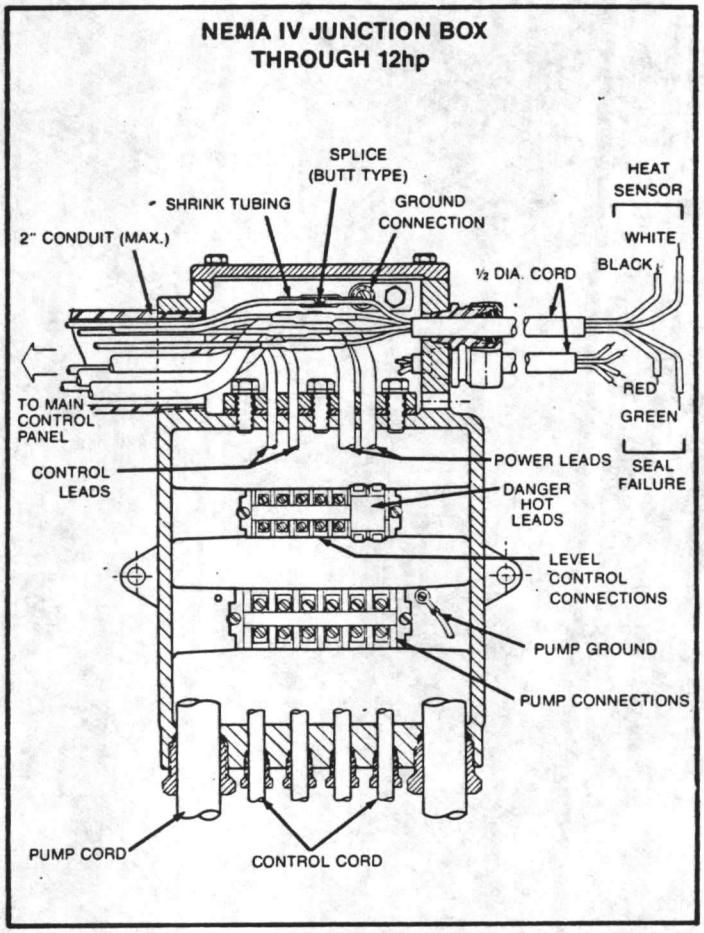


Fig. 1

WIRE SIZE TABLE

FOR REMOTE LOCATION OF CONTROL PANEL LENGTHS ARE BASED ON A VOLTAGE DROP OF TWO PERCENT

Maximum length in feet from NEMA 4 Junction Box to control panel. For 3 phase only and for power lines only. All control wires can be = 14-16 or 18 gage wire. If power lines are for 460 or 575 volts insulation of control wires must be for this voltage if used in conduit with power lines.

	Volts	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575
Wire Size	Motor HP	3	3	3	5	5	5	7½	7½	7½	10	10	10	15	15	15	20	20	20	25	25	25	30	30	30	35	35	35
12		110	450	700	90	370	580																					
10		180	720	1120	140	550	370	90	360	560	50	220	340															
8		270	1100	1650	220	900	1400	175	700	1100	105	420	650		320	500		230	360		180	280						
6		400	1600	2500	350	1400	2200	220	900	1400	150	600	930	105	420	650	90	370	570		360	560		320	500		230	360
4								370	1500	2300	230	950	1450	175	700	1100	140	550	850	125	500	800	100	400	620	90	360	560
2											370	1500	230	270	1100	1700	220	900	1400	210	820	1250	200	800	1250	150	600	930

*Special Junction Box required for wire sizes larger than #4.

NUMBER OF CONDUCTORS REQUIRED BETWEEN CONTROL PANEL AND NEMA 4 JUNCTION BOX

System Type	Number of Control Wires	Number of Power Lines	Number of Ground Wires #8	HEAT SENSOR & SEAL FAILURE	
				Number of Sensor Wires	Number of Ground Wires
Simplex	3	3	1	3	1
Simplex With Alarm	5	3	1	3	1
Duplex	5	6	1	6	2
Duplex With Alarm	7	6	1	6	2

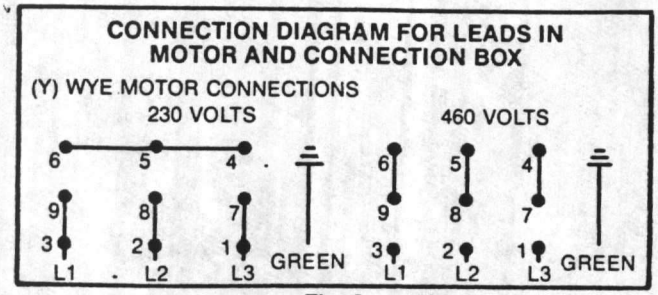


Fig. 2

IMPORTANT

If equipment is not properly wired and protected as recommended, the motor guarantee is void.

HEAT SENSORS AND SEAL FAILURE CONNECTIONS

Be sure that heat sensor wires are connected in series with the starter coil. Connections are provided on the terminal strip; see wiring diagram.

If seal failure unit is used, connect as shown with seal failure system. If seal failure unit is not used, the two seal failure wires are left open. **DO NOT CONNECT POWER TO THESE LINES AT ANY TIME.** (See Figure 3 and 4)

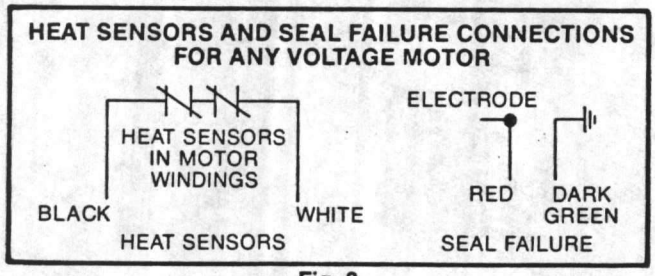


Fig. 3

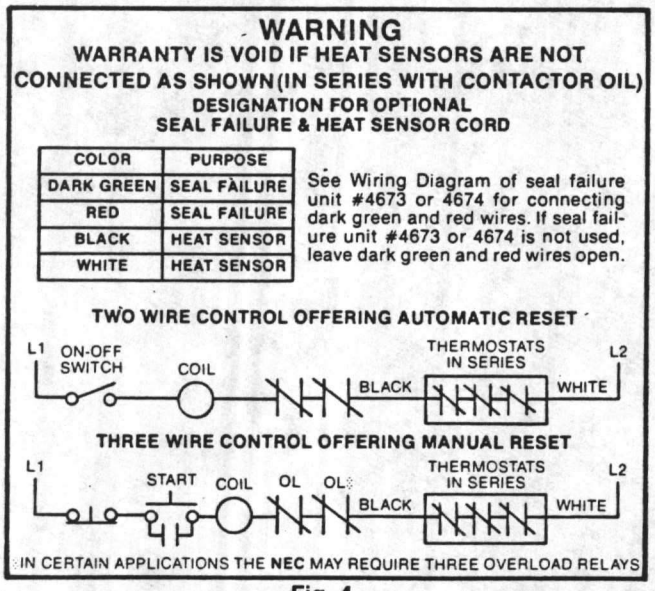


Fig. 4

OPERATION

STARTING SYSTEM

1. Turn H-O-A switch to off-position then turn on main circuit breakers.
2. Open all discharge valves and allow water to rise in sump pump.
3. Turn H-O-A switch to Hand position on one pump and notice operation. If pump is noisy and vibrates rotation is wrong. To change rotation interchange any two line leads to motor. DO NOT INTERCHANGE MAIN INCOMING LINES. If duplex system, check second pump in same manner.
4. Now set both H-O-A switches to Auto position and allow water to rise in sump until one pump starts. Allow pump to operate until level drops to turn-off point.
5. Allow sump level to rise to start other pump. Notice run lights on panel, pumps should alternate on each successive cycle of operation.
6. Turn both H-O-A switches to off position and allow sump to fill to the override control level.
7. Turn both switches to Auto position and both pumps should start and operate together until level drops to turn-off point.
8. Repeat this operation cycle several times before leaving job.
9. Check voltage when pumps are operating and check the amp draw of each pump. Check amps on each wire as sometimes a high leg will exist. One leg can be somewhat higher 5 to 10% without causing trouble. For excessive amp draw on one leg the Power Company should be consulted.

MAINTENANCE

As the motors are oil filled no lubrication or other maintenance is required.

If a seal failure unit is used no attention is necessary as long as the seal shows satisfactory operation.

If seal failure is not used the pump should be lifted once every two years and the oil be drained from the seal chamber to check for water.

If the pump is used on a HYDR-O-RAIL system it should be lifted once every six months and checked for corrosion and wear.

Generally these pumps give very reliable service and can be expected to operate for years on normal sewage pumping without failure.

LIGHTNING

In some areas where considerable lightning occurs, it is recommended that a lightning arrestor be installed at the control panel.

Complete data on lightning arrestors and cost is available from the factory. Lightning arrestors are good insurance against damage to an expensive motor.

WARNING: Before handling these pumps and controls, always disconnect the power first.

Do not smoke or use sparkable electrical devices or flames in a septic (gaseous) or possible septic sump.

TROUBLE CHECK LIST

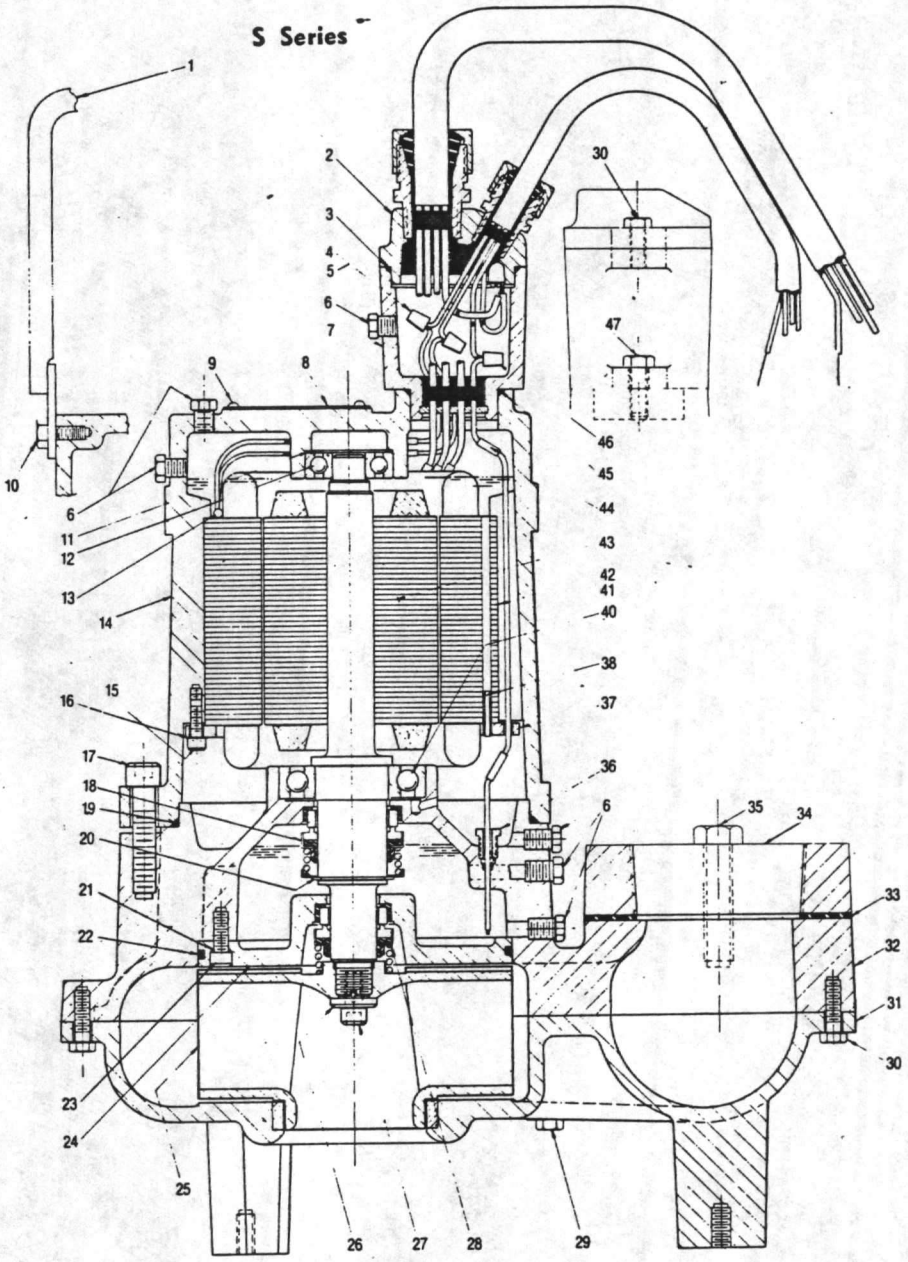
Below is a list of common problems and the probable causes:

CAUSE	PROBABLE CAUSE
Pump will not start	1. No power to the motor. Check for blown fuse or open circuit breaker. 2. Selector switch may be in the off position. 3. Control circuit transformer fuse may be blown. 4. Overload heater on starter may be tripped. Push to reset.
Pump will not start and overload heaters trip	1. Turn off power and check motor leads with megger or ohmmeter for possible ground. 2. Check resistance of motor windings. All 3 phases should show the same reading. 3. If no grounds exist and the motor windings check O.K. remove pump from sump and check for clogged or blocked impeller.
Pump operates with selector switch in hand position but will not operate in auto position	1. This indicates trouble in the float level control or the alternator relay. 2. To check for defective float control put selector switch in auto-position and turn off main power. Put a jumper wire on terminal strip. Turn on power and if pump starts trouble is in float control. Replace control.
Pump runs but will not shut-off	1. Pump may be air locked. Turn pump off and let set for several minutes then restart. 2. Lower float control may be hung-up in the closed position. Check in sump to be sure control is free. 3. Selector switch may be in the Hand Position.
Pump does not deliver proper capacity	1. Discharge gate valve may be partially closed or partially clogged. 2. Check valve may be partially clogged. Raise level up and down to clear. 3. Pump may be running in wrong direction. Low speed pumps can operate in reverse direction without much noise or vibration. 4. Discharge head may be too high. Check total head with gage when pump is operating. Total head is discharge gage pressure converted to feet plus vertical height from water level in sump to center line of pressure gage installed in discharge line. Gage should be installed on pump side of all valves. Multiply gage pressure in pounds by 2.31 to get head in feet. 5. If pump has been in service for some time and capacity falls off, remove pump and check for wear or clogged impeller.
Motor stops and then restarts after short period but overload heaters in starter do not trip	1. This indicates heat sensors in the motor are tripping due to excessive heat. Impeller may be partially clogged giving a sustained overload but not high enough to trip overload heater switch. 2. Motor may be operating out of liquid due to a failed level control. All Hydr-O-Matic S, SH, S3HRC and S4HRC submersible motors can operate for extended periods out of water without burning up the winding but the heat sensors give motor prolonged life by controlling winding temperature. 3. Pump may be operating on a short cycle due to sump being too small or from water returning to sump due to a leaking check valve.

S Series (1150 and 1750 RPM)

Ref. No.	Description	Qty.
1	Lifting Handle	1
2	Cord Cap Assy. (Single)	1
2	Cord Cap Assy. (Dual)	1
3	O-Ring	1
4	Wire Connector 230/3/60	4
5	Wire Connector 460/3/60	6
	Wire Conn. all 1ø & 200/575/3/60	3
6	Pipe Plug	5
7	Conn. Box 200/575V 3ø & all 1ø	
7	Conn. Box 230/460V 3ø	
7	Conn. Box Assy. 220V 1ø or 550V 3ø (3-wire)	1
*7	Conn. Box Assy. 220V 1ø or 550V 3ø (4-wire) w/Seal Failure	1
*7	Conn. Box Assy. 220V 1ø or 550V 3ø (6-wire) w/Seal Failure and Heat Sensor	1
*7	Conn. Box Assy. 3ø only (9-wire)	1
*7	Conn. Box Assy. 3ø only (10-wire) w/Seal Failure	1
*7	Conn. Box Assy. 3ø only (12-wire) w/Seal Failure and Heat Sensors	1
8	Nameplate	1
9	Drive Screw	3
10	Bolt	2
**11	Load Spring	1
12	Bearing (upper)	1
13	Heat Sensor Wiring Assy. (optional)	1
14	Motor Housing (1150 RPM) ½HP-1HP 200/230/460/575/3/60	1
14	Motor Housing (1150 RPM) ½HP-1HP 200/230/1/60	1
14	Motor Housing (1750 RPM) 1HP 200/230/1/60 1HP-3HP 200/230/460/575/3/60	1
14	Motor Housing (1750 RPM) 1½HP-3HP 200/230/1/60	1
15	Stator Bolt (2HP 200/230/1/60 1150 RPM only)	4
15	Stator Bolt all others	4
16	Lockwasher	4
17	Bolt	4
18	Seal	1
19	O-Ring	1
20	Snap Ring	1
21	O-Ring	3
22	O-Ring	1
23	Bolt	3
24	Seal Plate	1
25	Impeller 6¾"	1
25	Impeller 6¼"	1
25	Impeller 5-15/16"	1
25	Impeller 5¾"	1
25	Impeler 5⅜"	1
25	Impeller 5-1/16"	1
26	Impeller Washer	1
27	Impeller Bolt	1
28	Seal	1
28	Seal (Carbide optional)	1
29	Bolt	1
30	Bolt	10
31	Suction Base w/Wear Ring	1
32	Volute	1
33	Gasket	1
34	Disc. Flg. 3"	1
34	Disc. Flg. 4"	1
35	Bolt	2
36	Seal Failure Probe Assy. (optional)	1
37	Stator Holding Ring	1
38	Roll Pin	
40	Bearing	1
41	Spacer Ring ½"	1
41	Spacer Ring 1"	1
42	Stator ½HP-1HP 200/1/60 1150 RPM	1
42	Stator ½HP-1HP 230/1/60 1150 RPM	1
42	Stator ½HP 200/3/60 1150 RPM	1
42	Stator ½HP 230/460/3/60 1150 RPM	1
42	Stator ¾HP-1HP 200/3/60 1150 RPM	1
42	Stator ¾HP-1HP 230/460/3/60 1150 RPM	1
42	Stator ¾HP-1HP 575/3/60 1150 RPM	1
42	Stator ½HP 575/3/60 1150 RPM	1
42	Stator ¾HP-1HP 200/1/60 1750 RPM	1
42	Stator ¾HP-1HP 230/1/60 1750 RPM	1
42	Stator ¾HP-1HP 200/3/60 1750 RPM	1
42	Stator ¾HP-1HP 230/460/3/60 1750 RPM	1
42	Stator ¾HP-1HP 575/3/60 1750 RPM	1

S Series



Ref. No.	Description	Qty.
42	Stator 1½HP-3HP 200/1/60 1750 RPM	1
42	Stator 1½Hp-3HP 230/1/60 1750 RPM	1
42	Stator 1½HP-3HP 200/3/60 1750 RPM	1
42	Stator 1½HP-3HP 230/460/3/60 1750 RPM	1
42	Stator 1½HP-3HP 575/3/60 1750 RPM	1
43	Rotor & Shaft ½HP-1HP 200/230/1/60 1150 RPM	1
43	Rotor & Shaft ½HP 200/230/460/575/3/60 1150 RPM	1
43	Rotor & Shaft ¾HP-1HP 200/230/460/575/3/60 1150 RPM	1
43	Rotor & Shaft ¾HP-1HP 200/230/1/60 1750 RPM	1
43	Rotor & Shaft ¾HP-1HP 200/230/460/575/3/60 1750 RPM	1
43	Rotor & Shaft 1½HP-3HP 200/230/1/60 1750 RPM	1
43	Rotor & Shaft 1½HP-3HP 200/230/460/575/3/60 1750 RPM	1
44	Wire Connector 230/460/3/60	12
	All Others	6
45	O-Ring	1
46	Wire Connector (Single Cord)	1
	(Dual Cord)	3
47	Bolt	2

*For pumps manufactured prior to May 12. 1969

**For pumps manufactured after Nov. 2. 1973.

LIMITED WARRANTY

THE MARLEY PUMP COMPANY LIMITED WARRANTY. The Marley Pump Company, A Marley Company, warrants to the original purchaser of each of The Marley Pump Company's product(s) that any part thereof which proves to be defective in material or workmanship within one year from date of installation or 18 months from manufacture date, whichever comes first, will be replaced at no charge with a new or remanufactured part, F.O.B. factory. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight. Any item(s) designated as manufactured by others shall be covered only by the express warranty of the manufacturer thereof. This warranty does not apply to damage resulting from accident, alteration, design, misuse or abuse.

BUYER'S REMEDIES. If the material furnished to the Buyer shall fail to conform to this contract or to any express written warranty, The Marley Pump Company shall replace such nonconforming material at the original point of delivery and shall furnish instructions for its disposition. Any transportation charges involved in such disposition shall be for the Buyer's account. The Buyer's exclusive and sole remedy on account or in respect of the furnishing of material that does not conform to this contract, or to any express written warranty, shall be to secure replacement thereof as aforesaid. The Marley Pump Company shall not in any event be liable for the cost of any labor expended on any such material or for any incidental or consequential damages to anyone by reason of the fact that such material does not conform to this contract or to any express written warranty.

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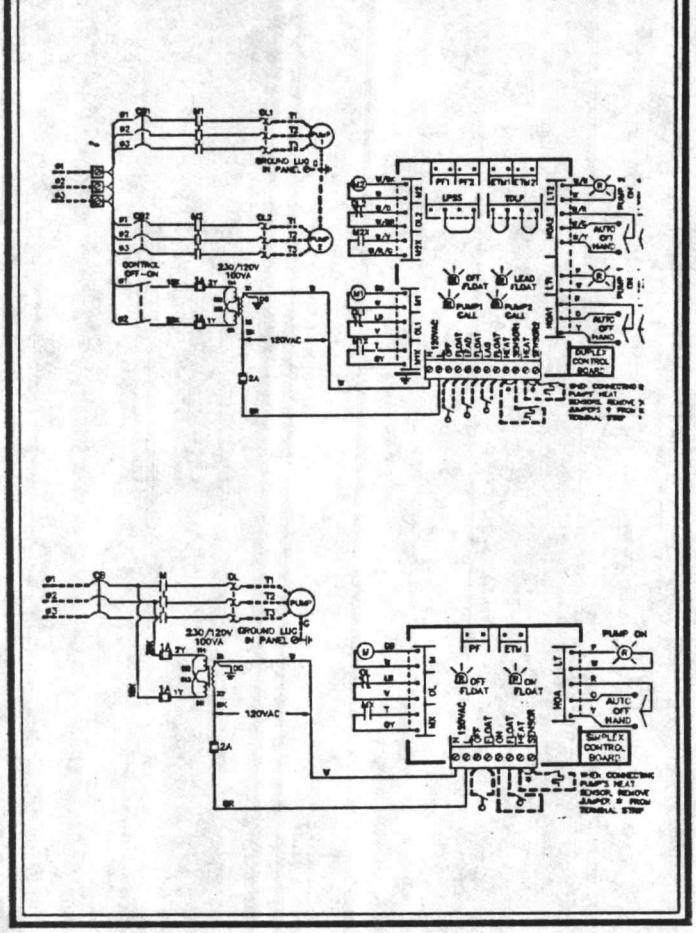


Installation and Service Manual

STANDARD ELECTRICAL "Q" PANELS

HYDROMATIC PUMPS
A Marley Pump Company

WARNING: Before handling these pumps and controls, always disconnect the power first.

Do not smoke or use sparkable electrical devices or flames in a septic (gaseous) or possible septic sump.

PANEL PREPARATION: Prior to installing the control panel, tighten all screws and nuts. Make sure that all electrical connections are secure.

CONTENTS

INSTALLATION INSTRUCTIONS

ELECTRICAL CONNECTIONS

The contractor must conform to the latest requirements of the National Electrical Code. All conduit and cables shall be in accordance with NEC code NFPA #70.

Prior to conducting any installation, repair or service with regard to the control panel, refer to the schematic appropriate for that panel. The schematic will provide guidance with regard to the terminal block connections.

Make the Following Electrical Connections:

a. Connect the pump hear sensor and seal failure leads (if available on the pump) to the appropriate terminal blocks in the control panel. If the heat sensor lead from the pump is wired as indicated, remove jumpers as defined by the schematic.
b. Connect all the float control leads to the appropriate panel terminal blocks. Contractor must be very careful in locating the floats at the proper elevations. The maximum distance from the control panel and the floats is the lesser of 100 feet or the maximum distance recommended for the pump.
c. Connect the pump leads to the control panel. When connecting the pump leads it is very critical that the proper sequence be maintained. On single phase pumps, connect the color coded pump leads to the appropriate terminals as directed by the control schematic.
d. BEFORE CONNECTING POWER TO THE CONTROL PANEL, MAKE SURE ALL CONTROL SWITCHES (e.g. H-O-A SWITCH) AND PROTECTIVE DEVICES (e.g. BREAKERS) ARE IN THE OFF POSITION. NOW CONNECT POWER TO THE TERMINAL BLOCK OR THE CIRCUIT BREAKER AS DIRECTED BY THE SCHEMATIC.
e. CONTROL PANEL MUST BE GROUNDED PROPERLY PER NEC AND/OR LOCAL CODES. TO FACILITATE THIS A GROUND LUG IS PROVIDED ON THE CONTROL PANEL.

START UP CHECK LIST

WARNING: Before handling these pumps and controls, always disconnect power first. Do not smoke or use sparkable electrical devices or flames in a septic (gaseous) or possible septic sump.

Check List:

1. Check junction box for moisture. Moisture may cause chattering of relays/contactors.
2. Check wiring of capacitor pack for single phase applications.
3. Energize control panel. (Turn on power to panel.)
4. Check overload relay and verify reset mode (if overload is supplied).
5. **WARNING! LIVE VOLTAGE CAN KILL!** Check voltage to the panel and at secondary of control transformer using a voltmeter. If no transformer is supplied, check voltage at the circuit breakers.
6. Check float operation and response of control panel to the float operation. For sequence of operation refer to design specification.
7. Check full load current with amprobe and compare it with the nameplate rating. (Clamp amprobe around one phase.)
8. With pump running, check discharge to verify the pump is running. Check for flow.
9. Check voltage with voltmeter and amperage with amprobe at overhead.
10. Check operation of start relay if supplied on single phase panels per procedure in item #7 of Maintenance Instructions below.
11. Make sure H-O-A switch is left in the "Auto" position after start-up is completed.

Pump Start Up:

Check the pump manuals.

PERIODIC MAINTENANCE

WARNING: Before handling these pumps and controls, always disconnect the power first. Do not smoke or use sparkable electrical devices or flames in a septic (gaseous) or possible septic sump.

The perodicity of the maintenance schedule will vary with operating and environmental conditions. It will also vary with the specific type of control supplied. The list herein is a guide only.

1. Exercise breaker through two cycles. Be careful not to over-exercise as the breaker is not a switching device. Excessive operations tend to affect the trip curve of the breaker.
2. Check contactors and relays for excessive humming. This can be accomplished by turning pumps on and off in the hand and off modes with the H-O-A switch.
3. Check bulbs in all fixtures.
4. Check continuity through control fuses.
5. Check voltage at primary and secondary of control transformer.
6. Check the pump full load amps.
7. Check the start relay (if supplied) by using an amprobe around the red wire (start winding). Amprobe should display a very brisk action from zero to locked rotor and back to operating load. This action occurs on pump start and the action must show no lazy movement.
8. Check junction boxes for moisture. Moisture may cause chattering of relays and contactors.
9. Check door gasket for integrity. This can be a visual inspection.
10. Check labels to verify they have not been damaged.
11. Lubricate enclosure hinges.
12. Pull floats and check for proper operation and insure there is no foreign build up on them.

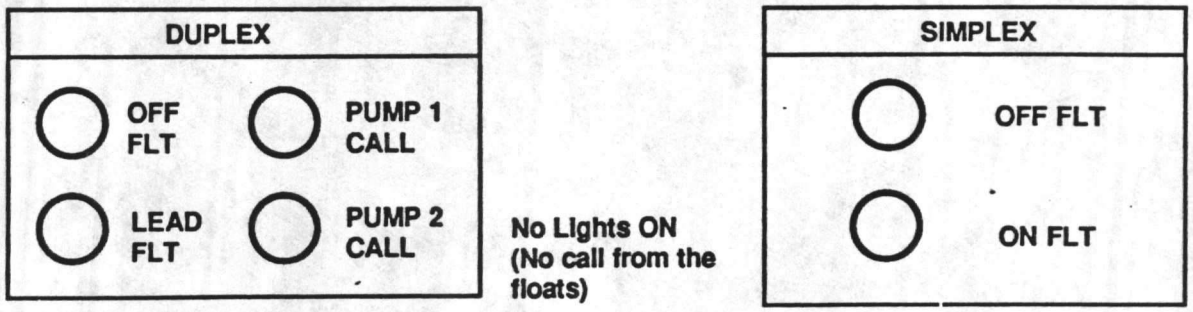
SPARE PARTS LIST

The following is a list of recommended spare parts; however conditions of service vary significantly and a general list may not in its entirety be applicable to a given installation. The user should exercise judgement in defining his specific requirements based on this guide.

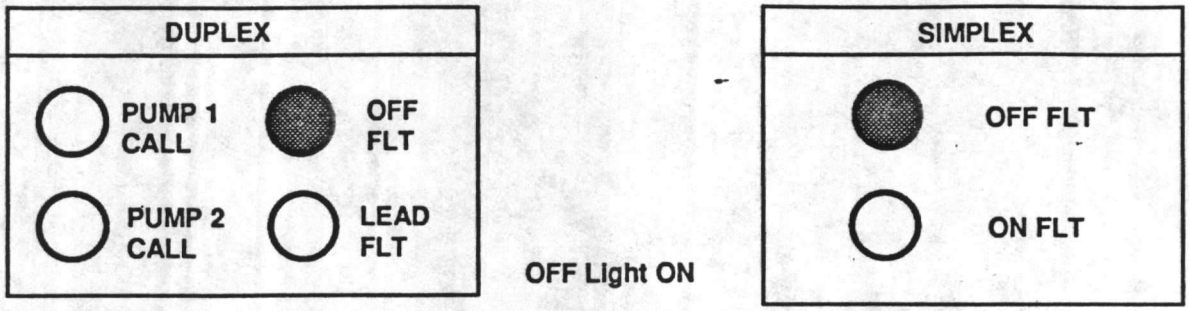
1. Fuses for control transformer primary and secondary.
2. Contactor.
3. Bulbs for lights.
4. Corrosion inhibitor.
5. Control transformer.
6. Duplex or simplex pump controller.

TROUBLESHOOTING CHART

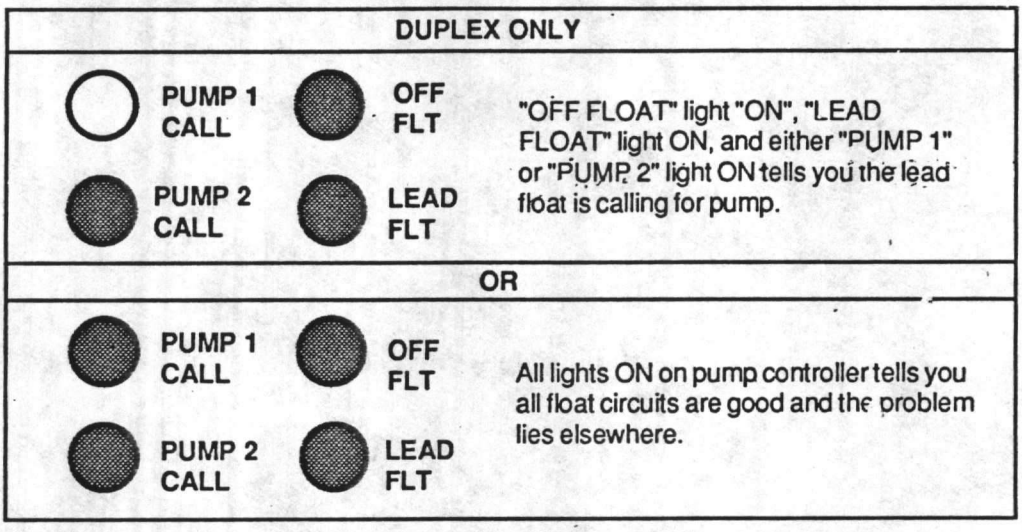
1. **WARNING: Before handling these pumps and controls, always disconnect the power first. Do not smoke or use sparkable electrical devices or flames in a septic (gaseous) or possible septic sump.**
2. Pump does not run in hand position.
   a. Check pump circuit breaker, control circuit breaker and control fuses for tripping or blown condition.
   b. Check overload relay to see if it is tripped. Reset relay if tripped.
   c. Check heat sensor reset to verify thermal overload of motor has not tripped.
   d. Check wiring of pump to control panel. It should agree with the schematic.
3. Pump does not run in auto position.
   a. Check items a. through d. per item #2 above.
   b. Floats may be miswired to control panel. Check float type (N.O. or N.C.) and hook-up by referring to the schematic. If the start and stop floats are hooked in reverse, pump will short cycle and will not pump the level down.
   c. Check pump controller indicating lights.



1. Make sure there is power to the controller.
2. Is water level in the system high enough to activate the floats?
3. If #1 and #2 check out, shut power off to the panel. Remove the off float wires and run a jumper between the "OFF FLOAT" connections. If "OFF FLOAT" light comes on, the float is stuck or the wiring connections are loose.



1. Is water level in the system high enough to activate the lead (ON) float?
2. If #1 checks out, shut off power to the panel. Remove the lead (ON) float wires and run a jumper between the "LEAD FLOAT" ("ON FLOAT") connections. If one or two pumps start, check the lead (ON) float for hang up or loose wiring connections.



1. Check hand-off-auto (H-O-A) switch for correct position.
2. Check heat sensor trip in pump with a jumper between "HEAT SENSOR 1" and "HEAT SENSOR 2" terminals.
3. Reset overload(s) if tripped.
4. Reset circuit breakers if tripped.

4. Pump runs but run light does not energize.
   a. Check the bulb.
   b. Check for loose wire at light or in panel.
5. Pump runs but does not pump down the wet well.
   a. Pump rotation may be wrong. Wiring of pump to control panel may be reverse sequenced.
   b. Impeller may be dragging in volute due to solids. High ampere draw would identify this.
   c. Refer to the pump manual for other possibilities such as closed discharge gate valve, etc.
6. Severe humming/chattering of contactors and control relays.
   a. There may be low voltage. Check voltage at primary and secondary of control transformer using a voltmeter. This low voltage condition may even cause severe chattering and burn-out of relays.
   b. Contactor may have dust around magnet of coil structure. Dry or clean as required.
   c. Check voltage to the control panel. Contactors require a minimum of 85% of full voltage to pull in without chatter. If the problem is a cronic one, measure voltage with recorder on a 24 hour basis.
   d. Make sure the floats are located away from any turbulence.
   e. Dry out the junction box (if furnished); moisture in the junction box may tend to cause relays to energize intermittently.
7. Nuisance tripping of overload on motor starters or circuit breakers.
   a. Check all reset buttons and tripped breakers.
   b. Check pump and draw with amprobe and compare to name-plate amps on pump.
   c. The impeller may be locked up due to excessive debris or solids.
   d. Possible motor failure (fault on windings.)
   e. Pump may be miswired to terminal block.

f. Voltage and current unbalance. Three phase only.
Voltage unbalance on three-phase power sources can cause motor current to become unbalanced and excessive heating will result. Tripping of the overload protectors and premature motor failures can be expected if the current unbalance exceeds five per cent.

$$\text{Percent Current Unbalance} = \frac{\text{Maximum Current Difference From Average Current}}{\text{Average Current}} \times 100$$

To determine if motor current unbalance is a function of the motor or the power supply:

1. Label the leads and the terminals 1, 2, and 3 respectively
2. Record the amperage for each lead.
3. Move each lead to the text terminal (1 to 2, 2 to 3, 3 to 1)
4. Again read the amperage of each lead.
5. Move each lead to the next terminal (1 to 3, 2 to 1, 3 to 2)
6. Again read the amperage of each lead.
7. If the unbalance moves with the motor leads, the unbalance is caused by the motor. If the unbalance remains with the terminals, the unbalance is in the power supply.
8. If the current unbalance exceeds five percent, nuisance tripping or excessive heating will result.
9. Connect leads for the lowest percent of current unbalance.

g. Connections and start components. Single phase only.

1. DISCONNECT ALL POWER FROM THE PANEL BEFORE MAKING THESE CHECKS.
2. Motor winding resistance readings.
   a. Disconnect all three motor leads.
   b. Using a volt-ohm meter, with the scale set on RX1, measure the resistance between the leads with the chart below.

WINDING	TYPICAL MOTOR LEADS	RESISTANCE READING
Main	Black to White	Lowest
Start	Black to Red	Next Lowest (middle)
Both	White to Red	Highest

3. Capacitor check.
   a. Make sure the capacitor is discharged. Use extreme caution as a spark might occur.
   b. Disconnect the capacitor leads and connect a volt-ohm meter to the capacitor terminals.
   c. The meter should indicate low ohms when it is first connected, but as the capacitor becomes charged (by the meter) it will return to a reading of infinity (open circuit).

NOTE: Set the meter on the RX10,000 scale to check the run capacitor.
Set the meter on the RX1,000 scale to check the start capacitor.

4. Start relay check.
   a. Check the coil resistance. It should be 3,000 to 7,000 ohms.
   b. Install a clamp on amp meter around the start winding lead.
   c. Set the ampmeter scale to at least 2 times the pump motor full load current.
   d. Place the HOA switch in the hand position to start the pump.
   e. The meter should read approximately 2 times full load current during starting.
   f. After the motor has started (within one second) the current should drop to a valve much less than full load current.
5. Motor voltage check.

COMPONENT	TYPICAL MOTOR LEAD	MODE	VOLTAGE READING
Main Winding	Black to White	Start	Line Voltage
Main Winding	Black to White	Run	Line Voltage
Start Winding	Black to Red	Start	Line Voltage
Start Winding	Black to Red	Run	120% Line Voltage

8. Short cycling pump.
   Check float controls.
9. Run light stays on
   Selector switch may be in the hand position.
10. Test for blown fuse.
    Check for continuity with a V-O-M set on OHM scale.

LIMITED WARRANTY

THE MARLEY PUMP COMPANY LIMITED WARRANTY.
The Marley Pump Company, a Marley Company, warrants to the original purchaser of each of The Marley Pump Company's product(s) that any part thereof which proves to be defective in material or workmanship within one year from date of installation or 18 months from manufature date, whichever comes first, will be replaced at no charge with a new or remanufactured part, F.O.B. factory. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight. Any item(s) designated as manufactured by others shall be covered only by the express warranty of the manufacturer thereof. This warranty does not apply to damage resulting from accident, alteration, design, misuse or abuse.

BUYER'S REMEDIES. If the material furnished to the Buyer shall fail to conform to this contract or to any express written warranty, The Marley Pump Company shall replace such nonconforming material at the original point of delivery and shall furnish instructions for its disposition. Any transportation charges involved in such disposition shall be for the Buyer's account. The Buyer's exclusive and sole remedy on account or in respect of the furnishing of material that does not conform to this contract, or to any express written warranty, shall be to secure replacement thereof as aforesaid. The Marley Pump Company shall not in any event be liable for the cost of any labor expended on any such material or for any incidental or consequential damages to anyone by reason of the fact that such material does not conform to this contract or to any express written warranty.

WARRANTY DISCLAIMER AND LIMITATION OR LIABILITY. THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID EXPRESSED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT.

MANUFACTURER EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY ARISING IN CONNECTION WITH THIS PRODUCT, INCLUDING WITHOUT LIMITATION, WHETHER IN TORT, NEGLIGENCE, STRICT LIABILITY CONTRACT OR OTHERWISE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

This warranty gives you specific legal rights, and you may also have other right which vary from from state to state.

MARLEY	THE MARLEY PUMP COMPANY
HP	HYDROMATIC PUMPS

5800 Foxridge Dr., Mission, KS 66202 1-800-HOT-PUMP
In Canada - 126 East Dr., Bramton, Ontario L6T 1C2 - (416) 793-8242
International Sales - Mission, KS Telex 4630138 MARLY UW - (913) 831-5700

Q-701
3/87

TAB PLACEMENT HERE

DESCRIPTION:

15400

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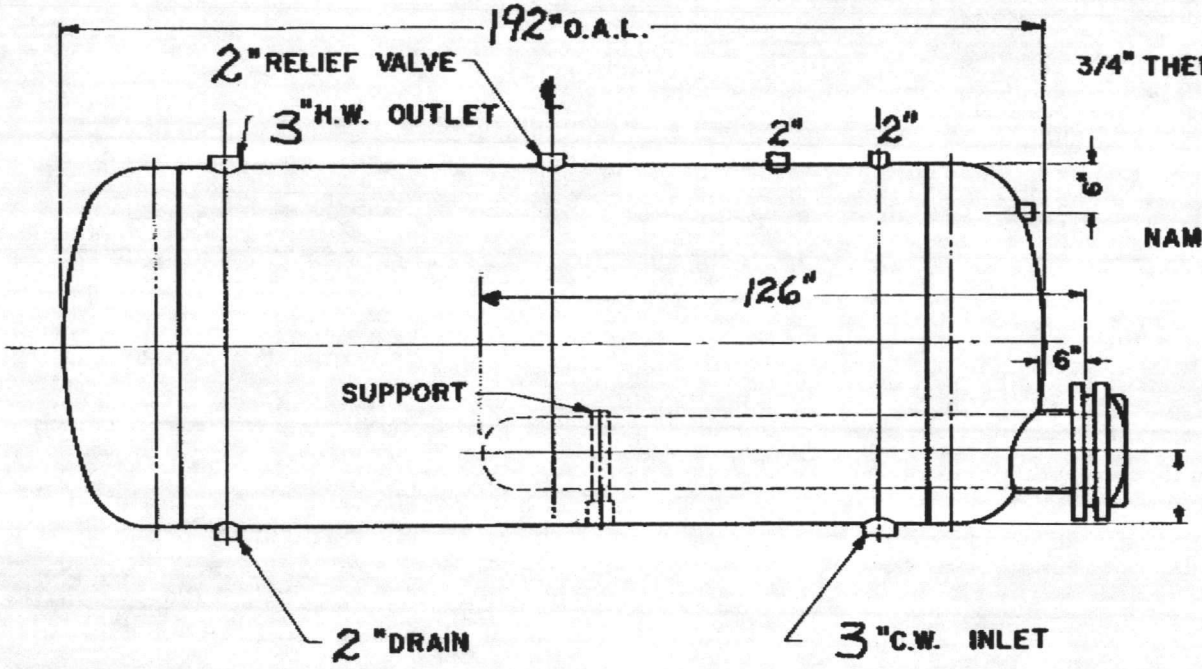
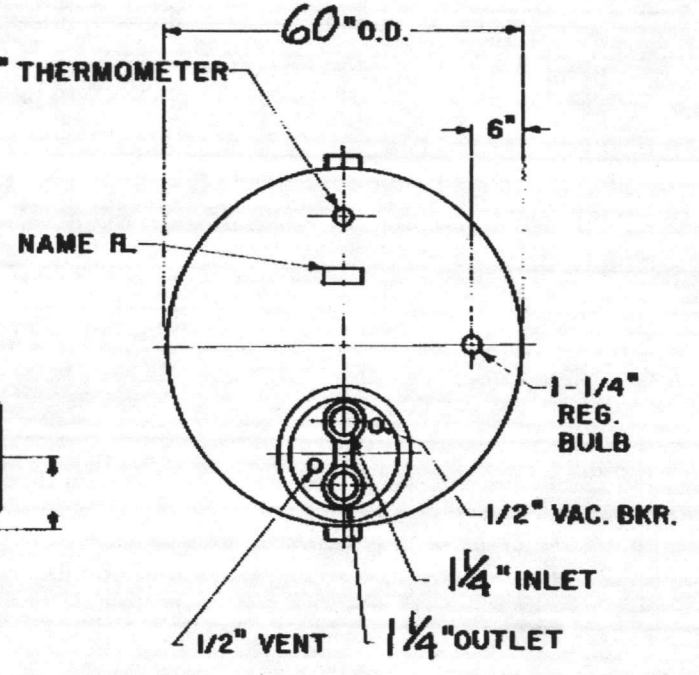
Confidential Records Management, Inc.
New Bern, NC
1-888-622-4425
9/08

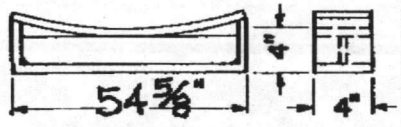




HEATING ELEMENT SPECIFICATIONS:

ELEMENT NUMBER	W420 126" LONG
WORKING PRESSURE	150 TEST PRESSURE 225
HEATING SURFACE REQUIRED	20.0 SQ. FT.
ELEMENT NECK	
SEAMLESS COPPER TUBES	3/4 OD x 18 GA.
TUBE SHEET (X) STEEL ( )	
ELEMENT HEAD (X) CAST IRON ( )	
ELEMENT SUPPORT (X) NOT REQ. ( )	
HTG. CAP. 1776 G.P.H. WATER	56°F. TO 110°F.
HTG. MED. 10 P.S.I. STEAM	
CIRC. BOILER WATER IN AT	°F. OUT AT °F.

SADDLE SPECIFICATION:



Nº. REQUIRED	2
(X) PLAIN SADDLES	
( ) WITH PIPE FLANGES	
CONSTRUCTION – WELDED STEEL	
PAINTED – RED OXIDE	

REVISION	1	2	3	4	5
DATE					

CUSTOMER: R & W CONST. CO. JACKSONVILLE, N.C.
P.O. Nº.
PROJECT: B.E.Q.'s NEW RIVER MCAS
ARCHITECT:
ENGINEER: U.S. NAVY
AGENT: HEAT TRANSFER SALES

TANK SPECIFICATIONS:

Nº. UNITS REQ. 1

DESIGN WORKING PRESSURE 125 P.S.I. TEST PRESSURE 188 P.S.I.
CONSTRUCTION (X) A.S.M.E. INSPECTED AND STAMPED
( ) MFG. STANDARD
MATERIAL: ASME GRADE STEEL CEMENT LINED

PAINT OR LINING
EXTERIOR – RED OXIDE
INTERIOR – CEMENT

WATER STORAGE HEATER

ADAMSON

ADAMSON CO. INC.

SCALE	CHECKED	DRAWN BY	DATE	JOB Nº.
NONE		L.F.	1/21/88	

TOTAL P.02

DWG. 1121 EH

"Quality Pumps Since 1939"

NOTICE: VENT HOLE FOR CHECK VALVE — PAGE 2

Zoeller Co.

3280 OLD MILLERS LANE
P.O. BOX 16347 • LOUISVILLE, KY. 40216
(502) 778-2731

FM447
0385

INSTALLATION INSTRUCTIONS

RECOMMENDED MODELS

SEWAGE	EFFLUENT*	DEWATERING
267, 268 Series 282, 284 Series 293, 294, 295 Series	53, 57, 59 Series 97 Series 137, 139 Series 161, 163, 165 Series 185, 188, 189 Series	All Models

* Effluent systems should specify that pumps should not handle solids exceeding five eighths inch (⅝") in order to prevent large solids from entering leeching fields, mound systems and etc. Where codes permit, sewage pumps can be used for effluent systems.

PREINSTALLATION CHECKLIST — ALL INSTALLATIONS

1. Inspect your pump. Occasionally, products are damaged during shipment. If the unit is damaged, contact your dealer before using.

2. Carefully read the literature provided to familiarize yourself with specific details regarding installation and use. These materials should be retained for future reference.

3. Make sure there is a properly grounded receptacle available. All pumps are furnished with provisions for proper grounding to protect you against the possibility of electrical shock.

(SEE WARNING BELOW)

4. Make certain that the receptacle is within reach of the pump's power supply cord. DO NOT USE AN EXTENSION CORD. Extension cords that are too long or too light do not deliver sufficient voltage to the pump motor. But, more important, they could present a safety hazard if the insulation were to become damaged or the connection end were to fall into the sump.

5. Check to be sure your power source is capable of handling the voltage requirements of the motor, as indicated on the pump name plate.

6. Make sure the pump electrical supply circuit is equipped with fuses or circuit breakers of adequate capacity. A separate branch circuit is recommended, sized according to the NEC for the current shown on the pump name plate.

CAUTIONS & WARNINGS

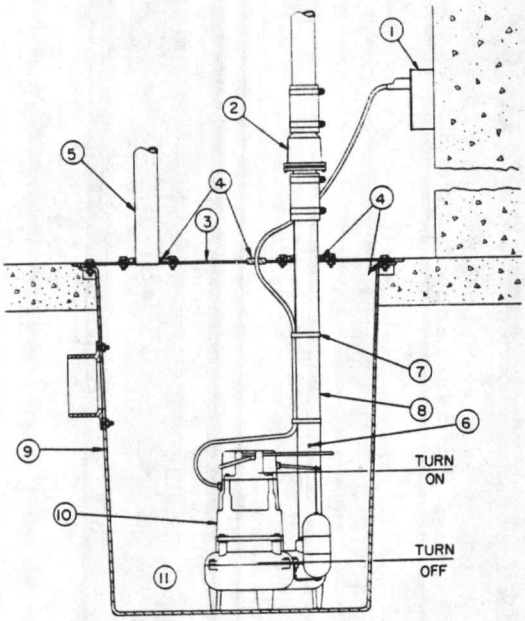
CAUTION:
Installation and checking of electrical circuits and hardware should only be performed by a qualified electrician.

CAUTION:
Repair and service should be performed by Zoeller Co. Authorized Service Station.

CAUTION:
Dewatering sump pumps are not designed for use in septic tanks to handle sewage or effluent.

CAUTION:
Maximum continuous operating temperature for standard model pumps is 130° F. - 54° C.

WARNING:
FOR YOUR PROTECTION ALWAYS DISCONNECT PUMP FROM ITS POWER SOURCE BEFORE HANDLING. Single phase pumps are supplied with a 3-prong grounded plug to protect you against the possibility of electrical shock. **DO NOT UNDER ANY CIRCUMSTANCES REMOVE THE GROUND PIN.** The 3-prong plug must be inserted into a mating 3-prong grounded receptacle. If the installation does not have such a receptacle, it must be changed to the proper type and grounded in accordance with the National Electrical Code and all applicable local codes and ordinances. Three phase pumps are to be installed in accordance with the National Electrical Code and all applicable local codes and ordinances.



TYPICAL SEWAGE INSTALLATION-RECOMMENDED INSTALLATION

(1) Electrical wiring and protection must be in accordance with NEC and any other applicable state and local electrical requirements.

(2) Install unicheck (combination union and check valve) preferably just above the basin to allow easy removal of the pump for cleaning or repair. If "High Head" installation, use 30 Series PVC type check valve with compression end fittings.

(3) All installations require a basin cover to prevent debris from falling into the basin and to prevent accidental injury.

(4) Gas tight seals are required in all sewage installations to contain gases and odors.

(5) Vent gases and odors to the atmosphere through vent pipe.

(6) When a Unicheck is installed, drill a 3/16" dia. hole in the discharge pipe even with the top of the pump. NOTE: The hole must also be below the basin cover.

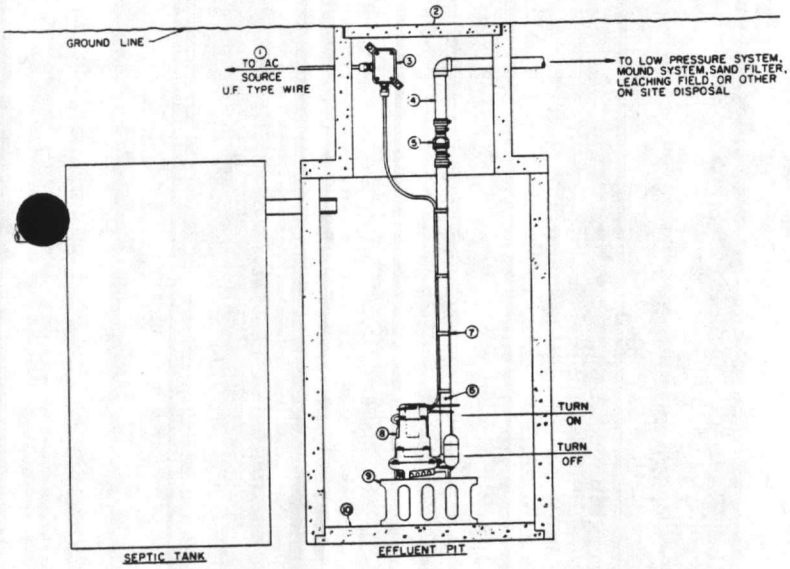
(7) Tape or clamp power cord to discharge pipe clear of the float mechanism.

(8) Use full-size discharge pipe.

(9) Basin must be in accordance with applicable codes and specifications.

• (10) Level pump in vertical position. Float mechanism must be clear of sides of basin.

(11) Clean basin. Free of debris after installation.



TYPICAL EFFLUENT INSTALLATION-RECOMMENDED INSTALLATION

(1) Electrical wiring and protection must be in accordance with NEC and any other applicable state and local electrical requirements.

(2) All installations require a basin cover to prevent debris from falling into the basin, and to prevent accidental injury.

(3) Wire pump to power through a J-Pak, watertight junction box or watertight splice. NOTE: Watertight enclosure is a must in damp areas.

(4) Use full-size discharge pipe.

(5) Install unicheck (combination union and check valve) preferably just above the basin to allow easy removal of the pump for cleaning or repair. If "High Head" installation is required, use 30 Series PVC type check valve with compression end fittings. For below cover installation use 30-0200 on 1½ inch pipe, and PVC compression end check valve on 2 or 3 inch pipe.

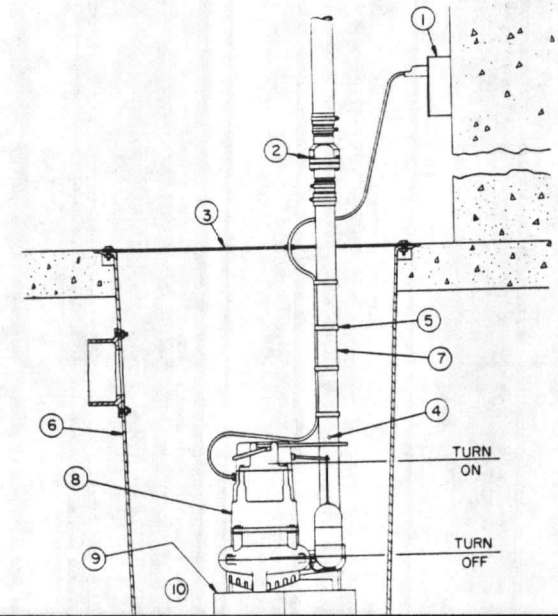
(6) When a Unicheck is installed, drill a 3/16" dia. hole in the discharge pipe even with the top of the pump. NOTE: The hole must also be below the basin cover.

(7) Tape or clamp power cord to discharge pipe clear of the float mechanism.

• (8) Level pump in vertical position. Float mechanism must be clear of sides of basin.

(9) Install blocks or bricks under pump to provide a settling basin.

(10) Clean basin. Free of debris after installation.



TYPICAL DEWATERING INSTALLATION-RECOMMENDED INSTALLATION

(1) Electrical wiring and protection must be in accordance with NEC and any other applicable state and local electrical requirements.

(2) Install unicheck (combination union and check valve) preferably just above the basin to allow easy removal of the pump for cleaning or repair. If "High Head" installation is required, use 30 Series PVC type check valve with compression end fittings. For below cover installation use 30-0200 on 1½ inch pipe, and PVC compression end check valve on 2 or 3 inch pipe.

(3) All installations require a basin cover to prevent debris from falling into the basin and to prevent accidental injury.

(4) When a Unicheck is installed, drill a 3/16" dia. hole in the discharge pipe even with the top of the pump. NOTE: The hole must also be below the basin cover.

(5) Tape or clamp power cord to discharge pipe clear of the float mechanism.

(6) Minimum 18" dia. x 24" deep basin.

Use a full-size discharge pipe.

• (8) Level pump in vertical position. Float mechanism must be clear of sides of basin.

(9) Install blocks or bricks under pump to provide a settling basin.

(10) Clean basin free of debris after installation.

SERVICE CHECK LIST

A. Pump will not start or run.	Check fuse, low voltage, overload open, open or incorrect wiring, open switch, impeller or seal bound mechanically, defective capacitor or relay when used, motor or wiring shorted. Float assembly held down. Switch defective, damaged, or out of adjustment.
B. Motor overheats and trips overload or blows fuse.	Incorrect voltage, negative head (discharge open lower than normal) impeller or seal bound mechanically, defective capacitor or relay, motor shorted.
C. Pump starts and stops too often.	Float tight on rod, check valve stuck or none installed in long discharge line, overload open, level switch(s) defective, sump pit too small.
D. Pump will not shut off.	Debris under float assembly, float or float rod bound by pit sides or other, switch defective, damaged or out of adjustment.
E. Pump operates but delivers little or no water.	Check strainer housing, discharge pipe, or if check valve is used vent hole should be open. Discharge head exceeds pump capacity. Low or incorrect voltage. Incorrect motor rotation. Capacitor defective. Incoming water containing air or causing air to enter pump.
F. Drop in head and/or capacity after a period of use.	Increased pipe friction, clogged line or check valve. Abrasive material and adverse chemicals could possibly deteriorate impeller and pump housing. Check line. Remove base and inspect.

*Check specific control installation instruction for other type control usage.

LIMITED WARRANTY

Zoeller Company warrants, to the purchaser and subsequent owner during the warranty period, every new Zoeller Company product to be free from defects in material and workmanship under normal use and service, when properly installed, used, and maintained, for a period of one year from date of installation or 18 months from date of manufacture, whichever comes first. Part(s) that fail (within one year of installation or 18 months from the date of manufacture, whichever comes first) that inspection determine to be defective in material or workmanship, will be repaired, replaced, or remanufactured at Zoeller Company's option provided, however, that by so doing we shall not be obligated to replace an entire assembly, the entire mechanism or the complete unit. No allowance will be made for shipping charges, damages, labor or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material which has been disassembled without prior approval of Zoeller Company, subjected to misuse, misapplication, neglect, alteration, accident or act of God; that have not been installed, operated or maintained in accordance with Zoeller Company installation instructions; that has been exposed to but not limited to the following: sand, gravel, cement, mud, tar, hydro carbons or hydro carbon derivatives (oil, gasoline, solvents, etc.) or other abrasive or corrosive substances, is in lieu of all other warranties expressed or implied; and we do not authorize any representative or other person to assume for us any other liability in connection with our products.

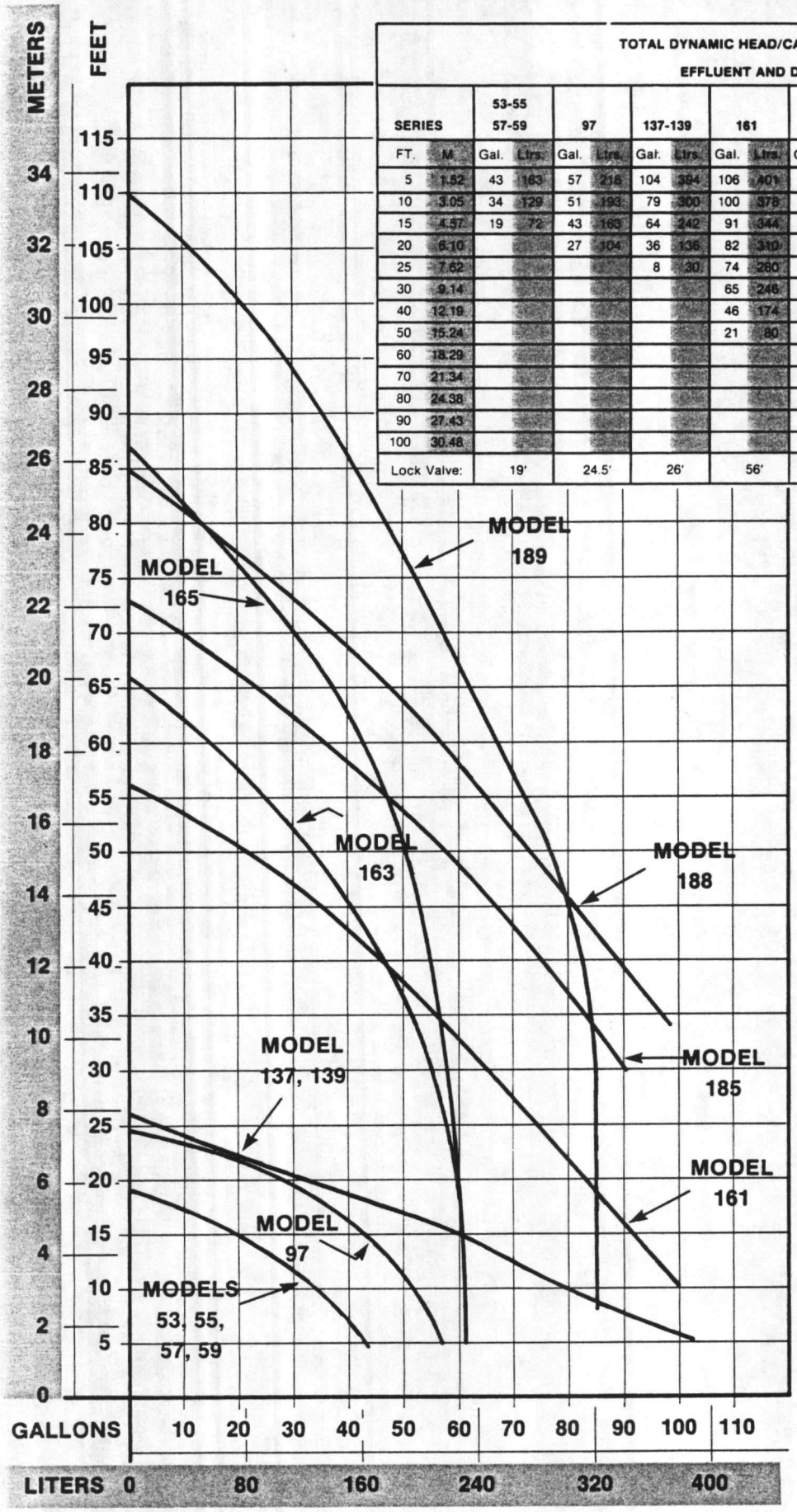
Contact Zoeller Company, 3280 Old Millers Lane, Louisville, Kentucky 40216, Attention: Customer Service Department to obtain any needed repair or replacement of part(s) or additional information pertaining to our warranty.

ZOELLER COMPANY EXPRESSLY DISCLAIMS LIABILITY FOR SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES OR BREACH OF EXPRESSED OR IMPLIED WARRANTY; AND ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICLUAR PURPOSE AND OF MERCHANTABILITY SHALL BE LIMITED TO THE DURATION OF THE EXPRESSED WARRANTY.

Some states do not allow limitations on the duration of an implied warranty, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

HEAD/CAPACITY CURVE
EFFLUENT and DEWATERING



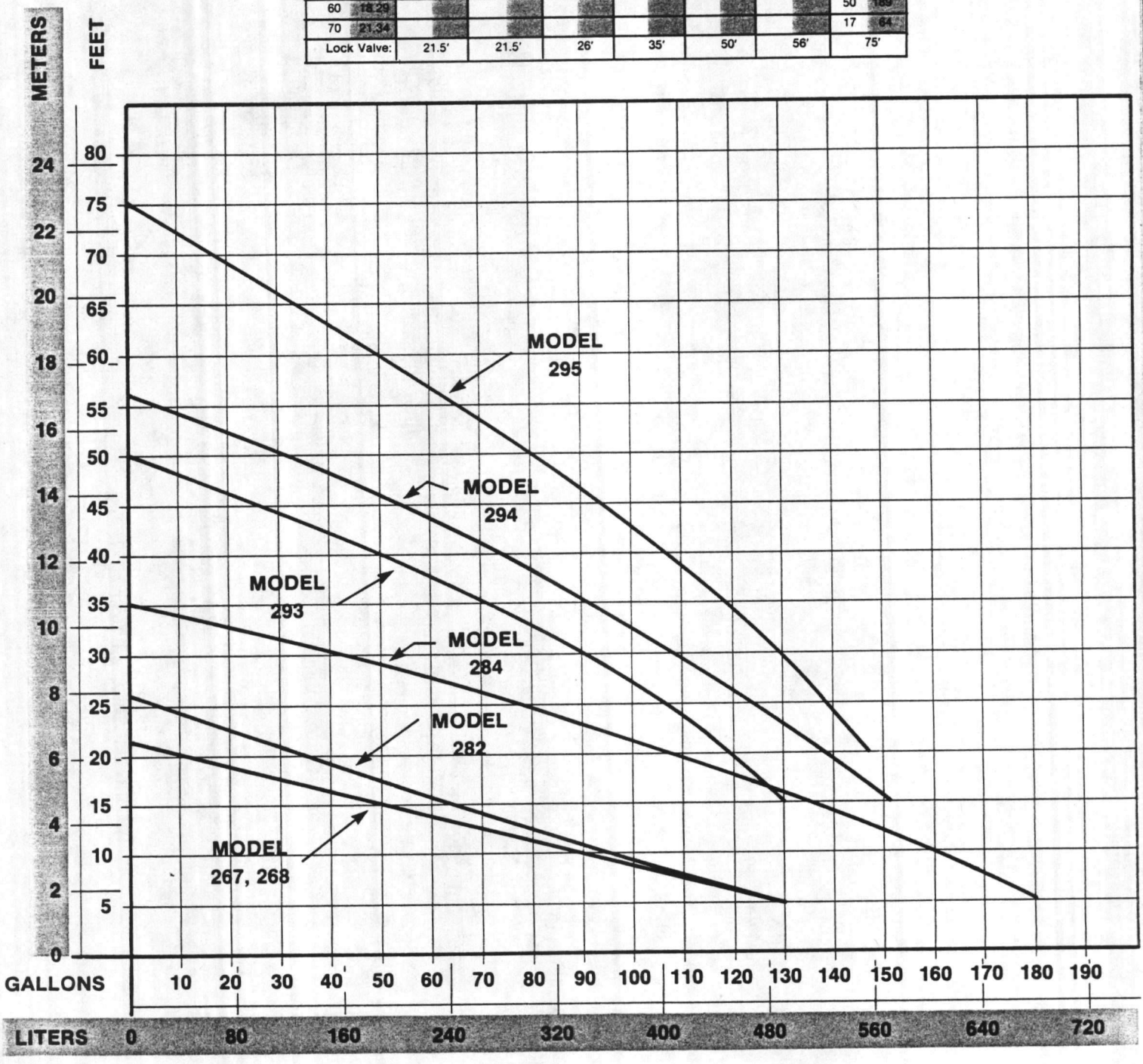
TOTAL DYNAMIC HEAD/CAPACITY PER MINUTE

EFFLUENT AND DEWATERING

SERIES		53-55 57-59		97		137-139		161		163		165		185		188		189	
FT.	M	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.
5	1.52	43	163	57	216	104	394	106	401	61	231	61	231					85	322
10	3.05	34	129	51	193	79	300	100	378	61	231	61	231					85	322
15	4.57	19	72	43	163	64	242	91	344	60	227	60	227					85	322
20	6.10			27	104	36	136	82	310	59	223	60	227					85	322
25	7.62					8	30	74	280	57	216	59	223					85	322
30	9.14							65	246	55	206	58	220	90	340			85	322
40	12.19							46	174	46	172	55	206	75	283	89	337	83	314
50	15.24							21	80	33	125	51	191	58	219	73	276	77	292
60	18.29									15	57	43	161	36	136	57	216	67	253
70	21.34											30	114	10	38	37	140	57	216
80	24.38											14	53			13	49	47	178
90	27.43																	36	136
100	30.48																	21	80
Lock Valve:		19'		24.5'		26'		56'		66'		87'		73'		85'		110'	

HEAD/CAPACITY CURVE
SEWAGE and DEWATERING

TOTAL DYNAMIC HEAD/CAPACITY PER MINUTE SEWAGE AND DEWATERING													
SERIES		267		268		282		284		293		294		295	
FT.	M	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.	Gal.	Ltrs.
5	1.52	128	484	128	484	130	492	180	681						
10	3.05	89	337	89	337	95	360	158	598						
15	4.57	50	189	50	189	63	238	135	511	130	492	151	571		
20	6.10	10	38	10	38	33	125	106	401	119	450	138	522	147	556
25	7.62							76	288	106	401	124	469	138	522
30	9.14							43	163	90	340	108	409	129	488
40	12.19									50	189	74	280	107	405
50	15.24											31	117	80	303
60	18.29													50	189
70	21.34													17	64
Lock Valve:		21.5'		21.5'		26'		35'		50'		56'		75'	



SSPMA MEMBER
SUMP AND SEWAGE PUMP MFRS. ASSN.

YOUR ASSURANCE OF QUALITY

EASY DO'S & DON'TS FOR INSTALLING A SUMP PUMP

1. **DO** read all installation material provided with the pump.
2. **DO** inspect pump for any visible damage caused by shipping. Contact dealer if pump appears to be damaged.
3. **DO** clean all debris from the sump. Be sure that the pump will have a hard flat surface beneath it. **DO NOT** install on sand, gravel, or dirt.
4. **DO** be sure that the sump is large enough to allow the level control switch(es) to operate properly.
5. **DO Always Disconnect Pump From Power Source Before Handling.** **DO** always connect to a separately protected and properly grounded circuit. **DO NOT** ever cut, splice, or damage power cord. **DO NOT** carry or lift pump by its power cord. **DO NOT** use an extension cord with a sump pump.
6. **DO** install a check valve and a union in the discharge line. **DO NOT** use a discharge pipe smaller than the pump discharge without first consulting the manufacturer.
7. **DO NOT** use a sump pump as a trench or excavation pump, or for pumping sewage, gasoline, or other hazardous liquids.
8. **DO** test pump immediately after installation to be sure that the system is working properly.
9. **DO** cover sump with an adequate sump cover.
10. **DO** review all applicable local and national codes and verify that the installation conforms to each of them.

ZOELLER CO.
3280 Old Millers Lane
P.O. Box 16347
Louisville, Kentucky 40216
(502) 778-2731

Manufacturers of . . .

"Quality Pumps Since 1939"

"Quality Pumps Since 1539"

LOELLER LO.

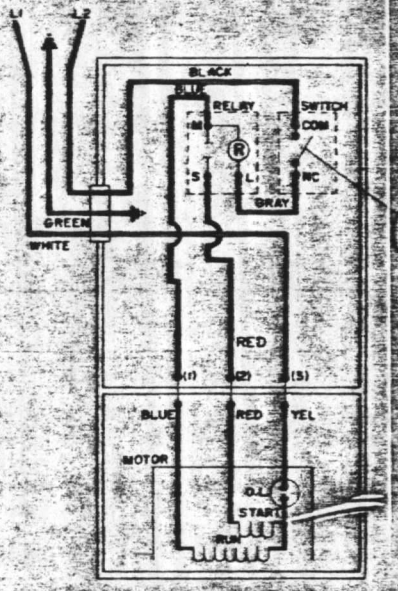
3280 OLD MILLERS LANE
P.O. BOX 16347 • LOUISVILLE, KY. 40216
(502) 778-2731

FM-434
0582

PARTS LIST: MODELS M139, D139, N139, E139

Consult Factory For All Other Models

Specifications Subject To Change Without Notice To Keep Current With Conditions.



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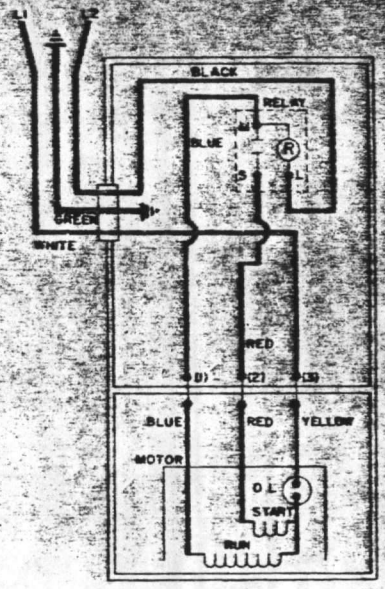
M139
D139



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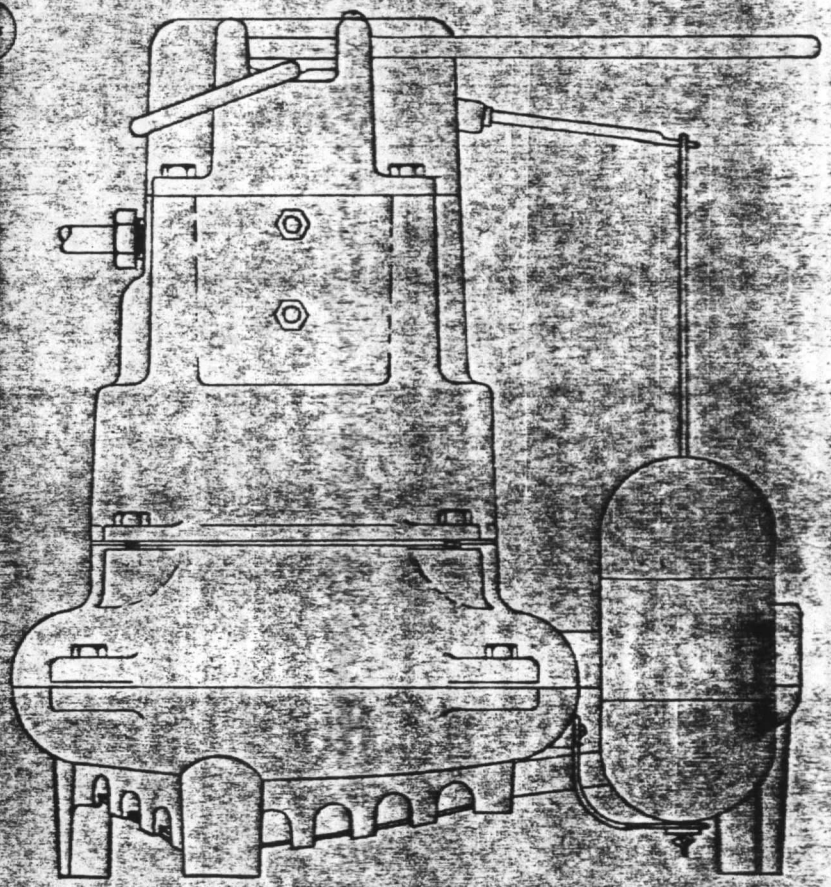
N139
E139



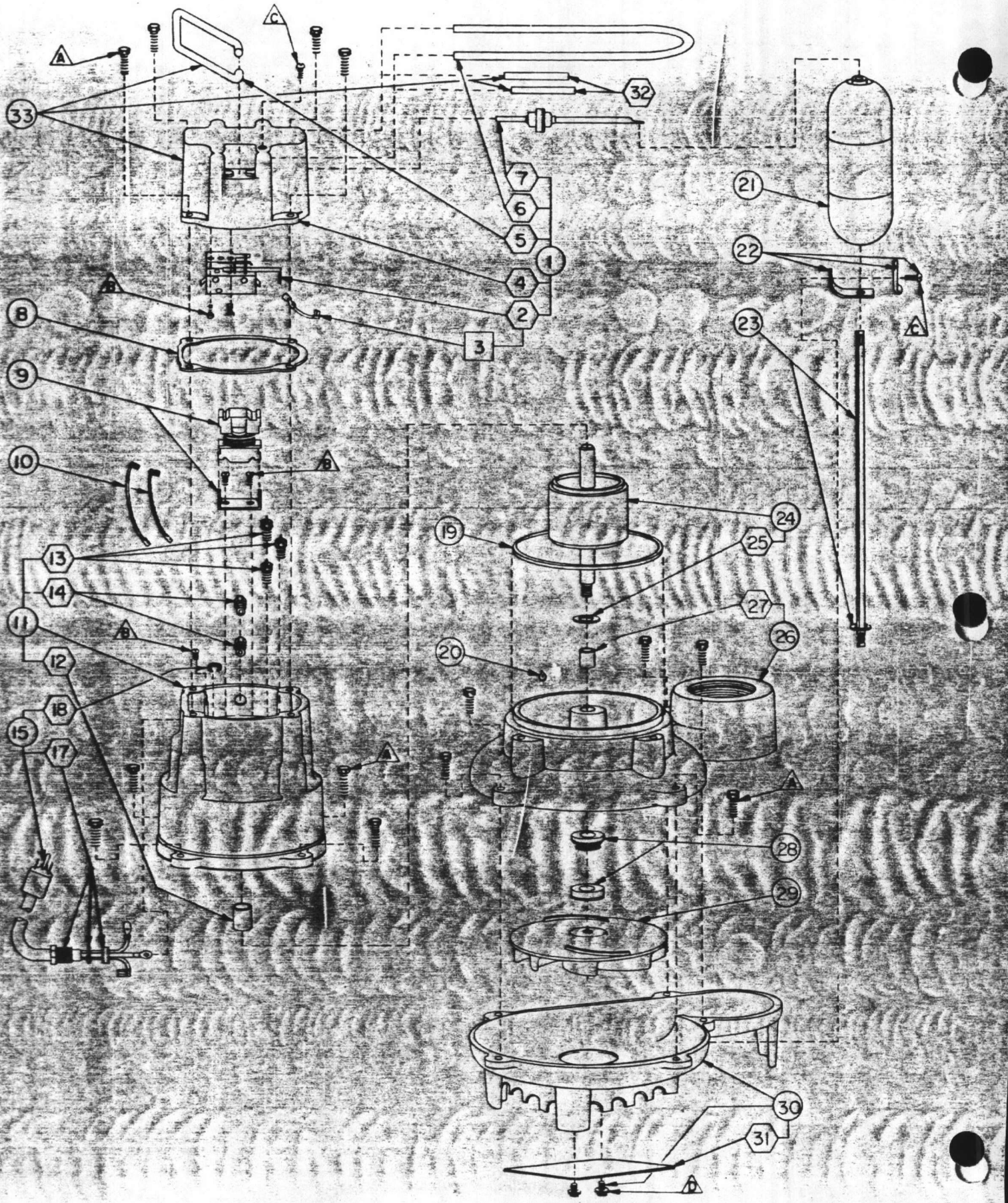
ZOELLER COMPANY
3280 Old Millers Lane
P.O. Box 16347
Louisville, KY 40216
(502) 778-2731

PARTS LIST
FM-434

Models M139 N139 D139 E139
Consult Factory for all Other Models.

	NOTES	FROM 2/81 NM TO					
		MODEL "M139" AUTOMATIC (115V) BRASS					
1 Sw. & Case Comp.		139043					
2 Switch Assm.		267015					
3 Lead Wire (Gray)		002227					
4 Case		001517					
5 Handle		267032					
6 Guard		267008					
7 Arm & Seal		267018					
8 Gasket Case or Cover		267007					
9 Relay Assm. (115V)		002474					
10 Wire Pkg. (Bl & R)		267014					
11 Mtr. Hsg., Brg., Stator & Term.	3, 4	002477					
12 Bearing — Upper		034052					
13 Seal — Thru Wall Term.		054038					
14 Plug		034090					
15 Cord, Term. & Seal (115V)	1	267033					
17 Seal Assm., Cord	1	094032					
18 Strain Relief	1	001770					
19 Seal, Mtr. Hsg.		267006					
20 Oil, Dielectric (24½ oz. can)		267056					
21 Float		034019					
22 Guide Assm.		094048					
23 Rod Assm., Float		147047					
24 Rotor (115/230V)	4	267005					
25 Washer, Thrust		002140					
26 Pump Hsg. & Brg.		139018					
27 Bearing — Lower		054024					
28 Seal, Shaft		267027					
29 Impeller		139006					
30 Base Assm.		139002					
31 Strainer Plate		137008					
34 Rebuild Kit	2	267059					

See next page for Models D139, N139 and E139.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ELLER COMPANY
80 Old Millers Lane
O. Box 16347
ouisville, KY 40216
02) 778-2731

PARTS LIST
FM-434

Models M139 N139
D139 E139
Consult Factory for all Other Models.

	FROM / TO	NOTES	2/81 NM					
			MODEL "D139" AUTOMATIC (230V) BRASS					
(5) Relay Assm. (230V)			147135					
(5) Cord, Term. & Seal (230V)		1	267034					
(1) Mtr. Hsg., Brg., Stator & Term.		3, 4	002478					
			MODEL "N139" NON-AUTOMATIC (115V) BRASS					
(5) Cord, Term. & Seal (115V)		1	003617					
(3) Cover & Handle			002599					
(4) Cover			001519					
(5) Handle			267032					
(31) Retainer, Hdl.			267053					
			MODEL "E139" NON-AUTOMATIC (230V) BRASS					
(5) Cord, Term. & Seal (230V)		1	003618					

NOTES:

1) Strain Relief (Item (18)) can be purchased separately, but is included with Cord, Term. & Seal Assm. (Item (15)) and with Seal, Cord Assm. (Item (17)).
2) Rebuild Kit (Item (34)) includes parts listed below.
3) Mtr. Hsg., Brg., Stator & Term. (Item (11)) are preassembled at the factory and must be replaced as a unit. Stator is permanently attached to the Mtr. Hsg.; Plug (Item (14)), Seal, Thru Wall Term. (Item (13)) and Bearing — Upper (Item (12)) are replaceable.
4) When ordering Mtr. Hsg., Brg., Stator & Term. (Item (11)) or Rotor (Item (24)) specify either General Electric or Emerson motor. GE motor can be identified by (4) half oval slots spaced at 90° around the outside diameter of the stator. Emerson motor can be identified by (2) half oval slots or holes spaced at 180° around the outside diameter of the stator.
A) See FM-160 for listing of all parts and prices.
B) "N.A." indicates, "Not Applicable."
C) "←" indicates, same as next latest effective part.

REBUILD KIT P/N 267059

ITEM	P/N	DESCRIPTION	QTY	ITEM	P/N	DESCRIPTION	QTY
[3]	002227	Lead Wire (Gray)	1	(19)	267006	Seal, Mtr. Hsg.	1
(5)	267032	Handle	1	(20)	267056	Oil, Dielectric (24.5 oz. can)	1
(6)	267008	Guard	1	(25)	002140	Washer, Thrust	1
(7)	267018	Arm & Seal Assm.	1	(28)	267027	Seal, Shaft	1
(8)	267007	Gasket-Case or Cover	1	(A)	001916	1/4-20 X 0.750 Lg. HHMS SST	13
(10)	267014	Wire Pkg. (BL & R)	1	(B)	001877	#6-32 X 0.250 Lg. RHMS ST	5
(13)	054038	Seal-Thru Wall Term.	3	(C)	001883	#10-24 X 0.375 Lg. RHMS SST	2
(14)	034090	Plug	2	(D)	002000	#10-24 X 0.375 SST HHSLTCF/.688	2
(17)	094032	Seal Assm., Cord	1				
(18)	001770	Strain Relief	1				

SCREWS

ITEM	P/N	DESCRIPTION	QTY	ITEM	P/N	DESCRIPTION	QTY
(A)	001916	0.250-20 X 0.750 HHM SS	13	(C)	001883	#10-24 X 0.375 RHM SL SS	2
(B)	001877	#6-32 X 0.250 RHM SL TC F ST. GR.	5	(D)	002000	#10-24 X 0.375 SST HHSL TC F/.688 WA.	2

ZOELLER CO.

3280 Old Millers Lane
P. O. Box 16347 • Louisville, Kentucky 40216
(502) 778-2731

ZOELLER COMPANY DATE OF MANUFACTURE CODE

Two letters appear behind the model number. The first letter designates the month and the second letter the year. Example: Model 54 MJ is a Model #54 pump manufactured in January 1980. Model 147 IH is a Model #147 pump manufactured in August 1967. A third letter, "X" may appear after the date code. This letter designates the pump has a special feature.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1951	AA	BA	CA	DA	EA	FA	GA	HA	IA	JA	KA	LA
1952	AB	BB	CB	DB	EB	FB	GB	HB	IB	JB	KB	LB
1953	AC	BC	CC	DC	EC	FC	GC	HC	IC	JC	KC	LC
1954	AD	BD	CD	DD	ED	FD	GD	HD	ID	JD	KD	LD
1955	AE	BE	CE	DE	EE	FE	GE	HE	IE	JE	KE	LE
1956	AF	BF	CF	DF	EF	FF	GF	HF	IF	JF	KF	LF
1957	AG	BG	CG	DG	EG	FG	GG	HG	IG	JG	KG	LG
1958	AH	BH	CH	DH	EH	FH	GH	HH	IH	JH	KH	LH
1959	AI	BI	CI	DI	EI	FI	GI	HI	II	JI	KI	LI
1960	AJ	BJ	CJ	DJ	EJ	FJ	GJ	HJ	LJ	JJ	KJ	LJ
1961	AM	BM	CM	DM	EM	FM	GM	HM	IM	JM	KM	LM
1962	AN	BN	CN	DN	EN	FN	GN	HN	IN	JN	KN	LN
1963	AO	BO	CO	DO	EO	FO	GO	HO	IO	JO	KO	LO
1964	AP	BP	CP	DP	EP	FP	GP	HP	IP	JP	KP	LP
1965	AR	BR	CR	DR	ER	FR	GR	HR	IR	JR	KR	LR
1966	AS	BS	CS	DS	ES	FS	GS	HS	IS	JS	KS	LS
1967	AT	BT	CT	DT	ET	FT	GT	HT	IT	JT	KT	LT
1968	AU	BU	CU	DU	EU	FU	GU	HU	IU	JU	KU	LU
1969	AV	BV	CV	DV	EV	FV	GV	HV	IV	JV	KV	LV
1970	AW	BW	CW	DW	EW	FW	GW	HW	IW	JW	KW	LW
1971	MA	NA	OA	PA	RA	SA	TA	UA	VA	WA	XA	YA
1972	MB	NB	OB	PB	RB	SB	TB	UB	VB	WB	XB	YB
1973	MC	NC	OC	PC	RC	SC	TC	UC	VC	WC	XC	YC
1974	MD	ND	OD	PD	RD	SD	TD	UD	VD	WD	XD	YD
1975	ME	NE	OE	PE	RE	SE	TE	UE	VE	WE	XE	YE
1976	MF	NF	OF	PF	RF	SF	TF	UF	VF	WF	XF	YF
1977	MG	NG	OG	PG	RG	SG	TG	UG	VG	WG	XG	YG
1978	MH	NH	OH	PH	RH	SH	TH	UH	VH	WH	XH	YH
1979	MI	NI	OI	PI	RI	SI	TI	UI	VI	WI	XI	YI
1980	MJ	NJ	OJ	PJ	RJ	SJ	TJ	UJ	VJ	WJ	XJ	YJ
1981	MM	NM	OM	PM	RM	SM	TM	UM	VM	WM	XM	YM
1982	MN	NN	ON	PN	RN	SN	TN	UN	VN	WN	XN	YN
1983	MO	NO	OO	PO	RO	SO	TO	UO	VO	WO	XO	YO
1984	MP	NP	OP	PP	RP	SP	TP	UP	VP	WP	XP	YP
1985	MR	NR	OR	PR	RR	SR	TR	UR	VR	WR	XR	YR
1986	MS	NS	OS	PS	RS	SS	TS	US	VS	WS	XS	YS
1987	MT	NT	OT	PT	RT	ST	TT	UT	VT	WT	XT	YT
1988	MU	NU	OU	PU	RU	SU	TU	UU	VU	WU	XU	YU
1989	MV	NV	OV	PV	RV	SV	TV	UV	VV	WV	XV	YV
1990	MW	NW	OW	PW	RW	SW	TW	UW	VW	WW	XW	YW

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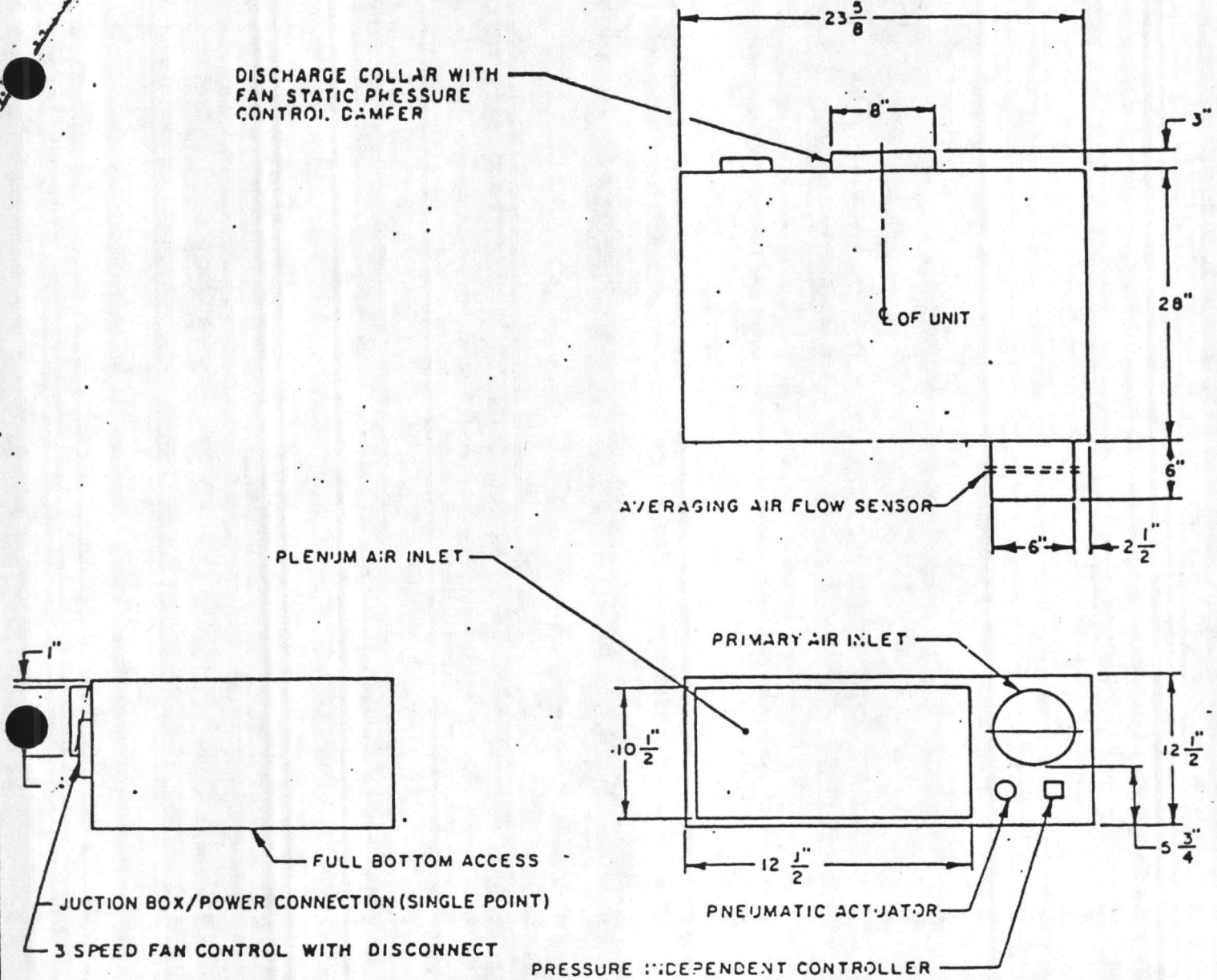
ENVIRO-TEC™ SUBMITTAL DATA



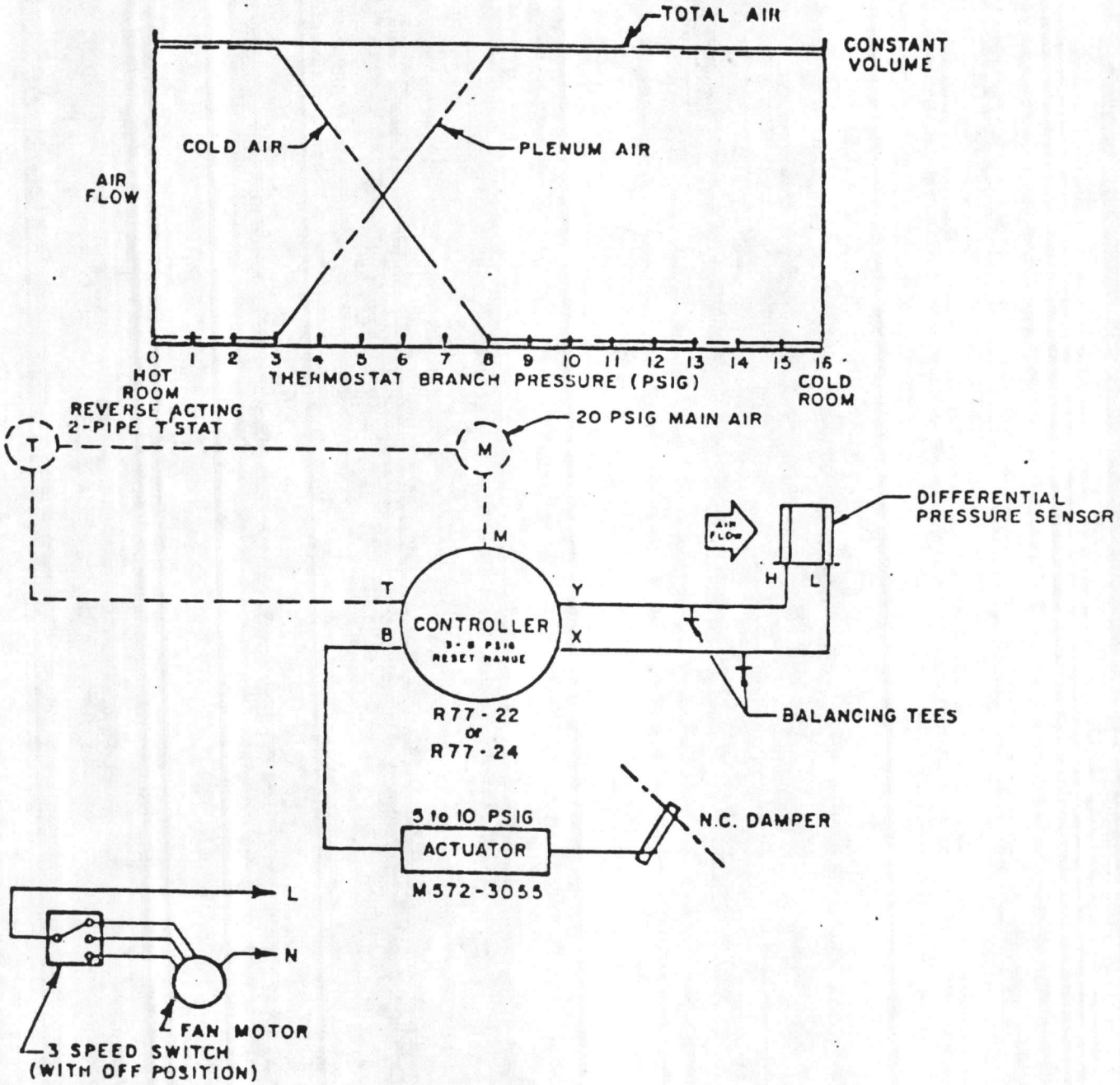
CONSTRUCTION NOTES:

1. MATERIAL: Zinc coated steel. Casing - 22 gauge; Air Valve - 16 gauge; Valve Seat - 20 gauge.
2. INSULATION: 3/4" thick dual density 4.0 P.C.F. fiberglass complying with NFPA 90-A and UL 181. All exposed edges are sealed.

ENVIRONMENTAL TECHNOLOGIES, A CORPORATION			
MODEL ABTX PNEUMATIC CONTROLS SIZE ONE	Drawn by Nance	Date: 16 APR 85	
	Revision No: 00	Revision Date:	
	Approved by: GW	Drawing No 10744	

ENVIRO-TEC™ SUBMITTAL DATA

A reverse acting, two-pipe thermostat is required. Damper is normally closed. All air to room flows through the fan. The thermostat modulates the cold air damper. Unit fan draws a constant volume of air either from the cold duct or the ceiling plenum to maintain a desired room temperature.



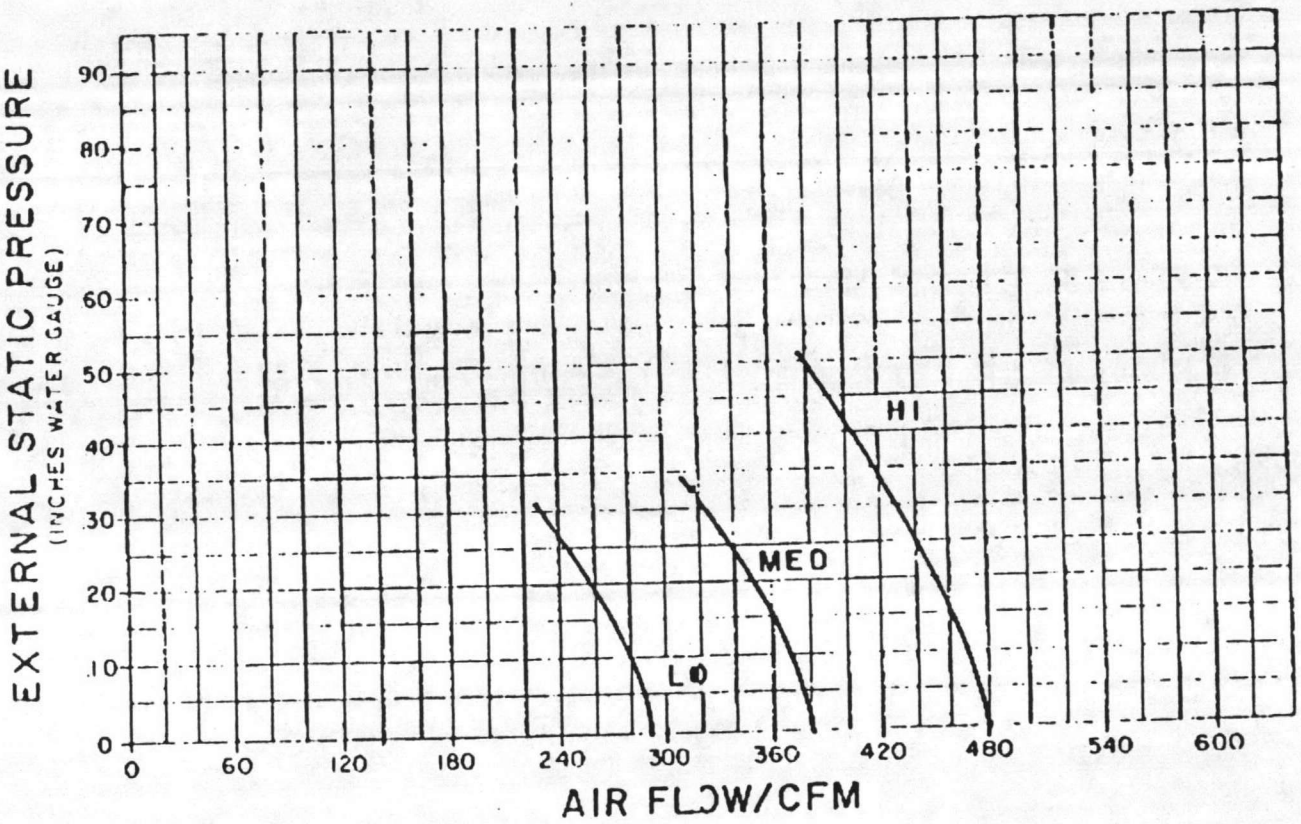
—— FACTORY PIPING - - - FIELD PIPING

PNEUMATIC AIR CONSUMPTION 00083 SCFM

TM	ENVIRONMENTAL TECHNOLOGIES, A CORPORATION			
ABX-4	PRESSURE INDEPENDENT	Drawn by Nance	Date 22 JAN 85	
		Revision No 00	Revision Date	
	PNEUMATIC CONTROLS	Approved by DW.	Drawing No 10681	

UNIT SIZE 1

FAN NO.	HP	VOLTAGE	AMPS @ 1550 RPM		
			HI	MED	LO
FA30	1/10	120	115	.82	64
FA31		277	.55	.45	.40



THIS FAN CURVE INDICATES THE FAN PERFORMANCE FOR EACH MOTOR SPEED TAP (HI, MED, LOW) AT 1075 RPM (MAXIMUM MOTOR EFFICIENCY) THE HIGH SPEED CURVE INDICATES MAXIMUM FLOW/PRESSURE OUTPUT OF THESE FAN ASSEMBLIES. FLOW REQUIREMENTS BELOW THE MAXIMUM MAY BE ACHIEVED BY ADJUSTING THE FAN SPEED CONTROL TO A LOWER SPEED AND TRIMMING THE ADJUSTABLE FAN STATIC PRESSURE CONTROL DAMPER. FLOWS (CFM) FROM MAXIMUM TO ZERO CAN BE ACHIEVED WITHOUT OVERLOADING OR STALLING THE MOTOR.

ENVIRONMENTAL TECHNOLOGIES, A CORPORATION

TITLE:

ABT FAN PERFORMANCE CURVE

UNIT SIZE 1

DRAWN BY: Nance	DATE: 13 SEPT 84
REVISION NO: 00	REVISION DATE:
APPROVED BY:	DRAWING NO: 10556

UNIT SIZE	CFM	DISCHARGE SOUND POWER OCTAVE BAND NUMBER 2	3	4	5	6	7	NC	RADIATED SOUND POWER MIN. INLET Ps OCTAVE BAND NUMBER 2	3	4	5	6	7	NC	1" INLET Ps OCTAVE BAND NUMBER 2	3	4	5	6	7	NC	2" INLET Ps OCTAVE BAND NUMBER 2	3	4	5	6	7	NC
1	250	55	51	47	40	38	38	22	54	46	40	34	29	23	-	55	47	41	35	30	25	-	57	50	45	39	32	28	21
	350	57	52	49	44	42	41	23	58	49	43	36	31	26	20	59	51	45	38	33	26	22	61	54	48	41	36	29	25
	450	60	54	52	48	46	44	26	62	53	46	39	34	29	24	64	56	49	41	36	28	27	66	59	52	45	40	31	31
2	400	58	56	51	46	45	45	27	61	51	44	37	33	32	23	62	54	46	39	34	34	25	64	57	50	42	37	36	30
	600	62	62	58	54	54	53	34	63	55	49	41	36	36	26	65	57	51	43	37	38	29	67	61	54	46	40	39	33
	800	69	68	65	62	63	62	42	66	61	54	47	41	40	33	68	63	56	49	42	40	36	70	67	58	52	44	42	43

NOTES:

Above data expressed in decibels Lw re: 10^{-12} watt.
Discharge sound power based on 100% induction air.
Radiated sound based on 100% primary air.
NC based on 10dB room absorption.
Radiated NC considers typical ceiling absorption.
- Indicates NC less than 20.

ENVIRONMENTAL TECHNOLOGIES, A CORPORATION

TITLE

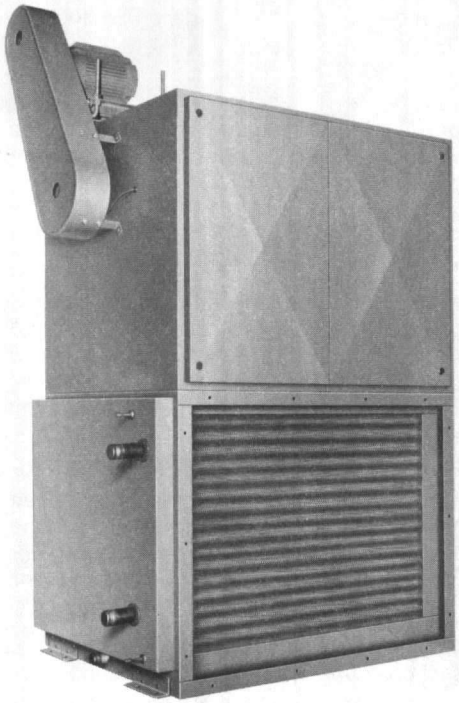
MODEL AHU CV
SOUND PERFORMANCE DATA

DRAWN BY	DATE 21 FEB 86
REVISION NO 00	REVISION DATE
APPROVED BY	DRAWING NO 10982

McQuay
Air Conditioning

INSTALLATION AND MAINTENANCE DATA

BULLETIN NO. IM 80-6
FEBRUARY, 1988
FORM NO. 211843Y REV. B



LSL Vertical Unit

SEASONMASTER
Low and Medium Pressure Central Station Air Conditioners

SEASONVENT
Low Pressure Heating & Ventilating Units

LHD Horizontal Unit

Table of Contents

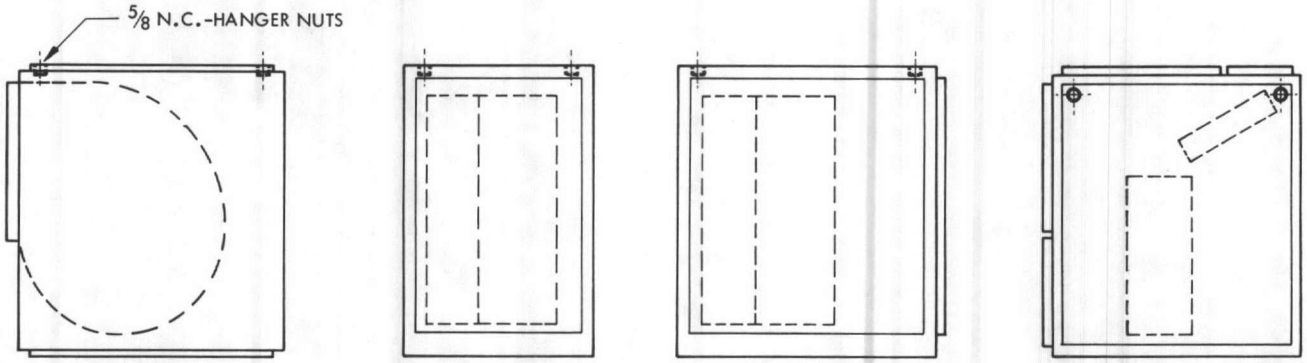
Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. CAUTION: Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

GENERAL

1. The items should be carefully checked against the bills of lading to be sure all crates and cartons have been received. All units should be carefully inspected for damage when received. Visible or concealed damage should be reported immediately to the carrier and a claim filed for damage.
2. SEASONMASTER and SEASONVENT units are constructed of heavy-gauge galvanized steel and are thoroughly inspected before leaving the plant. Care must be taken during installation to prevent damage to units.
3. In order to insure long and trouble-free life, the units should have proper care and maintenance. Enough space should be left around the unit for filter removal, lubrication, belt adjustment, and removal of coils if this should become necessary.
4. Flexible connections should be used on the inlet and outlet duct connections of the unit.
5. Special care should be taken when handling the blower section. All fans are dynamically balanced before leaving the plant. Rough handling, however, can cause misalignment or a sprung shaft. Fans and shaft should be carefully inspected before unit installation to make sure this has not happened.
6. The zone damper of the multi-zone units should be handled with special care. Zone dampers are set and inspected before leaving the plant but should be checked on arrival to the job to be sure the bell arm and connecting rod setscrews have not become loose in shipment.
7. Screws, bolts, etc., for assembly of sections are supplied in a bag attached to each section. Gasketing to be used between sections during field assembly is supplied in rolls in the unit.
8. Drain line from drain pan connection must be adequately pitched and must be trapped.

ASSEMBLY OF SECTIONS

Figure 1.



Blower Section All Models

LSL/MSL Horiz. Coil Section

LSL/MSL Vert. Coil Section

LML/MMM 106 thru 111 Coil Section

Some units are shipped in sections and must be assembled on the job.

HANDLING OF SECTIONS

1. Top hanger nuts are always provided regardless of unit mounting arrnagement. See Figure 1.
2. Hanger nuts have 5/8 N.C. threads.
3. If units are to be moved using just one hoist, a spreader bar should be used to prevent damage to the unit.

GASKETING

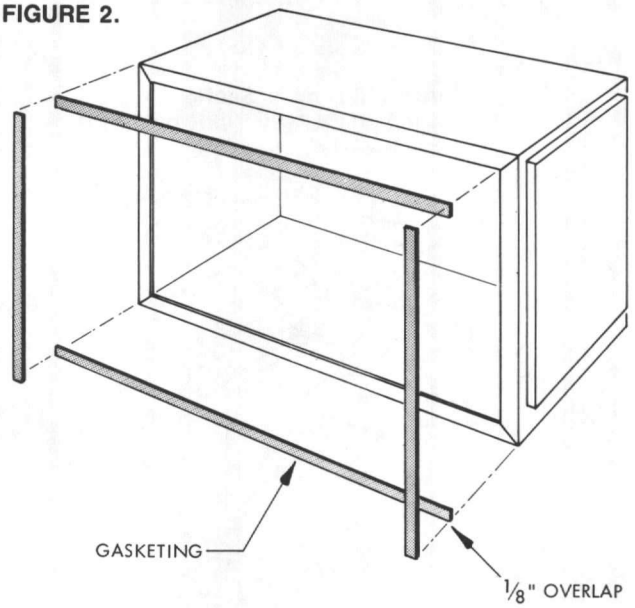
The gasketing is supplied with each section that has to be assembled on the job.

1. Gasket the perimeter of the section. Overlap the gasketing approximately 1/8" when splicing to prevent air leakage between sections. See Figure 2.
2. With gasketing in place, cut out mounting holes in gasketing so the bolts will clear.

FASTENING OF SECTIONS

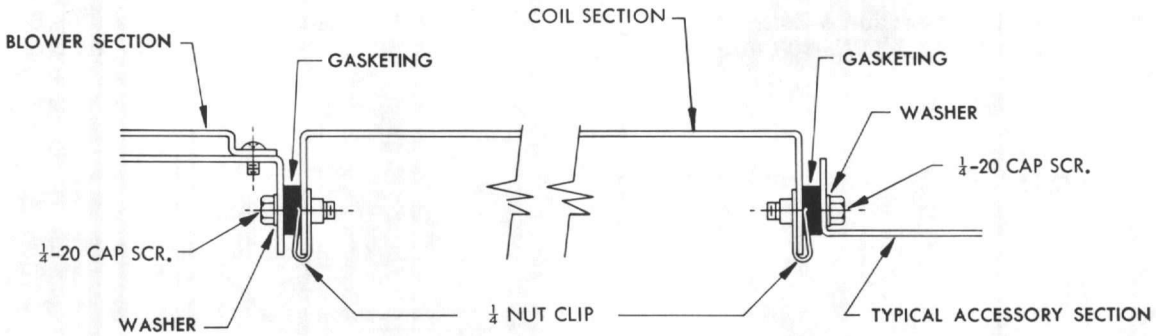
1. Illustrations show how the flanges of the various sections are bolted together. Figures 8 through 15 show how to fasten accessories to the coil section. The same procedure should be followed when bolting accessories to the blower section.
2. Figure 3 shows the typical attaching method used and the difference in the mounting flanges for air conditioning and heating and ventilating coil sections.
   a. Slip 1/4 nut clips on the coil section flange before gasketing. (See Figure 3).
   b. Gasket the perimeter of the coil section flange as outlined in "Gasketing."

FIGURE 2.

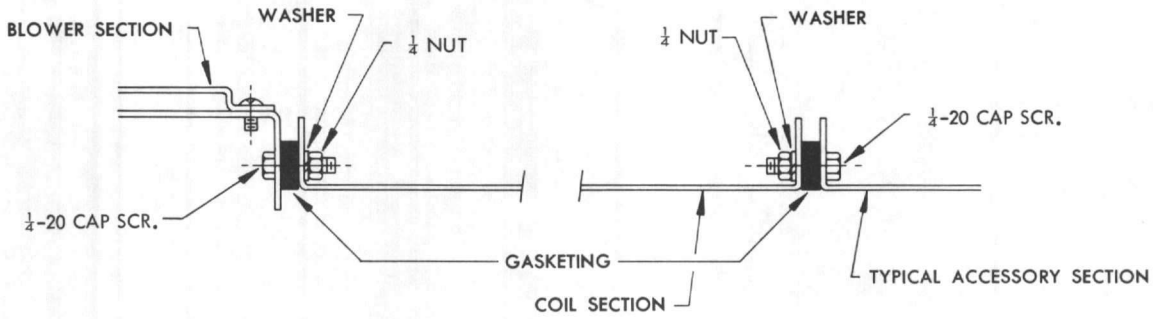


   c. Align the section that is to be bolted to the coil section so the mounting holes match.
   d. Bolt through the accessory or blower section (as shown in Figures 4 through 15) into the nut clips in the coil section with 1/4 N.C. bolts.

FIGURE 3. Typical Attaching Method



AIR CONDITIONING UNITS



HEATING AND VENTILATING UNITS

FIGURE 4.

Horizontal Blower Section
LSL-103H thru 111H & MSL-108H thru 111H

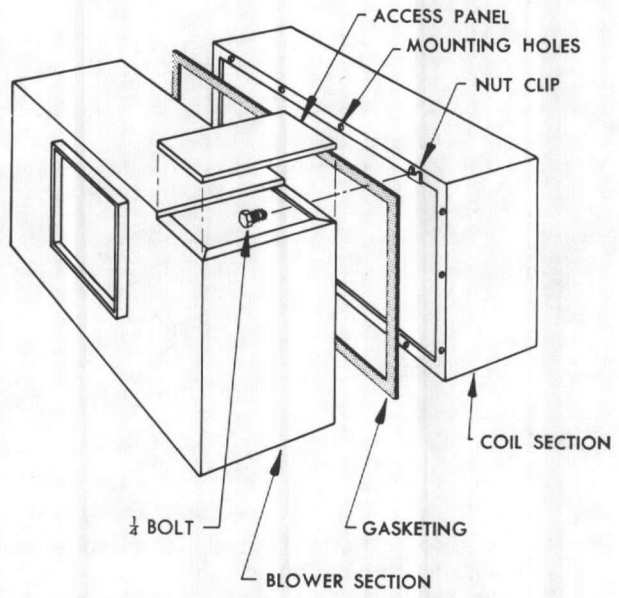


FIGURE 5.

Vertical Blower Section
LSL-103V thru 111V & MSL-108V thru 111V

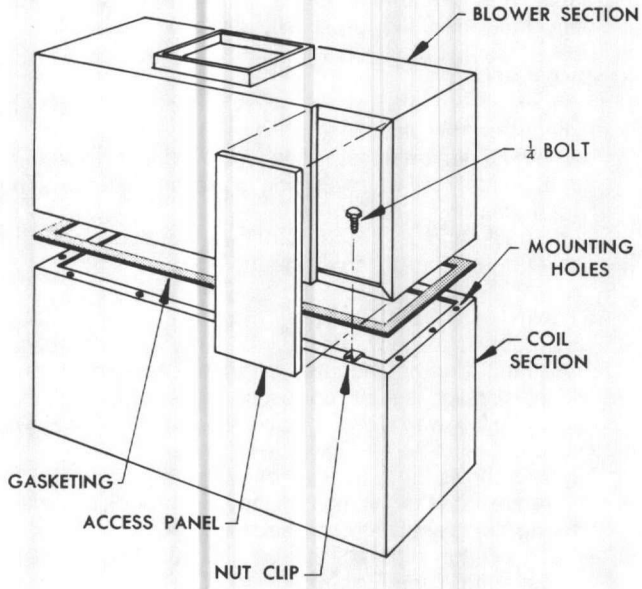


FIGURE 6.

Multi-zone Blower Section & Zone Dampers
LML-106 thru 111 & MMM-108 thru 111

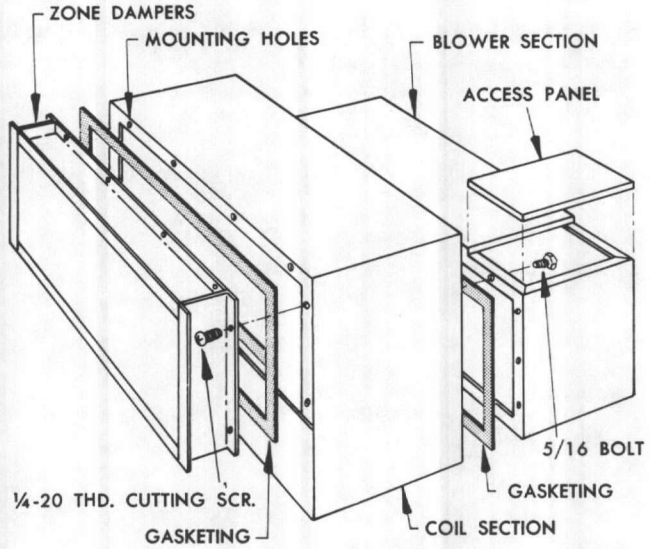


FIGURE 7.

Multi-zone Blower Section & Coil Section
LML-106 thru 111 & MMM-108 thru 111

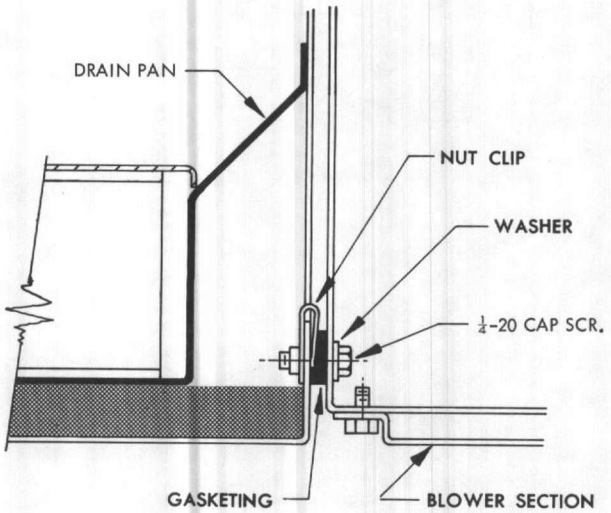


FIGURE 8.

Internal Face & Bypass
(All Models)

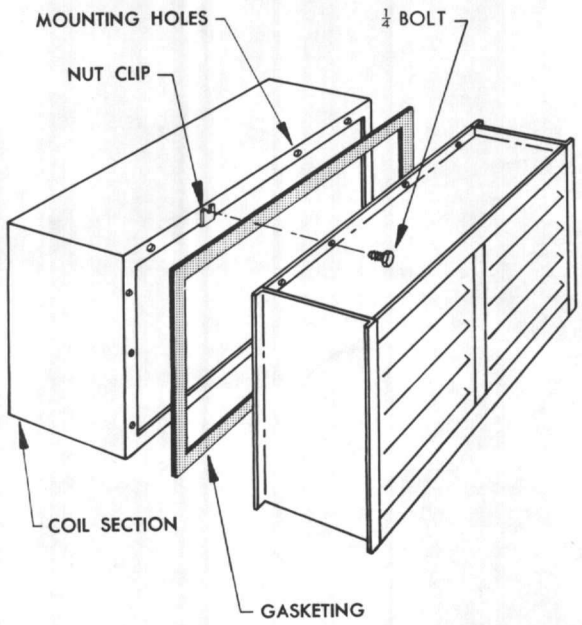


FIGURE 9.

Flat Filter, Preheat Coil Section
(All Models)

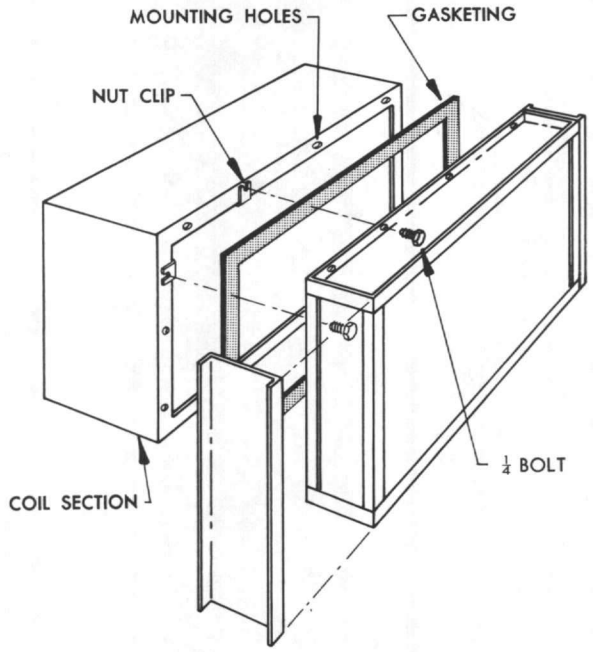


FIGURE 10.

Angular Filter, Heavy-Duty Filter,
Combination Angular Filter & Mixing Box
(All Models)

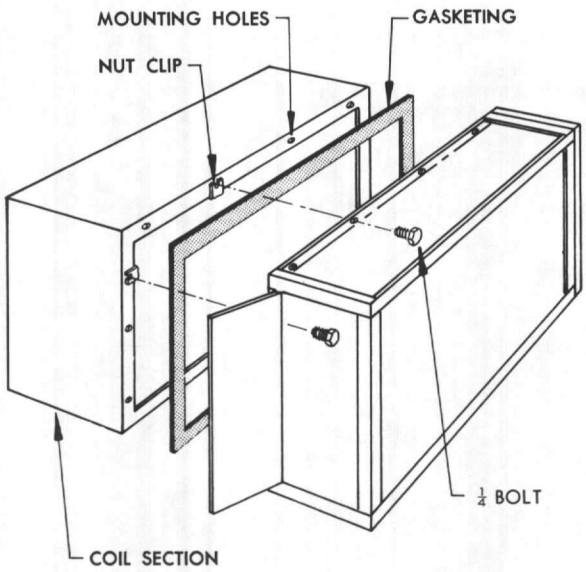


FIGURE 11.

External Face & Bypass
(All Models)

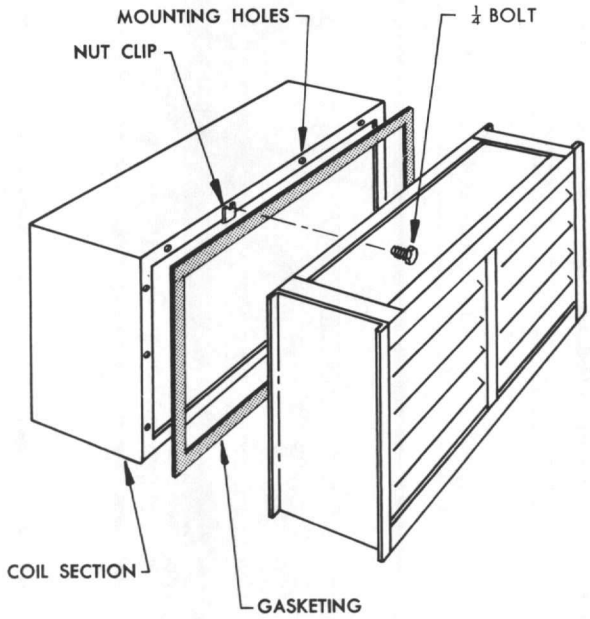


FIGURE 12.

Vertical Bypass Duct
LSL-103V thru 111V & MSL-108V thru 111V

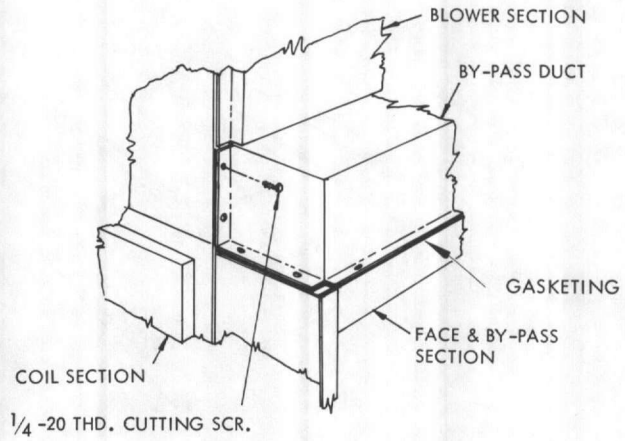


FIGURE 13.

Vertical Bypass Duct with Spacer Section
LSL-103V thru 111V & MSL-108V thru 111V

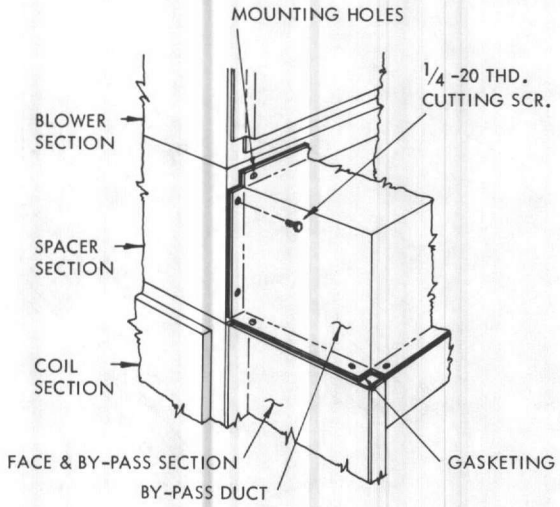


FIGURE 14.

Horizontal Bypass Duct
LHD/LSL-103H thru 111H & MSL-108H thru 111H
Vertical Bypass Duct
LHD-103V thru 111V

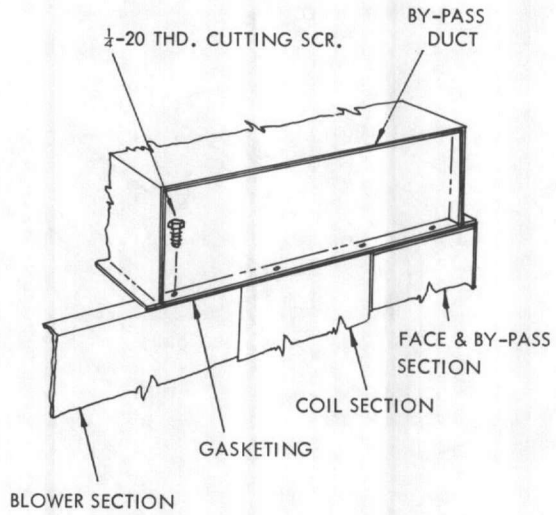
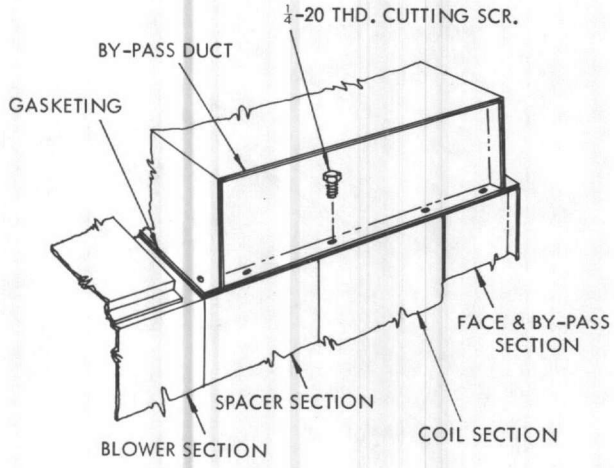


FIGURE 15.

Horizontal Bypass Duct with Spacer Section
LHD/LSL-103H thru 111H & MSL-108H thru 111H
Vertical Bypass Duct with Spacer Section
LHD-103H thru 111H



INSTALLATION

DRIVE INSTALLATION

1. Motors
   a. Units with motors mounted on outside of fan section: Motors of NEMA frame 254T are shipped unmounted. Certain smaller motors may also be shipped separately.
2. Bolt motor to motor base on unit. Use flexible electrical conduit at motor to permit six inches total motor movement for tensioning V-belts.
3. Install fan sheave close to the fan bearing; mount motor sheave, and align with a straight edge to insure true running belts.
4. If the motor sheave is a variable pitch type it should be set at minimum pitch diameter (four turns open) for start-up. Groove spacing should be checked to make sure it is equal. See Drive Adjustment, page 11 for explicit instructions. Tighten all setscrews and/or capscrews.
5. Adjust motor mount adjusting screws for adequate run-in belt tension. Attach belt guard (where used) to end panel of fan section with screws provided.

UNIT INSTALLATION

1. Unit is equipped with either ¾ diameter anchor holes or ⅝ N.C. tapped hanger holes for mounting the unit.
2. If the unit has ⅝ N.C. tapped hanger nuts they are accessible through knockouts or "Dot-Plugs" in the unit panels.
3. When unit is equipped with vibration isolators, instruction sheets will be sent with IM bulletin showing where to locate the isolators. Isolators for floor mounting are equipped with positioning pins and are not meant to be threaded into the unit.
4. Be sure unit is level to insure proper operation.

ZONE DAMPER ADJUSTMENT

If multi-zone damper blades do not close properly, adjust the blades as follows:

1. Loosen setscrews in bell arm for all zones.
2. Close tightly all cold deck dampers.
3. Align all bell arms so they are parallel. See Figure 16.
4. Tighten setscrews on bell arms while holding the dampers closed.
5. Zone damper blades should all close properly. If one or a few zones do not close completely, the procedure can be repeated for these zones.

DUCT CONNECTORS

Each zone divider has a "W" shaped duct clip. See Figure 17.

OUTDOOR INSTALLATION (OPTIONAL FEATURE)

Factory modifications for outdoor installation consist of a cap type access panel for the blower section and weather caps for the following accessories: internal and external bypass sections; flat, angular, and heavy-duty filter section; 1, 2, 3 and 4 row coil sections; and zone dampers. In addition, a motor and drive weatherhood (optional) may be supplied with the blower section.

1. Accessories
The assembly of accessory weather caps is illustrated in Figure 18a. Note the weather cap support angles are installed as the sections are assembled together and are held in place by the section-to-section fasteners. The weather cap is attached after the sections have been joined.

2. Motor and Drive Weatherhood (Optional Feature)
The assembly of the motor and drive weatherhood is illustrated in Figure 18a. Connect the extended lube lines before the bottom front panel is put in place.

FIGURE 16a. Zone Damper Linkage

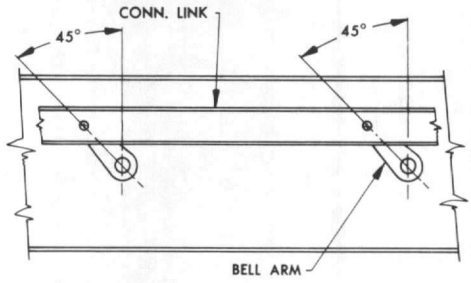
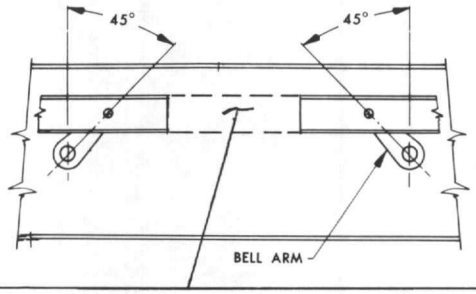
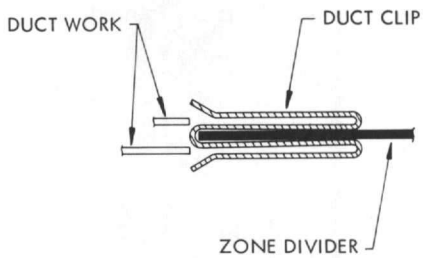


FIGURE 16b. Installation Modification for Multiple Zones



To divide the damper section into multiple zones, cut and remove sufficient connecting link to allow adjacent zones to operate independently.

FIGURE 17. Duct Connectors



WEATHER SEALING OF UNITS MODIFIED FOR OUTDOOR INSTALLATION

Units requiring a weathertight seal must be sealed on the jobsite as illustrated in Figure 18b. The responsibility for the weather seal is that of the installing contractor. The caulking consistency sealant used may be supplied by others or may be purchased from McQuay.

1. Cleaning
Before sealing, clean all seams with a solvent to remove oil and dirt and trim excess gasketing from section-to-section joints.

2. Sealing
All exterior seams, section-to-section joints, and fastener heads must be sealed. See Figure 18b.

FIGURE 18a. Outdoor Installation Assembly.

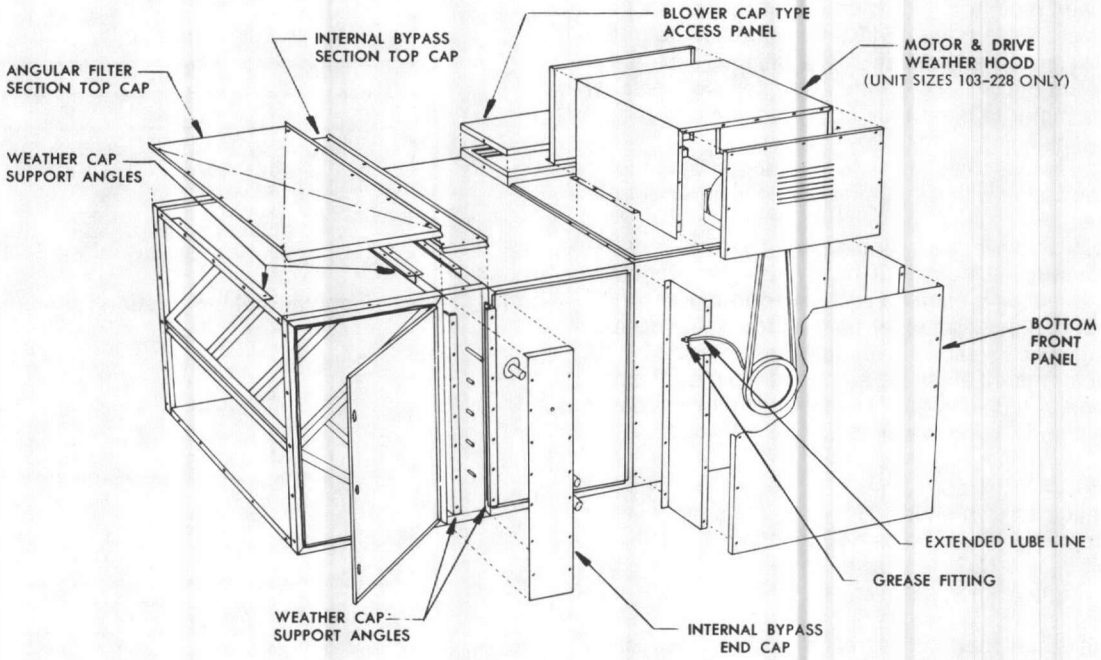
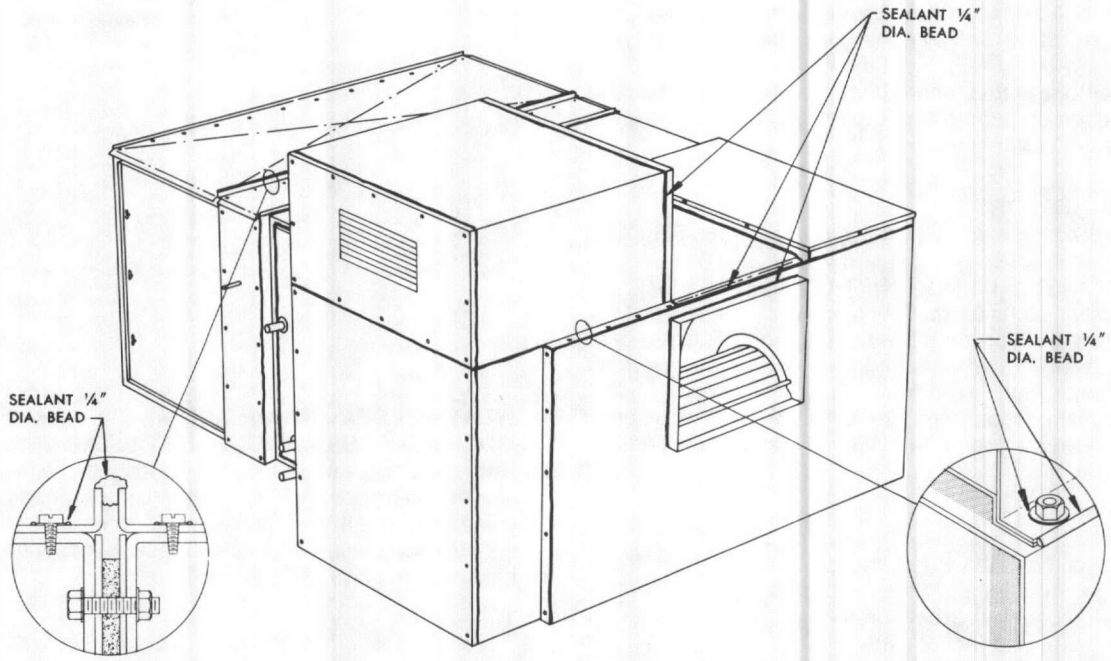


FIGURE 18b. Sealing of Outdoor Installation Units.



MAINTENANCE

The user is reminded that:

1. Electrical service to the fan motor must correspond to the rated voltage on the motor nameplate and be in conformance with the National Electrical Code and local restrictions.
2. The fan section metal frame must be connected to the building electrical ground.
3. A door electrical interlock is not provided as standard.
4. Thermal motor protection is external to the unit. Thermal protection and a disconnect switch per electrical codes are provided by others.

SAFETY PRECAUTIONS

1. Fan sections which have motor and drive mounted within the cabinet are not equipped with belt guards. The hinged access door and screw-fastened access panels must not be opened while the unit is operating to avoid the hazard of moving machinery and the strong suction forces tending to keep the door(s) in a closed position.
2. BEFORE ENTERING ANY FAN SECTION, MAKE SURE THE ELECTRICAL POWER SOURCE TO THE FAN MOTOR IS DISCONNECTED AND LOCKED.
3. Do not enter the fan section of an internally mounted motor type unit while the unit is operating to determine fan speed. With the electrical power locked off, measure the diameter of the V-belt outer surface where it passes around each sheave, and calculate fan speed from the motor nameplate rpm:

$$\text{Fan rpm} = \text{Motor rpm} \times \frac{\text{Measured diameter at Motor Sheave}}{\text{Measured diameter at Fan Sheave}}$$

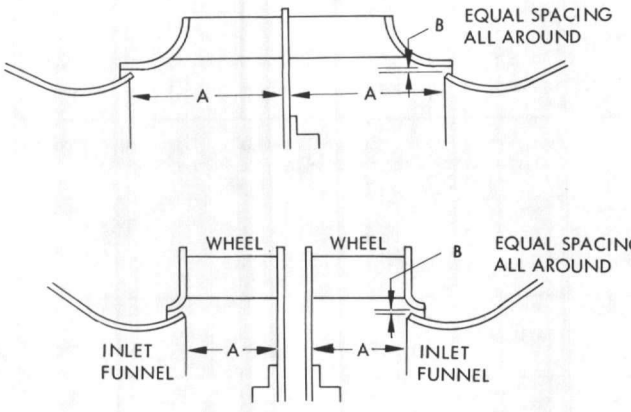
Fan speeds of units with external motors may be determined conventionally at the end of the extended shaft (through a hole in the belt guard).

BEFORE STARTUP CHECKS

1. BEFORE ENTERING FAN SECTION MAKE SURE THAT FAN ELECTRICAL POWER SOURCE IS DISCONNECTED AND LOCKED.
2. Check tightness of setscrews in bearings and fan wheel(s). If re-tightening is needed, make certain the fan wheel(s) are positioned per Tables 1 or 2 and setscrews are torqued per Table 3.
3. Rotate shaft by hand to be sure it is free.
4. Ball bearings on fan shaft are prelubricated, and do not need grease before startup.
5. Check alignment of fan and motor sheaves, and belt tension. Check tightness of sheave setscrews and/or capscrews; torque as in Table 2.
6. Restore electrical power and check fan(s) for proper direction of rotation (note "rotation" arrow on unit).
7. Leak test thermal system to insure that connections are tight.

TABLE 1.
Wheel-to-Inlet Funnel Relationship
Airfoil Type Fan Wheels

Note: Dimensional relationship must be held to obtain rated air performance.



UNIT SIZE	FAN DIA.	A ± 0.12″	B ± 0.10″
106	13 7/32	4.60	0.19
108	14 9/16	5.10	0.19
111	16 3/16	5.66	0.19

Dimension A is achieved by loosening setscrews in wheel hub(s), shifting wheel(s) axially as needed, and re-tightening setscrews.

Dimension B is obtained by loosening screw and washer fasteners around periphery of funnel(s), shifting funnel radially as required, and re-torqueing fasteners.

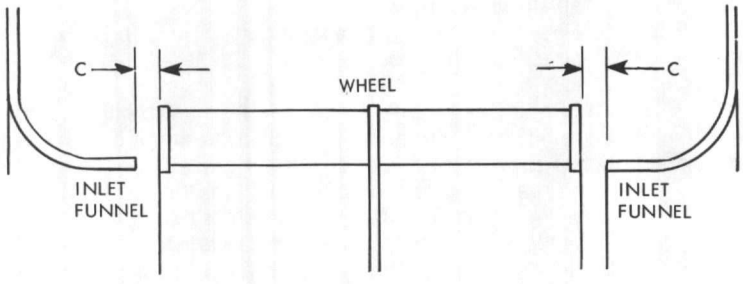


TABLE 2.
Wheel-to-Inlet Funnel Relationship
Forward Curved Type Fan Wheels

UNIT	SIZE	FAN DIA.	DIMENSION C
LYF LHD LSL LML	103	9	0.18″—0.31″
	104	12	0.18″—0.31″
	106	12¼	0.25″—0.38″
	206	(2) 9½	0.18″—0.31″
	108	15	0.25″—0.50″
	209	(2) 12¼	0.25″—0.38″
	111	16½	0.25″—0.50″
MSL	108	13½	0.25″—0.38″
MMM	111	15	0.12″—0.50″

Adjust dimension C by loosening wheel hub setscrews, shifting wheel(s) axially as needed, and re-tightening setscrews.

AFTER FIRST 48 HOURS OF OPERATION

1. Disconnect and lock electrical power source. Check tightness of all bearing, wheel, and sheave setscrews (or capscrews). Torque per Table 3.
2. Re-check belt tension, adjust if necessary. Belts tensioned sufficiently to slip one to two seconds at startup will perform satisfacorily, extending bearing life and reducing vibration. If re-tensioning is necessary, be certain sheave alignment is retained. (See belt adjustment, page 14).

TABLE 3.
Bearing Collar and Wheel Hub Setscrew Torque

SETSCREW DIAMETER (IN.)	TORQUE (FT.-LBS.) MINIMUM
1/4	4.4
5/16	10.5
3/8	19.0
7/16	29.0
1/2	42.0
5/8	92.0

OPERATING GUIDELINES

OPERATING LIMITS

1. Do not exceed the operating limits in Tables 4 or 5. A fan wheel overspeeded beyond the rpm and temperature limits shown may suffer permanent distortion or fracture. The resulting unbalance may cause severe unit vibration.
2. Vibration
   Each unit as shipped is trim-balanced, and should operate smoothly. Instruments are available to field-test vibration amplitude. The range of operating speeds and displacement amplitudes in Table 6 yield acceptably smooth fan operation.

Intermediate values may be interpolated. **Note:** Excessive vibration from any cause contributes to premature fan and motor bearing failure. Overall vibration levels should be monitored every 3 months of operation. An increase in level is an indication of potential trouble.

VIBRATION CAUSES

1. Wheel imbalance.
   a. Dirt or debris on wheel blades.
   b. Loose setscrews in wheel hub or bearing-to-shaft.
   c. Wheel distorted from overspeed.
2. Bent shaft.
3. Drive faulty.
   a. Variable pitch sheaves — axial, and radial runout of flanges; uneven groove space, out of balance. Also similar faults in driven shaft.
   b. Drive misalignment.
   c. Bad V-belts; lumpy, or mismatched, belt tension too tight or too loose.
4. Bad bearings, loose hold-down bearing bolts.
5. Motor imbalance.
6. Fan section not supported evenly on foundation.

PERIODIC SERVICE AND MAINTENANCE

1. Check all moving parts for wear every six months.
2. Check bearing collar setscrews for tightness every six months.

BALL BEARING LUBRICATION

1. Motor Bearings — All ball bearings are prelubricated and do not require addition of grease at time of installation. However, periodic cleaning out and renewal of grease is necessary. Please note that extreme care must be exercised to prevent foreign matter from entering the bearing. It is also important to avoid overgreasing. Only a high grade, clean mineral grease having the following characteristics should be used.
   a. Consistency a little stiffer than that of Vaseline, maintained over the operating temperature range; melting point preferably over 302°F (150°C), freedom from separation of oil and soap under operating and storage conditions; and freedom from abrasive matter, acid, alkali and moisture.
   b. Specific greasing instructions are to be found on a tag attached to the motor and should generally be adhered to.
2. Fan Shaft Bearings — All ball bearings are prelubricated and do not require addition of grease at time of installation. However, periodic renewal of grease is necessary.

Internal bearings are accessible through access panel in cabinet. Units that are equipped with extended lube lines will have grease fittings for internal bearings on drive end panel of blower section. Apply grease while bearings are

TABLE 4.
Maximum Operating Conditions
Airfoil Type Wheels

UNIT	SIZE	MAXIMUM RPM
LYF, LHD	106	3758
LSL, LML	108	3706
MSL, MMM	111	3053

NOTE: All motors external to fan cabinet. Maximum air temperature through fan section 225°F. (450°F with special high temperature bearings).

TABLE 5.
Maximum Operating Conditions
Forward Curved Type Fan Wheels

UNIT	SIZE	MAXIMUM RPM
LYF LHD LSL LML	103	1735
	104	1265
	106	1715
	206	2200
	108	1400
	209	1715
	111	1275
MSL	108	2120
MMM	111	1910

NOTE: All motors external to fan cabinet. Maximum air temperature through fan section 225°F. (450°F with special high temperature bearings).

TABLE 6.
Operating Guidelines

FAN SPEED RPM	VIBRATION DISPLACEMENT* MILS (0.001") AT FAN BEARINGS
600	2.4
1000	1.6
1600	1.0
3000	0.5

*At fan rotational frequency.

running, adding slowly until a slight bleeding of grease from the seals is noted. For greasing units with extended lube lines, remove access door so bearing can be viewed when greasing. Tie hinged door(s) open. DO NOT OVERLUBRICATE.

The lubrication interval varies with the period of operation and temperature of the ambient air. Follow instructions listed below:

TEMPERATURE RANGE	CONTINUOUS OPERATION	12 HR. DAY OPERATION
To 150°F	6 months	1 year
To 200°F	3 months	6 months
Over 200°F	1½ months	3 months

SLEEVE BEARING LUBRICATION

Sleeve bearings must be oiled after installation but before initial startup.

For motor bearings, drain plugs should be checked to see that they are tight and the oil well filled to the proper level while the motor is at rest.

The oil level should be checked periodically with the motor stopped. If the oil is dirty it should be drained and the bearing flushed with clean oil until the outcoming oil is clear. Then the oil well should be refilled. Use only a high grade mineral oil of SAE 20 for normal operation. Follow in general the oiling instructions on the tag attached to the motor.

TABLE 7.
Lubricants Recommended
For Fan Shaft Ball Bearings

AMBIENT TEMP. RANGE	LUBRICANT
To 225°F	Sinclair Oil Co. — Litholene
	Humble Oil Co. — Lidok #2
	Keystone Lubrication Co. — 84-H-MED
	Shell Oil Co. — Alvania #2
226°F to 300°F*	Socony-Mobil Oil Co. — Armvac-781
	Master Lubricants, Inc. — M-24-M
301°F to 450°F*	Dow-Corning — DC-41
	Dow-Corning — DC-44
	General Electric Co. — Versilube #300
	Keystone Lubrication Co. — #89 Med. Grade
	Keystone Lubrication Co. — #2 Consistency

*Special order (Hi-Temp) bearings required in these temperature ranges.

REPLACEMENT PARTS

When replacement parts are required on units manufactured by McQuay, furnish factory with unit model number and serial number as shown on serial plate on drive end of blower section.

AIR BALANCING

Most units are supplied with a variable pitch motor sheave to aid in airflow adjustment. They are typically set at the low end of the rpm range for field adjustment to the required airflow.

When the final adjustments are complete, the current draw of the motors should be checked and compared to the full load current rating of the motors. The amperage must not exceed the service factor stamped on the motor nameplate.

Upon completion of the air balance, it is a common industry recommendation that the variable pitched motor sheave be replaced with a properly sized fixed sheave. A matching fixed sheave will provide longer belt and bearing life and vibration free operation. Initially, it is best to have a variable pitched motor sheave for the purpose of air balancing, but once the balance has been achieved, fixed sheaves maintain balancing and alignment more effectively.

If units are supplied with electric heaters the total airflow must not be less than that required for their operation.

DRIVE ADJUSTMENTS

"VM" & "VP" Variable Pitch Key Type Sheaves (See Fig. 19)

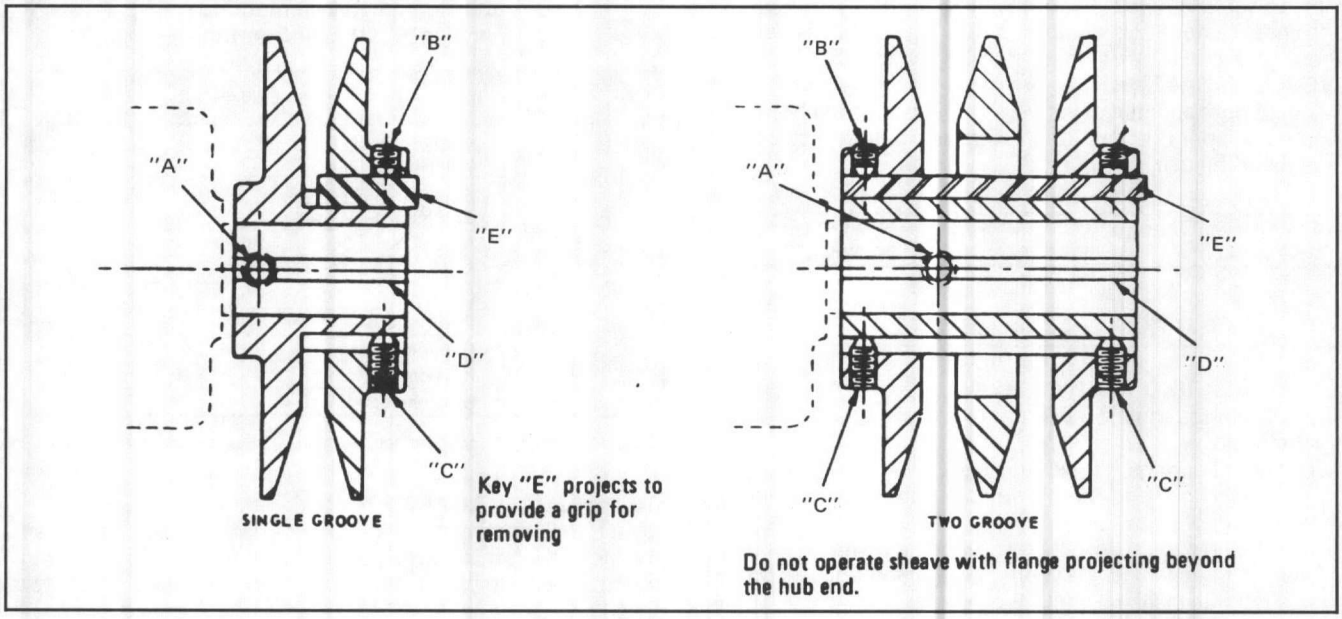
Mounting:

1. All sheaves should be mounted on the motor or driving shaft with the setscrew "A" toward the motor.
2. Be sure both driving and driven sheaves are in alignment and that shafts are parallel (see Figure 22).
3. Fit internal key "D" between sheave and shaft, and lock setscrew "A" securely in place.

Adjusting:

1. Loosen setscrews "B" and "C" in moving parts of sheave and pull out external key "E". (This key projects a small amount to provide a grip for removing.)
2. Adjust sheave pitch diameter for desired speed by opening moving parts by half or full turns from closed position. DO NOT OPEN MORE THAN FIVE FULL TURNS FOR "A" BELTS OR SIX FULL TURNS FOR "B" BELTS.
3. Replace external key "E" and securely tighten setscrews "B" over key and setscrews "C" into keyway in fixed half of the sheave.
4. Put on belts and adjust belt tension. DO NOT FORCE BELTS OVER GROOVES (see "Drive Belt Adjustment," pages 14 and 15).
5. Future adjustments should be made by loosening the belt tension and increasing or decreasing the pitch diameter of the sheave by half or full turns as required. Readjust belt tension before starting drive.
6. Two-groove sheaves must have both halves adjusted by the same number of turns from closed position to insure the same pitch diameter.
7. Be sure that all keys are in place and that all setscrews are tight before starting drive. Check setscrews and belt tension after 24 hours service.

Figure 19. "VP" Type Sheave Adjustment



"LVP" Variable Speed Sheaves (see Figure 20)

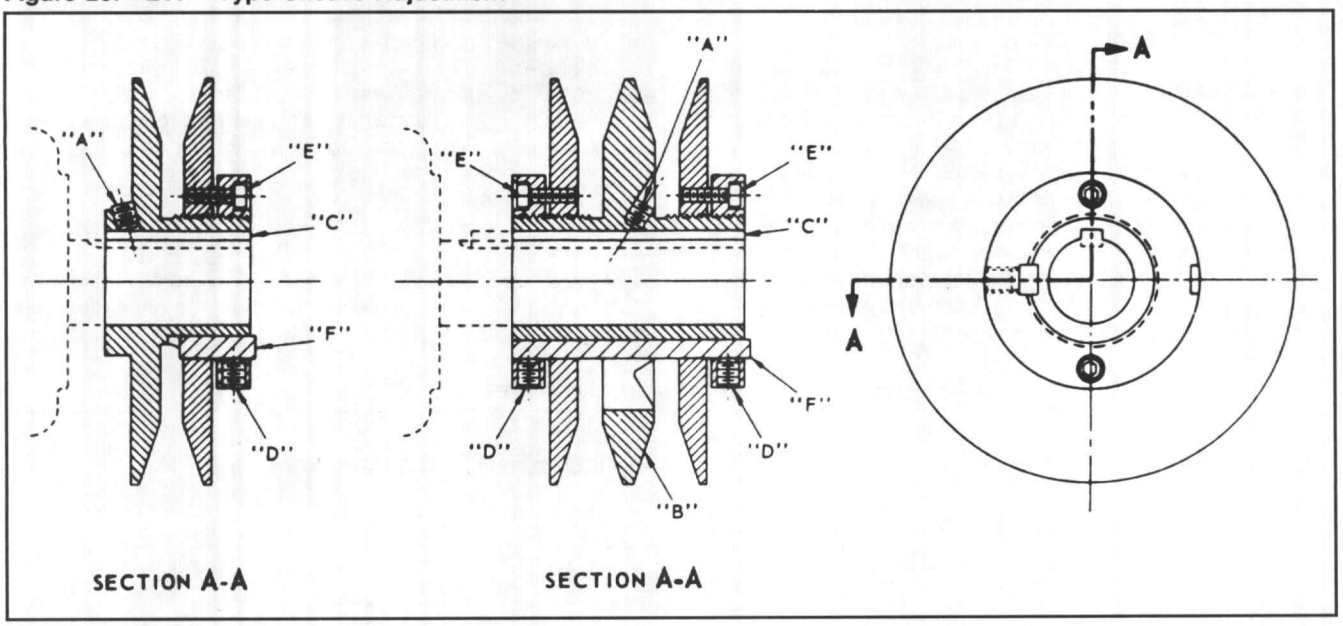
Mounting:

1. Slide sheave on motor shaft so that the side of the sheave with setscrew "A" is next to the motor, when setscrew "A" is in the hub or barrel of the sheave.
2. When setscrew "A" is at an angle in the center flange "B", it should be mounted away from the motor so that the other flange and locking ring can be removed to get to the setscrew.
3. To remove the flange and locking ring:
   a. Loosen setscrews "D".
   b. Loosen but DO NOT REMOVE capscrews "E".
   c. Remove key "F". **Note:** This key projects a small amount to provide a grip for removing.
   d. Rotate the flange counterclockwise until it disengages the threads on the sheave barrel.
4. Be sure that the driving and driven sheaves are in alignment and the shafts are parallel (see Figure 22). When aligning two-groove sheaves, allow room between the sheave and motor to get to capscrews "E".
5. Insert key "C" between the sheave and the shaft and tighten setscrew "A" securely.
6. If flange and locking ring have been removed, when replacing them make sure that the flange is open from the closed position by the same amount as the other flange. This can be determined by accurately measuring the top width of the grooves.
7. Insert key "F".
8. Tighten setscrews "D" and capscrews "E".
9. Put on belts and adjust belt tension. DO NOT FORCE BELTS OVER GROOVES (see "Drive Belt Adjustment," pages 14 and 15).
10. Be sure that all keys are in place and all setscrews and all capscrews are tight before starting the drive. Check and retighten all screws and retension belts after approximately 24 hours of service.

Adjusting:

1. Slack off belt tension if belts have been installed.
2. Loosen setscrews "D".
3. Loosen but DO NOT REMOVE capscrews "E".
4. Remove key "F". **Note:** This key projects a small amount to provide a grip for removing.
5. Adjust pitch diameter by opening or closing the movable flanges by half or full turns. **Note:** Two-groove sheaves are supplied with both grooves set at the same pitch diameter. BOTH MOVABLE FLANGES MUST BE MOVED THE SAME NUMBER OF TURNS TO INSURE THE SAME PITCH DIAMETER FOR SATISFACTORY OPERATION. DO NOT OPEN SHEAVES MORE THAN FIVE TURNS FOR "A" BELTS OR SIX TURNS FOR "B" BELTS.
6. Replace key "F".
7. Tighten setscrews "D" and capscrews "E".
8. If belts have been installed, readjust belt tension. If belts have not been installed, install them and adjust belt tension. DO NOT FORCE BELTS OVER THE GROOVES (see "Drive Belt Adjustment," pages 14 and 15).
9. Be sure that all keys are in place and all setscrews and all capscrews are tight before starting the drive. Check and retighten all screws and retension belts after approximately 24 hours of operation.

Figure 20. "LVP" Type Sheave Adjustment



"5VS" VARIABLE SPEED SHEAVES (see Figure 21)

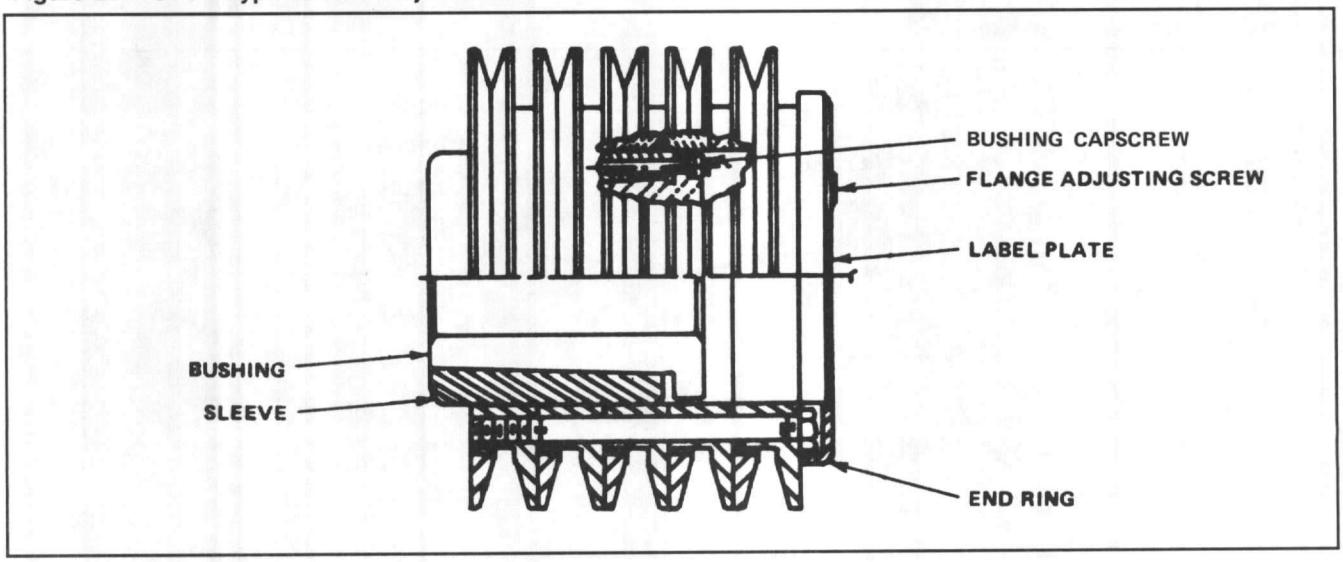
Mounting:

1. Use a small screwdriver or wedge to wedge the bushing apart far enough to achieve a sliding fit of the bushing on the motor shaft.
2. With the screwdriver still acting as a wedge, install the bushing loosely in the variable sheave.
3. Using the capscrews and lock washers provided, insert the screws through the drilled holes in the bushing and start to thread into the sleeve (see Figure 21). Do not use lubricant on the capscrews. Do not tighten.
4. Slide the bushing/sleeve assembly into place on the motor shaft with the bushing capscrews facing you.
5. Slide the shaft key into place.
6. Adjust the variable sheave to the approximate pitch diameter required. Each turn of the adjusting screws varies the pitch approximately 0.25 inches. Six complete turns are required to adjust from maximum to minimum pitch diameter.
7. Align the 5VS sheave with the companion sheave using the four-point method (see Figure 22). **NOTE:** Dimensions A, B, C and D must be equal for correct alignment.
8. Maintaining alignment, tap the bushing into the sheave until snug. Remove the screwdriver from the bushing.
9. Using a torque wrench, tighten the four bushing cap screws evenly and progressively to 35 ft-lbs.
10. Recheck the alignment. If a correction is required, remove the bushing from the companion sheave and move it accordingly.
11. Install and tension belts (see "Drive Belt Adjustment," pages 14 and 15).

Adjusting:

1. If a speed correction is required, stop the drive.
2. Remove the belts.
3. Remove the four bushing capscrews from the variable sheave. Install three of these screws into the threaded holes in the bushing flange and evenly jack the bushing from the sheeve. Remove these three screws and loosely intall all four into their original position.
4. Make the required pitch change by turning the adjusting screw.
5. Re-torque the bushing and install the belts (see "Drive Belt Adjustment," pages 14 and 15).

Figure 21. "5VS" Type Sheave Adjustment



"JVS" VARIABLE SPEED SHEAVES (see Figure 22)

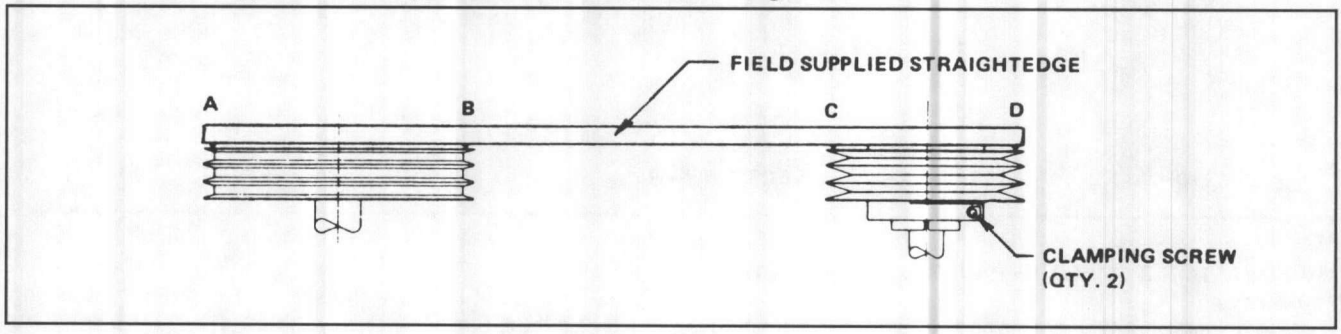
Mounting:

1. Loosen both clamping screws.
2. Adjust the JVS sheave to the approximate pitch diameter desired. One turn of the adjusting screw will vary the pitch diameter 0.2 inches. Seven turns are required to adjust the sheave from minimum to maximum pitch diameter.
3. Slide the JVS sheave on the shaft. **NOTE:** The central sleeve of the sheave is split at one end only. This end must be installed towards the motor as the split allows the sheave assembly to be secured to the shaft.
4. Align the JVS sheave with the companion sheave. This is most easily accomplished using the four-point method (see Figure 22). **NOTE:** Dimensions A, B, C and D must all be equal for correct alignment.
5. Torque the two clamp screws to these values: JVS130 — 160 in.-lbs. or 13 ft.-lbs; all others — 325 in.-lbs. or 27 ft.-lbs. **NOTE:** Be careful not to grasp flanges in such a manner as to cock them while tightening the clamp screws.
6. Install belts and properly tension (see "Drive Belt Adjustment," pages 14 and 15).
7. Start drive and check speeds.

Adjusting:

If a speed change is required, stop the drive, remove the belts, and loosen the two clamp screws. Adjust the pitch diameter of the sheave as required. Follow Steps 4 thru 7 above.

Figure 22. "JVS" Type Sheave Adjustment & General Sheave Alignment



DRIVE BELT ADJUSTMENT

Check drive for adequate run-in belt tension. Use the following procedure to determine the proper belt tension:

Step 1. Measure span length (t) in inches as shown in Figure 23.

Step 2. From Figure 23, the deflection height (h) is always 1/64" per inch of span length (t). For example, a 32" span length would require a deflection of 32/64" or 1/2".

Step 3. Determine the minimum and maximum recommended pounds force using Table 8.

Find the minimum recommended deflection force for the belt section and type based upon the small sheave diameter and drive ratio. For intermediate sheave diameters and/or drive ratio combinations, the minimum deflection force may interpolated.

Step 4. Using a spring scale, apply a perpendicular force to any ONE of the belts at the midpoint of the span as shown in Figure 23. Compare this deflection force with the values found in Step 3.

a. If the deflection force is below the minimum, the belts are too loose and the tension should be increased by increasing the center distance.

b. If the deflection force is higher than the maximum, the belts are too tight and the tension should be decreased.

When new V-belts are installed on a drive, the initial tension will drop rapidly during the first few hours. Check tension frequently during the first 24 hours of operation. Subsequent retensioning should fall between the minimum and maximum force.

To determine the deflection distance from normal position, use a straightedge or stretch a cord from sheave to sheave to use as a reference line. On multiple-belt drives an adjacent undeflected belt can be used as a reference.

Figure 23. Drive Belt Adjustment

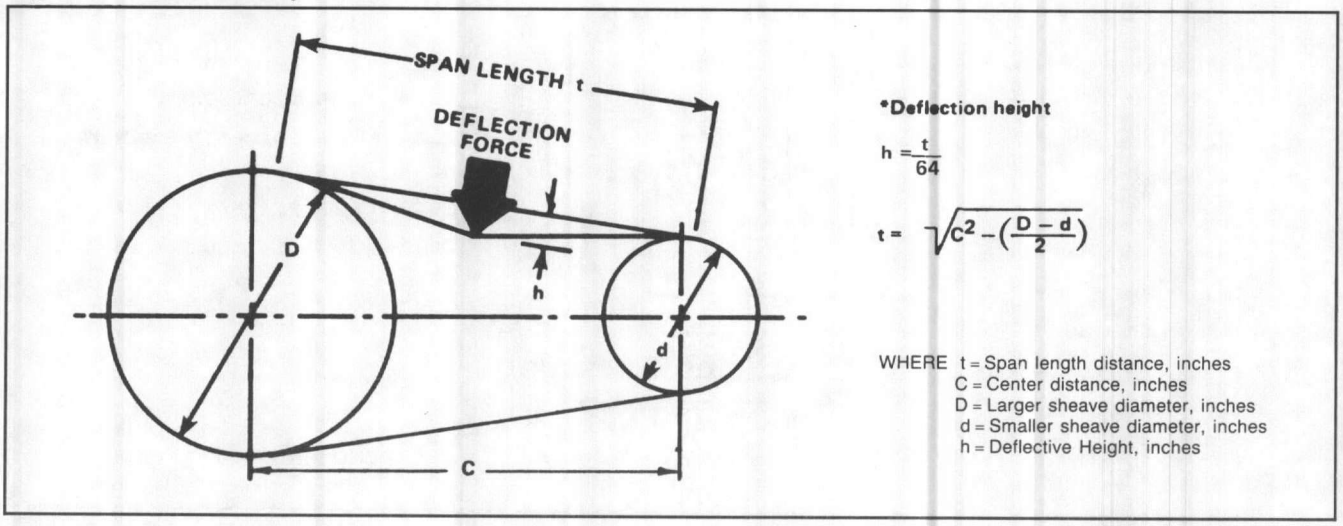


Table 8. Recommended pounds of force per belt

BELT SECTION	SMALL SHEAVE DIA. (IN.)	DRIVE RATIO			
		1.0 MIN.—MAX.	1.5 MIN.—MAX.	2.0 MIN.—MAX.	4.0 & OVER MIN.—MAX.
5VX	4.4	6.5— 9.8	7.6—11.4	8.0—12.0	9.0—13.5
	5.2	8.0—12.0	9.0—13.5	9.5—14.3	10.0—15.0
	6.3	9.5—14.3	10.0—15.0	11.0—16.5	12.0—18.0
	7.1	10.0—15.0	11.0—16.5	12.0—18.0	13.0—19.5
	9.0	12.0—18.0	13.0—19.5	14.0—21.0	15.0—22.5
	14.0	14.0—21.0	15.0—22.5	16.0—24.0	17.0—25.5
A	3.0	2.0— 3.0	2.3— 3.5	2.4— 3.6	2.6— 3.9
	4.0	2.6— 3.9	2.8— 4.2	3.0— 4.5	3.3— 5.0
	5.0	3.0— 4.5	3.3— 5.0	3.4— 5.1	3.7— 5.6
	7.0	3.5— 5.3	3.7— 5.6	3.8— 5.7	4.3— 6.5
B	4.6	3.7— 5.6	4.3— 6.5	4.5— 6.8	5.0— 7.5
	5.0	4.1— 6.2	4.6— 6.9	4.8— 7.2	5.6— 8.4
	6.0	4.8— 7.2	5.3— 8.0	5.5— 8.3	6.3— 9.5
	8.0	5.7— 8.6	6.2— 9.3	6.4— 9.6	7.2—10.8

WINTERIZING WATER COILS

Due to air stratification, failure of outdoor air dampers and/or preheat controls, coil freeze-up can occur. Routine draining of water cooling coils for winter shutdown cannot be depended on as insurance against freeze-up resulting in severe coil damage. It is recommended that all coils be drained as throughly as possible and then treated in the following manner.

Fill each coil independently with an anti-freeze solution using a small circulating pump and again thoroughly drain. Check freezing point of anti-freeze before proceeding to next coil. Due to a small amount of water always remaining in each coil, there will be a diluting effect. The small amount of anti-freeze solution remaining in coil must always be potent enough to prevent freeze-up.

Warning: Carefully read instructions for mixing anti-freeze solution used. Some products will have a high freezing point in its natural state than when mixed with water. THE FREEZING OF COILS IS NOT THE RESPONSIBILITY OF McQUAY.

APPLICATION RECOMMENDATION FOR COILS

OBSERVE ALL LOCAL CODES AND INDUSTRY STANDARDS

WATER COOLING COILS

1. Water supply, water return, drain and vent connections extend through the end panel of the coil section. All connections are labeled on the end panel.
2. Water supply and water return connections are male iron pipe.
3. When installing couplings, do not apply undue stress to the connection extending through unit panel. Use back-up pipe wrench to avoid breaking the weld between coil connection and header.
4. Follow recommendations of the control manufacturer regarding types, sizing and installation of controls.

DIRECT EXPANSION COILS

1. The coil distributor and suction connection extend through the end panel of the coil section.
2. Check nozzle in distributor for proper tonnage.
3. When a thermostatic expansion valve is supplied with the unit, it will be located outside the unit and connected directly to the distributor. Do not apply heat to the body of the expansion valve.
4. The thermostatic expansion valve must be of the external equalizer tube type. Connect the ¼-inch diameter external equalizer tube provided on the coil to connection on expansion valve.
5. Care should be exercised when piping up the system to be sure all joints are tight and all lines are dry and free of foreign material.
6. To be tight the system should hold a vacuum of 27 inches hg. overnight. A charge of FREON AND CO_2 should then be put in the system as a final check. System is then ready for charging.

STEAM COILS (Refer to Figure 24, page 17)

1. All steam coils in units are pitched toward return connection.
2. Steam supply and steam return connections are male iron pipe and are labeled on the end panel of coil selection. Connections extend through coil section end panel.
3. When installing couplings, do not apply undue stress to the connection extending through unit panel. Use a back-up pipe wrench to avoid breaking the weld between coil connection and header.
4. Support piping independently of coils and provide adequate piping flexibility. Stresses resulting from expansion of closely coupled piping can cause serious damage.
5. Do not reduce pipe size at the coil return connection. Carry return connection size through the dirt pocket, making the reduction at the branch leading to the trap.
6. It is recommended that vacuum breakers be installed on all applications to prevent retaining condensate in the coil. Generally, the vacuum breaker is to be connected between the coil inlet and the return main, as shown. However, for a system with a flooded return main, the vacuum breaker should be open to the atmosphere and the trap design should allow venting of large quantities of air.
7. Do not drip supply mains through the coil.
8. Do not attempt to lift condensate when using modulating or on/off control.
9. Size traps in accordance with manufacturers' recommendations. Be certain that the required pressure differential will always be available. DO NOT UNDERSIZE.

10. Float and thermostatic or bucket traps are recommended for low pressure steam. On high pressure steam, bucket traps are normally recommended. Thermostatic traps should be used only for air venting.
11. Bucket traps are recommended for use with on/off control only.
12. Locate traps at least 12 inches below the coil return connection.
13. Multiple coil installation.
    a. Each coil or group of coils that is individually controlled must be individually trapped.
    b. Coils in series: Separate traps are required for each coil, or bank of coils, in series.
    c. Coils in parallel: A single trap may generally be used but an individual trap for each coil is preferred.
    d. Do not attempt to lift condensate when using modulating or on/off control.
14. With coils arranged for series airflow a separate control is required on each bank or coil in the direction of airflow.
15. Modulating steam valves are not recommended on high pressure systems.
16. Modulating valves must be sized properly. DO NOT UNDERSIZE.
17. Freezing conditions (entering air temperatures below 35°F).
    a. 5JA, 8JA, 5RA and 8RA coils are definitely recommended.
    b. 5 psi steam must be supplied to coils at all times.
    c. Modulating valves are not recommended. Control should be by means of face and bypass dampers.
    d. Consideration should be given to the use of two or three coils in series with two position steam control valves on that coil or coils which will be handling 35°F, or colder, air. The desired degree of control can be attained with a modulating valve on the downstream coil.
    e. Provision should always be made to thoroughly mix fresh air and return air before it enters the coil. Also, temperature control elements must be properly located to obtain true air mixture temperatures.
    f. As additional protection against freeze-up, the trap should be installed sufficiently far below coil to provide an adequate hydrostatic head to ensure removal of condensate during an interruption in the steam pressure. Estimate 3 feet for each 1 psi of trap differential required.
    g. On startup, admit steam to coil ten minutes before admitting outdoor air.
    h. Provision must be made to close fresh air dampers if steam supply pressure falls below minimum specified.

WATER HEATING COILS

1. Water supply and water return connections extend through the end panel of the coil section. All connections are labeled on the end panel.
2. The drain and vent connections on the one and two row coils must be added to jobsite piping.
3. Water supply and water return connections are male iron pipe.
4. When installing couplings, do not apply undue stress to the connection extending through unit panel. Use a back-up pipe wrench to avoid breaking the weld between coil connection and header.
5. Follow recommendations of the control manufacturer regarding types, sizes and installation of control.
6. Hot water coils are not recommended for use with entering air below 40°F.
7. If fresh air and return air are to be heated by a hot water coil, care should be used in the design of the system to assure thorough mixing before air enters the coil.

FOR PREPARATION OF COILS FOR WINTER OPERATION, SEE PAGE 15.

FIELD INSTALLATION OR REMOVAL OF COILS

In all cases, the end panel of the coil section is removable. You should have access to both ends of the unit for ease of installation and proper positioning of baffles. The procedure outlined is for installation of coils. To remove coils, reverse the procedure.

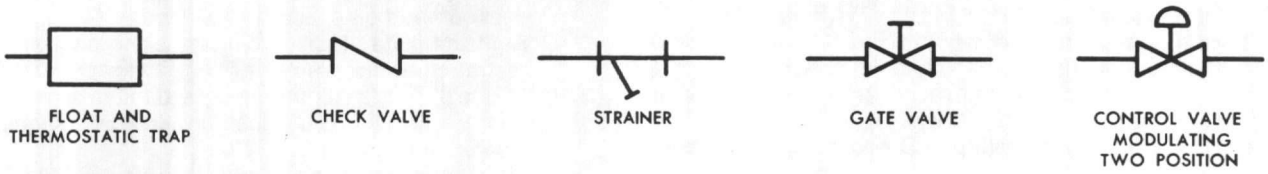
COOLING COILS

1. Models LSL/MSL-103 through 111 (Figure 25).
    a. Slide coil through opening in coil section onto bottom coil rests. Coil should be placed against baffles or existing coil in unit to prevent air bypass.
    b. Attach coil mounting angle to top coil rest and bolt header plates to bottom coil rest and coil mounting angle.
    c. Locate coil supply, return, vent and drain connections dimensionally and drill holes in end panels of unit. Holes should be located very carefully.
    d. Attach end panel to unit and slip grommets over connections to prevent air leakage.
2. Models LML/MMM-106 thru 111 (Figure 26).
    a. Slide coil through opening in coil section onto bottom coil rests. Coil should be placed against coil mounting angle at top and condensate shield at bottom.
    b. Coil is held in place with ¼-20 thread cutting screws through mounting angle and condensate shield into coil side plate.
    c. Locate coil supply, return, vent and drain connections dimensionally and drill holes in end panel of unit. Holes should be located very carefully.
    d. Attach end panel to unit and slip grommets over coil connections to prevent air leakage.

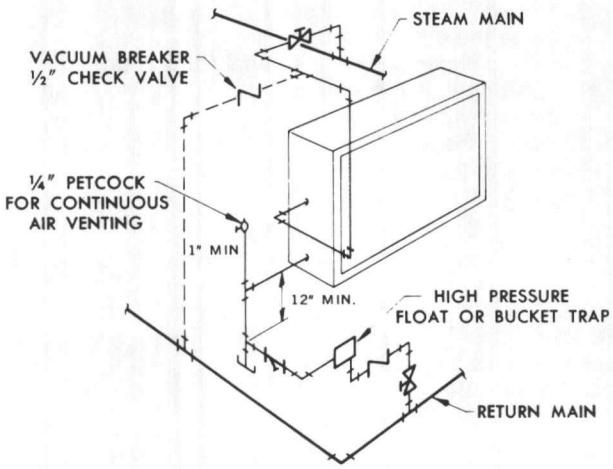
HEATING COILS, WATER

1. Models LSL/MSL-103 thru 111 H & V (Figure 25). Follow procedure as outlined for cooling coils above.
2. Models LML/MMM-106 thru 111 (Figure 27).
    a. Slide coil into place.
    b. Bolt coil header plate to coil rests in unit.
    c. Locate coil supply, return, vent and drain connections dimensionally and drill holes in end panel of unit. Holes should be located very carefully.
    d. Attach end panel to unit and slip grommet over coil connections to prevent air leakage.

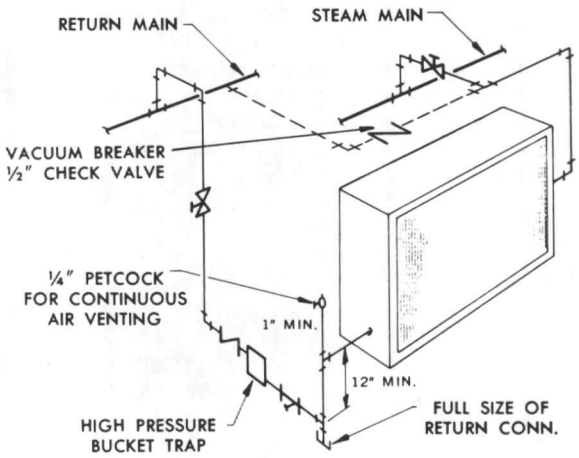
FIGURE 24.
Piping Arrangements



HIGH PRESSURE (OVER 25 PSI)

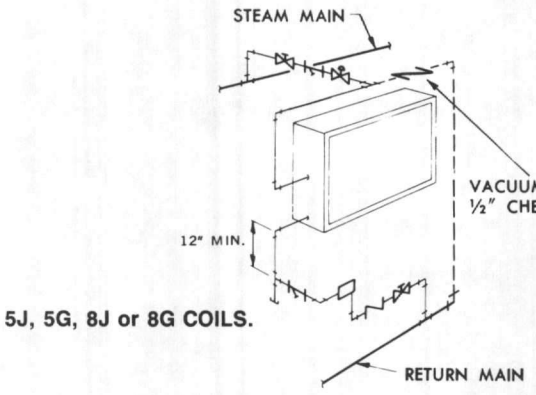


5GA or 8GA COILS. Note the addition of a vacuum breaker to permit the coil to drain during shutdown.

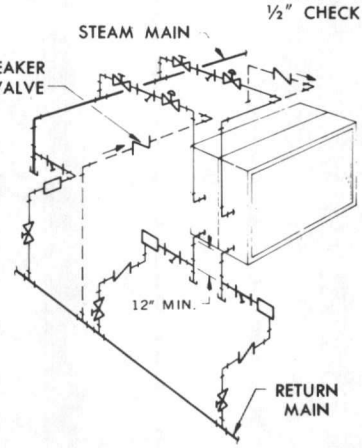


5TA, 8TA, 5HA or 5HB COILS. Condensate is lifted to overhead return main.

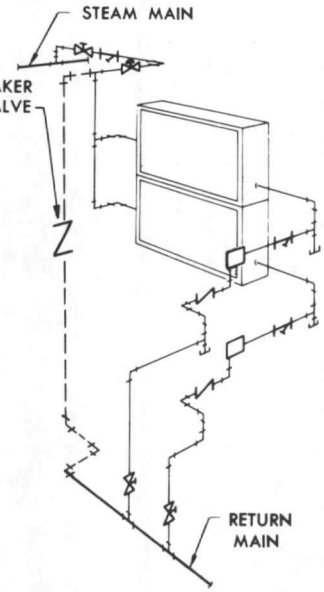
LOW PRESSURE (TO 25 PSI)



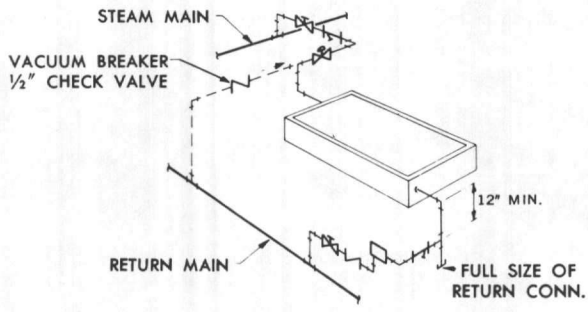
5J, 5G, 8J or 8G COILS.



5JA or 8JA COIL. Installed in series. Note that each coil must have a separate control valve and trap.



5RA, 8RA, 5SA or 5SB COILS. Banked two high. Individual trapping of each coil as shown is preferred.



5RA, 8RA, 5SA, or 5SB COILS. Installed for vertical airflow.

HEATING COILS, STEAM

Since coils are pitched in units, it is necessary to keep unit level to allow proper condensate drainage.

1. Models LSL/MSL-103 thru 111 H & V (Figure 28).
   a. Bolt parts C and D to bottom coil rest in unit. Holes in the coil rest that are used should be selected so the coil will be as close as possible to baffles or existing coil in unit.
   b. Slide coil into unit with part D hooked into flanges of bottom side plate of coil.
   c. Lift up coil so it rides over part C and slide coil in until the return connection end drops down. Part C provides adequate pitch and should be on end of coil opposite the return connection.
   d. Bolt parts A and B to top coil rests in unit with $^{5}/_{16}$-inch bolts and nut clips.
   e. Locate dimensionally the supply and return connections and drill holes in end panels for connections. Holes should be located very carefully.
   f. Attach end panels to unit and slip grommets over connections to prevent air leakage.
2. Models LML/MMM-106 thru 111 (Figure 27).
   a. Slide coil into unit.
   b. Place spacer under coil at end opposite the return connection and bolt spacer to coil rest.
   c. Bolt side plate of coil to spacer at one end, and coil rest at other end.
   d. Locate dimensionally the supply and return connections and drill holes in end panel of unit. Holes should be located very carefully.
   e. Attach end panels to unit and slip grommets over connections to prevent air leakage.

HEATING COILS, STEAM & WATER SEASONVENT UNITS

1. The 1 and 2 row coils are uncased coils.
2. Slide coil slab into coil section. There are fin channels to guide the coil through the section.
3. Locate dimensionally the supply and return connections and drill holes in end panels of unit. Holes should be located very carefully.
4. Attach end panels to unit and slip grommets over connections to prevent air leakage.

FIGURE 25
Coil Mounting Procedure for 5W & 5E Coils
LSL/MSL-103 thru 111 Horizontal and Vertical Units

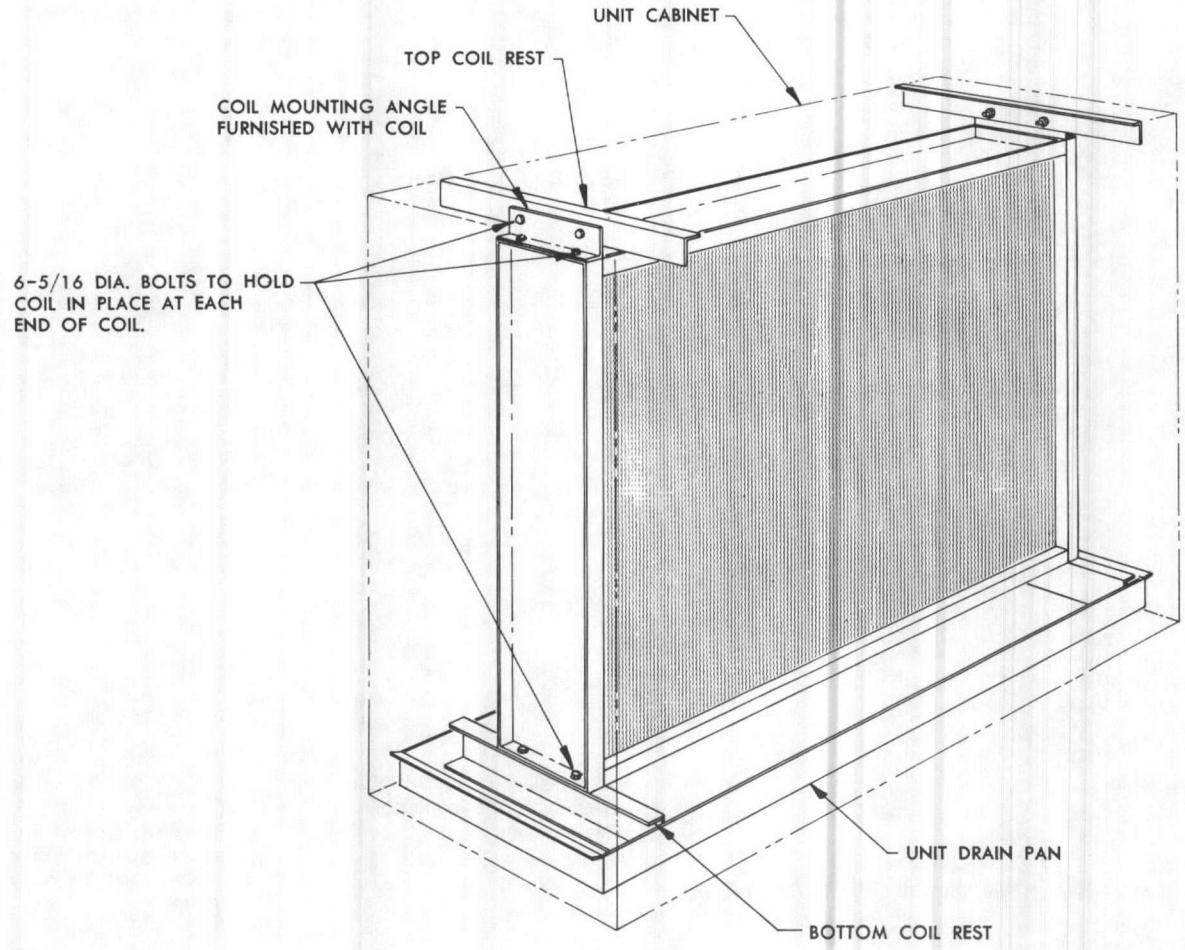


FIGURE 26
Coil Mounting Procedure for 5W & 5E Coils
LML/MMM-106 thru 111

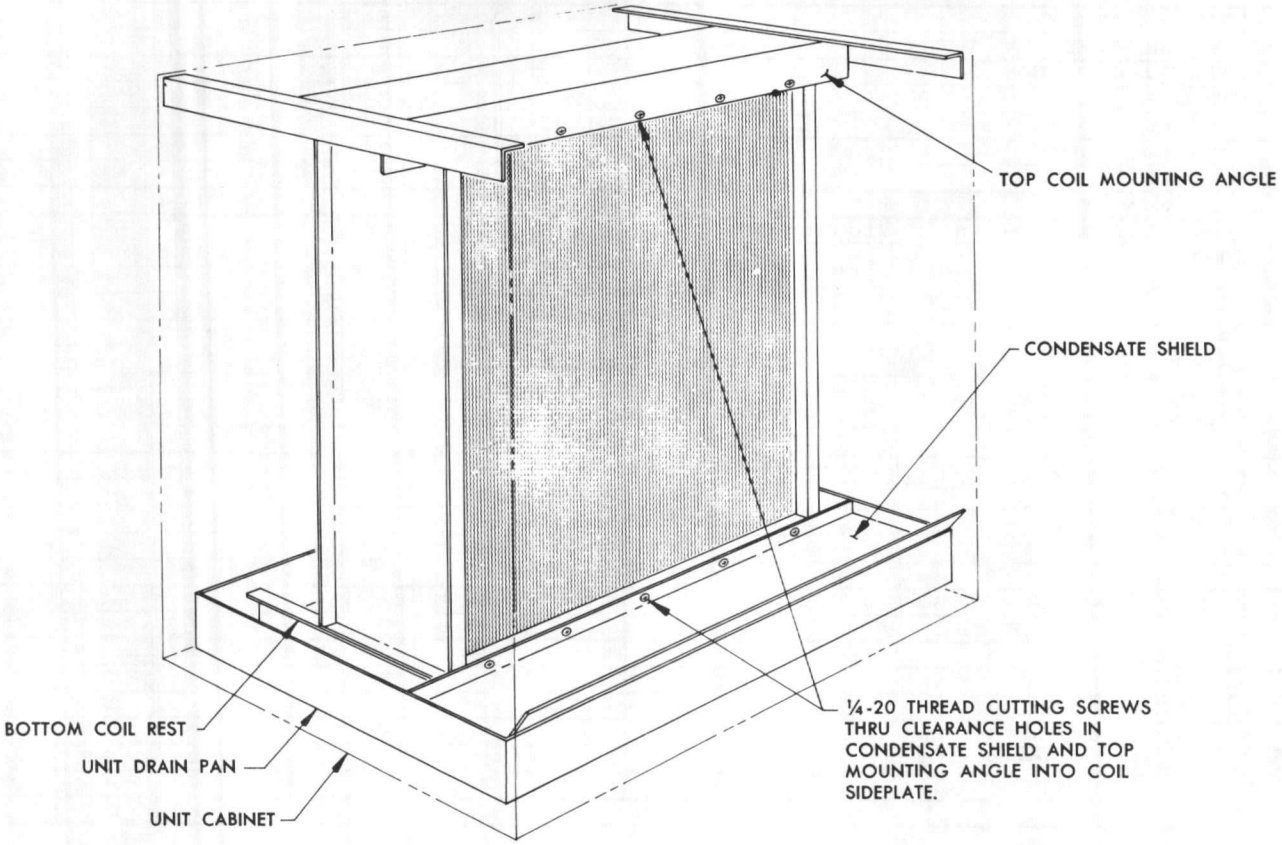
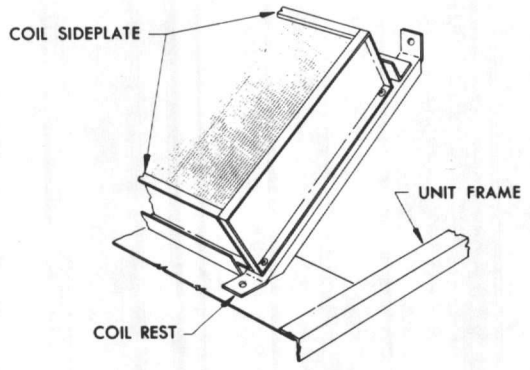
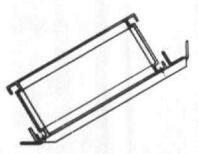


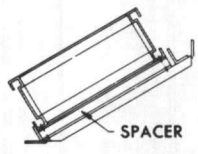
FIGURE 27
LML/MMM Heating Coil



LML-MMM WATER HEATING COILS

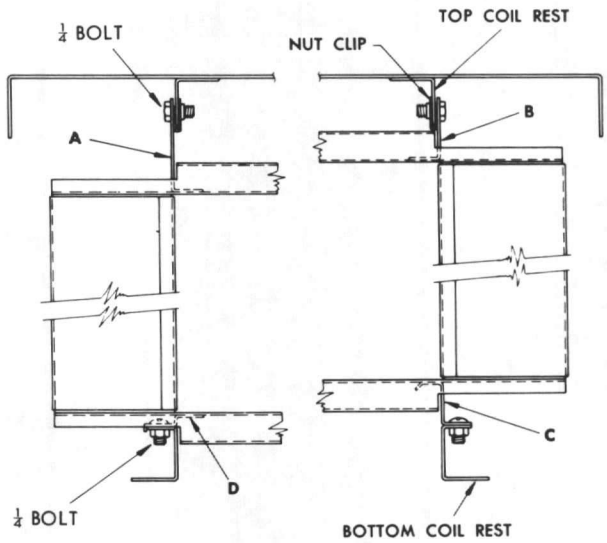


RETURN END OF LML-MMM STEAM HEATING COIL



LML-MMM STEAM HEATING COILS, SPACER OPPOSITE RETURN END OF COIL

FIGURE 28
LSL/MSL Heating Coil



APPROXIMATE SHIPPING WEIGHTS

DESCRIPTION	UNIT SIZE						
	103	104	106	206	108	209	111
BLOWER SECTION	144	175	260	330	396	430	459
BLOW-THRU COIL SECTION	—	—	411	—	453	—	531
DRAW-THRU COIL SECTION							
VERTICAL	135	145	171	—	230	—	278
HORIZONTAL	108	120	142	—	144	—	176
HEATING COIL SECTION							
1 & 2 ROW	52	59	72	79	81	93	93
ZONE DAMPER SECTION	—	—	110	—	119	—	147
HEATING AND COOLING COILS (LFA) — ALUMINUM FINS							
1 ROW	13	21	29	31	38	42	48
2 ROWS	22	30	45	48	58	66	76
3 ROWS	28	39	61	—	84	—	108
4 ROWS	35	49	76	—	104	—	135
5 ROWS	42	58	91	—	124	—	161
6 ROWS	49	68	106	—	144	—	187
8 ROWS	63	87	136	—	184	—	239
10 ROWS	76	106	165	—	225	—	292
BLOW-THRU HEATING COILS — ALUMINUM FINS							
1 ROW	—	—	20	—	25	—	32
2 ROWS	—	—	29	—	37	—	50
3 ROWS	—	—	38	—	50	—	67
4 ROWS	—	—	47	—	62	—	83
COMBINATION ANGULAR FILTER MIXING BOX	155	214	281	310	330	400	426
VERTICAL ANGULAR FILTER & BASE	163	225	295	326	346	420	446
FLAT FILTER SECTION	39	49	62	78	86	96	118
ANGULAR FILTER SECTION	90	109	150	165	188	215	231
HEAVY-DUTY FILTER SECTION	—	—	—	—	—	250	253
INTERNAL FACE & BYPASS SECTION	39	51	65	70	75	90	102
EXTERNAL FACE AND BYPASS SECTION	69	86	114	132	152	172	221
ACCESS & SPACER SECTION	61	69	81	91	89	105	107
MIXING BOX ONLY	122	133	162	182	203	240	274

MOTOR WEIGHTS
Standard Open Drip-proof, 1800 rpm

MOTOR HP	¼	⅓	½	¾	1	1½	2	3	5	7½	10	15
NEMA FRAME	48	48	56	56	143T	145T	145T	182T	184T	213T	215T	254T
MOTOR WEIGHT	17	22	32	32	39	48	48	75	91	126	150	225

McQuay Air Conditioning

INSTALLATION AND MAINTENANCE DATA

BULLETIN NO. IM 218-3
MAY, 1987
FORM 380571Y REV. D

HORIZONTAL FAN-COIL UNITS TYPES TSH, TCH & TSC

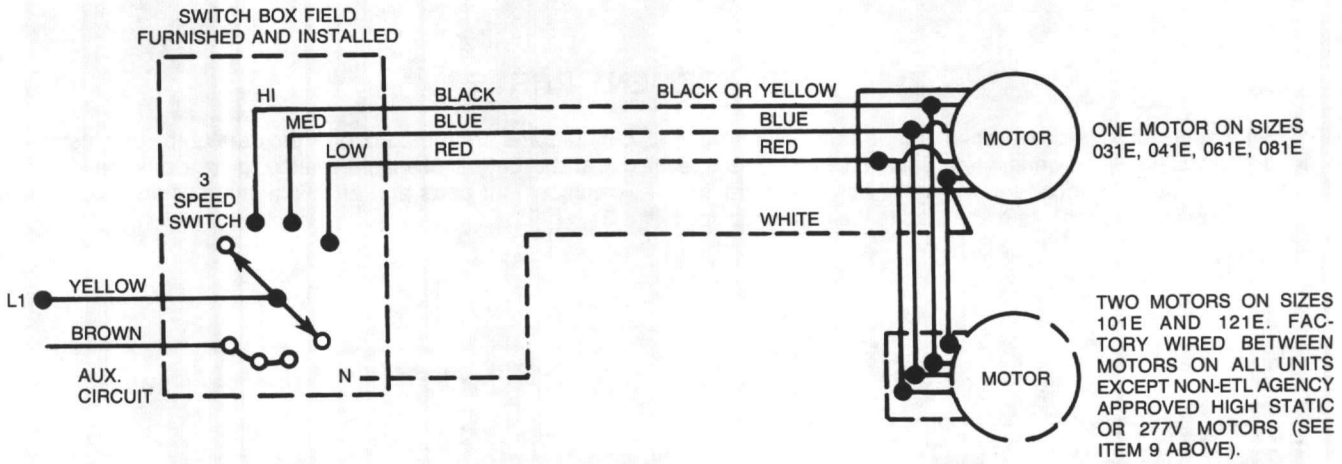
GENERAL NOTES

1. Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment.
   CAUTION: Sharp edges, coil surfaces and rotating fans are a potential injury hazard. Avoid contact.
2. Maximum entering water temperature is 200°F.
3. Units provided with electric heat are for use with chilled water only as the cabinet could exceed code limits with hot water in the coil.
4. Completed installation of TSH units must comply with the requirements of NFBA 90B with regard to the use of concealed ceiling spaces as return air plenums.
5. When return air duct is not provided, applicable codes may limit installation to a single story residence.

INSTALLATION

1. Examine unit for shipping damage.
2. Rotate fan wheels by hand to make sure the wheels rotate freely.
3. Unit is ready for installation.
4. Secure unit in proper position. Unit must be level to assure proper drainage and operation. If hanger rods are used, "back-up" nuts should be put on the rods to prevent loosening.
5. Water and drain connections can now be made to the unit. Piping must be installed in accordance with local codes and regulations.
   The drain pan has two connections; be sure to solder the tube cap over the drain not used. The tube cap is attached to the unit.
6. Vent the coils.
7. All water and drain lines should be well insulated to prevent sweating and heat loss.
8. If a secondary drain pan is supplied (optional), fasten it to the main pan with the two sheetmetal screws that have been provided.
9. Electrical connections can now be made to the motor or junction box (if furnished). The installer shall provide wiring to the unit, branch circuit overcurrent protection, and disconnect means to conform with the applicable electrical code. Care should be taken to route wiring through knockouts if optional field installed plenum is used. Motor is "thermally protected." Non-ETL Agency approved high static and 277 volt motors on unit sizes 101E and 121E are not factory wired together. These motors are provided with 3/8" electrical conduit fittings in lieu of junction boxes on the motors.
10. All windows and doors should be in and closed before starting up the unit.
11. During summer construction, there is an unusually high amount of moisture in the air; therefore, the initial pulldown should be very gradual (high speed for maximum airflow with reduced gpm and elevated chilled water temperature for reduced capacity). If this is done, it will reduce the possibility of the unit sweating.

WIRING DIAGRAM



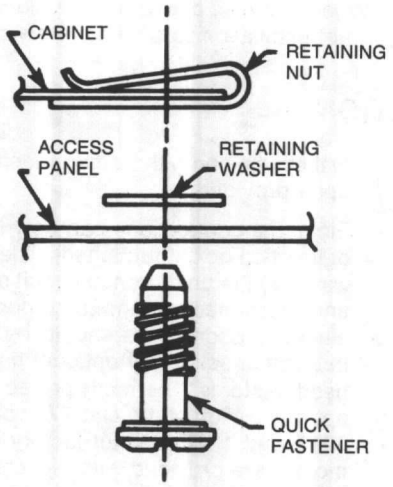
PLENUM SECTION FOR TSH UNITS

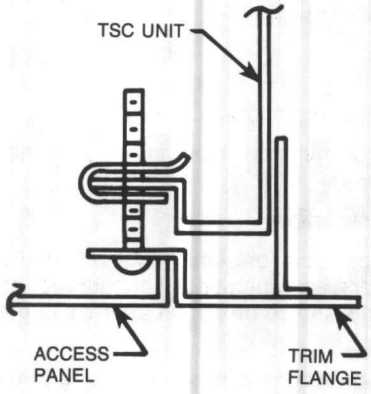
The plenum section may be shipped unmounted for field installation. The plenum can be mounted prior to installing the unit as follows:

1. Arrange for proper air intake. To change from back return to bottom return air, interchange the bottom panel and the duct flange.
2. Remove the appropriate knockouts for electrical and hanging (½″ hanging rods).
3. Hook the plenum section flange over the top edge of the fan deck and fasten the plenum section to the end baffle with sheetmetal screws.
4. Filters are removable through the air inlet, bottom or sides of the plenum.

TSC AND TCH UNITS

1. To hang the unit, first remove the bottom access panels by loosening the screws. Care should be taken so that the hinges do not damage the panels.
2. The unit can be hung from the ⅝″ diameter holes in each corner of the cabinet. If hanger rods are used, ''back-up'' nuts should be put on the rods to prevent loosening.
3. Follow the same procedure for installing the unit as described on the front page.
4. Attach the bottom and access panels to the cabinet. The access panel grille must be located under the fan housings. Care should be taken in handling the panels.
5. If a TCH trim flange has been furnished, attach it to the cabinet as shown below. The bottom and access panels are then attached to the trim flange with the return air grille below the fan housings.





MAINTENANCE

1. The motor has been oiled at the factory. It is not necessary to oil the first year when under continuous operation (approximately 10,000 hours). Oil once a year with 5cc (1 teaspoon) per bearing of SAE-20 non-detergent oil. DO NOT OVERLUBRICATE.
2. If motor service is required remove it in the following manner:
   a. Disconnect all electrical power to the unit. The ''off'' position on the fan control may not open all ungrounded supply circuit conductors.
   b. Remove motor drip pan.
   c. Remove bottom half of the fan housing.
   d. Remove the clamps that hold the motor in the motor base.
   e. Remove the motor.

REPLACEMENT PARTS

When writing for service or replacement parts, direct your letters to McQuay Air Conditioning Service Department and refer to the model number and the serial number of the unit as stamped on the serial plate attached to the unit. If replacement parts are required, give the date of the unit installation and the date of the failure; also, give a description of the replacement parts and an explanation of the malfunction.

McQuay
Air Conditioning

INSTALLATION AND MAINTENANCE DATA

BULLETIN NO. IM 268-4
JUNE,1986
FORM NO. 476505Y

SEASONPAK
Packaged air cooled water chiller

Models ALR-040C thru -195C

McQuay
SnyderGeneral Corporation
13600 Industrial Park Blvd., P.O. Box 1551, Minneapolis, MN 55440

TABLE OF CONTENTS

IMPORTANT

See freeze protection references under the heading "Water Piping" and heat recovery sections on page 6.

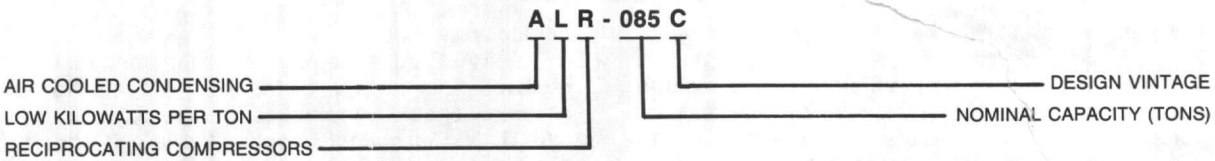
INTRODUCTION

GENERAL DESCRIPTION

McQuay type ALR SEASONPAK air cooled water chillers are complete, self-contained automatic refrigerating units that include the latest in engineered components arranged to provide a compact and efficient unit. Each unit is completely assembled and factory wired before evacuation, charging and testing, and comes complete and ready for installation. Each unit consists of twin air cooled condensers with integral subcooler sections, multiple accessible hermetic compressors, replaceable tube dual circuit shell-and-tube evaporator, and complete refrigerant piping. Liquid line components that are included are manual liquid line shutoff valves, charging valves, filter-driers, liquid line solenoid valves, sightglass/moisture indicators, and double diaphragm hydraulic element thermal expansion valves. Other features include compressor crankcase heaters, an evaporator heater for chilled water freeze protection, recycling pumpdown during "on" or "off" seasons, compressor lead-lag switch to alternate the compressor starting sequence, and sequenced starting of compressors.

The electrical control center includes all safety and operating controls necessary for dependable automatic operation. Condenser fan motors are fused in all three conductor legs and started by their own three-pole contactors. Compressors are not fused but may be protected by optional circuit breakers, or by field installed fused disconnect for protection.

NOMENCLATURE



INSPECTION

When the equipment is received, all items should be carefully checked against the bill of lading to insure a complete shipment. All units should be carefully inspected for damage upon arrival. All shipping damage should be reported to the carrier and a claim should be filed. The unit serial plate should be checked before unloading the unit to be sure that it agrees with the power supply available. Physical damage to unit after acceptance is not the responsibility of McQuay.

NOTE: Unit shipping and operating weights are available in the physical data tables 4 & 5, pages 9 and 10.

INSTALLATION

NOTE: Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. CAUTION: Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

HANDLING

Care should be taken to avoid rough handling or shock due to dropping the unit. Do not push or pull the unit from anything other than the base, and block the pushing vehicle away from the unit to prevent damage to the sheetmetal cabinet and end frame (see Figure 1).

Never allow any part of the unit to fall during unloading or moving as this may result in serious damage.

To lift the unit, 2½" diameter lifting holes are provided in the base of the unit. Spreader bars and cables should be arranged to prevent damage to the condenser coils or unit cabinet (see Figure 2).

Figure 1. Suggested Pushing Arrangement

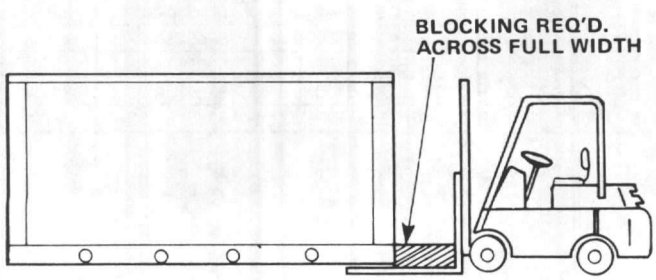
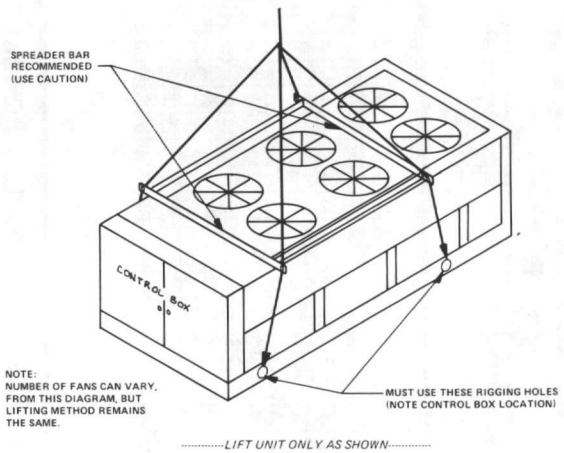


Figure 2. Suggested Lifting Arrangement

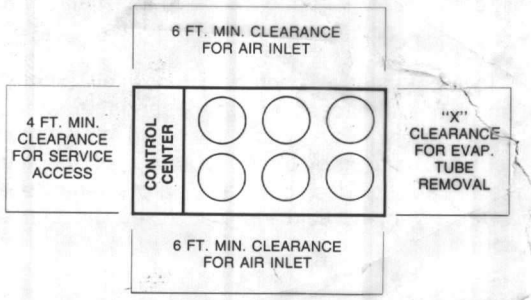


LOCATION

Care should be taken in the location of the unit to provide proper airflow to the condenser, minimizing effects on condensing pressure.

Minimizing clearances as shown in Figure 3 will prevent most discharge air recirculation to the condenser which will have a significant effect on unit performance.

Figure 3. Clearance Requirements



NOTES:
(1) Minimum clearance between units is 12 feet.
(2) Units must not be installed in a pit that is deeper than the height of the unit.
(3) Minimum clearance on each side is 12 feet when installed in a pit.

ALR UNIT SIZE	"X" DIMENSION
ALR-040C thru 095C	8 Ft. Minimum
ALR-105C thru 195C	10 Ft. Minimum

SERVICE ACCESS

Each end of the unit must be accessible after installation for periodic service work. Compressors, filter driers, and manual liquid line shutoff valves are accessible on each side of the unit adjacent to the control box. High pressure, low pressure, and motor protector controls are on the compressor. Freezestats and cooler barrel thermostat are near the cooler. Most other operational, safety and starting controls are located in the unit control box.

On all ALR units the condenser fans and motors can be removed from the top of the unit. A complete fan/motor assembly should be removed for service.
CAUTION: *Disconnect all power to the unit while servicing condenser fan motors.*

VIBRATION ISOLATORS

Vibration isolators are recommended for all roof mounted installations or wherever vibration transmission is a consideration. Table 1 lists spring isolators for all ALR unit sizes. Figure 4 shows isolator locations in relation to the unit control center. Figure 5 gives dimensions that are required to secure each McQuay isolator selection to the mounting surface. Table 3 shows the isolator loads at each location shown in Figure 4, and the maximum loads for each McQuay selection are shown in Table 2.

Table 1. Vibration Isolators (Spring)

ALR UNIT SIZE	ISOLATOR LOCATIONS					
	1	2	3	4	5	6
WITHOUT HEAT RECOVERY CONDENSERS						
040C	CP1-28	CP1-28	CP1-28	CP1-28	CP1-28	CP1-28
050C	CP1-31	CP1-31	CP1-31	CP1-31	CP1-31	CP1-31
060C	CP1-31	CP1-31	CP1-31	CP1-31	CP1-31	CP1-31
065C	CP1-32	CP1-32	CP1-32	CP1-32	CP1-32	CP1-32
075C	CP1-32	CP1-32	CP1-32	CP1-32	CP1-32	CP1-32
085C	CP2-27	CP2-27	CP2-26	CP2-27	CP2-27	CP2-26
095C	CP2-27	CP2-27	CP2-27	CP2-27	CP2-27	CP2-27
105C	CP2-28	CP2-28	CP2-31	CP2-28	CP2-28	CP2-31
115C	CP2-28	CP2-28	CP2-31	CP2-28	CP2-28	CP2-31
125C	CP2-31	CP2-31	CP2-31	CP2-31	CP2-31	CP2-31
145C	CP2-31	CP2-31	CP2-31	CP2-31	CP2-31	CP2-31
155C	CP2-31	CP2-31	CP2-32	CP2-31	CP2-31	CP2-32
175C	CP2-32	CP2-32	CP2-32	CP2-32	CP2-32	CP2-32
195C	CP2-32	CP2-32	CP2-32	CP2-32	CP2-32	CP2-32
WITH HEAT RECOVERY CONDENSER						
040C	CP1-31	CP1-31	CP1-31	CP1-31	CP1-31	CP1-31
050C	CP2-27	CP1-31	CP2-27	CP2-26	CP2-26	CP2-26
060C	CP2-27	CP2-27	CP2-28	CP2-32	CP2-32	CP2-27
065C	CP2-28	CP2-28	CP2-28	CP2-27	CP2-27	CP2-27
075C	CP2-28	CP2-28	CP2-28	CP2-27	CP2-27	CP2-27
085C	CP2-28	CP2-28	CP2-28	CP2-27	CP2-27	CP2-27
095C	CP2-31	CP2-31	CP2-31	CP2-28	CP2-28	CP2-28
105C	CP4-26	CP4-26	CP4-27	CP4-28	CP4-28	CP4-26
115C	CP4-26	CP4-26	CP4-26	CP4-28	CP4-32	CP4-27
125C	CP2-32	CP2-32	CP2-27	CP2-26	CP2-26	CP2-26
145C	CP2-32	CP2-32	CP2-27	CP2-26	CP2-26	CP2-32
155C	CP2-32	CP2-32	CP2-28	CP2-26	CP2-26	CP2-27
175C	CP4-28	CP4-28	CP4-28	CP4-32	CP4-27	CP4-27
195C	CP4-28	CP4-28	CP4-28	CP4-27	CP4-27	CP4-27

Table 2. Spring Flex Isolators

TYPE	COLOR	McQUAY PART NO.	MAX. LOAD EACH (LBS.)
CP1-25	RED STRIPE	477927A-25	450
CP1-26	2-WHITE STRIPES	477927A-26	600
CP1-27	ORANGE STRIPE	477927A-27	750
CP1-28	GREEN STRIPE	477927A-28	900
CP1-31	2 YELLOW STRIPES	477927A-31	1100
CP1-32	WHITE STRIPE	477927A-32	1300
CP2-25	RED STRIPE	477929A-25	900
CP2-26	2 WHITE STRIPES	477929A-26	1200
CP2-27	ORANGE STRIPE	477929A-27	1500
CP2-28	GREEN STRIPE	477929A-28	1800
CP2-31	2 YELLOW STRIPES	477929A-31	2200
CP2-32	WHITE STRIPE	477929A-32	2600
CP4-26	2 WHITE STRIPES	580513A-26	2400
CP4-27	ORANGE STRIPE	580513A-27	3000
CP4-28	GREEN STRIPE	580513A-28	3600
CP4-31	2 YELLOW STRIPES	580513A-31	4400
CP4-32	WHITE STRIPE	580513A-32	5200

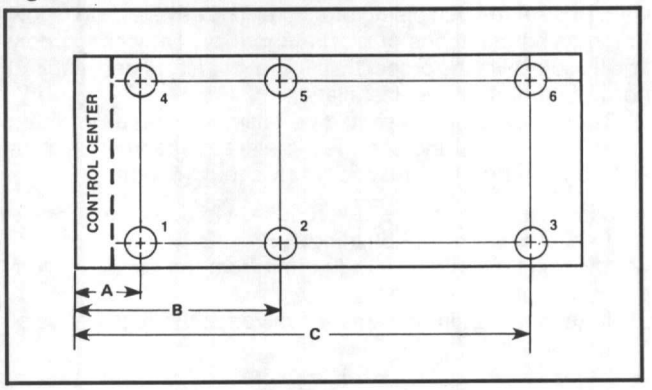
NOTE: All gray color with noted striping.

Table 3. Isolator Loads

ALR UNIT SIZE	ISOLATOR LOADS AT EACH MOUNTING LOCATION (LBS.)					
	1	2	3	4	5	6
WITHOUT HEAT RECOVERY CONDENSERS						
040C	677	677	677	677	677	677
050C	775	769	755	775	769	755
060C	810	804	789	810	804	789
065C	953	924	823	953	924	823
075C	1020	989	882	1020	989	882
085C	1086	1088	874	1086	1088	874
095C	1184	1136	967	1184	1136	967
105C	1184	1190	1483	1184	1140	1483
115C	1313	1329	1693	1313	1329	1693
125C	1367	1447	1727	1367	1447	1727
145C	1374	1461	1762	1374	1461	1762
155C	1552	1584	2005	1552	1584	2005
175C	2014	1931	1773	2014	1931	1773
195C	2076	1974	1779	2076	1974	1779
WITH HEAT RECOVERY CONDENSER						
040C	733	747	778	753	768	800
050C	916	965	1080	760	801	896
060C	1004	1016	1253	807	827	1010
065C	1244	1234	1200	1024	1016	988
075C	1294	1284	1249	1066	1058	1029
085C	1391	1357	1236	1156	1127	1027
095C	1537	1523	1472	1226	1214	1173
105C	1585	1625	2105	1278	1273	1688
115C	1739	1781	2303	1426	1419	1879
125C	1821	1895	2312	1450	1617	1864
145C	1835	1925	2373	1478	1598	1923
155C	2098	2035	2710	1679	1711	2196
175C	2357	2452	2633	1874	2155	2141
195C	2422	2496	2636	2014	2057	2192

NA = Not Available

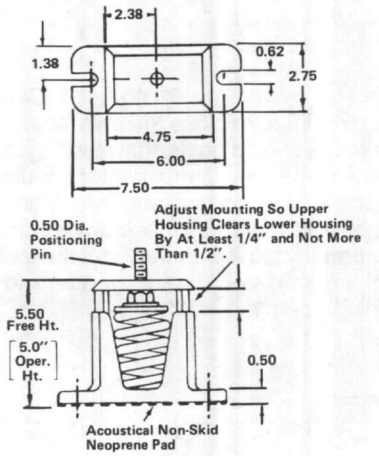
Figure 4. Isolator Locations



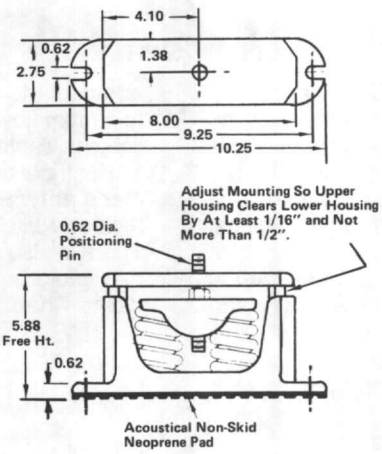
ALR UNIT SIZE	VIBRATION MOUNT LOCATION DIMENSIONS (INCHES)		
	A	B	C
040C	13	43	109
050C	13	58	162
060C	13	58	162
065C	13	58	215
075C	13	58	215
085C	13	58	215
095C	13	58	215
105C	13	58	215
115C	13	58	215
125C	13	58	215
145C	13	58	215
155C	13	58	215
175C	13	58	250
195C	13	58	250

Figure 5. Spring Isolators

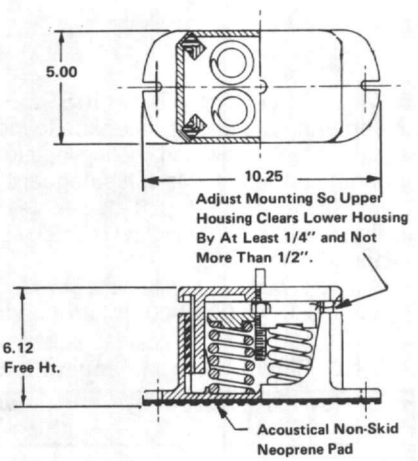
Ordering No. 477927A-25 thru 477927A-32



Ordering No. 477929A-25 thru 477929A-32



Ordering No.580513A-26 thru 580513A-32



WATER PIPING

Due to the variety of piping practices, it is advisable to follow the recommendations of local authorities. They can supply the installer with the proper building and safety codes required for a safe and proper installation.

Basically, the piping should be designed with a minimum number of bends and changes in elevation to keep system cost down and performance up. It should contain:

1. Vibration eliminators to reduce vibration and noise transmission to the building.
2. Shutoff valves to isolate the unit from the piping system during unit servicing.
3. Manual or automatic air vent valves at the high points of the system.
4. Some means of maintaining adequate system water pressure (e.g., expansion tank or regulating valve).
5. Temperature and pressure indicators located at the unit to aid in unit servicing.
6. A strainer or some means of removing foreign matter from the water before it enters the pump. It should be placed far enough upstream to prevent cavitation at the pump inlet (consult pump manufacturer for recommendations). The use of a strainer will prolong pump life and thus keep system performance up.
7. The shell-and-tube cooler has a thermostat and heating cable to prevent freeze-up down to – 20°F. It is suggested that the heating cable be wired to a separate 110V supply circuit, but it is factory wired to the control circuit. Any water piping to the unit must also be protected to prevent freezing.

   CAUTION: *If a separate disconnect is used for the 110V supply to the cooler heating cable, it should be clearly marked so that it is not accidentally shut off during cold seasons.*

Prior to insulating the piping and filling the system, a preliminary leak check should be made.

Piping insulation should include a vapor barrier to prevent moisture condensation and possible damage to the building structure. It is important to have the vapor barrier on the outside of the insulation to prevent condensation within the insulation on the cold surface of the pipe.

WATER COOLED CONDENSER FREEZE PROTECTION

CAUTION: *Condenser freeze protection is not provided with heat recovery units.*

If freeze protection is required, it can be accomplished in one of the following ways:

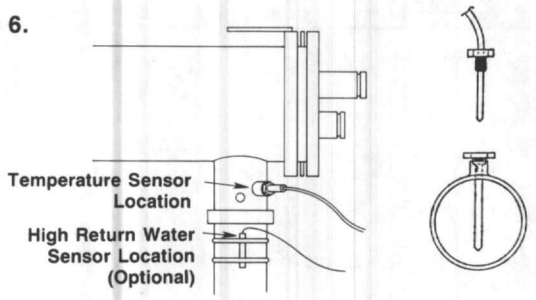
1. Wrap condenser and condenser water piping with heat tape and insulate.
2. Circulate warm water through condenser during freeze conditions.
3. Use an ethylene glycol solution in the condenser circuit.

CHILLED WATER THERMOSTAT

The chilled water thermostat is mounted inside the unit control center. To prevent damage to the thermostat sensor and wiring it is coiled up and taped to the bottom of the control box and must be field installed. Bring the sensor through the back of the control box and install in the return water connection of the cooler (Figure 6). The wiring should be routed and secured so it does not interfere with the operation or service of the unit.

CAUTION: *Care should be taken not to wipe off the heat conducting compound on the thermostat sensing bulb when removing it from the well to install it.*

Figure 6.



FLOW SWITCH

A WATER FLOW SWITCH MUST BE MOUNTED in either the entering or leaving water line to insure that there will be adequate water flow and cooling load to the evaporator before the unit can start. This will safeguard against slugging the compressors on startup. It also serves to shut down the unit in the event that water flow is interrupted to guard against evaporator freeze-up.

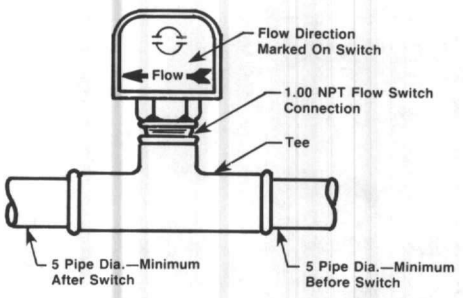
A flow switch is available from McQuay under ordering number 860-175033B-00. It is a "paddle" type switch and adaptable to any pipe size from 1″ to 6″ nominal. Certain minimum flow rates are required to close the switch and are listed in Table 3. Installation should be as shown in Figure 7.

Electrical connections in the unit control center should be made at terminals 5 and 6. The normally open contacts of the flow switch should be wired between these two terminals. There is also a set of normally closed contacts on the switch that could be used for an indicator light or an alarm to indicate when a "no flow" condition exists.

Table 3. Flow Switch Minimum Flow Rates

NOMINAL PIPE SIZE (INCHES)	MINIMUM REQUIRED FLOW TO ACTIVATE SWITCH (GPM)
1	6.00
1¼	9.80
1½	12.70
2	18.80
2½	24.30
3	30.00
4	39.70
5	58.70
6	79.20

Figure 7.



WATER CONNECTIONS

Water pipng to the cooler can be brought up from the botton of the unit or through the side between the vertical suports. The optional heat recovery condensers can be piped up from the bottom or the end of the unit. Figures 8 and 9 give the necessary dimensions and locations for all piping connections.

NOTE: ON UNIT SIZES 175C AND 195C , THERE IS A DIAGONAL BRACE OFF OF A VERTICAL SUPPORT WHICH WILL INTERFERE WITH THE WATER CONNECTION IF BROUGHT IN FROM THE SIDE. THIS BRACE CAN BE REMOVED, BUT ONLY AFTER THE UNIT IS IN PLACE.

REFRIGERANT CHARGE

All units are designed for use with Refrigerant 22 and are shipped with an operating charge. The operating charge for each unit is shown in the Physical Data tables on pages 9 and 10.

GLYCOL SOLUTIONS

The system glycol capacity, glycol solution flow rate in gpm, and pressure drop through the cooler may be calculated using the following formulas and table.

1. CAPACITY — Capacity is reduced from that with plain water. To find the reduced value multiply the chiller's water system tonnage by the capacity correction factor C to find the chiller's capacity in the glycol system.
2. GPM — To determine gpm (or delta-T) knowing delta-T (or gpm) and tons:

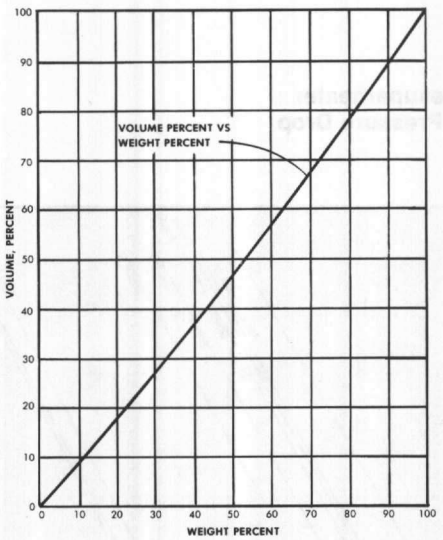
$$Glycol\ gpm = \frac{24 \times Tons\ (Glycol)}{delta\text{-}T} \times G\ (from\ table)$$

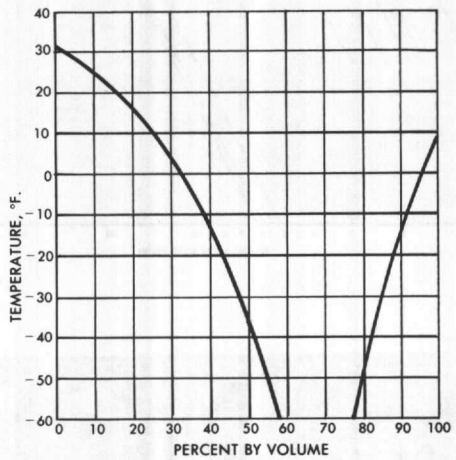
3. PRESSURE DROP — To determine glycol pressure drop through the cooler, enter the water pressure drop graph on page 8 at the glycol gpm. Multiply the water pressure drop found there by P to obtain corrected glycol pressure drop.

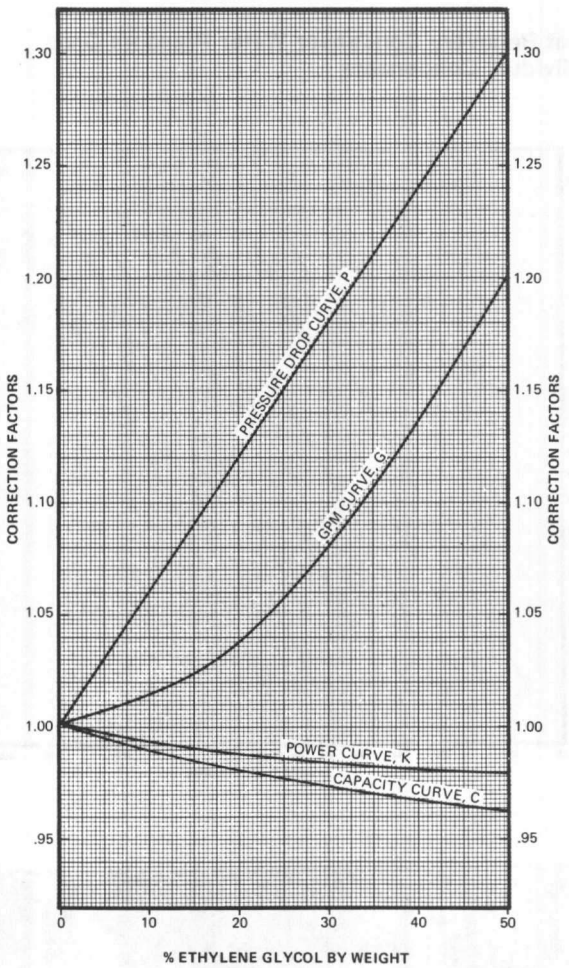
Test coolant with a clean, accurate glycol solution hydrometer (similar to that found in service stations) to determine freezing point. The obtain percent glycol from the freezing point table below.

PERCENT E.G.	FREEZING POINT	C	K	G	P
0	32°F	1.000	1.000	1.00	1.00
10	24°F	0.990	0.994	1.01	1.06
20	15°F	0.981	0.988	1.04	1.12
30	4°F	0.974	0.984	1.08	1.18
40	—12°F	0.968	0.981	1.13	1.24
50	—33°F	0.964	0.980	1.20	1.30

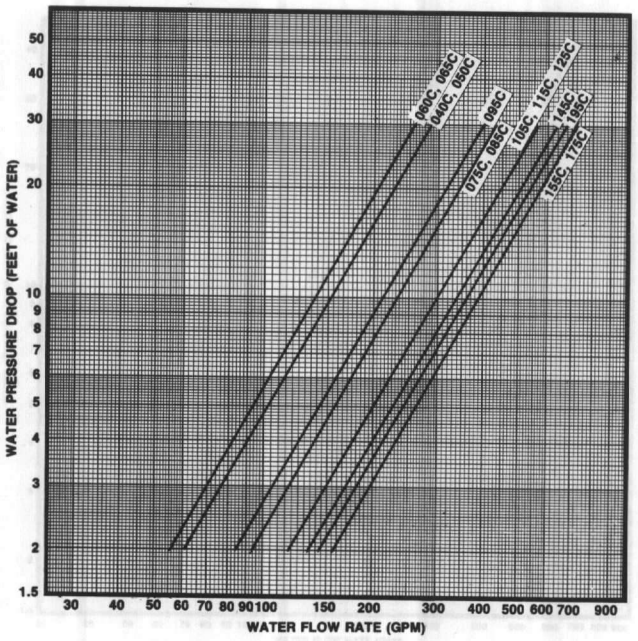
Condenser — The use of a glycol solution in the heat recovery condensers will not affect heat recovery capacity.



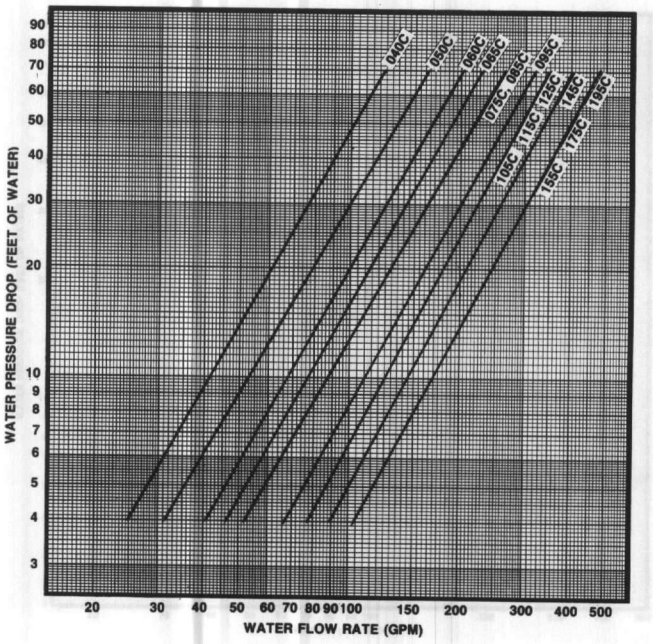




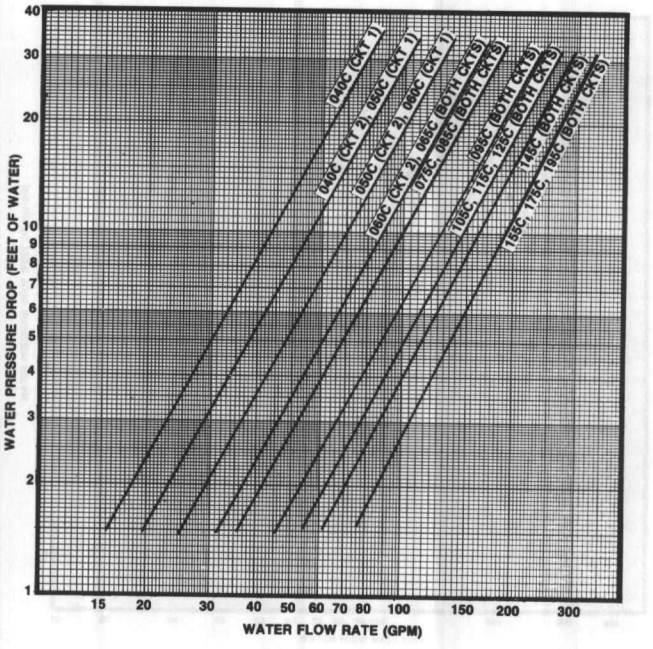
Evaporator Water Pressure Drop



Heat Recovery Condenser Water pressure Drop Condensers in Series



Heat Recovery Condenser Water Pressure Drop Individual Condensers



ALR Desuperheater Water Pressure Drop

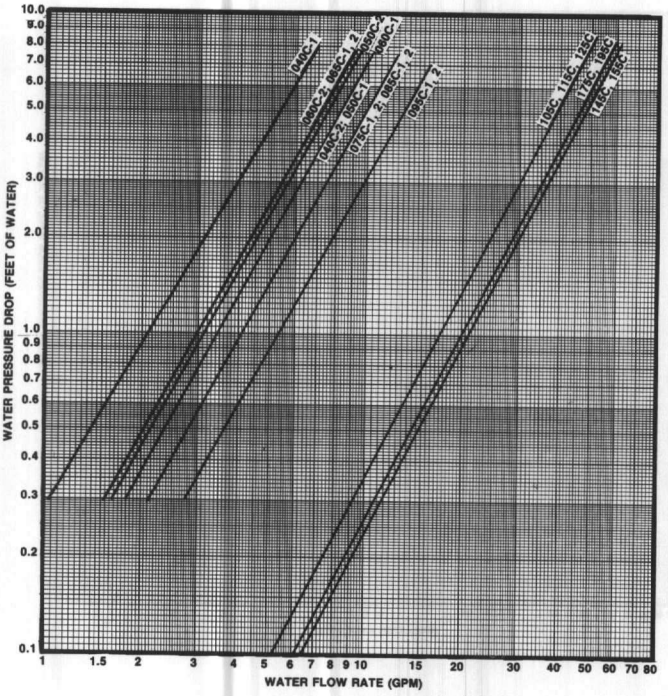


Table 4. Physical Data ALR-040C thru 095C

DATA	ALR MODEL NUMBER													
	040C		050C		060C		065C		075C		085C		095C	
	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2
BASIC DATA														
UNIT CAPACITY @ ARI CONDITIONS, TONS (1)	36.0		44.7		54.8		61.6		71.5		81.7		93.0	
NUMBER OF REFRIGERANT CIRCUITS	2		2		2		2		2		2		2	
UNIT OPERATING CHARGE, LBS. R-22	20.2	20.3	26.1	26.3	27.6	27.7	34.3	34.3	36.6	36.6	38.0	38.0	49.1	49.1
CABINET DIMENSIONS, LxWxH, INCHES	123x83x59		176x83x59		176x83x59		229x83x59		229x83x59		229x83x59		229x83x59	
UNIT OPERATING WEIGHT, LBS.	4061		4599		4806		5549		5782		6097		6573	
UNIT SHIPPING WEIGHT, LBS.	3869		4427		4657		5400		5548		5882		6370	
ADD'L WEIGHT IF COPPER FINNED COILS, LBS.	291		529		472		694		694		694		1103	
COMPRESSORS — COPELAMETIC FULLY ACCESSIBLE, SEMI-HERMETIC														
NOMINAL HORSEPOWER	20	25	25	30	30	35	35	35	40	40	50	50	60	60
NUMBER OF CYLINDERS PER COMPRESSOR	4	4	4	4	4	6	6	6	6	6	8	8	8	8
CYLINDER BORE, INCHES	2.5000	2.6875	2.6875	2.9375	2.9375	2.6875	2.6875	2.6875	2.9375	2.9375	2.6875	2.6875	2.9375	2.9375
CYLINDER STROKE, INCHES	2.0000	2.1875	2.1875	2.1875	2.1875	2.1875	2.1875	2.1875	2.1875	2.1875	2.3438	2.3438	2.3438	2.3438
OIL CHARGE PER COMPRESSOR	136	136	136	152	152	160	160	160	242	242	260	260	260	260
CAPACITY REDUCTION STEPS — PERCENT OF COMPRESSOR DISPLACEMENT (NOTE 4)														
STANDARD STAGING	0-22-50-72-100 or 0-28-50-78-100		0-23-50-73-100 or 0-27-50-77-100		0-22-59-81-100 or 0-28-50-78-100		0-33-66-83-100		0-33-66-83-100		0-25-50-75-100		0-25-50-75-100	
OPTIONAL STAGING	NA		NA		NA		0-17-33-50-67-83-100		0-17-33-50-67-83-100		0-25-50-63-75-88-100		0-25-50-63-75-88-100	
CONDENSERS — HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLER														
COIL FACE AREA, SQUARE FEET	28.9	28.9	43.3	43.3	43.3	43.3	57.8	57.8	57.8	57.8	57.8	57.8	57.8	57.8
FINNED HEIGHT x FINNED LENGTH, Inches	40x104	40x104	40x156	40x156	40x156	40x156	40x208	40x208	40x208	40x208	40x208	40x208	40x208	40x208
FINS PER INCH x ROWS DEEP	10x2	16x2	16x2	16x2	12x2	16x2	16x2	16x2	16x2	16x2	16x2	16x2	12x3	12x3
CONDENSER FANS — DIRECT DRIVE PROPELLER TYPE														
NUMBER OF FANS — FAN DIAMETER, INCHES	4 — 26		4 — 26		6 — 26		8 — 26		8 — 26		8 — 26		10 — 26	
NUMBER OF MOTORS — HORSEPOWER	4 — 1.0		4 — 1.0		6 — 1.0		8 — 1.0		8 — 1.0		8 — 1.0		10 — 1.0	
FAN AND MOTOR RPM	1100		1100		1100		1100		1100		1100		1100	
FAN TIP SPEED, FPM	7760		7760		7760		7760		7760		7760		7760	
TOTAL UNIT AIRFLOW, CFM	28,460		29,840		42,030		54,240		54,240		54,240		62,000	
DIRECT EXPANSION EVAPORATOR — BAFFLED SHELL AND THRU-TUBE														
SHELL DIAMETER, INCHES — TUBE LENGTH, FEET	10 — 08		10 — 08		10 — 08		10 — 08		12 — 08		12 — 08		12 — 08	
WATER VOLUME, GALLONS	23.00		20.60		17.90		17,90		28.00		25.80		24.30	
MAXIMUM WATER PRESSURE, PSIG (NOTE 3)	175		175		175		175		175		175		175	
HEAT RECOVERY CONDENSERS — WATER COOLED, SHELL AND TUBE TYPE														
TOTAL UNIT OPERATING CHARGE, LBS. R-22	64.6	63.0	79.2	106.2	107.5	104.2	121.0	121.0	120.9	120.9	122.3	122.3	188.4	188.4
ADD'N TO STD. UNIT SHIPPING WEIGHT, LBS.	Note 2	241	251	504	504	525	535	535	549	549	549	549	721	721
ADD'N TO STD. UNIT OPERATING WEIGHT, LBS.	Note 2	267	277	541	541	569	579	579	599	599	599	599	786	786
SHELL DIAMETER x TUBE LENGTH, INCHES	6x96	6x96	6x96	8x96	8x96	8x96	8x96	8x96	8x96	8x96	8x96	8x96	10x96	10x96
WATER VOLUME, GALLONS	2.7	3.2	3.2	4.5	4.5	5.3	5.3	5.3	5.9	5.9	5.9	5.9	7.7	7.7
MAXIMUM WATER PRESSURE, PSIG (NOTE 3)	250		250		250		250		250		250		250	

NOTES:

(1) Nominal capacity based on 95°F ambient air and 54°F/44°F water range.

(2) On an ALR-040C, a heat recovery condenser is not available on just Circuit 1. For heat recovery condensers on both circuits, add 470 lbs. to the shipping weight and 519 lbs. to the operating weight.

(3) If higher pressures are required, consult your local McQuay representative.

(4) Capacity reduction sequence depends on position of lead-lag switch.

(5) Cylinder bore for 50 hp: 2.6875; for 40 hp: 2.9375 (inches).
Cylinder stroke for 50 hp: 2.3438; for 40 hp: 2.1875 (inches).

Table 5. Physical Data / ALR-105C thru 195C

DATA	ALR MODEL NUMBER													
	105C		115C		125C		145C		155C		175C		195C	
	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2
BASIC DATA														
UNIT CAPACITY @ ARI CONDITIONS, TONS (1)	102.7		113.2		122.3		137.9		153.3		167.3		187.9	
NUMBER OF REFRIGERANT CIRCUITS	2		2		2		2		2		2		2	
UNIT OPERATING CHARGE, LBS. R-22	56.1	56.1	70.2	70.2	70.4	70.4	73.2	73.2	88.5	88.5	96.5	96.5	98.8	98.8
CABINET DIMENSIONS, LxWxH, INCHES	229x83x59		229x83x92		229x83x92		229x83x92		229x83x92		263x83x92		263x83x92	
UNIT OPERATING WEIGHT, LBS.	7713		8668		8978		9087		10,153		11,436		11,658	
UNIT SHIPPING WEIGHT, LBS.	7369		8350		8659		8786		9705		11,016		11,277	
ADD'L WEIGHT IF COPPER FINNED COILS, LBS.	1103		1236		1388		1388		2080		2429		2429	
COMPRESSORS — COPELAMETIC FULLY ACCESSIBLE, SEMI-HERMETIC														
NOMINAL HORSEPOWER	35-25	35-25	35-25	35-35	35-35	35-35	40-40	40-40	50-40	50-40	50-50	50-50	60-60	60-60
NUMBER OF CYLINDERS PER COMPRESSOR	6-4	6-4	6-4	6-6	6-6	6-6	6-6	6-6	8-6	8-6	8-8	8-8	8-8	8-8
CYLINDER BORE, INCHES	2.6875	2.6875	2.6875	2.6875	2.6875	2.6875	2.9375	2.9375	Note 5	Note 5	2.6875	2.6875	2.9375	2.9375
CYLINDER STROKE, INCHES	2.1875	2.1875	2.1875	2.1875	2.1875	2.1875	2.1875	2.1875	Note 5	Note 5	2.3438	2.3438	2.3438	2.3438
OIL CHARGE PER COMPRESSOR	160-136	160-136	160-136	160-160	160-160	160-160	242-242	242-242	242-242	260-240	260-240	260-260	260-260	260-260
CAPACITY REDUCTION STEPS — PERCENT OF COMPRESSOR DISPLACEMENT (NOTE 4)														
STANDARD STAGING	0-30-60-80-100		0-27-55-73-100 or 0-27-55-82-100		0-25-50-75-100		0-17-33-42-50-75-100		0-14-27-41-54-77-100		0-12-24-37 49-73-100		0-13-25-37-50-75-100	
OPTIONAL STAGING	0-20-40-50-60-80-100		0-18-36-45 55-73-100 or 1-18-36-45 55-82-100		0-17-33-42-50-75-100		0-17-33-42-50-67-83 92-100		0-14-27-36-54-64-73 86-100		0-13-25-38-50-63-75-88-100		0-13-25-38-50-63-75-88-100	
CONDENSERS — HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLER														
COIL FACE AREA, SQUARE FEET	57.8	57.8	115.6	115.6	115.6	115.6	115.6	115.6	115.6	115.6	135.0	135.0	135.0	135.0
FINNED HEIGHT x FINNED LENGTH, Inches	40x208	40x208	80x208	80x208	80x208	80x208	80x208	80x208	80x208	80x208	80x243	80x243	80x243	80x243
FINS PER INCH x ROWS DEEP	12x3	12x3	12x2	12x2	16x2	16x2	16x2	16x2	16x3	16x3	16x3	16x3	16x3	16x3
CONDENSER FANS — DIRECT DRIVE PROPELLER TYPE														
NUMBER OF FANS — FAN DIAMETER, INCHES	10 — 26		10 — 26		12 — 26		12 — 26		12 — 26		14 — 26		14 — 26	
NUMBER OF MOTORS — HORSEPOWER	10 — 1.0		10 — 1.0		12 — 1.0		12 — 1.0		12 — 1.0		14 — 1.0		14 — 1.0	
FAN AND MOTOR RPM	1100		1100		1100		1100		1100		1100		1100	
FAN TIP SPEED, FPM	7760		7760		7760		7760		7760		7760		7760	
TOTAL UNIT AIRFLOW, CFM	62,000		38,900/37,600		87,480		87,480		81,960		95,620		95,620	
DIRECT EXPANSION EVAPORATOR — BAFFLED SHELL AND THRU-TUBE														
SHELL DIAMETER, INCHES — TUBE LENGTH, FEET	14 — 10		14 — 10		14 — 10		14 — 10		16 — 10		16 — 10		16 — 10	
WATER VOLUME, GALLONS	41.3		38.2		38.2		36.1		53.7		50.3		45.6	
MAXIMUM WATER PRESSURE, PSIG (NOTE 3)	175		175		175		175		175		175		175	
HEAT RECOVERY CONDENSERS — WATER COOLED, SHELL AND TUBE TYPE														
TOTAL UNIT OPERATING CHARGE, LBS. R-22	214.5	214.5	248.3	248.3	248.5	248.5	247.2	247.2	295.4	295.4	323.4	323.4	325.8	325.8
ADD'N TO STD. UNIT SHIPPING WEIGHT, LBS.	844	844	863	863	863	863	884	884	966	966	986	986	986	986
ADD'N TO STD. UNIT OPERATING WEIGHT, LBS.	921	921	940	940	940	940	970	970	1068	1068	1088	1088	1088	1088
SHELL DIAMETER x TUBE LENGTH, INCHES	10x120	10x120	10x120	10x120	10x120	10x120	10x120	10x120	10x120	10x120	10x120	10x120	10x120	10x120
WATER VOLUME, GALLONS	9.2	9.2	9.2	9.2	9.2	9.2	10.3	10.3	12.2	12.2	12.2	12.2	12.2	12.2
MAXIMUM WATER PRESSURE, PSIG (NOTE 3)	250		250		250		250		250		250		250	

NOTES:

(1) Nominal capacity based on 95°F ambient air and 54°F/44°F water range.

(2) On an ALR-040C, a heat recovery condenser is not available on just Circuit 1. For heat recovery condensers on both circuits, add 470 lbs. to the shipping weight and 519 lbs. to the operating weight.

(3) If higher pressures are required, consult your local McQuay representative.

(4) Capacity reduction sequence depends on position of lead-lag switch.

(5) Cylinder bore for 50 hp: 2.6875; for 40 hp: 2.9375 (inches).
Cylinder stroke for 50 hp: 2.3438; for 40 hp: 2.1875 (inches).

Table 6. Major Components

UNIT SIZE	COMPRESSOR				EVAP.	CONTACTOR DESIGNATION FOR COMPRESSOR			
	NO. 1	NO. 2	NO. 3	NO. 4	VESSEL SIZE	1	2	3	4
ALR-040C	4D-20hp	4D-25hp	—	—	1008-3	M1-M5	M2-M6	—	—
ALR-050C	4D-25hp	4D-30hp	—	—	1008-2	M1-M5	M2-M6	—	—
ALR-060C	4D-30hp	6D-35hp	—	—	1008-1	M1-M5	M2-M6	—	—
ALR-065C	6D-35hp	6D-35hp	—	—	1008-1	M1-M5	M2-M6	—	—
ALR-075C	6D-40hp	6D-40hp	—	—	1208-3	M1-M5	M2-M6	—	—
ALR-085C	8D-50hp	8D-50hp	—	—	1208-2	M1-M5	M2-M6	—	—
ALR-095C	8D-60hp	8D-60hp	—	—	1208-1	M1-M5	M2-M6	—	—
ALR-105C	6D-35hp	6D-35hp	4D-25hp	4D-25hp	1410-3	M1-M5	M2-M6	—	—
ALR-115C	6D-35hp	6D-35hp	4D-25hp	6D-35hp	1410-2	M1-M5	M2-M6	M3-M7	M4-M8
ALR-125C	6D-35hp	6D-35hp	6D-35hp	6D-35hp	1410-2	M1-M5	M2-M6	M3-M7	M4-M8
ALR-145C	6D-40hp	6D-40hp	6D-40hp	6D-40hp	1410-1	M1-M5	M2-M6	M3-M7	M4-M8
ALR-155C	8D-50hp	6D-40hp	8D-50hp	6D-40hp	1610-3	M1-M5	M2-M6	M3-M7	M4-M8
ALR-175C	8D-50hp	8D-50hp	8D-50hp	8D-50hp	1610-2	M1-M5	M2-M6	M3-M7	M4-M8
ALR-195C	8D-60hp	8D-60hp	8D-60hp	8D-60hp	1610-1	M1-M5	M2-M6	M3-M7	M4-M8

Figure 8. ALR Dimensional Drawings / 040C thru 105C

ALL DIMENSIONS IN INCHES

FOR FAN ARRANGEMENTS SEE FIG. 11, PAGE 15.

MODELS 040C ONLY: Circuit 1 heat recovery condenser is located directly above circuit 2, *not* beside.

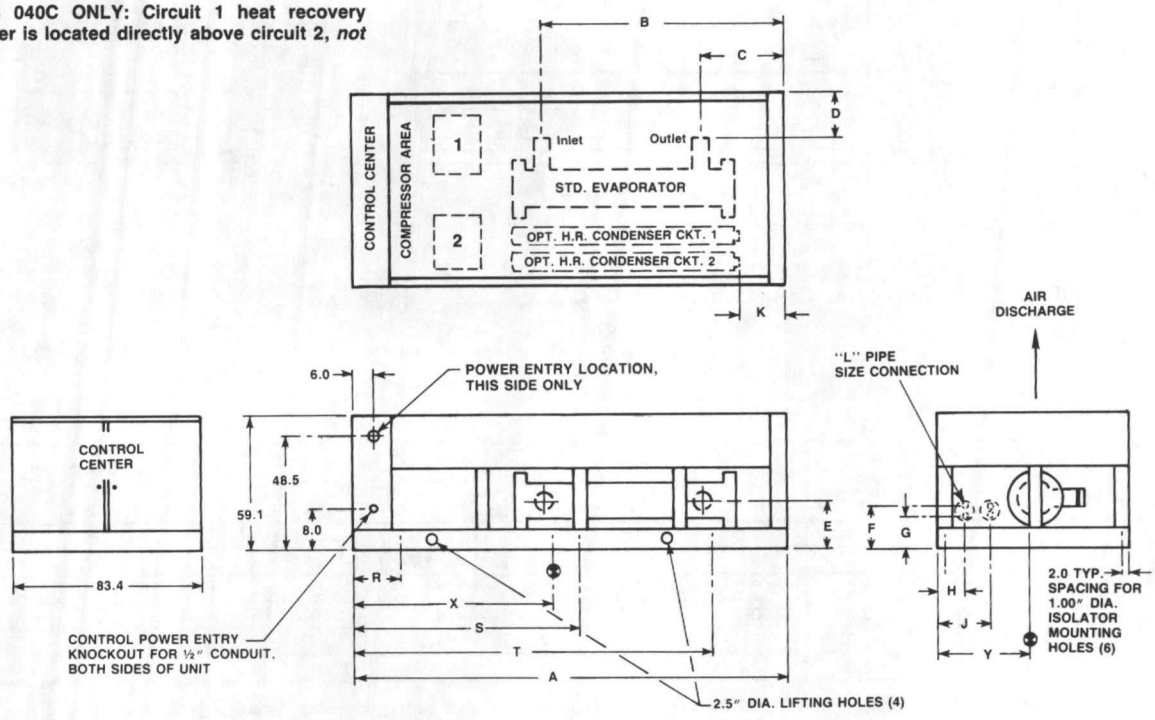


Table 7. Dimensional Data

ALR UNIT SIZE	LENGTH A	EVAPORATOR WATER CONNECTIONS					OPTIONAL WATER CONDENSER WATER CONNECTIONS										CTR. OF GRAVITY				ISOLATOR LOCATIONS		
							F		G				K		L		Std. Unit		Opt. H_2O Cond. Unit (2)				
		Size (1)	B	C	D	E	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	H	J	Ckt. 1	Ckt. 2	Ckt. 1	Ckt. 2	X	Y	X	Y	R	S	T
040C	122.7	4"	96.3	11.0	22.7	14.9	26.4	13.5	21.9	9.0	33.7	33.7	3.6	3.6	1½" FPT	1½" FPT	55.0	41.7	56.0	42.3	13.0	43.0	109.0
050C	175.7	4"	98.4	13.0	29.7	14.9	12.4	16.6	7.9	11.9	11.1	25.4	5.7	0.0	1½" FPT	2½" MPT	77.0	41.7	82.0	37.8	13.0	58.0	162.0
060C	175.7	4"	98.4	13.0	29.7	14.9	16.6	16.6	11.9	11.9	11.1	25.4	0.0	0.0	2½" MPT	2½" MPT	77.0	41.7	84.0	37.3	13.0	58.0	162.0
065C	228.7	4"	151.4	66.0	29.7	14.9	16.6	16.6	11.9	11.9	11.1	25.4	52.8	52.8	2½" MPT	2½" MPT	90.0	41.7	94.0	37.7	13.0	58.0	215.0
075C	228.7	5"	150.6	66.8	28.6	15.9	16.6	16.6	11.9	11.9	11.1	25.4	52.8	52.8	2½" MPT	2½" MPT	90.0	41.7	94.0	37.7	13.0	58.0	215.0
085C	228.7	5"	150.6	66.8	28.6	15.9	16.6	16.6	11.9	11.9	11.1	25.4	52.8	52.8	2½" MPT	2½" MPT	87.0	41.7	91.0	37.9	13.0	58.0	215.0
095C	228.7	5"	150.6	66.8	28.6	15.9	18.7	18.7	13.1	13.1	10.1	24.6	52.8	52.8	3" MPT	3" MPT	88.0	41.7	93.9	37.0	13.0	58.0	215.0
105C	228.7	6"	117.6	13.8	28.6	19.5	18.7	18.7	13.1	13.1	10.1	24.6	0.0	0.0	3" MPT	3" MPT	104.7	41.7	118.2	37.0	13.0	58.0	215.0

(1) EVAPORATOR CONNECTIONS: All connections NPS steel pipe. Connections are furnished with grooves for victaulic coupling by others.
(2) Includes both circuits.

Figure 9. ALR Dimensional Drawings / 115C thru 195C

FOR FAN ARRANGEMENTS SEE FIG. 11, PAGE 15.

ALL DIMENSIONS IN INCHES

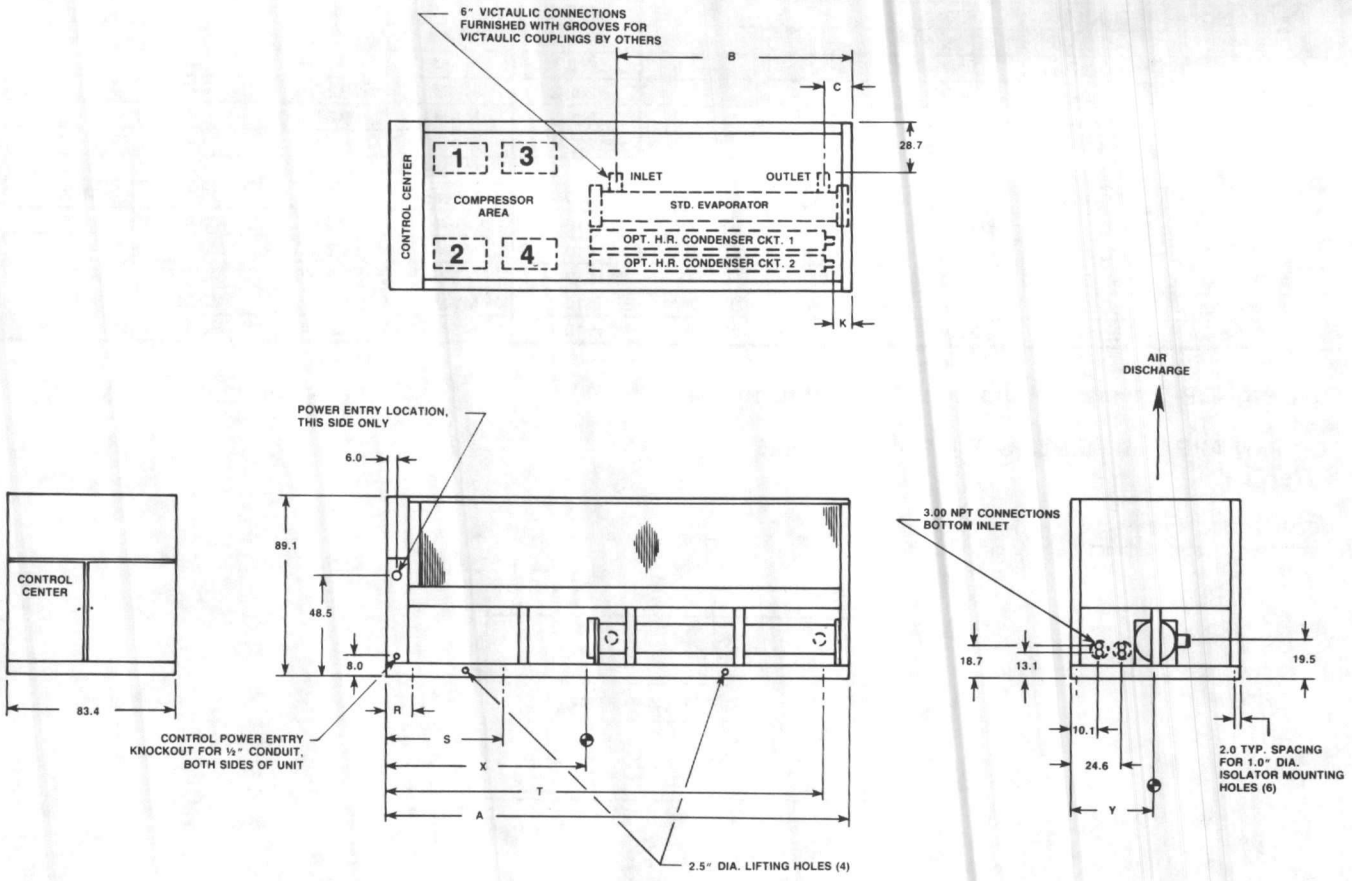


Table 8. Dimensional Data

ALR MODEL	LENGTH A	EVAPORATOR WATER CONN. (1)		K	CENTER OF GRAVITY				ISOLATOR LOCATIONS		
					STD. UNIT		OPT. H_2O COND. (2)				
		B	C		X	Y	X	Y	R	S	T
115C	228.7	117.6	13.8	0.0	109.5	41.7	118.2	37.4	13.0	58.0	215.0
125C	228.7	117.6	13.8	0.0	104.3	41.7	116.4	37.5	13.0	58.0	215.0
145C	228.7	117.6	13.8	0.0	104.9	41.7	117.1	37.4	13.0	58.0	215.0
155C	228.7	118.5	12.9	0.0	105.2	41.7	117.7	37.5	13.0	58.0	215.0
175C	263.4	153.2	47.6	32.4	114.2	41.7	123.9	37.8	13.0	95.0	249.7
195C	263.4	153.2	47.6	32.4	113.1	41.7	122.8	37.9	13.0	95.0	249.7

(1) EVAPORATOR CONNECTIONS: All connections NPS steel pipe. Connections are furnished with grooves for victaulic couplings by others.
(2) Includes both circuits.
(3) For unit sizes 175C and 195C, see note on water connections, Page 7.

FIELD WIRING

Wiring must comply with all applicable codes and ordinances. Warranty is voided if wiring is not in accordance with specifications. An open fuse indicates a short, ground, or overload. Before replacing a fuse or restarting a compressor or fan motor, the trouble must be found and corrected.

Copper wire is required for all power lead terminations at the unit while either aluminum or copper can be used for all other wiring.

ALR units may be ordered with internal power wiring for either single or multiple point power connection. If single point power connection is ordered, a single large power terminal block is provided and wiring within the unit is sized in accordance with the National Electrical Code. A single field supplied disconnect is required. An optional factory mounted transformer may be provided.

If multiple point power wiring is ordered, three power connections, one per compressor circuit plus one for condenser fans and control circuit, are required and wiring within the unit is sized in accordance with the National Electrical Code. disconnects are required for each of the three circuits. A single power block is provided for all of the condenser fans and the optional 115V control transformer.

It may be desirable to have the unit cooler heater on a separate disconnect switch from the main unit power supply so that the unit may be shut down without defeating the freeze protection provided by the cooler heater.

CAUTION: *Internal power wiring to the compressors for the single point versus the multiple point option are different. It is imperative that the proper field wiring be installed according to the way the unit is built.*

Table 9. Wire Sizing Ampacities

ALR MODEL	3 PH, 60 HZ ELEC. POWER POWER SUPPLY (1)	WIRE SIZE AMPS (4)				POWER ENTRY HUB QUANTITY & DIAMETER (5)	
		SINGLE POINT POWER SUPPLY (6)	MULTIPLE POINT POWER SUPPLY (7)			SINGLE POINT POWER SUPPLY	MULT. POINT POWER SUPPLY
			Elec. Ckt. 1 Fans & Controls	Elec. Ckt. 2 Compr. Ckt. 1	Elec. Ckt. 3 Compr. Ckt. 2		
040C	208	184	25.6	79	96	(1) 2″	(1) 2″
	230	184	25.6	79	96	(1) 2″	(1) 2″
	460 (8)	93	12.8	39	49	(1) 1¼″	(1) 1½″
	575	76	12.7	33	39	(1) 1″	(1) 1¼″
050C	208	234	25.6	96	133	(1) 2½″	(1) 2½″
	230	234	25.6	96	133	(1) 2½″	(1) 2½″
	460 (8)	118	12.8	49	66	(1) 1¼″	(1) 1½″
	575	92	12.7	39	45	(1) 1¼″	(1) 1¼″
060C	208	278	33.6	133	140	(1) 2½″	(1) 3″
	230	278	33.6	133	140	(1) 2½″	(1) 3″
	460 (8)	140	16.8	66	70	(1) 1½″	(1) 2″
	575	108	16.7	45	56	(1) 1¼″	(1) 1½″
065C	208	292	41.6	140	140	(1) 2½″	(1) 3″
	230	292	41.6	140	140	(1) 2½″	(1) 3″
	460 (8)	147	20.8	70	70	(1) 1½″	(1) 2″
	575	121	21.5	56	56	(1) 1¼″	(1) 2″
075C	208	384	41.6	191	191	(1) 3″	(1) 4″
	230	355	41.6	175	175	(1) 3″	(1) 4″
	460 (8)	180	20.8	89	89	(1) 2″	(1) 2″
	575	142	21.5	68	68	(1) 1½″	(1) 2″
085C	208	412	41.6	206	206	(1) 4″	(1) 4″
	230	412	41.6	206	206	(1) 4″	(1) 4″
	460 (8)	207	20.8	104	104	(1) 2½″	(1) 2½″
	575	—	—	—	—	—	—
095C	208	501	49.6	251	251	(1) 4″	(2) 2½″, (1) 1″
	230	501	49.6	251	251	(1) 4″	(2) 2½″, (1) 1″
	460 (8)	249	24.8	125	125	(1) 2½″	(1) 3″
	575	—	—	—	—	—	—
105C	208	455	50.6	217	217	(1) 4″	(2) 2″, (1) 1″
	230	455	50.6	217	217	(1) 4″	(2) 2″, (1) 1″
	460 (8)	229	25.3	109	109	(1) 2½″	(1) 2½″
	575	189	26.3	87	87	(1) 2″	(1) 2½″
115C	208	490	50.6	217	252	(1) 4.0″	(1)1″(1)2″(1)2½″
	230	490	50.6	217	252	(1) 4.0″	(1)1″(1)2″(1)2½″
	460 (8)	246	25.3	109	126	(1) 2.5″	(1) 2.5″
	575	203	26.3	87	101	(1) 2.0″	(1) 2.5″
125C	208	533	58.6	252	252	(1) 4.0″	(1) 1″ (2) 2.5″
	230	533	58.6	252	252	(1) 4.0″	(1) 1″ (2) 2.5″
	460 (8)	267	29.3	126	126	(1) 2.5″	(1) 3.0″
	575	222	30.7	101	101	(1) 2.5″	(1) 2.5″
145C	208	708	58.6	344	344	(2) 3.0″	(1) 1″ (2) 3″
	230	652	58.6	315	315	(2) 3.0″	(1) 1″ (2) 3″
	460 (8)	331	29.3	160	160	(1) 3.0″	(1) 3.0″
	575	260	30.7	122	122	(1) 2.5″	(1) 2.5″
155C	208	735	58.6	359	359	(2) 3.0″	(1) 1″ (2) 3″
	230	709	58.6	346	346	(2) 3.0″	(1) 1″ (2) 3″
	460 (8)	358	29.3	175	175	(1) 3.0″	(1) 4.0″
	575	—	—	—	—	—	—
175C	208	767	66.6	371	371	(2) 3.0″	(1) 1″ (2) 3″
	230	767	66.6	371	371	(2) 3.0″	(1) 1″ (2) 3″
	460 (8)	385	33.3	187	187	(1) 3.0″	(1) 4″
	575	—	—	—	—	—	—
195C	208	926	66.6	452	452	(2) 4.0″	(1) 1″ (2) 4″
	230	926	66.6	452	452	(2) 4.0″	(1) 1″ (2) 4″
	460 (8)	455	33.3	225	225	(1) 4.0″	(1) 4″
	575	—	—	—	—	—	—

NOTES:

(1) ALLOWABLE VOLTAGE LIMITS:
Unit Nameplate 208V/60Hz/3Ph: 187V to 253V (except ALR-075C: 180V to 220V).
Unit Nameplate 230V/60Hz/3Ph: 187V to 253V (except ALR-075C 207V to 253V).
Unit Nameplate 460V/60Hz/3Ph: 414V to 506V.
Unit Nameplate 575V/60Hz/3Ph: 517V to 633V.
Unit Nameplate 380V/50Hz/3Ph: 342V to 418V.

(2) Compressor RLA values are for wire sizing purposes only an do not reflect normal operating current draw. If unit is equipped with SPEEDTROL motors, the first motor on each refrigerant circuit is a 230V single phase, 1 hp motor, with an RLA of 5.6 amps.

(3) Compressor LRA for part winding start are for the first winding. If the unit is equipped with SPEEDTROL motors, the first motor on each refrigerant circuit is a 230V single phase, 1 hp motor, with an LRA of 14.5 amps.

(4) Unit wire size amps are equal to 125% of the largest compressor-motor RLA plus 100% of RLA of all other loads in the circuit including control transformer. Wire size amps for separate 115V control circuit power is 10 amps for ALR-040C thru ALR-095C and 12 amps for ALR-105C.

(5) Quantity and size of power entry hub(s) provided with unit.

(6) Single point power supply requires a single fused disconnect to supply electrical power to the unit.

(7) Multiple point power supply requires three independent power circuits with separate fused disconnects.

(8) Data also applies to 380V/50Hz/3Ph units.

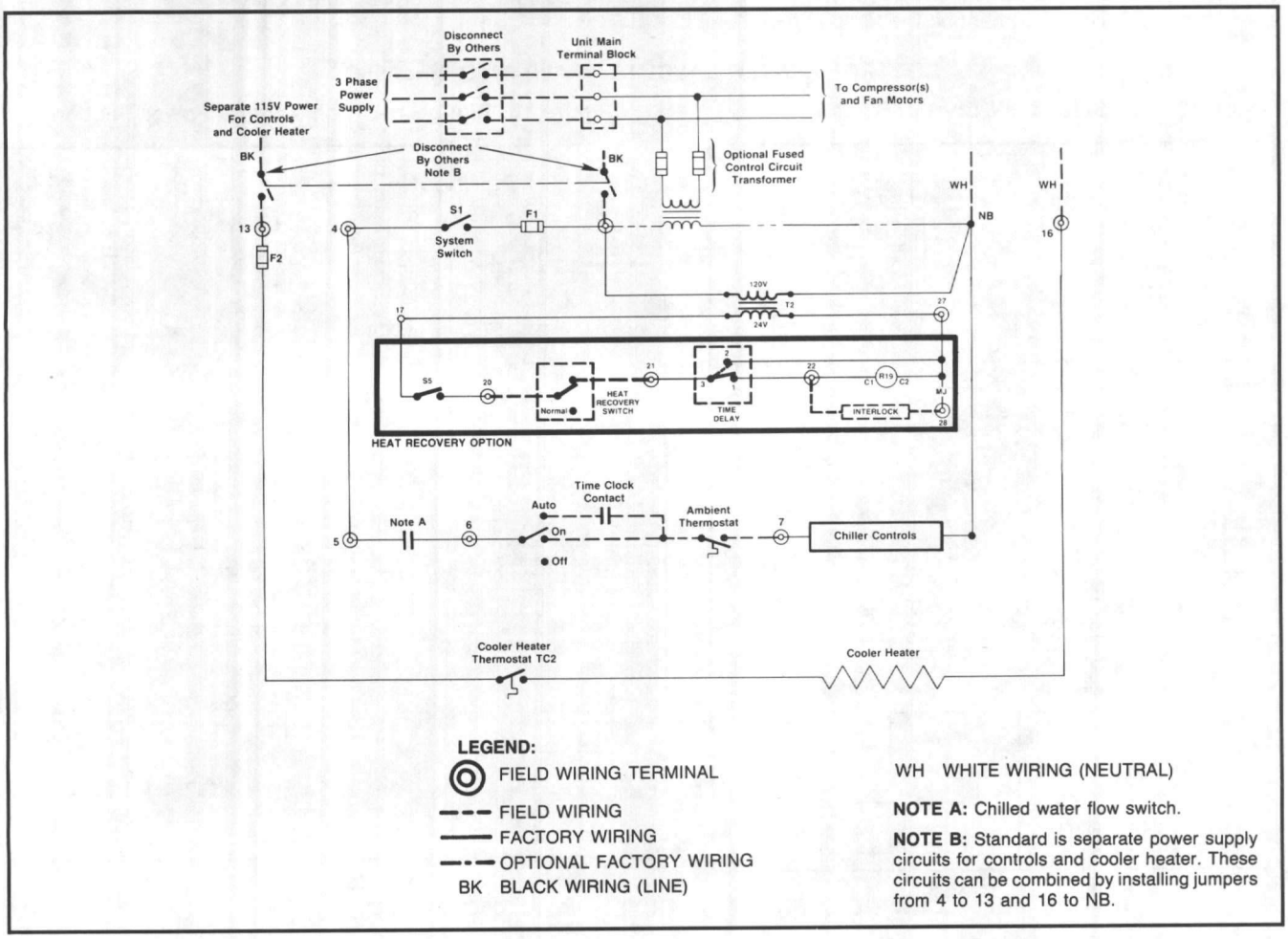
Table 10. Compressor and Condenser Fan Motors

ALR MODEL	3 PH, 60 HZ ELEC. POWER SUPPLY (1)	RATED LOAD AMPS (2)		LOCKED ROTOR AMPS (3)		
		FANS	COMPRESSORS	FANS (EACH)	COMPRESSORS	
					AL START	PW START
040C	208	(4) 4.0	(1) 63, (1) 77	17.0	(1) 308, (1) 428	(1) 188, (1) 250
	230	(4) 4.0	(1) 63, (1) 77	17.0	(1) 308, (1) 428	(1) 188, (1) 250
	460 (8)	(4) 2.0	(1) 31, (1) 39	9.9	(1) 154, (1) 214	(1) 84, (1) 117
	575	(4) 2.2	(1) 26, (1) 31	10.3	(1) 135, (1) 172	(1) 81, (1) 103
050C	208	(4) 4.0	(1) 77, (1) 106	17.0	(1) 428, (1) 470	(1) 250, (1) 292
	230	(4) 4.0	(1) 77, (1) 106	17.0	(1) 428, (1) 470	(1) 250, (1) 292
	460 (8)	(4) 2.0	(1) 39, (1) 53	9.9	(1) 214, (1) 235	(1) 117, (1) 141
	575	(4) 2.2	(1) 31, (1) 36	10.3	(1) 172, (1) 217	(1) 103, (1) 130
060C	208	(6) 4.0	(1) 106, (1) 112	17.0	(1) 470, (1) 565	(1) 292, (1) 340
	230	(6) 4.0	(1) 106, (1) 112	17.0	(1) 470, (1) 565	(1) 292, (1) 340
	460 (8)	(6) 2.0	(1) 53, (1) 56	9.9	(1) 235, (1) 283	(1) 141, (1) 156
	575	(6) 2.2	(1) 36, (1) 45	10.3	(1) 217, (1) 230	(1) 130, (1) 138
065C	208	(8) 4.0	(2) 112	17.0	(2) 565	(2) 340
	230	(8) 4.0	(2) 112	17.0	(2) 565	(2) 340
	460 (8)	(8) 2.0	(2) 56	9.9	(2) 283	(2) 156
	575	(8) 2.2	(2) 45	10.3	(2) 230	(2) 138
075C	208	(8) 4.0	(2) 153	17.0	(2) 660	(2) 400
	230	(8) 4.0	(2) 140	17.0	(2) 594	(2) 340
	460 (8)	(8) 2.0	(2) 71	9.9	(2) 297	(2) 170
	575	(8) 2.2	(2) 54	10.3	(2) 235	(2) 135
085C	208	(8) 4.0	(2) 165	17.0	(2) 1070	(2) 654
	230	(8) 4.0	(2) 165	17.0	(2) 1070	(2) 654
	460 (8)	(8) 2.0	(2) 83	9.9	(2) 535	(2) 330
	575	—	—	—	—	—
095C	208	(10) 4.0	(2) 201	17.0	(2) 1070	(2) 654
	230	(10) 4.0	(2) 201	17.0	(2) 1070	(2) 654
	460 (8)	(10) 2.0	(2) 100	9.9	(2) 535	(2) 428
	575	—	—	—	—	—
105C	208	(10) 4.0	(2) 112, (2) 77	17.0	(2) 565, (2) 428	(2) 340, (2) 250
	230	(10) 4.0	(2) 112, (2) 77	17.0	(2) 565, (2) 428	(2) 340, (2) 250
	460 (8)	(10) 2.0	(2) 56, (2) 39	9.9	(2) 283, (2) 214	(2) 156, (2) 117
	575	(10) 2.2	(2) 45, (2) 31	10.3	(2) 230, (2) 172	(2) 138, (2) 103
115C	208	(10) 4.0	(3) 112 (1) 77	17.0	(3) 565 (1) 428	(3) 340 (1) 250
	230	(10) 2.0	(3) 112 (1) 77	17.0	(3) 565 (1) 428	(3) 340 (1) 250
	460 (8)	(10) 2.0	(3) 56 (1) 39	9.9	(3) 283 (1) 214	(3) 156 (1) 117
	575	(10) 2.2	(3) 45 (1) 31	10.3	(3) 230 (1) 172	(3) 138 (1) 103
125C	208	(12) 4.0	(4) 112	17.0	(4) 565	(4) 340
	230	(12) 4.0	(4) 112	17.0	(4) 565	(4) 230
	460 (8)	(12) 2.0	(4) 56	9.9	(4) 283	(4) 156
	575	(12) 2.2	(4) 45	10.3	(4) 230	(4) 138
145C	208	(12) 4.0	(4) 153	17.0	(4) 660	(4) 400
	230	(12) 4.0	(3) 140	17.0	(4) 594	(4) 340
	460 (8)	(12) 2.0	(4) 71	9.9	(4) 297	(4) 170
	575	(12) 2.2	(4) 54	10.3	(4) 235	(4) 135
155C	208	(12) 4.0	(2) 165 (2) 153	17.0	(2) 1070 (2) 660	(2) 654 (2) 400
	230	(12) 4.0	(2) 165 (2) 140	17.0	(2) 1070 (2) 594	(2) 654 (2) 340
	460 (8)	(12) 2.0	(2) 83 (2) 71	9.9	(2) 535 (2) 297	(2) 330 (2) 170
	575	—	—	—	—	—
175C	208	(14) 4.0	(4) 165	17.0	(4) 1070	(4) 654
	230	(14) 4.0	(4) 165	17.0	(4) 1070	(4) 654
	460 (8)	(14) 2.0	(4) 83	9.9	(4) 535	(4) 330
	575	—	—	—	—	—
195C	208	(14) 4.0	(4) 201	17.0	(4) 1070	(4) 654
	230	(14) 4.0	(4) 201	17.0	(4) 1070	(4) 654
	460 (8)	(14) 2.0	(4) 100	9.9	(4) 535	(4) 330
	575	—	—	—	—	—

REFER TO PAGE 13 FOR ELECTRICAL DATA NOTES

Figure 10 shows typical field wiring that is required for unit installation. On models ALR-040C through 195C, the flow switch, time clock and/or ambient thermostat are connected between terminals 5 and 7.

Figure 10. Typical Field Wiring Diagram — ALR-040C thru 195C

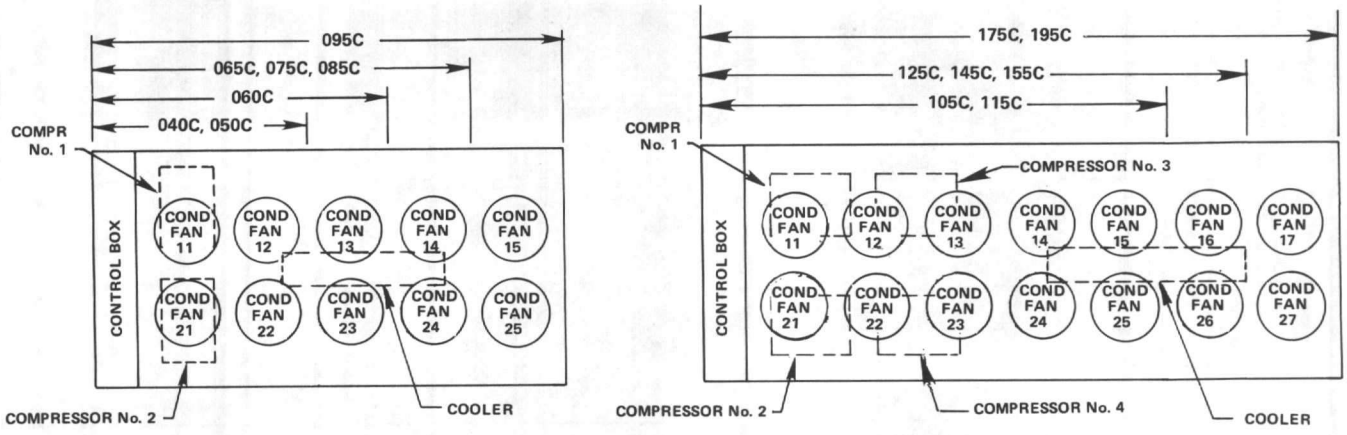


UNIT LAYOUT & PRINCIPLES OF OPERATION

Figure 11. Major Component Locations

The figure below illustrates component locations within the unit for each unit size.

TOP VIEW OF UNIT



CONTROL CENTER

All electrical controls are enclosed in a weatherproof control center with keylocked, hinged access doors. The control center is composed of two separate compartments, high voltage and low voltage. All of the high voltage components are located in the compartment on the right side of the unit.

The low voltage components are located on the left side with the live terminals located behind a deadfront panel. This protects service personnel from live terminals when accessing the adjustable and resettable controls.

CONTROL CENTER LAYOUTS — ALR-040C thru 095C

Figure 12. Left Side, 115V Control Section

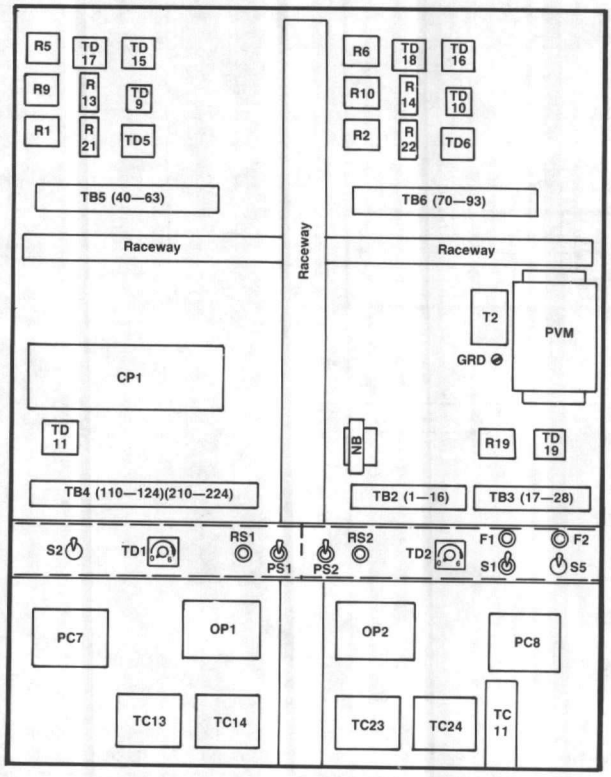
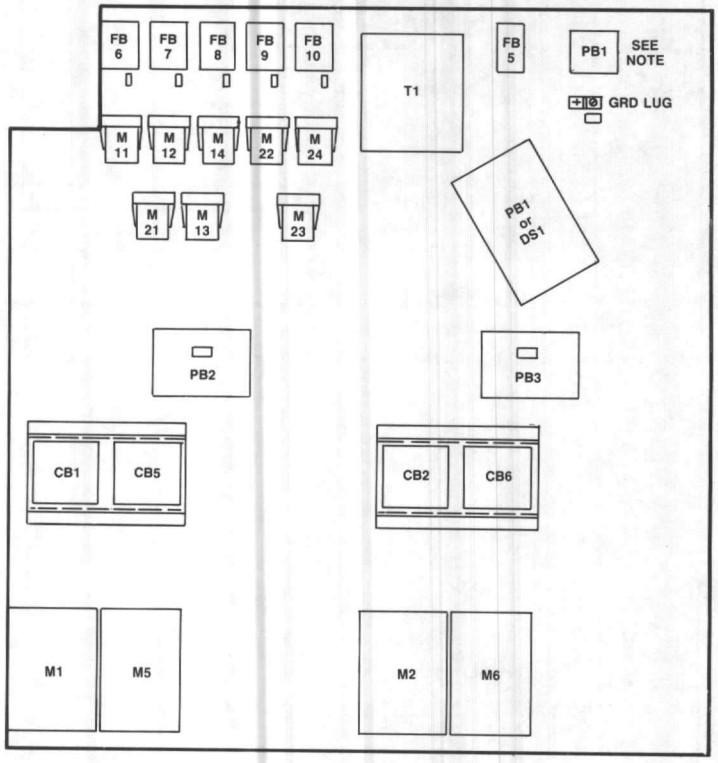


Figure 13. Right Side, High Voltage Power Section



CONTROL CENTER LAYOUTS — ALR-105C thru 195C

Figure 14. Left Side, 115V Control Section

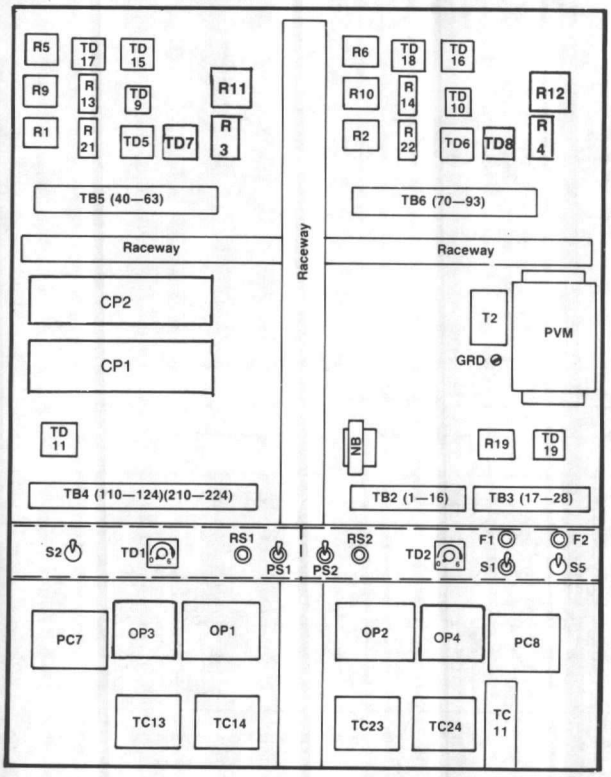
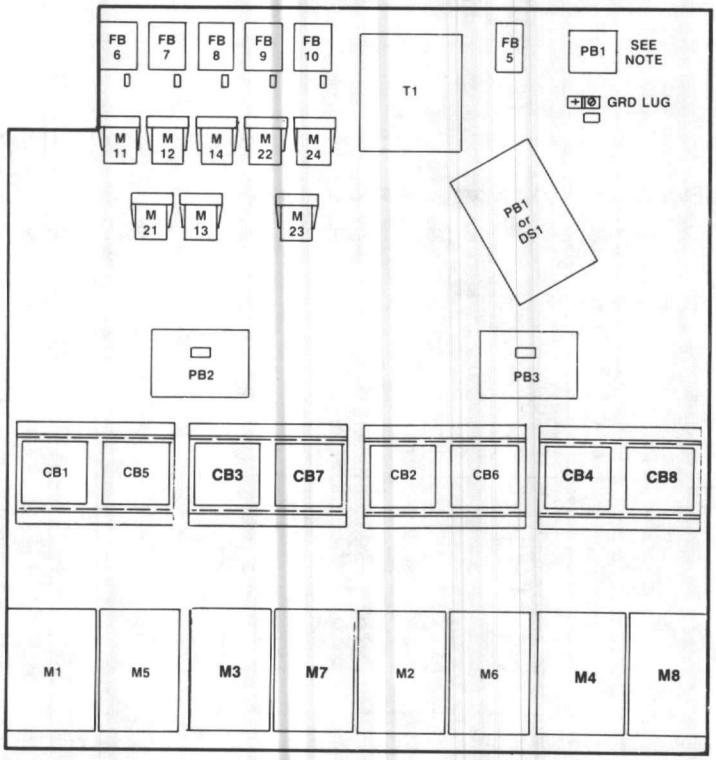


Figure 15. Right Side, High Voltage Power Section



NOTE: PB1, PB2, PB3 are used with multiple point power wiring.

ELECTRICAL LEGEND

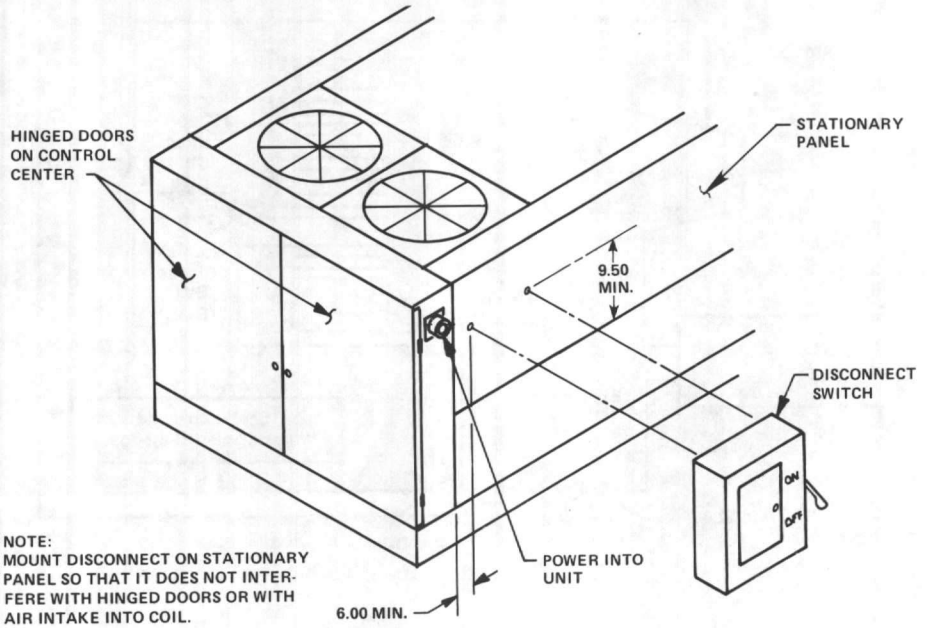
DESIGNATION	DESCRIPTON	STD. LOCATION
AB	ALARM BELL	FIELD MOUNTED
C11, C21	CAPACITORS FOR SPEEDTROL MOTORS	BACK OF CONTROL BOX OR ON BULKHEAD
CB1—8	CIRCUIT BREAKERS, COMPRESSOR MOTORS	CONTROL BOX
COMPR.1-4	COMPRESSORS 1 THRU 4	BASE OF UNIT
CP1	CENTRAL PROCESSOR	CONTROL BOX
CP2	CENTRAL PROCESSOR SATELLITE	CONTROL BOX
DAC1	DISCHARGE AIR CONTROL	CONTROL BOX
DAS1	DISCHARGE AIR SATELLITE	CONTROL BOX
DS1	DISCONNECT SWITCH, MAIN	CONTROL BOX
F1	FUSE, CONTROL CIRCUIT	CONTROL BOX
F2	FUSE COOLER HEATER	CONTROL BOX
FB1—4	FUSEBLOCKS, COMPRESSOR MOTORS	CONTROL BOX
FB5	FUSE BLOCK, CONTROL POWER	CONTROL BOX
FB6—10	FUSEBLOCKS, FAN MOTORS	CONTROL BOX
FS1, 2	FREEZESTATS, CONTROL	SUCTION LINE NEAR COOLER
GFI	GROUND FAULT INTERRUPTOR	CONTROL BOX
GRD	GROUND	CONTROL BOX
HP1, 2	HIGH PRESSURE CONTROLS	ON COMPRESSOR
HTR1—4	HEATERS, COMPRESSOR CRANKCASE	ON COMPRESSOR
HTR5	HEATER, COOLER BARREL	WRAPPED AROUND COOLER BARREL
JB5	JUNCTION BOX FOR COOLER HEATER	NEAR COOLER ON BASE RAIL
JB6	JUNCTION BOX FOR HEAT RECOVERY	UNDERSIDE OF COIL ON INTERMEDIATE TUBE SHEET
LP1, 2	LOW PRESSURE CONTROLS	ON COMPRESSOR
M1—10	CONTACTORS, COMRPESSOR	CONTROL BOX
M11—27	CONTACTORS, FAN MOTORS	CONTROL BOX
MJ	MECHANICAL JUMPERS	CONTROL BOX
MP1—4	MOTOR PROTECTORS, COMPRESSOR	COMPRESSOR JUNCTION BOX
MTR11—27	MOTORS, CONDENSER FANS	CONDENSER SECTION
NB	NEUTRAL BLOCK	CONTROL BOX
NSB	NIGHT SETBACK	CONTROL BOX
OP1—4	OIL PRESSURE CONTROLS	CONTROL BOX
PB1—3	POWER BLOCK, MAIN	CONTROL BOX
PC1—4	PRESSURE CONTROLS, SPECIALS	CONTROL BOX OR ON UNIT
PC5, 6	PRESSURE CONTROLS, HI AMBIENT UNLOADER	ON COIL HEADER
PC8—10	PRESSURE CONTROLS, SUCTION UNLOADER	CONTROL BOX
PC12—22	PRESSURE CONTROLS, FANTROL	ON COIL HEADER
PS1, 2	PUMPDOWN SWITCHES	CONTROL BOX
PVM	PHASE VOLTAGE MONITOR	CONTROL BOX

DESIGNATION	DESCRIPTION	STD. LOCATION
R1,2	RELAYS, RESET OR ALARM	CONTROL BOX
R5—8	RELAYS, SAFETY	CONTROL BOX
R9—12	RELAYS, STARTING	CONTROL BOX
R13, 14	RELAYS, LOW AMBIENT START	CONTROL BOX
R3, 4, 17, 18	RELAYS, CAPACITY CONTROL	CONTROL BOX
R19	RELAY, HEAT RECOVERY	CONTROL BOX
R21, 22	RELAYS, HI AMBIENT, HI RETURN WATER & SUCTION UNLOADERS	CONTROL BOX
R23—30	RELAYS, SPECIALS	CONTROL BOX
RS1—4	RESET SWITCHES	CONTROL BOX
S1	SWITCH, CONTROL STOP	CONTROL BOX
S2—4	SWITCHES, LEAD-LAG	CONTROL BOX
S5	SWITCH, HEAT RECOVERY	CONTROL BOX
SC11, 12	SPEED CONTROLS	BACK OF CONTROL BOX OR ON BULKHEAD
SL1	SOLENOID DOOR LOCK	CONTROL BOX
SV1, 2	SOLENOID VALVES, LIQUID LINES	CONDENSER SECTION
SV5, 6	SOLENOID VALVES, HOT GAS BYPASS	CONDENSER SECTION
SV10, 20	SOLENOID VALVES, WATER CONDENSER (NORMALLY OPEN)	CONDENSER SECTION
SV11, 21	SOLENOID VALVES, AIR CONDENSER	CONDENSER SECTION
T1	TRANSFORMER, MAIN CONTROL	CONTROL BOX
T2	TRANSFORMER, 24V CONTROL	CONTROL BOX
T3	TRANSFORMER, FAN SPEEDTROL	ON BULKHEAD
TB2	TERMINAL BLOCK, 120V, FIELD	CONTROL BOX
TB3	TERMINAL BLOCK, 24V, FIELD	CONTROL BOX
TB4—6	TERMINAL BLOCKS, CONTROL	CONTROL BOX
TC1	THERMOSTAT, UNIT	CONTROL BOX
TC2	THERMOSTAT, COOLER BARREL	ON COOLER
TC10	THERMOSTAT, SPECIAL	CONTROL BOX OR ON UNIT
TC11	THERMOSTAT, HI RETURN WATER UNLOADER	CONTROL BOX
TC12	THERMOSTAT, SPECIAL	CONTROL BOX OR ON UNIT
TC13—25	THERMOSTATS, FANTROL	CONTROL BOX
TD1—4	TIME DELAYS, COMPRESSOR LOCKOUT	CONTROL BOX
TD5—8	TIME DELAYS, COMPRESSOR PART WINDING	CONTROL BOX
TD9, 10	TIME DELAYS, LOW AMBIENT	CONTROL BOX
TD11, 12, 13	TIME DELAYS, COMPRESSOR SEQUENCING	CONTROL BOX
TD14	TIME DELAY, ALARM BELL	CONTROL BOX
TD15, 16	TIME DELAYS, FREEZESTAT	CONTROL BOX
TD17, 18, 19	TIME DELAYS, HEAT RECOVERY	CONTROL BOX
TD20—24	TIME DELAYS, SPECIAL	CONTROL BOX
U1, 2	UNLOADERS	ON COMPRESSORS

GENERAL NOTES

1. FIELD WIRING
2. WIRING IN REMOTE UNIT
3. WIRING CONNECTING UNITS
4. 200 WIRE NUMBER
5. OPTION BLOCK
6. FACTORY WIRED TERMINAL
7. FIELD WIRED TERMINAL
8. REMOTE PANEL TERMINAL
9. WIRE CONNECTOR
10. PLUG CONNECTOR
11. 289* OPTIONAL LINE ON TERMINAL BLOCK

Figure 16. Recommended Field Installed Unit Disconnect Location



NOTE:
MOUNT DISCONNECT ON STATIONARY PANEL SO THAT IT DOES NOT INTERFERE WITH HINGED DOORS OR WITH AIR INTAKE INTO COIL.

NORMAL SEQUENCE OF OPERATION

The following sequence of operation is typical for ALR SEASONPAK air cooled water chiller, Models ALR-040C through ALR-195C (items in *italics* apply only to *Models ALR-105C thru ALR-195C*). The sequence varies somewhat depending upon options.

Startup — With the control circuit power on and the control stop switch S1 closed, 115V power is applied through the control circuit fuse F1 to the compressor crankcase heaters (HTR1, HTR2, and *HTR3 and HTR4*), the compressor motor protectors (MP1, MP2, *MP3 and MP4*), and the primary of the 24V control circuit transformer. The 24V transformer provides power to the contacts of the low pressure controls LP1 and LP2 and the compressor lockout time delays TD1 and TD2.

When the remote time clock or manual shutdown switch turns on the chilled water pump, the flow switch closes and 115V power is applied to the relay contacts on the central processor CP1. The unit will automatically operate in response to the central processor CP1 provided the manual pumpdown switches PS1 and PS2 are closed (in the "auto" position); the compressor lockout time delays TD1 and TD2 have closed, energizing the safety relays (R5, R6, *R7 and R8*); and the freezestats FS1 and FS2, high pressure controls HP1 and HP2, and compressor motor protectors (MP1, MP2, *MP3 and MP4*) do not sense failure conditions.

On a call for cooling, the central processor CP1 energizes the liquid line solenoid valve SV1 for refrigerant circuit #1, opening the valve and allowing refrigerant to flow through the expansion valve and into the evaporator. As the evaporator refrigerant pressure increases, the low pressure control LP1 closes. This energizes the compressor starting relay R9, starting the compressor via the compressor contactors M1 and M5. Closing the R9 contacts also energizes the condenser fan motor contacts M11, M12, M13 and M14, starting the fan motors.

As additional stages of cooling capacity are required, the central processor CP1 energizes the liquid line solenoid valve SV2 of the refrigerant circuit #2. After the compressor sequencing time *delay TD11* has closed, the same starting sequence is initated in refrigerant circuit #2.

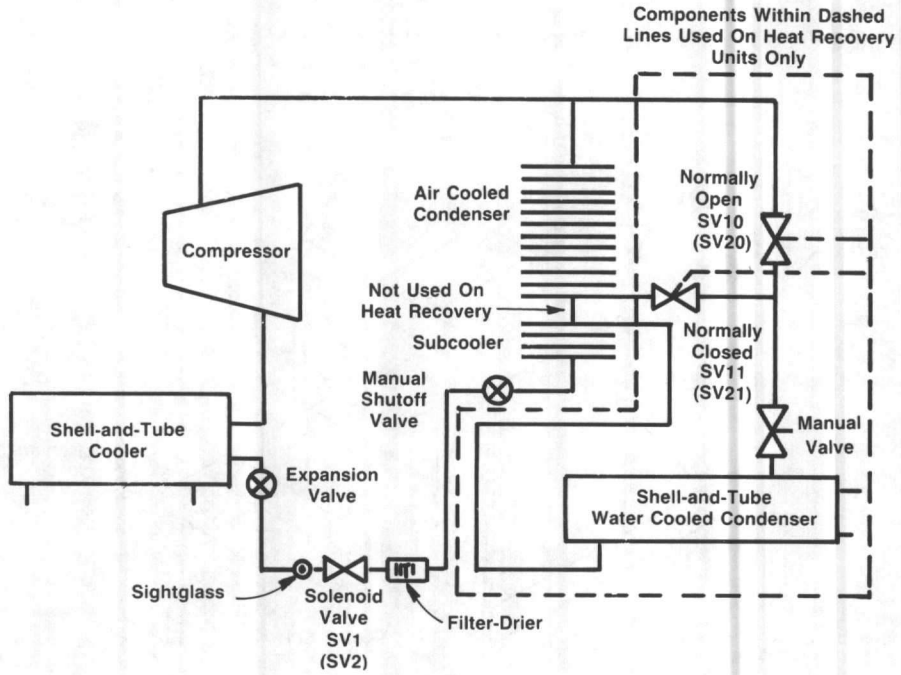
If still more cooling is required, the Central Processor will *start the remaining compressors* and then de-energize unloader solenoids until the capacity requirement is met.

Heat Recovery Units — On a call for heat, the heat recovery switch closes, energizing the heat recovery relay R19. When R19 is energized, the condenser fans are shut off, and solenoid valves SV10, SV11, SV20 and SV21 in the refrigerant lines route the discharge gas to the heat recovery condensers. Upon satisfying the heating demand, the heat recovery switch opens and the discharge gas is re-routed to the air cooled condensers. To avoid short cycling, the heat recovery time delays TD17 and TD18 will delay switchover to heat recovery.

Pumpdown — As the central processor is satisfied, it will unload the compressors and then de-energize the liquid line solenoid valves SV1 and SV2, causing the valves to close. When the compressor has pumped most of the refrigerant out of the evaporator and into the condenser, the low pressure controls LP1 and LP2 will open, shutting down the compressors and the condenser fan motors. In the event a closed solenoid valve allows refrigerant to leak into the evaporator, the increase in pressure will cause the low pressure control LP1 or LP2 to close. This will energize the compressor starting relays R9 or R10 and start the compressor, which will quickly pump the refrigerant out of the evaporator and into the condenser (recycling pumpdown).

A compressor which repeats recycling pumpdown every 5 minutes indicates a malfunction due to the temperature control or a system cause. A build up of heat in the compressor without proper cooling of suction gas could cause a mechanical failure in the compressor. McQuay recommends corrective measures be taken if the compressor recycles repeatedly within 15-minute intervals.

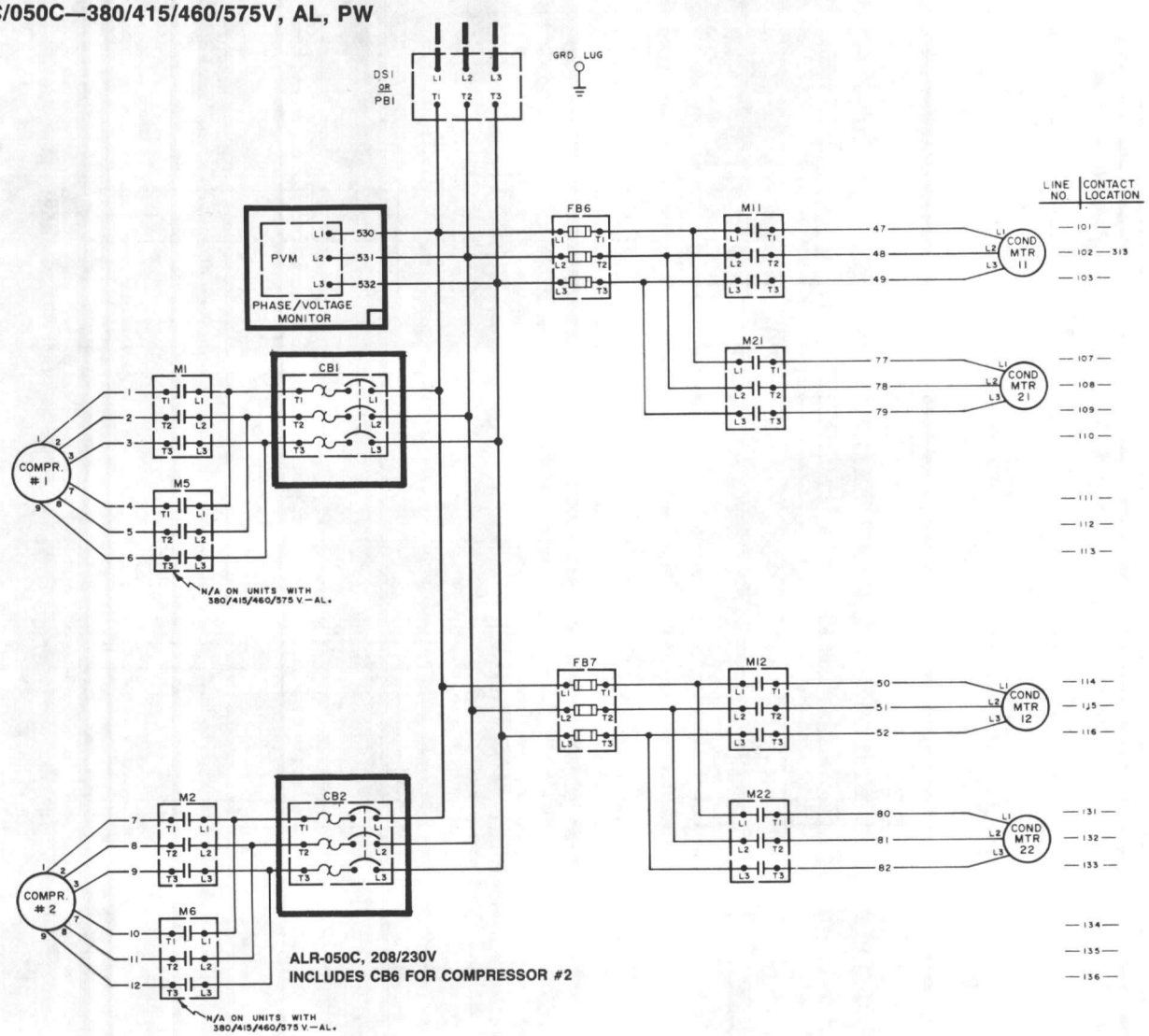
Figure 14. Refrigerant Piping Schematic

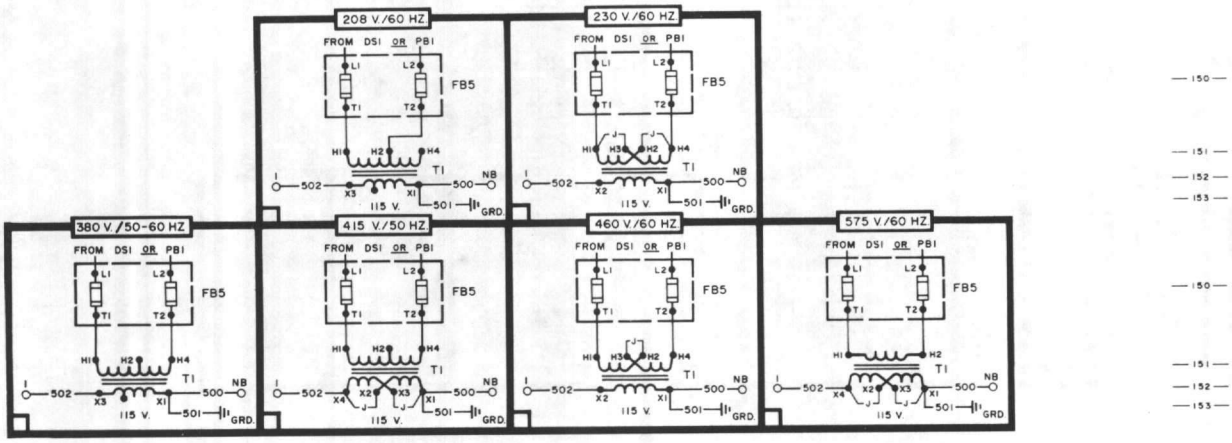


TYPICAL POWER WIRING DIAGRAMS

SINGLE POINT, WITHOUT SPEEDTROL

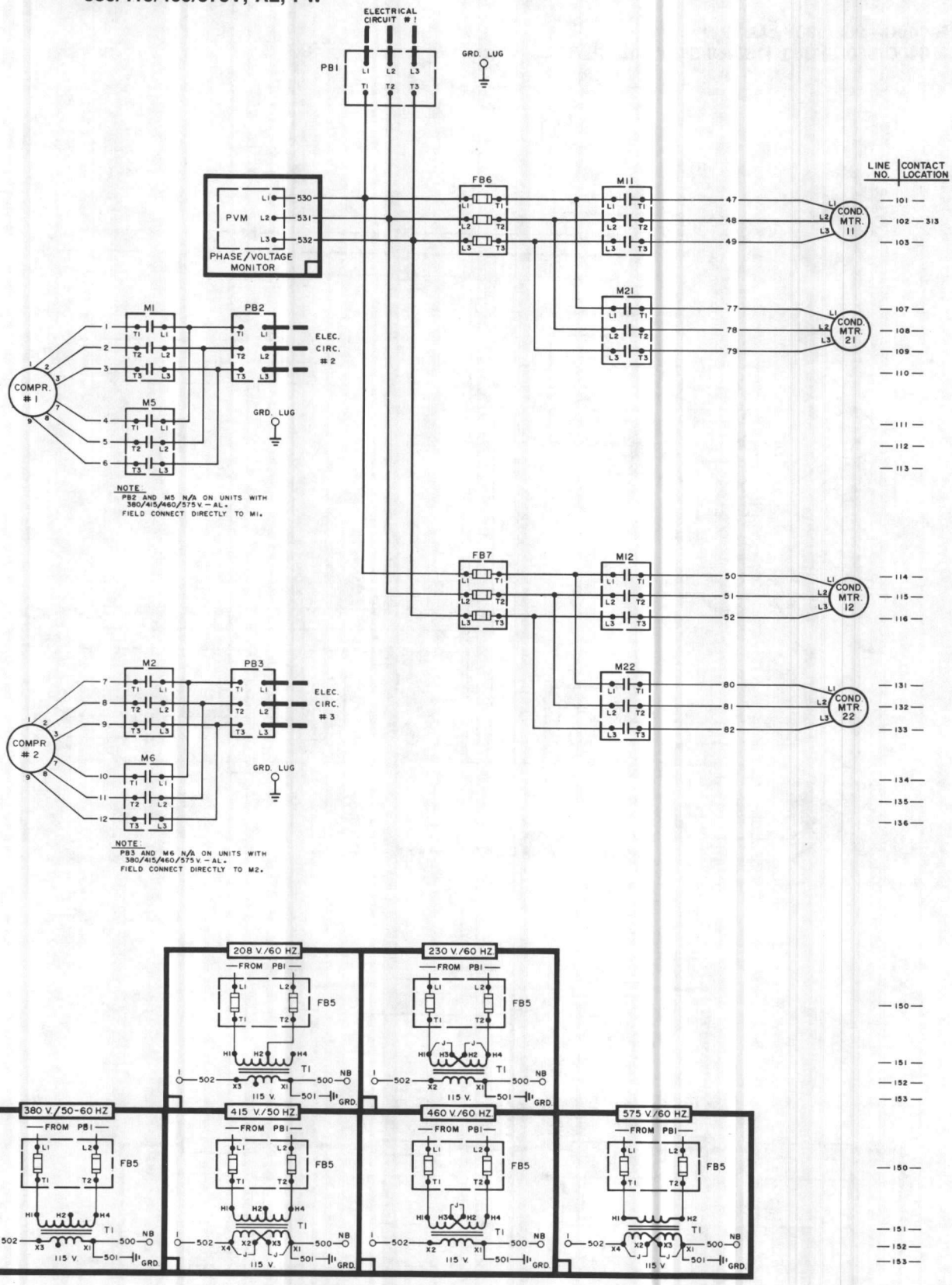
ALR-040C—208/230V, AL, PW
ALR-040C/050C—380/415/460/575V, AL, PW





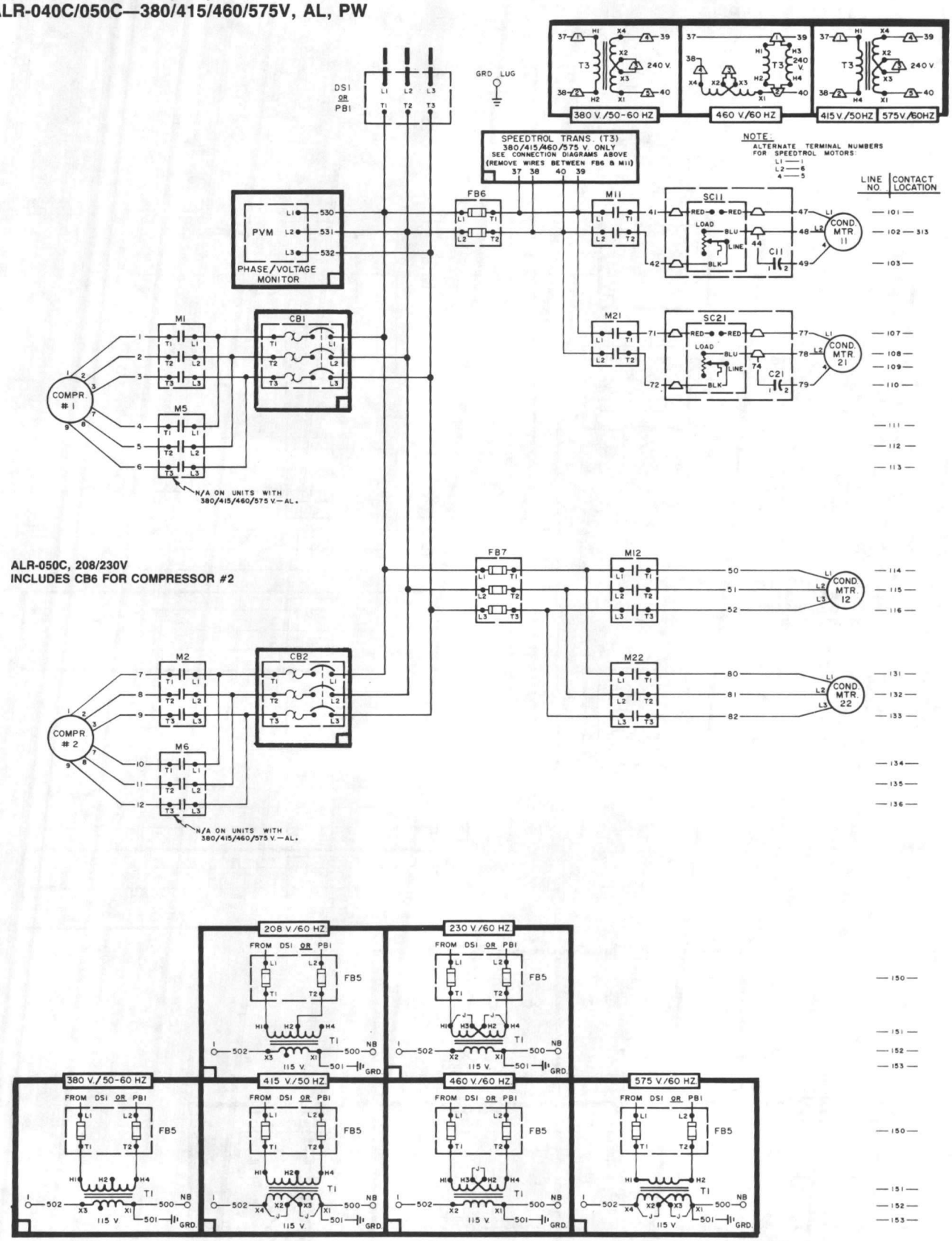
MULTIPLE POINT WITHOUT SPEEDTROL

ALR-040C/050C—208/230V, AL, PW
380/415/460/575V, AL, PW



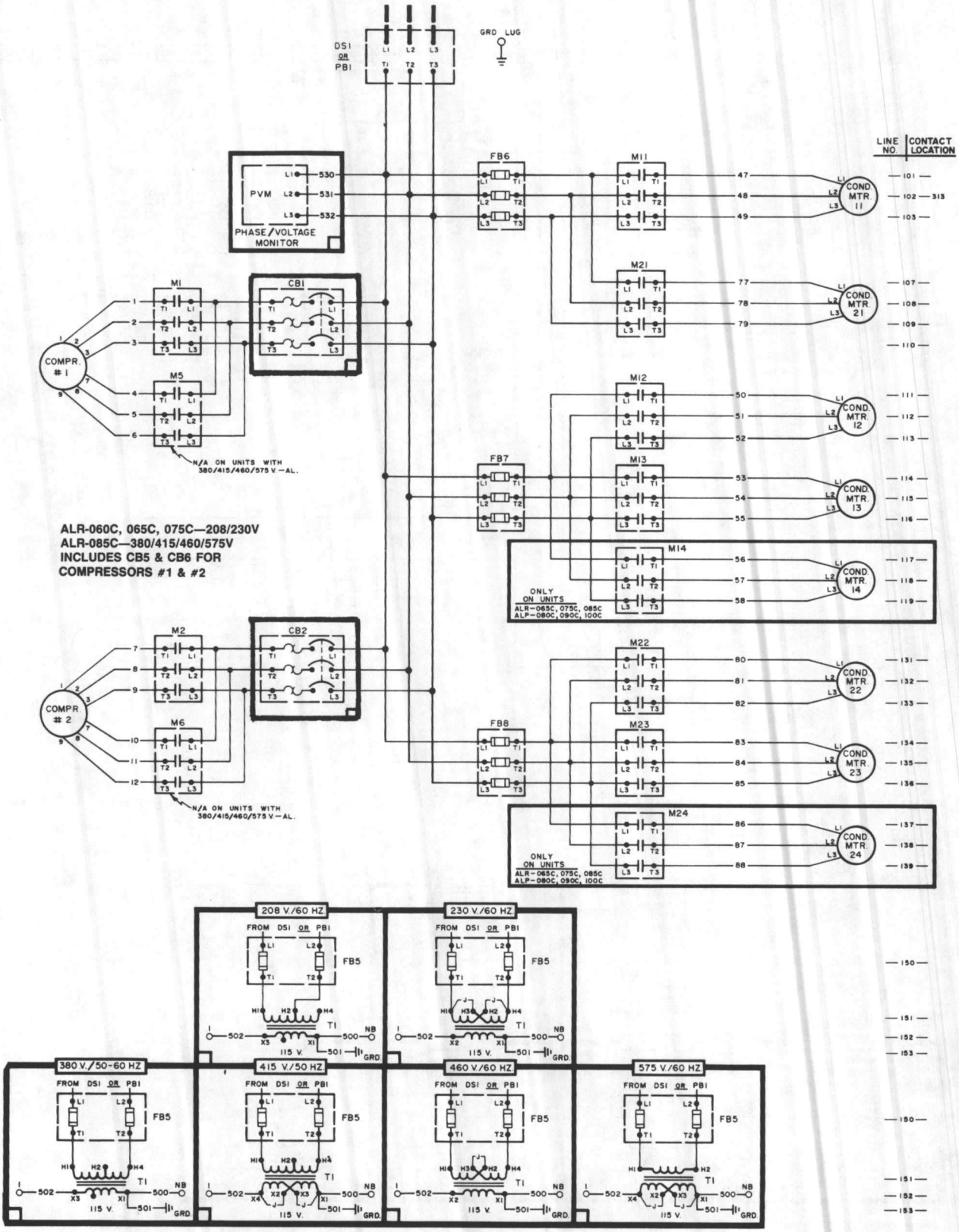
SINGLE POINT, WITH SPEEDTROL

ALR-040C—208/230V, AL, PW
ALR-040C/050C—380/415/460/575V, AL, PW



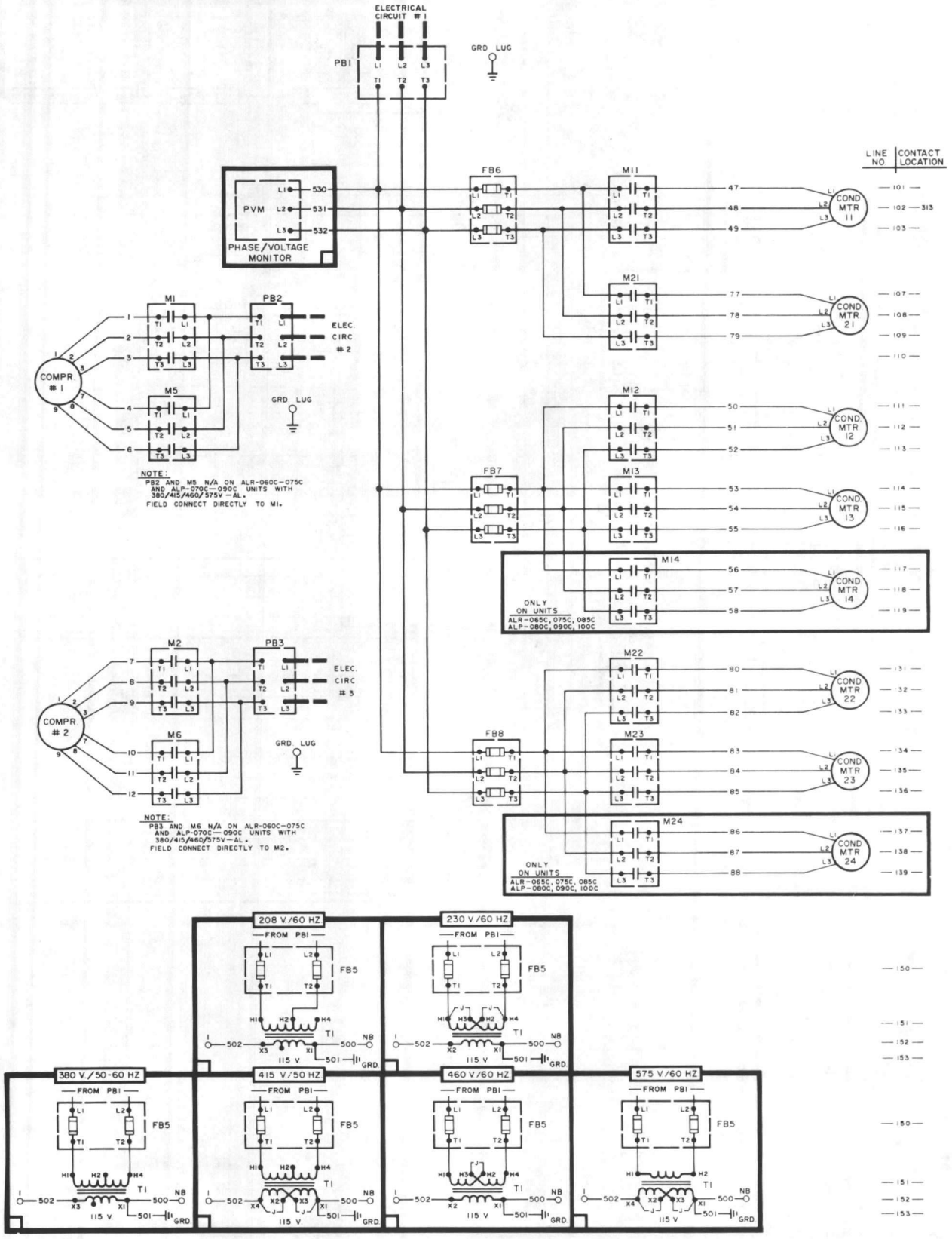
SINGLE POINT, WITHOUT SPEEDTROL

ALR-060C, 065C, 075C—380/415/460/575V, AL, PW
ALR-085C—208/230V, AL, PW



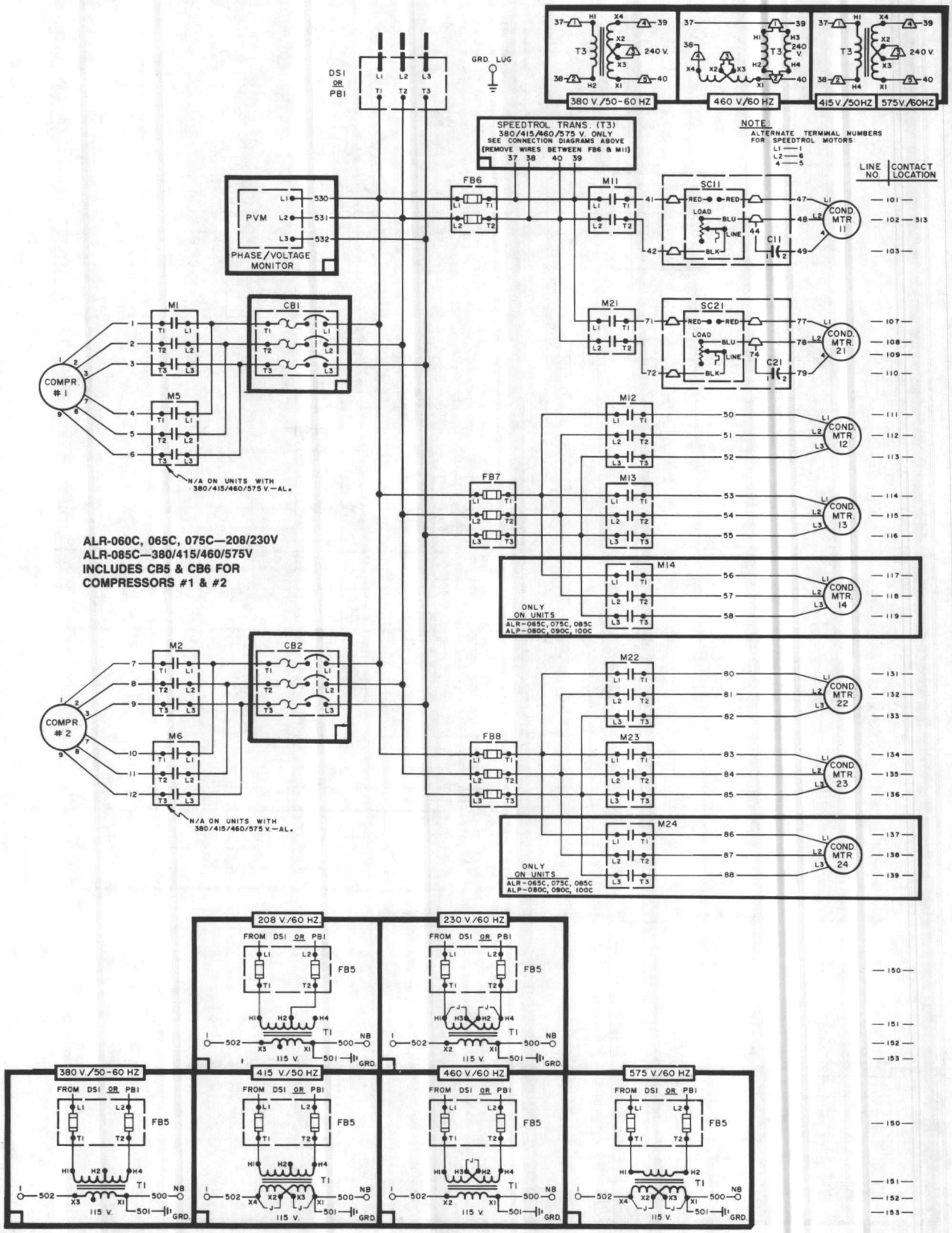
MULTIPLE POINT WITHOUT SPEEDTROL

ALR-060C, 065C, 075C, 085C—208/230V, AL, PW
380/415/460/575V, AL, PW



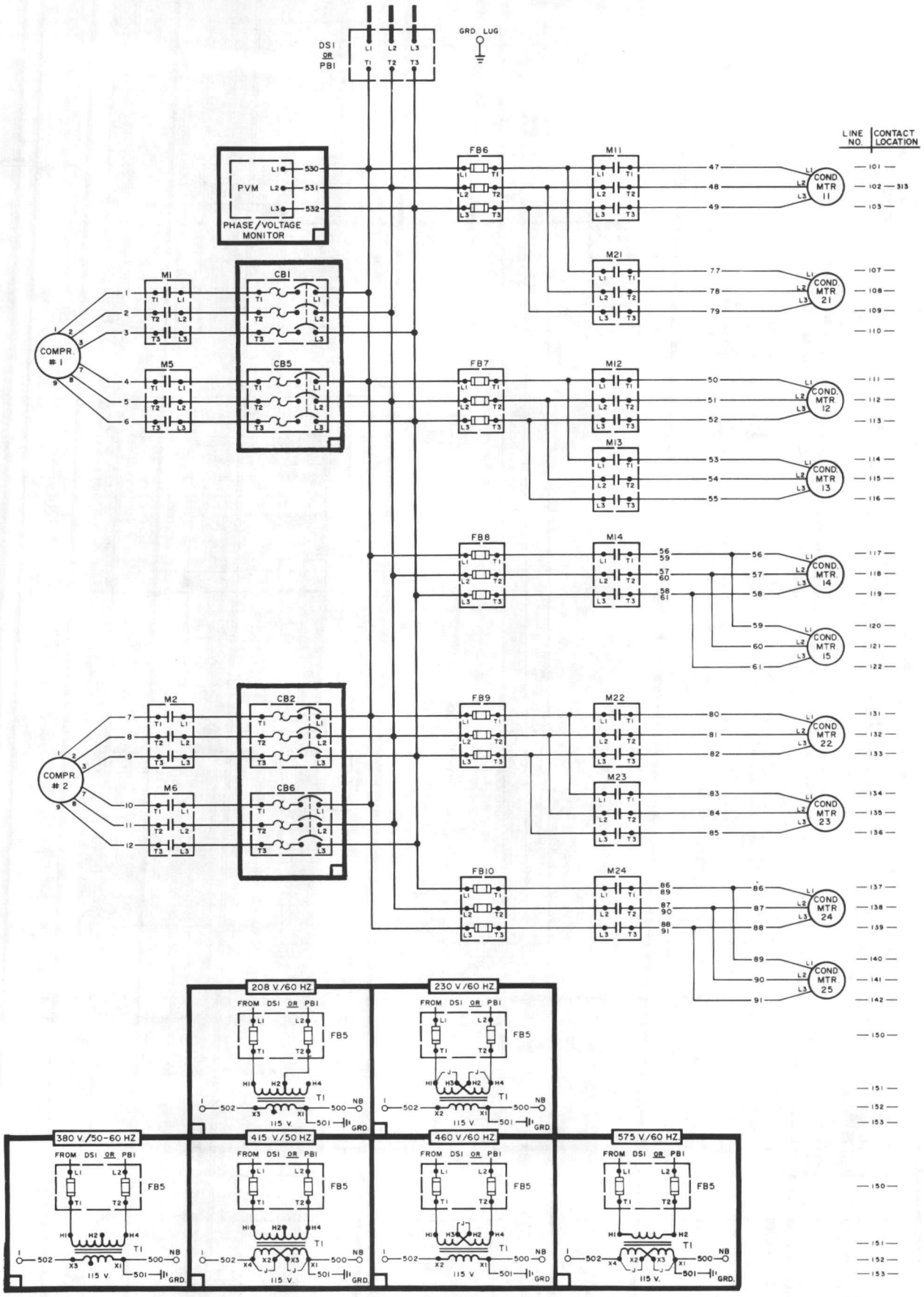
SINGLE POINT, WITH SPEEDTROL

ALR-060C, 065C, 075C—380/415/460/575V, AL, PW
ALR-085C—208/230V, AL, PW



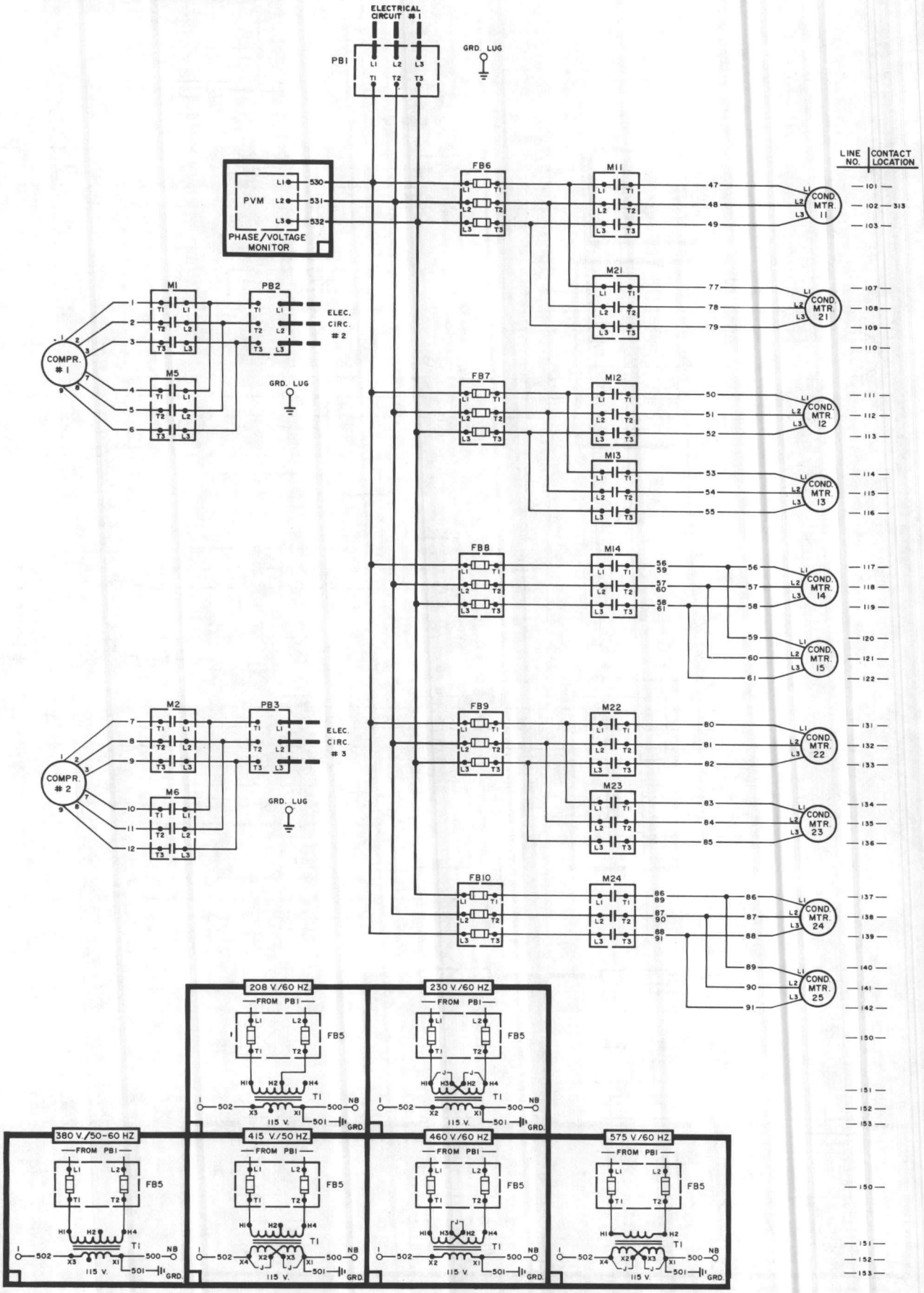
SINGLE POINT, WITHOUT SPEEDTROL

ALR-095C—208/230V, AL, PW
380/415/460/575V, AL, PW



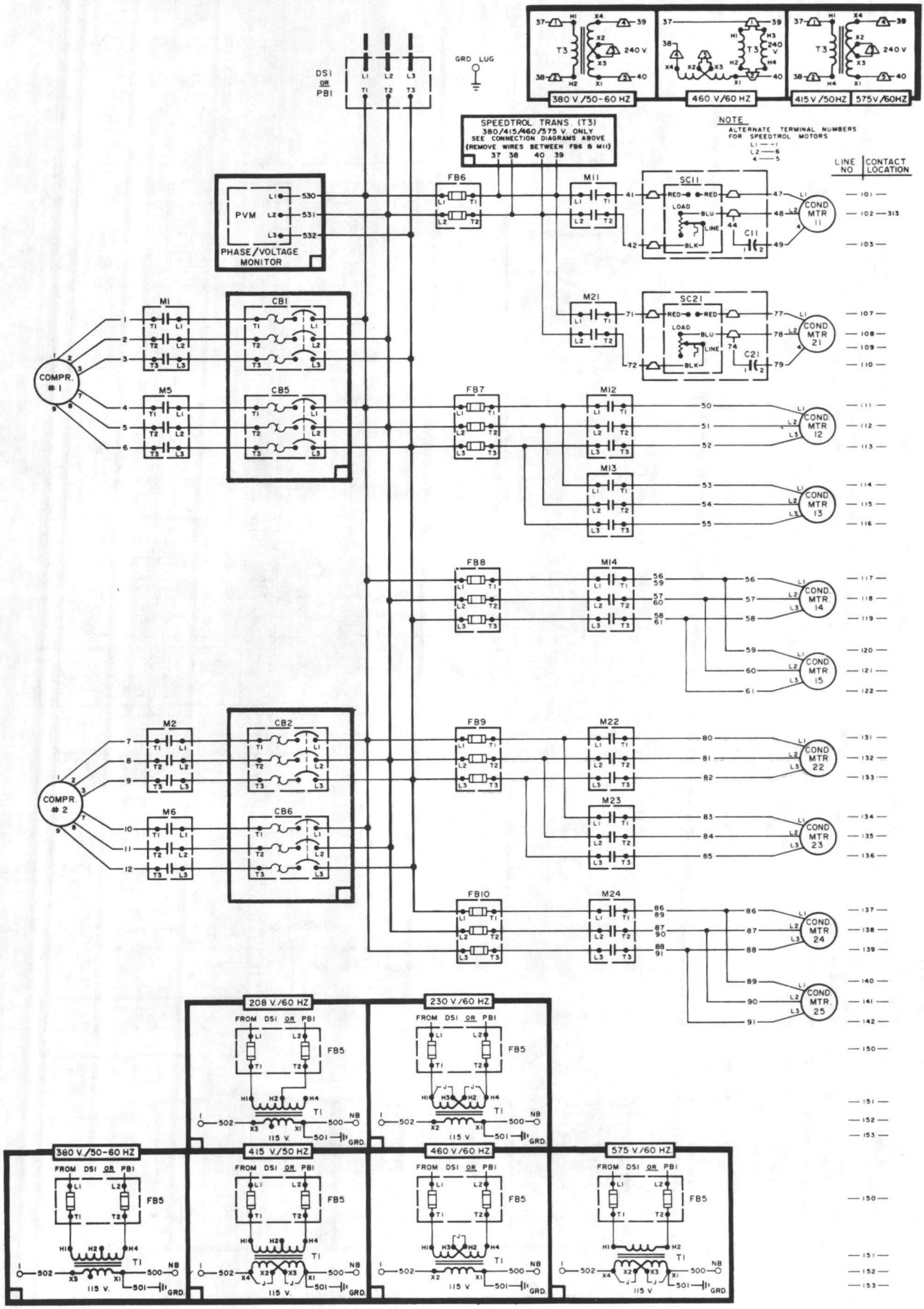
MULTIPLE POINT WITHOUT SPEEDTROL

ALR-095C—208/230V, AL, PW
380/415/460/575V, AL, PW



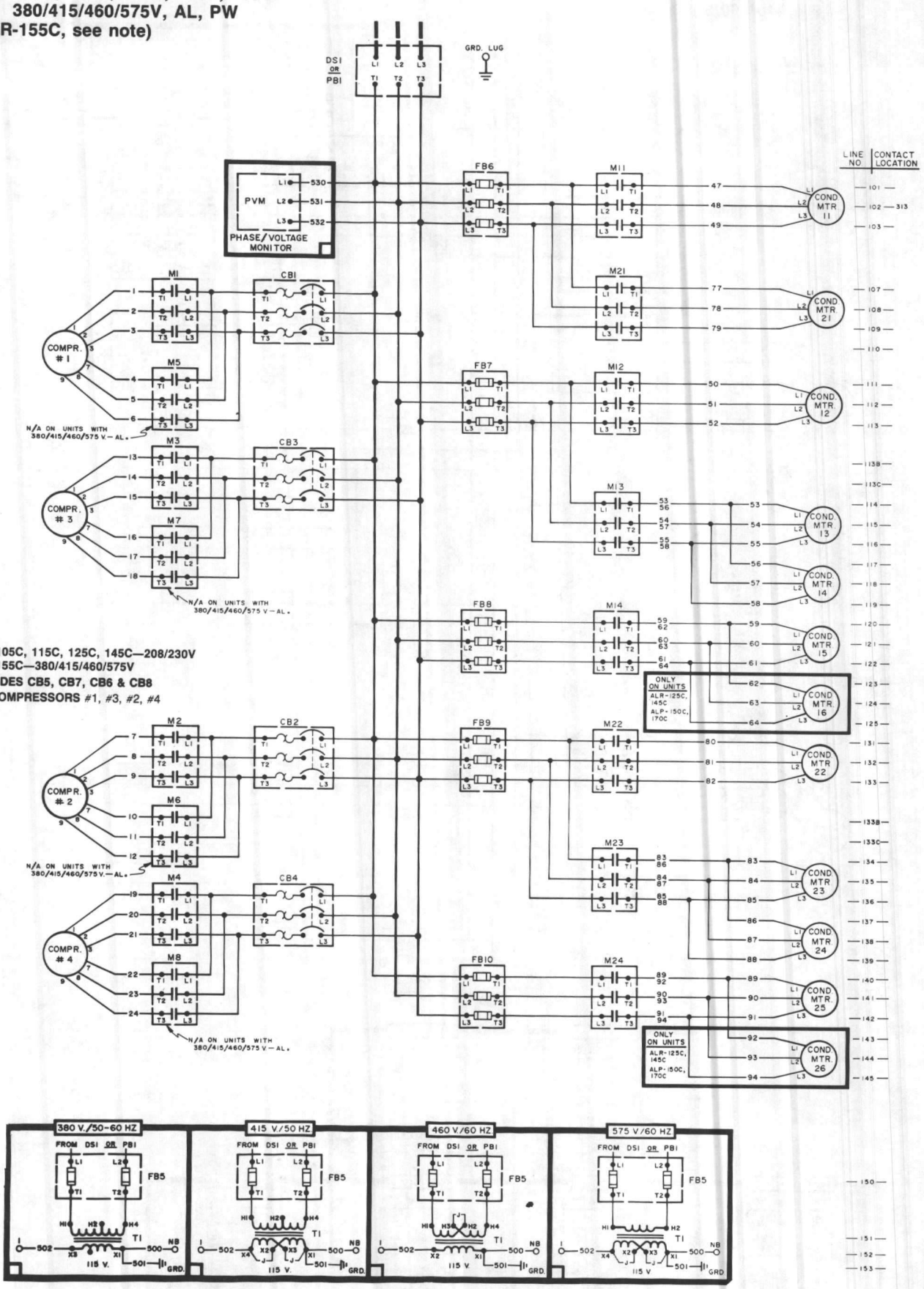
SINGLE POINT, WITH SPEEDTROL

ALR-095C—208/230V, AL, PW
380/415/460/575C, AL, PW



SINGLE POINT, WITHOUT SPEEDTROL

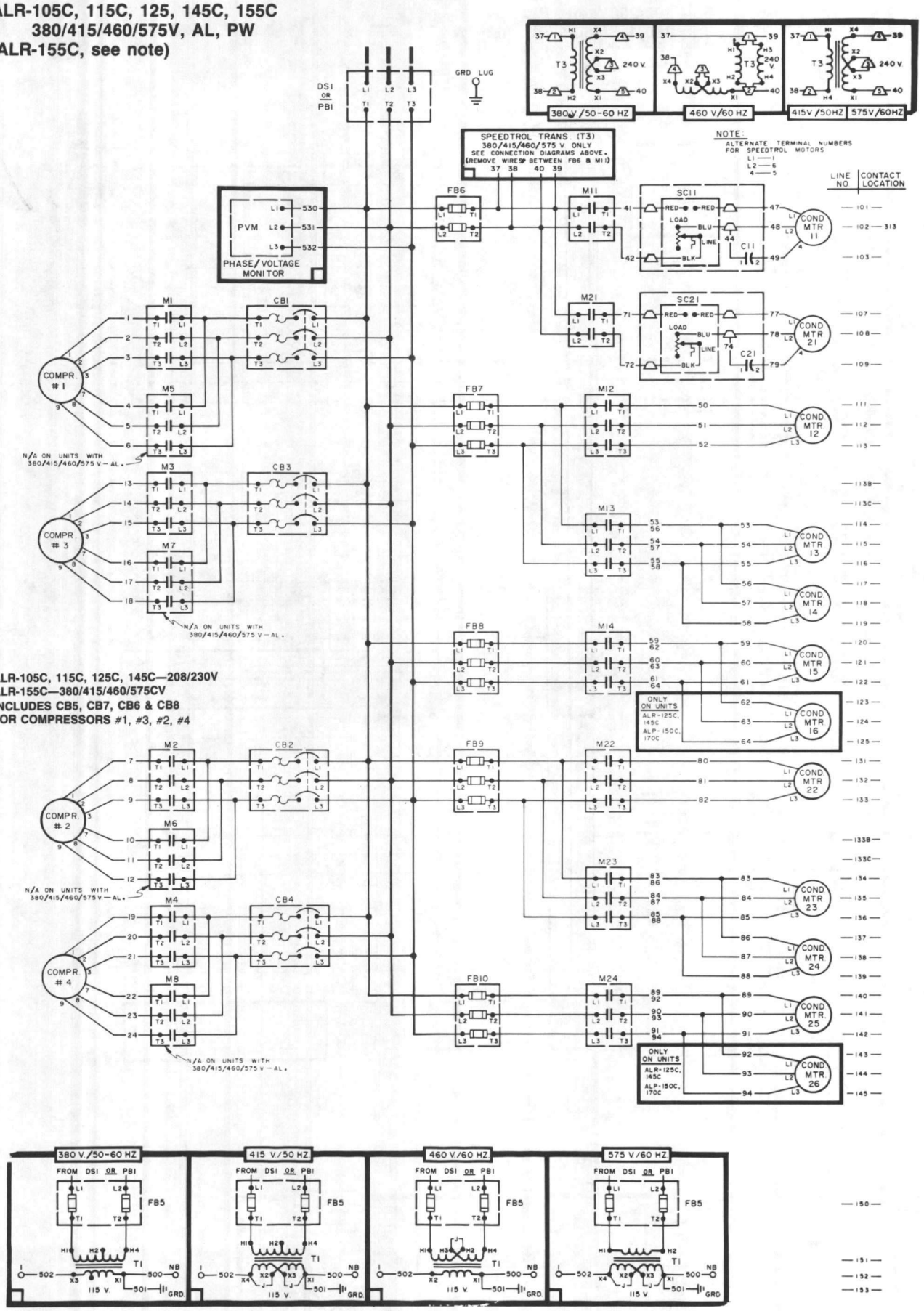
ALR-105C, 115C, 125C, 145C, 155C 380/415/460/575V, AL, PW (ALR-155C, see note)



ALR-105C, 115C, 125C, 145C—208/230V
ALR-155C—380/415/460/575V
INCLUDES CB5, CB7, CB6 & CB8
FOR COMPRESSORS #1, #3, #2, #4

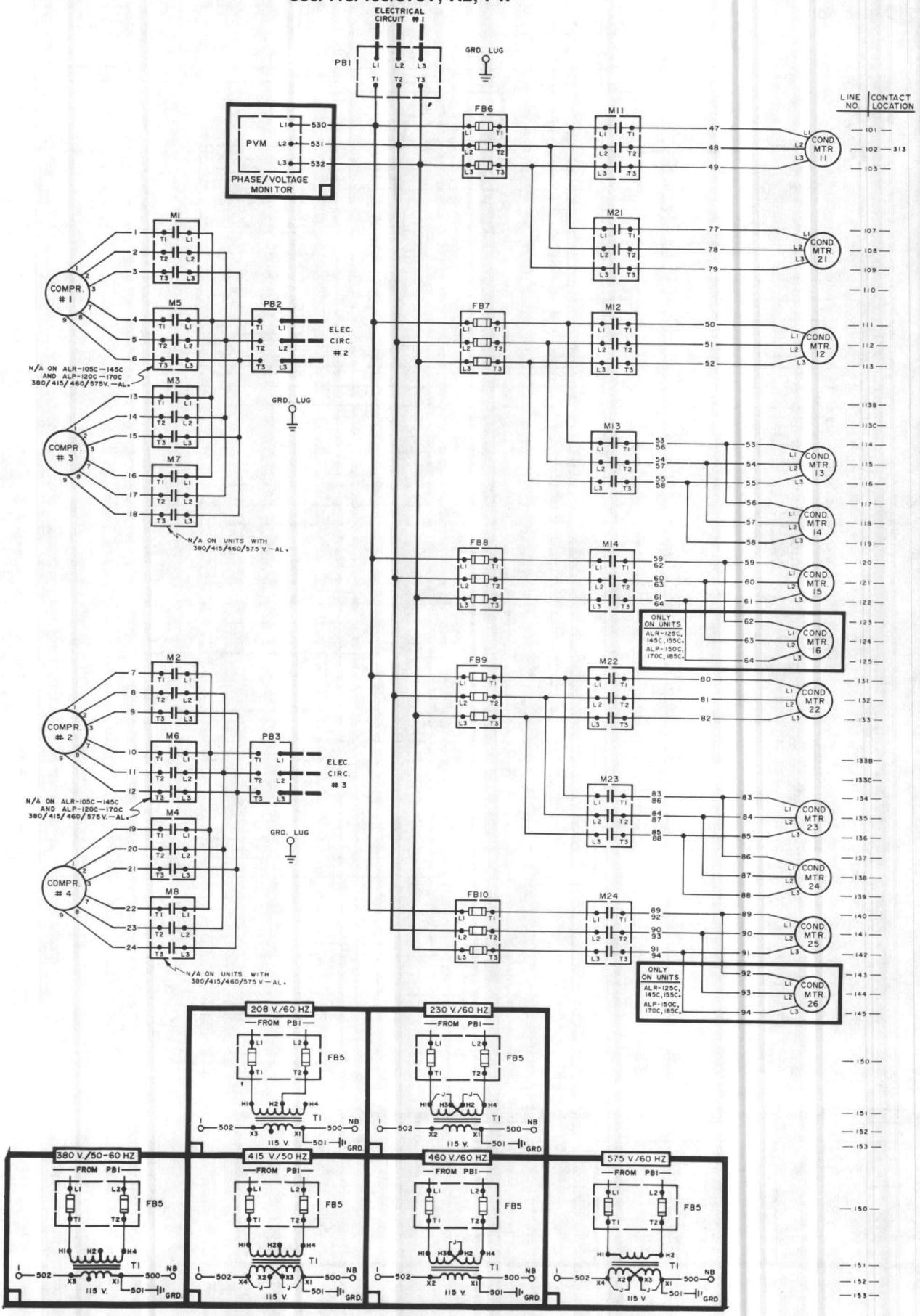
SINGLE POINT, WITH SPEEDTROL

ALR-105C, 115C, 125, 145C, 155C 380/415/460/575V, AL, PW (ALR-155C, see note)



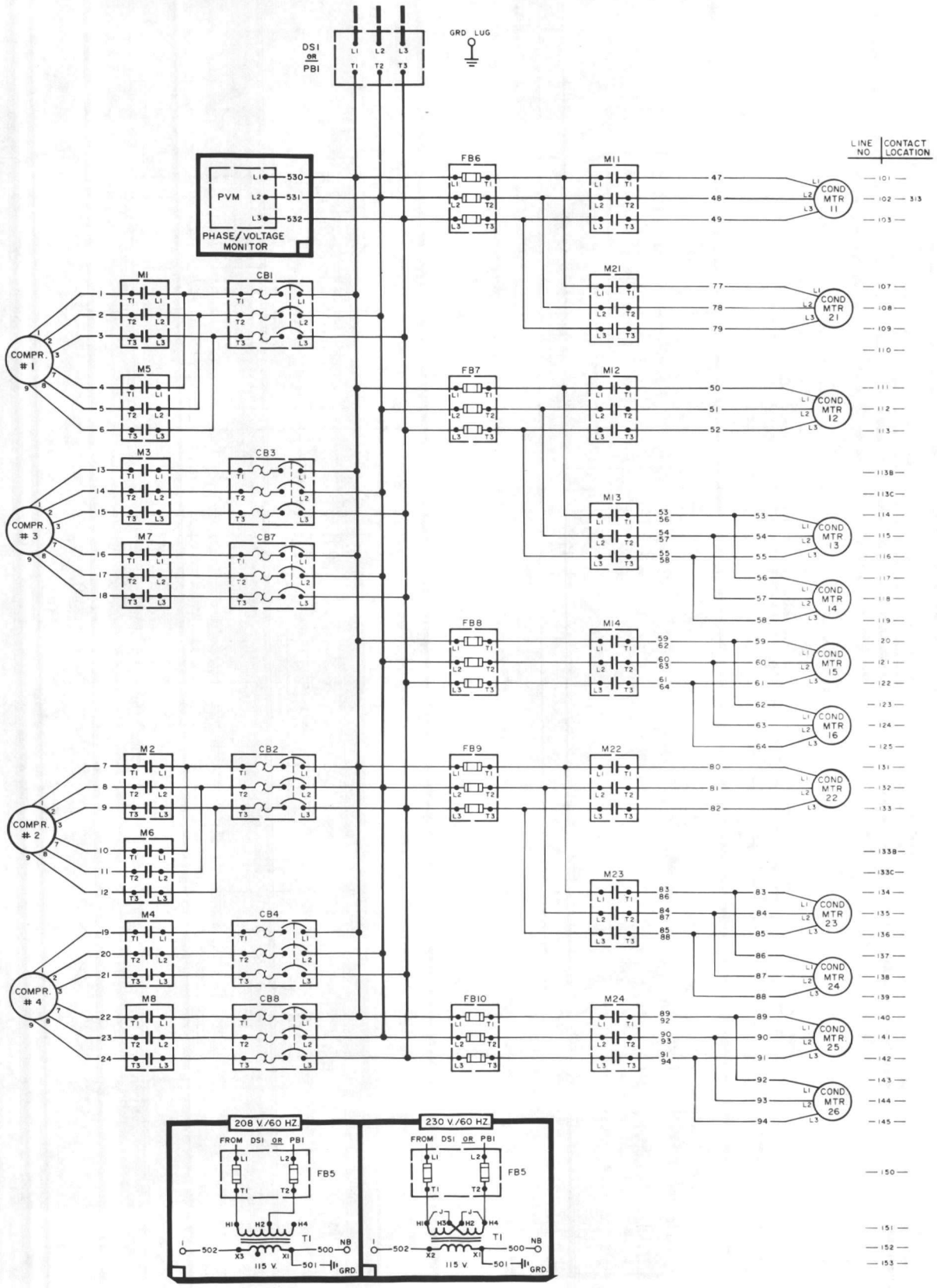
MULTIPLE POINT WITHOUT SPEEDTROL

ALR-105C, 115C, 125C, 145C, 155C—208/230V, AL, PW
380/415/460/575V, AL, PW



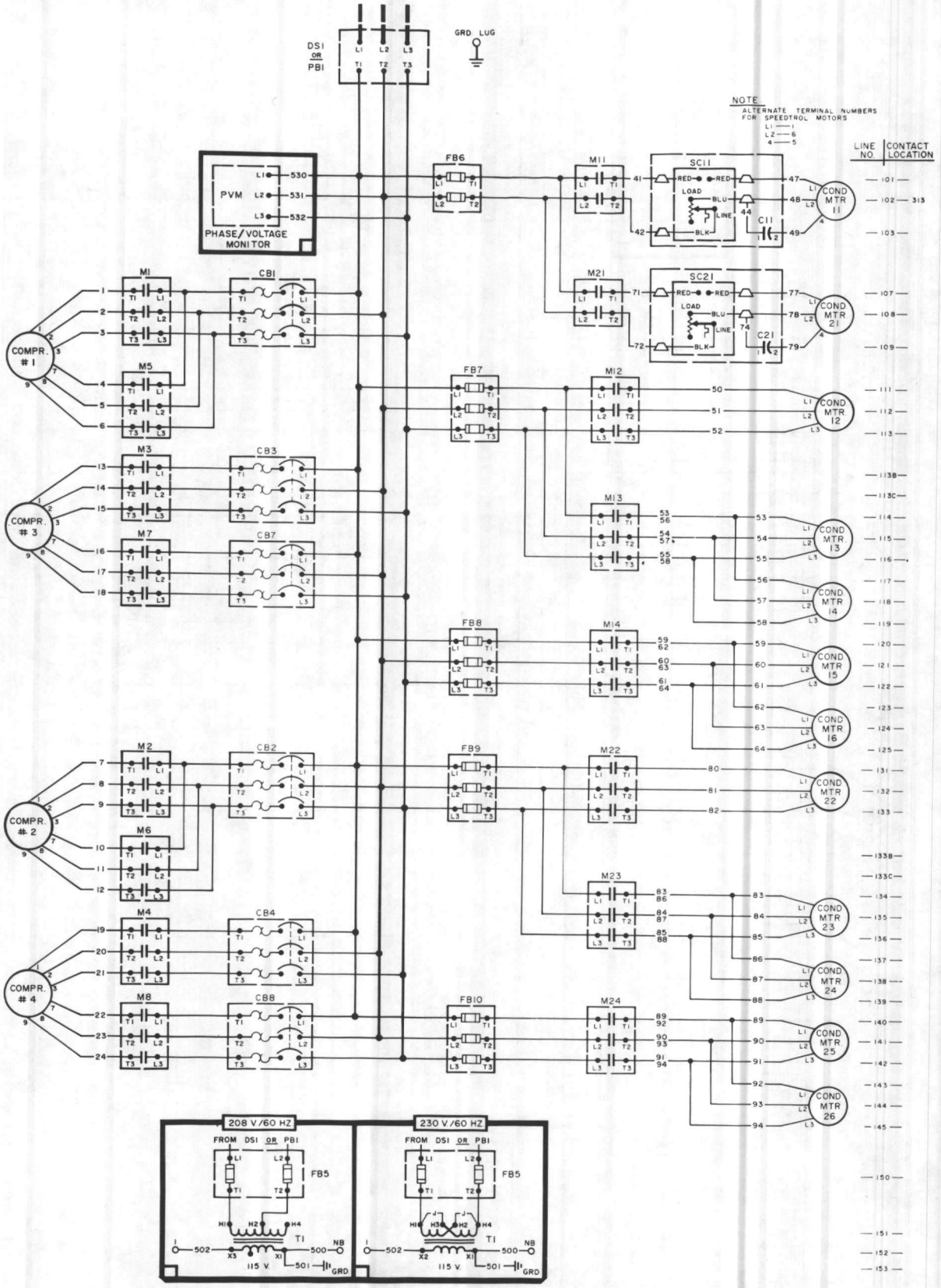
SINGLE POINT, WITHOUT SPEEDTROL

ALR-155C—208/230V, AL, PW



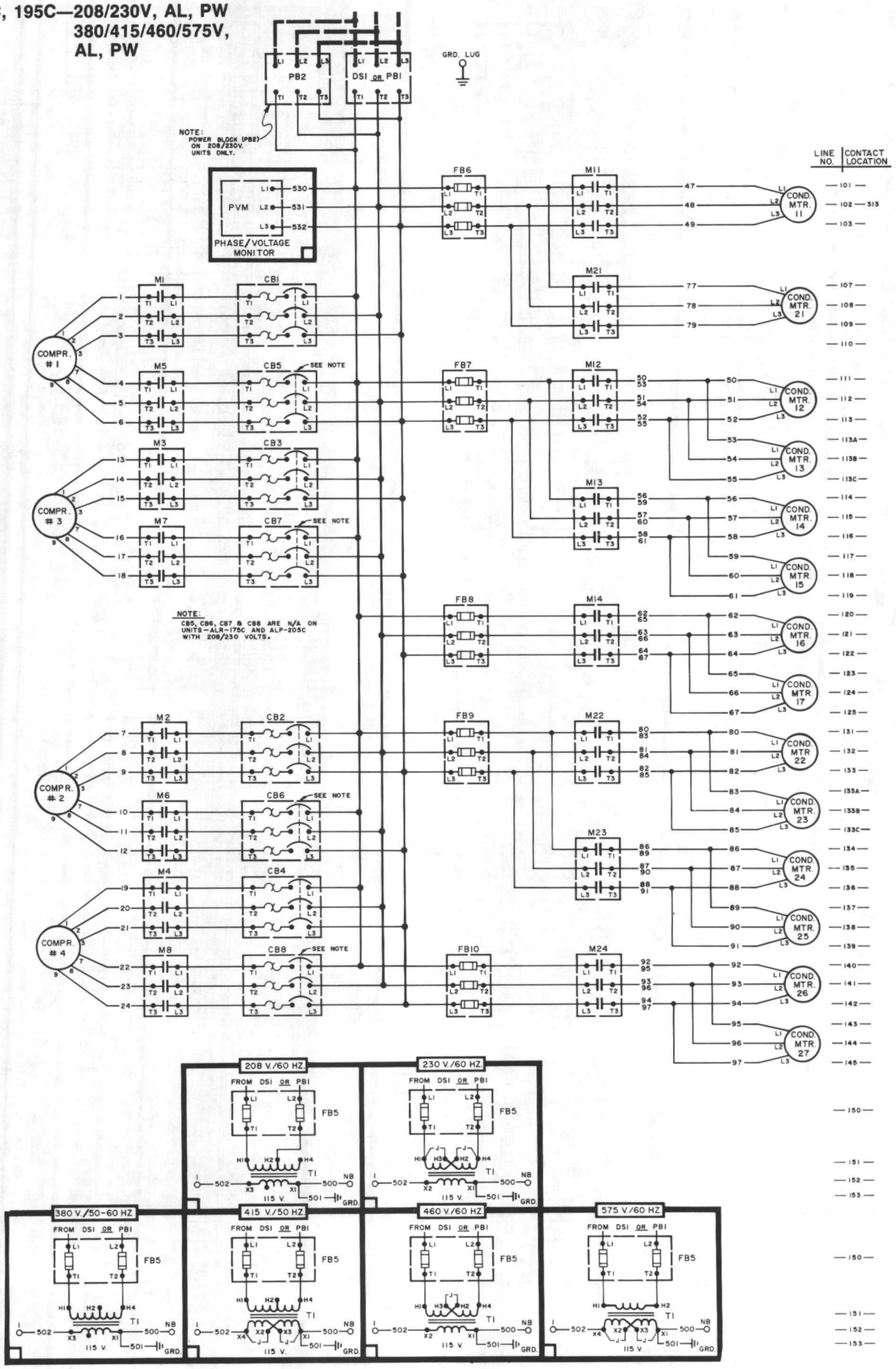
SINGLE POINT, WITH SPEEDTROL

ALR-155C—208/230V, AL, PW



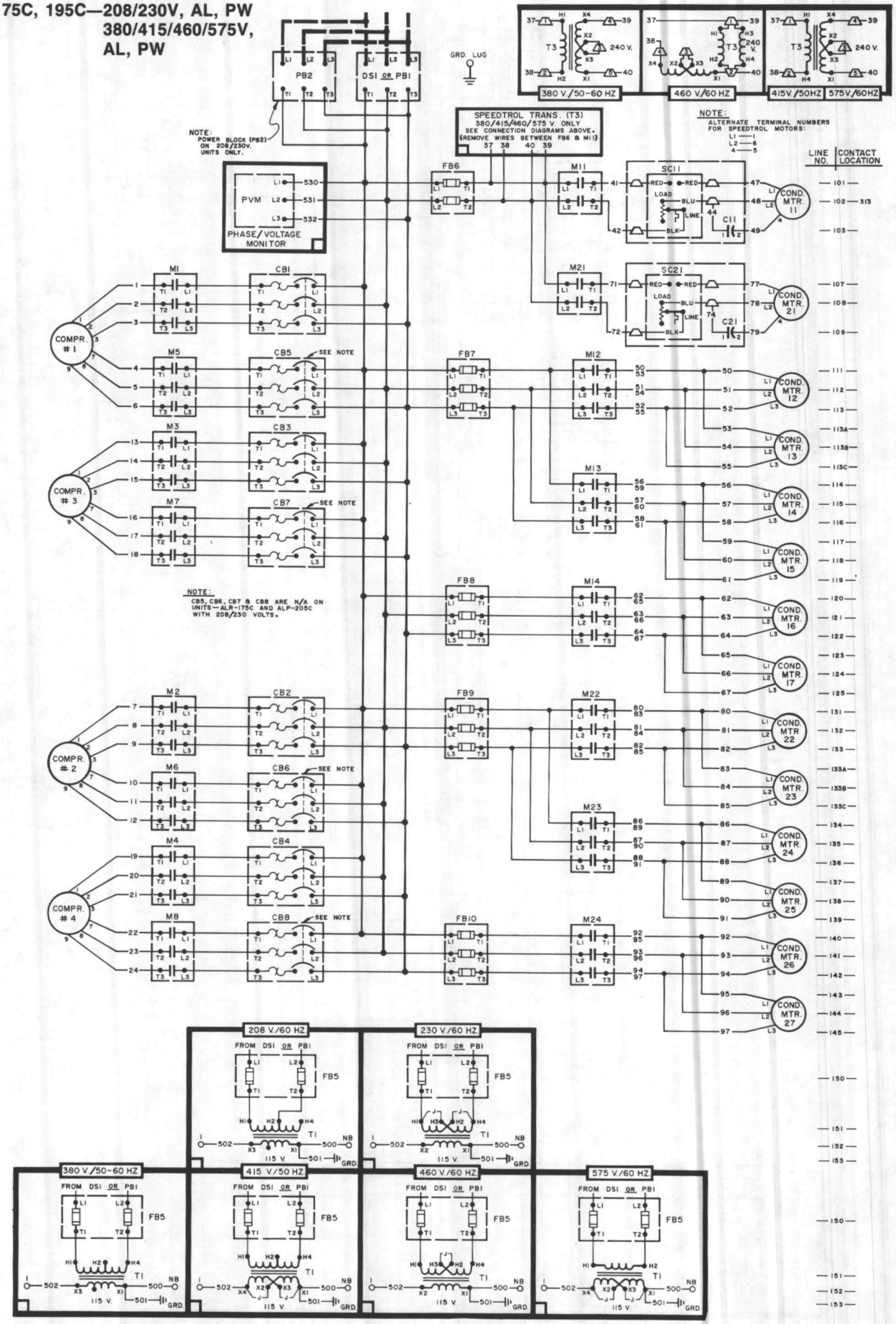
SINGLE POINT, WITHOUT SPEEDTROL

ALR-175C, 195C—208/230V, AL, PW
380/415/460/575V, AL, PW



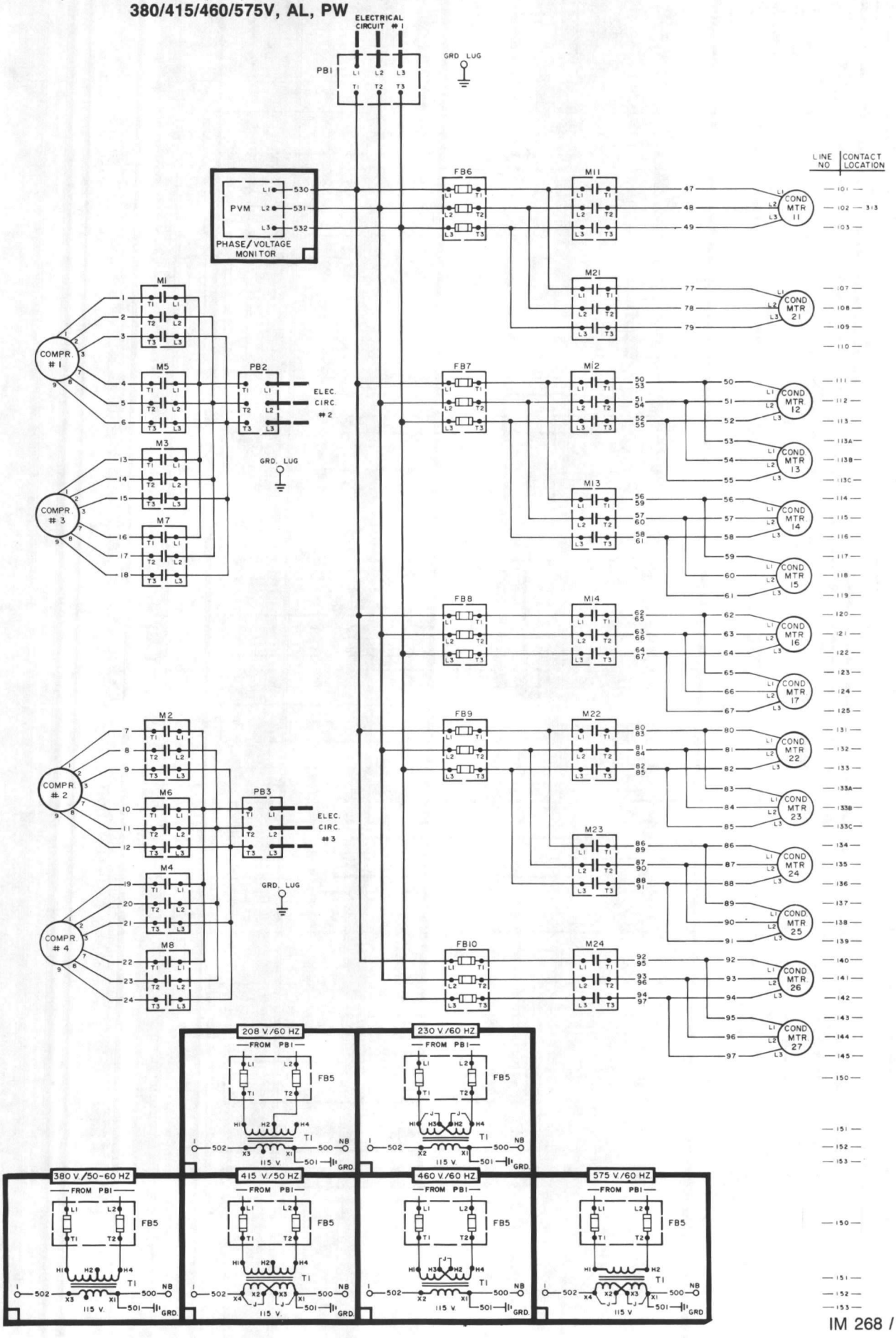
SINGLE POINT, WITH SPEEDTROL

ALR-175C, 195C—208/230V, AL, PW
380/415/460/575V, AL, PW



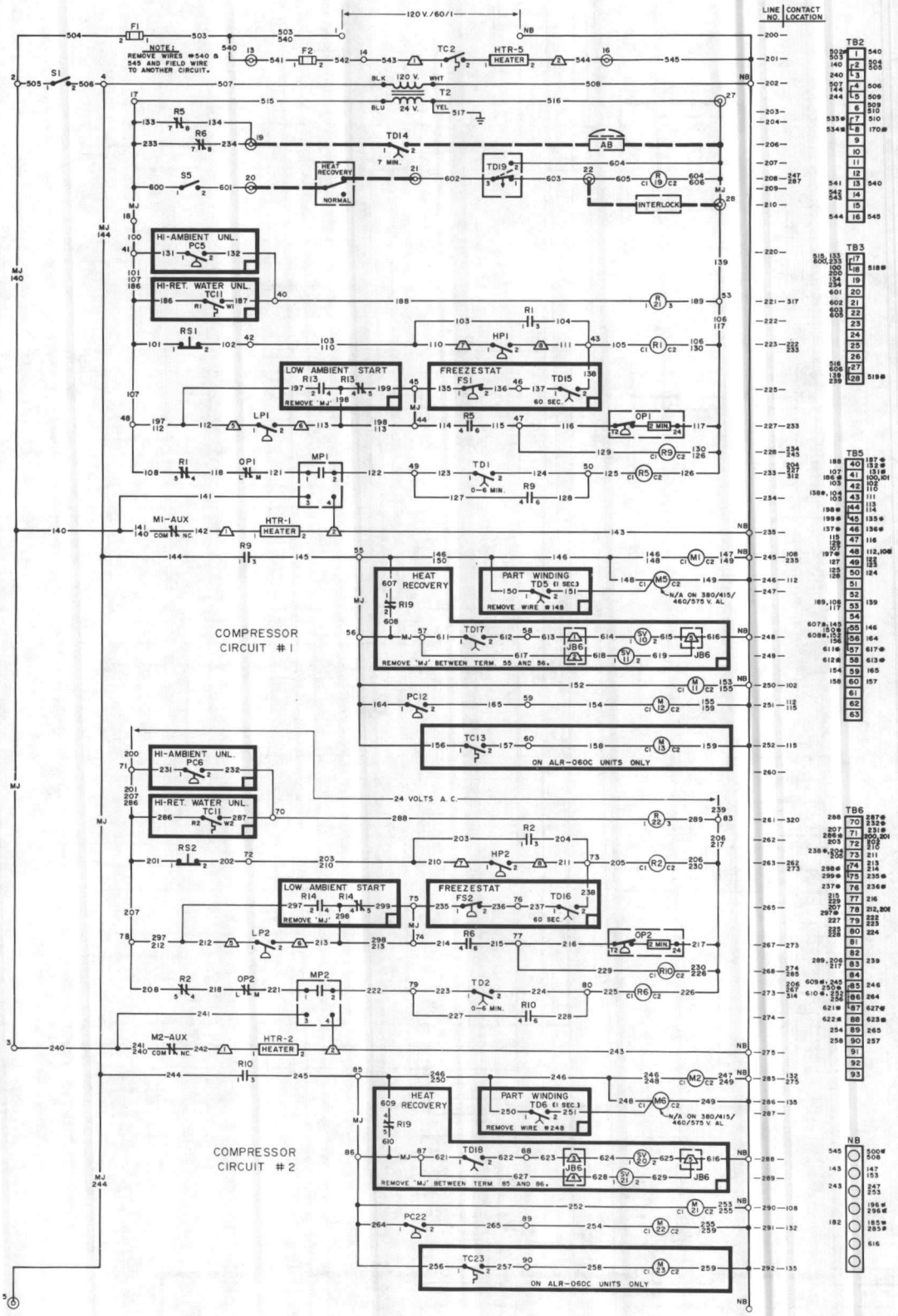
MULTIPLE POINT WITHOUT SPEEDTROL

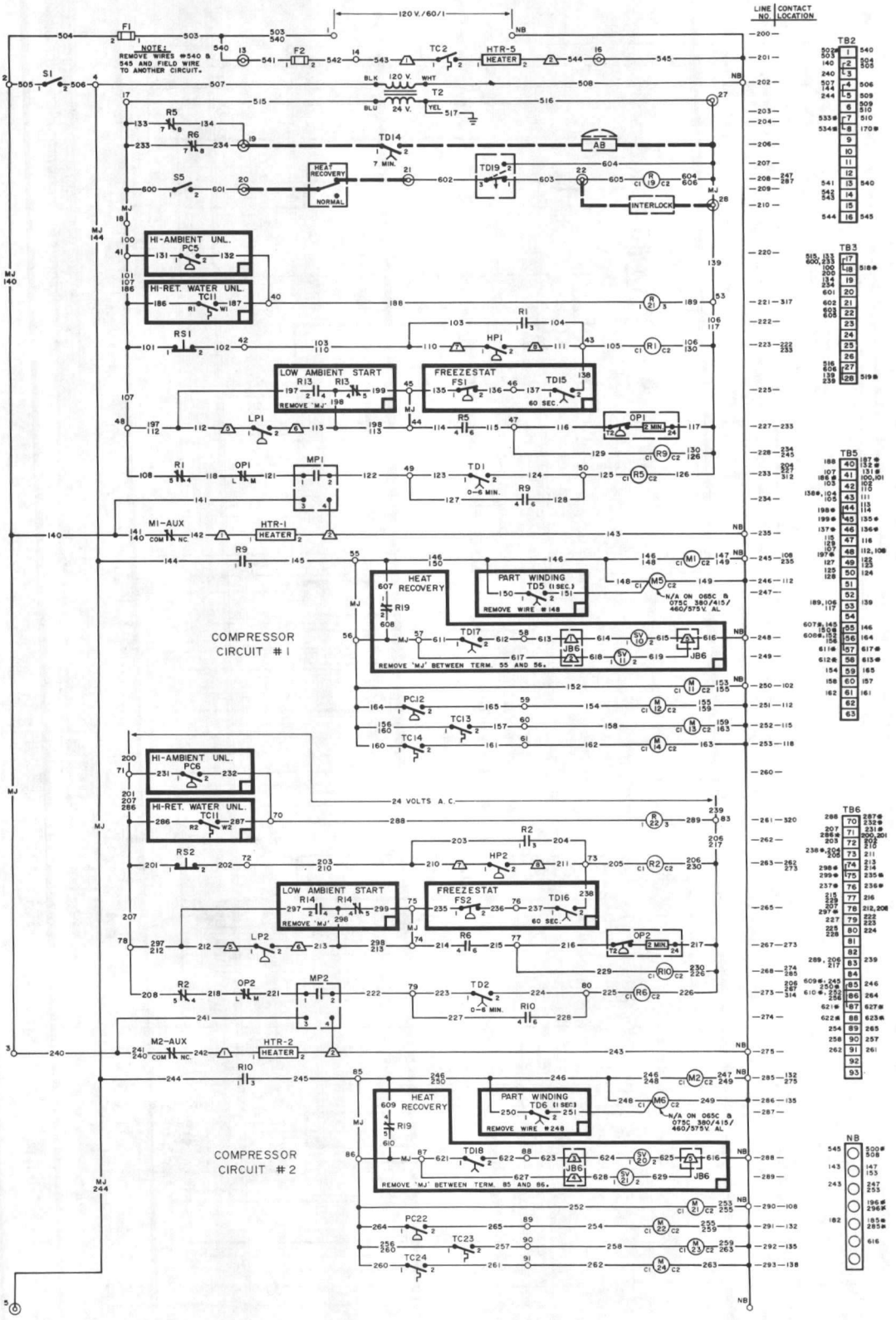
ALR-175C, 195C—208/230V, AL, PW
380/415/460/575V, AL, PW

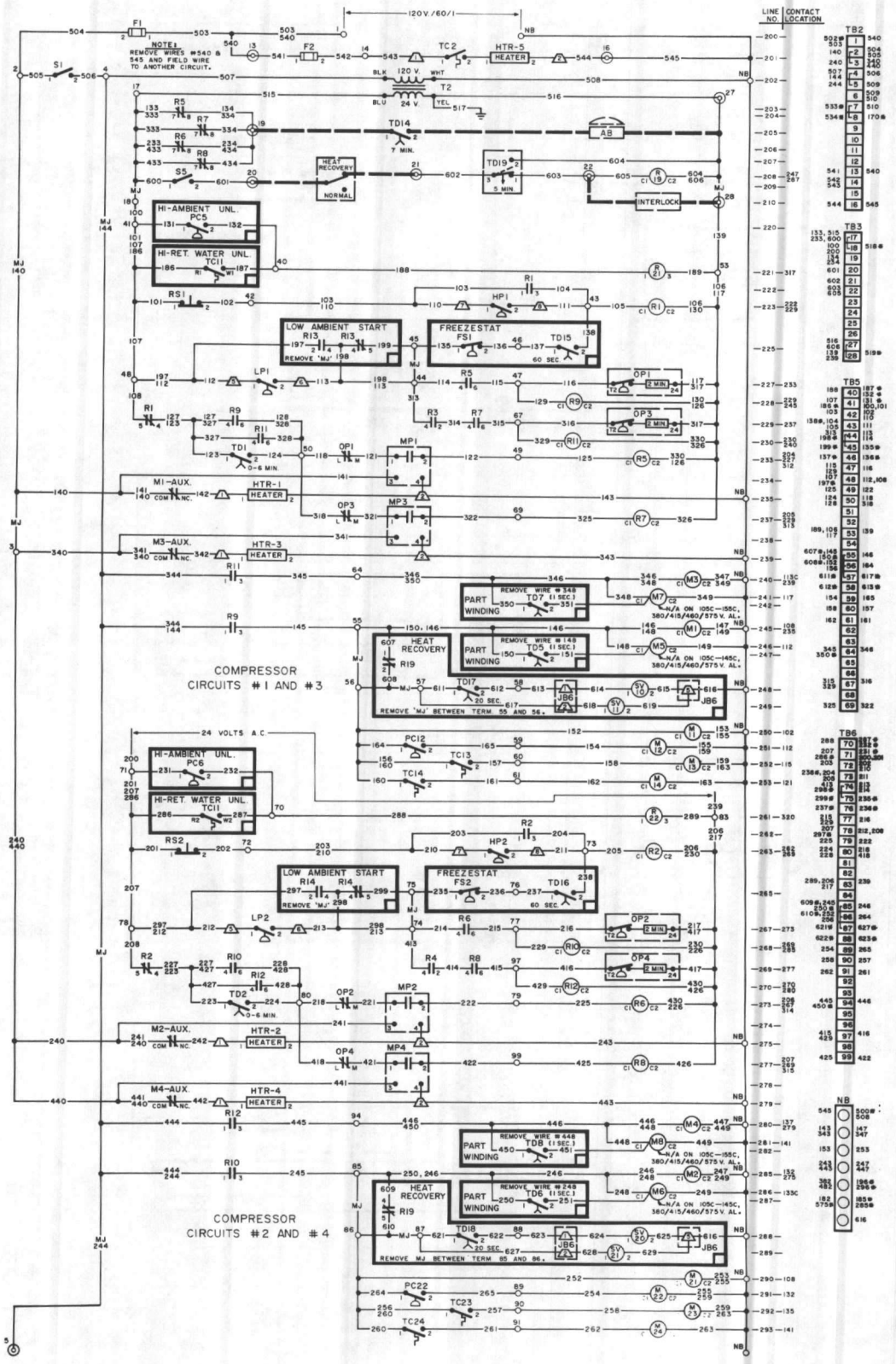


TYPICAL CONTROL AND SAFETIES WIRING DIAGRAMS

ALR-040C, 050C, 060C



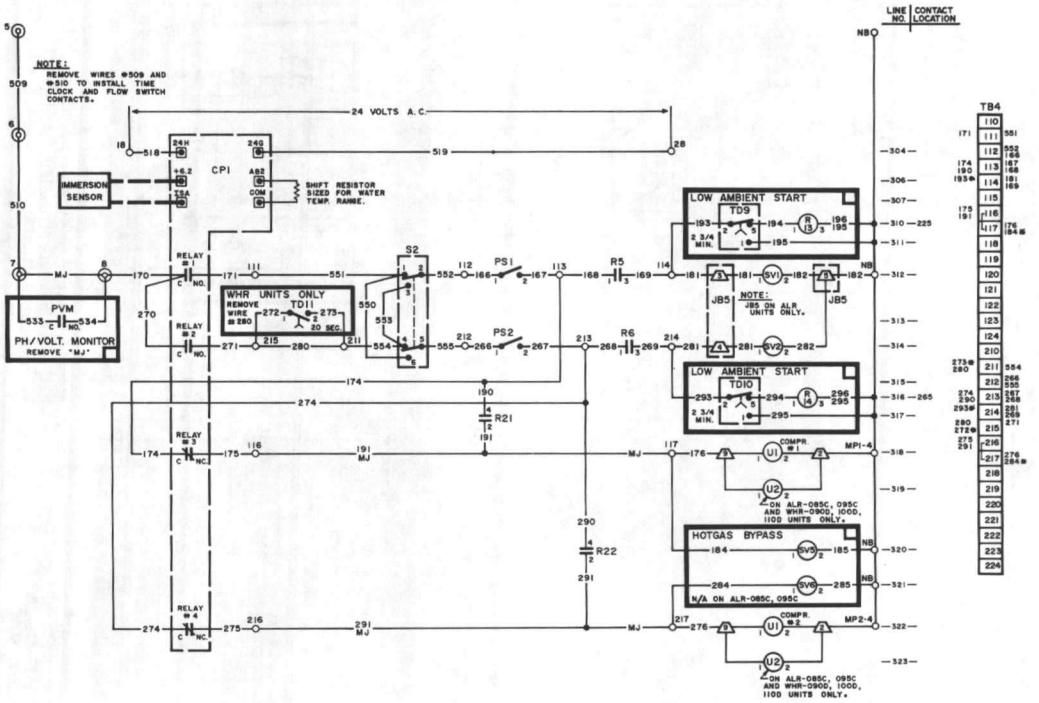

120 V./60/1
LINE NO.
CONTACT LOCATION
NOTE: REMOVE WIRES #540 & 545 AND FIELD WIRE TO ANOTHER CIRCUIT.
F1
F2
S1
T2
BLK 120 V. WHT
BLU 24 V. YEL
TC2
HTR-5 HEATER
R5
R6
TD14
7 MIN.
AB
HEAT RECOVERY
NORMAL
S5
TD19
INTERLOCK
HI-AMBIENT UNL.
PC5
HI-RET. WATER UNL.
TC11
RS1
R1
HP1
LOW AMBIENT START
R13
FREEZESTAT
FS1
TD15
60 SEC.
LP1
OP1
2 MIN
MP1
TD1
0-6 MIN.
M1-AUX
HTR-1 HEATER
HEAT RECOVERY
R19
PART WINDING
TD5 (1 SEC.)
REMOVE WIRE #148
TD17
JB6
COMPRESSOR CIRCUIT #1
PC12
TC13
TC14
HI-AMBIENT UNL.
PC6
HI-RET. WATER UNL.
TC11
24 VOLTS A.C.
RS2
R2
HP2
LOW AMBIENT START
R14
FREEZESTAT
FS2
TD16
60 SEC.
LP2
OP2
2 MIN
MP2
TD2
0-6 MIN.
M2-AUX
HTR-2 HEATER
HEAT RECOVERY
R19
PART WINDING
TD6 (1 SEC.)
REMOVE WIRE #248
TD18
JB6
COMPRESSOR CIRCUIT #2
PC22
TC23
TC24
REMOVE 'MJ' BETWEEN TERM. 55 AND 56.
REMOVE 'MJ' BETWEEN TERM. 85 AND 86.
N/A ON 065C & 075C 380/415/460/575V AL
TB2
TB3
TB5
TB6
NB


120V./60/1
LINE NO.
CONTACT LOCATION
TB2
TB3
TB5
TB6
NB
NOTE: REMOVE WIRES #540 & 545 AND FIELD WIRE TO ANOTHER CIRCUIT.
F1
F2
S1
T2
BLK 120 V. WHT
BLU 24 V. YEL
HTR-5 HEATER
TC2
TD14 7 MIN.
AB
HEAT RECOVERY NORMAL
TD19 5 MIN.
INTERLOCK
S5
R5
R6
R7
R8
HI-AMBIENT UNL. PC5
HI-RET. WATER UNL. TC11
LOW AMBIENT START R13 R13
REMOVE "MJ" 198
FREEZESTAT FS1
TD15 60 SEC.
RS1
HP1
R1
LP1
OP1 2 MIN.
OP3 2 MIN.
R9
R11
TD1 0-6 MIN.
OP1
MP1
M1-AUX.
HTR-1 HEATER
OP3
MP3
M3-AUX.
HTR-3 HEATER
PART WINDING TD7 (1 SEC.)
REMOVE WIRE # 348
M7
N/A ON 105C-155C, 380/415/460/575 V. AL.
M1
HEAT RECOVERY R19
PART WINDING TD5 (1 SEC.)
REMOVE WIRE # 148
M5
N/A ON 105C-145C, 380/415/460/575 V. AL.
TD17 20 SEC.
JB6
SV 10
SV 11
REMOVE "MJ" BETWEEN TERM. 55 AND 56.
COMPRESSOR CIRCUITS #1 AND #3
24 VOLTS A.C.
HI-AMBIENT UNL. PC6
HI-RET. WATER UNL. TC11
PCI2
TC13
TC14
M11
M12
M14
R2
RS2
HP2
LOW AMBIENT START R14 R14
REMOVE "MJ" 298
FREEZESTAT FS2
TD16 60 SEC.
LP2
OP2 2 MIN.
OP4 2 MIN.
R10
R12
TD2 0-6 MIN.
OP2
MP2
M2-AUX.
HTR-2 HEATER
OP4
MP4
M4-AUX.
HTR-4 HEATER
PART WINDING TD8 (1 SEC.)
REMOVE WIRE # 448
M8
N/A ON 105C-155C, 380/415/460/575 V. AL.
M2
HEAT RECOVERY R19
PART WINDING TD6 (1 SEC.)
REMOVE WIRE # 248
M6
N/A ON 105C-145C, 380/415/460/575 V. AL.
TD18 20 SEC.
JB6
SV 20
SV 21
REMOVE MJ BETWEEN TERM 85 AND 86.
COMPRESSOR CIRCUITS #2 AND #4
PC22
TC23
TC24
M21
M22
M23
M24

TYPICAL THERMOSTAT WIRING DIAGRAMS

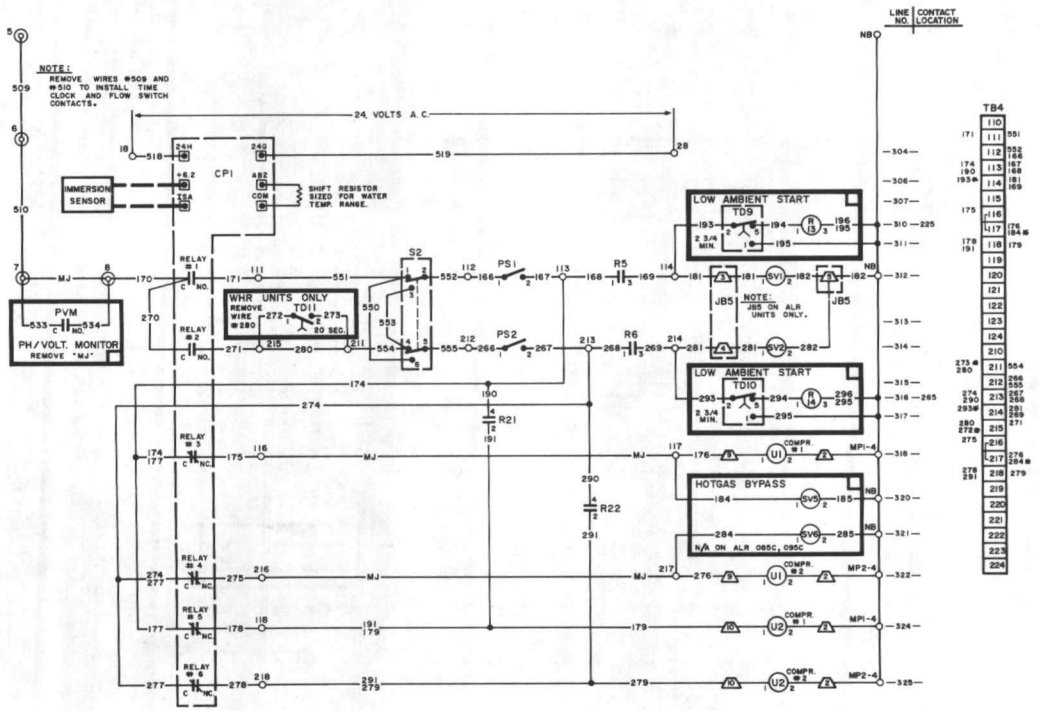
4-Stage Thermostat

ALR-040C, 050C, 060, 065, 075C, 090C, 095C



6-Stage Thermostat

ALR-065C, 075C, 085C, 095C

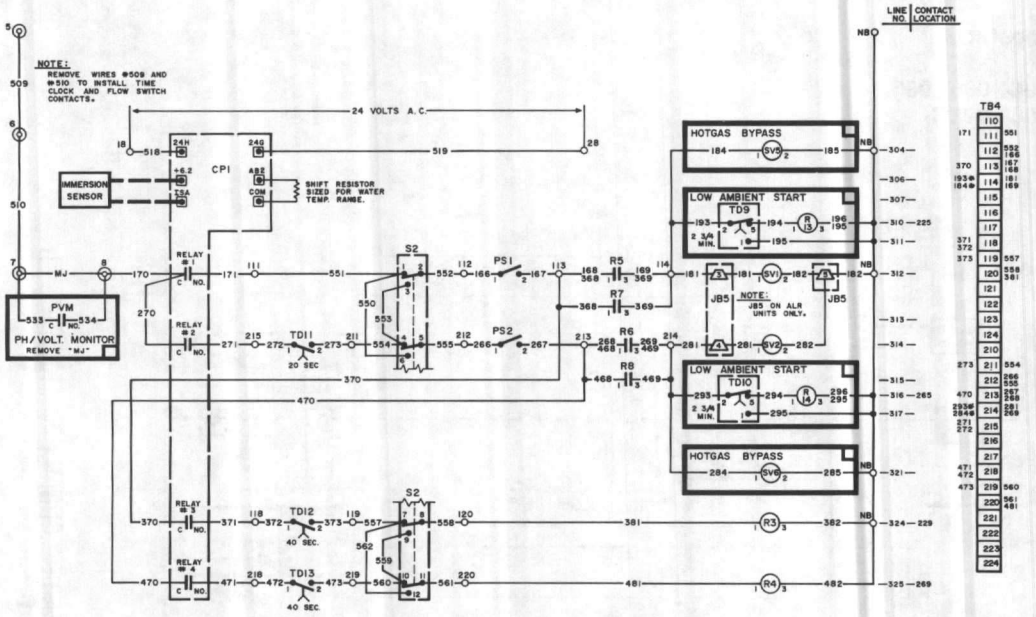


NOTES:

1. Units with hot gas bypass on only 1 circuit do not have lead lag.
2. R21 and R22 contacts only with optional high head or high water unloading.

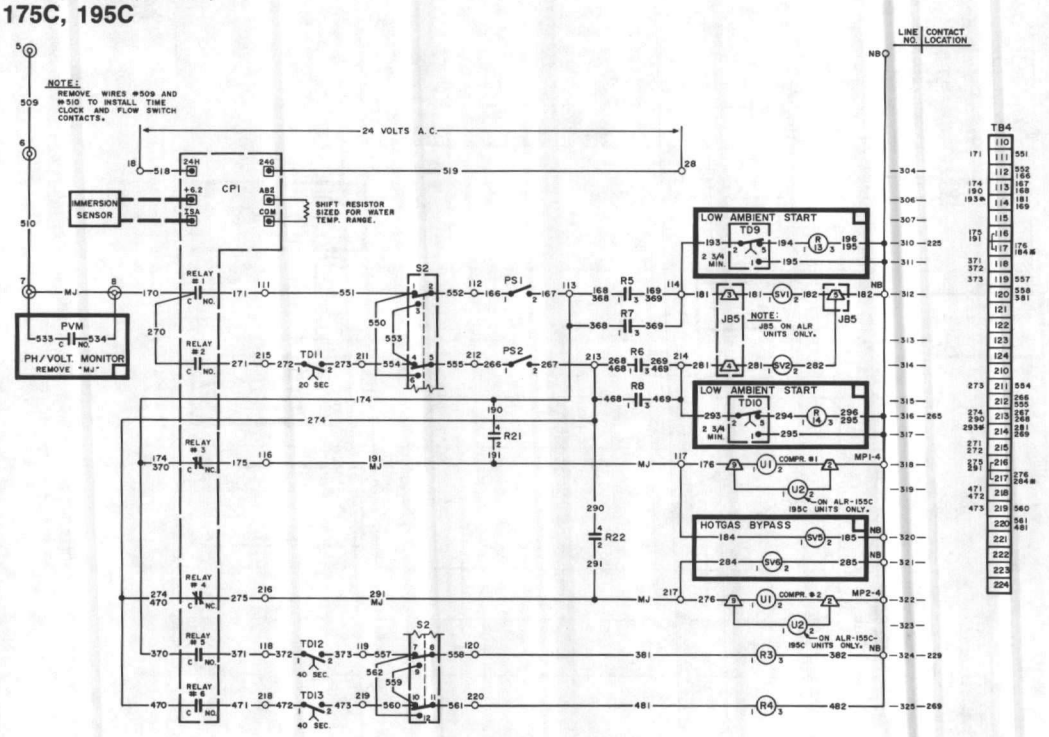
4-Stage Thermostat

ALR-105C, 115C, 125C



6-Stage Thermostat

ALR-105C, 115C, 125C, 145C, 155C, 175C, 195C

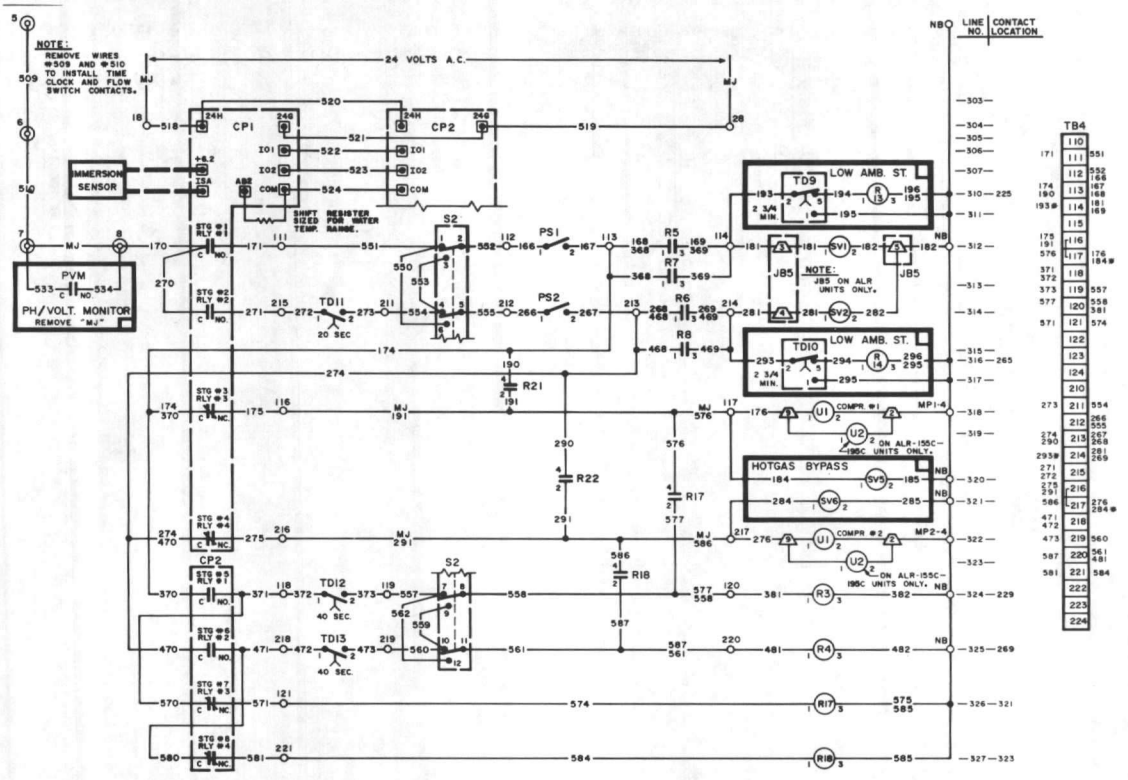


NOTES:

1. Units with hot gas bypass on only 1 circuit do not have lead lag.
2. R21 and R22 contacts only with optional high head or high water unloading.

8-Stage Thermostat

ALR-105C, 115C, 125C, 145C, 155C, 175C, 195C



NOTES:

1. Units with hot gas bypass on only 1 circuit do not have lead lag.
2. R21 and R22 contacts only with optional high head or high water unloading.

Table 11. Decision Table for ALR-040C thru 195C
Power Schematics for Compressor and Condenser Fan Motors

NOTE: Each unit will have three electrical schematics: power, safety and control, and thermostat.

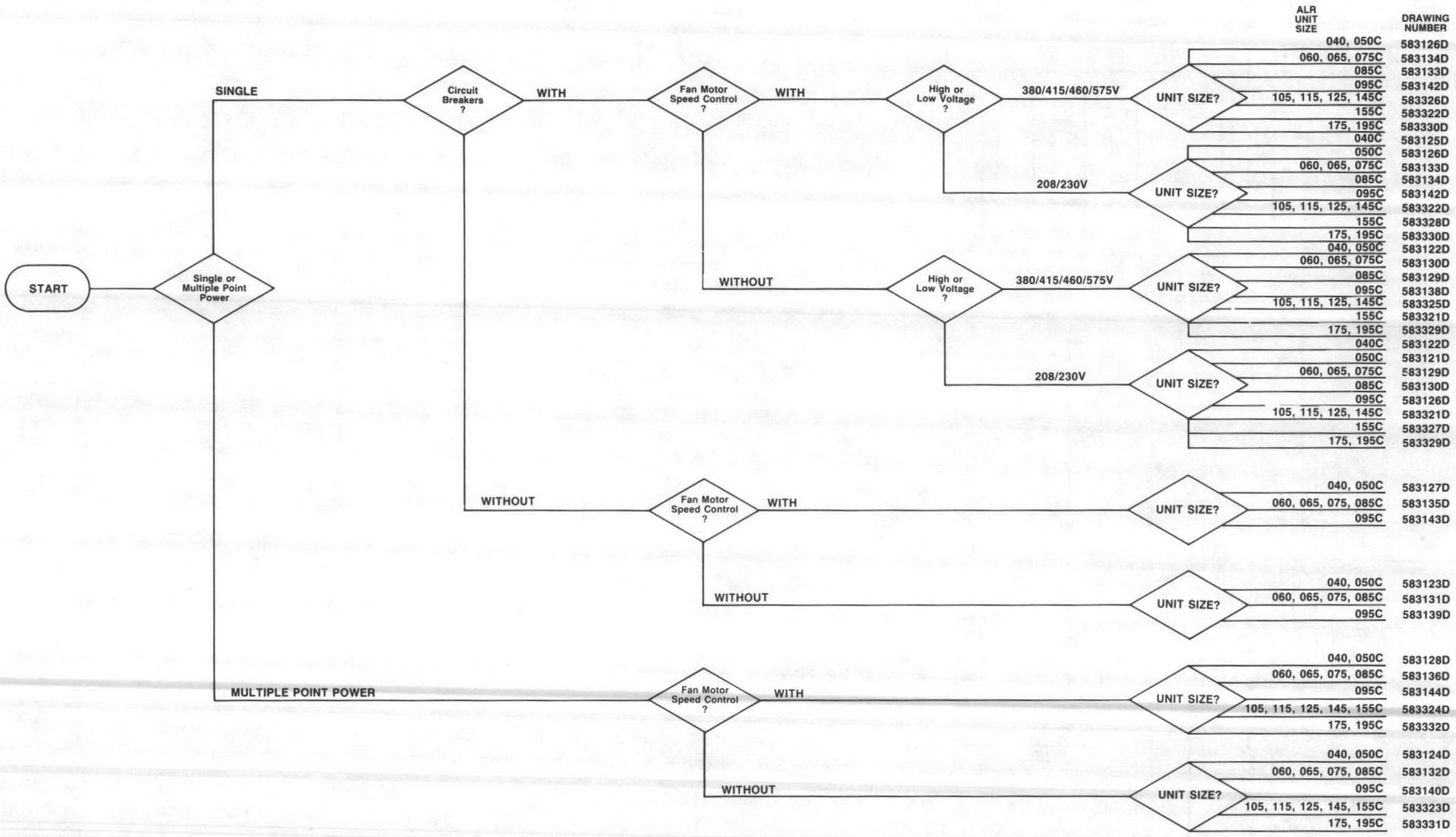


Table 12. Decision Table For Control & Safety Schematics

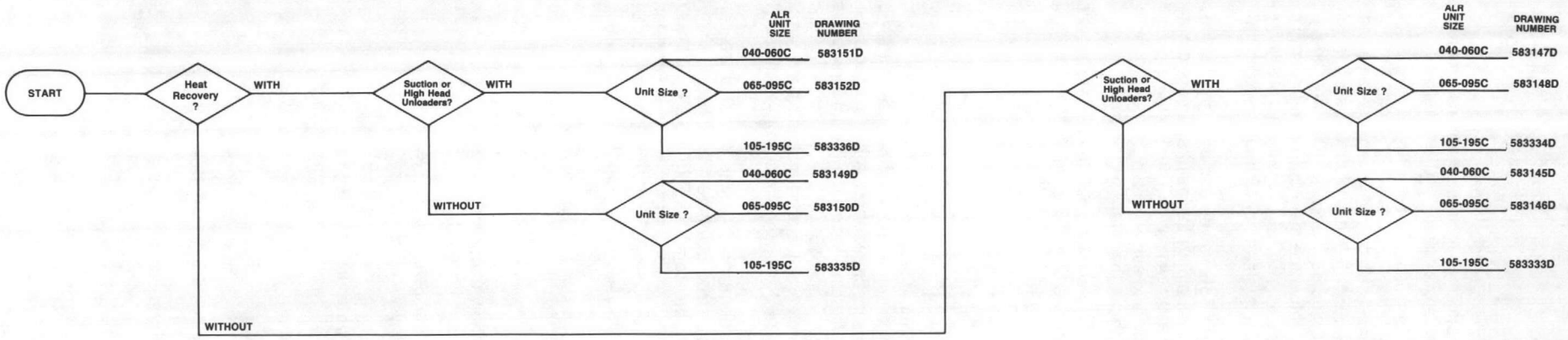
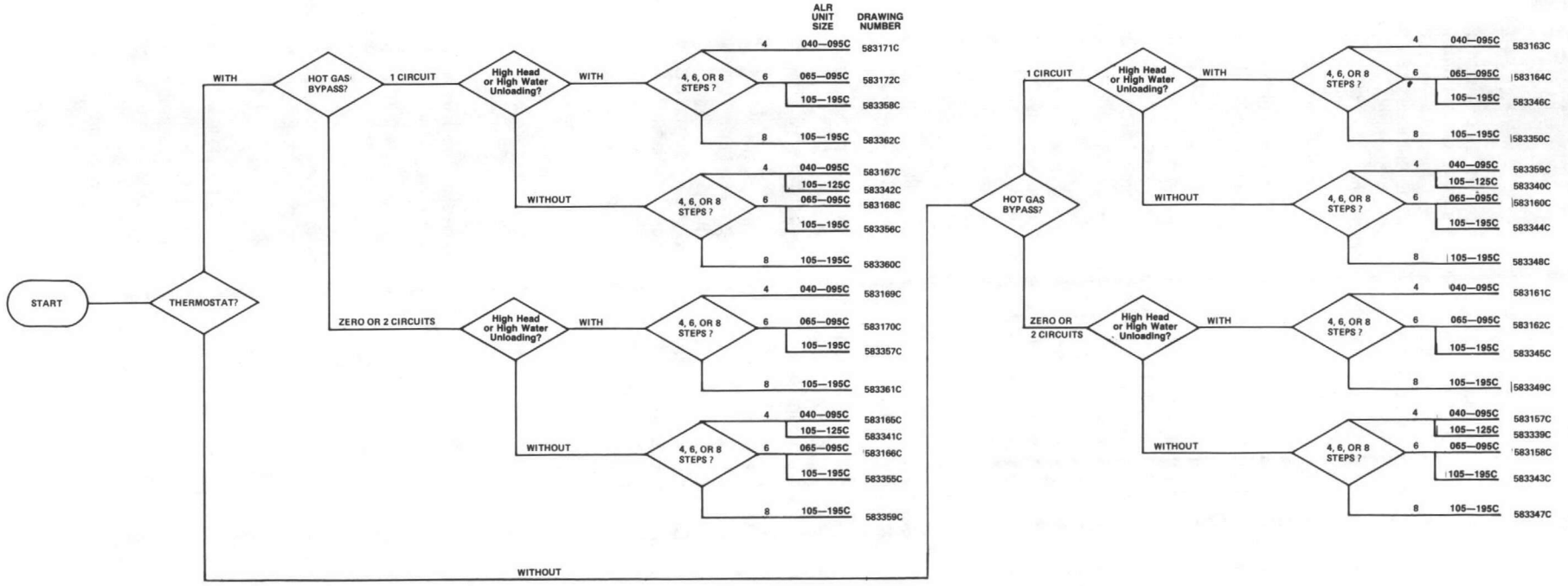


Table 13. Decision Table for Thermostat Control Schematics



STARTUP AND SHUTDOWN

PRE-STARTUP

1. With all electric disconnects open, check all screw or lug type electrical connections to be sure they are tight for good electrical contact. Check all compressor valve connections for tightness to avoid refrigerant loss at start-up. Although all factory connections are tight before shipment, some loosening may have resulted from shipping vibration.
2. Inspect all water piping for flow direction and correct connections at the evaporator.
3. Check to see that the thermostat water temperature sensor is installed in the return water line (return to chiller). On all ALR units the sensor well should be full of heat conducting compound and the sensor should be secured in the well with the nylon bushings provided.
4. Check the compressor oil level. Prior to startup, the oil level should cover at least one-third of the oil sightglass.
5. Check the voltage of the unit power supply and see that it is within the ± 10% tolerance that is allowed. Phase voltage unbalance must be within ± 2%.
6. Check the unit power supply wiring for adequate ampacity and a minimum insulation temperature rating of 75C.
7. Verify that all mechanical and electrical inspections have been completed per local codes.
8. See that all auxiliary control equipment is operative and that an adequate cooling load is available for initial startup.
9. Open the compressor suction and discharge shutoff valves until backseated. Always replace valve seal caps.
10. Making sure control stop switch S1 is open (off) and pumpdown switches PS1 and PS2 are on "manual pumpdown," throw the main power and control disconnect switches to "on." This will energize crankcase heaters. Wait a minimum of 12 hours before starting up unit.
11. Open all water flow valves and start the chilled water pump. Check all piping for leaks and vent the air from the evaporator as well as from the system piping. Flush the evaporator and system piping to obtain clean, non-corrosive water in the evaporator circuit.

CAUTION:*Most relays and terminals in the unit control center are hot with S1 and the control circuit disconnect on. Do not close S1 until startup.*

STARTUP

1. Double check that the compressor suction and discharge shutoff valves are backseated. Always replace valve seal caps.
2. Open the manual liquid line shutoff valve at the outlet of the subcooler.
3. Adjust the dial on temperature controller CP1 to the desired chilled water temperature.
4. Start the auxiliary equipment for the installation by turning on the time clock, ambient thermostat and/or remote on/off switch, and chilled water pump.
5. Check to see that pumpdown switches PS1 and PS2 are in the "manual pumpdown" (open) position. Throw the emergency stop switch S1 to the "on" position. If pressures on the low side of the system are above 60 psig, the unit will start and pump down.
6. After the compressor lockout timer TD1 has timed out, start the system by moving pumpdown switches PS1 and PS2 to the "auto pumpdown" position.
7. After running the unit for a short time, check the oil level in each compressor crankcase, rotation of condenser fans, and check for flashing in the refrigerant sightglass (see "Maintenance", page 46).
8. Superheat is factory adjusted to maintain between 10 and 12 degrees F. Verify that the superheat is between 8 and 12 degrees.
9. After system performance has stabilized, it is necesary that the "Compressorized Equipment Warranty Form" (Form No. 415415Y) be completed to obtain full warranty benefits. This form is shipped with the unit, and after completion should be returned to McQuay's Service Department through your sales representative.

TEMPORARY SHUTDOWN

Move pumpdown switches PS1 and PS2 to the "manual pumpdown" position. After the compressors have pumped down, turn off the chilled water pump.

CAUTION: *With the unit left in this condition, it is capable of recycling pumpdown operation. To defeat this mode of operation, move control stop switch S1 to the "off" position.*

It is important that the compressors pump down before the water flow to the unit is interrupted to avoid freeze-up in the evaporator.

STARTUP AFTER TEMPORARY SHUTDOWN

1. Start the chilled water pump.
2. With emergency stop switch S1 in the "on" position, move pumpdown switches PS1 and PS2 to the "auto pumpdown" position.
3. Observe the unit operation for a short time to be sure that the compressors do not cut out on low oil pressure.

EXTENDED SHUTDOWN

1. Close the manual liquid line shutoff valves.
2. After the compressors have pumped down, turn off the chilled water pump.
3. Turn off all power to the unit and to the chilled water pump.
4. Move the emergency stop switch S1 to the "off" position.
5. Close the compressor suction and discharge valves.
6. Tag all opened disconnect switches to warn against start-up before opening the compressor suction and discharge valves.
7. Drain all water from the unit evaporator and chilled water piping if the unit is to be shut down during winter.
8. Leave power applied to the cooler heating cable if a separate disconnect is used.

SYSTEM MAINTENANCE

GENERAL

On initial startup and periodically during operation, it will be necessary to perform certain routine service checks. Among these are checking the compressor oil level and taking condensing, suction and oil pressure readings. During operation, the oil level should be visible in the oil sightglass with the compressor running. On units ordered with gauges, condensing, suction and oil pressures can be read from the vertical supports on each side of the unit adjacent to the compressors.

The gauges are factory installed with a manual shutoff valve on each gauge line. The valves should be closed at all times except when gauge readings are being taken. On units ordered without gauges, Shrader fittings should be installed in the plugged ports provided on the suction and discharge King valves on each compressor circuit.

FAN SHAFT BEARINGS

The fan shaft bearings are of the permanently lubricated type. No lubrication is required.

ELECTRICAL TERMINALS

CAUTION: *Electric shock hazard. Turn off all power before continuing with following service.*

All power electrical terminals should be retightened every six months, as they tend to loosen in service due to normal heating and cooling of the wire.

COMPRESSOR OIL LEVEL

The oil level should be watched carefully upon initial startup and for sometime thereafter.

At the present time, Suniso No. 3GS, Calumet R015, and Texaco WF32 oils are approved by Copeland for use in these compressors. The oil level should be maintained at about one-third of the sightglass on the compressor body.

Oil may be added to the Copeland compressor through the oil fill hole in the crankcase. To add oil, isolate the crankcase and pour or pump in the necessary oil. If the system contains no refrigerant, no special precautions are necessary other than keeping the oil clean and dry.

If the system contains a refrigerant charge, close the suction valve and reduce crankcase pressure to 1 to 2 psig. Stop the compressor and close the discharge valve.

Add the required amount of oil. During the period the compressor is exposed to the atmosphere, the refrigerant will generate a vapor pressure, retarding the entrance of contaminants. Before resealing the compressor, purge the crankcase by opening the suction valve slightly for 1 or 2 seconds. Close the oil port, open the compressor valves and restore the system to operation.

CONDENSERS

Condensers are air cooled and constructed with 3/8" O.D. internally finned copper tubes bonded in a staggered pattern into slit aluminum fins. No maintenance is ordinarily required except the occasional removal of dirt and debris from the outside surface of the fins. McQuay recommends the use of foaming coil cleaners available at air conditioning supply outlets. Use caution when applying such cleaners as they may contain potentially harmful chemicals. Care should be taken not to damage the fins during cleaning. Periodic use of the purge valve on the condenser will prevent the buildup of non-condensables. The purge valve is located under the #1 fan deck of each compressor circuit.

On heat recovery units, if the air cooled condenser or discharge piping must be repaired the following procedure should be used to prevent excessive refrigerant loss. **NOTE:** *Circuit #2 components are in parentheses ( ). Start with unit OFF.*

CAUTION: ***Electric shock hazard. Turn off all power to unit while completing Steps 1, 2 and 3.***

1. Remove wires to the normally open solenoid valve SV10 (SV20) so valve will remain open when power is turned back on.
2. Install jumpers to energize SV11 (SV21) to open valve when unit is turned on.
3. Pull fuses to condenser fan motors.
4. Run water through cooler and shell-and-tube condenser.
5. With a cooling load on the cooler, turn on the unit with pumpdown switch PS1 (PS2) in the auto pumpdown position.
6. After five minutes move pumpdown switch PS1 (PS2) to the manual pumpdown position.

continued on next page

7. After unit has pumped down, move control stop switch to the "off" position to prevent possible recycling pumpdown.
8. Immediately close angle valve ahead of shell-and-tube condenser and rotolock valves on compressors.
9. Close manual liquid line valve.
10. Majority of refrigerant should now be in shell-and-tube condenser.

NOTE: *Refrigerant charge for heat recovery units is available in tables on pages 9 and 10.*

REFRIGERANT SIGHTGLASS

The refrigerant sightglasses should be observed periodically. (A monthly observation should be adequate.) A clear glass of liquid indicats that there is adequate refrigerant charge in the system to insure proper feed through the expansion valve. Bubbling refrigerant in the sightglass indicates that the system is short of refrigerant charge. Refrigerant gas flashing in the sightglass could also indicate an excessive pressure drop in the line, possibly due to a clogged filter-drier or a restriction elsewhere in the system. An element inside the sightglass indicates what moisture condition corresponds to a given element color. If the sightglass does not indicate a dry condition after about 12 hours of operation, the unit should be pumped down and the filter-driers changed.

LEAD-LAG

An optional feature on all McQuay ALR air cooled chillers is a system for reversing the sequence in which the compressors start. (Chillers with the hot gas bypass option on only one circuit do not have lead-lag.) For example, on a unit with the lead-lag switches in the "circuit 1 leads" position, the normal starting sequence is compressor #1, then compressor #2. With the lead-lag switches in the "circuit 2 leads" position, the reversed starting sequence is compressor #2, then compressor #1. It is achieved electrically by a multi-pole switching arrangement (see "Control Schematics" on pages 39 through 41). It is suggested that the lead-lag switches in the unit control center be switched annually to provide even compressor life.

SERVICE

NOTE: ***Service on this equipment is to be performed by qualified refrigeration personnel. Causes for repeated tripping of safety controls must be investigated and corrected.*** **CAUTION:** ***Disconnect all power before doing any service inside the unit.***

FILTER-DRIERS

To change the filter-drier, pump the unit down by moving pumpdown switches PS1 and PS2 to the "manual pumpdown" position.

UNIT SIZE	CIRCUIT NO.	JUMPER ACROSS TERMINALS
040C—195C	1	44 to 48
	2	74 to 78

Move the control switch S1 to the "off" position. Turn off all power to the unit and install jumpers across the terminals shown in the table. This will jump out the low pressure control. Close the manual liquid line shutoff valve(s). Turn power to the unit back on and restart the unit by moving the control switch S1 to the "on" position. The unit will start pumping down past the low pressure setting. When the evaporator pressure reaches 0—5 psig, move control switch S1 to the "off" position.

Frontseat the suction line King valve(s). Remove and replace the filter-drier(s). Evacuate the lines through the liquid line manual shutoff valve(s) to remove non-condensables that may have entered during filter replacement. A leak check is recommended before returning the unit to operation.

LIQUID LINE SOLENOID VALVE

The liquid line solenoid valves, which are responsible for automatic pumpdown during normal unit operation, do not normally require any maintenance. They may, however, require replacement of the solenoid coil or of the entire valve assembly.

The solenoid coil may be removed from the valve body without opening the refrigerant piping by moving pumpdown switches PS1 and PS2 to the "manual pumpdown" position. The coil can then be removed from the valve body by simply removing a nut or snap-ring located at the top of the coil. The coil can then be slipped off its mounting stud for replacement. Be sure to replace the coil on its mounting stud before returning pumpdown switches PS1 and PS2 to the "auto pumpdown" position.

To replace the entire solenoid valve follow the steps involved when changing a filter-drier.

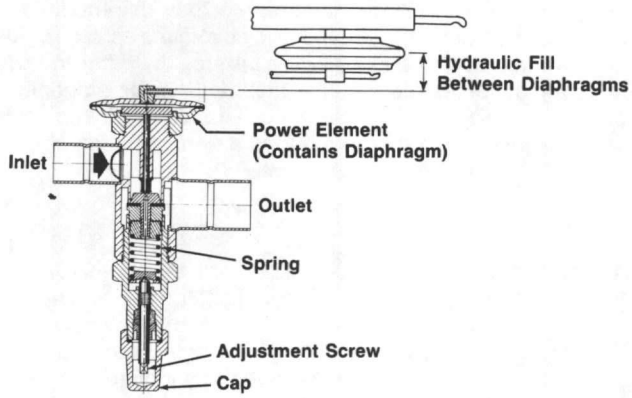
THERMOSTATIC EXPANSION VALVE

The expansion valve is responsible for allowing the proper amount of refrigerant to enter the evaporator regardless of cooling load. It does this by maintaining a constant superheat. (Superheat is the difference between refrigerant temperature as it leaves the evaporator and the saturation temperature corresponding to the evaporator pressure.) All ALR chillers

are factory set for between 8°F and 12°F superheat. If it is necessary to increase the superheat setting of the valve, remove the cap at the bottom of the valve to expose the adjustment screw. Turn the screw clockwise (when viewed from the adjustment screw end) to increase the superheat and counterclockwise to reduce superheat. Allow time for system rebalance after each superheat adjustment.

The expansion valve, like the solenoid valve, should not normally require replacement, but if it does, the unit must be pumped down by following the steps involved when changing a filter-drier.

If the problem can be traced to the power element only, it can be unscrewed from the valve body without removing the valve, but only after pumping the unit down.



EVAPORATOR

The evaporator is of the direct expansion, shell-and-tube type with refrigerant flowing through the tubes and water flowing through the shell over the tubes. The tubes are internally finned to provide extended surface as well as turbulent flow of refrigerant through the tubes. Normally no service work is required on the evaporator. There may be instances where a tube will leak refrigerant into the water side of the system. In the cases where only one or two tubes leak, the problem can best be solved by plugging the tube at both ends. When the tube must be replaced, the old tube can be removed and replaced.

To remove a tube, the unit should be temporarily pumped down. Follow the steps involved when changing a filter-drier. These steps will insure a minimum amount of refrigerant loss when the evaporator is opened up. The tubes are mechanically expanded into the tube sheets (see figure below) at each end of the cooler. In order to remove the tubes, it is necessary to break this bond by collapsing the tube. After doing this at both ends of the shell, the tube can be removed for replacement. The new tube can then be inserted and re-expanded into the tube sheet.

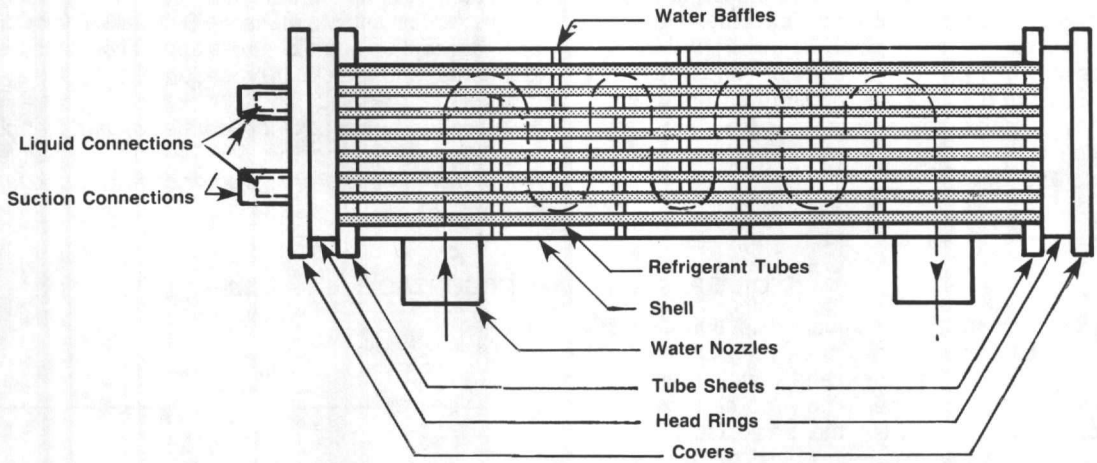
NOTE: *The bond produced by expansion must be refrigerant tight. This bond must be produced by applying Locktite (red) to the tube and rolling it into the tube sheet.*

After re-assembling the evaporator, a small amount of refrigerant should be introduced by momentarily opening the manual liquid line valve. A leak check should then be performed on the evaporator.

Tube removal can only take place after the leaking tube is located. One method that would work would be to subject each tube to air pressure by plugging each end and, with a pressure gauge attached to one of the end plugs, observing if there is a loss of air pressure over a period of a minute or two.

Another method is to place a cork plug in each tube on both ends of the cooler and applying pressure to the shell of the cooler. After a period of time the pressure will leak from the shell into the leaking tube or tubes and pop out the cork plug.

Top View of Typical Dual Circuit Shell-and-Tube Evaporator



IN-WARRANTY RETURN MATERIAL PROCEDURE

COMPRESSOR

Copeland Refrigeration Corporation has stocking wholesalers who maintain a stock of replacement compressors and service parts to serve refrigeration contractors and servicemen.

When a compressor fails in warranty, contact your local sales representative, or McQuay Warranty Claims Department at the address on the cover of this bulletin. You will be authorized to exchange the defective compressor at a Copeland wholesaler, or an advance replacement can be obtained. A credit is issued you by the wholesaler for the returned compressor after Copeland factory inspection of the inoperative compressor. If that compressor is out of Copeland's warranty, a salvage credit only is allowed. Pro-

vide McQuay with full details; i.e., McQuay unit model and unit serial numbers. Include the invoice and the salvage value credit memo copies and we will reimburse the difference. In this transaction, be certain that the compressor is definitely defective. If a compressor is received from the field that tests satisfactorily, a service charge plus a transportation charge will be charged against its original credit value.

On all out-of-warranty compressor failures, Copeland offers the same field facilities for service and/or replacement as described above. The credit issued by Copeland on the returned compressor will be determined by the repair charge established for that particular unit.

COMPONENTS OTHER THAN COMPRESSORS

Material may not be returned except by permission of authorized factory service personnel of McQuay Inc. at Minneapolis, Minnesota. A "return goods" tag will be sent to be included with the returned material. Enter the information as called for on the tag in order to expedite handling at our factories and prompt issuance of credits.

The return of the part does not constitute an order for replacement. Therefore, a purchase order must be entered through your nearest McQuay representative. The order should include part name, part number, model number and serial number of the unit involved.

Following our personal inspection of the returned part, and if it is determined that the failure is due to faulty material or workmanship, and in warranty, credit will be issued on customer's purchase order.

All parts shall be returned to the pre-designated McQuay factory transportation charges prepaid.

APPENDIX
STANDARD CONTROLS

NOTE: *PERFORM AN OPERATIONAL CHECK ON ALL UNIT SAFETY CONTROLS ONCE PER YEAR.*

THERMOSTAT

The thermostats supplied on all packaged chillers are factory calibrated for use in the return water line to the cooler inlet. The thermostat bulb is installed in a well in the return water line in order to be more stable under temperature changes due to load conditions. The return water does not change temperature as rapidly as the outlet because of the "flywheel effect" of the total water system. This results in stable control of the outlet water temperature. Normally the thermostat requires no adjustment in the field other than the dial setting for the required control point. The control will maintain an average leaving water temperature corresponding to dial setpoint (SPB) throughout the loading and unloading sequence of the unit. It should be realized, however, that there will be fluctuation in the leaving water temperature as the unit cycles, unloads and loads.

The throttling range is adjustable from 1°F to 3°F per output relay via the TRB dial. The control setpoint is adjustable from 30°F to 60°F via the SPB dial and is factory set at 44°F. The ambient operating temperature limits of the control is from 0°F to 140°F.

Although the central processor (CP1) is calibrated at the factory, if may be necessary to re-calibrate the control should any changes in unit operation be made in the field. Refer to the Installation and Maintenance Bulletin 348 for a more complete description of the control's application, settings and adjustments, and checkout procedures.

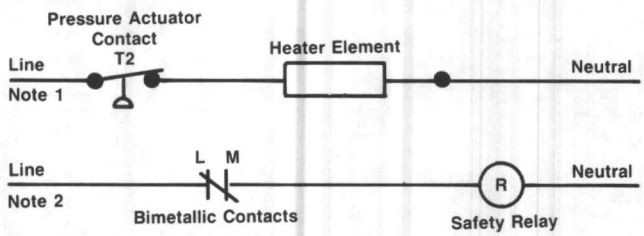
Operation Limits: *Do not operate unit at a thermostat setting below 42°F or above 50°F as serious problems may result such as cooler freezeup or compressor overheating.*

OIL PRESSURE SAFETY CONTROL

The oil pressure safety control is a manually resettable device which senses the differential between oil pressure at the discharge of the compressor oil pump and suction pressure inside the compressor crankcase. When the oil pressure reaches approximately 15 psi above the crankcase suction pressure, the pressure actuated contact of the control opens from its normally closed position. If this pressure differential cannot be developed, the contact will remain closed and energize a heater element within the control. The heater element warms a normally closed bimetallic contact and causes the contact to open, de-energizing a safety relay and breaking power to the compressor.

It takes about 120 seconds to warm the heater element enough to open the bimetallic contact, thus allowing time for the pressure differential to develop.

If during operation, the differential drops below 10 psi, the heater element will be energized and the compressor will stop. The control can be reset by pushing the reset button on the control. If the compressors does not restart, allow a few minutes for the heater element and bimetallic contacts to cool and reset the control again.



NOTES: 1. Hot only when the unit thermostat calls for compressor to run.
2. Hot only when other safety control contacts are closed.

To check the control, pump down and shut off all power to the unit. Open the circuit breakers or the fused disconnect for that compressor and install a voltmeter between terminals L and M of the oil pressure control. Turn on power

to the unit control circuit (separate disconnect or main unit disconnect depending on the type of installation). Check to see that the control stop switch S1 is in the "on" position. The control circuit should now be energized, but with the absence of compressor power, no oil pressure differential can develop and thus the pressure actuated contacts of the control will energize the heater element and open the bimetallic contacts of the control within 120 seconds. When this happens, the safety relay is de-energized, the voltmeter reading will rise to 24V, and the compressor contactor should open. Repeated operations of the control will cause a slight heat buildup in the bimetallic contacts resulting in a slightly longer time for reset with each successive operation.

HIGH PRESSURE CONTROL

The high pressure control is a single pole pressure activated switch that closes on a pressure rise. When the switch closes, R1 is energized which in turn de-energizes the control circuit, shutting down the compressor circuit. R1 also locks itself in a manually resettable holding circuit through RS1. The switch is factory set to close at 400 psig and open at 300 psig.

To check the control, either block off condenser surface or start the unit with condenser fan motor fuses in only one fan fuse block (FB6) and observe the cutout point of the control on a high pressure gauge.

The control is attached to a Shrader fitting and is located on a cylinder head near the discharge King valve. **CAUTION:** *Although there is an additional pressure relief device in the system set at 450 psig, it is highly recommended that the "control stop" switch S1 be close at hand in case the high pressure control should malfunction.*

After testing the high pressure control, check the pressure relief device (on the condenser header) for leaks.

LOW PRESSURE CONTROL

The low pressure control is a single pole pressure switch that closes on a pressure rise. It senses evaporator pressure and is factory set to close at 60 psig and automatically open at 35 psig. To check the control (unit must be running), move the pumpdown switch(es) PS1 and PS2 to the "manual pumpdown" position. As the compressor pumps down, condenser pressure will rise and evaporator pressure will drop. The lowest evaporator pressure reached before cutout is the cutout setting of the control. Wait for the compressor lockout time delays TD1 and TD2 to time out. By moving the pumpdown switch(es) PS1 and PS2 to the "auto pumpdown" position, evaporator pressure will rise. The highest evaporator pressure reached before compressor restart is the cut-in setting of the control.

The control is attached to a Shrader fitting and is located below the suction King valve body.

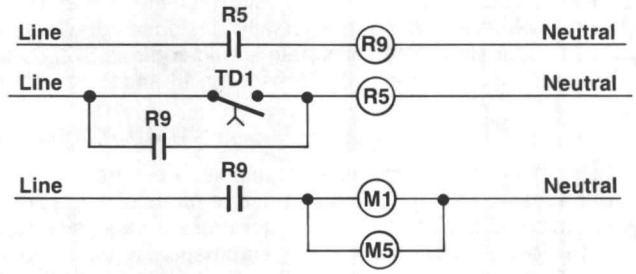
COMPRESSOR LOCKOUT

Compressor lockout consists of an adjustable 0 to 6 minute time delay. It is wired in series with the R5 relay that energizes the R9 relay starting the comrpessor. Its purpose is to prevent rapid compressor cycling when cooling demands are erratic. The circuit illustrated is for the compressor circuit #1 control circuit. The control circuit for compressor circuit #2 is wired the same way. Five minutes is recommended for the compressor lockout time delay.

When the unit thermostat no longer calls for cooling and the compressor contactor(s) have opened, the lockout time delay breaks open the circuit, preventing compressor restart.

The circuit remains open for a period of 5 minutes so that, if the unit thermostat should call for cooling before the delay period has expired, the compressor will not restart. After 5 minutes the time delay will close its contacts to complete the circuit to R5 energizing R9 and starting the compressor. When R9 is energized another set of contacts will shunt around TD1 to reset open for timing out the next compressor cycle.

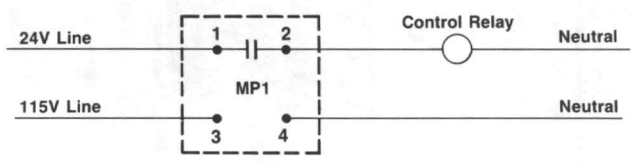
To check the control, the compressor must be running initially. Move the pumpdown switch PS1 or PS2 to the "manual pumpdown" position. Immediately after the compressor has stopped running, move the pumpdown switch back to the "auto pumpdown" position. The compressor should not restart for 5 minutes. Each refrigerant circuit can be checked the same way.



COMPRESSOR MOTOR PROTECTOR

The solid-state compressor motor protector module incorporates a two-minute "time off" relay utilizing the bleed down capacitor principle. Any time the protection system opens or power to the module is interrupted, the two-minute "time off" delay is triggered, and the module will not reset for two minutes. Once the two-minute period is passed, the motor protector contacts 1 and 2 reset, provided the protection system is satisfied and power is applied to the module.

NOTE: *If the power circuit is broken once the two-minute period is passed the pilot circuit will reset without delay when power is reapplied.*



FANTROL HEAD PRESSURE CONTROL

FANTROL is a method of head pressure control which automatically cycles the condenser fans in response to condenser pressure and ambient air temperature. This maintains head pressure and allows the unit to run at low ambient air temperatures.

All ALR units have dual independent circuits with the fans for circuit 1 and circuit 2 being controlled independently by the condensing pressure and ambient air of each circuit. Fans 11 and 21 start with each compressor and fans 12 and 22 cycle on and off in response to condenser pressure. The cutout and cut-in pressures are given in Table 13. Fans 13 and 14 (circuit 1) and fans 23 and 24 (circuit 2) are controlled by ambient temperature and are factory set at the values given in the table. Note that the number of fans on each unit varies. FANTROL sensor locations are shown in Figures 18 thru 21.

Table 14. Factory FANTROL Settings

ALR UNIT SIZE	CONDENSER FAN												STD. MINIMUM AMBIENT (FANTROL °F) (1)(2)	OPT. STEPS OF CAPAC. MINIMUM AMBIENT (FANTROL °F) (1)(2)
	PC12 (PSI)		PC22 (PSI)		TC13 (°F)		TC23 (°F)		TC14 (°F)		TC24 (°F)			
	Cutin	Cutout	Cutin	Cutout	Cutin	Cutout	Cutin	Cutout	Cutin	Cutout	Cutin	Cutout		
040C	290	170	290	170	—	—	—	—	—	—	—	—	30	40
050C	290	170	290	170	—	—	—	—	—	—	—	—	35	45
060C	290	170	290	170	71	66	69	64	—	—	—	—	20	35
065C	290	170	290	170	70	65	70	65	75	70	75	70	10	30
075C	290	170	290	170	63	58	63	58	69	64	69	54	20	25
085C	290	170	290	170	57	52	57	52	63	58	63	58	10	30
095C	290	170	290	170	49	44	49	44	59	54	59	54	10	30
105C	290	170	290	170	55	50	55	50	60	55	60	55	20	20
115C	290	170	290	170	60	55	57	52	65	60	62	57	20	20
125C	290	170	290	170	61	56	61	56	66	61	66	61	20	20
145C	290	170	290	170	60	55	60	55	65	60	65	60	20	20
155C	290	170	290	170	60	55	60	55	65	60	65	60	20	20
175C	290	170	290	170	65	60	65	60	70	65	70	65	20	20
195C	290	170	290	170	65	60	65	60	70	65	70	65	20	20

NOTES:
(1) With SPEEDTROL, all units minimum ambient operating temperature drops to 0°F.
(2) Minimum head pressure on partly loaded compressor is 110 psig; on full load it is 170 psig.

APPENDIX
OPTIONAL CONTROLS

SPEEDTROL HEAD PRESSURE CONTROL (OPTIONAL)

The SPEEDTROL system of head pressure control operates in conjunction with FANTROL by modulating the motor speed on fans 11 and 21 in response to condensing temperature. By reducing the speed of the last fan as the condensing pressure falls, the unit can operate at lower ambient temperatures.

The SPEEDTROL fan motor is a single phase, 208/240 volt, thermally protected motor specially designed for variable speed application. The solid-state speed controls SC11 and SC21 are mounted inside condenser fan 11 and 21 fan compartment. Units with 460 volt power have a transformer mounted inside the condenser fan 21 fan compartment to step the voltage down to 230 volts for the SPEEDTROL motor, shown in Figures 19 and 21.

The SPEEDTROL control starts to modulate the motor speed at approximately 105°F and maintains a minimum condensing pressure of 170 to 180 psig.

The SPEEDTROL sensors are clipped to a return bend on the bottom row of the condenser coil.

HIGH AMBIENT CONTROL (OPTIONAL)

The high ambient control is a single pole, pressure activated switch that closes on a pressure rise to partially unload one or both circuits. It senses condenser pressure and is factory set to close at 375 psig and will automatically reset at 300 psig. To check the control either block off condenser surface or start the unit with condenser fan motor fuses in only one fan fuse block (FB6) and observe the cut-in point of the control by monitoring when the compressor unloads. The purpose of the control is to allow the unit to continue operating when the ambient temperature exceeds the design temperatures of the unit. High ambient sensor locations are shown in Figures 18 and 20.

Figure 18.

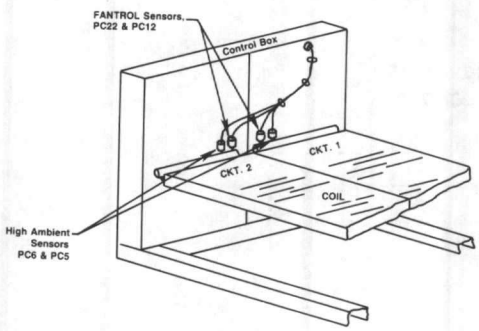


Figure 19.

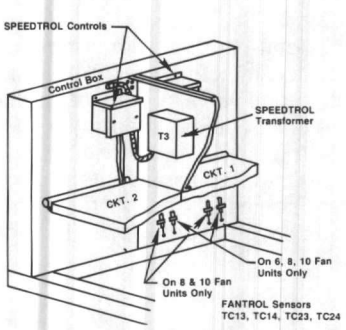


Figure 20.

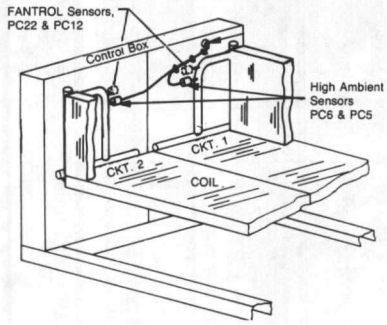
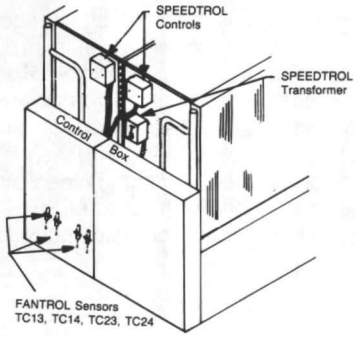


Figure 21.



HIGH RETURN WATER CONTROL (OPTIONAL)

The high return water control senses the temperature of return water and partially unloads one or both compressor circuits. The control has an adjustable 0 to 100°F temperature range with 3°F switch differential.

The purpose of the control is to prevent high superheated suction temperatures entering the compressor should the return water temperature become too high. High suction temperature with the compressor at full load could result in serious damage to the compressor. A 70°F setpoint is recommended for the high return water thermostat.

The unit is shipped from the factory with the control sensor taped to the bottom of the control box and must be field installed. It is recommended that the sensor be clamped to the side of the return water line near the cooler connection and insulated (see Figure 6, page 6).

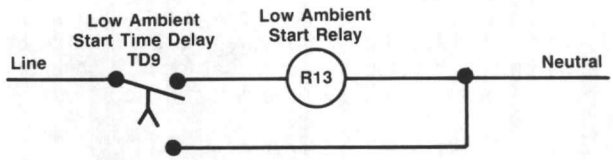
To check the control, the system should be operating at full load conditions. By slowly turning the dial setting down, the control should partially unload one compressor circuit. By continuing to dial the setting down, the second compressor circuit should unload depending on what the interstage differential is set at.

LOW AMBIENT START (OPTIONAL)

Low ambient start is available on all units as an option with FANTROL and included automatically with optional SPEEDTROL. It consists of a solid-state, normally closed time delay wired in series with a relay. These are both wired in parallel to the liquid line solenoid valve so that when the solenoid valve is energized by the unit thermostat the low ambient start relay is also energized through the time delay. The relay has contacts that essentially short-circuit the low pressure control and freezestat and allow the compressor to start with the low pressure control open.

After about 2¾ minutes, the time delay will open and de-energize the relay. If the system has not built up enough evaporator pressure to close the low pressure control, the compressor will stop. The time delay can be reset to its original normally closed position by moving the pumpdown switch(es) PS1 or PS2 to the "manual pumpdown" position. Moving the pumpdown switch back to the "auto pumpdown" position will again energize the relay for another attempt at startup. If the system has built up enough evaporator pressure, the compressor will continue to run.

To check the control, turn off all power to the unit and remove the wire(s) leading to the terminals of the low pressure control(s) LP1 and LP2 and the freezestat(s) FS1 and FS2. Remove power to the compressor and jumper across terminals 48 to 50 for circuit 1 and 78 to 80 for circuit 2. Switch the pumpdown switch(es) PS1 and PS2 to the "auto pumpdown" position. Energize the control circuit by turning on the control circuit disconnect or main power disconnect (depending on the installation) and the control stop switch S1. The compressor contactors should pull in instantly and trip back out after the 2¾ minute time delay.



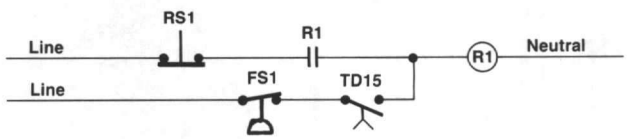
NOTE: Line is only hot when the unit thermostat calls for compressor to run.

FREEZE CONTROL (OPTIONAL)

The freeze control is a single pole pressure switch that closes on a pressure fall. It contains a pressure actuated contact that upon a fall in evaporator pressure energizes a 60 second time delay. After timing out, R1 is energized which in turn de-energizes the 24V control circuit, shutting down the compressor circuit. R1 also locks itself into a manually resettable holding circuit through RS1. The control is factory set to close at 54 psig and open at 57 psig. The 60 second time delay prevents nuisance cutouts due to momentary drops in suction pressure.

To check the control, the system must be operating. A voltmeter should be connected across terminals 45 and 46 in the control box. With the unit running there should be a 24V potential across these terminals. Observing evaporator pressure, move the pumpdown switch PS1 to the "manual pumpdown position. Evaporator pressure will begin to drop. When the voltmeter goes to zero, the pressure actuated switch has closed. Note the evaporator pressure when this happens, since the unit will pump down before the 60 second delay times out.

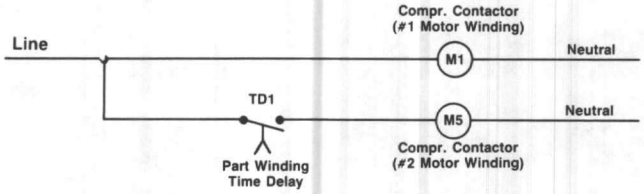
Compressor circuit 2 operates the same way except the voltmeter should be across terminals 75 and 76 in the control box and pumpdown switch PS2 switched to manual pumpdown.



PART WINDING START (OPTIONAL)

Part winding start is available on all voltage units and consists of a solid-state time delay wired in series with the contactor that energizes the second winding of each compressor motor. Its purpose is to limit current in-rush to the compressors upon startup. As each compressor starts, the contactor of the first motor winding is delayed for 1 second.

Control checkout is best accomplished by observation as each contactor is pulled in to see that the 1 second delay occurs before the second contactor pulls in.



PHASE/VOLTAGE MONITOR (OPTIONAL)

The phase/voltage monitor is a device which provides protection against three-phase electrical motor loss due to power failure conditions, phase loss, and phase reversal. Whenever any of these conditions occur, an output relay is deactivated, disconnecting power to the thermostatic control circuit, automatically pumping down the unit.

The output relay remains deactivated until power line conditions return to an acceptable level. Trip and reset delays have been provided to prevent nuisance tripping due to rapid power fluctuations.

When three-phase power has been applied, the output relay should close and the "run light" should come on. If the output relay does not close, perform the following tests.

1. Check the voltages between L1—L2, L1—L3 and L2—L3. These voltages should be approximately equal and within + 10% of the rated three-phase line-to-line voltage.
2. If these voltages are extremely low or widely unbalanced check the power system to determine the cause of the problem.
3. If the voltages are good, turn off the power and interchange any two of the supply power leads at the disconnect.

   This may be necessary as the phase/voltage monitor is sensitive to phase reversal. Turn on the power. The output relay should now close after the appropriate delay.

HOT GAS BYPASS (OPTIONAL)

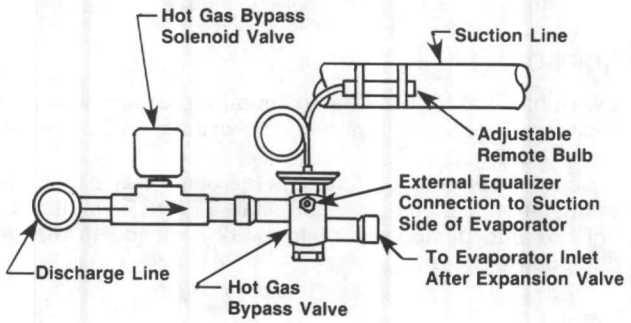
Hot gas bypass is a system for maintaining evaporator pressure at or above a minimum value. The purpose for doing this is to keep the velocity of the refrigerant as it passes through the evaporator high enough for proper oil return to the compressor when cooling load conditions are light. It also maintains continuous operation of the chiller at light load conditions.

The system consists of a solenoid valve piped in series with a pressure regulating valve as shown below. The solenoid valve is factory wired to open whenever the unit thermostat calls for the first stage of cooling. The pressure regulating valve is factory set to begin opening at 58 psig (32°F for R-22) when the air charged bulb is in an 80°F ambient temperature. Since the bulb is factory mounted on the suction line, and suction line temperatures are usually in the 50°F to 60°F range, the chart below indicates that for ALR chillers, the valve is factory set to begin opening at 54 to 56 psig. This setting can be changed as indicated above by changing the pressure of the air charge in the adjustable bulb. To raise the pressure setting, remove the cap on the bulb and turn the adjustment screw clockwise. To lower the setting, turn the screw counterclockwise. Do not force the adjustment beyond the range it is designed for, as this will damage the adjustment assembly.

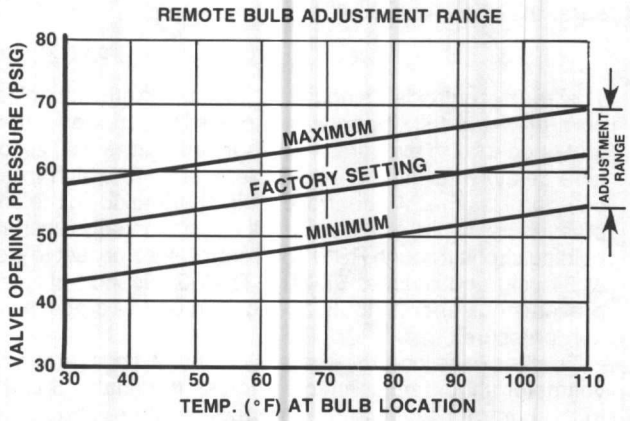
The regulating valve opening point can be determined by slowly reducing the system load (or increasing the required chilled water temperature setting indicated on the unit thermostat), while observing the suction pressure. When the bypass valve starts to open, the refrigerant line on the evaporator side of the valve will begin to feel warm to the touch.

CAUTION: *The hot gas line may become hot enough to cause injury in a very short time, so care should be taken during valve checkout.*

Hot Gas Bypass Piping Diagram



Hot Gas Bypass Adjustment Range



ALR CONTROLS, SETTINGS, AND FUNCTIONS

DESCRIPTION	FUNCTION	SYMBOL	SETTING	RESET	LOCATION	DIFFERENTIAL
FREEZE CONTROL	Protects the evaporator from water freezeup. Time delay prevents nuisance trips.	FS1, 2 TD15, 16	Closes at 54 psig. Opens at 57 psig. 60 second	Manual thru RS1, 2 N/A	Suction line near cooler Control box	3 psig. fixed N/A
HIGH PRESSURE CONTROL	Stops compressor when discharge pressure is too high.	HP1, 2	Closes at 400 psig. Opens at 300 psig.	Manual thru RS1, 2	On compressor	100 psig. fixed.
LOW PRESSURE CONTROL	(Used for pumpdown.) Stops compressor when suction pressure is too low.	LP1, 2	Closes at 60 psig. Opens at 35 psig.	Auto	On compressor	30 psig fixed.
COMPRESSOR MOTOR PROTECTOR (Texas Instruments)	Protects motor from high temperature by sensing winding temperature.	MP1—4	500 ohms cold to 20,000 ohms hot.	Auto from 2700—4500 ohms	Compressor junction box	15,000 ohms
OIL PRESSURE CONTROL	Stops compressor if oil pressure drops below setpoint for 120 seconds.	OP1—4	Pressure sensor opens at 14 psig oil prssure. If pressure drops below 10 psig the sensor closes, energizing a 120 second delay before stopping the compressor.	Manual	Control box	5 psig
HIGH AMBIENT UNLOADER PRESSURE CONTROL	Unloads compressor circuits if condenser pressure is too high.	PC5, 6	Closes at 375 psig. Opens at 300 psig.	Auto	On condenser coil header	75 psig
FANTROL CONDENSER PRESSURE CONTROL	Maintains condenser pressure by cycling the condenser fans in response to ambient air temperature (TC) and condenser pressure (PC).	PC12, 22 TC13, 14, 15 TC23, 24, 25	See table with FANTROL settings.	Auto	PC12—22 on coil header. TC13—25 in control box. Sensors mounted in back of control box.	See table with FANTROL settings.
PUMPDOWN SWITCH	Used to manually pump down compressor circuit.	PS1, 2	Auto/manual	N/A	Control box	N/A
PHASE/VOLTAGE MONITOR	Protects motor from power failure, phase loss and phase reversal.	PVM	N/A	When conditions return to an acceptable level.	Control box	N/A
RESET SWITCHES	Restarts compressor circuit if it cuts out on high pressure or freezestat.	RS1—4	N/A	Manual	Control box	N/A
CONTROL STOP SWITCH	Shuts down entire control circuit.	S1	On/off	N/A	Control box	N/A
LEAD-LAG SWITCHES	Reverses sequence that compressors start in.	S2—4	Circuit 1 leads Circuit 2 or Circuit 2 leads Circuit 1	N/A	Control box	N/A
HEAT RECOVERY SWITCH	Puts unit into the heat recovery mode.	S5	On/off	N/A	Control box	N/A
HEAT RECOVERY TIME DELAY	Allows condenser pressures to equalize before going into heat recovery mode.	TD17—19	20 seconds	N/A	Control box	N/A
SPEEDTROL HEAD PRESSURE CONTROL	Modulates condenser fan speed in resonse to condenser temperature.	SC11, 12	Maintains minimum condensing pressure of 170 to 180 psig.	N/A	Back of control box or on bulkhead	N/A
SOLENOID VALVES, LIQUID LINE	Close off liquid line for pumpdown.	SV1, 2	N/A	N/A	Condenser section on liquid line after filter-drier and before TEV.	N/A
SOLENOID VALVES, HOT GAS BYPASS	Close off hot gas line for pumpdown.	SV5, 6	N/A	N/A	Condenser section	N/A
SOLENOID VALVES, WATER CONDENSER	Open in heat recovery mode.	SV10, 20	N/A	N/A	Condenser section	N/A
SOLENOID VALVES, AIR CONDENSER	Close in heat recovery mode.	SV11, 21	N/A	N/A	Condenser section	N/A

continued on next page

ALR CONTROLS, SETTINGS, AND FUNCTIONS (Continued)

DESCRIPTION	FUNCTION	SYMBOL	SETTING	RESET	LOCATION	DIFFERENTIAL
UNIT THERMOSTAT (MASTER)	Measures return water temperature to control compressor staging.	CP1	Adjustable from 30°F to 60°F. Should be set between 42°F and 50°F.	N/A	Control box. Sensor in return water line from building to chiller.	Adjustable from 1°F to 3°F per stage.
UNIT THERMOSTAT (SATELLITE)	Adds additional stages of cooling to unit thermostat CP1.	CP2	N/A	N/A	Control box	Adjustable thru CP1
COOLER BARREL THERMOSTAT	Energizes cooler heating cable to prevent freeze-up in shutdown conditions.	TC2	38°F	Auto	On cooler	N/A
HIGH RETURN WATER THERMOSTAT	Unloads compressor circuits if return water temperature is too high.	TC11	Adjustable 0 to 100°F. Recommended 70°F setpoint.	Auto	Control box	3°F fixed
COMPRESSOR LOCKOUT TIME DELAY	Prevents short cycling of compressors.	TD1—4	Adjustable 0 to 6 minutes. Recommended 5 minute setpoint.	Auto	Control box	N/A
PART WINDING START TIME DELAY	Reduces inrush amp draw on startup.	TD5—8	1 second	N/A	Control box	N/A
LOW AMBIENT START TIME DELAY	Bypasses low pressure control and freezestat to allow evaporator pressure to build up in low ambient conditions.	TD9—10	2¾ minutes	Auto	Control box	N/A
COMPRESSOR SEQUENCING TIME DELAY	Staggers compressor starting to reduce inrush amp draw.	TD11—13	TD11: 20 seconds TD12, 13: 40 seconds	N/A	Control box	N/A
COMPRESSOR UNLOADERS	Solenoid valves on compressor heads to load or unload compressors (energize to unload; de-energize to load).	U1, 2	N/A	N/A	On compressor	N/A

The McQuay ALR SEASONPAK air cooled water chiller provides not only lower operating costs, but lower installation costs, low maintenance costs and greater design flexibility, in both comfort and process cooling applications.

In order for McQuay to better serve our customers, feedback of recurring service problems or complaints dealt with in the field would be appreciated. Problems or complaints can be reported to McQuay by filling out a Product Quality Report (Form No. 2S-636-784). These forms are available from McQuay service and sales representative organizations and should be routed back through these organizations to McQuay's Engineering and Marketing departments.

TROUBLESHOOTING CHART

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
COMPRESSOR WILL NOT RUN	1. Main switch open. 2. Fuse blown. Circuit breakers open. 3. Thermal overloads tripped. 4. Defective contactor or coil. 5. System shut down by safety devices. 6. No cooling required. 7. Liquid line solenoid will not open. 8. Motor electrical trouble. 9. Loose wiring.	1. Close switch. 2. Check electrical circuits and motor winding for shorts or grounds. Investigate for possible overloading. Replace fuse or reset breakers after fault is corrected. Check for loose or corroded connections. 3. Overloads are auto reset. Check unit closely when unit comes back on line. 4. Repair or replace. 5. Determine type and cause of shutdown and correct it before resetting safety switch. 6. None. Wait until unit calls for cooling. 7. Repair or replace coil. 8. Check motor for opens, short circuit, or burnout. 9. Check all wire junctions. Tighten all terminal screws.
COMPRESSOR NOISY OR VIBRATING	1. Flooding of refrigerant into crankcase. 2. Improper piping support on suction or liquid line. 3. Worn compressor.	1. Check setting of expansion valve. 2. Relocate, add or remove hangers. 3. Replace.
HIGH DISCHARGE PRESSURE	1. Noncondensables in system. 2. System overcharged with refrigerant. 3. Discharge shutoff valve partially closed. 4. FANTROL out of adjustment. 5. Fan not running. 6. Dirty condenser coil.	1. Purge the noncondensables. 2. Remove excess. 3. Open valve. 4. Adjust FANTROL settings. 5. Check electrical circuit. 6. Clean coil.
LOW DISCHARGE PRESSURE	1. Faulty condenser temperature regulation. 2. Suction shutoff valve partially closed. 3. Insufficient refrigerant in system. 4. Low suction pressure. 5. Compressor operating unloaded.	1. Check condenser control operation. 2. Open valve. 3. Check for leaks. Repair and add charge. 4. See Corrective Steps for low suction pressure below. 5. See Corrective Steps for failure of compressor to load below.
HIGH SUCTION PRESSURE	1. Excessive load. 2. Expansion valve overfeeding. 3. Compressor unloaders open.	1. Reduce load or add additional equipment. 2. Check remote bulb. Regulate superheat. 3. See Corrective Steps below for failure of compressor to load.
LOW SUCTION PRESSURE	1. Lack of refrigerant. 2. Evaporator dirty. 3. Clogged liquid line filter-drier. 4. Clogged suction line or compressor suction gas strainers. 5. Expansion valve malfunctioning. 6. Condensing temperature too low. 7. Compressor will not load. 8. Insufficient water flow. 9. Evaporator head ring gasket slippage.	1. Check for leaks. Repair and add charge. 2. Clean chemically. 3. Replace. 4. Clean strainers. 5. Check and reset for proper superheat. 6. Check means for regulating condensing temperature. 7. See Corrective Steps below for failure of compressor to unload. 8. Adjust gpm. 9. To troubleshoot, take pressure drop across vessel and consult factory to obtain design pressure drop for that vessel.
COMPRESSOR WILL WILL NOT UNLOAD OR LOAD	1. Defective capacity control. 2. Unloader mechanism defective. 3. Faulty thermostat stage or broken wire. 4. Stages not set for application.	1. Replace. 2. Replace. 3. Replace. 4. Reset thermostat setting to fit application.
COMPRESSOR LOADING/UNLOADING INTERVALS TOO SHORT	1. Erratic water thermostat. 2. Insufficient water flow.	1. Replace. 2. Adjust gpm.
LOSS OF OIL PRESSURE OR NUISANCE OIL PRESSURE CONTROL TRIPS	1. Clogged suction oil strainer. 2. Excessive liquid in crankcase. 3. Oil pressure gauge defective. 4. Low oil pressure safety switch defective. 5. Worn oil pump. 6. Oil pump reversing gear stuck in wrong position. 7. Worn bearings. 8. Low oil level. 9. Loose fitting on oil lines. 10. Pump housing gasket leaks. 11. Flooding of refrigerant into crankcase. 12. Insufficient waterflow.	1. Clean. 2. Check crankcase heater. Reset expansion valve for higher superheat. Check liquid line solenoid valve operation. 3. Repair or replace. Keep valve closed except when taking readings. 4. Replace. 5. Replace. 6. Reverse direction of compressor rotation. 7. Replace compressor. 8. Add oil. 9. Check and tighten system. 10. Replace gasket. 11. Adjust thermal expansion valve. 12. Adjust GPM.
COMPRESSOR LOSES OIL	1. Lack of refrigerant. 2. Excessive compression ring blow-by. 3. Suction superheat to high. 4. Crankcase heater burnt out.	1. Check for leaks and repair. Add refrigerant. 2. Replace compressor. 3. Adjust superheat. 4. Replace crankcase heater.

TROUBLESHOOTING CHART

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
MOTOR OVERLOAD RELAYS OPEN OR BLOWN FUSES	1. Low voltage during high load conditions. 2. Defective or grounded wiring in motor. 3. Loose power wiring. 4. High condensing temperature. 5. Power line fault causing unbalanced voltage. 6. High ambient temperature around the overload relay. 7. Failure of second starter to pull in on part winding start systems.	1. Check supply voltage for excessive line drip. 2. Replace compressor motor. 3. Check all connections and tighten. 4. See Corrective Steps for high discharge pressure. 5. Check supply voltage. Notify power company. Do not start until fault is corrected. 6. Provide ventilation to reduce heat. 7. Repair or replace starter or time delay mechanism.
COMPRESSOR THERMAL PROTECTOR SWTICH OPEN	1. Operating beyond design conditions. 2. Discharge valve partially shut. 3. Blown valve plate gasket.	1. Add facilities so conditions are within allowable limits. 2. Open valve. 3. Replace gasket.

McQuay Air Conditioning

INSTALLATION AND MAINTENANCE DATA

BULLETIN NO. IM 215
JULY, 1987
FORM NO. 380558Y

HORIZONTAL UNIT HEATERS

FOR STEAM AND HOT WATER HEATING SYSTEMS

CONTENTS

INSPECTION

When the equipment is received all items must be carefully checked against the bill of lading to be sure all cartons have been received. Visible or concealed damage should be reported immediately to the carrier and a claim filed with him for damage. The electrical nameplate should be checked to be sure it agrees with the power supply available.

INSTALLATION

Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. CAUTION: Sharp edges and coil surfaces are a potential injury hazard. Avoid contact.

UNIT MOUNTING

Use care in handling the units to avoid damage to the coil fins. Hang units with supporting rods; do not hang units from piping.

The horizontal unit heaters have two ½-13 weld nuts on top of the unit for threaded hanger rods.

OSHA regulations, as recorded in Federal Register Vol. 37, No. 202 in October 1972, require the use of a fan guard when the periphery of the fan blades is less than 7 feet above the floor or working surface. The customer must evaluate the location of the unit to determine if the guidelines set up by OSHA provide adequate protection against personal injury and provide protection if required. A fan guard designed to comply with OSHA requirements is available from the unit manufacturer.

PIPING

Typical piping diagrams are illustrated in Figures 1 through 4. All piping should be in conformance with good standard practice and local codes. Pipe size is based on the type of heating system, pressure and flow rate. Consult the ASHRAE guide for complete data. The selection of proper steam traps and air vents is very important. Steam traps must be properly sized and orificed for the pressure involved and should be sized for a minimum of two times the maximum condensing rate of the unit heater. In case of doubt, consult the steam trap manufacturer. Branch piping must allow for expansion and contraction without placing a strain on the unit heater. Piping should be independently supported, not supported by the unit.

Do not exceed 150 psig or 375°F temperature on standard coils, 350 psig or 450°F temperature on high pressure coils, or 300°F temperature on optional low flow water coils. The unit nameplate designates coil pressure.

PIPING DIAGRAMS

Figure 1. HOT WATER SYSTEM

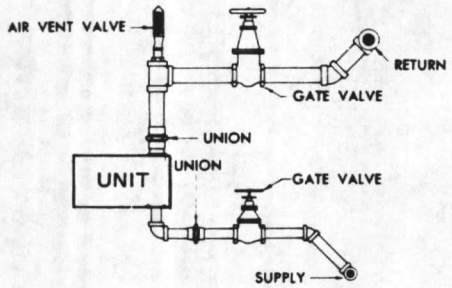


Figure 2. VAPOR & VACUUM STEAM SYSTEM

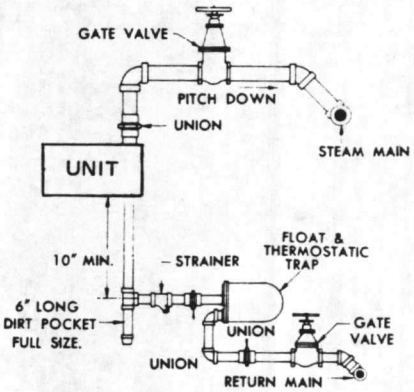


Figure 3. HIGH PRESSURE STEAM SYSTEM

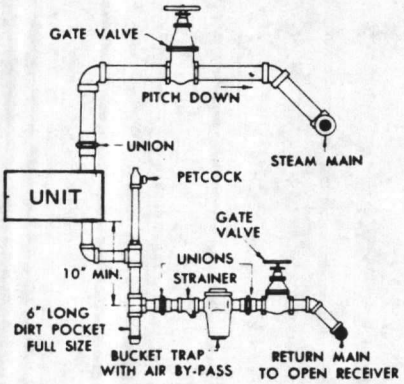
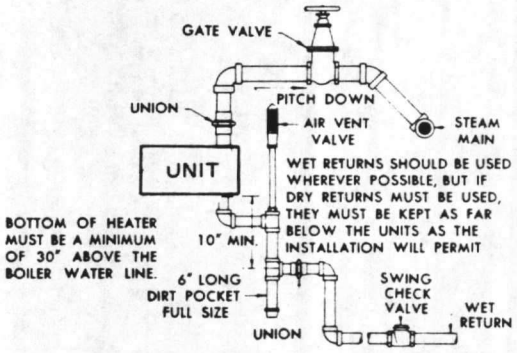


Figure 4. LOW PRESSURE STEAM GRAVITY SYSTEM



WIRING

Wire in accordance with local codes or the National Electrical Code, whichever is applicable. The installer shall provide wiring to the motor, branch circuit overcurrent protection, and disconnect means. All standard units except the UHH-094 are provided with motors which have internal thermal overloads. The installer must provide overload protection for the UHH-094 unit. Typical wiring diagrams are shown in Diagrams 1 through 6. Wiring instructions for the optional speed controller are included with the speed controller.

Diagrams 1 & 4. Although unit heaters are usually thermostatically controlled, there are some installations where manual "on-off" control is sufficient. These diagrams show this type of control. The single phase manual starter shown in Diagram 1 may be of the single pole or double pole type.

Diagrams 2 & 5. These diagrams show the most common method of controlling unit heaters. Each unit is controlled by a space thermostat and, in addition, a limit control (temperature or pressure type) is connected in the circuit so that the unit cannot operate when the temperature of the steam or water is too low.

Diagrams 3 & 6. These diagrams show the flexible method of control providing both automatic and manual operation. The automatic operation will be the same as in Diagrams 2 and 5. However, an additional provision is made for operating the unit manually. This permits the unit being used as an air circulator during the non-heating season.

Although Diagram 6 shows a multiple application, this same type of control may be applied to individual units by substituting a magnetic starter for the magnetic relay and omitting the manual starter.

TYPICAL WIRING DIAGRAMS

Diagram 1. Single Phase Power MANUAL CONTROL

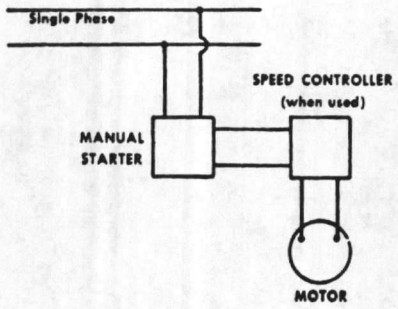


Diagram 2. Single Phase Power AUTOMATIC CONTROL

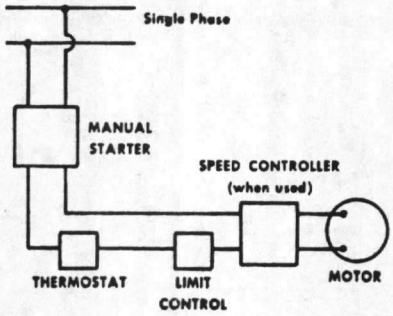


Diagram 3. Single Phase Power MANUAL OR AUTOMATIC CONTROL

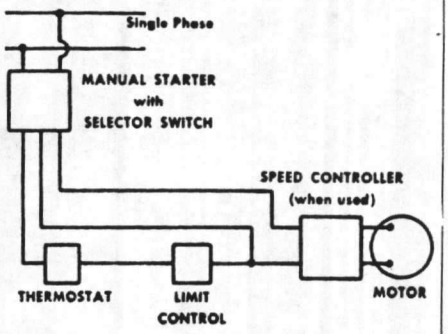


Diagram 4. 3-Phase Power MANUAL CONTROL

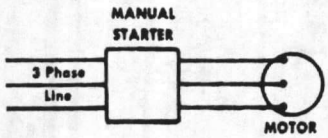


Diagram 5. 3-Phase Power AUTOMATIC CONTROL

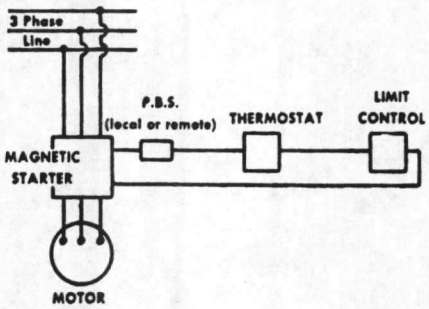
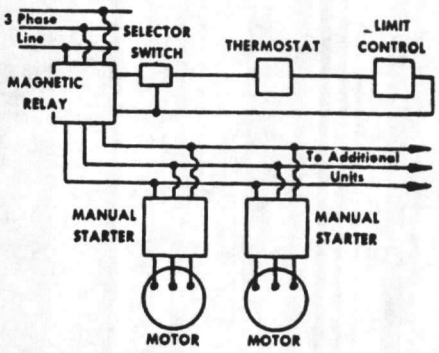


Diagram 6. 3-Phase Power MANUAL OR AUTOMATIC CONTROL



START-UP

Inspect the unit heater carefully before starting. Tighten any loose nuts, bolts or screws. Examine the propeller fan to see that it has not been damaged during installation, that it is tight on the shaft, and that it rotates freely and in the correct direction. The fan should be centered in the orifice (equal gap between fan and orifice on each side of fan), and the fan should protrude through the orifice (in direction of airflow) approximately ⅓ of the blade depth. Make sure that the line voltage at the unit is within 10% of the motor nameplate voltage. Vent the lines on hot water systems. Discharge louvers should not be closed more than 75% or motor overheating may occur.

MAINTENANCE

WARNING: Before performing any maintenance, disconnect the electrical power to avoid electrical shock or injury from rotating parts.

COIL CLEANING

All unit heater coils should be cleaned at least once a yaer and more often under unfavorable conditions. Build-up of dirt, grease, and lint will reduce original heating capacity and may overload motor. The following are suggested cleaning methods.

1. Disconnect the electrical power before servicing to avoid electrical shock or injury from rotating parts.
2. Use a brush to loosen dirt on side where air enters the coil and then turn fan on to blow the dirt from the unit.
3. Use compressed air to loosen dirt by blowing from leaving airside of unit.
4. For a more thorough cleaning of coil, remove the fan and motor and spray a mild alkaline solution over the coil. This must be followed by a very thorough hot water rinse.

INTERNAL CORROSION SAFEGUARDS

1. Provide controlled water treatment, but do not use an excess of boiler compounds.
2. De-aerate boiler feed water.
3. Insure rapid and continuous condensate drainage by proper sizing and installation of steam traps and piping.
4. Clean strainers and check steam traps for proper operation.
5. Provide proper vents for each unit. Verify annually that automatic vents are operating properly.
6. Use low pressure steam whenever possible.

GENERAL

Casings should be periodically cleaned to remove dirt, grease and corrosive substances which might injure the finish. Any rusted or corroded spots should be cleaned and repainted. Check accessories and motor mount. Also, check fan for tight connection to shaft, free rotation, and proper clearance.

MOTOR

Cleaning — Disconnect the electrical power before cleaning to avoid electrical shock or injury from rotating parts. Dur-

ing each inspection, remove all grease and dirt from the outside of the motor. This is important as grease and dirt act as insulation and thereby prevent heat dissipation, causing overheating of the motor.

Lubrication — Sleeve bearing motors with oilers should be relubricated at the end of the first year and after each 2000 hours of operation thereafter. Use one teaspoon or 5cc of SAE #20 non-detergent oil per bearing. Where motors are operated in high ambient temperatures and/or under severe conditions, they must be serviced more frequently. DO NOT OVERLUBRICATE.

SERVICE

This equipment should be serviced only by qualified, experienced technicians. Always disconnect the electrical power before servicing to avoid electrical shock or injury from rotating parts. If motor service is required, the motor can be removed as follows.

FACE MOUNTED MOTOR REMOVAL

1. Shut off electrical power to the unit.
2. Disconnect wires from motor.
3. Remove the fan guard/motor mount from the back panel of the unit by removing the four attaching screws.
4. Loosen the setscrew(s) on the fan and slide the fan off the motor shaft.
5. Remove four nuts holding the motor to the fan guard/motor mount.
6. Reverse process to reassemble. Fan should be centered in the orifice and ⅓ of the fan should protrude through the orifice in direction of airflow.

SHELF MOUNTED MOTOR REMOVAL

1. Shut off electrical power to unit.
2. Disconnect wires from motor.
3. Loosen the setscrew(s) on the fan and slide the fan off the motor shaft.
4. Remove the four nuts and bolts holding the motor to the motor shelf and lift the motor off the unit.
5. Reverse process to reassemble. Fan should be centered in the orifice and ⅓ of the fan should protrude through the orifice in direction of airflow.

REPLACEMENT PARTS

When writing for service or replacement parts always provide a complete description of the service part, part number (if known), plus complete serial and model number of unit involved.

McQuay Air Conditioning

INSTALLATION AND MAINTENANCE DATA

BULLETIN NO. IM 140-5
JANUARY, 1988
FORM NO.281170Y REV. E

CABINET UNIT HEATERS
Types CHF & CHB

INSTALLATION

NOTE: Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. CAUTION: Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

1. All items should be carefully checked against the bill of lading to be sure that all cartons have been received. The unit should be left in the carton until it is ready to be installed. If the units are not to be installed immediately, they must be stored in a dry location. All units should be carefully inspected for damage when received. Visible or concealed damage should be reported immediately to the carrier and a claim filed for damages.
2. To remove the front panel on a CHF unit, remove the screw under each access door and slide the panel up toward the grille, then away from the unit. See Figure 1.
3. Secure unit in its final location and check its position using a spirit level. Unit must be level to insure proper operation. Rotate fan wheels by hand to make sure they do not bind.
4. Steam or water connection can now be made to the unit. Piping must be installed in accordance with local codes and regulations. Select steam traps in accordance with manufacturer's recommendations. Be certain that the required pressure differential will always be available. Do not undersize steam traps. Vent all water coils before hydrostatic tests are performed.
5. Electrical connections can now be made to the unit. Wiring must comply with local codes and regulations. Proper fuse protection and a suitable electrical ground must be provided. Motor is thermally protected. See Figure 3.
6. When the solid-state fan control is to be wall mounted, the electrical junction box is to be furnished by the contractor and installed per architect's drawings and specifications. A 2 × 4 junction box at least 2⅛″ deep is required. Disconnect electrical power when connecting the control to prevent burnout of the electronic device. Warranty on the control is voided by shorting the output.
7. INVERTED AND CEILING MOUNTED UNITS—CHF and CHB units are suitable for inverted and ceiling mount applications. For these applications the motor clamps should be loosened and the motor rotated so that motor oilers are upright. Re-tighten the motor clamps. Converson kits are suggested for inverted and ceiling mount CHF units. For complete instructions refer to Installation and Maintenance Bulletin IM 141, which is included in the conversion kit.
8. CHB UNITS WITH WALL PLATES—Refer to Figure 2 for proper mounting position of CHB units for use with wall plates. For complete wall plate installation instructions refer to Installation and Maintenance Bulletin IM 370, which is included in the wall plate kit.
9. Test coil, piping, and electrical connections. Vent water coils.

Figure 1. CHF Front Panel Removal.

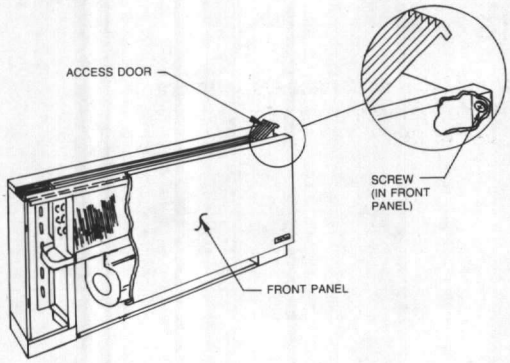


Figure 2. CHB With Wall Plate.

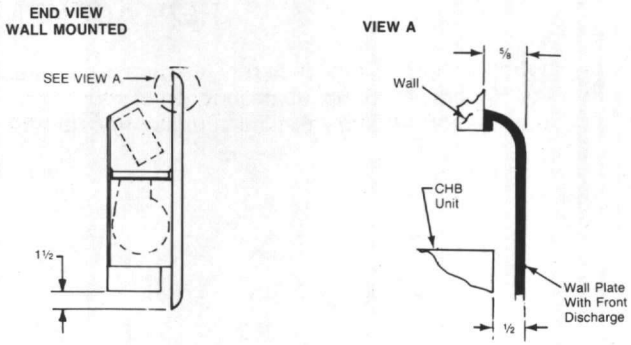
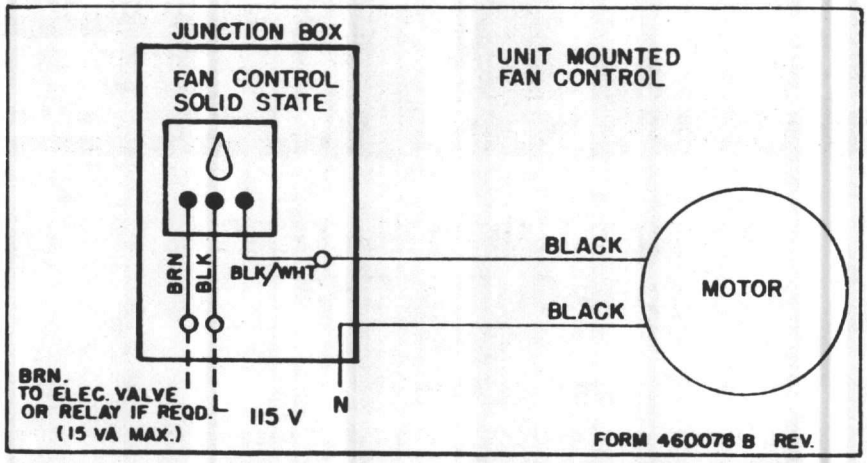


Figure 3. Wiring Diagram.



MAINTENANCE

Throwaway filters should be replaced frequently to obtain maximum performance.

Cleanable filters, if used, should be maintained according to the manufacturer's recommendation.

The motor has been oiled at the factory. It is not necessasry to add oil the first year when operating continuously. Oil once a year with 16 drops per bearing of SAE #20 non-detergent oil. Do not overlubricate.

If motor replacement is required, it can be removed in the following manner:

1. Disconnect all electrical power to the unit. **NOTE:** The "off" position on the fan control may not open all ungrounded supply circuit conductors.
2. Remove the two screws holding the fan housing together and then remove the front half of the housing.
3. Remove the clips holding the motor in the cradle base.
4. Remove the screw connecting the green ground lead to the motor base.
5. The motor may now be rotated out of the base. Be careful not to damage or bend the fan wheels.
6. Remove the fan wheels from the motor shaft. Loosen the setscrew on aluminum fan wheels or pull the plastic fan wheels straight off. **NOTE:** Notice the position of the hub on the motor shaft because it must be re-installed in the same position.

To replace the motor in the unit, reverse the procedure outlined above.

Aluminum fan wheels should be left loose on the motor shaft until the motor is secured to the base. The fans should be centered between the openings before the setscrew is tightened to the flat on the motor shaft.

Plastic fan wheels should be pushed onto the motor shaft before the motor is replaced in the base. If the fan is not centered in the openings, the motor must be removed from the base before repositioning the fans.

Before installing the clips over the resilient motor rings, be sure that the oil tubes are above the horizontal, that the motor through-bolts do not touch the motor base, and that the ground wire from the motor is secured to the base.

Replace the front half of the fan housing. The removable half must be positioned on the outside of the permanent half near the fan deck and inside the permanent half near the screw holes.

Rotate fan wheels by hand to be sure the fans do not touch the fan scroll.

REPLACEMENT PARTS

When writing for service or replacement parts, direct your letter to McQuay Service Department. Always provide complete description of service part including model number from vendor items, part number (if known), plus complete model and serial number of unit.

GREENHECK
P.O. BOX 128 SCHOFIELD, WISCONSIN 54476
PH. 715-359-6171

Centrifugal Roof Exhausters
Models CUE and G
Installation, Operating and Maintenance Manual

Installation

Upon receiving unit, check for any damage and report it immediately to the shipper. Also check to see that all accessory items are accounted for.

Move fan to desired location and fasten securely through mounting holes in base. Shims may be necessary depending upon roofing material thickness. The diagrams shown below depict dimensions for models CUE and G.

Access to the motor compartment is accomplished by removing the screws designated by R in drawings below. The cover can then be removed and placed in a flat area where winds will not blow it off the roof.

The voltage rating of the motor must be checked for compatability to supply voltage prior to final electrical connection. Electrical lead-in wires should be run through the conduit provided between the curb and the bottom of the motor compartment. Wiring must conform to local and national electrical codes.

A drain trough is provided on the CUE for one point drainage of residue. Some means for collection of this residue must be provided by either placing a container directly under the trough or by utilizing an adapter to direct the residue to another location.

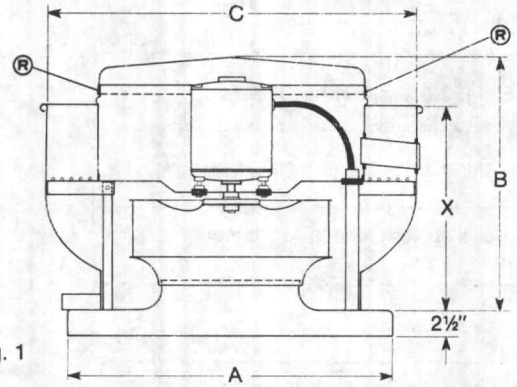


Fig. 1

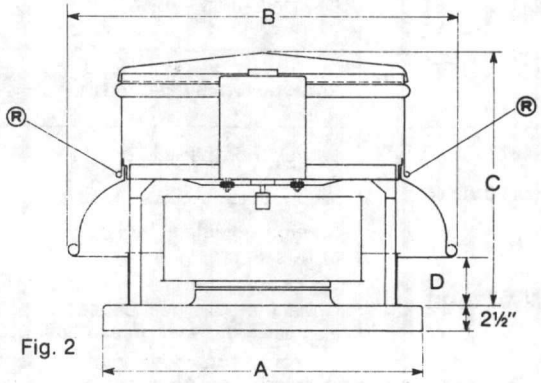


Fig. 2

DIMENSIONAL DATA

MODEL	Dimensions (inches)					
	A	B	C	X	Damper Size	Roof Opening
CUE-10	22	23¾	23⅝	16⅝	12	14½
CUE-14	26	24¾	27½	18½	16	18½
CUE-18	30	28⅝	34³⁄₁₆	20¾	18	20½

DIMENSION A-GIVEN IS THE INSIDE DIMENSION OF THE CURB CAP. THE ROOF CURB SHOULD BE 1½" LESS THAN THE CURB CAP TO ALLOW FOR CAULKING AND FLASHING.

DIMENSIONAL DATA

MODEL	A	B	C	D	Damper Size	Roof Opening
G-60, 65, 70, 75	17	19⅛	12⅛	3	8	10½
G-80, 85, 90, 95	19	21¾	14⅝	4	10	12½
G-100, 120	22	28⅞	18	5	12	14½
G-130, 140, 150	26	35½	19⅛	5	16	18½
G-160, 170	30	38³⁄₁₆	22¹⁄₁₆	6	18	20½
G-180	30	42⅜	23¼	7	18	20½

DIMENSION A-GIVEN IS THE INSIDE DIMENSION OF THE CURB CAP. THE ROOF CURB SHOULD BE 1½" LESS THAN THE CURB CAP TO ALLOW FOR CAULKING AND FLASHING.

Pre-starting checks

Check all fasteners for tightness. The wheel should rotate freely and be aligned as shown. Wheel position is preset and the unit tested at the factory, however, movement may occur during shipment and realignment may be necessary. Centering can be accomplished by loosening the set screws in the wheel and moving the wheel to the desired position.

Model G units have wheels that do not overlap and only need to be adjusted as to not rub on the venturi inlet of the curb cap.

Direction of the wheel is very critical. Improper rotation will result in excessive horsepower and possible motor burnout. Check rotation by only momentarily energizing the unit. The rotation should be as shown in the diagram to the left and be in the same direction as the rotation decals which appear on the unit.

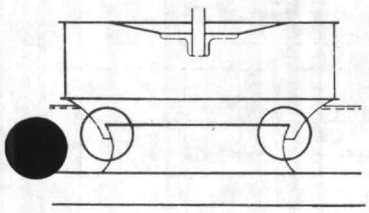


Fig. 3

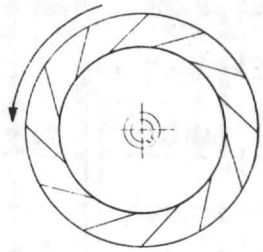


Fig. 4

Maintenance Section

Motor maintenance is generally limited to cleaning and lubrication (where applicable). Cleaning should be limited to exterior surfaces only. Removing dust and grease buildup on motor housing assures proper motor cooling. Greasing of motors is only intended when fittings are provided. Many fractional motors are permanently lubricated for life and require no further lubrication. Motors supplied with grease fittings should be greased in accordance with manufacturers' recommendations. When motor temperature does not exceed 104°F (40°C), the grease should be replaced after 2000 hours of running time as a general rule.

Wheels require very little attention when moving clean air. Occasionally, oil and dust may accumulate on the wheel causing imbalance. When this occurs, the wheel and housing should be cleaned to assure smooth and safe operation.

The unit should be made non-functional when cleaning wheel or housing. (Removal of fuses, locking disconnect off, etc.)

All fasteners should be checked for tightness each time maintenance checks are performed prior to restarting unit.

A proper maintenance program will help these units deliver years of dependable service.

TROUBLE SHOOTING

Problem	Cause	Corrective Action
Reduced Airflow	System resistance too high.	Check system: Backdraft or control dampers for proper operation, obstruction in ductwork, etc.
	Unit running backwards.	Correct as shown in Figure 4.
	Excessive dirt buildup on wheel.	Clean wheel.
	Improper wheel alignment.	See Fig. 3 & Prestarting Checks.
Excessive Noise or Vibration	Wheel improperly aligned and rubbing.	See Fig. 3 & Prestarting Checks.
	Foreign objects in wheel or housing.	Remove objects, check for damage or unbalance.
	Unbalance of wheel caused by excessive dirt and grease buildup.	Remove buildup.

NOTE: Before taking any corrective action, make certain unit is not capable of operation during repairs.

Warranty

The Greenheck Fan Corporation warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date.

Any units or parts which prove to be defective during the warranty period will be repaired at our option when returned to our factory, transportation prepaid.

The motor is warranted by the motor manufacturer for a period of one year. Should the motor prove defective during this period, it should be returned to the nearest authorized motor service station.

Greenheck Fan Corporation will not be responsible for any installation or removal costs.

Replacement Parts

Job: _____

Model _____ Serial No. _____

Greenheck Production No. _____

Sales Office _____ City _____

Part No.	Qty.	Part and description
		Motor
		Wheel
		Shock Mounts
		Other

Read and save these instructions

GREENHECK
P.O. BOX 128 SCHOFIELD, WISCONSIN 54476
PH. 715-359-6171

DIRECT DRIVE SIDEWALL PROPELLER FANS

INSTALLATION, OPERATING AND MAINTENANCE MANUAL

INSTALLATION

Upon receiving the unit, check for any damage and report it immediately to the shipper. Also assure all accessory items are accounted for.

Move fan to the desired location and determine the method by which the fan is to be mounted as shown below in figures 1, 2 and 3. Optional wall mount housings (Fig. 2) and wall mount collars (Fig. 3) provide a convenient means of mounting sidewall fans while maintaining the proper distance between propeller and damper.

Attach the fan to the wall by inserting a suitable fastener through each of the pre-punched mounting holes in the fan panel. Care should be taken not to bend or distort the fan panel or propeller during installation.

The motor voltage and amperage rating must be checked for compatibility with the electrical supply. Supply wiring to the fan must be properly fused and conform to local and national electrical codes.

TYPICAL INSTALLATIONS

Wall opening size and propeller-to-damper distance are two important dimensions for fan installation. Fans mounted to the wall require a different opening (W.O.) size than those mounted in collars or wall housings. Propeller-to-damper distance (M) is important to reduce turbulence and resulting damper flutter which may lead to premature damper failure.

Fig. #1 shows the recommended wall opening (W.O.) and the minimum distance suggested between the fan and damper for direct installations.

Figs. #2 and 3 show the wall opening (W.O.) required for installations with either a wall housing or collar.

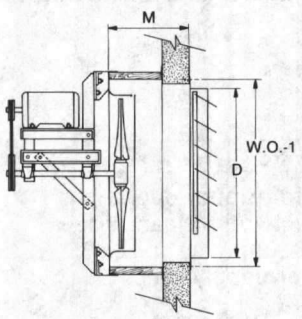


Fig. #1

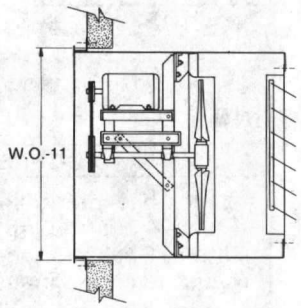


Fig. #2

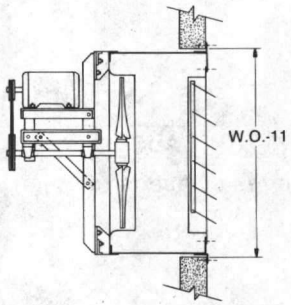


Fig. #3

Fan Size	D Damper Size	M Min.	WO-I Sq.	WO-II Sq.
8	10 x 10	13	10½	14¼
10	12 x 12	13	12½	16¼
12	14 x 14	13	14½	19¼
14	16 x 16	13	16½	21¼
16	18 x 18	13	18½	23¼
18	20 x 20	13	20½	25¼
20	22 x 22	13	22½	27¼
24	26 x 26	13	26½	33¾
30	32 x 32	13	32½	39¾
36	38 x 38	14	38½	45¾
42	44 x 44	15	45½	51¾
48	50 x 50	16	50½	57¾

PRE-STARTING CHECKS

Check all fasteners and set screws for tightness. The propeller should rotate freely and not rub on the fan panel venturi. Rotation direction of the propeller should be checked by momentarily turning the unit on. Rotation should be in the same direction as the rotation decal affixed to the unit or as shown in Fig. 4. For 3-phase installations, fan rotation can be reversed by simply interchanging any two of the three electrical leads. For single phase installations follow the wiring diagram located on the motor.

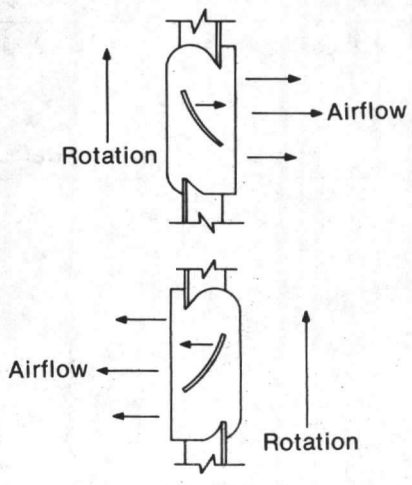


Fig. #4

ROUTINE MAINTENANCE

****

WARNING

DISCONNECT AND SECURE TO THE "OFF" POSITION ALL ELECTRICAL POWER TO THE FAN PRIOR TO INSPECTION OR SERVICING. FAILURE TO COMPLY WITH THIS SAFETY PRECAUTION COULD RESULT IN SERIOUS INJURY OR DEATH.

****

Once the fan has been put into operation, a periodic maintenance program should be set up to preserve the reliability and performance of the fan. Items to be included in this program are:

—LUBRICATION
—FASTENERS
—REMOVAL OF DUST/DIRT

MOTOR LUBRICATION

Many fractional horsepower motors installed on the smaller fans are lubricated for life and require no further lubrication. Motors equipped with oil holes should be oiled in accordance with the manufacturers instructions printed on the motor. Use a high grade SAE 20 machine oil and use caution not to over lubricate. Motors supplied with grease fittings should be greased according to directions printed on the motor.

FASTENERS

Any fan vibration has a tendency to loosen mechanical fasteners. A periodic inspection should include checking all fasteners for tightness. Particular attention should be paid to set screws or taper-lock bushings attaching the propeller to the motor shaft. In addition, check all fasteners attaching the motor to the motor plate.

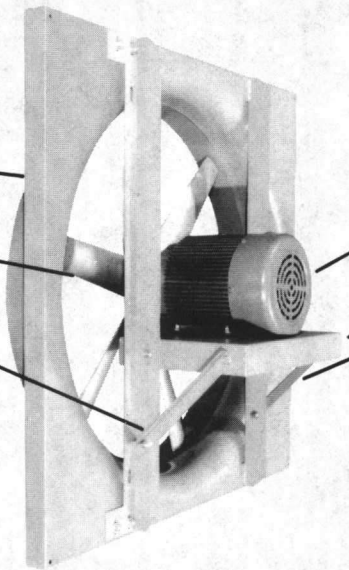
REMOVAL OF DUST AND DIRT

Dirt clogs cooling openings on the motor housing, contaminates bearing lubricant and collects on propeller blades causing severe imbalance if left unchecked. The exterior surface of the motor, fan panel and entire propeller should be thoroughly cleaned periodically. Use caution and do not allow water to enter the motor or bearings. Under no circumstances should motors or bearings be sprayed with steam or water.

TROUBLESHOOTING

PROBLEM	CAUSE	CORRECTIVE ACTION
Reduced airflow	System resistance is too high.	Check backdraft dampers for proper operation. Remove obstructions in ductwork. Clean dirty filters. Check for adequate supply air for exhaust fans or exhaust air for supply fans.
	Fan too close to damper.	Increase distance between fan and damper.
	Unit running backwards.	See pre-starting checks.
	Excessive dirt on propeller.	Clean propeller.
Excessive Noise	Vibration	Clean dirt build-up from propeller. Check all fasteners for tightness. Check for loose dampers, guards or ductwork.
	Defective motor.	Replace motor.

PARTS LIST



DIRECT DRIVE SIDEWALL PROPELLER FAN (TYPICAL)

REPLACEMENT PARTS

Always provide the unit serial number when requesting parts or information.

JOB _____

MODEL _____ SERIAL NO. _____

GREENHECK PRODUCTION ORDER NO. _____

SALES OFFICE _____ CITY _____

PART DESCRIPTION	QUANTITY	REMARKS
(1) FAN PANEL		
(2) PROPELLER		
(3) DRIVE FRAME ANGLE		
(4) MOTOR		
(5) MOTOR PLATE		
(6) GUSSET ANGLE		

BROAN®

MODELS 360 & 361 LO-SONE VENTILATORS INSTALLATION INSTRUCTIONS

READ AND SAVE THESE INSTRUCTIONS

1. ALL ELECTRICAL WORK MUST BE DONE IN ACCORDANCE WITH LOCAL AND/OR NATIONAL ELECTRICAL CODE AS APPLICABLE. **FOR SAFETY, THIS PRODUCT MUST BE GROUNDED.** IF YOU ARE UNFAMILIAR WITH METHODS OF INSTALLING ELECTRICAL WIRING, SECURE THE SERVICES OF A QUALIFIED ELECTRICIAN.
2. TURN OFF POWER AT SERVICE ENTRANCE BEFORE INSTALLING, WIRING OR SERVICING THIS PRODUCT.
3. Use only metal duct. DO NOT USE PLASTIC DUCT! Tape all duct connections.
4. **CAUTION: Always vent this product to the outside - NOT into spaces within walls or ceilings, attics, crawl spaces, garages, etc.**
5. To avoid motor bearing damage and noisy and/or unbalanced impellers, keep drywall spray, construction dust, etc. off power unit.
6. Fireplaces, gas furnaces, water heaters and the like, require proper flow of combustion air and exhaust. Make sure this flow is not altered when using any exhaust fan.
7. Your ventilator was designed to be installed in family rooms, offices, bathrooms, conference rooms, and other locations where quiet ventilation is required. When ventilating near cooking equipment, install a range hood or other suitable exhaust fan.
8. This unit is designed to adapt to many different installation requirements. Plan your installation carefully. For various ducting, mounting, and wiring options, see pages 2 and 3. This page shows the most common installation.
9. Please read specification label on product for further information and requirements.

TYPICAL MOUNTING

1. **Provide Frame** - Provide a solid frame to assure lowest sound levels. See Figure 1 for typical installation.

Brackets are factory set for 1/2" ceiling thickness. Make sure that housing will be flush with finished ceiling.

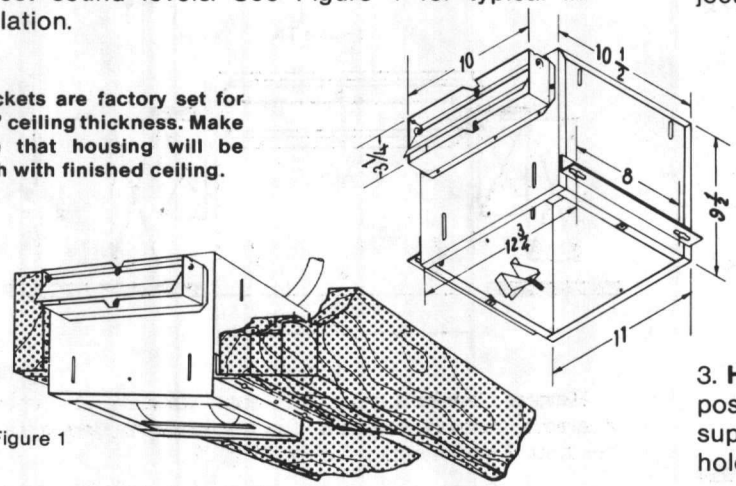


Figure 1

2. **Trace Keyhole Slots** - Hold unit against frame and trace keyhole slots in mounting brackets onto frame. Start screws provided in same end of all traced keyhole openings. Leave about 3/8" of screws projecting from frame. (Fig. 2)

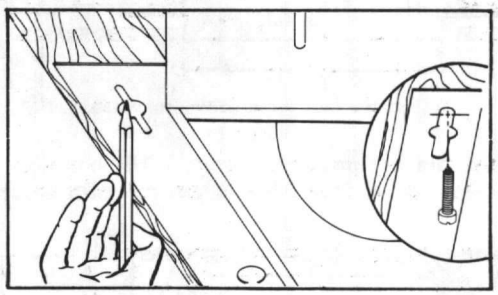


Figure 2

3. **Hang Unit** - Tighten mounting screws as firmly as possible to assure lowest sound levels. For additional support, fasten unit to frame with nail of screw through hole in center of each mounting bracket.

TYPICAL WIRING

SAFETY WARNING
TURN OFF PROPER 120 VOLT CIRCUIT AT THE SERVICE ENTRANCE BEFORE WIRING THE VENTILATOR. ALL ELECTRICAL CONNECTIONS MUST BE MADE IN ACCORDANCE WITH LOCAL CODES, ORDINANCES, AND NATIONAL ELECTRICAL CODE. IF YOU ARE UNFAMILIAR WITH METHODS OF INSTALLING ELECTRICAL WIRING, SECURE THE SERVICES OF A QUALIFIED ELECTRICIAN.

4. **Wire Unit** - Remove wiring adapter plate, which is located on top of housing (See Fig. 9), and attach electrical cable with appropriate electrical connector. Fasten incoming ground wire (bare or green wire) to adapter plate with green ground screw provided. Connect white wire to white, black wire to black. (Fig. 3) Replace wiring adapter plate so that tab on housing slides through slot on plate. (See Fig. 9)

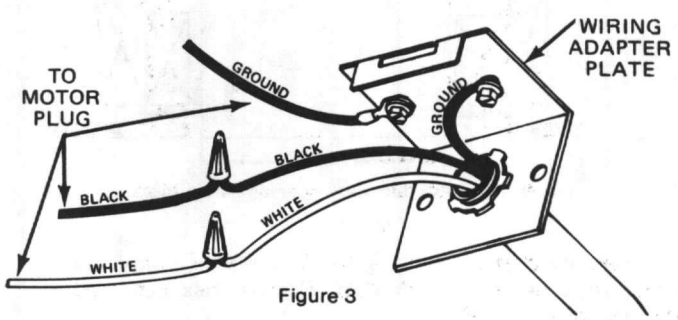


Figure 3

TYPICAL DUCTING

5. **Connect Ductwork** - Connect ductwork to damper/duct connector. (Fig. 4) Tape all joints with duct tape.

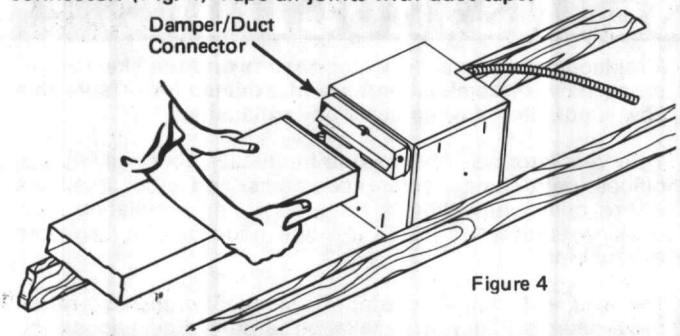


Figure 4

NOTE
MAKE SURE THAT BLOWER OUTLET MATCHES DAMPER POSITION ON VENTILATOR HOUSING.

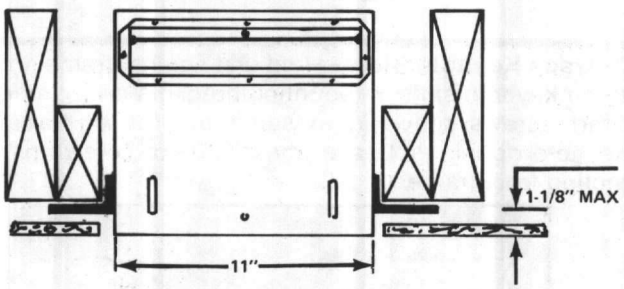
HOUSING SHOULD BE FLUSH WITH FINISHED CEILING. SEE " To adjust brackets" IN "INSTALLATION OPTIONS" SECTION.

GRILLE MOUNTING

6. Install grille using screws provided. Do not over-tighten.

INSTALLATION OPTIONS

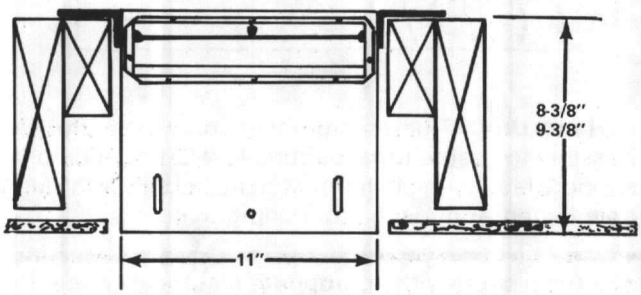
Mounting brackets may be adjusted and/or moved for various types of installations show below.



Adjustable for various ceiling thicknesses.

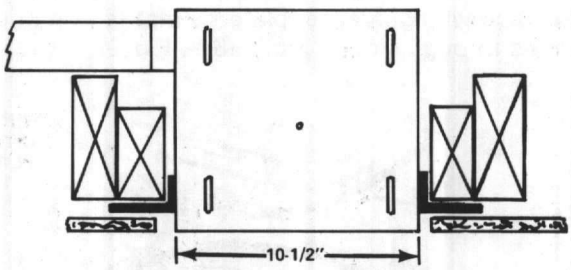
Figure 5

To adjust bracket position, loosen 7/16" hex nuts and move brackets up or down. Re-tighten hex nuts securely. (Fig. 5)



Installation from above finished ceiling.

Figure 6A



Installation with ductwork running across joists.

Figure 6B

To move brackets, remove 7/16" hex nuts. Re-position brackets on different set of slots. Replace hex nuts and tighten securely. (Fig. 6)

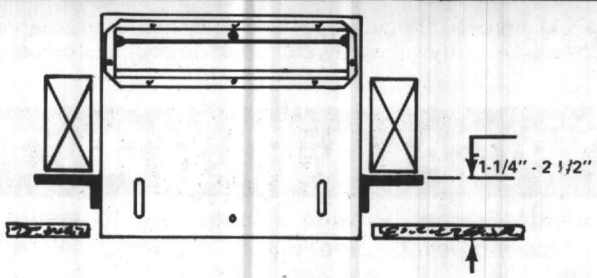


Figure 7A

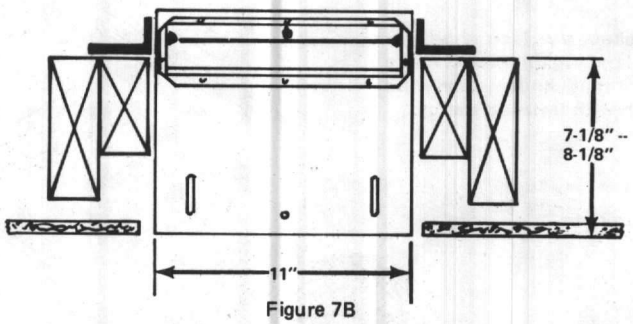


Figure 7B

Reverse brackets to give approximately 1" more clearance. Remove hex nuts, flip brackets over, and replace hex nuts. Tighten nuts securely. (Fig. 7)

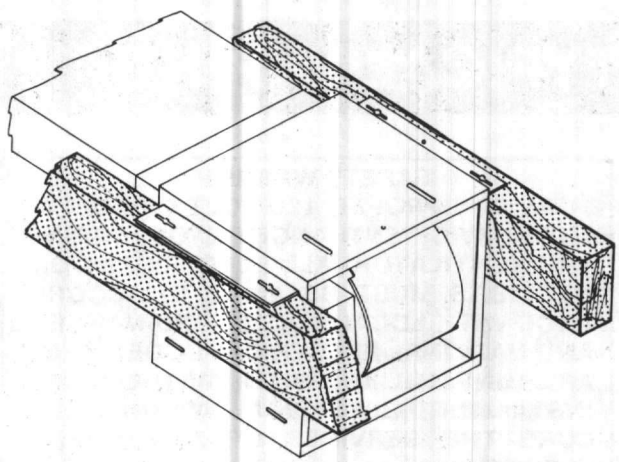


Figure 8

For in-line installations, remove 7/16" hex nuts. Reposition brackets so that housing opening is at the side instead of the bottom. (Fig. 8)

WIRING OPTIONS

If you do not have adequate access to wiring compartment from outside housing, wire unit from inside. Remove blower (described in "Vertical Ducting" section below.) Wiring compartment cover is fastened with two sheet metal screws.

Wiring may enter unit from top or side. To change wiring adapter plate position, remove sheet metal screws, flip plate over, and replace screws, Make sure that tab on housing slides through slot on plate. (Fig. 9)

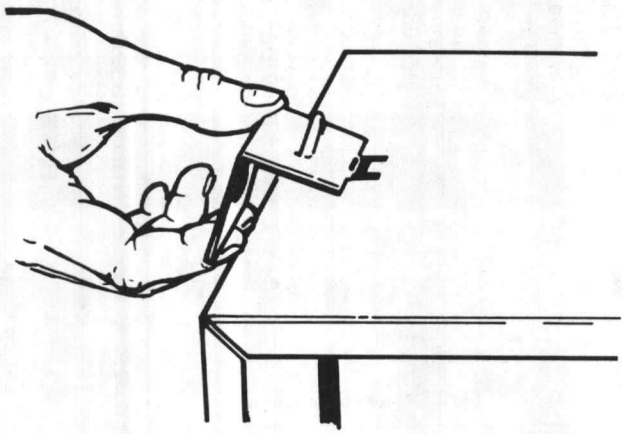


Figure 9

Unit may be installed with a variable speed switch to control fan speed and noise levels. Use a Broan No. 57 Solid State switch and single-gang switch box. Wire unit as shown in Figure 10.

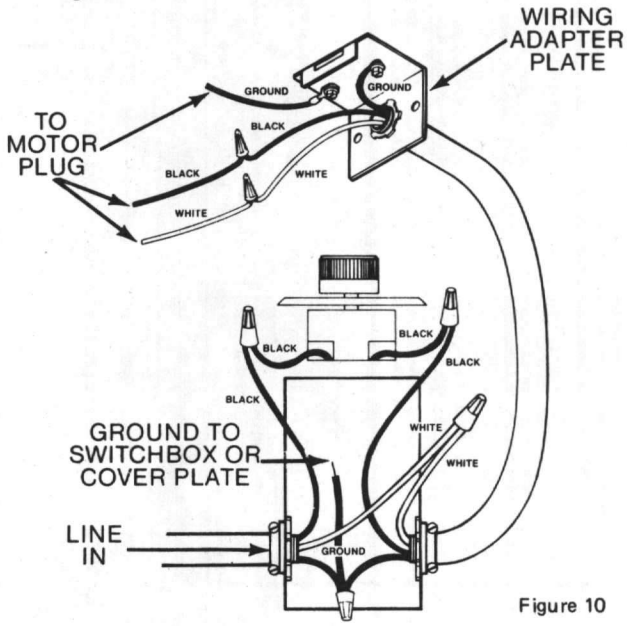
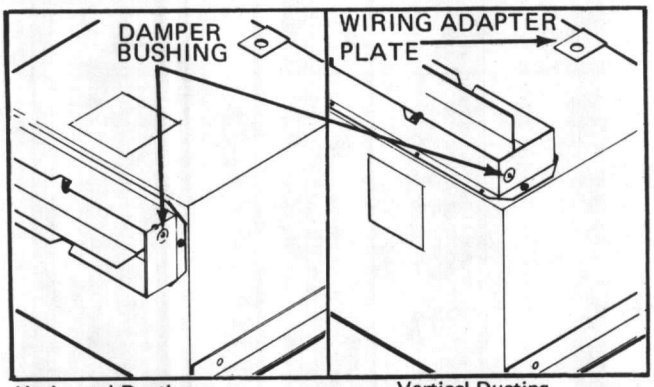


Figure 10

DUCTING OPTIONS

To duct ventilator vertically, change blower as follows:

a.) Remove and install damper on top of unit with damper bushings as shown. (Fig.11)



Horizontal Ducting (Unit is shipped in this position)

Vertical Ducting

Figure 11

b.) Unplug electrical connector from blower. Do not pull on plug wires. (Fig. 12)

c.) Remove 7/16" hex nuts holding blower in place.

d.) Lift out blower and line up blower dishcarge with vertical opening. See Figure13. Do not grasp blower by blower wheel, as wheel may be damaged.

e.) Replace hex nuts and tighten securely.

f.) Plug in blower.

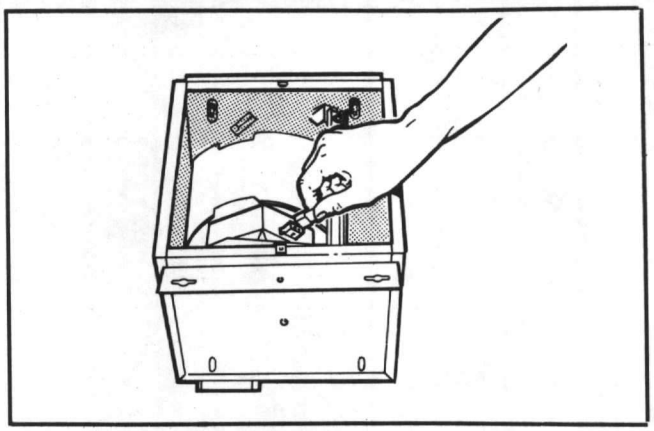


Figure 12

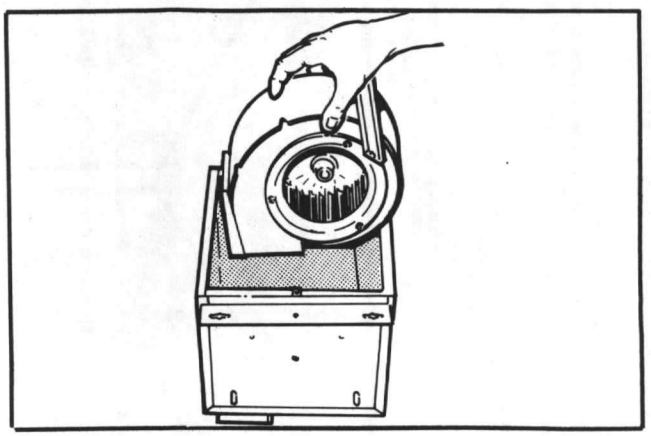
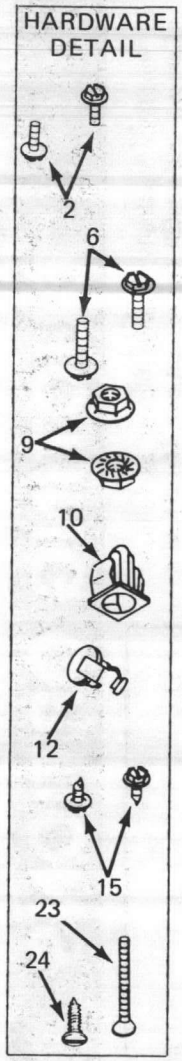


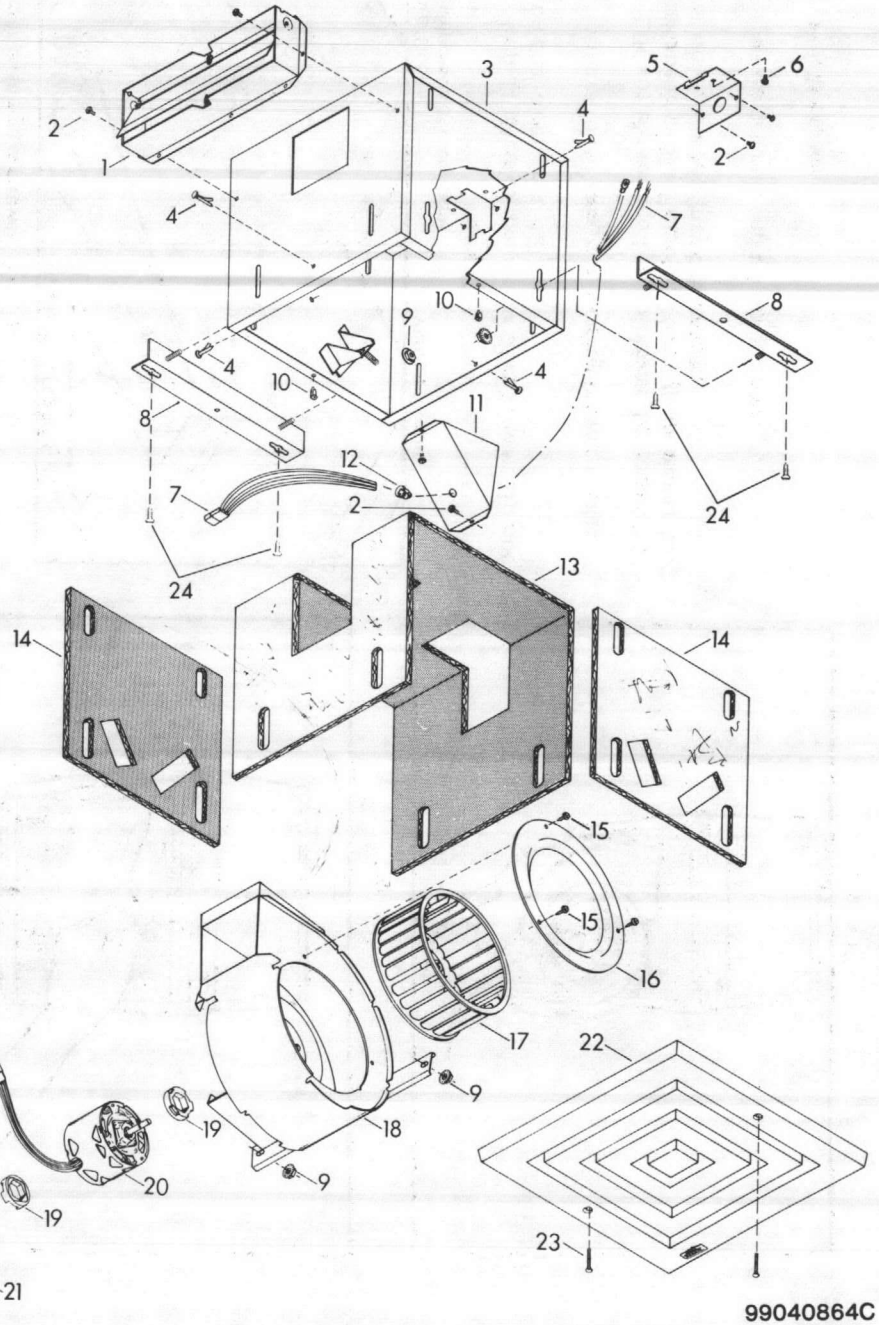
Figure 13

PARTS LIST - 360 & 361

KEY NO.	PART NUMBER	DESCRIPTION	QTY.
1	97005594	Damper Assembly	1
2	99170245	#8B x 3/8" Screw	10
3	97006017	Housing Assembly	1
4	99420466	Insulation Mounting Clip	4
5	98005512	Wiring Adapter Plate	1
6	99150471	#10-32 x 1/2" Ground Screw (Green)	2
7	97006039	Wiring Harness	1
8	97006061	Mounting Bracket Assembly	2
9	99260477	1/4-20 Whiz Nut	6
10	99420470	Grille Nut	2
11	98005513	Outlet Box Cover	1
12	99400035	Strain Relief Bushing	1
13	99500315	Wrapper Insulation	1
14	99500316	Side Insulation	2
15	99150417	#8A x 1/4" Screw	3
16	98001187	Venturi Ring	1
17	99020014	Blower Wheel, Clockwise	1
18	97006027	Blower Assembly	1
19	99100412	Motor Mounting Rubber	2
20	99080149	Motor (360)	1
	99080150	Motor (361)	1
21	98005533	Motor Cup	1
22	99110506	Grille	1
23	99150472	#8-18 x 1-1/4" Screw	2
24	99150480	#10 x .875 Screw*	4

*Standard Hardware, may be purchased locally.





99040864C

BROAN ONE YEAR LIMITED WARRANTY

Broan Mfg. Co., Inc. warrants that its products will be free from defects in materials or workmanship for a period of one year from the date of original purchase. During this one-year period, Broan will repair or replace, at its option, any product or part which is found to be defective under normal use and service without charge. Broan's obligation to repair or replace, at Broan's option, shall be the purchaser's sole and exclusive remedy under this warranty.

THIS WARRANTY DOES NOT EXTEND TO FLUORESCENT LAMP STARTERS AND TUBES, FILTERS, DUCTS, ROOF CAPS, WALL CAPS AND OTHER ACCESSORIES FOR DUCTING. This warranty does not include normal maintenance and service and does not apply to any products or parts which have been subject to misuse, negligence, accident, improper maintenance or repair by others than Broan, faulty installation or installation contrary to recommended installation instructions.

THERE IS NO OTHER EXPRESS WARRANTY, BROAN HEREBY DISCLAIMS ANY AND ALL IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO, THOSE OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE TO THE EXTENT PERMITTED BY LAW. The duration of any implied warranty which cannot be disclaimed is limited to the one-year period as specified in the express warranty. Some states do not allow limitation on how long an implied warranty lasts, so the above limitation may not apply to you. BROAN SHALL NOT BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH PRODUCT USE OR PERFORMANCE EXCEPT AS MAY OTHERWISE BE ACCORDED BY LAW. Some states do not allow the exclusion of incidental or consequential damages, so the above exclusion or limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. This warranty supersedes all prior warranties.

For service notify Broan Mfg. Co., Inc., Hartford, Wisconsin 53027, (Telephone: 414-673-4340) or, in California, notify Broan Mfg. Co., Inc., La Mirada, California 90638, (Telephone: 213-926-0595), giving the model number, part identification and nature of any defect in the product or part. At the time of requesting warranty service, evidence of the original purchase date must be presented.

BROAN MFG. CO., INC.
926 West State Street
Hartford, WI 53027

Taco	INSTALLATION AND OPERATION INSTRUCTIONS	
NUMBER IS 300-2.2	Effective: September 1, 1982 Supersedes: IS300-4 dated 3/31/68	

TACO BASE MOUNTED PUMPS (SLEEVE AND BALL BEARING)

Plant ID No. 001-922

A—INSTALLATION

A1-LOCATION

Locate pump in an easily accessible place with sufficient space around it for maintenance and servicing. On larger pumps allow head room for the use of hoists or overhead cranes. Locate pump on a dry and clean place so that motor will be protected from moisture and dust.

On closed heating systems place compression tank at the suction side of the pump. When pump head is less than 20 feet, it is permissible to connect compression tank to discharge side of pump.

On open systems, install pump close to liquid supply and make suction piping as short and as straight as possible.

A2-FOUNDATION

The foundation serves to carry the pump weight and to absorb vibration. Normally, the foundation is made of concrete block, preferably tied in with the floor or ground. Make the foundation block about 4" longer and 4" wider than the base of the frame. Height of the block may vary from 2/3 to 1 times the *width* of the foundation (Fig. 1). When foundation is poured, provide a hole near each of the four (4) corners. To simplify installation and maintenance use lead Anchors. Place the front Anchor about 2" from the edge of the foundation to clear overhanging casings (Fig. 2).

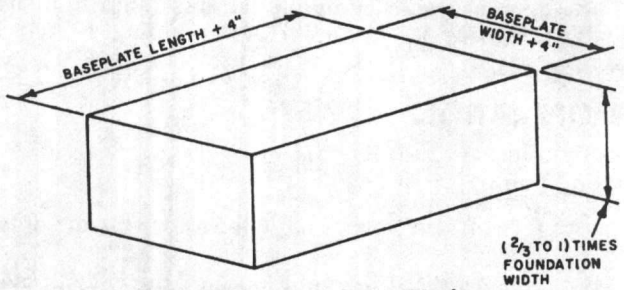


Fig. 1—Foundation Block

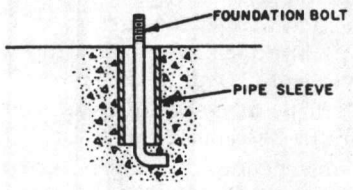


Fig. 2—Foundation Bolt

A3-PIPING

Correct piping is of prime importance for the proper operation and long life of the pump. Stresses induced by piping will cause excessive wear of seals, bearings, and couplings that could ultimately destroy these elements.

Both suction and discharge piping should be suspended close to the pump connections, so that no pipe weight rests on the pump. Pipe flanges and pump flanges should align perfectly before connections are made, piping should never be drawn by force into place.

Thermal expansion of piping requires special attention on heating installations. If no room is provided for pipe expansion, stresses are induced in the piping that will exert a load on the pump. Forces created by pipe stresses can exceed by far the load exerted through pipe and water weight. Stress forces can distort pump, bend shafts, wear out seals, and impeller wear rings, and ultimately burn out bearings. To protect pump from thermal pipe stresses, provide spring hangers and flexible connectors that are suitable to compensate for pipe expansion. (See Fig. 3).

Install gate valves on both suction and discharge side of the pump to allow servicing without draining the system. Also provide a flanged nipple (spool) between gate valve and suction end of the pump to enable you to take the pump apart without disturbing piping (Fig. 3). In order to have them easily accessible, the pump and flange nipples should not be covered with insulation.

On open pumping systems drawing water from a level below the pump (suction lift) install a foot valve with strainer. On open systems where the pump is located below the suction water level (suction head) install a check valve in the discharge line close to the pump.

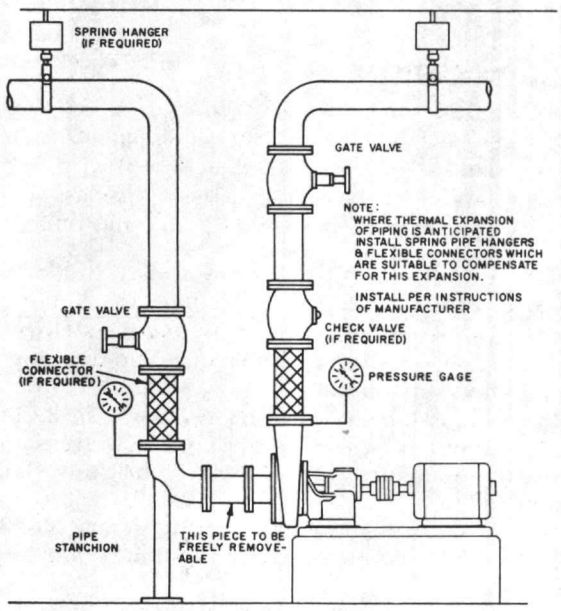


Fig. 3—Typical Installation—Vertical Piping

A—INSTALLATION-Continued

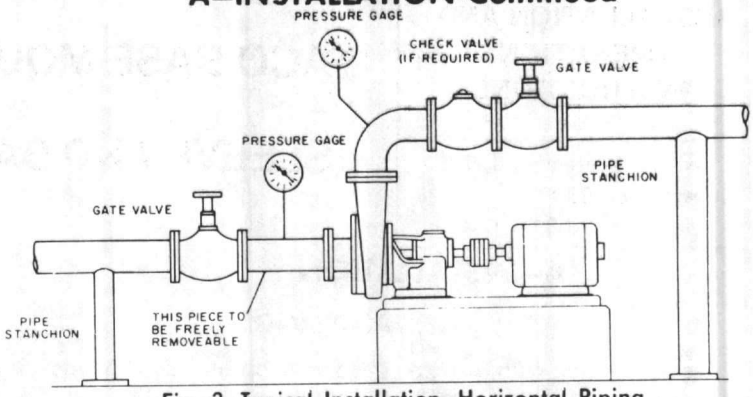


Fig. 3–Typical Installation–Horizontal Piping

A4-PUMP SETTING

When pump is set on its foundation, make sure to have it properly levelled. Place baseplate over foundation bolts provided for it, place shims at corners of baseplate when required and level with a spirit gauge. Tighten baseplate firmly to its foundations. Check also level of suction and discharge flanges.

A5-COUPLING ALIGNMENT

Proper alignment of pump and driver will assure trouble-free operation and long life of the pump. Misalignment will cause rapid wear of seals, couplings, and bearings. All pumps are carefully aligned before leaving the factory. However, experience indicates that alignment invariably changes in shipping and handling. Therefore, it is of utmost importance that alignment be checked at various steps of the installation process. i. e., **after leveling, after piping, and after first few weeks of operation.**

Check alignment by placing a slotted straight edge across the coupling halves at top, bottom, and at the sides. If any light is seen between the straight edge and one of the coupling flanges, it means the unit is out of alignment. (Fig. 4)

If light is seen at top and bottom position of the straight edge, alignment is out of height. Usually shims are placed under the motor feet. Loosen the four motor bolts, remove or add shims as required to correct proper height. Tighten the motor bolts and check to make sure alignment was corrected properly.

If alignment is out on the sides of the coupling, loosen the four motor bolts and lightly tap the motor in the direction required. Tighten the four motor bolts and check to make sure alignment was corrected properly.

As alignment in one direction may alter the alignment in another, be sure to check all alignments made.

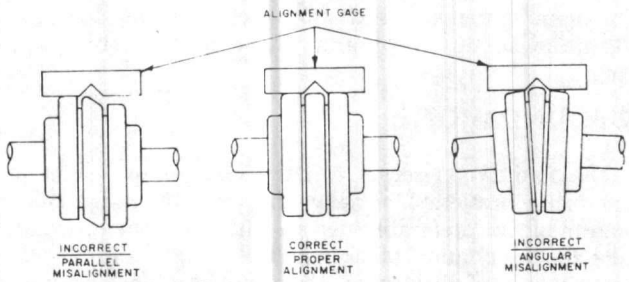


Fig. 4–Coupling Alignment

A6-CONNECTING PIPING

Piping may now be connected to pump. Make sure that pump and pipe flanges are strictly parallel and properly spaced for the gasket that will be used. Also check that pipes are supported properly and do not rest on pump flanges. Never draw pipes by force to pump flanges. Recheck alignment after piping connections are made. If misalignment was caused by piping, it is a sign that pipe stresses distorted the pump. Correct piping to relieve stresses.

B—PUMP START-UP & OPERATION

Before starting up pump for the first time several items are to be checked to avoid damaging pump.

B1-LUBRICATION

Sleeve Bearing pumps are filled with oil at the factory but some oil might be lost during shipment. As a matter of precaution, check oil level before starting up pump. Proper level is at the center of the sight glass. If oil level is too low, remove top cover (Fig. 5) and refill.

Drain and refill oil well once a year. Initial filling is Socony Mobil DTE Heavy Medium Oil, but any premium SAE Grade 20 Non-Detergent Motor Oil can be used.

Motor bearings also might loose oil during shipment. Check oil level as indicated on motor instruction. Electric motors have either an oil cup or a pipe plug for filling. An overflow is located at the side of the bearing area. Before starting unit, fill motor bearing with an oil can until oil flows out of overflow.

Ball Bearing pumps are greased at the factory. Grease will not flow out during shipment, so no checking will be required at startup.

Regrease ball bearings every two years or 3,000 hours of operation. Initial filling is LUBRIKO-grease, Density M31, manufactured by Master Lubricants Company, Philadelphia.

Any general purpose ball bearing grease No. 3 NLGI (National Lubricating Grease Institute) hardness may be used.

To grease bearings open side covers (Fig. 5), slide them about 1/2" to the side and introduce grease thru the opening with a putty knife. Fill grease chamber 2/3 high. Excessive grease causes unnecessary friction and will overheat bearing. If bearings run hot after regreasing, stop pump, open side cover, and wipe out excessive grease. Overheating will then cease.

Motor ball bearings also are greased at the factory. Grease should be replaced as indicated by motor manufacturer's instruction. Normally greasing is required every two years. On electric motors grease is usually introduced through a grease fitting with a grease gun.

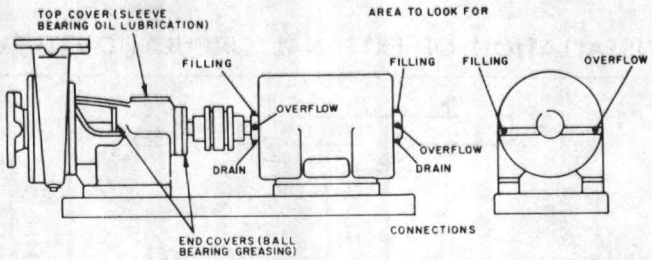


Fig. 5—Lubrication Points

B2-MOTOR WIRING & SENSE OF ROTATION

Check wiring of motor before starting to make sure that connections are wired properly for the voltage in use. Overvoltage can burn out motor windings. Check heater element in magnetic starter to see that it is rated the same as the motor.

AMP RATING FOR 3 PHASE SQUIRREL CAGE INDUCTION MOTORS

Motor HP	220 Volt 1750 RPM	220 Volt 3450 RPM	440 Volt 1750 RPM	440 Volt 3450 RPM
1/4	1.0	–	.5	–
1/3	1.4	–	.7	–
1/2	1.8	–	.9	–
3/4	2.4	2.2	1.2	1.1
1	3.6	3.4	1.8	1.7
1 1/2	4.8	4.6	2.4	2.3
2	6.2	5.6	3.1	2.8
3	9.0	8.0	4.5	4.0
5	14.4	13.4	7.2	6.7
7 1/2	20.0	19.2	10.0	9.6
10	26.4	25.6	13.2	12.8
15	39.0	38.0	19.5	19.0
20	51.0	50.0	25.5	25.0
25	62.0	60.0	31.0	30.0
30	74.0	72.0	37.0	36.0
40	96.0	–	48.0	–
50	120.0	–	60.0	–

Before attempting to check out sense of rotation of pump, fill pump with water to provide lubrication of the seal. **Do not operate pump dry for motor checkout.**

Next throw the switch and see if direction of rotation corresponds with arrows on frame of pump. The direction of rotation is counterclockwise facing the suction end of pump. Direction of rotation of three phase motors can be easily reversed by interchanging two of the three wires at the terminal board of the motor. Reversing of single phase motors is done by interchanging some internal wires or clamps. Instructions for reversing are found either on the motor nameplate or inside the motor terminal cover.

B3-PUMP START-UP

After you have checked lubrication and wiring you are ready to start the pump.

Open the gate valve in the suction side and close the valve on the discharge side. Start motor, wait until unit has come to full speed and then open discharge valve slowly. Do not run pump for more than a few minutes with completely shut valves. If system conditions call for part-time operation against shut valves, install a bypass line from discharge to suction.

B4-MECHANICAL SEAL AND STUFFING BOX CARE

Mechanical Seal (See caution below)*

Mechanical seals are the most delicate component of the pump. Special care has to be given to them to assure trouble-free operation.

The sealing element of a mechanical seal consists of a carbon washer rotating against a stationary ceramic ring.

Surfaces of both are highly lapped to assure sealing. Any dirt that penetrates between the two mating parts will cause a rapid wear of the seal faces and will ultimately result in seal leakage.

New heating systems are usually contaminated by various materials such as construction debris, welding slugs, pipe joint compound, mill scale, etc. It is of utmost importance that such systems be cleaned out thoroughly before putting pump into continuous operation.

Cleaning of a heating system is simple and easy. First flush out system with cold water at city pressure to remove all loose foreign matter that penetrated into the system. Afterwards boil out system with chemicals to remove dirt adhering to pipes.

Chemicals most commonly used for this procedure are sodium triphosphate, sodium carbonate, or caustic soda, but any nonfoaming detergents as used in dishwashers can be applied.

Fill system with clean water, add cleaning chemicals (1) lb. for every 40 to 50 gallons of water, (or Mfrs. Instruction) start pump and heat up system. Let system run for a few hours, then drain and refill with fresh water. Your pumps are now ready for continuous duty. (See caution below).*

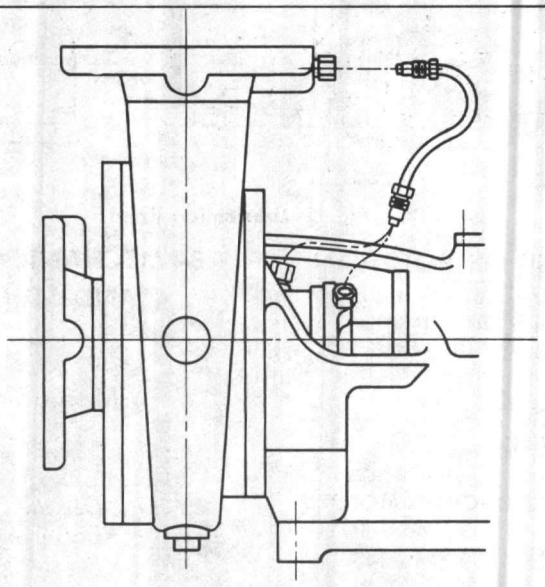
Stuffing boxes are less delicate in operation than mechanical seals. No chemical cleaning is necessary as on mechanical seal pumps, but flushing out with cold water is beneficial on this type of pump too.

After pump is started up adjust gland of stuffing box evenly so that it drips from one to three drops of water per minute. This drip is absolutely essential to prevent damage to packing and shaft sleeve. It also prevents overloading of motor. Excessive dripping may cause air to enter pump under certain conditions.

Sump of pump should be piped to any convenient sewer or drain. A pipe tapping is provided for this purpose at the side of the sump. Never plug this drain tapping.

*CAUTION: The addition of certain chemical additives to systems utilizing TACO Equipment, voids the warranty.

INSTALLATION OF EXTERNAL CIRCULATION TUBE

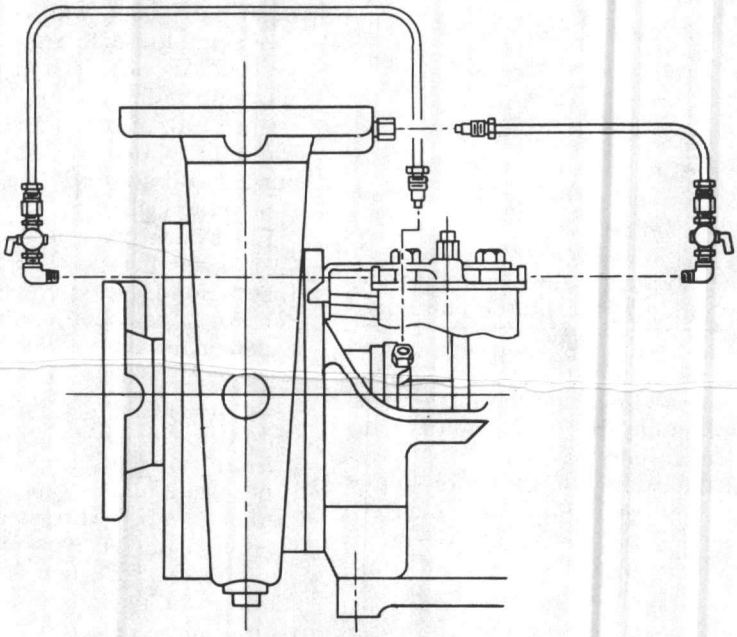


IMPORTANT

Before filling system with water, assemble external circulation tube to pump casing as follows:

1. Screw nut into body until hand tight.
2. With a wrench continue tightening for about one and one-half full additional turns. (It is not necessary to tighten nut all the way down)

INSTALLATION OF PUROCELL FILTER



IMPORTANT

1. Attach Filter to the pump by loosening the top bolt on the frame and casing and slip bracket under bolt and tighten.
2. If Recirculating line is installed — remove from frame and insert this end into inlet of Filter.
3. Attach line from outlet of the filter to seal retainer cap.

Taco, Inc. 1160 Cranston Street, Cranston, Rhode Island 02920 Telephone: (401) 942-8000 Telex: 92-7627

Litho in U.S.A.

Taco (Canada) Limited 1310 Aimco Blvd., Mississauga, Ontario L4W 1B2 Telephone: 416-625-2160 Telex: 06-961179

Taco	REPLACEMENT PARTS LIST
NUMBER **PL300-2.4**	Effective: June 1, 1983 Supersedes: PL300-2.4 dated 2/1/81

FOR FOLLOWING MODEL NUMBERS

BM or CC:	**3 - 10**	**4 - 8**	**4 - 10**	**and**	**4012**
BM or CC:	**3010**	**3012**	**4008**	**4010**	**and 4012**
SB or BB:	**3010**	**3012**	**4008**	**4010**	**and 4012**

WHEN SELECTING AND ORDERING PARTS, ALWAYS REFER TO SERIAL NUMBER ON NAME PLATE

—Example—

FLANGE SIZE — **FRAME SIZE AND STYLE**

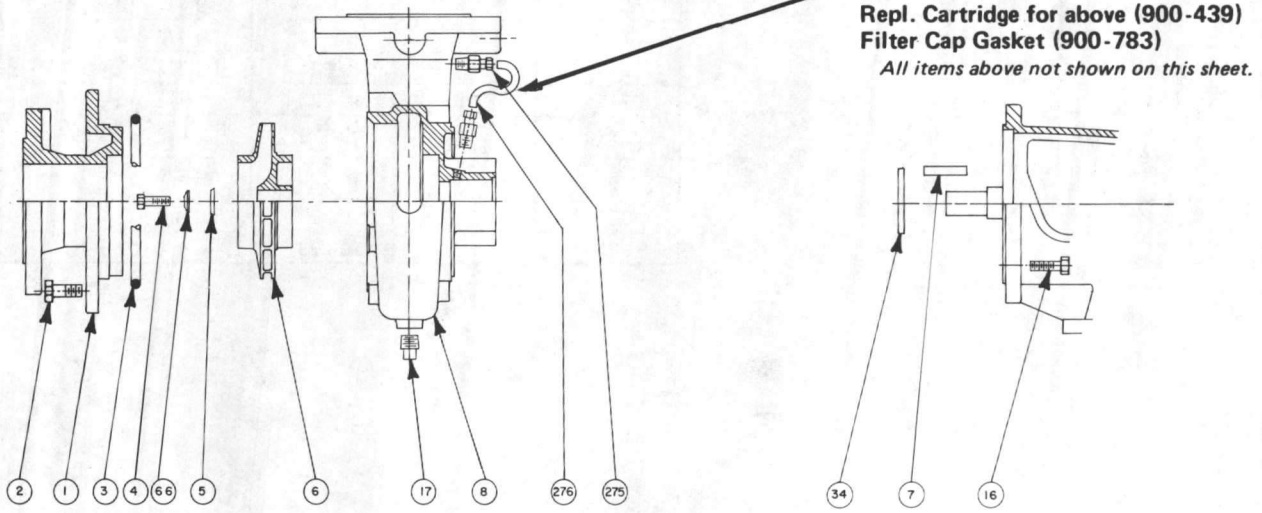
3010 – 9.8 C5B2

NOMINAL IMPELLER DIAMETER — **MATERIAL OF CONSTRUCTION**

ACTUAL IMPELLER DIAMETER — **SEAL OR PACKING DESIGN**

BASIC PARTS

FILTER KIT (900-1)
Repl. Cartridge for above (900-439)
Filter Cap Gasket (900-783)
All items above not shown on this sheet.



Item No.	No. Reqd.	DESCRIPTION	PART NO. PER PUMP SIZE					REMARKS
			3 - 10 3010	3 - 12 3012	4 - 8 4008	4 - 10 4010	4 - 12 4012	
1	1	Suction Cover	936-003	885-003	860-003	862-003	886-003	Add "B" after No. for Brnz.
2	8	Suction Cover Bolt	10-211	10-211	N/A	10-211	10-211	5/8 - 11 x 1½
2	8	Suction Cover Bolt	N/A	N/A	10-216	N/A	N/A	7/16 - 14 x 1
3	1	Suction Cover 'O' Ring	862-005	868-004	912-005	862-005	868-004	
4	1	Impeller Bolt (SS)	10-257	10-257	10-257	10-257	10-257	Stainless Steel
5	1	Impeller Washer	900-036	900-036	900-036	900-036	900-036	
6	1	Impeller (1)	936-005(1)	885-004(1)	860-005(1)	862-065(1)	886-004(1)	Add "B" after No. for Brnz.
6	1	Impeller	936-002	885-002	860-002	862-002	886-002	Add "B" after No. for Brnz.
7	1	Impeller Key (SS)	13-113A	13-113A (4)	13-113A	13-113A	13-113A	¼ x ¼ x 1½
8	1	Casing (2)	936-001(2)	885-001(2)	860-001(2)	862-001(2)	886-001(2)	Add "B" after No. for Brnz.
16	4	Casing Bolt	10-209	10-209	10-209	10-209	10-209	7/16 - 14 x 1½
17	1	Drain Plug	16-119	16-104	16-119	16-119	16-119	½ NPT Steel
34	1	Slinger Ring	900-041	900-041	900-041	900-041	900-041	
66	1	Belleville Washer	900-053	900-053	900-053	900-053	900-053	
222	1	Fitting	900-566	900-566	900-566	900-566	900-566	
275	2	Fitting	900-798	900-798	900-798	900-798	900-798	
276	1	Tube	900-728	900-728	900-728	900-728	900-728	

(1) For use on Close Coupled (Style 4) models with NEMA Frame Size 256 and smaller and all CC motors 3450 RPM.
(2) Throttle Bushing (Item 10), found in Seal Section, must be ordered with each casing.

TACO, Inc., 1160 Cranston Street, Cranston, Rhode Island 02920 U.S.A. Tel: (401) 942-8000 Telex: 92-7627

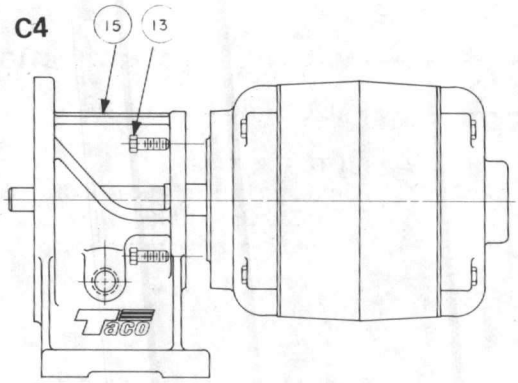
Litho in USA

Taco Heaters of Canada, Ltd., 3090 Lenworth Drive, Mississauga, Ontario Tel: (416) 625-2160 Telex: 06-961179

FRAME SIZE & STYLE – 0000-00-XX00

C1	**BALL BEARING DESIGN:**	Update pump with 862-162RP Complete Frame Assembly (see (1) at bottom of page.) Please furnish all nameplate data.
C2	**SLEEVE BEARING DESIGN:**	Update pump with 862-162RP Complete Frame Assembly (see (1) at bottom of page.) Please furnish all nameplate data.
C3	**SLEEVE BEARING DESIGN:**	Update pump with 862-162RP Complete Frame Assembly (see (1) at bottom of page.) Please furnish all nameplate data.
C6	**SLEEVE BEARING DESIGN:**	Update pump with 862-162RP Complete Frame Assembly (see (1) at bottom of page.) Please furnish all nameplate data.

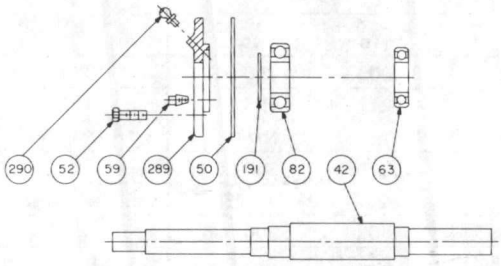
C4

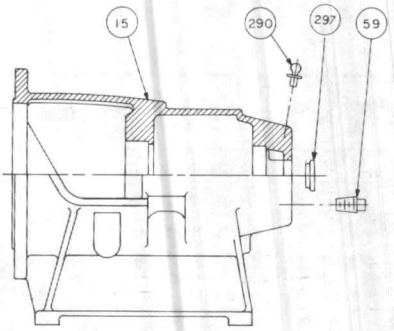


CLOSE COUPLED (CC) FRAMES ---------

NEMA FRAME Size "T"	NEMA FRAME Size "U"	ITEM 13 FR. BOLT Part No.	ITEM 13 FRAME BOLT Size	ITEM 15 PUMP FRAME
	213	10-223	(4) 1/2 - 13 x 1¼	936-004
184	215	10-223	(4) 1/2 - 13 x 1¼	936-004
213	254	10-223	(4) 1/2 - 13 x 1¼	936-004
215	256	10-223	(4) 1/2 - 13 x 1¼	936-004
254	284	10-223	(4) 5/8 - 11 x 1½	936-004T 900-128U
256	286	10-223	(4) 5/8 - 11 x 1½	936-004T 900-128U
284		10-223	(4) 5/8 - 11 x 1½	900-128
286		10-223	(4) 5/8 - 11 x 1½	900-128

C5 BALL BEARING DESIGN:

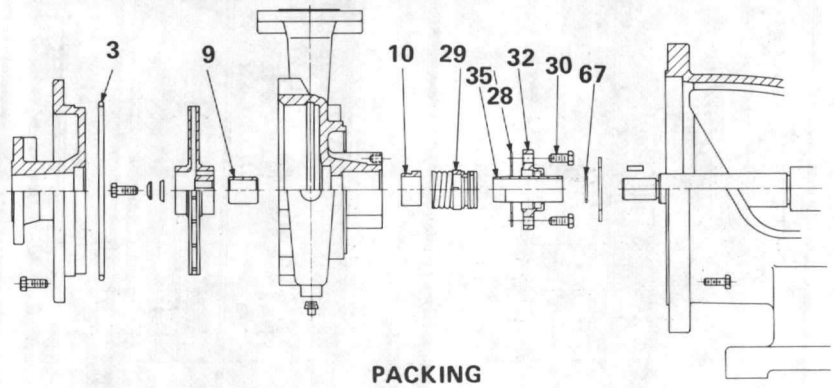




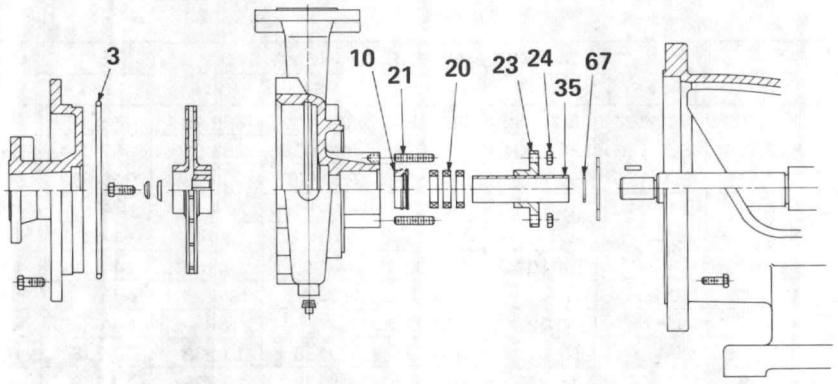
Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS
74	1	Frame Assembly (1)	862-162RP	
15	1	Frame	862-151	
42	1	Shaft	862-157	Add SS for Stainless Steel
50	1	Bearing Plate Gasket	862-153	
52	4	Bearing Plate Bolt	10-230	3/8 - 16 x 1
63	1	Ball Bearing	862-159	
82	1	Ball Bearing	862-101	
191	1	Retainer Ring	15-106	
289	1	Bearing Cover Plate Assembly	862-161	
290	2	Lubrication Fitting	15-200	
297	1	End Cap	862-170	

SEAL OR PACKING DESIGN – 0000-00-00X0

MECHANICAL SEAL



PACKING



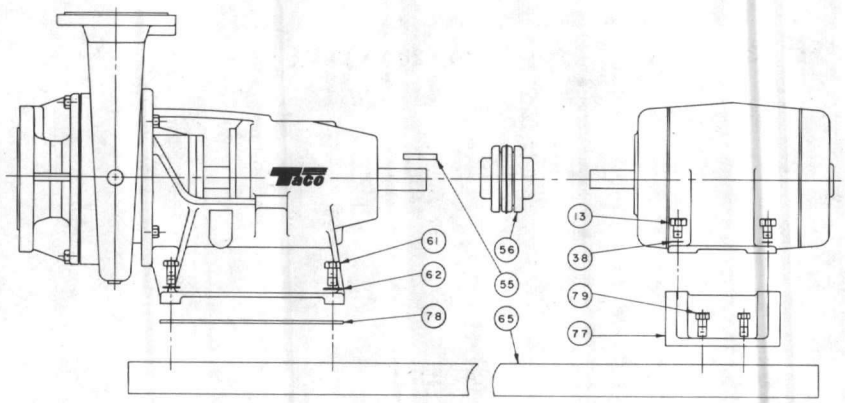
TYPE B STANDARD. TYPE D HI-TEMP. TYPE P PACKED. TYPE E CERAMIC.

Item No.	No. Reqd.	DESCRIPTION / FRAME STYLE	SEAL OR PACKING DESIGN									REMARKS
			Type 'B' & 'E'			Type 'D'			Type 'P'			
			4 (1)	1, 2, 3, 4 (2)	5, 6	4 (1)	1, 2, 3, 4 (2)	5, 6	4 (1)	1, 2, 3, 4 (2)	5, 6	
3	1	Suction Cov. 'O' Ring	*See Page 1*									
9	1	Impeller Spacer	900-026	862-081	862-104	900-026	862-081	862-104	Not Used	Not Used	Not Used	
10	1	Throttle Bushing	862-083	862-027	862-027	862-083	862-027	862-027	862-043	862-043	862-043	
20	1	Packing Set							900-242	900-242	900-242	
21	2	Studs							900-029	900-029	900-029	
22	1	Filler Ring (Not Shown)	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	862-062	862-062	862-062	
23	1	Gland							862-042	862-042	862-042	Add "B" after No. for Brz.
24	2	Hex Nuts							12-129	12-129	12-129	3/8 - 16
28	1	Retainer Cap Gasket	862-031	862-031	862-031	862-031	862-031	862-031				
29	1	Water Seal	900-024	862-029	862-029	900-087	900-089	900-089				
91	1	WATER SEAL KIT (3)	840-128BRP	862-171BRP	862-172BRP	840-128DRP	862-171DRP	862-172DRP	Not Used	Not Used	Not Used	Includes Items 28,29,35,67
30	4	Retainer Cap Bolt	10-230	10-230	10-230	10-230	10-230	10-230				3/8 - 16 x 1
32	1	Retainer Cap	862-082	862-100	862-100	862-082	862-100	862-100				
35	1	Sleeve	900-027B	862-080B	862-103B	900-027B	862-080B	862-103B	862-085	862-084	862-109	
67	1	Sleeve Gasket	920-007	862-059	862-113	920-007	862-059	862-113	920-007	862-059	862-113	

(1) For 1750 RPM motors up to NEMA 256 frame and all motors 3450 RPM–Style 4 only–0000-00-0X00
(2) For 1750 RPM motors 284 frame and larger–Style 4 and all Styles 1, 2 and 3–0000-00-0X00

(3) Ceramic Seal Kit, Style 4(1), is 840-128ERP.
Ceramic Seal Kit, Styles 1, 2, 3, 4(2), is 862-171ERP. Styles 5 and 6: 862-172ERP.

MOTOR PARTS – NOT PART OF SERIAL NUMBER
–Motor Frame Sizes Must be Specified When Ordering Parts Shown Below–



Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'T'								REMARKS
			182	184	213	215	254	256	284	286	
65	1	Base Plate (1)	862-186	862-186	862-186	862-186	862-187	862-187	862-187	862-187	
77	2	Spacer	862-143	862-136	860-004	862-036	862-038	862-053	862-054	862-063	
56	1	Coupler	900-195	900-195	900-526	900-526	900-536	900-536	900-539	900-201	
38	4	Mtr. Lock Wshrs.	14-101	14-101	14-101	14-101	N/A	N/A	N/A	N/A	3/8
38	4	Mtr. Lock Wshrs.	N/A	N/A	N/A	N/A	14-102	14-102	14-102	14-102	1/2
62	4	Frm. Lck. Wshrs.	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Mtr. Hx. Hd. Bolt	10-230	10-230	N/A	N/A	N/A	N/A	N/A	N/A	3/8 - 16 x 1
13	4	Mtr. Hx. Hd. Bolt	N/A	N/A	10-227	10-227	N/A	N/A	N/A	N/A	3/8 - 16 x 1½
13	4	Mtr. Hx. Hd. Bolt	N/A	N/A	N/A	N/A	10-238	10-238	10-238	10-238	1/2 - 13 x 1-5/8
61	4	Frm. Hx. Hd. Bolt	10-238	10-238	10-238	10-238	10-238	10-238	10-238	10-238	1/2 - 13 x 1-5/8
79	4	Spcr. Hx. Hd. Bolt	10-230	10-230	10-230	10-230	N/A	N/A	N/A	N/A	3/8 - 16 x 1
79	4	Spcr. Hx. Hd. Bolt	N/A	N/A	N/A	N/A	10-234	10-234	10-234	10-234	1/2 - 13 x 1
55	1	Coupler Key	13-101	13-101	13-101	13-101	13-101	13-101	13-101	13-101	5/16 x 5/16 x 2½
47	1	Coupler Guard	840-125	840-125	840-125	840-125	840-125	840-125	862-164	862-164	
48	4	C.G. Rd.Hd. Scrws.	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	1/4 - 20 x 3/8
111	1	Coupler Insert	900-513	900-513	900-513	900-513	900-514	900-514	900-515	900-516	

(1) Add "A" to base plate number when coupler guard is to be used.

MATERIALS OF CONSTRUCTION – – – 0000-00-000X

DESCRIPTION	1 STANDARD CONSTRUCTION	2 BRONZE FITTED	3 ALL BRONZE	4 ALL IRON	REMARKS
Casting	Iron	Iron	Bronze	Iron	Add Suffix 'B' for Bronze
Suction Cover	Iron	Iron	Bronze	Iron	Add Suffix 'B' for Bronze
Impeller	Iron	Bronze	Bronze	Iron	Add Suffix 'B' for Bronze
Wear Ring	Bronze	Bronze	Bronze		Only When Required
Seal Retainer Cap	Iron	Iron	Bronze	Iron	Add Suffix 'B' for Bronze
Packing Gland	Iron	Iron	Bronze	Iron	Add Suffix 'B' for Bronze
Throttle Bushing	Bronze	Bronze	Bronze	Iron	Add Suffix 'C' for Iron
Sleeve	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	
Shaft	Steel	Steel	Steel	Steel	Add 'SS' for St. Steel

Taco	REPLACEMENT PARTS LIST
NUMBER **PL300-2.3**	Effective: June 1, 1983 Supersedes: PL300-2.3 dated 2/1/81

FOR FOLLOWING MODEL NUMBERS:

BM or CC: 2 - 8 2½ - 8 2½ - 10 3 - 8 & 4 - 6
BM or CC: 2008 2010 2012 2508 2510 3008 & 4006
SB or BB: 2008 2010 2012 2508 2510 3008 & 4006

WHEN SELECTING AND ORDERING PARTS, ALWAYS REFER TO SERIAL NUMBER ON NAME PLATE

–Example–

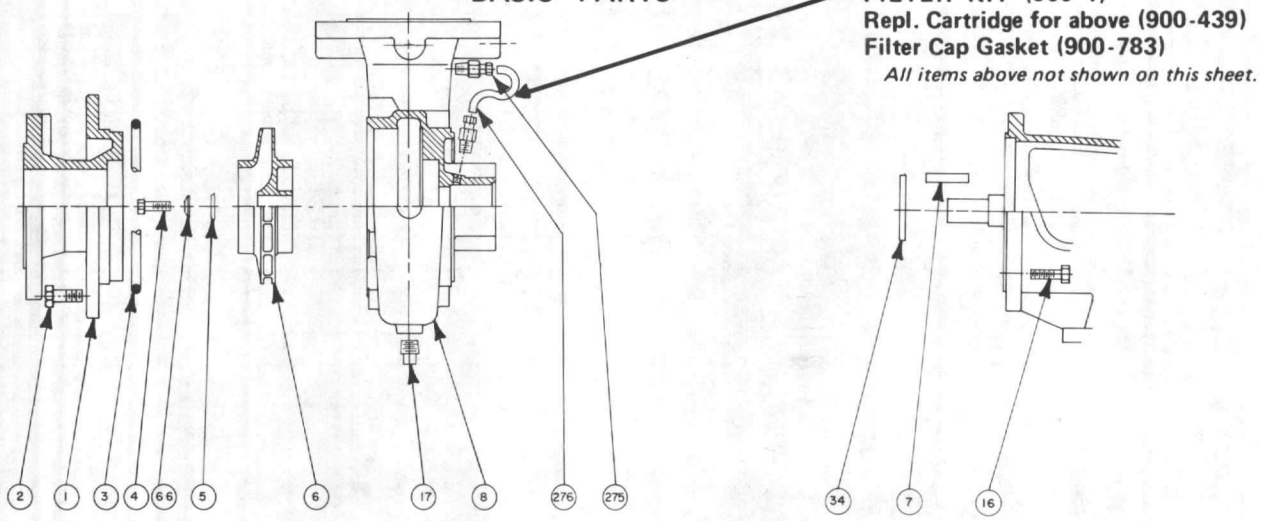
FLANGE SIZE — 2008 – 7.9 B5B2 — FRAME SIZE & STYLE

NOMINAL IMPELLER DIAMETER — MATERIAL OF CONSTRUCTION

ACTUAL IMPELLER DIAMETER — SEAL OR PACKING DESIGN

BASIC PARTS

FILTER KIT (900-1)
Repl. Cartridge for above (900-439)
Filter Cap Gasket (900-783)
All items above not shown on this sheet.



Item No.	No. Reqd.	DESCRIPTION	PART NO. PER PUMP SIZE						REMARKS
			2 - 8 2008	2 - 12 2012	2½ - 8 2508	2½ - 10 2510	3 - 8 3008	4 - 6 4006	
1	1	Suction Cover	920-003	884-003	928-003	922-003	934-003	938-003	Add 'B' for Brz.
2	8	Suction Cover Bolts	10-216	10-211	10-216	10-211	10-216	10-230	
3	1	Suction Cover 'O' Ring	912-005	868-004	912-005	862-005	912-005	918-005	
4	1	Impeller Bolt (SS)	10-257	10-259	10-257	10-257	10-257	10-257	3/8-16x11/2 SS
5	1	Impeller Washer	926-004	926-004	926-004	926-004	926-004	926-004	
6	1	Impeller	920-002	884-002	928-002	922-002	934-005	938-002	Add 'B' for Brz.
7	1	Impeller Key (SS)	13-104A	13-105A	13-104A	13-104A	13-104A	13-104A	
8	1	Casing	920-001	884-001	928-001	922-001	934-001	938-001	Add 'B' for Brz.
16	4	Casing Bolt	10-201	10-201	10-201	10-201	10-201	10-201	3/8-16x1-1/8
17	1	Drain Plug	16-102	16-104	16-102	16-102	16-102	16-102	3/8 NPT
34	1	Slinger Ring	900-044	900-044	900-044	900-044	900-044	900-044	
66	1	Belleville Washer	900-053	900-053	900-053	900-053	900-053	900-053	
222	1	Fitting	900-566	900-566	900-566	900-566	900-566	900-566	
275	2	Fitting	900-798	900-798	900-798	900-798	900-798	900-798	
276	1	Tube	900-728	900-728	900-728	900-728	900-728	900-728	

(1) Throttle Bushing (Item 10), found in Seal Section, must be ordered with each casing.

Taco, Inc. 1160 Cranston Street, Cranston, Rhode Island 02920 Telephone: (401) 942-8000 Telex: 92-7627

Litho in U.S.A.

Taco (Canada) Ltd. 3090 Lenworth Drive, Mississauga, Ontario Telephone: (416) 625-2160 Telex: 06-961179

FRAME SIZE & STYLE – 0000-00-XX00

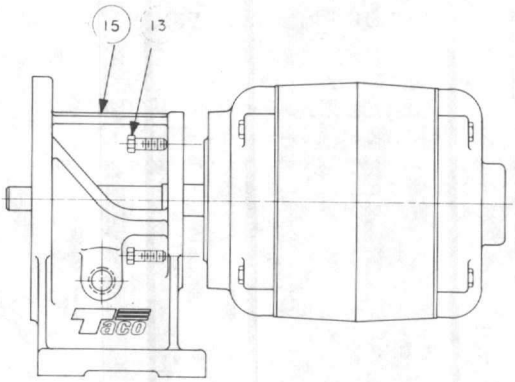
B1 BALL BEARING DESIGN: Update pump with 840-124RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

B2 SLEEVE BEARING DESIGN: Update pump with 840-124RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

B3 SLEEVE BEARING DESIGN: Update pump with 840-124RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

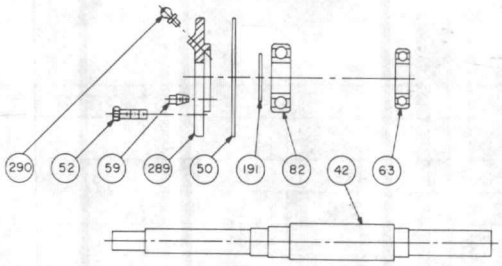
B6 SLEEVE BEARING DESIGN: Update pump with 840-124RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

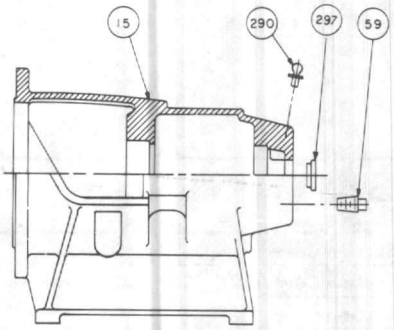
B4 CLOSE COUPLED (CC)



NEMA FRAME Size "T"	NEMA FRAME Size "U"	ITEM 13 FR. BOLT Part No.	ITEM 15 PUMP FR. 1750 "T"	ITEM 15 PUMP FR. 3450 "T"	ITEM 15 PUMP FR. 1750 "U"	ITEM 15 PUMP FR. 3450 "U"
	48	10-201			920-004	920-004
	56	10-201			920-004	920-004
143	182	10-201			920-004	920-004
145	184	10-201	920-004		920-004	920-004
182	213	10-223	928-004		928-004	928-004
184	215	10-223	928-004		928-004	928-004
213	254	10-223	928-004	928-004	928-004	928-004
215	256	10-223	928-004	928-004	928-004	928-004
254	285	10-223		928-004		900-126
256	286	10-223		928-004		900-126
284		10-223		900-126		

B5 BALL BEARING DESIGN:

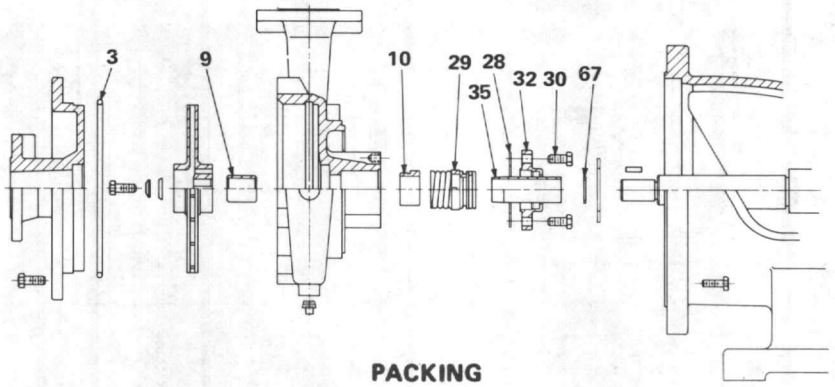




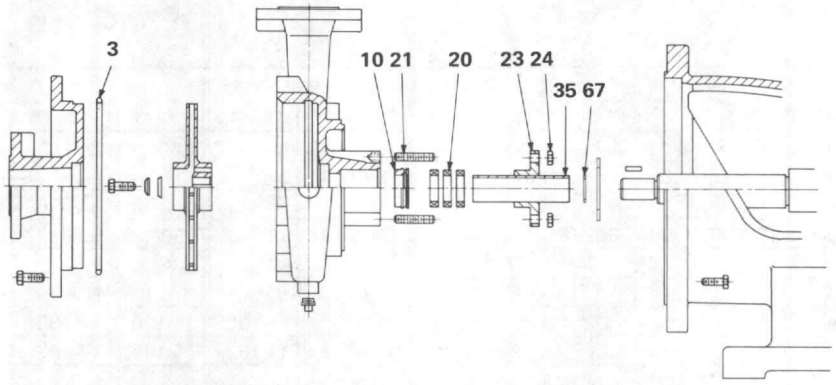
Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS REMARKS
74	1	Frame Assembly (complete)	840-124RP	
15	1	Frame	840-111	
42	1	Shaft	840-113	Add SS for Stainless Steel
50	1	Bearing Plate Gasket	840-123	
52	4	Bearing Plate Bolt	10-230	3/8 - 16 x 1
59	2	Drain Plug	16-111C	1/8 NPT Brass
63	1	Ball Bearing	840-114	
82	1	Ball Bearing	840-071	
191	1	Retainer Ring	15-105	
289	1	Bearing Cover Plate Assembly	840-120	
290	2	Lubrication Fitting	15-200	
297	1	End Cap	820-368	

SEAL OR PACKING DESIGN – 0000-00-00X0

MECHANICAL SEAL



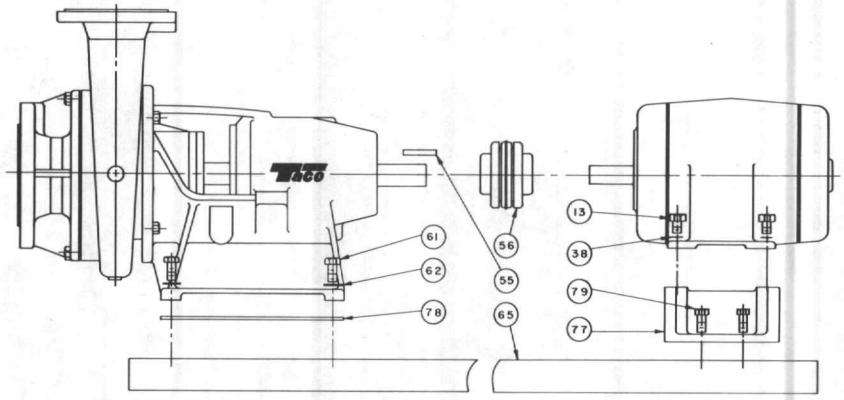
PACKING



TYPE B STANDARD. TYPE D HI-TEMP. TYPE P PACKED. TYPE E CERAMIC.

Item No.	No. Reqd.	DESCRIPTION	SEAL OR PACKING DESIGN				REMARKS
			Type 'B'	Type 'D'	Type 'P'	Type 'E'	
3	1	'O' Ring	*See Page 1*				
9	1	Impeller Spacer	900-026RP	900-026RP	Not Used	900-026RP	
10	1	Throttle Bushing	920-016	920-016	920-008	920-016	
20	1	Packing Set			900-241RP		
21	2	Studs			900-029		
22	1	Filler Ring (Not shown)	Not Used	Not Used	900-030		
23	1	Gland			920-015		Add 'B' For Bronze
24	2	Hex Nuts			12-129		3/8 – 16
28	1	Retainer Cap Gasket	920-014RP	920-014RP		920-014RP	
29	1	Water Seal	900-024RP	900-087RP		900-215RP	
91	1	WATER SEAL KIT	840-128BRP	840-128DRP	Not Used	840-128ERP	Incl. Items No. 28, 29, 35 & 67
30	4	Retainer Cap Bolts	10-208	10-208		10-208	3/8 – 16 x 7/8
32	1	Seal Retainer Cap	920-020	920-020		920-020	
35	1	Sleeve	900-027BRP	900-027BRP	920-006	900-027BRP	
67	1	Sleeve Gasket	920-007RP	920-007RP	920-007RP	920-007RP	

MOTOR PARTS – NOT PART OF SERIAL NUMBER
–Motor Frame Sizes Must be Specified When Ordering Parts Shown Below–



Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'T'										REMARKS
			143-145T	182T	184T	213T	215T	254T	256T	284T	284TS	286TS	
65	1	Base Plate (1)	820-957	820-957	820-957	840-418	840-418	840-418	840-418	840-419	840-419	840-419	
77	2	Spacer	840-098	840-003	840-004	840-005	840-006	840-041	840-040	N/A	N/A	N/A	
78	2	Frame Spacer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	840-106	840-106	840-106	
56	1	Coupler	900-193	900-206	900-206	900-195	900-195	900-197	900-197	900-538	900-197	900-199	
38	4	Mtr. Lck. Wshr.	14-104	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5/16
38	4	Mtr. Lck. Wshr.	N/A	14-101	14-101	14-101	14-101	N/A	N/A	N/A	N/A	N/A	3/8
38	4	Mtr. Lck. Wshr.	N/A	N/A	N/A	N/A	N/A	14-100	14-100	14-100	14-100	14-100	7/16
62	4	Frm. Lck. Wshr.	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Mtr. Hx. Hd. Blt.	10-254	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5/16-18x1¼
13	4	Mtr. Hx. Hd. Blt.	N/A	10-221	10-221	10-221	10-221	N/A	N/A	N/A	N/A	N/A	3/8-16x1¼
13	4	Mtr. Hx. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	10-209	N/A	N/A	N/A	N/A	7/16-14x1½
13	4	Mtr. Hx. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	N/A	10-202	10-202	10-202	10-202	7/16-14x1¼
61	4	Fr. Hex. Hd. Blt.	10-238	10-233	10-238	10-238	10-238	10-238	10-238	N/A	N/A	N/A	1/2-13x1-5/8
61	4	Fr. Hex. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10-217	10-217	10-217	1/2-13x2½
79	4	Spr. Hx. Hd. Blt.	10-230	10-230	10-230	10-230	10-230	N/A	N/A	N/A	N/A	N/A	3/8-16x1
55	1	Coupler Key	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	1/4x1/4x1½
47	1	Coupler Guard	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	
48	4	CG. RdHd. Scw.	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	1/4-20x3/8
111		Coup. Insert	900-512	900-512	900-512	900-513	900-513	900-514	900-514	900-515	900-514	900-515	

(1) Add "A" to base plate number when coupler guard is to be used.

MATERIALS OF CONSTRUCTION – – – 0000-00-000X

DESCRIPTION	1 STANDARD CONSTRUCTION	2 BRONZE FITTED	3 ALL BRONZE	4 ALL IRON	REMARKS
Casing	Iron	Iron	Bronze	Iron	Add Suffix 'B' for Bronze
Suction Cover	Iron	Iron	Bronze	Iron	Add Suffix 'B' for Bronze
Impeller	Iron	Bronze	Bronze	Iron	Add Suffix 'B' for Bronze
Wear Ring	Bronze	Bronze	Bronze		Only When Required
Seal Retainer Cap	Iron	Iron	Bronze	Iron	Add Suffix 'B' for Bronze
Packing Gland	Iron	Iron	Bronze	Iron	Add Suffix 'B' for Bronze
Throttle Bushing	Bronze	Bronze	Bronze	Iron	Add Suffix 'C' for Iron
Sleeve	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	
Shaft	Steel	Steel	Steel	Steel	Add 'SS' for St. Steel

Taco

INSTRUCTION SHEET

NUMBER

IS-100-1.3

Effective: May 1, 1981

Supersedes: IS 300-1-1 dated 11/25/68

PUMP SERVICING INSTRUCTIONS – NOS.

121-7	1600-1	1620-1
122-7	1602-1	1622-1
131-6	1604-1	1624-1
132-6	1610-1	1630-1
133-6	1612-1	1632-1
138-2	1614-1	1634-1

Plant ID. No. 001-322

ITEMS TO CHECK BEFORE STARTING

1. Motor and bracket have been properly lubricated at the factory and should not require additional lubricant. Before starting, check oil level in bracket thru sight oil gauge. Level should be between top and center of window. If, for some reason, level is below center of window, see instructions on oil well cover.
2. Check motor and power supply for proper wiring connections and voltage. If motor is damaged due to improper wiring hook-up, guarantee is void.
3. The casing is rotatable and may be installed in a vertical or horizontal pipe. The motor and bracket must be horizontal in all cases with oil well cover facing the ceiling.

LUBRICATION

Motor– Motor is well oiled before shipment in accordance with manufacturer's recommendation and should not require any oil upon arrival. When oil is required, follow instructions attached to the motor end shield plates.

Pump– (For best results TACO-LUBE #12 is recommended. Maintain oil level at all times within limits specified on oil well cover.

MOTOR ALIGNMENT

All circulator motors are aligned within required tolerances when shipped. They normally do not require any attention. If due to rough handling the motor base becomes bent, loosen screws connecting cast iron and steel sections of the motor base and place shims between the two sections until the motor shaft is properly aligned with the pump shaft.

TO REPLACE WATER SEAL AND/OR IMPELLER

1. Stop pump and close suction and discharge valves.
2. Drain water from casing.
3. Remove pipe plug on opposite side of oil gauge and drain oil (water may have gotten into oil reservoir).
4. Remove motor assembly from bracket.
5. Remove bracket from pump body. Loosen set screw and pull out pump end of drive coupling. DO NOT BEND SHAFT.
6. Remove oil well cover, loosen set screw in inside Thrust Collar and while holding Thrust Collar, remove Impeller and Shaft, Thrust Washers and Thrust Collar.
7. Clean bearings and bracket and inspect for possible damage. Clean sight oil gauge.
8. Remove stationary seal from bracket, clean recess and apply a film of light oil to OD of new stationary seat rubber cup, press firmly in place with thumbs. Be certain it is "bottomed" equally, otherwise it might leak.
9. Gently remove old seal parts from shaft with a rotating motion and clean entire shaft with soft clean cloth (Do not use much pressure). Drop new spring and holder onto the shaft.
10. Apply a good film of oil, from the very end of the shaft right down to, and slightly beyond the end of the spring. With the seal in the palm of the hand (seat facing the hand) and with an oscillating motion, press seal over end of shaft then down to free length of the spring. Line up seal, spring and spring holder.
11. Thoroughly clean both seal faces with a soft clean cloth.
12. Remove set screw from Thrust Collar. Apply a film of oil to each side of Thrust Collar, then place a Thrust Collar Washer on each side of the Thrust Collar with the LIGHT COLORED (Cadmium Plated) SIDES facing the Thrust Collar. While holding this 3 Part Assembly (Thrust Collar and two Washers) in the oil reservoir with grooves on OD of Collar facing the Impeller, slide Impeller and Shaft into bracket so that hole in Shaft is directly in line with screw hole in Thrust Collar. Insert and tighten set screw until it bottoms in the hole in the shaft, then turn back 1/16 of a turn. This automatically adjusts the spring tension on seal. THIS LAST OPERATION MUST BE ACCOMPLISHED IMMEDIATELY AFTER OPERATIONS 10 AND 11. IF TOO MUCH TIME ELAPSES, THE OIL MAY BE SQUEEZED OUT FROM UNDER SHAFT SEAL, PREVENTING THE RUBBER PART OF SEAL FROM SLIDING ON SHAFT WHICH IS NECESSARY WHEN PERFORMING OPERATION 12.
13. Re-assemble motor and coupling assembly to bracket and bracket to casing, making certain that casing gasket is in good condition and properly located. Engage teeth of rubber coupling insert with those in the metal ends. Bring all three parts together, then back off one end about 1/32" and tighten. Do not squeeze rubber insert, some pump sizes use A "FIGURE-8" shaped one piece coupler. Install without stretching or compressing.
14. Open valves in suction and discharge lines and vent air thru vent holes, if provided. Start motor for TWO SECONDS, then stop and inspect for water leaks. If any leaks occur, one or more previous operations must be repeated.
15. If no leaks occur, re-fill oil reservoir as previously indicated under LUBRICATION-PUMP and replace oil well cover.
16. Start pump and again check for leaks. (Note: If pump is operated longer than 30 SECONDS without being primed, the mechanical seal could be damaged).

Taco, Inc. 1160 Cranston Street, Cranston, Rhode Island 02920 Telephone: (401) 942-8000 Telex: 92-7627

Litho in U.S.A.

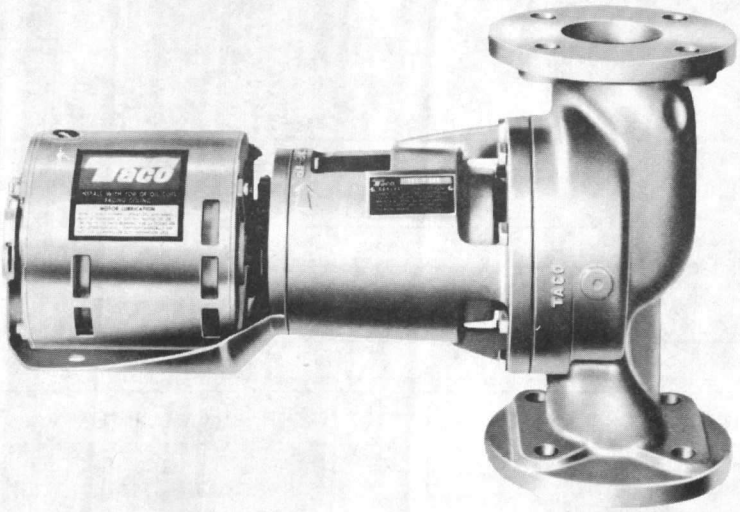
Taco (Canada) Ltd. 3090 Lenworth Drive, Mississauga, Ontario Telephone: (416) 625-2160 Telex: 06-961179

Taco	REPLACEMENT PARTS
NUMBER **304-001**	Effective: December 1, 1985 Supersedes: PL300-1 dated: 12/1/84

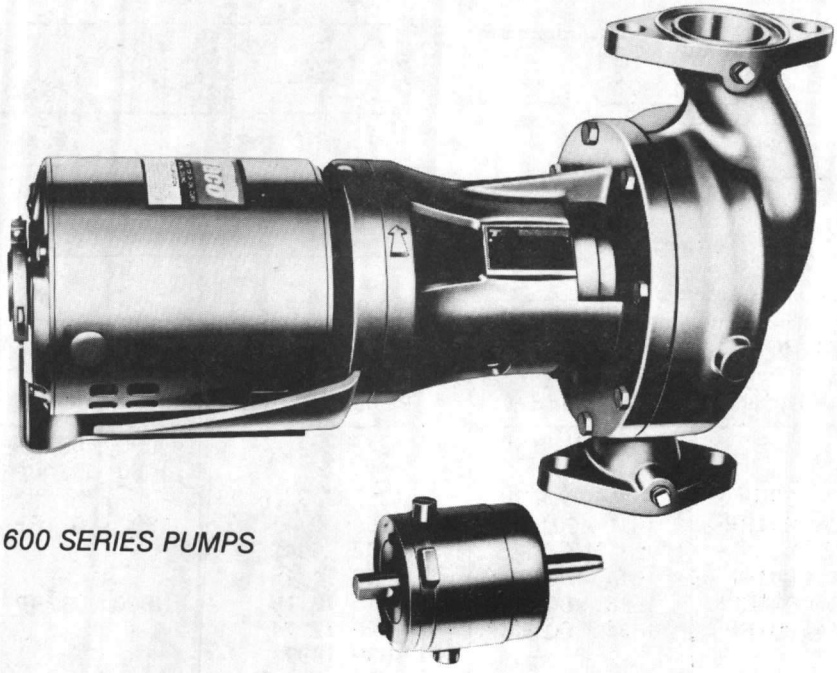
121 THRU 138 PUMPS
1600 SERIES PUMPS

IMPORTANT: When ordering, always specify part number, part name, and complete model number of pump.

CARTRIDGE DESIGN PUMPS



121 – 138 SERIES PUMPS



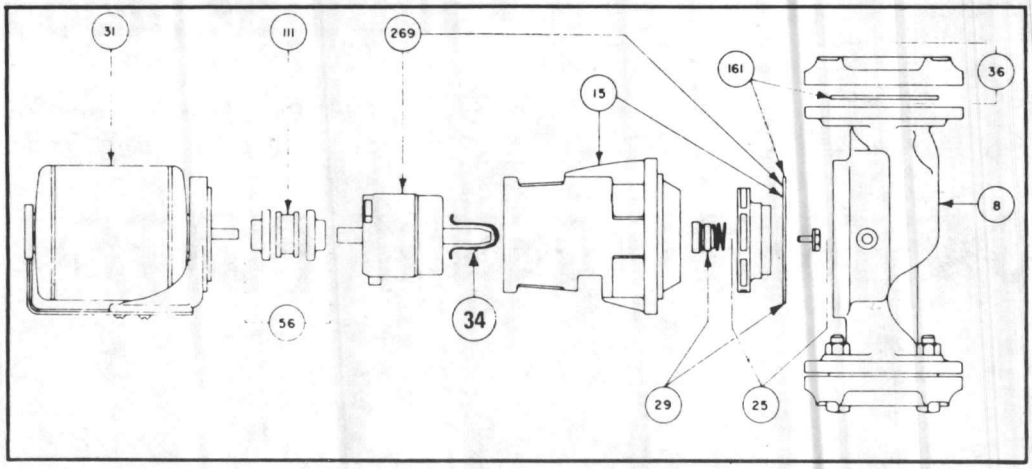
1600 SERIES PUMPS

Taco, Inc. 1160 Cranston Street, Cranston, Rhode Island 02920 Telephone: (401) 942-8000 Telex: 92-7627

Litho in U.S.A.

Form No. F304-001 Taco (Canada) Limited 1310 Aimco Blvd., Mississauga, Ontario L4W 1B2 Telephone: 416-625-2160 Telex: 06-961179

REPLACEMENT PARTS FOR (–9) AND SERIAL NUMBER CARTRIDGE DESIGN PUMPS



1600 - 4.25

SERIAL NUMBER CODE

C 1 N 1 N
- N — FLANGE TYPE
- 1 — MOTOR FRAME SIZE
- N — WATER SEAL
- 1 — BRACKET DESIGN
- C — MATERIAL OF CONSTRUCTION

MATERIAL OF CONSTRUCTION

X O O O O

A	CAST IRON PUMP AND IMPELLER (3)
B	ALL BRONZE PUMP AND IMPELLER
C	CAST IRON PUMP AND BRONZE IMPELLER

BRACKET DESIGN

O X O O O

1	ALL CURRENT STYLE PUMPS

WATER SEAL TYPE, ITEM # 29

O O X O O

N	1600 – 170RP NI – RESIST
H	1600 – 170HRP TUNGSTEN CARBIDE
E	1600 – 170ERP CERAMIC

MOTOR FRAME SIZE*

O O O X O

1	48 FRAME (1/4, 1/3, 1/2 HP)
2	56 FRAME (3/4, 1 HP)
3	56 FRAME (1 1/2, & 2 HP)
4	56 FRAME (3 HP)

* Refer to standard motors only. See nameplate for other motors.

FLANGE TYPE

O O O O X

N	NPT (STANDARD)
D	DIN (EXPORT)

ITEM # 8 REPLACEMENT BODY

PUMP MOD. NO.	CAST IRON	BRONZE
121	121 – 018RP	121 – 018BRP
122	"	"
131, 32, 33 & 38[1]	133 – 150RP	133 – 150BRP
1600, 10, 11[1]	1610 – 001RP	1610– 001BRP
1602, 1604[2]	N/A	N/A
1612, 14, 15	1614 – 001RP	1614 – 001BRP
1616, 18, 19	1618 – 004RP	1618 – 004BRP
1620, 22, 24	1634 – 001RP	1634 – 001BRP
1630. 1632	"	"
1634, 1635	"	"
1636, 1638	1640 –002RP	1640 – 002BRP
1640, 1641	"	"

ITEM # 36 REPLACEMENT FLANGE SET

PUMP MOD. NO.	CAST IRON	BRONZE
121	1600 – 033RP	1600 – 033BRP
122	1600 – 034RP	1600 – 034BRP
131, 32, 33, & 38[1]	"	"
1600, 10, 11[1]	1600 – 031RP	1600 – 031BRP
1602, 1604[2]	"	"
1612, 14, 15	"	"
1616, 18, 19	1600 –032RP	1600 – 032BRP
1620, 22, 24	"	"
1630, 1632	"	"
1634, 1635	"	"
1636, 1638	1600 – 174RP	1600 – 174BRP
1640, 1641	"	"

Note (1) When replacing Item #8 body on 131, 132, 133, 138 and 1600C – 1& –9, you must also order current style impeller.
Note (2) Body for the 1602 & 1604 are no longer available. Consult factory.
Note (3) 121 thru 138 only.

ITEM # 15 REPLACEMENT BRACKET					ITEM # 161 GASKET KIT
PUMP MOD. NO.	MOTOR FRAME SIZE (48)		MOTOR FRAME SIZE (56)		
	CAST IRON	BRONZE	CAST IRON	BRONZE	
121, 122	1600 – 155RP	1600 – 156RP	NA	NA	1600 –050RP
1600, 10, 11	"	"	"	"	"
1602, 1604	1600 – 175RP	1600 – 176BRP	"	"	"
1612, 20, 30	"	"	"	"	"
131, 132	"	"	"	"	"
1615*	–	–	–	–	"
133, 138	NA	N/A	1604 – 023RP	1604 – 024RP	"
1614, 22, 24	"	"	1604 – 023RP	1604 – 024RP	"
1632, 34	"	"	1604 – 023RP	1604 – 024RP	"
1635*	–	–	–		1600 – 050RP
1616, 36	"	"	1604 – 025RP	1604 – 026RP	1618 – 006RP
1619*	–	–	–	–	"
1638, 40, 41	"	"	1604 – 025RP	1604 – 026RP	"

* Select bracket, per motor frame size code in serial number.

ITEM #25 REPLACEMENT IMPELLER ASSEMBLY								
PUMP NO.	(-9) PUMPS	CURRENT	DIA. -9	DIA. CUR.	PUMP NO.	(-9) PUMPS	CURRENT	DIA. -9 CUR.
121, 122	121 – 142BRP	121 – 142BRP	4.30	4.30	1618	1618 – 001BRP	N/A	7.900
131	131 – 075BRP	1630 – 023BRP	4.80	4.40	1619*	N/A	1619 – 001BRP	
132	132 – 063BRP	1630 – 022BRP	5.20	4.90	1620	1620 – 022BRP	N/A	5.100
133	133 – 075BRP	1632 – 022BRP	5.75	5.65	1622	1622 – 020BRP	N/A	5.850
138	138 – 037BRP	1634 – 023BRP	6.25	6.15	1624	1624 – 040BRP	N/A	6.500
1600	1600 – 179BRP	1610 – 020BRP	4.75	4.50	1630	1630 – 022BRP	1630 – 022BRP	4.900
1602	1602 – 025BRP	N/A	5.500		1632	1632 – 022BRP	1632 – 022BRP	5.650
1604	1604 – 028BRP	N/A	6.200		1634	1634 – 023BRP	1634 – 023BRP	6.150
1610	1610 – 019BRP	1610 – 019BRP	4.750		1635*	N/A	1635 – 001BRP	–
1611*	N/A	1611 – 001BRP	–		1636	1636 – 001BRP	1636 – 001BRP	6.400
1612	1612 – 019BRP	1612 –019BRP	5.750		1638	1638 – 001BRP	1638 – 001BRP	6.900
1614	1614 – 018BRP	1614 – 018BRP	6.350		1640*	1640 – 001BRP	N/A	7.900
1615*	N/A	1615 – 001BRP	–		1641*	N/A	1641 – 001BRP	–
1616	1616 – 002BRP	1616 – 002BRP	7.100					

*When ordering, please advise diameter of impeller.

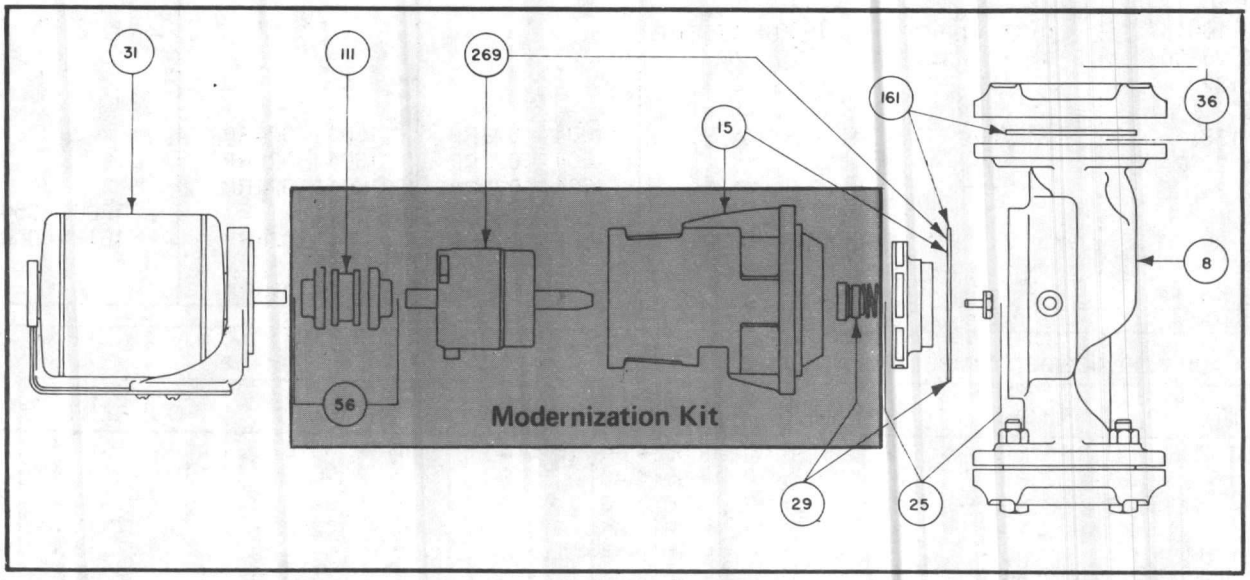
ITEM # 31 REPLACEMENT MOTOR ASSEMBLY*				
HP	115/60/1	115/230/60/1	200/60/3	230/460/60/3
1/4	121 – 151RP	N/A	121 – 148RP	121 – 137RP
1/3	131 – 143RP	N/A	131 – 115RP	131 – 137RP
1/2	N/A	132 – 096RP	132 – 066RP	132 – 097RP
3/4	N/A	133 – 119RP	133 – 140RP	133 – 134RP
1	N/A	138 – 119RP	138 – 148RP	138 – 142RP
1½	N/A	1636 – 013RP	1636 – 019RP	1636 – 010RP
2	N/A	1638 – 012RP	1638 – 015RP	1638 – 010RP
3	N/A	N/A	1640 – 013RP	1640 – 010RP

* When ordering other than standard, refer to nameplate, then consult factory.

ITEM #34 SHAFT SLEEVE	1600 – 205	All –9 and Serial Number Pumps.
ITEM #56 COUPLER	1624 – 053RP	All Inline Pumps ¼ thru 2 HP.
ITEM #56 COUPLER	1624 – 041RP	All Inline Pumps 3 HP.
ITEM #111 RUBBER INSERT	1624 – 004RP	All 4J Couplers.
ITEM #111 RUBBER INSERT	1624 – 020RP	All 3J Couplers.
ITEM #111 RUBBER INSERT	900 – 512	All 5J Couplers.
ITEM #269 CARTRIDGE ASSY.	1600 – 160RP	All -9 and Serial Number Pumps.

REPLACEMENT PARTS FOR OLD STYLE PUMPS AND CIRCULATORS *

*121+122-3-7; 131, 132+133-3-6; 138-1+2; 1600, 1602, 1604, 1610, 1612, 1614, 1620, 1622, 1624, 1630, 1632, 1634-1+-C1.



ITEM # 8	BODY	Same as –9 and Serial Number Pumps.
ITEM # 25	IMPELLER AND SHAFT ASSEMBLY	No longer available . Must purchase Item #74 Modernization Kit listed below, Plus –9 IMPELLER
ITEM # 29	SEAL KIT	Part No. 1600 – 055RP
ITEM # 31	MOTOR ASSEMBLY [1]	Same as –9 and Serial Number Pumps.
ITEM # 36	FLANGE SET	Same as –9 and Serial Number Pumps.
ITEM # 56	COUPLER	Same as –9 and Serial Number Pumps.
ITEM # 111	RUBBER INSERT	Same as –9 and Serial Number Pumps.
ITEM # 161	GASKET KIT	Same as –9 and Serial Number Pumps.

ITEM # 74 MODERNIZATION KIT*

PUMP NO.	MOTOR FRAME SIZE (48)		MOTOR FRAME SIZE (56)		
	CAST IRON	BRONZE	CAST IRON	BRONZE	
121, 122	121 – 154RP	122 – 002RP	N/A	N/A	
131, 132[2]	131 – 144RP	132 – 145RP	133 – 147RP	138 – 153RP	
133, 138	N/A	N/A	"	"	
1600, 1610	121 – 154RP	122 – 022RP	N/A	N/A	
1602, 1604[2]	131 – 144RP	132 – 145RP	133 – 147RP	133 – 147RP	
1612, 1620[2]	"	"	133 – 147RP	138 – 153RP	
1630[2]	"	"	"	"	
1614, 1622	N/A	N/A	"	"	
1624, 1632	N/A	N/A	"	"	
1634	N/A	N/A	"	"	

Note (1) When replacing 1/3 or 1/2 HP 56 Frame (old) motor with a new 48 Frame motor, adapter kit # 1600 – 194RP must be ordered.

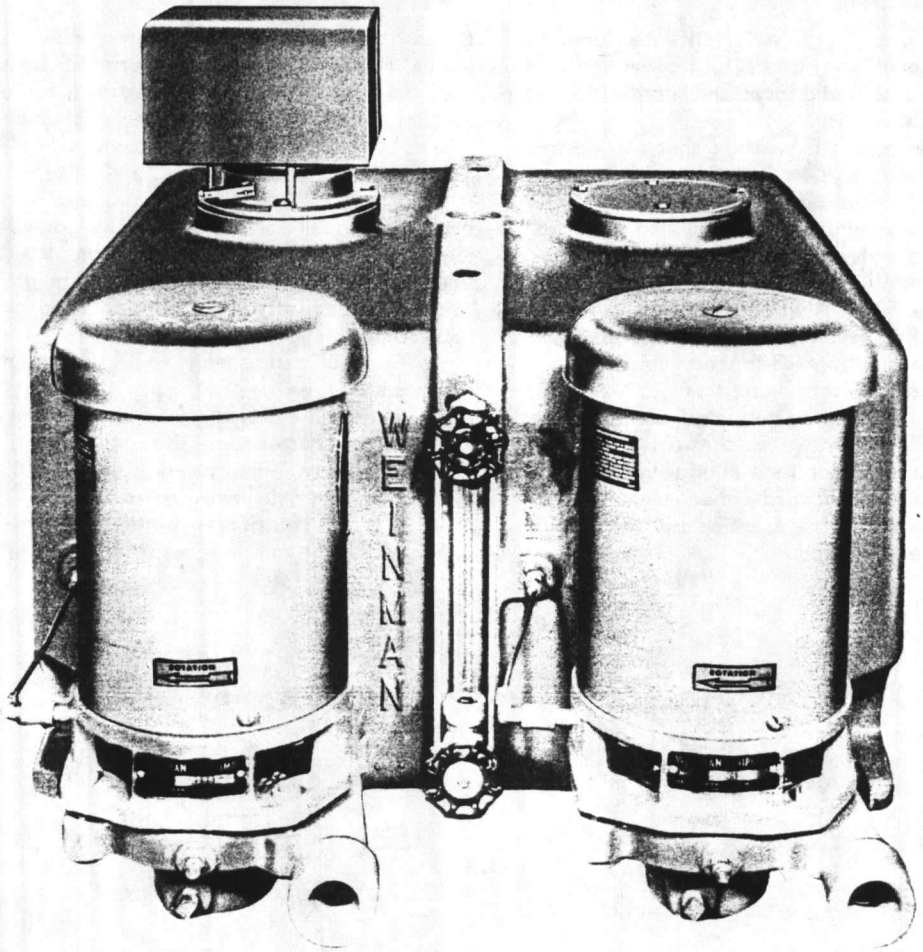
Note (2) Select modernization kit per motor frame size. Select impellers per selection chart on previous page, under –9 column

*Change

for quality, efficiency, dependability...

WEINMAN

CONDENSATE RETURN AND BOILER FEED UNITS
TYPES ACV, ACKV, AEV, AEKV, ADV and AFV



INSTALLATION and OPERATING
INSTRUCTIONS

These instructions are important. Please read them thoroughly before installing your Weinman Unit. Quiet, trouble-free operation depends on proper installation and operation procedure. By carefully following the procedure outlined you will insure top performance from your Weinman equipment over a long period of time.

Keep these instructions on hand for future reference, along with the enclosed parts list which will be of help to you should you need replacement parts.

Mueller Pump
AERMOTOR-MIDLAND-WEINMAN
A MUELLER COMPANY
P.O. Box 1364 Commerce & Exchange
Conway, Arkansas 72032 501-329-9811

How to Install, Maintain and Operate WEINMAN Condensate Return and Boiler Feed Units

Your Weinman Condensate Return and Boiler Feed Units are precision designed and built with quality materials and fine workmanship to warrant superior performance under the toughest operating conditions. To insure continued successful operation it is essential the following installation, maintenance and operation instructions be followed in every detail.

INSTALLATION

STEP 1: Choose a clean, dry, well ventilated area in which to install your unit. This not only assures proper operation and increased service life, but speeds maintenance.

STEP 2: Install the unit in a position that will permit the condensate to flow by gravity into the receiver. This eliminates the possibility of the return lines becoming moisture laden, thus preventing the system from freeing itself of air.

STEP 3: After installation, be certain the unit is perfectly level. Shim it when necessary to level.

STEP 4: Connect the discharge piping carefully. Be sure that it is supported independently to prevent pipe strain from being transferred to the pump casing. It's good to install a union, gate valve, and check valve in the discharge line.

STEP 5: Hook up the return piping making certain that it slopes slightly toward condensate receiver.

STEP 6: Install the vent piping. Be sure it is open to the atmosphere at all times.

WIRING

Check the motor nameplate for specific wiring requirements. For safe and proper operation, fuses installed in the safety switches and all wiring must conform to recommendations of the National Electrical Code.

PUMP ROTATION

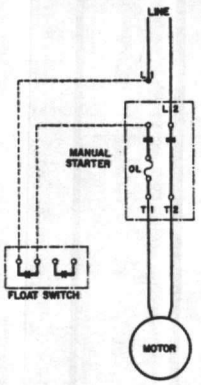
Pump rotation is clockwise as you look down on the pump. Single phase motors are wired so that they rotate clockwise automatically. Three phase motors, however, should be checked carefully for proper rotation prior to operation. To do this:

1. Connect wiring leads to pump motor in the usual manner.
2. Start the motor the first time by just touching the starter button and then stopping the motor immediately. When you do this check the pump shaft for proper clockwise rotation.
3. If pump rotation is counter-clockwise, switch any two of the motor wires to obtain proper rotation.

TYPICAL WIRING DIAGRAMS

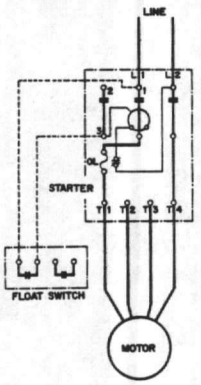
FLOAT SWITCH

SINGLE PHASE MANUAL STARTER



When using manual starter with three position selector switch (Hand-Off-Auto), connect line L1 to "Hand" terminal of switch, and float switch in series to "Auto" terminal and to line L1.

SINGLE PHASE MAGNETIC STARTER

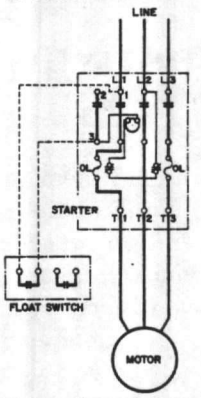


When using magnetic starter with three position selector switch (Hand-Off-Auto), connect float switch to terminals 1 and 2.

For low voltage, connect terminals T1 to T2, and T3 to T4.

For high voltage, connect terminal T2 to T3.

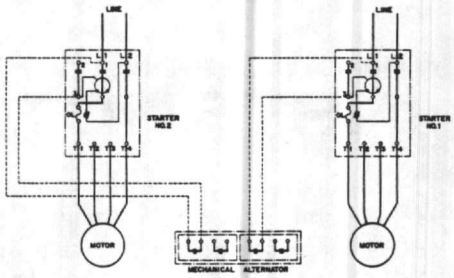
THREE PHASE MAGNETIC STARTER



When using magnetic starter with three position selector switch (Hand-Off-Auto), connect float switch to terminals 1 and 2.

MECHANICAL ALTERNATOR

SINGLE PHASE MAGNETIC STARTER

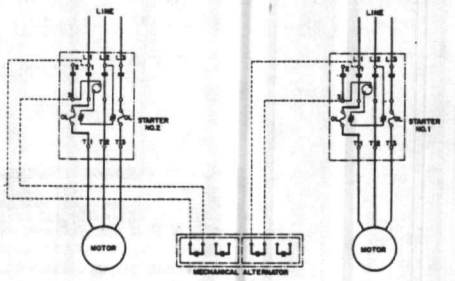


When using magnetic starter with three position selector switch (Hand-Off-Auto), connect alternator to terminals 1 and 2.

For low voltage, connect terminals T1 to T2 and T3 to T4.

For high voltage, connect terminal T2 to T3.

THREE PHASE MAGNETIC STARTER



When using magnetic starter with three position selector switch (Hand-Off-Auto), connect alternator to terminals 1 and 2.

LUBRICATION

Under normal condensate service requirements, lubricate motor bearings about once a year. WARNING! EXCESSIVE GREASING DAMAGES BEARINGS JUST AS QUICKLY AS INSUFFICIENT GREASING. It is essential to use a good grade of grease. Any of the following brands are acceptable for Weinman Pumps:

American Oil Company.....Amolith No. 2
Cities Service Oil Company.....Trojan H2
Humble Oil & Refining Company..Nebula EP No. 2
Shell Oil Company.....Alvania No. 2
Sinclair Refining Company.....Litholine 2
Texaco Inc.....Multifak 2
Union Oil Company.....UNOBA No. 2

OPERATION

Operation of Weinman Condensate Return and Boiler Feed Units is simple and easy, if you observe these rules in keeping them in proper condition.

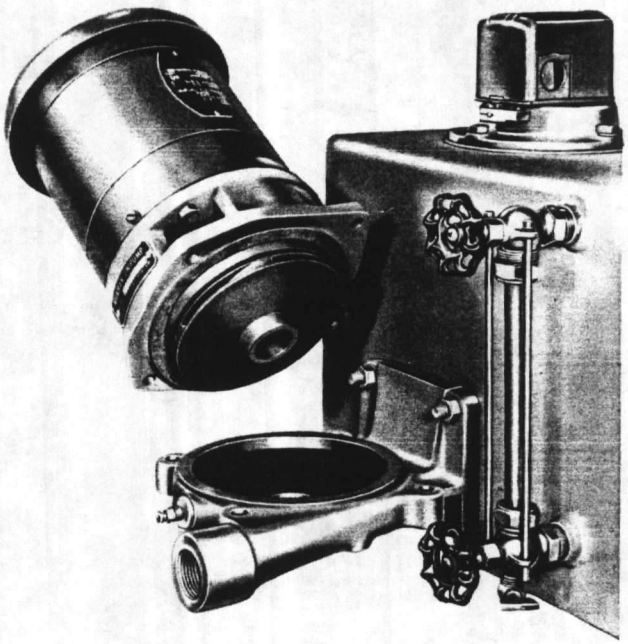
New or repaired water systems must be flushed for several days to eliminate all impurities and make sure the entire system is clean. This simple precaution will give you years more of maintenance-free service.

Heating systems should be flushed thoroughly at the start of each heating season for the same reason.

To flush your Weinman Unit . . . remove the drain plug at the receiver and drain the system water into the sewer. If the system water remains dirty after flushing . . . operate it for several days, draining the water into the sewer until it becomes clean.

DISASSEMBLY

Whenever it is necessary to repair the motor or replace the mechanical seal, the pump can be removed from its casing quickly and easily without disturbing the piping.



INSTALLING A NEW MECHANICAL SEAL

CAUTION: This seal is a precision product and should be handled accordingly. Be especially careful not to scratch or chip the lapped sealing faces of the washer and floating seat. If reinstalling a used seal, both sealing faces should be relapped.

INSTALLING STATIONARY ELEMENT

The seat must be seated securely in the seat ring with the lapped face out. The *unlapped* face is marked and correctly assembled when shipped. Oil the seat ring with *light oil* and seat it firmly and squarely. If this cannot be done with the fingers, use a sleeve as shown in Fig. 1, inserting the cardboard shipping disc between the sleeve and the lapped face to prevent scratching sealing face.

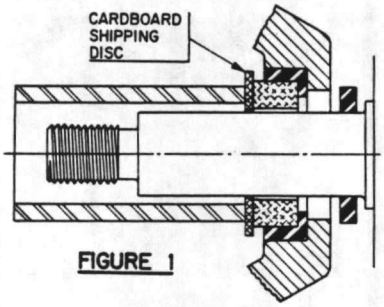


FIGURE 1

INSTALLING ROTATING ELEMENT

Oil shaft with *light oil.* Shaft should be clean and polished smooth. Slide seal body on shaft (washer end *first*) and seat firmly. A sleeve as shown in Fig. 2 will facilitate this operation and prevent the rubber driving ring from pulling out of place as the seal body is slid along the shaft. Assembly of impeller automatically sets seal in proper position.

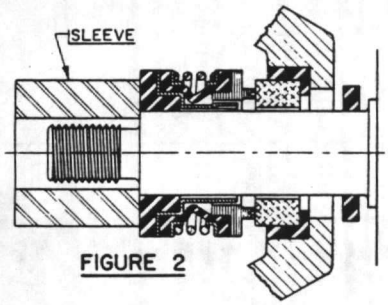
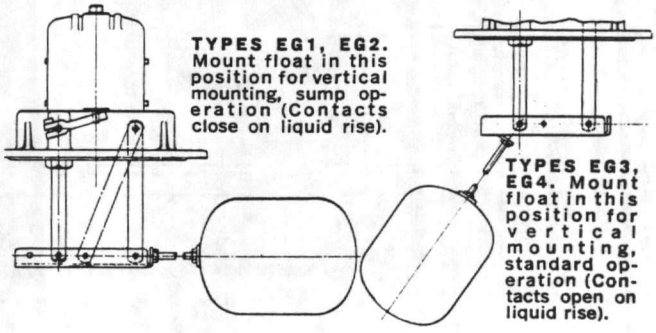


FIGURE 2

Make sure at all times, and particularly before final assembly, that both sealing faces are absolutely clean. Sealing faces should be oiled with clean, light oil.

NEVER RUN THE SEALING FACES DRY. The liquid being handled insures proper lubrication unless other methods of lubrication have been specified. In some cases a short period of operation is required to clear up slight leakage.

REVERSING FLOAT POSITION WHEN USING MECHANICAL ALTERNATOR

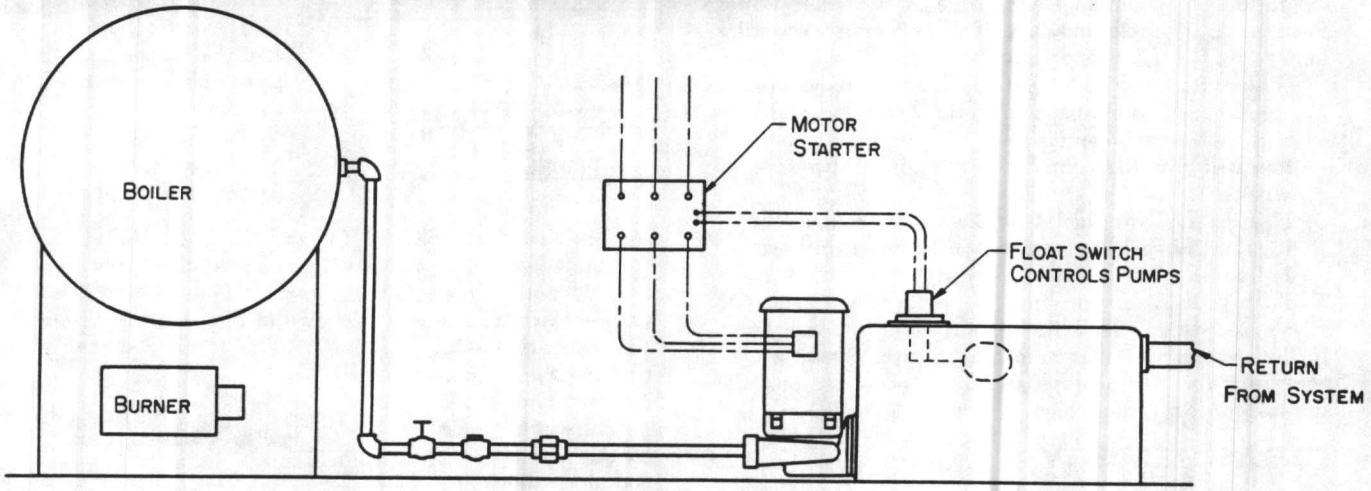


PUMP TROUBLES AND THEIR CAUSES

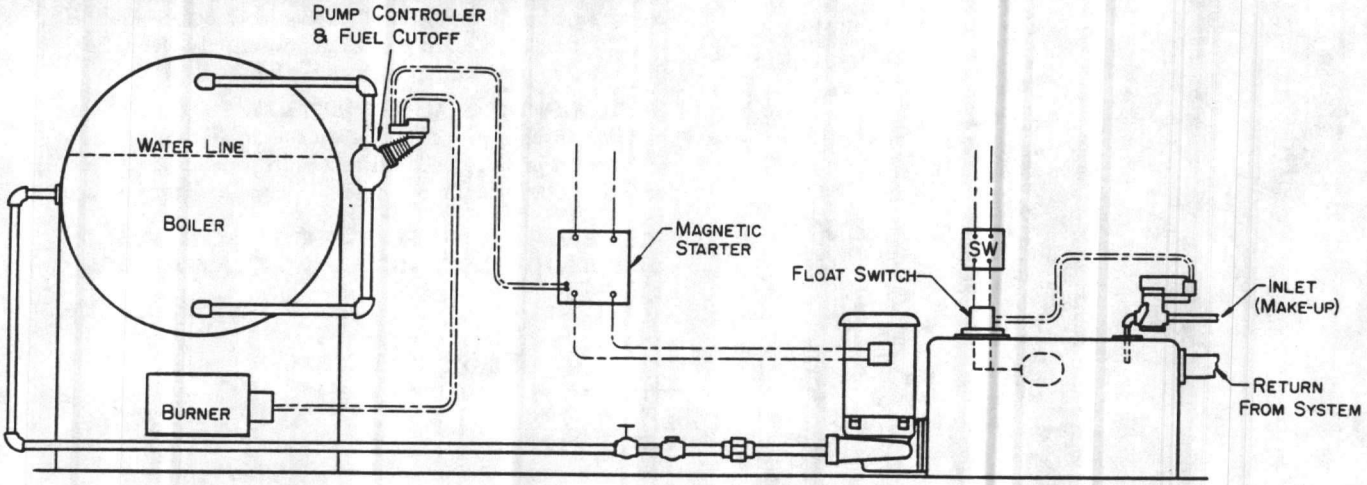
A. Failure to Pump
1. No water in the receiver
2. Rotation in wrong direction
3. Speed too low
4. Return water too hot
5. Total head too high

B. Overloaded Driving Unit
1. Total head too low
2. Unit misalignment (check for piping strains)

CONDENSATE RETURN UNIT CIRCUIT



BOILER FEED UNIT CIRCUIT



Mueller Pump
AERMOTOR-MIDLAND-WEINMAN
A MUELLER COMPANY
P.O. Box 1364 Commerce & Exchange
Conway, Arkansas 72032 501-329-9811

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BIF®
Products of
Leeds & Northrup
A UNIT OF GENERAL SIGNAL
Sumneytown Pike, North Wales, PA 19454, USA
Phone 215/643-2000 • Telex 846192 LEEDNTH

SHUNTFLO® METER
Axial-Turbine Type for Steam, Air or Gas
Product Series 402
Series Nos. KS-6501 and Up

INSTRUCTION MANUAL

TABLE OF CONTENTS

* APPLIES TO ELECTRONIC SHUNTFLO ONLY

Always Give SERIAL NUMBER When Ordering Spare Parts

GENERAL DESCRIPTION

BIF's Axial-Turbine Type Shuntflo Meter, Series 402, is a totalizing meter designed to measure the flow of steam, air, or gas. Self-contained and self-operating, it requires no mercury, pressure piping, or compressed air. No electricity is required except for operation of remote receivers.

This compact meter is easily installed, mounted directly in and supported by the line. Ruggedly constructed, all parts subject to pressure are of high tensile gray iron, bronze or cast steel.

As the steam, air, or gas flows through the meter body, a portion of the flow is diverted to drive the fan shaft assembly, rotating on a jewel bearing.

The speed of the turbine rotor is reduced by means of a second rotor which must be fully submerged in a damping liquid.

In steam meters, the damping liquid is water and maintains itself by condensation of steam through the top bearing. Do not insulate finned cooling chamber, as this will prevent steam condensation.

In air or gas meters, the damping liquid may be other than water, according to the conditions of the particular installation, and must be replenished occasionally. A gage glass assembly is recommended

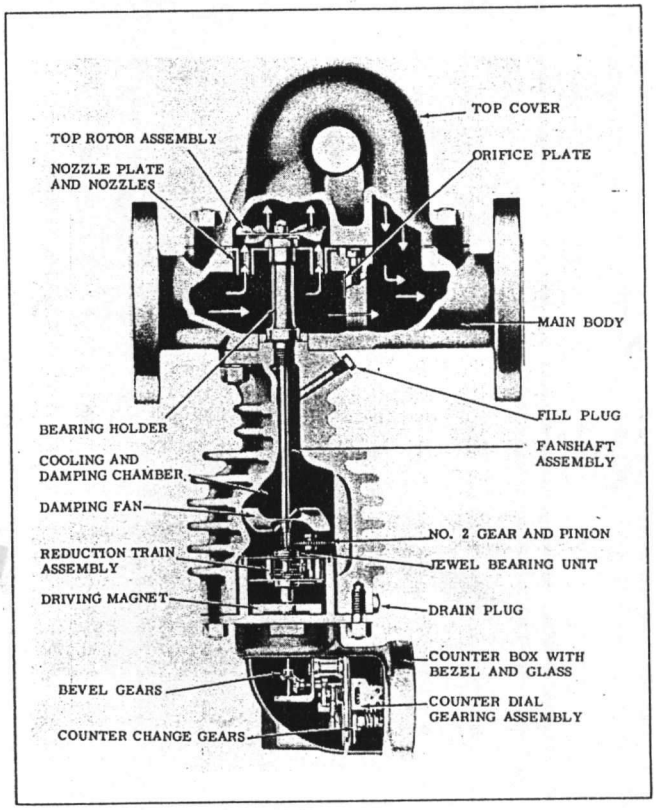


Fig. 1 — Cross section of Shuntflo Meter

Printed in U.S.A.

12/83 Supersedes 10/78

Ref. 402.44-2

for these installations and damping liquid replenished whenever the level drops below the center of the gage glass.

Rotational speed of the shaft is proportional to the rate of flow at all rates within the normal range of the meter. Therefore, the number of turns made by the shaft is a measure of the total flow.

Flow is indicated by four methods: mechanical counters, remote electromechanical counters, demand meters, and digital/analog electronic output. Any combination of indicators is available.

The mechanical counter uses suitable gearing to reduce the rotational speed of the fan shaft to a driving magnet in the damping chamber. A counter box located below the damping chamber contains a following magnet, change gears for registration in desired engineering units and either a six hand counter and dial or a cyclometer counter. Pressure compensated meters include with the change gears a pressure driven variable drive assembly.

The counter box may also contain an electric contactor to drive either a remote electro-mecha.ical counter or a remote demand meter.

A unit with electronic output has a damping chamber that contains a magnetic pickup to sense the fan shaft rotation. An electronic transmitter mounted near the meter contains a jumper wire to select either the digital 0-20 pulse per second or analog 4-20 mA DC output. The transmitter is instrument loop powered requiring only two low voltage wires to connect it to receiving instruments up to 1000 feet away. No other power is required at the meter. To use the 0-20 pulse per second mode a Shuntflo pulse receiver is required. This provides an isolated open collector transistor switch output and requires 117 VAC power.

INSTALLATION INSTRUCTIONS

Flow through the meter must be in the direction of the arrow cast on the body. The meter should be located upstream from any valve normally used to control the flow.

Space Requirements: For accurate metering, it is necessary to provide straight sections of pipe upstream and downstream from the meter, in addition to the clearance required. The straight sections must be of the same nominal size as the meter, and at least as long as specified in the following table:

METER TYPE AND SIZE	FITTINGS UPSTREAM	PIPE DIAM. UPSTREAM	PIPE DIAM. DOWNSTREAM
In-Line (1, 2, 3, 4, inch)	Any	12	6
By-Pass (5 inch and larger)	1 elbow or 2 elbows in same plane	10	5
	2 or more elbows not in same plane	25	5
	Gate valve (if not kept wide open)	25	5

Before installing the meter, blow out the main so that all loose particles are cleared.

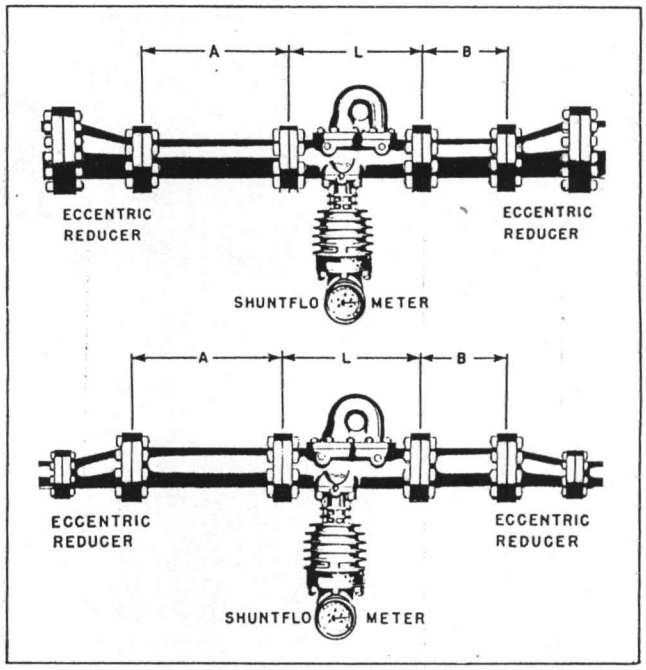
The Shuntflo Meter must be installed horizontally. The turbine spindle must be vertical with the counter dial at the bottom. It is sufficient to line up the meter vertically by eye. Where the main is vertical or inclined, a horizontal run of pipe must be provided for the meter, but not in such a manner that the meter will be at low pocket and become flooded.

CAUTION: Particular care must be taken when installing the meter in the line so that the gaskets do not project into the pipe and that the meter itself is not used as a lever as the strain may affect the bearing alignment.

To bring the meter vertical, use a pipe wrench on the body casting close to the flanges.

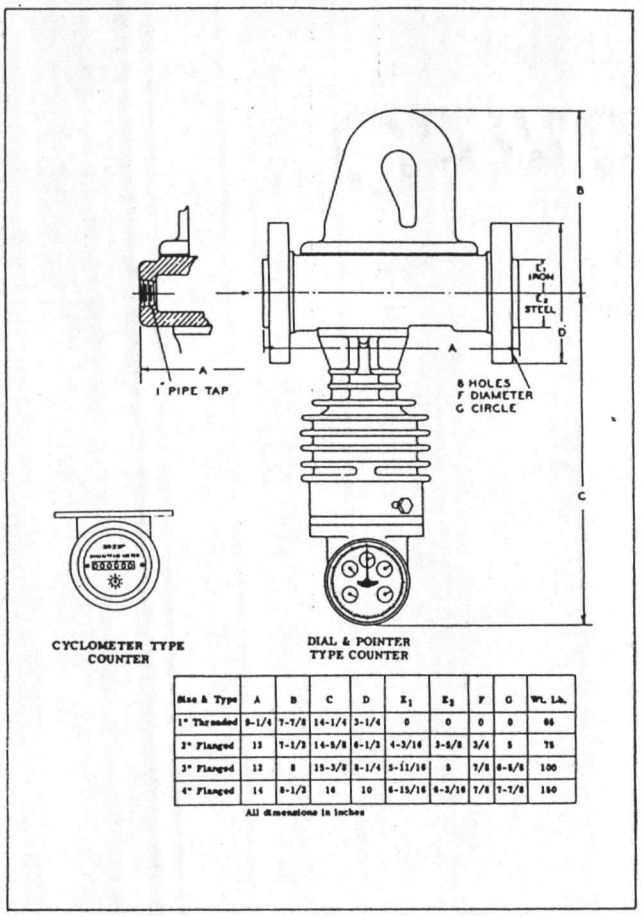
Before the flow is turned on, remove fill plug, Fig. 1, and fill the cooling chamber with the proper damping liquid (clean fresh water for steam meters) until it overflows at the plug hole. In replacing the plugs, do not use thread compound as this is liable to drop down into the mechanism. A smear of grease on the threads is sufficient to hold any ordinary pressure.

The shut-off valve controlling flow through the meter must be located downstream from the meter. With this valve closed, line fluid can now be carefully and gradually permitted to enter the pipe until the line and meter are filled. The flow can now be started by the same gradual and careful opening of the shut-off valve.



METER SIZE	A MINIMUM	L ACTUAL	B MINIMUM
2"	24"	12"	12"
3"	36"	12"	18"
4"	42"	14"	24"

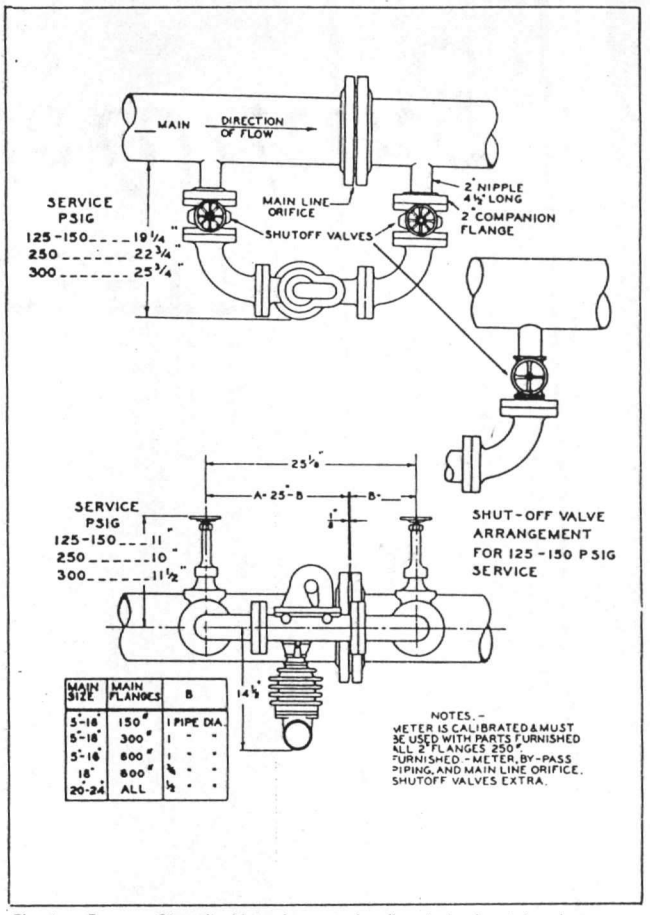
Fig. 2 — Installation in lines larger or smaller than meter size



Size & Type	A	B	C	D	E_1	E_2	F	G	Wt. Lb.
1" Threaded	5-1/4	7-7/8	14-1/4	3-1/4	0	0	0	0	65
2" Flanged	13	7-1/2	14-5/8	6-1/2	4-3/16	3-5/8	3/4	5	75
3" Flanged	12	8	15-3/8	8-1/4	5-11/16	5	7/8	6-1/8	100
4" Flanged	14	8-1/2	16	10	6-15/16	6-3/16	7/8	7-7/8	150

All dimensions in inches

Fig. 3 — Dimensions of standard in-line meters for steam service



MAIN SIZE	MAIN FLANGES	B
5"-18"	150#	1 PIPE DIA.
5"-18"	300#	1 " "
5"-16"	600#	1 " "
18"	600#	¾ " "
20-24"	ALL	½ " "

Fig. 4 — By-pass Shuntflo Meter for metering flow in horizontal main

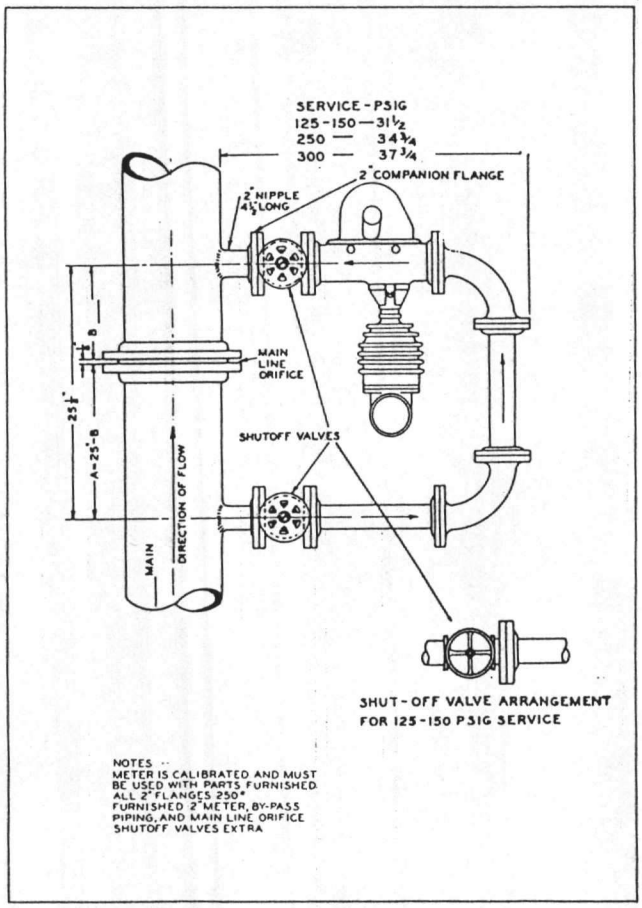
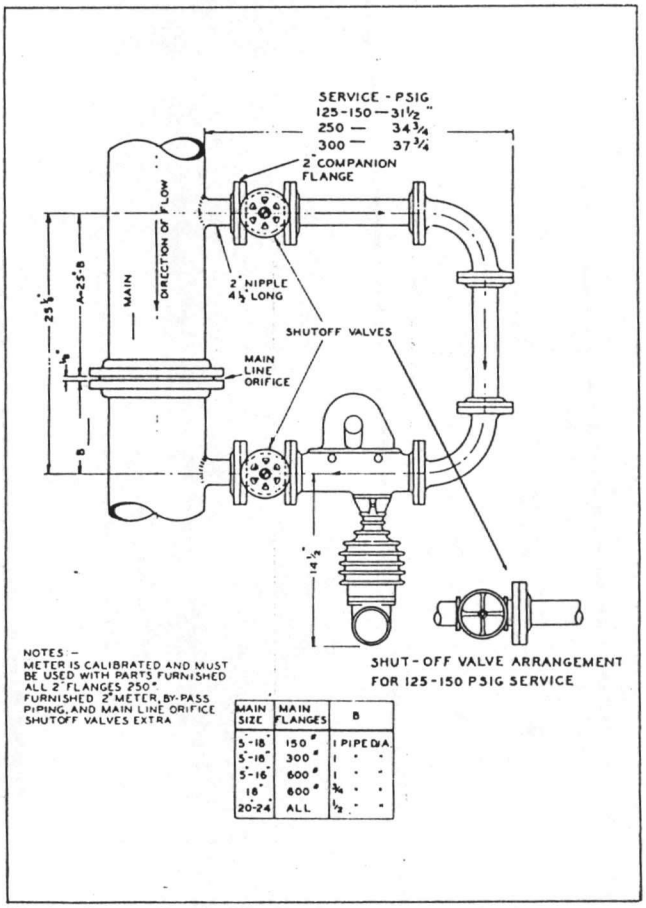


Fig. 5 — By-pass Shuntflo Meter for metering upward flow in vertical main



MAIN SIZE	MAIN FLANGES	B
5"-18"	150#	1 PIPE DIA.
5"-18"	300#	1 " "
5"-16"	600#	1 " "
18"	600#	¾ " "
20-24"	ALL	½ " "

Fig. 6 — By-pass Shuntflo Meter for metering downward flow in vertical main

Any valve upstream from the meter must now be locked in wide open position. Flow must be controlled by the shut-off valve downstream.

If the meter is used in another line or at a different steam pressure than that for which it is rated, be sure it will not be overloaded. Rated capacity and operating pressure are stamped on the nameplate.

Freezing: The lower part of the meter will freeze if left in an exposed condition with steam off the line. In such cases, drain out the damping water or provide heated enclosure. If meter is drained, be sure to refill before turning on steam.

Insulation: The body and top cover of the meter may be insulated if desired; but not the cooling chamber as its purpose is to condense the steam to maintain the damping liquid.

If the mechanical counter dial should face in an unwanted direction, remove the two screws on the underside of the counter box flange and rotate the counter box as required, replacing the two screws. Do not loosen the six nuts that fasten the bottom onto the damping chamber.

SHUNTFLO METER INSTALLATIONS FOR MAINS LARGER THAN 4 INCH (See Fig. 4, 5, or 6)

For installations of this kind, the equipment furnished includes meter, orifice, valves, bends,and nipples which have been calibrated together. The meter will register accurately only when used with these fittings installed as directed herewith.

Dimensions A and B are important, and distance B, in particular, should be accurate within 1/32 in.

Care should be taken that the nipples, which connect the by-pass loop to main, do not project inside the main and that there are no burrs left on the inside of the main. They should be welded on the main line.

The by-pass valves must always be wide open when the meter is in use.

The main line orifice should be installed with the side stamped "Upstream" facing the approaching flow, and accurately centered in the line. Keep the drain hole (in case of horizontal lines) at the bottom, and see that it is not covered by the gasket.

The meter must be horizontal: First, to bring the counter vertically below the meter body, and second, to allow condensation in the loop to trickle back into the main.

The by-pass may be insulated, but the lower part of the meter must never be covered, or it will fail to retain the necessary damping water.

All other directions given for use of Shuntflo Meters in this bulletin apply equally to large size installations.

INSTALLATION OF ELECTRONIC OUTPUT

To install the electronic output option, mount the transmitter box near the meter on a wall or stand. The two holes in the sides of the transmitter box should be at the bottom. Select a location that is cool, dry, and can be reached by the 25 ft. signal cable supplied with the meter. Do not splice additional wire onto the signal cable as this may cause electrical noise pick up. The signal cable may be cut shorter. Running the signal cable in conduit is preferred. Do not run it in conduit that carries power wiring. The cast iron conduit box on the Shuntflo Meter and the transmitter box will accept 1/2 inch conduit fittings. Remove the cast iron conduit box (Fig. 7) from the Shuntflo Meter, by removing the two 5/16 inch hex head bolts. Assure that the magnetic

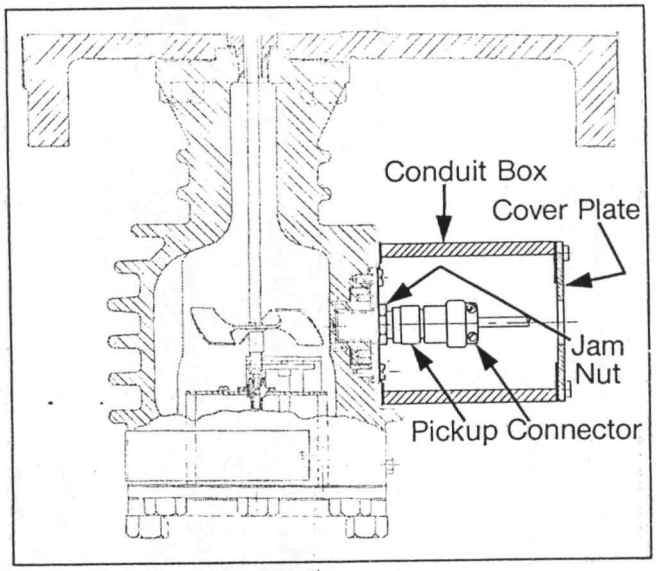


Fig. 7 — Electronic output cross section

pickup is not loose. If it is, tighten it only light finger tight and lightly tighten (10 inch pounds) the jam nut. The magnetic pickup is hollow and overtightening the jam nut will split it. Push the connector end of the signal cable first through the steel cover plate then through the cast iron conduit box. Align the keyway in the connector with the key in the pickup, push the connector on, and lightly tighten the knurled collar of the connector onto the pickup. Bolt the cast iron conduit box back onto the Shuntflo Meter. If conduit is used be sure it is suitable for this service. In some extreme situations the conduit end at the cast iron conduit box may reach a temperature of up to 300° F. Run the signal cable into the transmitter box, preferably through the left side. Connect the signal cable black wire to Terminal 1 (see Fig. 8) of the transmitter; the white wire to Terminal 2 and the braided shield to Terminal 3.

To connect the transmitter to receiving equipment run a twisted pair wire (minimum #22 AWG) into the remaining conduit hole of the transmitter box. The twisted pair wire must not be run in conduit that carries power wiring. Connect the positive wire to Terminal 4 and the negative to Terminal 5. If shielded twist pair wire is used, ground the shield at the receiver; do not ground it at the transmitter. Always follow local electrical codes. Always turn off power at the primary source when working on the transmitter.

If the transmitter is to be used for 4-20 mA DC operation, assure that the jumper (see Fig. 8) on the transmitter circuit card is between Terminals B and C. Also assure that the receiving equipment will supply loop power of sufficient voltage as shown in Fig. 9.

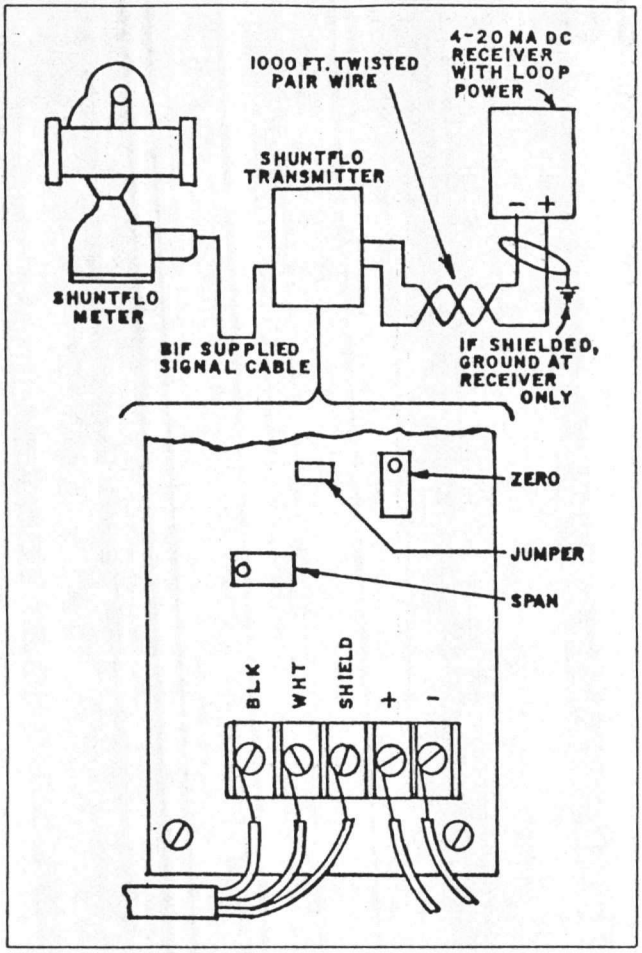


Fig. 8 — Transmitter wiring diagram

To use Fig. 9, determine the loop impedance, then find the range of voltages that are appropriate in the shaded area of the chart. The loop impedance is the sum of the wire resistance and the sum of the resistances of all receiving or indicating equipment. Most receivers supply 24 VDC which is enough for most installations. The only instance when 24 VDC is not sufficient is when several receivers are connected in series. Wire resistance almost never exceeds 50 ohms. If the receiver does not supply loop power, then a power supply of sufficient voltage (typically 24 VDC) and current (30 mA) must be used. If the receiver is a 4-20 mA DC flow computer, then typically a separate power supply is not needed. If the receiver is a 4-20 mA DC computer interface, then typically a power supply is needed, but may be available on the interface.

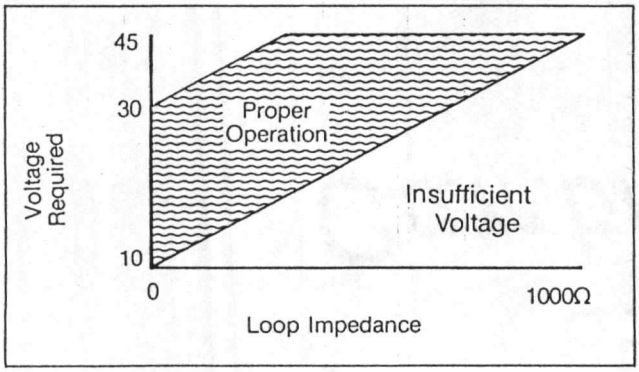


Fig. 9 — Transmitter voltage requirement

If several receivers are used, be sure only one supplies power (see Fig. 10). Carefully read and follow the receiver manufacturers instructions. Keep in mind that the Shuntflo is a two wire process transmitter. The Shuntflo transmitter output is isolated and may be grounded at any one point in the current loop or as directed by the receiver manufacturer.

Unless a special calibration is requested, a 4 mA signal corresponds to no flow and a 20 mA signal corresponds to approximately 150% of rated nameplate capacity. This is done to allow accurate metering during over range flow conditions common in steam lines. The exact 20 mA value appears on the transmitter nameplate. The rated nameplate capacity appears on the Shuntflo Meter nameplate. If the 4-20 mA mode is used, the transmitter must be used only with the Shuntflo meter for which it is calibrated. The meter and transmitter bear the same serial number.

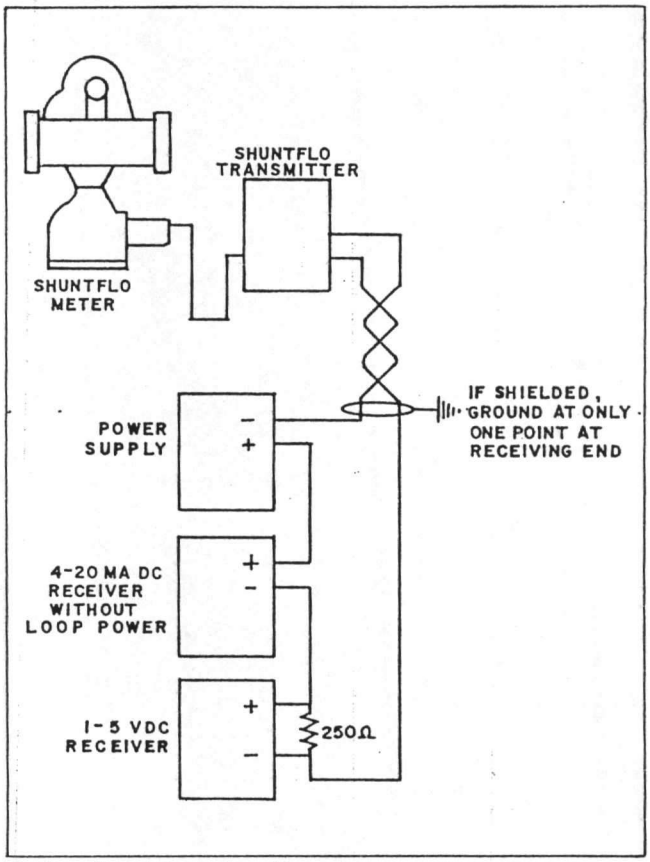


Fig. 10 — Alternate transmitter wiring

If the 0-20 pulse per second mode is desired, assure that that the jumper wire on the transmitter circuit card is between terminals A and B (see Fig. 8). A BIF Shuntflo pulse receiver must also be used. It may be up to 1000 feet from the transmitter. The pulse receiver requires 117 VAC power and supplies the loop power for the transmitter. Its output is an optically isolated open collector transistor switch. Mount the Shuntflo pulse receiver box at any convenient location near the equipment that will accept the signal. Connect the twisted pair signal wires from the Shuntflo transmitter to the pulse receiver card, the positive wire to Terminal 4, the negative wire to Terminal 5, the Shield (if used) to Terminal 3 (see Fig. 11). (**Note:** the twisted pair shield should not be grounded at the transmitter). Connect the positive input wire from the

equipment that will accept the signal to Terminal 6 and the negative to Terminal 7. Follow the equipment manufacturer's guide for using "open collector" inputs. Terminals 6 and 7 are optically isolated. Connect 117 VAC 50/60 Hz 2 Watt power to the pulse receiver card, the AC "hot" black wire to Terminal 1, the neutral white wire to Terminal 2, the green ground wire to Terminal 3. Always follow electrical codes when wiring and always observe high voltage warning on the receiver box. At 100% of nameplate capacity, the output will be about 20 pulses per second (20 Hz). The exact amount of flow per pulse may be determined from the nameplate on the Shuntflo Meter. This is listed as the amount of flow for 100 pulses. This value must be programmed into the final receiving equipment. Typically, this is done through switches or a keypad on digital computers or with a "span" potentiometer on recorders. In the pulse mode any Shuntflo pulse receiver, transmitter, and meter may be used as long as the correct pulse factor is programmed into the final receiving equipment. Follow manufacturer's instructions. The two wire loop between the Shuntflo transmitter and pulse receiver may be grounded at any point.

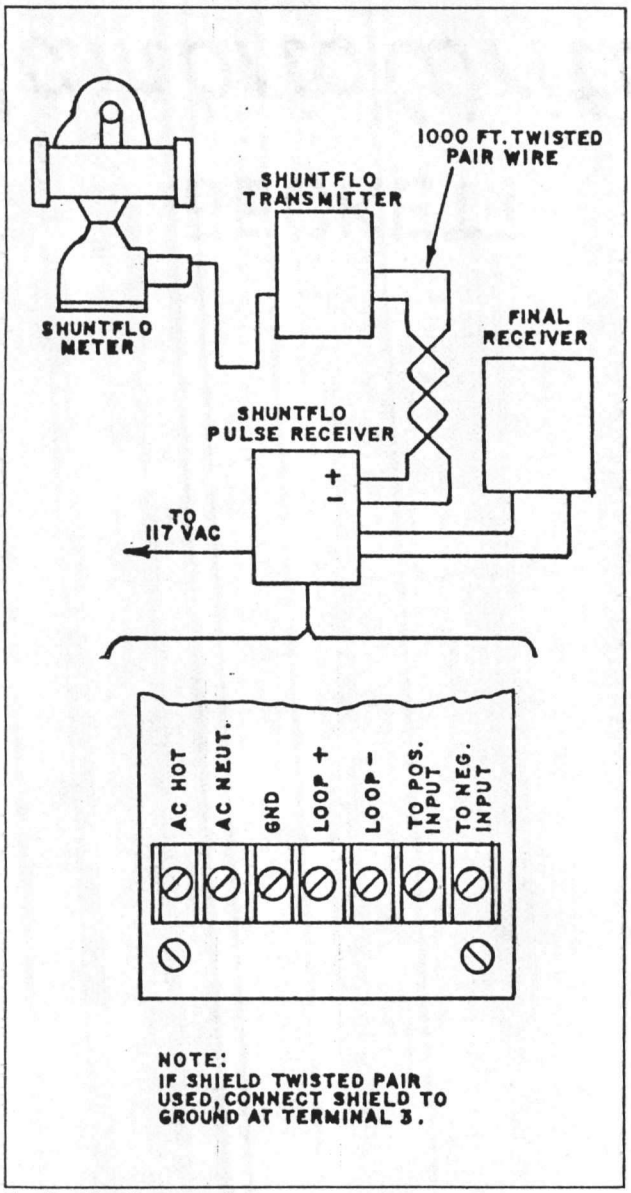


Fig. 11 — Receiver wiring diagram

CARE AND ADJUSTMENT

The meter is designed to stand any reasonable kind of handling when moving and installing. Its rugged exterior sometimes tempts one to handle it more as a valve or fitting than as an instrument. When moving to a new position, therefore, the following points must be watched:

a. Do not drop meter.

b. Do not use meter as a lever to adjust its position in the pipe line. Also it should not be under a leverage strain after bolting in the line.

c. Do not allow an unauthorized person to dismantle the meter or examine the interior.

d. When starting up the meter on a new line, see that the damping chamber is filled with the proper liquid.

The only operating attention which the meter will ordinarily require is the removal and cleaning of the counter glass, should this become fogged due to temperature extremes. The counter will not be disturbed in doing this.

If the meter is to be used under exceptional conditions, BIF will be glad to offer advice regarding its installation and measuring capacity.

TO EXAMINE FOR WEAR (SEMI—ANNUALLY)

Remove the top cover and try the rotor with the fingers to check side play (which should be less than 0.015 in.) and lift rotor to check end play (should be less than 0.050 in.). If either is excessive, the bearing should be replaced. Spare parts can be furnished by BIF at small cost.

TO REPLACE WORN TOP BEARING (SEE FIG. 12)

a. Remove top cover.

b. Release rotor No. 2 by removing nut and lockwasher. Lift rotor vertically to avoid bending top pivot.

c. Remove bearing cap No. 7.

d. Lift up the rotor shaft and remove all three parts, Nos. 3a, F and T.

e. Holding the rotor shaft up, slip on the new washer T with its curved surface downward.

f. Slip on the new washer F and new graphite bearing No. 3a and lower the shaft into its bottom bearing.

g. Several trials may be necessary to locate the bottom bearing, but there is no doubt as to when the shaft is in place, as it will "give" on its supporting spring when pushed down. Make sure that the shaft is on its spring before proceeding.

h. Screw down bearing cap No. 7 and check the end play, which should be between 0.015 in. minimum and 0.040 in. maximum. See that gasket No. 34 is properly located between bearing cap No. 7 and nozzle plate.

i. Replace the rotor, blow gently to be sure it rotates freely. Make sure that the nozzle plate is properly seated as it may have pulled up when the top cover was removed. Replace top cover.

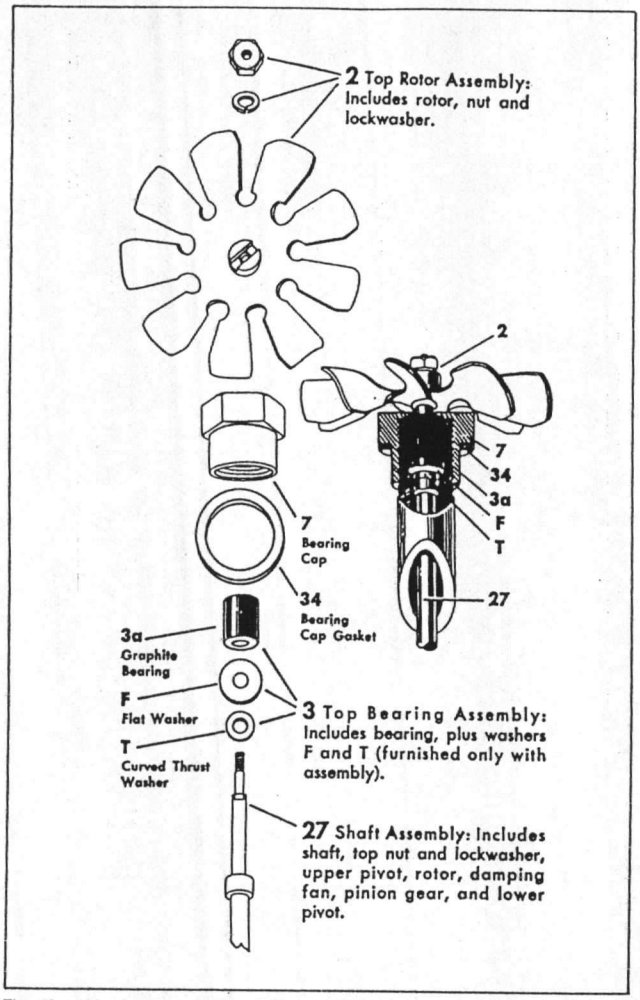


Fig. 12 — Upper rotor and bearing assembly

TO CHANGE THE ORIFICE

If the measuring range of the meter must be changed and a second orifice plate (attached to its carrier block) has been supplied, do not remove the meter from the line but turn off the flow, allow time for cooling, and follow these directions carefully.

a. Remove the top cover and top gasket (see Fig. 1). Remove rotor assembly and cap.

b. Lift out the nozzle plate, exposing the body chamber.

c. Remove the screw, releasing orifice and carrier assembly which usually may be withdrawn through the nozzle plate opening.

Note: Under some conditions the orifice is too large to be removed through the nozzle plate opening. In this case, the meter must be taken out of the line and the orifice plate removed through the inlet end of the meter body.

d. Do not detach either orifice plate from the carrier block to which it is secured.

To install the new orifice plate, simply reverse the procedure.

IMPORTANT

When using the second orifice, multiply dial readings by the factor supplied.

DIRECTIONS FOR READING THE COUNTER DIALS

UNIVERSAL COUNTER — DIAL AND POINTER TYPE

The universal counter has five small dials and an unnumbered large dial aroung the edge of the dial plate. A reading of the dials will give a number containing five digits. Such a reading taken at the end of a period minus a similar reading taken at the beginning of the period, times the multiplier, if any, will giver the correct number of pounds of steam (or cubic feet of gas) which has passed through the meter during the period.

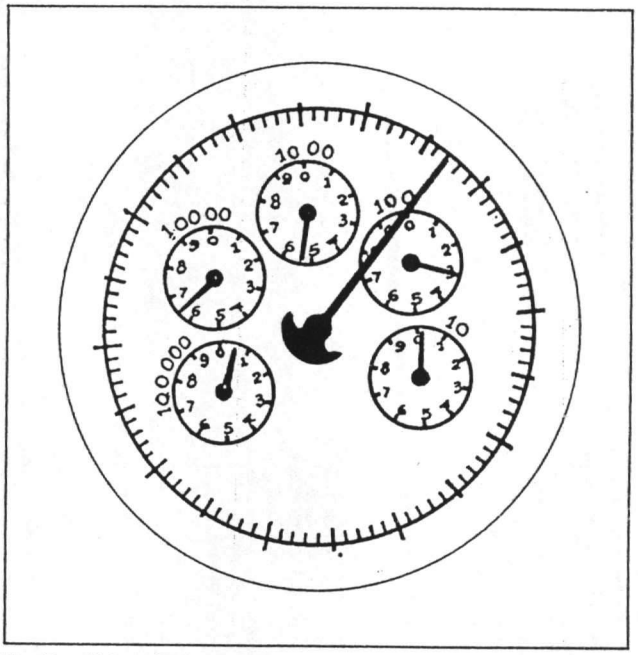


Fig. 13 — Universal counter dial

All dial hands turn clockwise. The reading of Fig. 13 is 06530. The fourth hand reads 3 (not 2) because the fifth hand has passed 0.

At 100,000 all the dial hands return to zero. If this occurs during the period between successive readings, the net reading is correctly obtained by adding 100,000 to the second reading and then subtracting the first reading as usual.

DIRECT READING COUNTER — DIAL AND POINTER TYPE

This direct reading counter has five small dials and a large dial of 100 graduations around the edge of the dial plate. A reading of the dials will give a number containing seven digits. Such a reading taken at the end of a period minus a similar reading taken at the beginning of the period, (times the dial multiplier, 0.1 or 10.0, if any), will give the number of pounds of steam (or cubic feet of gas) which has passed through the meter during the period.

All dial hands turn clockwise. The reading of Fig. 14 is 2953976. The first hand reads 2 (not 3) because the second hand has not passed 0. The fourth hand reads 3 (not 4) because the fifth hand has not passed 0.

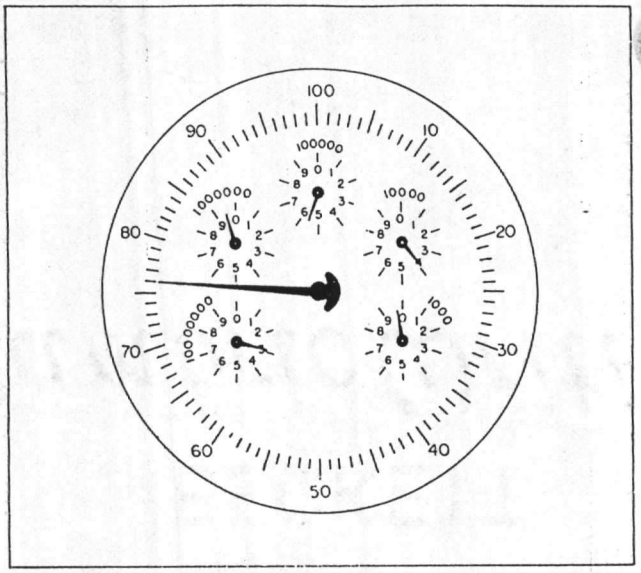


Fig. 14 — Direct reading counter dial

At 10,000,000 all the dial hands return to zero. If this occurs during the period between successive readings, the net reading is correctly obtained by adding 10,000,000 to the second reading and then subtacting the first reading as usual.

DIRECT READING COUNTER — CYCLOMETER TYPE

The Cyclometer Type Counter (Fig. 15) has six wheels and is read through a rectangular opening in the dial. The reading taken at the end of a period minus the reading taken at the beginning of the period, (times the dial multiplier 0.1 or 10.0, if any), will give directly the pounds of steam or cubic feet of air or gas which has passed through the meter during the period.

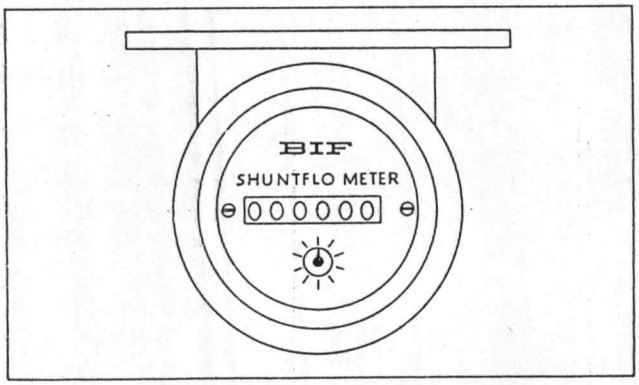


Fig. 15 — Direct reading counter cyclometer type

CORRECTING READINGS FOR VARIATIONS IN PRESSURE OR TEMPERATURE

STEAM

If variations in steam pressure or quality occur, use the BIF Correction Calculator For Steam to determine the factor necessary to apply to the dial readings. Instructions for use are on the Calculator.

AIR OR GAS

If variations in pressure or temperature occur, use the BIF Correction Calculator for Air/Gas.

ELECTRONIC OUTPUT — ZERO AND SPAN ADJUSTMENTS

Note: The Shuntflo transmitter has been factory adjusted. Normally, no further adjustments are required. If adjustments are needed they may be performed by BIF by returning the transmitter to the BIF W. Warwick plant, by contacting your local BIF authorized service person or by another qualified service person experienced in electronic instrumentation.

CAUTION: In some situations the instrument loop voltage may be hazardous. Disconnect power at the primary source and assure safe conditions exist before proceeding. These procedures call for opening the current loop which causes the voltage at the transmitter to rise to full loop voltage which might be dangerous.

Check the position of the jumper in the top center of the transmitter circuit card (see Fig. 9). If it is between A and B the transmitter is set for digital output and will switch between about 4 mA and about 20 mA. No zero or span adjustments should be made. If the jumper is between B and C the transmitter is set for analog operation and this procedure may be performed.

To adjust the zero setting on the electronic transmitter disconnect the black and white wires from terminals 1 and 2.

CAUTION: Be sure this operation is performed on the transmitter not on the Shuntflo Pulse Receiver as the black and white wires on terminals 1 and 2 at the pulse receiver carry 117 VAC.

Put an accurate recently calibrated digital milliammeter in the loop circuit by reconnecting the positive twisted pair wire from terminal 4 to the positive lead of the milliammeter and connecting the negative lead of the milliammeter to terminal 4.

Turn the power on at the primary source. Adjust the zero potentiometer on the transmitter (see Fig. 9) for a reading of 4.00 milliamps. Turn the power off at the primary source. Reconnect the positive twisted pair wire to terminal 4, the black wire to terminal 1 and the white wire to terminal 2. Turn the power on.

To adjust the span an accurate frequency meter and oscillator are required. It is necessary to calculate the exact frequency that corresponds to 20 mA by using this formula:

$$\text{Exact Frequency (Hz)} = \frac{A}{BC} \times 100$$

Where:

"A" is the transmitter nameplate value for 20 mA.

"B" is the Shuntflo Meter nameplate value for 100 pulse.

"C" is the "A" unit time conversion, 3600 for units in hours, 60 for units in minutes, 1 for units in seconds.

This frequency should be about 30 Hz for transmitters with the standard 20 mA value of 150% of the rated capacity on the Shuntflo Meter nameplate. Specially calibrated units may have frequencies from about 15 Hz to about 40 Hz.

For example, A & B are read off the Shuntflo Meter and Transmitter nameplates.

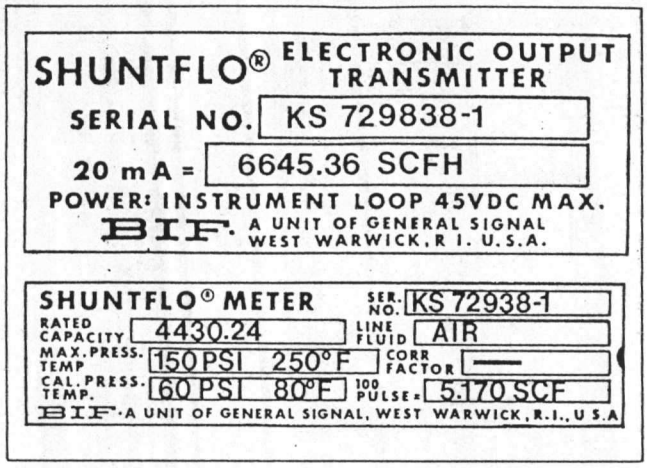


Fig. 16 — Nameplate information

Therefore:
A = 6645.36 SCFH
B = 5.170 SCF
C = 3600

"C" is 3600 since the "A" value is in hours. Had "A" been 110.76 SCFM "C" would be 60. Had "A" been 1.8459 SCFS "C" would be 1.

$$\text{Exact Frequency} = \frac{A}{BXC} \times 100 =$$

$$\frac{6645.36}{5.170 \times 3600} \times 100 = 35.70 \text{ Hz}$$

Be sure the calculated frequency is about 30 Hz for Shuntflos with standard calibration, or between about 15 Hz and about 40 Hz for Shuntflos with nonstandard calibration.

Turn the power off at the primary source. Connect a milliammeter to the loop circuit as in the zero adjustment procedure. Connect the frequency meter and oscillator to terminal 1 and 2 of the transmitter as shown in Fig. 18. Set the oscillator

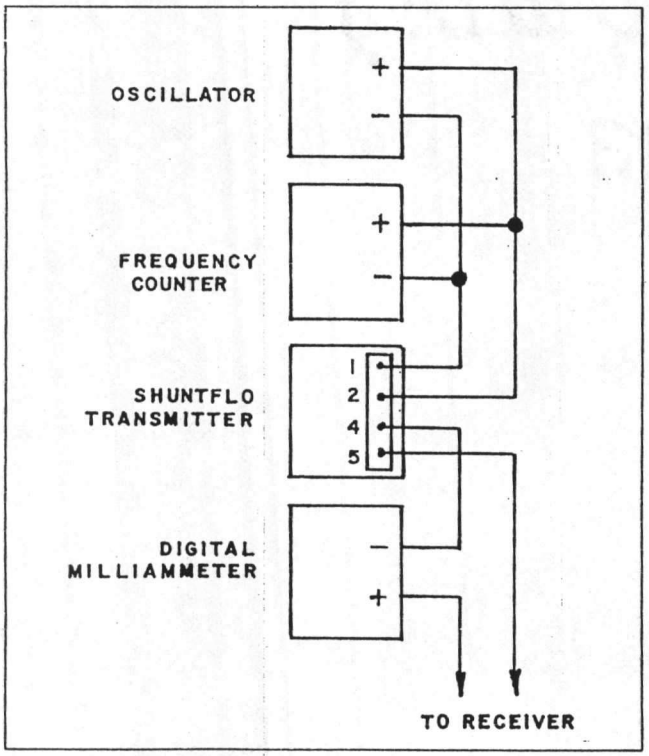


Fig. 17 — Adjusting 4-20 mA span

frequency to the calculated exact frequency and the oscillator level to about 100 mV peak to peak. Any wave form will work except very narrow pulses. Turn the power on at the primary source. Be sure the oscillator output and frequency meter input are isolated and not connected to ground or the transmitter may trigger on 60 Hz noise. If the transmitter does trigger on 60 Hz noise the output will be above 20 mA (about 30 to 50 mA). If this happens, remove the frequency meter, and/or isolate the oscillator, and/or reverse the wires at terminals 1 and 2 and/or increase the oscillator level to 2 volts peak to peak. Adjust the span potentiometer for a reading of 20 mA. Turn the power off at the primary source, reconnect the positive twisted pair wire to terminal 4 and turn the power on at the primary source.

If it is desired to change the 20 mA value to other than that for which the transmitter was factory calibrated, a new exact frequency must be calculated. The new 20 mA value must be between about 75% and about 200% of the rated capacity listed on the Shuntflo Meter nameplate.

Bear in mind that the actual flow capacity of the Shuntflo Meter is not changed by the transmitter adjustments. Change of capacity of the Shuntflo Meter requires a new orifice assembly. To calculate the new exact frequency, change the "A" value in the exact frequency formula to the new desired 20 mA value. If engineering units are changed be sure the "C" value is correct for the new "A" value. Proceed with the span adjustment procedure.

CHECKING FOR TROUBLE

Make sure that the meter is installed in the right direction. The arrow on the side of the meter should point in the direction the steam is flowing, i.e., downstream.

The flow in the line may be too small to register or may have ceased althogether.

Take a reading of the dial to make sure that the flow rate is within the measuring range of the meter. The maximum capacity of the meter is shown on the nameplate. The simplest way to do this is to take a reading on the meter for five minutes and then multiply by 12 to get the rate in pounds per hour. If possible, turn on all steam equipment to simulate maximum conditions and take a reading at this rate to check the maximum rate at which the meter will be required to measure. It is also well to check the lowest rate which will be encountered by simulating minimum conditions.

For a by-pass meter, make sure dimensions upstream and downstream from orifice plate are in accordance with BIF recommendations.

When accuracy is in question, make sure actual working pressure is that for which meter was calibrated. If not, make sure the proper correction factor is applied to meter readings.

If meter does not totalize, or if performance seems erratic, it would be well to examine the working mechanism of the meter.

Remove the counter from the damping chamber, leaving the steam, air, or gas flow turned on. If the line fluid is steam the counter may be hot, up to 300° F. Exercise care, such as wearing heavy gloves, to prevent skin burns. The mechanism of the counter should move freely and come to a gradual stop when the magnet is spun by hand. If any binding or roughness is noticed, the mechanism should be removed from the box and the fault corrected.

Test the strength of the following magnet by holding the mechanism upside down and suspending two counter box nuts or one counter box screw from one of the pole faces of the magnet. If the magnet is strong enough, they will not fall off even with slight jarring.

Make sure that the magnet is set so that the pole faces rotate in a plane parallel to and slightly below the top surface of the counter box.

After the counter is checked, replace it on the meter. If there is still faulty totalizing (or none at all) when steam is being used, the trouble is probably in the main part of the meter.

First, shut off the flow of steam, air, or gas at a valve upstream and depressurize the meter. Remove the top cover and examine the rotor to see that the shaft is not broken, or bent, and that it rotates freely by blowing on the rotor blades.

Turn the rotor by hand and observe the counter. The rotor must be rotated a number of turns before the movement shows on the counter, as there is a large speed reduction between the rotor and the counter.

However, if the counter does not move, take the counter off again and test the strength of the driving magnet in the damping chamber by placing a steel paper clip against the bottom of the chamber. If the magnet is okay, the paper clip will stick to the chamber at two places. If the magnet is satisfactory, the only remaining place where mechanical trouble might be is in the gear train in the damping chamber of the meter, in which case the meter should be sent back to the factory for repairs.

If there is any reason to believe that the nozzles or orifice plate might be fouled by foreign material from the line, it would be well, while the top cover is off, to remove the rotor and top bearing cap so that the nozzle plate can be lifted out for inspection and access to the orifice plate.

If there appears to be nothing wrong in the meter mechanism and the counter appears to be free, yet the meter still does not operate with flow through the line, the rated capacity of the meter is probably too large for the actual flow. In this event, determine the probable maximum flow, and arrange to have a new orifice assembly installed.

CHECKING THE ELECTRONIC SHUNTFLO TRANSMITTER

The Shuntflo transmitter is used to convert low voltage pulses from the magnetic pickup into a usable digital or analog signal and transmit this signal along twisted pair wire to a receiver. The receiver may be a wide variety of equipment if the transmitter is in the analog mode, but must be a Shuntflo pulse receiver if the digital mode is selected. In both modes the transmitter is loop powered deriving the electrical power for its circuitry from the signal.

Assure that the voltage at the transmitter is at least 10 VDC across terminals 4 and 5 with terminal 4 positive. If it is less, check the wiring and receiver. The receiver must supply the loop power for the transmitter or a separate power supply is required. See Fig. 9 for voltage requirements. If both test good, remove the wire from terminal 4 and place a voltmeter across the two twisted pair wires. **Caution:** full loop voltage will appear at the twisted pair wires which might be dangerous. If the voltage is restored, replace the transmitter circuit card. If the voltage is not restored, recheck the loop wiring and the receiver. To test the magnetic pickup, remove the black and white wires from terminals 1 and 2 of the transmitter. (Be sure this is not done to the Shuntflo pulse receiver by mistake, as these wires on the pulse receiver carry 117 VAC power.) An ohmmeter across the black and white wires should read about 70 ohms. If it is not about 70 ohms, check for an open or shorted cable, connector, or magnetic pickup. Be sure the shuntflo meter is depressurized and cool before removing any part of it. Assure that the pickup is not loose. If it is, remove the cast iron conduit box, back off the jam nut, lightly finger tighten the pickup and lightly tighten the jam nut (10 in. lbs.). The connector is silver soldered to the signal cable. Do not resolder with lead tin solder. If the cable or connector is wire frayed or damaged, replace it. Since this cable is rated for high temperature , only use a genuine BIF cable.

If the transmitter circuit card is suspect, it should be returned to BIF W. Warwick for evaluation. If it is necessary to repair the card in the field this must be done by a service person thoroughly experienced in circuit card repair. Certain components on the card have specified thermal coefficients. Care must be exercised if repairs are made or unstable, or non-linear operation will result.

TRANSMITTER CIRCUIT THEORY OF OPERATION

Fig. 19 is a schematic diagram of the circuit. Low voltage pulses from the magnetic pickup are applied to pins 12 and 13 of U1 with R1, 2, 3, 4 and C1, 2 forming differential input, gain and filtering functions. The pulse signal goes to pin 9 of U1 through DC blocking capacitor C3. Positive feedback from divider R6 and R7 goes to pin 10 to provide hysteresis to shape the pulse and reduce noise.

R10, C6, CR2, 3, C7 and R17 form the frequency to voltage converter for analog operation. R26 and R27 provide voltage pulses for digital operation. Jumer A, B, C, selects the mode. The selected voltage is balanced with feedback from R25 as controlled by U1 and current driver Q2. R11, 12, 18 controls the zero setting. CR1, R14, 15, 13, 20, 22, C8 and Q1 form the voltage regulated power supply. C4 is the ripple filter, R8, 9 and C5 generate the circuit ground reference. CR4 provides reverse voltage protection.

If components are replaced be sure the temperature coefficient is maintained; R11, 17, 18, 19, 25 ± 50 PPM/C°; R10, 12 ± 100 PPM/C°, C6 ± 50 PPM/C°. Do not replace 1N914 diodes with another type. In an emergency U1 LM124 may be temporarily replaced with the popular LM324 or LM224.

CHECKING THE SHUNTFLO PULSE RECEIVER

The Shuntflo pulse receiver is used when the Shuntflo transmitter is in the digital mode. In this mode the transmitter output switches between approximately 4 and 20 mA. The pulse receiver converts this current pulse into an optically isolated open collector transistor switch pulse and provides loop power for the transmitter.

To check the pulse receiver for proper operation disconnect the wires from terminals 6 and 7 and place an ohmmeter across the terminals. With flow and 117 VAC power on, the ohmmeter should erratically register high and low readings. **Caution,** do not touch the 117 VAC wiring or the fuse. If there is a constant registration, check the fuse, and assure that there is 117 VAC power. Next, place a voltmeter across terminals 4 and 5. There should be about 24 VDC with terminal 4 positive. If there is no or low voltage turn off the 117 VAC power at the primary source, disconnect the wire from terminal 4, restore 117 VAC power and recheck the voltage across terminals 4 and 5. If the voltage is then correct, check the twisted pair wire for a short. If the voltage is not correct replace the circuit card.

If it is elected to repair the circuit card in the field this should be done only by a qualified service person experienced in electronic instrument repair.

Fig. 20 is a schematic diagram of the circuit card. The current pulse from the shuntflo transmitter generates a voltage pulse across R3. This is amplified by U1 with positive feed back (hysteresis) from R5, 6. This signal is fed to Q1 through optoisolator U2. CR1 aids turn off of U2. T1, U1, C1, forms the power supply. R1, 2 and C2 provide circuit ground reference. C4 prevents U1 from oscillating. There are no critical components in this circuit.

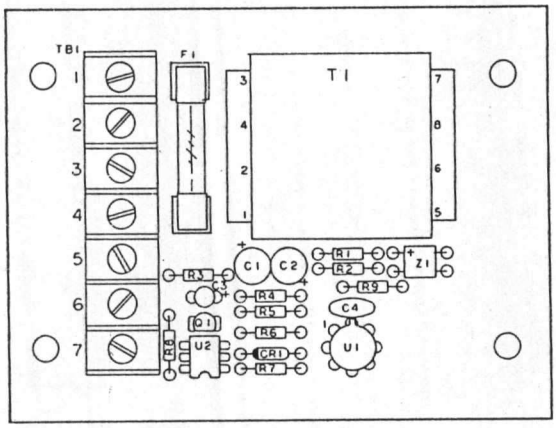


Fig. 18 — PC assembly — Shuntflo pulse receiver

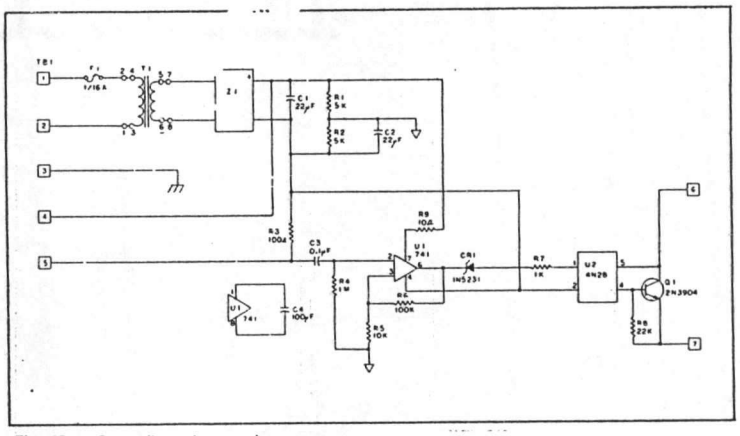


Fig. 19 — Shuntflo pulse receiver

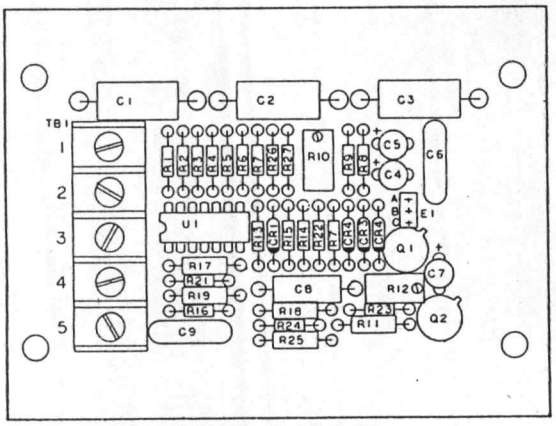


Fig. 20 — PC assembly — Shuntflo transmitter

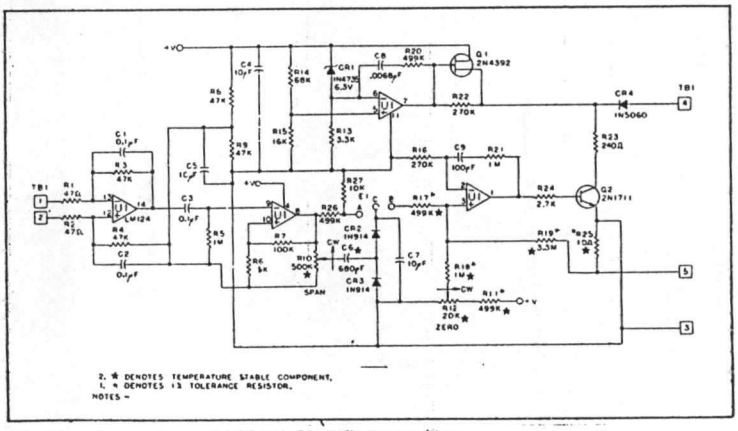


Fig. 21 — Loop powered 4-20 mA Shuntflo transmitter

When inspecting a Shuntflo Meter installation:

1. Be sure that the Meter is installed in the right direction. The arrow on the side of the Meter should point in the direction of flow, i. e., downstream.

2. Check the meter to be sure that the flow rate is within the measuring range of the Meter. The maximum capacity of the Meter is shown on the nameplate. The simplest way to do this is to take readings of the dial at a five minute interval and then multiply by 12 to get the rate per hour. If possible, have the customer simulate maximum conditions and take a reading at this rate to check the maximum capacity which the Meter will be required to measure. Also if practical, check the lowest rate which will be encountered by simulating minimum conditions.

3. See that customer understands proper method of reading Meter. Full instructions are given in instruction book furnished with Meter.

4. For a by-pass Meter, be sure dimensions upstream and downstream from Orifice Plate are in accordance with our standards.

5. When accuracy of registration is questioned be sure actual working pressure is that for which Meter was calibrated. If not, the proper Correction Factor must be applied to Meter readings.

If Meter does not totalize or is erratic when flow is on, examine the working mechanism of the Meter.

CHECKING THE COUNTER

Remove the Counter Box from the Damping Chamber, leaving the flow on. The mechanism in the Counter Box should rotate freely and come to a gradual stop when the magnet is spun by hand. If any binding or roughness is noticed, the mechanism should be removed from its housing and the fault corrected.

Test the strength of the following magnet by holding the mechanism upside down and suspending two Counter Box Nuts or one Counter Box Screw from one of the pole faces of the magnet. If the magnet is up to proper strength, they will not fall off, even with slight jarring.

Be sure the magnet is set so that, as it rotates, the pole faces travel in a plane parallel to and slightly below the top surface of the Counter Box.

Replace the Counter Box. If there is still faulty totalizing, the trouble may be in the Meter Body.

CHECKING THE METER

First shut off flow at a valve upstream and be sure meter is not under pressure. Allow the meter to cool before handling. Remove the top cover and examine the rotor to see that the shaft is not broken or bent, and that it rotates freely by blowing on the rotor blades.

Turn the rotor by hand and observe the counter. The rotor must be rotated several turns before movement shows on the counter.

If the counter does not move, remove it again and test for strength of the driving magnet in the damping chamber by placing a steel paper clip against the bottom of the damping chamber. If the magnet is O.K., the paper clip will stick to the chamber at two places. If the magnet is satisfactory, there may be a problem in the gear train in the damping chamber in which case the Meter should be replaced or if under warranty, returned to the factory.

If there is any reason to believe that the nozzles or orifice plate might be fouled by foreign material remove the rotor and top bearing cap so that the nozzle plate can be lifted out for inspection and access to the orifice plate.

If there appears to be nothing wrong in the Meter mechanism and the counter appears to be free, yet the Meter still does not operate with flow through the line, the Rated Capacity of the Meter is probably too large for the actual flow. In this event, ascertain the probable maximum flow and arrange to have the Meter returned to the factory for change of capacity.

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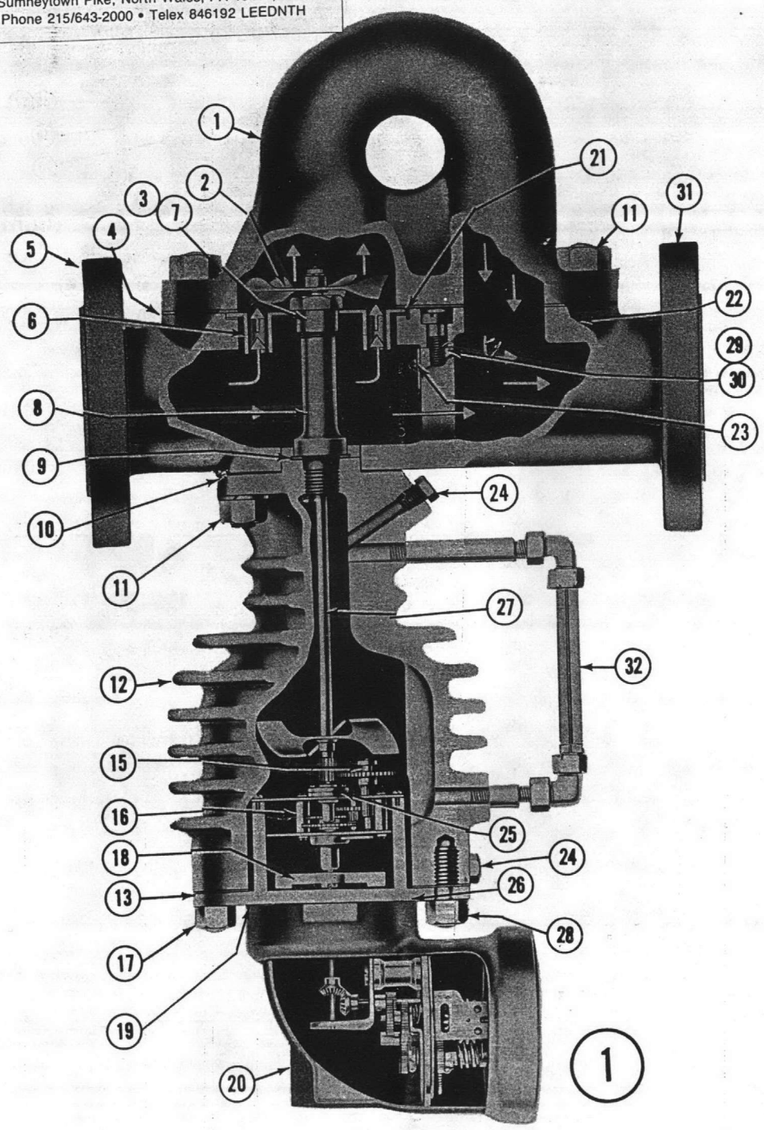
PARTS LIST

Serial Nos. KS-901 And Up

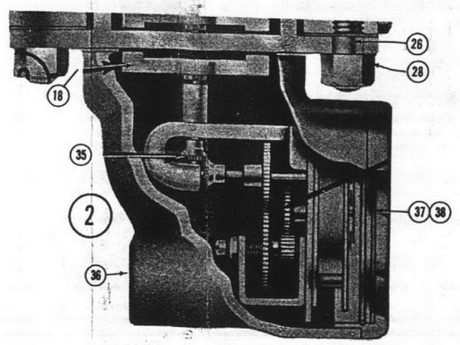


WHEN ORDERING PARTS, state Quantity, Part Name, Part No., and Serial Number of Unit.

Ref. No.	Part Name	Part No.
1a.	Iron Top Cover	GKP-2
1b.	Steel Top Cover	GKP-2A
•2a.	Top Rotor	GKA265
2b.	5/40 Self Locking Nut	417-0027-013
2c.	#5 Lockwasher	417-0036-683
• 3a.	Top Bearing Assy. Includes 3b,3c,3d, And #4	GKA269
3b.	Graphite Bearing	GK266
3c.	Flat Washer	GK267
3d.	Curved Washer	GK268-1
3e.*	Top Bearing Cap Gasket	GK230
•□□ 3f.	Top Bearing Assy. (Style 51 Only)	VA1000-B
4.*	Top Cover Gasket	GK59
5a.	2" Iron Body	GKP-1-D
5b.	3" Iron Body	GKP-111-D
5c.	4" Iron Body	GKP-112-D
5d.	1" Steel Body (Not Available In Iron)	GKP-256-1S
5e.	2" Steel Body	GKP-1-C
5f.	3" Steel Body	GKP-111-C
5g.	4" Steel Body	GKP-112-C
6a.	3/8" HP Steam Nozzle Assy. (2 Holes)	VA0074C
6b.	3/4" LP Steam Nozzle Assy. (2 Holes)	VA0073C
6c.	3/8" HP Gas/Air Nozzles Assy. (4 Holes)	VA1774D
6d.	3/4" LP Gas/Air Nozzles Assy. (4 Holes)	VA1775D
6e.	Slanting Nozzle Assy. (1" Bodies Only)	VA2782B
7.	Bearing Cap	GK44
8a.	Top Bearing Holder (1"&2")	GK43A
8b.	Top Bearing Holder (3")	GK117A
8c.	Top Bearing Holder (4")	GK118A
9.	Spacer (Select One)	GK103(A To H)
10.*	Cooling Chamber Gasket	GK60
11a.	1/2"-13x2" Screw	243985
11b.	Stud (Old Style)	131356
12.	Cooling Chamber	VN-1079-1
13a.*	Damping Chamber Gasket	GK272
•13b.	Damping Chamber Gasket (Style 51 Only)	GK98
15a.	#2 Gear And Pinion	VA6185B
15b.	Bearing Strip And Screws	VA4279C
•16a.	Gear Reduction Unit (Includes 15a,15b,18 & 24)	GKA270
16b.	4/40 x 1/4" Screw	417-0063-640
16c.	#4 Lockwasher	417-0036-322

*Note: See #76A Or 76B

Ref. No.	Part Name	Part No.
•17a.	Counter Box Cap Screw	135197
17b.	Nut	GK158
18.	Magnet Assembly	627667
19a.*	Counter Box Gasket	V6541B
20.	New Style Counter Box	-
21.	Dowel Pin	194126-4
22.	1/4" Pipe Plugs	416-3310-002
23.	4/40xl/4" Pan Head Screw	417-0063-640
24.	Drain Plugs	416-1540-001
•25a.	Jewel Bearing Assy.	GKA287
25b.	Jewel Bearing Only (Included in 25A)	GK-254
25c.	Jewel Spring (Included in 25A)	GK-36
26.	Damping Chamber Bottom	163716
•27a.	Fan Shaft Assy. (Includes #2) 1" And 2"	245226-1
•27b.	Fan Shaft Assy. (Includes #2) 3"	245226-2
•27c.	Fan Shaft Assy. (Includes #2) 4"	245226-3
28.	7/16"-14x3/4" Hex Cap Screw	816212-17
•29.*	Nozzle Plate Gasket	GK229
30.	Orifice Assembly (2",3" & 4") Includes Carrier, Plate & Screw	Serial No.
31a.	Nameplate With Serial No.	DN41
31b.	2/56 x 3/16" Screw	417-0074-601
32.	Gauge Glass Assembly	166282
35.	Bevel Gears	GK121
36.	Old Style Counter Box (Note: New Style #41 Will Be Furnished)	-
37.	Old Style Bezel Glass	V6483B
38.*	Old Style Gasket	V6484B



□□ Original Style 51 Parts, Serial Nos. KS-901 to KS-6500 All parts are interchangeable except for Ref. Nos. 3A thru 3 E - use 3F

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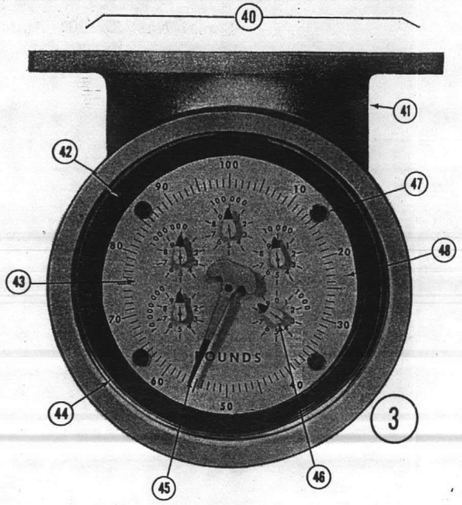
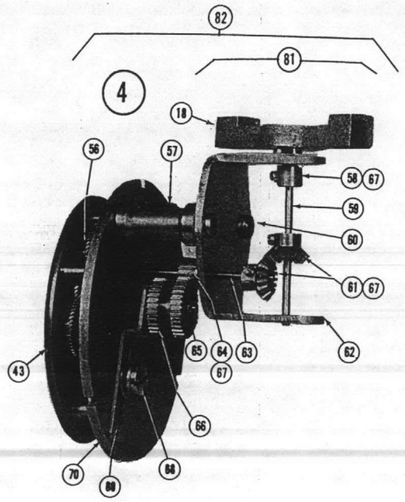
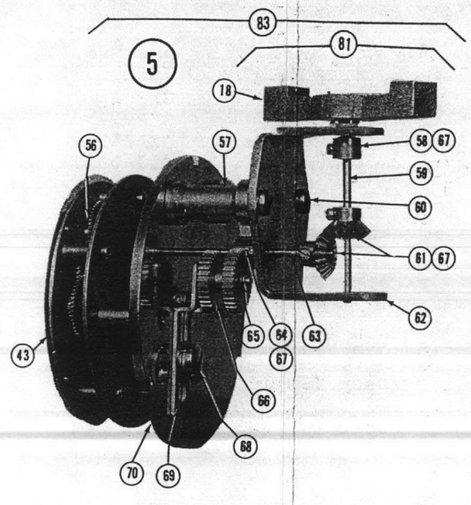
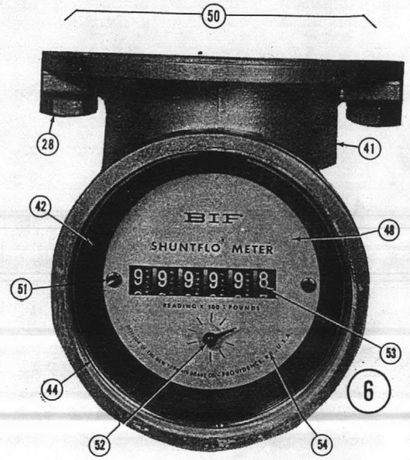
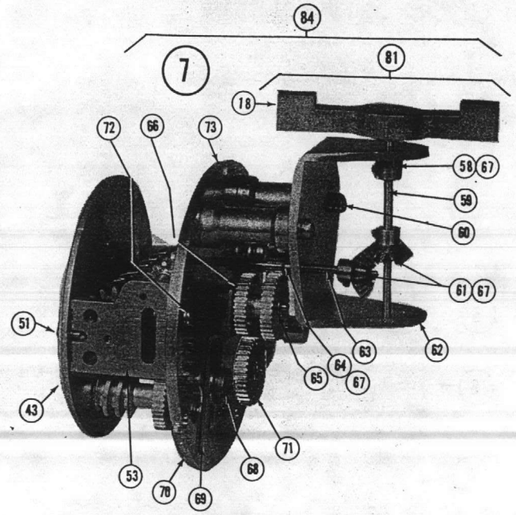








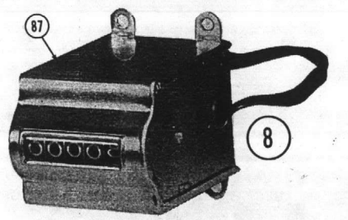


•Recommended Spare Parts

Ref. No.	Part Name	Part No.
40.	Complete Counter-Multihand Style 65	Serial No.
41a.	Counter Box Assembly-New Style(Includes #41b,42,44,48a, And 48b)	166733
41b.	Counter Box Only-New Style	163081
42.	Dust Washer	163091
43a.	Dial-Multihand-Style 65-DD Counter(No Legend-GK290)	163110
43b.	Dial-Legend=Pounds-GK291	163110-1
43c.	Dial-Legend=x10=Pounds-GK292	163110-2
43d.	Dial-Legend=x.10=Pounds-GK293	163110-3
43e.	Dial-Legend=Cubic Feet-GK294	163110-4
43f.	Dial-Legend=x10=Cubic Feet-GK295	163110-5
44.	Locking Ring	163093
45.	Large Hand	153719-1
46.	Small Hand	151662-1
47a.	4/40x1/8" Pan Head Screw	417-0063-638
47b.	Dial Washer	GK308
48a.	Bezel Glass	163092
48b.	Locking Ring	163093
50.	Complete-Counter-Cyclometer Style	Serial No.
51.	3/48 x 1/4" Pan Head	417-0063-621
52.	Register Hand	182160
53.	Cyclometer Register	196092-1
54a.	Dial-Cyclometer Type-x100= Pounds	DN353
54b.	Dial-Cylcometer-Type Pounds	DN353-1
54c.	Dial-Cyclometer-Type-x10= Pounds	DN353-2
54d.	Dial-Cyclometer-Type-x1000= Pounds	DN353-3
54e.	Dial-Cyclometer-Type Cubic Feet	DN353-4
54f.	Dial-Cyclometer Type-x10= Cubic Feet	DN353-5
54g.	Dial-Cyclometer-Type-x100= Cubic Feet	DN353-6
54h.	Dial-Cyclometer-Type-x1000= Cubic Feet	DN353-7
56a.	Counter Mechanism Assembly (Used With Contactor)	- VA6188B
56b.	Counter Mechanism Assembly (Dial And Pointer Type)	- 165681
57.	Stanchion	131326
58.	Collar	DC-129-2
59.	Vertical Bevel Spindle	162958
60.	6/32x1-1/8" Pan Head Screw	417-0063-687
61a.	Bevel Gear	GK121
62.	Bevel Gear Bracket	162957
63.	Horizontal Bevel Spindle	162959
64.	"A" Gear - 16T	GK122
65a.	"B" Gear	Serial No.
65b.	"B"-"C" Gear Hub	V0310D
65c.	Truarc Ring 5133-9	417-0105-002
66a.	"C" Gear	Serial No.
66b.	Hub	GK126
66c.	5/40x1/8" Set Screw	417-0057-023
67.	2/56x1/4" Pan Head Screw	417-0036-602
68a.	10/32x1/4" Pan Head Screw	417-0063-716
68b.	#10 Plain Washer	417-0037-028
68c.	#10 Lockwasher	417-0036-058
69.	Intermediate Brkt. Assy.	129105
70.	Mounting Plate	165479
71a.	"D" Gear	Serial No.
71b.	"D" Gear Hub	GK126
71c.	5/40x1/8" Set Screw	417-0057-023
72.	3/48x3/8" Pan Head Screw	417-0063-622
73a.	4/40x7/16" Fil.Head Screw	417-0061-643
73b.	#4 Lockwasher	417-0036-018
•75.	Filling Funnel	212075
•76a.	Full Set Of Gaskets GARLOCK GK59,GK60,GK229,GK230A, GK272,V6484B,V6541B)	-
•76b.	Full Set of Gaskets Teflon For Steel Meters - GK59A, GK60A,GK229A,GK230B,GK272A, V6484B,V6541A.	
•77a.	2" Flange Gasket (Not Included in 76)	DG-1-2
•77b.	3" Flange Gasket (Not Included in 76)	DG-1-4
•77c.	4" Flange Gasket (Not Included in 76)	DG-1-6
81.	Rear Counter Mechanism (Includes #18,51,57,Thru 64, 68,69 And 70)	162960
82a.	Counter-Multihand Mechanism Assy.(Less Dial & Gears) To Fit Old Style Counterbox #36 Consists Of 56A & 81	163099
82b.	Conversion Kit To adapt #82A To Fit New Style Counterbox #41	166734
83.	Multihand Counter Mechanism Assy.-Style 65 To Fit New Style Counterbox #41(Less Dial & Gears) Includes #81	165682
84.	Cyclometer Counter Assy. (Less Dial & Gears)	165683

ACCESSORIES

86.	Tamper Proof Parts(Not Shown)	163135
87a.	Remote Electric Totalizer-Wall Mtd.	151032
87b.	Remote Electric Totalizer Panel Mounted.	151033



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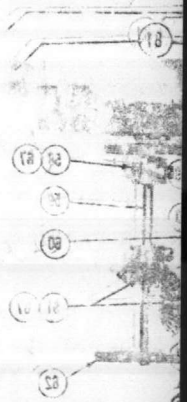

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