N62470-89-C-2648
HEATING & AIR CONDITIONING
FOR BLDGS. TT-2455 & TT-2457
REPLACE BOILER TT-2457
HOOD PROTECTION BLDG. BB-7

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

Russell Pierce
455-1830

Wayne Pierce
455-1830

LOCAL SUPPLIERS LIST

AIR HANDLING UNITS &
AIR CONDITIONING UNITS

Hoffman & Hoffman
P.O. Box 32258
Raleigh, NC 27622-2258

AIR COOLED CONDENSING UNITS

Morgan-Kirkman Associates, Inc.
P.O. Box 33442
Raleigh, NC 27636

BOILERS

Combustion System Sales
P.O. Box 2918
Greensboro,NC 27408

PUMPS

Heat Transfer Sales
1305 Millbrook Rd.
Bldg. C,Suite 24
Raleigh, NC 27609

TEMPERATURE CONTROL SYSTEMS

Triangle Automated Controls
2716 Discovery Dr.
Raleigh, NC 27604-1850

ALARM VALVES

Kannapolis Sprinkler Company
P.O. Box 598
Kannapolis, NC 28082-0598

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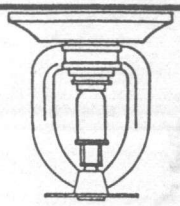
KANNAPOLIS SPRINKLER CO., INC.



P.O. BOX 598
KANNAPOLIS, N.C. 28082-0598

(704) 857-1105
FAX (704) 857-1107

BLDG. TT-2455 & TT-2457
CAMP LEJEUNE,N.C.
N62470-89-C-2648

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OPERATION & MAINTENANCE MANUAL
FIRE EXTINGUISHING SPRINKLER SYSTEM
SECTION 15330
(WET PIPE)

Alarm Check Valve - Model H

(for Wet Pipe Sprinkler Systems)

MODEL H-1 **FLANGE/FLANGE**
MODEL H-3 **FLANGE/GROOVE**

WITH RETARDING CHAMBER - MODEL H
AND WATER MOTOR ALARM - MODEL WM

Instructions for Care and Maintenance

GLOBE
FIRE EQUIPMENT CO.

4077 Air Park Drive • P.O. Box 796 • Standish, MI 48658

Phone 517/846-4583

Outside Michigan Toll Free 1-800-248-0278

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AVH-Rev.7/87

GLOBE
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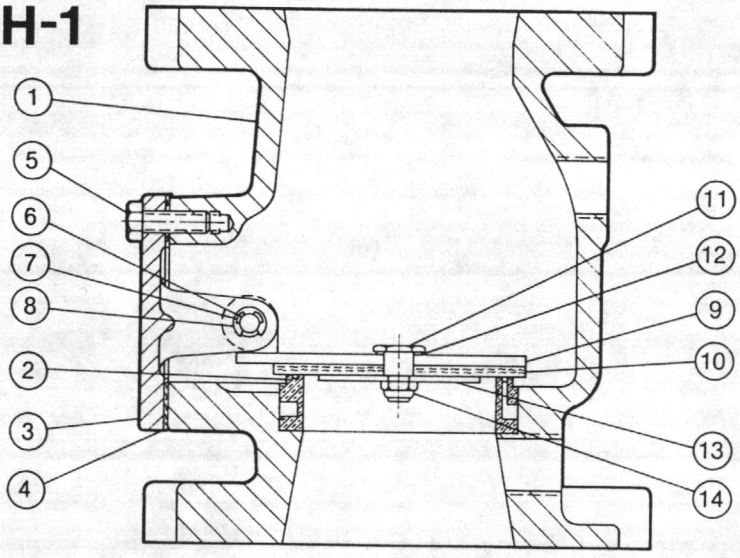
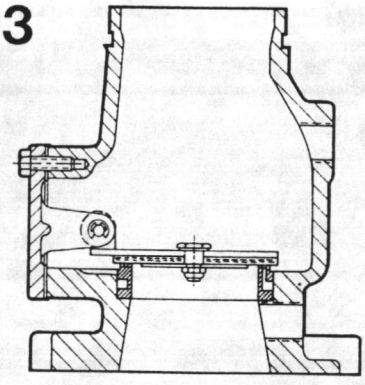
MODEL H ALARM VALVES

MODEL H-1 **FLANGE/FLANGE**
MODEL H-3 **FLANGE/GROOVE**

H-1



H-3



Parts List For Model H Alarm Valve Assemblies

Item	Part Name	Material	4" Valve Part No.	6" Valve Part No.	8" Valve Part No.
1	Body H-1	Cast Iron	323502	323562	323732
	Body H-3	Cast Iron	323542	323592	———
2	Seat Ring**	Bronze	323504	323564	323734
3	Hand Hole Cover	Cast Iron	323507	323567	323737
	H-1 Name Plate*	Aluminum	323519	323519	323733
	H-3 Name Plate*	Aluminum	323543	323543	———
4	Cover Gasket	Treated Paper	323508	323568	323738
5	Cover Bolt	Steel	323509	323569	323739
6	Hinge Pin	Stainless Steel	323516	323516	323746
7	Hinge Pin Bushing*	Bronze	323518	323518	323748
8	Retaining Ring	Stainless Steel	323517	323517	———
9	Clapper	Stainless Steel	323510	323570	323743
10	Clapper Facing	Rubber	323511	323571	323731
11	Shoulder Bolt (Cap Screw***)	Stainless Steel	323513	323573	323745
12	Sealing Washer	Hard Fiber	323515	323515	———
13	Disc Retainer	Stainless Steel	323512	323572	323742
14	Lock Nut (Lock Washer***)	Stainless Steel	323514	323514	323749

*Installed on Hand Hole Cover - Not Field Replaceable
**Installed in Body - Not Field Replaceable
***Used in 8" Valve Only

6" MODEL H ALARM VALVE

MODEL H-1 **FLANGE/FLANGE**
MODEL H-3 **FLANGE/GROOVE**

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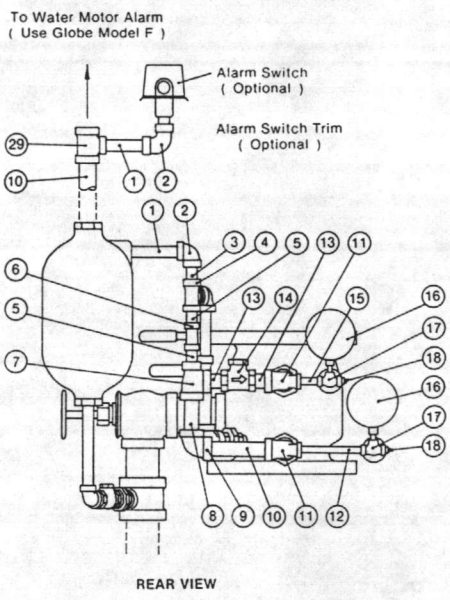
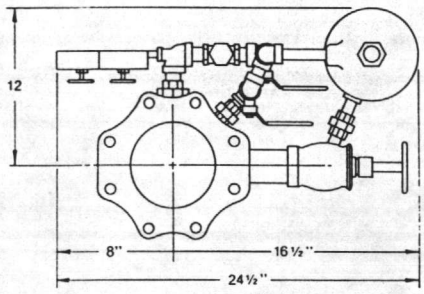
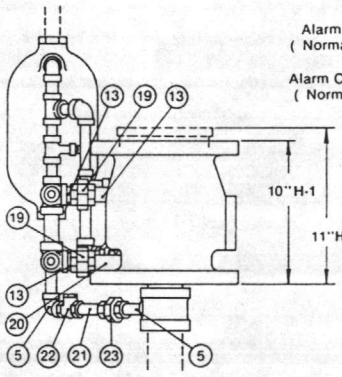


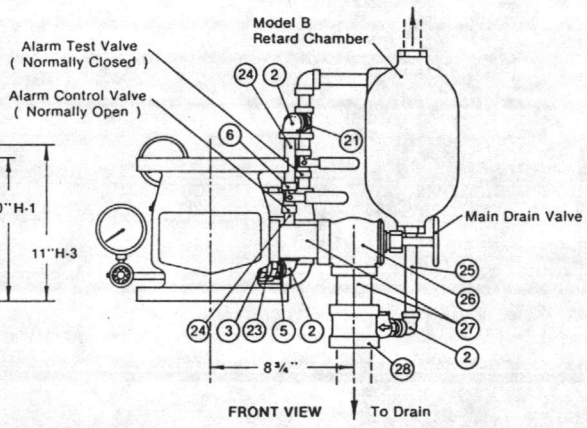
REAR VIEW



TOP VIEW



LEFT SIDE VIEW
(Shown With Gauges Removed)



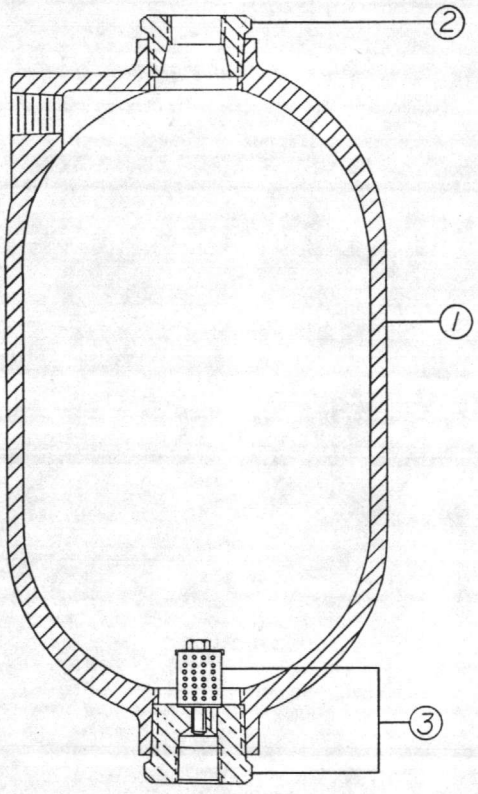
FRONT VIEW

Legend No.	Description	Qty.	Legend No.	Description	Qty.
1	½" x 4" Nipple	1	16	3½" Water Gauge-300 PSI	2
2	½" Elbow	4	17	¼" 3-Way Valve	2
3	½" x 1½" Nipple	2	18	¼" Plug	2
4	½" Tee	1	19	¾" Union	2
5	½" x Close Nipple	5	20	¾" x 2½" Nipple	1
6	½" Ball Valve	2	21	½" x 2" Nipple	2
7	¾" x ½" x ¾" Tee	1	22	½" Swing Check	1
8	¾" x 3½" Nipple	1	23	½" Union	2
9	¾" Elbow	1	24	½" x 3½" Nipple	2
10	¾" x 4½" Nipple	1	25	½" x 4½" Nipple	1
11	¾" x ¼" x ¾" Tee	2	26	2" Angle Valve	1
12	¼" x 5 Nipple	1	27	2" x 3" Nipple	2
13	¾" x Close Nipple	5	28	2" x 2" x ½" Tee	1
14	¾" Swing Check	1	29	¾" x ¾" x ½" Tee	—
15	¼" x 2" Nipple	1			

Vertical/Variable Pressure Trim Setup with Retard Chamber

GLOBE FIRE EQUIPMENT CO.

Model H Retard Chamber



PARTS LIST FOR:

- Model H Retard Chamber #323350

Item No.	Part Name	Material	Part No.
1	Retard Chamber Body	Cast Iron	323352
2	Outlet Plug	Cast Iron	323354
3	Drain Plug Assembly Drain Bushing Strainer Cup Screw	 Brass Brass Brass Brass	323358

Testing and Maintenance

Reference

NFPA 13A, Recommended Practice for the Inspection, Testing and Maintenance of Sprinkler Systems.

TESTING

Before proceeding with any tests involving water flow, certain precautions need to be taken.

1. Check the location where the test connection discharges to make sure that all is clear and that there is no possibility of the water flow causing damage or injury.
2. Check the end of the test connection to make sure that it is unobstructed. To obtain a satisfactory test, there must be an unrestricted flow of water when the test valve is wide open.
3. Check for alarm connections to a central station or fire department. If such connections are found, give proper notice to the signal receiving station before proceeding with the test.

   Note: A main drain test will also operate local fire alarms — unless they are temporarily shut off.

Testing Alarm Valve and Waterflow Alarm Devices

NFPA 13A recommends that the alarm valve and its waterflow alarm devices be tested at least quarterly.

The primary way to test this equipment is by opening the Inspectors Test Connection. This connection, generally located at the highest and most remote point on the system in relation to the alarm valve, consists of a test orifice and controlling globe valve. Opening of the globe valve (Inspectors Test Valve), and the subsequent discharge of water through the test orifice, simulates the operation of a sprinkler. Therefore, alarm devices should sound and/or operate when the Inspectors Test Valve is opened.

An alternate means of testing waterflow alarm devices is to open the Alarm Test Valve provided as part of the alarm valve trim. It must be noted, however, that opening of this valve only tests the alarms; it does not test the operation of the alarm valve since the supply for the alarm test line is taken from a point below the alarm valve clapper (see Description/Operation). This means of testing, therefore, should only be used when weather conditions or other circumstances prohibit using the Inspectors Test Connection.

Note: If alarms connect to a central station or fire department, notify the signal receiving station when all tests have been completed.

Flow Test at Main Drain Valve (Main Drain Test)

NFPA 13A recommends that a water flow test be made quarterly from the main drain valve at the system riser. The purpose of this test is to show whether or not the normal water supply is available to the system. By comparing static and residual pressure readings with those previously established, a main drain test can indicate the possible presence of closed valves or other obstructions in the supply piping.

The procedure for conducting a Main Drain Test is as follows:

1. With the Main Drain Valve closed, note and record the reading on the lower Pressure Gage at the Alarm Valve.
2. Open the Main Drain Valve slowly until it is wide open. Then, check to make sure that a full steady flow of water is discharging from from the main drain pipe.

   Note: If a full steady stream is not discharging, check the main drain piping further for possible obstructions.
3. Allow the water to flow until the reading on the lower Pressure Gage drops and stabilizes. Then, record this reading.

   Note: The first and higher pressure reading is the static pressure. The second, lower reading is the residual pressure with a given flow discharging from the main drain pipe.
4. Close the Main Drain Valve slowly.

   Caution: If alarms have been temporarily shut off, they must be returned to service. If alarms connect to a central station or fire department, notify the signal receiving station when the test has been completed.
5. Compare both pressure readings with previously established or normal readings.

   Note: If the readings compare favorably, the water supply may be considered satisfactory. If, however, the pressure readings vary to any great extent, the condition should be investigated to determine the cause. Some possible causes are:
   - Partially or totally closed system control valves.
   - Clogged or frozen water mains.
   - Serious leakage at valves or mains.

MODEL H ALARM VALVES

GLOBE FIRE EQUIPMENT CO.

MAINTENANCE

The GLOBE Model H Alarm Valve and its related equipment should be examined periodically to ensure proper operation and trouble-free service. Several areas to be routinely inspected are:

Clapper Facing. The rubber clapper facing should be checked for wear or damage, and to determine that it is free of dirt and other foreign substances. If found to be worn or damaged (e.g., foreign matter imbedded in the surface), the facing should be replaced. If it is dirty, it should be cleaned, but compounds which could damage the rubber facing must never be used.

Seat Ring. The seat ring should be checked for nicks and for stones, dirt or other foreign matter lodged in the grooves or holes. It should be cleaned thoroughly. If the seat ring is found to be severely damaged, the complete alarm valve assembly should be replaced or returned to GLOBE for possible reconditioning.

By-Pass Check Valve. The ¾" check valve in the external by-pass should be checked for clapper and seat condition.

Retard Chamber. The outlet plug and drain plug assemblies should be checked for obstructions. The screens should be cleaned thoroughly.

Alarm Line Strainer. The ¾" strainer in the alarm line of the constant pressure trim setup should be checked and cleaned thoroughly.

Alarm Test Valve, Main Drain Valve & Inspectors Test Valve. All controlling valves which are normally closed when the alarm valve is in the set position should be checked to be sure that they are fully closed and not leaking.

Alarm Valve & Trim. The overall setup should be checked for visible leaks and possible physical damage to the valve and connections (e.g., broken gages.)

Resetting of System

The GLOBE Model H Alarm Valve is self-setting when testing procedures are followed. When sprinklers operate, however, there are certain procedures which must be followed for restoring the system to service.

1. Close the System Control Valve (OS&Y, PIV or other).

   Caution: In the event of a fire, the system control valve is to be closed only after it has been determined, positively, that the fire has been extinguished.

2. Close the Alarm Control Valve.
3. Open the Main Drain Valve.

   Note: It is necessary to drain the system only as required to allow for sprinkler replacement.

4. Replace the sprinklers which have operated.
5. Close the Main Drain Valve.
6. Open the Inspectors Test Valve.

   Note: This valve is opened to permit air to be vented from the system as it is being filled with water.

7. Slowly open the System Control Valve.

   Caution: Open the valve only partially at the start of water flow into the system. Do not open it fully at this point. To do so may cause a water hammer to occur which could either damage the piping or trap large volumes of air within the system.

8. Continue filling the system until water discharges in a continuous stream from the Inspectors Test Connection.
9. Close the Inspectors Test Valve.
10. Turn the System Control Valve to its full open position, at the same time observing the Pressure Gages.

    Note: The system is filled when both gages are steady and have the same pressure reading.

11. Conduct a Main Drain Test to make sure the water supply is satisfactory (see Flow Test at Main Drain Valve).
12. Open the Alarm Control Valve.
13. Conduct a test of the alarm devices (see Testing Alarm Valve and Waterflow Alarm Devices).
14. Seal, lock, or otherwise secure the System Control Valve and Alarm Control Valve in an open position (per NFPA 13A). The system is now ready for service.
15. If alarms connect to a central station or fire department, notify the signal receiving station that the system has been returned to service.

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Outside Michigan Toll Free 1-800-248-0278 FAX (517) 846-9231

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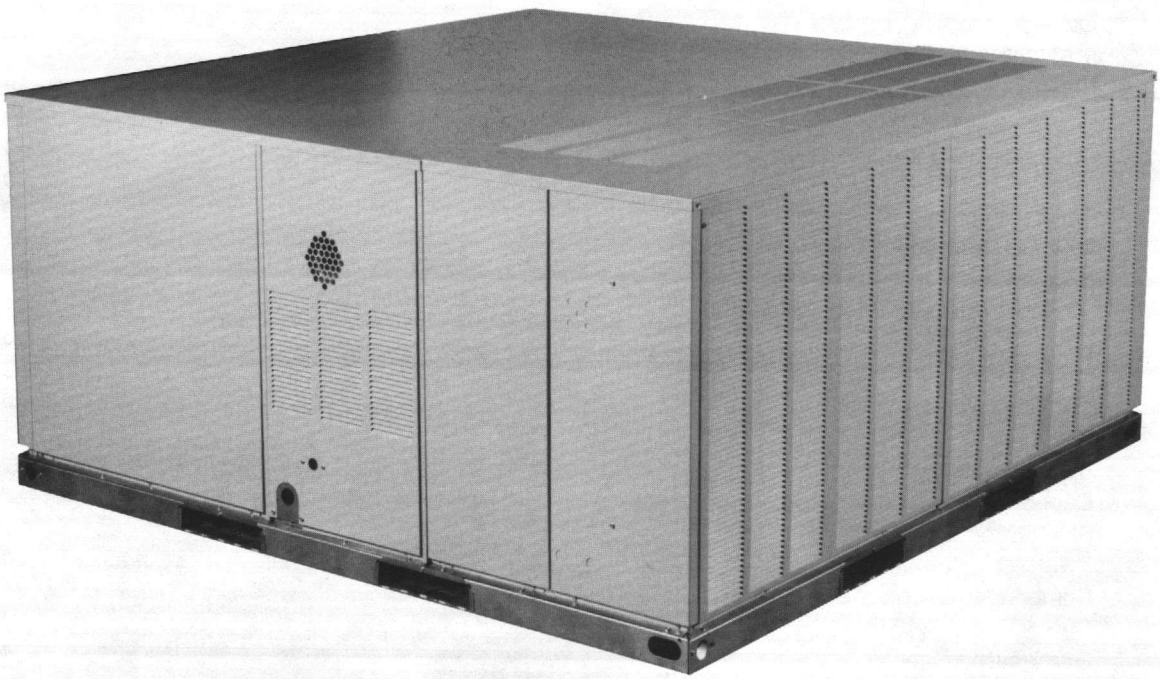
Corporation

INSTALLATION AND MAINTENANCE DATA

BULLETIN NO. IM 475
APRIL, 1989
FORM NO. 553470Y-01

PACKAGED ROOFTOP SYSTEMS



Models CUR075F Thru CUR126F

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NOMENCLATURE

CUR 075 F

COMMERCIAL UNITARY ROOFTOP

NOMINAL CAPACITY
- 075, 076 = 7½ Tons
- 085, 086 = 8½ Tons
- 100, 110 = 10 Tons
- 125, 126 = 12½ Tons

TO DESIGNATE VOLTAGE, HEAT & OPTIONS FOR STOCK UNITS

DESIGN VINTAGE

RECEIVING, INSPECTION & UNPACKING

When the equipment is received all items should be carefully checked against the bill of lading to be sure all crates and cartons have been received. Before accepting delivery, carefully inspect each carton or crate for visible shipping damage.

If any damage is noticed, the carrier should make the proper notation on the delivery receipt acknowledging the damage. Make notations of all damage on all copies of the bill of lading and have all copies countersigned by the delivering carrier. The carrier should also fill out a Carrier Inspection Report. The factory Traffic Department should then be contacted. File claim for damage with the carrier. Physical damage to the unit after acceptance is not the responsibility of SnyderGeneral Corporation.

Unpack each carton or crate and verify that all required parts and proper quantities of each item have been received. Refer to drawings for part descriptions. Report shortages or missing items to your local representative to arrange for replacement parts.

Due to availability of carriers and truck space, it is not possible to guarantee that all items will be shipped together. Verification of shipments must be limited to only those items on the bill of lading.

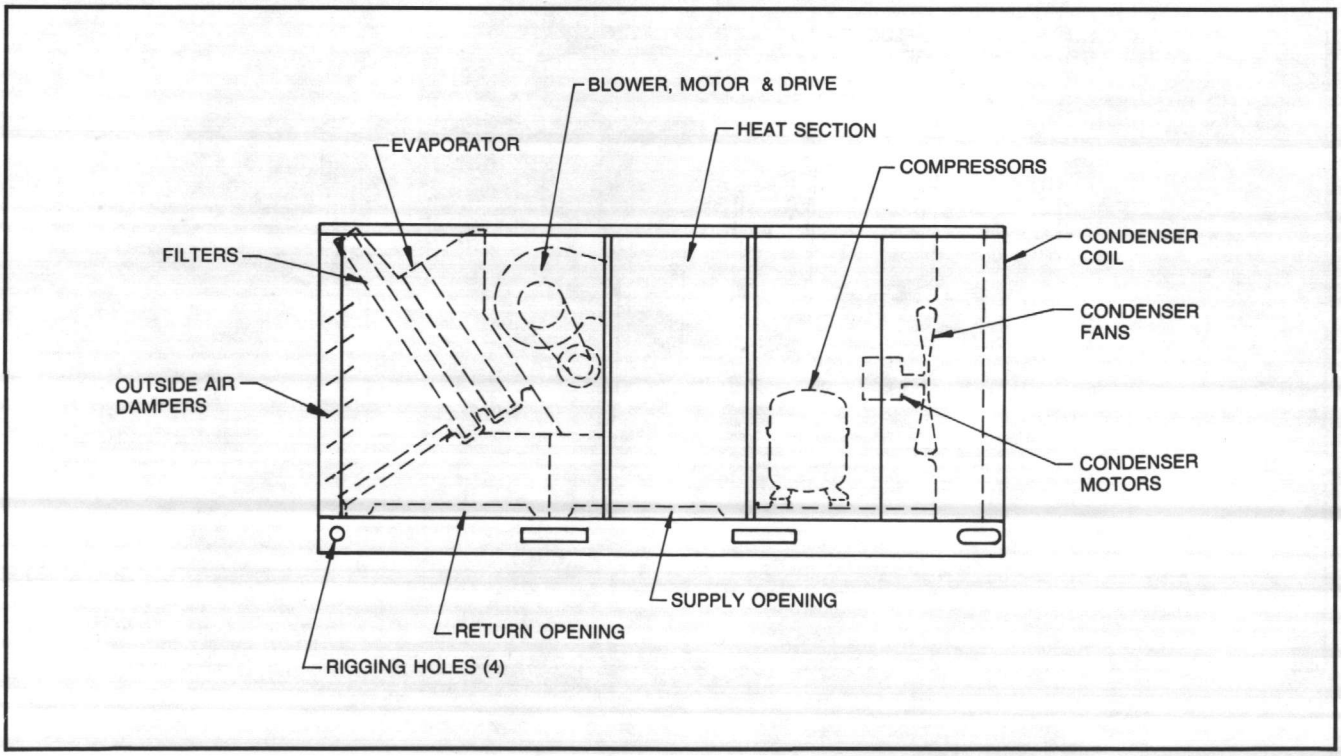
The unit nameplate must be checked to make sure the voltage agrees with the power supply available.

UNIT DESCRIPTION

Rooftop units are shipped fully assembled and factory tested. They are generally installed on a steel roof mounting curb assembly which has been shipped to the jobsite for installation on the roof structure prior to the arrival of the unit.

The model number shown on the unit identification plate identifies the various components of the unit such as refrigeration tonnage, vintage and voltage as shown above in the nomenclature.

Figure 1. Typical Component Location



GENERAL INSTALLATION

CAUTION: Sheetmetal parts, screws, clips and similar items inherently have sharp edges, and it is necessary that the installer and service personnel exercise caution.

The installation of this equipment shall be in accordance with the regulations of authorities having jurisdiction and all applicable codes. It is the responsibility of the installer to determine and follow the applicable codes.

This equipment is to be installed by an experienced installation company and fully trained personnel. System design and installation should, where applicable, follow information presented in accepted industry guides such as the ASHRAE Handbooks. The manufacturer assumes no responsibility for equipment installed in violation of any code or regulation.

The mechanical installation of the packaged rooftop units consists of making final connections between the unit and building services; supply and return duct connections; and drain connections (if required).

The internal systems of the unit are completely factory installed and tested prior to shipment and no additional field labor is required.

SERVICE CLEARANCES

Adequate clearance around the unit should be kept for safety, service, maintenance, and proper unit operation. As shown in Figure 2, a total clearance of 75″ on the main control panel side of the unit is recommended to facilitate possible fan shaft, coil, electric heat and gas furnace removal. Clearance of 48″ is recommended on all other sides of the unit to facilitate possible compressor removal, to allow service access and to insure proper ventilation and condenser airflow. The unit must not be installed beneath any obstruction.

The unit should be installed remote from all building exhausts to inhibit ingestion of exhaust air into the unit fresh air intake.

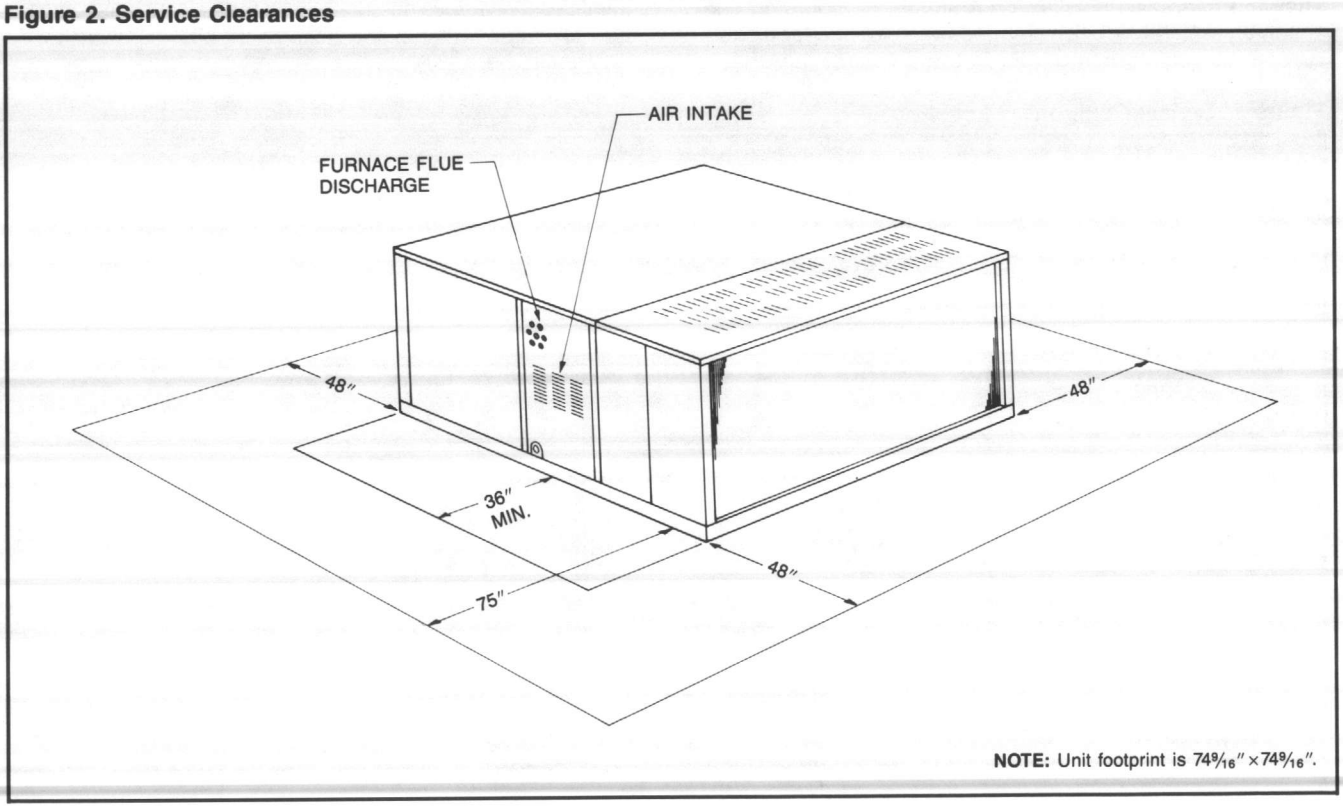
GAS HEAT UNITS

1. As shown in Figure 2 and as indicated on the unit dataplate, a minimum clearance of 36″ to any combustible material is required on the furnace access side of the unit. All combustile materials must be kept out of this area.
2. This 36″ minimum clearance must also be maintained to insure proper combustion air and flue gas flow. The combustion air intake and furnace flue discharge must not be blocked for any reason, including blockage by snow.
3. Adequate clearances from the furnace flue discharge to any adjacent public walkways, adjacent buildings, building openings or openable windows must be maintained in accordance with the latest edition of the National Fuel Gas Code (ANSI Z223.1).

   CAUTION: Flue gases are corrosive to certain building materials. Provide adequate clearance or other protection as required.
4. Minimum horizontal clearance of 48″ from the furnace flue discharge to any electric meters, gas meters, regulators and relief equipment is required.

   NOTE: Model CUR075 thru 150 rooftop units are designed for outdoor installation only. They may be installed over wood flooring or over Class A, B or C roof covering materials.

Figure 2. Service Clearances



NOTE: Unit footprint is 74 9/16″ × 74 9/16″.

UNIT & COMPONENT WEIGHTS

Figure 3. Corner and Center of Gravity Locations

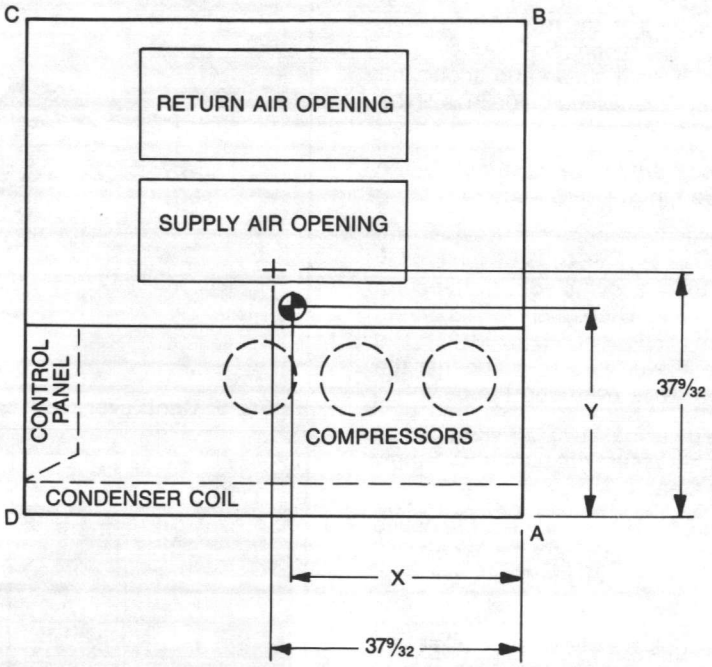


Table 1. Unit and Component Weights (lbs.) & Center of Gravity (inches)

DATA	CUR SERIES								
	075F	076F	085F	086F	100F	110F	125F	126F	150F
Corner Weight — A ①	263	278	278	279	292	352	375	376	
Corner Weight — B ①	227	227	228	233	241	303	315	323	
Corner Weight — C ①	185	186	191	195	197	257	265	273	
Corner Weight — D ①	215	229	233	233	240	298	315	218	
Center of Gravity — X (In.) ⑤	33.5	33.6	33.9	33.0	33.5	34.2	34.0	34.1	
Center of Gravity — Y (In.) ⑤	34.5	33.4	33.6	33.9	33.6	34.5	34.0	34.4	
Unit Shipping Weight ①	935	965	975	985	1015	1265	1325	1345	
Unit Operating Weight ①	890	920	930	940	970	1210	1270	1290	
Coil Guards ②	30	30	30	30	30	40	40	40	
Motor. Outs. Damper Act. ③	5	5	5	5	5	5	5	5	
Economizer ③	28	28	28	28	28	39	39	39	
Gas Heat — Model N10 ④	80	80	80	80	80	90	90	90	
Gas Heat — Model N14 ④	90	90	90	90	90	100	100	100	
Gas Heat — Model N21 ④	110	110	110	110	110	120	120	120	
Gas Heat — Model N24 ④	120	120	120	120	120	130	130	130	
Gas Heat — Model N28 ④	—	—	—	—	—	—	140	140	
Electric Heater ④	65	65	65	65	65	100	100	100	
Hot Water Coil ④	65	65	65	65	65	110	110	110	
Steam Coil ④	35	35	35	35	35	55	55	55	
Full Perimeter Curb ④	120	120	120	102	120	120	120	120	
Cantilever Curb	112	112	112	112	112	112	112	112	
Cantilever Curb Duct Support	27	27	27	27	27	27	27	27	
Copper Condenser Coil Fins ②	40	80	80	80	80	120	120	120	
Copper Evaporator Coil Fins ③	35	35	35	50	50	50	50	75	

NOTES:
① Weights are for basic cooling only unit; no options.
② Add 50% of weight listed to corners A and D.
③ Add 50% of weight listed to corners B and C.
④ Add 25% of weight listed to each corner.
⑤ Center of gravities are for cooling only units without options listed below.

ROOF CURB ASSEMBLY & INSTALLATION

GENERAL

1. Roof curbs are shipped unassembled. Field assembly, squaring, leveling and mounting on the roof structure are the responsibility of the installing contractor. All curb installations must comply with local codes and should be done in accordance with the established guidelines of the National Roofing Contractors Association.
2. All required hardware necessary for the assembly of the sheetmetal curb is included in the curb accessory.
3. Full perimeter or cantilever type curb accessories are available. The full perimeter curb (554208A-01) includes a duct connection frame to be assembled with the curb. A separate duct connection frame accessory (554208A-02) is available for use with the cantilever curb (8403100). The unit can be set on the cantilever curb so that either the condenser end or the two sides overhang the curb.
4. Curbs must be supported on at least two parallel sides by roof members. Roof members must not penetrate supply and return duct opening areas.
5. Curb insulation, cant strips, flashings and general roofing materials are to be furnished by the contractor. Wood nailing strip and curb gasketing is furnished with the curb accessory.
6. The unit and curb accessories are designed to allow vertical duct installation before unit placement. Duct installation after unit placement is not recommended.

INSPECTION

1. Before accepting delivery, inspect curb for shipping damage. Make notations of all damage on all copies of bill of lading and have all copies countersigned by the delivering carrier. File claim for damage with the carrier.
2. Verify that all required parts and proper quantities of each item as shown on bill of material have been received. Report shortages or missing items to delivering carrier and notify your local representative to arrange for replacement.

ASSEMBLY

CAUTION: All curbs look similar. To avoid incorrect curb positioning, check job plans carefully and verify markings on curb assembly.

CANTILEVER CURB

1. Position perimeter pieces, items ① and ②, as shown in Figure 4. Check lengths of all pieces against bill of material to insure proper placement and assembly.
2. Assemble side channels, item ①, to front and back channels, item ②, using bolts, washers, lock washers, and nuts, items ③, ④, ⑤, and ⑥. Hand tighten only at this time.
   Note: Flanges on item ① must go outside of item ② and under wood nailer strip.
3. The assembled roof mounting curb should now be checked for squareness. The curb assembly must be adjusted until both diagonal measurements (dimension "C") are equal within a tolerance of 1/8". All hand tightened fasteners should now be fully secured (refer to Table 2 and Figure 6).
4. Assemble duct connection frame accessory as shown in Figure 5. Fasten pieces together using sheetmetal screws provided (3/8" hex head). Note that this duct connection frame can be oriented two ways when set into the curb. Frame position must correspond to the intended unit orientation on the curb. The gasket provided with the duct connection accessory should be applied after duct installation. Refer to the "Vertical Discharge Duct Connections" section of this manual.

Figure 4. Cantilever Curb Joint

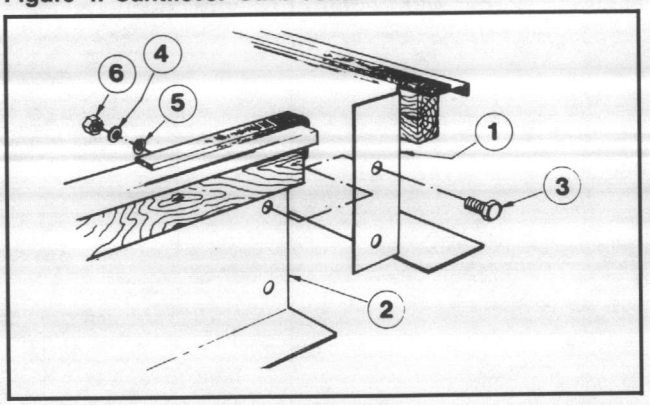


Figure 5. Cantilever Curb Duct Connection Accessory

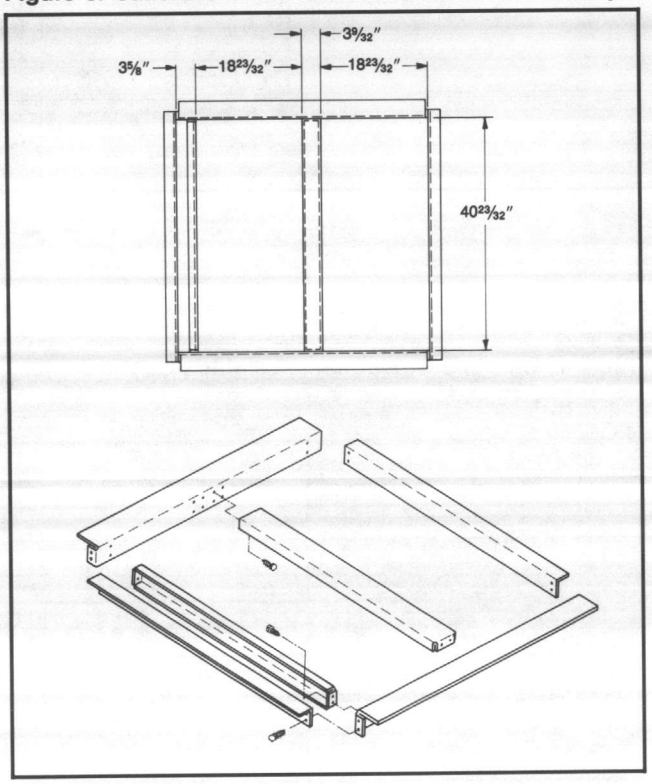


Figure 6. Typical Curb Installation

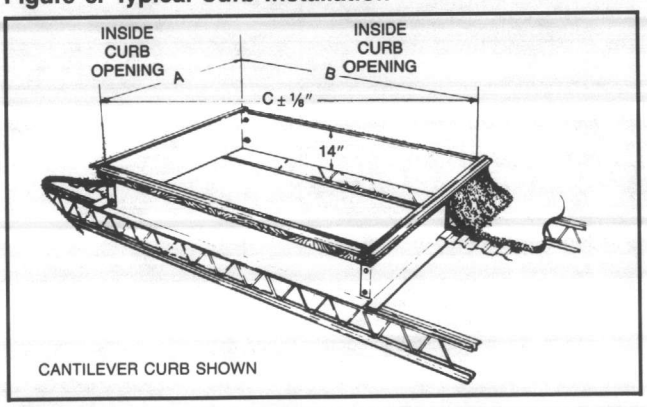


Table 2. Inside Opening Curb Dimensions

CURB TYPE	A	B	C
CANTILEVER	45	63 1/2	77 13/16
FULL PERIMETER	63 9/16	63 9/16	89 7/8

FULL PERIMETER CURB

1. Position perimeter pieces, item A, as shown in Figures 7 and 8. All perimeter pieces are identical.
2. The duct connection frame, items B and C, should be assembled with the curb as shown in Figures 7 and 8.
   Note: Top of duct connection frame must be flush with top of curb as shown in Figure 8.
3. Fasten pieces together using sheetmetal screws provided (3/8" hex head). Screws are included in shipping package (item D, Figure 7). Use three screws at each corner of the curb frame (item A) and two screws at each joint of the duct connection members (items B and C).
4. The assembled roof mounting curb should now be checked for squareness. The curb assembly must be adjusted until both diagonal measurements (dimension "C") are equal within a tolerance of 1/8" (refer to Table 2 and Figure 6).
5. Gasket material sufficient to seal the curb perimeter and the duct connection frame is included and attached to a duct connection member. Note that it should not be applied to the curb perimeter and the duct connection frame until the ducts are placed in the frame. Refer to the "Vertical Discharge Duct Connections" section of this bulletin.

Figure 7. Full Perimeter Curb

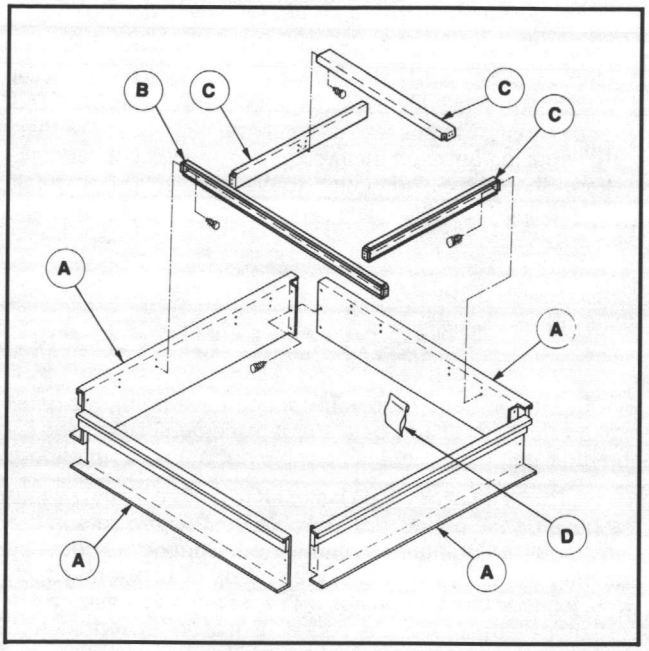
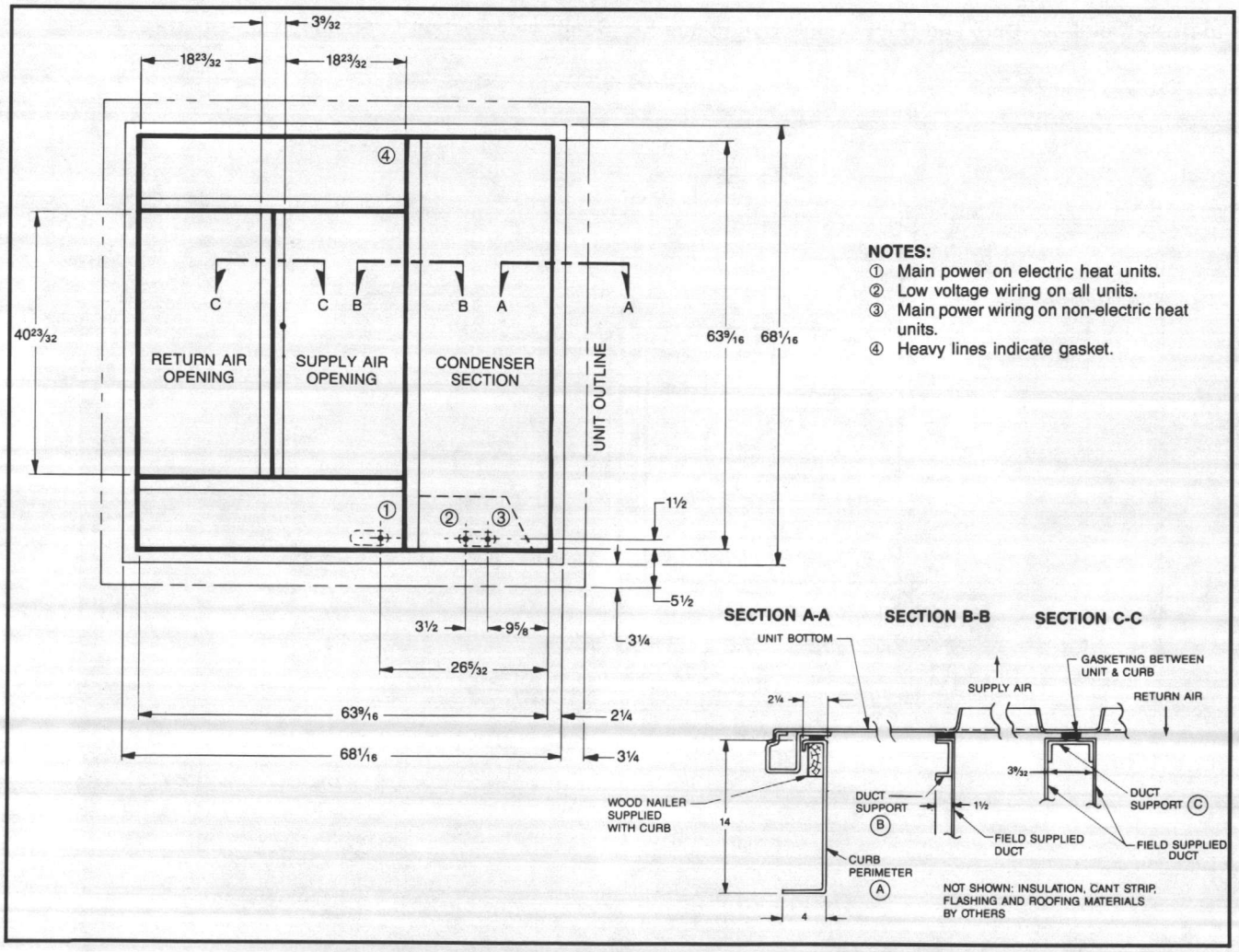


Figure 8. Full Perimeter Curb



INSTALLATION

1. Place assembled curb in proper location over roof opening. Check for squareness and adjust if required.
2. Curb must be installed level. One method to achieve a level installation is to stretch two diagonal lines across curb and equip them with line levels. There must not be more than 1/8" spacing between the two lines at the point of intersection. Should the lines touch at the intersection, recheck by placing the bottom line on top. Shim curb as required to bring it within the specified tolerance.
3. Attach the squared and leveled curb to the roof structure following industry accepted practice.
4. Install insulation, cant strips, roofing materials, flashing and counterflashing in accordance with the established guidelines of the National Roofing Contractors Association. The finished roof, including counterflashing around the curb, must be installed prior to setting the unit on the curb.

VERTICAL DISCHARGE DUCT CONNECTIONS

NOTE: The unit and curb accessories have been designed to allow duct installation before unit placement. Duct installation after unit placement is possible but not recommended.

NOTE: Ducts must never be fastened to bottom of unit so that the base pan is penetrated. Flexible duct connectors in the ducts near the unit are recommended. Support all ducts by securing to building structure. Weatherproof all external ductwork, joints and roof openings with flashing and mastic in accordance with applicable codes. Ducts in unconditioned spaces must be insulated and covered with a vapor barrier.

DUCT INSTALLATION BEFORE UNIT PLACEMENT

Ductwork may be installed prior to unit placement by using a duct connection frame. Two duct connection frame systems fit into the three possible curb configurations as shown in Figures 8, 9 and 10.

The frame to be used with full perimeter curbs is included with the curbs. It must be assembled and attached to the curb as shown in Figures 7 and 8.

The frame to be used with either configuration of the cantilever curb comes as an accessory (554208A-02). It must be assembled as shown in Figure 5 and then set into the curb as shown in Figure 9 or 10. Fastening the frame to the curb is not necessary.

Figure 9. Cantilever Curb and Duct Connection Frame Kit (Condenser Section Overhang)

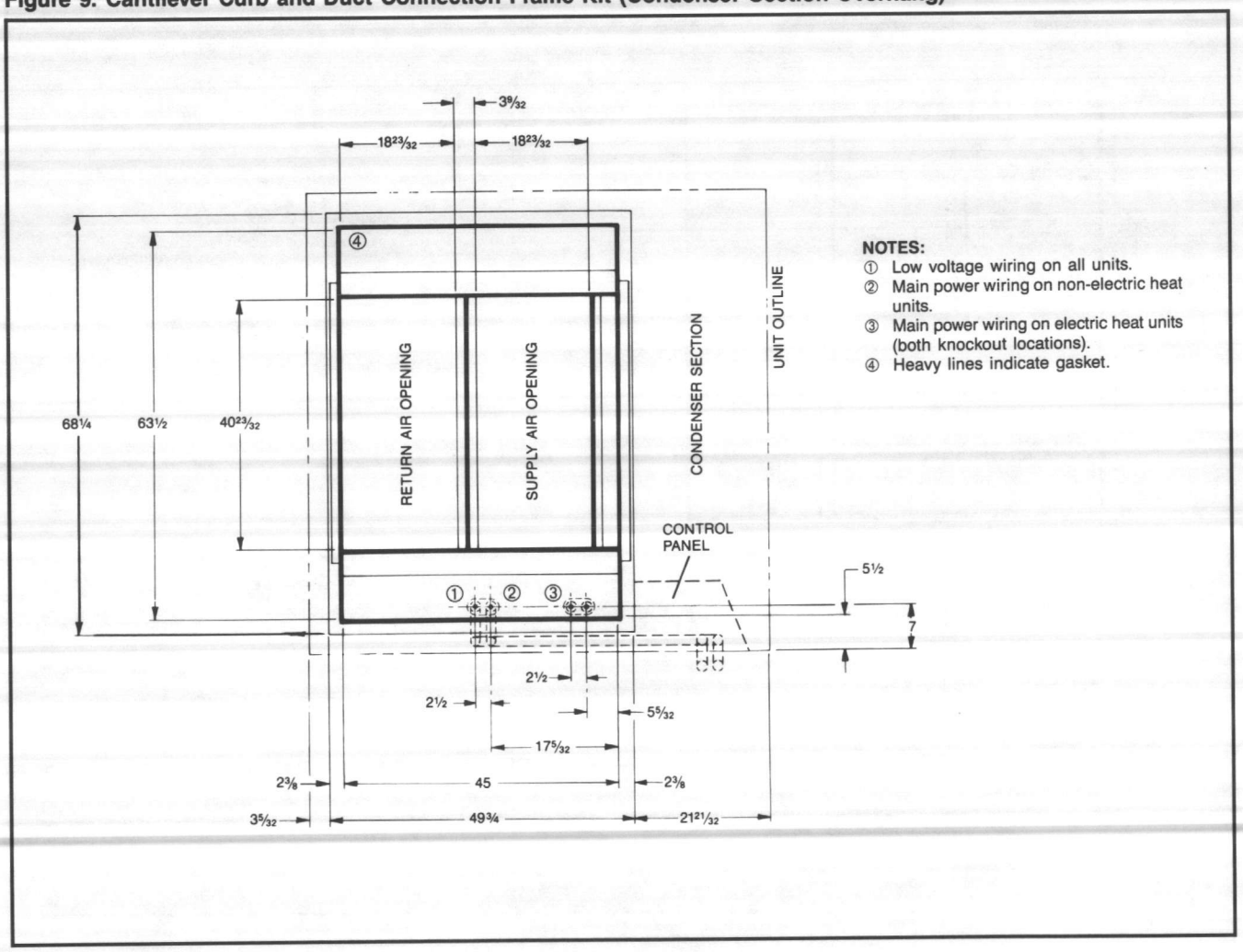
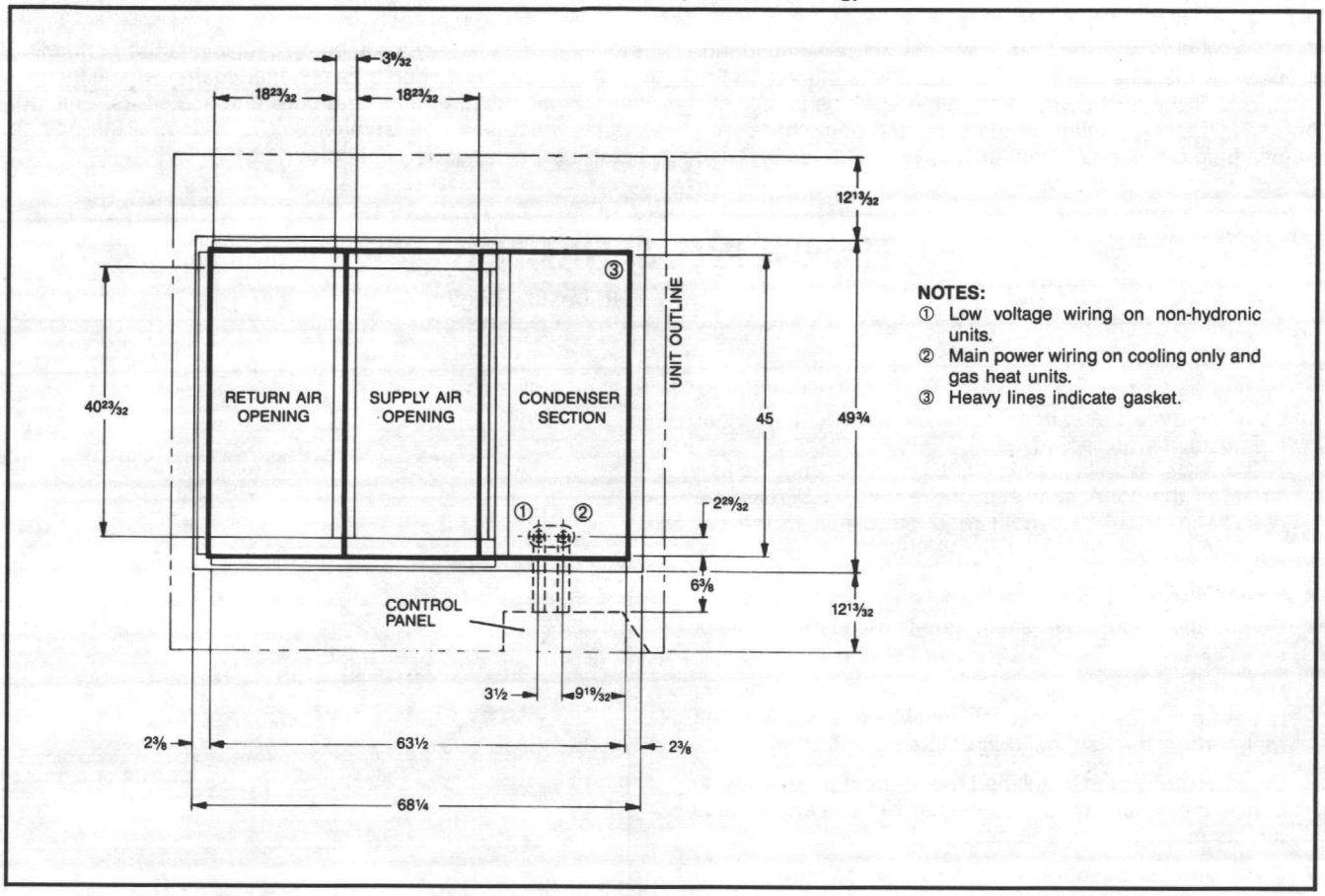


Figure 10. Cantilever Curb and Duct Connection Frame Kit (Side Overhang)



DUCT INSTALLATION

After the duct connection system has been assembled and installed, the ductwork may be set in place. To make the connection, prepare the duct with a 1½″ flange as shown in Figures 11 and 12. Then simply place the section into position on the connection frame. Riveting or bolting is not necessary and is not recommended.

Both duct connection systems include gasketing which must be applied to the connection frame and duct flanges after duct installation. Gasket must be installed over the duct flanges so that an airtight seal is made between the unit and the ductwork after the unit is placed on the curb.

Full Perimeter Curb: All gasketing must be field installed on the full perimeter curbs as shown in Figure 8. After duct sections have been installed, gasketing supplied with the curb accessory should be applied over the duct flanges, exposed connection frame, and curb perimeter.

Cantilever Curb: Gasket is factory installed on perimeter of curb. After duct connection frame and duct sections have been set on curb, gasketing supplied with connection frame accessory should be applied over duct flanges and exposed frame as shown in Figures 9 and 10.

Figure 11. Duct Placement (Full Perimeter Curb)

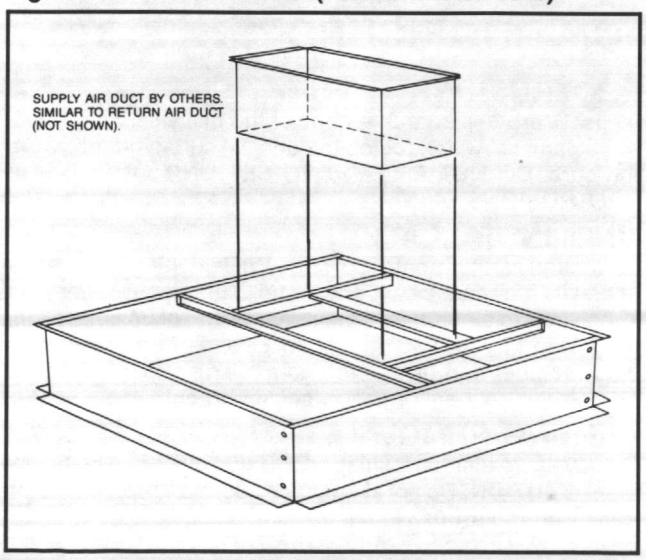
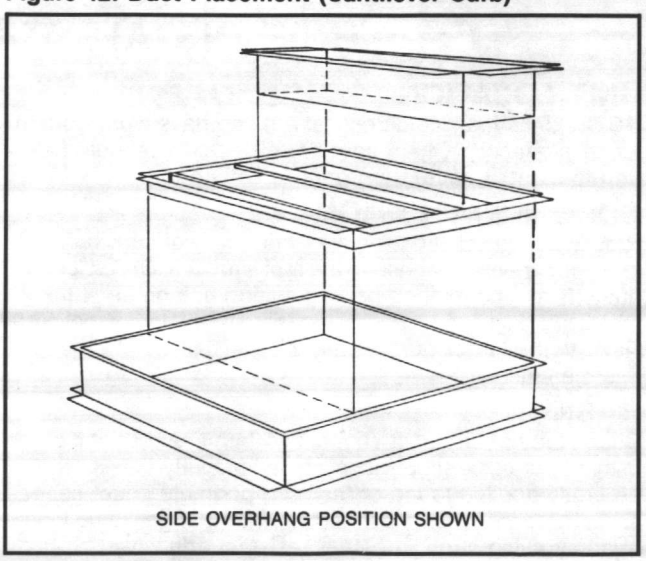


Figure 12. Duct Placement (Cantilever Curb)



DUCT INSTALLATION AFTER UNIT PLACEMENT

Duct installation after unit placement is not recommended. If ductwork must be installed after the unit is placed on the curb, one of the duct connection frame systems should still be used. Apply gasketing to the curb and duct connection frames before unit placement as shown in Figures 8, 9 and 10. (Gasket is factory installed on cantilever curb perimeter.) The duct sections should be fastened to the vertical flanges of the connection frame and curb and sealed as required. Ducts must never be fastened to the bottom of the unit so that the base pan is penetrated.

HANDLING & RIGGING

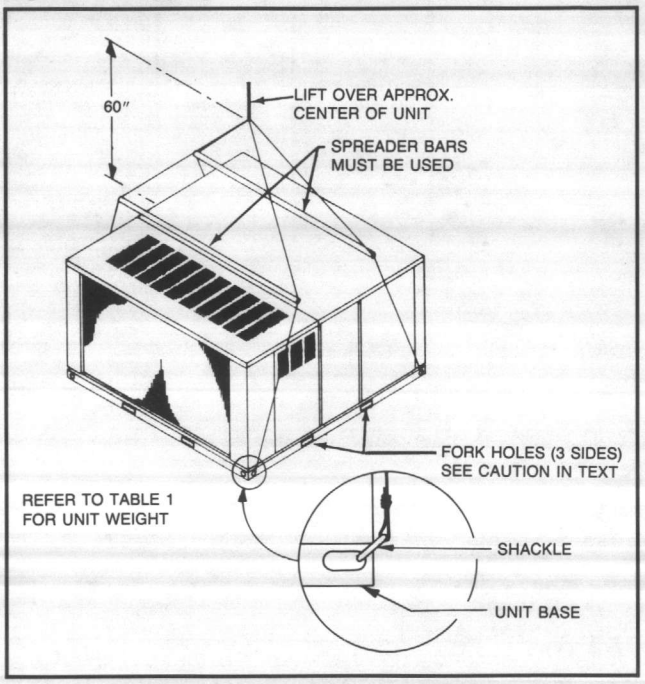
GENERAL HANDLING

1. To assist in determining rigging requirements, unit weights are shown in Table 1.
2. Provisions for forks have been included in the unit base frame on three sides. If unit is moved by forklift, no other fork locations are approved.
   CAUTION: If units are to be lifted two at a time, the fork holes on the condenser end of the unit MUST NOT be used. Minimum fork length required is 42″ to prevent damage to unit; 48″ is recommended.
3. Do not stand or walk on unit.
4. Do not drill holes anywhere in panels or in base frame of unit.
5. Unit access panels provide structural support. Do not remove any access panels until unit has been installed on roof curb or field supplied structure.
6. Do not roll unit across finished roof without prior approval of owner or architect. Do not skid or slide on any surface as this may damage unit base.
7. The unit must be stored on a flat, level surface.
8. Protect the condenser coil because it is easily damaged.

RIGGING DETAILS

1. Units must be lifted by the four lifting holes located at the base frame corners.
2. Lifting cables should be attached to the unit with shackles as shown in Figure 13.
3. The distance between the crane hook and the top of the unit must not be less than 60″.
4. Two spreader bars must span over the unit to prevent damage to the cabinet by the lift cables. Spreader bars must be of sufficient length so that cables do not come in contact with the unit during transport.
5. Remove wood struts mounted beneath unit base frame before setting unit on roof curb. These struts are intended to protect unit base frame from forklift damage. Removal is accomplished by extracting the sheetmetal retainers and pulling the struts through the base of the unit. Refer to rigging label on the unit.

Figure 13. Rigging



UNIT INSTALLATION ON ROOF CURB

UNIT LOCATION

NOTE: Units may look identical but can have significant internal differences. Check specific unit location carefully (referring to plans if necessary) prior to setting unit.

CURB INSTALLATION

Proper unit installation requires that the roof curb be firmly and permanently attached to the roof structure. Check for adequate fastening method prior to setting unit on curb. Insure that top of duct connection frame is flush with top of roof curb. Refer to the "Roof Curb Assembly & Installation" section of this manual.

GASKET

Check top of curb, duct connection frame and duct flanges to make sure gasket has been applied properly. Gasket should be firmly applied to top of the curb perimeter, duct flanges and any exposed duct connection frame. If gasket is loose, re-apply using strong weather resistant adhesive.

PROTRUSIONS

Inspect curb to insure that none of the utility services (electric, steam, hot water) routed through the curb protrude above the curb. DO NOT ATTEMPT TO SET UNIT ON CURB IF PROTRUSIONS EXIST.

UNIT INSTALLATION

Lower unit carefully onto roof curb. While rigging unit, center of gravity may cause condenser end to be slightly lower than supply/return air end. Bring condenser end of unit into alignment with the curb. With condenser end of unit resting on curb member and using curb as a fulcrum, lower opposite end of unit until entire unit is seated on curb.

RIGGING REMOVAL

Remove spreader bars, lifting cables and other rigging equipment. **CAUTION:** Do not allow crane hooks and spreader bars to rest on roof of unit.

HORIZONTAL DISCHARGE DUCT CONNECTIONS

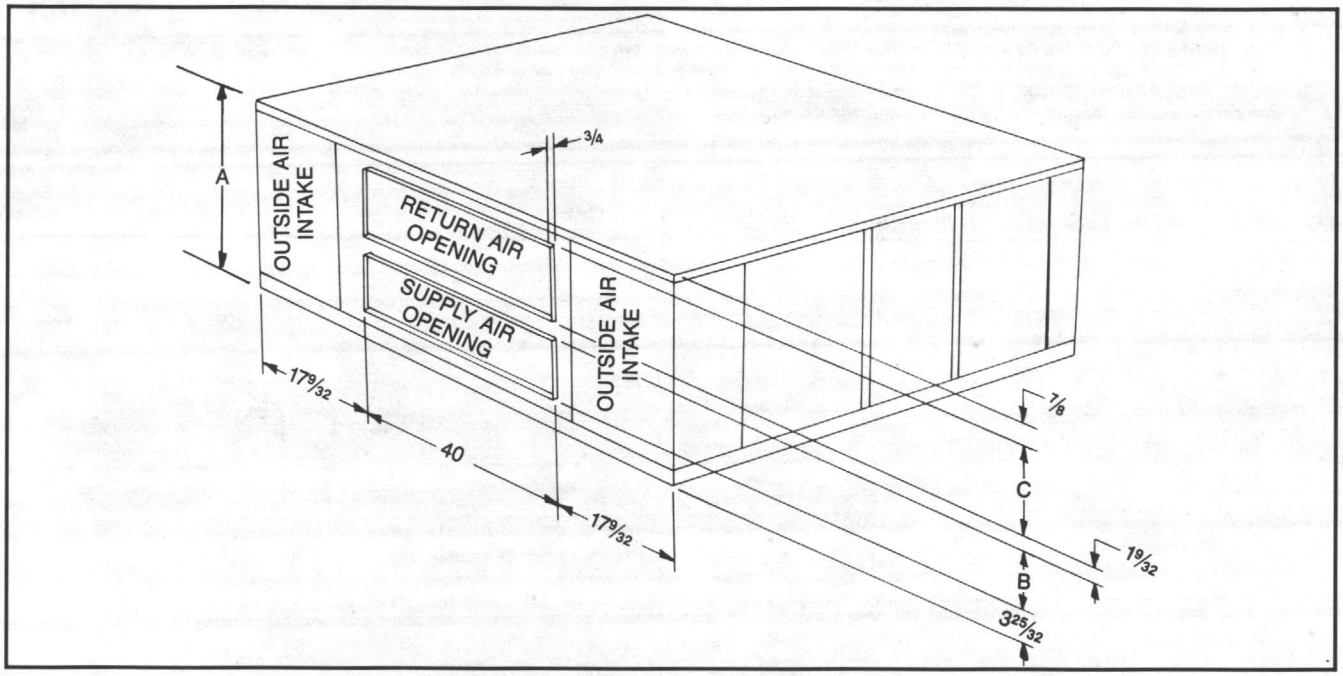
A 3/4" duct flange is provided for making duct connections on units with the optional factory installed horizontal discharge configuration. Refer to Figure 14. Units not equipped with an economizer may be converted from vertical to horizontal discharge in the field by using accessory number 554214A-01 (CUR075 thru 100) or 554214A-02 (CUR110 thru 150).

NOTE: Flexible duct connectors between the unit and ducts are recommended. Insulate and weatherproof all external ductwork and joints as required and in accordance with local codes.

Table 3. Horizontal Duct Connection Dimensions

UNIT SIZE CUR	A HEIGHT	B SUPPLY AIR	C RETURN AIR
075, 076, 085, 086, 100	36	12½	17 9/16
110, 125, 126, 150	52	20¼	25 13/16

Figure 14. Horizontal Discharge Duct Connections



ELECTRICAL INSTALLATION

GENERAL INSTRUCTIONS

1. The main power supply wiring to the unit and low voltage wiring to accessory controls must be done in accordance with these instructions, the latest edition of the National Electrical Code (ANSI/NFPA 70), and all local codes and ordinances. All field wiring shall conform with the temperature limitations for Type T wire (63°F/35°C rise).
2. Main power and low voltage wiring may enter the unit through the side or, with some models and curb configurations, through the roof curb and base frame. Refer to Figures 16 and 17 for external electrical entrance locations. Refer to Table 4 and Figures 8, 9, 10 and 15 for through-the-curb electrical entrance locations. Install conduit connectors at the desired entrance locations. External connectors must be weatherproof. All holes in unit base must be sealed (including around conduit nuts) to prevent water leakage into building. All required conduit and fittings must be supplied by others.
3. It is recommended that an independent 115V power source be brought to the vicinity of the rooftop unit for portable lights and tools used by the service mechanic.

WARNING: Do not tamper with factory wiring. The internal power and control wiring of these units is factory installed and each unit is thoroughly tested prior to shipment. Contact your local representative or the factory if assistance is required.

Figure 15. Through-the-curb Electrical Entrance Locations

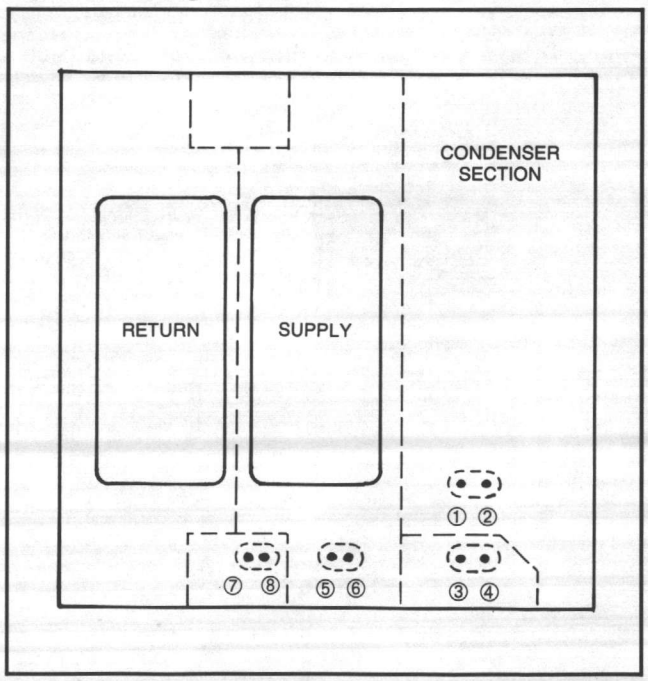


Table 4. Through-the-curb Electrical Entrance Locations (Refer to Figure 15)

MODEL TYPE	CURB CONFIGURATION					
	FULL PERIMETER		CONDENSER OVERHANG		SIDE OVERHANG	
	POWER	LOW VOLTAGE	POWER	LOW VOLTAGE	POWER	LOW VOLTAGE
COOLING ONLY	4	3	8	7	2	1
GAS HEAT	4	3	8	7	2	1
ELECTRIC HEAT	6	3	5, 6	7	N/A	1
HYDRONIC	4	3	8	7	N/A	N/A

NOTES:

1. Protect wiring from sharp edges. Follow National Electrical Code and all local codes and ordinances. Do not route wires through removable access panels.
2. Locations 7* and 8* require wiring to exit unit through the base rail and then re-enter unit at the external electrical entrance locations shown in Figures 16 and 17. Refer also to Figure 9.
3. Locations 1 and 2 require wiring to be routed through back of main control box. Refer to Figure 10. **CAUTION:** Conduit and fittings must be weathertight to prevent water entry into the building.
4. Knock-outs are provided at locations 3, 4, 5 and 6.
5. If an external field supplied disconnect is used, the power wiring will route as follows:
   a. POWER ENTRY LOCATION OTHER THAN 8: Exit unit via side location shown in Figures 16 and 17. Then enter disconnect box, connect to the disconnect, and leave the disconnect box. And then enter the unit again at the side location shown in Figures 16 and 17.
   b. POWER ENTRY AT LOCATION 8*: Exit the unit via base rail as shown in Figure 9. Then enter the disconnect box, connect to the disconnect, and leave the disconnect box. And then enter the unit again at the side location shown in Figure 17.

**It may be easier to prenetrate the roof outside the curb rather than use Locations 7 and 8.*

Figure 16. External Electrical Entrance Locations (Electric Heat Units)

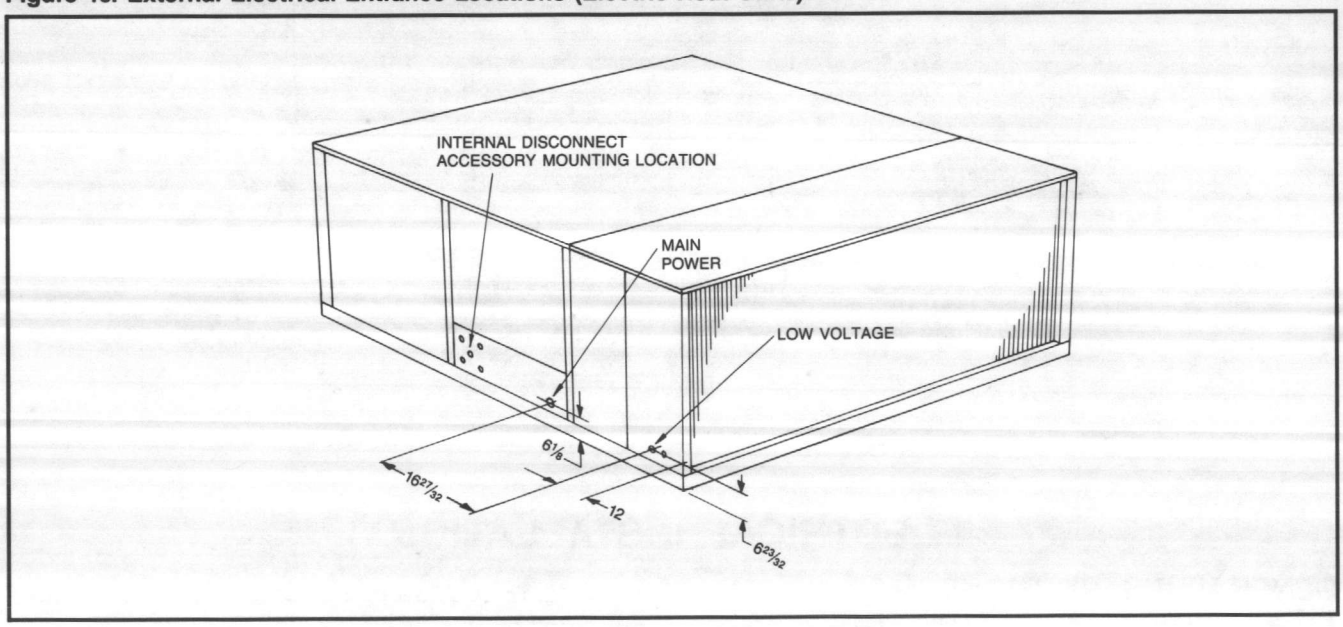
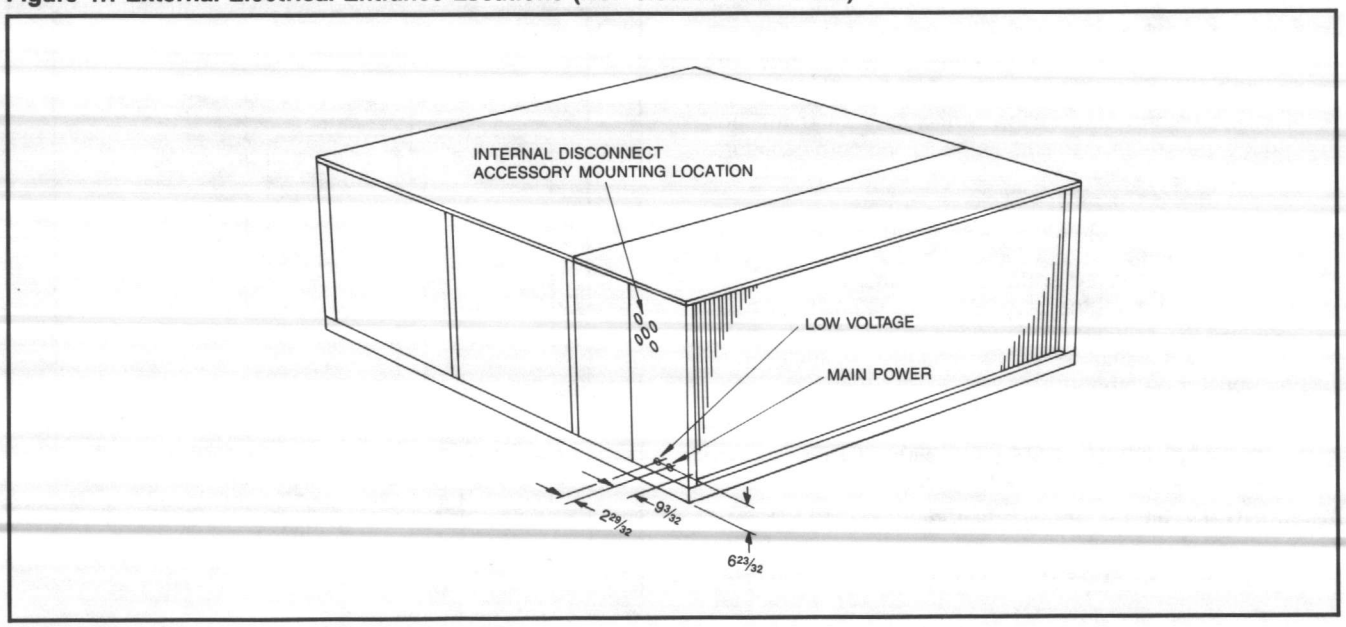


Figure 17. External Electrical Entrance Locations (Non-electric Heat Units)



MAIN POWER WIRING

1. The main power supply for the CUR075 thru 150 rooftop units shall be three phase, three wire. The unit is factory wired for the voltage shown on the unit dataplate.
   NOTE: If supply voltage is 208V, lead on primary of transformer T1 must be moved from the 230V to the 208V tap.
2. Main power wiring should be sized for the minimum wire ampacity shown on the unit dataplate. Size wires in accordance with the ampacity tables in Article 310 of the National Electrical Code. If long wires are required, it may be necessary to increase the wire size to prevent excessive voltage drop. Wires should be sized for a maximum of 3% voltage drop.
   CAUTION: Aluminum wire must not be used.
3. A weathertight disconnect switch, properly sized for the unit total load, must be field installed. A non-fused internal disconnect accessory is available which fits into the units at the locations shown in Figures 16 and 17. Knockouts for mounting disconnect are provided in the exterior panels. Refer to instructions packaged with disconnect accessory (Bulletin No. IM 465) for installation procedure. An external, field supplied disconnect may be mounted on the same fixed exterior panel shown in Figures 16 and 17.
   NOTE: Do not cover dataplate with field supplied disconnect switch.
4. Accessory disconnect switches are not fused. The power leads must be protected at the point of distribution in accordance with the unit dataplate.
5. All units must be electrically grounded in accordance with local codes or, in the absence of local codes, with the latest edition of the National Electrical Code (ANSI/NFPA 70). A ground lug is provided for this purpose. Size grounding conductor in accordance with Table 250-95 of the National Electrical Code. DO NOT use the ground lug for connecting a neutral conductor.
6. Power wiring should be connected to the main power terminal block. This terminal block is located within the main control box on units without electric heat (PB1) and within the electrical heat control box on units with electric heat (PB3).
7. Supply voltage to the rooftop unit must not vary by more than 10% of the value indicated on the unit dataplate. Phase voltage unbalance must not exceed 2%. Contact local power company for correction of improper voltage or phase unbalance.

WARNING: *Failure of unit due to operation on improper line voltage or with excessive phase unbalance constitutes product abuse and may cause severe damage to the unit electrical components.*

LOW VOLTAGE CONTROL WIRING

SPACE THERMOSTAT

1. A 24V thermostat must be field installed. It may be purchased with the unit or field supplied. All cooling and heating systems available in Models CUR075 thru 150 are 2-stage. (Controls and valves are field supplied in hydronic or steam heat units.) Thermostats may be programmable or electromechanical as required.
2. Locate thermostat or remote sensor in the conditioned space where it will sense average temperature. Do not locate the device where it may be directly exposed to supply air, sunlight or other sources of heat. Follow installation instructions packaged with the thermostat.
3. Use #16 AWG wire for 24V control wiring runs not exceeding 100 feet. Use #14 AWG wire for 24V control wiring of 101 to 200 feet. Low voltage wiring may be National Electrical Code (NEC) Class 2 where permitted by local codes.
4. Route thermostat wires from subbase terminals to the unit. Control wiring should enter through the unit base frame as shown in Figure 15 or through the fixed side panel as shown in Figures 16 and 17. Connect thermostat and any accessory wiring to low voltage terminal block TB1 in the main control box as shown in Figures 18, 19, 20, 21 or 22.
   NOTE: Field supplied conduit may need to be installed depending on unit/curb configuration.

NIGHT SETBACK THERMOSTAT & TIMECLOCK (OPTIONAL)

1. If a programmable type thermostat is not used, start/stop operation may be controlled with a field installed timeclock either purchased with the unit or field supplied. A night setback thermostat may also be incorporated for reduced space temperature control during unoccupied periods. Refer to Figures 20, 21 and 22.
2. Timeclock and night setback field wiring may be routed to the rooftop unit with the thermostat wiring.
3. Timeclocks require a separate continuous power supply for operation of the timer motor. The timeclock accessory available from SnyderGeneral (711956B-01) requires a 120V/60Hz power supply.
4. Thermostats to be used for night setback may be purchased with the unit. If provided locally, they should be Honeywell Model T834 or equal. Follow installation instructions provided with the thermostat.

REMOTE STATUS PANEL (OPTIONAL)

1. Remote status panel accessories are available for use with the rooftop unit and require field installation and wiring. (Optional unit mounted status monitor module must be provided for remote status indication.) Panels may be equipped with or without switches and are field convertible to 4 or 6 light indication. Follow installation instructions furnished with the status panel. Refer to Figures 18, 19 and 21.
2. Indication only (non-switching) status panel must be used with Honeywell T7300 programmable thermostat.
3. Wiring between unit, thermostat and status panel may be 24V NEC Class 2 where permitted by local codes. Wire runs up to 100 feet may use #16 AWG wire.

SPECIAL VENTILATION (OPTIONAL)

1. If the special ventilation accessory relay is to be used with the unit, a field supplied device with a set of normally open contacts must be field installed as shown in Figures 18, 19, 20, 21 and 22.
2. Wiring to field supplied special ventilation device may have to be 24V NEC Class 1. Specific application must be installed in accordance with the National Electrical Code and all local codes and ordinances.

ECONOMIZER & 2-POSITION MOTOR OPTION

CUR rooftop units may be equipped with an economizer or 2-position motorized damper option. When these motorized damper controls are used in conjunction with a timeclock (external or within programmable thermostat), a normally open (unoccupied) set of timeclock contacts may be wired between unit terminals R and D as shown in Figures 18, 20, 21 and 22. This configuration will cause the spring-return damper motor to close completely during the unoccupied period.

If a timeclock is not used (or if it is used and fan switch is set to AUTO), unit terminals D and 18 should be jumped together as shown in Figures 19, 20, 21 and 22. This configura-

tion will cause the spring-return damper motor to close completely whenever the fan is off.

HOT WATER & STEAM HEAT OPTION

Factory installed or accessory hot water or steam coils are available for use with the unit. The valve and all controls required to operate it and the fan must be field supplied. One method of controlling the fan is shown in Figure 22.

Figure 18. Field Wiring With Honeywell T7300A Thermostat, Q7300B Subbase with Switching and W950A (Indication Only) Status Panel. (Economizer or Motorized Damper Option Energized by Timeclock.)

NOTES:

1. On units not equipped with filter flag option, eliminate connection between unit terminal 5 and status panel terminal 5.
2. On units not equipped with fan switch option, eliminate connection between unit terminal 6 and status panel terminal 6.
3. When using remote sensor, system configuration switch #5 on subbase must be set to OFF.
4. If unit is equipped with heating section, thermostat terminal RH must be connected to terminal RC.
5. On units not equipped with economizer or motorized damper option, eliminate connections between thermostat RC and A1 terminals, and between thermostat A2 and unit D terminals.

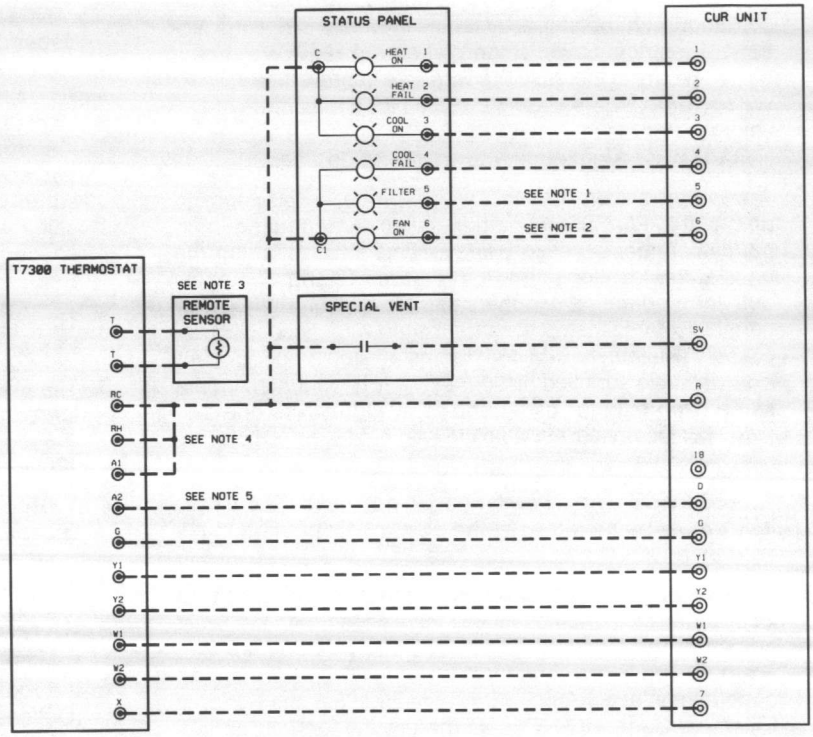
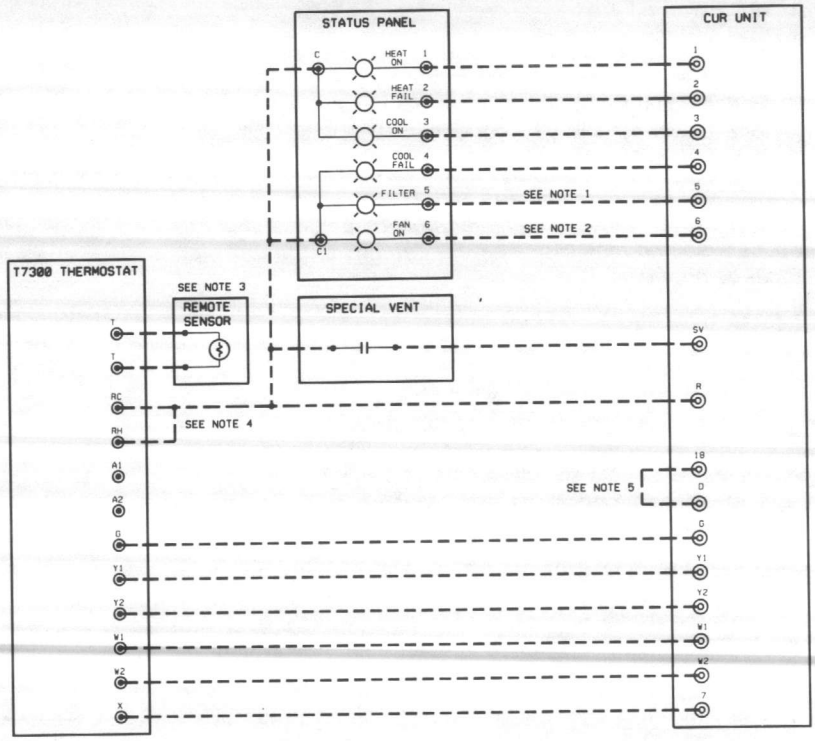


Figure 19. Field Wiring With Honeywell T7300A Thermostat, Q7300B Subbase with Switching and W950A (Indication Only) Status Panel. (Economizer or Motorized Damper Option Energized with Fan.)

NOTES:

1. On units not equipped with filter flag option, eliminate connection between unit terminal 5 and status panel terminal 5.
2. On units not equipped with fan switch option, eliminate connection between unit terminal 6 and status panel terminal 6.
3. When using remote sensor, system configuration switch #5 on subbase must be set to OFF.
4. If unit is equipped with heating section, thermostat terminal RH must be connected to terminal RC.
5. On units not equipped with economizer or motorized damper option, eliminate connection between unit terminals D and 18.



LEGEND:

- ◎ FIELD WIRED TO UNIT TERMINAL
- ⊙ FIELD WIRED TO DEVICE
- ⊗ LIGHT
- — — — — FIELD WIRING

Figure 20. Field Wiring With Honeywell T874D Thermostat and Q674E Subbase with Switching (or Equivalent).

NOTES:

1. If unit is equipped with economizer or motorized damper option, unit terminal D should be connected either to unit terminal 18 or to timeclock as shown. If D is connected to 18, economizer or 2-position motor will be enabled with fan. If D is connected to timeclock, economizer or 2-position motor will be enabled in "occupied" mode.
2. If unit is equipped with heating section, thermostat terminal RH must be connected to terminal RC.

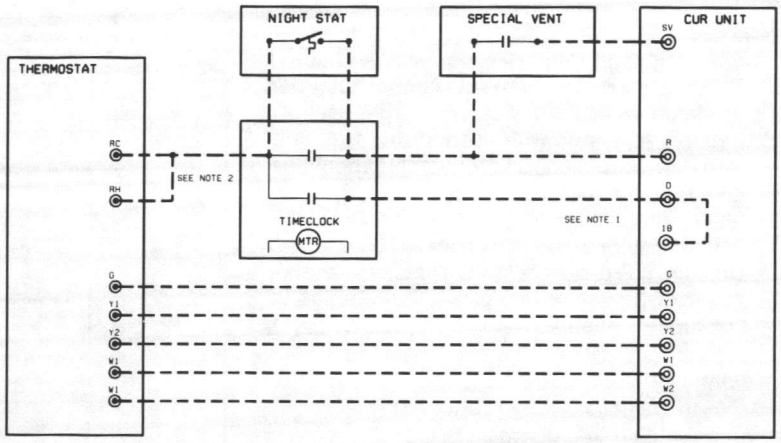
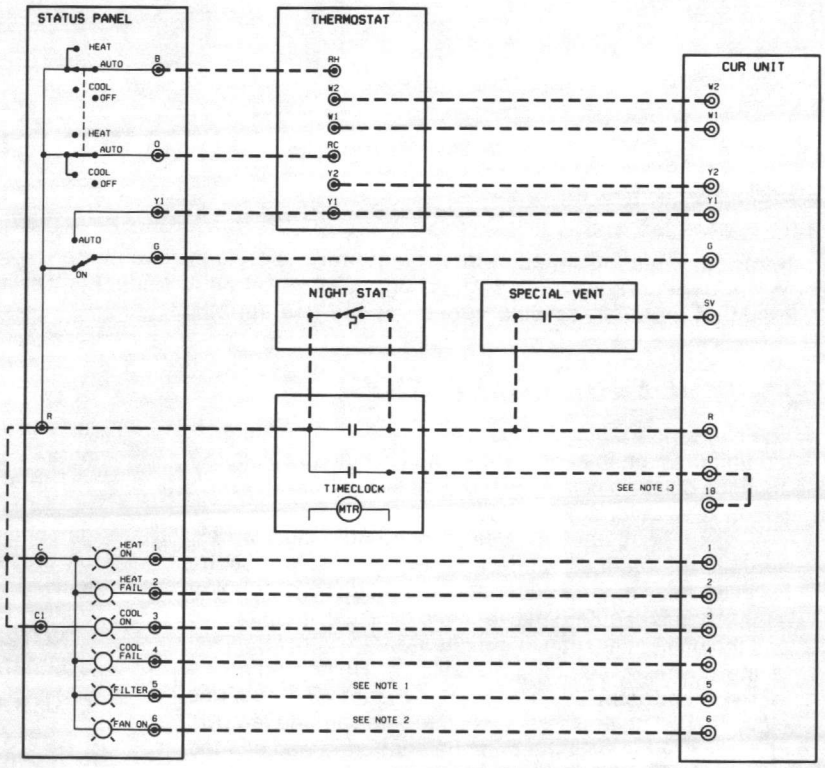


Figure 21. Field Wiring With Honeywell T874D Thermostat, Q674D Subbase without Switching (or Equivalent) and W950E Status Panel.

NOTES:

1. On units not equipped with filter flag option, eliminate connection between unit terminal 5 and status panel terminal 5.
2. On units not equipped with fan switch option, eliminate connection between unit terminal 6 and status panel terminal 6.
3. If unit is equipped with economizer or motorized damper option, unit terminal D should be connected either to unit terminal 18 or to timeclock as shown. If D is connected to 18, economizer or 2-position motor will be enabled with fan. If D is connected to timeclock, economizer or 2-position motor will be enabled in "occupied" mode.



LEGEND:

- ◎ FIELD WIRED TO UNIT TERMINAL
- ◉ FIELD WIRED TO DEVICE
- ⊗ LIGHT
- — — — — FIELD WIRING

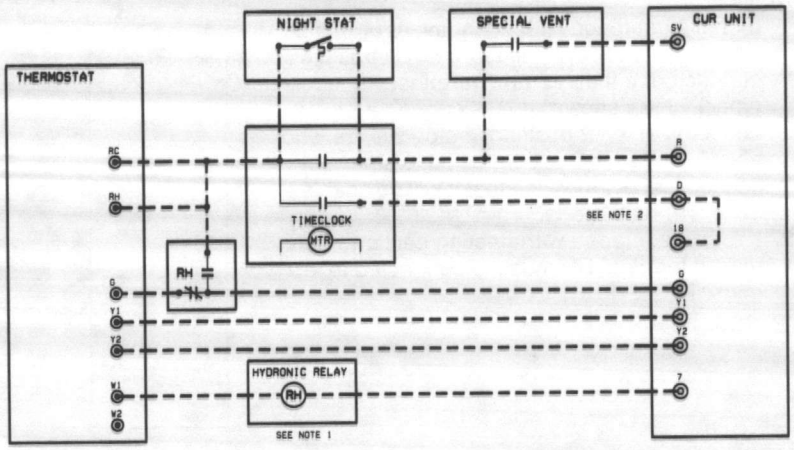
Figure 22. Typical Method to Control Fan on Hydronic Unit. (Honeywell T874D Thermostat and Q674E Subbase with Switching Shown.)

NOTES:

1. Field supplied relay RH required. Additional RH contacts (not shown) may control hot water or steam valve.
2. If unit is equipped with economizer or motorized damper option, unit terminal D should be connected either to unit terminal 18 or to timeclock as shown. If D is connected to 18, economizer or 2-position motor will be enabled with fan. If D is connected to timeclock, economizer or 2-position motor will be enabled in "occupied" mode.

LEGEND:

- ◎ FIELD WIRED TO UNIT TERMINAL
- ◉ FIELD WIRED TO DEVICE
- — — — — FIELD WIRING



GAS SUPPLY PIPING

⚠ WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to the User's Information Manual provided with this furnace. For assistance or additional information, consult a qualified installer, service agency or the gas supplier.

LOCATION AND INSTALLATION

1. The gas supply piping location and installation on the rooftop unit must be in accordance with local codes or, in the absence of locals codes, with ordinances of the latest edition of the National Fuel Gas Code (ANSI Z223.1).

   A manual gas shutoff valve must be field installed external to the rooftop unit. In addition, a drip leg must be installed near the inlet connection. A ground joint union connection is required between the external shutoff valve and the unit connection to the gas valve to permit removal of the burner assembly for servicing. Union should be located near gas valve as shown in Figure 23. Route gas piping to unit so that it does not interfere with the removal of access panels. Piping must be supported and aligned to prevent strains or misalignment of the manifold assembly. Refer to Figure 23.

⚠ WARNING

ALIGNMENT OF BURNERS WITH FURNACE TUBES IS CRITICAL FOR GOOD COMBUSTION.

RIGIDLY SUPPORT AND ALIGN PIPING SUCH THAT IT DOES NOT DISPLACE OR TURN MANIFOLD OR CONTROL VALVE WHEN MAKING CONNECTION.

2. All units are furnished with standard female NPT pipe connections. Connection pipe sizes for CUR075 thru 150 units is ½″ NPT on 105 and 140 MBH furnaces and ¾″ NPT on 210, 245 and 280 MBH furnaces.

   The size of the gas supply piping to the unit must be based on length of run, number of units on the system, gas characteristics, BTU requirement and available supply pressure. All piping must be done in accordance with local codes or, in the absence of local codes, with the latest edition of the National Fuel Gas Code (ANSI Z223.1).

   NOTE: The gas connection size at the unit does NOT establish the size of the supply line.

3. **CAUTION:** These units are designed for either natural or LP gas and are specifically constructed at the factory for only one of these fuels. The fuels are NOT interchangeable. However, the furnace can be converted in the field from one fuel to the other with the appropriate factory kit. Only a qualified contractor, experienced with natural and propane gas systems, should attempt conversion. Kit instructions must be followed closely to assure safe and reliable unit operation.

4. With all units on a common line operating under full fire, natural gas main supply pressure should be adjusted to approximately 7.0″ W.C., measured at the unit gas valve. If the gas pressure at the unit is greater than 10.5″ W.C., the contractor must furnish and install an external type, positive shutoff service pressure regulator. The unit will not function satisfactorily if supply gas pressure is less than

5.5″ W.C. or greater than 10.5″ W.C.

NOTE: A minimum horizontal distance of 48″ between the regulator and the furnace flue discharge is required.

5. With all units on a common line operating under full fire, LP gas main supply pressure should be at least 11.0″ W.C. and must be no greater than 13.0″ W.C., measured at the unit gas valve. Unit will not function satisfactorily if supply gas pressure is less than 11.0″ W.C. or greater than 13.0″ W.C.

6. All pipe connections should be sealed with a pipe thread compound which is resistant to the fuel used with the furnace. A soapy water solution should be used to check all joints for leaks.

   A ⅛″ NPT plugged tap is located on the entering side of the gas valve for test gauge connection to measure supply (main) gas pressure. Another ⅛″ tap is provided on the side of the manifold for checking manifold pressure.

   CAUTION: The furnace and its individual shutoff valve must be DISCONNECTED from the gas supply system during any pressure testing of that system at test pressures in excess of ½ psig (13.8″ W.C.)

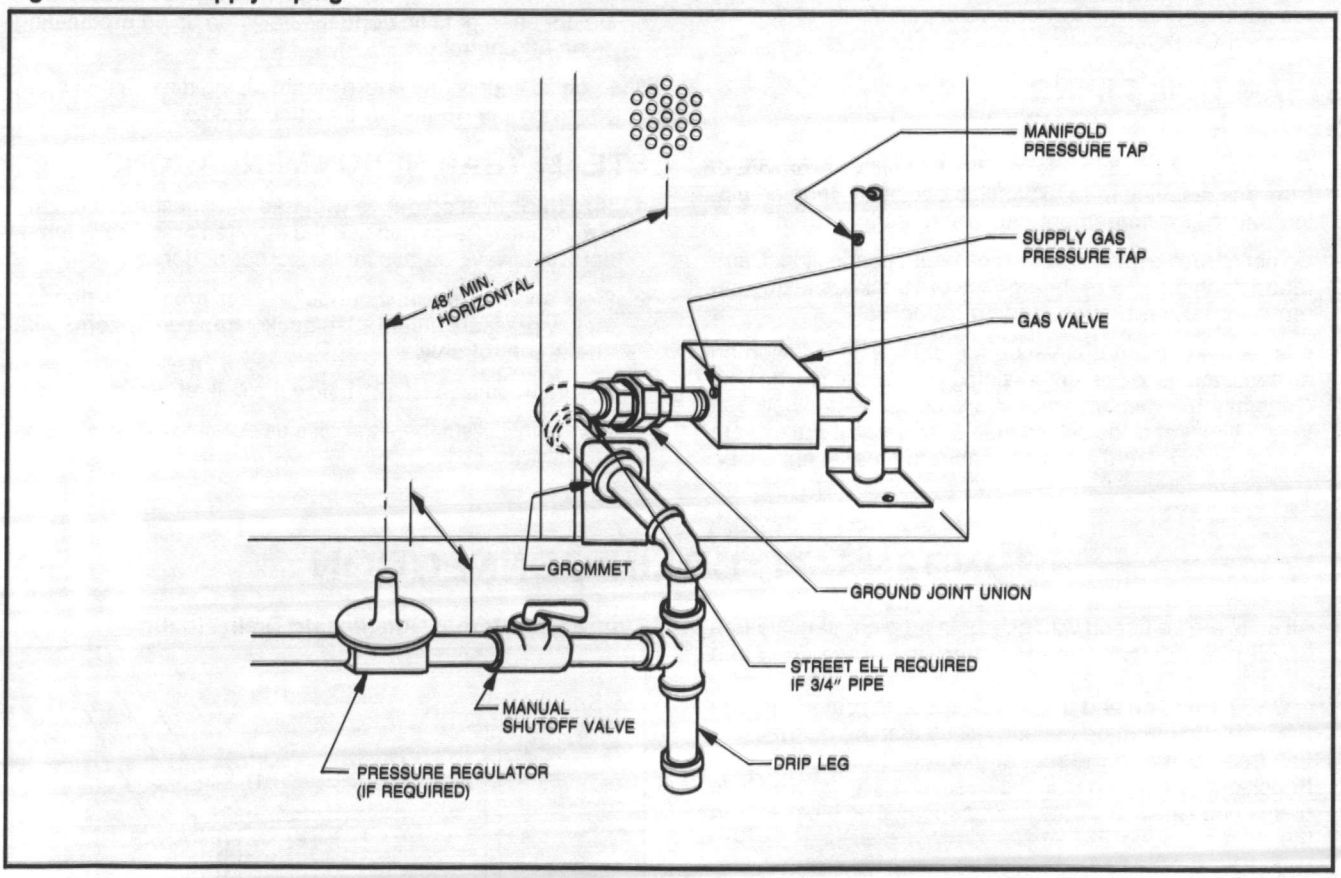
   CAUTION: The furnace must be ISOLATED from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing equal to or less than ½ psig.

7. There must be no obstruction to prevent the flow of combustion and ventilating air. A vent stack is not required and must never be used. The power ventor will supply an adequate amount of combustion air as long as the air passageways are kept free of any obstructions and the recommended external unit clearances are maintained.

⚠ WARNING

Units equipped with gas heating must not be operated in an atmosphere contaminated with chemicals which will corrode the unit such as halogenated hydrocarbons, cleaning solvents, refrigerants, pool exhaust, etc. Exposure to these compounds may cause severe damage to the gas furnace and result in improper or dangerous operation. Operation of the gas furnace in such a contaminated atmosphere constitutes product abuse and will void all warranty coverage by the manufacturer. Questions regarding specific contaminants should be referred to your local gas utility.

Figure 23. Gas Supply Piping



STEAM & HYDRONIC PIPING

LOCATION AND INSTALLATION

1. CUR075 thru 150 rooftop units furnished with hot water or steam coils require that supply and return lines be routed inside the curb and through the bottom of the unit. External lines are not recommended due to their exposure to freezing temperatures and interference with panel removal and service.

   NOTE: The side overhang curb configuration (refer to Figure 10) is not recommended for use with hydronic units.

2. Locate openings within the shaded area indicated in Figure 24. Openings for supply and return lines must be field cut in the embossment on the bottom of the unit.

3. Piping within the unit should be limited to only supply and return lines plus pipe unions to facilitate coil removal. All controls, valves, balancing cocks, strainers, etc. (furnished by others) should be located in the building.

4. Coil connection sizes for both hot water and steam are 2½″ NPT.

5. Upon completion of piping installation, all pipe openings in the unit must be sealed with plastic or rubber grommets, or with caulking compound to prevent pipe chaffing and air leakage.

6. **CAUTION:** Water coils must be protected from freezing (glycol, draining, etc.). Coil failure and water damage which results from freezing is not the responsibility of Snyder General Corporation.

STEAM COIL PIPING RECOMMENDATIONS

1. Be certain that adequate piping flexibility is provided. Stresses resulting from expansion of closely coupled piping and coil arrangement can cause serious damage.

2. 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.

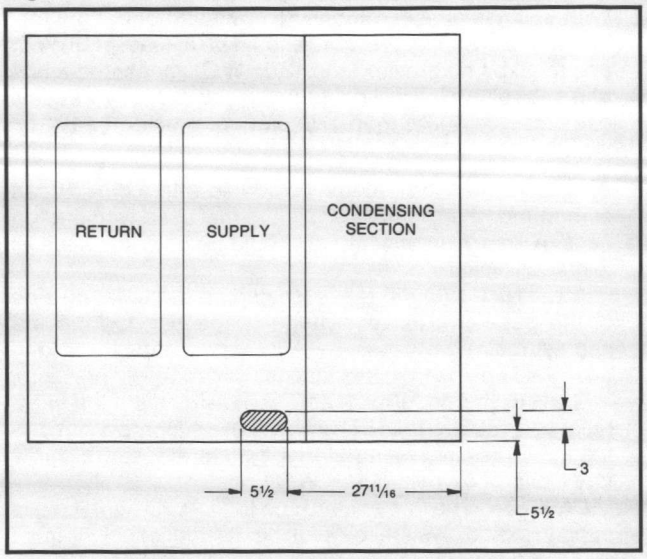
3. It is recommended that vacuum breakers be installed on all applications to prevent retaining condensate in the coil. Generally, the vacuum breaker is to be connected between the coil inlet and the return main. However, if the system has a flooded return main, the vacuum breaker should be open to the atmosphere and the trap design should allow venting of large quantities of air.

4. Do not drain steam mains or take-offs through coils. Drain mains ahead of coils through a steam trap to the return line.

5. Do not attempt to lift condensate when using modulating or on-off control.

6. Pitch all supply and return steam piping down a minimum of 1 inch per 10 feet in direction of flow.

Figure 24. Steam and Hydronic Piping Location



STEAM TRAP RECOMMENDATIONS

1. Size traps in accordance with trap manufacturer's recommendations. Be certain that the required pressure differential will always be available. Do not undersize.

2. Float and thermostatic or bucket traps are recommended for low pressure steam. Use bucket traps on systems with on-off control only.

3. Locate traps at least 12″ below the coil return connection.

4. Always install strainers as close as possible to the inlet side of the trap.

CONDENSATE DRAIN CONNECTION

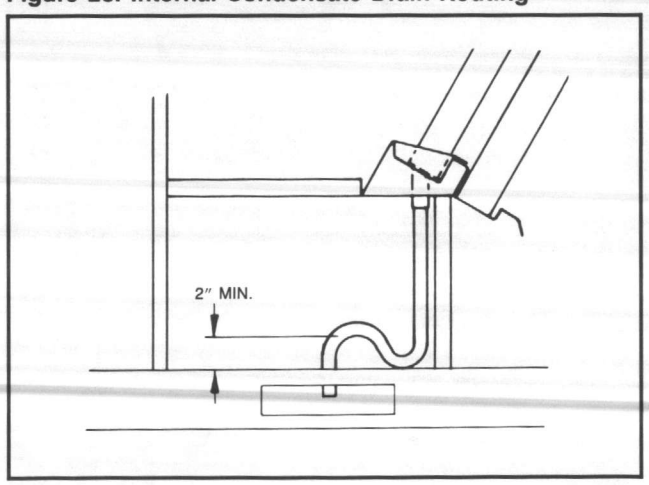
1. All units are equipped with a flexible tube condensate trap which may be connected to either side of the drain pan as shown in Figure 25.

   CAUTION: The end of the tube must be routed through the insulation and top of base rail so that the condensate has free access to the roof or external drainage system. Knock-outs are provided in the base rails. The unused hole on the opposite side of the drain pan must be blocked with the plug provided.

2. Drainage of condensate directly onto the roof may be acceptable; refer to local code. It is recommended that a small drip pad of either stone, mortar, wood or metal be provided to prevent any possible damage to the roof.

3. If condensate is to be piped into the building drainage system, the drain line must penetrate the roof external to the unit. Refer to local codes for additional requirements. The flexible tube condensate trap may be connected to an external drain line with a hose clamp.

Figure 25. Internal Condensate Drain Routing



4. Due to the fact that drain pans in any air conditioning unit will have some moisture in them, algae and fungus will grow due to airborne bacteria and spores. Periodic cleaning is necessary to prevent this build-up from plugging the drain and causing the drain pan to overflow.

CAUTION: The drain pan should also be kept clean to prevent the spread of disease. Cleaning should be performed by qualifed personnel.

UNIT OPTIONS

The following options may be factory or field installed (except where noted). Field installation is to be performed only by qualified personnel who are familiar with local codes and regulations and experienced with this type of equipment. Field installation instructions are provided with each accessory kit.

NOTE: This is a partial listing of the optional accessories available. Refer to product catalog and price list for a complete listing and part numbers.

LOW AMBIENT CONTROL (Ref. also IM 460)

Standard on all units is a thermostat (TC1) which controls condenser fan 1 in response to a combination of ambient and condenser air temperatures. The cut-in and cut-out temperatures for TC1 are 75°F and 55°F, respectively.

The low ambient control option will allow the unit's refrigeration system to operate in outdoor temperatures as low as 0°F by automatically cycling condenser fan 2 in response to condenser pressure.

Each refrigerant circuit is equipped with an independent condensing pressure control (PC1, PC2 and, on CUR 125 thru 150 units, PC3) set to open at 150 psig and close at 225 psig. These control condenser fan motor 2 in response to head pressure.

In addition to the condensing pressure switches, the low ambient option includes replacement low pressure switches (LP1, LP2, and on CUR125 thru 150 units, LP3) with a lower control band than the standard switches. These are provided to eliminate nuisance tripping which could otherwise occur during low ambient operation. The cut-in and cut-out pressures for the switches are 40 psig and 10 psig, respectively.

HIGH PRESSURE CONTROL (Ref. also IM 461)

The high pressure control option provides a way of independently shutting down each compressor in each refrigerant circuit if the circuit's condenser pressure rises too high. The high pressure switch works in conjunction with an impedance relay which prevents the compressor from starting until the control circuit is de-energized. This compressor lock-out characteristic is intended to alert maintenance personnel to a possible system problem, and to prevent compressor cycling. Causes of high condenser pressure may include non-condensables in the system, refrigerant overcharging, dysfunctional condenser fans, or a dirty condenser coil. Any problem should be corrected before resetting the control.

SEQUENCE OF OPERATION: If the pressure in the condenser rises above 400 ± 10 psig, the high pressure switch (HP1, HP2 or, on CUR125 thru 150 units, HP3) opens, thereby energizing the impedance relay (R1, R2 or, on CUR125 thru 150 units, R3). The impedance relay locks itself on by opening its normally closed contacts in series with the high pressure switch. The compressor contactor is de-energized because the voltage drop across the impedance relay coil is so high.

To reset the high pressure control, the condenser pressure must drop below 300 ± 20 psig. In addition, power must be removed from the impedance relay's coil by (1) raising the setpoint of the thermostat, (2) disconnecting the thermostat wire from the R terminal on TB1 terminal block or (3) opening the disconnect switch. On units equipped with pumpdown, remove power from the coil by opening the disconnect switch.

FREEZESTAT CONTROL (Ref. also IM 456)

The freezestat control option is intended to protect the unit's refrigeration system from liquid slugging due to evaporator coil freeze-up. One control (TC7) senses the coil temperature. When the coil temperature drops below the cut-out setpoint of the control, it breaks the refrigeration control circuit, thereby de-energizing any operational compressors. The cut-out setpoint is adjustable (15°F to 32°F), providing flexibility for different loading and airflow conditions. The cut-in setpoint is fixed at 39°F.

FIRESTAT CONTROL (Ref. also IM 457)

The firestat control option is intended to shut the unit down in case of a fire in the building. The option can include a supply air sensing thermostat, a return air sensing thermostat, or both. If either firestat is exposed to an air temperature over its setpoint, it will open, de-energizing the entire low voltage control circuit. As a result, any heating or cooling operation will be discontinued, the supply fan will shut down and the optional motorized outside air damper will close completely. The return air firestat TC5 is set to open at 125°F. The supply air firestat TC6 is set to open at 125°F on cooling only units and 240°F on heating/cooling units. Both firestats must be manually reset.

MOTORIZED OUTSIDE AIR DAMPER (Ref. also IM 453)

The motorized outside air option will provide 2-position control of the outside air damper. The open and closed positions of the damper may be set by adjusting the damper linkage arrangement.

The motorized outside air damper is energized through unit terminal D in two ways. It can be energized (1) with the fan, by connecting terminals D and 18 on terminal block TB1 or (2) with a 24-hour timeclock (refer to Figures 18, 20, 21 and 22). Whenever terminal D is energized, the outside air damper will open to its set position. Whenever terminal D is de-energized, the spring-return motor will fully close the outside air damper.

ECONOMIZER (Ref. also IM 451)

The economizer option will allow the building to utilize free outdoor cooling at times when mechanical cooling would otherwise be activated. The economizer control determines the suitability of the outdoor air by comparing its total heat content (enthalpy) with (1) an enthalpy control setpoint or (2) the total heat content of the return air. The latter scheme will provide the most economy and requires the use of the Return Air Enthalpy Control option or accessory. In either case, the economzer is activated by the space thermostat and functions as a true first stage of cooling. Figure 26 shows the temperature/humidity relationships for the various enthalpy control setpoints available under scheme (1) above.

Mechanical cooling is controlled independently of the economizer so that it is possible for both to operate simultaneously. This feature provides better temperature control without sacrificing economy.

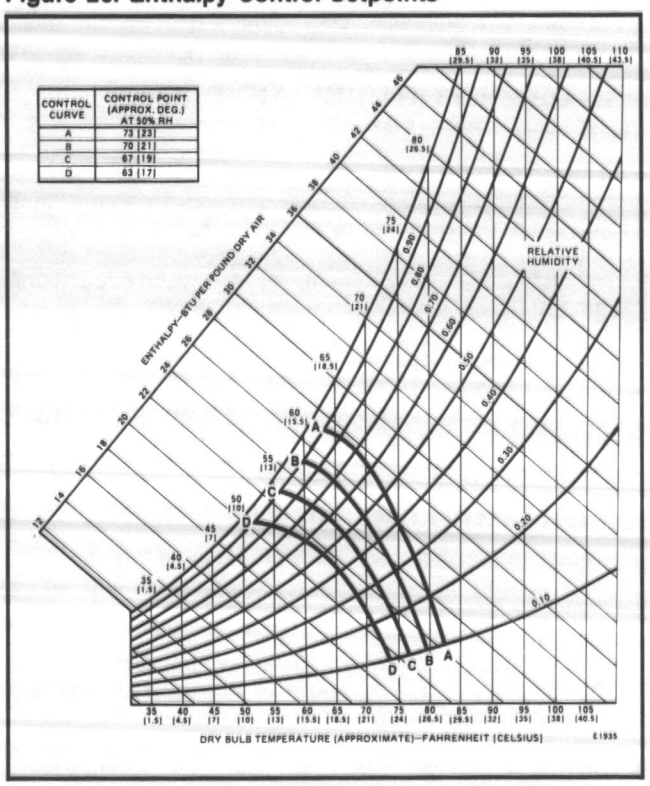
SEQUENCE OF OPERATION: The economizer is energized through unit terminal D in two ways. It can be energized (1) with the fan, by connecting terminals D and 18 on

terminal block TB1 or (2) with a 24-hour timeclock (refer to Figures 18, 20, 21 and 22). Whenever terminal D is de-energized, the spring-return motor will fully close the outside air damper. If terminal D is energized and the thermostat is not calling or the outside air is not suitable for cooling, the outside air damper will be held at minimum position. The damper will be at minimum position in the heating mode.

When the building space temperature rises above the first stage setpoint of the thermostat, the first stage cooling circuit will be energized through unit terminal Y1 and the supply fan (if not set for continuous operation) will be energized through unit terminal G. If the enthalpy of the outside air is below the economizer setpoint (single enthalpy option) or the return air enthalpy (differential enthalpy option), the outside air damper will be proportioned open (and the return air damper will be proportioned closed) to maintain a discharge air temperature of between 50°F and 56°F. An LED on the economizer module face will light to indicate low outdoor air enthalpy. If the outside air is unable to keep up with the building load, the space temperature will rise above the second stage setpoint of the thermostat. If the outside air is still suitable for cooling, the economizer module will cycle on the first stage compressor. Note that as the discharge air temperature drops, the economizer will start to close off the outdoor air damper.

If the enthalpy of the outside air is above the economizer setpoint (single enthalpy option) or the return air enthalpy (differential enthalpy option), the economizer will keep the outside air damper at minimum position, and the thermostat will cycle on compressors as required.

Figure 26. Enthalpy Control Setpoints



SPECIAL VENTILATION/SMOKE CONTROL (Ref. also IM 463)

The special ventilation option is intended to be used with a field supplied device (having normally open contacts), typically a smoke detector. Refer to Figures 18, 19, 20, 21 and 22. When activated, all cooling and heating will be shut down, the supply fan will be energized and the optional economizer or motorized outside air damper will be opened completely to admit the maximum amount of ventilation air. A multi-pole relay (R10) performs the required switching in the unit. This optional or accessory relay plugs into a socket which is standard on all units.

SEQUENCE OF OPERATION: If there is a special ventilation condition in the building, the field supplied device should make a contact closure, energizing unit terminal SV. Relay R10 is energized which simultaneously performs four functions:

1. Contacts between relay R10 terminals 1 and 9 open and contacts between 9 and 5 close, bypassing thermostat control and energizing supply fan contactor M10.
2. Contacts between R10 terminals 4 and 12 open and contacts between 12 and 8 close, bypassing timeclock or thermostat control and energizing the damper motor DM.
3. Normally closed contacts between R10 terminals 11 and 3 open, thereby de-energizing any heating or cooling that may be on.
4. Normally open contacts between R10 terminals 6 and 10 close, thereby jumping out the minimum position potentiometer on the optional economizer. As a result, the outside air damper will open completely.

POWER SAVER THERMOSTAT (Ref. also IM 468)

The power saver thermostat option is intended to provide energy savings by locking out a stage of electric heating when the ambient temperature is above the thermostat's setpoint. The setpoint of the power saver thermostat (TC15) is adjustable.

LOCAL/REMOTE STATUS MONITOR (Ref. also IM 464)

The local/remote status option will monitor and provide status indication of the following conditions: Cool On, Cool Fail, Heat On, and Heat Fail. Clogged Filter and Fan On status indication require separate accessories.

LOCAL STATUS INDICATION: The "heart" of the status monitor option is a printed circuit board (PCB1) which is plugged into socket P3 located in the main control box. LED lights on PCB1 provide local status indication for each refrigeration circuit, the heating system and the filter (if Clogged Filter accessory is furnished). The green LED indicates ON status and the red LED indicates FAIL status.

REMOTE STATUS INDICATION: The status monitor module (PCB1) will provide remote status indication if a remote status panel accessory is connected to the unit terminal block TB1 as shown in Figures 18, 19 and 21. On the remote panel, there is only one Cool On and one Cool Fail light. If any refrigeration circuit is on or if any circuit has failed, the appropriate indicator will light.

If furnished, the fan switch accessory will provide indication (remote only) of Fan On status. Since this is a differential pressure switch, false indication will never occur due to overload tripping, broken belts, etc.

Labels are included with the remote status panel to identify the light functions. Two panel covers are provided for four- or six-light applications.

HOT GAS BYPASS (Factory Installed Option Only)

Hot gas bypass is a system for maintaining evaporator pressure at or above a minimum value when the refrigeration system is operating under low load conditions. The reason for doing this is to prevent evaporator coil freeze-up, to prevent excessive compressor cycling and to keep refrigerant

velocity in the evaporator high enough for proper oil return to the compressor.

The hot gas bypass valve is factory set to begin opening at 57 psig suction pressure (32°F for R22) when the gas charged bulb is in a 60°F ambient temperature. Since the bulb is factory mounted in the discharge air, and discharge air temperatures are usually around 60°F, the valve should begin opening at 57 psig.

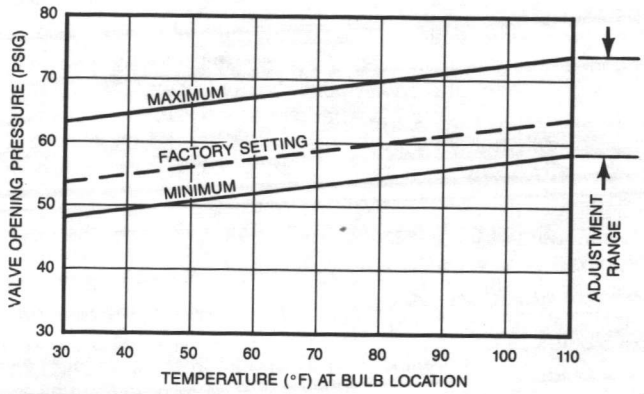
At a given bulb temperature, the valve opening pressure setting can be adjusted over a 15 psi range by changing the pressure of the gas charge in the adjustable bulb. At a 60°F bulb temperature, the range is 52 to 67 psig (refer to Figure 27). To raise the valve opening pressure setting, remove the cap on the bulb and turn the adjustment screw clockwise. To lower the setting, turn the screw counterclockwise. One turn is equivalent to a change of about 1 psi. Do not force the adjustment beyond the range for which it is designed or damage to the assembly will occur.

The valve opening pressure setting can also be changed by changing the air bulb ambient temperature. For every change of 7°F in the bulb temperature, the opening pressure will change 1 psi in the same direction. For example, if the air bulb (factory setting) were strapped to a 102°F liquid line, the valve opening pressure would increase 6 psi to 63 psig (refer to Figure 27).

The circuit cooling capacity reduction of the hot gas bypass valve will vary significantly with operating conditions, but is about 4 tons. The valve will operate at full capacity when the suction temperature has dropped about 6°F (7 to 8 psi for R22) relative to the suction temperature at valve opening.

On units equipped with optional pumpdown, the hot gas bypass option will include a solenoid valve which is mounted upstream from the hot gas bypass valve. The solenoid valve is energized (opened) when the thermostat makes a first stage cooling call.

Figure 27. Hot Gas Bypass Valve Adjustment



CHECK, TEST & START PROCEDURE

⚠ WARNING

ELECTRIC SHOCK HAZARD. Could cause severe injury or death. Failure to bond the frame of this equipment to the building electrical ground by use of the grounding terminal provided or other acceptable means may result in electrical shock. Disconnect electric power before servicing equipment. Service to be performed only by qualified personnel.

BEFORE START-UP

⚠ WARNING

MOVING MACHINERY HAZARD

DISCONNECT POWER TO THIS UNIT AND PADLOCK AT "OFF" BEFORE SERVICING THE FANS.

This procedure has been prepared as a guide for the proper Check, Test & Start of the rooftop unit.

The Check, Test & Start procedure provides a step-by-step sequence which, if followed, will assure the proper startup of the equipment in the minimum amount of time. Air balancing of duct system is not considered part of the Check, Test & Start of the rooftop unit. However, it is an important phase of any air conditioning system start-up and should be performed upon completion of the Check, Test & Start procedure.

The Check, Test & Start procedure at outside ambients below 55°F should be limited to a readiness check of the refrigeration system with the required final check and calibration left to be completed when the outside ambient rises above 55°F.

TOOLS REQUIRED TO PERFORM CHECK, TEST & START

1. Refrigeration gauge and manifold.
2. Voltmeter.
3. Clamp-on ammeter.
4. Ohmmeter.
5. Test lead. Minimum #16 AWG with insulated alligator clips.
6. Manometer for verifying gas pressure 0 to 20″ W.C.
7. Air temperature measuring device.
8. General refrigeration mechanics' tools.

TEMPORARY HEATING OR COOLING

If it is planned that the unit will be used for temporary heating or cooling, Check, Test & Start must first be performed in accordance with this bulletin. Failure to comply with this requirement will void the warranty. New filters should be installed after the machines are used for temporary heating or cooling and the coils, fans, and motors checked for unacceptable levels of construction dust and dirt.

CONTRACTOR RESPONSIBILITY

The installing contractor must be certain that:

- All supply and return air ductwork is in place and corresponds with installation instructions.
- All thermostats are mounted and wired in accordance with installation instructions.
- The remote status panel (optional equipment) is installed and wired in accordance with installation instructions.
- All electric power, all gas, hot water or steam line connections, and the condensate drain installation have been made to each unit on the job. These main supply lines must be functional and capable of operating all units simultaneously.

PRELIMINARY IN BUILDING

Prior to the beginning of Check, Test & Start procedures on the roof, the following steps should be completed in the building.

CAUTION: With the disconnect ON and the thermostat not satisfied, the machine will run. Do not start the machine until all the necessary pre-checks and tests have been performed.

1. THERMOSTAT. Set the thermostat in the conditioned space at a point at least 10°F below zone temperature. On cooling only models, set the thermostat system switch on COOL and the fan switch on AUTO. On heating/cooling models, set the thermostat system switch on AUTO and the fan switch on AUTO.
2. TIMECLOCK (OPTIONAL). Set the timeclock in the day or override mode.
3. NIGHT SETBACK THERMOSTAT (OPTIONAL). Set thermostat at a point at least 10°F below zone temperature.

CHECK OF ROOF CURB INSTALLATION

The proper installation of the unit on the roof curb should be checked. Any deficiencies observed should be noted in a separate report and forwarded to the contractor. The unit and curb assembly should have been installed level. The flashing of the roof mounting curb to the roof should be checked, especially at the corners, for good workmanship.

CHECK FOR MINIMUM CLEARANCES

A minimum of 36″ clearance must be provided on the main control box side of the unit. A minimum of 48″ clearance is recommended on all other sides. A clearance of 75″ is desirable on the control box side for removal of the fan shaft or heating section.

The outside air intake must be remote from all building exhausts. The condenser air intake must be remote from all exhausts to assure full condenser capacity.

CHECK & REPORT DAMAGE

Damaged or missing parts, if any, should be itemized in a separate report stating what action has been initiated by the contractor to correct them. The absence of this information will be the basis for assuming that the unit was complete and in good condition on date of Check, Test & Start.

CHECK FOR OBSTRUCTIONS, FAN CLEARANCE, WIRING

During the performance of the Check, Test & Start procedure you will have occasion to work in the various sections of the unit. It is important that you remove extraneous construction and shipping materials that may be found during this procedure.

All fans should be rotated manually to check for proper clearances and make certain that they rotate freely. Bolts and screws that may have jarred loose during shipment to the jobsite should be checked for tightness. All electrical connections should be re-tightened.

PRE-STARTUP PRECAUTIONS

It is important to your safety that the unit has been properly grounded during installation. Check ground lug connection in main control box for tightness prior to closing circuit breaker or disconnect switch.

Verify that supply voltage on line side of disconnect agrees with voltage on unit identification plate and is within the utilization voltage range as indicated in Table 5.

Table 5.*

SYSTEM VOLTAGE	NAMEPLATE	UTILIZATION VOLTAGE	
		MIN.	MAX.
208-230/60/3	208/230	187	253
480/60/3	460	414	506
575/60/3	575	517	633
380/50/3	380	342	418

*Full load amp rating of the motors must not be exceeded.

SYSTEM VOLTAGE — That nominal voltage value assigned to a circuit or system for the purpose of designating its voltage class.

NAMEPLATE VOLTAGE — That voltage assigned to a piece of equipment for the purpose of designating its voltage class and for the purpose of defining the minimum and maximum voltage at which the equipment will operate.

UTILIZATION VOLTAGE — The voltage of the line terminals of the equipment at which the equipment must give fully satisfactory performance.

Once it is established that supply voltage will be maintained within the utilization range under all system conditions, check and calculate if an unbalanced condition exists between phases. Calculate percent voltage unbalance as follows:

$$\text{③ Percent Voltage Unbalance} = 100 \times \frac{\text{② Max. voltage deviations from average voltage}}{\text{① Average voltage}}$$

GIVEN: Example — With voltage of 220, 216 and 213.

HOW TO USE THE FORMULA:

① Average voltage = 220 + 216 + 213 = 649 ÷ 3 = 216

② Max. voltage deviation from average voltage = 220 − 216 = 4

$$\text{③ Percent Voltage Unbalance} = 100 \times \frac{4}{216} = \frac{400}{216} = 1.8\%$$

Percent voltage unbalance must not exceed 2%.

CHECK FIELD DUCT CONNECTIONS

Verify that all duct connections are tight and that there is no air bypass between supply and return.

CONTROL SYSTEM CHECK, TEST & START PROCEDURE

CONTROL VOLTAGE CHECK

With disconnect switch in the open (off) position, disconnect wire 500 from low voltage transformer T1.

Close the disconnect switch to energize T1 control transformer.

Check primary and secondary (24V) of control transformer T1.

THERMOSTAT PRELIMINARY CHECK

With disconnect switch open and wire 500 disconnected from T1 transformer, attach one lead of ohmmeter to terminal R on TB1 terminal block. Touch, in order, the other ohmmeter lead to terminals Y1, Y2 and G at TB1 terminal block. There must be continuity from terminal R to terminals Y1, Y2 and G.

R to Y1 indicates first stage cool.
R to Y2 indicates second stage cool.
R to G indicates fan (auto).

Replace wire 500 on T1 transformer.

ECONOMIZER DAMPERS & FILTERS CHECK, TEST & START PROCEDURE

FILTER SECTION CHECK

Remove filter section access panels and check that filters are properly installed. Note airflow arrows on filter frames. Refer to Figure 32.

ECONOMIZER AIR CYCLE CHECK

All Options: Open disconnect switch. If economizer is not set up to operate with timeclock (refer to Figures 19, 20, 21 and 22), install jumper wire between terminals R and D, and disconnect jumper between terminals D and 18 on TB1 terminal block (disables fan). In order to disable mechanical cooling, disconnect wire 542 or optional freezestat lead from terminal A7 or A8 on TB2 terminal block (labeled FREEZE). In order to disable fan, remove thermostat wire from terminal G on TB1 terminal block. To disable heat on heating/cooling units, remove thermostat wires from terminals W1 and W2 on TB1 terminal block. Disconnect jumper wire at terminal P or P1 on face of economizer module. Place a jumper across ter-

minals T and T1 on the economizer module to simulate a warm mixed air temperature.

Standard Economizer Only: A 620 ohm resistor should be in place across the S_R and + terminals of the economizer module. Set the enthalpy control on the face of the module to the "A" setting. Close disconnect switch. Fresh air damper should modulate toward its open position. In addition, the LED on the face of the economizer module should light. Note that since the economizer is controlled by conditions of outside air temperature and humidity, it may not be possible to perform this check at outdoor temperatures above 75°F. Refer to Figure 26.

Disconnect the jumper and the mixed air sensor at T and T1 to simulate a low mixed air temperature. Fresh air damper should now modulate toward its full closed position.

Adjust and tighten damper motor and damper blade linkages.

Connect jumper wire across terminals P and P1 on economizer module. This enables the minimum fresh air position control so that outside air damper may now open to its minimum position. Turn minimum position potentiometer screw counterclockwise. Fresh air damper should modulate toward its closed position. Turn minimum position potentiometer screw clockwise. Fresh air damper should now modulate toward its open position.

Open disconnect switch. Spring return motor should close fresh air damper 100%. Set enthalpy control to its specified setpoint. If setpoint is not specified, it is recommended that the enthalpy control be set at "B."

Replace thermostat wires at terminals G, W1 and W2 on TB1 terminal block. Reconnect wire 542 or freezestat lead at terminal A7 or A8 on TB2 terminal block. If economizer is to be enabled with fan, remove R to D jumper and reconnect D to 18 jumper. Connect mixed air sensor to terminals T and T1 on the economizer module.

Differential Enthalpy Option Only: The enthalpy control on the face of the economizer module should be turned to the "D" setting (full clockwise). Close disconnect switch. Gently blow through a tube or straw into the upper left vent of the C7400 return sensor to simulate high return air enthalpy, or disconnect S_R terminal. Fresh air damper should modulate toward its open position. In addition, the LED on the face of the economizer module should light. Replace wire on S_R terminal.

Gently blow through a tube or straw into the upper left vent of the C7400 outdoor sensor to simulate high outdoor air enthalpy, or disconnect S_O terminal. Fresh air damper should modulate toward its closed position. The LED on the economizer module should turn off. Replace wire on S_O terminal.

Adjust and tighten damper motor and damper blade linkages.

Connect jumper wire across terminals P and P1 on economizer module. This enables the minimum fresh air position control so that outside air damper may now open to its minimum position. Turn minimum position potentiometer screw counterclockwise. Fresh air damper should modulate toward its closed position. Turn minimum position potentiometer screw clockwise. Fresh air damper should now modulate toward its open position.

Open disconnect switch. Spring return motor should close fresh air damper 100%. Replace thermostat wires at terminals G, W1 and W2 on TB1 terminal block. Reconnect wire 542 or freezestat lead at terminal A7 or A8 on TB2 terminal block. If economizer is to be enabled with fan, remove R to D jumper and reconnect D to 18 jumper. Remove jumper and connect mixed air sensor across terminals T and T1 on the economizer module.

ECONOMIZER FRESH AIR DAMPER SETTINGS

The minimum position potentiometer is located on the face of the economizer module. Unless regulated by local codes or unusual conditions exist, a 15% fresh air setting should not be exceeded to maintain optimum heating and cooling efficiency. Determine the fresh air requirement and check position of minimum position potentiometer. Readjust if necessary. Note that 15% fresh air does not correspond to 15% of motor stroke.

EVAPORATOR BLOWER FAN CHECK, TEST & START PROCEDURE

BEARING CHECK

Prior to energizing any fans, check and make sure that all setscrews are tight so that bearings are properly secured to shafts. Bearings are the eccentric locking type. If the eccentric collar has come loose during shipping, the bearing must be resecured to the shaft using the following procedure:

1. Slide the collar up to the bearing and turn it by hand in the direction of shaft rotation until it slips over the inner extension and engages in the eccentric.
2. Keep turning the collar in the direction of shaft rotation until the collar and inner ring eccentric grooves lock.
3. Place a punch in the blind hole in the collar and strike it sharply in the direction of shaft rotation to lock the collar and inner ring tightly together. This also tightens the bearing to the shaft.
4. Now tighten the collar setscrew firmly to lock the bearing on the shaft.

SET EVAPORATOR FAN RPM

Actual RPM's must be set and verified with a tachometer. Refer to Tables 7 and 8 for basic unit fan RPM. Refer also to "Air Balancing" section of this manual.

With disconnect switch open, disconnect thermostat wires from terminals Y1, Y2, W1 and W2. This will prevent heating and mechanical cooling from coming on. Place a jumper wire across terminals R and G at TB1 terminal block. Close disconnect switch; evaporator fan motor will operate so RPM can be checked.

CAUTION: Airflow must be adjusted so that temperature rise does not exceed 40°F on electric heat units with 70°F entering air. For gas heat units, the airflow must be adjusted so that the air temperature rise falls within the ranges given in Table 16.

DRIVE BELT TENSION AND ALIGNMENT ADJUSTMENT

Check that the driving and driven sheaves are in alignment and that the shafts are parallel by placing a straightedge across the faces of the sheaves. There should be no gap between the straightedge and the sheaves.

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

1. Measure span length (t) in inches as shown in Figure 28.
2. From Figure 28, the deflection height (h) is always 1/64" per inch of span length (t). For example, a 16" span length would require a deflection of 16/64" or 1/4".
3. Determine the minimum and maximum recommended pounds force using Table 6.

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

4. Using a spring scale, apply a perpendicular force to any ONE of the belts at the mid-point of the span as shown in Figure 28. Compare this deflection force with 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 the normal position, use a straightedge or stretch a cord from sheave to sheave to use as a reference line. On multple-belt drives, an adjacent undeflected belt can be used as a reference.

EVAPORATOR FAN ROTATION CHECK

Check that fan rotates clockwise when viewed from the drive side of unit and in accordance with rotation arrow shown on blower housing. If it does not, reverse the two incoming power cables at PB terminal block. In this case, repeat bearing check.

Do not attempt to change load side wiring. Internal wiring assures all motors will rotate in correct direction once evaporator fan motor rotation check has been made.

ELECTRICAL INPUT CHECK

Make preliminary check of evaporator fan ampere draw and verify that motor nameplate amps are not exceeded. A final check of amp draw should be made upon completion of air balancing of the duct system. Refer to Table 11.

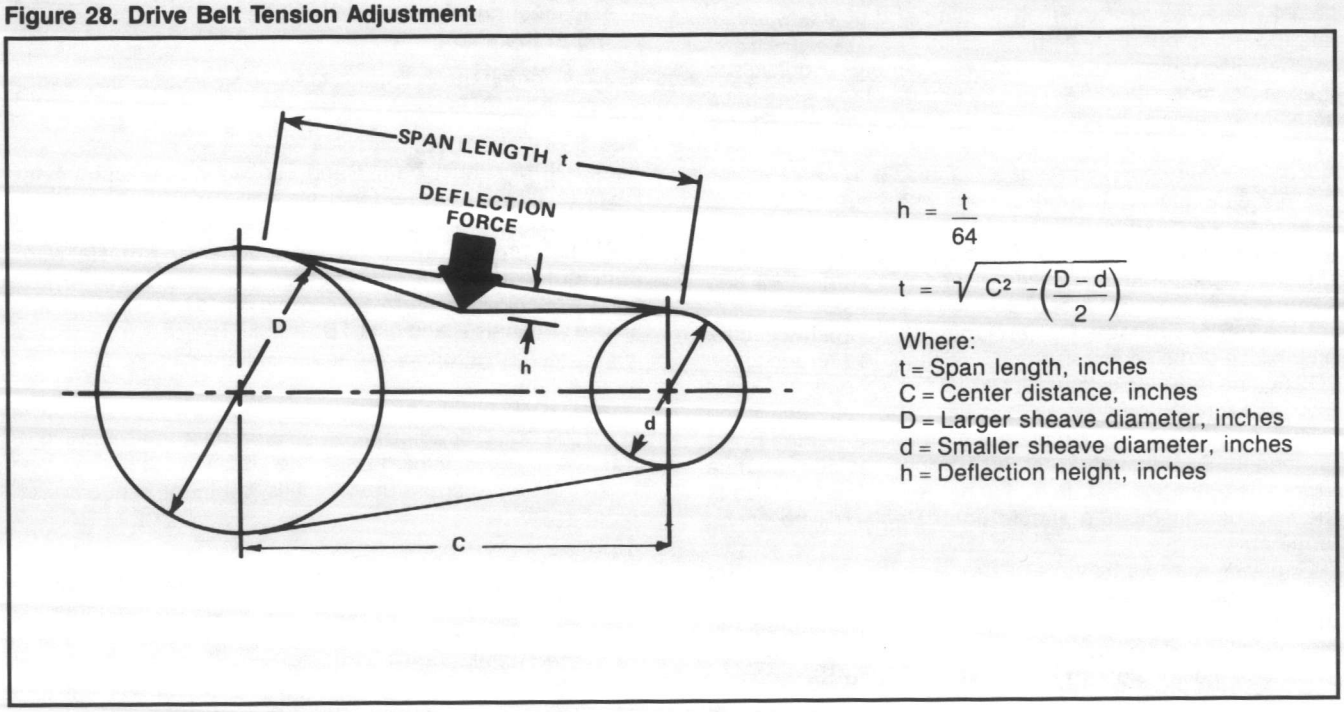
RESTORING CONNECTIONS

With disconnect switch open, remove jumper wire from terminals R and G at TB1 terminal block, and reconnect thermostat wires to terminals Y1, Y2, W1 and W2.

Table 6. 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.
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

Figure 28. Drive Belt Tension Adjustment



$$h = \frac{t}{64}$$

$$t = \sqrt{C^2 - \left(\frac{D-d}{2}\right)}$$

Where:
t = Span length, inches
C = Center distance, inches
D = Larger sheave diameter, inches
d = Smaller sheave diameter, inches
h = Deflection height, inches

Table 7. Supply Fan Performance Data ⑤

CUR MODEL	CFM	EXTERNAL STATIC PRESSURE (INCHES W.C.) ④															
		0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
075F, 076F	2600	***669***	***0.44***	816	0.59	916	0.75	1004	0.92	1084	1.09	1157	1.28	***1226***	***1.47***	***1291***	***1.67***
	2800	***734***	***0.53***	847	0.69	944	0.85	1030	1.03	1109	1.21	1181	1.40	***1249***	***1.60***	1312	1.91
	3000	770	0.62	877	0.79	973	0.97	1053	1.15	1135	1.34	1206	1.54	1273	1.75	1336	1.96
	3200	807	0.73	909	0.91	1002	1.10	1086	1.29	1162	1.49	1232	1.70	1298	1.91	1360	2.12
	3400	845	0.85	942	1.04	1032	1.24	1114	1.44	1159	1.65	1259	1.87	1324	2.09	1384	2.31
085F	3000	***770***	***0.62***	***877***	***0.79***	973	0.97	1053	1.15	1135	1.34	1206	1.54	1273	1.75	1336	1.96
	3200	***807***	***0.73***	909	0.91	1002	1.10	1086	1.29	1162	1.49	1232	1.70	1298	1.91	***1360***	***3.12***
	3400	***845***	***0.85***	942	1.04	1032	1.24	1114	1.44	1189	1.65	1259	1.87	1324	2.09	1384	2.31
	3600	***884***	***0.99***	976	1.19	1063	1.40	1144	1.61	1217	1.83	1285	2.05	1349	2.28	1410	2.51
	3800	923	1.14	1010	1.35	1095	1.57	1173	1.79	1246	2.02	1313	2.25	1376	2.48	1436	2.73
086F	3000	***802***	***0.68***	908	0.86	1002	1.07	1085	1.28	1161	1.50	1230	1.72	1297	1.95	***1359***	***2.18***
	3200	***841***	***0.80***	942	0.99	1034	1.20	1115	1.43	1190	1.66	1259	1.89	1324	2.13	1384	2.37
	3400	***880***	***0.94***	978	1.13	1006	1.35	1147	1.59	1220	1.83	1288	2.08	1352	2.33	1412	2.58
	3600	921	1.09	1014	1.29	1100	1.52	1178	1.76	1251	2.02	1318	2.28	1381	2.54	1440	2.80
	3800	962	1.26	1050	1.46	1134	1.70	1211	1.95	1282	2.22	1348	2.49	1410	2.76	1469	3.04
100F	3400	***880***	***0.94***	978	1.13	1066	1.35	1147	1.59	1220	1.83	***1288***	***2.08***	1352	2.33	1412	2.58
	3600	***921***	***1.09***	1014	1.29	1100	1.52	1178	1.76	***1251***	***2.02***	1318	2.28	1381	2.54	1440	2.80
	3800	962	1.26	1050	1.46	1134	1.70	1211	1.95	1282	2.22	1348	2.49	1410	2.76	1469	3.04
	4000	1004	1.45	1088	1.66	1169	1.90	1244	2.16	1314	2.44	1379	2.72	1440	3.00	***1498***	***3.29***
	4200	1046	1.66	1126	1.87	1204	2.12	1277	2.39	1346	2.67	1410	2.96	1470	3.26		
110F	3400	***679***	***0.73***	***781***	***0.98***	873	1.26	957	1.58	1034	1.91	1105	2.26	1171	2.26	1233	2.99
	3600	***706***	***0.83***	805	1.10	894	1.39	975	1.71	1051	2.05	1121	2.41	1188	2.78	***1249***	***3.17***
	3800	***733***	***0.95***	829	123	916	1.53	995	1.85	1069	2.20	1139	2.57	1204	2.95	1266	3.36
	4000	***761***	***1.07***	855	1.37	938	1.68	1016	2.01	1088	2.36	1156	2.74	1221	3.14	1282	3.55
	4200	790	1.21	880	1.52	961	1.84	1037	2.18	1108	2.54	1175	2.93	1239	3.33	1299	3.75
	4400	818	1.36	906	1.68	985	2.01	1059	2.36	1128	2.73	1194	3.13	1257	3.54	1316	3.97
125F	4000	***761***	***1.07***	***855***	***1.37***	938	1.68	1016	2.01	1088	2.36	1156	2.74	1221	3.14	1282	3.55
	4200	***790***	***1.21***	***880***	***1.52***	961	1.84	1037	2.18	1108	2.54	1175	2.93	1239	3.33	1299	3.79
	4400	***818***	***1.36***	***906***	***1.68***	985	2.01	1059	2.36	1128	2.73	***1194***	***3.13***	1257	3.54	1316	3.97
	4600	***847***	***1.53***	932	1.86	1009	2.20	1081	2.56	1149	2.94	1214	3.34	1275	3.76	1334	4.20
	4800	***876***	***1.71***	959	2.05	1034	2.40	1104	2.78	1170	3.16	1234	3.57	1294	4.00	1352	4.44
	5000	***906***	***1.90***	986	2.25	1059	2.62	1128	3.00	1193	3.40	1255	3.82	1314	4.25	1371	4.70
	5200	936	2.11	1013	2.47	1085	2.85	1152	3.25	1216	3.66	1276	4.08	1334	4.52	1390	4.98
	5400	966	2.34	1041	2.71	1111	3.10	1176	3.51	1238	3.92	1298	4.36	1355	4.81	***1410***	***5.27***
	5600	996	2.58	1069	2.96	1137	3.37	1201	3.78	1262	4.21	1321	4.65	1376	5.11	1430	5.58
126F	4000	***784***	***1.14***	***876***	***1.44***	959	1.76	1036	2.10	1108	2.47	1176	2.86	1239	3.26	1300	3.67
	4200	***814***	***1.29***	***903***	***1.60***	983	1.93	1058	2.28	1129	2.66	1195	3.05	1258	3.46	1318	3.89
	4400	***844***	***1.45***	930	1.78	1008	2.12	1081	2.48	1150	2.86	1215	3.26	1277	3.68	1337	4.12
	4600	***874***	***1.63***	957	1.97	1034	2.32	1105	2.69	1172	3.08	1236	3.49	1297	3.92	1356	4.37
	4800	***904***	***1.82***	986	2.17	1060	2.54	1129	2.92	1195	3.32	1258	3.74	1318	4.17	1375	4.63
	5000	932	2.02	1014	2.39	1086	2.77	1154	3.16	1218	3.57	1280	4.00	1338	4.44	1395	4.91
	5200	966	2.24	1043	2.62	1113	3.01	1179	3.42	1242	3.84	1302	4.27	1360	4.73	***1416***	***5.20***
	5400	997	2.48	1071	2.87	1141	3.28	1205	3.70	1267	4.12	1326	4.57	1382	5.03	1437	5.51
	5600	1029	2.74	1101	3.14	1168	3.56	1231	3.99	1291	4.43	1349	4.88	1405	5.36	1458	5.85

NOTES:

DO NOT SELECT IN SHADED AREAS (FOR INTERPOLATION ONLY)

① Selections in ***BOLD ITALICS*** require a field drive change. See Table 8 for drive ranges.
② Selections below **heavy line** require oversize motor.
③ Maximum fan RPM = 1500.
④ Table includes all internal pressure drops including cabinet losses. See Table 36 in product catalog for additional pressure drops that must be considered as part of external static pressure drop.
⑤ Refer to catalog for fan curves.

Table 8. Supply Fan RPM Range

CUR MODEL	MOTOR SHEAVE — ADJUSTABLE FAN SHEAVE — FIXED		FACTORY SETTING 2 TURNS OPEN					
	MOTOR SHEAVE — TURNS OPEN		0	1	2	3	4	5
075F, 076F	FAN RPM	1.0 HP MOTOR	1032	969	915	861	808	754
		1.5 HP MOTOR	1209	1146	1082	1018	955	891
085F	FAN RPM	1.5 HP MOTOR	1209	1146	1082	1018	955	891
		2.0 HP MOTOR	1351	1290	1228	1167	1105	1044
086F	FAN RPM	1.5 HP MOTOR	1209	1146	1082	1018	955	891
		2.0 HP MOTOR	1351	1290	1228	1167	1105	1044
100F	FAN RPM	2.0 HP MOTOR	1242	1186	1129	1073	1016	960
		3.0 HP MOTOR	1481	1413	1346	1279	1212	1144
110F	FAN RPM	2.0 HP MOTOR	1073	1016	960	903	847	790
		3.0 HP MOTOR	1242	1186	1129	1073	1016	960
125F	FAN RPM	3.0 HP MOTOR	1185	1131	1077	1023	969	915
		5.0 HP MOTOR	1400	1336	1273	1209	1146	1082
126F	FAN RPM	3.0 HP MOTOR	1185	1131	1077	1023	969	915
		5.0 HP MOTOR	1400	1336	1273	1209	1146	1082

NOTE: Allow ±5% variation in blower RPM due to pulley manufacturing tolerances.

COMPONENT ELECTRICAL DATA

Table 9. Compressors

MODEL	QUANTITY	HORSEPOWER	208-230/60/3		460/60/3		380/50/3		575/60/3	
			RLA	LRA	RLA	LRA	RLA	LRA	RLA	LRA
CUR075F	2	3.5	11.7	78	5.7	39	5.8	39	4.7	36
CUR076F	2	3.5	11.7	78	5.7	39	5.8	39	4.7	36
CUR085F	2	4.0	13.6	90	6.8	45	6.3	45	5.5	36
CUR086F	2	4.0	13.6	90	6.8	45	6.3	45	5.5	36
CUR100F	2	4.5	16.0	124	8.0	62	7.5	62	6.4	50
CUR110F	2	4.5	16.0	124	8.0	62	7.5	62	6.4	50
CUR125F	3	4.0	13.6	90	6.8	45	6.3	45	5.5	36
CUR126F	3	4.0	13.6	90	6.8	45	6.3	45	5.5	36

NOTE: All values are per compressor.

Table 10. Condenser Fan Motors

MODEL	QUANTITY	HORSEPOWER	FLA			
			208-230/60/3	460/60/3	380/50/3	575/60/3
CUR075F — CUR126F	2	1/2	3.5	1.8	1.8	1.1

NOTE: All values are per motor.

Table 11. Evaporator Fan Motors

HORSEPOWER	FLA			
	208-230/60/3	460/60/3	380/50/3	575/60/3
1.0	3.8 / 3.6	1.9	1.9	1.5
1.5	5.6 / 5.0	2.8	2.8	1.9
2.0	7.0 / 6.8	3.5	3.5	2.5
3.0	9.0 / 8.8	4.4	4.4	3.4
5.0	14.4 / 14.4	7.2	7.2	6.1

Table 12. Ventor Motor (Gas Furnace)

HORSEPOWER	208-230/60/3	
	FLA	LRA
1/16	.45/.40	.66/.60
1/12	.58/.52	.83/.75

NOTE: Transformer used on voltages other than 208-230.

REFRIGERATION SYSTEM CHECK, TEST & START PROCEDURE

PRELIMINARY CHECK

Make sure that hold-down bolts on compressors are secure and have not vibrated loose during shipment. Check that vibration grommets have been installed. Visually check all piping and clamps.

The entire refrigeration system has been factory charged and tested, making it unnecessary to field charge. Factory charges are shown in Table 13 and on the unit nameplate.

Table 13. Refrigerant Charge Per Circuit

CUR MODEL	CHARGE (LBS.)
075F	4.0
076F	5.0
085F	5.0
086F	5.5
100F	5.9
110F	6.5
125F	5.0
126F	6.0

CAUTION: Prior to startup of the refrigeration system, the compressor crankcase heaters must have been in operation for at least four hours. All subsequent startups must be preceded by the same four-hour heater operation if the main power to the unit has been interrupted.

Install service manifold hoses. Gauges should read saturation pressure corresponding to ambient temperature (non-pumpdown units only).

CAUTION: Do not connect gauge hoses to manifolds located in control box. These ports are intended for optional pressure switch installation only.

REFRIGERATION SEQUENCE CHECK UNITS WITHOUT PUMPDOWN

With disconnect switch open, remove the field connected thermostat wire from terminal R on TB1 terminal block. Place a jumper across terminals R and G, and across R and 11 on TB1 terminal block. This effectively bypasses the thermostat and optional economizer, simulating a first stage mechanical cooling call. Close the disconnect switch. The following operational sequence should be observed.

1. Current through primary winding of transformer T1 energizes the 24 volt control circuit.
2. When the room thermostat is above the thermostat setpoint, the thermostat makes R to G and Y1. Supply fan contactor M10 is energized and, if the outdoor enthalpy is not suitable for cooling (simulated above), the first stage compressor circuit is energized through low pressure switch LP1, optional high pressure switch HP1, time delay TD1 and optional freezestat TC7.

   NOTE: Time delay relays TD1, TD2 and TD3 are the capacitor bleed-down type. They initiate a 2½ to 4 minute time delay when they lose power. There should be no time delay on startup.
3. Contactor M10 closes its contacts L1 to T1, L2 to T2, and L3 to T3 to provide power to the supply fan motor.
4. Contactor M1 makes contacts L1 to T1 and L2 to T2, thereby energizing compressor motor 1. In addition, contactor M1 makes contacts L3 to T3, thereby allowing condenser fan motors 1 and 2 to be energized.

   NOTE: Condenser fan motor 1 is controlled by the outdoor air thermostat TC1. Condenser fan motor 2 will be locked on when any compressor is energized except when the optional low ambient control pressure switches PC1, PC2 and PC3 are provided. In this case, fan motor 2 will cycle with condenser pressure.
5. Place a jumper across terminals R and 13 on TB1 terminal block. This simulates a situation where the space temperature has continued to rise and the thermostat has made R to Y2, thereby energizing the second stage compressor circuit through low pressure switch LP2, optional high pressure switch HP2, time delay TD2 and optional freezestat TC7.

   NOTE: On units with economizer, if the outdoor air had been cool enough for free cooling (LED on economizer lit) but was unable to keep up with the cooling load, the second thermostat stage would energize the first mechanical cooling stage.
6. Contactor M2 makes contacts L1 to T1 and L2 to T2, thereby energizing compressor motor 2. In addition, contactor M2 makes contacts L3 to T3, thereby allowing both condenser fans to operate in case contactor M1 is de-energized.

   CUR125 Thru 150 Only: Normally open auxiliary contacts on M2 close, energizing the third stage compressor circuit through low pressure switch LP3, optional high pressure switch HP3, time delay TD3 and optional freezestat TC7. Contactor M3 makes contacts L1 to T1 and L2 to T2, thereby energizing compressor motor 3. In addition, contactor M3 makes contacts L3 to T3, thereby allowing both condenser fans to operate. Auxiliary contacts on contactor M3 close, locking the third stage circuit on until the first stage circuit is de-energized.
7. With all safety devices closed, the system will continue the cooling operation until the thermostat is satisfied.
8. Disconnect the jumper wire between R and 13 on TB1 terminal block (simulating a satisfied second stage of the thermostat). The second stage compressor will cycle off and TD2 will initiate its time delay cycle.
9. Disconnect the jumper wire between R and 11, and between R and G on TB1 terminal block (simulating a satisfied first stage of the thermostat). The first stage compressor and the supply fan will cycle off and TD1 will initiate its time delay cycle.

   CUR125 Thru 150 Only: Simultaneously, the third stage compressor will cycle off and TD3 will initiate its time delay cycle.
10. After a time delay of approximately 2½ to 4 minutes, the system will again be prepared to respond to the thermostat's call for cooling.
11. Open disconnect switch. Replace the thermostat wire at terminal R on TB1 terminal block.

REFRIGERATION SEQUENCE CHECK UNITS WITH PUMPDOWN

With disconnect switch open, remove the field connected thermostat wire from terminal R on TB1 terminal block. Place a jumper wire across terminals R and G on TB1 terminal block. Place a jumper between terminal R on TB1 and terminal 1 on relay R13. This effectively bypasses the thermostat and optional economizer, simulating a first stage mechanical cooling call. Close the disconnect switch. The following operational sequence should be observed.

1. Current through primary winding of transformer T1 energizes the 24 volt control circuit.
2. When the room temperature is above the thermostat setpoint, the thermostat makes R to G and Y1. Supply fan contactor M10 is energized and, if the outdoor enthalpy is not suitable for cooling (simulated above), relay R13 is energized and its normally open contacts (line 246) close. Liquid line solenoid SV1 is energized, thereby opening the valve. As the pressure in the evaporator rises, low pressure switch LP1 closes, energizing the first stage compressor circuit through optional high pressure switch HP1, time delay TD1 and optional freezestat TC7.

NOTE: Time delay relays TD1, TD2 and TD3 are the capacitor bleed-down type. They initiate a 2½ to 4 minute time delay when they lose power. There should be no time delay on startup.

3. Contactor M10 closes its contacts L1 to T1, L2 to T2 and L3 to T3 to provide power to the supply fan motor.

4. Contactor M1 makes contacts L1 to T1 and L2 to T2, thereby energizing compressor motor 1. In addition, contactor M1 makes contacts L3 to T3, thereby allowing condenser fan motors 1 and 2 to be energized.

   NOTE: Condenser fan motor 1 is controlled by the outdoor air thermostat TC1. Condenser fan motor 2 will be locked on when any compressor is energized except when the optional low ambient control pressure switches PC1, PC2 and PC3 are provided. In this case, fan motor 2 will cycle with condenser pressure.

5. Place a jumper between terminal R on TB1 terminal block and terminal 1 on relay R14. This simulates a situation where the space temperature has continued to rise and the thermostat has made R to Y2. Relay R14 is energized and its normally open contacts (line 248) close, energizing liquid line solenoid SV2, thereby opening the valve. As the pressure in the evaporator rises, low pressure switch LP2 closes, energizing the second stage compressor circuit through optional high pressure switch HP2, time delay TD2 and optional freezestat TC7.

   NOTE: On units with economizer, if the outdoor air had been cool enough for free cooling (LED on economizer lit) but was unable to keep up with the cooling load, the second thermostat stage would energize the first mechanical cooling stage.

6. Contactor M2 makes contacts L1 to T1 and L2 to T2, thereby energizing compressor motor 2. In addition, contactor M2 makes contacts L3 to T3, thereby allowing both condenser fans to operate in case contactor M1 is de-energized.

   CUR125 Thru 150 Only: Normally open auxiliary contacts on M1 should have already closed. Auxiliary contacts on M2 close, energizing liquid line solenoid SV3. As the pressure in the evaporator rises, low pressure switch LP3 closes, energizing the third stage compressor circuit through optional high pressure switch HP3, time delay TD3 and optional freezestat TC7. Contactor M3 makes contacts L1 to T1 and L2 to T2, thereby energizing compressor motor 3. In addition, contactor M3 makes contacts L3 to T3, thereby allowing both condenser fans to operate. Auxiliary contacts on contactor M3 close, locking the third stage circuit on until the first stage circuit is de-energized.

7. With all safety devices closed, the system will continue the cooling operation until the thermostat is satisfied.

8. Disconnect the jumper wire between R on TB1 and terminal 1 on relay 14 (simulating a satisfied second stage of the thermostat). Relay R14 contacts open, de-energizing liquid line solenoid SV2, thereby closing the valve. When the second stage compressor has pumped most of the refrigerant out of the evaporator and into the condenser, low pressure switch LP2 will open, shutting down the compressor and initiating the TD2 time delay cycle.

9. Disconnect the jumper wire between R on TB1 and terminal 1 on relay R13, and between terminals R and G on TB1 (simulating a satisfied first stage of the thermostat). Relay R13 contacts open, de-energizing liquid line solenoid SV1 and optional hot gas bypass solenoid SV5, thereby closing the valves. As a result of first stage pumpdown, low pressure switch LP1 opens, contactor M1 is de-energized, compressor 1 cycles off and TD1 initiates its time delay cycle. The supply fan motor and the condenser fan motors are de-energized.

   CUR125 Thru 150 Only: Contactor M1 opens its auxiliary contacts, thereby de-energizing liquid line solenoid SV3. The valve closes and refrigerant circuit 3 starts its pumpdown cycle. When low pressure switch LP3 opens, compressor 3 is de-energized and TD3 initiates its time delay cycle.

10. After a time delay of approximately 2½ to 4 minutes, the system will again be prepared to respond to the thermostat's call for cooling.

11. Open disconnect switch. Replace the thermostat wire at terminal R on TB1 terminal block.

REFRIGERATION PERFORMANCE CHECK

Under normal summertime (full load) operating conditions, superheat should be between 8°F and 14°F and subcooling measured at the condenser outlet should be 15°F (nominal). A 25°F to 35°F temperature difference should exist between the entering condenser air and the temperature corresponding to the compressor saturated discharge pressure.

The non-adjustable expansion valves in the units are equipped with a built-in MOP (Maximum Operating Suction Pressure) provision that limits evaporator pressure to approximately 90 to 95 psig. This feature acts to protect the compressors from excessive overload.

NOTE: Under unusually high load conditions when the MOP feature may be operating, the superheat value may exceed 14°F.

Check that compressor RLA corresponds to values shown in Table 9. RLA draw can be as much as 25% less than values in Table 9 at low load conditions and low ambient condensing temperatures. Values in Table 9 can be slightly exceeded at high load conditions and high ambient condensing temperatures.

CAUTION: If continuous fan operation is desired, the condensate trap below the drain pan must be primed before normal unit operation. To do this, either fill the trap with water manually, or run the unit with the fan switch set to AUTO for several cycles before setting the switch to ON.

GAS HEAT
CHECK, TEST & START PROCEDURE

⚠ WARNING

Should overheating occur or the gas supply fail to shut off, turn off the manual gas valve to the appliance before shutting off the electrical supply.

⚠ WARNING

Do not fire gas furnace with flue box cover removed. This is extremely hazardous.

CAUTION: Except during brief periods when gas pressures are being measured by qualified service personnel, the furnace access panel must always be secured in place when the furnace is in operation. An inspection port in the access panel is provided to monitor the flame.

GAS SUPPLY PRESSURES & REGULATOR ADJUSTMENTS

The first step in checking out the gas-fired furnace is to test the gas supply piping to the unit for tightness and purge the system of air using methods outlined in the latest edition of the National Fuel Gas Code (ANSI Z223.1).

Verify that the disconnect switch is in the "OFF" position.

A soapy water solution should be used to check for gas leaks. Since the unit is subject to considerable jarring during shipment, it is extremely important that all gas connections and joints be tested for tightness.

Gas piping downstream from the unit inlet should be checked for leaks during the subsequent sequence check.

The supply gas pressure should be adjusted to 7.0″ W.C. on natural gas and 11.0″ on propane gas with the gas burners operating. If there is more than one unit on a common gas line, the pressures should be checked with all units under full fire. A supply pressure tap is provided on the upstream side of the gas valve. A manifold pressure tap is provided on the manifold as shown in Figure 23.

The normal manifold pressure for full input is 3.5″ W.C. on natural gas and 9.5″ W.C. for propane gas. Minimum gas supply pressure is 5.5″ W.C. for natural gas and 8.0″ for propane gas. In order to obtain rating, gas supply pressure must be 11.0″ W.C. for propane gas. The pressure regulator on propane gas models is adjusted for 9.5″ W.C. manifold pressure and is intended to prevent overfiring only. Do not attempt adjustment of the built-in pressure regulator unless the supply pressure is at least 7.0″ W.C. on natural gas or 13.0″ W.C. on propane gas.

Due to the fact that gas appliances located more than 2000 feet above sea level must be de-rated 4% per 1000 feet of total elevation and that variance in gas heating value and specific gravity require change in manifold pressure to obtain rating, it is mandatory that the input be adjusted at the installation site. **All installations should be made as outlined in the latest edition of the National Fuel Gas Code ANSI Z223.1.** The section entitled "Procedures To Be Followed To Place An Appliance in Operation" should be followed. Refer also to the "User's Information Manual" supplied with the unit for additional information on the gas furnace.

Table 14. Heat Exchanger Specifications

MAXIMUM INPUT BUTH	NUMBER OF BURNERS	MAXIMUM BTUH PER BURNER
105,000	3	35,000
140,000	4	35,000
210,000	6	35,000
245,000	7	35,000
280,000	8	35,000

Table 15. Burner Orifice Specifications

BTUH/TUBE	ORIFICE SIZE (DRILL)	
	NATURAL GAS	PROPANE OR LP GAS
35,000	34	50

SEQUENCE OF OPERATION — GAS HEATING

With electricity and gas turned on, the system switch in the "HEAT" or "AUTO" position and the fan switch in the "AUTO" position, the thermostat will close the circuit between unit terminals R and W1 (R-W1) when the temperature falls below the thermostat setting. This energizes relay R9 and time delay relay TD9. Relay R9 energizes the ventor motor VM1. Operation of the ventor motor closes the centrifugal switch VMS located in the ventor motor. Unless excessive temperatures have opened high limit controls HL21, HL22 or HL23, power is fed to the ignition control module which then initiates a 15-second pre-purge time delay. During this period, the ventor motor will clear the combustion chamber of any residual gas. After the pre-purge period, the ignition control energizes the first stage operator (W1-C) on the gas valve and simultaneously initiates a "3-try" spark ignition sequence. When the burners are ignited, a minimum 4 micro-amp DC current will flow through the flame between the sensor electrode and the grounded burner. When the controller proves that the flame has been established, it will keep the gas valve energized and discontinue the ignition spark. First stage manifold pressure will be approximately 1.3″ W.C. for natural gas and 4.0″ W.C. for propane.

If the control is unable to ignite the burners after its initial attempt, it will initiate another purge and spark sequence. A third purge and spark sequence will be initiated if the second attempt is unsuccessful. If the third attempt is unsuccessful, the controller will close the gas valve and lock itself out. It may be reset by momentarily interrupting power. This may be accomplished by briefly lowering the room thermostat setpoint below room temperature, or by shutting off the main power to the unit.

Time delay relay TD9 will close its normally open contacts (line 201) after a delay of approximately 15 seconds. This action energizes contactor M10 and starts the supply fan motor. Operation of the supply fan circulates air across the heat exchanger and delivers heated air to the conditioned space.

In the event that the temperature at the thermostat continues to fall, the thermostat will also close the contact between terminals R and W2. This will energize the second stage of the gas valve (W2-C). After a delay of about 30 seconds, the gas manifold pressure will increase to approximately 3.5″ W.C. for natural gas and 9.5″ W.C. for propane.

When the space temperature rises, the thermostat will first open R-W2 and finally R-W1. Opening R-W1 will cause the gas valve to close, and the furnace to shut down.

The furnace has three high temperature limit controls which can shut down the burner. They do not shut down the ventor motor.

HL21 Automatic Reset High Limit Control. Located in the blower compartment next to the rear blower, it sensing element projects through the blower section bulkhead and senses the temperature at the rear of the furnace. It will cycle the furnace off if the temperature exceeds 165°F and allow furnace operation again at 125°F.

HL22 Manual Reset High Limit Control. Located next to HL21 in the blower compartment, it senses air temperature within the blower compartment and protects the filters from excessive temperature. It will shut down the furnace if it senses temperatures in excess of 160°F. The limit can only be reset by manually depressing the control mounted reset button after it has cooled.

HL23 Manual Reset Flame Rollout Control. Located in the burner compartment on the top shelf behind the ventor motor, it senses high temperature such as could occur if the heat exchanger tubes were plugged and the flame was rolling out instead of entering the tubes. It has a manual pushbutton reset that cannot be actuated until the limit control has cooled.

INPUT RATING

It is the responsibility of the contractor to adjust the gas input to the unit. The input rate can be calculated by using the formula:

$$\text{Input Btu/Hr.} = \frac{3600 \times HV}{T}$$

HV = Heating value of fuel = Btu/Ft³ of gas
T = Time in seconds per Ft³ of gas flow as read from gas meter

Adjust input rate by varying the adjustment of the gas pressure regulator on the gas valve. All adjustments must be made with furnace operating at high fire and at normal operating temperature. Clockwise rotation of the pressure regulator dial increases pressure and gas flow rate. Turn dial counterclockwise to decrease pressure and gas flow rate. The furnace should be adjusted to obtain a temperature rise within the range specified on the unit dataplate. Refer to Table 16.

CAUTION: Do not exceed input rating or manifold pressure values on the unit dataplate. If input rating on dataplate cannot be attained without exceeding listed manifold pressure, contact your local service representative.

NOTE: Thermal efficiency of the furnace is a product efficiency rating determined under continuous operating conditions independent of any installed system.

Table 16. Gas Furnace Air Temperature Rise

MODEL		N10, P10 ⑥	N14, P14 ⑥	N21, P21 ⑥	N24, P24 ⑥	N28, P28 ⑥
NUMBER OF TUBES		3	4	6	7	8
VENTOR MOTOR HP		1/16	1/16	1/16	1/16	1/12
MBH INPUT		105	140	210	245	280
MBH OUTPUT		83.6	109.2	163.8	189.9	218.4
MAX. AIR TEMP. RISE		40	45	55	60	60
CFM	2600	29.8	38.9	—	—	—
	2800	27.6	36.1	54.2	—	—
	3000	25.8	33.7	50.6	58.6	—
	3200	24.2	31.6	47.4	54.9	—
	3400	22.8	29.7	44.6	51.7	59.5
	3600	21.5	28.1	42.1	48.8	56.2
	3800	20.4	26.6	39.9	46.3	53.2
	4000	19.3	25.3	37.9	44.0	50.6
	4200	18.4	24.1	36.1	41.9	48.1
	4400	17.6	23.0	34.5	40.0	46.0
	4600	16.8	22.0	33.0	38.2	44.0
	4800	16.1	21.1	31.6	36.6	42.1
	5000	15.5	20.2	30.3	35.2	40.4
	5200	14.9	19.4	29.2	33.8	38.9
	5400	14.3	18.7	28.1	32.6	37.4
	5600	13.8	18.1	27.1	31.4	36.1
	5800	13.3	17.4	26.1	30.3	34.9
	6000	12.9	16.9	25.3	29.3	33.7

NOTES:

① Capacities are approved for altitudes to 2000 feet. At higher elevations, heating capacity must be reduced 4% (×0.96) for each 1000 feet above sea level.

② Air temperature rise is for total heating capacity. Temperature rises at other conditions may be calculated by using the formula:

$$\text{Temperature Rise} = \frac{\text{Output Capacity} - \text{Btuh}}{1.08 \times \text{ft}^3\text{/min. Airflow}}$$

③ For altitudes over 2000 feet, air temperature rise must be calculated using the formula:

$$\text{Temperature Rise} = \frac{\text{Output Capacity} - \text{Btuh}}{14.4 \times \text{ft}^3\text{/min. Airflow} \times \text{Specific Weight of Air}}$$

④ Two-stage control is standard.

⑤ Output capacity based on nominal 1000 Btu/Ft³ natural gas or 2500 Btu/Ft³ propane.

⑥ N — Natural Gas; P — Propane Gas

ELECTRIC HEAT CHECK, TEST & START PROCEDURE

WIRING TIGHTNESS CHECK

With disconnect switch in the OFF position, check all electric heater connections for tightness. Since the unit is subject to considerable stress during shipment, it is extremely important that this check is thorough.

SEQUENCE CHECK

Set the thermostat in the conditioned space to a point at least 10°F above zone temperature.

Remove the thermostat wire from terminal W2 at TB1 terminal block and close disconnect switch. The following operational sequence should be observed.

1. First stage heat relay R9 makes and closes contacts 2-4 to energize supply fan motor contactor M10. If the temperature at the limit switch HL31 is low enough, heater contactor M31 will be energized.
2. While electric heater is operating at first stage, attach thermostat wire to terminal W2 at TB1 terminal block. If the temperature at limit switch HL32 is low enough, second stage heater contactor M32 will be energized. Auxiliary contacts on M32 close, energizing heater contactor M33. Auxiliary contacts on M33 in series with its coil act to lock M33 in.
3. When the thermostat's second stage is satisfied, it de-energizes heater contactor M32. Contactors M31 and M33 stay energized until the first stage is satisfied.

The number of heater contactors used depends on heating capacity and voltage. Observe contactors for several cycles. Contactors should cycle first and second stage according to thermostat demand.

NOTE: The optional Power Saver Thermostat acts to lock out one heating stage when the outdoor air temperature is above its setpoint.

THERMOSTAT, NIGHT SETBACK & TIMECLOCK CHECK, TEST & START PROCEDURE

THERMOSTAT FINAL CHECK

With the thermostat fan switch at AUTO, operate the unit through at least one complete cycle with the thermostat system switch at COOL and one cycle with the system switch at HEAT.

Place the fan switch at ON. The fan should run continuously.

Proper control of the indoor air temperature can only be achieved if the thermostat is calibrated to the heating and/or cooling system. A vital consideration of this calibration is related to the thermostat heat anticipator.

Anticipators for the cooling operation are generally preset by the thermostat manufacturer and require no adjustment. Anticipators for the heating operation are of two types: preset or adjustable. Those that are preset will not have an adjustable scale and are generally marked accordingly.

Thermostat models having a scale as shown in Figure 29 must be adjusted to each application.

In most cases this adjustment setting can be found in the thermostat instructions. If this information is not available or if the correct setting is questioned, the procedure below should be followed:

1. Wrap 10 loops of single strand, insulated thermostat wire around the prongs of an ammeter. Set the scale to the 1 to 5 or 1 to 6 amp scale.
2. Connect the uninsulated ends of the wire jumper across terminals R and W1 on the subbase. See Figure 30. This test must be performed without the thermostat attached to the subbase.
3. Let the heating system operate in this position for about one minute. Read the ammeter scale. Whatever reading is indicated must be divided by 10 (for 10 loops of wire). This is the setting at which the adjustable heat anticipator should be set.

$$\text{Formula: } \frac{\text{Ammeter Reading}}{\text{10 Loops}} = \text{Anticipator Setting}$$

4. If a slightly longer cycle is desired, the pointer should be moved to a higher setting. Slightly shorter cycles can be achieved by moving to a lower setting.
5. On units with two stages of heat, check second stage heat anticipator setting by placing a jumper across terminals R and W1; repeat steps 1 through 3 taking amp reading of R to W2 jumper.
6. Remove the jumper wire(s) and reconnect the thermostat. Check the thermosat in the heating mode for proper operation.

Figure 29. Typical Heat Anticipator

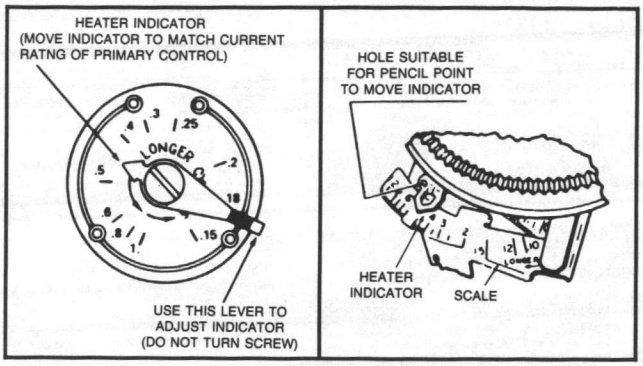
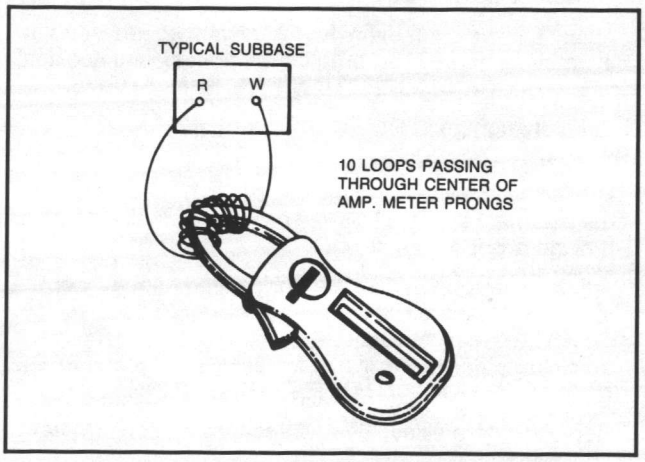


Figure 30.



Move the thermostat temperature levers and subbase switches to desired positions.

NIGHT SETBACK THERMOSTAT CHECK (OPTIONAL EQUIPMENT)

The electromechanical night setback thermostat controls the unit by jumping the timeclock and completing the circuit through the main thermostat. Refer to Figures 20, 21, 22. The unit heating will cycle off the night thermostat setpoint since it is lower than the main thermostat setpoint.

With timeclock contacts open, set night setback thermostat and space thermostat 10°F above zone temperature. Unit should operate on heating cycle.

Restore night thermostat to normal setting (recommend 55°F). Reset space thermostat to desired position.

TIMECLOCK CHECK (OPTIONAL EQUIPMENT)

Manually open and close timeclock contacts to check if it operates unit. Set time dial to correct time. Adjust cut-in and cut-out points.

AIR BALANCING

The drive on the supply fan is typically set in the middle of the RPM range. The drive motor sheave pitch diameter is field adjustable for the required airflow. Refer to "Drive Adjustments" section below.

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

The total airflow must not be less than that required for operation of the electric heaters or the furnace.

The operating balance should be checked with the economizer at full outside air and at minimum outside air.

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 alignment and minimize vibration more effectively.

DRIVE ADJUSTMENTS — MOUNTING & ADJUSTING MOTOR SHEAVES VL, VM & 2VP VARIABLE PITCH KEY TYPE SHEAVES (SEE FIGURE 31)

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.
3. Fit internal key "C" between sheave and shaft, and lock setscrew "A" securely in place.

ADJUSTING VL & VM SHEAVES:

1. Loosen setscrew "B."
2. Adjust sheave pitch diameter for desired speed by opening moving part by half or full turns from closed position. DO NOT OPEN MORE THAN FIVE FULL TURNS.
3. Securely tighten setscrew "B" over flat.

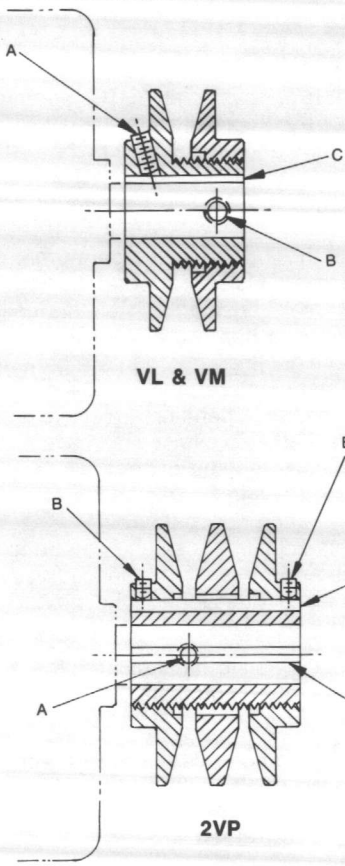
ADJUSTING 2VP SHEAVES:

1. Loosen setscrews "B" in moving parts of sheave and pull out external key "D." (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. Both halves must be adjusted by the same number of turns from closed position to insure the same pitch diameter. DO NOT OPEN MORE THAN FIVE FULL TURNS.
3. Replace external key "D" and securely tighten setscrews "B" over key.

AFTER ADJUSTING:

1. Put on belts and adjust belt tension. DO NOT FORCE BELTS OVER GROOVES.
2. 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.

Figure 31.



Do not operate sheave with flange projecting beyond the hub end.

3. 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.

MAINTENANCE

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 them.

⚠ WARNING

MOVING MACHINERY HAZARD

DISCONNECT POWER TO THIS UNIT AND PADLOCK AT "OFF" BEFORE SERVICING THE FANS.

Preventive maintenance is the best way to avoid unnecessary expense and inconvenience. Have this system inspected at regular intervals by qualified service personnel, at least twice a year. Routine maintenance should cover the following items:

1. Tighten all belts, setscrews, and wire connections.
2. Clean evaporator and condenser coils mechanically or with cold water, if necessary. Usually any fouling is only matted on the entering air face of the coil and can be removed by brushing.
3. Lubricate motor bearings (see below).
4. Align or replace belts as needed.
5. Replace filters as needed (see below).
6. Check for blockage of condensate drain.
7. Check power and control voltages.
8. Check running amperage.
9. Check operating temperatures and pressures.
10. Check and adjust temperature and pressure controls.
11. Check and adjust damper linkages.
12. Check operation of all safety controls.
13. Examine gas furnaces (see below and the User's Information Manual).
14. Check condenser fans and tighten setscrews.

FILTERS

Every application may require a different frequency of replacement of dirty filters. Filters must be replaced at least every three (3) months during operating seasons.

Filters supplied with the units are the disposable type and are as follows:

UNIT SIZE	QUANTITY	FILTER SIZE	PART NUMBER (CARTON OF 12)
075 — 100	3	25×25×2	349103X-00
110 — 150	3	16×25×2	182732X-00
	3	20×25×2	000160A-00

To remove the filters, remove the filter access panel on either side of the unit. See Figure 32.

LUBRICATION

The fan shaft bearings, the 1 to 3 HP supply fan motors, and the condenser fan motors are permanently lubricated. For lubrication of the compressors, use Suniso 3GS, Texaco WF32, or Calumet R015 oils. All three oils are compatible if mixed, and are suitable for both high and low temperature systems.

5 HP SUPPLY FAN MOTOR

Motor should have grease added after every 2,000 hours of operation. Relubricate while motor is warm and at a standstill. Remove and clean upper and lower grease plugs. Insert grease fitting into upper hole adding a small amount of clean grease with a low pressure gun. Run motor for ten minutes before replacing plugs.

CAUTION: Excessive grease will overheat the bearings. Use only a high grade mineral grease with a 200°F safe operating temperature.

NOTE: Specific greasing instructions may be found on a tag attached to the motor. If special lubrication instructions are shown on the motor nameplate, they will supersede all other instructions.

VENTOR MOTOR

To lubricate the ventor motor, remove the furnace access panel. Lubricate the motor in two locations as shown in Figure 33. Use SAE 20W lubricant and add five (5) drops to each location. The motor should be lubricated at the beginning of each heating season. DO NOT OVERLUBRICATE.

WARNING: DO NOT DRIP OIL ON THE GAS VALVE BECAUSE THE OIL MAY DAMAGE THE NON-METALLIC PARTS AND RENDER THE VALVE INOPERATIVE. REMOVE ANY OIL RESIDUES FROM THE BURNER COMPARTMENT.

GAS FIRED FURNACE INSPECTION & CLEANING

All flue product carrying areas of the furnace, its vent system, and main burners should be examined by a qualified service agency before the start of each heating season. This examination is necessary for continued safe operation. Particular attention should be given to deterioration from corrosion or other sources. This examination is accomplished in the following manner.

1. Disconnect power to the unit and remove furnace section access panel.
2. Refer to Figure 34. Remove burner assembly:
   a. Disconnect the three wires from the gas valve after noting which wires are connected to each terminal.
   b. Disconnect wires from the flame rod and ignition electrode.
   c. Disconnect the gas piping at the union.
   d. The entire burner assembly can now be removed from the unit. Note how the front of the burner assembly nests around wide location tabs, one at the top and one at the bottom.
3. Remove the flue box cover. The cover consists of two pieces which can be removed as a single unit. Remove the flue baffle.
4. Remove the turbulator from within each heat exchanger tube. The end corner of the turbulator mates with the groove at the tube end seam. To release the turbulator, grip the end of the turbulator with a pliers, force the corner away from the groove, and pull the turbulator out of the tube.
5. Inspect the burner assembly, the heat exchanger tubes, the turbulators, the flue box, the ventor fan and the ventor fan outlet openings for accumulations of soot and deterioration. Soot can be removed with a flexible wire brush. The inside of the tubes can be cleaned with a boiler tube type wire brush. If the bends of the tubes must be cleaned, remove the plate surrounding the burner end of the tubes. A brush or wad of steel wool can then be pulled through the tube with a cable. Be cautious not to damage the corrosion resistant coating on the various metal parts. Remove all residue.
6. If deterioration is evident, contact a qualified service agency. Minor deterioration of the turbulator ends is not cause for concern.
7. Upon completion of inspection and cleaning, replace all parts in the reverse order in which they were removed.
   CAUTION: Use all screws that were removed; they are necessary for safe and proper operation of the unit.
8. Inspect and periodically clean the vent outlet (bird screen) on the access panel.

NOTE: Periodic observation of the flame through the inspection port and a log of CO_2 measurements are recommended. They will aid in determining whether the furnace is operating efficiently or if the furnace requires cleaning.

Figure 32. Filter Access

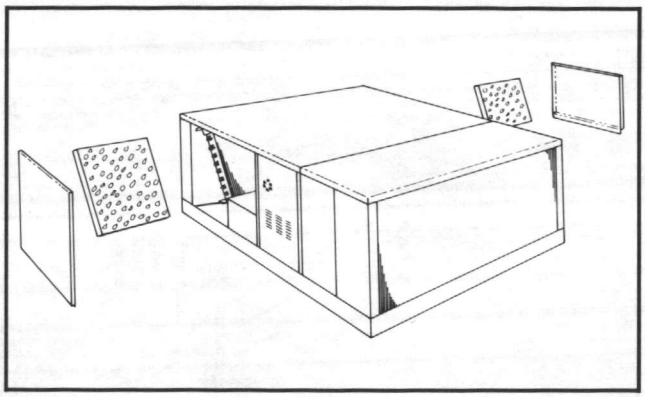


Figure 33. Ventor Motor

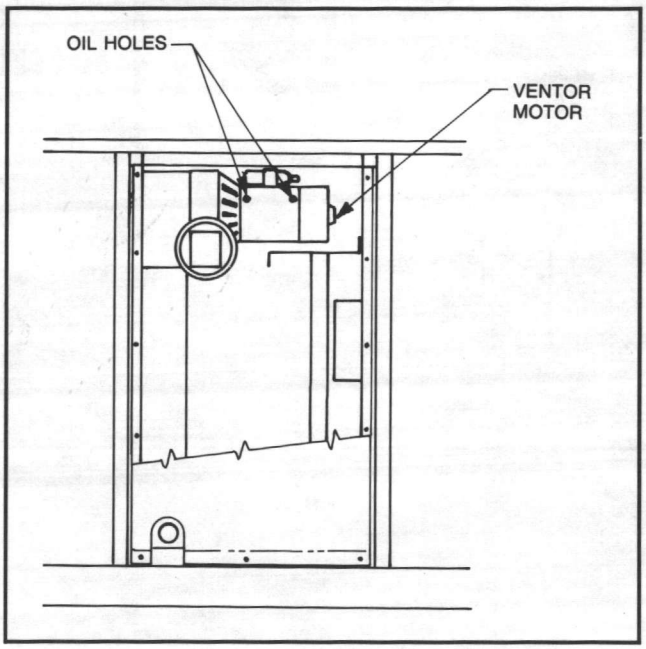
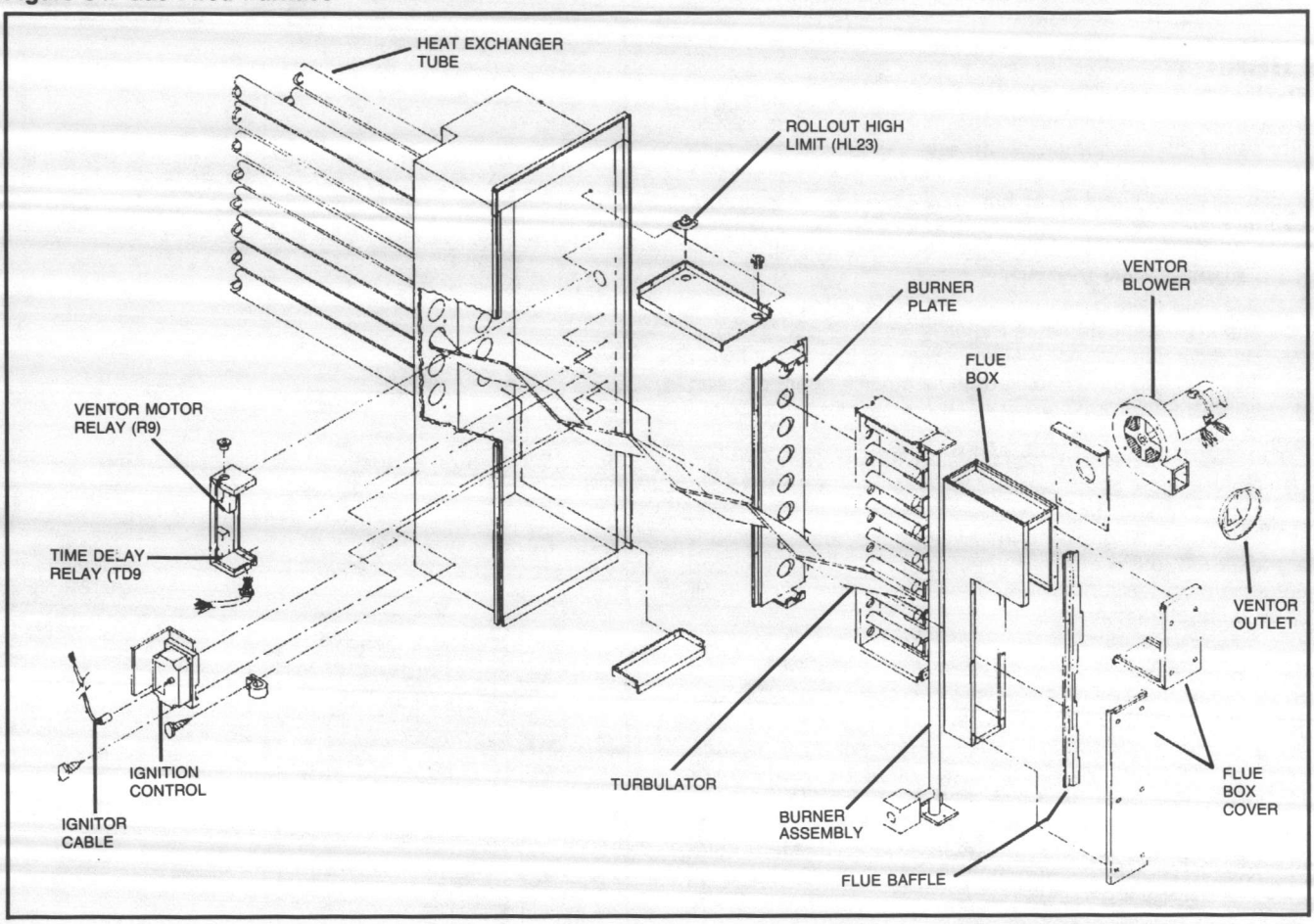


Figure 34. Gas Fired Furnace



SERVICE & WARRANTY PROCEDURE

IN-WARRANTY RETURN MATERIAL PROCEDURE

Material may not be returned except by permission of authorized factory service personnel. Contact your local sales representative for further "who to contact" information.

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. All parts shall be returned to the factory designated on the return goods tag, transportation charges prepaid.

The return of the part does not constitute an order for replacement. Therefore, a purchase order must be entered through your nearest sales representative. The order should include 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, credit will be issued on customer's purchase order.

REPLACEMENT PARTS

Replacement parts may be obtained by contacting your local sales representative or parts distributor. If you do not know who to contact, call SnyderGeneral Corporation at (612) 553-5009 for assistance. Refer to the model number and serial number of the unit as stamped on the serial plate attached to the unit. If replacement parts are required, mention the date of installation of the unit and the date of failure, along with an explanation of the malfunctions and a description of the replacement parts required.

CUR 075 THRU 150 CONTROLS, SETTINGS & FUNCTIONS

DESCRIPTION	FUNCTION	SYMBOL	SETTING	RESET	LOCATION	DIFFERENTIAL
CONDENSER PRESSURE SWITCH (OPTIONAL)	Maintains condenser pressure by recycling the condenser fans in response to condenser pressure.	PC1, 2, 3	Opens at 150±20 psig Closes at 225±20 psig	Auto	Control Box	75 psig, fixed
CONDENSER FAN TEMPERATURE SWITCH	Disables condenser fan 1 when outdoor temperature is below setpoint.	TC1	Opens at 55°F Closes at 75°F	Auto	Control Box	20°F, fixed
COMPRESSOR LOCKOUT TIME DELAY	Prevents short cycling of compressors. Starts timing on loss of power.	TD1, 2, 3	2½ to 4 minute delay on break (180 sec.—15%+35%)	Auto	Control box	N/A
HIGH PRESSURE CONTROL (OPTIONAL)	Stops compressor when discharge pressure is too high.	HP1, 2, 3	Opens at 400±10 psig Closes at 300±20 psig	Auto (latching relays R1, 2, 3 must be reset manually)	Control Box	100 psig, fixed
LOW PRESSURE CONTROL	Stops compressor when suction pressure is too low. Safety device and used for optional pumpdown.	LP1, 2, 3	Opens at 20±6 psig Closes at 60±8 psig (Opens at 10±6, Closes at 40±8 w/ PC1,2 & 3 option)	Auto	Control Box	40 psig, fixed (30 psig, fixed)
LIQUID LINE SOLENOID VALVE (OPTIONAL)	Closes off liquid line for pumpdown.	SV1, 2, 3	N/A	N/A	Supply Fan Section	N/A
HOT GAS BYPASS SOLENOID VALVE (OPTIONAL)	Closes off hot gas line for pumpdown. Opens for hot gas bypass with first cooling stage.	SV5	N/A	N/A	Supply Fan Section	N/A
HOT GAS BYPASS CONTROL VALVE (OPTIONAL)	Bypasses discharge gas into distributor when suction pressure drops below valve setting.	N/A	Starts opening at 57 psig; full open at 50 psig, adjustable (assumes bulb seeing 60°F discharge air)	N/A	Supply Fan Section (bulb senses discharge air)	N/A
MIXED AIR/DISCHARGE AIR SENSOR (STD.)	NTC thermistor device senses discharge air temperature. Resistance is read by economizer control.	MAT	N/A	N/A	Supply Air Section	N/A
ENTHALPY SENSOR (OPTIONAL)	Senses temperature and humidity conditions. Sends signal to economizer control.	OAE (outdoor sensor) RAE (return sensor)	N/A	N/A	Fresh Air Intake Section Return Air Section	N/A
ECONOMIZER CONTROL (OPTIONAL)	Modulates outdoor & return air dampers, in response to a cooling call, to maintain a mixed air temperature between 50°F and 56°F. Enables free or mechanical cooling depending on outdoor air enthalpy.	N/A	"B" or as required (standard economizer option) "D" (differential enthalpy option)	N/A	Return Air Section	N/A
MINIMUM POSITION POTENTIOMETER (OPTIONAL)	Maintains a minimum opening in economizer damper to provide for ventilation requirements when outside air is unsuitable for cooling.	N/A	As required	N/A	On face of economizer control (terminals P & P1 must be jumped)	N/A
DAMPER MOTOR (OPTIONAL)	Honeywell M7415: Modulates outdoor and return air dampers in response to economizer control. Honeywell M8415: 2-position motor opens outdoor air dampers when energized.	DM	N/A	N/A	Return Air Section	N/A
FILTER FLAG (OPTIONAL)	Indicates filters are clogged. Senses pressure drop across filters.	PC5	Closes at 0.1"—0.7" diff. W.C., adjustable	Manual	Evaporator Section	N/A
FREEZESTAT (OPTIONAL)	Protects compressors and evaporator from water freeze-up.	TC7	Closes at 39°F, fixed; Opens at 15—32°F, adjustable	Auto	Evaporator Section	7 to 24°F, adjustable
FIRESTAT (OPTIONAL)	Cuts power to control circuitry on temperature rise.	TC5 (return air) TC6 (supply air)	TC5: Opens at 125°F TC6 (cooling only): Opens at 125°F TC6 (heat units): Opens at 240°F	Manual	Supply Fan Section	25°F to reset

Continued on next page

CUR 075 THRU 150 CONTROLS, SETTINGS & FUNCTIONS (CONT'D.)

DESCRIPTION	FUNCTION	SYMBOL	SETTING	RESET	LOCATION	DIFFERENTIAL
POWER SAVER THERMOSTAT (OPTIONAL W/ ELECTRIC HEAT)	Locks out 2nd or 3rd stage of heat when outdoor temperature is above setpoint.	TC15	Adjustable 25 to 75°F Factory set to open at 50°F, close at 47°F	Auto	Electric Heat Control Box	3°F, fixed
HIGH LIMIT, SECONDARY ELECTRIC HEAT	Cuts power to heating elements on temperature rise.	HL1, 2, 3	Opens at 210°F±6°F	Manual	Electric Heat Control Box	60°F to reset
HIGH TEMPERATURE LIMIT SWITCH (ELECTRIC HEAT ONLY)	Cuts power to heater control circuit on temperature rise.	HL31, 32	Opens at 140±5°F Closes at 110±7°F	Auto	Electric Heat Control Box	30°F, fixed
GAS VALVE	Controls opening of stage 1 and stage 2 gas valves.	GV1	Refer to Gas Heat Check, Test & Start Procedure	N/A	Furnace Section	N/A
VENTOR CENTRIFUGAL SWITCH	Enables gas heat control circuit when ventor motor is running.	VMS	N/A	Auto	Mounted to ventor motor	N/A
FLAME SENSOR ELECTRODE	Proves burner flame exists (flame rectification method). Allows gas valve to remain energized.	FRS	N/A	N/A	Furnace Section	N/A
IGNITION ELECTRODE	Creates spark for direct ignition of burners.	IGN	N/A	N/A	Furnace Section	N/A
IGNITION CONTROL	Coordinates 3-try, 15-second pre-purge spark for ignition sequence.	N/A	N/A	N/A	Furnace Section	N/A
TIME DELAY RELAY (GAS HEAT ONLY)	On 1st stage heat call, provides power to supply fan contactor after a time delay. Allows furnace heat exchanger to warm up and cool down before and after heating operation.	TD9	15 seconds (nominal) on make. 75—95 seconds on break.	N/A	Furnace Control Box	N/A
HIGH TEMPERATURE LIMIT SWITCH (GAS HEAT ONLY)	Senses high air temperature in furnace section. Cuts power to heater control circuit on temperature rise.	HL21	Opens at 165±6°F Closes at 125±9°F	Auto	Supply Fan Section (Sensor senses furnace section air)	40°F, fixed
REVERSED AIRFLOW HIGH TEMPERATURE LIMIT SWITCH (GAS HEAT ONLY)	Senses high air temperature in filter section. Cuts power to heater control circuit on temperature rise.	HL22	Opens at 160±6°F	Manual	Supply Fan Section	60°F to reset
ROLLOUT LIMIT (GAS HEAT ONLY)	Senses burner flame rollout in burner compartment. Cuts power to heater control circuit on temperature rise.	HL23	Opens at 225±7°F	Manual	Furnace Section	60°F to reset
FAN SWITCH (OPTIONAL)	Pressure switch provides supply airflow status. Senses pressure difference across filters and evaporator coil.	PC6	Closes at 0.1±.05" diff. W.C.	Auto	Supply Fan Section	N/A

CONTROL LOCATIONS

Figure 35. Control Box Locations

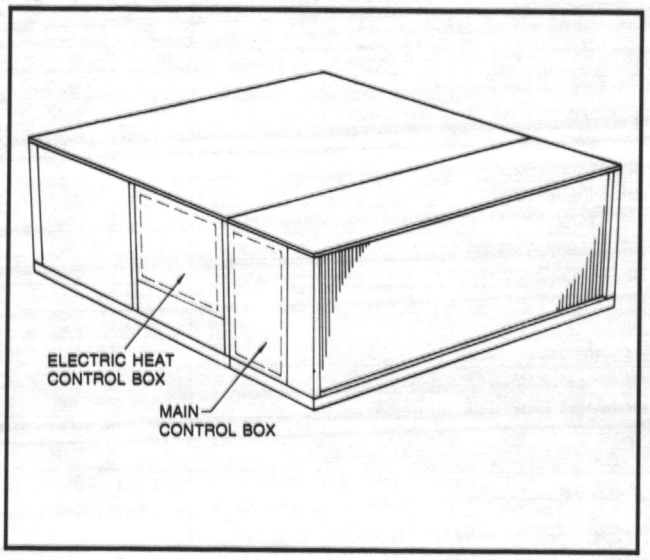


Figure 37. Electric Heat Control Box

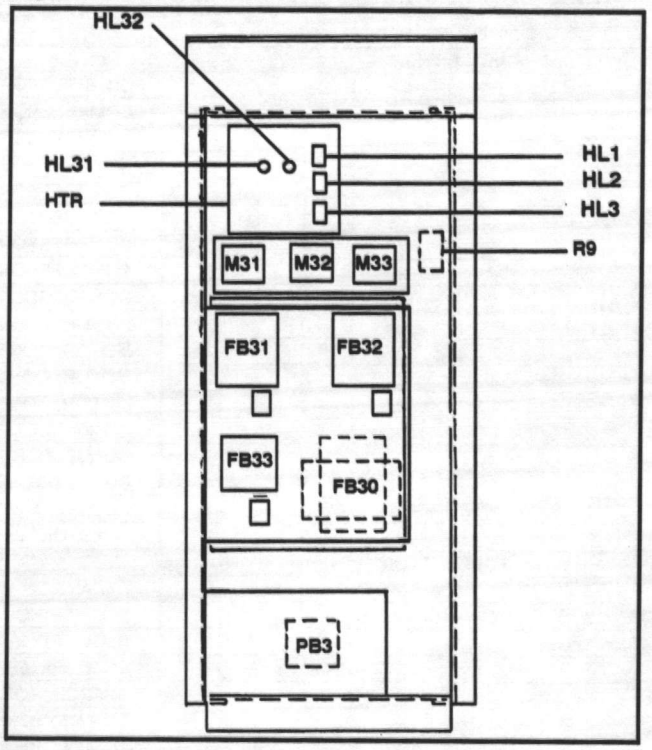
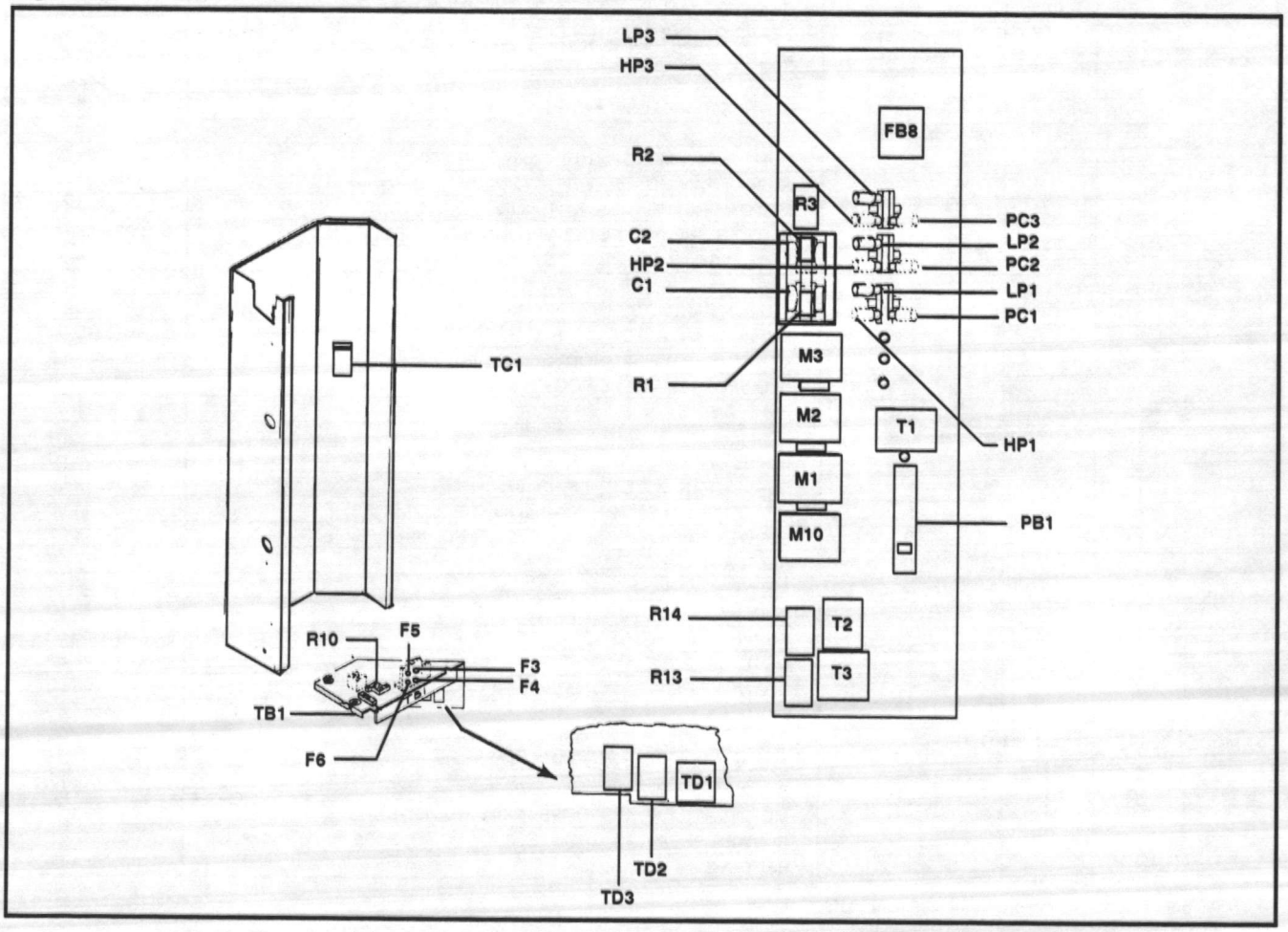


Figure 36. Main Control Box



PARTS LIST ①

QUANTITY PER UNIT					DESCRIPTION	PART NO.
075F 076F	085F 086F	100F 110F	125F 126F	150F		
CONDENSING SECTION						
2					COMPRESSOR, 3.25 HP, 208-230/60/3	491212B-01
2					COMPRESSOR, 3.25 HP, 460/60/3, 380/50/3	491212B-02
2					COMPRESSOR, 3.25 HP, 575/60/3	491212B-03
	2		3		COMPRESSOR, 3.5 HP, 208-230/60/3	491212B-04
	2		3		COMPRESSOR, 3.5 HP, 460/60/3, 380/50/3	491212B-05
	2		3		COMPRESSOR, 3.5 HP, 575/60/3	491212B-06
		2		3	COMPRESSOR, 4.5 HP, 208-230/60/3	491212B-07
		2		3	COMPRESSOR, 4.5 HP, 460/60/3, 380/50/3	491212B-08
		2		3	COMPRESSOR, 4.5 HP, 575/60/3	491212B-09
2	2	2	2	2	MOTOR MOUNT, CONDENSER FAN	491215B-01
2	2	2	2	2	MOTOR, CONDENSER FAN, 1/2 HP, TEFC, 208-230/60/1	491221B-00
2	2	2	2	2	MOTOR, CONDENSER FAN, 1/2 HP, TEFC, 460/60/1	491222B-00
2	2	2	2	2	MOTOR, CONDENSER FAN, 1/2 HP, TEFC, 575/60/1	497558B-00
2	2		2		CONDENSER FAN BLADE	491217B-01
		2		2	CONDENSER FAN BLADE	491217B-02
1	1	1	1	1	PRESSURE REGULATING HOT GAS BYPASS VALVE (OPTIONAL)	181723B-00
1	1	1	1	1	SOLENOID VALVE, HOT GAS BYPASS, 24V (OPTIONAL)	497524B-01
2	2	2	3	3	SOLENOID VALVE, LIQUID LINE, 24V (OPTIONAL)	497525B-01
EVAPORATOR SECTION						
2	2	2	3	3	EXPANSION VALVE, 4 TON	240296B-19
2	2	2			BLOWER/HOUSING ASSEMBLY (MODELS 075F THRU 100F)	489996AG01
		2	2	2	BLOWER/HOUSING ASSEMBLY (MODELS 110F THRU 150F)	489996AG02
1	1	1			EVAPORATOR FAN SHAFT (MODELS 075F THRU 100F)	551976B-01
		1	1	1	EVAPORATOR FAN SHAFT (MODELS 110F THRU 150F)	489723B-01
2	2	2	2	2	1/4 × 4.5″ KEY	232213A-07
1	1	1	1	1	1/4 × 2.0″ KEY	232213A-10
2	2	2			BEARING, BALL (MODELS 075F THRU 100F)	008299B-04
		2	2	2	BEARING, BALL (MODELS 110F THRU 150F)	008299B-07
2	2	2	2	2	BEARING MOUNTING BRACKET	491214B-01
1	1	1	1	1	MIXED AIR SENSOR	497541A-02
1	1	1	1	1	HIGH LIMIT (HL21)	497564B-01
1	1	1	1	1	REVERSED AIRFLOW HIGH LIMIT (HL22)	497564B-03
MODELS 075F & 076F, STANDARD MOTOR						
1					SUPPLY FAN MOTOR, 1 HP, 208-230/460/60/3	497528B-00
1					SUPPLY FAN MOTOR, 1 HP, 575/60/3	497529B-00
1					MOTOR SHEAVE, 1 GROOVE, 3.80″ PD, 5/8″ BORE	292254A-00
1					BLOWER SHEAVE, 1 GROOVE, 6.50″ PD, 1″ BORE	005362X-00
1					BELT, A-31	003655A-00
MODELS 075F & 076F, OVERSIZED MOTOR						
1					SUPPLY FAN MOTOR, 1.5 HP, 208-230/460/60/3	497530B-00
1					SUPPLY FAN MOTOR, 1.5 HP, 575/60/3	497531B-00
1					MOTOR SHEAVE, 1 GROOVE, 3.80″ PD, 5/8″ BORE	292254A-00
1					BLOWER SHEAVE, 1 GROOVE, 5.50″ PD, 1″ BORE	000971X-00
1					BELT, A-26	009481A-00
MODELS 085F & 086F, STANDARD MOTOR						
	1				SUPPLY FAN MOTOR, 1.5 HP, 208-230/460/60/3	497530B-00
	1				SUPPLY FAN MOTOR, 1.5 HP, 575/60/3	497531B-00
	1				MOTOR SHEAVE, 1 GROOVE, 3.80″ PD, 5/8″ BORE	292254A-00
	1				BLOWER SHEAVE, 1 GROOVE, 5.50″ PD, 1″ BORE	000971X-00
	1				BELT, A-26	009481A-00
MODELS 085F & 086F, OVERSIZED MOTOR						
	1				SUPPLY FAN MOTOR, 2 HP, 208-230/460/60/3	497532B-00
	1				SUPPLY FAN MOTOR, 2 HP, 575/60/3	497533B-00
	1				MOTOR SHEAVE, 1 GROOVE, 4.40″ PD, 7/8″ BORE	007289X-00
	1				BLOWER SHEAVE, 1 GROOVE, 5.70″ PD, 1″ BORE	000970X-00
	1				BELT, A-31	003655A-00
MODEL 100F, STANDARD MOTOR						
		1			SUPPLY FAN MOTOR, 2 HP, 208-230/460/60/3	497532B-00
		1			SUPPLY FAN MOTOR, 2 HP, 575/60/3	497533B-00
		1			MOTOR SHEAVE, 1 GROOVE, 4.40″ PD, 7/8″ BORE	007289X-00
		1			BLOWER SHEAVE, 1 GROOVE, 6.20″ PD, 1″ BORE	001034A-00
		1			BELT, A-31	003655A-00

① This is only a partial listing of the replacement parts available.
Contact your local sales representative for additional information.

Continued on next page

PARTS LIST ①

QUANTITY PER UNIT					DESCRIPTION	PART NO.
075F 076F	085F 086F	100F 110F	125F 126F	150F		
MODEL 100F, OVERSIZED MOTOR						
		1			SUPPLY FAN MOTOR, 3 HP, 208-230/460/60/3	497534B-00
		1			SUPPLY FAN MOTOR, 3 HP, 575/60/3	497535B-00
		1			MOTOR SHEAVE, 1 GROOVE, 4.40″ PD, 7/8″ BORE	007289X-00
		1			BLOWER SHEAVE, 1 GROOVE, 5.20″ PD, 1″ BORE	003692X-00
		1			BELT, A-31	003655A-00
MODEL 110F, STANDARD MOTOR						
		1			SUPPLY FAN MOTOR, 2 HP, 208-230/460/60/3	497532B-00
		1			SUPPLY FAN MOTOR, 2 HP, 575/60/3	497533B-00
		1			MOTOR SHEAVE, 1 GROOVE, 3.80″ PD, 7/8″ BORE	313106A-00
		1			BLOWER SHEAVE, 1 GROOVE, 6.20″ PD	005414X-00
		1			BELT, A-31	003655A-00
		1			BLOWER SHEAVE BUSHING, 1.188″ BORE	008044X-00
MODEL 110F, OVERSIZED MOTOR						
		1			SUPPLY FAN MOTOR, 3 HP, 208-230/460/60/3	497534B-00
		1			SUPPLY FAN MOTOR, 3 HP, 575/60/3	497535B-00
		1			MOTOR SHEAVE, 1 GROOVE, 4.40″ PD, 7/8″ BORE	007289X-00
		1			BLOWER SHEAVE, 1 GROOVE, 6.20″ PD	005414X-00
		1			BELT, A-31	003655A-00
		1			BLOWER SHEAVE BUSHING, 1.188″ BORE	008044X-00
MODELS 125F & 126F, STANDARD MOTOR						
			1		SUPPLY FAN MOTOR, 3 HP, 208-230/460/60/3	497534B-00
			1		SUPPLY FAN MOTOR, 3 HP, 575/60/3	497535B-00
			1		MOTOR SHEAVE, 1 GROOVE, 4.40″ PD, 7/8″ BORE	007289X-00
			1		BLOWER SHEAVE, 1 GROOVE, 6.50″ PD	005738X-00
			1		BELT, A-31	003655A-00
			1		BLOWER SHEAVE BUSHING, 1.188″ BORE	008044X-00
MODELS 125F & 126F, OVERSIZED MOTOR						
			1		SUPPLY FAN MOTOR, 5 HP, 208-230/460/60/3	497536B-00
			1		SUPPLY FAN MOTOR, 5 HP, 575/60/3	497537B-00
			1		MOTOR SHEAVE, 2 GROOVE, 4.40″ PD, 7/8″ BORE	006076X-00
			1		BLOWER SHEAVE, 2 GROOVE, 5.50″ PD	200621X-00
			2		BELT, A-31	003655A-00
			1		BLOWER SHEAVE BUSHING, 1.188″ BORE	008044X-00
MODEL 150F, STANDARD MOTOR						
				1	SUPPLY FAN MOTOR, 3 HP, 208-230/460/60/3	
				1	SUPPLY FAN MOTOR, 3 HP, 575/60/3	
				1	MOTOR SHEAVE, 1 GROOVE, 4.70″ PD, 7/8″ BORE	
				1	BLOWER SHEAVE, 1 GROOVE, 6.50″ PD	
				1	BELT, A-31	
				1	BLOWER SHEAVE BUSHING, 1.188″ BORE	
MODEL 150F, OVERSIZED MOTOR						
				1	SUPPLY FAN MOTOR, 5 HP, 208-230/460/60/3	
				1	SUPPLY FAN MOTOR, 5 HP, 575/60/3	
				1	MOTOR SHEAVE, 2 GROOVE, 4.70″ PD, 1.125″ BORE	
				1	BLOWER SHEAVE, 2 GROOVE, 6.50″ PD	
				2	BELT, A-31	
				1	BLOWER SHEAVE BUSHING, 1.188″ BORE	
FILTERS						
3	3	3			FILTER, 25 × 25 × 2 (MODELS 075F THRU 100F)	349103X-00
3	3	3			OPTIONAL PLEATED 25 × 25 × 2 (MODELS 075F THRU 100F)	312980B-07
		3	3	3	FILTER, 20 × 25 × 2 (MODELS 110F THRU 150F)	000160A-00
		3	3	3	FILTER, 16 × 25 × 2 (MODELS 110F THRU 150F)	182732X-00
		3	3	3	OPTIONAL PLEATED 16 × 25 × 2 (MODELS 110F THRU 150F)	312980B-02
		3	3	3	OPTIONAL PLEATED 20 × 25 × 2 (MODELS 110F THRU 150F)	312980B-04
MAIN CONTROL BOX COMPONENTS						
2	2	2	3	3	R1-2-3, HIGH PRESSURE RELAY, 1P, 24V	437558B-00
2	2	2	3	3	R13-14, PUMPDOWN RELAY, SPST, 24V	473565B-07
2	2	2	3	3	TD1-2-3, COMPRESSOR TIME DELAY, SPST, 24V	282101B-27
2	2	2	2	2	C1-2, 5.0 MFD FAN MOTOR CAPACITOR, 208-230V	492637A-01
2	2	2	2	2	C1-2, 7.5 MFD FAN MOTOR CAPACITOR, 460V, 575V	492637A-02
2	2	2	3	3	HP1-2-3, HIGH PRESSURE CONTROL	473561B-12
2	2	2	3	3	LP1-2-3, LOW PRESSURE SWITCH, NO LOW AMBIENT OPTION	473561B-13

① This is only a partial listing of the replacement parts available
Contact your local sales representative for additional information.

Continued on next page

PARTS LIST ①

QUANTITY PER UNIT					DESCRIPTION	PART NO.
075F 076F	085F 086F	100F 110F	125F 126F	150F		
MAIN CONTROL BOX COMPONENTS (CONT'D.)						
2	2	2	3	3	LP1-2-3, LOW PRESSURE SWITCH WITH LOW AMBIENT OPTION	473561B-14
2	2	2	3	3	PC1-2-3, CONDENSER FAN LOW AMBIENT PRESSURE SWITCH	473561B-15
2	2	2	3	3	HIGH/LOW MANIFOLD	497538B-01
1	1	1	1	1	PB1, 3 POLE MAIN POWER BLOCK	491256B-01
2	2	2			M1-2, COMP. CONT. W/O AUX. CONTACT, 25 FLA, 208-230/460/575	417696B-03
			3	3	M1-2-3, COMP. CONT, W/ AUX. CONTACT, 25 FLA, 208-230/460/575	497647B-03
1	1	1	1	1	M10, SUPPLY FAN CONTACTOR, 25 FLA, 208-230/460/575	417696B-03
1	1	1	1	1	TC1, FANTROL THERMOSTAT, 208-230/460/575	497509B-01
TRANSFORMERS						
1	1	1	1	1	T1, MAIN CONTROL TRANSFORMER, 208-230V	467381B-10
1	1	1	1	1	T1, MAIN CONTROL TRANSFORMER, 460V	467381B-11
1	1	1	1	1	T1, MAIN CONTROL TRANSFORMER, 575V	467381B-12
1	1	1	1	1	T2, PUMPDOWN TRANSFORMER, 208-230V	497575A-01
1	1	1	1	1	T2, PUMPDOWN TRANSFORMER, 460V	497575A-02
1	1	1	1	1	T2, PUMPDOWN TRANSFORMER, 575V	497575A-03
1	1	1	1	1	T3, GAS HEAT TRANSFORMER, 460V	497602A-01
1	1	1	1	1	T3, GAS HEAT TRANSFORMER, 575V	497602A-02
FUSES						
2	2	2	2	2	F3-4, PUMPDOWN FUSE, 2.0A, 208-230V	497598B-07
2	2	2	2	2	F3-4, PUMPDOWN FUSE, 1.3A, 460V	497598B-05
2	2	2	2	2	F3-4, PUMPDOWN FUSE, 1.0A, 575V	497598B-04
2	2	2	2	2	F5-6, GAS HEAT FUSE, 0.8A, 460V	497598B-03
2	2	2	2	2	F5-6, GAS HEAT FUSE, 0.5A, 575V	497598B-02
			2	2	FUSE ON FB8, 15A, 208-230V	258605D-05
MISCELLANEOUS UNIT CONTROLS						
1	1	1	1	1	TC5, RETURN AIR FIRESTAT, ALL UNITS	479388B-02
1	1	1	1	1	TC6, SUPPLY AIR FIRESTAT, HEAT UNITS	479388B-03
1	1	1	1	1	TC6, SUPPLY AIR FIRESTAT, COOLING ONLY	479388B-02
1	1	1	1	1	TC7, FREEZESTAT	497540B-01
1	1	1	1	1	PC5, CLOGGED FILTER PRESSURE CONTROL	497627B-02
1	1	1	1	1	PC6, FAN SWITCH PRESSURE CONTROL	497555A-01
ECONOMIZER COMPONENTS						
1	1	1	1	1	2-POSITION DAMPER MOTOR, HONEYWELL 8415A	497505B-02
1	1	1	1	1	ENTHALPY CONTROL, HONEYWELL C7400A	492622B-02
1	1	1	1	1	PROPORTIONAL DAMPER MOTOR, HONEYWELL M7415A	497505B-01
1	1	1	1	1	ECONOMIZER CONTROL MODULE, HONEYWELL W7459A	491209B-01
1	1	1	1	1	MIXED AIR SENSOR	497541A-02

GAS HEATING SECTION

MBH — QUANTITY PER UNIT					DESCRIPTION	PART NO.
105	140	210	245	280		
1	1	1	1		FURNACE VENTOR MOTOR, 1/16 HP, NATURAL GAS & PROPANE	497570B-01
				1	FURNACE VENTOR MOTOR, 1/12 HP, NATURAL GAS & PROPANE	497570B-02
1	1	1	1	1	TD9, TIME DELAY RELAY, 24V, NATURAL GAS & PROPANE	497569B-01
1	1	1	1	1	R9, VENTOR MOTOR RELAY, 24V, NATURAL GAS & PROPANE	473565B-06
1	1	1	1	1	HL23, ROLLOUT TEMPERATURE LIMIT, NATURAL GAS & PROPANE	497564B-02
1	1	1	1	1	ELECTRONIC IGNITION MODULE, FENWAL	497510B-01
1	1				IGNITOR CABLE, 15″, NATURAL GAS & PROPANE	554343AG02
		1	1	1	IGNITOR CABLE, 11″, NATURAL GAS & PROPANE	554343AG01
1	1				GAS VALVE, NATURAL GAS	497511B-01
		1	1	1	GAS VALVE, NATURAL GAS	497511B-02
1	1				GAS VALVE, PROPANE	497511B-03
		1	1	1	GAS VALVE, PROPANE	497511B-04
1	1	1	1	1	FLAME SENSOR, NATURAL GAS & PROPANE	497561B-01
1	1	1	1	1	IGNITOR ELECTRODE, NATURAL GAS & PROPANE	497556B-01

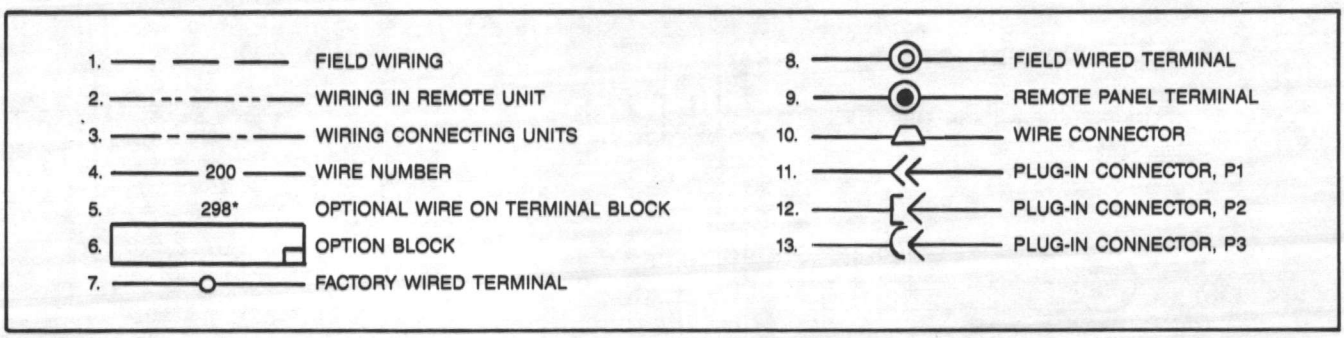
① This is only a partial listing of the replacement parts available. Contact your local sales representative for additional information.

WIRING DIAGRAMS

LEGEND:

Designation	Description	Standard Location
C1, 2	Capacitors for Condenser Motors	Control Box
C5	Capacitor for Furnace Ventor Motor	Heat Sect.
CM1, CM2	Condenser Fan Motor	Condenser Sect.
COMPR 1—3	Compressors 1—3	Condenser Sect.
DM	Damper Motor	Econ./Ret. Sect.
DS1	Disconnect Switch, Main	Control Box
DS3	Disconnect Switch, Main Elec. Heat	Heat Sect.
F1	Fuse, Control Circuit	Control Box
F3, 4	Fuse, Pumpdown	Control Box
F5, 6	Fuse, Gas Heat	Control Box
FB8	Fuseblock, Power Control	Control Box
FB30	Fuseblock, Power Control	Heat Sect.
FB31—33	Fuseblock, Electric Heat	Heat Sect.
FRS	Flame Rectification Sensor	Heat Sect.
GRD	Ground	Control Box & Heat Sect.
GV1	Gas Valve, Main	Heat Sect.
HL1—3	Hi-Limits, Elec. Heat, Secondary	Heat Sect.
HL21, 22	Hi-Limits, Gas Heat	Fan Sect.
HL23	Hi-Limit, Gas Heat, Rollout	Heat Sect.
HL31, 32	Hi-Limits, Elec. Heat, Primary	Heat Sect.
HP1—3	High Pressure Controls	Control Box
HTR1—3	Heaters, Crankcase Heaters	On Compressors
IGN	Ignition Electrode	Heat Sect.
LP1—3	Low Pressure Controls	Control Box
M1—3	Contactors, Compressor	Control Box
M1—3 AUX.	Auxiliary Contacts	Control Box
M10	Contactor, Supply Fan	Control Box
M31—33	Contactors, Electric Heat	Heat Sect.
M31—33 AUX.	Auxiliary Contacts	Heat Sect.
MAT	Mixed Air Sensor	Supply Fan Sect.
MJ	Mechanical Jumper	Control Box & Economizer Sect.

Designation	Description	Standard Location
OAE	Outside Air Enthalpy Sensor	Econ./Ret. Sect.
P1	Plug, For Economizer	Supply Fan Sect.
P2	Plug, For Heat	Control Box
P3	Plug, For Alarms	Control Box
PB1	Powerblock, Main	Control Box
PB3	Powerblock, Electric Heat	Heat Sect.
PC1, 2, 3	Pressure Switch, Low Ambient	Control Box
PC5	Pressure Switch, Clogged Filter	Supply Fan Sect.
PC6	Pressure Switch, Fan	Supply Fan Sect.
PCB1	Local/Remote Status Board	Control Box
R1—3	Relays, High Pressure	Control Box
R9	Relay, Heat	Heat Sect.
R10	Relay, Ventilation/Smoke	Control Box
R13, 14	Relays, Pumpdown	Control Box
RAE	Return Air Enthalpy Sensor	Econ/Return Sect.
SAF	Supply Air Fan Motor	Supply Fan Sect.
SV1—3	Solenoid Valves, Liquid	Supply Fan Sect.
SV5	Solenoid Valve, Hot Gas Bypass	Supply Fan Sect.
T1	Transformer, Main Control	Control Box
T2	Transformer, Pumpdown	Control Box
T3	Transformer, Gas Heat	Control Box
TB1	Terminal Block, 24V Field	Control Box
TB2	Terminal Block, 24V Field	Supply Fan Sect.
TC1	Thermostat, FANTROL	Control Box
TC5	Thermostat, Return Air Firestat	Supply Fan Sect.
TC6	Thermostat, Supply Air Firestat	Supply Fan Sect.
TC7	Thermostat, Freezestat	Supply Fan Sect.
TC15	Thermostat, Power Saver	Heat Sect.
TD1—3	Time Delay, Compressor Lockout	Control Box
TD9	Time Delay, Heat	Heat Sect.
VM1	Furnace Ventor Motor	Gas Heat Sect.
VMS	Ventor Motor Centrifugal Switch	Gas Heat Sect.



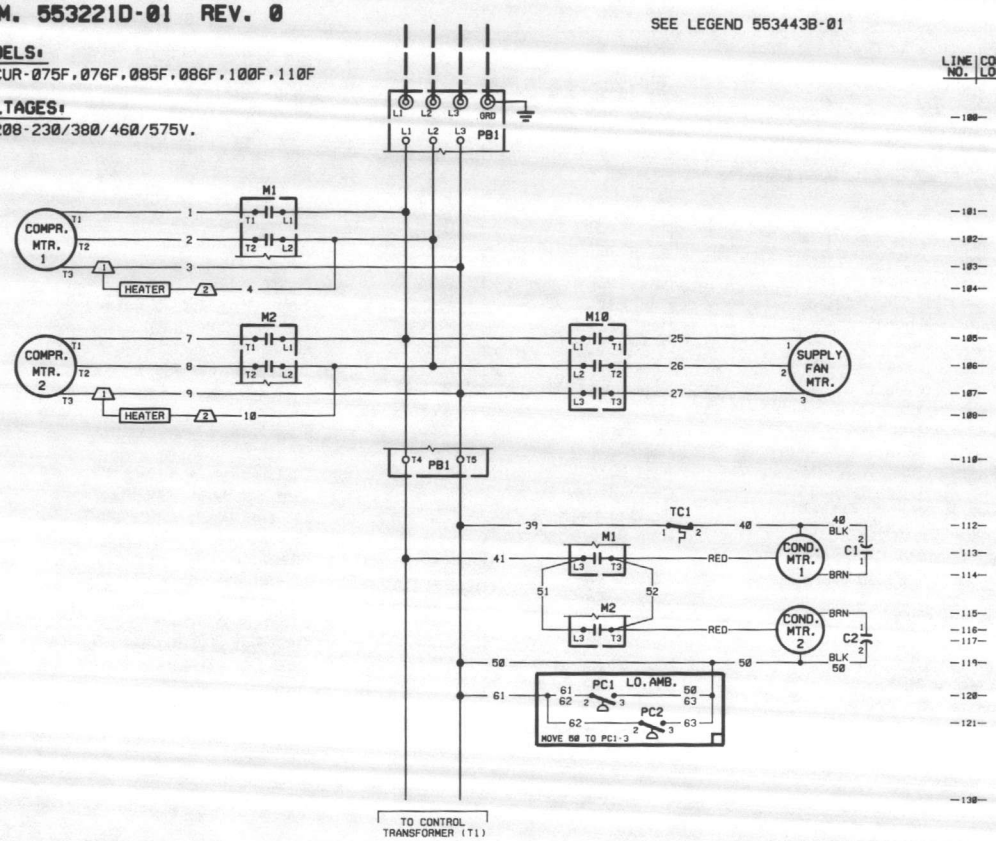
POWER WIRING DIAGRAMS

SCHEM. 553221D-01 REV. 0

SEE LEGEND 553443B-01

MODELS:
CUR-075F,076F,085F,086F,100F,110F

VOLTAGES:
208-230/380/460/575V.

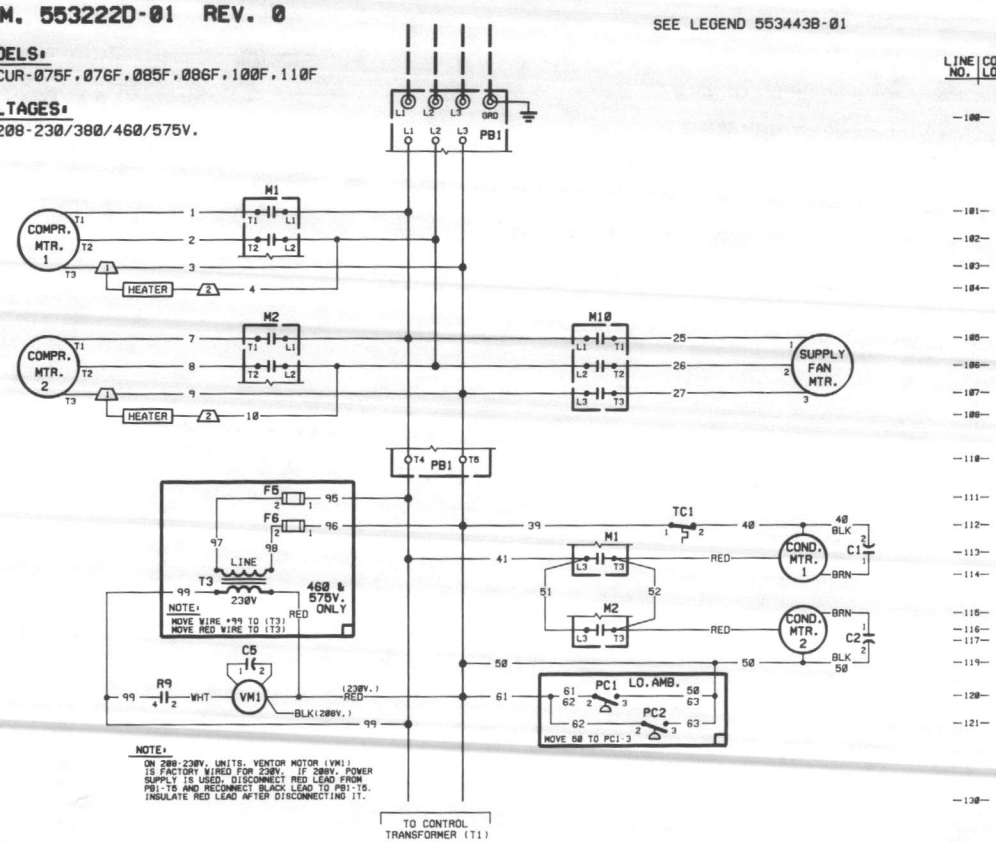


SCHEM. 553222D-01 REV. 0

SEE LEGEND 553443B-01

MODELS:
CUR-075F,076F,085F,086F,100F,110F

VOLTAGES:
208-230/380/460/575V.



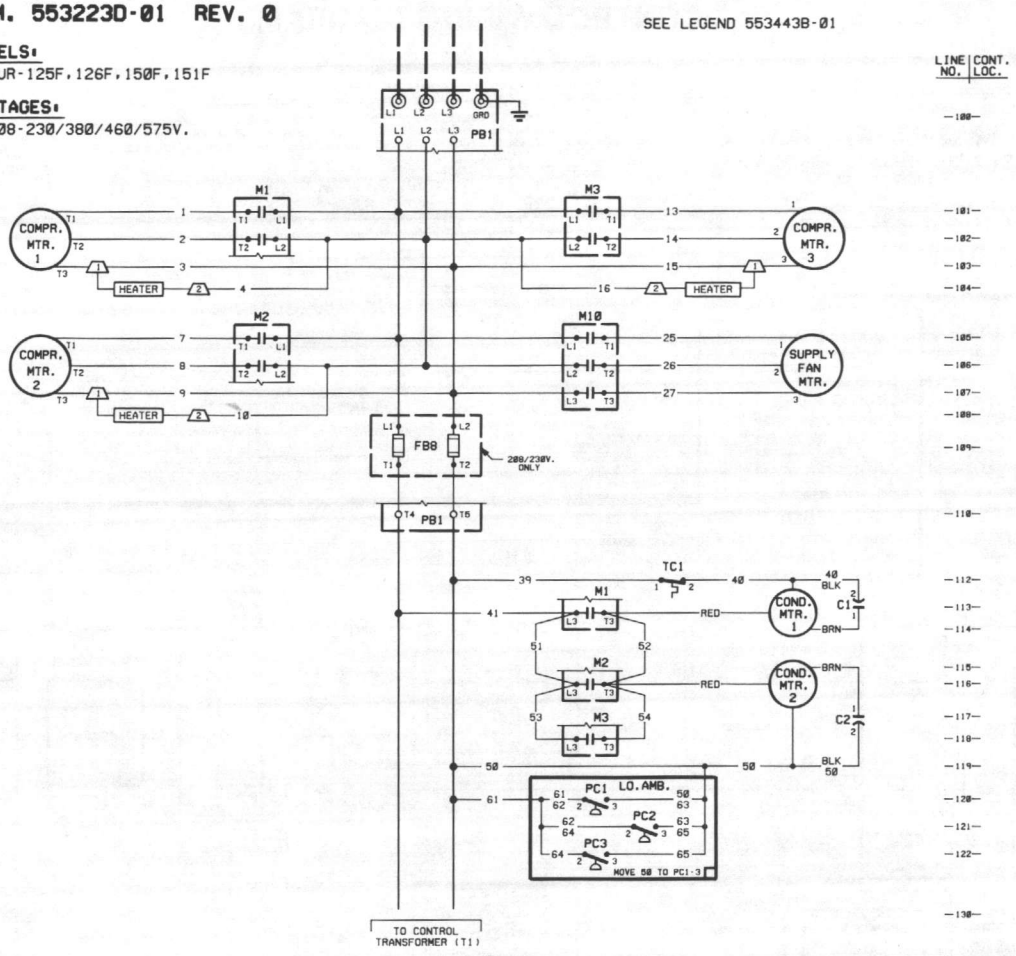
NOTE:
ON 208-230V. UNITS, VENTOR MOTOR (VM1) IS FACTORY WIRED FOR 230V. IF 208V. POWER SUPPLY IS USED, DISCONNECT RED LEAD FROM PB1-T5 AND RECONNECT BLACK LEAD TO PB1-T5. INSULATE RED LEAD AFTER DISCONNECTING IT.

SCHEM. 553223D-01 REV. 0

SEE LEGEND 553443B-01

MODELS:
CUR-125F,126F,150F,151F

VOLTAGES:
208-230/380/460/575V.

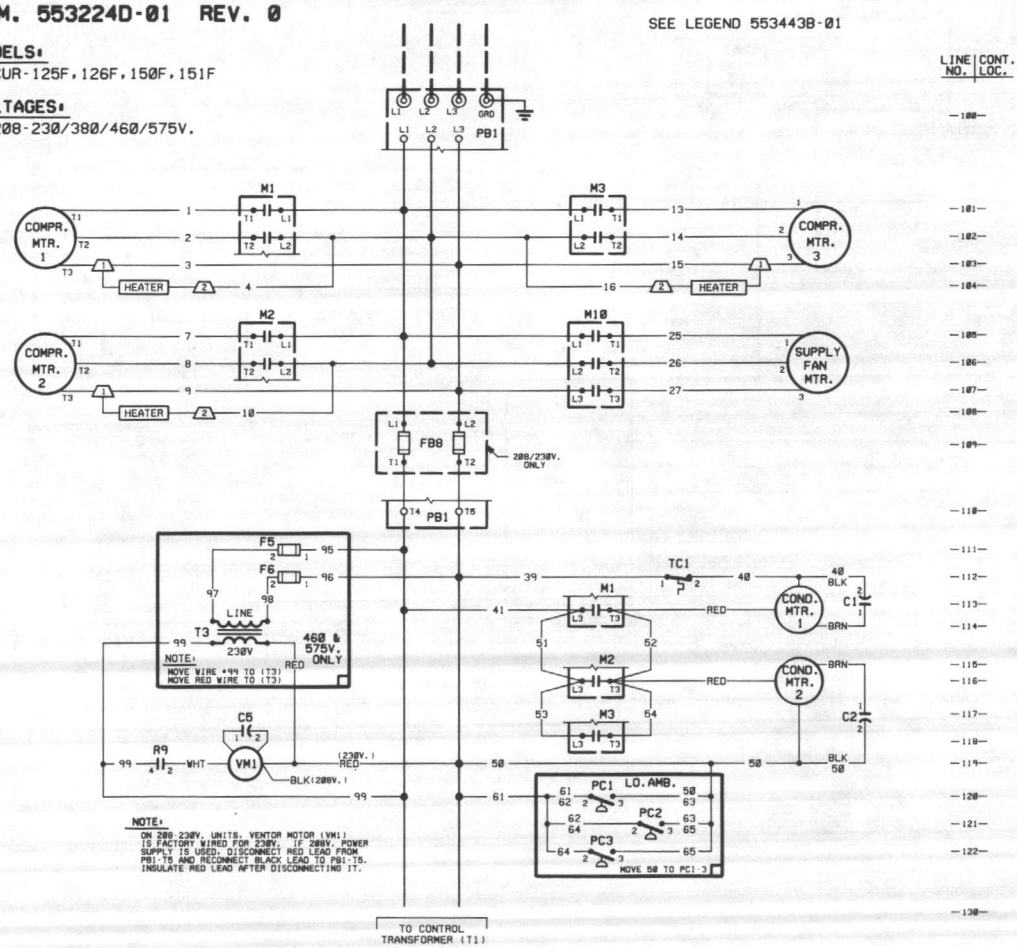


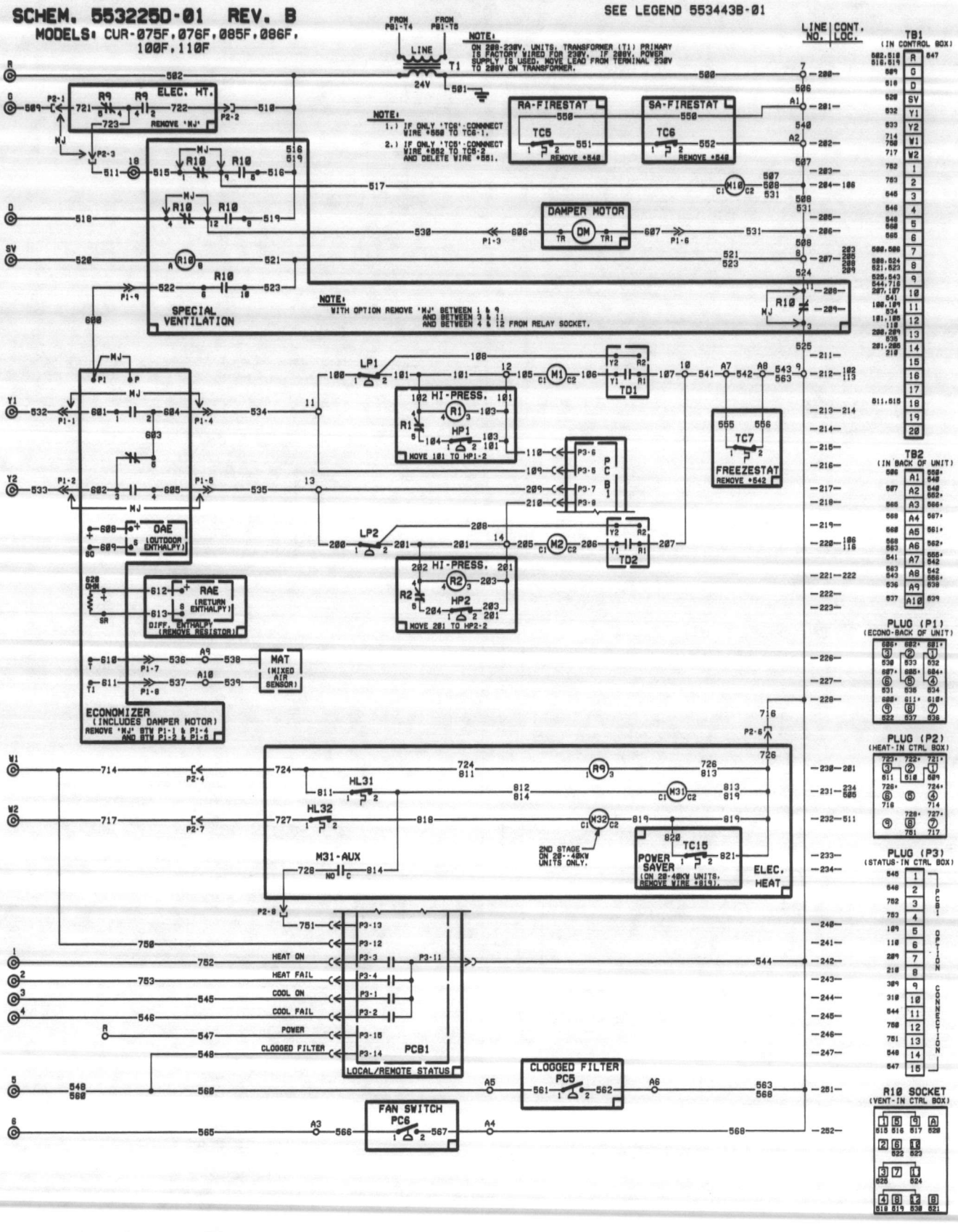
SCHEM. 553224D-01 REV. 0

SEE LEGEND 553443B-01

MODELS:
CUR-125F,126F,150F,151F

VOLTAGES:
208-230/380/460/575V.

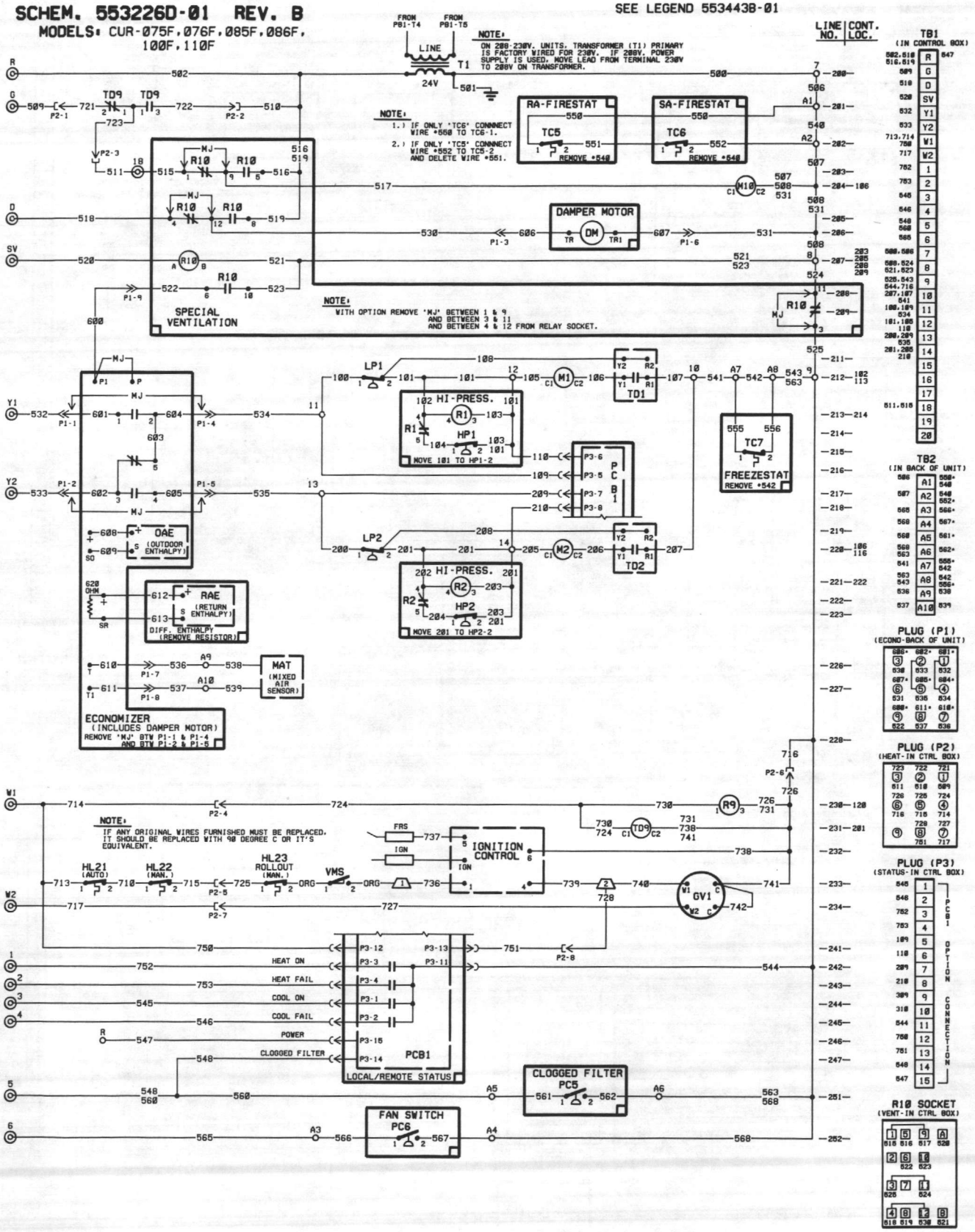



SCHEM. 553225D-01 REV. B
MODELS: CUR-075F,076F,085F,086F,
100F,110F
SEE LEGEND 553443B-01
LINE | CONT. NO. | LOC.
TB1
(IN CONTROL BOX)
TB2
(IN BACK OF UNIT)
PLUG (P1)
(ECONO-BACK OF UNIT)
PLUG (P2)
(HEAT-IN CTRL BOX)
PLUG (P3)
(STATUS-IN CTRL BOX)
R10 SOCKET
(VENT-IN CTRL BOX)
ELEC. HT.
REMOVE 'MJ'
SPECIAL VENTILATION
WITH OPTION REMOVE 'MJ' BETWEEN 1 & 9
AND BETWEEN 3 & 11
AND BETWEEN 4 & 12 FROM RELAY SOCKET.
RA-FIRESTAT
SA-FIRESTAT
REMOVE *548
DAMPER MOTOR
LP1
LP2
HI-PRESS.
MOVE 101 TO HP1-2
MOVE 201 TO HP2-2
TD1
TD2
FREEZESTAT
REMOVE *542
OAE
(OUTDOOR ENTHALPY)
RAE
(RETURN ENTHALPY)
DIFF. ENTHALPY
(REMOVE RESISTOR)
MAT
(MIXED AIR SENSOR)
ECONOMIZER
(INCLUDES DAMPER MOTOR)
REMOVE 'MJ' BTW P1-1 & P1-4
AND BTW P1-2 & P1-5
HL31
HL32
M31-AUX
2ND STAGE ON 20-40KW UNITS ONLY.
POWER SAVER
(ON 20-40KW UNITS, REMOVE WIRE *819).
ELEC. HEAT
HEAT ON
HEAT FAIL
COOL ON
COOL FAIL
POWER
CLOGGED FILTER
PCB1
LOCAL/REMOTE STATUS
CLOGGED FILTER PC5
FAN SWITCH PC6
FROM P81-T4
FROM P81-T5
LINE
T1
24V
ON 208-230V. UNITS, TRANSFORMER (T1) PRIMARY IS FACTORY WIRED FOR 230V. IF 208V. POWER SUPPLY IS USED, MOVE LEAD FROM TERMINAL 230V TO 208V ON TRANSFORMER.
IF ONLY 'TC6' CONNECT WIRE *550 TO TC6-1.
IF ONLY 'TC6' CONNECT WIRE *552 TO TC6-2 AND DELETE WIRE *551.

SCHEM. 553226D-01 REV. B

MODELS: CUR-075F,076F,085F,086F, 100F,110F

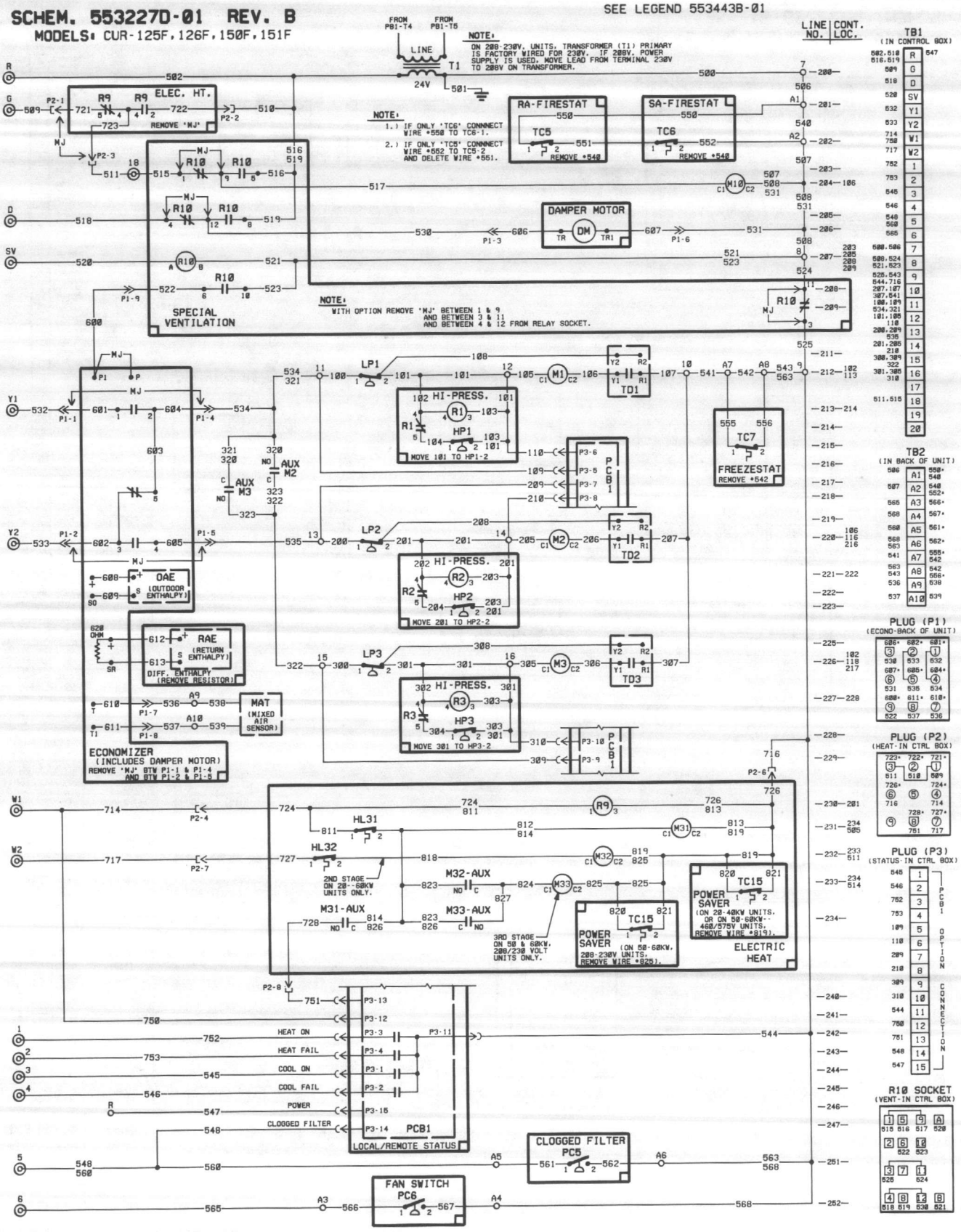
SEE LEGEND 553443B-01



SCHEM. 553227D-01 REV. B

MODELS: CUR-125F,126F,150F,151F

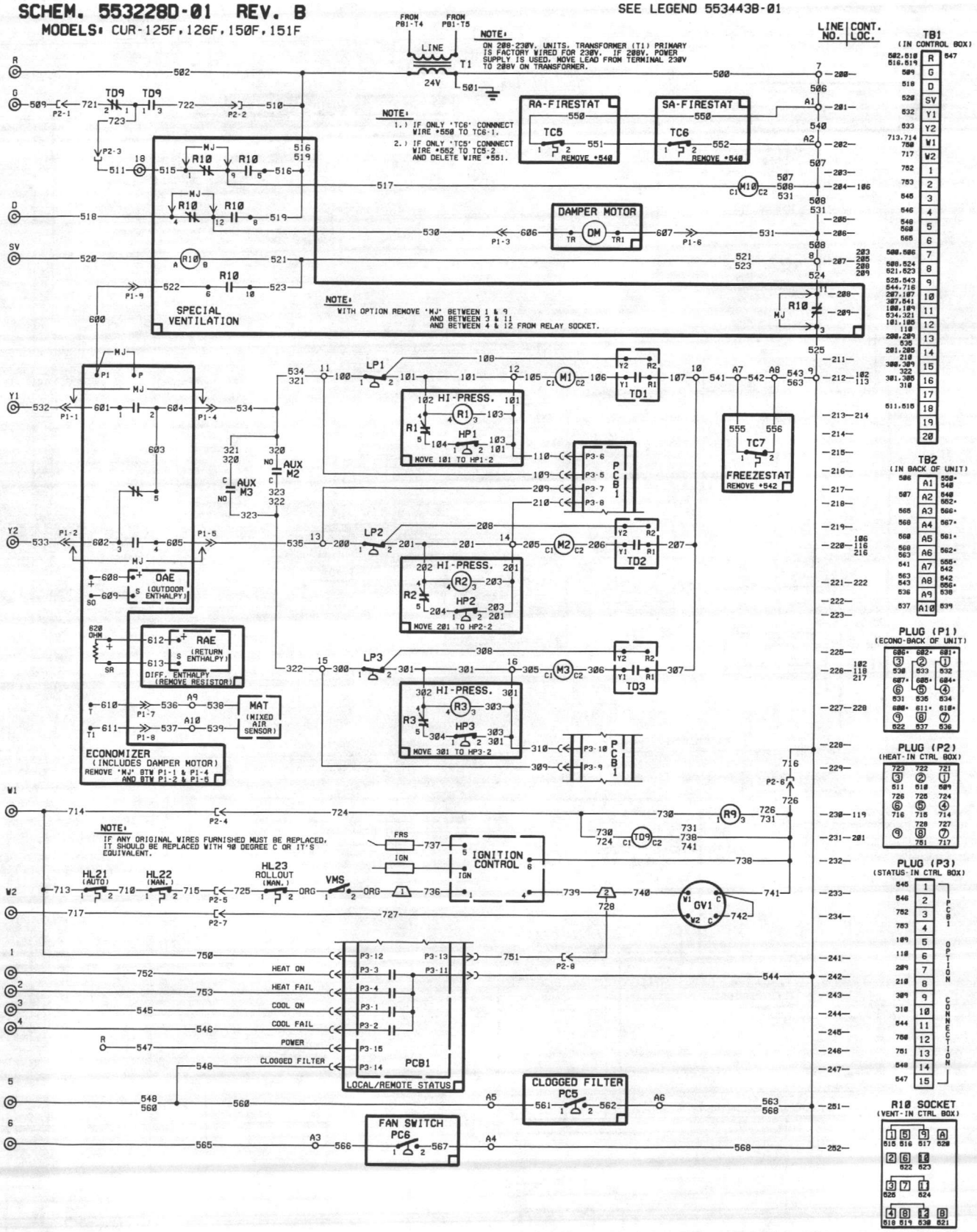
SEE LEGEND 553443B-01

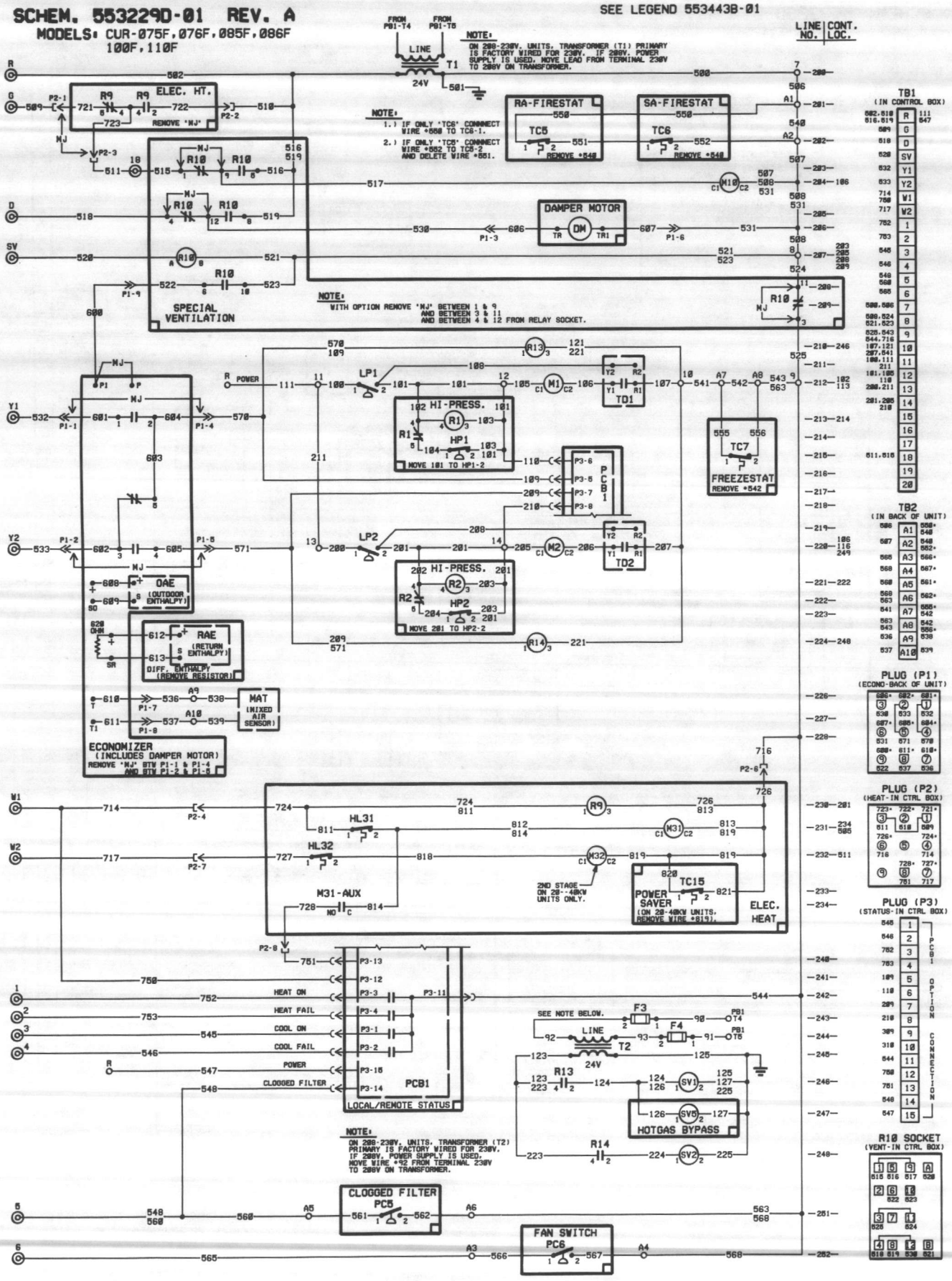


SCHEM. 553228D-01 REV. B

MODELS: CUR-125F,126F,150F,151F

SEE LEGEND 553443B-01

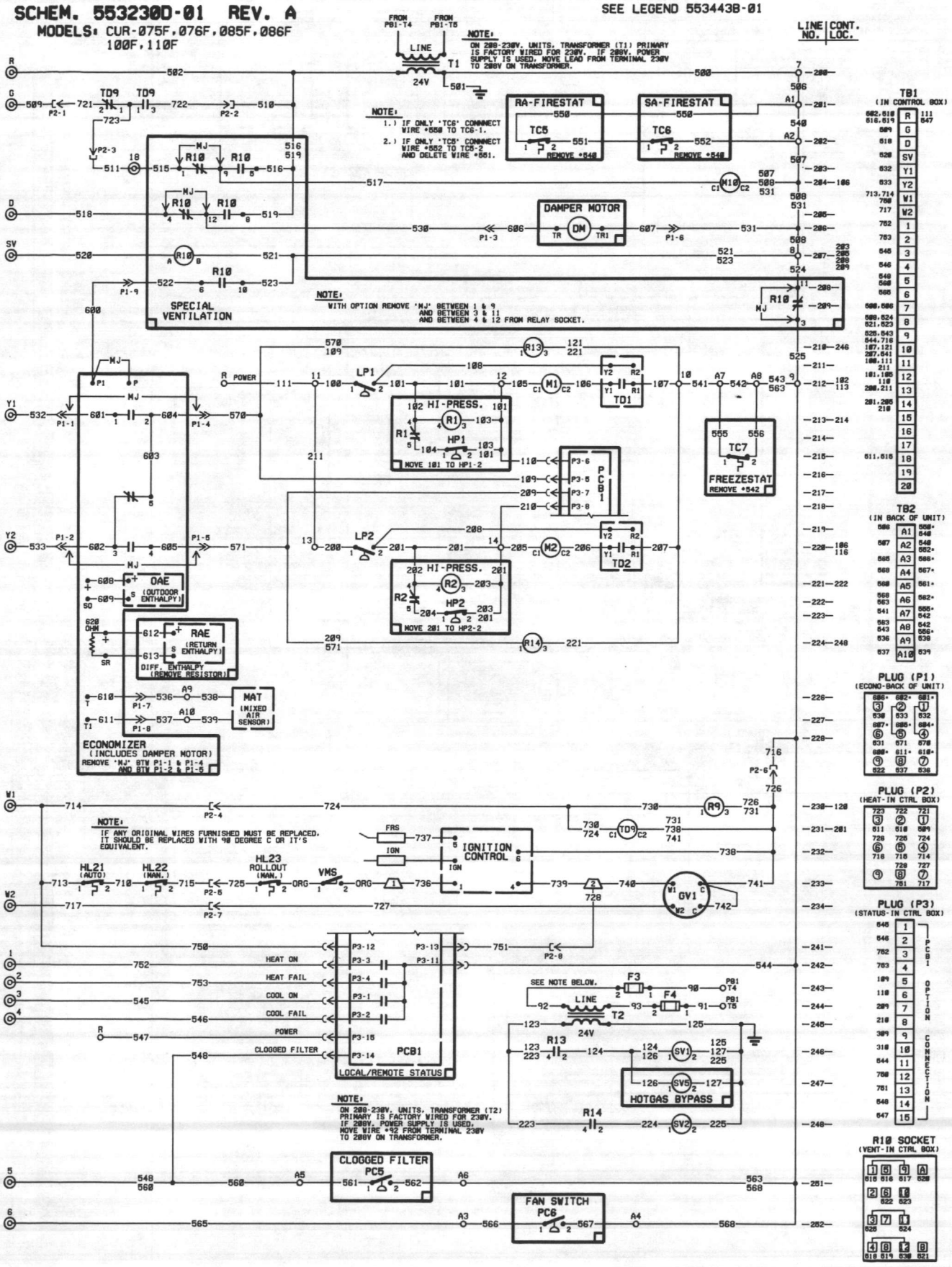



SCHEM. 553229D-01 REV. A
MODELS: CUR-075F,076F,085F,086F
100F,110F
SEE LEGEND 553443B-01
LINE NO. | CONT. LOC.
NOTE: ON 208-230V. UNITS, TRANSFORMER (T1) PRIMARY IS FACTORY WIRED FOR 230V. IF 208V. POWER SUPPLY IS USED, MOVE LEAD FROM TERMINAL 230V TO 208V ON TRANSFORMER.
ELEC. HT.
REMOVE *MJ*
RA-FIRESTAT
SA-FIRESTAT
TC5
TC6
REMOVE *548
NOTE: 1.) IF ONLY 'TC5' CONNECT WIRE *552 TO TC5-1.
2.) IF ONLY 'TC5' CONNECT WIRE *552 TO TC5-2 AND DELETE WIRE *551.
DAMPER MOTOR
SPECIAL VENTILATION
NOTE: WITH OPTION REMOVE 'MJ' BETWEEN 1 & 9 AND BETWEEN 3 & 11 AND BETWEEN 4 & 12 FROM RELAY SOCKET.
LP1
LP2
HI-PRESS.
MOVE 101 TO HP1-2
MOVE 201 TO HP2-2
TD1
TD2
FREEZESTAT
REMOVE *542
PCB1
OAE
(OUTDOOR ENTHALPY)
RAE
(RETURN ENTHALPY)
DIFF. ENTHALPY (REMOVE RESISTOR)
MAT
(MIXED AIR SENSOR)
ECONOMIZER
(INCLUDES DAMPER MOTOR)
REMOVE 'MJ' BTW P1-1 & P1-4 AND BTW P1-2 & P1-5
HL31
HL32
M31-AUX
2ND STAGE ON 20--40KW UNITS ONLY.
TC15
POWER SAVER
(ON 20-40KW UNITS, REMOVE WIRE *815).
ELEC. HEAT
HEAT ON
HEAT FAIL
COOL ON
COOL FAIL
POWER
CLOGGED FILTER
LOCAL/REMOTE STATUS
SEE NOTE BELOW.
F3
F4
T2
R13
R14
HOTGAS BYPASS
NOTE: ON 208-230V. UNITS, TRANSFORMER (T2) PRIMARY IS FACTORY WIRED FOR 230V. IF 208V. POWER SUPPLY IS USED, MOVE WIRE *92 FROM TERMINAL 230V TO 208V ON TRANSFORMER.
CLOGGED FILTER PC5
FAN SWITCH PC6
TB1
(IN CONTROL BOX)
TB2
(IN BACK OF UNIT)
PLUG (P1)
(ECONO-BACK OF UNIT)
PLUG (P2)
(HEAT-IN CTRL BOX)
PLUG (P3)
(STATUS-IN CTRL BOX)
OPTION CONNECTION
R10 SOCKET
(VENT-IN CTRL BOX)

SCHEM. 553230D-01 REV. A

MODELS: CUR-075F,076F,085F,086F
100F,110F

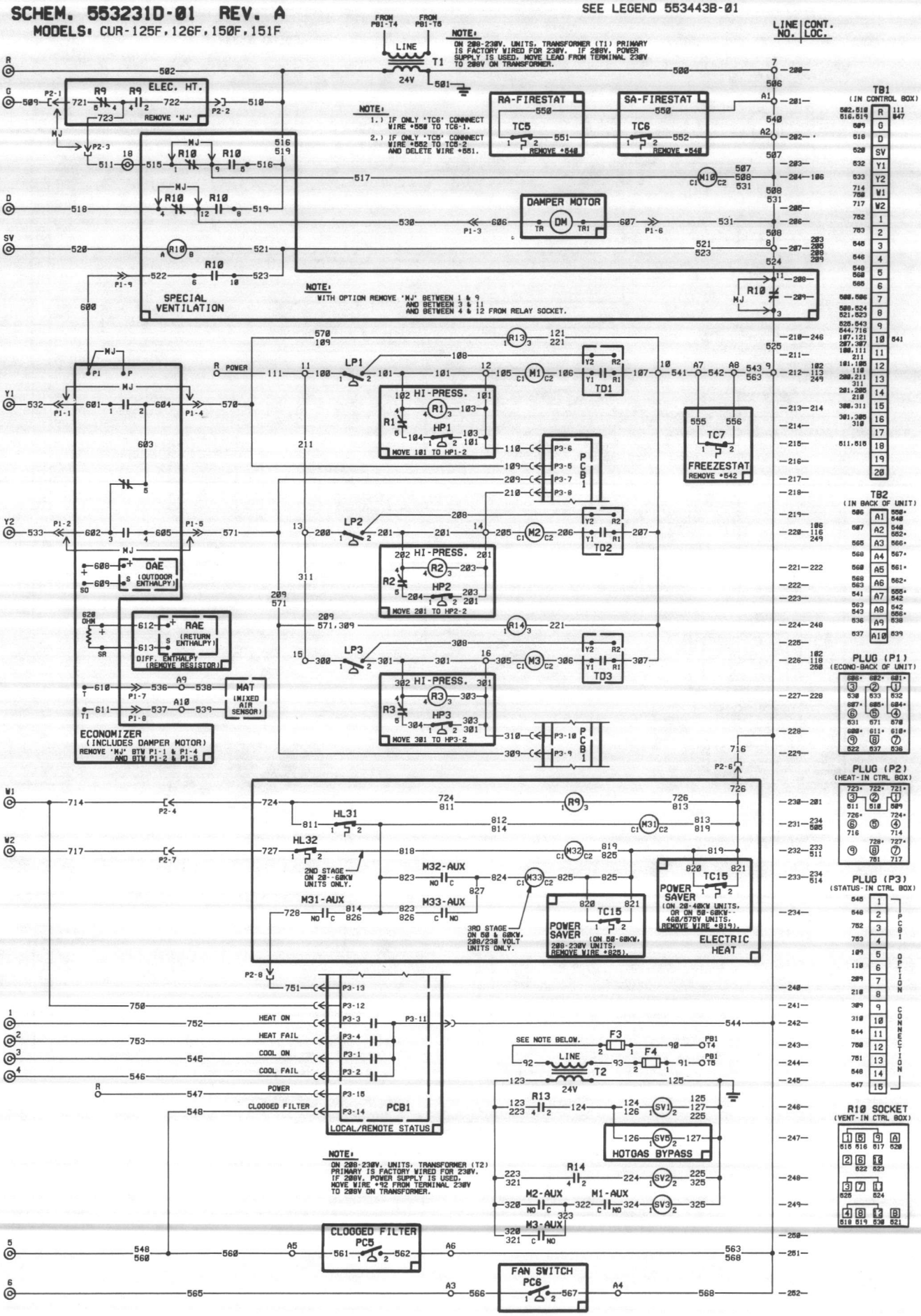
SEE LEGEND 553443B-01



SCHEM. 553231D-01 REV. A

MODELS: CUR-125F,126F,150F,151F

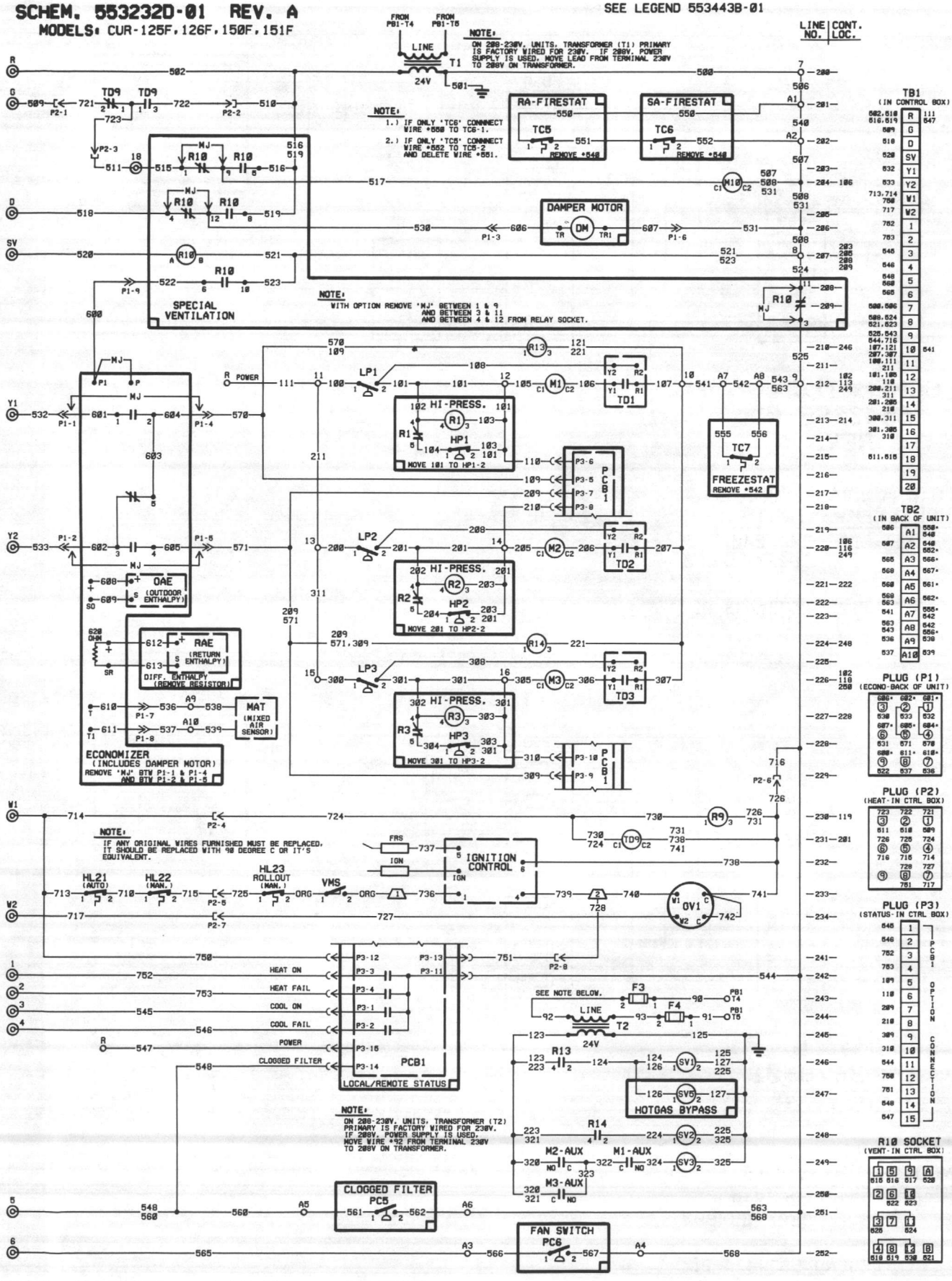
SEE LEGEND 553443B-01



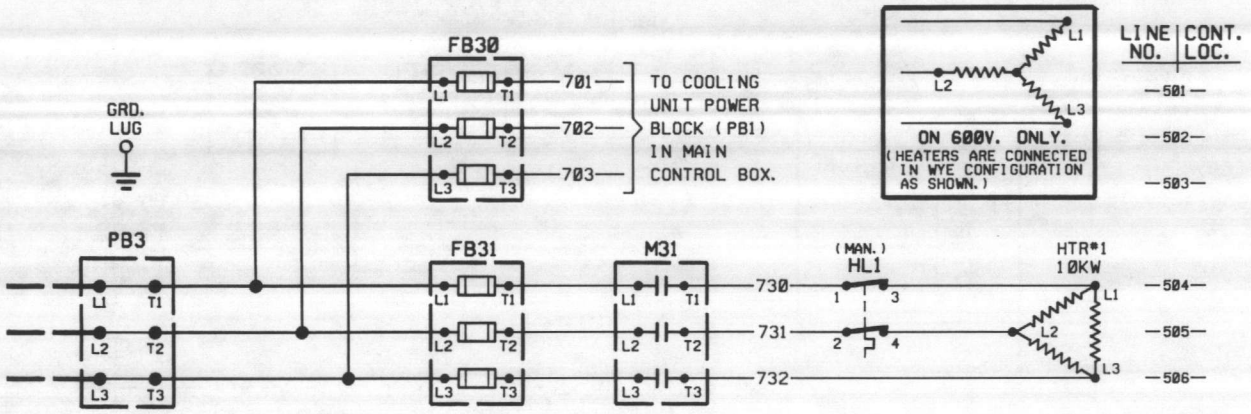
SCHEM. 553232D-01 REV. A

MODELS: CUR-125F,126F,150F,151F

SEE LEGEND 553443B-01



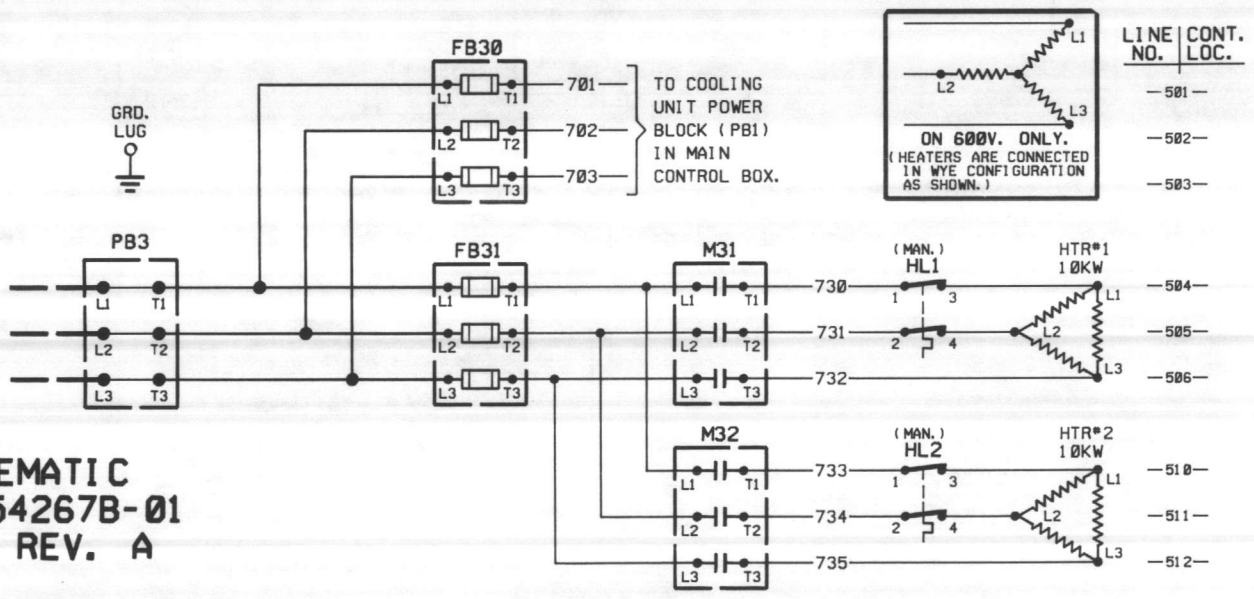
ELECTRIC HEAT WIRING DIAGRAMS



SCHEMATIC 554266B-01 REV. A

HTR. MODEL	NOM. KW	NOM. VOLTS
E02	10	208/240
		380/480/600

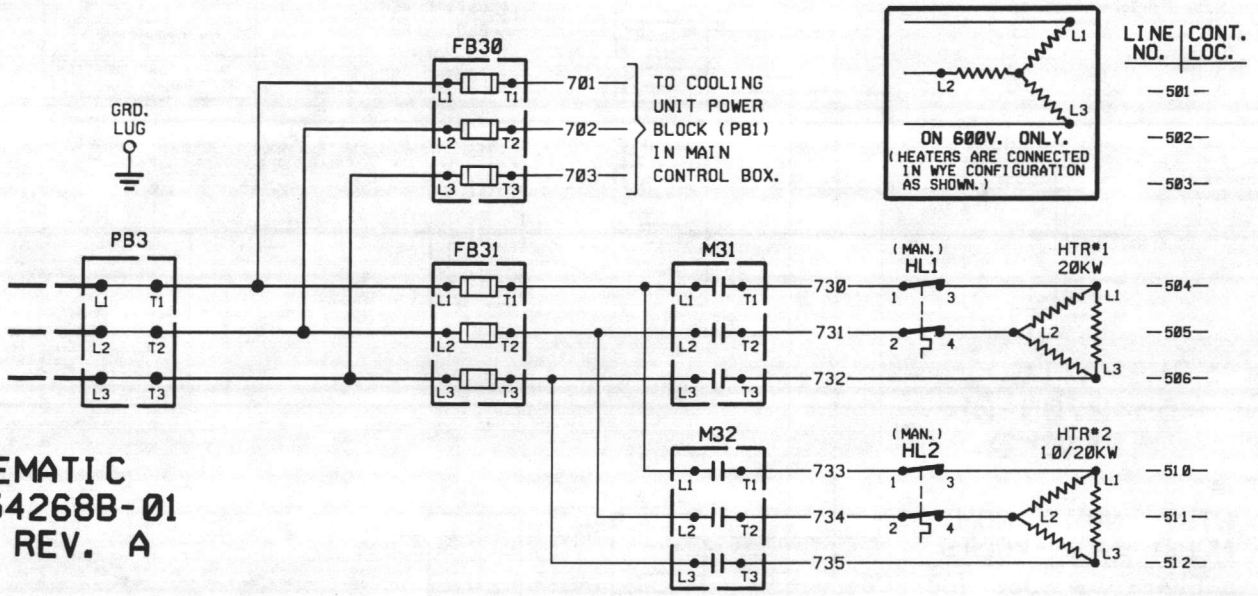
SEE LEGEND 553443B-01



SCHEMATIC 554267B-01 REV. A

HTR. MODEL	NOM. KW	NOM. VOLTS
E05	20	208/240
		380/480/600

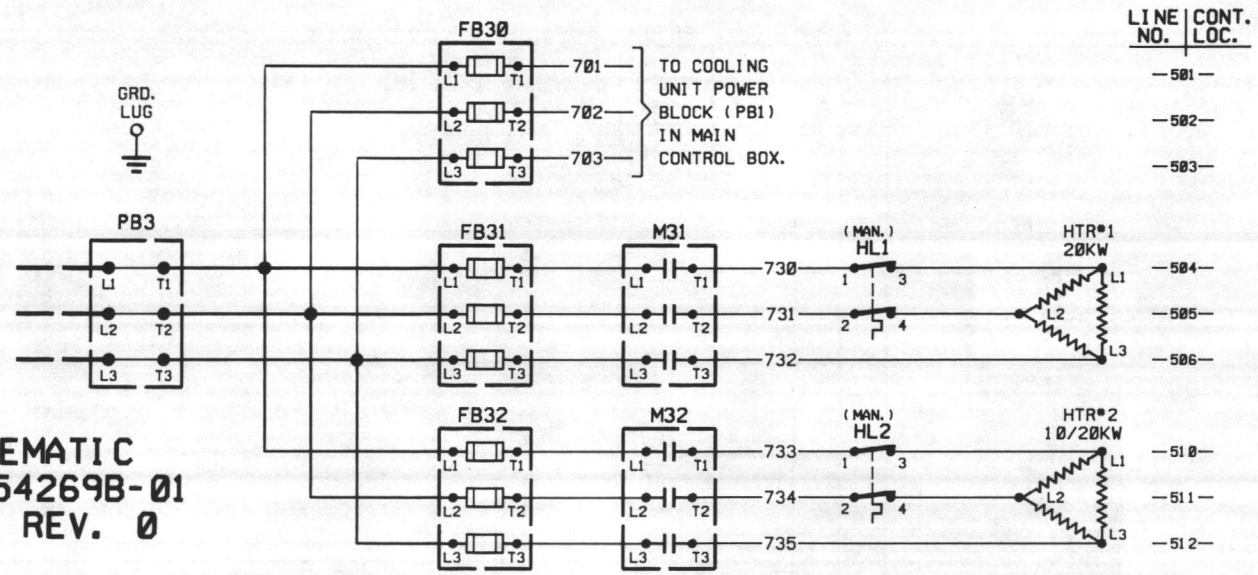
SEE LEGEND 553443B-01



SCHEMATIC
554268B-01
REV. A

HTR. MODEL	NOM. KW	NOM. VOLTS
E08	30	380/480/600
E11	40	380/480/600

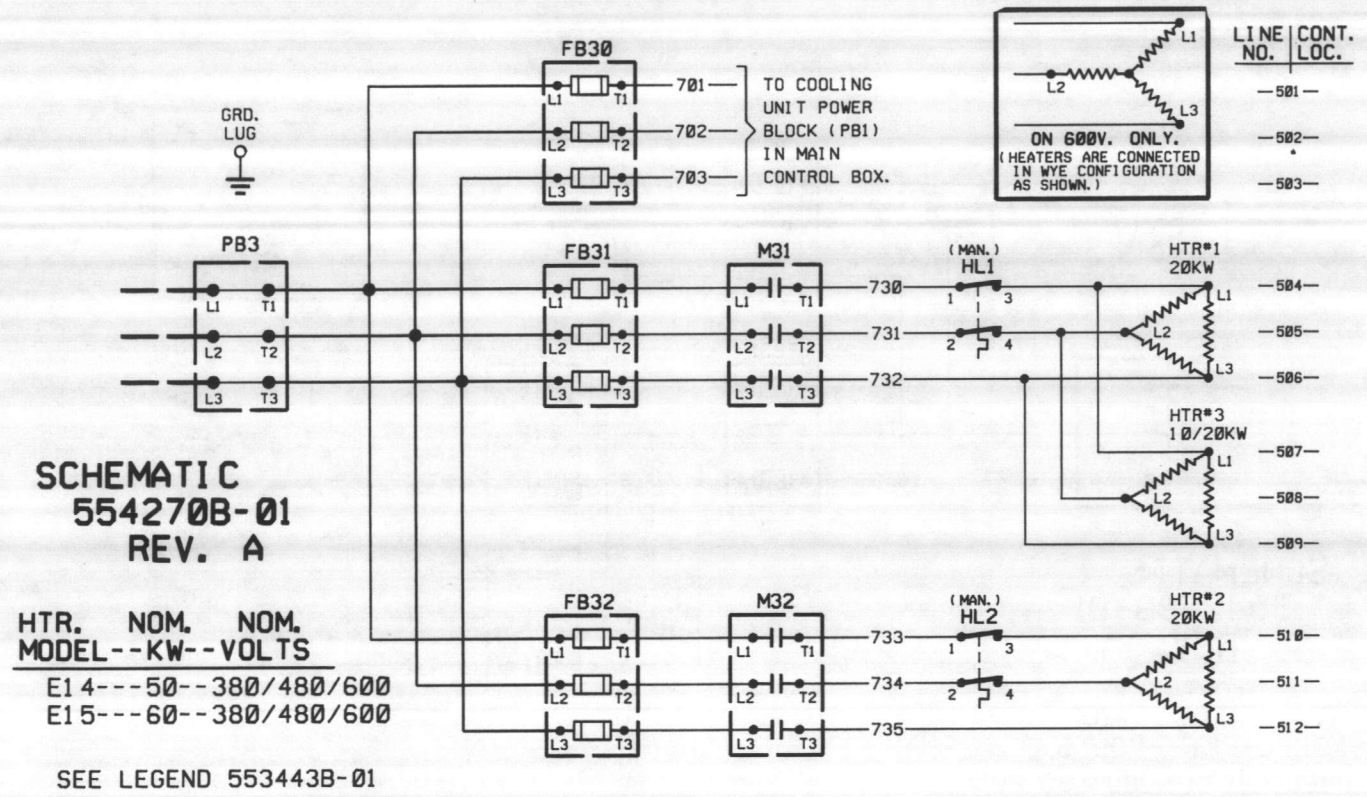
SEE LEGEND 553443B-01

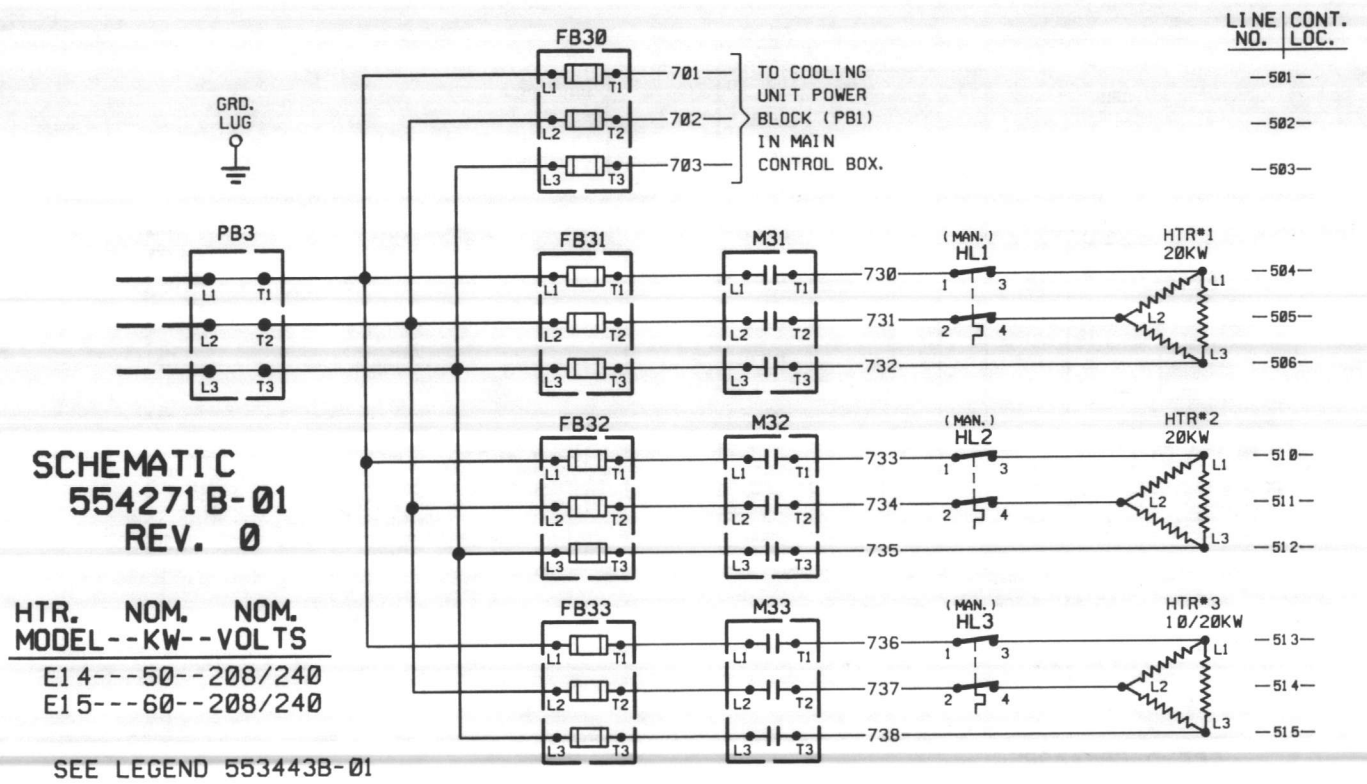


SCHEMATIC
554269B-01
REV. 0

HTR. MODEL	NOM. KW	NOM. VOLTS
E08	30	208/240
E11	40	208/240

SEE LEGEND 553443B-01


FB30
GRD. LUG
PB3
FB31
M31
(MAN.) HL1
HTR*1 20KW
HTR*3 10/20KW
FB32
M32
(MAN.) HL2
HTR*2 20KW
701
702
703
TO COOLING UNIT POWER BLOCK (PB1) IN MAIN CONTROL BOX.
730
731
732
733
734
735
ON 600V. ONLY.
(HEATERS ARE CONNECTED IN WYE CONFIGURATION AS SHOWN.)
LINE NO.
CONT. LOC.
501
502
503
504
505
506
507
508
509
510
511
512
SCHEMATIC 554270B-01 REV. A
HTR. MODEL
NOM. KW
NOM. VOLTS
E14 50 380/480/600
E15 60 380/480/600
SEE LEGEND 553443B-01

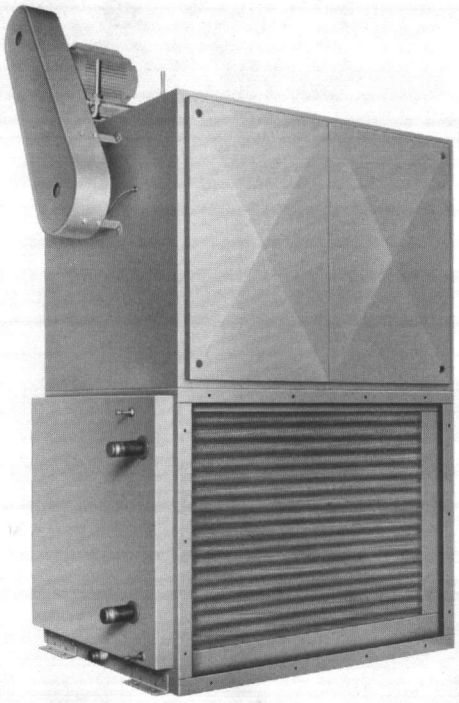

FB30
GRD. LUG
PB3
FB31
M31
(MAN.) HL1
HTR*1 20KW
FB32
M32
(MAN.) HL2
HTR*2 20KW
FB33
M33
(MAN.) HL3
HTR*3 10/20KW
701
702
703
TO COOLING UNIT POWER BLOCK (PB1) IN MAIN CONTROL BOX.
730
731
732
733
734
735
736
737
738
LINE NO.
CONT. LOC.
501
502
503
504
505
506
510
511
512
513
514
515
SCHEMATIC 554271B-01 REV. 0
HTR. MODEL
NOM. KW
NOM. VOLTS
E14 50 208/240
E15 60 208/240
SEE LEGEND 553443B-01

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

McQuay
Air Conditioning

INSTALLATION AND MAINTENANCE DATA

BULLETIN NO. IM 80-7
JULY, 1989
FORM NO. 211843Y REV. C



LSL Vertical Unit

SEASONMASTER
Low and Medium Pressure Central Station Air Conditioners

Models: LSL/MSL 103C — 111C
LSB/MSB 106E — 111E
LML/MMM 106E — 111E

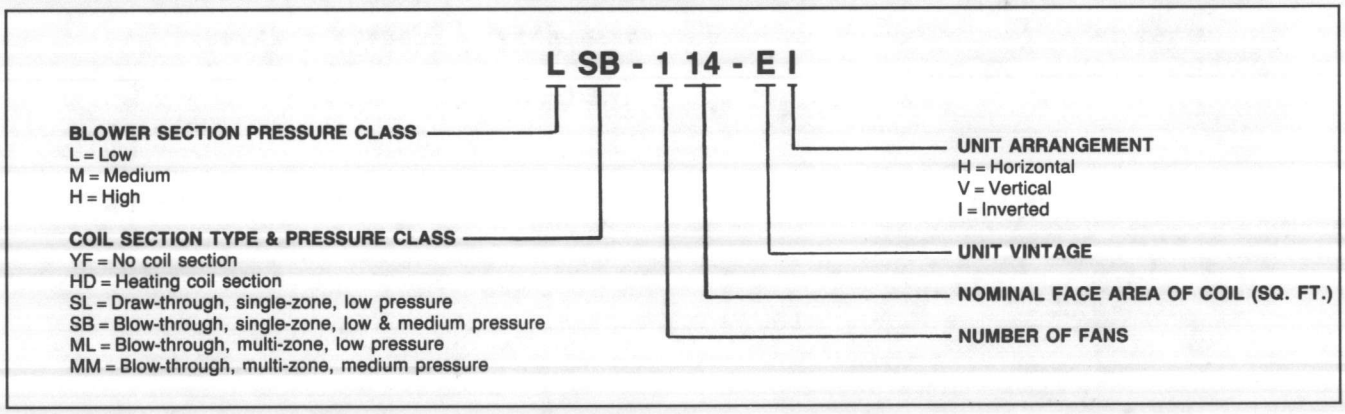
SEASONVENT
Low Pressure Heating & Ventilating Units

Models: LYF/LHD 103C — 111C

LHD Horizontal Unit

TABLE OF CONTENTS

NOMENCLATURE



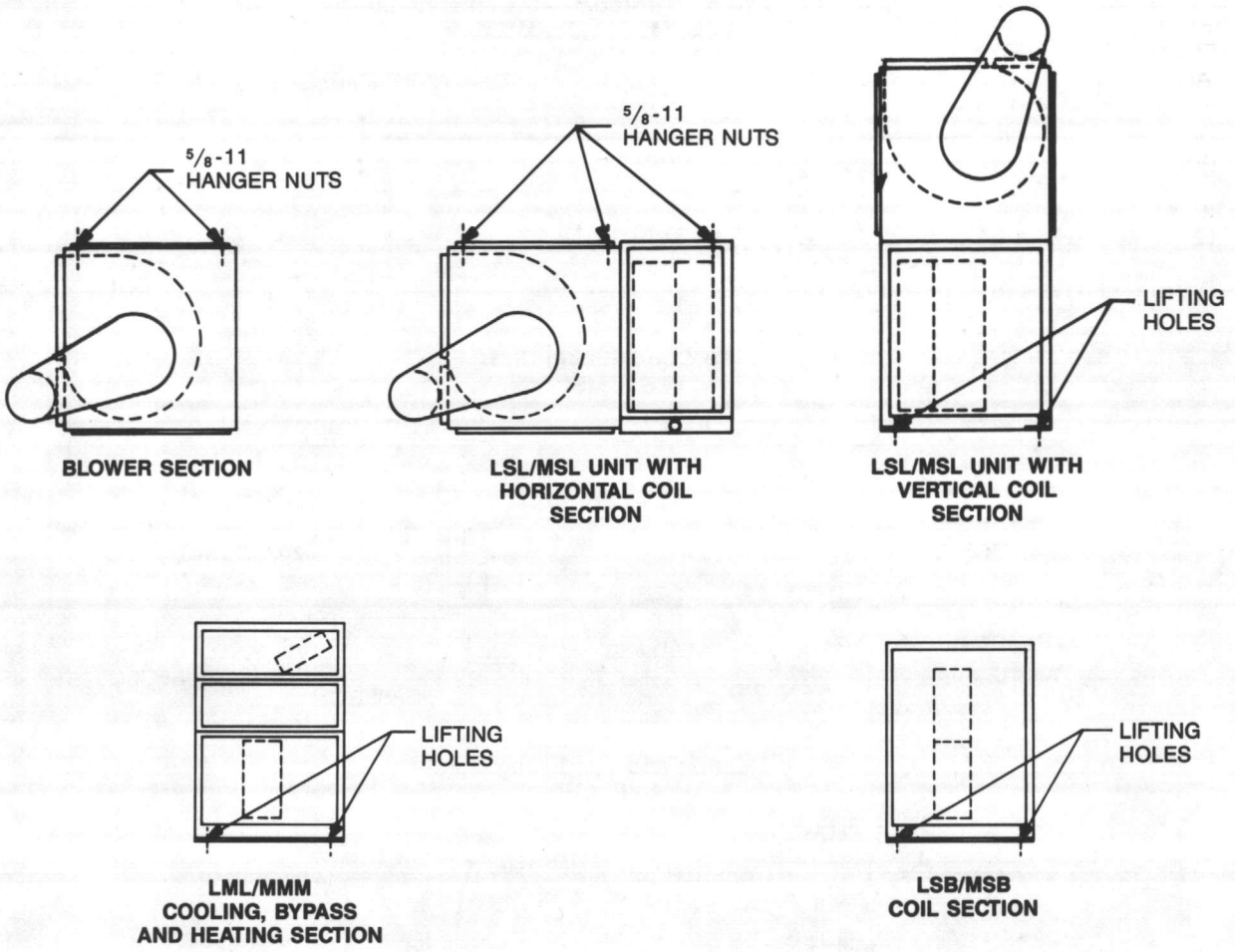
Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. CAUTION: Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

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.



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

HANDLING OF SECTIONS

1. Top hanger nuts are provided regardless of unit mounting arrangement, except on multizone, blow-through coil section, and vertical coil sections. See Figure 1.
2. Hanger nuts have 5/8" 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."
   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"-20 bolts.

FIGURE 2.

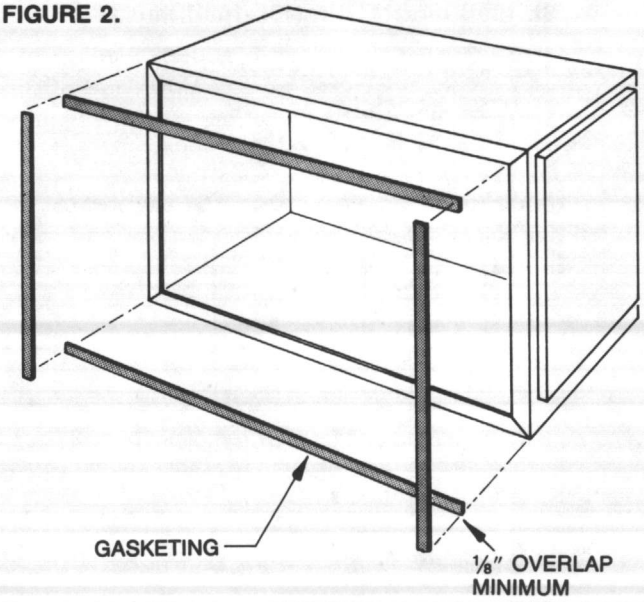
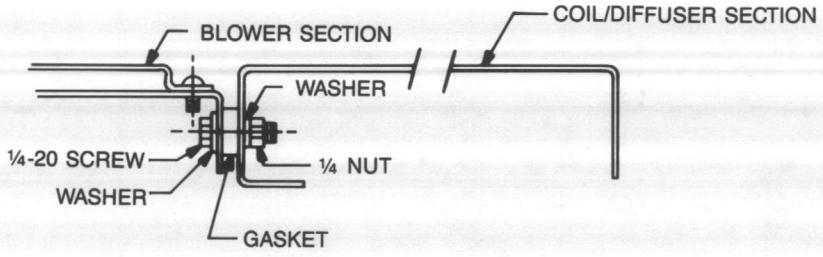
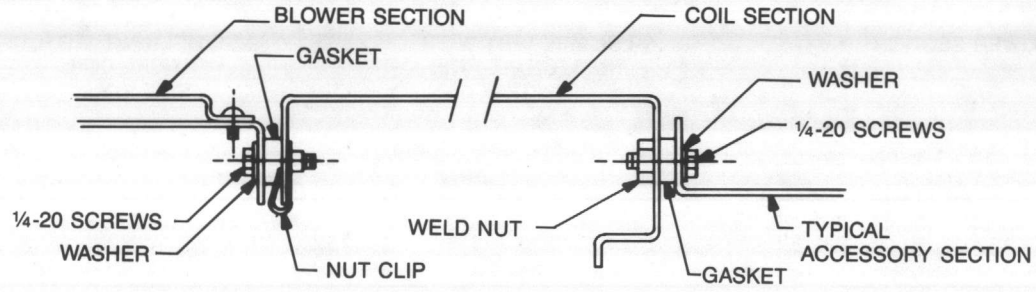


FIGURE 3. Typical Attaching Method

Multi-zone and Blow-through Air Conditioning Unit
LSB, MSB, LML, MMM



Air Conditioning Unit
LSL, MSL



Heating and Ventilating Unit
LYF, LHD

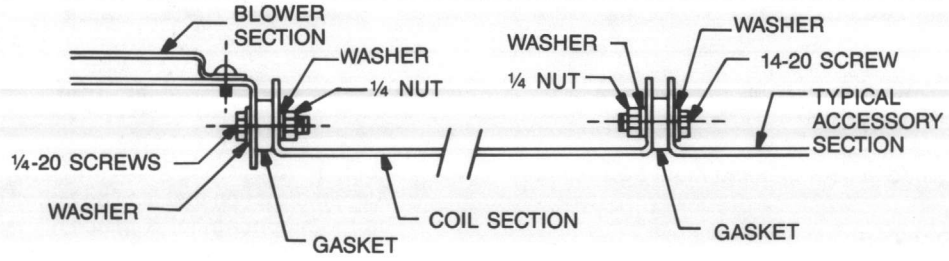


FIGURE 4.

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

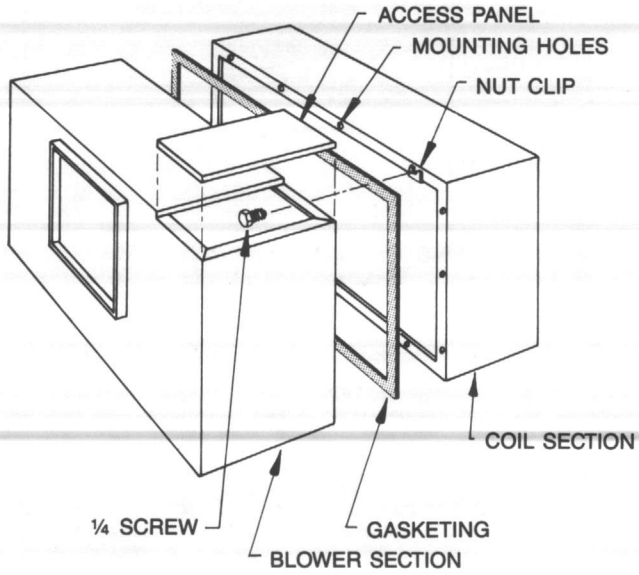


FIGURE 5.

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

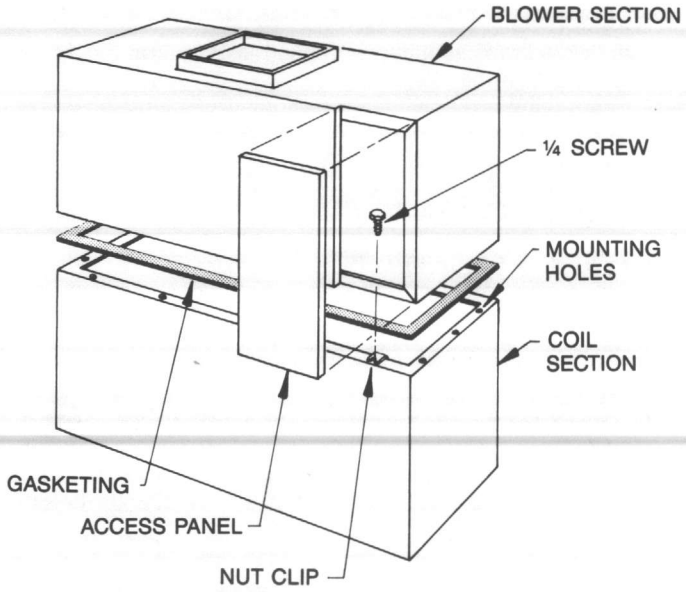
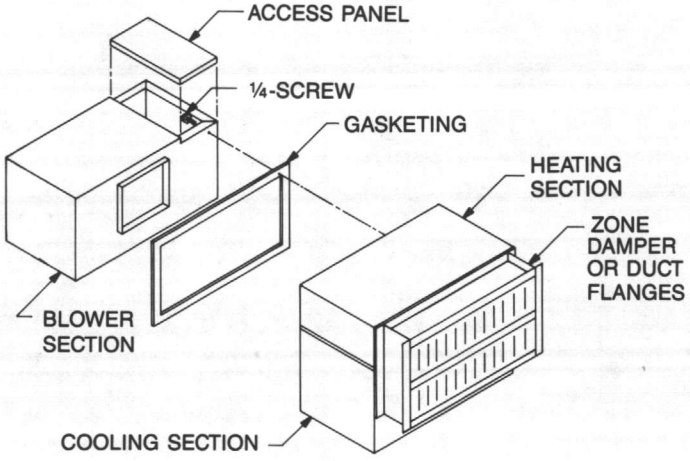


FIGURE 6a.

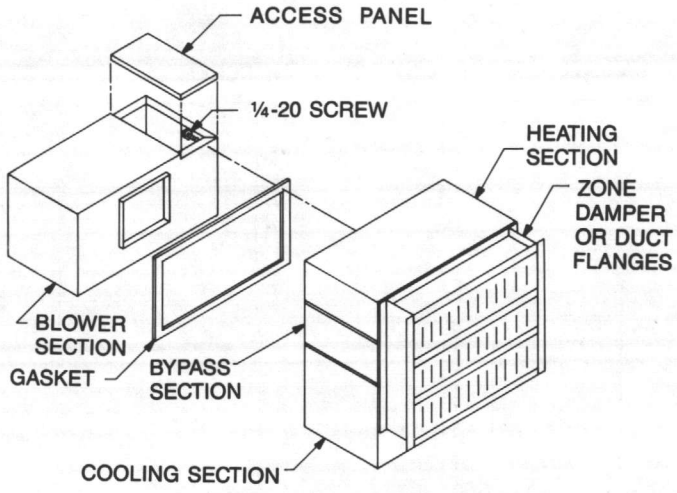
2-Deck Multi-zone Unit
(LML, MMM)



HORIZONTAL DISCHARGE SHOWN

FIGURE 6b.

3-Deck Multi-zone Unit
LML-106 thru 111 & MMM-108 thru 111



HORIZONTAL DISCHARGE SHOWN

FIGURE 7.

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

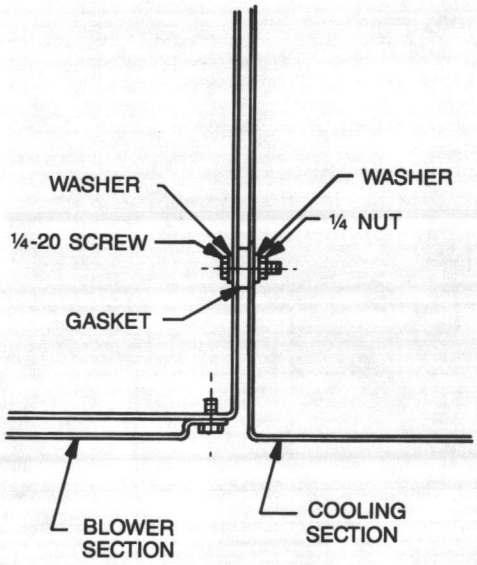


FIGURE 8.

Internal Face & Bypass
(All Models)

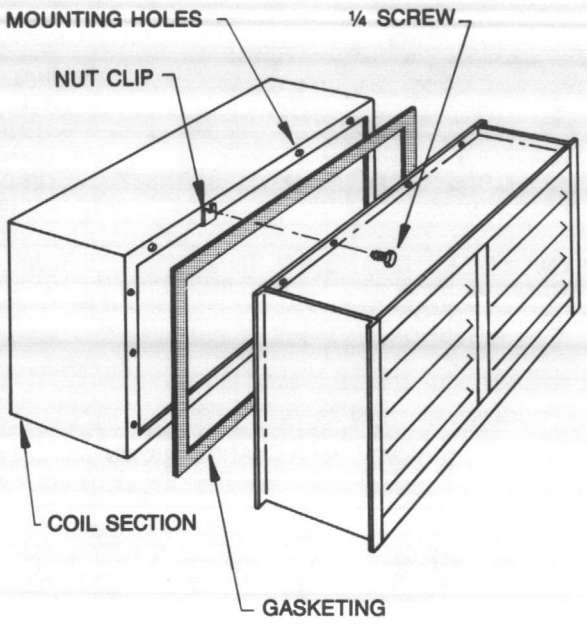


FIGURE 9.

Flat Filter, Preheat Coil Section
(All Models)

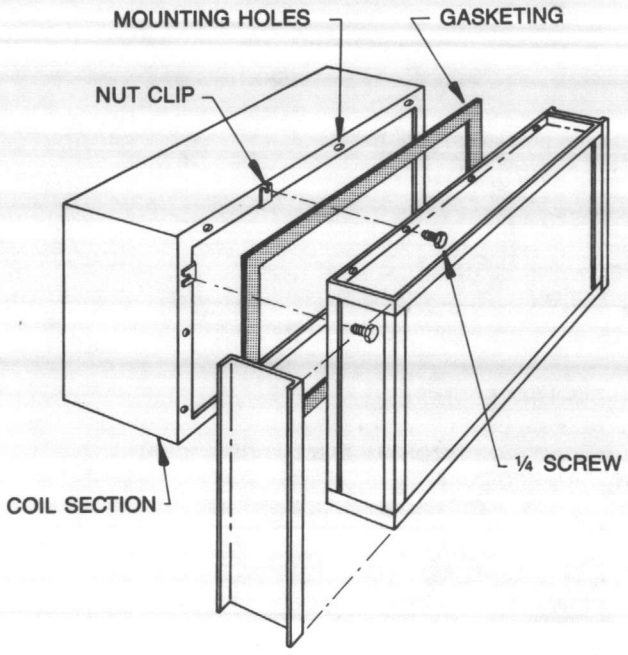


FIGURE 10.

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

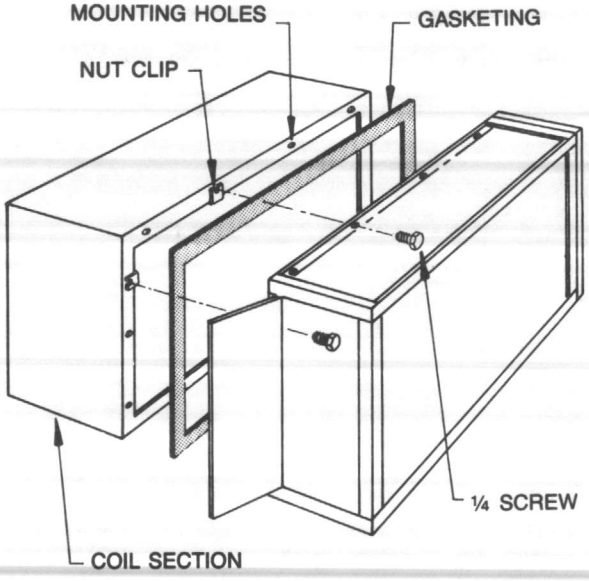


FIGURE 11.

External Face & Bypass
(All Models)

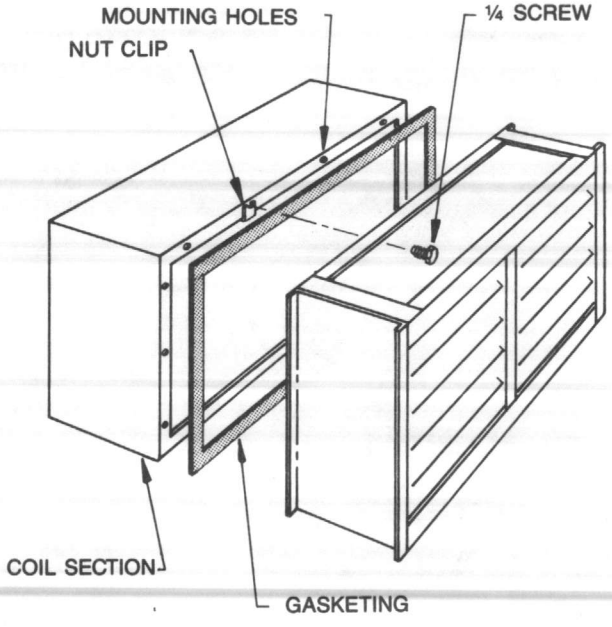


FIGURE 12.

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

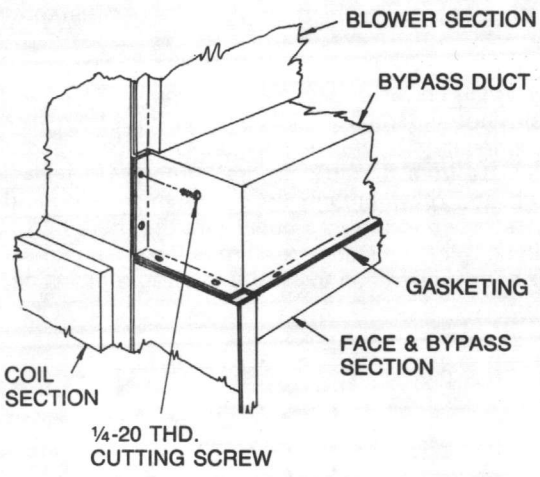


FIGURE 13.

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

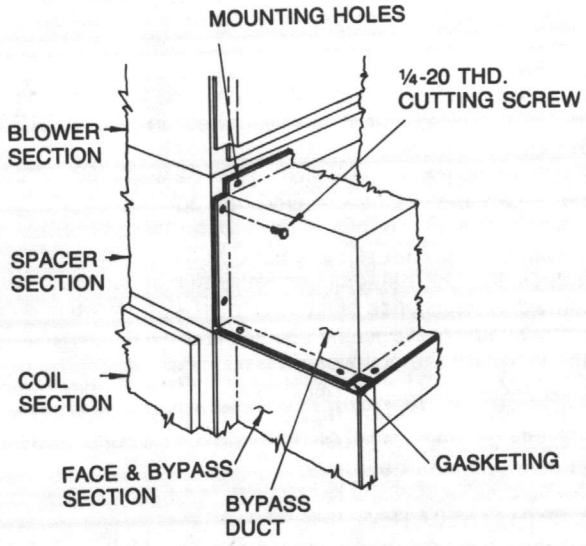


FIGURE 14.

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

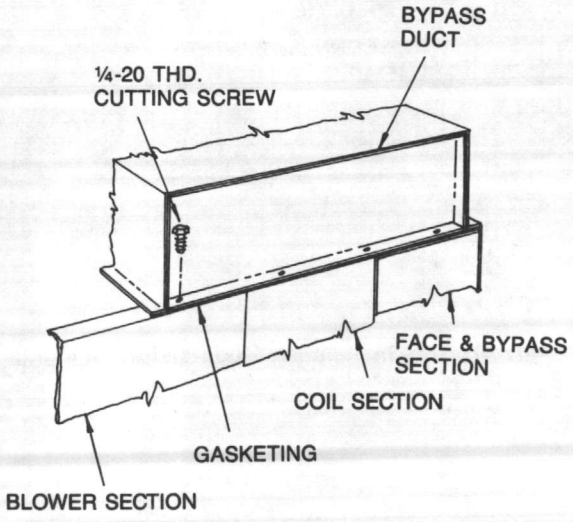
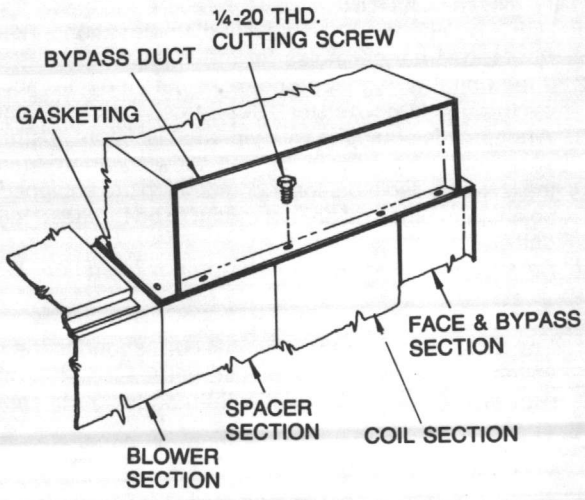


FIGURE 15.

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

The installation of this equipment shall be in accordance with the regulations of authorities having jurisdiction and all applicable codes. It is the responsibility of the installer to determine and follow the applicable codes.

Sheetmetal parts, self-tapping screws, clips, and such items inherently have sharp edges, and it is necessary that the installer exercise caution.

This equipment is to be installed only by an experienced installation company which employs trained personnel.

GENERAL

The system design and installation should follow accepted industry practice, such as described in the ASHRAE Handbook.

These units are NOT DESIGNED to be weatherproof and therefore should not be installed outdoors.

Adequate space should be left around the unit for piping coils and drains, filter replacement, and maintenance such as lubrication and belt adjustment. Sufficient space should be provided on the side of the unit for shaft removal and coil removal should that become necessary. Space at least equal to the length of the coil would be required for coil removal. For ease of removal, consideration should be given to removing the coil from the end opposite the piping connections.

Flexible connectors should be used on the outlet and inlet duct connections of all units.

DRIVE INSTALLATION

1. All units have externally mounted motors. 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 12 for explicit instructions. Tighten all setscrews and/or capscrews.
5. Adjust motor mount adjusting screws for adequate 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" tapped hanger holes for mounting the unit.
2. If the unit has ⅝" 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 the unit 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.

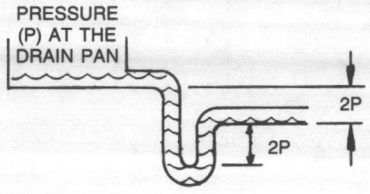
ELECTRICAL INSTALLATION

1. Electrical service to the fan must correspond to the rated voltage on the motor nameplate and be in conformance with the National Electric 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 electric codes are provided by others.

PIPING & DRAIN PAN TRAPS

Piping should be in accordance with accepted industry standards. Undue stress should not be applied at the connection to coil headers. Pipework should be supported independently of the coils.

Drain lines and traps should be run full size from the drain pan connection. Drain pans should have traps to permit the condensate from the coils to drain freely. On both blow-through and draw-through units, the trap depth and the distance between the trap outlet and the drain pan outlet should be twice the static pressure in the drain pan section under normal operation to assure the trap remains sealed.



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. Ductwork should be inserted into this clip as shown in Figure 17.

FIGURE 16a. Zone Damper Linkage

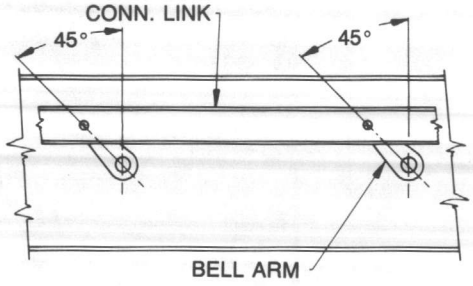
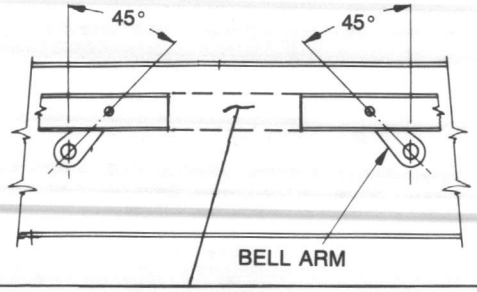
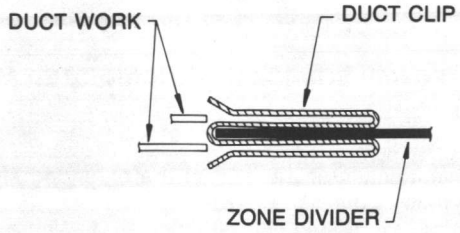


FIGURE 16b. Installation Modification for Multiple Zones



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



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.

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

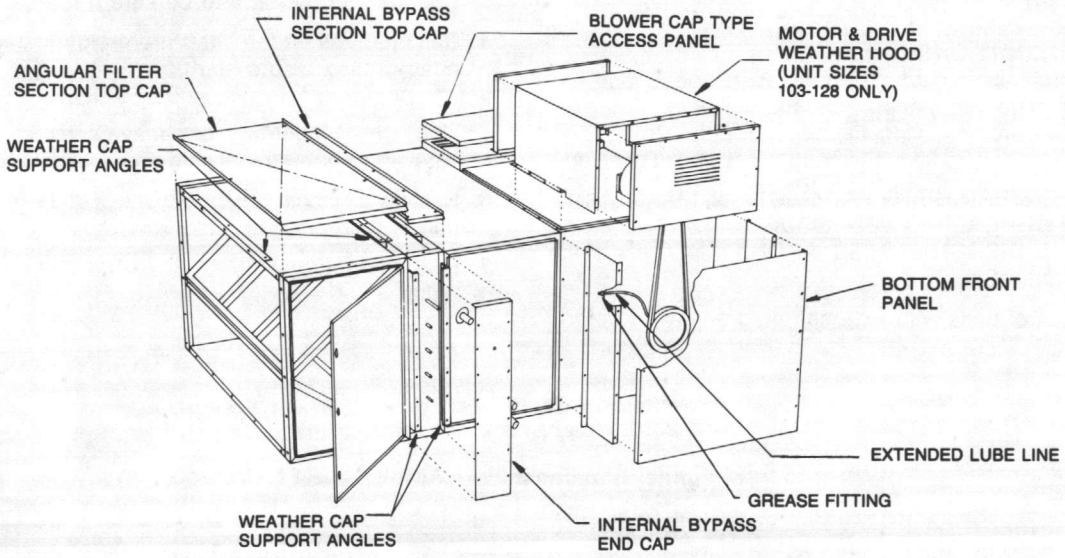
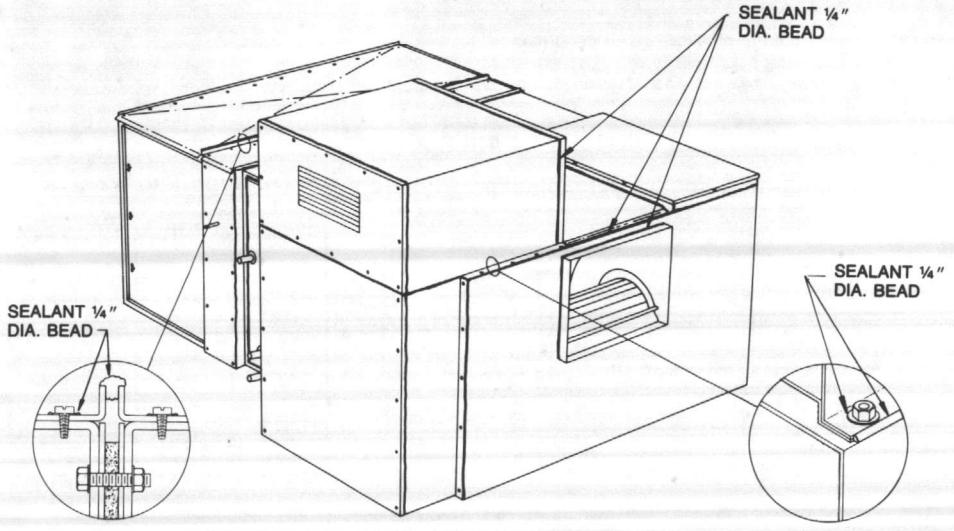


FIGURE 18b. Sealing of Outdoor Installation Units



START-UP AND MAINTENANCE

When performing startup and service, thorough safety precautions should always be taken. Only qualified individuals should perform these functions.

BEFORE ENTERING FAN SECTION MAKE SURE THAT FAN ELECTRICAL POWER SOURCE IS DISCONNECTED AND LOCKED IN THE "OFF" POSITION.

⚠ WARNING

MOVING MACHINERY HAZARD

DISCONNECT POWER TO THIS UNIT AND PADLOCK AT "OFF" BEFORE SERVICING THE FANS.

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. 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 IN THE "OFF" POSITION.
3. 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).

   Approximate fan speed can be calculated. With electrical power locked off, measure the diameter of the V-belt outer surface where it passes around each sheave and use the following formula:

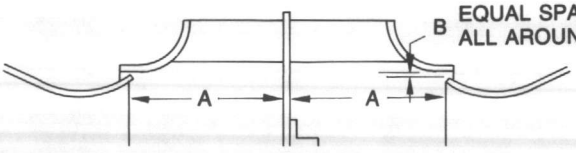
$$\text{Fan rpm} = \text{Motor rpm} \times \frac{\text{Measured diameter at Motor Sheave}}{\text{Measured diameter at Fan Sheave}}$$

BEFORE STARTUP CHECKS

1. BEFORE ENTERING FAN SECTION MAKE SURE THAT FAN ELECTRICAL POWER SOURCE IS DISCONNECTED AND LOCKED IN THE "OFF" POSITION.
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 3.
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

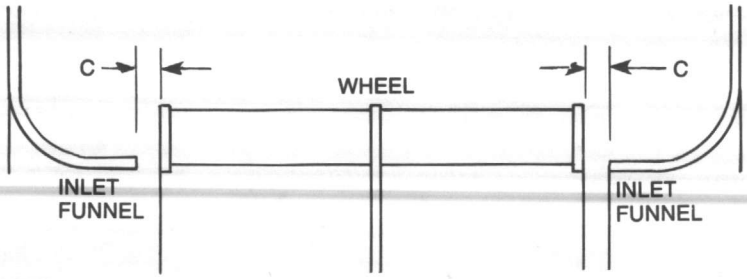


UNIT SIZE	FAN DIA.	A ± 0.12″	B ± 0.10″
106	13 7/32	4.60	0.19
108	14 9/16	5.10	0.19
111	16 3/16	5.66	0.19

NOTES:
1. Dimensional relationship must be held to obtain rated air performance.
2. Dimension A is achieved by loosening setscrews in wheel hub(s), shifting wheel(s) axially as needed, and re-tightening setscrews.
3. 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″

NOTE:
1. 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 satisfactorily, 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

Do not exceed the operating limits in Tables 5 or 6. 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.

VIBRATION LEVELS

Each unit as shipped has been trim-balanced and should operate smoothly. Instruments are available to field test the vibration levels at the bearings. Although the factory specification is much tighter, to assure satisfactory operation after enduring the rigors of shipping and installation, the following is accepted industry guidelines for field balancing fans found in Table 4.

TABLE 4.
Vibration Levels

FAN SPEED (RPM)	VIBRATION
800 or less	5 mils maximum displacement
801 and greater	0.20 in/sec. maximum veolcity

NOTE: Excessive vibration from any cause contributes to premature fan and motor bearing failure. Overall vibration levels should be monitored every six 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 spacing; out of balance. Also similar faults in driven sheave.
   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, sheave, and wheel hub setscrews, sheave capscrews, and bearing holddown bolts for tightness every six months.

TABLE 5.
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 bearing lubricant).

TABLE 6.
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 bearing lubricant).

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 aiso important to avoid overgreasing. Only a high grade, clean mineral grease having the following characteristics should be used.
   a. 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 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 running, adding slowly until a very 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. Wipe off any excess grease to prevent overheating.

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

*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

⚠ WARNING

MOVING MACHINERY HAZARD

DISCONNECT POWER TO THIS UNIT AND PADLOCK AT "OFF" BEFORE SERVICING THE FANS.

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.

BEFORE ENTERING ANY FAN SECTION, MAKE SURE THE ELECTRICAL POWER SOURCE TO THE FAN MOTOR IS DISCONNECTED AND LOCKED.

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 the sheave (pitch diameter) and calculate fan speed from the motor nameplate rpm.

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

"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.

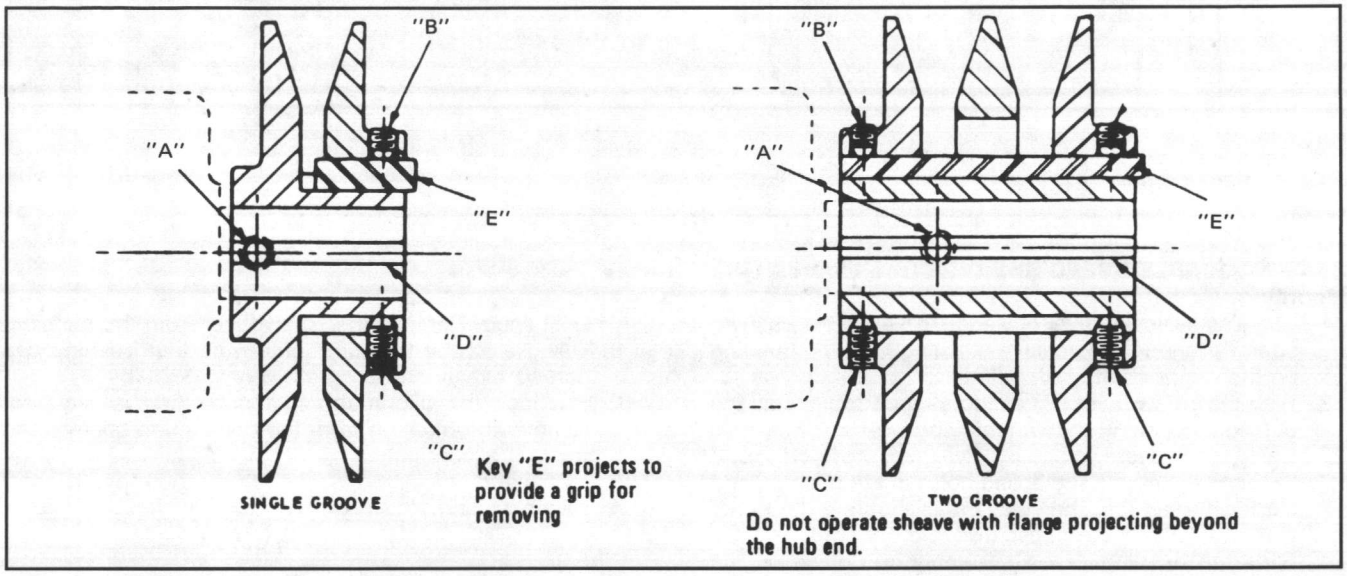
Adjusting:

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 15 and 16).
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



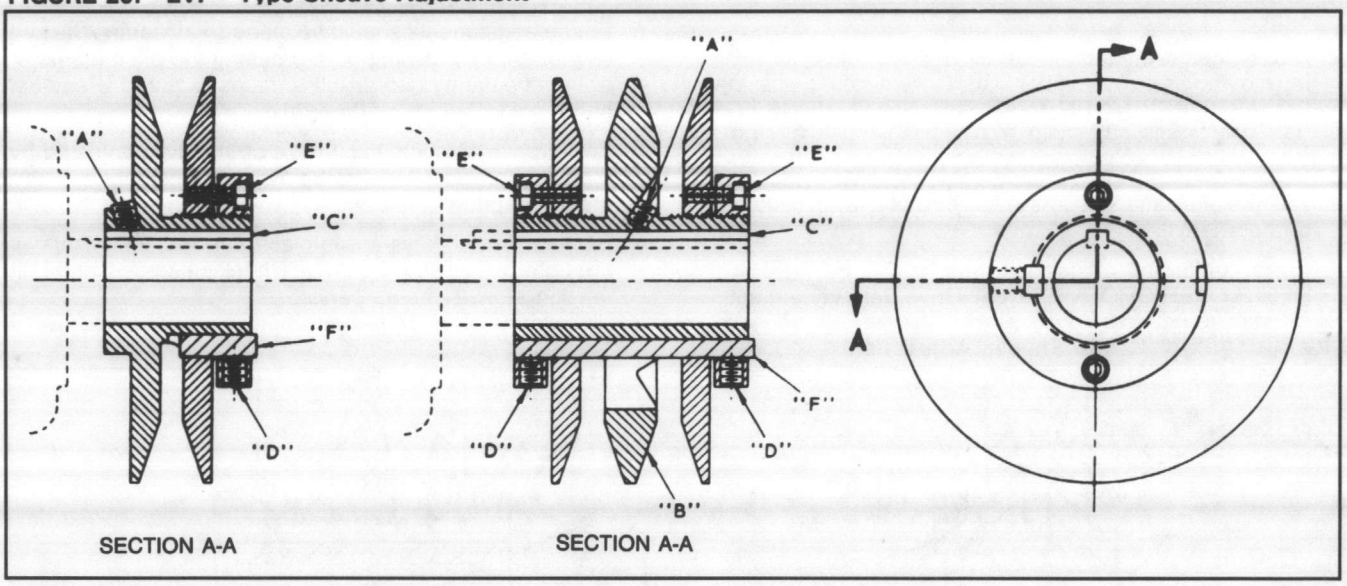
"LVP" Variable Speed Sheaves (see Figure 20)
Mounting:

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 outer locking ring and flange 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 inner and outer flanges are 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 15 and 16).
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 15 and 16).
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)

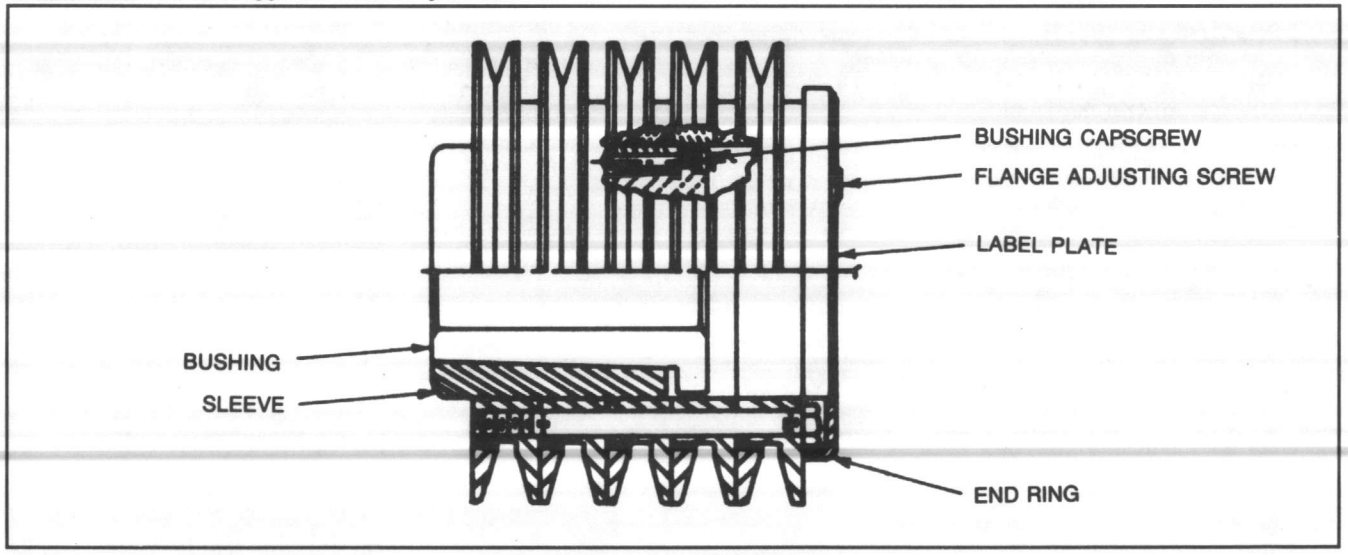
Mounting:

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 15 and 16).

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 15 and 16).

FIGURE 21. "5VS" Type Sheave Adjustment



NOTE: On multiple belt drives, the center of the drive should be aligned, not the edge of the drive.

"JVS" VARIABLE SPEED SHEAVES (see Figure 22)

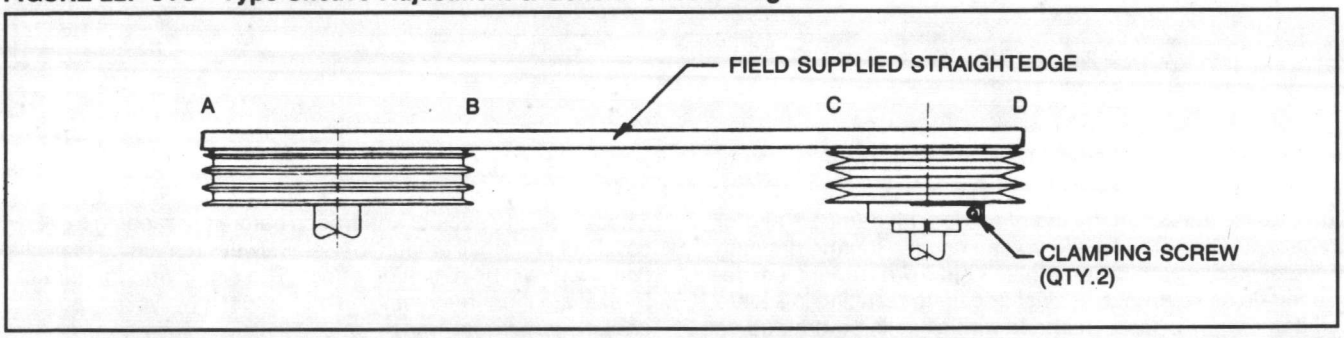
Mounting:

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 15 and 16).
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.

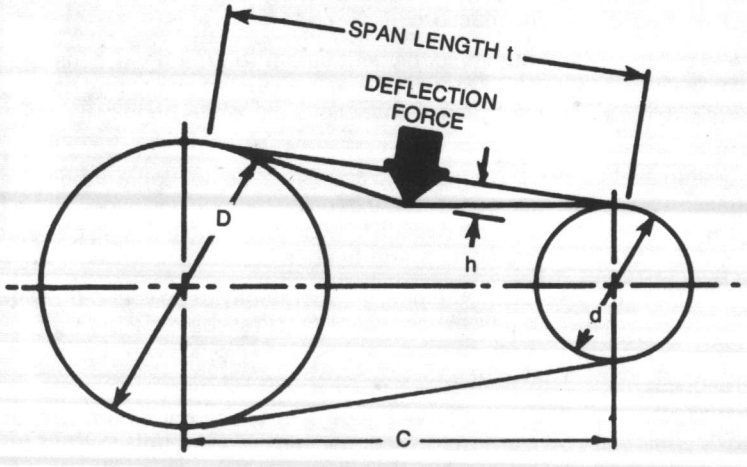
a. If the deflection force is below the minimum, the belts are too loose and the tension should be increased by increasing the center distance.

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



*DEFLECTION HEIGHT

$$h = \frac{t}{64}$$

$$t = \sqrt{C^2 - \left(\frac{D-d}{2}\right)^2}$$

WHERE t = Span length distance, inches
C = Center distance, inches
D = Larger sheave diameter, inches
d = Smaller sheave diameter, inches
h = Deflective Height, inches

TABLE 8. Recommended Pounds Of Force Per Belt (Deflection Force)

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 higher 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

GENERAL

Piping design, sizing, and installation information presented in ASHRAE Handbooks should, where applicable, be followed in the design and installation of piping.

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 N.P.T. 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.

STEAM COILS (Refer to Figure 24, page 18)

1. All steam coils in units are pitched toward return connection.
2. Steam supply and steam return connections are male N.P.T.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.

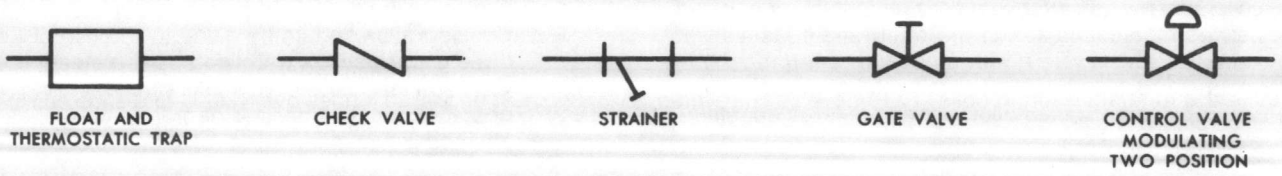
6. It is recommended that vacuum breakers be installed on all applications to prevent retaining condensate in the coil. Generally, the vacuum breaker is to be connected between the coil inlet and the return main, as shown. However, for a system with a flooded return main, the vacuum breaker should be 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

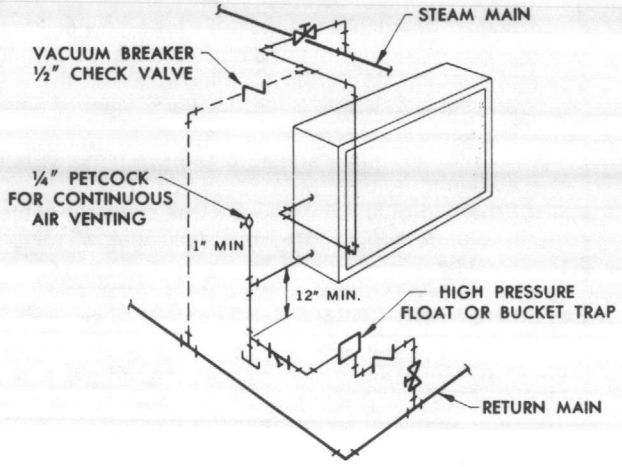
1. Water supply and water return connections extend through the end panel of the coil section. All connections are labeled on the end panel.
2. The drain and vent connections on the one and two row coils must be added to jobsite piping.
3. Water supply and water return connections are male N.P.T. iron 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 16.

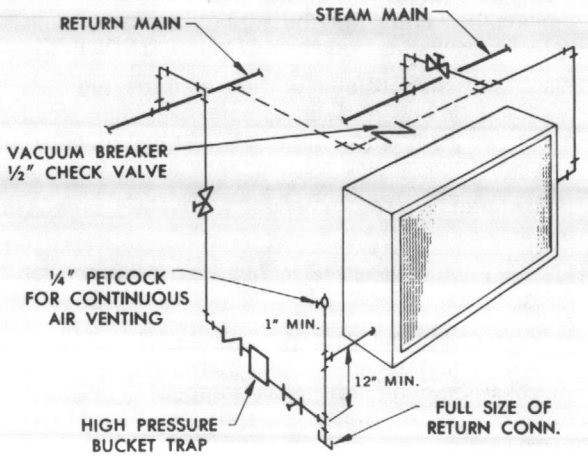
FIGURE 24.
Piping Arrangements



HIGH PRESSURE (OVER 25 PSI)

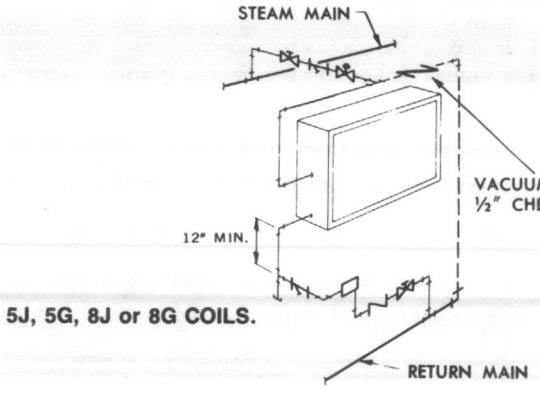


5GA or 8GA COILS. Note the addition of a vacuum breaker to permit the coil to drain during shutdown.

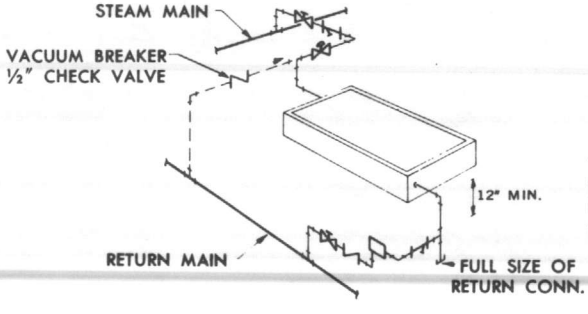


5TA, 8TA, 5HA or 5HB COILS. Condensate is lifted to overhead return main.

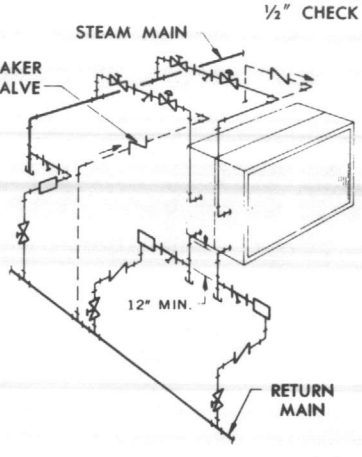
LOW PRESSURE (TO 25 PSI)



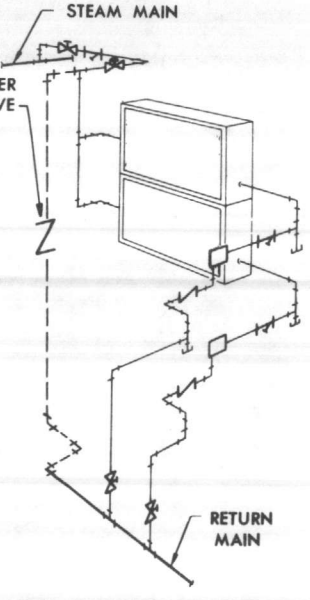
5J, 5G, 8J or 8G COILS.



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



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.

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 (ALL UNITS) & WATER HEATING COILS (LSL/MSL & LSB/MSB) (FIGURE 25).

1. 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.
2. Attach coil mounting angle to top coil rest and bolt header plates to bottom coil rest and coil mounting angle.
3. Locate coil supply, return, vent and drain connections dimensionally and drill holes in end panels of unit. Holes should be located very carefully.
4. Attach end panel to unit and slip grommets over connections to prevent air leakage.

HEATING COILS, WATER (LML/MMM) (FIGURE 27).

1. Slide coil into place.
2. Bolt coil header plate to coil rests in unit.
3. Locate coil supply, return, vent and drain connections dimensionally and drill holes in end panel of unit. Holes should be located very carefully.
4. Attach end panel to unit and slip grommet over coil connections to prevent air leakage.

HEATING COILS, STEAM

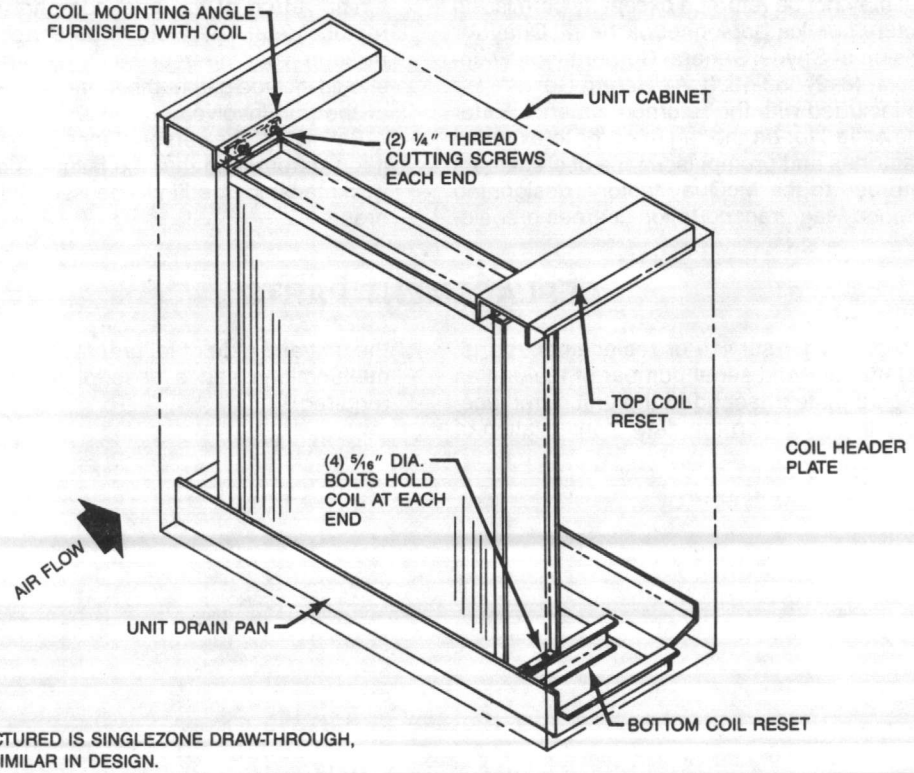
Since coils are pitched in units, it is necessary to keep unit level to allow proper condensate drainage.

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. LSL/MSL Coil Mounting Procedure for 5W & 5E Coils—Horizontal & Vertical Units



NOTE:
CABINETRY PICTURED IS SINGLEZONE DRAW-THROUGH, OTHERS ARE SIMILAR IN DESIGN.

FIGURE 26. LML/MMM Water Heating Coil

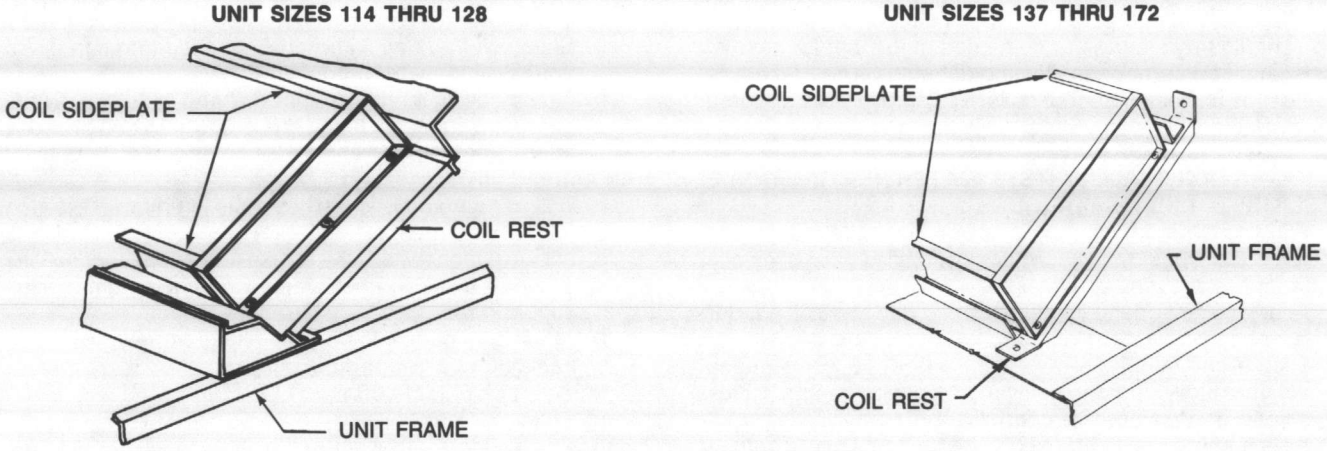
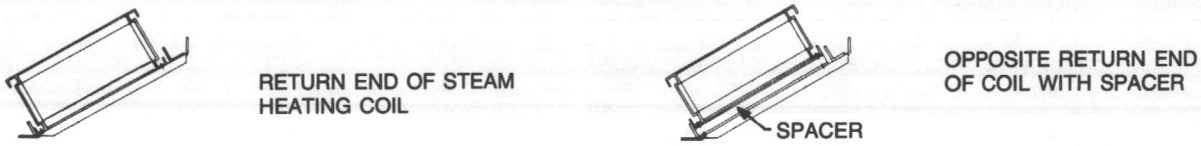


FIGURE 27. LML/MMM Steam Heating Coil



IN-WARRANTY RETURN MATERIAL PROCEDURE

Defective material may not be returned except by permission of authorized factory service personnel of the McQuay Air Conditioning Division of SnyderGeneral Corporation in Minneapolis, Minnesota, (612) 553-5330. 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. All parts shall be returned to the McQuay factory, designated on the "Return Goods" tag, transportation charges prepaid.

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 number, model number and serial number of the unit involved.

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

REPLACEMENT PARTS

When writing to McQuay for service or replacement parts, refer to the model number and serial number of the unit as stamped on the serial plate attached to the unit. If replacement parts are required, mention the date of installation of the unit and date of failure, along with an explanation of the malfunctions and a description of the replacement parts required.

TABLE 9. Approximate Shipping Weights (Lbs.)

DESCRIPTION	UNIT SIZE						
	103	104	106	206	108	209	111
BLOWER SECTION							
Low-Medium Pressure, FC Wheel	144	175	260	330	396	430	459
Low-Medium Pressure, AF Wheel	—	—	—	—	396	—	459
BLOW-THROUGH COIL SECTION							
Single-zone Diffuser Section	—	—	80	—	102	—	118
Single-zone Coil Section	—	—	258	—	302	—	358
Multi-zone 2-Deck Dampers	—	—	403	—	469	—	550
Multi-zone 3-Deck Section	—	—	522	—	626	—	723
BLOW-THROUGH ZONE DAMPERS							
Multi-zone 2-Deck Dampers	—	—	94	—	96	—	136
Multi-zone 3-Deck Damper	—	—	155	—	180	—	218
BLOW-THROUGH COIL SECTION LINERS							
Single-zone Diffuser Liners	—	—	22	—	31	—	35
Single-zone Coil Liners	—	—	52	—	71	—	85
Multi-zone 2-Deck Liners	—	—	80	—	100	—	134
Multi-zone 3-Deck Liners	—	—	118	—	155	—	184
BLOW-THROUGH COIL SECTION EXTENSION							
Single-zone Vertical Discharge Coil Section	—	—	20	—	24	—	25
DRAW-THROUGH 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
3 & 4 Row	—	—	90	—	131	—	185
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-THROUGH HEATING COILS (LFA) — ALUMINUM FINS							
1 Row	—	—	20	—	25	—	32
2 Rows	—	—	29	—	37	—	50
3 Rows	—	—	38	—	50	—	67
4 Rows	—	—	47	—	62	—	83
ACCESSORY SECTIONS							
Mixing Box Only	122	133	162	182	203	240	274
Combination Angular Filter & Mixing Box	155	214	281	310	330	400	426
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 & Bypass Section	69	86	114	132	152	172	221

TABLE 10. Motor Weights

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
MAX-E-DRIVE*	—	—	—	—	—	147	147	147	147	147	147	193

*MAX-E-DRIVE weights do not include motor weight.

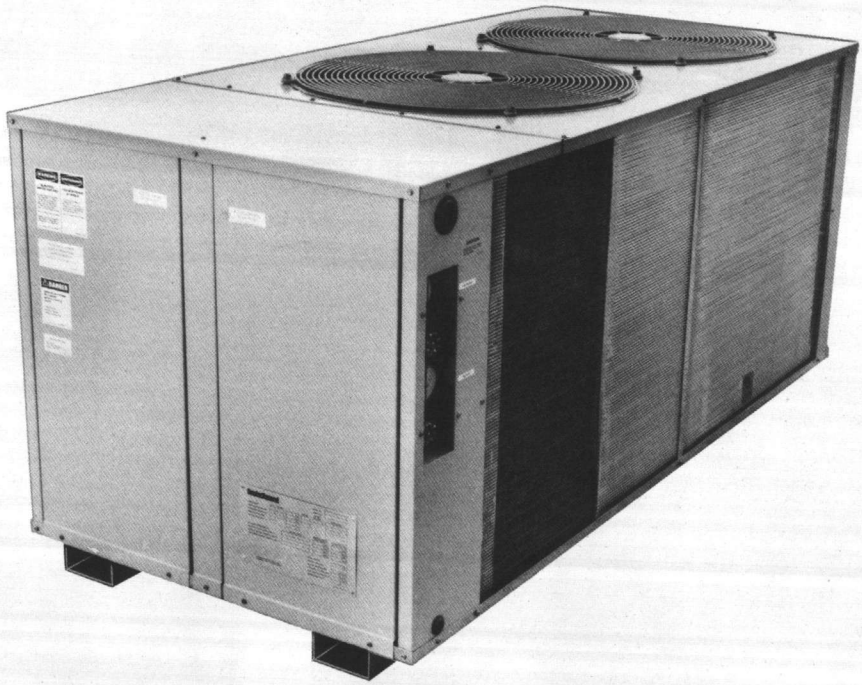
McQuay SnyderGeneral 13600 Industrial Park Blvd., P.O. Box 1551, Minneapolis, MN 55440

SnyderGeneral
Corporation

INSTALLATION AND MAINTENANCE DATA

BULLETIN NO. IM 402-2
SEPTEMBER, 1988
FORM NO. 552199Y

ALP
Packaged air cooled condensing unit



Models ALP-013C, 016C & 021C

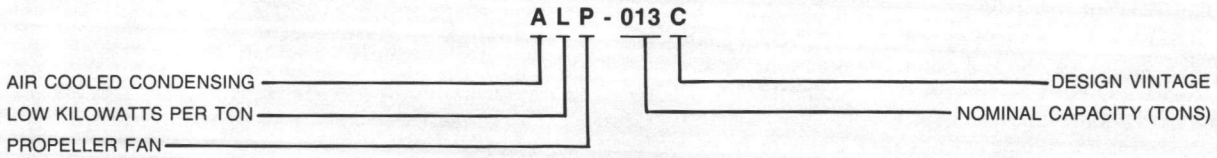
TABLE OF CONTENTS

INTRODUCTION

Model type ALP air cooled condensing units are designed for outdoor installations and are compatible with either air handling or chilled water systems. Each unit is completely assembled and factory wired before evacuation, charging and testing. Each unit consists of an air cooled condenser with integral subcooler section. Two speed compressors*, complete discharge piping and suction and liquid connections for connection to any air or water cooling evaporator.

*Optional

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.

INSTALLATION

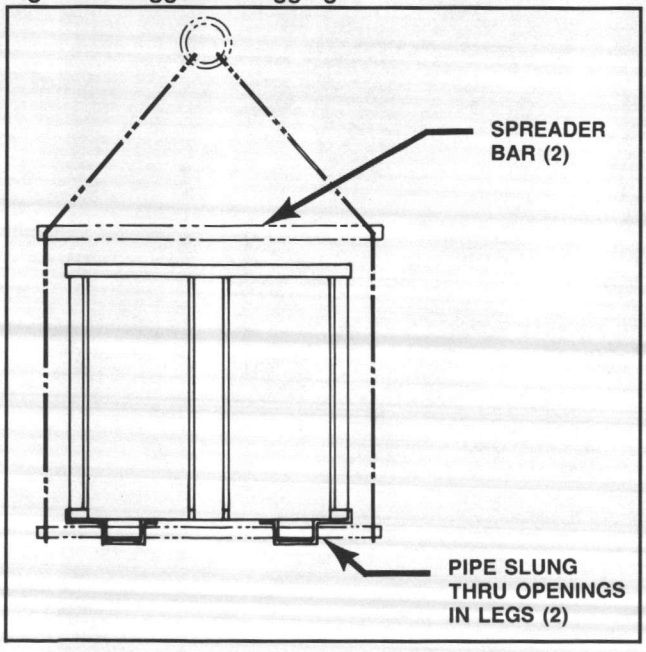
NOTE: Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. CAUTION: Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

RIGGING AND MOVING UNITS

The exact method of handling and setting the unit depends on available equipment, size of unit, final location, and other variables. It is therefore up to the judgement of the riggers and movers to determine the specific method of handling each unit.

All units are equipped with built-in skids for rigging and moving.

Figure 1. Suggested Rigging



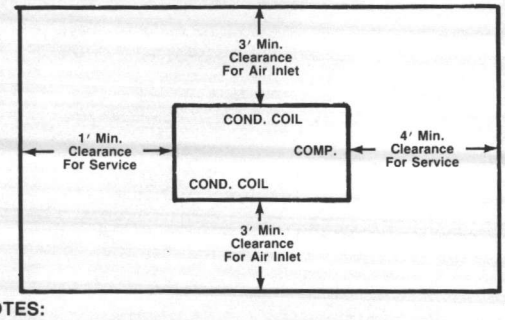
LOCATION

Due to vertical condenser design, it is recommended that the unit is oriented so that prevailing winds blow parallel to the unit length, thus minimizing effects on condensing pressure. If it is not practical to orient the unit in this manner, a wind deflector should be constructed.

Units are designed for outdoor application and may be mounted on a roof or concrete slab (ground level installation). Roof-mounted units should be installed level on steel channels or an I-beam frame to support the unit above the roof.

The roof must be strong enough to support the weight of the unit. See Physical Data for unit weight. Concrete slabs used for unit mounting should be installed level and be properly supported to prevent settling. A one-piece concrete slab with footings extended below the frost line is recommended.

Figure 2. Clearance Around Unit.



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.

REFRIGERANT PIPING

GENERAL

Piping design, sizing and installation information presented in ASHRAE Handbooks should, where applicable, be followed in the design and installation of piping. Model type ALP condensing units are adaptable to either chilled water or air handling air conditioning applications. The only restriction on applications is that the evaporator be selected for a system using refrigerant R-22.

REFRIGERANT PIPING

Piping between the condensing unit and the cooling coil must be designed and installed to minimize pressure drop, prevent liquid refrigerant carryover to the compressor and to assure a continuous return of compressor oil from the system. Piping sketches and tables are not intended to provide information on all of the possible arrangements.

Piping recommendations include:

1. The use of type K or L clean copper tubing. All joints should be thoroughly cleaned and brazed with high temperature solder.
2. Piping sizes should be based on temperature/pressure limitations as recommended in the following paragraphs. Under no circumstances should pipe size be based upon the coil or condensing unit piping connection size.
3. Suction line piping pressure drop should not exceed the pressure equivalent of 2°F (3 psi) per 100 feet of equivalent pipe length. After the suction line size has been determined, the vertical suction risers should be checked to verify that oil will be carried up the riser and back to the compressor. The suction line should be pitched in the direction of refrigerant flow and adequately supported. Lines should be free draining and fully insulated between the evaporator and the compressor. Table 3, shows piping information for units operating at suction temperatures between 40°F and 45°F and a condenser entering air temperature of 95°F. If operating conditions are expected to vary substantially from these operating levels, the pipe sizing should be rechecked.
4. Vertical suction risers should be checked using Table 1 to determine the minimum tonnage required to carry oil up suction risers of various sizes.
5. The liquid line should be sized for a pressure drop not to exceed the pressure equivalent of 2°F (6 psi) saturated temperature.

Table 1. Minimum tonnage (R-22) to carry oil up suction riser at 40°F saturated suction.

Line Size OD	1⅛	1⅜	1⅝	2⅛	2⅝	3⅛	3⅝	4⅛
Min. Tons	1.50	2.50	3.80	7.60	13.10	20.4	29.7	41.3

NOTE: When compressor minimum tonnage is less than shown in the above table for a given line size, double suction risers will be required.

Table 2. Recommended line sizes (Max. equivalent feet of copper tubing*)

ALP UNIT MODEL NUMBER	SUCTION LINE SIZE O.D. COPPER			LIQUID LINE SIZE O.D. COPPER		
	1⅜"	1⅝"	2⅛"	⅝"	⅞"	1⅛"
013C	70	160	—	35	200	—
016C	35	80	300	16	100	365
021C	—	50	180	—	60	220

*Equivalent line lengths in the above table are suitable for a unit operating at 40°F sat. suction, 50°F return gas and 95°F ambient.

Table 3. Equivalent feet of straight tubing for copper fittings and valves

FITTING TYPE	5/8	7/8	1⅛	1⅜	1⅝	2⅛	2⅝	3⅛	3⅝	4⅛
ELBOWS										
90° Standard	1.6	2.0	2.6	3.3	4.0	5.0	6.0	7.5	9.0	10.0
90° Long Radius	1.0	1.4	1.7	2.3	2.6	3.3	4.1	5.0	5.9	6.7
90° Street	2.5	3.2	4.1	5.6	6.3	8.2	10.0	12.0	15.0	17.0
45° Standard	0.8	0.9	1.3	1.7	2.1	2.6	3.2	4.0	4.7	5.2
45° Street	1.3	1.5	2.1	3.0	3.4	4.5	5.2	6.4	7.3	8.5
180° BEND	2.5	3.2	4.1	5.6	6.3	8.2	10.0	12.0	15.0	17.0
TEES										
Full Size	1.0	1.4	1.7	2.3	2.6	3.3	4.1	5.0	5.9	6.7
Reducing	1.6	2.0	2.6	3.3	4.0	5.0	6.0	7.5	9.0	10.0
VALVES										
Globe Valve, Open	18	22	29	38	43	55	69	84	100	120
Gate Valve, Open	0.7	0.9	1.0	1.5	1.8	2.3	2.8	3.2	4.0	4.5
Angle Valve, Open	7.0	9.0	12	15	18	24	29	35	41	47

NOTES:

1. Liquid and suction lines based on a recommended equivalent pressure drop of 2°F (3 psi for suction line, 6 psi for liquid line) per 100 ft. of equivalent length.
2. When the refrigerant required to charge a system exceeds the pumpdown capacity of the unit of the unit plus the capacity of the liquid line (see Table 4), the use of separate refrigerant storage receiver will be required. The pumpdown capacity of each unit is based on the condenser 90% full at 90°F (see physical data).
3. Total equivalent feet for a given piping layout must include the equivalent length of straight pipe for fittings, valves and specialties added to the total run of straight pipe.
4. Piping design, sizing an installation information presented in ASHRAE Handbooks should, where applicable, be followed in the design and installation piping.
5. Units running at 50% load do not require double suction risers.

Figure 3. Single Circuit Evaporator — Recommended Piping

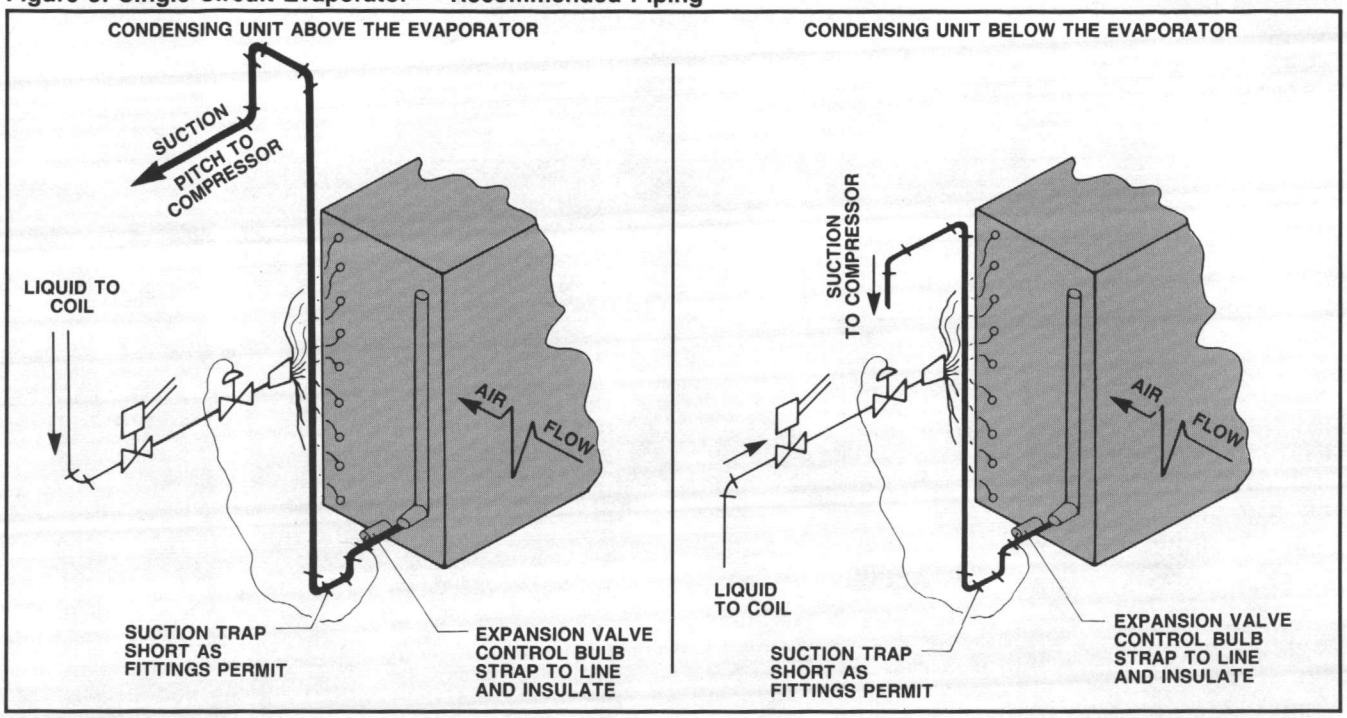
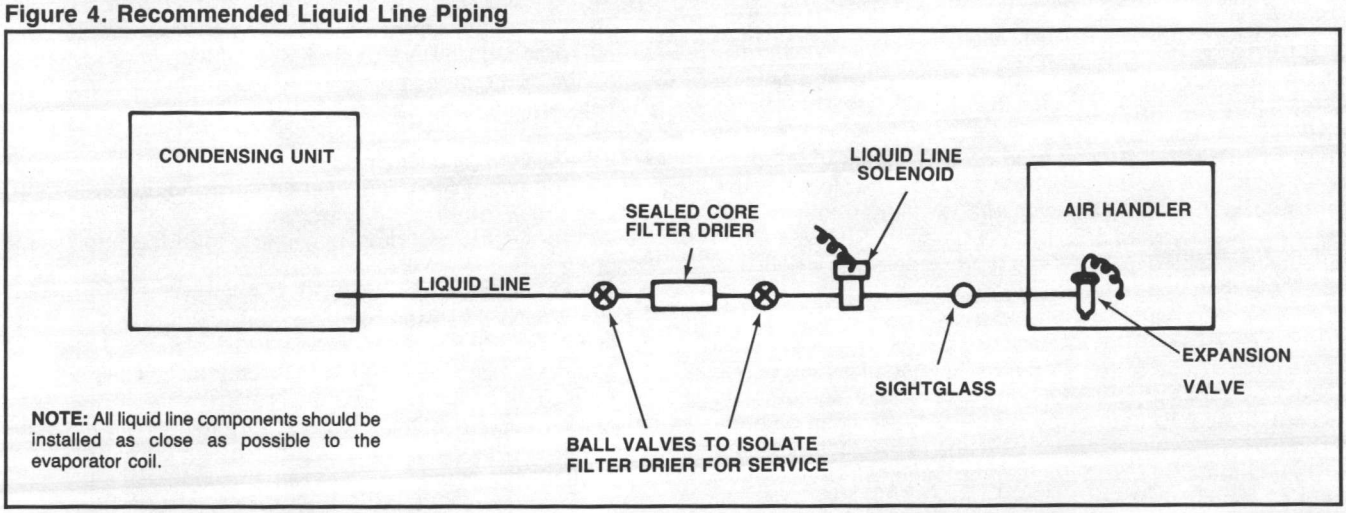


Figure 4. Recommended Liquid Line Piping



NOTE: All liquid line components should be installed as close as possible to the evaporator coil.

Table 4. Weight of refrigerant R-22 in copper lines (Pounds Per 100 feet of type L tubing)

O.D. Line Size	Vol. per 100 Ft. in Cu. Ft.	Weight of Refrigerant, Lbs.			
		Liquid @100°F	Hot Gas @120°F Cond.	Suction Gas (Superheated to 65°F) 20°F	40°F
3/8	0.054	3.84	.202	.052	.077
1/2	0.100	7.12	.374	.096	.143
5/8	0.162	7.12	.605	.156	.232
7/8	0.336	24.0	1.26	.323	.480
1 1/8	0.573	40.8	2.14	.550	.820
1 3/8	0.872	62.1	3.26	.839	1.250
1 5/8	1.237	88.0	4.62	1.190	1.770
2 1/8	2.147	153.0	8.04	2.06	3.060
2 5/8	3.312	236.0	12.4	3.18	4.720
3 1/8	4.728	336.0	17.7	4.55	6.750
3 5/8	6.398	456.0	24.0	6.15	9.140
4 1/8	8.313	592.0	31.1	8.00	11.190

LIQUID LINE COMPONENTS

Liquid line accessory kits are available for each ALP unit size. Table 5 shows the ordering number to be used for each ALP unit size. The components in these kits are:

1. Sealed core filter drier.
2. Refrigerant solenoid valve/230 volt coil.
3. Refrigerant sightglass/moisture indicator.
4. Expansion valve/R-22.

Table 5. Liquid line accessory kits.

ALP UNIT SIZE	LIQUID LINE ACCESSORY KIT ORDERING NO.	CONNECTION SIZES O.D. (IN.)				
		FILTER-DRIER	SOLENOID VALVE	SIGHT-GLASS	EXPANSION VALVE IN	EXPANSION VALVE OUT
013C	886-550442A-01	7/8	7/8	7/8	7/8	1 3/8
016C	886-550442A-01	7/8	7/8	7/8	7/8	1 3/8
021C	886-550442A-02	7/8	7/8	7/8	7/8	1 3/8

HOT GAS BYPASS COMPONENTS

Hot gas bypass kits are available for each ALP unit size. Each kit includes a solenoid valve, a hot gas bypass valve and instruction drawing. See page 33 for hot gas bypass operation.

Table 6. Hot Gas Bypass Kits.

ALP UNIT SIZE	KIT NUMBER	LINE SIZE O.D. (IN.)
013C	550443A-01	5/8
016C & 021C	550443A-02	7/8

REFRIGERANT PIPING CONNECTIONS

Refrigerant piping conections will be made at the compressor end of the unit. Suction and liquid lines should be routed through the compressor enclosure on the side of the unit.

HOLDING CHARGE

The Model ALP condensing unit is shipped with a holding charge of refrigerant. At the time the unit was received a visual inspection of the unit piping should have been made to be sure no breakage had occurred or that fittings might have been loosened. A pressure check should indicate a positive pressure in the unit. If no pressure is evident, the unit will have to be leak tested and the leak repaired. This should be noted and reported to your sales representative or freight carrier if the loss is due to shipping damage.

LEAK TESTING

In the case of loss of the refrigerant holding charge, the unit should be checked for leaks prior to charging the complete system. If the full charge was lost, leak testing can be done by charging the refrigerant into the unit to build the pressure to approximately 10 psig and adding sufficient dry nitrogen to bring the pressure to a maximum of 125 psig. The unit should then be leak tested with a Halide or electronic leak detector. After making any necessary repair, the system should be evacuated as described in the following paragraphs.

CAUTION: Do not use oxygen to build up pressure. A serious explosion could be the result.

EVACUATION

After it has been determined that the unit is tight and there are no refrigerant leaks, the system should be evacuated. The use of a vacuum pump with a pumping capacity of approximately 3 cu. ft./min. and the ability to reduce the vacuum in the unit to at least 1 millimeter (1000 microns) is recommended.

1. A mercury manometer, electronic or other type of micron gauge should be connected to the unit at a point remote from the vacuum pump. For readings below 1 millimeter, an electronic or other micron gauge should be used.
2. The triple evacuation method is recommended and is particularly helpful if the vacuum pump is unable to obtain the desired 1 millimeter of vacuum. The system is first evacuated to approximately 29 inches of mercury. Enough refrigerant vapor is then added to the system to bring the pressure up to 0 pounds.
3. Then the system is once again evacuated to 29 inches of vacuum. This procedure is repeated three times. This method can be most effective by holding system pressure at 0 pounds for a minimum of 1 hour between evacuations.

   The first pull down will remove about 90% of the non-condensibles, the second about 90% of that remaining from the first pull down and after the third only 1/10 of 1% non-condensibles will remain.

Table 7 shows the relationship between pressure, microns, atmospheres, and the boiling point of water.

CHARGING THE SYSTEM

1. After all refrigerant piping is complete and the system has been evacuated, it can be charged as described in the paragraphs following. Connect the refrigerant drum to the gauge port on the liquid line and purge the charging line between the refrigerant cylinder and the valve. Then open the valve to the mid-position.
2. If the system is under a vacuum, stand the refrigerant drum with the connection up and open the drum and break the vacuum with refrigerant gas.
3. With a system gas pressure higher than the equivalent of a freezing temperature, invert the charging cylinder and elevate the drum above the condenser. With the drum in this position, valves open and liquid refrigerant will flow into the condenser. Approximately 75% of the total requirement estimated for the unit can be charged in this manner.
4. After 75% of the required charge has entered the condenser, reconnect the refrigerant drum and charging line to the suction side of the system. Again purge the connecting line, stand the drum with the connection up, and place the service valve in the open position.

IMPORTANT: At this point charging procedure should be interrupted and prestart checks made before attempting to complete the refrigerant charge, (see startup procedures).

NOTE: It is recommended that the total operating charge per circuit be stamped on the unit nameplate for future reference.

REFRIGERANT CHARGE

Each ALP condensing unit is designed for use with R-22. See physical data for approximate refrigeration charges for operation of the unit. Additional refrigerant will be needed for the system piping and evaporator. Estimated total operating charge should be calculated before charging system.

CAUTION: Total operating charge per circuit should not exceed the condenser pumpdown capacity per circuit plus the capacity of the liquid line. A liquid receiver on each refrigerant circuit should be used if the unit operating charge exceeds the pumpdown capacity. Refer to the ASHRAE Handbook for the design and installation of piping and components.

Table 7. Pressure-vacuum equivalents

ABSOLUTE PRESSURE ABOVE ZERO		VACUUM BELOW ONE ATMOSPHERE		APPROXIMATE FRACTION OF ONE ATMOSPHERE	BOILING POINT OF H_2O AT EACH PRESSURE (°F)
MICRONS	PSIA	MERCURY (mm)	MERCURY (Inches)		
0	0	760.00	29.921	—	—
50	0.001	759.95	29.920	1/15,200	— 50
100	0.002	759.90	29.920	1/7,600	— 40
150	0.003	759.85	29.920	1/5,100	— 33
200	0.004	759.80	29.910	1/3,800	— 28
300	0.006	759.70	29.910	1/2,500	— 21
500	0.009	759.50	29.900	1/1,520	— 12
1,000	0.019	759.00	29.880	1/760	1
2,000	0.039	758.00	29.840	1/380	15
4,000	0.078	756.00	29.760	1/189	29
6,000	0.117	754.00	29.690	1/127	39
8,000	0.156	752.00	29.600	1/95	46
10,000	0.193	750.00	29.530	1/76	52
15,000	0.290	745.00	29.330	1/50	63
20,000	0.387	740.00	29.130	1/38	72
30,000	0.580	730.00	28.740	1/25	84
50,000	0.967	710.00	27.950	1/15	101
100,000	1.930	660.00	25.980	2/15	125
200,000	3.870	560.00	22.050	1/4	152
500,000	9.670	260.00	10.240	2/3	192
760,000	14.697	0	0	1 Atmosphere	212

Figure 5. Dimensional Data — ALP-013C, 016C & 021C.

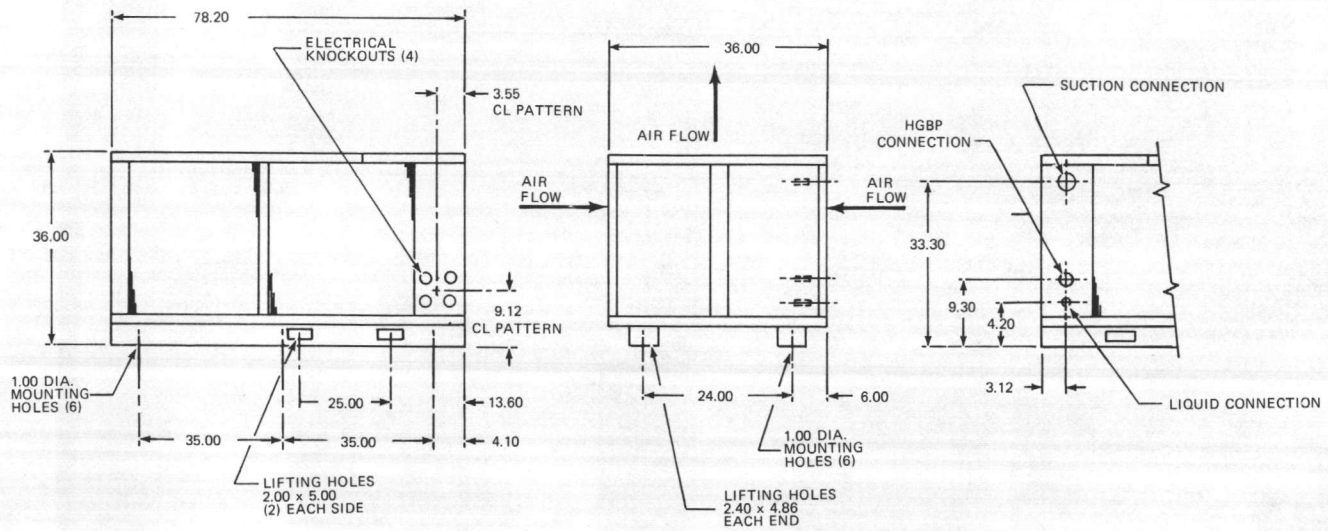


Table 8. Dimensional Data.

ALP UNIT SIZE	REFRIGERATION CONNECTION SIZES			ELECTRICAL CONNECTIONS
	SUCTION	LIQUID	HGBP	
013C	1⅜ O.D.S.	⅝ O.D.S.	⅞ O.D.S.	(4), ⅞ dia. knockouts provided where shown. Field to use ⅞ dia. as pilot for making larger holes if needed.
016C	1⅝ O.D.S.	⅝ O.D.S.	1⅛ O.D.S.	
021C	1⅝ O.D.S.	⅝ O.D.S.	1⅛ O.D.S.	

PHYSICAL DATA

Table 9. ALP physical data.

DATA	ALP MODEL NUMBER		
	013C	016C	021
BASIC DATA			
UNIT NOMINAL CAPACITY (TONS)①	11.4	15.7	20.4
NUMBER OF REFRIGERANT CIRCUITS	1	1	1
UNIT OPERATING CHARGE, LBS. R-22	11.0	12.0	12.0
PUMPDOWN CAP., 90% FULL @ 90°F (lbs.) ②	25.0	26.0	26.0
CABINET DIMENSIONS, L x W x H, INCHES	78x36x36	78x36x36	78x36x36
UNIT WEIGHT, LBS.	600	690	720
ADD'L WT. IF COPPER FINNED COILS, LBS.	210	223	210
COMPRESSORS — HERMETIC			
NOMINAL HORSEPOWER	10	15	20
NUMBER OF CYLINDERS	3	6	6
OIL CHARGE (PINTS)	6	15	15
CAPACITY REDUCTION STEPS — PERCENT OF COMPRESSOR DISPLACEMENT			
STANDARD STAGING	1	1	1
OPTIONAL STAGING	2	2	2
CONDENSERS — HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLER			
COIL FACE AREA, SQUARE FEET	30.3	30.3	30.3
FINNED HEIGHT x FINNED LENGTH, INCHES	66x66	66x66	66x66
FINS PER INCH x ROWS DEEP	16x2	12x2	16x2
CONDENSER FANS — DIRECT DRIVE PROPELLER TYPE			
NUMBER OF FANS — FAN DIA., INCHES	2 — 24	2 — 24	2 — 24
NUMBER OF MOTORS — HORSEPOWER	2 — .5	2 — .5	2 — .5
FAN AND MOTOR RPM	1075	1075	1075
FAN TIP SPEED, FPM	6750	6750	6750
TOTAL UNIT AIRFLOW, CFM	10,150	10,550	10,150

NOTES:
① Nominal capacity based on 95°F ambient air and 45°F suction.
② Total pumpdown capacity will be unit pumpdown capacity plus liquid line capacity (see Table 4).

ELECTRICAL DATA

Table 10. Electrical Data.

ALP UNIT SIZE	3-PHASE ELEC. POWER①	WIRE SIZING AMPS②	HUB DIA. (IN.) ④	MAX. FUSE SIZE RECOMMENDED AMPS
013C	208-230/60	53.6	1	70
	460/60	27.7	¾	35
	575/60	21.9	½	30
	380/50	28.1	¾	35
	415/50	28.1	¾	35
016C	208-230/60	79.0	1¼	100
	460/60	39.3	¾	50
	575/60	31.2	¾	40
	380/50	39.8	¾	50
	415/50	39.8	¾	50
021C	208-230/60	107.9	1¼	150
	460/60	53.7	1	70
	575/60	46.3	¾	60
	380/50	54.2	1	70
	415/50	54.2	1	70

Table 11. Compressor and Condenser Fan Motors

ALP SIZE	3-PHASE ELEC. POWER①	RATED LOAD AMPS		BRANCH CIRCUIT SELECTION CURRENT	LOCKED ROTOR AMPS	
		FANS (EA.)	COMPRESSOR③	COMPRESSOR	FANS (EA.)	COMPRESSOR
013C	208-230/60	3.5	30	36.1	8.8	192
	460/60	1.8	15	19.0	4.4	96
	575/60	1.4	12	15.2	3.5	77
	380/50	1.8	16	19.0	4.4	93
	415/50	1.8	16	19.0	4.4	93
016C	208-230/60	3.5	46	56.5	8.8	248
	460/60	1.8	23	28.2	4.4	124
	575/60	1.4	19	22.6	3.5	100
	380/50	1.8	24	28.2	4.4	126
	415/50	1.8	24	28.2	4.4	126
021C	208-230/60	3.5	68	79.5	8.8	362
	460/60	1.8	34	39.8	4.4	181
	575/60	1.4	27	34.8	3.5	145
	380/50	1.8	35	39.8	4.4	190
	415/50	1.8	35	39.8	4.4	190

ELECTRICAL DATA NOTES:

① ALLOWABLE VOLTAGE LIMITS:
- Unit nameplate 208V/60Hz/3Ph: 187V to 253V
- Unit nameplate 230V/60Hz/3Ph: 187V 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 Unit wire size amps are equal to 125% of the compressor branch circuit selection current plus 100% of RLA of all other loads in the circuit including control transformer.

③ RLA of 2 speed compressors running on low speed will be 50% of Table 11 RLA value.

④ Each ALP unit is provided with ⅞" dia. knockouts to be used as a pilot for making larger power entry hubs.

FIELD WIRING

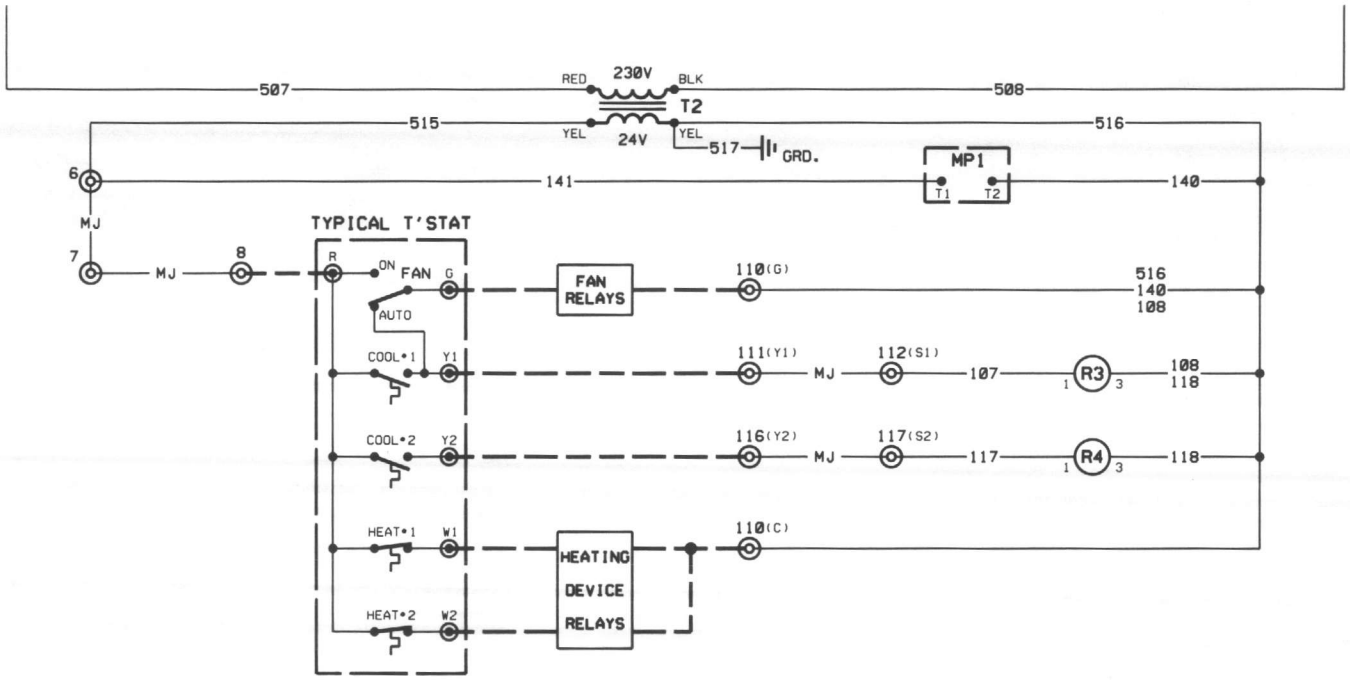
WARNING: USE ONLY COPPER CONDUCTORS IN MAIN TERMINAL BLOCK

Wiring should be done in accordance with all applicable codes and ordinances. Warranty is voided if wiring in 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.

Figure 6 shows typical field wiring that is required for unit installation. Items that require field wiring are liquid line solenoid SV1, and the cooling thermostat, as well as the unit power supplies.

NOTE: See dimensional data for knockout locations.

Figure 6. Typical Field Wiring.



ELECTRICAL LEGEND

DESIGNATION	DESCRIPTON	STD. LOCATION
AB	ALARM BELL	FIELD MOUNTED
C11, C12	CAPACITORS FOR FAN MOTORS	BACK OF CONTROL BOX
COMPR. 1	COMPRESSOR	BASE OF UNIT
F1	FUSE, CONTROL CIRCUIT	CONTROL BOX
FB5	FUSE BLOCK, CONTROL POWER	CONTROL BOX
FB6	FUSEBLOCK, FAN MOTORS	CONTROL BOX
GRD	GROUND	CONTROL BOX
HP1, 2	HIGH PRESSURE CONTROL	ON COMPRESSOR
HTR	HEATER, COMPRESSOR CRANKCASE	ON COMPRESSOR
LP1	LOW PRESSURE CONTROL	ON COMPRESSOR
M1—9	CONTACTORS, COMPRESSOR	CONTROL BOX
M11—12	CONTACTORS, FAN MOTORS	CONTROL BOX
MJ	MECHANICAL JUMPERS	CONTROL BOX
MP1—4	MOTOR PROTECTOR COMPRESSOR	COMPRESSOR JUNCTION BOX
MTR11	MOTORS, CONDENSER FANS	CONDENSER SECTION

DESIGNATION	DESCRIPTION	STD. LOCATION
NB	NEUTRAL BLOCK	CONTROL BOX
PB1	POWER BLOCK, MAIN	CONTROL BOX
PC12	PRESSURE CONTROL, (FANTROL)	CONTROL BOX
R13	RELAYS, LOW AMBIENT START	CONTROL BOX
R3, 4	RELAYS CAPACITY CONTROL	CONTROL BOX
SC11	SPEED CONTROLS	ON BULKHEAD
T1	TRANSFORMER, MAIN CONTROL	CONTROL BOX
T2	TRANSFORMER, 24V CONTROL	CONTROL BOX
TB2	TERMINAL BLOCK, 120V, FIELD	CONTROL BOX
TB3	TERMINAL BLOCK, 24V, FIELD	CONTROL BOX
TB4—6	TERMINAL BLOCKS, CONTROL	CONTROL BOX
TD4—6	TERMINAL BLOCKS CONTROL	CONTROL BOX
TD1—2	TIME DELAYS, COMPRESSOR LOCKOUT	CONTROL BOX
TD9	TIME DELAYS, LOW AMBIENT	CONTROL BOX

Figure 7. Control Center Layout — ALP-013C, 016C, 021C

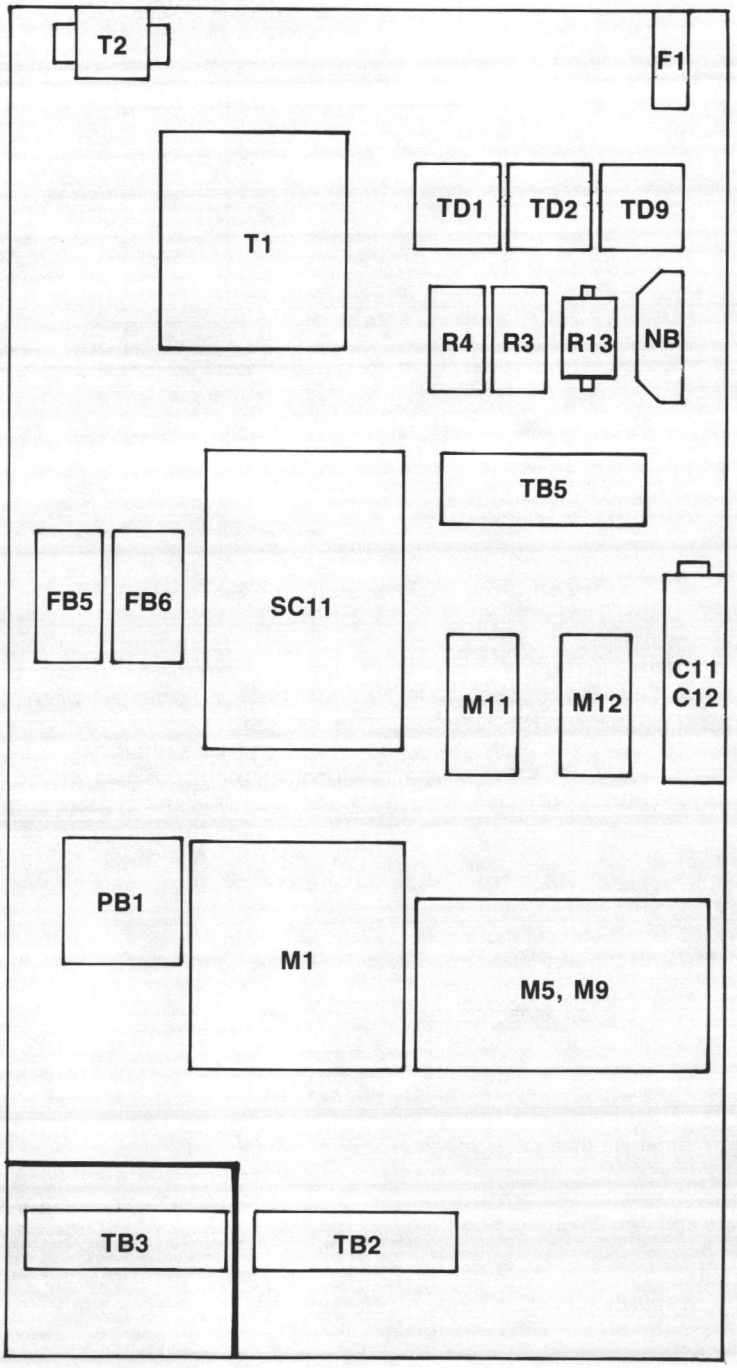
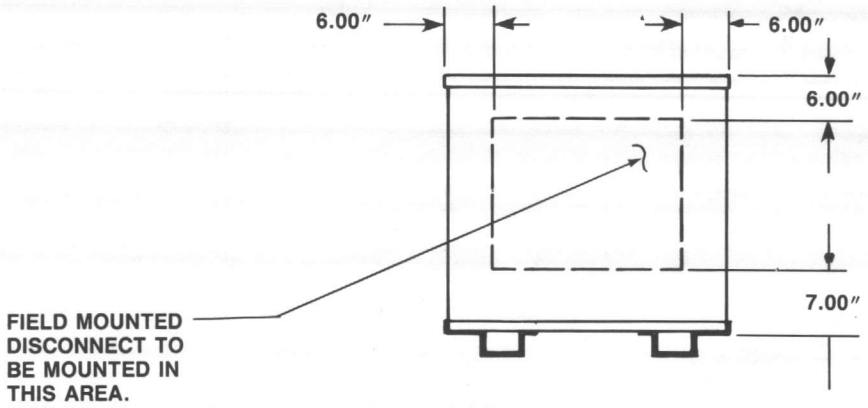


Figure 8. Recommended Unit Disconnect Location.



NOTE: Disconnect to be mounted end opposite control box.

NORMAL SEQUENCE OF OPERATION

The following sequence of operation is typical for ALP air cooled condensing units, models ALP-013C, 016C & 021C. The sequence varies somewhat depending upon options.

Start up—with power to the unit the control circuit is energized through the control circuit fuse block FB5. If there is no call for cooling the crankcase heater HTR1 will be energized and operating. Power will also be supplied to the 24V transformer providing power for the thermostat and the compressor motor protector.

On call for the first stage of cooling relay R3 is energized opening contacts 4-5 de-energizing the crankcase heater, and closes contacts 4-2 energizing the liquid line solenoid SV1. This allows refrigerant to flow through the thermostatic expansion valve and into the evaporator. As the refrigerant pressure in the evaporator increases, the low pressure control LP1 closes. Power will now be fed to the compressor contactor M5 provided the motor protector MP1 and high pressure control HP1 do not sense failure conditions. (Compressor motor protector closes 2 minutes after 24V power is supplied).

On call for second stage of cooling relay R4 energizes opening contacts 4-5 de-energizing the low speed compressor contactor M5, and closes contacts 4-2 to energize the high speed compressor contactors M1 & M9.

NOTE: Unit is capable of starting on high speed provided the thermostat is calling for second stage of cooling at start-up.

On initial power to the unit time delay relays TD1 and TD2 will close immediately. After the unit cycles off on the thermostat TD1 and TD2 will prevent compressor restart for 5 minutes.

PUMPDOWN CYCLE

Pumpdown—As the units thermostat is satisfied, it will de-energize the liquid line solenoid valve SV1 causing the valve to close. When the compressor has pumped most of the refrigerant out of the evaporator and into the condenser, the low pressure control LP1 will open, shutting down the compressor and condenser fan motors.

If refrigerant leaks into the evaporator the increase in pressure will cause the low pressure control LP1 to close. This will energize the compressor contactor M5 starting the compressor, which will quickly pump the refrigerant out of the evaporator and into the condenser (recycling pumpdown).

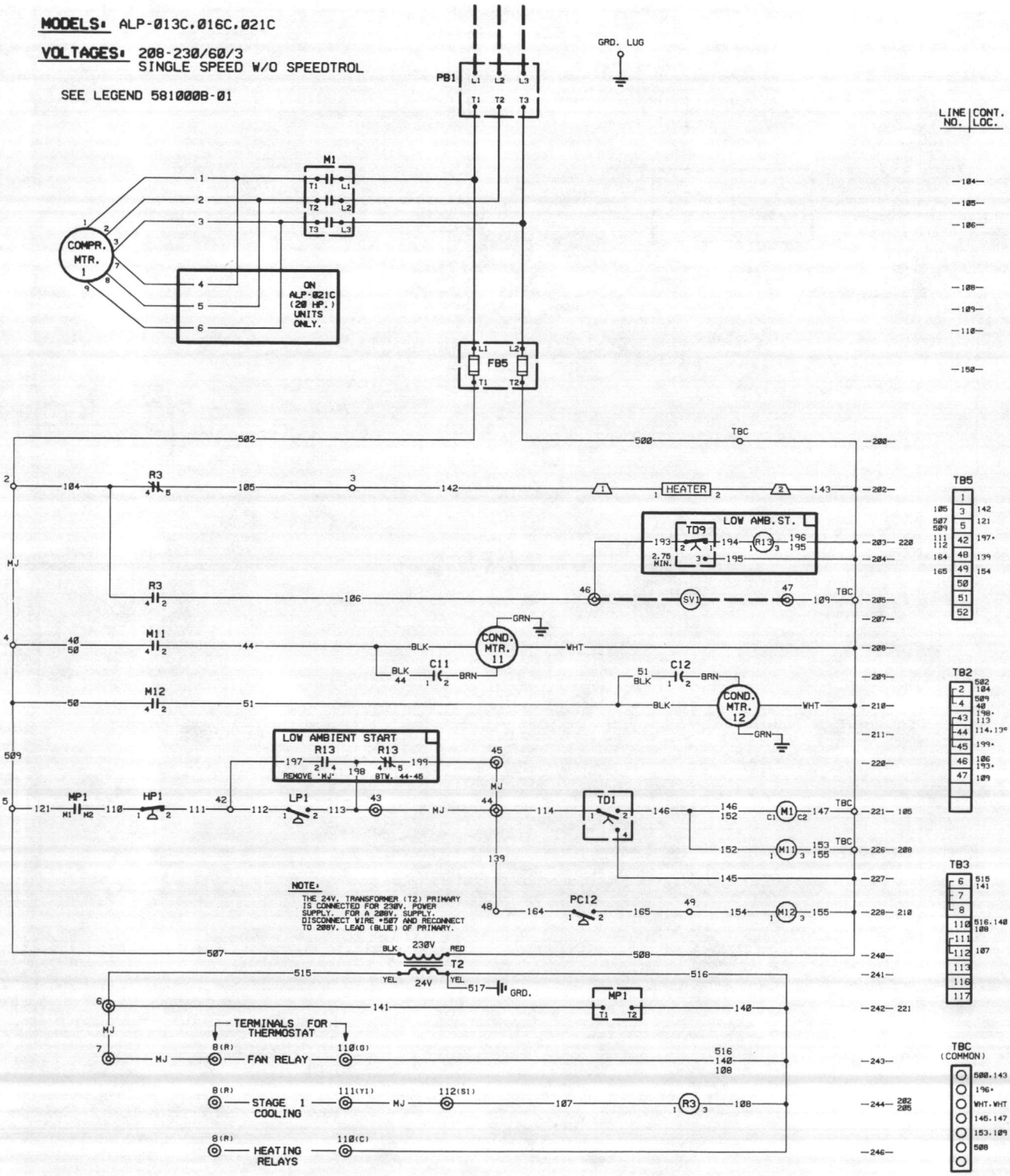
A compressor which repeats pumpdown every 5 minutes indicates a malfunction. Corrective measures must be taken if the compressor recycles repeatedly with in 15 minute intervals.

SCHEM. 551661D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 208-230/60/3
SINGLE SPEED W/O SPEEDTROL

SEE LEGEND 581000B-01

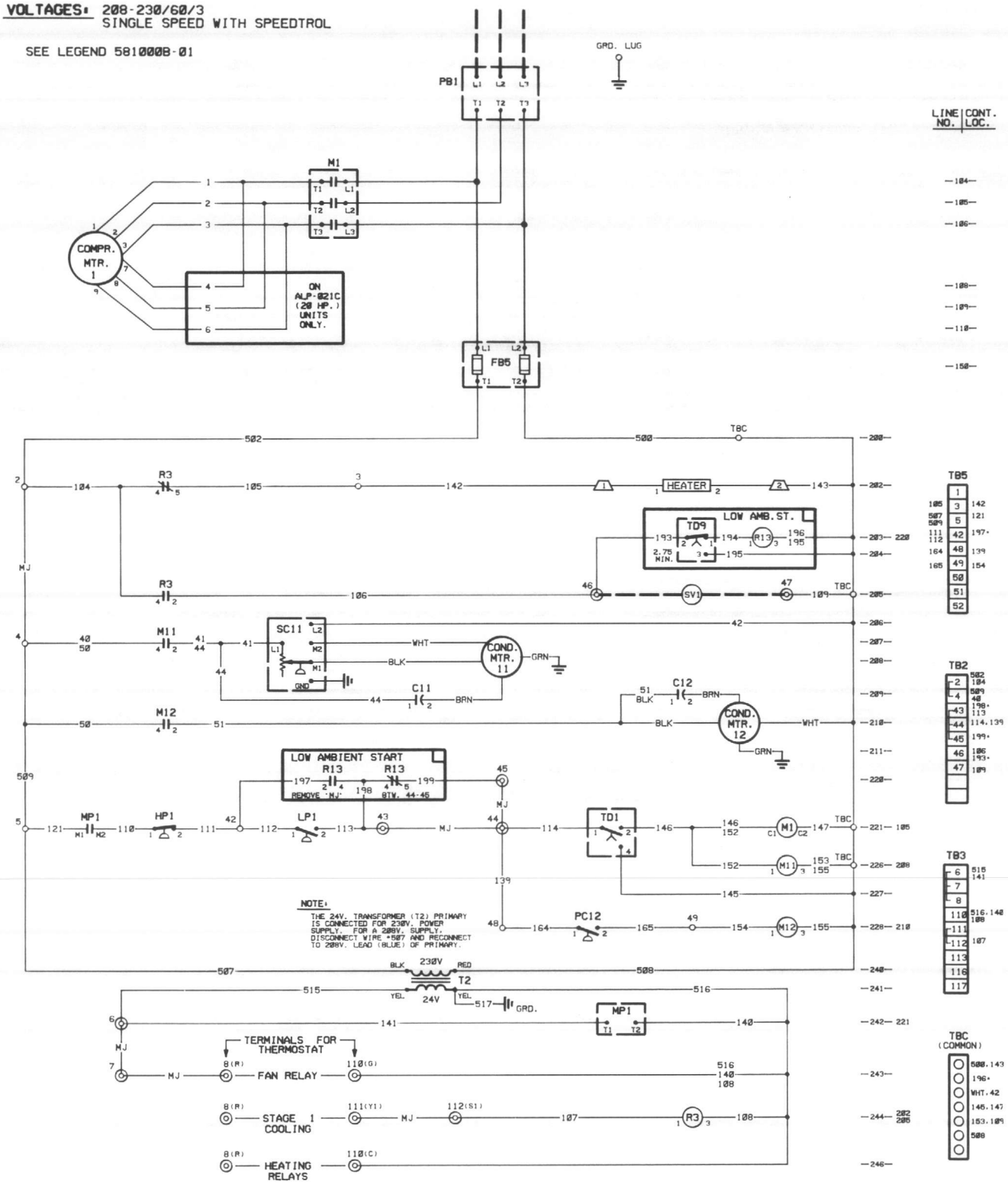


SCHEM. 551662D-02 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 208-230/60/3
SINGLE SPEED WITH SPEEDTROL

SEE LEGEND 581000B-01

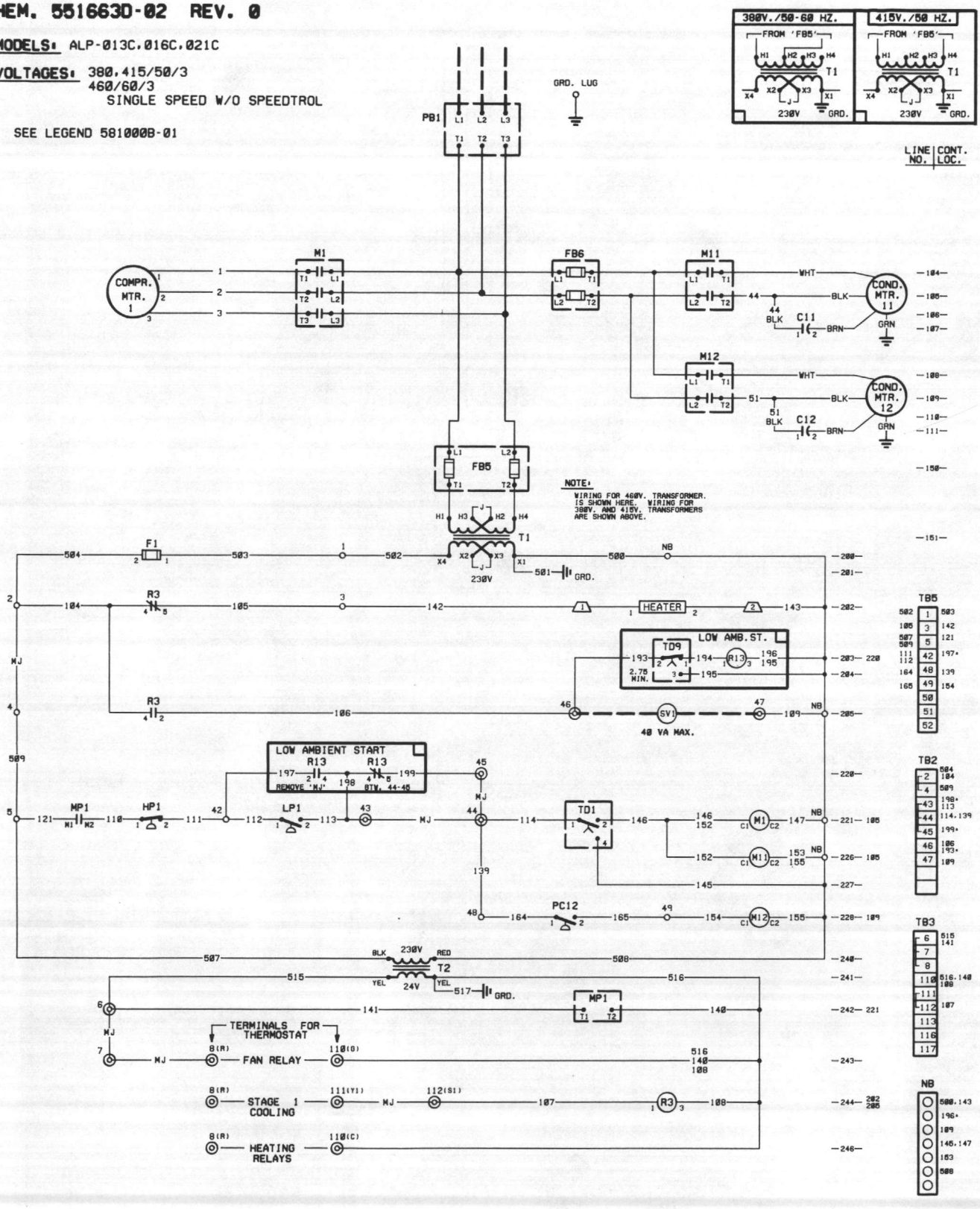


SCHEM. 551663D-02 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 380,415/50/3
460/60/3
SINGLE SPEED W/O SPEEDTROL

SEE LEGEND 581000B-01

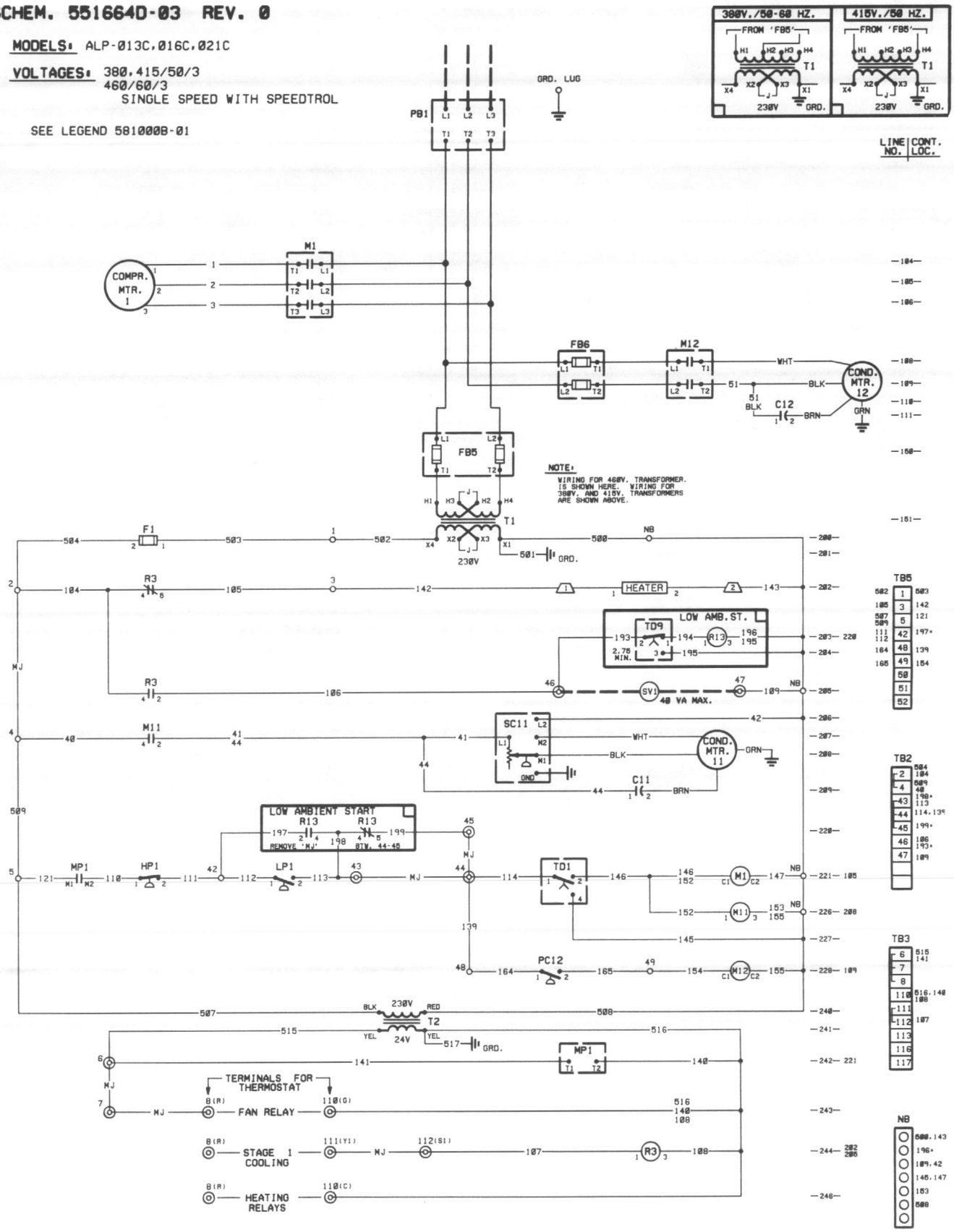


SCHEM. 551664D-03 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 380,415/50/3
460/60/3
SINGLE SPEED WITH SPEEDTROL

SEE LEGEND 581000B-01

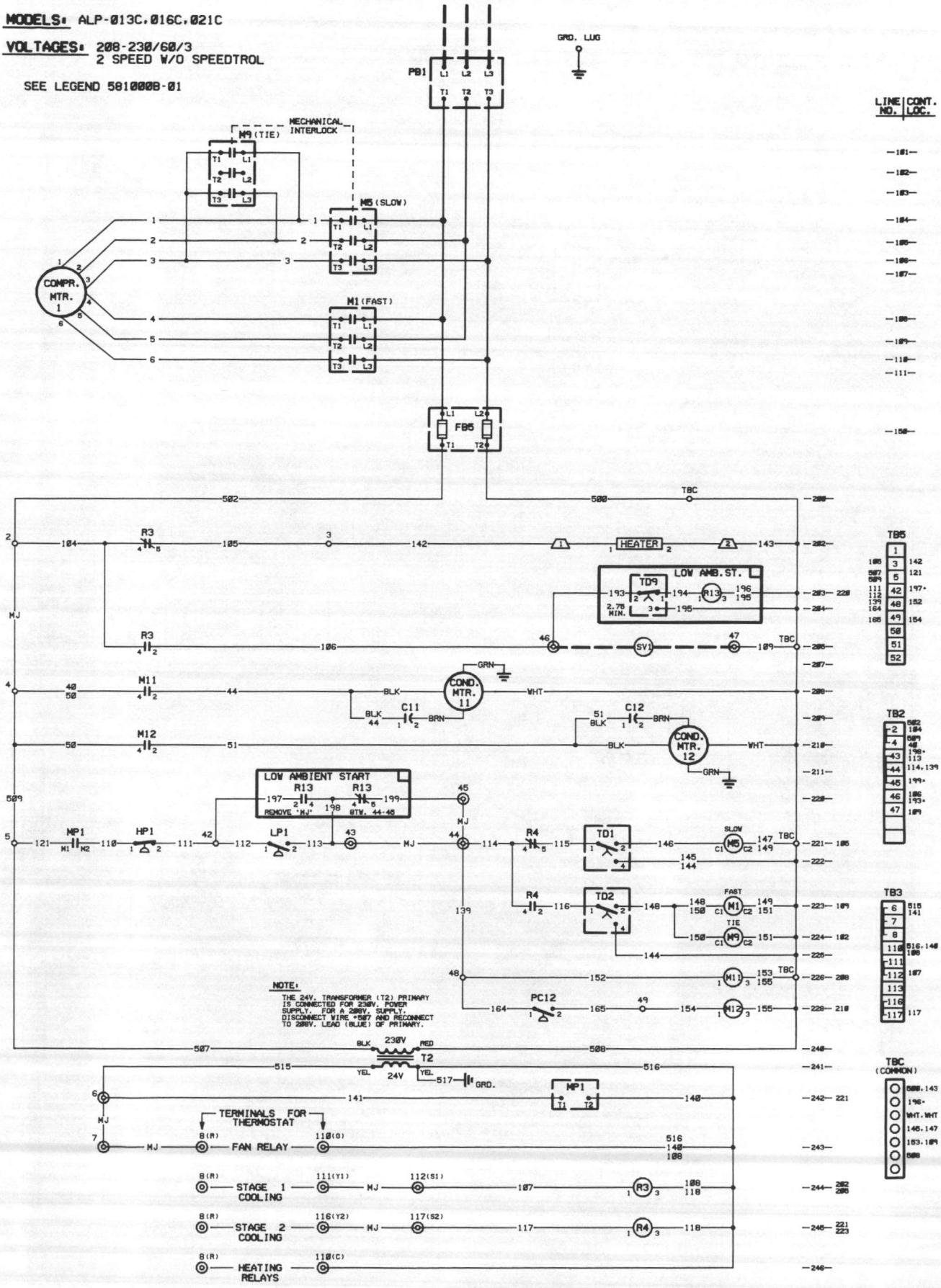


SCHEM. 551665D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 208-230/60/3
2 SPEED W/O SPEEDTROL

SEE LEGEND 581000B-01

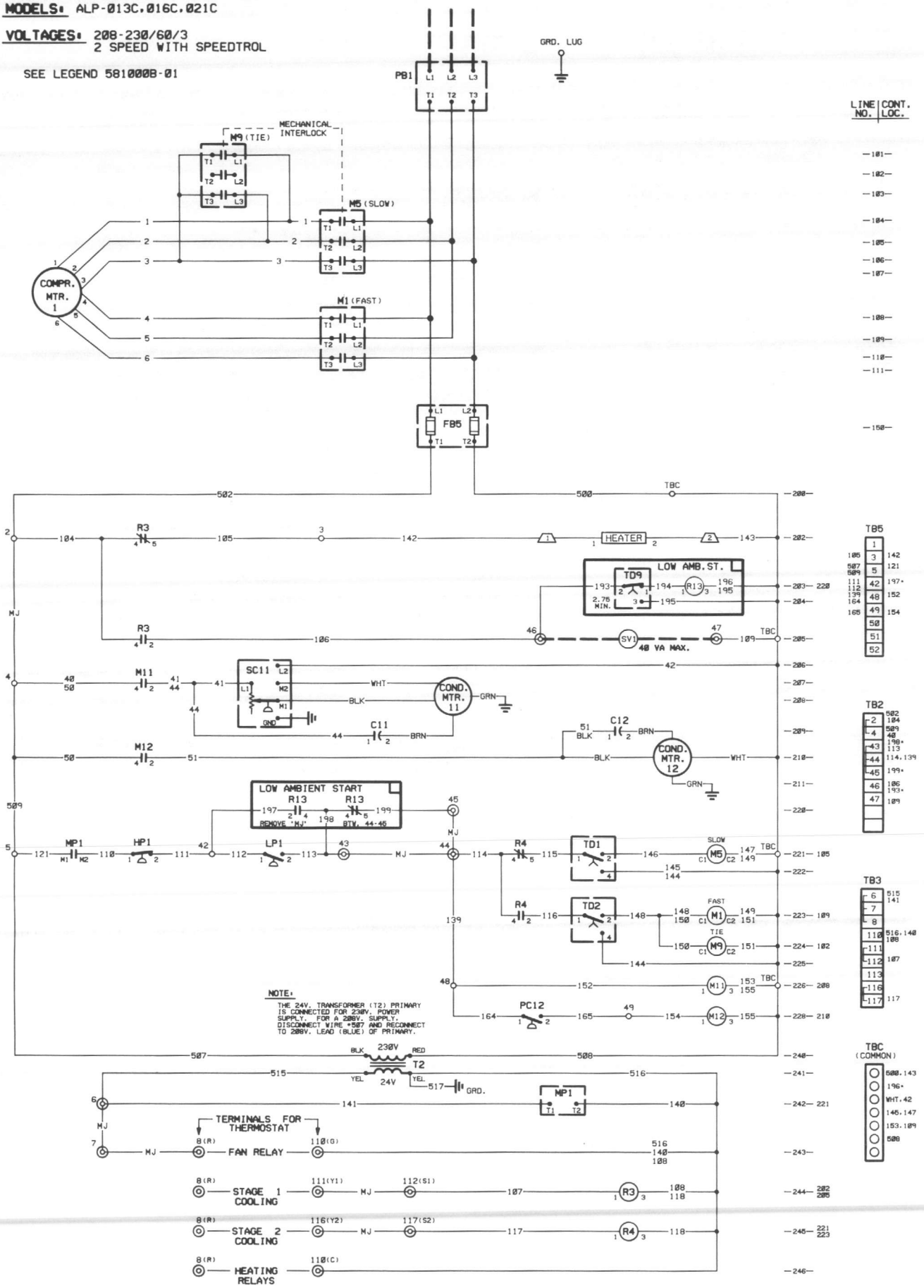


SCHEM. 551666D-02 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 208-230/60/3
2 SPEED WITH SPEEDTROL

SEE LEGEND 581000B-01

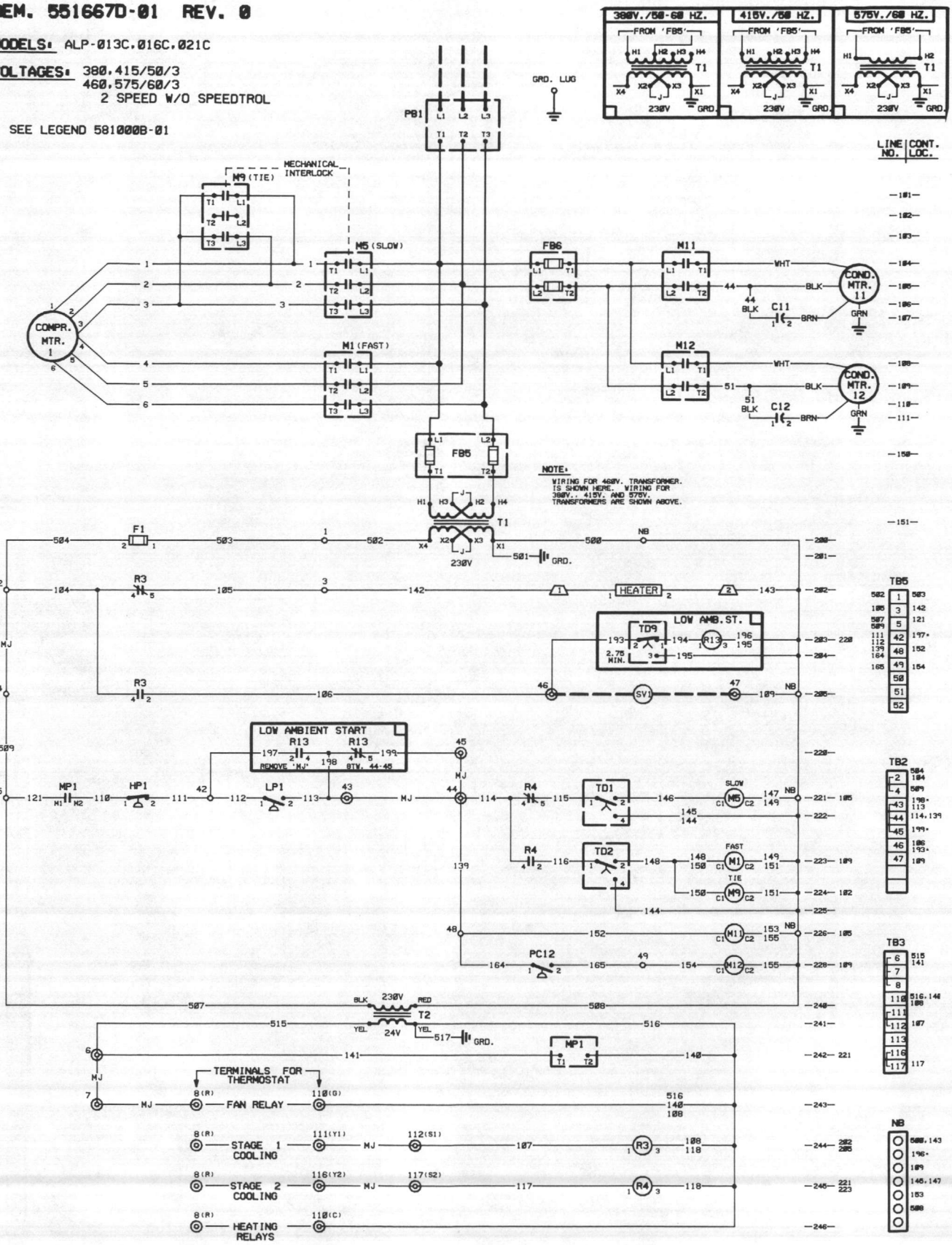


SCHEM. 551667D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 380,415/50/3
460,575/60/3
2 SPEED W/O SPEEDTROL

SEE LEGEND 581000B-01

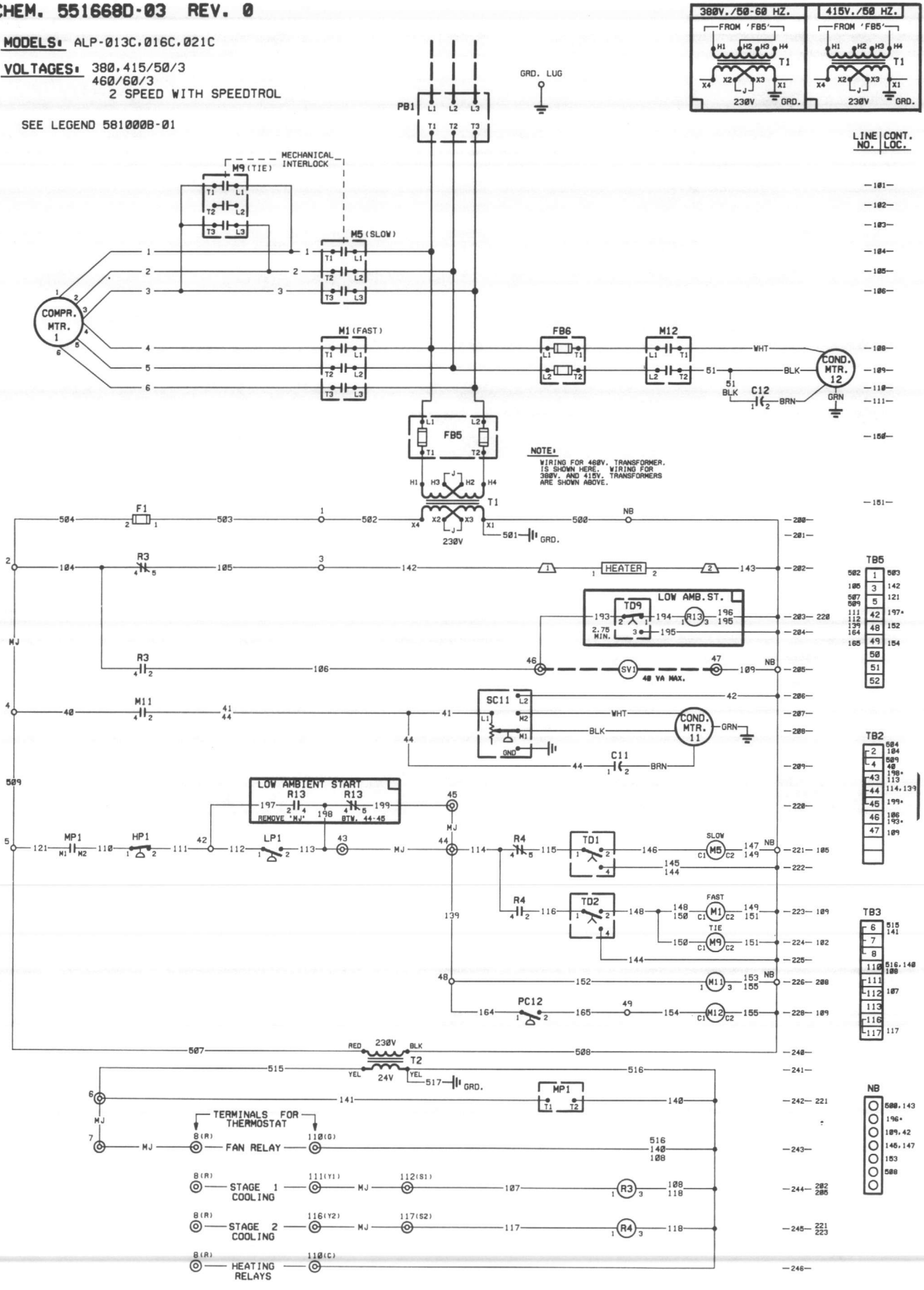


SCHEM. 551668D-03 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 380,415/50/3
460/60/3
2 SPEED WITH SPEEDTROL

SEE LEGEND 581000B-01



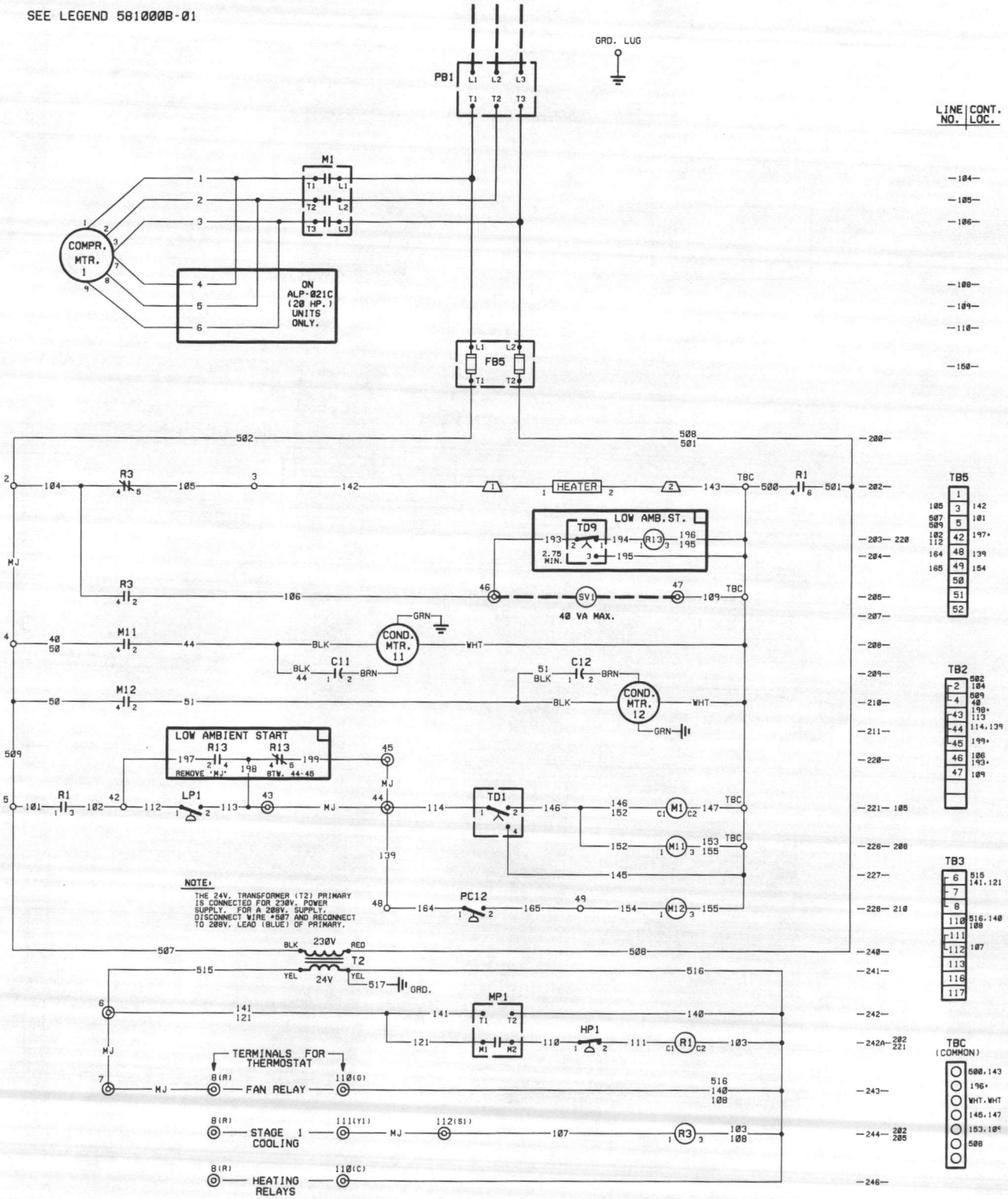
CSA APPROVED UNITS ONLY

SCHEM. 551697D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 208-230/60/3
SINGLE SPEED W/O SPEEDTROL

SEE LEGEND 581000B-01



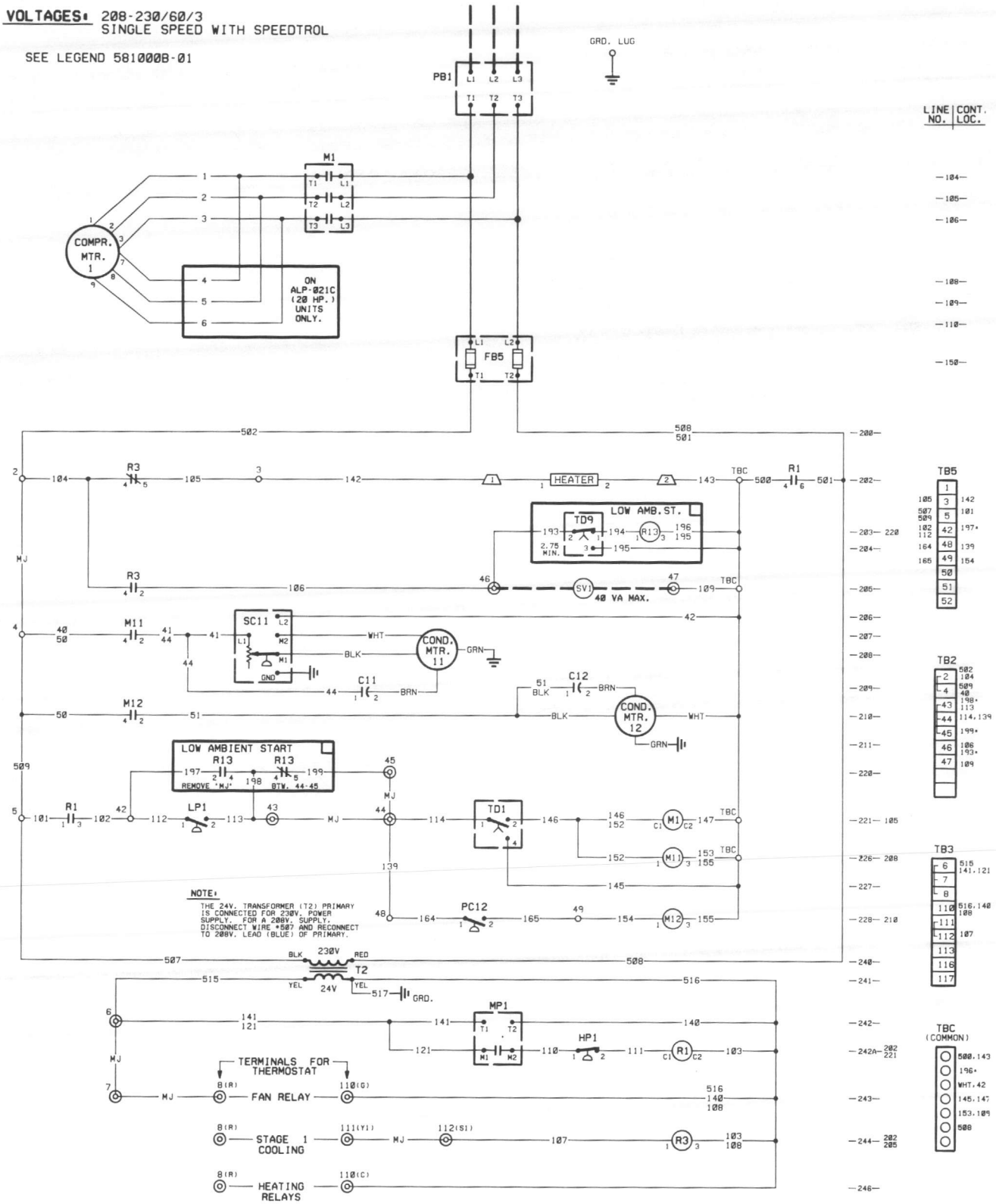
CSA APPROVED UNITS ONLY

SCHEM. 551698D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 208-230/60/3
SINGLE SPEED WITH SPEEDTROL

SEE LEGEND 581000B-01



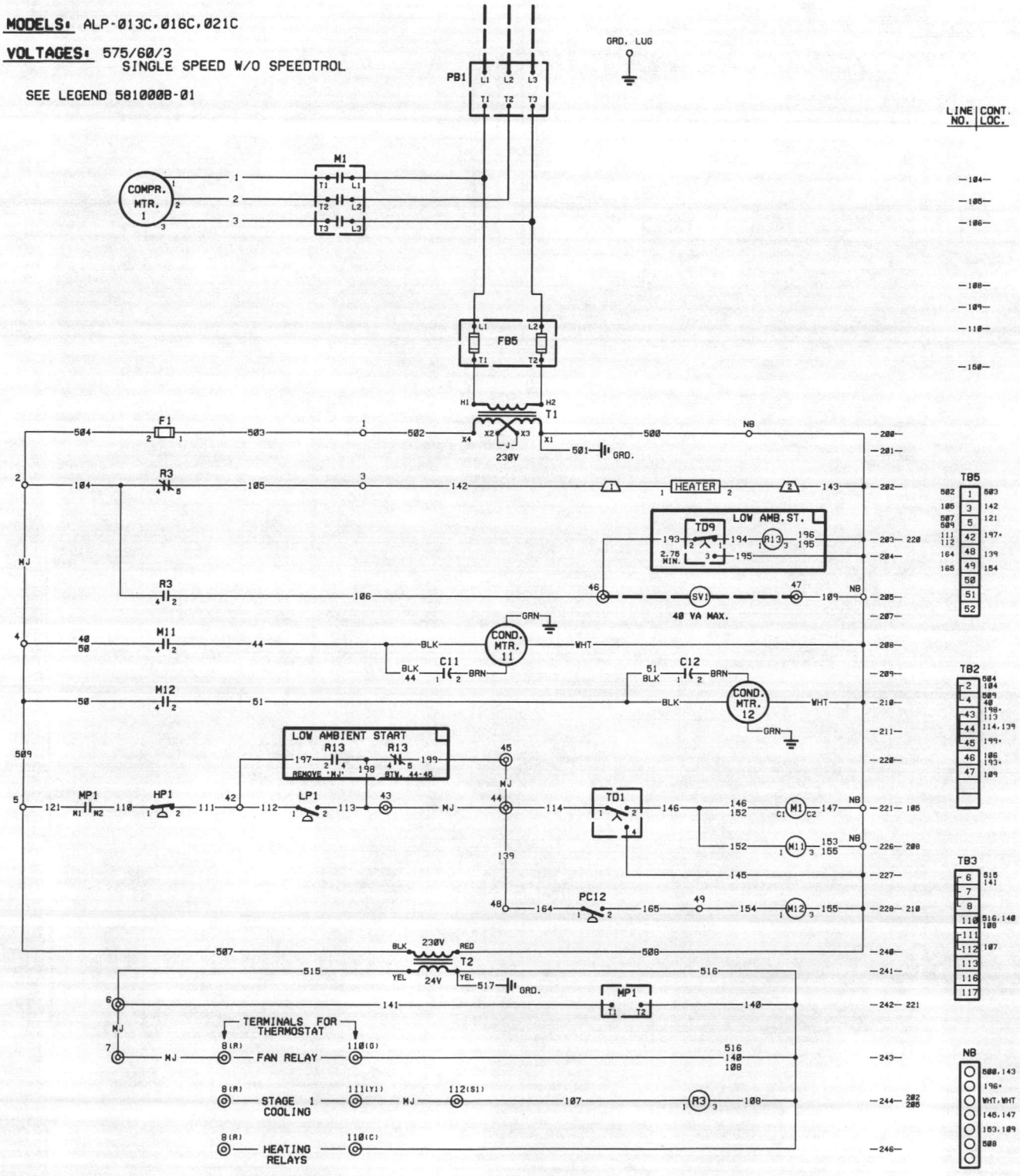
CSA APPROVED UNITS ONLY

SCHEM. 553201D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 575/60/3
SINGLE SPEED W/O SPEEDTROL

SEE LEGEND 581000B-01



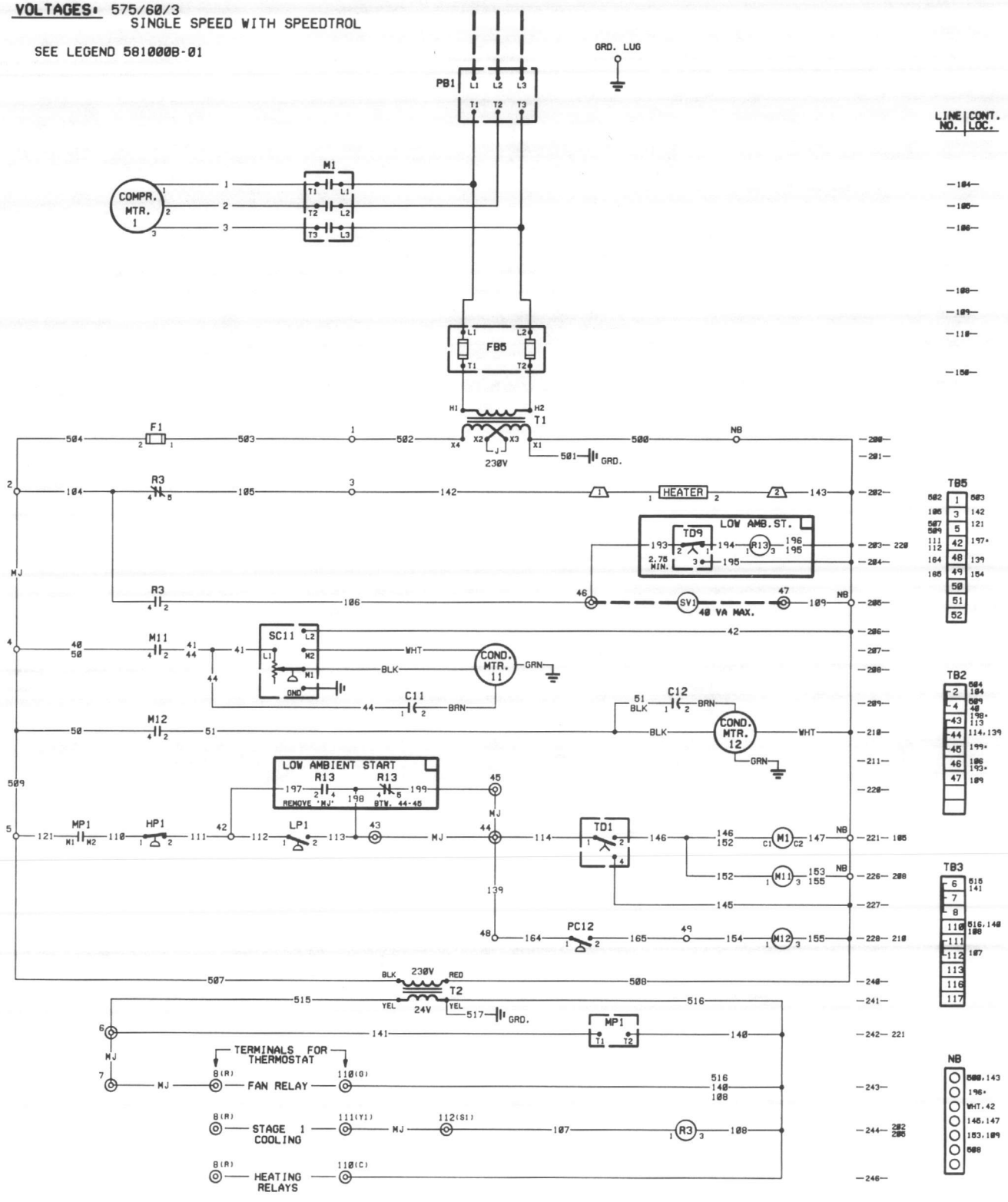
CSA APPROVED UNITS ONLY

SCHEM. 553202D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 575/60/3
SINGLE SPEED WITH SPEEDTROL

SEE LEGEND 581000B-01



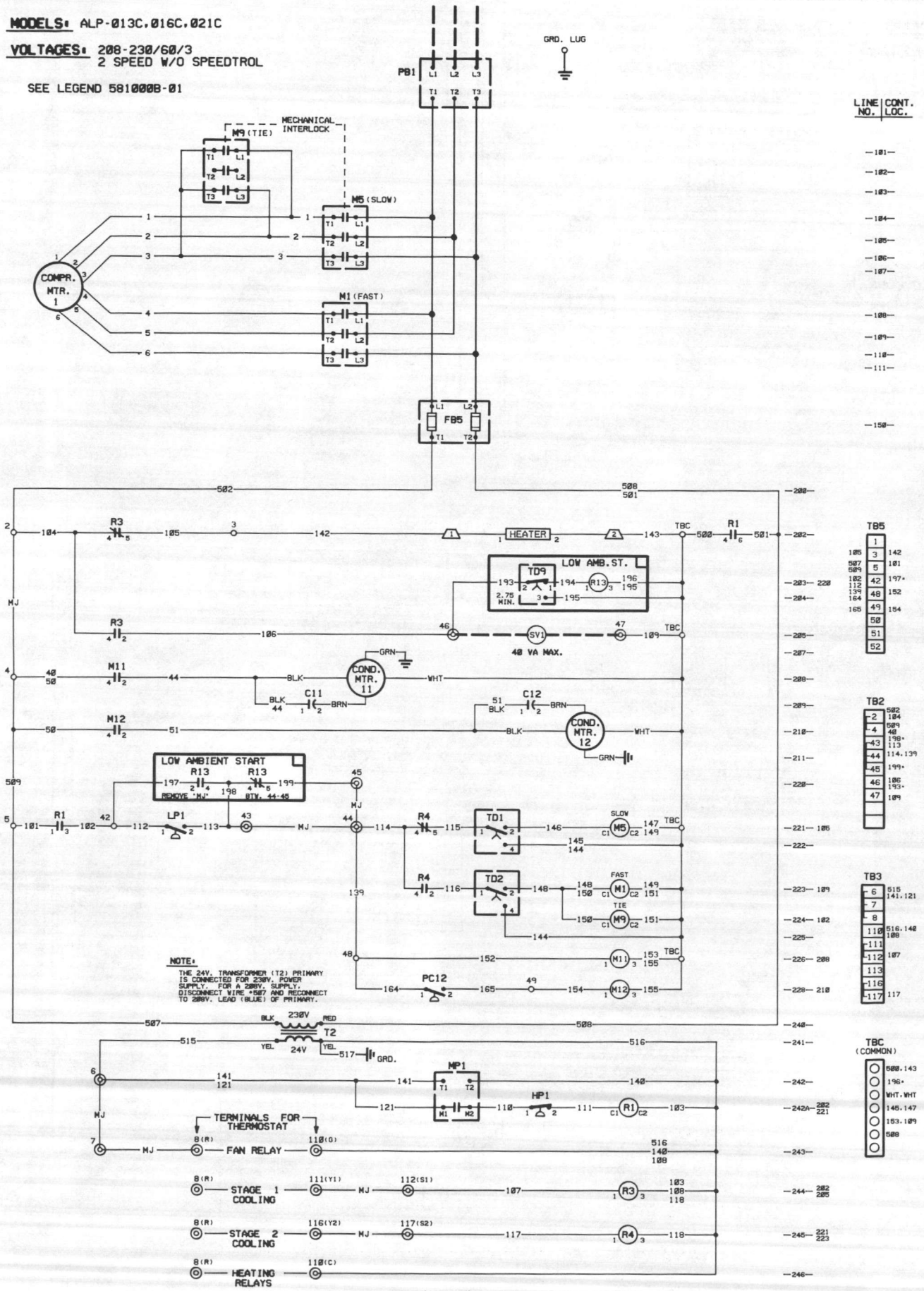
CSA APPROVED UNITS ONLY

SCHEM. 551699D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 208-230/60/3
2 SPEED W/O SPEEDTROL

SEE LEGEND 581000B-01



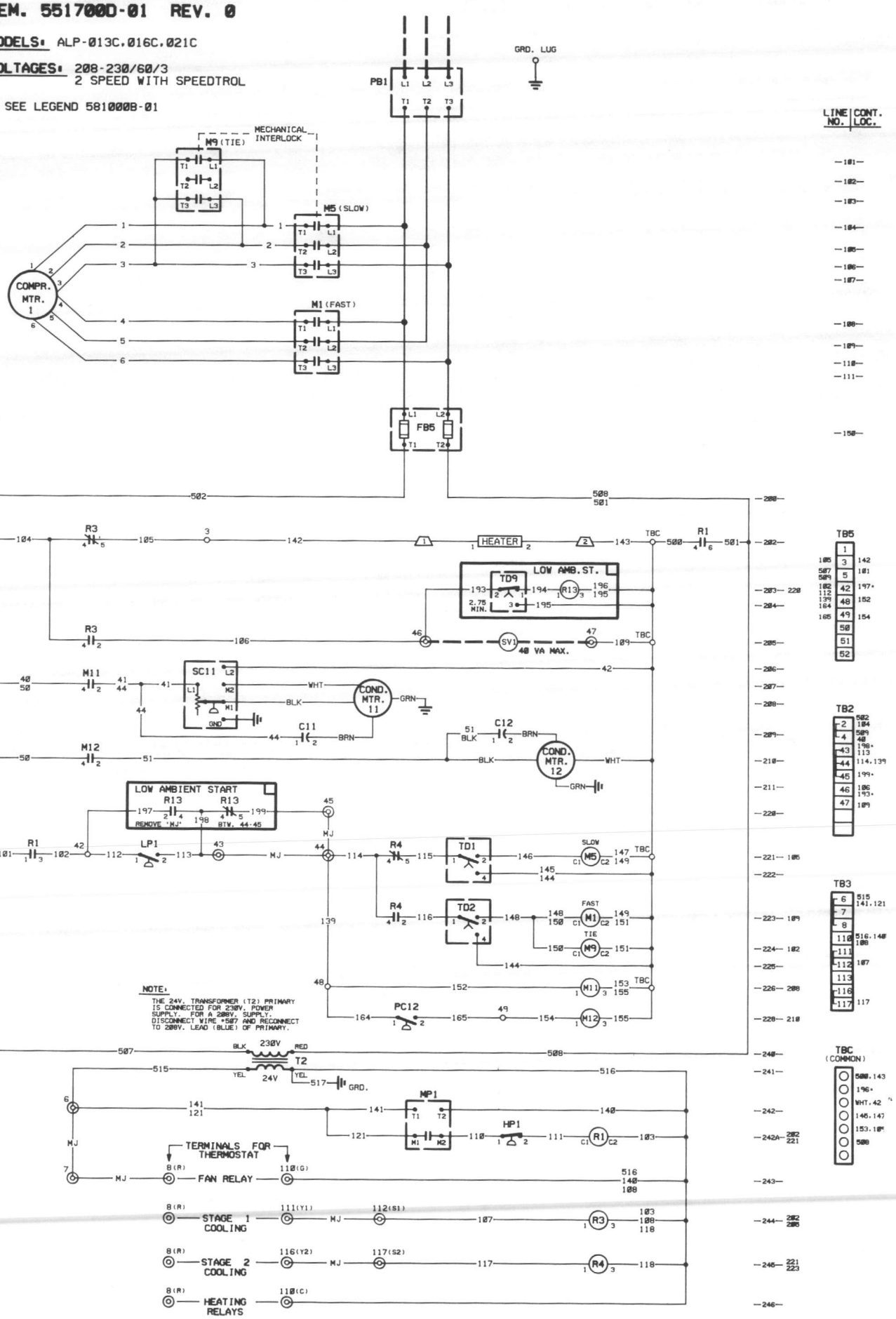
CSA APPROVED UNITS ONLY

SCHEM. 551700D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 208-230/60/3
2 SPEED WITH SPEEDTROL

SEE LEGEND 581000B-01



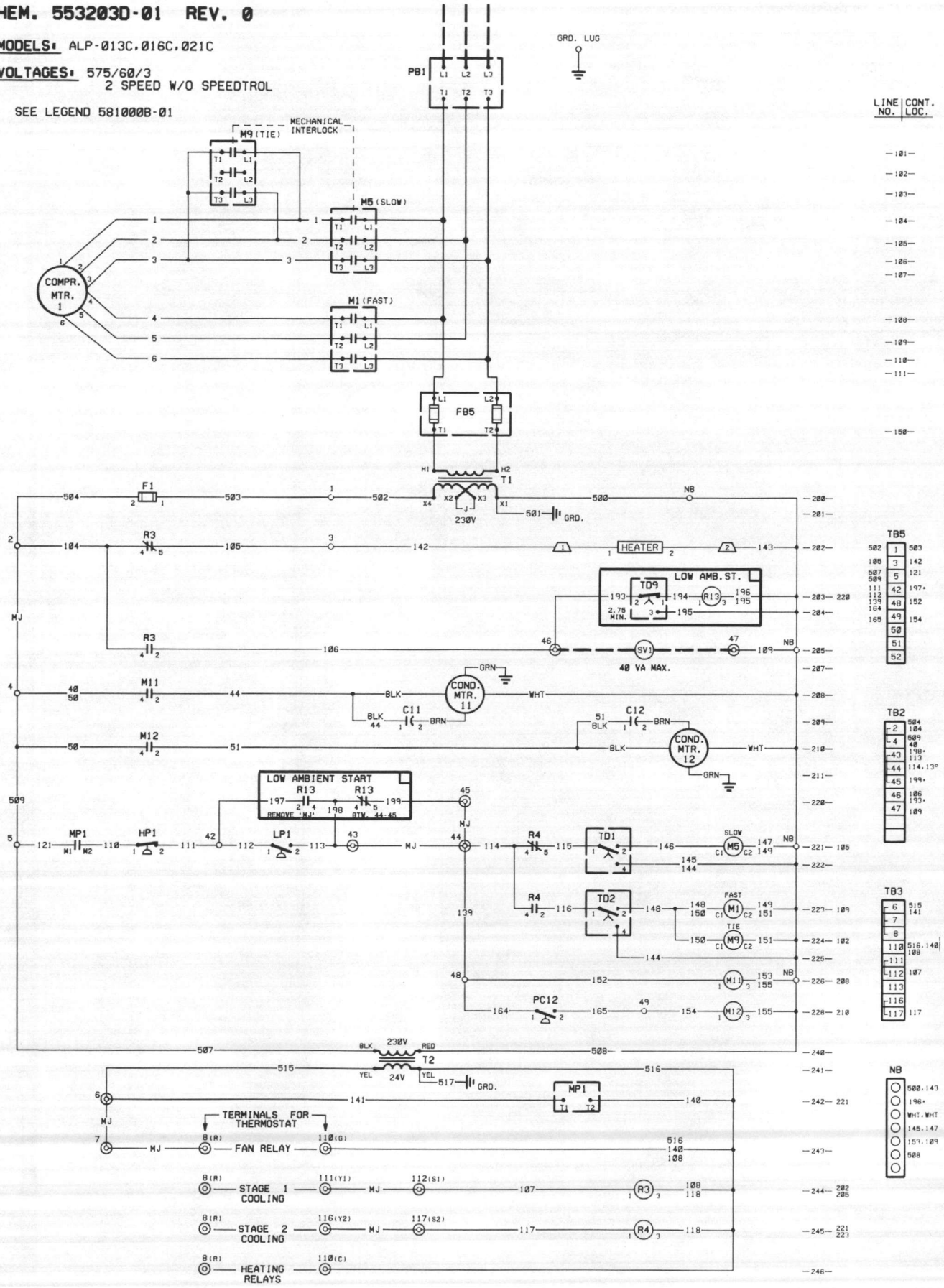
CSA APPROVED UNITS ONLY

SCHEM. 553203D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 575/60/3
2 SPEED W/O SPEEDTROL

SEE LEGEND 581000B-01



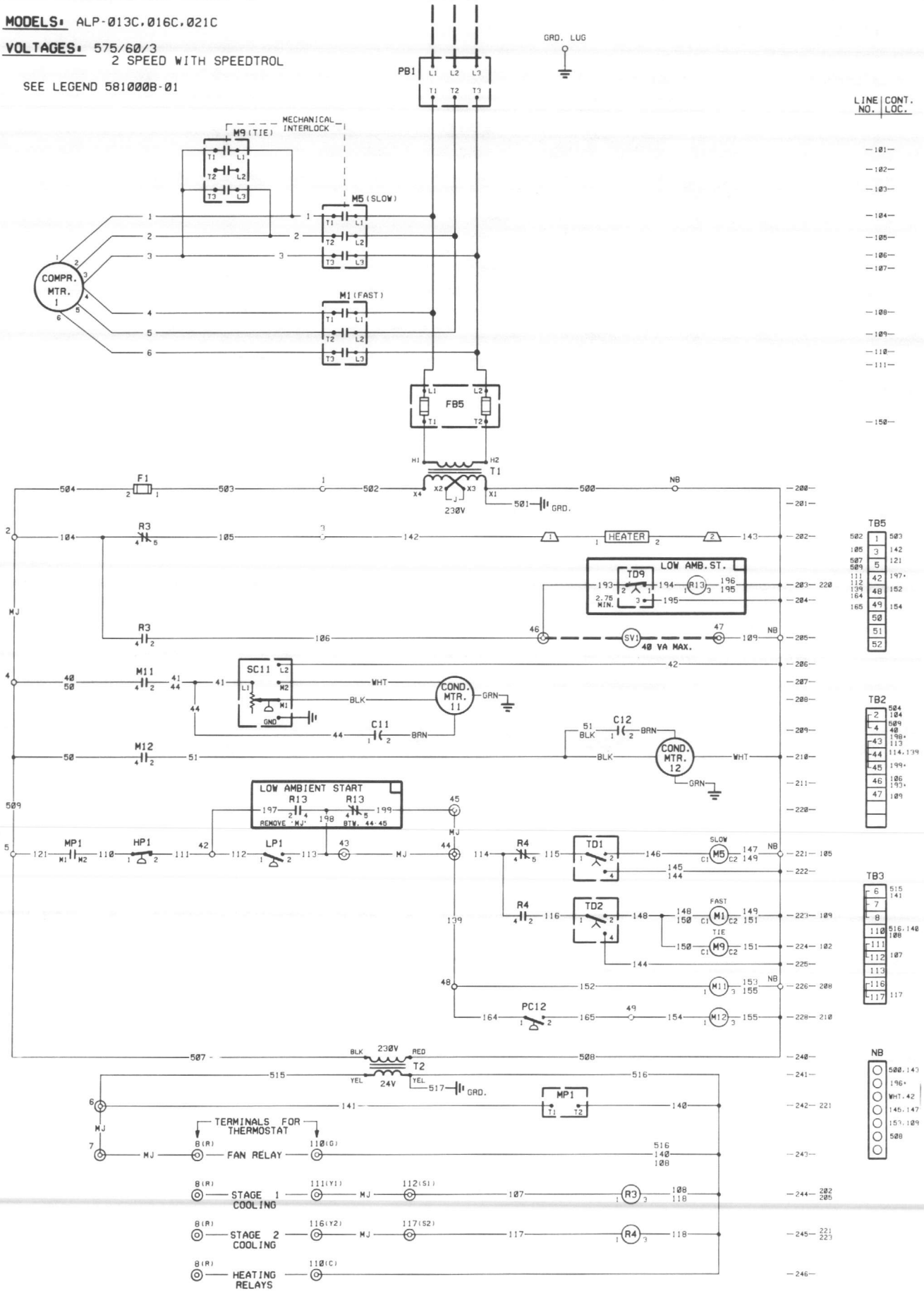
CSA APPROVED UNITS ONLY

SCHEM. 553204D-01 REV. 0

MODELS: ALP-013C,016C,021C

VOLTAGES: 575/60/3
2 SPEED WITH SPEEDTROL

SEE LEGEND 581000B-01



STARTUP

PRE-STARTUP

NOTE: REMOVE COMPRESSOR SHIPPING BLOCKS BEFORE ATTEMPTING TO START COMPRESSOR.

1. With 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. 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%.
3. Check the unit power supply wiring for adequate ampacity and a minimum insulation temperature rating of 75C.
4. Verify that all mechanical and electrical inspections have been completed per local codes.
5. See that all auxiliary control equipment is operative and that an adequate cooling load is available for initial startup.
6. Adjust the dial on the temperture controller to well below desired set point to prevent unit operation. Leave the unit disconnect on and allow the crankcase heater to operate at least 8 hours prior to start-up.

CAUTION: ***Most relays and terminals in the unit control center are hot with the unit disconnect on.***

STARTUP

1. Start the auxiliary equipment for the installation.
2. Adjust the dial on the temperature controller to the desired leaving air temperature.
3. After running the unit for a short period of time, check for proper rotation of the condenser fans and check for refrigerant flashing in the sightglass.
4. Superheat should be adjusted to maintain between 8 and 12 degrees F.
5. After system performance has been stabilized, it is necessary that the "Compressorized Equipment Warranty Registration Form" (Form No. 550488A-01) be completed to obtain full warranty benefits. Consult the Product Warranty Certificate for details. Both forms are supplied with the units where required.

SYSTEM MAINTENANCE

GENERAL

On initial startup and periodically during operation, it will be necessary to perform certain routine service checks. Among these are taking condensing and suction pressures. On units ordered with gauges, condensing and suction pressures can be read from the vertical support on the 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.

FAN MOTOR BEARINGS

The fan motor 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.

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. Use locally purchased foaming condenser coil cleaners for periodic cleaning of the coil. 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.

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. On sightglasses ordered as part of the "Liquid Line Accessory Kits" listed on page 6, 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.

SERVICE

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

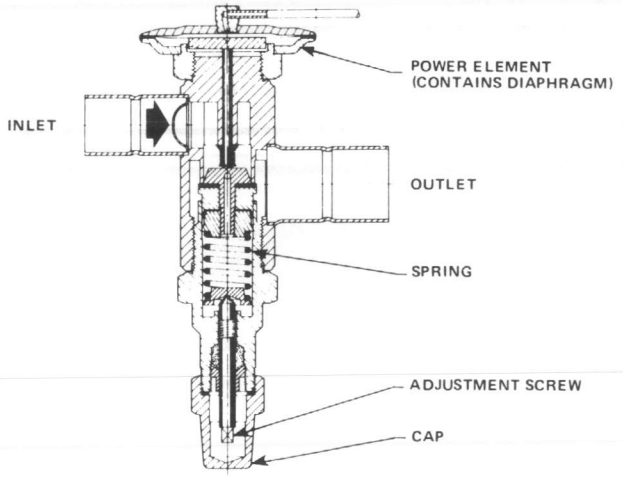
THERMOSTATIC EXPANSION VALVE

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.) Typically, superheat should run in the range of 10°F to 15°F.

The superheat setting can be adjusted by removing 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 setting 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.



FILTER-DRIERS

To change liquid line filter-drier, close the field supplied manual liquid line shut-off valve (see Figure 4). By jumping out the low pressure control allow the unit to pumpdown to 0—5 PSIG. When the evaporator pressure reaches 0—5 PSIG, shut the unit off at the disconnect.

After the filter drier has been changed purge some refrigerant through the line to remove any non-condensables that may have entered during filter replacement. A leak check is recommended before returning unit to operation.

LIQUID LINE SOLENOID VALVE

The liquid line solenoid valves, which is responsible for automatic pumpdown during normal unit operation, do not normally require any maintenance. They may, however, require replacement of the solenoid coil. The solenoid coil may be removed from the valve body without opening the system by disconnecting power to the unit. The coil can then be removed from the valve body by simply removing the nut or snap-ring located at the top of the coil.

APPENDIX
STANDARD CONTROLS

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

HIGH PRESSURE CONTROL

The high pressure control is a single pole pressure activited switch that opens on a rise in pressure. When the switch opens, it de-energizes the compressor circuit preventing unit operation until the high pressure control resets itself. The control is factory set to open at 385 PSIG and reset at 285 PSIG. The control is attached to a shrader fitting on the hot gas stub located in the compressor compartment.

To check the control, either block off the condenser surface or start the unit with condenser fan motors off and observe the cut-out point of the control on the high side of the system.

CAUTION: Although there is a additional pressure relief device in the system set at 450 PSIG, it is highly recommended that the unit disconnect be close at hand in case the high pressure control should malfunction. After testing the high pressure control, check the pressure relief device 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 opens at 35 PSIG. To check the low pressure control (unit must be running), remove wire #107 from terminal #112 de-energizing R-3 relay which in turn will de-energize the liquid line solenoid. As the compressor pumps down, condenser pressure will rise and evaporator pressure will drop. The lowest evaporator pressure reached before cut-out is the cut-out setting of the control. Reconnecting wire #107 to terminal #112 will energize the liquid line solenoid allowing evaporator pressure to rise. The highest evaporator pressure reached before compressor restart is the cut-in setting of the control.

NOTE: Allow 5 minutes for compressor time delay before reconnecting wire #107.

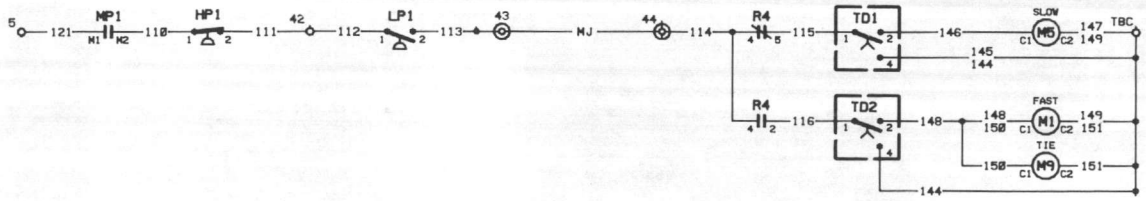
COMPRESSOR LOCKOUT

Compressor lockout consists of two non-adjustable 5 minute time delays TD1 & TD2. These solid-state time delays are wired in series with the compressor contactors M5, M1 & M9. Its purpose is to prevent rapid compressor cycling when cooling demand is eratic.

The circuit illustrated is for a two speed compressor. Standard single speed compressor lockout utilizes only one time delay TD1 in series with compressor contactor M1.

On initial power to unit the time delays will not delay operation and the compressor may start immediately on call for cooling. Once the unit thermostat is satisfied and the low pressure control opens, the time delay will prevent compressor restart for 5 minutes. It is possible that if the unit switches from low to high speed and back to low speed in less than 5 minutes, compressor operation maybe interrupted for the remainder of the delay on TD1.

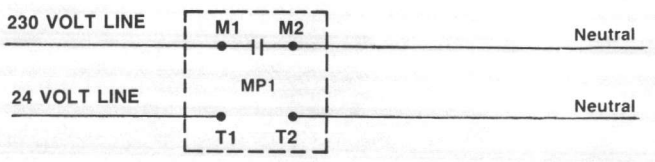
To check the time delay, the compressor must be running initially. Allow the unit to pumpdown by adjusting the temperature control to simulate no call for cooling. Immediately after the compressor has stopped running, adjust the temperature control to call for cooling. The compressor should not restart for 5 minutes.



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 M1 and M2 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 condenser fan motor 12 in response to condenser pressure. This maintains head pressure and allows the unit to run at low ambient air temperatures.

All ALP units have Fantrol which is a non-adjustable control set to open at 170 PSIG and close at 290 PSIG. The control is attached to a Schrader fitting on the liquid line inside the compressor compartment.

Table 12. Fan Control Minimum Ambient Operation.

ALP UNIT SIZE	Fantrol (STANDARD)	Fantrol WITH OPTIONAL LOW AMBIENT	Speedtrol
013C	60°F	45°F	0°F
016C	55°F	30°F	0°F
021C	45°F	10°F	0°F

NOTE: Wind conditions may affect actual minimum ambient values.

APPENDIX
OPTIONAL CONTROLS

Speedtrol HEAD PRESSURE CONTROL (OPTIONAL)

The Speedtrol method of head pressure control operates in conjunction with Fantrol by modulating the motor speed on fan 11 in response to condenser pressure. By reducing the speed of the last fan as the condensing pressure falls, the unit can operate at lower ambient temperatures.

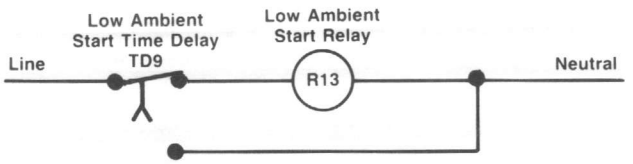
The Speedtrol fan motor is a single phase, 208/240 volt, thermally protected motor specially designed for variable speed operation. The solid-state speed control SC11 is mounted in the unit control panel and is connected to a Schrader fitting on the liquid line. The control is factory set to start modulating fan speed at 230 PSIG, and will maintain a minimum condensing pressure of 170 to 180 PSIG. Minimum starting voltage for Speedtrol motors is 120 volts.

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 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 de-energizing relay R3 in the thermostat circuit.

Due to vertical condenser design it is recommended that the unit be oriented so that prevailing winds blow parallel to the unit length, thus minimizing effects on minimum ambient operation. If it is not practical to orient the unit in this manner, a wind deflector should be constructed.



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

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. Hot gas bypass kits are described on page 6.

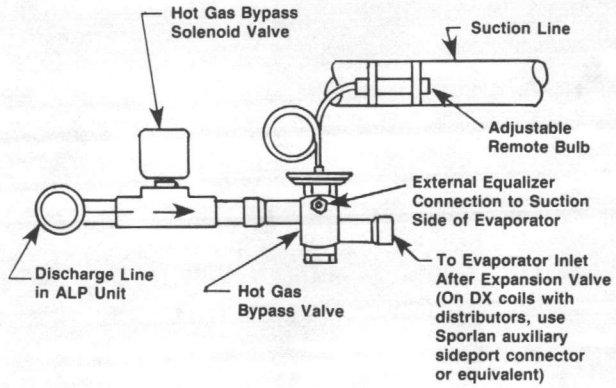
The solenoid valve should be wired to open whenever the liquid line solenoid valve is energized. This can be accomplished by wiring the hot gas solenoid (SV5) in parallel with the liquid line solenoid at terminals 46 and 47. The pressure regulating valve is factory set to begin opening at 58 psig (32°F for R-22) when the air charged bulb is in an 80°F ambient temperature. The bulb can be mounted anywhere as long as it senses a fairly constant temperature at various load conditions. The compressor suction line is one such mounting location. It is generally in the 50°F to 60°F range. The chart below indicates that when the bulb is sensing 50°F to 60°F temperatures, the valve will 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.

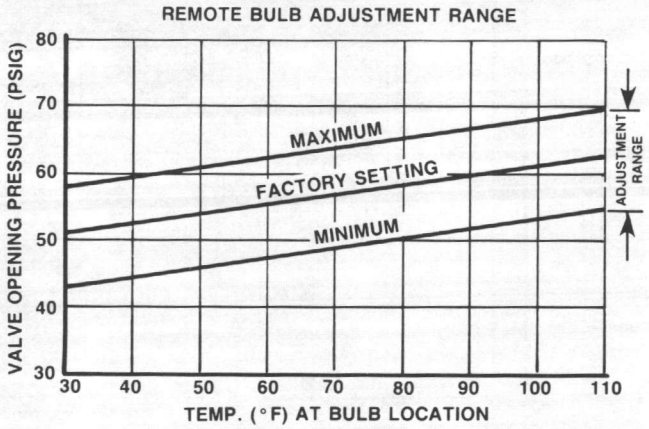
CAUTION: *The hot gas line may become hot enough to cause injury in a very short time, so care should be taken during valve checkout.*

On installations where the condensing unit is remote from the evaporator, it is recommended that the hot gas bypass valve be mounted near the condensing unit to minimize the amount of refrigerant that will condense in the hot gas line during periods when hot gas bypass is not required.

Hot Gas Bypass Piping Diagram



Hot Gas Bypass Adjustment Range



VAV—DIRECT EXPANSION VALVE

The application of Variable Air Volume (VAV) to a Direct Expansion System can have critical affect on the useful life and performance of the condensing unit. Areas of greatest concern are compressor motor cooling, oil return, and refrigerant flow control.

Hot gas bypass is recommended on all compressor circuits expected to be in operation during reduced load and airflow conditions. Hot gas bypass will help to insure proper motor cooling and maintain sufficient refrigerant velocity for proper oil return. Failing to install hot gas bypass can result in compressor failure.

If building load is expected to be well below design levels due to unoccupied space or simply lack of cooling load, it may be desirable to modify system control to prevent unneeded stages of cooling from being used. Too frequent starting and stopping of compressors can result in compressor failure.

The important factor is that the design engineer must be aware of the fact that the VAV system can have a critical affect on the refrigeration system and that precautionary measures must be taken to prevent refrigeration system failure.

ALP CONTROLS, SETTINGS, AND FUNCTIONS

DESCRIPTION	FUNCTION	SYMBOL	SETTING	RESET	LOCATION	DIFFERENTIAL
HIGH PRESSURE CONTROL	Stops compressor when discharge pressure is too high.	HP1	Opens at 385 psig Closes at 285 psig.	Auto	Liquid line	100 psig. fixed.
LOW PRESSURE CONTROL	(Used for pumpdown.) Stops compressor when suction pressure is too low.	LP1	Closes at 60 psig. Opens at 35 psig.	Auto	Suction line	25 psig fixed.
COMPRESSOR MOTOR PROTECTOR (Texas Instruments)	Protects motor from high temperature by sensing winding temperature.	MP1	500 ohms cold to 20,000 ohms hot.	Auto from 2700—4500 ohms	Compressor junction box	15,000 ohms
FANTROL CONDENSER PRESSURE CONTROL	Maintains condenser pressure by cycling the condenser fans in response to condensing pressure	PC12	See FANTROL in standard control appendix.	Auto	Liquid line	120 fixed
SPEEDTROL HEAD PRESSURE CONTROL	Modulates condenser fan speed in resonse to condensing pressure.	SC11	Maintains minimum condensing pressure of 170 to 180 psig.	Auto	Liquid line	N/A
SOLENOID VALVES, LIQUID LINE	Close off liquid line for pumpdown.	SV1	N/A	N/A	Field installed near condensing unit.	N/A
SOLENOID VALVES, HOT GAS BYPASS	Close off hot gas line for pumpdown.	SV5	N/A	N/A	Condenser section	N/A
COMPRESSOR LOCKOUT TIME DELAY	Prevents short cycling of compressors.	TD1, 2	Fixed Recommended 5 minute setpoint.	Auto	Control box	N/A
LOW AMBIENT START TIME DELAY	Bypasses low pressure control to allowevaporator pressure to build up in low ambient conditions.	TD9	2¾ minutes	Auto	Control box	N/A

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. Fan not running. 5. Dirty condenser coil. 6. FANTROL out of adjustment.	1. Purge the noncondensables. 2. Remove excess. 3. Open valve. 4. Check electrical circuit. 5. Clean coil. 6. Adjust FANTROl settings.
LOW DISCHARGE PRESSURE	1. Faulty condenser temperature regulation. 2. Insufficient refrigerant in system. 3. Low suction pressure. 4. Compressor operating unloaded.	1. Check condenser control operation. 2. Check for leaks. Repair and add charge. 3. See Corrective Steps for low suction pressure below. 4. See Corrective Steps for failure of compressor to load below.
HIGH SUCTION PRESSURE	1. Excessive load. 2. Expansion valve overfeeding.	1. Reduce load or add additional equipment. 2. Check remote bulb. Regulate superheat.
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 air flow	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 airflow.
COMPRESSOR SPEED CONTROL INTERVALS TOO SHORT	1. Erratic thermostat. 2. Bad contactor. 3. Faulty time delays.	1. Replace. 2. Replace. 3. Replace
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 dip. 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 SWITCH OPEN	1. Operating beyond design conditions.	1. Add facilities so conditions are within allowable limits.

SnyderGeneral
Corporation
13600 Industrial Park Blvd., Minneapolis, MN 55440
401 Randolph Street, Red Bud, IL 62278

INSTALLATION AND OPERATING MANUAL

FOR

BUILDING TT2475

CAMP LEJEUNE

JACKSONVILLE, NORTH CAROLINA

FEDERAL BOILER MODEL FR-PK-220

SERIAL NO. 96-1018-02

FEDERAL BOILER COMPANY

SUBSIDIARY OF THE BETHLEHEM CORPORATION

25TH & LENNOX STREETS

EASTON, PA 17942

TEL: 215-258-7111

FAX: 215-258-8154

FORM H-2 MANUFACTURERS DATA REPORT FOR ALL TYPES OF BOILERS EXCEPT WATERTUBE AND THOSE MADE OF CAST IRON

As Required by the Provisions of the ASME Code Rules S.O. 96-1018-02

1. Manufactured and certified by The Bethlehem Corporation, 25th & Lennox Sts., Easton, Pa. 18042
(name and address of manufacturer)

2. Manufactured for Stock
(name and address of purchaser)

3. Location of installation Unknown
(name and address)

4. Unit identification: complete boiler (complete boiler, superheater, waterwall, economizer, etc.) | 96-1018-02 (mfr's. serial no.) | XX (CRN) | OL160-7 (drawing no.) | 5376 (Nat'l. Bd. no.) | 1988 (year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction and workmanship conform to ASME Code, Section IV, 1986 (year) | A86 (addenda (date)) | XX (Code Case no.)

6. Shells or drums: 1 (no.) | SA-515-70 (mat'l. spec., gr.) | 5/16" (thickness (in.)) | 27 1/2" (dia. (I.D.)) | 59 3/8" (length (overall)) | XX (dia. (I.D.)) | XX (length (overall))

7. Joints: Welded (long. (seamless, welded)) | 60% (eff. (as compared to seamless)) | Welded (girth (seamless, welded)) | One (1) (no. of shell courses)

8. Tubesheet: SA-36 (mat'l. spec., grade) | 5/16" (thickness) Tube holes: Direct 16, Return 16, 2 17/32" (no. & dia.)

9. Tubes: No. (32) SA178-A (mat'l. spec., grade) | Straight (straight or bent) Dia. 2 1/2" O.D. Length 46" & 60 3/4" (if various, give max. & min.) Gauge 0.105" (or thickness)

10. Heads: XX (mat'l. specification no.) | XX (thickness) | XX (flat, dished, ellipsoidal) | XX (radius of dish)

11. Furnace: SA-515-70 (mat'l. spec., gr.) | 5/16" (thickness) | 1 (no.) | 23 1/2"x25 1/2" (size (O.D. or W x H)) | XX (length (each section)) | 42 5/8" (total) | Plain (type (plain, corrugated, etc.)) Seams: Welded (type (seamless, welded))

12. Staybolts: 72 (no.) | 3/4" (size (dia.)) | SA-36 (mat'l. spec, gr.) | various XX (size) | (telltale) | 0.442" (net area) | 7 1/2", 7 11/16" (pitch (hor. and vert.)) | 30 (MAWP (psi))

13. Stays or braces:

Location	Mat'l. Spec.	Type	No. & Size	Pitch	Total Net Area	Fig. HG 343 L/1	Dist. Tubes to Shell	Area to be Stayed	MAWP psi.
(a) F.H. above tubes	None								
(b) R.H. above tubes	None								
(c) F.H. below tubes	None								
(d) R.H. below tubes	SA-36	Straight	12-3/4"	7"	4.85	---	---	9.28	30
(e) Through stays	SA-36	Straight	2-3/4"	9 1/4"	0.884	---	12 7/8"	218	30

14. Other parts 1. Furnace Front 2. Flue Top 3. (2) Side Plates & Int. T.S.
(brief description — i.e. dome, boiler piping, etc.)

1. SA-36, 24" x 26", 5/16", 30 P.S.I.
2. SA-36, 23 1/2" x 43 1/8", 5/16", 30 P.S.I.
3. SA-36, 12 1/4" x 34 1/2", 5/16", 30 P.S.I., SA-36, 21" x 25", 7/16", 30 P.S.I.

(mat'l. spec., grade, size, material thickness, MAWP)

15. Nozzles, inspection and safety valve openings:

Purpose (inlet, outlet, drain, etc.)	No.	Dia. or Size	Type	How Attached	Mat'l	Nom. Thickness	Reinforcement Mat'l.	Location
Handhole up to 3" x 4"	None				NA		NA	
Manhole	None							
Supply	1	4"	Coup.	Welded	SA-105	---	---	Shell
Return	1	3"	Thr'd.	Welded	SA-181	---	---Rear	Tubesheet
Relief Valve	1	1 1/4"	Thr'd.	Welded	SA-181	---	---	Shell
Washouts	6	1 1/2"	Thr'd.	Welded	SA-181	---	---Shell	& Tubeshe

16. Boiler supports: XX (no.) | XX (type (saddles, legs, lugs)) | XX (attachment (bolted or welded))

17. Design pressure: 30 (psi) Based on HG-340 (Code par. and/or formula) Heating surface 120 Sq. Ft. (sq. ft. or kW (total)) Shop hydro. test 60 (psi (complete boiler))

(6/83) FOR 15 P.S.I.G. STEAM OR 30 P.S.I.G. HOT WATER

This form (E00101) may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

18. Remarks: Manufacturers' Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report: _____

(name of part, item number, mfr's. name and identifying stamp)

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this data report are correct and that all details of design, material, construction, and workmanship of this boiler conform to the ASME BOILER AND PRESSURE VESSEL CODE, SECTION IV.

"H" Certificate of Authorization no. 12860 expires 31 January, 19 89

Date Feb. 11, 1988 Name The Bethlehem Corporation Signed John Russell Young

(manufacturer that constructed and certified boiler) (by representative)

CERTIFICATE OF SHOP INSPECTION

Boiler constructed by The Bethlehem Corporation at 25th & Lennox Sts., Easton, Pa. 18042

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the state or province of Pennsylvania and employed by Hartford Steam Boiler Inspection & Insurance Co. of Hartford, Ct. have inspected parts of this boiler referred to as data items 4,5,6,7,8,9,11,12,13,14,15 & 17 and have examined Manufacturers' Partial Data Reports for items NA

and state that, to the best of my knowledge and belief, the manufacturer has constructed this boiler in accordance with the applicable sections of the ASME BOILER AND PRESSURE VESSEL CODE.

By signing this certificate neither the inspector nor his employer makes any warranty, expressed or implied, concerning the boiler described in this Manufacturers' Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 2-12-88 Signed W.B. Gook Commissions NB 4829 PA. 1860

(Authorized Inspector) (Nat'l. Bd. (incl. endorsements) state, prov. and no.)

CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the field assembly construction of all parts of this boiler conforms with the requirements of SECTION IV of the ASME BOILER AND PRESSURE VESSEL CODE.

"H" Certificate of Authorization no. _____ expires _____, 19____.

Date _____ Name _____ Signed _____

(assembler that certified and constructed field assembly) (by representative)

CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the state or province of _____ and employed by _____ of _____ have compared statements in this Manufacturers' Data Report with the described boiler and state that the parts referred to as data items _____, not included in the certificate of shop inspection, have been inspected by me and that to the best of my knowledge and belief the manufacturer and/or the assembler has constructed and assembled this boiler in accordance with the applicable sections of the ASME BOILER AND PRESSURE VESSEL CODE. The described boiler was inspected and subjected to a hydrostatic test of _____ psi.

By signing this certificate neither the inspector nor his employer makes any warranty, expressed or implied, concerning the boiler described in this Manufacturers' Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date _____ Signed _____ Commissions _____

(Authorized Inspector) Nat'l. Bd. (incl. endorsements) state, prov. and no.)

FEDERAL

SERIES FR-PK
PACKAGED STEEL — STEAM OR HOT-WATER BOILERS

(F) —Forced Draft
(N) —Natural Draft
(SBI TABLE 2 BOILERS)

FR-PK (LB)-LESS BURNER

FR-PKG—GAS FIRED

FR-PK2—#2 OIL FIRED

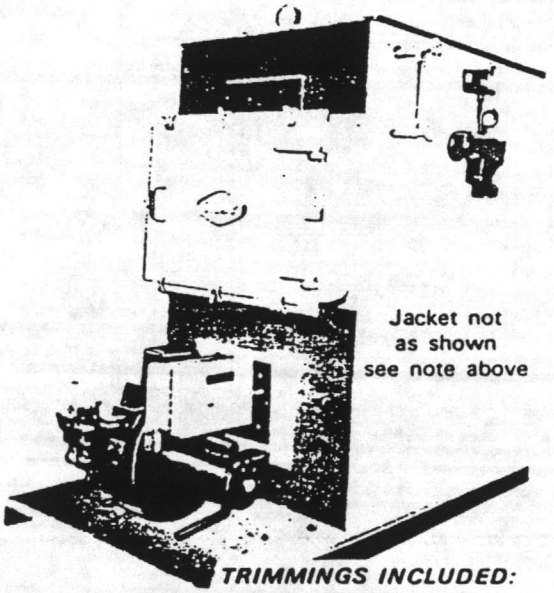
FR-PKG2—GAS/#2 OIL FIRED

FR-PK4—#4 OIL FIRED

FR-PKG4—GAS/#4 OIL FIRED

- **FORCED DRAFT** (F Series) — Eliminates necessity for induced draft or tall stacks.
- **NATURAL DRAFT** (N Series)—Used where chimneys provide adequate draft.
- **SBI TABLE 2 BOILERS** — Heating surface and furnace volume comply with Steel Boiler Institute requirements. ASME constructed and labeled.
- **3 PASS HORIZONTAL TUBULAR DESIGN** — Full water-leg construction.
- **PLATFORM** — Insulated with 3" poured refractory floor insures protection and full insulation in combustion area.
- **MATCHED BOILER-BURNER FIRING** — Eliminates necessity for combustion chamber.
- **TANKLESS COILS** — Precisely positioned to develop maximum heat transfer and fully rated output.

- **FRONT SMOKE BOX** — Seal welded to boiler. Sliding insulated door for easier opening.
- **OBSERVATION PORT** — Spring loaded design relieves pressure in case of puffs. Pyrex sight glass.
- **BURNER PLATE** — Special refractory insulation protects burner and blast tube.
- **JACKET**- Wrap-around Baked-on Enamel finish. High density insulation minimizes stand-by heat loss.



TRIMMINGS INCLUDED:

STEAM: Steam pressure gauge, water gauge glass with gauge cocks, steam pressure control McDonald Miller #767 low water cut off with built in blow off and steam safety valve.

WATER: Combination pressure, temperature and altitude gauge, dual limit control and pressure relief valve.

FEDERAL

the Bethlehem Corporation

FEDERAL BOILER COMPANY, INC., 25th & Lennox Streets • P.O. Box 348, Easton, PA 18044 • (215) 258-7111

FEDERAL SERIES FR PK PACKAGED STEEL — STEAM OR HOT-WATER BOILERS

RATINGS AND SPECIFICATIONS

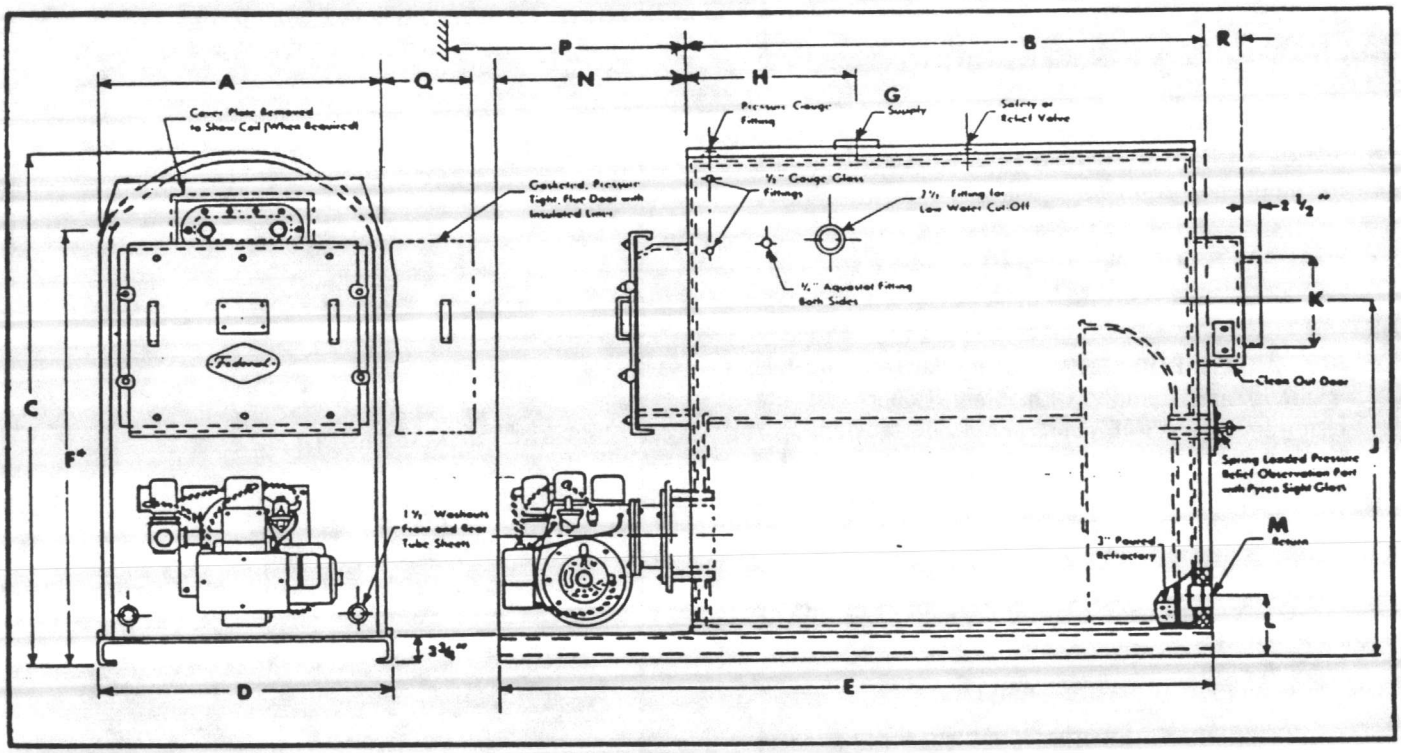
MODEL NUMBER •		FR-PK	150	180	220	260	300	350	400	450	500
SBI RATING	MBh-GROSS	•	540	648	792	936	1080	1260	1440	1620	1800
	MBh-NET WATER	•	470	563	689	814	939	1096	1252	1409	1565
	MBh-NET STEAM		405	486	594	702	810	946	1095	1245	1394
	SQ. FT. STEAM-NET		1690	2020	2480	2930	3380	3940	4560	5190	5810
SBI FIRING RATE	NO. 2 OIL	GPH	5.0	6.0	7.5	9.0	10	12	14	15	17
	NO. 4 OIL	GPH	5.0	6.0	7.0	8.5	9.5	11	13	14	16
	GAS	MBh	675	810	990	1170	1350	1575	1800	2025	2250
SBI HEATING SURFACE	MEASURED ON FIRESIDE	SQ. FT.	82	98	120	142	164	191	219	245	272
	OUTSIDE TUBE SURFACE	SQ. FT.	88	106	129	153	177	206	236	265	294
NATURAL DRAFT UNITS	STD. CHIMNEY DIAM.	IN.	12	12	14	15	16	16	18	18	20
	STD. CHIMNEY HEIGHT	FT.	35	35	35	30	30	35	35	40	40
	N.Y.C. CHIMNEY DIAM.	IN.	12	12	12	14	14	14	16	18	18
	N.Y.C. CHIMNEY HEIGHT	FT.	38	40	41	44	46	48	51	53	56
FORCED DRAFT	MINIMUM VENT DIAM. •	IN.	8	9	9	10	10	12	12	12	12
WATER CONTENT	STEAM BOILER	GALS.	89	107	129	160	180	210	239	257	282
	WATER BOILER	GALS.	122	145	177	199	223	260	296	310	341
APPROXIMATE DRY WEIGHT		LBS.	2700	2900	3100	3300	3700	4100	4500	4900	5200
SAFETY VALVE CAPACITY REQ'D.		LBS. ST./HR.	540	648	792	936	1080	1260	1440	1620	1800

STEAM OR WATER

•20 FT. MAXIMUM STUB STACK HEIGHT ON FORCED DRAFT UNITS

•(F) FORCED DRAFT SERIES

•(N) NATURAL DRAFT SERIES



DIMENSIONS (in inches)

MODEL NUMBER	150	180	220	260	300	350	400	450	500	
A —Width of Boiler (Jacketed)	31	31	31	38¼	38¾	38¾	38¾	46½	46½	A
B —Length of Boiler (Jacketed)	44	52½	63	49⅜	55⅛	63⅜	72¼	61⅜	66¾	B
C —Height of Boiler (Jacketed)	60⅛	60⅛	60⅛	69⅛	69⅛	69⅛	69⅛	77⅛	77⅛	C
D —Width of Base	31½	31½	31½	39¼	39¼	39¼	39¼	47	47	D
E —Length of Base	75¼	84	91	85	90½	99	107½	97	102	E
F —Water Line Height*	49⅝	49⅝	49⅝	58⅜	58⅜	58⅜	58⅜	66⅝	66⅝	F
G —Supply Connection	4	4	4	6	6	6	6	6	6	G
H —Supply Location	21 13/16	21 13/16	21 13/16	24 13/16	24 13/16	24 13/16	24 13/16	24 13/16	24 13/16	H
J —Height—Centerline Rear Horiz. Outlet	40¼	40¼	40¼	47⅛	47⅛	47⅛	47⅛	53½	53½	J
K —Diameter—Rear Horiz. Outlet	12	12	12	14	14	14	14	16	16	K
L —Height—Centerline of Return	7⅞	7⅞	7⅞	8⅛	8⅛	8⅛	8⅛	8⅛	8⅛	L
M—Return Connection	3	3	3	4	4	4	4	4	4	M
N —Base Extension	31¼	31½	28	35⅜	35⅜	35⅛	35¼	35⅜	35¼	N
P —Tube Removal Space	42	50	61	47	53	62	70	60	65	P
Q —Minimum Door Clearance (Right or Left side)	27	27	27	29	29	29	29	36	36	Q
R —Extended Depth Rear Smoke Box	4½	4½	4½	4½	4½	4½	4½	6½	6½	R

*Normal Water Line Without Coil. With Coil Add 1⅜"

Refer to Price Sheet for Burner Descriptions and Optional Equipment

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BOILER ROOM

The boiler room should be well lighted and should have an emergency light source for use in case of power failure. If a flashlight is used for this purpose, it should be maintained in good condition and should be protected against removal from the boiler room.

Proper and convenient water fill connections should be installed and provision should be made to prevent boiler water from back feeding into the service water supply. Provision should also be made in every boiler room for a convenient water supply which can be used to flush out the boiler or to clean the boiler room floor.

Proper and convenient sewer connections should be provided for draining boilers. Unobstructed floor drains, properly located in the boiler room, will facilitate proper cleaning of the boiler room.

The boiler room must have an adequate air supply to permit clean, safe combustion and to minimize soot formation. An unobstructed air opening should be provided. It may be sized on the basis of one square inch per 2000 Btuh maximum fuel input of the combined burners located in the boiler room, or as specified in The National Fire Protection Association, or American Insurance Association standards for oil installations and for gas installations for the particular job conditions. The boiler room air supply opening must be kept clear at all times.

CLEANING AND FILLING A NEW BOILER

Steam Boiler

Before putting water into a new boiler, make certain that the firing equipment is in operating condition to the extent that this is possible without actually lighting a fire in the empty boiler. This is necessary because raw water must be boiled (or heated to at least 180° F) *immediately* after it is introduced into the boiler, in order to drive off the dissolved gases, which might otherwise corrode the boiler.

Fill the boiler to the proper water line and operate the boiler with steam in the entire system for a few days to bring the oil and dirt back from the system to the boiler. This is not necessary if the condensate is to be temporarily wasted to the sewer, in which case the system should be operated until the condensate runs clear.

The oil and greases which accumulate in a new steam boiler can usually be washed out by boiling as follows:

(a) Fill the boiler to the normal waterline.
(b) Remove the safety valve.
(c) Provide a boil-out compound of caustic soda and trisodium phosphate in the proportions of 2½ lbs. of each chemical per 120 gallons of boiler water. *Caution:* Use care in handling these chemicals. The caustic soda is extremely corrosive to skin and clothing. DO NOT PERMIT EITHER THE DRY MATERIAL OR THE CONCENTRATED SOLUTION TO COME INTO CONTACT WITH SKIN OR CLOTHING.
(d) Mix the chemicals with water and pour into the boiler through the safety valve opening.
(e) Replace the safety valve.
(f) Start the firing equipment.
(g) Boil the water for at least 5 hours.
(h) Stop the firing equipment.
(i) Drain the boiler in a manner and to a location that hot water can be discharged with safety.
(j) Wash the boiler thoroughly, using a hose with sufficient pressure.
(k) Fill the boiler to the normal waterline.
(l) Add a charge of boiler water treatment compound.
(m) Boil, or bring water temperature to at least 180° F *immediately*.
(n) The boiler is now ready to be put into service or on stand-by.

In stubborn cases this simple boil-out may not remove all the oil and grease, and another boil-out with surface blow-off may be necessary. For this type of cleaning proceed as follows:

(1) Prepare the boiler for cleaning by running a temporary pipe line from the surface blow-off connection to an open drain or some other location where hot water may be discharged with safety. If no such tapping is available, use the safety valve tapping but run the pipe full size and as short a length as possible. Do not install a valve or any other obstruction in this line.
(2) Fill the boiler until water reaches the top of the water gauge glass.

(3) Add caustic soda and trisodium phosphate in the proportions of 2½ lbs. of each chemical per 120 gallons of boiler water. *Caution:* Use care in handling these chemicals. The caustic soda is extremely corrosive to skin and clothing. DO NOT PERMIT EITHER THE DRY MATERIAL OR THE CONCENTRATED SOLUTION TO COME INTO CONTACT WITH SKIN OR CLOTHING.

(4) Start the firing equipment and operate sufficiently to boil the water without producing steam pressure.

(5) Boil for about five hours.

(6) Open boiler feed valve sufficiently to permit a steady trickle of water to run out the overflow pipe.

(7) Continue this slow boiling and trickle of water for several hours until the water coming from the overflow pipe is clear.

(8) Stop the firing equipment.

(9) Drain the boiler in a manner and to a location that hot water can be discharged with safety.

(10) Remove covers and plugs from all washout openings and wash the water side of the boiler thoroughly, using a hose with sufficient pressure.

(11) Refill boiler to 1″ of water in the water gauge glass.

Note: If water in water gauge glass does not appear to be clear, repeat steps 2 to 11 and boil out the boiler for a longer time.

(12) Remove temporary piping.

(13) Close boiler.

(14) Replace safety valve.

(15) Add a charge of boiler water treatment compound.

(16) Boil, or bring water temperature to at least 180° F *immediately*.

(17) The boiler is now ready to be put into service or on stand-by.

Hot Water Boiler

Before putting water into a new boiler, make certain that the firing equipment is in operating condition to the extent that this is possible without actually lighting a fire in an empty boiler. This is necessary because raw water must be heated to at least 180° F *immediately* after it is introduced into the boiler, in order to drive off the dissolved gases which might otherwise corrode the boiler.

The oil and grease which accumulate in a new hot water boiler can be washed out in the following manner:

(a) Add caustic soda or trisodium phosphate to the boiler water at the rate of 1 lb. of *either* chemical per 50 gallons of total water in the system. *Caution:* Use care in handling these chemicals. The caustic soda is extremely corrosive to skin and clothing. DO NOT PERMIT EITHER THE DRY MATERIAL OR THE CONCENTRATED SOLUTION TO COME INTO CONTACT WITH SKIN OR CLOTHING.

(b) Fill the entire system with water.

(c) Start the firing equipment.

(d) Circulate the water through the entire system.

(e) Vent the system, including the radiation.

(f) Allow boiler water to reach operating temperature if possible.

(g) Continue to circulate the water for a few hours.

(h) Stop the firing equipment.

(i) Drain the system in a manner and to a location that hot water can be discharged with safety.

(j) Wash the water side of the boiler thoroughly, using a hose with sufficient pressure.

(k) Refill the system with fresh water.

(l) Bring water temperature to at least 180° F *immediately*.

(m) Tighten hand holes, manholes and plugs while boiler is hot.

(n) The boiler is now ready to put into service or on stand-by.

Deaeration

It is strongly recommended that the water in a boiler be deaerated and be treated with a suitable boiler water treatment compound whenever the boiler is filled with water. This is applicable whether the boiler is in operation or on stand-by, and is particularly necessary immediately upon refilling the boiler after washing, inspection or repair. (See section on Water Treatment.)

Feeding Water Treatment Compound into the System

A feeder for introducing boiler water treatment compound into a boiler is convenient. The feeder may be made of pipe fittings and placed in the return line.

In a system equipped with a pump-assisted return or with a boiler feed pump, the feeder should be placed in the piping on the discharge side of the pump.

Do not introduce water treatment by placing it in a condensate receiver, hot well, or make-up tank.

Local Water Conditions

Local water conditions may necessitate analysis by a suitable water treatment consultant.

START UP

When initially firing the boiler observe the following:

(a) Never operate a boiler without being sure it is filled with water. This should be obvious but it is repeated here because insurance company records show that many boilers are damaged because a fire was started in an empty boiler.

(b) When starting the firing equipment, follow the firing equipment manufacturer's instructions, which should be posted in the boiler room.

(c) Do not light the pilot light until the combustion chamber has been vented.

(d) Do not turn on the fuel supply at any time unless you know the combustion chamber has been properly vented and unless you know the pilot light is in proper operation.

(e) In case of "flash-back", shut off the fuel supply at once and do not turn it on again until the boiler has been thoroughly vented.

(f) Bring the temperature up slowly.

Following a cold start, condensation may occur in a gas fired boiler to such an extent that it appears that the boiler is leaking. This condensation can be expected to stop after the boiler is hot.

CUTTING-IN

When placing a boiler on the line with other boilers which are already in service, keep its stop valve at the boiler outlet and return stop valve closed until the pressure within the boiler is exactly the same as the pressure in the steam main. See that the line between the stop valve at the boiler outlet and the steam main is drained, then open the stop valve very slightly. If there is no unusual disturbance, such as noise, vibration etc., continue to slowly open the valve to a "full open" position, then open the valve in the return line.

Caution: When the stop valve at the boiler outlet is closed, the stop valve in the return line of that boiler must also be closed.

OPERATION

Steam Boilers

Whenever going on duty, check the water level in all steam boilers at once.

The maximum operating pressure of a steam boiler should be 3 or 4 psi lower than the "set" pressure of the safety valve. This pressure differential is required to permit the valve to close tightly after it has popped under pressure.

Where low pressure steam boilers are used solely for heating and where practically all of the condensate is returned to the boiler, do not "blowdown" the boiler. High pressure boilers and low pressure process boilers should be "blowndown" as required to maintain chemical concentrates at the desired level and to remove precipitated sediments. Boilers which are equipped with a slow opening blowoff valve and a quick opening blowoff cock, should have the lever valve or cock opened first, followed by gradual opening and closing of the slow opening valve. When the slow opening valve has been shut tight, then close the lever valve or cock.

Caution: Do not open the slow opening valve first and pump the lever action valve open and closed, as the water hammer is apt to break the valve bodies or pipe fittings.

If rust appears in the water gauge glass, this is an indication of corrosion that must not be ignored. Check the boiler water to be sure that the water treatment compound is at proper strength and make sure the boiler is not requiring considerable quantities of make-up water. Check the return line and other parts of the system for evidence of corrosion.

A wide fluctuation of water line may indicate that the boiler is foaming or priming. This may be due to the water line being carried too high, or especially in low pressure boilers, a very high rate of steaming. Foaming may also be caused by dirt or oil in the boiler water. Foaming can sometimes be cured by blowing the boiler down, draining two or three inches, then refilling a few times. In persistent cases, it may be necessary to take the boiler out of service, drain and wash out thoroughly as described for a new steam boiler installation and then refill and put back into service.

If the water disappears from the water gauge glass, stop the boiler immediately, and in the case of a coal fired boiler, close the ashpit door and open the fire doors and cover the fire with ash, fresh fine coal or earth. *Do Not* turn on the the water feed line. *Do Not* open safety valve. Let the boiler cool until the crown sheet is at hand touch temperature. Then add water to 1″ in the water gauge glass. *Do Not* put the boiler back into service until you have located and corrected the condition responsible for low water.

Low Water Cutoff, Pump Control and Waterfeeder

Check the operation of the low water cutoff, pump control, and the water feeder if one is installed. Follow the instructions on the tag or plate, attached to each control, to "blowdown" the control regularly as recommended by the manufacturer.

Due to mud accumulations, despite "blowdowns", some manufacturers recommend that the float chamber be opened once a year and cleaned out. It is advisable to test the low water cutoff under actual operating conditions. With the burner operating and the boiler steaming at proper water level, close all the valves in the feedwater and condensate return lines so that the boiler will not receive any replacement water. Then carefully observe the waterline to determine where the cutoff switch stops the burner in relation to the lowest permissible waterline established by the boiler manufacturer.

If the burner cutoff level is not at, or slightly above, the lowest permissible waterline, in a new installation the low water cutoff should be moved to the proper elevation, or in an existing installation should be serviced, repaired, or replaced if necessary.

Hot Water Boilers

Whenever going on duty, check the pressure and temperature in all water boilers.

When the boiler is cold the stationary and movable hands of the combination altitude pressure gauge should be together; when the boiler is hot, the movable hand should be above the stationary hand.

> The stationary hand should be aligned with the movable hand at the time the system is initially filled, or it may be set to indicate the minimum pressure under which the system can operate and still maintain a positive pressure at the highest point in the system.

The maximum operating pressure of a hot water boiler should be 3 or 4 psi lower than the relieving pressure of the relief valve. This pressure differential is required to permit the valve to close tightly after it has opened under pressure.

General

Where water losses from a steam boiler or a hot water boiler become abnormal, as indicated by the requirements of large amounts of make-up water, an investigation should be made immediately to determine the cause. Proper repair or replacement of parts should be made at once rather than to increase the water treatment to protect the system due to excessive raw water make-up. If the operator cannot determine the cause of the water loss, a competent contractor or consulting engineer should be contacted.

When make-up water is needed and the boiler or condensate tank is not equipped with an automatic water feeder, manually add feed water to a steam boiler, preferably when the boiler is not steaming, or to a water boiler when it is not at its maximum operating water temperature.

(a) Use every practical means for excluding oxygen from the boiler water. Oxygen will be brought in with the make-up water; therefore, hold make-up to a minimum. If the boiler loses more than

3″ of water per month, this is an indication of a probable leak in some part of the system. The leak should be discovered and corrected.

(b) If the system includes a pump for returning condensate or adding feed water, be certain that the air vent at the receiver is operating properly.

If large quantities of feed water are required, deaerating equipment is highly desirable to remove dissolved gases, thereby minimizing oxygen corrosion.

MAINTENANCE

General

Clean the boiler tubes and other heating surfaces whenever required. The frequency of the cleaning must be determined by trial. It cannot be predicted. Clean the smoke boxes when required.

Draining and Washing Steam or Water Boilers

A clean, properly maintained, steam heating boiler or hot water system should not be drained unless there is a possibility of freezing, unless the boiler has accumulated a considerable amount of sludge or dirt on the water side, or unless draining is necessary to permit repairs.

Very little sludge should accumulate in a boiler where little make-up water is added and where an appropriate boiler water treatment is maintained at proper strength.

Anti-Freeze Solutions

Anti-Freeze solutions, when used in a heating system, should be tested from year to year as recommended by the manufacturer of the anti-freeze which is used. Anti-freeze solutions must not be circulated through

Water Heaters

Any water heater installed in, or connected to a boiler, should be back-washed periodically, using valves to reverse the direction of flow through the heater. The purpose of this back-washing is to reduce the amount of scale which will accumulate at the outlet side of the heater. Continue the back-washing until the water runs clear. The back-washing may be done frequently and the maximum interval should be determined by trial.

Fireside Corrosion

In this manual some of the causes of water side corrosion have been outlined and procedures recommended which, if followed, may be expected to minimize trouble from this source. Boilers can, however, also corrode on the fireside. This results from corrosive substances in the fuel and it may be difficult to control. Some fuel oils contain substances which cause fireside corrosion. Sulphur, vanadium and sodium are among the materials that may contribute to this problem. Fuel oils in use today are commonly specified according to United States Department of Commerce Commercial Standard CS12-48 and this Standard does not place any quantity limits on sulphur for No. 4 and heavier oils and does not mention vanadium nor sodium.

In the distillation of oils, the vanadium, sodium and much of the sulphur remain in the residuals. Therefore, the probability of this type of corrosion is greater when the fuel oil is a residual (No. 6) or is a No. 4 or No. 5 mixture containing residual.

Deposits of sulphur compounds may cause fireside corrosion. The probability of trouble from this source depends to a large degree on the amount of sulphur in the fuel and on the care used in cleaning the fireside heating surfaces. This is particularly true when preparing a boiler for a period of idleness. Preventing this trouble depends also on keeping the boiler heating surfaces dry when a boiler is out of service.

Deposits of vanadium, or vanadium and sodium compounds also may cause fireside corrosion and these compounds may be corrosive during the season when boilers are in service.

The man responsible for boiler maintenance should be certain that the fireside surfaces of the boilers in his care are thoroughly cleaned at the end of the firing season. He should also observe the fireside surfaces during the firing season and if signs of corrosion are discovered, a reputable consultant should be engaged.

Steam Boilers

If rust appears in the water gauge glass, this is an indication of corrosion that must not be ignored. Check the boiler water to be sure that the treatment is at proper strength and make sure that the boiler is not requiring considerable quantities of make-up water. Check the return line and other parts of the system for evidence of corrosion.

Check the water gauge glass regularly. The required frequency must be determined by trial. The check should be made when there is steam pressure on the boiler. Close the lower gauge glass valve, then open the drain cock which is on the bottom of this valve, and blow the glass clear. Close the drain cock and open the lower gauge glass valve. Water should return to the gauge glass immediately. If water return is sluggish, leave the lower gauge glass valve open and close the upper gauge glass valve. Then open the drain cock and allow water to flow until it runs clear. Then close the drain valve and repeat the first described test, with the lower gauge glass valve closed.

If leaks appear around the water gauge glass or fittings, correct the leaks at once. Steam leaks may result in a false water line reading and may damage the fittings.

In a clean boiler room, safety valves on steam boilers should be checked for proper operation at the beginning of the regular heating season and about every six months. If the presence of chemical fumes or dirt might tend to affect proper operation, the safety valves should be checked about every month. It is preferred that the safety valves be tested by raising the steam pressure until the valve pops. If this is not practical, the valves may be tested by operating the hand lever, but the steam pressure should be as high as practical so that the seat and valve passages will be blown clear of any foreign matter.

Caution: Take necessary precautions to prevent the possibility of scalding the operator, or others, during this test.

(a) If the popping pressure remains constant, no attention is required. If a valve fails to seal tight, blow it at the set pressure. If it still leaks, or if popping pressure is higher than that marked on the valve, replace it. Do not dismantle the safety valve or attempt to adjust it except under supervision of an authorized boiler inspector.

(b) ASME rated safety valves were supplied as part of the original equipment with the boiler. When replacement is necessary, use only ASME rated valves.

Water Boilers

Relief valves on water boilers need to be tested only once a year at the beginning of the heating season, unless the presence of chemical fumes or other injurious materials make more frequent testing necessary.

These valves should be tested by operating the hand lever. Observe valves closely after the test to be sure they are closed tightly and do not drip. Continued dripping may indicate the presence of dirt on the valve seat, and the valve should be reflushed. If dripping continues, the valve should be replaced.

ASME rated relief valves were supplied as a part of the original equipment with the boiler. When replacement is necessary, use only ASME rated valves.

REMOVAL OF BOILER FROM SERVICE

Steam Heating Boiler

When a steam heating boiler is to be taken out of service at the end of the heating season, or for repairs, proceed as follows: While maintaining boiler temperature (from 180°F to 200°F), drain off the boiler water until it runs clear. Then refill to the top of the water gauge glass, and add sufficient water treatment compound to bring the treatment up to strength. When all the gases are dissolved, the firing equipment may be shut down.

High Pressure Boiler

For high pressure units, a different approach is used. At least 15 minutes before going off the line, the proper amount of chemical to protect the boiler during standby should be added. After going off the line, fill the boiler to the top. Shut off the steam valve and seal the boiler when it is cool to prevent any ingress of air into the boiler. Test the boiler water for proper chemical content at least once a month. The company supplying the water treatment compound for the boiler will give the proper chemical treatment for boilers in standby condition.

Water Boiler

For a water boiler, the procedure is to drain from the bottom of the boiler while it is still hot (180°F to 200°F) until the water runs clean, then to refill to the normal water fill pressure. This should be a yearly procedure. If water treatment is used in the system, sufficient treatment compound should be added to condition the added water.

General

When the boiler (any of those referred to above) is cool, clean the tubes and other heating surfaces thoroughly, and scrape the surfaces down to clean metal. Clean the smoke boxes and other areas where soot or scale may accumulate.

Soot is not corrosive when it is perfectly dry, but can be very corrosive when it is damp. For this reason it is necessary to remove all the soot from a boiler at the beginning of the non-operating season, or any extended non-firing period.

Swab the heating surfaces with neutral mineral oil to protect against rust. If the boiler room is damp, place a tray of calcium chloride or slaked lime in the combustion chamber and replace the chemical when it becomes mushy.

Drain a steam boiler back to normal water level before putting the boiler back in service.

Check the boiler occasionally during the idle period and make certain it is not rusting.

This is an opportune time to repaint the exposed metal parts of the boiler and to inspect and service the firing equipment and combustion chamber.

BOILER REPAIRS

Do not permit repairs to the boiler while it is in service, or under pressure, except with the approval and under the supervision of an authorized boiler inspector or responsible engineer.

When repair work is required, notify the representative of the company who insures the boiler and be guided by his instructions.

All repair work should be done by experienced boiler mechanics. Welding should be done by ASME Code Certified Welders.

Take every precaution necessary to insure against injury to men who are working in the boiler room and particularly to those working inside the steam space or in the combustion chamber of the boiler. Pull the main burner switch and lock it out or tag it, swing the burner out of place, if possible, close and lock valves, etc., and always have one man standing by outside when a man is working inside a boiler.

When practical, use a flashlight in preference to an extension light for internal inspection purposes. If an extension cord is taken into a boiler, be certain that the cord is rugged and in good condition and that it is properly grounded.

If one tube in a boiler should develop a leak due to corrosion, it is likely that other tubes are corroded also. Have the boiler examined by a capable and experienced inspector before ordering the replacement of one or a few tubes. If all tubes will need replacement soon, it is preferable and less expensive to have the work done at one time.

When a sealer is used to eliminate system leaks and similar problems, or if the sealer is used in conjunction with other compounds, the system should be completely flushed and drained after the sealers have performed their function. A maximum interval of five days with a sealer in the system is recommended. Sealers have a detrimental effect on boilers, pumps and relief valves and should be flushed out as quickly as possible.

BOILER WATER TREATMENT

Use every practical means for protecting the boiler water against contamination by free oxygen or carbon dioxide gases.

Determine the water containing capacity of your boiler so you can instruct your maintenance crew regarding the required amount of boiler water treatment compound. If this information is not given on the boiler, in the boiler catalog, or other publications, then meter the water at the time of the initial filling and record the information.

Whenever a boiler is refilled with water, boil the water or heat it to at least 180°F *immediately* to drive off the dissolved gases, and add a charge of boiler water treatment compound to control corrosion. If a chromate water treatment compound is used, follow the instructions listed below to determine the amount required. Draw a color comparison sample as described below. Use other boiler water treatment compounds in the amounts specified by the supplier. The material may be introduced through an opening such as the safety valve or manhole opening, or through a feeder if one is available. In high pressure units a reliable water treatment firm should be consulted and their recommendations put into effect.

A chromate boiler water treatment compound is effective for use as a boiler water conditioner in all regular low pressure steam boilers where all, or practically all, of the condensate is returned to the boiler. This material is effective in controlling corrosion and pitting. When maintained at the recommended concentration in a clean boiler, it will prevent or arrest oxygen and CO_2 corrosion. This compound is intended solely for controlling corrosion and is not a cleaner, nor does it control for formation of scale.

The use of chromate boiler water treatment compound in a water boiler involves different considerations. Too high a concentration must be avoided as it may damage pump seals. Therefore, with a lower level of protection, it is necessary to take even greater precautions to keep free oxygen out of the system. Free oxygen can enter from system leaks, faulty vents, or vents improperly located with regard to pumps, and from makeup water.

If a chromate boiler water treatment compound is used, draw a *color test sample* of water into a clear glass bottle. Mark and retain this sample for use in making periodic tests as described below. Draw a new sample whenever a new charge of boiler water treatment compound is added. The sample should be drawn after the compound is completely dissolved and thoroughly mixed in the boiler water, and should be stored in an air tight bottle.

A chromate boiler water treatment compound, consisting of 95% sodium chromate and 5% sodium borate has been tested extensively over a five-year period in the laboratories of a reliable and well known boiler tube manufacturer. These tests have shown that the material, when used and maintained at the concentrations listed below, is effective in controlling or arresting corrosion. These chemicals may be purchased from any reliable chemical company. **Caution:** Chromate is still recognized as one of the best inhibitors for protection of metal, although it is now prohibited by many states or cities for use as water treatment, due to the toxic effect of the chromate when dumped in rivers, streams, and sanitary sewage systems.

a. *Water Treatment for Low Pressure Steam Boilers*

Low pressure steam boilers should be maintained with a chromate concentration of 2 lbs. per 100 gallons of boiler water (2200 PPM). This concentration will be effective where all or practically all of the condensate is returned to the boilers. After boiler and system have been cleaned and refilled as previously described, test the pH of the water in the system as described below. The pH should be higher than 7, but lower than 11. Add some of the washout chemical if necessary, to bring the pH within the specified range. Under service conditions where a considerable amount of make-up is required, the owner should employ a professional water treatment company to provide and supervise the use of the required water treatment.

b. *Water Treatment for High Pressure Boilers*

In high pressure boilers the water treatment should be prescribed by a reputable water treatment company. Water conditions vary from time to time, and from place to place, and in these boilers, to have good service results, the water treatment should be tailored to fit the boiler and the water conditions.

c. *Water Treatment for Low Pressure Water Boilers*

Low pressure water boilers should be maintained with a chromate concentration of 1 lb. per 400 gallons of boiler water (300 PPM). Test the pH of the water in the system. The pH should be higher than 7, but lower than 9. Add some of the washout chemical, if necessary, to bring the pH within the specified range. As previously noted, with this lower level of protection, care must be exercised to eliminate all of the free oxygen in the system.

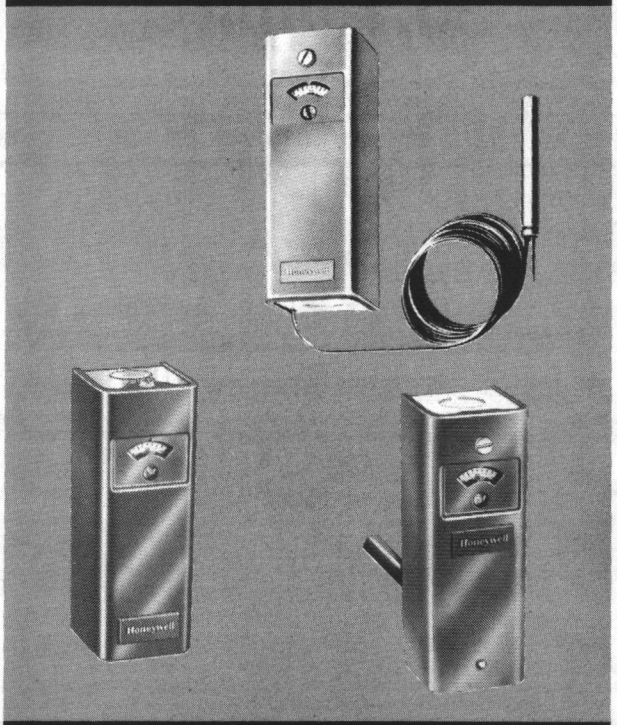
Making a pH or Alkalinity Test — The condition of the boiler water can be quickly tested with hydrion paper which is used in the same manner as litmus paper, except it gives specific readings. A color chart on the side of the small hydrion dispenser gives the reading in pH. Hydrion paper is inexpensive and obtainable from any chemical supply house or through your local druggist.

Honeywell

AQUASTAT CONTROLLERS

AQUASTAT CONTROLLERS ARE IMMERSION TYPE DEVICES FOR LIMITING OR REGULATING THE TEMPERATURE OF LIQUIDS IN BOILERS, STORAGE TANKS, AND OTHER APPLICATIONS WHERE TEMPERATURE CONTROL OF LIQUIDS IS REQUIRED. AS THE TEMPERATURE OF THE CONTROLLED MEDIUM RISES TO THE SET POINT, EXPANSION OF THE FLUID IN THE SENSING ELEMENT OPERATES THE INTERNAL SWITCH OR SWITCHES.

- The L4006,7, and 8 provide spst switching for high or low limit control of a burner.
- The L4006G model has two spst switches that make and break in sequence to provide boiler sequencing.
- The L6006 and 8 provide spdt switching for low limit and circulator control.
- The L6006C model is designed for surface mounting on pipe or tank.
- Models which break contact on a temperature rise to the set point are calibrated for high limit use. They are also suitable for low limit control if a separate high limit control is used.
- Ambient-compensated models are available to prevent control-point shift caused by temperature fluctuation at the case.
- Visible control point scale and external adjustment screw permit easy setting.
- Models are available for either horizontal or vertical insertion of the sensing element. The sensing element may be directly immersed or placed in an immersion well.
- Remote bulb models are available if the controller must be mounted at a location away from the sensing element.
- Remote bulb models may also be used to sense air temperature in ducts and in outside air sensing applications.
- Totally enclosed Micro Switch snap-acting switches are used in all models.



L4006,7,8; L6006,8

Form Number 60-2104—2

R.E.
REV. 6-79 (.19)

SPECIFICATIONS

IMPORTANT

THE SPECIFICATIONS GIVEN IN THIS PUBLICATION DO NOT INCLUDE NORMAL MANUFACTURING TOLERANCES. THEREFORE, THIS UNIT MAY NOT MATCH THE LISTED SPECIFICATIONS EXACTLY. ALSO, THIS PRODUCT IS TESTED AND CALIBRATED UNDER CLOSELY CONTROLLED CONDITIONS, AND SOME MINOR DIFFERENCES IN PERFORMANCE CAN BE EXPECTED IF THOSE CONDITIONS ARE CHANGED.

TRADELINE MODELS

TRADELINE models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. TRADELINE model specifications are the same as those of standard models except as noted below.

TRADELINE MODELS AVAILABLE:

L6006A Aquastat Controller.

- Includes well adapter and tube of heat-conductive compound.
- Horizontal or vertical mount available on same model.

L6006C Aquastat Controller.

- Designed for surface mounting in any position.

SPST MODELS:

MODEL	APPLICATION	RANGE F [C]	MIDSCALE DIFFERENTIAL F [C]	INSERTION[a]	SWITCHING ON TEMP. RISE	AVAILABLE OPTIONS
L4006A	high or low limit	[4 to 82] 40 to 180 100 to 240 [38 to 116]	2 or 5 fixed [1.1 or 2.8] or 5 to 30 adj. [2.8 to 17]	horizontal	breaks	TRADELINE models which include well and tube of heat-conductive compound. Plastic shield for covering well in water heater applications. 3/4 in. NPT brass spud. Celsius scale markings. Factory-set stops at 160 F, 185 F, 190 F, 200 F, or 220 F [71, 85, 88, 93 or 104 C]. Dial marked WARM, NORMAL, HOT. Insulation depths of 1-1/2, 3, or 5 inches [38.1, 66.2, or 127 mm].

[a] Copper well or fitting is supplied with all models except remote bulb type. When ordering, specify boiler tapping size (1/2 or 3/4 inch) and insulation depth.

[b] Manual reset (trip-free)—Switch breaks circuit and locks out when controlled medium reaches set point. Controlled temperature must drop 20 degrees F [6.6 degrees C] below set point before contacts can be manually reset.

(L4006 models continued on page 3)

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—

1. **Order number.**
2. **Operating range.**
3. **Differential; adjustable, nonadjustable, or manual reset.**
4. **Capillary length.**
5. **Boiler tapping and insulation depth.**
6. **Accessories.**

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. **YOUR LOCAL HONEYWELL RESIDENTIAL DIVISION SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).**
2. **RESIDENTIAL DIVISION CUSTOMER SERVICE**
   HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH
   MINNEAPOLIS, MINNESOTA 55422 (612) 542-7500

(IN CANADA—HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9)
INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

(SPST MODELS continued)

MODEL	APPLICATION	RANGE F [C]	MIDSCALE DIFFERENTIAL F [C]	INSERTION[a]	SWITCHING ON TEMP. RISE	AVAILABLE OPTIONS
L4006B	circulator	40 to 180 [4 to 82] or 100 to 240 [38 to 116]	5 [2.8] fixed or 5 to 30 [2.8 to 17] adj.	horizontal	makes	3 inch [76.2 mm] insulation depth. 3/4 inch NPT brass spud.
L4006C	high or low limit	100 to 240 [38 to 116]	2 or 5 [1.1 or 2.8] fixed	horizontal direct	breaks	10 in. [254 mm] element. Factory–set stop at 205 F [96 C].
L4006E[b]	high limit	110 to 250 [43 to 121]	manual reset	horizontal or vertical	breaks	3/4 in. NPT brass spud. 3 in. [76.2 mm] insulation depth.
L4006G	sequencing	100 to 240 [38 to 116]	5 [2.8] fixed interstage 3-10 F [1.7 to 5.6] adj.	horizontal or vertical	breaks two switches	
L4007A	high or low limit	100 to 240 [38 to 116]	2 or 5 [1.1 or 2.8] fixed, 5 to 30 [2.8 to 17] adj.	vertical	breaks	Celsius scale markings.
L4007B	circulator	100 to 240 [38 to 116]	5 [2.8] fixed or 5 to 30 [2.8 to 17] adj.	vertical	makes	
L4008A[a]	high or low limit	40 to 180 [4 to 82] or 100 to 240 [38 to 116]	2 [1.1] or 5 [2.8] fixed, 5 to 30 [2.8 to 17] adj.	remote bulb	breaks	5 ft. 6 in., 8 ft. 6 in. or 10 ft. [1.7, 2.6, or 3.0 m] remote capillary. Factory-set scale stop at 120 or 200 F [49 or 93 C]. External adjusting knob. Celsius scale markings.
L4008B[a]	circulator	100 to 240 [38 to 116]	5 [2.8] fixed or 5 to 30 [2.8 to 17] adj.	remote bulb	makes	8 ft. 6 in. [2.6 m] capillary.
L4008C[a]	ambient-compensated high limit	0 to 70 [-18 to 21] or 40 to 180 [4 to 82]	2 or 5 [1.1 or 2.8] fixed	remote bulb	breaks	7 ft. 6 in., 20 ft. [2.3, 6.1 m] capillary or fast response element. External adj. knob. 150 VA rating at 120, 240V ac. High limit stamped on case scale lock.
L4008D[a]	ambient-compensated circulator	0 to 70 [-18 to 21] or 40 to 180 [4 to 82]	2 or 5 [1.1 or 2.8] fixed	remote bulb	makes	TRADELINE model available. Celsius scale markings. Hot tinned 8 ft. [2.4 m] capillary. Electrical Rating: 2.3 amp at 120-240V ac, full load. Fast response, 10 ft. [3.0 m] armored capillary with 3 ft. [914.4 mm] bulb. External adjustment knob. Factory-set scale stops at 120, 220, or 250 F [49, 104 or 121 C]. Plastic shield for covering well in water heater applications.
L4008E[ab]	high limit	40 to 80 [4 to 82] or 110 to 290 [43 to 144]	manual reset	remote bulb	breaks	Factory-set scale stop at 250 F [121 C]. 8 ft. 6 in. [2.6 m] capillary.

(L4008 models continued on page 4)

(SPST MODELS continued)

MODEL	APPLICATION	RANGE F [C]	MIDSCALE DIFFERENTIAL F [C]	INSERTION[a]	SWITCHING ON TEMP. RISE	AVAILABLE OPTIONS
L4008J[a]	high limit	100 to 240 [38 to 116]	5 [2.8] fixed	remote bulb	breaks	All models less case and cover. 18 in. [457.2 mm] capillary and 1/2 in. [12.7 mm] well assy. Factory-set scale stop at 220 F [104 C].
L4008K[a]	circulator	40 to 180 [4 to 82]	5 [2.8] fixed	remote bulb	makes	All models less cover.

SPDT MODELS:

MODEL	APPLICATION	RANGE F [C]	MIDSCALE F [C] DIFFERENTIAL	INSERTION[a]	AVAILABLE OPTIONS
L6006A[a]	circulator and low limit or high limit	100 to 240 [38 to 116] or 110 to 290 [43 to 144]	5 [2.8] fixed or 5 to 30 [2.8 or 17] adj.	horizontal	TRADELINE model which includes well adapter and tube of heat-conductive compound. 3/4 in. NPT brass spud. 3 in. [76.2 mm] insulation depth. Horizontal or vertical mount available on same models.
L6006B	circulator and low limit or high limit	100 to 240 [38 to 116]	5 [2.8] fixed or 5 to 30 [2.8 or 17] adj.	horizontal	3/4 in. brass bulb compression fitting.
L6006C	circulator, low limit, and high limit	65 to 200 [18 to 93]	5 [2.8] fixed	horizontal or vertical surface mounted	
L6008A[a]	circulator and low limit cooling	100 to 240 [38 to 116] -30 to 70 [-35 to 21]	5 [2.8] fixed or 5 or 30 [2.8 or 17] adj.	remote bulb	TRADELINE model with 5 ft. [1.5 m] capillary. Range of -30 to 70 F [-35 to 21 C]. Celsius scale markings. Without cover.
L6008C[a]	dual fuel changeover	0 to 70 [-18 to 21] 40 to 180 [4 to 82]	2 or 5 [1.1 or 2.8] fixed	remote bulb; may be duct mounted	TRADELINE model. 150 VA switch rating. Celsius scale markings. 7 ft. 6 in. [2.3 m] armored capillary. External adjustment knob. Lock type cover. 20 ft. [6.1 m] element. Averaging element.
L6008E[a]	ambient compensated	40 to 180 [4 to 82]	5 [2.8] fixed	remote bulb	All models less enclosure. Front mounted.

[a]Copper well or fitting is supplied with all models except remote bulb type. When ordering, specify boiler tapping size (1/2 or 3/4 inch) and insulation depth.

[b]Manual reset (trip-free)—Switch breaks circuit and locks out when controlled medium reaches set point. Controlled temperature must drop 20 degrees F [6.6 degrees C] below set point before contacts can be manually reset.

NOTE: The following specifications are standard. Variances, available as options, are noted in the preceding table.

ELECTRICAL RATING (AMPERES):

Models with 2 F [1.1 C] fixed differential—

	120V ac	240V ac
Full Load	2.6	1.3
Locked Rotor	15.6	7.8

Models with 5 F [2.8 C] differential—

	120V ac	240V ac
Full Load	8	5.1
Locked Rotor	48	30.6
Inductive Current	.25 at 1/4 to 12V dc	

PRESSURE RATING:

Capillary bulb (direct immersion)—200 psi [1378.9 kPa].

Immersion well—255 psi [1758.2 kPa].

SENSING BULB MATERIAL: Copper.

SENSING BULB FULL: Liquid. Toluene or Silicone.

CAPILLARY LENGTH (including bulb): Remote bulb models–60 inches [1524 mm].

SENSING BULB DIMENSIONS: 2-7/8 inches [73.2 mm] long, 3/8 inch [9.6 mm] diameter.

INSERTION DEPTH: 3-3/8 inches [85.8 mm].

INSULATION: Brass. 1-1/2 or 3 inches [38.1 or 76.2 mm]. Specify when ordering.

PROVISION FOR WIRING: Screw terminals.

MOUNTING: Horizontal and vertical models mount directly to an immersion well installed in a boiler fitting. L6006C contains bracket and clamp for surface mounting on pipe or tank. Remote bulb models have 3 mounting holes in rear of case for screw mounting to a vertical surface.

FINISH: Gray.

INSTALLATION DIMENSIONS: See Figs. 1, 2, and 3.

IMMERSION WELL DIMENSIONS: See Fig. 4.

BOILER FITTING AND BULB DIMENSIONS: See Fig. 5.

ACCESSORIES:

Weatherproof enclosure–Q615.

Immersion wells–

Copper, 1/2 NPT, 1-1/2 inch [38.1 mm] insulation–Part No. 121371A.

Copper, 1/2 NPT, 3 inch [76.2 mm] insulation–Part No. 121371L.

Copper, 3/4 NPT, 1-1/2 inch [38.1 mm] insulation–Part No. 121371B.

Copper, 3/4 NPT, 3 inch [76.2 mm] insulation–Part No. 121371M.

Copper, 3/4 NPT, 1-1/2 inch [38.1 mm] insulation, plastic sleeve–Part No. 12131K.

Copper, 3/4 NPT, 3 inch [76.2 mm] insulation, plastic sleeve–Part No. 121371N.

Stainless steel, 1/2 NPT, 1-1/2 inch [38.1 mm] insulation–Part No. 121371E.

Stainless steel, 3/4 NPT, 1-1/2 inch [38.1 mm] insulation–Part No. 121371F.

Bulb Compression Fittings (see Fig. 7)–

Brass, 1/2 NPT plug. 1-1/2 inch [38.1 mm] insulation–Part No. 104486B.

Brass, 3/4 NPT plug. 1-1/2 inch [38.1 mm] insulation–Part No. 104486C.

Capillary Compression Fittings (see Fig. 8)–

Copper, 1/2 NPT plug. 1-1/2 inch [38.1 mm] insulation–Part No. 104484C.

Copper, 3/4 NPT plug. 1-1/2 inch [38.1 mm] insulation–Part No. 104484B.

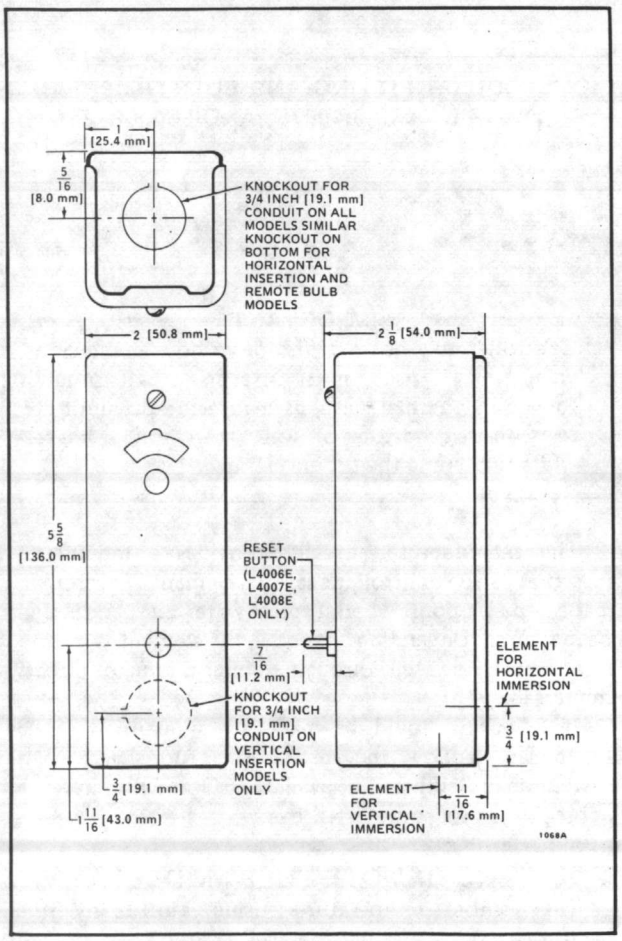


FIG. 1–CASE INSTALLATION DIMENSIONS FOR DIRECT INSERTION MODELS.

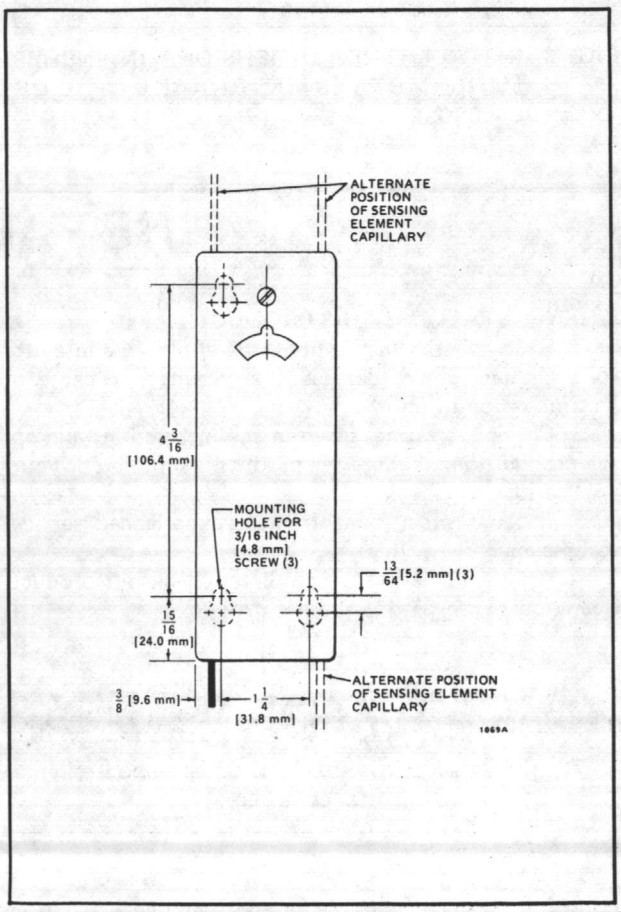


FIG. 2–INSTALLATION DIMENSIONS FOR REMOTE BULB MODELS. OTHER DIMENSIONS SAME AS FIG. 1.

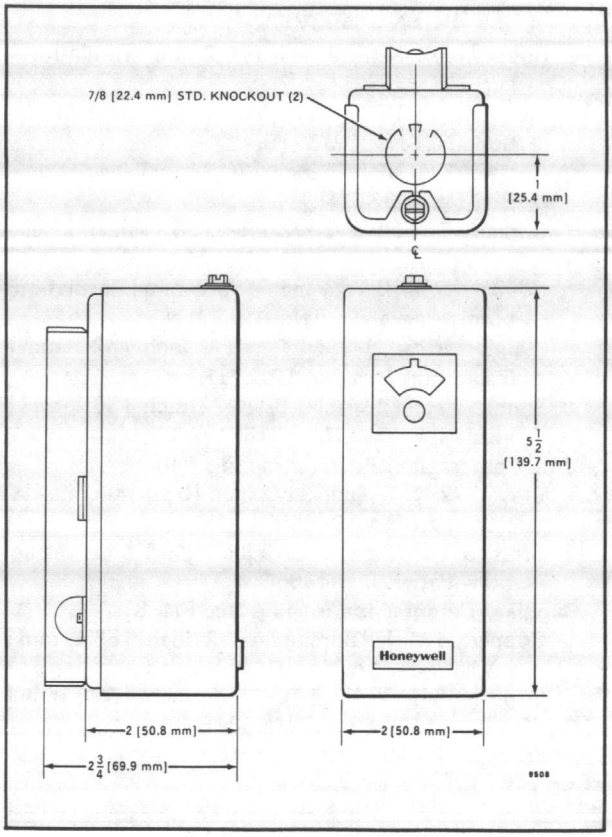


FIG. 3–INSTALLATION DIMENSIONS IN INCHES [MILLIMETRES IN BRACKETS] FOR L6006C.

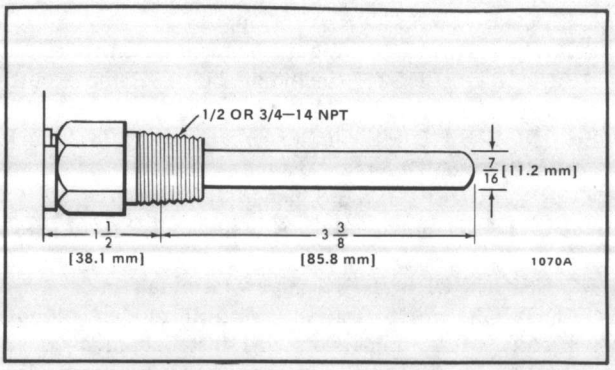


FIG. 4–IMMERSION WELL DIMENSIONS FOR ALL MODELS EXCEPT L4006C, L4007D, AND L6006B.

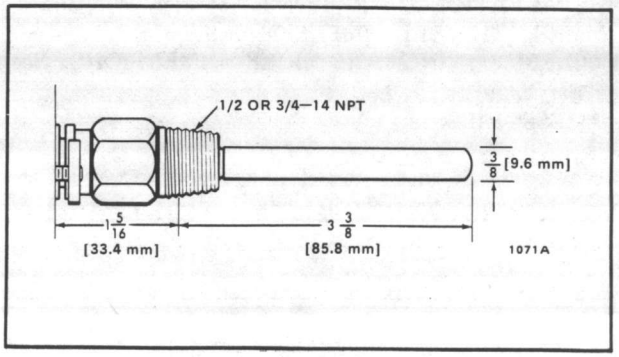


FIG. 5–BOILER FITTING AND BULB DIMENSIONS FOR L4006C, L4007D, AND L6006B.

INSTALLATION

WHEN INSTALLING THIS PRODUCT . . .

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

CAUTION

Do not replace immersion-type Aquastat controller with strap-on Aquastat controller.

Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.

Do not secure draw nut so tightly that retainer clamp could collapse tubing.

IMPORTANT

Controller may be used with or without immersion well. Well, if used, must fit sensing bulb snugly for good thermal response. Insert bulb until it rests against bottom of well, then hold it there while tightening the tubing clamp.

The manufacturer usually provides a tapping for insertion of the controller's sensing element. This tapping is located at a point where typical water temperature can be measured. Depending on model, the element is inserted in an immersion well, through a boiler fitting, or directly immersed.

Installation should be made by a qualified service technician. Follow the instructions furnished by the system manufacturer, if available. Otherwise, refer to appropriate procedure listed below.

MOUNTING REMOTE BULB MODELS

The remote temperature-sensing bulb can either be installed in an immersion well (Fig. 6) that extends into the boiler or tank, or it can be directly immersed in the liquid. For installations not using a well, secure

the remote bulb with a bulb compression fitting (Fig. 7), or capillary compression fitting (Fig. 8).

Well, bulb compression fitting or capillary compression fitting must be ordered separately. Sizes available: 1/2 in., 3/4 in. NPT spud. Well, if used, must fit sensing bulb snugly for good thermal response. Insert bulb until it rests against bottom of well, then hold it there while tightening the tubing clamp (Fig. 6).

The boiler manufacturer generally provides a tapping for the insertion of the Aquastat controller's sensing element. This tapping should be located at a point where typical water temperature can be measured. The bulb or protecting immersion well must never be located close to a hot or cold water inlet or a steam coil.

If the system is filled, drain system to a point below the boiler tapping, or wherever the sensing bulb is to be installed.

The bulb can also be installed in the supply line of an indirect water heater, in the direct water heater itself, or in the feed riser, about 6 in. [152.4 mm] above the boiler. If the riser is valved, the bulb can be installed between the boiler and the valve.

NOTE: Avoid making sharp bends or kinks in the capillary. Bends should be no sharper than 1 inch [25.4 mm] radius.

After installing, carefully coil excess capillary at the bottom of the controller case.

IMMERSION WELL MOUNTING

1. Screw the well into the boiler, tank, or pipe tapping.
2. Insert bulb in well, pushing tubing until bulb bottoms in well.
3. Attach retainer clamp to end of well spud. Loosen draw nut and spread jaws of clamp with screwdriver if necessary.
4. With retainer clamp attached to well spud (be sure jaws of clamp hook over ridge at end of spud, as shown at points "A"), adjust tubing to fit through retainer clamp groove, as shown at point "B."
5. Tighten draw nut so that retainer clamp is firmly attached to well spud and tubing is held securely in place.

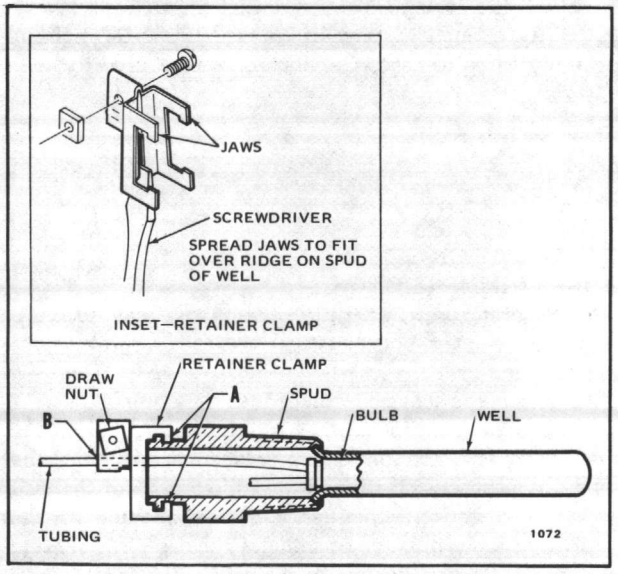


FIG. 6—IMMERSION WELL FITTING.

MOUNTING WITH BULB COMPRESSION FITTING

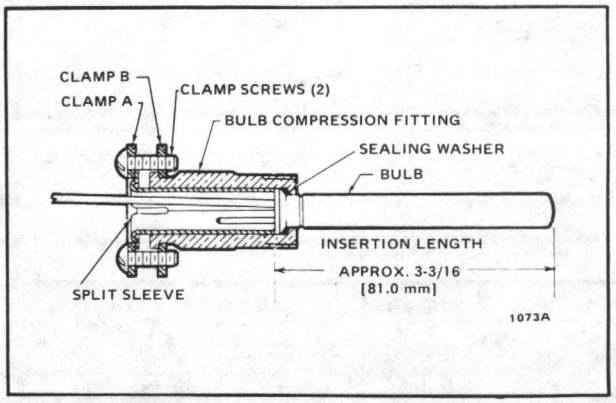


FIG. 7—BULB COMPRESSION FITTING. USE WITH MODEL L4008A,B,E,J, OR L6008A.

1. Screw the fitting into boiler or pipe tapping.
2. Slide sealing washer onto bulb.
3. Insert bulb into boiler fitting until bulb bottoms.
4. Slide split sleeve into fitting.
5. Place clamps A and B on assembly so that sleeve is drawn into fitting when screws are tightened. NOTE: Make sure that nub on clamp A engages space between sleeve and clamp.
6. Tighten clamp screws evenly.

MOUNTING WITH CAPILLARY COMPRESSION FITTING

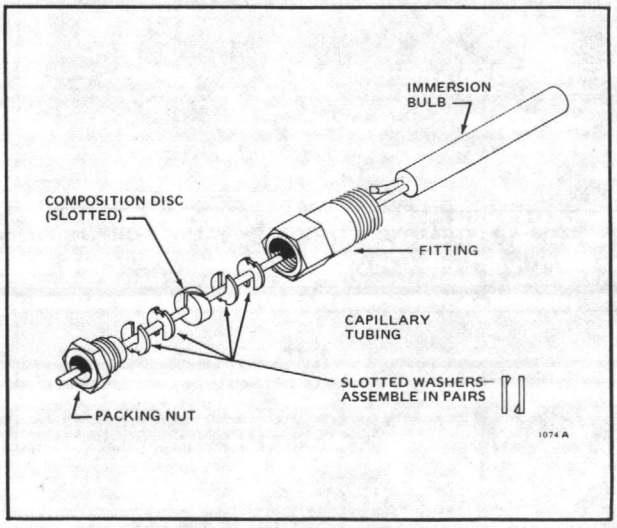


FIG. 8—CAPILLARY COMPRESSION FITTING. USE WITH MODEL L4008C,D,K, OR L6008C,E.

1. Screw fitting into boiler or pipe tapping.
2. Place packing nut on tubing.
3. Slide bulb completely through fitting.
4. Place composition disc and 4 slotted brass washers on tubing in the order shown in Fig. 8. *Turn brass washers so that slots are 180 degrees apart.*
5. Slide seal assembly into fitting and tighten packing nut.

DUCT MOUNTING

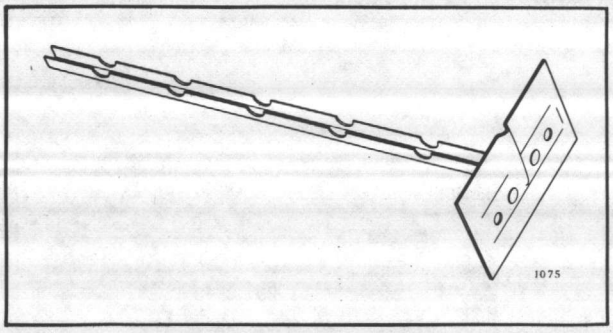


FIG. 9–BULB SUPPORT.

1. Drill a 3/4 inch [19.1 mm] hole in the duct wall large enough to admit the sensing bulb into the holder.
2. Using the holder as a template, mark and drill holes for bulb holder mounting screws.
3. Break holder to desired length (Fig. 10).

NOTE: Holder must be long enough to hold sensing bulb in freely circulating air away from duct wall. Neatly coil excess capillary at controller case or at bulb holder.

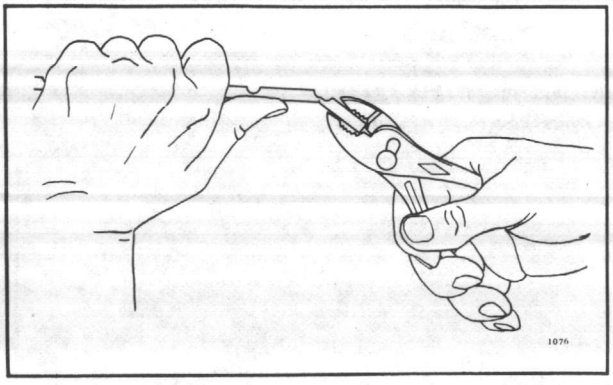


FIG. 10–REMOVING EXCESS BULB SUPPORT.

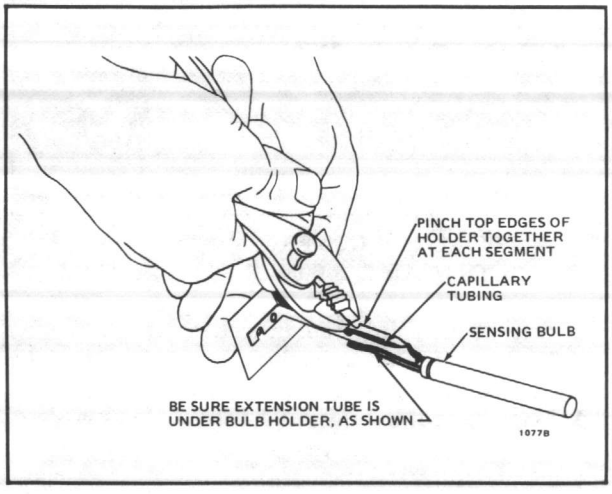


FIG. 11–SECURING CAPILLARY IN BULB HOLDER.

4. Place capillary in bulb holder channel. Pinch top edges of holder together at each segment (Fig. 11).
5. Insert bulb holder into controlled area through hole prepared in step 1.
6. Fasten bulb holder to duct wall with screws furnished.

MOUNTING DIRECT IMMERSION MODELS

FOR MODELS USING AN IMMERSION WELL

The well of the Aquastat controller must always be exposed to circulation of the medium under control, but must never be located close to a hot or cold inlet or steam coil. Where the tapping is on the *side* of the boiler, use an Aquastat controller with horizontal well. Where the tapping is on *top* of the boiler, use a model with a vertical well.

INSTALLING THE IMMERSION WELL

On existing installations, shut off the power and remove the old control. If the old immersion well appears suitable, and if the adapter clamp on the Aquastat controller fits the old well spud, the well need not be replaced.

1. If the system is filled, drain system to a point below the boiler tapping.
2. Remove plug (or old well) from boiler tapping.
3. Install the 121371 Immersion Well included with the controller. If boiler tapping is greater than 1/2 inch [12.7 mm], a reduction fitting must be used to adapt the boiler opening to the 1/2 inch [12.7 mm] threads that are standard with the well or fitting. Fittings with 3/4 inch [19.1 mm] threads are also available.
4. Fill the system. Make sure that the well is screwed in tightly enough to prevent leakage. Do NOT tighten or apply force to case after controller is secured to well.

INSTALLATION OF SENSING BULB IN IMMERSION WELL

1. Loosen screw (at top of case, above scale-setting), and remove cover. Loosen two screws that secure adapter clamp. See Fig. 12.
2. Insert the sensing element into the immersion well.
3. Fasten the case of the Aquastat controller to the well with the adapter clamp. Make certain that the clamp is properly positioned over the groove of the well spud. Also be sure the flange at the opening of the well fits snugly into the opening of the case. The sensing element bulb must bottom in the well.

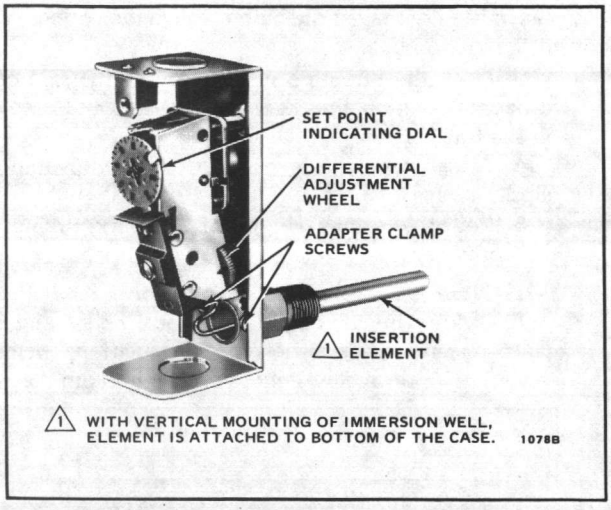


FIG. 12–INTERNAL VIEW OF L6006A.

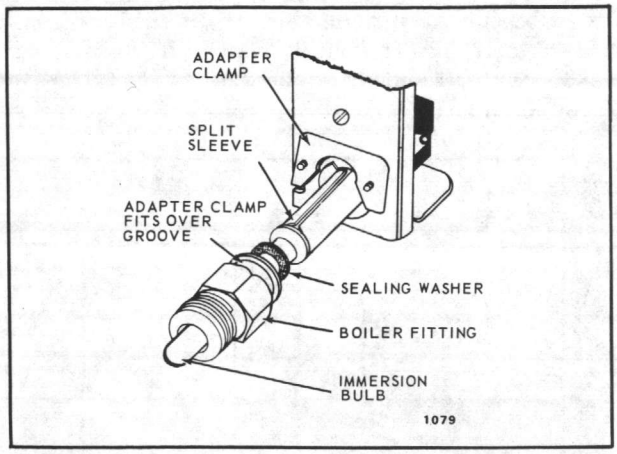


FIG. 13–DIRECT IMMERSION MODEL WITH BULB COMPRESSION FITTING PARTIALLY REMOVED.

MODELS DESIGNED FOR DIRECT IMMERSION (WITHOUT WELL)

Some models, which provide direct immersion of the sensing element into the boiler, include a 104486 Bulb Compression Fitting Assembly instead of an immersion well. Install fitting in boiler tapping. Be sure sealing washer is in place as shown in Fig. 13. Make sure that spud of bulb compression fitting is screwed in tightly enough to prevent leaking. Insert immersion bulb (sensing element) through bulb compression fitting. Adjust the adapter clamp so that it fits over the groove at the opening of the bulb compression fitting. Tighten adapter clamp screws so that Aquastat controller is firmly attached to bulb compression fitting.

MOUNTING DUAL FUEL CHANGEOVER MODELS

These models have a 5 foot [1.5 m] capillary. This capillary establishes the maximum distance between the case and the outdoor mounting.

The bulb should be installed on the outside of the building in the shield provided (Fig. 14) where it will be exposed to representative air temperature, but not to direct sunlight. It should be mounted high enough so that accumulated snow, leaves, or other debris cannot obstruct circulation of air around it, and where children cannot reach it. Avoid vents from the building.

Install the case at the indoor location selected, fastening with screws through holes in back of the case. Bring the bulb and tubing out through a 3/4 inch [19.1 mm] hole in the outside wall. In uncoiling the tubing, carefully avoid sharp bends or kinks. Excess tubing should be left coiled near the case. Do not make sharp bends near the case or bulb.

Slip the bulb through the supports in the shield. Pinch the split supporting clip until it holds the bulb firmly in position. If the seal-off tube protrudes from under the shield, it may be bent under as shown in Fig. 14.

Hold the shield over the mounting position and form a small-radius bend in the tubing. Place the split plug around the tubing and move the shield into mounting location as a unit. Push the split plug into the hole until it is wedged securely in place. Fasten the shield in place on the wall with the screws provided.

NOTE: If the tubing is properly shaped and the split plug installed as directed, the shield will cover the split plug, and the hole in the wall will be hidden from sight.

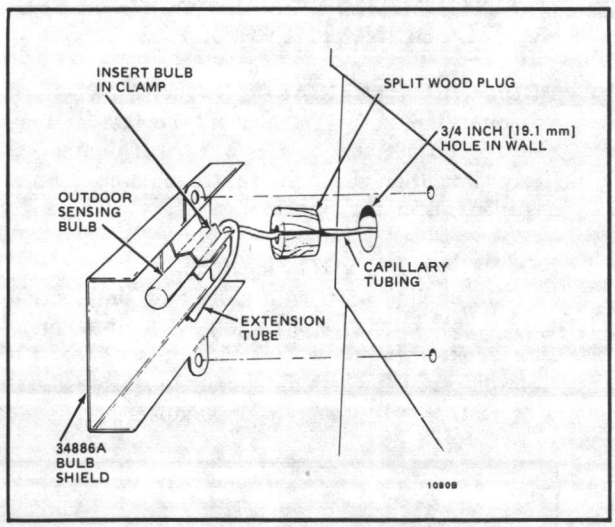


FIG. 14–MOUNTING BULB IN SHIELD OUTSIDE BUILDING.

MOUNTING THE L6006C

The L6006C is designed for surface mounting on piping or tanks. Mount the L6006C directly on tank surface using the adjustable mounting bracket as shown in Fig. 15. The control can be mounted in any position. (If mounting L6006C on pipe, see NOTE below). Turn on power.

NOTE: When mounting the L6006C on piping, the pipe should be 1 inch [25.4 mm] diameter or larger for

accurate temperature sensing. Remove any insulation from pipe. Thoroughly scrape off all scale, rust, or paint. Mount controller using adjustable bracket furnished.

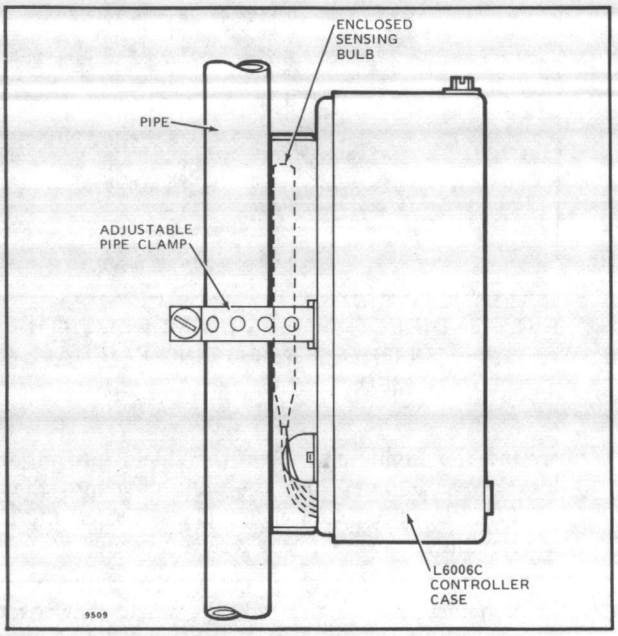


FIG. 15–MOUNTING L6006C DIRECTLY ON SURFACE.

MOUNTING THE L6008A REMOTE BULB COOLING THERMOSTAT

MOUNTING WITH GUARD BRACKET

Mount the bulb in the guard bracket as shown in Fig. 16. Locate the bulb and bracket combination in freely circulating air in the controlled area. With screws provided, fasten the bracket in place.

MOUNTING ON SUCTION LINE

1. In cooling units with more than one suction line, sensing bulb should be placed on the common line.

2. Make certain the bulb is at least 2 feet [0.6 m] from the point at which the suction line leaves the cooler. This will prevent the outside temperature from being transmitted to the remote bulb through the copper tubing of the suction line.

3. Place the remote sensing bulb on the side of the horizontal suction line between the coil and trap (not on the trap).

4. Attach the sensing bulb to the suction line with clips or straps.

5. Coil the excess length of capillary tubing near the L6008A case.

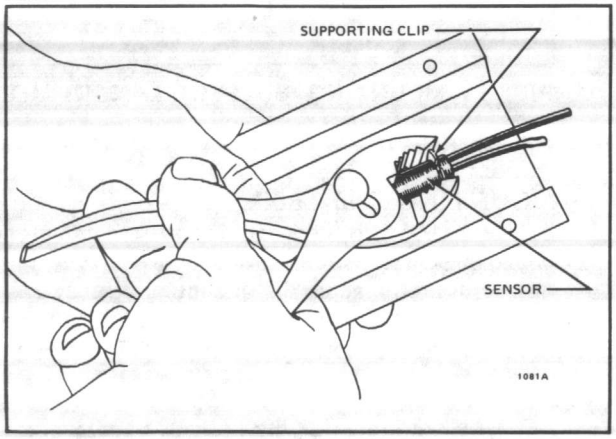


FIG. 16–SECURING REMOTE BULB IN CLIP.

WIRING

All wiring must comply with local codes and ordinances regarding wire size, type of insulation, enclosure, etc. Figs. 17 through 24 show typical hookup diagrams.

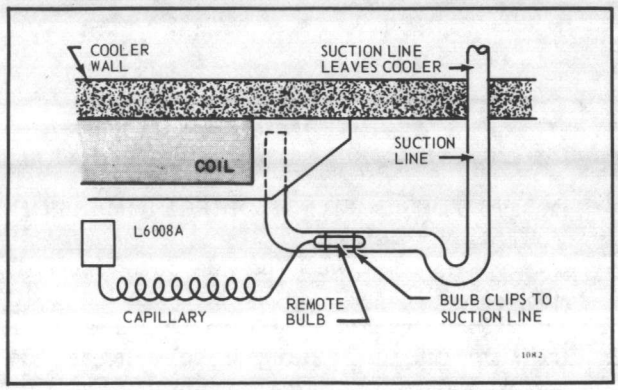


FIG. 17–ATTACHING REMOTE BULB TO HORIZONTAL SUCTION LINE.

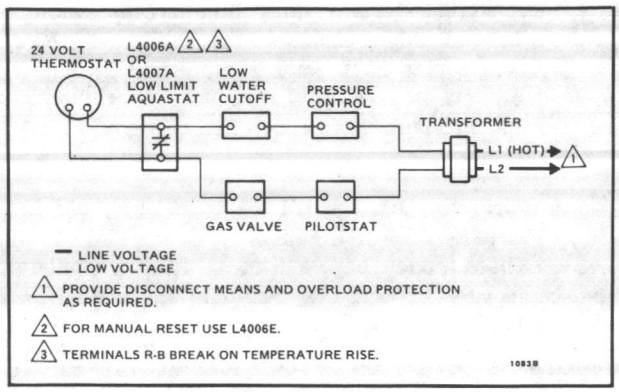


FIG. 18–TYPICAL GAS-FIRED SYSTEM WITH DOMESTIC HOT WATER.

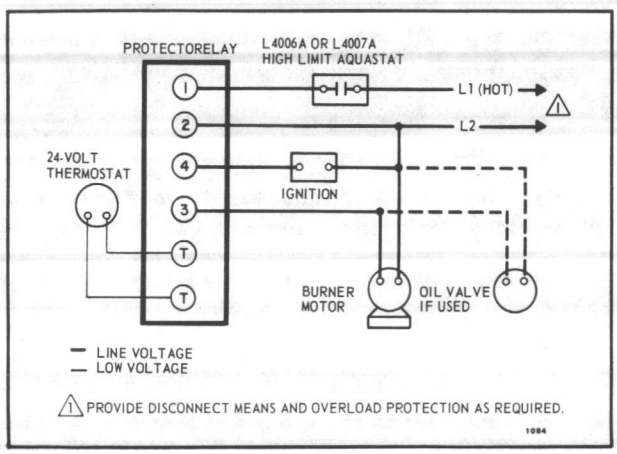


FIG. 19–TYPICAL OIL-FIRED GRAVITY SYSTEM.

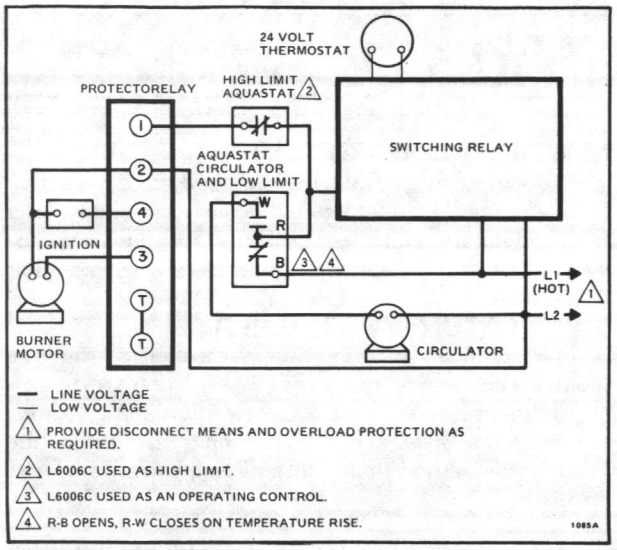


FIG. 20–TYPICAL OIL-FIRED HYDRONIC SYSTEM WITH DOMESTIC HOT WATER.

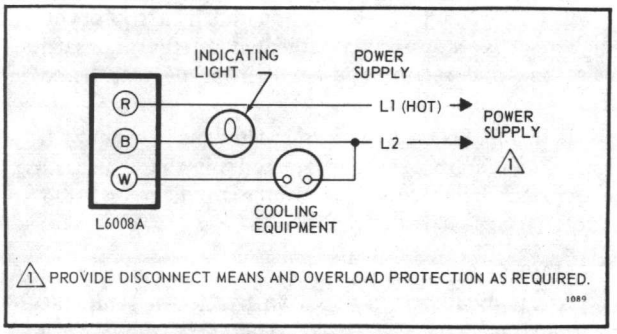


FIG. 21–L6008A USED TO CONTROL COOLING EQUIPMENT AND INDICATING LIGHT.

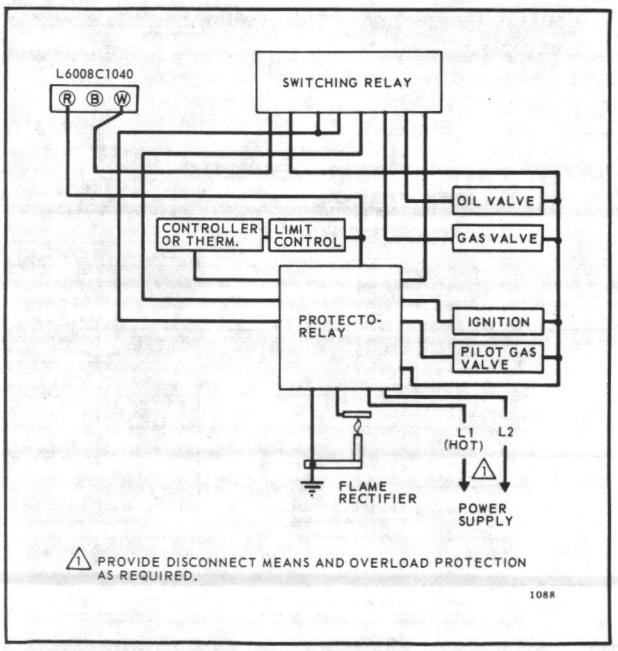


FIG. 22–TYPICAL WIRING DIAGRAM FOR L6008C1040 USED TO SWITCH FROM GAS TO OIL ON TEMPERATURE DROP.

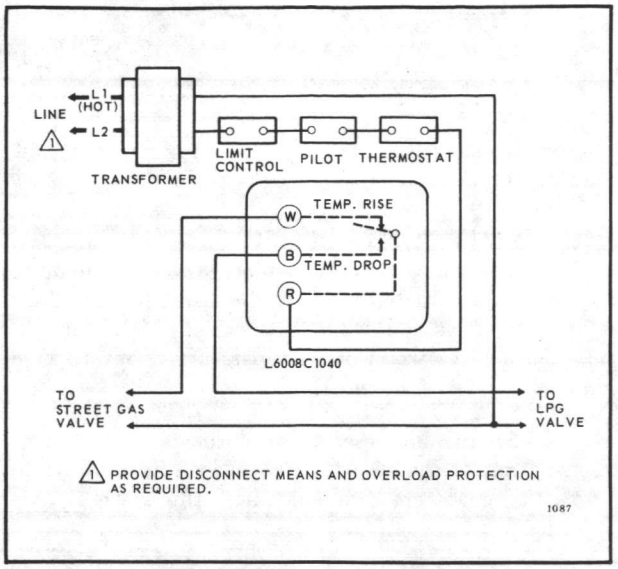


FIG. 23–TYPICAL WIRING DIAGRAM FOR L6008C1040 USED TO SWITCH STREET GAS TO LPG ON TEMPERATURE DROP.

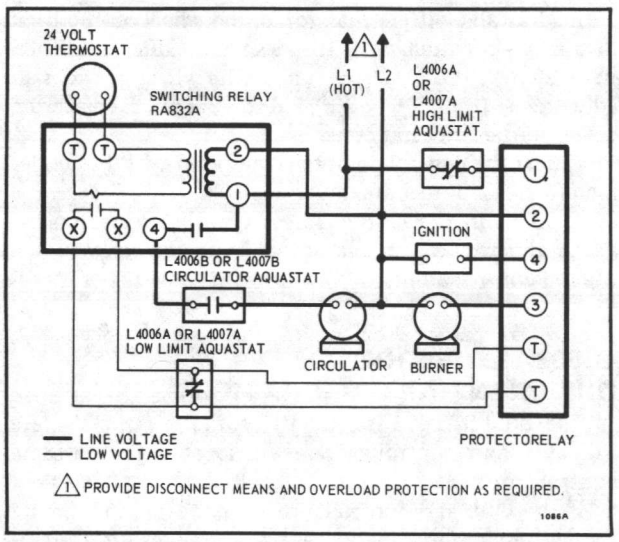


FIG. 24–OIL-FIRED SUMMER-WINTER HYDRONIC SYSTEM WITH DOMESTIC HOT WATER.

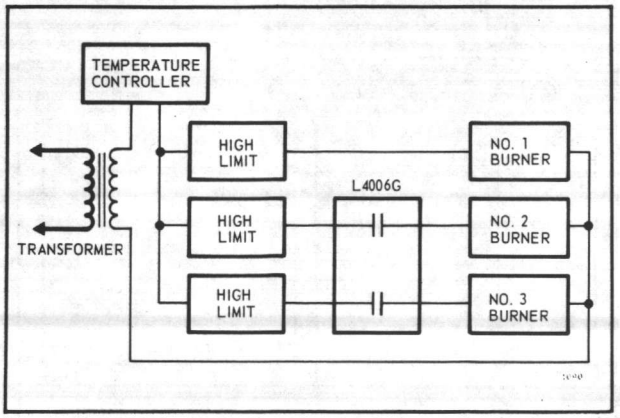


FIG. 25–TYPICAL HOOKUP FOR L4006G BOILER SEQUENCING AQUASTAT.

OPERATION

For proper selection of settings, follow the boiler manufacturer's recommendations.

HIGH LIMIT CONTROLLER

R-B terminals provide high limit switching function (contacts open on temperature rise at set point). Shuts off burner if water temperature exceeds high limit setting. Burner restarts when temperature drops to high limit setting, less differential.

NOTE: On manual reset models, the reset button on the front of the case must be pushed in to allow the burner to operate after a high limit shutdown.

LOW LIMIT CONTROLLER

R-B terminals provide low limit switching function (contacts open on temperature rise at set point). Maintains minimum boiler temperature for domestic hot water. Turns on boiler at temperature setting, minus differential.

CIRCULATOR CONTROLLER

R-W terminals provide circulation control function (contacts close on temperature rise at set point). Prevents circulation of water that is below the desired heating temperature. Breaks circulator circuit on temperature drop below setting minus differential, remakes on rise to setting.

ADJUSTMENTS

Set the differential to correspond with the boiler manufacturer's recommendations. To adjust models with adjustable differential, rotate the wheel on the back of the snap switch until the desired reading is aligned with the "V" notch in the frame. The wheel provides an adjustment from 5 to 30 F [2.8 to 16.7 C]. Replace the cover on the Aquastat controller.

Adjust the control point to correspond with the boiler manufacturer's recommendations. To adjust, insert a screwdriver in the slotted screw type head located beneath the window in the cover. Turn the scale to the desired control point.

L6008A LOCATION DIFFERENTIAL CALIBRATION

The L6008A1093 is calibrated for applications where the bulb and controller case are located in the same control space.

If the bulb and controller case are located in separate rooms, and if the temperature in the 2 rooms is different, an adjustment is required. The dial setting (control space temperature setting) must be adjusted to compensate for the difference in temperature.

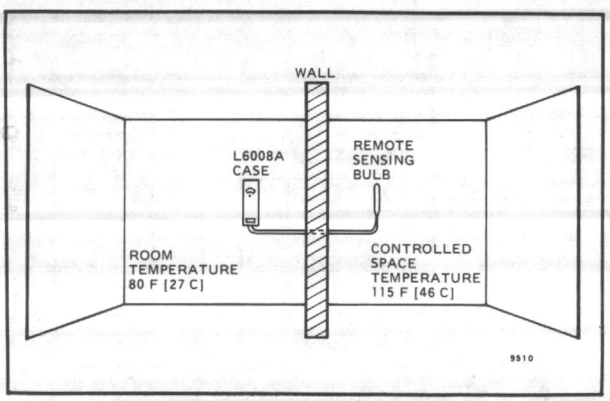


FIG. 26–L6008A CALIBRATION.

1. If the L6008A case is located in a room with a higher temperature than indicated on the dial setting, raise the dial setting the number of degrees listed in Table 1.

2. If the L6008A case is located in a room with a lower temperature than indicated on the dial setting, lower the dial setting the number of degrees listed in Table 1.

EXAMPLE: In the example shown in Fig. 26, the L6008A case is located in a room with a lower temperature than the controlled space. Therefore, the controlled space setting (dial setting) must be adjusted to compensate for the difference in temperature (35 F [19.5 C]) between the 2 rooms. Table 1 indicates that the dial setting should be lowered 5 degrees to compensate for the 35 F [19.5 C] temperature difference.

TABLE – 1

DIFFERENCE BETWEEN DESIRED ROOM TEMPERATURE AND CASE TEMPERATURE F [C]	ADJUST DIAL SETTING DEGREES F [DEGREES C]
0 [0]	0 [0]
5 [2.8]	3/4 [0.45]
10 [5.6]	1-1/2 [0.9]
15 [8.3]	2 [1.2]
20 [11.1]	2-3/4 [1.7]
25 [13.9]	3-1/2 [2.1]
30 [16.7]	4-1/4 [2.6]
35 [19.5]	5 [3.0]
40 [22.2]	5-3/4 [3.5]
45 [25.0]	6-1/2 [3.9]
50 [27.8]	7 [4.2]
55 [30.6]	8 [4.8]
60 [33.4]	8-1/2 [5.1]
70 [38.9]	10 [6.0]
80 [44.5]	11-1/2 [6.9]

CHECKOUT

Check to make certain that the Aquastat controller has been installed and adjusted properly. Put the system into operation and observe the action of the device through several cycles to make certain it provides proper control of the system as described under OPERATION. Further adjustments can then be made to meet more exact comfort requirements.

Dear Customer,

We welcome your comments and suggestions for improving this publication. Your assistance is greatly appreciated and will enable us to provide better technical information for you.

Please send your comments and suggestions to:
Honeywell Inc.
Honeywell Plaza
Minneapolis, Minnesota 55408
ATTN: Publications Supervisor MN12-3247

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WATTS
174A-740 SERIES
ASME WATER PRESSURE RELIEF VALVES
for Pressure Protection of Hot Water Heating Boilers
Sizes: ¾" thru 2"

The 174A-740 Series was developed to offer a complete line of boiler safety relief valve sizes from ¾" through 2" inclusive and with corresponding high BTU discharge capacity ratings. Watts was the first to offer this full selection of sizes, which afford complete pressure protection for the great majority of all hot water heating and supply boilers with a single valve.

Sizes 1" to 2" inclusive are proportionately larger valves to the ¾" size. They are designed for larger institutional and industrial installations to protect high BTU rated boilers that need greater relief capacities.

Whenever plans call for the latest and finest in A.S.M.E. relief valves, you'll find them in the Watts line.

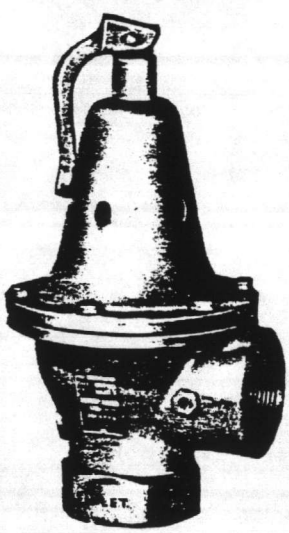
FEATURES

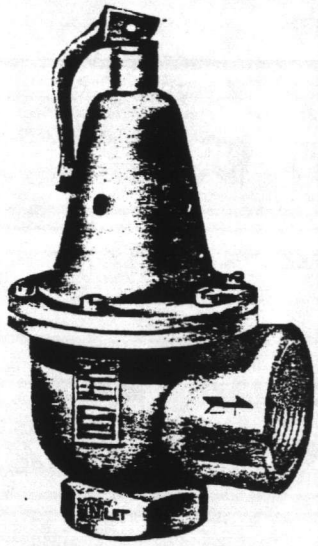
- Seat located above drain: water can't be trapped and sediment can't foul seat
- Non-mechanical seat-to-disc alignment will not stick or freeze
- Water seal of high temperature resisting material isolates spring working parts from water during relief
- No. 740 has the same design features as No. 174A except for difference in body construction and material

SPECIFICATIONS

BOILER RELIEF VALVES

Each hot water space heating boiler shall be equipped with a pressure relief valve set to relieve below the maximum boiler working pressure. The device shall be certified in accordance with the A.S.M.E. low pressure heating boiler code Section 4. The BTU rating of the valve must be in excess of the BTU output heating of the boiler. Watts Regulator Company Series 174A, 740 or equal.

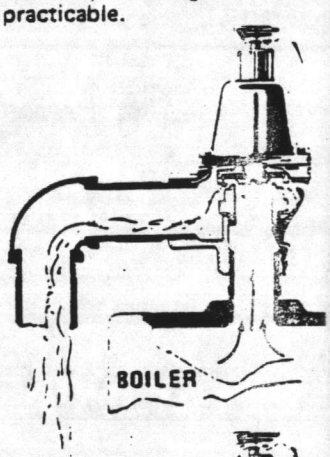




OPERATION: A hot water heating boiler operates normally full of water and steams only when there is trouble with the firing controls. When this occurs, it is good "safety" procedure to reduce the energy stored in the boiler by lowering the heat content of the boiler as rapidly as practicable.

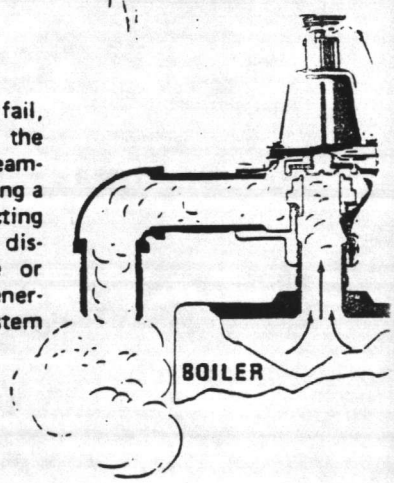
WATER DISCHARGE

As thermal expansion conditions develop, pressures may be built up to the setting of the relief valve. In this phase of operation, it acts as a **water relief valve,** discharging the small quantity of **water** which is expanded in the system.



STEAM DISCHARGE

Should operating controls fail, permitting run-away firing, the boiler water may reach steam-forming temperatures, creating a steam pressure condition. Acting as a **steam safety valve,** it discharges **steam** at the rate or faster than the boiler can generate it, thus restoring system pressure to a safer level.



WATTS REGULATOR

WATTS REGULATOR COMPANY
Box 628, Lawrence, MA 01842 (617) 688-1811
Telex: 94-7460
Toronto, Canada (416) 742-6891 Telex: 06527137

MATERIALS

174A Series

- Bronze body construction
- Non-metallic disc-to-metal seating

740 Series

- Iron body construction
- Non-metallic disc-to-metal seating

PRESSURE - TEMPERATURE

174A Series

Pressure range 30 lbs. to 150 lbs. with corresponding high BTU/HR ratings from 650,000 to 14.370,000 BTU/HR.

740 Series

Pressure range 30 lbs. to 75 lbs. with corresponding high ratings from 925,000 to 10.700.000 BTU/HR.

STANDARDS

HV ASME NB

Tested and rated by A.S.M.E. National Board of Boiler and Pressure Vessel Inspectors.

CAPACITY

No. 174A Series

SETTINGS and RELIEVING CAPACITIES
(National Board Certified Ratings)
BTU Steam Discharge Capacities

Size	30 lbs.	100 lbs.	125 lbs.	150 lbs.
¾"	650,000	1,695,000	2,070,000	2,445,000
1"	1,005,000	2,635,000	3,215,000	3,795,000
1¼"	1,682,000	4,399,000	5,370,000	6,340,000
1½"	2,020,000	5,290,000	6,460,000	7,630,000
2"	3,815,000	9,970,000	12,170,000	14,370,000

NOTE: We recommend No. 740 Series as best buy for hot water space heating boiler requirements between 30 through 75 lbs.

No. 740 Series

SETTINGS and RELIEVING CAPACITIES
(National Board Certified Ratings)
BTU Steam Discharge Capacities

Size	30 lbs.	45 lbs.	50 lbs.	75 lbs.
¾" x 1"	925,000	1,245,000	1,352,000	1,886,000
1" x 1¼"	1,300,000	1,749,000	1,899,000	2,649,000
1¼" x 1½"	2,105,000	2,830,000	3,075,000	4,285,000
1½" x 2"	2,900,000	3,903,000	4,238,000	5,910,000
2" x 2½"	5,250,000	7,050,000	7,650,000	10,700,000

NOTE: Valve settings, other than shown above, are available in 5 lb. increments between the pressure range of 30 through 75 lbs.

DIMENSIONS - WEIGHT

No. 174A Series

No.	Size	Model	Height	Length	Weight
174A	3/4" x 3/4"	M3	5 1/8"	2 1/2"	1 1/2 lbs.
174A	1" x 1"	M1	5 3/4"	3"	3 1/8 lbs.
174A	1 1/4" x 1 1/4"	M1	8 3/8"	4 3/4"	6 1/4 lbs.
174A	1 1/2" x 1 1/2"	M	9"	4 7/8"	7 1/4 lbs.
174A	2" x 2"	M	11 5/8"	6 1/4"	13 3/4 lbs.

No. 740 Series

No.	Size	Model	Height	Length	Weight
740	3/4" x 1"	M1	5 5/8"	3"	1 7/8 lbs.
740	1" x 1 1/4"	M	7 1/4"	3 1/2"	3 1/8 lbs.
740	1 1/4" x 1 1/2"	M	8 3/4"	4 5/8"	6 1/8 lbs.
740	1 1/2" x 2"	M	9 1/4"	5 1/4"	7 1/2 lbs.
740	2" x 2 1/2"	M	11 5/8"	6 3/4"	16 1/2 lbs.

WATTS REGULATOR
WATTS REGULATOR COMPANY

THE NAME THAT PROTECTS *YOUR* NAME
Box 628, Lawrence, MA 01842 (617) 688-1811
Toronto, Canada Soestduinen, The Netherlands
TELEX 94-7480 CANADIAN TELEX 06527137

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McDONNELL
NO. 51 BOILER WATER FEEDER and NO. 51-2 COMBINED BOILER FEEDER and LOW WATER CUT-OFF
—for boilers above 5,000 sq. ft. capacity

THE faithful performance of the McDonnell No. 51 Boiler Water Feeder is based squarely on design and construction that only many years of concentration on the practical requirements of a large capacity boiler feeder could have developed.

Cool Feed Valve

Of first importance in the design of the No. 51 is the McDonnell Cool Feed Valve Principle (Patent No. 1,934,486) which prevents water surrounding the feed valve from reaching the temperature at which lime and scale is precipitated on the seat. This prevents the binding and sticking of the feed valve which has been a constant source of feeder trouble before the cool feed valve principle was introduced in McDonnell feeders.

As important as the cool feed valve principle is the manner in which it is carried out in these large capacity boiler feeders. As brought out in the sectional views, all working parts are totally isolated from the heat of the float chamber. Two sylphon bellows seal the float chamber and valve from the lever compartment, eliminating all packing and reducing friction to the minimum.

Stainless Steel Valve

The valve is stainless steel of file hardness. It is protected by a large strainer, mounted in a removable plate for ease in cleaning. The large float gives plenty of power to close the valve against water pressure up to 150 lbs., and this closing power is multiplied at the moment of closing or opening by an ingenious leverage arrangement. A typical refinement is the slot and roller construction which assures a straight thrust of the valve stem.

The No. 51 is for hand fired boilers, and the No. 51-2 is the same feeder with the McDonnell No. 2 Switch added to convert it into a combined boiler feeder and low water cut-off for automatically fired jobs. The standard No. 2 switch is provided with both line voltage cut-off terminals and alarm terminals.

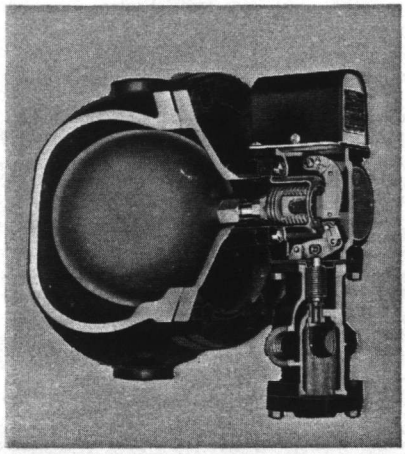
Service Range of No. 51 and 51-2 is as follows:

For boilers above 5,000 sq. ft. capacity. Maximum steam pressure, 35 lbs. Maximum water pressure 150 lbs.

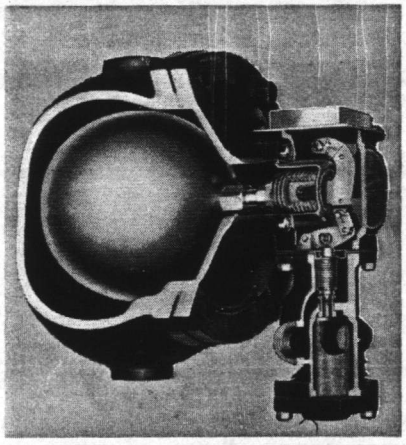
Electrical Ratings—No. 2 Switch
(Underwriters' Listed) Model 2
Ampere Rating: 115V.D.C. .5 Amps.

	115V.A.C.	230V.A.C.
Motor Duty		
Full Load	10.2	5.1
Locked Rotor	61.2	30.6

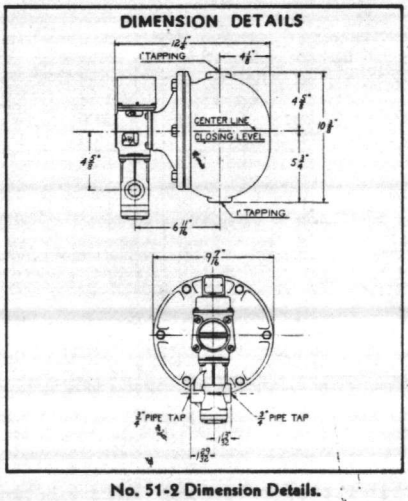
PILOT DUTY: 115-230V. 60 Cycle A.C. 125V.A.



No. 51-2 Combined Boiler Water Feeder and Low Water Cut-off for automatically fired boilers —the unit that makes the boiler water level as automatic as the firing.



No. 51 Boiler Water Feeder for hand fired boilers.

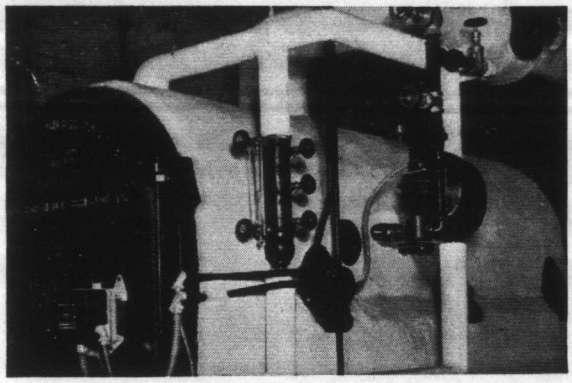


No. 51-2 Dimension Details.

Operation of No. 51-2

When the McDonnell No. 51-2 Combined Boiler Feeder and Cut-off is installed on a heating boiler, the feeder takes care of all normal operation, maintaining a safe boiler water level by supplying water to the boiler whenever the water drops to the minimum safe level. In the event of an emergency such as extreme priming or foaming or failure of the water supply, the No. 2 Switch stops the burner until a safe level is restored by the feeder. It then permits the burner to operate and returns the control to the feeder.

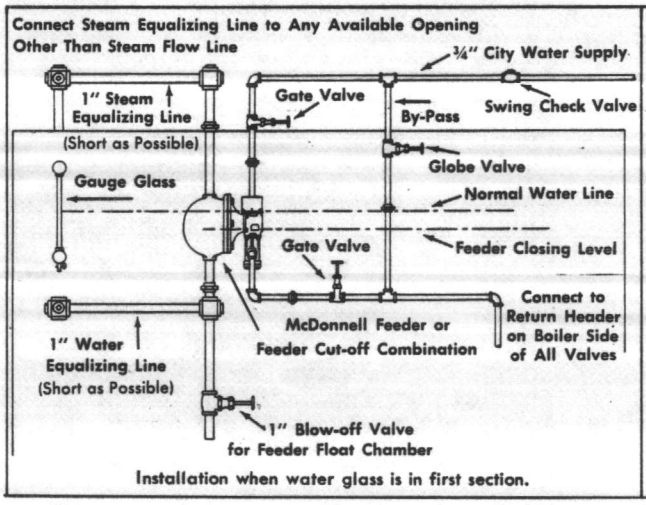
In this way the switch functions only as an emergency device. This is the only correct practice, and a Feeder Cut-off Combination operating like the McDonnell is the only completely automatic boiler water level control for automatic fired jobs.



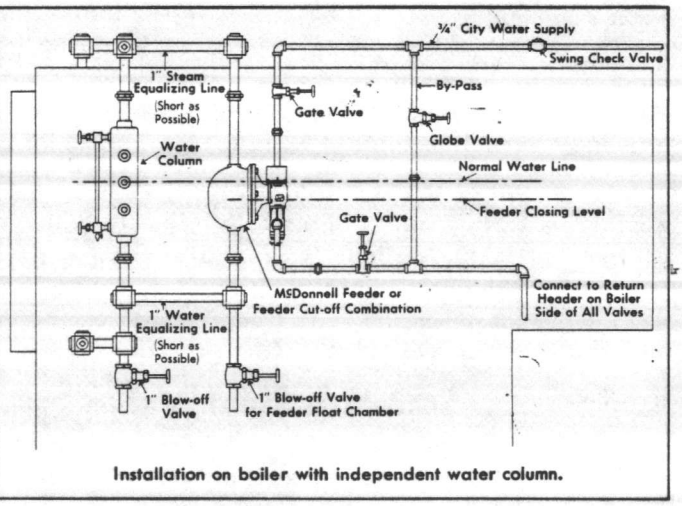
Typical installation of McDonnell No. 51-2 feeder cut-off combination

Installation of No. 51 and No. 51-2

The Nos. 51 and 51-2 are installed with one inch equalizing pipes as diagrammed below. All jobs fall into one of the two classes illustrated. When the water glass is in the first section the equalizing pipes are installed as shown at left, and when the boiler is equipped with a water column the feeder is piped as shown at right. For heating jobs, the closing level is set 2" to 2½" below the normal water level, but never lower than 1 inch of water in the gauge glass. Complete installation instructions and wiring instructions are packed in shipping crates.

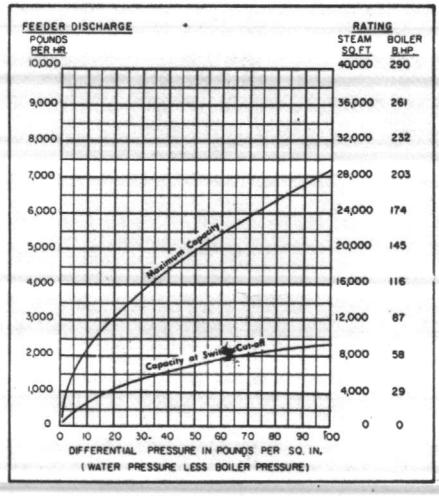


Installation when water glass is in first section.



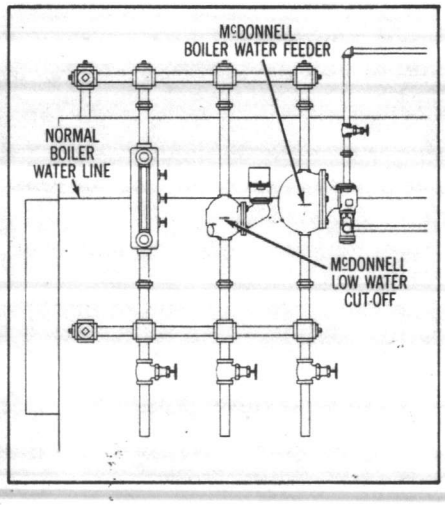
Installation on boiler with independent water column.

For Process and Larger Boilers



The No. 51-2 Feeder Cut-off Combination is designed for use on closed heating systems, and will satisfy the great bulk of such boilers over 5,000 sq. ft. in size. It is not intended for use on process boilers, and it may not be suitable on larger heating boilers or boilers with low differential pressures. In such cases, the closely set operating levels of the No. 51-2 may stop the burner before the feeder has caught up with boiler requirements.

A separate No. 51 Feeder and a separate No. 61 or 63 Cut-off are recommended instead, with operating levels set far enough apart so the feeder will feed at its maximum rate long before the cut-off switch stops the burner. Curve of feeding capacities at various pressures and float levels is shown at left; typical installation is diagrammed at right.



McDONNELL & MILLER, *Inc.*, 3500 N. Spaulding Avenue, CHICAGO, ILL. 60618

Bulletin L-55G ©

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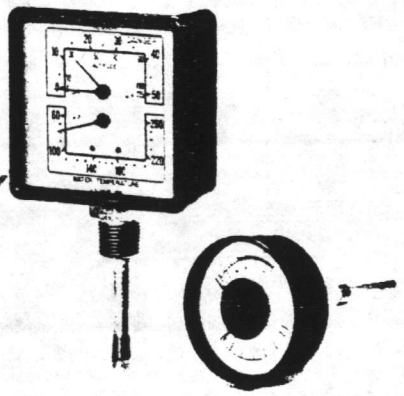
INDEX—

COMBINATION PRESSURE, TEMPERATURE & ALTITUDE GAUGES

PTA1088 & PT1088

Specially constructed for use on all hot water heating boilers, these combination gauges give accurate indication of temperature, pressure and altitude. Red pointer (available in 3½" case only) is hand-set on the job to indicate desired pressure or altitude. Pressure scale is black with red danger band. Gauges are designed to withstand the conditions normally encountered on domestic heating systems. The 2½" round case Pressure, Temperature, Altitude gauge is ideal where mounting space is limited.



PTA1088

SPECIFICATIONS:

DIAL SIZE: 3½" square or 2½" round

CASE: Drawn steel, black corrosion resistant paint

RING: Drawn steel, friction fit black corrosion resistant paint

WINDOW: Flat glass—square case
Flat plastic—round case

DIAL: Steel with white background. Pressure scale in black with red danger band. Water temperature and altitude scales in red (black in 2½" round case)

MOVEMENT: Quality brass

POINTERS: Black indicating pointers for pressure and temperature. Red set hand for indicating desired system altitude. (3½" case only)

CONNECTION: Square—½" NPT LM or LBM
Round—¼" NPT CBM

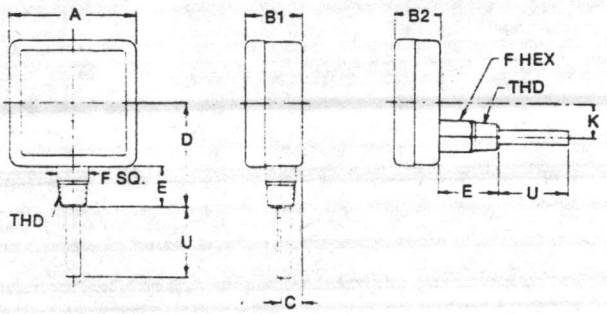
TEMPERATURE ELEMENT: Helical bi-metallic element enclosed in a brass bulb.

SOCKET: Brass

ACCURACY: Pressure & Altitude—3-2-3%
Temperature—2% of scale range

FIGURE NUMBER & CONNECTION		SIZE AND RANGES
PTA1088	½" LM	3½", 50 psig, 115 ft. H_2O and 60-260°F.
	½" LBM	3½", 50 psig, 115 ft. H_2O and 60-260°F.
	¼" CBM*	2½", 75 psig, 170 ft. H_2O and 60-320°F. (Round Case)
PT1088	½" LM	3½", 200 psig and 80-320°F.
	½" LBM	3½", 200 psig and 80-320°F.

	FIGURE NUMBER	DIAL SIZE	A	B	B1	B2	C	D	E	F	K	U
1	PTA 1088	3½" LM	3.63	—	1.62	—	.59	2.94	1.12	.875	—	2.00
	PTA 1088	3½" LBM	3.63	—	—	1.22	—	—	1.66	.875	.95	2.00
2	PTA 1088	2½" CBM	2.71	1.11	—	—	—	—	.78	.562	—	1.62
	PTA 1088	2½" CBM	2.71	1.11	—	—	—	—	2.02	.562	—	1.62



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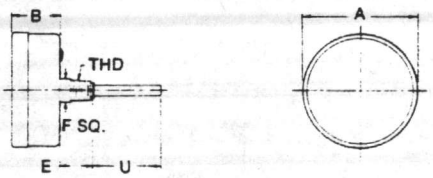


2

KEEP THIS MANUAL NEAR BOILER

RETAIN FOR FUTURE REFERENCE

UTICA BOILERS

SERIES SF CAST IRON

OIL FIRED BOILERS

For Forced Hot Water

INSTALLATION MANUAL

AND

OPERATING INSTRUCTIONS

INSTALLATION PROCEDURE

All installations must conform to the requirements of the authority having jurisdiction. Such applicable requirements take precedence over the general instructions of this manual.

LOCATE BOILER in front of final position before removing crate. Provide a level solid base as near chimney as possible and centrally located with respect to the heat distribution system as practical.

REMOVE CRATE and plastic protective wrapper and inspect for damage. All equipment is carefully manufactured, inspected and packaged by experienced workmen. Our responsibility ceases upon delivery of the crated boiler to the carrier in good condition. Any claims for damage or shortage in shipment must be filed immediately against the carrier by the consignee.

Move boiler to permanent position by sliding or walking.

Allow 24" at front and right side of boiler for servicing and cleaning, or removing tankless heater coil. Minimum clearance to construction or combustible materials should be not less than 6" from the top, sides and rear of unit and 6" from the flue pipe in any direction. Greater distances for access should supersede fire protection clearances.

BOILER ROOM VENTILATION should be adequate to provide sufficient air to properly support combustion. Except for large rooms or basements where the boiler is installed in a confined space or within a building of unusually tight construction, air for combustion and room ventilation must be obtained from outdoors or from spaces freely communicating with the outdoors. Permanent openings into the boiler room, one near the top and one near the bottom of the boiler room, with a total free area equal to the area of all flue outlets of all fuel burning equipment in the room must be provided. Air openings to boiler room should not be obstructed.

INSPECT CHIMNEY to make certain it is constructed according to National Board of Fire Underwriters. Local regulations may differ from this code and should be checked. Where there is a conflict, the local code will prevail.

The chimney should extend at least 2' above any portion of the building within 10'. It should produce a negative draft of .06 to .08 inches of water column (W.C.) as measured with a draft gauge between the boiler and barometric draft control while maintaining an .02 inch W.C. negative draft in the combustion chamber. Inadequate draft will cause improper combustion, resulting in dirty flue ways and high fuel bills. CONNECT FLUE PIPE same size as boiler outlet to chimney, sloping upward continuously toward chimney approximately 1/4" per foot. Bolt or screw joints together to avoid sag.

If an oil fired water heater is vented into the same flue as the boiler, provide a separate hole into the chimney whenever possible. When this isn't possible, use a "Y" connection in the flue pipe, using a separate draft regulator for each unit. When a chimney will not provide adequate draft to handle the input from the water heater and boiler simultaneously, wire the units so that only one will operate at a time, favoring the water heater.

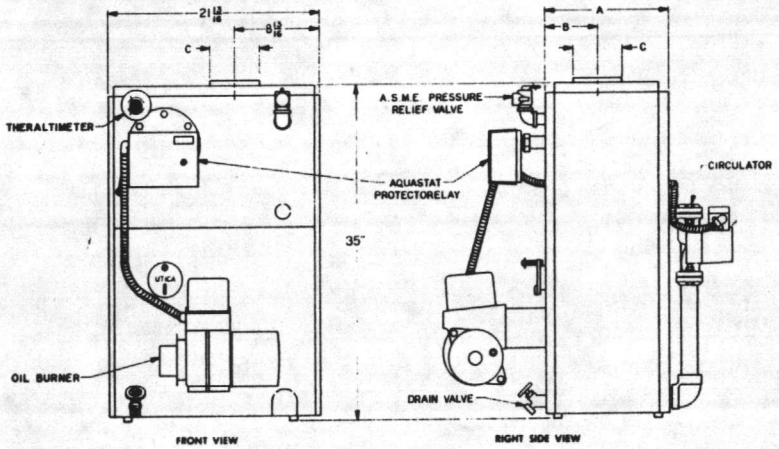
RATINGS AND DATA

Boiler No.	Heating Capacity Btu/Hr.	Net I=B=R Water Rating		I=B=R Burner Capacity G.P.H.	Chimney Size	Nozzle Furnished* G.P.H.
		Btu/Hr.	Sq. Ft.			
SF-365	79,000	68,700	458	.65	8×8×15	.65 80° B
SF-3100	117,000	101,700	678	1.00	8×8×15	.90 80° B
SF-4125	149,000	129,600	864	1.25	8×8×15	1.25 80° B
SF-4150	175,000	152,200	1015	1.50	8×8×15	1.50 80° B
SF-5175	206,000	179,100	1194	1.75	8×8×15	1.75 80° A
SF-5200	231,000	200,900	1339	2.00	8×8×15	2.00 80° A
SF-6225	254,000**	221,000	1473	2.25	8×12×15	2.25 80° B
SF-7280	308,000**	268,000	1787	2.80	8×12×15	2.75 60° B

*Nozzle listed is for use with Beckett burner. When alternate burner is used, consult burner manufacturer's recommendations.
**I = B = R gross output.

DIMENSIONS

Boiler No.	A Length of Flush Jacket	B Front of Casing to Center Line of Flue Outlet	C Diam. of Flue Outlet
SF-3	12⅝	6½	5
SF-4	16¼	7⅞	6
SF-5	19⅞	9½	7
SF-6	23½	12¼	6
SF-7	27⅛	13⅛	6



CONNECT MAIN SUPPLY AND RETURN PIPING as suggested in Fig. 1. When the boiler is used in connection with refrigerated systems, the chilled medium must be piped in parallel with the boiler with appropriate valves to prevent the chilled medium from entering the boiler. Fig. 2. Heating cycle, open valves A and B, close C and D. Cooling cycle, open valves C and D, close A and B.

When the boiler is connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation, the boiler piping system must be supplied with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

CONNECT PIPING TO BUILT-IN WATER HEATER—if used—as recommended in Fig. 3.

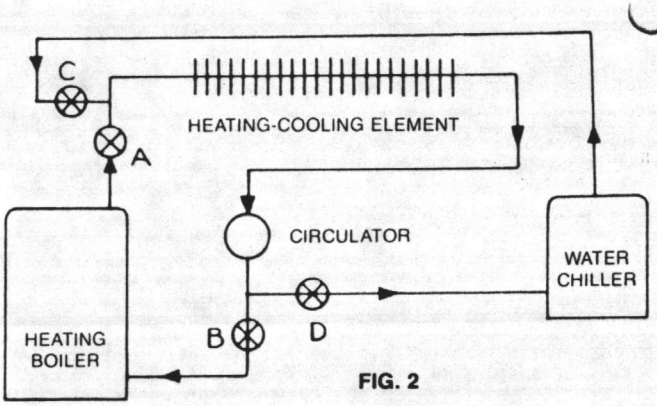


FIG. 2

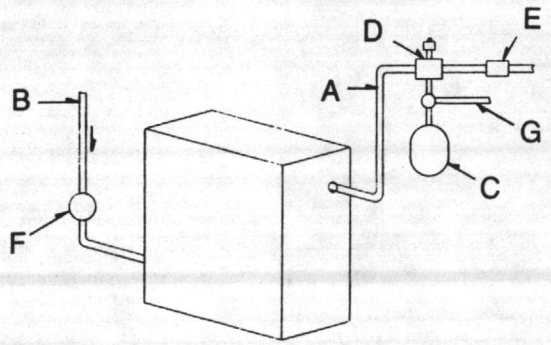
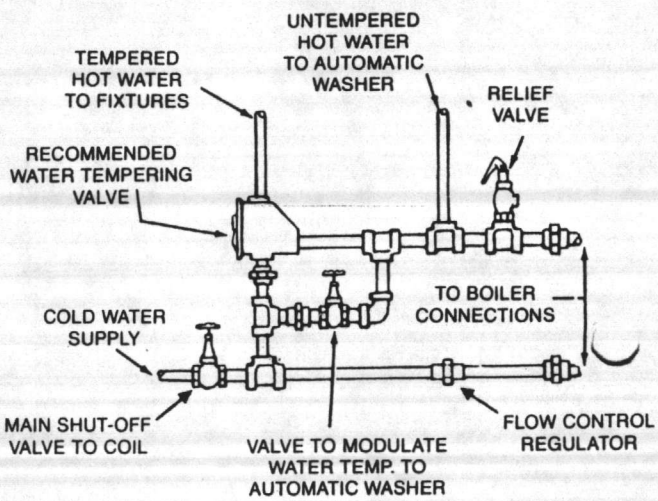


FIG. 1

A. Supply Pipe
B. Return Pipe
C. Expansion Tank
D. Air Scoop & Vent
E. Flow Control Valve Required if the tankless heater is used. Optional if tankless heater is not used.
F. Circulator
G. Cold Water Supply

PIPING FOR DOMESTIC HOT WATER FIG. 3



ELECTRICAL WIRING should conform with latest edition of National Electrical Code ANSI/NFPA No. 70 and/or local authority having jurisdiction. A separate electrical circuit should be run from the entry box with a fused disconnect switch in this circuit. See wiring diagram for suggested circuitry and field wiring. Wiring for zone valve installations are furnished with zone valve packages.

THERMOSTAT should be installed on an inside wall about four feet above the floor. Never install a thermostat on an outside wall or where it might be affected by drafts, hot or cold water pipes, sunlight, lighting fixtures, television or near a fireplace or chimney.

OIL TANK AND PIPING should be installed in accordance with the National Board of Fire Underwriters' and local regulations. Oil storage tank, vent, fill pipe and caps should be as prescribed by local codes. In no case should the vent pipe be smaller than 1-1/4" I.P.S. The fill pipe should not be less than 2" I.P.S.

The suction line from the tank to the burner should be one continuous piece of tubing to prevent air entering the line. The suction line may be 3/8" O.D. copper tubing for runs of 50 feet or less, and 1/2" O.D. for longer runs. An oil return line, same size as the suction line, must be used on any installation where the bottom of the tank is below the fuel unit of the burner. Oil lines should be buried or otherwise protected from mechanical injury. Flare fittings on all oil lines are recommended. Compression fittings on the suction line often allow air to be drawn into the fuel pump, making it difficult to maintain oil pressure at the nozzle. Do not run overhead fuel lines from tank to oil burner.

Fuel pump connections and by-pass should be made according to instructions attached to fuel pump. If tank is more than 20' from boiler, a two stage fuel unit should be installed in place of the single stage pump supplied as standard equipment with the burner. Make certain the rotation and speed are the same and the pump is suitable for the burner horsepower rating.

An oil line filter and shut-off valve should be installed in the suction line. Shut-off valves should be installed in both the suction and return lines at burner for convenience in servicing burner. Allow extra tubing at burner so burner may be removed from boiler for cleaning without disconnecting the tubing.

OPERATING INSTRUCTIONS

FILL SYSTEM AND BOILER WITH WATER and vent air from system. Check system for leaks. When air control devices and purge valves are used, the instructions furnished with such devices should be followed.

START-UP AND ADJUSTMENT OF OIL BURNER (See oil burner instructions for nozzle and electrode setting)

1. Check oil burner nozzle to make certain it is tight in adaptor. Burner mounting bolts should be tight.
2. Check electrode setting, as they may have been jarred out of position during transportation. See chart for measurements.
3. Lubricate burner motor and circulator motor if required. Some circulators are water lubricated and do not require oiling.
4. Set room thermostat to call for heat, or jump thermostat contacts on boiler control.
5. Open all oil line valves.
6. Turn service switch on. Burner should start.
7. On one pipe fuel systems only, vent pump as soon as burner starts. Allow oil to run until all traces of air in the suction line disappear.
8. Turn "OFF" burner and install pressure gauge port on pump.
9. Start burner again and check oil pressure for 100 lbs. Adjust if necessary.
10. **CAUTION: DO NOT SET FIRE VISUALLY.** Instruments are the only reliable method to determine proper air adjustments. An improperly adjusted burner causes soot and high fuel bills because of incomplete combustion of the fuel oil. This in turn may require excessive boiler maintenance, service costs, and in some instances, house cleaning or redecorating. A competent service mechanic should be consulted to make the proper adjustments with a smoke tester, CO_2 Indicator and draft gauge. Bacharach or Dwyer test kits include these instruments and instructions to obtain proper trouble-free operation of the boiler burner.

A 1/4" diameter hole is provided in the inspection cover plate above the burner to take draft readings in the combustion chamber. Rotate the cover plate left until sampling tube can be inserted into the combustion chamber space.

Adjust draft regulator and oil burner air shutter(s) to obtain an "overfire" draft of .02 inches W.C. negative pressure in the combustion chamber and 10% to 12% CO_2 with zero to a trace of smoke in the breech. The over-fire draft of .02 inches W.C. is required to eliminate back pressures in the combustion chamber that cause smoke and odors in the boiler room.

CHECK SAFETY CONTROL CIRCUIT after burner adjustments have been made for satisfactory performance.

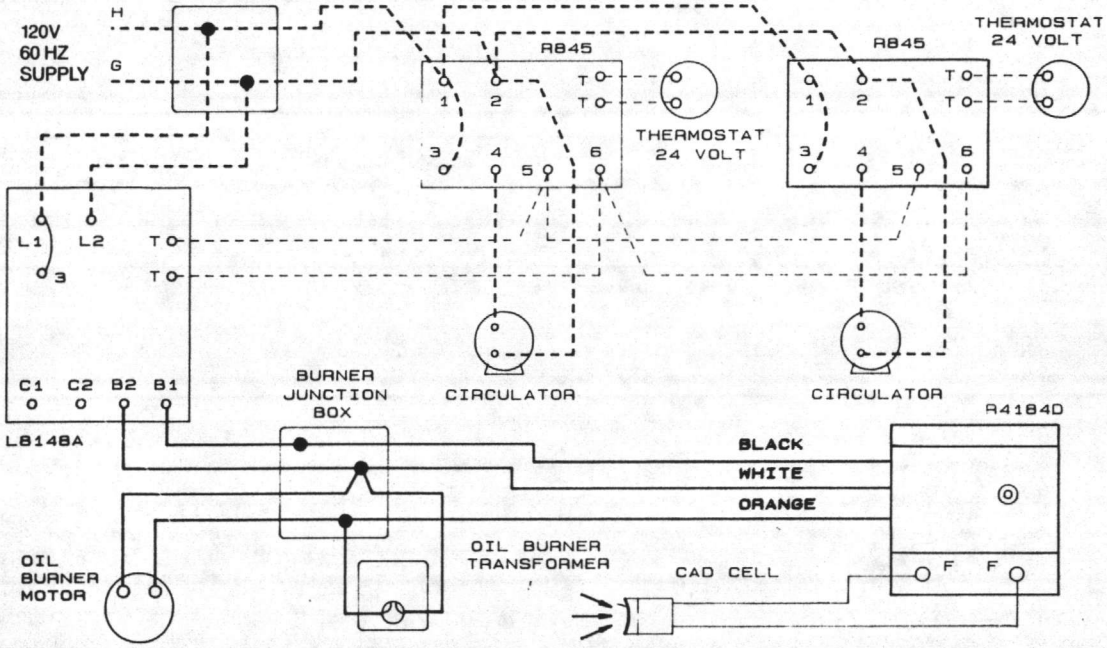
1. High limit control: Remove cover and note temperature setting. With the burner operating, decrease this setting to minimum point. When boiler water temperature exceeds this set point, the high limit switch will open, shutting off the power to the oil burner. Return setting to desired high limit point. Burner should re-start.
2. Primary control and flame sensor:
   To check
   A. Flame failure—simulate by shutting off oil supply with hand valve while burner is on. Sixty seconds after flameout, the safety switch locks out, ignition stops, motor stops and oil valve—when used—closes. To restart, open oil supply valve and reset safety switch.
   B. Ignition failure—with burner off, close oil supply valve and run through start-up procedure. The safety switch should lock out as in flame failure.
   C. Power failure — Turn off main power supply switch while burner is operating. When burner stops, restore power and burner should start.

   If operation is not as described above, check wiring and controls.

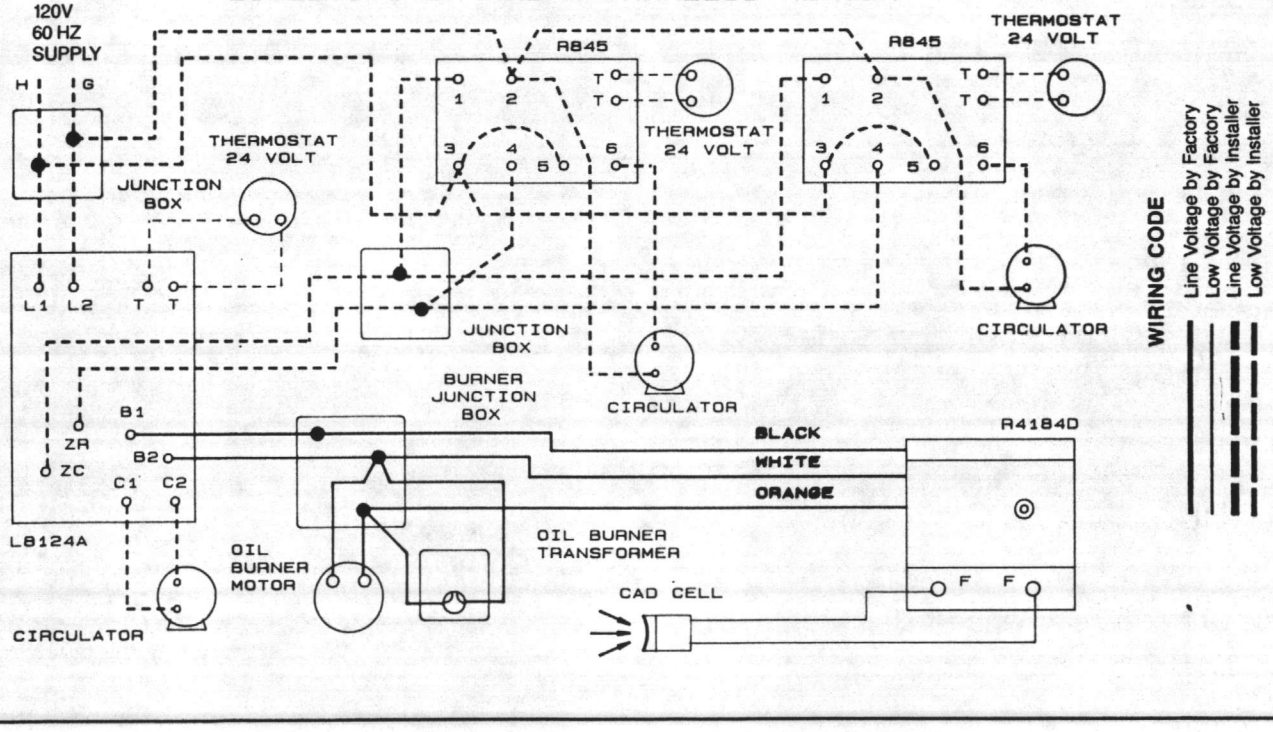
PREVENTIVE MAINTENANCE of an oil fired boiler reduces operating costs. The boiler and vent pipe should be inspected for accumulation of soot or scale deposits periodically but at least once every year before the start of the heating season. When soot is present on the section walls and flueways, improper combustion will result, causing additional sooting and scaling until flueways are completely closed. To remove soot and scale from the flueways, remove top jacket panel, top cleanout plate, and burner. Using a flue brush, brush the soot and scale into the combustion space where it can be removed through the burner opening. **DO NOT USE A VACUUM CLEANER WHEN SILICA FIBER CHAMBERS ARE INSTALLED.**

It is recommended to replace the nozzle at the start of each heating season. Lubricate the burner motor and circulator motor—if required—with a few drops of a good grade of light motor oil. Do not over oil. Have a competent service man service the burner and check the controls and check the electrodes for carbon or cracks in the insulators. Burners should be adjusted to produce the conditions shown in Start-up and Adjustment of Oil Burner procedure.

WIRING DIAGRAM FOR OIL FIRED BOILERS WITH A CIRCULATOR ZONED SYSTEM LESS TANKLESS HEATER



WIRING DIAGRAM FOR OIL FIRED BOILERS WITH A CIRCULATOR ZONED SYSTEM AND A TANKLESS HEATER



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SF INST Rev. 1/88

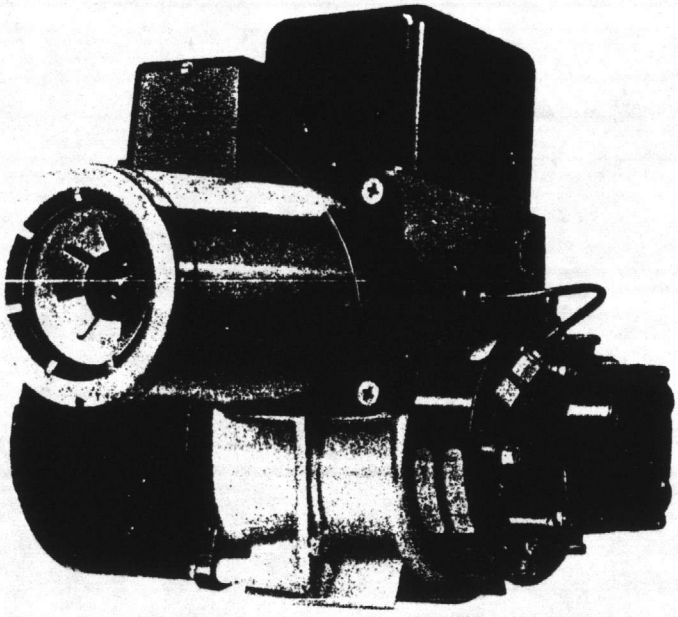
Printed in U.S.A.

RWB Beckett

INSTRUCTION MANUAL

model AFG

OIL BURNER



SPECIFICATIONS

CAPACITIES – MODEL AFG
.....0.50 to 3.00 gallons per hour
.....70,000 to 420,000 BTU/HR input

FUELS
No. 1 or No. 2 Heating Oil (ASTM D396) Only
In Canada, No. 1 or No. 2 Furnace Oil

DIMENSIONS (Standard)
Height.....11-1/2"
Width.....12-7/8"
Depth (Chassis Only).....6-9/16"

ELECTRICAL CHARACTERISTICS (See Note)
Power Supply.....115 V/60 Hz 1 PH
Operating Load.....(Max.) 5.8 Amps
Motor.....1/7 HP, 3450 RPM, N.E.M.A. "M" Flange, manual reset overload, protection
Ignition.....10,000 V/23 ma secondary, continuous-duty shielded, transformer or solid-state ignition system

FUEL UNIT
.....Suntec or Webster

Beckett warrants its equipment specifically to those who have purchased it for resale, including your dealer. In the event of any problems with your equipment or its installation, you should contact your dealer for assistance.

Underwriters Laboratories has certified this burner to comply with ANSI Standard 296.6 and has listed it for use with No. 1 or No. 2 fuel oil as specified in ASTM D396. State and local approvals are as shown on burner rating label.

Dear Homeowner:

Over forty years of engineering and product development have gone into your new oil burner. Its quality and design are unsurpassed. Properly installed and maintained it will provide many years of efficient, trouble-free operation. Please read this Instruction Manual carefully, and give special attention to the following points:

COMBUSTION AIR
An oil burner must have a generous supply of combustion air to operate properly. Details are found in this manual.

OIL SUPPLY
Always keep the fuel tank full, **especially in the summer** in order to prevent condensation of moisture on the inside surface of the tank.

FILTER
The line filter cartridge must be replaced every year in order to avoid contamination of the fuel unit and atomizing nozzle.

MOTOR OILING
Some motors are permanently lubricated and have no provisions for oiling. Follow the motor manufacturer's instructions for oiling where applicable, or add a few drops of SAE20W non-detergent oil at both oil ports annually.

WARNINGS
NEVER use gasoline in your heating appliance. Gasoline is more combustible than fuel oil and could result in a serious explosion.
NEVER use crankcase or waste oil in your heating appliance. Fuel unit malfunction could result from contamination.
NEVER burn garbage or refuse in your heating appliance or try to light oil by tossing burning material into the appliance.
NEVER store any combustible materials (especially paper and oily rags) on or around the heating appliance.
NEVER TAMPER WITH THE UNIT OR CONTROLS. INSTALLATION AND ADJUSTMENT OF THE BURNER REQUIRES TECHNICAL KNOWLEDGE AND USE OF COMBUSTION TEST INSTRUMENTS. CALL YOUR SERVICEMAN.

TO THE INSTALLER

INSTALLATION OF THE BURNER MUST BE DONE BY A QUALIFIED INSTALLER IN ACCORDANCE WITH REGULATIONS OF THE NATIONAL FIRE PROTECTION STANDARD FOR OIL-BURNING EQUIPMENT, NFPA NO. 31, AND IN COMPLETE ACCORDANCE WITH ALL LOCAL CODES AND AUTHORITIES HAVING JURISDICTION.

A QUALIFIED INSTALLER IS AN INDIVIDUAL OR AGENCY WHO IS RESPONSIBLE FOR THE INSTALLATION AND ADJUSTMENT OF THE EQUIPMENT AND WHO IS PROPERLY LICENSED AND EXPERIENCED TO INSTALL OIL-BURNING EQUIPMENT IN ACCORDANCE WITH ALL CODES AND ORDINANCES.

A properly designed chimney of adequate size and height and adequate combustion air supply are essentials for the best operation of any heating plant.

For those installations not requiring a chimney, such as "through the wall" venting units, refer to the manufacturer's recommendations.

When installing the heater and/or burner be sure to provide adequate space for easy service and maintenance.

CONCEALED DAMAGE

If any damage to the burner or controls is found during unpacking, notify the carrier at once and file the appropriate claim.

R.W. BECKETT CORPORATION
P.O. Box 1289 • Elyria, Ohio 44036

Form No. 6104 BAFG 388
Printed in U.S.A.

ADJUSTING THE BURNER

* **Initial air adjustments:** Allow sufficient air to obtain a clean looking flame by loosening the lock screws and moving the air shutter and if necessary the bulk air band.

Reduce the air supply until the flame tips appear slightly smoky, then increase the air just enough to cause the flame tips to appear absolutely clean. Proceed to "Draft control adjustments" then to "Final air adjustments".

* **Draft control adjustments:** When the burner air supply and draft are properly adjusted the combustion chamber draft will normally be negative .01"-.02" WC. Larger installations may require slightly greater draft. Some newer equipment may require a positive draft. Where applicable, set the chamber draft to the manufacturer's recommended settings. Proceed to "Final air adjustments".

* **Final air adjustments:** Allow at least ten minutes for warm-up, and longer if the appliance is new, in order to burn off the oil deposits on the heat exchanger and other surfaces.

Using suitable test instruments for smoke and C02 or 02 set the air settings to obtain a trace of smoke. Measure the C02/02 at this point and add sufficient air to reduce the C02 or increase the 02 by one percent (1%) as an insurance margin, unless otherwise specified by the appliance manufacturer's instructions. EXAMPLE: 13% C02 @ a trace of smoke reduced to 12% C02.

C02 measured in the stack (ahead of the draft control) should be a minimum of 10% for knocked down appliances or retrofit applications and a minimum of 12% for units with burners tested and supplied by the manufacturer as a package.

Tighten all the locking screws after the final adjustments are made.

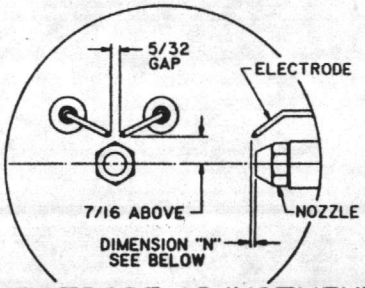
Start and stop the unit several times to make sure there are no significant rumbles or pulsations.

Check and adjust all controls in accordance with the Control Manufacturer's instruction sheets. Test the primary control safety switch to insure a safety shutdown will occur in the event of equipment malfunction.

* **Specific air adjustments for "V" head (variable):** In addition to the above instructions the "V" head has the ability to control air by moving the head either forward or back. Once the head position is set for a specific firing rate according to the instructions found in the section "ATTACHING 'L or V-HEAD' AIR TUBE COMBINATIONS" it might be necessary to move the head forward or back one position at a time in order to optimize the smoke and C02 readings.

ATTACHING 'F-HEAD' AIR TUBE COMBINATIONS

1. If using a flange and gasket, slide them onto the air tube then attach the air tube to the burner using the four sheet metal screws provided.
2. Install nozzle recommended by manufacturer into nozzle line. Use 70-80° hollow or solid nozzles on conversions or upgrades.
3. Check and set electrodes as shown in FIG. 2.
4. Insert 'nozzle line electrode assembly' into tube using the "Z" dimension shown in FIG. 3 to position the assembly. To install long assemblies (over 9"), rotate the assembly 180° from installed position, partially insert into tube and rotate back.
5. Secure the assembly by tightening the escutcheon plate to the side of the housing and by tightening the knurled lock nut onto the nozzle line. (lock nut's 'recessed side' faces out)
6. Attach 'connector tube assembly' to pump and nozzle line.



ELECTRODE ADJUSTMENTS (FOR 'F' HEADS)

MODELS	DIMENSION "N"
F0 Thru F3I	I/16"
F30 Thru F300	I/8"-5/32"

FIG. 2

DIMENSIONAL RELATIONSHIPS

"A" = Useable Air Tube Length "R" = "A" + 2-3/16" "Q" = "A" + 1-13/16"		"L" = "A" + 5/8" "Z" = 1-1/8" "E" = 1-5/8"	
"S" dimension	1⅜"	1⅝"	2-13/32"
Tube "A" dimension	2⅜ - 3"	3⅜-4½"	over 4⅞"

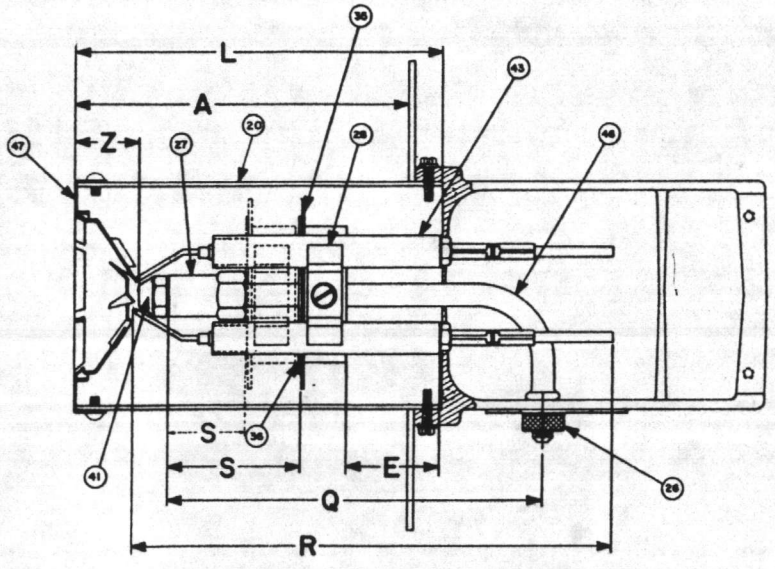


FIG. 3

AIR TUBE COMBINATION PARTS

REF.	DESCRIPTION	PART NO.
20	Air Tube Specify Type F or M	Note
	Knurled Locknut	3-666
27	Nozzle Adapter-Single	2-13
28	Electrode Clamp	1-49
	Static Plate and Nozzle Line Support Assy.	Note
32	Shroud Type M Straight	31315
33	Shroud Type M Conic	31313
35	Centering Spider Spacer Assy. Type F	5-503
	Centering Spider Spacer Assy. Type M	31320
36	Static Plate (Refer to Firing Rate Chart)	
41	Nozzle	
43	Electrode Rod and Insulator	
	usable length to 9" Type F	5780
	Type M	5940
	usable length over 9" Type F	5782
46	Nozzle Line and Vent Plug	Note
47	Burner head, specify Type F, V1 or L1	

NOTE: Specify Burner model number "AFG," part description; air tube combination with usable air tube length (Dimension "A") and firing rate.

ATTACHING 'L or V-HEAD' AIR TUBE COMBINATIONS

1. If using a flange and gasket, slide them onto the air tube then attach the air tube to the burner using the four sheet metal screws provided.
2. Install nozzle recommended by manufacturer into nozzle line without removing head by using a 3/4" and 5/8" open-end wrench. Use 60-70° hollow or solid nozzles on conversions or upgrades.

Check and set electrode and head dimensions as shown in FIG. 4

4A. 'L-HEAD' AIR TUBE COMBINATIONS: **FIXED** (MA, MB and MC)

a) Insert 'nozzle line electrode head assembly' into tube using the "Z" dimension shown in FIG. 5 to position the assembly.
b) Secure the assembly by tightening the escutcheon plate to the side of the housing and by tightening the knurled lock nut onto the nozzle line. (lock nut's 'recessed side' faces out).

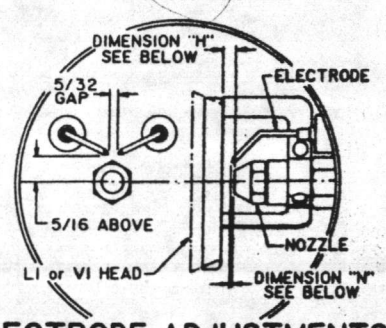
4B. 'V-HEAD' AIR TUBE COMBINATIONS: **VARIABLE** (MD and ME)

a) Attach 'Adjusting Plate Assembly' to the side of the housing securing it in the number "0" position. Refer to FIG. 6.
b) Insert 'nozzle line electrode head assembly' into the tube and through the Adjusting Plate Assy. Loosely attach the knurled lock nut to the nozzle line. (lock nut's 'recessed side' faces out).
c) Tighten the acorn nut on the Adjusting Plate Assy. when the head is at the proper "Z" dimension as shown in FIG. 6 or 7.
d) Loosen the Adjusting Plate Assy. hold down screw. Slide the head and plate to the required firing rate setting as shown in chart "A" below. Tighten the screw and knurled nut.

5. Attach 'connector tube assembly to the pump and nozzle line.

FIRING RATE	ADJUSTING PLATE SETTINGS
0.75 - 1.00	0
1.00 - 1.50	1
1.50 - 1.75	2
1.75 - 2.25	3
2.25 - 2.50	4
2.50 - 2.75	5

CHART "A"



ELECTRODE ADJUSTMENTS (FOR LI or VI HEADS)

MODELS	DIMENSION "N"	DIMENSION "H" (HEAD TO NOZZLE)
LI	1/16"	7/32" to 9/32"
VI	1/16"	7/32" to 9/32"

FIG. 4

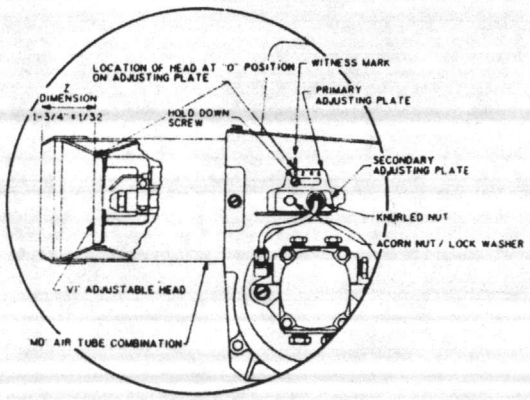


FIG. 6

DIMENSIONAL RELATIONSHIPS "MA", "MB" & "MC"

"Z" = 1-3/8" ± 1/32"	"E" = 1-5/8"
"A" = 50M* = 5-1/16"	"Q" = 50M* = 5-15/32"
70M* = 6-27/32"	70M* = 7-7/32"
90M* = 8-27/32"	90M* = 9-11/32"
"L" = 50M* = 5-11/16"	"R" = 50M* = 6-1/2"
70M* = 7-7/16"	70M* = 8-21/32"
90M* = 9-7/16"	90M* = 10-1/2"

(*)=Insert "A", "B" or "C" depending on the Air Tube Combination

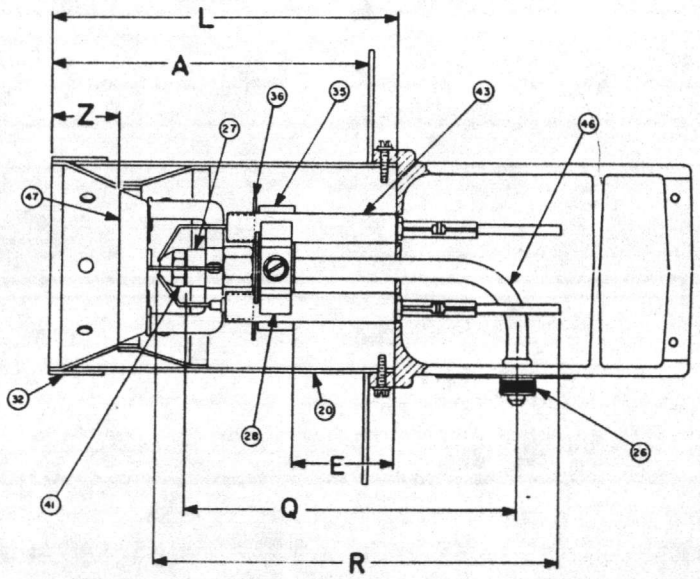


FIG. 5

DIMENSIONAL RELATIONSHIPS "MD" & "ME"

"Z" = 1-3/4" ± 1/32"	"E" = 1-5/8"
"A" = 50M* = 5-7/32"	"Q" = 50M* = 4-15/32"
70M* = 7-5/16"	70M* = 7-19/32"
90M* = 9-1/16"	90M* = 9-11/32"
"L" = 50M* = 5-13/16"	"R" = 50M* = 6-1/2"
70M* = 7-15/16"	70M* = 8-21/32"
90M* = 9-11/16"	90M* = 10-1/2"

(*)=Insert "D" or "E" depending on the Air Tube Combination

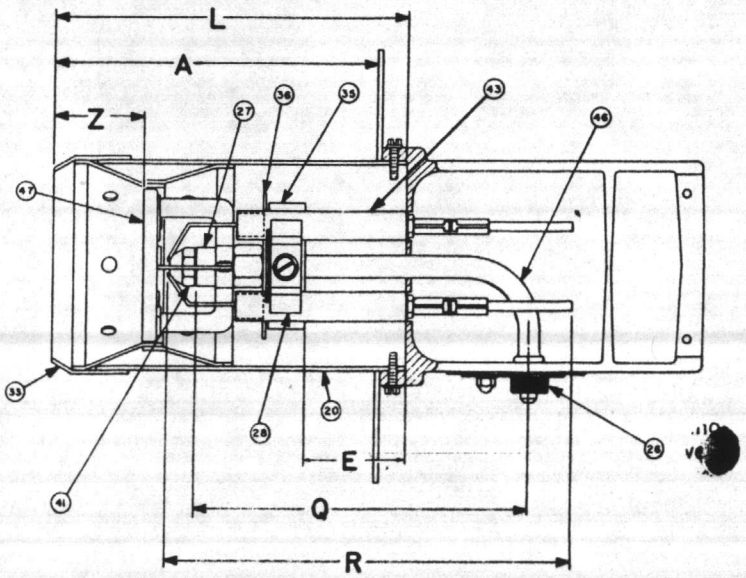
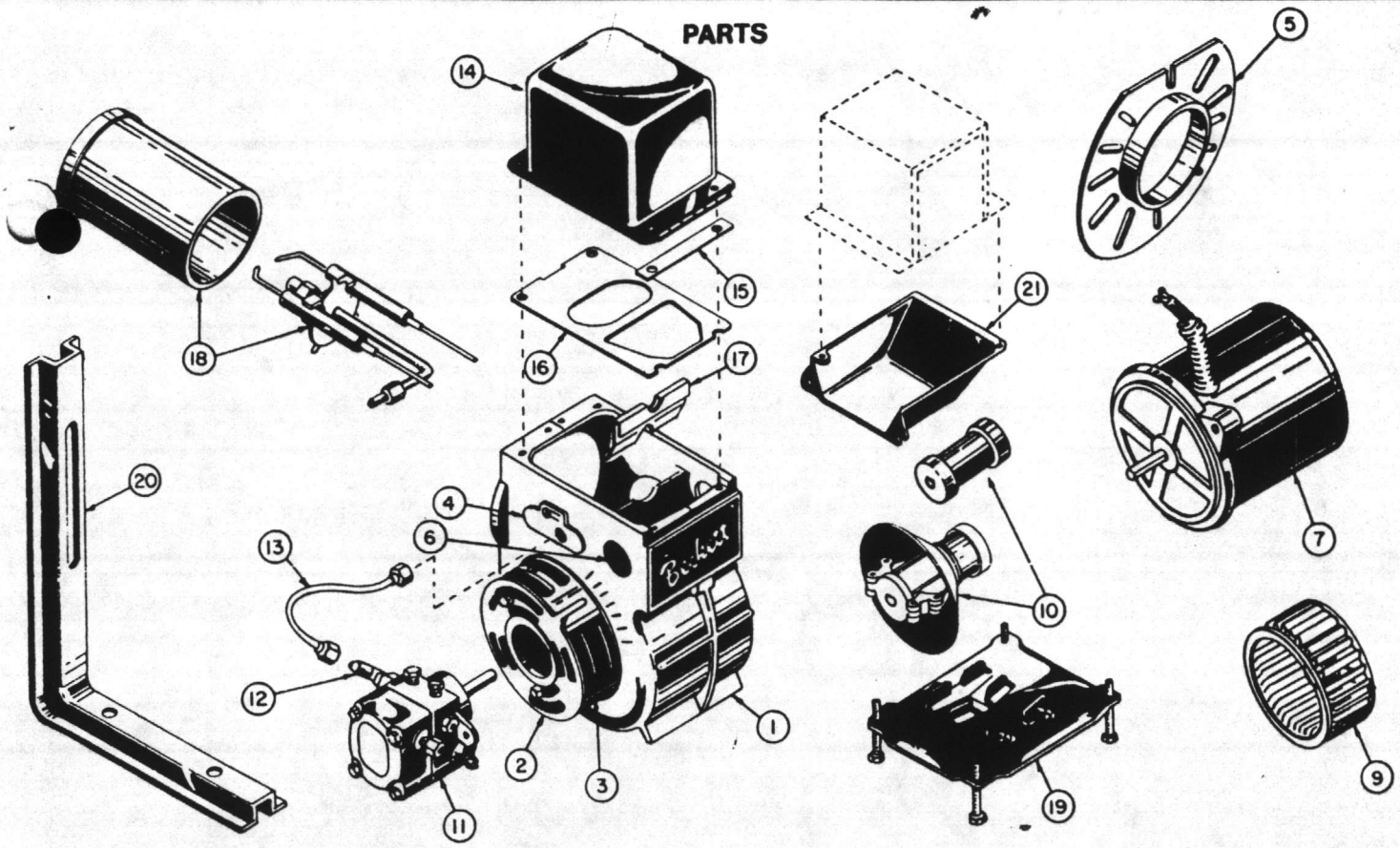


FIG. 7

PARTS



WHEN ORDERING PARTS - STATE BURNER MODEL, PART DESCRIPTION AND PART NUMBER

REF.	DESCRIPTION	PART NO.
1	Burner Housing Assembly	5877
2*	Air Shutter	3709
	Retaining Screws	4198
3	Air Band	3492
	Screw	4198
	Nut	4150
4*	Escutcheon Plate	3493
	Adjusting Plate Assy.	5941
	Screw	4187
5	Flange	
	Square Plate*	3399
	Gasket, Square Plate*	3380
6*	Hole Plug	2139
7	Drive Motor	2456
	Mounting Screws	4189
9	Blower Wheel (Use Only RWB Replacement)	2999
10	Inlet Air Shut-Off	5861

REF.	DESCRIPTION	PART NO.
10	Coupling	2454
11	Fuel Unit	
	Mounting Screws	4189
12	Pump Nozzle Port Fitting	2256
13	Connector Tube Assembly	5636
14	Ignition Transformer Assembly	5878
	Consists of the following:	
	Ignition Transformer	2442
	Hinge Screws	4217
	Holding Screws	4292
15*	Hinge to Housing Gasket	31232
16	Transformer Gasket	3502
17*	Low Firing Rate Baffle	3708
18	Air Tube Combination (Specify Type F or M)	
19	Pedestal Support Kit	5685
20	Extended Pedestal Kit	5606
21	Junction Box Kit	5770

*These items included in 5877 Burner Housing Assembly.

RECOMMENDED FIRING RATES GPH

HEAD DESIGN	ATC CODE	HEAD	STATIC PLATE	FRONT VENTURI	With Inlet Air Shut-Off MIN	With Inlet Air Shut-Off MAX	Without Inlet Air Shut-Off MIN	Without Inlet Air Shut-Off MAX
Fixed	XR	F0	3-3/8"	None	0.40	0.75	0.40	0.75
Fixed	XN	F3	2-3/4"	None	0.75	1.25	0.75	1.25
Fixed	YB	F6	2-3/4"	None	1.25	1.65	1.25	1.65
Fixed	XO	F12	2-3/4"	None	1.65	1.75	1.65	2.00
Fixed	XP	F22	2-3/4"	None	1.75	2.25	1.75	2.50
Fixed	XS	F31	None	None	2.50	2.75	2.50	3.00
Fixed	*MA	L1	3-3/8"	4 holes	0.40	0.75	0.40	0.75
Fixed	MB	L1	3-3/8"	8 holes	0.50	1.00	0.50	1.00
Fixed	*MC	L1	2-3/4"	8 holes	0.50	1.25	0.50	1.25
Adjustable	MD	V1	2-3/4"	8 holes	0.75	2.00	0.75	2.75
Adjustable	*ME	V1	2-3/4"	0 holes	1.00	2.00	1.00	2.75

INSTALLATION INSTRUCTIONS

* **Installation information:** Refer to fuel unit manufacturer literature for piping, connections, lift and tank installation. If such information is unavailable use the following guidelines.

FUEL UNITS/FUEL LINES

* **Fuel supply "level with" or "above" burner:** A single stage fuel unit connected to the fuel supply with a single supply line is the most common type of installation for these conditions. Manual venting of the fuel unit is usually required on initial start-up. Failure to vent air could result in an air lock/oil starvation condition. (One pipe)

* **Fuel supply below the level of burner:** Use a single stage fuel unit in lift conditions of up to 10 ft, and a two stage fuel unit when the lift exceeds 10 ft. Both conditions require the use of a return line which purges the fuel unit of air returning it to the fuel tank. The "by-pass" plug must be inserted into the fuel unit when installing a return line. (Two pipe)

* **Fuel line installation:** Continuous lengths of heavy wall copper tubing are recommended and should be installed under the floor when possible. **Always use flare fittings.** Always install fittings in accessible locations. Never use teflon tape on any fuel fitting. Use of teflon will void any warranty. Fuel lines should not run against the appliance or the ceiling joists.

* **Fuel line valve and filter:** Install two high quality shutoff valves in accessible locations on the oil supply line. Locate one close to the tank and the other close to the burner ahead of the filter. Some filters come with built-in shutoff valves.

Install a generous capacity filter inside the building between the fuel tank shutoff valve and the burner locating both the filter and the valve close to the burner for ease of servicing.

Always use flare fittings. Never use compression fittings.

COMBUSTION AIR SUPPLY

* **Appliance located in confined space:** The confined space should have two permanent openings: one near the top of the enclosure and one near the bottom of the enclosure. Each opening shall have a free area of not less than (1) one square inch per 1,000 BTU's per hour of the total input rating of all appliances within the enclosure. The openings shall have free access to the room interior which should have adequate infiltration from the outside.

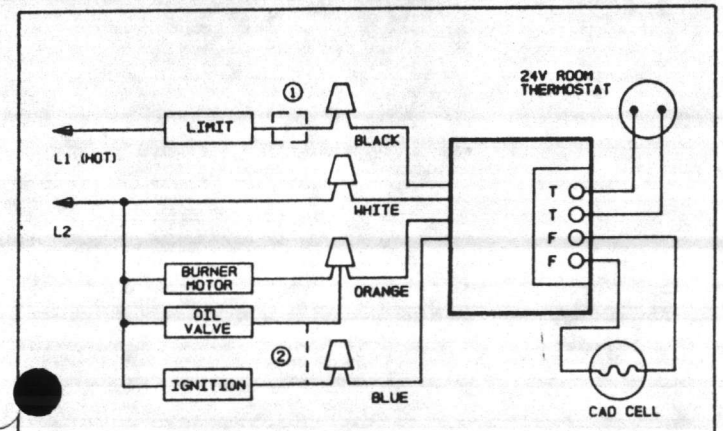
* **Additional "air using" appliances and devices:** It might be necessary to duct outside air to the burner in order to support clean combustion.

COMBUSTION CHAMBERS

* **Protecting stainless steel chambers:** A chamber burn-out could result from the use of a high performance burner. Protect the chamber from high temperatures through the use of a "wet-pac" or a similar ceramic liner. Some new equipment may contain stainless steel chambers which have been designed and tested by the manufacturer for use with flame retention burners. In such a case ceramic protection would not be necessary.

WIRING

* **Line to control/control to burner:** All wiring must be in accordance with the National Electric Code and local codes and regulations. Refer to the diagram below for correct connections.



① TO USE WITH LINE VOLTAGE THERMOSTAT JUMPER TERMINALS T-T AND ADD THERMOSTAT AS SHOWN AT ① IN SERIES WITH LIMIT CONTROL.

② FOR CONSTANT IGNITION BURNER CONNECT IGNITION TO ORANGE LEAD AND TAPE BLUE LEAD.

BURNER SET-UP

BURNER ASSEMBLY

* **"Burner/appliance" package:** The burner is pre-assembled and mounted to the appliance. If the burner lacks a control refer to "WIRING" in the preceding column. Refer to the section on either "ATTACHING 'F-HEAD' AIR TUBE COMBINATIONS" or "ATTACHING 'L or V-HEAD' AIR TUBE COMBINATIONS", depending on the combination used, for the necessary adjustments, then proceed to **BURNER START-UP.**

* **"Assembled burner" package:** The burner is pre-assembled and packaged in a carton. If the burner lacks a control refer to "WIRING" in the preceding column. Refer to the section on either "ATTACHING 'F-HEAD' AIR TUBE COMBINATIONS" or "ATTACHING 'L or V-HEAD' AIR TUBE COMBINATIONS", depending on the combination used, for the necessary adjustments, then proceed to "BURNER MOUNTING".

* **"Chassis/Air Tube" package:** The air tube must be attached to the chassis before proceeding. Refer to the section on "ATTACHING 'F-HEAD' AIR TUBE COMBINATIONS" or "ATTACHING 'L or V-HEAD' AIR TUBE COMBINATIONS", depending on the combination used, for the necessary adjustments. If the burner lacks a control refer to "WIRING" in the preceding column, then proceed to "BURNER MOUNTING".

BURNER MOUNTING

* **Mounting options:** The burner may be mounted to the appliance with either a flange or a pedestal.

* **Mounting dimensions:** The air tube should be mounted on a (2) two degree downward pitch. (Refer to FIG. 1) If a *Beckett* flange is used the tube will automatically have the correct pitch.

The air tube length is determined by the insertion depth of the appliance. (Refer to FIG. 1)

The "head" end of the tube must be 1/4" back from the inside wall of the combustion chamber. Never allow the tube to extend into the chamber. (Refer to FIG. 1)

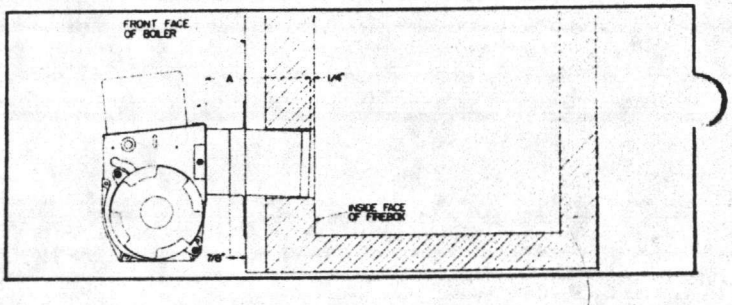


FIG. 1

The Air Tube Length (Dimension A) is the distance from the front of the burner housing to the drain hole in the burner head. (NOTE: Adjustable Flange width = 7/8", Cast Iron Flange = 1-1/8".)

BURNER START-UP

STARTING THE BURNER

* **Precautions:** Do not attempt to start the burner when excess oil has accumulated, when the furnace or boiler is full of vapor, or when the combustion chamber is very hot.

* **Procedures:**

1. **Set the thermostat** substantially above room temperature.
2. **Open the shut-off** valves in the oil supply line to the burner.
3. **Check initial air adjustment.** Normally the bulk air band should be closed and the shutter partially opened.
4. **Close the line switch** to start the burner. If the burner does not start immediately reset the manual overload switch on the motor, if so equipped, and the safety switch of the burner primary control.
5. **Vent the fuel unit** as soon as the burner motor starts rotating. To vent the fuel unit attach a clear plastic hose over the vent plug. Loosen the plug and catch the oil in an empty container. Tighten the plug when all the air appears to be purged.

* **Burner stops during venting:** Wait three to five minutes for the control safety switch to cool, then manually reset the switch completing the venting procedure.

* **Burner stops after flame is established:** Additional venting is probably required. Repeat the venting procedure.

OIL BURNER CERTIFICATE

BURNER:
MODEL _____ SERIAL NO. _____
INSTALLATION ADDRESS _____
_____

HEATING UNIT:
MODEL _____ SERIAL NO. _____

BURNER DATA:
NOZZLE TYPE _____ GPH _____ ANGLE _____

PERFORMANCE DATA:
FIRING RATE = _____ GPH @ _____ PSI
C02/02 OVER FIRE = _____ C02/02 @ BREECHING = _____
SMOKE = _____ FUEL GRADE = _____
DRAFT OVER FIRE = _____ DRAFT @ BREECH = _____
AMBIENT TEMP. = _____ NET FLUE GAS TEMP. = _____
FLUE GAS TEMP AT BREECHING = _____

Heating system and controls have been checked for proper operation
By _____
Per _____ Date ____/____/____
Address _____
_____
Phone (____)-____-____

FOR SERVICE CALL
Name _____ Phone _____
Address _____

TO THE SERVICEMAN:

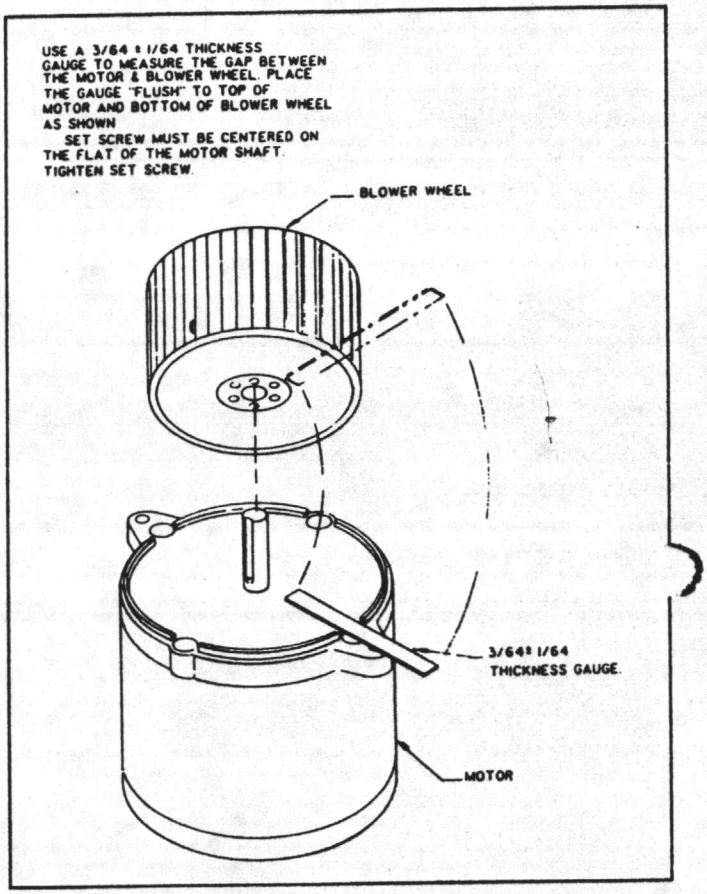
Before you begin to service the burner take the time to work through the following simple checklist. Also instruct the homeowner to follow this checklist before calling you. It could save you a service call.

- Be sure there is oil in the tank and all the valves are open.
- Be sure the thermostat is set above room temperature.
- Be sure the main line switch is "ON" and fuses are not blown or breakers are not tripped.
- Reset the Safety Switch of the Burner Primary Control.
- Press Thermal Protector button on motor.
- If installation is equipped with a Manual Reset Limit Control press the reset button.
- Make sure the blower housing and the fan are clear of any lint or dirt.

If all the above conditions check out fine and the burner runs, but no flame is observed, the fuel unit may be airbound. Follow the instructions on venting the fuel unit.

SUGGESTED COMBUSTION CHAMBER DIMENSIONS - UPGRADING OR CONVERSION

Chamber Dimensions (In Inches)					
Firing Rate (GPH)	Round I.D.	Rectangular W	Rectangular L	Height	Floor To Nozzle
.50	8	7	8	12	5-6
.75	9	8	9	12	5-6
1.00	10	9	10	12-1/2	5-6
1.25	11	10	11	12-1/2	5-6
1.50	12	11	12	13	6-7
2.00	14	12	15	13-1/2	6-7
2.50	16	13	17	14	7-8
3.00	18	14	18	15	7-8



LOW FIRING RATE BAFFLE USEAGE CHART

Head	Firing Rate, GPH	Without IAS	With IAS
F0	0.50	X	X
	0.65	X	X
	0.75	—	—
F3	0.75	X	X
	0.85	X	—
	0.90	—	—
	1.00	—	—
F6	0.85	X	X
	0.90	X	X
	1.00	—	—
L1	0.50 - 0.85	X	X
V1	0.75 - 1.00	X	X

* The Baffle is required as indicated by the [X] on the chart.

R.W. BECKETT CORPORATION
P.O. Box 1289 • Elyria, Ohio 44036

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 Instruction Sheet

102-052

Horizontal Circulators Nos. 110 thru 120

Plant I.D. No. 001-318

APPLICATION:

1. Maximum recommended working pressure is 125 psi (862 K Pa).
2. Maximum water temperature must not exceed 240°F.
3. Cast Iron Circulators should be used for closed systems only.
4. Bronze circulators must be used in open or fresh water systems and potable water systems.

INSTALLATION:

1. Mounting position — Circulators must be mounted with motor in a horizontal position.
2. Rotating casing — Casing has an arrow on front which indicates direction of flow. To rotate casing remove the casing bolts, rotate casing and replace bolts. Make sure gasket is properly located before tightening bolts.
3. Electrical connections — Observe all applicable codes when connecting to power supply. The motors do not require overload protection.
4. Fill system — It is good practice to flush a new system of foreign matter before starting circulator.

TO REPLACE MOTORS:

1. Disconnect wiring.
2. Loosen the two set screws at pump end of spring coupling, remove bolts between bracket and motor and separate.
3. Loosen other set screw of coupling and remove coupling from old motor.
4. Slide coupler with single set screw over new motor shaft and tighten against flat surface of shaft.
5. Place new motor assembly into bracket and replace bolts.
6. Extend pump end of spring coupling over impeller shaft 3/16" and tighten both set screws. If impeller and shaft move into body during this operation, water will flow from weep hole in bracket. If this does occur, extend spring coupler a little more or until water stops flowing. CAUTION: UNDER NO CIRCUMSTANCES SHOULD THE WEEP HOLE BE PLUGGED.
7. Rewire motor.

TO REPLACE SPRING COUPLING

Follow same procedure outline above.

LUBRICATING INSTRUCTIONS

Re-oil pump and motor annually with SAE No. 30 oil.

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

COMPARE. YOU'LL TAKE TACO.

TACO, Inc., 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex: 92-7627
TACO, (Canada) Ltd., 1310 Aimco Blvd., Mississauga, Ontario L4W 1B2 (416) 625-2160 Telex: 06-961179

REPLACING SEALS

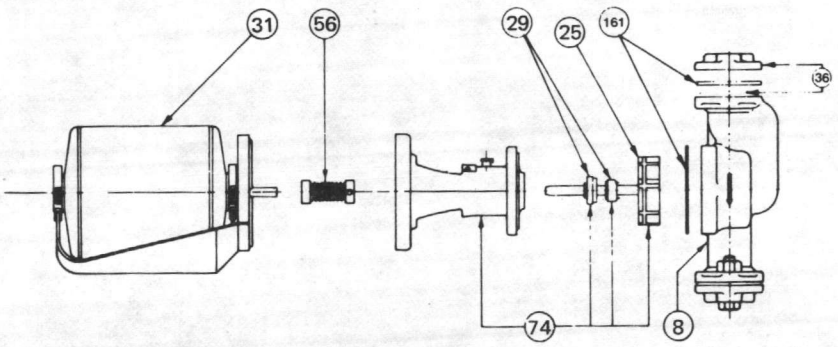
Water flowing from weep hole in bracket normally indicates dirt on the seat or seal needs replacement. Before taking pump apart extend spring coupling and impeller shaft into body as far as it will go. This will separate the seal halves and permit a greater flow thru the weeping hole and wash any foreign matter off the seats. Release and if flow stops, it indicates that the seals do not require replacement. If the flow does not stop, loosen the two set screws on the coupling and extend as far as it will go. If leak stops it means there was insufficient tension on the coupling. If leak continues, indications are that the seal needs replacement. Proceed as follows: —

1. Disconnect wiring.
2. Valve off or drain system.
3. Remove body bolts and pull entire assembly out of body.
4. Loosen the two set screws at pump end of spring coupler, file off any burrs on shaft and pull impeller and shaft from bracket.
5. Pry out old seal seat from bracket with a screwdriver and old part from impeller shaft with a pair of pliers.
6. Clean shaft and seal bearing surfaces thoroughly with clean cloth.
7. Dip CARBON part of seal in water to lubricate, place on top of impeller shaft with carbon facing up. Push down on shaft with palm of hand as far as it will go. Then with both thumbs push all the way down making certain that prongs engage the two holes in the impeller. If there are no holes in the impeller, break off the prongs with a pair of pliers and smooth burrs with a file.
8. Separate rubber from ceramic part, wet it and set into recess in bracket. Set ceramic seal into rubber with seat facing out by starting at a slight angle first, then pushing away and down simultaneously. The rubber rings should not be folded over during the operation. Make certain that both the rubber and ceramic are "bottomed" squarely.
9. Clean both seal surfaces with a clean lintless cloth.
10. Place a few drops of oil along the impeller shaft and push slowly with a twisting motion through ceramic part into bracket and spring coupling.
11. While holding impeller and shaft with seal faces mating, insert an Allen wrench into one of the set screws in the coupling, extend spring — 3/16".
12. Remove old body gasket, clean surfaces and replace with new gasket.
13. Place entire assembly into body, replace and tighten bolts gradually and evenly all around.
14. Refill system. If water leaks from weep hole in bracket increase tension on spring coupling slightly more or until leak stops.
15. Rewire motor.

Taco	REPLACEMENT PARTS LIST
NUMBER **104-003**	**Effective: April 15, 1987** **Supersedes: PL100-1.2 dated 6/1/83**

REPLACEMENT PARTS FOR 110 Through 120

REFER TO 103-012 for LIST PRICES



PARTS FOR 110 to 120 CIRCULATORS

NAMEPLATE MODEL NO.	ITEM 8 BODY	ITEM 25 IMPELLER & SHAFT	ITEM 31 MOTOR	ITEM 74 BEARING BRACKET	ITEM 161 GASKETS
CAST IRON					
HC, 110, 110C	110-226RP	110-207RP	110-223RP	110-361RP	110-127RP
HDH, 111, 111C	111-004RP	111-053RP	110-185RP	111-058RP	110-127RP
112	110-226RP	112-043RP	112-074RP	112-120RP	110-127RP
113	113-001RP	113-009RP	110-185RP	113-013RP	110-127RP
120-1 to 120-5	N/A	120-056RP	120-105RP	120-076RP	120-073RP
120-6 to 120-12	120-083RP	120-038RP	120-105RP	120-067RP	120-073RP
CAST IRON WITH NON-FERROUS IMPELLER					
112C	110-226RP	112-055RP	112-074RP	112-103BRP	110-127RP
113C	113-001RP	113-009RP	110-185RP	113-013RP	110-127RP
120C-1 to 120C-5	N/A	120-060RP	120-105RP	120-078RP	120-073RP
120C-6 to 120C-12	120-083RP	120-054RP	120-105RP	120-069RP	120-073RP
BRONZE					
HCB, 110B	110-226BRP	110-207RP	110-223RP	110-362BRP	110-127RP
111B	111-004BRP	111-053RP	110-185RP	111-059BRP	110-127RP
112B	110-226BRP	112-055RP	112-074RP	112-103BRP	110-127RP
113B	113-001BRP	113-009RP	110-185RP	113-012BRP	110-127RP
117B	N/A	110-207RP	110-223RP	110-362BRP	110-127RP
117B-S2, -S3	N/A	110-207RP	110-223RP	110-362BRP	110-127RP
120B-1 to 120B-5	N/A	120-060RP	120-105RP	120-077BRP	120-073RP
120B-6 to 120B-12	120-083BRP	120-054RP	120-105RP	120-068BRP	120-073RP

ITEM 29 – Water Seal 110-275RP

ITEM 56 – Coupler, 110-009RP

ITEM – Flange Set ¾", 1", 1¼", & 1½" Interchangeable. Refer to Price Sheets 103-003. For 120 models with 2 holes, specify 1600-032BRP for Bronze, 1600-032RP for Cast Iron.

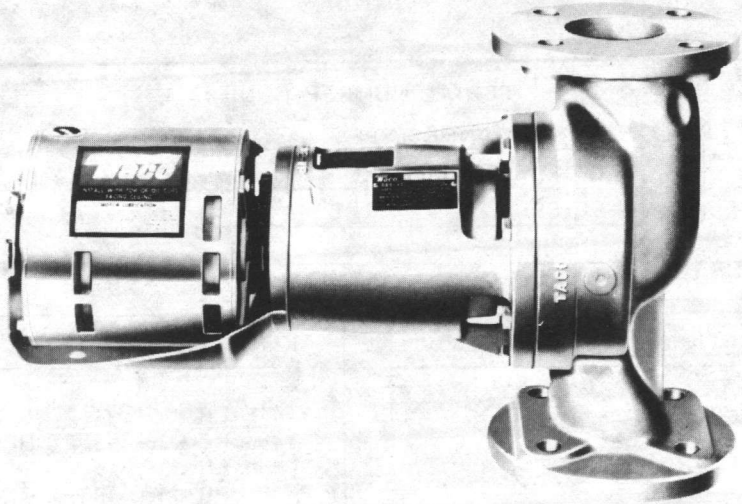
For 120 models with 4 holes, specify 120-044RP for Cast Iron, 120-044BRP for Bronze.

Taco	REPLACEMENT PARTS
NUMBER **304-001**	Effective: November 1, 1987 Supersedes: 304-001 dated: 12/1/85

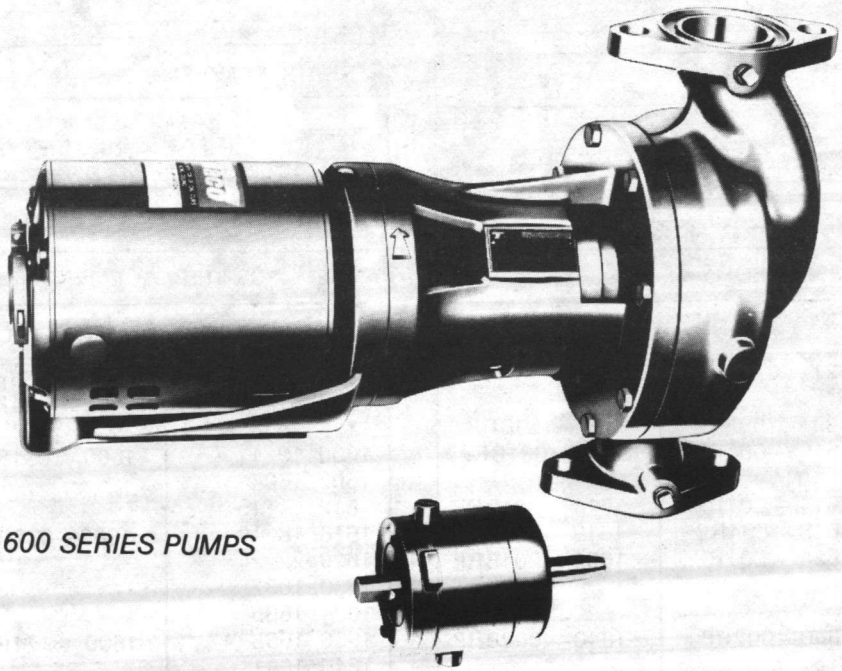
121 THRU 138 PUMPS
1600 SERIES PUMPS

IMPORTANT: When ordering, always specify part number, part name, and complete model number of pump.

CARTRIDGE DESIGN PUMPS



121 – 138 SERIES PUMPS



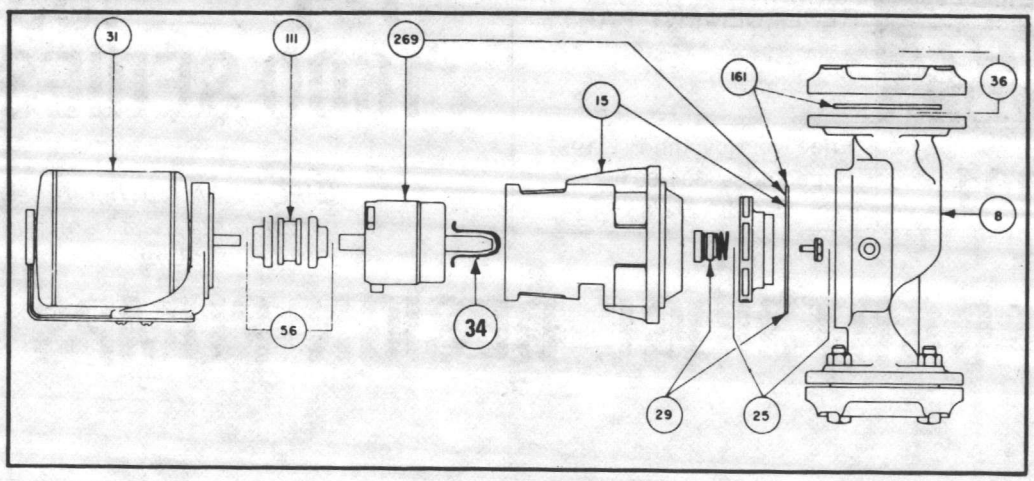
1600 SERIES PUMPS

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



SERIAL NUMBER CODE

1600 - 4.25 C 1&2 N 1 N

- N — FLANGE TYPE
- 1 — MOTOR FRAME SIZE
- N — WATER SEAL
- 1&2 — 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	"	"
1600, 10, 11	1600 – 031RP	1600 – 031BRP
1602, 1604	"	"
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.

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	N/A	N/A	1600 –050RP
1600, 10, 11	"	"	N/A	N/A	"
1602, 1604	1600 – 175RP	1600 – 176BRP	N/A	N/A	"
1612, 20, 30	"	"	N/A	N/A	"
131, 132	"	"	N/A	N/A	"
1615 *	–	–	–	–	"
133, 138	NA	N/A	1604 – 023RP	1604 – 024RP	"
1614, 22, 24	N/A	N/A	1604 – 023RP	1604 – 024RP	"
1632, 34	N/A	N/A	1604 – 023RP	1604 – 024RP	"
1635 *	—	—	–		"
1616, 36	N/A	N/A	1604 – 025RP	1604 – 026RP	1618 – 006RP
1619 *	—	—	–	–	"
1638, 40, 41	N/A	N/A	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. 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.

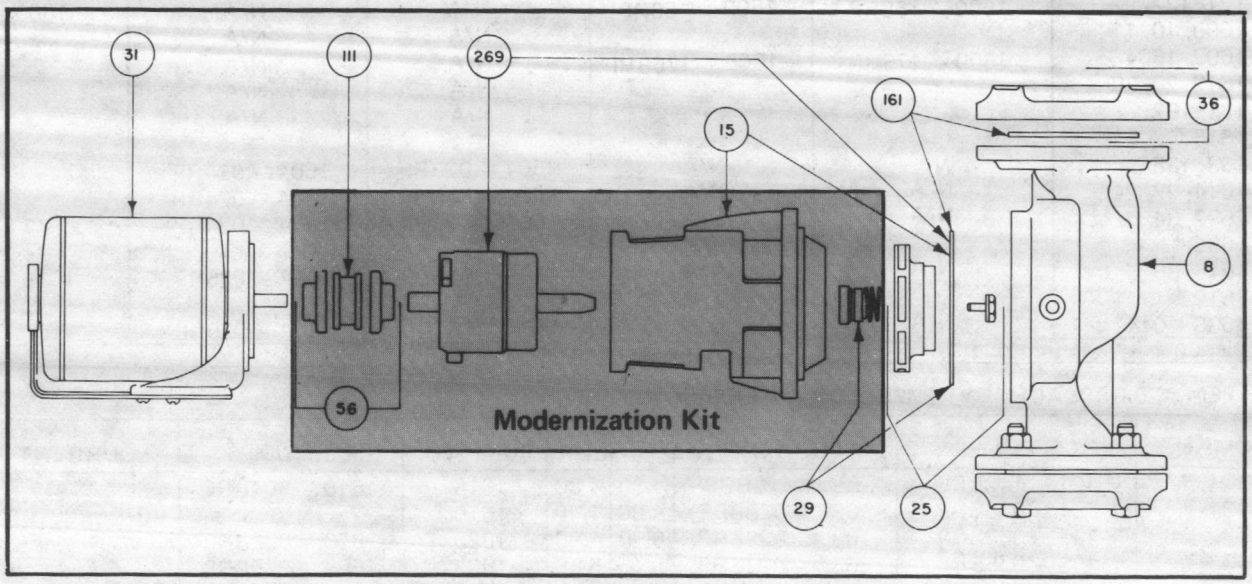
ITEM # 31 REPLACEMENT MOTOR ASSEMBLY *				
HP	115/60/1	115/230/60/1	200/60/3	230/460/60/3
1/4	121 – 151RP	N/A	121 – 148RP	121 – 137RP
1/3	131 – 143RP	N/A	131 – 115RP	131 – 137RP
1/2	N/A	132 – 096RP	132 – 066RP	132 – 097RP
3/4	N/A	133 – 119RP	133 – 140RP	133 – 134RP
1	N/A	138 – 119RP	138 – 148RP	138 – 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	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 (2) Select modernization kit per motor frame size. Select impellers per selection chart on previous page, under –9 column

*Change

Taco

REPLACEMENT PARTS LIST

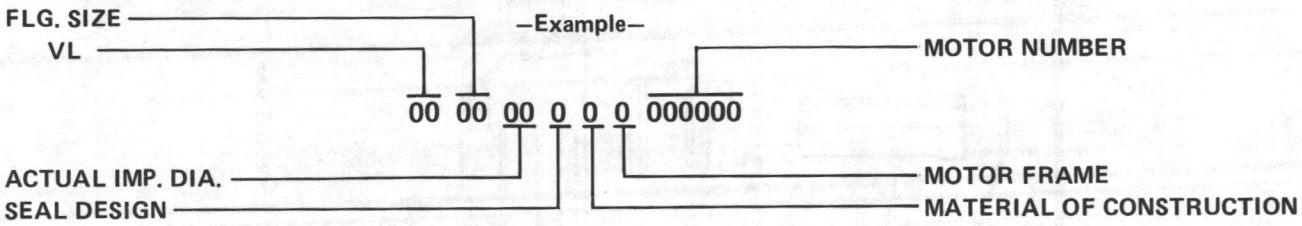
NUMBER

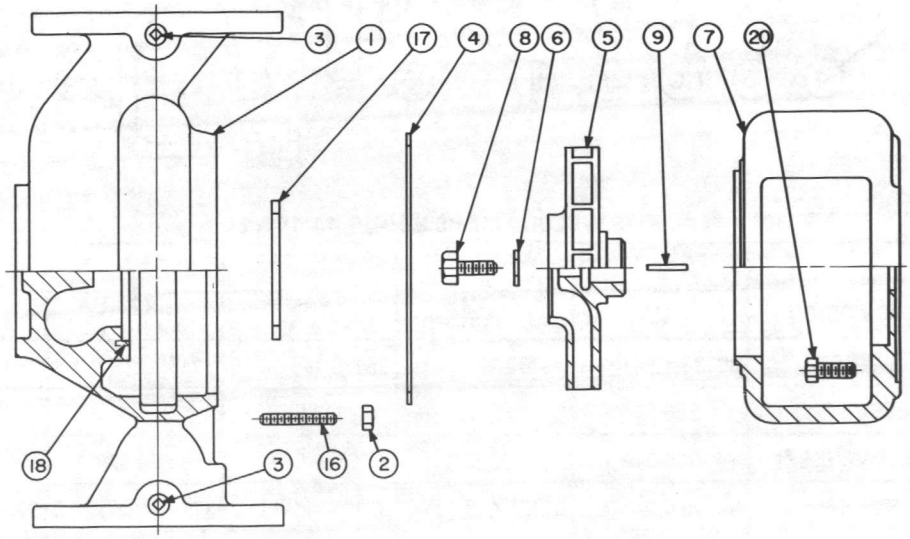
304-011

Effective: May 1, 1985
Supersedes: 304-011
dated 5/1/84

FOR FOLLOWING MODEL NUMBERS
VL 2008 & 2508

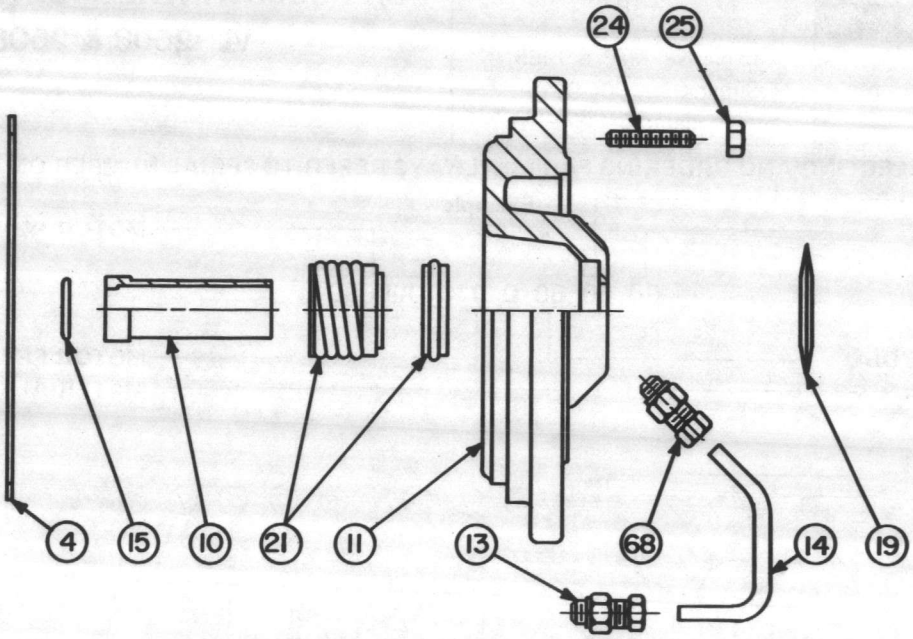
WHEN SELECTING AND ORDERING PARTS, ALWAYS REFER TO SERIAL NUMBER ON NAME PLATE





ITEM #	REQ	DESCRIPTION	2008 FRAME B or C	2008 FRAME D or E/F or G	2508 FRAME B or C	2508 FRAME D or E	2508 FRAME F or G
1	1	CASING	31164-164-124-0	31164-164-124-0	31164-430-124-6	31164-430-124-6	31164-430-124-6
2	8	NUT	21782-675-314-2	21782-675-314-2	21782-675-314-2	21782-675-314-2	21782-675-314-2
3	3	¼" NPT PLUG	16-104	16-104	16-104	16-104	16-104
4	1	GASKET	38133-125-781-8	38133-125-781-8	38133-125-781-8	38133-125-781-8	38133-125-781-8
5	1	IMP. C.I.	31635-121-124-2	31635-429-124-7	31677-117-124-5	31677-329-124-0	31677-329-124-0
5	1	IMP. BRZ.	31635-121-445-2	31635-429-445-7	31677-117-445-5	31677-329-445-0	31677-329-445-0
6	1	IMP. WASHER	950-046	950-047	950-046	950-047	950-047
7	1	ADAPTER	37641-118-122-5	37652-109-122-3	37641-118-122-5	37652-109-122-3	37654-117-122-2
8	1	IMP. BOLT	10-257	10-262	10-257	10-262	10-262
9	1	IMP. KEY	13-118	13-119	13-118	13-119	13-119
16	8	STUD	21712-437-950-1	21712-437-950-1	21712-437-950-1	21712-437-950-1	21712-437-950-1
17	1	WEAR RING C.I.	34114-210-124-4	34114-210-124-4	34114-211-124-1	34114-211-124-1	34114-211-124-1
17	1	WEAR RING BRZ.	34114-210-445-4	34114-210-445-4	34114-211-445-1	34114-211-445-1	34114-211-445-1
18	1	DOWEL PIN	21123-076-939-8	21123-076-939-8	21123-076-939-8	21123-076-939-8	21123-076-939-8
20	4	HEX HD. SCREW	21763-328-951-4	21763-448-951-7	21763-328-951-4	21763-448-951-7	21763-562-951-8

SEAL DESIGN OO OO OO X OO OOOOOO



SEAL PARTS FOR VL 2008 & 2508 – SEAL KITS INCLUDE ITEMS NO. 4, 6, 10, 15 & 21

ITEM #	REQ	DESCRIPTION	SEAL TYPE B FRAME B or C	SEAL TYPE B FRAME D or E/F or G	SEAL TYPE D FRAME B or C	SEAL TYPE D FRAME D or E/F or G	SEAL TYPE E FRAME B or C	SEAL TYPE E FRAME D or E/F or G
4	1	GASKET	38133-125-781-8	38133-125-781-8	38133-125-781-8	38133-125-781-8	38133-125-781-8	38133-125-781-8
10	1	SLEEVE (SS)	950-516	950-517	950-516	950-517	950-516	950-517
10	1	SLEEVE (BRZ)	950-519	950-520	950-519	950-520	950-519	950-520
11	1	COVER	37165-422-124-2	37165-419-124-6	37165-422-124-2	37165-419-124-6	37165-422-124-2	37165-419-124-6
13	1	FITTING	900-798	900-798	900-798	900-798	900-798	900-798
14	1	TUBE	900-728	900-728	900-728	900-728	900-728	900-728
15	1	O RING	950-110	950-111	950-110	950-111	950-110	950-111
19	1	DEFLECTOR	34111-259-005-0	34113-199-005-0	34111-259-005-0	34113-199-005-0	34111-259-005-0	34113-199-005-0
21	1	SEAL (TYPE B)	950-664	950-665				
21	1	SEAL (TYPE D)			950-667	950-668		
21	1	SEAL (TYPE E)					950-670	950-671
30	1	SEAL KIT (TYPE B)	950-664SRP 950-664BRP	950-665SRP 950-665BRP				
30	1	SEAL KIT (TYPE D)			950-667SRP 950-667BRP	950-668SRP 950-668BRP		
30	1	SEAL KIT (TYPE E)					950-670SRP 950-670BRP	950-671SRP 950-671BRP
24	8	STUD	21712-271-950-3	21712-332-950-3	21712-271-950-3	21712-332-950-3	21712-271-950-3	21712-332-950-3
25	8	NUT	21782-672-314-1	21782-673-314-8	21782-672-314-1	21782-673-314-8	21782-672-314-1	21782-673-314-8
68	1	FITTING	17-473	17-473	17-473	17-473	17-473	17-473

F 304-011

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

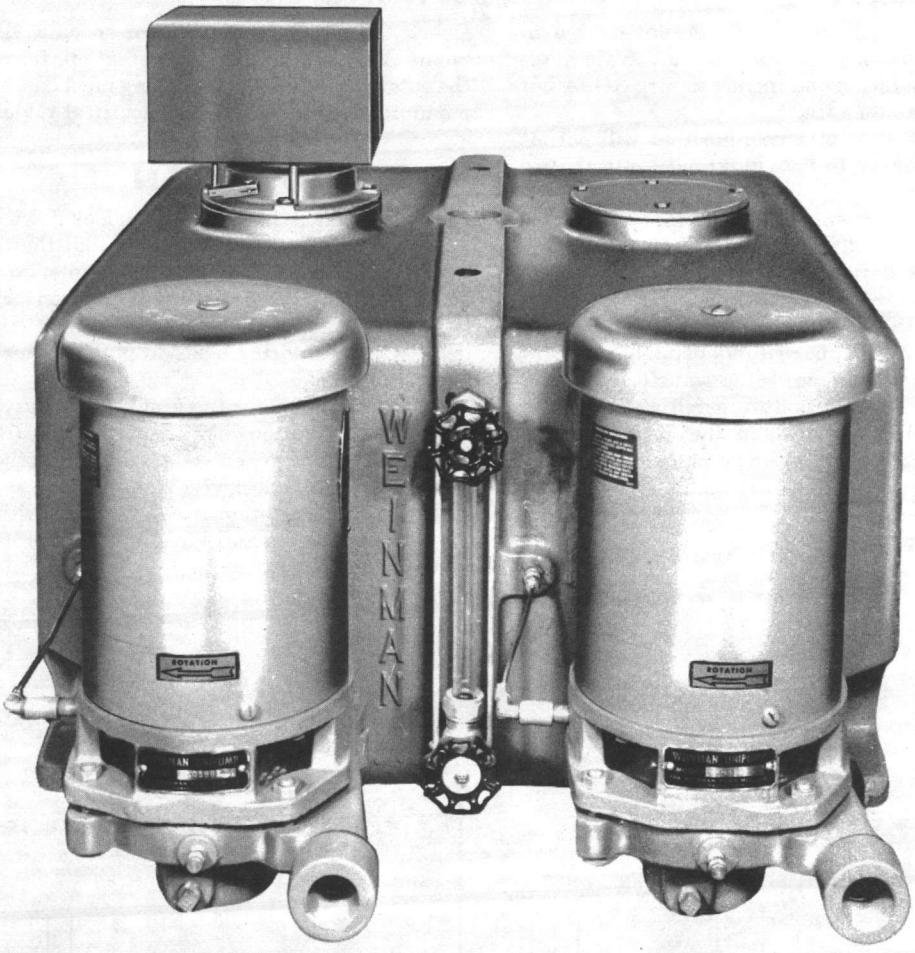
Litho in U.S.A.

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

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

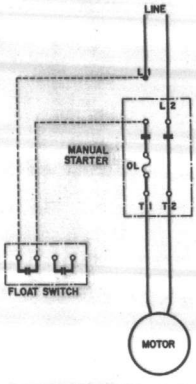
Pump rotation is clockwise as you look down on the pump. Single phase motors are wired so that they rotate clockwise automatically. Three phase motors, however, should be checked carefully for proper rotation prior to operation. To do this:

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

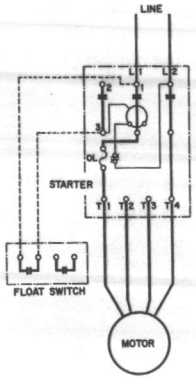
FLOAT SWITCH

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

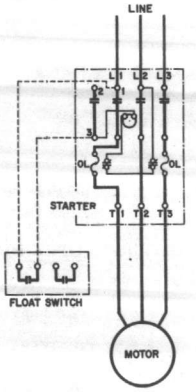


When using magnetic starter with three position selector switch (Hand-Off-Auto), connect float switch to terminals 1 and 2.

For low voltage, connect terminals T1 to T2, and T3 to T4.

For high voltage, connect terminal T2 to T3.

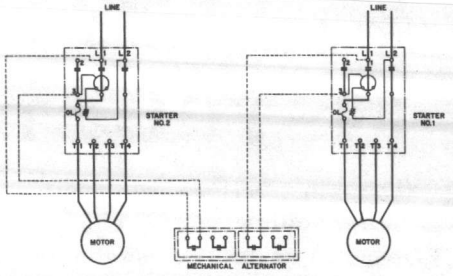
THREE PHASE MAGNETIC STARTER



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

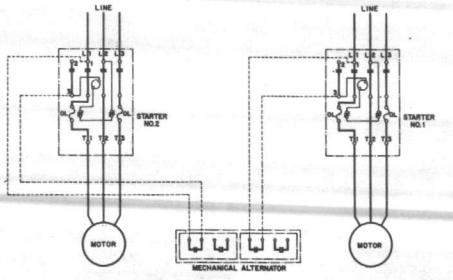


When using magnetic starter with three position selector switch (Hand-Off-Auto), connect alternator to terminals 1 and 2.

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.

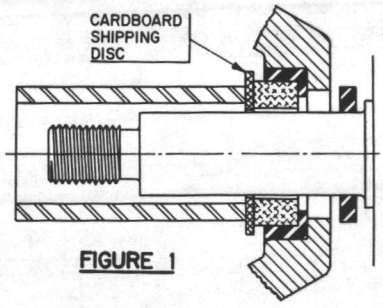


FIGURE 1

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.

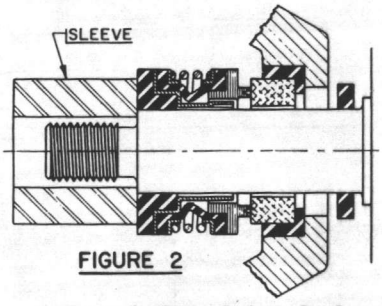
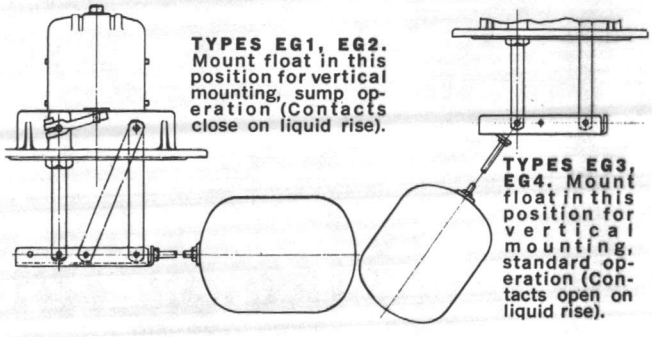


FIGURE 2

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

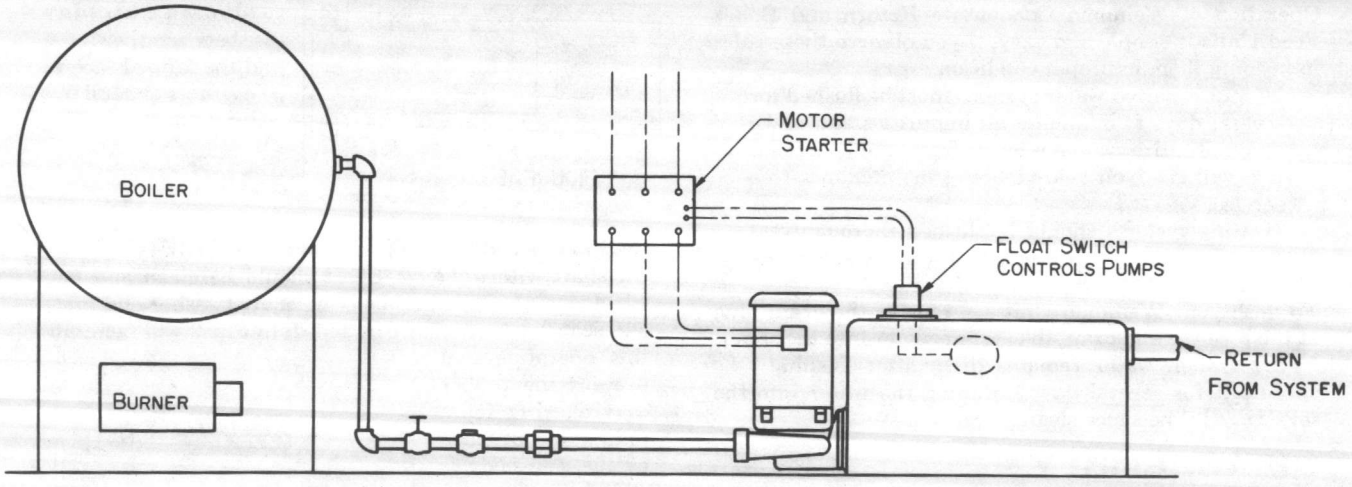
A. Failure to Pump

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

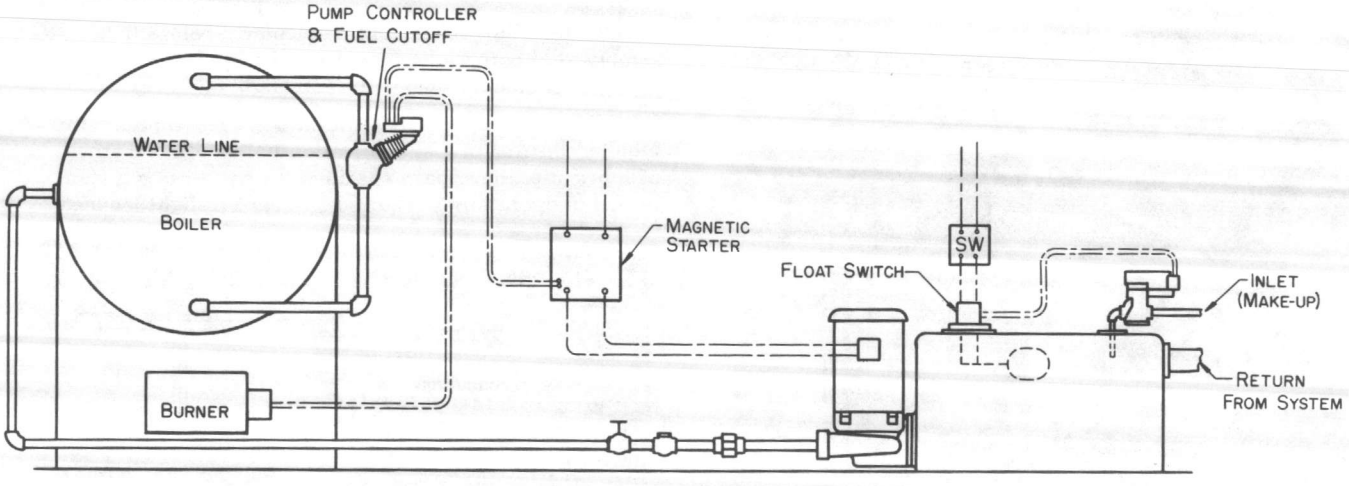
B. Overloaded Driving Unit

1. Total head too low
2. Unit misalignment (check for piping strains)

CONDENSATE RETURN UNIT CIRCUIT



BOILER FEED UNIT CIRCUIT



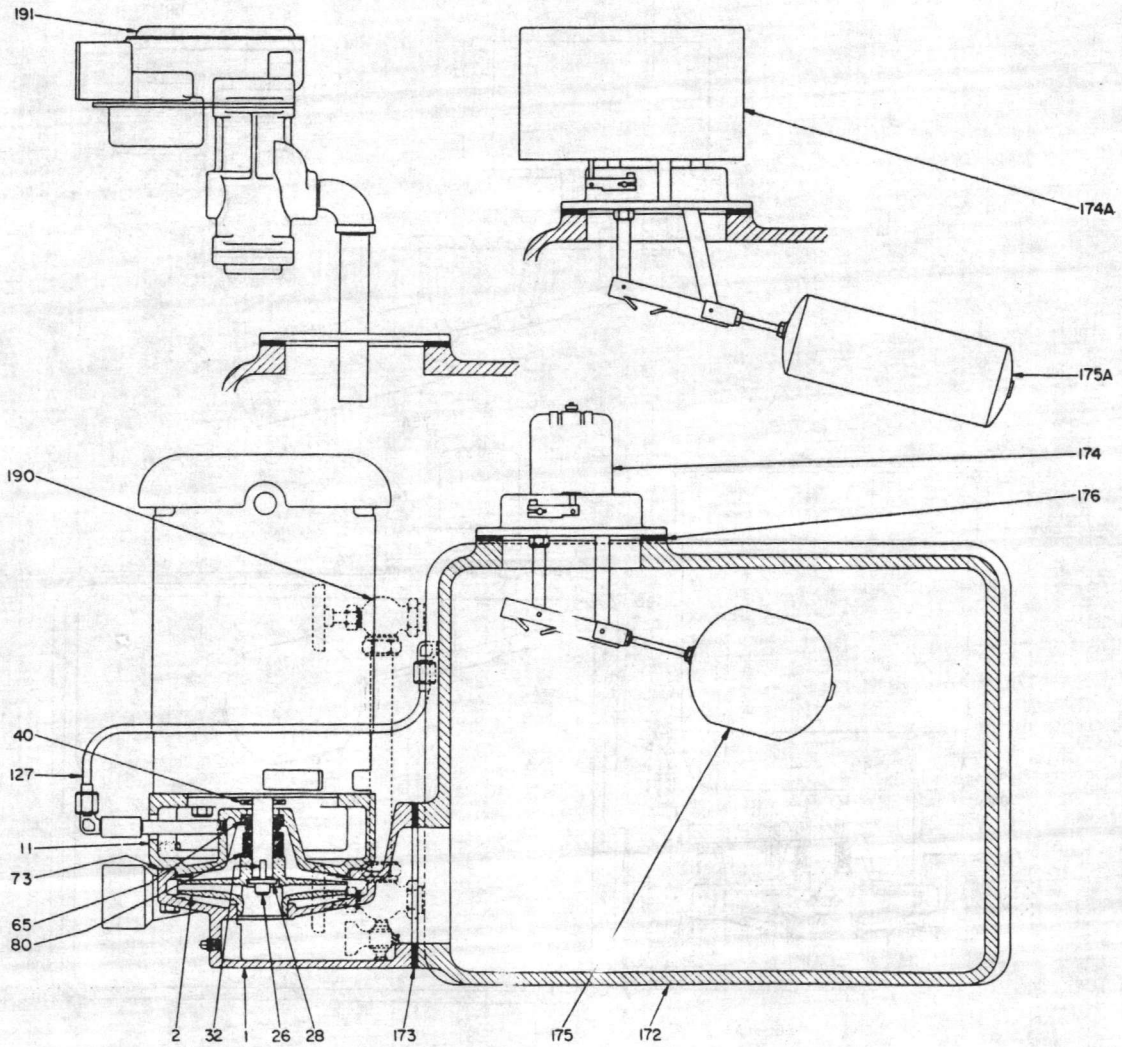
Mueller Pump
AERMOTOR-MIDLAND-WEINMAN
A MUELLER COMPANY
P.O. Box 1364 Commerce & Exchange
Conway, Arkansas 72032 501-329-9811

Printed in U.S.A.

Mueller Pump
AERMOTOR-MIDLAND-WEINMAN
A MUELLER COMPANY
P.O. Box 1364 Commerce & Exchange
Conway, Arkansas 72032 501-329-9811

REPAIR PARTS LIST

TYPES "ACV & AEV" VERTICAL CONDENSATE UNIT
CAST IRON RECEIVERS
(With Type 6 Mechanical Shaft Seal)



Item No.	Name	Material of Construction (St'd Fitted)
1	CASING	CAST IRON
* 2	IMPELLER	BRONZE
11	CASING COVER	CAST IRON
*26	IMPELLER SCREW	STAINLESS
*28	IMPELLER SCREW WASHER	STAINLESS
*32	IMPELLER KEY	STAINLESS
40	DEFLECTOR (Liquid)	NEOPRENE
† *65	MECHANICAL SHAFT SEAL (Stationary Element)	CERAMIC
*73	CASING GASKET	ASBESTOS
† *80	MECHANICAL SHAFT SEAL (Rotating Element)	CARBON
127	SEAL VENT PIPING	COPPER
172	RECEIVER	CAST IRON
*173	RECEIVER GASKET	RUBBER
174	FLOAT SWITCH	Sq. D. #9037
174A	MECHANICAL ALTERNATOR	Sq. D. #9038
175	FLOAT (Float Switch)	COPPER
175A	FLOAT (Alternator)	COPPER
176	FLOAT SWITCH GASKET	RUBBER
190	WATER GAUGE	BRASS
191	MAKE-UP VALVE (When Specified)	McDonnell #101

* FOR DOMESTIC SERVICE WE RECOMMEND THESE PARTS BE CARRIED IN STOCK AS SPARES.

† FURNISHED ONLY IN PAIRS AS COMPLETE UNIT.

WHEN WRITING THE FACTORY REGARDING YOUR PUMP – ALWAYS INCLUDE SERIAL NUMBER

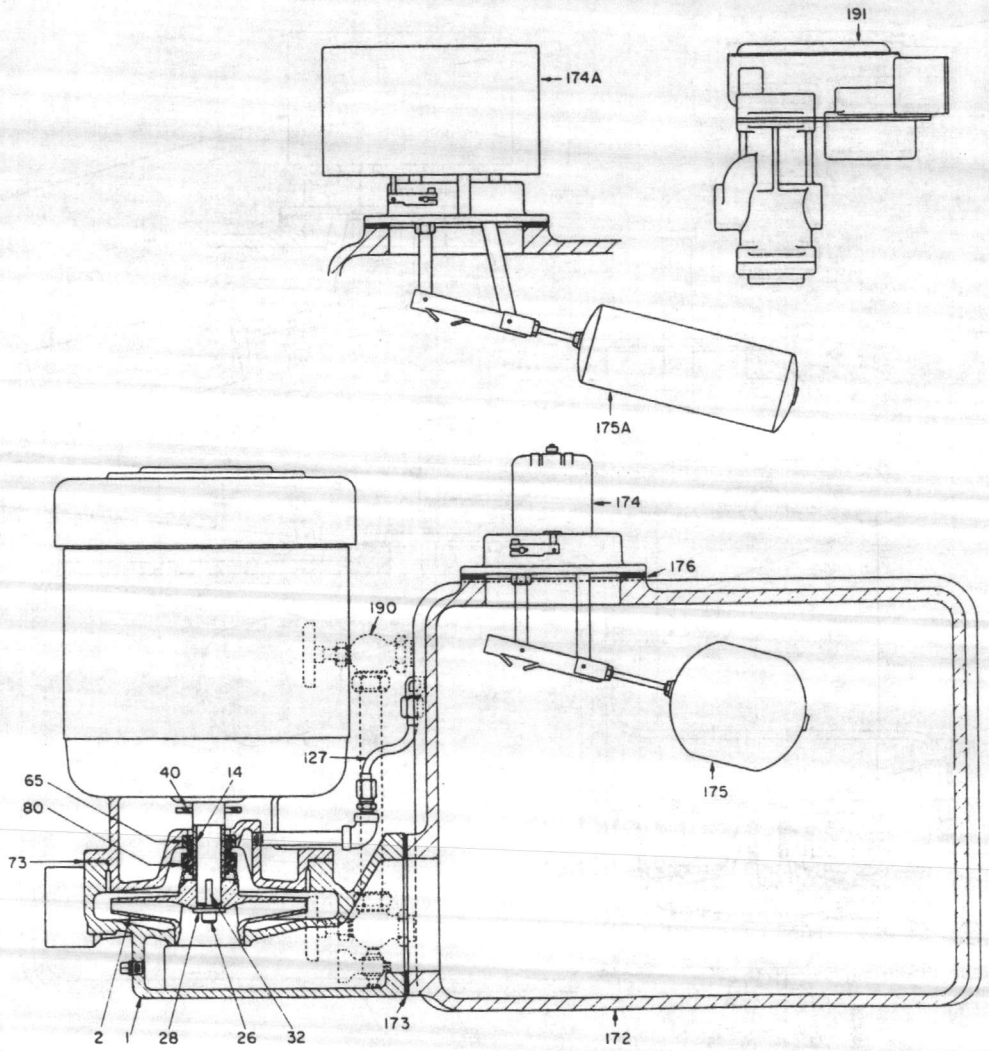
Supersedes Section No. 900, Page 501

WEINMAN

Mueller Pump
AERMOTOR-MIDLAND-WEINMAN
A MUELLER COMPANY
P.O. Box 1364 Commerce & Exchange
Conway, Arkansas 72032 501-329-9811

REPAIR PARTS LIST

TYPES "ACV & AEV" VERTICAL CONDENSATE UNIT
CAST IRON RECEIVERS
(With Type 21 Mechanical Shaft Seal)



Item No:	Name	Material of Construction (St'd Fitted)
1	CASING	CAST IRON
* 2	IMPELLER	BRONZE
*14	SHAFT SLEEVE	BRONZE
*26	IMPELLER SCREW	STAINLESS
*28	IMPELLER SCREW WASHER	STAINLESS
*32	IMPELLER KEY	STAINLESS
40	DEFLECTOR (Liquid)	NEOPRENE
† *65	MECHANICAL SHAFT SEAL (Stationary Element)	CERAMIC
*73	CASING GASKET	ASBESTOS
† *80	MECHANICAL SHAFT SEAL (Rotating Element)	CARBON

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174	FLOAT SWITCH	Sq. D. #9037
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* FOR DOMESTIC SERVICE WE RECOMMEND THESE PARTS BE CARRIED IN STOCK AS SPARES.

† FURNISHED ONLY IN PAIRS AS COMPLETE UNIT.

WHEN WRITING THE FACTORY REGARDING YOUR PUMP – ALWAYS INCLUDE SERIAL NUMBER

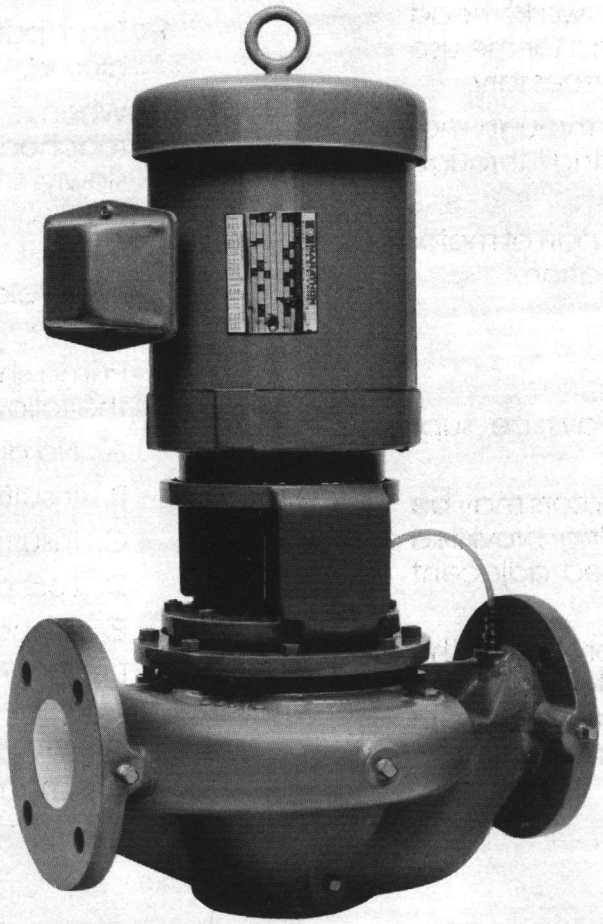
Supersedes March 26 1962 Issue

Taco

302-006

"VL" VERTICAL IN-LINE PUMP

INSTALLATION OPERATION & MAINTENANCE MANUAL



COMPARE. YOU'LL TAKE TACO.

TACO, Inc., 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex: 92-7627
TACO, (Canada) Ltd., 1310 Aimco Blvd., Mississauga, Ontario L4W 1B2 (416) 625-2160 Telex: 06-961179

Form No. 302-006 Effective 4/1/87 Plant ID No. 001-933

APPLICATION

1. Working Pressure: 175 psig
2. Temperature: 250°F Standard
   300°F Hi Temp.

INSTALLATION

A. LOCATION

1. Install vertically with motor up.
2. Pump should be accessible for inspection and repair work, head room must be provided for the use of hoist or tackle as necessary.
3. Lift pump by slinging through motor eye bolts securing through pump adapter.
4. In no case should any part of motor be covered with insulation.

B. FOUNDATION

1. The pump must always be supported.
2. Pumps with smaller motors may be suspended in the piping, provided the piping is supported adjacent to the pump.
3. For pumps with larger motors the pump should be attached to a support utilizing the tapped hole in the bottom of the pump casing.

OPERATION

A. BEFORE OPERATING FOR THE FIRST TIME CHECK THE FOLLOWING:

1. Is motor correctly wired for voltage available.
2. Has pump been primed. Pump should never be run dry.
3. All rotating parts turn freely.

B. STARTING PUMP

1. Start pump with discharge valve closed.
2. When correct pressure has been reached, open discharge valve slowly.
3. Do not operate pump for prolonged periods with discharge valve closed, so as to avoid overheating.
4. Pump should be stopped if any of the following occur.
   A. No discharge.
   B. Insufficient discharge.
   C. Insufficient pressure.
   D. Loss of suction.
   E. Excessive Power Consumption.
   F. Vibration.

   Check problem analysis further in this manual.

MAINTENANCE

A. ROUTINE INSPECTIONS

Routine inspections should be made on a regular basis. Inspections made while pump is running should reveal potential failures.

1. Inspect motor bearings for any sign of temperature rise. Temperature should not exceed 160°F. Temperature rise may indicate the early stages of bearing problems.
2. Listen for any unusual noise.
   A. Air trapped in pump.
   B. Hydraulic noise.
3. Check suction gauge reading and confirm that it is normal.
4. Check discharge gauge reading and confirm that is normal.
   A. If gauge readings are abnormal find out why.

B. CLOSE COUPLED PUMPS

The pump section is attached directly to the motor shaft and does not contain bearings.

C. CLOSE COUPLED MOTORS

The motor must be lubricated in accordance with the manufacturers recommendations.

D. MECHANICAL SEAL

The mechanical seal is the "John Crane" Type 21 General Purpose Seal. For the application of other seal types, consult your representative.

DIS-ASSEMBLY AND RE-ASSEMBLY

A. GENERAL

If the pump has been maintained and serviced properly, breakdowns which necessitate the pump being dis-assembled should not occur often.

1. If a problem occurs, the cause should be determined, if possible, before dis-assembling. (See "Problem Analysis")
2. If the pump is being dis-assembled, all parts must be carefully handled, avoid heavy blows and shocks.
3. All parts must be carefully cleaned and inspected for wear. Recondition or replace parts where necessary.
4. The following pump sizes come with clamped casing cover units.

1506	2006	2506	3006	
1507	2007	2507	3007	4007

5. The following pump sizes come with bolted casing cover units.

*1507	2007	2507	2008	3007
4007	2508	3008		

* Bolted casing cover unit used only with motor frame sizes 143, 145, 182 & 184.

B. DIS-ASSEMBLY

1. Drain liquid from casing by removing drain plug.
2. If fitted with re-circulating lines, please disconnect.
3. Remove nuts from casing studs, remove casing cover and adapter complete with motor.
4. Remove impeller bolt, in a counter clockwise direction, impeller and impeller key.
5. In all cases of mechanical seal arrangement, after removing the cover and its seal assembly, the rotating element may be drawn off the shaft sleeve. The stationary element removed from the cover.
6. All parts must be cleaned and inspected for wear. Replace parts where necessary.

C. RE-ASSEMBLY

1. Be certain that all parts to be replaced are free from burrs, with screw threads and connecting faces clear and free from damage.
2. Insert stationary element of seal into casing cover, assemble over shoulder of adapter.
3. Place spring and spring holder on shaft sleeve to abut against sleeve shoulder. Slide rotary seal on sleeve until it contacts spring.
4. Slide shaft sleeve on shaft. Larger bore first. Be certain that "O" ring is correctly seated in groove.
5. Assemble impeller key and impeller on shaft. Refit with new impeller washer on impeller bolt and tighten carefully, then be certain that impeller rotates freely by hand.
6. Assemble cover and adapter complete with motor into casing. Insure that gasket is seated correctly, screw on nuts and tighten uniformly.
7. Reconnect recirculating line, if fitted and drain plug.

D. PROBLEM ANALYSIS

A. NO DISCHARGE
   1. Pump not primed.
   2. Speed too low.
   3. System head to high.
   4. Suction lift higher than pump is designed.
   5. Impeller completely clogged.
   6. Incorrect direction of rotation.
   7. Air leak in suction line.

B. INSUFFICIENT DISCHARGE FLOW
   1. Air leak in suction line.
   2. Speed too low.
   3. System head higher than anticipated.
   4. Insufficient NPSH: Suction lift to high. Check gauges, also check for clogged suction line or screen.
   5. Impeller partially plugged.
   6. Mechanical defects.
      A. Worn wear rings.
      B. Impeller damaged.
      C. Incorrect direction of rotation.

C. INSUFFICIENT DISCHARGE PRESSURE
   1. Speed too low.
   2. System head less than anticipated.
   3. Air in system.
   4. Mechanical defects.
      A. Worn wear rings.
      B. Impeller damaged.
      C. Impeller diameter too small.
      D. Incorrect direction of rotation.

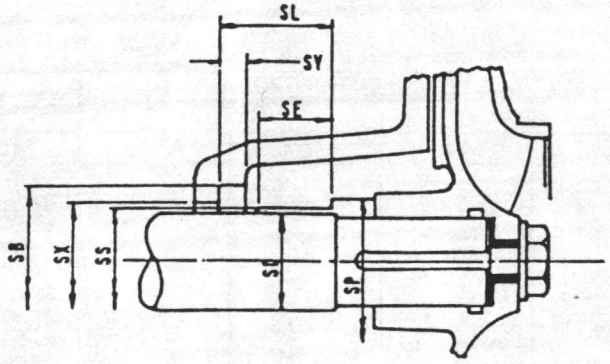
D. LOSS OF SUCTION
   1. Leak in suction line.
   2. Suction lift too high.
   3. Insufficient NPSH.
   4. Air in system.
   5. Casing gasket defective.

E. EXCESSIVE POWER CONSUMPTION
1. Speed too high.
2. System head lower than rating.
3. Specific gravity of liquid too high.
4. Mechanical defects.
   A. Shaft bent.
   B. Rotating elements binds.
   C. Worn wear ring.

F. VIBRATION
1. Air leak in suction line.
2. Air in system.
3. Impeller partially plugged.
4. Foundation not rigid.
5. Mechanical defects.
   A. Damaged impeller.
   B. Motor bearings worn.
   C. Rotor out of balance.
   D. Shaft bent.

G. MOTOR RUNS HOT
1. Speed too high.
2. Specific gravity of liquid too high.
3. Mechanical defects.
   A. Shaft bent.
   B. Rotating elements binds.
   C. Defective motor.
   D. Voltage lower than rating.

MECHANICAL SEAL DIMENSIONS

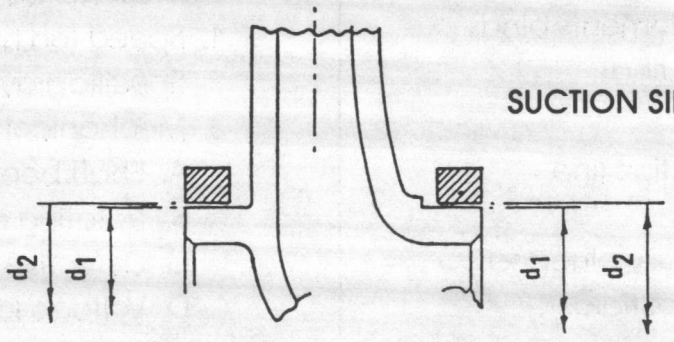


ALL DIMENSIONS IN INCHES

MOTOR SIZE	SEAL SIZE SS	SB	SD	SE	SL	SP	SX	SY
143 JP 145 JP 182 JP 184 JP	1.125 ±0.002	1.750 ±0.001	1.000	1.063	1.500	1.375	1.312	0.375
213 JP 215 JP 254 JP 256 JP 284 JP 286 JP 324 JP 326 JP	1.500 ±0.002	2.125 ±0.001	1.375	1.1000	1.563	1.750	1.688	0.375

Mechanical seal pumps have 'John Crane' Type 21 seals as standard.

CASING/IMPELLER WEAR RING CLEARANCES



PUMP SIZE	WEAR RING SUCTION SIDE				CLEARANCE	
	Dia d_1		Dia d_2			
	Max.	Min.	Max.	Min.	Max.	Min.
1506 1507	2.744	2.740	2.759	2.757	0.019	0.012
2006 2007 2008	3.128	3.134	3.153	3.151	0.019	0.012
2506 2507 2508	3.728	3.724	3.744	3.742	0.020	0.012
3006 3007 3008 2510	4.516	4.512	4.531	4.520	0.019	0.012
4007 3010	5.102	5.098	5.122	5.620	0.024	0.012

NOTE: CASING WEAR RING FITTED TO SUCTION SIDE ONLY

OPERATING AND MAINTENANCE INSRUCTIONS
TEMPERATURE CONTROL SYSTEM

JOB: H & A/C FOR BUILDINGS TT-2455 & TT-2457, C-2648
MCB, CAMP LEJEUNE, NC

ENGINEER: A.D. ENERGY ENGINEERS LIMITED

CONTRACTOR: R & W CONSTRUCTION COMPANY, INC.

Submitted by:

TRIANGLE AUTOMATED CONTROLS, INC.

2716 Discovery Drive

Raleigh, North Carolina 27604

(919) 878-8015

EQUIPMENT SCHEDULE

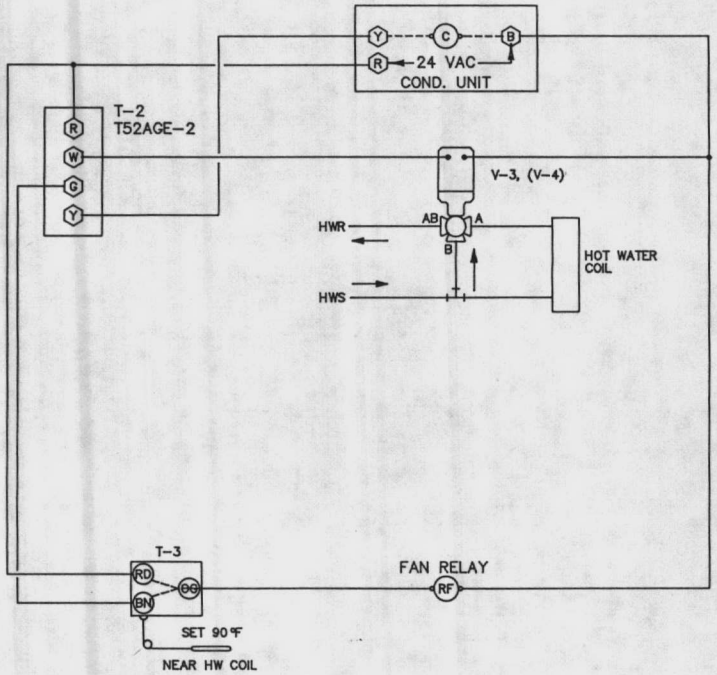
DATE: 6/5/89

JOB: HEATING & A/C FOR BLDGS. TT-2455,2457,AND 2475 AND BLDG. BB-7

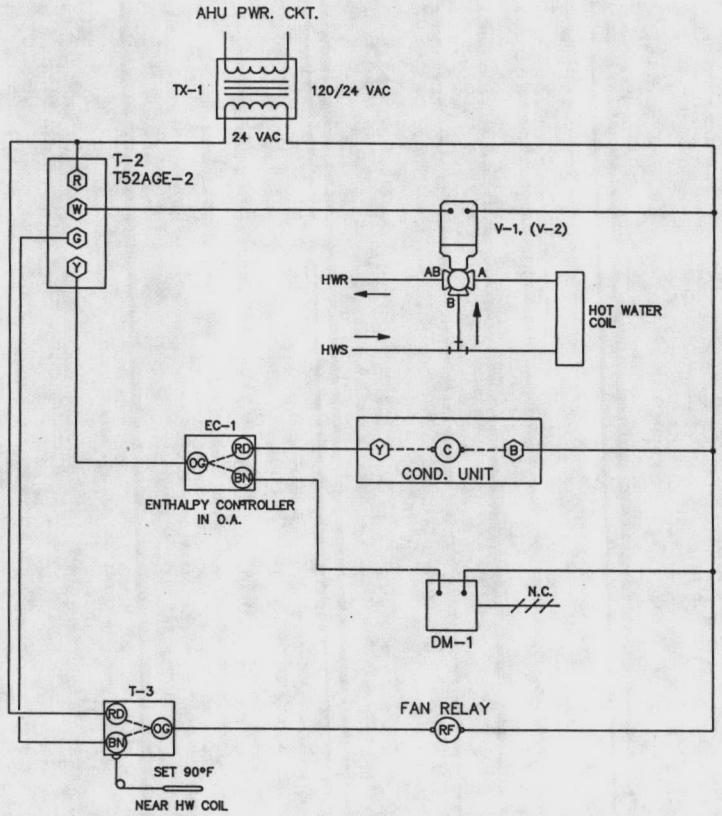
CAMP LEJEUNE, NC

N62470-89-C-2648

QUANTITY	IDENTIFIER	PART NUMBER	MANUFACTURER	DESCRIPTION	LOCATION
4	T-2	T52AGE-2	JOHNSON CONTROLS	SPACE T'STAT	AHU-1,2 & RT-1,2
4	T-3	TC-4111	BARBER COLMAN	DUCT T'STAT	AHU-1,2 & RT-1,2
1	V-1	VA-9313-201-4-8	BARBER COLMAN	3 WAY VALVE, CV=12	AHU-1 HW COIL
1	V-2	VA-9313-201-4-9	BARBER COLMAN	3 WAY VALVE, CV=16	AHU-2 HW COIL
1	V-3	VA-9313-201-4-6	BARBER COLMAN	3 WAY VALVE, CV=6.8	RT-1 HW COIL
1	V-4	VA-9313-201-4-6	BARBER COLMAN	3 WAY VALVE, CV=6.8	RT-2 HW COIL
1	D-1	OBD10-50x24	PENN VENTILATOR	OPPOSED BLADE DAMPER	AHU-1, O.A.
1	D-2	OBD10-69x26	PENN VENTILATOR	OPPOSED BLADE DAMPER	AHU-2, O.A.
1	D-3	OBD10-30x72	PENN VENTILATOR	OPPOSED BLADE DAMPER	AHU-2, R.A.
3	DM-1	MA-12313	BARBER COLMAN	2 POSITION SPRING RETURN DAMPER ACTUATOR, 24 V.	AT D-1,D-2, and D-3
3		AM-217	BARBER COLMAN	WIRING HARNESS KIT	DM-3
2	EC-1	THC-2	BARBER COLMAN	TWO POSITION ENTHALPY CONTROLLER	AT AHU-1,AHU-2



RT-1 CONTROL (TYPICAL FOR RT-2)



AHU-1 CONTROL (TYPICAL FOR AHU-2)

SEQUENCE OF OPERATION:

1) WITH SPACE THERMOSTAT SWITCHED TO "COOL", AND FAN SWITCH IN "AUTO" POSITION, THE FAN AND COMPRESSOR CYCLE TOGETHER.

2) WITH MODE SWITCH IN "COOL" POSITION AND FAN SWITCH IN "ON" POSITION THE COMPRESSOR CYCLES AND THE FAN RUNS CONTINUOUSLY.

3) WITH MODE SWITCH IN "HEAT" POSITION AND FAN SWITCH IN "AUTO", THE STEAM VALVE CYCLES AND THE FAN RUNS WHILE THERE IS HEAT IN THE STEAM COIL.

4) WITH MODE SWITCH IN "HEAT" AND FAN SWITCH IN "ON", THE STEAM VALVE CYCLES AND THE FAN RUNS CONTINUOUSLY.

5) WITH THE MODE SWITCH IN THE "OFF" POSITION AND THE FAN SWITCH IN "ON", THE FAN RUNS CONTINUOUSLY BUT NO HEATING OR COOLING TAKES PLACE.

6) WITH THE MODE SWITCH IN THE "OFF" POSITION AND THE FAN IN "AUTO", NO EQUIPMENT OPERATES.

AHU-1,2 ONLY

7) WHEN THE OUTDOOR AIR IS USEFUL FOR COOLING (AS DETERMINED BY ENTHALPY CONTROLLER EC-1), THE COMPRESSOR IS LOCKED OUT AND THE OUTSIDE AIR/RETURN AIR DAMPERS POSITION TO ALLOW VENTILATION UPON A CALL FOR COOLING FROM THE SPACE THERMOSTAT.

TRIANGLE AUTOMATED CONTROLS, INC.

2716 DISCOVERY DRIVE, RALEIGH, N.C. 27604

REVISIONS	
DATE	CHG
3/89	AS BUILT

JOB: H & A/C FOR BUILDING TT-2455 & TT-2457

LOCATION: MARINE CORPS BASE, CAMP LEJEUNE, NC.

ARCHITECT:

ENGINEER: A.D. ENERGY ENGINEERS LIMITED

CONTRACTOR: R & W CONSTRUCTION COMPANY, INC.

DATE	DRAWN BY	JOB NUMBER	DRAWING NUMBER
6/19/89	EW	#41-B-2648	1 OF 1

JOHNSON CONTROLS

Johnson Controls, Inc.
Control Products Division

1302 E. Monroe St.
Goshen, IN 46526

Series T52
Low Voltage Multi-Stage Thermostat With Automatic Changeover

Application

T52 low voltage thermostats are for control applications where automatic or manual switchover of multiple heating and cooling stages is required.

T52AAE, T52AGE, and T52BGE meet DOD Specifications.

All Series T52 thermostats are designed for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) that protect against, or systems (alarm, supervisory systems) that warn of control failure.

Operation

All T52 thermostats are equipped with heating and cooling anticipation. See equipment manufacturer's instructions for selection of the proper anticipator setting. If the heat anticipator value is not indicated, determine the current (amps.) draw of the primary control or valve and set as follows:

For Gas System

Set the heat anticipation indicator to correspond to the secondary (thermostat) current of the valve or relay. (See Fig. 2.)

For Oil System

Set the heat anticipation indicator .15 amp. higher than the rated secondary current of the relay. (See Fig. 2.)

For longer heating cycles, set the anticipation indicator at a slightly higher value; for shorter cycles, at a slightly lower value. Move only ¼ to ½ scale division at a time. NEVER SET THE INDICATOR MORE THAN 1½ SCALE DIVISIONS UNDER THE PRIMARY CONTROL OR VALVE CURRENT RATING.

Installation

Locate the thermostat where it is exposed to normal free air circulation of the heating/cooling source. Do not mount the thermostat where it may be affected by heat or cold from water pipes, windows, doors, lamps, sunlight, or other heat or cold sources.

NOTE: The thermostat must be mounted level for accurate operation. The recommended location is on a solid inside wall or partition, and at approximately four to five feet above the floor.

Mounting holes are provided for installation on a standard single gang outlet box or flush mounting on a wall in a horizontal position. Two 1" sheet metal screws are furnished.

Mount the thermostat as follows:

1. Loosen the cover screws with the Allen wrench provided, and remove the cover.
2. Loosen all circuit screws and remove the wiring sub-base.
3. Mount the wiring sub-base directly to wall or horizontal outlet box.
4. Pull the wires through the slot in the wiring sub-base and use two 1" sheet metal screws for wall mounting or two 1" flat head machine screws for outlet box mounting. Level the plate using a spirit level.
5. Make all wiring connections. See Wiring section.
6. Assemble the thermostat base to the wiring sub-base and tighten all the circuit screws.

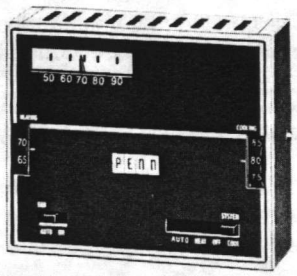


Fig. 1 — T52 Thermostat with Fan and System Switches.

7. If locked set points are desired, they must be made after checkout and before cover is locked in place.

Wiring

Make all wiring connections using copper conductors only, and in accordance with the National Electrical Code and local regulations.

CAUTION: Disconnect the power supply before wiring connections are made to prevent possible electrical shock or damage to the equipment.

The wiring sub-base terminal markings are in accordance with NEMA Pub. No. DC-1.

The terminal markings are:

Fan	— "G"
Heat	— "W"
Cool	— "Y"
Power	— "R"
Damper	— "O"

Use No. 18 solid copper wire or larger, and attach directly to the sub-base terminals. Pull the wires through the slot in the sub-base and strip the insulation from wire leads. Do not strip too much

insulation from the wire. Bare wire should not extend below the bottom of the terminal. Push excess wire back through the slot in the sub-base and plug the wiring hole in the wall so that draft does not affect the thermostat calibration. (See Fig. 2.)

Checkout Procedure

Before leaving the installation, observe at least three complete operating cycles to be sure that all components are functioning correctly.

1. When installation is complete, place the fan and system switches on auto.
2. Move the heating set point above room temperature to initiate a call for heat.
3. Check to see that the heating stage(s) operate automatically.
4. Move the cooling set point below room temperature to initiate a call for cooling.
5. Check to see that the cooling stage(s) operate automatically and that the fan is energized.
6. Check the remaining positions of the fan and system switches, as required.

Service

If the system fails to maintain proper temperature control, check the following items before adjusting or replacing the thermostat:

1. Thermostat location (see Installation on Page 1).
2. System and thermostat wiring, circuit breakers, etc.
3. Operation of limit and operating controls.
4. Air conditioning filters, motors, and blower.

Calibration

The thermostat and thermometer are calibrated at the factory and should not require further adjustment. If re-calibration of the thermostat is necessary, proceed as follows:

1. Loosen the cover screws with the Allen wrench provided and remove the thermostat cover.
2. Determine the temperature affecting the thermostat with an accurate mercury thermometer. Adjust the set point dial (loosen dial locks if locked) to agree with the thermometer reading.
3. Hold the dial and turn the calibration screw, see Fig. 2, to the point where the mercury switch just makes contact (heating switch) or breaks contact (cooling switch).

   On 2 stage heat or cool switches, turn calibration screw to the point where only the first switch makes or breaks contact. NOTE: Work quickly . . . do not handle or breathe on the thermostat any more than necessary.
4. Relock the set points, if desired.
5. Replace the cover. Make sure the system switch is on and check the calibration.

The thermometer can be recalibrated. Remove the thermostat cover. Place an accurate test thermometer and the cover side by side and allow to reach a stable temperature before adjusting. Turn the hex nut until the pointer corresponds to the test thermometer.

Repairs and Replacement

Field repairs must not be made. For a replacement thermostat, contact the nearest Johnson Controls wholesaler.

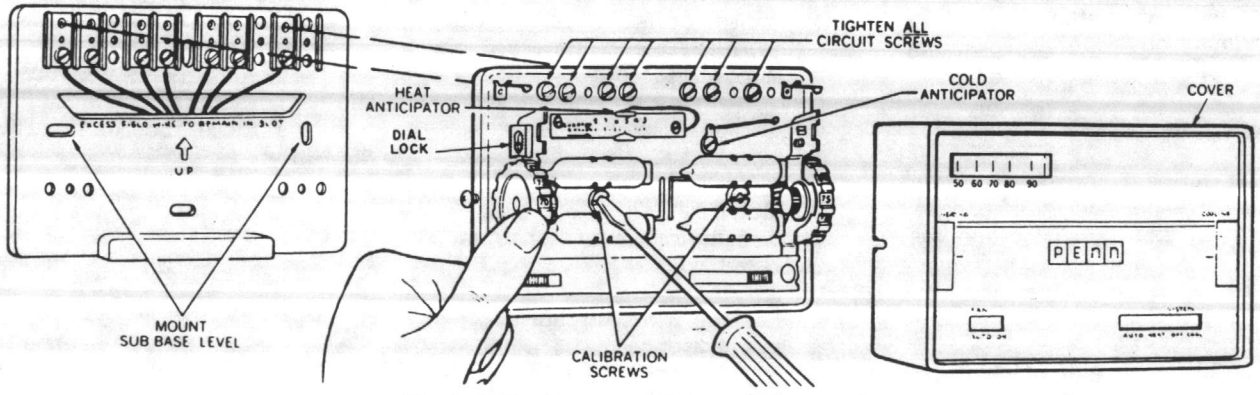
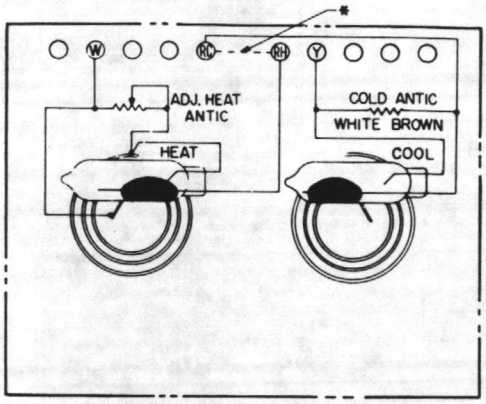


Fig. 2 — Drawing showing mounting procedure.

Wiring Diagrams



*UNIT STANDARD WITH JUMPER FOR COMMON VOLTAGE SOURCE. REMOVE JUMPER FOR ELECTRICALLY SEPARATED CIRCUITS.

LEGEND

W	HEAT
RC	COOL POWER SUPPLY
RH	HEAT POWER SUPPLY
Y	COOL

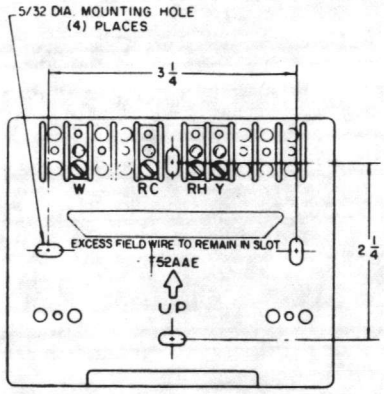
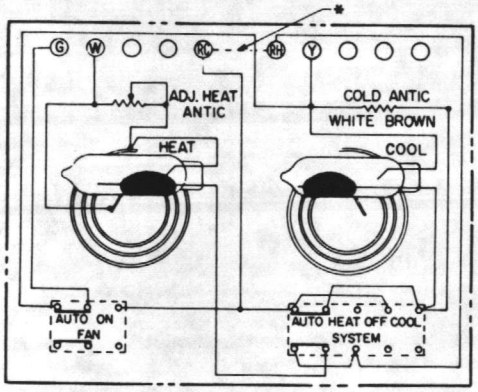


Fig. 3—Wiring sub-base and diagram for the T52AAE with one-stage heating and one-stage cooling.



*UNIT STANDARD WITH JUMPER FOR COMMON VOLTAGE SOURCE. REMOVE JUMPER FOR ELECTRICALLY SEPARATED CIRCUITS.

LEGEND

G	FAN
W	HEAT
RC	COOL POWER SUPPLY
RH	HEAT POWER SUPPLY
Y	COOL

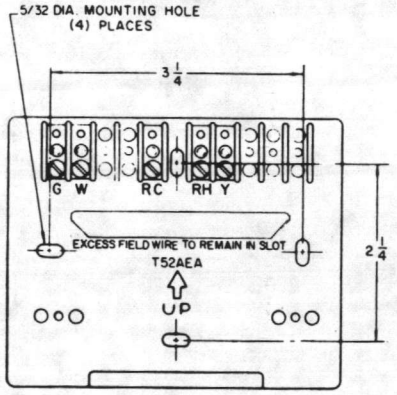
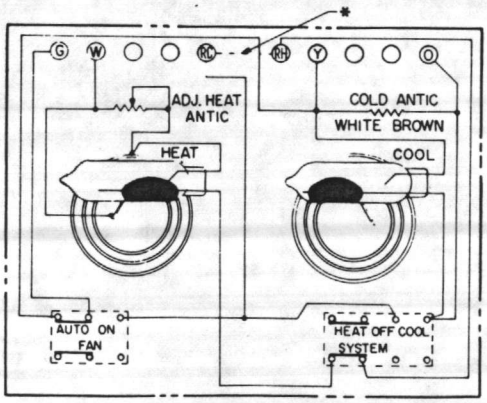


Fig. 4—Wiring sub-base and diagram for the T52AEA with one-stage heating and one-stage cooling.



*UNIT STANDARD WITH JUMPER FOR COMMON VOLTAGE SOURCE. REMOVE JUMPER FOR ELECTRICALLY SEPARATED CIRCUITS.

LEGEND

G	FAN
W	HEAT
RC	COOL POWER SUPPLY
RH	HEAT POWER SUPPLY
Y	COOL
O	DAMPER

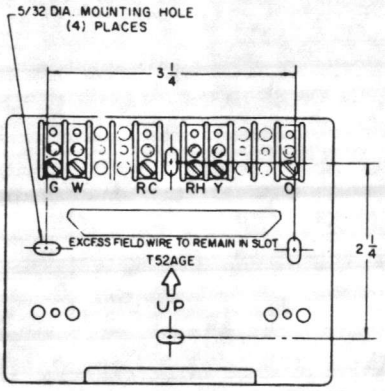


Fig. 5—Wiring sub-base and diagram for the T52AGE with one-stage heating and one-stage cooling.

Litho In U.S.A. 0384-Z

BARBER COLMAN COMPANY
a Siebe company

General Instructions

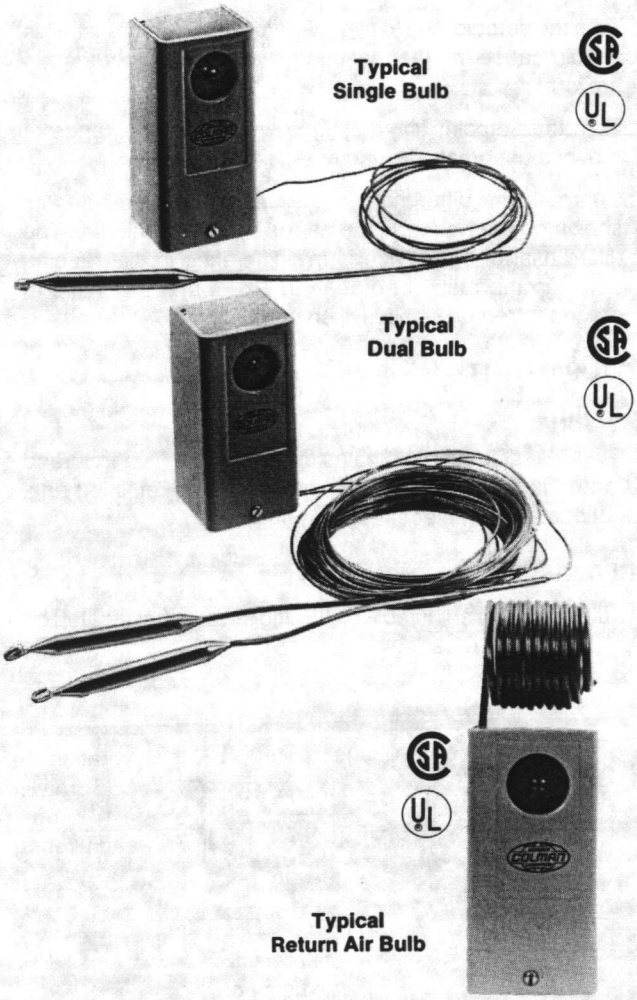
TC-4100 Series
TC-4200 Series
Bulb Thermostats
Return Air Thermostats

APPLICATION

For on-off control of media temperature in ducts, tanks, liquid lines, etc.

SPECIFICATIONS

Setpoint Dial Range: Dial plate is marked as °F on one side and °C on the other. See Table 2 for specific ranges.
Sensing Element: Liquid-filled copper.
Differential: See Table 2.
Dual Bulb Units: One bulb senses the controlled media; the second bulb senses the outside air temperature. The temperature of the controlled media increases as outside air temperature decreases.
Ambient Temperature Limits:
Case,
Shipping −40 to 160°F (−40 to 71°C).
Operating −40 to 150°F (−40 to 65°C); except return air bulb unit, −40 to 140°F (−40 to 60°C).
Bulb, See Table 2.
Electrical Switch: Snap action SPDT, one per stage.
Ratings, See Table 1.
Connections: Coded screw terminals.
Cover: All metal with 1/2″ to 3/4″ conduit openings.
Case Locations: NEMA Type 1 indoor only.
Mounting: Case can be mounted in any position.
See ACCESSORIES for bulb mounting kits (order separately).
Dimensions:
Case, 4-5/8″ high × 2-1/4″ wide × 2″ deep (117 mm × 57 mm × 51 mm).
Element and Capillary, See Table 2.



ACCESSORIES

AT-201	Copper bulb well requires AT-209
AT-203	Stainless steel bulb well requires AT-209
AT-206	Copper bulb well
AT-208	Duct mounting kit
AT-209	Bulb mounting kit
AT-210	Concealed adjustment plate
AT-211	Outside bulb shield

AT-210

TABLE 1. MAXIMUM ELECTRICAL RATING (All Units Except TC-4115*)

Switch Rating (50/60 Hz)	24V	120V	240V
Full Load Amps	9.8	9.8	8.0
Locked Rotor Amps	58.8	58.8	48.0
Pilot Duty VA	60	360	360
Non-Inductive Amps (Resistive)			
Single Stage	22	22	22
Two Stage	16	16	8.0

*TC-4115 for System 8000 and applications requiring less than one (1) amp. Electrical Rating: 1.0 amp at 24 Vac; 0.25 amp at 24 Vdc.

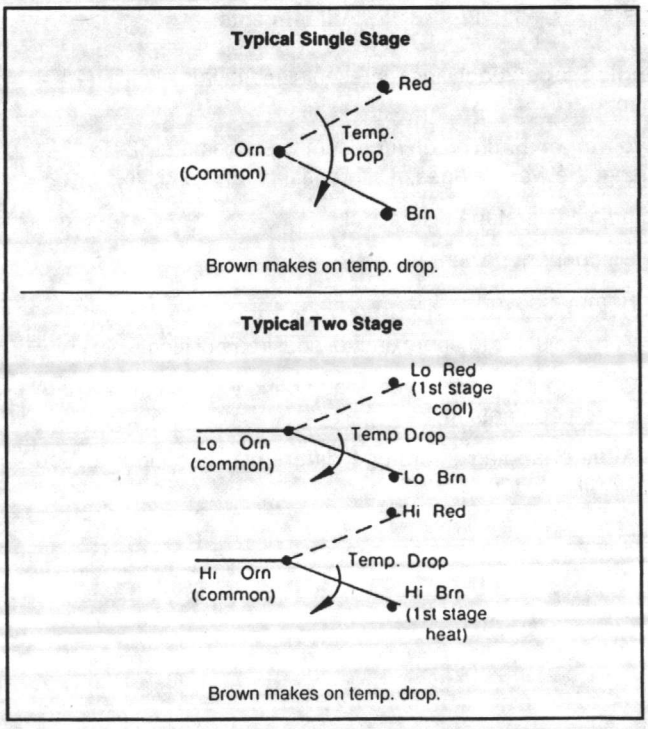


Figure 1. Switch Action and Terminal Identification

CHECKOUT

After installing a thermostat, make an initial check of the switching action. Verify the switch action by listening to the switch contacts.

1. Turn the setpoint dial to a temperature above ambient. This should cause the thermostat to switch, making orange to brown.
2. Turn the setpoint dial setting down gradually. Orange to brown must break, making orange to red.
3. Compare the differential of the device to the differential shown on the performance charts by turning the dial. The differential of the device is the difference in dial reading between the make of orange to brown and the make of orange to red on single switch units.

ADJUSTMENTS

Setpoint

Screwdriver adjustment. Scales dual marked °F on front and °C on back. To change scale, remove spring retaining ring, select scale and replace retaining ring.

Differential

The differential is adjustable by turning the adjustor located on the side of the device (see Figure 15).

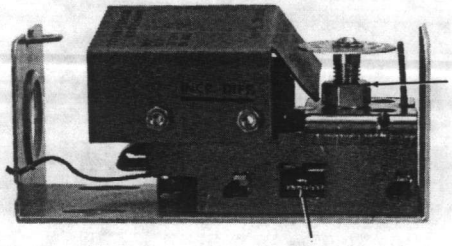


Figure 15. Adjustments

Single Stage: Each line represents approximately 3°F (2°C) change.

Two Stage: Each notch represents approximately 2°F (1°C) change between stages. (Differential per switch is fixed.)

To adjust interstage differential:

1. Disconnect power to unit.
2. Remove cover.
3. Turn adjustor to approximately desired position.
4. Check out by turning dial and noting dial readings where switch contacts make.
5. After changing interstage differential, recalibrate. See CALIBRATION.

CALIBRATION

1. With all power disconnected, soak bulb(s) for 10 minutes at known temperature (must be 70°F for dual bulb).
2. Turn dial and note where switch contacts make.
3. Turn dial midway between click points.
4. Turn the calibration nut (located under dial) until the temperature of the bulb is indicated on the dial (see Figure 15).

NOTE

On two stage units follow above procedure. LO switch is first stage on cooling applications. HI switch is first stage on heating applications.

MAINTENANCE

Regular maintenance of the total system is needed to assure sustained optimum performance. Thermostats should be periodically inspected for dirt or blockage of air over the elements.

REPAIR

Field repair is not recommended. Replace defective device.

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION

1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL U.S.A. 61132-2940

General Instructions

Enthalpy Control
THC-1
THC-2

DEVICE INFORMATION

Identification

The enthalpy controller is used to measure the total heat in the outside air and control the amount of outdoor air used in the system for cooling. The enthalpy controller has a SPDT switch which is used to run the outdoor air damper to the minimum position whenever the total heat in the outdoor air renders it useless for cooling.

This controller may be identified by referring to the part number found on the outside of the carton and on the unit. Stamped on the back of the controller is the date of manufacture (four digits, the first two representing the week of the year and the last two representing the year).

Pre-Installation

The controller is supplied with a mounting template and five mounting screws (one extra). Before installation make a visual inspection of the controller for obvious signs of damage. Check the part number to be sure the right device is being installed.

INSTALLATION

The controller may be mounted in any position where it is exposed to freely circulating outdoor air. Mounting on the inner surface of the outdoor air duct is usually satisfactory. Avoid locations where excessive moisture, corrosive fumes, or vibration are present.

Performance

The unit has a SPDT switch with a rating of 2.5 amperes maximum at 24 VAC. Differential is approximately 8 percent R.H. and 2 degrees F.

THC-1

On an enthalpy increase to above the setpoint, the switch makes to the "normally closed" contact. On an enthalpy decrease to below the setpoint, the switch makes to the "normally open" contact.

THC-2

On enthalpy increase to above the setpoint, the switch makes orange to red. On an enthalpy decrease to below the setpoint, the switch makes orange to brown.

For the control ranges, see chart 1. For intermediate settings, see the psychrometric chart, chart 2. At temperatures falling between the curves plotted in Chart 2, performance is parallel to the adjacent curve.

Chart 1.

Dial Range	10% R.H.	50% R.H.	80% R.H.	Control Curve Ref: Fig. 2
A	88°F	83°F	74°F	A
B	83°F	78°F	70°F	B
C	78°F	73°F	64°F	C
D	73°F	68°F	59°F	D

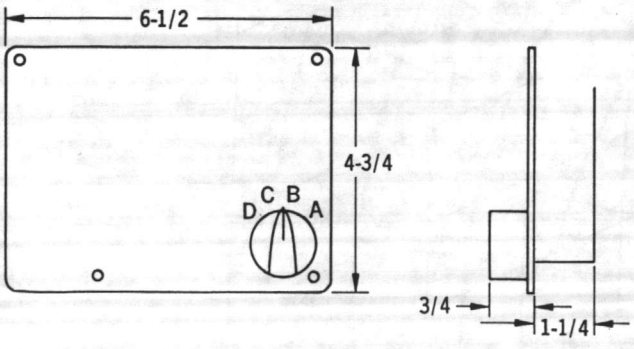


Figure 1, Dimensions THC-1

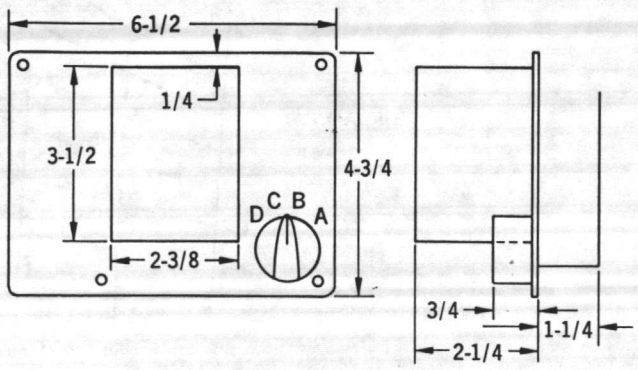


Figure 2, Dimensions THC-2

The control settings should be selected from the psychrometric chart, Chart 2. The areas to the right of each curve in Chart 2 represent enthalpy values in excess of those desired. Under these conditions the outdoor air damper should close to its minimum open position. The areas to the left of each curve represent enthalpy values where outdoor air should be utilized for cooling, i.e., outdoor damper open.

Procedure

1. Remove adhesive from the back of mounting template and press template to desired mounting location on duct.
2. Drill the four mounting holes as indicated on template, using 1/8 diameter drill.
3. Cut out center portion of duct as outlined on template.
4. Using mounting screws provided, mount controller to duct.
5. Wiring: THC-1 has spade connections on switch. THC-2 has 1/2 inch conduit opening and 6 inch long color coded pigtails.

   Make all electrical connections in accordance with job wiring diagram and in compliance with national and local electrical codes. Typical wiring diagrams are shown on pages 3 and 4 of this bulletin. For use with Digi-Dap CP-8173-064. See EN 118.

6. **THC-1**
   Switch spade coding: "normally closed" makes on an increase in enthalpy; "normally open" makes on a decrease in enthalpy.
   THC-2
   Color coding: orange is common of SPDT switch. Red closes on an increase in enthalpy; brown closes on a decrease in enthalpy.

CHECKOUT

Check that wiring is made in accordance with the job wiring diagram. Set the knob to the "A" scale. Then the outdoor air damper should go to the open position (unless outdoor air conditions are to the right of curve "A", Chart 2). Set the knob to the "D" scale and outdoor air damper should close (unless outdoor air conditions are to the left of Curve "D", Chart 2).

RUN/ADJUST

All controllers are calibrated at the factory and no field calibration should be required or attempted.

REPAIR

Field repair of the controller is not recommended. If the system is not operating properly and the reason is traced to the enthalpy controller, it should be replaced.

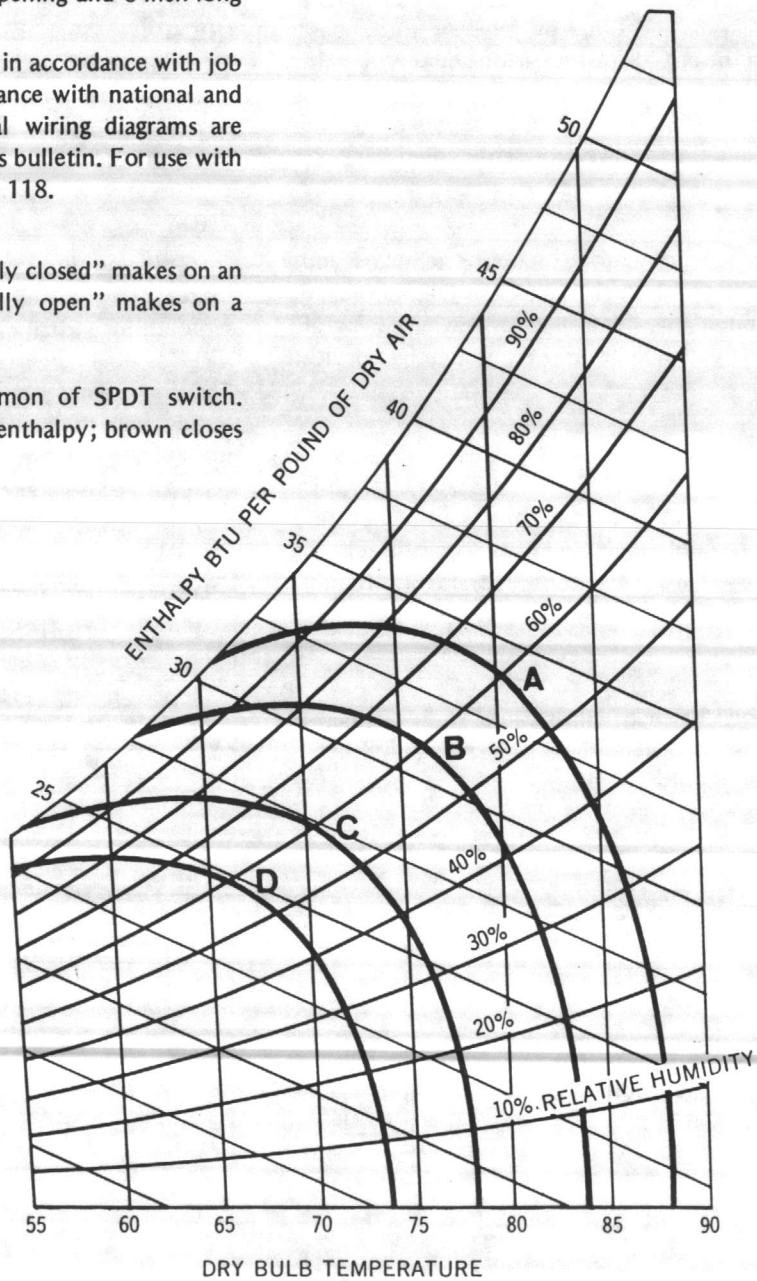
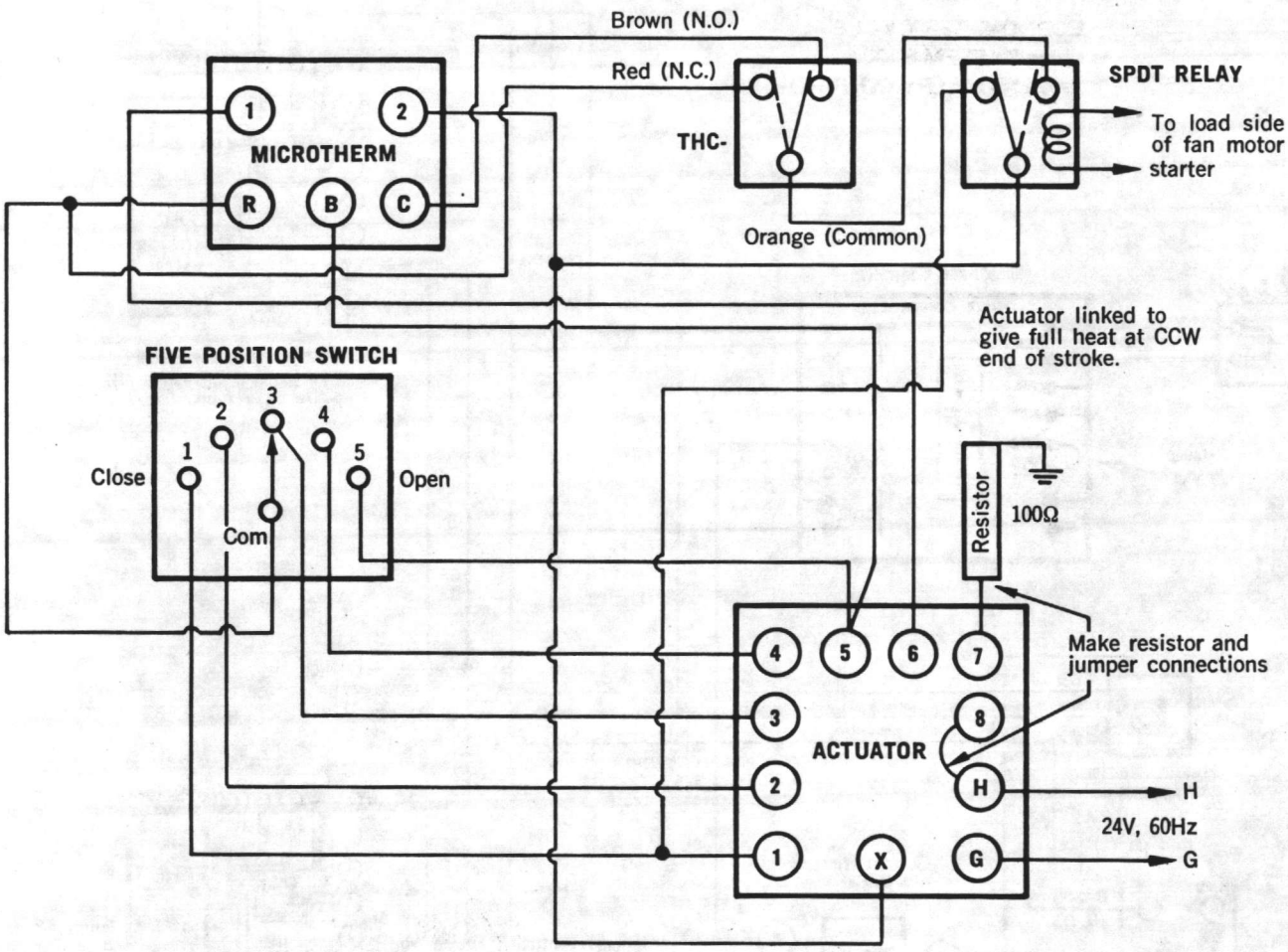
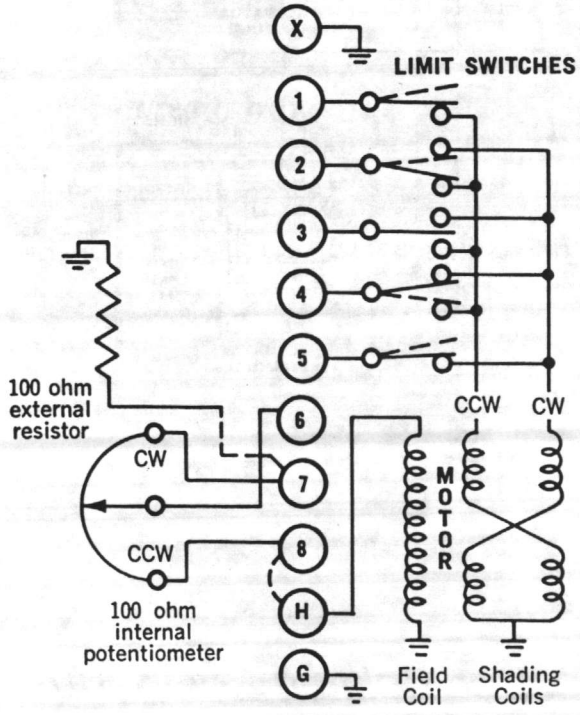


Chart 2.

ECONOMIZER CYCLE Using MICROTHERM With ADJUSTABLE MINIMUM POSITION and ENTHALPY CONTROL



INTERNAL WIRING



CONTACT CHART

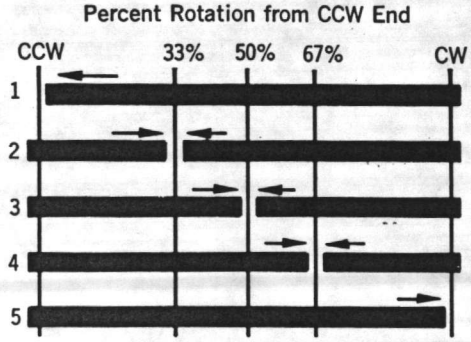


Figure 3.

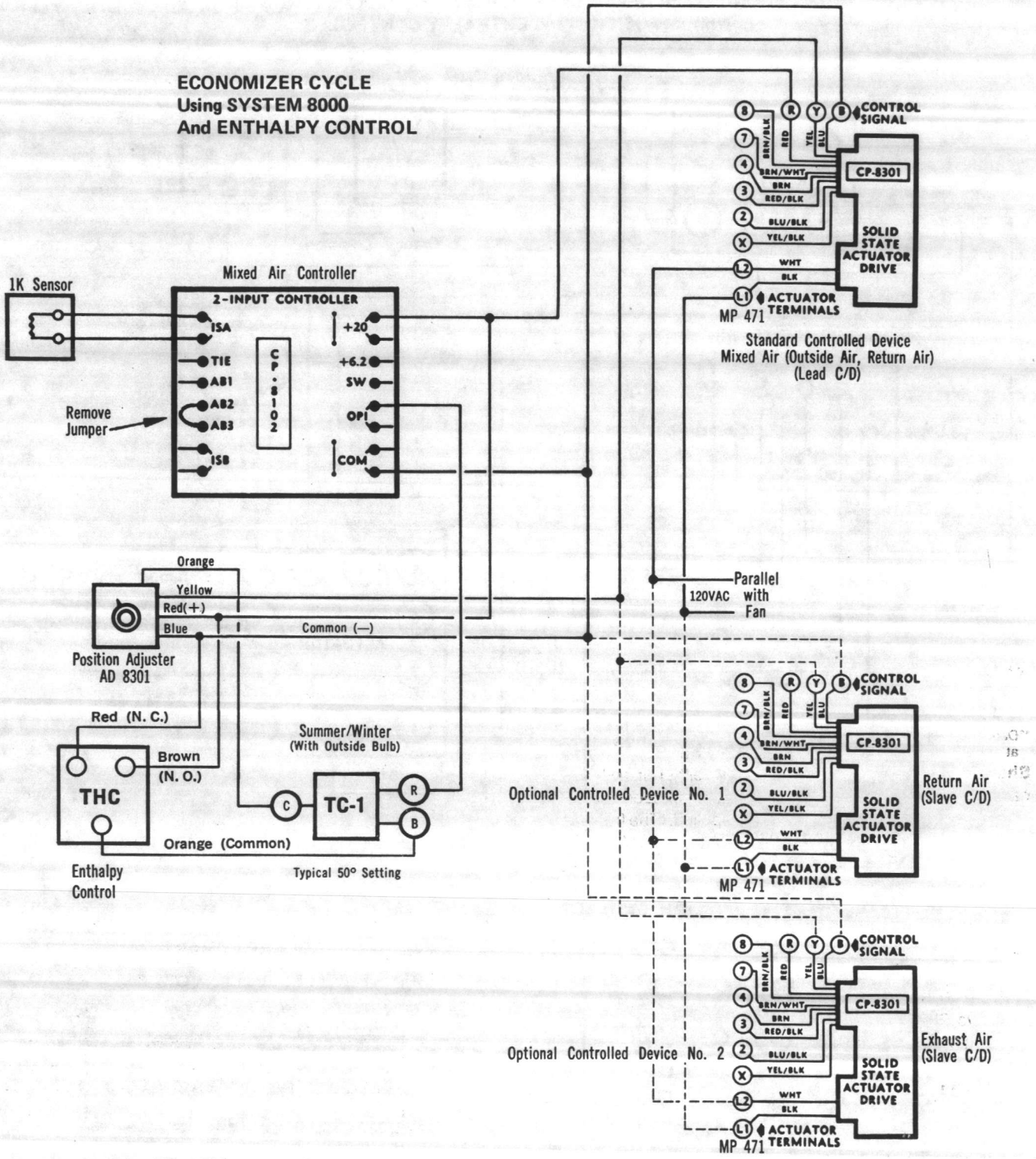


Figure 4.

Barber-Colman Company
ENVIRONMENTAL CONTROLS DIVISION
1354 Clifford Avenue
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LITHO IN U.S.A.

General Instructions

MA-12313, MA-12323-002 & MA-12323-102 Two-Position Electric Spring Return Gear Train Actuators

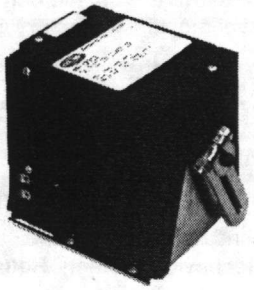
AM-217

APPLICATION

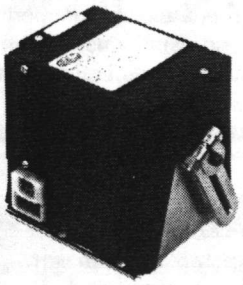
For two-position operation of dampers and other equipment which require the return to normal position upon power interruption.

SPECIFICATIONS

Control Circuit: Two wire.
Power Supply: 24 Vac Class 2 (+10, −15% for 0 to 90° travel, +10, −10% for 90 to 180° travel), 60 Hz.
24 Vac Class 2 (+10, −10%), 50 Hz.
VA:
Running, 14.4.
Holding, 9.6.
Watts:
Running, 12.7.
Holding, 7.3.
Torque:
Rated, 25 lb.-in. (2.8 N-m).
Limit, Will not exceed 40 lb.-in. (4.5 N-m) under stall conditions.
Maximum Damper Size:**
Parallel, 14 ft.² (1.3 m²).
Opposed, 18 ft.² (1.7 m²).
**Damper ratings are nominal and based on standard (not low leakage) dampers at 1" (25.4 mm) W.C. pressure and 2000 fpm (10 m/s).
Shaft Output: Dual 3/8" (9.5 mm) dia.; either or both shafts can be used as long as torque rating is not exceeded.
Shaft Rotation: CCW when power is applied. (The front of the actuator is defined as the right end when facing the field terminal connections.) Factory set at 90°; field adjustable 75°, 90°, 110°, 160°, 180°. *When used with 50 Hz power supply, rotation is limited to 75° and 90° adjustments.*
Timing:
Powered, 28 sec/90°.
Spring Return, 18 sec/90°.
Auxiliary Switch: *On MA-12323-002 and MA-12323-102 only,* two SPDT snap acting, independently field adjustable within 180° of actuator rotation.
Environment:
Ambient Temperature Limits,
Shipping and Storage −40 to 160°F (−40 to 71°C).
Operating −40 to 140°F (−40 to 60°C).
Humidity, 5 to 95% RH, non-condensing.
Locations, NEMA Type 1 indoor only (NEMA Type 3R with AM-219 installed).
Vibration, Maximum 1G in any plane.
Connections: See Table 1.
Case: Glass reinforced thermoplastic (PET) cover, plated steel base.
Mounting: Any position. Five 9/32" (7.1 mm) mounting holes provided.
Crank Arm for Actuator: AM-112 included with actuator. Slot (3/8") provides for adjustable radius from 7/8" (22 mm) to 3-1/8 (79 mm).
Dimensions: 5-1/2" high × 5" wide × 7-9/32" deep (140 mm × 127 mm × 185 mm). 3/8" (9.5 mm) shaft diameter.



MA-12313*



MA-12323-002*
MA-12323-102*

*Front of actuator is defined as the right end when facing the field terminal connections.

TABLE 1. SPECIFICATIONS

Actuator Part Number	Auxiliary Switch	Connections	Replacement for
MA-12313	No	Two (2) Side Mounted #6 Self Tapping Screw/ 1/4" Tab	Honeywell M-8415A-1004 ††
MA-12323-002	(2) SPDT Snap Acting	Side Mounted, Molded†	
MA-12323-102		Incl. AM-217 Wiring Harness	

†Field wiring requires Barber-Colman AM-217 harness kit or:
Auxiliary switches use Molex type connector #03-09-1094 and female terminals #1381.
Power/control wiring use AMP type connector #480003-5 using female terminals #60295-1.
††Change rotation to 75°.

TABLE 2. AUXILIARY SWITCH AMP RATINGS

24/120 Vac		240 Vac	
FLA	LRA	FLA	LRA
2	12	1	6

ACCESSORIES

Damper Linkage Accessories:

AM-111	Crank arm for 5/16" diameter damper shaft
AM-112	Crank arm for 3/8" diameter damper or MA-123X3 actuator shaft
AM-113	Crank arm for actuator or 1/2" diameter damper shaft
AM-115	Crank arm for 7/16" diameter damper shaft
AM-122	Linkage connector straight type
AM-123	Damper clip
AM-125	5/16" diameter × 20" damper rod
AM-125-048	5/16" diameter × 48" damper rod
AM-132	Ball joint connector
AM-217	Wiring harness kit, connectors have 18" (457 mm) leads
AM-219	Conduit box kit
AM-221	1 SPDT switch kit
AM-222	2 SPDT switch kit
TOOL-16	Wrench for cam adjustment

THEORY OF OPERATION

Run

Closed Position: Open circuit between +24 Vac side of power supply and terminal T. The internal spring will return the output shaft CW to 0° if the actuator had been energized.

Full Open: Circuit between 24 Vac power supply and terminals D and T will energize the actuator and rotate the output shaft CCW to the full end of the travel movement, factory set at 90°.

PRE-INSTALLATION

Inspection

Visually inspect the carton for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the carton and visually inspect the device for obvious defects. Return damaged or defective products.

Required Installation Items

- Wiring diagram
- Tools (not provided):
  Volt-ohm meter
  Appropriate screwdriver for mounting screws
  Appropriate drill and drill bit for mounting screws
- Appropriate accessories
- Mounting screws (not provided)

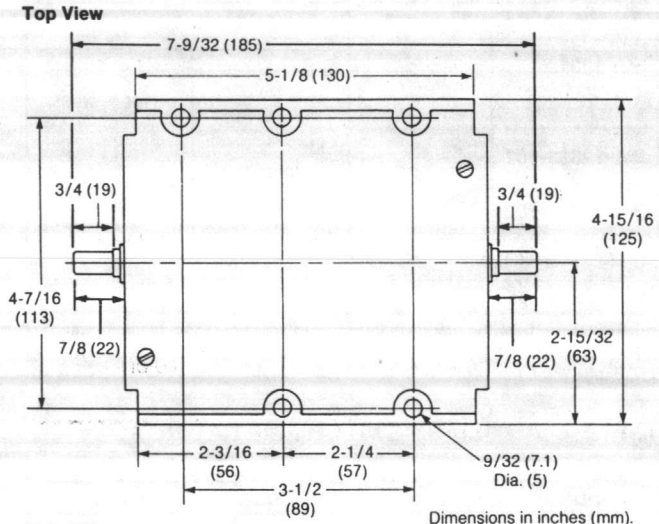


Figure 1. Mounting Dimensions for MA-123X3 Series

INSTALLATION

CAUTION

1. Installer must be a qualified, experienced technician.
2. Disconnect power supply before installation to prevent electrical shock and equipment damage.
3. Make all connections in accordance with the wiring diagram, and in accordance with national and local electrical codes. *Use copper conductors only.*
4. Do not exceed ratings of the device.
5. Avoid locations where excessive moisture, corrosive fumes or vibrations are present. NEMA Type 1 housings are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment. NEMA Type 3R housings (with AM-219 installed) are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet and external ice formation.

Mounting

Location: The actuator can be mounted in any position in a weather protected area. Five 9/32" (7.1 mm) mounting holes are provided in the base of the actuator (see Figure 1). Two (2) mounting screws on right side and one (1) screw on left side of actuator are the minimum number of required fasteners. Locate the actuator as close to the damper as possible.

Wiring

TABLE 3. TERMINAL DESIGNATION (MA-12323-002 & MA-12323-102)

Terminal	Function	AM-217 Wiring Harness Color Code
D	+24 Vac to go to full open position	Yellow
T	24G Vac	White

TABLE 4. AUX. SWITCH TERMINAL DESIGNATION (MA-12323-002 & MA-12323-102)

Terminal	Function	AM-217 Wiring Harness Color Code
NO (SW. #1)	Normally open	Blue
NC (SW. #1)	Normally closed	Blk/Yel
C (SW. #1)	Common	Wht/Blk
NO (SW. #2)	Normally open	Brn/Wht
NC (SW. #2)	Normally closed	Brown
C (SW. #2)	Common	Red

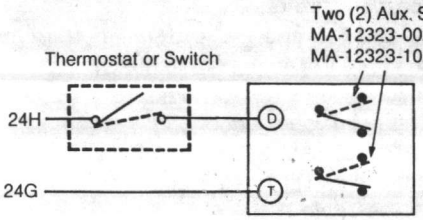


Figure 2. Typical Wiring for MA-123X3 Series

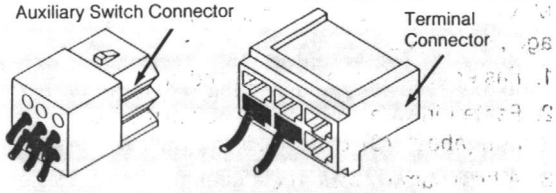


Figure 3. AM-217 Harness Kit

Damper Linkage

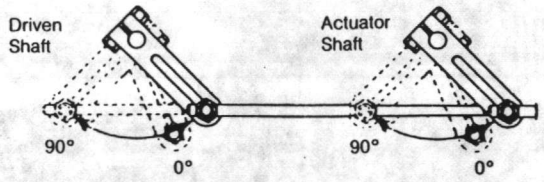


Figure 4. 90° Damper Linkage

Figure 4 illustrates linkage for 90° actuator shaft rotation operating an arm through 90° arc. To fasten linkage proceed as follows:

1. Fasten linkage connector at end of driven crank shaft arm.
2. Fasten linkage connector at end of slot of actuator crank arm.
3. Attach damper rod to connectors.

Normally Closed

1. Loosen crank arm from actuator shaft and swing linkage and damper shaft through entire rotation to insure the proper damper action.
2. Return damper to closed position.
3. Tighten crank arm on actuator shaft.
4. Loosen the connector on the actuator crank arm.
5. Pull damper rod through the crank arm connector until the damper is tightly closed.
6. Tighten clamp connecting link on actuator crank arm.

Normally Open

1. Move damper to approximately 85° of full open position and clamp conneting links to damper rod.
2. Check adjustment for proper operation by running actuator and driven shaft between limits of travel.

CAUTION

If crank arm does not provide proper travel, reset connecting link in linkage connector. NEVER ATTEMPT TO TURN THE ACTUATOR SHAFT WITH A WRENCH OR A CRANK. This will cause internal damage.

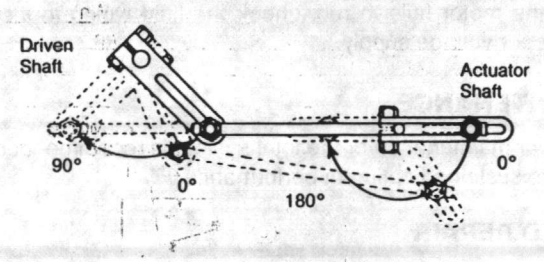


Figure 5. Linkage for 180° Actuator Shaft Rotation for 90° Damper

Figure 5 illustrates linkage for 180° actuator shaft rotation operating an arm through 90° arc (see Field Adjustment — Maximum Output Shaft Rotation on this page). To fasten linkage proceed as follows:

1. Fasten linkage connector at end of driven crank shaft arm.
2. Fasten linkage connector at punch mark on actuator crank arm (about .707 of the radius).
3. Attach damper rod to connectors.

Normally Closed

1. Loosen crank arm from actuator shaft and swing linkage and damper shaft through entire rotation to insure the proper damper action.
2. Return damper to closed position.
3. Tighten crank arm on actuator shaft.
4. Loosen the actuator crank arm connector.
5. Pull damper rod through the crank arm connector until the damper is tightly closed.
6. Tighten clamp connecting link on actuator crank arm.

Normally Open

1. Move damper to approximately 85° of full open position and clamp connecting links to damper rod.
2. Check adjustment for proper operation by running actuator and driven shaft between limits of travel.

CAUTION

If crank arm does not provide proper travel, reset connecting link in linkage connector. NEVER ATTEMPT TO TURN THE ACTUATOR SHAFT WITH A WRENCH OR A CRANK. This will cause internal damage.

FIELD ADJUSTMENTS

Maximum Output Shaft Rotation (See Figure 6)

CAUTION

Output shaft rotation must not exceed 90° for actuators with 50 Hz power supplies.

The factory set output shaft rotation is 90°. This setting may be changed by:

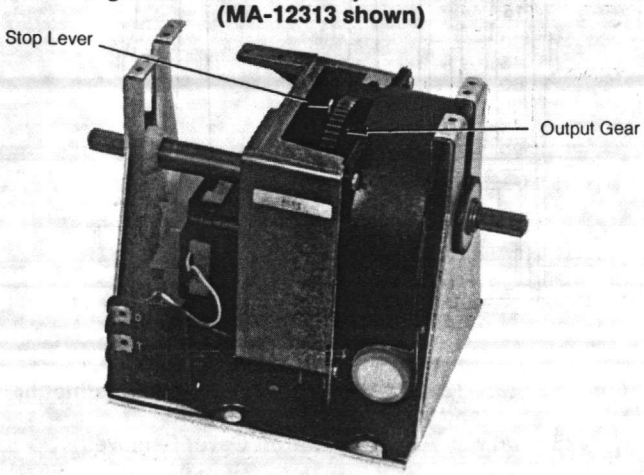
1. Removing the two single slotted screws on the top of the actuator cover.
2. Remove the cover.
3. Lift the stop lever away from the output gear until the lever can be rotated to a different setting.

NOTE

A small screwdriver may be needed to lift the stop lever away from the output gear when it is in the 110 or 180° position.

4. Move the stop lever to the required setting.
5. Replace cover and screws.

Figure 6. Maximum Output Shaft Rotation (MA-12313 shown)



Auxiliary Switches (MA-12323 & MA-12323-002 Only) (See Figure 8)

Settings are field adjustable by:

1. Removing the two single slotted screws holding the plate that is located just above the output terminals.
2. Remove the adjustment switch plate.
3. Move the adjustment lever to the required position (each "click" on the movement of the lever is approximately 3°), 15° scale increments.
4. Replace the plate and screws.

NOTE

If switching action is required between 90 and 180°, rotate auxiliary switch cam 90° CCW with TOOL-16. The cams are located under the actuator cover (see Figure 9). Switches are now lever adjustable between 90 and 180°.

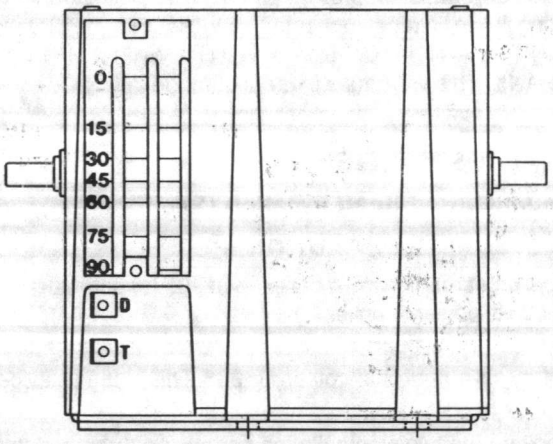


Figure 7. MA-12313 Terminal Configuration
(Shown with Cover Removed)

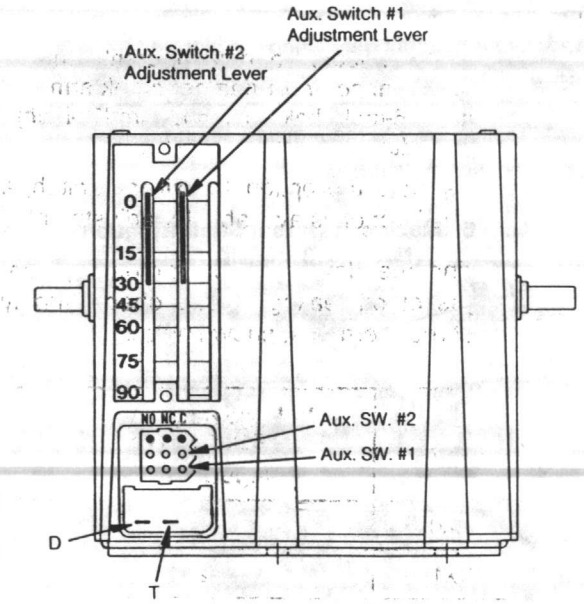


Figure 8. MA-12323-002 & MA-12323-102 Adjustments and Terminal Configurations
(Shown with Adjustment Lever Cover Removed)

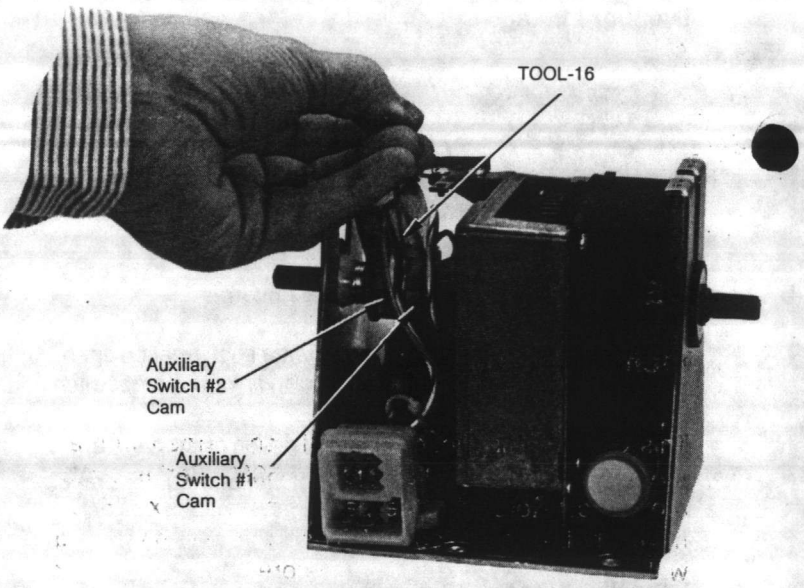


Figure 9. MA-12323-002 & MA-12323-102 Auxiliary Switch Cam Rotation

CHECKOUT

After the entire system has been installed, the following check for proper operation can be made (see Figure 2 for typical system):

1. Be sure that the system power is connected and on.
2. Be sure control (manual or automatic) is operating properly per system requirements.
3. Connect 24 Vac power supply between T & D. The actuator shaft will rotate CCW to the maximum position.
4. Disconnect the +24 Vac power supply at terminal T. The actuator shaft will rotate CW spring return to 0°.
5. Action of auxiliary switch (on MA-12323-002 only):
   a. C made to N.C. when actuator is at de-energized and spring return to 0°.
   b. C made to N.O. when actuator shaft rotation reaches auxiliary switch setting.
6. Be sure there is no binding of the linkage at any point in the stroke.
7. If the motor fails to run, check the field wiring to insure proper voltage supply.

MAINTENANCE

Regular maintenance of the total system is recommended to assure sustained optimum performance.

FIELD REPAIR

None. Replace with a functional actuator.

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BARBER COLMAN COMPANY

General Instructions

MA-5200 and MA-5300 Series Two-Position Actuators
MP-5200 Series Proportional Actuators

DEVICE INFORMATION

Identification

This General Instruction Sheet is concerned with all MA and MP-5200-0-0-2 and MA-5330 Series Actuators. Actuators with the part number suffix "-500" have a built-in adjustable SPDT switch. When working with actuators manufactured before this series, refer to replacement section below.

Pre-Installation

MA and MP-5210 Series: These actuators, two position and proportional, respectively, are supplied without additional linkage or hardware. AV-600 valve linkage and appropriate valve body or AM-601 damper linkage must be ordered separately.

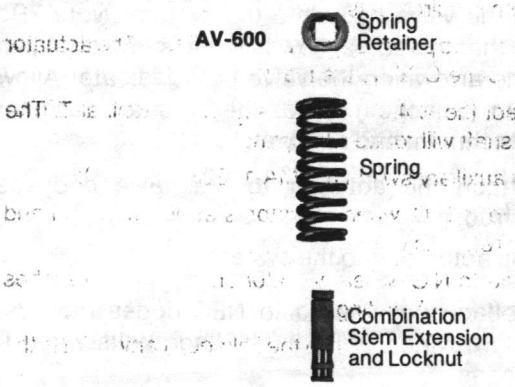
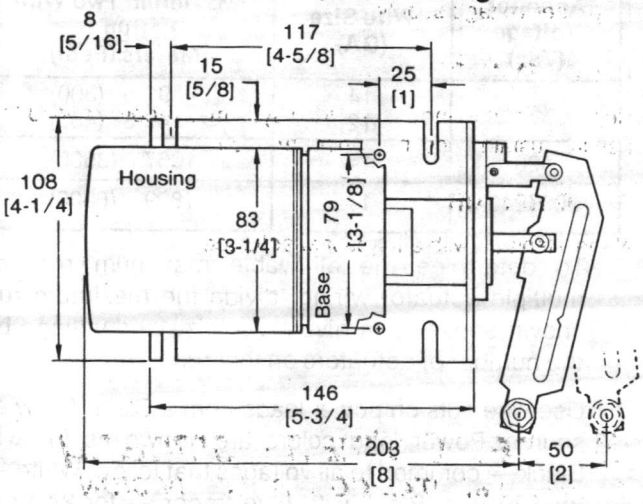
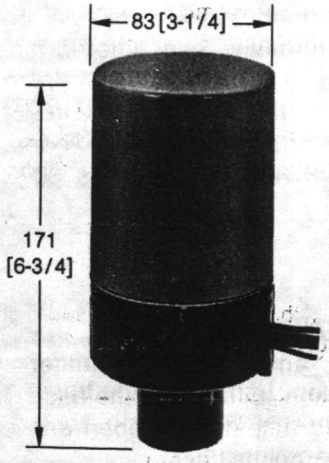


Figure 1. AV-600, Valve Linkage

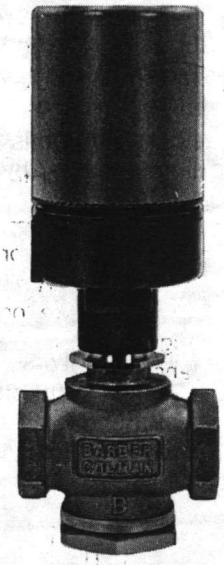


All Dimensions in Millimeters [Inches in Brackets]

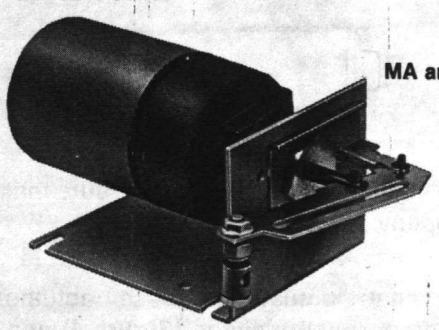
Figure 2. AM-601 Damper Linkage



MA and MP-5210 Series



MA and MP-5210 Series AV-600 and Valve Body
NOTE: Allow 76mm [3"] above actuator for removal



MA-5330 Series and MP-52220 Series

MA-5330 Series and MP-5220 Series: These actuators, two position and proportional, respectively, are supplied with AM-601 damper linkage. Also required for installation will be four 1/4-inch diameter bolts or other fasteners to mount the actuator. Additional hardware normally required for linking the damper would be:

AM-132—balljoint connector for damper crank arm
AM-122—straight connector for damper crank arm
AM-125—8 mm (5/16-inch) link rod x 508 mm (20-inch)
AM-111 thru 115—damper shaft crank arms

When actuators have the optional auxiliary switch, a Tool-12 adjusting wrench is available for adjustment.

Before mounting the device check for dents, bent parts and signs of oil leakage. Also check supply voltage against requirements, shown below:

Part Number	Voltage Requirements 50/60 Hz (Vac) Input: 10 watts
MA-MP-5XX0	120
MA-MP-5XX1	240
MA-MP-5XX2	208
MA-MP-5XX3	24

INSTALLATION

Requirements

These actuators will operate correctly in any position and are unaffected by normally encountered environmental conditions. Ambient temperature limitations: For MA Series, minimum is -17°C (0°F) and maximum is 60°C (140°F). For MP-5220 Series, minimum is -28°C (-20°F) and maximum is 60°C (140°F).

Procedure

CAUTION

Do not twist or exert any force on actuator housing during installation. Either turn the base by hand or if necessary use 1-5/8" open end wrench on flats provided on the base.

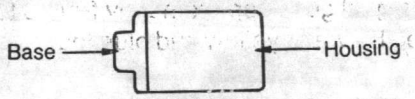


Figure 3

1. Before installing the device, check to be sure that it operates properly.

   MP, (proportional) actuators. These actuators require the proper input voltage **(Figure 4)** and a control voltage of 1 to 15 Vdc. The actuator with the proper valve or damper linkage should go from retract to extend position as the control voltage goes from approximately 6 to 9 Vdc. For this checkout step, the AD-8301 manual positioner may be used to supply the control voltage.

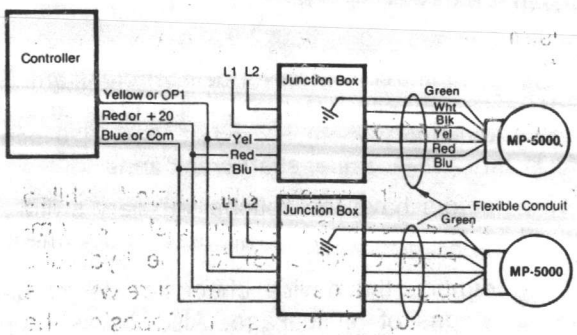


Figure 4. MP Wiring

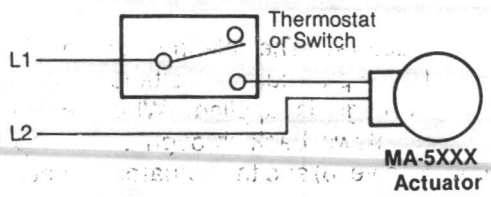


Figure 5. MA Wiring

MA (two position) actuators: When the proper ac voltage **(Figure 5)** is applied, the actuator motor should run causing the actuator to extend.

2. Install and connect the device physically.

   a. Damper actuators: Position actuator and mark mounting holes using the actuator bracket as a template.

      The best position for the actuator is with the actuator crank arm and the crank arm on the driven shaft, at a 90° angle to the linkrod at mid-stroke. It may be necessary to swivel the actuator linkage to arrive at the best mounting location.

      Allow adequate working space to wire the actuator into the system.

      Drill mounting holes for the appropriate 1/4-inch diameter mounting fasteners and mount the actuator. The actuator must be mounted firmly enough to prevent excessive actuator movement under normal damper loading. If there is excessive actuator movement, the damper may not fully open or fully close.

   b. Valve actuators: Remove as required the valve body from the actuator by loosening the 1-5/8-inch flange nut.

      Pipe the valve body into the system. Note: Be sure that the actual flow is in the same direction as the arrows on the valve body indicate. Allow 76mm (3 inches) above the actuator case for reattachment and removal.

      Reattach the actuator to the valve body as required.

3. Wire the actuator into the system.

   Low voltage units wired to NEC codes may use Class Two wiring. Wire line voltage units wired to NEC codes.

Actuator Voltage (Vac)	Wire Size (GA)	Maximum Two Wire Run Meters (Feet)
24	14	91.5 (300)
	12	146.3 (480)
120	14	1067 (3500)
208/240	14	1829 (6000)

   To determine the allowable maximum run for multiple actuator wiring, divide the maximum run shown above for a given wire size and voltage by the number of actuators on that run.

   Use wire nuts on power leads from a Class A power source. Power lead colors are shown as follows: Black — common to all voltages that follow. White wire for 120 Vac. Black with blue tracer — for 24 Vac. Black with brown tracer — 208 Vac. White with black tracer — 240 Vac. A green grounding wire is provided. All leads are 1.2 m (4 feet).

MP (proportional) actuators:

NOTE

System 8000 controllers can control a maximum of two (2) MP-5200 Series Actuators. AD-8101 adaptors can be added as shown in EN-111 to control two additional MP-5200 Series per adaptor.

Actuator wires are connected as shown in **(Figure 4).** Barber-Colman approved, three conductor twisted 18 AWG wire has 600 volt PVC insulation and should be used from the controller. This twisted wire can be put in the same conduit with power wiring to the actuator. Also acceptable is any three wire (18 ga.) cable with Class I lead insulation in conduit separate from line voltage **(Figure 4).**

MA (two position) actuators: These are wired as shown with the thermostat or switch device controlling the off-on status of the actuator motor **(Figure 5).**

4. Finish the damper actuator mechanical hook-up. After wiring, assemble the straight connector, linkrod, balljoint connector, and damper shaft crank arm as shown **(Figure 6).**

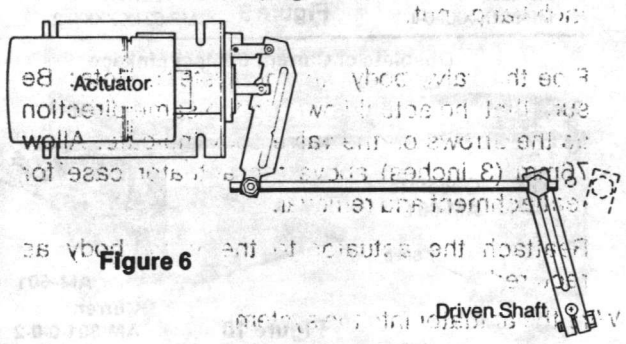


Figure 6

Tighten both the actuator connector to the linkrod and the damper crank arm to the damper shaft. Both crank arms should be approximately 90° to the linkrod at midstroke. Normally dampers are linked to full heat with the actuator retracted.

By extending and retracting the actuator the actuator crank arm will rotate 80°. (See Number 1 above.)

Determine the proper radius on the damper shaft crank arm to fully open and close the damper.

Tighten down the connector to the damper crank arm and the linkrod.

The installation is now complete.

Auxiliary Switch

Hydraulic actuators may be ordered with a built-in adjustable SPDT auxiliary switch **(Figures 7 and 8).** This switch must be ordered as part of the actuator and cannot be field installed. Note: For MP Series actuators only, the switch common wire is internally connected to the black power lead. Because of this, the switch must be wired to control the same voltage as the actuator itself. Switch rating is 10 amperes at 120/240 Vac. Leads are 1.2m (4 feet).

The switch's brown wire is normally open and the orange wire is normally closed. The switching point is adjustable over the entire actuator stroke and is factory set to occur at the retracted end. Use Tool-12 to adjust the switch point.

CHECKOUT

The actuator is now installed and should run properly when the system is energized. The following checks can be easily performed to see if the device is operational.

MP Series Actuators: First, the actuator motor should run continually when power is applied. If the motor is not running, something is wrong with either actuator or the supply voltage. Second, the damper or valve should go from full heat to full cool shaft extended as the control signal goes approximately from 6 to 9 Vdc, as measured between yellow and blue leads.

NOTE

At very low ambient temperature (around minus 20°F) the actuator may run slowly until the oil warms up. This condition may exist for 30 minutes.

MA Series Actuators: When the proper voltage is supplied to the actuator, the actuator motor should run, causing the actuator shaft to extend.

If the actuator fails to function properly, refer to the section on repairs.

RUN/ADJUST

No adjustments are made at the actuator. All adjustments are made at the controller.

Theory of Operation

See Figures 6 and 7. The permanently sealed oil filled case (1) contains a movable hydraulic piston assembly (2) and an electric pump (3) for the hydraulic system. The pump generates a fluid pressure which is transmitted to the top of the piston. Opposing the hydraulic force is the spring of the valve or damper linkage.

MA Series Actuators: The electric pump (3) is powered by the input supply voltage and runs whenever the voltage is applied. When power is removed, the oil flows back through the pump by means of check valve (6) and the actuator retracts.

MP Series Actuators: The electric pump (3) is powered by the input supply voltage and runs continuously. An unregulated, unfiltered power supply (4) is powered by a transformer winding from the pump motor winding. The

power supply produces 20 Vdc which powers the controller. The controller returns a 1 to 15 Vdc control voltage to the actuator transducer (5). This controls the internal pressure and the resultant actuator action.

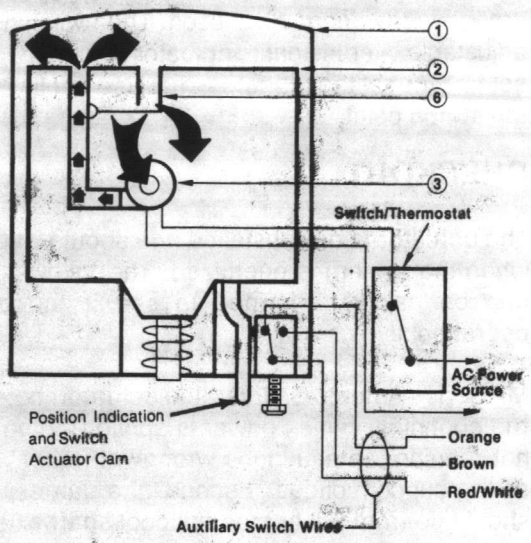


Figure 7. MA Series Actuator

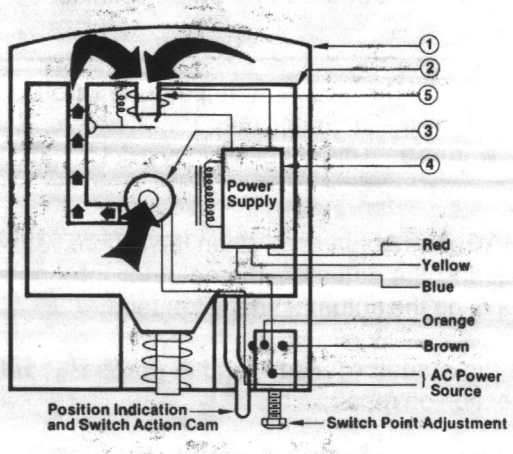


Figure 8. MP Series Actuator

MAINTENANCE

The power unit of the actuator is sealed in oil and requires no maintenance.

REPAIR

MA Series Actuators:

1. Check the actuator by applying the proper supply voltage.
2. The motor should run when power is applied; if not, the actuator is defective and should be replaced.
3. The actuator should extend; if it does not, check the mechanical linkage. Either the mechanical linkage prevents proper action or the actuator is defective.
4. If the linkage moves properly, but the actuator does not extend, replace the actuator.
5. If applying power causes the actuator to perform correctly, the actuator and linkage are functional and the wiring and thermostat should be checked.

MP Series Actuators: Repairs to this device consist mainly of checking the unit wiring and replacement of the power supply. Other field repairs are not recommended. Use the procedure below to locate a malfunction.

1. The actuator motor should run continually. If it does not run, check the supply voltage and the unit wiring.
2. Voltage between the blue (−) and the red (+) leads should be 20 (+2, −3) Vdc.

NOTE

Only when connected to 8000 controller, adaptor or AD-8969-611.

3. Input voltage on the blue (−) and yellow (+) wires should be between 1 and 15 Vdc. If it is not, refer to EN-111 for service information.

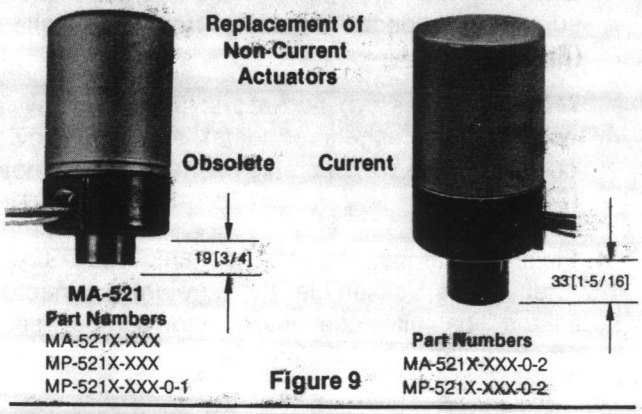


Figure 9

Obsolete or Current Damper Linkage

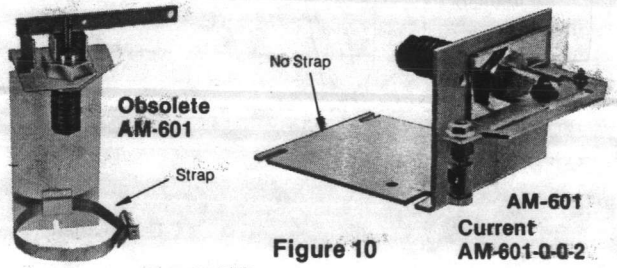


Figure 10

Obsolete Valve Linkages or AV-600 Linkage

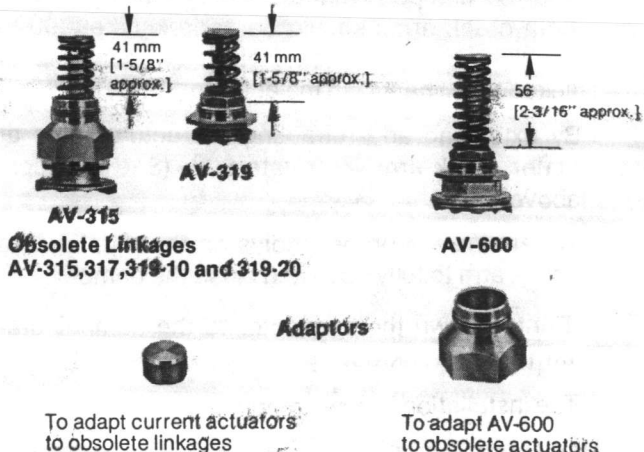


Figure 11

NOTE: When replacing MP-521X-XXX with MP-521X-XXX-0-2 consult EN-111, Section C.1.2.

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