



FILE INFORMATION
DIVISION TAB - TRANE REFRIGERATION
PRODUCTS
PRODUCT TAB - UNITARY SPLIT SYSTEM
AIR CONDITIONERS
MODEL TAB - Model RAUB
LITERATURE ITEM - Installation, Operation,
Maintenance

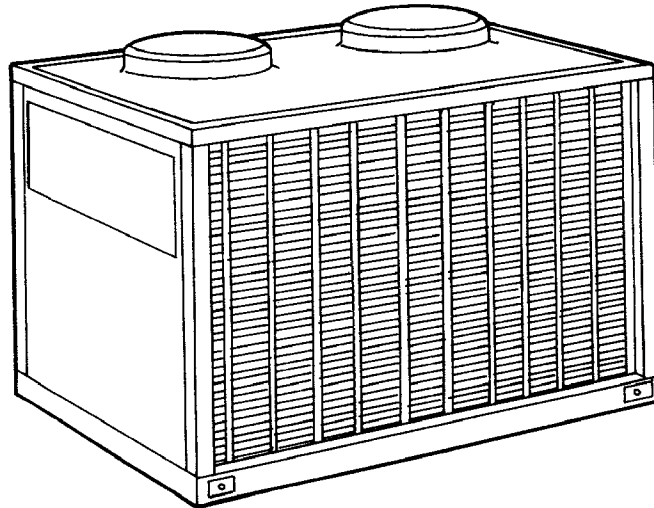
LITERATURE FILE NO.

RAUB-IOM-3

INST.- OPER.- MAIN.

Since the Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

MARCH 1983
Supersedes RAUB-IN-10
Dated November 1980,
RAUB-IN-10A Dated
March 1981, RAUB-IN-13
Dated January 1981,
and RAUB-M-10 Dated
November 1980



SPLIT SYSTEM CONDENSING UNITS

RAUB 20 THROUGH 60-TONS
A, B, C DESIGN SEQUENCE

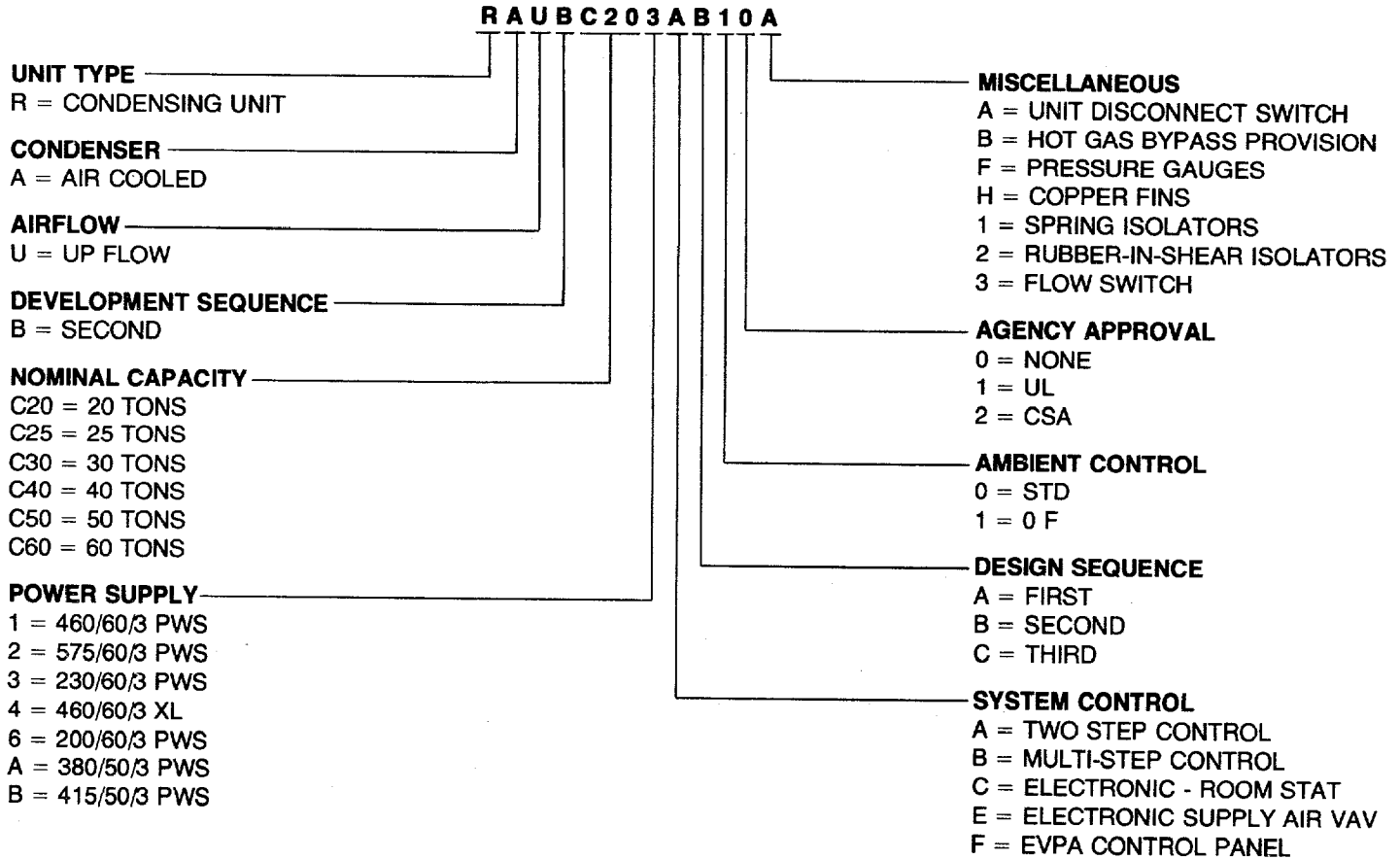
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RAUB MODEL NUMBER DESCRIPTION

Trane products are identified by a multiple character model number that precisely identifies a particular type of unit. An explanation of the multiple character RAUB number is listed below to enable the owner or service engineer to define the specific operation, components and options.



RAUB UNIT NAMEPLATE

The RAUB unit nameplate is located in the upper left hand corner of the control box end of the unit. It lists the model number, electrical information, refrigerant type and charge, unit weight and other specific, important unit information.



MODEL NO

SERIAL NO

FOR OUTDOOR INSTALLATION ONLY
SEE ADDITIONAL NAMEPLATE IN GAS HEAT SECTION WHEN USED

UNIT POWER SUPPLY

RATED VOLTAGE HZ PHASE

UTILIZATION VOLTAGE RANGE

THIS UNIT IS SUITABLE FOR OPERATION ON THE FOLLOWING NOMINAL SYSTEM VOLTAGES

	CIRCUIT - 1	CIRCUIT - 2
MINIMUM CIRCUIT AMPACITY	<input type="text"/>	<input type="text"/> AMPS
RECOMMENDED DUAL ELEMENT FUSE	<input type="text"/>	<input type="text"/> AMPS
MAXIMUM FUSE SIZE	<input type="text"/>	<input type="text"/> AMPS

	QTY	VOLT	HZ	PH	RLA, EA	LRA, EA
COMPRESSOR MOTOR	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
					FLA, EA	HP, EA
COND FAN MOTOR	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
EVAP FAN MOTOR	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
EXHAUST FAN MOTOR	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
BURNER MOTOR	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
ELECTRIC HEATER CIRCUIT	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>		KW

FACTORY CHARGE)-EACH SYSTEM LBS OF R-22

FIELD CHARGED-EACH SYSTEM LBS OF R-12 LBS OF R-22

UNIT WEIGHT

TEST PRESSURE DESIGN PRESSURE 405 PSIG LOW 300 PSIG
HIGH 450 PSIG

FOR CONTINUED EFFICIENT OPERATION OF THIS UNIT REFER TO
OPERATION MAINTENANCE MANUAL

THE TRANE COMPANY, LA CROSSE WISCONSIN 54601
MADE IN U.S.A. X39680091-01

GENERAL INFORMATION

Model RAUB condensing units are designed for outdoor mounting with a vertical air discharge. They are usually installed on a flat roof but can also be installed on a concrete slab at ground level. In either case, the unit must be installed so that it is level to within ± 2 -inches side to side and end to end. Each unit is leak-tested and evacuated at the factory, and shipped with a holding charge of Refrigerant-22. An access panel on the end of the unit provides access to the compressor section and a hinged door provides access to the control panel on the side of the unit. Table 1 provides general data.

NOTE: "Warnings" and "Cautions" appear at appropriate places in this instruction manual. Your personal safety and the proper operation of this machine require that you follow them carefully. The Trane Company assumes no liability for installations or servicing performed by unqualified personnel.

An Installation Checklist is provided at the end of the INSTALLATION section of this manual and should be completed after all installation procedures have been accomplished. Periodic Maintenance checklists are provided at the beginning of the MAINTENANCE section of this manual for performing recommended maintenance. These checklists should not be substituted for the detailed information given in appropriate sections of this manual.

A Start-Up Log is provided at the end of the START-UP section of this manual. Data should be entered in this log during initial start-up to ensure that the unit is operating properly and that all recommended checks have been completed. A Maintenance Log at the end of the "Periodic Maintenance" section enables the operator/serviceman to maintain a record of system operating data.

INSTALLATION

The installation information contained in this manual applies to the Model RAUB condensing unit only. Supplemental installation instructions are provided for the Model BRCB evaporator unit and for RAUB/EVPA and RAUB/VAV equipment. Refer to the following publications:

BRCB-M-1 for BRCB information.

RAUB-IN-11 for Model RAUB with EVPA control option.

RAUB-IN-12 for Model RAUB with VAV control option.

SHIPPING AND RECEIVING

Model RAUB condensing units are leak-tested and evacuated at the factory and then shipped with a holding charge of R-22 refrigerant. Inspect each unit as it is delivered to the job site for any in-transit damage. All shipments are made F.O.B. Trane Company manufacturing plant, therefore claims for shipping damage must be filed with the delivering carrier.

To protect against loss from in-transit damage, complete the following upon receipt of the unit:

1. Inspect individual pieces of the shipment before accepting. Check for rattles, bent corners, or other visible damage or indications of shipping damage.
2. If a shipment has apparent damage, inspect it throughout before accepting. Make specific notations concerning the damage on the freight bill. Do not refuse delivery.
3. Inspect the unit for concealed damage before it is stored and as soon as possible after delivery. Concealed damage must be reported within 15 days.
4. Do not move damaged material from the receiving location. It is the receiver's responsibility to provide reasonable evidence that concealed damage did not occur after delivery.
5. If concealed damage is discovered, stop uncrating the shipment. Retain all internal packing, cartons and crates. Take photographs of the damaged equipment, if possible.

6. Notify the carrier's terminal of damage immediately by phone and by mail. Request a joint inspection of the damaged equipment immediately by the carrier and consignee.
7. Notify the Trane sales representative of the damage and arrange for repair. Do not repair the unit, however, until damage is inspected by the carrier's representative.

Also, after receiving the unit, rotate the condenser fans manually to make sure that they rotate freely. Check for any materials shortage. If ordered, accessories ship in the positions shown in Figures 1 through 3.

Compare the data on the unit nameplate with the ordering and shipping information to verify that the correct unit has been received.

Before unit start-up, read this manual to become familiar with the unit and its operation.

LOCATION AND CLEARANCES

Refer to Figures 4 through 8 for detailed unit dimensions, connections and clearances.

Locate the condensing unit where air will flow without obstruction upward through the condensing coil and away from the fan discharge.

CAUTION: If unit is placed under an overhang, allow at least 6-feet of clearance above the unit to prevent recirculation of hot discharge air.

If the unit is being placed near a wall or other obstruction which may hinder airflow, the minimum condenser air clearances as shown in Figures 4 through 8 must be maintained. Increase the minimum condenser air clearance to 16 feet if:

1. The installation has obstructions on two or more sides.
2. The installation includes more than one unit (side by side installation).

If the condensing unit is to be installed in a well, increase the minimum condenser air clearance to 16 feet and make sure that the fan assemblies protrude out of the well and above ground level. Refer to Figure 9.

NOTE: FOUR FEET OF SERVICE CLEARANCE SHOULD BE MAINTAINED ON THE COMPRESSOR SIDE OF THE CONDENSING UNIT.

FOUNDATION

When the unit is about to be set on the ground, place it above the snow line and above any possible blowing debris. Provide concrete footings or foundation for support. Support is not needed around the total perimeter of the unit; only at the four or six mount-

ing feet around the unit. Construct the footings in accordance with the loading data given in Figures 4 through 8. Install isolators, if desired, or hold-down bolts in the footings to anchor the unit. Refer to Figures 10 and 11 for spring isolator and isolation pad selection and location. Figure 12 gives isolator dimensions.

For rooftop installations, make certain the roof is strong enough to adequately support the unit and to avoid the transmission of vibration. Table 1 lists unit operating weights. To reduce vibration transmission into the building, the use of isolators should be considered. Anchor the unit to the roof with hold-down bolts or isolators. Check with a roofing contractor for proper waterproofing installation practices to ensure that the roof does not develop leaks as a result of the unit weight, vibration or hot weather.

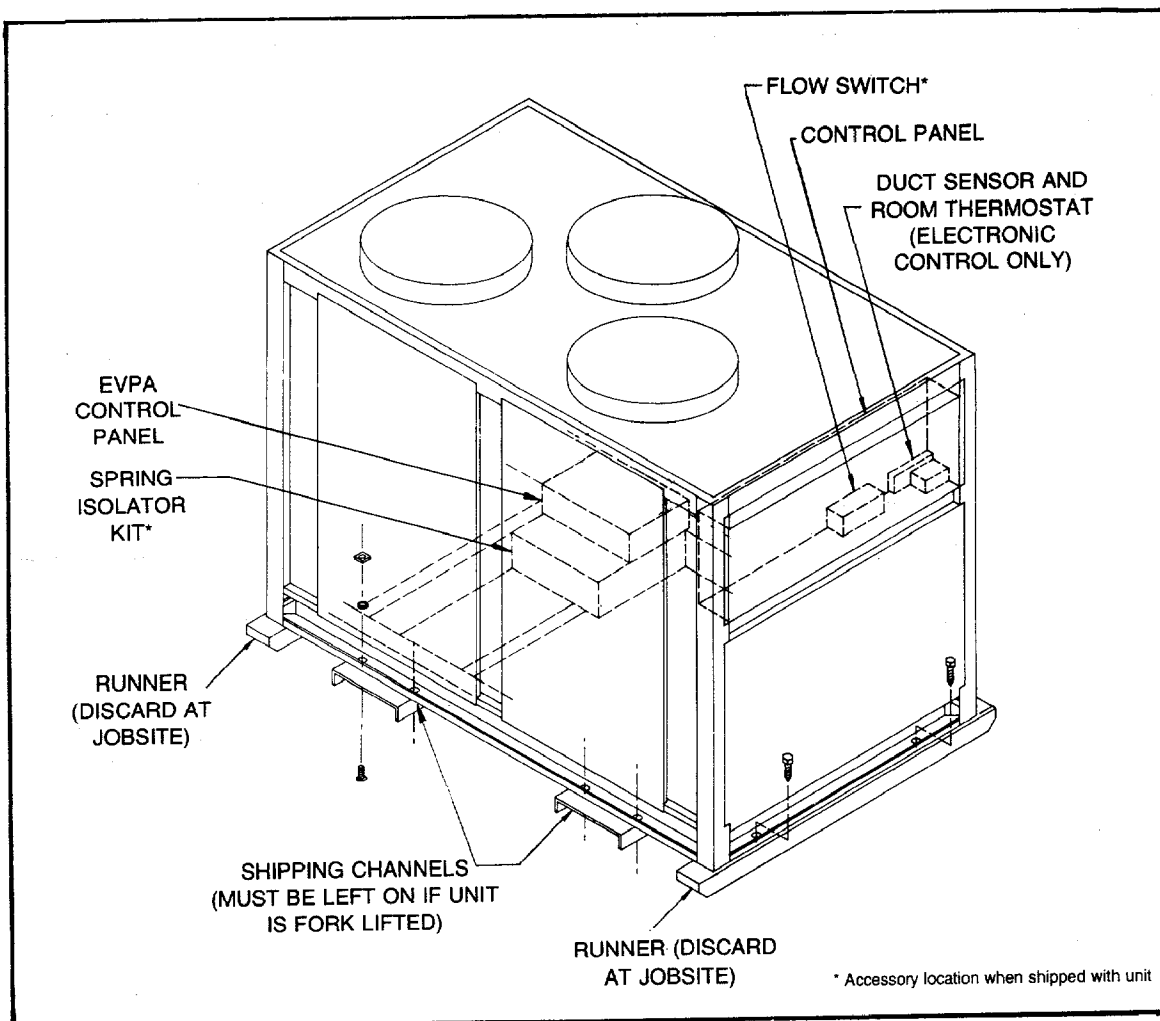


FIGURE 1 - Shipping Location of Accessories (RAUB 20 to 30)

TABLE 1 - General Data

MODEL	UNIT WEIGHTS (LBS.)		REFRIGERANT				CONDENSER FANS AND MOTORS			COMPRESSOR		
	SHIPPING	OPERATING	TYPE	HOLDING	OPERATING	PUMPDOWN	NO.	FAN DIA. (IN.)	MOTOR HP (EA.)	NO.	TYPE	OIL CHG. PER COMP. (PINTS)*
				CHG. (LBS.)	CHG. (LBS.)	STORAGE (LBS.)						
RAUB 20	1,765	1,745	R-22	1.3	28	67	2	26	1.0	1	Hermetic	19
RAUB 25	1,945	1,925	R-22	1.3	31	76	3	26	1.0	1	Hermetic	19
RAUB 30	2,155	2,145	R-22	1.5	40	96	3	26	1.0	1	Hermetic	19
RAUB 40	3,140	3,090	R-22	1.3 ¹	29 ¹	68 ¹	4	26	1.0	2	Hermetic	19 ¹
RAUB 50	3,620	3,660	R-22	1.3 ¹	31 ¹	71 ¹	6	26	1.0	2	Hermetic	19 ¹
RAUB 60	3,770	3,720	R-22	1.5 ¹	40 ¹	92 ¹	6	26	1.0	2	Hermetic	19 ¹

NOTE:

1. Per refrigeration system.
2. Assumes system tubing previously wetted with oil.

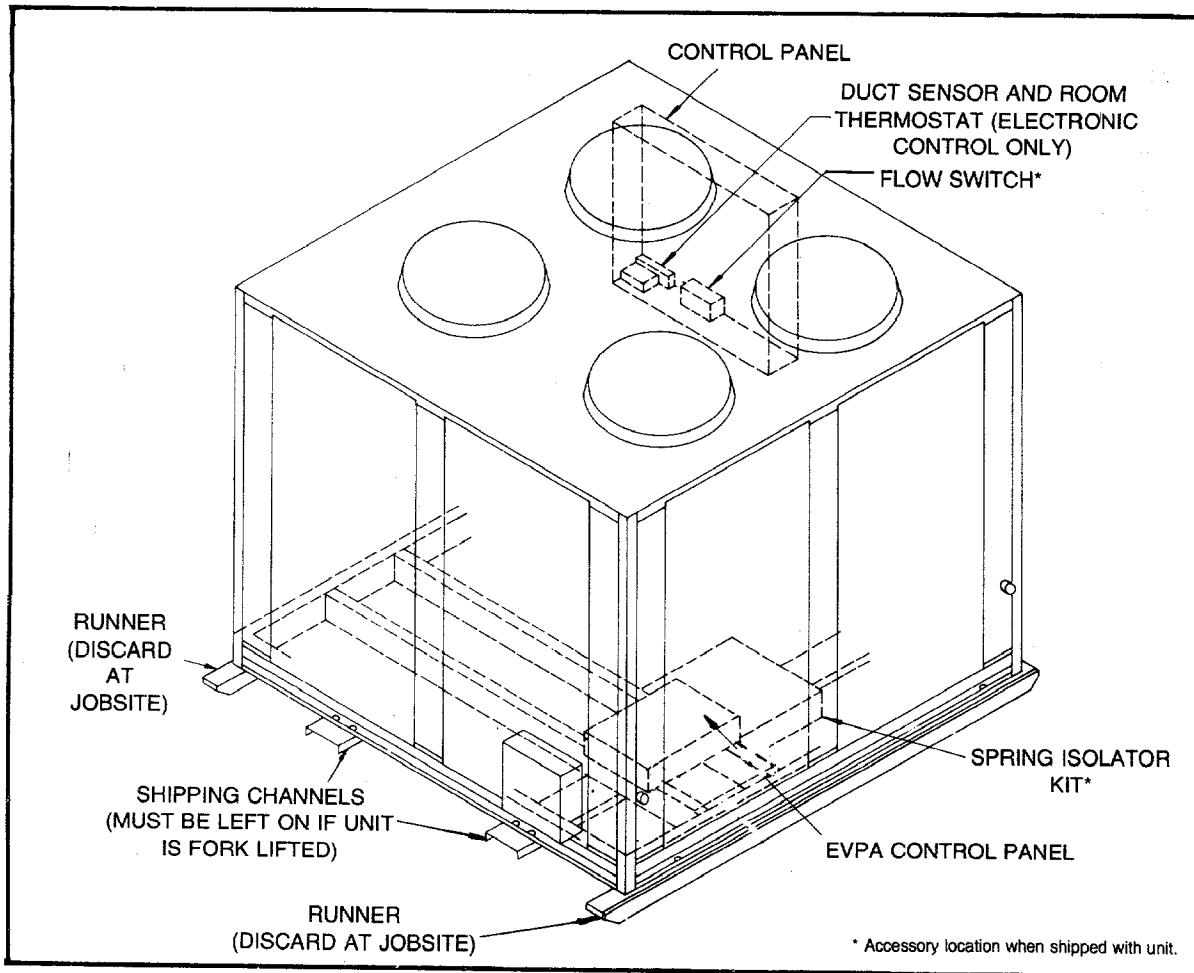


FIGURE 2 - Shipping Location of Accessories (RAUB 40)

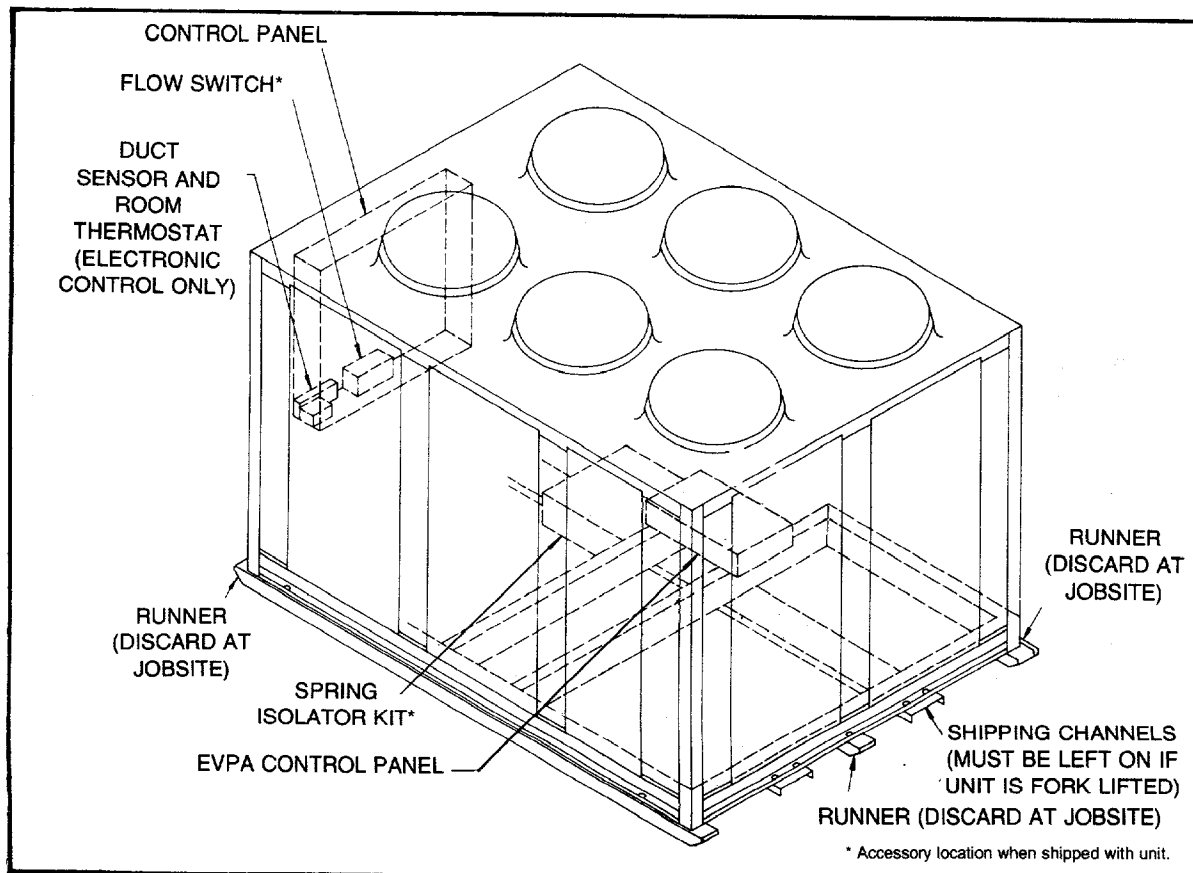


FIGURE 3 - Shipping Location of Accessories (RAUB 50 and 60)

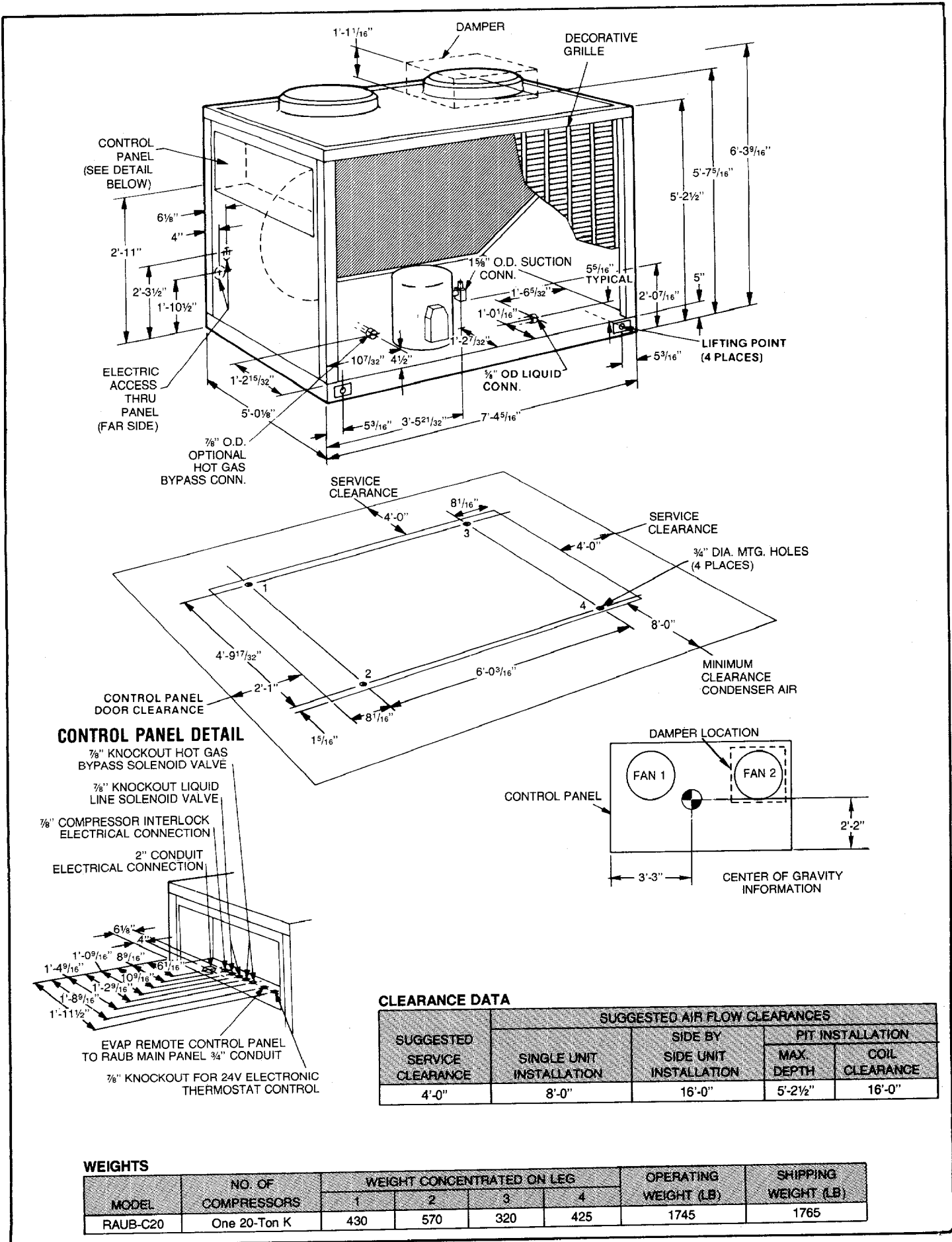
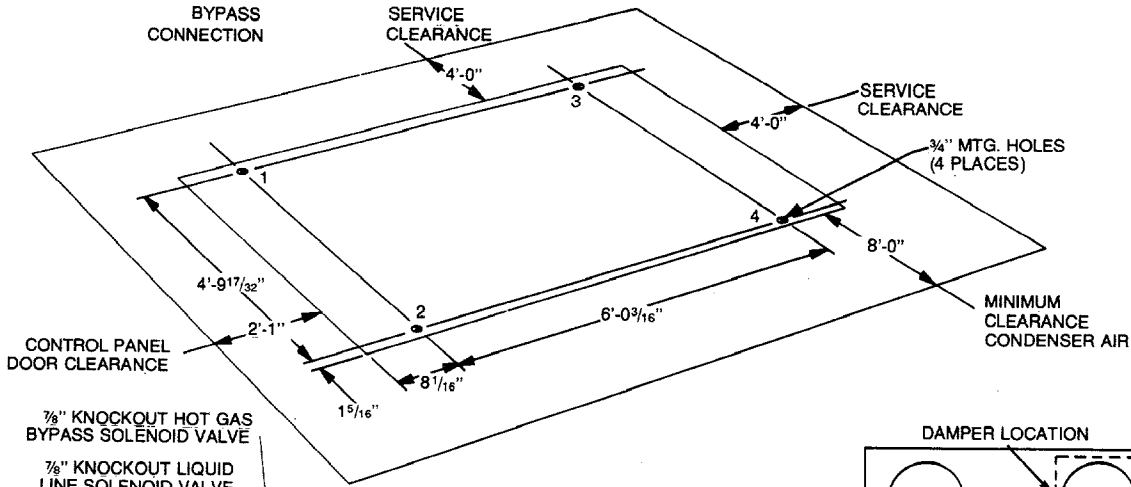
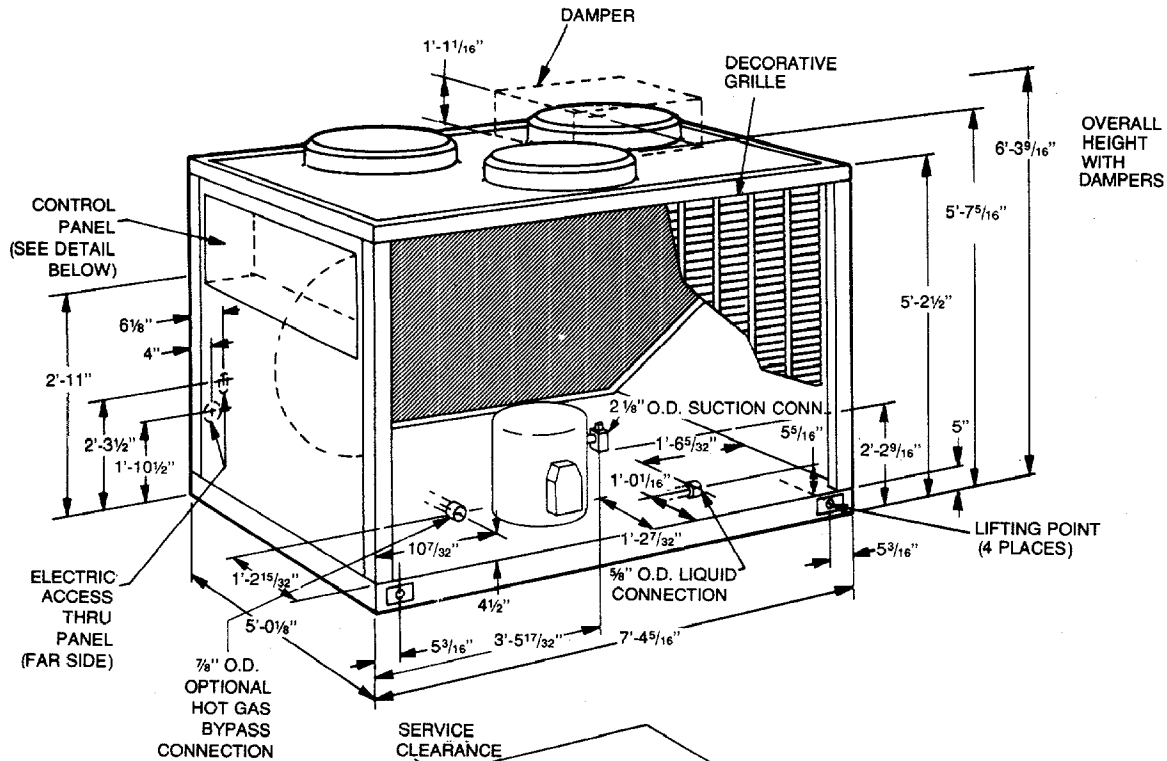
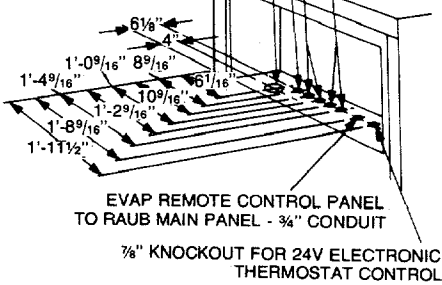
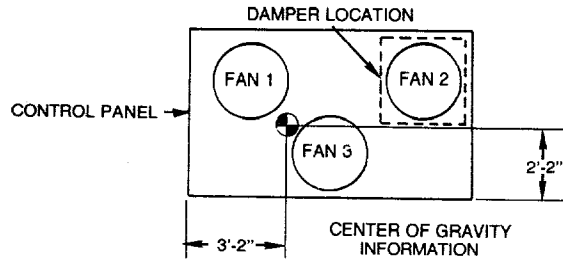


FIGURE 4 - Dimensional Data, RAUB-C20



- 7/8" KNOCKOUT HOT GAS BYPASS SOLENOID VALVE
- 7/8" KNOCKOUT LIQUID LINE SOLENOID VALVE
- 3/8" COMPRESSOR INTERLOCK ELECTRICAL CONN.
- 2" CONDUIT ELECTRICAL CONN.

CONTROL PANEL DETAIL



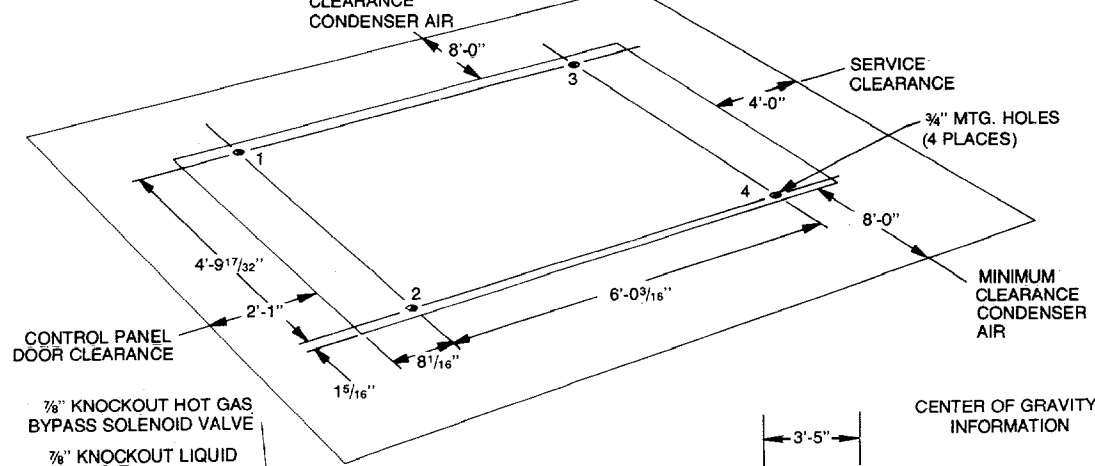
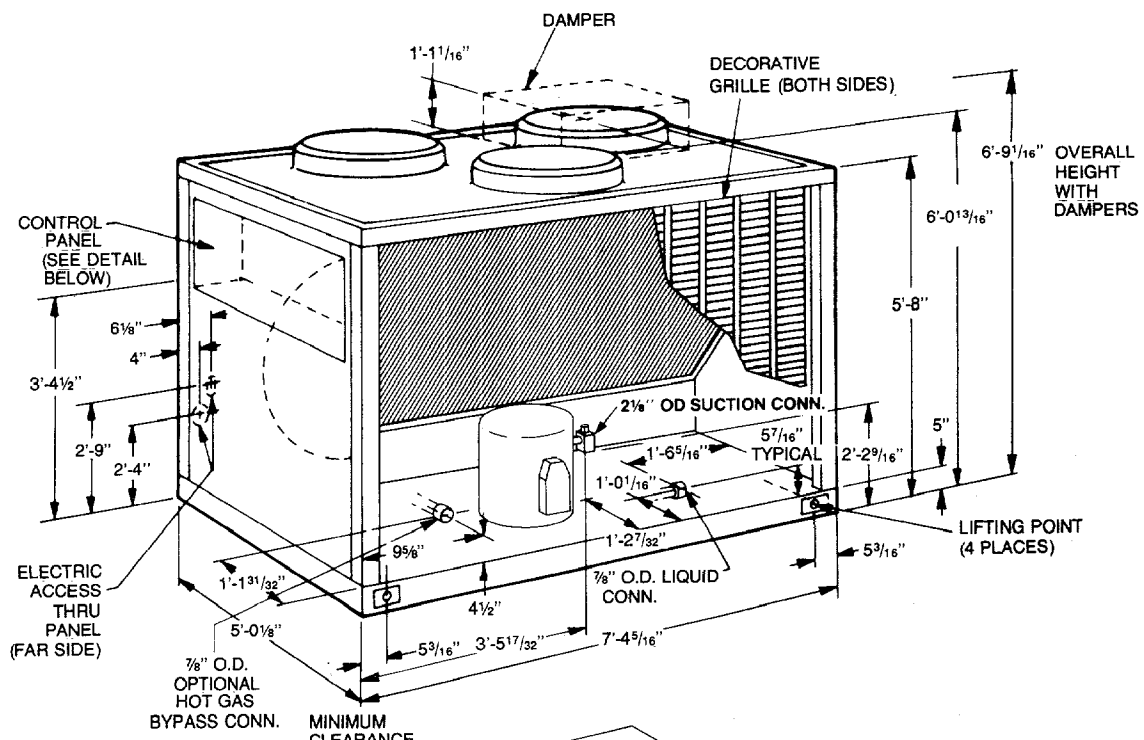
CLEARANCE DATA

SUGGESTED SERVICE CLEARANCE	SUGGESTED AIRFLOW CLEARANCES			
	SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION	
			MAX DEPTH	COIL CLEARANCE
4'-0"	8'-0"	16'-0"	5'-2 1/2"	16'-0"

WEIGHTS

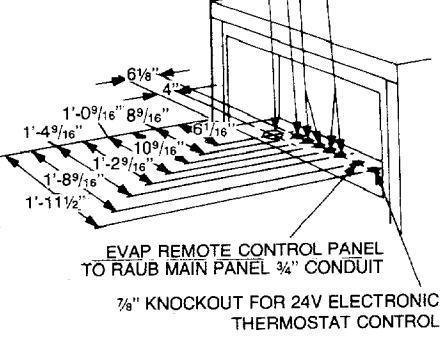
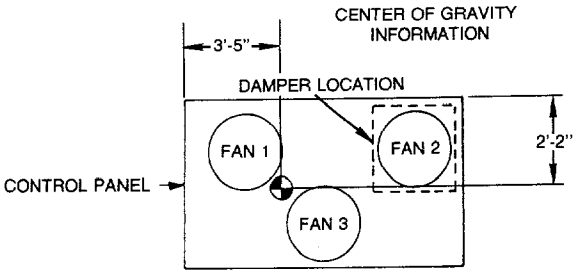
MODEL	NO. OF COMPRESSORS	WEIGHT CONCENTRATED ON LEG				OPERATING WEIGHT	SHIPPING WEIGHT
		1	2	3	4		
RAUB-C25	One 25-Ton K	465	660	330	470	1925	1945

FIGURE 5 - Dimensional Data, RAUB-C25



CONTROL PANEL DETAIL

- 7/8" KNOCKOUT HOT GAS BYPASS SOLENOID VALVE
- 7/8" KNOCKOUT LIQUID LINE SOLENOID VALVE
- 7/8" COMPRESSOR INTERLOCK ELECTRICAL CONNECTION
- 2 CONDUIT ELECTRICAL CONN.



CLEARANCE DATA

SUGGESTED SERVICE CLEARANCE	SUGGESTED AIRFLOW CLEARANCES			
	SINGLE UNIT INSTALLATION	SIDE BY SIDE UNIT INSTALLATION	PIT INSTALLATION	
			MAX DEPTH	COIL CLEARANCE
4'-0"	8'-0"	16'-0"	5'-3"	16'-0"

WEIGHTS

MODEL	NO. OF COMPRESSORS	WEIGHT CONCENTRATED ON LEG				OPERATING WEIGHT (LBS)	SHIPPING WEIGHT (LBS)
		1	2	3	4		
RAUB-C30	One 30-Ton K	540	715	380	510	2145	2155

FIGURE 6 - Dimensional Data, RAUB-C30

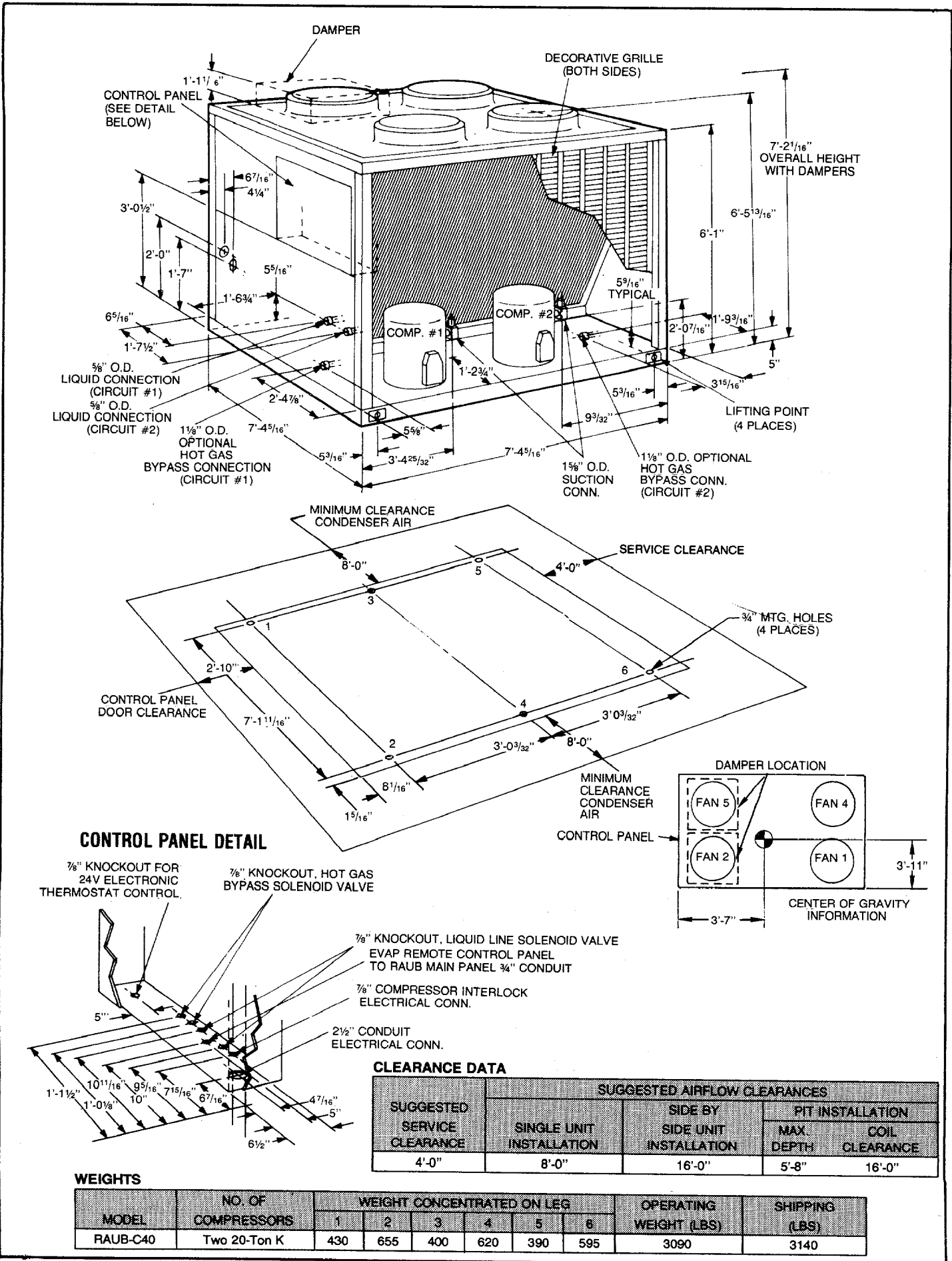


FIGURE 7 - Dimensional Data, RAUB-C40

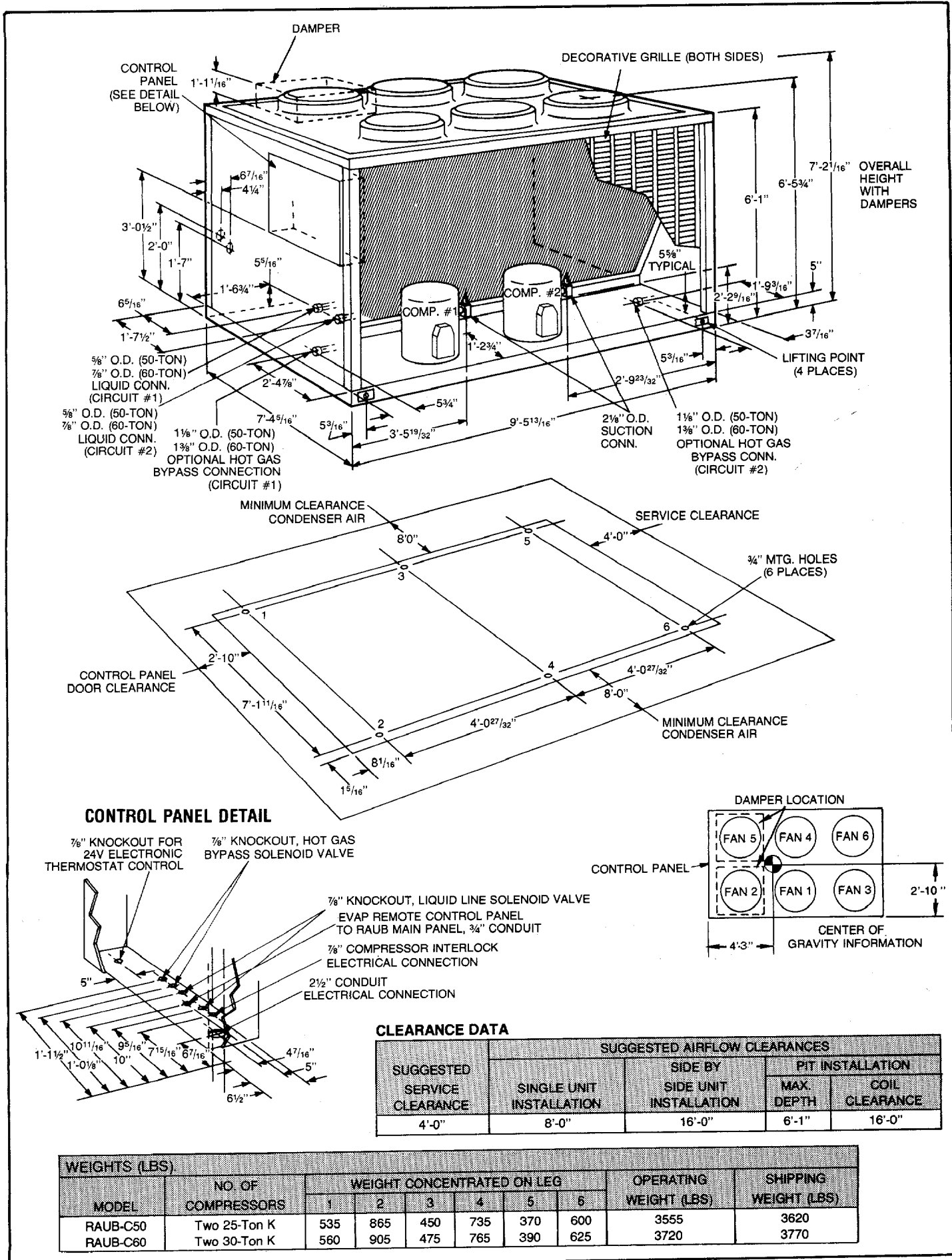


FIGURE 8 - Dimensional Data, RAUB C50 and C60

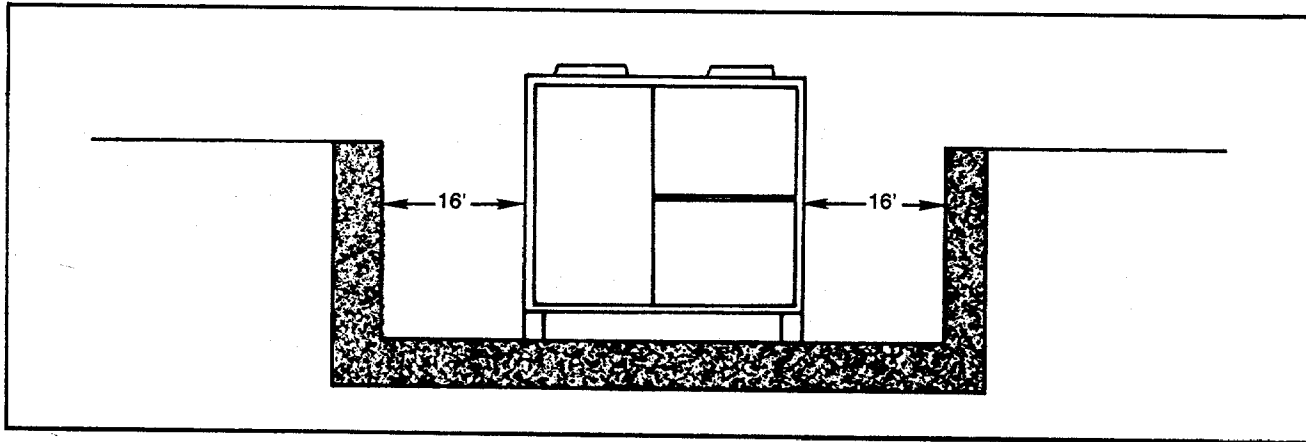
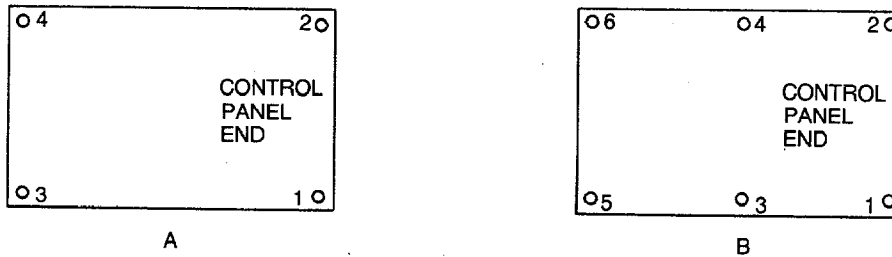


FIGURE 9 - Well Installation

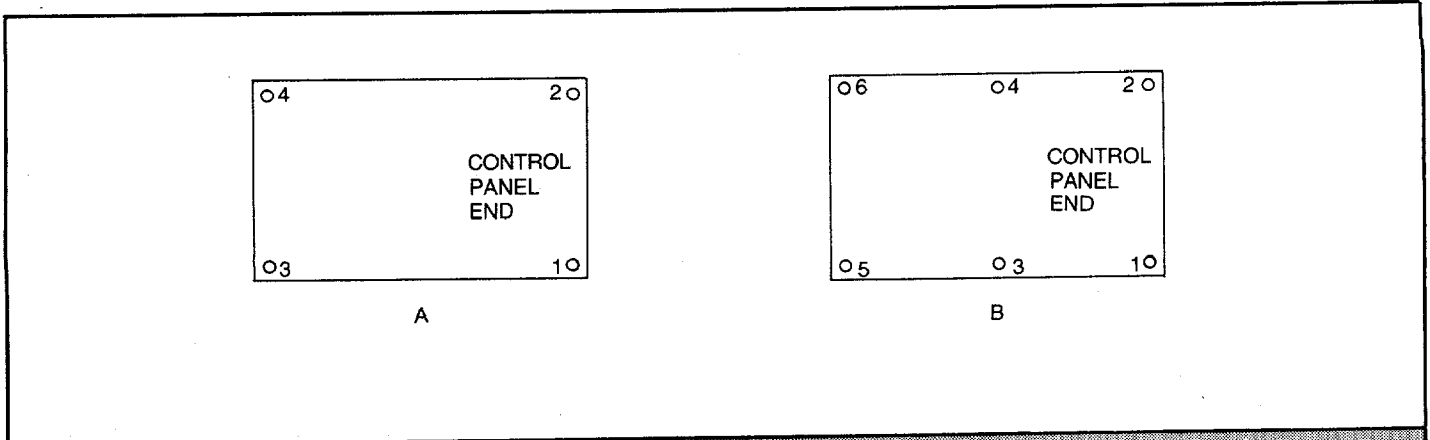


A

B

UNIT	FIG	MOUNTING LOCATION & ISOLATOR PART NO.					
		LOC 1	LOC 2	LOC 3	LOC 4	LOC 5	LOC 6
RAUB-C20	A	CP-1-26	CP-1-27	CP-1-25	CP-1-26	—	—
RAUB-C25	A	CP-1-26	CP-1-27	CP-1-25	CP-1-26	—	—
RAUB-C30	A	CP-1-27	CP-1-28	CP-1-26	CP-1-27	—	—
RAUB-C40	B	CP-1-26	CP-1-27	CP-1-26	CP-1-27	CP-1-26	CP-1-27
RAUB-C50	B	CP-1-26	CP-1-28	CP-1-26	CP-1-28	CP-1-25	CP-1-27
RAUB-C60	B	CP-1-27	CP-1-31	CP-1-27	CP-1-28	CP-1-26	CP-1-28

FIGURE 10 - Spring Isolator Selection and Location



UNIT	FIG	MOUNTING LOCATION & ISOLATOR PART NO.					
		LOC 1	LOC 2	LOC 3	LOC 4	LOC 5	LOC 6
RAUB-C20	A	R-3 RED	R-3 GRN	R-3 RED	R-3 RED	—	—
RAUB-C25	A	R-3 RED	R-3 GRN	R-3 RED	R-3 RED	—	—
RAUB-C30	A	R-3 GRN	R-3 GRAY	R-3 RED	R-3 GRN	—	—
RAUB-C40	B	R-3 RED	R-3 GRN	R-3 RED	R-3 GRN	R-3 RED	R-3 GRN
RAUB-C50	B	R-3 GRN	R-3 GRAY	R-3 RED	R-3 GRAY	R-3 RED	R-3 GRN
RAUB-C60	B	R-3 GRN	R-3 GRAY	R-3 RED	R-3 GRAY	R-3 RED	R-3 GRN

FIGURE 11 - Isolation Pad Selection and Location

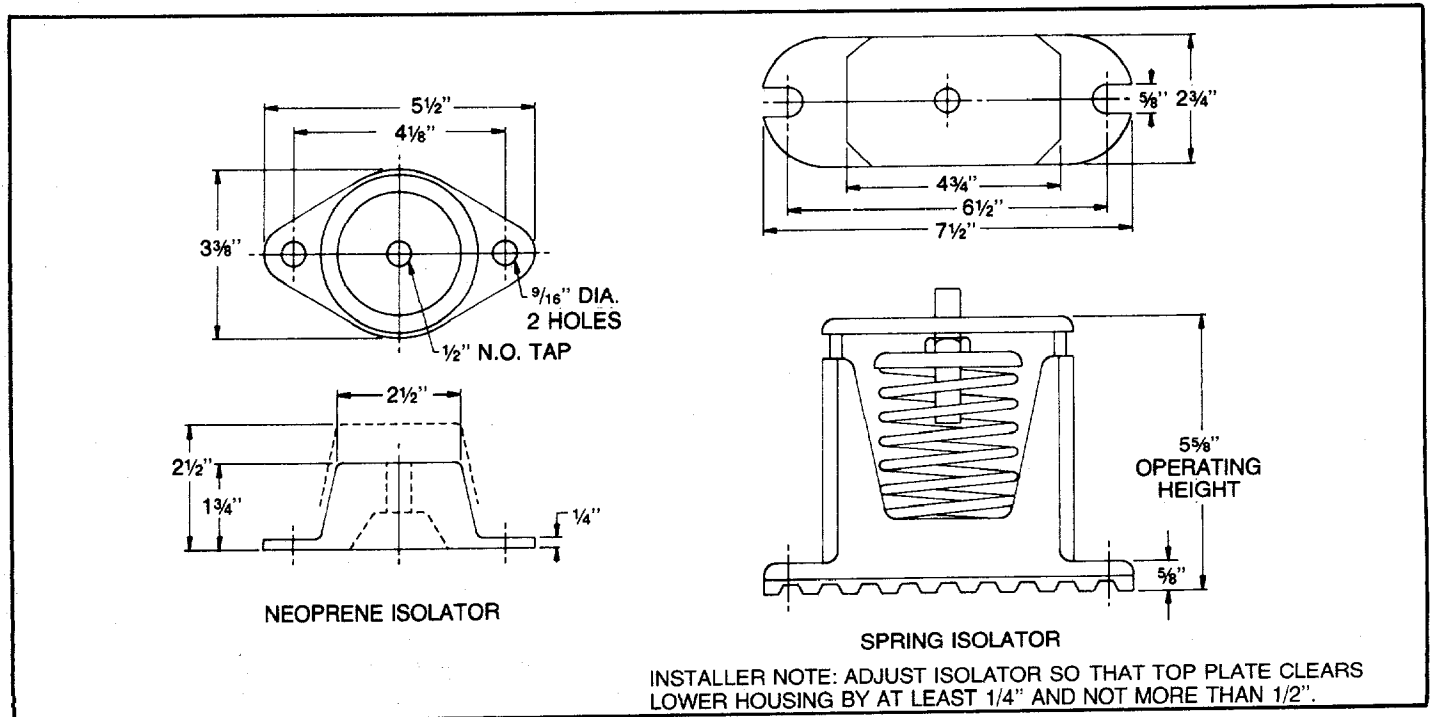


FIGURE 12 - Isolator Dimensions

HANDLING AND RIGGING

All 20 through 60-ton RAUB units can be lifted with a fork truck provided that the middle shipping channels are left under the unit (refer to Figures 1 and 3). Any time a fork truck is used, the forks **must** protrude beyond the width of the unit.

Rig the unit using either belts or cable slings. The slings must be fastened to the unit at the four holes in the base of the unit, as shown in Figure 13. Use spreaders to protect the top of the unit when it is lifted. The point where the slings must meet at the lifting hook must be at least six feet above the unit. Refer to Figures 4 through 8 for center-of-gravity information and to Figure 13 for proper rigging procedures.

WARNING: TO PREVENT OVERSTRESSING THE BASE RAILS, THE UNIT SHOULD BE RIGGED AS SHOWN IN FIGURE 13 AND LIFTED AS SMOOTHLY AS POSSIBLE. FAILURE TO DO SO COULD RESULT IN SERIOUS PERSONAL INJURY AND DAMAGE TO THE UNIT.

PRE-INSTALLATION LEAK TEST

Trane condensing units and some evaporators are shipped with a holding charge of Refrigerant-22. Before installing these units, momentarily open the service port in either the suction or discharge line access valve to verify that the holding charge has not been lost.

If no refrigerant escapes when opening the service port, the condensing unit should be leak tested to determine the source of refrigerant loss. Pressurize the unit to 100 psi with refrigerant and use a halogen leak detector, halide torch or soap bubbles to check for leaks. If a leak is found, release the test pressure and repair the leak. If no leak is found, use nitrogen to increase the test pressure to 150 psi and repeat the leak tests. When repairing leaks, refer to BRAZING PROCEDURES in the MAINTENANCE PROCEDURES section of this manual. Retest the unit to make sure the problem has been corrected.

WARNING: DO NOT USE OXYGEN, ACETYLENE OR AIR IN PLACE OF REFRIGERANT AND DRY NITROGEN FOR LEAK TESTING. A VIOLENT EXPLOSION WILL RESULT WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.

REFRIGERANT PIPING

It is essential that refrigerant piping be properly sized and applied since these factors have a significant effect on system performance and reliability. The interconnecting piping must be selected and applied according to Trane recommendations and specifications on the job plan. This should have been completed when components were selected for the system.

RECOMMENDED LINE SIZES

If there is no job specification or piping layout, refer to the following recommendations.

The interconnecting line sizes are listed in Table 2. These tube sizes are within the velocity, pressure drop and refrigerant charge limitations necessary for proper system operation. (The refrigerant charge limitation is the maximum system charge for a specific compressor and is determined by the design of the compressor). The line lengths in Table 2 are based on pressure drop and refrigerant charge limitations in the **liquid line**. Pressure drop limits assume that equivalent length equals two times the physical length. In most applications this is a reasonable assump-

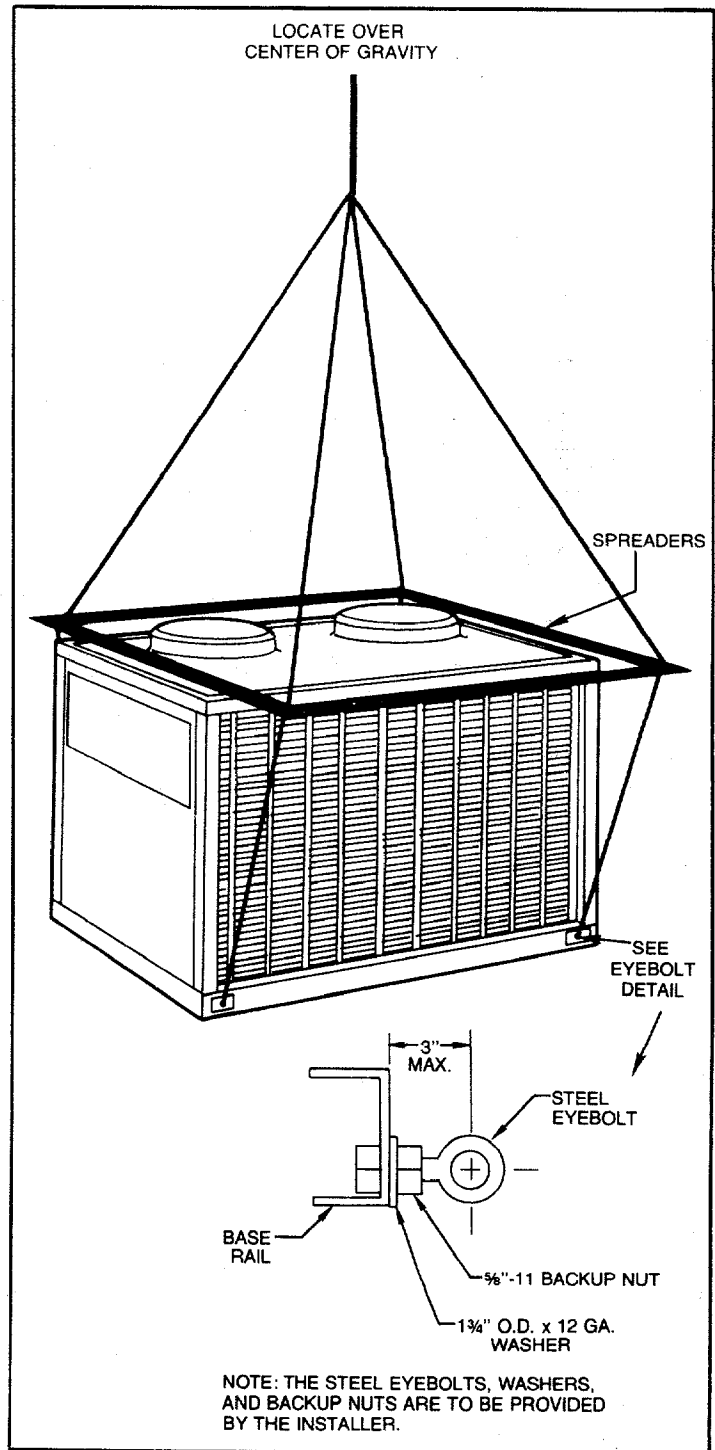


FIGURE 13 - Rigging

tion. However, actual pipe sizes must be calculated (see EB-S/S-38) if one or more of the following situations exist:

1. **LONG LIQUID RISER** — installations with liquid line risers have an added pressure drop of 0.5 psi per foot of riser. If the riser is more than 15-feet, the system may require a larger diameter and/or shorter piping run to ensure adequate sub-cooling at the expansion valve.
2. **EXCESSIVE BENDS, REDUCERS, VALVES** — a greater than normal number of tube bends, reducers, and/or valves may increase the equivalent length and pressure drop above the assumption of two times the physical length. Actual pressure drop should be calculated for these situations.

3. LONG PIPING LENGTHS — for total piping lengths greater than the lengths given in Table 2, larger liquid lines may be required. However, guidelines specified in Engineering Bulletin EB-S/S-38 must be followed.

Trane recommends the use of Type L (medium wall) refrigerant tubing. Only refrigerant grade copper tubing should be used since it is available cleaned, dehydrated and capped to avoid contamination prior to installation. Copper tubing used for plumbing usually has oil, grease or other contaminants on the interior wall and these can cause serious operating problems if not removed prior to installation. Tube size recommendations in this manual are based on Type L (medium wall) tubing.

LIQUID LINE COMPONENTS

A properly sized liquid line filter drier must be installed upstream from the expansion valve. In addition, a moisture indicator/sight glass should be installed between the expansion valve and filter drier. Both of these components should be installed at the evaporator close to the expansion valve as shown in Figure 14.

The number of other valves, reducers and tube bends should be minimized as these items tend to increase the pressure drop and reduce subcooling at the expansion valve.

At least one liquid line solenoid valve must be installed on each refrigerant circuit. With unloaded compressor operation, max-

TABLE 2 - Interconnecting Line Sizes⁺

CONDENSING UNIT	LENGTH OF INTERCONNECTING LINES (FT)**																			
	0-20		21-40		41-60		61-80		81-100		101-120		121-140		141-160		161-180		181-200	
	LINE SIZE — O.D. (IN.)																			
	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ	SUCT
RAUB-C20	5/8	1 1/8	5/8	1 1/8	5/8	1 1/8	5/8	2 1/8	5/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8
RAUB-C25	5/8	1 1/8	5/8	1 1/8	5/8	2 1/8	5/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8
RAUB-C30	7/8	1 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8
RAUB-C40*	5/8	1 1/8	5/8	1 1/8	5/8	1 1/8	5/8	2 1/8	5/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8
RAUB-C50*	5/8	1 1/8	5/8	1 1/8	5/8	2 1/8	5/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8
RAUB-C60*	7/8	1 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8	7/8	2 1/8

* Two line sets required.

** For vertical suction riser, suction line size in shaded region must either be reduced to 1%, or double riser must be utilized (see Engineering Bulletin EB-S/S-38).

+ Refer to Engineering Bulletin No. EB-S/S-38 for applications with liquid line riser greater than 15 feet, or for line lengths greater than listed in table.

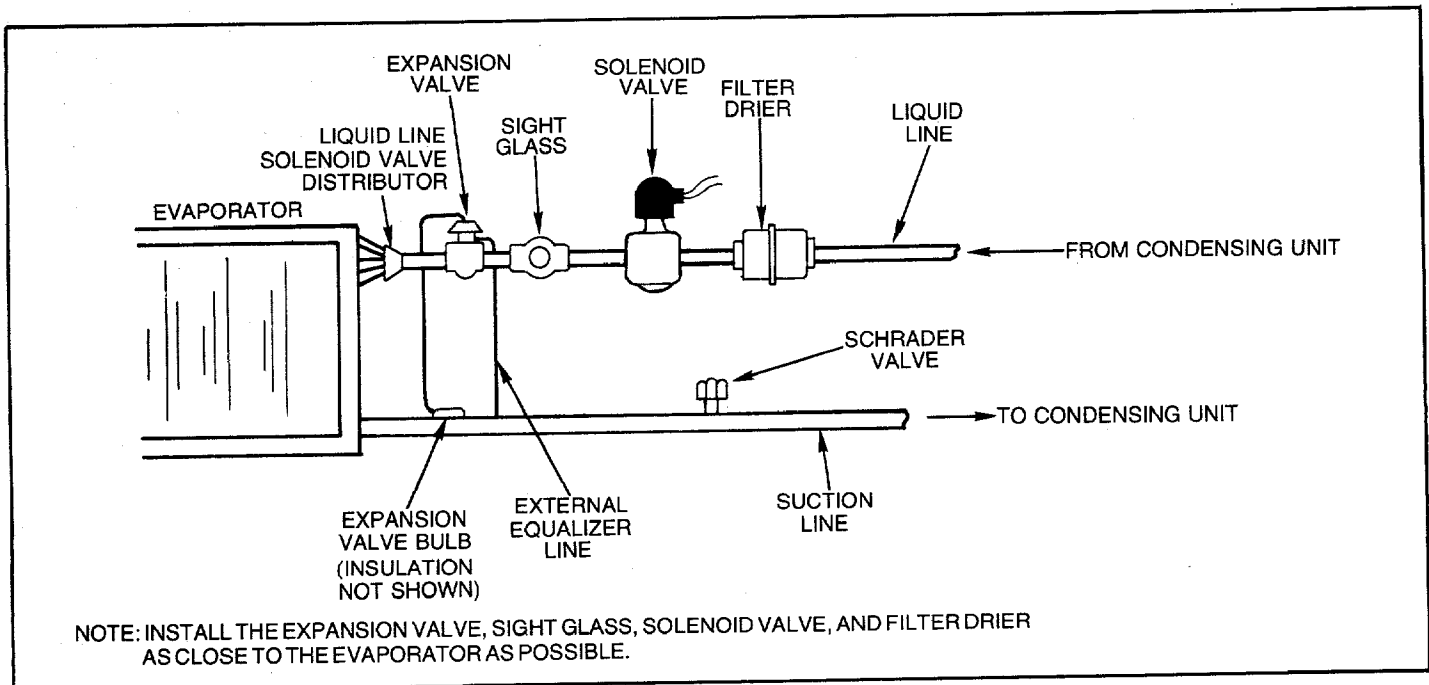


FIGURE 14 - Diagram of Refrigerant Piping Components in Liquid Line

imum system efficiency is achieved with a full evaporator coil. However, this can result in poor system moisture removal capacity. Generally, moisture removal is not a problem with 1/2 compressor loading, but can be of concern with RAUB 25 and 30 ton condensing units which unload to 1/3 capacity on each compressor. On these units, better moisture removal capacity can be achieved by separating the refrigerant coil into two equal sections and shutting off half of the coil when the compressor is at 1/3 loading.

Factory-installed solenoid valves are provided on BRCB evaporators to shut off one-half of the evaporator coil. When other air-to-air low sides are utilized a solenoid valve can be installed between the filter drier and sight glass in order to shut off one-half of the evaporator coil. On units where the solenoid valves are factory-installed, it is permissible to install the sight glass between the unit and the filter drier. However, all of these components should be installed close to the expansion valve and no more than one-half of the coil should be shut off.

Liquid line refrigerant velocities should be kept below 5-7 feet per second in order to prevent "liquid hammer" because of the liquid line solenoid valves. However, this is a secondary consideration, and it is more important to insure that compressor refrigerant charge limits are not exceeded.

RISERS AND TUBE ROUTING

Liquid line riser lengths are limited only by the additional pressure drop (0.5 psi/ft.) which results from the liquid column. No limit exists on the length of liquid line drops and no special line sloping considerations are necessary.

Normally it is not necessary or desirable to insulate liquid lines. In most applications the ambient temperature is lower than the refrigerant temperature and has the desirable effect of increasing subcooling at the expansion valve. However, liquid lines routed through extremely high ambient environments (such as a boiler room) may reduce subcooling to below acceptable levels. To minimize this loss, liquid lines passing through extremely warm

(above 110 F) areas should be insulated. Increasing liquid line size will only tend to aggravate this problem.

SUCTION LINE

The suction line sizes recommended in Table 2 will result in sufficient refrigerant vapor velocity to ensure good oil entrainment. It is also important to utilize good tube routing practices to ensure proper oil return to the compressor. Where suction lines must rise more than four feet, a "P" trap should be used at the base of the riser in order to facilitate oil return. This P-trap should be repeated for each 25 feet of riser. However, it is critical that no long traps be used which could accumulate significant quantities of oil. In other words, line traps should be constructed with no horizontal length in the bottom. Two street ells may be directly connected together to form this P-trap.

It is not recommended that horizontal suction lines be pitched towards the compressor. However, they should be reasonably level to prevent the oil from pooling in the line close to the compressor during the OFF cycle. Vertical risers should be no larger than 1-5/8-inch O.D. on 20 through 60-ton RAUB units even if horizontal runs are 2-1/8-inch O.D. If pressure drop in the 1-5/8-inch riser is unacceptable, double risers should be utilized as shown in Figure 15. In this case, the small riser should be 1-5/8-inch O.D. and the large riser should be 2-1/8-inch O.D. On dual compressor 40-60 ton RAUB units, some of the compressors may not unload. In this case, a 2-1/8 inch suction line riser is acceptable.

Insulate the suction line with 1/2-inch thick closed cell neoprene insulation such as Armaflex or similar material. Do not run the suction and liquid line in contact with each other without insulation between them.

REFRIGERANT PIPING INSTALLATION INSTRUCTIONS

One of two methods may be used to properly route piping within the unit. The first method requires the use of unit isolators, yet provides a direct and flexible means of routing the piping. The second method does not require isolators, but necessitates cutting holes in the unit's cabinetry. It also does not offer as much routing flexibility as the first method.

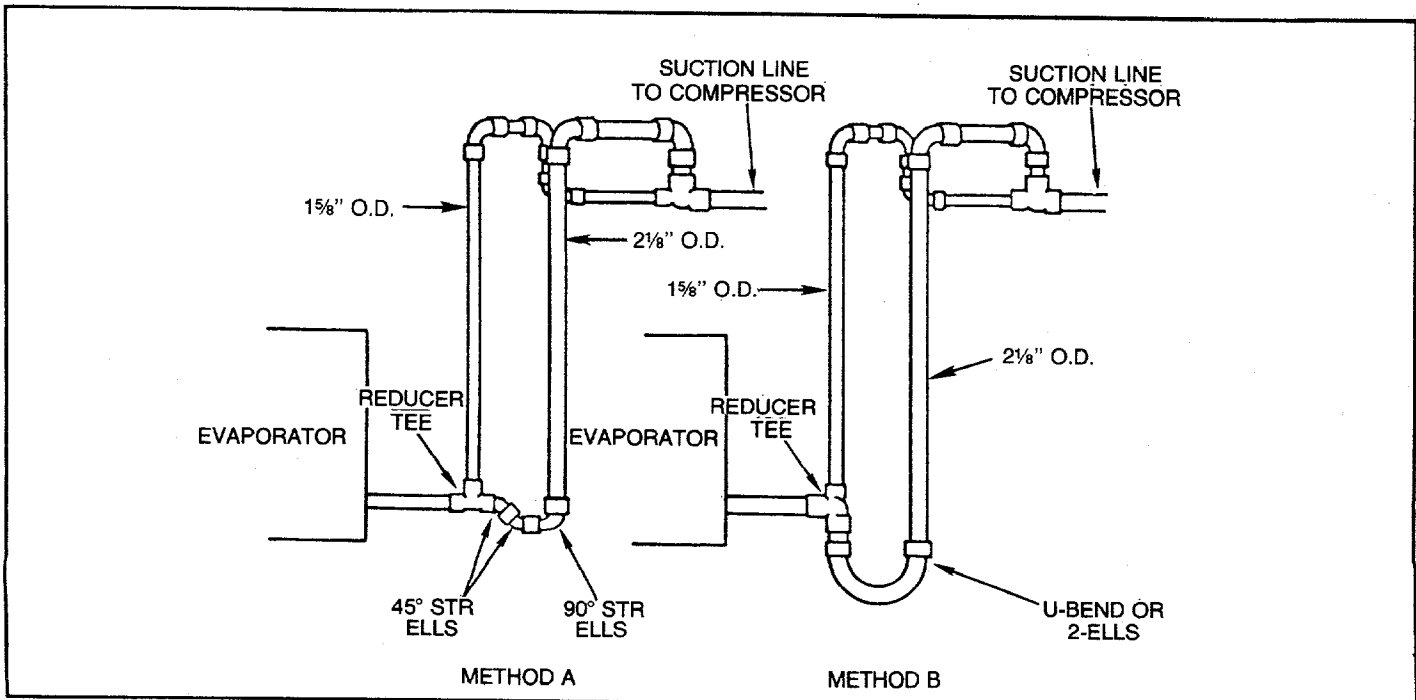


FIGURE 15 - Double Riser Suction Line

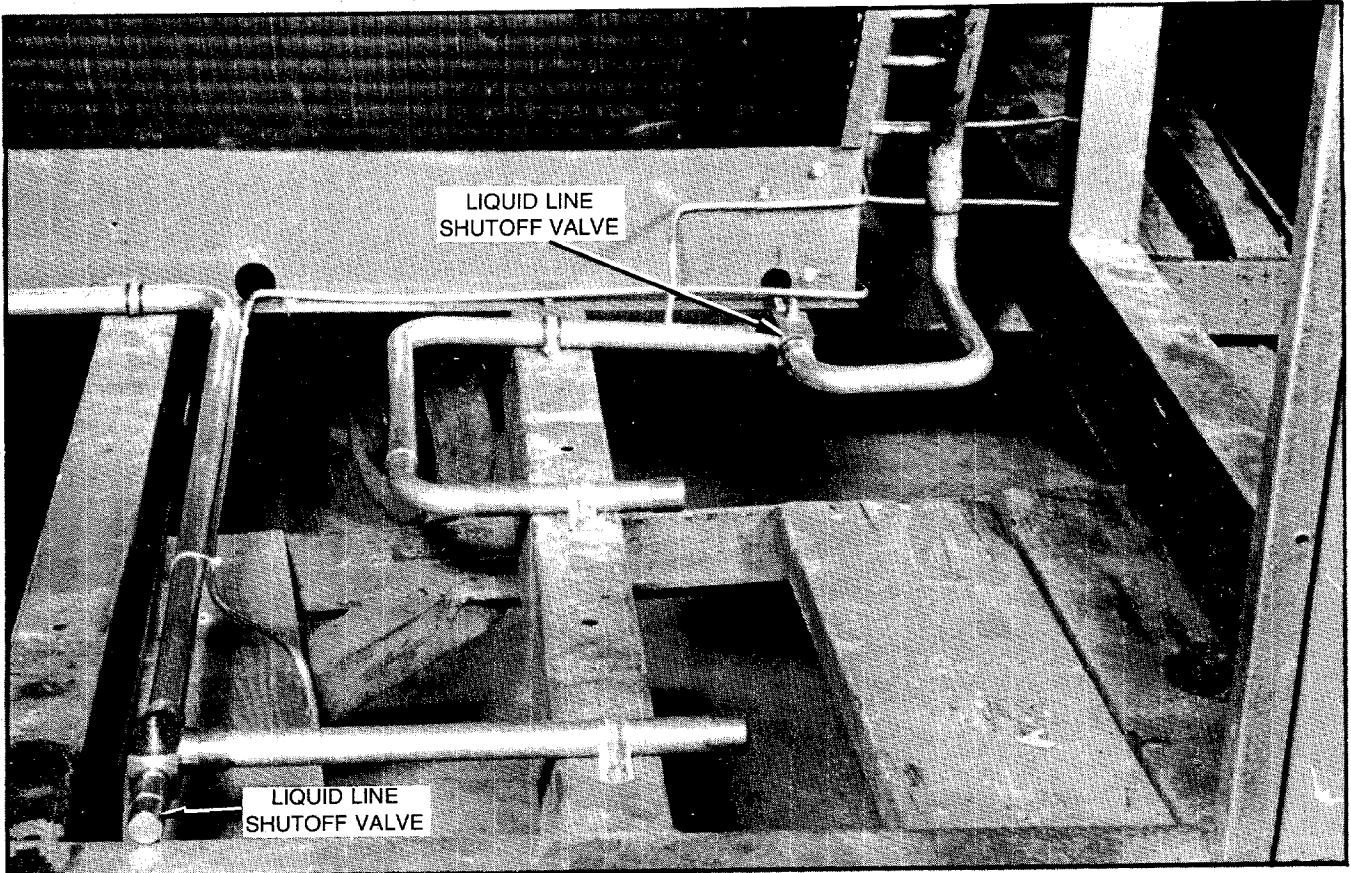


FIGURE 16 - Liquid Line(s) Piping (40, 50 and 60-Ton Units)

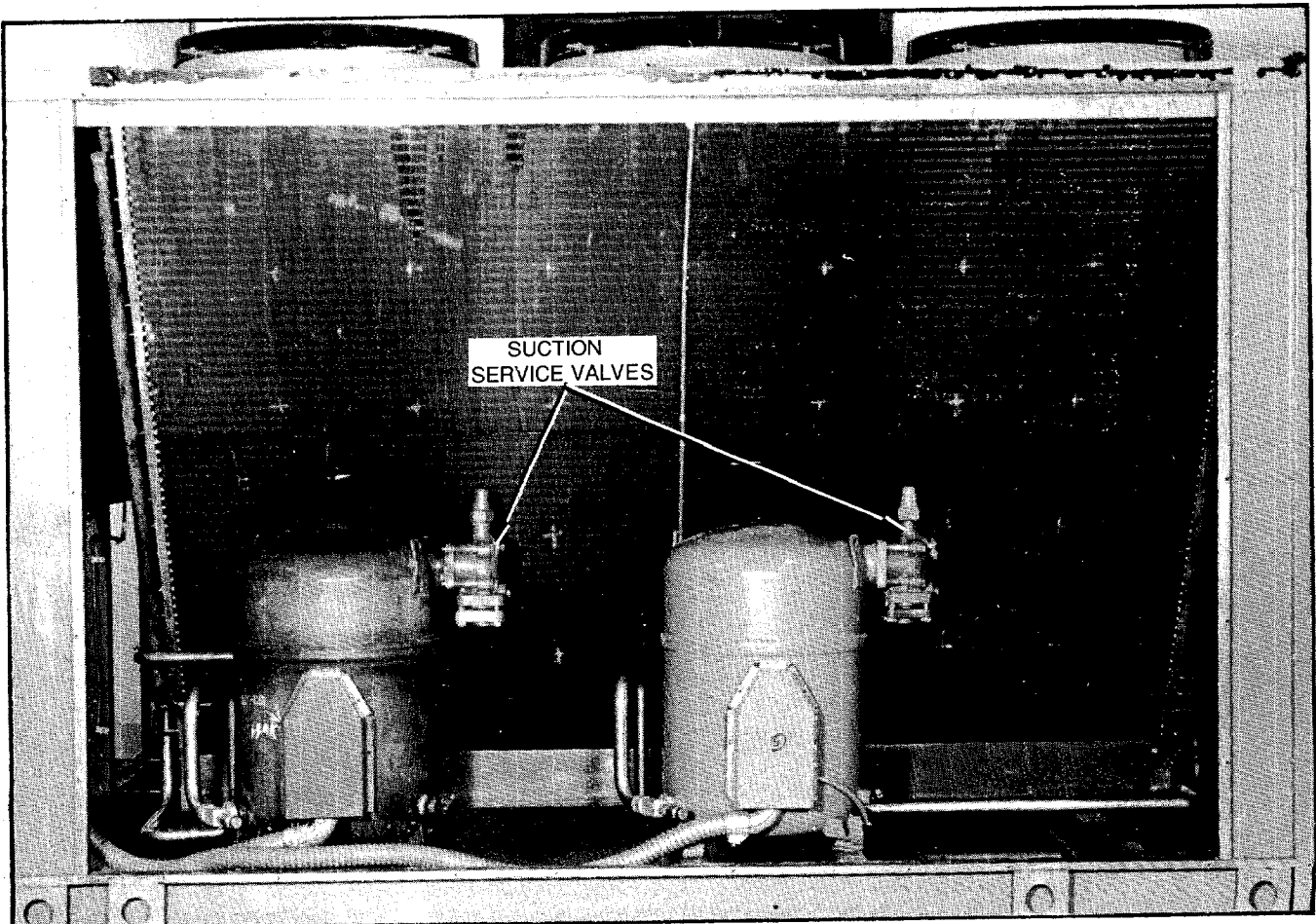


FIGURE 17 - Suction Line(s) Piping

NOTE: In addition to the following instructions, the refrigerant piping should be installed in accordance with the discussion presented in Engineering Bulletin EB-S/S-38 and this manual.

IMPORTANT: Leave a 4 to 5-foot clearance in front of the compressor section for compressor removal.

Units Mounted On Isolators

Field refrigerant piping can be routed under the framework on units equipped with isolators. Piping the unit in this manner takes a minimum amount of copper and allows the flexibility of running the piping unobstructed in any direction once it is dropped below the unit framework. **A 5-1/2-inch minimum clearance must be provided between the unit base and the isolator base for routing insulated suction line.** Units equipped with spring isolators have sufficient clearance, however, units equipped with neoprene isolators will need 4-inch blocks placed under each isolator to meet the specified clearance.

RAUB 20 to 60-ton condensing units have refrigerant connections at the liquid line stubs and at the compressor suction service valves. Figure 18 illustrates the connection points in the 20, 25 and 30-ton units and Figure 19 shows the points in the 40, 50 and 60-ton machines.

Procedure:

1. Remove all decorative grilles from the unit.
2. Release the unit's holding charge.
3. Remove the suction flange(s) and closure plates from the suction service valve(s).
4. Remove the cap(s) from the liquid line stub connections.
5. Proceed to pipe the liquid line(s) as shown in Figures 18 and 19.
6. Two 90-degree elbows are required to drop each liquid line below the unit framework. Once the drop is made, run the liquid line(s) to the desired location in accordance with the guidelines presented in the Trane Engineering Bulletin EB-S/S-38 and this manual.
 - a. Allow at least a 1-1/2-inch clearance between the liquid line(s) and any surface or obstruction to prevent direct line contact and possible noise transmission.
 - b. Clamp the liquid line(s) at a location no less than 3-feet and no more than 6-feet from the stub locations.
7. Once the liquid line(s) has been formed, braze all connections.
8. Proceed to pipe the suction line(s) as shown in Figures 18 and 19.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE - UNSAFE PRESSURES COULD RESULT CAUSING A VIOLENT EXPLOSION AND SERIOUS PERSONAL INJURY OR DEATH. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigeration piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system resulting in equipment damage.

9. Run the suction line(s) vertically downward to the base of the unit.

10. A 90-degree elbow will be required to run each suction line horizontally below the unit framework.
11. Run the suction line(s) to the desired location in accordance with the guidelines presented in Trane Engineering Bulletin EB-S/S-38 and this manual.
 - a. Allow at least a 1-1/2-inch clearance between the line(s) and any surface or obstruction to prevent direct line contact and possible noise transmission.
 - b. Clamp the line(s) at a location no less than 10-feet and no more than 15-feet from the suction service valve(s) to prevent noise transmission and provide adequate support.
12. With each suction valve coupling removed from its service valve, braze the coupling to the suction line.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE - UNSAFE PRESSURES WOULD RESULT CAUSING AN EXPLOSION AND SERIOUS PERSONAL INJURY OR DEATH. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system resulting in equipment damage.

13. Bolt each suction line up to its service valve and reposition the line.
14. Proceed brazing the connections with the line in place or with the connections referenced and the line removed.

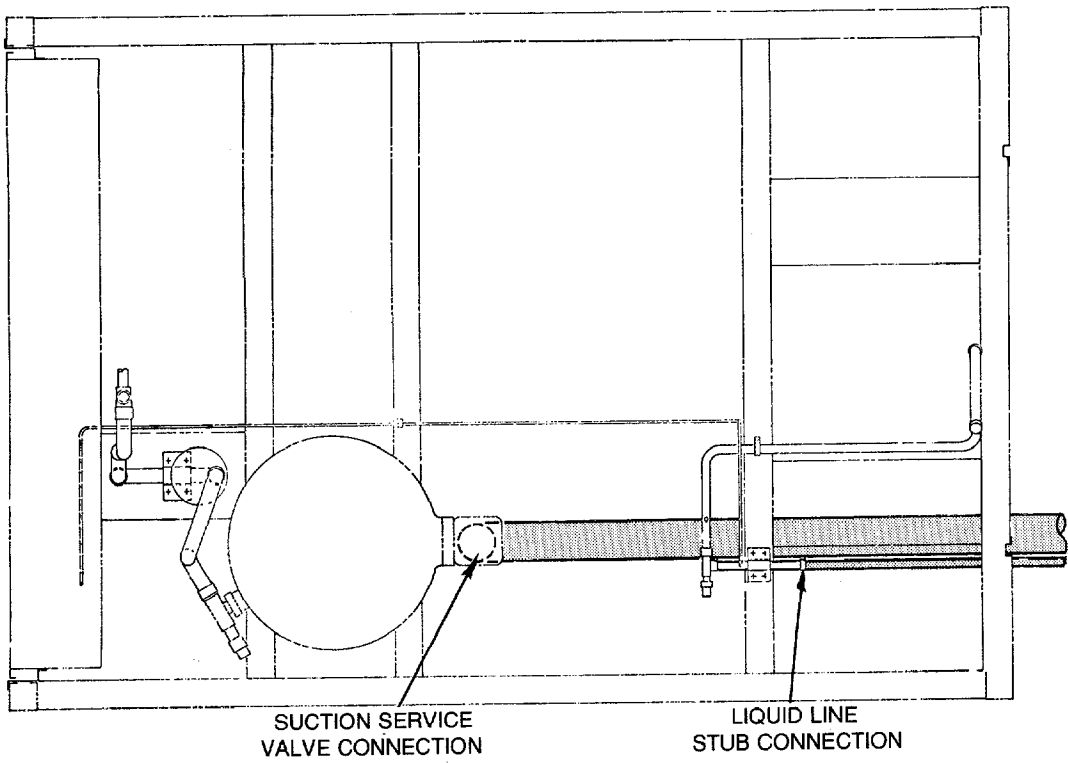
Units Without Isolators

Units shipped without vibration isolators will need holes cut in the cabinetry in order to route field refrigerant piping. The following procedure should be used.

20 to 30-Ton Units

1. Remove the decorative grilles enclosing the compressor section.
2. Release the unit's holding charge.
3. Remove the suction flange and closure plates from the suction service valve.
4. Remove the cap from the liquid line stub connection.
5. Cut holes in the center support and filler post as shown in Figure 20.
6. Pipe the liquid line as illustrated in Figure 21.
7. Run the liquid line through the appropriate hole location using two lengths of liquid line, one coupling and one 90-degree elbow.
8. Center the line in the opening.
9. Clamp the liquid line to the unit base rail just ahead of the notched out hole.
10. Run the line to the desired location and proceed brazing the connections with the line in place or with the connections referenced and the line removed.

TOP VIEW



SIDE VIEW

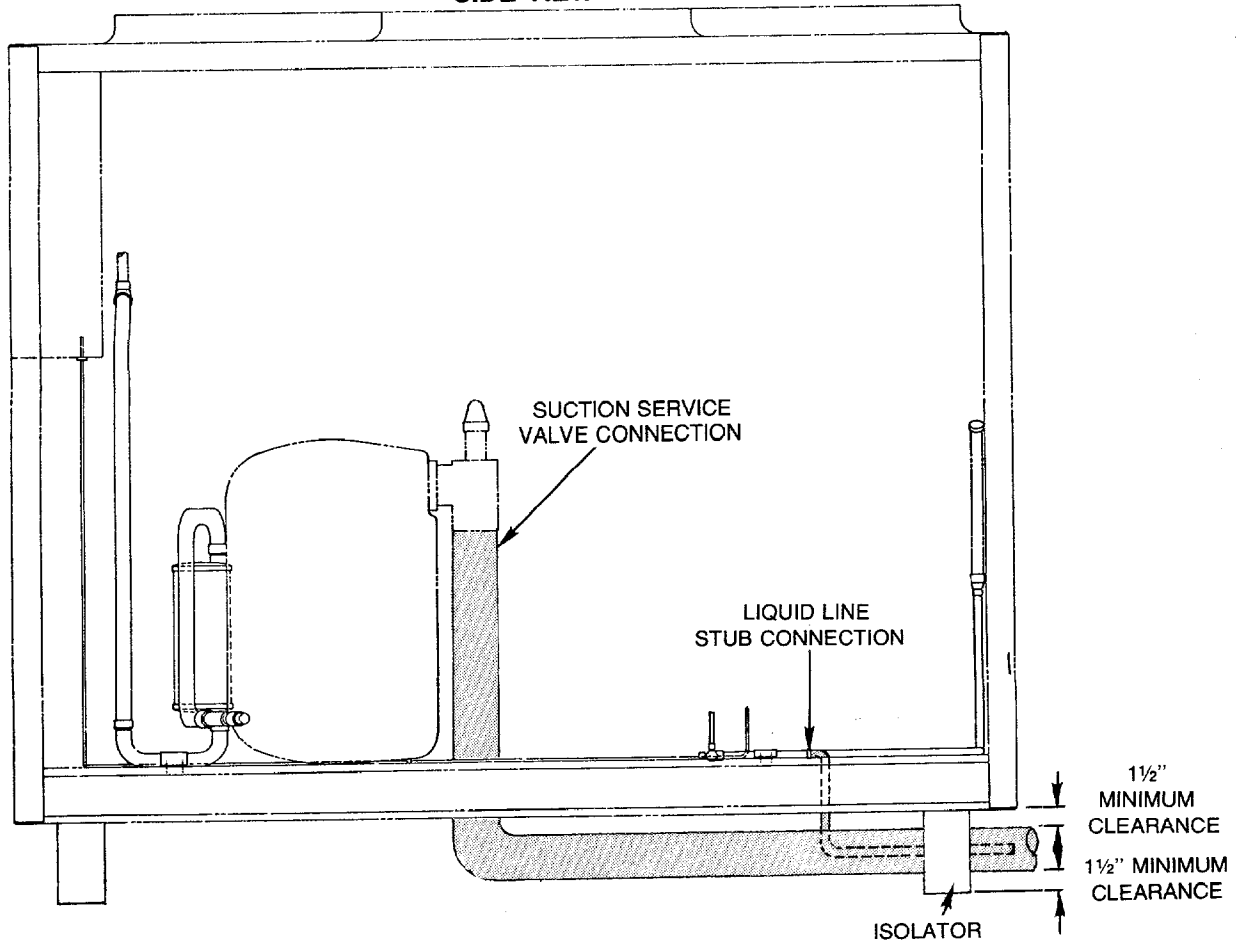


FIGURE 18 - Piping Installation: 20 Through 30-Ton Units With Isolators

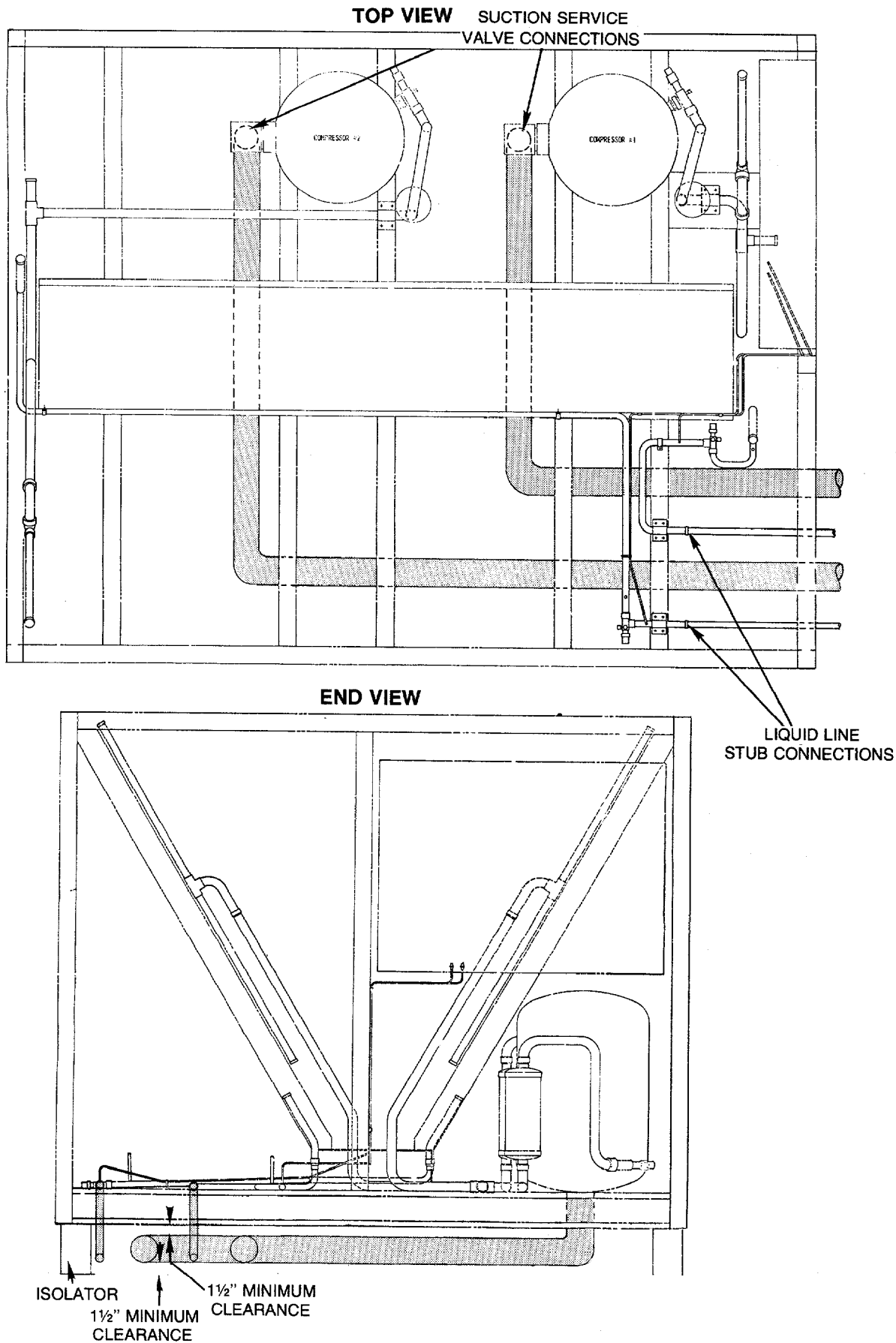


FIGURE 19 - Piping Installation: 40 Through 60-Ton Units Equipped With Isolators

NOTE: RUN THE SUCTION LINE THROUGH THE CENTER FILLER 1-INCH FROM THE FLOOR OF THE UNIT.

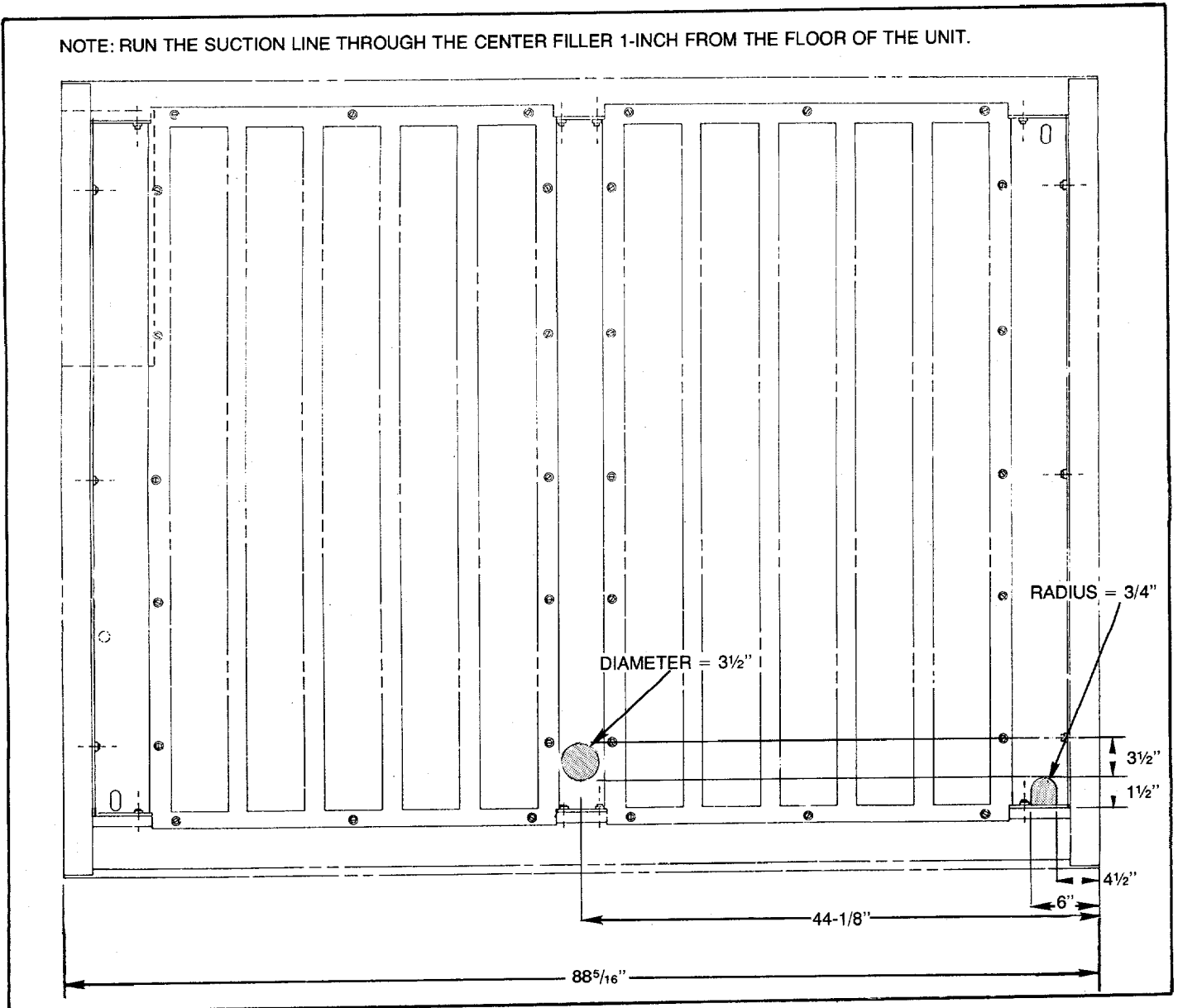


FIGURE 20 - Hole Locations: 20 Through 30-Ton Units

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE - UNSAFE PRESSURES COULD RESULT CAUSING A VIOLENT EXPLOSION AND SERIOUS PERSONAL INJURY OR DEATH. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system which may cause damage to the refrigeration system.

11. Proceed piping the suction lines as shown in Figure 21.
12. Pipe the line through the appropriate hole, using two lengths of pipe, a short radius street elbow and a 45-degree elbow. See Figure 21.
13. Center the suction line in the hole.
14. Run the line to the desired location in accordance with the guidelines presented in Trane Engineering Bulletin EB-S/S-38 and this manual.
 - a. Allow at least a 1-1/2-inch clearance between the liquid

line(s) and any surface or obstruction to prevent direct line contact and possible noise transmission.

- b. Clamp the liquid line(s) at a location no less than 3 feet and no more than 6 feet from the stub locations.
15. With each suction valve coupling removed from its service valve, braze the coupling to its respective suction line.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE - UNSAFE PRESSURES COULD RESULT. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system which may cause damage to the refrigeration system.

16. Bolt each suction line up to its service valve and reposition the line(s).
17. Finish brazing the connections with the line in place or with the connections referenced and the line removed.

SIZE	A
20 Ton	41-21/32"
25 Ton	41-17/32"
30 Ton	40-21/32"

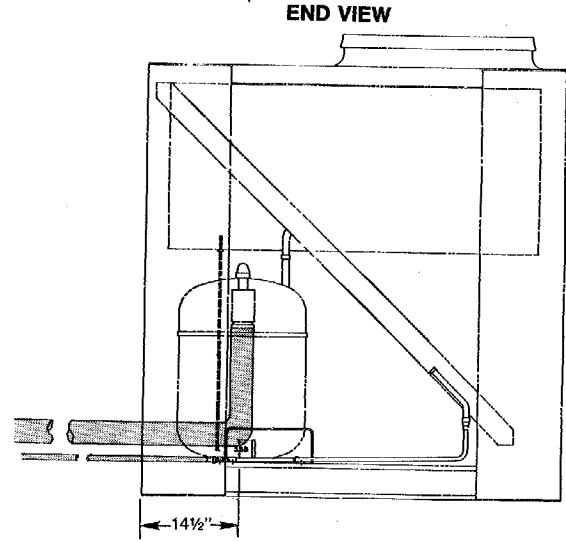
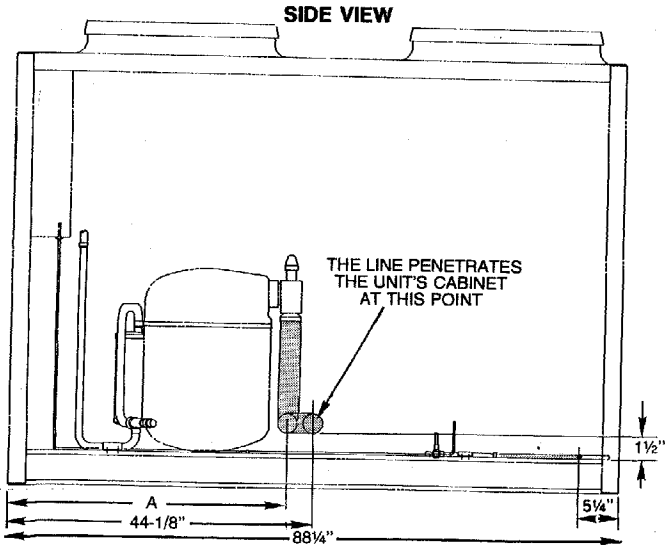
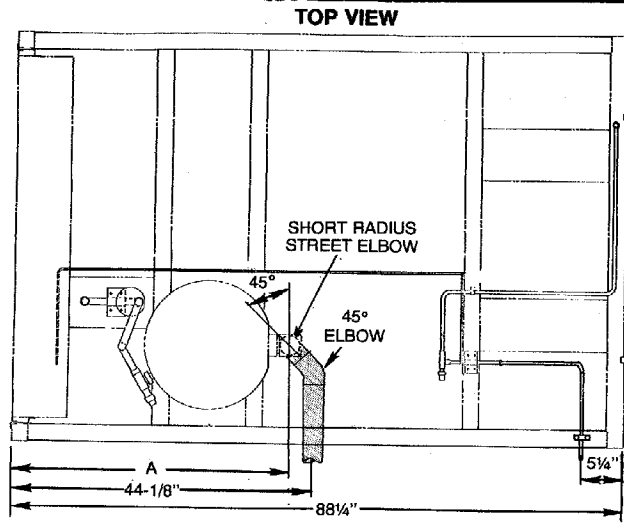


FIGURE 21 - Piping Installation: 20 Through 30-Ton Units Without Isolators

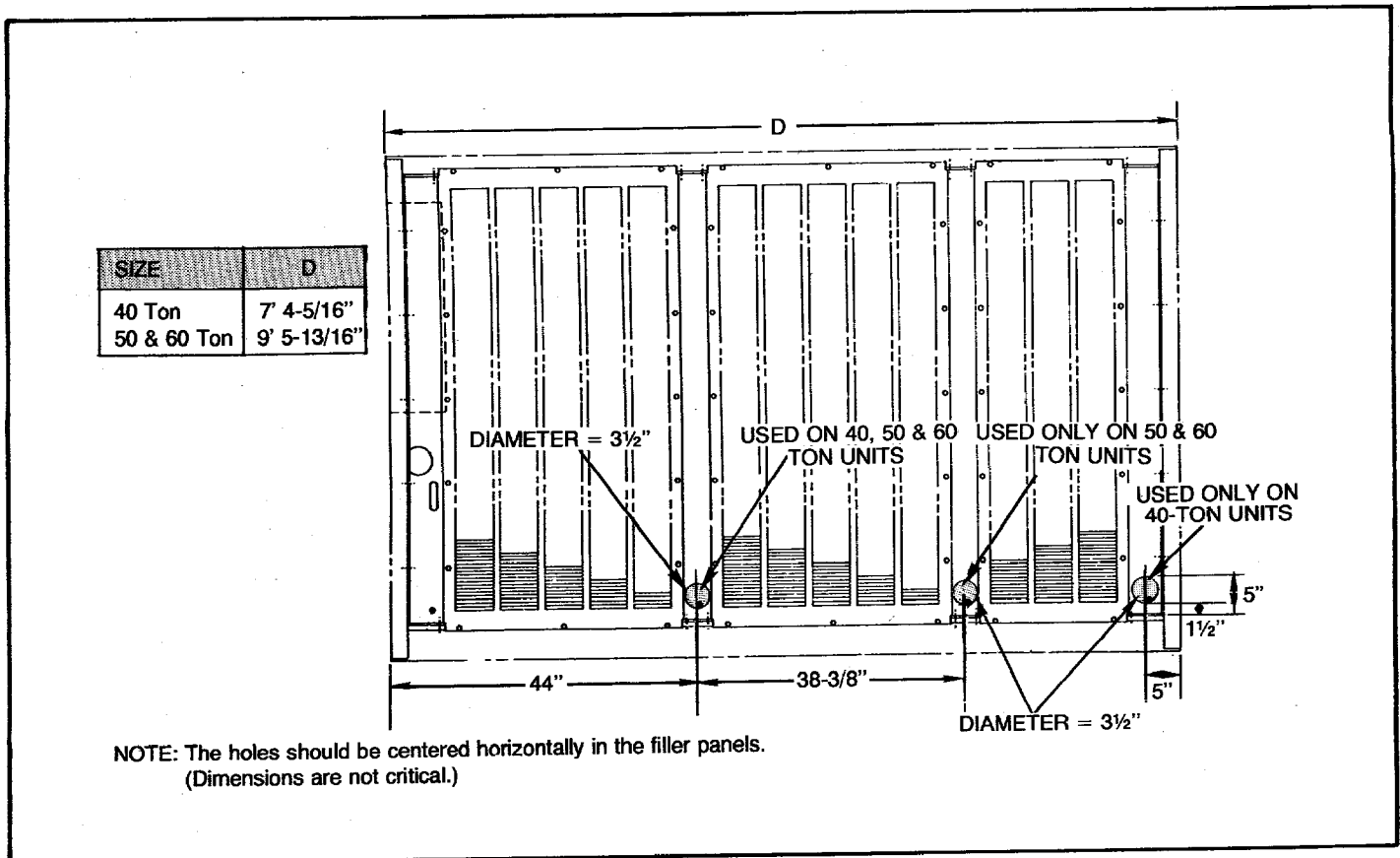


FIGURE 22 - Suction Line Hole Locations: 40 Through 60-Ton Units Without Isolators

40 to 60-Ton Units

1. Remove the decorative grilles enclosing the compressor section and the liquid line stub locations.
2. Release the unit's holding charge.
3. Remove the suction flanges and closure plates from the suction service valves.
4. Remove the caps from the liquid line stub connections.
5. Cut holes in the filler and condenser section end panels as illustrated in Figures 22 and 23.
6. Proceed to pipe the liquid lines as shown in Figures 24 and 25.
7. Pipe the liquid lines through the two holes, using two couplings and straight lengths of pipe.
8. Center the lines in their respective holes.
9. Clamp both liquid lines to the unit's base just ahead of the notched out holes with standard straps and sheet metal screws.
10. Run the lines to the desired location in accordance with the guidelines presented in Trane Engineering Bulletin EB-S/S-38 and this manual. Proceed to braze the connections with

the lines in place or with the connections referenced and the lines removed.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE - UNSAFE PRESSURES COULD RESULT. BE SURE THE AREA IS WELL VENTILATED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SERIOUS PERSONAL INJURY.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system which may cause damage to the refrigeration system.

11. Provide no less than 3 feet and no more than 6 feet of line between the unit and the first clamp location to prevent noise transmission and also to provide adequate support.
12. Cut holes in the compressor section filler panels as shown in Figures 22 and 23. The hole locations will vary with unit tonnage.
13. Proceed to pipe the suction lines as illustrated in Figures 24 and 25.
14. Pipe the suction lines through each hole, using two pipe lengths, a 90-degree street elbow and a 45-degree elbow for each line.

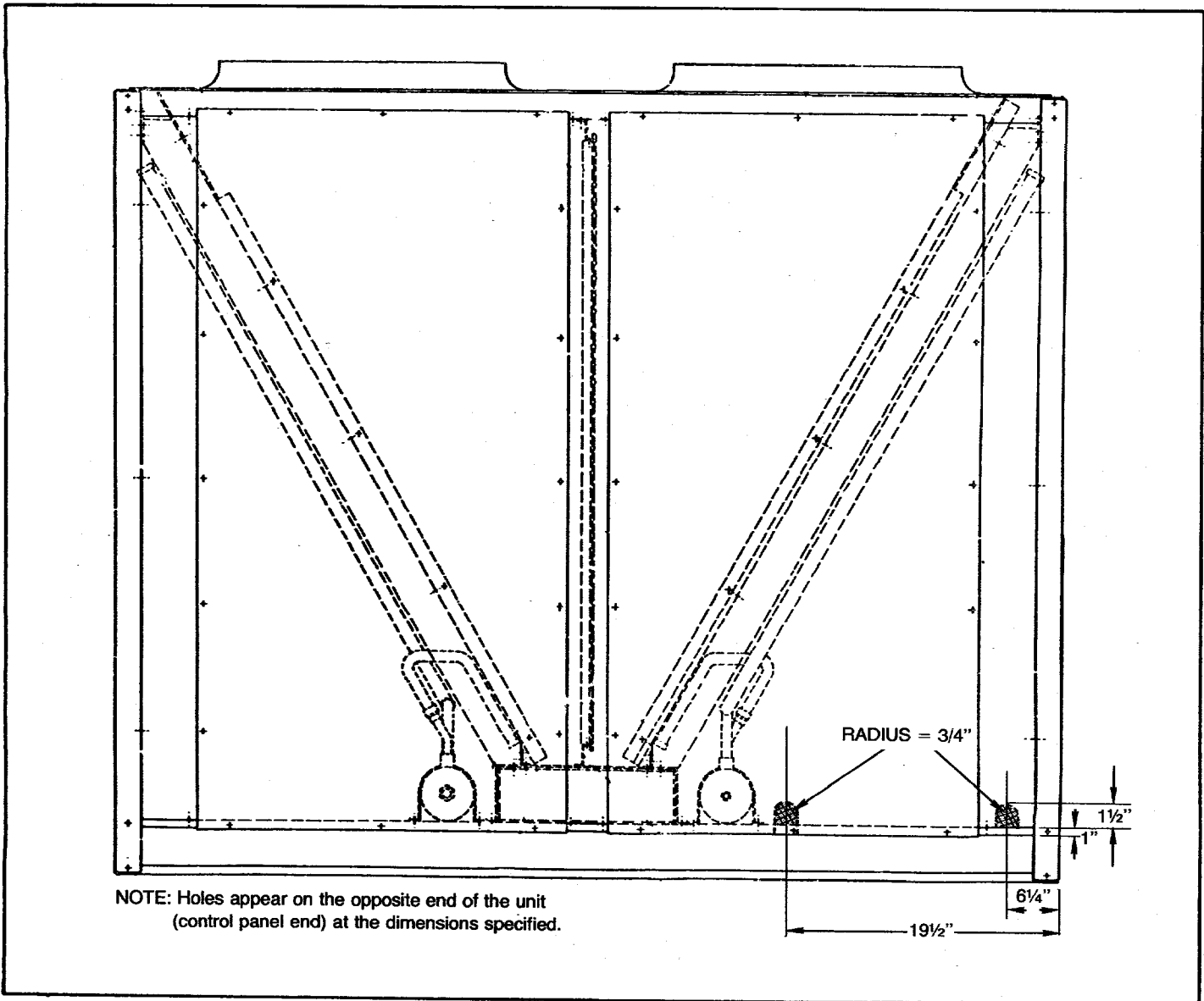


FIGURE 23 - Liquid Line Hole Locations: 40 Through 60-Ton Units Without Isolators

15. Center each suction line in its respective hole.
16. Run the lines to the desired location in accordance with the guidelines presented in the Trane Engineering Bulletin EB-S/S-38 and this manual.
 - a. Allow at least 1-1/2-inch clearance between the lines and any surface or obstruction to prevent direct line contact.
 - b. To prevent noise transmission and provide adequate support, allow no less than 10-feet and no more than 15-feet of suction line between the suction service valves and the first clamp locations.
17. With each suction service valve coupling removed from its valve, braze each coupling to its respective suction line.

WARNING: NEVER USE A TORCH ON A REFRIGERANT LINE UNTIL IT HAS BEEN DETERMINED THAT ALL GAS HAS BEEN ELIMINATED FROM THE LINE - UNSAFE PRESSURES COULD RESULT CAUSING A VIOLENT EXPLOSION AND SERIOUS PERSONAL INJURY OR DEATH. BE SURE THE AREA IS WELL VENTILATED.

CAUTION: Pump dry nitrogen through the system refrigerant piping whenever brazing is in progress. Failure to do this will permit oxides to form and accumulate in the refrigerant system which may cause damage to the refrigeration system.

18. Bolt each suction line up to its service valve and reposition the lines.
19. Proceed to braze the connections with the lines in place or with the connections referenced and the lines removed.

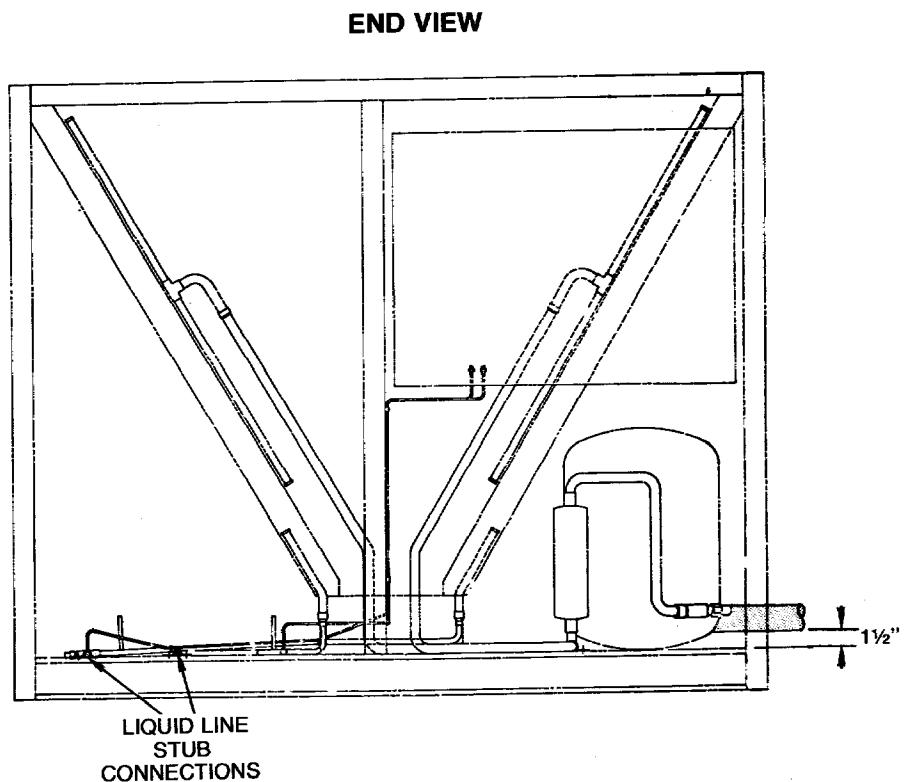
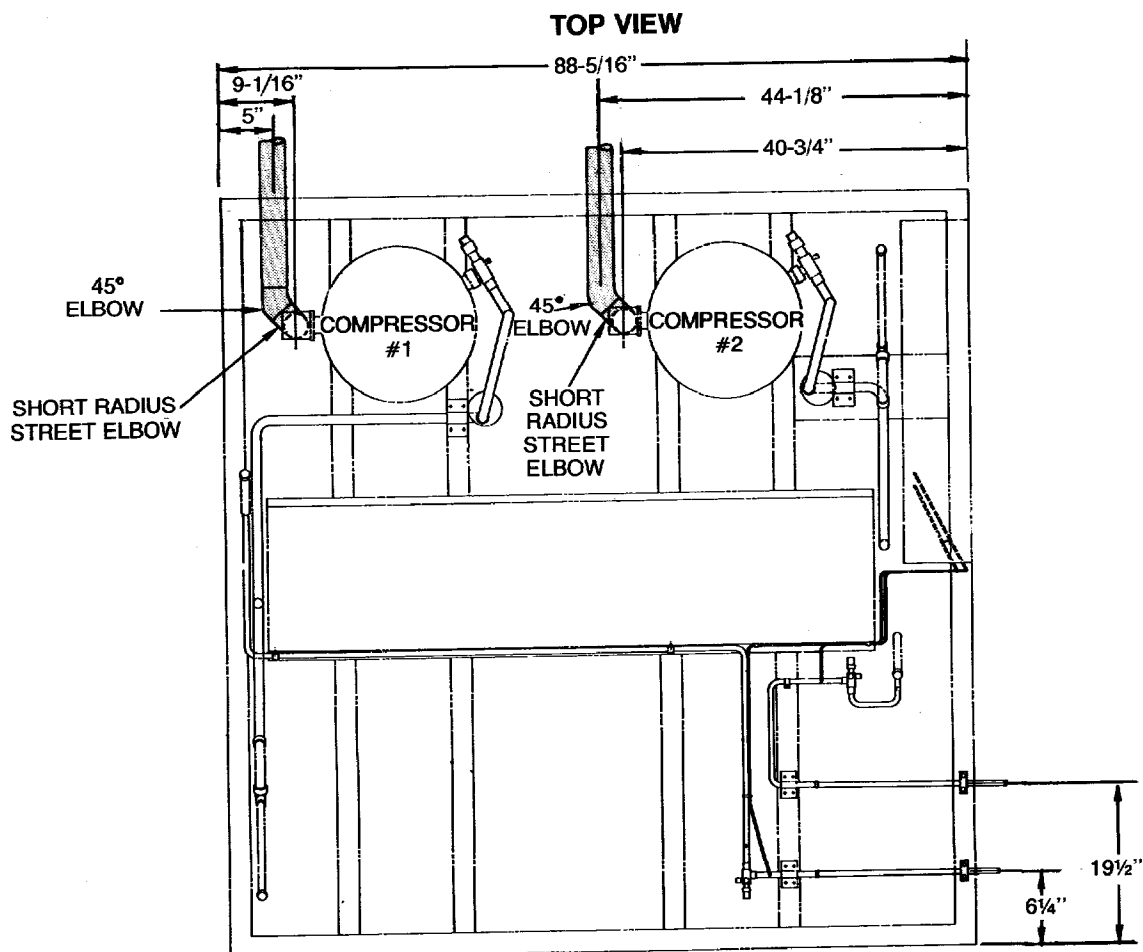


FIGURE 24 - Piping Installation: 40-Ton Units Without Isolators

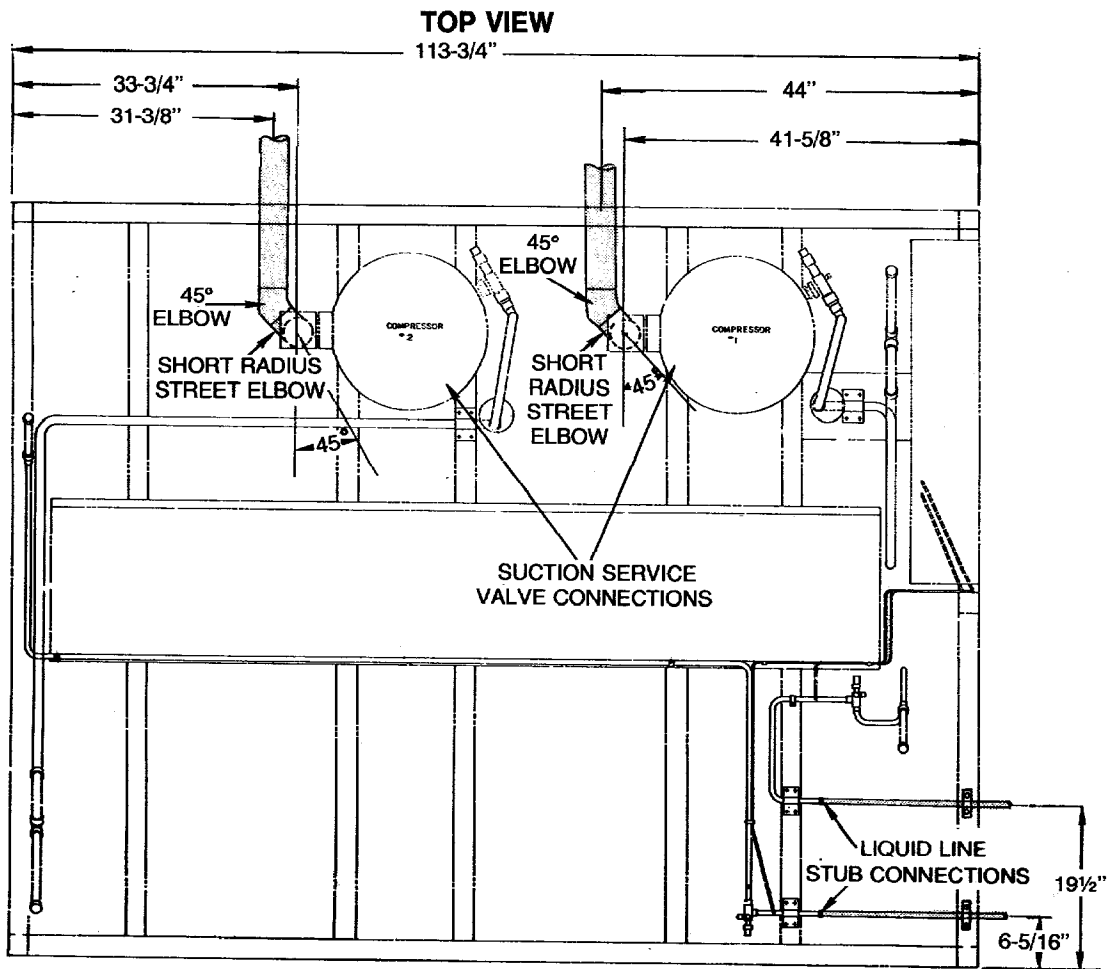


FIGURE 25 - Piping Installation: 50 and 60-Ton Units Without Isolators

THERMOSTATIC EXPANSION VALVE SELECTION

The thermostatic expansion valve is a modulating valve designed to regulate the rate of refrigerant flow into the evaporator in exact proportion to the rate of refrigerant evaporation. This can be done such that refrigerant superheat leaving the evaporator is held relatively constant. In order to maximize compressor reliability, Trane recommends that expansion valves be adjusted to achieve approximately 12 F superheat leaving the evaporator at rating point conditions (80/67 - 95 F). Refer to "Thermostatic Expansion Valve Adjustment and Superheat Measurement" in the MAINTENANCE PROCEDURES section of this manual for the recommended superheat adjustment procedures.

Trane recommends that externally equalized valves be utilized in order to compensate for pressure drop between the expansion valve and superheat control point at the evaporator outlet.

Thermostatic expansion valves are more likely to hunt at low system versus valve capacity conditions where the valve pin is close to the valve seat. This is more pronounced on larger tonnage valves and on systems with unloading compressors. Both major expansion valve manufacturers have a balance-ported valve which tend to overcome this problem. The Trane Company recommends this feature (when valve sizing allows) in order to maintain satisfactory superheat control down to lower valve loading conditions.

Various bulb charges are available and are described in valve supplier catalogs. Trane recommends the use of VGA charge (Sporlan) or straight W charge (Alco) on RAUB 20 through 60-ton systems. These charges provide smooth control at air conditioning conditions and are less prone to charge migration than the conventional gas charge.

Thermostatic expansion valves are rated by the valve manufacturer in accordance with A.R.I. Standard 750 and A.N.S.I. Standard B60.1. Capacity application ratings (tons) are given for varying evaporator suction temperatures (F) and valve pressure drops (PSI). Catalog values assume liquid entering the valve at **all times** and a liquid temperature of 100 F. Correction factors are provided for liquid temperatures other than 100 F.

Thermostatic expansion valves must be selected considering actual operating conditions rather than nominal valve and system capacities. Valve capacity is a function of evaporator saturated suction temperature leaving the evaporator, liquid temperature entering the expansion valve, and valve pressure drop. Pressure drop across the valve is the difference between compressor discharge and suction pressures, less pressure drops in the discharge line, condenser, subcooler, liquid line, suction line, evaporator, distributor tubes and distributor. Valves should normally be selected so that actual system capacity is 70 to 100 percent of valve rated capacity at design conditions.

Normally, the factory superheat setting (static superheat) is made with the valve pin starting to move away from the seat. Valves are generally designed so that an increase in superheat from 4 to 6 F

over the factory static superheat setting is necessary for the valve pin to open to its rated position. Valves in this size range are rated at approximately 75 percent of full stroke to provide a reserve. Valves with a balance port feature can provide satisfactory control with loads 15 to 25 percent of nominal valve capacity.

Recommended expansion valve selections for RAUB 20 through 60-ton systems are given in Table 3. These selections assume two expansion valves per evaporator and Trane Type F coils which have Alco venturi type distributors. Other assumptions are detailed in Table 3.

CAUTION: For proper performance, consult the valve manufacturer's catalog for valve and distributor installation recommendations, or for valve sizing procedures on systems with a different configuration than assumed in Table 3.

BRAZING AND LEAK TESTING

For proper brazing techniques when installing refrigerant tubing, refer to BRAZING PROCEDURES in the MAINTENANCE section of this manual.

After completing the installation of all refrigerant piping, the system should be thoroughly checked for possible leaks. Refer to LEAK TESTING in the MAINTENANCE section of this manual.

ELECTRICAL WIRING

WARNING: BEFORE WORKING ON THIS OR ANY ELECTRICAL EQUIPMENT, DISCONNECT ALL ELECTRICAL POWER. FAILURE TO DO SO MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH DUE TO ACCIDENTAL ELECTRIC SHOCK.

Install all electrical wiring in conformance with local and national electrical codes. Ground the unit in accordance with local codes. A grounding lug is provided in the unit control panel. Make certain that all connection and contactor lugs are tight.

Figures 26 and 27 illustrate typical field wiring required for 20 through 60 ton Model RAUB condensing units with standard controls. Figures 28 through 31 illustrate typical field wiring for 20 through 60 ton units with electronic controls.

NOTE: THESE DIAGRAMS ARE "TYPICAL FIELD WIRING" ONLY. THE ACTUAL AS WIRED DIAGRAMS FOR YOUR UNIT, INCLUDING FIELD WIRING AND CONNECTION AND SCHEMATIC WIRING DIAGRAMS, ARE LOCATED INSIDE THE MAIN CONTROL PANEL ACCESS DOOR.

ELECTRICAL DATA

Table 4 lists the electrical characteristics for RAUB 20 through 60-ton units.

CAUTION: The Trane Company recommends only the use of copper conductors with this equipment. Use of other than copper conductors may result in galvanic corrosion and possible damage to the equipment.

TABLE 3 - Recommended Expansion Valve Selections

CONDENSING UNIT MODEL NO.	NO OF VALVES	NO OF CIRC.	SPORLAN SELECTION			ALCO SELECTION		
			VALVE NO.	INLET (ODF)	OUTLET (ODF)	VALVE NO.	INLET (ODF)	OUTLET (ODF)
RAUB-C20	2	8	OVE-10-VGA	5/8	7/8, 1 1/8	TRAE10HW	5/8 - 1 1/8	7/8 - 1 1/8
RAUB-C25	2	12	OVE-15-VGA	7/8	1 1/8	TRAE15HW	5/8 - 1 1/8	7/8 - 1 1/8
RAUB-C30	2	12	OVE-15-VGA	7/8	1 1/8	TRAE15HW	5/8 - 1 1/8	7/8 - 1 1/8
RAUB-C40	2	16	OVE-20-VGA	7/8	1 1/8	TRAE20HW	5/8 - 1 1/8	7/8 - 1 1/8
RAUB-C50	2	18	OVE-30-VGA	1 1/8	1 1/8	TRAE30HW	5/8 - 1 1/8	7/8 - 1 1/8
RAUB-C60	2	20	OVE-30-VGA	1 1/8	1 1/8	TRAE30HW	5/8 - 1 1/8	7/8 - 1 1/8

- NOTES:
 1. Assumes 2 ALCO venturi type distributors and 5/16" x 30" distributor tubes.
 2. Assumes coil sized to provide between 35 F and 45 F saturated suction at rating point condition (80/67 - 95 F).
 3. Assumes liquid lines and components sized within guidelines specified in Trane Engineering Bulletin EB-S/S-38 on interconnecting lines.

TABLE 4 - Electrical Data

MODEL	UNIT VOLTAGE ¹	COMPRESSOR MOTOR			CONDENSER FAN MOTOR				UNIT CHARACTERISTICS ⁶					
		NO.	RLA ²	LRA ^{2,3,7}	KW INPUT ⁷	NO.	HP (EA.)	RLA ²	LRA ²	KW INPUT ⁷	UNIT RLA	MAX. FUSE SIZE	MIN. CIRCUIT AMP. ⁵	RECOMMENDED DUAL ELEMENT FUSE SIZE ⁴
RAUB-C206	200/60/3	1	75.4	396	22.1	2	1.0	4.1	20.7	0.95	81.8	175	102.5	110
RAUB-C203	230/60/3	1	65.6	344	22.1	2	1.0	3.6	18.0	0.95	71.2	150	89.2	100
RAUB-C201	460/60/3	1	32.8	172	22.1	2	1.0	1.8	9.0	0.95	35.6	70	44.6	50
RAUB-C204	460/60/3	1	32.8	172	22.1	2	1.0	1.8	9.0	0.95	35.6	70	44.6	50
RAUB-C202	575/60/3	1	26.2	138	22.1	2	1.0	1.4	7.2	0.95	28.4	60	35.6	40
RAUB-C20A	380/50/3	1	34.0	166	18.1	2	0.7	1.6	8.0	0.70	35.2	70	45.7	50
RAUB-C20B	415/50/3	1	31.1	181	18.1	2	0.7	1.7	7.5	0.70	32.3	70	42.3	50
RAUB-C256	200/60/3	1	91.5	426	27.2	3	1.0	4.1	20.7	0.95	101.8	200	126.7	150
RAUB-C253	230/60/3	1	79.6	370	27.2	3	1.0	3.6	18.0	0.95	88.6	175	110.3	125
RAUB-C251	460/60/3	1	39.8	185	27.2	3	1.0	1.8	9.0	0.95	44.3	90	55.2	60
RAUB-C254	460/60/3	1	39.8	185	27.2	3	1.0	1.8	9.0	0.95	44.3	90	55.2	60
RAUB-C252	575/60/3	1	31.8	148	27.2	3	1.0	1.4	7.2	0.95	35.3	70	44.0	50
RAUB-C25A	380/50/3	1	41.5	178	21.8	3	0.7	1.6	8.0	0.70	43.7	90	56.7	60
RAUB-C25B	415/50/3	1	38.0	195	21.8	3	0.7	1.7	7.5	0.70	40.1	90	52.6	60
RAUB-C306	200/60/3	1	109.0	489	32.5	3	1.0	4.1	20.7	0.95	121.8	250	148.6	175
RAUB-C303	230/60/3	1	94.8	425	32.5	3	1.0	3.6	18.0	0.95	106.0	200	129.3	150
RAUB-C301	460/60/3	1	47.4	213	32.5	3	1.0	1.8	9.0	0.95	53.0	110	64.7	70
RAUB-C304	460/60/3	1	47.4	213	32.5	3	1.0	1.8	9.0	0.95	53.0	110	64.7	70
RAUB-C302	575/60/3	1	37.9	170	32.5	3	1.0	1.4	7.2	0.95	42.3	80	51.6	60
RAUB-C30A	380/50/3	1	50.0	205	26.2	3	0.7	1.6	8.0	0.70	52.3	110	67.3	80
RAUB-C30B	415/50/3	1	45.8	224	26.2	3	0.7	1.7	7.5	0.70	48.0	100	62.4	70
RAUB-C406	200/60/3	2	75.4	396	22.1	4	1.0	4.1	20.7	0.95	163.6	250	186.1	200
RAUB-C403	230/60/3	2	65.6	344	22.1	4	1.0	3.6	18.0	0.95	142.4	225	162.0	175
RAUB-C401	460/60/3	2	32.8	172	22.1	4	1.0	1.8	9.0	0.95	71.2	110	81.0	90
RAUB-C404	460/60/3	2	32.8	172	22.1	4	1.0	1.8	9.0	0.95	71.2	110	81.0	90
RAUB-C402	575/60/3	2	26.2	138	22.1	4	1.0	1.4	7.2	0.95	56.8	90	64.6	70
RAUB-C40A	380/50/3	2	34.0	166	18.0	4	0.7	1.6	8.0	0.70	70.2	110	82.9	90
RAUB-C40B	415/50/3	2	31.1	181	18.0	4	0.7	1.7	7.5	0.70	64.4	100	76.8	80
RAUB-C506	200/60/3	2	91.5	426	27.2	6	1.0	4.1	20.7	0.95	203.6	300	230.5	250
RAUB-C503	230/60/3	2	79.6	370	27.2	6	1.0	3.6	18.0	0.95	177.2	250	200.7	200
RAUB-C501	460/60/3	2	39.8	185	27.2	6	1.0	1.8	9.0	0.95	88.6	125	100.4	110
RAUB-C504	460/60/3	2	39.8	185	27.2	6	1.0	1.8	9.0	0.95	88.6	125	100.4	110
RAUB-C502	575/60/3	2	31.8	148	27.2	6	1.0	1.4	7.2	0.95	70.6	110	80.0	80
RAUB-C50A	380/50/3	2	41.5	178	21.7	6	0.7	1.6	8.0	0.70	87.4	125	103.0	110
RAUB-C50B	415/50/3	2	38.0	195	21.7	6	0.7	1.7	7.5	0.70	80.2	125	95.7	100
RAUB-C606	200/60/3	2	109.0	489	32.5	6	1.0	4.1	20.7	0.95	243.6	350	269.9	300
RAUB-C603	230/60/3	2	94.8	425	32.5	6	1.0	3.6	18.0	0.95	212.0	300	234.9	250
RAUB-C601	560/60/3	2	47.4	213	32.5	6	1.0	1.8	9.0	0.95	106.0	150	117.5	125
RAUB-C604	460/60/3	2	47.4	213	32.5	6	1.0	1.8	9.0	0.95	106.0	150	117.5	125
RAUB-C602	575/60/3	2	37.9	170	32.5	6	1.0	1.4	7.2	0.95	84.6	125	93.7	100
RAUB-C60A	380/50/3	2	50.0	205	26.2	6	0.7	1.6	8.0	0.70	104.6	150	122.1	125
RAUB-C60B	415/50/3	2	45.8	224	26.2	6	0.7	1.7	7.5	0.70	96.0	150	113.3	125

- NOTES:
 1. Voltage is three phase, 60 or 50 hertz. Range is plus or minus 10 percent of nominal voltage.
 2. Electrical information is for each individual motor.
 3. Part winding starters standard on all 200 and 230-volt units for incremental start.
 4. Maximum fuse size permitted by N.E.C. 440-22 is 225 percent of one compressor motor RLA plus the total RLA of the other motors in circuit. Select the next smaller standard fuse size.
 5. Minimum circuit ampacity equals the RLA of one compressor times 1.25 plus the total RLA of the remaining motors.
 6. Local codes may take precedence.
 7. Compressor kw at 95 F ambient and 45 F saturated suction temperature.
 8. Recommended dual element fuse size is 150 percent of the RLA of one compressor plus the RLA of the remaining motors. Select the next smaller fuse size unless the number exceeds the next smaller fuse size plus 90 percent of the increment to the next larger fuse. If so, then select the next larger fuse size.
 9. All unit voltages use part winding starters except the 460/60/3 which may be either part winding starter or across the line starter. All unit nameplates will show only across the line locked rotor amps.

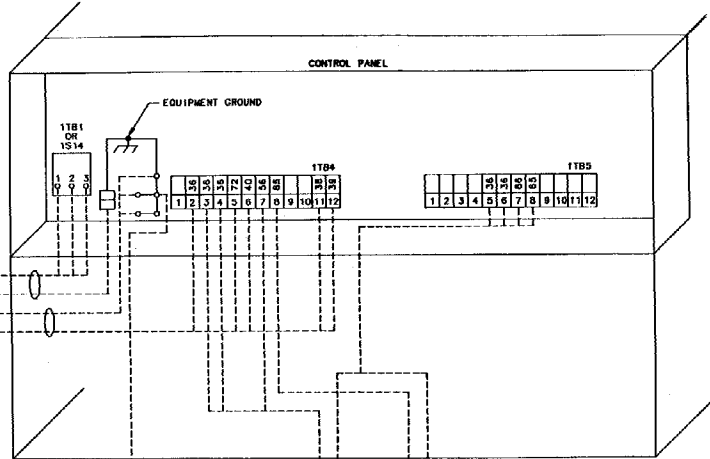
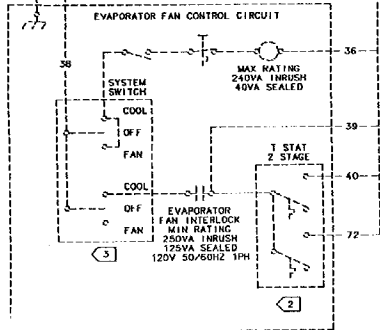
CAUTION
DO NOT ENERGIZE
UNIT UNTIL CHECK-OUT
AND START-UP PROCEDURE
HAS BEEN COMPLETED

NOTES:

1. ALL WIRING AND DEVICES SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
2. SUGGESTED THERMOSTAT—PENN T25A OR EQUIVALENT
3. SUGGESTED SWITCH-CUTLER HAMMER 7562K53 2PDT OR EQUIVALENT.
4. CONDENSER FAN MOTORS PROTECTED UNDER PRIMARY SINGLE-PHASING CONDITIONS.

USE COPPER CONDUCTORS ONLY

POWER SOURCE
200/230/460/575V 60HZ 3PH L1
380/415V 50HZ 3PH
SEE UNIT NAMEPLATE
FOR VOLTAGE



LIQUID LINE SOLENOID VALVE
MAX RATING
72 VA INRUSH
30 VA SEALED

HOT GAS BYPASS SOLENOID VALVE
MAX RATING
72 VA INRUSH
30 VA SEALED

HOT GAS BYPASS SOLENOID VALVE
MAX RATING
72 VA INRUSH
30 VA SEALED

WARNING
DISCONNECT ELECTRICAL POWER
SOURCE TO PREVENT INJURY OR
DEATH FROM ELECTRICAL SHOCK

CAUTION
USE COPPER CONDUCTORS ONLY
TO PREVENT EQUIPMENT DAMAGE

CONDENSER FAN FUSE (1F1-1F2-1F3, CLASS KR)						
UNIT VOLTAGE	200	230	380	415	460	575
TIME DELAY						
"A" DESIGN SEQUENCE	30A	30A	15A	15A	15A	15A
"C" DESIGN SEQUENCE	15A	15A	15A	15A	15A	15A
CONTROL POWER FUSE						
1F7				TYPE S		6.2 A

FIGURE 26 - Field Wiring, Two Step Controls (20, 25 and 30-Ton Units)

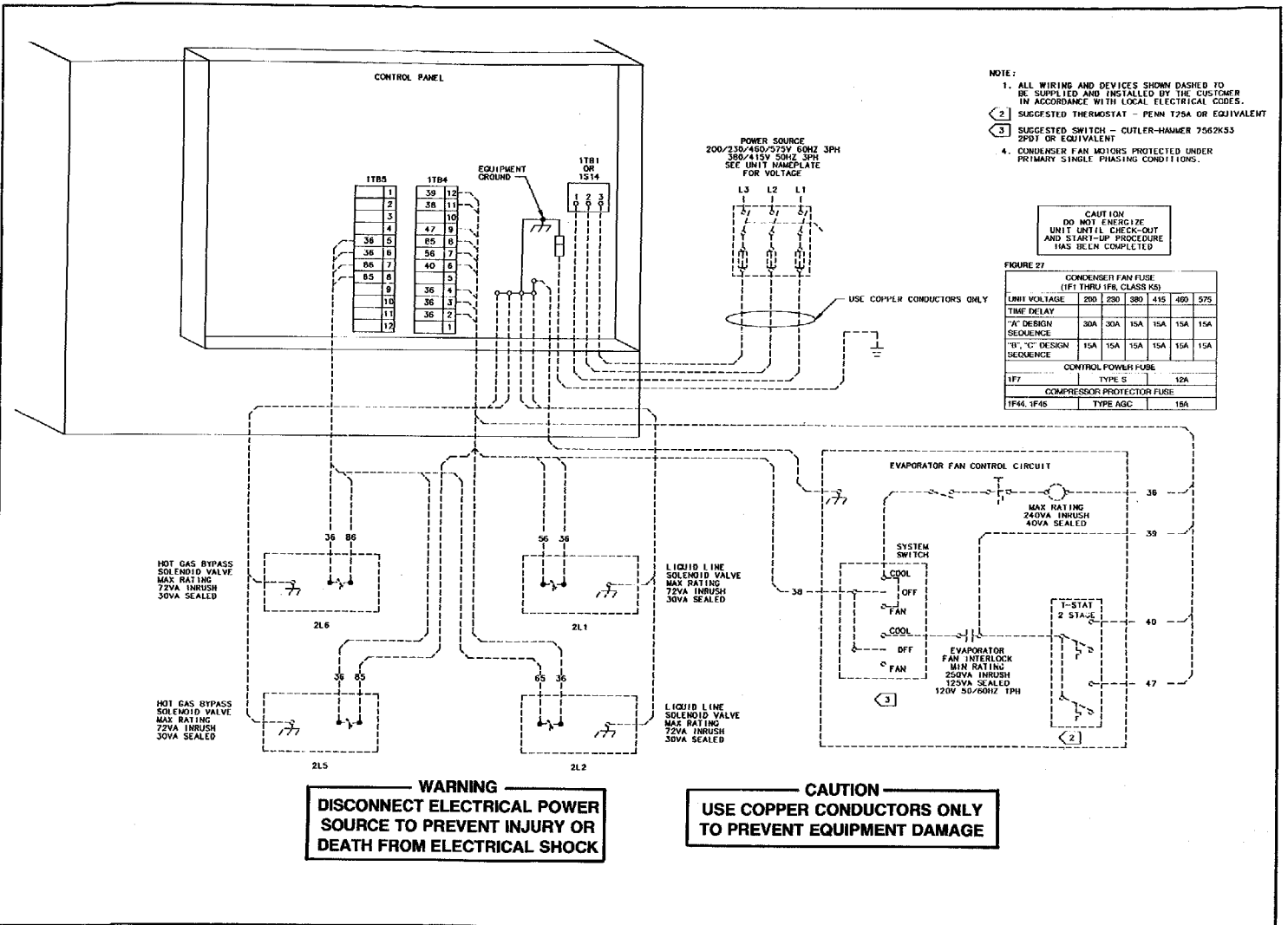
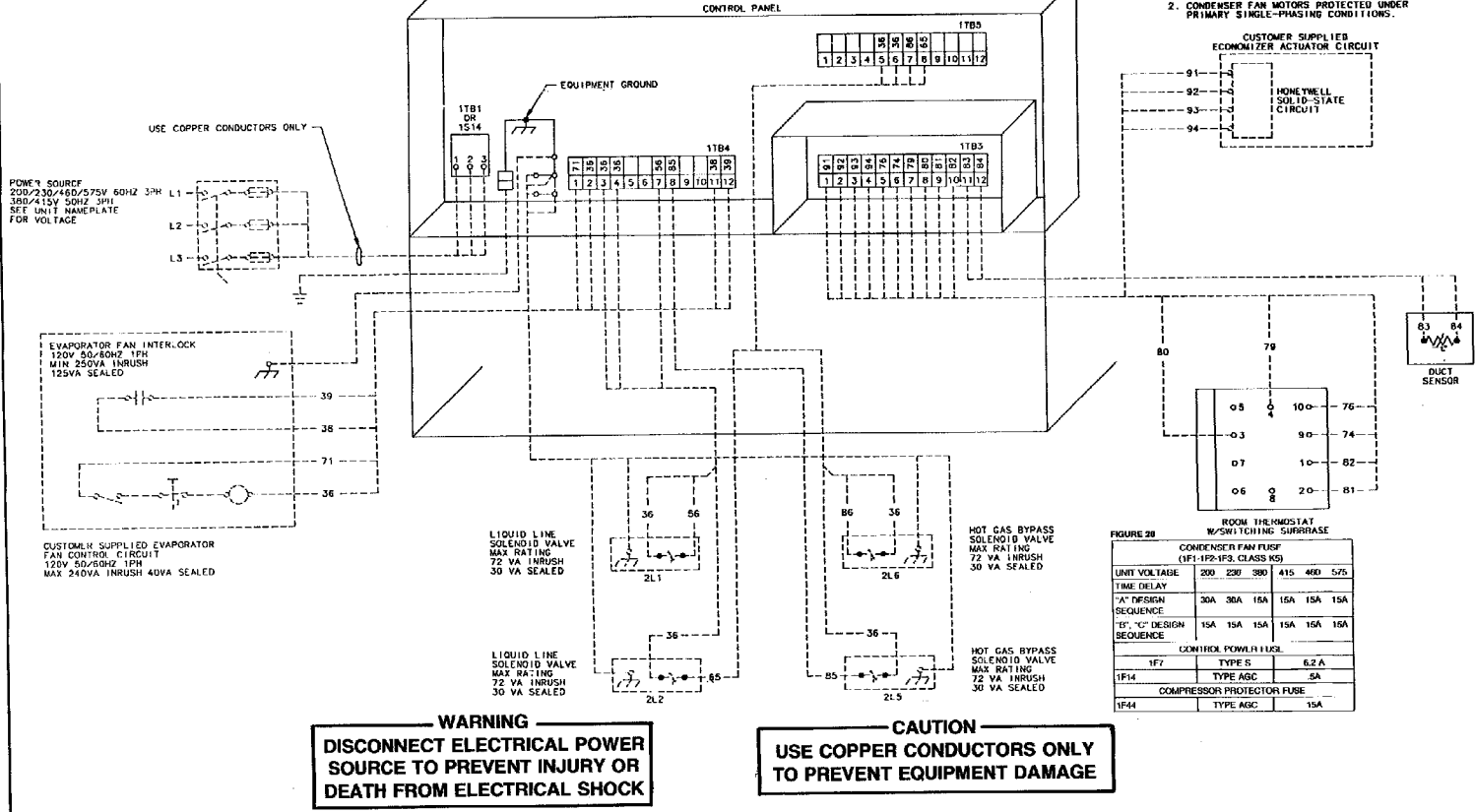


FIGURE 27 - Field Wiring: Two Step Controls (40, 50 and 60-Ton Units)

CAUTION
DO NOT ENERGIZE
UNIT UNTIL CHECK-OUT
AND START-UP PROCEDURE
HAS BEEN COMPLETED.

- NOTES:
1. ALL WIRING AND DEVICES SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
 2. CONDENSER FAN MOTORS PROTECTED UNDER PRIMARY SINGLE-PHASING CONDITIONS.



WARNING
DISCONNECT ELECTRICAL POWER
SOURCE TO PREVENT INJURY OR
DEATH FROM ELECTRICAL SHOCK

CAUTION
USE COPPER CONDUCTORS ONLY
TO PREVENT EQUIPMENT DAMAGE

FIGURE 20
ROOM THERMOSTAT W/SWITCHING SURFACE

UNIT VOLTAGE	CONDENSER FAN FUSE (1F1-1F5 CLASS K)				
	200	230	380	415	460/575
TIME DELAY	1	1	1	1	1
"A" DESIGN SEQUENCE	30A	30A	15A	15A	15A
"B" OF DESIGN SEQUENCE	15A	15A	15A	15A	15A
CONTROL POWER FUSE					
1F7	TYPE S		6.2 A		
1F14	TYPE AGC		.5A		
COMPRESSOR PROTECTOR FUSE					
1F4	TYPE AGC		15A		

FIGURE 28 - Field Wiring, Electronic Thermostat Controls (20, 25 and 30-Ton Units)

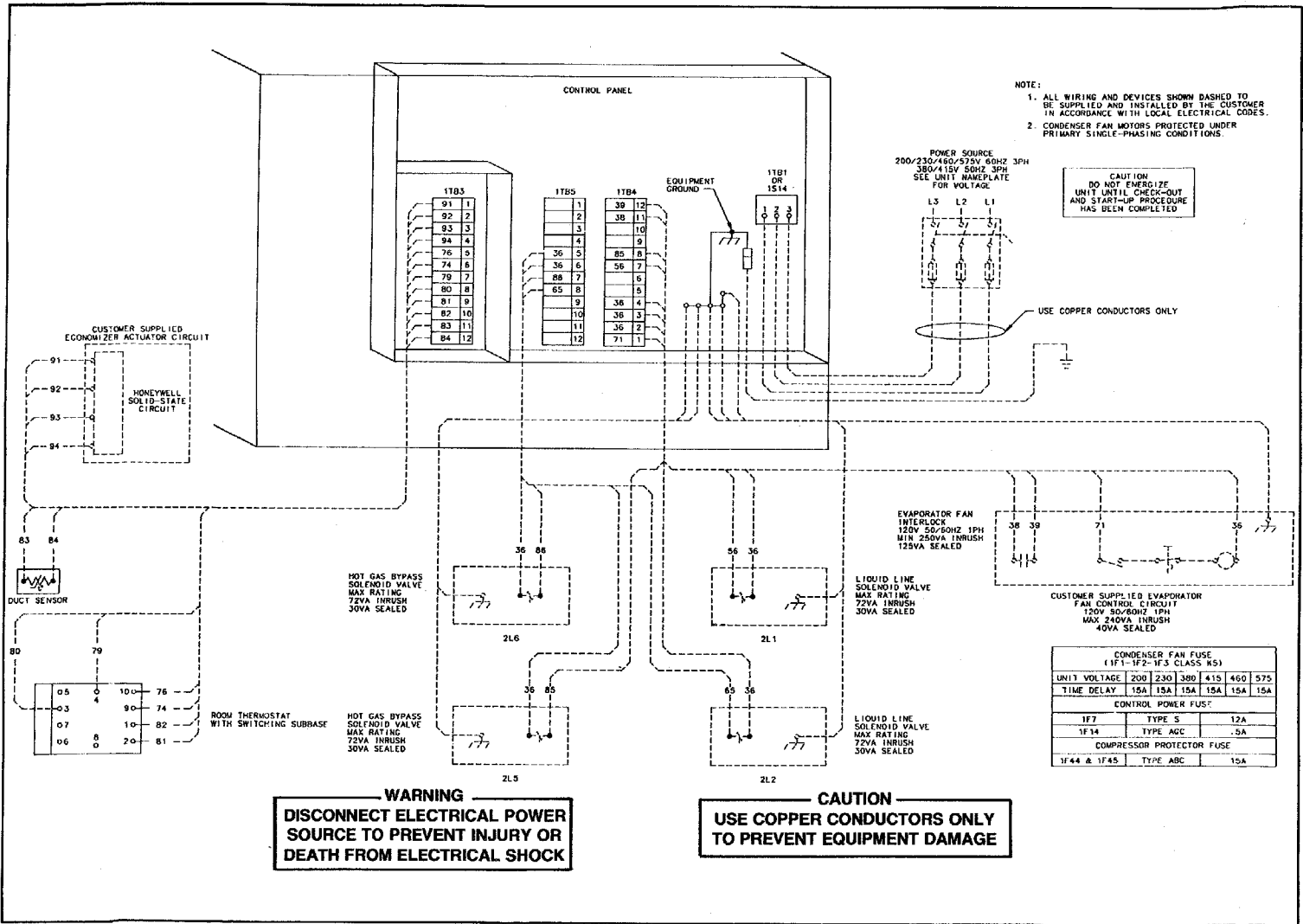


FIGURE 29 - Field Wiring, Electronic Thermostat Controls (40, 50 and 60-Ton Units)

CAUTION
DO NOT ENERGIZE
UNIT UNTIL CHECK-OUT
AND START-UP PROCEDURE
HAS BEEN COMPLETED

- NOTES:
1. ALL WIRING AND DEVICES SHOWN DASHED TO BE SUPPLIED AND INSTALLED BY THE CUSTOMER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
 2. SUGGESTED SWITCH: CUTLER HAMMER 7582K33 2PDT OR EQUIVALENT.
 3. CONDENSER FAN MOTORS PROTECTED UNDER PRIMARY SINGLE-PHASING CONDITIONS.

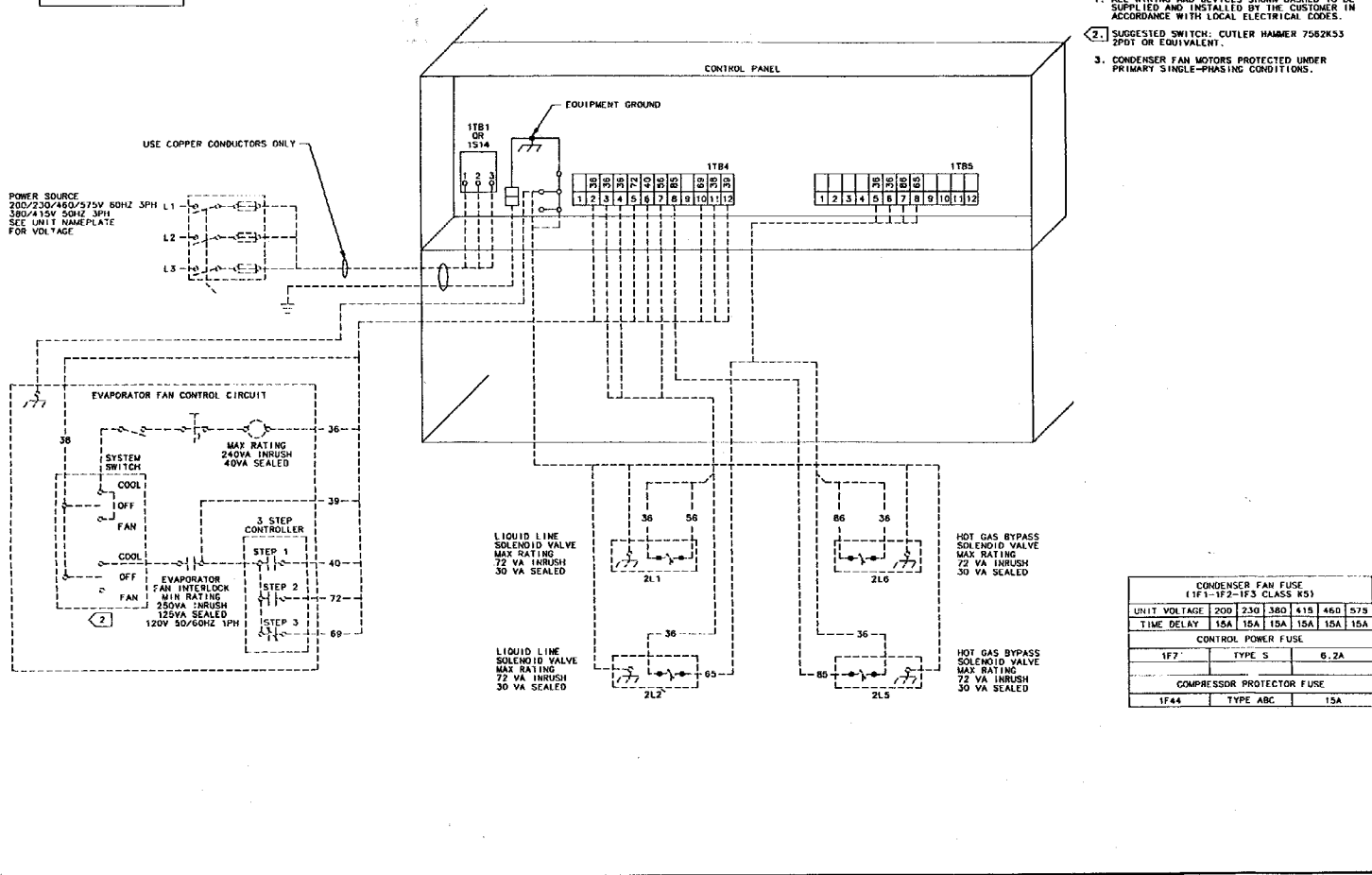


FIGURE 30 - Field Wiring, Multi-Step Controls (25 and 30-Ton Units)

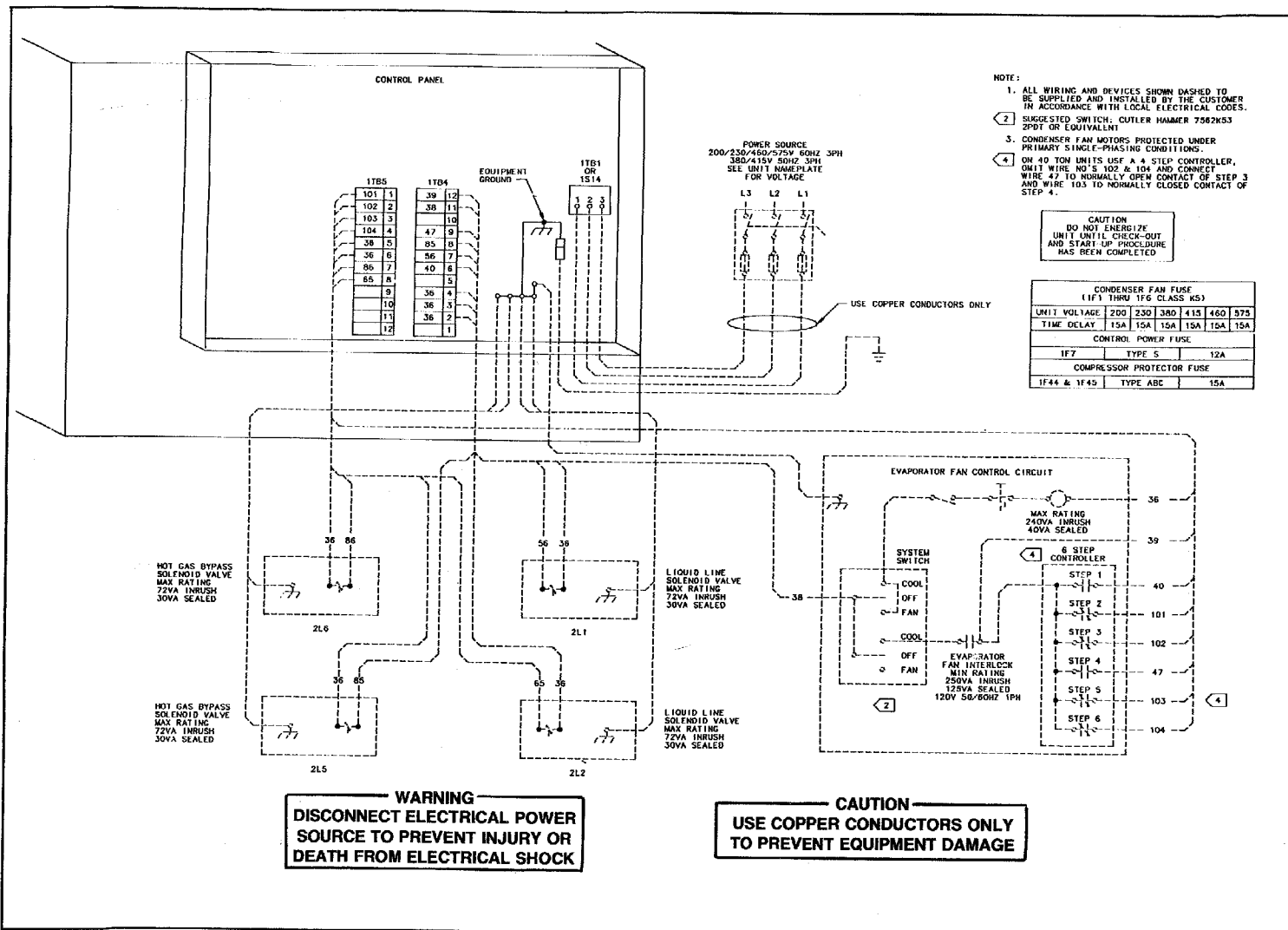


FIGURE 31 - Field Wiring, Multi-Step Controls, (40, 50 and 60-Ton Units)

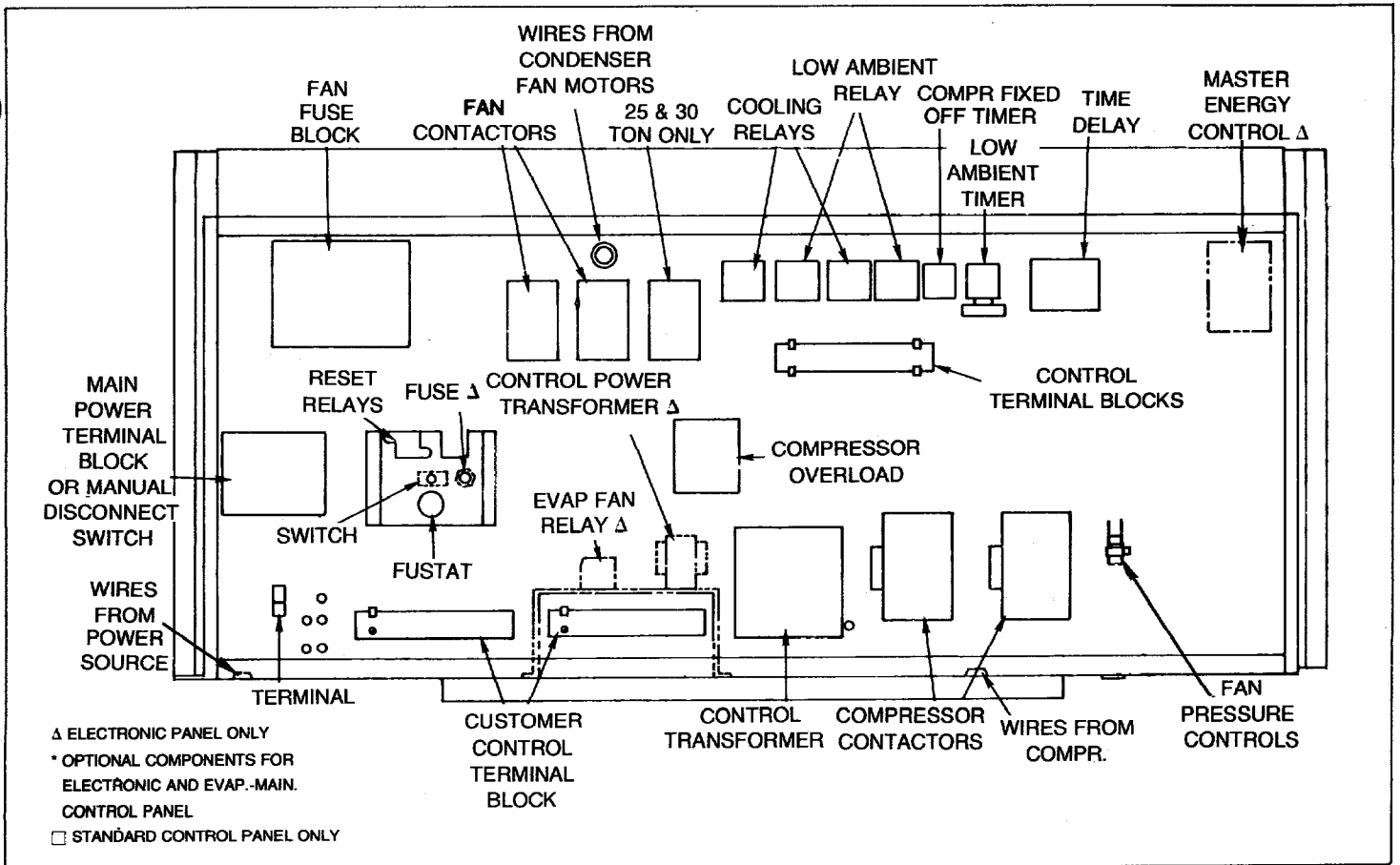


FIGURE 32 - Control Panel (20, 25 and 30-Ton Units)

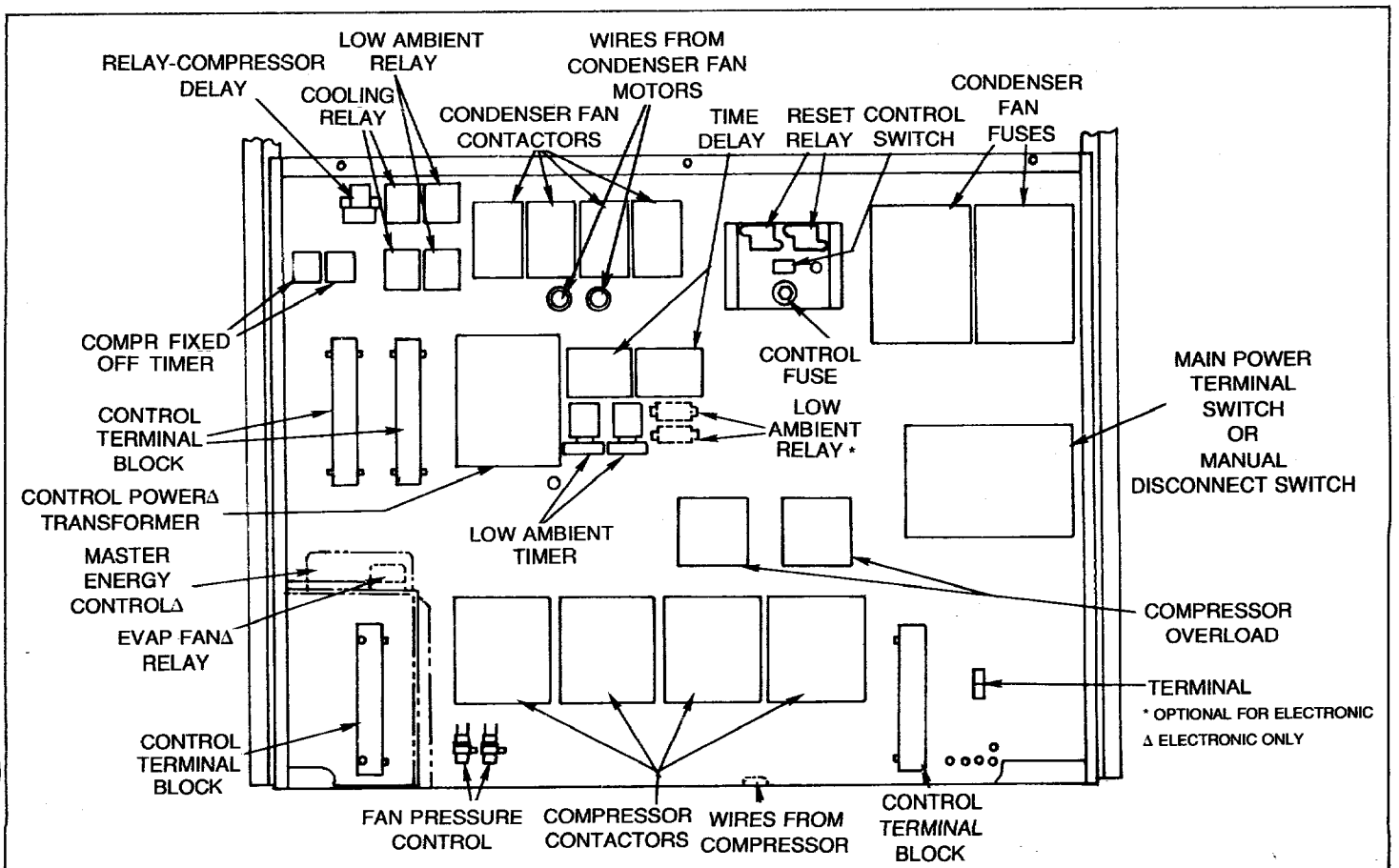


FIGURE 33 - Control Panel (40, 50 and 60-Ton Units)

THERMOSTAT INSTALLATION (ELECTRONIC THERMOSTAT CONTROLS)

Recommended wire sizes and lengths for installing the unit thermostat (24 VAC circuit) are provided in Table 5. The total resistance of these low voltage wires must not exceed one ohm. Any resistance in excess of one ohm may cause the control circuit to malfunction.

TABLE 5 - Recommended Thermostat Wire Size

WIRE GAUGE	MAXIMUM WIRE LENGTH
22 Gauge	30 Ft.
20 Gauge	50 Ft.
18 Gauge	75 Ft.
16 Gauge	125 Ft.
14 Gauge	200 Ft.

When selecting a thermostat location, be sure to choose a site in a frequently occupied area with good air circulation at an average temperature. The thermostat should be positioned approximately five feet above the floor.

Avoid mounting the thermostat in areas subject to the following:

- drafts or "dead" spots behind doors or in corners;
- hot or cold air from ducts;
- radiant heat from the sun, or from appliances;
- concealed pipes and chimneys;
- unheated or uncooled surfaces behind the thermostat, such as outside walls;
- in an area where the thermostat will be affected by a unit in another zone.

CAUTION: If an energy management device, time clock, or other power consuming device is used, a separate power supply must be provided for that device. Do not use the unit control circuitry, or damage to the unit may result.

DUCT SENSOR INSTALLATION (ELECTRONIC THERMOSTAT CONTROL)

All units with electronic thermostat control are shipped with a duct sensor which must be installed for proper unit operation. Refer to Figure 34 for duct sensor dimensions. Resistor R1 is factory installed and serves a protective function in the event the duct

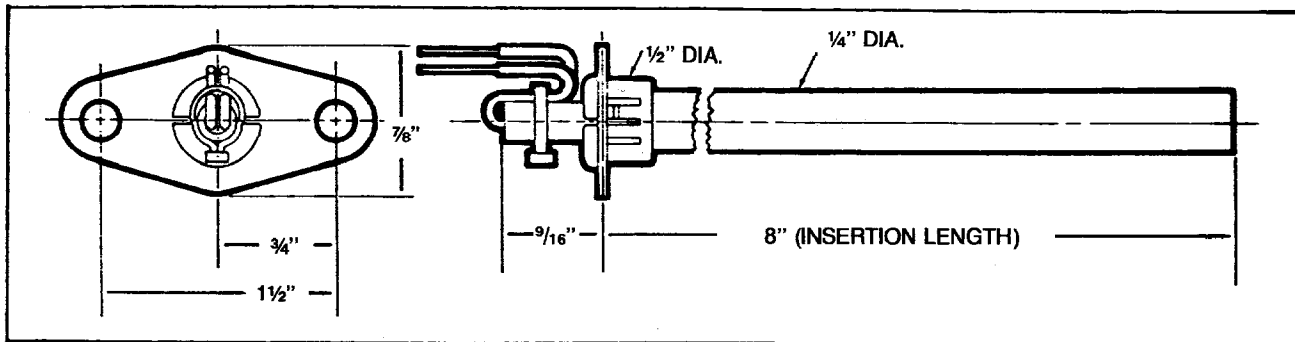


FIGURE 34 - Duct Sensor Dimensions

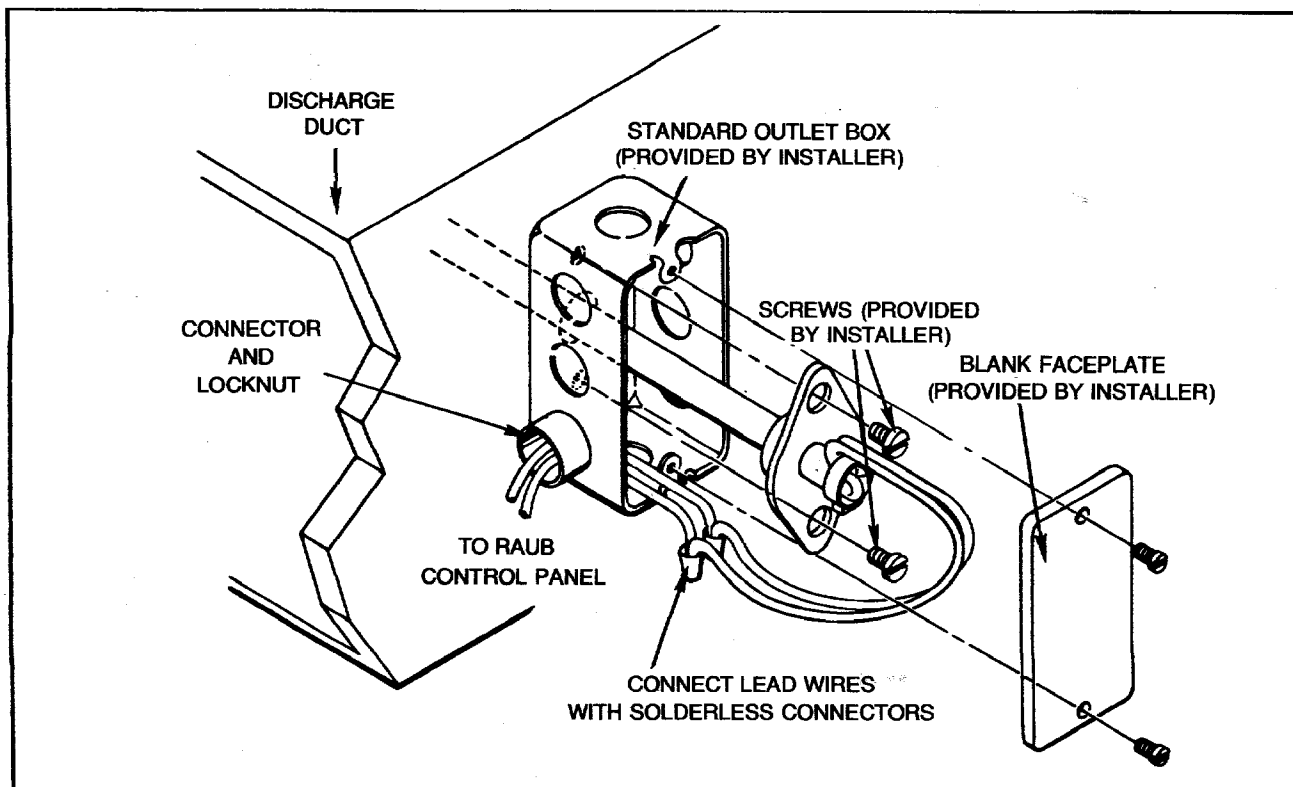


FIGURE 35 - Duct Sensor Assembly

sensor is not installed. Use the following procedure when installing the duct sensor:

1. Remove resistor 1R1 from Terminals 1TB5-11 and 1TB5-12.
2. Mount the duct sensor (2RT1) in an average temperature location at the outlet of the supply air ductwork. See Figure 35. If an economizer or heating section is incorporated in the system, the duct sensor must be located downstream (after mixing has occurred).
3. Connect the leads of the duct sensor across terminals 1TB5-11 and 1TB5-12.

NOTE: When an economizer is being used with these controls, the duct sensor must be installed.

INSTALLATION CHECKLIST

Complete this checklist as the unit is installed to verify that all recommended installation procedures are accomplished before the unit is started. **This checklist does not replace the detailed instructions provided in the INSTALLATION section of this manual.** Read the entire section carefully to become familiar with the installation procedures **before** installing the unit.

RECEIVING

- Unit nameplate data corresponds with ordering information.
- Unit inspected for shipping damage and claim filed, if necessary.
- Unit checked for material shortage and any shortages reported.

UNIT LOCATION

- Condenser air clearances over unit good.
- Service clearances around unit good.
- Unit secured in correct location.

REFRIGERANT PIPING

- Liquid line sized properly and within recommended maximum line length.
- Suction line sized properly.
- Thermostatic expansion valve properly sized and installed close to evaporator.
- Liquid line filter drier installed near expansion valve.
- Sight glass installed in liquid line between evaporator and filter drier.
- Low ambient accessories installed, if necessary.
- Check all unit and piping connections for leaks.

ELECTRICAL WIRING

- Field installed wiring complies with all applicable codes.
- Compressor contactor and terminal block lugs checked for tightness.
- Thermostat properly mounted and wired.
- Any other accessories properly installed and wired.
- Grounding wires securely bonded to earth ground.
- Duct sensor(s) properly installed (units with electronic thermostat controls or supply air controls).

PRE-START CHECKS

Before starting the unit, complete the procedures outlined below to make sure that the unit is properly installed and ready for start-up.

WARNING: OPEN THE UNIT DISCONNECT SWITCH AND LOCK IT IN THAT POSITION TO PREVENT ACCIDENTAL START-UP. NEVER OPEN AN ACCESS PANEL TO INSPECT OR SERVICE THE UNIT WITHOUT FIRST OPENING THE DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH DUE TO ACCIDENTAL ELECTRICAL SHOCK OR ENTANGLEMENT IN MOVING PARTS.

1. Inspect all electrical connections to be sure that the wires are securely attached to their terminals. Make sure that all wires are clear of any rotating parts such as fan blades.
2. Check the condenser and evaporator fans. Fan blades must be secure on the motor shafts and must rotate freely. Airflow must be unobstructed.
3. Make sure the evaporator air filters are clean.
4. Check the evaporator and condenser coils to ensure that they are clean, that the fins are straight, and that there are no obstructions to airflow.
5. Check the voltage at the line side of the disconnect switch. The voltage must be within 10 percent of the unit nameplate voltage.
6. Check the compressor oil level sight glass. If oil is not visible and the unit has not yet been operated, add oil. The oil level must be visible in the sight glasses. If the unit has been operated and no oil is visible, determine the reason for the shortage before adding oil.

EVACUATION

After completing the PRE-START CHECKS use a vacuum pump to remove air, moisture and contaminants from the system. The system should be evacuated to a pressure of 500 microns or less. Refer to EVACUATION PROCEDURES in the MAINTENANCE PROCEDURES section of this manual.

REFRIGERANT CHARGING

With the system properly evacuated, determine the required charge of Refrigerant-22 and charge the system as outlined under REFRIGERANT CHARGING in the MAINTENANCE PROCEDURES section of this manual.

START-UP, TWO-STEP CONTROLS

Set the room thermostat as follows to start the unit:

1. Turn the System Control switch to cool.
2. Set the thermostat at a point below room temperature.

The unit will operate automatically in response to cooling needs as determined by the thermostat setting.

START-UP, ELECTRONIC THERMOSTAT CONTROLS

To start the system:

1. Close the unit disconnect switch.
2. Place the thermostat sub-base fan switch in the AUTO position. Fan operation is continuous in the ON or AUTO position.
3. Place the thermostat sub-base system switch in the COOL position.

4. Lower the room thermostat to a setting below the room temperature.
5. Close the control circuit switch 1S1.

The unit will operate automatically in response to the cooling needs as determined by the thermostat setting.

INITIAL START-UP CHECKS

Compressor Oil Charge

Proper oil charge is critical for reliable operation of reciprocating compressors. Both undercharging and overcharging will result in compressor damage.

On most applications, the factory oil charge is correct and no addition of oil is required. However, it may be necessary to add oil to systems which have extremely long interconnecting lines.

An oil level sight glass is provided integral to the compressor shell in order to confirm proper oil charge on all 20 through 60-ton units. The following procedure should be followed:

1. Check the oil level **prior to initial refrigerant charging and start-up** of a new system. To be proper, the oil level must be visible in the sight glass. Note the oil level mark for future reference.
2. Approximately one hour after initial start-up and after the oil sump is warm to the touch, check the oil level with the compressor running **fully loaded**. The oil level must be visible in the sight glass. If it is not visible, add oil until the level is halfway up the sight glass.

CAUTION: Do not attempt to check the oil level at part load compressor operation. It is not intended that the oil level be visible in the sight glass under these conditions. Adding oil could result in a compressor oil overcharge and subsequent compressor damage.

3. Allow the compressor to run at full load until the oil sump is warm to the touch. If the oil level increases from Step 2, oil

should be removed and the process repeated until the sight glass level remains at the halfway mark.

CAUTION: Checking oil level with a cold sump can incorrectly indicate excess oil in the sump due to refrigerant in the oil.

Crankcase Heater

Normally, it is not necessary to energize the crankcase heater prior to **initial start-up**. However, if more than 30-minutes has elapsed between refrigerant charging and start-up a significant amount of refrigerant could migrate to the compressor. When there is a time lapse between charging and start-up, the crankcase heater should be energized for at least eight hours prior to starting the unit.

CAUTION: Failure to energize the crankcase heater and wait eight hours before starting the compressor may result in excessive oil foaming at start-up and possible damage to the compressor bearings.

COMPRESSOR MOTOR

With the compressor operating, check the amp draw. The amperage should not exceed the "Maximum Allowable Amps" listed in Table 6. The amp draw may be less than the value listed in the table.

Voltage at the compressor terminals must be within the "Allowable Voltage Range" listed in Table 4. If not, check the voltage at the unit terminal block and at the disconnect switch to determine if voltage problems are being caused by feeder line, loose terminals, or defective unit wiring.

VOLTAGE IMBALANCE

Voltage imbalance on three phase systems can cause motor overheating and eventual failure. Maximum allowable imbalance is two percent, which must be measured at the compressor terminals. Voltage imbalance is defined as 100 times the maximum de-

TABLE 6 - Maximum Allowable Amp Draw

CONDENSING UNIT	ELECTRICAL CHARACTERISTICS	ALLOWABLE VOLTAGE RANGE	MAX. ALLOWABLE AMPS	
			MATCHED EVAP.	OVERSIZED EVAP.
RAUB-C206	200/60/3	180-220	97	100
RAUB-C203	230/60/3	207-253	84	87
RAUB-C204	460/60/3	414-506	42	43
RAUB-C202	575/60/3	517-633	34	35
RAUB-C256	200/60/3	180-220	118	121
RAUB-C253	230/60/3	207-253	103	106
RAUB-C254	460/60/3	414-506	51	53
RAUB-C202	575/60/3	517-633	41	42
RAUB-C306	200/60/3	180-220	143	149
RAUB-C303	230/60/3	207-253	124	130
RAUB-C304	460/60/3	414-506	62	65
RAUB-C302	575/60/3	517-633	50	52
RAUB-C406	200/60/3	180-220	97	100
RAUB-C403	230/60/3	207-253	84	87
RAUB-C404	460/60/3	414-506	42	43
RAUB-C402	575/60/3	517-633	34	35
RAUB-C506	200/60/3	180-220	119	122
RAUB-C503	230/60/3	207-253	103	106
RAUB-C504	460/60/3	414-506	52	53
RAUB-C502	575/60/3	517-633	41	43
RAUB-C606	200/60/3	180-220	143	150
RAUB-C603	230/60/3	207-253	125	130
RAUB-C604	460/60/3	414-506	62	65
RAUB-C602	575/60/3	517-633	50	52

TABLE 7 - RAUB 20-60 Operating Modes

CONDENSING UNIT	SYSTEM LOADING (SEE NOTE 1)	COMPRESSOR LOADING								REC. EVAP. COIL LOADING	CONDENSER FAN OPERATION					
		COMPRESSOR NO. 1				COMPRESSOR NO. 2					#1	#2	#3	#4	#5	#6
		33%	50%	66%	100%	33%	50%	66%	100%							
RAUB-C20	50%		X							1/2	P	X				
	100%				X					FULL	P	X				
RAUB-C25	33%	X								1/2	P	X				
	66%			X						FULL	P	X	X			
	100%				X					FULL	P	X	X			
RAUB-C30	33%	X								1/2	P	X				
	66%			X						FULL	P	X	X			
	100%				X					FULL	P	X	X			
RAUB-C40	25%		X							1/2	P	X				
	50%				X					1/2	P	X				
	75%		X						X	FULL	P	X		P	X	
	100%				X				X	FULL	P	X		P	X	
RAUB-C50	33%			X						1/2	P	X	X			
	50%				X					1/2	P	X	X			
	83%			X					X	FULL	P	X	X	P	X	X
	100%				X				X	FULL	P	X	X	P	X	X
RAUB-C60	33%			X						1/2	P	X	X			
	50%				X					1/2	P	X	X			
	83%			X					X	FULL	P	X	X	P	X	X
	100%				X				X	FULL	P	X	X	P	X	X

NOTES:

- Assumes use of 2-step controller on 20 ton unit, 3-step controller on 25 and 30 ton units, and 4-step controller on 40, 50 and 60 ton units. This table does not apply to Multi-Step control (Option "B"). Unloading modes determined by the type of capacity controls.

2. Legend:

- X — In operation with compressor.
- P — In operation in response to fan pressure switch.

viation of the three voltages from the average, without regard to sign, divided by the average voltage. For example, if the three measured voltages are 221, 230 and 227, the average voltage would be:

$$\frac{221 + 230 + 227}{3} = 226 \text{ volts}$$

and the percent voltage imbalance would be:

$$\frac{100 \times (226 - 221)}{226} = 2.2\%$$

In this example, 2.2 percent imbalance is not acceptable and could result in as much as 20 percent current imbalance. This will increase the motor winding temperature, and thus decrease the life of the motor.

If more than 2.0 percent imbalance exists, check the voltage readings at the disconnect switch to determine if the imbalance is present in the incoming power lines. If so, the power company should be notified to correct it. If the imbalance is due to problems within the unit, check the unit electrical wiring connections.

OPERATING PRESSURES

Install pressure gauges on the discharge and suction line access valves next to the compressor. When the unit reaches stabilized operation, suction and discharge pressures can be read. Refer to "Operating Pressures" in the MAINTENANCE PROCEDURES section of this manual to compare the measured pressures with the normal system operating pressures.

EXPANSION VALVE SUPERHEAT

After checking operating pressures, check the expansion valve superheat as detailed in the MAINTENANCE section of this manual. The valve should be controlling smoothly without continuing superheat "hunting".

UNLOADING SEQUENCE

After checking to see that the pressures, oil level, superheat setting and refrigerant charge are correct, raise and lower the thermostat setting to confirm that the system loading and unloading sequence is correct. See Table 7.

START-UP LOG

DATE _____

I. NAMEPLATE INFORMATION

Model No. _____ Serial No. _____
Voltage _____ RLA _____

II. COMPRESSOR(S)

A. VOLTAGE AT COMPRESSOR TERMINALS

Comp. No. 1: T1 _____ T2 _____ T3 _____

Comp. No. 2: T1 _____ T2 _____ T3 _____

Voltage Imbalance: Comp. No. 1 _____ Comp. No. 2 _____

B. AMP DRAW

Comp. No. 1: L1 _____ L2 _____ L3 _____

Comp. No. 2: L1 _____ L2 _____ L3 _____

III. OPERATING CONDITIONS

A. COMPRESSOR NO. 1

Discharge Pressure _____ Suction Pressure _____

Liquid Line Pressure _____ Suction Line Temp. _____

Liquid Line Temp. _____ Superheat _____

Subcooling _____ Evap. Entering Air Temp. (DB/WB) _____

Ambient Temp. _____ Evap. Discharge Air Temp. (DB/WB) _____

B. COMPRESSOR NO. 2

Discharge Pressure _____ Suction Pressure _____

Liquid Line Pressure _____ Suction Line Temp. _____

Liquid Line Temp. _____ Superheat _____

Subcooling _____ Evap. Entering Air Temp. (DB/WB) _____

Ambient Temp. _____ Evap. Discharge Air Temp. (DB/WB) _____

IV. CONTROLS

Fans Operating (Yes or No): Fan No. 1 _____ No. 2 _____ No. 3 _____

Crankcase Heater Operating (Yes or No): Comp. No. 1 _____ Comp. No. 2 _____

V. REFRIGERANT PIPING

Evacuation Level _____ System Charge _____

OPERATION

SYSTEM CONTROL

Four different types of system control are available with the Model RAUB Split System Condensing Unit. They include two-stage electro-mechanical (shipped less thermostat and toggle switch), electronic with room thermostat, electronic with supply air sensor (RAUB/NAV systems) and four-stage electronic Honeywell (RAUB/EVPA systems).

Units With Two-Step Control

The recommended controls (to be supplied by others) for units with two-step controls are a Penn T25A two-stage electro-mechanical thermostat and a Cutler-Hammer 7562K53 2PDT toggle switch or equivalent. With the control circuit switch closed, the evaporator fan can be operated independently by placing the "Fan-Off-Cool" switch in the "Fan" position. Moving the switch to the "Cool" position will allow the system to operate in the cooling cycle according to thermostat demand.

NOTE: A detailed sequence of operation is contained in RAUB-W-35.

Units Shipped With Electronic Thermostat Controls

Refer to Figure 36.

RAUB units shipped with electronic thermostat controls are controlled by a Honeywell T7067A electronic thermostat coupled with a W973 logic panel (MEC). With the control circuit switch (1S1) in the closed position, the evaporator fan may be operated independently by moving the fan switch located on the thermostat subbase to the "On" position. With the fan in either the "On" or "Auto" position and the thermostat switch in either the "Auto" or "Cool" position, the unit will operate according to thermostat demand.

NOTE: A detailed sequence of operation is contained in RAUB-W-36.

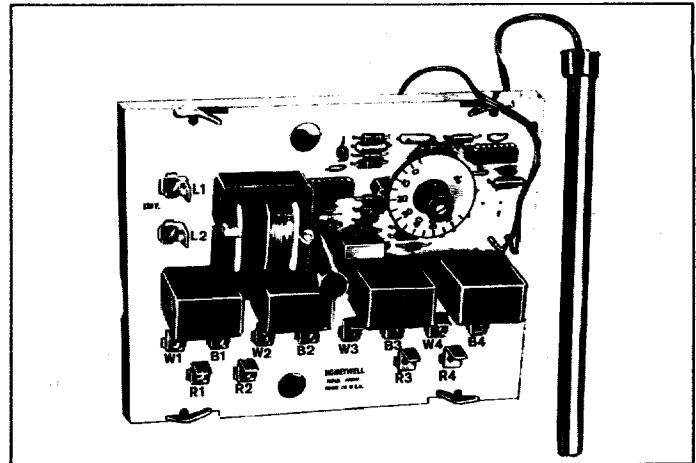


FIGURE 37 - Honeywell CR71A 4-Step Controller

RAUB/EVPA Systems

Refer to Figure 37.

RAUB units equipped with EVPA control panels are controlled by an electronic Honeywell CR71A four-stage controller. To operate the system, start the chilled water pump and close the control circuit switch. The controller will operate the unit according to the return chilled water temperature.

NOTE: A detailed sequence of operation is contained in RAUB-W-37.

Multi-Step Control

RAUB units shipped with multi-step controls are designed for use with field-provided controls where maximum unloading is desired.

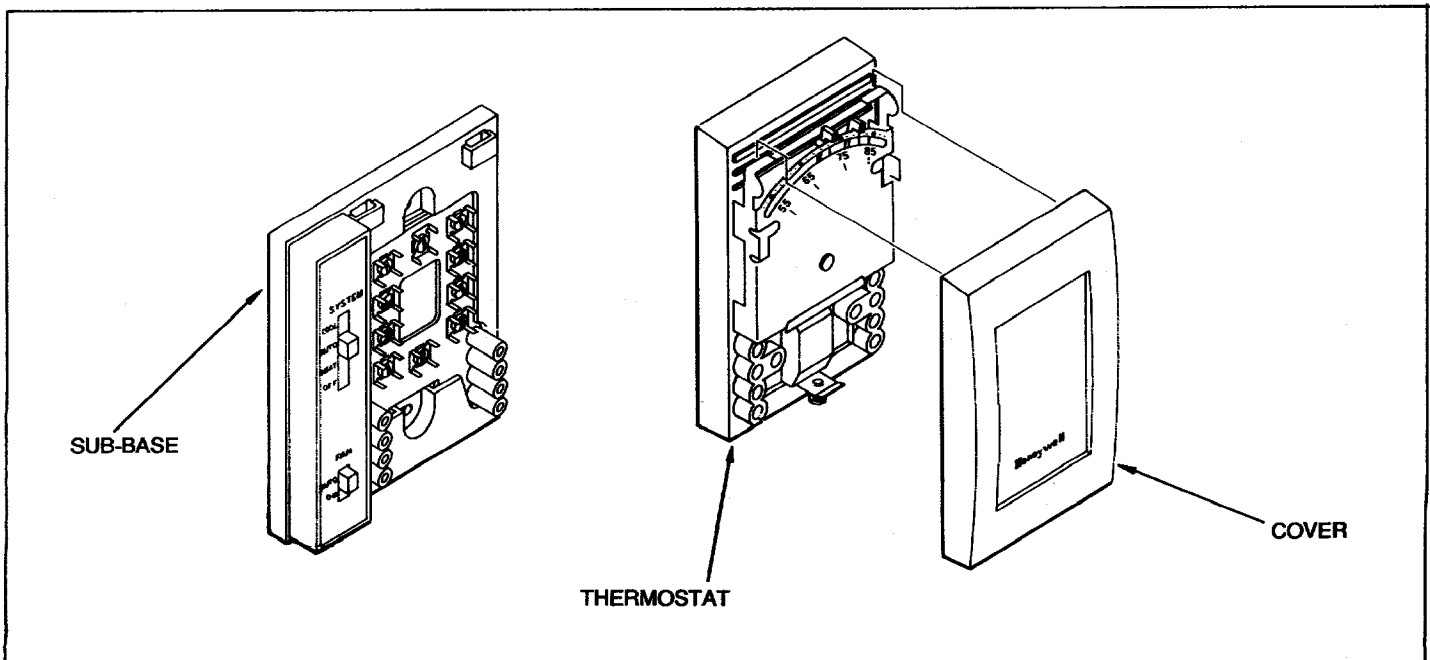


FIGURE 36 - Honeywell Electronic Thermostat With Switching Sub-base

NOTE: A detailed sequence of operation is contained in RAUB-W-39.

Electronic Supply Air VAV

RAUB units shipped with electronic supply air VAV controls are controlled by an electronic VAV transmitter in conjunction with an electronic logic panel. With the field-provided system control switch in the closed position and the unit control circuit switch (1S1) in the closed position, the evaporator fan will operate continuously and cooling will be in response to supply air temperature.

FAN SEQUENCING

Refer to Figure 38 and Table 8.

- On 20-ton units, fan number 2 will operate with the compressor and fan number 1 will cycle in response to liquid pressure.
- On 25 and 30-ton units, fan number 2 will operate with the compressor, fan number 1 will cycle in response to liquid pressure and fan number 3 will operate with compressor unloading.

- On 40-ton units, fans 2 and 5 will operate with the compressors and fans 1 and 4 will cycle in response to liquid pressure.
- On 50 and 60-ton units, fans 2, 5, 3 and 6 will operate with the compressors and fans 1 and 4 will cycle in response to liquid pressure.

THERMOSTATS

In operation, the zone thermostat measures continuously the temperature of the air being supplied to the zone. If controlled by the electro-mechanical thermostat, temperature sensitive elements merely make and break switches, enabling various stages of cooling to come on.

If controlled by the electronic thermostat, a 20-volt DC regulated power supply is provided to the thermostat. A continuous signal of 1 to 16 volts DC is returned to the Honeywell master energy controller by the thermostat. This signal is monitored by the controller to determine actual zone cooling requirements. The controller will then, according to the voltage value received, operate the necessary mechanical components through relay stages which are sensitive to the zone signal.

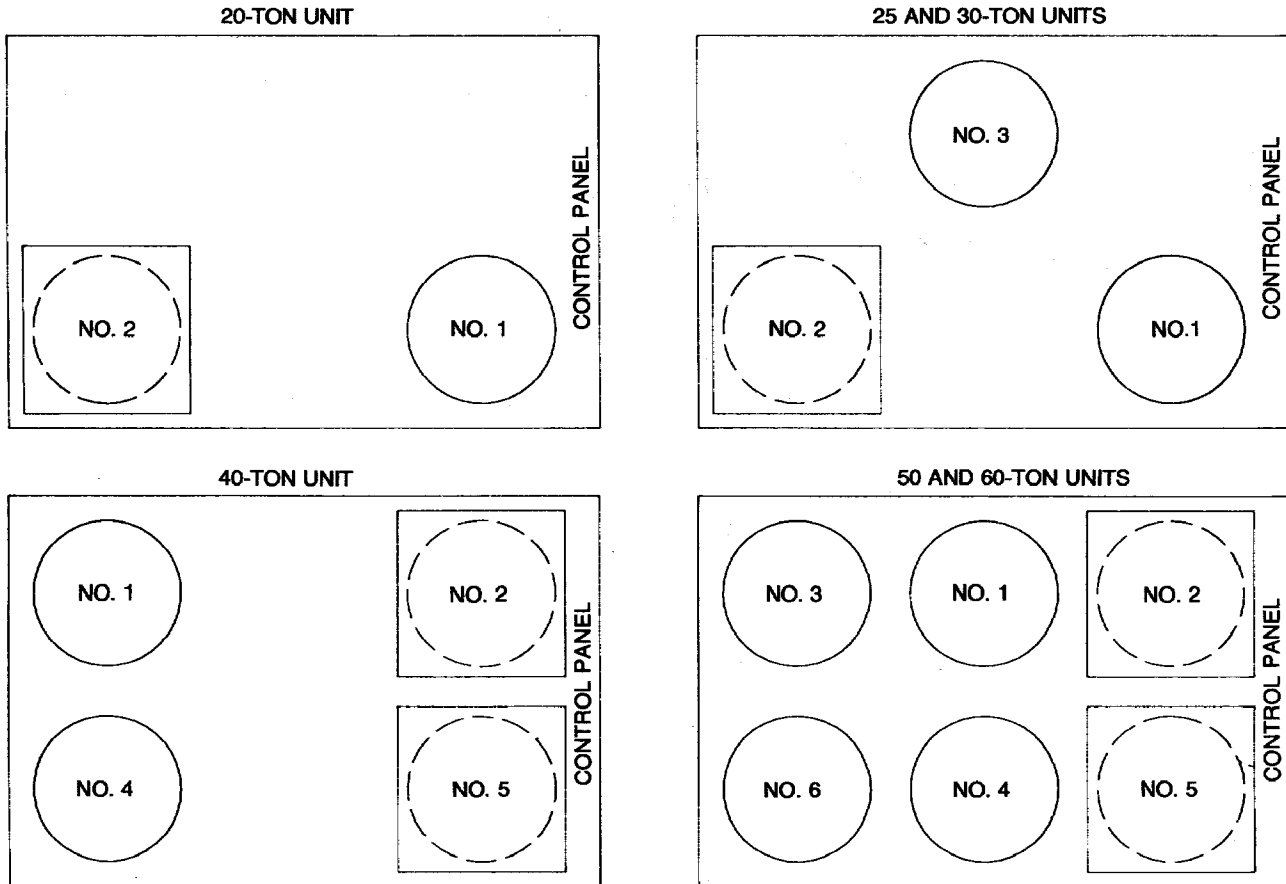


FIGURE 38 - Condenser Fan Sequence

TABLE 8 - Fan Sequencing

MODEL	FAN OPERATES WITH COMPRESSOR(S)	FAN CONTROLLED BY FAN PRESSURE SWITCH	FAN OPERATES WITH COMPRESSOR UNLOADING
	FAN NUMBER	FAN NUMBER	FAN NUMBER
RAUB 20	2	1	—
RAUB 25	2	1	3 ¹
RAUB 30	2	1	3 ¹
RAUB 40	2 and 5	1 and 4	—
RAUB 50	2, 5, 3, 6	1 and 4	—
RAUB 60	2, 5, 3, 6	1 and 4	—

NOTE:

1. Fan #3 operates with cooling stages 2 and 3.
2. Fans 3 and 6 operate with compressor unloading on multi-step controls.

Electrical Sequence of Operation, 2-Step Controls

See Figure 39.

Although the controls used with these units are optional, a Penn T25A thermostat and Cutler-Hammer 7562K53 2PDT toggle switch are the recommended equipment. The following discussion assumes the use of the recommended controls.

The system's operation is controlled by a system control switch and a two-stage thermostat. Closing the unit disconnect switch supplies power to the system control switch (1S1), control power transformer and compressor crankcase heater (2B7HR1).

The evaporator fan can be operated independently by placing the Fan-Off-Cool switch in the "Fan" position. This energizes the evaporator fan contactors, starting the fan. Moving the Fan-Off-Cool switch to the "Cool" position, energizes the evaporator fan contactors and closes the evaporator fan interlock contacts, supplying power to the thermostat and the normally open contacts (1K13) of the low ambient relay.

20 To 30-Ton Units

Sensing a need for cooling, the first-stage contacts of the two-stage thermostat will close, supplying power to the compressor fixed "on" timer (1U3). The fixed "on" timer times to close upon de-energization or when the compressor stops. If the compressor has been off for five minutes and the timer has timed out, power will be supplied through the 1U3's closed contacts to the first-stage cooling relay (1K1), the low ambient timer (1U5) and the compressor unloader solenoid (2B7L3). Compressor unloader solenoid 2B7L4 is also energized on 25 and 30-ton units.

Energizing 1K1 closes its two normally open sets of contacts. One set energizes the first-stage liquid line solenoid valve (2L1) and the second set supplies power to the compressor control circuit.

Supplying power to the low ambient timer (1U5) will energize the low ambient relays (1K13 and 1K14) through its normally closed time-to-open contacts for approximately three minutes. Energizing 1K13 will close its two normally open sets of contacts. The first set bypasses the thermostat and the second set bypasses the low pressure cut-out switch (2B7S4), supplying power to the condenser fan contactor (1K8), condenser fan pressure control (1S10) and compressor contactor (1K3). Energizing 1K3 will close its auxiliary compressor contacts.

NOTE: Units equipped with part-winding starter, supply power to the part-winding time delay (1DL1) and compressor contactor 1K5's auxiliary contacts in addition to 1K8, 1S10 and 1K3. After 0.5 second timing, 1DL1 will close, energizing 1K5. This will close the auxiliary contacts of 1K5 and also supply power to the second set of compressor motor windings.

Energizing 1K14 will open its two normally closed set of contacts, de-energizing two optional hot gas bypass valves for a three-minute period. This allows sufficient head pressure to build up before hot gas is allowed to pass. **After approximately three minutes, the 1U5 contacts will open de-energizing the 1K13 and 1K14 low ambient relays.** At this point, the control circuit will once again operate according to thermostat demand and the compressor and the condenser fans will operate through the low pressure control. **NOTE: On units equipped with hot gas bypass, the hot gas solenoid valve will energize, allowing the hot gas valve to operate according to suction pressure.**

As the cooling load increases, the second-stage contacts of the thermostat will close, energizing the second-stage cooling relay (1K2). The normally closed set of 1K2 contacts will open, de-energizing the compressor unloader solenoid (2B7L3), which will fully load the compressor. **NOTE: On 25 and 30-ton units, compressor unloader solenoid 2B7L4 is de-energized in addition to the 2B7L3 solenoid to provide 100 percent compressor operation. The normally open set of 1K2 contacts will close, energizing the second circuit's liquid line solenoid valve. NOTE: On units with hot gas bypass, the second circuit hot gas bypass solenoid valve will also be energized by way of the closed set of 1K14 contacts. The unit is now operating at 100 percent capacity.**

As the cooling load subsides, the second-stage thermostat contacts will open, de-energizing 1K2 and returning the unit to first-stage operation. As the cooling load is further reduced and finally satisfied, the first-stage thermostat contacts will open, de-energizing the first control relay (1K1). De-energizing 1K1 will open its two sets of contacts. The first set will de-energize (close) the liquid line solenoid valve, shutting off refrigerant flow to the evaporator. Opening the second set will leave only the compressor auxiliary contacts (1K3 Aux.) to supply power to the compressor control circuit.

The compressor will continue to operate, removing the remaining refrigerant from the evaporator and lowering the suction pressure. When the suction pressure is reduced to approximately 7 psig, the low pressure control will open, de-energizing the compressor and condenser fan contactor relays. De-energizing 1K3 will open its auxiliary contacts, locking out the control circuit.

The unit will restart after a call for cooling is established and the compressor fixed "off" timer times out.

40 To 60-Ton Units

Sensing a need for cooling, the first-stage contacts of the thermostat will close, supplying power to the first circuit's fixed "off" timer (1U3). 1U3's contacts time to close upon de-energization and will be closed provided the unit has not operated for five minutes. Current passing through 1U3's closed contacts will supply power to the cooling relay (1K1), low ambient timer (1U5) and time delay between compressors timer (1DL3).

Energizing 1K1 will close its two sets of contacts. One set will energize the liquid line solenoid valve (2L1) and the second set will supply power to the first compressor's control circuit (the reset relay circuit).

Supplying power to the low ambient timer (1U5) will energize relay 1K13 for a three-minute period and close its two sets of contacts. One set will bypass the thermostat's first-stage contacts which will insure a three-minute compressor operation despite the thermostat's demand. The second set will bypass the low pressure cut-out, providing power to the compressor contactor (1K3), condenser fan contactor (1K8) and condenser fan pressure control (1S10). **NOTE: On part-winding starter units, power is also supplied to part-winding start time delay 1DL1 which will close 0.5 seconds after energization, supplying power to compressor contactor 1K5. NOTE: On units equipped with hot gas bypass, an additional set of normally closed 1K13 contacts will open, de-energizing the first circuit's hot gas bypass solenoid for a three-minute period.**

NOTES:

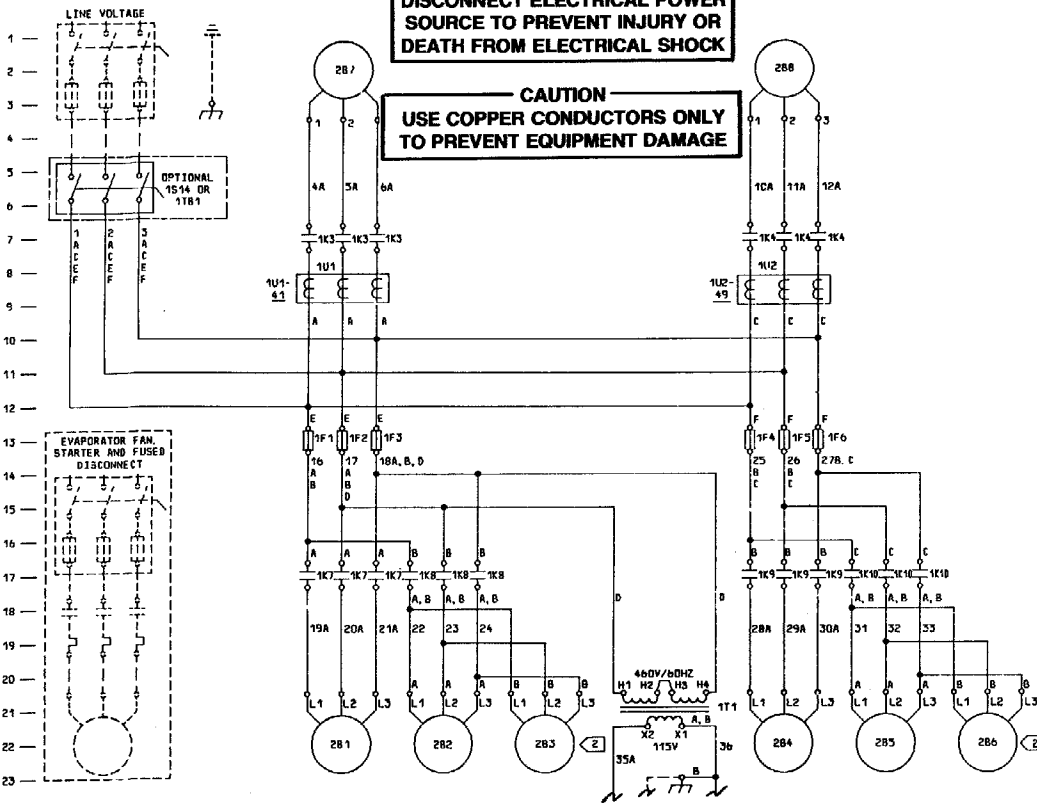
1. UNLESS OTHERWISE NOTED ALL SWITCHES ARE SHOWN AT 25°C(77°F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. DASHED LINE ENCLOSURES AND/OR DASHED DEVICE OUTLINES INDICATE COMPONENTS PROVIDED BY THE FIELD. PHANTOM LINE ENCLOSURES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBER. AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT. AN OPEN ARROWHEAD BELOW THE LINE NUMBER POINTING UPWARD INDICATES A TIMED CONTACT WHICH BEGINS TIMING WHEN ENERGIZED.

2 283, 286, AND ASSOCIATED WIRING ARE USED ONLY ON 50 AND 60 TON UNITS.

3 SUGGESTED PARTS ARE A PENN 725A THERMOSTAT AND A CUTLER-HAMMER 756253 2PDT TOGGLE SWITCH OR EQUIVALENT

WARNING
DISCONNECT ELECTRICAL POWER
SOURCE TO PREVENT INJURY OR
DEATH FROM ELECTRICAL SHOCK

CAUTION
USE COPPER CONDUCTORS ONLY
TO PREVENT EQUIPMENT DAMAGE



LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1DL3	DELAY BETWEEN COMPRESSORS	3D
1F1-1F6	CONDENSER FAN FUSE	19
1F7	CONTROL CIRCUIT FUSE	24
1F44, 1F45	COMP PROTECTOR FUSE	41, 49
1K1, 1K2	COOLING RELAY	27, 32
1K3	COMPRESSOR CONTACTOR	43
1K4	COMPRESSOR CONTACTOR	52
1K7, 1K8	CONDENSER FAN CONTACTOR	40, 44
1K9, 1K10	CONDENSER FAN CONTACTOR	49, 53
1K11, 1K12	RESET RELAY	4D, 48
1K13, 1K14	LOW AMBIENT RELAY	28, 33
151	CONTROL CIRCUIT SWITCH	2B
151D, 1511	FAN PRESSURE CONTROL	4D, 49
1514	HANDUAL DISCONNECT SWITCH	5
1T1	CONTROL POWER TRANSFORMER	21
1T81	POWER TERMINAL BLOCK	5
1T84, 5, 6, 7	CONTROL TERMINAL BLOCK	
1U1, 1U2	COMPR CURRENT OVERLOAD	8
1U3, 1U4	COMPR FIXED OFF TIMER	28, 33
1U5, 1U6	LOW AMBIENT TIMER	28, 34
281-286	CONDENSER FAN MOTOR	22
287, 288	COMPRESSOR	2
287R1	CRANKCASE HEATER	25
288R2	CRANKCASE HEATER	26
287S2, 288S3	HIGH PRESSURE CUTOUT	41, 49
287S4, 288S5	LOW PRESSURE CUTOUT	41, 49
287S6	COMPR WINDING THERMOSTAT	41
288S7	COMPR WINDING THERMOSTAT	49
2L1, 2L2	LIQUID LINE SOLENOID	39, 48
2L3, 2L6	HOT GAS BYPASS SOLENOID	37, 46

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	INSIDE UNIT CONTROL PANEL
2	OUTSIDE UNIT CONTROL PANEL

(CONTINUED ON
NEXT PAGE)

46

(CONTINUED FROM
PREVIOUS PAGE)

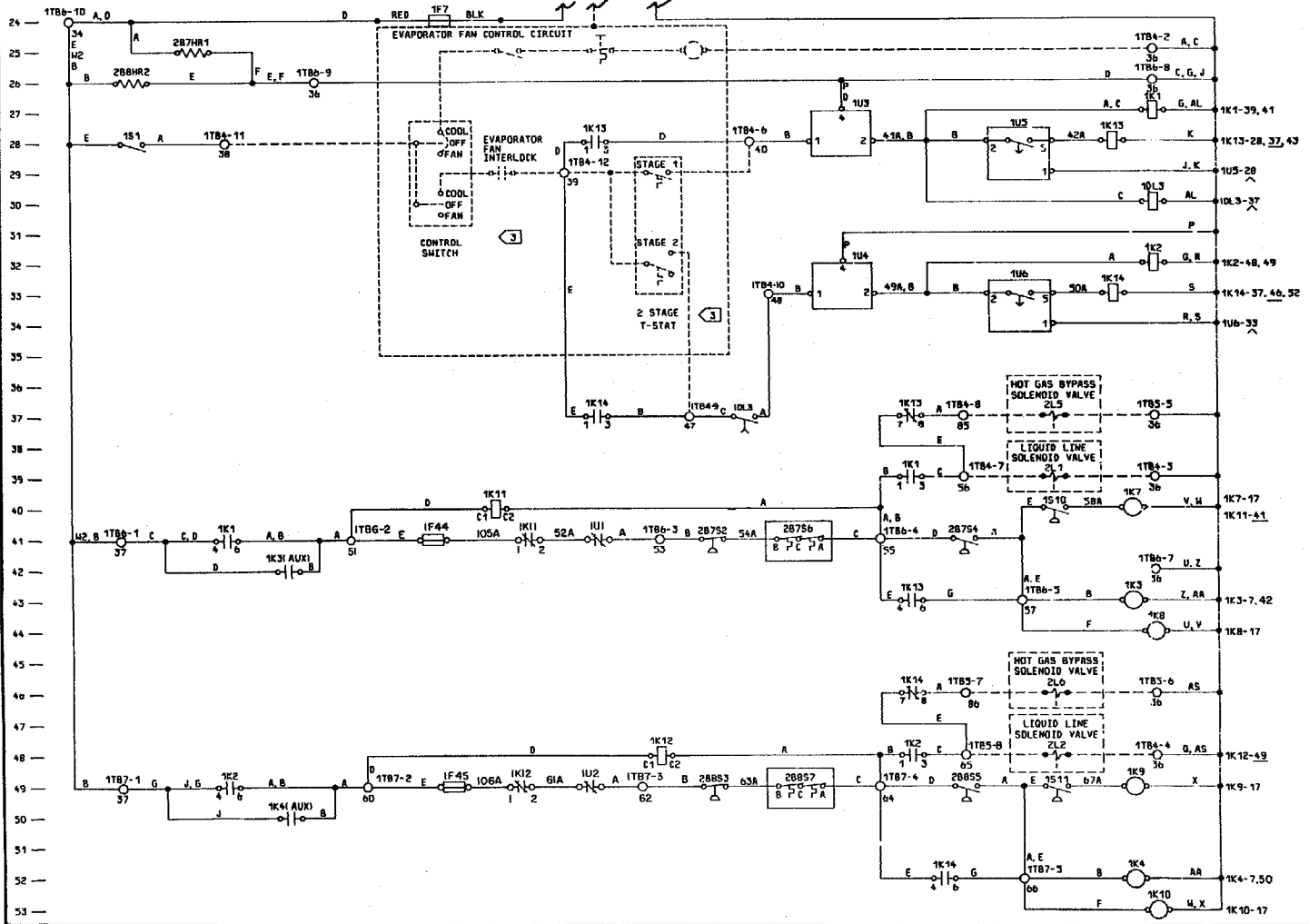


FIGURE 39 - System Wiring Diagram, 40, 50 and 60-Ton Units, Cross-the-Line Start, 460/60/3, 2-Step Control

2304-0840A

After approximately three minutes, the low ambient timer contacts will reopen, de-energizing the low ambient relay (1K13). At this point, the first control circuit will once again operate according to thermostat demand and the compressor and condenser fans will operate through the low pressure cut-out. The first compressor is now operating at 100 percent capacity.

As the need for cooling increases, the thermostat's second stage contacts will close, supplying power to the second circuit's compressor fixed "off" timer (1U4) through the time delay between compressor contacts (1DL3). 1DL3 will close 0.5 second after the first control relay energizes. 1U4's contacts time to close upon de-energization and will be closed provided 1U4 has been de-energized for five minutes. Current passing through 1U4's closed contacts supplies power to the second cooling relay (1K2) and the second circuit low ambient timer (1U6).

Energizing 1K2 will close its two sets of contacts. One set will energize the liquid line solenoid valve (2L2) and the second set will supply power to the second compressor control circuit (the reset relay circuit).

Supplying power to the low ambient timer (1U6) will energize the low ambient relay (1K14) for a three-minute period and close its two sets of normally open contacts. One set of 1K14's contacts bypasses the thermostat's second-stage contacts, allowing three-minute compressor operation regardless of the thermostat's demand. The second set bypasses the second circuit's low pressure cut-out (2B8S5), providing power to compressor contactor (1K4), condenser fan contactor (1K10) and condenser fan pressure control switch (1S11). **NOTE: On part-winding starter units, power is also supplied to the part-winding start time delay (1DL2) which will close 0.5 seconds after energization, supplying power to compressor contactor 1K5. NOTE: On units equipped with hot gas bypass, an additional set of normally closed 1K14 contacts will open, de-energizing the hot gas solenoid for a three-minute period.**

After approximately three minutes, the second circuit's low ambient timer contacts will open, de-energizing relay 1K14. At this point, both circuits will be operating according to thermostat demand and the compressors and condenser fans will operate through their respective low pressure cut-out controls. The unit is now operating at full capacity.

As the cooling load diminishes, the thermostat's second stage contacts will open, de-energizing cooling relay 1K2. De-energizing 1K2 will open its two sets of normally open contacts. The first set will de-energize the liquid line solenoid valve (2L2), shutting off refrigerant flow to the evaporator. The second set which supplies the compressor control circuit will open, leaving only the second compressor's auxiliary contacts to supply control power. The suction pressure will reduce until the second circuit's low pressure cut-out opens, de-energizing the compressor and condenser fan relays. The compressor auxiliary contacts will open, locking out the second control circuit. It should be noted that the second circuit cannot re-energize until the second stage thermostat contacts have reclosed and timer 1U4 has remained de-energized for five minutes.

When the cooling load has been satisfied, the thermostat's first-stage contacts will open, de-energizing cooling relay 1K1. Just as on the second circuit, the liquid line solenoid valve will shut and control power will be provided through only the first compressor's auxiliary contacts. At approximately 7 psi, the low pressure cut-out will open, de-energizing the compressor and condenser fan relays and also the first compressor's auxiliary set of contacts. The unit will not restart until a call for cooling has been re-established and timer 1U3 has timed out.

SAFETY AND OPERATING CONTROLS

The operation of the High Pressure Cut-out, Low Pressure Control, Compressor Fixed Off Timer and the Low Ambient Timer has been checked at the factory and does not require extensive re-checking at the jobsite. The control settings are listed in Table 9.

High Pressure Cut-out (2B7S2)

The high pressure cut-out, sensing the compressor discharge pressure, prevents the compressor motor from being overloaded. It opens the control circuit, stopping the compressor should condensing pressure exceed safe operating limits (405 ± 10 psig).

Low Pressure Control (2B7S4)

Sensing pressure on the suction side of the compressor, the low pressure control terminates the pumpdown cycle when the pressure is reduced to the cut-out setting of the control (7 ± 3 psig). When the system is to be restarted, the build-up of suction pres-

TABLE 9 - Control Settings

CONTROL	FAN NO.	SETTINGS	
		CUT-IN	CUT-OUT
High Pressure (2B7S2 & 2B8S3*)	—	300 ± 20 PSIG	405 ± 10 PSIG
Low Pressure (2B7S4 & 2B8S5*)	—	22 ± 3 PSIG	7 ± 3 PSIG
Discharge Temperature Limit	—	Manual**	280 ± 7.5 F
Fan Pressure			
20-Ton (1S10)	1	300 ± 10 PSIG	155 ± 10 PSIG
25-Ton (1S10)	1	300 ± 10 PSIG	155 ± 10 PSIG
30-Ton (1S10)	1	300 ± 10 PSIG	155 ± 10 PSIG
40-Ton (1S10 & 1S11)*	1 & 4	300 ± 10 PSIG	155 ± 10 PSIG
50-Ton (1S10 & 1S11)*	1 & 4	300 ± 10 PSIG	155 ± 10 PSIG
60-Ton (1S10 & 1S11)	1 & 4	300 ± 10 PSIG	155 ± 10 PSIG
Compressor Fixed Off Timer (1U3 & 1U4*)			5-Minutes
Low Ambient Timer (1U5 & 1U6*)			3-Minutes

* Used on 40 thru 60-ton units only.

** Cannot be reset until discharge gas temperature drops below 180 F.

TABLE 10 - Damper Operation

FULLY CLOSED	FULLY OPEN
170 PSI	250 PSI

sure, resulting from the opening of the first liquid solenoid valve, will close the control contacts at 22 ± 3 psig.

Condenser Fan Pressure Control (1S10 and 1S11)

The last condenser fan energized by each compressor circuit operates in response to liquid line pressure. See Figure 40 for fan numbering sequence. At 300 ± 10 psig the condenser fan contactor is energized. When condenser pressure falls to 155 ± 10 psig the contactor is de-energized.

Compressor Fixed Off Timer(s) (1U3 and 1U4)

Units equipped with compressor fixed off timers provide a 5-minute compressor fixed off period which will prevent rapid compressor cycling. The timers begin timing upon de-energization.

Low Ambient Timers (1U5 and 1U6)

Low ambient timers are standard equipment on units shipped without controls (ninth model number digit is A, B or F) and are optional equipment on all other units.

The timers are called fixed on timers on units shipped without controls and serve a dual function. Low ambient timers act as anti-recycle timers by incurring a three minute compressor fixed on period and also provide low ambient compressor start-up by bypassing the low pressure switch for three minutes.

On all other units, the timers are provided only for low ambient start-up.

Low Ambient Dampers

Refer to Figure 40.

Low ambient dampers on 20 through 60-ton units are factory installed optional items. They control the flow of air across the coils. During start-up, the blades must be inspected for proper alignment, obstructions and free operation.

To check damper operation, the damper must be fully open when the discharge pressure reaches 250 psig. On dual compressor units, check damper operation for each circuit separately in the same manner as single compressor units. Damper operation will occur between the liquid line pressures given in Table 10.

Discharge Temperature Limit

The discharge temperature limit control senses compressor discharge gas temperature and shuts the system off by opening the control circuit when discharge temperature exceeds 280 ± 7.5 F. This manual reset control protects the compressor from excessive oil and/or refrigerant temperatures, which commonly occur due to loss of refrigerant charge. Reset cannot be accomplished until the discharge line temperature drops below 180 F.

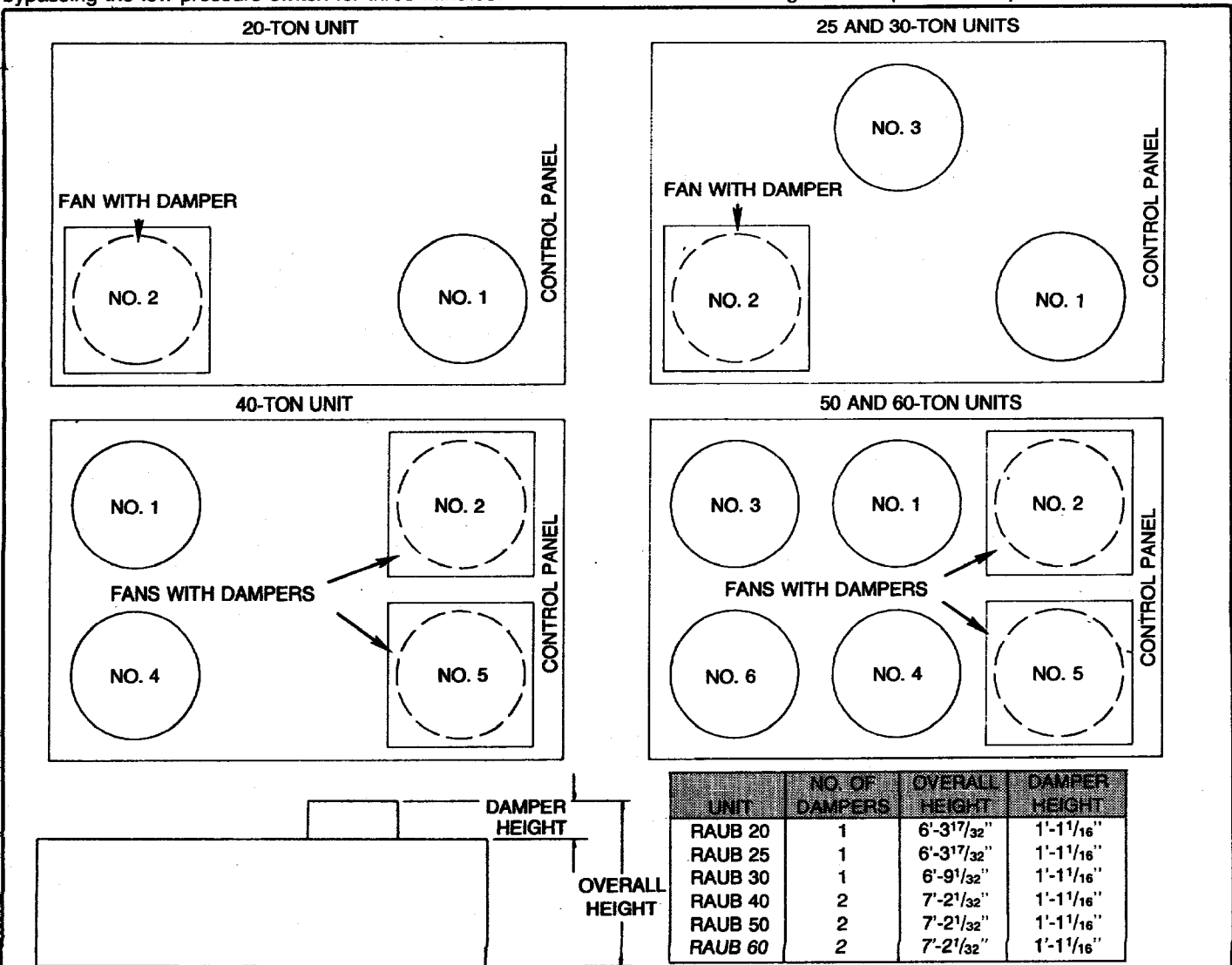


FIGURE 40 - Low Ambient Dampers

MAINTENANCE

PERIODIC MAINTENANCE

Perform all of the indicated maintenance procedures at the intervals scheduled. This will prolong the life of the unit and reduce the possibility of costly equipment failure. A MAINTENANCE LOG is provided on page 51 of this manual for recording operating data on a regular basis.

ONCE A MONTH

Conduct the maintenance inspections outlined below on a monthly basis during the cooling season.

- 1. Inspect the evaporator coil air filters. Clean or replace if necessary.
- 2. Inspect the evaporator and condenser coils for dirt and foreign debris. If the coils appear dirty, clean them according to the instructions provided under "Coil Cleaning" in the MAINTENANCE PROCEDURES section of this manual.
- 3. Check compressor oil level.

ONCE A YEAR

The following maintenance practices must be performed at the beginning of each cooling season to ensure efficient unit operation.

WARNING: OPEN THE UNIT DISCONNECT SWITCH AND LOCK IT IN THAT POSITION TO PREVENT ACCIDENTAL START-UP. NEVER OPEN AN ACCESS PANEL TO INSPECT OR SERVICE THE UNIT WITHOUT FIRST OPENING THE DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK OR CONTACT WITH MOVING PARTS.

- 1. Inspect the evaporator coil air filters. Clean or replace if necessary.
- 2. Clean both the evaporator and condenser coils. Follow the procedures outlined under "Coil Cleaning" in the MAINTENANCE PROCEDURES section of this manual.
- 3. With the unit disconnect switch open, check to see that each condenser and evaporator fan is securely fastened to its motor shaft. All fans should turn freely and airflow should be unobstructed.
- 4. Replace worn or frayed evaporator fan belts. Check the belt tension of the evaporator fans. A 1/2-inch deflection under light hand pressure is normal. Tighten if necessary.
- 5. Remove the condensing unit control box cover and inspect the panel wiring. All electrical connections should be secure. Inspect the compressor and condenser fan motor contactors. If the contacts appear severely burned or pitted, replace the contactor (refer to Figure 41). Do not clean the contacts. Inspect the condenser fan capacitors for visible damage.
- 6. Remove any accumulation of dust and dirt from the condensing unit.

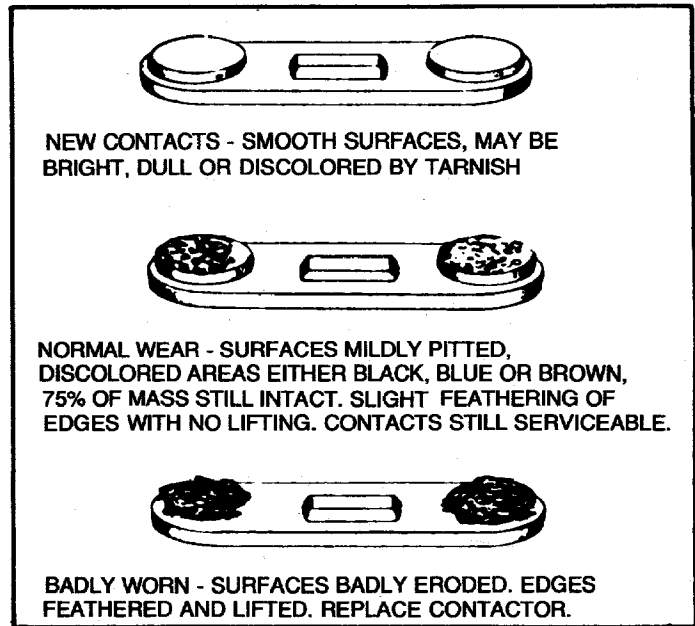


FIGURE 41 - Compressor Contactor Replacement Guide

- 7. Clean and inspect the drain pan of the evaporator unit. Make sure the drain piping is clear.
- 8. Observe the compressor oil level sight glass while the unit is running. If oil is visible, the level is normal. If an oil level does not appear in the sight glass, refer to page 40 of this manual.
- 9. Check the superheat and subcooling.
 - a. The condenser and evaporator coils must be clean before making the following checks.
 - b. Determine the superheat of the system. Refer to "Measuring Superheat" in the MAINTENANCE PROCEDURES section of this manual.
 - c. Adjust the superheat if necessary (instructions are provided in the "Measuring Superheat" section of this manual).
 - d. When the superheat setting is correct, check the subcooling. Refer to "Measuring Subcooling" in the MAINTENANCE PROCEDURES section of this manual.
 - e. If the subcooling is low, leak test the system to determine if there is a leak. Refer to "Leak Testing" in the MAINTENANCE PROCEDURES section of this manual.
 - f. Charge the system with refrigerant if necessary. Instructions are provided under "Checking Refrigerant Charge" in the MAINTENANCE PROCEDURES section of this manual.
 - g. Enter the operating pressures, superheat, and subcooling in the MAINTENANCE LOG provided on the following page.

SHUTDOWN AND START-UP

Shutdown: Short Duration

The system can be shutdown for short periods of time, such as over the weekend by placing the control circuit switch or the system control switch in the OFF position.

NOTE: The unit disconnect switch must remain closed. This will permit the crankcase heater to continue to function, preventing refrigerant from condensing in the compressor oil sump.

Start-up: Short Duration

The system is returned to operation after a shutdown of short duration, such as over a weekend, by adjusting the thermostat setting to the desired temperature, placing the control circuit switch in the ON position, and setting the system control switch in the COOL position.

Shutdown: Seasonal

For seasonal shutdown, open the unit electrical disconnect switch to prevent the unit from starting accidentally.

Start-up: Seasonal

To start the unit after an extended shutdown period, complete the following procedures.

1. Perform all of the "Once a Year" checks listed in the PERIODIC MAINTENANCE section of this manual.
2. Move the control circuit and/or system control switch to OFF.
3. Close the condensing unit electrical disconnect switch. This will energize the compressor crankcase heater. If operating properly, the crankcase should be hot to the touch. Wait a minimum of eight hours before turning the system control switch to the COOL position.

CAUTION: Failure to wait eight hours before turning the system control switch to COOL may result in damage to the compressor bearings.

4. Start the system by adjusting the thermostat setting to the desired temperature, placing the system control switch in the COOL position, and placing control circuit switch in the ON position.
5. Place a clamp-on ammeter on each compressor lead and check the motor amperage. The amperage draw should not be greater than that given in Table 6, "Maximum Allowable Amp Draw".
6. Place the clamp-on ammeter around one of the three leads from the outdoor fan motor. The amp draw should be no greater than the nameplate rating for the condenser fan motors.

MAINTENANCE PROCEDURES

This section of the manual describes specific maintenance procedures which must be performed as a part of the unit's maintenance program. Before performing any of these operations, however, be sure that power to the unit is disconnected unless otherwise instructed.

WARNING: WHEN MAINTENANCE CHECKS AND PROCEDURES MUST BE COMPLETED WITH THE ELECTRICAL POWER ON, CARE MUST BE TAKEN TO AVOID CONTACT WITH ENERGIZED COMPONENTS OR MOVING PARTS. FAILURE TO EXERCISE CAUTION WHEN WORKING WITH ELECTRICALLY-POWERED EQUIPMENT MAY RESULT IN SERIOUS INJURY OR DEATH.

COIL CLEANING

Refrigerant coils must be cleaned at least once a year, or more frequently if the unit is located in a dirty environment. This will help maintain unit operating efficiency and reliability. The relationship between regular coil maintenance and efficient/reliable unit operation is outlined below.

1. Clean condenser coils minimize compressor head pressure and amperage draw, and promote system efficiency.
2. Clean evaporator coils minimize water carry-over and help eliminate frosting and/or compressor flood back problems.
3. Clean coils minimize required fan brake horsepower and maximize efficiency by keeping coil static pressure loss at a minimum.
4. Clean coils keep motor temperature and system pressure within safe operating limits for good reliability.

Specific instructions for cleaning condenser coils are provided in the following paragraphs. Follow these instructions as closely as possible to avoid potential damage to the coils.

To clean condenser coils, the following equipment is required: a soft brush and either a garden pump-up sprayer or a high pressure sprayer. In addition, a high quality detergent must be used: suggested brands include SPREX A.C., OAKITE 161, OAKITE 166, and COILOX. Follow the manufacturer's recommendations for mixing to make sure the detergent is alkaline with a pH value less than 8.5.

1. Disconnect power to the unit.

WARNING: OPEN UNIT DISCONNECT SWITCH. FAILURE TO DISCONNECT UNIT FROM ELECTRICAL POWER SOURCE MAY RESULT IN SEVERE ELECTRICAL SHOCK, AND POSSIBLE INJURY OR DEATH.

2. Remove enough panels from the unit to gain access to the coil.
3. Protect all electrical devices such as motors and controllers from dust and spray.
4. Straighten coil fins with a fin rake, if necessary.
5. Use a soft brush to remove loose dirt and debris from both sides of the coil.
6. Mix the detergent with water according to the manufacturer's instructions. The detergent-and-water solution may be heated to a maximum of 150 F to improve its cleansing ability.

WARNING: DO NOT HEAT THE DETERGENT-AND-WATER SOLUTION TO TEMPERATURES IN EXCESS OF 150 F. HIGH-TEMPERATURE LIQUIDS SPRAYED ON THE COIL EXTERIOR WILL RAISE THE PRESSURE WITHIN THE COIL AND MAY CAUSE IT TO BURST, RESULTING IN POSSIBLE INJURY TO SERVICE PERSONNEL AND EQUIPMENT DAMAGE.

7. Place the detergent-and-water solution in the sprayer. If a high-pressure sprayer is used, be sure to follow these guidelines:
 - Minimum nozzle spray angle is 15 degrees.
 - Spray the solution perpendicular (at a 90 degree angle) to the coil face.
 - Keep the sprayer nozzle at least six inches from the coil.
 - Sprayer pressure must not exceed 600 psi.

CAUTION: Do not spray motors or other electrical components. Moisture can cause component failure.

8. Spray the leaving air side of the coil first, then spray the entering air side of the coil. Allow the detergent-and-water solution to stand on the coil for five minutes.
9. Rinse both sides of the coil with cool, clean water.
10. Inspect the coil. If it still appears to be dirty, repeat Steps 8 and 9.
11. Replace all unit panels and parts, and restore electrical power to the unit.
12. Remove protective covers installed in Step 3.

CONTROL TESTING

The following procedures can be used to check the operation of the high and low pressure controls. To determine operating pressures, attach gauges to the compressor suction and discharge access ports.

High Pressure Control

WARNING: BEFORE DISCONNECTING ANY WIRING, OPEN THE UNIT DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH CAUSED BY ACCIDENTAL ELECTRIC SHOCK.

1. Open the unit electrical disconnect switch.
2. Disconnect the condenser fan motor leads at the condenser fan relays. This will de-energize the condenser fans.
3. Remove the reset relay controlling compressor number two from its socket to prevent compressor number two from starting while checking the high pressure control for compressor number one.
4. Close the unit disconnect switch and start the unit.

CAUTION: Be prepared to open the unit disconnect switch immediately if the compressor continues to run after the discharge pressure exceeds the high pressure control cut-out range. Failure to do so could damage the system.

5. Observe the rising discharge pressure. When the pressure reaches 405 ± 10 psig, as shown in Table 9, the compressor should shut-off. If the pressure reaches 415 psig without the high pressure control contacts opening, immediately open the unit disconnect switch. Check to make sure that the high

pressure control attached to liquid line number one is wired to low voltage circuit number one. If this is not a problem, replace the faulty high pressure control.

6. On RAUB 40, 50 and 60-ton units, repeat steps 1 through 5 to test the high pressure control in the second compressor circuit. Replace the reset relay for compressor number two and then remove the reset relay controlling compressor number one. This will prevent compressor number one from operating while checking the operation of the high pressure control for compressor number two.
7. Open the unit disconnect switch.
8. Reconnect the wires removed in Step 2.
9. Allow the discharge pressure(s) to drop below the cut-in setting in Table 9 and then close the unit disconnect switch. This will close the reset relay that locked out the compressor contactor when the high pressure control tripped.
10. The unit should start. If not, allow the discharge pressure to decrease further and repeat Step 9.

Low Pressure Control

To check the operation of the control, simply observe the control cut-out pressure during a normal pump-down sequence. If the control fails to function at the cut-out pressure, replace the control with a new control.

EVACUATION PROCEDURES

For field evacuation, use a rotary-style vacuum pump capable of pulling a vacuum of 100 microns or less.

When hooking the vacuum pump to a refrigeration system, it is important to manifold the pump to both the high and low side of the system (liquid line access valve and compressor suction access valve). Follow the pump manufacturer's directions as to the proper methods of using the vacuum pump.

CAUTION: Do not, under any circumstances, use a megohm meter or apply power to the windings of a compressor while it is under a deep vacuum. In the rarified atmosphere of a vacuum, the motor windings can be damaged.

The lines used to connect the pump to the system should be copper and of the largest diameter that can practically be used. Using larger line sizes with minimum flow resistance can significantly reduce evacuation time. Rubber or synthetic hoses are not recommended for unit evacuation because they have moisture absorbing characteristics which result in excessive rates of out-gassing and pressure rise during the standing vacuum test. This makes it impossible to determine if the unit has a leak, excessive residual moisture, or a continual or high rate of pressure increase due to the hoses.

An electronic micron vacuum gauge should be installed in the common line ahead of the vacuum pump shutoff valve, as shown in Figure 42. Close Valves B and C, and open Valve A. After several minutes, the gauge reading will indicate the minimum blank-off pressure the pump is capable of pulling. Rotary pumps should produce vacuums of less than 100 microns.

Open Valves B and C. Evacuate the system to a pressure of 500 microns or less. Once 500 microns or less is obtained, with Valve A closed, a time versus pressure rise should be performed. The maximum allowable rise over a 15 minute period is 200 microns. If the pressure rise is greater than 200 microns but levels off to a

constant value, excessive moisture is present. If the pressure steadily continues to rise, a leak is indicated. Figure 43 illustrates three possible results of the time versus temperature rise check.

LEAK TESTING

When leak testing the unit, the following safety precautions must be observed:

WARNING: DO NOT WORK IN A CLOSED AREA WHERE REFRIGERANT OR NITROGEN MAY BE LEAKING. A SUFFICIENT QUANTITY OF VAPORS MAY BE PRESENT TO CAUSE PERSONAL INJURY. PROVIDE ADEQUATE VENTILATION.

WARNING: DO NOT USE OXYGEN, ACETYLENE, OR AIR IN PLACE OF REFRIGERANT AND DRY NITROGEN FOR LEAK TESTING. A VIOLENT EXPLOSION WILL RESULT WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

WARNING: ALWAYS USE A PRESSURE REGULATOR, VALVES, AND GAUGES TO CONTROL DRUM AND LINE PRESSURES WHEN PRESSURE TESTING THE SYSTEM. EXCESSIVE PRESSURES MAY CAUSE LINE RUPTURES, EQUIPMENT DAMAGE, OR AN EXPLOSION WHICH COULD RESULT IN PERSONAL INJURY OR DEATH.

Leak test the liquid line, evaporator, and suction line at pressures dictated by local codes.

CAUTION: Do not exceed 200 psig when leak testing the system.

1. Charge enough refrigerant into the system to raise the pressure to 100 psig.
2. Use a halogen leak detector or halide torch to check for leaks. Be thorough in this test, checking the interconnecting piping joints, the evaporator unit, and the condensing unit.
3. If a leak is found during the testing, release the test pressure, break the connection, and remake it as a new joint. Refer to the "Braze Procedures" in this section of the manual for proper brazing techniques.

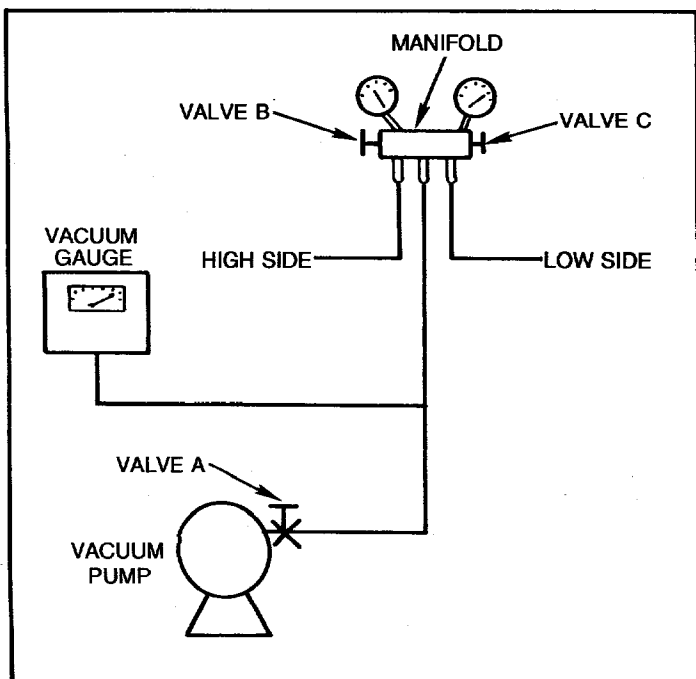


FIGURE 42 - Vacuum Pump Hook-up

4. If no leak is found, use nitrogen to increase the test pressure to 150 psig, and repeat the leak test. Soap bubbles should be used to check for leaks when nitrogen is added. If a leak is found after increasing the pressure to 150 psig using nitrogen, release the pressure and repair the leak.
5. Retest the system to make sure the new connection is solid.
6. If a leak is suspected after the system has been fully charged with refrigerant, use a halogen leak detector, halide torch, or soap bubbles to check for leaks.

BRAZING PROCEDURES

Proper brazing techniques are essential when installing refrigerant piping. The following factors should be kept in mind when forming sweat connections.

1. When copper is heated in the presence of air, copper oxide forms. To prevent copper oxide from forming inside the tubing during brazing, sweep an inert gas, such as dry nitrogen, through the tubing. Nitrogen displaces air in the tubing and prevents oxidation of the interior surfaces. A nitrogen flow of one to three cubic feet per minute is sufficient to displace the air. Use a pressure regulating valve or flow meter to control the flow.
2. Ensure that the tubing surfaces to be brazed are clean, and that the ends of the tubes have been carefully reamed to remove any burrs.
3. Make sure the inner and outer tubes of the joint are symmetrical and have a close clearance, providing an easy slip fit. If the joint is too loose, the tensile strength of the connection will be significantly reduced. The overlap distance should be equal to the diameter of the inner tube.
4. Wrap the body of each refrigerant line component with a wet cloth to keep it cool during brazing. Also move line insulation and tube grommets away from the joints. Excessive heat can damage these components.
5. If flux is used, apply it sparingly to the joint. Excess flux will contaminate the refrigerant system.
6. Apply heat evenly over the length and circumference of the joint. The entire joint should become hot enough to melt the brazing material.
7. Begin brazing when the joint is hot enough to melt the brazing rod. The hot copper tubing, not the flame, should melt the rod.
8. Continue to apply heat around the circumference of the joint until the brazing material is drawn into the joint by capillary action, making a mechanically sound and gas-tight connection. Remove the brazing rod as soon as a complete fillet is formed to avoid possible restriction in the line.
9. Visually inspect the connection after brazing to locate any pin holes or crevices in the joint. The use of a mirror may be required, depending on joint location.

REFRIGERANT CHARGING

Once the system is properly installed, leak tested and evacuated, refrigerant charging should begin. Liquid refrigerant is charged into the system through the liquid line access valve.

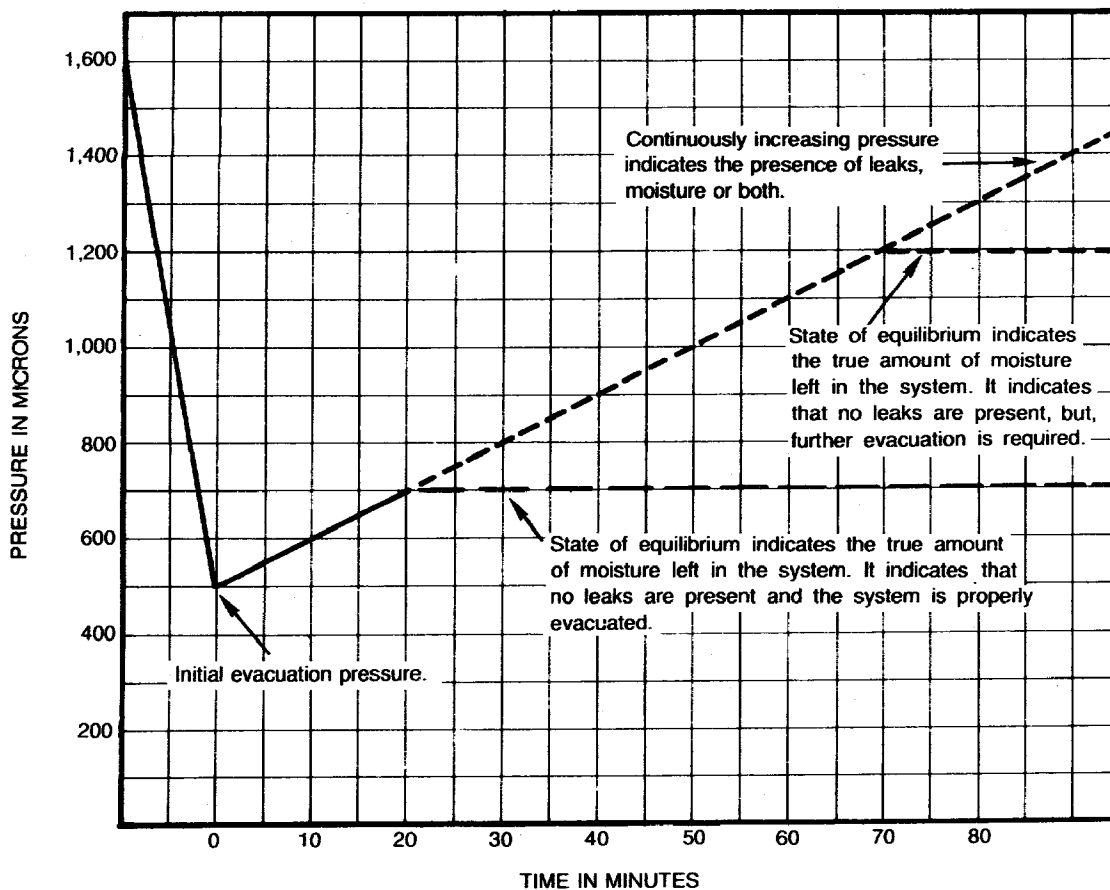


FIGURE 43 - Time Vs. Pressure Rise After Evacuation

Refrigerant should be charged into the system by weight. Use an accurate scale or a charging cylinder to determine the exact weight of the refrigerant entering the system. Failure to use either a scale or charging cylinder can lead to under-charging or over-charging, resulting in unreliable operation.

The weights of refrigerant required for the evaporator unit and the condensing unit are given in Table 11. The weight of refrigerant required for the system piping can be determined by measuring the refrigerant lines and using the data in Tables 12 and 13. The total system operating charge is calculated by adding the charge weight requirements of each part of the system. Refer to the following example.

TABLE 11 - Operating Unit Refrigerant Charge Weight

CONDENSING UNIT			EVAPORATOR		
MODEL NUMBER	R-22 CHARGE		MODEL NUMBER	R-22 CHARGE	
	LBS./CIRC.	TOTAL LBS.		LBS./CIRC.	TOTAL LBS.
RAUB-C20	28 lbs.	28 lbs.	BRCB-C20	4 lbs.	4 lbs.
			BRCB-C25	5 lbs.	5 lbs.
RAUB-C25	31 lbs.	31 lbs.	BRCB-C25	5 lbs.	5 lbs.
			BRCB-C30	6 lbs.	6 lbs.
RAUB-C30	40 lbs.	40 lbs.	BRCB-C30	6 lbs.	6 lbs.
			BRCB-C40*	8 lbs.	6 lbs.
RAUB-C40	29 lbs.	58 lbs.	BRCB-C40	4 lbs.	8 lbs.
			BRCB-C50	5 lbs.	10 lbs.
			(2) BRCB-C20	4 lbs.	8 lbs.
			(2) BRCB-C25	5 lbs.	10 lbs.
RAUB-C50	31 lbs.	62 lbs.	(2) BRCB-C30	6 lbs.	12 lbs.
			(2) BRCB-C30	6 lbs.	12 lbs.
RAUB-C60	40 lbs.	80 lbs.	(2) BRCB-C40	8 lbs.	16 lbs.

* Tee together as one circuit.

EXAMPLE: The installation consists of an RAUB 25 condensing unit, a BRCB 2500 evaporator, and 30-feet of 7/8-inch liquid line and 1-5/8-inch suction line and a filter drier. The refrigerant charges are as follows:

RAUB 25	= 31 lbs.
BRCB 2500	= 5 lbs.
Liquid line (3.79 oz./ft. x 30 ft. x 1/16 oz./lb.)	= 7.2 lbs.
Suction Line (.288 oz./ft. x 30 ft. x 1/16 oz./lb.)	= 0.5 lbs.
Filter Drier	= 1.1 lbs.
TOTAL CHARGE	44.8 lbs.
	or approx. 44 lbs.-13 oz.

WARNING: DO NOT APPLY FLAME TO A REFRIGERANT DRUM IN AN ATTEMPT TO INCREASE THE DRUM PRESSURE. UNCONTROLLED HEAT MAY CAUSE EXCESSIVE DRUM PRESSURES AND AN EXPLOSION MAY RESULT CAUSING SERIOUS PERSONAL INJURY OR DEATH.

WARNING: SHOULD LIQUID REFRIGERANT COME IN CONTACT WITH THE SKIN, THE INJURY SHOULD BE TREATED AS IF THE SKIN HAS BEEN FROSTBITTEN OR FROZEN. SLOWLY WARM THE AFFECTED AREA WITH LUKEWARM WATER. SEEK MEDICAL ATTENTION.

Proceed as follows to charge the system with refrigerant.

1. Charge liquid refrigerant into the liquid line of the No. 1 compressor circuit, using the liquid line access valve. The vacuum within the system will draw most of the required refrigerant into the system. If the pressure within the system equalizes with the pressure in the charging cylinder before the required charge has been drawn in, proceed to Step 2.

NOTE: On 40, 50 and 60-ton units, this charging process must be repeated for compressor circuit Number 2.

2. If the system cannot be completely charged by liquid refrigerant entering the system liquid line as outlined in Step 1, complete the process by charging gaseous refrigerant into the suction line. Proceed as follows:
 - a. Close the liquid line valve on the manifold gauge set.
 - b. Connect the manifold gauge set to the suction and discharge access valves (shown in Figure 44). The manifold valves should be closed.
 - c. Start the unit by following the procedures outlined in the SYSTEM START-UP section of this manual.
 - d. With the condensing unit operating, slowly open the suction line valve on the manifold gauge set. The remainder of the refrigerant will be drawn into the system.

CAUTION: Do not allow liquid refrigerant to enter the suction line. Excessive liquid will damage the compressor.

CHECKING REFRIGERANT CHARGE

Before taking measurements to determine if the system is correctly charged with refrigerant, verify that all other aspects of the system operation are proper. The following conditions must be checked and satisfied.

TABLE 12 - Refrigerant Line Charge Weight

TUBE O.D. (INCHES)	REFRIGERANT LINE CHG. WT. (Oz/Ft)	
	LIQUID LINE	SUCTION LINE
5/8	1.827	—
3/4	2.728	—
7/8	3.790	—
1 1/8	6.461	—
1 1/4	—	0.203
1 3/8	—	0.288
2 1/8	—	0.500

TABLE 13 - Filter Drier Refrigerant Charge

CONDENSING UNIT	LIQUID LINE O.D.	SPORLAN PART NO.	REFRIGERANT CHARGE OUNCES
RAUB-C20/C40	5/8	C-305-S	1 lb. - 1 oz.
	3/4	C-307-S	1 lb. - 1 oz.
	7/8	C-307-S	1 lb. - 1 oz.
	1 1/8	C-419-S	1 lb. - 8 oz.
RAUB-C25/C50	5/8	C-305-S	1 lb. - 1 oz.
	3/4	C-307-S	1 lb. - 1 oz.
	7/8	C-307-S	1 lb. - 1 oz.
	1 1/8	C-419-S	1 lb. - 8 oz.
RAUB-C30/C60	3/4	C-417-S	1 lb. - 8 oz.
	7/8	C-417-S	1 lb. - 8 oz.
	1 1/8	C-419-S	1 lb. - 8 oz.

WARNING: EXERCISE EXTREME CAUTION WHEN CHECKING ROTATION OF CONDENSER AND EVAPORATOR FANS TO AVOID ENTANGLEMENT IN FAN BLADES. FAILURE TO EXERCISE CAUTION MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

1. Check the evaporator and condenser fans to ensure that they are rotating in the proper direction, that the fan blades do not have dirt buildup, and that each fan is turning at the proper RPM. Make sure that the evaporator fan RPM is correct for the airflow desired and for the external static pressure being imposed by the duct system.
2. Make sure the evaporator air filters are clean.
3. Check the evaporator and condenser coils to ensure that they are clean, that the fins are straight, and that there are no obstructions to airflow.
4. Measure the suction line superheat and adjust the expansion valve, if necessary. (Refer to "Measuring Superheat" in the MAINTENANCE PROCEDURES section of this manual.) The expansion valve superheat setting must be between 12 and 16 F.

Visually inspect the liquid line sight glass to see if clear liquid is present. Bubbles in the liquid line sight glass indicate either low refrigerant charge, excess liquid line pressure drop, or excess liquid line heat gain.

CAUTION: A clear sight glass does NOT necessarily mean the system has sufficient refrigerant.

After verifying that the system is operating properly, determine if the refrigerant charge is correct. This is accomplished by checking both system operating pressures and subcooling leaving the condensing unit.

CAUTION: It is not sufficient to check only operating pressures or only subcooling. Both must be in the acceptable range in order to establish correct system charge.

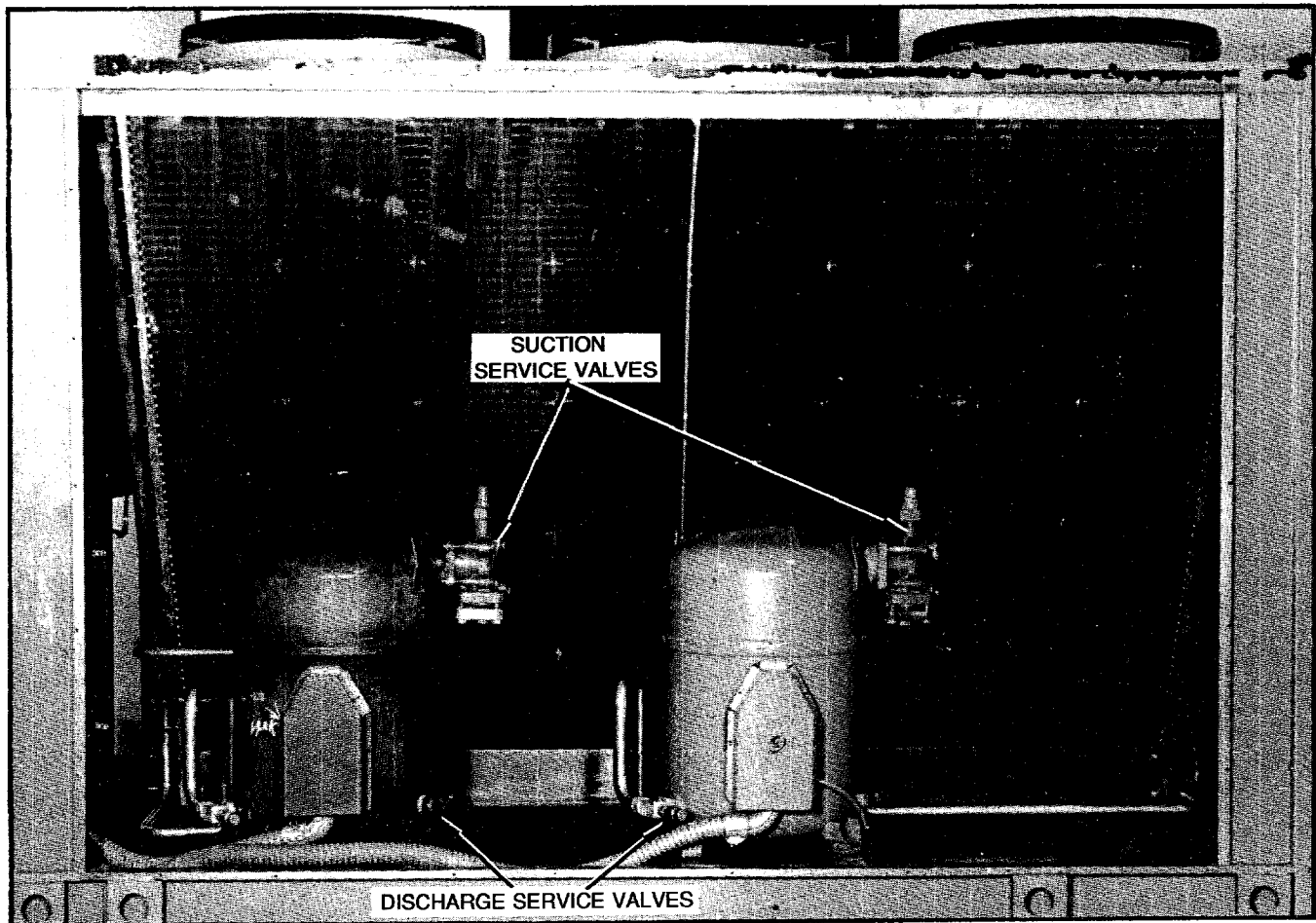


FIGURE 44 - Compressor Access Valves

Operating Pressures:

Measure the suction and discharge line pressures and compare these readings with the normal operating pressures listed in Figures 45 through 50 and Tables 14, 15 and 16. Refer to "Operating Pressures" in the MAINTENANCE PROCEDURES section of this manual. Figure 44 illustrates suction and discharge service valves.

Subcooling:

Determine the system subcooling. (Refer to "Measuring Subcooling" in the MAINTENANCE PROCEDURES section of this manual.) If the system is properly charged, subcooling at the liquid line access valve should be 14 to 19 F.

The system is low on refrigerant if: 1) the suction and discharge pressures are lower than the normal operating pressures as determined from Figures 45 through 50 and Tables 14, 15, and 16, 2) liquid subcooling is low (less than 14-19 F).

The system is overcharged with refrigerant if: 1) the suction and discharge pressures are higher than normal operating pressures, and 2) liquid subcooling is high (greater than 14-19 F).

CAUTION: If both the suction and discharge pressures are low but subcooling is in the acceptable range, the system has a problem other than a shortage of refrigerant. Do not add refrigerant. Refer to the TROUBLESHOOTING section of this manual.

Adding Refrigerant:

Use the suction line access valve to add refrigerant to a system with a low charge, making sure that only refrigerant vapor enters the suction line. Continue to add refrigerant until the subcooling is between 14 and 19 F. At this point, the operating pressures should be within the limits defined by Figures 45 through 50 and Tables 14 through 16.

Removing Refrigerant:

If the system is overcharged, some refrigerant must be removed to lower the subcooling to the 14-19 F range. Refrigerant should be discharged from the system slowly to keep oil loss at a minimum. The liquid line access valve can be depressed to remove refrigerant. However, refrigerant should not be discharged into the atmosphere.

CAUTION: Do not allow refrigerant to come in contact with the skin. If this occurs, the injury should be treated as if the skin has been frostbitten or frozen. Slowly warm the affected area with lukewarm water.

OPERATING PRESSURES

Operating pressure data can be used to determine if the system is operating properly. System malfunctions — such as low airflow, line restrictions, incorrect refrigerant charge, malfunctioning expansion valve, damaged compressor, and so on — will result in pressure variations which are outside the normal range. If the

condensing unit and evaporator are checked individually, as described below, the operating pressures can be used to determine which side of the system (high side or low side) is malfunctioning. In addition, the relationship of suction vs. discharge pressure, as well as whether these pressures are higher or lower than expected, will provide valuable clues for determining the specific problem(s).

CAUTION: Operating pressure data, by itself, cannot be used to accurately charge system. Charging by weight is preferred. If this is not feasible, a combination of operating pressures and subcooling measurement is necessary to properly charge the system. Refer to "Checking Refrigerant Charge" in the MAINTENANCE section of this manual.

Unfortunately, many application variables exist which affect operating pressures. These include indoor dry bulb and wet bulb temperature, outside dry bulb temperature, suction line pressure drop, and evaporator airflow. Since these variables can give misleading results, it is not recommended that operating pressures be used as the sole check of system operation. Further, the following conditions must be satisfied before checking system operating pressures.

1. The outdoor ambient temperature must be between 65 and 105 F. At ambient temperatures outside of this range, meaningful operating pressures cannot be measured.
2. The relative humidity of the air entering the evaporator must be above 40 percent. If it is less than 40 percent, meaningful operating pressures cannot be measured.
3. All compressors must be operating fully loaded. Set the thermostat as necessary to accomplish this.
4. All condenser fans must be operating. If necessary, jumper the fan pressure switches. Be sure to remove the jumpers when measurements are completed.
5. Do not take measurements with the low ambient dampers and/or hot gas bypass operating. Disconnect the low ambient dampers and de-energize the hot gas bypass before taking measurements. Be sure to reconnect low ambient dampers/hot gas bypass after taking measurements.

Use the following steps to check operating pressures.

1. Condensing unit performance (this is a check of only the condensing unit, not the system).
 - a. Measure pressures (psig) at the suction and discharge line access valves next to the compressor.
 - b. Measure the dry bulb air temperature (F) entering the condenser coil.
 - c. If the outside ambient is between 65 and 105 F, enter the appropriate graph in Figures 45 through 50 at the measured suction pressure and condenser ambient. Read the corresponding discharge pressure.
 - d. The measured discharge pressure should be within ± 7 psig of the graph pressure. If the difference is greater than ± 7 psig, refer to the TROUBLESHOOTING section of this manual.
2. Evaporator Performance:
 - a. Measure the actual wet bulb temperature (F) of the air entering the evaporator. Be sure to measure the mixed air condition if outside air is being ducted in.
 - b. Find the correct combination of condensing unit and evaporator from Table 14. Match the condenser entering air temperature (measured in Step 1) with the evaporator wet bulb temperature (measured in Step 2) to determine the correct suction pressure.
 - c. Use Table 15 to correct the suction pressure (from Table 14) for the line sizes used in your installation.
 - d. Use Table 16 to correct the suction pressure (from Step 2) for the airflow of your evaporator.
 - e. The measured suction pressure at the compressor should be within ± 2 psi of the corrected pressure from Tables 14 through 16. If not, improper system operation is indicated. Refer to the TROUBLESHOOTING section of this manual.

CAUTION: Table 14 is not accurate if the relative humidity of the entering evaporator air is less than 40%, or if an evaporator/condensing unit other than those listed is used.

TABLE 14 - Compressor Suction Pressures (PSIG)

CONDENSING UNIT	EVAPORATOR	EVAP. AIRFLOW (SCFM)	CONDENSER AMBIENT, F														
			65			75			85			95			105		
			WET BULB, F			WET BULB, F			WET BULB, F			WET BULB, F			WET BULB, F		
			55	60	65	55	60	65	55	60	65	55	60	65	55	60	65
COMPRESSOR SUCTION PRESSURES, PSIG																	
RAUB-C20	BRCB-C20	8,000	48.1	53.3	58.9	50.2	60.1	70.0	52.2	63.6	76.7	54.1	65.8	79.3	56.0	68.0	81.8
	BRCB-C25	10,000	51.6	57.4	63.7	53.5	64.5	75.6	55.4	67.9	82.5	57.2	70.0	84.8	58.9	72.0	87.1
RAUB-C25	BRCB-C25	10,000	50.2	55.6	61.4	51.7	61.9	72.1	53.4	65.1	78.4	55.3	67.2	80.8	57.4	69.6	83.5
	BRCB-C30	12,000	53.9	59.6	65.7	55.3	66.1	76.8	56.9	69.2	83.2	58.7	71.2	85.5	60.6	73.4	87.9
RAUB-C30	BRCB-C30	12,000	50.3	55.7	61.5	51.9	62.1	72.4	53.6	65.3	78.7	55.4	67.3	81.0	57.2	69.4	83.4
	BRCB-C40	16,000	55.2	61.4	67.7	56.6	68.1	79.4	58.2	71.2	86.0	59.8	73.0	88.0	61.4	74.9	90.1
RAUB-C40	BRCB-C40	16,000	48.5	53.7	59.3	50.5	60.5	70.5	52.5	64.0	77.2	54.5	66.2	79.7	56.3	68.4	82.3
	BRCB-C50	20,000	52.4	58.1	64.2	54.4	65.1	75.9	56.3	68.5	82.7	58.1	70.7	85.1	59.8	72.7	87.4
	BRCB-C20(2)	16,000	48.0	53.2	58.8	50.1	60.0	69.9	52.1	63.5	76.5	54.1	65.7	79.1	55.9	67.9	81.7
	BRCB-C25(2)	20,000	51.5	57.3	63.5	53.4	64.4	75.4	55.3	67.8	82.3	57.1	69.9	84.7	58.9	71.9	87.0
RAUB-C50	BRCB-C50	20,000	50.7	55.9	61.5	52.2	62.1	72.0	53.9	65.2	78.2	55.9	67.4	80.7	58.1	69.9	83.4
	BRCB-C25(2)	20,000	50.3	55.7	61.5	51.8	62.0	72.3	53.5	65.2	78.6	55.4	67.4	81.0	57.5	69.8	83.7
	BRCB-C30(2)	24,000	54.0	59.7	65.8	55.4	66.2	77.0	57.0	69.3	83.4	58.8	71.4	85.7	60.8	73.6	88.2
RAUB-C60	BRCB-C30(2)	24,000	50.3	55.7	61.6	52.0	62.2	72.5	53.7	65.4	78.9	55.5	67.5	81.2	57.3	69.6	83.6
	BRCB-C40(2)	32,000	55.2	61.3	67.8	56.7	68.2	79.6	58.3	71.3	86.1	59.9	73.2	88.2	61.5	75.1	90.3

NOTES:

1. Table only good for relative humidity of air entering evaporator greater than 40%.
2. Interpolation between wet bulb temperatures is allowable. Do not extrapolate outside range given.

TABLE 15 - Suction Pressure Correction for Line Size (PSI)

CONDENSING UNIT	1 1/2" O.D. SUCTION LINE LENGTH, FEET								
	0	25	50	75	100	125	150	175	200
RAUB-C20	-1.1	-2.5	-3.7	-4.9	-6.0	-7.0	-7.9	-8.8	-9.7
RAUB-C40	-1.1	-2.5	-3.8	-4.9	-6.0	-7.0	-8.0	-8.9	-9.7
CONDENSING UNIT	1 3/4" O.D. SUCTION LINE LENGTH, FEET								
	0	25	50	75	100	125	150	175	200
RAUB-C20	+0.7	0	-0.6	-1.3	-1.8	-2.4	-3.0	-3.5	-4.0
RAUB-C25	-1.3	-2.3	-3.2	-4.1	-4.9	-5.7	-6.4	-7.1	-7.8
RAUB-C30	-1.7	-3.0	-4.2	-5.3	-6.3	-7.3	-8.2	-9.0	-9.9
RAUB-C40	+0.7	0	-0.6	-1.2	-1.8	-2.4	-3.0	-3.5	-4.0
RAUB-C50	-1.3	-2.2	-3.1	-3.9	-4.7	-5.4	-6.1	-6.8	-7.4
RAUB-C60	-1.8	-3.1	-4.2	-5.4	-6.4	-7.3	-8.2	-9.1	-9.9
CONDENSING UNIT	2 1/4" O.D. SUCTION LINE LENGTH, FEET								
	0	25	50	75	100	125	150	175	200
RAUB-C20	+1.8	+1.6	+1.4	+1.2	+1.0	+0.8	+0.7	+0.5	+0.3
RAUB-C25	+0.3	0	-0.2	-0.5	-0.8	-1.1	-1.3	-1.6	-1.8
RAUB-C30	+0.4	0	-0.3	-0.7	-1.1	-1.4	-1.8	-2.1	-2.4
RAUB-C40	+1.8	+1.6	+1.4	+1.2	+1.0	+0.9	+0.7	+0.5	+0.3
RAUB-C50	+0.2	0	-0.3	-0.6	-0.8	-1.1	-1.3	-1.6	-1.8
RAUB-C60	+0.4	0	-0.4	-0.7	-1.1	-1.5	-1.8	-2.2	-2.5

* 0 feet provided for interpolation purposes only.

TABLE 16 - Suction Pressure Correction for Airflow (PSI)

CONDENSING UNITS	PERCENT OF RATED EVAPORATOR AIRFLOW								
	-20%	-15%	-10%	-5%	0%	+5%	+10%	+15%	+20%
RAUB-C20-60	-2.6	-1.9	-1.2	-0.6	0	+0.5	+1.0	+1.4	+1.9

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

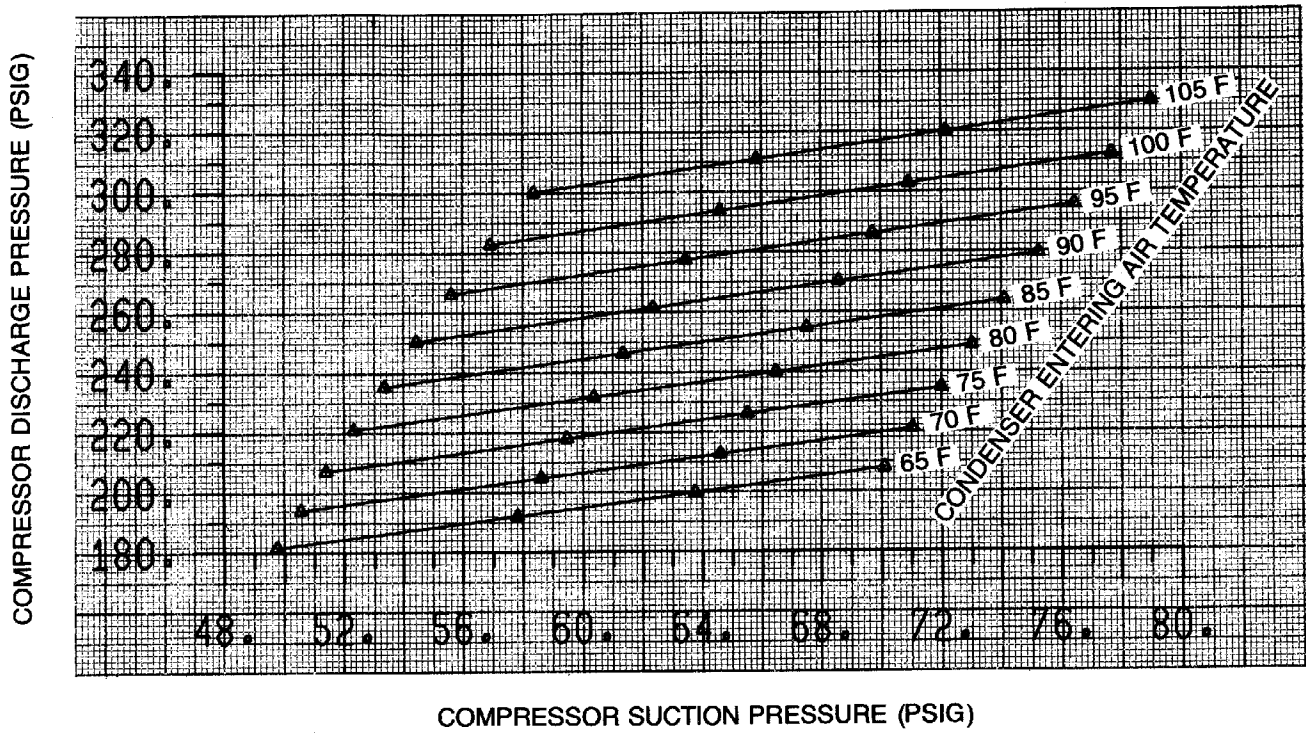


FIGURE 45 - RAUB-C20 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

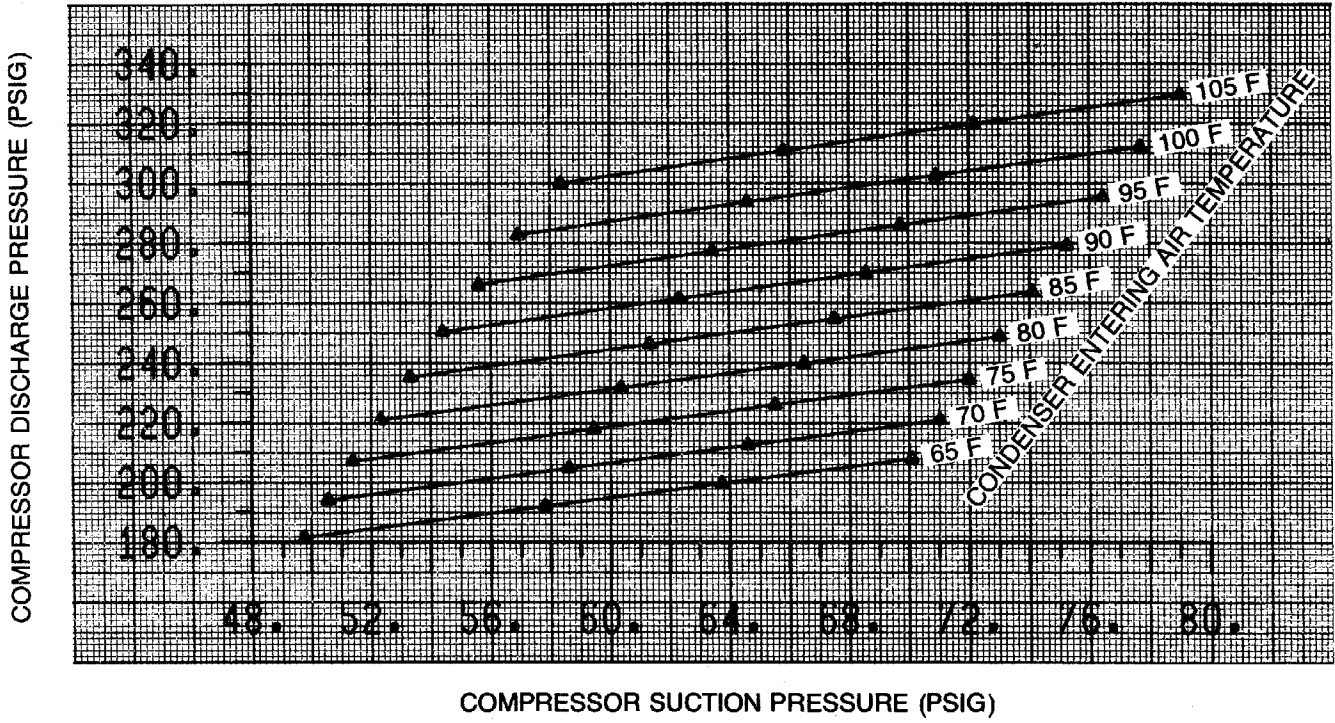


FIGURE 46 - RAUB-C25 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

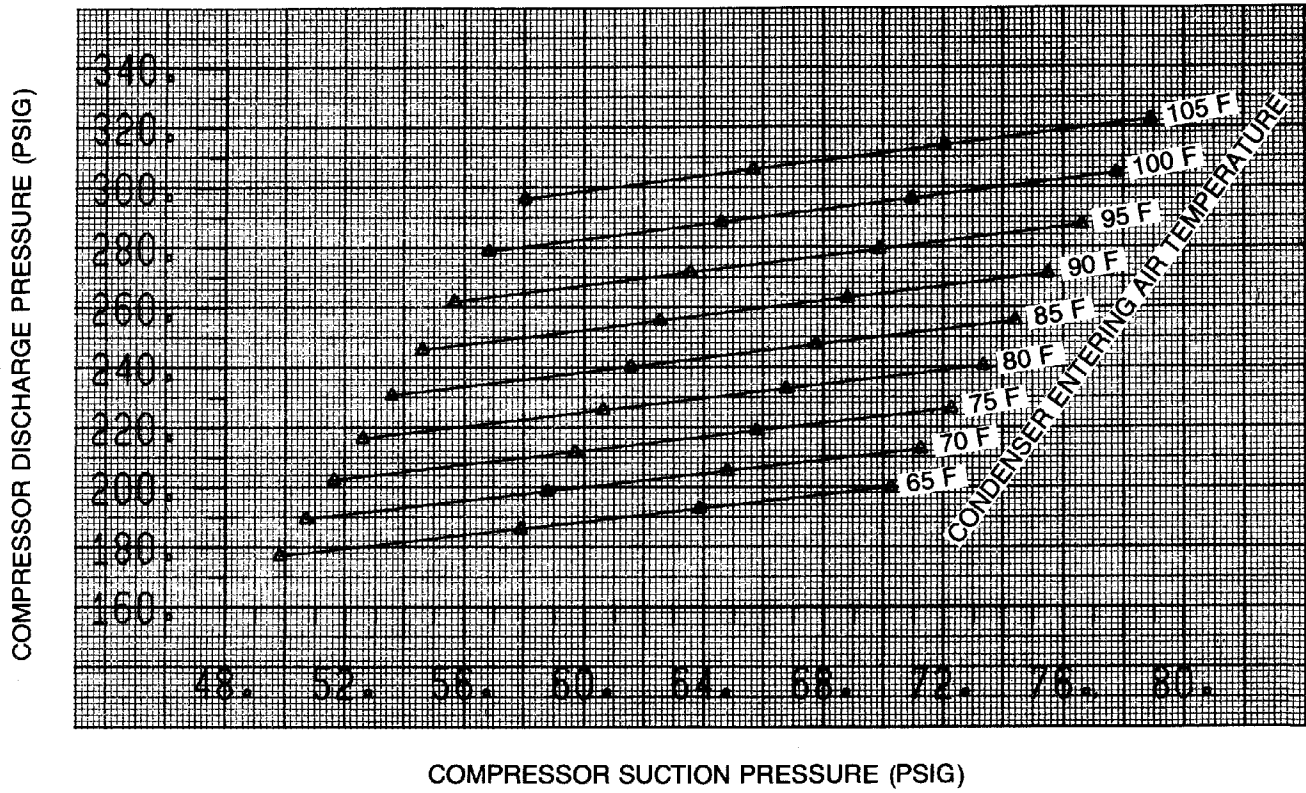


FIGURE 47 - RAUB-C30 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

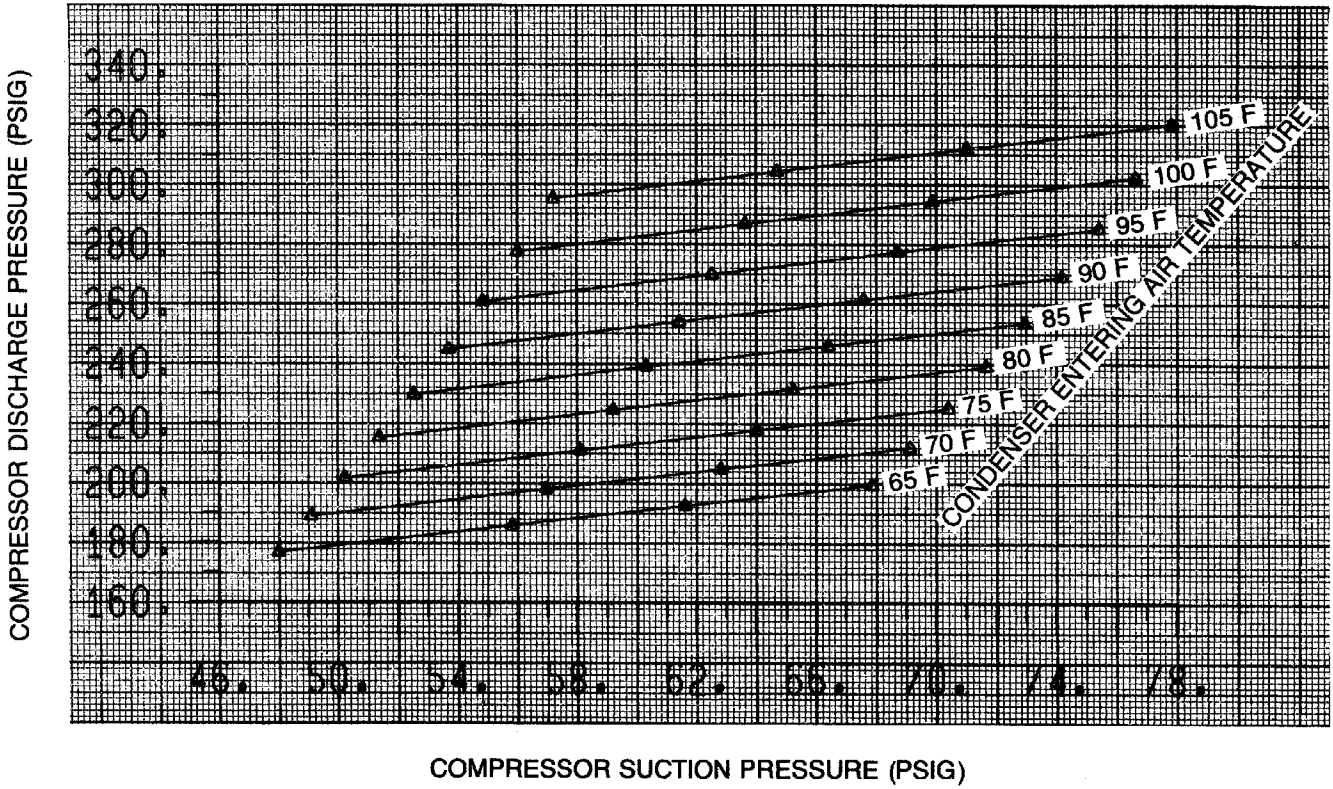


FIGURE 48 - RAUB-C40 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

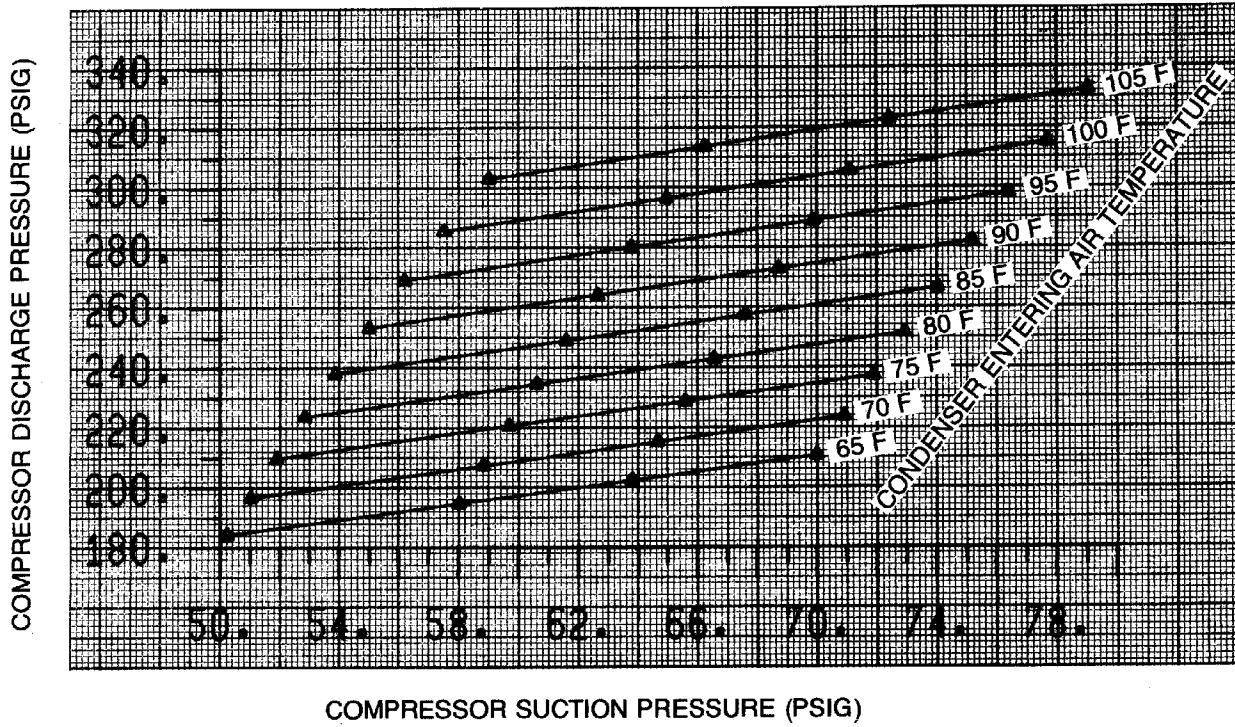


FIGURE 49 - RAUB-C50 Operating Pressures

NOTE: PRESSURES GIVEN WITH ALL CONDENSER FANS OPERATING

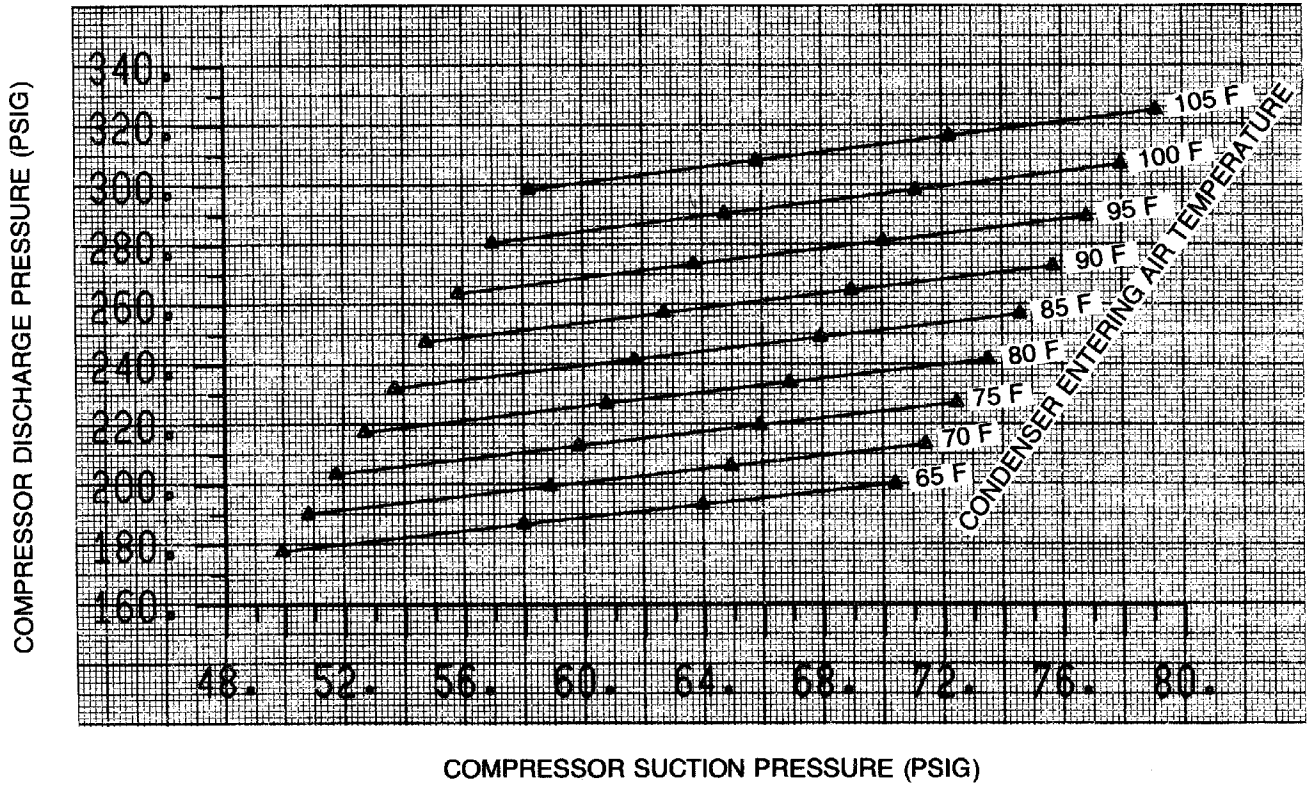


FIGURE 50 - RAUB-C60 Operating Pressures

THERMOSTATIC EXPANSION VALVE ADJUSTMENT AND SUPERHEAT MEASUREMENT

Since the reliability and performance of the refrigeration system is heavily dependent on proper expansion valve adjustment, the importance of proper suction gas superheat cannot be over-emphasized. The accurate measurement of suction superheat will provide the following information:

1. How well the expansion valve is controlling the refrigerant flow.
2. The efficiency of the evaporator coil.
3. The amount of protection the compressor is receiving against flooding or overheating.

The safe setting range for suction gas superheat on Trane equipment is 12 to 16 degrees at the evaporator. Settings within this range will allow for measurement error. Superheat of less than 12 degrees can cause refrigerant floodback which could cause serious compressor damage. Superheat greater than 16 degrees can reduce system efficiency by reducing the effective evaporator surface.

CAUTION: When checking the superheat setting, the outdoor ambient must be between 65 and 105 F. Entering evaporator air should be above 40 percent relative humidity and all condenser fans and compressors must be operating fully loaded.

To determine suction gas superheat, the pressure at the outlet of the evaporator must be measured and then converted to saturated vapor temperature by using a Refrigerant-22 pressure/temperature chart. The saturated vapor temperature can then be subtracted from the actual suction temperature which is measured on the suction line close to the expansion valve bulb. The difference between the two temperatures is known as suction gas superheat. On many Trane fan/coil units an access valve is provided close to the expansion valve bulb. This valve must be added on Climate Changers and other evaporators which are not so equipped. To obtain an accurate reading, an access valve

TABLE 17 - Pressure/Temperature Conversions for Calculating Suction Line Superheat

SATURATED TEMPERATURE	PRESSURE USING REFRIGERANT-22
30	54.9
31	56.2
32	57.5
33	58.8
34	60.1
35	61.5
36	62.8
37	64.2
38	65.6
39	67.1
40	68.5
41	70.0
42	71.4
43	73.0
44	74.5
45	76.0
46	77.6
47	79.2
48	80.8
49	82.4
50	84.0

close to the expansion valve bulb must be utilized when determining suction gas superheat.

Instruments to Use

1. The gauge used to measure suction pressure should be of the best quality available. Gauges permanently installed on the equipment should not be used. A good quality gauge on a standard refrigerant manifold set is recommended.
2. To measure suction temperature, an electronic temperature tester will be sufficient. Testers manufactured by Robinnaire, Annie, and Thermal are among those available. Glass thermometers do not have sufficient contact area to give accurate readings.

Procedure

1. Cut the suction line insulation to gain access to the suction line. If armaflex is used, it is best to cut around the circumference of the tubing.
2. Clean the line carefully and attach the electronic temperature sensor. Black electrical tape works well when securing the sensor of the temperature tester to the suction line. (Make sure the sensor is making good contact with the tube.)
3. Rejoin the armaflex and seal with plastic tape to prevent sensor contact with ambient air.

NOTE: For measurement accuracy the temperature sensor must be installed and insulated properly. Make sure the armaflex extends at least six inches on both sides of the sensor location. Seal both ends of the armaflex to keep ambient air from getting under the insulation and affecting the temperature readings.

4. Install a pressure gauge to monitor suction pressure.
5. Operate the system for approximately 10 to 15 minutes to be sure that the expansion valve has time to stabilize.
6. To measure superheat, compare the saturated vapor temperature of the refrigerant converted from the suction pressure reading (see Table 17) to the actual temperature measured at the line by the electronic tester. Proper suction superheat is 12 to 16 degrees.

EXAMPLE:

Suction Pressure = 66.0 psig
 Suction Temperature = 52 F
 Suction Pressure converted to Saturated Vapor Temperature (from Table 17) = 38 F
 Suction Superheat
 = (Actual Line Temp.) - (Saturated Vapor Temp.)
 = (52 F) - (38 F)
 = 14 F

If initial suction superheat readings fall below 12 degrees, the adjusting stem on the expansion valve should be adjusted clockwise to close the valve, limiting the flow of refrigerant to the evaporator and thus increasing superheat. Adjustment should be made a half turn at a time. Conversely, if the initial suction superheat reading is greater than 16 degrees, the adjusting stem on the expansion valve should be adjusted counterclockwise to open the valve, increasing the flow of refrigerant to the evaporator and thus decreasing superheat. Adjustments should be made until an acceptable reading is obtained. The system should be allowed to restabilize for 10 minutes after each adjustment.

MEASURING SUBCOOLING

1. The outdoor ambient temperature must be between 65 and 105 F. At ambient temperatures outside of this range, meaningful operating pressures cannot be measured.
2. The relative humidity of the air entering the evaporator must be above 40 percent. If it is less than 40%, meaningful operating pressures cannot be measured.
3. All compressors must be operating fully loaded. Set the thermostat as necessary to accomplish this.
4. All condenser fans must be operating. If necessary, jumper the fan pressure switches. Be sure to remove the jumpers when measurements are completed.
5. Do not take measurements with the low ambient dampers and/or hot gas bypass operating. Disconnect the low ambient dampers and de-energize the hot gas bypass before taking measurements. Be sure to reconnect low ambient dampers/hot gas bypass after taking measurements.

The proper setting range for liquid subcooling is 14 to 19 F. The compressor must be fully loaded and both compressors must be operating if so equipped. Use these steps to measure subcooling:

1. Measure the liquid line pressure at the liquid line access valve installed inside the condensing unit. Convert this pressure reading to saturated temperature by using a Refrigerant-22 pressure/temperature chart (refer to Table 18).
2. Measure the actual liquid line temperature on the liquid line close to the access valve. To ensure an accurate reading, clean the line thoroughly where the electronic temperature sensor will be attached. Glass thermometers do not have sufficient contact area to give accurate readings. After securing the sensor to the line, wrap the sensor and line with insulation to prevent contact with ambient air.
3. Determine the system subcooling by subtracting the actual liquid line temperature (measured in Step 2) from the saturated liquid temperature (calculated in Step 1).
4. If the system is properly charged, subcooling at the liquid line access valve should be 14-19 F.

COMPRESSOR OIL CHARGE

Proper oil charge is critical for reliable operation of reciprocating compressors. Both undercharging and overcharging will result in compressor damage.

On most applications, the factory oil charge is correct and no addition of oil is required. However, it may be necessary to add oil to systems which have extremely long interconnecting lines.

An oil level sight glass is integral to the compressor shell in order to confirm proper oil charge on all 20 through 60-ton units. The following procedure should be followed:

1. Check the oil level **prior to initial refrigerant charging and start-up** of a new system. To be proper, the oil level must be visible in the sight glass. Note the oil level mark for future reference.
2. Approximately one hour after initial start-up, and after the oil sump is warm to the touch check the oil level with the compressor running **fully loaded**. The oil level must be visible in the sight glass. If it is not visible, add oil until the level is halfway up the sight glass.

TABLE 18 - Pressure/Temperature Conversion for Calculating Liquid Line Subcooling

SATURATED TEMPERATURE	PRESSURE USING REFRIGERANT 22
70	121.4
75	132.2
80	143.6
85	155.7
90	168.4
95	181.8
100	195.9
105	210.8
110	226.4
115	242.7
120	259.9
125	277.9
130	296.8
135	316.6
140	337.2
145	358.9
150	381.5

CAUTION: Do not attempt to check the oil level at part load compressor operation. It is not intended that the oil level be visible in the sight glass under these conditions. Adding oil could result in a compressor overcharge and subsequent compressor damage.

3. Allow the compressor to run at full load until the compressor sump is warm to the touch. If the oil level increases from Step 2, oil should be removed and the process repeated until the sight glass level is maintained at the halfway mark.

CAUTION: Checking oil level with a cold sump can incorrectly indicate excessive oil charge due to refrigerant in the oil.

TROUBLESHOOTING

The Troubleshooting Chart on the following pages is provided to serve as an aid for identifying the cause of any system malfunctions that may occur. The chart is divided into three columns:

- the "SYMPTOM" column describes the behavior the unit is exhibiting;
- the "PROBABLE CAUSE" column identifies possible sources of malfunction;
- the "RECOMMENDED ACTION" column indicates the procedures required to correct the malfunction.

If operating difficulties are encountered, make the following preliminary checks before referring to the Troubleshooting Chart:

- Check the thermostat to ensure that it is properly set, receiving control power, and "making/breaking" on a call for heating or cooling.
- Verify that the unit is receiving electrical supply power, and that the fuses are intact.
- Check the filters to make sure they are positioned properly, and free of dirt and debris.

After completing the checks listed above, inspect the system for other obvious causes of trouble such as broken fan belts, a clogged condenser coil, or restricted air ducts. If everything appears to be in order, but the unit still fails to operate properly, refer to the appropriate section of the Troubleshooting Chart.

NOTE: The Troubleshooting Chart which follows is provided solely as a guide for determining the cause of mechanical failure or malfunction. When mechanical problems do occur, Trane recommends that trained service personnel be contacted to help ensure proper diagnosis and repair of the unit.

WARNING: OPEN THE UNIT DISCONNECT SWITCH AND LOCK IT IN THAT POSITION TO PREVENT ACCIDENTAL START-UP. NEVER OPEN AN ACCESS PANEL TO INSPECT OR SERVICE THE UNIT WITHOUT FIRST OPENING THE DISCONNECT SWITCH. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH FROM ELECTRICAL SHOCK OR CONTACT WITH MOVING PARTS.

TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
A. Compressor does not start, and does not hum.	1. No power to unit.	1. Check for the following: <ul style="list-style-type: none"> a. Disconnect switch open. b. Fuses blown.
	2. No call for cooling.	2. Check for the following: <ul style="list-style-type: none"> a. Defective thermostat. b. Broken or improper control wiring. c. Blown control power fuse.
	3. Anti-recycle timer has not timed out (if installed).	3. Wait at least five minutes for the anti-recycle timer to time out.
	4. Unit locked out by reset relay.	4. Check for the following: <ul style="list-style-type: none"> a. Excessive discharge pressure. Refer to Symptom L, "Discharge pressure too high". b. Defective high pressure control. c. Compressor winding stat open. Refer to Low Suction Pressure. d. Defective comp. protector or fuse-check for winding stats shorted to motor windings. e. Defective reset relay contact. f. Comp. current overload open. Refer to Symptom F.
	5. Compressor contactor will not close.	5. Check for the following: <ul style="list-style-type: none"> a. Defective comp. contactor. b. Improper wiring. c. Reset relay open. d. Low pressure control open. e. Cooling relay not energized. Defective relay-check thermostat circuit. See Symptom A, Cause 2.
	6. Compressor winding stat open.	6. Refer to Symptom F. <ul style="list-style-type: none"> a. Check compressor amp draw. b. Defective low pressure control - replace.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
B. Compressor hums, but will not start.	<ol style="list-style-type: none"> 1. Low voltage at the compressor. 2. Defective compressor. 	<ol style="list-style-type: none"> 1. Check for the following: <ol style="list-style-type: none"> a. A single blown fuse. b. Low line voltage. c. Defective compressor contactor. d. Loose wiring connections. e. Defective part winding start time delay. 2. Check for the following: <ol style="list-style-type: none"> a. Open motor winding. b. Excessive amp draw on all phases.
C. Second stage compressor fails to start.	<ol style="list-style-type: none"> 1. Time delay contacts fail to close. 2. No call for cooling. 3. Unit locked out by reset relay. 4. Compressor contactor will not close. 	<ol style="list-style-type: none"> 1. Replace time delay relay. 2. Check for the following: <ol style="list-style-type: none"> a. Defective thermostat. b. Broken or improper control wiring. 3. Same as A-4. 4. Same as A-5.
D. Compressor short cycles.	<ol style="list-style-type: none"> 1. Intermittent contact in control circuit. 2. Poor thermostat placement. 3. Defective anti-recycle timer. 4. Defective liquid line solenoid valve. 5. Low refrigerant charge. 6. Plugged liquid line filter-driers. 7. Defective low pressure control. 8. Defective low ambient time delay relay. 	<ol style="list-style-type: none"> 1. Check for the following: <ol style="list-style-type: none"> a. Defective relay contacts. b. Loose wiring connections. 2. Refer to "Thermostat Installation" in the ELECTRICAL WIRING section of this manual. 3. Replace. 4. Replace. 5. Check for leak, add refrigerant. 6. Replace. 7. Replace. 8. Replace.
E. Compressor runs continuously.	<ol style="list-style-type: none"> 1. Unit undersized for load (cannot maintain space temperature). 2. Thermostat setpoint too low. 3. Defective thermostat or control wiring (conditioned space too cold). 4. Welded contacts on compressor contactor. 	<ol style="list-style-type: none"> 1. Check for cause of excessive load. 2. Readjust thermostat. 3. Replace thermostat. Replace or repair control wiring. 4. Repair or replace contactor.

**(CONTINUED ON
NEXT PAGE)**

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
	5. Leaky valves in compressor (indicated by operation at abnormally low discharge and high suction pressures). 6. Shortage of refrigerant (indicated by reduced capacity coupled with high superheat, low subcooling, and low suction pressure). 7. Liquid line solenoid valve stuck open. 8. Defective low pressure control.	5. Replace compressor. 6. Find and repair refrigerant leak. Recharge system. 7. Repair/replace. 8. Replace.
F. Compressor motor winding stat open.	1. Excessive load on evaporator (indicated by high supply air temperature). 2. Lack of motor cooling (indicated by excessive superheat). 3. Improper voltage at compressor. 4. Internal parts of compressor damaged.	1. Check for the following: a. Excessive airflow. b. High return air temperature. 2. Check for the following: a. Improper expansion valve setting. b. Faulty expansion valve. c. Restriction in liquid line. 3. Check for the following: a. Low or imbalanced line voltage. b. Loose power wiring. c. Defective compressor contactor. 4. Replace compressor.
G. Compressor is noisy.	1. Internal parts of compressor damaged or broken (compressor knocks). 2. Liquid floodback (indicated by abnormally cold suction line and low superheat). 3. Liquid refrigerant in the compressor at start-up. (Indicated by abnormally cold compressor shell.)	1. Replace compressor. 2. Check and adjust superheat. 3. Replace crankcase heater.
H. System short of capacity.	1. Low refrigerant charge (indicated by low subcooling and high superheat). 2. Clogged filter drier (indicated by temperature change in refrigerant line through drier). 3. Incorrect thermostatic expansion valve setting.	1. Add refrigerant. 2. Replace filter drier or core of drier. 3. Readjust expansion valve.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
	<ol style="list-style-type: none"> 4. Expansion valve stuck or obstructed (indicated by high superheat and high space temperature). 5. Low evaporator airflow. 6. Noncondensibles in system. 7. Leaky valves in compressor (indicated by operation at abnormally low discharge and high suction pressures). 	<ol style="list-style-type: none"> 4. Repair or replace expansion valve. 5. Check filters. Adjust airflow. 6. Evacuate and recharge system. 7. Replace compressor.
I. Suction pressure too low.	<ol style="list-style-type: none"> 1. Shortage of refrigerant (indicated by high superheat and low subcooling). 2. Thermostat set too low (indicated by low discharge pressure and low space temperature). 3. Low airflow. 4. Clogged filter drier. 5. Expansion valve power assembly has lost charge. 6. Obstructed expansion valve (indicated by high superheat). 	<ol style="list-style-type: none"> 1. Find and repair refrigerant leak. Recharge system. 2. Re-adjust thermostat. 3. Check for clogged filters, incorrect fan speed, or high duct static pressure. 4. Check for frosting on filter drier. Replace if necessary. 5. Repair or replace expansion valve power head assembly. 6. Clean or replace valve.
Suction pressure too high.	<ol style="list-style-type: none"> 1. Excessive cooling load (indicated by high supply air temperatures). 2. Overfeeding of expansion valve (indicated by abnormally low superheat and liquid flooding to compressor). 3. Suction valves broken (indicated by noisy compressor). 	<ol style="list-style-type: none"> 1. See Symptom E, "Compressor runs continuously". 2. Adjust superheat setting and check to see that remote bulb is properly attached to suction line. 3. Replace compressor.
K. Discharge pressure too low.	<ol style="list-style-type: none"> 1. Shortage of refrigerant (indicated by low subcooling and high superheat plus bubbles in sight glass). 2. Broken or leaky compressor discharge valves (indicated by suction and discharge pressures that equalize rapidly after shutdown). 3. Condenser fan control stuck in closed position (contacts closed when pressure is below 155 psig.) 4. Unit running below minimum operating ambient. 5. Low ambient damper stuck open (indicated by low discharge pressure). 	<ol style="list-style-type: none"> 1. Repair leak and recharge system. 2. Replace compressor. 3. Replace defective control. 4. Provide adequate heat pressure controls or a unit ambient lockout switch. 5. Repair or replace damper operator.

**(CONTINUED FROM
PREVIOUS PAGE)**

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
L. Discharge pressure too high.	<ol style="list-style-type: none"> 1. Too little or too warm condenser air; restricted air flow. 2. Air or noncondensable gas in system (indicated by exceptionally hot condenser and excessive discharge pressure). 3. Overcharge of refrigerant (indicated by high subcooling, low superheat, and high suction pressure). 4. Excessive system load. 5. Defective condenser fan or fan pressure control (indicated by one fan off and high condenser pressure). 6. Defective or inoperative low ambient dampers. 	<ol style="list-style-type: none"> 1. Clean coil. Check fan and motors for proper operation. 2. Evacuate and recharge system. 3. Remove excess refrigerant. 4. Reduce load. 5. Repair or replace switch. 6. Repair or replace defective parts.

IMPORTANT: Fill out the following form when contacting your Trane Service Company for parts or information.

UNIT MODEL NUMBER _____

UNIT TYPE NUMBER _____

DATE OF INSTALLATION _____

INSTALLED BY _____

TRANE SERVICE COMPANY _____

ADDRESS _____

PHONE _____