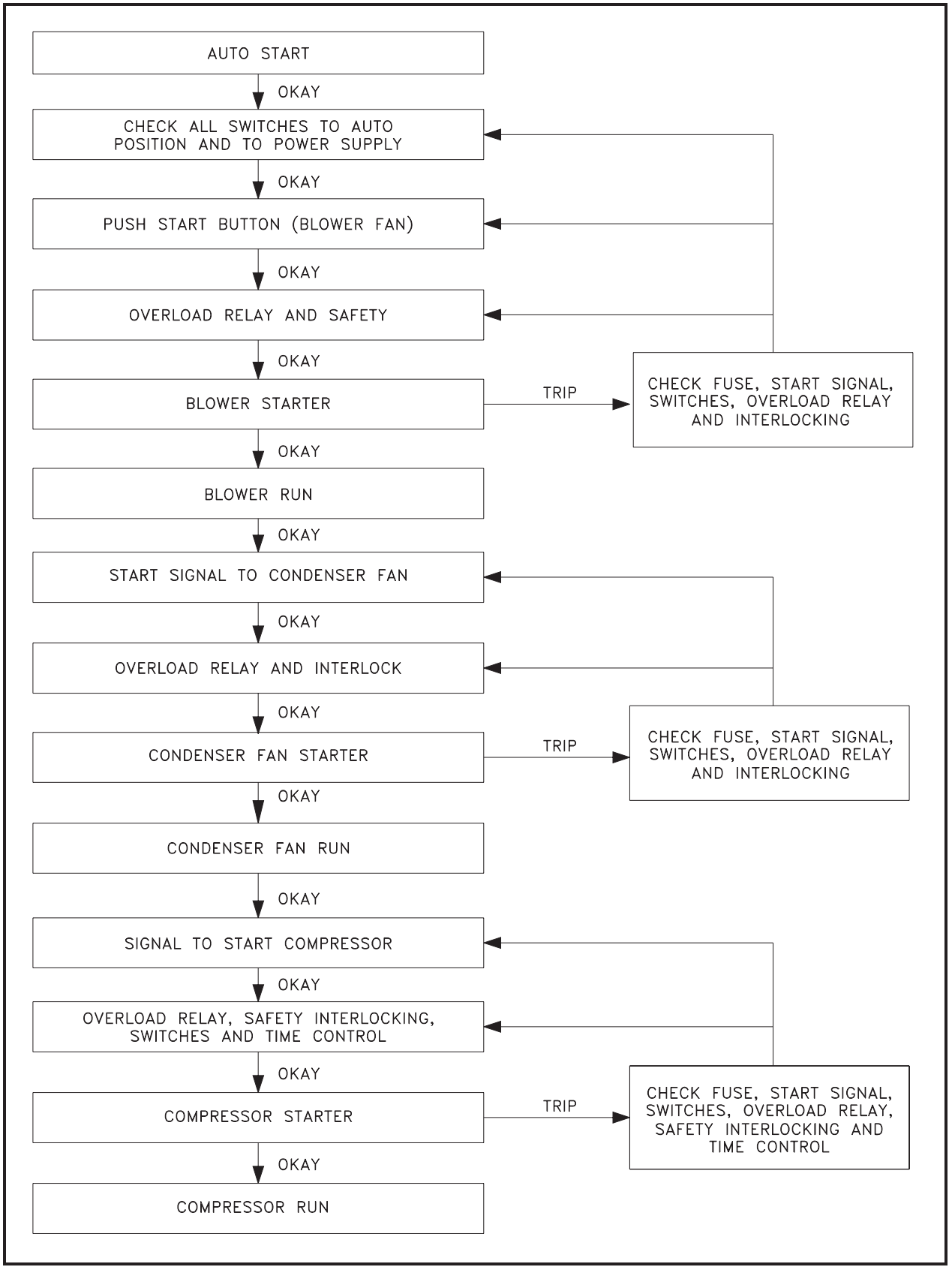
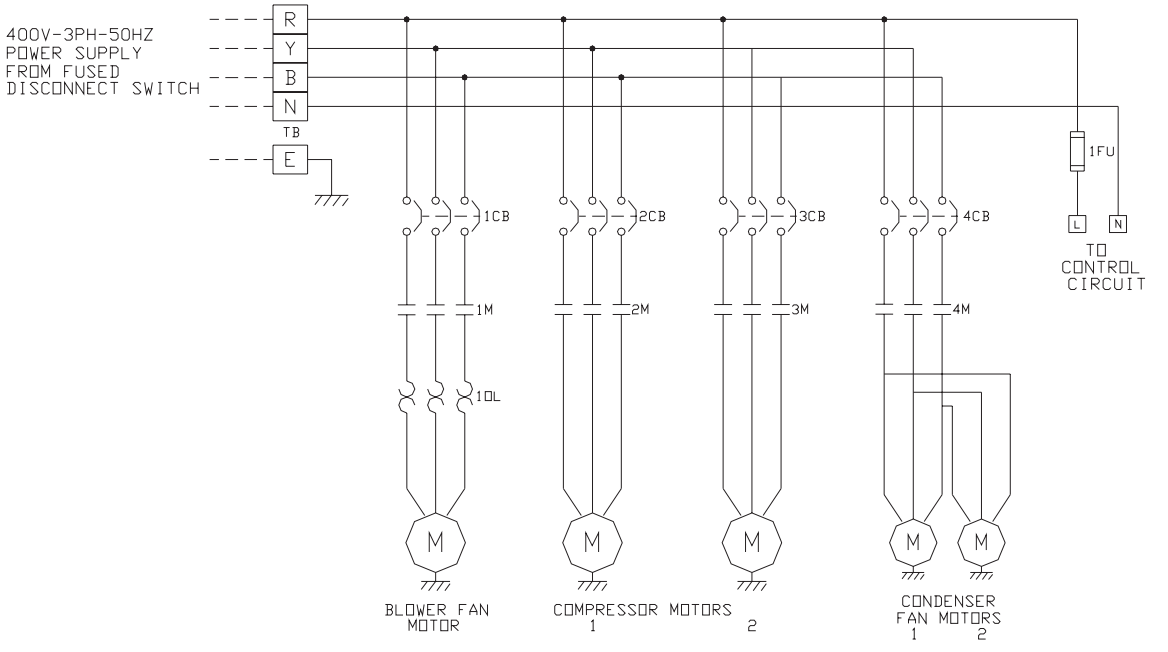
4.0 OPERATION

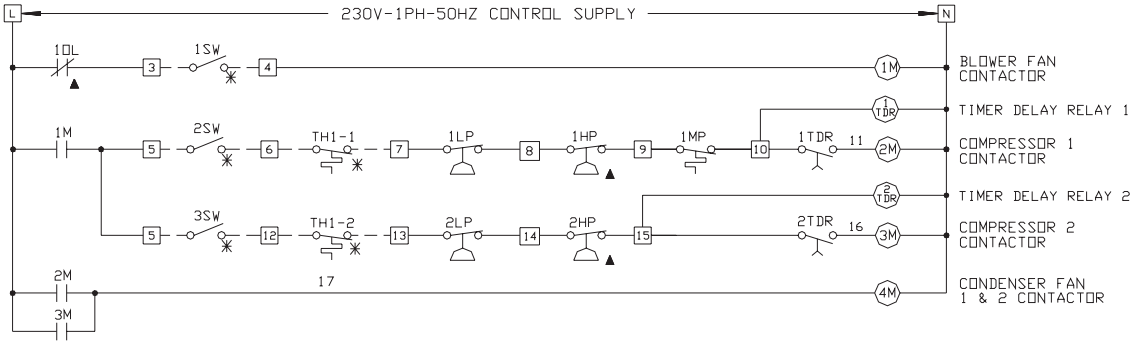
4.1 TYPICAL OPERATING SEQUENCE



4.0 OPERATION

4.2a TYPICAL WIRING SCHEMATIC – COOLING ONLY

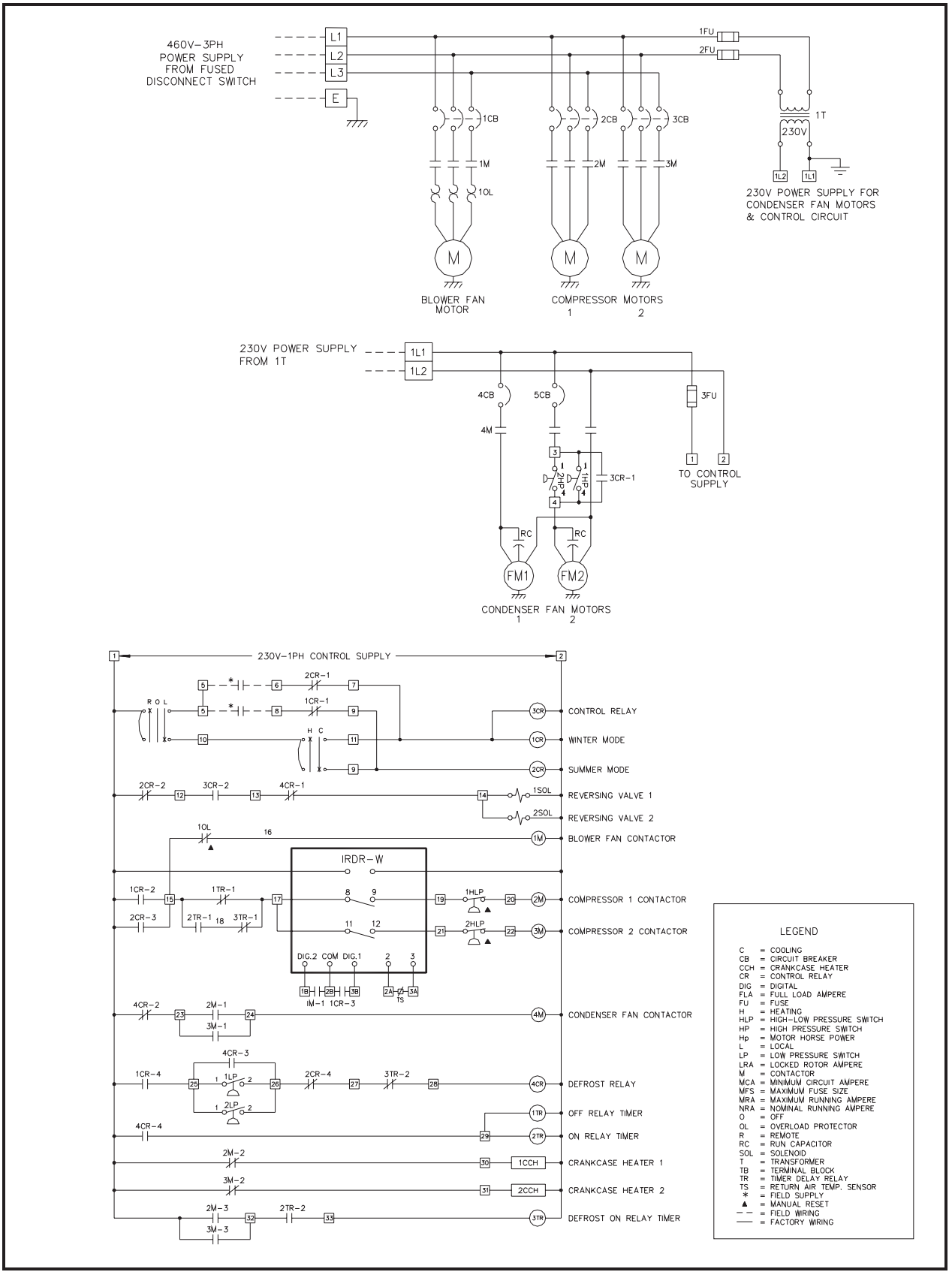




LEGEND

ATH	= AMBIENT THERMOSTAT	MTA	= MAXIMUM MUST TRIP AMPERE
M	= CONTACTOR	NRA	= NOMINAL RUNNING AMPERE
CB	= CIRCUIT BREAKER	OL	= OVERLOAD PROTECTOR
FLA	= FULL LOAD AMPERE	RLA	= RATED LOAD AMPERE
FU	= FUSE	SW	= SWITCH
Hp	= MOTOR HORSE POWER	TB	= TERMINAL BLOCK
HP	= HIGH PRESSURE SWITCH	TDR	= TIMER DELAY RELAY
LP	= LOW PRESSURE SWITCH	TH	= THERMOSTAT
LRA	= LOCKED ROTOR AMPERE		
MCA	= MINIMUM CIRCUIT AMPERE	✳	= FIELD SUPPLY
MFS	= MAXIMUM FUSE SIZE	▲	= MANUAL RESET
MP	= MOTOR PROTECTOR	- - -	= FIELD WIRING
MRA	= MAXIMUM RUNNING AMPERE	——	= FACTORY WIRING

4.2b TYPICAL WIRING SCHEMATIC – HEAT PUMP



4.0 OPERATION

4.3 PHASE ROTATION

If during initial start up the compressor does not build up pressure, noise is abnormally loud and power consumption is minimal, then there is a possibility that the unit is operating at reverse rotation. Shut down the power and connect phase to the proper terminals.

4.4 CYCLE LIMIT RATE

Each compressor must not be cycle on-off for more than 12 times per hour. The higher number of starts per hour will reduce the life of the compressor. Thus, it is suggested that anti short cycle timer is provided in the system.

4.5 FAN CYCLING (HEAT PUMP)

During cooling only, the head pressure control would allow the unit to operate at lower ambient temperature by building up the discharge pressure through cycling of fans (for single fan unit, this is achievable by reducing the fan speed). If there is demand for cooling, the unit would run on cooling until the manual change over is set to heating. Please observe the lowest ambient for cooling mode.

4.6 DEFROST CYCLE (HEAT PUMP)

During heating, a defrost controller would initiate the defrost cycle once there is demand for it. The sensor from the controller would sense the suction pressure and if the pressure is lower then the preset value, then a signal would be sent to the control panel which then relay the signal to the reversing valve to reverse the cycle. Now, the outdoor coil would be discharging hot air and defrosting the ice on the fins surface. The standard factory set timer for the defrost cycle is 10 minutes which could be adjusted according to the site condition.

4.7 CRANKCASE HEATER (HEAT PUMP)

Refrigerant tend to migrate to colder section of the unit. During winter, the compressor compartment is at lower temperature than the evaporator and thus refrigerant tend to accumulate in the compressor compartment. Connect power source to the unit a few hours prior to compressor start up so that the refrigerant would be forced out of the compressor compartment. It is good practice to let the crankcase heater to be energized continuously, independent of compressor operation.

4.8 STOP VALVE

Inspect all stop valves prior to start up. They shall be in open position.

4.9 HYDROPHILIC CONDENSER COIL (STANDARD FOR HEAT PUMP)

Hydrophilic fins assist condensation to be removed faster and therefore reduce the possibility of icing on the coil.

5.0 MAINTENANCE

5.1 MAINTENANCE

The AP.BDQTCQ are designed to provide years of services with minimum maintenance. Nonetheless, it is a good practice to carry out regular inspection and checking to ensure the unit's optimum performance. The following schedule is only meant to be a guide. Actual maintenance schedule for each installation shall depend upon the duty usage, the cleanliness of the surrounding environment, and the cleanliness of the spaced to be air-conditioned.

ITEM	MAINTENANCE PROCEDURE	RECOMMENDED SCHEDULE
Air Filters	1. Washable type. 2. Clean with a vacuum cleaner or tapped lightly and then wash in luke warm water (below 40°C [104°F]). 3. Make sure the filter is dry.	Once a month or depending upon the condition of the circulated air.
Belt	1. Check the tension and alignment. 2. Move the motor if the belt is loose.	Once every six months.
Pulley	1. Make sure the set screws are properly tightened and there is no crack on the pulley.	Once every six months.
Blower	1. Turn the blower manually. It should run smoothly and there is no excessive bearing noise.	Once every six months.
Bearing and Shaft	1. Check for evidence of wear.	Once a year.
Bolts, Screws and Nuts.	1. Tighten any loose components.	Once a year.
Coil	1. Check and remove clogged item between fins.	Once a year.
Paint	1. Check any evidence of corrosion.	Once a year.
Compressor	1. Check if there is any leakage.	Every six months.
Electrical	1. Check voltage, current and wiring. 2. Check connections.	Every two months.
Drain Pan and Pipe	1. Pour some water into the drain pan and let the water run through. If the pipe is clogged, remove the dirt.	Every six months.

5.2 TIGHTENING OF PULLEY SET SCREW

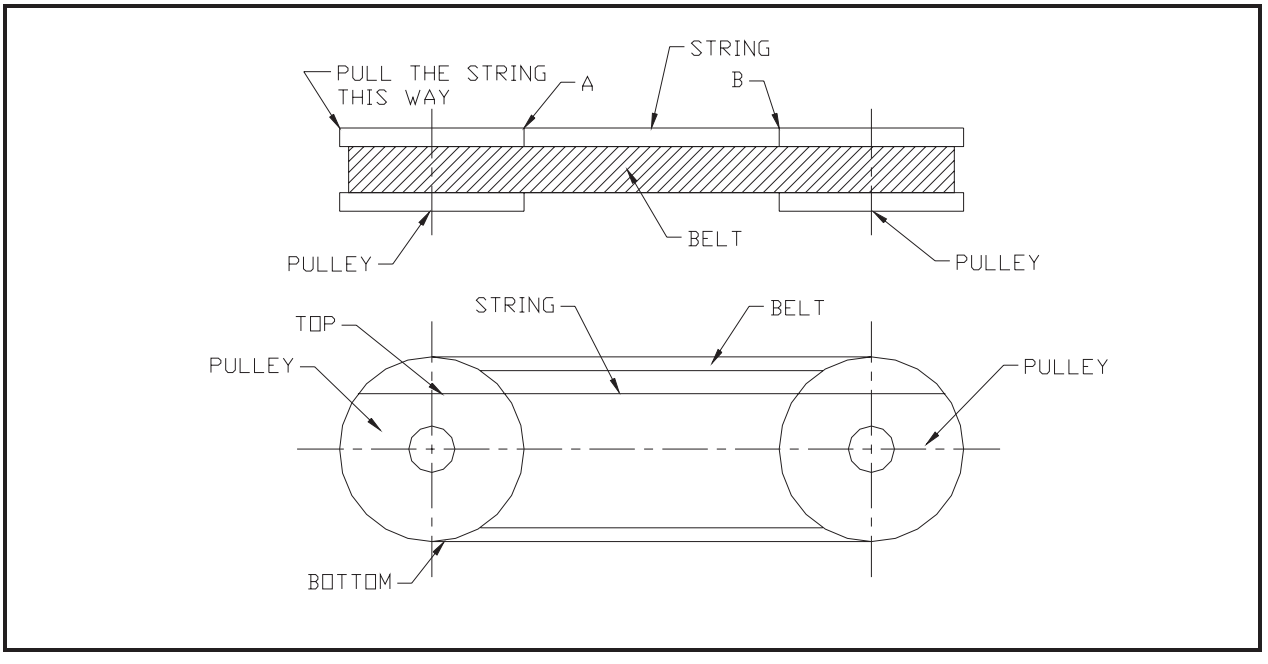
Apply one or two drops of thread locker 243 to the engagement area of set screws before tightening to the pulleys according to the recommended torque.

Set Screw Size - Inches [mm]	Tightening Torque (NM)
5/16 [7.9]	13
3/8 [9.5]	26

5.3 PULLEY ALIGNMENT

1.) Insert one end of the string inside the gap between belt and pulley.
2.) Rotate the pulley so that string is clipped between the pulley and the belt.
3.) Pull the other end of the string as per Figure 5.3.
4.) Inspect for any gap between the string and pulley at A and B.
5.) If any gap was found, then adjust either pulley to make the gap as small as possible.
6.) Repeat steps 1, 2, 3, 4 and 5 for bottom of the same side, top and bottom of the other side. (As shown as Figure 5.4)

Figure 5.3:



5.4 BELT TENSION INSPECTION GUIDE

When installing or replacing belts, always use a complete set of new belts. Mixing old and new belts will result in the premature wear or breakage of the newer belts.

Correct tensioning of V-belts drive is carried out as follows,

1. Fit the belts into the grooves and increase the centre distance until the belts are snug.
   (Note: Never lever belts over sheaves)
2. Tighten belts and equalize belt slack so that it is on the same side of belt for all belts. Failure to do so may result in uneven belt stretching.
3. As shown in Figure 8, measure the span length (mm) of the drive. Determine the deflection at the centre of the span according to the table below.

Belt Span (mm)	Deflection (mm)
250-300 310-360 370-420	4 5 6
430-480 490-540 550-600	7 8 9
610-660 670-720 730-780	10 11 12
790-840 850-900 910-960	13 14 15
970-1020 1030-1080 1090-1140	16 17 18

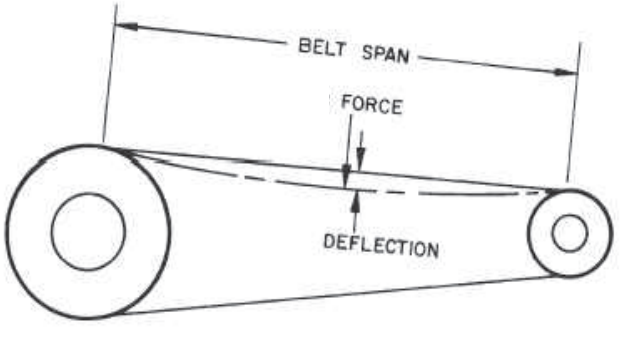


FIGURE 5.4

4. From table below, find the appropriate deflection force according to belt type. The deflection force for any V-belt should be within the minimum and maximum force shown in the table. When the tension drops to the minimum value, readjust to the maximum value.

Deflection Force (Kg)								
Belt Type	SPZ		SPA		SPB		SPC	
Diam. Of smaller sheave (mm)	Min.	Max	Min.	Max	Min.	Max	Min.	Max
63-80	1.2	1.9	-	-	-	-	-	-
90-112	1.6	2.4	1.9	2.9	-	-	-	-
125-160	1.9	2.8	2.6	4.0	3.3	5.0	-	-
180-224	1.9	2.9	3.0	4.6	4.3	6.4	5.8	8.7
250-355	-	-	3.2	4.8	5.1	7.7	7.9	11.9
400-630	-	-	-	-	5.5	8.2	10.3	15.4

Note: A new drive should be tensioned to the higher value. After the drive has been running for 30 minutes, the tension should be checked and readjusted to higher value.

5.5 LEAK TEST (SYSTEM PRESSURE TEST)

1.) Leak test pressure is at 200 psig [1380 kPa]. Disconnect or shut off all valves which may be damaged by 200 psig [1380 kPa] test pressure.

2.) Open all valves in system so that entire system can be pressurized and connect refrigerant cylinder to charging connection.

3.) Charge in freon vapor to the only in system. Partially charge the systems until 50 psig [345 kPa] and then pressurize with dry nitrogen until 200 psig [1380 kPa]. Stop charging gas if noise of escaping gas is heard. Skip to sequence (6.)
Caution: Always use inert gas such as Nitrogen for testing. Never use other gases such as Oxygen or acetylene which may be flammable.

4.) With pressure at 200 psig [1380 kPa], shut off the valve connecting nitrogen cylinder to the system. Disconnect nitrogen cylinder and leave pressure gauge indicating 200 psig [1380 kPa] connected to system.

5.) With halide torch or electronic leak detector, leak check every flange, joint, relief valve, pressure control, coils and headers. Mark every leak and record down as remarks.

6.) When all leaks have been found, release the charge to prevent refrigerant accumulation around the system.

7.) Repair all leaks (check off on your remarks): If rebrazing is required, feed nitrogen through into the system at slightly excessive pressure (leave system open and make sure nitrogen flows through).

8.) After repairing leaks, re-check as per procedure 1 through 7.

9.) When system tight after leak test, keep pressurized at 200 psig [1380 kPa] and hold for 12 hours. Drops in pressure should be negligible (some may be due to temperature change only.)

10.) Leak check again.

11.) When system is tight, proceed with vacuum test and dehydration.

5.6 VACUUM TEST AND DEHYDRATION

The purpose of evacuation is to evacuate the system when it is known or suspected that the system has been exposed to atmosphere, and there is a possibility that moisture has entered the system.

1.) Blow-off charge or pump down the refrigerant.

2.) Connect vacuum pump to the liquid line valve and carefully check the unit piping to ensure all passages are open. (NEVER USE SYSTEM COMPRESSOR TO EVACUATE).

3.) Start vacuum pump operation and pull vacuum to about 2 to 2.5 mm Hg [0.26 to 0.33 kPa] absolute pressure. During evacuation the pressure may remain steady for sometime at about 0.5 inch or 12 mm Hg [1.69 kPa] absolute pressure. This is caused by moisture evaporating in the system. This "boiling off" or "evaporation period" last about the same time as it took from initial start to reach this point.

4.) When the "boiling off" period lasts longer that indicated under 3, break vacuum with refrigerant or nitrogen gas to sweep moisture out and evacuate and dryer shells, etc., up to a temperature of 100°F [37.8°C].

5.) Break vacuum with refrigerant or nitrogen gas until pressure is 0 psig [0 kPa].

6.) Re-evacuate to 1 mm Hg [0.133 kPa] absolute pressure.

7.) Disconnect vacuum pump and leave system standing for 6 hours. There should be no change in vacuum during this period. If there is a change repeat 1 to 7.

5.7 REPLACEMENT OF DRIERS OR SIGHT GLASS

1.) Break vacuum with nitrogen.
2.) When permanently brazed drier or sight glass is used, open one valve on system to atmosphere while maintaining slight nitrogen flow.
3.) When flare connected drier or sight glass is used, use similar procedure as under 2. However, no valve need to be left open to atmosphere.
4.) When replaceable dryer core is used follow procedure as under 3. Insert drier core(s). Tighten cap screws.
5.) Re-evacuate system to 1 mm Hg [0.133 kPa] absolute.

5.8 CHARGING

1.) Connect refrigerant cylinder through charging connection to charging valve.
2.) Loosen flare nut on other end of charging connection and blow air out with refrigerant. Tighten flare nut on charging connection.
3.) Weight refrigerant cylinder.
4.) Open charging valve and charge in refrigerant vapor through suction access valve until about 150 psig [1034 kPa]. Switch to liquid line access valve and charge in liquid refrigerant. Continue charging with liquid refrigerant until clear glass is observed.
5.) Shut off refrigerant charging valve but keep connected. Check charging valve flare nut for leak. Check and record down discharge and suction pressure. If more than one system to be charged, follow procedure 1 through 4 for each system. After all the systems have been done up to step 4, proceed with 5 and 6.
6.) Shut off the system (compressor, fans, pumps) and leave for 24 hours.

5.9 LUBRICATION

5.9.1 COMPRESSOR

Use POE (Polyol ester) oil for HFC refrigerants (R134a, R407c etc) compressors. Please refer to compressor name plate for original oil charge. Recharging shall be 118ml less than the original charge.

5.9.2 BLOWER BEARING

The fan bearing should be lubricated in accordance with manufacturer's recommendation:
a.) Fan equipped with deep grooved ball bearing inserted in rubber damper has sufficient high-grade grease sealed in at the time of manufacture, there is no need for replenishment.
b.) The pillow block housing has lubrication point can be lubricated when required refer to below table for greasing interval and grease amount accordance to factory recommendation: -

i) Relubrication Schedule

Relubrication Schedule in Month *							
Bore (mm) RPM	25 and below	From 26 to 35	From 36 to 45	From 46 to 55	From 56 to 65	From 66 to 75	From 76 to 85
750	24	18	12	12	8	8	8
1000	18	12	12	8	8	6	6
1250	18	12	8	8	6	6	6
1500	12	8	8	6	6	4	4
1750	12	8	6	6	4	4	2
2000	12	8	6	4	4	2	2
2250	8	6	6	4	2	2	2
2500	8	6	4	4	2	2	2
2750	8	6	4	4	2	2	2
3000	6	4	4	4	2	2	2
3250	6	4	4	4	2	2	2
3500	6	4	4	2	2	2	2
3750	6	4	4	2	2	2	2
4000	6	4	4	2	2	2	1

Note: Suggested greasing interval is based on 12 hour per day operation.
For continuous (24hour) operation, decrease greasing interval by 50%.

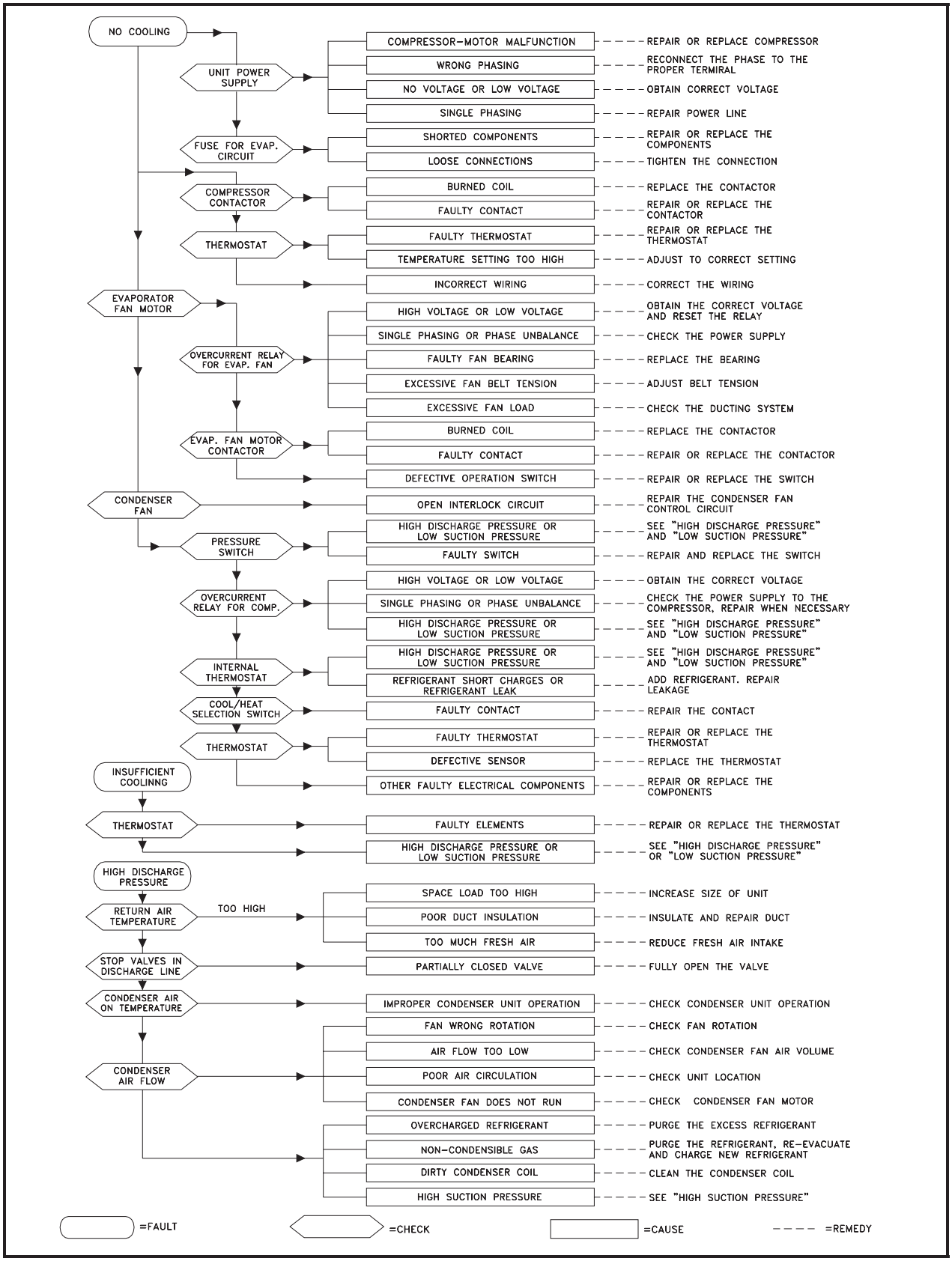
ii) Amount of recommended grease for ball bearing unit. (Recommended grease: Shell Alvania RL2, GOLD No. 3 or equivalent).

Bore Dia Code (Refer to the code casted on the bearing housing)	Grease Amount (g)
206	3.3
207	4.5
208	5.6
209	6.5
210	7.7
211	10.3
212	13.2
213	14.9
214	18.2
215	21.0
216	25.0
217	31.0
218	38.0

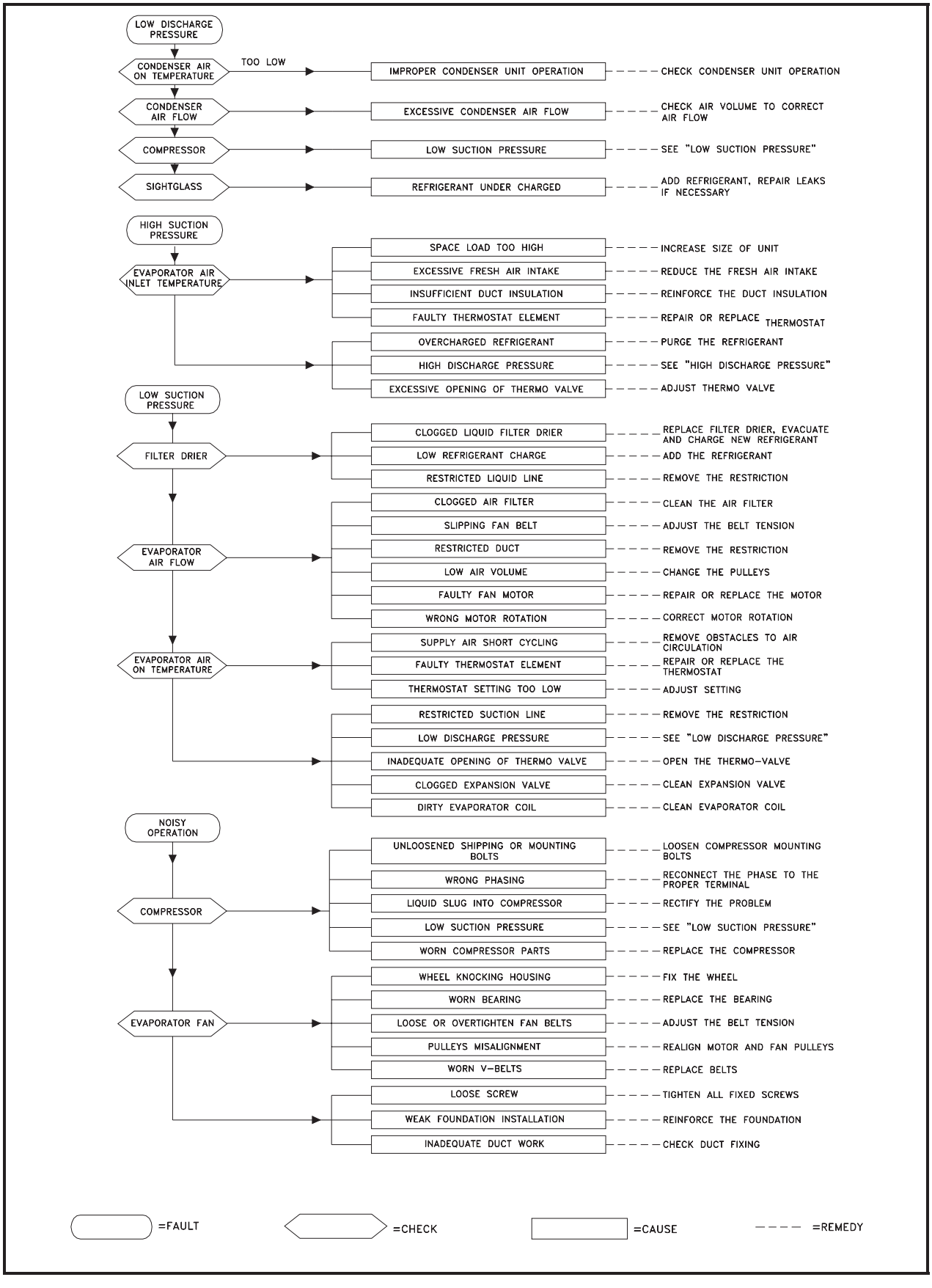
CAUTION: DO NOT exceed the initial greasing amount. Excessive and inadequate greasing may cause failure.
Note: The bearing should be relubricated while they are rotating and pumped in slowly until a slight bead forms around the seals.

5.0 MAINTENANCE

5.10 TROUBLE SHOOTING CHART



5.0 MAINTENANCE



5.14 OPERATING PARAMETERS

Job Name_____ Unit Model_____ Date_____

Job Location_____ Unit Serial No._____ F/O_____

					Actual	Controller Setpoint	-
GENERAL		Room Temperature		°C			-
	Evaporator	On Coil	(Dry Bulb)	°C		-	-
			(Wet Bulb)	°C		-	-
		Off Coil	(Dry Bulb)	°C		-	-
			(Wet Bulb)	°C		-	-

					System 1	System 2	System 3
SYSTEM	Pressure	Suction Pressure		bar			
		Disch. Pressure		bar			
		Liquid Pressure		bar			
	Temp	Suction Temp		°C			
		Disch. Temperature		°C			
		Liquid Temperature		°C			
	SSH	Suction Superheat		°C			
		Disch. Superheat		°C			
		Subcooling		°C			
	Condenser	On Coil	(Dry Bulb)	°C			
			(Wet Bulb)	°C			
		Off Coil	(Dry Bulb)	°C			
			(Wet Bulb)	°C			

ELECTRICAL	Amperage	Blower Fan		A			-		-			
		Compressors		A	System 1		System 2		System 3			
		Condenser Fans		A	1	2	3	4	5	6		
	Voltage	L1~L2		V								
		L1~L3		V								
		L2~L3		V								

REMARKS

_____

_____

_____

DETAILS OF STARTUP ENGINEER

_____
SIGNATURE

_____
NAME/TITLE

_____
COMPANY

_____
ADDRESS

_____
CONTACT NO.

CUSTOMER ACCEPTANCE OF STARTUP

_____
SIGNATURE

_____
NAME/TITLE

_____
COMPANY

_____
ADDRESS

_____
CONTACT NO.