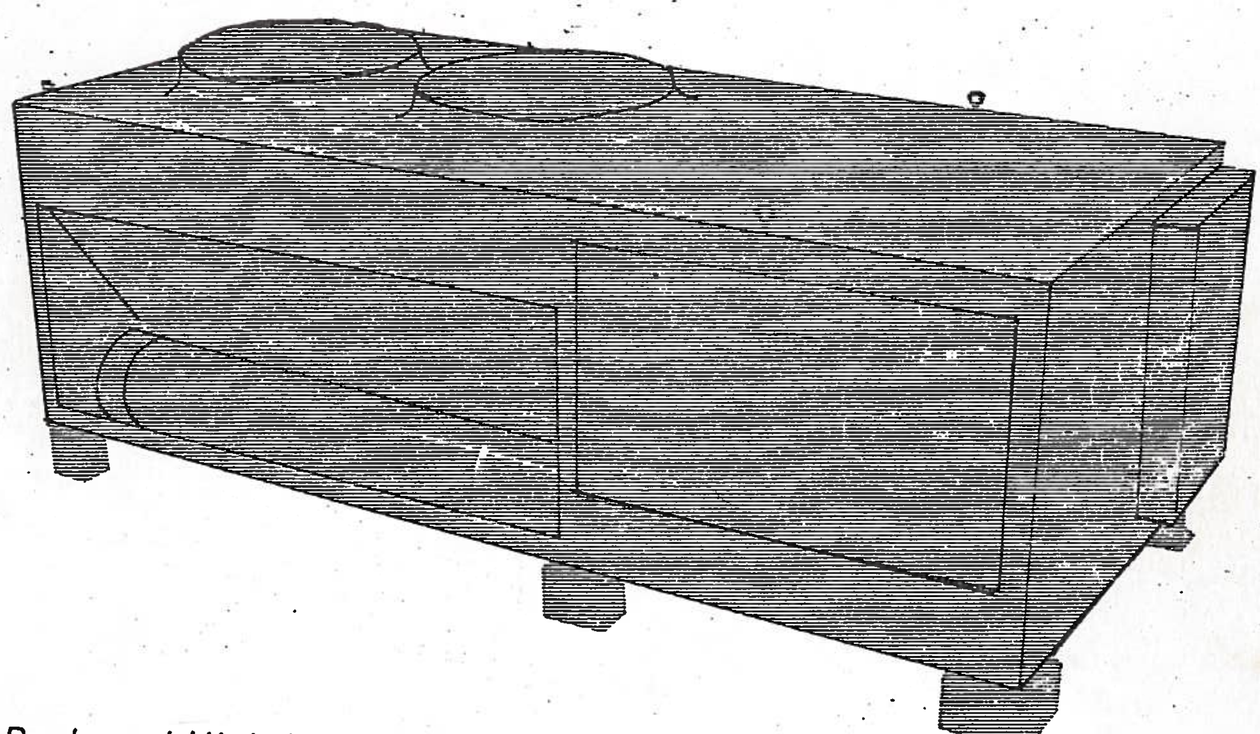
INSTALLATION AND OPERATING INSTRUCTIONS

Air-Cooled Condensing Units



Packaged High-Sides for R12, R22 and R502

KPSC Single Compressor 3-40 hp
KPPC Parallel Compressors 15-70 total hp
KPDS Dual System—Two 7.5-35 hp systems in one frame

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KP - AIR COOLED CONDENSING UNITS

I RECEIPT OF EQUIPMENT

1. DAMAGE CHECK

All equipment should be carefully checked for damage as soon as it is received. If any damage is evident a notation must be made on the delivery receipt before it is signed and a claim should then be filed against the delivery carrier. Also see I-6, loss of gas holding charge.

2. HANDLING

Never hoist a unit from any point excepting the lifting rings provided for this purpose. If at all possible, move the unit to its final location before uncrating and removing from skids.

3. LEVELING AND BOLT DOWN PROCEDURE

A solid level foundation should be provided for the unit large enough to accommodate all of the base feet. If the mounting location is not sturdy and perfectly level, carefully check the space under the feet at various points before bolting down, and place shims under low points before tightening down hold-down bolts. Improper bolting-down procedure can seriously warp the framework, particularly of the large 3, 4 and 5 condenser fan units.

4. CHECK VOLTAGE

Carefully check nameplate voltage and current characteristics to be sure the power available agrees with that for which the unit is designed. Knockout in electrical enclosure to be made adjacent to terminal board strip.

5. COMPRESSOR LOCATION

Large air-cooled condensing units dissipate a tremendous amount of heat and require large volumes of air. If the location is in the middle of a large flat roof, or in such a position that the air to reach the condenser must travel over a hot roof area, excessive head pressure and high power consumption will result.

6. LOSS OF GAS HOLDING CHARGE

Each condensing unit is evacuated to remove moisture, leak tested, and then shipped with a gas holding charge. This holding charge must be evacuated along with the system prior to charging. Loss of this holding charge indicates a leak has developed in transit. The system should not be charged until the source of this leak is found. SEE PRESSURE TESTING SEC. II-3

7. CHECK COMPRESSOR

The compressors are bolted to the frame of the condensing unit using solid mounting techniques. Check the compressor mounting bolts. Tighten these bolts as much as possible to prevent excess vibration.

II REFRIGERATION PIPING

1. IMPORTANCE OF CORRECT SUCTION AND LIQUID LINE SIZES

Undersized lines will create many problems in a refrigeration system. High pressure drop in the suction line robs the system's capacity and causes power bills to be excessive. High pressure drop in liquid line causes flash gas at the expansion valve, which results in coil starving, again causing reduced capacity. On the other hand, lines that are too large will not bring oil back to the compressor. The proper balance is to design suction lines for approximately 1200 ft. per min. velocity in risers and approximately 600 ft. per min velocity in horizontal runs. "P" traps should be installed at the bottom of all risers in suction lines for proper oil return. Horizontal runs should grade slightly toward the "P" trap or to the compressor. Provision must be made for expansion and contraction, especially if there are long runs without any elbows or bends. Suction and liquid lines must be adequately supported at frequent intervals but not anchored so solidly that they cannot move during expansion and/or contraction. Subcooled liquid materially helps to reduce flash gas in liquid lines.

On parallel compressor systems, if one compressor cycles off due to part load conditions, suction lines must be sized to allow for oil return under reduced load conditions.

2. LINE FABRICATION & SOLDERING

Copper pipe should be cut with a wheel type cutter and not a hacksaw. Using a hacksaw produces copper sawdust which can cause problems if it gets into the system. Also, if the pipes to be used are not capped and perfectly clean they should be dragged with a clean lint free rag before fabricating into the system.

Soft solders should be avoided wherever possible as in most cases they require the use of a flux. Most of the low temperature solder flux consists of heavy wax type materials which if allowed to enter the system cause excessive service problems in the form of wax at expansion valves which looks like moisture but cannot be removed by the average drier core. Where silver brazing must be used between copper and brass or copper and steel joints, care should be taken to avoid excessive use of flux lest it be pushed into the system to create problems at a later date. Easy-Flo or silver solders which contain sufficient silver content to still retain joint strength and yet require minimum use of flux are recommended here. For copper to copper joints phos-copper solders with 4 to 6% silver content are recommended. No flux is required, and the resultant joints are of maximum strength without brittleness. Nitrogen should be used to exclude the oxygen within the pipes during soldering in order to prevent the creation of large quantities of copper oxide. Copper oxide is a good abrasive and if it gets into the compressor it can cause excessive wear and/or shorting out of electrical motor windings. A good drier and sight-glass with a moisture indicator should be installed in all systems.

3. PRESSURE TESTING

Test pressures should not exceed 75% of the relief valve setting. A mixture of freon and nitrogen may be used to raise the pressure for leak testing if desired. After the system has been thoroughly tested with a Halide torch it is recommended that an electronic tester be used for final testing. Check all joints, factory as well as field. Shipping damage can produce leaks which would otherwise go undetected.

4. Liquid-suction heat exchangers should be used on all systems where condensing units are installed below the evaporator.

III EVACUATION

NEVER USE THE COMPRESSOR AS A VACUUM PUMP

If voltage is applied to the motor windings of a compressor that is under a deep vacuum a motor burn-out is almost certain.

After the system is thoroughly leak tested be sure all hand valves are open before evacuating. A good two stage vacuum pump is mandatory if moisture is to be removed by evacuation. A single stage pump will not remove moisture. A good electronic vacuum gauge is recommended for vacuum. Connect the vacuum meter to some point on the system, such as the purge connections on the condenser, so the actual vacuum in the system is read rather than the vacuum at the vacuum pump. Use as large evacuation lines as possible, since sixteen times as long is required to pull a given vacuum with 1/4" evacuation lines as would be obtained with 1/2" lines. The vacuum pump should be connected to both high and low sides of the system. A vacuum of 500 microns or lower is an indication that all free moisture is out of the system. If time permits, triple evacuate the system. This is especially recommended for low temperature condensing units. After pulling a vacuum to 500 microns or more, break the vacuum with refrigerant 12 if desired, even though another refrigerant may be eventually used, and reevacuate to 500 microns. Again break the vacuum with refrigerant gas.

Before the final evacuation install the system drier.

IV CHARGING THE SYSTEM

1. NEVER CHARGE LIQUID REFRIGERANT DIRECTLY INTO THE COMPRESSOR SUCTION.

2. The system should be charged through the Schraeder fitting provided on the system drier. When attaching the charging hose to the fitting, allow refrigerant to pass through the hose so air is not sucked into the system. Open the liquid line solenoid valve using the manual lifting stem if so equipped.

   Refrigerant liquid may now be charged directly into the system through the drier. The amount of liquid charged into the system should not exceed the evaporator charge plus 25% of the condenser flooding charge.

   Charge refrigerant gas into the condenser through the Schraeder fitting provided on the condenser inlet header. Open the inlet valve to the receiver.

   Adjust the flooding head pressure control to the lowest pressure. This can be done by removing the cap and turning the setting device counter clockwise. RESET THE LIQUID SOLENOID LIFTING STEM FOR NORMAL OPERATION IF SO EQUIPPED.

   Charging the system in low ambient or a system without condenser fan cycling may require that the condenser air flow be interrupted to build system head pressure. Block the inlet to the condenser with paper or cardboard for this purpose.

   The system may now be started. Additional liquid can be added to the system through the system drier by shutting the receiver outlet valve so liquid is only drawn from the cylinder. Gas can be added to the system through the suction line.

   Since the system is not fully charged, and the safety controls are set (see Table 1A), the cold weather start-up timer (Section V), will probably stop the compressor periodically during final charging. The system will restart by resetting the pumpdown switch.

   If the system is started under low ambient conditions, the suction pressure will be lower than the summer design conditions. If the system is charged until the design suction pressure is attained, a system overcharge is likely.

   The old rule "charge until the sight glass is clear" is not always correct. Generally, the room where the evaporator is located is warmer than the design room temperature. This can overload the expansion valve and liquid line, causing bubbles at the sight glass. We can approximate the total charge required by adding the evaporator charge, the low ambient charge and the liquid line charge.

   Please see Table for approximate condenser flooding charge requirements and Table 3 for liquid line charge. Evaporator operating charge is shown on the certified drawings.

   The system should be short of charge until the room temperature is pulled down. Once the room temperature is at design conditions, finish charging the system. DO NOT OVERCHARGE THE SYSTEM.

V CONTROLS AND STARTUP

1. REFRIGERATION OIL

Texaco WR321 or Calumet R015 oil should be used in all KP units.

2. OIL LEVEL

The oil level should be maintained in the compressor near the center of the sight-glass. Oil level should be checked quite frequently during startup and during the first 48 hours of operating time. KP condensing units are shipped from the factory with a normal oil charge for the compressor and some oil will normally have to be added on startup of the system. Since no dependable rule of thumb can be used, the only safe method is to carefully check the oil level and add oil as needed. If oil is required to be added, an oil pump is recommended to pump the oil directly into the compressor against suction pressure. Refrigeration oil should be purchased in sealed containers and should not be left open to atmosphere. Exposure to air and moisture for extended periods will result in contamination of the oil, and cause harmful reactions in the compressor. Do not transfer oil from one container to another.

3. OIL FAILURE SWITCH

An oil pressure failure switch is installed on each KP compressor. If the system is plagued with oil failure safety switch tripouts, it is almost always traceable to one of the following sources.

a. Shortage of oil in the compressor.
b. Oil trapping in the system.
c. Liquid slugback to the compressor for some cause.
d. Compressor short cycling.
e. Refrigerant in the oil on startup.
f. Malfunctioning oil pump.
g. Lint or dirt on the oil suction screen.
h. Excessively low suction pressure.
i. Possibly a defective control but not probably.
j. Low refrigerant charge in low ambient conditions.

4. CRANKCASE HEATERS

Crankcase heaters are provided to reduce the possibility of refrigerant condensing in the crankcase oil.

NOTE: The use of a crankcase heater installed on the compressor does not always assure that liquid refrigerant will not condense in the oil under severe weather conditions. If the compressor is subjected to extremely low temperatures and the evaporator is in a relatively warm location the temperature at the compressor may still drop below evaporator temperature in which case liquid refrigerant will condense in the oil.

5. HIGH AND LOW PRESSURE CONTROLS

KP's are furnished with individual high pressure and low pressure controls. The separation of the two is for safety purposes so that interlocks can be provided for protection of the system. (see Table 1A for suggested (settings.)

6. LIQUID REFRIGERANT SOLENOID SAFETY LOCKOUT

A relay is provided that will not allow the liquid solenoid to open if any of the safety controls are tripped, such as high head pressure, oil failure safety switch, thermal overloads, or if the system is short of refrigerant charge.

7. COLD WEATHER STARTUP TIMER

When the compressor starts after a shutdown period, a time delay device causes the compressor to run for a predetermined time allowing head pressure to build up and suction pressure to stabalize. This assures liquid refrigerant flow through the expansion valves in sufficient quantities to keep the compressor running. SET TIMER AT 4 MINS. MINIMUM.

8. CONTROL VOLTAGE

Control voltage is 110/120V as standard. A step down control transformer is provided.

9. CHECK CONDENSER FAN ROTATION

All KP high-side systems are factory tested for operation before leaving the plant and direction of rotation of all condenser fans is checked to see that they are the same. However, on installation phase reversals may cause the fans to run backward. If this is not corrected, excessive head pressure will result. On start-up be sure to check that fan rotation is according to arrow decal on unit. Reversing of any two wires on the main 3 phase power supply to unit will change the direction of the fan rotation. Compressor motors can run compressor in either direction.

10. COMPRESSOR COOLING FANS

Compressor cooling fans are provided for all low temperature compressors, or compressors with capacity control. The fan motors have built-in thermal overload protection.

11. PUMPDOWN AND RESET SWITCH

With button out in the reset and pumpdown position, the control circuit is reset and the liquid line solenoid valve is de-energized. This allows the compressor to pump-down on the low pressure control.

With the button in, in the run position, the liquid solenoid valve is energized and allows the system to cycle on the room thermostat.

12. LOW AMBIENT FLOODING CONTROLS ARE STANDARD

Condenser Liquid Flooding utilizes a field adjustable (225 to 65 psig) condensate hold-back valve. See Table 1A for suggested pressure settings.

13. CONDENSER FAN CYCLING

Pressure switches to cycle all but one condenser fan in response to head pressure. See Table 1D for suggested pressure settings used on all multiple condenser fan systems.

VI OPTIONAL FEATURES

1. KOR OIL RETURN SYSTEM

KOR oil return systems consist of an oil separator reservoir with internal float, the compressor oil level float switches, located in an extension on the crankcase. The oil level sight glass is relocated on the extension end. The float switches operate oil fill solenoids located in oil lines between the separator and the crank-case. The separator is electrically heated when the system is off-the-line. At the time of start-up, the system is charged with oil which becomes stored in the separator/reservoir for make-up when the crankcase float lowers and energizes the oil fill solenoid. KOR is standard on KPPC systems.

2. R-22 COMPRESSOR CAPACITY CONTROL

R-22 compressor capacity unloading arrangement for design suction conditions above 25°F. KOR oil return system and cylinder head cooling fans will be provided. Suction lines must be sized for oil return velocities at the reduced capacity.

CAPACITY REDUCTION IS AVAILABLE AS FOLLOWS:

HP	STEPS
20,25,30	50%
35,40	66%, 33%
50,60	50%

Unloader solenoid is actuated by a reverse acting, field adjusted, low pressure control. Not recommended for KPDS or KPPC systems.

VII TROUBLE SHOOTING TIPS

IMPORTANT NOTE:

1. A two minute anti-recycle time delay is built-in to all compressors with the following model suffix designation:

   TSC, TSD, TSK (SEE PAGE 11)

   This is part of the compressor solid state protection module and is not adjustable.

   (a) After a main power interruption, the compressor will not start for two minutes.
   (b) If power voltage is low, the compressor will stop and attempt a restart in two minutes.
   (c) If the room thermostat opens and the compressor pumps down, and shuts off, it will not restart for two minutes even if the thermostat is closed.

2. The system will not restart automatically should a 10 min or longer power interruption occur. Restarting should only be attempted by qualified refrigeration service personnel.

   Start-up Procedure

   (a) Manually unlock and release reset switch and allow the system to pumpdown, being careful not to damage the compressor with liquid slug back.
   (b) When pumpdown is complete, manually lock the reset button in the run position.

3. HAVING TO ADD AN EXCESSIVE AMOUNT OF OIL

   (a) Check expansion valve superheat settings. If the superheat setting on the expansion valve is too high, low suction pressures result causing reduced velocity in the suction lines. Under this condition excessive quantities of oil will accummulate in evaporator and the suction lines. Many apparent oil return problems are due to this cause.
   (b) Check suction line sizes, riser sizes and "P" traps ahead of risers.

4. OIL FAILURE TRIPOUTS

   (a) Oil screen may be partially restricted.
   (b) Check for refrigeration slug-back to compressor. Suction gas temperature at the compressor should have not less than 15 degrees of superheat over the evaporator temperature.
   (c) Refer to #4 under Controls and Startup

5. SYSTEM PURGING

   If the system has been opened for servicing or reason exists to expect that air may have been pulled into the system, it may be necessary to purge the condenser. A Schrader type valve for purging is provided on each Krack-Pak located at the top of the common hot gas inlet header. The system should be shut down in order to purge. Any noncondensables in the system will eventually nigrate and be present at the condenser. If noncondensables are present in the system, a noticeable reduction in head pressure should be observed, after purging.

VIII SERVICE DIAGNOSIS CHART

SYMPTOM	POSSIBLE CAUSE
COMPRESSOR WILL NOT START	1. Low line voltage 2. Blown fuse 3. Tripped circuit breaker 4. Open disconnect 5. Defective solid state module 6. Control circuit open 7. Burned motor windings 8. Open motor windings 9. Shorted motor windings 10. Low refrigerant charge 11. Compressor mechanical damage 12. Single phasing 13. Two minute anti-recycle timer
COMPRESSOR STARTS BUT TRIPS ON OVERLOAD	1. Low line voltage 2. Single phasing 3. Shorted or grounded motor winding 4. Tight bearings or mechanical damage in compressor 5. Damaged discharge valves in compressor 6. Defective overload protector 7. Excessive suction and/or discharge pressure 8. Burned contacts on motor contactor 9. Loose wiring in power circuit 10. Unbalanced three phase voltages
UNIT SHORT CYCLES	1. Low pressure control differential set too close 2. Shortage of refrigerant 3. Compressor discharge valves leaking 4. Liquid solenoid valve leaking 5. Room thermostat located in evaporator discharge air
HIGH HEAD PRESSURE	1. Refrigerant overcharge 2. Condenser fans off 3. Condenser fan rotation reversed 4. Blocked condenser surface 5. Malfunction of winter flooding control valves 6. High suction pressure 7. Noncondensables in system 8. Excessive ambient temperature entering the condenser
HEAD PRESSURE TOO LOW	1. Low ambient temperatures entering the condenser 2. Malfunction of winter flooding control valves 3. Refrigerant shortage 4. Restricted refrigerant flow 5. Damaged valves or rods in compressor 6. Evaporator malfunction

SYMPTOM	POSSIBLE CAUSE
REFRIGERATED SPACE TEMPERATURE TOO HIGH	1. Defective temperature control 2. Refrigerant shortage 3. Restricted refrigerant flow 4. Thermal expansion valve improperly adjusted 5. Evaporator coil iced or dirty 6. Evaporator fan malfunction 7. Compressor malfunctioning 8. Higher than normal load in refrigerated space
LOW OIL PRESSURE	1. Loss of oil from compressor due to: a. Oil trapping in system b. Compressor short cycling c. Excessively low suction pressure d. Insufficient oil in system 2. Refrigerant flood-back to compressure suction 3. Restriction in oil pump inlet screen 4. Malfunctioning oil pump 5. Excessively worn compressor bearings 6. Low refrigerant charge

TABLE 1A CONTROL SETTINGS

SYSTEM		MINIMUM LOW PRESSURE CONTROL SETTING	MAXIMUM HIGH PRESSURE CONTROL SETTING	MINIMUM HEAD PRESSURE CONTROL SETTING
R-12	HIGH	4 psig (-11°F)	200 psig	100 psig
R-12	MEDIUM	2 psig (-16°F)	200 psig	100 psig
R-22	HIGH	20 psig (-5°F)	345 psig	140 psig
R-502	MEDIUM	20 psig (-13°F)	345 psig	155 psig
R-502	LOW	1.9 psig (-45°F)	345 psig	115 psig

1. This pressure setting is the cut-out pressure setting; the cut-in pressure setting will be 5 - 10 psig or more above these settings. These pressure settings are the minimum conditions; the actual conditions should be equivalent to 20°F to 25°F below room design conditions.
2. For ground mounted condensing units, add 0.5 psig to this setting for every foot the evaporator is above the condensing unit. These settings are for systems using flooding type or combination fan cycling and flooding head pressure control.
3. These settings may vary for high ambient temperature design conditions.

TABLE 1D PRESSURETROL PRESSURE SETTINGS
(ABOVE 40^{o}F AMBIENT)

SYSTEM		2 FAN UNIT CUT IN	2 FAN UNIT CUT-OUT	3, 4, 5 FAN UNITS CUT-IN	3, 4, 5 FAN UNITS CUT-OUT
R-12	PC-1	135 psig	110 psig	145 psig	120 psig
	PC-2	-	-	135	110
R-22	PC-1	175	150	195	170
	PC-2	-	-	175	150
R-502 MEDIUM	PC-1	190	165	215	185
	PC-2	-	-	190	165
R-502 LOW	PC-1	150	125	160	135
	PC-2	-	-	150	125

NOTE: WHEN USED WITH FLOODING WINTER CONTROL CUT-OUT SETTING SHOULD BE ABOVE WINTER CONTROL SETTING.

TABLE 3 LIQUID LINE CHARGE

LINE DIAMETER	R-12	R-22	R-502
1/2 INCH	12	13.5	13
5/8	7.5	8.3	7.9
7/8	3.5	4.0	3.8
1-1/8	2.1	2.3	2.2
1-3/8	1.4	1.5	1.5

$$\frac{\text{Liquid line length (feet)}}{\text{Charge factor}} = \text{Liquid line charge (lbs)}$$

TABLE 4 COPELAND COMPRESSORS USED IN KP SYSTEMS

SYSTEM	HP	STANDARD COMPRESSOR	VOLTAGE 208-230	VOLTAGE 440-460	DISCUS COMPRESSOR	VOLTAGE 208-230	VOLTAGE 440-460
R12 HIGH TEMP	3	NRB2-0310	TFC	TFD	-	-	-
	5	MRF2-0500	TFC	TFD	MDA1-0500	TFC	TFD
	8	9RC1-0750	TFC	TFD	9DB1-0750	TFC	TFD
	9	-	-	-	9DF1-0900	TFC	TFD
	10	-	-	-	9DS1-1000	TFC	TFD
	11	4RA3-1000	TSK	TSK	4DA1-1000	TSK	TSK
	15	4RH1-1500	TSK	TSK	4DH1-1500	TSK	TSK
	20	6RA4-2000	TSK	TSK	4DJ1-2000	TSK	TSK
	21	6RH1-2000	TSK	TSK	6DH1-2000	TSK	TSK
R22 HIGH TEMP	3	ERF1-0310	TFC	TFD	-	-	-
	5	NRA2-0500	TFC	TFD	-	-	-
	8	MRH4-0760	TFC	TFD	MDA1-0750	TFC	TFD
	10	9RC1-1010	TLC	TLD	9DB1-1000	TFC	TFD
	15	9RS1-1500	TLC	TLD	9DS1-1500	TSC	TSD
	20	4RA3-2000	TSK	TSK	4DA1-2000	TSK	TSK
	25	4RH1-2500	TSK	TSK	4DH1-2500	TSK	TSK
	30	4RJ2-3000	TSK	TSK	4DJ2-3000	TSK	TSK
	35	6RH1-3500	TSK	TSK	6DH1-3500	TSK	TSK
	40	6RJ1-4000	TSK	TSK	6DJ1-4000	TSK	TSK
	50	-	-	-	8RP1-5000	TSK	TSK
	60	-	-	-	8RS1-6000	TSK	TSK
R502 MED TEMP	4	3RA1-0310	TAC	TAD	-	-	-
	5	NRM1-0500	TFC	TFD	-	-	-
	8	MRH4-0760	TFC	TFD	MDA1-0750	TFC	TFD
	10	9RC1-1010	THC	THD	9DB1-1000	TFC	TFD
	15	9RS1-1500	THC	THD	9DS1-1500	TSC	TSD
	20	4RA3-2000	TSK	TSK	4DA1-2000	TSK	TSK
	25	4RH1-2500	TSK	TSK	4DH1-2500	TSK	TSK
	30	4RJ2-3000	TSK	TSK	4DJ2-3000	TSK	TSK
	35	6RJ1-3500	TSK	TSK	6DH1-3500	TSK	TSK
	40	6RJ1-4000	TSK	TSK	6DJ1-4000	TSK	TSK
	50	-	-	-	8RP1-5000	TSK	TSK
R502 LOW TEMP	3	NRD1-0310	TFC	TFD	-	-	-
	5	MRB1-0500	TFC	TFD	MDA1-0600	TFC	TFD
	6	-	-	-	9DA1-0600	TFC	TFD
	7	-	-	-	9DB1-0750	TFC	TFD
	8	9RS3-0760	TFC	TFD	9DF1-0900	TFC	TFD
	9	-	-	-	9DB1-1000	TFC	TFD
	10	4RA3-1000	TSK	TSK	4DA1-1000	TSK	TSK
	15	4RL1-1500	TSK	TSK	4DL1-1500	TSK	TSK
	20	6RA4-2000	TSK	TSK	4DT1-2200	TSK	TSK
	22	-	-	-	4DT1-2200	TSK	TSK
	25	6RL1-2500	TSK	TSK	6DL1-2700	TSK	TSK
	30	6RT1-3000	TSK	TSK	6DT1-3000	TSK	TSK