Number One Air Conditioning Maker

Carrier

Division of Carrier Corporation

Carrier Parkway • Syracuse, N.Y. 13221

Installation, Start-Up and Service Instructions

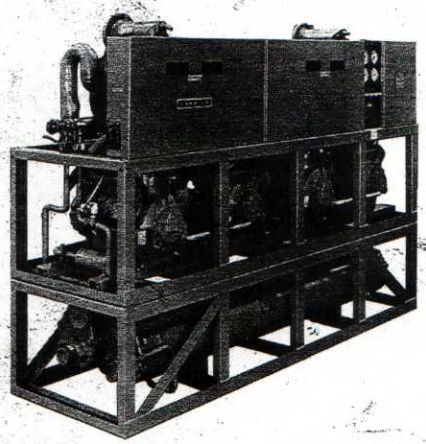
30HR,HS
070 thru 160

→Reciprocating Liquid Chillers

For Model D Units, 30HR,HS070-160

→All 208/230 Volt Units Have Extended-Voltage Compressor Motors

→All Units Have Suction-Cutoff Unloading System



SAFETY CONSIDERATIONS

Installation, start-up and servicing of this equipment can be hazardous due to system pressures, electrical components and equipment location (roofs, elevated structures, etc.).

Only trained, qualified installers and service mechanics should install, start-up and service this equipment.

When working on the equipment, observe precautions in the literature, tags, stickers and labels attached to the equipment and to any other safety precautions that apply.

- Follow all safety codes.
- Wear safety glasses and work gloves.
- Use care in handling, rigging and setting bulky equipment.

WARNING: Be sure power to equipment is shut off before performing maintenance or service.

INSTALLATION

LOCATION

Do not store units in an area exposed to weather because of sensitive control mechanisms and electrical devices. Locate unit indoors.

See Fig. 1 for door clearance. Allow following clearances for service access.

Front	3 to 4 ft
Rear	2 ft
Ends	tube removal at one (either) end, see Fig. 1; 2 ft at opposite end.

Floor must be strong enough to support operating weight (see Table 1). If necessary, add supporting structure (steel beams or reinforced concrete slabs) to floor to transfer weight to nearest beams.

Figure 1 shows location of 6 mounting holes. Each point supports approximately 1/6 of the operating weight.

Do not remove unit from skid until it is in final location. Rig from the 2-in. diam holes in the cooler end flanges. Lower carefully onto floor or rollers. Push or pull only on the skid, *not the unit*. If the unit is moved on rollers, use a minimum of 3, evenly spaced.

Areas where corners will be located must be level before unit is placed. Level unit with spirit level on frame channels. Bolt to floor (recommended for basement or ground floor installations that transmit vibration to ground without affecting building structure).

All compressors have mufflers and are attached rigidly on top of rails mounted on spring vibration isolators. Remove rail mounting bolts so rails float freely on springs. *If bolts are not removed, they may retighten from vibration during operation.*

Interconnecting piping must be flexible enough to prevent vibration transmission. If vibration still occurs, use isolators on unit. If installation is on upper floor where vibration cannot be transmitted to the ground, use field-purchased isolator springs under each unit mounting hole.

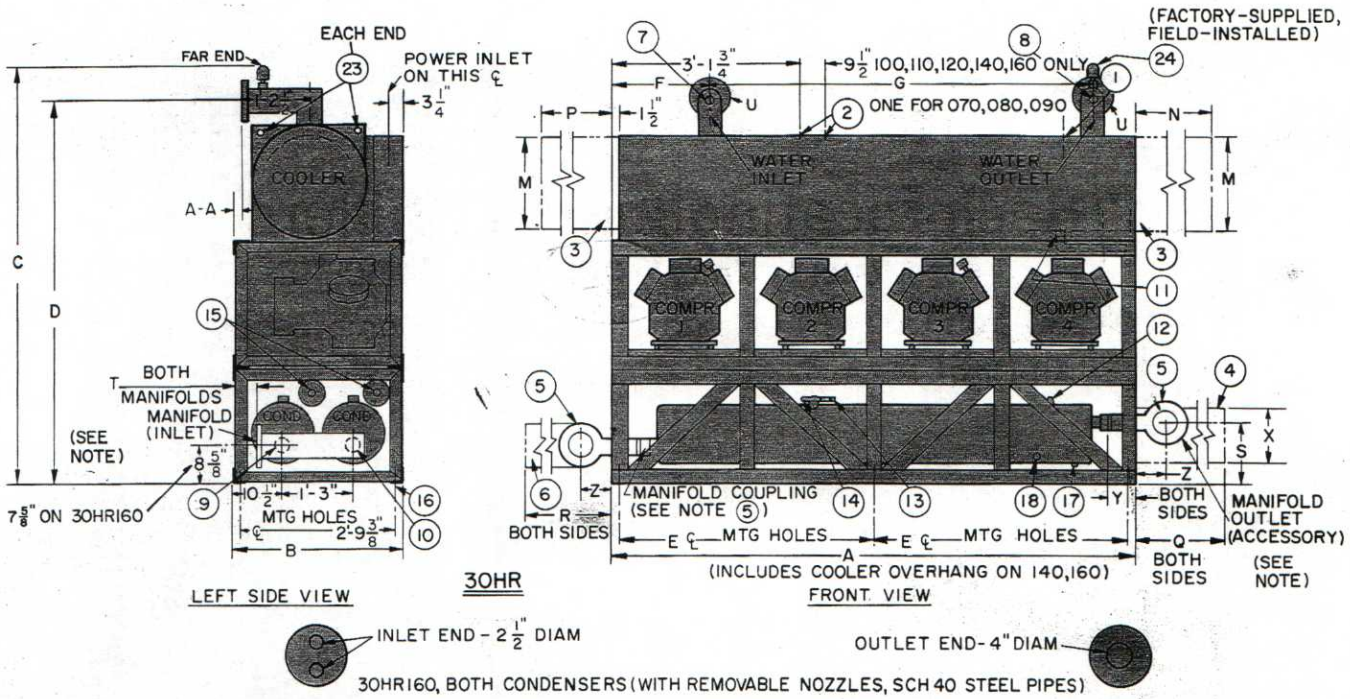
CONDENSER

Run water supply lines as short as possible. Size lines according to head pressure available (not necessarily connection size), especially on cooling tower applications. See Carrier System Design Manual, Part 3, Piping Design.

For installations requiring a water regulating valve, a separate valve is required (not supplied by Carrier) for each circuit. Water bypass valves must be installed on cooling tower applications where low outdoor ambients affect head pressure.

The 30HS units using air-cooled or evaporative condensers should have adequate means for head pressure control when operating below 60 F outdoor ambient.

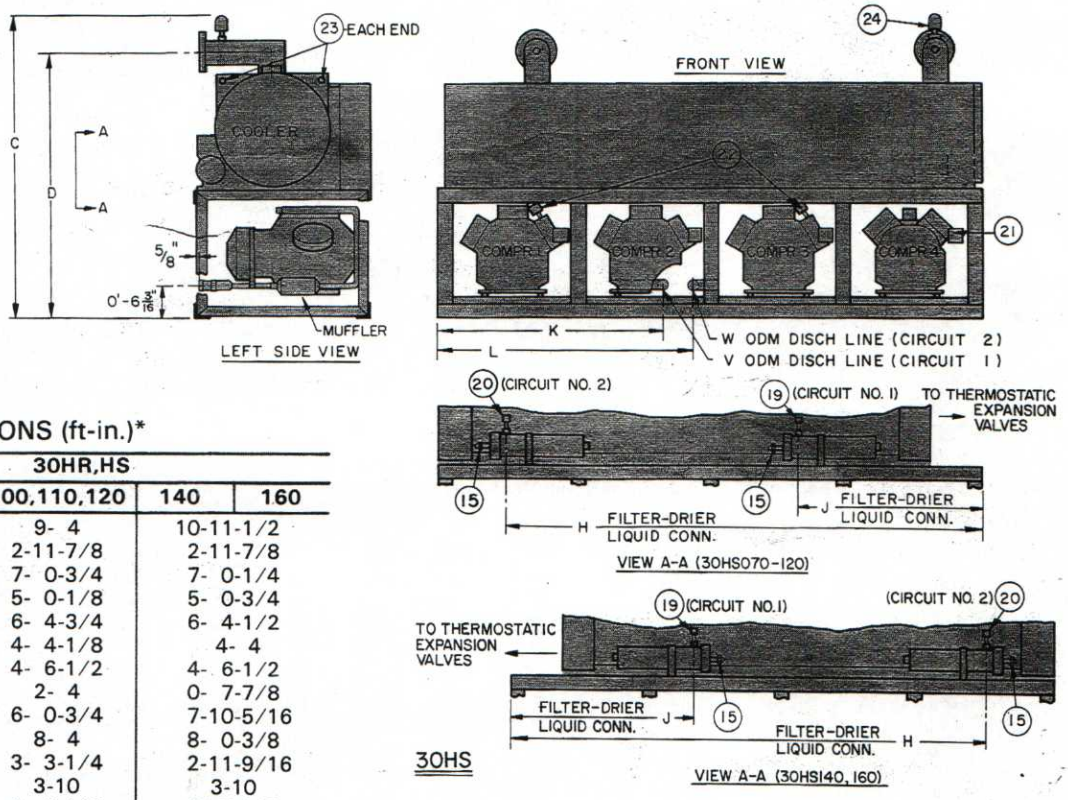
Accessory water manifold packages are available to manifold 2 condensers on 30HR070-140 units. Connections are shown in Fig. 1. Each package



→ NOTE: Accessory manifold inlet and outlet connections:

070-090 units — 4", 150 lb ASA flat-face flange.

100-140 units — 5", 150 lb ASA flat-face flange.



DIMENSIONS (ft-in.)*

DIM.	30HR,HS			
	070,080,090	100,110,120	140	160
A	8-6	9- 4	10-11-1/2	
B	2-11-7/8	2-11-7/8	2-11-7/8	
C (HR)	6- 9-5/8	7- 0-3/4	7- 0-1/4	
C (HS)	4- 9-3/4	5- 0-1/8	5- 0-3/4	
D (HR)	6-2	6- 4-3/4	6- 4-1/2	
D (HS)	4- 2-3/4	4- 4-1/8	4- 4	
E	4- 1-1/2	4- 6-1/2	4- 6-1/2	
F	1- 8-1/4	2- 4	0- 7-7/8	
G	6- 0-3/4	6- 0-3/4	7-10-5/16	
H (HS)	7-10-5/8	8- 4	8- 0-3/8	
J (HS)	3- 3-1/2	3- 3-1/4	2-11-9/16	
K (HS)	4- 6-5/8	3-10	3-10	
L (HS)	5- 0-1/8	4- 3-1/2	4- 3-1/2	
M (Diam)	1-0	1- 3-1/2	1- 5-1/2	
N	6-10-3/4	6- 8	9- 2-1/2	
P	5-11-3/8	5- 5	—	
Q (HR)	6- 6-1/8	6- 1	6- 1	
R (HR)	1-4	1- 4-1/4	1- 4-1/4	
S (HR)	1- 2-3/8	1- 2-1/4	†	
T (HR)	0- 5-1/8	0- 4-3/4	0- 4-3/4	
U (Diam)‡	0-4	0- 5	0- 6	
V (HS)	**	††	0- 2-1/8	

30HR140 only (no manifold on 30HR160).

*Apply to both HR and HS except as noted.
†140: 1-2-1/4; 160: 0-11-3/4
‡150-lb ASA flat-face flanged water connection.

DIMENSIONS (ft-in.)* (Cont'd)

DIM.	30HR,HS			
	070,080,090	100,110,120	140	160
W (HS)	0- 1-3/8	††	0- 2-1/8	
X (HR)	1- 0-1/4	0-11-3/8	1- 0-7/8	
Y (HR)	0- 7-7/8‡‡	0- 5-1/8	0-5-1/8	0-6-5/16
Z (HR)	0- 6-3/4	0- 6-1/2	0- 6-1/2	
AA	0-0	0- 3-1/4	0- 4	

**070: 0-1-5/8; 080: 0-1-5/8; 090: 0-2-1/8
††100: V = W = 0-1-5/8; 110: V = 0-2-1/8, W = 0-1-5/8; 120: V = W = 0-2-1/8
‡‡Inlet End is 0-7-5/8

Fig. 1 — Dimensions

LEGEND (Numbered Callouts) Fig. 1

1 — Two 7/8-in. diameter knockouts in top of control box for any field control wiring from accessory equipment interlocks and for 115-v control wiring.
2 — Power wiring inlet(s).
3 — Space required to remove cooler tubes.
4 — Space required to remove condenser tubes, either end (HR only).
5 — Water manifold (accessory package for HR only). None on HR160. Instructions for field welding included in package. Dimensions "R" and "Z" are nominal.
6 — Space required to remove water manifold, both ends. Not on HR160.
7 — Connection for temp controller bulb, 3/4 FPT.
8 — Connection for freezestat bulb, 1/2 FPT.
9 — Both ends 3-in. diam sch 40 steel pipe (HR only). All but HR160.
10 — Sch 40 steel pipe (both ends). For HR070,080,090: 2-1/2 in. diam; HR100,110,120,140: 3-in. diam.
11 — 3/4-in. MPT water drain conn.
12 — Each condenser: 1/4-in. purge valve (HR only).
13 — Each condenser: 5/8-in. SAE flare relief valve (HR only).
14 — Each condenser: 1/4-in. flare conn for water reg valve (HR only).
15 — On each filter-drier: 1/4-in. SAE flare field charging valve (HS only).
16 — 3/4-in. diameter (6 mounting holes).
17 — Each condenser: 3/8-in. pipe plug drain, each end (HR only).
18 — Each condenser: liquid level test cock (HR only).
19 — 1-1/8 in. ODM refrigerant liquid inlet from condenser (circuit no. 1), HS only.
20 — 7/8-in. ODM (HS070,080,090), 1-1/8 in. ODM (HS100, 110,120,140,160) refrigerant liquid inlet from condenser (circuit no. 2).
21 — Oil Pressure Safety Switch, all compressors (standard on HS only, accessory for HR).
22 — Compressor unloaders.
23 — Rigging holes, 2-in. diam.
24 — Factory-supplied, field-installed chilled water flow switch. See Fig. 2.

contains 2 manifolds, each in 2 sections to be field welded. Manifolds should not be used where regulating valves are required because separate valves must be used on each condenser circuit.

Set water regulating valve to maintain designed head pressure. Do not adjust to compensate for high head pressures caused by fouled condenser tubes, excess refrigerant or the presence of noncondensables. Due to changes in water temperature, it may be necessary to adjust the valve seasonally. After adjusting for designed head pressure, shut unit down. Water regulating valve should shut off flow of water in a few minutes. If it does not, raise head pressure setting. Make sure capillary tube from each water regulating valve is connected to proper condenser purge valve.

Condenser water must enter at bottom connections shown in Fig. 1 for proper operation of internal subcooler located in bottom of condenser.

CAUTION: Retighten all condenser head bolts before filling system with water. Torque bolts to 150-170 lb-ft.

On 30HR units, pressure relief valve is on condenser side. On 30HS units relief valve is factory installed in each refrigerant circuit, after the muffler, and set to relieve at 450 psig. In case of a high pressure cutout failure, valve will open to prevent excessive pressure buildup in refrigerant circuit. Most local codes require that a relief valve be vented directly to outdoors. *The vent line must not be smaller than relief valve outlet.*

Provide means for draining system and for servicing the unit in winter.

On all 30HS units, install a liquid line shutoff valve between each filter drier and condenser.

Table 1 — Physical Data

UNIT AND COMPRESSOR

UNIT 30HR,HS		070	080	090	100	110	120	140	160
APPROX OPER WT (lb)*	HR	4760	4945	5070	6290	6415	6440	7355	7775
	HS	3305	3360	3420	4360	4420	4480	5065	5175
OPER REFRIG CHG (lb)	HR	See Note							
	HS†	15.3			21.0			27.0	
COMPR 06E		Recip Semihermetic, 1750 Rpm							
Cap. Contr Steps		6	6	6	8	8	8	8	8
Total Cyl		14	16	18	20	22	24	24	24
Tot. Oil Chg (pt)		47	52	57	66	71	76	76	76
COND NO. 09RP									
Ckt No. 1‡		043	054	070	054	070	070	070	084
Ckt No. 2‡		033	033	033	054	054	070	070	084

COOLER

COOLER 10HA400	364	194	454
UNIT 30HR,HS	070,080,090	100,110,120	140,160
SHELL, Net Vol (Gal.)**	21.7	40.4	52.4
NO. OF TUBES 5/8-in. OD, Internal Fin Copper	188	258	258
WATER CONN. (in.) Inlet and Outlet††	4	5	6
Drain	3/4		
REFRIG CIRCUITS	2		
MAXIMUM DESIGN WORKING PRESS. (psig)	Refrigerant (tube) Side — 235		
	Water (shell) Side — 150		

CONDENSER

09RP	033	043	054	070	084
TUBES	Integral Fin, 40 Fins/in.				
Number	45	61	61	75	85
Inside Area (sq ft)	41.1	55.7	68.8	84.6	95.4
Outside Area (sq ft)	167.1	226.5	279.7	344.0	387.9
SUBCOOLER TUBES (No.)	5				9
Inside Area (sq ft)	4.6		5.6		10.1
Outside Area (sq ft)	18.5		22.8		41.1
WATER CONN. (in.)					
Inlet	2-1/2		3		2-1/2‡‡
Outlet	2-1/2		3		4
NO. OF WATER PASSES	3				
MAXIMUM DESIGN WORKING PRESS. (psig)	Refrigerant Side — 385				
	Water Side — 250				

Orifice plate at condenser water inlet.

*Includes refrigerant operating charge.

†Cooler operating charge only. Add charge for remote condenser and interconnecting piping.

→ ‡Viewed from front of unit: Rear condenser is circuit no. 1; Front condenser is circuit no. 2.

**Includes nozzles.

††ASA flat-face flange.

‡‡Two inlets on 30HR160 (see Fig. 1). All others have one inlet and one outlet.

NOTE: For 070, 080 and 090 units, the charge is 2/3 in circuit 1 and 1/3 in circuit 2. For units 100, 120, 140 & 160, the charge is half in each circuit. For unit 110, charge per circuit is listed (ckt 1/ckt 2).

Table 2 — Electrical Data

COMPLETE CHILLER

VOLTS		NOM	208/230		460		575		COMPRESSOR USAGE†			
		Supply Range*	187—253		414—508		518—632		Circuit 1		Circuit 2	
									Compressor No.			
UNIT 30		MKW	MCA	MFA	MCA	MFA	MCA	MFA	1	2	3	4
HR	070	73.4	241	300	108	125	93	125	2150	A150	6175	—
	080	82.3	270	350	119	150	105	125	6175	A150	6175	—
	090	91.2	299	350	130	150	117	150	6175	F175	6175	—
	100	103.8	178	250	148	175	129	150	6175	A150	6175	A150
	110	112.7	207 178	250 250	159 —	175 —	141 —	175 —	6175	F175	6175	A150
	120	121.6	207	250	170	200	153	175	6175	F175	6175	F175
	140	155.8	267	400	122	175	111	150	6299	F175	6299	F175
	160	190.0	315	450	147	200	120	150	6299	F299	6299	F299
HS	070	84.7	304	400	128	175	110	150	2250	A250	6275	—
	080	95.3	334	400	144	175	122	150	6275	A250	6275	—
	090	105.9	364	400	160	200	134	175	6275	F275	6275	—
	100	120.0	222	300	177	225	151	175	6275	A250	6275	A250
	110	130.6	252 222	350 300	183 —	225 —	163 —	200 —	6275	F275	6275	A250
	120	141.2	252	350	209	250	175	200	6275	F275	6275	F275
	140	176.8	311	450	134	200	115	150	6299	F275	6299	F275
	160	212.4	358	500	153	200	133	175	6299	F299	6299	F299

INDIVIDUAL COMPRESSORS

VOLTS				208/230			460			575		
UNIT 30		Compr 06E‡	KW	RLA	LRA	MTA	RLA	LRA	MTA	RLA	LRA	MTA
HR	070 thru 120	150 175	21.5 30.4	63 92	283 446	88 128	29 40	142 223	40 56	24 36	98 164	33 50
	140, 160	175 299	30.4 47.5	92 140	446 690	128 196	40 65	223 345	56 90	36 53	164 240	50 73
HS	070 thru 120	250 275	24.7 35.3	82 112	345 506	114 156	33 49	173 253	45 68	29 41	120 176	40 57
	140, 160	275 299	35.3 53.1	112 159	506 690	156 222	49 68	253 345	68 95	41 59	176 240	57 82

■ Two electrical power circuits are required. A separate entrance and a terminal block are provided for each circuit. For 30HR,HS110 units, upper value is circuit 1 and lower value is circuit 2. For other size units, the value shown is same for both circuits.

KW — Maximum Power Input (each compressor)
LRA — Locked Rotor Amps
MCA — Minimum Circuit Amps. Complies with NEC. Section 430-24.
MFA — Maximum Fuse Amps
MKW — Maximum Unit Power Input
MTA — Must Trip Amps (compressor circuit breaker)
RLA — Rated Load Amps

***Supply Range** — Units are suitable for use on electrical systems where voltage supplied to the unit terminals is not below or above the listed range limits.

†Circuits and compressors are numbered from left to right when viewed from the front of the unit. Prefix: 2, 6 — has unloader; A, F — no unloader.

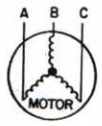
‡Models 150 and 250 are 4-cylinder compressors; models 175, 275 and 299 have 6 cylinders.

NOTES:
1. Compressor motors on all units are thermally protected by over-temperature sensors in the discharge side of the compressor.
2. Maximum allowable phase unbalance: volts, 2%; amps, 10%.
3. Maximum incoming wire size:
   For all voltages:
   500 MCM for 30HR,HS070-160
4. To reduce demand loading during intermediate seasons, 3-compressor units (070-090) have a manual switch (CS) to cut out compressor No. 2. On 4-compressor units (100-160), a switch (CS) is provided to cut out compressor No. 4.
5. All units have a compressor starting sequence transfer switch. *Three-compressor units:* switch position no. 1, *3-1-2;* switch position no. 2, *1-3-2.*
   Four-compressor units: switch position no. 1, *3-1-2-4;* switch position no. 2, *1-3-2-4.*

Unbalanced 3-Phase Supply Voltage — *Never operate a motor where a phase unbalance in supply voltage is greater than 2%.* Use the following formula to determine the % voltage unbalance:

$$\% \text{ Voltage Unbalance} = 100 \times \frac{\text{max voltage deviation from average voltage}}{\text{average voltage}}$$

Example: Supply voltage is 240-3-60



AB = 243 volts
BC = 236 volts
AC = 238 volts

$$\text{Average Voltage} = \frac{243 + 236 + 238}{3} = 239 \text{ volts}$$

Determine maximum deviation from average voltage:

(AB) 243 — 239 = 4 volts
(BC) 239 — 236 = 3 volts
(AC) 239 — 238 = 1 volt

Maximum deviation is 4 volts. Determine % voltage unbalance:

$$\% \text{ Voltage Unbalance} = 100 \times \frac{4}{239} = 1.7\%$$

This amount of phase unbalance is satisfactory as it is below the maximum allowable of 2%.

IMPORTANT: If the supply voltage phase unbalance is more than 2%, contact your local electric utility company immediately.

CHECK VALVES

Two in-line check valves, one for each refrigerant circuit, are shipped loose with each 30HS unit for field installation in discharge piping to remote condenser(s). Mount each valve *close to the unit, in a horizontal position, with the bonnet up.*

FLOW SWITCHES

For each unit (30HR,HS070-160), a flow switch is factory provided, but must be field installed. For installation, attach conduit as shown in Fig. 2.

IMPORTANT: Flow arrow on side of chilled water flow switch must point toward flange on OUT nozzle. The 2 black wires from conduit are attached to the chilled water flow switch terminals as shown in Fig. 2.

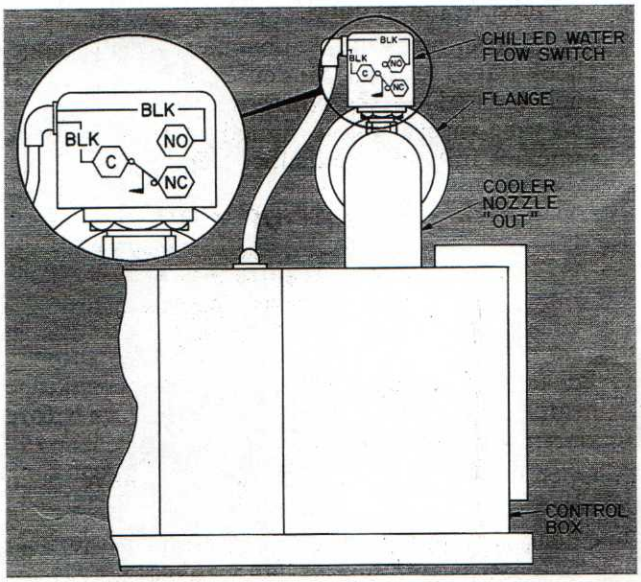


Fig. 2 — Chilled Water Flow Switch Installation

COOLER

Cooler water inlet and outlet connections are standard 150 pound ASA flanges (see Fig. 1). Chilled water temperature controller sensing bulb is factory installed in the *return* water nozzle for *return* water control.

If *leaving* water control is required, cams in controller must be reset and the sensing bulb must be installed in the *leaving* water nozzle. *Otherwise, do not relocate bulb.*

See Carrier System Design Manual, Part 3, piping Design for chilled water piping details.

Plan piping for minimum number of changes in elevation. Install manual or automatic vent valve at high points in line. Maintain system pressure by using a pressure tank or combination relief and reducing valve.

Install thermometers in entering and leaving lines. Provide drain connections at all low points to permit complete drainage of system. Connect shutoff valve to drain line before operating unit. Install shutoff valves near entering and leaving water connections. Use flexible connections on condenser and cooler piping to reduce vibration transmission.

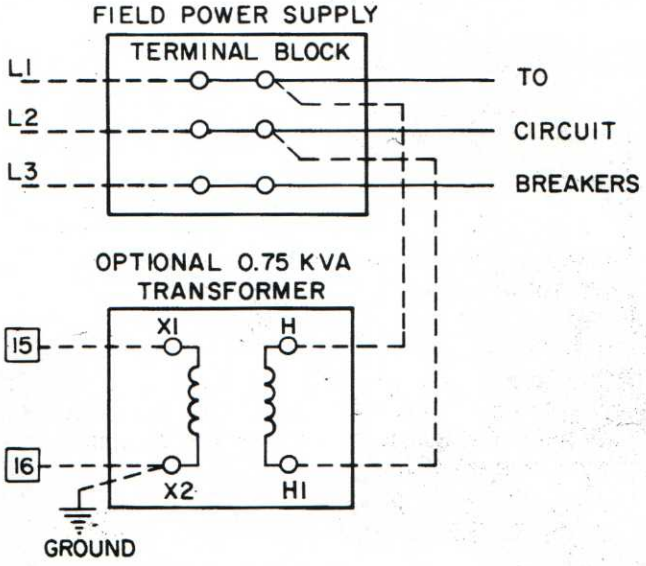
Insulate piping after leak testing to prevent heat gain and sweating. Cover insulation with moisture seal.

ELECTRICAL

All field wiring must comply with local code requirements. Electrical data for the complete unit and for individual compressors is in Table 2.

Control circuit voltage is 115 volts for all 60-Hertz units. Accessory transformer permits control power to be taken directly from unit power terminal block (see Fig. 3). Transformer wiring instructions are furnished with accessory package.

All units, for all voltages, are wired for across-the-line start.



Connection details furnished with accessory transformer package.

Fig. 3 — Accessory Transformer Connections

START-UP AND SERVICE

INITIAL CHECK

IMPORTANT: Do not attempt to start chiller, even momentarily, until the following steps have been completed.

1. Electrical power source must agree with unit nameplate rating.
2. Check all auxiliary components such as circulating pumps, air handling equipment, or other equipment connected to chiller. Consult manufacturer's instructions.
3. Check chilled water safety thermostat. See Safety Thermostat for adjustment.
4. Backseat (open) compressor suction and discharge shutoff valves. Close valves one turn to allow some pressure to each test gage (if installed).
5. Open liquid line valves.

6. Fill chilled water circuit with clean water or other noncorrosive fluids to be cooled. Bleed all air out of high points of system. Set flow rate per job requirements.
7. Set temperature controller (see Capacity Control).
8. Check tightness of all electrical connections.
9. Compressor oil should be visible in bull's-eye.
10. Be sure there are no refrigerant leaks (see Leak Test and Dehydration).
11. Be sure compressor contains oil (see Oil Charge.
12. Crankcase heater must be firmly locked into compressor crankcase and energized for 24 hours.
13. Check compressor suspension. *The mounting rail lock bolts must be removed. Be sure compressor hold-down bolts are tight.*

LEAK TEST AND DEHYDRATION

For proper procedure, refer to Carrier Standard Service Techniques Manual, Chapter 1, Refrigerants.

All 30HR Units are fully charged with R-22 at factory (see Table 1). A leak test should be performed at time of installation to assure that leaks have not developed during shipment. Dehydration is not necessary unless complete refrigerant charge has been lost.

All 30HS Units are shipped with R-22 holding charge only. Complete system, including factory and field piping, should be leak tested and dehydrated at time of installation.

REFRIGERANT CHARGING

Complete operating charge for remote condenser and interconnecting piping used with 30HS units must be field supplied.

Do not open condenser liquid valves or compressor discharge valves until the charge (positive pressure) is found in remainder of system. Check liquid line sight glasses when unit is started to be sure unit is fully charged.

The liquid charging method is recommended for complete charging or when additional charge is required.

CAUTION: When charging, circulate water thru condenser and cooler at all times to prevent freezing. Freezing damage is considered abuse and is not covered by Carrier Warranty.

Be careful not to overcharge system. Overcharging results in higher discharge pressure with higher cooling water consumption, possible compressor damage and higher power consumption.

Liquid Charging Method — Charge thru filter-drier liquid line charging valve. *Never charge liquid into the low pressure side of system.*

1. Frontseat (close) condenser liquid line shutoff valve.
2. Connect a refrigerant cylinder loosely to charging valve connection of filter-drier. Purge charging line and tighten connections.
3. Open filter-drier liquid line charging valve.
4. If system has been dehydrated and is under vacuum, break vacuum with refrigerant (gas charge). Build up system pressure to 58 psi for R-22 (32 F). Invert refrigerant cylinder so that liquid refrigerant will be charged.
5. a. For complete charge see Charging in Carrier Standard Service Techniques Manual, Chapter 1, Refrigerants. Follow Charging By Weight procedure. (When charge is nearly full, complete process by observing sight glass for clear liquid flow.)
   b. For complete charge where refrigerant cylinder cannot be weighed or for adding refrigerant, follow the procedure Charging By Sight Glass in the manual.
6. To ensure maximum subcooler performance, check liquid level in condenser by means of test cock located on the condenser shell near right end tube sheet. Liquid discharge from test cock indicates fully charged subcooler.

START-UP

CAUTION: Start-up should be performed only under supervision of experienced refrigeration mechanic.

1. Be sure all compressors are warm (crankcase heaters should be energized for 24 hours before start-up).
2. Open all system valves that may have been closed during or after charging.
3. Check air-handling equipment, chilled water and condenser water pumps, and any other equipment connected to chiller.
4. Start unit.
5. Check all controls for proper operation. (Follow check procedures given in these instructions.)
6. Adjust water-regulating valve to most economical head pressure (based on relative cost of water and electricity). Head pressure is normally 200 to 230 psi for R-22.
7. Check chilled water leaving temperature to see that it remains well above freezing.
8. Check amount of compressor oil. Add or remove oil to achieve required level during steady operation (see Oil Charge).

OIL CHARGE

All units are factory charged with oil (see Table 1).

Observe oil level closely at start-up. If oil level is below bull's-eye and cannot be seen, add oil until level is approximately 1/4 bull's-eye.

If oil is visible in bull's-eye, do not add oil until after several hours of operation; then, if oil level is not between 1/4 and 1/3 bull's-eye, add enough to attain this level. To add or remove oil, see Carrier

Standard Service Techniques Manual, Chapter 1, Refrigerants. One method is shown below.

To Add Oil — Close suction shutoff valve and pump down crankcase to 2 psig. (Low pressure cutout must be jumpered.) Wait a few minutes and repeat as needed until pressure remains at 2 psig. Remove oil-fill plug above bull's-eye, add oil thru plug hole and replace plug. Run compressor for about 20 minutes and check oil level.

→ *Use only Carrier-approved compressor oil:*

Sun Oil Co. ..... Suniso 3GS
Texaco, Inc. ..... Capella WFI-32-150
E.I. DuPont Co. ..... Zephron 150 (synthetic)

Do not reuse oil that has been drained and do not use oil that has been exposed to atmosphère.

To Remove Oil — Pump down compressor to 2 psig. Loosen the 1/4-in. pipe plug in compressor base and allow oil to seep out past plug threads.

Crankcase will be under slight pressure. Be careful not to remove plug; the entire oil charge may be lost.

Small amounts of oil can be removed thru oil pump discharge connection while compressor is running.

CRANKCASE HEATERS

Heaters are furnished on all compressors to prevent accumulation of liquid refrigerant during shutdown. On 60-Hertz units, heaters are 115 volts; each is 125 watts. On each compressor, heater is located in the bottom cover and held in place by clip and bracket. Make sure heater is tight to prevent backing out *(heater will eventually burn out if exposed to air).* Heater is wired into control circuit, connected to normally closed contacts on crankcase heater relay, to energize when compressor shuts off.

De-energizing Crankcase Heater — *Crankcase heaters should be energized at all times when unit is not operating.* However, during a prolonged shutdown, servicing, heaters may be de-energized providing compressor service valves are closed. When operation is to resume service valves must be reopened and heaters should be energized for 24 hours before unit start-up.

COMPRESSOR REPLACEMENT

If a replacement 6-cylinder compressor has center-bank cylinder head with discharge valve pad facing pump end, remove head and install reverse flange head from original compressor (discharge valve pad toward motor end). *Center-bank cylinder head cannot be rotated 180°.*

CIRCUIT BREAKERS

One breaker for each compressor provides 3-leg overload protection. Do not bypass connections or increase size of breaker to correct trouble. Determine cause of trouble and correct before resetting breaker. Tripped breaker must be manually reset by throwing switch OFF, then ON again. See circuit breaker must trip amps (MTA) in Table 2, Electrical Data.

MOISTURE-LIQUID INDICATOR

Clear flow of liquid refrigerant indicates sufficient charge in system. Bubbles indicate undercharged system or presence of noncondensables. Moisture, measured in parts per million (ppm), in system will change color of indicator. *Green — moisture is below 45 ppm; chartreuse (caution) — 45 to 130; yellow (wet) — above 130.* Change filter-drier cores at first sign of moisture in system. Each refrigerant circuit has an indicator.

With unit running, indicating element must be in contact with *liquid* refrigerant to give true moisture indication. 30HS units (shipped with holding charge only) must be fully charged and run before moisture content can be determined.

IMPORTANT: Unit must be in operation at least 12 hours before moisture indicator will give an accurate reading.

LIQUID LINE SOLENOID VALVE

One valve in each refrigerant circuit prevents liquid refrigerant from migrating to the cooler during shutdown.

THERMOSTATIC EXPANSION VALVES

These valves control flow of liquid refrigerant by maintaining constant superheat of vapor leaving cooler. Factory set to maintain a superheat of 8 to 10 F; do not adjust setting unless absolutely necessary. There is one valve for each refrigerant circuit.

COMPRESSOR THERMAL PROTECTION

A discharge thermostat, installed in one cylinder head of each compressor, senses an overtemperature condition. If the discharge gas temperature of any compressor exceeds 295 ± 5 F, the thermostat opens and shuts off that compressor and the other compressor in circuit. The thermostat reset temperature is approximately 250 F. See Fig. 4 for switch connections.

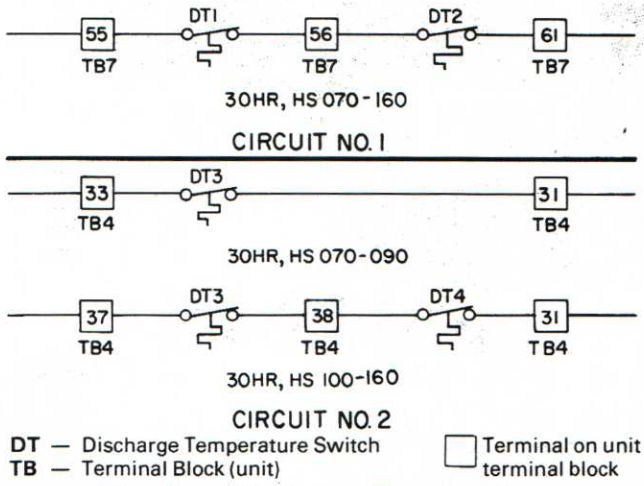


Fig. 4 — Discharge Temperature Switch Connections

OIL PRESSURE SAFETY SWITCH

Control (Fig. 5) is standard on 30HS units (on compressor no. 1 and 3 only); accessory for 30HR (see Table 3 for wiring connections).

Before initial start-up and at scheduled intervals thereafter test be the time-delay switch.

Before testing, shield the control to prevent moving air from contacting the time-delay switch as this is a thermal device and moving air will affect timing.

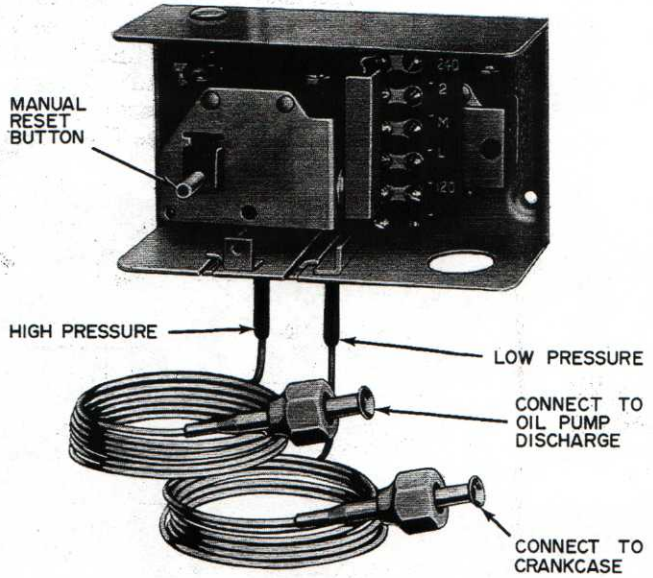
Open 115-volt control circuit breaker and all compressor circuit breakers. Remove all oil pressure safety switch (OPSS) covers and disconnect the wire at the 120-volt terminal of each OPSS. Check each control as follows: reconnect the L2 wire to 120-v terminal of OPSS no. 1 and close 115-volt control circuit breaker. Energize the control circuit by pressing the START-STOP button to START. Sequencer energizes compressor no. 1 contactor(s) and indicator light; heater in OPSS is now energized. In approximately 45 seconds, warp switch in the control opens, de-energizing the contactor(s) and light. *If contactor(s) remains energized more than 60 seconds, the control should be replaced.*

Allow approximately 5 minutes for the thermal switch to cool, then manually reset the control. Open the 115-volt control circuit breaker and disconnect the L2 wire from the 120-v terminal. Repeat test procedure for each remaining OPSS control.

CAUTION: Be sure L2 wire to 120-v terminal is disconnected from every switch except the one being tested.

When test has been completed, reconnect all OPSS controls at 120-v terminal and replace covers.

Do not attempt to field repair a control that requires service. Contact your local Carrier representative.



(Switch shown is Penn Controls.)

Fig. 5 — Oil Pressure Safety Switch

SAFETY THERMOSTAT

The low water temperature cutout (Safety Thermostat, Fig. 6) is a noncycling, manual-reset type, to protect against freeze-up due to operating malfunction. On all units, bulb is installed in leaving chilled water connection (item 8, Fig. 1). Freezestat is set to break control circuit at 36 ± 2 F, locking out unit. The thermostat must be reset before unit can restart. The chilled water circulating pump continues to operate during lockout period.

→ **Table 3 — Wiring Connections, Oil Pressure Switch**

OIL PRESSURE SWITCH TERMINAL	CONTROL BOX TERM. OR CONNECTION			
	070-090		100-160	
	COMPRESSOR NUMBER			
	1	3	1	3
2	63	23	63	35
M	61	31	61	31
L	62	32	62	32
120V	53	30	53	42

☐ Terminal on terminal strip in control box.

NOTES:
1. Wire from switch terminals to indicated terminals or connections in unit control box.
2. Refer to wiring label on unit.

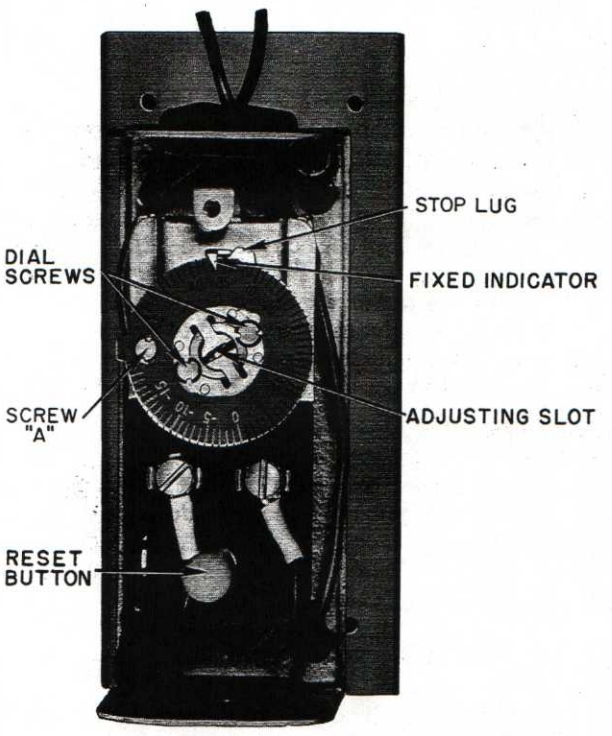


Fig. 6 — Safety Thermostat

For glycols, or brines, loosen screw "A" (Fig. 6), hold stop lug against fixed indicator and turn dial to lower setting. Tighten screw "A." *Do not disturb this screw for any other adjustment.*

Check thermostat at installation and at least once each season thereafter.

To Check — Insert screwdriver into adjusting slot and turn dial assembly until desired cutoff temperature is directly under fixed indicator. Place bulb in vacuum bottle filled with mixture of water and crushed ice. Stir mixture with thermometer; as ice melts, temperature of mixture will go down. Note temperature where thermostat cuts out. This should be within 1 F or 2 F of dial setting. Recalibrate if variation is greater.

To Recalibrate — Break painted seal at dial screw. With a screwdriver in the adjusting slot, *hold the angular position of the dial assembly while completing the following steps:*

1. Loosen the 2 dial screws.
2. Rotate *dial only* until number under the fixed indicator is observed temperature of mixture.
3. Retighten dial screws.

Turn dial assembly until desired compressor cutoff temperature is directly under fixed indicator. Recalibration is now complete.

HIGH- AND LOW-PRESSURE SWITCHES

High-Pressure Switch — Slowly close discharge shutoff valve until compressor shuts down (should be at cutout pressure shown in Table 4).

Re-energize compressor contactor and control relay for circuit by pressing START-STOP button to STOP then to START.

Reopen discharge shutoff valve; compressor should start when pressure drops to cut-in pressure shown.

Table 4 — Pressure Switch Settings (psig)

UNIT 30	HIGH PRESSURE* (±7 psig)		LOW PRESSURE (±4 psig)	
	Cutout	Cut-in	Cutout	Cut-in
HR	265	185	24	74
HS	340	250	24	74

*Fixed range; 80 ±14 psig differential.

Low-Pressure Switch — Range is adjustable from 5 psig minimum cutout to 100 psig maximum cut-in. Differential is adjustable from 8 to 50 psig. To check: slowly close suction shutoff valve and allow compressor to pump down. Compressor should cut out when suction pressure falls to 24 psig and automatically restart when pressure builds up to 74 psig.

WINTER START (30HS units with remote air-cooled condenser(s) — Proper condenser head pressure control should eliminate the need for winter-start modifications. However, if nuisance cutouts on low pressure occur during cold weather start-up, adjust the low-pressure switch (LPS) cutout point to 15 psig. If cutouts still occur (and the condenser fan regulation is functioning properly), disconnect LPS capillaries from crankcases of compressors no. 1 and no. 3 and readjust LPS back to 30 psig. Reconnect each capillary to the 1/4-in. flare port on respective charging valve for each circuit (located at the filter-drier). *Be sure charging valve is back-seated when installing the capillary and mid-seated after capillary is installed.*

NOTE: Add 1/4-in. tubing to the short LPS capillaries.

The 1/4-in. flare connections will make all additional connections mechanical (no sweat connections).

Check both switches at start-up and at least once each year.

Table 5 — Capacity Control Steps

UNIT 30HR 30HS	CONTR STEPS	TRANS SW POS 1* % Cap.	Oper Cylinders Tot.	Ckt 1 Compr 1	Ckt 1 Compr 2	Ckt 2 Compr 3	Ckt 2 Compr 4	TRANS SW POS 2* % Cap.	Oper Cylinders Tot.	Ckt 1 Compr 1	Ckt 1 Compr 2	Ckt 2 Compr 3	Ckt 2 Compr 4
070	1	28.6	4	—	—	4	—	14.3	2	2	—	—	—
	2	42.9	6	2	—	4	—	42.9	6	2	—	4	—
	3	57.2	8	2	—	6	—	57.2	8	2	—	6	—
	4	71.2	10	4	—	6	—	71.2	10	4	—	6	—
	5	85.7	12	4	4	4	—	85.7	12	4	4	4	—
	6	100.0	14	4	4	6	—	100.0	14	4	4	6	—
080	1	25.0	4	—	—	4	—	25.0	4	4	—	—	—
	2	50.0	8	4	—	4	—	50.0	8	4	—	4	—
	3	62.5	10	4	—	6	—	62.5	10	4	—	6	—
	4	75.0	12	6	—	6	—	75.0	12	6	—	6	—
	5	87.5	14	6	4	4	—	87.5	14	6	4	4	—
	6	100.0	16	6	4	6	—	100.0	16	6	4	6	—
090	1	22.2	4	—	—	4	—	22.2	4	4	—	—	—
	2	44.4	8	4	—	4	—	44.4	8	4	—	4	—
	3	55.5	10	4	—	6	—	55.5	10	4	—	6	—
	4	66.7	12	6	—	6	—	66.7	12	6	—	6	—
	5	88.8	16	6	6	4	—	88.8	16	6	6	4	—
	6	100.0	18	6	6	6	—	100.0	18	6	6	6	—
100	1	20.0	4	—	—	4	—	20.0	4	4	—	—	—
	2	40.0	8	4	—	4	—	40.0	8	4	—	4	—
	3	50.0	10	4	—	6	—	50.0	10	4	—	6	—
	4	60.0	12	6	—	6	—	60.0	12	6	—	6	—
	5	70.0	14	6	4	4	—	70.0	14	6	4	4	—
	6	80.0	16	6	4	6	—	80.0	16	6	4	6	—
	7	90.0	18	6	4	4	4	90.0	18	6	4	4	4
	8	100.0	20	6	4	6	4	100.0	20	6	4	6	4
110	1	18.2	4	—	—	4	—	18.2	4	4	—	—	—
	2	36.3	8	4	—	4	—	36.3	8	4	—	4	—
	3	45.4	10	4	—	6	—	45.4	10	4	—	6	—
	4	54.5	12	6	—	6	—	54.5	12	6	—	6	—
	5	72.7	16	6	6	4	—	72.7	16	6	6	4	—
	6	81.8	18	6	6	6	—	81.8	18	6	6	6	—
	7	90.9	20	6	6	4	4	90.9	20	6	6	4	4
	8	100.0	22	6	6	6	4	100.0	22	6	6	6	4
120, 160	1	16.6	4	—	—	4	—	16.6	4	4	—	—	—
	2	33.3	8	4	—	4	—	33.3	8	4	—	4	—
	3	41.0	10	4	—	6	—	41.0	10	4	—	6	—
	4	50.0	12	6	—	6	—	50.0	12	6	—	6	—
	5	66.7	16	6	6	4	—	66.7	16	6	6	4	—
	6	75.0	18	6	6	6	—	75.0	18	6	6	6	—
	7	91.6	22	6	6	4	6	91.6	22	6	6	4	6
	8	100.0	24	6	6	6	6	100.0	24	6	6	6	6
140	1	19.0	4	—	—	4	—	19.0	4	4	—	—	—
	2	38.0	8	4	—	4	—	38.0	8	4	—	4	—
	3	47.6	10	4	—	6	—	47.6	10	4	—	6	—
	4	57.0	12	6	—	6	—	57.0	12	6	—	6	—
	5	69.0	16	6	6	4	—	69.0	16	6	6	4	—
	6	78.6	18	6	6	6	—	78.6	18	6	6	6	—
	7	90.4	22	6	6	4	6	90.4	22	6	6	4	6
	8	100.0	24	6	6	6	6	100.0	24	6	6	6	6

*Transfer Switch, manually operated.

NOTE:
Circuits and compressors numbered from left to right when viewed from front of unit.

CAPACITY CONTROL

Controls cycle compressors and alternately load and unload cylinders to give capacity control steps as shown in Table 5. Controls for each unit include a step controller, a chilled water temperature controller and 2 solenoid-operated cylinder unloaders.

Step Controller — A 24-volt transformer in the step controller provides power to a low voltage motor with windings for rotating a camshaft clockwise and counterclockwise. Factory-set cams operate load switches which start or stop compressors and load or unload cylinders. Motor windings of camshaft drive motor are energized by a balancing relay which contains windings in the temperature bridge circuit between chilled water

temperature controller and motor balancing potentiometer located at end of camshaft. When unit is loading or unloading, (respectively, clockwise or counterclockwise rotation as viewed from potentiometer end), each chilled water temperature corresponds to a position of camshaft. A limit switch restricts rotation in each direction.

At initial start-up or after a power interruption, a relay in the step controller ensures that the camshaft will rotate in the unload direction to the correct position to begin the compressor starting sequence. After completion of the reset cycle, the camshaft rotation reverses and the compressor starting sequence begins.

Compressors start one at a time at brief intervals until load demand is satisfied. After completing starting sequence, controller will stop and start, unload and load compressors to maintain unit cooling capacity to satisfy load requirements. Factory cam settings on step controller protect compressors against rapid cycling.

Chilled Water Temperature Controller (Fig. 7) — A sensing bulb is factory inserted in return water nozzle of the chilled water system to relay water temperature to potentiometer which actuates step controller. *Cams in step controller are factory-set to control from return water temperature.* If unit is to be applied with control bulb in leaving chilled water line, cams must be reset in field. If this is required, contact local Minneapolis-Honeywell representative.

Adjust set point (main scale) and throttling (modulating) range of chilled water temperature controller before initial start-up.

Set point = design leaving chilled water temperature minus X value. The X values, established by test, are such that the compressor is prevented from cycling more than once in a 5-minute period. See Table 6.

Throttling Range = Design Rise + X value. Enter graph, Fig. 8 at set point and move across to intersection of throttling range. Read setting from top scale (minimum to F).

Example: 30HR100 w/4 compressors, 10 F rise
45 F Leaving Chilled Water Temperature

Set Point:	45 — 1 = 44 F
Throttling Range:	10 + 1 = 11 F

Table 6 — "X" Values

NO. OF COMPRESSORS	DESIGN RISE		
	8 F	10 F	12 F
3	1.25	1.5	1.75
4	0.75	1.0	1.25

SEQUENCE OF OPERATION

The 115-1-60 control power can be supplied directly from a separate source thru a code-approved fused disconnect or thru a field-installed accessory transformer with primary side connected to the L1 and L2 terminals of unit power terminal block. A double-pole circuit breaker protects control circuit and serves as control circuit switch. Crankcase heaters are wired in control circuit ahead of the START-STOP switch. They are always operative as long as control circuit switch is on even though unit may be off because of safety device action. Heaters are wired so they are on only when their respective compressors are cycled off.

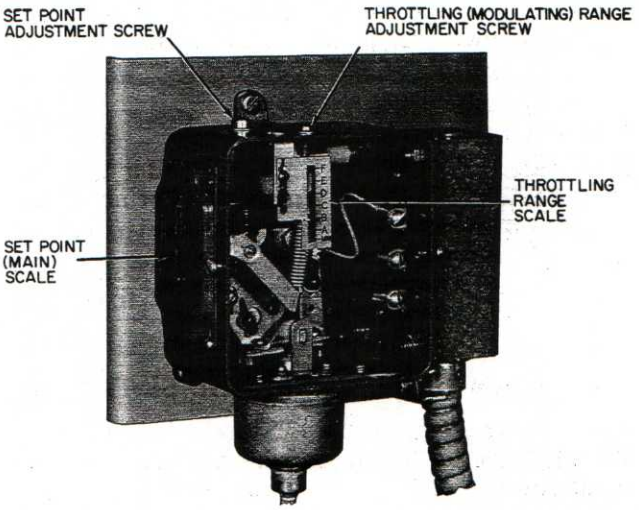


Fig. 7 — Chilled Water Temperature Controller

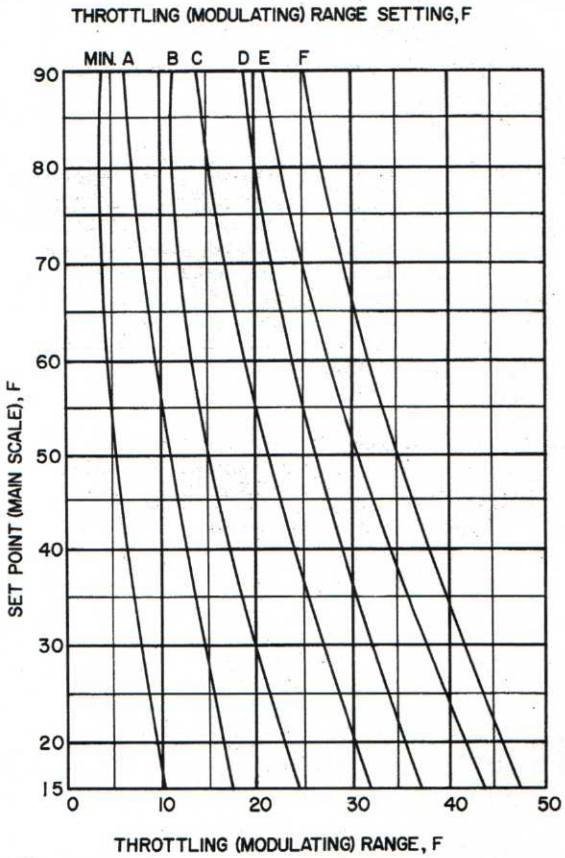


Fig. 8 — Temperature Controller Graph

WARNING: The control circuit power must never be off except when unit is being serviced.

After a prolonged shutdown, the crankcase heaters should be on for 24 hours before starting the unit.

When power is supplied to control circuit and control circuit switch is on, unit is ready for operation providing all safety devices are satisfied, interlocks are closed and instructions on warning labels have been followed.

When START-STOP button on control panel is pressed to START, a white light in button comes on and step controller and control relays 1 thru 4 are energized. After a maximum of 1.5 minutes, step controller cycles back (in the unload direction) to correct cam position to begin compressor starting sequence. The compressors start one at a time at brief intervals until load requirement is satisfied. After completing starting sequence, controller stops and starts, unloads and loads compressors to maintain capacity control in response to water temperature controller demand. Factory cam settings on step controller protect compressors against rapid cycling.

Complete Unit Stoppage can be caused by any of the following conditions: general power failure, blown fuse in control power feed disconnect, open control circuit breaker, START-STOP button pressed to STOP, open contacts in low water temperature cutout, open contacts in any auxiliary interlock, open contacts in chilled water flow switch.

Single-Circuit Stoppage can be caused by open contacts in compressor discharge temperature sensor, open contacts in low-pressure switch, open contacts in oil safety switch (when used), open contacts in high-pressure switch.

Stoppage of one circuit by safety device action does not affect the other circuit. Besides stopping compressor(s), all devices listed *except the low-pressure switch* will also close liquid line solenoid valve for that circuit.

CAUTION. If unit, or single circuit, stops more than once as a result of any of the above safety devices, determine and correct the cause before attempting another restart.

Restart Procedure, after cause for stoppage is corrected. (Automatic restarts are under sequence-starting control.)

GENERAL POWER FAILURE — Unit will restart automatically when power is restored.

BLOWN FUSE IN POWER FEED DISCONNECT — Replace fuse. Restart is automatic.

LOW WATER TEMPERATURE CUTOUT — Press the control RESET button (on control panel). Restart is automatic.

AUXILIARY INTERLOCK — Automatic restart after condition is corrected.

OPEN CONTROL CIRCUIT BREAKER — Close breaker. Unit will restart automatically.

HIGH-PRESSURE SWITCH — Press unit START-STOP button to STOP then to START. Unit will restart under sequence control.

LOW-PRESSURE SWITCH — Compressors will restart automatically when pressure comes up sufficiently.

COMPRESSOR DISCHARGE TEMPERATURE SENSOR — After discharge temperature cools down, press unit START-STOP button to STOP then to START. Unit will restart under sequence control.

OIL SAFETY SWITCH — Press RESET button on the switch and press unit START-STOP button to STOP then to START. Unit will restart under sequence control.