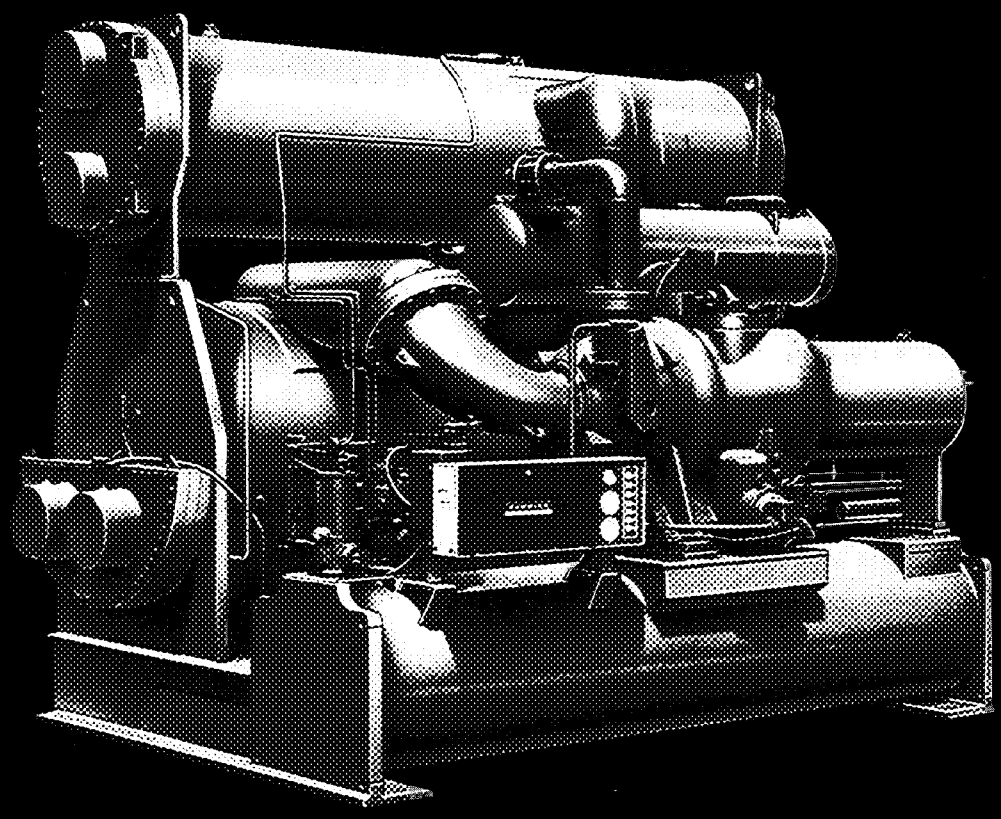
Carrier Packaged Hermetic Centrifugal Liquid Chillers

19EF
750-1300 tons



- Proven reliability
- Efficient operation
- Low installation costs

Carrier®

Form 19EF-1P

Superior Design. . . Proven Reliability

Carrier's Design Philosophy is to improve upon existing designs.

The 19EF centrifugal liquid chiller is an excellent example of the superior machine resulting from this approach. Carrier designed the 19EF using components that have demonstrated their reliability in current product lines. The time-tested compressor and efficient heat exchangers were chosen with the customer's needs in mind. The benefits are *low installation costs* and *more efficient operation,* backed by Carrier's proven quality and dependability. These improvements save time at installation, minimize maintenance cost, and keep operating costs low — all part of Carrier's plan to provide economical, energy-saving, efficient cooling with minimum maintenance.

Low installation costs

- The 19EF is normally shipped as a completely assembled, single piece machine, ready for installation — or you can get a split shipment (compressor package and heat exchanger package) for those jobs with minimum entrance requirements or hoisting limits.
- Pre-testing of mechanical and electrical systems means no delays at installation.
- Start-up service — factory-trained representatives check the installation and start the machine — regardless of geographic location

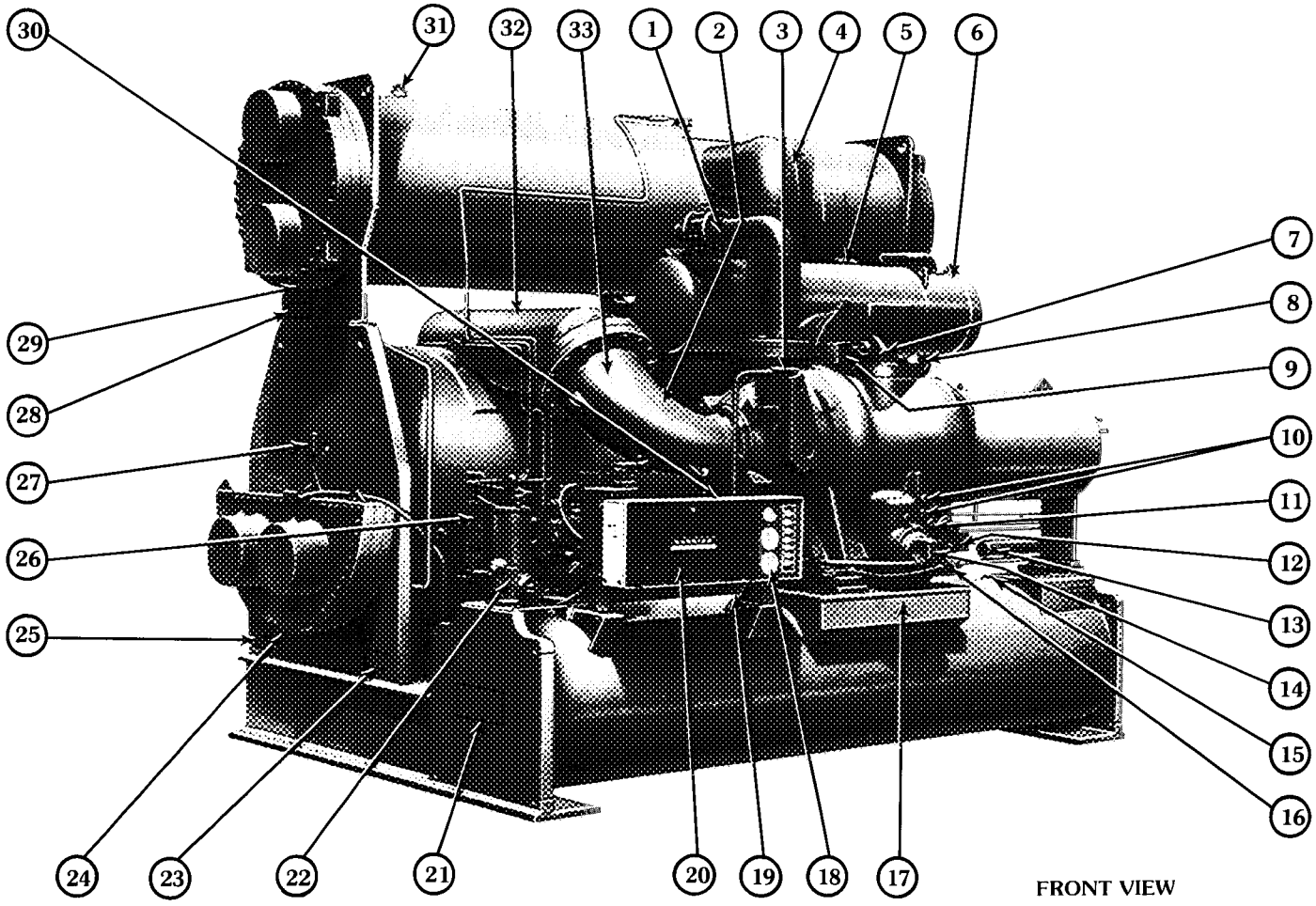
Proven reliability

- The 19EF combines the third generation of compressors and second generation of heat exchangers distinguished by the lowest warranty rate of any centrifugal chiller.
- Performance is assured — no delay in delivery pending factory capacity test.
- Spot tests of random chillers, ranging from complete mechanical teardowns to ARI-dictated capacity tests, ensure reliability and capacity.
- This machine is designed in accordance with and stamped by ASME, both refrigerant and water side, assuring safe operation.

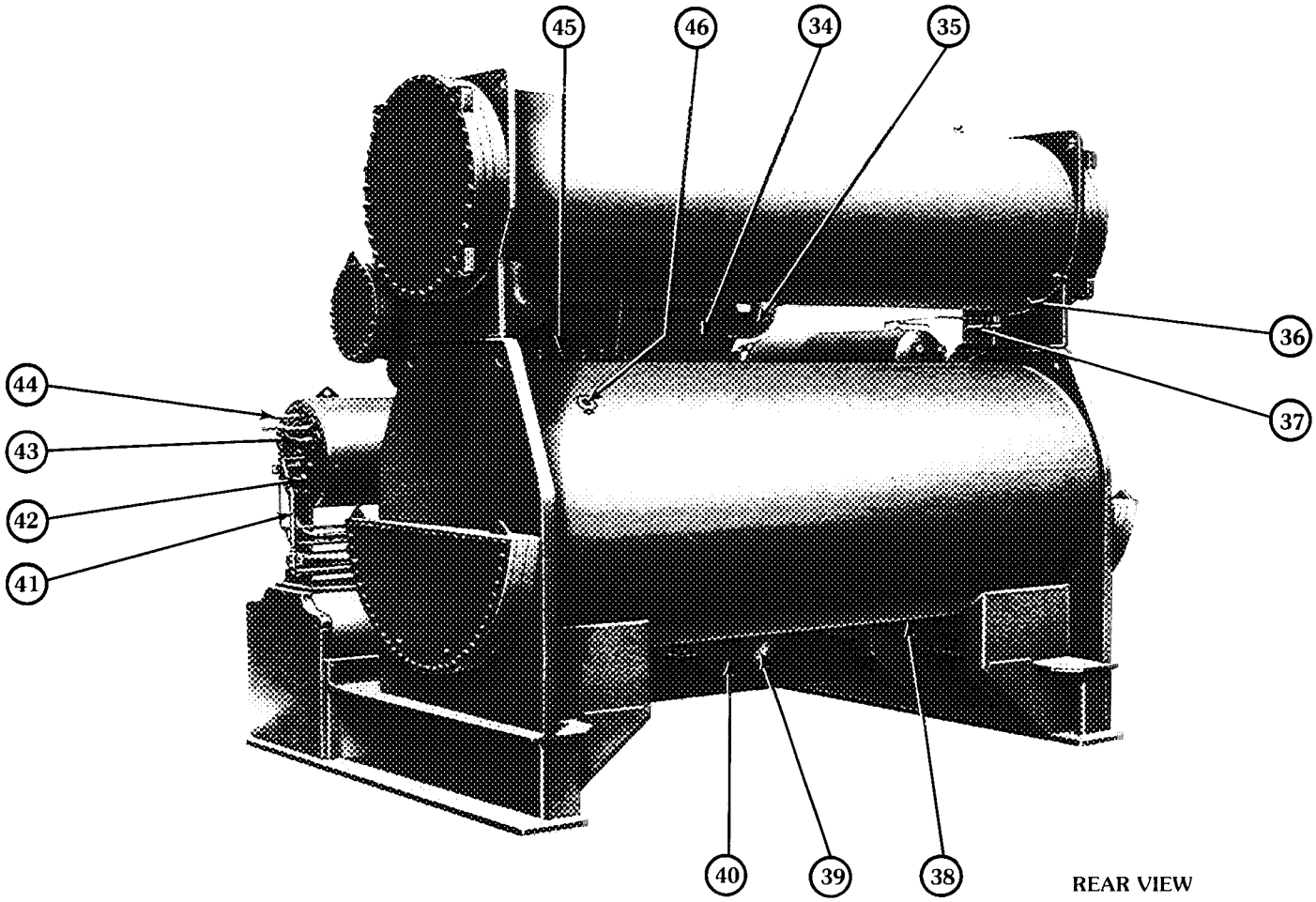
Economical operation

Standard components provide design IKW/ton of 0.65. By mix-matching components, IKW/ton of 0.60 can be achieved with no penalty to lead time and with little increase in cost — for the ultimate in performance.

- Heat exchanger includes refrigerant thermal economizer, a flash economizer, and Carrier's own high-performance tubes.
- Choose compressor to meet your requirements by selecting from various compressor, motor, and impeller sizes.
- Efficient design allows operation at lower condensing water temperatures with no hot gas bypass — even when the load dips to 10% of design.
- Low chilled water recycle control circuit permits the machine to supercool the loop and then shut down till cooling is needed again — no wasted energy.



FRONT VIEW



REAR VIEW

19EF MACHINE COMPONENTS

1 — Economizer Gas Line to Compressor
2 — Oil Cooler/Filter (Hidden)
3 — Guide Vane Actuator
4 — Compressor Discharge Pipe
5 — Flash Gas Chamber Vent Connection
6 — Condenser Float Valve Chamber Vent Connection
7 — Gear Inspection Cover
8 — Economizer High-Side Drain
9 — Thrust Bearing Temperature Gage
10 — Oil Level Sight Glasses (2)
11 — Oil Heater/Thermostat
12 — Oil Heater Terminal Box
13 — Refrigerant Filter
14 — Oil Pump Terminal Box
15 — Refrigerant Charging Valve (Service Valve 10)
16 — Oil Drain and Charging Valve (Hidden)
17 — Storage Tank Nameplate
18 — Cooler Pressure Gage
19 — Storage Tank Vent Valve (Service Valve 9)
20 — Control Center
21 — Rigging Guide
22 — Dehydrator
23 — Machine Identification Plate
24 — Cooler Water Box Drain, 3/4-in FPT Connection
25 — Cooler Nameplate
26 — Cooler Sight Glass
27 — Chilled Water Low-Temperature Cutout and Recycle Switch
28 — Condenser Nameplate
29 — Condenser Water Box Drain, 3/4-in FPT Connection
30 — Oil Cooler
31 — Condenser Vent Connection (Service Valve 11)
32 — Cooler Suction Pipe
33 — Compressor Suction Elbow
34 — Vessel Support Plate
35 — Refrigerant Liquid Outlet
36 — Condenser Liquid Temperature Well
37 — Service Valve 1
38 — Cooler Drain Connection
39 — Cooler Liquid Inlet from Economizer
40 — Refrigerant Transfer Pipe
41 — Motor Cooling Liquid Supply Line
42 — Motor Sight Glass
43 — Motor Rotation Arrow
44 — Compressor Motor Terminal
45 — Cooler Relief Valves (3 or 4)
46 — Pumpout Connection

Quality options offer added efficiency

Safety indicator panel

This accessory provides the operator with an instant trouble-shooting capability Seven panel lights monitor high motor or bearing temperature, low refrigerant temperature, high condenser pressure, starter (overloads and protective devices), low water flow (cooler or condenser), low oil pressure, low chilled water temperature. When safety is tripped, the light goes on Panel does not affect the integrity of the central control system, is easily connected to the machine without disturbing factory wiring In addition, a remote sound or light alarm can be easily field installed to alert you, should a safety light be tripped on the indicator panel Only a simple 2-wire hook-up is required.

Insulation

The 19EF machines come with factory insulation of the motor and miscellaneous motor cooling piping.

Lead-lag control

Desirable when 2 or more machines are installed in series or parallel. Centralized control features the following capabilities:

- parallel operation
- series operation with split or common point control
- 2 or more chiller operations
- uneven sized chillers working together
- independent control of chillers, both manually and automatically
- automatic lead-lag operation
- reassignment of lead-lag hierarchy
- automatic standby

Panel lights indicate system operating mode.

Isolation assembly

Isolation pads can be shipped as an option at nominal additional cost.

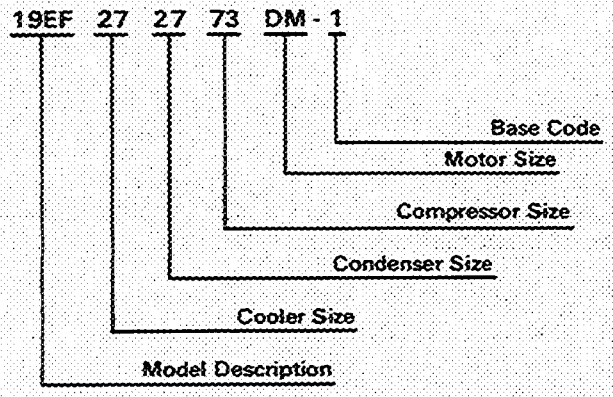
Auto. start

Remote control, time clock, outdoor air temperature, EMS control to start and stop the chillers and the chilled water and condenser water pumps. Provides pre-flow and part-flow of the pumps — interlocks the operation of the pumps as a function of the chiller

Required ASME code

Symbol stamp is provided for both the refrigerant and water side of all EF vessels.

MODEL NUMBER DESCRIPTION



1. First 4 code number positions describe chiller model (19EF).
2. Obtain cooler size from Selection Procedure and enter in positions 5 and 6.
3. Obtain condenser size from Selection Procedure and enter in positions 7 and 8.
4. Obtain compressor size from Selection Procedure and enter in positions 9 and 10.
5. Obtain motor size from Selection Procedure and enter in positions 11 and 12.
6. Select Base Code from the following options:
   - 1 — complete machine, shipped in one piece, with storage tank
   - 2 — complete machine, shipped in one piece, without storage tank
   - 3 — heat exchanger and compressor shipped separately, with storage tank
   - 4 — heat exchanger and compressor shipped separately, without storage tank

Selection procedure

This example represents the machine selected to satisfy a 980 ton at 44 F leaving chilled water and 85 F entering condenser water condition. (See selection example)

Selection data note

The Selection Data tables list typical combinations of heat exchanger, compressor size, motor size and compressor power input (IKW) that efficiently deliver the desired refrigeration capacity at specified condenser and cooler leaving water temperatures

Selections have been made at commonly used design conditions of 2-pass cooler and condenser, 0 0005 fouling factor and 10 F water temperature rise in accordance with ARI Standard 550-77 for centrifugal chillers

For rapid selection of chillers operating at other than the listed tonnages, use the following procedure.

I Establish design conditions.

Example

Required Capacity	980 tons
Leaving Chilled Water Temperature (LCWT)	44 F
Entering Condenser Water Temperature (ERWT)	85 F
Chilled Water Temperature Rise or GPM*	12 F
Condenser Water Temperature Rise or GPM*	2940 GPM
Pressure Drop Limitations	
Cooler	22 ft
Condenser	25 ft
Power Limitation	675 IKW/ton at design

*Flow/Rise Calculation
Cooler tons = (GPM x Rise)/24
Cond tons = (GPM x Rise)/29

II Make preliminary selection of heat exchangers at a capacity equal to or higher than required capacity

Using example, enter Selection Data table for 1000 tons.

A unit producing 1000 tons at 44 F cooler LCWT and 95 F condenser LRWT has a cooler size of 26, a condenser size of 26 and a compressor size of 73

III Determine number of passes for selected heat exchangers.

Enter Pressure Drop Curve.

At 1960 gpm, size 26 cooler, the pressure drop in the cooler is 11.0 feet. At 2940 gpm, size 26 condenser, the pressure drop in the condenser is 17 5 feet.

IV Adjust leaving water temperatures for number of passes and for temperature rise:

Enter Pass-Rise Temperature Adjustment table (this page) and find:

At 2 pass and 12 F rise (cooler) there is no adjustment required. At 2 pass and 9 7F rise (condenser) there is no adjustment required.

For cases where temperature adjustment is required, you may find it necessary to round off to the next most severe condition.

V Make final selection of heat exchanger and compressor. Make preliminary determination of motor size DL and power input (kW) 662.

In this example, since no temperature adjustment is necessary, the final selection is the same as the preliminary heat exchanger (Cooler, size 26, Condenser, size 26.) Compressor size is 73 Motor size is DL. Power input (preliminary) is 662 kW

VI Adjust power input (kW) if the required capacity is less than the capacity of the selected unit.

Multiply the power input of the selected unit by the required capacity divided by selected unit capacity

Required kW = 649 kW =

$$662\ \text{kW} \times \frac{980\ \text{tons required}}{1000\ \text{tons selected unit}}$$

VII Make final motor selection — From the Electrical Data table, determine if the maximum kW of the next smaller motor exceeds the required kW. If so, use the smaller motor. If not, use the motor selected in Step V.

Max kW of size DL motor = 692
Required kW (Step VI) = 649
Use size DL motor.

Note restrictions on motor-voltage and motor-compressor combinations in the Electrical Data section before finalizing motor selection.

VIII Establish electrical data for selected motor.

If supply voltage is same as design center voltage, obtain the full load amperage (FLA), locked rotor amperage (LRA) and overload trip amperage (OLTA) directly from the Electrical Data tables.

If supply voltage is different from design center voltage, adjust the amperage as indicated in the Electrical Data note

Maximum tonnage for any of the listed component combinations, component selections at other than the listed conditions, or component selections requiring lower input kW per ton can be readily obtained from Carrier's Computer Selection Service thru your local Carrier office

PASS-RISE TEMPERATURE ADJUSTMENT

WATER TEMP RISE (F)	COOLER PASSES				CONDENSER PASSES			
	1	2	3	4	1	2	3	4
5	-2 0	+0 5	—	—	+2 0	-0 5	—	—
10	-4 5	0	+1 5	+2 5	+4 0	0	-1 5	-2 0
15	—	-0 5	+2 0	+3 0	+5 5	0	-1 5	-2 5
20	—	-0 5	+2 0	+3 0	—	0	-2 0	-3 0

Selection data
Physical data

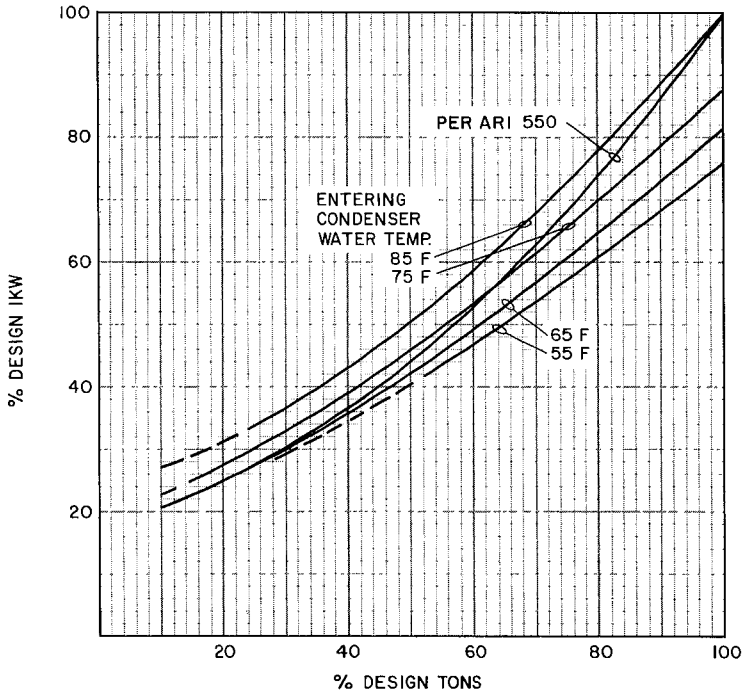
RIGGING AND OPERATING WEIGHTS* (lb)

HEAT EXCHANGER COMBINATIONS	2020	2222	2424	2525	2626	2727	2828	2929	2932
Cooler	8,407	8,917	11,571	11,799	12,025	15,329	15,549	15,766	15,766
Cond/Flash Economizer†	7,452	8,030	9,111	9,426	9,736	11,149	11,468	11,766	19,500
Base	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240
Compr/Suction Elbow	8,107	8,107	8,107	8,107	8,107	8,107	8,107	8,107	8,107
Pumpout Unit	210	210	210	210	210	210	210	210	210
Control Box	50	50	50	50	50	50	50	50	50
Factory Piping	685	760	990	990	990	985	985	985	985
REFRIGERANT (R-500) CHARGE									
Cooler	965	1,100	1,260	1,295	1,330	1,575	1,620	1,675	1,675
Condenser-Economizer	1,167	1,155	1,300	1,290	1,285	1,490	1,485	1,480	2,508
RIGGING WEIGHT	33,283	34,569	38,839	39,407	39,973	45,135	45,714	46,279	54,527
WATER	2,030	2,485	2,665	3,045	3,230	3,495	3,735	3,910	5,092
OPERATING WEIGHT	35,313	37,054	41,504	42,452	43,203	48,630	49,449	50,189	59,619

HEAT EXCHANGER COMBINATIONS	5020	5222	5424	5525	5626	5727	5828	5929	5932
Cooler	10,299	10,973	14,016	14,346	14,677	18,549	18,872	19,195	19,195
Cond/Flash Economizer†	7,452	8,030	9,111	9,426	9,736	11,149	11,468	11,766	19,500
Base	6,852	6,852	6,852	6,852	6,852	6,852	6,852	6,852	6,852
Compr/Suction Elbow	8,107	8,107	8,107	8,107	8,107	8,107	8,107	8,107	8,107
Pumpout Unit	210	210	210	210	210	210	210	210	210
Control Box	50	50	50	50	50	50	50	50	50
Factory Piping	780	860	1,100	1,100	1,100	1,090	1,090	1,090	1,090
REFRIGERANT (R-500) CHARGE									
Cooler	1,342	1,558	1,738	1,782	1,843	2,185	2,252	2,326	2,326
Condenser-Economizer	1,167	1,155	1,300	1,290	1,285	1,490	1,485	1,480	2,508
RIGGING WEIGHT	36,259	37,795	42,484	43,163	43,860	49,682	50,386	51,076	59,324
WATER	2,300	2,825	3,140	3,455	3,670	3,970	4,240	4,450	5,512
OPERATING WEIGHT	38,559	40,620	45,624	46,618	47,530	53,652	54,626	55,526	64,836

*Includes storage tank Based on 150 psig design pressure, 2-pass water boxes, maximum motor, high voltage and Refrigerant 500
†Flash economizer and cover weights included

19EF PART-LOAD PERFORMANCE



NOTE Dashed line indicates that performance may not be obtainable for all model sizes Consult with local Carrier sales representative

800 TONS

Adj Lvg Cond Water Temp (F)		Adj Lvg Chilled Water Temp (F)			
		40	42	44	46
90	lkW	560	537	518	486
	Clr	24	22	22	22
	Cond	22	22	22	22
	Comp	55	53	53	51
	Mtr	DJ	DH	DH	DG
	R	500	500	500	500
95	lkW	586	580	562	535
	Clr	24	24	24	22
	Cond	25	24	24	24
	Comp	71	61	55	53
	Mtr	DJ	DJ	DJ	DH
	R	12	12	500	500
100	lkW	620	615	596	587
	Clr	24	24	24	22
	Cond	25	24	24	22
	Comp	71	61	61	61
	Mtr	DK	DK	DK	DJ
	R	12	12	12	12
105	lkW	683	647	649	605
	Clr	51	24	24	22
	Cond	25	24	24	22
	Comp	73	63	63	61
	Mtr	DL	DL	DL	DK
	R	12	12	12	12

900 TONS

Adj Lvg Cond Water Temp (F)		Adj Lvg Chilled Water Temp (F)			
		40	42	44	46
90	lkW	622	583	548	538
	Clr	25	25	24	24
	Cond	24	24	24	24
	Comp	65	63	61	61
	Mtr	DK	DJ	DH	DH
	R	500	500	500	500
95	lkW	648	638	600	593
	Clr	25	25	25	24
	Cond	26	25	25	25
	Comp	71	71	63	63
	Mtr	DL	DL	DK	DK
	R	12	12	500	500
100	lkW	706	669	658	652
	Clr	25	25	25	24
	Cond	26	25	25	24
	Comp	73	71	71	71
	Mtr	DM	DL	DL	DL
	R	12	12	12	12
105	lkW	776	737	720	686
	Clr	26	25	25	24
	Cond	25	25	25	24
	Comp	75	73	73	71
	Mtr	DN	DM	DM	DL
	R	12	12	12	12

1000 TONS

Adj Lvg Cond Water Temp (F)		Adj Lvg Chilled Water Temp (F)			
		40	42	44	46
90	lkW	659	650	612	600
	Clr	26	26	25	25
	Cond	25	25	25	25
	Comp	73	73	71	61
	Mtr	DL	DL	DK	DK
	R	500	500	500	500
95	lkW	718	704	662	645
	Clr	26	26	26	25
	Cond	27	26	26	26
	Comp	81	71	73	63
	Mtr	DM	DM	DL	DL
	R	12	12	500	500
100	lkW	788	735	726	719
	Clr	26	26	26	25
	Cond	27	26	26	25
	Comp	83	81	81	71
	Mtr	DN	DM	DM	DM
	R	12	12	12	12
105	lkW	815	805	801	745
	Clr	54	26	26	25
	Cond	26	26	26	25
	Comp	83	83	83	71
	Mtr	DP	DP	DN	DN
	R	12	12	12	12

1100 TONS

Adj Lvg Cond Water Temp (F)		Adj Lvg Chilled Water Temp (F)			
		40	42	44	46
90	lkW	739	695	643	645
	Clr	27	27	26	26
	Cond	26	26	26	26
	Comp	75	73	71	71
	Mtr	DM	DM	DL	DL
	R	500	500	500	500
95	lkW	818	762	708	707
	Clr	27	27	27	26
	Cond	28	27	27	27
	Comp	77	75	73	73
	Mtr	DP	DN	DM	DM
	R	500	500	500	500
100	lkW	875	862	809	786
	Clr	29	27	27	26
	Cond	29	27	27	26
	Comp	83	77	81	75
	Mtr	DP	DP	DP	DN
	R	12	500	12	500
105	lkW	—	875	818	798
	Clr	—	59	59	59
	Cond	—	29	29	29
	Comp	—	83	81	81
	Mtr	—	DP	DP	DP
	R	—	12	12	12

1200 TONS

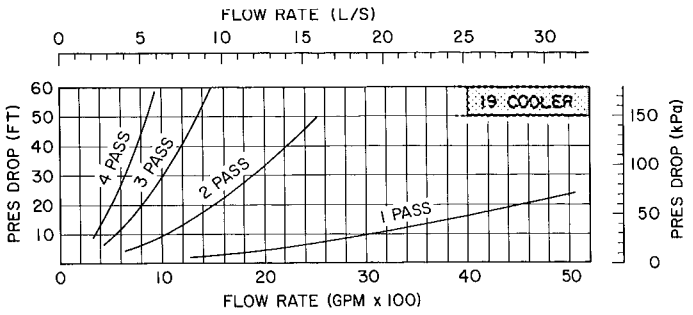
Adj Lvg Cond Water Temp (F)		Adj Lvg Chilled Water Temp (F)			
		40	42	44	46
90	lkW	802	761	747	700
	Clr	28	28	27	27
	Cond	27	27	27	27
	Comp	75	73	83	81
	Mtr	DP	DN	DN	DM
	R	500	500	500	500
95	lkW	—	828	781	769
	Clr	—	28	28	27
	Cond	—	28	28	28
	Comp	—	85	83	73
	Mtr	—	DP	DN	DN
	R	—	500	500	500
100	lkW	—	—	871	838
	Clr	—	—	59	27
	Cond	—	—	29	27
	Comp	—	—	81	75
	Mtr	—	—	DP	DP
	R	—	—	12	500
105	lkW	—	—	—	—
	Clr	—	—	—	—
	Cond	—	—	—	—
	Comp	—	—	—	—
	Mtr	—	—	—	—
	R	—	—	—	—

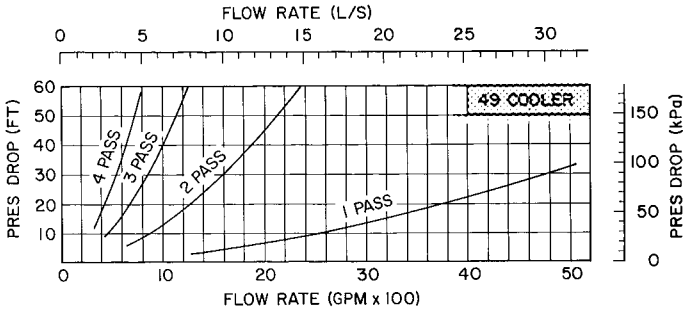
MAX CAPACITY

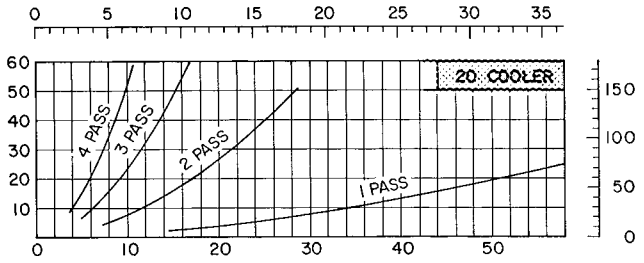
Adj Lvg Cond Water Temp (F)		Adj Lvg Chilled Water Temp (F)			
		40	42	44	46
90	Tons	1288	1321	1398	1418
	lkW	875	875	872	875
	Clr	29	29	29	29
	Cond	29	29	29	29
	Comp	85	85	83	83
	Mtr	DP	DP	DP	DP
	R	500	500	500	500
95	Tons	1155	1273	1285	1363
	lkW	875	872	875	874
	Clr	29	29	29	29
	Cond	29	29	29	29
	Comp	87	85	85	83
	Mtr	DP	DP	DP	DP
	R	500	500	500	500
100	Tons	1135	1176	1260	1259
	lkW	874	856	874	873
	Clr	59	59	59	29
	Cond	29	29	29	29
	Comp	77	81	75	75
	Mtr	DP	DP	DP	DP
	R	500	12	500	500
105	Tons	1075	1101	1148	1176
	lkW	875	875	875	875
	Clr	59	59	59	59
	Cond	29	29	29	29
	Comp	83	83	81	81
	Mtr	DP	DP	DP	DP
	R	12	12	12	12

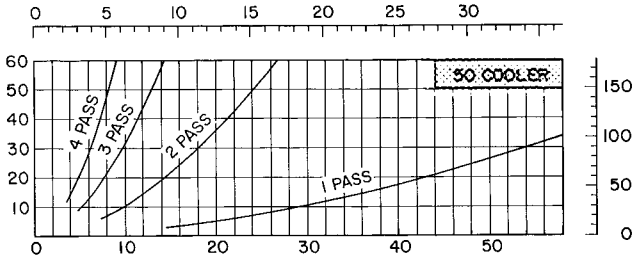
Clr — Cooler
Comp — Compressor
Cond — Condenser
lkW — Power Input
Mtr — Motor
R — Refrigerant

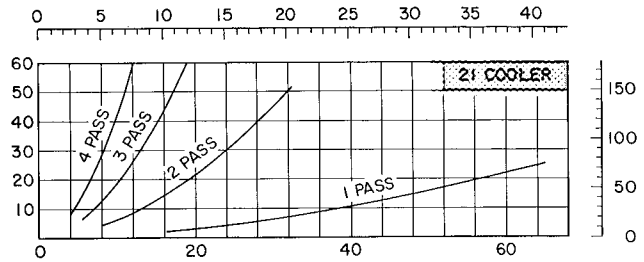
Selection data (cont)

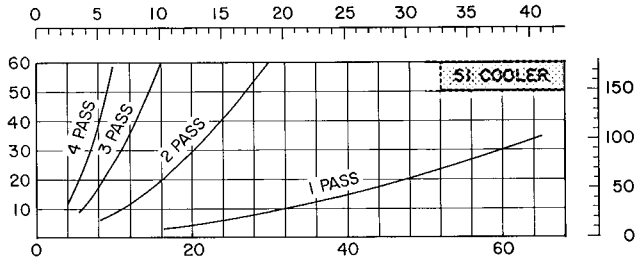


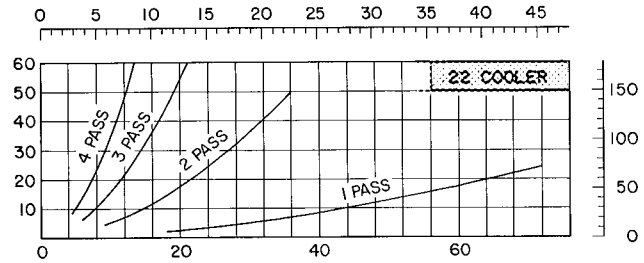


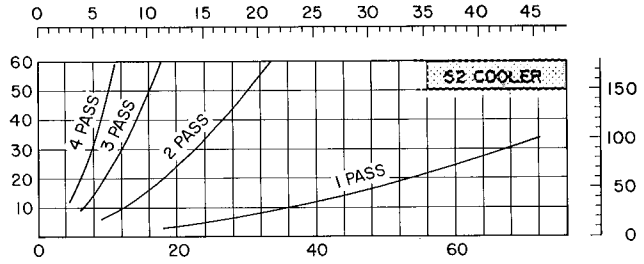


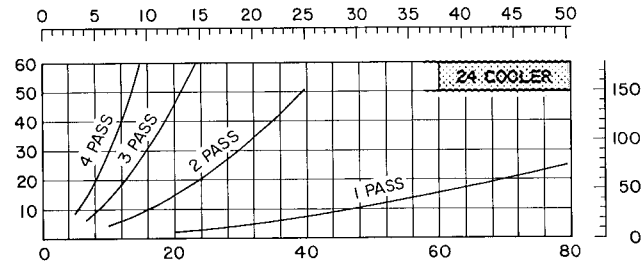


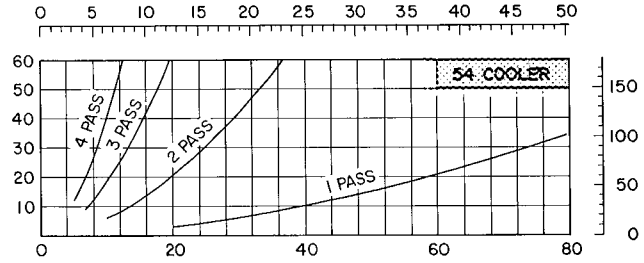


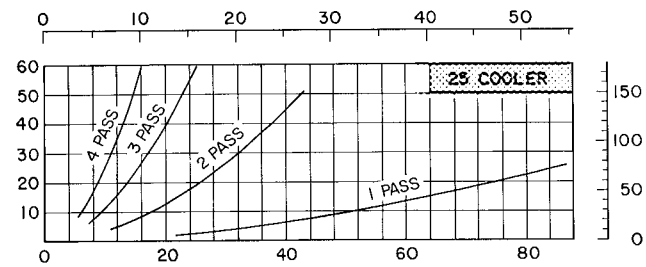


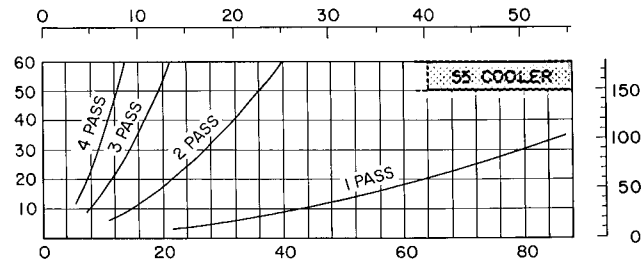


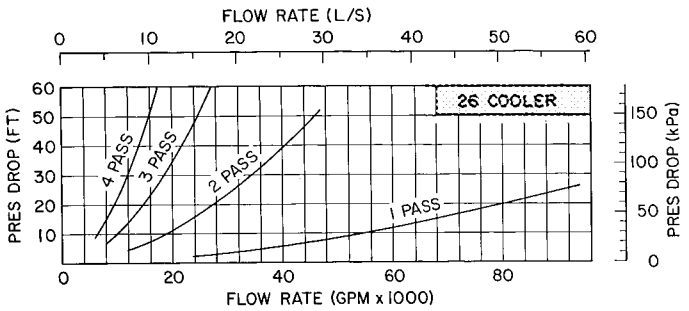


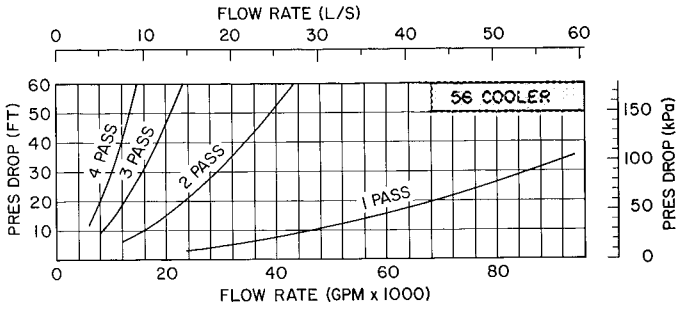


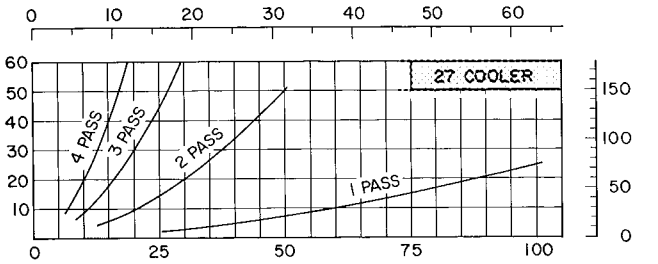


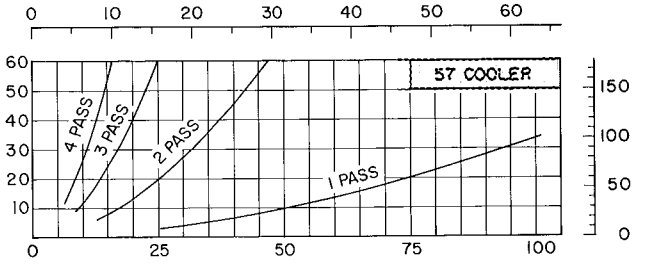





FLOW RATE (L/S)
0 10 20 30 40 50 60
26 COOLER
PRES DROP (FT)
4 PASS
3 PASS
2 PASS
1 PASS
PRES DROP (kPa)
0 20 40 60 80
FLOW RATE (GPM x 1000)


FLOW RATE (L/S)
0 10 20 30 40 50 60
56 COOLER
PRES DROP (FT)
4 PASS
3 PASS
2 PASS
1 PASS
PRES DROP (kPa)
0 20 40 60 80
FLOW RATE (GPM x 1000)


0 10 20 30 40 50 60
27 COOLER
4 PASS
3 PASS
2 PASS
1 PASS
0 25 50 75 100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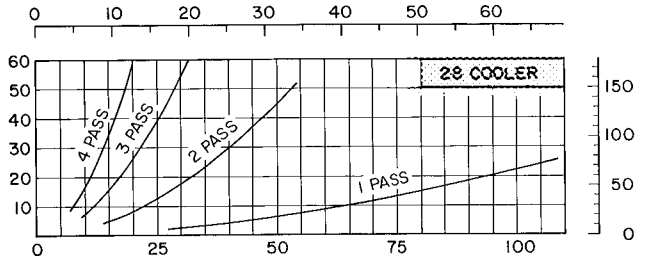
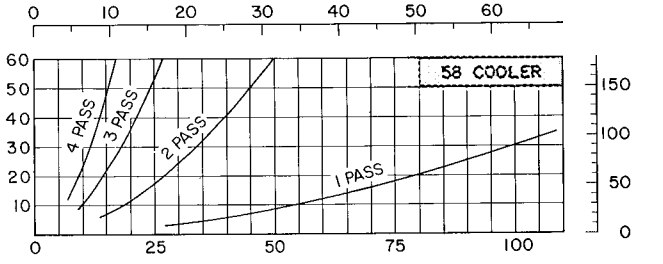
57 COOLER
4 PASS
3 PASS
2 PASS
1 PASS
0 25 50 75 100


0 10 20 30 40 50 60
28 COOLER
4 PASS
3 PASS
2 PASS
1 PASS
0 25 50 75 100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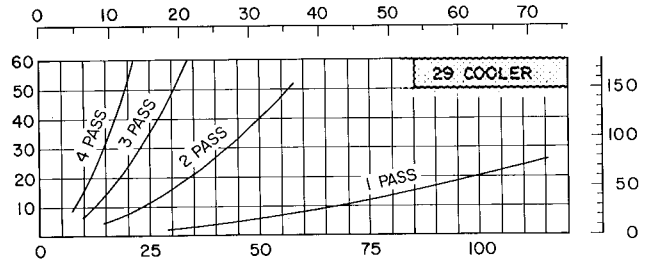
58 COOLER
4 PASS
3 PASS
2 PASS
1 PASS
0 25 50 75 100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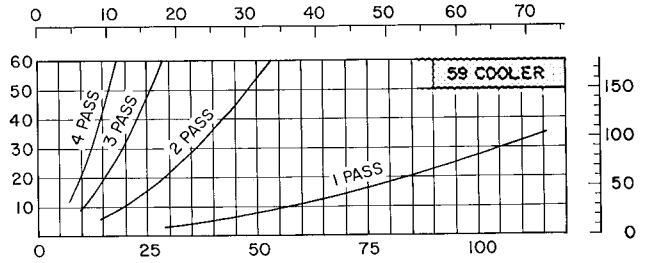
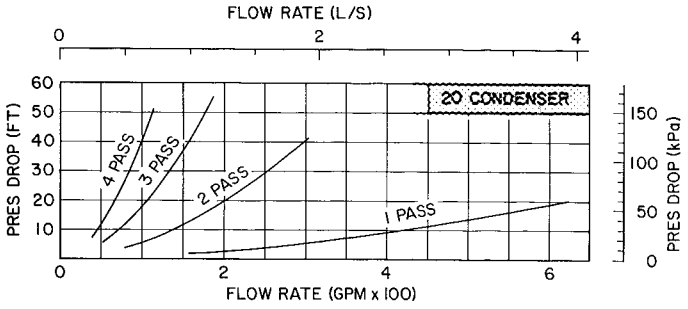
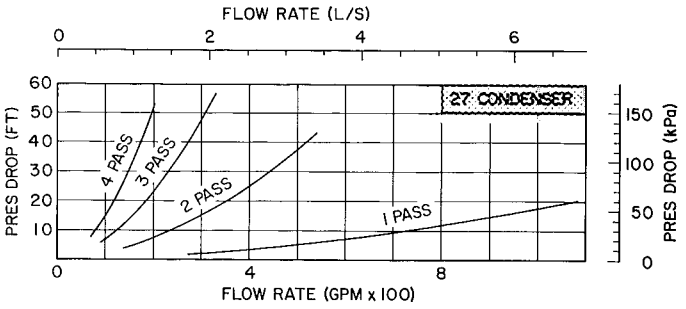
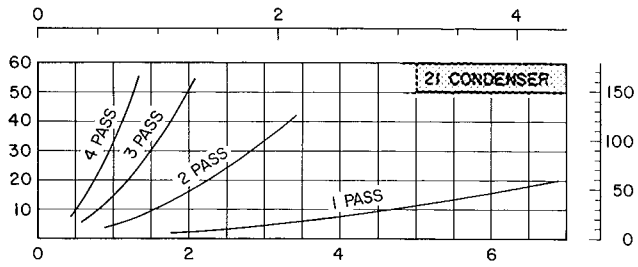
29 COOLER
4 PASS
3 PASS
2 PASS
1 PASS
0 25 50 75 100

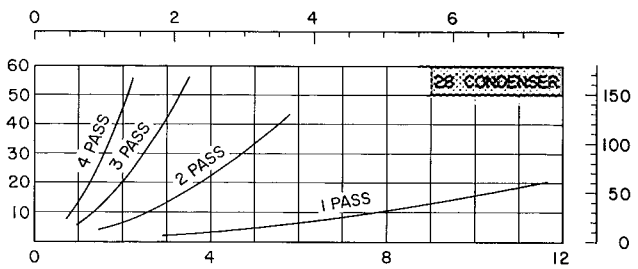

0 10 20 30 40 50 60 70
59 COOLER
4 PASS
3 PASS
2 PASS
1 PASS
0 25 50 75 100

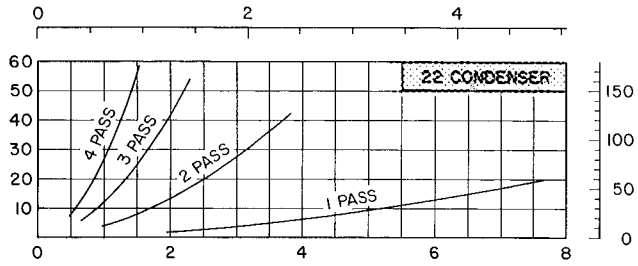
Selection data (cont)

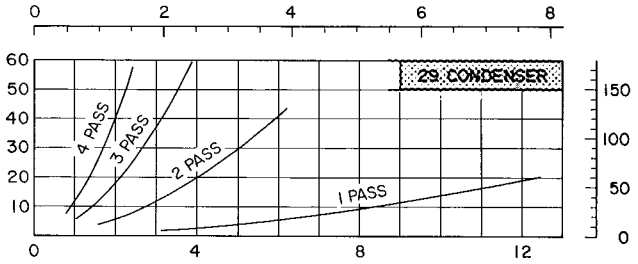


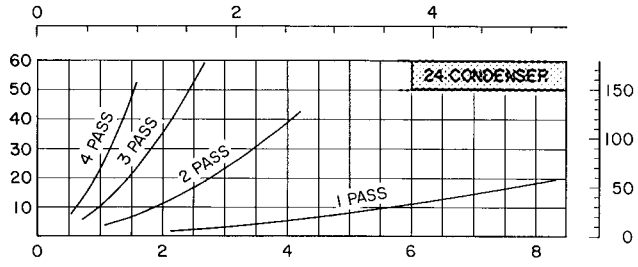


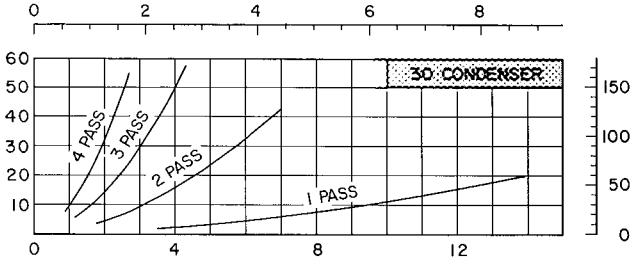


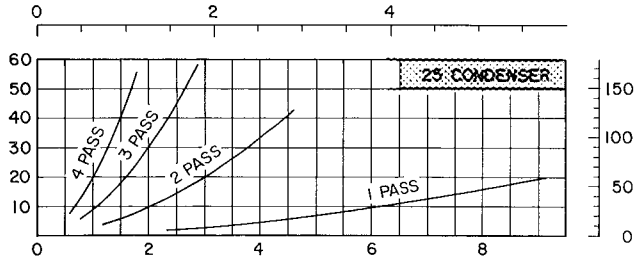


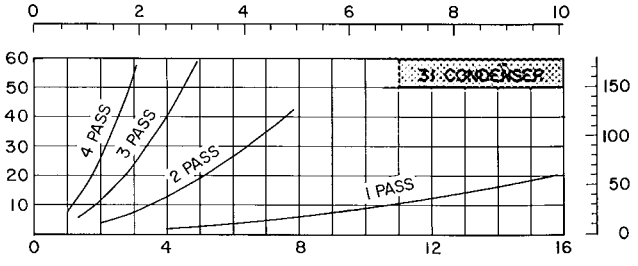


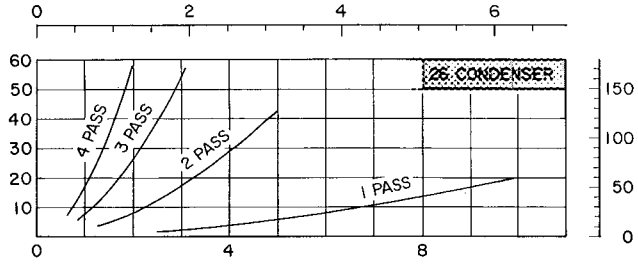


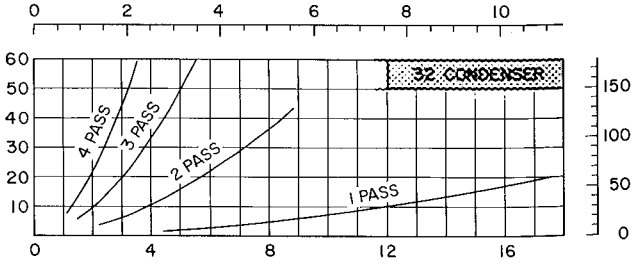












Electrical data

MTR	MAX kW	200 V		230 V		380 V		460 V		575 V		MTR	MAX kW	2400 V	4160 V
		3.21 FLA/kW		2.79 FLA/kW		1.69 FLA/kW		1.39 FLA/kW		1.12 FLA/kW				.270 FLA/kW	.156 FLA/kW
		LRA Star	LRA Delta	LRA Star	LRA Delta	LRA Star	LRA Delta	LRA Star	LRA Delta	LRA Star	LRA Delta			LRA	LRA
DF	478	2494	7795	2169	6777	1312	4101	1084	3388	867	2711	DF	453	571	330
DG	523	—	—	—	—	1458	4557	1205	3765	964	3012	DG	497	613	354
DH	561	—	—	—	—	1410	4405	1164	3639	932	2912	DH	533	656	378
DJ	597	—	—	—	—	1507	4709	1245	3890	996	3112	DJ	568	716	413
DK	639	—	—	—	—	1847	5772	1526	4769	1221	3815	DK	609	758	437
DL	692	—	—	—	—	1993	6228	1647	5145	1317	4116	DL	659	829	479
DM	746	—	—	—	—	2139	6684	1767	5522	1414	4418	DM	709	909	524
DN	807	—	—	—	—	2139	6684	1767	5522	1414	4418	DN	770	972	561
DP	875	—	—	—	—	2139	6684	1767	5522	1414	4418	DP	835	1054	608
												DQ	875	1121	647

FLA — Full Load Amps
kW — Compressor Power Input (kilowatts)
LRA — Locked Rotor Amps
MTR — Motor

NOTE Overload Trip Amps = FLA x 1 08

Power Factor
Low Voltage — 90
High Voltage — 89

19EF ELECTRICAL DATA

ITEM	HP	DESIGN CENTER VOLTAGE	SUPPLY VOLTAGE	FULL LOAD AMPS	LOCKED ROTOR AMPS
			3-Phase, 60-Hz		
OIL PUMP	1½	220	200-240	5 2	28 2
		430	380-480	2 6	13 3
		575	550-600	2 1	10 7
			1-Phase, 60-Hz		
PURGE PUMP	⅛	—	115	4 4	—
			3-Phase, 60-Hz		
PUMPOUT COMPRESSOR	2	208	—	8 8	48 5
		230	—	7 6	43 0
		460	—	3 8	22 5

NOTES Listed motor voltages are design voltages Motors are suitable for use with supply voltages as noted, and will operate satisfactorily at 10% below the minimum and at 10% above the maximum supply voltage

200 v — for use on 200- to 208-v systems
230 v — for use on 220- to 240-v systems
380 v — for use on 360- to 400-v systems
460 v — for use on 440- to 480-v systems
575 v — for use on 550- to 600-v systems
2400 v — for use on 2300- to 2500-v systems
4160 v — for use on 4000- to 4300-v systems
6900 v — for use on 6600- to 7200-v systems

To establish electrical data for your selected voltage, if other than listed voltage, use the following formulas:

$$\text{FLA} = \text{listed FLA} \times \frac{\text{listed voltage}}{\text{selected voltage}}$$

$$\text{OLTA} = \text{listed OLTA} \times \frac{\text{listed voltage}}{\text{selected voltage}}$$

$$\text{LRA} = \text{listed LRA} \times \frac{\text{selected voltage}}{\text{listed voltage}}$$

EXAMPLE Find the full load amperage for a motor listed at 1 12 amps per kW input and 550 volts

$$\text{FLA} = 1\ 12 \times \frac{575}{550} = 1\ 17$$

LEGEND FLA — Full Load Amps per kW input
LRA — Locked Rotor Amps
OLTA — Overload Trip Amps (= FLA x 1 08)

CONTROL TRANSFORMER REQUIREMENTS

MODEL 19EF	
Control Circuit	
Inrush va	1800
Sealed va	550
Purge System	
Inrush va	—
Sealed va	—
Oil Heater	
Inrush va	1500
Sealed va	—

NOTE Oil heater must be on separate circuit providing continuous service

Compressor motor controllers

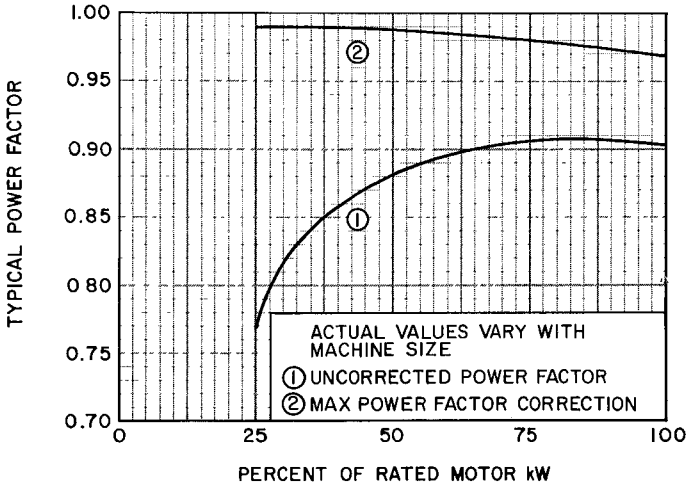
Compressor motors as well as controls and accessories require the use of starting equipment systems specifically designed for 19 Series chillers. Refer to Application Data, Starting Equipment publications or consult Carrier regarding design information for selection of controllers.

Capacitors

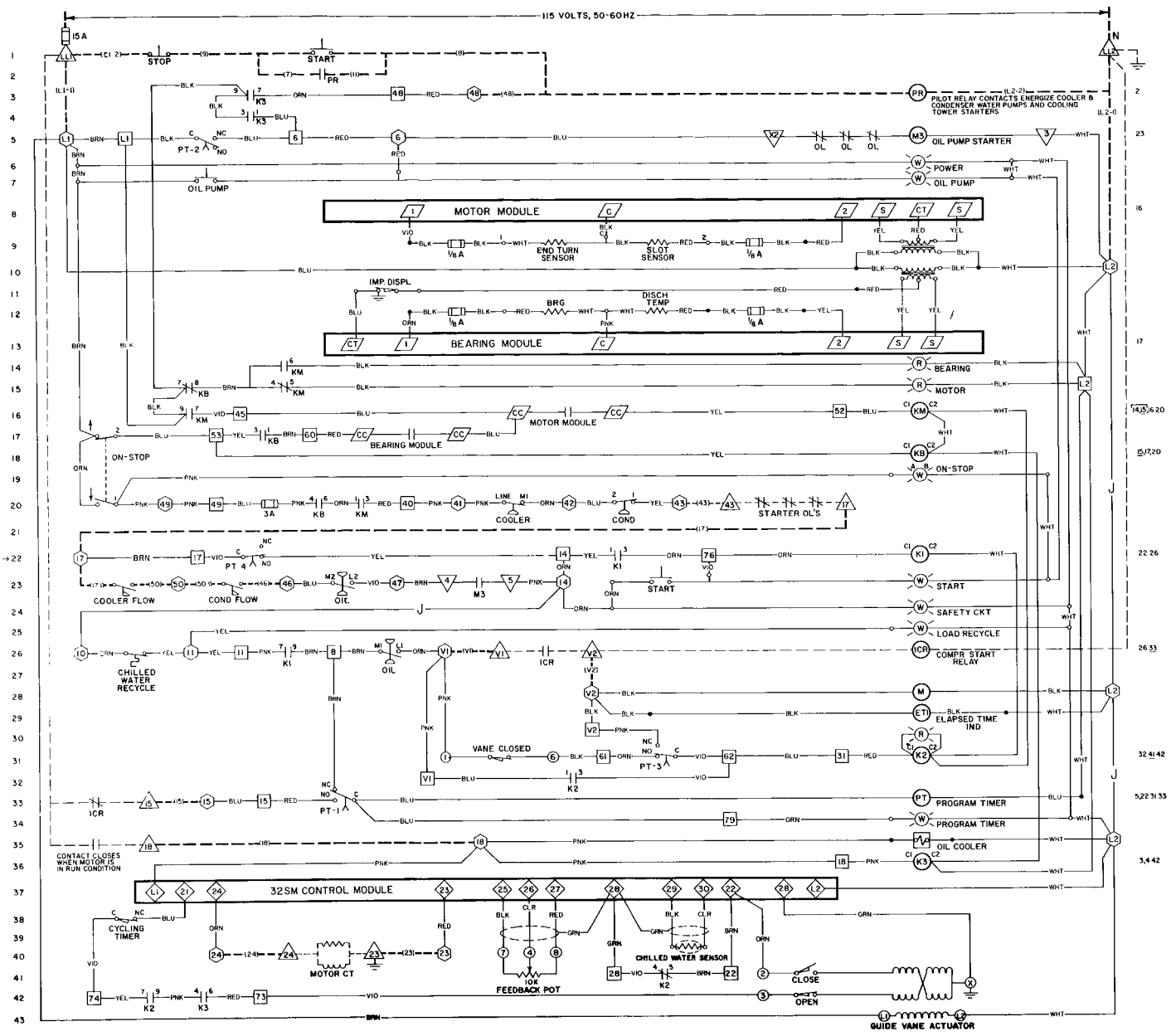
Power factor considerations may indicate use of capacitors. Properly-sized capacitors improve power factors as illustrated in the Typical Power Factors curve.

However, the P.F. of Carrier are so high that correction is usually not necessary.

TYPICAL POWER FACTORS



Typical control wiring schematic

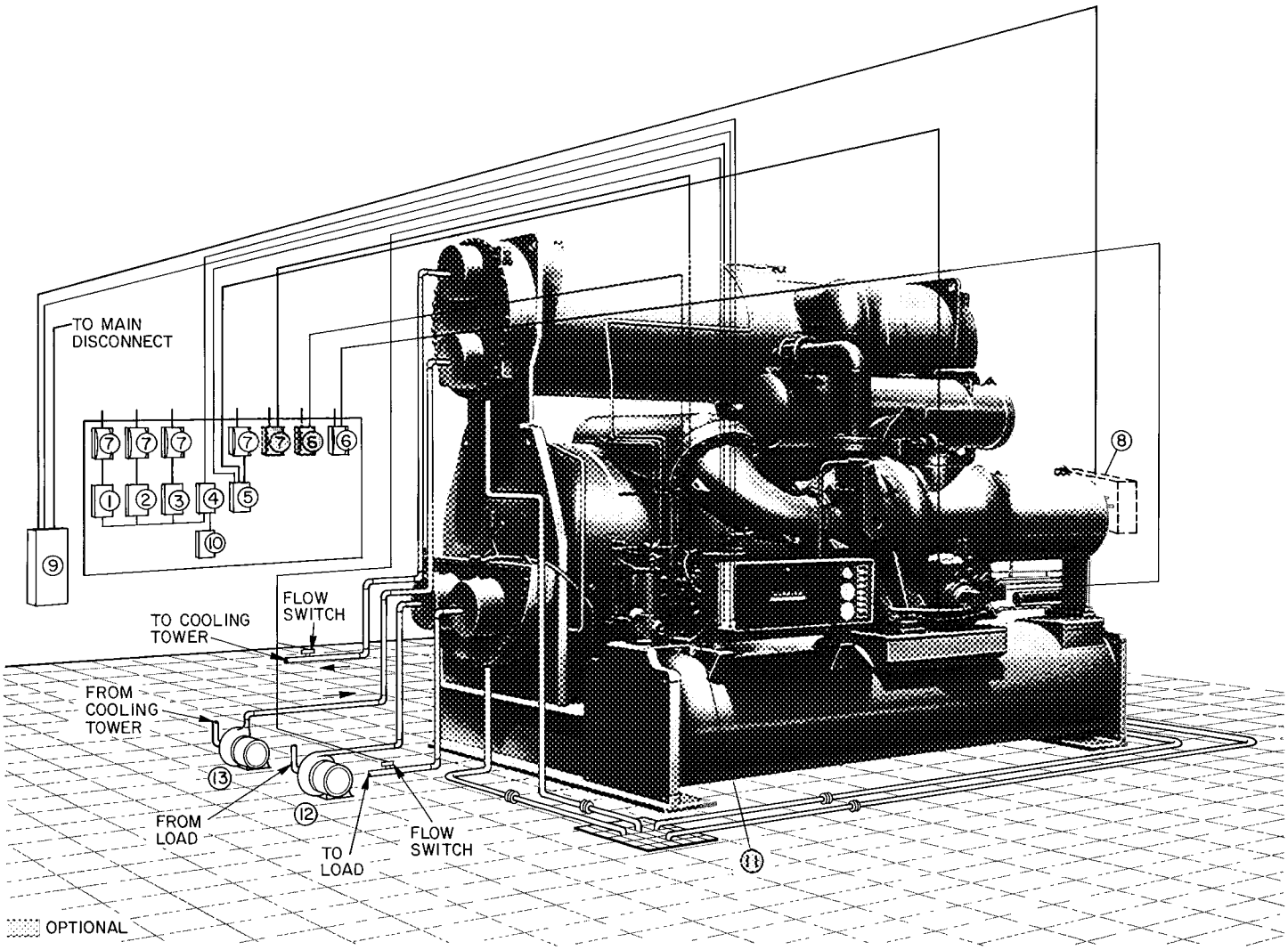


LEGEND

- Field Wiring
- Starter Wiring
- Factory Wiring
- Printed Circuit

- Field Wiring Terminal
- Relay Module Terminal
- Main Starter Terminal
- Guide Vane Actuator Terminal
- Capacity Control Module Terminal
- Temperature Sensor Module Terminal

Typical piping and wiring



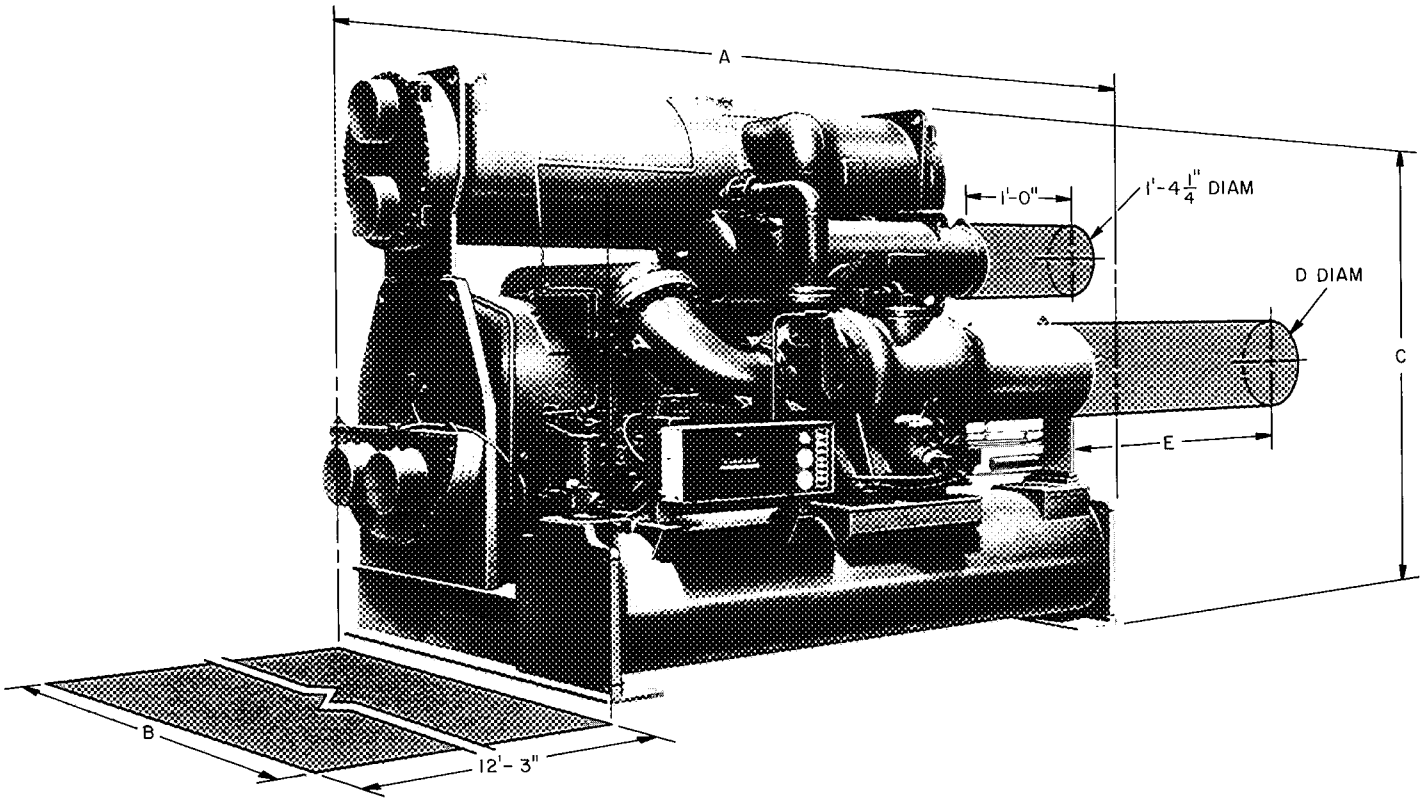
LEGEND

1 — Chilled Water Pump Starter
2 — Condenser Water Pump Starter
3 — Cooling Tower Fan Starter
4 — Pilot Relays
5 — Oil Pump Starter
6 — Fused Disconnect (Oil Heater)
7 — Fused Disconnects
8 — Compressor Motor Terminal Box
9 — Compressor Motor Starter
10 — Auto -Recycle Switch
11 — Pumpout (Optional) Terminal Box
12 — Cooler Water Pump
13 — Condenser Water Pump

NOTES

1 Wiring and piping shown are for general point-of-connection only and are not intended to show details for a specific installation Certified field wiring and dimensional diagrams are available on request
2 All wiring must comply with applicable codes
3 Refer to Carrier System Design Manual for details regarding piping techniques
4 A separate 115-volt fused power source for controls is required unless compressor motor control is furnished with a transformer
5 Provide a separate fused 115-volt power source for oil heater and thermostat

Dimensions



SPACE REQUIRED FOR SERVICE AND ACCESS

Certified dimension drawings available on request

DIMENSIONS (ft-in.)

SIZE	LENGTH* A		WIDTH B	HEIGHT C	
	Long Cooler	Short Cooler		Base Code 1†	Base Code 2‡
1920	19-6⅜	14-8⅜	9-11½	9-4⁵⁄₁₆	8- 0⁹⁄₁₆
2021 2122				9-4⁵⁄₁₆	—
2020 2121				—	8- 0⁹⁄₁₆
2222				9-11	8- 7¼
2424 2525 2626				10-4⅝	9- 0⅜
2727 2828 2929				11-3³⁄₁₆	9-11⁷⁄₁₆
2730 2831 2932				12-2½	10-10¾

*Length including nozzle at both ends
†With storage tank
‡Without storage tank

SERVICE CLEARANCE FOR MOTORS

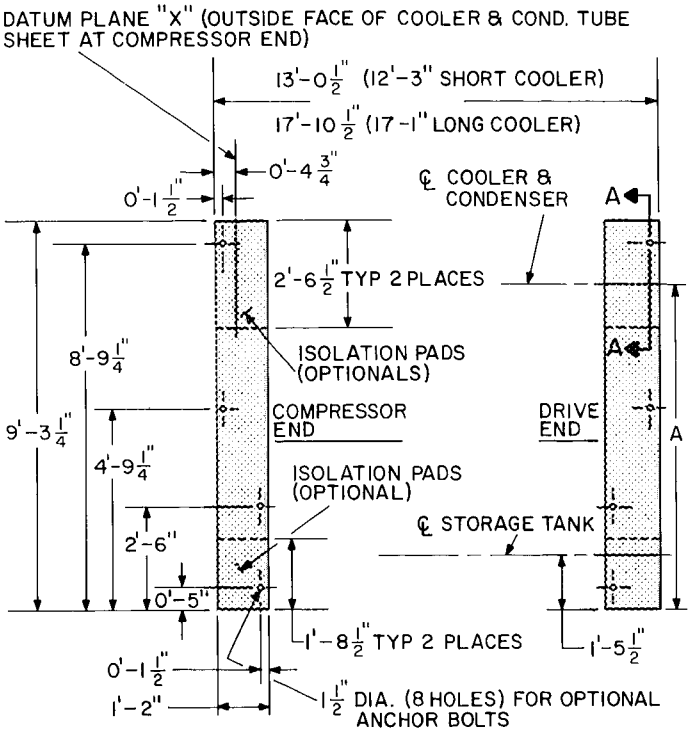
COMPR FRAME	MOTOR SIZE	CLEARANCE	
		D Diam	E Length
5	DF-DH DK-DP	1-11¼ 1-11¼	3-2 3-7½

NOZZLE SIZES

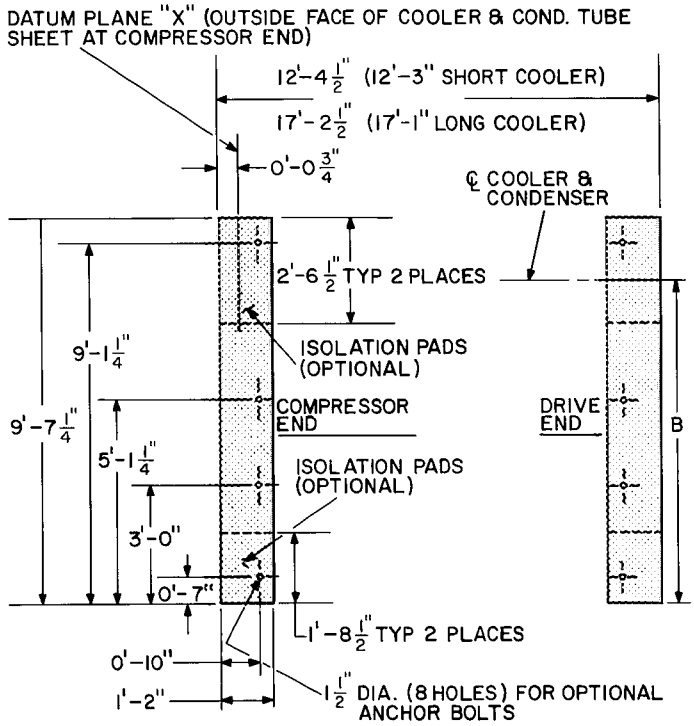
COOLER SIZE	CONDENSER SIZE	NOZZLE SIZES (in.)*							
		Cooler Passes				Condenser Passes			
		1	2	3	4	1*	2	3	4
19 49	—	12	10	8	6	—	—	—	—
20,21,22 50,51,52	20,21,22	16	10	10	8	16	12	10	8
24,25,26 54,55,56	24,25,26	18	12	10	10	18	12	10	10
27,28,29 57,58,59	27,28,29	20	14	12	10	20	14	12	10

*5- and 6-in nozzles are Schedule 40 8-, 10-, and 20-in nozzles are Schedule 20 12-in nozzles are 250W, 312W, or 375W 14-, 16-, and 18-in nozzles are 312W or 375W

STANDARD MACHINE CONTACT SURFACES

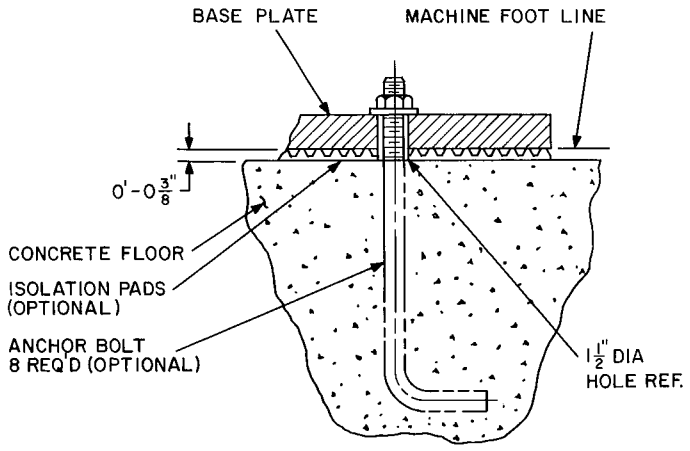


WITH STORAGE TANK



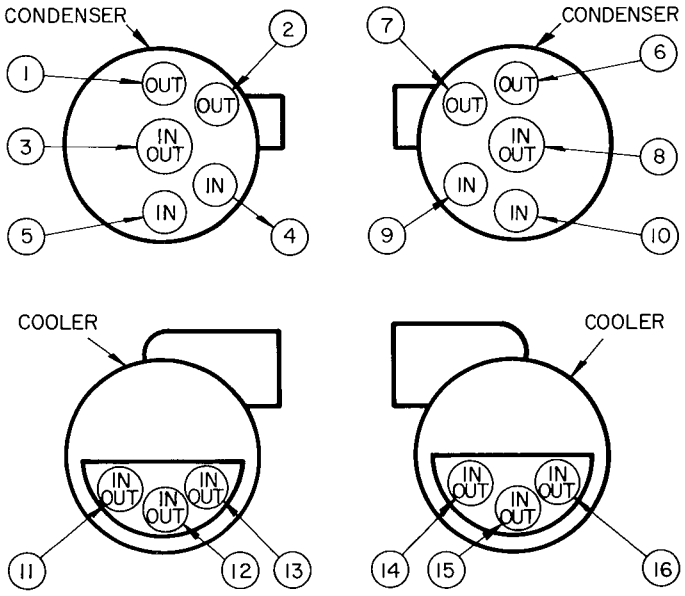
WITHOUT STORAGE TANK

COOLER SIZE	A (ft-in.)	B (ft-in.)
19,20,21 49,50,51	7-4 7/8	7-8 7/8
22,24,25,26 52,54,55,56	7-1 1/16	7-5 1/16
27,28,29 57,58,59	6-9 3/4	7-1 3/4



SECTION A-A (Rotated 90°)
OPTIONAL ANCHOR BOLTS & ISOLATION PADS

NOZZLE ARRANGEMENTS



COMPRESSOR END

MOTOR END

COOLER NOZZLE NO. Pass	In	Out	ARR
1	12	15	A
	15	12	B
2	11	13	C
	13	11	D
	14	16	E
	16	14	F
3	11	14	G
	13	16	H
	14	11	J
	16	13	K
4	11	13	L
	13	11	M
	14	16	N
	16	14	P

CONDENSER NOZZLE NO. Pass	In	Out	ARR
1	3	8	Q
	8	3	R
2	5	1	S
	10	6	T
3	4	7	U
	9	2	V
4	4	2	W
	9	7	X

Complete nozzle arrangement consists of cooler arrangement followed by condenser arrangement For example:

2-pass cooler with leaving nozzle Number 14 = Arr F
1-pass condenser with leaving nozzle Number 3 = Arr R
Complete nozzle arrangement = FR

Controls

19EF SAFETY AND CONTROL COMPONENT FEATURES

SAFETY CUTOUTS:	
Bearing High Temperature	*
Motor High Temperature	*
Gas Discharge High Temperature	*
Refrigerant High Pressure (Condenser)	*
Refrigerant Low Temperature (Cooler)	*
Oil Pump Motor Overload	√
Lube Oil Low Pressure	*
Impeller Displacement Limit	*
Cooler and Condenser Water Flow Switches	√
INTERLOCKS:	
Unloaded (Vanes Closed) Start	*
Pre-Lube and Post-Lube (via Program Timer)	*
Starting Sequence (via Program Timer)	*
Low Chilled Water Temp/Recycle Sequence (via Program Timer)	*
Oil Cooler Water Flow (Solenoid)	*
Machine Manual Reset after Safety Cutout	*
CAPACITY CONTROL:	
Guide Vane Actuator	*
Solid-State Leaving Chilled Water Control	*
Motor Current (demand) Limit — Adjustable 40 - 100%	*
Manual Leaving Chilled Water Reset	*
OTHERS:	
Elapsed Time Indicator	*
Start Counter	*
Manual (Local) Start	*
Auto (Remote) Start	#
Pneumatic LCW Control Transducer	#
Safety Indicator Panel	#
Lead-Lag Panel	#
Mounted Oil Pump Starter	√

*Factory supplied and installed

√Required — Field- and/or Factory-Option Supplied

#Optional

Control system

The safety controls of each Carrier centrifugal chiller are factory wired and mounted to ensure machine protection against condenser high pressure, cooler low temperature, bearing or motor overtemperature, motor overload and oil low pressure. Other safety controls ensure no-load starting of compressor and prevent compressor restart until a safe, preset interval has elapsed.

The capacity control system is a fully automatic, modular, solid state system for precise control of machine capacity at all loads. When it is desirable to use pneumatic controls to interface with a complete pneumatic system, control interface devices are available.

The operating capacity of each chiller is matched directly with the need for cooling. As cooling needs change, guide vanes in the refrigerant vapor stream entering the compressor change position to maintain the selected chilled water (brine) temperature.

The changes in vane position are initiated by a solid-state thermistor in the chilled water line. This probe constantly relays any variations in water temperature to a solid-state capacity control module in the chiller control center The control module, in turn, amplifies and modulates the probe signals. The amplified signals cause a guide vane actuator motor to adjust the guide vane position as required.

If chilled water temperature drops below the selected design temperature, the actuator moves the guide vanes towards a closed position, the rate of refrigerant evaporation slows and chiller capacity decreases A rise in chilled water temperature above the set point causes the actuator to move the vanes towards a more open position Refrigerant begins to evaporate at a more rapid rate and chiller capacity increases

Built-in safeguards in the capacity control system prevent motor overload When motor full load current is reached, the guide vanes stop opening immediately If motor current continues to increase, the guide vanes begin to close until motor current is reduced To minimize start-up current demand, capacity control interlocks keep the guide vanes in a closed (minimum capacity) position until the compressor motor reaches run condition.

Control sequence

Before the chiller can start, the condenser and chilled water pumps must be operating Field-supplied pilot relays for pumps and fan are normally applied as shown in the Typical Control Wiring Schematic.

Closing the chiller ON-STOP switch energizes the temperature control circuits in the compressor safety system Once these temperature sensing circuits have been energized, the circuits containing pressure sensing devices can be energized. If condenser pressure and cooler refrigerant pressure/temperature are satisfactory, the machine control circuit can then be energized by pressing chiller START button. A program timer now begins a series of 4 timed steps (PT-1 thru -4) to ensure the proper sequencing of the oil pump and compressor start.

When the compressor motor reaches RUN condition, a normally open contact closes to energize holding relay K3 This locks in control circuit power to oil pump and water pump motors whenever the chiller compressor is operating. Energizing the K2 and K3 relays also permits the capacity control circuit to position the compressor guide vanes as required to maintain the selected chilled water temperature

To guard against stress or damage to the compressor motor, the program timer keeps the chiller control circuit de-energized for approximately 15 minutes after a compressor stop

The chiller is stopped by pressing the ON-STOP switch. The auxiliary water pumps and fan motor are stopped by pressing the field-s ıpplied STOP button

Typical control components

Condenser high-pressure cutout (manual reset) — Shuts down compressor if condenser pressure rises above cutout set point.

Bearing high-temperature cutout — Prevents damage to motor and compressor bearings from excessive temperature. Keeps compressor from starting or shuts compressor off if bearing temperature reaches set point Chiller ON-STOP button must be opened and reclosed to reset this safety circuit.

Motor winding high-temperature cutout — Prevents compressor start or shuts compressor off if motor winding temperature reaches set point. Requires opening and reclosing chiller ON-STOP button to reset.

Cooler low-refrigerant cutout — Switch trips when refrigerant charge is low, shutting off compressor. Switch protects the cooler tubes from freeze-up if water flow drops off or chilled water thermostat is set too low. Switch requires manual reset.

Oil low-pressure cutout — Prevents compressor start until oil pressure is adequate for good bearing lubrication. Automatically stops compressor if oil pressure falls to set point. Coastdown lubrication is provided in the compressor.

Chilled water low-temperature recycle switch — Stops compressor when chilled water temperature drops to a point indicating minimum refrigeration load. Allows chiller to recycle automatically when water temperature rises to a point that indicates need for further cooling. Also provides protection against tube freeze-up

Vane closed switch — Prevents compressor start unless compressor inlet guide vanes are in closed position Ensures no-load starting

Capacity control module (solid state) — Transmits signals from temperature sensing element in the chilled water line to compressor guide vane actuator. Provides precise control of vane position, and hence, machine capacity at all loads. Module contains a motor load control that overrides the chilled water temperature control and closes the guide vanes to prevent motor overload.

Guide vane actuator — Motor opens and closes compressor guide vanes in response to signals from capacity control module

Program timer — Sequences the start of oil pump and compressor motor to ensure adequate lubrication before compressor starts during operation and as the compressor coasts down at shutdown The program timer also provides a 15-minute delay between any compressor stop and subsequent start-up

Guide specifications

Furnish and install — Hermetic centrifugal liquid chilling package(s) suitable for chilling water as shown when supplied with condenser water and electric power as shown on the plans.

Selection — Each unit shall allow for water side fouling factor of .0005 in the cooler tubes and .0005 in the condenser tubes. Cooler and condenser water pressure drops shall not exceed those shown on plans. The kW power draw shall not exceed that shown on plans. Machine shall be rated in conformance with the most recent ARI Standard 550. Each unit shall conform to ANSI/ASHRAE 15-1978 Safety Codes.

Water chiller shall be complete with compressor and motor, evaporator, condenser, lubrication system, capacity control and controller, motor starter, instrument and control panel mounted and factory wired on the machine, purge system and other items as herein specified.

The machine shall be shipped completely factory assembled with all refrigerant piping and control wiring factory installed. The entire refrigerant charge of (R-12/ R-500) shall be supplied In addition, the necessary labor for pressure testing, checking and setting all controls, charging the unit, placing it into operation and reviewing the operating instructions with the owner's representative by a factory trained employee shall be included.

Compressor shall be of high-performance multi-stage hermetic design A thrust bearing of the Kingsbury type with forced-fed lubrication shall axially position the shaft under unidirectional thrust loading. To prevent potential machine hazards, the impeller shall be designed so that the thrust loading is positive and unidirectional under all operating conditions.

Friction losses shall be maintained at a minimum by an impeller design utilizing precision shaft placement. Impeller shall be of an in-line design for even unloading, and ease of maintenance. Impellers shall be overspeed tested a minimum of 20% above operating conditions.

Babbitt-lined journal bearings to be self-aligning type, pressure lubricated. Compressor transmission gears must be arranged for visual inspection without disassembly or removal of compressor casing or impeller The gears are to be of the double-helical design, symmetrical and center supported by a spherically seated, self-aligning bearing All bearings must be serviceable without necessitating complete compressor disassembly or breaking of main refrigerant piping connections

Compressor shall be capable of operation without surge, cavitation or undue vibration from full load to 10% load without hot gas bypass when supplied with design entering water quantity.

Forced-fed lubrication system with a hermetic motor-driven oil pump shall be furnished as part of the water chiller. System shall be complete with oil pump, oil cooler, pressure regulator, oil filters, thermostatically controlled oil heater and necessary motor controls. Oil pumps shall be energized prior to chiller motor energization. Oil pump starter shall be factory supplied and mounted on the chiller and factory wired with only field power leads required.

Oil pump controls are to have delayed action so that oil pressure is provided during machine coastdown. Oil pump is to be provided with a separate 460-volt, 3 phase, 60-Hertz power source Oil pump shall have momentary switches to permit only manual operation of pump when compressor is not operating. When compressor is not operating, automatic operation modes are unacceptable since they are conducive to refrigerant absorption

Motors shall be of the single-speed, non-reversing squirrel-cage induction type, and shall be suitable for voltage as shown on plans The design speed shall be 3550 rpm The motor shall be suitable for operation in a refrigerant atmosphere. Compressor motor to be cooled by atomized subcooled refrigerant in contact with the motor windings. Water jacket designs are not acceptable, as they produce substantial temperature gradients throughout the motor windings Motor stator shall be arranged for service or removal without complete compressor disassembly or breaking of main refrigerant piping connections. Full load operation of the motor shall not exceed nameplate rating Motor shall be built for connection to Star Delta type reduced voltage starter.

Evaporator and condenser shall be fabricated with high performance integrally-finned copper tubing rolled into the tube sheets in both the evaporator and condenser as well as expanded into the tube support sheets in the evaporator Tubing shall be finned except in the area adjacent to and in contact with the tube and tube support sheets. Tube support sheets shall be spaced at approximately 2-1/2 ft intervals to maintain proper tube spacing and to minimize tube vibration and wear.

Tubes shall be removable from either end of the heat exchanger without affecting strength and durability of the tube sheet and without causing leakage at adjacent tubes.

Water boxes are to be machine welded to the heat exchanger tube sheet and to be equipped with tapped drain and vent connections

Construction and materials for the heat exchangers shall conform to ANSI/ASHRAE 15-1978 Safety Code for mechanical refrigeration (which in turn requires conformance to the ASME Code for Unfired Pressure Vessels where applicable)

Controls shall be solid-state, fully automatic and "fail-safe." Safety shutdown shall be provided for low refrigerant temperature or pressure, bearing high temperature, high refrigerant pressure, motor temperature and motor overload. Each of the above controls shall have manual reset flags. Recycle shutdown shall be provided for low- oil pressure and low-chilled water temperature. These controls shall be automatic reset Motor shall be protected against drawing more than rated full load amperes. Motor-driven elapsed running time meter shall be factory installed on each machine. Solid-state chilled water controller shall be located within control panel and capable of throttling range setting of 1 5 F

Each safety switch shall be wired across its own set of terminals for easy isolation.

Demand limiter — Demand Limiter Device shall be provided within the standard control panel so that maximum current may be manually set to any fraction between 40% and 100% of full load amperes. Limiters with 4-point settings in the control panel are not acceptable.

Chiller shall be equipped with instrument gage and control panel indicating condenser pressure, evaporator pressure and oil pressure. Panel shall contain switches permitting manual or automatic operation of oil pump and purge pump In addition to gages, pilot lights and switches, the panel shall contain evaporator low-temperature or pressure cutout, condenser high-pressure cutout, and differential oil pressure controller interlocked so that compressor will only operate if adequate oil pressure is maintained to bearings. High-pressure cutout and evaporator low temperature cutout shall be arranged in a lockout circuit provided with reset buttons. Panel shall also operate the capacity control mechanism to limit the load on compressor motor to a safe maximum.

Purge system shall be furnished factory installed, wired and piped; system shall be self-contained and provided with any necessary devices for evacuating air and water vapor from the system and for condensing, separating and returning refrigerant to the system Compression type purges are not acceptable as they are susceptible to leaks. If city or other water piping is required for purge operation, chiller manufacturer shall include same in his bid.

Refrigerant — When high-pressure (R-12 or R-500) refrigerant is used, machine shall come factory equipped with a refrigerant storage vessel and pumpout compressor (for multiple_____may be used). Storage vessel shall be external to the cooler and condenser and of sufficient capacity that the entire charge may be transferred to the vessel with 20% excess volume remaining in the vessel and a pumpout compressor factory installed (for multiple machine installations one pumpout may be used).

Refrigerant flow control shall be by means of a positive metering device. The chiller shall be capable of operating with entering condensing water temperatures per ARI part load conditions without a tower water bypass valve. If this cannot be done, the chiller manufacturer shall include the price of a tower bypass valve in his bid.

Chiller manufacturer shall furnish magnetic motor starters, Star-Delta closed transition type, with suitable 3-leg overloads. Starters shall be furnished with NEMA 1 enclosures for installation by the electrical contractor. The disconnect, protection devices and control voltage shall be provided by others.

Electrical — Electrical contractor shall furnish and install all electrical lines, disconnect switches, circuit breakers, auxiliary starters, and shall install the main starter and the control wiring according to the diagram furnished by the centrifugal refrigerating machine manufacturer.

Piping — Piping contractor shall make water connections to the oil cooler, and such other water supply, drain and vent connections as are required by the drawings and local codes.

Initial refrigerant and oil charge shall be provided.

Water chiller unit performance data shall be submitted for approval.

Nameplates — Chiller shall bear firmly attached metal plates which state name of manufacturer, chiller unit model number, compressor type and refrigerant used.

Operating and maintenance instructions prepared by chiller manufacturer shall be included in Operating and Maintenance Instructions herein before specified.

Start-up — Chillers shall be leak tested, refrigerant pressure tested, evacuated, dehydrated, charged, started, controls calibrated, and operating instructions given to owner's personnel by a factory trained service mechanic employed by the chiller manufacturer. Start-up supervision will not be acceptable.

The drawings are based on a Carrier machine. If another manufacturer is substituted, that manufacturer shall be responsible for all electrical, mechanical, structural or architectural changes.

Equivalent material which qualifies to meet the above specification will be acceptable. Manufacturers other than Carrier shall submit a 1/2-in. scale plan and section drawing showing proper fit and clearance for tube pull, motor or compressor removal, other maintenance clearances required and rigging clearance needed within the mechanical room.

Guarantee — All equipment furnished under this section of the specifications shall be guaranteed against defective workmanship and material for a period of one (1) year from date of beneficial use to the owner or 18 months from time of delivery whichever occurs first.

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