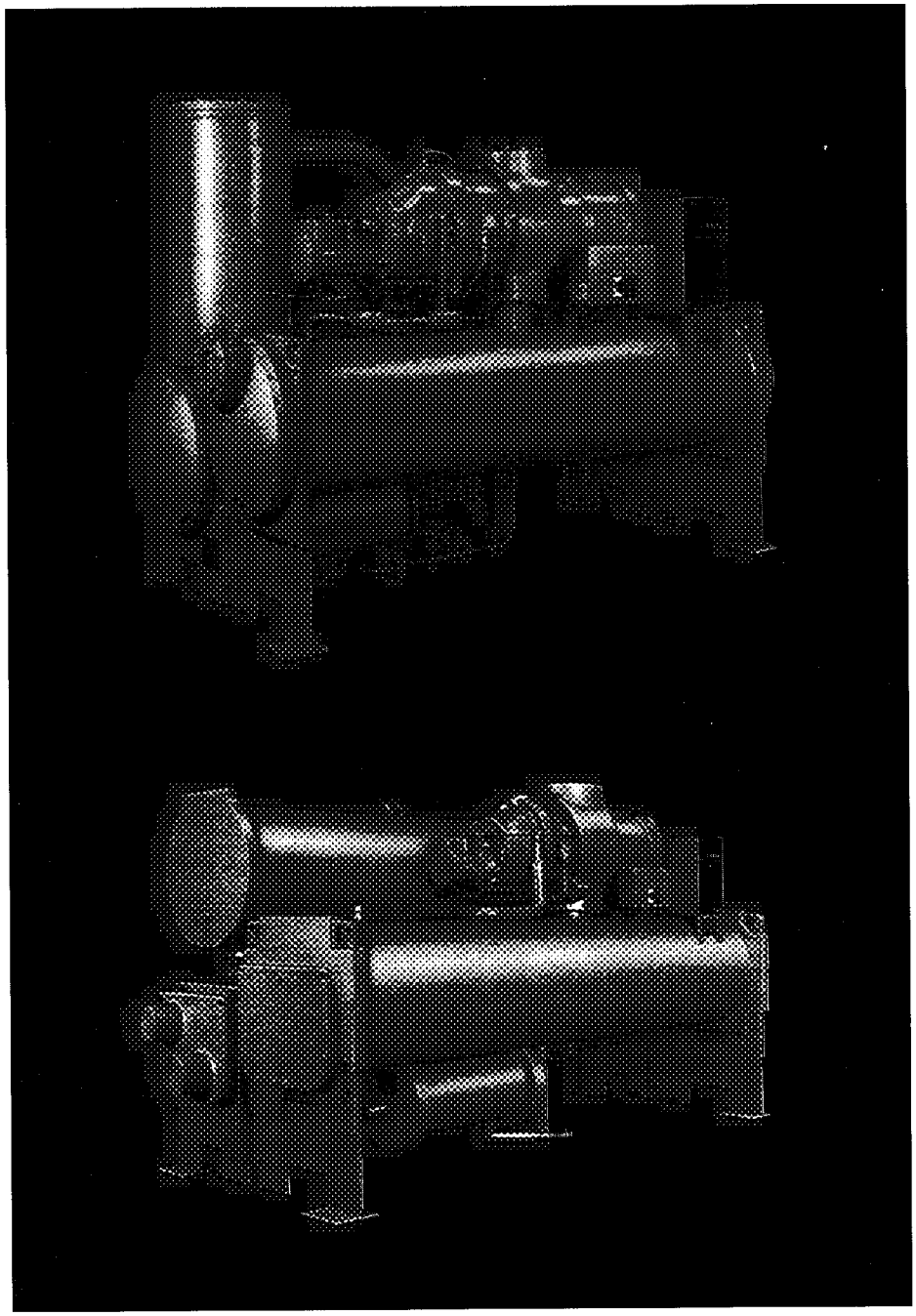
Carrier®

Product Data

23XL
Hermetic Screw Liquid Chiller
50/60 Hz

60 Hz — 160 to 350 Nominal Tons (560 to 1,232 kW)
50 Hz — 130 to 290 Nominal Tons (460 to 1,020 kW)



The 23XL screw chiller provides the performance and reliability of a centrifugal class machine by utilizing advanced engineering technology. Optimized for low life cycle costs, the 23XL offers superior value in a compact design.

Features/Benefits

- Exceptional full and part load efficiencies, coupled with a design that is easy to install and maintain, provide low overall cost of ownership.
- The rugged, reliable, and fully field serviceable compressor is designed for a lifetime of trouble-free operation.
- A low leak, ASME certified, positive pressure design uses environmentally acceptable HCFC-22 or HFC-134a refrigerant.
- Innovative direct digital controls combine an easy to use Local Interface Device (LID) with sophisticated capabilities.
- Carrier's factory testing program ensures quality while providing peace of mind and protecting your chiller investment.

Low operating costs

Advanced internally and externally enhanced heat transfer surfaces provide exceptional thermal performance.

Precise compressor tolerances in a design optimized for air-conditioning duty provide superior compression efficiency.

Integral FLASC (FLAsh SubCooler) increases the refrigeration effect and reduces compressor power consumption.

Variable refrigerant metering eliminates inefficient vapor bypass and provides superior part-load performance when compared to fixed orifice metering designs.

High efficiency hermetic motors, cooled by liquid refrigerant, reduce motor electrical losses.

Low installation costs

A positive pressure design reduces the size of the chiller by as much as 35% when compared to negative pressure designs The reduced machine size results in lower floor space requirements and easier installation.

The take-apart bolted design incorporates flanges on all major connections. Disassembly enables major components to easily fit through tight spaces. This eliminates the expense and inconvenience of cutting and welding, proving that the 23XL is an ideal replacement chiller.

Hermetic design eliminates additional machine room cooling requirements and reduces installation costs.

Single point electrical connection, provided with the optional unit-mounted starter, eliminates start-up problems caused by miswiring, further reducing installation costs.

Quiet operation reduces the need for costly sound insulation in acoustically demanding applications.

Elimination of the purge device means no purge vent or water piping is required.

Low maintenance costs

A field serviceable twin screw compressor dramatically reduces maintenance expenses when compared to compressor exchange programs.

Elimination of the oil pump, oil cooler, and purge device equates to fewer parts that require maintenance.

Direct digital controls provide preventive and predictive maintenance algorithms for increased machine uptime and reduced service expenses

Optional refrigerant discharge isolation valves enable service personnel to store the refrigerant charge in the cooler or condenser during servicing.

The hermetic twin screw compressor is designed specifically for air-conditioning and light-brine duty.

Proprietary manufacturing techniques yield rotor clearances measured in microns for unsurpassed compression efficiency.

AFBMA (Anti-Friction Bearing Manufacturers Association) Class 5 compressor bearings provide precise rotor positioning to reduce compressor wear. Carrier's unique design provides the most conservatively loaded bearing system in the industry.

Bottom-mounted capacity control slide valve offers inherently accurate positioning, preventing the wear potential associated with top-mounted designs.

Motor cooling is provided via the same simple system proven effective in the Carrier 19D series hermetic centrifugal chillers.

Optional Variable VI (Volumetric Index) offers simple, automatically controlled, compression ratio control for optimized dual duty applications such as comfort cooling and thermal storage.

Low leak, positive pressure design minimizes environmental impact and saves money.

Positive pressure design uses refrigerant HCFC-22 or HFC-134a.

ASME (American Society of Mechanical Engineers) construction requires rigorous pressure testing and ensures leak-tight assembly.

O-ring seals on the hermetic compressor replace leak-prone gaskets.

Straight-thread, O-ring sealed fittings replace leaky, tapered pipe thread fittings.

Brazed joints provide tight seals and flare connections are used for service joints only.

Use of positive pressure refrigerants result in a smaller footprint, reducing installation costs and providing more rentable space.

Positive pressure keeps air and moisture out of the chiller, eliminating the need for a purge device and the associated loss of refrigerant.

Direct Digital Product Integrated Control (PIC) provides unsurpassed flexibility and functionality. The PIC can be easily integrated directly into the Carrier Comfort Network.

The Product Integrated Control (PIC) monitors over 100 functions and conditions. In addition, it displays over 125 operating states and diagnostic messages for improved operator control.

A Proportional/Integral/Derivative (PID) control algorithm provides tight chilled water control without hunting.

Table of contents

Automatic two chiller lead/lag capability provides integral standby controls.

A 16 line by 40 character LCD display offers "all in one glance" access to key chiller operating information.

Local Interface Device (LID) provides unparalled ease of user interface The LCD display features 4 menu specific soft keys and a simple, intuitive design.

Modular pull-out/plug-in design requires minimal wiring and simplifies installation.

Low voltage design is safe and reliable.

Battery backup provides protection during power failures and eliminates time consuming control reconfiguration.

The extensive service menu can be password protected to prevent unauthorized access. Diagnostic capabilities assist technicians in troubleshooting and recommend proper corrective action for pre-set alarms, resulting in greater machine uptime.

An automatic capacity override feature prevents nuisance shutdowns by unloading the compressor whenever key safety limits are approached.

Encapsulated circuit boards, designed and built by Carrier, offer superior reliability compared to open board designs Stringent quality standards are enforced and ensured through in-house construction.

Optional control modules offer unique control expandability that includes chilled water reset, demand limit from remote sources, and much, much more.

Extensive factory testing

Components are tested individually and after assembly to ensure quality and outstanding performance.

ASME Inspections of all pressure vessels occur at major points of assembly ASME rated materials and processes result in the "U" stamp, a sign of pressure vessel integrity.

Compressors are 100% run tested before mounting as an additional step in the quality process to ensure proper functioning.

Hydrostatic vacuum and pressure testing of assembled chillers ensures leak integrity.

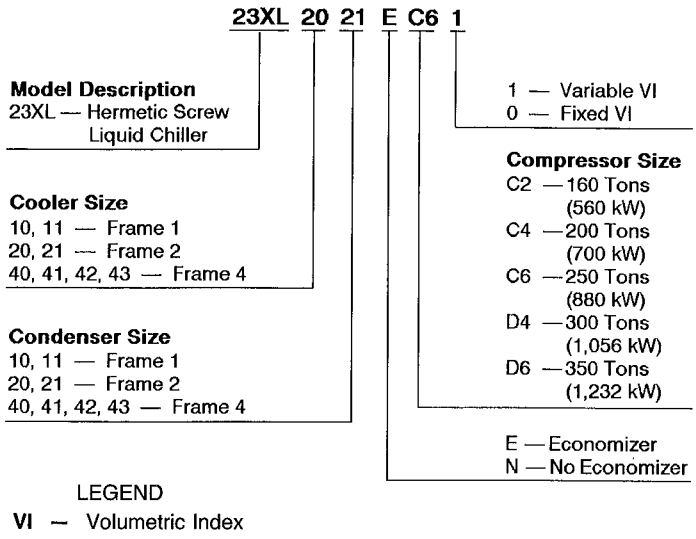
The controls and optional unit-mounted starter are tested after mounting to verify proper electrical functioning

An optional certified or witnessed ARI 550 performance test is available.

Storage tank and pumpout system

Carrier's policy is to protect the environment by ensuring the containment of refrigerant during both operation and service To help meet this requirement, the 23XL chiller can be teamed with an optional partner. The 19XB Positive Pressure Storage System. See the 19XB Product Data manual for further details.

Model number nomenclature



Canadian Standards Association

ASME 'U' Stamp

Underwriters' Laboratories

ARI (Air Conditioning and Refrigeration Institute) Performance Certified

Carrier Corporation, TR-1 Plant Registered to ISO 9001 Certificate No. A1028

Features/Benefits (cont)

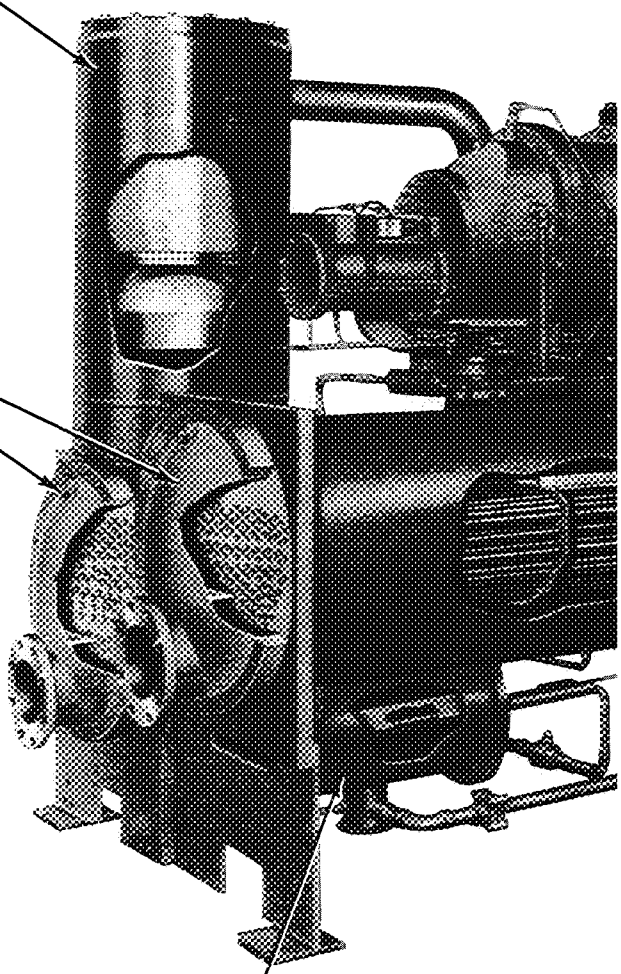
23XL HERMETIC SCREW LIQUI (FRAME 1 AND 2 MACHINES)

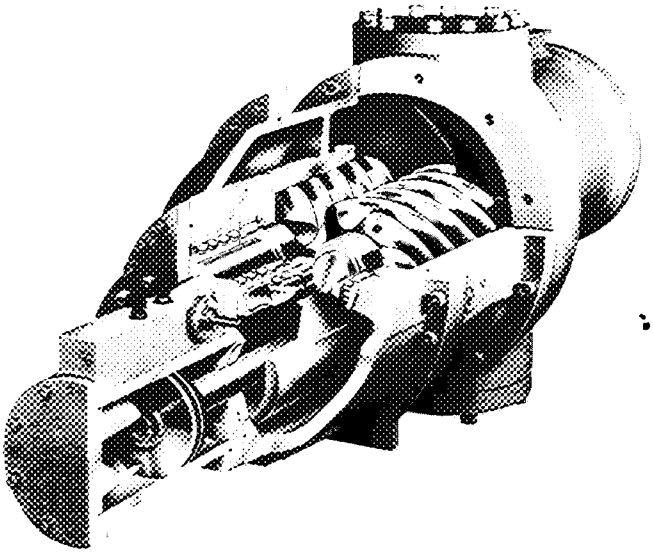
Technologically advanced chille today's environmental and ener

- Compact positive pressure design pro
- Low sound levels for the most demar
- Variable refrigerant metering for supe
- High efficiency design optimized for a
- Comprehensive factory testing progra

OIL SEPARATOR
- Two-stage design, vortex and coalescing
- Sight glass to monitor oil level

BOLT-ON WATERBOXES
- Provides full bundle access during tube cleaning
- ASA 150 flanges simplify installation





COMPRESSOR
- Field serviceable twin-screw design
- Bottom mounted slide valve
- AFBMA Class 5 bearings
- HCFC-22
- Optional variable Volume Index (VI) control

ECONOMIZER
- Simple, reliable, no moving parts

CHILLER (FRAME 1 AND 2 MACHINES)

LIQUID CHILLER
NES)

d chillers designed to answer
ıd energy-efficiency concerns

:sign provides migration path to HFC's
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for superior part-load performance
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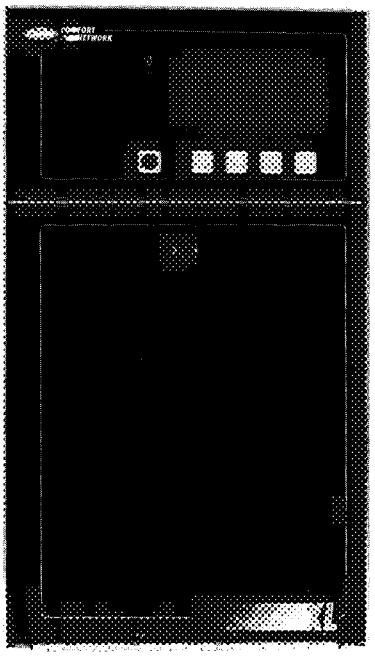

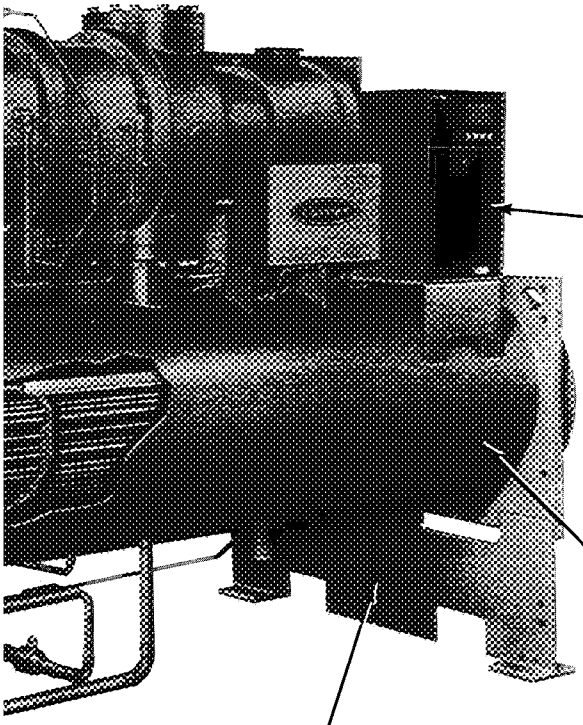

MICROPROCESSOR CONTROL CENTER

- 16 line x 40 character LCD display
- "All in one glance" access to key chiller operating data
- Monitors over 100 functions and conditions
- Displays over 125 operating and diagnostic conditions
- Carrier Comfort Network (CCN) compatible

HEAT EXCHANGERS

- ASME refrigerant side construction
- High performance internally and externally enhanced tubes
- Tubing roller expanded into double grooved tube sheets
- Patented condenser flash subcooler

RABBET-FIT CONNECTOR

- Simplifies installation for tight access applications
- Complements flanged component design
- Ideal replacement chiller

Features/Benefits (cont)

23XL HERMETIC SCREW LIQU (FRAME 4 MACHINES)

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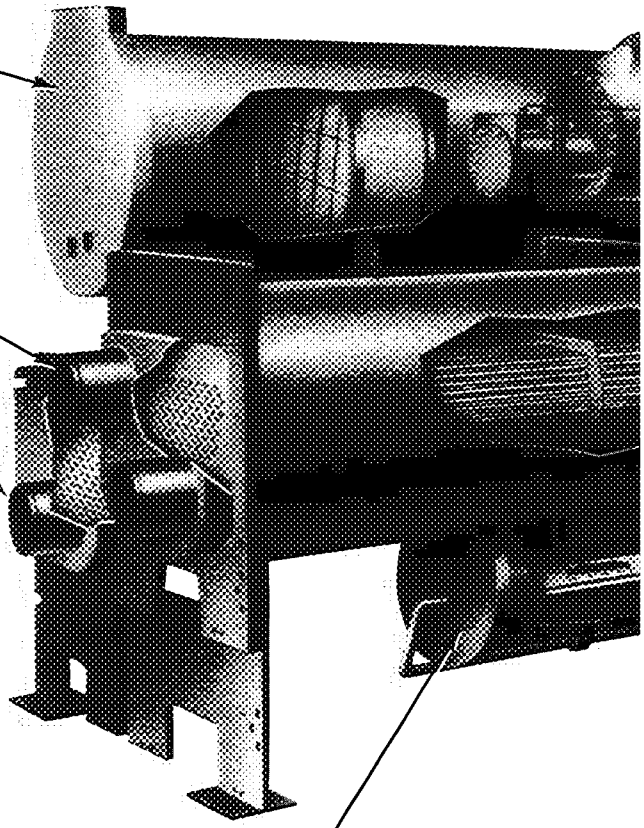
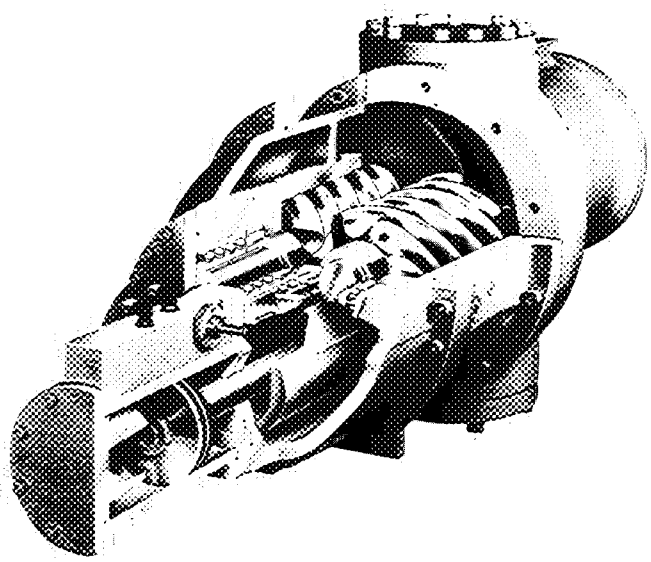
OIL SEPARATOR
- High efficiency coalescing design
- Sight glasses to monitor oil level

NOZZLE-IN-HEAD WATERBOXES
- Victaulic grooved nozzles are standard
- ASA 150 flanges available
- Marine waterboxes are optional





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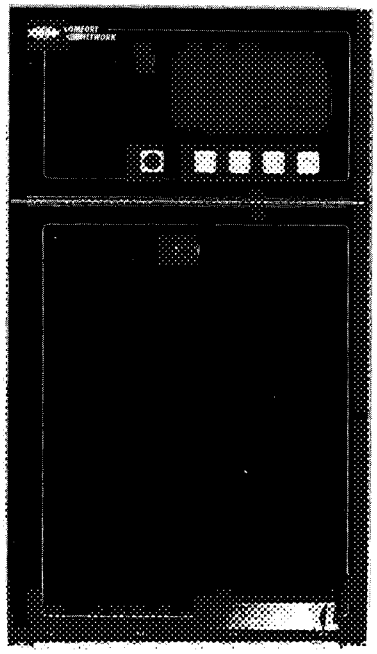

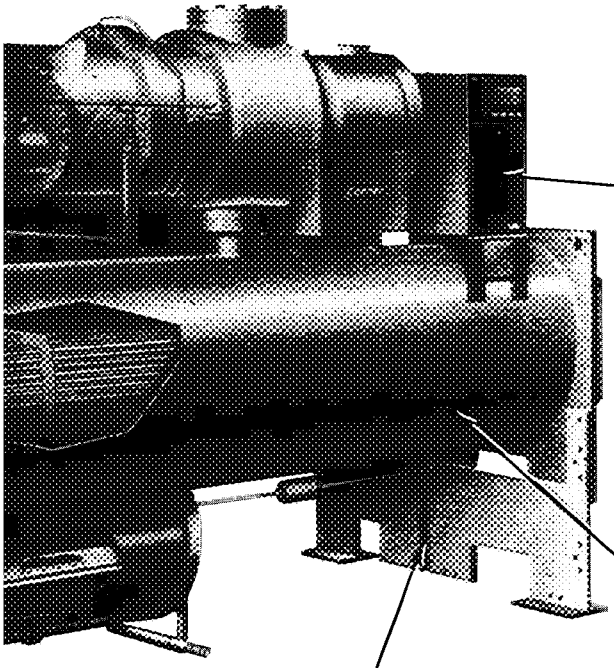

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23XL Refrigeration Cycle

The compressor continuously draws refrigerant vapor from the cooler at a rate determined by the position of the capacity control slide valve. This compressor suction reduces the pressure in the cooler and causes the remaining refrigerant to boil vigorously at a low temperature (typically 38 to 42 F [3 to 6 C]).

The energy required for boiling is obtained as heat from the water (or brine) flowing through the cooler tubes. With heat removed, the chilled water (brine) can then be used for air conditioning or for process cooling.

After removing heat from the water (brine), the refrigerant vapor passes through the compressor. Compression adds more energy to the refrigerant, raising its temperature upon discharge (typically 75 to 95 F [24 to 35 C]) to a level above that of the water flowing through the condenser tubes. This relatively cool condensing water removes some of the heat from the vapor, causing it to condense into a liquid.

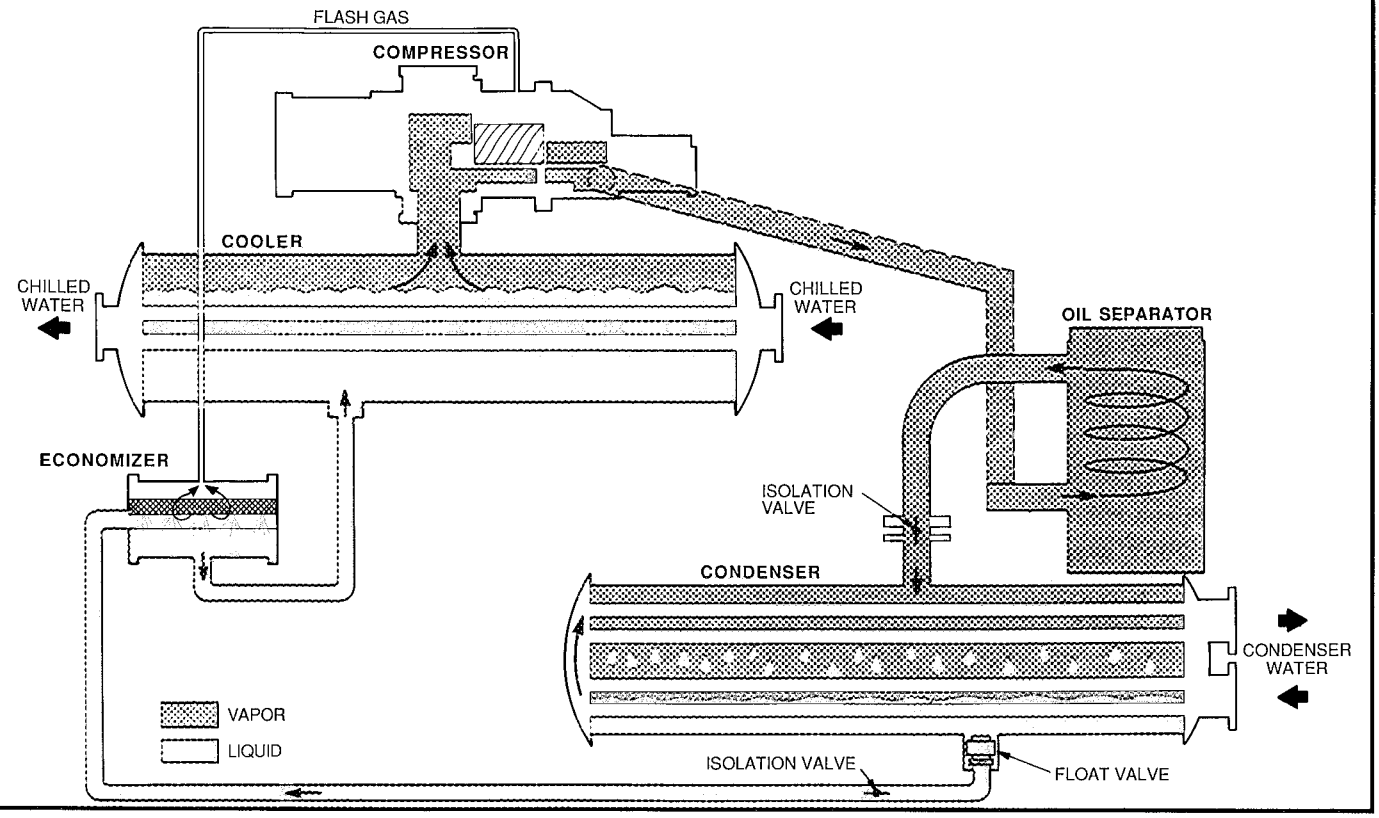
The liquid refrigerant passes through orifices into the FLASC (FLAsh SubCooler) chamber. Since the FLASC chamber is at a lower pressure, part of the liquid refrigerant flashes to vapor, thereby cooling the remaining liquid. The FLASC vapor is recondensed on the tubes which carry the entering condenser water. The liquid then passes through a float-type metering device before returning to the cooler. This float device maintains a liquid seal to eliminate inefficient vapor bypass from the FLASC chamber to the cooler.

On certain models, an economizer is installed between the cooler and condenser. With these models, the float valve meters liquid refrigerant into the economizer instead of the cooler. Pressure in this chamber is intermediate between condenser and cooler pressures. At this lower pressure, some of the liquid refrigerant flashes to vapor, cooling the remaining refrigerant. The vapor returns directly to the compressor where it mixes with vapor from the cooler at an intermediate point of compression. This provides an increase in the mass flow of refrigerant, resulting in an increase in capacity. The cooled liquid refrigerant in the economizer is metered through an orifice into the cooler. Because pressure in the cooler is lower than economizer pressure, some of the liquid flashes and cools the remainder to evaporator (cooler) temperature.

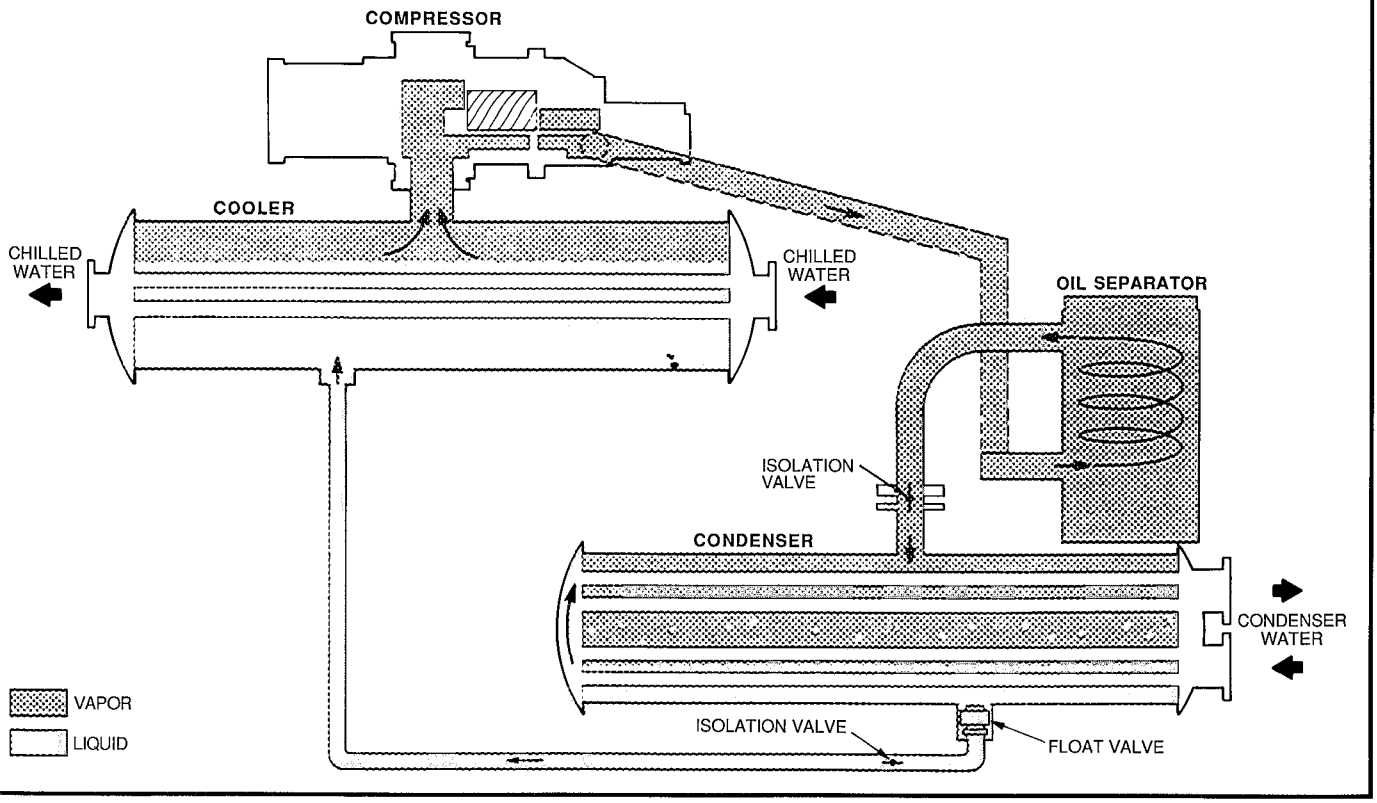
During both the economized and non-economized cycles, liquid refrigerant returns to the cooler to replenish the refrigerant leaving as result of compressor suction. The cycle is now complete.

Features/Benefits (cont)

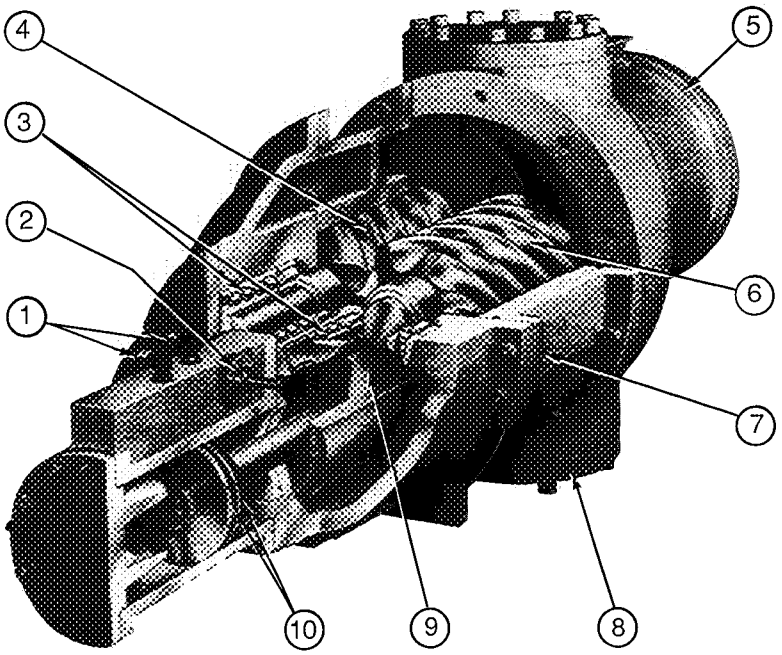
TYPICAL 23XL REFRIGERATION CYCLE ECONOMIZED MACHINES



TYPICAL 23XL REFRIGERATION CYCLE NON-ECONOMIZED MACHINES

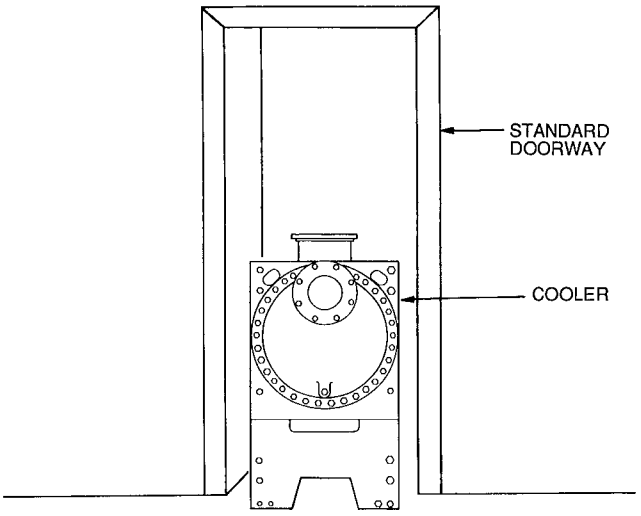


SCREW COMPRESSOR COMPONENTS

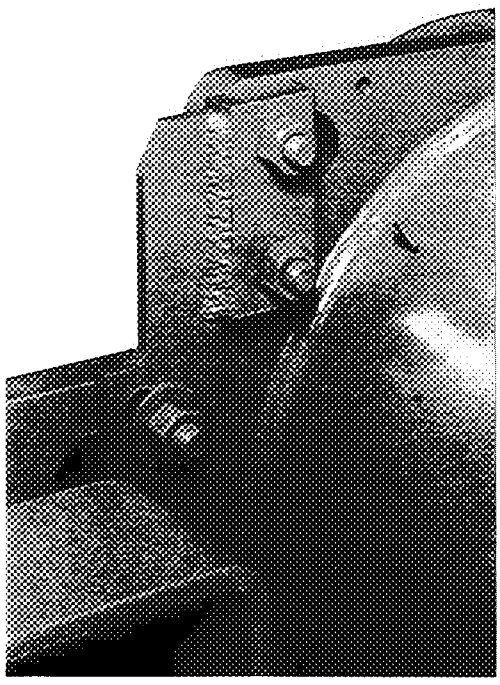


1 — Control Oil Lines
2 — Capacity Control Solenoid Valve
3 — Discharge Bearing Assemblies
4 — Male Rotor
5 — Semi-Hermetic Motor
6 — Female Rotor
7 — Rotor Oil Injection Port
8 — Suction Inlet Flange
9 — Capacity Control Slide Valve
10 — Slide Piston Seals

TAKE-APART DESIGN SIMPLIFIES INSTALLATION



TYPICAL RABBET-FIT BOLT CONNECTOR FOR EASY REALIGNMENT



Options and accessories

ITEM	OPTION*	ACCESSORY†
Shipped Factory Charged with Refrigerant	X	
Shipped Factory Charged with Nitrogen	X	
Full Insulation (except waterbox covers)	X	
Refrigerant Isolation Package	X	
Waterbox Options (Frame 4 Machines Only):		
300 psig (2068 kPa) Nozzle-in-Head Waterboxes	X	
300 psig (2068 kPa) Marine Waterboxes	X	
Automatic Electric Hot Gas Bypass	X	
Unit Mounted Wye-Delta or Solid-State Starter with:		
Normal I.C. Circuit Breaker	X	
High I.C. Circuit Breaker**	X	
3-Phase Ammeter/Voltmeter	X	
Lightning/Surge Arrestor Package	X	
kW Transducer	X	
3-Phase Under/Over Voltage Protection	X	
Ground Fault Protection††	X	
Phase Failure/Reversal/Unbalance Protection††	X	
Power Factor Correction Capacitors	X	
Combination 3-Phase Under/Over Voltage and Phase Failure/Reversal/Unbalance Protection††	X	
Control Options Module	X	
.035-in. Wall Copper Tubes, Enhanced	X	
.028 or .035-in. Wall Copper Tubes, Not Enhanced	X	
.028 or .035-in. Wall Tubes, Cupronickel	X	
Factory Performance Test	X	
Export Crating	X	
Pumpdown/Storage Unit		X
Stand Alone Pumpout/Storage Unit		X
Option Module Upgrade Kit		X
Soleplate Package		X
Spring Isolators		X
Spare Sensor Package		X
Control Options Module Upgrade Kit		X
Flow Switch, Differential Pressure Type		X

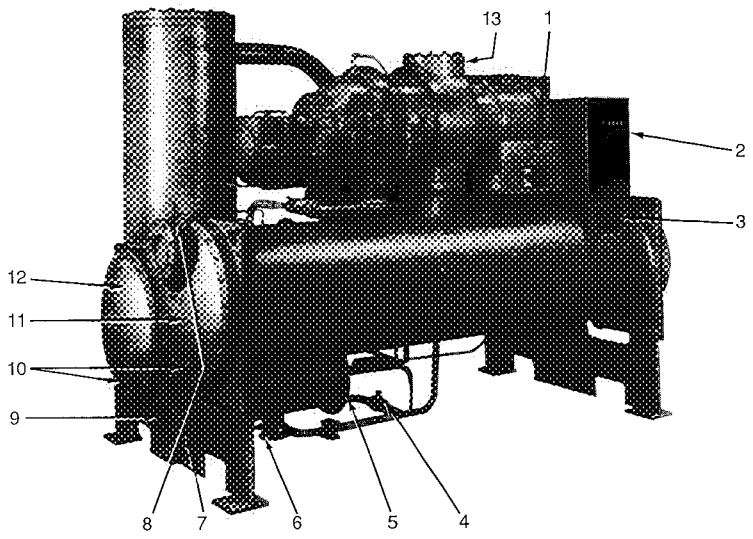
LEGEND

I.C. — Interrupting Capacity

*Factory Installed.
†Field Installed.
**Only available on wye-delta starters.
††Indicates an option on wye-delta starter, but a standard feature on solid-state starter.

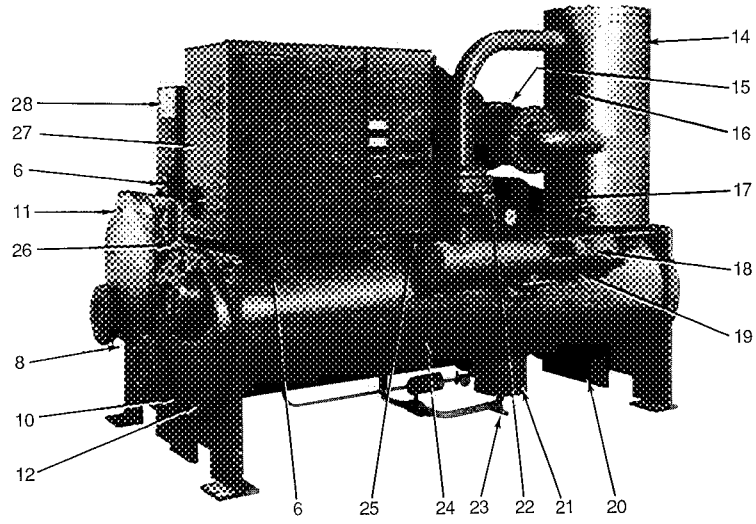
Machine components

FRONT VIEW



1 — Power Panel
2 — Local Interface Display (LID) Control Center
3 — ASME Nameplate, Cooler
4 — Cooler Refrigerant Isolation Valve
5 — ASME Nameplate, Economizer (Hidden)
6 — Service Valve
7 — Take-Apart Rabbet Fit Connector (Lower)
8 — Cooler Temperature Sensor
9 — ASME Nameplate, Condenser
10 — Typical Waterbox Drain Port
11 — Cooler Supply/Return End Waterbox Cover
12 — Condenser Supply/Return End Waterbox Cover
13 — Compressor Nameplate (Hidden)

REAR VIEW

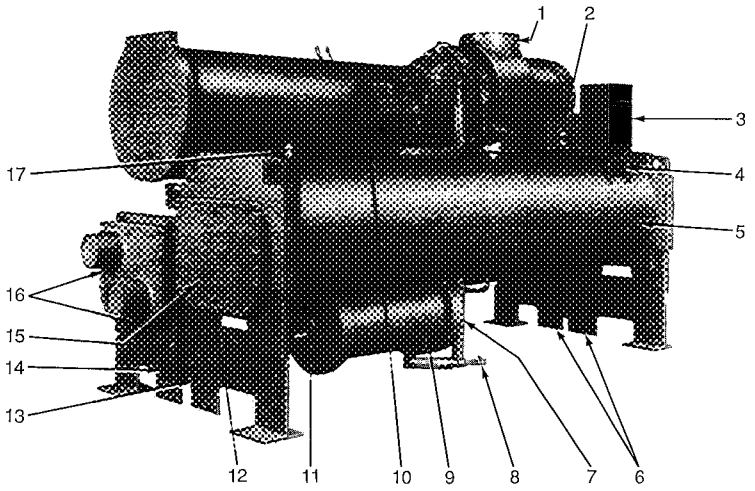


14 — Oil Separator
15 — ASME Nameplate, Muffler (Hidden)
16 — ASME Nameplate, Oil Separator
17 — Cooler Relief Valves (Hidden)
18 — Oil Sump Filter Assembly
19 — Oil Charging Valve
20 — Vessel Separation Feet
21 — Float Chamber
22 — Condenser Isolation Valve (Option)
23 — Refrigerant Charging Valve
24 — Condenser
25 — Condenser Relief Valves (Hidden)
26 — Take-Apart Rabbet Fit Connector (Upper)
27 — Unit Mounted Starter (Option)
28 — Machine Identification Nameplate

FRAME 1 AND 2 MACHINES

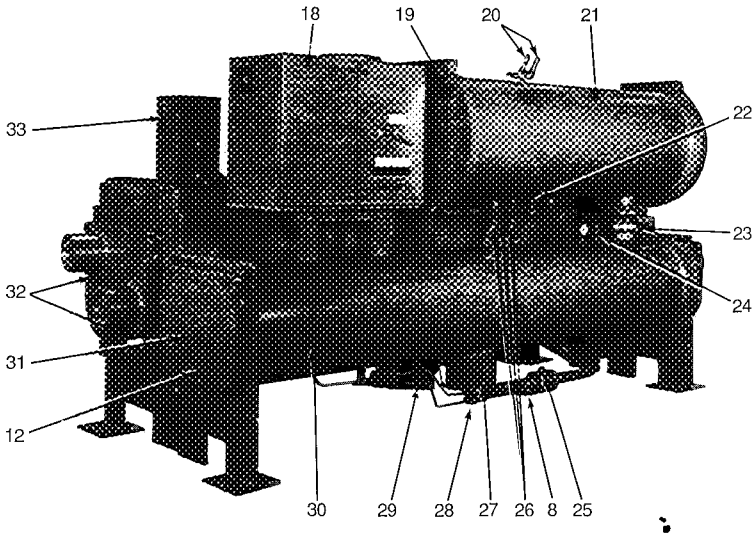
Machine components (cont)

FRONT VIEW



1 — Compressor Nameplate (Hidden)
2 — Power Panel
3 — Local Interface Display (LID) Control Center
4 — ASME Nameplate, Cooler
5 — Cooler
6 — Vessel Separation Feet
7 — Economizer Float Valve Access Cover (Hidden)
8 — Refrigerant Charging Valve
9 — Economizer
10 — Oil Filter Assembly (Hidden)
11 — ASME Nameplate, Economizer
12 — Typical Waterbox Drain Port
13 — Take-Apart Rabbet Fit Connector
14 — ASME Nameplate, Condenser
15 — Cooler Supply/Return End Waterbox Cover
16 — Condenser Temperature Sensors
17 — Cooler Relief Valve

REAR VIEW



18 — Unit Mounted Starter (Option)
19 — ASME Nameplate, Oil Separator
20 — Oil Separator Relief Valves
21 — Oil Separator
22 — Oil Charging Valve
23 — Condenser Isolation Valve (Option)
24 — Service Valve
25 — Cooler Refrigerant Isolation Valve
26 — Condenser Relief Valves and Oil Filter
27 — Float Chamber
28 — Poppet Valve Assembly
29 — Motor Cooling Isolation Valve
30 — Condenser
31 — Condenser Supply/Return End Waterbox Cover
32 — Cooler Temperature Sensors
33 — Machine Identification Nameplate

FRAME 4 MACHINES

Physical data

NOMINAL CAPACITY TONS (kW)		COOLER		CONDENSER		ECONOMIZER	COMPRESSOR		UNIT MOUNTED STARTER	TOTAL DRY WEIGHT		REFRIGERANT WEIGHT*		TOTAL OPERATING WEIGHT	
60 Hz	50 Hz	Size	Frame	Size	Frame		Size	VI		lb	kg	lb	kg	lb	kg
160 (560)	130 (460)	10,11	1	10,11	1	N	C2	0	Y	9,750	4423	600	272	11,055	5015
									N	9,250	4196	600	272	10,555	4788
185 (650)	150 (530)	10,11	1	10,11	1	N	C4	0	Y	9,750	4423	600	272	11,055	5015
									N	9,250	4196	600	272	10,555	4788
200 (700)	165 (580)	10,11	1	10,11	1	Y	C4	0 or 1	Y	10,050	4559	650	295	11,410	5176
									N	9,550	4332	650	295	10,910	4949
230 (810)	190 (670)	20,21	2	20,21	2	N	C6	0	Y	10,630	4822	700	318	12,210	5538
									N	10,130	4595	700	318	11,710	5312
250 (880)	205 (720)	20,21	2	20,21	2	Y	C6	0 or 1	Y	10,930	4958	750	340	12,560	5697
									N	10,430	4731	750	340	12,060	5470

NOMINAL CAPACITY TONS (kW)		COOLER		CONDENSER		ECONOMIZER	COMPRESSOR		UNIT MOUNTED STARTER	TOTAL DRY WEIGHT		REFRIGERANT WEIGHT*		TOTAL OPERATING WEIGHT	
60 Hz	50 Hz	Size	Frame	Size	Frame		Size	VI		lb	kg	lb	kg	lb	kg
275 (968)	230 (810)	43	4	43	4	N	D4	0 or 1	Y	19,920	9036	1200	544	24,250	11,000
									N	19,420	8809	1200	544	24,050	10,909
300 (1056)	250 (880)	43	4	43	4	Y	D4	0 or 1	Y	20,480	9290	1300	590	25,010	11,345
									N	19,980	9063	1300	590	24,510	11,118
325 (1144)	270 (950)	43	4	43	4	N	D6	0 or 1	Y	19,920	9036	1200	544	24,250	11,000
									N	19,420	8809	1200	544	24,050	10,909
350 (1232)	290 (1020)	43	4	43	4	Y	D6	0 or 1	Y	20,480	9290	1300	590	25,010	11,345
									N	19,980	9063	1300	590	24,510	11,118

LEGEND

NIH — Nozzle-In-Head
MWB — Marine Waterbox
VI — Volumetric Index

*Indicates HCFC-22 refrigerant.

NOTES:
1. Frame 1 and 2 machine weights are based on 2-pass, 150 psig (1034 kPa) heat exchangers with 0.035 in. wall thickness and copper tubes Add Refrigerant Weight to Total Dry Weight to obtain Rigging Weight with factory charge.
2. Frame 4 machine weights are based on 3-pass, 300 psig (2068 kPa), NIH waterbox arrangements with 0.305 in wall thickness and turbo chill tubes. To calculate Frame 4 MWB vessel weight add 425 lb (193 kg) for 2-pass MWB and 1,160 lb (526 kg) for 1- and 3-pass MWB. To calculate Frame 4 MWB water weight, add 425 lb (193 kg) for 2-pass MWB and 845 lb (383 kg) for 1- and 3-pass MWB
3. To obtain chiller weights on Frame 4 machines using HFC-134a refrigerant, refer to the Computer Selection Program or contact Syracuse.
4. To obtain weights for sizes 40, 41, and 42 chillers, refer to the Computer Selection Program or contact Syracuse.

Physical data (cont)

COMPRESSOR WEIGHTS

23XL UNIT	COMPRESSOR SIZE (Tons)	ASSEMBLY	
		lb	kg
Frame 1	C2	2270	1029
	C4	2300	1043
Frame 2	C6	2400	1088
Frame 4	D4	3300	1497
	D6	3400	1542

COMPONENT WEIGHTS

COMPONENT	FRAME 1 AND 2		FRAME 4	
	lb	kg	lb	kg
Oil Separator	1180	535	2880*	1306*
Economizer†	296	134	560	254
Muffler	170	77	*	*
Discharge Piping:				
Pipe	44	20	—	—
Isolation Valve†	30	14	30	14
Adaptor Flange	76	34	76	34
Power Panel	20	9	20	9
Starter†	500	227	500	227
Control Center	31	14	31	14

*The Frame 4 muffler is included in the oil separator weight.
†Optional.

MOTOR WEIGHTS*

COMPRESSOR		MAX IkW	STATOR		ROTOR		MOTOR CASING AND COVER	
Size	VI Type		lb	kg	lb	kg	lb	kg
C2	0	125	230	104	58	26	310	141
C4	0	155	249	113	63	29	310	141
C4	1	195	276	125	69	31	310	141
C6	0 or 1							
D4	0 or 1	280	460	208	110	49	370	167
D6	0 or 1	280	460	208	110	49	370	167

LEGEND
IkW — Input Kilowatt
VI — Volumetric Index
*C2-C6 listed weights are for low-voltage motors (200-600 v) D4-D6 listed weights are for low-voltage motors (320-600 v)

HEAT EXCHANGER WEIGHTS

ENGLISH

SIZE	DRY WT (lb)*		MACHINE CHARGE					
			Refrigerant (lb)				Water (gal)	
	Cooler Only†	Cond Only	Economizer		No Economizer		Cooler	Cond
			HCFC-22	HFC-134a	HCFC-22	HFC-134a		
10	2480	2890	650	**	600	**	34	39.2
11	2650	3020	650	**	600	**	40	44.4
20	2845	3250	750	**	700	**	45	49.2
21	3000	3445	750	**	700	**	49	56.4
40	5030	4690	1000	700	900	650	49.2	51.6
41	5180	4835	1100	800	1000	750	54	57
42	5345	5005	1200	900	1100	850	60	63
43	5525	5185	1300	1000	1200	950	66	70

SI

SIZE	DRY WT (kg)*		MACHINE CHARGE					
			Refrigerant (kg)				Water (L)	
	Cooler Only†	Cond Only	Economizer		No Economizer		Cooler	Cond
			HCFC-22	HFC-134a	HCFC-22	HFC-134a		
10	1125	1310	295	**	272	**	130	150
11	1202	1370	295	**	272	**	152	168
20	1291	1474	340	**	318	**	170	186
21	1361	1563	340	**	318	**	186	214
40	2282	2127	454	318	408	295	186	195
41	2350	2193	499	363	454	340	204	216
42	2424	2270	544	408	499	386	227	239
43	2506	2352	590	454	544	431	250	264

LEGEND
NIH — Nozzle-In-Head

*Weight based on:
035 in. wall copper Turbo-B2 tubes in cooler, Turbo chill in condenser
2-pass, 150 psig (1034 kPa) NIH waterbox arrangements (sizes 10, 11, 20, 21)
3-pass, 300 psig (2068 kPa) NIH waterbox arrangements (sizes 40, 41, 42, 43)
†Weight of optional economizer is not included and must be added to cooler weight
**Not available

NOTE: Standard shipment is with refrigerant charged, so be sure to add refrigerant charge to dry weight.

WATERBOX COVER WEIGHTS (FRAME 1 AND 2 MACHINES)*

HEAT EXCHANGER	WATERBOX DESCRIPTION	PSI (kPa)	FRAME 1		FRAME 2	
			lbs	kg	lbs	kg
Cooler or Condenser	NIH, 1 Pass	150 (1034)	118	54	128	58
	NIH, 2 Pass (Plain)		100	46	148	67
	NIH, 2 Pass (With Pipe Nozzles)		185	84	200	91
	NIH, 3 Pass	150 (1034)	166	76	180	82

LEGEND

NIH — Nozzle-In-Head

*These weights are given for reference only. They have been included in heat exchanger weights shown in the Heat Exchanger Weights table on page 14

NOTE: Add 30 lb (14 Kg) for bolts.

WATERBOX COVER WEIGHT (FRAME 4 MACHINES)*

HEAT EXCHANGER	WATERBOX DESCRIPTION	ENGLISH (lb)				SI (kg)			
		Frame 4, Std Nozzles		Frame 4, Flanged		Frame 4, Std Nozzles		Frame 4, Flanged	
		150 psig	300 psig	150 psig	300 psig	1034 kPa	2068 kPa	1034 kPa	2068 kPa
COOLER	NIH, 1 Pass Cover	284	414	324	491	129	188	147	223
	NIH, 2 Pass Cover	285	411	341	523	129	187	155	237
	NIH, 3 Pass Cover	292	433	309	469	133	197	140	213
	NIH, Plain End Cover	243	292	243	292	110	133	110	133
	MWB Cover	CS	621	CS	621	CS	282	CS	282
	Plain End Cover	CS	482	CS	482	CS	219	CS	219
CONDENSER	NIH, 1 Pass Cover	306	446	346	523	139	202	157	237
	NIH, 2 Pass Cover	288	435	344	547	131	197	156	248
	NIH, 3 Pass Cover	319	466	336	502	145	212	153	228
	NIH, Plain End Cover	226	271	226	271	103	123	103	123
	MWB Cover	CS	474	CS	474	CS	215	CS	215
	Plain End Cover	CS	359	CS	359	CS	163	CS	163

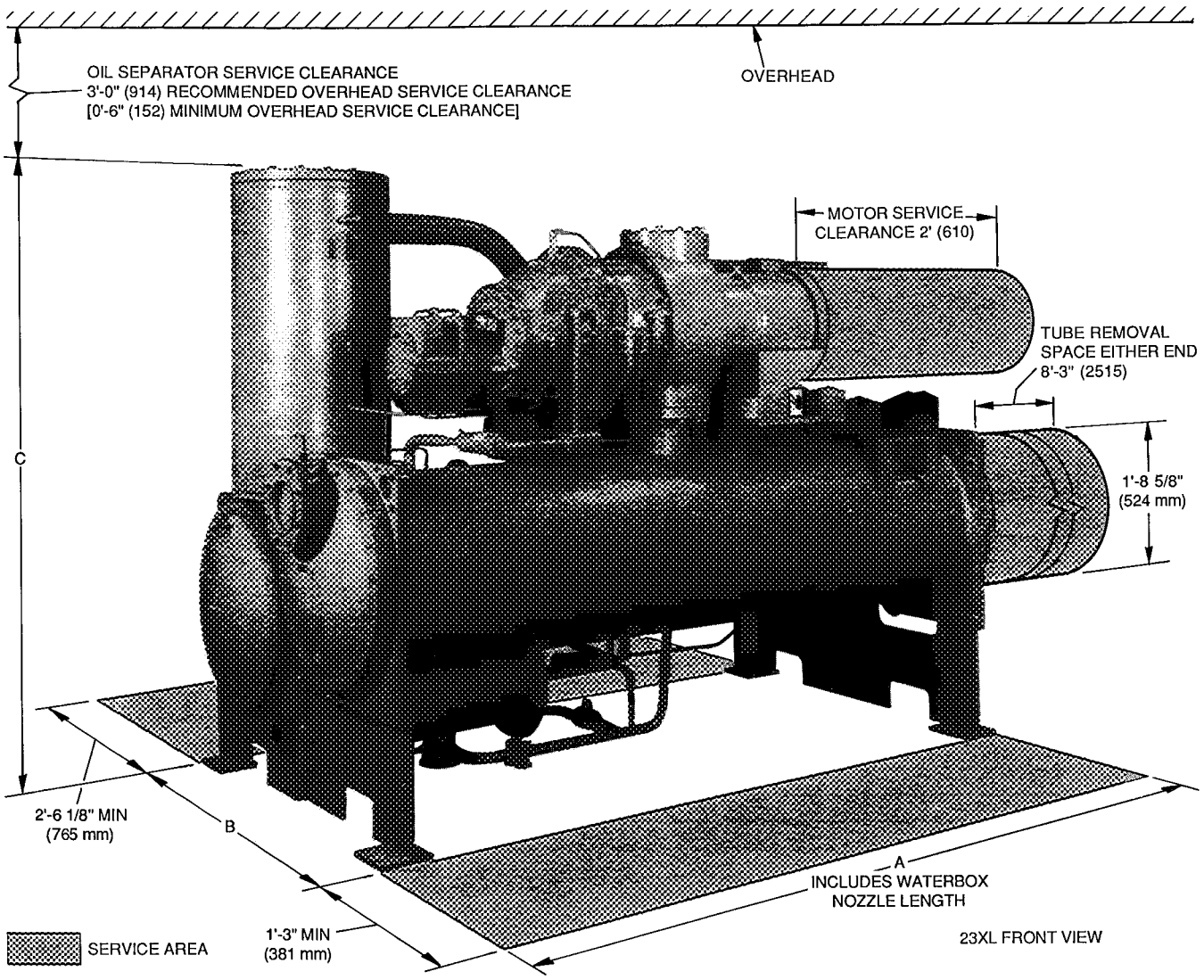
LEGEND

CS — Contact Syracuse
MWB — Marine Waterbox
NIH — Nozzle-In-Head

*These weights are given for reference only. The 150 psig (1034 kPa) standard waterbox cover weights have been included in the heat exchanger weights shown in the Heat Exchanger Weights table on page 14

Dimensions

23XL FRAME 1 AND 2 MACHINES

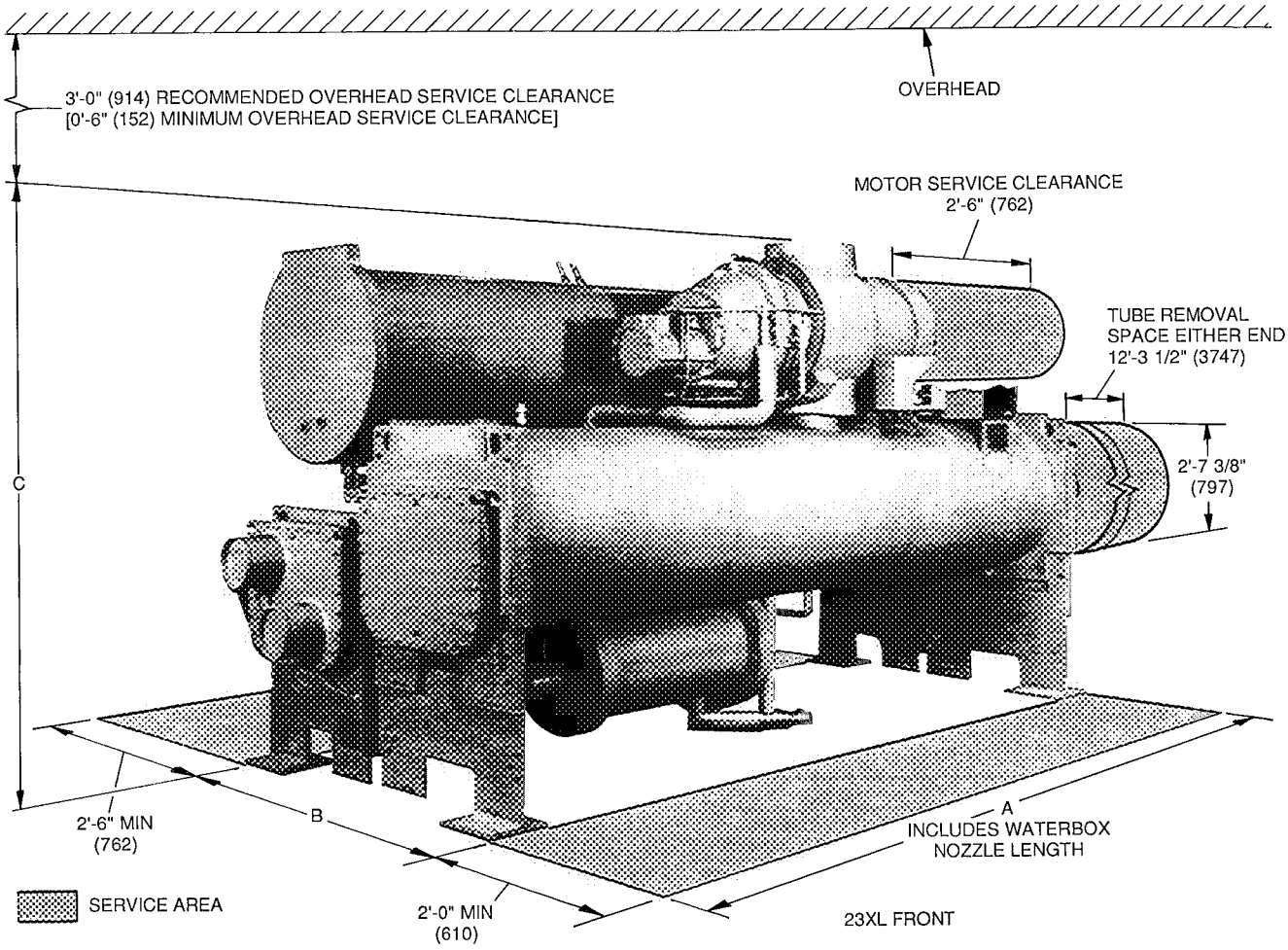


NOTES:
1. Service access should be provided per ANSI/ASHRAE 15 (American National Standards Institute/ American Society of Heating Refrigeration and Air Conditioning Engineers), Latest Edition. NFPA (National Fire Protection Association) 70 and local safety codes.
2. A minimum of 6 in overload clearance for service rigging is recommended
3. Certified drawings available upon request.
4. [ ] indicates millimeters

HEAT EXCHANGER SIZE	A (LENGTH)				OVERALL B (WIDTH)		OVERALL C (HEIGHT)		NOZZLE PIPE SIZE (in.)	
	1 Pass		2 and 3 Pass*							
	ft-in.	mm	ft-in.	mm	ft-in.	mm	ft-in.	mm	1-Pass	2 and 3-Pass
10 or 11	9-5	2870	9-6½	2908	4- 9¼	1454	6- 9⅝	2073	6	6
20 or 21					4-11	1499	6-11⅜	2118	8	6

*2 and 3-pass length applies if either (or both) cooler or condenser is a 2 or 3-pass design.

23XL FRAME 4 MACHINES



NOTES:
1. For flanged waterbox nozzles, refer to the certified drawings for length addition measurements.
2. Service access should be provided based on American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) 15, latest edition, National Fire Protection Association (NFPA) 70, and local safety codes.
3. A minimum of 6 in (152 mm) overhead clearance for service rigging is recommended.
4. Certified drawings are available upon request.
5. [ ] indicates millimeters

HEAT EXCHANGER (Cooler and Condenser Size)	A (LENGTH)				OVERALL B (WIDTH)		OVERALL C (HEIGHT)		NOZZLE PIPE SIZE (in.) (Nominal Pipe Size)		
	2 Pass*		1 or 3 Pass†								
	ft-in.	mm	ft-in.	mm	ft-in.	mm	ft-in.	mm	1-Pass	2-Pass	3-Pass
40-43	13-7¾	4159	14-3¼	4350	5-10⅞	1800	7-6¹¹⁄₁₆	2303	10	8	6

HEAT EXCHANGER (Cooler and Condenser Size)	A (Length With Marine Waterbox — Not Shown)			
	2 Pass*		1 or 3 Pass†	
	ft-in.	mm	ft.-in.	mm
40-43	14-9⅝	4512	16-5½	5017

*Assumes both cooler and condenser nozzles on same end of chiller.
†1 or 3 pass length applies if either (or both) cooler or condenser is a 1 or 3 pass design.

Electrical data

COMPRESSOR		MOTOR ELECTRICAL CHARACTERISTICS	60 HZ MOTORS						50 HZ MOTORS		
			Low Voltage						Low Voltage		
Size	VI Type		Max IkW	208 V	230 V	400 V	460 V	575 V	Max IkW	346 V	400 V
C2	0	RLA per IkW LRA Wye LRA Delta	125	3 02 664 1992	2.86 745 2230	1.61 404 1212	1.40 345 1035	1.12 280 840	125	1.87 405 1210	1.61 347 1040
C4	0	RLA per IkW LRA Wye LRA Delta	155	3.03 865 2592	2.95 965 2900	1.61 495 1485	1.39 406 1218	1.12 340 1010	155	1.87 495 1478	1.61 406 1220
C4	1	RLA per IkW LRA Wye LRA Delta	195	2 96 840 2510	2 73 935 2800	1.60 590 1770	1.37 470 1400	1.09 375 1120	195	1.87 590 1758	1.58 470 1410
C6	0	RLA per IkW LRA Wye LRA Delta	195	2.96 840 2510	2.73 935 2800	1.60 590 1700	1.37 470 1400	1.09 375 1120	195	1.87 590 1758	1.58 470 1410
C6	1	RLA per IkW LRA Wye LRA Delta	195	2.96 840 2510	2.73 935 2800	1.60 590 1770	1.37 470 1400	1.09 375 1120	195	1 87 590 1758	1.58 470 1410
D4	0, 1	RLA per IkW LRA Wye LRA Delta	280	— — —	— — —	1 61 831 2493	1.40 690 2070	1.12 551 1653	280	1.87 812 2435	1.61 679 2038
D6	0, 1	RLA per IkW LRA Wye LRA Delta	280	— — —	— — —	1.61 831 2493	1.40 690 2070	1.12 551 1653	280	1.87 812 2435	1.61 679 2038

LEGEND

IkW — Compressor Motor Power Input (Kilowatts)
LRA — Locked Rotor Amps
OLTA — Overload Trip Amps (= RLA x 1.08)
RLA — Rated Load Amps
VI — Volumetric Index

NOTES:
1 Standard Voltages:

60 HZ		50 HZ	
Volt	For Use on Supply Voltages	Volt	For Use on Supply Voltages
208/230*	200 to 240 v systems	346	320 to 360 v systems
400	360 to 439 v systems	400	380 to 415 v systems
460	440 to 480 v systems		
575	550 to 600 v systems		

*Not available on Frame 4 units

Motor nameplates can be stamped for any voltage within the listed supply voltage range. Chillers shall not be selected at voltages above or below the listed supply voltage range

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

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

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

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

Example: Find the rated load amperage for a 575-v motor listed at 1.14 amps per kW input for use at 550 volts.

$$\text{RLA} = 1\ 14 \times \frac{575}{550} = 1.19$$

AUXILIARY RATINGS (115 V, 1 Phase, 50/60 Hz)

ITEM	POWER	SEALED KVA	AVERAGE WATTS
CONTROLS	24 V DC	0.16	160
OIL HEATER*	115-230/1/60	—	500

*Frame 1 and 2 machines

Compressor motor controllers

Compressor motors, controls, and accessories require the use of starting equipment systems specifically designed for 23 Series Chillers. Refer to Carrier Engineering Requirement Z-375.

Capacitors/power factors

Power factor considerations may indicate use of capacitors. Properly sized capacitors improve power factors, especially at part load Contact your local Carrier sales representative for further information on power factors.

Performance data

Computerized ratings

Because of the large number of available Carrier 23XL Screw Chiller component combinations and the wide variability in required operating conditions, it is impractical to provide tabular performance information. Tabulated performance ratings predict "typical" chiller performance. Actual chiller performance may vary significantly at actual operating conditions and as chiller components are optimized around these conditions.

Computerized performance ratings are available through your local Carrier sales representative. These ratings are custom matched to meet project-specific operating conditions and energy efficiency requirements

ARI Certification Program

The computerized performance ratings of the Carrier 23XL Screw Chiller are certified by the Air Conditioning and Refrigeration Institute (ARI). The Certification Program requires that the manufacturer's ratings be regularly checked for accuracy through a program of chiller testing in strict compliance with ARI Standard 550. This independent verification provides assurance of chiller performance.

Part-load performance

Frequently, a chiller will operate at part-load for a large majority of its total operating hours. In some cases, a chiller with better part-load performance will offer an annualized operating cost advantage over one which performs less efficiently at lower loads.

Established by ARI, the Integrated Part-Load Value (IPLV) is a weighted average of kW/ton values over a wide range of chiller operation. IPLV provides a convenient method of comparing the part-load performance of different chillers at standardized typical conditions. The IPLV rating method has been incorporated into the ARI Certification Program. The 23XL Screw Chiller computerized ratings are certified in accordance with this program.

Variables such as local weather data, building load profiles, and local utility rate structures may significantly alter the impact of part-load performance on actual operating cost. Any operating cost analysis should include all factors relevant to a particular application.

Application data

HEAT EXCHANGER MINIMUM/MAXIMUM FLOW RATES*

ENGLISH (gpm)

COOLER		1 PASS		2 PASS		3 PASS	
Frame	Size	Min	Max	Min	Max	Min	Max
1	10	513	2053	257	1027	171	685
	11	645	2582	323	1290	215	861
2	20	689	2758	345	1379	230	919
	21	813	3250	406	1625	271	1084
4	40	590	2359	295	1179	197	786
	41	666	2663	333	1332	222	888
	42	754	3016	377	1508	251	1005
	43	851	3403	425	1701	284	1134

CONDENSER		1 PASS		2 PASS		3 PASS	
Frame	Size	Min	Max	Min	Max	Min	Max
1	10	619	2476	310	1238	206	826
	11	729	2915	364	1457	243	972
2	20	788	3151	394	1576	263	1051
	21	948	3793	474	1896	316	1265
4	40	613	2454	307	1227	205	818
	41	692	2769	346	1384	231	923
	42	785	3141	393	1570	262	1047
	43	886	3546	443	1773	295	1182

*Flow rates based on standard tubes, cooler and condenser. Minimum flow based on tube velocity of 3 ft/sec (0.9 m/sec); maximum based on 12 ft/sec (3 6 m/sec).

SI METRIC (L/s)

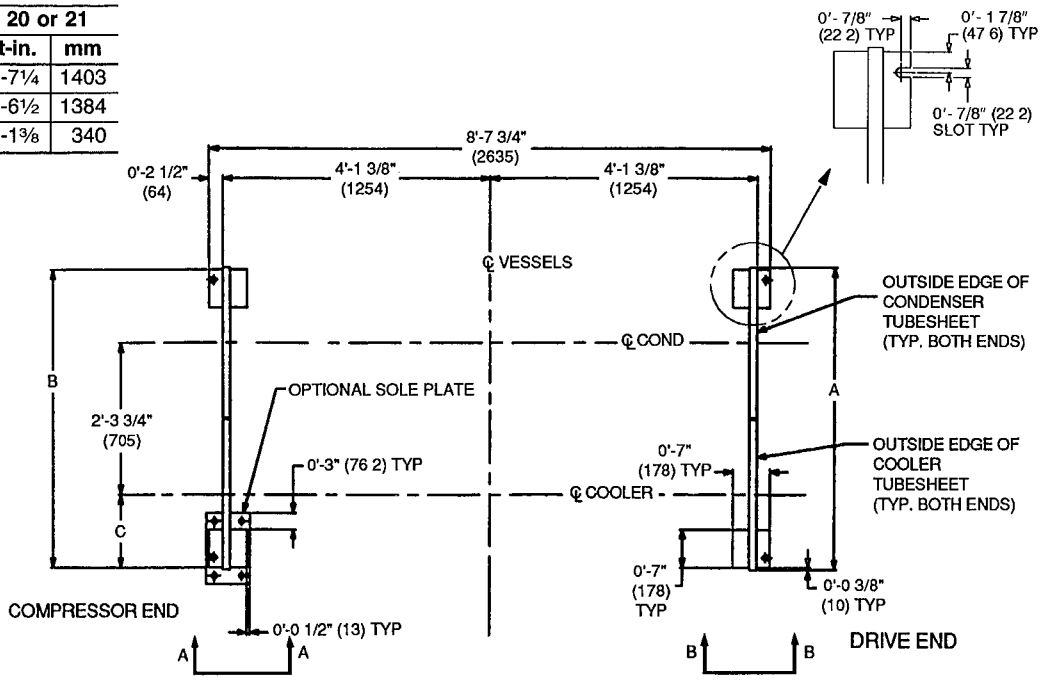
COOLER		1 PASS		2 PASS		3 PASS	
Frame	Size	Min	Max	Min	Max	Min	Max
1	10	32	129	16	65	11	43
	11	41	163	20	81	13	54
2	20	43	174	22	87	14	58
	21	51	205	25	102	17	68
4	40	37	149	18	74	12	50
	41	42	168	21	84	14	56
	42	47	190	24	95	16	63
	43	54	215	27	107	18	71

CONDENSER		1 PASS		2 PASS		3 PASS	
Frame	Size	Min	Max	Min	Max	Min	Max
1	10	39	156	19	78	13	52
	11	46	184	23	92	15	61
2	20	50	198	25	99	16	66
	21	60	239	30	119	20	80
4	40	38	154	19	77	13	51
	41	43	175	22	87	14	58
	42	50	198	25	99	16	66
	43	55	223	28	111	18	74

Application data (cont)

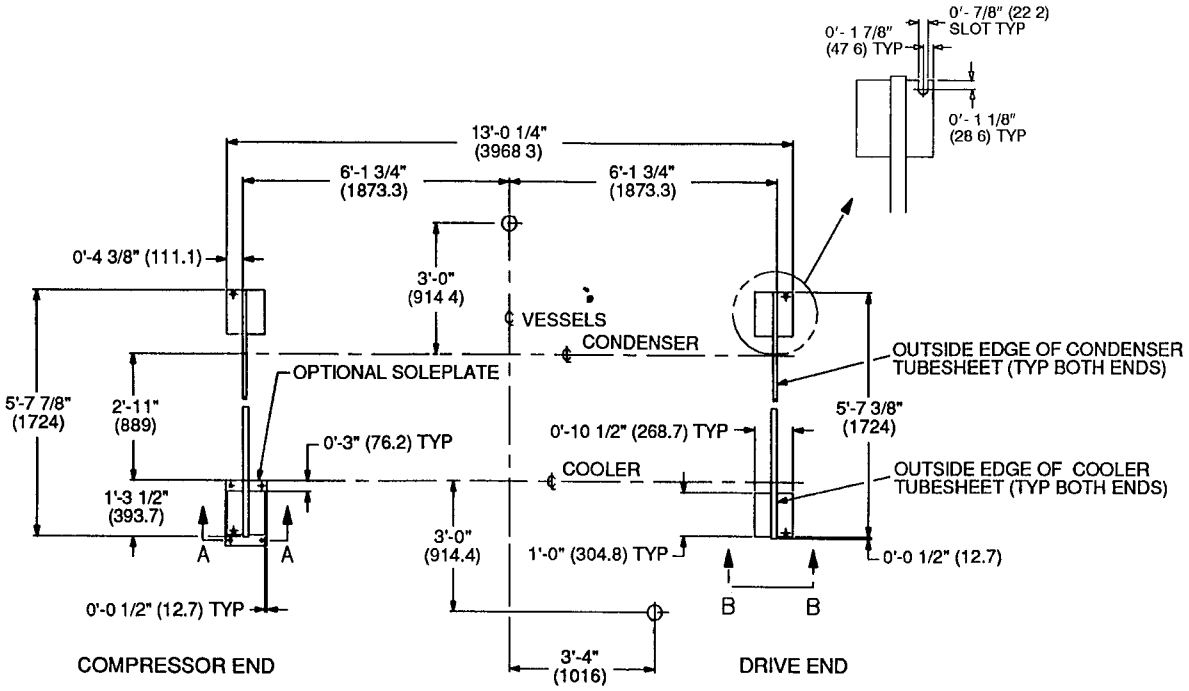
MACHINE FOOTPRINT (FRAME 1 AND 2 MACHINES)

DIMENSION	HEAT EXCHANGER SIZE			
	10 or 11		20 or 21	
	ft-in.	mm	ft-in.	mm
A	4-5¼	1353	4-7¼	1403
B	4-4½	1334	4-6½	1384
C	1-0⅜	314	1-1⅜	340



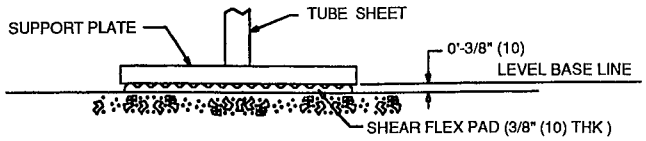
NOTES:
1. Dimensions in ( ) are in millimeters
2 Use grout and package components to establish the level base line.
3 If chiller is set on concrete pad, electrical contractor is to locate conduit stub-ups outside of pad. *Approximate* location shown.

MACHINE FOOTPRINT (FRAME 4 MACHINE)



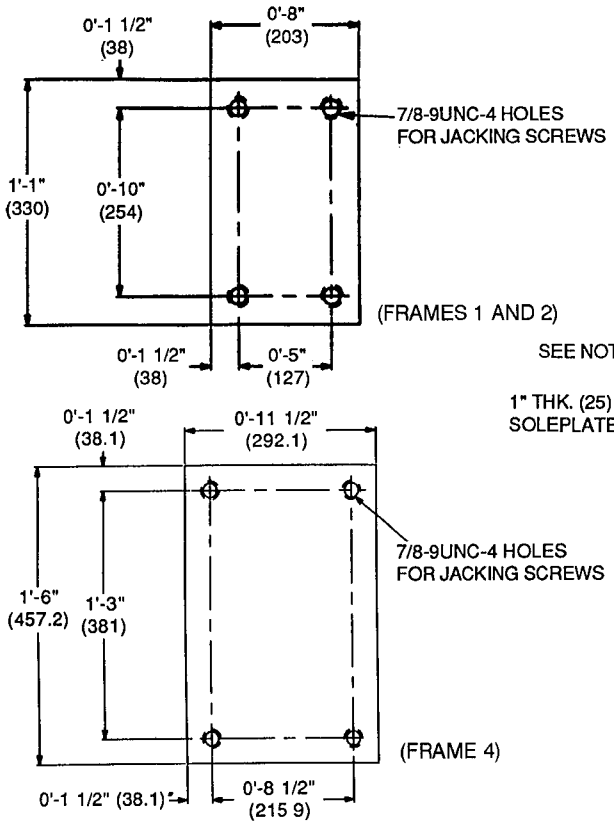
NOTES:
1. Dimensions in ( ) are in millimeters.
2. Use grout and package components to establish the level base line.
3. If chiller is set on concrete pad, electrical contractor is to locate conduit stub-ups outside of pad *Approximate* location shown.

STANDARD ISOLATION
VIEW B-B



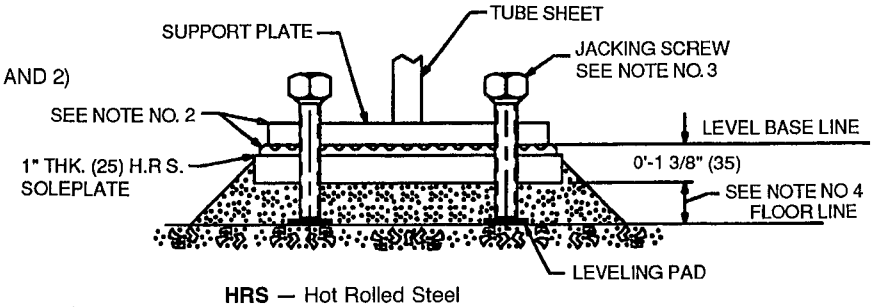
NOTES:
1 Dimensions in ( ) are in millimeters.
2 Isolation package includes 4 shear flex pads.

ACCESSORY ISOLATION



SOLE PLATE DETAIL

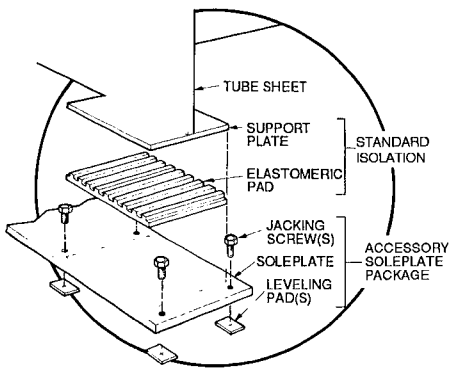
SECTION A-A



HRS — Hot Rolled Steel

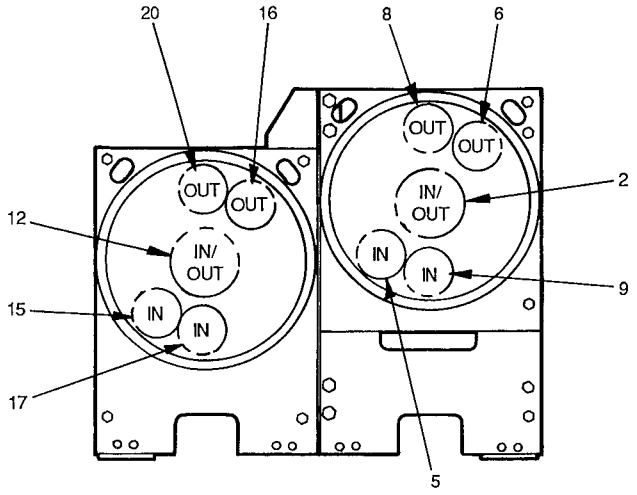
NOTES:
1. Dimensions in ( ) are in millimeters
2. Accessory (Carrier supplied, field installed) soleplate package includes 4 soleplates, 16 jacking screws and leveling pads. Requires accessory spring vibration isolation package
3 Jacking screws to be removed after grout has set
4. Thickness of grout will vary, depending on the amount necessary to level chiller. Use only pre-mixed non-shrinking grout, Celcote HT-648 or Master Builders 636, 0'-1½" (38.1) to 0'-2¼" (57) thick.

TYPICAL ISOLATION ASSEMBLIES
(Isometric View)

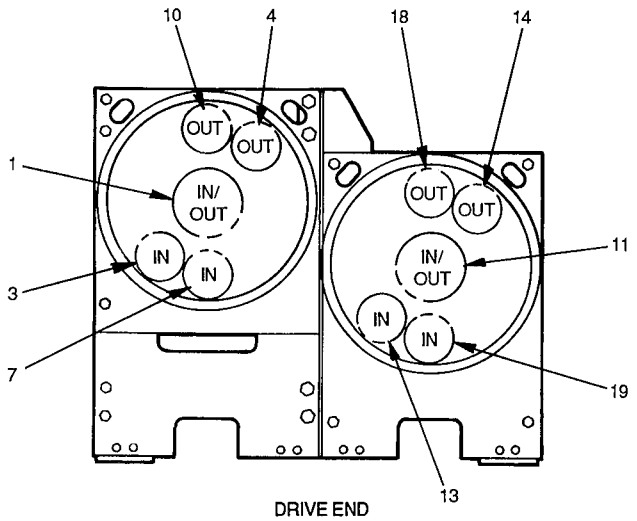


Application data (cont)

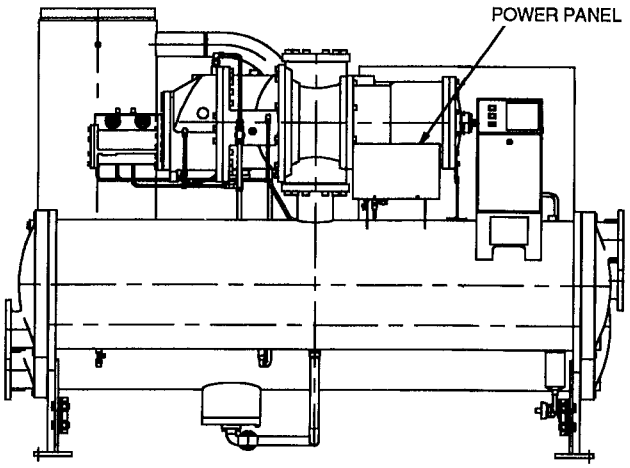
FRAME 1 AND 2 NOZZLE ARRANGEMENTS



COMPRESSOR END



DRIVE END



COMPRESSOR END FRONT VIEW DRIVE END

COOLER AND CONDENSER NOZZLE ARRANGEMENTS

NOZZLE ARRANGEMENT CODES							
Cooler				Condenser			
Pass	In	Out	Code	Pass	In	Out	Code
1	1	2	A	1	11	12	J
	2	1	B		12	11	K
2	3	4	C	2	13	14	L
	5	6	D		15	16	M
3	7	8	E	3	17	18	N
	9	10	F		19	20	P

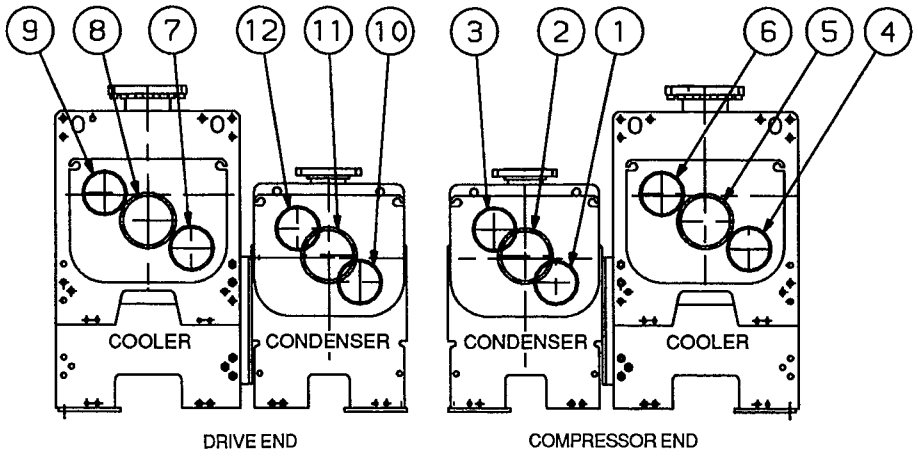
WATERBOX NOZZLE SIZES

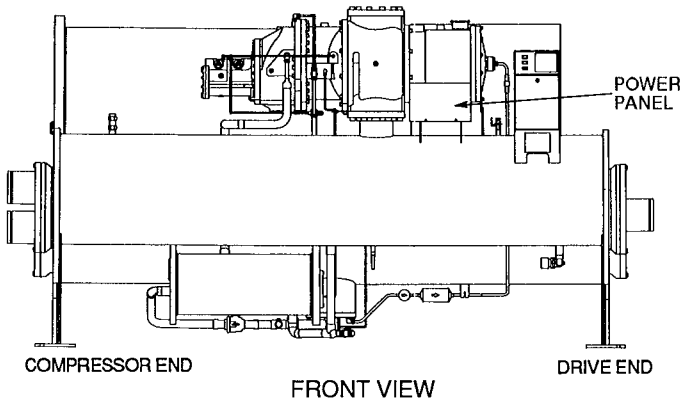
FRAME	PASS	NOMINAL PIPE SIZE (in.)	ACTUAL PIPE ID (in.)
		Cooler and Condenser	Cooler and Condenser
1	1	6	6.065
	2	6	6.065
	3	6	6.065
2	1	8	7.981
	2	6	6.065
	3	6	6 065

LEGEND
ID — Inside Diameter

NOTE: All nozzles are nozzle-in-head (NIH) type with 150 psig (1034 kPa) ASA (American Standards Association) flanged connections.

FRAME 4 NOZZLE ARRANGEMENTS





COOLER AND CONDENSER NOZZLE ARRANGEMENTS

NOZZLE ARRANGEMENT CODES							
Cooler				Condenser			
Pass	In	Out	Code	Pass	In	Out	Code
1	8	5	A	1	11	2	P
	5	8	B		2	11	Q
2	7	9	C	2	10	12	R
	4	6	D		1	3	S
3	7	6	E	3	10	3	T
	4	9	F		1	12	U

WATERBOX NOZZLE SIZES

FRAME	PASS	NOMINAL PIPE SIZE (in.)	ACTUAL PIPE ID (in.)
		Cooler and Condenser	Cooler and Condenser
4*	1	10	10.020
	2	8	7.981
	3	6	6.065

*Frame 4 waterboxes are factory fabricated with bolt-on covers

Application data (cont)

Vent and drain connections

All vents and drain connections are found in the waterbox covers. Connection size is ¾-in. FPT.

Provide high points of the machine piping system with vents and the low points with drains. If shut-off valves are provided in the main water pipes near the unit, a minimum amount of system water is lost when the heat exchangers are drained. This reduces the time required for drainage and saves on the cost of re-treating the system water.

It is recommended that pressure gages be provided at points of entering and leaving water to measure pressure drop through the heat exchanger. Gages may be installed as shown in Pressure Gage Location table shown below. Pressure gages installed at the vent and drain connections do not include nozzle pressure losses.

Use a reliable manometer to measure pressure differential when determining water flow. Regular gages are insensitive and do not provide accurate measurement of flow conditions.

PRESSURE GAGE LOCATION

NUMBER OF PASSES	GAGE LOCATION (Cooler or Condenser)
1, 3	One gage in each waterbox
2	Two gages in waterbox with nozzles

Range of application

The 23XL refrigeration machines are designed for standard water chilling 60 Hz applications of 160 to 350 tons (560 to 1,232 kW) and 50 Hz applications of 130 to 290 tons (460 to 1,020 kW) using refrigerant HCFC-22. The Frame 4 heat exchangers are available with HCFC-22 or HFC-134a.

ASME stamping

All 23XL heat exchangers are constructed in accordance with American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) 15 Safety Code for Mechanical Refrigeration (latest edition). This code, in turn, requires conformance with American Society of Mechanical Engineers (ASME) Code for Unfired Pressure Vessels wherever applicable.

Relief-valve discharge pipe sizing

The 23XL is equipped with 3 relief valves (1 on the cooler and 2 on the condenser). One additional relief valve (Frame 1 and 2 machines) or 2 relief valves (Frame 4 machines) is (are) provided on the oil separator when an optional refrigerant isolation package is used.

Relief-valve discharge piping sizing should be calculated per the current version of the ASHRAE 15, latest edition, code using the tabulated C factors for each vessel shown below·

VESSEL	VESSEL SIZE	RELIEF VALVE SIZE (in. FPT)	C FACTOR (lb air/min)
Cooler	10, 11	¾	46.6
	20, 21	¾	46.6
	40, 41	1	63.8
	42, 43	1	63.8
Condenser	10, 11	¾	46 6
	20, 21	¾	46.6
	40, 41	1¼	111.8
	42, 43	1¼	111 8
Oil Separator*	10, 11	½ Flare	20.3
	20, 21		
	40, 41	¾	46.6
	42, 43	¾	46.6

*Oil separator relief valve provided with optional refrigerant isolation package.

NOTE: Frame 1 and 2 values are for HCFC-22 refrigerant. Frame 4 values are for both HCFC-22 and HFC-134a refrigerant.

Carrier further recommends that an oxygen sensor be installed to protect personnel. Sensor should be able to sense the depletion or displacement of oxygen in the machine room below 19.5% volume oxygen per ASHRAE 15, latest edition.

Design pressures

Design and test pressures for 23XL heat exchangers are listed below

DESIGN AND TEST PRESSURES

PRESSURES	SHELL SIDE (Refrigerant)		TUBE SIDE (Water)	
	psi	kPa	psi	kPa
Design	300	2068	150	1034
Hydrostatic Test	—	—	225	1551
Air Test	375	2586	—	—

HEAT EXCHANGER MATERIAL SPECIFICATIONS

ITEM	MATERIAL	SPECIFICATION
Shell	HR Steel	ASME SA516 GR .70
Tube Sheet	HR Steel	ASME SA516 GR .70
Waterbox*	Cast Iron	ASTM A-48 Class 35
Waterbox Cover†	HR Steel	ASME SA516 GR .70
Waterbox Shell†	HR Steel	ASME SA675 GR .60
Tubes	Finned Copper	ASME SB359
Discharge/Suction	Steel	ASME SA105/SA106

LEGEND

ASME — American Society of Mechanical Engineers
ASTM — American Society for Testing and Materials
HR — Hot Rolled

*Frame 1 and 2 machines
†Frame 4 machines

Insulation

INSULATION REQUIREMENTS

COMPONENT	FRAME	FT^2	M^2
Cooler	1	60	5.57
	2	66	6.13
	4	113	10 49
Compressor	1, 2	35	3.25
	4	41	3.81
Economizer	1, 2	17	1 58
	4	28	2.60
Economized Liquid Lines	—	21	1.95
Non-Economized Liquid Lines	—	9	.84

Factory insulation (optional) — Optional factory insulation is available for the evaporator shell and tube sheets, suction pipe, motor end of compressor, economizer, and economizer line(s). Insulation applied at the factory is 3/4-in (19.0 mm) thick and has a thermal conductivity K value of 0.28 Btu · in./hr · ft^2 · °F (0.0404 W/m · °C). Insulation conforms with UL (Underwriters' Laboratories) Standard 94. Classification 94HBF.

Insulation at jobsite — As indicated in the following Condensation vs Relative Humidity table, the factory insulation provides excellent protection against condensation under most operating conditions. If temperatures in the equipment area exceed the maximum design conditions, extra insulation is recommended.

If the machine is to be field insulated, obtain the approximate insulation areas from the Insulation Area drawing on page 26.

Insulation of waterbox covers is made only in the field and this information is not included in Insulation Requirements table. When insulating the covers, allow for service access and removal of covers.

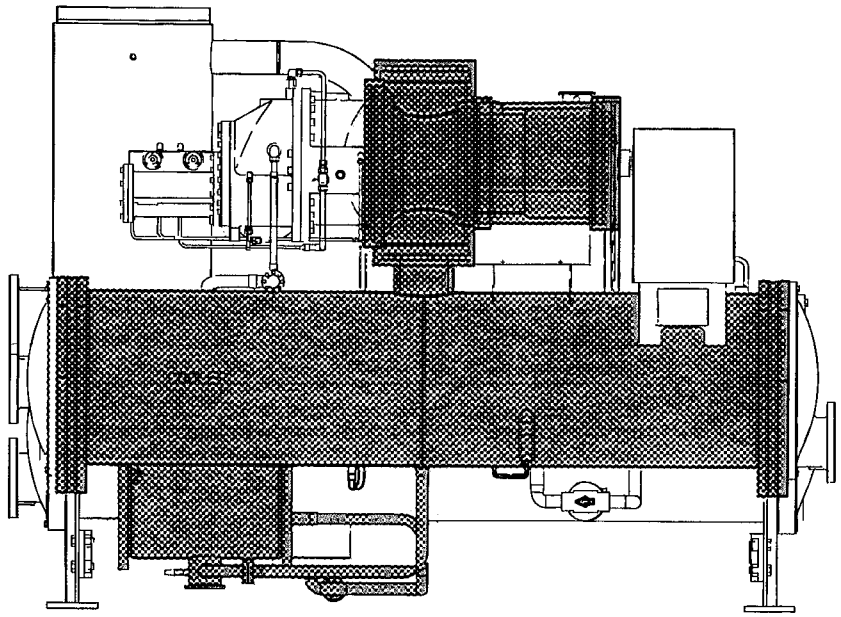
CONDENSATION VS RELATIVE HUMIDITY*

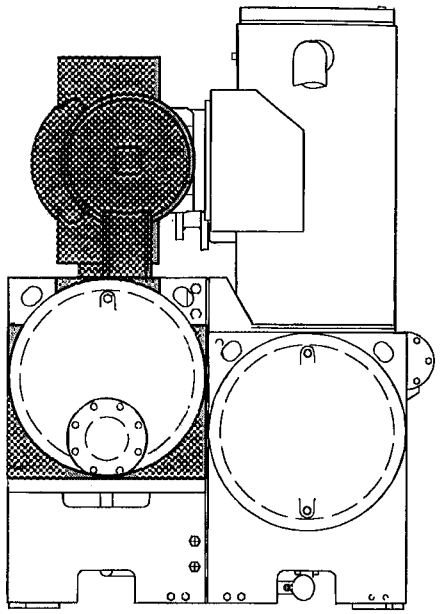
AMOUNT OF CONDENSATION	ROOM DRY-BULB TEMP		
	80 F (27 C)	90 F (32 C)	100 F (38 C)
	Percent Relative Humidity		
None	80	76	70
Slight	87	84	77
Extensive	94	91	84

*These approximate figures are based on 35 F (1.7 C) saturated suction temperature A 2 °F (1 1 °C) change in saturated suction temperature changes the relative humidity values by 1% in the same direction

Application data (cont)

INSULATION AREA FOR FRAME 1 AND 2 MACHINES

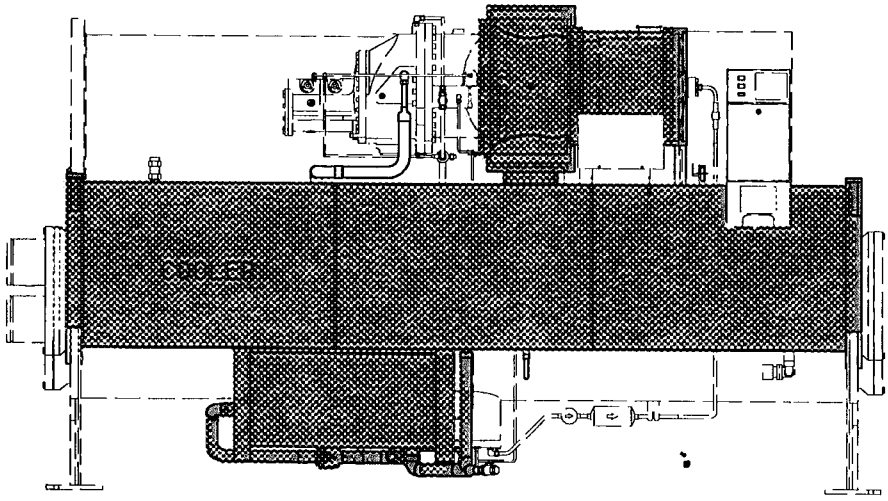


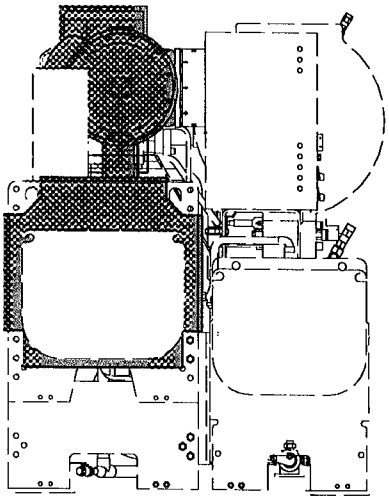


Indicates factory-installed insulation.

NOTE: Waterbox cover insulation must be field supplied and installed

INSULATION AREA FOR FRAME 4 MACHINES





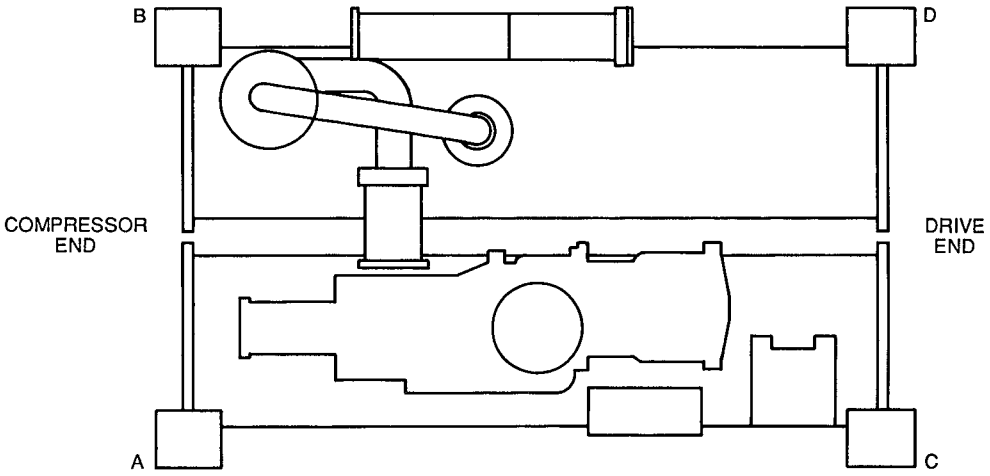
Indicates factory-installed insulation.

NOTE: Waterbox cover insulation must be field supplied and installed.

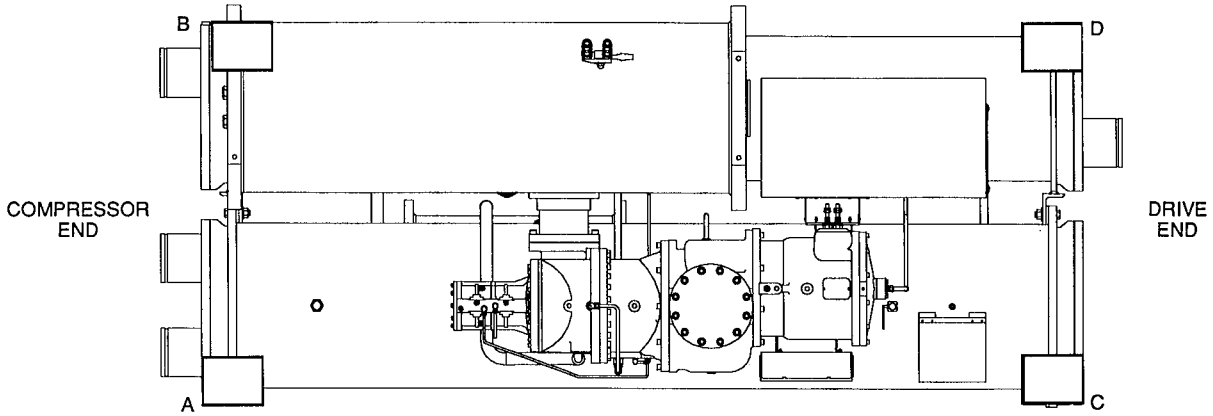
FLOOR CONTACT SURFACE LOADING

HEAT EXCHANGER FRAME	PAD POSITION	MINIMUM		MAXIMUM	
		lb	kg	lb	kg
1	A	2970	1347	3310	1501
	B	2740	1243	3200	1451
	C	2270	1029	2630	1193
	D	2120	961	2570	1165
2	A	3090	1401	3450	1565
	B	3030	1374	3520	1596
	C	2500	1134	2930	1329
	D	2550	1156	3020	1370
4	A	4240	1923	5940	2694
	B	4530	2054	6320	2866
	C	4420	2004	6180	2803
	D	4720	2141	6580	2984

FRAME 1 AND 2 MACHINES



FRAME 4 MACHINES



Controls

Microprocessor controls

Microprocessor controls provide the safety, interlock, capacity control and indications necessary to operate the chiller in a safe and efficient manner.

Control system

The microprocessor control on each Carrier 23XL screw chiller is factory mounted, wired, and tested to ensure machine protection and effective capacity control. In addition, the program logic ensures proper starting, stopping and recycling of the machine and provides a communication link to the Carrier Comfort Network (CCN).

Features

Control system

Component Test and Diagnostic Check
Menu-Driven Keypad Interface for Status Display, Set Point Control and System Configuration
CCN Compatible
Automatic 2 Chiller Lead/Lag with Integral Standby Controls
Primary and Secondary Status Messages
Individual Start/Stop Schedules for Local and CCN Operation Modes
Recall of Up to 25 Alarm/Alert Messages with Diagnostic Help

Safety cutouts

Each of these protective limits shall require manual reset and cause an alarm message to be displayed on the LCD screen informing the operator of the shutdown cause.

Motor High Temperature*, †
Refrigerant (Condenser) High Pressure*, †
Refrigerant (Cooler) Low Temperature*, †
Lube Oil Low Pressure
Lube Oil Sump Level
Compressor (Refrigerant) Discharge Temperature*
Under Voltage**
Over Voltage**
Cooler and Condenser Water Flow††
Motor Overcurrent†
Motor Acceleration Time
Intermittent Power Loss
Compressor Starter Fault†
Low Discharge Superheat Temperature (Frame 1 and 2 Machines)
High Oil Filter Pressure Drop
Excessive Starter Transition Time
Lack of Motor Current Signal
Motor Power Supply Phase Reversal
Temperature Sensor and Transducer Faults
Single Cycle Dropout**
Motor Wiring Correction (Due to Incorrect Rotation)

Capacity control

Leaving Chilled Water Control
Entering Chilled Water Control
Soft Loading Control by Temperature or Load Ramping
Slide Valve Actuator Module
Hot Gas Bypass Valve (Optional)
Power (Demand) Limiter
Auto. Chilled Water Reset

Interlocks

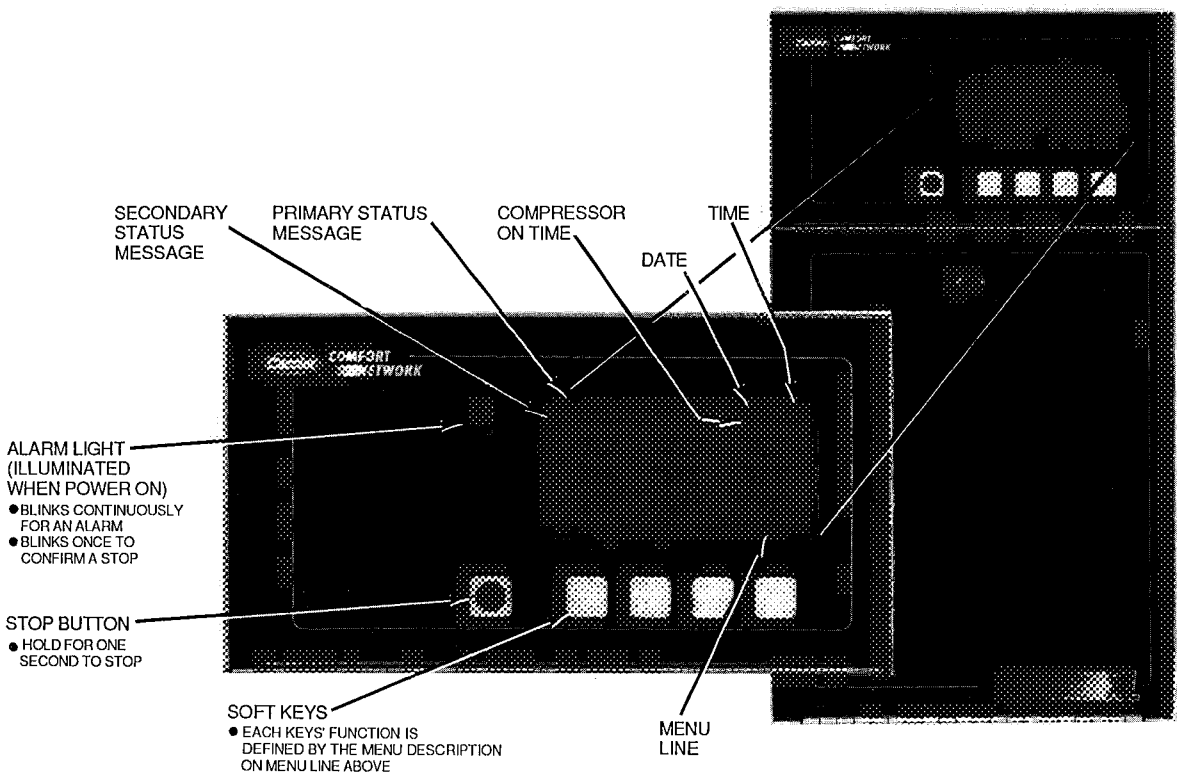
Manual/Automatic Remote Start
Starting/Stopping Sequence
    Pre-Flow/Post-Flow
    Compressor Starter Run Interlock
Pre-Start Check of Safeties and Alerts
Low Chilled Water (Load) Recycle
Monitor/Number Compressor Starts and Run Hours
Manual Reset of Safeties

Indications

Chiller Operating Status Messages
Power-On
Pre-Start Diagnostic Check
Compressor Motor Amps
Pre-alarm Alert
Alarm
Contact for Remote Alarm
Safety Shutdown Messages
Elapsed time (Hours of Operation)
Chiller Input kW ||

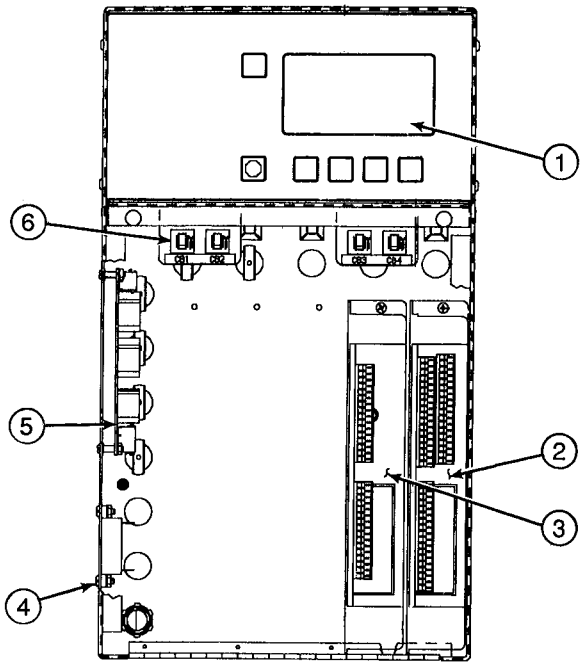
*These can be configured by user to provide alert indication at user-defined limit.
†Override protection: Causes compressor to first unload and then, if necessary, shut down.
**Will not require manual reset or cause an alarm if auto-restart after power failure is enabled.
††Required: Field or factory supplied flow switch (installed at jobsite).
||With optional kW transducer.

MICROPROCESSOR CONTROL CENTER



Controls (cont)

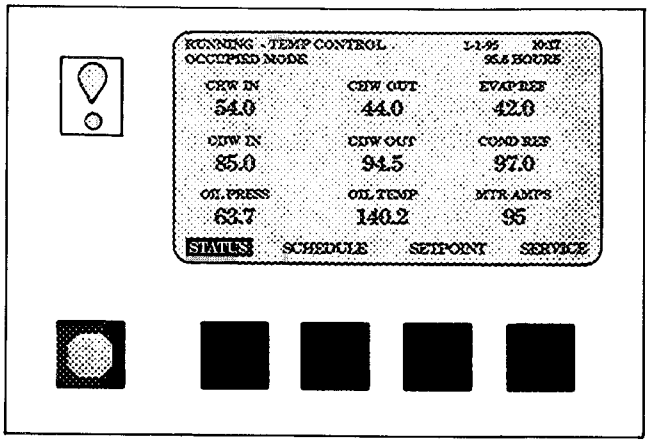
CONTROL CENTER (FRONT VIEW), WITH OPTIONS

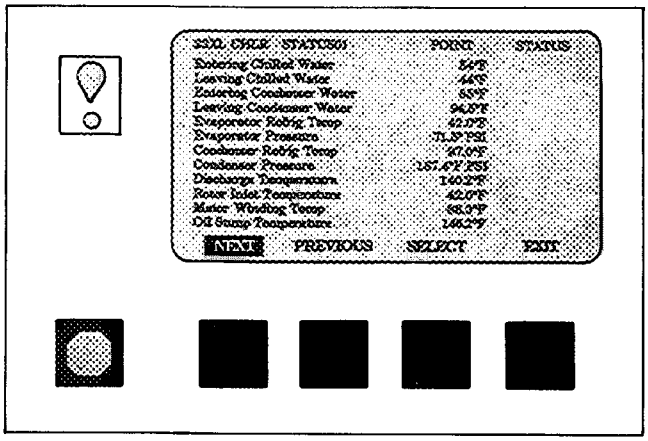


LEGEND

1 — Local Interface Device (LID)
Input/Output Interface Panel Display
2 — Processor Module (PSIO)
The PSIO is the brain of the Product Integrated Controls
3 — Optional 8 Input Module for Spare Inputs to Control Interface (One of Two Available)
4 — Power Transformer
5 — 6-Pack Relay Board
6 — Circuit Breakers (4)

TYPICAL LOCAL INTERFACE DEVICE (LID) DISPLAY SCREENS

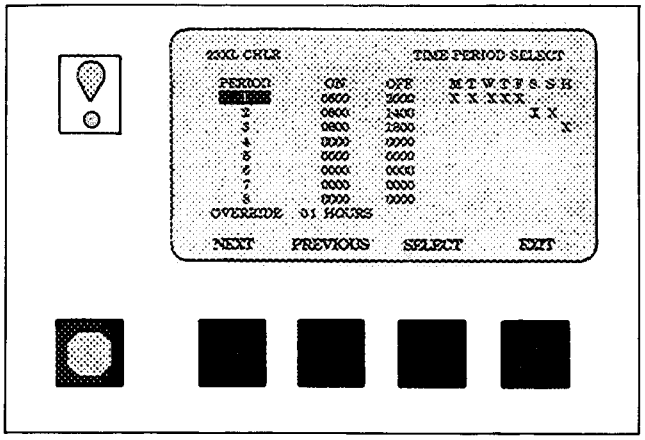




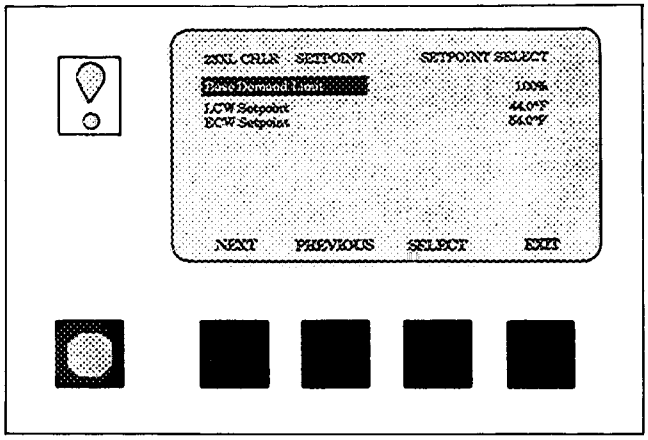
Default Display — Displays information most commonly required for chiller operating logs. Two line system status messages inform the operator of the operating mode or any alert or alarm messages. The four "soft keys" allow access to other control functions.

Status Screens — The Status screens display readings of every point monitored by the microprocessor. Cooler, condenser, and oil pressure are included on the Status screens.

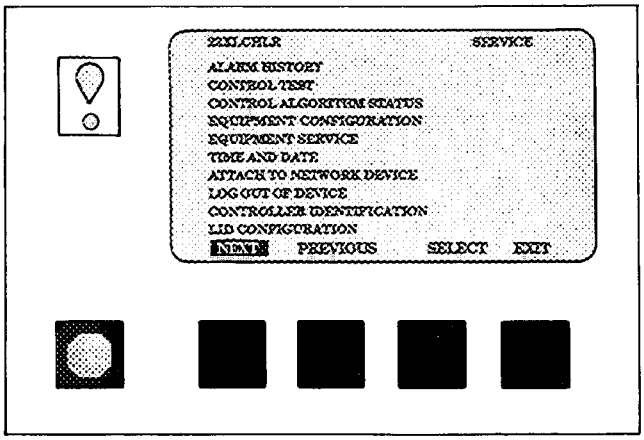
TYPICAL LOCAL INTERFACE DEVICE (LID) DISPLAY SCREENS (cont)



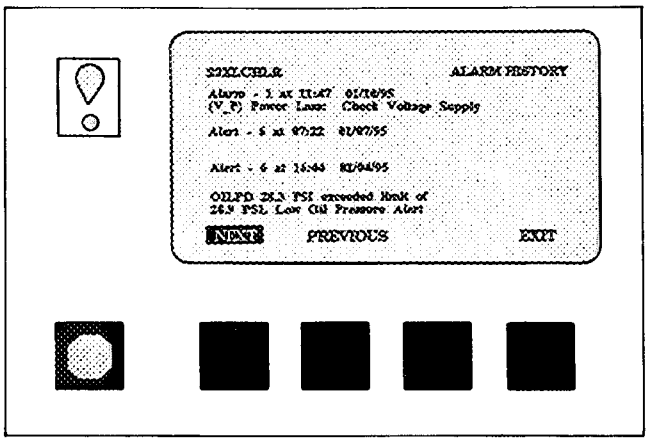
Schedule Screen — A user established occupancy schedule can be easily configured for your particular application. A 365-day real time, battery backed-up clock will automatically start and stop the chiller according to your established schedule or the building's master schedule in a CCN system.



Set Point Screen — The chilled water and demand limit set points can be entered, stored, viewed, or changed easily from this screen



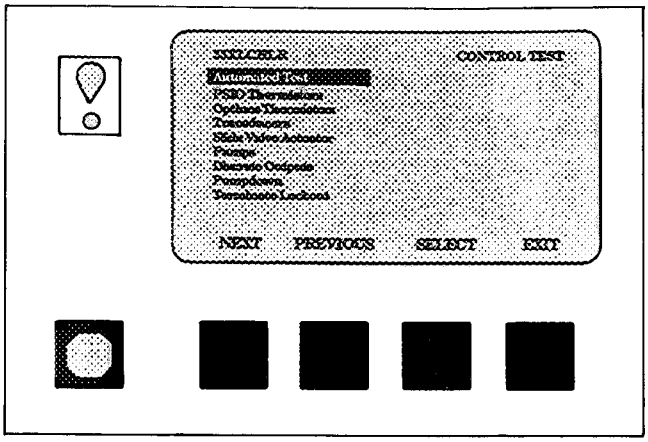
Service Screens — The password protected service screens provide the service technician with an array of information to configure the chiller for your particular application and troubleshoot any problems that may occur.



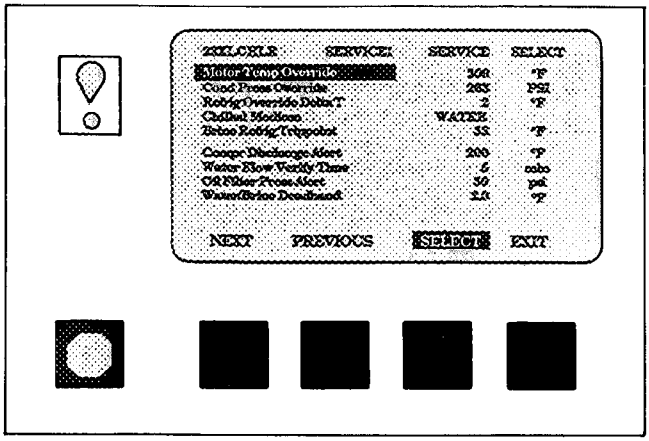
Alarm History File — The Alarm History file stores the last 25 alarms or alerts that have occurred along with the time and date they occurred. It allows service technicians to quickly review alarm or alert history to identify problems that exist, as well as the actions required to resolve the problem.

Controls (cont)

TYPICAL LOCAL INTERFACE DEVICE (LID) DISPLAY SCREENS (cont)

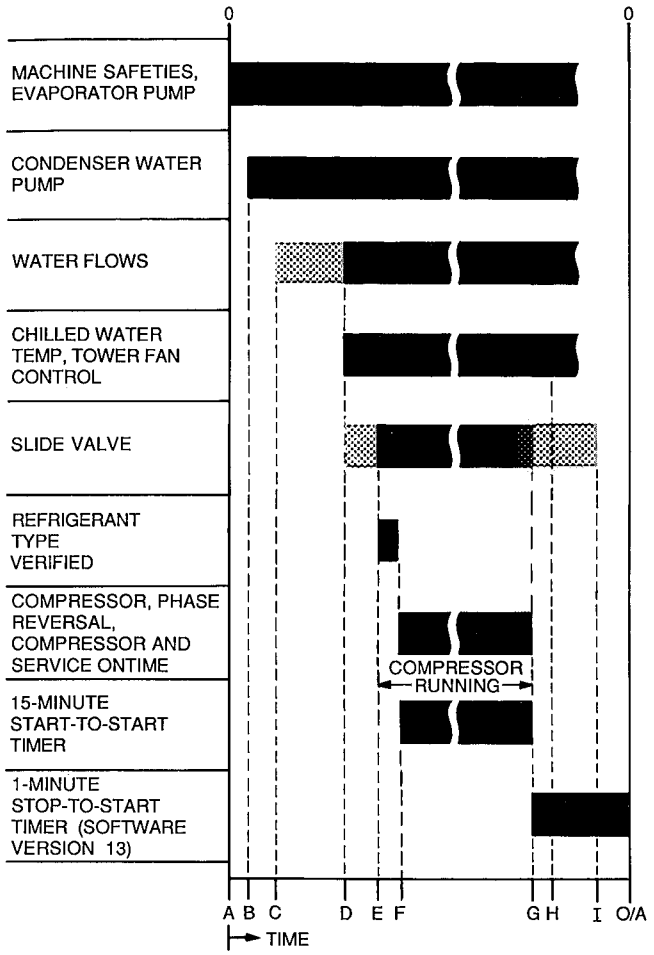


The Control Test Screen — This screen allows access to the various control tests available to the service technician. The technician can then quickly identify sources of problems and to get the chiller back on line.



The Service Configuration Screens — The Service Configuration screen allows the service technician to configure the controls for your particular application and set the override and alert levels for several points monitored by the control system.

CONTROL SEQUENCE



A — START INITIATED: Pre-start checks are made; evaporator pump started

B — Condenser water pump started (5 seconds after A)

C — Water flows verified (30 seconds to 5 minutes maximum)

D — Chilled water temperature checked against control point; tower fan control enabled; slide valve decrease timer checked to verify slide valve position

E — Refrigerant type verified (up to 3 minutes after D).

F — Compressor motor starts; phase reversal conditions monitored; compressor ontime and service ontime start; 15-minute inhibit timer starts (10 seconds after E)

G — Shutdown initiated: Compressor motor stops; compressor ontime and service ontime stop; 1-minute inhibit timer on PSIO Software Version 13 and higher; slide valve decrease activated for 1 minute

H — Evaporator pump deenergized (30 seconds after G); condenser pump and tower fan control may continue to operate if condenser pressure is high; evaporator pump may continue if in RECYCLE mode

I — Slide valve decrease timer expires (3 minutes after G)

O/A — Restart permitted (both inhibit timers expired) (minimum of 15 minutes after F; minimum of 1 minute after G)

Controls (cont)

Control sequence

To start: Push Start button — Start initiated; all safeties are checked to see that they are satisfied (if one is not, an indication of the fault will be displayed and the start aborted). The signal is sent to start the chilled water pump. After 5 seconds, the signal is sent to start the condenser water pump.

The microprocessor then puts the start on hold. It checks if water flows are established. If not satisfied, it will continue to monitor water flows according to the adjustable setting (30 seconds to 5 minutes). If satisfied, it checks the chilled water temperature against the control point, enables tower fan control, and checks the slide valve decrease timer (to verify that the slide valve is in the unloaded position).

If the above checks are satisfied, the microprocessor sends the signal to start the compressor motor. It monitors the motor acceleration time and if it is excessive, aborts the start. If the starter fails to transition run, the start is aborted. Compressor ontime and service ontime start.

Once started: Phase reversal conditions are monitored to verify proper rotation of the compressor rotors. The microprocessor initializes the primary restart protection (15 minutes — start to start). The slide valve opens in a soft loading mode and is then transferred to the capacity control mode.

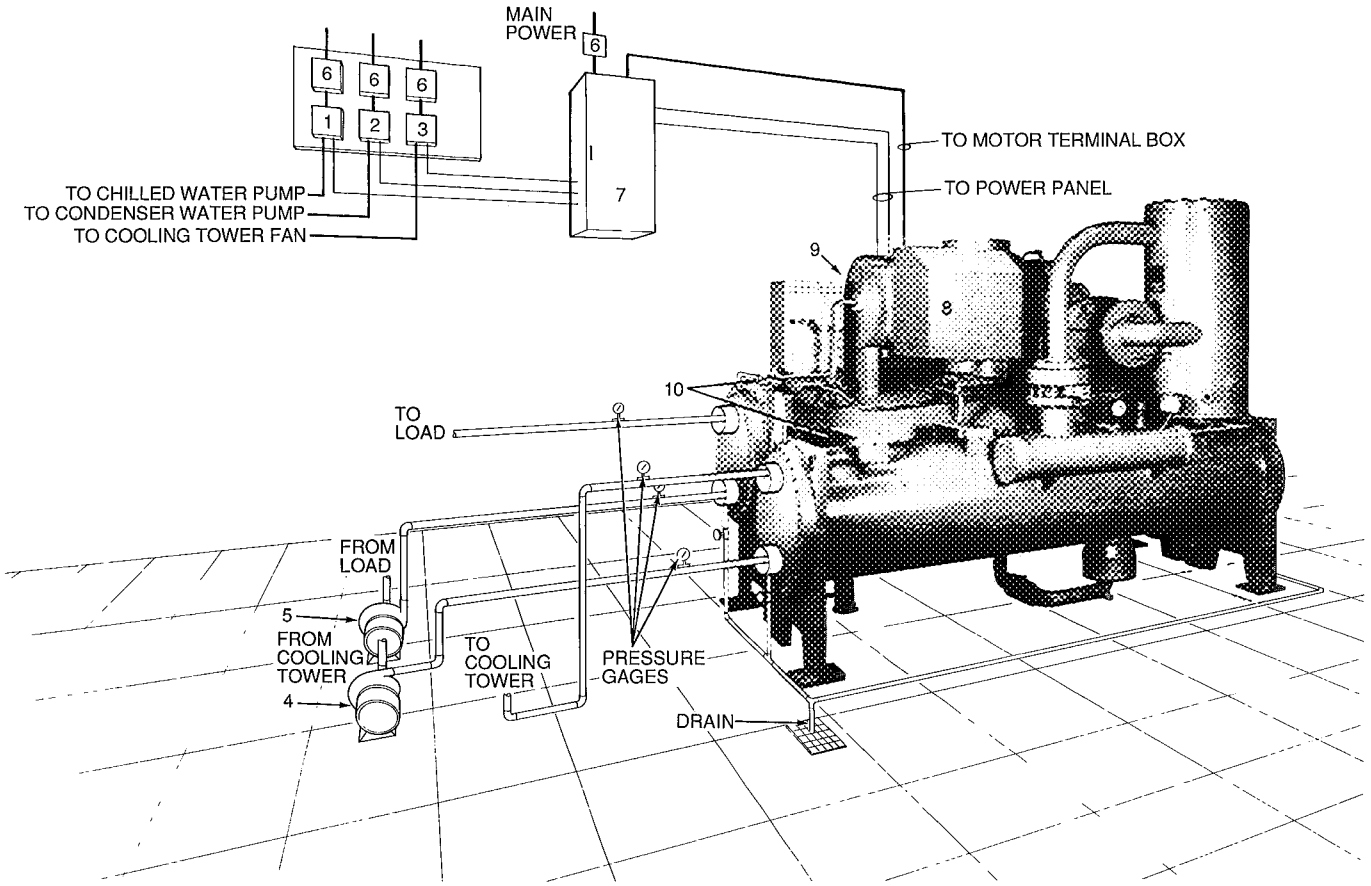
To stop: Push Stop button — Signal sent to de-energize compressor motor. Compressor ontime and service ontime stop. The secondary restart protection (1 minute stop-to-start) is initialized and the slide valve decrease timer is activated.

The microprocessor verifies that power to the compressor is off and, after 30 seconds, sends the signal to de-energize the chilled water pump. (If shutdown was caused by low load recycle algorithm, chilled water pump will continue to run.) Condenser water pump and tower fan may continue to operate if condenser pressure is high.

Restart: Restart is permitted after the slide valve timer and the primary and secondary start protection timers have expired (a minimum of 15 minutes after the compressor starts and a minimum of 1 minute after the shutdown is initiated).

Typical piping and wiring

23XL CHILLER WITH FREE-STANDING STARTER



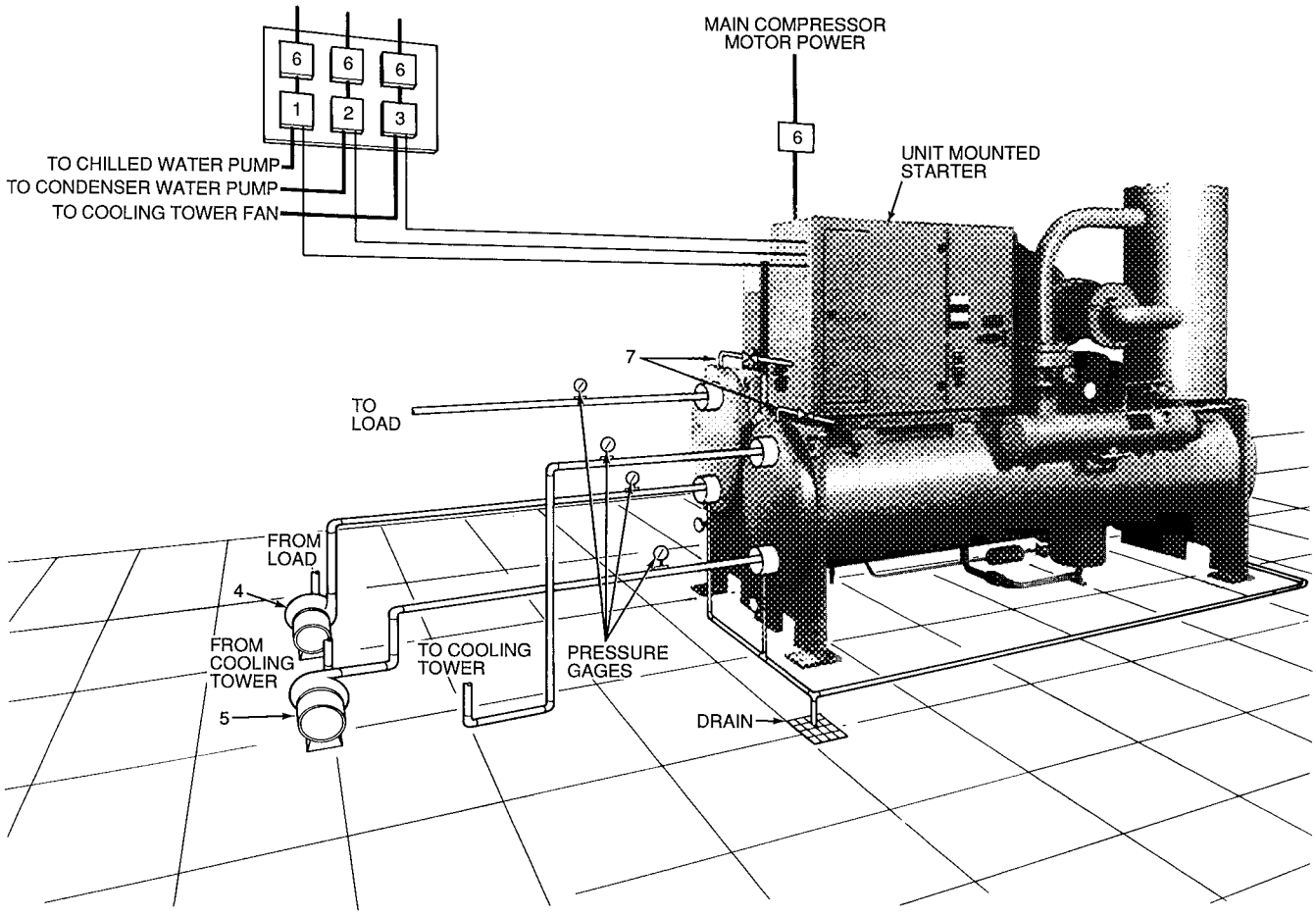
LEGEND

1	—	Chilled Water Pump Starter
2	—	Condenser Water Pump Starter
3	—	Cooling Tower Fan Starter
4	—	Condenser Water Pump
5	—	Chilled Water Pump
6	—	Disconnect
7	—	Freestanding Compressor Motor Starter
8	—	Compressor Motor Terminal Box
9	—	Power Panel (Hidden)
10	—	Vents
		Piping
		Control Wiring
		Power Wiring

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. 23XL machines should be installed using certified drawings.
2. All wiring must comply with applicable codes.
3. Refer to Carrier System Design Manual for details regarding piping techniques.
4. Wiring not shown for optional devices such as:
   - remote start/stop
   - remote alarm
   - optional safety device
   - 4 to 20 mA resets
   - optional remote sensors

Typical piping and wiring (cont)

23XL CHILLER WITH OPTIONAL UNIT-MOUNTED STARTER

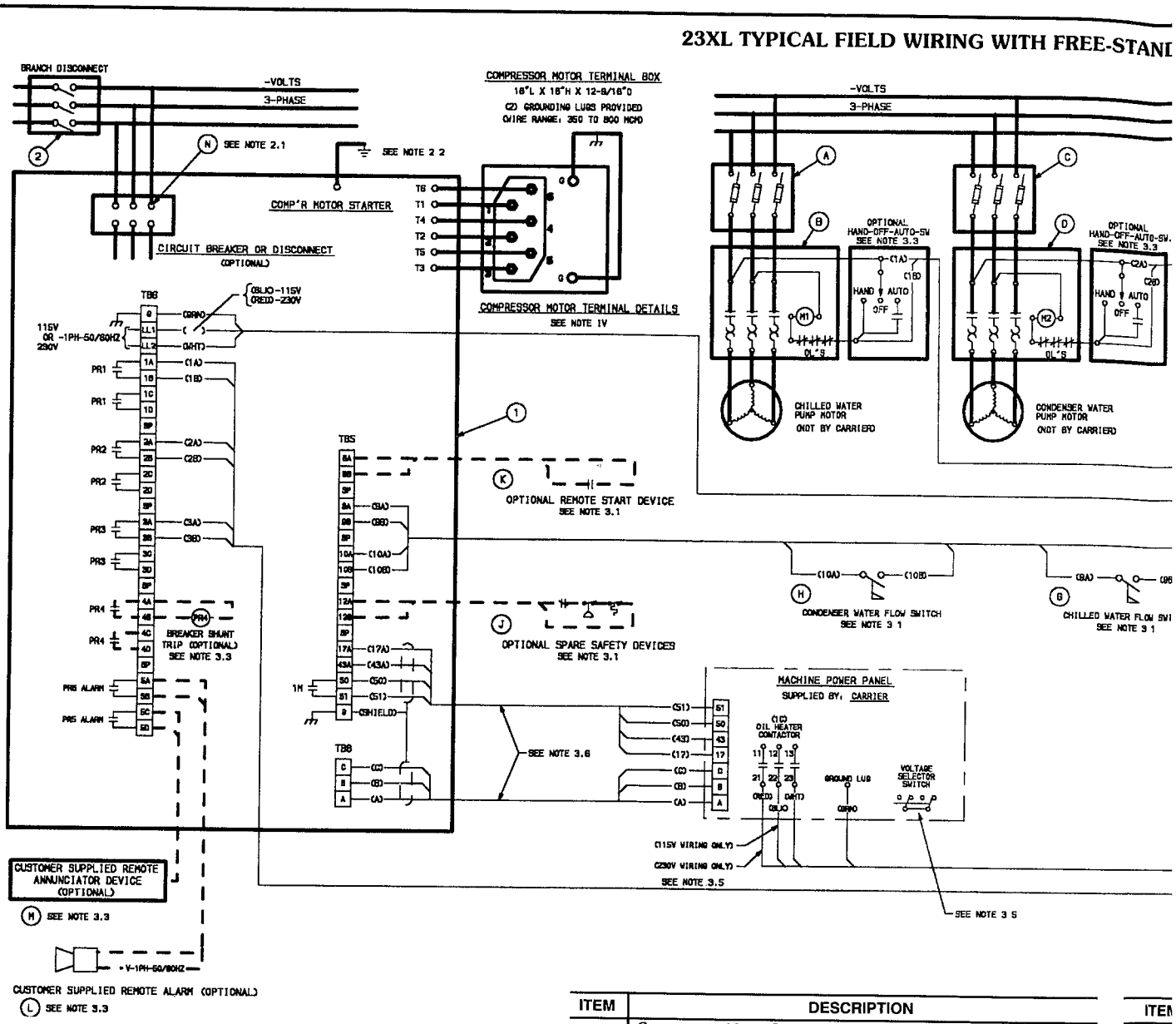


LEGEND

1	—	Chilled Water Pump Starter
2	—	Condenser Water Pump Starter
3	—	Cooling Tower Fan Starter
4	—	Chilled Water Pump
5	—	Condenser Water Pump
6	—	Disconnect
7	—	Vents
		Piping
		Control Wiring
		Power Wiring

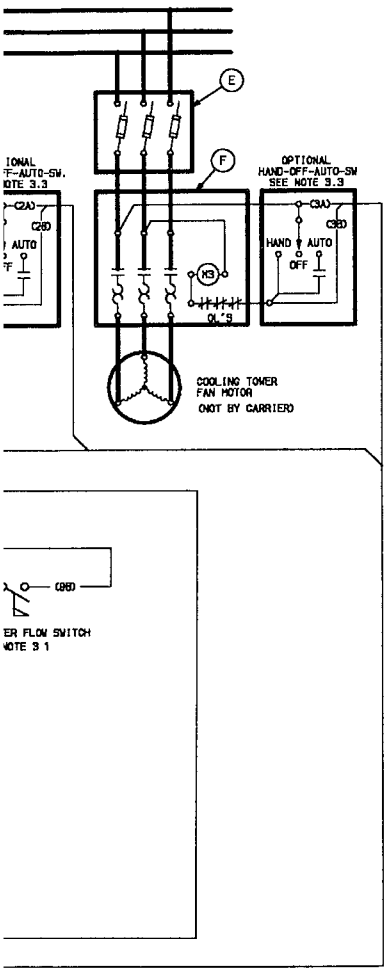
NOTES:
1. Wiring and piping shown are for general point-of-connection only and are not intended to show details for a specific installation. Certified field wiring and dimensional diagrams are available on request. 23XL machines should be installed using certified drawings
2. All wiring must comply with applicable codes
3. Refer to Carrier System Design Manual for details regarding piping techniques.
4. Wiring not shown for optional devices such as:
   - remote start/stop
   - remote alarm
   - optional safety device
   - 4 to 20 mA resets
   - optional remote sensors

Typical field wiring



ITEM	DESCRIPTION		ITEM
	Compressor Motor Starter w/o Integral Disconnect or Breaker		A
	Compressor Motor Starter w/Integral Disconnect		B
	Compressor Motor Starter w/Integral Circuit Breaker		C
	Compressor Motor Starter w/High Interrupt Capacity Breaker		D
	Pilot Relays (With two N O Contacts Each) See Note 3.5	PR1 (Chilled Water Pump)	E
		PR2 (Condenser Water Pump)	F
		PR3 (Cooling Tower Fan)	G
		PR4 (Shunt Trip Output)	H
		PR5 (Alarm Output)	J
1	Control Power Transformer (2 KVA)		K
	Controls and Oil Heater Circuit Breaker		L
	Starter Management Module Package		M
	3 Phase Volts/Amps Meter Package		N
	Power Factor Correction Package		P
	Lightning/Surge Arrestor Package		G
	kW Transducer		
	Shunt Trip (Req Disconnect or Breaker and PR4 Relay)		
	3 Phase Under/Over Voltage		
	Ground Fault (Requires Shunt Trip w/PR4 Relay)		
	Phase Reversal		
2	Compressor Motor Starter Branch Disconnect		

TANDING STARTER (FRAME 1 AND 2 MACHINES)



ITEM	DESCRIPTION
A	Chilled Water Pump Starter Disconnect
B	Chilled Water Pump Motor Starter
C	Condenser Water Pump Starter Disconnect
D	Condenser Water Pump Motor Starter
E	Cooling Tower Fan Motor Starter Disconnect
F	Cooling Tower Fan Motor Starter
G	Chilled Water Flow Switch (N O) See Note 3.1
H	Condenser Water Flow Switch (N O). See Note 3 1
J	Spare Safety Devices (N O) See Note 3 1
K	Remote Start/Stop Device (N O) See Note 3 1
L	Remote Alarm See Note 3 3
M	Remote Annunciator See Note 3 3
N	Lug Adapters See Note 2 1
P	8 Lead to 3 Lead Jumpers See Note 4 0
G	Lead Connectors See Note 4 0

IMPORTANT: Refer to certified drawings for additional information. Certified drawings are available upon request.

LEGEND

- Required Power Wiring
- Required Control Wiring
- Options Wiring

NOTES:

I GENERAL

1 0 Starters shall be designed and manufactured in accordance with Carrier Engineering Requirement Z-375

1 1 All field-supplied conductors, devices, field-installation wiring, and termination of conductors and devices, must be in compliance with all applicable codes and job specifications.

1 2 The routing of field-installed conduit and conductors and the location of field-installed devices, must not interfere with equipment access or the reading, adjusting, or servicing of any component

1 3 Equipment, installation, and all starting and control devices must comply with details in equipment submittal drawings and literature

1 4 Contacts and switches are shown in the position they would assume with the circuit deenergized and the chiller shut down

1 5 WARNING — Do not use aluminum conductors

1 6 Installer is responsible for any damage caused by improper wiring between starter and machine

II POWER WIRING TO STARTER

2.0 Power conductor rating must meet minimum unit nameplate voltage and compressor motor RLA (rated load amps).
When (3) conductors are used:
Minimum ampacity per conductor = 1 25 x compressor RLA
When (6) conductors are used:
Minimum ampacity per conductor = 0 721 x compressor RLA

2 1 Lug adapters may be required if installation conditions dictate that conductors be sized beyond the minimum ampacity required Contact starter supplier for lug information

2 2 Compressor motor and controls must be grounded by using equipment grounding lugs provided inside starter enclosure

III CONTROL WIRING

3 0 Field supplied control conductors to be at least 18 AWG (American Wire Gage) or larger

3 1 Chilled water and condenser water flow switch contacts, optional remote start device contacts and optional spare safety device contacts, must have 24 vdc rating Max current is 60 ma, nominal current is 10 ma Switches with gold plated bifurcated contacts are recommended

3 2 Remove jumper wire between 12A and 12B before connecting auxiliary safeties between these terminals

3 3 Pilot relays can control cooler and condenser pump and tower fan motor contactor coil loads rated 10 amps at 115 vac up to 3 amps at 600 vac. Control wiring required for Carrier to start pumps and tower fan motors must be provided to assure machine protection If primary pump and tower fan motor control is by other means, also provide a parallel means for control by Carrier Do not use starter control transformer as the power source for pilot relay loads.

3 4 Do not route control wiring carrying 30 v or less within a conduit which has wires carrying 50 v or higher or along side wires carrying 50 v or higher

3 5 Voltage selector switch in machine power panel is factory set for 115 v control power source When 230 v control power source is used, set switch to 230 v position

3 6 Control wiring cables between starter and power panel must be shielded with minimum rating of 600 v, 80 C Ground shield at starter

IV POWER WIRING BETWEEN STARTER AND COMPRESSOR MOTOR

4 0 Low voltage (600 v or less) compressor motors have (6) ½ in terminal studs (lead connectors not supplied by Carrier) Either 3 or 6 leads must be run between compressor motor and starter, depending on type of motor starter employed If only 3 leads are required, jumper motor terminals as follows: 1 to 6, 2 to 4, 3 to 5 Center to center distance between terminals is 2 73 inches. Compressor motor starter must have nameplate stamped as to conforming with Carrier requirement "Z-375."

4 1 When more than one conduit is used to run conductors from starter to compressor motor terminal box, one conductor from each phase must be in each conduit, to prevent excessive heating. (e.g., conductors to motor terminals 1, 2 and 3 in one conduit, and these to 4, 5 and 6 in another)

4 2 Compressor motor power connections can be made through top, bottom, or right side of compressor motor terminal box by rotating the terminal box and using holes cut by contractor to suit conduit Flexible conduit should be used for the last few feet to the terminal box for unit vibration isolation Use of stress cones or 12 conductors larger than 500 MCM may require an oversize (special) motor terminal box (not supplied by Carrier) Lead connections between 3-phase motors and their starters must not be insulated until Carrier personnel have checked compressor rotation

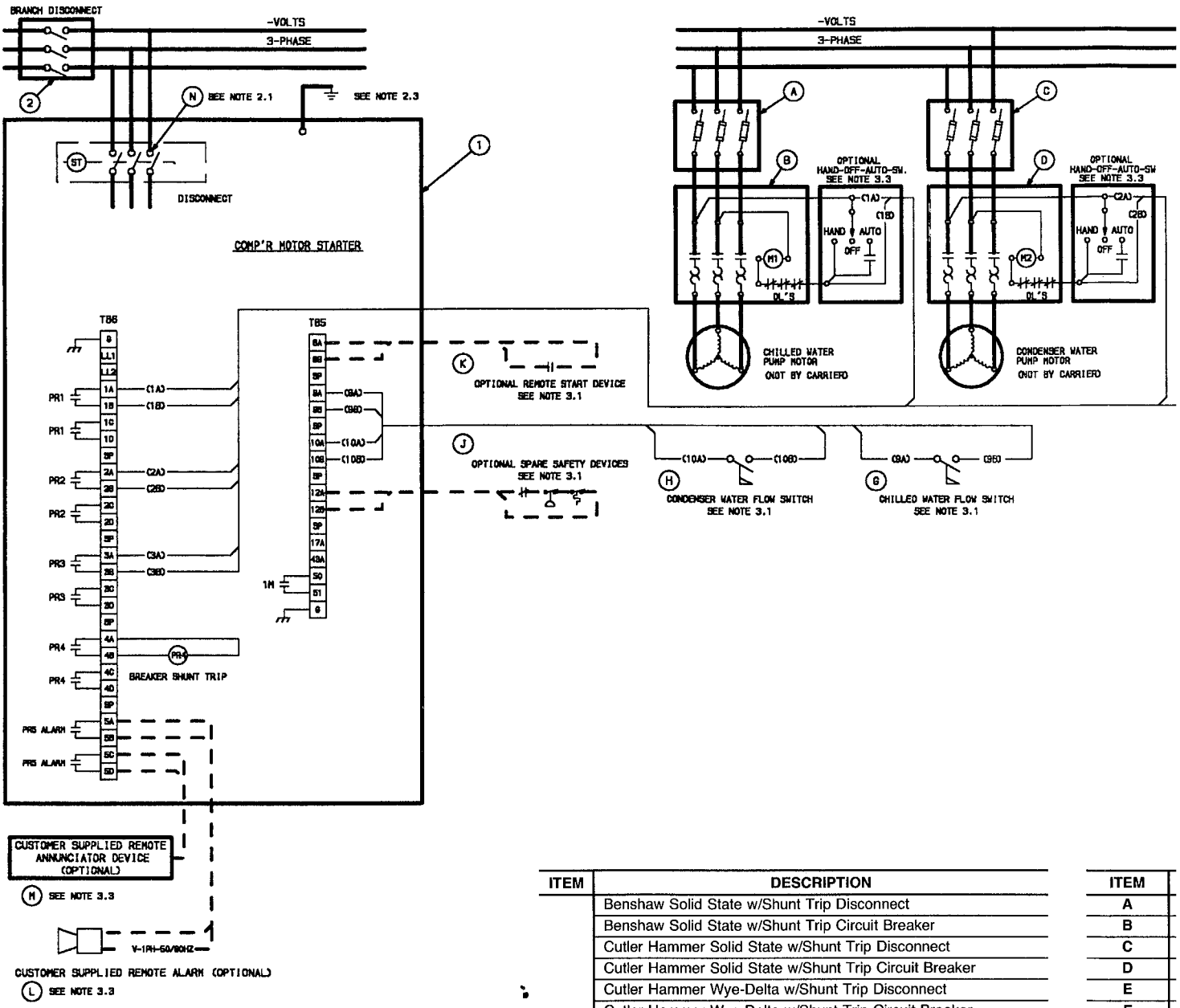
4 3 Compressor motor frame to be grounded in accordance with the National Electrical Code (NFPA-70) and applicable codes Means for grounding compressor motor is (2) Thomas and Betts pressure connectors for 350 to 800 MCM wire, supplied and located in the back upper and lower right side corners of the compressor motor terminal box.

4 4 Do not allow motor terminals to support weight of wire cables Use cable supports and strain reliefs as required

4 5 Use back up wrench when tightening lead connectors to motor terminal studs Torque to 10-15 lb-ft max

Typical field wiring (cont)

23XL TYPICAL FIELD WIRING WITH OPTIONAL UNIT-MOUI



ITEM	DESCRIPTION	
1	Benshaw Solid State w/Shunt Trip Disconnect	
	Benshaw Solid State w/Shunt Trip Circuit Breaker	
	Cutler Hammer Solid State w/Shunt Trip Disconnect	
	Cutler Hammer Solid State w/Shunt Trip Circuit Breaker	
	Cutler Hammer Wye-Delta w/Shunt Trip Disconnect	
	Cutler Hammer Wye-Delta w/Shunt Trip Circuit Breaker	
	Cutler Hammer Wye-Delta w/Shunt Trip Hi Interrupt Breaker	
	Pilot Relays (With Two N O. Contacts Each) See Note 3 3	PR1 (Chilled Water Pump)
		PR2 (Condenser Water Pump)
		PR3 (Cooling Tower Fan)
		PR4 (Shunt Trip Outout)
		PR5 (Alarm Output)
	Control Power Transformer (2 KVA)	
	Controls and Oil Heater Circuit Breaker	
	Starter Management Module Package	
	3 Phase Volts/Amps Meter Package	
	Power Factor Correction Package	
	Lightning/Surge Arrestor Package	
	kW Transducer	
	3 Phase Under/Over Voltage	
	Ground Fault (Standard in Solid State)	
	Phase Reversal (Standard in Solid State)	
2	Compressor Motor Starter Branch Disconnect	

ITEM
A
B
C
D
E
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K
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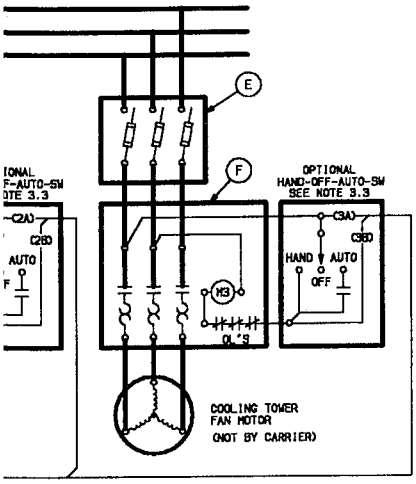
M
N

T-MOUNTED STARTER (FRAME 1 AND 2 MACHINES)



IMPORTANT: Refer to certified drawings for additional information. Certified drawings are available upon request.

LEGEND
- Required Power Wiring
- Required Control Wiring
- Options Wiring

ITEM	DESCRIPTION
A	Chilled Water Pump Starter Disconnect
B	Chilled Water Pump Motor Starter
C	Condenser Water Pump Starter Disconnect
D	Condenser Water Pump Motor Starter
E	Cooling Tower Fan Motor Starter Disconnect
F	Cooling Tower Fan Motor Starter
G	Chilled Water Flow Switch (N O) See Note 3 1
H	Condenser Water Flow Switch (N O). See Note 3 1
J	Spare Safety Devices (N O) See Note 3 1
K	Remote Start/Stop Device (N O.) See Note 3 1
L	Remote Alarm See Note 3 3
M	Remote Annunciator See Note 3 3
N	Lug Adapters See Note 2 1

NOTES:

I GENERAL

1 0 Starters shall be designed and manufactured in accordance with Carrier Engineering Requirement Z-375

1 1 All field-supplied conductors, devices, field-installation wiring, and termination of conductors and devices, must be in compliance with all applicable codes and job specifications

1 2 The routing of field-installed conduit and conductors and the location of field-installed, devices must not interfere with equipment access or the reading, adjusting, or servicing of any component.

1 3 Equipment installation and all starting and control devices must comply with details in equipment submittal drawings and literature

1 4 Contacts and switches are shown in the position they would assume with the circuit deenergized and the chiller shut down

1 5 WARNING — Do not use aluminum conductors

II POWER WIRING TO STARTER

2 0 Power conductor rating must meet minimum unit nameplate voltage and compressor motor RLA (rated load amps)

When (3) conductors are used:
Minimum ampacity per conductor = 1 25 x compressor RLA

When (6) conductors are used:
Minimum ampacity per conductor = 0 721 x compressor RLA

2 1 Lug adapters may be required if installation conditions dictate that conductors be sized beyond the minimum ampacity required Solid-state starters are provided with:

A Two (2) 0-250 MCM lugs provided per phase for power conductor terminations when compressor motor RLA is 400 amps or less

B Three (3), 250-500 MCM lugs provided per phase for power conductor terminations when compressor motor RLA is more than 400 amps

Wye-Delta starters are provided with:

A Two (2) 250-500 MCM lugs provided per phase for power conductor terminators when compressor motor RLA is 420 amps or less.

B. Two (2) #1-500 MCM lugs provided per phase for power conductor terminations when compressor motor RLA is more than 420 amps.

2 2 Power conductors to starter must enter through top of enclosure Flexible conduit should be used for the last few feet to the enclosure to provide unit vibration isolation

2 3 Compressor motor and controls must be grounded by using equipment grounding lugs provided inside starter enclosure

2 4 Wye-Delta starters require the assembly and the installation of a "Top Hat" (located inside enclosure) to provide the required wire bending space for incoming power leads

III CONTROL WIRING

3 0 Field supplied control conductors to be at least 18 AWG (American Wire Gage) or larger

3 1 Chilled water and condenser water flow switch contacts, optional remote start device contacts and optional spare safety device contacts, must have 24 vdc rating Max current is 60 ma, nominal current is 10 ma Switches with gold plated bifurcated contacts are recommended

3 2 Remove jumper wire between 12A and 12B before connecting auxiliary safeties between these terminals

3 3 Pilot relays can control cooler and condenser pump and tower fan motor contactor coil loads rated 10 amps at 115 vac up to 3 amps at 600 vac. Control wiring required for Carrier to start pumps and tower fan motors must be provided to assure machine protection If primary pump and tower fan motor control is by other means, also provide a parallel means for control by Carrier Do not use starter control transformer as the power source for pilot relay loads.

3 4 Do not route control wiring carrying 30 v or less within a conduit which has wires carrying 50 v or higher or along side wires carrying 50 v or higher

Guide specifications

Packaged Hermetic Screw Liquid Chiller

Size Range: **160 to 350 Tons (560 to 1,232 kW) — 60 Hz**
130 to 290 Tons (460 to 1,020 kW) — 50 Hz
Carrier Model Number: **23XL**

Part 1 — General

1.01 SYSTEM DESCRIPTION

A. Microprocessor-controlled liquid chiller utilizing a twin rotor, 3550 rpm (60 Hz) or 2960 rpm (50 Hz), direct drive, semi-hermetic, screw compressor using refrigerant HCFC-22 or HFC-134a. Chillers using CFC refrigerants such as CFC-11, 12, or 500 shall not be acceptable.

If a liquid chiller utilizing HCFC-123 refrigerant is proposed, the manufacturer shall include in the chiller price:

1. A vapor activated alarm system consisting of all alarms, sensors, safeties, and ventilation equipment as required by ANSI/ASHRAE Standard 15 (latest edition) with the quotation System shall be capable of responding to HCFC-123 levels of 10 ppm Allowable Exposure Limit (AEL).
2. External refrigerant storage tank and pumpout unit.
3. High efficiency purge unit.
4. Relief valve installed in series with rupture disk.
5. Chiller pressurizing system to prevent leakage of noncondensables into chiller during shutdown periods.

1.02 QUALITY ASSURANCE

A. Chiller performance shall be rated in accordance with ARI Standard 550 (latest edition).

B. Equipment and installation shall be in compliance with ANSI/ASHRAE 15 (latest edition).

C. Cooler and condenser shall include ASME "U" stamp and nameplate certifying compliance with ASME Section VIII, Division 1 code for unfired pressure vessels.

D. Chiller shall be manufactured in a facility that has been registered by UL to the ISO 9000 Series Standards for quality.

E. Chiller shall be designed and constructed to meet UL and CSA requirements and shall have labels appropriately affixed.

F. Each compressor assembly shall undergo a mechanical run-in test to check proper operation of components and to verify that vibration levels, oil pressures/temperatures, and efficiencies are within acceptable limits. Each compressor assembly shall be pneumatically proof tested at 405 psig (2792 kPa) and leak tested with a tracer gas at 225 psig (1551 kPa).

G. Both cooler and condenser shall be proof tested at 375 psig (2586 kPa) on the refrigerant side and leak tested with a refrigerant tracer gas at 300 psig (2068 kPa). The water side of each heat exchanger shall be hydrostatically tested at 1.5 times rated working pressure.

H The entire chiller assembly shall be leak tested with a refrigerant tracer gas at 300 psig (2068 kPa).

I. Prior to shipment, the chiller controls shall be tested under power to verify proper controls operation.

1.03 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled in accordance with manufacturer's instructions.

B. Unit shall be shipped with all refrigerant piping and control wiring factory installed.

C. Unit shall be shipped charged with either refrigerant HCFC-22, refrigerant HFC-134a, or a nitrogen holding charge, and oil as specified on the equipment schedule.

D. Unit shall be shipped with firmly attached labels that indicate the name of the manufacturer, chiller model number, chiller serial number, and the refrigerant used.

1.04 WARRANTY

Warranty shall include parts and labor for one year after startup or 18 months from shipment, whichever occurs first.

Part 2 — Products

2.01 EQUIPMENT

A. General:

Factory assembled, single piece, liquid chiller shall consist of compressor, motor, lubrication system, cooler, condenser, initial oil and refrigerant operating charges, microprocessor control system, and documentation required prior to start-up. Compressor motor starter shall be mounted on the chiller, wired, and tested by the chiller manufacturer.

B. Compressor:

1 One positive displacement field-serviceable helical, rotary, semi-hermetic, twin rotor-type compressor. Compressor section joints shall be sealed using O-rings instead of gaskets to reduce the occurrence of refrigerant leakage.

2. The compressor casing shall be cast-iron with design pressure rating of 300 psig (2068 kPa) or higher.

3. The compressor/motor shall be designed to operate at 3550 rpm (60 Hz) or 2960 rpm (50 Hz) input speed.

4. Bearings shall be pressure lubricated rolling element type, AFBMA Class 5 or superior.

5. Capacity control shall be via a hydraulically activated slide valve located below rotating screw rotors.

6. Discharge oil separation shall be accomplished external to the compressor casing. Oil separator and return system shall be designed to ensure that oil is adequately returned to the compressor and does not collect in the heat exchangers.

7. Compressor safeties shall include high compressor discharge temperature, high motor winding temperature, low oil pressure, reverse rotation, and high discharge pressure.

8. Compressor shall be equipped with internal pressure relief to protect against overpressure. For compressors not equipped with internal pressure relief, the high side of the chiller shall be protected with an external relief valve capable of passing the full load flow produced by the compressor.
9. Compressor shall be provided with a lubrication system to deliver oil under pressure to the bearings. System shall consist of:
   a. Six-micron oil filter with isolation valves shall allow filter change without removal of refrigerant charge.
   b. Oil sump heater (115/230 volt, single phase, 50 or 60 Hz), if required for proper operation. Heater shall be controlled by unit microprocessor and factory wired.
   c. Positive oil flow sensing/verification shall occur through a float type oil level sensor used in conjunction with an oil pressure sensor. Systems which rely on a flow switch to monitor oil flow can be activated by the flow of refrigerant rather than oil and can give an erroneous signal and are therefore unacceptable.
10. Compressor shall be fully field serviceable. Compressors which must be removed and returned to the factory for service shall not be acceptable.
11. Acoustical attenuation shall be provided, as required, to achieve a maximum (full load or part load) sound level of [ ] dBA, measured per ARI Standard 575 (latest edition). Attenuation shall be designed to be easily removed and reinstalled.

C. Motor:
1. Compressor motors shall be of the single speed, non-reversing, squirrel cage induction type suitable for the voltage shown on the equipment schedule.
2. Motors design speed shall be 3550 rpm at 60 Hz or 2960 rpm at 50 Hz
3. Motors shall be suitable for operation in a refrigerant atmosphere and shall be cooled by atomized refrigerant in contact with the motor windings.
4. Motor stator shall be arranged for service or removal with only minor compressor disassembly and without breaking of main refrigerant piping connections.
5. Full load operation of the motor shall not exceed nameplate rating.
6. Low-voltage motors (600 v or less) shall be suitable for connection to wye-delta type reduced inrush or solid-state type reduced voltage starters.
7. Should the mechanical contractor choose to provide a chiller with an open motor instead of the specified semi-hermetic motor, the contractor shall either:

   Supply additional ventilation to maintain a maximum mechanical room temperature of 104 F (40 C). Additional ventilation requirements shall be calculated as follows:

$$CFM = \frac{(\text{Full load motor kW})(0.05)(3413)}{(104 - 95)(1.08)}$$

$$CFM = (\text{FLkW motor})(17.6)$$

   or, if the mechanical room is air conditioned, the mechanical contractor shall install additional cooling equipment to dissipate the motor heat as per the following formula:

$$Btuh = (\text{FLkW motor})(0.05)(3413)$$

$$Btuh = (\text{FLkW motor})(171)$$

   and, alternately

$$TONS = \frac{Btuh}{12{,}000}$$

   In either case, the additional piping, valves, air-handling equipment, insulation, wiring, switchgear changes, ductwork, and coordination with other trades shall be the responsibility of the mechanical contractor. Shop drawings reflecting any changes to the design shall be included in the submittal, and incorporated into the final as-built drawings for the project.

   Also, if an open motor is provided, a mechanical room thermostat shall be installed and set at 104 F (40 C). If this temperature is exceeded, the chillers shall shut down and an alarm signal shall be generated to the central EMS display module prompting the service personnel to diagnose and repair the cause of the overtemperature condition. The mechanical contractor shall be responsible for all changes to the design, including coordination with temperature control, electrical, and other trades.

   In addition, the electrical power consumption of any auxiliary ventilation and/or mechanical cooling required to maintain mechanical room conditions as stated above shall be considered in the determination of conformance to the scheduled chiller energy efficiency requirement.

D. Cooler and Condenser:
1. Cooler and condenser shall be of shell and tube type construction, each in separate shells. Units shall be fabricated with high-performance tubing, steel shell and tube sheets. Waterboxes shall be nozzle-in-head type with nozzles either flanged or with Victaulic connections.
2. Tubing shall be copper, high-efficiency type, with integral internal and external enhancement. Tubes shall be nominal ¾-in. OD with nominal wall thickness of 0.025 in. measured at the root of the fin. Tubes shall be rolled into tube sheets and shall be individually replaceable. Tube sheet holes shall be double grooved for joint structural integrity. Intermediate support sheet spacing shall not exceed 36 inches.
3. Waterboxes and nozzle connections shall be designed for 150 or 300 psig (1034 or 2068 kPa) maximum working pressure.

4. Cooler and condenser shall display ASME nameplates that show pressure and temperature data and the "U" stamp for ASME Section VIII, Division 1. Pressure relief valves shall be installed on each heat exchanger.
5. Waterboxes shall have vents, drains, and covers to permit tube cleaning within the space shown on the drawings. A thermistor type temperature sensor shall be factory installed in each water nozzle.
6. Cooler shall be designed so as to prevent liquid refrigerant from entering the compressor. Devices that introduce pressure losses (such as mist eliminators) shall not be acceptable because they are subject to structural failures that can result in extensive compressor damage.
7. Tubes shall be individually replaceable from either end of the heat exchanger without affecting the strength and durability of the tube sheet and without causing leakage in adjacent tubes.
8. The condenser shell shall include an external thermal economizer which cools the condensed liquid refrigerant to a reduced temperature, thereby increasing the refrigeration cycle efficiency.
9. An optional refrigerant isolation valve package shall be factory installed to allow isolation of the refrigerant charge in the cooler or condenser

E. Refrigerant Flow Control:

To improve part load efficiency, liquid refrigerant from the condenser shall be metered using a direct acting, float-type metering device to maintain the proper liquid level of refrigerant in the heat exchangers under both full and part load operating conditions. By maintaining a liquid seal at the flow orifice, bypassed hot gas from the condenser to the cooler is eliminated. The float device chamber shall have a bolted access cover to allow field inspection and the float device shall be field serviceable. Fixed orifices shall not be acceptable.

F. Controls, Safeties and Diagnostics:

1. Controls·

a. The chiller shall be provided with a factory installed and wired microprocessor control system with individually replaceable modular component construction. The system shall include a control center, power supply, temperature (thermistor), and pressure (transducer) sensors, and all necessary auxiliary devices required for proper operation Controls shall be provided with a 15-year battery backup to prevent the loss of configuration information in case of power failure.

The chiller control system shall have the ability to interface and communicate directly to the building control system without the use of additional field-installed hardware or software. Additional hardware will be necessary if the building control system is not Carrier Comfort Network (CCN)

The control center shall include a 16-line by 40-character liquid crystal display (LCD) screen, 4 function keys, a stop button, and an alarm light, and shall include mounting and wiring provisions for two optional input modules (8 input channels each). The microprocessor shall be configurable to display either English or SI metric units.

The default standard display screen shall simultaneously indicate the following information:

- Date and time of day
- 24 character primary system status message
- 24 character error message
- Chiller operating hours
- Entering chilled water temperature
- Leaving chilled water temperature
- Evaporator refrigerant temperature
- Entering condenser water temperature
- Leaving condenser water temperature
- Condenser refrigerant temperature
- Oil supply pressure
- Oil sump temperature
- Percent motor Rated Load Amps (RLA)

The default screen shall be displayed if there is no manual activity at the control console for 15 minutes.

The 4 function keys shall be software driven within the Status, Schedule, Set Point and Service menu structures (as described on page 42).

b. Capacity control shall be by means of a hydraulically operated slide valve under the compressor rotors. Load modulation shall be from 100% to 20% of compressor full load under normal ARI conditions without the use of hot gas bypass. The slide valve shall be precisely positioned by a PID (proportional-integral-derivative) control algorithm to ensure precise control (± .5 F [.3 C]) of desired chilled water temperature without hunting or overshooting the set point.

c The microprocessor control system shall automatically control the chilled water pump and condenser water pump.

d. Upon request to start the compressor, the control system shall start the chilled water and condenser water pumps and verify that flows have been established. The controller shall then compare the entering/leaving chilled water temperature with the chilled water set point. If the chilled water temperature is less than the chilled water set point, the control system will shut down the condenser water pump and tower fans and wait for the cooling load to be established.

e. A user-configurable ramp loading rate, effective during the chilled water temperature pulldown period, shall control the rate of slide valve opening to prevent a rapid increase in compressor power consumption. The controls shall allow configuration of the ramp loading rate in either degree/minute of chilled water temperature pulldown or percent motor amps/minute. During the ramp loading period, a message shall be displayed informing the operator that the chiller is operating in ramp loading mode.

f. The control system shall include capability for automatic 2-chiller lead/lag with integral standby. Controls shall automatically redefine standby chiller as lag chiller in the event of a failure of either lead chiller or existing lag chiller. Sequencing shall be based on leaving chiller water temperature.

g. The control system shall include compressor runtime timers to protect the motor from rapid cycling (a 15-minute minimum start-to-start timer and a 1-minute minimum stop-to-start timer). In addition the compressor will be inhibited from restarting if more than 8 manual starts within a 12 hour period have occurred.

h. The control system shall automatically cycle the compressor to minimize energy usage whenever the leaving chilled water temperature is 5 F (3 C) below the desired chilled water set point. The chilled water pump will remain on, and when the leaving chilled water temperature rises above the set point by a user-configured amount, the compressor shall automatically restart. During the shutdown period, a message shall be displayed informing the operator a recycle restart is pending.

i. The control center shall monitor line voltage and if loss of voltage, high or low line voltage, or single cycle dropout is sensed, the chiller shall shut down. Upon restoration of line voltage, if the auto-restart after power failure algorithm is enabled, the chiller shall automatically resume the mode of operation prior to shutdown.

j. The control system shall allow configuration of reset of the chilled water temperature set point based on either water temperature rise across the evaporator, an external 4-20 mA signal, or a remote temperature sensor (such as outdoor air).

   When reset is active, a message shall be displayed indicating the type of reset in effect.

k. The control center shall limit amp draw of the compressor to the rated load amps (RLA) or to a lower value (ranging from 40% to 100%) of compressor RLA. The control center shall allow configuration of demand limit based on either a user input or an external 4-20 mA signal.

   When demand limit is active, a message shall be displayed indicating the source of the demand signal.

STATUS FUNCTION

In addition to the default screen, status screens shall be accessible to view the status of every point monitored by the control center including:

- Evaporator pressure
- Condenser pressure
- Compressor discharge temperature
- Motor winding temperature
- Number of compressor starts
- Control point settings
- Discrete output status of various devices
- Compressor motor starter status
- Optional spare input channels (16 maximum)

SCHEDULE FUNCTION

The chiller controls shall be configurable for manual or automatic start-up and shutdown. In automatic operation mode, the controls shall be capable of automatically starting and stopping the chiller according to a stored user programmable Occupancy Schedule. The controls shall include built-in provisions for accepting a minimum of three, 365-day Occupancy Schedules (the Local Time Schedule shall be Schedule 01, the Ice Build Time Schedule shall be Schedule 02, and the CCN Default Schedule shall be 03). Each schedule shall allow a minimum of 8 separate occupied/unoccupied periods. All of the 8 occupied periods can be scheduled by individual day for any day of the week. A separate schedule shall be provided for holidays. Schedules shall allow specifications of Daylight savings start/end and up to 18 user-defined holidays up to one year in advance (month, day, and duration of days). Display of the Occupancy Schedules shall be viewable on the LCD screen. Each schedule shall provide a means of configuring an occupancy time override to permit a "one time extension" of an occupied period on the configured day. The controls shall also provide for chiller start-up and shutdown through a remote contact closure from a customer supplied device or from a building management system software command.

SET POINT FUNCTION

The controls shall provide the capability to view and change the leaving chilled water set point, entering chilled water set point, and demand limit set point at any time during chiller operation or shutdown periods. The controls shall allow for the specification of capability control through either leaving chilled water or entering chilled water.

SERVICE FUNCTION

The controls shall provide a password protected service function which allows authorized individuals to:

- View the alarm history file which contains the last 25 alarm/alert messages with time and date stamp. These messages shall be displayed in text form, not in codes.
- Execute the chiller Control Test function for quick identification of malfunctioning components
- View/modify chiller configuration
- View/modify chiller occupancy periods
- View/modify schedule holiday periods
- View/modify schedule override periods
- View/modify system time and date

2. Safeties:
   a. Unit shall automatically shut down when any of the following conditions occur: (Each of these protective limits shall require manual reset and cause an alarm message to be displayed on the LCD screen informing the operator of the shutdown cause.)
      1) Motor overcurrent
      2) Over voltage*
      3) Under voltage*
      4) Single cycle dropout*
      5) Low evaporator refrigerant temperature
      6) High condenser pressure
      7) High motor temperature
      8) High compressor discharge temperature
      9) Low oil pressure
      10) Low oil level
      11) Loss of cooler water flow
      12) Loss of condenser water flow
      13) Starter fault
      14) High oil filter differential pressure
      15) Low discharge superheat temperature (Frame 1 and 2 machines).
      16) High oil pressure
      17) Excessive starter transition time
      18) Motor current signal loss
      19) Motor power supply phase reversal
      20) Temperature sensor and transducer faults
      21) Single cycle dropout
      22) Motor wiring correction

      *Will not require manual reset or cause an alarm if auto-restart after power failure is enabled.

   b. The control system shall detect conditions which approach protective limits and take self-corrective action prior to an alarm occurring. The system shall automatically reduce chiller capacity when any of the following are out of normal operating range:
      - High condenser pressure
      - High motor temperature
      - Low evaporator refrigerant temperature
      - High motor amps

      During the capacity override period, a pre-alarm (alert) message shall be displayed informing the operator which condition is causing the capacity override. Once the condition is again within acceptable limits, the override condition shall terminate and the chiller shall revert to normal chilled water control. If during either condition the protective limit is reached, the chiller will shut down, an alarm shall be generated, and a text message will be displayed informing the operator which condition caused the shutdown and alarm.

3. Diagnostics and Service.
   a. The control system shall execute a series of prestart checks whenever a start command is received to determine if pressures, temperatures, and timers are within pre-start limits thereby allowing start-up to proceed. If any of the limits are exceeded, a text alert message will be displayed informing the operator of the cause of the pre-start alert.
   b. The control system shall include a self-diagnostic Control Test to allow quick identification of abnormal system conditions and malfunctioning chiller components All pressure and temperature sensors shall be checked to ensure they are within their normal operating range. A pump test shall automatically energize the chilled water and condenser water pumps. The control system shall confirm that water flows have been established and require operator confirmation prior to proceeding to the next test.
   c. A slide valve test shall energize the Increase and Decrease slide valve solenoids to check for proper operation. The controls shall require manual operation confirmation of proper solenoid operation prior to proceeding to the next test.
   d. In addition to the automated Control Test, the controls shall provide a manual test that permits selection and testing of individual control components and inputs. A thermistor test and transducer test shall display the actual reading of each transducer and each thermistor installed on the chiller on the LCD screen.
   e. All sensors shall have quick disconnects to allow replacement of the sensor without replacement of the entire sensor wire. Pressure transducers shall be capable of field calibration to ensure accurate readings and to avoid unnecessary transducer replacement. Transducers shall be serviceable without the need for refrigerant charge removal or isolation.

Guide specifications (cont)

G. Low-Voltage Unit Mounted Starter:

A reduced voltage wye-delta or solid-state starter shall be supplied. The compressor motor starter shall be factory mounted, wired, and tested prior to shipment by the chiller manufacturer. Customer electrical connection for compressor motor power shall be limited to main starter power connection only.

Solid-state starter shall provide stepless compressor motor accelerating and limit motor inrush current to 150-300% of compressor motor RLA. The starter shall include 6 Silicon Control Rectifiers (SCR) with integrally mounted bypass contactors to provide SCR bypass once the motor has achieved full voltage and speed. The starter shall also include automatic acceleration kick circuitry which monitors motor current to sense when the inrush current subsides and automatically ramps voltage up at a faster rate to eliminate the instability that occurs at the breakaway torque point.

Starter shall be UL and CSA approved and shall include:

- NEMA 1 enclosure with integral fan cooling and lockable hinged doors
- Main power disconnect (non-fused type)
- Solid-state 3-phase overload relay with manual reset
- 2 KVA control/oil heater transformer
- Branch circuit breaker for control power and oil heater
- 5 pilot relays for control of chilled water pump, condenser water pump, tower fan, customer remote alarm, shunt trip, and main power disconnect. The shut trip shall be energized by the SMM during unauthorized operation (such as loss of communication between the SSM [Starter Management Module] and PSIO [Processor Sensor Input/Output Module]).

Solid-state starters also include the following standard features:

- Current imbalance detector which monitors 3 phase motor current to provide the following protection:
  - — Phase loss
  - — Phase reversal
  - — Phase imbalance
  - — Ground fault
  - — Shorted SCR
  - — Current flow while stopped protection
- Diagnostic LED's shall be provided to indicate:
  - — Starter on
  - — Run (up to voltage)
  - — Phase correct
  - — Overtemperature fault
  - — SCR gates energized
  - — Ground fault
  - — Current imbalance fault
  - — Shorted SCR
- I^2T fuses that protect the solid-state circuitry at 200,000 amp interrupting capacity

H. Electrical Requirements:

1. Electrical contractor shall supply and install main electrical power line, disconnect switches, circuit breakers, electrical protection devices per local code requirements and as indicated necessary by the chiller manufacturer
2. Electrical contractor shall wire the water flow switches to the chiller control circuit to ensure that chiller will not operate until flows are established and maintained.
3. Electrical contractor shall supply and install electrical wiring and devices required to interface the chiller controls with the building control system, if applicable.
4. Electrical power shall be supplied to the unit at the voltage, phase, and frequency listed in the equipment schedule.

I. Piping Requirements — Instrumentation and Safeties:

1. Mechanical contractor shall supply and install pressure gages in readily accessible locations in piping adjacent to the chiller such that they can be easily read from a standing position on the floor. Gages shall be Marsh Master or equal with 4½ in. nominal diameter face Scale range shall be such that design values shall be indicated at approximately mid-scale.

   Gages shall be installed in the entering and leaving water lines of the cooler and condenser.
2. Mechanical contractor shall supply and install flow detection devices in chilled water and condenser water piping. Switches shall make contact when flow is established. Flow switches shall be installed in horizontal runs at least 5 pipe diameters downstream from any bend or tee.

J. Insulation:

1. Chilled water piping and cooler waterboxes shall be insulated by the mechanical contractor.
2. Factory installed insulation shall be available for the chiller. Additional insulation shall be installed at the jobsite by the mechanical contractor.
3. Chiller insulation shall be ¾ in. thick and shall have a thermal conductivity not exceeding 0.28 Btu · in /hr · sq ft · F and shall conform to UL Standard 94, Classification 94 HBF.

K. Vibration Isolation:

Chiller manufacturer shall furnish neoprene isolator pads for mounting equipment on a level concrete surface.

L. Start-up:

1. The chiller manufacturer shall provide a factory-trained representative, employed by the chiller manufacturer, to perform the start-up procedures as outlined in the start-up, operation and maintenance manual provided by the chiller manufacturer.
2. After the above services have been performed, the same factory-trained representative shall be available for a period of classroom instruction (not to exceed 4 hours) to instruct the chiller owner's personnel in the proper operation and maintenance of the chiller.
3. Manufacturer shall supply the following literature:
   a. Start-up, Operation and Maintenance Instructions.
   b. Installation Instructions.
   c. Field Wiring Diagrams.

M. Optional:

An optional freestanding refrigerant storage tank and pumpout unit shall be provided. The storage vessels shall be designed per ASME Section VIII Division 1 code with 300 psig (2068 kPa) design pressure. Double relief valves per ANSI/ASHRAE 15, latest edition, safety code shall be provided. The tank shall include a liquid level gage and pressure gage. The pumpout unit shall utilize a semi-hermetic reciprocating compressor with water cooled condenser. Condenser water piping, 3 phase motor power, and 115 volt control power shall be installed at the jobsite by the installing contractor.