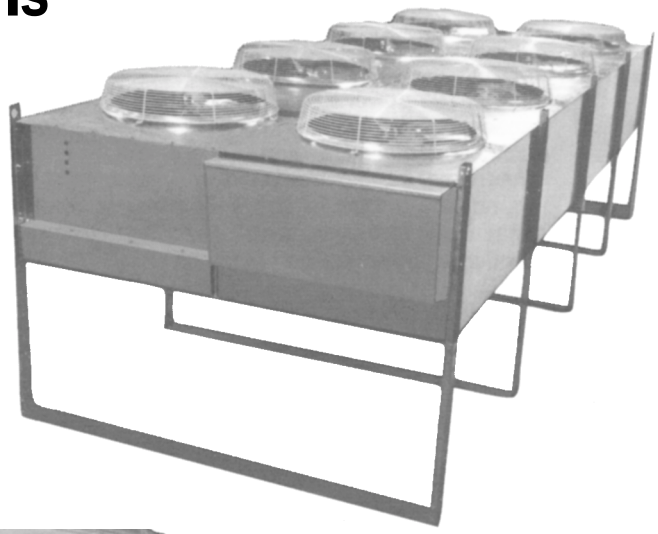
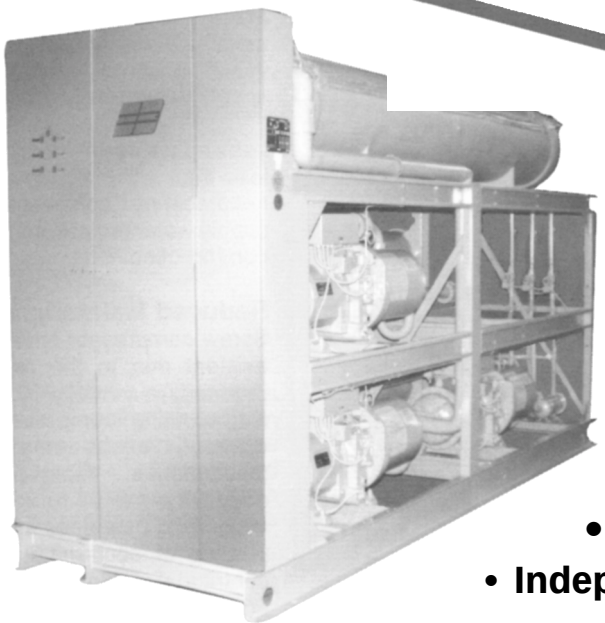
HRSC

Rotary Screw Chillers

with Remote Air-Cooled Condensers

40 to 230 tons





FEATURES

- Rotary screw compressors
- Independent refrigerant circuits
- Efficient performance
- Smooth, quiet operation
- Reduced maintenance expense

DUNHAM-BUSH®

Form No. 5304A

SCREW COMPRESSORS REPRESENT GREATER VALUE THROUGH EXPANDING TECHNOLOGY
MODEL HRSC REMOTE CONDENSER ROTARY SCREW PACKAGE

The HRSC Outperforms Recips and Centrifugals

Today's highly-competitive construction market forces engineers, contractors and equipment manufacturers to continually improve the value of their products and services. D-B's HRSC screw compressor chillers are an excellent example of innovative design, backed by 30 years of air conditioning experience and thorough testing. Neither reciprocating nor centrifugal compressors can match the screw compressor on a first cost versus performance analysis.

Lower First Cost

D-B HRSC chillers are available in a compact package up to 250 tons allowing easier installation and smaller equipment rooms. The multiple compressor, staggered start design, combined with modulating capacity control, eliminates the need for expensive starters and hot gas bypass. The two-pole compressor motor allows a .91 power factor without the use of correction capacitors. Optional single-source power minimizes electrical installation and factory electrical testing guarantees trouble free start-up. And, best of all, redundancy is built in above 75 tons, in contrast to centrifugal designs which require tremendous premiums for compressor back-up.

Higher Operating Efficiencies

Due to efficiencies of the screw compressors, the HRSC chillers offer major savings during part load operations. Due to the modulating compessor capacity control and the cycling off of unnecessary compressors, over cooling associated with stepped capacity control is prevented. In fact, four compressor HRSC units allow capacity reduction down to 7.5% of design without requiring energy wasting, hot gas bypass. Due to part load savings, the HRSC offers lower energy costs when a substantial amount of part load operation is required.

Greater Reliability

Screw compressors are inherently reliable since they use approximately 1/10 the moving parts of reciprocating compressors. Reliability is further enhanced by utilizing suction gas to cool the motor and compressor pressure differential to force feed oil to the bearings and rotors. This eliminates maintenance-prone oil pumps and liquid injection cooling. The compressor is further protected by a full set of safety controls. Another outstanding attribute is the screw compressor's resistance to damage from liquid slugging which is the major cause of reciprocating compressor failures. This slugging resistance is the result of the suction cooled motor, superheating the refrigerant, the structural integrity of the rotors as compared to pistons, and the modulating
capacity control allowing superior thermal expansion valve operation.

Unsurpassed Redundancy and Serviceability

In addition to the reliable design, the HRSC offers more back-up than any reciprocating or centrifugal chiller on the market today. Up to four compressors are offered, each with its own refrigeration system. In the unlikely event of a compressor failure, no other refrigerant circuit is affected. This basically means up to 75% back-up is provided on all components including most controls. Add to this a design which allows easy replacement of compressors and heat exchangers (none are welded in place) and easy maintenance requirements which are considerably less than the requirements of reciprocating chillers.

The reliability and redundancy offered by the HRSC is ideal for critical installations.

Quiet Operation

This compressor is, quite simply, the quietest compressor in its size range. The inherently balanced compression results in a compressor vibration amplitude of only 7 microns. The compressor noise also occurs at a higher vibration frequency allowing effective attenuation by the optional compressor acoustical enclosure and by equipment room walls. The screw compressor is quieter than competitive screw compressors due to the ribbed, double wall construction and the greater amount of rotor surface area.

Infinitely Modulating Capacity Control

Precise control of leaving water temperature is maintained by the screw compressor modulating slide valve, in combination with a microprocessor based supply water temperature controller.

Leaving water temperature variations are controlled to less than 1/2°F accuracy; five times the accuracy of reciprocating compressors. Maintaining constant supply water temperature allows much closer control of comfort conditions.

Reduced Maintenance Expense

Screw compressor chiller maintenance is almost non-existent due to the reliability in design and, when required, is virtually identical to the requirements of reciprocating compressors. Centrifugal chillers, in contrast, require very specialized and proprietary maintenance. Most centrifugal chillers also utilize negative pressure refrigeration systems which involve a significant expense in lost refrigerant due to periodic purging of contaminants. When all of these extra centrifugal maintenance expenses are taken into account, it becomes apparent that the HRSC offers a lower total operating cost than any competitive alternative.

CONTENTS

SPD-SD REMOTE AIR COOLED CONDENSER

DIRECT DRIVE FANS - Direct drive fans, as opposed to belt drive fans, are practically a maintenance free design. Competitive belt drive designs involve continual belt tightening, belt replacement and bearing lubrication. Direct drive fans, offered by DB, eliminate sheaves and belts.

3 PHASE MOTOR - 3 phase, 1140 RPM, 6 pole motors are provided and include inherent motor protection consisting of a thermal sensing overload safety. The permanently lubricated ball bearing design reduces maintenance requirements. The 3 phase motor design reduces energy costs as compared to single phase motors, and also eliminates maintenance problems associated with backward running fans and start capacitors.

PROPELLER FAN - The fans have heavy gauge aluminum blades securely riveted to zinc plated, chromate treated steel center hub. A low tip speed design reduces vibration and sound levels to a minimum.

Casings are designed for 20 year life starting with a cabinet offering unsurpassed corrosion protection. The 12 gauge aluminum panels, with reinforced aluminum and galvanized steel gussets, are far superior to painted galvanized construction, especially since every punch, break, or scratch exposes raw steel to the atmosphere.

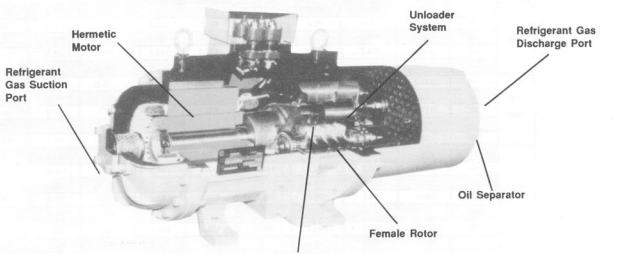
The aluminum panels are mounted on galvanized steel legs with cross rails.

Condenser fans are provided with aluminum baffles to prevent air bypass through non-operating fans.

Condensing coils are horizontally arranged, and completely incased by panels, to achieve built-in coil protection against hail and vandalism as well as uniform air distribution. A separate sub-cooling circuit with a liquid seal receiver is provided for each refrigerant circuit to maximize efficiency.
The high efficiency condenser coil is constructed of 1/2" copper tubes mechanically expanded into aluminum fins. The die formed fins utilize a self-spacing collar design which completely covers the tube surface and are mechanically bonded to the tubes through the expansion process.

Controls - The SPD-SD condenser is supplied with a single power connection and individual pressure sensing fan cycling controls for operation to 30°F. ambient. The unit is supplied with a low ambient lock-out thermostat.

SCREW COMPRESSOR RELIABILITY



Fewer Moving Parts - The D-B SSC semi-hermetic screw compressors have fewer moving parts than reciprocating compressors since components such as pistons, connecting rods, valve plates, oil pump and mechanical linkages for capacity control have been eliminated. This results in an inherently more reliable design.

Resistance to Slugging - Screw compressors have greater resistance to liquid flood-back than reciprocating compressors. This is mainly due to the relative size and strength of the compression mechanism (rotors vs. connecting rods). The rotary compressor is further protected by the suction cooled motor design, which superheats refrigerant before compression, and the modulating capacity control allowing superior expansion valve performance.

Additional Design Features - THREE PHASE, REFRIGERANT COOLED, HERMETIC MOTOR
- High efficiency. Two-pole squirrel cage, induction type
- Power factor of 91% (208 and 460 volt). Greatly exceeds reciprocating compressors
- Optional star-delta winding for reduced inrush current
- 80 mesh, stainless steel suction strainer

SCREW ROTORS
- Precision formed ductile cast iron
- 6 Lobed female and 5 lobed male rotor design provides greater surface area

BEARINGS
- Four precision roller bearings support the rotors and carry radial loads
- Four heavy duty ball bearings absorb the axial thrust

OIL SEPARATOR COMPARTMENT
- Carbon steel impingement plate separates oil from discharge vapor
- 150 mesh, stainless steel oil strainer protects the lubricating system
- Separated oil is force fed to rotors and bearings using compressor pressure differential and thus eliminating service associated with oil pumps

CAPACITY DATA 60 Hz

Model HRSC	Leaving Water Temp. °F.	AMBIENT AIR TERMPERTURE °F.									
		85		90		95		100		105	
		TONS	KW	TONS	KW	TONS	KW	TONS	KW	TONS	KW
50D	42	41.7	41.9	39.9	44.0	38.1	45.2	37.5	48.1	36.5	50.1
	44	42.8	42.3	41.4	44.6	40.4	46.6	39.0	48.8	37.7	50.7
	45	43.5	42.9	42.3	45.2	40.9	47.2	39.6	49.3	38.5	51.3
	46	44.2	43.5	42.9	45.6	41.6	47.8	40.4	49.9	39.1	51.9
	48	45.7	44.1	44.2	46.2	43.0	48.5	41.7	50.5	40.5	52.4
60D	42	49.6	50.9	48.1	53.4	46.8	56.1	45.1	58.8	43.8	61.5
	44	51.3	51.9	49.8	54.4	48.5	57.1	46.9	59.7	45.4	62.5
	45	52.3	52.2	50.7	54.8	49.3	57.5	47.6	60.2	46.2	62.9
	46	53.3	52.7	51.7	55.2	50.2	58.1	48.6	60.8	47.2	63.5
	48	55.0	53.7	53.4	56.3	52.0	59.1	50.3	61.8	48.9	65.2
75D	42	60.1	63.1	58.2	66.3	56.5	70.0	54.5	73.1	52.9	76.9
	44	62.2	64.4	60.2	67.6	58.8	71.2	56.5	74.4	55.0	78.0
	45	63.5	65.0	61.6	68.3	59.8	71.8	58.3	75.1	56.2	78.7
	46	64.6	65.7	62.5	68.8	60.8	72.5	58.6	75.6	57.3	79.2
	48	66.9	66.6	64.8	69.8	63.0	73.3	60.8	76.6	59.3	80.2
100D	42	82.5	83.8	78.8	87.9	75.4	90.4	74.2	96.3	72.5	100.2
	44	84.6	84.7	81.9	89.1	80.0	93.2	77.3	97.5	74.8	101.4
	45	86.0	85.9	83.7	90.4	81.0	94.5	78.5	98.5	76.3	102.6
	46	87.5	86.9	84.8	91.2	82.5	95.7	80.0	99.8	77.7	103.8
	48	90.4	88.1	87.5	92.4	85.2	96.9	82.7	101.0	80.2	104.9
110D	42	88.9	95.9	86.1	100.5	85.4	105.5	80.7	110.1	78.3	115.2
	44	92.0	97.6	89.2	102.3	86.7	107.3	83.7	112.0	81.3	117.0
	45	93.6	98.6	90.8	103.2	88.1	108.3	85.2	113.0	82.6	117.9
	46	95.5	99.5	92.3	104.2	89.6	109.3	86.7	114.0	84.1	119.1
	48	98.5	101.3	95.5	106.1	92.7	111.1	89.6	115.8	87.0	120.9
120D	42	99.0	101.0	95.7	106.1	93.3	111.7	90.1	116.8	87.5	122.2
	44	102.9	102.8	99.6	108.0	97.1	113.6	93.7	118.8	90.8	124.4
	45	104.5	103.8	101.2	109.1	98.6	114.7	95.3	119.9	92.5	125.4
	46	106.5	104.7	103.2	110.0	100.3	115.6	97.1	121.0	94.2	126.5
	48	110.6	106.6	107.1	111.9	104.2	117.6	100.8	122.9	97.6	128.6
135D	42	111.3	116.5	107.9	122.4	104.9	128.4	101.6	134.4	98.6	140.5
	44	115.2	118.5	111.7	124.4	108.6	130.4	105.1	136.4	102.2	142.6
	45	117.3	119.6	113.8	125.5	110.7	131.6	107.1	137.6	104.0	143.7
	46	119.2	120.6	115.6	126.5	112.5	132.6	108.8	138.5	105.8	144.8
	48	123.1	122.8	119.4	128.4	116.2	134.7	112.5	140.5	109.3	146.7
150D	42	121.9	133.9	118.1	140.5	115.0	147.4	111.4	152.9	108.7	161.0
	44	126.3	136.2	122.5	142.8	119.1	149.8	115.8	156.4	112.8	163.4
	45	128.3	137.5	124.4	144.1	121.3	151.0	117.6	157.6	114.8	164.6
	46	130.6	138.8	126.6	145.3	123.5	152.2	119.7	158.8	116.8	165.8
	48	134.9	141.0	130.9	147.5	127.6	154.4	123.9	160.9	120.8	167.8
180D	42	147.7	161.0	141.8	168.6	136.3	176.7	130.6	184.1	125.1	192.2
	44	152.8	163.9	148.2	171.6	144.1	179.7	139.5	187.3	135.3	195.5
	45	155.2	165.6	150.7	173.2	146.4	181.4	141.9	189.2	137.6	197.4
	46	157.9	166.9	153.2	174.9	148.8	183.4	144.1	191.3	139.8	199.7
	48	163.1	169.9	158.1	177.7	153.7	186.1	149.0	193.9	144.2	202.1
210D	42	169.2	184.8	163.9	193.9	159.3	204.1	154.2	213.1	149.6	223.1
	44	174.7	188.2	169.4	197.4	165.2	207.5	159.6	215.1	154.8	226.6
	45	177.7	189.8	172.4	199.0	167.6	209.2	162.4	218.3	157.5	228.4
	46	180.7	191.5	175.2	200.7	170.5	210.9	165.1	224.4	160.4	230.2
	48	186.5	194.9	181.0	204.1	176.2	214.2	171.0	227.6	165.9	233.4
225D	42	179.6	201.2	173.9	211.1	168.9	222.0	163.2	232.0	158.2	242.9
	44	184.2	204.9	178.8	214.7	174.0	225.6	168.2	235.5	163.3	246.5
	45	187.5	206.8	181.8	216.8	176.9	227.7	171.2	237.5	166.3	248.4
	46	190.5	208.7	184.7	218.5	179.8	229.4	174.1	239.1	169.1	250.0
	48	196.3	212.1	190.6	221.9	185.6	232.7	179.9	242.6	174.9	252.7
240D	42	195.1	218.9	189.1	228.9	183.5	239.6	177.4	250.0	171.9	260.2
	44	201.9	222.9	195.7	233.1	189.9	243.8	183.7	254.0	177.9	264.8
	45	205.3	225.0	199.0	235.1	193.1	246.1	186.7	256.7	180.9	267.1
	46	208.6	227.3	202.1	237.5	196.3	248.5	189.8	258.6	184.0	269.5
	48	215.4	231.8	208.8	242.1	202.6	253.0	196.1	263.3	190.0	274.2

CAPACITY DATA 60 Hz (Cont'd)

Model HRSC	Leaving Water Temp. °F.	AMBIENT AIR TERMPERTURE °F.									
		85		90		95		100		105	
		TONS	KW	TONS	KW	TONS	KW	TONS	KW	TONS	KW
255D	42	205.3	231.0	199.0	241.8	193.3	253.5	187.0	264.6	181.3	275.8
	44	212.5	235.2	206.0	246.2	200.1	257.8	193.6	268.8	187.6	280.5
	45	216.0	237.4	209.5	248.3	203.5	260.2	196.9	271.4	190.9	282.8
	46	219.5	239.8	212.8	250.8	206.9	262.5	200.2	273.4	194.2	285.2
	48	226.9	244.4	220.1	255.3	213.8	267.1	207.1	278.1	200.8	289.9
270D	42	215.1	242.7	208.7	254.7	202.6	267.0	196.1	278.6	190.2	291.0
	44	222.6	247.3	215.8	259.0	209.8	271.7	203.0	283.2	196.9	295.8
	45	225.7	249.5	219.5	261.2	213.4	273.9	206.5	286.1	200.5	298.0
	46	229.9	252.0	223.1	263.0	217.1	276.2	210.1	287.9	204.0	300.4
	48	237.9	256.5	230.9	268.2	224.5	280.9	217.5	292.6	211.2	305.1
300D	42	236.0	267.3	229.0	280.5	222.7	295.1	215.8	308.2	209.3	322.7
	44	244.2	272.4	236.9	285.6	230.7	300.0	223.3	313.2	216.8	327.8
	45	248.2	274.9	240.9	287.9	234.7	302.5	227.4	315.6	220.8	329.9
	46	252.3	277.3	245.1	290.5	238.8	304.8	231.4	317.8	225.0	332.2
	48	261.5	282.0	254.1	295.1	247.5	309.4	240.0	322.5	233.3	336.9

NOTES:
1. Ratings based on 10°F chilled water range and .00025 fouling factor.
2. KW is for compressor motors only. See page 10 for fan data.
3. Ratings are for 60 Hertz electrical service. For 50 Hertz service, multiply tons by .85 and KW by .83.

60 Hz HRSC ELECTRICAL DATA (50 - 150)

Model HRSC	Volts 60 Hz 3 Ph.	Type of Start	COMPRESSORS				Minimum Circuit Ampacity	Max. Fuse Size
			RATED LOAD AMPS MOTOR NO.		LOCKED ROTOR AMPS MOTOR NO.			
			1	2	1	2		
50	208/230	XL	179	-	1040	-	224	400
	208/230	Y-D	179	-	347	-	224	400
	460	XL	74	-	422	-	93	150
	460	Y-D	74	-	141	-	93	150
60	208/230	XL	205	-	1228	-	257	450
	208/230	Y-D	205	-	409	-	257	450
	460	XL	91	-	485	-	114	200
	460	Y-D	91	-	162	-	114	200
75	208/230	XL	209	-	1415	-	262	450
	208/230	Y-D	209	-	472	-	262	450
	460	XL	98		539	-	123	200
	460	Y-D	98		180	-	123	200
100	208/230	XL	179	179	1040	1040	403	500
	208/230	Y-D	179	179	347	347	403	500
	460	XL	74	74	422	422	167	200
	460	Y-D	74	74	141	141	167	200
110	208/230	XL	205	179	1228	1040	436	600
	208/230	Y-D	205	179	409	347	436	600
	460	XL	91	74	485	422	188	250
	460	Y-D	91	74	162	141	188	250
120	208/230	XL	205	205	1228	1228	462	600
	208/230	Y-D	205	205	409	409	462	600
	460	XL	91	91	485	485	205	250
	460	Y-D	91	91	162	162	205	250
135	208/230	XL	209	205	1415	1228	467	600
	208/230	Y-D	209	205	472	409	467	600
	460	XL	98	91	539	485	213	300
	460	Y-D	98	91	180	162	213	300
150	208/230	XL	209	209	1415	1415	471	600
	208/230	Y-D	209	209	472	472	471	600
	460	XL	98	98	539	539	221	300
	460	Y-D	98	98	180	180	221	300

60 Hz HRSC ELECTRICAL DATA (180-300)

Model HRSC	Volts 60 HZ 3 PH.	Type of Unit	COMPRESSORS								Minimum Circuit Ampacity		Maximum Fuse Size	
			RATED LOAD AMPS MOTOR NO.				LOCKED ROTOR AMPS MOTOR NO.							
			1	2	3	4	1	2	3	4	Cir.1	Cir.2	Circ.1	Cir.2
180	208/230	XL	205	205	205	-	1228	1228	1228	-	667	-	800	-
	208/230	Y-D	205	205	205	-	409	409	409	-	667	-	800	-
	460	XL	91	91	91	-	485	485	485	-	296	-	350	-
	460	Y-D	91	91	91	-	162	162	162	-	296	-	350	-
210	208/230	XL	209	209	205	-	1415	1415	1228	-	471	262	600	450
	208/230	Y-D	209	209	205	-	472	472	409	-	471	262	600	450
	460	XL	98	98	91	-	539	539	485	-	312	-	400	-
	460	Y-D	98	98	91	-	180	180	162	-	312	-	400	-
225	208/230	XL	209	209	209	-	1415	1415	1415	-	471	262	600	450
	208/230	Y-D	209	209	209	-	472	472	472	-	471	262	600	450
	460	XL	98	98	98	-	539	539	539	-	319	-	400	-
	460	Y-D	98	98	98	-	180	180	180	-	319	-	400	-
240	208/230	XL	205	205	205	205	1228	1228	1228	1228	462	462	600	600
	208/230	Y-D	205	205	205	205	409	409	409	409	462	462	600	600
	460	XL	91	91	91	91	485	485	485	485	387	-	450	-
	460	Y-D	91	91	91	91	162	162	162	162	387	-	450	-
255	208/230	XL	209	205	205	205	1415	1228	1228	1228	467	462	600	600
	208/230	Y-D	209	205	205	205	472	409	409	409	467	462	600	600
	460	XL	98	91	91	91	539	485	485	485	396	-	450	-
	460	Y-D	98	91	91	91	180	162	162	162	396	-	450	-
270	208/230	XL	209	209	205	205	1415	1415	1228	1228	471	462	600	600
	208/230	Y-D	209	209	205	205	472	472	409	409	471	462	600	600
	460	XL	98	98	91	91	539	539	485	485	403	-	500	-
	460	Y-D	98	98	91	91	180	180	162	162	403	-	500	-
300	208/230	XL	209	209	209	209	1415	1415	1415	1415	471	471	600	600
	208/230	Y-D	209	209	209	209	472	472	472	472	471	471	600	600
	460	XL	98	98	98	98	539	539	539	539	417	-	500	-
	460	Y-D	98	98	98	98	180	180	180	180	417	-	500	-

NOTES:

1. XL: Across the line; Y-D: Star-Delta.
2. RLA (Rated Load Amps) rated.
3. Starting current for normal Y-D start is shown. In certain compressor failure modes, Y-D inrush can be as high as XL inrush.
4. Wire Size Amps (ampacity) equal 125% of the rated load amps for the largest motor in the circuit plus 100% of the rated load amps for all other motors in the circuit, per N.E.C.
5. Maximum fuse size is based on 225% of the rated load amps for the largest motor in the circuit plus 100% of the rated load amps for all other motors in the circuit. This is the largest fuse allowed per N.E.C. A smaller fuse is often recommended based on unit application and ambient temperature.

VOLTAGE TOLERANCES:

1) 208 volt: min. 187, max. 229
2) 230 volt: min. 207, max. 253
3) 460 volt: min. 414, max. 506

CAPACITY CONTROL

Each compressor can modulate from 100% to 30% of full load by slide valve operation. This provides reduction down to 7.5% on four-compressor units.

Further reduction is possible on all units through use of the hot gas bypass option which reduces compressor capacity to 10%. Minimum capacities are tabulated below.

Model Number	Circuits	Standard Min. Unloading	Optional Hot Gas Bypass
HRSC 50-75	1	30%	15%
HRSC 100-150	2	15%	7.5%
HRSC 180-225	3	10%	5%
HRSC 240-300	4	7.5%	4%

PHYSICAL DATA

MODELS HRSC-50 THRU 150

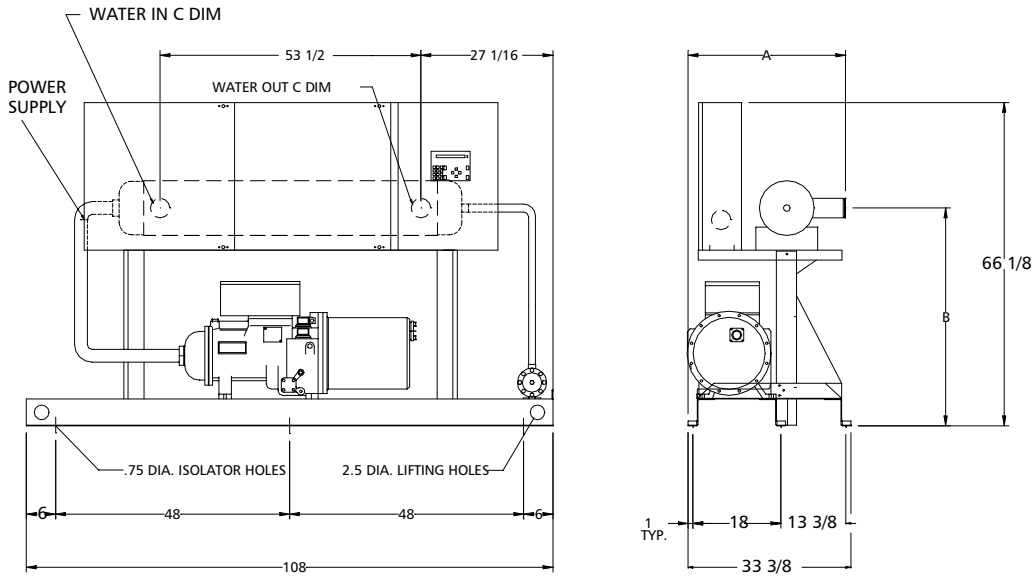
Model HRSC	50	60	75	100	110	120	135	150
Nominal Capacity - Tons	40	50	60	80	85	95	110	120
SEMI-HERMETIC SCREW TYPE COMPRESSORS								
No. of Compressors	1	1	1	2	2	2	2	2
Nominal Size (HP)	50	60	75	(2)50	50-60	(2)60	60-75	(2)75
Oil Charge (Oz./Compr)	202	236	236	(2)202	(1)202(1)236	(2)236	(2)236	(2)236
Crankcase Heater (Watts)	200	200	200	(2)200	(2)200	(2)200	(2)200	(2)200
COOLER								
Storage Capacity (Gal.)	6.25	9.4	11.1	17.6	25.4	25.4	29.4	29.4
Diameter x Length	860	1060	1160	1360	12102	12102	14102	14102
REMOTE CONDENSERS								
No. of SPD-SD Condensers	1	1	1	1	1	1	1	1
SPD-SD Condenser Size	70	70	70	140	140	140	140	140
UNIT								
Refrigerant Charge - R22 (lbs.)(1)	96	130	156	208	228	247	280	312
HRSC Operating Weight (lbs.)(2)	1700	2100	2325	3240	3555	4590	5415	5910

MODELS HRSC-180 THRU 300

Model HRSC	180	210	225	240	255	270	300
Nominal Capacity - Tons	145	165	175	190	205	210	230
SEMI-HERMETIC SCREW TYPE COMPRESSORS							
No. of Compressors	3	3	3	4	4	4	4
Nominal Size (HP)	(3)60	(1)60(2)75	(3)75	(4)60	(3)60(1)75	(2)60(2)75	(4)75
Oil Charge (Oz.) (Compr)	(3)236	(3)236	(3)236	(4)236	(4)236	(4)236	(4)236
Crankcase Heater (Watts)	(3)200	(3)200	(3)200	(4)200	(4)200	(4)200	(4)200
COOLER							
Storage Capacity (Gal.)	60.5	60.5	60.5	67.7	67.7	67.7	67.7
Diameter x Length	18122	18122	18122	20122	20122	20122	20122
REMOTE CONDENSERS (See Note 1)							
No. of SPD-SD Condensers	1/1	1/1	1/1	2	2	2	2
SPD-SD Condenser Size	70/140	70/140	70/140	140	140	140	140
UNIT							
Refrigerant Charge - R22 (lbs.)(1)	390	442	481	546	575	611	663
HRSC Operating Weight (lbs.)(2)	8710	8860	8950	10460	10560	10650	10800

NOTES: 1. Refrigerant charge includes condenser but does not include refrigerant piping.
2. HRSC operating weight does not include remote condenser. See page 12 for condenser weights.

DIMENSIONAL DATA

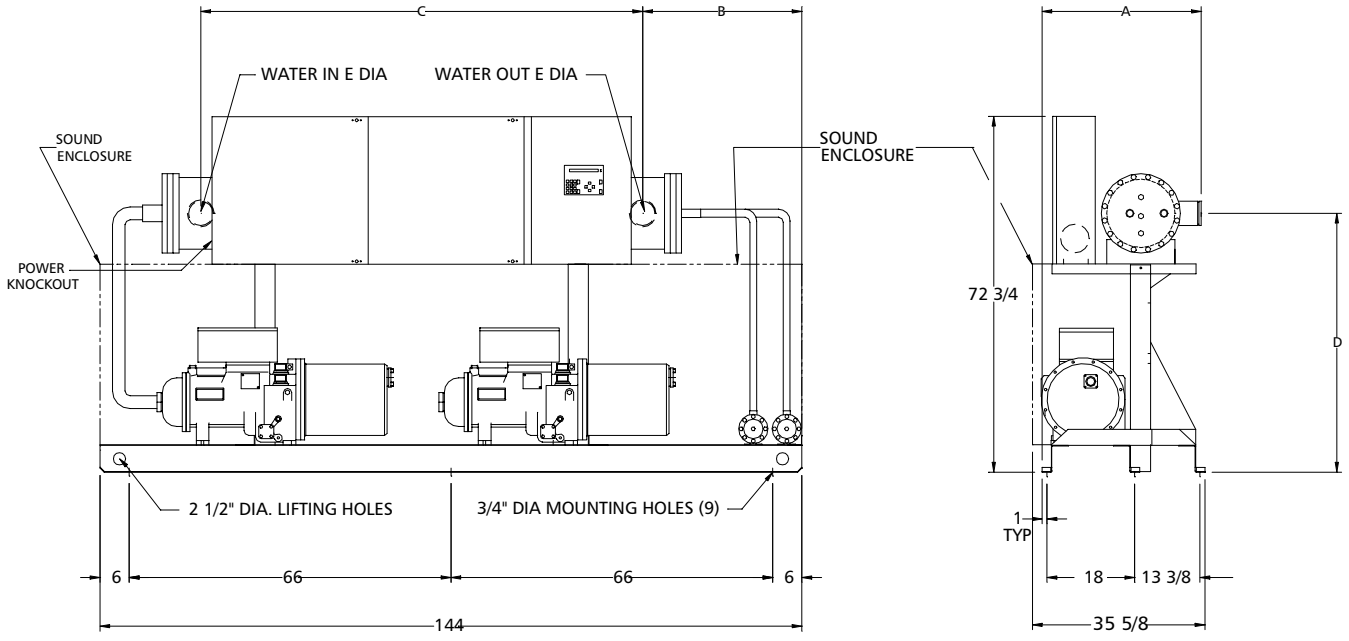


DIMENSIONS

Unit Model HRSC	A	B	C
50	30 15/16	43 1/2	3" MPT
60	31 3/4	44	4" MPT
75	32 3/8	44 5/8	4" MPT

ALL DIMENSIONS ARE IN INCHES.

OVERALL
NOTE: ADD 2" FOR ACOUSTICAL COMPRESSOR ENCLOSURE



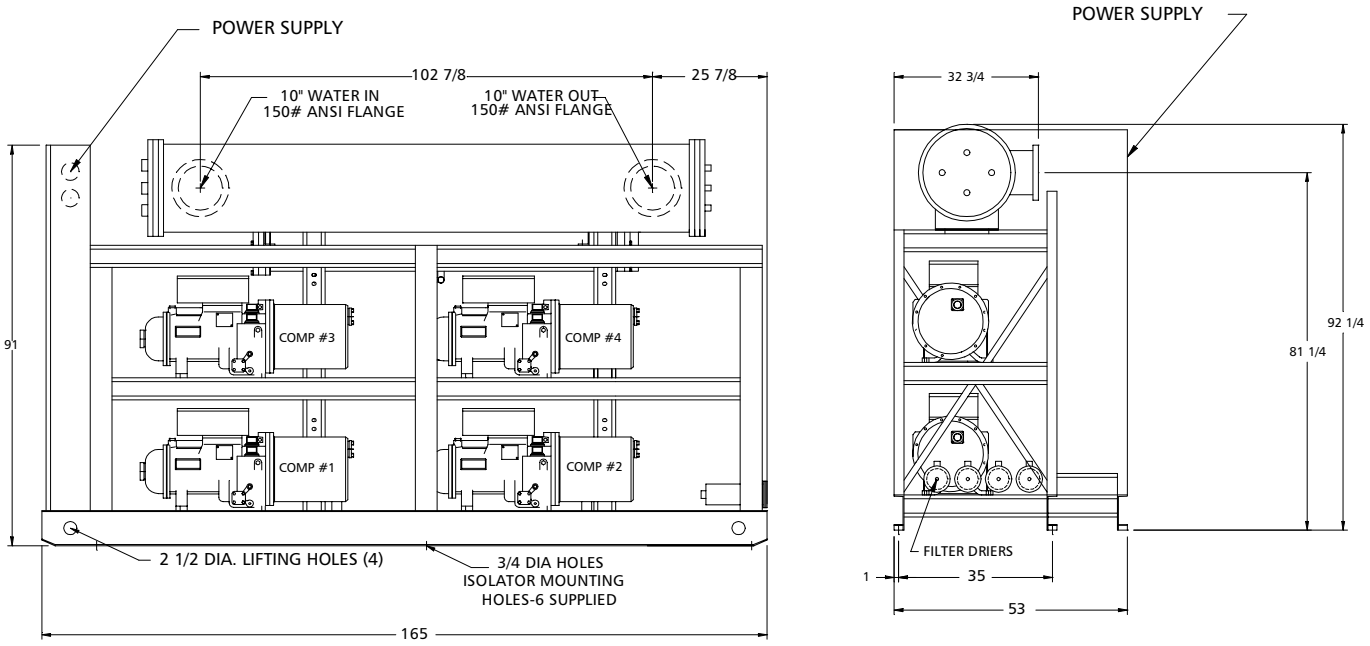
OVERALL W/SOUND ENCLOSURE

DIMENSIONS

Unit Model HRSC	A	B	C	D	E
100	33 5/8	52	53 1/2	52 3/4	4" MPT
110-120	32 5/8	32 1/4	91 3/8	52	4" VIC
135-150	34 3/8	32 3/4	90 5/8	53	5" VIC

ALL DIMENSIONS ARE IN INCHES.

DIMENSIONAL DATA

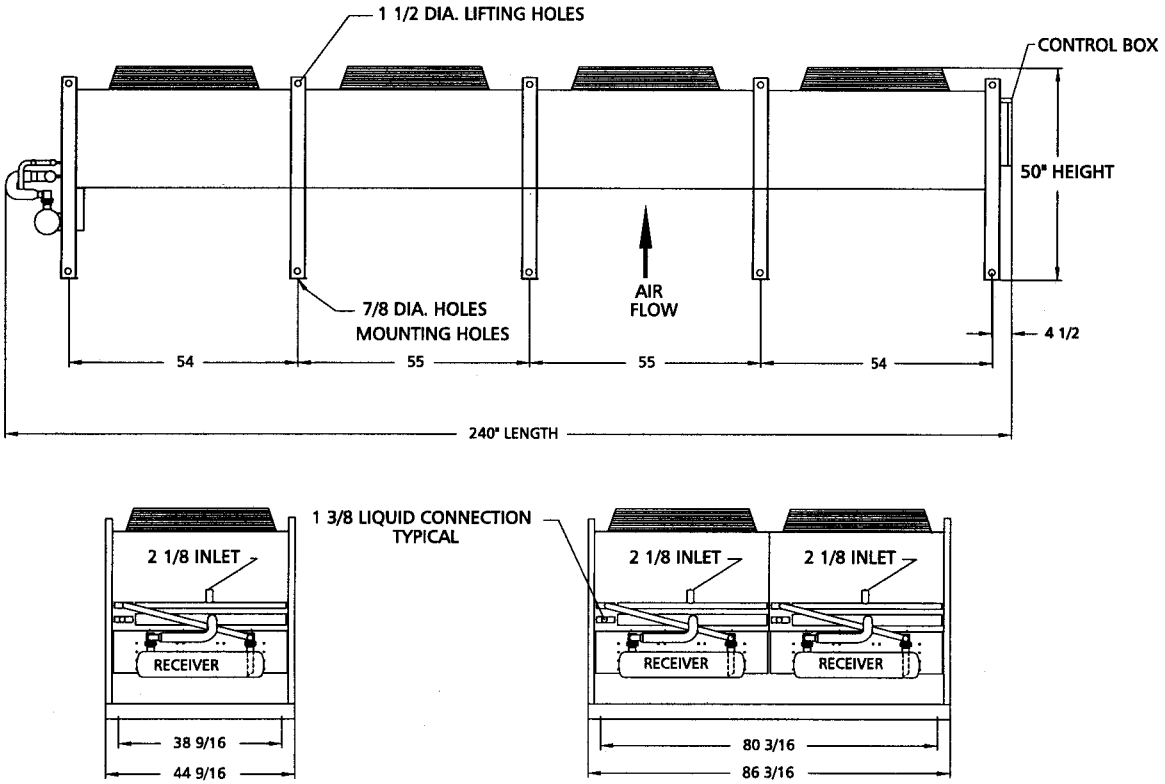


DIMENSIONS

MODEL HRSC	A	B	C	D	E	F
180-225	105 1/2	24 1/2	8"	31 3/4	80 1/4	92
240-300	102 7/8	25 7/8	10"	32 3/4	82 1/4	94

ALL DIMENSIONS ARE IN INCHES.

DIMENSIONAL DATA
AIR-COOLED CONDENSER
SPD70 SD, SPD 140 SD

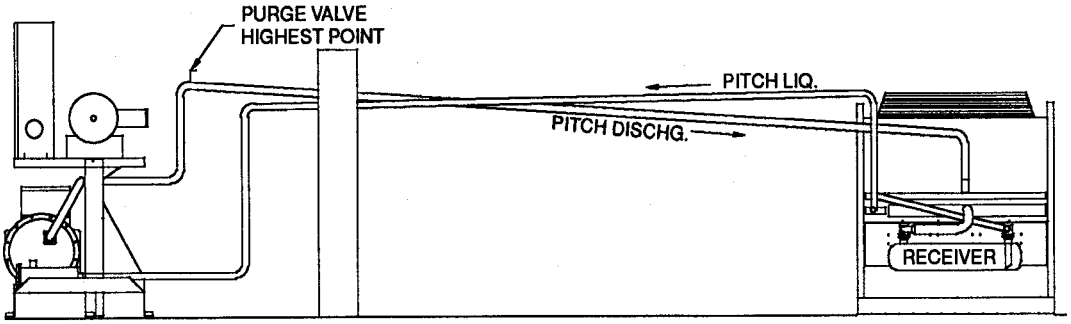


SPD-SD GENERAL AND ELECTRICAL DATA

Unit Size	Fans		Motors		Unit Full Load Amps		Unit Minimum Circuit Ampacity		Unit Maximum Fuse Size		Unit kW	Unit Operating Wt. Lbs.
	No.	Dia. (In.)	No.	HP	208/230	460	208/230	460	208/230	460		
70	4	30	4	1 1/2	23.6	12	26	13	30	15	5.8	1600
140	8	30	8	1 1/2	47.2	24	51	25	60	30	11.6	3000

NOTE: Motor data based on 3 phase 60 Hz. electrical supply.

HRSC SYSTEM REQUIREMENTS



A maximum of 15 feet rise of the compressor discharge line or a maximum of 10 feet rise of the liquid line.

NOTE: If condenser is within 10 ft. of compressor and at same level, discharge lines can be piped directly from the compressor to condenser.

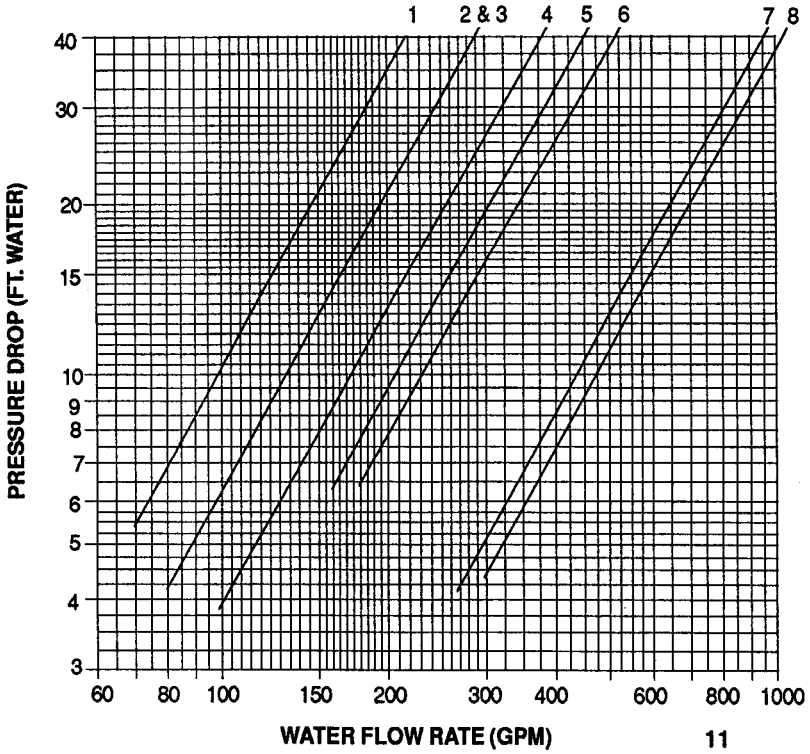
- Horizontal lines must pitch 1/2" per 10 feet in the direction of refrigerant flow.
- Each refrigerant circuit must be piped independently.
- Lines must be sized according to latest edition of ASHRAE Handbook. Liquid lines should be sized based on 10°F liquid subcooling at the condenser.
- Maximum of 50 linear feet of refrigerant line length (contact factory if application requires longer runs).
- All installations require authorized Dunham-Bush start up. Factory is to review all field piping.

EVAPORATOR WATER PRESSURE DROP

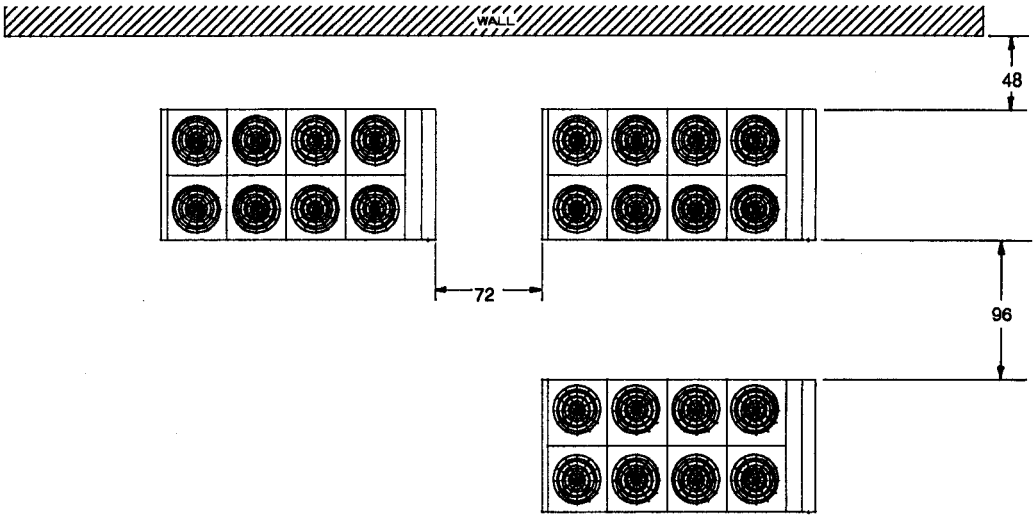
MODEL HRSC-D	CHILLER MODEL	CURVE NO.	MIN. GPM	MAX. GPM
50	CHS008601B*	1	70	242
60	CHS010601B*	2	78	316
75	CHS011601B*	3	85	316
100	CHD013601B*	4	100	420
110,120	EXD12102J07DVT0	5	160	444
135,150	EXD14102J07DVT0	6	175	553
180,220,225	EXT18122J07DFR0	7	270	1060
240,255,270,300	EXF20122J07DFR0	8	300	1140

*These chillers have welded heads. All other chillers have removable heads.

NOTE: Constant water flow through the evaporator is required with a minimum of three gallons per ton of system water loop volume. System volume should increase up to ten gallons per ton for process loads, low load applications with small temperature ranges, or systems with widely fluctuating loads.



SPD CONDENSER CLEARANCE



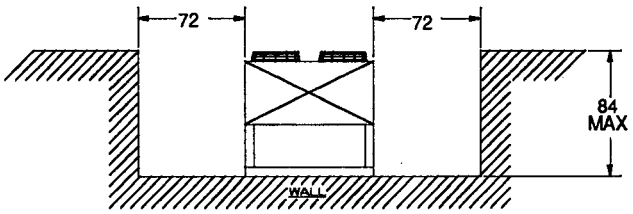


FIGURE #4
SINGLE PIT
(SEE NOTE 2)

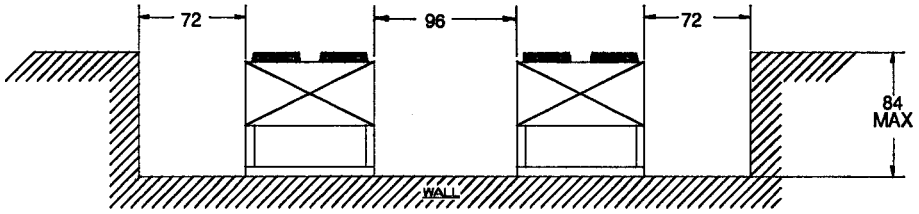


FIGURE #5
DOUBLE PIT
(SEE NOTE 2)

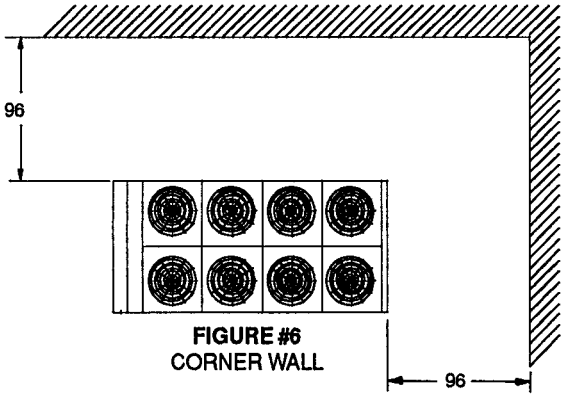


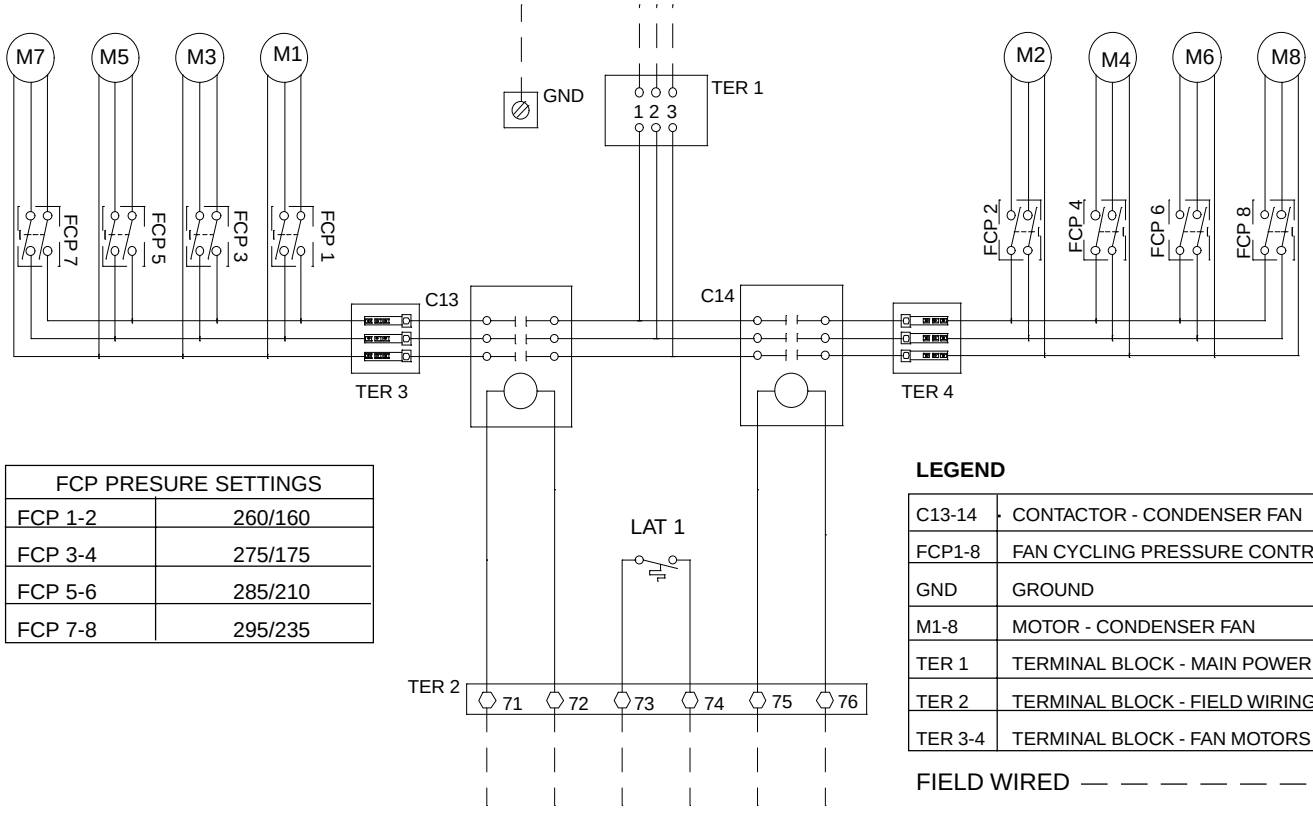
FIGURE #6
CORNER WALL

NOTE:

1) ALL DIMENSIONS ARE MINIMAL UNLESS OTHERWISE NOTED.
2) PIT INSTALLATIONS ARE NOT RECOMMENDED. RECIRCULATION OF HOT CONDENSER AIR IN COMBINATION WITH SURFACE AIR TURBULENCE CANNOT BE PREDICTED. HOT AIR RECIRCULATION WILL SEVERELY AFFECT UNIT EFFICIENCY (EER) AND CAN CAUSE HI PRESSURE TRIPS OR FAN MOTOR TEMPERATURE TRIPS. DUNHAM-BUSH WILL NOT BE RESPONSIBLE FOR DUCTING FANS TO A HIGHER LEVEL TO ALLEVIATE THE ABOVE-MENTIONED CONDITIONS.

TYPICAL POWER WIRING
SPD140 SD

USE COPPER CONDUCTORS ONLY
REFER TO UNIT SPEC PLATE FOR CORRECT VOLTAGE



FCP PRESURE SETTINGS	
FCP 1-2	260/160
FCP 3-4	275/175
FCP 5-6	285/210
FCP 7-8	295/235

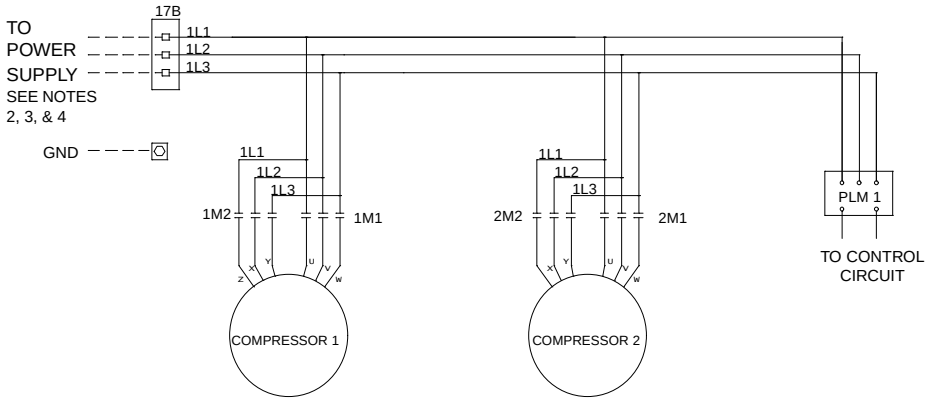
LEGEND

C13-14	CONTACTOR - CONDENSER FAN
FCP1-8	FAN CYCLING PRESSURE CONTROL
GND	GROUND
M1-8	MOTOR - CONDENSER FAN
TER 1	TERMINAL BLOCK - MAIN POWER
TER 2	TERMINAL BLOCK - FIELD WIRING
TER 3-4	TERMINAL BLOCK - FAN MOTORS

FIELD WIRED — — — — — — —

FIELD INTERLOCK WIRING TO INDOOR UNIT

HRSC150D POWER WIRING



COMPRESSOR MOTORS 1-2 SEE NOTE 5

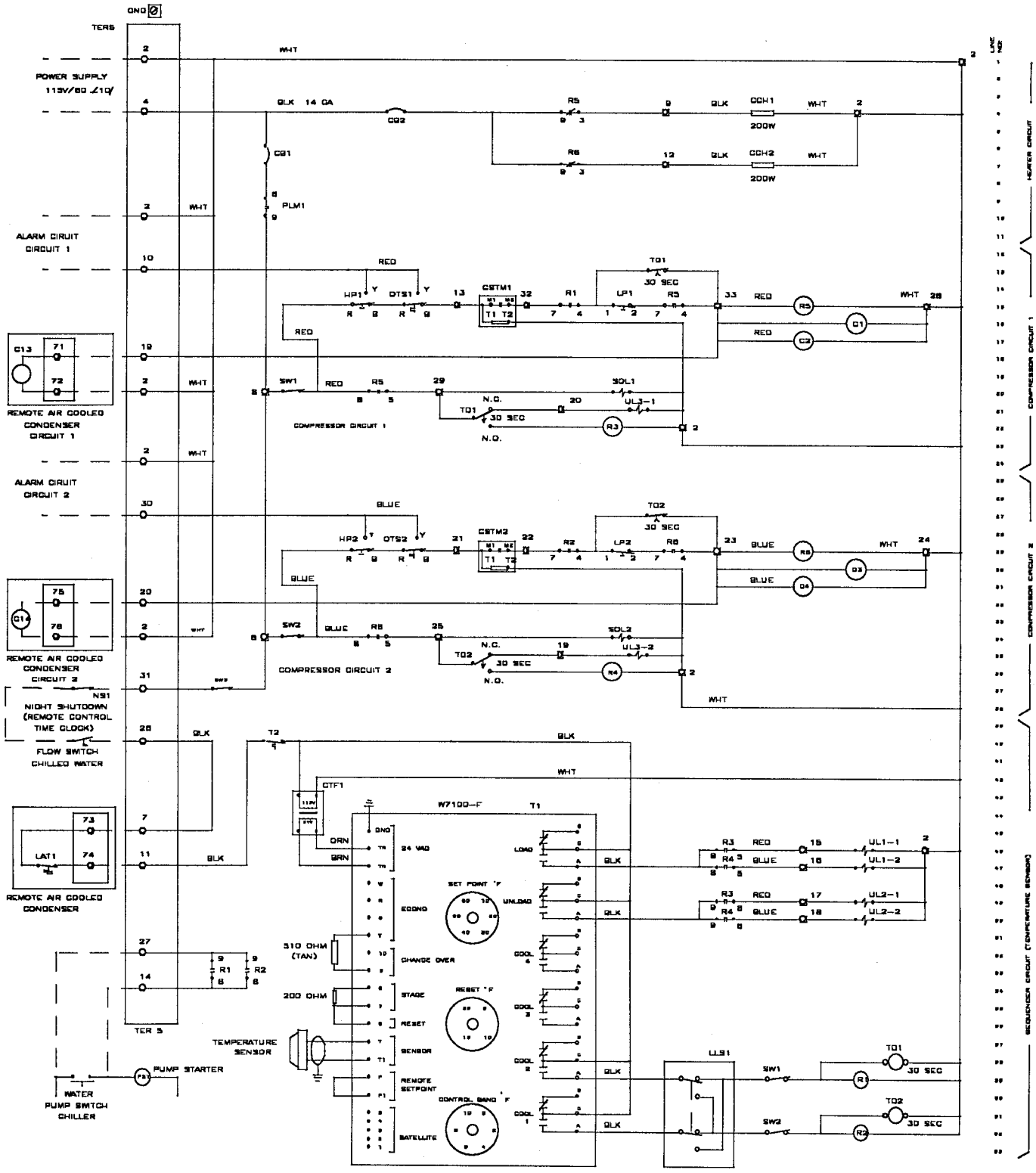
NOTE:

1. FUSES SHALL BE TIME DELAY TYPE.
2. ALL FIELD WIRING SHALL COMPLY WITH LOCAL, STATE AND NATIONAL CODES.
3. USE COPPER CONDUCTORS ONLY.
4. DISCONNECT MEANS AND BRANCH CIRCUIT PROTECTION SHALL BE PROVIDED BY INSTALLER.
5. IF POWER SUPPLY HAS BEEN INTERRUPTED FOR A PROLONGED PERIOD, OIL SUMP HEATERS MUST BE ENERGIZED FOR 24 HOURS MINIMUM BEFORE STARTING COMPRESSORS.

LEGEND

GND	GROUND
M	COMPRESSOR CONTACTOR
PLM	PHASE LOSS MONITOR
TB	TERMINAL BLOCK

TYPICAL HRSC 150D CONTROL WIRING



NOTES:

1. FOR CONTACTOR COILS C1-4 SEE POWER WIRING DIAGRAM FOR CONTACTS.
2. TRANSFORMER CTF1 IS NOT TO BE GROUNDED ON THE SECONDARY SIDE.
3. T1 AND T2 TEMPERATURE SENSORS ARE LOCATED IN THE WATER OUTLET.
4. REFER TO W7100 MANUAL FOR SETPOINT AND CONTROL BAND INSTRUCTIONS. RECOMMENDED INITIAL CONTROL BAND SETTING IS 3.
5. COMPRESSOR MODULES ARE NON-AUTOMATIC RESET, 45-6 WILL ALSO LOCK OUT ELECTRICALLY WHEN ANY SAFETY TRIPS. THESE CONTROLS CAN BE RESET BY TURNING SWITCH #1 OFF MOMENTARILY FOR COMPRESSOR #1, SWITCH #2 OFF MOMENTARILY FOR COMPRESSOR #2.
6. T1 TEMPERATURE SENSOR MUST HAVE SHIELDED CABLE IF LONGER THAN 50 FT. OR RUN WITH POWER LEADS.

———— FACTORY WIRING
— — — — FIELD WIRING

LEGEND

C1-2	CONTACTOR - COMPRESSOR	PLM1	PHASE LOSS MONITOR
C13-14	CONTACTORS - REMOTE FANS	R1-2	RELAY - STAGING
CB1	CIRCUIT BREAKER - CONT. CIRC	R3-R	RELAY-CAP. CONTROL & C.C. HTR
CB2	CIRCUIT BREAKER - HEATERS	R5-6	RELAY-INTERLOCK
CCH2	CRANKCASE HEATER	SOL1-2	SOLENOID-LIQUID LINE
CSTM2	COMPRESSOR SOLID STATE MODULE	SW1-2	SWITCH-COMPRESSOR CIRCUITS
CTF1	CONTROL TRANSFORMER	T1	SWITCH-MASTER
HP1-2	HI PRESSURE CONTROL	T1	THERMOSTAT-SEQUENCER
LLS1	LEAD LAG SWITCH	T2	THERMOSTAT-LOW TEMPERATURE
LLTL	LOAD LIMIT THERMOSTAT	TER5	TERMIANL BOARD - CUSTOMER o
LP1-2	LOW PRESSURE CONTROL		TERMINAL BOARD - FACTORY □
LPF1-2	LOW PRESSURE FREEZE CONTROL	TD1-2	TIME DELAY-CAP. CONT.& L.P. LOCKOUT
OTS1-2	OIL TEMPERATURE SAFETY	UL1-3	UNLOADER SOLENOID-COMPRESSOR

SPECIFICATION GUIDELINES

HRSC INDOOR CHILLER UNIT

General
Furnish and install as shown on plans, a D-B Remote Air-Cooled Packaged Chiller, consisting of an HRSC indoor unit and SPD remote air-cooled condenser.

The unit is to be complete with screw compressor(s), cooler, remote condenser, starting control and safety and operating controls. It is to be given a complete factory electrical test, and is to be shipped with a holding charge of dry nitrogen.

The unit shall be built in accordance with all applicable national and local codes including the ANSI B9.1 safety code; the National Electrical Code and applicable ASME code for Unfired Pressure Vessels.

The unit shall be furnished for operation on a ___Volt, 3 phase ___ Hertz power supply and to have an EER rating not to be less than ___.

Dimensions and Capacity
The unit shall be furnished as shown on capacity schedules and drawings.

Construction
The HRSC unit shall be constructed from painted, heavy gauge, galvanized steel with built-in skid and lifting holes. Components shall be arranged for easy access and all compressors and heat exchangers shall be easily removed and replaced.

Evaporator
Cooler shall be direct expansion, shell and tube type. The shell shall be fabricated from carbon steel pipe, with finned copper tubes. Models HRSC50-100 shall have welded heads and tubes brazed to the tubesheets. Models HRSC110-300 shall have removable heads and tubes roller-expanded into the tubesheets. The cooler shall be insulated with not less than 3/4" of closed cell foamed plastic. Cooler shall be designed, constructed and inspected to comply with current ASME code for unfired pressure vessels. Shell side (water) design working pressure is to be 200 PSIG and tube side (refrigerant) design working pressure is to be 250 PSIG.

The coolers are to be circuited so that each compressor is connected to an independent refrigerant circuit.

Compressor
The overall compressor design shall include a suction cooled motor, integral lubrication system utilizing compressor pressure differential, and semi-hermetic design.

The rotors are to be precision made from ductile cast iron.

Male rotors are to have 5 lobes and female rotors 6 lobes.

The casing is to be constructed from a high strength iron casting, having reinforced double wall construction, to provide a rigid structure and minimize transmission of noise.

Four roller bearings are to be used to support the rotors and be designed to absorb the radial loads. Four ball bearings are also required to absorb the axial thrust and to position the rotors.

An 80 mesh reinforced stainless steel strainer shall be provided at the suction of the compressor.

A two-pole hermetic squirrel cage motor is to be supplied. A dust-proof terminal box, located in an accessible location on the compressor, shall contain all connection terminals.

An oil separator which is an integral part of the compressor compartment is to be furnished. An impingement plate is to be directly connected to the discharge end of the compressor. An easily removable 150 mesh stainless steel oil strainer is to be installed in the compressor body.

An electric crankcase oil heater shall be provided to maintain the proper oil temperature when the system is not in operation.

Capacity Control
An infinitely variable capacity control system that is capable of exactly matching the demand requirement of the system is to be supplied. A microprocessor based controller shall modulate a compressor slide valve, in response to supply water temperature and maintain water temperature within 1/2°F of setpoint. This system is to provide precise and stable control of supply water temperature over the complete range of operating conditions. It shall be capable of a system capacity control range from 100% to ____% at specified conditions. (See page 3)

Refrigerant Circuit
Each compressor shall be provided with an independent refrigerant circuit for maximum standby protection. Parallel compressors are not acceptable due to oil control problems and cross contamination. The numbers of compressors and refrigerant circuits shall be as follows:

HRSC-D 50-75	1 Compressor
HRSC-D 100-150	2 Compressors
HRSC-D 180-225	3 Compressors
HRSC-D 240-300	4 Compressors

Each refrigerant circuit shall include expansion valve, sight glass, moisture indicator, solenoid valve, replaceable core filter drier, liquid line shut off valves, charging and gauge connections and discharge line check valve.

Control Center
The Control Center is to be a fully enclosed steel cabinet with hinged access doors. Dual compartments, separating safety and operating controls from the power controls, are to be provided. Controls shall include:

- High pressure cutout, manual reset
- Low pressure cutout, manual reset
- Compressor starting contactors and solid state, thermal sensing overloads, manual reset
- High refrigerant discharge temperature, manual reset
- Low water temperature freeze protection, manual reset
- Protection against low voltage, phase loss and phase reversal (auto-reset)
- Power terminal block for single or dual source power
- Microprocessor based controller and factory installed sensor including integral anti-cycle protection
- Complete labeling of all control components
- Numbered terminal strips for easier wire tracing

REMOTE SPE-SD AIR COOLED CONDENSER

The condenser shall be supplied with direct drive fans with 3 phase, 1140 RPM, fan motors and aluminum fan blades with a zinc plated steel hub. The unit shall have a vertical air discharge.

The casing shall be 12 gauge aluminum panels with galvanized steel legs and cross rails. The unit shall be supplied with copper tubes, mechanically expanded into die formed aluminum fins with self-spacing collars. Each refrigerant circuit shall be supplied with a separate sub-cooling coil with a liquid seal receiver installed between the condenser and sub-cooler circuit. The unit shall be supplied with pressure sensing fan cycling controls for head pressure control to 30°F. The condenser shall be supplied with a low ambient lock-out thermostat to prevent the HRSC unit from starting when the ambient is below set point.

Microcomputer Control (NC25-4) - Provide microcomputer to include the following:

Control

- Staging and loading
- Lead/lag and load balance
- Ramp up at start-up
- Alarm output and customer interlocks
- Fan control
- Compressor current limit

Protection

- Low and high pressure, freeze up
- Sensor failure
- High oil and motor temperature
- Anti-recycle timing

Readouts

- Analog Inputs: leaving water and ambient temperatures, evaporator and condenser pressure, amps
- Digital Inputs: compressor contactor, flow switch (optional), customer on/off

Setpoints

- Leaving water temperature, freeze up temperature, high and low pressure, amp limit, ramp up

UNIT OPTIONS

Alarm History

- Three most recent alarms; low pressure, high pressure, freeze protection, sensor failure, external shutdown

Remote Monitoring

- RS232 communication link for remote monitoring direct to PC or by optional telephone modem

Short Circuit Protection - Individual compressor (fusing) (circuit breakers) shall be provided.

Star-Delta Open Transition Start - Provide reduced inrush starting for each compressor as scheduled.

Hot Gas Bypass - provide a hot gas bypass valve and hot gas solenoid valve on last circuit off to permit operation of the system down to ___% (see page 3) of full load capacity.

Pressure Gauges - Provide factory mounted and piped suction and discharge pressure gauges for each refrigerant circuit. Each gauge is supplied with its own manual shut-off valve.

Low Ambient 0°F - Variable speed drive on the last fan cycled to control discharge pressure, used in conjunction with standard fan cycling control. The variable speed fan motor is 1 HP, single phase.

Control Circuit Transformer - Provide a factory mounted and wired control circuit transformer for the 115 volt control circuit.

Pressure Sensing Freezestat - A pressure sensing freeze-stat shall be provided, in addition to the temperature sensing freeze-stat, on each circuit complete with a two minute time delay to prevent nuisance trips.

Indicator Lights - provide externally visible indicator lights that signal control circuit operation, individual compressor operation and safety failure for each refrigerant circuit.

Water Flow Switch - provide a flow switch, for field installation, to shut down the unit on loss of chilled water flow.

Vibration Isolators - Provide (rubber-in-shear) (spring vibration) isolators, for field installation, under unit base members.

Acoustical Enclosure - Provide a sound attenuating cabinet for the compressor(s), constructed of 18 gauge galvanized steel and completely insulated with 1", 3 lb. density sound absorbing insulation.