

Application guidelines

Inverter scroll compressors **VZH088-117-170** single and manifold

R410A



VZH088-117-170 - single compressors 4
VZH088-117-170 - hybrid manifoldng..... 70

VZH scroll specificities6

Inverter compressors7
 Compressor size7
 Frequency converter variants7
 Compressor and frequency converter combinations7

Nomenclature and specifications.....8
 Compressor nomenclature8
 Frequency converter nomenclature.....8

Technical specifications9
 Compressor specifications9
 Frequency converter specifications.....9
 Oil injection control9
 Bearings lubrication9
 Capacity Tables 10

Dimensions 22
 VZH088-G/H manifolded version22
 VZH088-J single version.....23
 VZH088-J manifolded version.....23
 VZH117-G/H single version.....24
 VZH117-G/H manifolded version24
 VZH117-J single version.....25
 VZH117-J manifolded version.....25
 VZH170-G/H single version.....26
 VZH170-G/H manifolded version26
 VZH170-J single version.....27
 VZH170-J manifolded version.....27
 Sight glass / oil level switch28
 Schrader28
 Oil equalisation connection.....28
 Oil drain fitting28
 Suction & discharge connections28
 Frequency converter dimensions.....28
 CDS303 frequency converter - enclosure B129

Electrical data, connections and wiring..... 35
 Supply voltage.....35
 Compressor electrical specifications35
 Fuses / circuit breakers36
 Wire sizes37
 Wiring & EMC protection37
 EMC correct installation of an IP20 frequency drive CDS303.....38
 Wiring diagram.....38
 Wiring connections.....39
 Electrical connections.....40
 Soft-start control.....40
 Phase sequency and reverse rotation protection.....40
 IP rating.....40
 Motor protection40
 Voltage imbalance40

Approvals and certificates 41
 Approvals and certificates.....41
 Pressure equipment directive 97/23/EC41
 Internal free volume41

Operating conditions 42
 Application envelopes42
 Short cycle timer function.....42
 Discharge gas temperature protection function43
 Discharge gas thermostat43
 Oil return management function (single compressor)44
 Oil return management in hybrid manifolding44
 High and low pressure protection.....44

System design recommendations 46
 Essential piping design considerations46
 Oil management47
 Heat exchangers49
 Refrigerant charge limits49
 Off-cycle migration.....49
 Liquid floodback during operation.....50

Specific application recommendations 51
 Low ambient compressor operations51
 Brazed plate heat exchangers.....52
 Reversible heat pump systems.....52
 Defrost cycle logic.....53

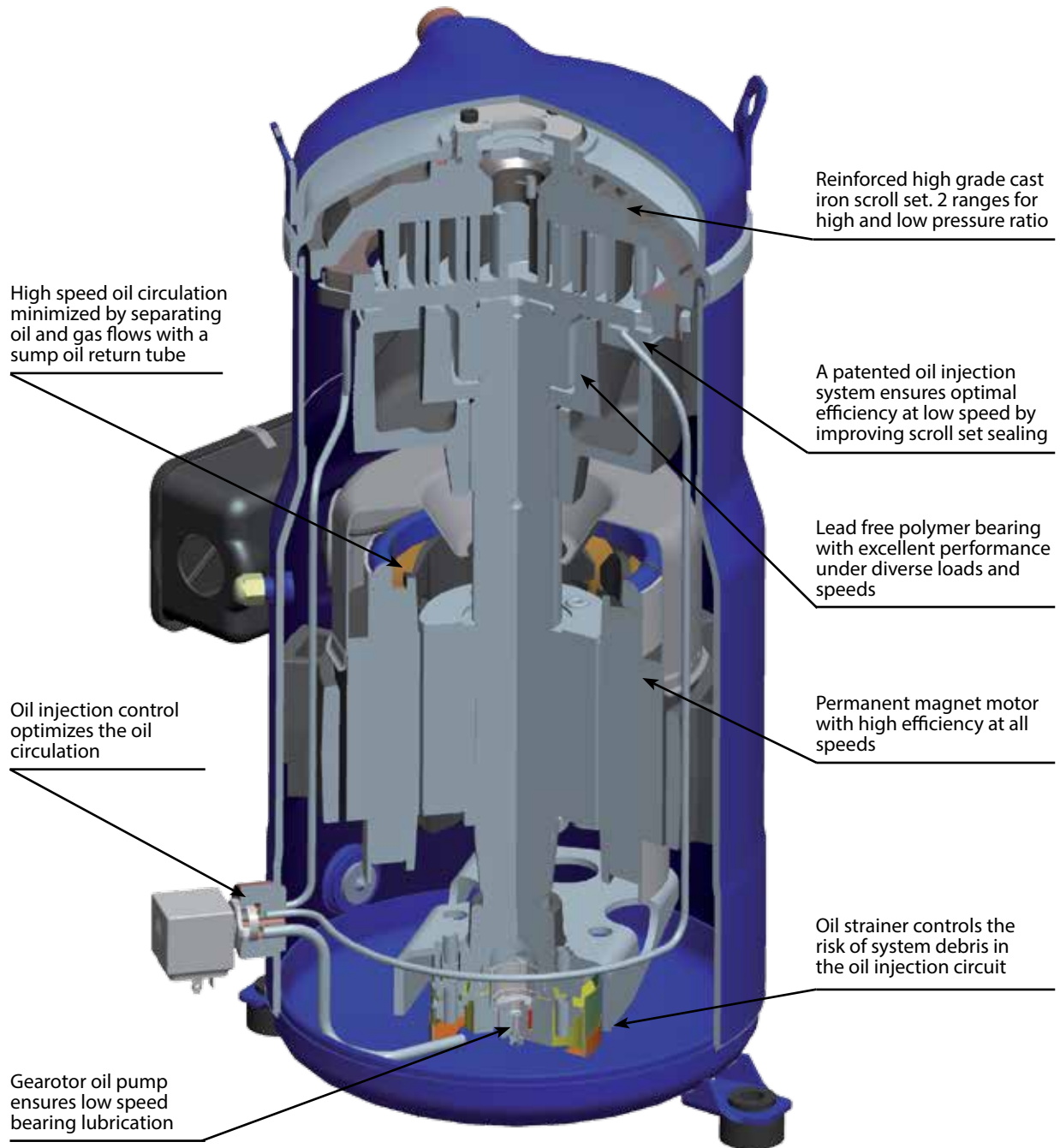
Sound and vibration management 55
 Running sound level55
 Sound generation in a refrigeration or air conditioning system.....55
 Compressor sound radiation.....55
 Mechanical vibrations.....55
 Speed by-pass.....55
 Gas pulsation55

Installation 56
 Compressor handling56
 Mounting.....56
 Removing connections shipping plugs56
 System cleanliness57
 Tubing.....57
 Filter driers57
 Brazing and soldering57
 Compressor connection.....57
 High voltage test58
 System pressure test59
 Leak detection59
 Vacuum pump down and moisture removal59
 Refrigerant charging59
 Loss of charge protection.....59
 Commissioning60
 Oil level checking and top-up.....60

Trouble shooting 61

Ordering information and packaging..... 64
 Kit ordering and shipping64
 Packaging.....64
 Ordering information.....64
 VZH voltage code G - 380-480 Volt65
 VZH voltage code H - 525-600 Volt65
 VZH voltage code J - 200-240 Volt.....66

Accessories 67
 Valves, adapters, connectors & gaskets for use on suction and discharge connections.....67
 Crankcase heaters & thermostats67
 Lubricant, acoustic hoods and spare parts67
 Spare parts frequency converter68



Compressor size

Inverter technology offers more flexibility in compressor selection than fixed speed compressors. Selection of the right inverter compressor size can be done by different methods:

1. Maximum cooling capacity: Select a compressor size which achieves the peak load system cooling capacity demand at its maximum speed.
2. Nominal cooling capacity: Select a compressor size which achieves the nominal system cooling capacity at a rotational speed of 3600 - 4500 rpm (60-75 rps).

3. Best Seasonal Efficiency Ratio: Select a compressor size which achieves the minimum system cooling demand at its minimum speed. Ensure that the compressor is able to cover the peak load system cooling capacity. This selection makes the compressor to run for a maximum of time at part load where the system efficiency is highest.

Performance tables at 3 speeds can be found in the following pages. Detailed performances can be found in datasheets and in selection programs.

Frequency converter variants

Different frequency converter variants are available according to:

1. Main supply voltage
2. IP class (CDS303 drives are available in IP20 or IP55 housings).

3. RFI class (Radio Frequency Interference) H2 or H3.

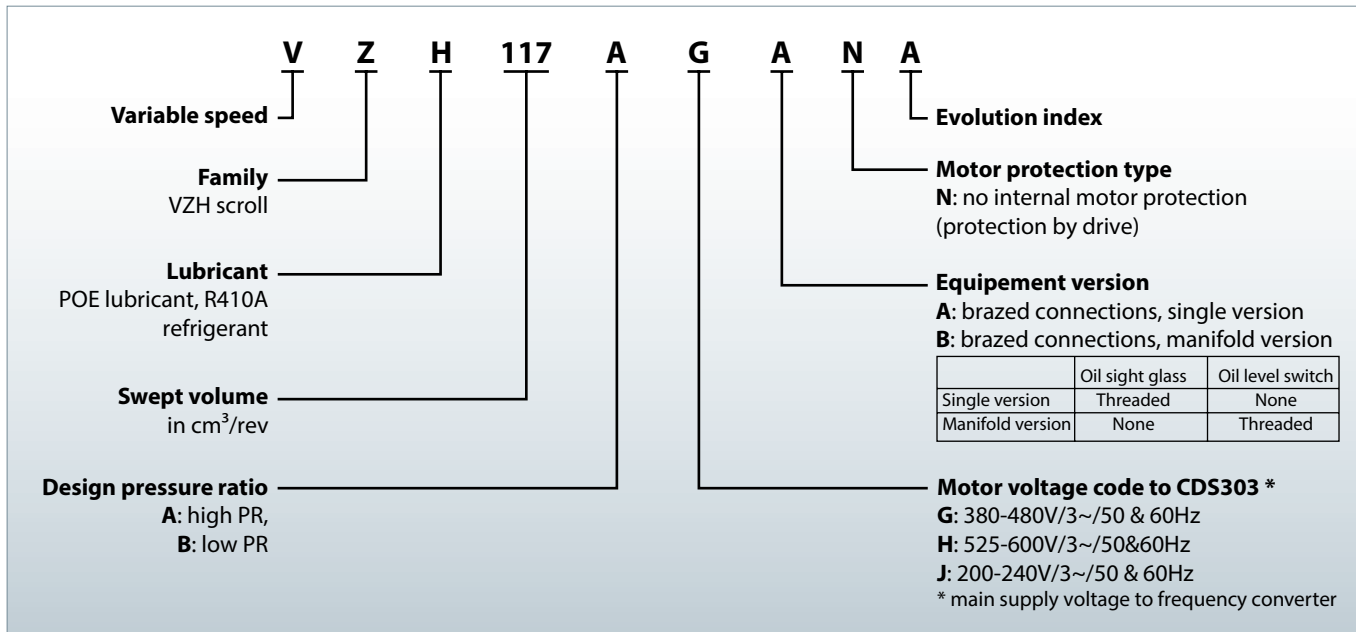
4. Printed Circuit Board (PCB) coated or not coated.

Compressor and frequency converter combinations

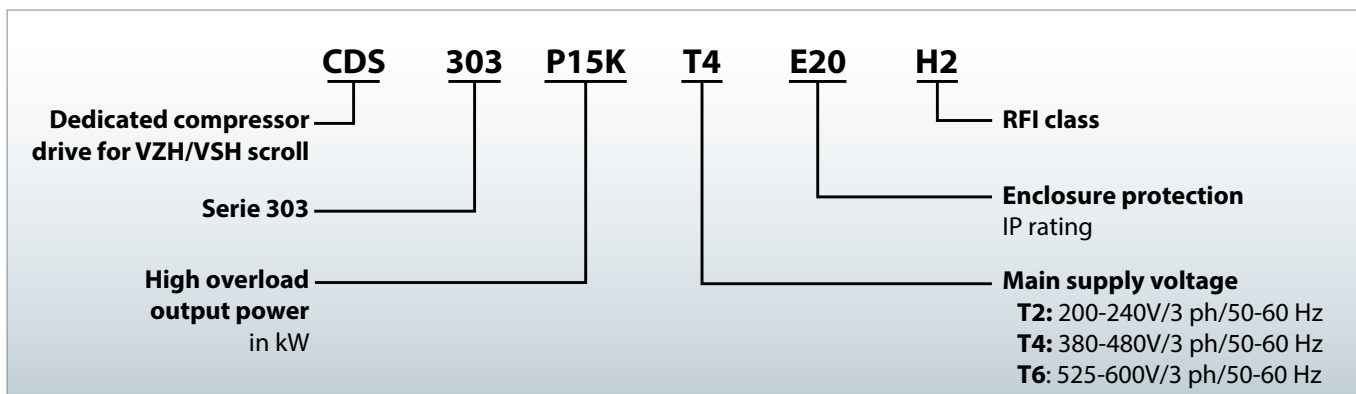
When the compressor size and mains voltage have been defined with above selection criteria, the code number tables from section "Ordering information and packaging" give the appropriate frequency converter sizes and up to 8 corresponding code numbers for each compressor model.

⚠ Note this compressor is equipped with a four poles electrical motor so the applied frequency from the inverter will be 50 Hz for 25 rps (1500 rpm) up to 200 Hz for 100 rps (6000 rpm).

Compressor nomenclature



Frequency converter nomenclature



Note:
 High overload output power: output power @160% Torque
 Normal overload: output power @110% torque, it is the power printed in the nameplate.
 For example:
 T/C: CDS303P15KT4E20H2-P15K high overload output power, take the reference of drive nomenclature 18.5kW(400V)-normal overload power, power printed in the nameplate.
 Please note in this guideline, only drive power use high overload power; all the other data, such as fuses/circuit breaker, etc. is reference to Normal overload power.

Compressor specifications

Compressor model	Swept volume (cm ³ /rev)	Displacement				Oil charge (dm ³)	Net weight (kg)
		25 rps (m ³ /h)	50 rps (m ³ /h)	60 rps (m ³ /h)	100 rps (m ³ /h)		
VZH088	88.4	7.7	15.4	18.6	30.8	3.3	55
VZH117	116.9	10.1	20.3	24.6	40.6	3.6	61
VZH170	170.2	14.8	29.6	35.7	54.2	6.7	112

Frequency converter specifications

Mains supply voltage	T2: 200 - 240 V +/-10% (3-phase)
	T4: 380 - 480 V +/-10% (3-phase)
	T6: 525 - 600 V +/-10% (3-phase)
Supply frequency	50 / 60 Hz
Output voltage	0 - 100 % of supply voltage
Inputs	6 digital (0 - 24 V), 2 analogue (0 /±10 V or 4 - 20 mA, scalable)
Programmable outputs	2 digital (0- 24 V), 1 analogue (0-24 V), 2 relay
Protection functions	Over-current protection, low / high current handling
Compressor functions	Discharge gas temperature protection, pressostat / thermostat function, short cycle protection, oil return management

Oil injection control

VZH compressors are equipped with an oil injection system that makes the compression pockets more tight thus improving the isotropic efficiency of the compressor as well as controls the oil circulation ratio, at all running speeds. The frequency converter via an oil injection valve controls this system. The oil injection valve is a normally closed valve. At low speed, the valve is closed and the oil is injected to the scroll set suction ports.

The compressors are delivered with no coils. 208V-240V or 24V coils are available as accessory (refer to "Accessories" section). The coil must be installed for oil injection control.

Control parameters are factory preset but accessible on the parameter list as read only values.

Bearings lubrication

Optimal bearings lubrication is ensured by a gearotor oil pump at all compressor speeds.

Capacity at EN12900 rating conditions - High pressure ratio - VZH088AJ - VZH117AJ - VZH170AJ

Models	rpm	Freq	Te	-25		-20		-15		-10		-5		0		5		10		15		
				Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VZH088AJ	1500	25	20	-	-	5300	1.5	6600	1.57	8000	1.65	9700	1.71	11700	1.7	13900	1.58	-	-	-	-	
			30	-	-	4800	2.08	5900	2.05	7300	2.07	8900	2.11	10800	2.14	12800	2.11	15200	1.98	17800	1.72	
			40	-	-	4200	2.97	5300	2.78	6600	2.71	8000	2.7	9700	2.72	11600	2.74	13700	2.7	16100	2.58	
			50	-	-	-	-	4500	3.85	5700	3.63	7000	3.53	8500	3.5	10200	3.52	12000	3.54	14100	3.52	
			60	-	-	-	-	-	-	-	-	5700	4.67	7000	4.55	8400	4.53	10000	4.55	11800	4.59	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600	60	20	11200	4.27	13700	4.34	16700	4.41	20200	4.5	24300	4.61	29100	4.74	34600	4.88	-	-	-	-	
			30	9700	5.14	12100	5.2	14900	5.28	18200	5.36	22000	5.45	26500	5.57	31500	5.7	37300	5.85	43800	6.03	
			40	-	-	10600	6.33	13200	6.39	16200	6.45	19700	6.53	23700	6.62	28300	6.73	33600	6.86	39500	7.01	
			50	-	-	-	-	11500	7.89	14100	7.93	17200	7.98	20700	8.05	24800	8.13	29500	8.22	34800	8.34	
			60	-	-	-	-	-	-	-	-	14300	9.94	17300	9.97	20800	10.01	24800	10.07	29400	10.14	
			68	-	-	-	-	-	-	-	-	-	-	-	-	17200	11.97	20600	11.99	24600	12.02	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	6000	100	20	-	-	22300	7.79	27200	8.1	33000	8.46	39700	8.87	47600	9.34	56600	9.89	-	-	-	-	
			30	-	-	20100	9.21	24700	9.45	30100	9.73	36500	10.05	43800	10.43	52100	10.87	61700	11.38	72500	11.98	
			40	-	-	17900	11.05	22200	11.22	27100	11.42	32900	11.64	39500	11.92	47100	12.24	55700	12.62	65500	13.08	
			50	-	-	-	-	19400	13.59	23700	13.7	28800	13.83	34600	13.99	41300	14.19	48900	14.44	57600	14.75	
			60	-	-	-	-	-	-	-	-	24000	16.8	28900	16.84	34500	16.91	41000	17.02	48400	17.17	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	VZH117AJ	1500	25	20	-	-	7200	1.97	8800	2.06	10800	2.17	13000	2.24	15700	2.23	18700	2.07	-	-	-	-
				30	-	-	6400	2.73	8000	2.69	9800	2.72	12000	2.78	14400	2.81	17200	2.77	20400	2.61	23900	2.26
				40	-	-	5600	3.9	7100	3.66	8800	3.56	10800	3.54	13000	3.57	15600	3.59	18400	3.55	21600	3.39
50				-	-	-	-	6000	5.06	7600	4.77	9400	4.63	11400	4.6	13600	4.62	16200	4.64	19000	4.62	
60				-	-	-	-	-	-	-	-	7600	6.13	9300	5.98	11300	5.95	13400	5.98	15900	6.02	
68				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
68				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3600		60	20	15000	5.6	18400	5.69	22400	5.8	27100	5.92	32600	6.06	39000	6.22	46400	6.42	-	-	-	-	
			30	13000	6.75	16200	6.83	20000	6.93	24400	7.04	29600	7.16	35500	7.31	42300	7.48	50100	7.69	58800	7.92	
			40	-	-	14300	8.31	17700	8.39	21800	8.48	26500	8.58	31800	8.7	38000	8.84	45100	9.01	53000	9.21	
			50	-	-	-	-	15400	10.36	18900	10.42	23100	10.49	27800	10.57	33300	10.67	39600	10.8	46700	10.95	
			60	-	-	-	-	-	-	-	-	19200	13.06	23200	13.1	27900	13.15	33300	13.23	39500	13.32	
			68	-	-	-	-	-	-	-	-	-	-	-	-	23000	15.72	27700	15.75	33000	15.79	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
6000		100	20	-	-	30000	10.23	36500	10.64	44200	11.11	53300	11.65	63900	12.27	76000	12.99	-	-	-	-	
			30	-	-	27000	12.09	33200	12.41	40400	12.78	48900	13.2	58700	13.7	70000	14.28	82800	14.95	97300	15.73	
			40	-	-	24100	14.51	29800	14.74	36400	14.99	44100	15.29	53000	15.65	63200	16.08	74800	16.58	88000	17.18	
			50	-	-	-	-	26000	17.85	31900	17.99	38600	18.16	46400	18.37	55400	18.64	65700	18.97	77300	19.37	
			60	-	-	-	-	-	-	-	-	32200	22.06	38700	22.11	46300	22.2	55000	22.35	65000	22.56	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
VZH170AJ		1500	25	20	-	-	11100	3.15	13500	3.13	16300	3.1	19600	3.04	23500	2.9	27900	2.65	-	-	-	-
				30	-	-	9800	4.09	12100	4.03	14800	4.02	17900	4.02	21500	4	25600	3.92	30300	3.75	35500	3.45
				40	-	-	8400	5.38	10500	5.2	13000	5.12	15800	5.1	19100	5.11	22800	5.12	27100	5.09	31900	4.98
	50			-	-	-	-	8800	6.85	11000	6.61	13500	6.49	16300	6.45	19600	6.46	23400	6.48	27700	6.48	
	60			-	-	-	-	-	-	-	-	10700	8.39	13100	8.22	15900	8.15	19100	8.13	22800	8.15	
	68			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	68			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	3600	60	20	22700	7.59	27200	7.76	32800	7.95	39400	8.12	47300	8.26	56500	8.34	67200	8.33	-	-	-	-	
			30	20000	9.55	24400	9.64	29700	9.78	35900	9.95	43300	10.12	51900	10.26	61800	10.36	73200	10.38	86200	10.3	
			40	-	-	21800	12.07	26600	12.12	32300	12.22	39000	12.37	46800	12.52	55800	12.66	66100	12.76	77900	12.81	
			50	-	-	-	-	23300	15.09	28300	15.07	34100	15.13	40900	15.24	48800	15.37	57900	15.5	68400	15.61	
			60	-	-	-	-	-	-	-	-	28300	18.56	34000	18.56	40600	18.63	48300	18.73	57300	18.84	
			68	-	-	-	-	-	-	-	-	-	-	-	-	33000	21.72	39500	21.75	47100	21.83	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	6000	100	20	-	-	44800	13.52	54400	14.12	65900	14.78	79500	15.55	95200	16.48	113300	17.61	-	-	-	-	
			30	-	-	39600	16.57	48700	17.14	59400	17.7	71900	18.29	86300	18.95	103000	19.74	121900	20.71	143400	21.89	
			40	-	-	35300	20.18	43700	20.81	53500	21.35	64800	21.83	77900	22.3	92800	22.83	109900	23.44	129300	24.2	
			50	-	-	-	-	38600	25.3	47300	25.88	57300	26.33	68800	26.7	82000	27.03	97100	27.38	114200	27.79	
			60	-	-	-	-	-	-	-	-	48500	31.97	58300	32.3	69600	32.52	82500	32.67	97200	32.81	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 10 K
Subcooling = 0 K
Pe: Power input in kW

Presented data are for models with motor voltage code J

Capacity at ARI rating conditions - High pressure ratio - VZH088AJ - VZH117AJ - VZH170AJ

Models	rpm	Freq	Te	-25		-20		-15		-10		-5		0		5		10		15		
				Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VZH088AJ	1500	25	20	-	-	5700	1.5	7000	1.57	8500	1.65	10300	1.71	12400	1.7	14800	1.58	-	-	-	-	
			30	-	-	5100	2.08	6400	2.05	7900	2.07	9600	2.11	11600	2.14	13800	2.11	16300	1.98	19100	1.72	
			40	-	-	4500	2.97	5800	2.78	7200	2.71	8800	2.7	10600	2.72	12600	2.74	14900	2.7	17500	2.58	
			50	-	-	-	-	5000	3.85	6300	3.63	7800	3.53	9400	3.5	11300	3.52	13300	3.54	15700	3.52	
			60	-	-	-	-	-	-	-	-	6600	4.67	8000	4.55	9700	4.53	11500	4.55	13500	4.59	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600	60	20	12000	4.27	14600	4.34	17800	4.41	21500	4.5	25900	4.61	31000	4.74	36800	4.88	-	-	-	-	
			30	10500	5.14	13000	5.2	16100	5.28	19600	5.36	23700	5.45	28400	5.57	33900	5.7	40000	5.85	47000	6.03	
			40	-	-	11600	6.33	14400	6.39	17700	6.45	21500	6.53	25800	6.62	30800	6.73	36500	6.86	42900	7.01	
			50	-	-	-	-	12800	7.89	15700	7.93	19100	7.98	23000	8.05	27500	8.13	32600	8.22	38500	8.34	
			60	-	-	-	-	-	-	-	-	16500	9.94	20000	9.97	23900	10.01	28500	10.07	33700	10.14	
			68	-	-	-	-	-	-	-	-	-	-	-	-	21200	11.97	25400	11.99	30200	12.02	
	6000	100	20	-	-	23800	7.79	29000	8.1	35100	8.46	42300	8.87	50700	9.34	60300	9.89	-	-	-	-	
			30	-	-	21700	9.21	26600	9.45	32400	9.73	39200	10.05	47000	10.43	56000	10.87	66200	11.38	77700	11.98	
			40	-	-	19600	11.05	24200	11.22	29600	11.42	35800	11.64	43000	11.92	51200	12.24	60600	12.62	71100	13.08	
			50	-	-	-	-	21600	13.59	26400	13.7	32000	13.83	38400	13.99	45800	14.19	54200	14.44	63700	14.75	
			60	-	-	-	-	-	-	-	-	27700	16.8	33200	16.84	39700	16.91	47000	17.02	55500	17.17	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	VZH117AJ	1500	25	20	-	-	7700	1.97	9400	2.06	11500	2.17	13900	2.24	16700	2.23	19800	2.07	-	-	-	-
				30	-	-	6900	2.73	8600	2.69	10600	2.72	12900	2.78	15500	2.81	18500	2.77	21800	2.61	25600	2.26
				40	-	-	6100	3.9	7700	3.66	9600	3.56	11800	3.54	14200	3.57	16900	3.59	20000	3.55	23500	3.39
				50	-	-	-	-	6700	5.06	8500	4.77	10400	4.63	12600	4.6	15100	4.62	17900	4.64	21000	4.62
				60	-	-	-	-	-	-	-	-	8800	6.13	10800	5.98	13000	5.95	15400	5.98	18200	6.02
				68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
3600		60	20	16000	5.6	19600	5.69	23900	5.8	28900	5.92	34800	6.06	41600	6.22	49400	6.42	-	-	-	-	
			30	14100	6.75	17500	6.83	21600	6.93	26300	7.04	31800	7.16	38200	7.31	45400	7.48	53700	7.69	63100	7.92	
			40	-	-	15600	8.31	19400	8.39	23800	8.48	28800	8.58	34700	8.7	41400	8.84	49000	9.01	57600	9.21	
			50	-	-	-	-	17200	10.36	21100	10.42	25700	10.49	30900	10.57	36900	10.67	43800	10.8	51600	10.95	
			60	-	-	-	-	-	-	-	-	22200	13.06	26800	13.1	32100	13.15	38200	13.23	45200	13.32	
			68	-	-	-	-	-	-	-	-	-	-	-	-	28400	15.72	34100	15.75	40500	15.79	
6000		100	20	-	-	32000	10.23	38900	10.64	47200	11.11	56800	11.65	68000	12.27	80900	12.99	-	-	-	-	
			30	-	-	29100	12.09	35700	12.41	43500	12.78	52600	13.2	63100	13.7	75200	14.28	88800	14.95	104300	15.73	
			40	-	-	26300	14.51	32500	14.74	39700	14.99	48100	15.29	57700	15.65	68800	16.08	81300	16.58	95500	17.18	
			50	-	-	-	-	29000	17.85	35500	17.99	43000	18.16	51600	18.37	61500	18.64	72700	18.97	85500	19.37	
			60	-	-	-	-	-	-	-	-	37100	22.06	44600	22.11	53200	22.2	63100	22.35	74400	22.56	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
VZH170AJ		1500	25	20	-	-	11800	3.15	14400	3.13	17400	3.1	20900	3.04	25000	2.9	29600	2.65	-	-	-	-
				30	-	-	10600	4.09	13000	4.03	15900	4.02	19200	4.02	23100	4	27500	3.92	32500	3.75	38100	3.45
				40	-	-	9200	5.38	11500	5.2	14200	5.12	17300	5.1	20800	5.11	24800	5.12	29400	5.09	34700	4.98
				50	-	-	-	-	9800	6.85	12200	6.61	15000	6.49	18100	6.45	21800	6.46	25900	6.48	30600	6.48
				60	-	-	-	-	-	-	-	-	12400	8.39	15100	8.22	18300	8.15	21900	8.13	26100	8.15
				68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600	60	20	24300	7.59	29100	7.76	35000	7.95	42000	8.12	50400	8.26	60200	8.34	71500	8.33	-	-	-	-	
			30	21600	9.55	26300	9.64	32000	9.78	38700	9.95	46600	10.12	55800	10.26	66400	10.36	78500	10.38	92400	10.3	
			40	-	-	23800	12.07	29100	12.12	35200	12.22	42500	12.37	50900	12.52	60700	12.66	71800	12.76	84600	12.81	
			50	-	-	-	-	26000	15.09	31500	15.07	37900	15.13	45400	15.24	54100	15.37	64200	15.5	75600	15.61	
			60	-	-	-	-	-	-	-	-	32700	18.56	39100	18.56	46700	18.63	55500	18.73	65600	18.84	
			68	-	-	-	-	-	-	-	-	-	-	-	-	40700	21.72	48600	21.75	57800	21.83	
	6000	100	20	-	-	47800	13.52	58100	14.12	70300	14.78	84700	15.55	101400	16.48	120600	17.61	-	-	-	-	
			30	-	-	42700	16.57	52500	17.14	63900	17.7	77300	18.29	92800	18.95	110600	19.74	130800	20.71	153800	21.89	
			40	-	-	38600	20.18	47800	20.81	58400	21.35	70600	21.83	84800	22.3	101000	22.83	119500	23.44	140400	24.2	
			50	-	-	-	-	43100	25.3	52700	25.88	63800	26.33	76500	26.7	91000	27.03	107500	27.38	126300	27.79	
			60	-	-	-	-	-	-	-	-	56000	31.97	67200	32.3	80000	32.52	94700	32.67	111300	32.81	
			68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 11.1 K
Subcooling = 8.3 K
Pe: Power input in kW

Presented data are for models with motor voltage code J

Capacity at EN12900 rating conditions - High pressure ratio - VZH088AG - VZH117AG - VZH170AG

Models	rpm	To	-25		-20		-15		-10		-5		0		5		10		15	
		Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VZH088AG	1500 rpm	20	-	-	5400	1.47	6600	1.54	8100	1.62	9800	1.68	11800	1.67	14000	1.55	-	-	-	-
		30	-	-	4800	2.04	6000	2.01	7400	2.03	9000	2.08	10800	2.1	12900	2.07	15300	1.95	17900	1.69
		40	-	-	4200	2.92	5300	2.74	6600	2.66	8100	2.65	9800	2.67	11700	2.69	13800	2.65	16200	2.54
		50	-	-	-	-	4500	3.79	5700	3.57	7000	3.47	8500	3.44	10200	3.46	12100	3.47	14300	3.45
		60	-	-	-	-	-	-	-	-	5700	4.59	7000	4.47	8500	4.45	10100	4.47	11900	4.5
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3600 rpm	20	11300	4.19	13800	4.26	16800	4.34	20300	4.42	24500	4.53	29300	4.65	34800	4.8	-	-	-	-
		30	9800	5.04	12200	5.11	15000	5.18	18300	5.26	22200	5.36	26700	5.47	31800	5.6	37600	5.75	44200	5.93
		40	-	-	10700	6.21	13300	6.27	16300	6.34	19900	6.42	23900	6.51	28500	6.61	33800	6.74	39800	6.89
		50	-	-	-	-	11500	7.75	14200	7.79	17300	7.84	20900	7.91	25000	7.98	29700	8.08	35000	8.19
		60	-	-	-	-	-	-	-	-	14400	9.77	17500	9.8	21000	9.84	25000	9.89	29600	9.96
		68	-	-	-	-	-	-	-	-	-	-	-	-	17300	11.76	20800	11.78	24800	11.81
	6000 rpm	20	-	-	22500	7.65	27400	7.96	33200	8.31	40000	8.71	48000	9.18	57100	9.72	-	-	-	-
		30	-	-	20200	9.04	24900	9.28	30400	9.56	36700	9.88	44100	10.25	52500	10.68	62100	11.18	73000	11.77
		40	-	-	18100	10.85	22300	11.02	27300	11.21	33100	11.44	39800	11.71	47400	12.02	56200	12.4	66000	12.85
		50	-	-	-	-	19500	13.35	23900	13.46	29000	13.59	34900	13.74	41600	13.94	49300	14.18	58000	14.49
		60	-	-	-	-	-	-	-	-	24200	16.5	29100	16.54	34800	16.61	41300	16.72	48800	16.87
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
VZH117AG	1500 rpm	20	-	-	7200	1.93	8900	2.03	10800	2.13	13100	2.2	15800	2.19	18800	2.04	-	-	-	-
		30	-	-	6400	2.68	8000	2.64	9900	2.67	12100	2.73	14500	2.76	17300	2.72	20500	2.56	24100	2.22
		40	-	-	5600	3.83	7100	3.59	8900	3.49	10900	3.48	13100	3.51	15700	3.53	18600	3.49	21800	3.33
		50	-	-	-	-	6100	4.97	7700	4.69	9400	4.55	11500	4.52	13700	4.54	16300	4.56	19100	4.54
		60	-	-	-	-	-	-	-	-	7700	6.02	9400	5.88	11400	5.84	13500	5.87	16000	5.92
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600 rpm	20	15100	5.5	18500	5.59	22500	5.69	27300	5.81	32900	5.95	39300	6.11	46700	6.3	-	-	-	-
		30	13100	6.63	16400	6.71	20200	6.81	24600	6.91	29800	7.04	35800	7.18	42600	7.35	50400	7.55	59300	7.78
		40	-	-	14400	8.16	17900	8.24	21900	8.33	26700	8.43	32100	8.55	38300	8.69	45400	8.85	53400	9.05
		50	-	-	-	-	15500	10.17	19100	10.23	23200	10.3	28000	10.38	33600	10.48	39900	10.61	47000	10.76
		60	-	-	-	-	-	-	-	-	19300	12.83	23400	12.87	28100	12.92	33600	12.99	39800	13.09
		68	-	-	-	-	-	-	-	-	-	-	-	-	23200	15.44	27900	15.47	33300	15.51
	6000 rpm	20	-	-	30200	10.05	36800	10.45	44600	10.91	53700	11.44	64400	12.05	76600	12.76	-	-	-	-
		30	-	-	27200	11.88	33400	12.19	40700	12.55	49300	12.97	59200	13.46	70500	14.02	83400	14.68	98000	15.45
		40	-	-	24200	14.25	30000	14.47	36700	14.73	44500	15.02	53400	15.37	63700	15.79	75400	16.29	88600	16.88
		50	-	-	-	-	26200	17.54	32100	17.68	38900	17.84	46800	18.05	55800	18.31	66100	18.63	77900	19.03
		60	-	-	-	-	-	-	-	-	32400	21.67	39000	21.72	46700	21.81	55400	21.95	65500	22.16
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
VZH170AG	1500 rpm	20	-	-	11200	3.1	13600	3.07	16400	3.05	19800	2.98	23600	2.84	28100	2.6	-	-	-	-
		30	-	-	9900	4.02	12200	3.96	14900	3.95	18000	3.95	21600	3.93	25800	3.85	30500	3.68	35800	3.39
		40	-	-	8500	5.29	10600	5.11	13100	5.03	16000	5.01	19200	5.02	23000	5.03	27300	5	32200	4.89
		50	-	-	-	-	8900	6.72	11000	6.5	13600	6.38	16400	6.34	19800	6.35	23600	6.37	27900	6.36
		60	-	-	-	-	-	-	-	-	10800	8.24	13200	8.07	16000	8	19200	7.99	22900	8.01
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600 rpm	20	22900	7.46	27500	7.63	33000	7.81	39700	7.98	47700	8.12	57000	8.19	67700	8.18	-	-	-	-
		30	20200	9.38	24600	9.47	29900	9.61	36200	9.78	43600	9.94	52300	10.08	62300	10.17	73800	10.2	86800	10.12
		40	-	-	21900	11.86	26800	11.9	32500	12.01	39300	12.15	47100	12.3	56200	12.44	66600	12.54	78500	12.58
		50	-	-	-	-	23400	14.82	28500	14.81	34300	14.87	41200	14.97	49200	15.1	58400	15.23	68900	15.33
		60	-	-	-	-	-	-	-	-	28500	18.23	34200	18.23	40900	18.3	48700	18.4	57700	18.51
		68	-	-	-	-	-	-	-	-	-	-	-	-	33200	21.33	39800	21.37	47400	21.45
	6000 rpm	20	-	-	45100	13.28	54800	13.87	66400	14.52	80100	15.27	95900	16.18	114200	17.3	-	-	-	-
		30	-	-	39900	16.27	49000	16.84	59800	17.39	72400	17.97	87000	18.62	103700	19.39	122800	20.34	144500	21.51
		40	-	-	35600	19.83	44100	20.45	53900	20.97	65300	21.44	78500	21.91	93500	22.42	110800	23.03	130300	23.78
		50	-	-	-	-	38900	24.85	47700	25.42	57800	25.86	69400	26.22	82700	26.55	97800	26.89	115000	27.29
		60	-	-	-	-	-	-	-	-	48900	31.4	58800	31.73	70100	31.94	83100	32.09	97900	32.23
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 10 K
Subcooling = 0 K
Pe: Power input in kW

Presented data are for models with motor voltage code G

Capacity at ARI rating conditions - High pressure ratio - VZH088AG - VZH117AG - VZH170AG

Models	rpm	To	-25		-20		-15		-10		-5		0		5		10		15	
		Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VZH088AG	1500 rpm	20	-	-	5700	1.47	7100	1.54	8600	1.62	10400	1.68	12500	1.67	14900	1.55	-	-	-	-
		30	-	-	5200	2.04	6500	2.01	7900	2.03	9700	2.08	11600	2.1	13900	2.07	16400	1.95	19200	1.69
		40	-	-	4600	2.92	5800	2.74	7200	2.66	8800	2.65	10700	2.67	12700	2.69	15000	2.65	17600	2.54
		50	-	-	-	-	5100	3.79	6400	3.57	7800	3.47	9500	3.44	11300	3.46	13400	3.47	15800	3.45
		60	-	-	-	-	-	-	-	-	6600	4.59	8100	4.47	9700	4.45	11600	4.47	13600	4.5
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3600 rpm	20	12000	4.19	14700	4.26	17900	4.34	21700	4.42	26100	4.53	31200	4.65	37100	4.8	-	-	-	-
		30	10600	5.04	13100	5.11	16200	5.18	19700	5.26	23900	5.36	28600	5.47	34100	5.6	40300	5.75	47300	5.93
		40	-	-	11700	6.21	14600	6.27	17800	6.34	21600	6.42	26000	6.51	31000	6.61	36800	6.74	43200	6.89
		50	-	-	-	-	12900	7.75	15800	7.79	19300	7.84	23200	7.91	27700	7.98	32900	8.08	38800	8.19
		60	-	-	-	-	-	-	-	-	16600	9.77	20100	9.8	24100	9.84	28700	9.89	34000	9.96
		68	-	-	-	-	-	-	-	-	-	-	-	-	21300	11.76	25600	11.78	30400	11.81
	6000 rpm	20	-	-	24000	7.65	29200	7.96	35400	8.31	42700	8.71	51100	9.18	60700	9.72	-	-	-	-
		30	-	-	21800	9.04	26800	9.28	32700	9.56	39500	9.88	47400	10.25	56400	10.68	66700	11.18	78300	11.77
		40	-	-	19800	10.85	24400	11.02	29800	11.21	36100	11.44	43300	11.71	51600	12.02	61000	12.4	71700	12.85
		50	-	-	-	-	21800	13.35	26600	13.46	32200	13.59	38700	13.74	46100	13.94	54600	14.18	64200	14.49
		60	-	-	-	-	-	-	-	-	27900	16.5	33500	16.54	40000	16.61	47400	16.72	55900	16.87
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
VZH117AG	1500 rpm	20	-	-	7700	1.93	9500	2.03	11600	2.13	14000	2.2	16800	2.19	20000	2.04	-	-	-	-
		30	-	-	6900	2.68	8700	2.64	10700	2.67	13000	2.73	15600	2.76	18600	2.72	22000	2.56	25800	2.22
		40	-	-	6100	3.83	7800	3.59	9700	3.49	11900	3.48	14300	3.51	17100	3.53	20200	3.49	23700	3.33
		50	-	-	-	-	6800	4.97	8500	4.69	10500	4.55	12700	4.52	15200	4.54	18000	4.56	21200	4.54
		60	-	-	-	-	-	-	-	-	8900	6.02	10800	5.88	13100	5.84	15500	5.87	18300	5.92
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600 rpm	20	16200	5.5	19800	5.59	24000	5.69	29100	5.81	35000	5.95	41900	6.11	49700	6.3	-	-	-	-
		30	14200	6.63	17600	6.71	21700	6.81	26500	6.91	32000	7.04	38500	7.18	45800	7.35	54100	7.55	63600	7.78
		40	-	-	15700	8.16	19500	8.24	23900	8.33	29100	8.43	34900	8.55	41700	8.69	49300	8.85	58000	9.05
		50	-	-	-	-	17300	10.17	21300	10.23	25800	10.3	31100	10.38	37200	10.48	44100	10.61	52000	10.76
		60	-	-	-	-	-	-	-	-	22300	12.83	27000	12.87	32400	12.92	38500	12.99	45600	13.09
		68	-	-	-	-	-	-	-	-	-	-	-	-	28700	15.44	34300	15.47	40800	15.51
	6000 rpm	20	-	-	32300	10.05	39200	10.45	47500	10.91	57300	11.44	68500	12.05	81500	12.76	-	-	-	-
		30	-	-	29300	11.88	36000	12.19	43900	12.55	53000	12.97	63600	13.46	75700	14.02	89500	14.68	105100	15.45
		40	-	-	26500	14.25	32800	14.47	40000	14.73	48500	15.02	58200	15.37	69300	15.79	81900	16.29	96200	16.88
		50	-	-	-	-	29200	17.54	35800	17.68	43300	17.84	52000	18.05	61900	18.31	73300	18.63	86200	19.03
		60	-	-	-	-	-	-	-	-	37400	21.67	45000	21.72	53600	21.81	63600	21.95	75000	22.16
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
VZH170AG	1500 rpm	20	-	-	11900	3.1	14500	3.07	17500	3.05	21100	2.98	25200	2.84	29900	2.6	-	-	-	-
		30	-	-	10700	4.02	13100	3.96	16000	3.95	19400	3.95	23300	3.93	27700	3.85	32700	3.68	38400	3.39
		40	-	-	9300	5.29	11600	5.11	14300	5.03	17400	5.01	21000	5.02	25000	5.03	29700	5	34900	4.89
		50	-	-	-	-	9900	6.72	12300	6.5	15100	6.38	18300	6.34	21900	6.35	26100	6.37	30800	6.36
		60	-	-	-	-	-	-	-	-	12500	8.24	15200	8.07	18400	8	22100	7.99	26300	8.01
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600 rpm	20	24500	7.46	29300	7.63	35200	7.81	42400	7.98	50800	8.12	60700	8.19	72100	8.18	-	-	-	-
		30	21800	9.38	26500	9.47	32200	9.61	39000	9.78	46900	9.94	56200	10.08	66900	10.17	79100	10.2	93100	10.12
		40	-	-	24000	11.86	29300	11.9	35500	12.01	42800	12.15	51300	12.3	61100	12.44	72400	12.54	85200	12.58
		50	-	-	-	-	26200	14.82	31700	14.81	38200	14.87	45800	14.97	54500	15.1	64600	15.23	76200	15.33
		60	-	-	-	-	-	-	-	-	32900	18.23	39400	18.23	47000	18.3	55900	18.4	66100	18.51
		68	-	-	-	-	-	-	-	-	-	-	-	-	41000	21.33	49000	21.37	58200	21.45
	6000 rpm	20	-	-	48200	13.28	58500	13.87	70800	14.52	85300	15.27	102100	16.18	121500	17.3	-	-	-	-
		30	-	-	43000	16.27	52900	16.84	64400	17.39	77900	17.97	93500	18.62	111400	19.39	131800	20.34	154900	21.51
		40	-	-	38900	19.83	48100	20.45	58800	20.97	71200	21.44	85400	21.91	101800	22.42	120400	23.03	141400	23.78
		50	-	-	-	-	43400	24.85	53100	25.42	64200	25.86	77000	26.22	91700	26.55	108400	26.89	127300	27.29
		60	-	-	-	-	-	-	-	-	56400	31.4	67700	31.73	80600	31.94	95400	32.09	112200	32.23
		68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 11.1 K
Subcooling = 8.3 K
Pe: Power input in kW

Presented data are for models with motor voltage code G

Capacity at EN12900 rating conditions - High pressure ratio - VZH088AH - VZH117AH - VZH170AH

Models	rpm	To	-25	-20	-15	-10	-5	0	5	10	15	
		Tc	Qo	Qo	Qo	Qo	Qo	Qo	Qo	Qo	Qo	
VZH088AH*	1500 rpm	20	-	5400	6600	8100	9800	11800	14000	-	-	
		30	-	4800	6000	7400	9000	10800	12900	15300	17900	
		40	-	4200	5300	6600	8100	9800	11700	13800	16200	
		50	-	-	4500	5700	7000	8500	10200	12100	14300	
		60	-	-	-	-	5700	7000	8500	10100	11900	
		68	-	-	-	-	-	-	-	-	-	
	3600 rpm	20	11300	13800	16800	20300	24500	29300	34800	-	-	
		30	9800	12200	15000	18300	22200	26700	31800	37600	44200	
		40	-	10700	13300	16300	19900	23900	28500	33800	39800	
		50	-	-	11500	14200	17300	20900	25000	29700	35000	
		60	-	-	-	-	14400	17500	21000	25000	29600	
		68	-	-	-	-	-	-	17300	20800	24800	
	6000 rpm	20	-	22500	27400	33200	40000	48000	57100	-	-	
		30	-	20200	24900	30400	36700	44100	52500	62100	73000	
		40	-	18100	22300	27300	33100	39800	47400	56200	66000	
		50	-	-	19500	23900	29000	34900	41600	49300	58000	
		60	-	-	-	-	24200	29100	34800	41300	48800	
		68	-	-	-	-	-	-	-	-	-	
	VZH117AH*	1500 rpm	20	-	7200	8900	10800	13100	15800	18800	-	-
			30	-	6400	8000	9900	12100	14500	17300	20500	24100
			40	-	5600	7100	8900	10900	13100	15700	18600	21800
			50	-	-	6100	7700	9400	11500	13700	16300	19100
			60	-	-	-	-	7700	9400	11400	13500	16000
			68	-	-	-	-	-	-	-	-	-
3600 rpm		20	15100	18500	22500	27300	32900	39300	46700	-	-	
		30	13100	16400	20200	24600	29800	35800	42600	50400	59300	
		40	-	14400	17900	21900	26700	32100	38300	45400	53400	
		50	-	-	15500	19100	23200	28000	33600	39900	47000	
		60	-	-	-	-	19300	23400	28100	33600	39800	
		68	-	-	-	-	-	-	23200	27900	33300	
6000 rpm		20	-	30200	36800	44600	53700	64400	76600	-	-	
		30	-	27200	33400	40700	49300	59200	70500	83400	98000	
		40	-	24200	30000	36700	44500	53400	63700	75400	88600	
		50	-	-	26200	32100	38900	46800	55800	66100	77900	
		60	-	-	-	-	32400	39000	46700	55400	65500	
		68	-	-	-	-	-	-	-	-	-	
VZH170AH*		1500 rpm	20	-	11200	13600	16400	19800	23600	28100	-	-
			30	-	9900	12200	14900	18000	21600	25800	30500	35800
			40	-	8500	10600	13100	16000	19200	23000	27300	32200
			50	-	-	8900	11000	13600	16400	19800	23600	27900
			60	-	-	-	-	10800	13200	16000	19200	22900
			68	-	-	-	-	-	-	-	-	-
	3600 rpm	20	22900	27500	33000	39700	47700	57000	67700	-	-	
		30	20200	24600	29900	36200	43600	52300	62300	73800	86800	
		40	-	21900	26800	32500	39300	47100	56200	66600	78500	
		50	-	-	23400	28500	34300	41200	49200	58400	68900	
		60	-	-	-	-	28500	34200	40900	48700	57700	
		68	-	-	-	-	-	-	33200	39800	47400	
	6000 rpm	20	-	45100	54800	66400	80100	95900	114200	-	-	
		30	-	39900	49000	59800	72400	87000	103700	122800	144500	
		40	-	35600	44100	53900	65300	78500	93500	110800	130300	
		50	-	-	38900	47700	57800	69400	82700	97800	115000	
		60	-	-	-	-	48900	58800	70100	83100	97900	
		68	-	-	-	-	-	-	-	-	-	

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 10 K
Subcooling = 0 K

Presented data are for models with motor voltage code H

Capacity at ARI rating conditions - High pressure ratio - VZH088AH - VZH117AH - VZH170AH

Models	rpm	To	-25	-20	-15	-10	-5	0	5	10	15
		Tc	Qo	Qo	Qo	Qo	Qo	Qo	Qo	Qo	Qo
VZH088AH*	1500 rpm	20	-	5700	7100	8600	10400	12500	14900	-	-
		30	-	5200	6500	7900	9700	11600	13900	16400	19200
		40	-	4600	5800	7200	8800	10700	12700	15000	17600
		50	-	-	5100	6400	7800	9500	11300	13400	15800
		60	-	-	-	-	6600	8100	9700	11600	13600
		68	-	-	-	-	-	-	-	-	-
	3600 rpm	20	12000	14700	17900	21700	26100	31200	37100	-	-
		30	10600	13100	16200	19700	23900	28600	34100	40300	47300
		40	-	11700	14600	17800	21600	26000	31000	36800	43200
		50	-	-	12900	15800	19300	23200	27700	32900	38800
		60	-	-	-	-	16600	20100	24100	28700	34000
		68	-	-	-	-	-	-	21300	25600	30400
	6000 rpm	20	-	24000	29200	35400	42700	51100	60700	-	-
		30	-	21800	26800	32700	39500	47400	56400	66700	78300
		40	-	19800	24400	29800	36100	43300	51600	61000	71700
		50	-	-	21800	26600	32200	38700	46100	54600	64200
		60	-	-	-	-	27900	33500	40000	47400	55900
		68	-	-	-	-	-	-	-	-	-
VZH117AH*	1500 rpm	20	-	7700	9500	11600	14000	16800	20000	-	-
		30	-	6900	8700	10700	13000	15600	18600	22000	25800
		40	-	6100	7800	9700	11900	14300	17100	20200	23700
		50	-	-	6800	8500	10500	12700	15200	18000	21200
		60	-	-	-	-	8900	10800	13100	15500	18300
		68	-	-	-	-	-	-	-	-	-
	3600 rpm	20	16200	19800	24000	29100	35000	41900	49700	-	-
		30	14200	17600	21700	26500	32000	38500	45800	54100	63600
		40	-	15700	19500	23900	29100	34900	41700	49300	58000
		50	-	-	17300	21300	25800	31100	37200	44100	52000
		60	-	-	-	-	22300	27000	32400	38500	45600
		68	-	-	-	-	-	-	28700	34300	40800
	6000 rpm	20	-	32300	39200	47500	57300	68500	81500	-	-
		30	-	29300	36000	43900	53000	63600	75700	89500	105100
		40	-	26500	32800	40000	48500	58200	69300	81900	96200
		50	-	-	29200	35800	43300	52000	61900	73300	86200
		60	-	-	-	-	37400	45000	53600	63600	75000
		68	-	-	-	-	-	-	-	-	-
VZH170AH*	1500 rpm	20	-	11900	14500	17500	21100	25200	29900	-	-
		30	-	10700	13100	16000	19400	23300	27700	32700	38400
		40	-	9300	11600	14300	17400	21000	25000	29700	34900
		50	-	-	9900	12300	15100	18300	21900	26100	30800
		60	-	-	-	-	12500	15200	18400	22100	26300
		68	-	-	-	-	-	-	-	-	-
	3600 rpm	20	24500	29300	35200	42400	50800	60700	72100	-	-
		30	21800	26500	32200	39000	46900	56200	66900	79100	93100
		40	-	24000	29300	35500	42800	51300	61100	72400	85200
		50	-	-	26200	31700	38200	45800	54500	64600	76200
		60	-	-	-	-	32900	39400	47000	55900	66100
		68	-	-	-	-	-	-	41000	49000	58200
	6000 rpm	20	-	48200	58500	70800	85300	102100	121500	-	-
		30	-	43000	52900	64400	77900	93500	111400	131800	154900
		40	-	38900	48100	58800	71200	85400	101800	120400	141400
		50	-	-	43400	53100	64200	77000	91700	108400	127300
		60	-	-	-	-	56400	67700	80600	95400	112200
		68	-	-	-	-	-	-	-	-	-

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 11.1 K
Subcooling = 8.3 K

Presented data are for models with motor voltage code H

Capacity at EN12900 rating conditions - Low pressure ratio - VZH088BJ - VZH117BJ - VZH170BJ

Models	rpm	Freq	Te	-25		-20		-15		-10		-5		0		5		10		15		
				Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VZH088BJ	1500	25	20	-	-	6000	1.83	7300	1.73	8800	1.64	10500	1.57	12400	1.52	14600	1.48	-	-	-	-	
			30	-	-	5100	2.38	6300	2.3	7700	2.22	9300	2.14	11100	2.06	13100	2	15500	1.95	18100	1.92	
			40	-	-	4200	2.98	5300	2.94	6600	2.88	8100	2.82	9700	2.75	11600	2.68	13800	2.6	16200	2.54	
			50	-	-	-	-	-	-	5500	3.72	6800	3.69	8300	3.64	10000	3.58	12000	3.51	14200	3.43	
			60	-	-	-	-	-	-	-	-	-	-	6800	4.81	8300	4.79	10100	4.74	12100	4.67	
			63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
			60	60	20	11000	4.53	13500	4.5	16600	4.42	20200	4.31	24400	4.21	29300	4.14	34900	4.15	-	-	-
	30	9700	5.58		12100	5.64	14900	5.6	18300	5.5	22200	5.38	26700	5.25	31800	5.16	37600	5.12	44200	5.18		
	40	-	-		10600	6.92	13300	6.98	16400	6.94	19900	6.84	24000	6.7	28600	6.55	33900	6.44	39800	6.38		
	50	-	-		-	-	-	-	14200	8.66	17400	8.62	21000	8.52	25100	8.37	29800	8.22	35000	8.09		
	60	-	-		-	-	-	-	-	-	-	-	17400	10.75	21000	10.65	25000	10.51	29600	10.35		
	63	-	-		-	-	-	-	-	-	-	-	-	-	19600	11.43	23500	11.3	27800	11.14		
	6000	100	20	-	-	22200	7.74	26900	7.73	32500	7.69	39100	7.68	46800	7.76	55600	8	-	-	-	-	
			30	-	-	20200	9.84	24800	9.92	30200	9.87	36400	9.77	43700	9.69	52000	9.69	61400	9.84	72100	10.21	
			40	-	-	18000	11.99	22200	12.23	27200	12.28	32900	12.2	39600	12.05	47200	11.9	55800	11.83	65600	11.9	
			50	-	-	-	-	-	-	23500	14.84	28600	14.87	34400	14.75	41100	14.56	48800	14.36	57500	14.22	
			60	-	-	-	-	-	-	-	-	-	-	28100	17.71	33800	17.57	40200	17.34	47700	17.08	
			63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
			VZH117BJ	1500	25	20	-	-	8100	2.4	9800	2.27	11800	2.16	14100	2.06	16700	1.99	19600	1.95	-	-
	30	-				-	6900	3.12	8500	3.02	10300	2.91	12400	2.81	14900	2.71	17600	2.62	20800	2.56	24300	2.52
	40	-				-	5700	3.91	7200	3.86	8900	3.79	10800	3.7	13100	3.61	15600	3.51	18500	3.42	21800	3.33
50	-	-				-	-	-	-	7400	4.88	9100	4.85	11100	4.79	13500	4.71	16100	4.61	19100	4.51	
60	-	-				-	-	-	-	-	-	-	-	9100	6.32	11200	6.29	13500	6.22	16200	6.13	
63	-	-				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
60	60	20				14800	5.95	18200	5.91	22300	5.8	27100	5.66	32800	5.53	39300	5.44	46800	5.45	-	-	-
30		13000		7.33	16200	7.4	20000	7.35	24600	7.23	29800	7.06	35800	6.9	42700	6.77	50500	6.73	59300	6.81		
40		-		-	14300	9.09	17800	9.17	22000	9.12	26700	8.98	32200	8.8	38400	8.61	45500	8.45	53400	8.37		
50		-		-	-	-	-	-	19100	11.37	23300	11.32	28200	11.19	33700	11	40000	10.8	47000	10.62		
60		-		-	-	-	-	-	-	-	-	-	23400	14.11	28200	13.99	33600	13.8	39800	13.59		
63		-		-	-	-	-	-	-	-	-	-	-	-	26300	15.01	31500	14.84	37400	14.63		
6000	100	20		-	-	29800	10.16	36100	10.16	43600	10.1	52500	10.08	62800	10.19	74600	10.5	-	-	-	-	
		30		-	-	27100	12.93	33300	13.02	40500	12.96	48900	12.83	58600	12.72	69800	12.73	82500	12.92	96800	13.41	
		40		-	-	24200	15.75	29900	16.07	36500	16.13	44200	16.02	53100	15.82	63300	15.63	74900	15.54	88100	15.62	
		50		-	-	-	-	-	-	31600	19.49	38300	19.53	46200	19.37	55200	19.12	65500	18.86	77200	18.67	
		60		-	-	-	-	-	-	-	-	-	-	37800	23.26	45300	23.07	54000	22.77	64000	22.44	
		63		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		VZH170BJ		1500	25	20	-	-	11500	3.23	13900	3.1	16700	2.96	19900	2.81	23700	2.64	27900	2.45	-	-
30	-					-	10000	4.37	12200	4.23	14900	4.1	17900	3.97	21400	3.82	25500	3.66	30000	3.48	35200	3.26
40	-					-	8400	5.65	10500	5.49	13000	5.36	15800	5.24	19000	5.13	22700	5	27000	4.87	31800	4.71
50	-		-			-	-	-	-	10900	6.91	13400	6.8	16400	6.71	19700	6.62	23600	6.53	28000	6.43	
60	-		-			-	-	-	-	-	-	-	-	13400	8.72	16300	8.67	19700	8.63	23700	8.59	
63	-		-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
60	60		20			21300	8.5	26200	8.34	32200	8.17	39300	7.98	47600	7.75	57200	7.45	68400	7.09	-	-	-
30			18800	10.58	23500	10.45	29100	10.32	35700	10.18	43300	10.02	52300	9.82	62600	9.56	74300	9.22	87700	8.8		
40			-	-	20800	12.96	25800	12.85	31800	12.75	38700	12.64	46800	12.5	56100	12.32	66800	12.09	79000	11.77		
50			-	-	-	-	-	-	27500	15.93	33600	15.85	40700	15.76	48900	15.64	58400	15.48	69200	15.26		
60			-	-	-	-	-	-	-	-	-	-	33800	19.85	40800	19.76	49000	19.65	58400	19.5		
63			-	-	-	-	-	-	-	-	-	-	-	-	38200	21.2	45900	21.1	54900	20.96		
6000	100		20	-	-	43700	14.95	53600	15.07	65200	15.01	78800	14.74	94500	14.2	112600	13.33	-	-	-	-	
			30	-	-	39400	18.02	48700	18.27	59600	18.43	72400	18.44	87200	18.25	104100	17.8	123500	17.06	145500	15.95	
			40	-	-	34800	21.87	43400	22.14	53400	22.38	65100	22.55	78600	22.59	94200	22.44	112000	22.07	132300	21.41	
			50	-	-	-	-	-	-	46300	27.32	56700	27.52	68800	27.67	82700	27.71	98700	27.58	117000	27.24	
			60	-	-	-	-	-	-	-	-	-	-	57400	33.96	69400	34.05	83300	34.05	99400	33.91	
			63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 10 K
Subcooling = 0 K
Pe: Power input in kW

Presented data are for models with motor voltage code J

Capacity at ARI rating conditions - Low pressure ratio - VZH088BJ - VZH117BJ - VZH170BJ

Models	rpm	Freq	To	-25		-20		-15		-10		-5		0		5		10		15	
			Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VZH088BJ	1500 rpm	25	20	-	-	6400	1.83	7800	1.73	9400	1.64	11200	1.57	13200	1.52	15600	1.48	-	-	-	-
			30	-	-	5500	2.38	6800	2.3	8300	2.22	10000	2.14	11900	2.06	14100	2	16600	1.95	19400	1.92
			40	-	-	4600	2.98	5800	2.94	7200	2.88	8800	2.82	10600	2.75	12600	2.68	15000	2.6	17600	2.54
			50	-	-	-	-	-	-	6100	3.72	7600	3.69	9200	3.64	11100	3.58	13300	3.51	15700	3.43
			60	-	-	-	-	-	-	-	-	-	-	7800	4.81	9600	4.79	11600	4.74	13800	4.67
			63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3600 rpm	60	20	11800	4.53	14500	4.5	17700	4.42	21500	4.31	26000	4.21	31200	4.14	37100	4.15	-	-	-	-
			30	10400	5.58	13000	5.64	16100	5.6	19700	5.5	23900	5.38	28700	5.25	34200	5.16	40400	5.12	47400	5.18
			40	-	-	11600	6.92	14500	6.98	17900	6.94	21700	6.84	26100	6.7	31100	6.55	36800	6.44	43200	6.38
			50	-	-	-	-	-	-	15800	8.66	19300	8.62	23300	8.52	27800	8.37	33000	8.22	38800	8.09
			60	-	-	-	-	-	-	-	-	-	20100	10.75	24100	10.65	28700	10.51	33900	10.35	
			63	-	-	-	-	-	-	-	-	-	-	-	23000	11.43	27400	11.3	32500	11.14	
	6000 rpm	100	20	-	-	23700	7.74	28700	7.73	34600	7.69	41700	7.68	49800	7.76	59100	8	-	-	-	-
			30	-	-	21800	9.84	26700	9.92	32500	9.87	39200	9.77	46900	9.69	55800	9.69	65900	9.84	77300	10.21
			40	-	-	19700	11.99	24300	12.23	29700	12.28	35900	12.2	43100	12.05	51300	11.9	60700	11.83	71200	11.9
			50	-	-	-	-	-	-	26200	14.84	31800	14.87	38200	14.75	45600	14.56	54000	14.36	63600	14.22
			60	-	-	-	-	-	-	-	-	-	-	32400	17.71	38800	17.57	46200	17.34	54700	17.08
			63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
VZH117BJ	1500 rpm	25	20	-	-	8600	2.4	10500	2.27	12600	2.16	15000	2.06	17700	1.99	20900	1.95	-	-	-	-
			30	-	-	7400	3.12	9100	3.02	11100	2.91	13400	2.81	16000	2.71	18900	2.62	22300	2.56	26100	2.52
			40	-	-	6200	3.91	7800	3.86	9700	3.79	11800	3.7	14200	3.61	17000	3.51	20100	3.42	23600	3.33
			50	-	-	-	-	-	-	8200	4.88	10200	4.85	12400	4.79	14900	4.71	17800	4.61	21100	4.51
			60	-	-	-	-	-	-	-	-	-	-	10500	6.32	12800	6.29	15500	6.22	18600	6.13
			63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600 rpm	60	20	15800	5.95	19400	5.91	23800	5.8	28900	5.66	34900	5.53	41900	5.44	49800	5.45	-	-	-	-
			30	14000	7.33	17500	7.4	21600	7.35	26400	7.23	32000	7.06	38500	6.9	45900	6.77	54200	6.73	63600	6.81
			40	-	-	15600	9.09	19500	9.17	24000	9.12	29100	8.98	35100	8.8	41800	8.61	49400	8.45	58000	8.37
			50	-	-	-	-	-	-	21200	11.37	25900	11.32	31300	11.19	37400	11	44300	10.8	52000	10.62
			60	-	-	-	-	-	-	-	-	-	27000	14.11	32400	13.99	38600	13.8	45600	13.59	
			63	-	-	-	-	-	-	-	-	-	-	30900	15.01	36800	14.84	43600	14.63		
	6000 rpm	100	20	-	-	31800	10.16	38500	10.16	46500	10.1	55900	10.08	66800	10.19	79400	10.5	-	-	-	-
			30	-	-	29300	12.93	35900	13.02	43600	12.96	52600	12.83	63000	12.72	74900	12.73	88500	12.92	103800	13.41
			40	-	-	26400	15.75	32600	16.07	39800	16.13	48200	16.02	57800	15.82	68900	15.63	81400	15.54	95600	15.62
			50	-	-	-	-	-	-	35200	19.49	42600	19.53	51300	19.37	61200	19.12	72500	18.86	85400	18.67
			60	-	-	-	-	-	-	-	-	-	43500	23.26	52100	23.07	62000	22.77	73400	22.44	
			63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
VZH170BJ	1500 rpm	25	20	-	-	12300	3.23	14800	3.1	17800	2.96	21200	2.81	25200	2.64	29700	2.45	-	-	-	-
			30	-	-	10800	4.37	13200	4.23	16000	4.1	19300	3.97	23000	3.82	27300	3.66	32200	3.48	37800	3.26
			40	-	-	9200	5.65	11500	5.49	14100	5.36	17200	5.24	20700	5.13	24700	5	29300	4.87	34500	4.71
			50	-	-	-	-	-	-	12100	6.91	14900	6.8	18200	6.71	21900	6.62	26100	6.53	30900	6.43
			60	-	-	-	-	-	-	-	-	-	15400	8.72	18800	8.67	22700	8.63	27100	8.59	
			63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600 rpm	60	20	22700	8.5	28000	8.34	34400	8.17	41900	7.98	50700	7.75	61000	7.45	72800	7.09	-	-	-	-
			30	20300	10.58	25400	10.45	31400	10.32	38400	10.18	46600	10.02	56200	9.82	67200	9.56	79800	9.22	94100	8.8
			40	-	-	22700	12.96	28200	12.85	34700	12.75	42200	12.64	50900	12.5	61000	12.32	72600	12.09	85700	11.77
			50	-	-	-	-	-	-	30600	15.93	37400	15.85	45200	15.76	54200	15.64	64700	15.48	76600	15.26
			60	-	-	-	-	-	-	-	-	-	39000	19.85	46900	19.76	56200	19.65	66900	19.5	
			63	-	-	-	-	-	-	-	-	-	-	44800	21.2	53700	21.1	64000	20.96		
	6000 rpm	100	20	-	-	46700	14.95	57200	15.07	69500	15.01	83900	14.74	100600	14.2	119900	13.33	-	-	-	-
			30	-	-	42500	18.02	52500	18.27	64200	18.43	77900	18.44	93700	18.25	111800	17.8	132500	17.06	156000	15.95
			40	-	-	38000	21.87	47400	22.14	58300	22.38	71000	22.55	85600	22.59	102500	22.44	121700	22.07	143600	21.41
			50	-	-	-	-	-	-	51600	27.32	63100	27.52	76400	27.67	91700	27.71	109300	27.58	129400	27.24
			60	-	-	-	-	-	-	-	-	-	66100	33.96	79800	34.05	95600	34.05	113900	33.91	
			63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 11.1 K
Subcooling = 8.3 K
Pe: Power input in kW

Presented data are for models with motor voltage code J

Capacity at EN12900 rating conditions - Low pressure ratio - VZH088BG - VZH117BG - VZH170BG

Models	rpm	To		-25		-20		-15		-10		-5		0		5		10		15		
		Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe		
VZH088BG	1500 rpm	20	-	-	6100	1.8	7400	1.7	8800	1.61	10600	1.54	12500	1.49	14700	1.46	-	-	-	-	-	-
		30	-	-	5200	2.34	6400	2.26	7800	2.18	9300	2.1	11200	2.03	13200	1.96	15600	1.91	18300	1.88	-	-
		40	-	-	4300	2.93	5400	2.89	6700	2.83	8100	2.77	9800	2.7	11700	2.63	13900	2.56	16300	2.49	-	-
		50	-	-	-	-	-	-	5500	3.65	6900	3.62	8400	3.58	10100	3.52	12100	3.45	14300	3.37	-	-
		60	-	-	-	-	-	-	-	-	-	-	6800	4.73	8400	4.7	10100	4.65	12200	4.59	-	-
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3600 rpm	20	11100	4.45	13600	4.42	16700	4.34	20400	4.23	24600	4.13	29500	4.07	35100	4.07	-	-	-	-	-	-
		30	9700	5.48	12200	5.54	15000	5.5	18400	5.41	22400	5.28	26900	5.16	32000	5.06	37900	5.03	44500	5.09	-	-
		40	-	-	10700	6.8	13400	6.86	16500	6.82	20100	6.72	24200	6.58	28800	6.44	34100	6.32	40100	6.26	-	-
		50	-	-	-	-	-	-	14300	8.5	17500	8.47	21100	8.37	25300	8.23	30000	8.07	35300	7.94	-	-
		60	-	-	-	-	-	-	-	-	-	-	17600	10.56	21200	10.46	25200	10.32	29800	10.17	-	-
		63	-	-	-	-	-	-	-	-	-	-	-	-	19800	11.22	23700	11.1	28100	10.94	-	-
	6000 rpm	20	-	-	22300	7.6	27100	7.6	32700	7.55	39400	7.54	47100	7.62	56000	7.86	-	-	-	-	-	-
		30	-	-	20400	9.67	25000	9.74	30400	9.69	36700	9.6	44000	9.52	52400	9.52	61900	9.67	72700	10.03	-	-
		40	-	-	18100	11.78	22400	12.02	27400	12.06	33200	11.98	39900	11.84	47500	11.69	56200	11.62	66100	11.69	-	-
		50	-	-	-	-	-	-	23700	14.58	28800	14.61	34700	14.49	41400	14.3	49100	14.1	57900	13.96	-	-
		60	-	-	-	-	-	-	-	-	-	-	28300	17.4	34000	17.26	40600	17.03	48100	16.78	-	-
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VZH117BG	1500 rpm	20	-	-	8200	2.36	9900	2.23	11900	2.12	14200	2.02	16800	1.95	19800	1.91	-	-	-	-	-	-
		30	-	-	6900	3.07	8500	2.96	10400	2.86	12500	2.76	15000	2.66	17800	2.58	20900	2.51	24500	2.47	-	-
		40	-	-	5700	3.84	7200	3.79	8900	3.72	10900	3.64	13200	3.55	15700	3.45	18600	3.36	21900	3.27	-	-
		50	-	-	-	-	-	-	7400	4.8	9200	4.76	11200	4.7	13600	4.62	16200	4.53	19200	4.43	-	-
		60	-	-	-	-	-	-	-	-	-	-	9200	6.21	11200	6.18	13600	6.11	16300	6.02	-	-
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3600 rpm	20	14900	5.84	18300	5.8	22400	5.7	27300	5.56	33000	5.43	39600	5.35	47200	5.35	-	-	-	-	-	-
		30	13100	7.2	16300	7.27	20200	7.22	24700	7.1	30000	6.94	36100	6.77	43000	6.65	50900	6.61	59700	6.69	-	-
		40	-	-	14400	8.93	18000	9	22100	8.95	26900	8.82	32400	8.64	38700	8.46	45800	8.3	53800	8.22	-	-
		50	-	-	-	-	-	-	19200	11.17	23500	11.12	28400	10.99	34000	10.8	40300	10.61	47400	10.43	-	-
		60	-	-	-	-	-	-	-	-	-	-	23600	13.86	28400	13.74	33900	13.56	40100	13.35	-	-
		63	-	-	-	-	-	-	-	-	-	-	-	-	26500	14.74	31800	14.57	37700	14.37	-	-
	6000 rpm	20	-	-	30000	9.98	36400	9.98	43900	9.92	52900	9.9	63200	10.01	75200	10.32	-	-	-	-	-	-
		30	-	-	27400	12.7	33500	12.79	40800	12.73	49300	12.61	59100	12.5	70300	12.5	83100	12.7	97500	13.17	-	-
		40	-	-	24400	15.47	30100	15.78	36800	15.84	44500	15.74	53500	15.54	63800	15.36	75500	15.26	88700	15.35	-	-
		50	-	-	-	-	-	-	31800	19.15	38600	19.18	46500	19.03	55600	18.78	66000	18.52	77700	18.34	-	-
		60	-	-	-	-	-	-	-	-	-	-	38000	22.85	45600	22.66	54400	22.37	64500	22.04	-	-
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VZH170BG	1500 rpm	20	-	-	11600	3.17	14000	3.04	16800	2.91	20100	2.76	23800	2.6	28200	2.41	-	-	-	-	-	-
		30	-	-	10000	4.3	12300	4.16	15000	4.03	18100	3.9	21600	3.76	25700	3.6	30300	3.42	35500	3.2	-	-
		40	-	-	8500	5.55	10600	5.4	13100	5.27	15900	5.15	19200	5.04	22900	4.92	27200	4.78	32000	4.63	-	-
		50	-	-	-	-	-	-	11000	6.78	13500	6.68	16500	6.59	19900	6.5	23800	6.42	28200	6.32	-	-
		60	-	-	-	-	-	-	-	-	-	-	13500	8.57	16500	8.52	19900	8.48	23800	8.43	-	-
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3600 rpm	20	21400	8.35	26400	8.2	32400	8.03	39600	7.84	47900	7.61	57700	7.32	68900	6.96	-	-	-	-	-	-
		30	19000	10.39	23700	10.26	29300	10.14	35900	10	43700	9.85	52700	9.65	63000	9.39	74900	9.06	88400	8.64	-	-
		40	-	-	20900	12.73	26000	12.62	32000	12.52	39000	12.42	47100	12.28	56500	12.11	67300	11.87	79600	11.57	-	-
		50	-	-	-	-	-	-	27700	15.65	33800	15.57	41000	15.48	49300	15.36	58800	15.2	69800	14.99	-	-
		60	-	-	-	-	-	-	-	-	-	-	34100	19.5	41100	19.41	49400	19.31	58800	19.16	-	-
		63	-	-	-	-	-	-	-	-	-	-	-	-	38500	20.82	46300	20.73	55300	20.59	-	-
	6000 rpm	20	-	-	44100	14.69	54000	14.8	65700	14.75	79300	14.48	95200	13.95	113500	13.1	-	-	-	-	-	-
		30	-	-	39700	17.7	49100	17.95	60100	18.1	72900	18.11	87800	17.92	104900	17.49	124500	16.75	146600	15.67	-	-
		40	-	-	35000	21.48	43700	21.74	53800	21.98	65600	22.15	79200	22.19	94900	22.05	112900	21.68	133300	21.03	-	-
		50	-	-	-	-	-	-	46700	26.84	57100	27.04	69300	27.18	83300	27.22	99400	27.09	117800	26.76	-	-
		60	-	-	-	-	-	-	-	-	-	-	57800	33.36	69900	33.45	84000	33.45	100100	33.31	-	-
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 10 K
Subcooling = 0 K
Pe: Power input in kW

Presented data are for models with motor voltage code G

Capacity at ARI rating conditions - Low pressure ratio - VZH088BG - VZH117BG - VZH170BG

Models	rpm	To	-25		-20		-15		-10		-5		0		5		10		15	
		Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VZH088BG	1500 rpm	20	-	-	6500	1.8	7900	1.7	9400	1.61	11200	1.54	13300	1.49	15700	1.46	-	-	-	-
		30	-	-	5600	2.34	6900	2.26	8300	2.18	10100	2.1	12000	2.03	14200	1.96	16700	1.91	19600	1.88
		40	-	-	4700	2.93	5900	2.89	7300	2.83	8900	2.77	10700	2.7	12700	2.63	15100	2.56	17700	2.49
		50	-	-	-	-	-	-	6200	3.65	7600	3.62	9300	3.58	11200	3.52	13400	3.45	15800	3.37
		60	-	-	-	-	-	-	-	-	-	-	7900	4.73	9600	4.7	11600	4.65	13900	4.59
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3600 rpm	20	11900	4.45	14600	4.42	17800	4.34	21700	4.23	26200	4.13	31400	4.07	37400	4.07	-	-	-	-
		30	10500	5.48	13100	5.54	16200	5.5	19800	5.41	24100	5.28	28900	5.16	34400	5.06	40700	5.03	47700	5.09
		40	-	-	11700	6.8	14600	6.86	18000	6.82	21900	6.72	26300	6.58	31400	6.44	37100	6.32	43500	6.26
		50	-	-	-	-	-	-	15900	8.5	19500	8.47	23500	8.37	28100	8.23	33200	8.07	39100	7.94
		60	-	-	-	-	-	-	-	-	-	-	20200	10.56	24300	10.46	29000	10.32	34200	10.17
		63	-	-	-	-	-	-	-	-	-	-	-	-	23200	11.22	27600	11.1	32700	10.94
	6000 rpm	20	-	-	23900	7.6	28900	7.6	34900	7.55	42000	7.54	50200	7.62	59600	7.86	-	-	-	-
		30	-	-	22000	9.67	26900	9.74	32700	9.69	39500	9.6	47300	9.52	56200	9.52	66400	9.67	77900	10.03
		40	-	-	19800	11.78	24500	12.02	29900	12.06	36200	11.98	43400	11.84	51700	11.69	61100	11.62	71800	11.69
		50	-	-	-	-	-	-	26400	14.58	32000	14.61	38500	14.49	45900	14.3	54400	14.1	64100	13.96
		60	-	-	-	-	-	-	-	-	-	-	32600	17.4	39100	17.26	46500	17.03	55100	16.78
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
VZH117BG	1500 rpm	20	-	-	8700	2.36	10500	2.23	12700	2.12	15100	2.02	17900	1.95	21100	1.91	-	-	-	-
		30	-	-	7500	3.07	9200	2.96	11200	2.86	13500	2.76	16100	2.66	19100	2.58	22500	2.51	26300	2.47
		40	-	-	6300	3.84	7900	3.79	9800	3.72	11900	3.64	14300	3.55	17100	3.45	20200	3.36	23800	3.27
		50	-	-	-	-	-	-	8300	4.8	10200	4.76	12500	4.7	15000	4.62	18000	4.53	21300	4.43
		60	-	-	-	-	-	-	-	-	-	-	10600	6.21	12900	6.18	15600	6.11	18700	6.02
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600 rpm	20	15900	5.84	19600	5.8	23900	5.7	29100	5.56	35200	5.43	42200	5.35	50200	5.35	-	-	-	-
		30	14100	7.2	17600	7.27	21800	7.22	26600	7.1	32300	6.94	38800	6.77	46200	6.65	54600	6.61	64000	6.69
		40	-	-	15700	8.93	19600	9	24200	8.95	29400	8.82	35300	8.64	42100	8.46	49800	8.3	58500	8.22
		50	-	-	-	-	-	-	21400	11.17	26100	11.12	31500	10.99	37700	10.8	44600	10.61	52400	10.43
		60	-	-	-	-	-	-	-	-	-	-	27200	13.86	32700	13.74	38900	13.56	45900	13.35
		63	-	-	-	-	-	-	-	-	-	-	-	-	31100	14.74	37100	14.57	43900	14.37
	6000 rpm	20	-	-	32000	9.98	38800	9.98	46900	9.92	56300	9.9	67300	10.01	80000	10.32	-	-	-	-
		30	-	-	29500	12.7	36100	12.79	43900	12.73	53000	12.61	63500	12.5	75500	12.5	89200	12.7	104600	13.17
		40	-	-	26600	15.47	32900	15.78	40100	15.84	48600	15.74	58300	15.54	69400	15.36	82000	15.26	96300	15.35
		50	-	-	-	-	-	-	35400	19.15	43000	19.18	51700	19.03	61600	18.78	73100	18.52	86000	18.34
		60	-	-	-	-	-	-	-	-	-	-	43800	22.85	52500	22.66	62500	22.37	73900	22.04
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
VZH170BG	1500 rpm	20	-	-	12400	3.17	14900	3.04	17900	2.91	21400	2.76	25400	2.6	30000	2.41	-	-	-	-
		30	-	-	10800	4.3	13300	4.16	16100	4.03	19400	3.9	23200	3.76	27600	3.6	32500	3.42	38100	3.2
		40	-	-	9300	5.55	11600	5.4	14300	5.27	17300	5.15	20900	5.04	24900	4.92	29600	4.78	34800	4.63
		50	-	-	-	-	-	-	12200	6.78	15100	6.68	18300	6.59	22000	6.5	26300	6.42	31200	6.32
		60	-	-	-	-	-	-	-	-	-	-	15500	8.57	18900	8.52	22800	8.48	27300	8.43
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3600 rpm	20	22900	8.35	28200	8.2	34600	8.03	42200	7.84	51100	7.61	61400	7.32	73300	6.96	-	-	-	-
		30	20500	10.39	25600	10.26	31600	10.14	38700	10	47000	9.85	56600	9.65	67700	9.39	80400	9.06	94800	8.64
		40	-	-	22900	12.73	28400	12.62	34900	12.52	42500	12.42	51300	12.28	61500	12.11	73100	11.87	86400	11.57
		50	-	-	-	-	-	-	30900	15.65	37600	15.57	45500	15.48	54700	15.36	65200	15.2	77200	14.99
		60	-	-	-	-	-	-	-	-	-	-	39300	19.5	47300	19.41	56600	19.31	67400	19.16
		63	-	-	-	-	-	-	-	-	-	-	-	-	45100	20.82	54100	20.73	64500	20.59
	6000 rpm	20	-	-	47100	14.69	57600	14.8	70000	14.75	84500	14.48	101400	13.95	120800	13.1	-	-	-	-
		30	-	-	42800	17.7	52900	17.95	64700	18.1	78500	18.11	94400	17.92	112700	17.49	133500	16.75	157200	15.67
		40	-	-	38300	21.48	47700	21.74	58700	21.98	71500	22.15	86300	22.19	103200	22.05	122600	21.68	144700	21.03
		50	-	-	-	-	-	-	52000	26.84	63500	27.04	76900	27.18	92400	27.22	110100	27.09	130400	26.76
		60	-	-	-	-	-	-	-	-	-	-	66600	33.36	80400	33.45	96400	33.45	114700	33.31
		63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 11.1 K
Subcooling = 8.3 K
Pe: Power input in kW

Presented data are for models with motor voltage code G

Capacity at EN12900 rating conditions - Low pressure ratio - VZH088BH - VZH117BH - VZH170BH

Models	rpm	To	-25	-20	-15	-10	-5	0	5	10	15
		Tc	Qo	Qo	Qo	Qo	Qo	Qo	Qo	Qo	Qo
VZH088BH*	1500 rpm	20	-	6100	7400	8800	10600	12500	14700	-	-
		30	-	5200	6400	7800	9300	11200	13200	15600	18300
		40	-	4300	5400	6700	8100	9800	11700	13900	16300
		50	-	-	-	5500	6900	8400	10100	12100	14300
		60	-	-	-	-	-	6800	8400	10100	12200
		63	-	-	-	-	-	-	-	-	-
	3600 rpm	20	11100	13600	16700	20400	24600	29500	35100	-	-
		30	9700	12200	15000	18400	22400	26900	32000	37900	44500
		40	-	10700	13400	16500	20100	24200	28800	34100	40100
		50	-	-	-	14300	17500	21100	25300	30000	35300
		60	-	-	-	-	-	17600	21200	25200	29800
		63	-	-	-	-	-	-	19800	23700	28100
	6000 rpm	20	-	22300	27100	32700	39400	47100	56000	-	-
		30	-	20400	25000	30400	36700	44000	52400	61900	72700
		40	-	18100	22400	27400	33200	39900	47500	56200	66100
		50	-	-	-	23700	28800	34700	41400	49100	57900
		60	-	-	-	-	-	28300	34000	40600	48100
		63	-	-	-	-	-	-	-	-	-
VZH117BH*	1500 rpm	20	-	8200	9900	11900	14200	16800	19800	-	-
		30	-	6900	8500	10400	12500	15000	17800	20900	24500
		40	-	5700	7200	8900	10900	13200	15700	18600	21900
		50	-	-	-	7400	9200	11200	13600	16200	19200
		60	-	-	-	-	-	9200	11200	13600	16300
		63	-	-	-	-	-	-	-	-	-
	3600 rpm	20	14900	18300	22400	27300	33000	39600	47200	-	-
		30	13100	16300	20200	24700	30000	36100	43000	50900	59700
		40	-	14400	18000	22100	26900	32400	38700	45800	53800
		50	-	-	-	19200	23500	28400	34000	40300	47400
		60	-	-	-	-	-	23600	28400	33900	40100
		63	-	-	-	-	-	-	26500	31800	37700
	6000 rpm	20	-	30000	36400	43900	52900	63200	75200	-	-
		30	-	27400	33500	40800	49300	59100	70300	83100	97500
		40	-	24400	30100	36800	44500	53500	63800	75500	88700
		50	-	-	-	31800	38600	46500	55600	66000	77700
		60	-	-	-	-	-	38000	45600	54400	64500
		63	-	-	-	-	-	-	-	-	-
VZH170BH*	1500 rpm	20	-	11600	14000	16800	20100	23800	28200	-	-
		30	-	10000	12300	15000	18100	21600	25700	30300	35500
		40	-	8500	10600	13100	15900	19200	22900	27200	32000
		50	-	-	-	11000	13500	16500	19900	23800	28200
		60	-	-	-	-	-	13500	16500	19900	23800
		63	-	-	-	-	-	-	-	-	-
	3600 rpm	20	21400	26400	32400	39600	47900	57700	68900	-	-
		30	19000	23700	29300	35900	43700	52700	63000	74900	88400
		40	-	20900	26000	32000	39000	47100	56500	67300	79600
		50	-	-	-	27700	33800	41000	49300	58800	69800
		60	-	-	-	-	-	34100	41100	49400	58800
		63	-	-	-	-	-	-	38500	46300	55300
	6000 rpm	20	-	44100	54000	65700	79300	95200	113500	-	-
		30	-	39700	49100	60100	72900	87800	104900	124500	146600
		40	-	35000	43700	53800	65600	79200	94900	112900	133300
		50	-	-	-	46700	57100	69300	83300	99400	117800
		60	-	-	-	-	-	57800	69900	84000	100100
		63	-	-	-	-	-	-	-	-	-

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

Superheat = 10 K
Subcooling = 0 K

Presented data are for models with motor voltage code H

Capacity at ARI rating conditions - Low pressure ratio - VZH088BH - VZH117BH - VZH170BH

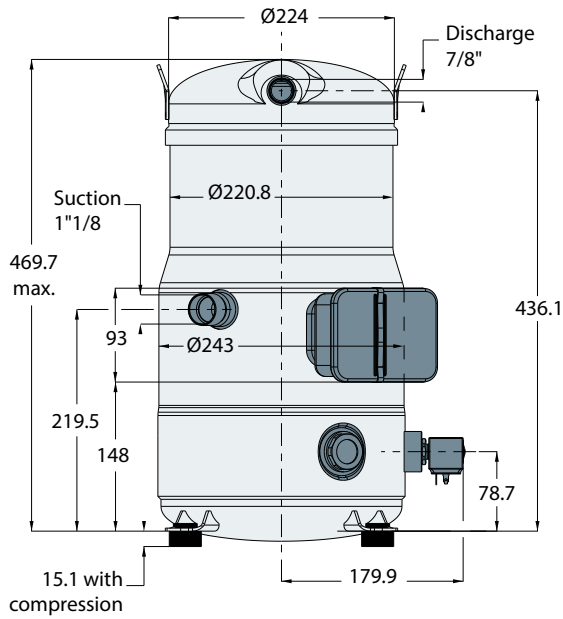
Models	rpm	To	-25	-20	-15	-10	-5	0	5	10	15
		Tc	Qo	Qo	Qo	Qo	Qo	Qo	Qo	Qo	Qo
VZH088BH*	1500 rpm	20	-	6500	7900	9400	11200	13300	15700	-	-
		30	-	5600	6900	8300	10100	12000	14200	16700	19600
		40	-	4700	5900	7300	8900	10700	12700	15100	17700
		50	-	-	-	6200	7600	9300	11200	13400	15800
		60	-	-	-	-	-	7900	9600	11600	13900
		63	-	-	-	-	-	-	-	-	-
	3600 rpm	20	11900	14600	17800	21700	26200	31400	37400	-	-
		30	10500	13100	16200	19800	24100	28900	34400	40700	47700
		40	-	11700	14600	18000	21900	26300	31400	37100	43500
		50	-	-	-	15900	19500	23500	28100	33200	39100
		60	-	-	-	-	-	20200	24300	29000	34200
		63	-	-	-	-	-	-	23200	27600	32700
	6000 rpm	20	-	23900	28900	34900	42000	50200	59600	-	-
		30	-	22000	26900	32700	39500	47300	56200	66400	77900
		40	-	19800	24500	29900	36200	43400	51700	61100	71800
		50	-	-	-	26400	32000	38500	45900	54400	64100
		60	-	-	-	-	-	32600	39100	46500	55100
		63	-	-	-	-	-	-	-	-	-
VZH117BH*	1500 rpm	20	-	8700	10500	12700	15100	17900	21100	-	-
		30	-	7500	9200	11200	13500	16100	19100	22500	26300
		40	-	6300	7900	9800	11900	14300	17100	20200	23800
		50	-	-	-	8300	10200	12500	15000	18000	21300
		60	-	-	-	-	-	10600	12900	15600	18700
		63	-	-	-	-	-	-	-	-	-
	3600 rpm	20	15900	19600	23900	29100	35200	42200	50200	-	-
		30	14100	17600	21800	26600	32300	38800	46200	54600	64000
		40	-	15700	19600	24200	29400	35300	42100	49800	58500
		50	-	-	-	21400	26100	31500	37700	44600	52400
		60	-	-	-	-	-	27200	32700	38900	45900
		63	-	-	-	-	-	-	31100	37100	43900
	6000 rpm	20	-	32000	38800	46900	56300	67300	80000	-	-
		30	-	29500	36100	43900	53000	63500	75500	89200	104600
		40	-	26600	32900	40100	48600	58300	69400	82000	96300
		50	-	-	-	35400	43000	51700	61600	73100	86000
		60	-	-	-	-	-	43800	52500	62500	73900
		63	-	-	-	-	-	-	-	-	-
VZH170BH*	1500 rpm	20	-	12400	14900	17900	21400	25400	30000	-	-
		30	-	10800	13300	16100	19400	23200	27600	32500	38100
		40	-	9300	11600	14300	17300	20900	24900	29600	34800
		50	-	-	-	12200	15100	18300	22000	26300	31200
		60	-	-	-	-	-	15500	18900	22800	27300
		63	-	-	-	-	-	-	-	-	-
	3600 rpm	20	22900	28200	34600	42200	51100	61400	73300	-	-
		30	20500	25600	31600	38700	47000	56600	67700	80400	94800
		40	-	22900	28400	34900	42500	51300	61500	73100	86400
		50	-	-	-	30900	37600	45500	54700	65200	77200
		60	-	-	-	-	-	39300	47300	56600	67400
		63	-	-	-	-	-	-	45100	54100	64500
	6000 rpm	20	-	47100	57600	70000	84500	101400	120800	-	-
		30	-	42800	52900	64700	78500	94400	112700	133500	157200
		40	-	38300	47700	58700	71500	86300	103200	122600	144700
		50	-	-	-	52000	63500	76900	92400	110100	130400
		60	-	-	-	-	-	66600	80400	96400	114700
		63	-	-	-	-	-	-	-	-	-

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W

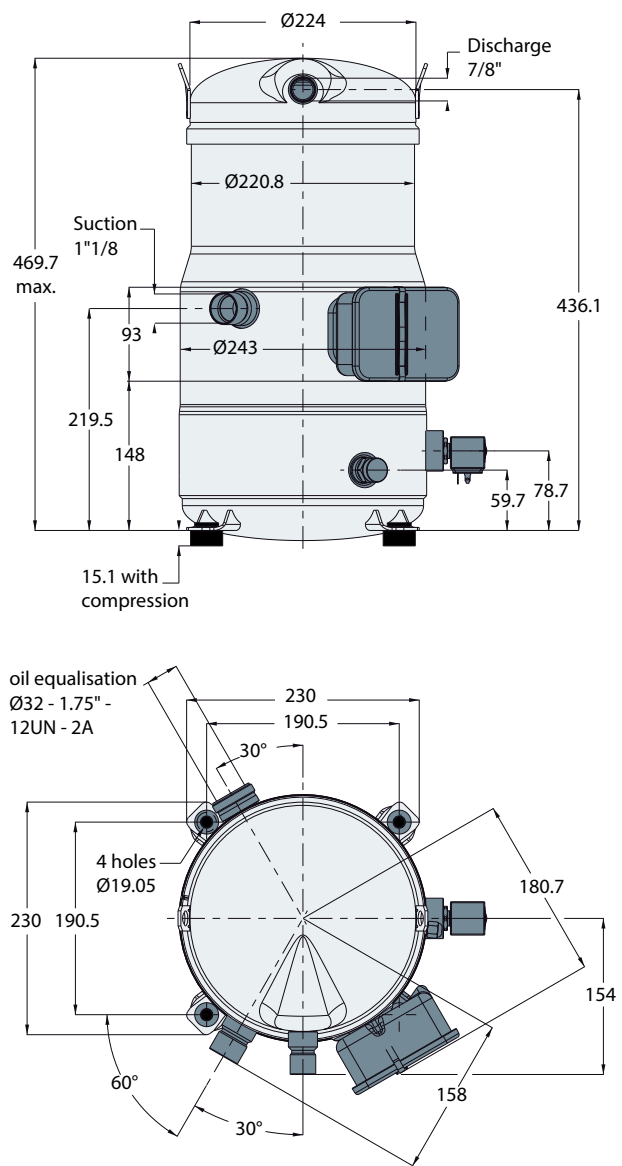
Superheat = 11.1 K
Subcooling = 8.3 K

Presented data are for models with motor voltage code H

VZH088-G/H single version

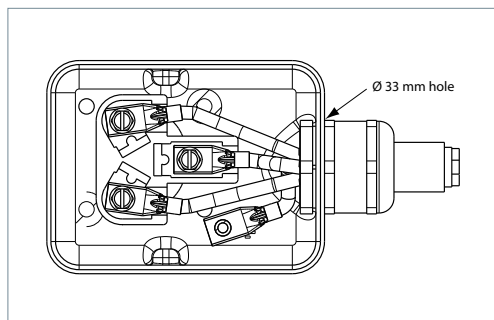


VZH088-G/H manifolded version

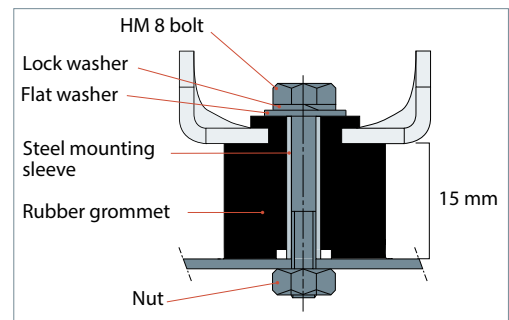


All dimensions in mm

Electrical box

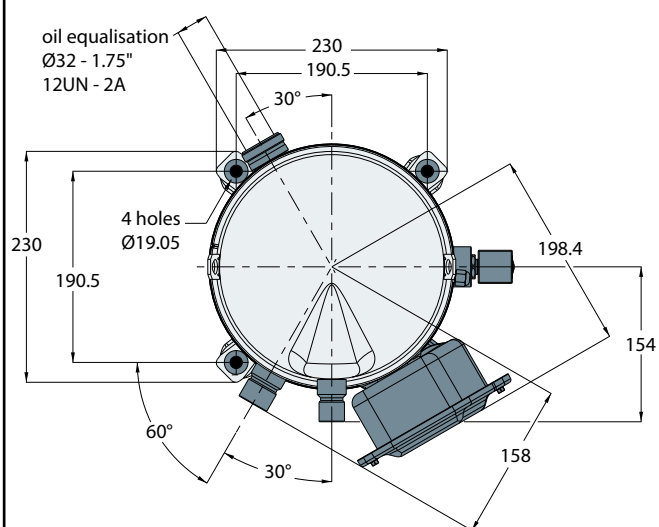
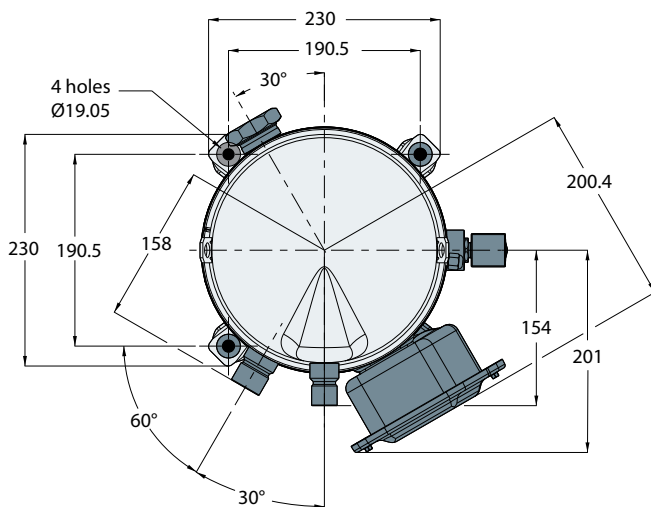
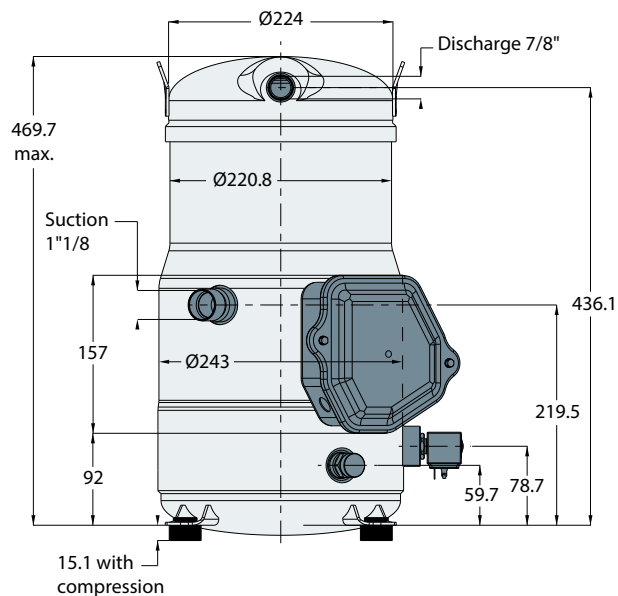
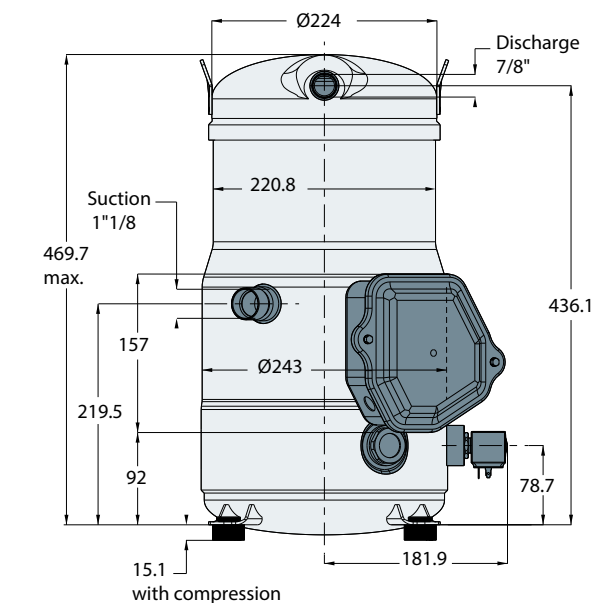


Grommet



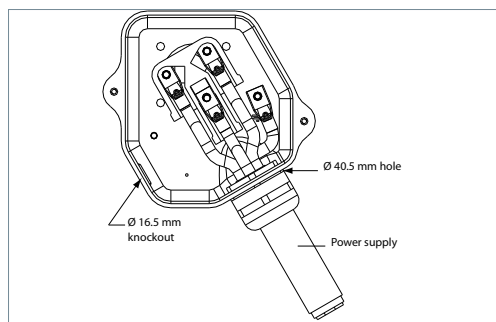
VZH088-J single version

VZH088-J manifolded version

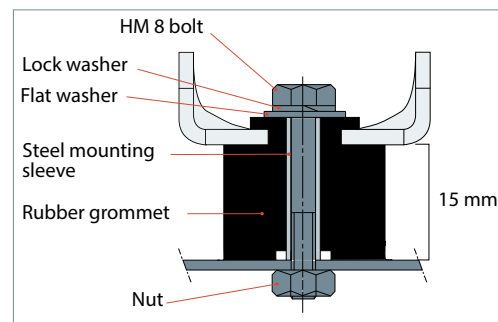


All dimensions in mm

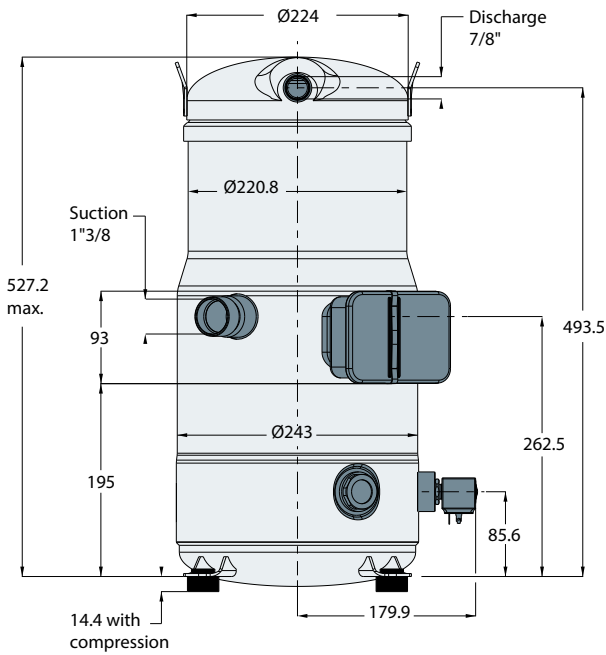
Electrical box



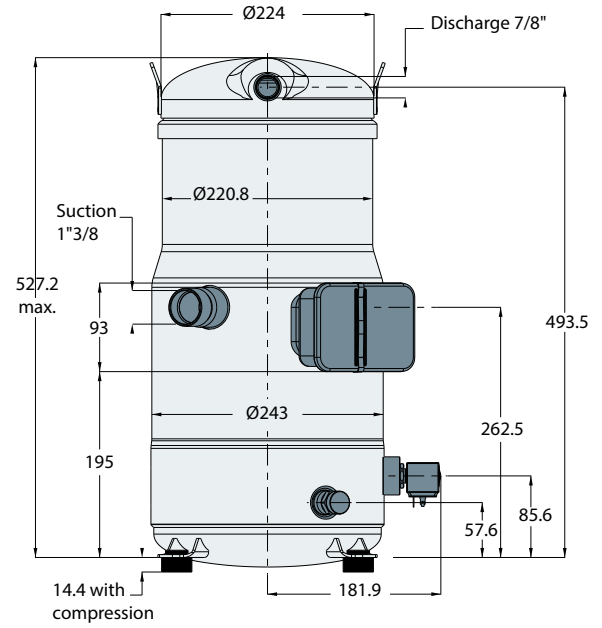
Grommet



VZH117-G/H single version



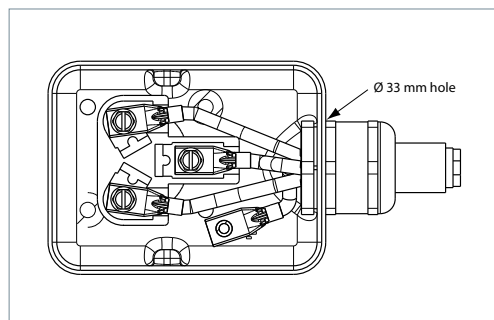
VZH117-G/H manifolded version



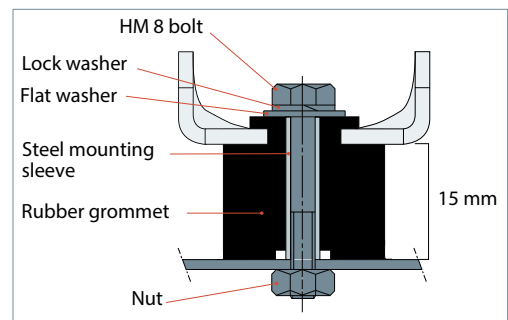
$\text{Ø}32$ oil equalisation
1.75" - 12 UN - 2A

All dimensions in mm

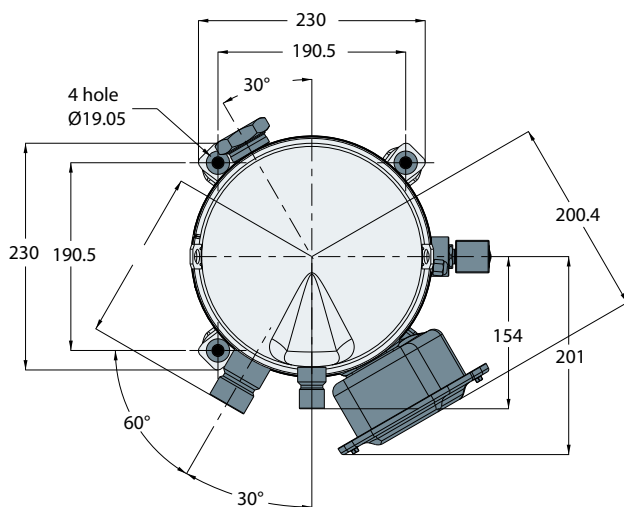
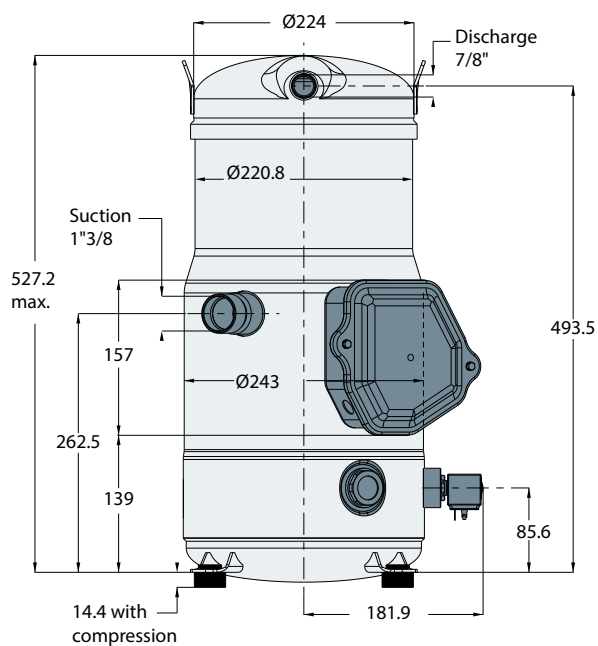
Electrical box



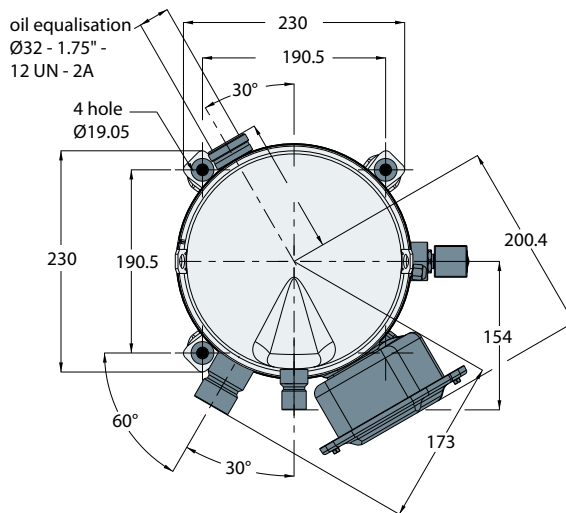
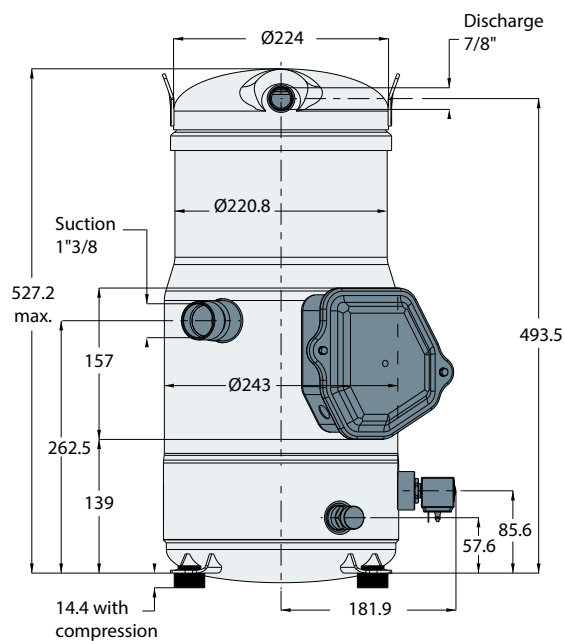
Grommet



VZH117-J single version

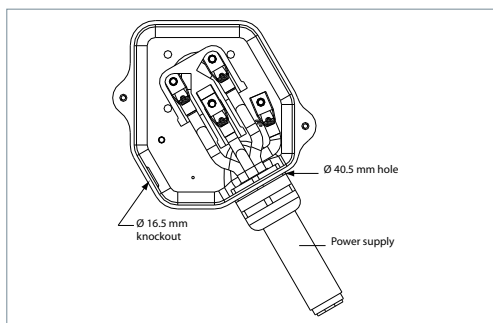


VZH117-J manifolded version

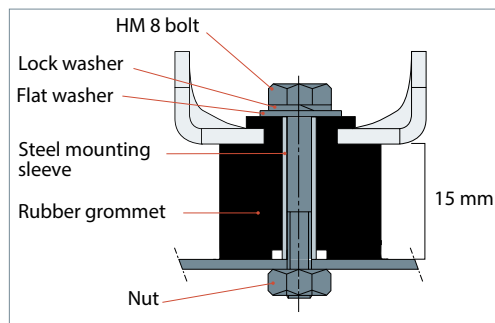


All dimensions in mm

Electrical box

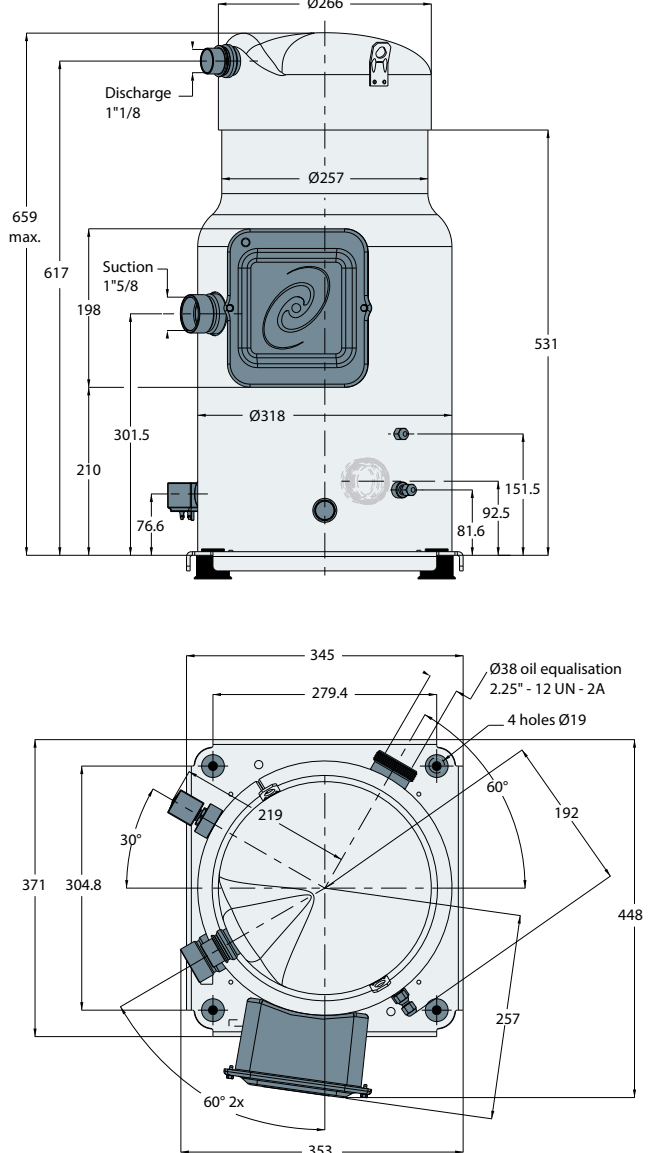
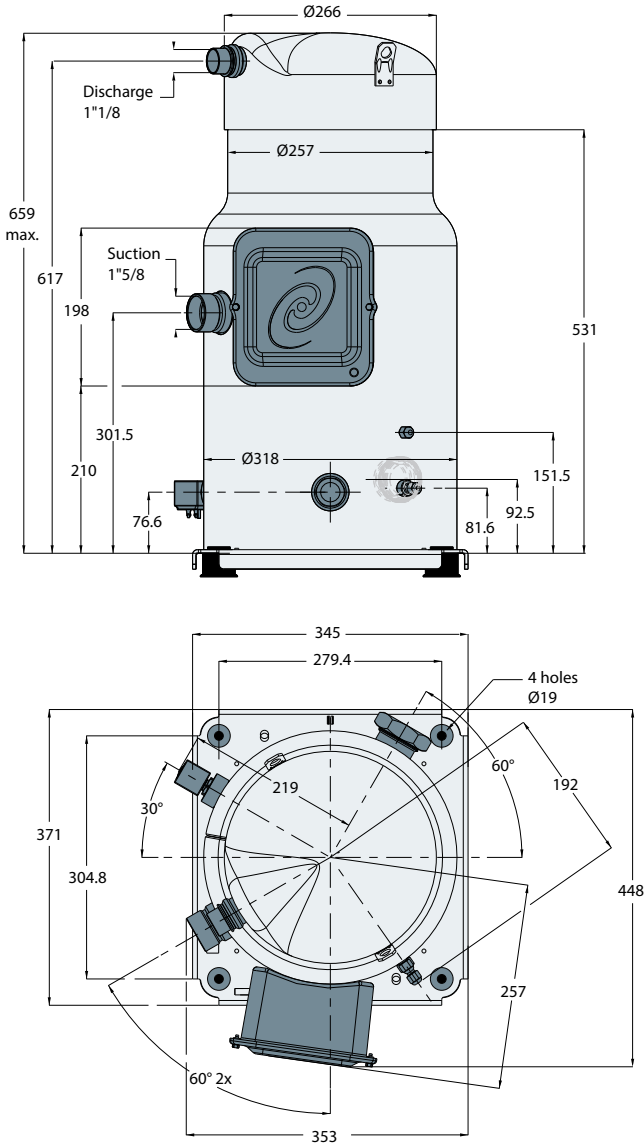


Grommet



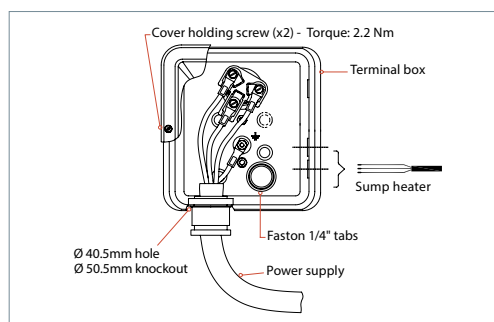
VZH170-G/H single version

VZH170-G/H manifolded version

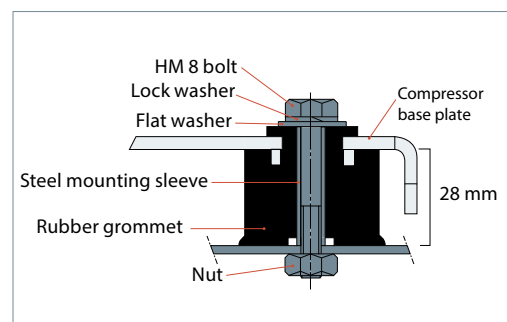


All dimensions in mm

Electrical box

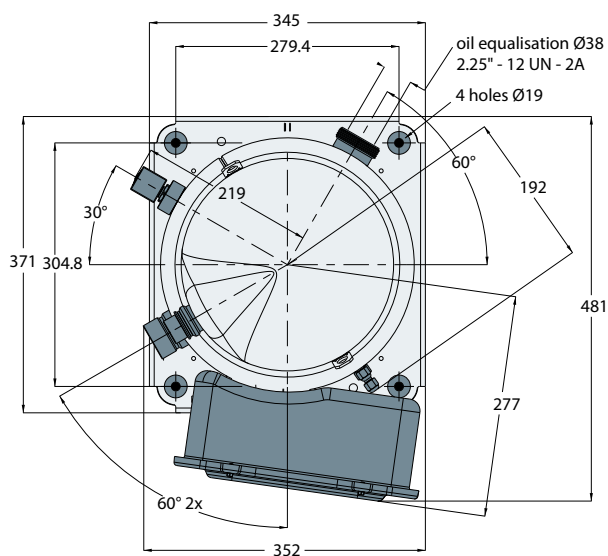
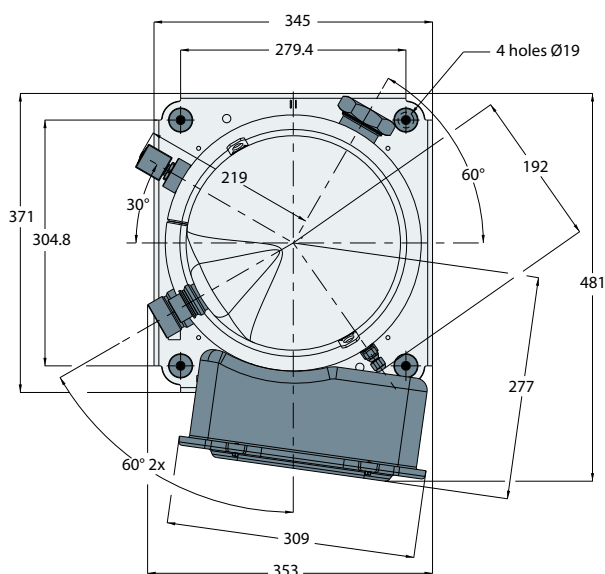
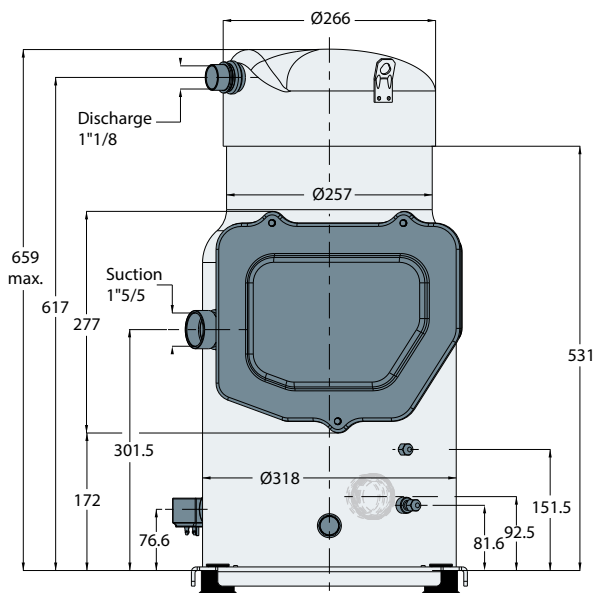
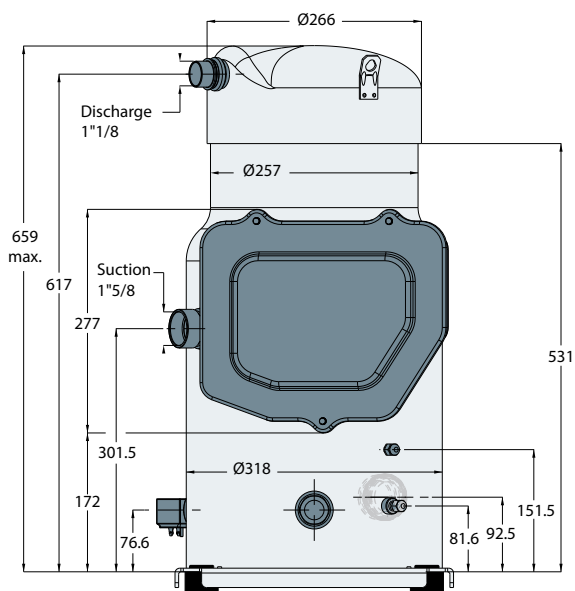


Grommet



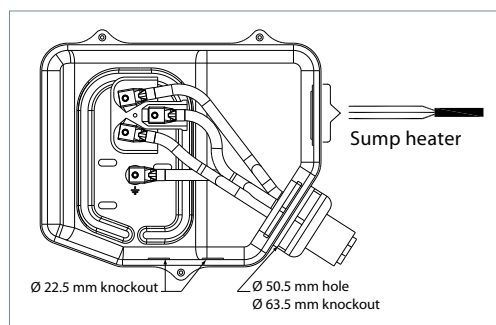
VZH170-J single version

VZH170-J manifolded version

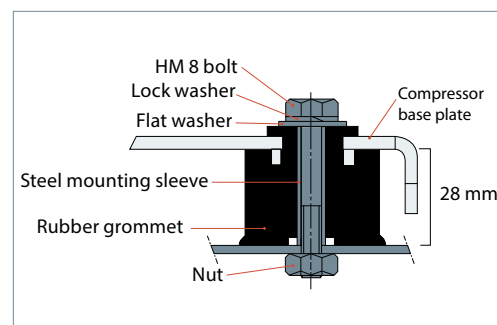


All dimensions in mm

Electrical box



Grommet



Sight glass / oil level switch

VZH compressors single versions come equipped with a threaded oil sight glass with 1"1/8 – 18 UNEF connection. It can be used for visual check of oil amount and conditions.

VZH compressors manifold versions come equipped with a screw-in optical part on oil level switch port located below the electrical box.

Schrader

The oil fill connection and gauge port is a 1/4" male flare connector incorporating a schrader valve.

Oil equalisation connection

VZH compressors are equipped with rotolock oil equalisation connection. This connection is used when compressors are mounted in parallel. Contact Danfoss for further details and refer to hybrid manifolding specific section at the end of this document.

	Oil equalization
VZH088	Rotolock 1"3/4
VZH117	Rotolock 1"3/4
VZH170	Rotolock 2"1/4

Oil drain fitting

VZH170 are equipped with oil drain connection. This connection is a female 1/4" NPTF flare fitting, which allows oil to be removed for testing, replacement etc...

This fitting contains an internal extension tube in order to collect the oil at the bottom of the oil sump.

VZH088 and VZH117 are not equipped with oil drain fitting.

Suction & discharge connections

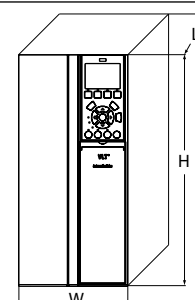
VZH compressors are all delivered with suction and discharge brazed connections only. They are copper plated steel connections.

	Suction	Discharge
VZH088	1" 1/8	7/8"
VZH117	1" 3/8	7/8"
VZH170	1" 5/8	1"1/8

Rotolock adaptors are available, refer to section "Accessories".

Frequency converter dimensions

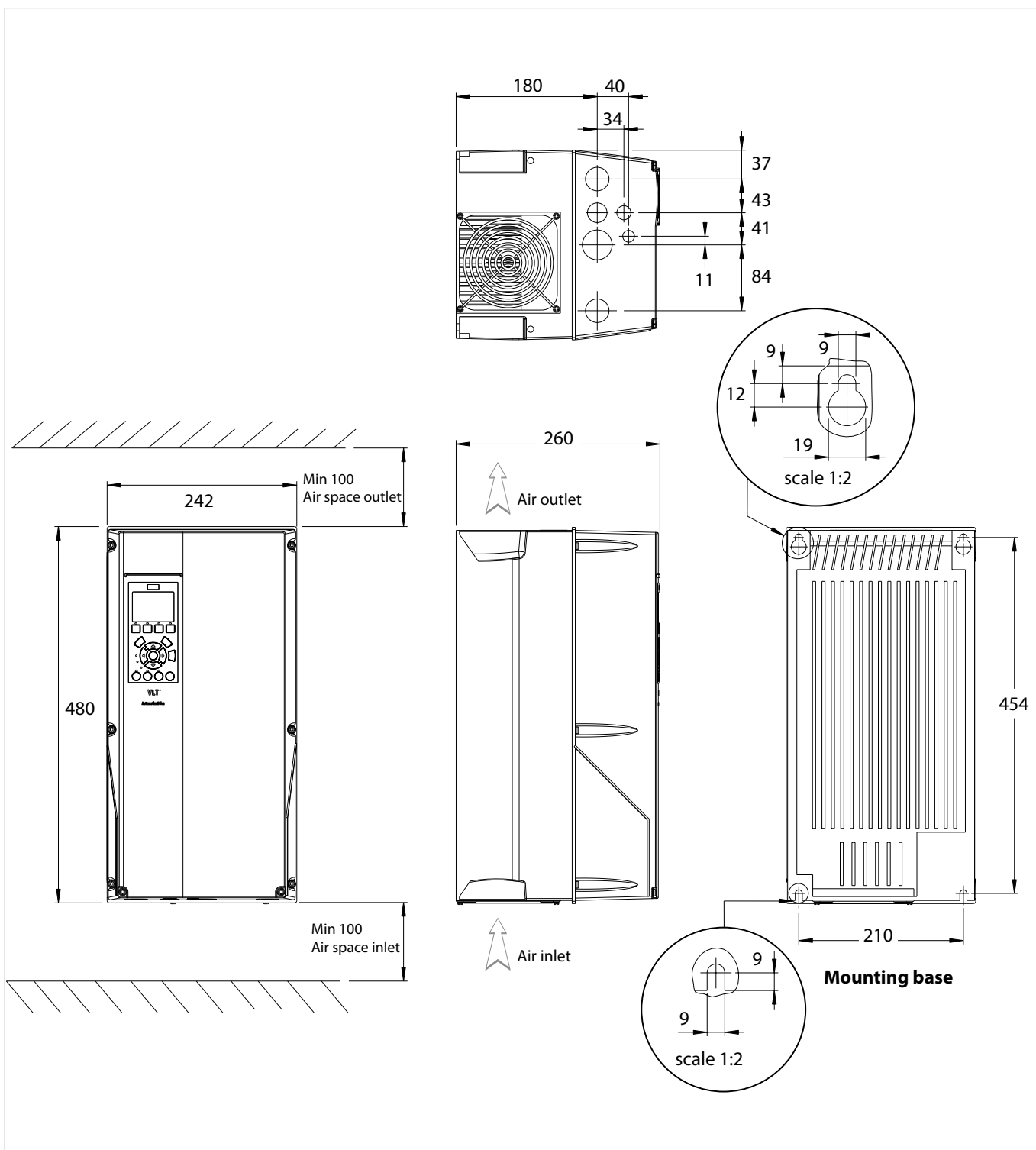
Frequency converter dimensions depend on supply voltage, IP rating and power. The below table gives an overview of the overall dimensions and different drive enclosures (B1 - C3). Details for each drive enclosure are on the following pages.



Drive supply voltage	Drive power kW	Compressor voltage code	Compressor model	IP20		IP55	
				Drive enclosure	Overall drive size (H x W x L) mm	Drive enclosure	Overall drive size (H x W x L) mm
T2: 200-240/3/50-60	15	J	VZH088	B4	595x230x242	C1	680x308x310
	18.5		VZH117	C3	630x308x333	C1	680x308x310
	22		VZH170	C3	630x308x333	C1	680x308x310
T4: 380-480/3/50-60	15	G	VZH088	B3	420x165x249	B1	480x242x260
	18.5		VZH117	B4	595x230x242	B2	650x242x260
	22		VZH170	B4	595x230x242	B2	650x242x260
T6: 525-600/3/50-60	18	H	VZH088	B4	595x230x242	-	-
	30		VZH117	B4	595x230x242	-	-
	30		VZH170	B4	595x230x242	-	-

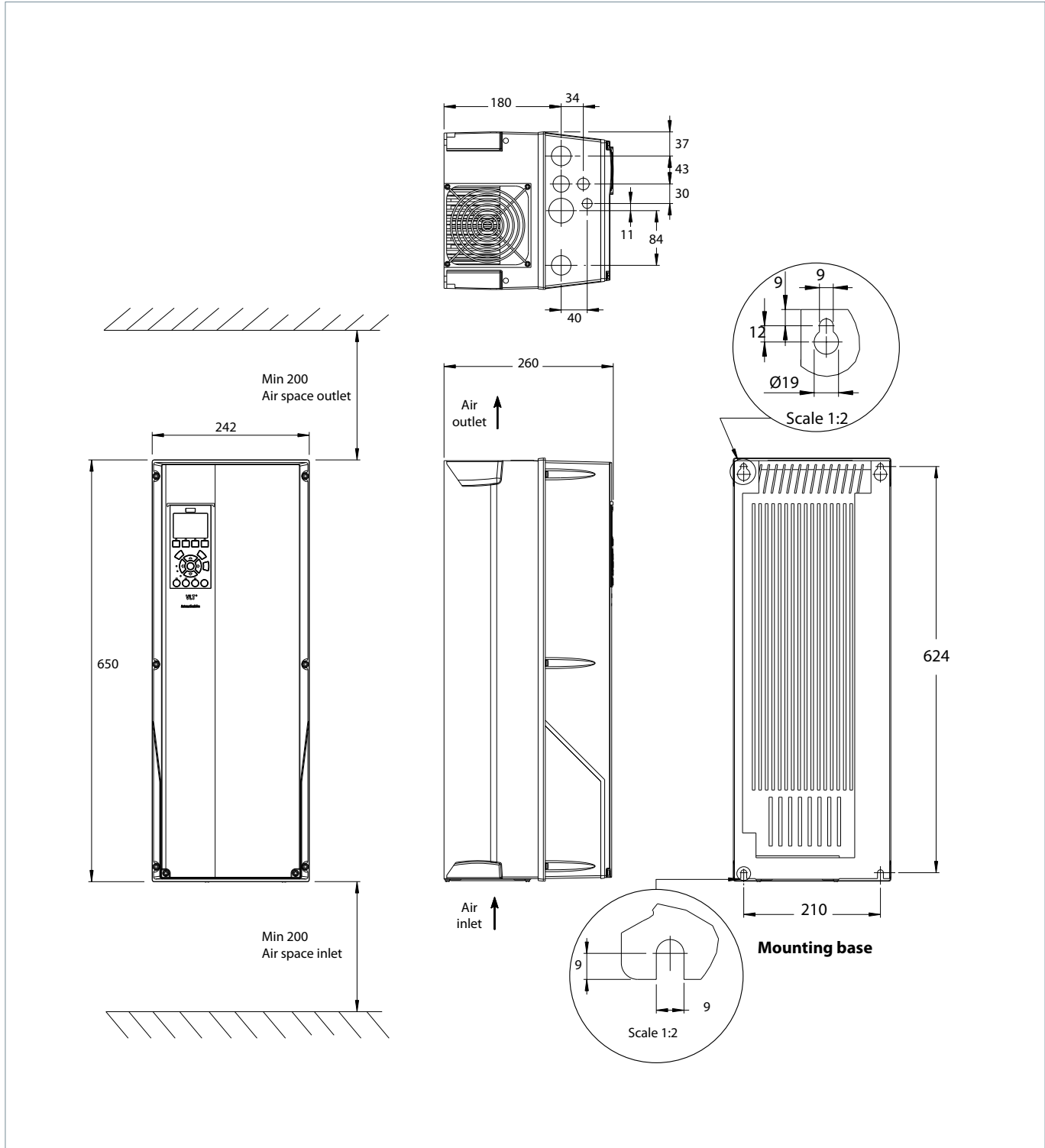
CDS303 frequency converter - enclosure B1

380-480 Volts - 15 kW - IP55 housing



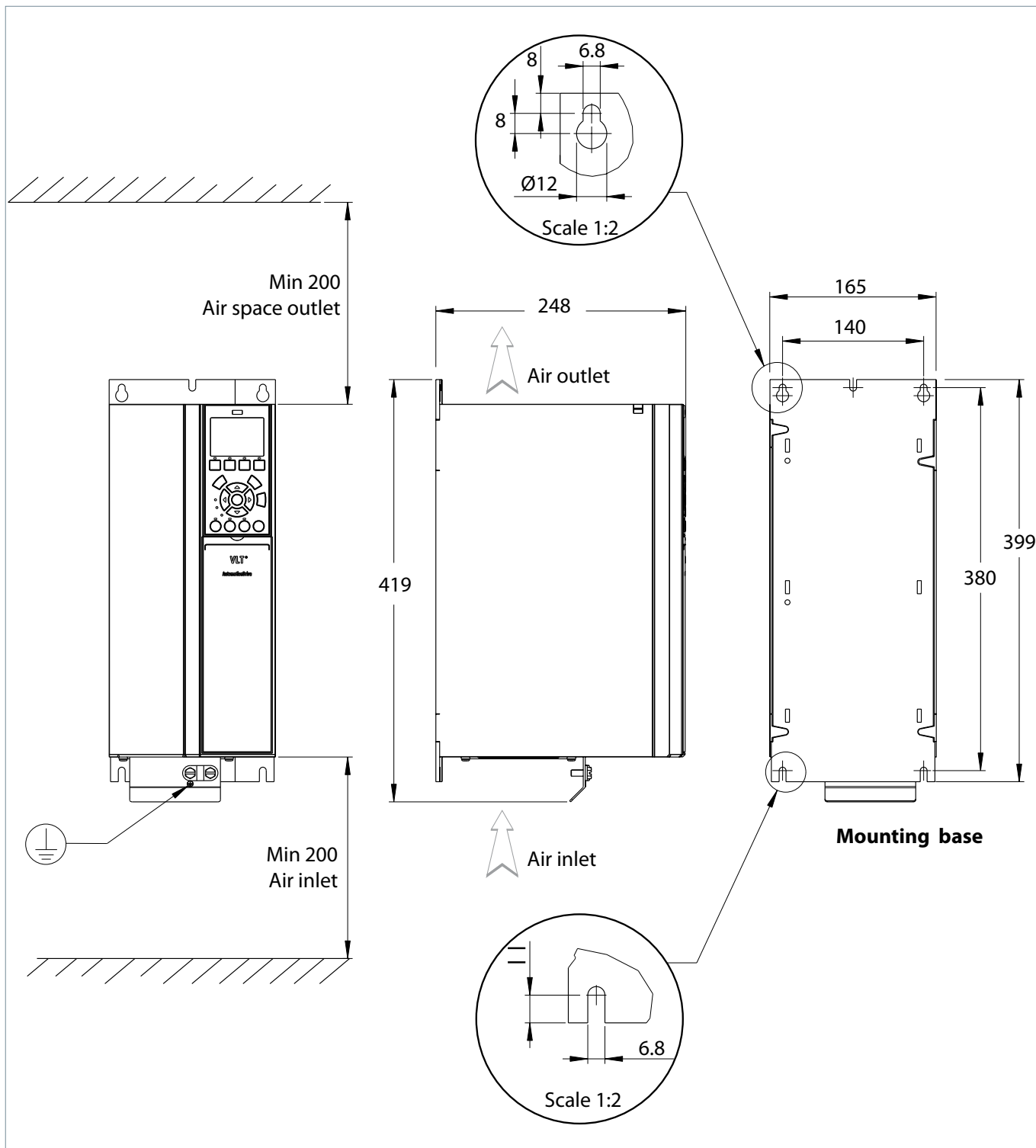
CDS303 frequency converter - enclosure B2

380-480 volts – 18-22 kW - IP55 housing



CDS303 frequency converter - enclosure B3

380-480 volts - 15 kW - IP20 housing

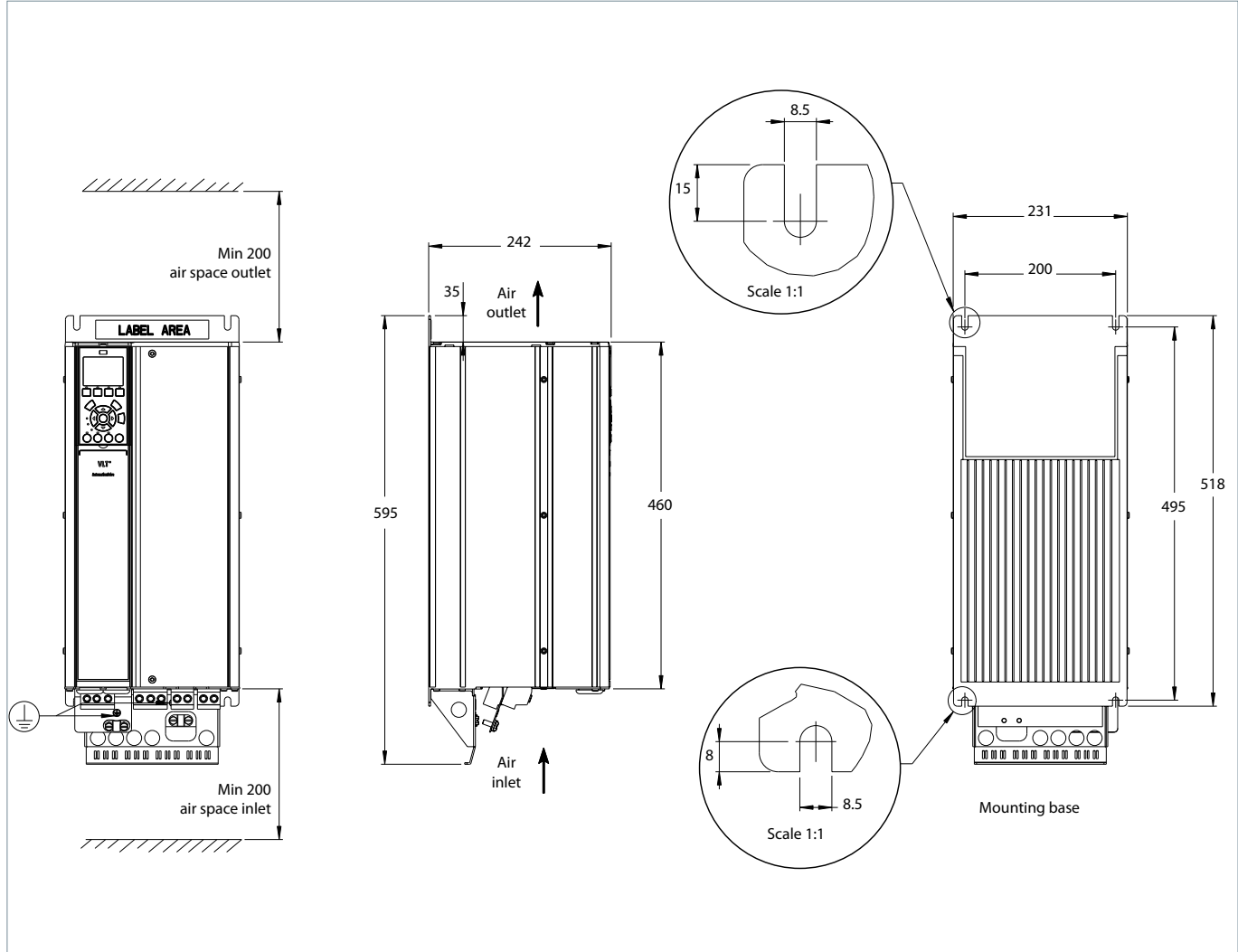


CDS303 frequency converter - enclosure B4

380-480 volts – 18-22 kW - IP20 housing

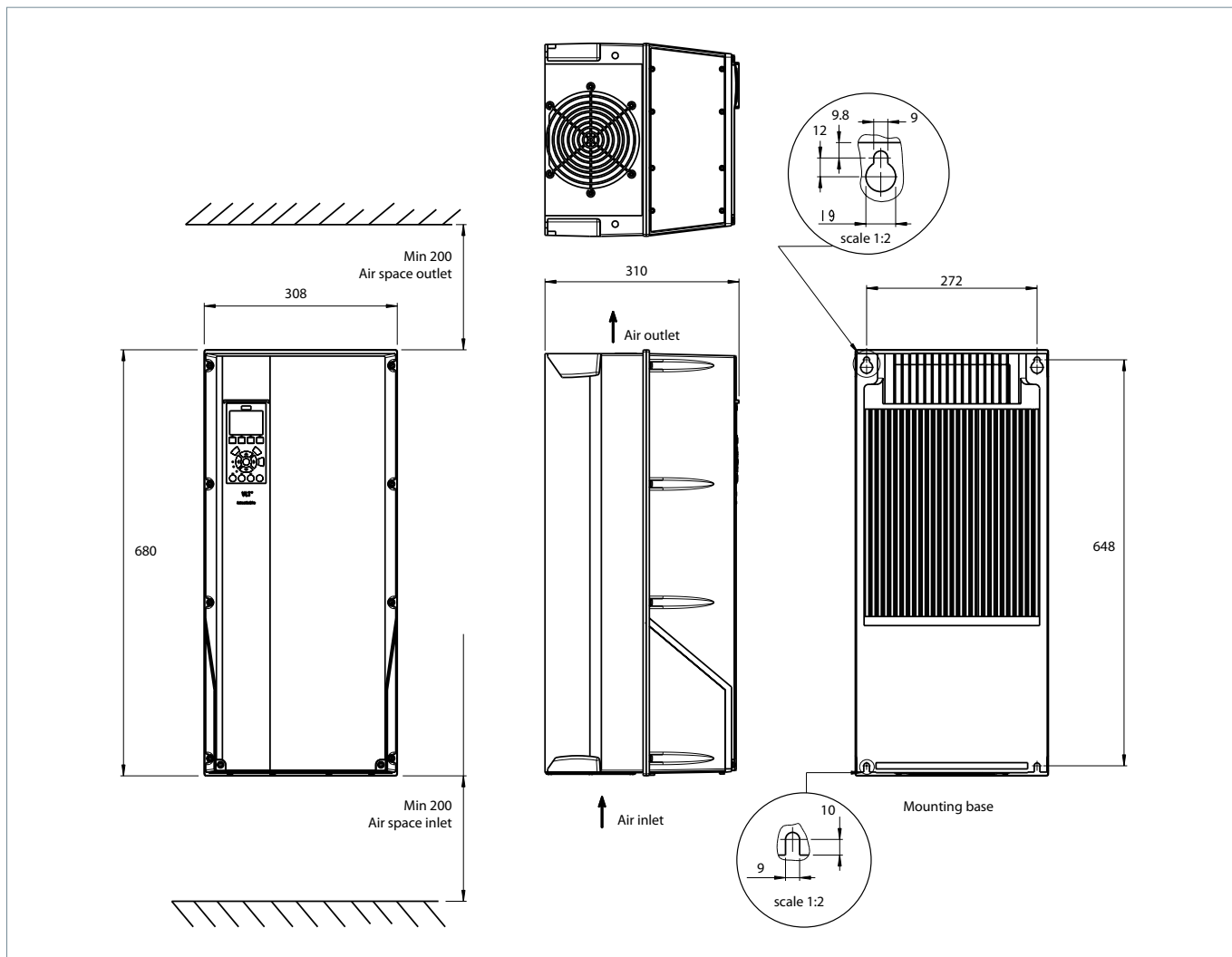
200-240 volts - 15 kW - IP20 housing

525-600 volts - 18-30 kW - IP20 housing



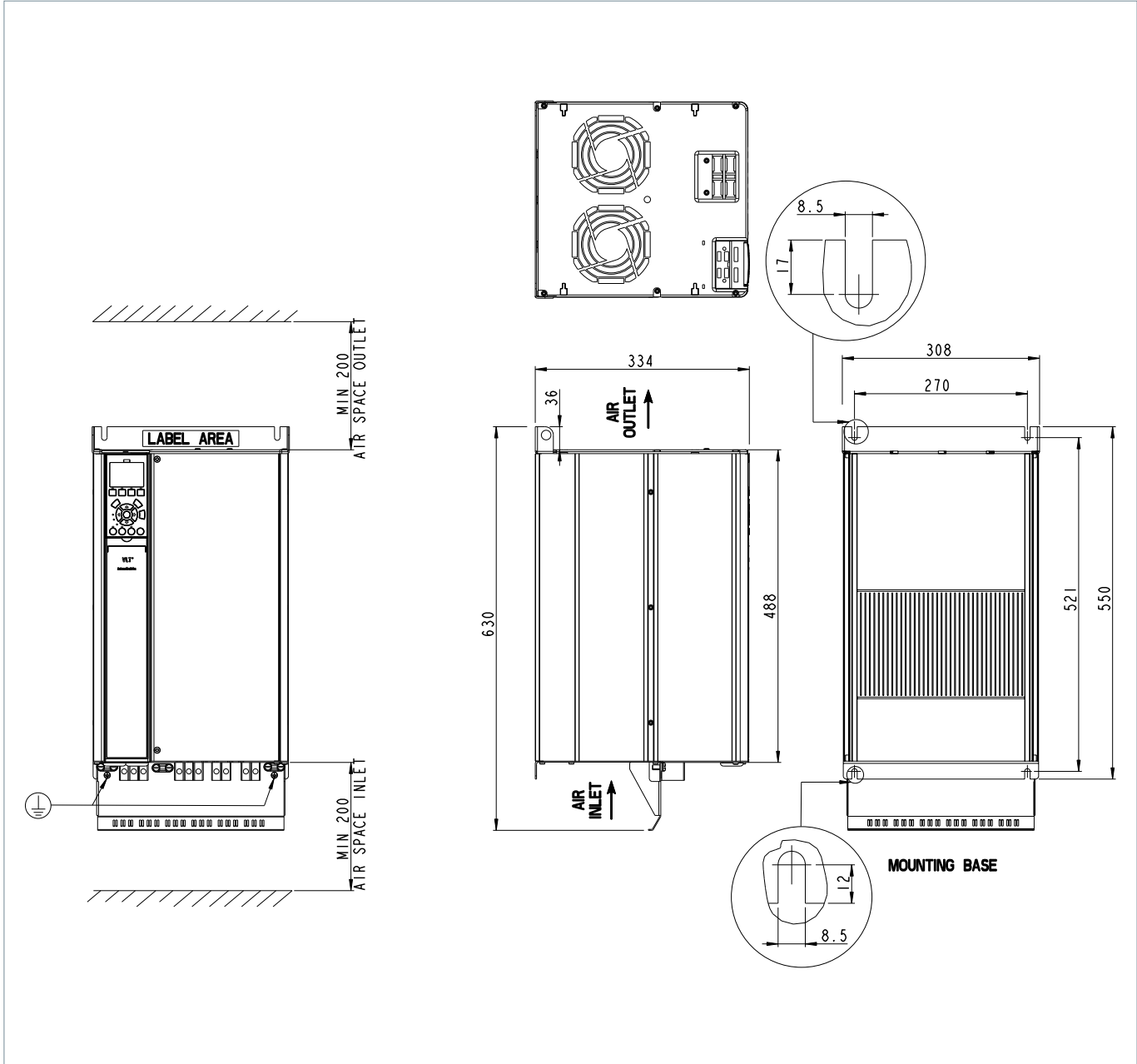
CDS303 frequency converter - enclosure C1

200-240 volts – 15-18-22 kW - IP55 housing



CDS303 frequency converter - enclosure C3

200-240 volts – 18-22 kW - IP20 housing



Supply voltage

Because VZH compressors are powered by a frequency converter, the mains frequency, 50 or 60 Hz, is no longer an issue. Only the mains voltage is to be taken into account. With 3 motor voltage codes, the most common mains voltages and frequencies are covered. Never connect the VZH compressor directly to the mains power supply.

On VZH all data published and in our polynomials are based on 208V frequency converter supply for code J and 400V frequency converter supply for code G.

When having a supply of 230V, 380V or 460V the following coefficients must be applied:

$$I_{460} = 0.87 * I_{400}$$

$$I_{380} = 1.05 * I_{400}$$

$$I_{230} = 0.90 * I_{208}$$

There is no modification for cooling capacity and power input.

Since data published for code H is based on 575V frequency converter supply, thus there will be no coefficients modification applied for H code.

Voltage code	Mains voltage range of drive
J	200-240 V / 3 ph / 50 Hz & 200-240 V / 3 ph / 60 Hz (±10%)
G	380-480 V / 3 ph / 50 Hz & 380 - 480 V / 3 ph / 60 Hz (±10%)
H	525-600V / 3 ph / 50 Hz & 525-600V / 3 ph / 60 Hz (±10%)

Compressor electrical specifications

	Compressor	RW	RLA	MMT
		(Ohm)	(A)	(A)
200 - 240 Volt	VZH088-J	0.03	74.8	93.5
	VZH117-J	0.02	88.0	110.0
	VZH170-J	0.01	115.0	143.8
380 - 480 Volt	VZH088-G	0.10	37.5	46.9
	VZH117-G	0.08	44.0	55.0
	VZH170-G	0.05	61.0	76.3
525 - 600 Volt	VZH088-H	0.10	37.5	46.9
	VZH117-H	0.08	44.0	55.0
	VZH170-H	0.05	61.0	76.3

RW: Winding resistance per winding (in CDS303 parameter list)
 RLA: Rated load current
 MMT: Maximum must trip current
 Note that parameter 1-30 in the frequency converter settings reflects the winding resistance per winding. This is not the same value as measured at the motor terminals.

RLA (Rated Load Amp)

Rated Load Amp value is the current value at maximum load, in the operating envelope, and at maximum speed. We have agency (UL, CE, etc) approved at our max operating, the drive can limit the amps but the OEM is responsible for that submittal to agency.

MMT (Maximum Must Trip current)

The Maximum Must Trip current is defined for compressors not equipped with their own motor protection. This MMT value is the maximum at which the compressor can be operated in transient conditions and out of the operating envelope. The tripping current

of external overcurrent protection, in this case preprogrammed in the drive, never exceeds the MMT value.

For VZH compressors, according to UL requirements, MMT value is 125% of RLA. This value is printed on the compressor nameplate.

Fuses / circuit breakers

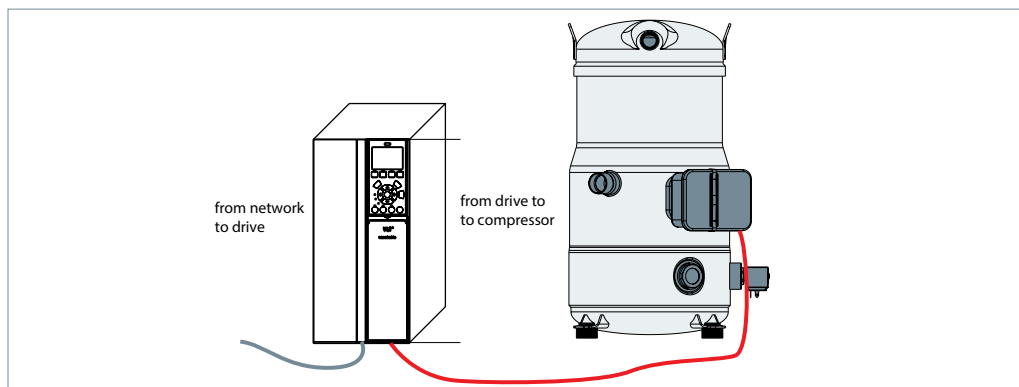
Danfoss recommends using the fuses/circuit breakers listed below to protect service personnel and property in case of component break-down in the frequency converter. For circuit breakers, Moeller types have been tested

and are recommended. Other types of circuit breakers may be used provided they limit the energy to a level equal to or lower than the Moeller types.

Frequency converter		EN50178 compliant fuses		UL Compliant fuses						Recommended circuit breaker	
				Bussmann			SIBA	Little fuse		IP20	IP55
		Size	Type	Type RK1	Type J	Type T	Type RK1	Type RK1	Type RK1	Moeller type	
200-240 V	CDS-15kW	125 A	gG	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	NZMB1-A100	NZMB2-A200
	CDS-18.5 kW	125 A	gG	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	NZMB2-A200	NZMB2-A200
	CDS-22 kW	160 A	gG	FWX-150	-	-	2028220-150	L255-150	A25X-150	NZMB2-A200	NZMB2-A200
380-480 V	CDS-15 kW	63 A	gG	KTS-R50	JKS-50	JJS-50	5014006-050	KLS-R50	A6K-50R	PKZM4-50	PKZM4-63
	CDS-18.5 Kw	63 A	gG	KTS-R60	JKS-60	JJS-60	5014006-063	KLS-R60	A6K-60R	NZMB1-A100	NZMB1-A100
	CDS-22 kW	80 A	gG	KTS-R80	JKS-80	JJS-80	2028220-100	KLS-R80	A6K-80R	NZMB1-A100	NZMB1-A100
525-600V	CDS-18.5 kW	40A	gG	KTS-R50	JKS-50	JJS-50	5014006-050	KLS-R50	A6K-50R	NZMB1-A100	-
	CDS-30 kW	63A	gG	KTS-R80	JKS-80	JJS-80	5014006-080	KLS-R80	A6K-80R	NZMB1-A100	-

Wire sizes

Below table lists recommended wiring sizes for the motor compressor power supply cables. These wiring sizes are valid for a cable length up to 20 m.



	From network to frequency converter			From frequency converter to compressor		
	Type	mm ²	AWG	Type	mm ²	AWG
200 - 240 V	CDS-15kW	25	4	VZH088-J	25	4
	CDS-18.5 kW	35	2	VZH117-J	35	2
	CDS-22 kW	50	1	VZH170-J	50	1
380 - 400 V	CDS-15 kW	6	10	VZH088-G	6	10
	CDS-18.5 Kw	10	8	VZH117-G	10	8
	CDS-22 kW	16	6	VZH170-G	16	6
525 - 600 V	CDS-18.5 kW (IP20)	10	8	VZH088-H	6	10
	CDS-30kW (IP20)	25	4	VZH117-H	10	8
	CDS-30kW (IP20)	25	4	VZH170H	16	6

Note: The wire size here is the guidelines but not the actual needed cable. The needed cable size should be specified by the OEM depending on the unit design, ambient temperature, the wire material, current, etc...

Wiring & EMC protection

The motor compressor power supply from the CDS303 frequency converter to the VZH compressor must be done with a braided screened / armored cable. This cable needs to have its screen / armor conduit connected to earth on both ends. Avoid terminating this cable connection with twisting ends (pigtails) because that would result in an antenna phenomena and decrease the effectiveness of the cable.

Control cables to the CDS303 frequency converter must use the same installation principles as the power supply cable.

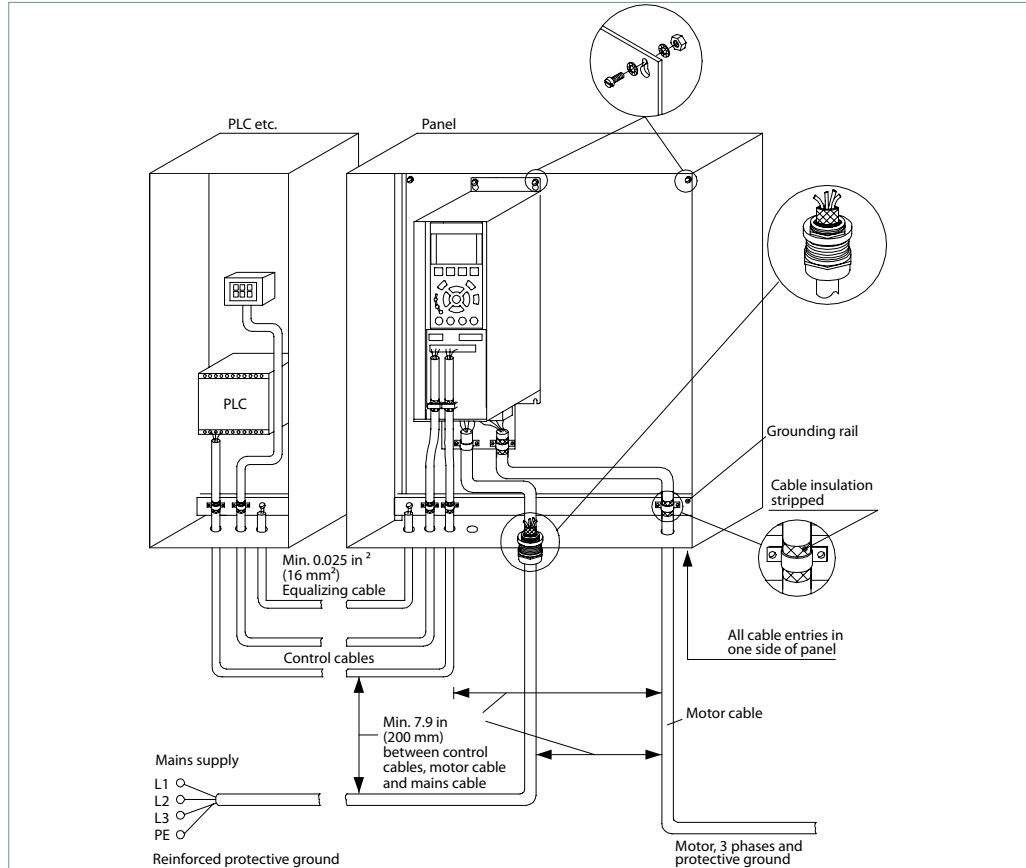
The motor compressor cable must be installed in a conduit separated from the control and mains cables.

Physical installation of the frequency converter on the mounting plate must ensure good electrical contact between the mounting plate and the metal chassis of the converter. Use star-washers and galvanically conductive installation plates to secure good electrical connections. Refer to instructions MG34M302 for tightening torques and screw sizes.

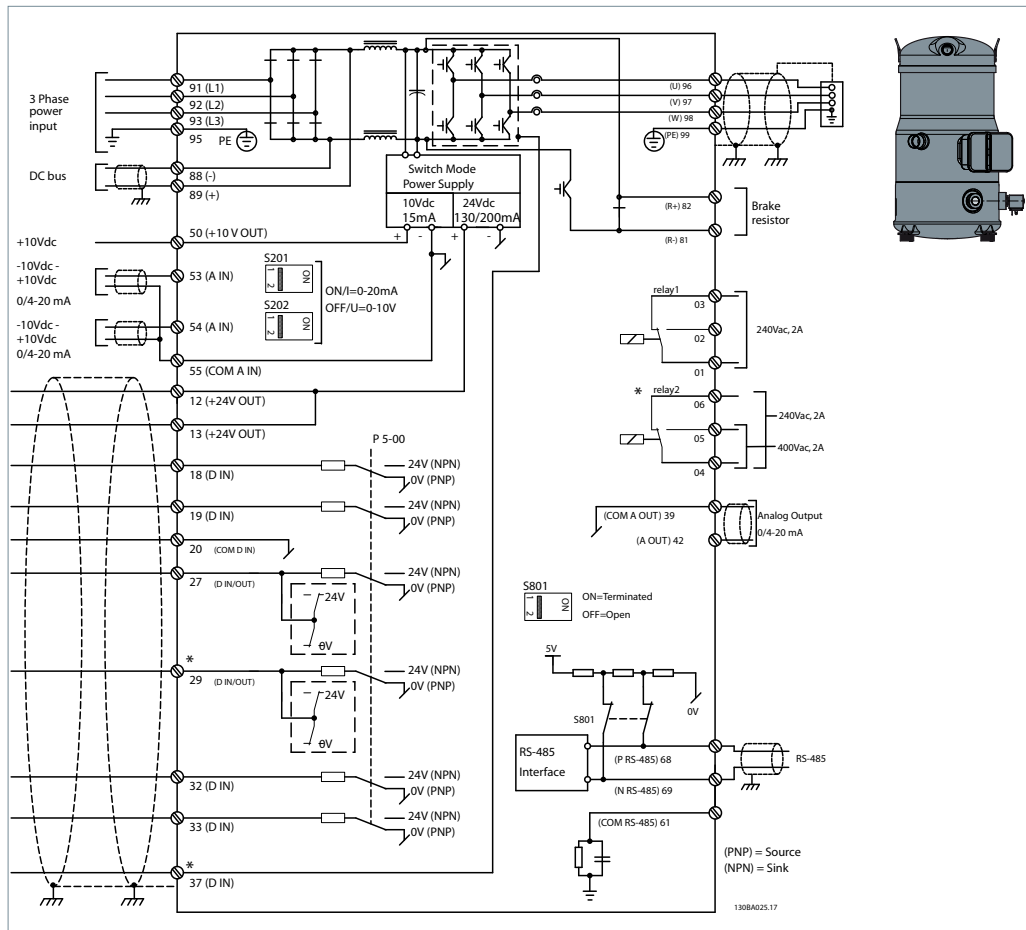
Note that the CDS303 must be mounted on a plain wall to ensure a good air flow through its heat exchanger.

EMC correct installation of an IP20 frequency drive CDS303

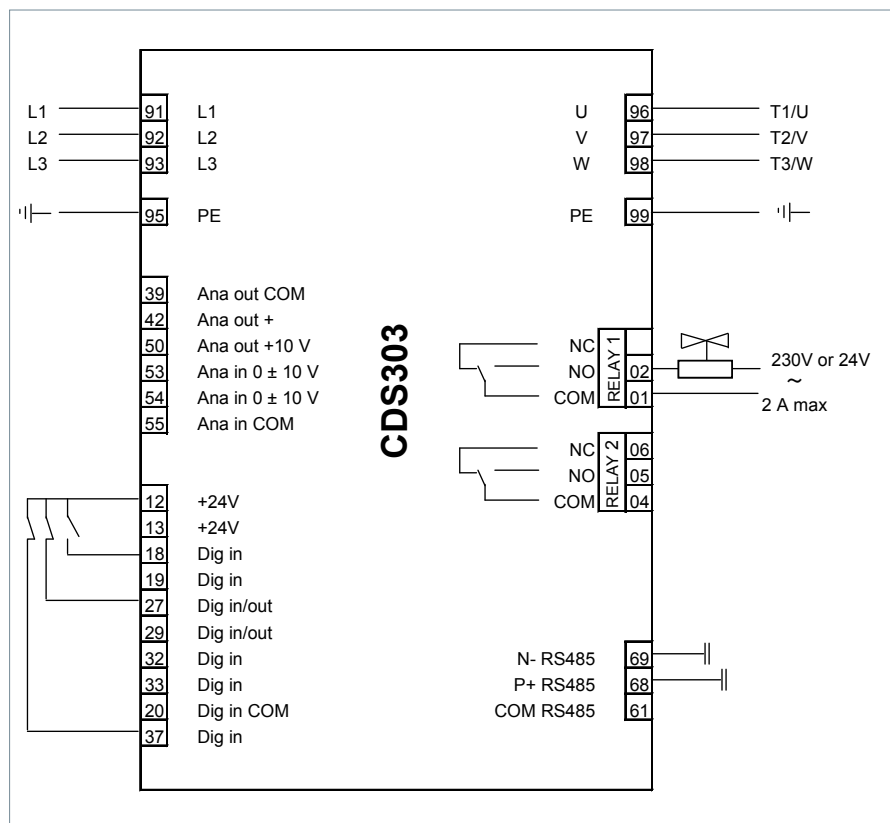
EMC qualification reports are available upon request to Danfoss technical support.



Wiring diagram



Wiring connections



- Legends:
- Ana: Analogue
 - Dig: Digital
 - in: Input
 - out: Output
 - COM: Common
 - NC: Normally-closed
 - NO: Normally-open

		Open loop	Process loop
91, 92, 93	3 Phase mains input	X	X
95	Earth	X	X
39, 42	Analogue output	-	-
50	Analogue output	-	-
53	PLC+ (0 to 10 V)	X	-
54	Sensor -	-	X
55	PLC-	X	-
12	HP/LP switch	X	X
12	External On/Off (NO)	X	X
13	Factory bridged to 37	X	X
13	Sensor +	-	X
18	External On/Off (NO)	X	X
19	Digital input	-	-
27	LP switch (NC) / safety devices	X	X
29	Digital input/output	-	-
32, 33	Digital input	-	-
20	Digital input Common	-	-
37	Factory bridged to 13 / HP switch	X	X
98	To compressor terminal T3	X	X
97	To compressor terminal T2	X	X
96	To compressor terminal T1	X	X
99	To compressor earth connection	X	X
02, 01	Relay 1 to oil solenoid valve	X	X
06, 05, 04	Relay 2	-	-
69, 68	RS485 Bus	-	-
61	RS485 Bus Common	-	-

-: Optional connection
X: Mandatory connection

The CDS303 frequency converter is factory preset with parameters for the open loop control principle. The process loop control principle can be selected by changing parameters in the «Quick menu».

Open loop: preset on input 53
0 - 10 V control

Frequency converter in slave mode

Process loop: preset on input 54

4 - 20 mA control

Frequency converter under own PID controller

T37 is CE and UL approved for STO, Safety Torque Function

Electrical connections

Electrical power is connected to the compressor terminals by Ø 4.8 mm (3/16") screws. The maximum tightening torque is 3 Nm. Use a 1/4" ring terminal on the power leads.

The cable gland has to be of EMC design to guarantee a good grounding of the armored cable. Paint free areas on electrical box allow correct ground continuity.

Soft-start control

The CDS303 frequency converter generates by design a compressor soft start with an default initial ramp up of 2700rpm/s.

Basically seen from the mains the inrush peak reach a level which is only a few percent more than the rated nominal current.

Current inrush will not exceed the frequency converter maximum current.

Phase sequency and reverse rotation protection

The CDS303 frequency converter is preset to run the VZH compressors clockwise so the only care is to properly connect the CDS303 output to the compressor connectors:

- CDS303 terminal U (96) to VZH terminal T1/U
- CDS303 terminal V (97) to VZH terminal T2/V
- CDS303 terminal W (98) to VZH terminal T3/W

Mains connection to the CDS303 frequency converter order has no influence on the output phase sequence which is managed by the frequency converter.

However, the connection between the drive and the compressor can still be mis-wired. Special attention needs to be paid and strictly follows wire connection instruction.

IP rating

The compressor terminal box IP rating according to CEI529 is IP54 when correctly sized IP54 rated cable glands are used.

Element	Numerals or letters	Meaning for the protection of equipment
First characteristic numeral	0 1 2 3 4 5 6	Against ingress of solid foreign objects (non protected) ≥ 50 mm diameter ≥ 12.6 mm diameter ≥ 2.5 mm diameter ≥ 1.0 mm diameter dust protected dust tight
Second characteristic numeral	0 1 2 3 4 5 6 7 8	Against ingress of water with harmful effects (non protected) vertically dripping dripping (15° tilted) spraying splashing jetting powerful jetting temporary immersion continuous immersion

Motor protection

Motor protection is provided by the frequency converter. All parameters are factory preset in order to guarantee locked rotor or overload current protection.

When a warning situation is reached in the current control, the CDS303 frequency converter will automatically reduce the compressor speed in order to keep the motor current of the compressor below the maximum allowed.

Voltage imbalance

The maximum allowable voltage imbalance between each phase is 3%. Voltage imbalance causes high amperage over one or several phases, which in turn leads to overheating and possible drive damage.

Then the compressor electrical motor is never affected by main voltage imbalance situations which are totally made transparent by the frequency converter.

Mains imbalance function in CDS303 frequency converter can be set to "[0] Trip" or "[1] Warning" in 14.12 parameter. It is, by default, factory preset to "[1] Warning".

Approvals and certificates

VZH compressors comply with the following approvals and certificates.

CE 0062 or CE 0038 (European Directive)		VZH code G & code J
UL (Underwriters Laboratories)		All VZH models
EMC 2004 / 108 / EC		All VZH models

Pressure equipment directive 97/23/EC

Products	VZH088	VZH117	VZH170
Fluids	Group 2		
Category PED	II		
Evaluation module	D1		
TS - service temperature LP	-35°C < TS < +55°C		-35°C < TS < +51°C
PS - service pressure LP	33.3 bar(g)	33.3 bar(g)	30.2 bar(g)

Internal free volume

Products	Internal free volume at LP side without oil (litre)
VZH088	12.7
VZH117	15.1
VZH170	29.9

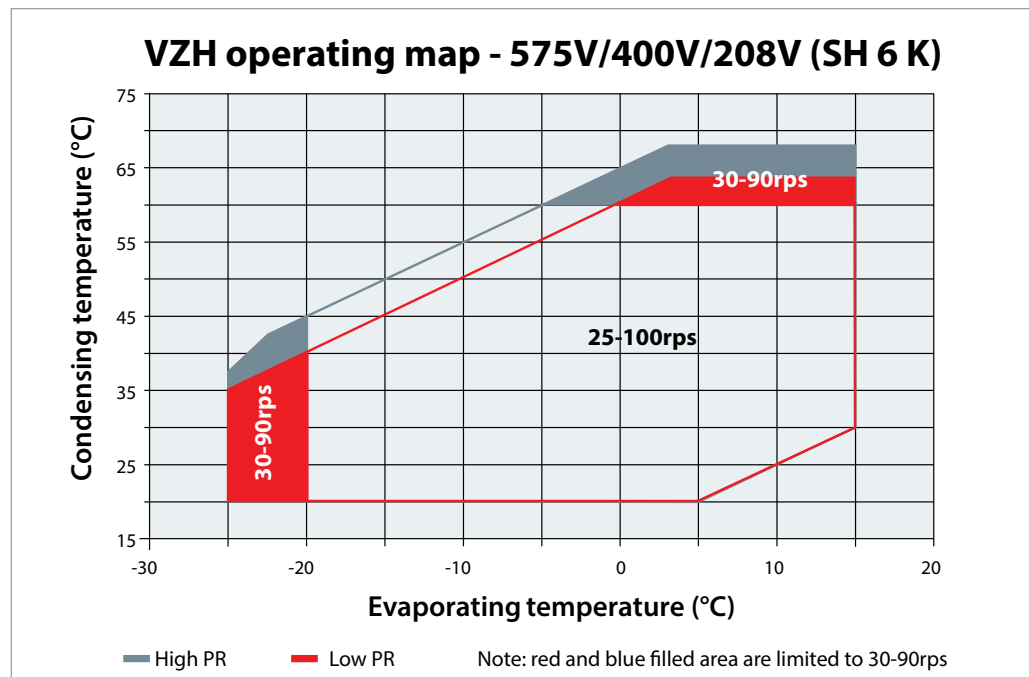
Application envelopes

The operating envelopes for VZH scroll compressors are given in the figures below, where the condensing and evaporating temperatures represent the range for steady state operation. Under transient conditions, such as start-up and defrost, the compressor may operate outside this envelope for short periods.

The figures below show the operating envelopes for VZH compressors with refrigerants R410A. Due to bearing loads and scroll stability, there will be speed restrictions on the envelopes. The operating limits serve to define the envelope within which reliable operations of the compressor are guaranteed:

- Maximum discharge gas temperature: +135°C.

- Minimum suction superheat should be above 5K and minimum sump superheat should be above 10K due to the risk of liquid flood back.
- Attention to suction line insulation to reduce usefulness superheat.
- Minimum and maximum evaporating and condensing temperatures as per the operating envelopes
- VZH drive could only protect compressor from over current. Customers need to have high pressure, low pressure sensor and discharge temperature thermostat to fully protect the envelop. Since out of map running will threaten the reliability of compressor, customers must qualify map protection under all extreme conditions.



Note: W64 warning will not influence compressor running, the warning indicates voltage is reaching limits. Only alarms will stop the compressor.
 for 380V power input, permitted highest condensing temperature will decrease accordingly:
 -High PR: 25-100rps, condensing temperature from 60C to 56C; 30-90rps, condensing temperature from 68C to 65C
 -Low PR: 25-100 rps, condensing temperature from 60C to 56C; 30-90 rps, condensing temperature from 63C to 62C.

Short cycle timer function

Short cycle control is directly provided by the CDS303 frequency converter, when parameter 28.0x is enabled.
 The function is factory set to enabled, with minimum running time 12 seconds and interval between starts 300 seconds.
 Short cycle settings are accessible in parameter 28.0x list, in the "compressor functions" menu.

When fully controlled from an external main controller it is recommended to limit to 12 the number of start / stop per hour.

Please note to ensure compressor is well lubricated, it is required to keep VZH compressor running at least 3 minutes each time after start.

Discharge gas temperature protection function

A discharge temperature monitor function can be enabled in the frequency converter. All settings are available in parameter list 28.2x, they are factory preset as follow:

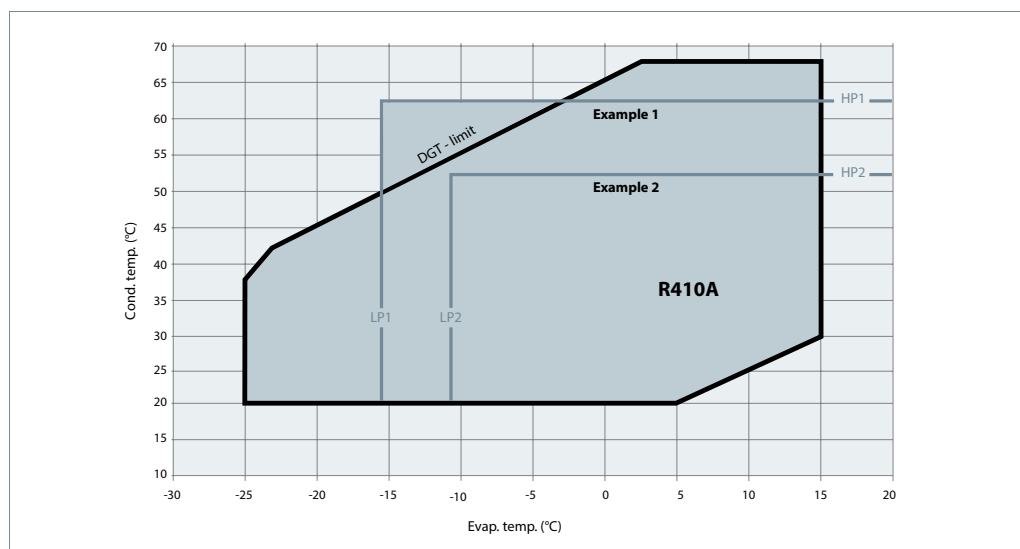
- 28.20: [0] none - temperature source (sensor input)
- 28.21: [60] °C - temperature unit
- 28.24: 130 - warning level
- 28.25: [1] decrease cooling - warning action
- 28.26: 145 - emergency level
- 28.27: is the actual discharge temperature measured by the sensor.

To activate the discharge temperature monitor function, with the factory setting, the only modification required is to connect the sensor to Analog Input 54 (4 - 20 mA) between 13 and 54, and set the parameter 28.20 to "[2] Analog input 54". When the warning level is reached "decrease cooling" action starts by decreasing the compressor speed by steps of 10 rps(600rpm) every 3 minutes until the temperature, either drops below the level, programmed in parameter 28.24 (warning level) or exceed the level programmed in parameter 28.26 (emergency level). When the emergency level is reached, the compressor is stopped and the frequency converter shows an "alarm".

Discharge gas thermostat

Discharge gas temperature (DGT) protection is required if the high and low pressure switch settings do not protect the compressor against operations beyond its specific application

envelope. Please refer to the examples below, which illustrate where DGT protection is required (Ex. 1) and where it is not (Ex. 2).



Example 1 (R410A, SH = 6 K)
 LP switch setting:
 LP1 = 3.3 bar (g) (-15.5°C)
 HP switch setting:
 HP1 = 38 bar (g) (62°C)
 Risk of operation beyond the application envelope.
 DGT protection required.

Example 2 (R410A, SH = 6 K)
 LP switch setting:
 LP2 = 4.6 bar (g) (-10.5°C)
 HP switch setting:
 HP2 = 31 bar (g) (52°C)
 No risk of operation beyond the application envelope.
 No DGT protection required.

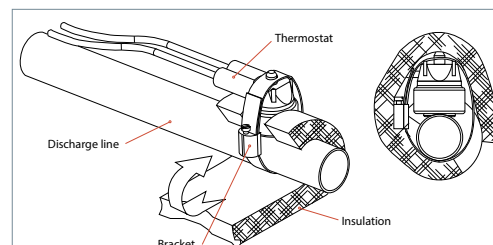
The discharge gas temperature must not exceed 135°C.

A discharge gas temperature protection device must be installed on all heat pumps. In reversible air-to-air and air-to-water heat pumps the discharge temperature must be monitored during development test by the equipment manufacturer.

The compressor must not be allowed to cycle on the discharge gas thermostat. Continuous operations beyond the compressor's operating range will cause serious damage to the compressor!

A DGT accessory is available from Danfoss: refer to accessories pages at the end of this document.

The discharge gas thermostat accessory kit (code no.7750009) includes all components required for installation, as shown below. The thermostat must be attached to the discharge line within 150 mm from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe.



Oil return management function (single compressor)

Insufficient oil level can be the result of oil depositing itself in pipes and heat exchangers. The oil deposit can be returned to the crankcase, by increasing velocity for short periods, at regular time intervals or when velocity is too low to ensure adequate oil returns.

With oil return management these two oil return mechanisms can be programmed in the CDS303.

With oil return management function enabled, the CDS303 performs oil return by boosting the compressor speed to 4200 rpm (70 rps) for a selectable duration as programmed in parameter 28.13. The boosts are performed at fixed time intervals (as programmed in parameter 28.12) or if the compressor speed has been less than 3000

rpm (50 rps) for too long (as programmed in 28.11) whichever occurs first. Thus the maximum time between two consecutive oil return boosts is programmed in 28.12.

ID	Name	Factory Setup	"long pipe (25-30m)"	Unit
2810	Oil Return Management	On	On	
2811	Low Speed Running Time	60	30	min
2812	Fixed Boost Interval	24	6	h
2813	Boost Duration	30	60	s

Considering oil return risk, split system with more than 10m piping length need mandatory application approval by Danfoss application specialists.

Oil return management in hybrid manifolding

Use the accessory "oil level switch" with the appropriate compressor housing having the

fitting preassembled and refer to "VZH hybrid manifolding" section at the end of this document.

High and low pressure protection

High pressure

According to EN378-2, a high-pressure (HP) safety switch is required to shut down the compressor. The high-pressure switch can be set to lower values depending on the application and ambient conditions. The HP switch must either be placed in a lockout circuit or consist of a manual reset device to prevent cycling around the high-

pressure limit. If a discharge valve is used, the HP switch must be connected to the service valve gauge port, which must not be isolated. The HP switch must be connected to the CDS303 input 37 or an external contactor placed between the drive and the compressor.

Low pressure

A low-pressure (LP) safety switch must be used. Deep vacuum operations of a scroll compressor can cause internal electrical arcing and scroll instability. VZH compressors exhibit high volumetric efficiency and may draw very low vacuum levels, which could induce such a problem. The minimum low-pressure safety switch (loss-of-charge safety switch) setting is given in the following table. For systems without

pump-down, the LP safety switch must either be a manual lockout device or an automatic switch wired into an electrical lockout circuit. The LP switch tolerance must not allow for vacuum operations of the compressor. LP switch settings for pump-down cycles with automatic reset are also listed in the table below. Lock-out circuit or LP switch or series with other safety devices must be connected to CDS303 input 27.

Pressure settings

Pressure settings		R410A
Working pressure range high side	bar (g)	13.5 - 44.5
Working pressure range low side	bar (g)	2.3 - 11.6
Maximum high pressure safety switch setting	bar (g)	45
Minimum low pressure safety switch setting *	bar (g)	1.5
Minimum low pressure pump-down switch setting **	bar (g)	2.3

*LP safety switch shall never be bypassed.

** Recommended pump-down switch settings: 1.5 bar below nominal evaporating temperature with minimum of 2.3

Electronic expansion valve

With variable capacity systems, an electronic expansion valve (EXV) is the mandatory solution to handle refrigerant mass flow variations. Danfoss recommend to use ETS products. Ramp-up and ramp-down settings, of both EXV and compressor, must be done with great care. Customer could also use thermostatic expansion valve (TXV) if they have qualified their systems and get Danfoss approval.

Ramp-up of the EXV must be shorter than the ramp-up of the compressor, to avoid any low pressure operation on suction side of the compressor. The EXV can also be opened, up to a certain degree, before the start up of the compressor.

Ramp-down of the EXV must be longer than the ramp-down of the compressor, also to avoid low pressure operation (except with pump-down).

EXV should be closed, and remained closed, when the compressor is off, to avoid any liquid refrigerant entering the compressor.

It is recommended to use expansion valve with MOP (Maximum Operating Pressure) function. MOP is a feature added to EXV's (also to TXV's) that limit the maximum suction pressure of the unit. The customer would need to set this at the 15°C limit we have on our VS operating envelope. Regardless of EXV or TXV, customer needs to qualify the expansion device. Testing needs to be done at both max and min operating conditions to guarantee the valve closes enough on the min and opens far enough on the max.

Crankcase heating function

A DC-hold current through the motor windings can be used as an alternative to an external crankcase heater to keep the compressor warm when stopped.

For VZH088 and VZH117 this function is factory preset to "disabled". Go to parameter 28.3x in the frequency converter for settings (factory presets are done).

For VZH170, this function must not be used and is factory preset to "disabled". An external crankcase heater is required, and surface sump heater type should be preferred. Refer to accessory list for code numbers.

28-3* Crankcase heating	VZH088-J	VZH117-J	VZH170-J	VZH088-G	VZH117-G	VZH170-G	VZH088-H	VZH117-H	VZH170-H	
Enabled / disabled	28-30	Enabled	Enabled	Disabled	Enabled	Enabled	Disabled	Enabled	Enabled	Disabled
Heating DC current(A)	28-31	19.4	22.9	-	16.5	18.0	-	16.5	18.0	-
Crankcase Heating Delay	28-32					5s				

Essential piping design considerations

The working pressure in systems with R410A is about 60% higher than in systems with R22 or R407C. Consequently, all system components and piping must be designed for this higher pressure level.

Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and slope of the tubing coming from the evaporator. Tubing returns from the evaporator should be designed so as not to trap oil and to prevent oil and refrigerant migration back to the compressor during off-cycles. In systems with R410A, the refrigerant mass flow will be lower compared to R22/R407C systems. To maintain acceptable pressure

drops and acceptable minimum gas velocities, the refrigerant piping must be reduced in size compared to R22 / R407C systems. Take care not to create too high pressure drops neither since in R410A systems the negative impact of high pressure drops on the system efficiency is stronger than in R22/R407C systems. The design in this guideline is for short circuit application. But for long circuit and split system application, oil separator is recommended to use based on system qualification status. CDS303 frequency converter integrates a special feature in the compressor functions in order to improve and secure the oil recovery from the system. Refer to "Oil Return Management" section.

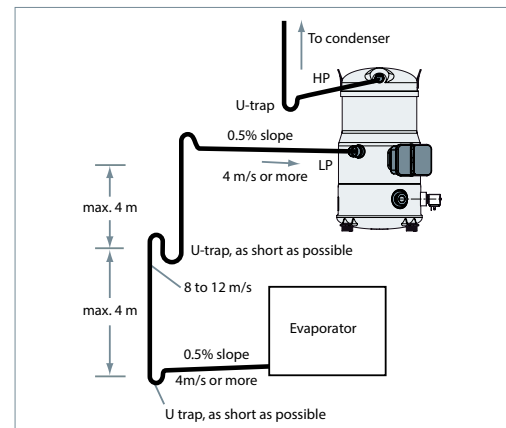
Piping should be designed with adequate three-dimensional flexibility. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. This protection proves necessary to avoid excess vibration, which can ultimately result in connection or tube failure due to fatigue or wear from abrasion. Aside from

tubing and connection damage, excess vibration may be transmitted to the surrounding structure and generate an unacceptable noise level within that structure as well. For more information on noise and vibration, see "Sound and Vibration Management" section.

Suction lines

If the evaporator lies above the compressor, as is often the case in split or remote condenser systems, the addition of a pump-down cycle is strongly recommended. If a pump-down cycle were to be omitted, the suction line must have a loop at the evaporator outlet to prevent refrigerant from draining into the compressor during off-cycles.

If the evaporator were situated below the compressor, the suction riser must be trapped so as to prevent liquid refrigerant from collecting at the outlet of the evaporator while the system is idle, which would mislead the expansion valve's sensor (thermal bulb) at start-up.



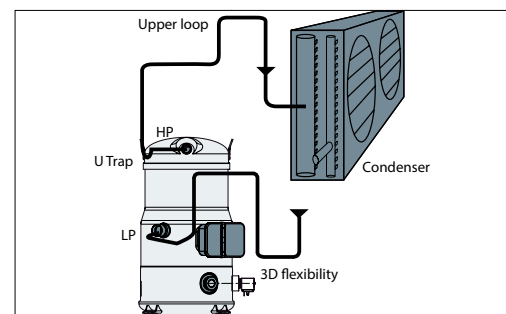
Discharge lines

When the condenser is mounted at a higher position than the compressor, a suitably sized «U»-shaped trap close to the compressor is necessary to prevent oil leaving the compressor from draining back to the discharge side of the compressor during off cycle. The upper loop also helps avoid condensed liquid refrigerant from draining back to the compressor when stopped. For Inverter applications with long lines it is recommended to use an oil separator even if it is only the condenser which is far away from the unit.

Piping design must also be made with care in order to make sure the remaining oil not trapped by the oil separator is well carried over the system.

Basic principal is shown here. Note that for the discharge line, same concept as for suction line with U-trap every 4 m must be applied between

discharge U-trap and upper U-trap when the condenser is above the compressor unit. It is also recommend installing one check valve on the discharge line to the condenser next to the condenser to avoid the possibility of having the discharge tube full of liquid during off cycles; discharge lines flooded by liquid being able to create start-up issues by drive over-torque or HP switch trip.



Oil management

Compressors discharge a small percentage of oil that is mixed with the compressed refrigerant. The oil is circulated through the system and the compressor is dependent on the system design to bring it back. The use of variable speed compressor technology in systems with long piping, especially for split systems, is among the most challenging configurations for oil return. In order to prevent compressors from breaking down due to oil level issues, Danfoss requires the use of an oil separator in all long piping systems, particularly for split systems.

Variable speed compressors used in split systems as well as long piping provide an increased challenge to system oil management due to the reduced velocities at low speed operation. Low oil velocity can cause oil deposits in pipes, heat exchangers and other system components that can cause an insufficient oil level inside the compressor.

It is the responsibility of the systems OEM to ensure the proper oil return to the compressors including the qualification of all possible operating modes, equipment configurations and accessory options (multiple evaporators, reheat coils for example) that could impact oil return to the compressors.

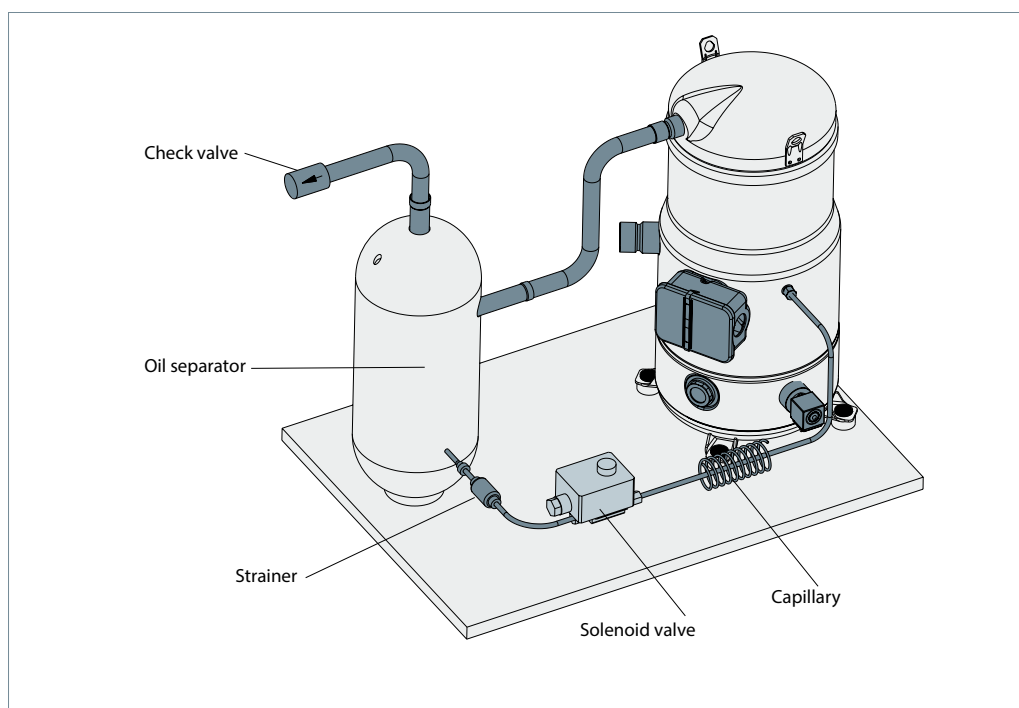
Especially for split systems using variable speed compressors, in which every installation is unique and qualification of individual installations is not practical, Danfoss requires that OEMs install an oil separator.

The requirement of an oil separator is also suitable for any other system with complex piping (long line set, U trap...), multiple heat exchangers and elevation changes.

Many oil separator designs exist, the selection, requirements and recommendations of the Oil Separator manufacturer should be followed.

Customers have the opportunity to select Chiyoda (CE marked) since it has been tested successfully by Danfoss. Detailed information hereafter.

Please note that an oil separator is not 100% efficient. A good system design and efficient oil management remain essential.



Compressor		VZH088	VZH117	VZH170
Brand		Chiyoda		
Contact information		Email: sales@chiyodaseiki.com Tel: +86(512)62833498 Address: No.1 Sheng gang Rd, Suzhou Industrial Park, Jiang su,PRC, China. Website: http://www.chiyodaseiki.com/		
Model		OS-165DF088CE	OS-165DF117CE	OS-165DF170CE
outline				
"OS separator (CE)"				
Type		centrifugal		
ΦD: Outer Diameter(mm)		Φ165.2	Φ165.2	Φ165.2
Volume(L)		7.2	8.3	10.5
Inlet size(in)		7/8"	7/8"	1"1/8"
outlet size (in)		7/8"	7/8"	1"1/8"
Footprint LxW(mm x mm)		190.5x102		
H1: Height(mm)		297	355	469
H2: Height(mm)		457	515	635
H: Height(mm)		469	527	645
Capillary tube		Inner diameter(mm) Φ1.6 Φ1.8 Φ1.8 length(mm) 1400 1530 1380		
Strainer		Mesh size 100 100 100 Orifice(mm) Φ2.0		
Solenoid valve		code number 032F1201 connection(in) 1/4"		
solenoid coil		"Model: Danfoss (Orifice Φ2.0) (CE)" "24V 50Hz AC" code number 018F6257 specification 1m 3-core cable "220-230V 50/60Hz AC" code number 018F6282 specification 1m 3-core cable		

Customers can of course contact Danfoss application engineers for support regarding recommendations in such systems.

Heat exchangers

To obtain optimum efficiency of the complete refrigerant system, optimized R410A heat exchangers must be used. R410A refrigerant has good heat transfer properties: it is worthwhile designing specific heat exchangers to gain in size and efficiency.

An evaporator with optimized R410A distributor and circuit will give correct superheat at outlet and optimal use of the exchange surface. This is critical for plate evaporators that have generally a shorter circuit and a lower volume than shell & tubes and air cooled coils.

For all evaporator types a special care is required for superheat control leaving the evaporator and oil return.

A sub-cooler circuit in the condenser that creates high sub-cooling will increase efficiency at high condensing pressure. In R410A systems the positive effect of sub-cooling on system efficiency will be significantly larger than in R22/R407C systems.

Furthermore, for good operation of the expansion device and to maintain good efficiency in the evaporator it is important to have an adequate liquid sub-cooling. Without adequate sub-cooling, flash gas will be formed at the expansion device resulting in a high degree of vapour at the evaporator inlet leading to low efficiency.

Refrigerant charge limits

VZH compressors can tolerate liquid refrigerant up to a certain extend without major problems. However, excessive liquid refrigerant in the compressor is always unfavourable for service life. Besides, the installation cooling capacity may be reduced because of the evaporation taking place in the compressor and/or the suction line instead of the evaporator. System design must be such that the amount of liquid refrigerant in the compressor is limited. In this respect, follow the guidelines given in the section: "Essential piping design recommendations" in priority.

If the refrigerant charge exceeds the values in below table, a suction line accumulator is strongly recommended.

Model	Refrigerant charge limit (kg)
VZH088	5.9
VZH117	7.9
VZH170	13.5

More detailed information can be found in the paragraphs hereafter. Please contact Danfoss technical support for any deviation from these guidelines.

Off-cycle migration

Liquid refrigerant can find its way into the compressor by means of off-cycle migration or liquid floodback during operation.

Off-cycle refrigerant migration is likely to occur when the compressor is located at the coldest part of the installation, when the system uses a bleed-type expansion device, or if liquid is allowed to migrate from the evaporator into the compressor sump by gravity. If too much liquid refrigerant accumulates in the sump it will saturate the oil and lead to a flooded start: when the compressor starts running again, the refrigerant evaporates abruptly under the sudden decrease of the bottom shell pressure, causing the oil to foam. In extreme situations, this might result in liquid slugging (liquid entering the scroll

elements), which must be avoided as it causes irreversible damage to the compressor.

The presence of liquid in the crankcase can be easily detected by checking the sump level through the oil sight glass. Foam in the oil sump indicates a flooded start.

VZH scroll compressors can tolerate occasional flooded starts as long as the total system charge does not exceed the maximum compressor refrigerant charge limit.

Off-cycle migration can be prevented by implementing a crankcase heating or adding a pump-down cycle to the operation cycle and a liquid line solenoid valve.

Crankcase heater / sump heater: When the compressor is idle, the oil temperature in the sump of the compressor must be maintained at no lower than 10 K above the saturation temperature of the refrigerant on the low-pressure side. This requirement ensures that the liquid refrigerant is not accumulating in the sump.

A crankcase heater is only effective if capable of sustaining this level of temperature difference. Tests must be conducted to ensure that the

appropriate oil temperature is maintained under all ambient conditions (temperature and wind).

Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (eg. seasonal shut-down).

Refer to section “Crankcase heating function” for details and settings of crankcase heating function integrated in the drive.

Liquid line solenoid valve (LLSV): An LLSV may be used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer or excessive migration to the compressor during off-cycles. When installed,

EXV ensures also this function. The quantity of refrigerant on the low-pressure side of the system can be further reduced by using a pump-down cycle in association with the LLSV.

Pump-down cycle: A pump-down cycle represents one of the most effective ways to protect against the off-cycle migration of liquid refrigerant. Once the system has reached its set point and is about to shut off, the LLSV on the condenser outlet closes. The compressor then pumps the majority of the refrigerant charge into the condenser and receiver before the system

stops on the low pressure pump-down switch. This step reduces the amount of charge on the low side in order to prevent off-cycle migration. The recommended low-pressure pump-down switch setting is 1.5 bar below the nominal evaporating pressure. It shall not be set lower than 2.3 bar.

Liquid receiver: Refrigerant charge optimisation varies with compressor speed. To avoid flash gas at low speed, a receiver may be necessary. Receiver dimensioning requires special attention.

The receiver shall be large enough to contain part of the system refrigerant charge, but shall not be too large, to avoid refrigerant overcharging during maintenance operations.

Liquid floodback during operation

Liquid floodback occurs when liquid refrigerant returns to the compressor when it is running. During normal operation, refrigerant leaves the evaporator and enters the compressor as a superheated vapour. The suction gas can still contain liquid refrigerant for example with a wrong dimensioning, a wrong setting or malfunction of the expansion device or in case of evaporator fan failure or blocked air filters. A continuous liquid floodback will cause oil dilution and, in extreme situations, lead to liquid slugging.

VZH scroll compressors can tolerate occasional liquid floodback. However system design must be such that repeated and excessive floodback is not possible.

During operations, liquid floodback may be detected by measuring either the oil sump temperature or the discharge gas temperature. If at any time during operations, the oil sump temperature drops to within 10K or less above the saturated suction temperature, or should the discharge gas temperature be less than 35K above the saturated discharge temperature, this indicates liquid floodback.

Low ambient compressor operations
Low ambient operations and minimum pressure differential at steady running conditions

The VZH compressor requires a minimum pressure differential of 6 to 7 bar between the suction and discharge pressures to force the orbiting scroll-down against the oil film on the thrust bearing. Anything less than this differential and the orbiting scroll can lift up, causing a metal-to-metal contact. It is therefore necessary to maintain sufficient discharge pressure in order to ensure this pressure differential. Care

should be taken during low ambient operations when heat removal from air-cooled condensers is greatest and head pressure control may be required for low ambient temperature applications. Operation under low pressure differential may be observed by a significant increase in the sound power level generated by the compressor.

Low ambient start-up

Under cold ambient conditions, upon start-up the pressure in the condenser may be so low that a sufficient pressure differential across the expansion device cannot be developed to properly feed the evaporator. As a result, the compressor may go into abnormal low suction pressure, which can lead to compressor failure. Under no circumstances should the compressor be allowed to operate under vacuum. The low-pressure control must be set in accordance with

the table section "Pressure settings" in order to prevent this from happening.

Low pressure differentials can also cause the expansion device to "hunt" erratically, which might cause surging conditions within the evaporator, with liquid spillover into the compressor. This effect is most pronounced during low load conditions, which frequently occur during low ambient conditions.

Head pressure control under low ambient conditions

Several possible solutions are available to prevent the compressor from drawing down to a vacuum upon start-up under low ambient conditions. In air-cooled machines, cycling the fans with a head pressure controller will ensure that the fans remain off until the condensing pressure has reached a satisfactory level. In water-cooled units, the same can be performed using a water regulator valve that is also operated by head pressure, thereby ensuring that the water valve does not open until the condensing pressure reaches a satisfactory level.

Under very low ambient conditions, in which testing has revealed that the above procedures might not ensure satisfactory condensing and suction pressures, the use of a liquid receiver with condenser and receiver pressure regulators would be possible.

Condensing pressure control is also strongly recommended to improve any system efficiency. The most accurate value is to control the condensing temperature at 12 K above the ambient temperature for air cooled condensers.

Note: The minimum condensing pressure must be set at the minimum saturated condensing temperature shown in the application envelopes.

For further information, please contact Danfoss Technical support.

Crankcase heaters

A crankcase heating will minimize refrigerant migration caused by the large temperature gradient between the compressor and the remainder of the system.

Surface sump or belt type crankcase heaters can be used, see section "Accessory". They must be connected to the CDS303 relay 2.

Low load operations

It is recommended that the unit be tested and monitored at minimum load and, if possible, during low ambient conditions as well. During conditions of low load on the system, the following considerations should be taken into account to ensure proper system operating characteristics.

- The superheat setting of the expansion device should be sufficient to ensure proper superheat levels during low loading periods. 5 to 6 K stable superheat is required. In addition, the refrigerant charge should be sufficient to ensure proper sub-cooling within the condenser so as to avoid the risk of flashing in the liquid line before the expansion device. The expansion device should be sized to ensure proper control of the refrigerant flow into the evaporator.

An oversized valve may result in erratic control. This can lead to liquid refrigerant entering the compressor if the expansion valve does not provide stable refrigerant super-heat control under varying loads.

- Condenser fans should be cycled in such a way that the minimum pressure differential is maintained between the suction and discharge pressures. Inverter fans can also be used to control the amount of heat to be removed from the condenser.

- The compressors should be run for a minimum period in order to ensure that the oil has sufficient time to properly return to the compressor sump and that the motor has sufficient time to cool under conditions of lowest refrigerant mass flows.

Refer to section “Oil return management function”.

Brazed plate heat exchangers

A brazed plate heat exchanger needs very little internal volume to satisfy the set of heat transfer requirements. Consequently, the heat exchanger offers very little internal volume for the compressor to draw vapour from on the suction side. The compressor can then quickly enter into a vacuum condition. It is therefore important that the expansion device be sized correctly and that a sufficient pressure differential across the expansion device be available to ensure adequate refrigerant feed into the evaporator. This aspect is of special concern when operating the unit under low ambient and load conditions. For further information on these conditions, please refer to the previous sections.

Due to the small volume of the brazed plate heat exchanger, no pump-down cycle is normally required.

The suction line running from the heat exchanger to the compressor must be trapped to avoid refrigerant migration to the compressor.

When using a brazed plate condenser heat exchanger, a sufficient free volume for the discharge gas to accumulate is required in order to avoid excess pressure build-up. At least 1 meter of discharge line is necessary to generate this volume. To help reduce the gas volume immediately after start-up even further, the supply of cooling water to the heat exchanger may be opened before the compressor starts up so as to remove superheat and condense the incoming discharge gas more quickly.

Because of the large compressor capacity variation and VZH capability to run at low condensing temperature an EXV (electronic expansion valve) is mandatory.

Reversible heat pump systems

Transients are likely to occur in reversible heat pump systems, i.e. a changeover cycle from cooling to heating, defrost or low-load short cycles. These transient modes of operation may lead to liquid refrigerant carry-over (or flood-back) or excessively wet refrigerant return conditions. As such, reversible cycle applications require specific precautions for ensuring a long compressor life and satisfactory

operating characteristics. Regardless of the refrigerant charge in the system, specific tests for repetitive flood-back are required to confirm whether or not a suction accumulator needs to be installed. The following considerations cover the most important issues when dealing with common applications. Each application design however should be thoroughly tested to ensure acceptable operating characteristics.

Discharge temperature monitoring

Heat pumps frequently utilize high condensing temperatures in order to achieve a sufficient temperature rise in the medium being heated. At the same time, they often require low evaporating pressures to obtain sufficient temperature differentials between the evaporator and the outside temperature. This situation may result in high discharge temperature; as such, it is mandatory that a discharge gas safety control is carried to protect the compressor from excessive

temperatures. Operating the compressor at too high discharge temperatures can result in mechanical damage to the compressor as well as thermal degradation of the compressor lubricating oil and a lack of sufficient lubrication.

Refer to section “Discharge gas temperature protection” function for frequency converter settings and accessories availability.

Discharge line and reversing valve

The VZH scroll compressor is a high volumetric machine and, as such, can rapidly build up pressure in the discharge line if gas in the line becomes obstructed even for a very short period of time which situation may occur with slow-acting, reversing valves in heat pumps. Discharge pressures exceeding the operating envelope may result in nuisance high-pressure switch cutouts and can generate excessive load on bearings and motor.

gas to collect and to reduce the pressure peak during the time it takes for the valve to change position. At the same time, it is important that the selection and sizing of the reversing or 4-way valve ensure that the valve switches quickly enough to prevent against too high discharge pressure and nuisance high-pressure cutouts.

To prevent such occurrences, it is important that a 1-meter minimum discharge line length be allowed between the compressor discharge port and the reversing valve or any other restriction. This gives sufficient free volume for the discharge

Check with the valve manufacturer for optimal sizing and recommended mounting positions.

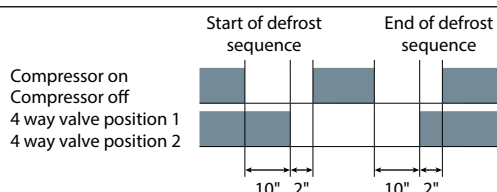
It is strongly recommended to reduce the compressor speed to 25/30 rps before the 4-way valve is moved from a position to another.

Refer also to high and low pressure protection.

Defrost and reverse cycle

After the 4-way valve is moved to defrost position, and in order to shorten the defrost period, the compressor speed can be maintained at 70 rps during the defrost period.

When the compressor is started again, after defrost, it will run at 25/30 rps for a 10 seconds period. After this period it is recommended to maintain the speed at 50 rps for 10 to 15 seconds. Thus to avoid excessive liquid refrigerant to come back to the compressor sump.

Defrost cycle logic


In order to limit liquid amount handled by the compressor when beginning & ending defrost, below defrost cycle logic is suggested:

- stop the compressor before moving the 4 way valve:

- step 1: stop the compressor
- step 2: wait for 10 seconds
- step 3: move the 4 way valve
- step 4: wait for 2 seconds
- step 5: restart the compressor

Defrost cycle logic must respect all system components recommendations, in particular 4 way valve Max. Operating Pressure Differential.

EXV can also be opened when the compressor is stopped and before 4 way valve is moving in order to decrease pressure difference. Opening degree and time have to be set in order to keep a minimum pressure for 4 way valve moving. Danfoss recommend above defrost cycle logic, but the control logic is also system specified.

Application Guidelines
Specific application recommendations
Single compressors
Suction line accumulator

The use of a suction line accumulator is strongly recommended in reversible-cycle applications. This because of the possibility of a substantial quantity of liquid refrigerant remaining in the evaporator, which acts as a condenser during the heating cycle.

This liquid refrigerant can then return to the compressor, either flooding the sump with refrigerant or as a dynamic liquid slug when

the cycle switches back to a defrost cycle or to normal cooling operations.

Sustained and repeated liquid slugging and floodback can seriously impair the oil's ability to lubricate the compressor bearings. This situation can be observed in wet climates where it is necessary to frequently defrost the outdoor coil in an air source heat pump. In such cases a suction accumulator becomes mandatory.

Water utilizing systems

Apart from residual moisture in the system after commissioning, water could also enter the refrigeration circuit during operation. Water in the system shall always be avoided. Not only because it can shortly lead to electrical failure, sludge in sump and corrosion but in particular because it can cause serious safety risks.

Common causes for water leaks are corrosion and freezing.

Corrosion: Materials in the system shall be compliant with water and protected against corrosion.

Freezing: When water freezes into ice its volume expands which can damage heat exchanger walls and cause leaks. During off periods water inside heat exchangers could start freezing when ambient temperature is lower than 0°C. During on periods ice banking could occur when the circuit is running continuously at too low load. Both situations should be avoided by connecting a pressure and thermostat switch in the safety line.

Running sound level

For all VZH models, noise level given in table doesn't include inferior hood attenuation.

Model	Frequency RPS	200V		400V		575V	
		Without acoustic hood (dBA)	With acoustic hood (dBA)	Without acoustic hood (dBA)	With acoustic hood (dBA)	Without acoustic hood (dBA)	With acoustic hood (dBA)
VZH088	30	70	64	69	62	72	66
	60	78	73	77	72	79	73
	90	86	80	85	79	88	82
VZH117	30	73	67	71	64	72	66
	60	82	77	80	75	82	76
	90	88	83	87	81	91	85
VZH170	30	72	66	72	65	77	71
	60	84	78	85	78	85	79
	90	95	90	94	89	95	89

Average sound power for reference at ARI A/C conditions measured in free space.
 Note: running sound level for 575V VZH is preliminary data

Sound generation in a refrigeration or air conditioning system

Typical sound and vibration in refrigeration and air conditioning systems encountered by design and service engineers may be broken down into the following three source categories.
Sound radiation: this generally takes an airborne path.

Mechanical vibrations: these generally extend along the parts of the unit and structure.
Gas pulsation: this tends to travel through the cooling medium, i.e. the refrigerant.

The following sections focus on the causes and methods of mitigation for each of the above sources.

Compressor sound radiation

For sound radiating from the compressor, the emission path is airborne and the sound waves are travelling directly from the machine in all directions.
 The VZH scroll compressor is designed to be quiet and the frequency of the sound generated is pushed into the higher ranges, which not only are easier to reduce but also do not generate the penetrating power of lower-frequency sound.
 Use of sound-insulation materials on the inside of unit panels is an effective means of substantially

reducing the sound being transmitted to the outside. Ensure that no components capable of transmitting sound/vibration within the unit come into direct contact with any non insulated parts on the walls of the unit.
 Because of the VZH unique design of a full-suction gas-cooled motor, compressor body insulation across its entire operating range is possible. Acoustic hoods are available from Danfoss as accessories. These hoods are quick and easy to install and do not increase the overall size of the compressors to a great extend.

Mechanical vibrations

Vibration isolation constitutes the primary method for controlling structural vibration. VZH scroll compressors are designed to produce minimal vibration during operations. The use of rubber isolators on the compressor base plate or on the frame of a manifolded unit is very effective in reducing vibration being transmitted from the compressor(s) to the unit. Once the supplied rubber grommets have been properly mounted, vibrations transmitted from the compressor base

plate to the unit are held to a strict minimum. In addition, it is extremely important that the frame supporting the mounted compressor be of sufficient mass and stiffness to help dampen any residual vibration potentially transmitted to the frame.
 For further information on mounting requirements, please refer to the section on mounting assembly.

Speed by-pass

If vibrations occurs at some typical frequencies of the VZH variable speed compressor system, design must be checked: frame, piping, pipes using cushioned clamps. But if some frequencies remain showing unacceptable vibration level,

speed by-pass is adjustable in the frequency converter, in order to avoid some frequency ranges. Four by-pass ranges are adjustable, and settings can be done in parameters 4.6x.

Gas pulsation

The VZH scroll compressor has been designed and tested to ensure that gas pulsation has been optimized for the most commonly encountered air conditioning pressure ratios. On heat pump installations and other installations where the pressure ratio lies beyond the typical range, testing should be conducted under all expected

conditions and operating configurations to ensure that minimum gas pulsation is present. If an unacceptable level is identified, a discharge muffler with the appropriate resonant volume and mass should be installed. This information can be obtained from the component manufacturer.

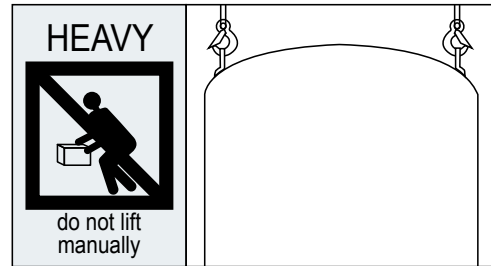
Each compressor is shipped with printed instructions for installation. These instructions can also be downloaded from:

<http://instructions.cc.danfoss.com>

Compressor handling

Each VZH scroll compressor is equipped with two lift rings on the top shell. Always use both these rings when lifting the compressor. Use lifting equipment rated and certified for the weight of the compressor. A spreader bar rated for the weight of the compressor is highly recommended to ensure a better load distribution. The use of lifting hooks closed with a clasp certified to lift the weight of the compressor is also highly recommended. Always respect the appropriate rules concerning lifting objects of the type and weight of these compressors. Maintain the compressor in an upright position during all handling operations.

When the compressor is mounted as part of an installation, never use the lift rings on the compressor to lift the installation. The risk is that the lugs could separate from the compressor or that the compressor could separate from the base frame with extensive damage and possible personal injury as a result.



Never use only one lifting lug to lift the compressor. The compressor is too heavy for the single lug to handle, and the risk is that the lug could separate from the compressor with extensive damage and possible personal injury as a result.

Never apply force to the terminal box with the intention of moving the compressor, as the force placed upon the terminal box can cause extensive damage to both the box and the components contained inside.

Mounting

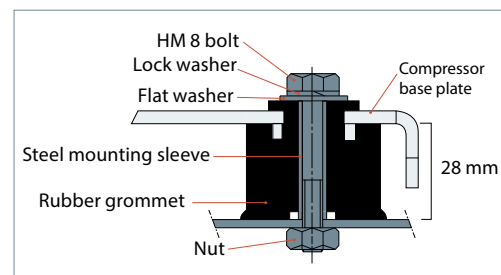
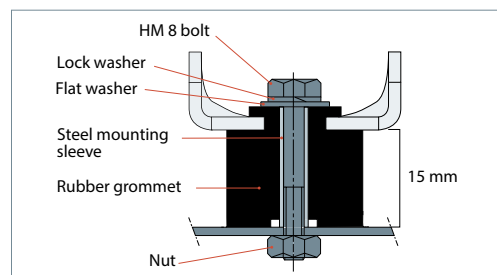
Maximum inclination from the vertical plane while operating must not exceed 3 degrees.

be used to mount the compressor in a single application. The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The grommets attenuate to a great extent the transmission of compressor vibrations to the base frame.

VZH compressors come delivered with four rubber mounting grommets and metal sleeve liners that serve to isolate the compressor from the base frame. These grommets must always

The required bolt size for the VZH088 & 117 compressors is HM8-40. This bolt must be tightened to a torque of 15 Nm.

The required bolt size for VZH170 compressors is HM8-55 and must be tightened to a torque of 21Nm.



Removing connections shipping plugs

Before the suction and discharge plugs are removed, the nitrogen holding charge must be released via the suction schrader valve to avoid an oil mist blowout. Remove the suction plug first and the discharge plug afterwards. The plugs shall be removed only just before connecting the

compressor to the installation in order to avoid moisture from entering the compressor. When the plugs are removed, it is essential to keep the compressor in an upright position so as to avoid oil spillage.

System cleanliness

The refrigerant compression system, regardless of the type of compressor used, will only provide high efficiency and good reliability, along with a long operating life, if the system contains solely the refrigerant and oil it was designed for. Any other substances within the system will not improve performance and, in most cases, will be highly detrimental to system

operations. The presence of non-condensable substances and system contaminants such as metal shavings, solder and flux, have a negative impact on compressor service life. Many of these contaminants are small enough to pass through a mesh screen and can cause considerable damage within a bearing assembly.

The use of highly hygroscopic polyolester oil in R410A compressors requires that the oil be exposed to the atmosphere as little as possible. System contamination is one of main factors affecting equipment reliability and compressor service life. It is important therefore to take system cleanliness into account when assembling a refrigeration system. During the manufacturing process, circuit contamination may be caused by:

- Brazing and welding oxides,
- Filings and particles from the removal of burrs in pipe-work,
- Brazing flux,
- Moisture and air.

Consequently, when building equipment and assemblies, the precautions listed in the following paragraphs must be taken.

Tubing

Only use clean and dehydrated refrigeration grade copper tubing. Tube-cutting must be carried out so as not to deform the tubing roundness and to ensure that no foreign debris remains within the tubing. Only refrigerant grade fittings should be used and these must be

of both a design and size to allow for a minimum pressure drop through the completed assembly. Follow the brazing instructions below. Never drill holes into parts of the pipe-work where filings and particles can not be removed.

Filter driers

For new installations with VZH compressors with polyolester oil, Danfoss recommends using the Danfoss DML 100% molecular sieve, solid core filter drier. Molecular sieve filter driers with loose beads from third party suppliers shall be avoided. For servicing of existing installations where acid formation is present the Danfoss DCL solid core filter driers containing activated alumina are recommended.

The drier is to be oversized rather than undersized. When selecting a drier, always take into account its capacity (water content capacity), the system refrigeration capacity and the system refrigerant charge.

Brazing and soldering
Copper to copper connections

When brazing copper-to-copper connections, the use of copper/phosphorus brazing alloy containing 5% silver or more with a melting

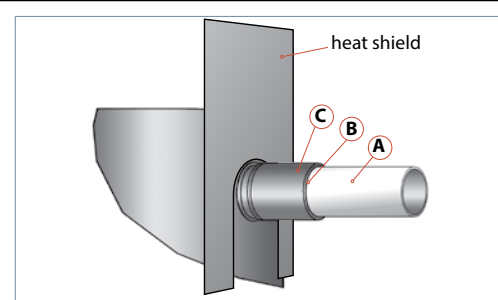
temperature of below 800°C is recommended. No flux is required during brazing.

Dissimilar metals connections

When manipulating dissimilar metals such as copper and brass or steel, the use of silver solder and anti-oxidant flux is necessary.

Compressor connection

When brazing the compressor fittings, do not overheat the compressor shell, which could severely damage certain internal components due to excessive heating. Use of a heat shield and/or a heat-absorbent compound is highly recommended. Due to the relatively sizable tubing and fitting diameters a double-tipped torch using acetylene is recommended for brazing operation on VZH compressors.



For brazing the suction and discharge connections, the following procedure is advised:

- Make sure that no electrical wiring is connected to the compressor.
- Protect the terminal box and compressor painted surfaces from torch heat damage (see diagram).
- Remove the Teflon gaskets when brazing rotolock connectors with solder sleeves.
- Use only clean refrigeration-grade copper tubing and clean all connections.
- Use brazing material with a minimum of 5% silver content.
- Purge nitrogen or CO₂ through the compressor in order to prevent against oxidation and flammable conditions. The compressor should not be exposed to the open air for extended periods.
- Use of a double-tipped torch is recommended.
- Apply heat evenly to area A until the brazing temperature is reached. Move the torch to area B and apply heat evenly until the brazing temperature has been reached there as well, and then begin adding the brazing material. Move the torch evenly around the joint, in applying only enough brazing material to flow the full circumference of the joint.
- Move the torch to area C only long enough to draw the brazing material into the joint, but not into the compressor.

- Remove all remaining flux once the joint has been soldered with a wire brush or a wet cloth. Remaining flux would cause corrosion of the tubing.

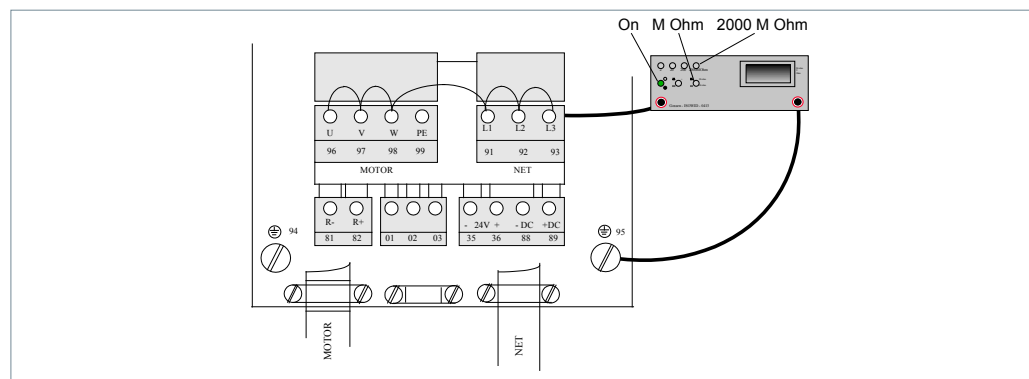
Ensure that no flux is allowed to enter into the tubing or compressor. Flux is acidic and can cause substantial damage to the internal parts of the system and compressor.

The polyolester oil used in VZH compressors is highly hygroscopic and will rapidly absorb moisture from the air. The compressor must therefore not be left open to the atmosphere for a long period of time. The compressor fitting plugs shall be removed just before brazing the compressor. The compressor should always be the last component brazed into the system

Before eventual unbrazing the compressor or any system component, the refrigerant charge must be removed from both the high- and low-pressure sides. Failure to do so may result in serious personal injury. Pressure gauges must be used to ensure all pressures are at atmospheric level.

For more detailed information on the appropriate materials required for brazing or soldering, please contact the product manufacturer or distributor. For specific applications not covered herein, please contact Danfoss for further information.

High voltage test



It is not necessary to perform a Hipot test (dielectric withstand test) on frequency converters. This has already been done during factory final test.

If a Hipot test has to be done anyway, following instructions must be followed in order to not damage the frequency converter:

- Compressor not connected
- L1, L2, L3, U, V, W terminals must be shorten and connected to high voltage terminal of the testing device.
- Ground terminal (chassis) must be connected to low voltage terminal of the testing device.

- 2000VDC(for T2)/2150VDC(for T4)/2250VDC(for T6) for 1 seconds must be applied
 - Ramp up time 3 seconds
 - Full DC voltage must be established during 2 seconds
 - The current leakage during the test must be below 1mA
 - Ramp down time to 0V in 25 seconds.
- When running high voltage tests of the entire installation, frequency converter and compressor electrical motor compressor test can be conducted together. When conducting a high voltage test make sure the system is not under vacuum: this may cause electrical motor compressor failure.

System pressure test

Always use an inert gas such as nitrogen for pressure testing. Never use other gasses such as oxygen, dry air or acetylene as these may form

an inflammable mixture. Do not exceed the following pressures:

Maximum compressor test pressure (low side)	33.3 bar(g) for VZH088 & 117 30.2 bar(g) for VZH170
Maximum compressor test pressure (high side)	45 bar (g)
Maximum pressure difference between high and low side of the compressor	37 bar

Pressurize the system on HP side first then LP side to prevent rotation of the scroll. Never let the

pressure on LP side exceed the pressure on HP side with more than 5 bar.

Leak detection

Leak detection must be carried out using a mixture of nitrogen and refrigerant or nitrogen and helium, as indicated in the table below. Never use other gasses such as oxygen, dry air or acetylene as these may form an inflammable mixture.

Pressurize the system on HP side first then LP side.

Leak detection with refrigerant	Leak detection with a mass spectrometer
Nitrogen & R410A	Nitrogen & Helium

Vacuum pump down and moisture removal

Moisture obstructs the proper functioning of both the compressor and the refrigeration system. Air and moisture reduce service life and increase condensation pressure, which causes abnormally high discharge temperatures that are then capable of degrading the lubricating properties of the oil. The risk of acid formation is also increased by air and moisture, and this condition can also lead to copper plating. All

these phenomena may cause both mechanical and electrical compressor failures. The typical method for avoiding such problems is a vacuum pump-down executed with a vacuum pump, thus creating a minimum vacuum of 500 microns (0.67 mbar). Please refer to News bulletin T11-026-0302 "Vacuum pump down and dehydration procedure".

Refrigerant charging

For the initial charge the compressor must not run and eventual service valves must be closed. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. This initial charging operation must be done in liquid phase as far away as possible from the compressor. The best location is on the liquid line between the condenser outlet and the filter drier. Then during commissioning, when needed, a complement of charge can be done

in liquid phase: slowly throttling liquid in on the low pressure side as far away as possible from the compressor suction connection. The refrigerant charge quantity must be suitable for both summer and winter operations.

Refer to news bulletin FRCC.EN.050 "Danfoss Commercial Compressors recommended refrigerant system charging practice" for more details.

Loss of charge protection

Customer need to protect compressor against loss of charge. Compared with fix speed compressor, loss of charge could be more severe to variable speed compressors. When loss of charge occurs, variable speed compressors will speed up to compensate capacity reduction, Further drive will active derating function to slow compressor heating up. Thus compressors

will run longer time at high temperature but low oil viscosity than fixed speed and will lead to compressor damage eventually. Low pressure switch and discharge gas thermostat could protect loss of charge somehow. But it is highly recommended to protect compressor from high superheat.

Commissioning

The system must be monitored after initial startup for a minimum of 60 minutes to ensure proper operating characteristics such as:

- Proper metering device operation and desired superheat readings
- Suction and discharge pressure are within acceptable levels
- Correct oil level in compressor sump indicating proper oil return
- Low foaming in sight glass and compressor sump temperature 10K above saturation temperature to show that there is no refrigerant migration taking place
- Acceptable cycling rate of compressors, including duration of run times.

⚠ Note this compressor is equipped with a four poles electrical motor so the applied frequency from the inverter will be 50 Hz for

A short cycling protection is provided in the CDS303 frequency converter. It is factory preset "enabled" with the following parameters in:

28.01 - interval between 2 starts: 300 secondes
 28.02 - minimum run time: 12 seconds.

This minimum run time is set to guaranty long enough running time at start up in order to create enough refrigerant flow velocity in the system to recover the oil to the compressor sump.

- Current draw of compressor within acceptable values (RLA ratings)
- No abnormal vibrations and noise.

25 rps (1500 rpm) up to 200 Hz for 100 rps (6000 rpm).

Oil level checking and top-up

In installations with good oil return and line runs up to 20 m, no additional oil is required. If installation lines exceed 20 m, additional oil may be needed. 4% of the total system refrigerant charge (in kg) can be used to roughly define the required oil top-up quantity (in liters) but in any case the oil charge has to be adjusted based on the oil level in the compressor sight glass. This procedure must be conducted with the system running at high load (compressor at full speed)

When the compressor is running under stabilized conditions the oil level must be visible in the sight glass.

The presence of foam filling in the sight glass indicates large concentration of refrigerant in the oil and / or presence of liquid returning to the compressor.

Mandatory check is made at low load and stabilised conditions, compressor at minimum speed, for a minimum duration of 1 hour. The oil level must be always visible at the compressor sight glass. If any deviation is observed, this means that some oil is trapped in the system, heat exchangers and/or pipes.

The CDS303 frequency converter integrates an oil recovery management algorithm which needs to be adjusted in regards to the system design. Oil return management function forces the compressor to rotate at 4200rpm (70 Hz) for an adjustable given period of time in order to build a good refrigerant gas velocity in the system to

allow the oil recovery to the compressor sump. This oil management function is factory preset with the following parameters:

- 28-10 Oil return management : enabled
- 28-11 Low speed running time : 60 minutes. This is the duration during which the compressor rotation speed is below 3000rpm (50 Hz)
- 28-12 Fixed boost interval : 24 hours
- 28-13 Boost duration : 30 seconds

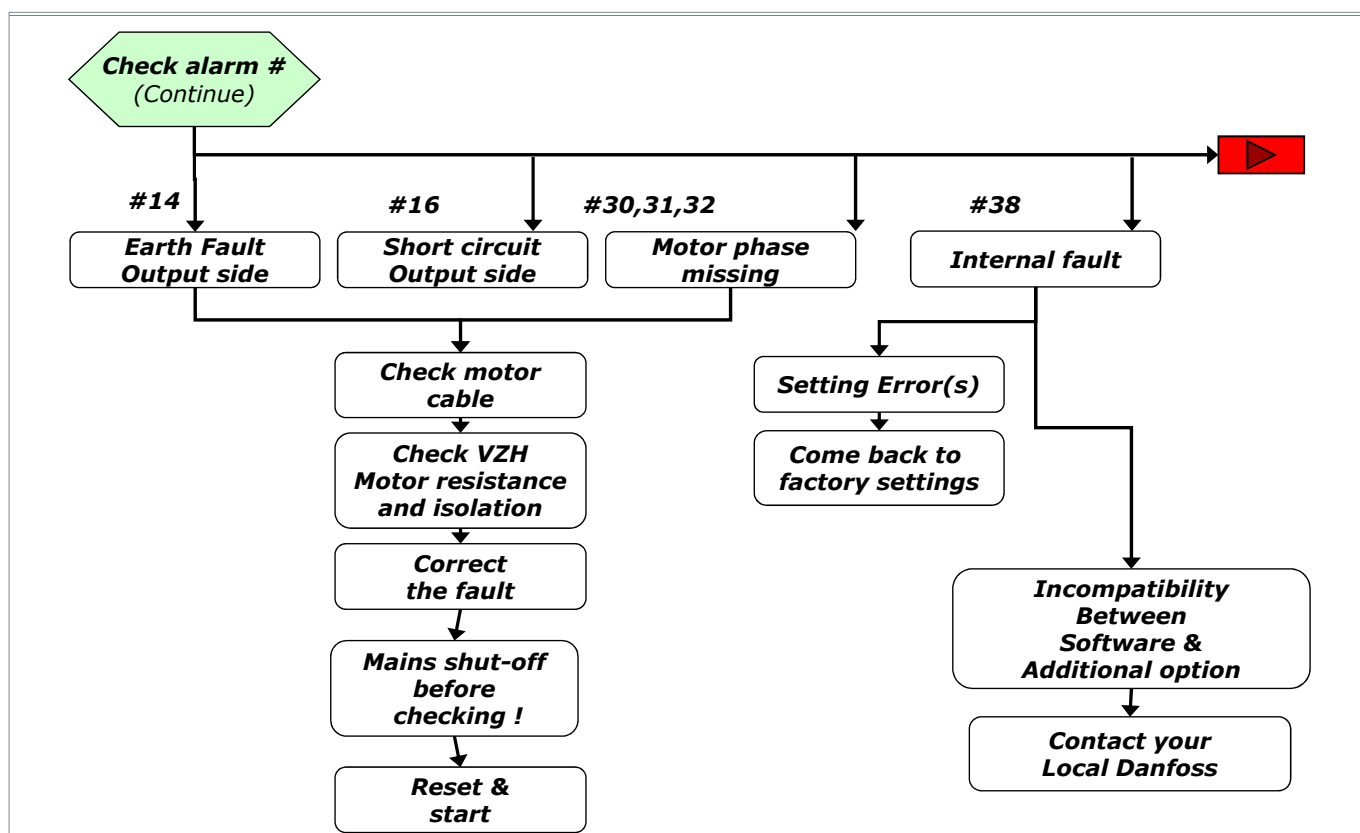
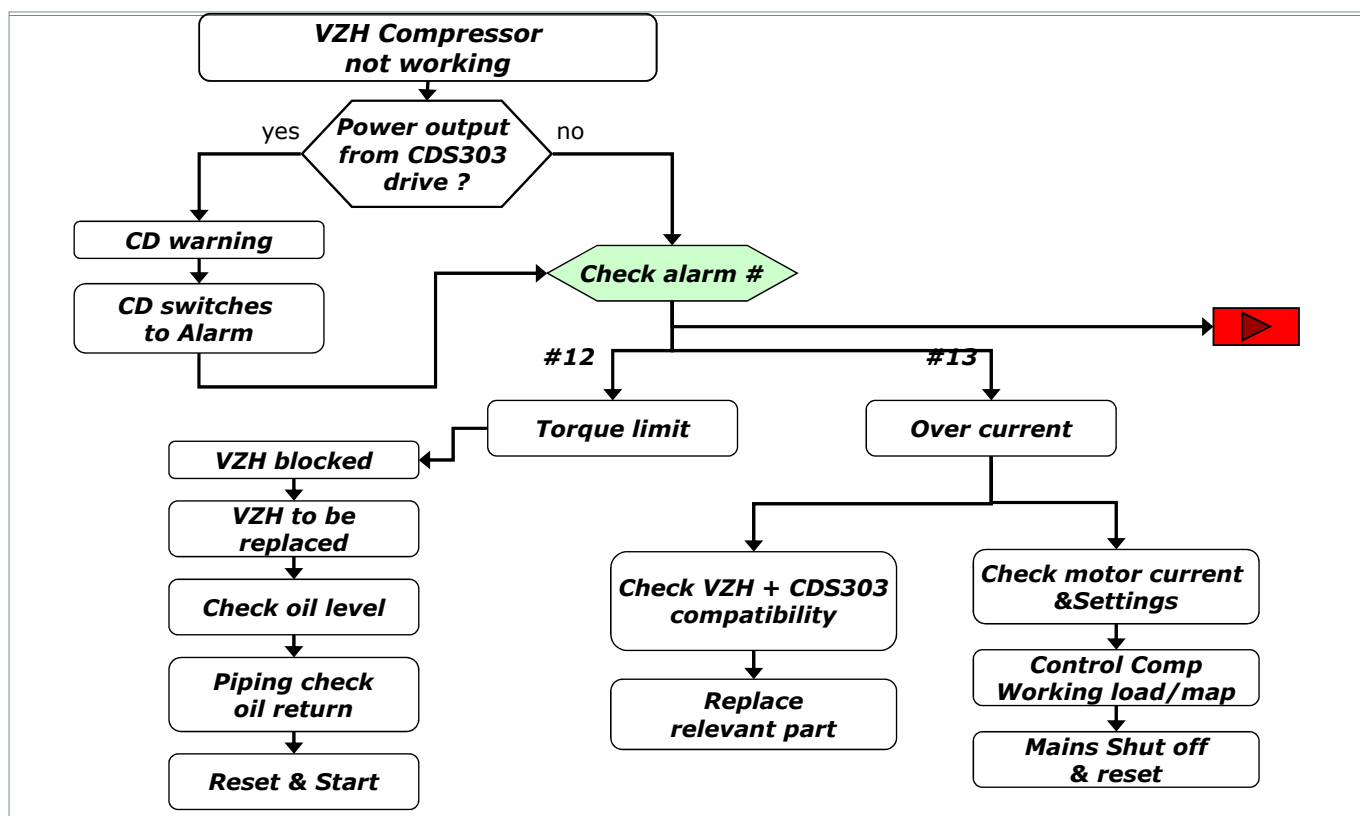
If the oil level decreases down to the bottom side of the sight glass, parameter 28-11 must be adjusted to start the boost cycle. During this boost cycle the oil level in the sight has to be monitored in order to adjust the boost duration on parameter 28-13 to a value that allows the oil level to be recovered at ½ of the sight glass.

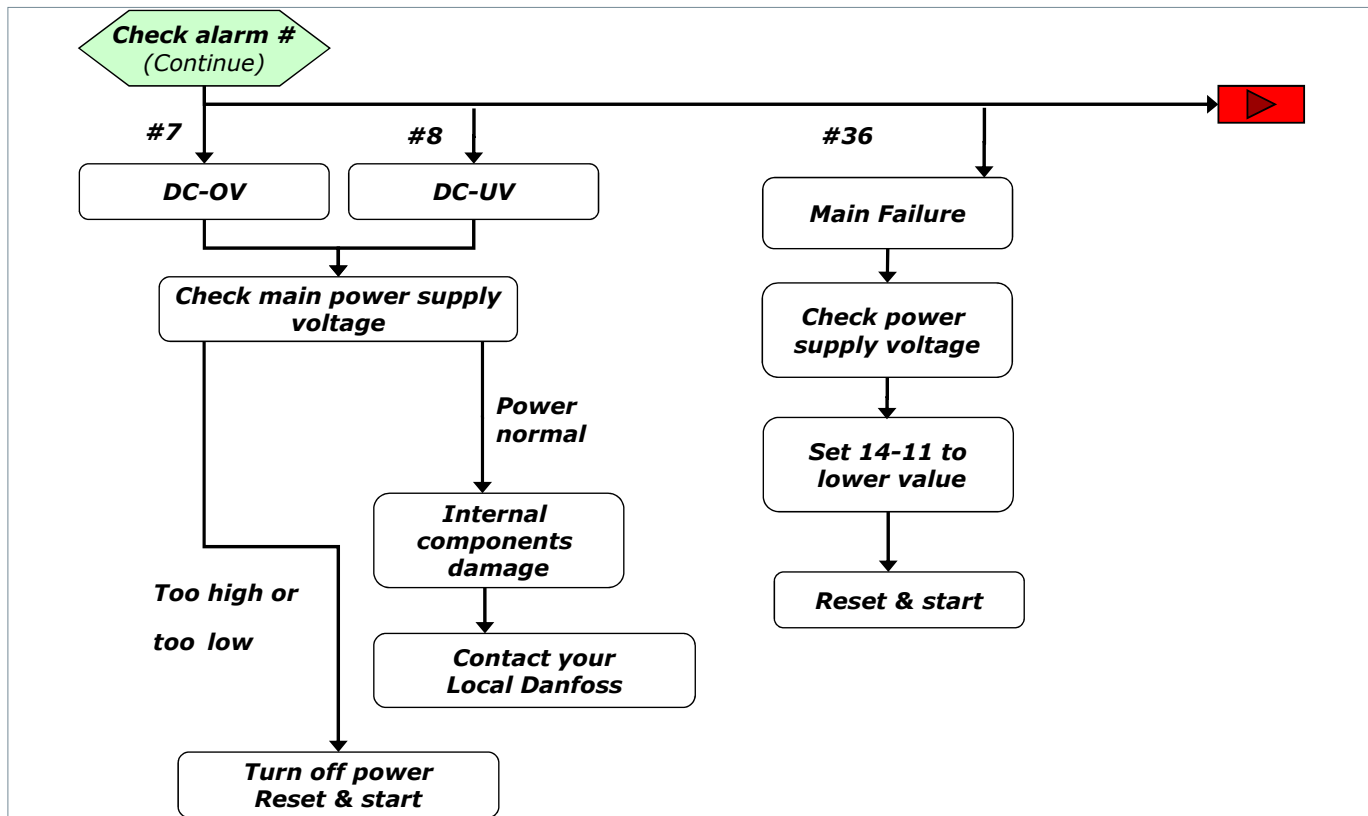
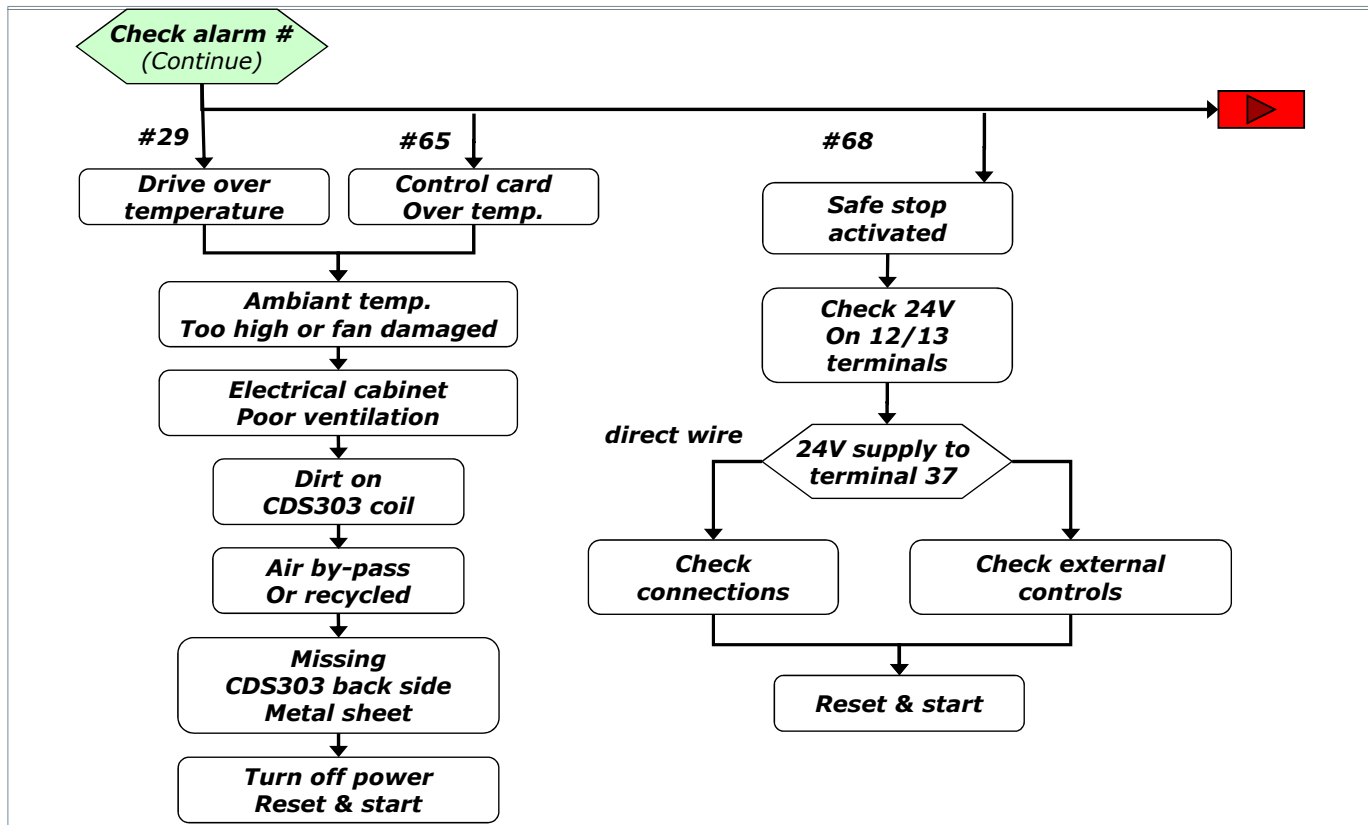
The oil level can also be checked a few minutes after the compressor stops, the level must be between ¼ and ¾ of sight glass.

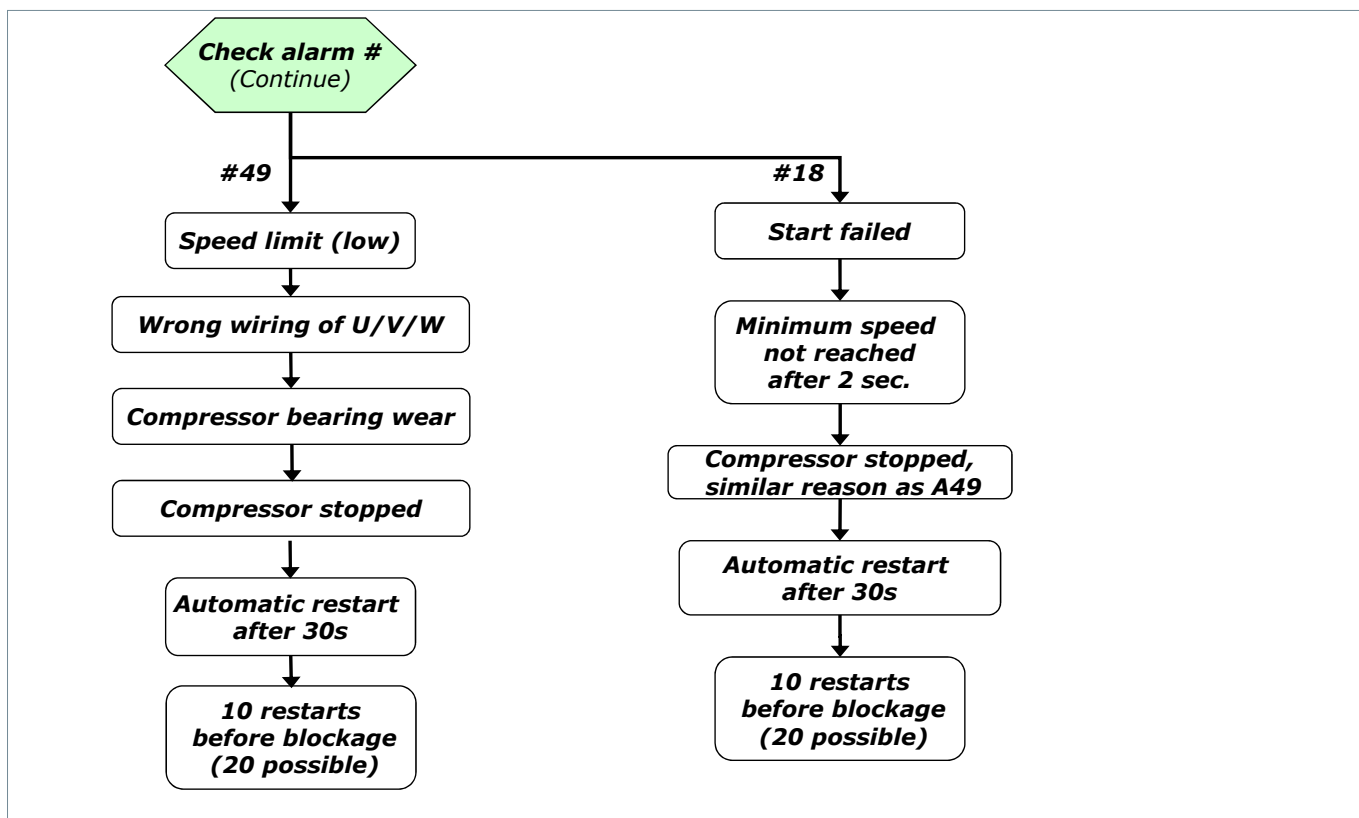
When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

Always use original Danfoss POE oil 160SZ from new cans.

Top-up the oil while the compressor is idle. Use the schrader connector or any other accessible connector on the compressor suction line and a suitable pump. See News bulletin "Lubricants filling in instructions for Danfoss Commercial Compressors".







Kit ordering and shipping

The tables on the following pages give code numbers for ordering purposes for the VZH

compressor and CDS303 frequency converter kit packed and shipped separately.

Packaging
Compressor single pack


Compressor model	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
VZH088	718	565	470	70
VZH117	718	565	470	76
VZH170	765	515	450	112

Frequency converter single pack


Drive supply voltage	Drive power (kW)	IP20				IP55			
		Height (mm)	Width (mm)	Depth (mm)	Weight (kg)	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
T2:	15	346	810	320	24	430	805	405	46
Code J	18 - 22	437	805	405	36	437	805	405	46
T4:	15	349	500	330	13	346	810	320	24
Code G	18 - 22	346	810	320	24	346	810	320	28
T6:	18.5-30	346	810	320	24	-	-	-	-
code H									

Ordering information

VZH scroll compressors and drive can be ordered in single packs. Please use the code numbers

from below tables for ordering. A coil for injection valve must be ordered separately.

Compressors

Compressor model	Pressure ratio	Equipment version	Code no.		
			G 380-480V/3ph/50&60Hz	J 200-240V/3ph/50&60Hz	H 525-600V/3ph/50&60Hz
VZH088	High	Single	120G0010	120G0012	120G0047
	Low	Single	120G0011	120G0013	120G0049
	High	Manifold	120G0022	120G0024	120G0048
	Low	Manifold	120G0023	120G0025	120G0050
VZH117	High	Single	120G0014	120G0016	120G0051
	Low	Single	120G0015	120G0017	120G0053
	High	Manifold	120G0026	120G0028	120G0052
	Low	Manifold	120G0027	120G0029	120G0054
VZH170	High	Single	120G0018	120G0020	120G0055
	Low	Single	120G0019	120G0021	120G0057
	High	Manifold	120G0030	120G0032	120G0056
	Low	Manifold	120G0031	120G0033	120G0058

Coils

Coil model	Code no.
208V-240V coil + adaptor	120Z0521
24V coil + adaptor	120Z0522

VZH voltage code G - 380-480 Volt

Compressor model	Frequency converter				
	Model & power	IP class	RFI class	Coating	Code n° for ordering
VZH088-G	CDS303 15.0kW	IP20	H3	No	134G3576
				Yes	134G3577
			H2	No	134F9366
		Yes		134G3578	
		IP55	H3	No	134G4008
				Yes	134G4010
H2	No		134G4012		
	Yes	134G4013			
VZH117-G	CDS303 18.5kW	IP20	H3	No	134G3579
				Yes	134G3580
			H2	No	134F9368
		Yes		134G3581	
		IP55	H3	No	134G4015
				Yes	134G4016
H2	No		134G4018		
	Yes	134G4019			
VZH170-G	CDS303 22.0kW	IP20	H3	No	134G3582
				Yes	134G3583
			H2	No	134F9371
		Yes		134G3584	
		IP55	H3	No	134G4020
				Yes	134G4021
H2	No		134G4022		
	Yes	134G4023			

LCP: user interface 120Z0326 (accessory)

VZH voltage code H - 525-600 Volt

Compressor model	Frequency converter			
	Model & power	IP class	RFI class	Code n° for ordering
VZH088-H	CDS303 18.5kW	IP20	HX	134L7237
VZH117-H	CDS303 30kW	IP20	HX	134L7239
VZH170-H	CDS303 30kW	IP20	HX	134L7239

VZH voltage code J - 200-240 Volt

Compressor model	Frequency converter			
	Model & power	IP class	RFI class	Code n° for ordering
VZH088-J	CDS303 15.0kW	IP20	H3	134G3474
			H2	134F9361
		IP55	H3	134G4001
			H2	134G4002
VZH117-J	CDS303 18.5kW	IP20	H3	134G3585
			H2	134F9363
		IP55	H3	134G4003
			H2	134G4004
VZH170-J	CDS303 22.0kW	IP20	H3	134G3586
			H2	134F9365
		IP55	H3	134G4005
			H2	134G4006

LCP: user interface 120Z0326 (accessory)

Valves, adapters, connectors & gaskets for use on suction and discharge connections
Solder sleeve adapter sets

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0125	Solder sleeve adapter set (1"3/4 Rotolock, 1"1/8 ODF), (1"1/4 Rotolock, 7/8" ODF)	VZH088-117	Multipack	8
	7765028	Solder sleeve adapter set, (2"1/4 Rotolock, 1"5/8 ODF), (1"3/4 Rotolock, 1"1/8 ODF)	VZH170	Multipack	6

Crankcase heaters & thermostats
Crankcase heaters

Type	Code n°	Description	Application	Packaging	Pack size
	7773109	Belt type crankcase heater, 65 W, 110 V, CE mark, UL		Multipack	6
	7973001	Belt type crankcase heater, 65 W, 110 V, CE mark, UL		Industry pack	50
	7773107	Belt type crankcase heater, 65 W, 230 V, CE mark, UL		Multipack	6
	120Z0038	Belt type crankcase heater, 65 W, 230 V, CE mark, UL		Multipack	8
	7973002	Belt type crankcase heater, 65 W, 230 V, CE mark, UL	VZH088-117	Industry pack	50
	7773117	Belt type crankcase heater, 65 W, 400 V, CE mark, UL		Multipack	6
	120Z0039	Belt type crankcase heater, 65 W, 400 V, CE mark, UL		Multipack	8
	120Z0466	Belt type crankcase heater, 65 W, 460 V, CE mark, UL		Multipack	6
	120Z0467	Belt type crankcase heater, 65 W, 575 V, CE mark, UL		Multipack	6
	7773110	Belt type crankcase heater, 75 W, 110 V, CE mark, UL		Multipack	6
	7773108	Belt type crankcase heater, 75 W, 230 V, CE mark, UL	VZH170	Multipack	6
	7773118	Belt type crankcase heater, 75 W, 400 V, CE mark, UL		Multipack	6

Surface sump heaters

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0388	Surface sump heater, 80 W, 24 V, CE, UL		Multipack	8
	120Z0389	Surface sump heater, 80 W, 230 V, CE, UL		Multipack	8
	120Z0390	Surface sump heater, 80 W, 400 V, CE, UL	VZH088-117	Multipack	8
	120Z0391	Surface sump heater, 80 W, 460 V, CE, UL		Multipack	8
	120Z0402	Surface sump heater, 80 W, 575 V, CE, UL		Multipack	8
	120Z0360	Surface sump heater + bottom insulation, 56 W, 24 V, CE, UL		Multipack	6
	120Z0376	Surface sump heater + bottom insulation, 56 W, 230 V, CE, UL		Multipack	6
	120Z0377	Surface sump heater + bottom insulation, 56 W, 400 V, CE, UL	VZH170	Multipack	6
	120Z0378	Surface sump heater + bottom insulation, 56 W, 460 V, CE, UL		Multipack	6
	120Z0379	Surface sump heater + bottom insulation, 56 W, 575 V, CE, UL		Multipack	6

Discharge thermostats and sensors

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0157	Discharge temperature sensor / converter kit	VZH all models	Single pack	1
	120Z0158	Discharge temperature sensor	VZH all models	Single pack	1
	120Z0159	Discharge temperature converter	VZH all models	Single pack	1
	7750009	Discharge thermostat kit	VZH all models	Multipack	10

Lubricant, acoustic hoods and spare parts
Acoustic hoods

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0509	VZH088-G acoustic hood	VZH088-G/H	Single pack	1
	120Z0510	VZH088-J acoustic hood	VZH088-J	Single pack	1
	120Z0511	VZH088-G manifolding acoustic hood	VZH088-G/H manifolding	Single pack	1
	120Z0512	VZH088-J manifolding acoustic hood	VZH088-J manifolding	Single pack	1
	120Z0513	VZH117-G acoustic hood	VZH117-G/H	Single pack	1
	120Z0514	VZH117-J acoustic hood	VZH117-J	Single pack	1
	120Z0515	VZH117-G manifolding acoustic hood	VZH117-G/H manifolding	Single pack	1
	120Z0516	VZH117-J manifolding acoustic hood	VZH117-J manifolding	Single pack	1
	120Z0517	VZH170-G acoustic hood	VZH170-G/H	Single pack	1
	120Z0519	VZH170-J acoustic hood	VZH170-J	Single pack	1
	120Z0518	VZH170-G manifolding acoustic hood	VZH170-G/H manifolding	Single pack	1
	120Z0520	VZH170-J manifolding acoustic hood	VZH170-J manifolding	Single pack	1

Mounting kits

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0066	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers	VZH088-117	Single pack	1
	8156138	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers	VZH170	Single pack	1

Terminal boxes, covers & T-block connectors

Type	Code n°	Description	Application	Packaging	Pack size
	8173230	T block connector 52 x 57 mm	VZH088-G/H, VZH117-G/H	Multipack	10
	8173021	T block connector 60 x 75 mm	VZH088-J.VZH117-J.VZH170-G/H	Multipack	10
	8173331	T block connector 80 x 80 mm	VZH170-J	Multipack	10
	120Z0146	Electrical box	VZH088-G/H.VZH117-G/H	Single pack	1
	120Z0147	Electrical box	VZH170-J	Single pack	1
	120Z0148	Electrical box	VZH088-117-J	Single pack	1
	120Z0538	Electrical box	VZH170-G/H	Single pack	1
	120Z0149	Electrical box cover	VZH088-G/H.VZH117-G/H	Single pack	1
	120Z0150	Electrical box cover	VZH170-J	Single pack	1
	120Z0537	Electrical box cover	VZH170-G/H	Single pack	1
	120Z0151	Electrical box cover	VZH088-117-J	Single pack	1

Coil

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0521	Coil / 208-240V and adaptor	VZH all models	Single pack	1
	120Z0522	Coil / 24V and adaptor	VZH all models	Single pack	1

Valve Body

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0145	Valve body	VZH all models	Single pack	1

Lubricant / oils

Type	Code n°	Description	Application	Packaging	Pack size
160SZ	7754023	POE lubricant, 160SZ, 1 litre can	VZH with R410A	Multipack	12
160SZ	7754024	POE lubricant, 160SZ, 2 litre can	VZH with R410A	Multipack	8

Oil level switch

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0560	Oil level switch screw in- mechanical part	all models	Single pack	1
	120Z0561	Oil level switch - electrical part (24V AC/DC)	all models	Single pack	1
	120Z0562	Oil level switch - electrical part (230V AC)	all models	Single pack	1

Spare parts frequency converter
LCP's

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0326	LCP display	Frequency converter / all models	Single pack	1
	175Z0929	RS cable to LCP	Frequency converter / all models	Single pack	1
	130B0264	LCP cradle, required to mount the LCP on IP55 casings	Frequency converter / all models	Single pack	1

Fans

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0328	Fan IP20	VZH088 G & J	Single pack	1
	120Z0329	Fan IP20	VZH117 G & J	Single pack	1
	120Z0330	Fan IP20	VZH170-G & J	Single pack	1
	120Z0331	Fan IP55	VZH088 G & J	Single pack	1
	120Z0332	Fan IP55	VZH117 G & J	Single pack	1
	120Z0333	Fan IP55	VZH170-G & J	Single pack	1
	120Z0334	Fan 2 internal IP55	VZH088 G & J	Single pack	1
	120Z0335	Fan 2 internal IP55	VZH117 G & J	Single pack	1
	120Z0336	Fan 2 internal IP55	VZH170-G & J	Single pack	1

Control card

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0337	Control card	Frequency converter / all models	Single pack	1

Power cards

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0338	Power card IP20	15 kW	Single pack	1
	120Z0339	Power card IP20	18,5 kW	Single pack	1
	120Z0340	Power card IP20	22 kW	Single pack	1
	120Z0341	Power card IP55	15 kW	Single pack	1
	120Z0342	Power card IP55	18,5 kW	Single pack	1
	120Z0343	Power card IP55	22 kW	Single pack	1

Accessory bags

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0345	Accessory bag IP20	VZH088-J, VZH117-G, VZH170-G	Single pack	1
	120Z0346	Accessory bag IP20	VZH117-J, VZH170-J	Single pack	1
	120Z0344	Accessory bag IP20	VZH088-G	Single pack	1
	120Z0348	Accessory bag IP55	VZH088-J, VZH117-J, VZH170-J	Single pack	1
	120Z0347	Accessory bag IP55	VZH088-G	Single pack	1
	120Z0349	Accessory bag IP55	VZH117-G, VZH170-G	Single pack	1

Relays card

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0350	Relays card	Frequency converter	Single pack	1

Converters

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0351	RS232/RS485 Converter	Frequency converter	Single pack	1
	120Z0352	USB/RS485 Converter	Frequency converter	Single pack	1

Switch mode power modules

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0418	Switch. mode power module IP55	18,5 kW	Single pack	1
	120Z0419	Switch. mode power module IP55	22 kW	Single pack	1

General overview..... 71
 Scope71
 Benefits.....71

Oil management concept..... 72
 Systems72
 Approved hybrid tandem configurations and capacity range 73

System design recommendation..... 74
 Electronic expansion valve74
 Pressure switch settings.....74
 Essential piping design considerations.....74
 Cycle rate limit of SH compressors.....75
 Defrost cycle logic.....75

Installation and service 76
 Handling76
 Compressor mounting76
 Tightening torques76
 Rubber connection76
 Tandem piping design.....77
 Wiring and rotation direction77
 Failure analysis.....77
 Oil equalisation connection.....77
 Refrigerant charge limit77

Ordering information..... 78
 Ordering information.....78

VZH088 79
 Compressor mounting80
 Oil equalization connection80
 Suction washer.....80

VZH117 81
 Compressor mounting81
 Oil equalisation connection.....82
 Suction washer.....82

VZH170 83
 Compressor mounting83
 Oil equalisation connection.....84
 Suction washer.....84

Scope

The application guideline describes the operating characteristics, design features and application requirements for hybrid manifolding of the Danfoss SH fixed speed compressor and VZH Inverter compressor in air conditioning and heat pump applications.

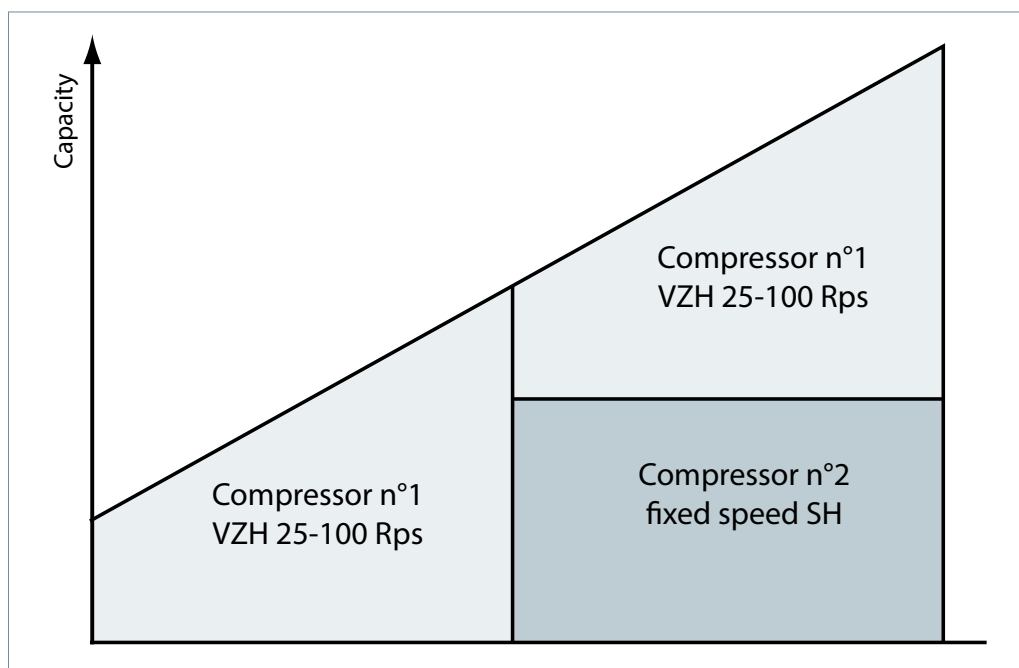
- It is essential to respect all instructions given in these guidelines, the instruction leaflet delivered with each compressor and the Application Guidelines for single compressors.
- For additional system components related to specific application requirements, the supplier recommendations must always be respected.

To ensure proper parallel installation and running conditions, the following recommendations must be followed:

Benefits

A parallel compressor installation refers to a system of interconnected compressors with a common suction line and common discharge line. The technique of mounting compressors in parallel is also called manifolding. The hybrid manifolding in this application guideline refers to manifolding of Danfoss Inverter compressor (VZH) and fixed speed compressor (SH), which has several benefits.

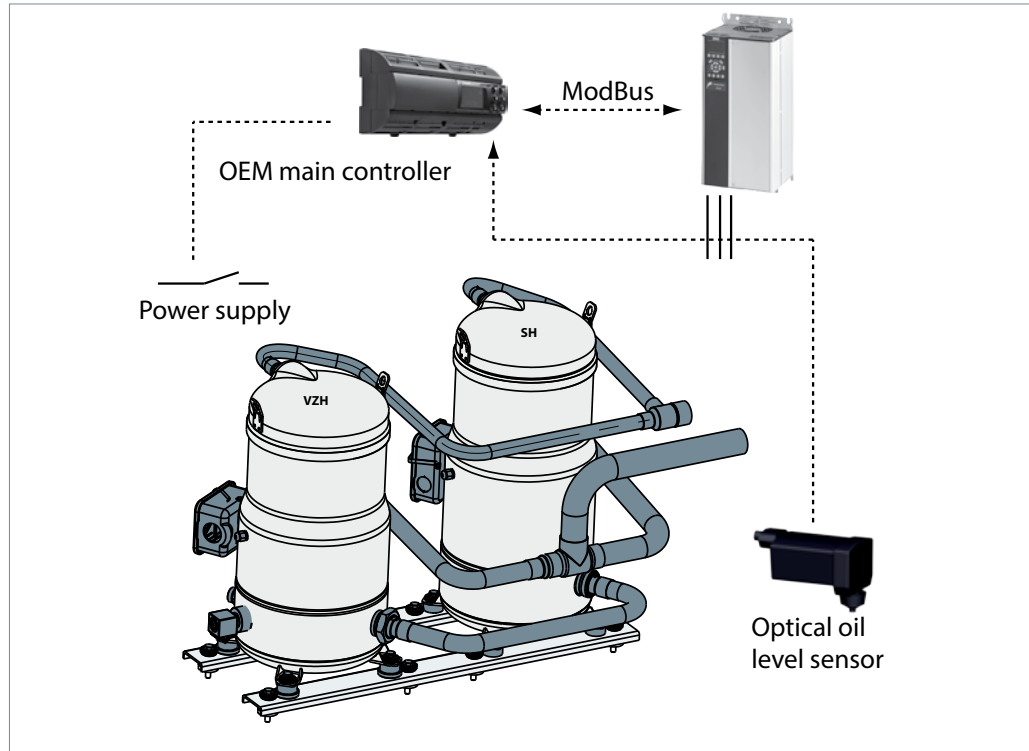
The main reason is reduced operating cost through greater control of capacity and power consumption. This is achieved by both staggering compressor switch-on sequences and regulating speed of Inverter compressor that allow the parallel system to continuously match its power with the capacity needed.



A second reason for manifolding of Inverter compressor and fixed speed compressor is improved part load efficiency. In the variable speed+fixed speed parallel installation, the system can run either only Inverter compressor at lower load or both Inverter and fixed speed compressors at higher load with fixed speed compressor operating at 100% load. Therefore the higher part load efficiency can be achieved. Conventional fixed speed compressor unloading

methods and manifolding of fixed speed compressors impose a serious penalty for part load efficiency, mainly at low load operation.

Third, the capacity of hybrid manifolding system can be widely regulated ex. 10% to 100%. The continuous capacity regulation allows for accurate temperature control and comfort indoor environment.

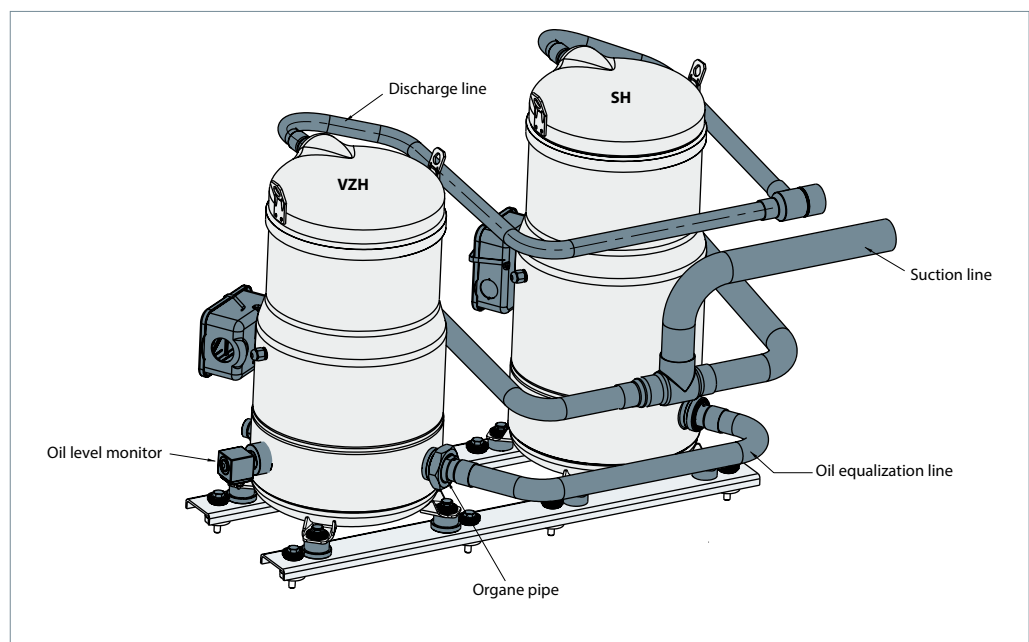


Systems

The oil management system architecture is described as below. Compressor sumps and low pressure shells are interconnected. An interconnecting pipe, on the lower part of the compressor (below the oil level), ensures oil balancing. To ensure a pressure drop balancing and equal distribution of oil returning from the system when all compressors are running, the manifolding of VZH and SH compressors by Danfoss is designed in an innovative way which is robust with any kind of upstream piping.

The patented 2 pieces of organ pipes are connected with standard oil equalization line. The ends of them are inserted into both compressors via oil equalization port. The patented organ pipe design allows for better separation of oil and gas in the oil equalization line and facilitate the balance of oil level and low side pressure between compressors.

Considering oil return risk, split system with more than 10m piping length need mandatory application approval by Danfoss application specialists.

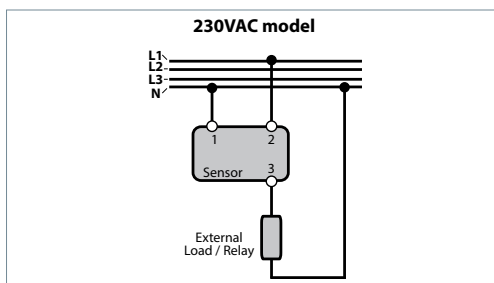


A restrictor is used in suction line of either fixed speed or Inverter to well balance the low side pressure between Inverter and fixed speed compressors when fixed speed is ON and Inverter is running at 100 rps, which is sized to make

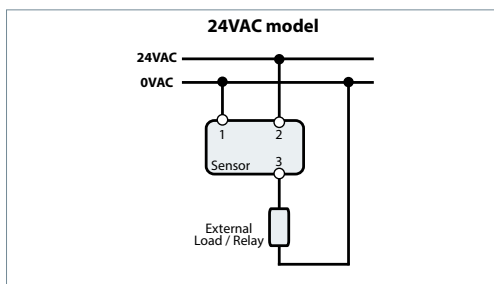
sure fixed speed have reasonable oil level at this condition. That means when Inverter run at any frequency below 100 rps, the fixed speed never has oil starvation while the Inverter has the possibility of oil loss.



An optical-electrical level sensor is fixed in Inverter compressor. The oil level sensor monitors the compressor internal oil level and send oil level signal to OEM main controller. While the oil level is below the limit of minimum oil level, the OEM main controller will enter an oil management action (refer to oil management specification for hybrid manifold system for details) to ensure the normal oil level or protection of system.



An TEKLAB LC-XT optical-electrical level sensor is fixed on the inverter compressor. The oil level sensor monitors the compressor oil level and sends oil level signal to an external relay (provided by OEM).



If OEM main controller receives “ON” signal, the oil level stays above required minimum level. ON the contrary, signal OFF indicates oil below minimum required level and will trigger OEM main controller to activate oil management action (refer to document “oil management specification for hybrid manifold system” to get details). Regarding this oil level signal, a 5±2 seconds delay is recommended to be used to consider the oil level fluctuation which may trigger false alarms.

For customers who needs UL certificates, please order 24V AC/DC sensor.

Approved hybrid tandem configurations and capacity range

Different configuration of hybrid tandems are possible , all VZH models(high low pressure ratio/different voltage) could be manifold with fix speed compressors.

Danfoss VSD : VZH compressor Drive™ 380-480 Volt

Model	Description	50Hz		60Hz	
		kW	TR	kW	TR
VZH178	VZH088+SH90	68.9	19.6	73.9	21.0
VZH208	VZH088+SH120	77.7	22.1	83.7	23.8
VZH257	VZH117+SH140	97.8	27.8	105.2	29.9
VZH278	VZH117+SH161	101.6	28.9	110.1	31.3
VZH301	VZH117+SH184	106.2	30.2	115.7	32.9
VZH350	VZH170+SH180	137.5	39.1	147.4	41.9
VZH410	VZH170+SH240	151.9	43.2	164.9	46.9
VZH465	VZH170+SH295	164.6	46.8	179.3	51.0
VZH470	VZH170+SH300	167.4	47.6	183.6	52.2

ARI conditions: 7.2/54.4/11.18.3
G motor code: 380-480V/3ph/50-60Hz

The kit available for these tandems are tested with Danfoss recommended piping design. If the piping is customized by the customer, additional test to check oil balancing must be performed. Please contact your Danfoss Application Specialist for support.

Electronic expansion valve

With variable capacity systems, an electronic expansion valve (EXV) is the mandatory solution to handle refrigerant mass flow variations. Ramp up and ramp-down settings, of both EXV and compressor, must be done with great care. Ramp-up of the EXV must be shorter than the ramp-up of the compressor, to avoid any low pressure operation on suction side of the compressor. The EXV can also be opened, up to a certain degree, before the start up of the compressor. Ramp-down of the EXV must be longer than the ramp-down of the compressor, also to avoid low pressure operation (except with pump-down). EXV should be closed, and remained closed,

when the compressor is off, to avoid any liquid refrigerant entering the compressor.

The expansion device should be sized to ensure proper control of the refrigerant flow into the evaporator. An oversized valve may result in erratic control. This consideration is especially important in variable speed+fixed speed manifolded units where low load conditions may require low speed running of Inverter compressor. This can lead to liquid refrigerant entering the compressor if the expansion valve does not provide stable refrigerant superheat control under varying loads.

Pressure switch settings

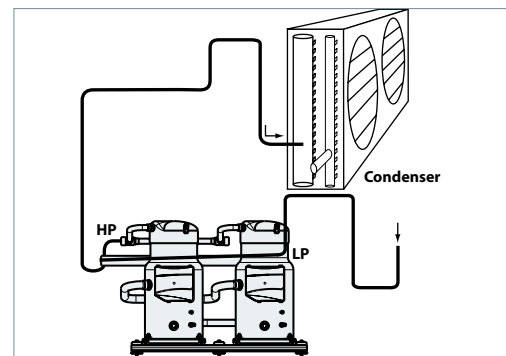
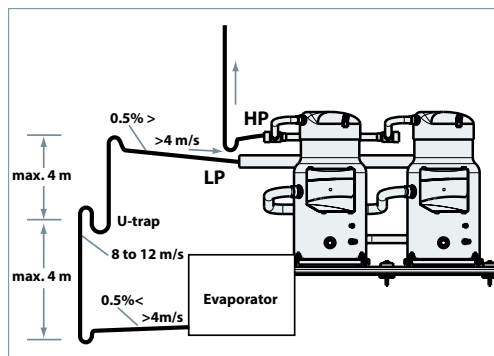
The pump down pressure switch must have a set point slightly higher than the lowest compressor safety pressure switch set point. The high-pressure safety pressure switch shall stop all

compressors. Please refer to the chapter on VZH single compressors and the Danfoss SH single compressors application guidelines (reference FRCC.PC.007) for recommended settings.

Essential piping design considerations

Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and slope of the tubing coming from the evaporator. Tubing returns from the evaporator should be designed so as to not trap oil and to prevent oil and refrigerant migration back to the compressor during off cycles. A double suction riser may be required for low load operation if suction gas velocity is not sufficient. The additional capacity range of Hybrid tandems makes oil return even more important due to the lower velocities with respect to system pipe size. Oil boost function shall be written in OEM main controller to return oil from system pipes

to compressor when oil balance can't be reached or maintained in a defined time period. In oil boost mode, the inverter compressor will be increased to a certain level and meanwhile the fixed speed compressor keeps running regardless of oil level. In addition to oil boost operation, hybrid tandems also need to balance oil between compressors when both compressors are running to maintain proper oil levels. Oil balancing in variable speed hybrids relies on the oil equalization line, suction restrictors, organ pipe and oil level switch to balance oil between the two compressors. Please refer to oil management specification for hybrid manifold system for more details.



If the evaporator lies above the compressor, as is often the case in split or remote condenser systems, the addition of a pump-down cycle is strongly recommended. If a pump-down cycle is

omitted, the suction line should have a loop at the evaporator outlet to prevent refrigerant from draining into the compressor during off-cycles.

If the evaporator was situated below the compressors, the suction riser must be trapped so as to prevent liquid refrigerant from collecting at the thermal bulb location.

When the condenser is mounted at a higher position than the compressors, a suitably sized "U"-shaped trap close to the compressors is necessary to prevent oil leaving the compressor from draining back to the discharge side of the compressors during off cycle. The upper loop also helps avoid liquid refrigerant from draining back to the compressor when stopped.

Piping should be designed with adequate three-dimensional flexibility. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. This protection proves necessary to avoid excess vibration, which

can ultimately result in connection or tube failure due to fatigue or wear from abrasion. Aside from tubing and connection damage, excess vibration may be transmitted to the surrounding structure and generate an unacceptable noise level within that structure as well (for more information on noise and vibration, see section "Sound and vibration management" in Danfoss SH scroll compressors application guidelines).

The design in this guideline is for short circuit application. But for long circuit and split system application, oil separator is recommended to use based on system qualification status.

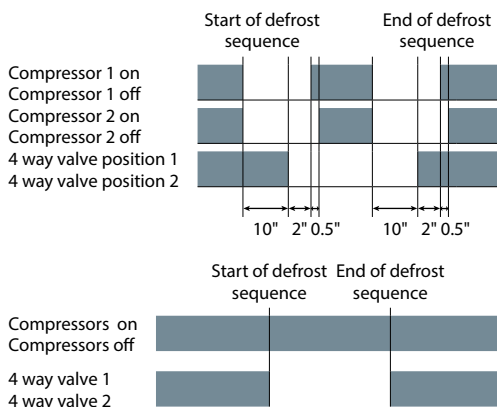
Besides, in order to reduce the piping vibration, customers need to add support specified for their own design.

Cycle rate limit of SH compressors

The system must be designed in a way that guarantees a minimum compressor running time of 3 minutes so as to provide for sufficient motor cooling after start-up along with proper oil return. Note that the oil return may vary since it depends upon system design. There must be no more than 12 starts per hour; a number higher than 12 reduces the service life of the motor compressor unit. If necessary, place an anti-short-cycle timer in the control circuit, connected as shown in the wiring diagram in the Danfoss SH scroll compressors application guidelines. A 4-minute timeout is recommended.

Short cycle control is directly provided by the CDS303 frequency converter, when parameter 28.0x is enabled. The function is factory set to enabled, with minimum running time 12 seconds and interval between starts 300 seconds. Short cycle settings are accessible in parameter 28.0x list, in the compressor functions" menu.

Defrost cycle logic



- first stop compressors
 - wait for 10 seconds
 - move the 4 way valve
 - wait for 2 seconds
 - restart the compressors with a max. 0.5 second delay between 2 successive starts
- or
- keep all compressors running during defrost cycle

Defrost cycle logic must respect all system components recommendations, in particular 4 way valve Max. Operating Pressure Differential. EXV can also be opened when compressors are stopped and before 4 way valve is moving in order to decrease pressure difference. Opening degree and time have to be set in order to keep a minimum pressure for 4 way valve moving. Danfoss recommend above two defrost cycle logic, but the control logic is also system specified.

In order to limit liquid amount handled per compressor when beginning & ending defrost, one of the 2 defrost cycle logics are required:

- stop all compressors before moving the 4 way valve:

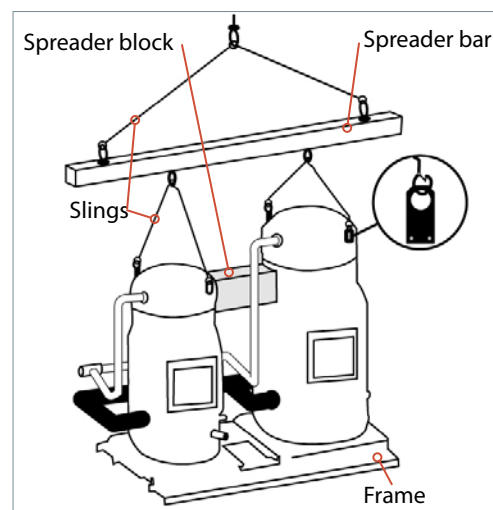
Installation and service procedures for a parallel system are similar to basic system installations. The selection of additional system components for parallel installations follows the basic system

common rules. Please refer to the Application Guidelines for Danfoss SH scroll compressors (FRCC.PC.007) for detailed installation and service procedures.

Handling

Danfoss Commercial Compressors recommends using the lift and handling devices, as shown in picture beside, and that the following procedure be used to prevent damage.

- Two lift rings are provided on each compressor. Use all four rings.
- Maximum loads authorized per sling and for the hoist hook must not be lower than the weight of the assembly.
- The minimum spreader bar length must be at least equal to the centre distance between the two compressors to prevent bending the frame.
- When lifting, use a spreader block between the compressors to prevent any unit frame damage.
- When the tandem unit is already mounted into an installation, never lift the complete installation by using the lift rings on the compressors.



Compressor mounting

For VZH tandem systems, Danfoss supply both rigid and rubber connections, but only rubber connection is recommended by Danfoss. For customers who prefer to configure compressor lay out on their own, they could also get rigid mounting components.

Regarding rubber connection, compressors are mounted on the base with enough stiff by grommets. To have enough stiffness, compressors could be mounted on the rails then fix the rails to a frame. Or compressors with rubber connection could be mounted on the frame directly.

Tightening torques

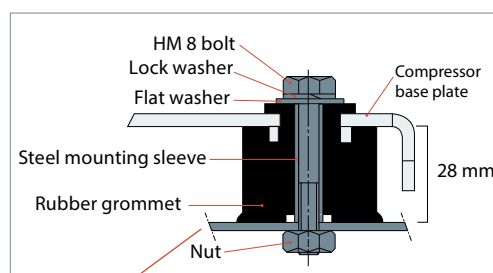
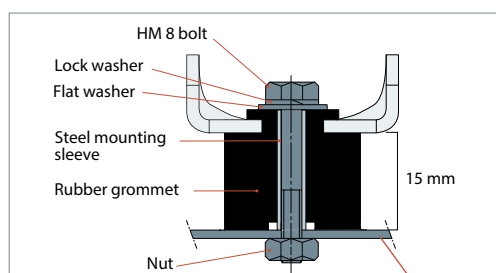
VZH compressors come delivered with four rubber mounting grommets and metal sleeve liners that serve to isolate the compressor from the base frame. The grommets must be compressed until contact between the

flat washer and the steel mounting sleeve is established. The grommets attenuate to a great extent the transmission of compressor vibrations to the base frame.

Rubber connection

The required bolt size for the VZH088 & 117 hybrid compressors is HM8-40. This bolt must be tightened to a torque of 15 Nm.

The required bolt size for VZH170 hybrid compressors is HM8-55 and must be tightened to a torque of 21Nm.



Base plate, rails, etc. with enough rigidity

Tandem piping design

For each tandem configuration specific outline drawings are available as indicated on the following pages. These drawings must always be respected.

No changes shall be made to the indicated tubing diameter and fitting types. The oil equalisation line shall be made of copper tube and assembled in such a way that it does not extend above the connection height and must be horizontal so as not to trap oil.

Wiring and rotation direction

All compressors in a tandem and trio unit must be electrically wired individually.

Compressors should run with the correct rotation direction. This can be achieved by having the correct phase sequence on each compressor motor terminal (L1-T1, L2-T2, L3-T3).

Failure analysis

When one compressor in a parallel system fails, the chance of foreign particles entering other compressors is greatly increased. Therefore a

failure analysis must be done quickly to insure further proper running conditions for the overall installation (i.e. : oil analysis).

Oil equalisation connection

Danfoss Commercial Compressors has developed specially adapted oil equalisation

Systems (VZH+SH) which ensure proper oil balancing between the compressors. Hence, Danfoss hybrid manifolding compressors are equipped with rotolock connections and patented design organ pipes:

- SH090 to 184: 1" 3/4 rotolock connection allowing use of 1" 3/4 - 1" 1/8 Organ pipe and 1-1/8" oil equalisation line

- SH180 to 380: 2" 1/4 rotolock connection allowing the use of 2" 1/4 - 1" 3/8 Organ pipe and 1-3/8" oil equalisation line
- VZH088/117: 1" 3/4 rotolock connection allowing use of 1" 3/4 - 1" 1/8 Organ pipe and 1-1/8" oil equalisation line
- VZH170: 2" 1/4 rotolock connection allowing the use of 2" 1/4 - 1" 3/8 Organ pipe and 1-3/8" oil equalisation line

Refrigerant charge limit

Compressor models	Refrigerant charge limit (kg)
VZH088 + SH090	8.0
VZH088 + SH120	8.5
VZH117 + SH140, VZH117 + SH161, VZH117 + SH184	10.5
VZH170 + SH180, VZH170 + SH240, VZH170 + SH295/300	17.5

Ordering information

To build a complete tandem, customers must order 2 compressors and 1 manifolding kit and 1 mounting kit (for VZH170 hybrid rubber connection). Manifolding kit selection should base on compressor models and oil level switch voltage.

Ordering example:

VZH170AGBNB+SH180 code 4, 24V type:

- Rubber grommet solution:
 - 1x VZH170(120G0030)+1x SH180(120H0267)
 - + 1 x new manifolding kit(120Z0591)+1x rubber mounting kit(8156138)

Please note for VZH170 hybrid manifolding, rigid spacers is delivered with compressor SH180/240/295/300, please leave rigid connection when rubber connection is adopted.

Danfoss VZH and SH scroll compressors can be ordered in either industrial packs or in single packs. Please refer to single compressor application guideline for ordering. The tandem kits can be ordered with code numbers from below table.

For rubber connection:

- VZH088:1FS+1VS+1new manifolding kit
- VZH117:1FS+1VS+1new manifolding kit
- VZH170: 1FS+1VS+1new manifolding kit+1 rubber mounting kit(8156138)

Mounting kit for rubber connection

Hybrid		VZH088/117	VZH170
No	Code number	120Z0066	8156138
14	grommet	4	4
15	sleeve	4	4
16	bolt	4	4
17	washers	4	4

Note: rubber mounting kit for manifolding is the same as single compressor mounting kit.

Manifolding kit 24V Type

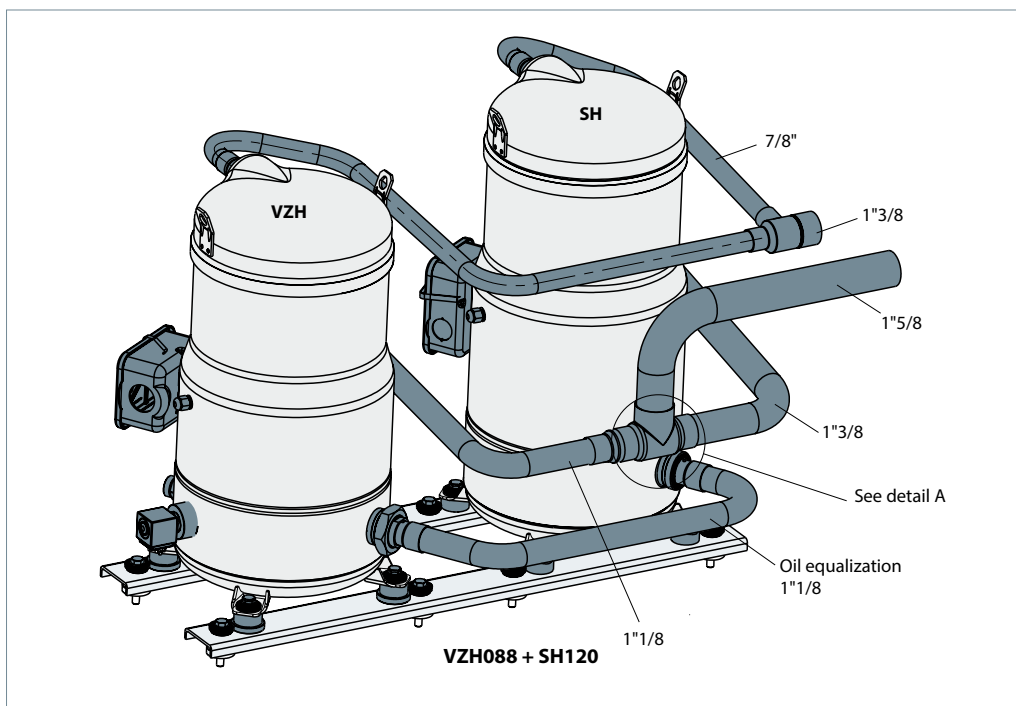
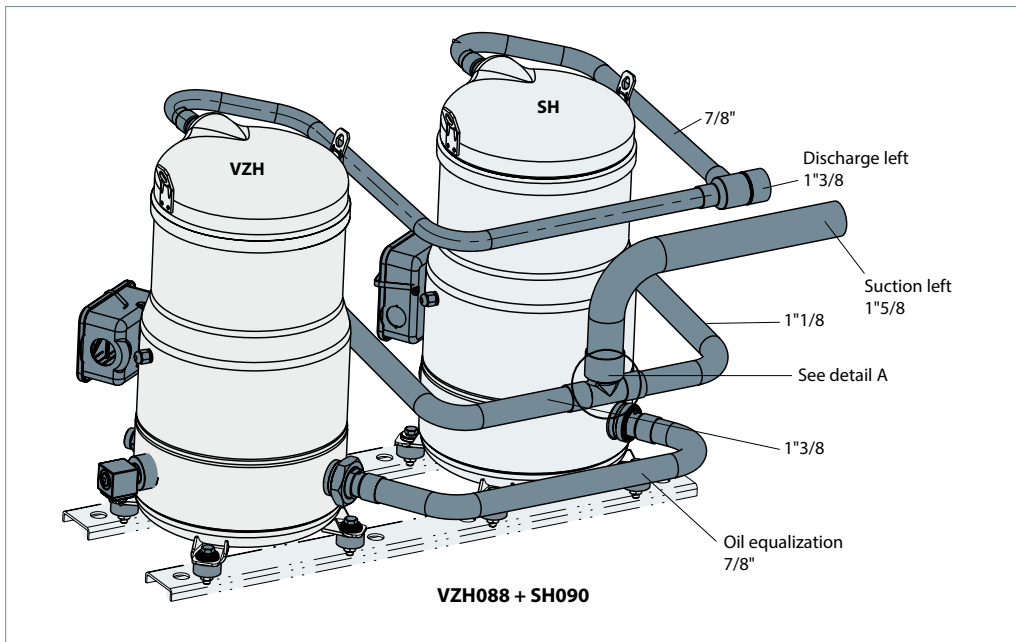
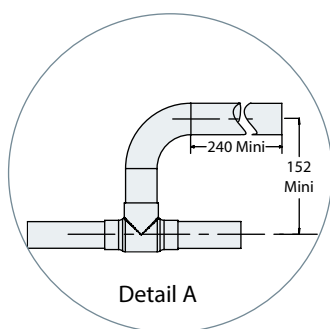
24VAC/ VDC type	New code number	Code Number							
		120Z0586	120Z0587	120Z0588	120Z0589	120Z0590	120Z0591	120Z0592	120Z0593
No	Description	VZH088+SH090	VZH088+SH120	VZH117+SH140	VZH117+SH161	VZH117+SH184	VZH170+SH180	VZH170+SH240	VZH170+SH295/300
1	Oil level monitor-Electrical part	1	1	1	1	1	1	1	1
2	Organ pipe Nelico	2	2	2	2	2			
3	Sleeve 1 1/8"	2	2	2	2	2			
4	Sleeve 1 3/8"						2	2	2
5	Teflon gasket 1 1/8"	2	2	2	2	2			
6	Teflon gasket 1 3/8"						2	2	2
7	Restrictor VZH088+SH090	1							
8	Restrictor VZH088+SH120		1						
9	Restrictor VZH117+SH140/VZH117+SH161			1	1				
10	Restrictor VZH117+SH184					1			
11	Restrictor VZH170+SH180						1		
12	Restrictor VZH170+SH240							1	
13	Rigid spacer 7mm		4			4			

Manifolding kit 230V Type

230VAC/ VDC type	New code number	Code Number							
		120Z0594	120Z0595	120Z0596	120Z0597	120Z0598	120Z0599	120Z0600	120Z0601
No	Description	VZH088+SH090	VZH088+SH120	VZH117+SH140	VZH117+SH161	VZH117+SH184	VZH170+SH180	VZH170+SH240	VZH170+SH295/300
1	Oil level monitor-Electrical part	1	1	1	1	1	1	1	1
2	Organ pipe Nelico	2	2	2	2	2			
3	Sleeve 1 1/8"	2	2	2	2	2			
4	Sleeve 1 3/8"						2	2	2
5	Teflon gasket 1 1/8"	2	2	2	2	2			
6	Teflon gasket 1 3/8"						2	2	2
7	Restrictor VZH088+SH090	1							
8	Restrictor VZH088+SH120		1						
9	Restrictor VZH117+SH140/VZH117+SH161			1	1				
10	Restrictor VZH117+SH184					1			
11	Restrictor VZH170+SH180						1		
12	Restrictor VZH170+SH240							1	
13	Rigid spacer 7mm		4			4			

Composition of VZH088 tandem

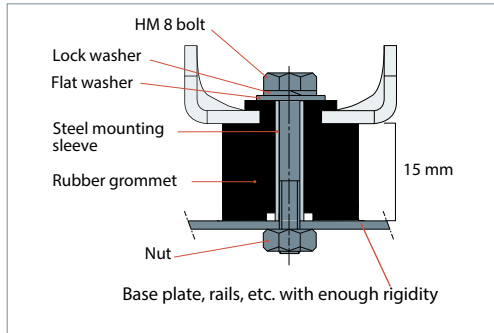
Tandem model	Composition	
	Variable speed	Fixed speed
VZH088 + SH090	VZH088	SH090
VZH088 + SH120	VZH088	SH120



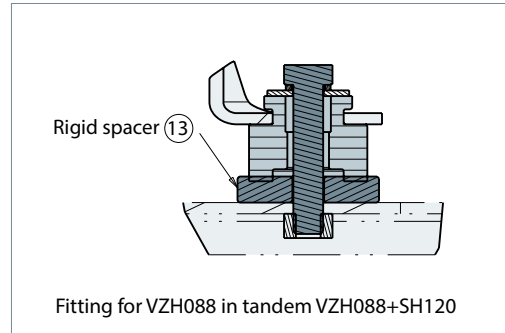
Compressor mounting

The tandem is fixed on the frame using the flexible grommets supplied with the compressor.

The compressors are fixed on the rails (not included) using rubber grommets, mounting sleeves, washers (delivered with the compressors).



Because VZH088 is 7 mm smaller than SH120 and in order to have the oil equalisation connection at the same level for both compressors, an additional 7mm rigid spacer (13) must be added under the VZH088 feet only for composition of VZH088 + SH120 (see below drawing).

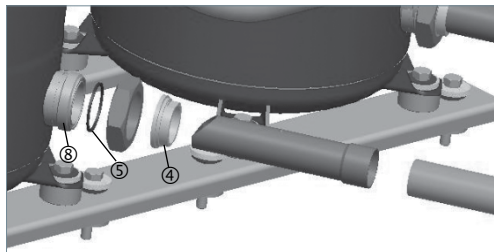


Oil equalization connection

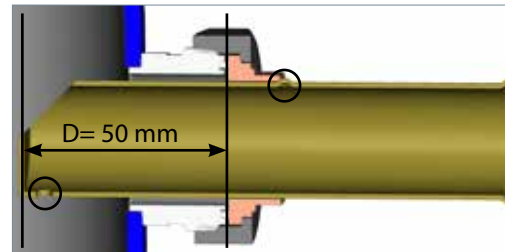
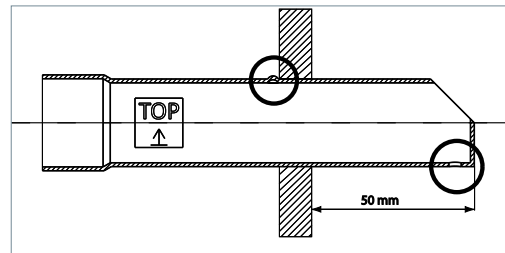
The level of oil is naturally balanced by a 1"1/8 oil equalization line.

The kit 120Zxxxx includes a 1"3/4 to 1"1/8 adaptor sleeve (4) & a teflon seal (5) to connect the oil line to the compressor 1"3/4 oil connector (8).

The oil line is brazed to the sleeve which is inserted (depth D=50mm) into the compressor and fitted using rotolock system.

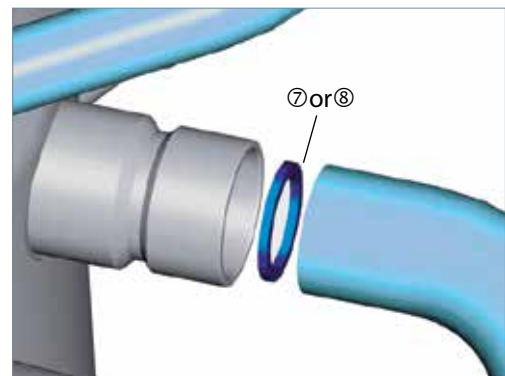


⚠ The organ pipe needs to be installed in the direction indicated by the label attached, which will ensure best oil balance.



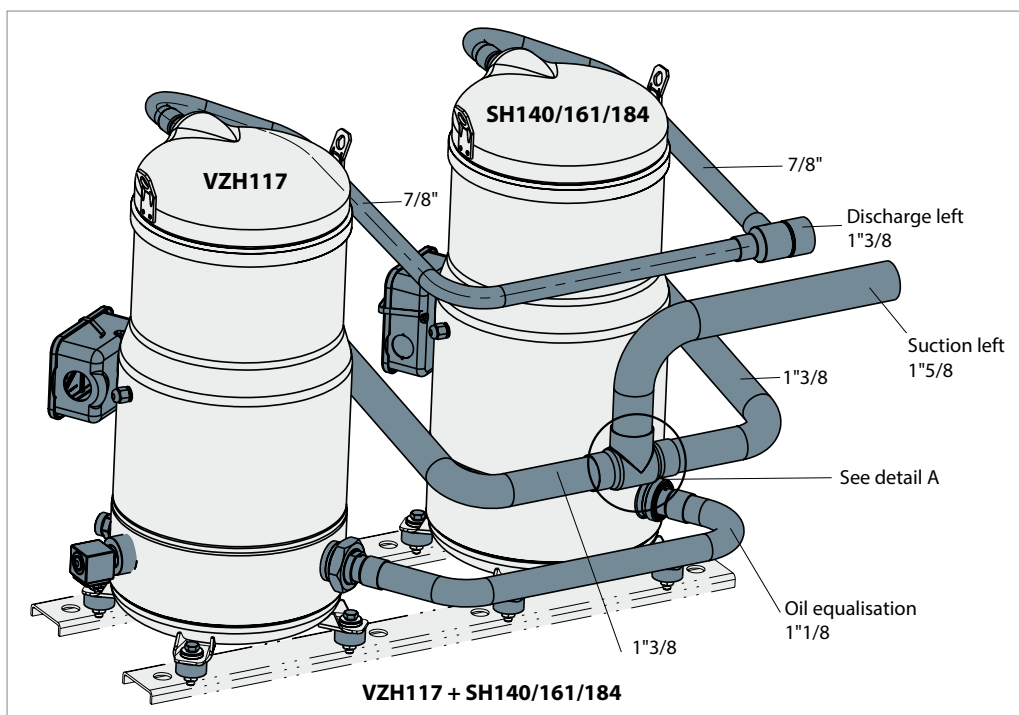
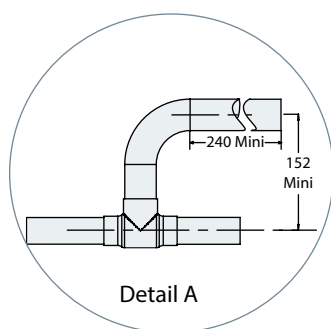
Suction washer

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. But, this oil equalisation is also function of the configuration of the suction pipe. Suction washer is on fixed speed compressors.



Composition of VZH117 tandem

Tandem model	Composition	
	Variable speed	Fixed speed
VZH117 + SH140	VZH117	SH140
VZH117 + SH161	VZH117	SH161
VZH117 + SH184	VZH117	SH184

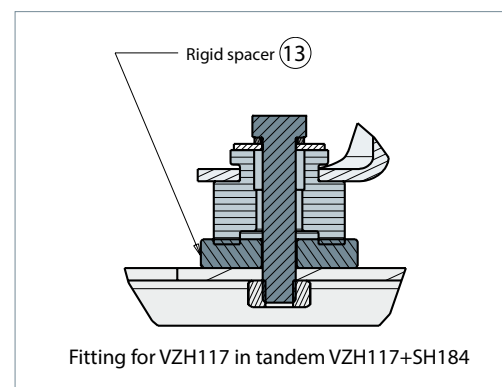
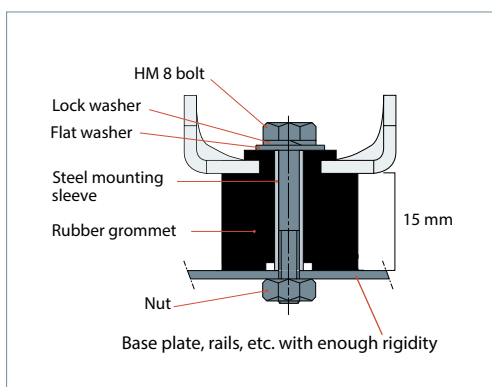


Compressor mounting

The tandem is fixed on the frame using the flexible grommets supplied with the compressor.

The compressors are fixed on the rails (not included) using the rubber grommets, mounting sleeves, washers (delivered with the compressors).

Because VZH117 are 7 mm smaller than SH 184 and in order to have the oil equalisation connection at the same level for both compressors, an additional 7mm rigid spacer ⁽¹³⁾ must be added under the VZH117 feet only for the composition of VZH117+SH184 (see below drawing).



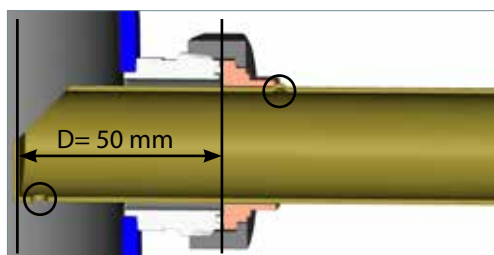
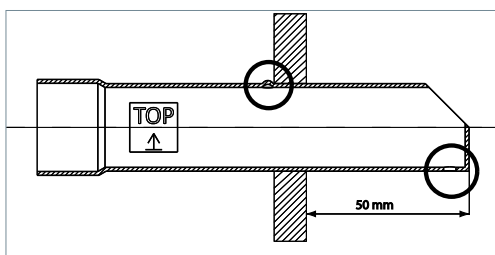
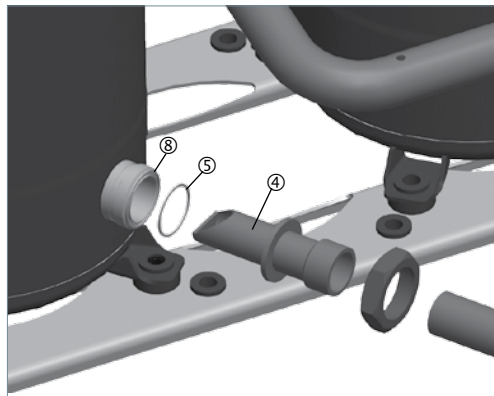
Oil equalisation connection

The level of oil is naturally balanced by a 1"1/8 oil equalization line.

The kit 120Zxxxx includes a 1"3/4 to 1"1/8 adaptor sleeve (4) & a teflon seal (5) to connect the oil line to the compressor 1"3/4 oil connector (8).

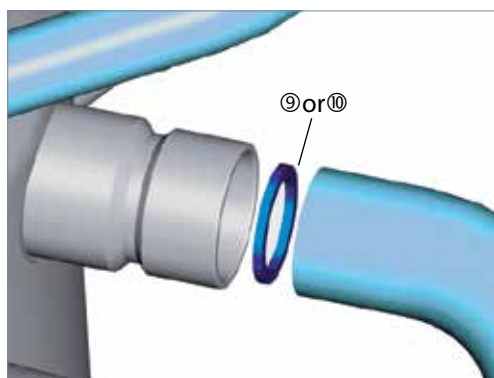
The oil line is brazed to the sleeve which is inserted (depth D=50mm) into the compressor and fitted using rotolock system.

⚠ The organ pipe needs to be installed in the direction indicated by the label attached, which will ensure best oil balance.



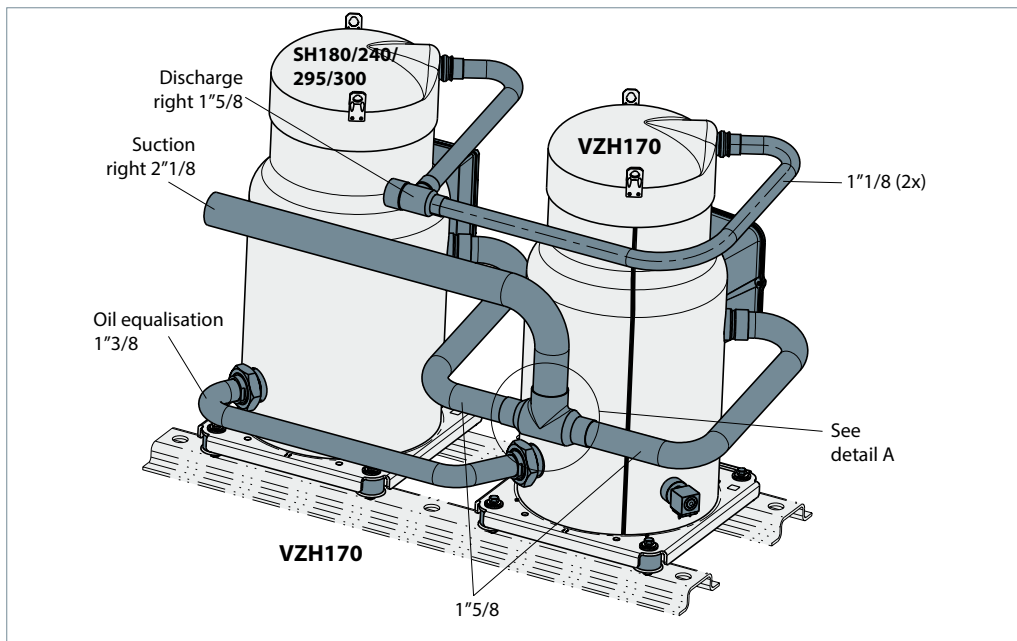
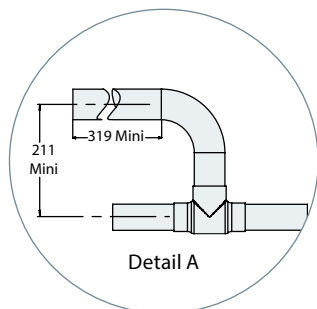
Suction washer

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. But, this oil equalisation is also function of the configuration of the suction pipe. Suction washer is on fixed speed compressors.



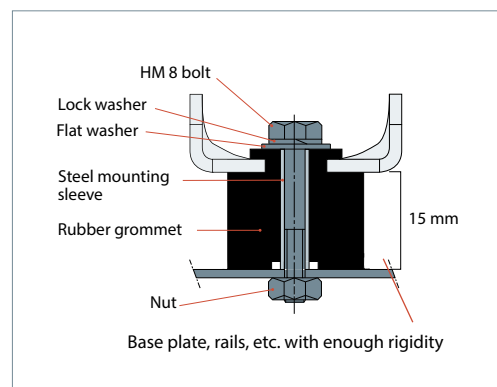
Composition of VZH170 tandem

Tandem model	Composition	
	Variable speed	Fixed speed
VZH170 + SH180	VZH170	SH180
VZH170 + SH240	VZH170	SH240
VZH170 + SH295/300	VZH170	SH295 or 300



Compressor mounting

The tandem is fixed on the frame by using rubber grommets, mounting sleeves, washers (delivered together with VZH compressor, for SH, to be ordered from mounting kit 8156138).

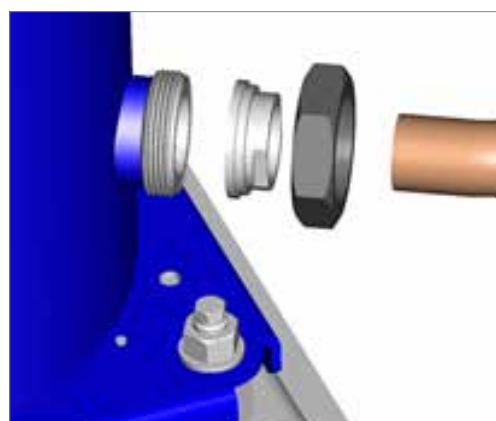
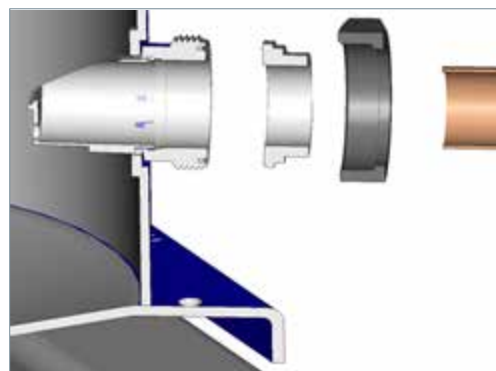


Oil equalisation connection

The level of oil is naturally balanced by a 1”3/8 oil equalization line.

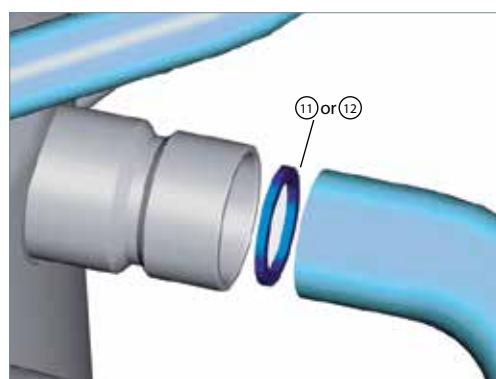
The plastic organ pipe (1) connected to the fitting (2) is preinstalled in the compressor. Oil line (3) is brazed to the sleeve (4). Then sleeve and teflon seal are fixed on the fitting by the rotolock nut (5).

Note: Both the plastic organ pipe (1) and the fitting (2) are preassembled in the compressors. Customers only need to connect oil equalization line etc. as described above.



Suction washer

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. But, this oil equalisation is also function of the configuration of the suction pipe. Suction washer is on fixed speed compressors.



Previous version

- Page 36: Recommended circuit breaker.
- Page 42: Application envelopes, Short cycle timer function.
- Page 43: Oil return management function (single compressor).
- Page 44: Electronic expansion valve.
- Page 44: Crankcase heating function.
- Page 52: Mounting.
- Page 54: High voltage test.
- Page 56: Oil level checking & top-up.
- Page 60: Compressor single pack.
- Page 64: LCP's accessories.
- Page 70: Essential piping design considerations.
- Page 71: Cycle rate limit of SH compressors.
- Page 72: Compressor mounting & Tightening torques.
- Page 74: Ordering information.

Current version

- Page 36: Updated Recommended circuit breaker with IP20 & IP55.
- Page 37: Added schematic diagram under wire sizes.
- Page 42: Updated Application envelopes & Short cycle timer function.
- Page 44: Updated Oil return management function (single compressor) with table.
- Page 45: Updated Electronic expansion valve.
- Page 45: Added 28-3* Crankcase heating table in Crankcase heating function.
- Page 47-48: Added Oil management.
- Page 53: Added Defrost cycle logic.
- Page 56: Updated Mounting.
- Page 58: Updated High voltage test with diagram.
- Page 59: Added Loss of charge protection.
- Page 60: Updated Oil level checking & top-up.
- Page 64: Updated Compressor single pack dimensions & weight.
- Page 68: Updated LCP's accessories with code no 130B0264.
- Updated all VZH tandem drawings under manifold compressors.
- Page 74: Updated Essential piping design considerations.
- Page 75: Updated Cycle rate limit of SH compressors & added Defrost cycle logic.
- Page 76: Updated Compressor mounting & Tightening torques.
- Page 78: Updated Ordering information.
- Page 80-83: Updated VZH088, VZH117, VZH170 compressor mounting with fitting diagrams.

Danfoss Commercial Compressors

is a worldwide manufacturer of compressors and condensing units for refrigeration and HVAC applications. With a wide range of high quality and innovative products we help your company to find the best possible energy efficient solution that respects the environment and reduces total life cycle costs.

We have 40 years of experience within the development of hermetic compressors which has brought us amongst the global leaders in our business, and positioned us as distinct variable speed technology specialists. Today we operate from engineering and manufacturing facilities spanning across three continents.



Danfoss Scrolls



Danfoss Inverter Scrolls



Danfoss Maneurop Reciprocating Compressors



Secop Compressors for Danfoss



Danfoss Turbocor Compressors



Danfoss Optyma Condensing Units

Our products can be found in a variety of applications such as rooftops, chillers, residential air conditioners, heatpumps, coldrooms, supermarkets, milk tank cooling and industrial cooling processes.

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