ENGINEERING
TOMORROW

Application guidelines

Danfoss scroll compressors
VZH088-117-170
Single

R410A

www.danfoss.com

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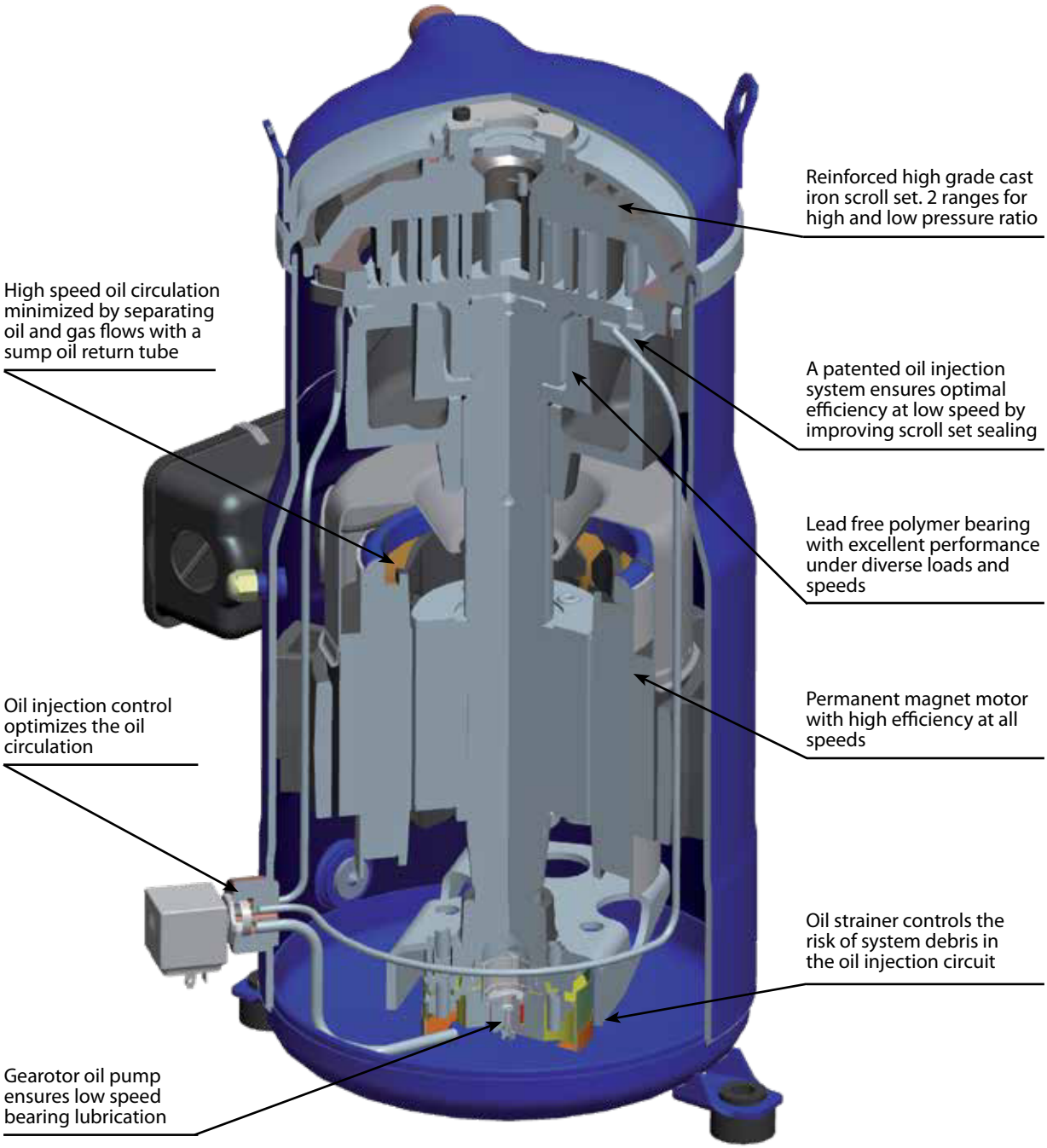
Danfoss scroll compressors are designed and manufactured according to the state of the art and to valid European and US regulations. Particular emphasis has been placed on safety and reliability. Related instructions are highlighted with the following icons:

 This icon indicates instructions to avoid safety risk.

 This icon indicates instructions to avoid reliability risk.

The purpose of this guideline is to help customers qualify compressors in the unit. You are strongly advise to follow these instructions. For any deviation from the guidelines, please contact Danfoss Technical Support. In any case, Danfoss accepts no liability as a result of the improper integration of the compressor into the unit by the system manufacturer.


Reinforced high grade cast iron scroll set. 2 ranges for high and low pressure ratio
High speed oil circulation minimized by separating oil and gas flows with a sump oil return tube
A patented oil injection system ensures optimal efficiency at low speed by improving scroll set sealing
Lead free polymer bearing with excellent performance under diverse loads and speeds
Oil injection control optimizes the oil circulation
Permanent magnet motor with high efficiency at all speeds
Oil strainer controls the risk of system debris in the oil injection circuit
Gearotor oil pump ensures low speed bearing lubrication

Compressor nomenclature

V Z H 117 A G A N A

Variable speed

Family
VZH scroll

Lubricant
POE lubricant, R410A refrigerant

Swept volume
in cm^3/rev

Design pressure ratio
A: high PR,
B: low PR

Motor voltage code to CDS303 *
G: 380-480V/3~/50 & 60Hz
H: 525-600V/3~/50&60Hz
J: 200-240V/3~/50 & 60Hz
* main supply voltage to frequency converter

Equipement version
A: brazed connections, single version
B: brazed connections, manifold version
D: brazed connections, unified version

	Oil sight glass	Oil level switch
Single version	Threaded	None
Manifold version	None	Threaded
Unified version	Threaded	Threaded

Motor protection type
N: no internal motor protection (protection by drive)

Evolution index

Frequency converter nomenclature

CDS 303 P15K T4 E20 H2

Dedicated compressor drive for VZH/VSH scroll

Serie 303

High overload output power
in kW

Main supply voltage
T2: 200-240V/3 ph/50-60 Hz
T4: 380-480V/3 ph/50-60 Hz
T6: 525-600V/3 ph/50-60 Hz

Enclosure protection
IP rating

RFI class

Note:
High overload output power: output power @160% Torque

Compressor size

To have the optimum compressor selection, select a compressor size which achieves the peak load system cooling capacity demand at its maximum speed.

Detailed performances can be found in datasheets and in selection programs.

Frequency converter variants

Different frequency converter variants are available according to:
1. Mains supply voltage
2. IP class (CDS303 drives are available in IP20 or IP55 housings)
3. RFI (Radio Frequency Interference) class H2/H3 or HX
4. Printed Circuit Board (PCB) coated or not coated.

Compressor and frequency converter combinations

When the compressor size and mains voltage have been defined in the above selection criteria, the code number tables from the "Ordering information and packaging" section provides the appropriate frequency converter sizes and up to eight 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).**

Please refer to the table below

		min	max
Compressor speed	rps	25	100
	rpm	1500	6000
Drive output frequency	Hz	50	200

Compressor specifications

Compressor model	Swept volume		Displacement								Oil charge				Net weight	
			25 rps		50 rps		60 rps		100 rps		Single and manifold version		Unified version			
	cm^3/rev	cu.in/rev	m^3/h	cu.ft/h	m^3/h	cu.ft/h	m^3/h	cu.ft/h	m^3/h	cu.ft/h	dm^3	oz	dm^3	oz	kg	lbs
VZH088	88.4	5.39	7.96	281	15.91	562	19.09	675	31.82	1125	3.3	112	3.8	128	55	121
VZH117	116.9	7.13	10.52	372	21.04	744	25.25	892	42.08	1487	3.6	122	4.1	139	61	134
VZH170	170.2	10.38	15.32	541	30.64	1083	36.76	1299	61.27	2165	6.7	227	7.7	260	112	247

Frequency converter specifications

Mains supply voltage	T2: 200 - 240 V ±10% (3-phase) T4: 380 - 480 V ±10% (3-phase) T6: 525 - 600V ±10% (3-phase)
Supply frequency	50 / 60 Hz
Output voltage	0 - 100 % of supply voltage
Inputs	6 digital (0-24V), 2 analog (0/±10V or 4-20mA, scalable)
Programmable outputs	2 digital (0-24V), 1 analog (0/4-20mA), 2 relay
Protection functions	Over-current protection, low / high current handling
Compressor functions	Motor protection, compressor ramp up/down control

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.

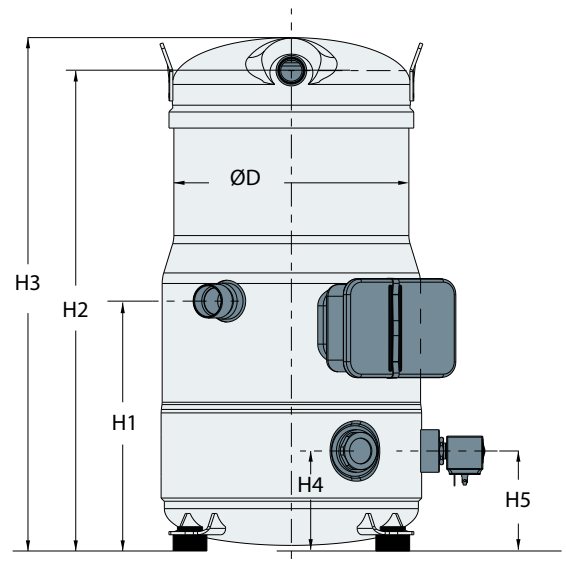
The compressors are delivered with no coils. 208V-240V / 110V-120V / 24V coils are available as accessory (refer to "Accessories" section). The coil must be installed for oil injection control.

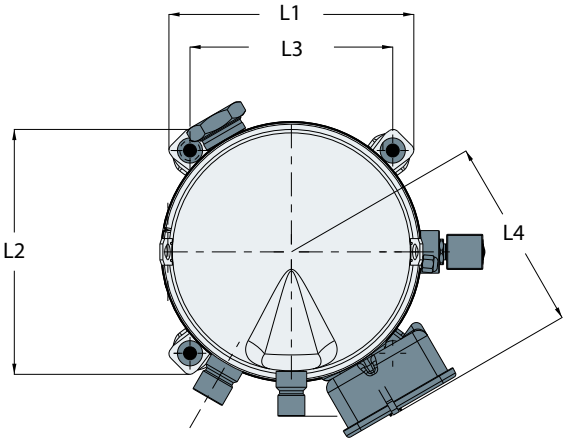
Control parameters are factory preset but accessible on the parameter list as read only values.

Bearings lubrication

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

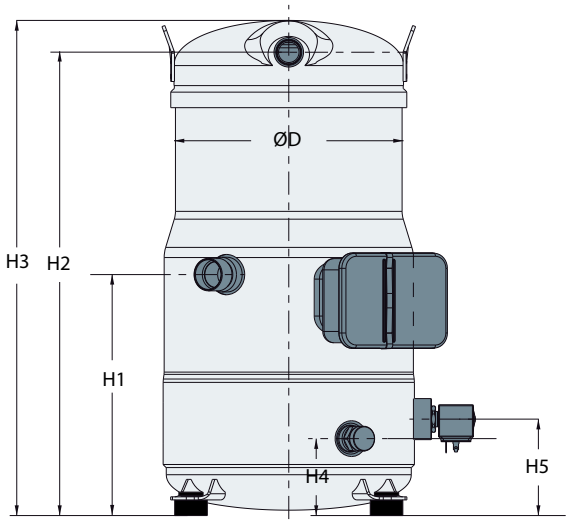
VZH088-G/H single version

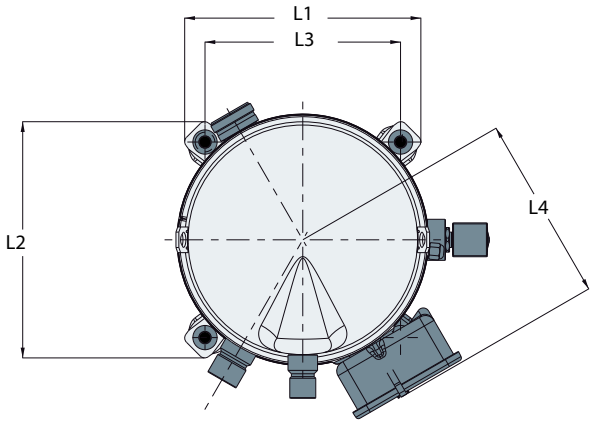




1

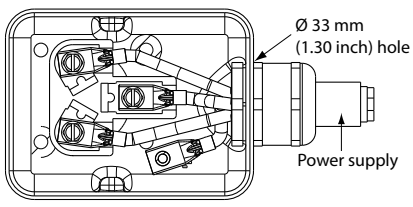
VZH088-G/H manifolded version



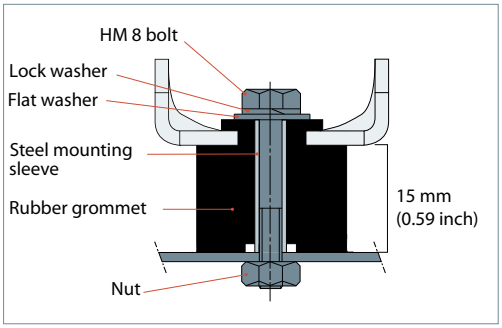


2

Electrical box

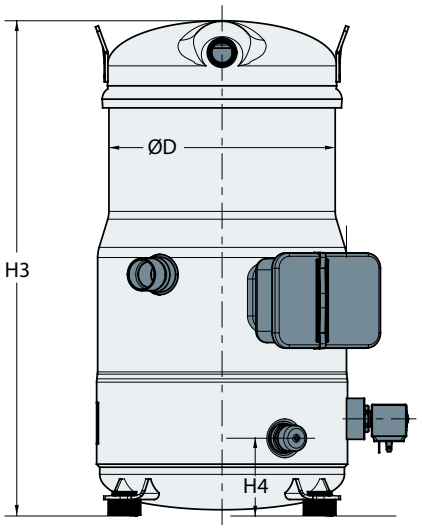


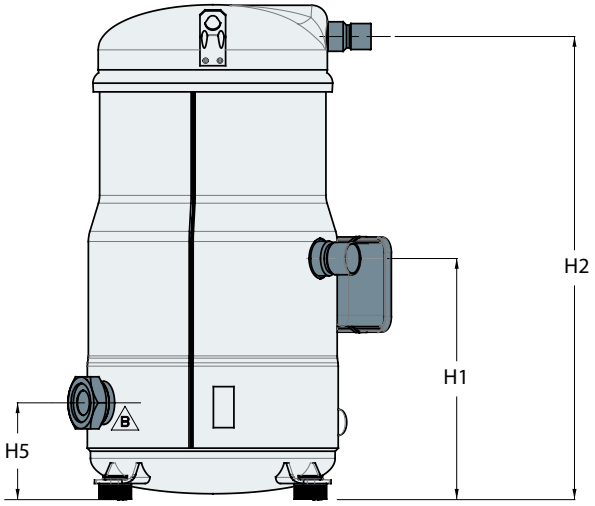
Grommet

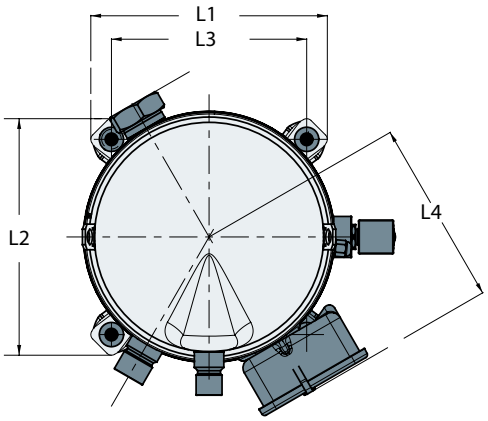


Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Single	VZH088-G/H	220.8	8.69	234.6	9.23	451.2	17.76	484.8	19.08	93.8	3.69	93.8	3.69	230	9.05	230	9.05	190.5	7.5	180.7	7.11	8560025
Manifolding	VZH088-G/H	220.8	8.69	234.6	9.23	451.2	17.76	484.8	19.08	74.8	2.94	93.8	3.69	230	9.05	230	9.05	190.5	7.5	180.7	7.11	8560055

VZH088 -G/H unified version

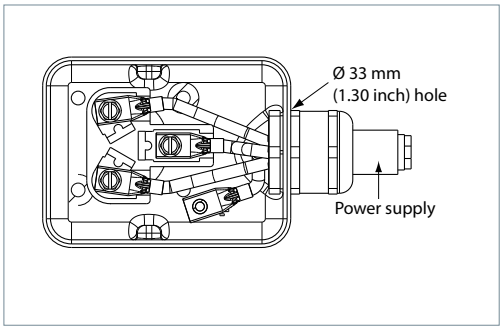




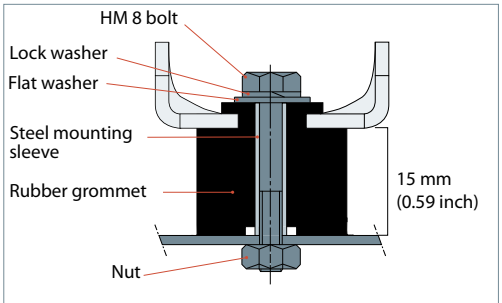


3

Electrical box

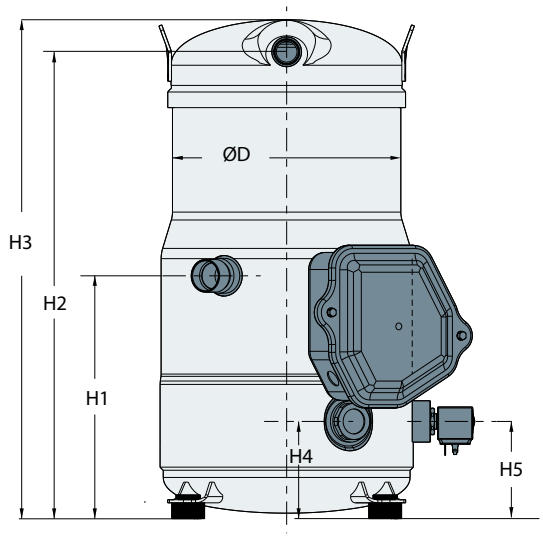


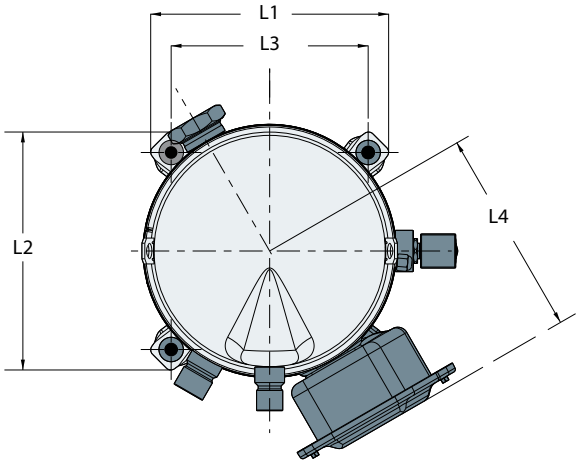
Grommet



Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Unified	VZH088-G/H	220.8	8.69	234.6	9.23	451.2	17.76	484.8	19.08	74.8	2.94	93.8	3.69	230	9.05	230	9.05	190.5	7.5	180.7	7.11	8560097

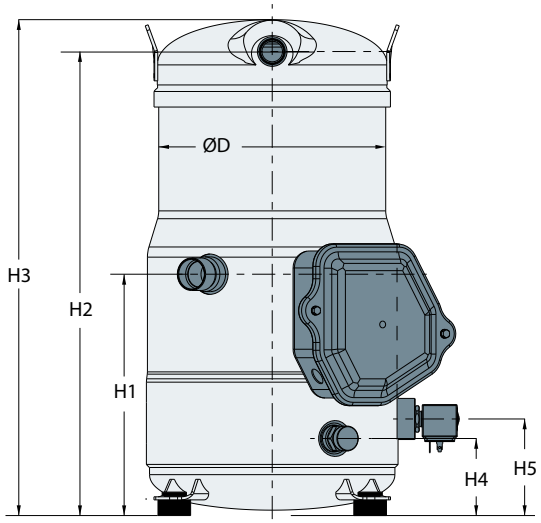
VZH088-J single version

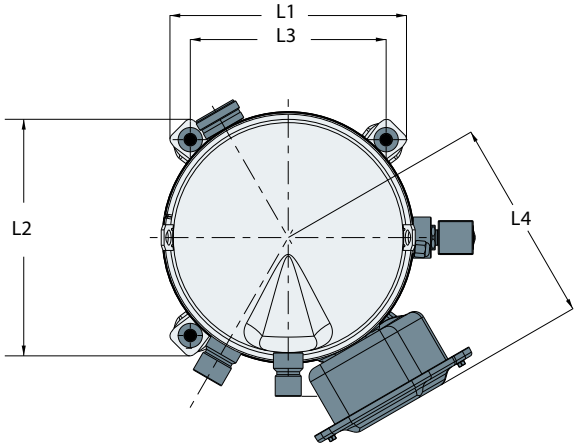




4

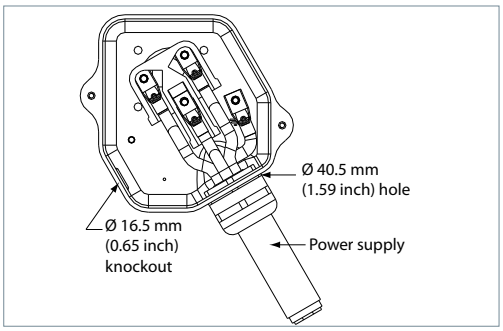
VZH088-J manifolded version



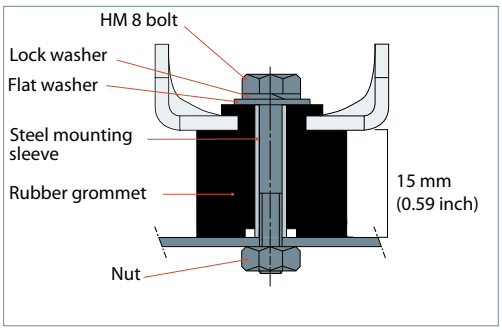


5

Electrical box



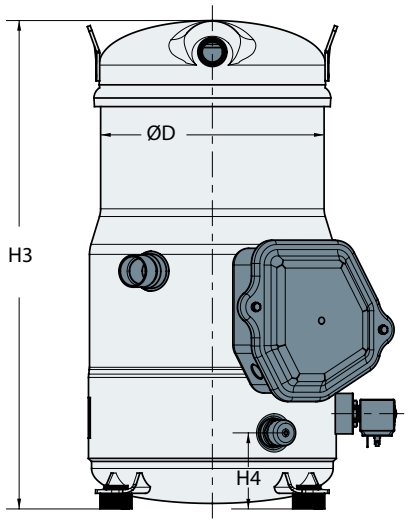
Grommet

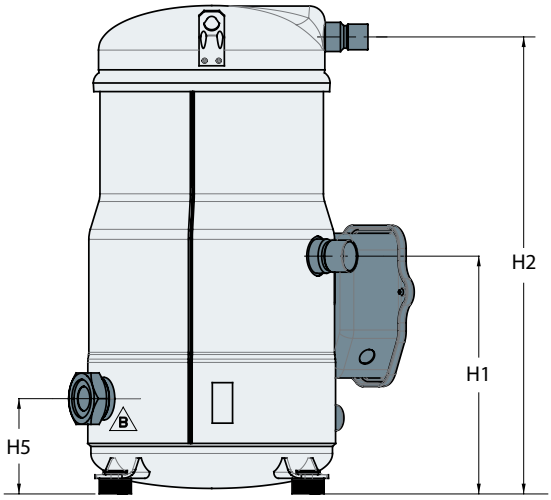


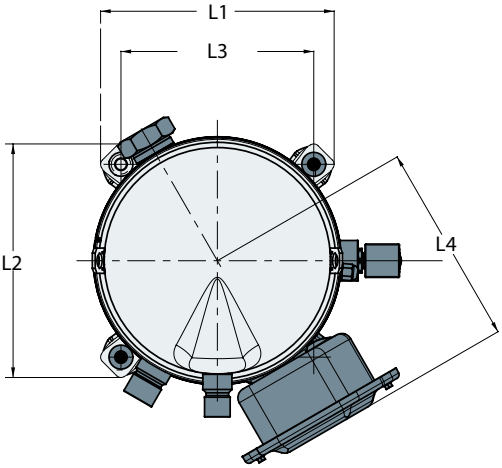
Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Single	VZH088-J	220.8	8.69	234.6	9.23	451.2	17.76	484.8	19.08	93.8	3.69	93.8	3.69	230	9.05	230	9.05	190.5	7.5	200.4	7.81	8560030
Manifolding	VZH088-J	220.8	8.69	234.6	9.23	451.2	17.76	484.8	19.08	74.8	2.94	93.8	3.69	230	9.05	230	9.05	190.5	7.5	200.4	7.81	8560056

Dimensions

VZH088 -J unified version

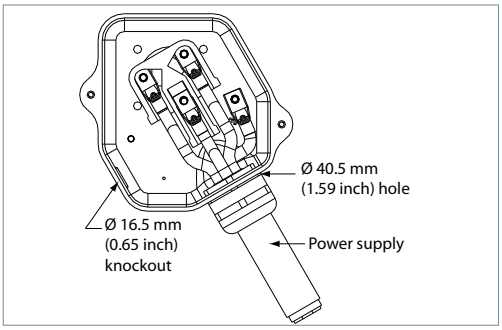




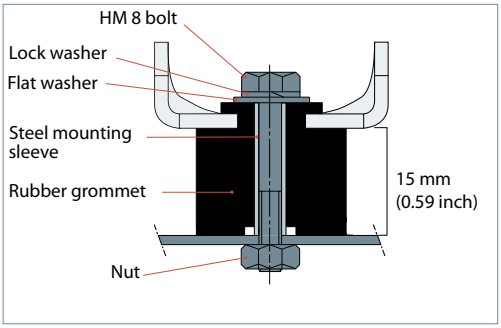


6

Electrical box

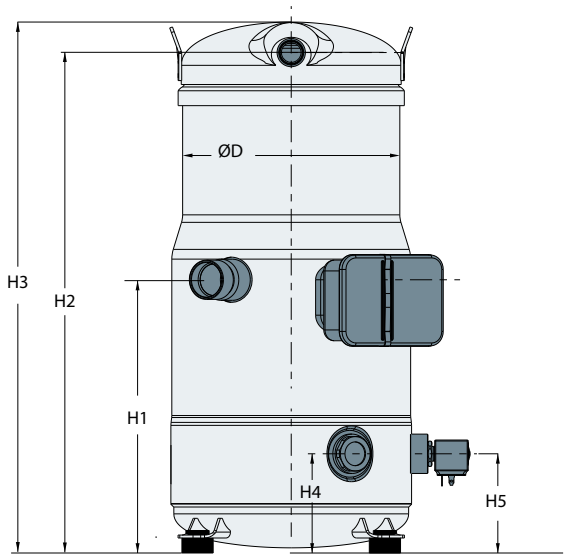


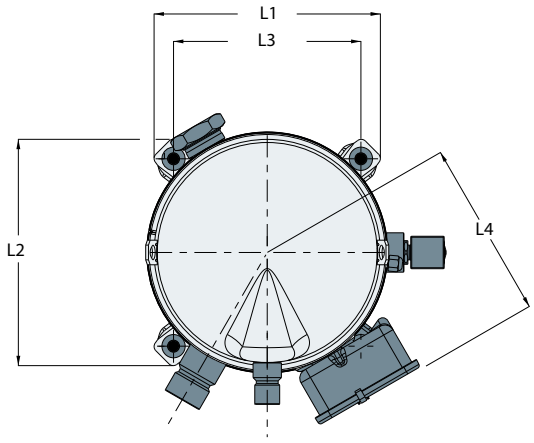
Grommet



Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Unified	VZH088-J	220.8	8.69	234.6	9.23	451.2	17.76	484.8	19.08	74.8	2.94	93.8	3.69	230	9.05	230	9.05	190.5	7.5	200.4	7.81	8560098

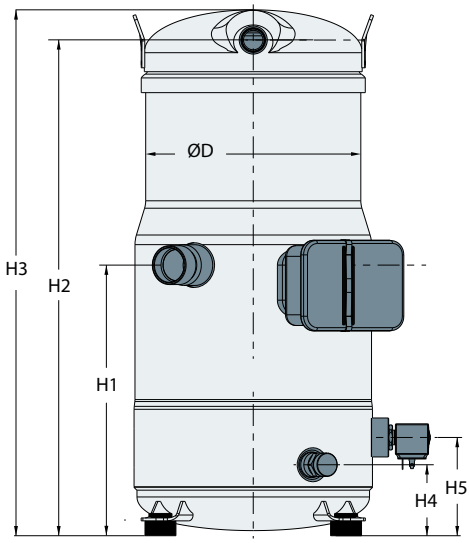
VZH117-G/H single version

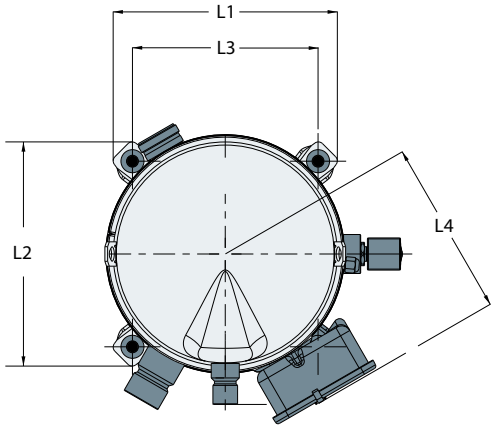




7

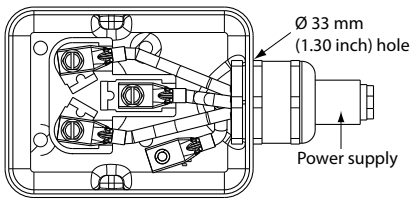
VZH117-G/H manifolded version



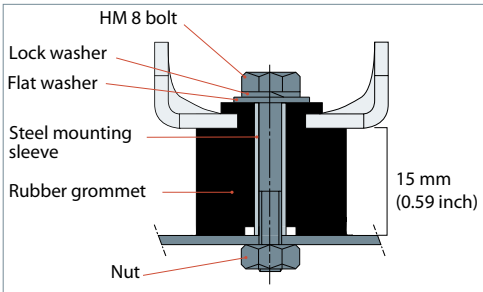


8

Electrical box

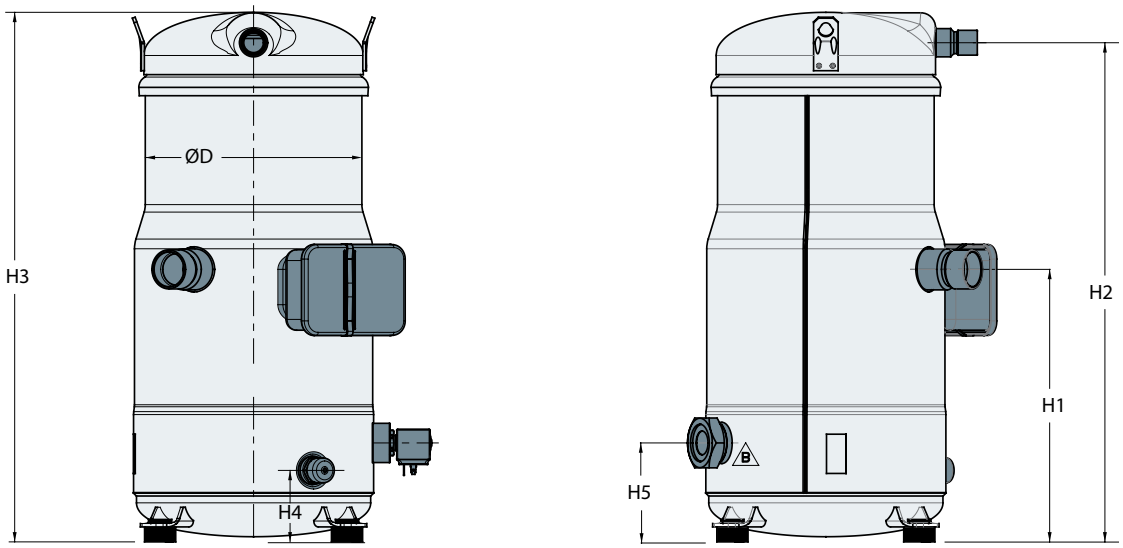


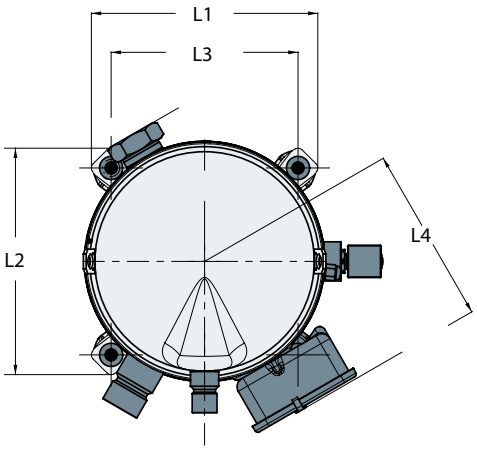
Grommet



Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Single	VZH117- G/H	220.8	8.69	276.9	10.92	507.9	20.02	541.6	21.34	100	3.96	100	3.96	230	9.05	230	9.05	190.5	7.5	180.7	7.13	8560026
Manifolding	VZH117- G/H	220.8	8.69	276.9	10.92	507.9	20.02	541.6	21.34	72	2.86	100	3.96	230	9.05	230	9.05	190.5	7.5	180.7	7.13	8560057

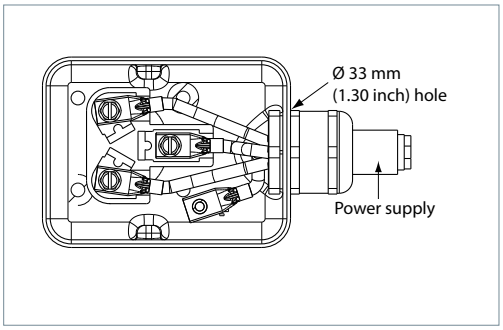
VZH117-G/H unified version



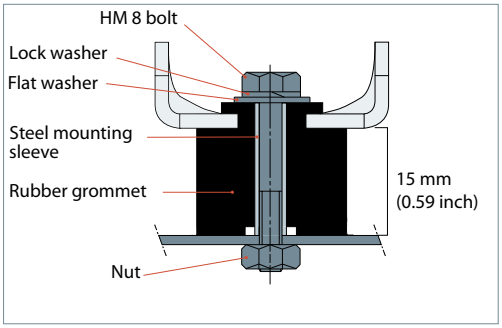


9

Electrical box

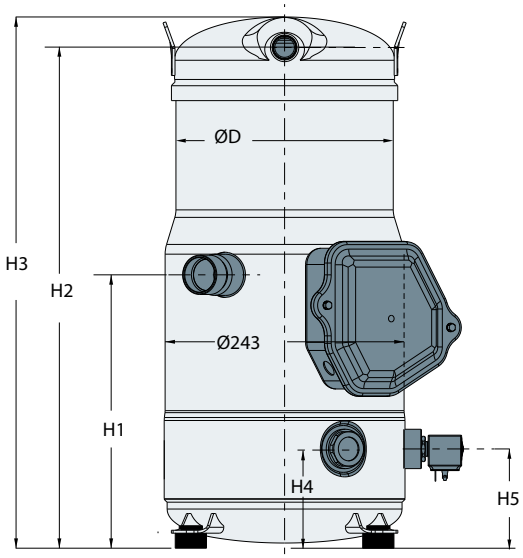


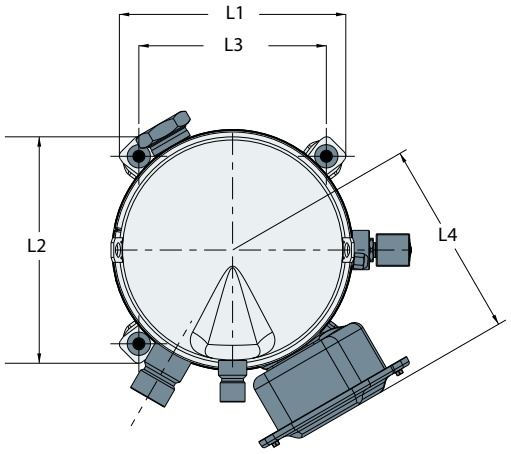
Grommet



Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Unified	VZH117-G/H	220.8	8.69	276.9	10.92	507.9	20.02	541.6	21.34	72	2.86	100	3.96	230	9.05	230	9.05	190.5	7.5	180.7	7.13	8560099

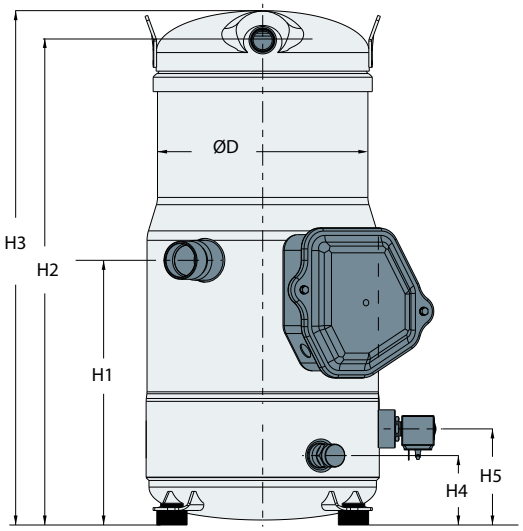
VZH117-J single version

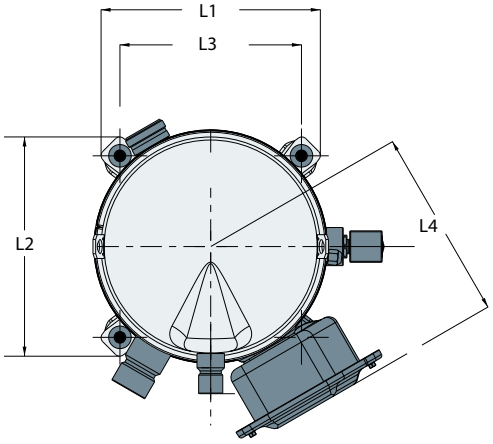




10

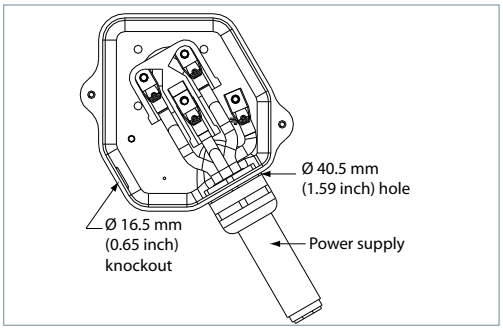
VZH117-J manifolded version



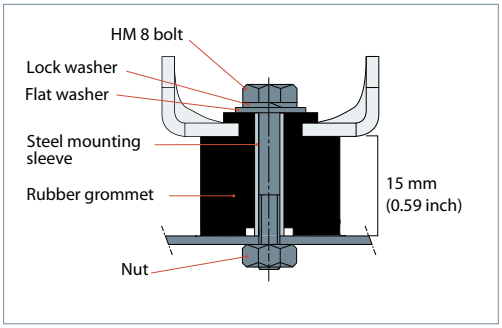


11

Electrical box

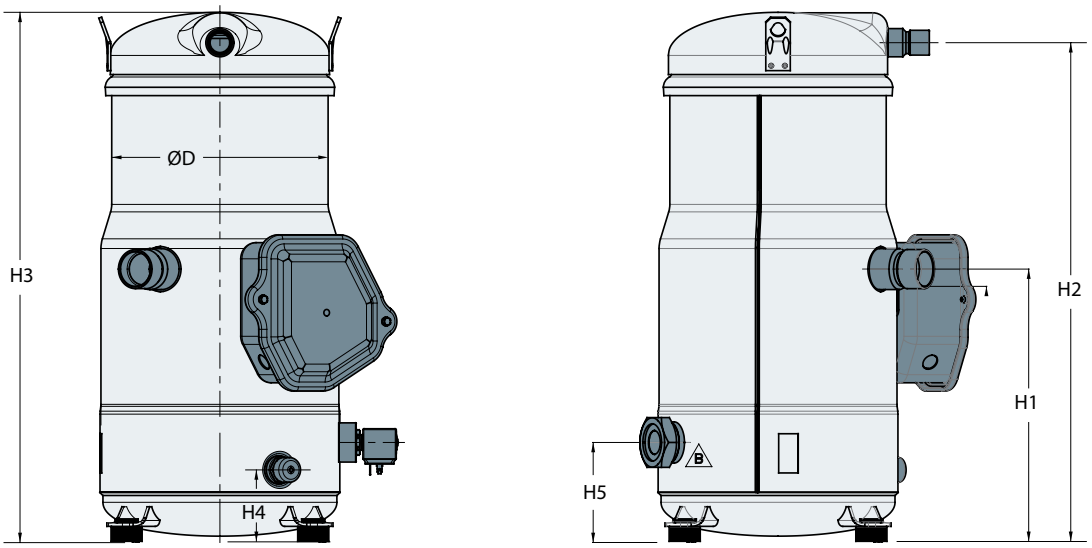


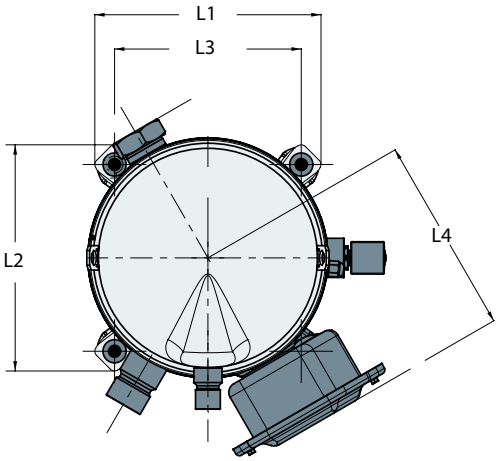
Grommet



Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Single	VZH117-J	220.8	8.69	276.9	10.92	507.9	20.02	541.6	21.34	100	3.96	100	3.96	230	9.05	230	9.05	190.5	7.5	200.4	7.87	8560031
Manifolding	VZH117-J	220.8	8.69	276.9	10.92	507.9	20.02	541.6	21.34	72	2.86	100	3.96	230	9.05	230	9.05	190.5	7.5	200.4	7.87	8560058

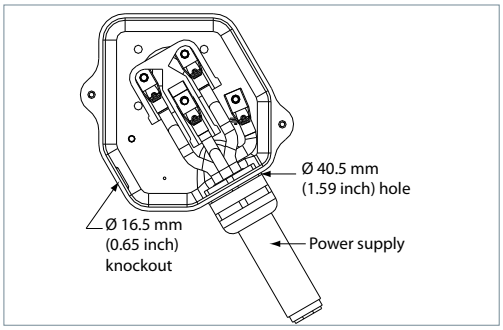
VZH117-J unified version



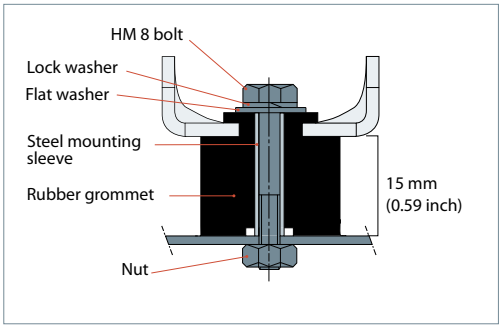


12

Electrical box

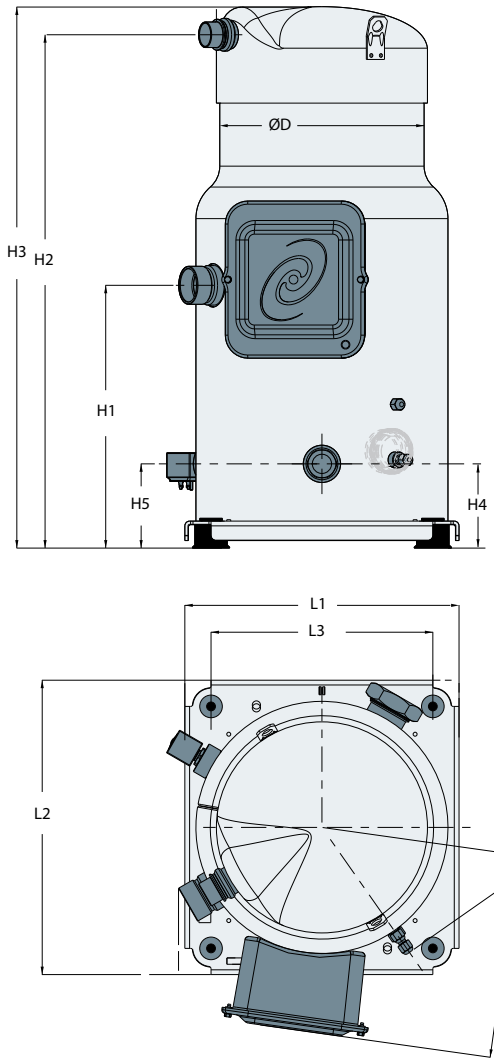


Grommet

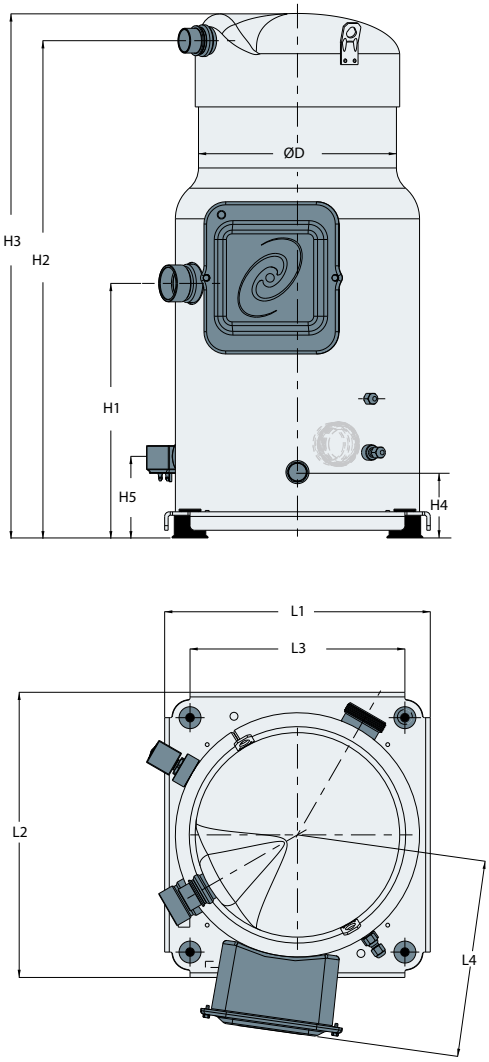


Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Unified	VZH117-J	220.8	8.69	276.9	10.92	507.9	20.02	541.6	21.34	72	2.86	100	3.96	230	9.05	230	9.05	190.5	7.5	200.4	7.87	8560100

VZH170-G/H single version

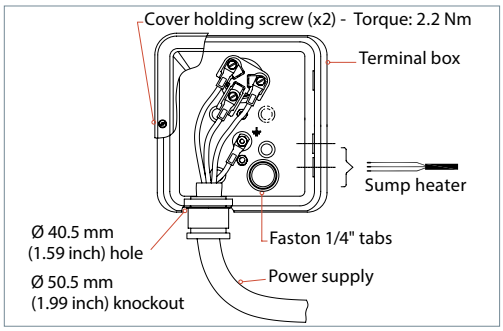


VZH170-G/H manifolded version



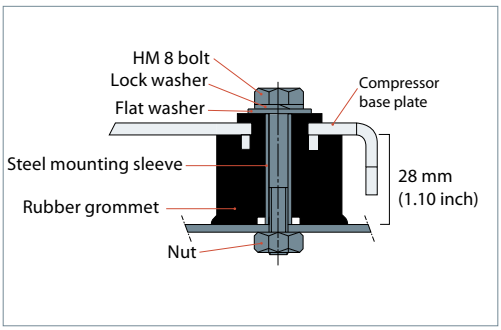
13

Electrical box



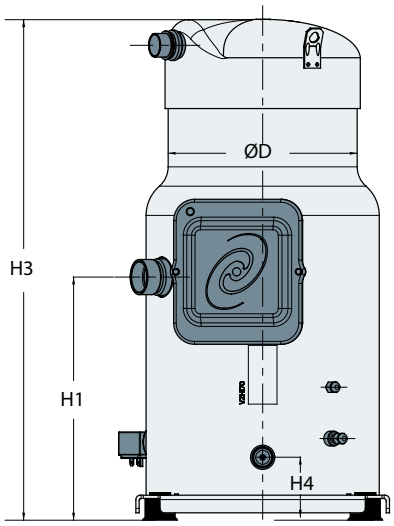
14

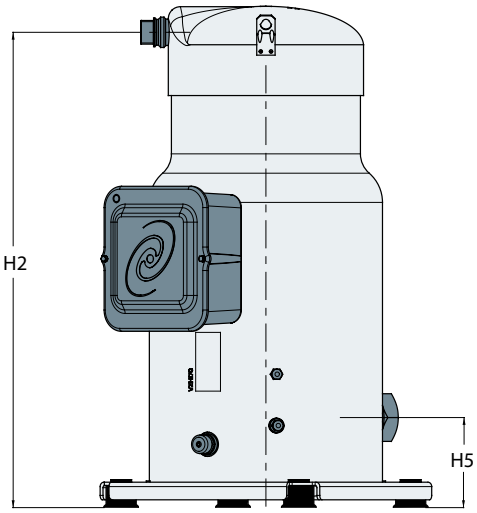
Grommet

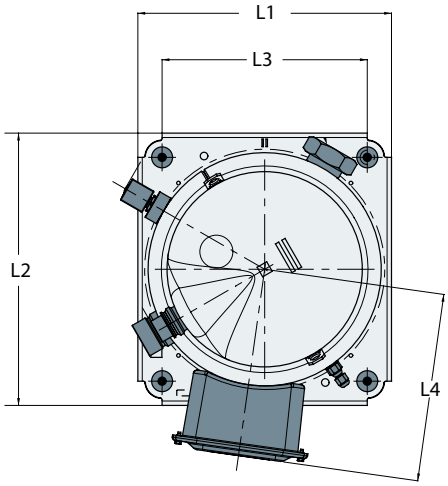


Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Single	VZH170-G/H	257	10.12	329	12.97	644.5	25.39	686.5	27.04	104.1	4.10	104.1	4.10	345	13.58	371	14.61	279.4	11	257	10.12	8551186
Manifolding	VZH170-G/H	257	10.12	329	12.97	644.5	25.39	686.5	27.04	83.6	3.3	104.1	4.10	345	13.58	371	14.61	279.4	11	257	10.12	8551187

VZH170-G/H unified version

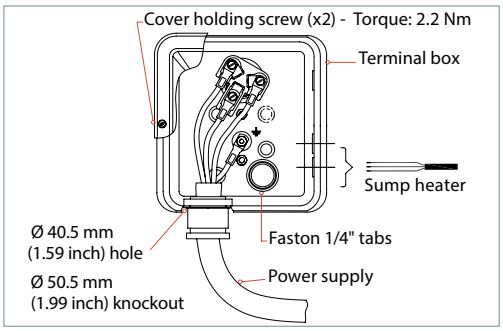




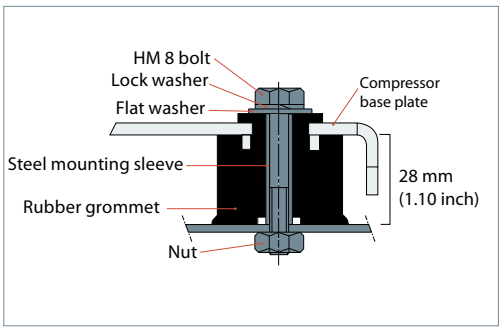


15

Electrical box

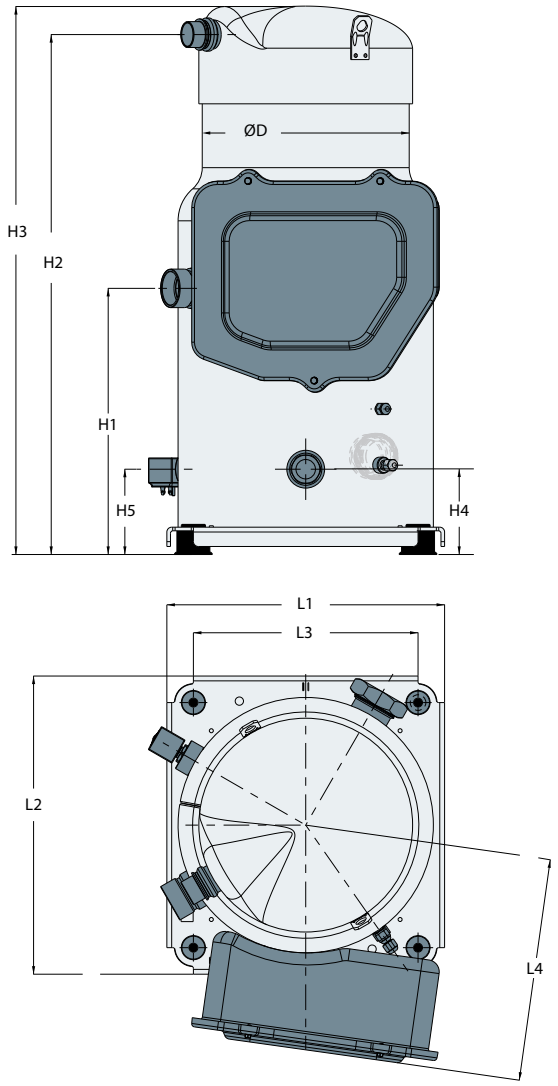


Grommet



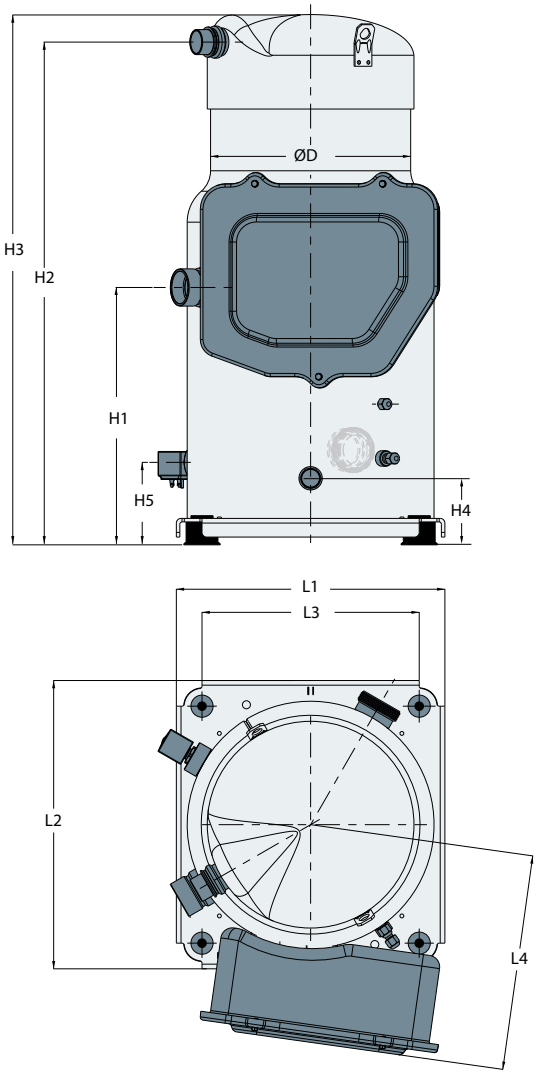
Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Unified	VZH170-G/H	257	10.12	329	12.97	644.5	25.39	686.5	27.04	83.6	3.3	120.5	4.74	345	13.58	371	14.61	279.4	11	257	10.12	8560095

VZH170-J single version



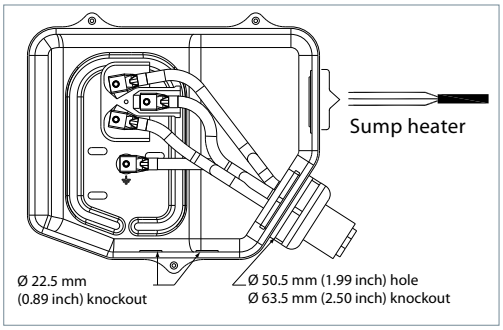
16

VZH170-J manifolded version

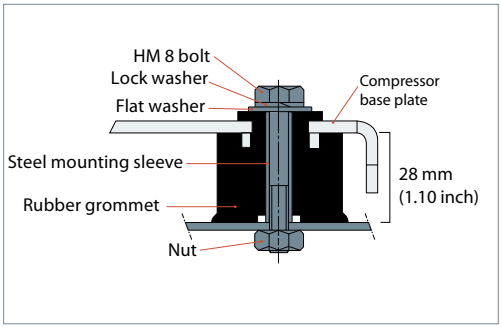


17

Electrical box

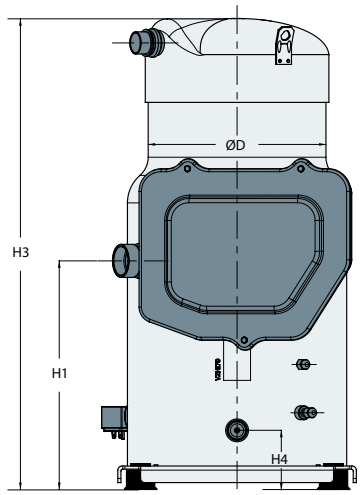


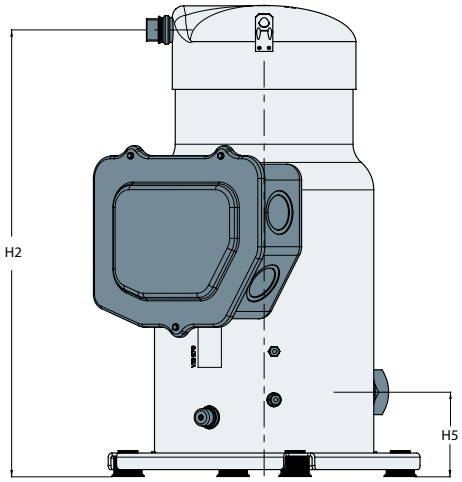
Grommet

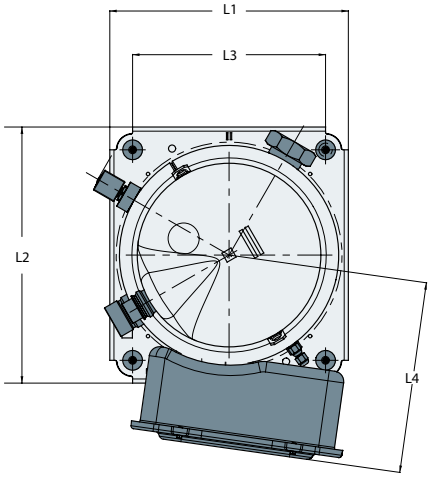


Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Single	VZH170-J	257	10.12	329	12.97	644.5	25.39	686.5	27.04	104.1	4.10	104.1	4.10	345	13.58	371	14.61	279.4	11	277	10.90	8551174
Manifolding	VZH170-J	257	10.12	329	12.97	644.5	25.39	686.5	27.04	83.6	3.3	104.1	4.10	345	13.58	371	14.61	279.4	11	277	10.90	8551188

VZH170-J unified version







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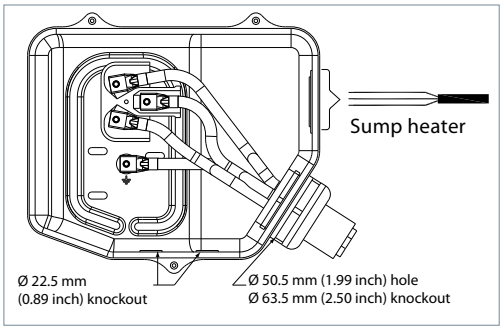
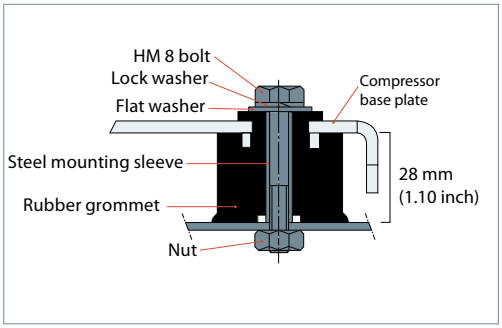
Electrical box



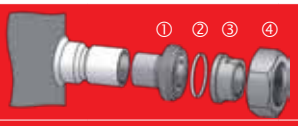
Grommet



Version	Compressor model	D		H1		H2		H3		H4		H5		L1		L2		L3		L4		Outline drawing number
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
Unified	VZH170-J	257	10.12	329	12.97	644.5	25.39	686.5	27.04	83.6	3.3	120.5	4.74	345	13.58	371	14.61	279.4	11	277	10.90	8560096

Connection Details

	VZH088 Single	VZH088 Manifolding	VZH088 Unified	VZH117 Single	VZH117 Manifolding	VZH117 Unified	VZH170 Single	VZH170 Manifolding	VZH170 Unified
Suction connection	1"1/8	1"1/8	1"1/8	1"3/8	1"3/8	1"3/8	1"5/8	1"5/8	1"5/8
Discharge connection	7/8"	7/8"	7/8"	7/8"	7/8"	7/8"	1"1/8	1"1/8	1"1/8
Oil sight glass	Threaded (1"1/8 – 18 UNF)	None	on oil equalization port	Threaded (1"1/8 – 18 UNF)	None	on oil equalization port	Threaded (1"1/8 – 18 UNF)	None	on oil equalization port
Oil level sensor	None	Threaded M20x1.5		None	Threaded M20x1.5		None	Threaded M20x1.5	
Oil equalization connection	Rotolock 1"3/4			Rotolock 1"3/4			Rotolock 2"1/4		
Oil drain connection	Female 1/4" Flare incorporating a Schrader valve								
Low pressure gauge port (Schrader)	Male 1/4" Flare incorporating a Schrader valve								
Outline	❶ / ❹	❷ / ❺	❸ / ❻	❼ / ❿	❽ / ⓫	❾ / ⓬	⓭ / ⓰	⓮ / ⓱	⓯ / ⓲



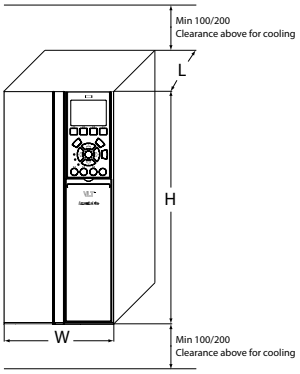
Compressor models	Brazed connection size		Rotolock adaptor set (①adaptor, ②gasket, ③sleeve, ④nut)			Rotolock adaptor (① adaptor only)
			Rotolock	Solder sleeve ODF	Code Number	Code Number
VZH088	Suction	1"1/8	1"3/4	1"1/8	120Z0125	120Z0364
	Discharge	7/8"	1"1/4	7/8"		120Z0367
VZH117	Suction	1"3/8	1"3/4	1"3/8	120Z0405	120Z0431
	Discharge	7/8"	1"1/4	7/8"		120Z0367
VZH170	Suction	1"5/8	2"1/4	1"5/8	7765028	120Z0432
	Discharge	1"1/8	1"3/4	1"1/8		120Z0364

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

Rotolock adaptors are available, refer to the information above.

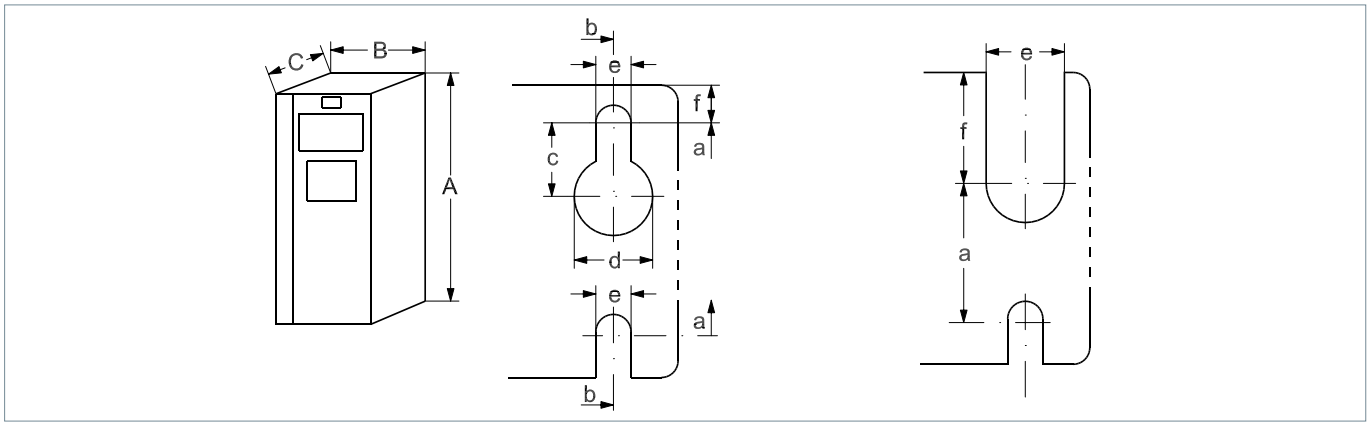
CDS303 Frequency converter

Frequency converter dimensions depend on supply voltage, IP rating and power. The table below gives an overview of the overall dimensions and different drive enclosures (B1 - B4). 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 (inch)	Clearance above/below mm (inch)	bracket supplied (mm^2)	Drive enclosure	Overall drive size [H x W x L] mm (inch)	Clearance above/below mm (inch)	bracket supplied (mm^2)
T2: 200-240/3/ 50-60	15	J	VZH088	B4	595x230x242 (23.43x9.09x9.53)	200 (8)	2pcs, ø24-28k28b 1pcs, ø32-36 k36b	C1	680x308x310 (26.78x12.13x12.20)	200 (8)	1pcs, ø32-36 k36b 1pcs, ø36-40 k40b
	18.5		VZH117	C3	630x308x333 (24.8x12.13x13.15)	200 (8)	1pcs, ø32-36 k36b 1pcs, ø36-40 k40b	C1	680x308x310 (26.78x12.13x12.20)	200 (8)	1pcs, ø32-36 k36b 1pcs, ø36-40 k40b
	22		VZH170	C3	630x308x333 (24.8x12.13x13.15)	200 (8)	1pcs, ø32-36 k36b 1pcs, ø36-40 k40b	C1	680x308x310 (26.78x12.13x12.20)	200 (8)	1pcs, ø32-36 k36b 1pcs, ø36-40 k40b
T4: 380-480/3/ 50-60	15	G	VZH088	B3	420x165x249 (16.5x6.5x9.76)	200 (8)	3pcs, Ø13-22	B1	480x242x260 (18.9x9.45x10.24)	100 (4)	3pcs, ø3-32
	18.5		VZH117	B4	595x230x242 (23.42x9.09x9.53)	200 (8)	2pcs, ø24-28 k28b	B2	650x242x260 (25.6x9.53x10.24)	200 (8)	3pcs, ø3-32
	22		VZH170	B4	595x230x242 (23.42x9.09x9.53)	200 (8)	2pcs, ø24-28 k28b	B2	650x242x260 (25.6x9.53x10.24)	200 (8)	3pcs, ø14-40
T6: 525-600/3/ 50-60	18	H	VZH088	B4	595x230x242 (23.42x9.09x9.53)	200 (8)	2pcs, ø24-28 k28b	-	-	-	-
	30		VZH117	B4	595x230x242 (23.42x9.09x9.53)	200 (8)	2pcs, ø24-28 k28b	-	-	-	-
	30		VZH170	B4	595x230x242 (23.42x9.09x9.53)	200 (8)	2pcs, ø24-28 k28b	-	-	-	-

For customers who needs other size brackets, please refer to accessories for ordering.



Enclosure		Height						Width				Depth		Mounting hole						Max. Weight	
Frame	IP Class	A		A[1)]		a		B		b		C		d		e		f		kg	lb
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
B1	IP55	480	18.90	-	-	454	17.87	242	9.53	210	8.27	260	10.24	19	0.75	9	0.35	9	0.35	23	51
B2	IP55	650	25.59	-	-	624	24.57	242	9.53	210	8.27	260	10.24	19	0.75	9	0.35	9	0.35	27	60
B3	IP20	399	15.71	420	16.54	380	14.96	165	6.5	140	5.51	249	9.8	12	0.47	6.8	0.27	7.9	0.31	12	26
B4	IP20	520	20.47	595	23.43	495	19.49	230	9.06	200	7.87	242	9.53	-	-	8.5	0.33	15	0.59	23	51
C1	IP55	680	26.77	-	-	648	25.51	308	12.13	272	10.71	310	12.20	19	0.75	9	0.35	9.8	0.39	45	99
C3	IP20	550	21.65	630	24.80	521	20.51	308	12.13	270	10.63	333	13.11	-	-	8.5	0.33	17	0.67	50	110

A[1)] Including decoupling plate.

The dimensions are only for the physical units, but when installing in an application it is necessary to add space for free air passage both above and below the units. The amount of space for free air passage is listed in "frequency converter dimensions - Clearance above/below (mm/inch)".

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 in case of motor burnt.

VZH all published data and polynomials are based on 208V frequency converter power supply for code J and 400V 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	200-240V / 3ph / 50Hz & 60Hz (±10%)
G	380-480V / 3ph / 50Hz & 60Hz (±10%)
H	525-600V /3ph / 50Hz & 60Hz (±10%)

Compressor electrical specifications

	Compressor	RW (Ohm)	RLA (A)	MMT (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 and rated drive input voltage.

RLA is the measured value at the compressor terminals (after the drive).

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 ULrequirements, MMT value is 125% of RLA. This value is printed on the compressor nameplate.

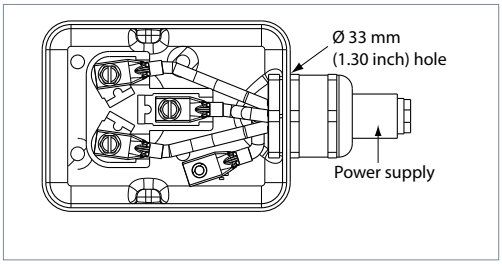
Wiring connections

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

⚠ Cable gland or similar protection component must be used on electrical box's knockouts to against accidental contact with electrical parts inside.

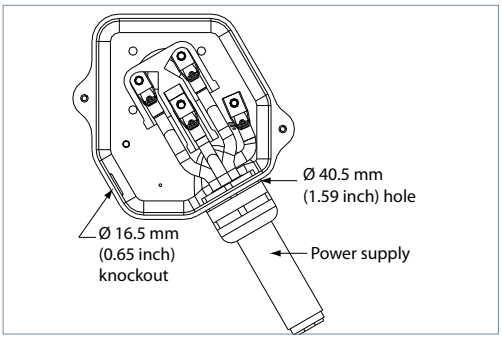
VZH088/117-G/H

The terminal box is provided with a φ 33mm (φ1.3 inch) hole (ISO32) for power supply.



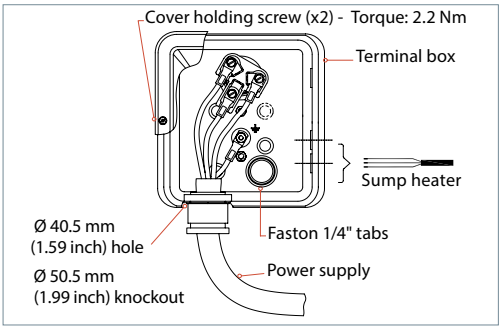
VZH088/117-J

The terminal box is provided with a φ 40.5mm (φ1.59 inch) hole (ISO40) for power supply and a φ 16.5mm (φ0.65 inch) knockout (ISO16) .



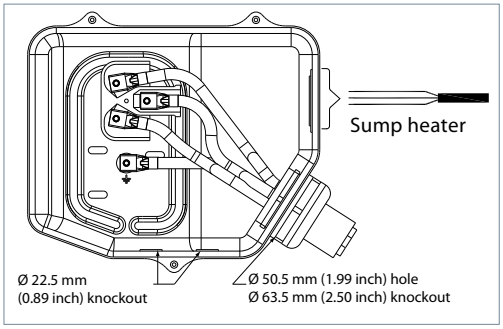
VZH170-G/H

φ 40.5mm (φ 1.59inch) (ISO 40) hole with possible φ 50.5mm (φ 1.98inch)(ISO50) knockout for power supply



VZH170-J

φ 50.5mm (φ 1.98inch) (ISO 50 & UL1"1/2 conduit) hole with possible φ 63.5mm (φ 2.5inch) (ISO63 and UL 2"conduit) knockout for power supply.
• 2 x φ 22.5mm (φ 0.89inch) (PG16 and UL ." conduit) knockouts.



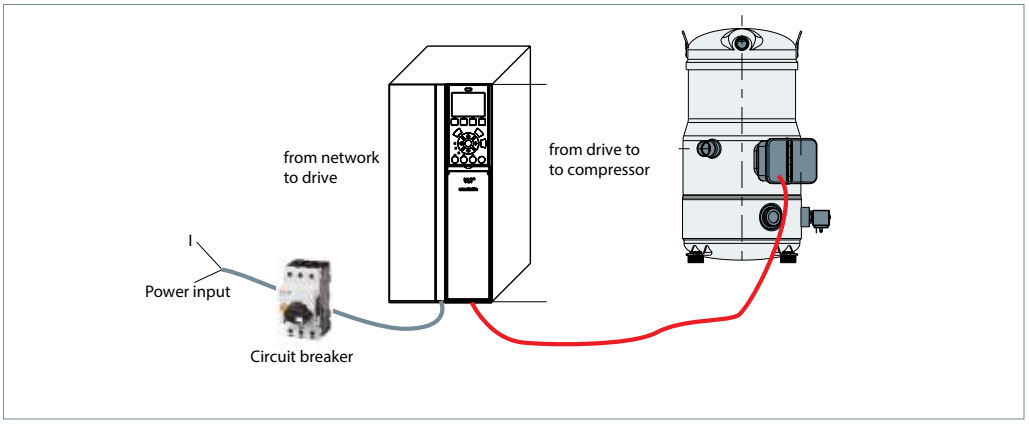
Fuses / circuit breakers

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.

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	L25S-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	IJS-80	5014006-080	KLS-R80	A6K-80R	NZMB1-A100	-

Wire sizes

Below table lists maximum wiring sizes for the motor compressor power supply cables.



	From network to frequency converter			From frequency converter to compressor		
	Type	mm²	AWG	Type	mm²	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 is the maximum wire size connectors can accept 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...

Soft-start control

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

Current inrush will not exceed the frequency converter maximum current.

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

Phase sequence and reverse rotation protection

The compressor will only operate properly in a single direction. If electrical connections are done correctly between the drive and the compressor terminals (compressor T1/T2/T3 and drive terminals U, V & W matching), the drive will provide correct phase supply to the compressor, and reverse rotation will be not possible:

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

If compressor T1/T2/T3 and drive U, V & W terminals are not matching, the compressor can operate in a reverse rotation. This results in excessive noise, no pressure differential between suction and discharge, and suction line warming rather than immediate cooling. The compressor can be rapidly damaged in these conditions. If reverse rotation symptoms occur, shut the compressor down and connect the phases to their proper terminals.

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

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	Agains ingress of water with harmful effects (non protected vertically dripping dripping (15° tilted) spaying splashing jetting powerful jetting temporary immersion continuous immersion

Motor protection

VZH scroll compressors are not equipped with an internal motor protector. Motor protection is provided by the variable speed drive. All parameters are factory preset in order to guaranty locked rotor or overload current protection.

When a warning situation is reached in the current control, the CDS 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.

Approvals and certificates

VZH compressors comply with the following approvals and certificates.

CE (European Directive)	CE	VZH code G & code J
UL (Underwriters Laboratories)	cULus	All VZH models
EMC 2014/30/EU		All VZH models

Pressure equipment directive 2014/68/EU

Products	VZH088	VZH117	VZH170
Fluids	Group 2		
Category PED	II		
Evaluation module	D1		
TS - service temperature LP	-35°C < TS < +55°C -31°F < TS < 131°F		-35°C < TS < +51°C -31°F < TS < 123.8°F
PS - service pressure LP	33.3 bar(g) 483 psi(g)	33.3 bar(g) 483 psi(g)	30.2 bar(g) 438 psi(g)

Low voltage directive 2014/35/EU

Products	VZH088-117-170
Declaration of conformity ref. Low voltage Directive 2014/35/EU	Contact Danfoss

Internal free volume

Products	Internal free volume at LP side without oil	
	litre	cu.inch
VZH088	12.7	775
VZH117	15.1	921
VZH170	29.9	1825

Direct and indirect exposure of drive to water

IP20 drives are intended for indoor or cabinet mounting. Application example: drive fitted in a machine room, basement or in an electrical cabinet together with other electric / electronic components such as the unit controller or contactors.

For outdoor use the electrical cabinet must be IP54 or the drive itself must be IP54 at least. Application example: rooftop units or condensing units.

If IP54 with LCP make sure that the gasket is applied to ensure tightness.

It is recommended to place drive at least 30cm (11.81 inches) from ground to protect against floods.

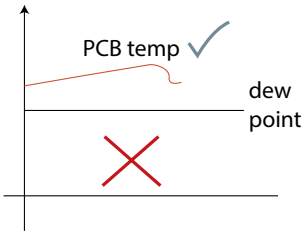
Condensation

Condensation must always be avoided. There is a specific risk of condensation when the frequency converter or some of its components are colder than moist ambient air. In this situation, the moisture in the air can condense on the electronic components.

- Operating with the frequency converter constantly connected to the mains can help to reduce the risk of condensation. Install a cabinet heater in situations where there is a real possibility of condensation due to ambient conditions.

- If the drive is IP 20, then evaluate and prevent possibility of condensation above drive. Example: condensation on metallic frame above drive, piping…

If unavoidable, solutions like cabinet heater, a pace heater, top hat on the drive, insulation in the electric panel can be a solution.



- Water resulting of condensation must not accumulate on the bottom of electric panel. Provide a drain for condensed water to run out if necessary.

- No other forced cooling then internal drive fan.

Dust Exposure

Avoid Dust forms and deposits on the surface of the drive and inside on circuit boards and the electronic components. These deposits act as insulation layers and hamper heat transfer to the ambient air, reducing the cooling capacity. The components become warmer. This causes accelerated aging of the electronic components, and the service life of the unit decreases. Dust deposits on the heat sink in the back of the unit also decrease the service life of the unit.

The drive cooling fans have small bearings into which dust can penetrate and act as an abrasive. This leads to bearing damage and fan failure.

Under the conditions described above, it is advisable to clean the frequency converter during periodic maintenance. Remove dust off the heat sink and fans and clean the filter mats.

Mechanical Mounting Clearance

For optimal cooling conditions, mount the drive on vertical position. Allow a free air passage above and below the frequency converter. See Table below:

Enclosure type*	B1	B2/B3/B4/C1/C3	C2/C4
a (mm/inch)	100/3.94	200/7.87	225/8.86
b (mm/inch)	100/3.94	200/7.87	225/8.86

*: Enclosure please refer to drive enclosure table in section "CDS303 Frequency converter".

Horizontal mounting is NOT the preferred position, however if unavoidable, lay PCB on the left side (270°) to avoid condensation accumulation on the electronics.

Ambient temperature

The maximum ambient temperature for the drive is 50°C (122°F).

Make sure that the clearance limits described above are respected.

The drive must be installed on a wall or on a back plate to ensure proper cooling

Do not place the drive under direct sunlight. Insulation inside the electrical panel can reduce impact of sun radiation.

Test at the unit at highest ambient maximum load is recommended. Look for over temperature drive alarm

The drive could operate lower to -10C (14F)with proper operation, such as inside the cabinet, install the space heater. However, LCP may not function well under such low temperature.

EMC

Frequency converter (and other electrical devices) generate electronic or magnetic fields that may interfere with their environment. The electromagnetic compatibility (EMC) of these effects depends on the power and the harmonic characteristics of the devices.

The EMC product standard for frequency converters defines 4 categories (C1, C2, C3, and C4) with specified requirements for emission and immunity. Table below states the definition of the 4 categories and the equivalent classification from EN 55011.

Category	Definition	Equivalent emission class in EN 55011
C1	Frequency converters installed in the first environment (home and office) with a supply voltage less than 1000 V.	Class B
C2	Frequency converters installed in the first environment (home and office) with a supply voltage less than 1000 V, which are not plug-in and not movable, and must be installed and commissioned by a professional.	Class A Group 1
C3	Frequency converters installed in the second environment (industrial) with a supply voltage lower than 1000 V.	Class A Group 2
C4	Frequency converters installed in the second environment with a supply voltage equal to or above 1000 V or rated current equal to or above 400 A or intended for use in complex systems.	No limit line. Make an EMC plan

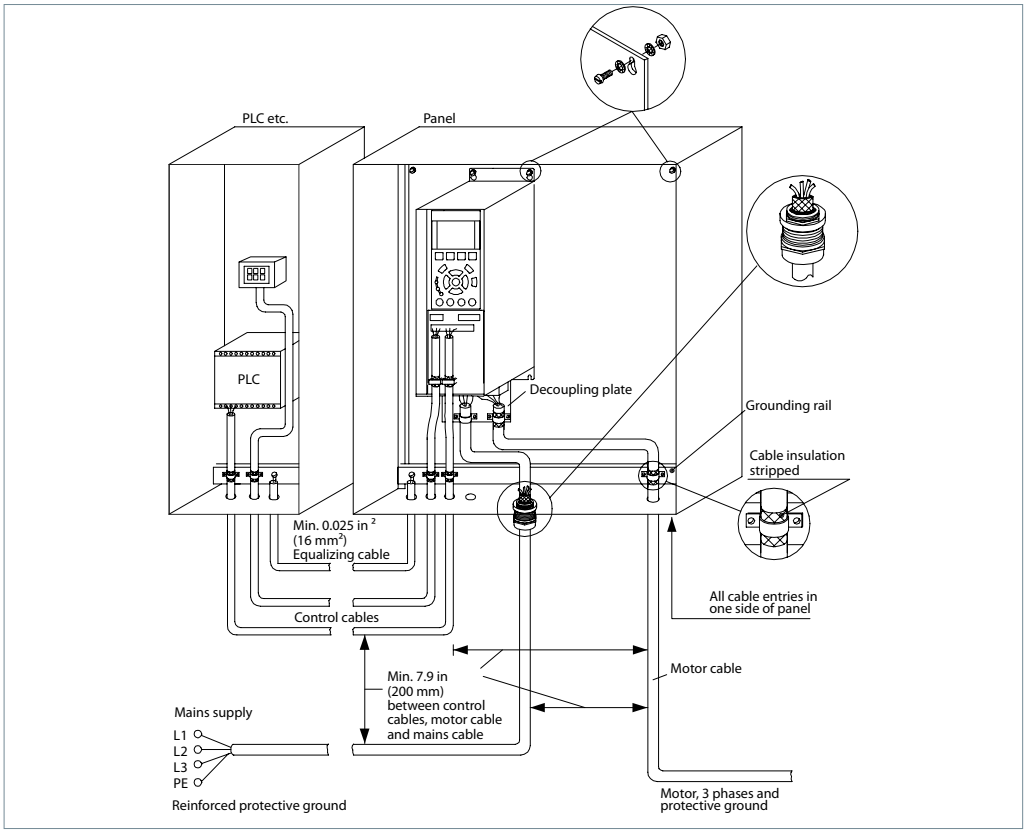
VZH compressor with drive package achieve EMC Class A Group 1 emission and immunity requirements.

EMC best practices

- Use screened (shielded) cables for motor, control wiring and communication.
- Separate cables for input power, motor wiring and control wiring. Failure to isolate power, motor, control and communication cables can result in unintended behavior or reduced performance. Minimum 200 mm (7.9 in) clearance between power, motor and control cables is required.
- Ensure VFD proper grounding
- Motor cables should be as short as possible to reduce noise level and leakage currents.

EMC correct installation of an frequency drive CDS303

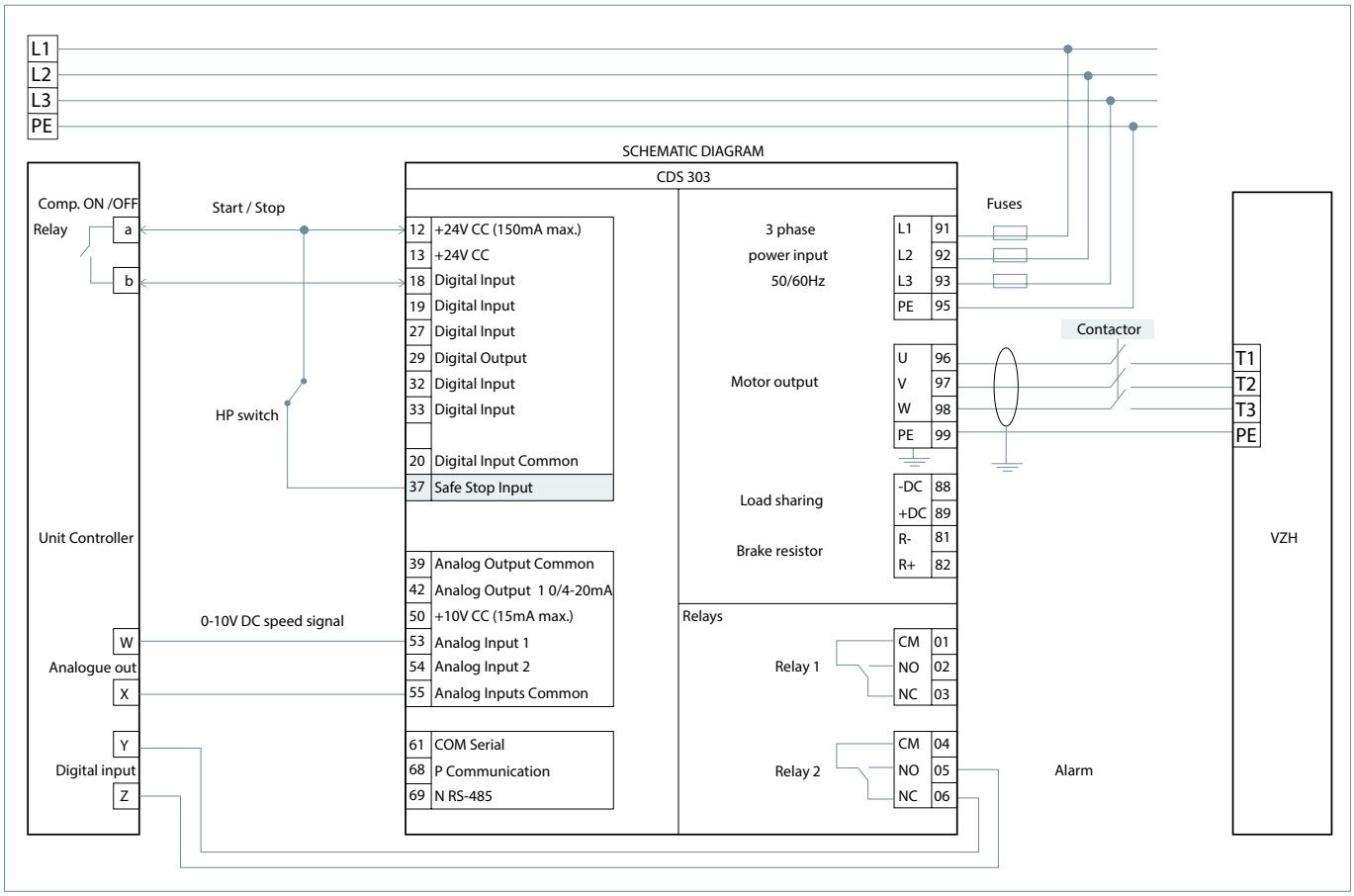
EMC qualification reports are available upon request to Danfoss technical support.



The frequency converter is pre-set for speed open loop control. This means that the speed set-point is given by a 0-10V, where 0V corresponds to the minimum compressor speed and 10V is maximum compressor speed.

The unit controller must have full control of the compressor operation and application protections such as compressor envelope control, oil return management and short cycling protection.

Below is the Danfoss proposed system configuration and wiring.



NOTE 1: Only relevant parameters or the ones different from factory defaults are shown.
NOTE 2: Oil boost, short cycle protection to be programmed in the unit controller
NOTE 3: Use Safe Stop for HP switch in CDS303 or use an output contactor (CDS803)

Drive parameters to adjust (See Note 1)

Drive parameters		Description	Value	Default
Short cycle protection is done by unit controller				
28.00	Short cycle protection	Short cycle protection done in unit controller: (preferred option)	Disable	Enable
Short cycle protection is done in drive; If short cycle protection enabled in drive, the Terminal 18 start/stop will be ignored during minimum run time. To be able to stop compressor during this minimum run time (Low pressure trip..), it is necessary to use Terminal 27 (Par 5.12) and set it to "Coast inverse" If Modbus is used it is not necessary to connect terminal 27, but a "Coasting" command must be sent to be able to stop compressor in case of an alarm during minimum run time.				
28.00	Short cycle protection	Short cycle protection done by the drive.	Enable	Enable
28.01	Interval between starts	Start command is ignored until the timer (300s) has elapsed. Only then, can the compressor start.	300 sec	300sec
28.02	Minimum Run time	The compressor cannot stop until the set time (180s) has elapsed. The timer starts counting following a compressor start. **Stop** command is ignored. Only a coast (inverse) command can override the time and stop the compressor.	180 sec	180sec
5.12	Terminal 27 Digital input	Designated for the LP switch.	[2]* Coast inverse	coast inverse

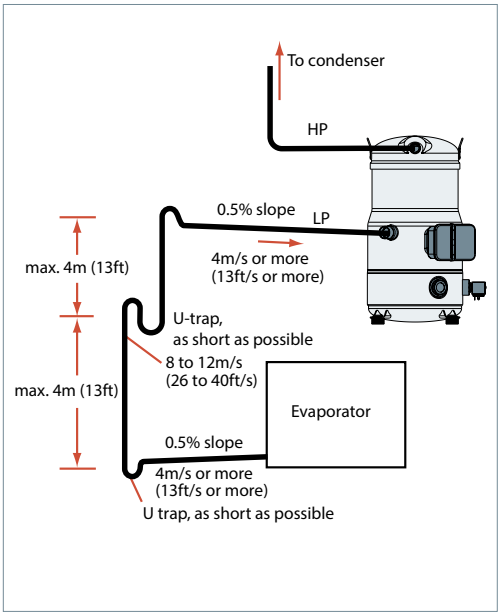
General requirements

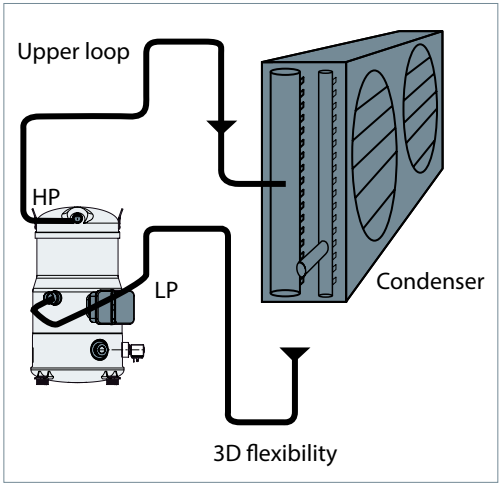
Proper piping practices should be employed to:

1. Ensure adequate oil return, even under minimum load conditions (refrigerant speed, piping slopes…). For validation tests see section "Manage oil in the circuit".

2. Avoid condensed liquid refrigerant from draining back to the compressor when stopped (discharge piping upper loop). For validation tests see section "Manage off cycle migration".

General recommendations are described in the figures below:





3. Piping should be designed with adequate three-dimensional flexibility to avoid excess vibration. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. For more information on noise and vibration, see section on: "Sound and vibration management".

4. The design in this guideline is for short circuit application. However, for long circuit and split system application, an oil separator and an external non-return valve are mandatory to use.

General requirements

Compressors used in single applications must be mounted with flexible grommets.

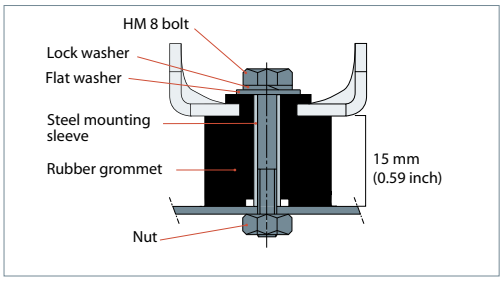
During operation, the maximum inclination from the vertical plane must not exceed 3 degrees.

Single requirements

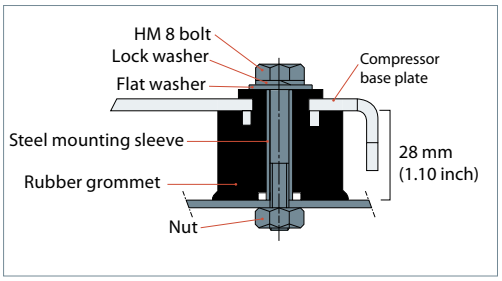
Maximum inclination from the vertical plane while operating must not exceed 3 degrees.

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 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.

The required bolt size for the VZH088 & 117 compressors is HM8-40. This bolt must be tightened to a torque of 15 Nm (11 ft/lbs.).



The required bolt size for VZH170 compressors is HM8-55 and must be tightened to a torque of 21Nm (15 ft/lbs).



Requirement

R Oil level must be visible or full in the sight glass when the compressor is running and when all compressors of the circuit are stopped.

System evaluation

	Single compressor
Non split	Test N°1
Split	1. Since each installation is unique, test can not validate the oil return, Oil separator is mandatory 2. Pay special attention to "Piping design" on field 3. Oil level must be checked and adjusted at commissioning.

Test, criteria and solutions

Test N°	Purpose	Test condition	Pass criteria	Solutions
1	Check proper oil return	 Lowest foreseeable evaporation, and highest foreseeable condensation. **Minimum speed running** 6 hours. For reversible system, perform test in both heating and cooling mode.	Oil level must be visible or full in the sight glass when the compressor is running.	1. Top-up with oil, generally 3% of the total system refrigerant charge (in weight). Above 3% look for potential oil trap in the system. 2. Adjust oil boost function, for more details see section"Oil management logic". 3. Oil separator can be added

Typical sounds and vibrations in systems can be broken down into the following three categories:
- Sound radiation (through air)
- Mechanical vibrations (through parts and structure)
- Gas pulsation (through 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 compressors, the emission path is air and the sound waves are travelling directly from the machine in all directions.

Sound levels are as follows:
- For compressors running alone:

Model	Frequency RPS	200V			400V			575V		
		Without accoustic hood (dBA)	With accoustic hood (dBA)	Acoustic hood code	Without accoustic hood (dBA)	With accoustic hood (dBA)	Acoustic hood code	Without accoustic hood (dBA)	With accoustic hood (dBA)	Acoustic hood code
VZH088	30	70	64	120Z0510 (single version)	69	62	120Z0509 (single version)	72	66	120Z0509 (single version)
	60	78	73	120Z0512 (manifolding /unified version)	77	72	120Z0511 ((manifolding /unified version)	79	73	120Z0511 (manifolding /unified version)
	90	86	80		85	79		88	82	
VZH117	30	73	67	120Z0514 (single version)	71	64	120Z0513 (single version)	72	66	120Z0513 (single version)
	60	82	77	120Z0516 (manifolding /unified version)	80	75	120Z0515 (manifolding /unified version)	82	76	120Z0515 (manifolding /unified version)
	90	88	83		87	81		91	85	
VZH170	30	72	66	120Z0519 (single version)	72	65	120Z0517 (single version)	77	71	120Z0517 (single version)
	60	84	78	120Z0520 (manifolding /unified version)	85	78	120Z0518 (manifolding /unified version)	85	79	120Z0518 (manifolding /unified version)
	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

Mitigations methods:
We can consider two means to reduce compressors sound radiations:
1. Acoustic hoods are quick and easy to install and do not increase the overall size of the compressors. Acoustic hoods are available from Danfoss as accessories.

Refer to the table above for sound levels, attenuation and code numbers.
2. Use of sound-insulation materials on the inside of unit panels is also an effective means to reduce radiation.

Mechanical vibrations

A compressor generates some vibrations that propagate into the surrounding parts and structure. The vibration level of a VZH compressor alone does not exceed 127 µm peak to peak. However, when system structure natural frequencies are close to running frequency, vibrations are amplified due to resonance phenomenon.

A high vibration level is damageable for piping reliability and generates high sound levels.

Mitigations methods:
1. Danfoss VZH scroll compressors are designed to produce minimal vibration during operations. To ensure minimum vibrations transmission to the structure, strictly follow mounting requirements (mounting feet, rails etc..). For further information on mounting requirements, please refer to "Design compressor mounting".

2. Ensure that there is no direct contact (without insulation) between vibrating components and structure.

3. Resonance phenomenon
To avoid resonance phenomenon, pipings and frame must have natural frequencies as far as possible from running frequencies.

This could be challenging on a variable system as all resonant frequencies between min speed to maximum speed will be exited.

It is mandatory to check that piping vibrations are acceptable across speed range. This test can be done by increasing slowly speed and monitoring piping behavior through, strain gage, acceleration, or displacement measurement. As alternative visual check with strobe light can also emphasis high piping displacement.

If some resonant frequencies generate high piping vibration, problem can be solved by increasing piping stiffness with brackets or changing layout. Dampers can also be installed to mitigate vibration.

If some frequencies continue to produce unacceptable vibration levels, 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 made in parameter group 4.6x

Gas pulsation

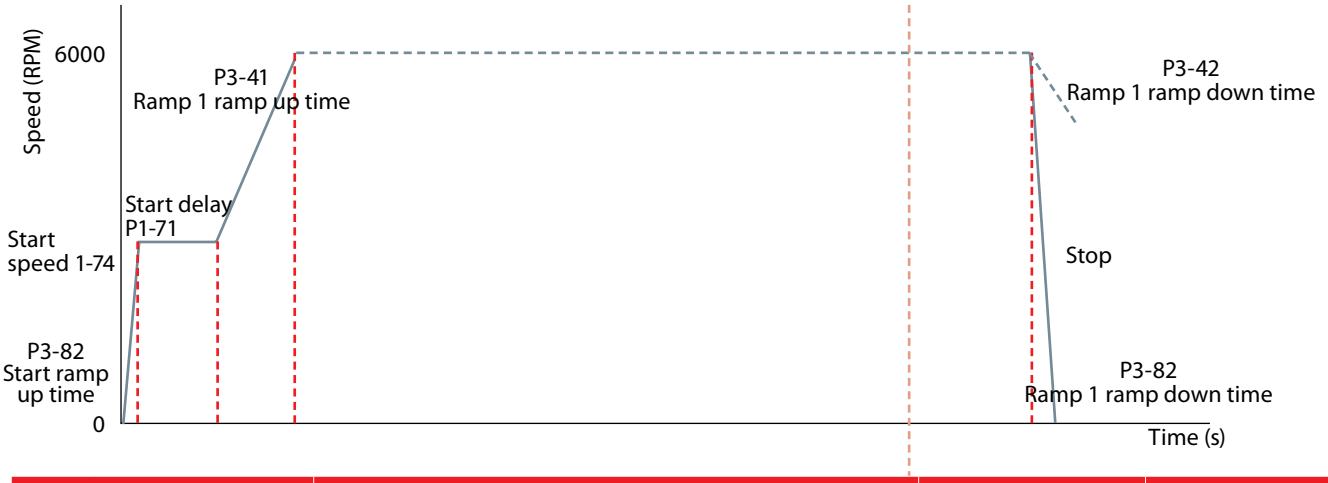
The Danfoss VZH scroll compressor has been designed and tested to ensure that gas pulsation is optimized for the most commonly encountered air conditioning pressure ratio. Manifolded compressors are equivalents to lagged sources of gas pulsation. Therefore, pulse level can vary during time.

Mitigations methods:
If an unacceptable level is identified, a discharge muffler with the appropriate resonant volume and mass can be installed.

Speed limit requirement

R Speed limit guerantees compressor reliability and must be respect. In drive control logic, default setting values have been qualified by Danfoss. Customer could change the default values in the acceptable range if the changes have been qualified by OEM.

Start/Stop/Ramp setting

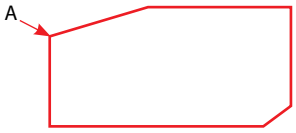


Drive parameters		Description	Default value (recommended)	Range
1.71	Start delay (s)	Start-up sequence: at start, compressor runs at start speed (1.74) during the Start delay (1.71) During this time the speed set-point is ignored	60sec	10-300s
1.74	Start speed (RPS)		30rps 1800rpm	30-60rps 1800-3600rpm
3.41	Ramp 1 ramp up time (s)	Defines speed ramp up slope. Ramp 1 ramp up time (s) is the time it takes to increase compressor speed from 0rps to 90rps. It is a linear ramp thus gives constant acceleration during ramping. Eg: if current speed is 55rps and desired speed is 100rps, then compressor will take 90sec (180sec/90rps)*(100-55)rps=90sec	180sec	15-3600s
3.42	Ramp 1 ramp down time (s)	Defines speed ramp down slope. in similar way that ramp-up.	180sec	15-3600s
3.82	Starting/stopping ramp Time (s)	Fast acceleration from standstill to minimum speed with a quick ramp. The start / stop command bypasses the normal ramp time and the frequency converter ramps the compressor fast.	2sec	0-5s

	During normal operation, refrigerant enters the compressor as a superheated vapor. Liquid flood back occurs when a part of the refrigerant entering the compressor is still in liquid state.	Liquid flood back can cause oil dilution and, in extreme situations lead to liquid slugging that can damage compression parts.
Requirement	In steady state conditions, • the expansion device must ensure a suction superheat within 5K to 30K (9 to 54°F). • Oil superheat must be higher than 10K (18°F).	In transient conditions, • cumulative time with oil SH below 10K should not exceed 1700h during lifetime and not last more than 60s per event.
System evaluation	Use the table in relation with the application to quickly evaluate the potential tests to perform.	

Application	Tests to perform
Non reversible	Liquid flood back test
Reversible	Liquid flood back test Defrost test

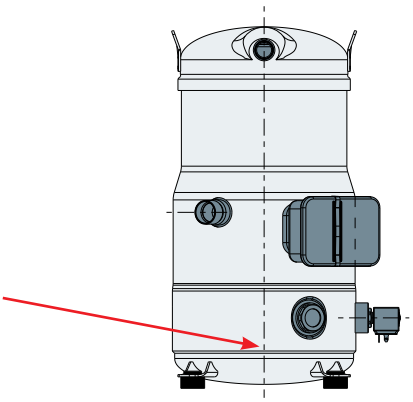
Test, criteria and solutions

Test N°	Purpose	Test condition	Pass criteria	Solutions
Liquid flood back test	Steady-state	Liquid flood back testing must be carried out under expansion valve threshold operating conditions: •Lowest foreseeable evaporation, and highest foreseeable condensation. •Minimum speed running. For reversible system, perform test in both heating and cooling mode 	Suction superheat >5K(9°F)	1. Check expansion valve selection and setting. -For Thermostatic expansion valve (TXV) check bulb position... -For Electronic expansion valve (EXV) check measurement chain and PID.... 2. Add a suction accumulator*.
	Transient	Tests must be carried out with most unfavorable conditions : • fan staging, • compressor staging • …	Oil superheat shall not be more than 30 sec below the safe limit (10K/18°F)	
Defrost test	Check liquid floodback during defrost cycle	Defrost test must be carried out in the most unfavorable condition (at 0°C (32°F) evaporating temperature).	Oil superheat shall not be more than 30 sec below the safe limit (10K/18°F)	1. Check defrost logic. In reversible systems, the defrost logic can be worked out to limit liquid floodback effect. (for more details see “Control Logic”). 2. Add a suction accumulator*.

*Suction accumulator offers protection by trapping the liquid refrigerant upstream from the compressor. The accumulator should be sized at least 50 % of the total system charge. Suction accumulator dimensions can impact oil return (gas velocity, oil return hole size…), therefore oil return has to be checked according to section “Manage oil in the circuit”.

Oil temperature sensor must be placed between oil sight glass and compressor baseplate. Some thermal paste shall be used to improve the conductivity. The sensor must also be correctly thermally insulated from the ambiance.

The Oil superheat is defined as:
(Oil temperature - Evaporating temperature)



Manage off cycle migration

R Off -cycle refrigerant migration happens:
• when the compressor is located at the coldest part of the installation, refrigerant vapor condenses in the compressor.
• or directly in liquid-phase by gravity or pressure difference.

When the compressor restarts, the refrigerant diluted in the oil, or stored in evaporator, generates poor lubrication conditions, and may reduce bearings life time. In extreme situations, this leads to liquid slugging that can damage the compressor scroll set.

Requirement

- Compressor can tolerate occasional flooded start, but it should remain exceptional situation and unit design must prevent that this situation happen at each start
- Right after start, liquid refrigerant must not flow massively to compressor
- The charge limit is a threshold beyond some protective measures must be taken to limit risk of liquid slugging and extreme dilution at start.

System evaluation

Use the table below in relation with the system charge and the application to quickly define necessary safeties to implement.

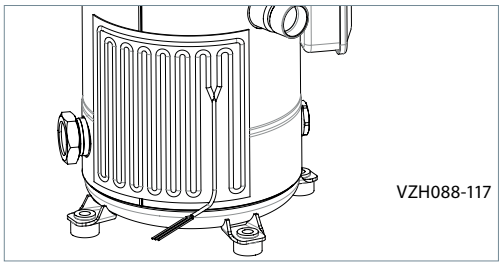
Application	BELOW charge limit	ABOVE charge limit
All	Ensure tightness between condenser & evaporator when system is OFF • Thermostatic expansion Valve (TXV) , Liquid Line Solenoid Valve LLSV** strongly recommended • Electronic expansion valve (EXV) must close when system stop including in power shut down situation	
Non split	No test or additional safeties required	• Surface Sump Heater * • External Non-Return Valve
Split	Since each installation is unique, refrigerant charge may vary • Surface Sump Heater * • Liquid Line Solenoid Valve**+ pump-down cycle*** • External Non-Return Valve	

Charge limit is defined in table below:

	Models	Refrigerant charge limit	
		(kg)	(lb)
Single	VZH088	6.0	13
	VZH117	8.0	18
	VZH170	13.0	29

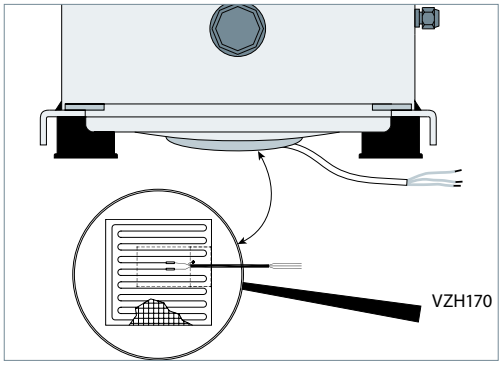
*Surface Sump heater
The surface sump heater are designed to protect the compressor against off-cycle migration of refrigerant.
For VZH088-117 the surface sump heater is located on the compressor shell.
For better standby energy consumption, Danfoss provides 48W and 80W two optional surface sump heater. The selection of surface sump heater could refer to below principle:

Compressor Surrounding Ambient	Surface Sump Heater
Unit has enclosure, no wind	48W SSH
Unit has no enclosure, with wind	80W SSH
Unit has no enclosure, wind >5m/s (ft/s)& ambient temperature <-5°C	80W SSH + additional SSH/thermal insulation



For VZH170, the 56W surface sump seater is located below the sump, associated with a thermal insulation.

The heater must be turned on whenever all the compressors are off.
Surface sump heater accessories are available from Danfoss (see section “Accessories”).



**Liquid line solenoid valve (LLSV)
A LLSV is used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer to the compressor during off -cycles. 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
By decreasing pressure in the sump, pump down:

- Evacuates refrigerant from oil
- Set the sump saturating pressure much lower than ambiance temperature and due to that, avoid refrigerant condensation in the compressor.
- Pump-down must be set higher than 2.3 bar(g) / 33(psig).

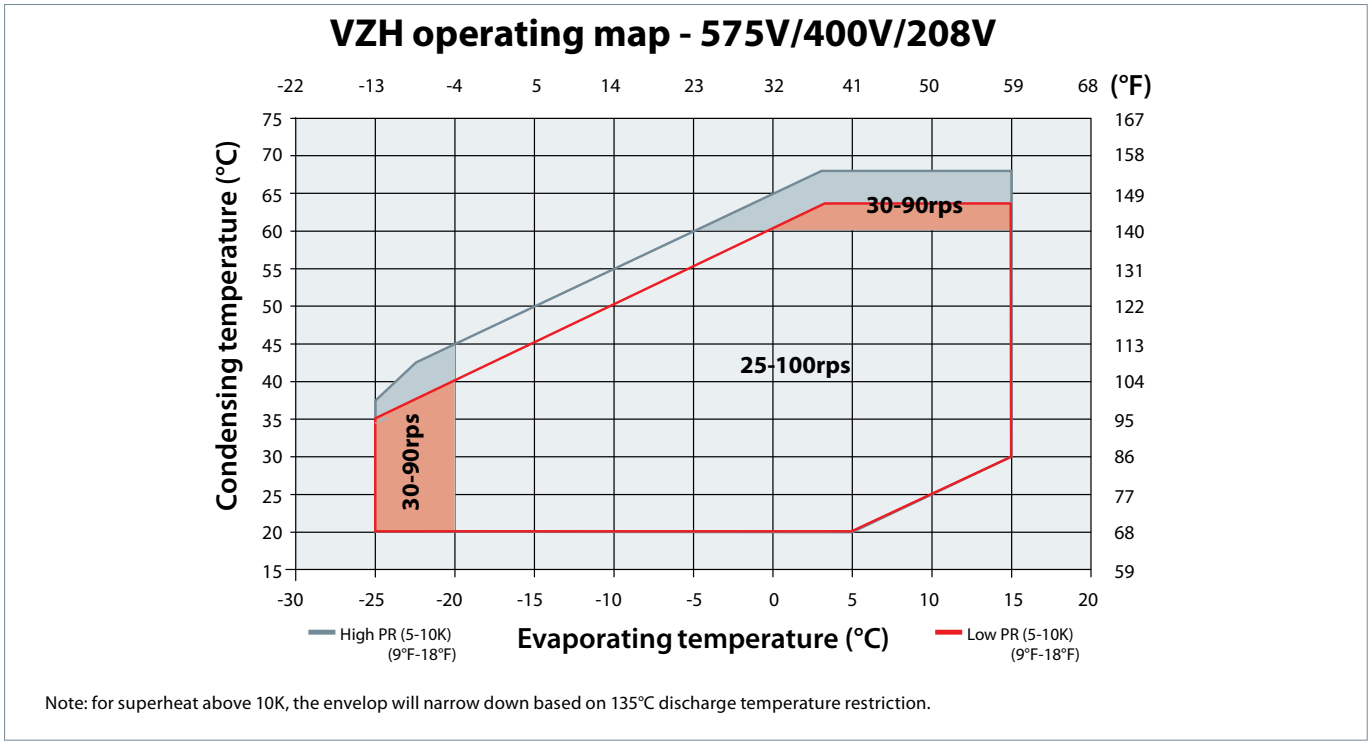
For more details on pump-down cycle see section “Control Logic”.

Requirement

R The operating envelope for VZH scroll compressors is given in the figures below and guarantees reliable operations of the compressor for steady-state operation.

Moreover, the discharge gas temperature must not exceed 135°C (275°F). Steady-state operation envelope is valid for a suction superheat within 5K to 30K (9°F to 54°F) range.

Single envelope control



Note: for superheat above 10K, the envelop will narrow down based on 135°C discharge temperature restriction.

Note: Red and Gray filled area are limited to 30-90rps.
for 380V power input, permitted highest condensing temperature will decrease accordingly:
-High PR: 25-100rps, condensing temperature from 60°C to 56°C (140°F to 133°F); 30-90rps, condensing temperature from 68°C to 65°C (154°F to 149°F).
-Low PR: 25-100 rps, condensing temperature from 60°C to 56°C; (140°F to 133°F) 30-90 rps, condensing temperature from 63°C to 62°C (145°F to 144°F).

Pressure settings	R410A	
	bar (g)	psi (g)
Working pressure range high side	High PR 13.5 - 44.5 Low PR 13.5 - 40	High PR 195.8 - 645.4 Low PR 195.8 - 580.1
Working pressure range low side	2.3 - 11.6	33.36 - 168.24
Maximum high pressure safety switch setting	45	652.67
Minimum low pressure safety switch setting *	1.5	21.75
Minimum low pressure pump-down switch setting	1.5 bar below nominal evaporating pressure with minimum of 2.3 bar(g)	21 psi below nominal evaporating pressure with minimum of 33 psig

*LP safety switch shall never be bypassed.

System evaluation

VZH drive can only protect the compressor from over current. To manage operating envelop, an advanced envelope protection principle needs to be used with variable speed compressors. This solution offers much better protection than basic protection, and also offers the possibility to adjust running conditions to avoid tripping (for example reduce compressor speed when reaching high pressure limit).

The advanced protection principle is based on a permanent measurement of suction and discharge pressure. Unit controller is permanently checking that the compressor is running within the defined envelope.

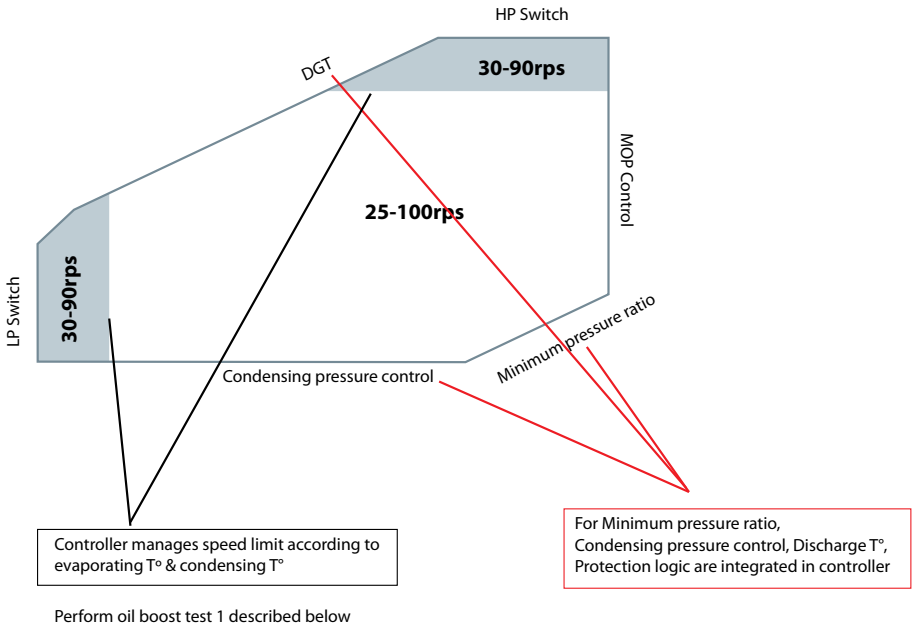
When compressor reach a limit, controller can act on different parameter to avoid unit tripping.

On top of suction and discharge pressure limitations, the discharge T° must remain below 135°C (275°F).

Low pressure switch and high pressure switch remain necessary as an ultimate protection.

Protection required

- HP switch*
- LP switch*
- DGT set @ 135°C (275°F) if necessary see Discharge T° protection
- Measurements of suction and discharge pressure, unit controller with is permanently maintaining compressor within its envelope

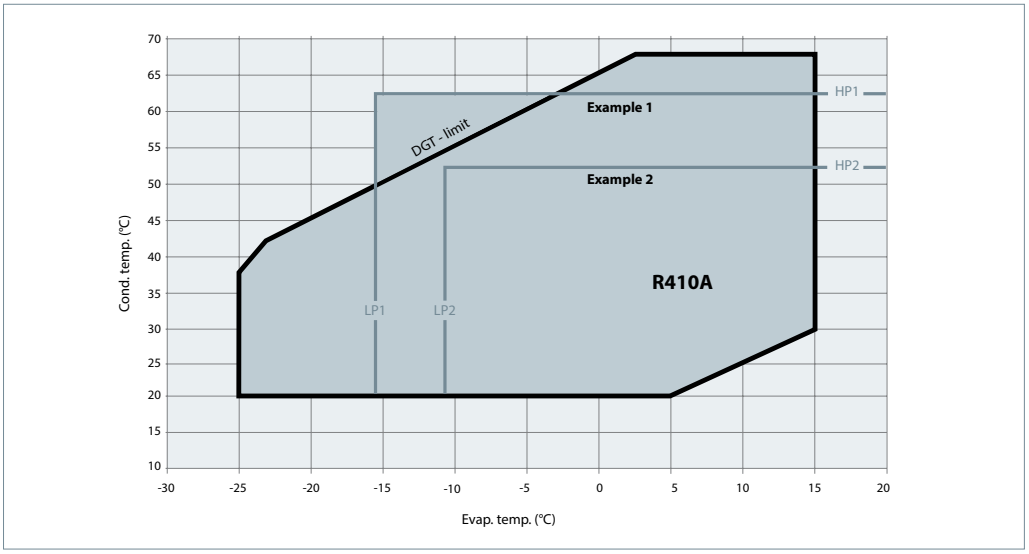


* for more details see “Control Logic”

Test	Purpose	Test conditions	Pass criteria	Solutions
1	Check reaction of system to oil boost	Stabilized the system in area below minimum speed (2400RPM) until oil boost happen	No safeties happen Superheat requirement fulfilled	Modify ramp-up Modify superheat control

Discharge temperature protection

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 = 6K/10.8°F)
LP switch setting:
LP1 = 3.3 bar (g) (-15.5°C/4.1°F)
HP switch setting:
HP1 = 38 bar (g) (62°C/143.6°F)
Risk of operation beyond the application envelope.
DGT protection required.

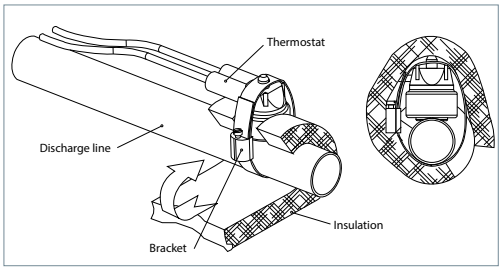
Example 2 (R410A, SH = 6K/10.8°F)
LP switch setting:
LP2 = 4.6 bar (g) (-10.5°C/13.1°F)
HP switch setting:
HP2 = 31 bar (g) (52°C/125.6°F)
No risk of operation beyond the application envelope.
No DGT protection required.

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.

The discharge gas thermostat accessory kit (code 7750009) includes all components required for installation as shown on the right. DGT installation must respect below requirements:

- The thermostat must be attached to the discharge line within 150 mm (5.91 inch) from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe.
- The DGT should be set to open at a discharge gas temperature of 135°C (275°F) or lower..



MOP (Max operating pressure) control

In steady state, it is essential to prevent the compressor running when evaporating T° is higher than the specified envelope. Operating the compressor higher than maximum evaporating temperature will cause low viscosity of lubricant and lead to high dilution. Eventually the compressor will get damaged.

This protection can be achieved by using MOP function on expansion device. 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 (59°F) 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.

Complementary to MOP, the unit controller can increase compressor speed to keep evaporating T° lower than limit.

Condensing pressure control

In steady state, the condensing T° must be maintained at a higher T° than specified in envelope. This can be done by using fan speed controller, or constant pressure valve. Keep condensing pressure at a minimum level is also important to maintain the pressure differential across the thermostatic expansion valve and prevent cut out on the LP protection in cold ambient.

As an alternative the unit controller can increase compressor speed to keep condensing T° lower than limit.

Minimum pressure ratio

In steady state, the pressure ratio must be a higher T° than specified in envelope. 2 type of control can be considered:

- Set the minimum condensing T° at 20°C (68°F) together with MOP set at 15°C (59°F).
- Unit controller monitors permanently Condensing and Evaporating T°, and adjust compressor speed or condensing T° to keep running conditions within envelope.

Safety control logic requirements

	Tripping conditions		Re-start conditions	
	Value	Time	Value	Time
HP switch	See Pressure settings table from section "Manage operating envelope"	Immediate, no delay. No by- pass	Conditions back to normal. Switch closed again	Manual reset
LP safety switch				Maximum 5 auto reset during a period of 12 hours, then manual reset.

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 before and after the drive.

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.

OEM need to set port 27 to "coast inverse or external interlock" to get rid of minimum running time restriction.

Electronic expansion valve

With variable capacity systems, an electronic expansion valve (EXV) is the strongly recommended solution to handle refrigerant mass flow variations. Danfoss recommends the use of ETS products. 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 remain closed, when the compressor is off, to avoid any liquid refrigerant entering the compressor.

Reverse rotation protection

Due to drive protection, compressors could work properly even if the power connection between the drive and mains is dis-matched. However, the wires between compressor and drive must be connected accordingly.

To protect compressors from reverse rotation, pressure difference could be checked as a reference value. Use pressure sensors to monitor pressure difference between discharge and suction of the compressor, and for normal operation, discharge pressure should be at least 1 bar higher than suction pressure within 30 s running after compressor starting.

Short cycle protection

Short cycling protection requirements need to be implemented in OEM unit controller. Meantime, the factory default setting needs to be disabled (28-00 short cycle protection change from default setting "enable" to "disable").

- 3 minutes minimum running time: in order to get oil return back from circuit to compressor sump

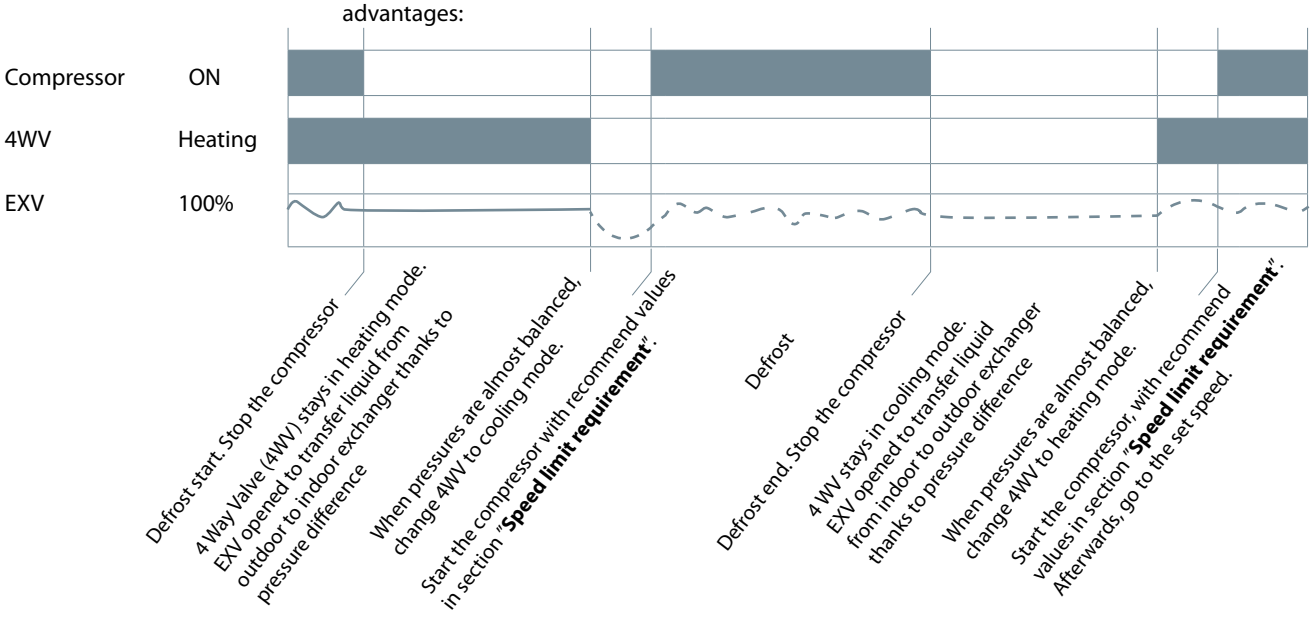
- 12 starts maximum per hour: to avoid threaten the life time of motor and other mechanics due to frequent starts, OEM needs to limit the starts cycles within 12 times per hour.

- 10s minimum OFF time: to make sure discharge valve is closed and motor is stopped before next start, OEM needs to set the minimum off time as 10 seconds.

Defrost cycle logic

In reversible systems, the defrost logic can be worked out to limit liquid flood back effect by:
1. Running full load during defrost to share liquid refrigerant between all compressors.
2. Transferring liquid refrigerant from one exchanger to the other one thanks to pressures.

The following defrost logic combines both advantages:



* EXV Opening degree and time have to be set to keep a minimum pressure for 4 way valve moving.

Danfoss recommend above defrost cycle logic, but the control logic is also system specified.

In any case, defrost logics must respect requirements and tests described in "Manage superheat" and "Manage operating envelope".

Pump-down logic recommendations

Pump down is initiated prior to shutting down the last compressor on the circuit by de-energizing a liquid line solenoid valve or closing electronic expansion valve. When suction pressure reached the cut-out pressure, compressor is stopped, and liquid solenoid valve or electronic expansion valve remains closed. Two types of pump-down exist:

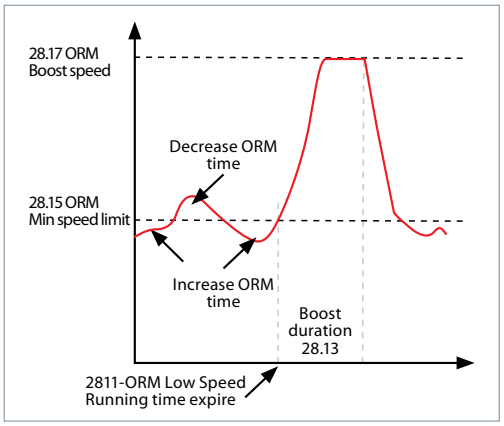
- One shot pump down (preferred): when last compressor of the circuit stops, suction presssure is decreased 1.5 bar below nominal evaporating pressure. Even if suction pressure increases again, the compressor will not restart.
- Continuous pump-down: traditional pump-dow, Compressor restarts automatically when suction pressure increases up to 4 cycles maximum. A non-return valve in the discharge line is recommended.

Oil boost

An insufficient oil level can be the result of low refrigerant velocity in pipes and heat exchangers. An oil boost sequence consisting of increasing refrigerant velocity for short periods, at regular time intervals can improve oil return.
Oil boost function can be done in 2 ways
1. Using internal CDS drive oil boost function
2. Program oil boost function in unit controller and use optical oil level sensor to trig it.
As oil boost logic needs to increase / decrease speed, make sure expansion device is fast enough to maintain liquid flood back within acceptable limit during those transients (§ Manage superheat).

CDS Drive oil boost function

If the compressor runs below ORM Min Speed Limit, 28.14) for more than low speed running time, 28-11, then function will override the unit controller and accelerate compressor speed to ORM Boost Speed, 28.16 for Boost duration 28.13 (28.13 does not include the ramping up time).
When the boost is finished, the compressor speed goes back to run on reference (speed setpoint) and the time counter is reset and restarting from zero.
On top of that compressor will boost to ORM Boost Speed, 28.16 at a fixed time interval as programmed in parameter 28-12.



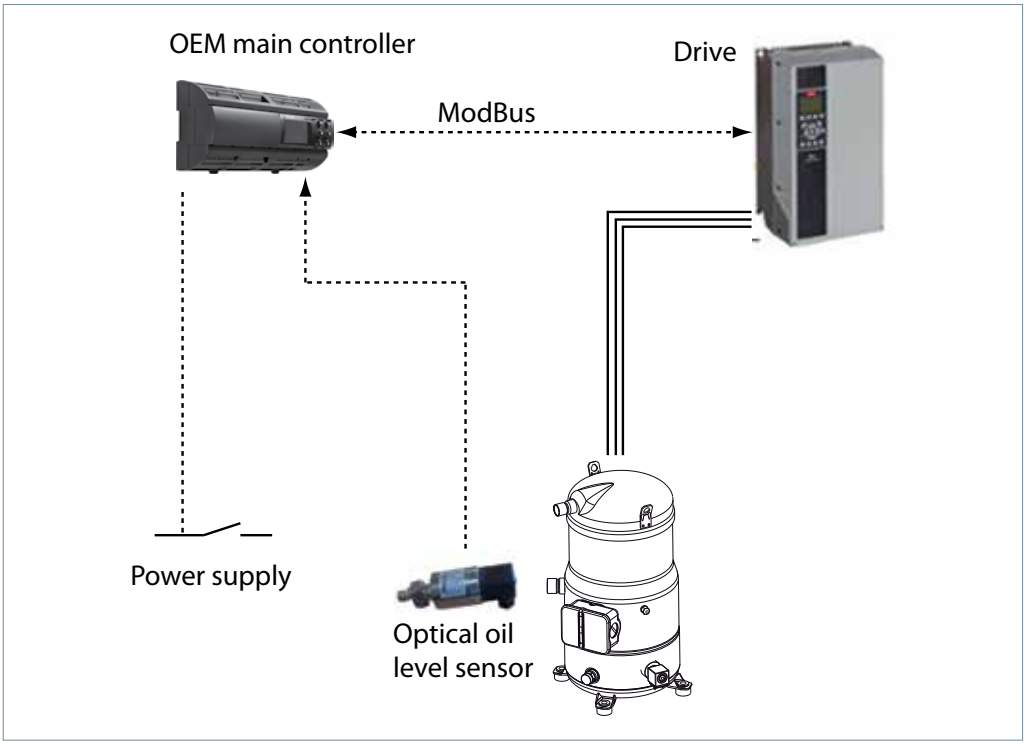
Feedback and status message
A feedback signal can be routed back to the unit controller via programable digital output, relay_2 or Modbus when an oil boost is initiated.
The unit controller can take actions to keep the system stabilized during the oil boost period.
A status message "Oil Boost" is also displayed on the drive LCP during boost.

Feedback and status message			
Drive parameters	Description	value	Default
05-02	Terminal 29 Mode	Output	Input
5-31	Terminal 29 Digital Output	Oil boost active	No Operation
5-40.1	Function Relay	Oil boost active	VLT running
16-94 (read)	Ext. Status Word	1000000hex (bit 24)	

Drive parameters		Description	Default value	Range
"28.10"	Oil return management	Enables/disables Oil Return Management	Enable	On / Off
"28.11"	Low speed running	Threshold for boost decision	30min	1-1440min
"28.12"	Fixed boost interval	Maximum time between oil return boosts	6h	1-168h
"28.13"	Boost duration	desired duration of oil boosts	60sec	10-255s
"28.14"	ORM Min speed limit	Now accessible with latest drive software Please udate	50rps 3000rpm	1500-4200rpm
"28.16"	ORM boost speed	Now accessible with latest drive software Please udate	70rps 4200rpm	par. 28-14 - 6000rpm

1. Oil management logic for single system

The oil management system architecture for single system is described as below. The oil level is permanently monitored by OEM main controller. When oil level is below the minimal, OEM controller enters in oil boost mode to recover a proper oil level in compressor. If oil level cannot be recovered, controller stops the system.



2. Oil management description

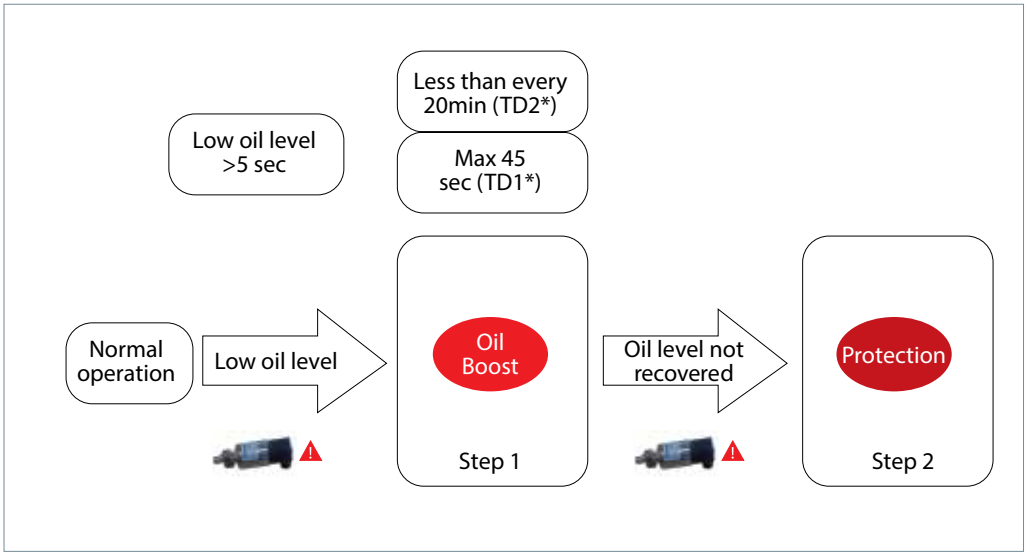
2.1 Basic rules

This specification describes the control logic to implement in OEM controller. This control logic must be implemented and thoroughly tested by OEM.

As oil boost logic needs to increase speed, make sure expansion device is fast enough to maintain liquid flood back within acceptable limit during those transients (Manage super heat chapter).

2.2 Oil management models

The oil management control logic must include 2 steps.



Step 1(oil boost)
If oil level sensor detects low level for more than 5 seconds, oil is trapped in the system. Oil boost is activated(VS speed is increased). It considerably increases refrigerant velocity in the system and recovers oil.

TD1 is the maximum time to complete step 1. If oil is not recovered within TD1 switch to step 2. If oil is recovered within TD1 come back to normal operation.

TD2 is the minimum interval between two step 1. In case of low oil level detection within a time <TD2, switch to step 1.

Step 2(Protection)
If oil is still lower than limit after completed step 1, or if oil level drop within a time <TD2, controller must enter in protection mode, and stop the system in alarm.
Note: TD time is adjustable.

2.3 Steps description

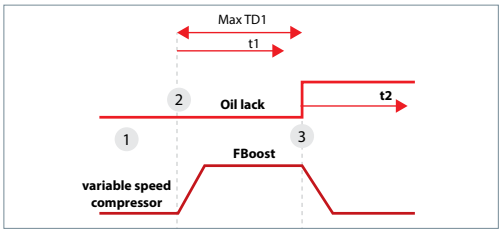
2.3.1 Oil boost

Function description
Return oil trapped in the system to compressor by increasing refrigerant mass-flow in the system.

Enter condition
Low oil level in VS compressor detected by oil level sensor.

Cancel condition
High oil level in VS compressor detected by oil level sensor.
OR
t1>TD1, Oil boost duration exceeds Maximum Oil boost duration

Control sequence
1. At initial state, VS (variable speed compressor) is on.
2. Low oil level detected in compressor. Reset and Start t1.
3. VS compressor speed must increase to Fboost
4. When High oil level detected in VS compressor.
• VS compressor speed must be decreased to the initial speed
• Reset and start t2
• Reset t1



2.3.2 Protection

Function description
Stop the compressor to prevent short of oil running.

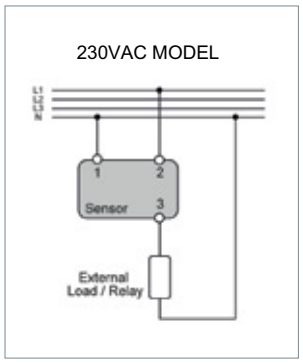
Enter condition
Low oil level in VS compressor detected by oil level sensor.
AND
(t1>TD1, Oil boost duration exceeds TD1 OR t2<TD2, Interval between two Oil boost is < TD2)

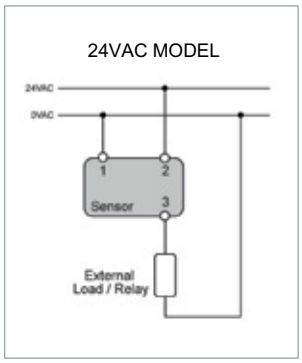
Cancel condition
Manual Reset
Control sequence
Stop VS compressor
Reset t1
Reset t2

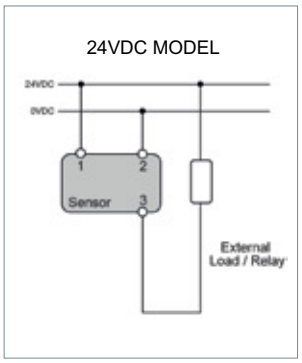
2.4 Parameter and variable table

Name	Text	Attribute	Range	Default	Unit
Fboost	Boost action frequency	Parameter	25-100	70	rps
TD1	Maximum oil boost duration	Parameter	10-240	45	Second
TD2	Interval minimum between two oil boost	Parameter	10-60	20	Minutes
t1	Oil boost timer	Variable			Second
t2	Interval minimum between two oil boost	Variable			Minutes

2.5 Sensor Wiring diagram







An TEKLAB LC-XN 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). 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.

- Lack of oil: Circuit between 2 and 3 will be opened internally, there will be no current flowing through load or coil of external relay. For relay, output is open.
- Enough oil: Circuit between 2 and 3 will be closed internally, there will be current flowing through load or coil of external relay. For relay, output is closed

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

	Excessive air and moisture • can increase condensing pressure and cause excessively high discharge temperatures. • can create acid giving rise to copper platting. • can destroy the lubricating properties of the oil.	All these phenomena can reduce service life and cause mechanical and electrical compressor failure.
Requirements	VZH compressors are delivered with < 100 ppm moisture level. At the time of commissioning, system moisture content may be up to 100 ppm.	During operation, the filter drier must reduce this to a level between 20 and 50 ppm.
Solutions	To achieve this requirement, a properly sized and type of drier is required. Important selection criteria's include: • driers water content capacity, • system refrigeration capacity, • system refrigerant charge.	For new installations with VZH compressors with PVE oil, Danfoss recommends using the Danfoss DML (100% molecular sieve) solid core filter drier.

Compressor storage

Store the compressor not exposed to rain, corrosive or flammable atmosphere between -35°C to 70°C (-31°F to 158°F) when charged with nitrogen and between -35°C (-31°F) and Ts max value (see section "Pressure equipment directive") when charged with R410A refrigerant.

Compressor holding charge

Each compressor is shipped with a nominal dry nitrogen holding charge between 0.3 and 0.7 bar (4 psi and 10psi) and is sealed with elastomer plugs.

⚠ Respect the following sequence:

- Remove the nitrogen holding charge via the suction Schrader valve to avoid an oil mist blow out.
- Remove the suction plug first and the discharge plug afterwards to avoid discharge check valve gets stuck in open position.

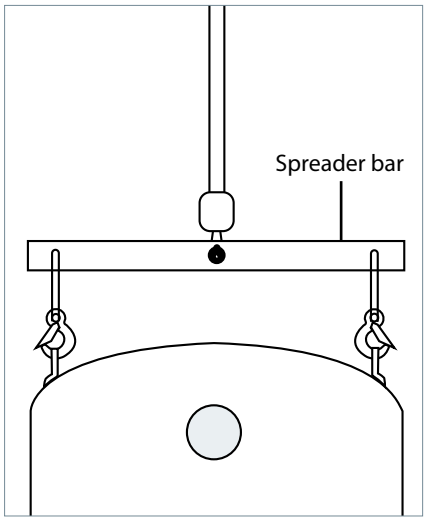
An opened compressor must not be exposed to air for more than 20 minutes to avoid moisture is captured by the POE oil.

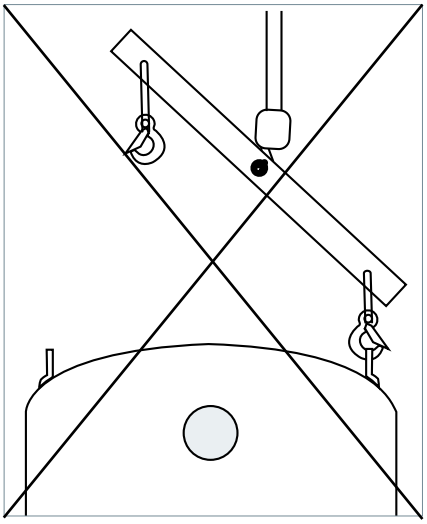
Handling

⚠ Each Danfoss VZH scroll compressor is equipped with one lift ring on the top shell.

- Always use one lift ring and discharge tube when lifting the compressor.
- Use lifting equipment rated and certified for the weight of the compressor or compressor assembly.
- 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 is recommended.
- Never use the lift rings on the compressor to lift the full unit.

Maintain the compressor in an upright position during all handling manoeuvres (maximum of 15° from vertical).





Piping assembly

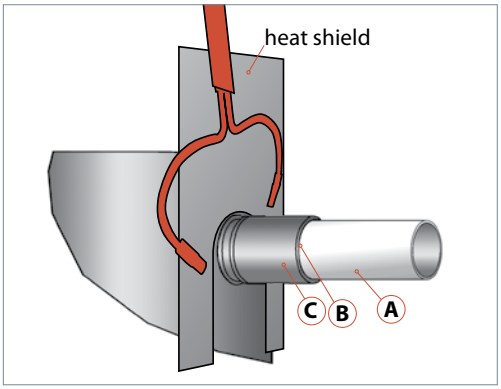
Good practices for piping assembly is a pre-requisite to ensure compressor service life (system cleanliness, brazing procedure...)

System cleanliness

Circuit contamination possible cause	Requirement
Brazing and welding oxides	During brazing, flow nitrogen through the system
Filings and particles from the removal of burrs in pipe-work	Remove any particles and burrs generated by tube cutting and hole drilling
Moisture and air	Use only clean and dehydrated refrigeration grade copper tubing Opened compressor must not be exposed to air more than 20 minutes to avoid moisture captured by PVE oil.

Brazing procedure:

- Brazing operations must be performed by qualified personnel.
- Make sure that no electrical wiring is connected to the compressor.
- To prevent compressor shell and electrical box overheating, use a heat shield and/or a heat-absorbent compound.
- Clean up connections with degreasing agent
- Flow nitrogen through the compressor.
- Use flux in paste or flux coated brazing rod.
- Use brazing rod with a minimum of 5% silver content.
- It is recommended to use double-tipped torch using acetylene to ensure a uniform heating of connection.
- To enhance the resistance to rust, a varnish on the connection is recommended.



⚠ Before eventual un-brazing of the compressor or any system component, the refrigerant charge must be removed.

System pressure test and leak detection

⚠ The compressor has been strength tested and leak proof tested (<3g/year) at the factory.
For system tests:

- Always use an inert gas such as Nitrogen or Helium.
- Pressurize the system on HP side first then LP side.
- Do not exceed the following pressures:

Maximum compressor test pressures	
Maximum compressor test pressure high side (HP)	45 bar (g) (653psig) HP-LP<37bar (537psi)
Maximum compressor test pressure low side (LP)	33.3 bar(g) / (483psig) for VZH088 & 117 30.2 bar(g) / (438psig) for VZH170 LP-HP<5bar (73psi) Maximum speed 4,8 bar/second (70psi/s)*

* If an external non return valve is present on the discharge line, maximum pressurizing speed must be respected to ensure pressure equalization between LP and HP side over scroll elements.

Vacuum evacuation and moisture removal

Requirements:
- Never use the compressor to evacuate the system.
- Connect a vacuum pump to both the LP and HP sides.
- Evacuate the system to a pressure of 500 µm Hg (0.67 mbar/0.02 in.Hg) absolute.

Recommendations:
- Energized heaters improve moisture removal.
- Alternate vacuum phases and break vacuum. with Nitrogen to improve moisture removal.

For more detailed information see "Vacuum pump-down and dehydration procedure" TI-026-0302.

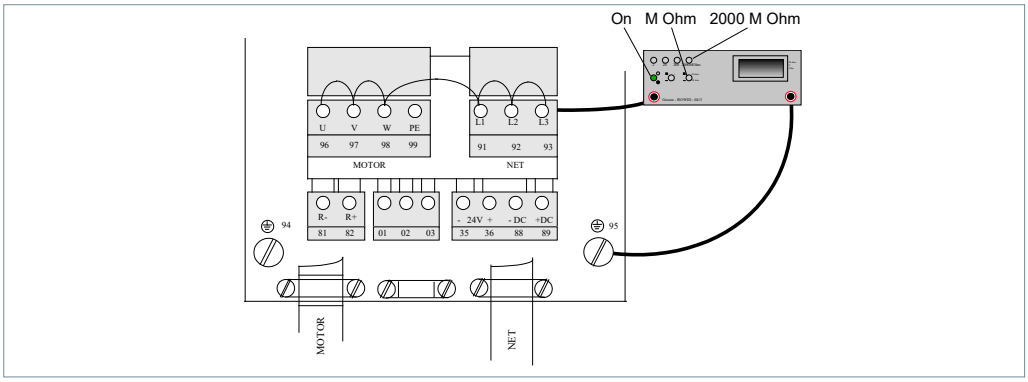
Refrigerant charging

Initial charge:
- For the initial charge, the compressor must not run.
- Charge refrigerant as close as possible to the nominal system charge.
- This initial charging operation must be done in liquid phase between the condenser outlet and the filter drier.

If needed, a complement of charge can be done:
- In liquid phase while compressor is running by slowly throttling liquid in.
- Never bypass safety low pressure switch.

For more detailed information see "Recommended refrigerant system charging practice" FRCC.EN.050.

Dielectric strength and insulation resistance tests



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.

Do not use a megohm meter nor apply power to the compressor while it is under vacuum as this may cause internal damage.

- 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.

Preliminary check

⚠ Check electrical power supply:

- Phase order: Reverse rotation is obvious if the compressor do not build up pressure and sound level is abnormal high. VZH compressor will only operate properly in one direction. If electrical connections are done correctly between the drive and the compressor terminals (compressor terminals T1,T2,T3 and drive terminals U, V & W matching), the drive will provide correct phase supply to the compressor, and reverse rotation will be not possible:For more details refer to "Motor protection".
- Voltage and voltage unbalance within tolerance: For more details refer to section "Motor voltage".

Initial start-up

- Cranckcase heaters must be energized at least 6 hours in advance to remove refrigerant.
- Do not provide any power to the drive unless suction and discharge service valves on compressor are open, if installed.
- Energize the drive. The compressor must start, according to defined ramp-up settings. If the compressor does not start, check wiring conformity.
- Check the frequency converter control panel: If any alarm is displayed check the wiring and in particular the polarity of the control cables.If an alarm is shown, refer to the frequency converter application manual. Verify in particular the combination of compressor, frequency converter and refrigerant.
- Check current draw and voltage levels on the mains. The values for the compressor electrical motor can be directly displayed on the frequency converter control panel.

System monitoring

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
- Surface sump heaters must be energized at least 6 hours in advance to remove refrigerant.
- 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.

A short cycling protection is provided in the CDS 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.

Oil level checking and top-up

In installations with good oil return and line runs up to 15m (49.2 feet), no additional oil is required. If installation lines exceed 15m (49.2 feet), additional oil may be needed. 3% of the total system refrigerant charge (in kg/lb) 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.

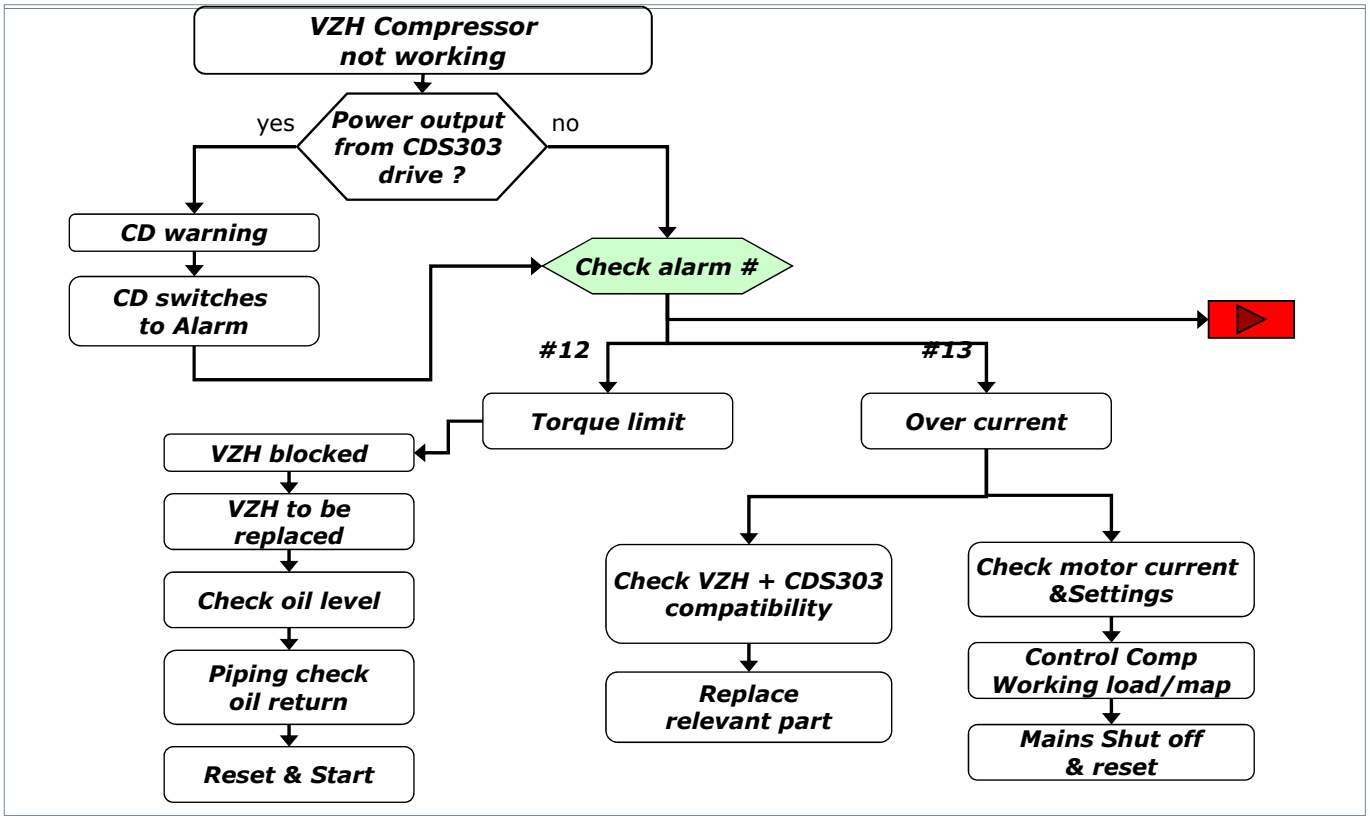
When the compressor is running under stabilized conditions, the oil level must be visible in the sight glass.

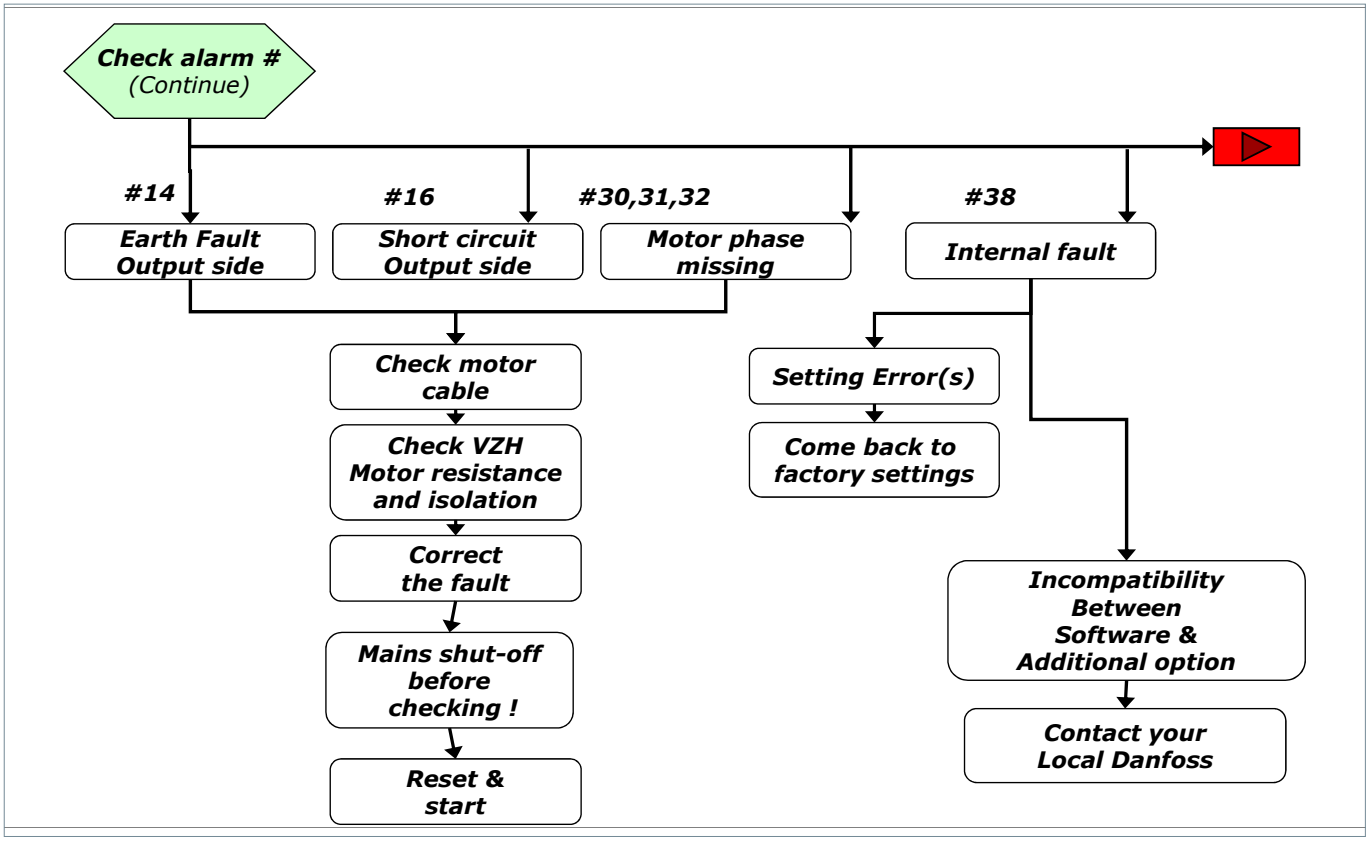
The presence of foam filling in the sight glass indicates large concentration of refrigerant in the oil and / or presence of liquid returning to the compressor.

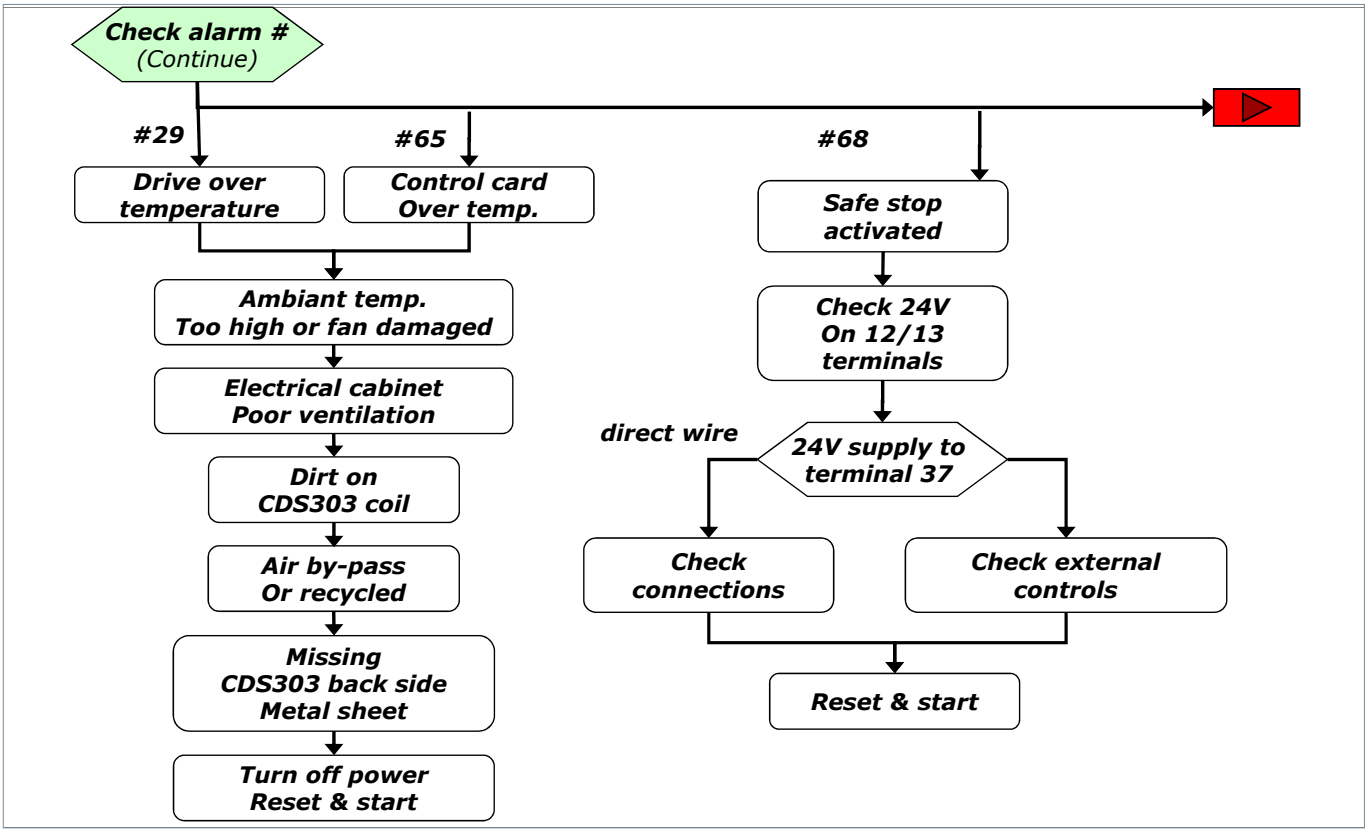
The oil level can also be checked a few minutes after the compressor stops, the level must be between 1/4 and 3/4 of sight glass.

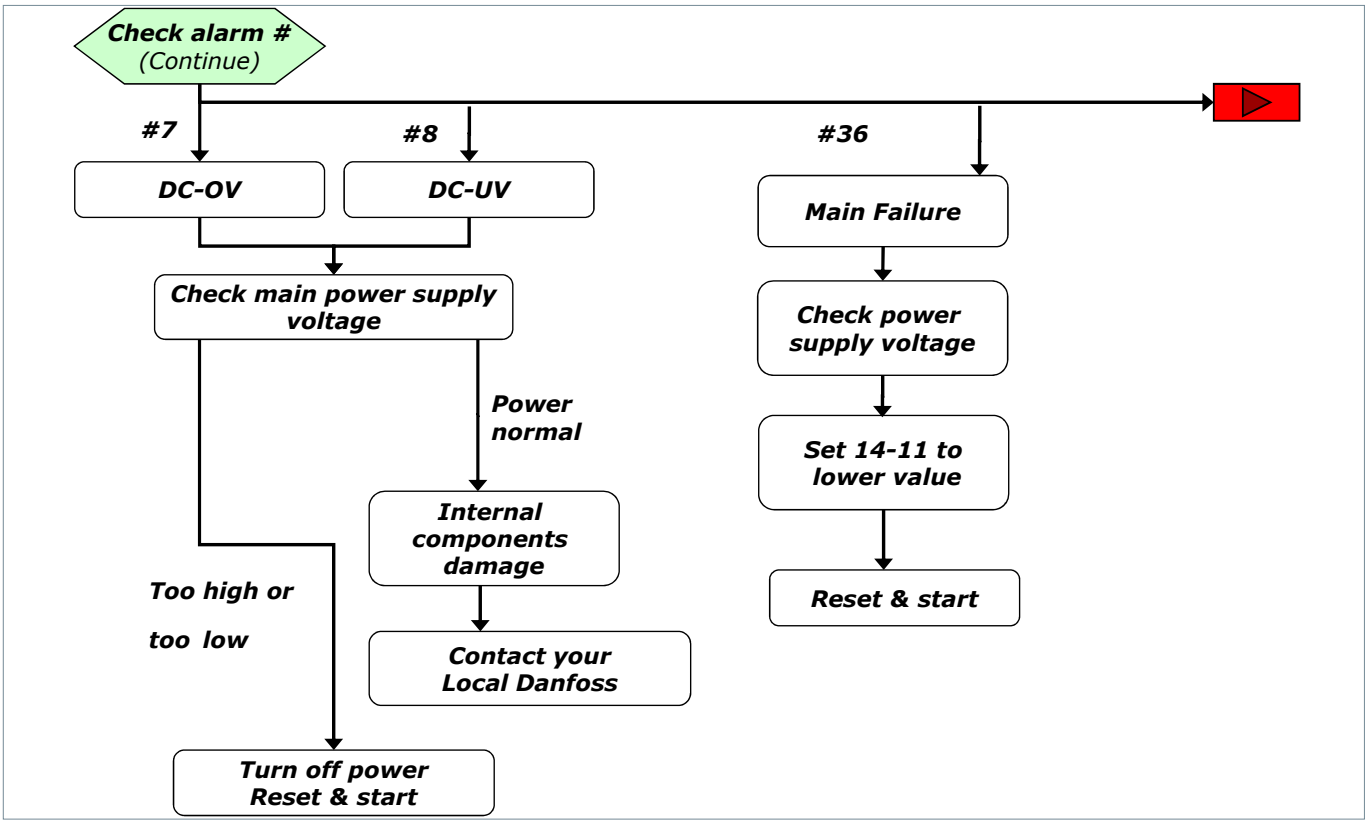
When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

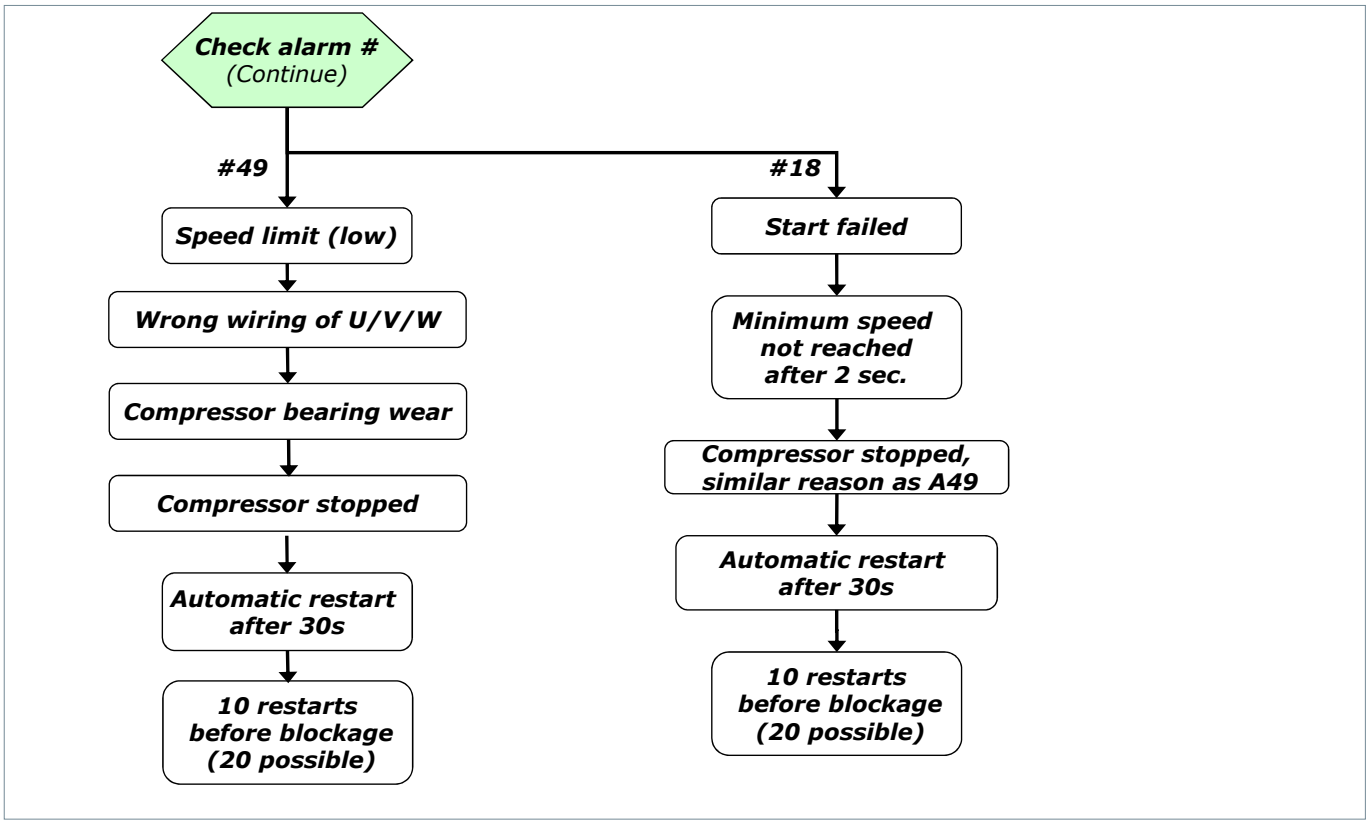
Top-up the oil while the compressor is idle. Use the schrader connector or any other accessible connector on the compressor suction line and a suitable pump. See news bulletin "Lubricants filling in instructions for Danfoss Commercial Compressors" TI 2-025-0402.


VZH Compressor not working
Power output from CDS303 drive ?
yes
no
CD warning
CD switches to Alarm
Check alarm #
#12
#13
Torque limit
Over current
VZH blocked
VZH to be replaced
Check oil level
Piping check oil return
Reset & Start
Check VZH + CDS303 compatibility
Replace relevant part
Check motor current &Settings
Control Comp Working load/map
Mains Shut off & reset


Check alarm # (Continue)
#14
#16
#30,31,32
#38
Earth Fault Output side
Short circuit Output side
Motor phase missing
Internal fault
Check motor cable
Check VZH Motor resistance and isolation
Correct the fault
Mains shut-off before checking !
Reset & start
Setting Error(s)
Come back to factory settings
Incompatibility Between Software & Additional option
Contact your Local Danfoss


Check alarm #
(Continue)
#29
#65
#68
Drive over temperature
Control card Over temp.
Safe stop activated
Ambiant temp. Too high or fan damaged
Check 24V On 12/13 terminals
Electrical cabinet Poor ventilation
direct wire
24V supply to terminal 37
Dirt on CDS303 coil
Check connections
Check external controls
Air by-pass Or recycled
Reset & start
Missing CDS303 back side Metal sheet
Turn off power Reset & start


Check alarm #
(Continue)
#7
#8
#36
DC-OV
DC-UV
Main Failure
Check main power supply voltage
Check power supply voltage
Power normal
Set 14-11 to lower value
Internal components damage
Too high or
too low
Reset & start
Contact your Local Danfoss
Turn off power Reset & start


Check alarm #
(Continue)
#49
Speed limit (low)
Wrong wiring of U/V/W
Compressor bearing wear
Compressor stopped
Automatic restart after 30s
10 restarts before blockage (20 possible)
#18
Start failed
Minimum speed not reached after 2 sec.
Compressor stopped, similar reason as A49
Automatic restart after 30s
10 restarts before blockage (20 possible)

Danfoss recommends that compressors and compressor oil should be recycled by a suitable company at its site.

Single pack

Packaging

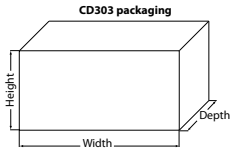
Compressor single pack

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

Compressor industrial pack

Compressor model	Nbr*	Length (mm)	Width (mm)	Height (mm)	Gross Weight (kg)	Static stacking pallets
VZH088	8	1150	950	680	494	2
VZH117	8	1150	950	750	544	2
VZH170	4	1150	965	768	647	2

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: Code J	15	346	810	320	24	430	805	405	46
	18 - 22	437	805	405	36	437	805	405	46
T4: Code G	15	349	500	330	13	346	810	320	24
	18 - 22	346	810	320	24	346	810	320	28
T6: code H	18.5-30	346	810	320	24	-	-	-	-

Compressor code numbers

Danfoss scroll compressors VZH can be ordered in either industrial packs or in single packs. Drive can be ordered in single packs. Please use the code numbers from below tables for ordering.

Single pack

Compressor model	Pressure ratio	Equipment version	Technical Name	X=motor code		
				G 380-480V/3ph/ 50&60Hz	J 200-240V/3ph/ 50&60Hz	H 525-600V/3ph/ 50&60Hz
VZH088	High	Single	VZH088AXANA	120G0010	120G0012	120G0047
	Low	Single	VZH088BXANA	120G0011	120G0013	120G0049
	High	Manifold	VZH088AXBNA	120G0022	120G0024	120G0048
	Low	Manifold	VZH088BXBNA	120G0023	120G0025	120G0050
	High	Unified	VZH088AXDNA	120G0102	120G0103	120G0104
	Low	Unified	VZH088BXDNA	120G0105	120G0106	120G0107
VZH117	High	Single	VZH117AXANA	120G0014	120G0016	120G0051
	Low	Single	VZH117BXANA	120G0015	120G0017	120G0053
	High	Manifold	VZH117AXBNA	120G0026	120G0028	120G0052
	Low	Manifold	VZH117BXBNA	120G0027	120G0029	120G0054
	High	Unified	VZH117AXDNA	120G0108	120G0109	120G0110
	Low	Unified	VZH117BXDNA	120G0111	120G0112	120G0113
VZH170	High	Single	VZH170AXANB	120G0018	120G0020	120G0055
	Low	Single	VZH170BXANB	120G0019	120G0021	120G0057
	High	Manifold	VZH170AXBNB	120G0030	120G0032	120G0056
	Low	Manifold	VZH170BXBNB	120G0031	120G0033	120G0058
	High	Unified	VZH170AXDNB	120G0114	120G0115	120G0116
	Low	Unified	VZH170BXDNB	120G0117	120G0118	120G0119

Industrial pack

Compressor model	Technical Name	X = Motor code	
		Code G	Code J
VZH088	VZH088AXANA	120G0078	120G0080
	VZH088BXANA	120G0079	120G0081
	VZH088AXBNA	120G0090	120G0092
	VZH088BXBNA	120G0091	120G0093
	VZH088AXDNA	120G0208	120G0209
	VZH088BXDNA	120G0210	120G0211
VZH117	VZH117AXANA	120G0082	120G0084
	VZH117BXANA	120G0083	120G0085
	VZH117AXBNA	120G0094	120G0096
	VZH117BXBNA	120G0095	120G0097
	VZH117AXDNA	120G0212	120G0213
	VZH117BXDNA	120G0214	120G0215
VZH170	VZH170AXANB	120G0086	120G0088
	VZH170BXANB	120G0087	120G0089
	VZH170AXBNB	120G0098	120G0100
	VZH170BXBNB	120G0099	120G0101
	VZH170AXDNB	120G0216	120G0217
	VZH170BXDNB	120G0218	120G0219

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	Coating	Code n° for ordering
VZH088-J	CDS303 15.0kW	IP20	H3	No	134G3474
			H2	No	134F9361
				Yes	134X1964
		IP55	H3	No	134G4001
			H2	No	134G4002
VZH117-J	CDS303 18.5kW	IP20	H3	No	134G3585
			H2	No	134F9363
				Yes	134X1965
		IP55	H3	No	134G4003
			H2	No	134G4004
VZH170-J	CDS303 22.0kW	IP20	H3	No	134G3586
			H2	No	134F9365
				Yes	134X1966
		IP55	H3	No	134G4005
			H2	No	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	Multipack	8
	120Z0405	Solder sleeve adapter set (1"3/4 Rotolock, 1"3/8 ODF), (1"1/4 Rotolock, 7/8" ODF)	VZH117	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

Surface sump heaters & thermostats

Surface sump heaters

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0388	Surface sump heater, 80 W, 24 V, CE, UL	VZH088-117	Multipack	8
	120Z0389	Surface sump heater, 80 W, 230 V, CE, UL		Multipack	8
	120Z0390	Surface sump heater, 80 W, 400 V, CE, UL		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	VZH170	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		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

Accessories

Oil sight glass

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0700	Oil sight glass for unified version	VZH088/117 unified version	Single pack	1
	120Z0701	Oil sight glass for unified version	VZH170 unified version	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
	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
	042N4202	Coil 110-120V	VZH all models	Single pack	1
	042N0156	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

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

LCP's

Spare parts frequency converter

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
	130B3406	Fan IP55	VZH117 G & J	Single pack	1

Control card

Type	Code n°	Description	Application	Packaging	Pack size
	130B5667	Control card	Frequency converter / all models	Single pack	1

Accessory bags

Type	Code n°	Description	Application	Packaging	Pack size
	130B1300	Accessorry bag IP20	VZH088-J, VZH117-G, VZH170-G	Single pack	1
	130B0980	Accessorry bag IP20	VZH088-G	Single pack	1

Relays card

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

Brackets

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0642	16AC bracket for VZH088/117 CDS303 drives	Frequency converter	Single pack	1
	120Z0643	20AC bracket for VZH088/117 CDS303 drives	Frequency converter	Single pack	1

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