ENGINEERING
TOMORROW

Application Guide

Scroll compressors
PSG605 to **PSG800**

R1234ze(E), R515B, R600a 50Hz -60Hz

www.danfoss.com

Contents

Safety and warnings

Danfoss 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.

Introduction

Product description

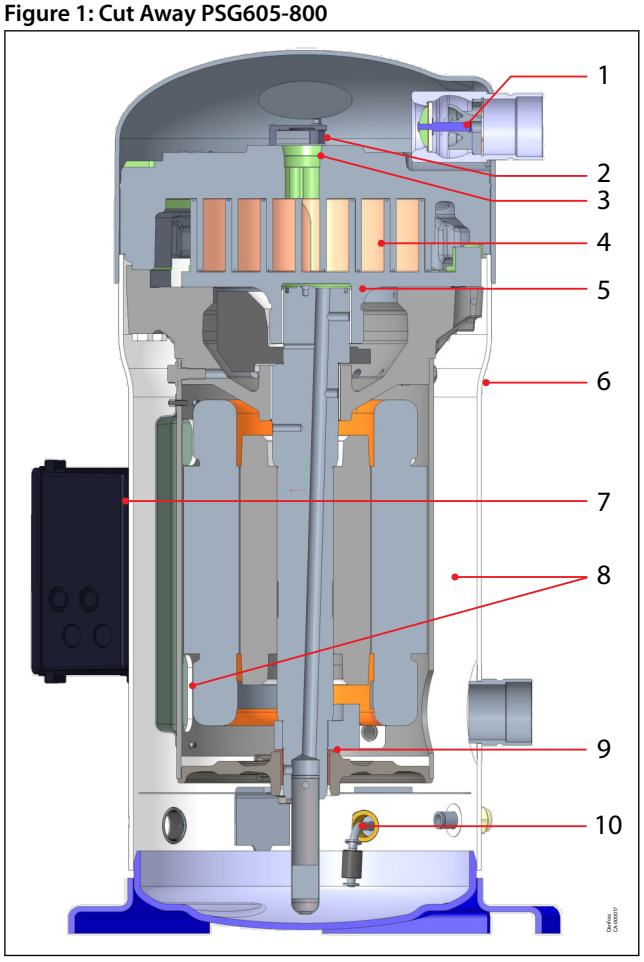
The PSG compressor is a high-temperature scroll compressor specifically optimized for W/W High Temperature Heat Pump applications ranging from 100 kW to 1 MW. It is primarily qualified with low-GWP refrigerants such as R-1234ze (A2L), R-515B (A1), and R-600a (A3), which opens up new possibilities for heat pump and booster systems that need to supply hot water up to 100°C. The compressor's design has been refined to accommodate the standard source temperatures available in processes (10-40°C), ensuring efficient operation in W/W units, whether as a single stage or potentially as a second stage in a multistage system.

The PSG family includes two models: the PSG605 and PSG800, delivering 105 m^3/h and 140 m^3/h respectively at 50 Hz. Both compressors are compatible with a variety of manifold solutions, from tandem (both even and uneven) to even trios, providing maximum flexibility in creating potential unit lineups.

Additionally, a new generation of Oil Level Switch is integrated directly into the compressor, mitigating reliability risks associated with temporary oil shortages, while also providing oil temperature monitoring via an integrated NTC sensor.

Cut Away PSG605-800

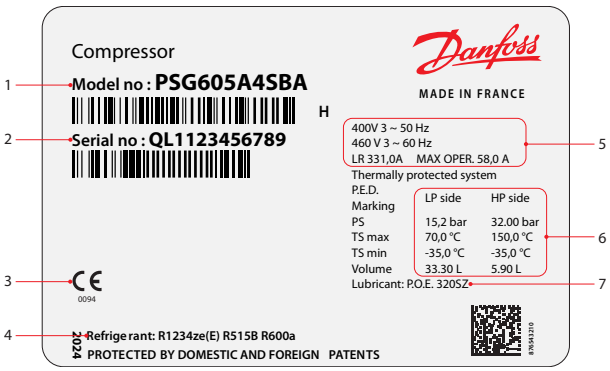
Figure 1: Cut Away PSG605-800



1	New ZNRV valve, suited for PSG map
2	Discharge port gas deflector lowers the sound level
3	Specific check valve
4	High slenderness wrap for compactness
5	Orbital disk for compactness
6	Flared and stratched midshell
7	A3 refrigerant compliant module
8	Specific gas path flow
9	Flanged polymer bearing for better reliability
10	Oil Level Switch

Product identification

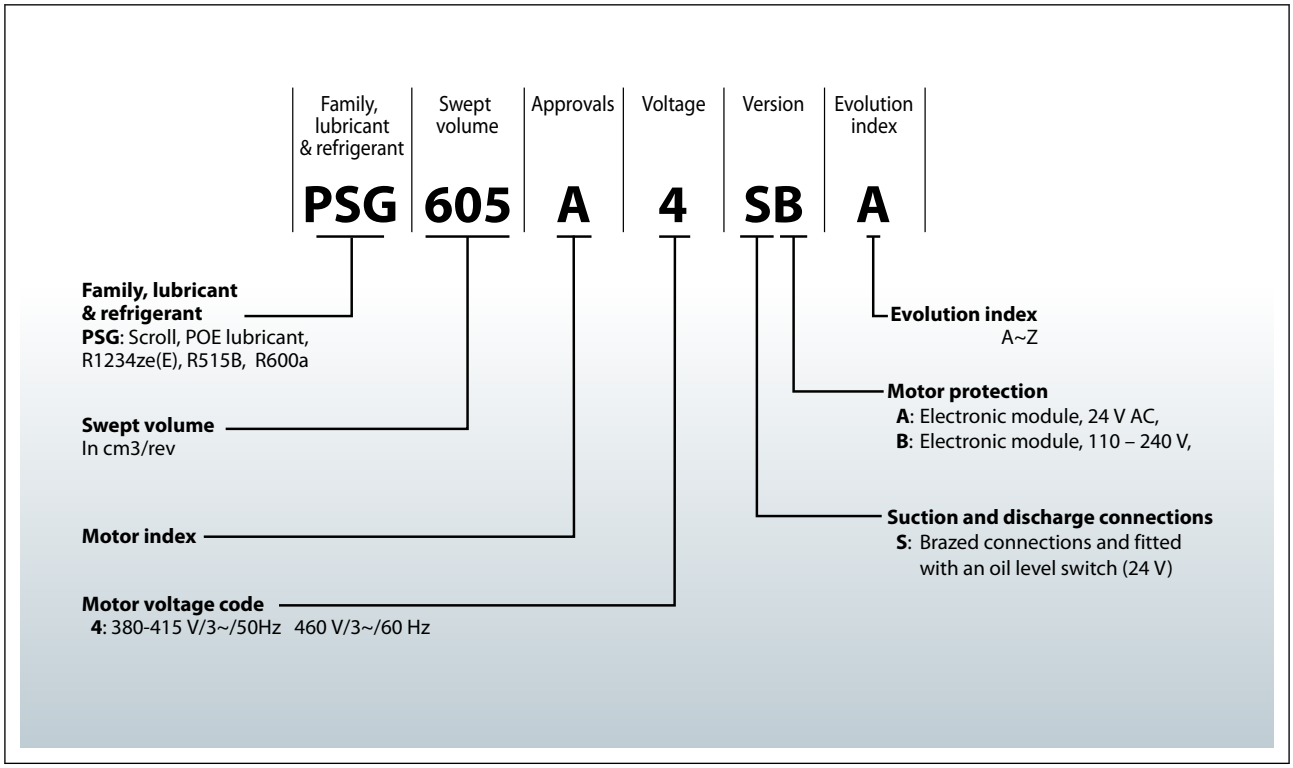
Name Plate



1	Model number
2	Serial number
3	Approvals
4	Refrigerant
5	Supply voltage, Starting current & Maximum operating current
6	Housing service pressure
7	Factory charged lubricant

Nomenclature

The example below presents the compressor nomenclature which equals the technical reference as shown on the compressor nameplate. Code numbers for ordering are listed in section Ordering codes.



Compressors serial number

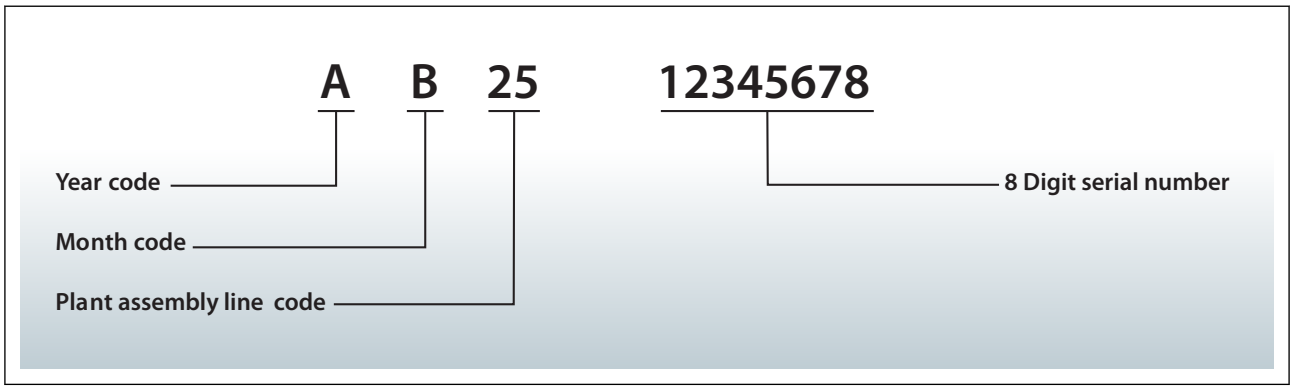


Table 1: Serial number code legend table

Year code		Month code		Plant assembly line code	
Year	Code	Month	Code	Plant	Code
1990, 2010	A	January	A	Trévoux, France	11
1991, 2011	B	February	B		
1992, 2012	C	March	C		
1993, 2013	D	April	D	Wuqing ,China	25
1994, 2014	E	May	E		
1995, 2015	F	June	F		
1996, 2016	G	July	G		
1997, 2017	H	August	H		
1998, 2018	J	September	J		
1999, 2019	K	October	K		
2000, 2020	L	November	L		
2001, 2021	M	December	M		
2002, 2022	N				
2003, 2023	P				
2004, 2024	Q				
2005, 2025	R				
2006, 2026	S				
2007, 2027	T				
2008, 2028	U				
2009, 2029	V				

Certificates, declarations and approvals

Certificates, declarations, and approvals

PSG scroll compressors comply with the following approvals and certificates.
Certificates are listed on: Documentation for Commercial Compressor | Danfoss

Table 2: Approval and certificates

Approval and certificates	Certification logo	Models
CE0094 (European Directive)	CE	All PSG models
UL (underwriter laboratories)	c UL us	All PSG models

Low voltage directive 2014/35/EU

Table 3: Low voltage directive 2014/35/EU

Products	PSG models
Declaration of conformity	Contact Danfoss

Machines directive 2006/42/EC

Table 4: Machines directive 2006/42/EC

Products	PSG models
Manufacturer's declaration of incorporation	Contact Danfoss

Pressure equipment directive 2014/68/EU

Table 5: Pressure equipment directive 2014/68/EU

Products	PSG605-800
Refrigerant fluids	Group 2 (R1234ze;R515B) Group 1 (R600a)
Category PED	II (R1234ze;R515B) III (R600a)
Maximum / Minimum temperature (Low side) - Ts	-35°C < Ts < 70°C -31°F < Ts < 158°F
Maximum allowable pressure (Low side) - Ps	15.2 bar(g) / 220 psig
Maximum allowable pressure (High side) - Ps	32 bar(g) / 464 psig
Declaration of conformity	Contact Danfoss

Internal free volume

Table 6: Internal free volume

Products	Internal free volume without oil			
	Low pressure side		High pressure side	
	litre	cu.inch	litre	cu.inch
PSG605	33.3	2032	5.9	360
PSG800	33.3	2032	5.9	360

Refrigerants

General information

When choosing a refrigerant, different aspects must be taken into consideration:
- Legislation (now and in the future)
- Safety
- Application envelope in relation to expected running conditions
- Compressor capacity and efficiency
- Compressor manufacturer recommendations & guidelines

Additional points could influence the final choice:
- Environmental considerations
- Standardisation of refrigerants and lubricants
- Refrigerant cost
- Refrigerant availability

R1234ze(E)

R1234ze(E) is a pure HFO fluid with a zero Ozone Depletion Potential (ODP=0) and a very low Global Warming Potential (GWP: 6/AR5 ; 7/AR4)

R1234ze(E) can be used as low GWP alternative to R134a replacement in chillers, refrigeration systems, heat pump and for high evaporating applications.

R1234ze(E) has nevertheless less volumetric efficiency and cooling capacity compared to R134a it is therefore not considered as the direct drop-in solution in existing systems.

R1234ze(E) is classified A2L with low flammability properties.

Low flammable refrigerants must be handled appropriately both with respect to avoiding ignition sources and with respect to relevant standards and legislations. Please refer to European regulations and directives about the use of refrigerant of the A2L safety group (EN378, EN60335). Outside Europe refer to the local regulation.

R515B

R515B is an azeotropic HFO/HFC blend (R1234ze(E) :91.2%; R227e: 8.9%) with a zero Ozone Depletion Potential (ODP=0) and a low Global Warming Potential (GWP: 299/AR5 ; 293/AR4)

R515B is classified A1, nonflammable, and therefore can be used as low GWP alternative to R134a replacement in chillers, refrigeration systems, heat pump applications where the long-term solution R-1234ze(E) cannot be implemented for regulatory criteria.

R515B demonstrates cooling capacity and an efficiency similar to refrigerant R1234ze(E).

R600a

R600a (Isobutane) is a pure hydrocarbon refrigerant with a zero Ozone Depletion Potential (ODP=0) and a very low Global Warming Potential (GWP: 3).

With PSG compressors it can be used as a low GWP alternative in in some heat pump applications.

R600a has a higher energy efficiency compared to traditional refrigerants like R134a, but it is not considered a direct drop-in solution for existing systems due to its flammability and different thermodynamic properties.

R600a is classified as A3 with high flammability properties. Highly flammable refrigerants must be handled with extreme care to avoid ignition sources and must comply with relevant standards and legislations. Please refer to European regulations and directives about the use of refrigerants of the A3 safety group (EN378, EN60335). Outside Europe, refer to the local regulations.

Technical specifications

50-60 Hz data Single compressor

Table 7: Technical specification 50-60 Hz data Single compressor

Model	Swept volume		Displacement (50 Hz) [1]		Displacement (60 Hz) [2]		Oil charge		Net weight [3]	
	cm^3/rev	cu.in/rev	m^3/h	cu.ft/h	m^3/h	cu.ft/h	dm^3	oz	kg	lbs
PSG605	605	40.76	105.27	3718	127.05	4487	6.1	206	176	388
PSG800	800	49.8	139.2	4916	168	5933	6.1	206	195	430

[1] Displacement at nominal speed: 2900rpm at 50 Hz
[2] Displacement at nominal speed: 3500rpm at 60 Hz
[3] Net weight with oil charge

Performance data

R1234ze(E) 50-60 Hz, Single compressor

Table 8: R1234ze(E)

Conditions		Model	Nominal cooling capacity		Heating capacity		Power input	COP[1]	COP heating	EER[2]
Frequency	Tevap/Tcond /Superheat/ Subcooling		W	Btu/h	W	Btu/h	kW	W/W	W/W	Btu/w/W
50 Hz	5°C / 50°C / 10K / 0K (41°F/ 122°F / 18 °F /0 °F	PSG605	47765	162979	62132	212000	15.1	3.16	4.11	10.78
		PSG800	64190	219023	82032	279901	18.9	3.40	4.35	11.61
	20°C / 90°C / 10K / 0K (68°F/ 194°F / 18 °F /0 °F	PSG605	42938	146509	73376	250366	32.0	1.34	2.29	4.57
		PSG800	57840	197356	95516	325911	41.3	1.40	2.31	4.78
60 Hz	5°C / 50°C / 10K / 0K (41°F/ 122°F / 18 °F /0 °F	PSG605	57484	196141	74678	254808	18.4	3.12	4.05	10.64
		PSG800	77360	263960	98497	336081	23.5	3.30	4.20	11.26
	20°C / 90°C / 10K / 0K (68°F/ 194°F / 18 °F /0 °F	PSG605	51550	175894	87080	297126	39.5	1.31	2.21	4.46
		PSG800	69310	236493	114650	391198	50.3	1.38	2.28	4.70

[1] Coefficient Of Performance
[2] Energy Efficiency Ratio

R600a 50-60 Hz, Single compressor

Table 9: R600a

Conditions		Model	Nominal cooling capacity		Heating capacity		Power input	COP[1]	Heating COP	EER[2]
Frequency	Tevap/Tcond /Superheat/ Subcooling		W	Btu/h	W	Btu/h	kW	W/W	W/W	Btu/w/W
50 Hz	5°C / 50°C / 10K / 0K (41°F/ 122°F / 18 °F /0 °F	PSG605	36140	123313	46467	158548	10.9	3.32	4.27	11.34
		PSG800	47970	163678	61764	210746	13.8	3.48	4.48	11.87
	20°C / 90°C / 10K / 0K (68°F/ 194°F / 18 °F /0 °F	PSG605	36714	125272	57149	194996	21.5	1.71	2.66	5.82
		PSG800	47950	163610	75383	257216	27.5	1.74	2.74	5.94
60 Hz	5°C / 50°C / 10K / 0K (41°F/ 122°F / 18 °F /0 °F	PSG605	43745	149262	56228	191856	13.1	3.33	4.28	11.36
		PSG800	57480	196128	74010	254191	16.5	3.48	4.51	11.86
	20°C / 90°C / 10K / 0K (68°F/ 194°F / 18 °F /0 °F	PSG605	43626	148856	68526	233816	26.2	1.66	2.61	5.68
		PSG800	57910	197595	90760	309681	33.1	1.75	2.74	5.97

[1] Coefficient Of Performance
[2] Energy Efficiency Ratio

R515B 50-60 Hz

Table 10: R515B

Conditions		Model	Nominal cooling capacity		Heating capacity		Power input	COP[1]	COP heating	EER[2]
Frequency	Tevap/Tcond /Superheat/ Subcooling		W	Btu/h	W	Btu/h	kW	W/W	W/W	Btu/w/W
50 Hz	5°C / 50°C / 10K / 0K (41°F/ 122°F / 18 °F /0 °F	PSG605	47300	161392	61146	208636	15.0	3.16	4.08	10.77
		PSG800	63600	217010	81385	277694	18.8	3.38	4.33	11.54
	20°C / 90°C / 10K / 0K (68°F/ 194°F / 18 °F /0 °F	PSG605	41780	142558	70577	240815	31.9	1.31	2.21	4.47
		PSG800	56280	192033	93828	320149	41.0	1.37	2.29	4.69
60 Hz	5°C / 50°C / 10K / 0K (41°F/ 122°F / 18 °F /0 °F	PSG605	56930	194251	73921	252224	18.4	3.10	4.02	10.57
		PSG800	76570	261264	97606	333043	23.4	3.28	4.18	11.18
	20°C / 90°C / 10K / 0K (68°F/ 194°F / 18 °F /0 °F	PSG605	50123	171025	85335	291170	39.0	1.28	2.19	4.38
		PSG800	67500	230317	112732	384653	49.9	1.35	2.26	4.61

[1] Coefficient Of Performance
[2] Energy Efficiency Ratio

Tandem and trio performances

The impact of manifolding on compressor performances depends widely of the customer system itself. Therefore, it would be unrealistic to provide data that corresponds accurately to a particular system. In first approach, to support compressors selection at full load, the manifold performances can be considered as the sum of capacities of the compressors composing the manifold. For better accuracy, the customer should integrate the appropriate weighing coefficients according to his system very pressure drops and part load levels.

Sound and vibration data

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.

Table 11: Compressor sound radiation levels for compressors running alone

Compressor model	50 Hz		60 Hz	
	Sound power R1234ze/ R515B, dB(A)	Sound power R600a, dB(A)	Sound power R1234ze/ R515B, dB(A)	Sound power R600a, dB(A)
PSG605	85	82	87	84
PSG800	88	86	89	88

NOTE:
Sound power and attenuation are given at ARI conditions, measured in free space.

For compressors running simultaneously,

- The global sound level of “n” identical compressors is:

$L_{GLOBAL} = Li + 10 \quad Log_{10} \quad n$

Example for the tandem

PSG1210 = PSG605+PSG605 (50 Hz)

$L_{PSG605} = 85dB(A)$

$L_{PSG1210} = 10\ Log_{10}(10^{0.1\times85} + 10^{0.1\times85}) = 88dB(A)$

Mechanical vibrations

A compressor generates some vibrations that propagate into the surrounding parts and structure. The vibration level of a PSG compressor alone does not exceed 154 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.

Operating envelope data

Operating envelope

Figure 2: R1234ze(E) / R515B PSG605-800

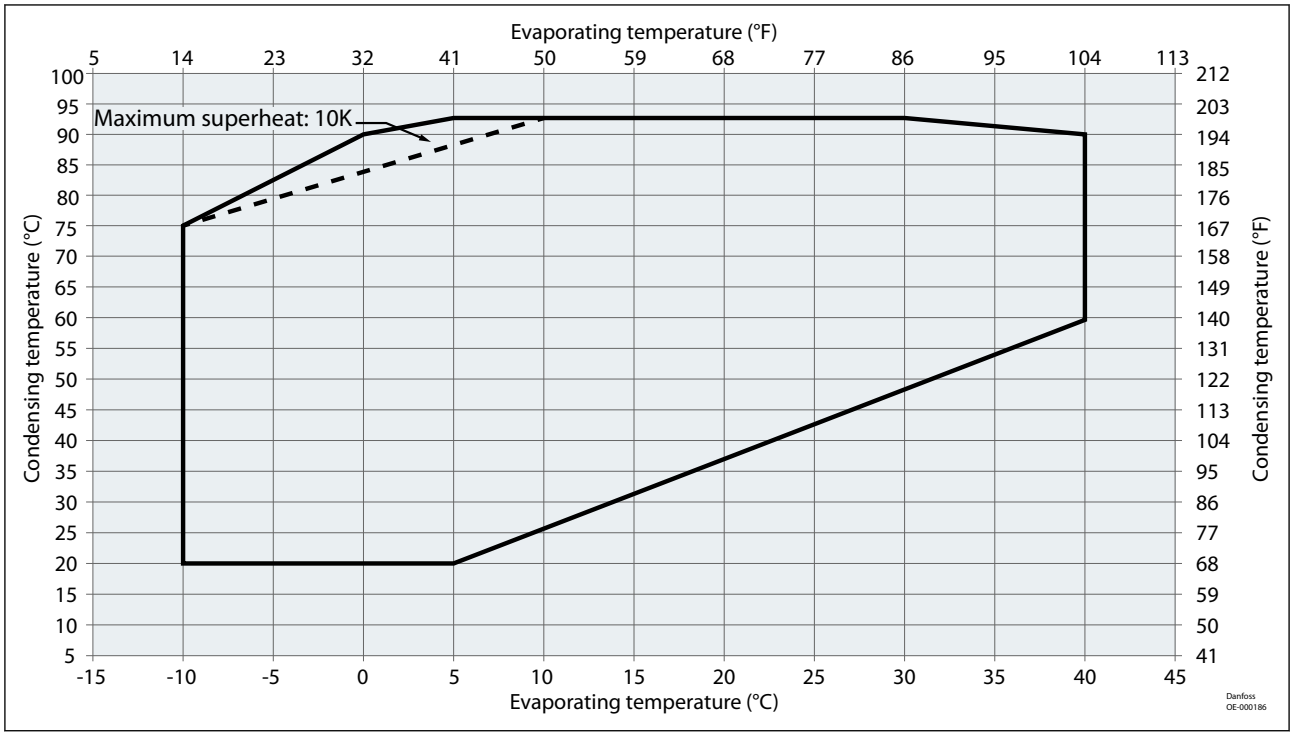


Figure 3: R1234ze(E) / R515B Superheat envelope

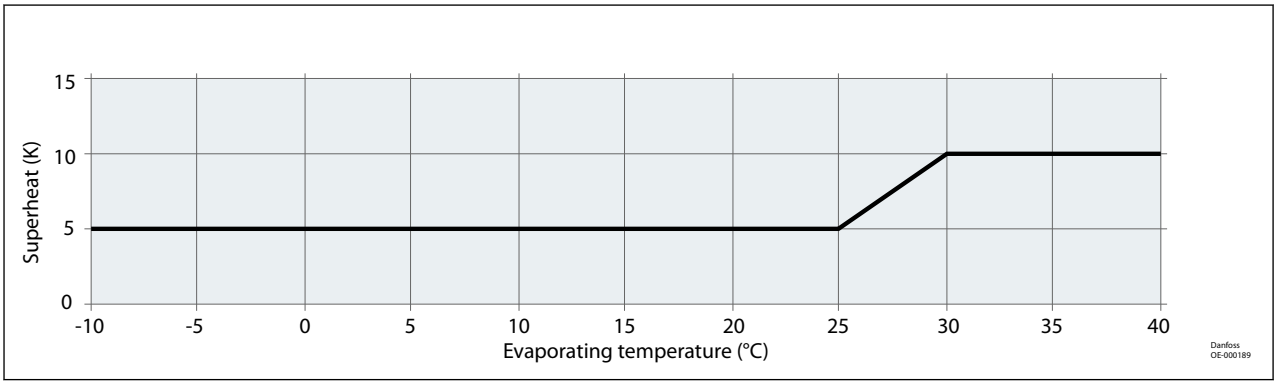


Figure 4: R600a PSG605-800

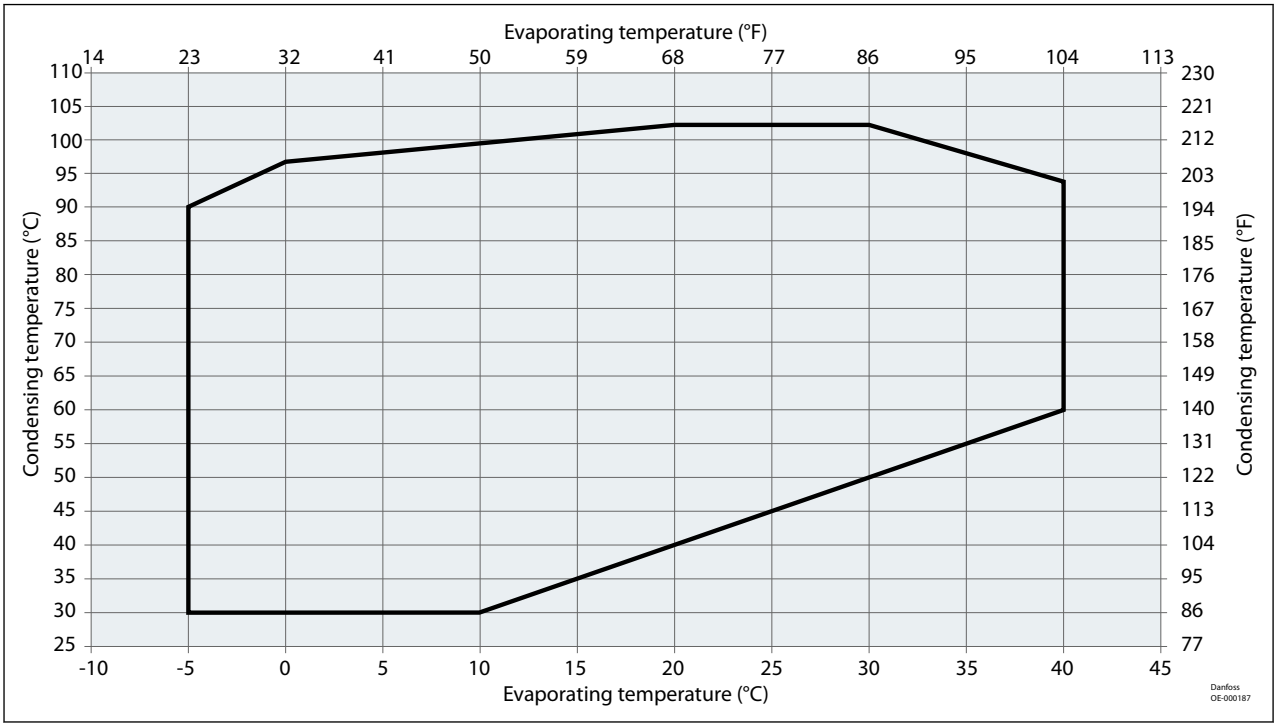
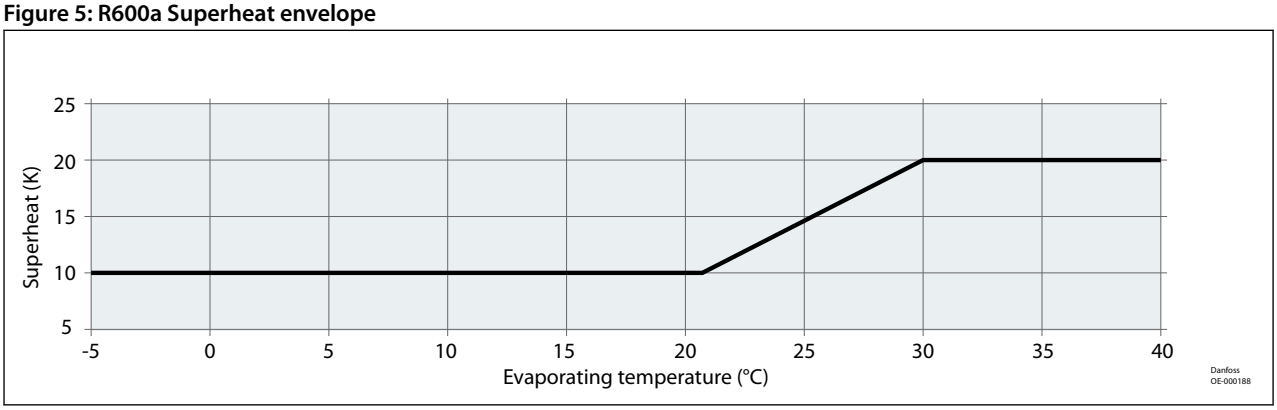


Figure 5: R600a Superheat envelope



Pressure settings

Table 12: Pressure settings

Pressure settings		R1234ze(E) /R515B		R600a	
Working range high side	bar(g)	3.3	25.3	3.0	19.6
	psi(g)	47	367	44	284
Working range low side	bar(g)	0.47	6.66	0.31	4.31
	psi(g)	6.9	96.6	4.5	62.5
Maximum high pressure safety switch setting	bar(g)	27		21	
	psi(g)	387		305	
Minimum low pressure safety switch setting	bar(g)	0.2			
	psi(g)	2.9			
Minimum low pressure pumpdown switch setting	bar(g)	0.5 bar below nominal evap pressure with a minimum of 0.2 bar(g)			
	psi(g)	7 psi below nominal evap pressure with a minimum of 2.9 psi(g)			

Dimensions

Single compressors

Figure 6: PSG605-800 outline drawing

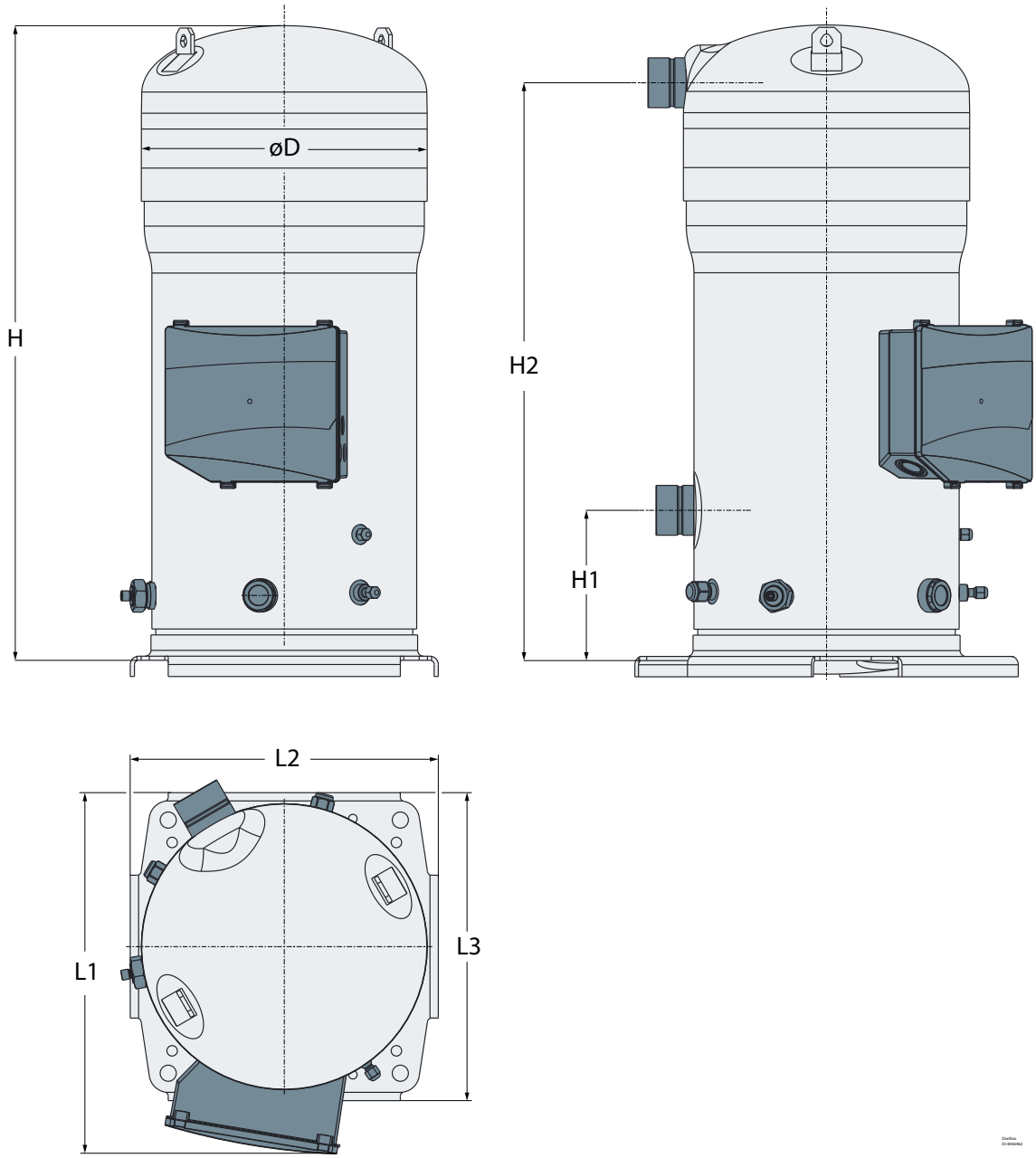


Table 13: Single compressor

Compressor model	D		H		H1		H2		L1		L2		L3		Outline drawing no.	
	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
PSG605	344	13.6	764	30.1	181	7.1	695	27.36	436	17.17	371	14.61	371	14.61	1	8556462
PSG800	344	13.6	780	30.71	181	7.1	711	28	436	17.17	371	14.61	371	14.61	1	8556464

Mechanical connections

Connection details

Figure 7: Outline drawing 1

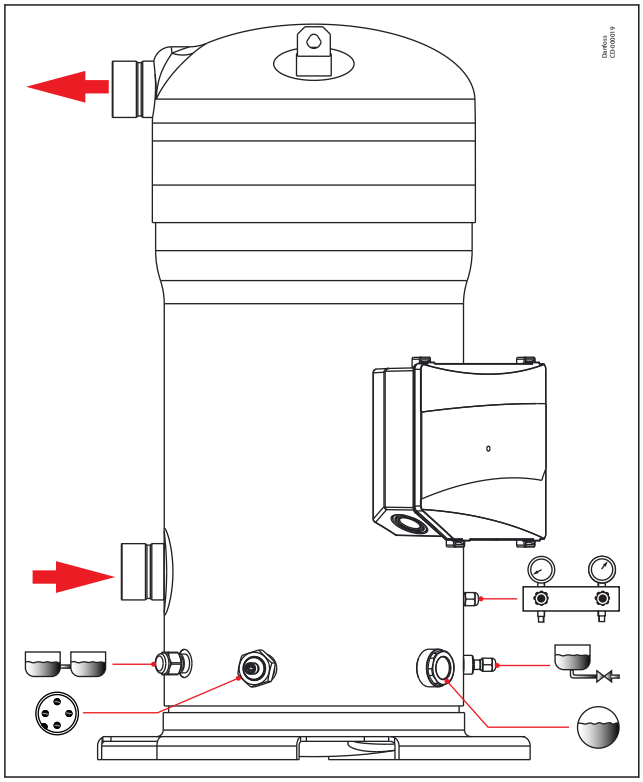


Table 14: Connection details

Connection Details		PSG605-800
Suction connection		Brazed 2"1/8
Discharge connection		Brazed 2"1/8
Oil sight glass		Threaded (1"1/8 – 18 UNEF)
Oil equalization connection		1/2" Flare
Oil drain connection		Female ¼" Flare incorporating a Schrader valve
Low pressure gauge port (Shrader)		Male ¼" Flare incorporating a Schrader valve
Oil level switch		-
Outline drawing		1

Design compressor mounting

General requirements

Compressors used in parallel applications can be mounted directly on rails and the manifold assembly must be mounted with flexible grommets onto the frame.

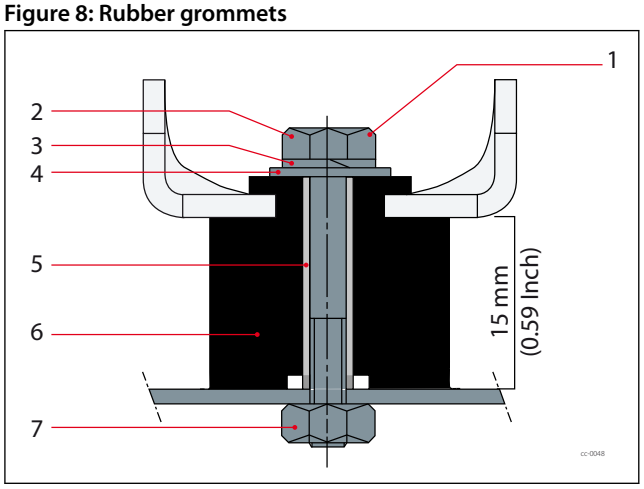
During operation, the maximum inclination from the vertical plane must not exceed 3 degrees.

Single requirements, PSG605-800 mounting

To be used in single applications, an additional accessory including flexible grommets is necessary kit 8156138.

The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The required bolt size for the PSG compressors is HM8-55. This bolt must be tightened to a torque of 21 Nm.

Figure 8: Rubber grommets



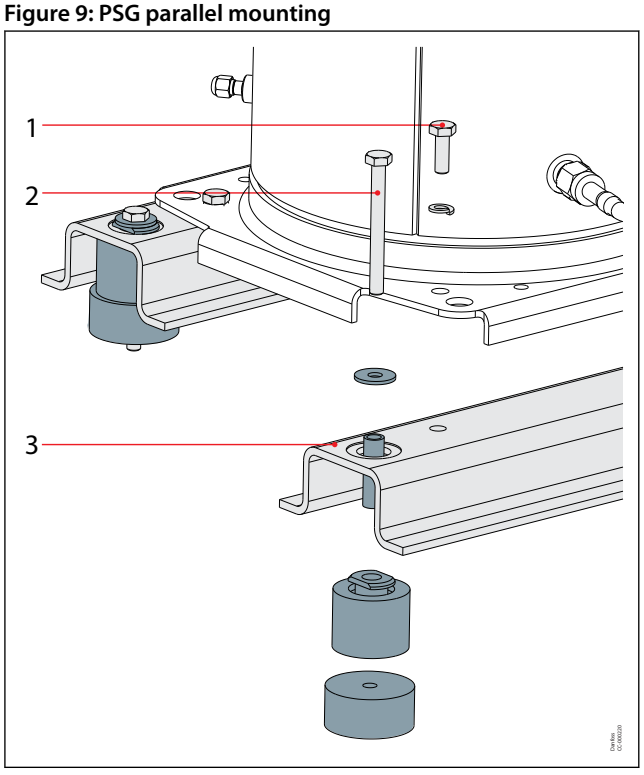
1	Tightening torque 15 Nm
2	HM 8 bolt (4 pcs)
3	Lock washer (4 pcs)
4	Flat washer (4 pcs)
5	Steel mounting sleeve (4 pcs)
6	Rubber grommet (4 pcs)
7	Nut (4 pcs)

Parallel mounting requirement

For parallel mounting, the compressors can be mounted directly on the rails. Rubber grommets and spacers must be installed below the rails.

These parts are included in accessories.

Figure 9: PSG parallel mounting



1	HM 10 x 30 class 10.9, Tightening torque 50 Nm
2	HM 10 x 100 class 10.9, Tightening torque 50 Nm
3	Thickness: 6 mm (0.24 inch)
	Included in tandem/trio kit
	Not supplied

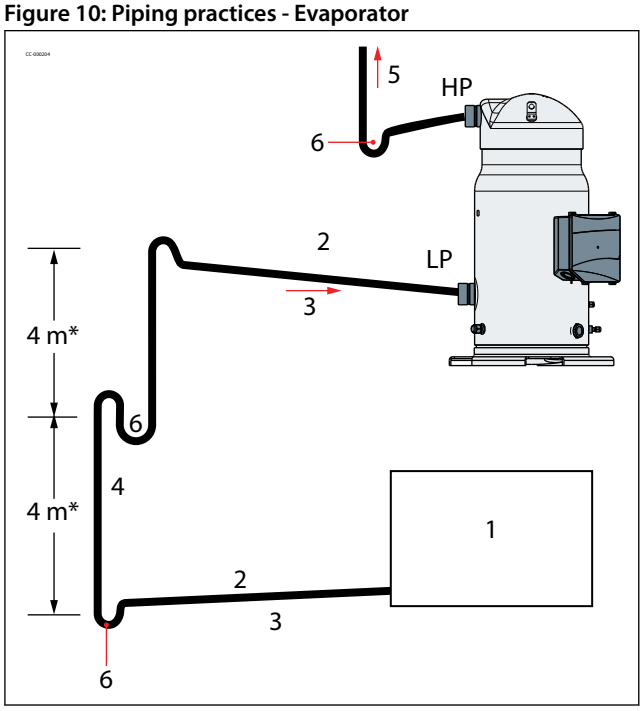
Design piping

General requirements

Proper piping practices should be employed to:

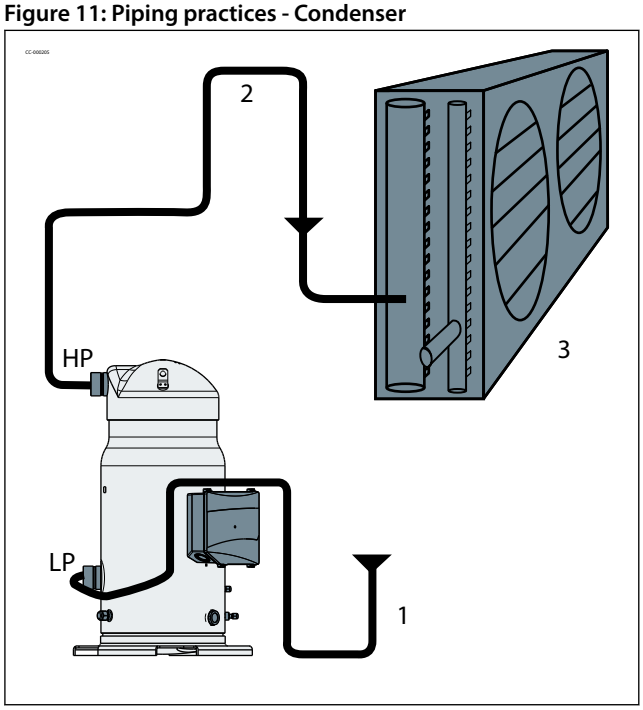
1. Ensure adequate oil return, even under minimum load conditions (refrigerant speed, piping slopes…). For validation tests see section Manage oil in the circuit.
2. Avoid condensed liquid refrigerant from draining back to the compressor when stopped (discharge piping upper loop). For validation tests see section Manage off cycle migration.
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 Sound and vibration data.

Figure 10: Piping practices - Evaporator



1	Evaporator
2	0.5% slope
3	4m/s or more
4	8 to 12 m/s
5	To condenser
6	U-trap, as short as possible
*****	Max.

Figure 11: Piping practices - Condenser



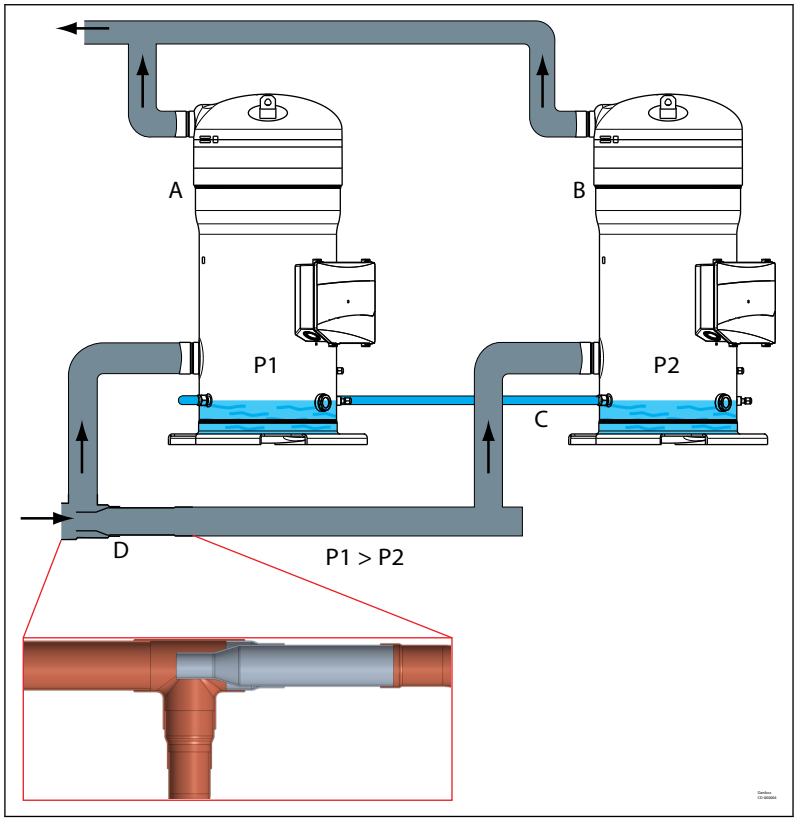
1	3D flexibility
2	Upper loop
3	Condenser

Dynamic systems

The dynamic system provides truly positive oil management, uniting the advantages of both a mechanical and a static system, i.e. flexible oil management allowing a large number of compressors, simplicity and cost effectiveness.

The suction connections of the two individual compressors are interconnected by a suction oil separator / gas restrictor (suction Tee). The compressor which appears first on the suction line is called the “upstream compressor” while the second one will be referred to as the “downstream compressor”.

The oil which clings back along the main suction line is separated by the suction Tee which returns 80 to 100% of the oil in the suction gas to the upstream compressor. The Tee creates a slight pressure drop in the suction line of the downstream compressor, which therefore has a slightly lower sump pressure. The pressure drop should be between 15 and 150 mbar at any condition. Driven by the sump pressure difference, the excess oil from the upstream compressor runs into the downstream compressor sump. To avoid the migration of the normal oil charge from one compressor to the other, the oil equalisation line protrudes into each compressor shell, thereby ensuring a real overflow function. Suitable oil management, with no mechanical components or pressure equalisation line is created. The active components in this oil balancing system are calibrated and qualified by Danfoss Commercial Compressors. (Refer to the restrictor and reducer fitting drawings) Danfoss does not supply the various tees and reducers; however, the restrictor tube is included in the PSG mounting kits.



A	Upstream compressor
B	Downstream compressor
C	Oil equaliser
D	Restrictor and reducer fittings

Tandem assemblies

Figure 12: Outline drawing

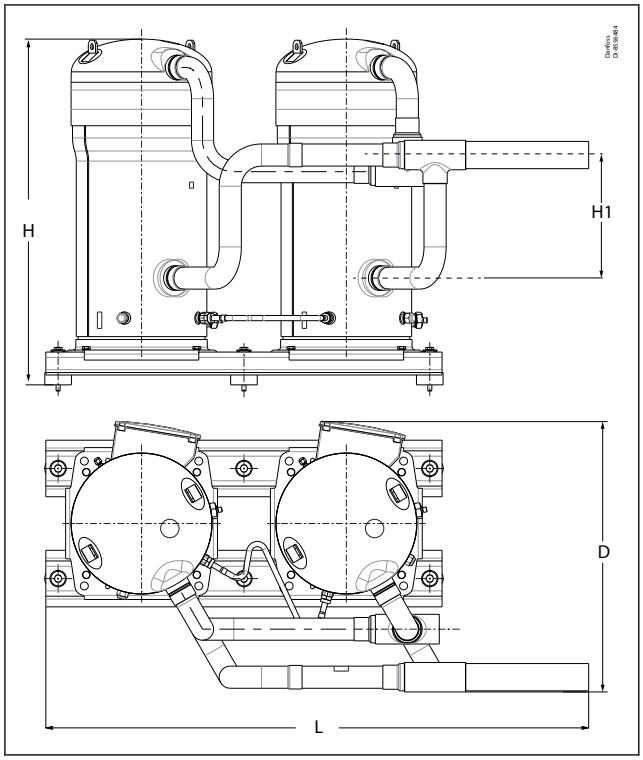


Table 15: Tandem assemblies

Tandem model	Composition Cp1 + Cp2	Suction	Discharge	D		H		H1		L		Outline drawing number	Mounting and restrictor kit code
				mm	inch	mm	inch	mm	inch	mm	inch		
PSG1210	2 X PSG605	2"5/8	2"5/8	660	26	844	33.3	300	11.8	977 (right suct) 1325 (left suct)	38.5 52	8556484	120Z0884
PSG1600	2 X PSG800	2"5/8	2"5/8	660	26	860	33.9	300	11.8	984 (right suct) 1343 (left suct)	38.8 53	8556488	120Z0884

Electrical connections

Wiring connections

According to compressor model, electrical power is connected to the compressor terminals either by M5 studs and nuts. The maximum tightening torque is 3 Nm.

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

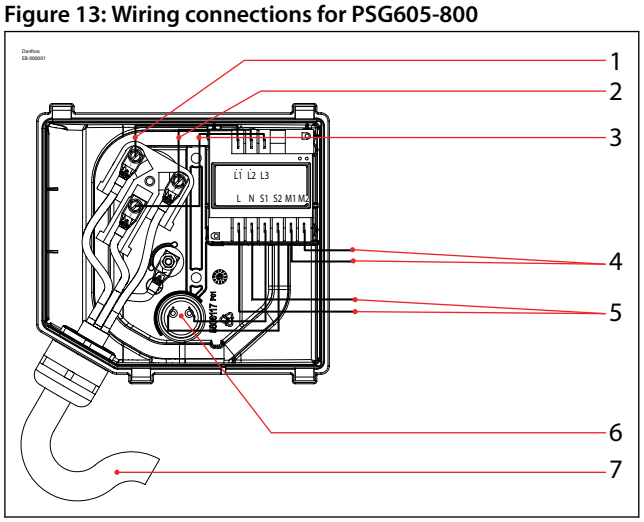
PSG605-800

The terminal box is provided with 2 triple knockouts and 1 single knockout for power supply and 4 double knockouts for the safety control circuit.

The 3 power supply knockouts accommodate the following diameters:
- Ø 50.8 mm (φ 2 inch) (UL 1"1/2 conduit) & Ø 43.7 mm (φ 1.72 inch) (UL 1"1/4 conduit) & Ø 34.5 mm (φ 1.36 inch) (UL 1" conduit)
- Ø 40.5 mm (φ 1.59 inch) (ISO40) & Ø 32.2 mm (φ 1.27 inch) (ISO32) & Ø 25.5 mm (φ 1 inch) (ISO25)
- Ø 25.5 mm (φ 1 inch) (ISO25)

The 4 others knockouts are as follows:
- Ø 22.5 mm (φ 0.89 inch) (PG16) (UL 1/2") & Ø 16.5 mm (φ 0.65 inch) (ISO16) (x2)
- Ø 20.7 mm (φ 0.81 inch) (ISO20 or PG13.5) (x2)

Figure 13: Wiring connections for PSG605-800



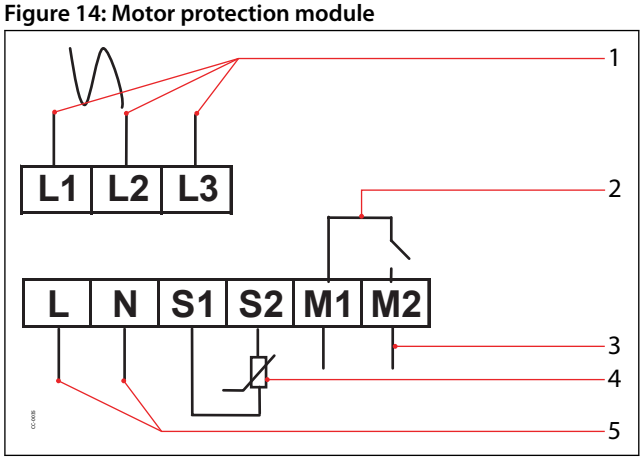
1	Black
2	Blue
3	Brown
4	M1, M2 Control circuit
5	Module power supply
7	Faston 1/4" tabs
8	Power supply

Motor protection module

The motor protection modules come preinstalled within the terminal box. Phase sequence protection connections and thermistor connections are pre-wired and should not be removed.

The module must be connected to a power supply of the appropriate voltage. The module terminals are 6.3mm (0.25inch) size Faston type.

Figure 14: Motor protection module



1	Phase sequence input
2	Internal control contact
3	Safety circuit
4	Thermistor connection
5	Module power

Electrical specifications

Motor voltage

Danfoss scroll compressors PSG are available in different motor voltages as listed below.

Table 16: Motor voltage

Motor voltage code	Code 4
50 Hz - Nominal voltage	380-415V - 3ph
60 Hz - Nominal voltage	460V - 3ph

NOTE:
Voltage range: Nominal voltage ± 10%. The voltage range indicates where the compressor can run in the majority of the application envelope. A boundary voltage supply which accumulates under specific conditions such as high ambiance, high superheat, or map boundary conditions, may lead to a compressor trip.

Voltage imbalance

The maximum allowable voltage imbalance is 2%. Voltage imbalance causes high amperage over one or several phases, which in turn leads to overheating and possible motor damage. Voltage imbalance is given by the formula:

$$\%\ \text{voltage imbalance} = \frac{|\ Vavg - V1{-}2\ | + |\ Vavg - V1{-}3\ | + |\ Vavg - V2{-}3\ |}{2 \times Vavg} \times 100$$

Vavg	Mean voltage of phases 1, 2, 3.
V1-2	Voltage between phases 1 and 2.
V1-3	Voltage between phases 1 and 3.
V2-3	Voltage between phases 2 and 3.

IP rating

The compressor terminal box according to IEC60529 is IP54 for all models when correctly sized IP54 rated cable glands are used.

First numeral, level of protection against contact and foreign objects

5 - Dust protected

Second numeral, level of protection against water

4 - Protection against water splashing

Terminal box temperature

The temperature inside the terminal box must not exceed 70°C (158°F). Consequently, if the compressor is installed in an enclosure, precautions must be taken to avoid that the temperature around the compressor and in the terminal box would rise too much. A ventilation installation on the enclosure panels may be necessary. If not, the electronic protection module may not operate properly. Any compressor damage related to this will not be covered by Danfoss warranty. In the same manner, cables must be selected in a way that ensures the terminal box temperature does not exceed 70°C (158°F).

Three phase electrical characteristics

Table 17: Motor voltage code 4 - 380-415V/3ph/50Hz, 460V/3ph/60Hz

Compressor models	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
PSG605	331	49	58	0.44
PSG800	391	62	78	0.285

LRA (Locked Rotor Amp)

Locked Rotor Amp value is the higher average current as measured on mechanically blocked compressors tested under nominal voltage. The LRA value can be used as a rough estimation for the starting current. However, in most cases, the real starting current will be lower. A soft starter can be applied to reduce starting current (see section Soft starts).

RLA (Rated Load Amperage)

The RLA values presented are simply calculated by dividing the maximum current before tripping at overload test conditions by 1.4.

MOC (Maximum Operating Current)

The max operating current is the amperage the compressor will draw when it operates at maximum load of operating envelope within the voltages printed on the nameplate.

MOC can be used as a basis for contactors selection.

Winding resistance

Winding resistance is the resistance between phases at 25°C (77°F) (resistance value +/- 7%). Winding resistance is generally low and it requires adapted tools for precise measurement. Use a digital ohm-meter, a “4 wires” method and measure under stabilised ambient temperature. Winding resistance varies strongly with winding temperature. If the compressor is stabilised at a different value than 25°C (77°F), the measured resistance must be corrected using the following formula:

$$R_{tamb} = R_{25°C\ (77°F)} \frac{a + t_{amb}}{a + t_{25°C\ (77°F)}}$$

$t_{25°C}$	reference temperature = 25°C (77°F)
t_{amb}	temperature during measurement °C (°F)
$R_{25°C\ (77°F)}$	winding resistance at 25°C (77°F)
R_{amb}	winding resistance at tamb
a	Coefficient a = 234.5

Motor protection

PSG605-800

PSG Compressors are delivered with a pre-installed motor protection module inside the terminal box. This device provides efficient and reliable protection against overheating and overloading as well as phase loss/reversal.

The motor protector comprises a control module and PTC sensors embedded in the motor winding.

The motor temperature is being constantly measured by a PTC thermistor loop connected on S1-S2 . If any thermistor exceeds its response temperature, its resistance increases above the trip level (4.500 Ω) and the output relay then trips – i.e. contacts M1-M2 are open. After cooling to below the response temperature (resistance < 2.750 Ω), a 5-minute time delay is activated.

After this delay has elapsed, the relay is once again pulled in – i.e. contacts M1-M2 are closed. The time delay may be cancelled by means of resetting the mains (L-N -disconnect) for approximately 5 sec.

A red/green twin LED is visible on the module. A solid green LED denotes a fault free condition. A blinking red LED indicates an identifiable fault condition:

Figure 15: PTC Overheat

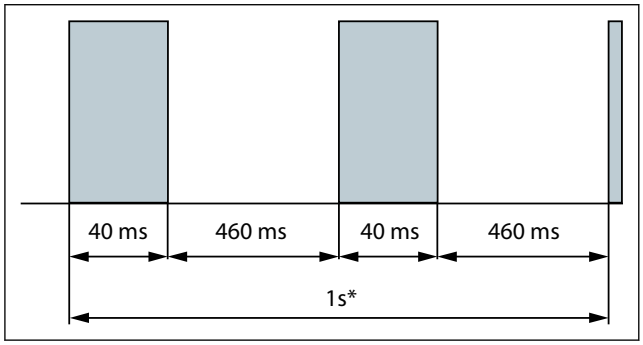
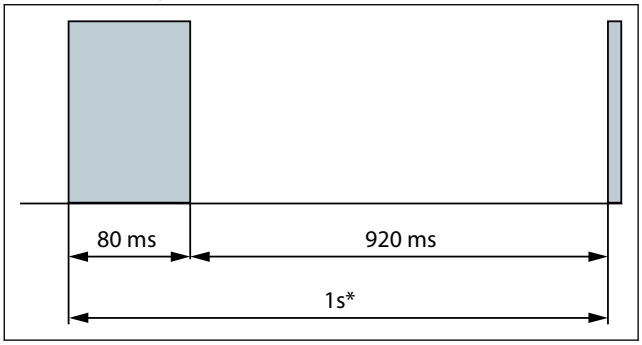


Figure 16: Delay timer active (after PTC over temp.)



*	approx. 1 second

While not compulsory, an additional thermal magnetic motor circuit breaker is still advisable for either alarm or manual reset.

Then it must be set at max operating current

- When the motor temperature is too high, then the internal PTC over temp. and module is activated.
- When the current is too high the thermal magnetic motor circuit breaker will trip before the module activate therefore offering possibility of manual reset.

Phase sequence and reverse rotation protection

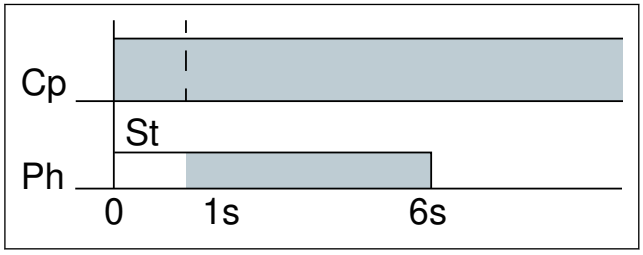
PSG605-800

Use a phase meter to establish the phase orders and connect line phases L1, L2 and L3 to terminals T1, T2 and T3, respectively.

Compressor models PSG605-800 are delivered with an electronic module which provides protection against phase reversal and phase loss at start-up.

The phase sequencing and phase loss monitoring functions are active during a 5-sec window 1 second after compressor start-up (power on L1-L2-L3).

Figure 17: Phase sequence module logic



Cp	Compressor
Ph	Phase monitoring
St	start

Should one of these parameters be incorrect, the relay would lock out (contact M1-M2 open). The red LED on the module will show the following blink code:

Figure 18: In case of phase reverse error

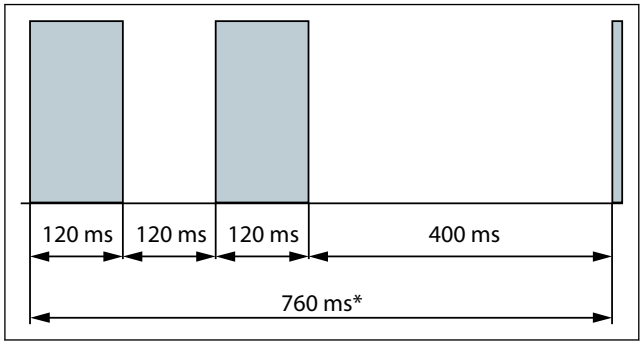
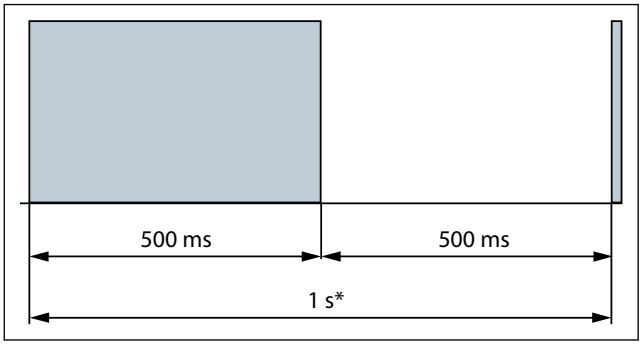


Figure 19: In case of phase loss error:



*	Approximate

The lockout may be cancelled by resetting the power mains (disconnect L-N) for approximately 5 seconds.

For more detailed information see " Instructions for electronic module" AN160986418236.

Application

Manage oil in the circuit

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.

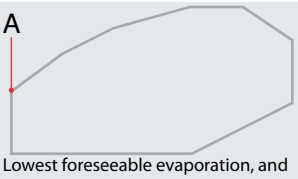
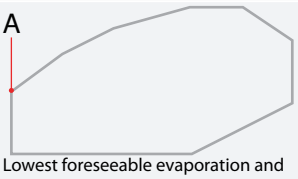
System evaluation

Table 18: Manage oil in the circuit - System evaluation

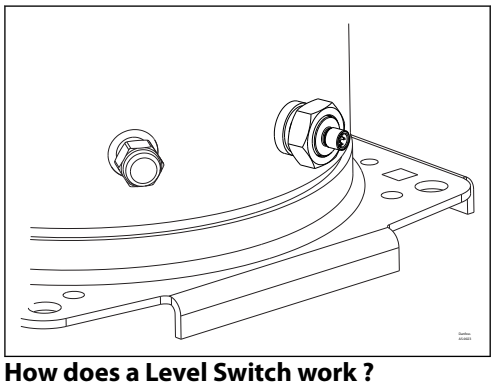
Split type	Manifold compressors
Non split	Test No.1+2
Split	Test No.1+2+3

Test, criteria and solutions

Table 19: Manage oil in the circuit - Test, criteria and solutions

Test No.	Purpose	Test conditions	Pass criteria	Solutions
1	Check proper oil return	 Lowest foreseeable evaporation, and highest foreseeable condensation. **Minimum number of compressor** running for 6 hours.	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.	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. Integrate a function in control logic to run all compressors simultaneously in order to boost oil return (for more details see section Control logic) 3. Oil separator can be added
2	Check oil balancing	 Lowest foreseeable evaporation and highest foreseeable condensation and nominal capacity condition for tandem 2 compressors running for 6 hours, for trio, compressor running follow the running sequence: (1+2+3)2hrs→ (1+2)2hrs →(2+3)2hrs→ (1+3)2hrs	Oil level must be visible or full in the sight glass when the compressors are running and when all compressors of the circuit are stopped	1. Top-up with oil, generally 3% of the total system refrigerant charge (in weight). 2. Check that manifold piping is conform to Danfoss requirements. 3. Integrate a function in control logic to stop manifold periodically in order to balance oil (for more details see section Control logic)
3	Oil return in split systems	Since each installation is unique, test 1 and 2 can not fully validate the oil return. Oil level must be checked and adjusted at commissioning.	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.	1. Pay special attention to "Piping design" 2. Oil separator is strongly recommended, espacially in case of part load.

Oil level Switch (OLS)



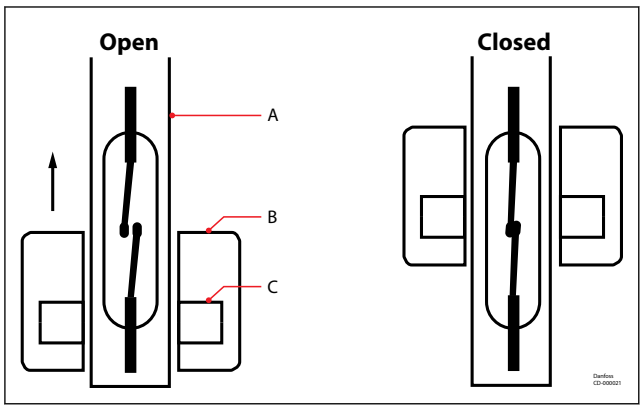
How does a Level Switch work ?

The OLS is a level switch designed to help to ensure sufficient lubricant in the scroll compressor's sump, thereby preventing reliability risks associated with temporary oil shortages.

The switch component features a potential-free reed contact, which is closed by a permanent magnet built into the float when the lubricant level is at its nominal value in the compressor sump.

A change in the switch status occurs when the lubricant level falls below the oil sight glass, triggering a signal to alert that action is needed to restore the lubricant level in the compressor sump.

NOTE:
The stem is sealed, so the reed switch is not in contact with the oil/refrigerant



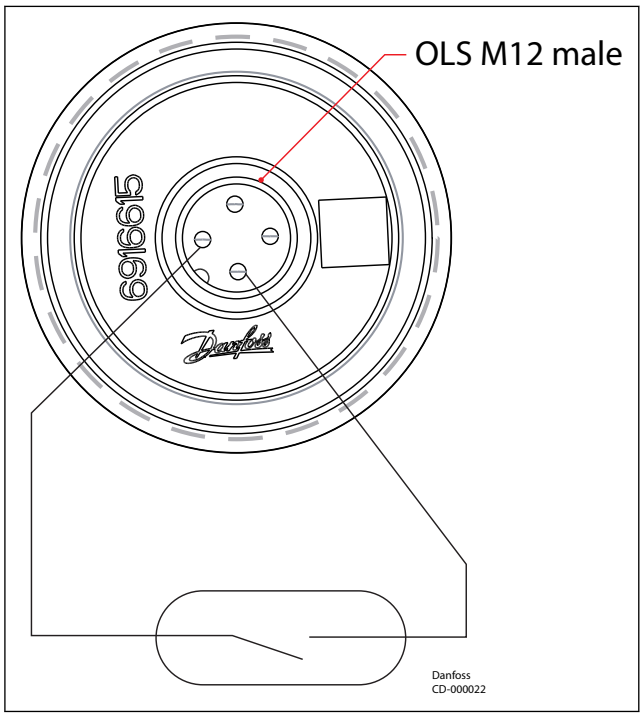
A	Stem
B	Float
C	Ring magnet

Connection

The reed switch is internally connected between terminals 1 and 2. Therefore, connect the controller to terminals 1 and 2 using an M12 cable.

Please note that the OL switch is delivered without the M12 included. Danfoss offers following references

034G2201	Straight M12 cable female / 2 meters
034G2200	Straight M12 cable female / 8 meters



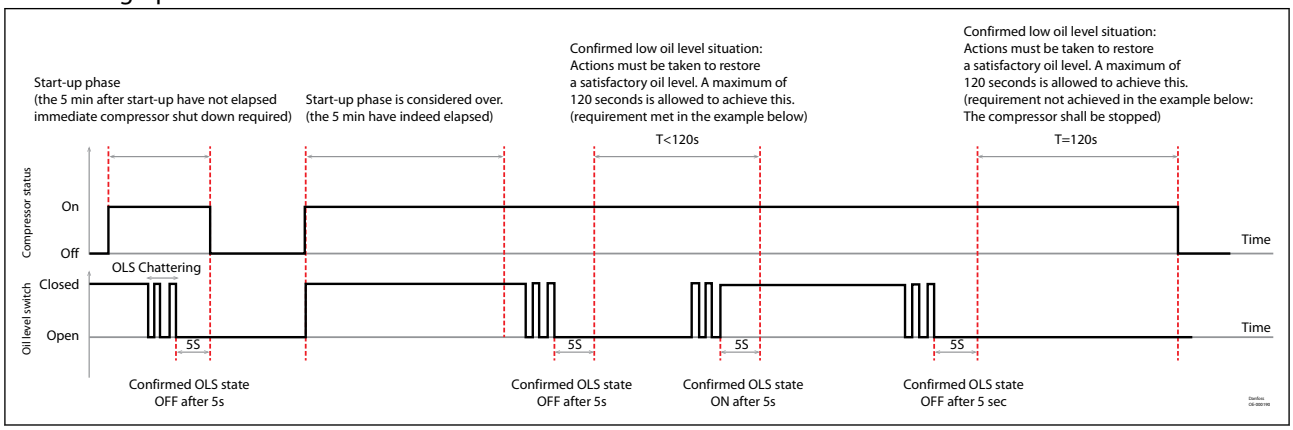
Voltage range	0-26.4V AC 50/60Hz 0-26.4V DC
Maximum power	10 VA
Maximum current	0.5 A

Keep in mind that the float height may be impacted by transient phenomena in the compressor sump that could lead to unintended switch activations. An OLS signal indicates that the lubricant level has left the safe zone, but this does not necessarily represent a risk if this state is very short-lived. However, if the duration is prolonged over several seconds, occurs during stable conditions, or if the frequency of alerts increases, then actions should be taken to protect the compressor and the unit. This is why the signal given by the OLS is generally sent to a controller. The actions to protect the unit can vary (compressor shutdown, forced oil return, setpoint change, etc.). Each assembler will be able to define the best strategy to adopt based on their know-how and the architecture of their own system.

Nevertheless, we recommend adopting the following approach to manage compressor protection:

- During a period of 5 minutes following an event (compressor start-up, defrosting, etc...), if a continuous oil shortage signal is reported for more than 5 seconds, the affected compressor should be immediately stopped
- Should a signal appear after more than five minutes have passed since the last event (start-up, defrosting, etc.), actions should be taken to restore the compressor to an acceptable oil level[1]. A time of 120 seconds can be allowed to achieve this objective; if the result is not conclusive after this period, the compressor must be stopped.

Below is a graphical illustration of some cases



Manage sound and vibration

Sound radiations

Mitigations methods: Use of sound-insulation materials on the inside of unit panels is an effective mean to reduce sound radiation.

NOTE:
During compressor shut down, a short reverse rotation sound is generated. The duration of this sound depends on the pressure difference at shut down and should be less than 3 seconds. This phenomenon has no impact on compressor reliability.

Gas pulsation

The 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.

1 The oil level will be considered acceptable if the OLS remains closed continuously for 5 seconds

Mitigation methods

1. To ensure minimum vibrations transmission to the structure, strictly follow Danfoss mounting requirements (mounting feet, rails etc..). For further information on mounting requirements, please refer to section Design compressor mounting.
2. Ensure that there is no direct contact (without insulation) between vibrating components and structure.
3. To avoid resonance phenomenon, pipings and frame must have natural frequencies as far as possible from running frequencies(50 or 60 Hz). Solutions to change natural frequencies are to work on structure stiffness and mass (brackets, metal sheet thickness or shape…)

Manage operating envelope

Requirement

R The Operating envelope data guarantees reliable operations of the compressor for steady-state operation.

The steady-state operation envelope is valid for a suction superheat in accordance with the recommendation given by the superheat graph, and under nominal voltage.

High and low pressure protection

R Low-pressure (LP) and high-pressure (HP) safety switches must never be bypassed nor delayed and must stop all the compressors.

LP switch auto restart must be limited to 5 times within 12 hours.

! HP safety switch must be reset manually.

Depending on application operating envelope, you must define HP and LP limits within operating envelope and pressure setting table above.

Discharge gas temperature (DGT) protection

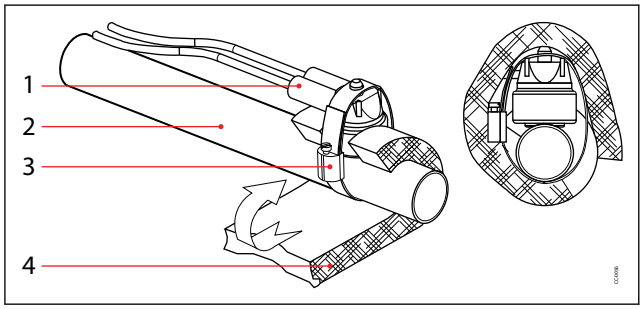
PSG compressors do not include an integrated discharge temperature protection : an additional external discharge protection is required.

The additional discharge gas protection should be set to open at a maximum gas temperature of 135°C (275°F). A PT1000 is recommended.

This protection should be considered as a compressor safety device and its purpose is not to ensure map operation control.

The discharge gas thermostat or sensor must be attached to the discharge line within 150mm (5.91 inch) from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe (see Figure 20: Discharge Gas Temperature protection (DGT))

Figure 20: Discharge Gas Temperature protection (DGT)



1	Sensor
2	Discharge line
3	Bracket
4	Insulation

System evaluation

HP and LP must be monitored to respect operating envelope limitations.

Table 20: System evaluation

Advanced
• HP and LP sensor • Operating envelope limits integrated into control logic • Temperature measurement (monitoring by sensor)
Whole operating envelope limits integrated into control logic 

Manage superheat

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 the compressor.

Requirement

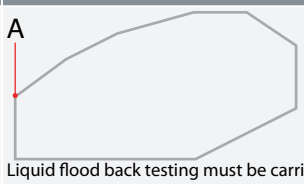
In steady state conditions the expansion device must ensure a suction superheat in accordance with the recommendation given by the superheat graph.

System evaluation

A liquid return test should be conducted in accordance with the following instructions:

Test, criteria and solutions

Table 21: Test, criteria and solutions

Test	Purpose	Test condition	Pass criteria	Solutions
Liquid flood back test	Steady-state	A  Liquid flood back testing must be carried out under expansion valve threshold operating conditions: • Lowest foreseeable evaporation, and highest foreseeable condensation. • Minimum number of compressor running.	Suction superheat >5K (9°F) and the oil superheat shall not be more than 60 sec below the safe limit defined in the Dilution Chart. (see Dilution Chart)	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 [1]
	Transient	Tests must be carried out with most unfavorable conditions : • fan staging, • compressor staging • …	Oil superheat shall not be more than 60 sec per hour below the safe limit defined in the Dilution Chart. (see Dilution Chart)	
Defrost test	Check liquid floodback during defrost cycle	Defrost test must be carried out in the most unfavorable conditions (at 0°C (32°F) evaporating temperature).	Oil superheat shall not be more than 60 sec per hour below the safe limit defined in the Dilution Chart. (see Dilution Chart)	1. Check defrost logic. 2. Add a suction accumulator Test, criteria and solutions

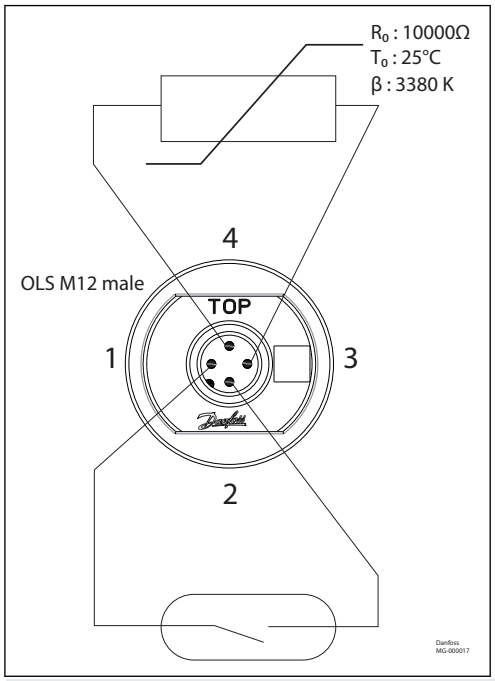
[1] Suction accumulator offers protection by trapping the liquid refrigerant upstream from the compressor. The accumulator should be sized at least 50 % of the total system charge. Suction accumulator dimensions can impact oil return (gas velocity, oil return hole size…), therefore oil return has to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

Oil temperature measurement

Oil temperature is a critical parameter for verifying correct compressor operation. In the dilution graph provided below, one of the required input values is the oil superheat.

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

Oil temperature can be accurately measured using the NTC sensor integrated in the Oil Level Switch (OLS).



Voltage range	0-26.4 VAC 50/60Hz 0-26.4 V DC
Maximum power	10 VA
Maximum current	0.5 A

Dilution Chart - PSG605-800

Figure 21: Dilution Chart R1234ze(E) / R515B

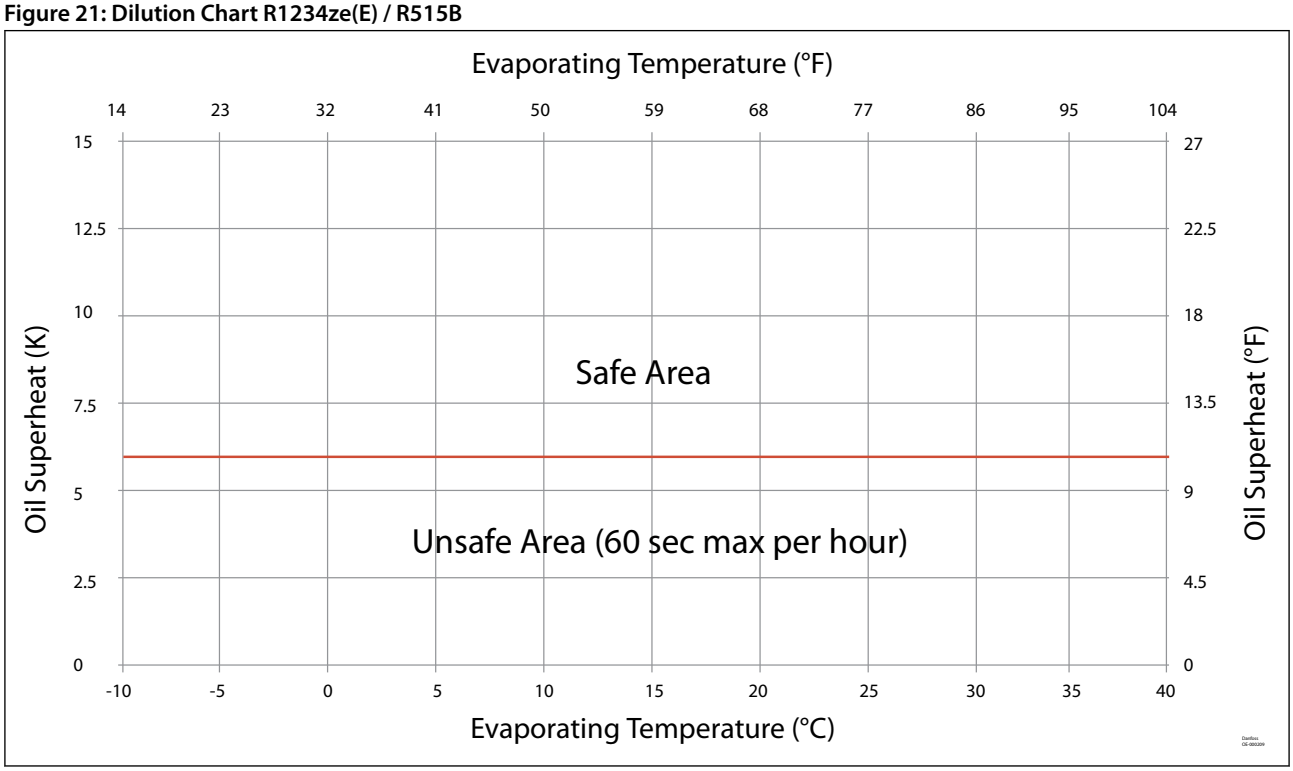
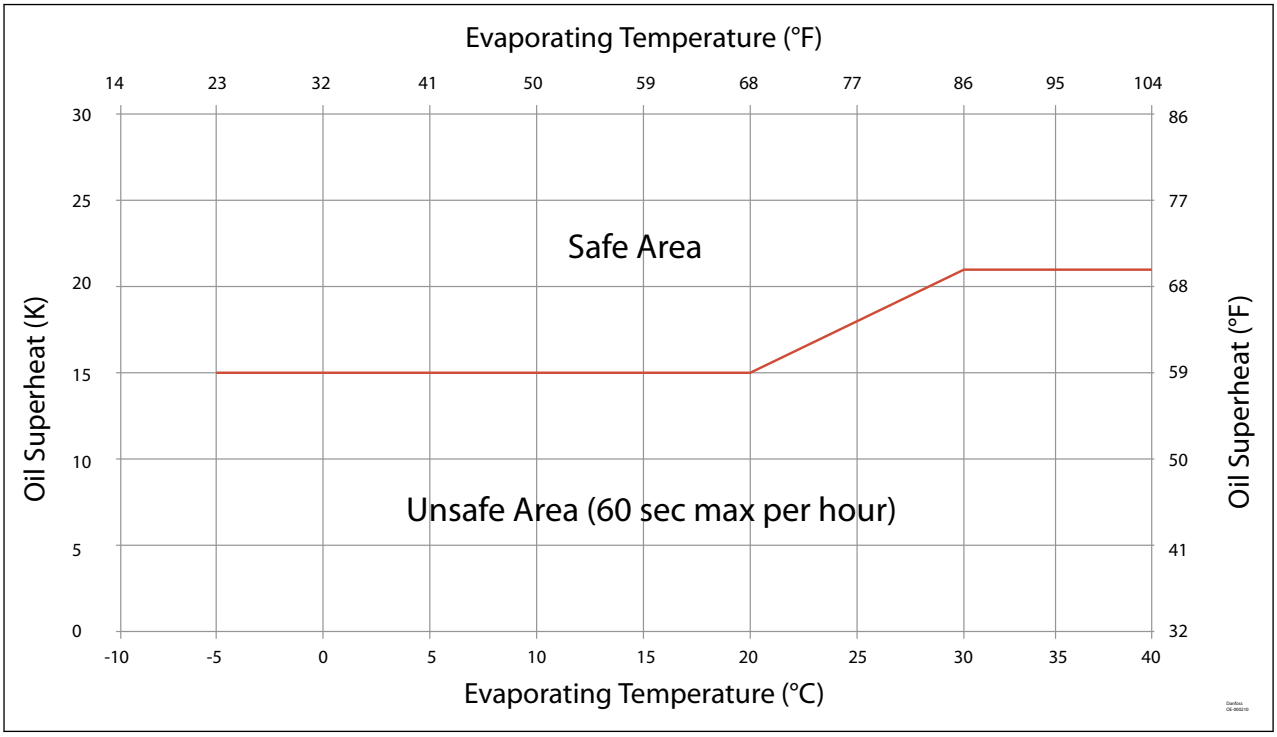


Figure 22: Dilution Chart R600a (reference at 20 °C / 68 °F ambient temperature)



Manage off cycle migration

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.

Table 22: System evaluation

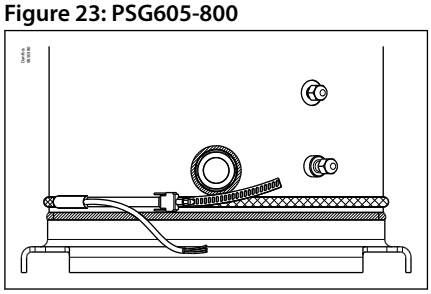
Application	BELOW charge limit	ABOVE charge limit
All	Ensure tightness between condenser & evaporator when system is OFF • Thermostatic expansion Valve (TXV), Liquid Line Solenoid Valve LLSV strongly recommended • Electronic expansion valve (EXV) must close when system stop including in power shut down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

Crankcase heater

The crankcase heater are designed to protect the compressor against off-cycle migration of refrigerant.

For PSG compressor the use of a belt heater 75W is recommended.

Figure 23: PSG605-800



The heater must be turned on whenever all the compressors are off. Crankcase heater accessories are available from Danfoss (see section Accessories and Spare parts).

Liquid line solenoid valve (LLSV)

A Liquid line solenoid valve (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 system:
- 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 0.2 bar(g) (2.9 psig). For more details on pump-down cycle see section Control logic.

Charge limits

Table 23: Charge limits for Single models

Models	Composition	Refrigerant charge limit			
		R1234ze(E)/R515B		R600a	
		kg	lbs	kg	lbs
PSG605	-	15	33	11	24
PSG800	-	15	33	11	24

Table 24: Charge limits for Tandem models

Models	Composition	Refrigerant charge limit			
		R1234ze(E)/R515B		R600a	
		kg	lbs	kg	lbs
PSG1210	PSG605+PSG605	25	55	17	36
PSG1600	PSG800+PSG800	34	75	24	53

Power supply and electrical protection

Wiring information

Requirements
- Protect the compressor from short circuit and overcurrent by a thermal magnetic motor circuit breaker set to Max. operating current or lower (see table in section Three phase electrical characteristics).
- PSG Compressors are delivered with a pre-installed motor protection module inside the terminal box that must be powered on.
- HP safety switch and electronic module relay output (M1-M2) must be wired in the safety chain. Other safety devices such as LP can be either hardware or software managed.
- Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (e.g. seasonal shutdown).

The wiring diagrams below are examples for a safe and reliable compressor wiring:

Figure 24: Compressor model PSG605

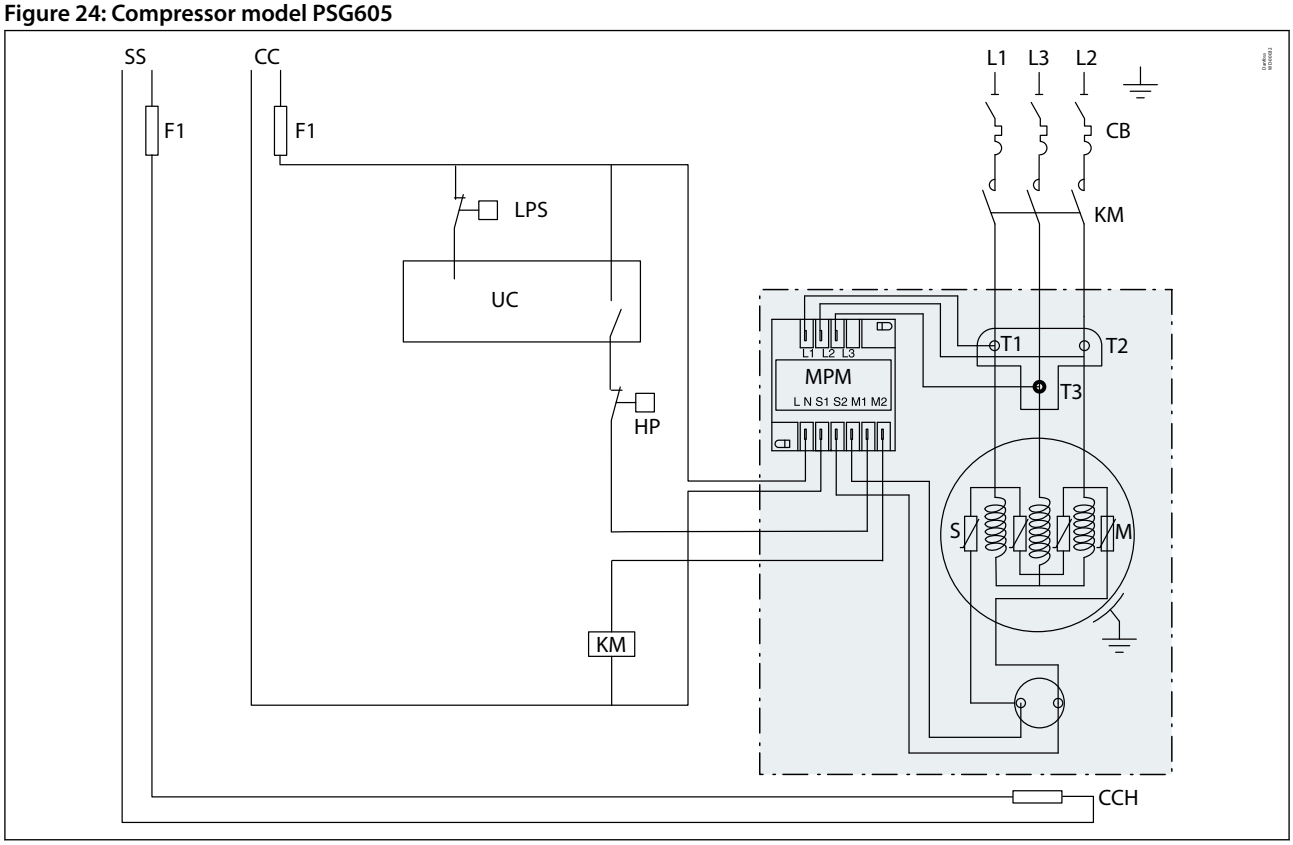
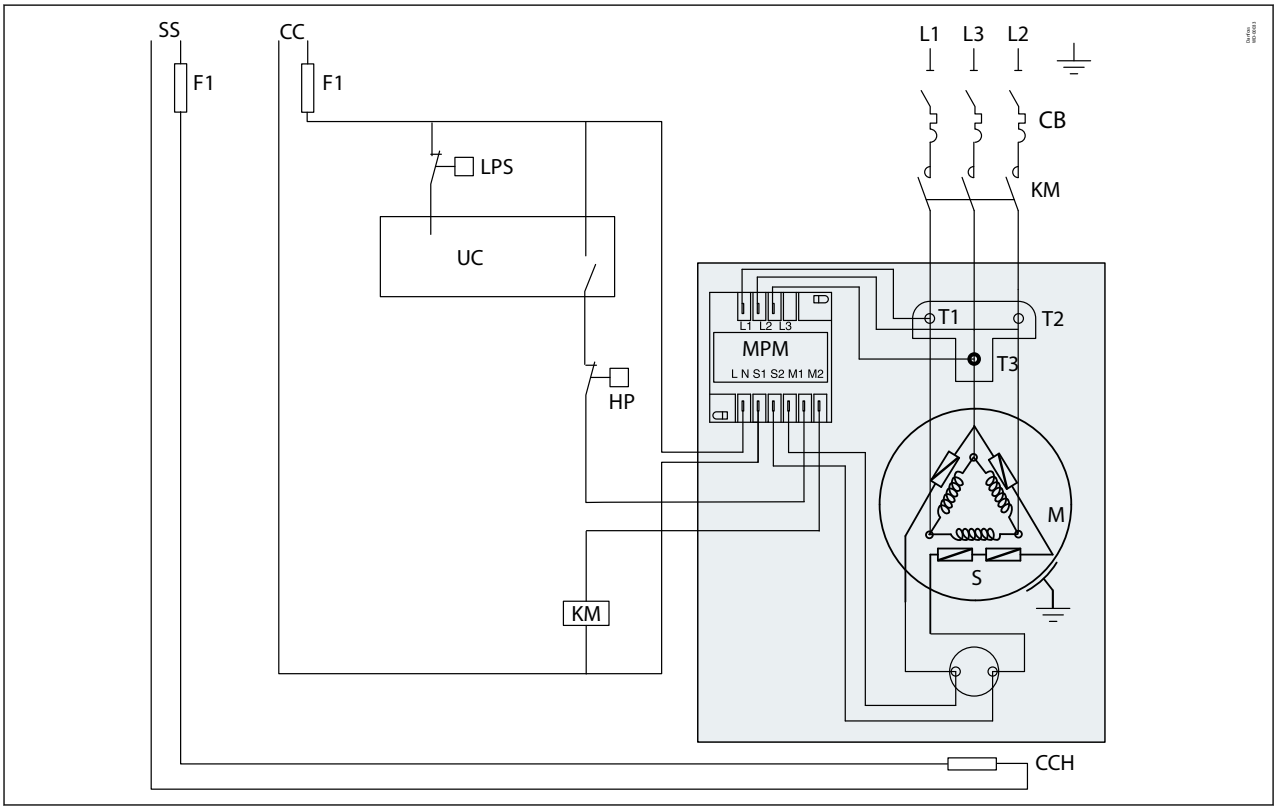


Figure 25: Compressor model PSG800



CB	Thermal magnetic motor circuit breaker	**LPS**	Safety pressure switch
CC	Control circuit	**M**	Compressor motor
CCH	Crankcase heater	**MPM**	Motor Protection Module
F1	Fuses	**S**	Thermistor chain (motor)
HP	High pressure safety switch		
KM	Compressor contactor		

Soft starts

Soft starters are designed to reduce the starting current of 3-phase AC motors. Soft starter must be set so compressor start-up time is always less than 0.5 seconds to ensure proper lubrication of compressor parts.

Ramp-down must be set to minimum to ensure proper discharge valve closing.

Make sure that the soft starter selected is compatible with R1234ze(E)/R515B/R600a refrigerants.

Control logic

Safety control logic requirements

Table 25: Safety control logic requirements

Safeties	Tripping conditions		Re-start conditions	
	Value	Time	Value	Time
HP safety 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.
Electronic module (Motor protection)	Contact M1-M2 opened			

Cycle rate limit requirements

Danfoss requires a minimum compressor running time of 2 minutes to ensure proper oil return and sufficient motor cooling.

Additionally, compressor must not exceed 12 starts per hour. 12 starts per hour must not be considered as an average, this is the maximum number of starts acceptable to keep a good regulation accuracy during low load.

Oil management logic recommendations

In some cases, oil management can be enhanced by control logic:

- If oil return test failed, a function can be integrated in control logic to run all compressors simultaneously during 2 minutes every hour in order to boost oil return. Time and delay can be fine-tuned by oil return test No.1 in section Manage oil in the circuit. During oil boost, pay special attention to superheat management to avoid liquid flood back.
- In trio system, after running long time in same state with 2 or 3 compressors, (1+2+3) or (1+2), (2+3) or (3+1), oil unbalance may appears. A function can be implemented in control logic to stop all compressors during one minute every two hours in order to balance oil. Time and sequence can be fine-tuned during Oil balancing test in section Manage oil in the circuit.
- The OLS can also assist in this process. A switch signal indicates the detected oil level is approaching a critical threshold, necessitating prompt action to restore normal levels and prevent compressor seizure.

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 last compressor of the circuit stops, suction presssure is decreased 0.5 bar (7 psi) below nominal evaporating pressure with minimum of 0.2 bar(g) (2.9 psig). Even if suction pressure increases again, the compressor will not restart.

Non Return Valve (NRV)

PSG compressors integrate tight internal non return valve (INRV), therefore no external Non Return Valve (NRV) is needed.

Reduce moisture in the system

Excessive air and moisture

- Can increase condensing pressure and cause 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

- The compressors are delivered with < 100ppm moisture level.
- At the time of commissioning, system moisture content may be up to 100ppm.
- During operation, the filter drier must reduce this to a level between 20 and 50ppm.

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 of compressors with polyolester oil, Danfoss recommends using the Danfoss DML (100% molecular sieve) solid core filter drier.

Assembly line procedure

Compressor storage

Store the compressor not exposed to rain, corrosive or flammable atmosphere between -35 °C (-31 °F) and 70 °C (158 °F) when charged with nitrogen and between -35 °C (-31 °F) and Ts max value (see section Pressure equipment directive 2014/68/EU) when charged with refrigerant

Compressor holding charge

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

Respect the following sequence to avoid discharge check valve gets stuck in open position:

- Remove the suction plug first
- Remove the discharge plug afterwards

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

Compressor handling and storage

Each Danfoss scroll compressor is equipped with two lift rings on the top shell.

Always use both these rings when lifting the compressor. Use lifting equipment rated and certified for the weight of the compressor. The use of a spreader bar rated for the lifting lugs spacing and the weight of the compressor is necessary to ensure better load distribution. The use of lifting hooks closed with a clasp and certified to lift the weight of the compressor is also highly recommended. Always respect the appropriate rules concerning lifting objects of the type and weight of these compressors. Maintain the compressor in an upright position during all handling manoeuvres (maximum of 15° from vertical).

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

Store the compressor not exposed to rain, corrosive or flammable atmosphere between -35°C and Ts value when charged with refrigerant and between -35°C and 70°C when charged with nitrogen.

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

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

Figure 26: Heavy

Figure 27: Correct

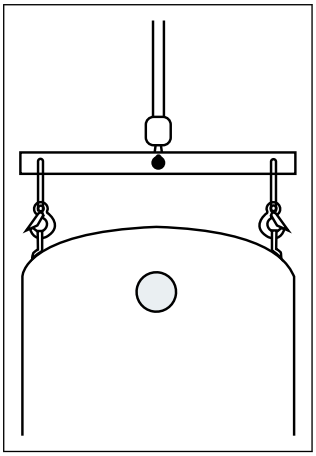
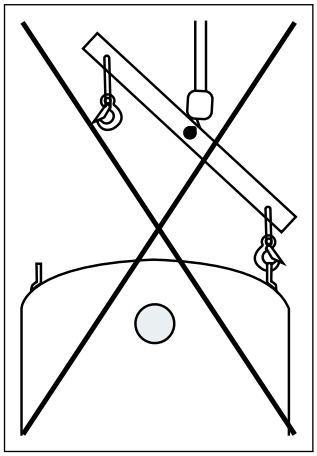


Figure 28: Incorrect



Piping assembly

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

Table 26: System cleanliness

Circuit contamination possible cause	Requirement
Brazing and welding oxides	During brazing, flow nitrogen through the system.
Particles and burrs	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 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. (A typical content of 30-40% Ag (Silver) is recommended by Danfoss)
- It is recommended to use double-tipped torch using acetylene to ensure a uniform heating of connection.
- For discharge connections brazing time should be less than 2 minutes to avoid NRVI damages if any.
- To enhance the resistance to rust, a varnish on the connection is recommended.

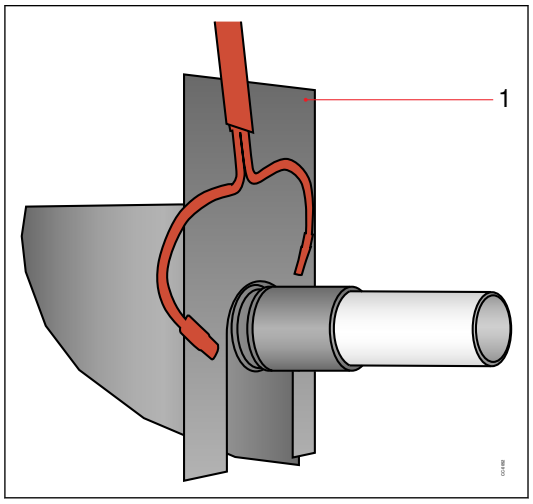
The compressor connectors are made of steel copper coated, which benefit to protect against corrosion and facilitate adhesion during brazing operation.

As per standards practice in the refrigeration industry, Danfoss Commercial Compressor recommend to use of **silver cadmium free solder** alloy and **flux** (added or flux coated rods). The significant silver content in these brazing alloy will help the brazing operation, providing an excellent fluidity and a limited heating temperature. It will bring also a

good resistance to corrosion, a proper elongation compatible with system vibration, and good behavior under thermal variation improving the strength of connection and limiting fractures and refrigerant leaks. (Crucial with A2L and A3 refrigerants).

A typical content of 30 – 40% Ag (Silver) is recommended by Danfoss.

The use of self-flux alloys (as phosphorous alloys) is not recommended by Danfoss. This type of brazing require a higher working temperature, that may overheat the connectors, damaging the thin layer of copper, resulting in phosphides creation and joint zone embrittlement.



1	Heat shield

For more detailed information see "Brazing technique for compressors connectors" AP192186420580.

R Before eventual un-brazing of the compressor or any system component, the refrigerant charge must be removed and the installation vacuumed.

System pressure test and leak detection

R 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 indicated in table below.

Table 27: Maximum compressor test pressures

Maximum compressor test pressures	
Maximum compressor test pressure high side (HP)	35.2 bar(g) / (510 psig)
Maximum compressor test pressure low side (LP)	16.7 bar(g) / (242 psig)
Maximum speed	4.8bar/sec (70 psi/s)

Vacuum evacuation and moisture removal

R 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 before evaporator, 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“ AP000086421422.

Dielectric strength and insulation resistance tests

Several tests have been performed on each compressor at the factory between each phase and ground.

- Dielectric strength test is done with a high potential voltage (hi-pot) of 2Un +1000V AC at least, and leakage current must be less than 5 mA.
- Insulation resistance is measured with a 500 V DC megohm tester and must be higher than 1 megohm.

Recommendations:

- Additional dielectric test is not recommended as it may reduce motor lifetime. Nevertheless, if such as test is necessary, it must be performed at a lower voltage.
- Insulation resistance test can be done.
- The presence of refrigerant around the motor windings will result in lower resistance values to ground and higher leakage current readings. Such readings do not indicate a faulty compressor. To prevent this, the system can be first operated briefly to distribute refrigerant.

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

Commissioning

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

The compressors are equipped with an electronic module: reverse rotation will be automatically detected. For more details refer to section Motor protection.

- **Voltage and voltage unbalance within tolerance**: For more details refer to section Motor voltage.

Initial start-up

- Crankcase heaters must be energized at least 6 hours in advance to remove refrigerant.
- A quicker start-up is possible by “jogging” the compressor to evacuate refrigerant. Start the compressor for 1 second, then wait for 1 to 2 minutes. After 3 or 4 jogs the compressor can be started. This operation must be repeated for each compressor individually.

System monitoring

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

- Correct superheat and subcooling.
- Current draw of individual compressors within acceptable values (max operating current).
- No abnormal vibrations and noise.
- Correct oil level.

If Oil Top-up is needed, it must be done while the compressor is idle. Use the schrader connector or any other accessible connector on the compressor suction line. Always use original Danfoss POE oil 320SZ from new cans. For more detailed information see “Lubricants filling in instructions for Danfoss Commercial Compressors” AP000086435866.

Dismantle and disposal

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

Packaging

Single pack

Table 28: Single pack

Compressor model	Length		Width		Height		Gross weight	
	mm	inch	mm	inch	mm	inch	kg	lbs
PSG605	750	29.5	750	29.5	1050	41.3	215	474
PSG800	750	29.5	750	29.5	1050	41.3	221	487

Industrial pack

Table 29: Industrial pack

Compressor model	Nbr[1]	Length		Width		Height		Gross weight		Static stacking pallets
		mm	inch	mm	inch	mm	inch	kg	lbs	
PSG605	4	1150	45.3	965	38	800	31.5	840	1851	2
PSG800	4	1150	45.3	965	38	800	31.5	870	1918	2

[1] Number of compressors per pack.

Ordering

Compressor code numbers

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

Single pack

Table 30: Single pack

Compressor model	Connections	Motor protection	Code no.
			4
			380-415/3/50 460/3/60
PSG605	Brazed	Module 24 V AC[1]	120H2511
	Brazed	Module 110 – 240 V[1]	120H2509
PSG800	Brazed	Module 24 V AC[1]	120H2515
	Brazed	Module 110 – 240 V[1]	120H2513

[1] Electronic motor protection, module located in terminal box.

NOTE:
Mounting kit for PSG605-800 single compressor applications: Ref 8156138.

Industrial pack

Table 31: Industrial pack

Compressor model	Connections	Motor protection	Code no.
			4
			380-415/3/50 460/3/60
PSG605	Brazed	Module 24 V AC[1]	120H2512
	Brazed	Module 110 – 240 V[1]	120H2510
PSG800	Brazed	Module 24 V AC[1]	120H2516
	Brazed	Module 110 – 240 V[1]	120H2514

[1] Electronic motor protection, module located in terminal box.

Accessories and spare parts

Motor protection modules

Table 32: Motor protection modules

Code no.	Description	Application	Packaging	Pack size
120Z0976	Electronic motor protection module, 24 V AC	PSG605-800	Single pack	1
120Z0977	Electronic motor protection module, 110/240 V	PSG605-800	Single pack	1

Crankcase heaters

Table 33: Crankcase heaters

Code no.	Description	Application	Packaging	Pack size
7773108	Belt type crankcase heater,75W,230V,CE & UL	PSG605-800	Multipack	6
7973005	Belt type crankcase heater,75W,230V,CE & UL	PSG605-800	Industry pack	50
7773118	Belt type crankcase heater,75W,400V,CE & UL	PSG605-800	Multipack	6
120Z0464	Belt type crankcase heater,75W,460 V,CE & UL	PSG605-800	Multipack	6
120Z0870	Belt type crankcase heater,75W, 24 V,CE & UL	PSG605-800	Multipack	6

Mounting hardware and gas restrictor kit

Table 34: Mounting hardware and gas restrictor kit

Code no.	Description	Application	Packaging	Pack size
120Z0884	Tandem hardware: Solid grommets, sleeve, spacers,washers Gas restrictor 2"1/8 - D31	PSG tandems	Single pack	1

Lubricant

Table 35: Lubricant

Code no.	Description	Packaging	Pack size
7754121	320SZ POE lubricant, 1 litre can	Multipack	12
120Z0572	320SZ POE lubricant, 2.5 litre can	Multipack	4

Terminal boxes, covers and T-block connectors

Table 36: Terminal boxes, covers and T-block connectors

Code no.	Description	Application	Packaging	Pack Size
120Z0458	Terminal box 210 x 190 mm, incl. cover	PSG605-800	Single pack	1
120Z0774	T block connector 80x80 mm	PSG605-800	Multipack	10

Oil level switch

Table 37: Oil level switch

Code no	Description	Application	Packaging	Pack size
120Z0970	Kits OLS 24V	PSG605-800	Single pack	1

Miscellaneous

Table 38: Miscellaneous

Code no.	Description	Packaging	Pack Size
8156019	Sight glass with gaskets (black & white)	Multipack	4
8156129	Gasket for oil sight glass, 1"1/8 (white teflon)	Multipack	10
7956005	Gasket for oil sight glass, 1"1/8 (white teflon)	Multipack	50
8154001	Danfoss Commercial Compressors blue spray paint	Single pack	1

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