ENGINEERING
TOMORROW

Application Guide

Scroll compressors
PSH065 and **PSH105**

50Hz-R410A

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.

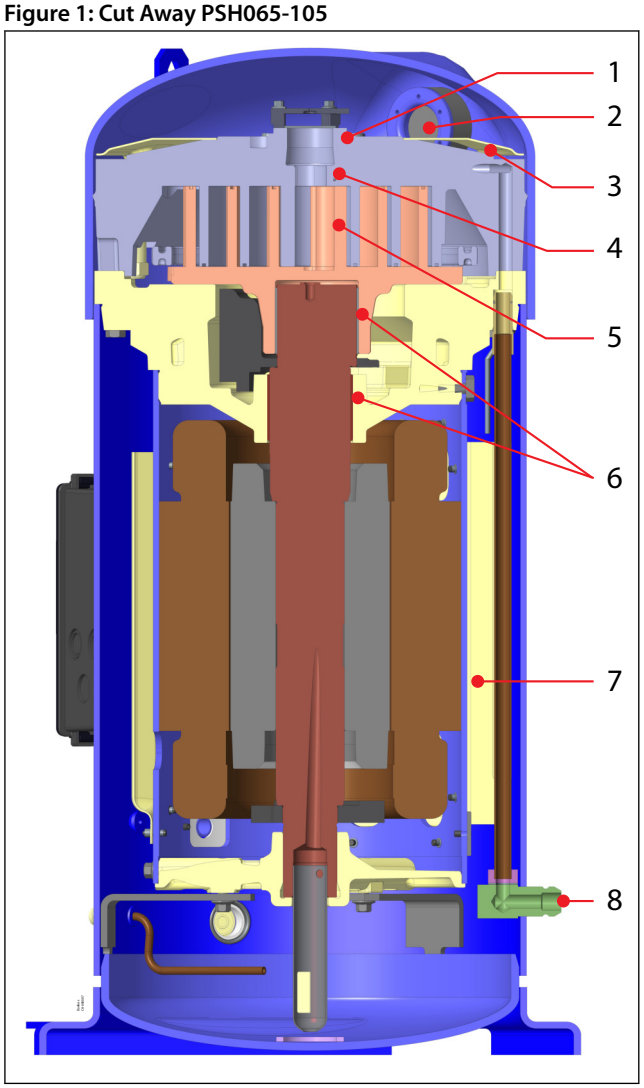
The purpose of this guideline is to help customers qualify compressors in the unit. You are strongly advise to follow these instructions. For any deviation from the guidelines, please contact Danfoss Technical Support. In any case, Danfoss accepts no liability as a result of the improper integration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

Introduction

Product description

Danfoss PSH065-105 compressor is optimized for heat pump application. Moreover, it benefits from an improved design to achieve the highest efficiency and increased life time.

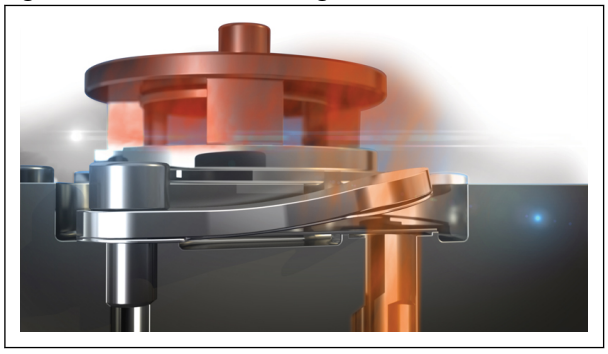
Figure 1: Cut Away PSH065-105



1	Intermediate discharge valves (IDVs) increase seasonal efficiency
2	Internal Non Return Valve (INRV) prevents excessive leak rate from high pressure side
3	Heat shield lowers the heat transfer between discharge and suction gas and the acoustic level
4	Integrated discharge gas temperature protection (DGT)
5	Built in pressure ratio optimization dedicated to heat pump application
6	Lead free polymer bearings improve behavior under poor lubrication conditions
7	Patented gas path flow with gas intake design induce higher resistance to liquid slugging
8	Injection port to both enlarge the application envelope and improve efficiency

How do IDVs work?

Figure 2: Intermediate Discharge Valve (IDV)



Danfoss Intermediate Discharge Valves (IDVs) are located close to the discharge side of the compressor. They reduce excessive compression of refrigerant under part-load conditions while maintaining the same cooling capacity. The IDVs open when discharge pressure falls below the built-in optimization point. They adapt the effort of the motor to the varying load and pressure conditions in the system, thus reducing the effort of the motor and its electrical consumption and improving the system's seasonal energy efficiency.

Injection system

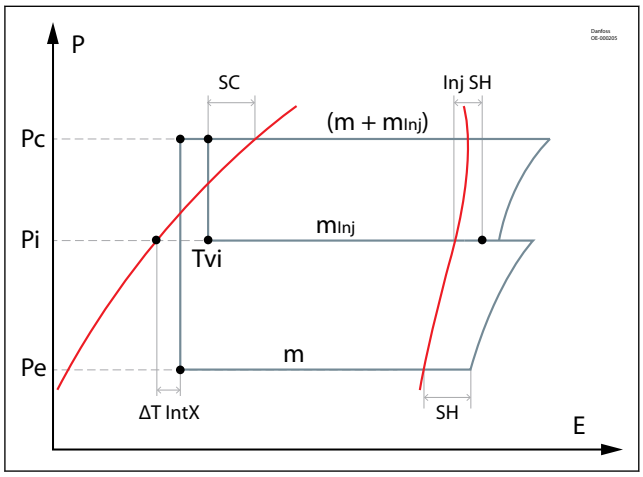
Vapor injection

The PSH065-105 compressor is fitted with an injection port that enables to carry out vapor injection by connecting an intermediate exchanger.

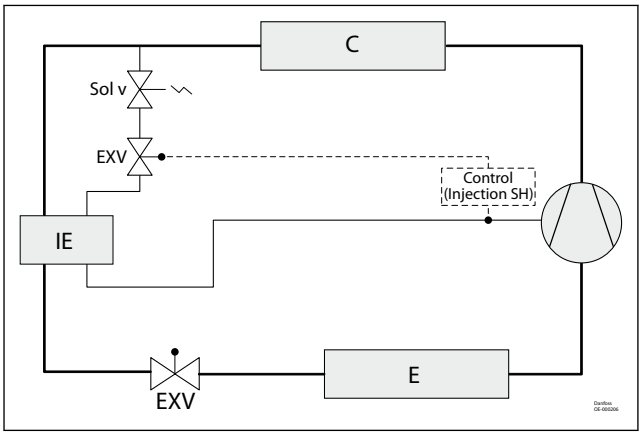
This vapor injection will have three benefits:

- Operating envelope enlargement by reduction of resulting discharge temperature.
- Cooling capacity and cooling efficiency improvement by reduction of the liquid temperature before expansion (Intermediate exchanger acting as economizer).
- Heat capacity and heating efficiency improvement by increase of the massflow at the condenser side (condenser massflow will be the sum of the evaporator massflow and the injected massflow).

The diagrams below explain the vapor injection principle, considering:
m inj: Injected massflow
ΔT IntX: Difference of temperature between the outlet of intermediate exchanger and the intermediate pressure bubble point.
Suct SH: Superheat at compressor suction.
Inj SH: Superheat of injected gas (at intermediate pressure).
SC: Subcooling at intermediate exchanger inlet.
For system with vapor injection we should also consider, in addition of the suction superheat and the condenser subcooling, the injection superheat and Intermediate exchanger DeltaT as key influent parameters on the compressor performance.



P	Pressure
E	Enthalpy



C	Condenser
E	Evaporator
IE	Intermediate Exchanger

The injection massflow must be regulated through an EXV piloted by the injection superheat which must be above 5 K.

It is recommended to install an additional solenoid valve on the injection line to prevent the refrigerant to come back directly into the compressor scroll set in case of power shortage.

The vapor injection must not be activated during inversion cycles (cooling mode and defrost)

Wet injection

Whenever the vapor is no longer enough to cool the scroll and the application requires more envelope then the controller must reduce the injection SH down to zero and control the injection by reading the compressor DGT. This part is called wet (to differentiate from liquid). There is no gain in efficiency and capacity, only envelope. Considering the distance between sensor and scroll set, the wet injection is activated for when discharge temperature exceeds 121°C (250°F) at the measurement point (the surface of discharge pipe with 40mm away from the compressor discharge port). A minimum 4K (7.2°F) subcooling is necessary to ensure correct wet injection.

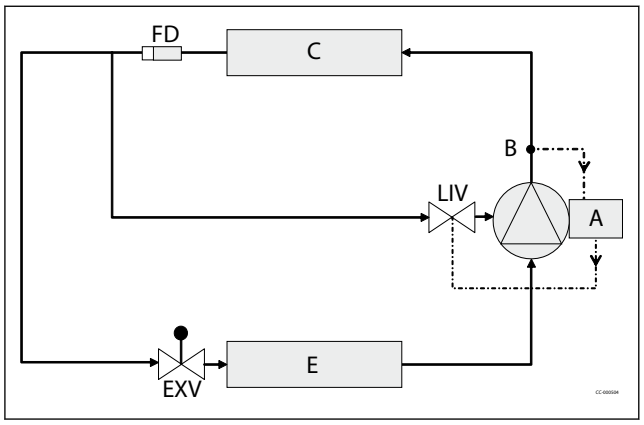
Liquid injection

Danfoss PSH065-105 requires liquid injection to maintain sufficiently low discharge gas temperature in the operating envelope. The PSH065-105 compressors are provided with a liquid injection connection.

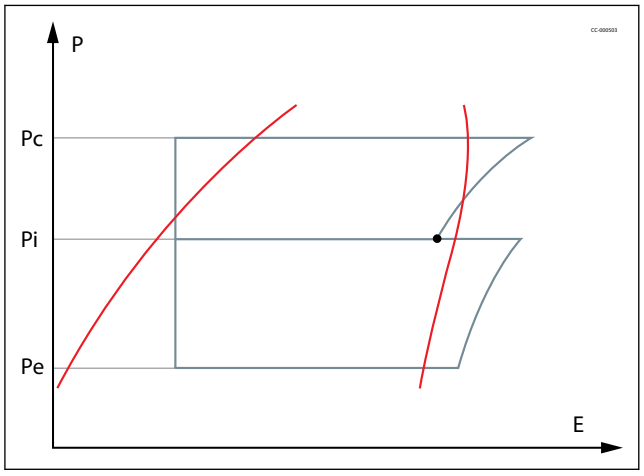
The compressor's liquid injection port should be connected to the system main liquid line after condenser & filter drier. The liquid phase refrigerant is directly injected into the compressor scroll set. Liquid refrigerant vaporize in the scroll and absorb the heat, result in cooling down the compressor's discharge temperature.

A LIV (Liquid Injection Valve) is needed to control the liquid injection mass flow, keep the constant compressor discharge gas temperature. The LIV's liquid injection regulation is based on the discharge gas temperature measured via temperature sensor located on discharge line. Considering the distance between sensor and scroll set, the liquid injection is activated for when discharge temperature exceed 121°C (250°F) at the measurement point (the surface of discharge pipe with 40mm away from the compressor discharge port).

A minimum 4K (7.2 °F) subcooling is necessary to ensure correct liquid injection.



FD	Filter drier
A	Control
B	Discharge T sensor
C	Condenser
E	Evaporator



P	Pressure
E	Enthalpy

Product identification

Name Plate

Figure 3: 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.

Family, lubricant & refrigerant	Nominal capacity	Approvals	Voltage	Version	Evolution index
PSH	**105**	**A**	**8**	**VB**	**A**

Family, lubricant & refrigerant
PSH: Heat pump optimized scroll, POE lubricant, for R410A

Nominal capacity
in kW at 50 Hz with R410A and at condition:
-7°C /50°C Superheat 5K /
Sub cooling 5K (w/o injection)

Motor index

Motor voltage code
8: 380V/3~/50 Hz

Evolution index
A~Z

Motor protection
B: Electronic module, 110-240V

Options
V: Vapor Injection (single version)
M: Vapor Injection (manifolding version)

(No control logic and
no injection valve included)

Compressors serial number

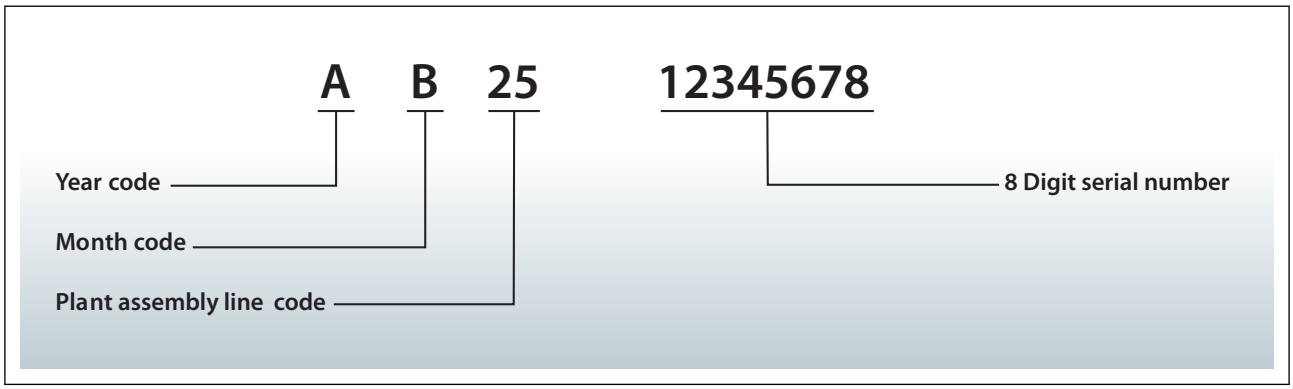


Table 1: Serial number code legend table

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

Pressure requirement

Products	PSH065/105
Maximum/Minimum temperature - Ts	-35°C < Ts < 52°C
Maximum allowable pressure (Low side) - Ps	31.1 bar(g)

Internal free volume

Products	Internal free volume without oil (liter)		
	Low pressure side	High pressure side	Total
PSH065	27.1	2.8	29.9
PSH105	28.2	3.8	32

Operating envelope data

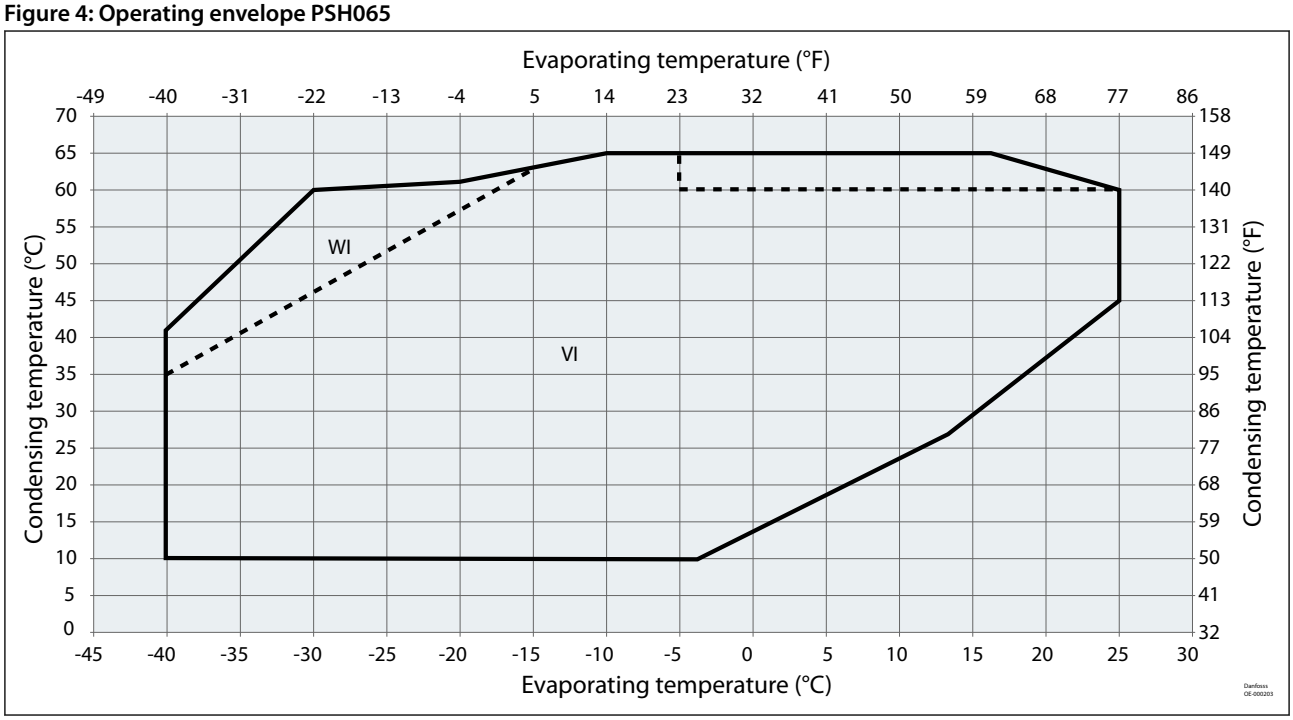
The operating envelope for PSH065/105 compressors is given in the figures below and guarantees reliable operation of the compressor for steady-state and transient operation.

In every instance, the discharge temperature must be kept below 135°C.

Steady-state operation envelope is valid for a suction superheat within 5K range at nominal Voltage

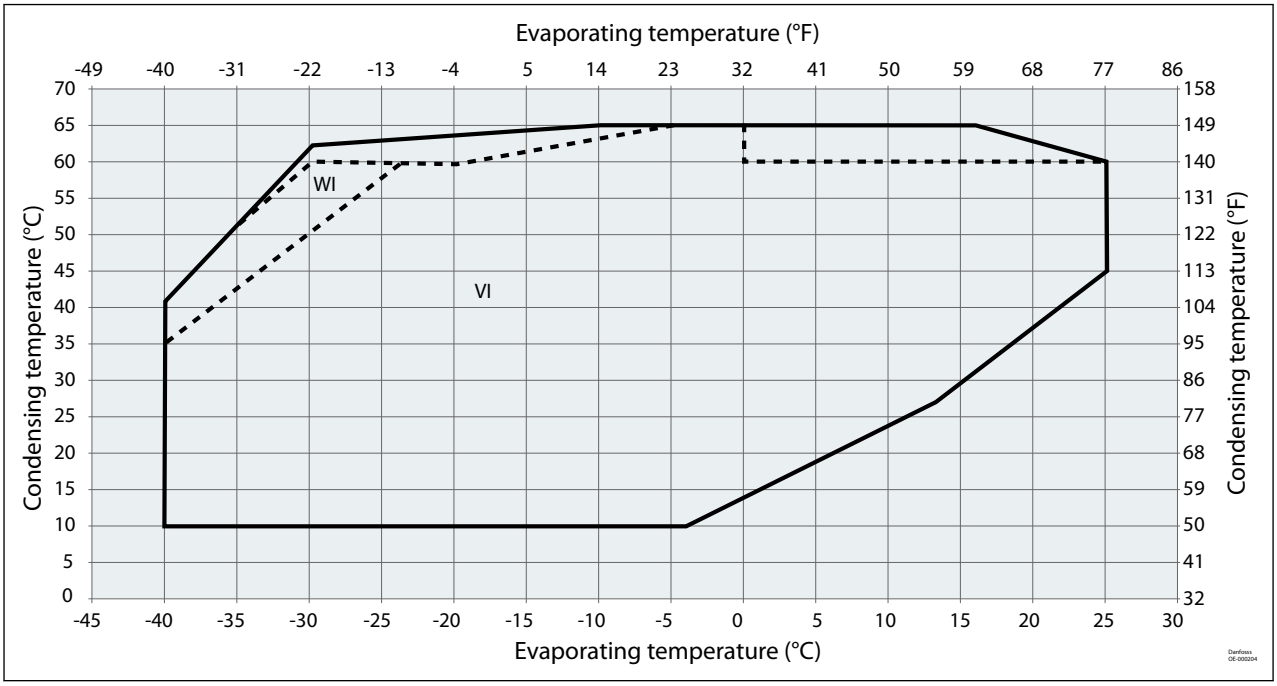
Operating envelope

Figure 4: Operating envelope PSH065



- - - -	WI &VI Envelop
———	LI & No LI Envelop

Figure 5: Operating envelope PSH105



- - - -	WI &VI Envelop
———	LI & No LI Envelop

Pressure settings

Pressure settings		PSH065/105
Working range high side	bar(g)	9.9 – 41.7
Working range low side	bar(g)	0.8 - 15.5
Maximum high pressure safety switch setting	bar(g)	43.1
Minimum low pressure safety switch setting	bar(g)	0.6

Dimensions

Single compressors

Figure 6: PSH065

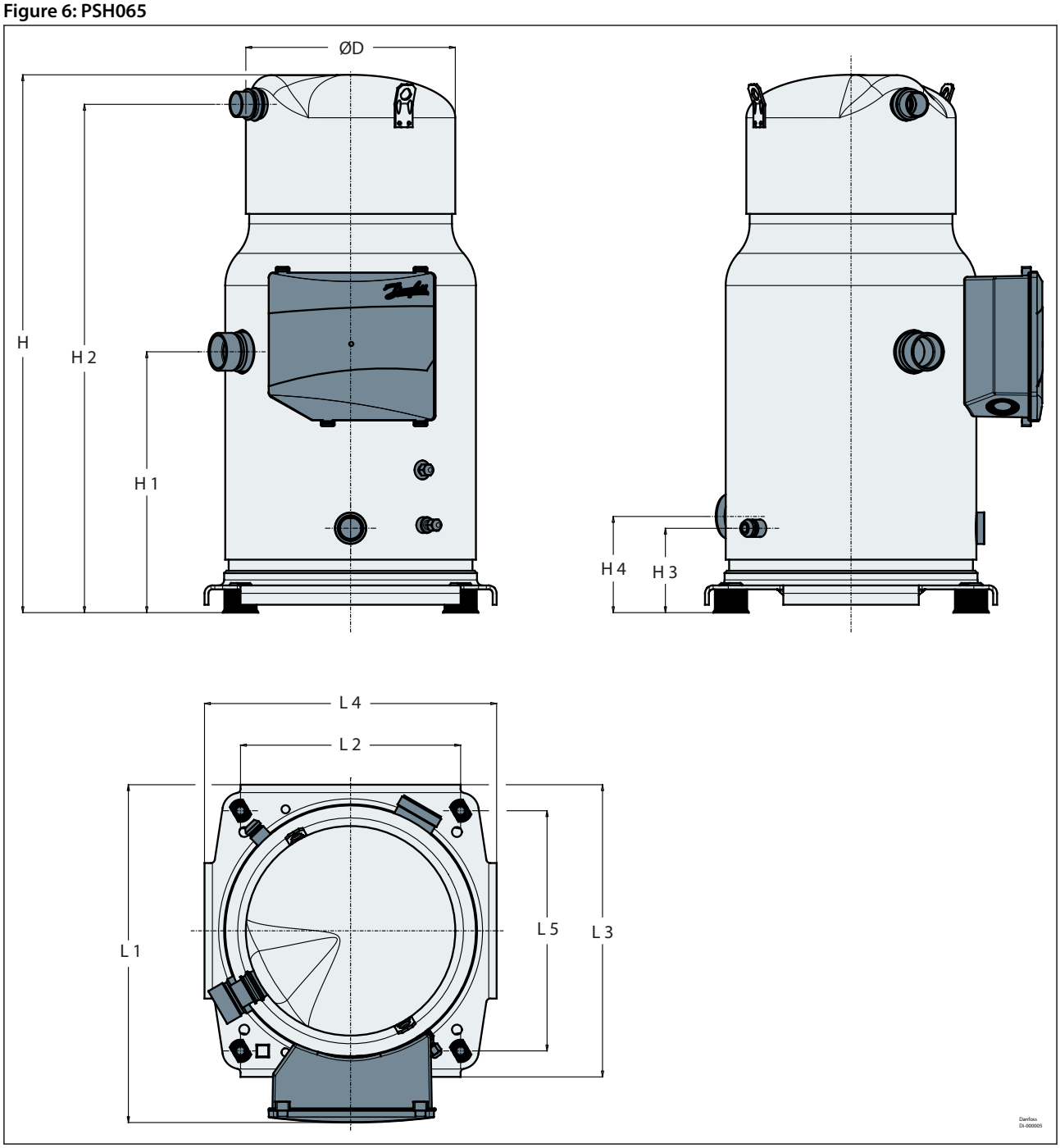
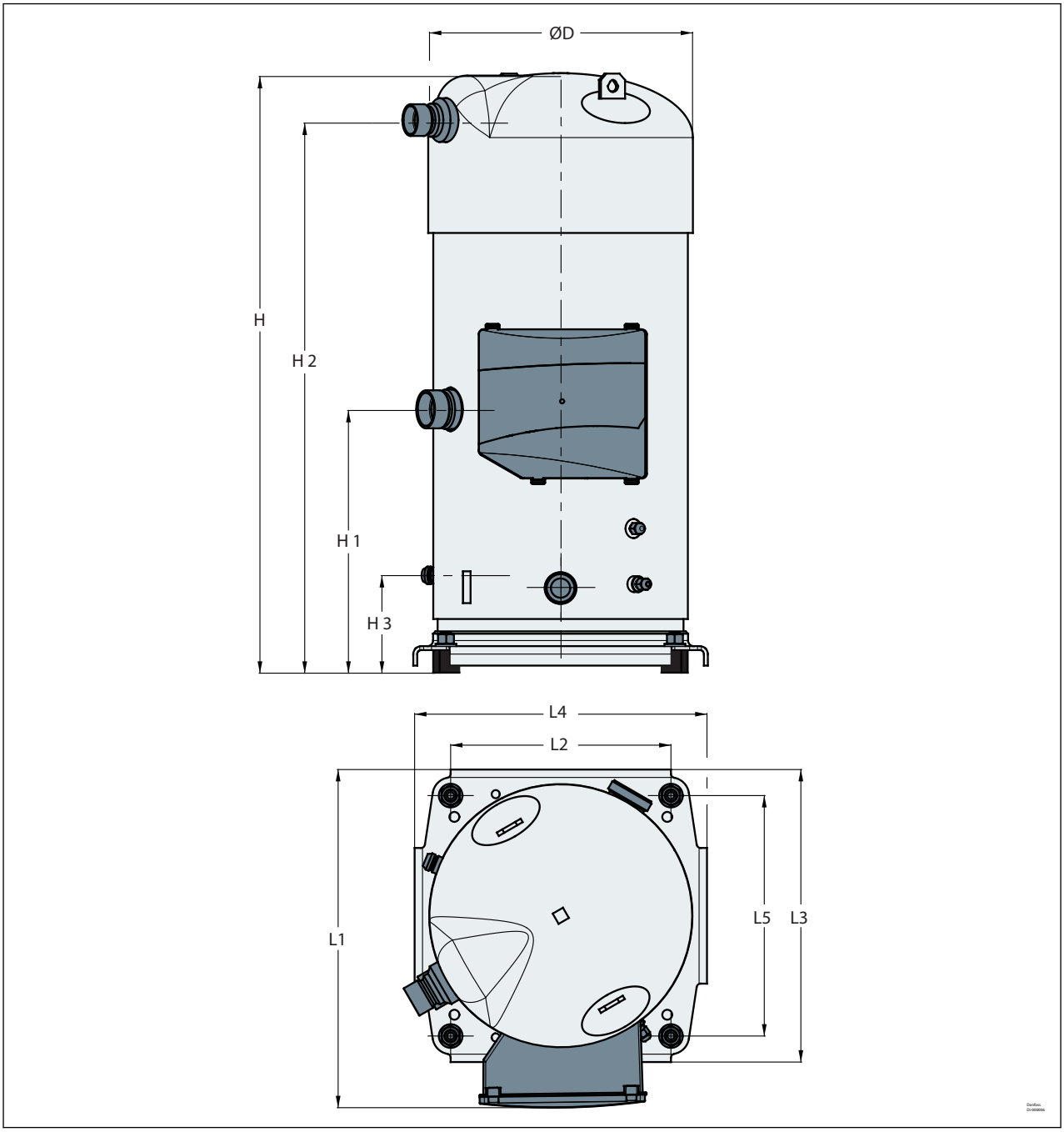


Figure 7: PSH105



Compressor model	D (mm)	H (mm)	H1 (mm)	H2 (mm)	H3 (mm)	H4 (mm)	L1 (mm)	L2 (mm)	L3 (mm)	L4 (mm)	L5 (mm)	Outline drawing number
PSH065 Single version	265.9	682.5	331	645	107	-	429	279.4	371	370.8	305	8556305
PSH065 manifolding version	265.9	682.5	331	645	107	122	429	279.4	371	370.8	305	8556341
PSH105	333	755.5	332.5	696.5	123.5	-	429	279.4	371	370.8	305	8556300

Technical specifications

Table 2: 50Hz data

Model	Swept volume	Displacement[1]	Oil charge	Net weight[2]
	cm^3/rev	m^3/h	dm^3	kg
PSH065	272.8	47.5	6.1	117
PSH105	442.6	77	6.1	179

[1] Displacement at nominal speed: 2900rpm at 50Hz
[2] net weight with oil charge

Table 3: With vapor injection performance

Model	Conditions						Nominal heating capacity	Power input	Heating COP
	Evap temp	Cond temp	ΔT intX	Suction Superheat	Injection Superheat	Subcooling			
	°C	°C	K	K	K	K	W	W	W/W
PSH065	-8	58	5	10	5	5	70994	25795	2.8
	-7	50	5	10	5	5	73075	21686	3.4
PSH105	-8	58	5	10	5	5	116701	42141	2.8
	-7	50	5	10	5	5	119793	35747	3.4

Table 4: Without vapor injection performance

Model	Conditions				Nominal cooling capacity	Power input	Cooling Evap temp Cond temp Suction COP
	Evap temp	Cond temp	Suction Superheat	Subcooling			
	°C	°C	K	K	W	W	W/W
PSH065	3	50	10	5	62100	20065	3.1
PSH105	3	50	10	5	101574	32740	3.1

Mechanical connections

Connection details

Figure 8: PSH065

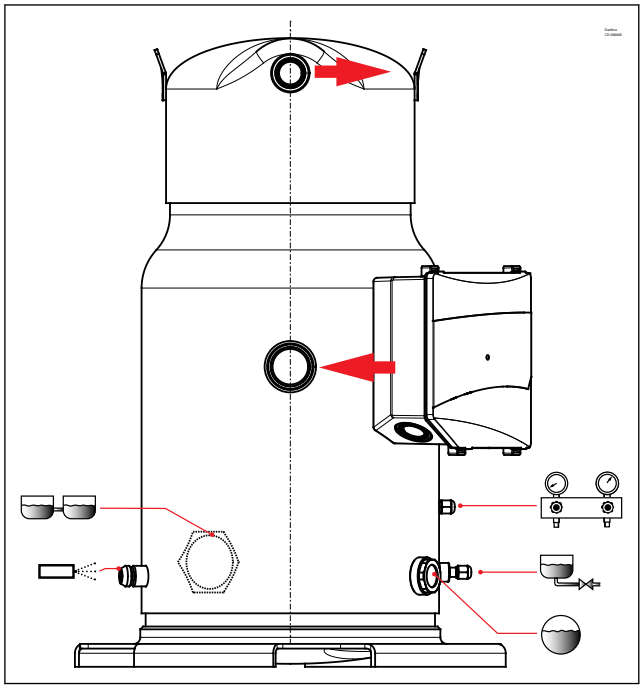
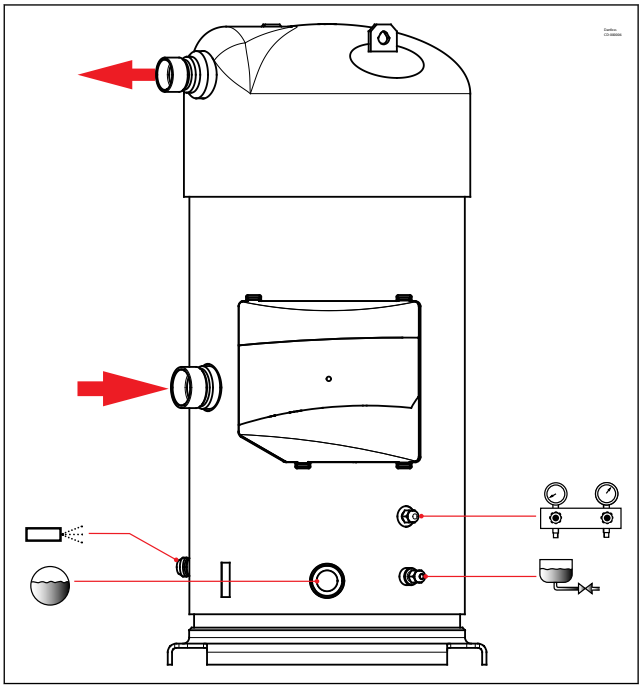


Figure 9: PSH105



Connection Details		PSH065 Single	PSH065 Manifolding	PSH105
Suction connection		Brazed 1"5/8	Brazed 1" 5/8	Brazed 1" 5/8
Discharge connection		Brazed 1"1/8	Brazed 1" 1/8	Brazed 1" 3/8
Oil sight glass		None	Threaded (1"1/8 - 18 UNEF)	Threaded (1"1/8 - 18 UNEF)
Oil equalization connection		None	Rotolock 2" 1/4	Rotolock 2" 1/4
Oil drain connection		None	Male ¼" Flare incorporating a Schrader valve	
Low pressure gauge port (Shrader)		None	Male ¼" Flare incorporating a Schrader valve	
Injection connection		3/8" ODF	3/8" ODF	1/2" ODF

Design compressor mounting

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

Mounting of PSH065

Compressors PSH065 is delivered with rubber grommets and steel mounting sleeve used to isolated the compressor from the base frame.

The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The required bolt size for the PSH065 compressors is HM8-55. This bolt must be tightened to a torque of 21Nm.

Figure 10: Rubber grommets from kit

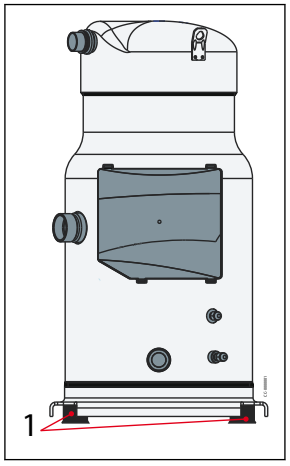
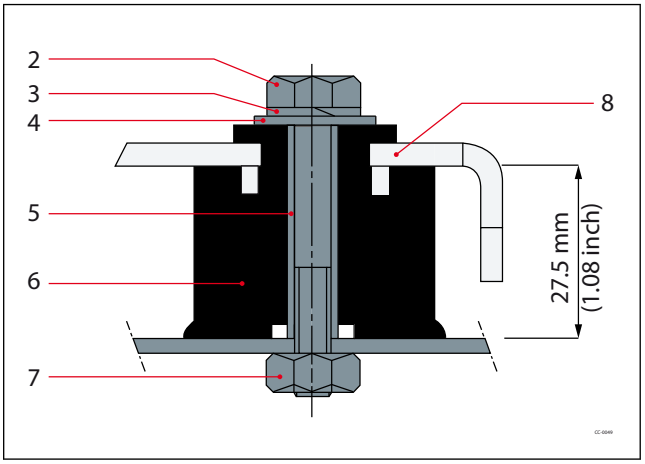


Figure 11: Rubber grommets



1	Rubber grommets from kit	**5**	Steel mounting sleeve
2	HM 8 bolt	**6**	Rubber grommet
3	Lock washer	**7**	Nut
4	Flat washer	**8**	Compressor base plate

Mounting of PSH105

Compressors PSH105 is delivered with rigid grommets used to isolated the compressor from the base frame.

The M16 nut must be tightened to a torque of 55 Nm. The HM8 bolt must be tightened to a torque of 16Nm.

Figure 12: Rigid grommets from kit

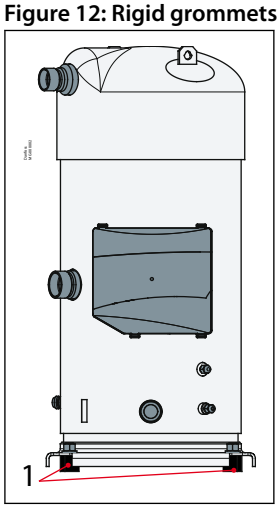
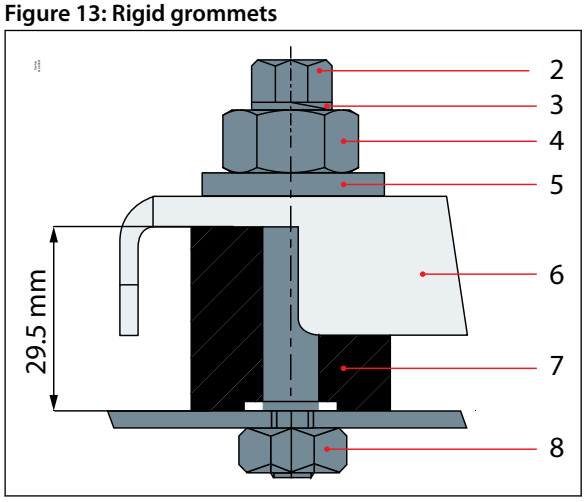


Figure 13: Rigid grommets



1	Rigid grommets	**5**	Flat washer
2	HM 8 bolt	**6**	Compressor baseplate
3	Lock washer	**7**	Rigid spacer
4	M16 Nut	**8**	M8 Nut

Design piping

General requirements

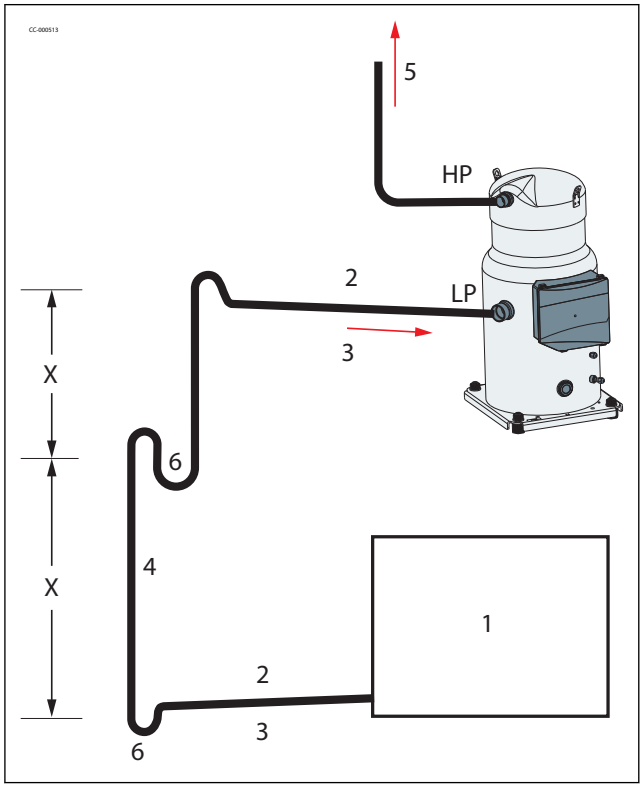
Proper piping practices should be employed to:

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.

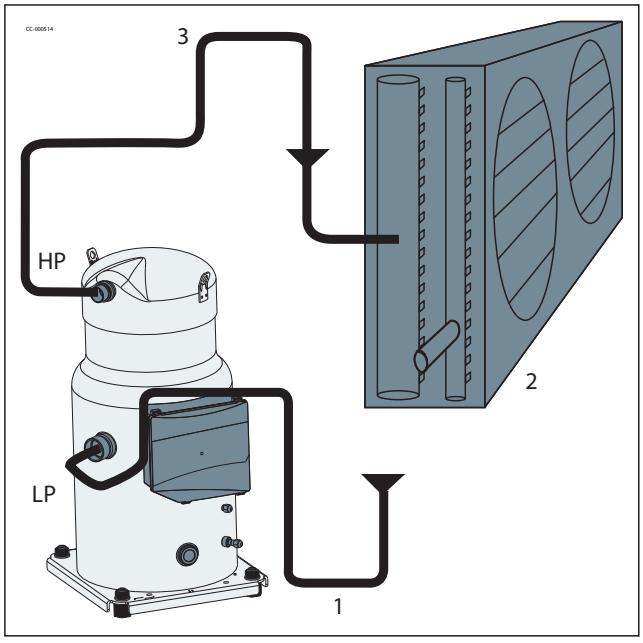
General recommendations are described in the figures below:

Figure 14: Suction lines



1	Evaporator
2	0.5% slope
3	4 m/s (13 ft/s) or more
4	8 – 12 m/s (26 – 40 ft/s)
5	To condenser
6	U-trap, as short as possible
X	Max. 4 m (13 ft)

Figure 15: Discharge lines



1	3D flexibility
2	Condenser
3	Upper loop

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 Manage sound and vibration.

Electrical connections

Motor voltage

Table 5: Motor voltage for 50 Hz

Motor voltage code	Code 8
Nominal voltage	380 V - 3ph
Voltage range	342 – 418 V

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.

Wiring connections

For PSH065, electrical power is connected to the compressor terminals by Ø 4.8 mm (3/16") screws. For PSH105,electrical power is connected to the compressor terminals by M5 studs and nuts.. The maximum tightening torque is 3 Nm. Use a 1/4" ring terminal on the power leads.

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.

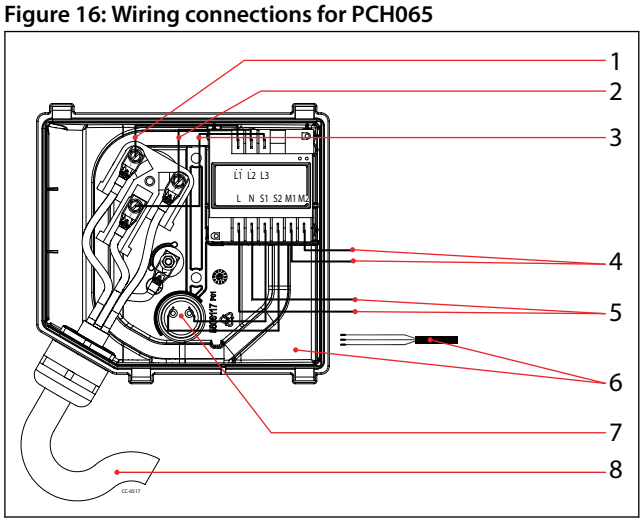
The 3 power supply knockouts accommodate the following diameters:

- 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 16: Wiring connections for PCH065



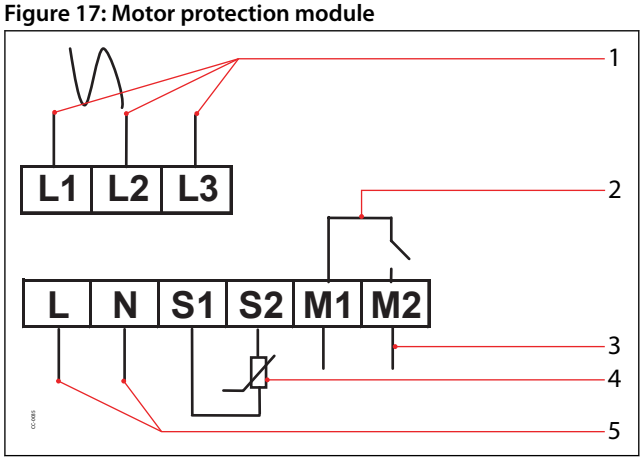
1	Black
2	Blue
3	Brown
4	M1, M2 Control circuit
5	Module power supply
6	Sump heater
7	Faston 1/4" tabs
8	Power supply

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 17: Motor protection module



B1	Black
B2	Blue
B3	Brown
1	Phase sequence input
2	Internal control contact
3	Safety circuit
4	Thermistor connection
5	Module power

IP rating

The compressor terminal box according to IEC529 is IP54 for all models when correctly sized IP54 rated cable glands are used.

First numeral, level of protection against contact and foreign object
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 6: Motor voltage code 8 (380 V / 3ph / 50 Hz)

Compressor models	LRA	Max. operating current	Winding resistance
	A	A	Ω
PSH065	250	56	0.496
PSH105	349	91	0.285

LRA (Locked Rotor Amp)

Locked Rotor Amp value is the highest average current 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).

MOC (Maximum Operating Current)

The max. operating current is the current when the compressors operate at maximum load conditions and within the voltages printed on the nameplate (max. evaporating temperature and max. condensing temperature). Max Oper. A can be used to select cables and contactors. In normal operation, the compressor current consumption is always less than the Max Oper. A. value.

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 with 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

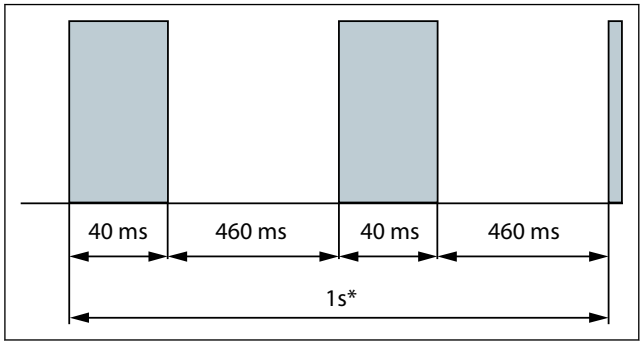
Compressor PSH065-105 is delivered with a pre-installed motor protection module inside the terminal box. This device provides efficient and reliable protection against overheating and overloading as well as phase loss/reversal.

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 (4500 Ω) and the output relay then trips – i.e. contacts M1-M2 are open.

After cooling to below the response temperature (resistance < 2750 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.

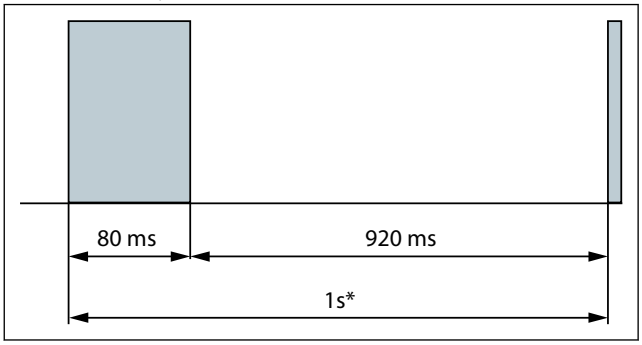
A red/green twin LED is visible on the module. A solid green LED denotes a fault free condition. A blinking red LED indicates an identifiable fault condition:

Figure 18: PTC Overheat



*	approx. 1 second

Figure 19: Delay timer active (after PTC over temp.)



*	approx. 1 second

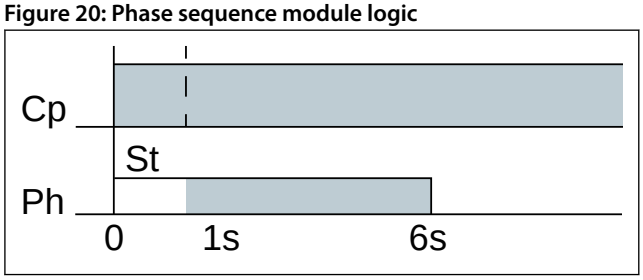
Phase sequence and reverse rotation protection

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 PSH065/105 is 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).

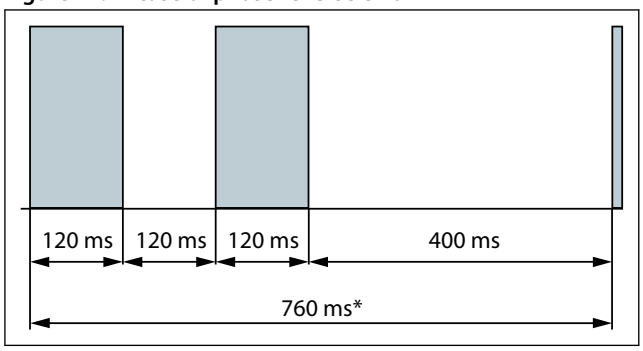
Figure 20: Phase sequence module logic



Cp	Compressor
Ph	Phase monitoring
St	start

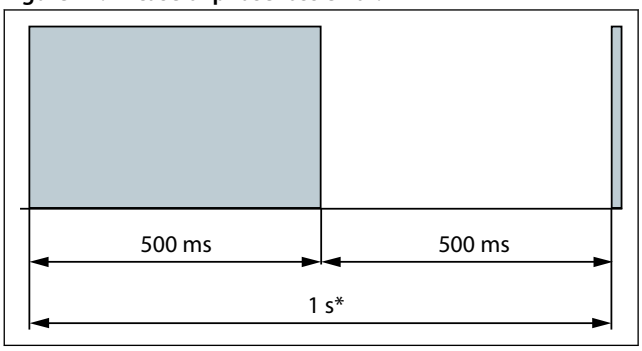
Should one of these parameters be incorrect, the relay would lock out (contact M1-M2 open). The red LED on the module will show the following blink code:

Figure 21: In case of phase reverse error



*	Approximate

Figure 22: 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" FRCC.PI.031.

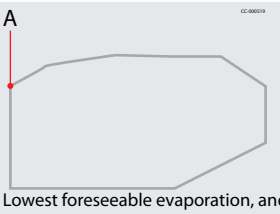
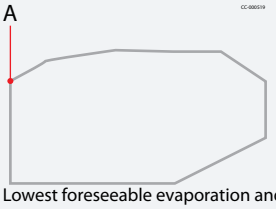
Application

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.

Test, criteria and solutions

Test No.	Purpose	Test conditions	Pass criteria	Solutions
1	Check proper oil return	A  Lowest foreseeable evaporation, and highest foreseeable condensation. **Minimum number of compressor** running for 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 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	A  Lowest foreseeable evaporation and highest foreseeable condensation and nominal capacity condition for tandem 2 compressors running for 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 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")

Manage sound and vibration

Manage sound and vibration General

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 as follows:

- For compressors running alone:

Table 7: Compressor sound radiation

Compressor model	Composition	50 Hz
		Sound power dB(A)
PSH065	–	85
PSH105	–	89
PSH130E	2XPSH065	88

Sound power and attenuation are given at conditions -7/50/5/5, measured in free space. Maximum sound is +3dB(A)

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.

Mechanical vibrations

A compressor generates vibrations that propagate into the surrounding parts and structure. The vibration level of the PSH065/105 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.

Mitigations 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, piping and frame must have natural frequencies as far as possible from running frequency (50Hz). Solutions to change natural frequencies are to work on structure stiffness and mass (brackets, metal sheet thickness or shape…).

Gas pulsation

PSH065/105 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.

Manage operating envelope

High and low pressure protection

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.

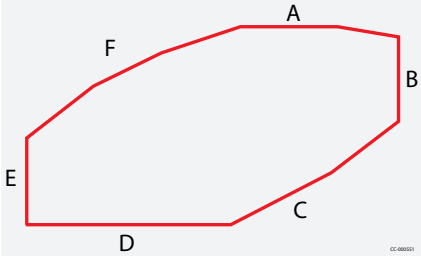
System evaluation

HP and LP must be monitored to respect operating envelope limitations. We consider two types of operating envelope management:

Table 8: Operating envelope management

Basic	Advanced
• HP and LP switch • MOP (Max Operating Pressure) ensured by expansion device • Condensing pressure control • Discharge gas sensor piloting injection expansion device	• HP and LP sensor • Operating envelope limits (permanent and transient) integrated into control logic

See Test, criteria and solutions.



A	HP switch setting
B	MOP + test No. 3
C	Tests No. 1 and 2
D	Condensing pressure control
E	LP switch setting
F	DGT (integrated)*

NOTE:
*PSH 065/105 compressor includes an integrated Discharge Gas Temperature protection (DGT). Excessive discharge temperature will result in tripping of electronic module output relay.

Test, criteria and solutions

Test No.	Purpose	Test condition	Pass criteria	Solutions
1	Check that Area 1 is reached within maximum transient time	Start test at minimum foreseeable evaporating temperature (minimum ambient temperature...)	Continuous running within area 1. At start-up or for any map exit, respect max. transient time according to area number.	Work on compressor staging,fan staging, water flow etc.
2		Perform a defrost test if reversible unit		
3		Perform a start-up test at maximum foreseeable evaporating temperature (max ambient temperature, or start up with hot water…)		Improve MOP function. Work on compressor staging,fan staging, water flow etc.

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 any conditions the expansion device must ensure a suction superheat within 5 – 30 K.

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

Suction accumulator must be added in system

Test	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: a high pressure ratio and minimum evaporator load.	Suction superheat >5 K	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 • …etc.	Oil superheat shall not be more than 30 sec below the safe limit defined in the Dilution Chart (see graph below).	
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 30 sec below the safe limit defined in the Dilution Chart (see graph below).	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[1]

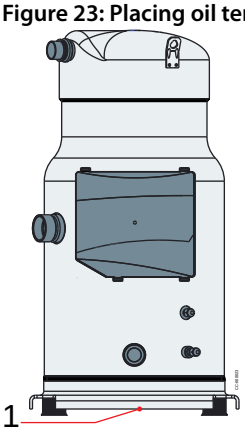
[1] Suction accumulator offers protection by trapping the liquid refrigerant upstream from the compressor. The accumulator should be sized at least 50 % of the total system charge. Suction accumulator dimensions can impact oil return (gas velocity, oil return hole size…), therefore oil return has to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

Placing oil temperature sensor

Oil temperature sensor must be placed on the bottom of the 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)

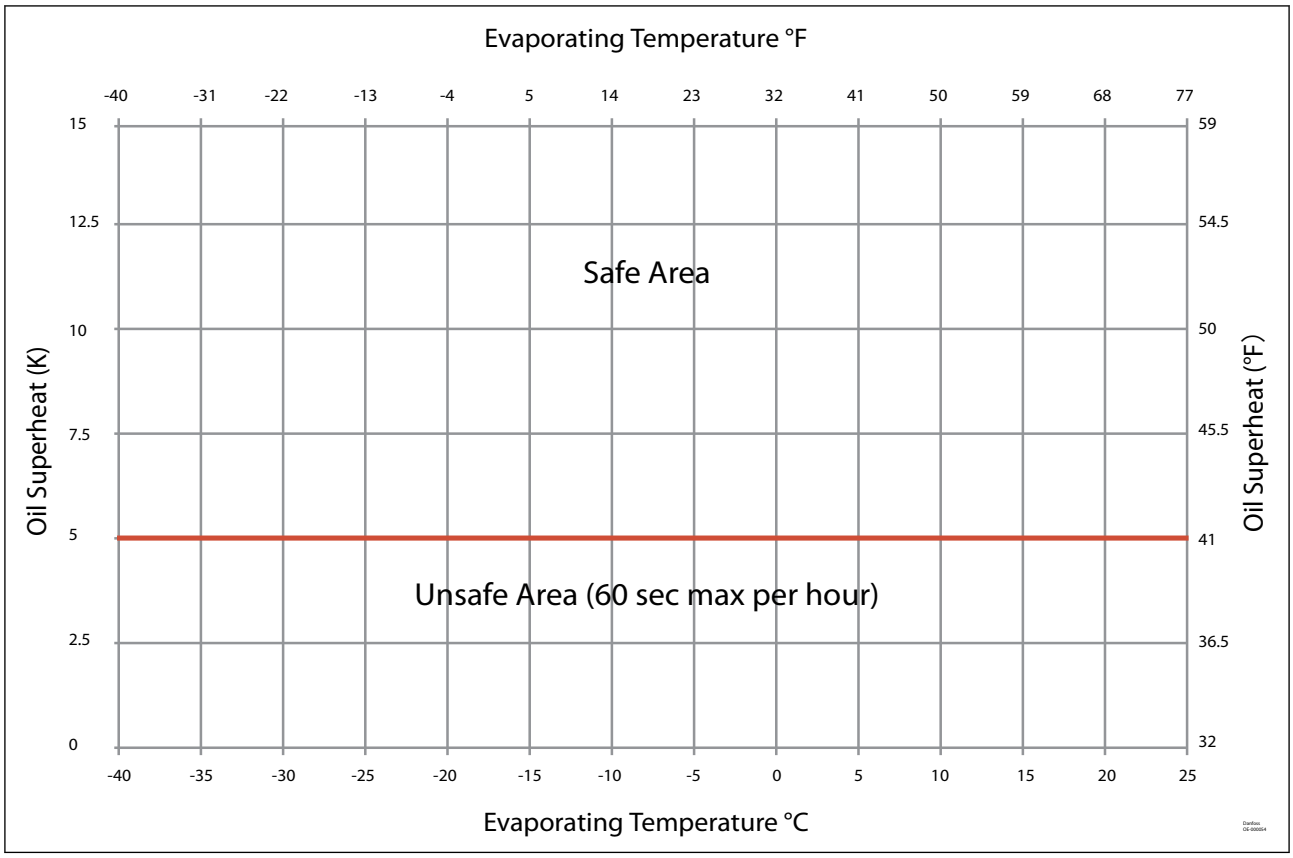
Figure 23: Placing oil temperature sensor on the bottom of the baseplate



1	Oil temperature sensor must be placed on the bottom of the baseplate.

Dilution Chart - PSH065/105

Dilution Chart (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 tables below in relation with the system charge and the application to quickly define necessary safeties to implement and test to perform:

Table 9: 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

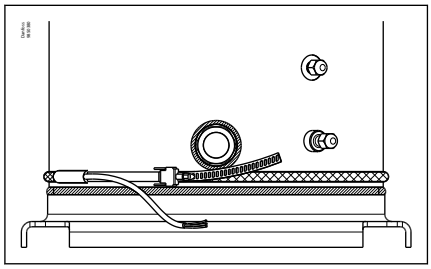
Crankcase heater

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

For PSH065/105 the use of a 75W belt heater is recommended. if the ambient temperature is between -5°C and -23°C. For ambient temperature between -23°C and -28°C a 130W belt heater must be used. For ambient temperature below -28°C two pieces 130W belt heater must be used.

Table 10: surface sump selection principle

T ambiance	Surface Sump Heater
-23~-5	75 W SSH
-28~-23	130 W SSH
-33~-28	130W+130W



The heater must be turned on whenever all the compressors are off. Crankcase 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.

Charge limits

Charge limit is defined in table below:

Table 11: Charge limits

Models	Refrigerant charge limit (kg)
PSH065	13.5
PSH105	17
PSH130E	25

Provide 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”).
- Compressor PSH065/105 is 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.
- Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (e.g. seasonal shutdown).

Wiring diagrams

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

Figure 24: Compressor model PSH065

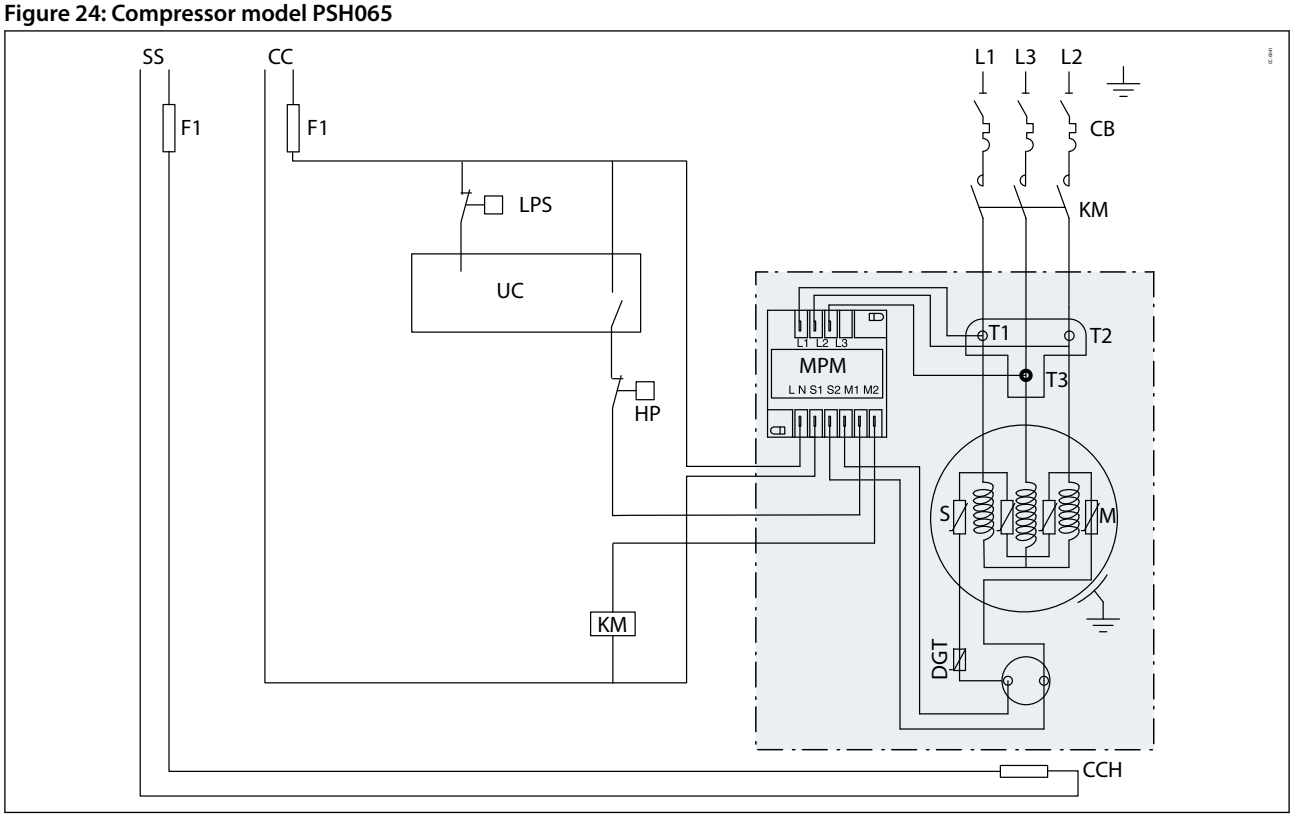
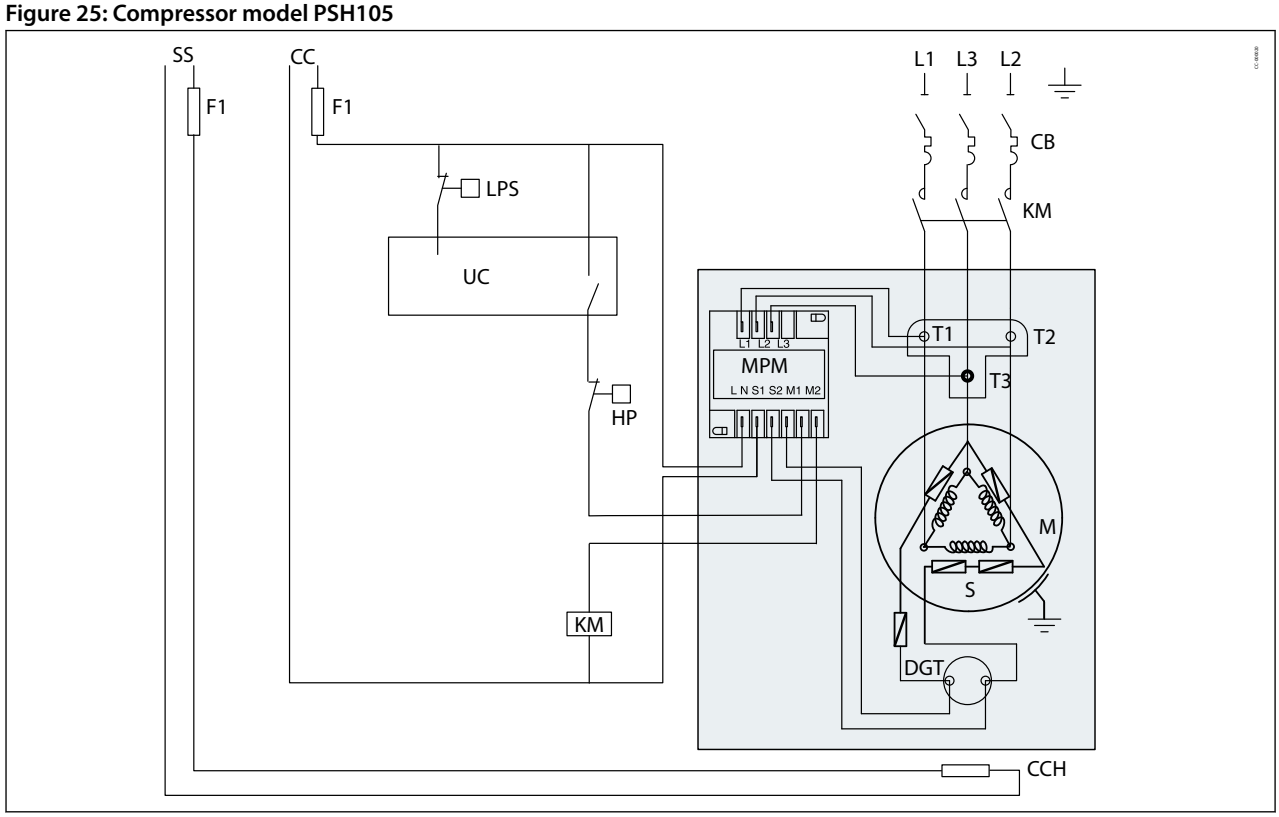


Figure 25: Compressor model PSH105



SS	Separate supply
CC	Control circuit
F1	Fuses
KM	Compressor contactor
HP	High pressure safety switch
LPS	Safety pressure switch
DGT	Discharge gas thermistor (embedded in compressor)
M	Compressor motor
MPM	Motor Protection Module
S	Thermistor chain (motor and discharge temperature)
SSH	Surface sump heater
CB	Thermal magnetic motor circuit breaker

Control logic

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, DGT)	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.

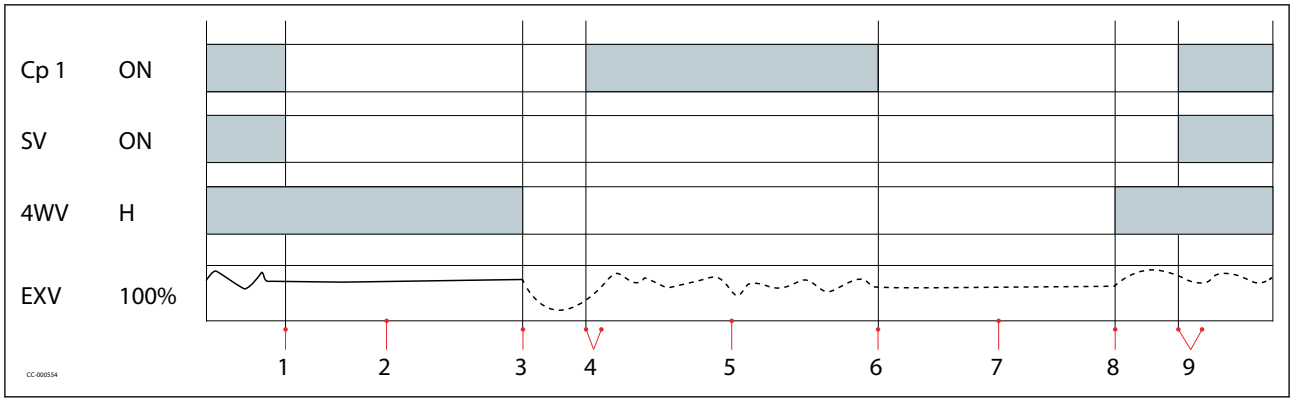
Defrost logic recommendations / Reversible systems

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:

Figure 26: Defrost logic advantages



Cp 1	Compressor 1
SV	Solenoid valve on injection pipe
ON	On
H	Heating
1	Defrost start. Stop compressor
2	4 Way Valve (4WV) stays in heating mode. EXV opened to transfer liquid from outdoor to indoor exchanger thanks to pressure difference
3	When pressures are almost balanced*, change 4WV to cooling mode.
4	Start compressor
5	Defrost
6	Defrost end. Stop the compressor
7	4 WV stays in cooling mode. EXV opened to transfer liquid from indoor to outdoor exchanger thanks to pressure difference
8	When pressures are almost balanced*, change 4WV to heating mode.
9	Start compressor and open solenoid valve

*EXV Opening degree and time have to be set to keep a minimum pressure for 4 way valve moving. In any case, defrost logics must respect requirements and tests described in sections Manage superheat and Manage operating envelope.

During inversion cycle of defrost mode, the vapor injection must be stopped. To ensure compressor reliability, the 4-way valve must not reverse when the compresor is stopped due to heating or cooling demand (stop on thermostat).

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

PSH065/105 compressor is 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

Danfoss recommends using the Danfoss DML (100% molecular sieve) solid core filter drier.

Assembly line procedure

Compressor storage

The compressor must not be exposed to rain, nor corrosive or flammable atmosphere during storage. Store the compressor between -35 °C and 70 °C when charged with nitrogen and between -35°C and 52°C when charged with R410A 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

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

Handling

R The PSH065/105 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 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.
- For tandem and trio assemblies, use a spreader bar and all compressor rings as shown in picture below.
- 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).

Figure 27: Heavy do not lift manually

Figure 28: Correct handling

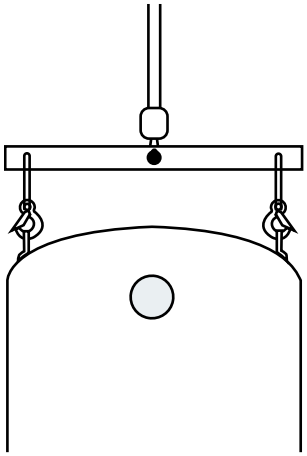
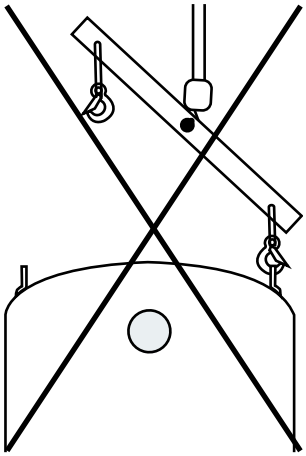


Figure 29: incorrect handling



Piping assembly

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

Table 12: 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.
- 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.

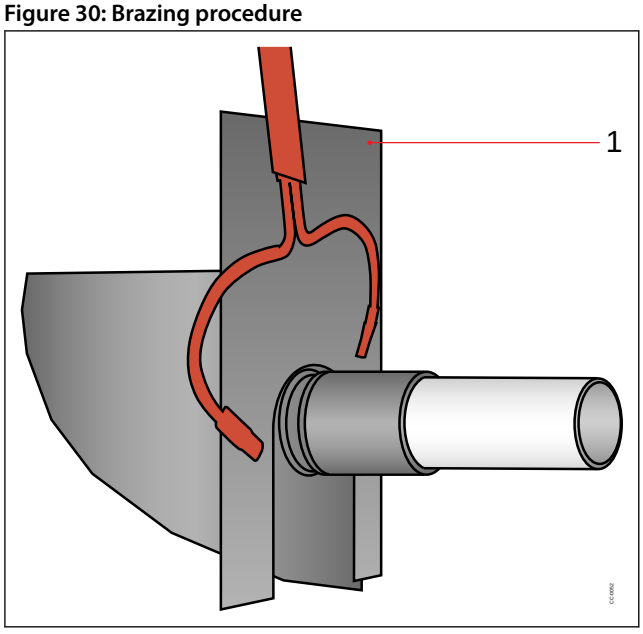
PSH compressors connectors are made of steel copper coated, which benefit to protect against corrosion and facilitate adhesion during brazing operation.

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 refrigerants) A typical content of 34% 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.

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

Figure 30: Brazing procedure



1	Heat shield

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 13: System pressure test and leak detection

Maximum compressor test pressures	PSH065/105
Maximum compressor test pressure high side (HP)	53.6 bar (g) HP-LP < 37 bar
Maximum compressor test pressure low side (LP)	34.2 bar (g) LP-HP < 5 bar Maximum speed 4.8 bar/second [1]

[1] The 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“ 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 +1000 V 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 20 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

R Check electrical power supply:

- Phase order: The PSH065/105 compressor is 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 protection.

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 160SZ from new cans. For more detailed information see "Lubricants filling in instructions for Danfoss Commercial Compressors" AP000086435866.

Tandem requirements (Static)

Tandem use static oil balancing principle to equalize oil level between the compressors by gravity. This is ensured by a precise suction and oil equalization piping design.

The discharge line has no impact on oil balancing. It is shown with tee, to indicate that both left and right side discharge headers are possible.

By default, PSH tandems are not factory-built. To complete an assembly in the field, you will need:

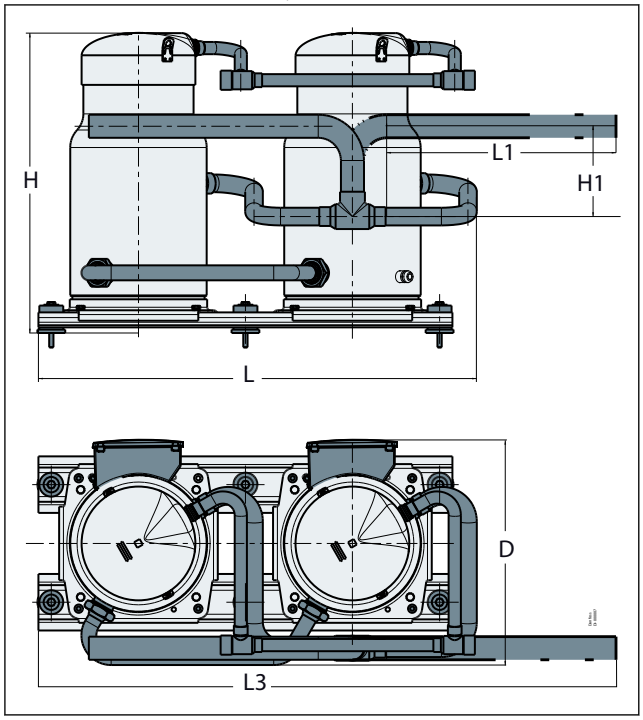
- Tubings, according to specific outline drawings indicated in the following table.
- Manifolding accessory kit.
- Compressors.

R Suction and oil equalization piping drawings must be respected (diameters, minimum straight lengths, …)

R when tandem part load running, idle compressor injection path (the path connected to compressor injection port) must be closed by the solenoid valve or EXV.

Tandem assembly

Figure 31: Tandem assembly



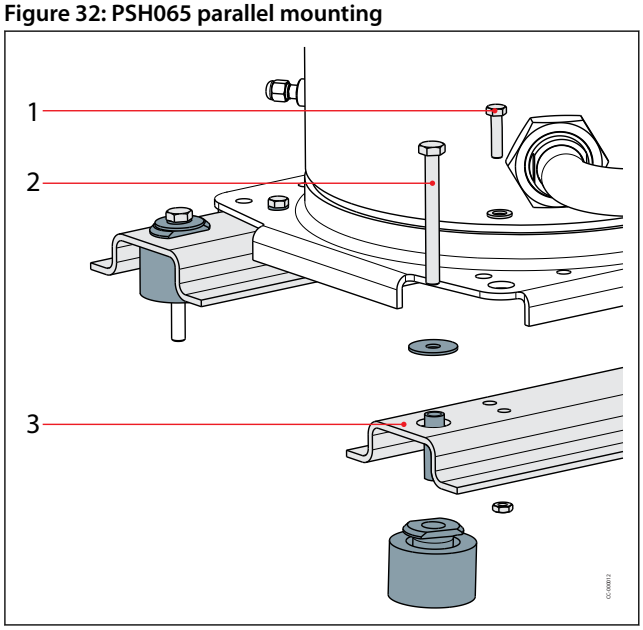
Tandem model	Composition	Suction form	Suction	Dis-charge	Oil equali-zation	D (mm)	H (mm)	L1 (mm)	L2 (mm)	L3 (mm)	H1 (mm)	Outline drawing number	Tandem kit code
PSH130E	PSH065+PSH065	Right	2"1/8	1"5/8	1"3/8	527	701	535	1025	-	211	8556339	120Z0792
		Left	2"1/8	1"5/8	1"3/8	527	701	535	-	1350	211		

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.

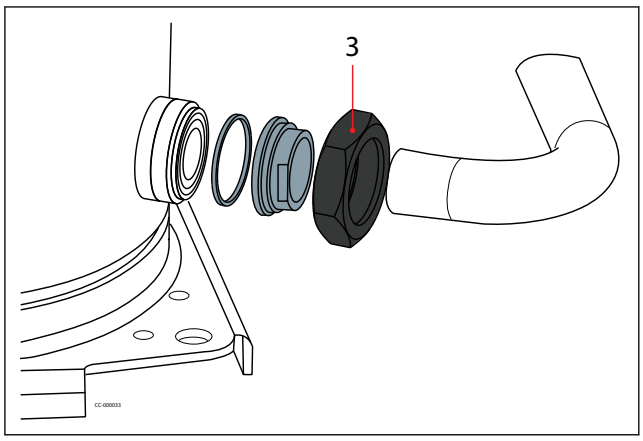
Figure 32: PSH065 parallel mounting



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: 5 mm (0.2 inch)
	Included in tandem/trio kit
	Not supplied

Oil equalization design

The oil level is balanced by a pipe of 1"3/8. To connect the equalization line on rotolock connections, the adaptor sleeves included in the tandem or trio accessory kit must be used.



3	Tightening torque 145 Nm
	Supplied with the compressor
	Included in tandem kit

Dismantal and disposal

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

Packaging

Single pack

Figure 33: Single pack

Compressor model	Length	Width	Height	Gross weight
	[mm]	[mm]	[mm]	[kg]
PSH065	760	600	992	127
PSH105	760	600	992	191

Industrial pack

Figure 34: Industrial pack

Compressor model	Compressors per pack	Length	Width	Height	Gross weight	Static stacking pallets
		[mm]	[mm]	[mm]	[kg]	
PSH065	6	1150	965	800	712	2
PSH105	4	1150	965	800	744	2

Ordering

Compressor code numbers

The PSH065/105 can be ordered in either industrial or single packs. Please use the code numbers from below tables for ordering.

Single pack

Compressor model	Connections	Motor protection	Code no. 8
			380/3/50
PSH065 Single	Brazed	Module 110 – 240 V[1]	120H1589
PSH065 Manifolding	Brazed	Module 110 – 240 V	120H1777
PSH105	Brazed	Module 110 – 240 V	120H1473

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

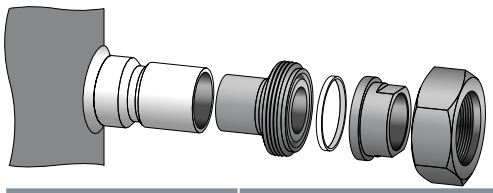
Industrial pack

Compressor model	Connections	Motor protection	Code no. 8
			380/3/50
PSH065 Single	Brazed	Module 110 – 240 V[1]	120H1588
PSH065 Manifolding	Brazed	Module 110 – 240 V	120H1778
PSH105	Brazed	Module 110 – 240 V	120H1472

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

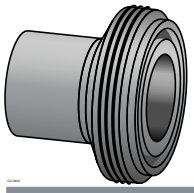
Accessories and Spare parts

Solder sleeve adapter set



Code no.	Description	Application	Packaging	Pack size
120Z0504	Rotolock adaptor set (2"1/4 ~ 1"5/8), (1"3/4 ~ 1"3/8)	PSH105	Multipack	6
7765028	Rotolock adaptor set (2"1/4 ~ 1"5/8), (1"3/4 ~ 1"1/8)	PSH065	Multipack	6

Rotolock adapter



Code no.	Description	Application	Packaging	Pack size
120Z0431	Adaptor (1"3/4 Rotolock - 1"3/8 ODS)	Models with 1"3/8 ODF	Multipack	10
120Z0432	Adaptor (2"1/4 Rotolock - 1"5/8 ODS)	Models with 1"5/8 ODF	Multipack	10
120Z0364	Adaptor (1"3/4 Rotolock - 1"1/8 ODS)	Models with 1"1/8 ODF	Multipack	10

Gaskets

Code no.	Description	Application	Packaging	Pack size
8156132	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Multipack	10
7956003	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Industry pack	50
8156133	Gasket, 2"1/4	Models with 2"1/4 rotolock connection	Multipack	10
7956004	Gasket, 2"1/4	Models with 2"1/4 rotolock connection	Industry pack	50

Solder sleeve

Code no.	Description	Application	Packaging	Pack size
8153003	Solder sleeve P10 (1"3/4 Rotolock - 1"3/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10
8153004	Solder sleeve P10 (1"3/4 Rotolock - 1"1/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10
8153006	Solder sleeve P03 (2"1/4 Rotolock - 1"5/8 ODF)	Models with 2"1/4 rotolock connection	Multipack	10

Rotolock nut

Code no.	Description	Application	Packaging	Pack size
8153124	Rotolock nut,1"3/4	Models with 1-3/4" rotolock connection	Multipack	10
8153126	Rotolock nut, 2"1/4	Models with 2-1/4" rotolock connection	Multipack	10

Rotolock service valve set

Code no.	Description	Application	Packaging	Pack size
120Z0547	Valve set, V03 (2"1/4 ~ 1"5/8), V10 (1"3/4 ~ 1"3/8)	PSH105	Multipack	4
7703383	Valve set, V03 (2"1/4 ~ 1"5/8), V02 (1"3/4 ~ 1"1/8)	PSH065	Multipack	4

Motor protection modules

Code no.	Description	Application	Packaging	Pack size
120Z0585	Electronic motor protection module, 115/240 V	PSH065/105	Single pack	1

Terminal boxes, covers and T-block connectors

Code no.	Description	Application	Packaging	Pack Size
120Z0458	Terminal box 210 x 190 mm, incl. cover	PSH065/105	Single pack	1
120Z0774	T block connector 80 x 80 mm	PSH105	Multipack	10
8173230	T block connector 60 x 75 mm	PSH065	Multipack	10

Belt heater

Code no.	Description	Application	Packaging	Pack size
7773108	Belt type crankcase heater,75W,230 V,CE & UL	PSH065/105	Multipack	6
7773118	Belt type crankcase heater,75W,400 V,CE & UL	PSH065/105	Multipack	6
7773122	Belt type crankcase heater, 130W, 230V, CE & UL	PSH065/105	Multipack	4
7773123	Belt type crankcase heater, 130W, 400V, CE & UL	PSH065/105	Multipack	4

Lubricant

Code no.	Description	Packaging	Pack size
7754023	POE lubricant, 1 litre can	Multi pack	12
120Z0571	POE lubricant, 2.5 litre can	Multi pack	4

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

Mounting hardware

Code no.	Description	Application	Packaging	Pack size
8156138	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	PSH065	Single pack	1
7777045	Mounting kit for 1 scroll compressors including 4 hexagon rigid spacer, 4 sleeves, 4 bolts, 4 washers	PSH065	Single pack	1

Tandem kit

Code no.	Description	Application	Packaging	Pack size
120Z0792	Kit Tandem, Solid, OEL 1" 3/8	PSH130E	Singlepack	1

Updates

Release date (Year/Month)	Guideline codification number	List of changes	Reason for change
2020/11	AB328937813817en-000101	First release	-
2021/08	AB328937813817en-000201	Update PSH105 power connection Add PSH065 manifolding application	-
2022/04	AB328937813817en-000301	Crankcase heater (CCH) updated	-
2025/04	AB328937813817en-000401	Extend envelope from -35°C to -40°C Layout changed	-

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