ENGINEERING
TOMORROW

Application Guide

Scroll compressors
PSH052 to **PSH105**

R410A-R454B,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.

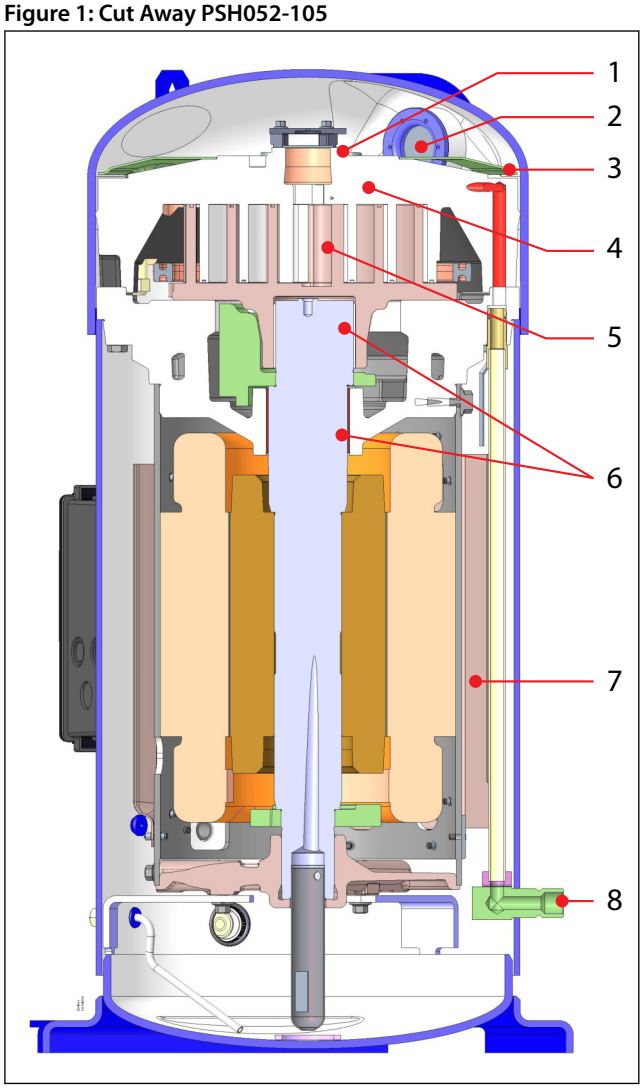
Introduction

Product description

Danfoss scroll compressor PSH for R410A and R454B is available as single compressor and can be assembled in tandem or trio combinations.

PSH series scroll compressor benefit from an improved design to achieve the highest efficiency and increased life time.

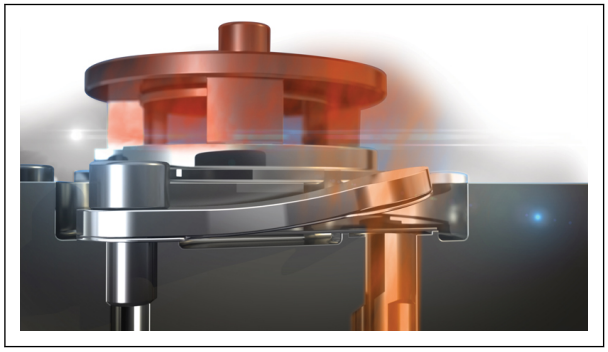
Figure 1: Cut Away PSH052-105



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 induces 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 PSH052-105 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.

Figure 3: Upstream exaction

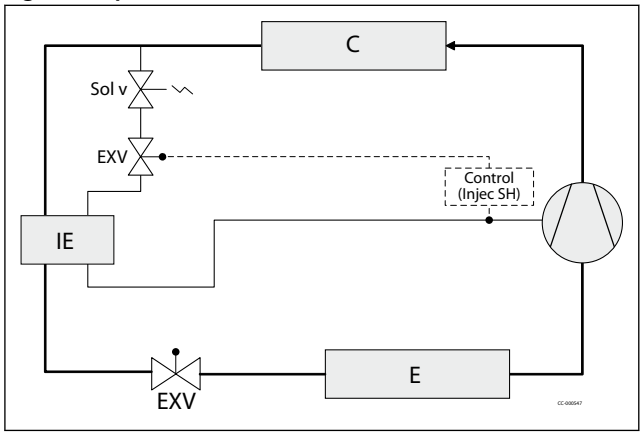
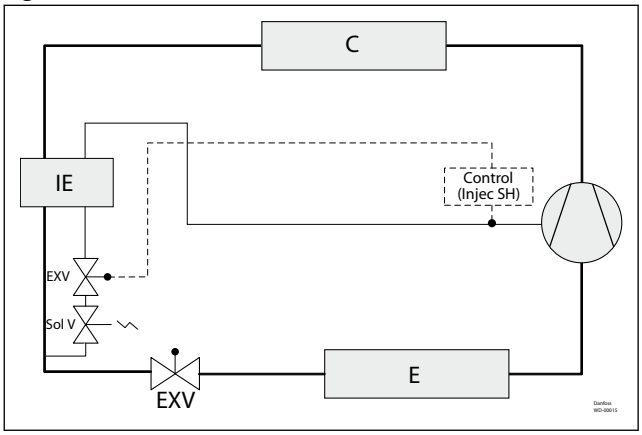


Figure 4: Downstream exaction



C	Condenser
E	Evaporator
IE	Intermediate Exchanger

Figure 5: Upstream exaction

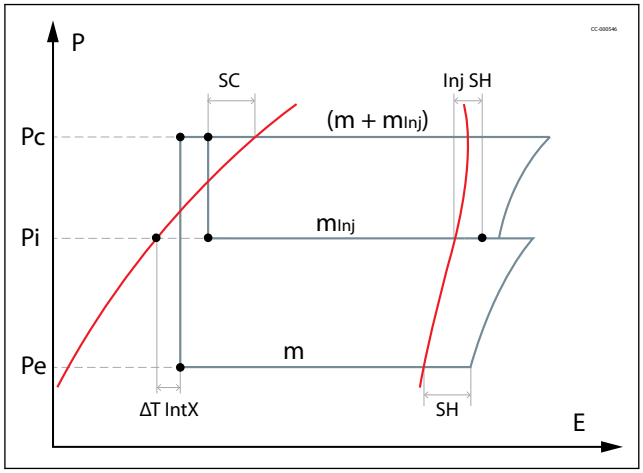
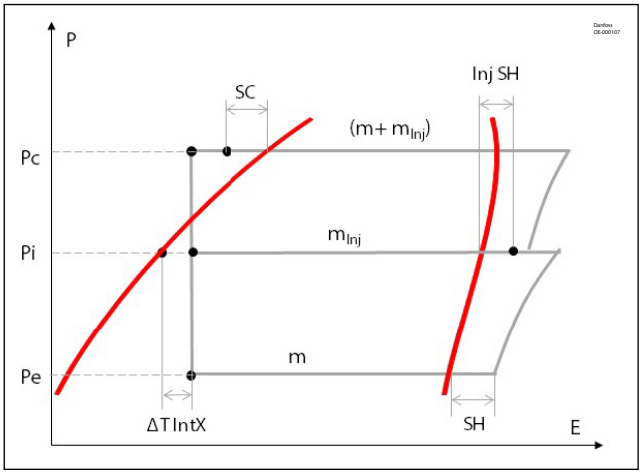


Figure 6: Downstream exaction

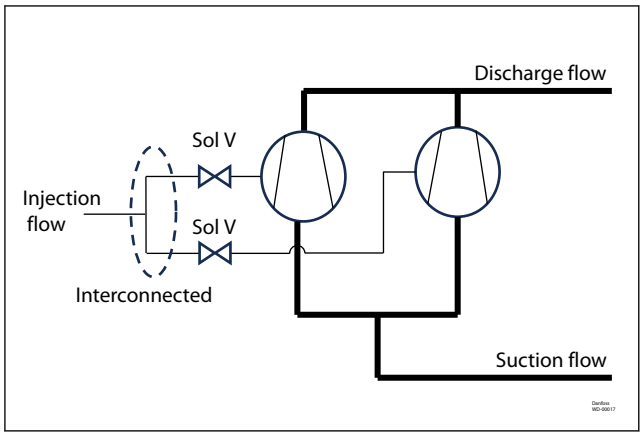


P	Pressure
E	Enthalpy

The injection massflow must be regulated through an EXV, the injection superheat must be above 5 K.

For single compressor, it is highly 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.

For manifolding, it is mandatory to install an additional solenoid valve on each compressor's injection line in case of they are interconnected. When the compressor is OFF, the related solenoid valve must shut off the branch injection line to avoid refrigerant flowing into the stand by compressor.



The vapor injection must not be activated during inversion cycle of defrost mode

For compressor start-up, vapor injection valve opening must delay than compressor start-up at least 5 seconds.

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.Injection temperature at measurement point set point is 121°C (250°F), maximum safety value is 135°C (275°F).

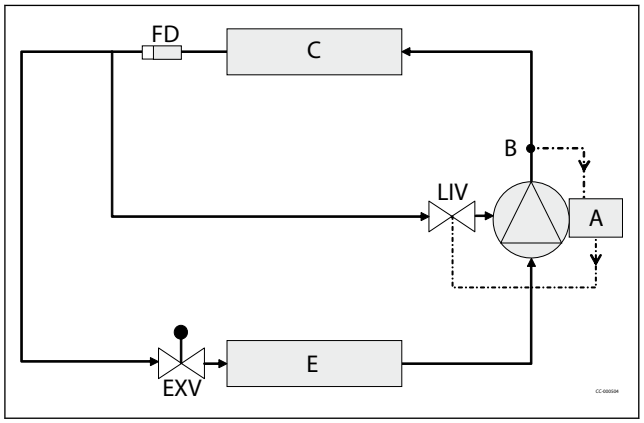
Liquid injection

Danfoss PSH052-105 requires liquid injection to maintain sufficiently low discharge gas temperature in the operating envelope. The PSH052-105 compressors are provided with a liquid injection connection.

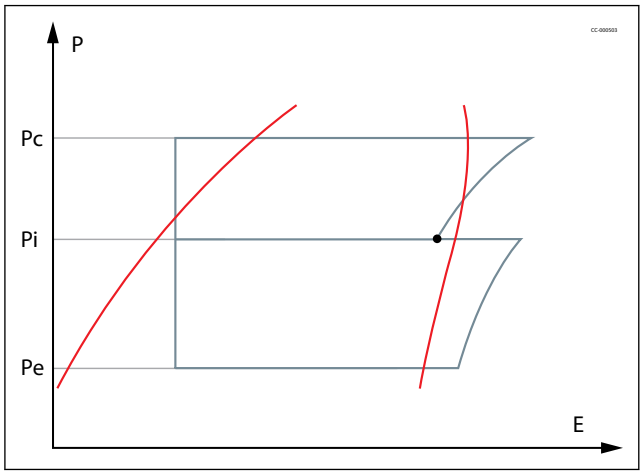
The compressor's liquid injection port should be connected to the system main liquid line after condenser & filter drier. The liquid phase refrigerant is directly injected into the compressor scroll set. Liquid refrigerant vaporize in the scroll and absorb the heat, result in cooling down the compressor's 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 7: Name Plate

1	Model number
2	Serial number
3	Refrigerant
4	Supply voltage, Starting current & Maximum operating current
5	Housing service pressure
6	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.

Family, lubricant & refrigerant	Nominal capacity	Approvals	Voltage	Version	Evolution index
PSH	105	A	4	EM	A

Family, lubricant & refrigerant
PSH: Heat pump optimized scroll, POE lubricant, for R410A and R454B

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

UL index

Motor voltage code
3: 208-230V/3~/60Hz
4: 380-415V/3~/50Hz - 460V/3~/60Hz
7: 575V/3~/60Hz

Evolution index
A~Z

Motor protection
M: Electronic module, 110-240V, R410A/R454B
N: Electronic module,24V AC, R410A/R454B

Connections
E: with OSG/OEQ, Vapor/Wet/ Liquid injection version

Compressors serial number

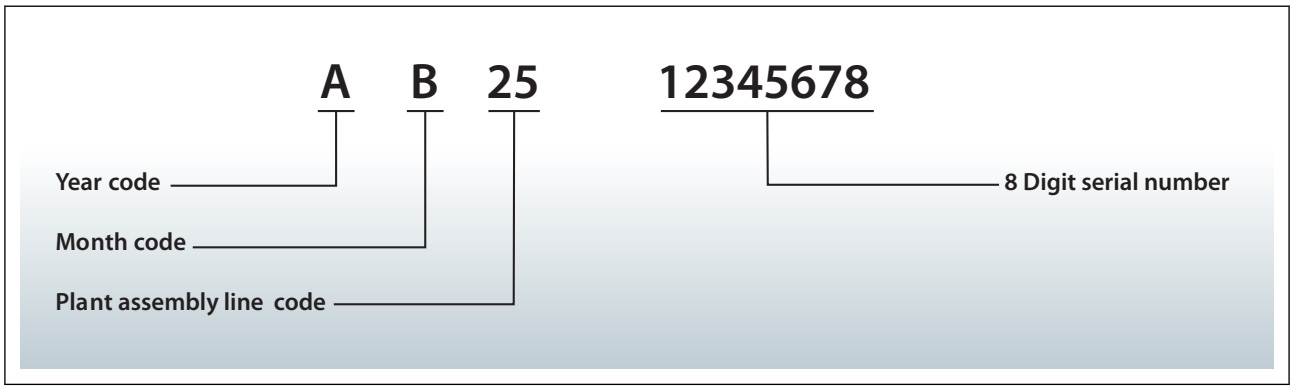


Table 1: Serial number code legend table

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

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

Table 2: Certificates, declarations, and approvals

Certificates, declarations, and approvals	Certification logo	Models
CE 0062, CE 0038 or CE 0094 (European Directive)	CE	All PSH models
UL (Underwriters Laboratories)	c UL us	All PSH models
Other approvals / certificates		Contact Danfoss

Low voltage directive 2014/35/EU

Table 3: Low voltage directive 2014/35/EU

Products	PSH models
Declaration of conformity	Contact Danfoss

Machines directive 2006/42/EC

Table 4: Machines directive 2006/42/EC

Products	PSH models
Manufacturer's declaration of incorporation	Contact Danfoss

Pressure equipment directive 2014/68/EU

Table 5: Pressure equipment directive 2014/68/EU

Products	PSH052-065	PSH079-105
Category PED R410A	II	III
Category PED R454B	III	IV
Maximum / Minimum temperature - Ts	-35°C < Ts < 52°C -31°F < Ts < 125.6°F	-35°C < Ts < 52°C -31°F < Ts < 125.6°F
Maximum allowable pressure (Low side) - Ps	31.1 bar(g) 451 psig	31.1 bar(g) 451psig
Maximum allowable pressure (High side) - Ps	48.7 bar(g) 706 psig	48.7 bar(g) 706 psig
Declaration of conformity	Contact Danfoss	Contact Danfoss

Internal free volume

Table 6: Internal free volume

Products	Internal free volume without oil					
	Low pressure side		High pressure side		Total	
	[litre]	[cu.inch]	[litre]	[cu.inch]	[litre]	[cu.inch]
PSH052	27.4	1672	2.8	171	30.2	1843
PSH065	27.1	1654	2.8	171	29.9	1825
PSH079	31.1	1898	4.1	250	35.2	2148
PSH105	28.2	1721	3.8	232	32	1953

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
- Standardization of refrigerants and lubricants
- Refrigerant cost
- Refrigerant availability

R410A

R410A is a HFC blend (R32: 50%; R125: 50%) with a zero Ozone Depletion Potential (ODP=0) and a Global Warming Potential of 1924/AR5 (2088/AR4). It is a near-azeotropic mixture with a temperature glide less than 0.2 K.

With its high net refrigeration effect coupled to a high density, the R410A has appeared in last decade to be the preferred refrigerant for use in commercial air conditioners and heat pumps.

R454B

R454B is a HFO/HFC blend (R32 :68.9%; R1234yf: 31.1%) with a zero Ozone Depletion Potential (ODP=0) and a low Global Warming Potential (GWP: 467/AR5; 466/AR4). It is a near-azeotropic mixture with a temperature glide around 1 K.

R454B has very close match to R410A in terms of capacity and discharge temperature difference, and it offers better efficiencies compared to R410A.

R454B is classified A2L with low flammability properties. 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

Technical specification

50-60 Hz data Single compressor

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

Model	Nominal tons	Swept volume		Displacement (50 Hz) [1]		Displacement (60 Hz) [2]		Oil charge		Net weight [3]	
	TR	cm^3/rev	cu.in/rev	m^3/h	cu.ft/h	m^3/h	cu.ft/h	dm^3	oz	kg	lbs
PSH052	20	227.6	13.89	39.6	1398	47.8	1688	6.1	206	114	251
PSH065	25	272.8	16.65	47.5	1677	57.3	2024	6.1	206	117	258
PSH079	30	345	21.05	60	2119	72.3	2553	6.1	206	162	357
PSH105	40	442.6	27.01	77	2719	92.9	3281	6.1	206	176	388

[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

R410A 50-60 Hz, Single compressor

Table 8: 50-60 Hz Performance data (Heating)

Model		Nominal tons	Nominal Heating capacity		Power input	COP	E.E.R.
		TR	W	Btu/h	kW	W/W	Btu/h/W
50Hz	PSH052	20	60200	205402	22.13	2.72	9.28
	PSH065	25	71000	242252	25.82	2.75	9.38
	PSH079	30	94000	320728	34.18	2.75	9.38
	PSH105	40	116500	397498	42.06	2.77	9.45
60Hz	PSH052	20	72000	245664	26.28	2.74	9.35
	PSH065	25	84800	289338	30.84	2.75	9.38
	PSH079	30	112400	383509	40.87	2.75	9.38
	PSH105	40	140000	477680	50.54	2.77	9.45

Table 9: 50-60 Hz Performance data (Cooling)

Model		Nominal tons	Nominal Cooling capacity		Power input	COP	E.E.R.
		TR	W	Btu/h	kW	W/W	Btu/h/W
50Hz	PSH052	20	51500	175718	17.11	3.01	10.27
	PSH065	25	62200	212226	20.13	3.09	10.54
	PSH079	30	79400	270913	26.29	3.02	10.30
	PSH105	40	101400	345977	32.71	3.10	10.58
60Hz	PSH052	20	62500	213250	20.49	3.05	10.41
	PSH065	25	75600	257947	24.79	3.05	10.41
	PSH079	30	95500	325846	31.83	3.00	10.24
	PSH105	40	123600	421723	39.87	3.10	10.58

NOTE:
TR: Ton of Refrigeration,
COP: Coefficient Of Performance
EER: Energy Efficiency Ratio
Standard rating conditions For Heating(With injection): Evaporating temperature: -8°C (17.6°F), Condensing temperature: 58°C (136.4°F), Superheat: 8K (14.4°F), Subcooling: 5K (9°F), Injection Superheat: 5K (9°F)

For Cooling (Without injection): Evaporating temperature: 3°C (37.4°F), Condensing temperature: 50°C (122°F), Superheat: 8K (14.4°F), Subcooling: 5K (9°F)

Subject to modification without prior notification.

Data given for motor code 4 compressor with above conditions

For regular updates and detailed capacities, please refer to Coolselector®2.

R454B 50-60 Hz, Single compressor

Table 10: 50-60 Hz Performance data (Heating)

Model		Nominal tons	Nominal Heating capacity		Power input	COP	E.E.R.
		TR	W	Btu/h	kW	W/W	Btu/h/W
50Hz	PSH052	20	49300	168212	18.67	2.64	9.01
	PSH065	25	58000	197896	21.32	2.72	9.28
	PSH079	30	76000	259312	28.68	2.65	9.04
	PSH105	40	96500	329258	35.48	2.72	9.28
60Hz	PSH052	20	59400	202673	22.08	2.69	9.18
	PSH065	25	69900	238499	25.51	2.74	9.35
	PSH079	30	90800	309810	33.88	2.68	9.14
	PSH105	40	115200	393062	42.04	2.74	9.35

Table 11: 50-60 Hz Performance data (Cooling)

Model		Nominal tons 60 Hz	Nominal Cooling capacity		Power input	COP	E.E.R.
		TR	W	Btu/h	kW	W/W	Btu/h/W
50Hz	PSH052	20	50000	170600	16.50	3.03	10.34
	PSH065	25	61200	208814	19.25	3.18	10.85
	PSH079	30	77500	264430	25.16	3.08	10.51
	PSH105	40	102000	348024	31.19	3.27	11.16
60Hz	PSH052	20	61000	208132	19.81	3.08	10.51
	PSH065	25	74300	253512	23.07	3.22	10.99
	PSH079	30	93000	317316	30.39	3.06	10.44
	PSH105	40	123000	419676	37.85	3.25	11.09

NOTE:
TR: Ton of Refrigeration,
COP: Coefficient Of Performance
EER: Energy Efficiency Ratio
Standard rating conditions For Heating(With injection): Evaporating temperature: -14°C (6.8°F), Condensing temperature: 54°C (129.2°F), Superheat: 8K (14.4°F), Subcooling: 5K (9°F), Injection Superheat: 5K (9°F)

For Cooling (Without injection): Evaporating temperature: 5°C (41°F), Condensing temperature: 50°C (122°F), Superheat: 10K (18°F), Subcooling: 0K (0°F)

Subject to modification without prior notification.

Data given for motor code 4 compressor with above conditions

For regular updates and detailed capacities, please refer to Coolselector®2.

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 - Single

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 12: Compressor sound radiation (R410A Max. DGT 135°C)

Compressor model	50 Hz		60 Hz		Acoustic hood code number
	Sound power dB(A)	Attenuation dB(A) [1]	Sound power dB(A)	Attenuation dB(A) [1]	
PSH052	82	6	86	7	120Z0926
PSH065	85	6	88	7	120Z0926
PSH079	86	6	89	7	120Z0926
PSH105	89	6	91	7	120Z0926

[1] Attenuation given with acoustic hood

Table 13: Compressor sound radiation(R454B Max. DGT 135°C)

Compressor model	50 Hz		60 Hz		Acoustic hood code number
	Sound power dB(A)	Attenuation dB(A) [1]	Sound power dB(A)	Attenuation dB(A) [1]	
PSH052	83	6	87	7	120Z0926
PSH065	86	6	89	7	120Z0926
PSH079	87	6	90	7	120Z0926
PSH105	90	6	92	7	120Z0926

[1] Attenuation given with acoustic hood

NOTE:
Sound power and attenuation are given at the condition -7/50/SH5/SC5 with vapor injection, 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 trio

PSH315 = 3 × PSH105 (50 Hz)

$L_{PSH105} = 89dB(A)$

$L_{PSH315} = 89 + 10 \quad Log_{10} \quad 3 = 93.8dB(A)$

- The global sound level of “n” different compressors with respectively Li sound level is:

$$L_{GLOBAL} = \overset{i=n}{\underset{i=1}{10 \log_{10} (\sum 10^{0.1} * Li)}}$$

Example for the tandem

PSH170 = PSH105+PSH065 (50 Hz)

L_{PSH065} =85dB(A),L_{PSH105} =89dB(A)

L_{PSH170} $=10\ Log_{10}(10^{0.1\times85} + 10^{0.1\times89}) =$ $90.5dB(A)$

Mechanical vibrations

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

The operating envelope for PSH052-105 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. Minimum suction temperature cannot lower than -35°C. Minimum ambient temperature during start and operation cannot lower than -33°C.

Operating envelope

Figure 8: PSH052-105 R410A SH5K8 50Hz

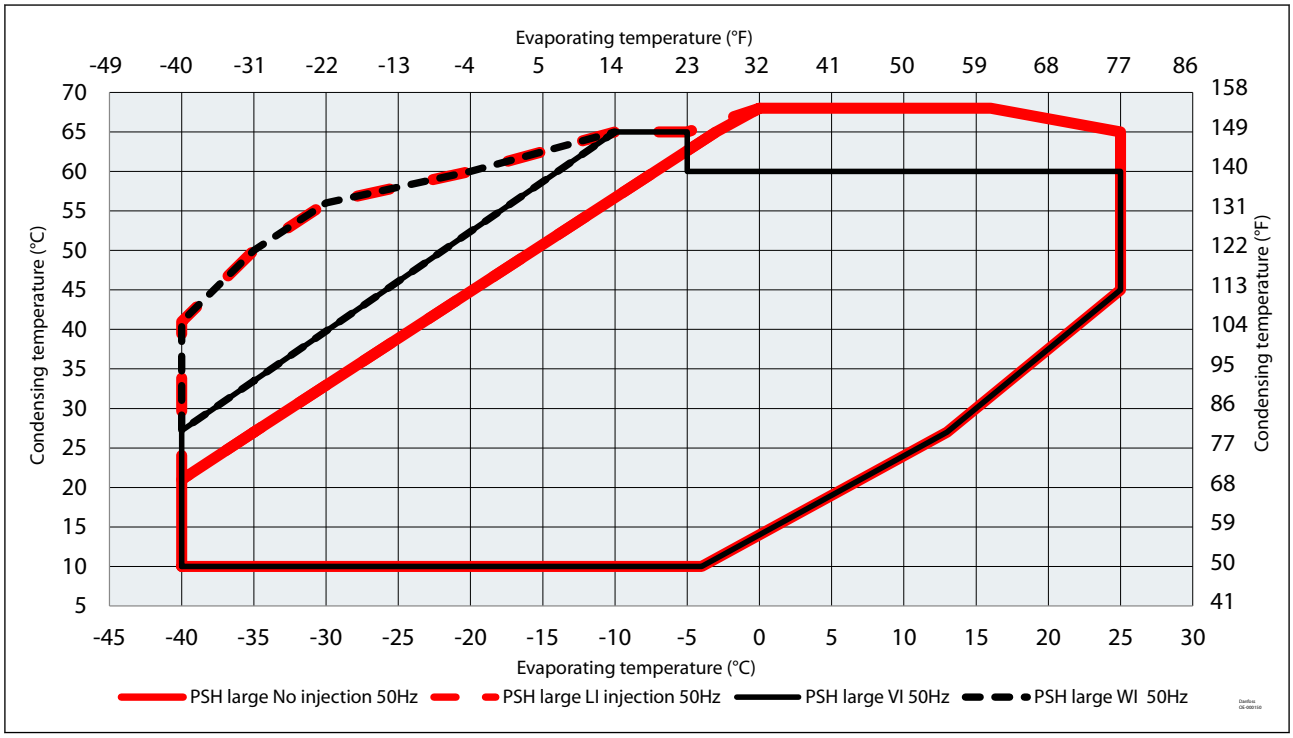


Figure 9: PSH052-105 R410A SH5K8 60Hz

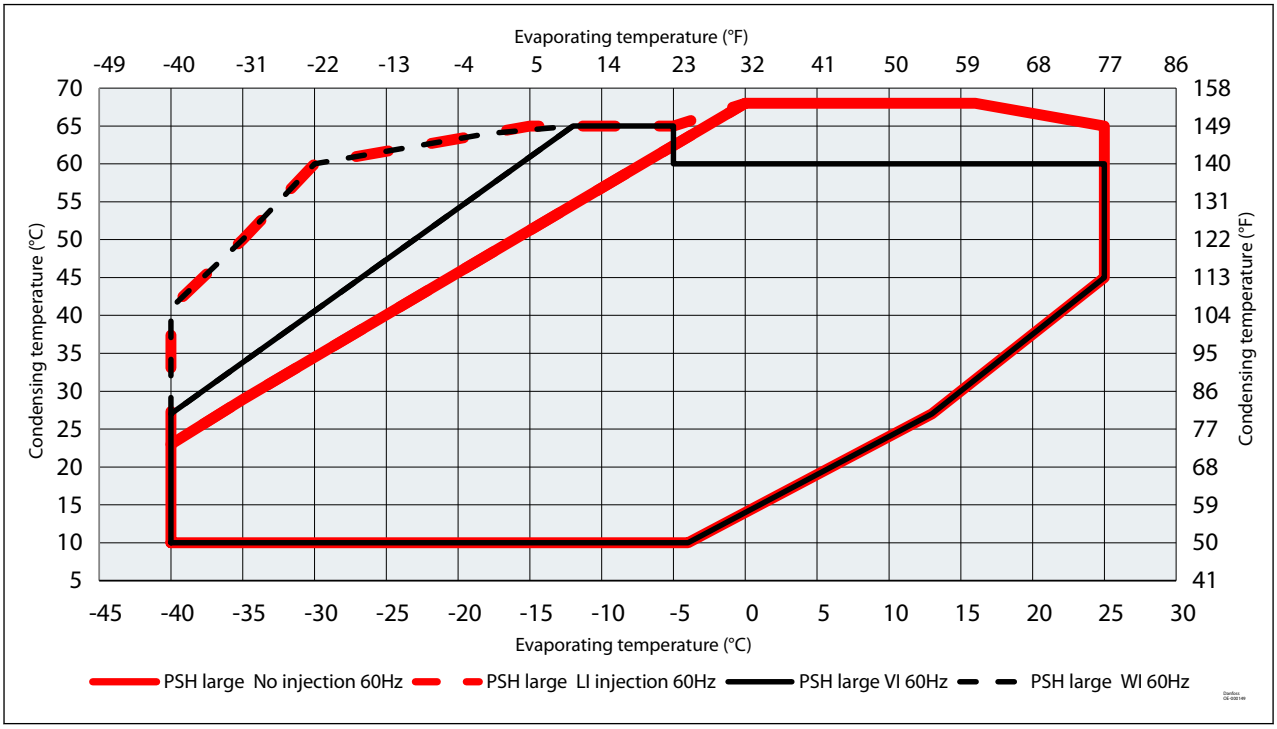


Figure 10: PSH052-105 R454B SH5K 50Hz

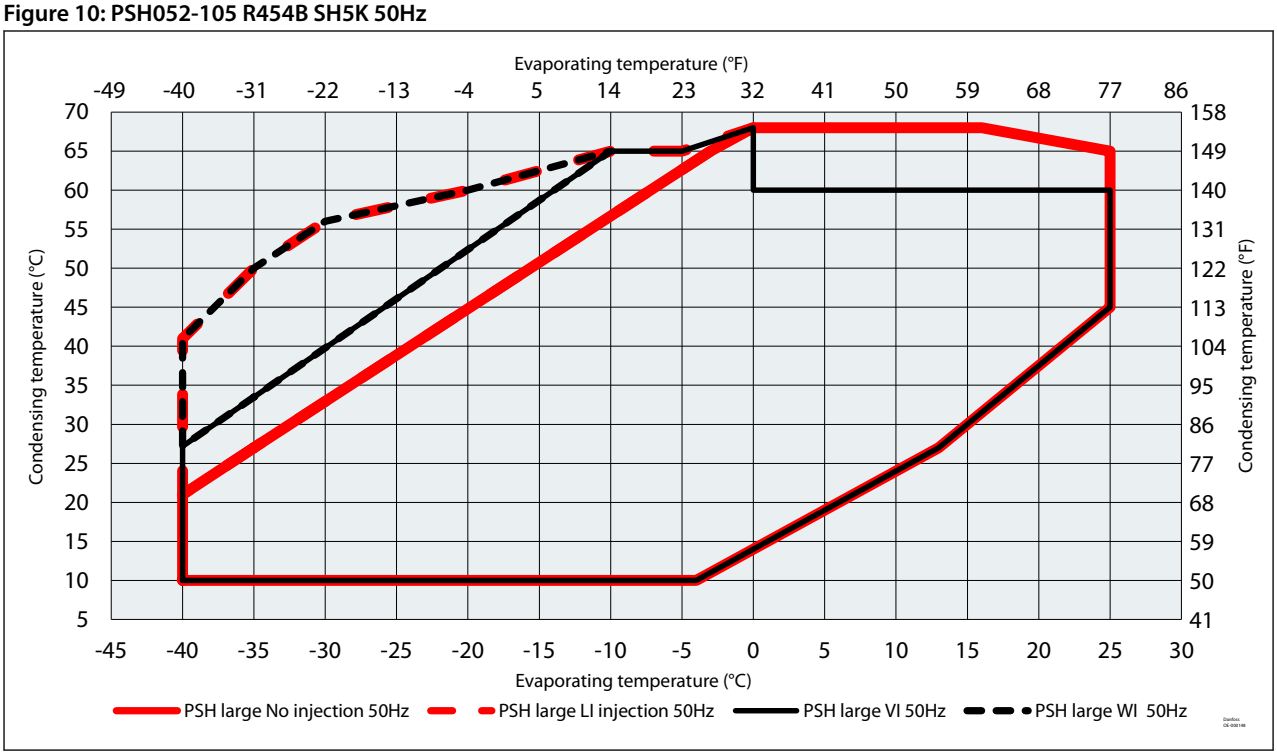
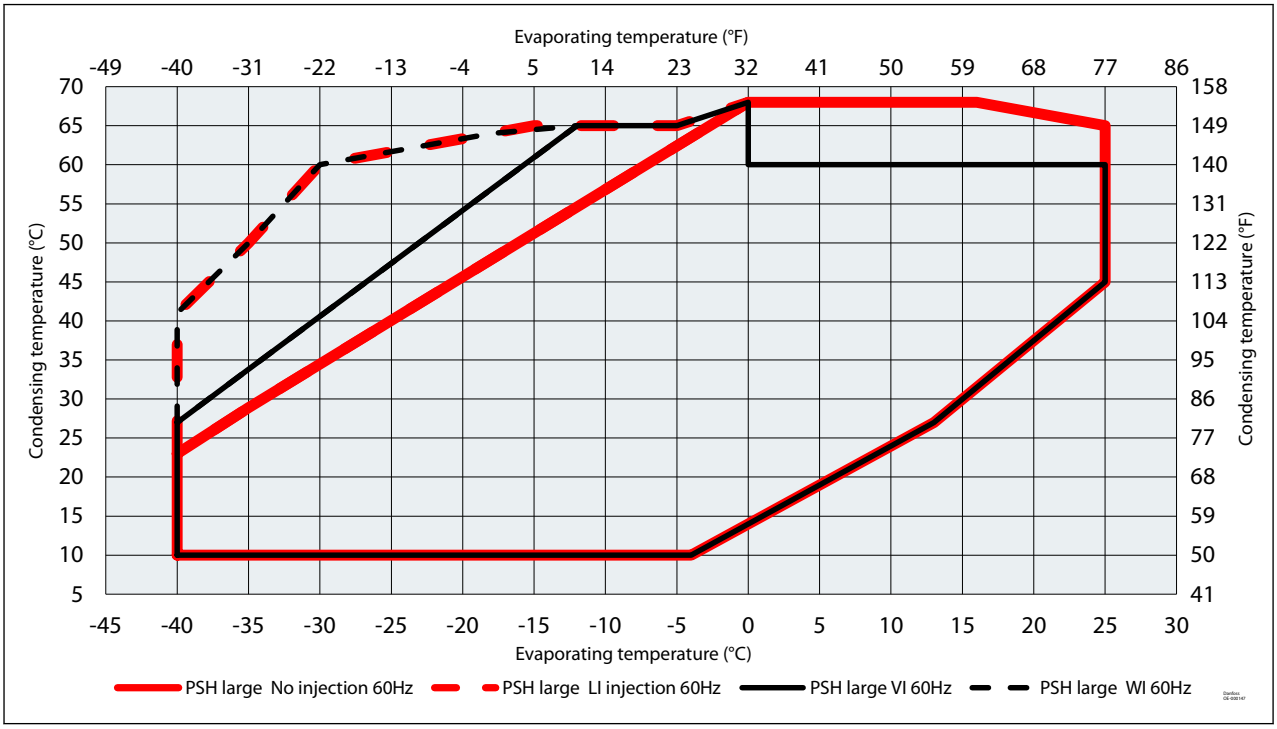


Figure 11: PSH052-105 R454B SH5K 60Hz



NOTE:
The application envelope of a cross-platform manifold results in the conjunction of map limitations of compressors composing the tandem.

Pressure settings

Table 14: Pressure settings

Pressure settings		R410A	R454B
Working range high side	bar(g)	9.9-44.5	9-41.2
	psig	144-645	131-598
Working range low side	bar(g)	0.8-15.5	0.6-14.2
	psig	11-225	8-206
Maximum high pressure safety switch setting	bar(g)	45.9	42.6
	psig	666	618
Minimum low pressure safety switch setting	bar(g)	0.6	0.4
	psig	8	5
Minimum low pressure pump-down switch setting	bar(g)	1.5 bar below nominal evaporating pressure of the unit and not below the minimum low pressure safety switch setting	
	psig	22 psi below nominal evap. and not below the minimum low pressure safety switch setting	

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.

Dimensions

Single compressors

Figure 12: PSH052-065

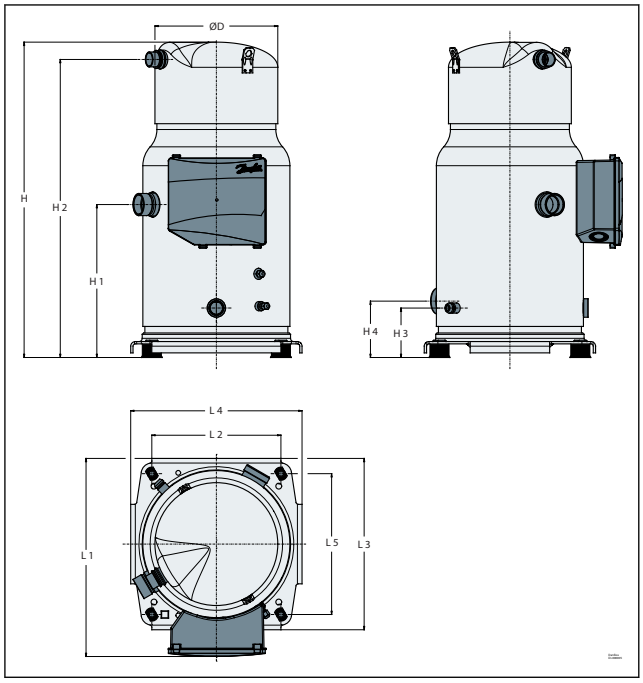
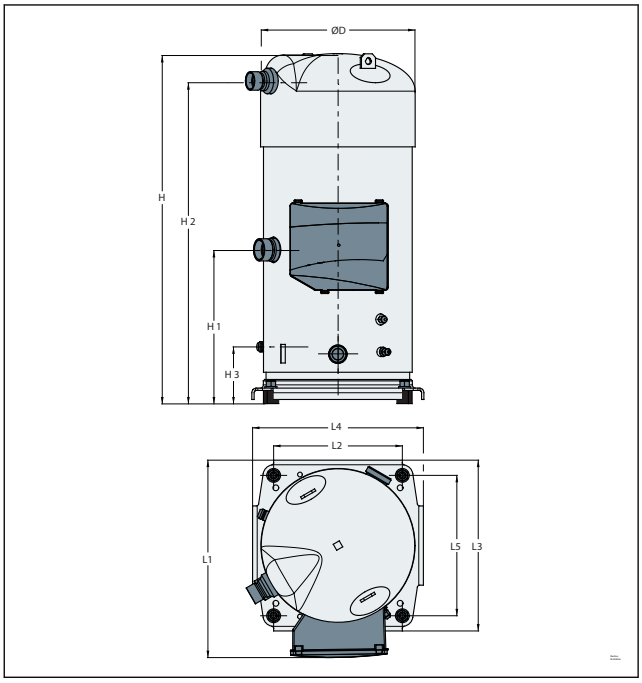


Figure 13: PSH079-105



Compressor model	Motor voltage code	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
PSH052-PSH065	3,4,7	265.9	682.5	331	645	107	122	429	279.4	371	370.8	305	8556466
PSH079	4,7	333	752.5	329.5	693.5	120.5	120.4	429	279.4	371	370.8	305	8556468
PSH079	3	333	752.5	329.5	693.5	120.5	120.4	484	279.4	371	370.8	305	8556478
PSH105	4,7	333	755.5	332.5	696.5	123.5	123.4	429	279.4	371	370.8	305	8556470
PSH105	3	333	755.5	332.5	696.5	123.5	123.4	446	279.4	371	370.8	305	8556449

Tandem assemblies

Figure 14: Outline drawing number 1

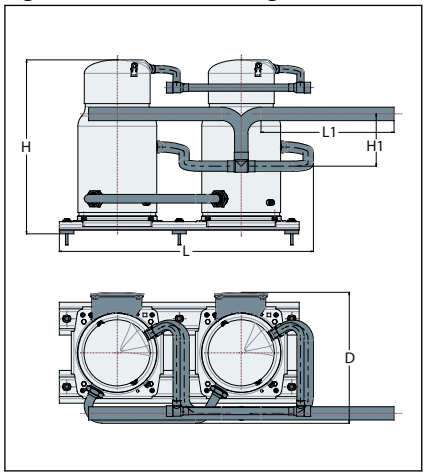


Figure 15: Outline drawing number 2

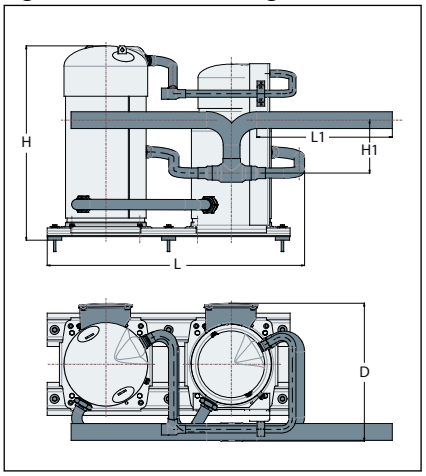


Figure 16: Outline drawing number 3

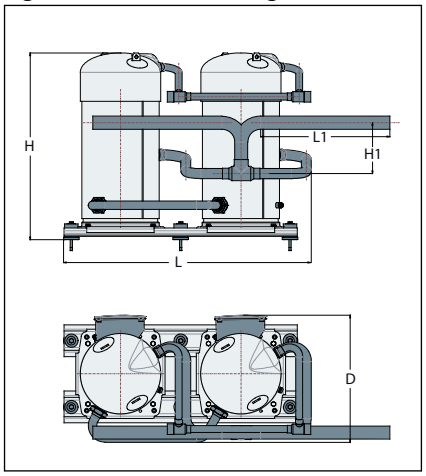


Table 15: Tandem assemblies

Tandem model	Composition	Motor voltage code	L		D		H		L1		H1		Outline drawing number	
			mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
PSH104E	PSH052+PSH052	3, 4, 7, 9	1024	40.3	527	20.7	702	27.6	536	21.1	211	8.3	1	8556339
PSH130E	PSH065+PSH065	3, 4, 7, 9	1024	40.3	527	20.7	702	27.6	536	21.1	211	8.3	1	8556339
PSH158E	PSH079+PSH079	4, 7, 9	1026	40.4	527	20.7	775	30.5	536	21.1	211	8.3	3	8556409
		3	1026	40.4	582	22.9	775	30.5	536	21.1	211	8.3		
PSH170U	PSH065+PSH105	4, 7, 9	1025	40.4	549	21.6	775	30.5	540	21.3	211	8.3	2	8556406
		3	1025	40.4	566	22.3	775	30.5	540	21.3	211	8.3		
PSH184U	PSH079+PSH105	4, 7, 9	1007	39.6	560	22	775	30.5	540	21.3	211	8.3	3	8556407
		3	1007	39.6	615	24.2	775	30.5	540	21.3	211	8.3		
PSH210E	PSH105+PSH105	4, 7, 9	1025	40.4	550	21.7	775	30.5	540	21.3	211	8.3	3	8556408
		3	1025	40.4	567	22.3	775	30.5	540	21.3	211	8.3		

NOTE:
Tandems to be achieved by assembly of individual compressors.

By convention, the last letter of tandems designation has been set to help to discern easily which type of manifold we are considering

U : Uneven tandem
E : Even tandem

Trio assemblies

Figure 17: Outline drawing number 5

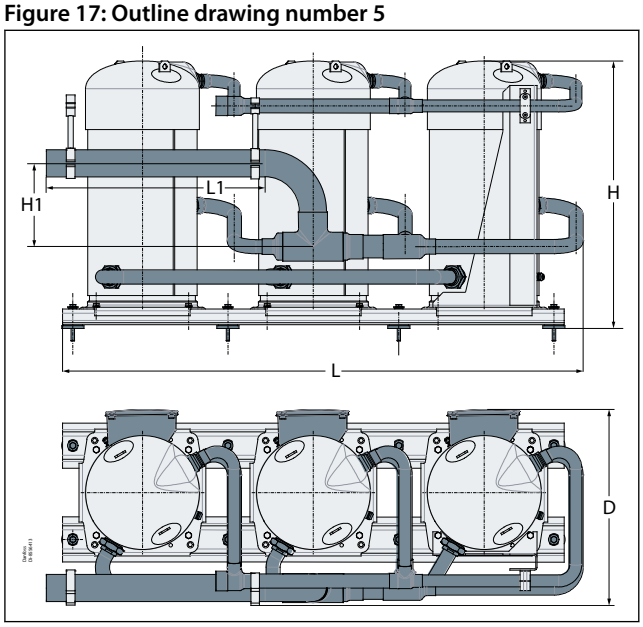


Table 16: Trio assemblies

Trio model	Composition	Motor voltage code	L		D		H		L1		H1		Outline drawing number	
			mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
PSH237T	PSH079 + PSH079 + PSH079	4, 7, 9	1530	60.2	545	21.5	783	30.8	535	21.1	211	8.3	4	8556411
		3	1530	60.2	600	23.6	783	30.8	535	21.1	211	8.3		
PSH263T	PSH079 + PSH079 + PSH105	4, 7, 9	1528	60.2	545	21.5	783	30.8	535	21.1	211	8.3	4	8556410
		3	1528	60.2	600	23.6	783	30.8	535	21.1	211	8.3		
PSH289T	PSH105 + PSH105 + PSH079	4, 7, 9	1526	60	574	22.6	783	30.8	640	25.2	244	9.6	4	8556412
		3	1526	60	629	24.8	783	30.8	640	25.2	244	9.6		
PSH315T	PSH105 + PSH105 + PSH105	4, 7, 9	1526	60	574	22.6	783	30.8	640	25.2	244	9.6	4	8556413
		3	1526	60	591	23.3	783	30.8	640	25.2	244	9.6		

NOTE:
Trio to be achieved by assembly of individual compressors

Mechanical connections

Connection details

Figure 18: PSH052-065

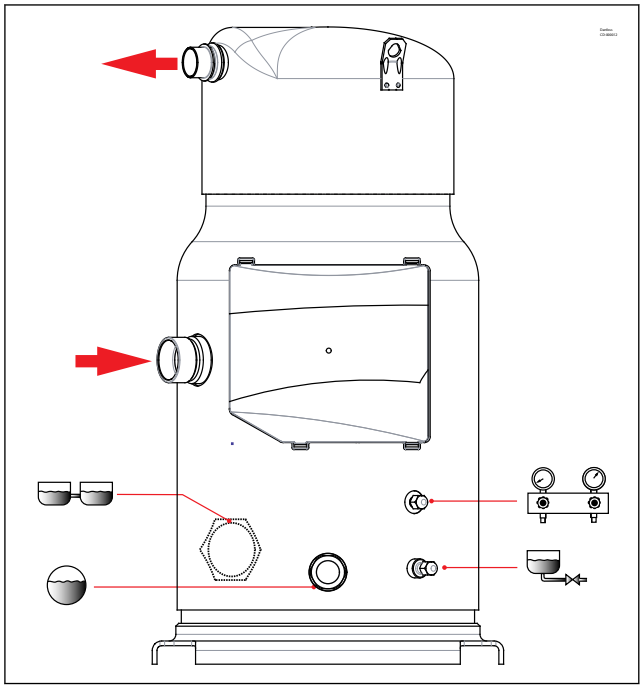
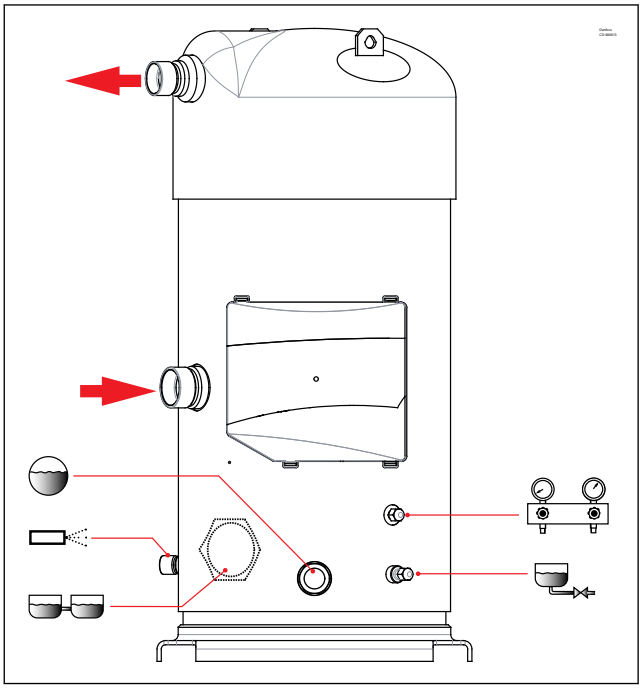
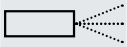


Figure 19: PSH079-105



Connection details		PSH052-065	PSH079	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		Threaded (1"1/8 - 18 UNEF)		
Oil equalization connection		Rotolock 2" 1/4		
Oil drain connection		Female ¼" Flare incorporating a Schrader valve		
Low pressure gauge port (Shrader)		Male ¼" Flare incorporating a Schrader valve		
Injection connection		5/8" ODF		

Design compressor mounting

General requirements

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

Single requirements

Mounting of PSH052-079

Compressors PSH052-079 is delivered with rubber grommets and steel mounting sleeve used to isolate the compressor from the base frame.

The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The required bolt size for the PSH052-079 compressors is HM8-55. This bolt must be tightened to a torque of 21Nm.

Figure 20: Rubber grommets from kit

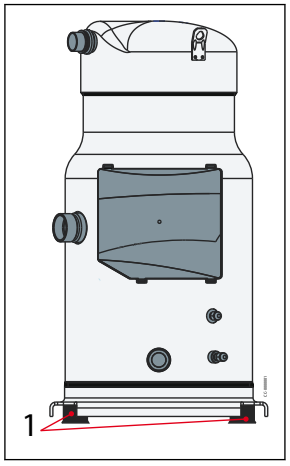
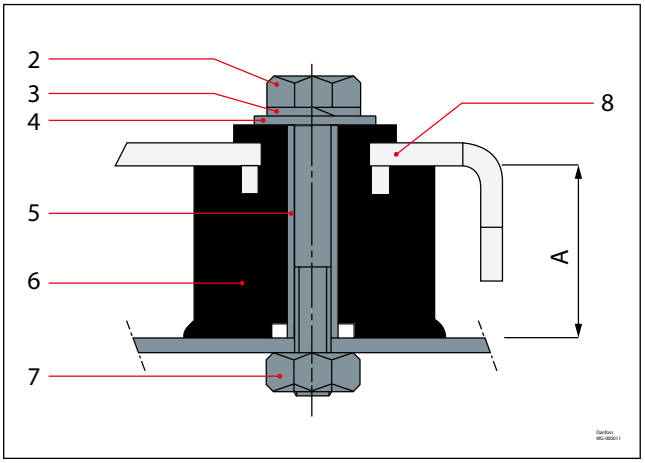


Figure 21: Rubber grommets



A	PSH052-065: 27.5 mm / 1.08 inch PSH079: 26.5mm / 1.04 inch
1	Rubber grommets from kit
2	HM 8 bolt
3	Lock washer
4	Flat washer
5	Steel mounting sleeve
6	Rubber grommet
7	Nut
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 22: Rigid grommets from kit

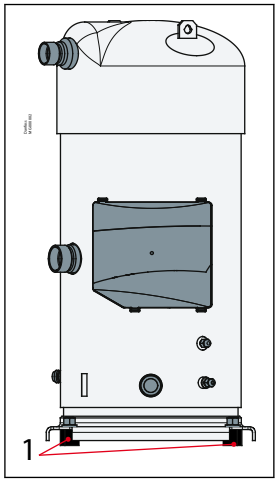
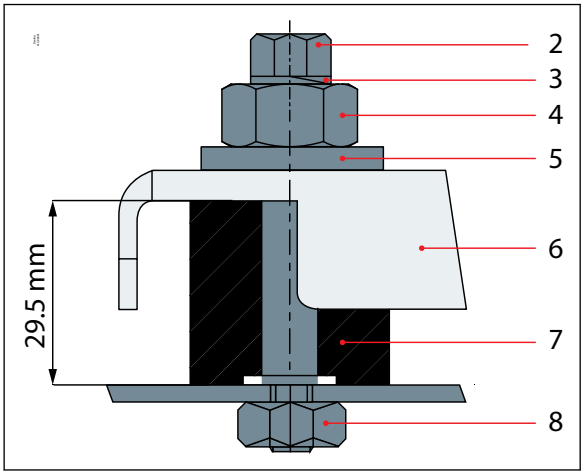


Figure 23: Rigid grommets



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

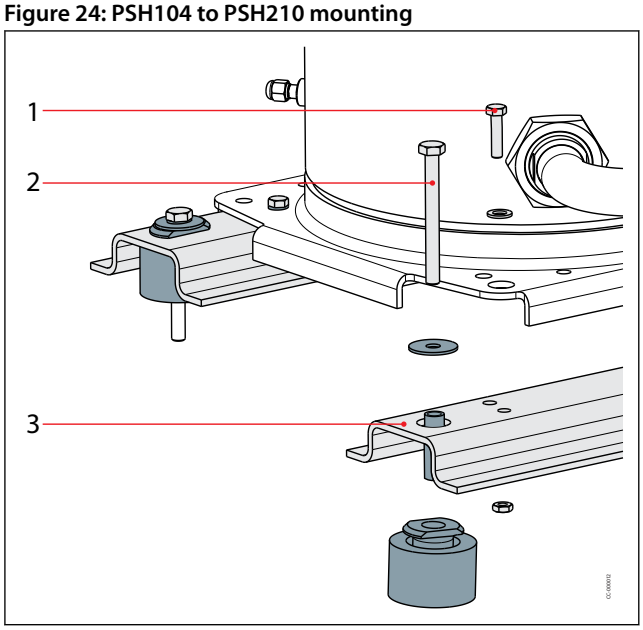
Tandem requirements

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.

Mounting of PSH104-210

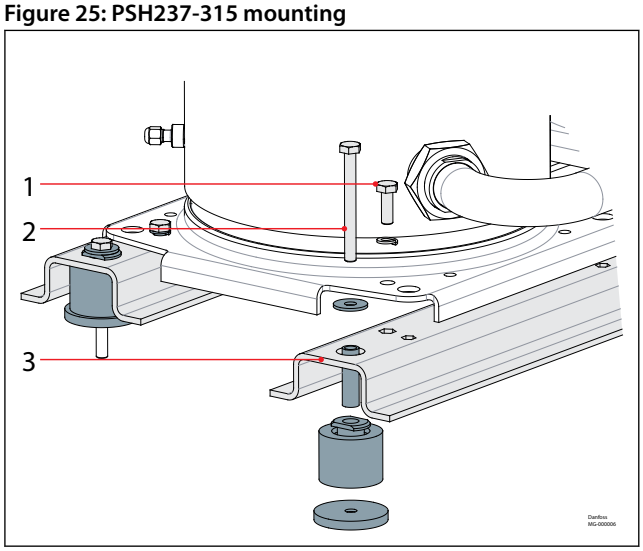
Figure 24: PSH104 to PSH210 mounting



1	HM10 x 30 class 10.9 Tightening torque 50 Nm
2	HM10 x 100 class 10.9 Tightening torque 50Nm
3	Thickness : 5mm (0.2 inch)
	Included in tandem kit
	Not supplied

Mounting of PSH237-315

Figure 25: PSH237-315 mounting



1	HM10 x 30 class 10.9 Tightening torque 50 Nm
2	HM10 x 100 class 10.9 Tightening torque 50Nm
3	Thickness : 5.5mm (0.22 inch)
	Included in trio kit
	Not supplied

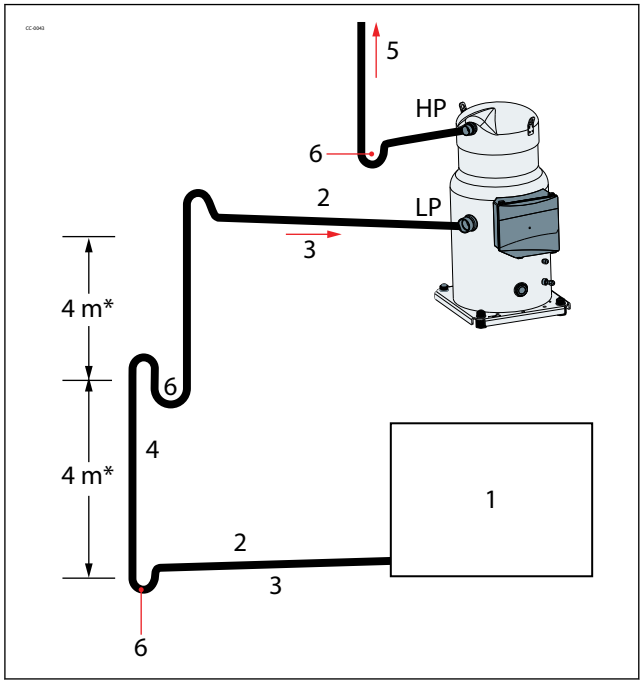
Design piping

General requirements

Proper piping practices should be employed to:

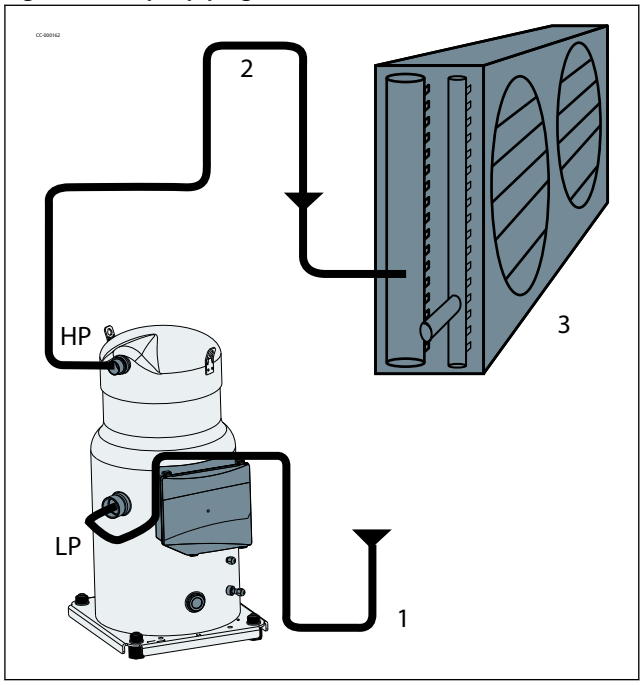
1. Ensure adequate oil return, even under minimum load conditions (refrigerant speed, piping slopes…). For validation tests see section Manage oil in the circuit.
2. Avoid condensed liquid refrigerant from draining back to the compressor when stopped (discharge piping upper loop). For validation tests 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 26: Proper piping - 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 27: Proper piping - Condenser



1	3D flexibility
2	Upper loop
3	Condenser

Tandem and trio requirements (Static)

Tandem and trio 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 and trios are not factory-built. To complete an assembly in the field, you will need:

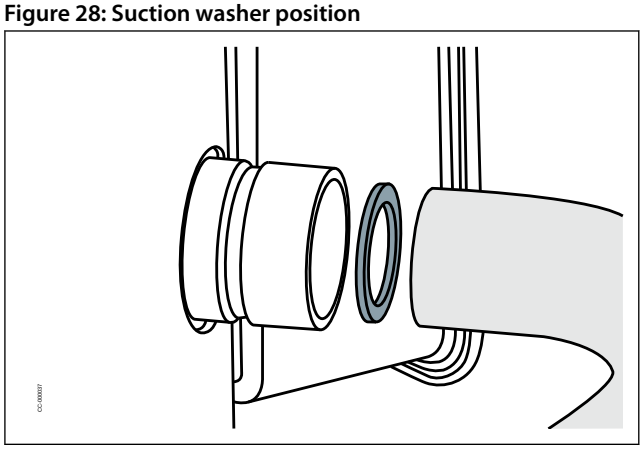
- Tubings, according to specific outline drawings indicated in the following table.
- Manifolding accessory kit.
- Compressors.

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

Suction washer position

Depending on manifold configuration, it is essential to equalize the pressure of compressor sumps. Hence, a suction washer must be added on certain compressors according to the table. Suction washers are included in tandem or trio accessory kits as described in the illustrations.

Figure 28: Suction washer position



	Included in tandem or trio accessory kit
	Not supplied

By convention, the compressor order (No.1, No.2 ...) is defined counting from left to right, placed on the side facing the electrical boxes of the compressors (see example below on a trio)

Figure 29: Example of right suction

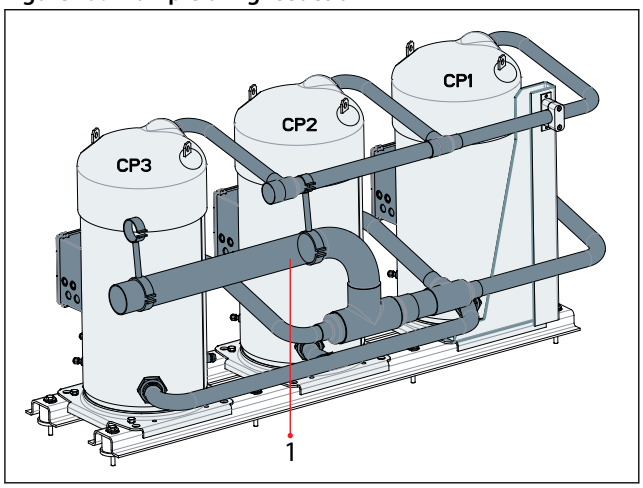
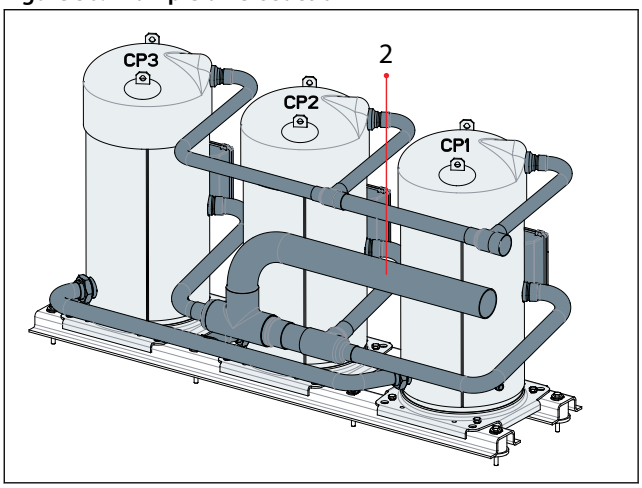


Figure 30: Example of left suction



1	Trio models with Right suction
2	Trio models with Left suction
Cp1	Compressor 1
Cp2	Compressor 2
Cp3	Compressor 3

Tandem models

Table 17: Tandem models

Model	Composition Cp1 + Cp2	Suction	Discharge	Oil equalization	Outline drawing number	Suction from	Washer inner diameter	Washer in suction of	Tandem kit code
PSH104E	PSH052+PSH052	2"1/8	1"5/8	1"3/8	8556339	Left Right	Not Needed	-	120Z0792
PSH130E	PSH065+PSH065	2"1/8	1"5/8	1"3/8	8556339	Left Right	Not Needed	-	120Z0792
PSH158E	PSH079+PSH079	2"1/8	1"5/8	1"3/8	8556409	Left Right	Not Needed	-	120Z0792

Model	Composition Cp1 + Cp2	Suction	Dis-charge	Oil equaliza-tion	Outline drawing number	Suction from	Washer inner di-ameter	Washer in suction of	Tandem kit code
PSH170U	PSH065+PSH105	2"5/8	1"5/8	1"5/8	8556406	Left	28mm(1.10inch)	Cp1	120Z0904
						Right	27mm(1.06inch)	Cp1	
PSH184U	PSH079+PSH105	2"5/8	1"5/8	1"5/8	8556407	Left	33mm(1.30inch)	Cp1	120Z0903
						Right	30mm(1.18inch)	Cp1	
PSH210E	PSH105+PSH105	2"5/8	1"5/8	1"5/8	8556408	Left	Not Needed	-	120Z0785
						Right			

Trio models

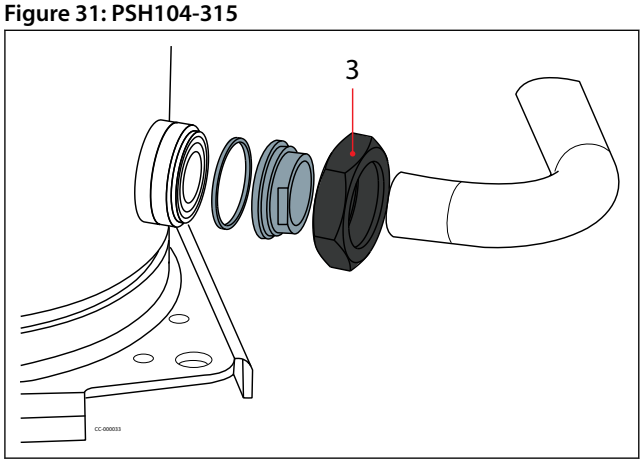
Table 18: Trio models

Model	Composition Cp1 + Cp2 + Cp3	Suction	Dis-charge	Oil equali-zation	Outline drawing number	Suction from	Washer inner diameter	Washer in suction of	Trio kit code
PSH237T	PSH079+PSH079+PSH079	2"5/8	1"5/8	1"5/8	8556411	Left	cp1:30mm(1.18inch) cp3:30mm(1.18inch)	Cp1&cp3	120Z0900
						Right	cp1:31mm(1.22inch)	Cp1	
PSH263T	PSH079+PSH079+PSH105	2"5/8	1"5/8	1"5/8	8556410	Left	29mm(1.14inch)	Cp1	120Z0901
						Right	29mm(1.14inch)	Cp1	
PSH289T	PSH105+PSH105+PSH079	3"1/8	1"5/8	1"5/8	8556412	Left	29mm(1.14inch)	Cp3	120Z0901
						Right	29mm(1.14inch)	Cp3	
PSH315T	PSH105+ PSH105 +PSH105	3"1/8	2"1/8	1"5/8	8556413	Left	Cp2: 33mm(1.30inch), Cp3: 32mm(1.26inch)	Cp2 & CP3	120Z0902
						Right	CP2:33mm(1.30inch) CP3:33mm(1.30inch)	Cp2 & CP3	

Oil equalization design PSH104-315

The oil level is balanced by a pipe of 1"3/8 or 1"5/8. To connect the equalization line on rotolock connections, the adaptor sleeves included in the tandem or trio accessory kit must be used.

Figure 31: PSH104-315



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

Electrical connections

Wiring connections

For PSH compressors, electrical power is connected to the compressor terminals 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.

PSH052-105 (Except PSH079/105 code 3)

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.

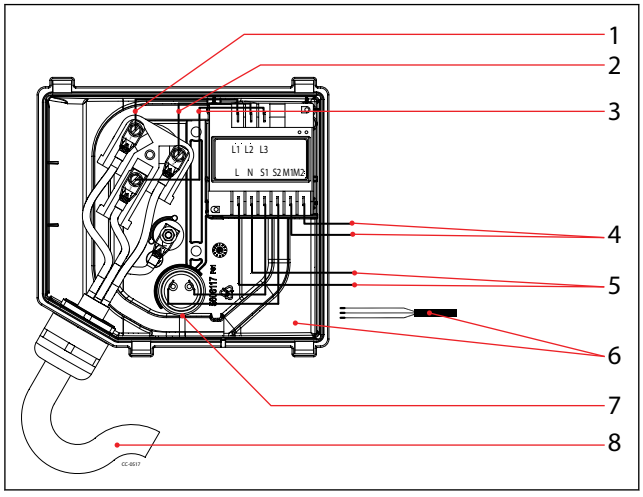
The 3 power supply knockouts accommodate the following diameters:

- Ø 50.8mm (φ 2inch) (UL 1"1/2 conduit) & Ø 43.7mm (φ 1.72inch) (UL 1"1/4 conduit) & Ø 34.5mm (φ 1.36 inch) (UL 1" conduit)
- Ø 40.5mm (φ 1.59inch) (ISO40) & Ø 32.2mm (φ 1.27inch) (ISO32) & Ø 25.5 mm (φ 1 inch) (ISO25)
- Ø 25.5 mm (φ 1 inch) (ISO25)

The 4 other knockouts are as follows:

- Ø 22.5mm (φ 0.89inch) (PG16) (UL 1/2") & Ø 16.5mm (φ 0.65inch) (ISO16) (x2)
- Ø 20.7mm (φ 0.81inch) (ISO20 or PG13.5) (x2)

Figure 32: PSH052-105 (Except PSH079/105 code 3)



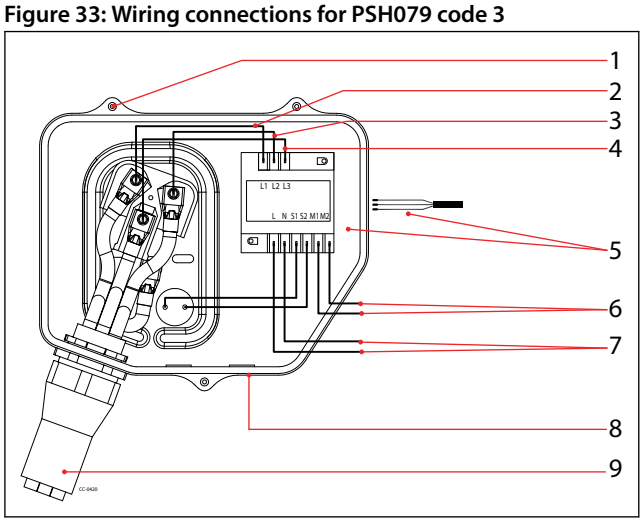
1	Black
2	Blue
3	Brown
4	M1, M2 Control circuit
5	Module power supply
6	Sump heater
7	Faston 1/4" tabs
8	Power supply

PSH079 code 3

The terminal box is provided with:

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

Figure 33: Wiring connections for PSH079 code 3



1	Cover holding screws (x3). Torque 2.2 Nm
2	Black
3	Blue
4	Brown
5	Sump heater
6	M1, M2 Control circuit
7	Power supply
8	Terminal box
9	Power supply

PSH105 code 3

The terminal box is provided with 2 triple knockouts for power supply, 2 double knockouts and 3 simple knockouts for the safety control circuit.

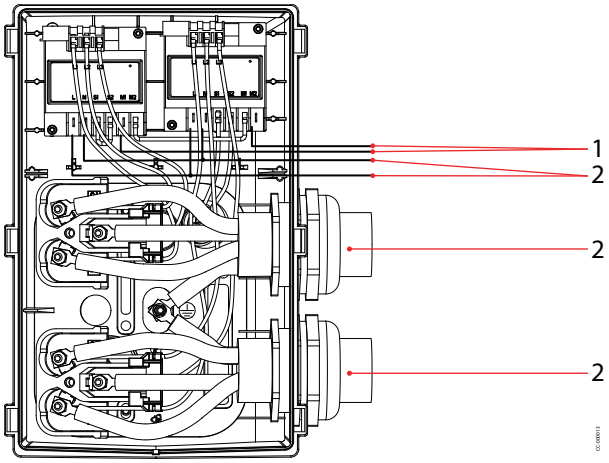
The 2 power supply knockouts accommodate the following diameters:

- Ø 63.5mm (φ 2.5inch) (ISO63 and UL 2"conduit) & Ø 54.2mm (φ 2.13inch) (PG42)& 43.7mm (UL 1"1/4 conduit)

The 5 other knockouts are as follows:

- Ø 22.5mm (φ 0.89inch) (PG16) (UL 1/2") & Ø 16.5mm (φ 0.65 inch) (ISO16)
- Ø 25.5mm (φ 1inch) (ISO25) & 20mm (φ 0.79inch) (ISO20 or PG13.5)
- Ø 22.5mm (φ 0.89inch) (PG16) (UL 1/2")
- Ø 25.5mm (φ 1inch) (ISO25) (x2)

Figure 34: Wiring connections for PSH105 code 3



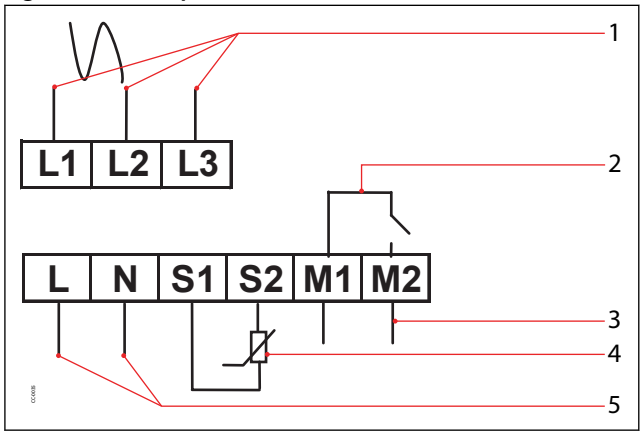
1	M1, M2 Control circuit
2	Power supply

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 35: 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 PSH are available in four different motor voltages as listed below.

Table 19: Motor voltage

Frequency	Motor voltage code	Code 3	Code 4	Code 7
50 Hz	Nominal voltage	-	380-415V-3ph	-
60 Hz	Nominal voltage	208-230V-3ph	460V-3ph	575V-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 20: Motor voltage code 3

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
PSH052	455	84	103	0.153
PSH065	600	117	123	0.105
PSH079	735	153	168	0.045
PSH105	761	140	185	0.10

Table 21: Motor voltage code 4

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
PSH052	230	40	43	0.567
PSH065	290	49	56	0.421
PSH079	310	58	69	0.228
PSH105	385	69	91	0.285

Table 22: Motor voltage code 7

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
PSH052	175	35	35	0.475
PSH065	220	41	42	0.683
PSH079	260	50	57	0.325
PSH105	296	58	72	0.678

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 broken link: X019816).

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

PSH052-105

Compressor models PSH052-105 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 (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 36: PTC Overheat

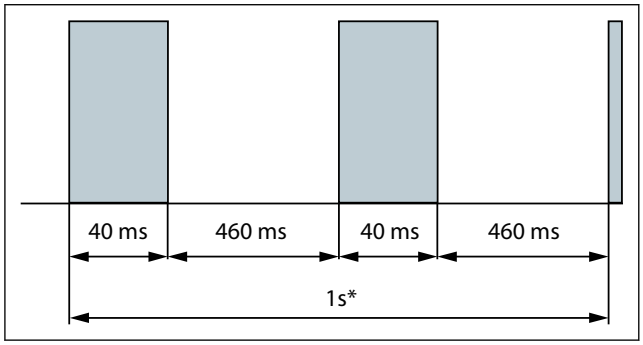
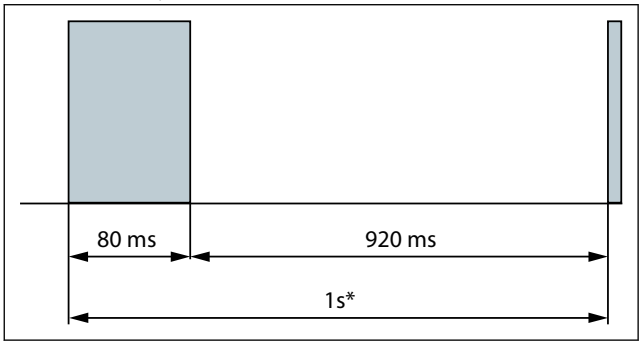


Figure 37: Delay timer active (after PTC over temp.)



*	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 the Max Operating Current value (MOC) :

- 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

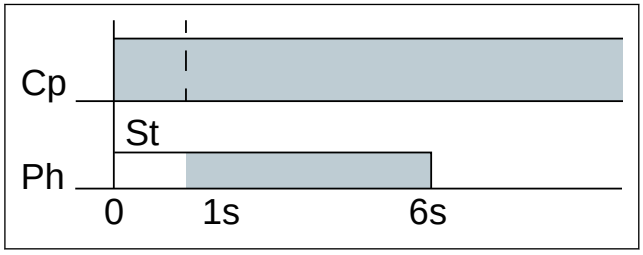
PSH052-105

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 PSH052-105 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 38: 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 39: In case of phase reverse error

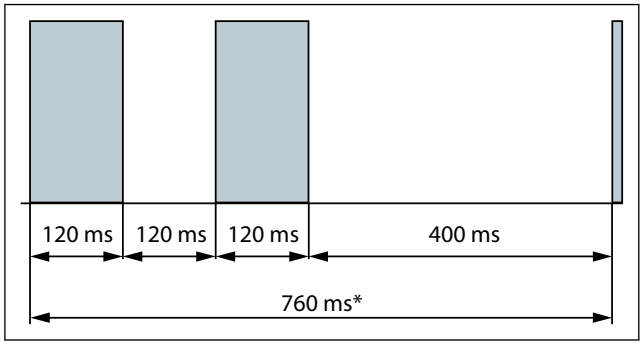
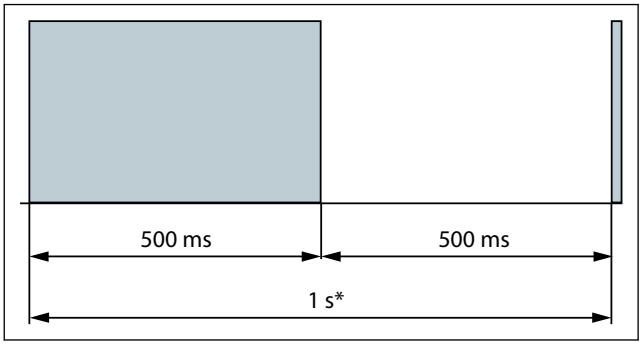


Figure 40: In case of phase loss error:



*	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.

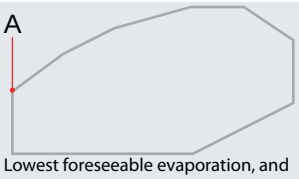
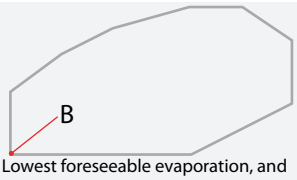
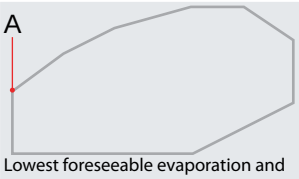
System evaluation

Table 23: Manage oil in the circuit - System evaluation

Split type	Single compressor	Manifold compressors
Non split	Test No.1+2	Test No.1+2+3
Split	Test No.1+2+4	Test No.1+2+3+4

Test, criteria and solutions

Table 24: 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. 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 proper oil return at low injection flow conditions	 Lowest foreseeable evaporation, and lowest foreseeable condensation on the injection area. **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. Typically, up to 3% of the total system refrigerant charge (in weight). Above 3% look for potential oil trap in the system. 2. Check that injection line is properly sized and have no possible oil trap (for more details see section Design piping). 3. Integrate a function in control logic to run all compressors simultaneously in order to boost oil return (for more details see section Control logic) 4. Oil separator can be added
3	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 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)
4	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.

Manage sound and vibration

Sound radiations

Mitigations methods: We can consider two means to reduce compressors sound radiations:

1. Acoustic hoods are quick and easy to install and do not increase the overall size of the compressors. Acoustic hoods are available from Danfoss as accessories. Refer to the tables above for sound levels, attenuation and code numbers.
2. Use of sound-insulation materials on the inside of unit panels is also 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.

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

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

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

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.

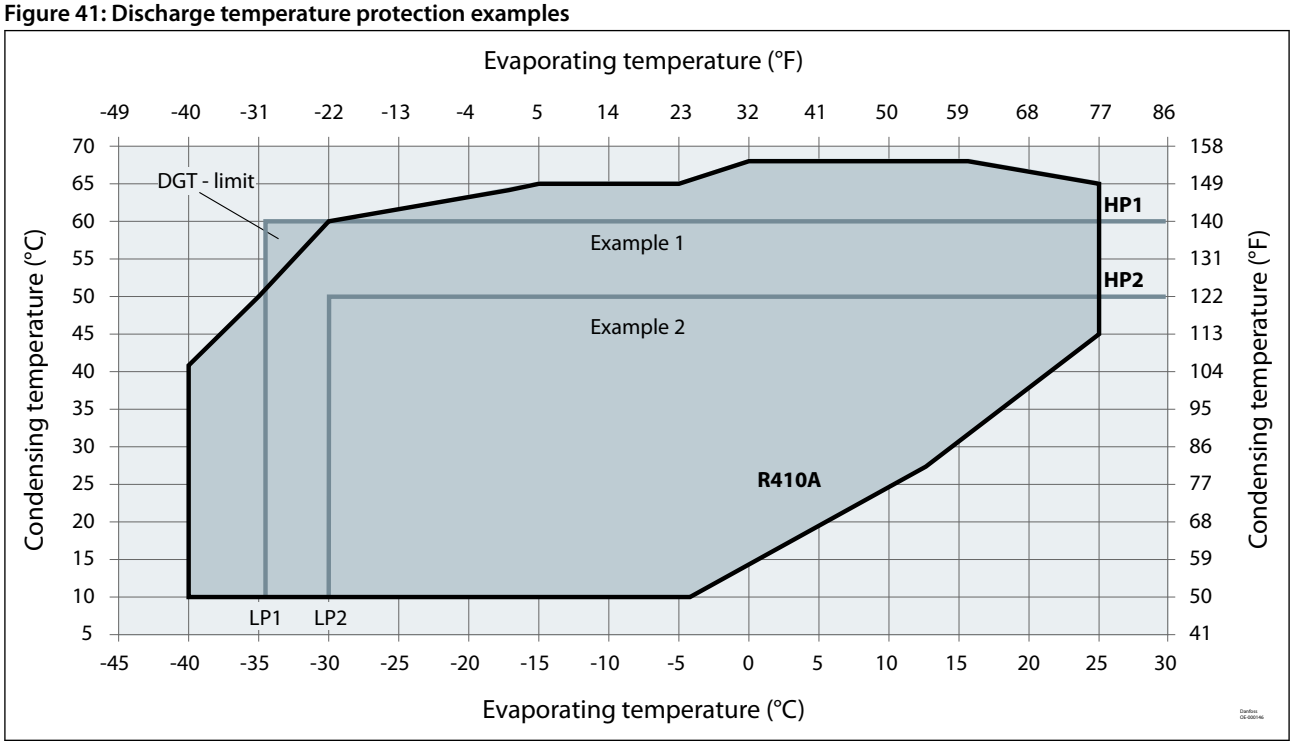
Discharge temperature protection

PSH052-105 include an integrated discharge temperature protection. Excessive discharge temperature will result in tripping of electronic module output relay.

This protection, effective for suction superheat above 5K (9°F), should be considered as a compressor safety device and its purpose is not to ensure operation map control.

In case of basic map control by pressure switches that can not ensure totally that the compressor will remain in its operating envelope, an additional external discharge protection is required. (see below Figure 41: Discharge temperature protection examples)

Figure 41: Discharge temperature protection examples



Example 1 (R410A, SH = 5K)
LP switch setting: LP1 = 1.3 bar (g) (-34°C), HP switch setting: HP1 =37 bar (g) (60°C)
Risk of operation beyond the application envelope.
DGT protection required.

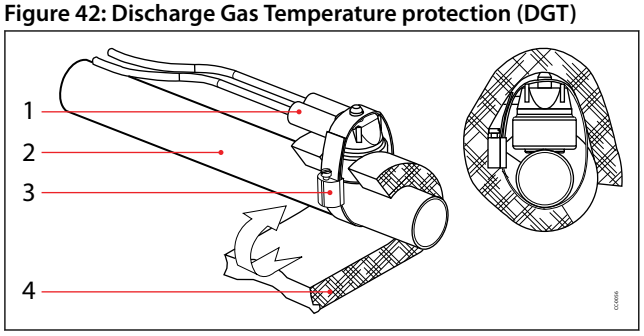
Example 2 (R410A, SH = 5K)
LP switch setting: LP2 = 1.7 bar (g) (-30°C), HP switch setting: HP2 = 30 bar (g) (50°C)
No risk of operation beyond the application envelope.
No DGT protection required.

This external protection device can be a thermostat or a temperature sensor. The discharge gas temperature protection must trip the power supply when it reaches the setting point to protect the compressor from overheating.

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

The discharge gas thermostat must be attached to the discharge line within 40mm (1.57 inch) from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe (see Figure 42: Discharge Gas Temperature protection (DGT))

Figure 42: Discharge Gas Temperature protection (DGT)



1	Thermostat or temperature sensor
2	Discharge line
3	Bracket
4	Insulation

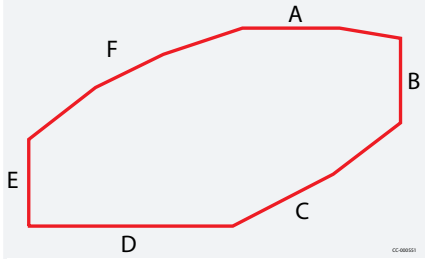
System evaluation

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

Table 25: 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 broken link: X002047.



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:
*PSH052-105 compressor includes an integrated Discharge Gas Temperature protection (DGT). Excessive discharge temperature will result in tripping of electronic module output relay.

Manage superheat

Requirement

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

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.

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

R Suction accumulator must be added in system

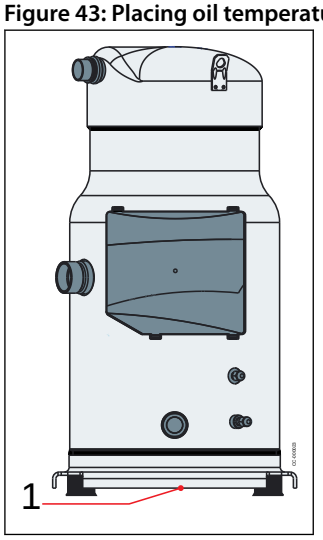
Test	Purpose	Test condition	Pass criteria	Solutions
Liquid flood back test	Steady-state	 Liquid flood back testing must be carried out under expansion valve threshold operating conditions: a high pressure ratio and minimum evaporator load.	Suction superheat >5 K	Check expansion valve selection and setting. • For Thermostatic expansion valve (TXV) check bulb position... • For Electronic expansion valve (EXV) check measurement chain and PID....
	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).	In reversible systems, the defrost logic can be worked out to limit liquid floodback effect (for more details see Control logic).

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)

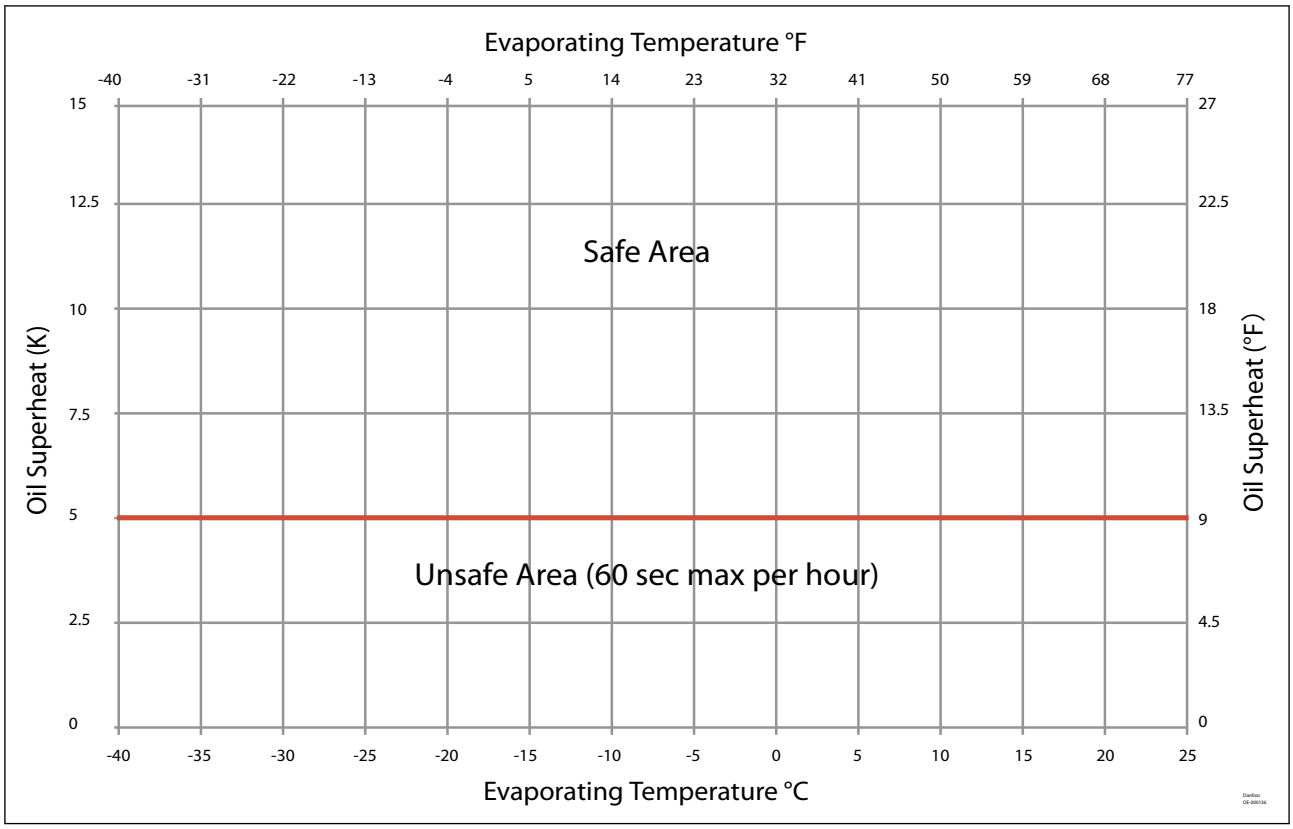
Figure 43: Placing oil temperature sensor



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

Dilution Chart - PSH052-105 R410A/R454B

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.
- Recommend to install an additional solenoid valve on the injection line to prevent the refrigerant coming back directly into the compressor scroll set during off-cycles.

System evaluation

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

Table 26: System charge

BELOW charge limit	ABOVE charge limit
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	
No test or additional safeties required	• Crankcase heater

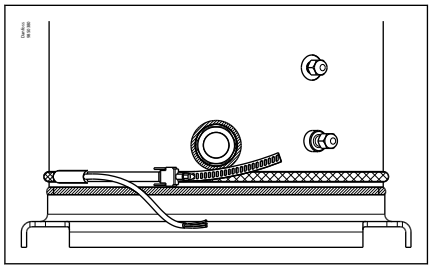
Crankcase heater

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

For PSH052-105 the use of a 75W belt heater is mandatory, 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 27: Belt sump selection principle

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



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 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 the minimum low pressure safety switch setting. For more details on pump-down cycle see section Control logic.

Charge limits

Table 28: Charge limits for single models

Models	Refrigerant charge limit	
	kg	lbs
PSH052-065	13.5	30
PSH079-105	17	37

Table 29: Charge limits for Tandem models

Model	Composition	Refrigerant charge limit	
		kg	lbs
PSH104E	2xPSH052	17.6	38.8
PSH130E	2xPSH065	17.6	38.8
PSH158E	2xPSH079	22.1	48.7

Model	Composition	Refrigerant charge limit	
		kg	lbs
PSH170U	PSH65+PSH105	19.8	43.7
PSH184U	PSH079+PSH105	22.1	48.7
PSH210E	2xPSH105	22.1	48.7

Table 30: Charge limits for Trio models

Model	Composition	Refrigerant charge limit	
		kg	lbs
PSH237T	3xPSH079	28.8	63.5
PSH263T	PSH105+PSH079+PSH079	28.8	63.5
PSH289T	PSH105+PSH105+PSH079	28.8	63.5
PSH315T	3xPSH105	28.8	63.5

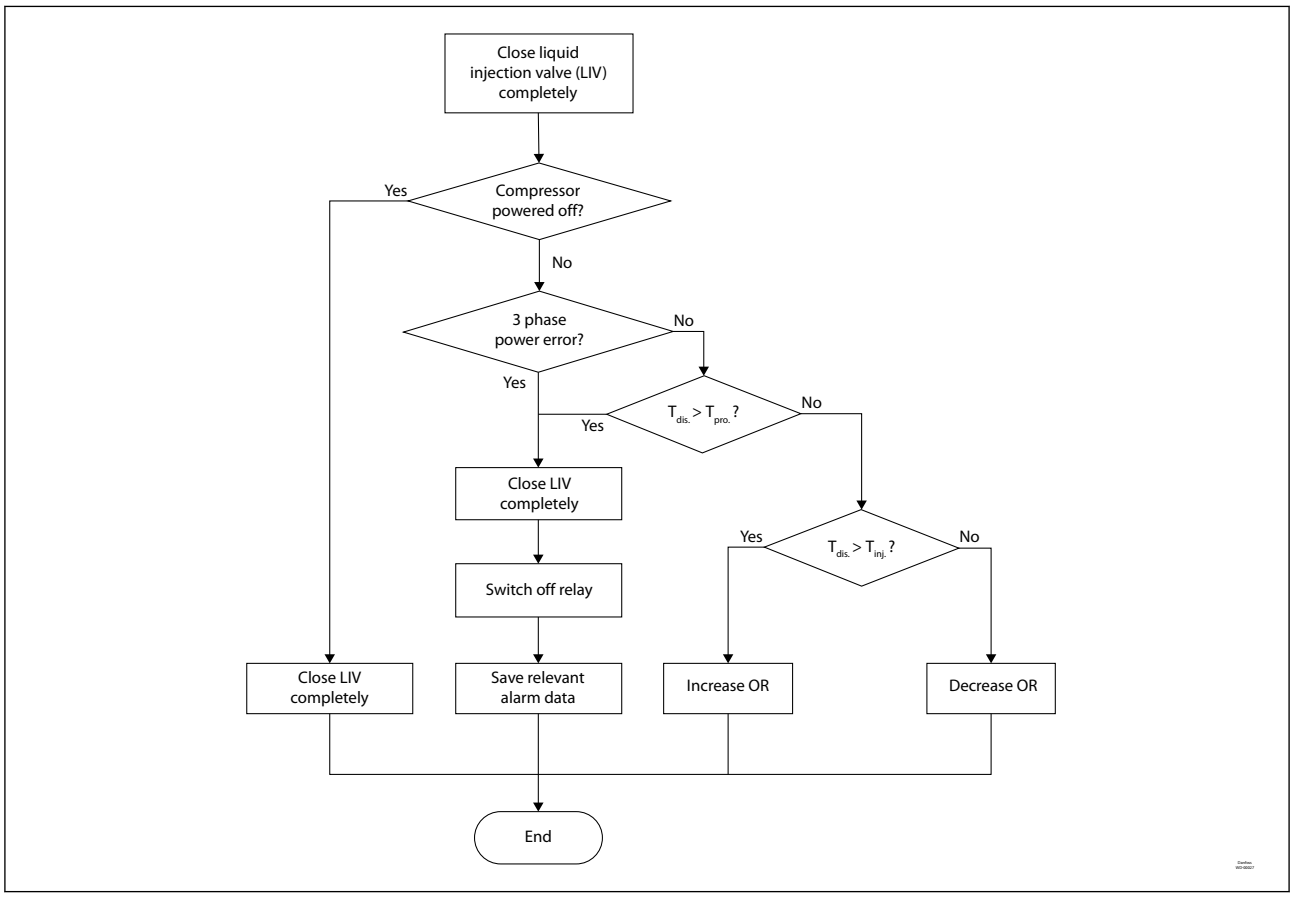
Manage injection

PSH compressors can be used on single configuration but also in tandem and trio manifold.

This paragraph focuses on single and tandem configurations. For trios configurations, please contact Danfoss.

Liquid injection only

PSH compressors can be used with only with liquid injection (see “Introduction” for a general presentation). On this configuration, the compressor is running without injection (see “Operating envelope data” - LI/Non injection operating map). A liquid injection occurs to extend the map and control the DGT. To do so, the architecture of the unit and the control logic have to manage the flow of liquid injected following the flowchart below.



OR	Opening ratio of injection valve
$T_{dis.}$	Compressor discharge temperature
$T_{pro.}$	Discharge temperature protection setpoint. It should be 135°C
$T_{inj.}$	The advice discharge temperature control point is 121°C

NOTE:
To avoid short cycling of the Liquid Injection valve, an hysteresis of [+2K/-2K] on the discharge temperature control point can be applied. It can be customizable on a range [+5K/-5K] by step of 1K.

For reliability reasons, Danfoss recommend to control each compressor. This means that an individual DGT and an LIV per compressor is recommended.

DGT criteria

The temperature sensor should be placed in contact on the discharge pipe at 40mm from the connection to the compressor. Thermal paste between the sensor and the pipe combined to a surrounded thermal insulation improve the measurement of this temperature.

The table below presents a pre-selection of LIV, DGT sensor and controller for the different configurations of PSH using R454B. the components selected based on dedicated conditions, they can cover most of the applications. customer should always do their qualification based on different system. If any question Please contact Danfoss technical support.

Model		LIV	DGT temperature sensor	Controller
50 and 60 Hz	PSH052	ETS5M13 (released Q2/2025)	AKS sensor (or other PT1000)	EKE100 1V (release Q4/2024)
	PSH065			
	PSH079			
	PSH105			
	PSH104 (2*PSH052)			
	PSH130 (2*PSH065)			
	PSH158 (2*PSH079)			
	PSH210 (2*PSH105)			

Vapor + Wet injection

To improve the performances, PSH compressors can use Vapor + Wet injection (see “Introduction” for a general presentation). A continuous 5K superheated vapor injection occurs on the related map (see “Operating envelope data” - VI operating map). When the DGT starts to increase due to the operating conditions, the superheat of the vapor injection shall be decreased to keep the DGT between 121°C and 135°C. A dedicated expansion valve, an Intermediate Exchanger and a solenoid valve per compressor (EXV + IE + Sol v on Figure 5 and 6) need to be integrated on the refrigerant circuit.

The table below presents a pre-selection of EXV, IE and Sol v for the different configurations of PSH using R454B.

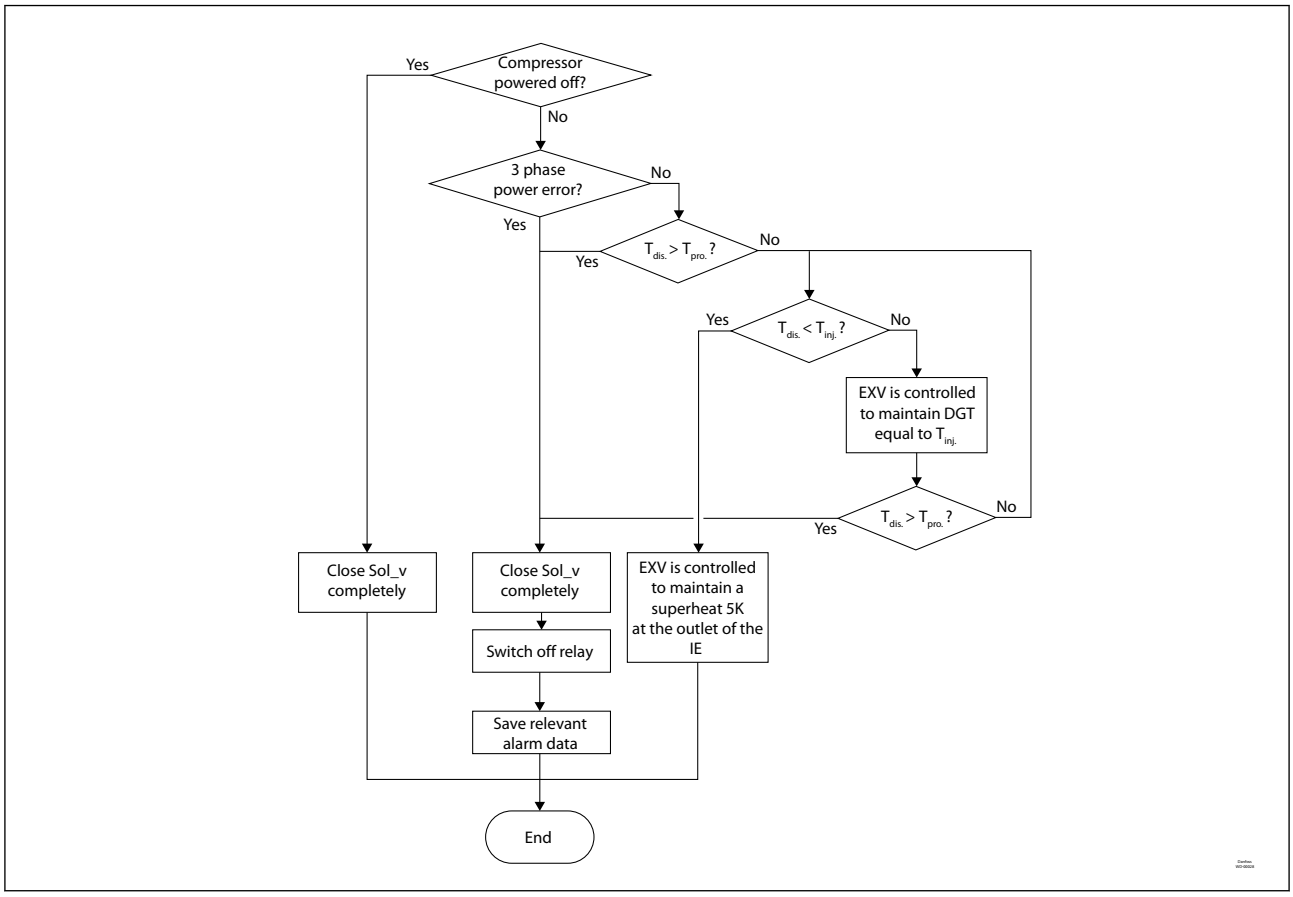
Note: these selections allow to cover Vapor + Wet injection for hydronic Heat pumps for evaporating temperature up to 15°C and pressure ratio higher than 2.

For more specific applications or for optimized selection, please contact Danfoss.

Model		Architecture	Injection EXV	IE	Injection and DGTtemperature sensor	Sol v(1 per comp.)
50 Hz	PSH052	Upstream	ETS5M17	C55L-EU-10	AKS sensor (or other PT1000)	EVR10v2
		Downstream		C55L-EU-12		
	PSH065	Upstream	ETS5M20	C55L-EU-12		EVR10v2
		Downstream		C55L-EU-14		
	PSH079	Upstream	ETS5M25	C55L-EU-16		EVR10v2
		Downstream		C55L-EU-18		
	PSH105	Upstream	ETS5M25	C55L-EU-20		EVR15v2
		Downstream	ETS5M30	C55L-EU-22		
	PSH104 (2*PSH052)	Upstream	ETS5M25	C55L-EU-18		EVR10v2
		Downstream		C55L-EU-20		
	PSH130 (2*PSH065)	Upstream	ETS5M30	C55L-EU-22		EVR10v2
		Downstream		C55L-EU-24		
	PSH160 (2*PSH079)	Upstream	ETS5M40	C55L-EU-24		EVR10v2
		Downstream		C55L-EU-26		
	PSH210 (2*PSH105)	Upstream	ETS8M40S-10	C55L-EU-38		EVR15v2
		Downstream		C55L-EU-40		
60 Hz	PSH052	Upstream	ETS5M20	C55L-EU-12		EVR10v2
		Downstream		C55L-EU-14		
	PSH065	Upstream	ETS5M20	C55L-EU-14		EVR10v2
		Downstream	ETS5M24	C55L-EU-16		
	PSH079	Upstream	ETS5M25	C55L-EU-18		EVR10v2
		Downstream	ETS5M30	C55L-EU-20		
	PSH105	Upstream	ETS5M30	C55L-EU-22		EVR15v2
		Downstream		C55L-EU-24		
	PSH104 (2*PSH052)	Upstream	ETS5M25	C55L-EU-22		EVR10v2
		Downstream		C55L-EU-24		
	PSH130 (2*PSH065)	Upstream	ETS5M30	C55L-EU-24		EVR10v2
		Downstream		C55L-EU-26		
	PSH160 (2*PSH079)	Upstream	ETS5M40	C55L-EU-26		EVR10v2
		Downstream	ETS8M40S-10	C55L-EU-28		
	PSH210 (2*PSH105)	Upstream	ETS5M40	C55L-EU-44		EVR15v2
		Downstream	ETS8M40S-10	C55L-EU-46		

EXV	Electronic Expansion Valve (ETS 5M will release in Q2/2025)
IE	Intermediate Exchanger
Sol v	Solenoid Valve

In the VI+WI injection configuration, the architecture of the unit and the control logic must manage the flow of liquid injected following the flowchart below.



$T_{dis.}$	Compressor discharge temperature
$T_{pro.}$	Discharge temperature protection setpoint. It should be 135°C
$T_{inj.}$	The advice discharge temperature control point is 121°C

NOTE:
To avoid short cycling of the Liquid Injection valve, an hysteresis of [+2K/-2K] on the discharge temperature control point can be applied. It can be customizable on a range [+5K/-5K] by step of 1K.

This control logic of the VI+WI injection will be embedded in EKE100 2V using the “DGT control” mode. (released Q4/2024)

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 models PSH052-105 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 44: Compressor model PSH052-079

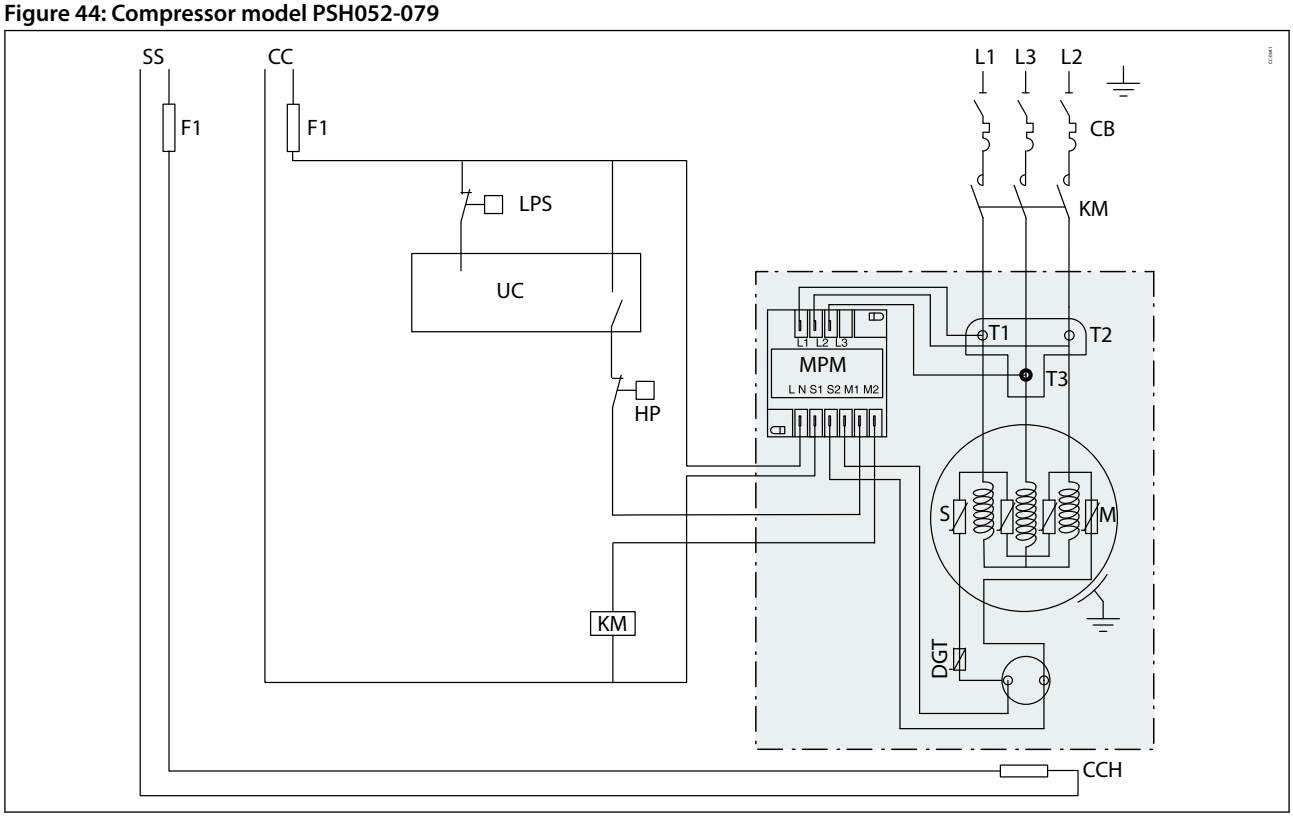


Figure 45: Compressor model PSH105

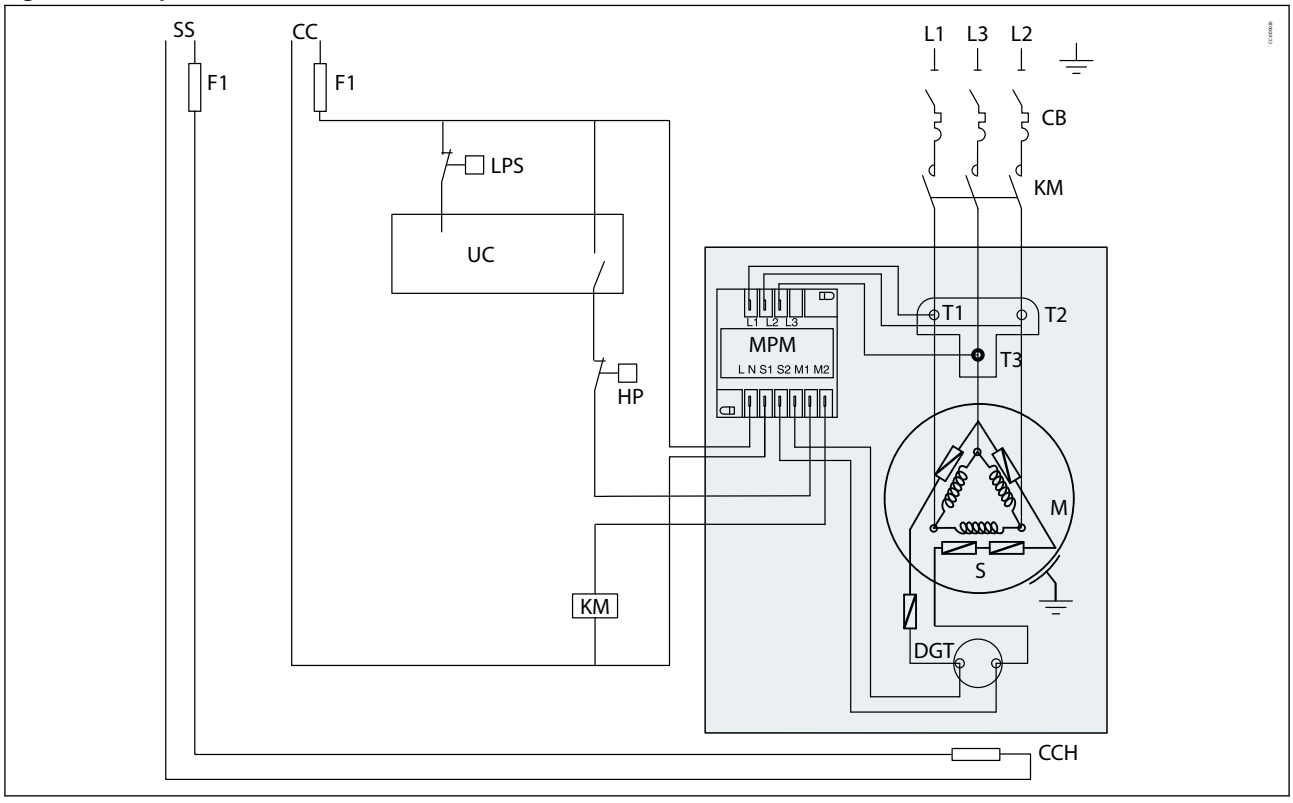
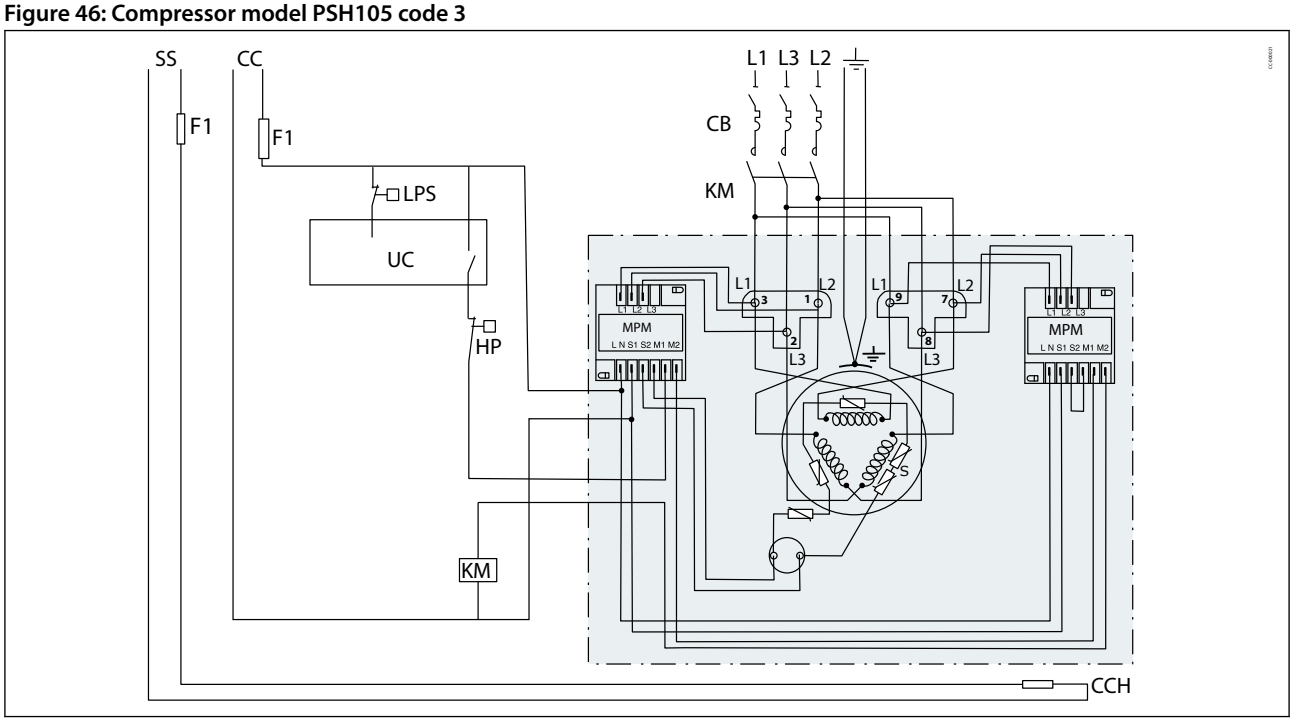


Figure 46: Compressor model PSH105 code 3



CB	Thermal magnetic motor circuit breaker	**M**	Compressor motor
CC	Control circuit	**MPM**	Motor Protection Module
DGT	Discharge gas thermistor (embedded in compressor)	**S**	Thermistor chain (motor and discharge temperature)
F1	Fuses	**SS**	Seprate supply
HP	High pressure safety switch	**CCH**	Crankcase heater
KM	Compressor contactor	**UC**	Unit Controller
LPS	Safety pressure switch		

Soft starts

Soft starters are designed to reduce the starting current of 3-phase AC motors. Soft starters can be used on PSH compressor but, in order to ensure proper lubrication of compressor parts, the settings must ensure that the compressor start-up time is always less than 0.5 seconds.

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

In case of use with R454B make sure that the softstarter selected is compatible with A2L refrigerants.

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 N°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.

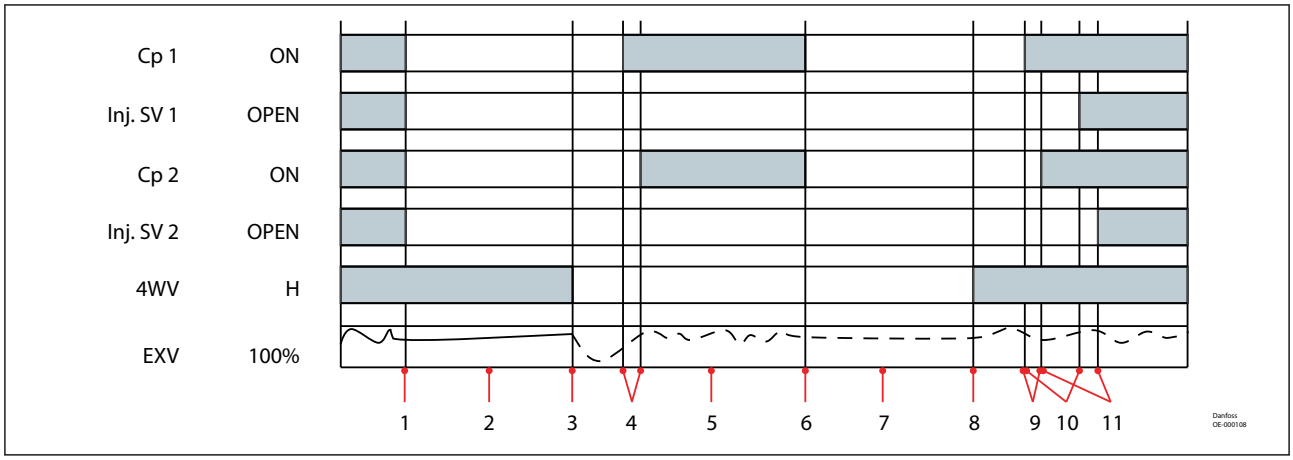
Defrost logic recommendations / Reversible systems

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. Reducing refrigerant flooding to compressor by transferring liquid refrigerant from one exchanger to the other before reversing valve thanks to pressures.

The following defrost logic combines both advantages:

Figure 47: Defrost logic advantages



Cp 1	Compressor 1
Cp 2	Compressor 2
ON	On
H	Heating
Inj.SV	Injection solenoid valve
OPEN	Open
1	Defrost start. Stop all compressors
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[1], change 4WV to cooling mode.
4	Start Cp1 and Cp 2 with 0.5 seconds delay between 2 successive starts
5	Defrost
6	Defrost end. Stop all compressors
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[1], change 4WV to heating mode.
9	Start Cp1 and Cp2 with a minimum delay of 0.5 s between two successive starts
10	Open vapor injection valve 1 with at least 5 seconds delay than compressor 1 start-up
11	Open vapor injection valve 2 with at least 5 seconds delay than compressor 2 start-up

R In reversible systems, to ensure compressor reliability, the 4-way valve must not reverse when the compressor is stopped due to heating or cooling demand (stop on thermostat).

[1] 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 Operating envelope data.

Pump-down logic recommendations

Pump down is initiated prior to shutting down the last compressor on the circuit by de-energizing a liquid line solenoid valve or closing electronic expansion valve. When suction pressure reached the cut-out pressure, compressor is stopped, and liquid solenoid valve or electronic expansion valve remains closed.The injection line should keep on working in case of the high discharge temperature during the pump down cycle.

Two types of pump-down exist:

- One shot pump down (preferred): when last compressor of the circuit stops, suction presssure is decreased 1.5bar (22psi) below nominal evaporating pressure with the minimum low pressure safety switch setting. Even if suction pressure increases again, the compressor will not restart.
- Continuous pump-down: traditional pump-down, Compressor restarts automatically when suction pressure increases up to 4 cycles maximum.

Non Return Valve (NRV)

PSH052-105 compressors integrate tight internal non return valve (INRV), therefore no external Non Return Valve (NRV) is needed.

Reduce moisture in the system

R 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
- Remove the injection port plug at last

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 Each Danfoss PSH 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 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 48: Heavy

Figure 49: Correct

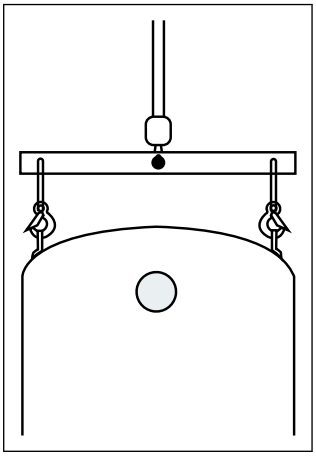


Figure 50: Incorrect

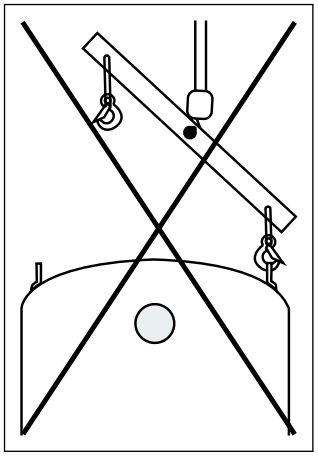
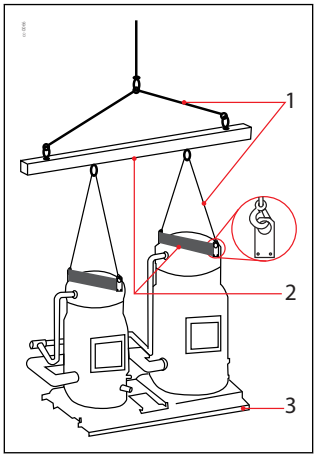


Figure 51: Handling



1	Slings
2	Spreader bars
3	Frame

Piping assembly

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

Table 31: 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.

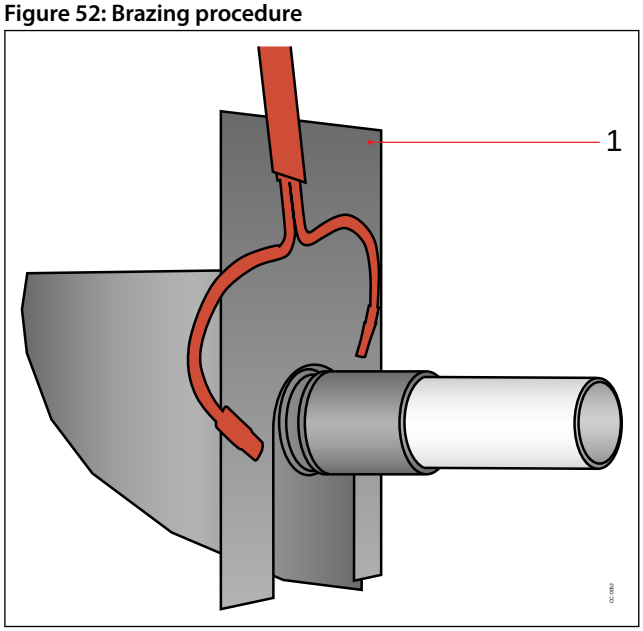
PSH compressors connectors are made of steel copper coated, which benefit to protect against corrosion and facilitate adhesion during brazing operation.

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 52: Brazing procedure



1	Heat shield

Before eventual un-brazing of the compressor or any system component, the refrigerant charge must be removed and the installation vacuumed (especially with A2L refrigerants).

System pressure test and leak detection

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

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

Table 32: System pressure test and leak detection

Maximum compressor test pressures	PSH052-105
Maximum compressor test pressure high side (HP)	53.6 bar (g) (777 psig) HP-LP<37 bar (537 psi)
Maximum compressor test pressure low side (LP)	34.3bar (g) (497psig) LP – HP <5bar (73psi) Maximum speed 4.8bar/s (70psi/s) [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 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 PSH052-105 compressors 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 160SZ 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 33: Single pack packaging

Compressor model	Length		Width		Height		Gross weight	
	mm	inch	mm	inch	mm	inch	kg	lbs
PSH052	750	29.5	750	29.5	1050	41.3	128	282
PSH065	750	29.5	750	29.5	1050	41.3	131	289
PSH079	750	29.5	750	29.5	1050	41.3	178	392
PSH105	750	29.5	750	29.5	1050	41.3	195	430

Industrial pack

Table 34: Industrial pack packaging

Compressor model	Compressors per pack	Length		Width		Height		Gross weight		Static stacking pallets
		mm	inch	mm	inch	mm	inch	kg	lbs	
PSH052	6	1150	45.3	965	38	768	30.2	693	1528	2
PSH065	6	1150	45.3	965	38	768	30.2	712	1570	2
PSH079	4	1150	45.3	965	38	800	31.5	678	1594	2
PSH105	4	1150	45.3	965	38	800	31.5	744	1640	2

Ordering

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

Single pack

Compressors compatible R454B and R410A

Table 35: Single pack compressors compatible R454B and R410A

Compressor model	Connections	Motor protection	Code no.		
			3	4	7
			208-230/3/60	380-415/3/50 460/3/60	575/3/60
PSH052	Brazed	Module 110-240V	120H2233	120H2229	120H2225
PSH065	Brazed	Module 110-240V	120H2221	120H2217	120H2213
PSH079	Brazed	Module 110-240V	120H2209	120H2205	120H2201
PSH105	Brazed	Module 110-240V	120H2045	120H2197	120H2193
PSH052	Brazed	Module 24V AC	120H2231	120H2227	120H2223
PSH065	Brazed	Module 24V AC	120H2219	120H2215	120H2211
PSH079	Brazed	Module 24V AC	120H2207	120H2203	120H2199
PSH105	Brazed	Module 24V AC	120H2047	120H2195	120H2191

Industrial pack

Compressors compatible R454B and R410A

Table 36: Industrial pack compressors compatible R454B and R410A

Compressor model	Connections	Motor protection	Code no.		
			3	4	7
			208-230/3/60	380-415/3/50 460/3/60	575/3/60
PSH052	Brazed	Module 110-240V	120H2234	120H2230	120H2226
PSH065	Brazed	Module 110-240V	120H2222	120H2218	120H2214
PSH079	Brazed	Module 110-240V	120H2210	120H2206	120H2202
PSH105	Brazed	Module 110-240V	120H2044	120H2198	120H2194
PSH052	Brazed	Module 24V AC	120H2232	120H2228	120H2224

Compressor model	Connections	Motor protection	Code no.		
			3	4	7
			208-230/3/60	380-415/3/50 460/3/60	575/3/60
PSH065	Brazed	Module 24V AC	120H2220	120H2216	120H2212
PSH079	Brazed	Module 24V AC	120H2208	120H2204	120H2200
PSH105	Brazed	Module 24V AC	120H2046	120H2196	120H2192

Accessories and Spare parts

Solder sleeve adapter set

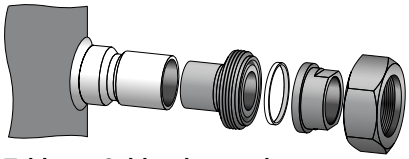


Table 37: Solder sleeve adapter set

Code no.	Description	Application	Packaging	Pack size
7765028	Rotolock adaptor set (2"1/4 ~ 1"5/8) , (1"3/4 ~ 1"1/8)	PSH052-079	Multipack	6
120Z0504	Rotolock adaptor set (2"1/4 ~ 1"5/8), (1"3/4 ~ 1"3/8)	PSH105	Multipack	6

Rotolock adapter

Table 38: Rotolock adapter

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

Gaskets

Table 39: 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

Table 40: Solder sleeve

Code no.	Description	Application	Packaging	Pack size
8153004	Solder sleeve P02 (1"3/4 Rotolock - 1"1/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10
8153003	Solder sleeve P10 (1"3/4 Rotolock - 1"3/8 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

Table 41: 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

Motor protection modules

Table 42: Motor protection modules

Code no.	Description	Application	Packaging	Pack size
120Z0937	Electronic motor protection module, 24 V AC	PSH052-105	Single pack	1
120Z0938	Electronic motor protection module, 110/240 V	PSH052-105	Single pack	1

Crankcase heaters

Table 43: Belt type heaters

Code no.	Description	Application	Packaging	Pack size
7773108	Belt type crankcase heater,75W,230V,CE & UL	PSH052-105	Multipack	6
7973005	Belt type crankcase heater,75W,230V,CE & UL	PSH052-105	Industry pack	50
7773118	Belt type crankcase heater,75W,400V,CE & UL	PSH052-105	Multipack	6
120Z0464	Belt type crankcase heater,75W,460V,CE & UL	PSH052-105	Multipack	6
120Z0465	Belt type crankcase heater,75W,575V,CE & UL	PSH052-105	Multipack	6
120Z0870	Belt type crankcase heater,75W,24V,CE & UL	PSH052-105	Multipack	6
7773122	Belt type crankcase heater, 130W, 230V, CE & UL	PSH052-105	Multipack	4
7773123	Belt type crankcase heater, 130W, 400V, CE & UL	PSH052-105	Multipack	4

Mounting hardware

Table 44: Mounting hardware

Code no.	Description	Application	Packaging	Pack size
8156138	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	PSH052-079	Single pack	1
7777045	Mounting kit for 1 scroll compressors including 4 hexagon rigid spacer, 4 sleeves, 4 bolts, 4 washers	PSH105	Single pack	1

Lubricant

Table 45: Lubricant

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

Terminal boxes, covers and T-block connectors

Table 46: Terminal boxes, covers and T-block connectors

Code no.	Description	Application	Packaging	Pack Size
120Z0774	T block connector 80 x 80 mm	PSH052-105	Multipack	10
120Z0458	Terminal box 210 x 190 mm, incl. cover	PSH052-105	Single pack	1

Acoustic hoods

Table 47: Acoustic hoods

Code no.	Description	Application	Packaging	Pack Size
120Z0926	Acoustic hood PSH	PSH052-105	Single pack	1

Miscellaneous

Table 48: 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

Tandem kits

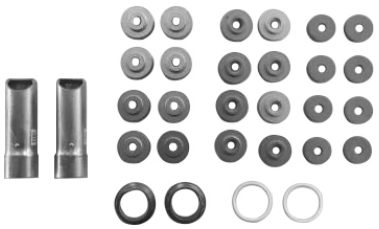


Table 49: Tandem kits

Code no.	Description	Application	Packaging	Pack Size
120Z0792	Kit Tandem, Solid, OEL 1" 3/8	PSH104-130-158E	Single pack	1
120Z0904	Kit PSH Tandem,solid,washer 27/28 mm,OEL 1" 5/8	PSH170U	Single pack	1
120Z0903	Kit PSH Tandem,solid,washer 27/28 mm,OEL 1" 5/8	PSH184U	Single pack	1
120Z0785	Kit Tandem, Solid,OEL 1"5/8	PSH210E	Single pack	1

Trio kits

Table 50: Trio kits

Code no.	Description	Application	Packaging	Pack Size
120Z0901	Kit PSH Trio,solid,washer 29 mm,OEL 1" 5/8	PSH263-289T	Single pack	1
120Z0902	Kit PSH Trio,solid,washer 32/33 mm,OEL 1" 5/8	PSH315T	Single pack	1
120z0900	Kit PSH Trio,solid,washer 30/31mm,OEL 1" 5/8	PSH237T	Single pack	1

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