ENGINEERING TOMORROW

Application Guide

Scroll compressors
PSH019 to **PSH039**

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.

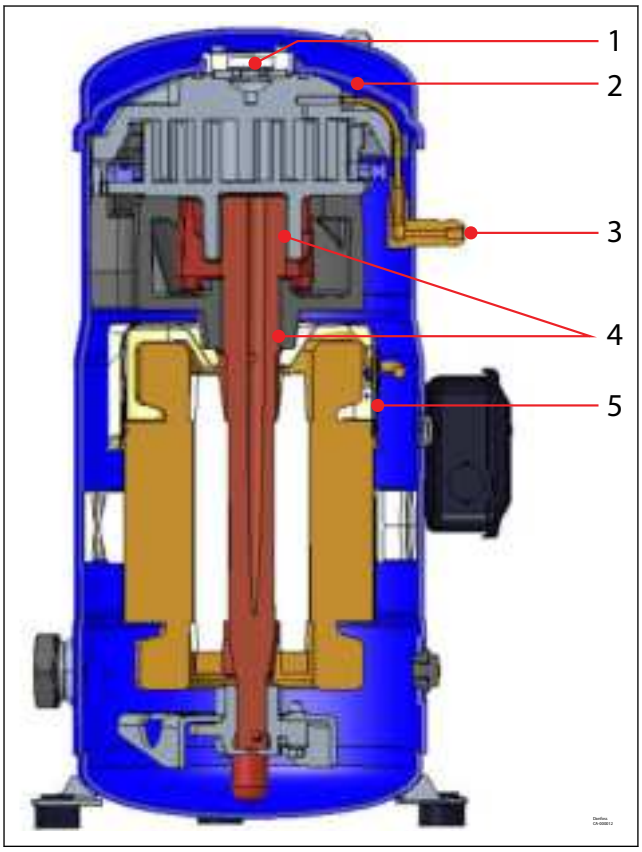
Introduction

Product description

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

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

Figure 1: Cut Away PSH019-023-026-030-034-039



1	Intermediate discharge valves (IDVs) increase seasonal efficiency
2	Heat shield lowers the heat transfer between discharge and suction gas and the acoustic level
3	Injection port to both enlarge the application envelope and improve efficiency
4	Lead free polymer bearings improve behavior under poor lubrication conditions
5	Patented motor cap for optimal motor cooling and higher resistance to liquid slugging

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

PSH019-023-026-030-034-039 compressor is fitted with an injection connection that could be used with Vapor injection/Wet injection/Liquid injection application.

Vapor injection

The PSH019-023-026-030-034-039 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).
- Heating 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

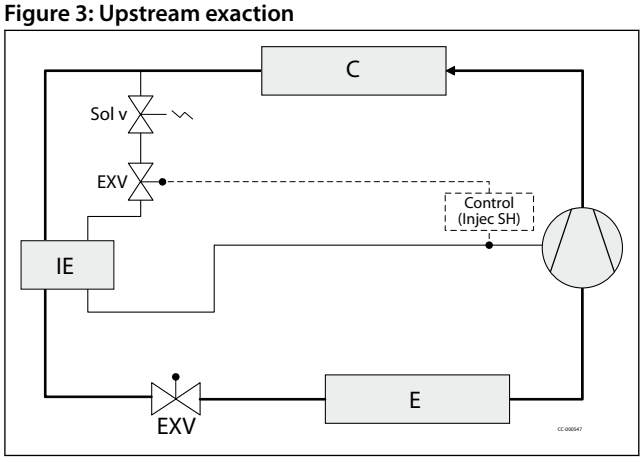
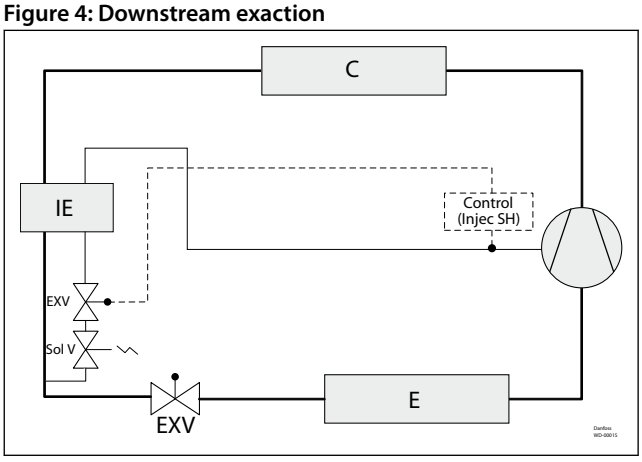


Figure 4: Downstream exaction



C	Condenser
E	Evaporator
IE	Intermediate Exchanger

Figure 5: Upstream exaction

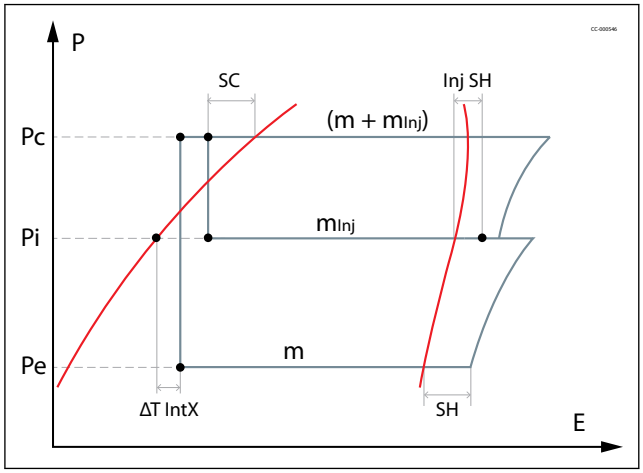
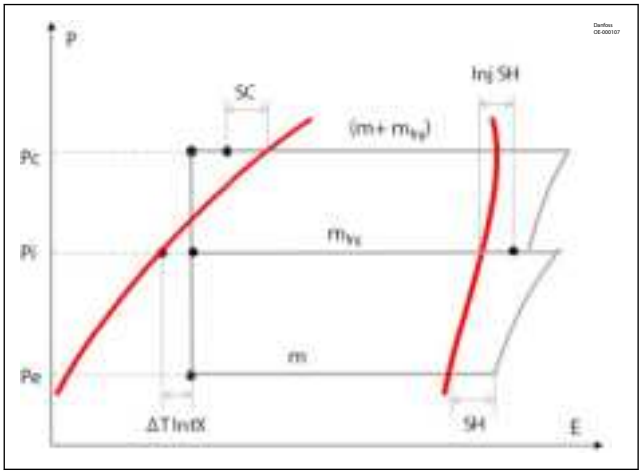


Figure 6: Downstream exaction

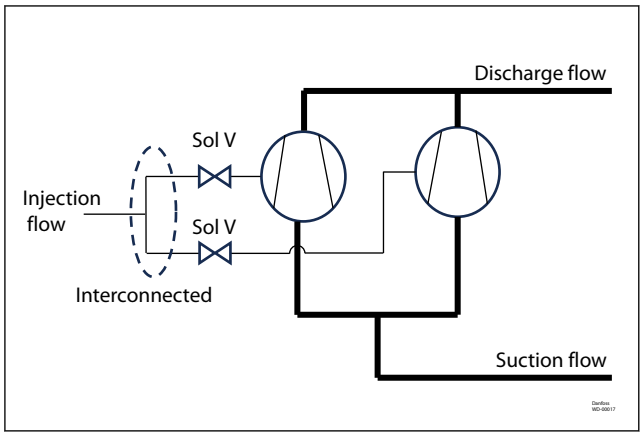


P	Pressure
E	Enthalpy

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 standby 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

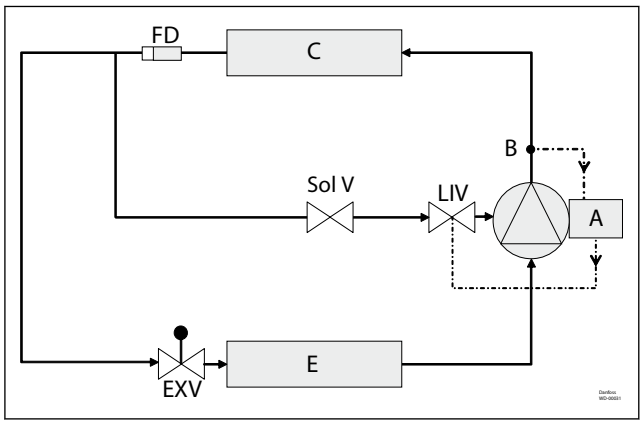
PSH019-023-026-030-034-039 could use liquid injection to maintain a sufficiently lower discharge gas temperature in lower evaporating and higher condensing temperature areas in the operating envelope.

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.

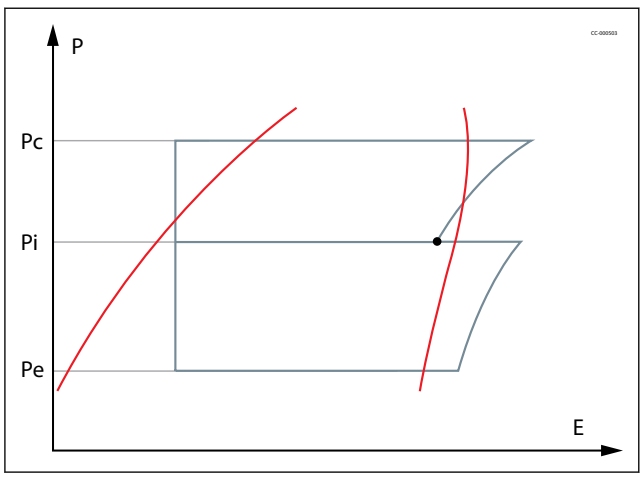
A LIV (Liquid Injection Valve) is needed to control the liquid injection mass flow, keep the constant compressor discharge gas temperature. The LIV's liquid injection regulation is based on the discharge gas temperature measured via temperature sensor located on discharge line. Considering the distance 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). Maximum safety value is 135°C (275°F)

An additional solenoid valve is required on liquid injection line. It is used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer to scroll set during off-cycle.

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	039	A	4	EL	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
9: 380-400V/3~/60Hz

Evolution index
A~Z

Motor protection
L: Internal overload protector

Connections
E: with OSG/OEQ, Vapor/Wet/ Liquid injection version
F: without OSG/OEQ, Vapor/Wet/ Liquid injection version

Compressors serial number

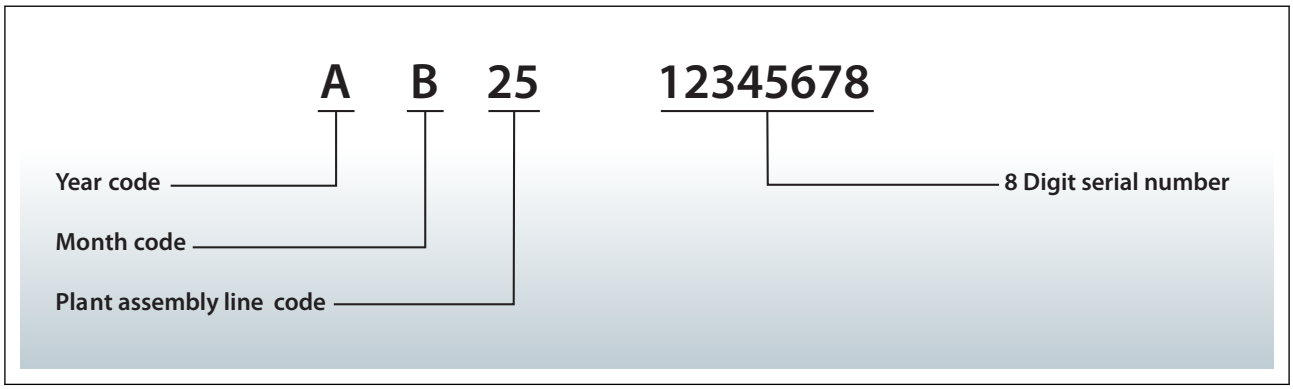


Table 1: Serial number code legend table

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 (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	PSH019-023-026-030-034-039
Category PED R410A	II
Category PED R454B	III
Maximum / Minimum temperature - Ts	-35°C < Ts < 55°C -31°F < Ts < 131°F
Maximum allowable pressure (Low side) - Ps	33.3 bar(g) 483 psig
Maximum allowable pressure (High side) - Ps	48.7 bar(g) 706 psig
Declaration of conformity	Contact Danfoss

Internal free volume

Table 6: Internal free volume

Products	Internal free volume without oil					
	Low pressure side		High pressure side		Total	
	[litre]	[cu.inch]	[litre]	[cu.inch]	[litre]	[cu.inch]
PSH019	11.7	714	0.7	43	12.4	757
PSH023	13.6	830	0.7	43	14.3	873
PSH026	13.6	830	0.7	43	14.3	873
PSH030	13.6	830	0.7	43	14.3	873
PSH034	13.6	830	0.7	43	14.3	873
PSH039	13.9	848	0.7	43	14.6	891

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 60 Hz	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
PSH019	7.5	88.40	5.39	15.40	544	18.60	657	3.0	101	58.5	129
PSH023	9	103.50	6.32	18.00	636	21.80	770	3.3	112	64.5	142
PSH026	10	116.90	7.13	20.30	717	24.60	869	3.3	112	64.5	142
PSH030	12	133.00	8.12	23.12	816	27.90	985	3.3	112	67.5	149
PSH034	13	151.17	9.22	26.40	932	31.90	1127	3.3	112	69.5	153
PSH039	15	170.30	10.39	29.60	1045	35.80	1264	3.6	122	72.0	159

[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 60 Hz	Nominal Heating capacity		Power input	COP	E.E.R.
		TR	W	Btu/h	kW	W/W	Btu/h/W
50Hz	PSH019	7.5	23600	80476	9.22	2.56	8.73
	PSH023	9	27900	95139	10.45	2.67	9.10
	PSH026	10	31600	107756	11.60	2.72	9.28
	PSH030	12	36200	123514	13.26	2.73	9.31
	PSH034	13	41200	140574	14.93	2.76	9.42
	PSH039	15	46000	156952	16.79	2.74	9.35
60Hz	PSH019	7.5	28700	97867	10.76	2.67	9.10
	PSH023	9	33500	114235	12.35	2.71	9.24
	PSH026	10	37800	128898	13.68	2.76	9.41
	PSH030	12	43500	148422	15.59	2.79	9.52
	PSH034	13	49300	168212	17.61	2.80	9.55
	PSH039	15	55200	188342	19.78	2.79	9.52

Table 9: 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	PSH019	7.5	19500	66495	6.96	2.80	9.55
	PSH023	9	23200	79112	8.15	2.85	9.72
	PSH026	10	26300	89683	8.94	2.94	10.03
	PSH030	12	30200	103042	10.13	2.98	10.17
	PSH034	13	34400	117373	11.39	3.02	10.30
	PSH039	15	38500	131362	12.83	3.00	10.24
60Hz	PSH019	7.5	23800	81158	8.19	2.90	9.89
	PSH023	9	28300	96503	9.66	2.93	9.99
	PSH026	10	31900	108779	10.65	3.00	10.23
	PSH030	12	36600	124879	12.12	3.02	10.30
	PSH034	13	41800	142622	13.62	3.07	10.47
	PSH039	15	46700	159340	15.26	3.06	10.44

NOTE:
TR: Ton of Refrigeration,
COP: Coefficient Of Performance
EER: Energy Efficiency Ratio
Standard rating conditions For Heating(With vapor 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 60Hz	Nominal Heating capacity		Power input	COP	E.E.R
		TR	W	Btu/h	Kw	W/W	Btu/h/W
50Hz	PSH019	7.5	18600	63426	7.66	2.43	8.29
	PSH023	9	22200	75702	8.75	2.54	8.66
	PSH026	10	25200	85932	9.72	2.59	8.83
	PSH030	12	28900	98607	10.99	2.63	8.97
	PSH034	13	32800	111914	12.42	2.64	9.01
	PSH039	15	37000	126244	13.86	2.67	9.11
60Hz	PSH019	7.5	22900	78089	8.97	2.56	8.73
	PSH023	9	26900	91729	10.34	2.60	8.87
	PSH026	10	30900	105369	11.49	2.69	9.17
	PSH030	12	35100	119761	12.90	2.72	9.28
	PSH034	13	40000	136480	14.71	2.72	9.28
	PSH039	15	44800	152858	16.41	2.73	9.31

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

Model		Nominal tons 60Hz	Nominal Heating capacity		Power input	COP	E.E.R
		TR	W	Btu/h	Kw	W/W	Btu/h/W
50Hz	PSH019	7.5	18800	64108	6.53	2.88	9.82
	PSH023	9	22600	77066	7.64	2.95	10.06
	PSH026	10	25600	87296	8.60	2.98	10.16
	PSH030	12	29600	100995	9.55	3.10	10.58
	PSH034	13	33600	114643	10.77	3.12	10.65
	PSH039	15	37900	129315	12.15	3.12	10.65
60Hz	PSH019	7.5	23000	78430	7.70	2.98	10.16
	PSH023	9	27500	93775	9.03	3.04	10.37
	PSH026	10	31200	106392	10.14	3.07	10.47
	PSH030	12	35800	122150	11.40	3.14	10.71
	PSH034	13	40700	138868	12.92	3.15	10.75
	PSH039	15	45900	156611	14.53	3.16	10.78

NOTE:
TR: Ton of Refrigeration,
COP: Coefficient Of Performance
EER: Energy Efficiency Ratio
Standard rating conditions For Heating(With vapor 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

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]	
PSH019	75	4	77	4	120Z0956+120Z0833
PSH023	76.5	4	78.5	5	120Z0955+120Z0833
PSH026	77.5	4	79	5	120Z0955+120Z0833
PSH030	77.5	4	79	5	120Z0955+120Z0833
PSH034	79	4	81	5	120Z0955+120Z0833
PSH039	79	4	83	5	120Z0954+120Z0833

[1] Attenuation given with acoustic hood

Max sound power level: +3dB(A)

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 tandem

PSH039 = 2 X PSH039 (50 Hz)

$L_{PSH039} = 79dB(A)$

$L_{PSH078} = 79 + 10 \quad Log_{10} \quad 2 = 82dB(A)$

Operating envelope data

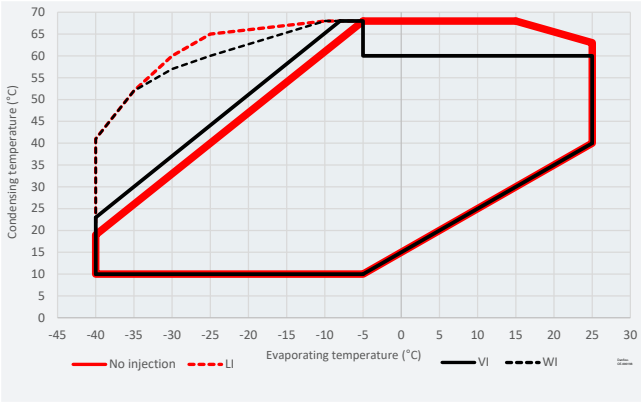
The operating envelope for PSH019-023-026-030-034-039 compressors is given in the figures below and guarantees reliable operation of the compressor for steady-state and transient operation.

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

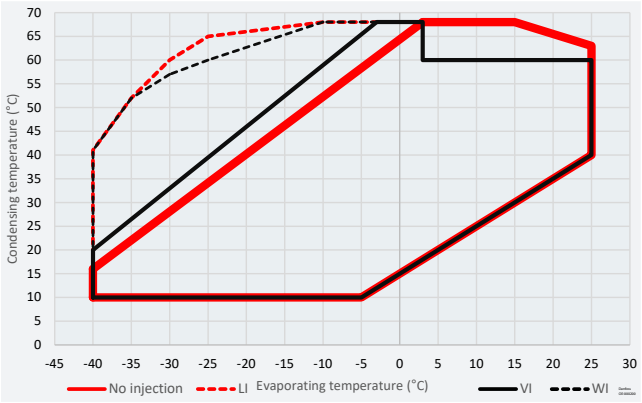
Steady-state operation envelope is valid for a suction superheat within 5K range at nominal Voltage. Minimum suction gas temperature cannot lower than -35°C. Minimum ambient temperature during start and operation cannot lower than -33°C.

Operating envelope

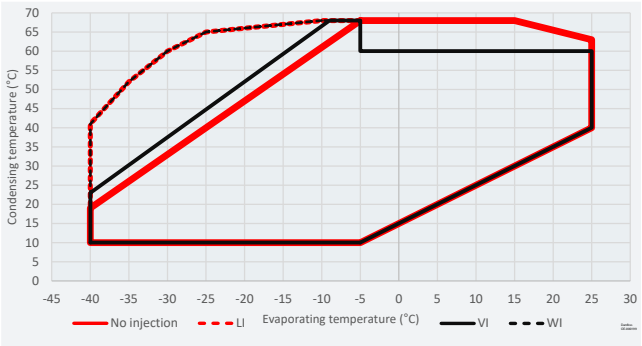
PSH019-039 R410A SSH5K, 50Hz



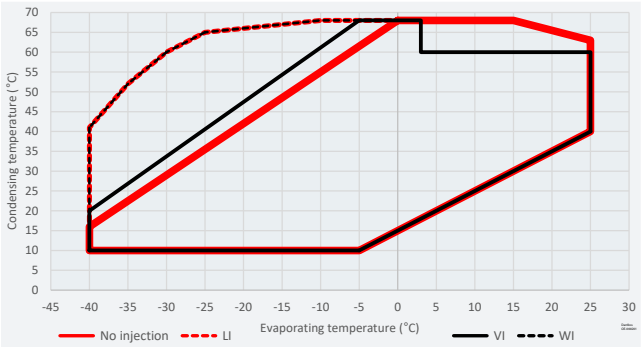
PSH019-039 R454B SSH5K, 50Hz



PSH019-039 R410A SSH5K, 60Hz



PSH019-039 R454B SSH5K, 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 13: Pressure settings

Pressure settings		R410A	R454B
Working range high side	bar(g)	9.8-44.5	9.9-41.2
	psig	143-645	144-598
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 with minimum 0.8bar(g) for R410A and 0.6bar(g) for R454B	
	psig	22 psi below nominal evaporating pressure with minimum 12 psig for R410A and 9 psig for R454B	

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 8: PSH019-023-026-030-034-039

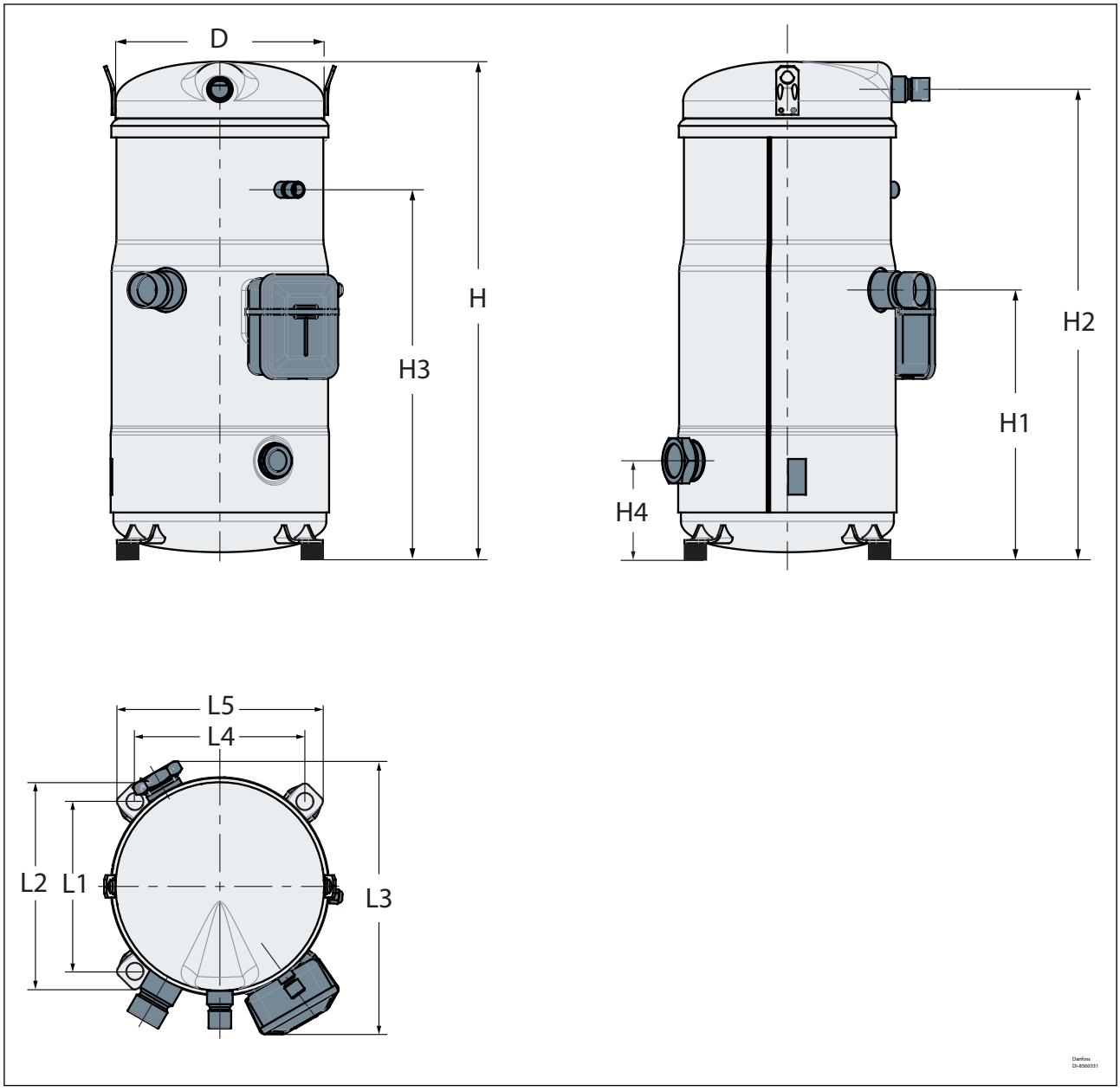


Table 14: Single compressors

Compressor model	Motor 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
PSH019	3, 4, 7, 9	224	485	235	451	339	94	190.5	230	306	190.5	230	8560319
PSH023-026	3, 4, 7, 9	224	542	278	509	396	101	190.5	230	306	190.5	230	8560325
PSH030-034	3	224	542	278	509	396	101	190.5	230	342	190.5	230	8560321
PSH030-034	4, 7, 9	224	542	278	509	396	101	190.5	230	306	190.5	230	8560325
PSH039	4	234	558	299	524	411	108	190.5	230	306	190.5	230	8560331
PSH039	3, 7, 9	234	558	299	524	411	108	190.5	230	342	190.5	230	8560327

Tandem assemblies

Figure 9: Outline drawing number 1

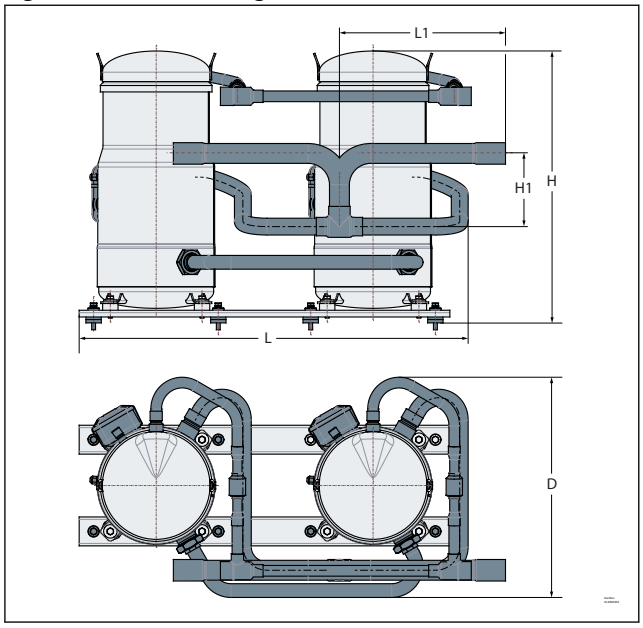


Table 15: Tandem assemblies

Tandem model	Composition	Motor voltage code	L		D		H		L1		H1		outline drawing number
			mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
PSH038E	PSH019+PSH019	3,4,7,9	798	31.4	457	18.0	493	19.4	253	10.0	152	6	8560342
PSH046E	PSH023+PSH023	3,4,7,9	808	31.8	457	18.0	565	22.2	239	9.4	152	6	8560343
PSH052E	PSH026+PSH026	3,4,7,9	808	31.8	457	18.0	565	22.2	239	9.4	152	6	8560344
PSH060E	PSH030+PSH030	3,4,7,9	808	31.8	462	18.2	565	22.2	345	13.6	152	6	8560344
PSH068E	PSH034+PSH034	3,4,7,9	808	31.8	462	18.2	565	22.2	345	13.6	152	6	8560344
PSH078E	PSH039+PSH039	3,4,7,9	808	31.8	462	18.2	565	22.2	345	13.6	152	6	8560345

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

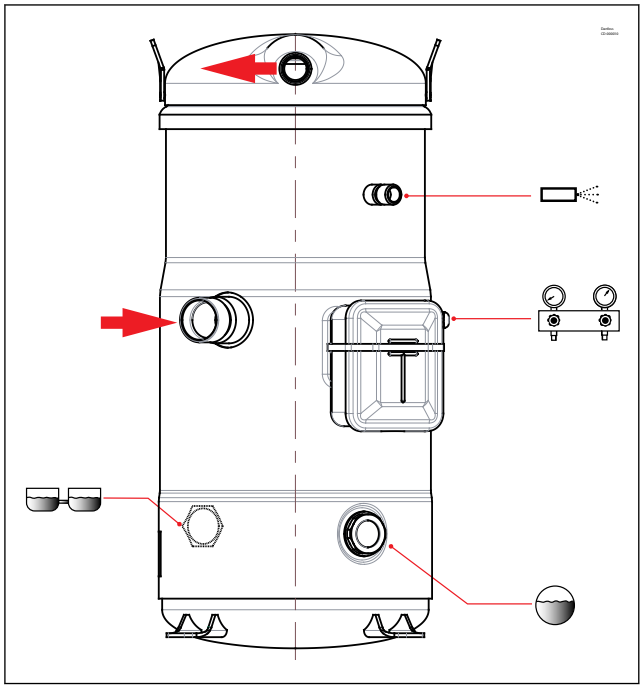
By convention, the last letter of tandems designation has been set to help to discern easily which type of manifold we are considering

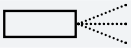
E : Even tandem

Mechanical connections

Connection details

Figure 10: PSH019-023-026-030-034-039



Connection details		PSH019	PSH023-026-030-034-039
Suction connection		Brazed 1"1/8	Brazed 1" 3/8
Discharge connection		Brazed 7/8"	Brazed 7/8"
Oil sight glass		Threaded (1"1/8 - 18 UNEF)	
Oil equalization connection		Rotolock 1"3/4	
Low pressure gauge port (Shrader)		Male ¼" Flare incorporating a Schrader valve	
Injection connection		1/2" ODF	

Design compressor mounting

General requirements

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

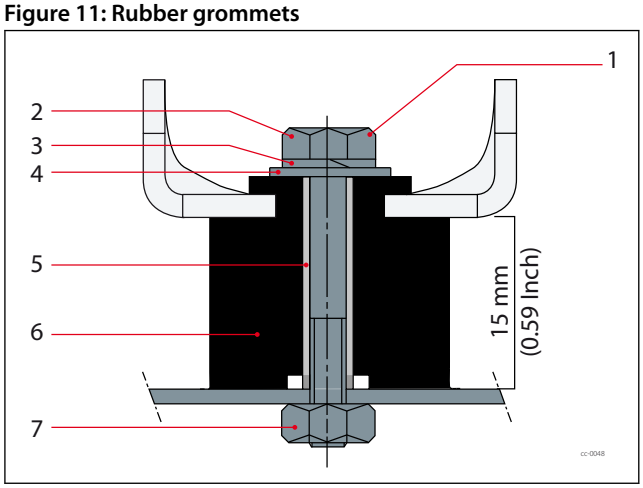
Single requirements

Mounting of PSH019-023-026-030-034-039

Compressors PSH019-023-026-030-034-039 are delivered with rubber grommets and steel mounting sleeve used to isolated the compressor from the base frame.

The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The required bolt size for the PSH019-023-026-030-034-039 compressors is HM8-40. This bolt must be tightened to a torque of 15Nm.

Figure 11: Rubber grommets



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

Part 2, 3, 4, 5, 6 and 7 are delivered along with compressor

Tandem requirements

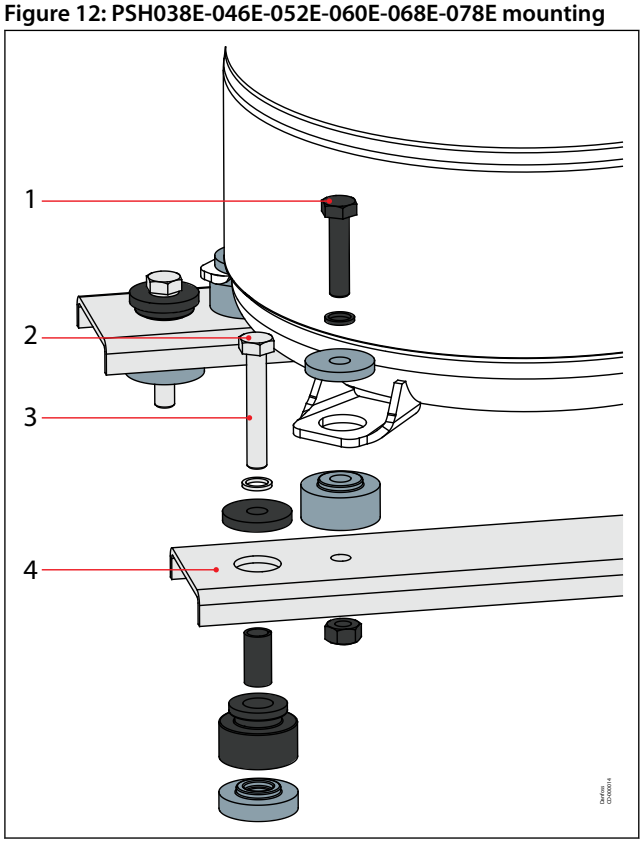
Mounting of PSH038E-046E-052E-060E-068E-078E

The compressors must be mounted with rigid mounting spacers on rails. Rubber grommets and spacers must be installed below the rails.

The rigid mounting spacers are included in tandem accessory kits. The rubber grommets are supplied with compressor.

For more details about parallel mounting feet, please see parallel unit outline drawing.

Figure 12: PSH038E-046E-052E-060E-068E-078E mounting



1	Tightening torque 15Nm
2	Not supplied Φ8x75mm 0.31x2.95inch
3	Tightening torque 15Nm
4	4mm (0.16 inch) thickness
	Supplied with the compressor
	Included in manifolding kit
	Not supplied

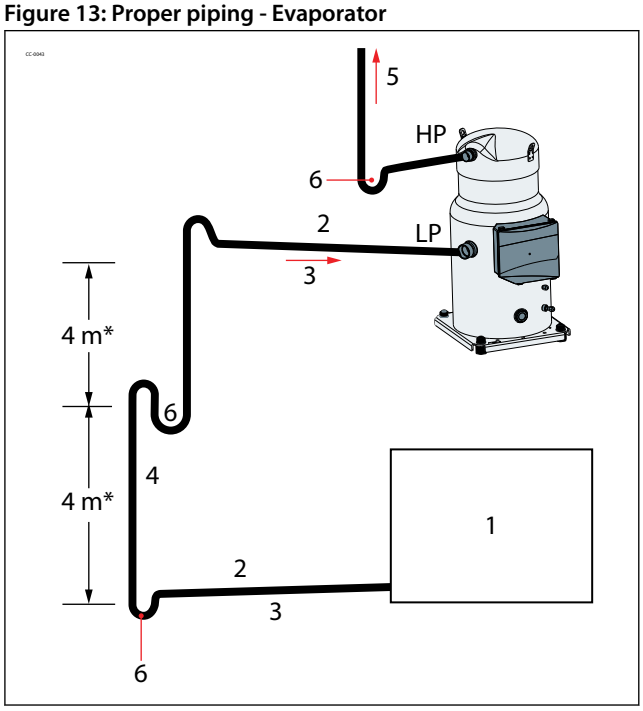
Design piping

General requirements

Proper piping practices should be employed to:

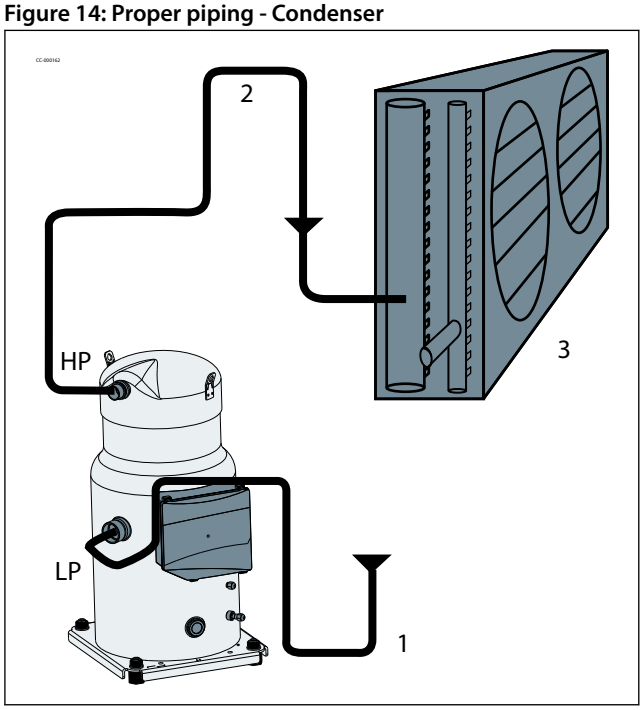
1. Ensure adequate oil return, even under minimum load conditions (refrigerant speed, piping slopes…). For validation tests see section Manage oil in the circuit.
2. Avoid condensed liquid refrigerant from draining back to the compressor when stopped (discharge piping upper loop). For validation tests 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 13: 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 14: Proper piping - Condenser



1	3D flexibility
2	Upper loop
3	Condenser

Tandem requirements (Static)

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

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

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

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

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

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)

Figure 15: Example of left suction

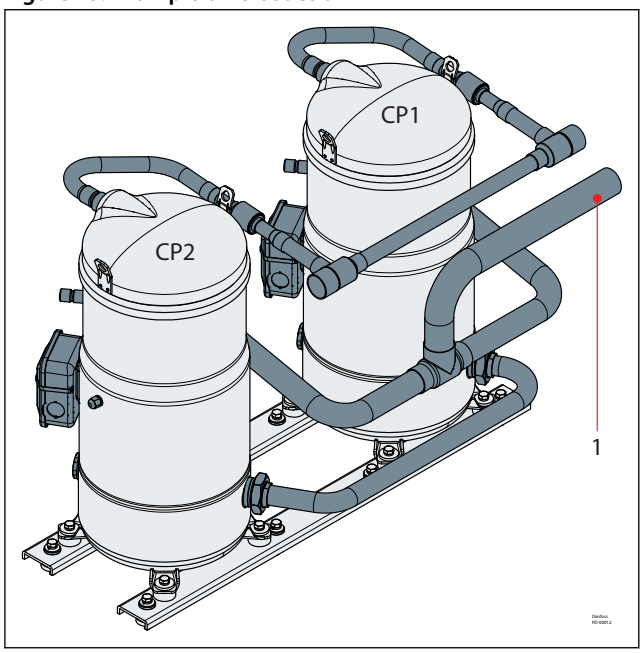
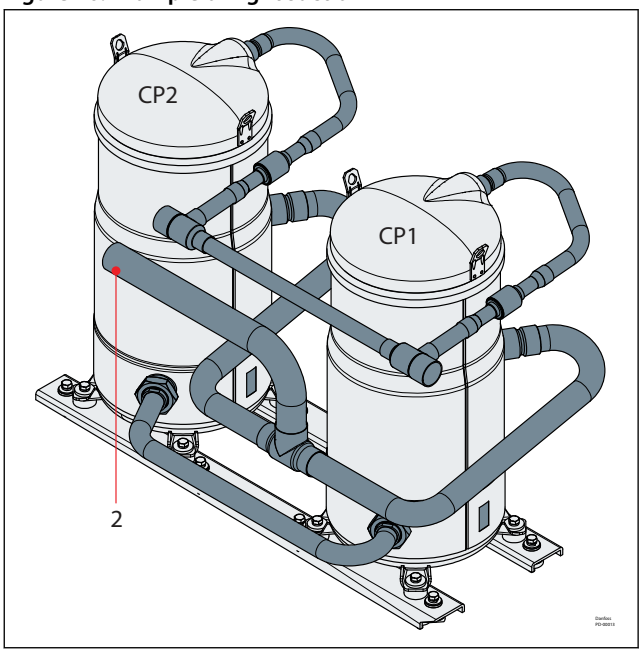


Figure 16: Example of right suction



1	Manifolding models with Left suction
2	Manifolding models with Right suction
Cp1	Compressor 1
Cp2	Compressor 2

Tandem models

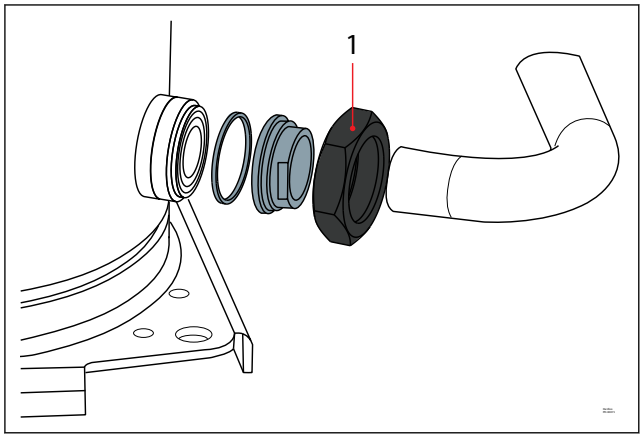
Table 16: Tandem models

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
PSH038E	PSH019+PSH019	1"3/8	1"3/8	1"1/8	8560342	Left Right	Not Needed	-	7777054
PSH046E	PSH023+PSH023	1"5/8	1"3/8	1"1/8	8560343	Left Right	Not Needed	-	7777054
PSH052E	PSH026+PSH026	1"5/8	1"3/8	1"1/8	8560344	Left Right	Not Needed	-	7777054
PSH060E	PSH030+PSH030	1"5/8	1"3/8	1"1/8	8560344	Left Right	Not Needed	-	7777054
PSH068E	PSH034+PSH034	1"5/8	1"3/8	1"1/8	8560344	Left Right	Not Needed	-	7777054
PSH078E	PSH039+PSH039	1"5/8	1"3/8	1"1/8	8560345	Left Right	Not Needed	-	7777054

Oil equalization design PSH038E-046E-052E-060E-068E-078E

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

Figure 17: PSH038E-046E-052E-060E-068E-078E



1	Tightening torque 100Nm
	Supplied with the compressor
	Included in tandem kit

Electrical connections

Wiring connections

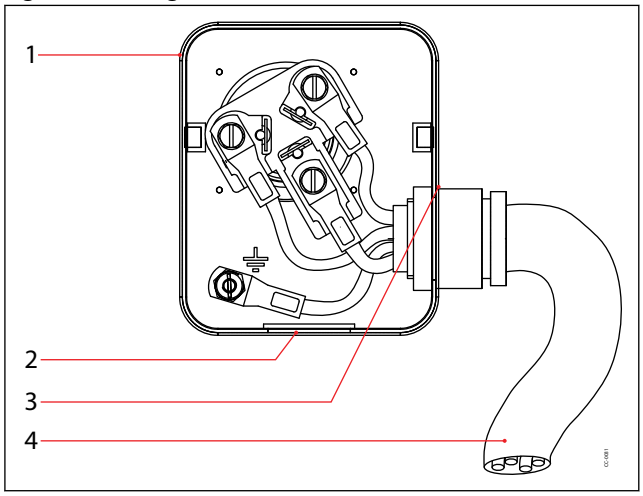
Electrical power is connected to the compressor terminals by 4.8mm (10-32) screws. The maximum tightening torque is 3 Nm.

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

PSH019-023-026-030-034-039 (*except PSH030-034 code3, PSH039 code3/7/9)

The terminal box is provided with a Ø 25.5mm (φ1 inch) (ISO25) and a Ø 29mm (φ1.14 inch) (PG21) knockouts.

Figure 18: Wiring connections for PSH019-023-026-030-034-039 (*except PSH030-034 code3, PSH039 code3/7/9)



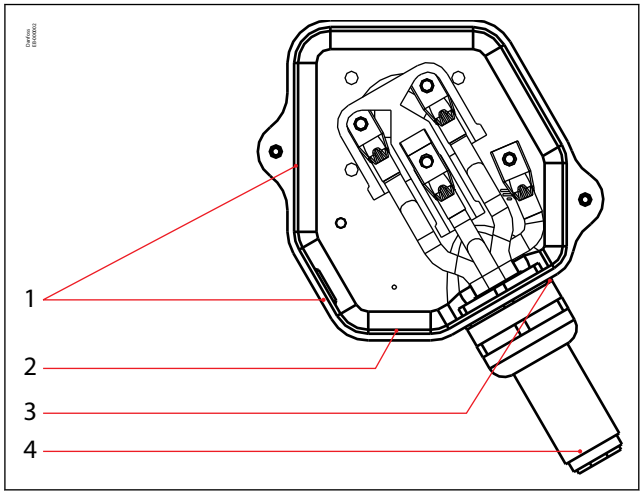
1	Terminal box
2	Ø 29mm (φ1.14inch) knockout
3	Ø 25.5mm (φ1inch) knockout
4	Power supply

PSH030-034 code3 & PSH039 code 3/7/9

The terminal box is provided with a Ø 43.7mm (φ1.72inch) hole (UL 1"1/4 conduit) for power supply and 3 other knockout holes:

- Ø22.2mm (φ 0.87inch) (PG16) (UL 1/2")
- Ø16.5mm (φ 0.65inch) (ISO16) (x2)

Figure 19: Wiring connections for PSH030-034 code3, PSH039 code3/7/9



1	Ø 16.5mm (φ0.65inch) knockout
2	Ø22.2mm (φ 0.87inch) knockout
3	Ø 43.7mm (φ1.72inch) hole
4	Power supply

Electrical Specifications

Motor voltage

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

Table 17: Motor voltage

Frequency	Motor voltage code	Code 3	Code 4	Code 7	Code 9
50 Hz	Nominal voltage	-	380-415V-3ph	-	-
60 Hz	Nominal voltage	208-230V-3ph	460V-3ph	575V-3ph	380-400V-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

Three phase electrical characteristics

Table 18: Motor voltage code 3

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
PSH019	203	32.8	39.5	0.39
PSH023	267	39.7	45.3	0.27
PSH026	267	45.0	50.5	0.27
PSH030	304	41.2	57	0.24
PSH034	315	53	64	0.22
PSH039	351	52.1	72.1	0.22

Table 19: Motor voltage code 4

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
PSH019	98	16.1	17.9	1.47
PSH023	142	19.2	20.5	1.05
PSH026	142	22.4	22.6	1.05

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
PSH030	147	25.3	25.4	0.92
PSH034	158	25.8	28.3	0.83
PSH039	197	30.7	36.5	0.83

Table 20: Motor voltage code 7

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
PSH019	84	13.0	14.3	2.34
PSH023	103	17.8	16.2	1.57
PSH026	103	18.5	17.8	1.57
PSH030	122	20.2	20.1	1.38
PSH034	136	22	22.8	1.32
PSH039	135	24.3	25.6	1.32

Table 21: Motor voltage code 9

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
PSH019	124	22.2	21.2	1.05
PSH023	160	24.3	25.0	0.72
PSH026	160	25.7	27.1	0.72
PSH030	168	26.4	30.5	0.62
PSH034	177	30.2	34.1	0.57
PSH039	239	37	38.4	0.57

LRA (Locked Rotor Amp)

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

RLA (Rated Load Amperage)

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

MOC (Maximum Operating Current)

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

MOC can be used as a basis for contactors selection.

Winding resistance

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

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

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

Motor protection

PSH019 to PSH039

Compressor models PSH019 to 039 are provided with internal overload motor protection to prevent against excessive current and temperature caused by overloading, low refrigerant flow or phase loss.

The protector is located in star point of motor and, should it be activated, will cut out all three phases. It will be reset automatically.

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

Then it must be set at Max Operating Current(MOC):

- When the motor temperature is too high, then the internal protector will trip.
- When the current is too high the thermal magnetic motor circuit breaker will trip before the internal protection therefore offering possibility of manual reset.

Phase sequence and reverse rotation protection

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

PSH019 to PSH039

Compressor models PSH019 to PSH039 incorporates an internal reverse vent valve which will react when the compressor is run in reverse and will allow refrigerant to circulate through a by-pass from the suction to the discharge. Although reverse rotation is not destructive for these models, it should be corrected as soon as possible. Repeated reverse rotation over 24 hours may have negative impact on the bearings.

Reverse rotation will be obvious to the user as soon as power is turned on: the compressor will not build up pressure, the sound level will be abnormally high and power consumption will be minimal. If reverse rotation symptoms occur, shut the compressor down and connect the phases to their proper terminals. If reverse rotation is not halted, the compressor will cycle off-on the motor protection.

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.

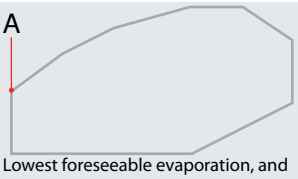
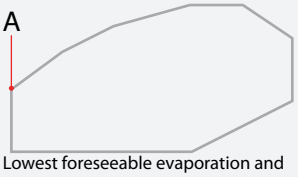
System evaluation

Table 22: Manage oil in the circuit - System evaluation

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

Test, criteria and solutions

Table 23: 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 oil balancing	 Lowest foreseeable evaporation and highest foreseeable condensation and nominal capacity condition for tandem 2 compressors running for 6 hours. For reversible system, perform test in both heating and cooling mode.	Oil level must be visible or full in the sight glass when the compressors are running and when all compressors of the circuit are stopped	1. Top-up with oil, generally 3% of the total system refrigerant charge (in weight). 2. Check that manifold piping is conform to Danfoss requirements. 3. Integrate a function in control logic to stop manifold periodically in order to balance oil (for more details see section Control logic)
3	Oil return in split systems	Since each installation is unique, test 1 and 2 can not fully validate the oil return. Oil level must be checked and adjusted at commissioning.	Oil level must be visible or full in the sight glass when the compressor is running and when all compressors of the circuit are stopped.	1. Pay special attention to "Piping design" 2. Oil separator is strongly recommended, espacially in case of part load.

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 Mounting hardware.
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

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.

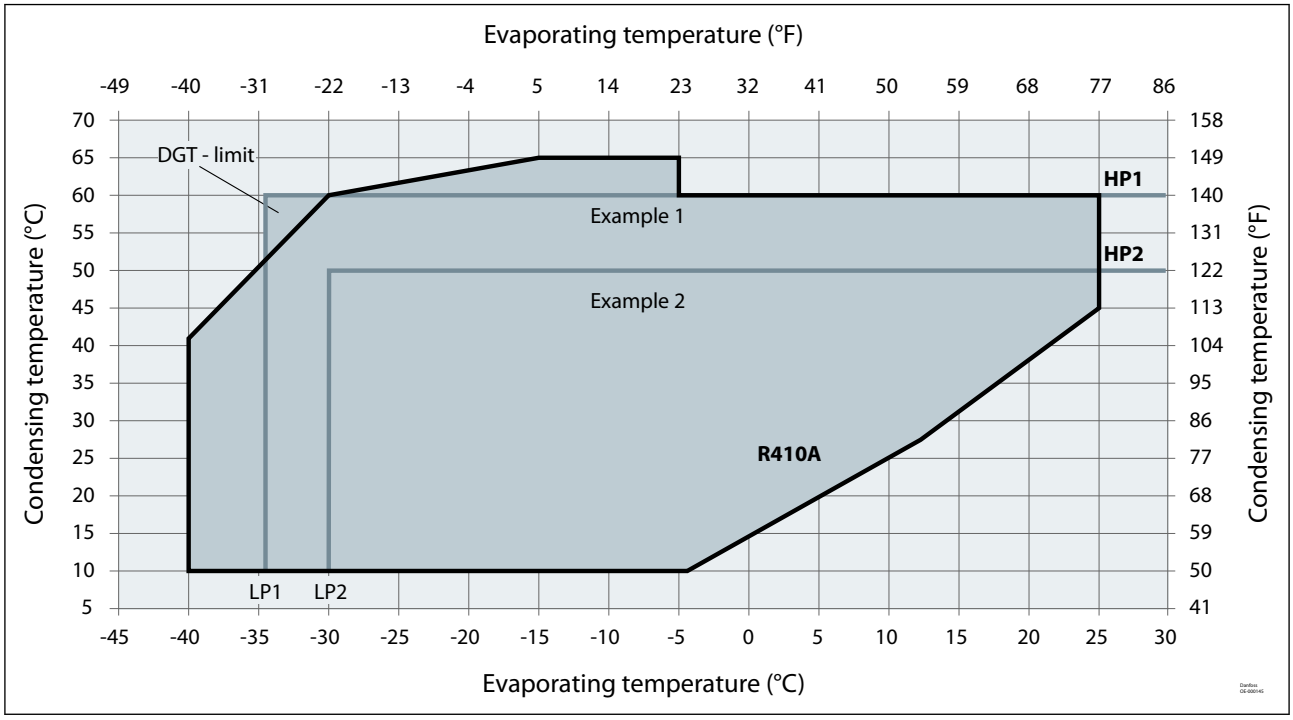
Depending on application operating envelope, you must define HP and LP limits within operating envelope and pressure setting table above.

Discharge temperature protection

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 20: Discharge temperature protection examples)

Figure 20: 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.

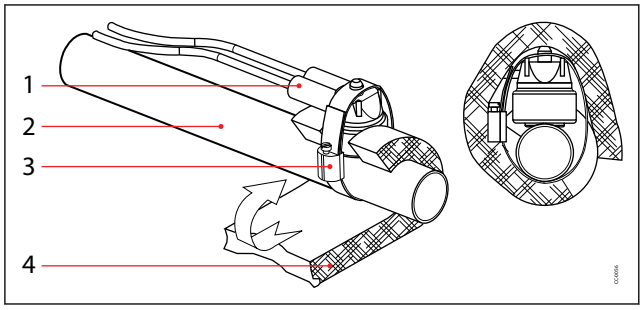
PSH019-023-026-030-034-039 have no integrated discharge temperature protection, an external protection is required.

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 21: Discharge Gas Temperature protection (DGT))

Figure 21: Discharge Gas Temperature protection (DGT)



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

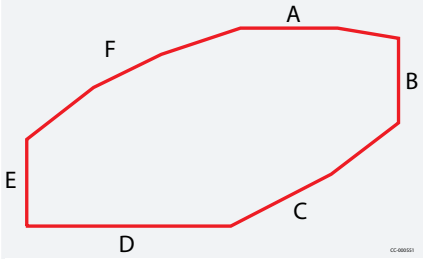
System evaluation

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

Table 24: Operating envelope management

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

See Test, criteria and solutions.



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

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

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 (9°F) and the oil superheat shall not be more than 60 sec below the safe limit defined in the Dilution Chart. (see Dilution Chart - PSH019-023-026-030-034-039 R410A/R454B	1.Check expansion valve selection and setting. • For Thermostatic expansion valve (TXV) check bulb position... • For Electronic expansion valve (EXV) check measurement chain and PID.... 2.Add a suction accumulator[1]
	Transient	Tests must be carried out with most unfavorable conditions : • fan staging • compressor staging • …etc.	Oil superheat shall not be more than 60 sec below the safe limit defined in the Dilution Chart (see Dilution Chart - PSH019-023-026-030-034-039 R410A/R454B).	
Defrost test	Check liquid floodback during defrost cycle	Defrost test must be carried out in the most unfavorable conditions (at 0 °C (32 °F) evaporating temperature).	Oil superheat shall not be more than 60 sec below the safe limit defined in the Dilution Chart (see Dilution Chart - PSH019-023-026-030-034-039 R410A/R454B).	1.In reversible systems, the defrost logic can be worked out to limit liquid floodback effect (for more details see Control logic). 2.Add a suction accumulator[1]

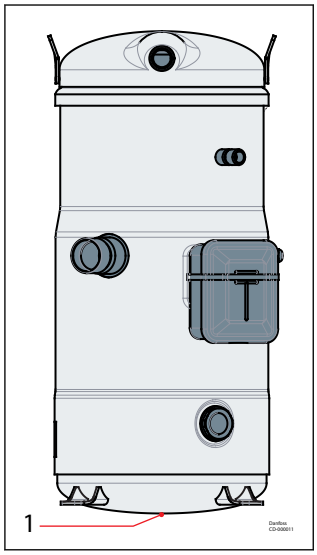
[1] Suction accumulator offers protection by trapping the liquid refrigerant upstream from the compressor. The accumulator should be sized at least 50 % of the total system charge. Suction accumulator dimensions can impact oil return (gas velocity, oil return hole size…), therefore oil return has to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

Placing oil temperature sensor

Oil temperature sensor must be placed on the bottom of the baseplate. Some thermal paste shall be used to improve the conductivity. The sensor must also be correctly thermally insulated from the ambiance.

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

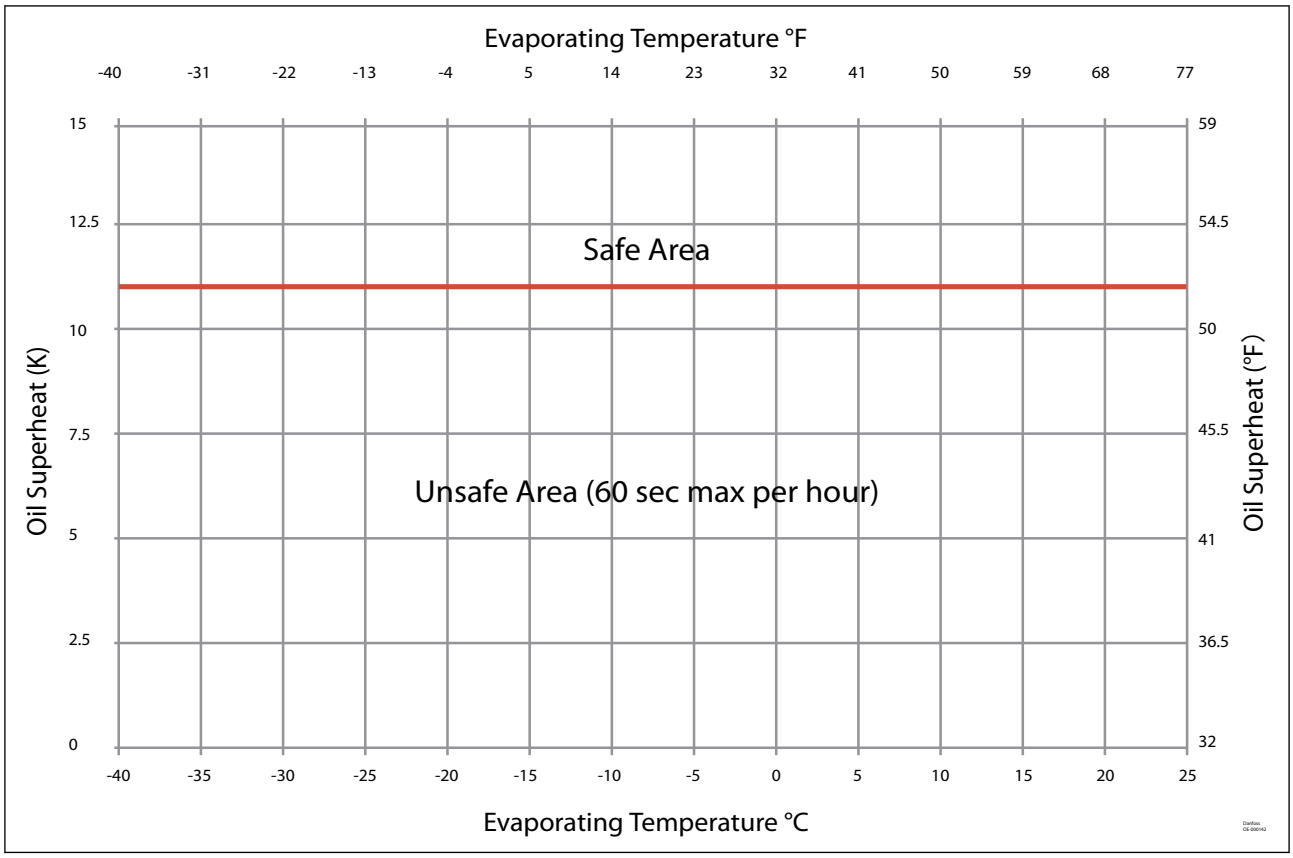
Figure 22: Placing oil temperature sensor



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

Dilution Chart - PSH019-023-026-030-034-039 R410A/R454B

Dilution Chart (reference at 20 °C / 68 °F ambient temperature)



Manage off cycle migration

R Off -cycle refrigerant migration happens:

- When the compressor is located at the coldest part of the installation, refrigerant vapor condenses in the compressor.
- Or directly in liquid-phase by gravity or pressure difference. When the compressor restarts, the refrigerant diluted in the oil, or stored in evaporator, generates poor lubrication conditions, and may reduce bearings life time. In extreme situations, this leads to liquid slugging that can damage the compressor scroll set.

Requirement

- Compressor can tolerate occasional flooded start, but it should remain exceptional situation and unit design must prevent that this situation happen at each start.
- Right after start, liquid refrigerant must not flow massively to compressor
- The charge limit is a threshold beyond some protective measures must be taken to limit risk of liquid slugging and extreme dilution at start.
- 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 25: 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

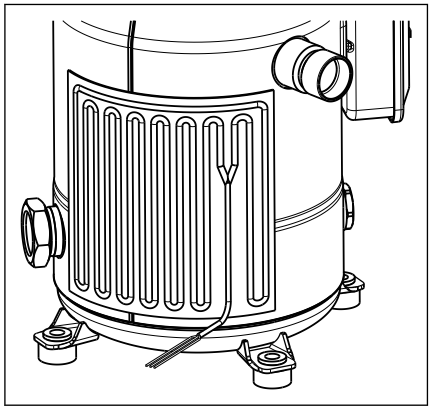
The surface sump heaters are designed to protect the compressor against off-cycle migration of refrigerant.

For PSH019-023-026-030-034-039, the use of a 80W surface sump heater is mandatory, if the ambient temperature is between -5°C and -23°C. For ambient temperature between -23°C and -33°C an additional 48W surface sump heater must be used.

Table 26: surface sump selection principle

T ambiance	Surface Sump Heater
-23~-5	80 W SSH
-33~-23	80W+48W SSH

Figure 23: PSH019 to 039



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.

Non Return Valve (NRV)

Non-return valve at discharge prevents from liquid or gas migration. Selection of non-return valve is a trade-off between pressure dropping at high mass flow, and the state of the valve stability while at low mass flow.

For PSH019 to 039 compressors, an external Non-Return Valve (NRV) in the discharge line is mandatory. The following table displays present Danfoss non-return valve selection per each specific compressor.

Compressor model	NRV model
PSH019-023	NRV 16s
PSH026-030-034-039	NRV 19s

Charge limits

Table 27: Charge limits for single models

Models	Refrigerant charge limit	
	kg	lbs
PSH019	5	11
PSH023	6	13.2
PSH026	7	15.4
PSH030	8	17.6
PSH034	9	19.8
PSH039	10	22.0

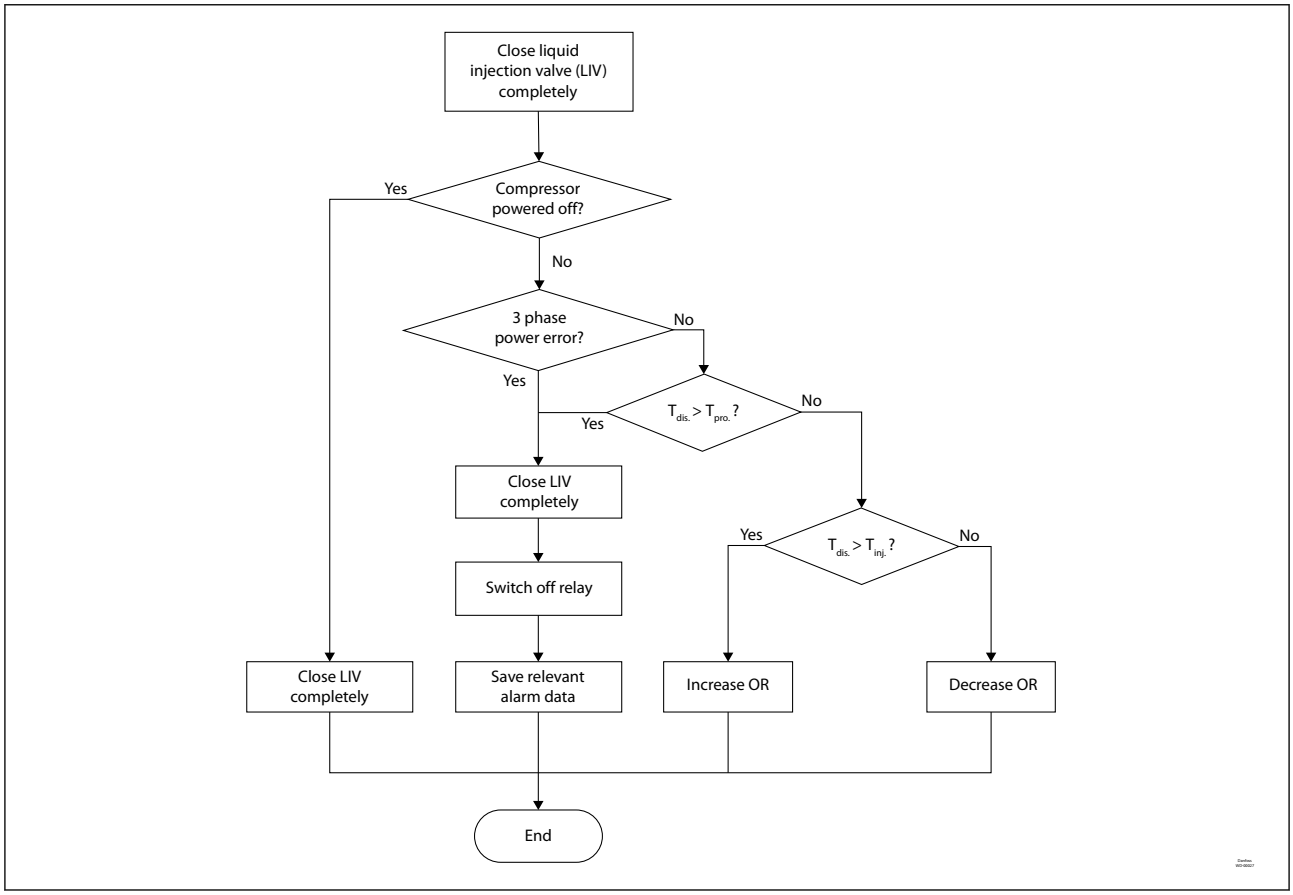
Manage injection

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

This paragraph focuses on single and tandem configurations.

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 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:
The hysteresis of [+2K/-2K] applied is dedicated to avoid short cycling of injection valve, it has to be customizable on the range [-5K/+5K] by step of 1K.

For reliability reasons, It is mandatory to control each compressor. This means that an individual DGT and an LIV per compressor is mandatory.

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	PSH019	ETS 5M13	AKS21 sensor (or other PT1000)	EKE110 1V
	PSH023			
	PSH026			
	PSH030			
	PSH034			
	PSH039			
	PSH038E(2*PSH019)			
	PSH046E(2*PSH023)			
	PSH052E(2*PSH026)			
	PSH060E(2*PSH030)			
	PSH068E(2*PSH034)			
	PSH078E(2*PSH039)			

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.

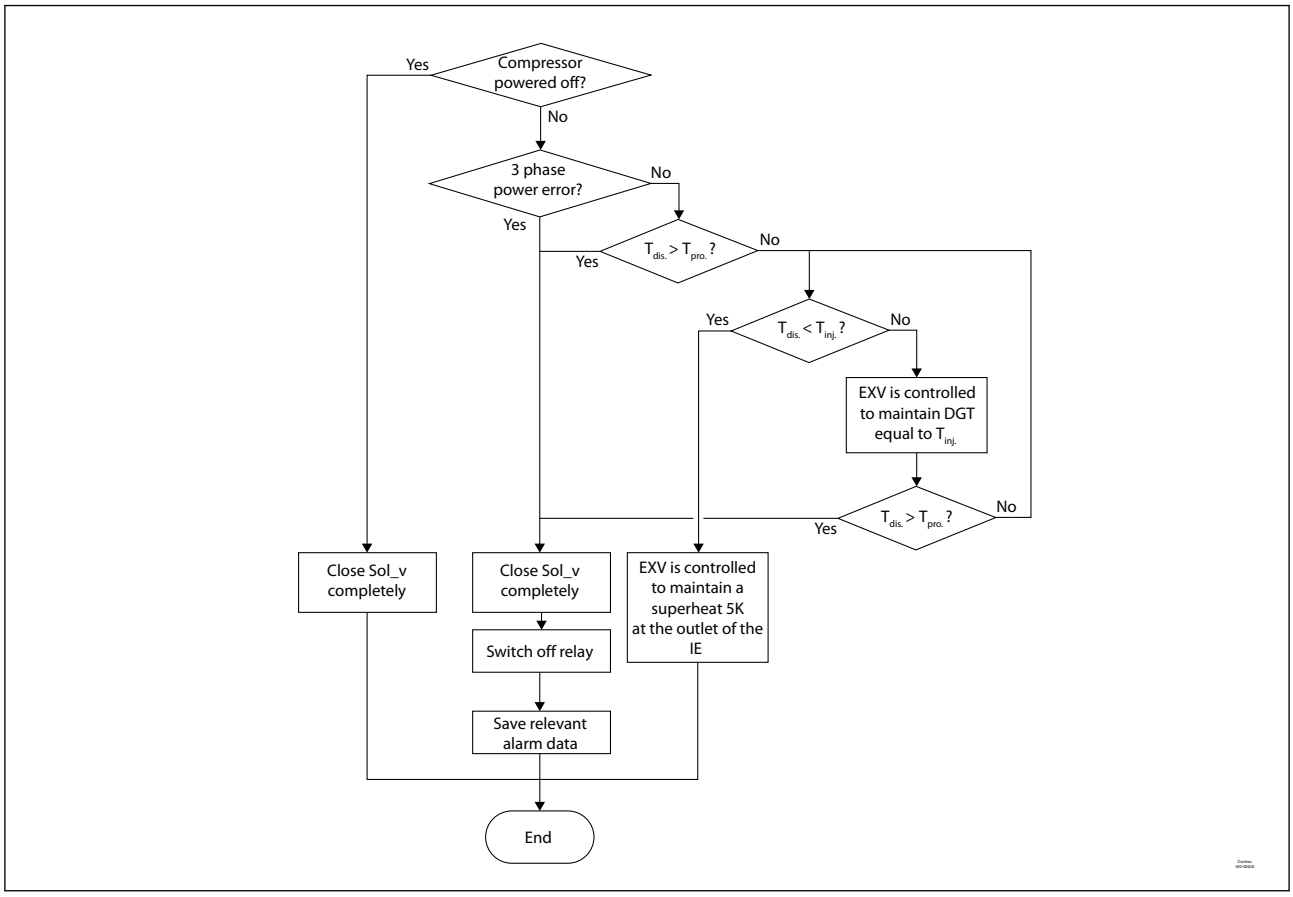
The table below presents a pre-selection of EXV, IE and Sol v for the different configurations of PSH using R454B.

NOTE: *These selections allow to cover Vapor + Wet injection for hydronic Heat pumps for evaporating temperature up to 15°C, a pressure ratio higher than 2 and a subcooling at condenser outlet higher or equal to 4K. 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.)
50Hz	PSH019	Upstream	ETS 5M13	C17L-EZ-24	AKS21 sensor (or other PT1000)	EVR3 v2
		Downstream		C17L-EZ-26		
	PSH023	Upstream	ETS 5M13	C17L-EZ-26		EVR6 v2
		Downstream		C17L-EZ-30		
	PSH026	Upstream	ETS 5M13	C17L-EZ-30		EVR8 v2
		Downstream		C17L-EZ-34		
	PSH038E(2*PSH019)	Upstream	ETS 5M17	C17L-EZ-46		EVR3 v2
		Downstream		C17L-EZ-48		
	PSH046E(2*PSH023)	Upstream	ETS 5M20	C17L-EZ-48		EVR6 v2
		Downstream		C17L-EZ-56		
	PSH052E(2*PSH026)	Upstream	ETS 5M20	C17L-EZ-52		EVR8 v2
		Downstream		C17L-EZ-64		
60Hz	PSH019	Upstream	ETS 5M13	C17L-EZ-24		EVR3 v2
		Downstream		C17L-EZ-26		
	PSH023	Upstream	ETS 5M13	C17L-EZ-30		EVR6 v2
		Downstream		C17L-EZ-36		
	PSH026	Upstream	ETS 5M13	C17L-EZ-34		EVR8 v2
		Downstream		C17L-EZ-42		
	PSH038E(2*PSH019)	Upstream	ETS 5M20	C17L-EZ-46		EVR3 v2
		Downstream		C17L-EZ-46		
	PSH046E(2*PSH023)	Upstream	ETS 5M20	C17L-EZ-54		EVR6 v2
		Downstream		C17L-EZ-68		
	PSH052E(2*PSH026)	Upstream	ETS 5M20	C17L-EZ-62		EVR8 v2
		Downstream		C17L-EZ-78		
50Hz	PSH030	Upstream	ETS 5M13	D62L-8	AKS sensor (or other PT1000)	EVR 10 v2
		Downstream				
	PSH034	Upstream	ETS 5M13	D62L-8		
		Downstream		D62L-10		
	PSH039	Upstream	ETS 5M13	D62L-10		
		Downstream				
	PSH060E(2*PSH030)	Upstream	ETS 5M20	D62L-12		
		Downstream		D62L-14		
	PSH068E(2*PSH034)	Upstream	ETS 5M20	D62L-14		
		Downstream				
	PSH078E(2*PSH039)	Upstream	ETS 5M24	D62L-14		
		Downstream		D62L-16		
60Hz	PSH030	Upstream	ETS 5M13	D62L-8		EVR 10 v2
		Downstream	ETS 5M13	D62L-10		
	PSH034	Upstream	ETS 5M13	D62L-10		
		Downstream	ETS 5M13			
	PSH039	Upstream	ETS 5M17	D62L-10		
		Downstream	ETS 5M17			
	PSH060E(2*PSH030)	Upstream	ETS 5M20	D62L-14		
		Downstream	ETS 5M20	D62L-16		
	PSH068E(2*PSH034)	Upstream	ETS 5M24	D62L-16		
		Downstream	ETS 5M24			
	PSH078E(2*PSH039)	Upstream	ETS 5M24	D62L-16		
		Downstream	ETS 5M35	D62L-18		

EXV	Electronic Expansion Valve
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:
The hysteresis of [+2K/-2K] applied is dedicated to avoid short cycling of injection valve, it has to be customizable on the 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.

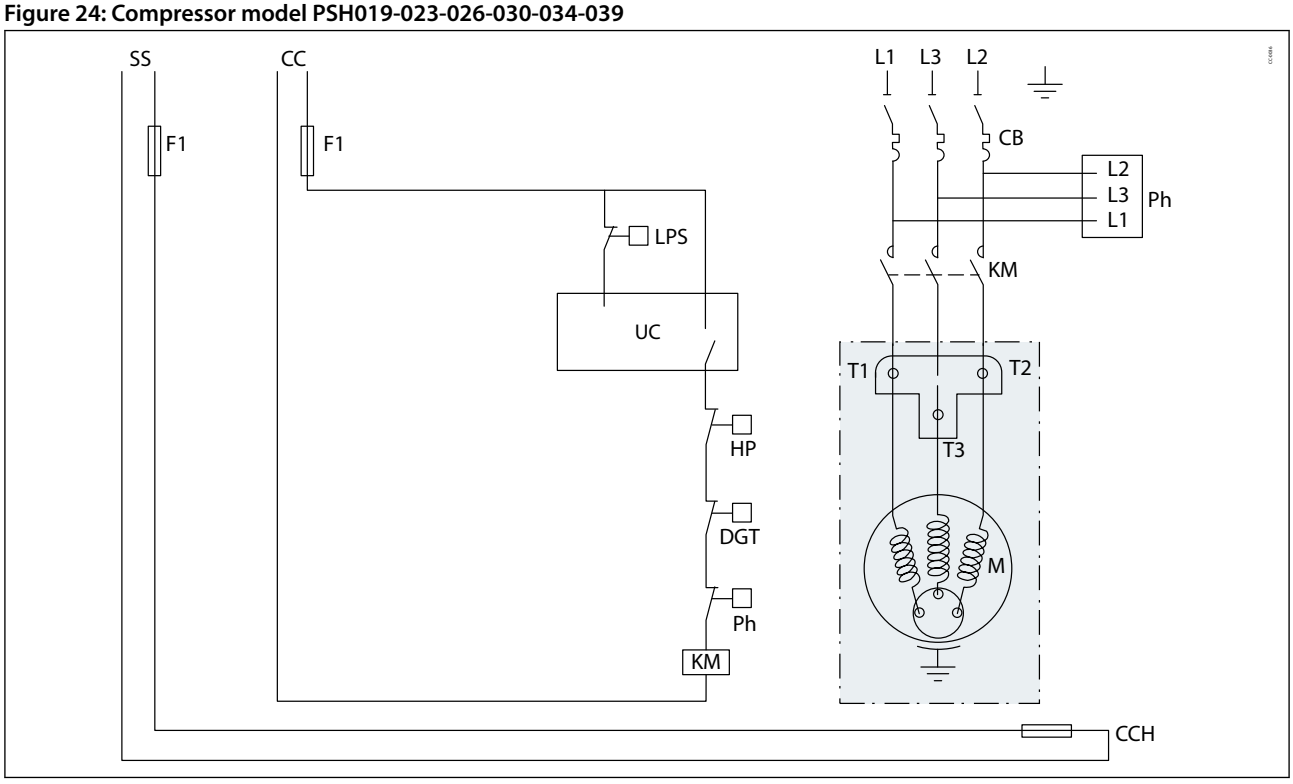
Power supply and electrical protection

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).
- HP safety switch and DGT must be wired in the safety chain. Other safety devices such as LP can be either hardware or software managed.
- Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (e.g. seasonal shutdown).

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

Figure 24: Compressor model PSH019-023-026-030-034-039



CB	Thermal magnetic motor circuit breaker	**M**	Compressor motor
CC	Control circuit	**MPM**	Motor Protection Module
DGT	Discharge gas thermistor	**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.

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.

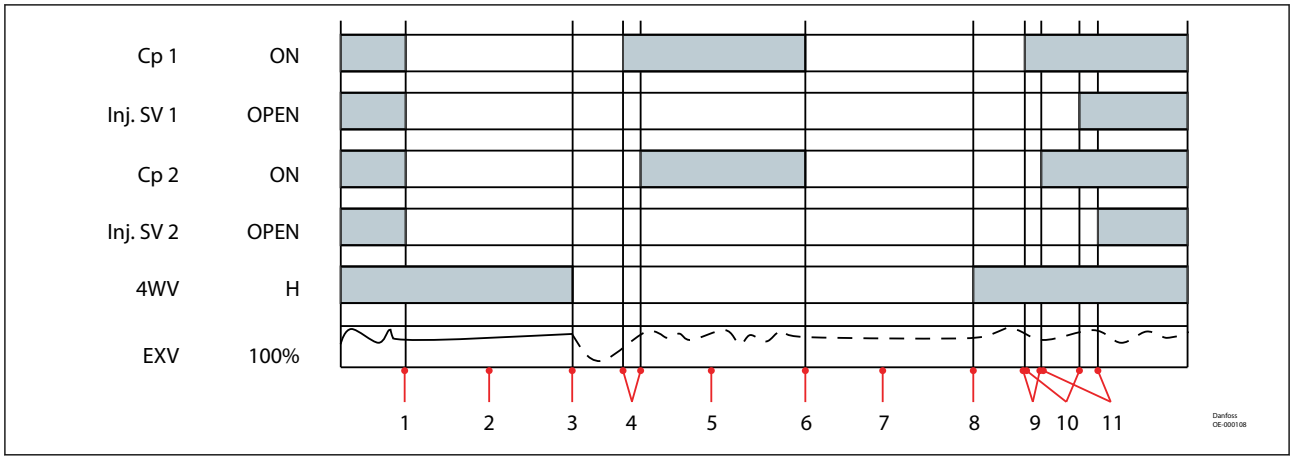
Defrost logic recommendations / Reversible systems

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 25: 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.

One shot pump down: 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.

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 mandatory to ensure safe compressor handling.
- It is recommended to maintain the spreader bar in an upright position during all handling manoeuvres (+/- 15° from horizontal)
- The use of lifting hooks closed with a clasp is recommended.
- For tandem 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 26: Heavy

Figure 27: Mandatory

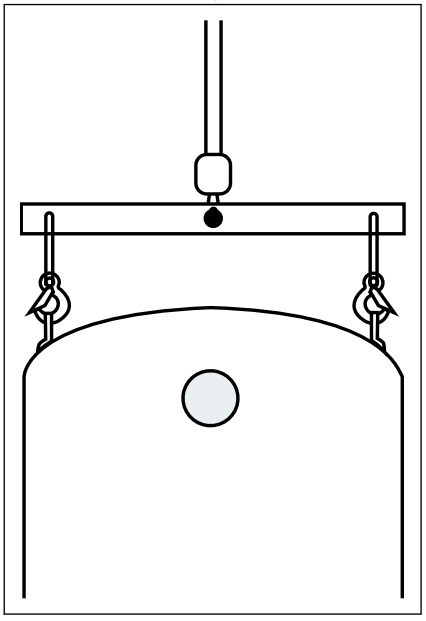


Figure 28: Forbidden

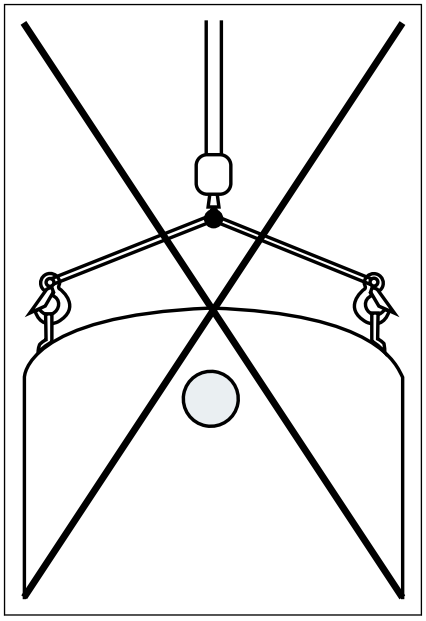


Figure 29: Incorrect

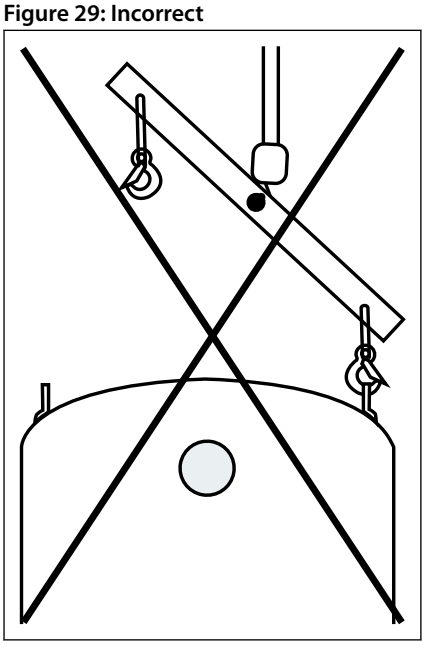
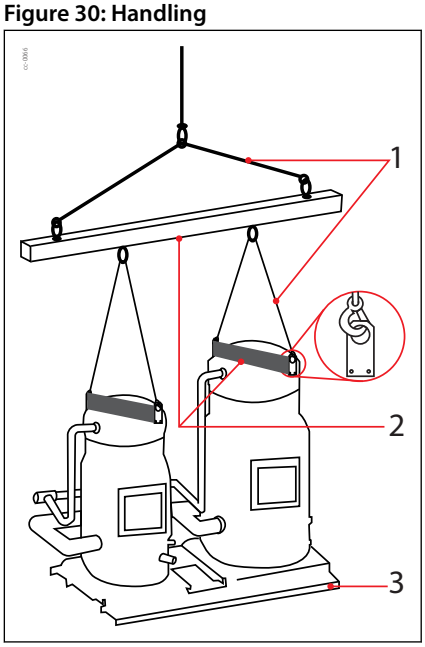


Figure 30: Handling



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 28: 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.
- To enhance the resistance to rust, a varnish on the connection is recommended.

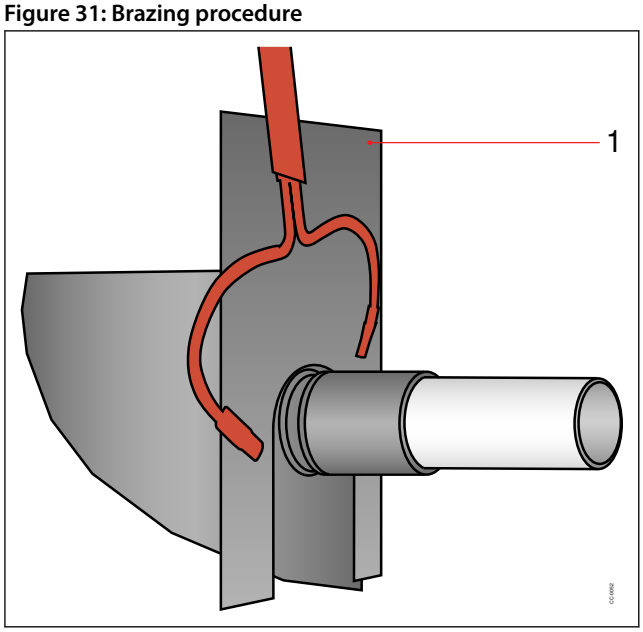
PSH compressors connectors are made of steel copper coated, which benefit to protect against corrosion and facilitate adhesion during brazing operation.

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 31: Brazing procedure



1	Heat shield

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

System pressure test and leak detection

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

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

Table 29: System pressure test and leak detection

Maximum compressor test pressures	PSH019-023-026-030-034-039
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)	36.7bar (g) (532psig) 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. For PSH019-023-026-030-034-039 compressors equipped with internal reverse vent valve which can protect compressor without damage within duration below 24h. For more details refer to section Phase sequence and reverse rotation 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.

Packaging

Single pack

Table 30: Single pack packaging

Compressor model	Length		Width		Height		Gross weight	
	mm	inch	mm	inch	mm	inch	kg	lbs
PSH019	565	22.24	470	18.50	718	28.27	69	152
PSH023	565	22.24	470	18.50	718	28.27	76	168
PSH026	565	22.24	470	18.50	718	28.27	76	168
PSH030	565	22.24	470	18.50	718	28.27	79	174
PSH034	565	22.24	470	18.50	718	28.27	81	179
PSH039	565	22.24	470	18.50	718	28.27	84	185

Industrial pack

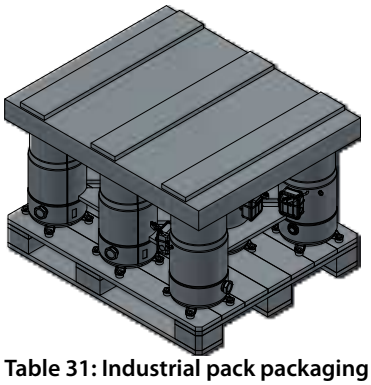


Table 31: Industrial pack packaging

Compressor model	Compressors per pack	Length		Width		Height		Gross weight		Static stacking pallets
		mm	inch	mm	inch	mm	inch	kg	lbs	
PSH019	8	1150	45.28	950	37.40	680	26.77	508	1120	2
PSH023	8	1150	45.28	950	37.40	750	29.53	564	1243	2
PSH026	8	1150	45.28	950	37.40	750	29.53	564	1243	2
PSH030	8	1150	45.28	950	37.40	750	29.53	578	1274	2
PSH034	8	1150	45.28	950	37.40	750	29.53	594	1310	2
PSH039	8	1150	45.28	950	37.40	750	29.53	622	1371	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 32: Single pack compressors compatible R454B and R410A

Compressor model	Connections	Motor protection	Code no.			
			3	4	7	9
			208-230/3/60	380-415/3/50 460/3/60	575/3/60	380-400/3/60
PSH019	Brazed	Internal	120H2109	120H2107	120H2105	120H2103
PSH023	Brazed	Internal	120H2101	120H2099	120H2097	120H2095
PSH026	Brazed	Internal	120H2093	120H2091	120H2089	120H2087
PSH030	Brazed	Internal	120H2085	120H2083/120H2061*	120H2081	120H2079
PSH034	Brazed	Internal	120H2077	120H2075/120H2059*	120H2073	120H2071
PSH039	Brazed	Internal	120H2069	120H2067/120H2057*	120H2065	120H2063

NOTE:
* single version, compressor without OSG/OEQ

Industrial pack

Compressors compatible R454B and R410A

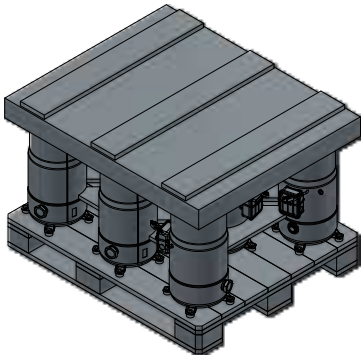


Table 33: Industrial pack compressors compatible R454B and R410A

Compressor model	Connections	Motor protection	Code no.			
			3	4	7	9
			208-230/3/60	380-415/3/50 460/3/60	575/3/60	380-400/3/60
PSH019	Brazed	Internal	120H2110	120H2108	120H2106	120H2104
PSH023	Brazed	Internal	120H2102	120H2100	120H2098	120H2096
PSH026	Brazed	Internal	120H2094	120H2092	120H2090	120H2088

Compressor model	Connections	Motor protection	Code no.			
			3	4	7	9
			208-230/3/60	380-415/3/50 460/3/60	575/3/60	380-400/3/60
PSH030	Brazed	Internal	120H2086	120H2084/120H2062*	120H2082	120H2080
PSH034	Brazed	Internal	120H2078	120H2076/120H2060*	120H2074	120H2072
PSH039	Brazed	Internal	120H2070	120H2068/120H2058*	120H2066	120H2064

NOTE:
* single version, compressor without OSG/OEQ

Accessories and Spare parts

Solder sleeve adapter set

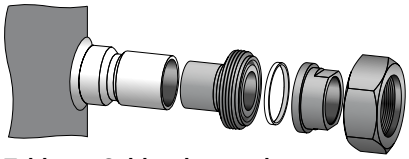


Table 34: Solder sleeve adapter set

Code no.	Description	Application	Packaging	Pack size
120Z0125	Rotolock adaptor set (1"3/4 ~ 1"1/8) , (1"1/4 ~ 7/8")	PSH019(R410A)	Multipack	8
120Z0405	Rotolock adaptor set (1"3/4 ~ 1"3/8), (1"1/4 ~ 7/8")	PSH023-039(R410A)	Multipack	8

Rotolock adapter

Table 35: Rotolock adapter

Code no.	Description	Application	Packaging	Pack size
120Z0431	Adaptor (1"3/4 Rotolock - 1"3/8 ODS)	Models with 1"3/8 ODF (R410A)	Multipack	10
120Z0367	Adaptor (1"1/4 Rotolock - 7/8" ODS)	Models with 7/8" ODF (R410A)	Multipack	10
120Z0364	Adaptor (1"3/4 Rotolock - 1"1/8 ODF)	Models with 1"1/8 ODF (R410A)	Multipack	10

Gaskets

Table 36: 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
8156131	Gasket, 1"1/4	Models with 1"1/4 rotolock connection	Multipack	10
7956002	Gasket, 1"1/4	Models with 1"1/4 rotolock connection	Industry pack	50

Solder sleeve

Table 37: Solder sleeve

Code no.	Description	Application	Packaging	Pack size
8153003	Solder sleeve P10 (1"3/4 Rotolock - 1"3/8 ODF)	Models with 1"3/4 rotolock connection (R410A)	Multipack	10
8153004	Solder sleeve P02 (1"3/4 Rotolock - 1"1/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10
8153012	Rotolock connector P05 (1"¼ Rotolock - 7/8" ODF)	Models with 1"¼ rotolock connection (R410A)	Multipack	10

Rotolock nut

Table 38: Rotolock nut

Code no.	Description	Application	Packaging	Pack size
8153124	Rotolock nut,1"3/4	Models with 1-3/4" rotolock connection	Multipack	10
8153123	Rotolock nut,1"1/4	Models with 1-1/4" rotolock connection	Multipack	10

Crankcase heaters

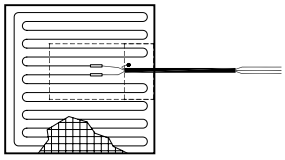


Table 39: Surface sump heaters

Code no.	Description	Application	Packaging	Pack size
120Z0667	48W 24V surface sump heater CE and UL	PSH019-023-026-030-034-039	Single pack	1
120Z0668	48W 230V surface sump heater CE and UL		Single pack	1
120Z0669	48W 400V surface sump heater CE and UL		Single pack	1
120Z0670	48W 460V surface sump heater CE and UL		Single pack	1
120Z0671	48W 575V surface sump heater CE and UL		Single pack	1
120Z0388	80W 24V surface sump heater CE and UL		Multipack	8
120Z0389	80W 230V surface sump heater CE and UL		Multipack	8
120Z0390	80W 400V surface sump heater CE and UL		Multipack	8
120Z0391	80W 460V surface sump heater CE and UL		Multipack	8
120Z0402	80W 575V surface sump heater CE and UL		Multipack	8

Mounting hardware

Table 40: Mounting hardware

Code no.	Description	Application	Packaging	Pack size
120Z0066	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	PSH019-023-026-030-034-039	Single pack	1

Lubricant

Table 41: 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 42: Terminal boxes, covers and T-block connectors

Code no.	Description	Application	Packaging	Pack Size
120Z0413	Terminal box cover	PSH039 code 3/7/9 - PSH030 code3 - PSH034 code3	Single pack	1
8156135	Service kit for terminal box 96 x 115 mm, including 1 cover, 1 clamp	PSH019 to 039 (except PSH039 code 3/7/9 PSH030 code3 and PSH034 code3)	Multipack	10
8173230	T block connector 52 x 57 mm	PSH019 to 039 (except PSH039 code 3/7/9)	Multipack	10
8173021	T block connector 60 x 75 mm	PSH039 code 3/7/9	Multipack	10

Acoustic hoods

Table 43: Acoustic hoods

Code no.	Description	Application	Packaging	Pack Size
120Z0956	Acoustic hood body	PSH019	Single pack	1
120Z0955	Acoustic hood body	PSH023-026-030-034	Single pack	1
120Z0954	Acoustic hood body	PSH039	Single pack	1
120z0833	Acoustic hood top	PSH019-023-026-030-034-039	Single pack	1

Miscellaneous

Table 44: 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

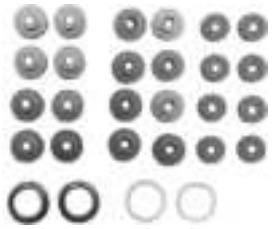


Table 45: Tandem kits

Code no.	Description	Application	Packaging	Pack Size
7777054	Suction washer, rigid spacer, sleeve for oil connection	Even tandem	Single pack	1

Updates

Release data (Year/ Month)	Guideline literature number	List of changes
12/24	AB492637854347en-000101	First release
03/25	AB492637854347en-000201	• New release PSH019/023/026 codes • The condensing temperature of map is extended to 10°C; The map area of R454B VI is extended to evaporating temperature 3°C/condensing temperature 68°C **(page 16)** • Charge limit updated **(page38)**
08/25	AB492637854347en-000301	• Maximum condensing temperature of PSH039A4 50Hz VI envelope extended from 60°C to 68°C.**(page 18)** • Outline drawing of PSH052E was updated from 8560343 to 8560344.

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