ENGINEERING
TOMORROW

Application Guide

Scroll compressors
DSH090 to **DSH600**

R410A - R454B - R452B, 50Hz -60Hz



www.danfoss.com

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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

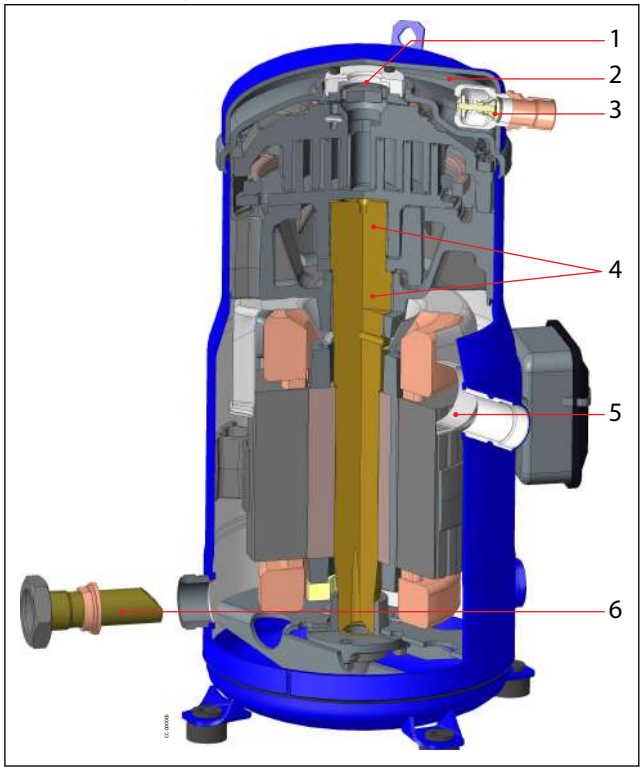
Product description

Danfoss scroll compressor DSH for R410A, R454B and R452B is available as single compressor and can be assembled in tandem or trio combinations.

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

Cut Away DSH090-184

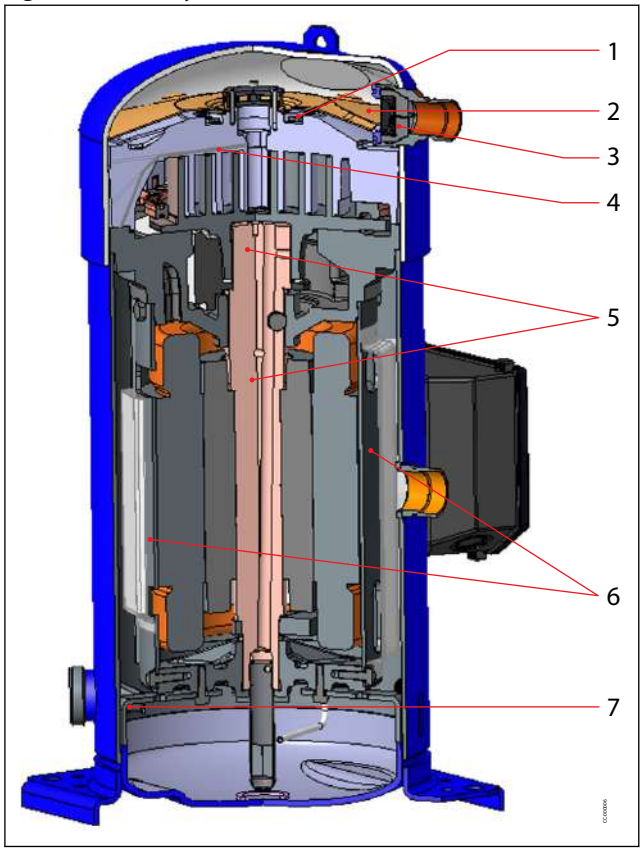
Figure 1: Cut Away DSH090-184



1	Intermediate discharge valves (IDVs) increase seasonal efficiency
2	Heat shield lowers the heat transfer between discharge and suction gas and the sound level
3	Internal Non Return Valve (INRV) prevents excessive leak rate from high pressure side
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
6	Organ pipe masters oil circulation in manifold configuration.

Cut Away DSH240-600

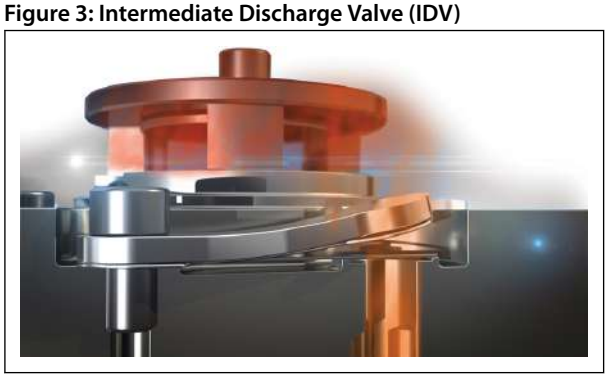
Figure 2: Cut Away DSH240-600



1	Intermediate discharge valves (IDVs) increase seasonal efficiency
2	Heat shield lowers the heat transfer between discharge and suction gas and the sound level
3	Internal Non Return Valve (INRV) prevents excessive leak rate from high pressure side
4	Integrated discharge gas temperature protection (DGT)
5	Lead free polymer bearings improve behavior under poor lubrication conditions
6	Patented gas path flow with gas intake design induce higher resistance to liquid slugging
7	Organ pipe masters oil circulation in manifold configuration

How do IDVs work?

Figure 3: Intermediate Discharge Valve (IDV)

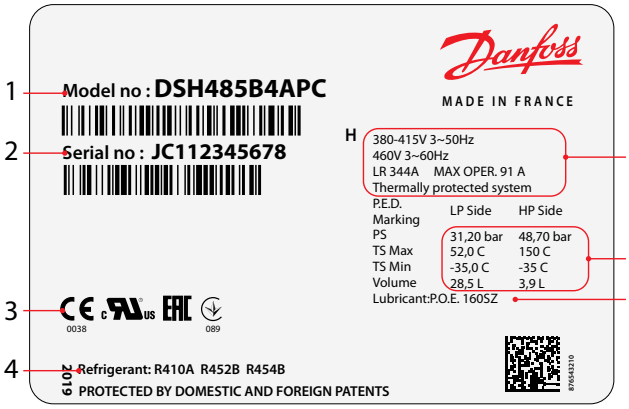


Danfoss Intermediate Discharge Valves (IDVs) are located close to the discharge side of the compressor. They reduce excessive compression of refrigerant under part-load conditions while maintaining the same cooling capacity. The IDVs open when discharge pressure falls below the built-in optimization 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.

Product identification

Name Plate

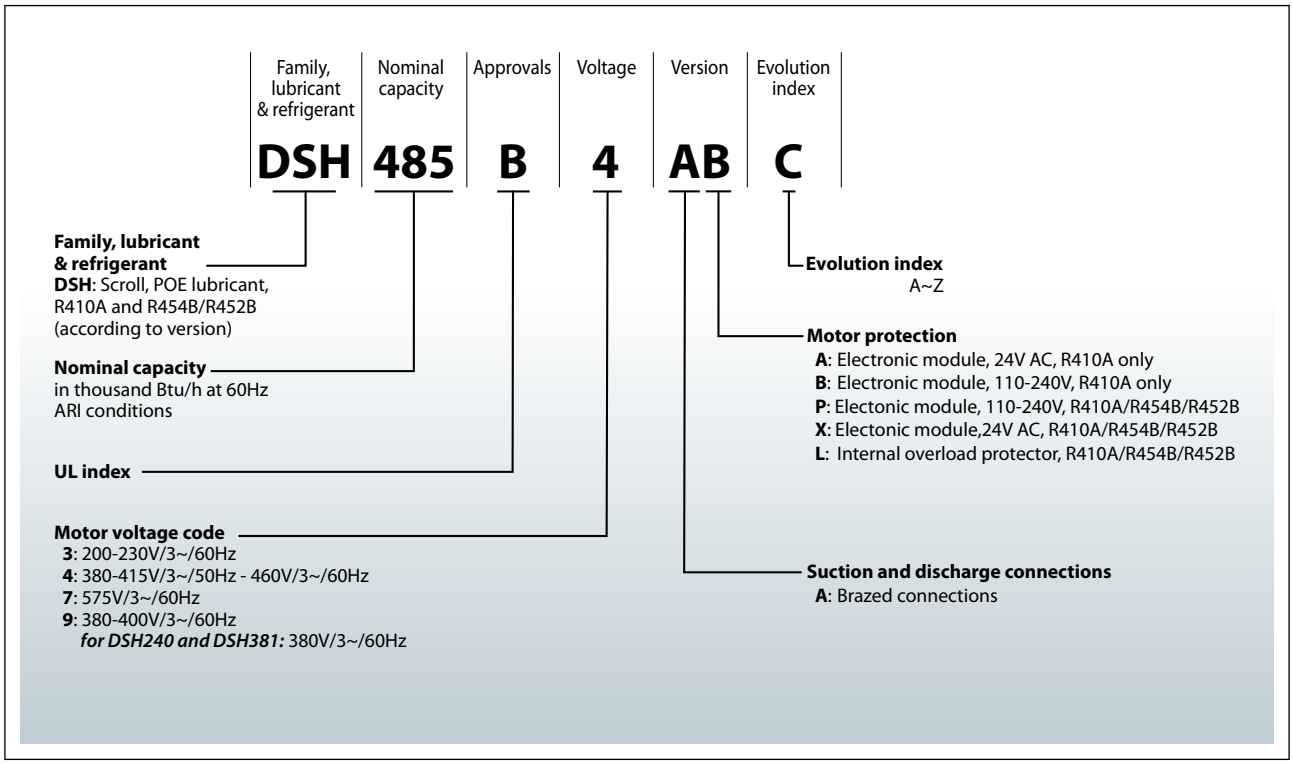
Figure 4: Name Plate



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

Nomenclature

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



Compressors serial number

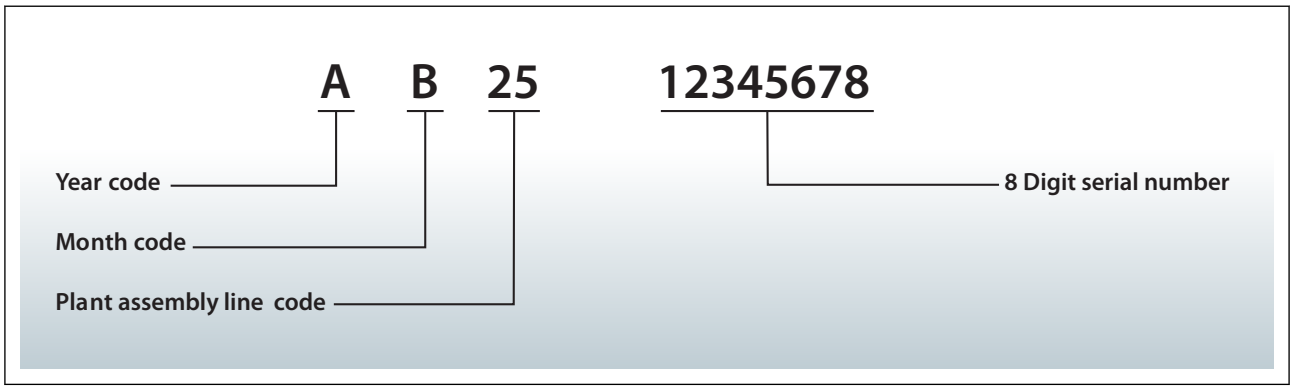


Table 1: Serial number code legend table

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

DSH 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 DSH models
UL (Underwriters Laboratories)	c UL us	All DSH models
Other approvals / certificates		Contact Danfoss

Low voltage directive 2014/35/EU

Table 3: Low voltage directive 2014/35/EU

Products	DSH models
Declaration of conformity	Contact Danfoss

Machines directive 2006/42/EC

Table 4: Machines directive 2006/42/EC

Products	DSH models
Manufacturer's declaration of incorporation	Contact Danfoss

Pressure equipment directive 2014/68/EU

Table 5: Pressure equipment directive 2014/68/EU

Products	DSH090 to 184	DSH240-295	DSH381-485-600
Category PED R410A	II	II	III
Category PED R452B / R454B	III	III	IV
Maximum / Minimum temperature - Ts	-35°C < Ts < 55°C -31°F < Ts < 131°F	-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	R410A : 33.3 bar (g) / R452B and R454B : 31.2 bar(g) R410A : 483 psig / R452B and R454B : 453 psig	31.2 bar(g) 451 psig	31.2bar(g) 451psig
Maximum allowable pressure (High side) - Ps	48.7 bar(g) 706 psig	48.7 bar(g) 706 psig	48.7 bar(g) 706 psig
Declaration of conformity	Contact Danfoss	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]
DSH090	11.7	714	0.7	43	12.4	757
DSH105	13.6	830	0.7	43	14.3	873
DSH120	13.6	830	0.7	43	14.3	873
DSH140	13.6	830	0.7	43	14.3	873
DSH161	13.6	830	0.7	43	14.3	873
DSH184	13.9	848	0.7	43	14.6	891
DSH240	27.5	1678	2.9	177	30.4	1855
DSH295	27.1	1654	2.8	171	29.9	1825
DSH381	31.1	1898	4.0	244	35.1	2142
DSH485	28.5	1739	3.9	238	32.4	1977
DSH600	30.1	1837	4.0	244	34.1	2081

Refrigerants

General Information

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

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

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.

R452B

R452B is a HFO/HFC blend (R32: 67%; R125: 7%; R1234yf: 26%) with a zero Ozone Depletion Potential(ODP=0) and a low Global Warming Potential (GWP: 676/AR5 ; 698/AR4). It is a near-azeotropic mixture with a temperature glide around 1 K.

R452B has very close capacities versus R410A and due to its very limited discharge temperature difference it appears today as the best candidate for a direct drop in of R410A.

R452B 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.

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
DSH090	7.5	88.4	5.39	15.4	544	18.6	657	3	102	58	128
DSH105	9	103.5	6.32	18	636	21.8	770	3.3	112	64	141
DSH120	10	116.9	7.13	20.3	717	24.6	869	3.3	112	64	141
DSH140	12	133	8.12	23.1	816	27.9	985	3.3	112	67	148
DSH161	13	151.7	9.26	26.4	932	31.9	1127	3.3	112	69	152
DSH184	15	170.3	10.39	29.6	1045	35.8	1264	3.6	122	71.5	158
DSH240	20	227.6	13.89	39.6	1398	47.8	1688	6.1	206	114	251
DSH295	25	276.2	16.85	48.1	1699	58	2048	6.1	206	117	258
DSH381	30	345	21.05	60	2119	72.3	2553	6.1	206	162	357
DSH485	40	442.6	27.01	77	2719	92.9	3281	6.1	206	176	388
DSH600	50	553	33.75	96.2	3397	116.1	4100	6.1	206	215	474

[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

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	DSH090	7.5	20048	68402	6.57	3.05	10.40
	DSH105	9.0	23578	80449	7.69	3.07	10.47
	DSH120	10.0	26787	91396	8.65	3.10	10.57
	DSH140	12.0	30370	103621	9.74	3.12	10.64
	DSH161	13.0	34894	119059	11.09	3.15	10.74
	DSH184	15.0	39036	133191	12.42	3.14	10.72
	DSH240	20.0	52730	179920	17.04	3.09	10.56
	DSH295	25.0	64520	220149	20.35	3.17	10.82
	DSH381	30.0	80707	275379	25.83	3.12	10.66
	DSH485	40.0	104687	357202	32.39	3.23	11.03
	DSH600	50.0	128864	439698	40.60	3.17	10.83
60Hz	DSH090	7.5	27471	93730	8.60	3.19	10.90
	DSH105	9.0	32279	110136	10.06	3.21	10.94
	DSH120	10.0	36629	124977	11.31	3.24	11.05
	DSH140	12.0	41510	141631	12.81	3.24	11.06
	DSH161	13.0	47222	161122	14.77	3.20	10.91
	DSH184	15.0	53157	181371	16.44	3.23	11.03
	DSH240	20.0	71760	244852	22.46	3.20	10.90
	DSH295	25.0	87610	298934	26.96	3.25	11.09
	DSH381	30.0	110116	375726	34.41	3.20	10.92
	DSH485	40.0	143956	491192	43.03	3.35	11.42
	DSH600	50.0	175344	598291	53.80	3.26	11.12

NOTE:
TR: Ton of Refrigeration,
COP: Coefficient Of Performance
EER: Energy Efficiency Ratio
Standard rating conditions For 50 Hz: Evaporating temperature: 5°C (41°F), Condensing temperature: 50°C (122°F), Superheat: 10K (18°F), Subcooling: 0K (0°F)

For 60 Hz: Evaporating temperature: 7.2°C (45°F), Condensing temperature: 54.4°C (130°F), Superheat: 11.1K (20°F), Subcooling: 8.3K (15°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.

R452B 50-60 Hz, Single compressor

Table 9: 50-60 Hz Performance data

Model		Nominal cooling capacity		Power input	COP	E.E.R.
		W	Btu/h	kW	W/W	Btu/h/W
50Hz	DSH090	19590	66839	6.46	3.03	10.35
	DSH105	23451	80016	7.40	3.17	10.81
	DSH120	26366	89961	8.24	3.20	10.92
	DSH140	30180	102974	9.35	3.23	11.01
	DSH161	34855	118924	10.58	3.30	11.25
	DSH184	38779	132313	11.83	3.28	11.18
	DSH240	52130	177873	16.1	3.23	11.02
	DSH295	63995	218359	19.4	3.30	11.27
	DSH381	78977	269477	24.8	3.19	10.89
	DSH485	102623	350160	30.69	3.34	11.41
60Hz	DSH090	26652	90936	8.38	3.18	10.85
	DSH105	31925	108929	9.64	3.31	11.30
	DSH120	35779	122078	10.89	3.29	11.21
	DSH140	40984	139838	12.51	3.28	11.18
	DSH161	46938	160152	13.84	3.39	11.57
	DSH184	52181	178040	15.81	3.30	11.26
	DSH240	70756	241427	21.4	3.31	11.30
	DSH295	86418	294866	25.5	3.39	11.57
	DSH381	105020	358339	32.5	3.23	11.02
	DSH485	138878	473866	40.92	3.39	11.58

NOTE:
TR: Ton of Refrigeration,
COP: Coefficient Of Performance
EER: Energy Efficiency Ratio
Standard rating conditions For 50 Hz: Evaporating temperature: 5°C (41°F), Condensing temperature: 50°C (122°F), Superheat: 10K (18°F), Subcooling: 0K (0°F)

For 60 Hz: Evaporating temperature: 7.2°C (45°F), Condensing temperature: 54.4°C (130°F), Superheat: 11.1K (20°F), Subcooling: 8.3K (15°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

Model		Nominal cooling capacity		Power input	COP	E.E.R.
		W	Btu/h	kW	W/W	Btu/h/W
50Hz	DSH090	19346	66010	6.37	3.03	10.36
	DSH105	22940	78270	7.26	3.16	10.78
	DSH120	26220	89463	8.16	3.21	10.97
	DSH140	29879	101946	9.28	3.22	10.98
	DSH161	34151	116525	10.45	3.27	11.15
	DSH184	37926	129403	11.70	3.24	11.06
	DSH240	50691	172964	15.92	3.18	10.87
	DSH295	62304	212589	19.07	3.27	11.15
	DSH381	78379	267438	24.41	3.21	10.96
	DSH485	101653	346851	30.39	3.34	11.41

Model		Nominal cooling capacity		Power input	COP	E.E.R.
		W	Btu/h	kW	W/W	Btu/h/W
60Hz	DSH090	26320	89804	8.18	3.22	10.98
	DSH105	31296	106782	9.49	3.30	11.25
	DSH120	35528	121223	10.66	3.33	11.37
	DSH140	40482	138126	12.19	3.32	11.33
	DSH161	45966	156834	13.79	3.33	11.38
	DSH184	51267	174922	15.36	3.34	11.39
	DSH240	68133	232478	20.81	3.27	11.17
	DSH295	83489	284872	24.94	3.35	11.42
	DSH381	105020	358339	32.50	3.23	11.02
	DSH485	137206	468160	40.43	3.39	11.58

NOTE:
TR: Ton of Refrigeration,
COP: Coefficient Of Performance
EER: Energy Efficiency Ratio
Standard rating conditions For 50 Hz: Evaporating temperature: 5°C (41°F), Condensing temperature: 50°C (122°F), Superheat: 10K (18°F), Subcooling: 0K (0°F)

For 60 Hz: Evaporating temperature: 7.2°C (45°F), Condensing temperature: 54.4°C (130°F), Superheat: 11.1K (20°F), Subcooling: 8.3K (15°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 11: Compressor sound radiation (R410A/R452B/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]	
DSH090	73	6	76	6	120Z0034
DSH105	75	6	78	6	102Z0035
DSH120	75	6	78	6	120Z0035
DSH140	76	6	79	6	120Z0035
DSH161	76	6	79	6	120Z0035
DSH184	78	6	81	6	120Z0135
DSH240	82	6	85	4	120Z0022
DSH295	82	6	85	4	120Z0022
DSH381	89	6	91	4	120Z0022 120Z0579 [2]
DSH485 [3]	89	4	91	4	120Z0022
DSH600 [3]	91	/	93	/	/

[1] Attenuation given with acoustic hood
[2] For DSH381code 3
[3] No acoustic hood available for DSH485 code 3 and DSH600

Table 12: Compressor sound radiation(R452B/R454B Max. DGT 150°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]	Body	Top
DSH090	73	4	76	4	120Z0490	120Z0493
DSH105	75	4	78	5	120Z0491	120Z0493
DSH120	75	4	78	5	120Z0491	120Z0493
DSH140	76	4	79	5	120Z0491	120Z0493
DSH161	76	4	79	5	120Z0491	120Z0493
DSH184	78	5	81	6	120Z0492	120Z0493
DSH240	82	5	85	4	120Z0768	
DSH295	82	5	85	4	120Z0768	
DSH381 [2]	89	4	91	4	120Z0768	
DSH485 [2]	89	4	91	4	120Z0768	

[1] Attenuation given with acoustic hood
[2] No acoustic hood available for DSH381code 3 and DSH485 code3

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

For compressors running simultaneously,

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

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

Example for the trio

DSH720 = 3 × DSH240 (50 Hz)

L_{DSH240} = 82dB(A)

L_{DSH720} = 82 + 10 Log_{10} 3 = 86 . 8dB(A)

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

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

Example for the tandem

DSH424 = DSH184+DSH240 (50 Hz)

L_{DSH184} = 78dB(A), L_{DSH240} = 82dB(A)

L_{DSH424} =10 $Log_{10}(10^{0.1\times78} + 10^{0.1\times82})$ = 83 . 5dB(A)

Mechanical vibrations

A compressor generates some vibrations that propagate into the surrounding parts and structure. The vibration level of a DSH compressor alone does not exceed 120µm peak to peak for DSH090 to DSH184, and 154µm peak to peak for DSH240 to DSH600. 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 DSH scroll compressors guarantees reliable operations of the compressor for steady-state operation.

Steady-state operation envelope is valid for a suction superheat within 5K to 30K range at nominal Voltage.

Operating envelope

Figure 5: R410A - DSH090 to DSH184

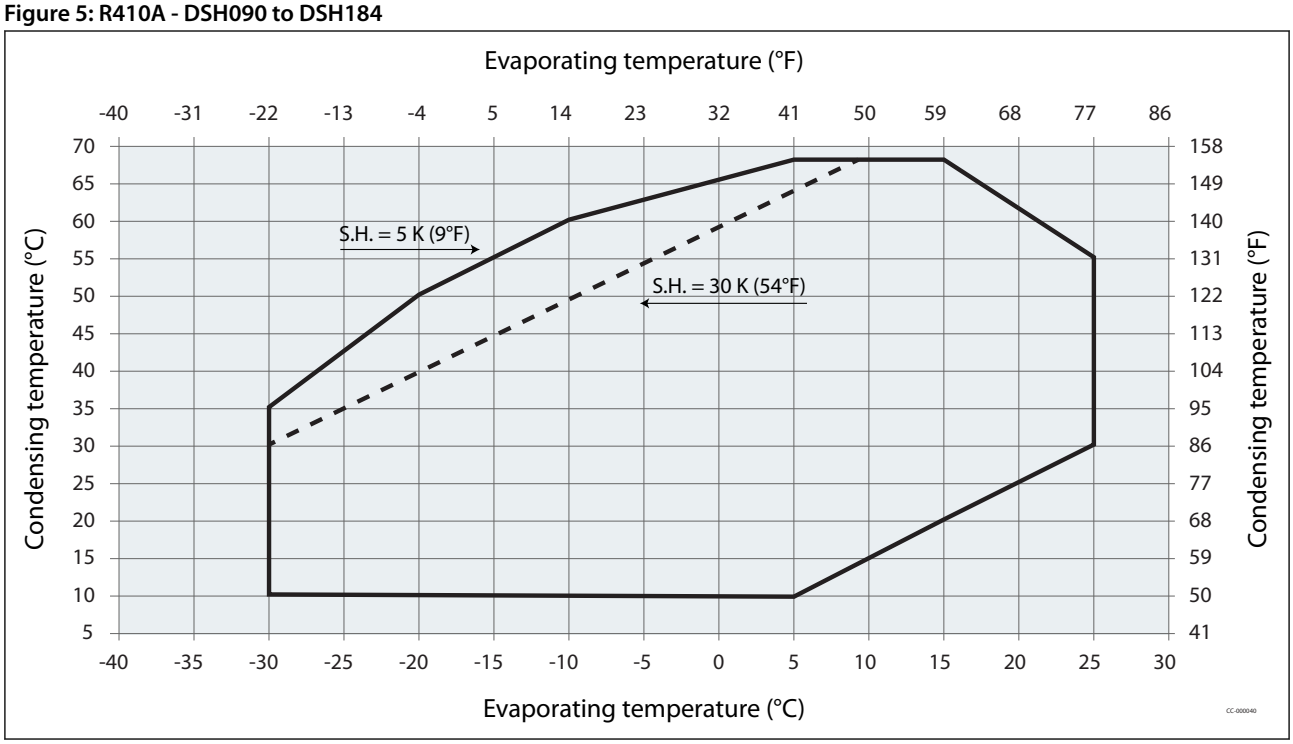


Figure 6: R410A - DSH240 to DSH600

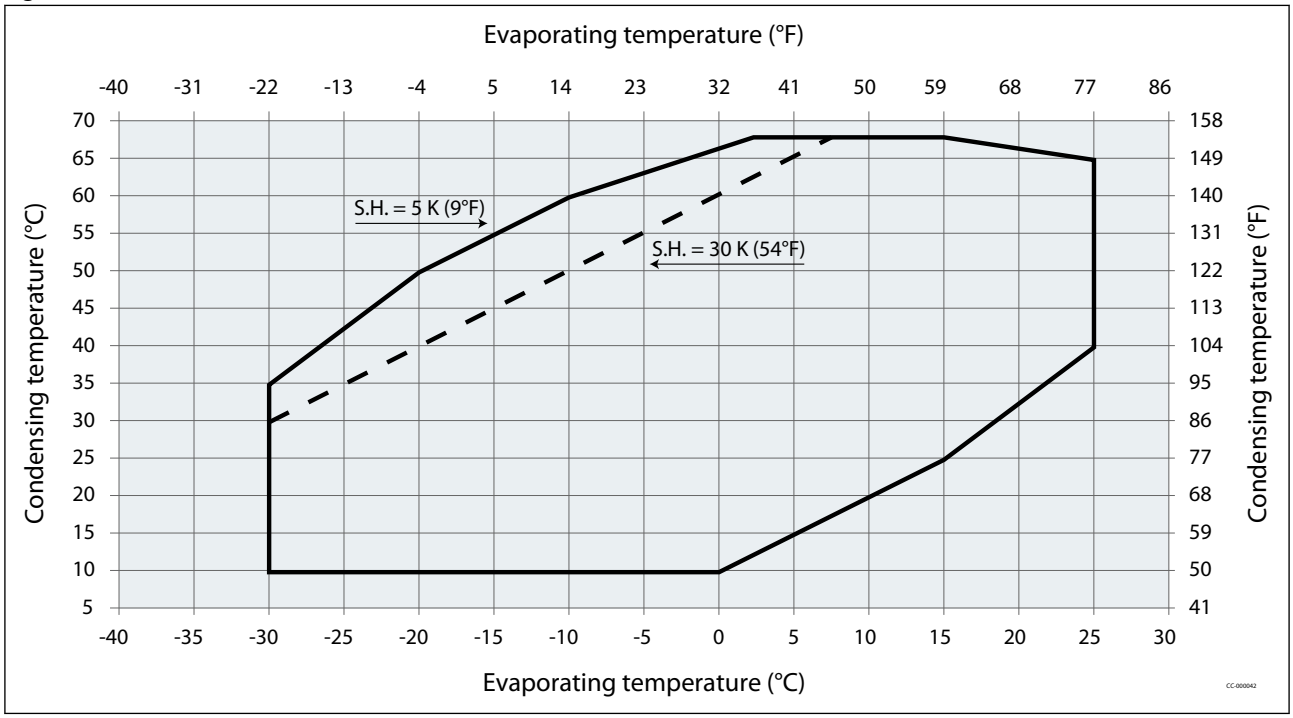


Figure 7: R452B / R454B - DSH090 to DSH105 (Max. DGT 150°C)

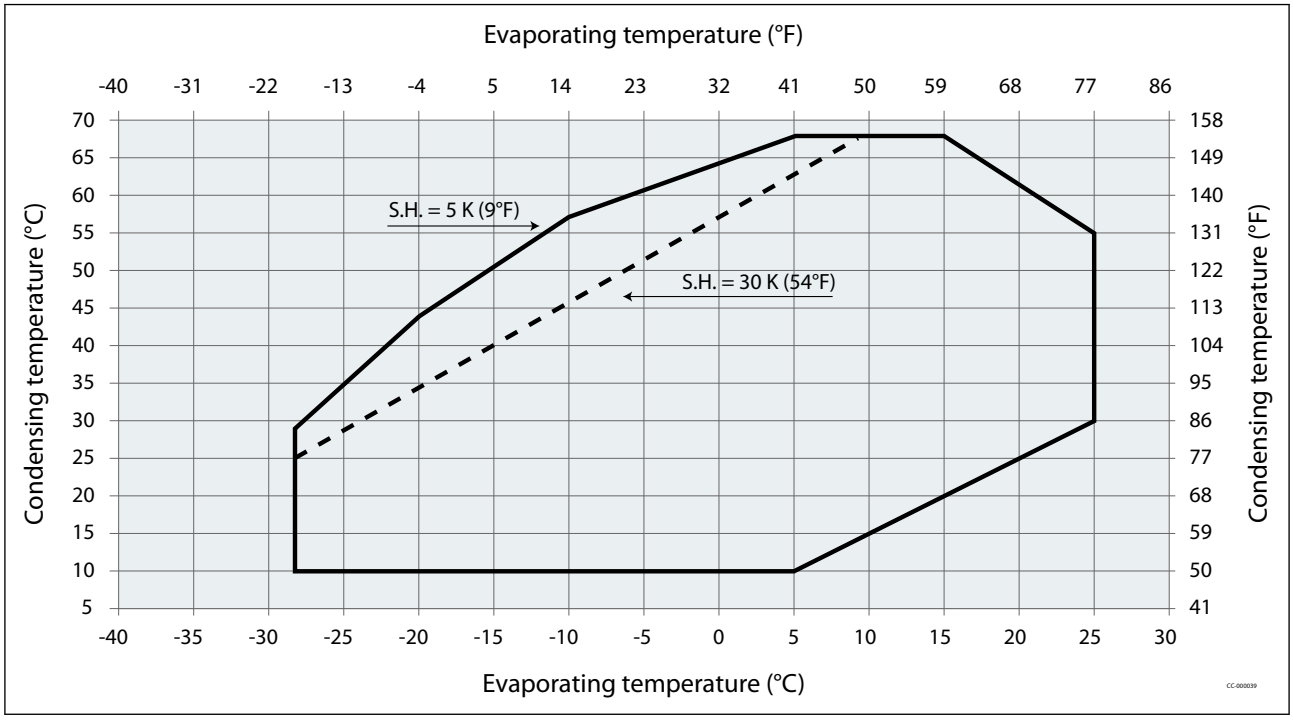


Figure 8: R452B / R454B - DSH120 to DSH184 (Max. DGT 150°C)

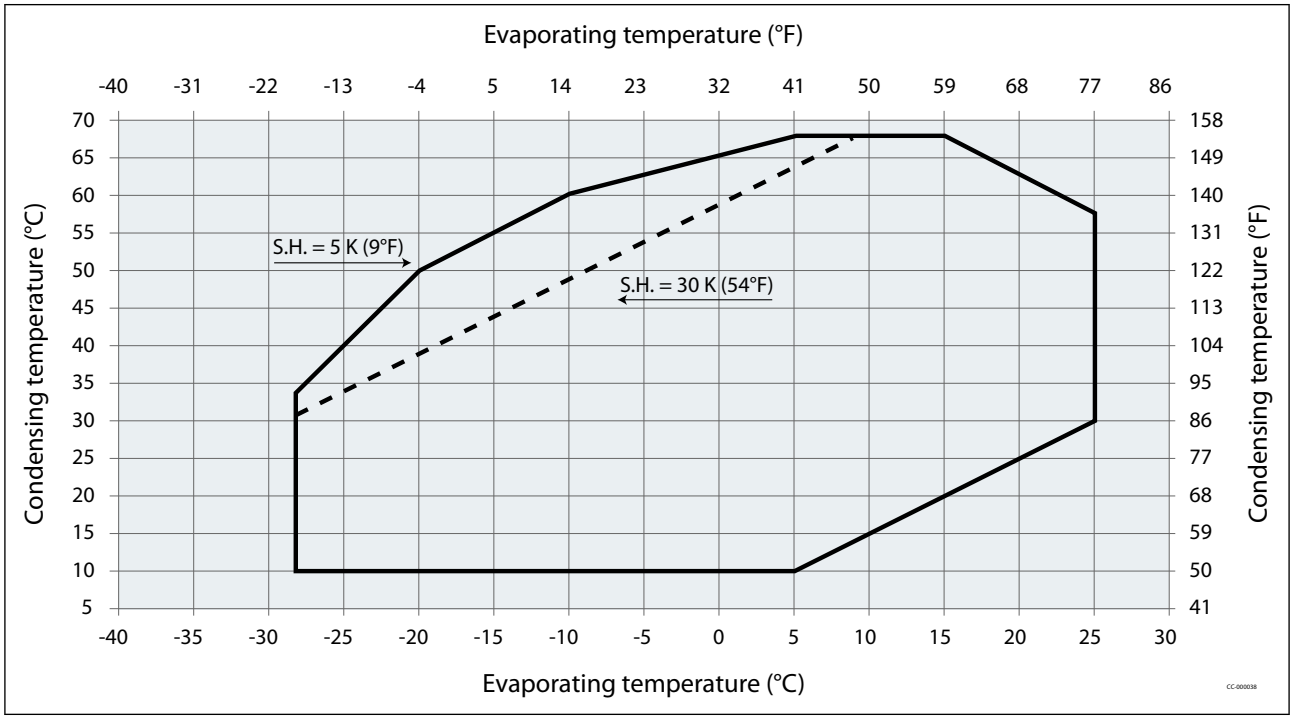
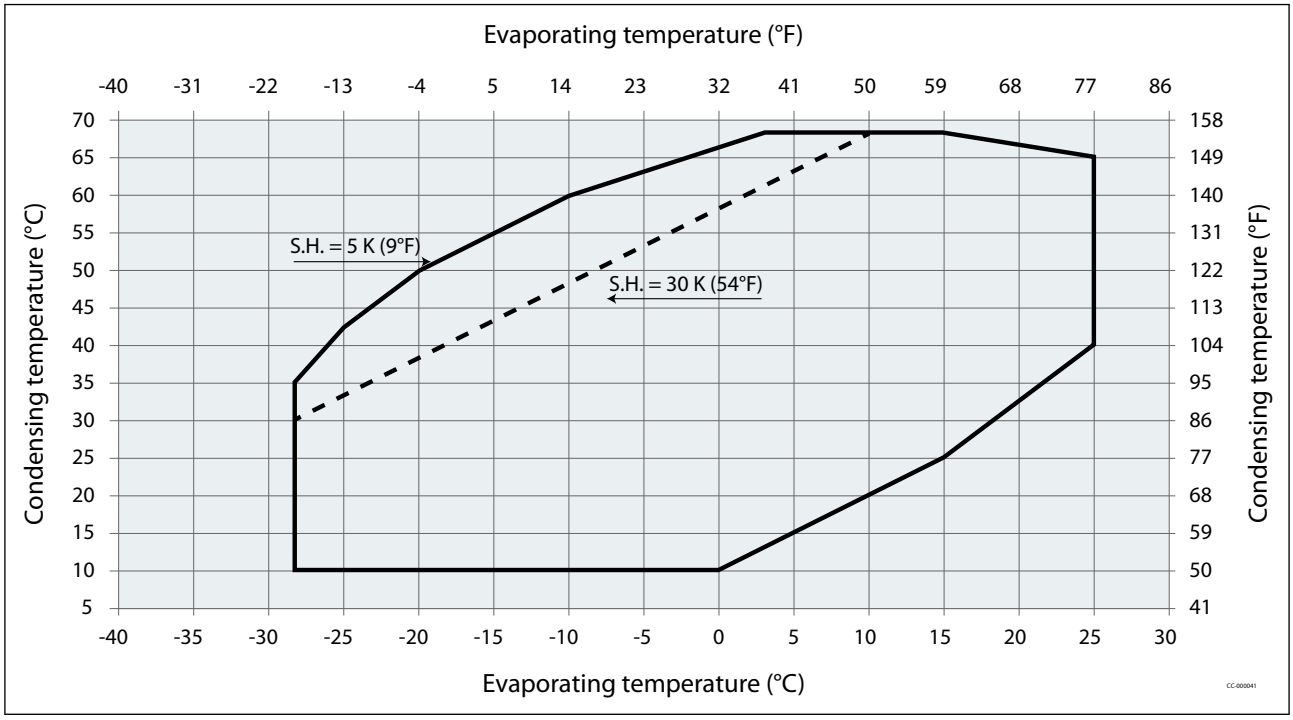


Figure 9: R452B / R454B - DSH240 to DSH485



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	R452B / R454B
Working range high side	bar(g)	9.9-44.7	9-41.7
	psig	144-648	131-605
Working range low side	bar(g)	1.7-15.5	1.7-14.4
	psig	25-225	25-209
Maximum high pressure safety switch setting	bar(g)	46.1	43.1
	psig	669	625
Minimum low pressure safety switch setting	bar(g)	1.5	1.5
	psig	22	22
Minimum low pressure pump-down switch setting	bar(g)	1.5 bar below nominal evap. pressure with minimum of 1.7 bar(g)	
	psig	22 psi below nominal evap. pressure with minimum of 25 psig	

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 10: Outline drawing number 1

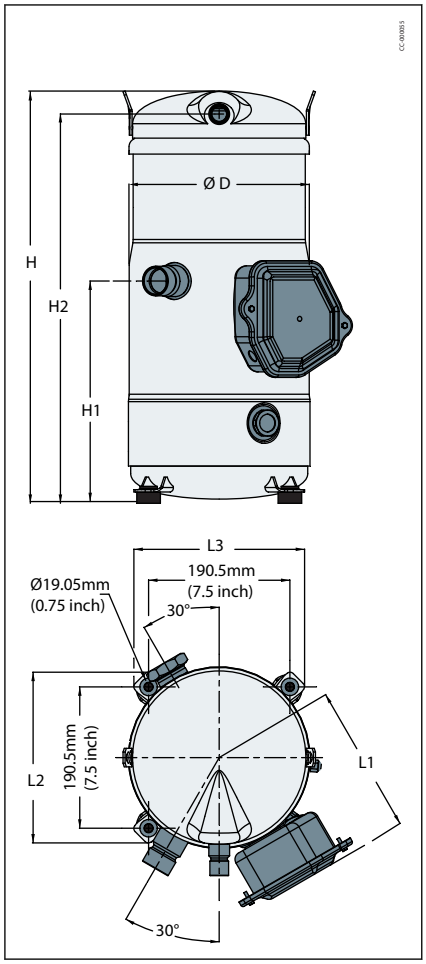


Figure 11: Outline drawing number 2

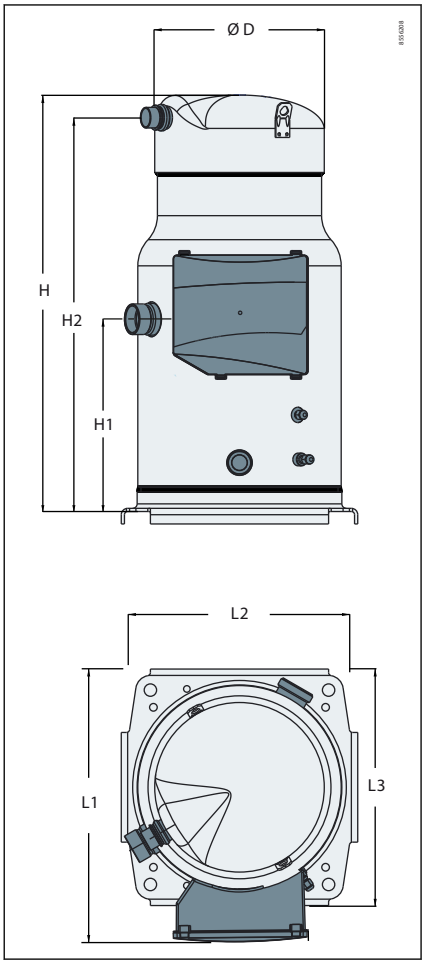


Figure 12: Outline drawing number 3

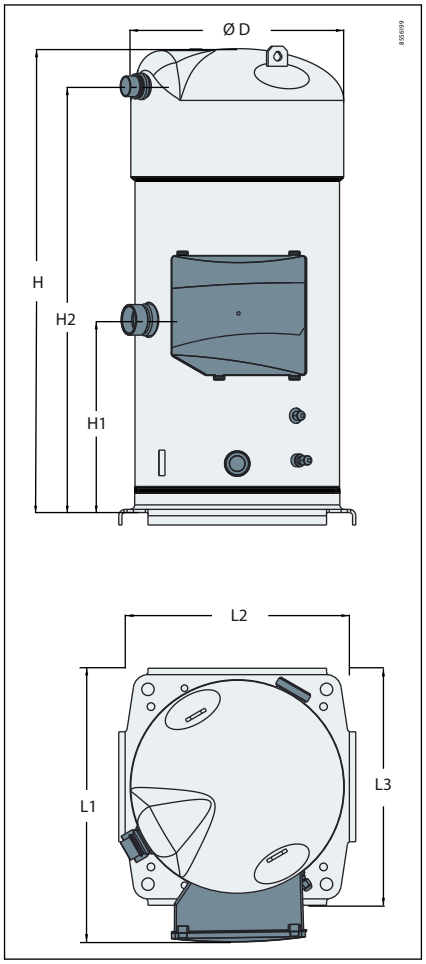


Table 14: Single compressors

Compressor model	Motor voltage code	D		H		H1		H2		L1		L2		L3		Outline drawing number	
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
DSH090	3,4,7,9	243	9.57	485	19.09	235	9.25	451	17.76	180	7.09	230	9.06	230	9.06	1	8560176
DSH105-120-140-161	3 [1],4,7,9	243	9.57	542	21.34	278	10.94	509	20.04	180	7.09	230	9.06	230	9.06	1	8560177
DSH140-161	3	243	9.57	542	21.34	278	10.94	509	20.04	201	7.91	230	9.06	230	9.06	1	8560041
DSH184	3,4,7,9	243	9.57	558	21.97	299	11.77	524	20.63	201	7.91	230	9.06	230	9.06	1	8560178
DSH240	3,4,7,9	320	12.6	653	25.71	302	11.87	618	24.33	427	16.81	371	14.61	371	14.61	2	8556208
DSH295	3,4,7,9	320	12.6	653	25.71	302	11.87	618	24.33	427	16.81	371	14.61	371	14.61	2	8556208
DSH381	4,7,9	333	13.11	726	28.58	302	11.87	667	26.26	429	16.89	371	14.61	371	14.61	3	8556199
DSH381	3	333	13.11	726	28.58	302	11.87	667	26.26	478	18.82	371	14.61	371	14.61	3	8556239
DSH485	4,7,9	333	13.11	726	28.58	302	11.87	667	26.26	429	16.89	371	14.61	371	14.61	3	8556198
DSH485	3	333	13.11	726	28.58	302	11.87	667	26.26	446	17.56	371	14.61	371	14.61	3	8556237
DSH600	4, 7	333	13.11	799	31.46	302	11.87	732	28.82	429	16.89	371	14.61	371	14.61	3	8556192

[1] DSH105-120

Tandem assemblies

Figure 13: Outline drawing number 1

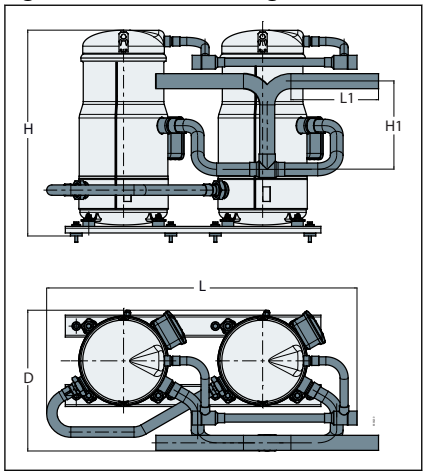


Figure 14: Outline drawing number 2

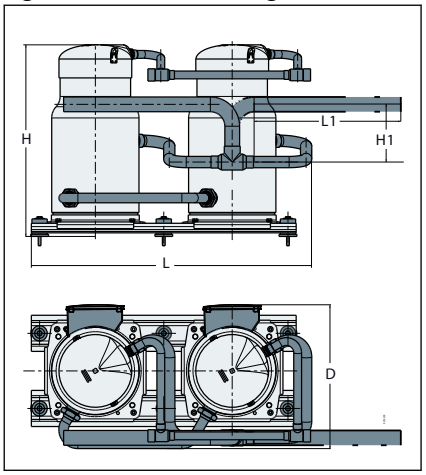


Figure 15: Outline drawing number 3

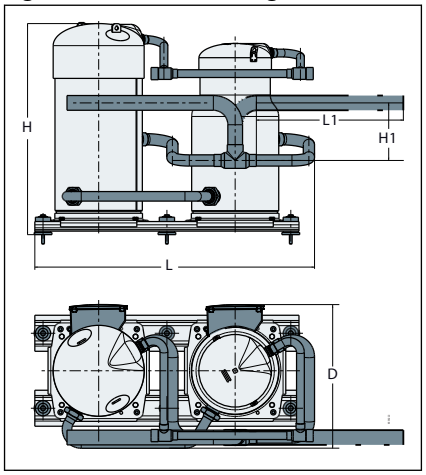


Figure 16: Outline drawing number 4

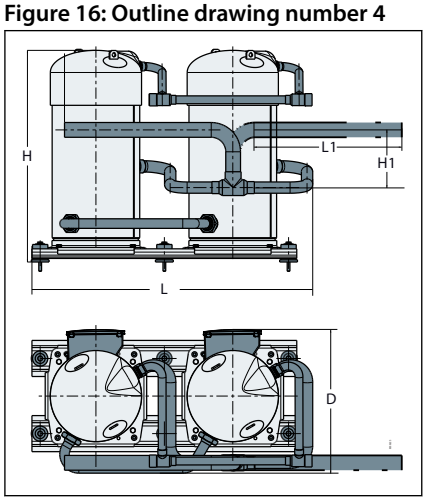


Figure 17: Outline drawing number 5

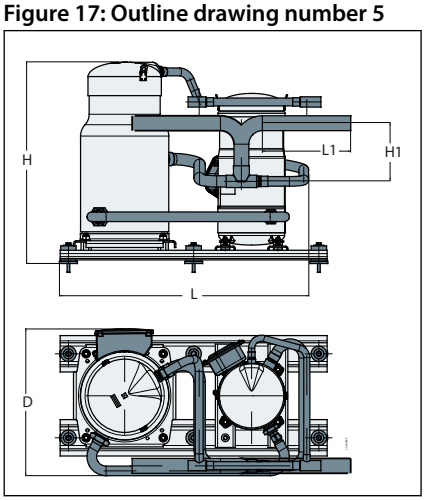


Table 15: Tandem assemblies

Tandem model	Motor voltage code	Composition	L		D		H		L1		H1		Outline drawing number	
			mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
DSH180E	3, 4, 7, 9	DSH090 + DSH090	850	33.46	384	15.12	507	19.96	240	9.45	242	9.53	1	8560115
DSH195U	3, 4, 7, 9	DSH090 + DSH105	850	33.46	386	15.2	565	22.24	240	9.45	242	9.53	1	8556233
DSH210U	3, 4, 7, 9	DSH090 + DSH120	850	33.46	386	15.2	565	22.24	240	9.45	242	9.53	1	8556233
DSH210E	3, 4, 7, 9	DSH105 + DSH105	850	33.46	384	15.12	565	22.24	240	9.45	242	9.53	1	8560114
DSH230U	3, 4, 7, 9	DSH090 + DSH140	850	33.46	386	15.2	565	22.24	240	9.45	242	9.53	1	8556233
DSH240E	3, 4, 7, 9	DSH120 + DSH120	850	33.46	384	15.12	565	22.24	240	9.45	242	9.53	1	8560114
DSH251U	3, 4, 7, 9	DSH090 + DSH161	850	33.46	386	15.2	565	22.24	240	9.45	242	9.53	1	8556233
DSH260U	3, 4, 7, 9	DSH140 + DSH120	850	33.46	386	15.2	565	22.24	240	9.45	242	9.53	1	8556230
DSH274U	3, 4, 7, 9	DSH090 + DSH184	850	33.46	428	16.85	580	22.83	240	9.45	242	9.53	1	8556232
DSH281U	3, 4, 7, 9	DSH161 + DSH120	850	33.46	386	15.2	565	22.24	240	9.45	242	9.53	1	8556230
DSH280E	3, 4, 7, 9	DSH140 + DSH140	850	33.46	384	15.12	565	22.24	240	9.45	242	9.53	1	8560114
DSH289U	3, 4, 7, 9	DSH105 + DSH184	850	33.46	428	16.85	580	22.83	240	9.45	242	9.53	1	8556231
DSH301U	3, 4, 7, 9	DSH161 + DSH140	850	33.46	386	15.2	565	22.24	240	9.45	242	9.53	1	8556230
DSH304U	3, 4, 7, 9	DSH120 + DSH184	850	33.46	428	16.85	580	22.83	240	9.45	242	9.53	1	8556231
DSH322E	3, 4, 7, 9	DSH161 + DSH161	850	33.46	384	15.12	565	22.24	240	9.45	242	9.53	1	8560114
DSH324U	3, 4, 7, 9	DSH140 + DSH184	850	33.46	428	16.85	580	22.83	240	9.45	242	9.53	1	8556231
DSH345U	3, 4, 7, 9	DSH161 + DSH184	850	33.46	428	16.85	580	22.83	240	9.45	242	9.53	1	8556231
DSH368E	3, 4, 7, 9	DSH184 + DSH184	850	33.46	428	16.85	580	22.83	240	9.45	242	9.53	1	8560113
DSH360X	3, 4, 7, 9	DSH120 + DSH240	903	35.55	533	20.98	731	28.78	359	14.13	211	8.31	5	8560128
DSH424X	3, 4, 7, 9	DSH184 + DSH240	903	35.55	533	20.98	731	28.78	359	14.13	211	8.31	5	8556259
DSH456X	3, 4, 7, 9	DSH161 + DSH295	903	35.55	533	20.98	731	28.78	359	14.13	211	8.31	5	8560128

Tandem model	Motor voltage code	Composition	L		D		H		L1		H1		Outline drawing number	
			mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
DSH479X	3, 4, 7, 9	DSH184 + DSH295	903	35.55	533	20.98	731	28.78	359	14.13	211	8.31	5	8556259
DSH565X	3, 4, 7, 9	DSH184 + DSH381	903	35.55	533	20.98	803	31.61	359	14.13	211	8.31	5	8556260
DSH482E	3, 4, 7, 9	DSH240 + DSH240	1025	40.35	527	20.75	701	27.6	535	21.06	211	8.31	2	8556228
DSH535U	3, 4, 7, 9	DSH240 + DSH295	1025	40.35	527	20.75	701	27.6	535	21.06	211	8.31	2	8556228
DSH590E	3, 4, 7, 9	DSH295 + DSH295	1025	40.35	527	20.75	701	27.6	535	21.06	211	8.31	2	8556228
DSH620U	4, 7, 9	DSH240 + DSH381	1025	40.35	527	20.75	774	30.5	535	21.06	211	8.31	3	8556222
DSH620U	3	DSH240 + DSH381	1025	40.35	576	22.68	774	30.5	535	21.06	211	8.31	3	8556222
DSH675U	4, 7, 9	DSH295 + DSH381	1025	40.35	527	20.75	774	30.5	535	21.06	211	8.31	3	8556222
DSH675U	3	DSH295 + DSH381	1025	40.35	576	22.68	774	30.5	535	21.06	211	8.31	3	8556222
DSH725U	4, 7, 9	DSH240 + DSH485	1025	40.35	546	21.5	774	30.5	535	21.06	211	8.31	3	8556207
DSH725U	3	DSH240 + DSH485	1025	40.35	563	22.17	774	30.5	535	21.06	211	8.31	3	8556207
DSH760E	4, 7, 9	DSH381 + DSH381	1025	40.35	527	20.75	774	30.5	535	21.06	211	8.31	4	8556223
DSH760E	3	DSH381 + DSH381	1025	40.35	576	22.68	774	30.5	535	21.06	211	8.31	4	8556223
DSH780U	4, 7, 9	DSH295 + DSH485	1025	40.35	546	21.5	774	30.5	540	21.26	211	8.31	3	8556220
DSH780U	3	DSH295 + DSH485	1025	40.35	563	22.17	774	30.5	540	21.26	211	8.31	3	8556220
DSH865U	4, 7, 9	DSH381 + DSH485	1025	40.35	546	21.5	774	30.5	540	21.26	211	8.31	4	8556224
DSH865U	3	DSH381 + DSH485	1025	40.35	563	22.17	774	30.5	540	21.26	211	8.31	4	8556224
DSH970E	4, 7, 9	DSH485 + DSH485	1025	40.35	546	21.5	774	30.5	540	21.26	211	8.31	4	8556205
DSH970E	3	DSH485 + DSH485	1025	40.35	563	22.17	774	30.5	540	21.26	211	8.31	4	8556205
DSH895U	4, 7	DSH295 + DSH600	1050	41.39	550	21.65	870	34.25	545	21.46	206	8.11	4	8556250
DSH1085U	4, 7	DSH485 + DSH600	1058	41.65	550	21.65	870	34.25	545	21.46	206	8.11	4	8556248
DSH1200E	4, 7	DSH600 + DSH600	1085	42.72	550	21.65	870	34.25	545	21.46	206	8.11	4	8556247

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

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

U : Uneven tandem
E : Even tandem
X: Crossplatfom (medium-large) tandem

Trio assemblies

Figure 18: Outline drawing number 6

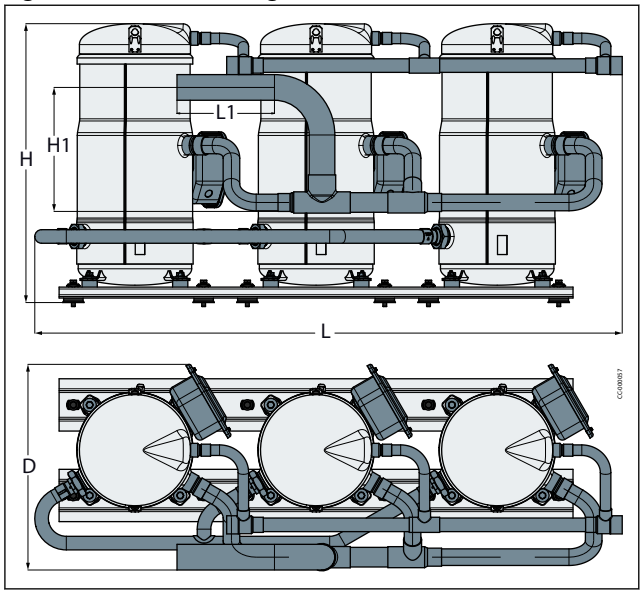


Figure 19: Outline drawing number 7

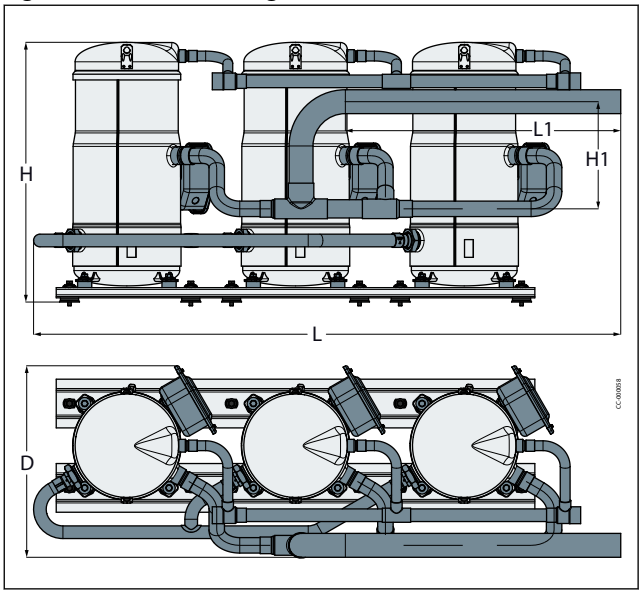


Figure 20: Outline drawing number 8

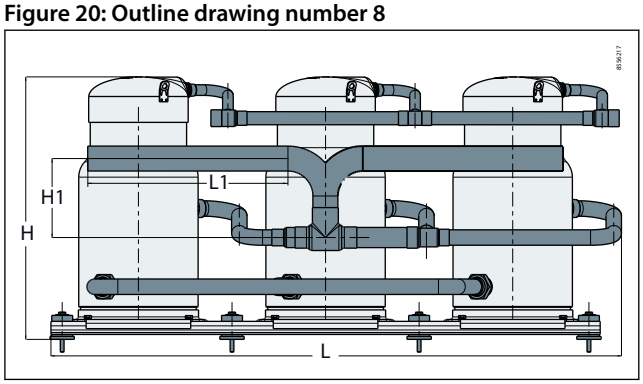


Figure 21: Outline drawing number 9

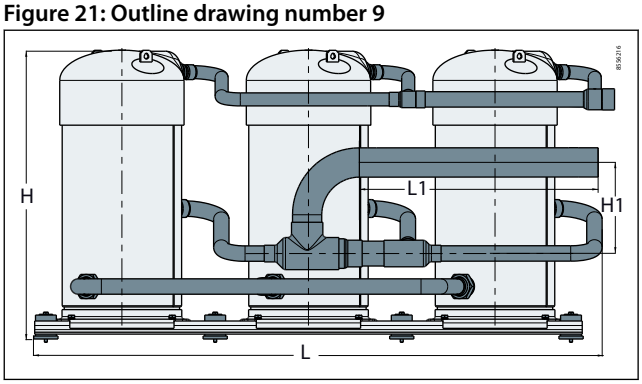


Table 16: Trio assemblies

Trio model	Motor votlage code	Composition	L		D		H		L1 (Minimum)		H1		Outline drawing number	
			mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
DSH420T	3, 4, 7, 9	3×DSH140	1230	48.4	402	15.8	571	22.5	205	8.1	242	9.5	6	8560134
			1326	52.2	402	15.8	571	22.5	622	24.5	242	9.5	7	8560134
DSH483T	3, 4, 7, 9	3×DSH161	1230	48.4	402	15.8	571	22.5	205	8.1	242	9.5	6	8560134
			1326	52.2	402	15.8	571	22.5	622	24.5	242	9.5	7	8560134
DSH552T	3, 4, 7, 9	3×DSH184	1236	48.7	433	17.0	587	23.1	205	8.1	242	9.5	6	8560133
			1326	52.2	433	17.0	587	23.1	622	24.5	242	9.5	7	8560133
DSH720T	3, 4, 7, 9	3×DSH240	1467	57.76	543	21.38	701	27.6	535	21.06	211	8.31	8	8556217
DSH885T	3, 4, 7, 9	3×DSH295	1467	57.76	543	21.38	701	27.6	535	21.06	211	8.31	8	8556217
DSH971T	4, 7, 9	2×DSH295 + DSH381	1524	60	545	21.46	774	30.5	535	21.06	211	8.31	9	8556317
DSH1140T	4, 7, 9	3×DSH381	1467	57.76	545	21.46	774	30.5	535	21.06	211	8.31	9	8556229
DSH1140T	3	3×DSH381	1467	57.76	594	23.39	774	30.5	535	21.06	211	8.31	9	8556229
DSH1245T	4, 7, 9	2×DSH381 + DSH485	1520	59.84	573	22.56	774	30.5	535	21.06	211	8.31	9	8556234
DSH1245T	3	2×DSH381 + DSH485	1520	59.84	594	23.39	774	30.5	535	21.06	211	8.31	9	8556234
DSH1350T	4, 7, 9	DSH381 + 2 x DSH485	1520	59.84	573	22.56	774	30.5	640	25.19	244	9.61	9	8556235
DSH1350T	3	DSH381 + 2×DSH485	1520	59.84	590	23.23	774	30.5	640	25.19	244	9.61	9	8556235
DSH1455T	4, 7, 9	3×DSH485	1520	59.84	573	22.56	774	30.5	640	25.19	244	9.61	9	8556216
DSH1455T	3	3×DSH485	1520	59.84	590	23.23	774	30.5	640	25.19	244	9.61	9	8556216
DSH1570T	4, 7	2×DSH485 + DSH600	1584	62.36	573	22.56	870	34.25	628	24.72	257	10.12	9	8556246
DSH1685T	4, 7	DSH485 + 2xDSH600	1584	62.36	573	22.56	870	34.25	628	24.72	257	10.12	9	8556245
DSH1800T	4, 7	3×DSH600	1605	63.19	573	22.56	870	34.25	628	24.72	257	10.12	9	8556244

NOTE:
Trio to be achieved by assembly of individual compressors

Mechanical connections

Connection Details

Table 17: Connection Details

Connection Details		DSH090	DSH105-120-140-161-184	DSH240-295-38	DSH485	DSH600
Suction connection		Brazed 1"1/8	Brazed 1"3/8	Brazed 1"5/8	Brazed 1"5/8	Brazed 2"1/8
Discharge connection		Brazed 7/8"	Brazed 7/8"	Brazed 1"1/8	Brazed 1"3/8	Brazed 1"3/8
Oil sight glass		Threaded (1"1/8 – 18 UN-EF)	Threaded (1"1/8 – 18 UNEF)	Threaded (1"1/8 – 18 UN-EF)	Threaded (1"1/8 – 18 UN-EF)	Threaded (1"1/8 – 18 UN-EF)
Oil equalization connection		Rotolock 1"3/4	Rotolock 1"3/4	Rotolock 2"1/4	Rotolock 2"1/4	Rotolock 2"1/4
Oil drain connection		None		Female ¼" Flare incorporating a Schrader valve		
Low pressure gauge port (Shrader)		Male ¼" Flare incorporating a Schrader valve				
Outline drawing		1	1	2	2	2

Figure 22: Outline drawing 1

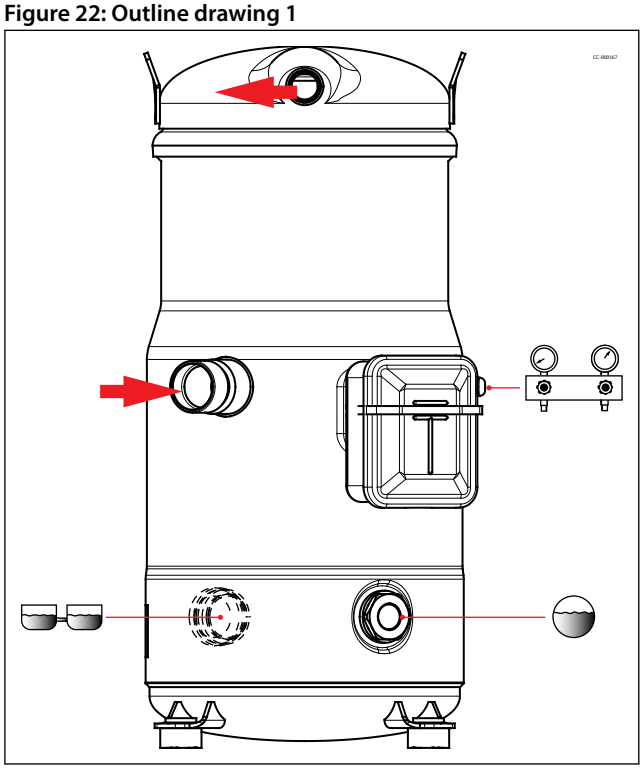
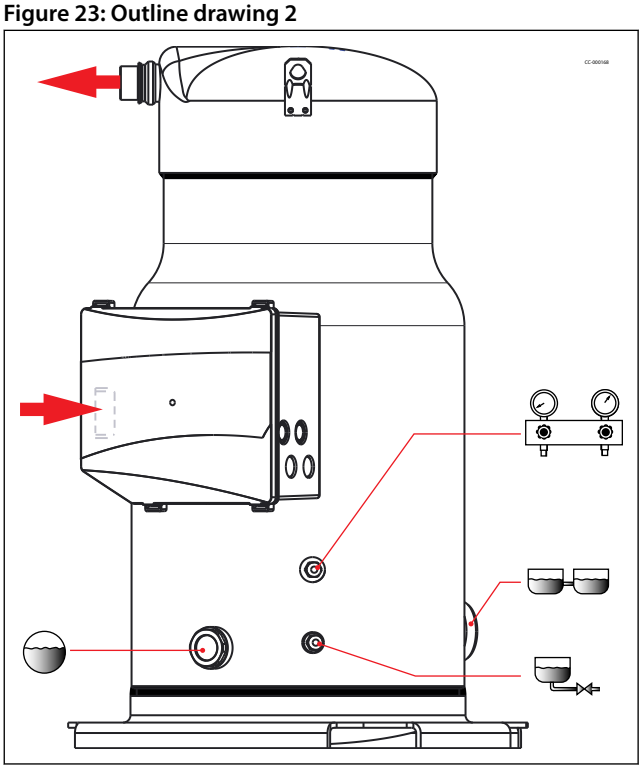


Figure 23: Outline drawing 2



Design compressor mounting

General requirements

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

Compressors used in parallel applications must be mounted with rigid spacers onto rails (or directly on rails according to compressor models) and the manifold assembly must be mounted with flexible grommets onto the frame.

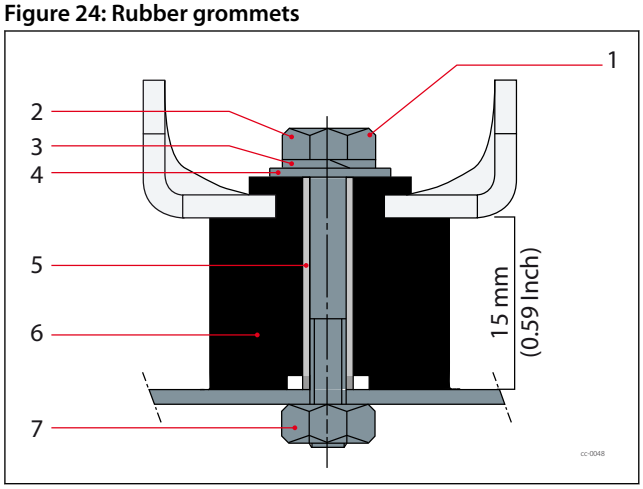
During operation, the maximum inclination from the vertical plane must not exceed 3 degrees.

Single requirements DSH090-105-120-140-161-184 mounting

Compressors DSH090-105-120-140-161-184 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 DSH090-105-120-140-161-184 compressors is HM8-40. This bolt must be tightened to a torque of 15Nm.

Figure 24: 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

Single requirements DSH240-295-381-485 -600 mounting

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

The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The required bolt size for the DSH240-295-381-485-600 compressors is HM8-55. This bolt must be tightened to a torque of 21Nm.

Figure 25: Rubber grommets from kit 8156138

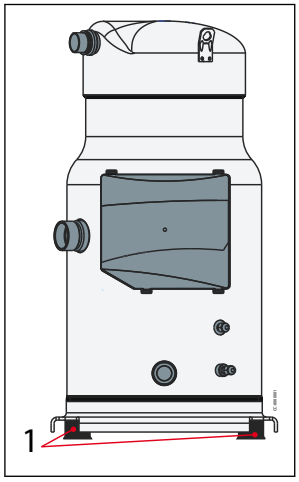
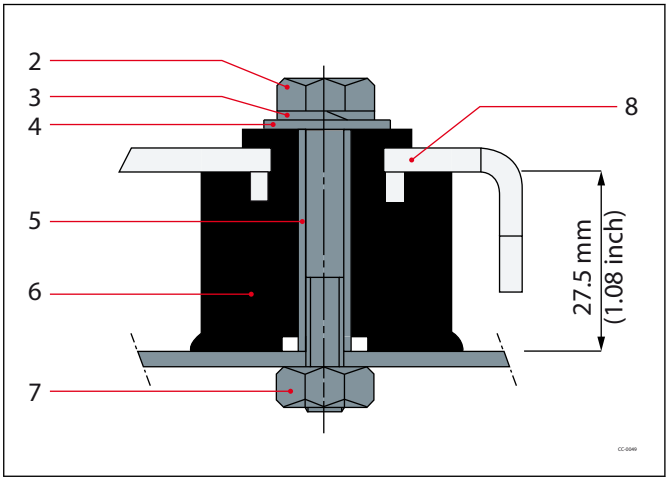


Figure 26: Rubber grommets



1	Rubber grommets from kit 8156138	**5**	Steel mounting sleeve (4 pcs)
2	HM 8 bolt (4 pcs)	**6**	Rubber grommet (4 pcs)
3	Lock washer (4 pcs)	**7**	Nut (4 pcs)
4	Flat washer (4 pcs)	**8**	Compressor base plate

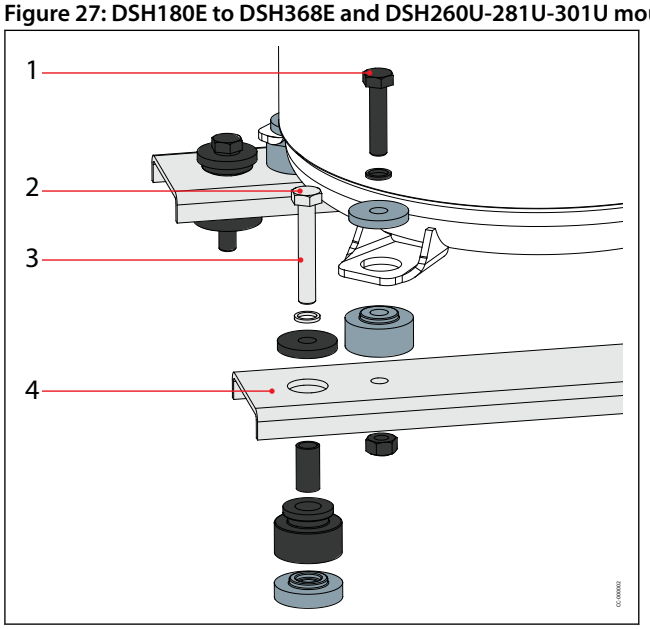
Manifolding requirements DSH180E-210E-240E-280E-322E-368E and DSH260U-281U-301U mounting

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 27: DSH180E to DSH368E and DSH260U-281U-301U mounting

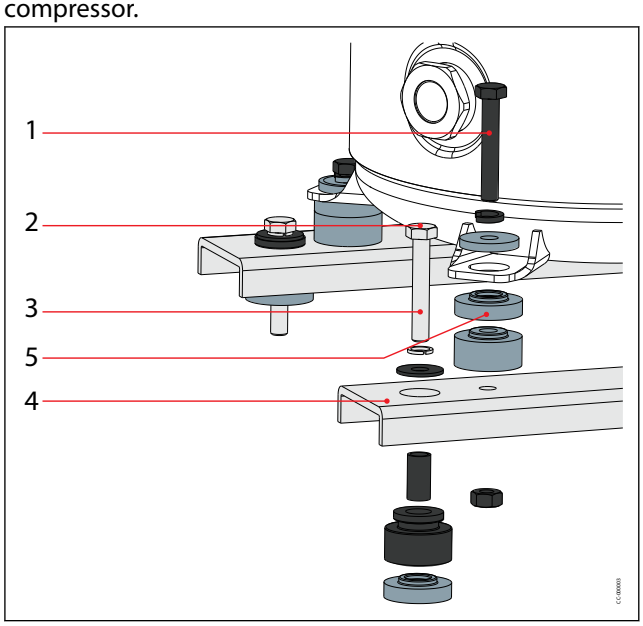


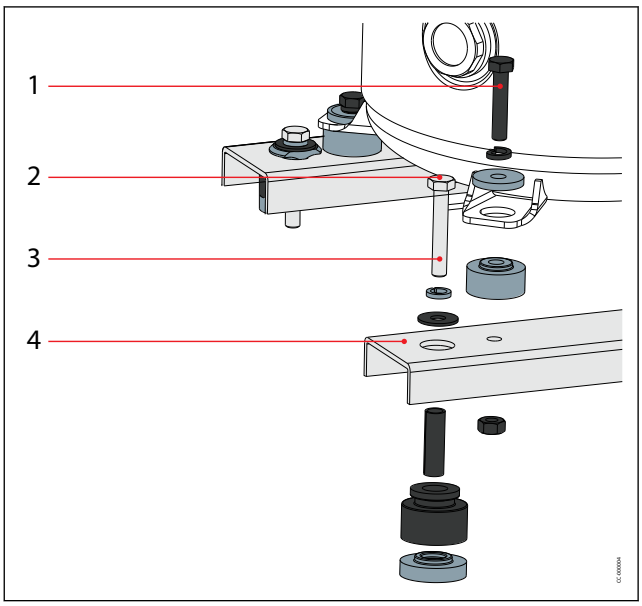
1	Tightening torque 15Nm
2	Not supplied Φ8x75mm 0.31x2.95inch
3	Tightening torque 15Nm
4	4mm (0.16 inch) thickness
	Supplied with the compressor
	Included in manifolding kit
	Not supplied

Manifolding requirements DSH195U-210U-230U-251U-274U-289U-304U-324U-345U mounting

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.





1	Tightening torque 15Nm	**5**	Additional rigid spacer (Refer to table below)
2	Not supplied HM8mm 0.31 inch		Supplied with the compressor
3	Tightening torque 15 Nm		Included in manifolding kit
4	4mm (0.16 inch) Thickness		Not supplied

Table 18: Additionnal rigid spacer

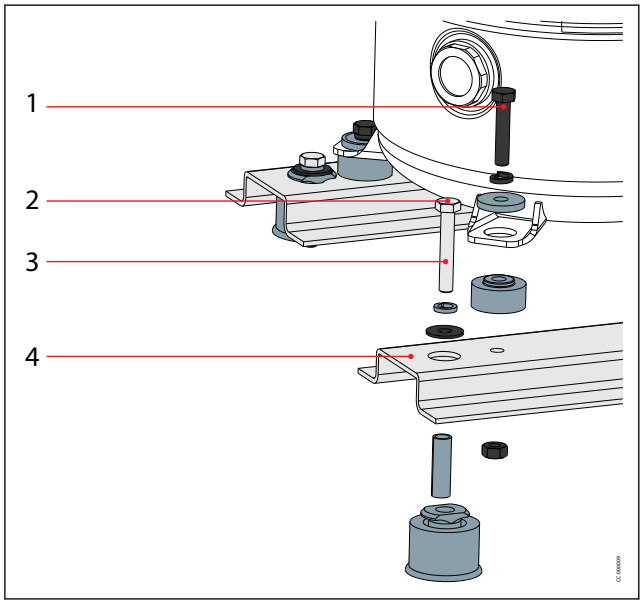
Tandem	Additionnal rigid spacer (to be added on the smallest compressor of the tandem)
DSH195U-210U-230U-251U-289U-304U-345U	7 mm
DSH274U	14 mm

Tandem requirements DSH420T-483T-552T

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 and rubber grommets are included in tandem accessory kits.

Figure 28: DSH420T-483T-552T mounting



1	Tightening torque 15Nm
2	Not supplied HM8mm 0.31 inch
3	Tightening torque 15 Nm
4	3mm (0.12inch) Thickness
	Supplied with the compressor
	Included in manifolding kit
	Not supplied

Tandem requirements DSH360X-424X-456X-479X-565X mounting

The large compressor, DSH240, 295 or 381, is mounted with rigid spacers on the rails.

The DSH120, 161 or 184 compressor is fixed on beams by rigid spacer, and the beams are mounted with rigid spacers on the rails. Rubber grommets and spacers must be installed below the rails.

Figure 29: DSH240-295-381 mounting

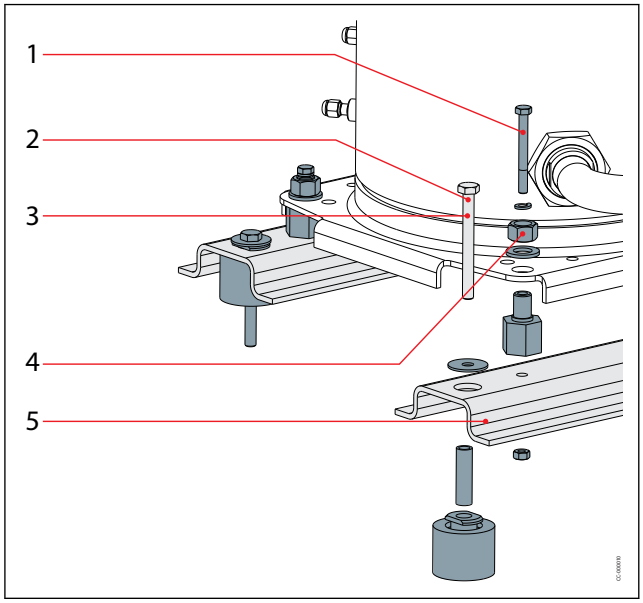
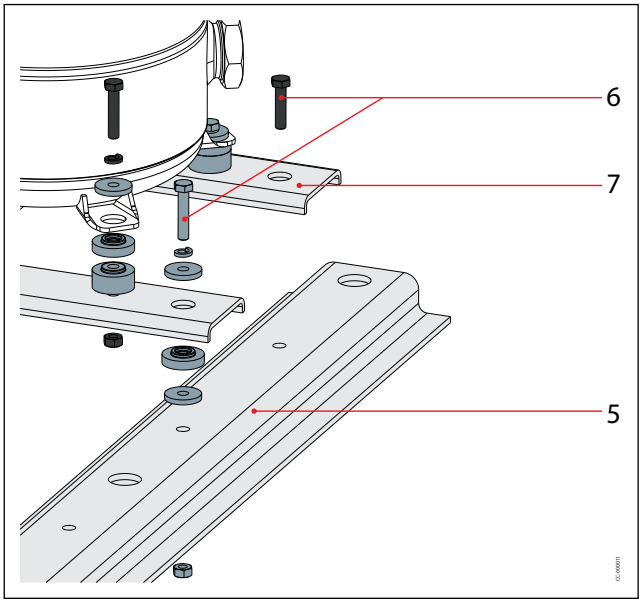


Figure 30: DSH120-161-184 mounting



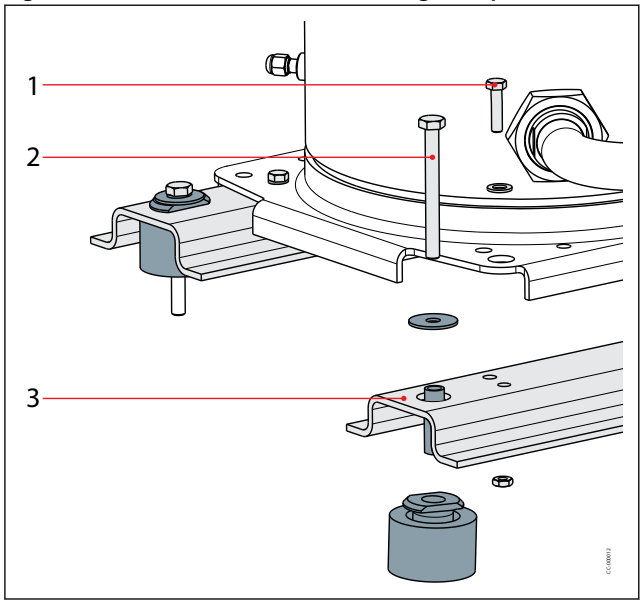
1	Tightening torque 16Nm	**6**	Tightening torque 15Nm
2	Not supplied Φ10mm	**7**	4mm (0.16inch) thickness
3	Tightening torque 50Nm		Supplied with the compressor
4	Tightening torque 55Nm		Included in manifolding kit
5	5mm (0.2inch) thickness		Not supplied

Tandem requirements DSH482 to DSH1800 mounting (except DSH565)

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

These parts are included in accessories.

Figure 31: DSH482 to DSH1800 mounting (except DSH565)



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) (6mm (0.24 inch) for manifold configurations using one or several DSH600)
	Included in tandem/trio kit
	Not supplied

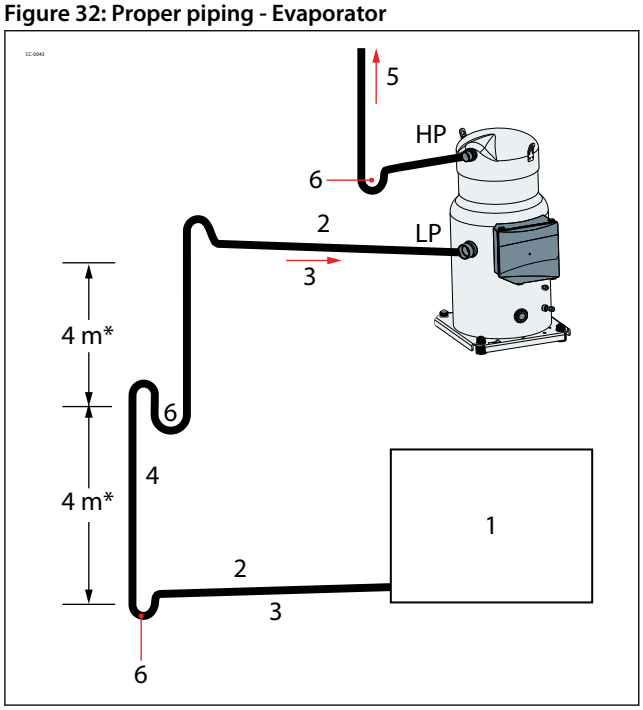
Design piping

General requirements

Proper piping practices should be employed to:

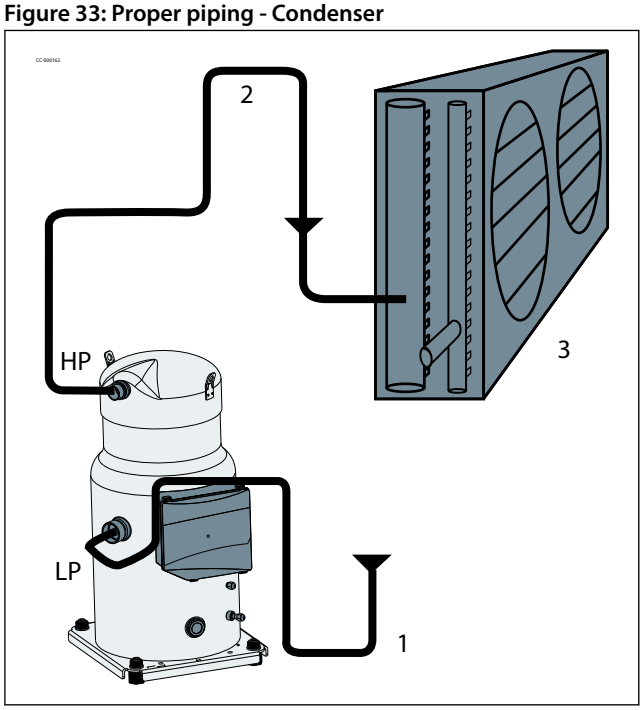
1. Ensure adequate oil return, even under minimum load conditions (refrigerant speed, piping slopes…). For validation tests see section Manage oil in the circuit.
2. Avoid condensed liquid refrigerant from draining back to the compressor when stopped (discharge piping upper loop). For validation tests see section Manage off cycle migration.
3. Piping should be designed with adequate three-dimensional flexibility to avoid excess vibration. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. For more information on noise and vibration, see section Sound and vibration data.

Figure 32: 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 33: 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, DSH tandems and trios are not factory-built. To complete an assembly in the field, you will need:

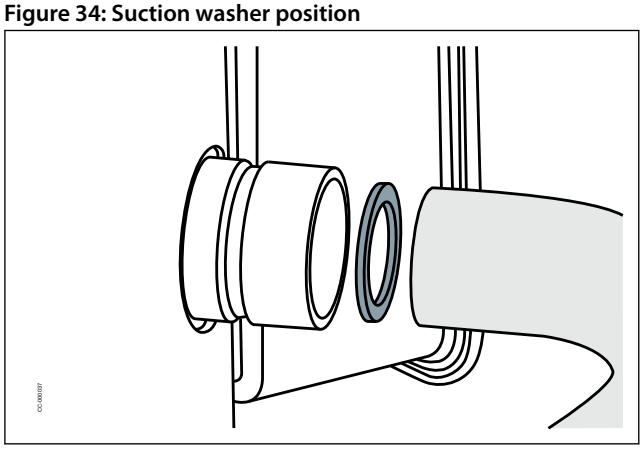
- Tubings, according to specific outline drawings indicated in the following table.
- Manifolding accessory kit.
- Compressors.

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

Suction washer position

R 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 34: 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 35: Example of right suction

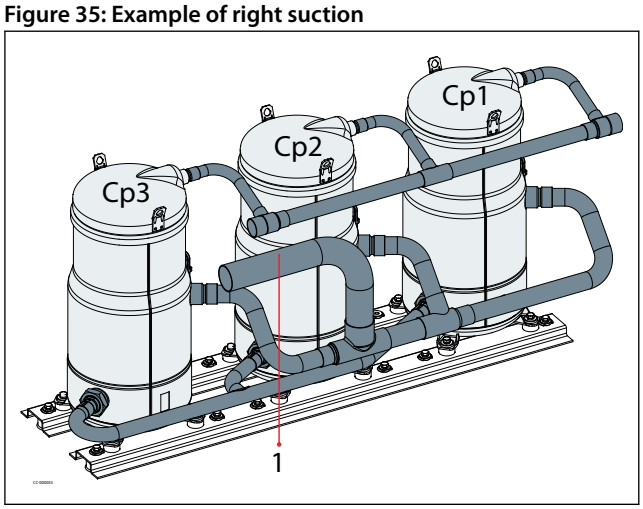
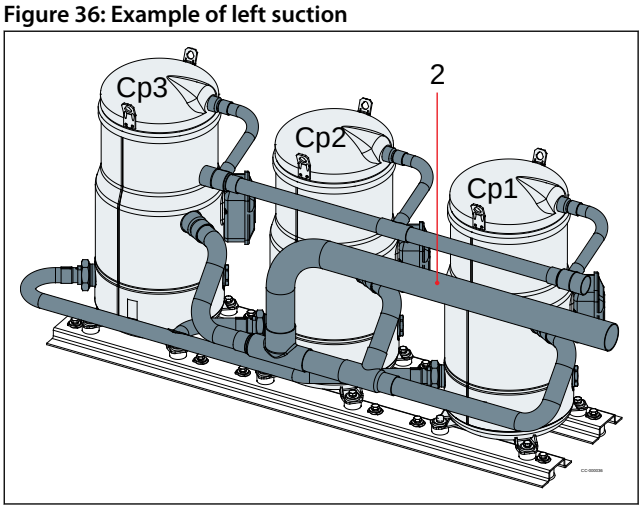


Figure 36: Example of left suction



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

Tandem models

Table 19: Tandem models

Tandem 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
DSH180E	DSH090+DSH090	1"5/8	1" 3/8	1" 1/8	8560115	Left Right	Not needed	-	120Z0634
DSH195U	DSH090+DSH105	1"5/8	1" 3/8	1" 1/8	8556233	Left Right	25mm(0.98 inch) 26mm(1.02 inch)	Cp2 Cp2	120Z0694
DSH210U	DSH090+DSH120	1"5/8	1" 3/8	1" 1/8	8556233	Left Right	27mm(1.06 inch) 27mm(1.06 inch)	Cp2 Cp2	120Z0694
DSH210E	DSH105+DSH105	1"5/8	1" 3/8	1" 1/8	8560114	Left Right	Not needed	-	120Z0634
DSH230U	DSH090+DSH140	1"5/8	1" 3/8	1" 1/8	8556233	Left Right	23mm(0.91inch) 23mm(0.91inch)	Cp1 Cp1	120Z0694
DSH240E	DSH120+DSH120	1"5/8	1" 3/8	1" 1/8	8560114	Left Right	Not needed	-	120Z0634
DSH251U	DSH090+DSH161	1"5/8	1" 3/8	1" 1/8	8556233	Left Right	21mm(0.83inch) 21mm(0.83inch)	Cp1 Cp1	120Z0694
DSH260U	DSH140+DSH120	1"5/8	1" 3/8	1" 1/8	8556230	Left Right	27mm(1.06 inch) 27mm(1.06 inch)	Cp1 Cp1	120Z0692
DSH274U	DSH090+DSH184	1"5/8	1" 3/8	1" 1/8	8556232	Left Right	20mm(0.79inch) 20mm(0.79inch)	Cp1 Cp1	120Z0693
DSH281U	DSH161+DSH120	1"5/8	1" 3/8	1" 1/8	8556230	Left Right	25mm(098 inch) 25mm(098 inch)	Cp1 Cp1	120Z0692
DSH280E	DSH140+DSH140	1"5/8	1" 3/8	1" 1/8	8560114	Left Right	Not needed	-	120Z0634
DSH289U	DSH105+DSH184	1"5/8	1" 3/8	1" 1/8	8556231	Left Right	23mm(0.91inch) 23mm(0.91inch)	Cp1 Cp1	120Z0693
DSH301U	DSH161+DSH140	1"5/8	1" 3/8	1" 1/8	8556230	Left Right	27.5mm(1.08 inch) 26mm(1.02 inch)	Cp1 Cp1	120Z0692
DSH304U	DSH120+DSH184	1"5/8	1" 3/8	1" 1/8	8556231	Left Right	24mm(0.94inch) 24mm(0.94inch)	Cp1 Cp1	120Z0694
DSH322E	DSH161+DSH161	1"5/8	1" 3/8	1" 1/8	8560114	Left Right	Not needed	-	120Z0634
DSH324U	DSH140+DSH184	1"5/8	1" 3/8	1" 1/8	8556231	Left Right	25mm(0.98 inch) 25mm(0.98 inch)	Cp1 Cp1	120Z0694
DSH345U	DSH161+DSH184	1"5/8	1" 3/8	1" 1/8	8556231	Left Right	27.5mm(1.08 inch) 27.5mm(1.08 inch)	Cp1 Cp1	120Z0694
DSH360X	DSH120+DSH240	2"1/8	1" 3/8	1" 3/8	8560128	Left Right	24mm(0.94inch) 25mm(0.98 inch)	Cp1 Cp1	120Z0781
DSH368E	DSH184+DSH184	1"5/8	1" 3/8	1" 1/8	8560113	Left Right	Not needed	-	120Z0634
DSH424X	DSH184+DSH240	2"1/8	1" 3/8	1" 3/8	8556259	Left Right	35.5mm(1.4 inch) 35.5mm(1.4 inch)	Cp2 Cp2	120Z0781
DSH456X	DSH161+DSH1295	2"1/8	1" 3/8	1" 3/8	8560128	Left Right	25mm(0.98 inch) 26mm(1.02 inch)	Cp1 Cp1	120Z0781
DSH479X	DSH184+DSH295	2"1/8	1" 3/8	1" 3/8	8556259	Left Right	26mm(1.02 inch) 26mm(1.02 inch)	Cp1 Cp1	120Z0781
DSH482E	DSH240+DSH240	2"1/8	1" 5/8	1" 3/8	8556228	Left Right	Not needed	-	120Z0792
DSH535U	DSH240+DSH295	2"1/8	1" 5/8	1" 3/8	8556228	Left Right	31mm(1.22 inch) 31mm(1.22 inch)	Cp1 Cp1	120Z0796

Tandem 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
DSH565X	DSH184+DSH381	2"1/8	1" 3/8	1" 3/8	8556260	Left	24mm(0.94inch)	Cp1	120Z0781
						Right	24mm(0.94inch)	Cp1	
DSH590E	DSH295+DSH295	2"1/8	1" 5/8	1" 3/8	8556228	Left	Not needed	-	120Z0792
						Right			
DSH620U	DSH240+DSH381	2"1/8	1" 5/8	1" 3/8	8556222	Left	29mm(1.14 inch)	Cp1	120Z0791
						Right	29mm(1.14 inch)	Cp1	
DSH675U	DSH295+DSH381	2"1/8	1" 5/8	1" 3/8	8556222	Left	31mm(1.22 inch)	Cp1	120Z0796
						Right	31mm(1.22 inch)	Cp1	
DSH725U	DSH240+DSH485	2"1/8	1" 5/8	1" 5/8	8556207	Left	24mm(0.94inch)	Cp1	120Z0786
						Right	24mm(0.94inch)	Cp1	
DSH760E	DSH381+DSH381	2"1/8	1" 5/8	1" 3/8	8556223	Left	Not needed	-	120Z0792
						Right			
DSH780U	DSH295+DSH485	2"5/8	1" 5/8	1" 5/8	8556220	Left	27mm(1.06 inch)	Cp1	120Z0787
						Right	27mm(1.06 inch)	Cp1	
DSH865U	DSH381+DSH485	2"5/8	1" 5/8	1" 5/8	8556224	Left	30mm(1.18 inch)	Cp1	120Z0788
						Right	30mm(1.18 inch)	Cp1	
DSH895U	DSH295+DSH600	2"5/8	1" 5/8	1" 5/8	8556250	Left	Not needed	-	120Z0726
						Right			
DSH970E	DSH485+DSH485	2"5/8	1" 5/8	1" 5/8	8556205	Left	Not needed	-	120Z0785
						Right			
DSH1085U	DSH485 + DSH600	2"5/8	1" 5/8	1" 5/8	8556248	Left	Not needed	-	120Z0726
						Right	38mm(1.5 inch)	Cp2	120Z0821
DSH1200E	DSH600 + DSH600	2"5/8	1" 5/8	2" 1/8	8556247	Left	Not needed	-	120Z0726
						Right			

Trio models

Table 20: Trio models

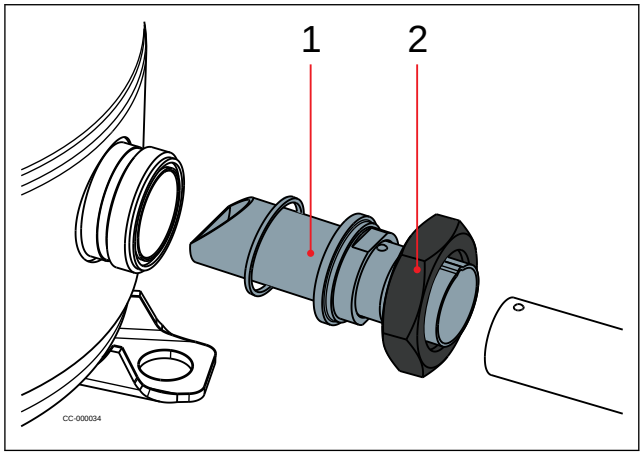
Trio model	Composition Cp1 + Cp2 +Cp3	Suction	Dis-charge	Oil equaliza-tion	Outline drawing number	Suction from	Washer inner di-ameter	Washer in suction of	Trio kit code
DSH420T	DSH140+DSH140 +DSH140	2"1/8	1" 3/8	1" 1/8	8560134	Left	26mm(1.02 inch)	Cp1	120Z0714
							25mm(0.98 inch)	Cp3	
						Right	26mm(1.02 inch)	Cp1	
							24mm(0.94inch)	Cp3	
DSH483T	DSH161+DSH161 +DSH161	2"1/8	1" 3/8	1" 1/8	8560134	Left	26mm(1.02 inch)	Cp1	120Z0714
							25mm(0.98 inch)	Cp3	
						Right	26mm(1.02 inch)	Cp1	
							25mm(0.98 inch)	Cp3	
DSH552T	DSH184+DSH184 +DSH184	2"1/8	1" 3/8	1" 1/8	8560133	Left	26mm(1.02 inch)	Cp1	120Z0714
							25mm(0.98 inch)	Cp3	
						Right	25.5mm(1.00 inch)	Cp1	
							25mm(0.98 inch)	Cp3	
DSH720T	DSH240+DSH240+DSH240	2"5/8	1" 5/8	1" 5/8	8556217	Left	30 mm(1.18 inch)	Cp3	120Z0784
						Right	34.5 mm(1.36 inch)	Cp1 & Cp3	120Z0794
DSH885T	DSH295+DSH295+DSH295	2"5/8	1" 5/8	1" 5/8	8556217	Left	30 mm(1.18 inch)	Cp3	120Z0784
						Right	34.5 mm(1.36 inch)	Cp1 & Cp3	120Z0794
DSH971T	DSH295+DSH295+DSH381	2"5/8	1" 5/8	1" 5/8	8556317	Left	Not needed	-	120Z0790
						Right	Not needed	-	120Z0790
DSH1140T	DSH381+DSH381+DSH381	2"5/8	1" 5/8	1" 5/8	8556229	Left	31 mm(1.22 inch)	Cp1	120Z0783
							29 mm(1.14 inch)	Cp3	
						Right	31 mm(1.22 inch)	Cp1	120Z0782
DSH1245T	DSH381+DSH381 +DSH485	2"5/8	2" 1/8	1" 5/8	8556234	Left	29 mm(1.14 inch)	Cp1	120Z0789
						Right	29 mm(1.14 inch)	Cp1	
DSH1350T	DSH485+DSH485 +DSH381	3"1/8	2" 1/8	1" 5/8	8556235	Left	29 mm(1.14 inch)	Cp3	120Z0789
						Right	29 mm(1.14 inch)	Cp3	

Trio model	Composition Cp1 + Cp2 +Cp3	Suction	Dis-charge	Oil equaliza-tion	Outline drawing number	Suction from	Washer inner di-ameter	Washer in suction of	Trio kit code
DSH1455T	DSH485+DSH485+DSH485	3"1/8	2" 1/8	1" 5/8	8556216	Left	33 mm(1.3 inch)	Cp2 & Cp3	120Z0793
						Right	29 mm(1.14 inch)	Cp3	
DSH1570T	DSH485+DSH485+DSH600	3"1/8	2" 1/8	1" 5/8	8556246	Left	36mm(1.42 inch)	Cp3	120Z0822
						Right	36mm(1.42 inch)	Cp3	120Z0822
DSH1685T	DSH485+DSH600+DSH600	3"1/8	2" 1/8	1" 5/8	8556245	Left	42mm (1.65 inch)	Cp2	120Z0819
						Right	41mm (1.61 inch)	Cp3	120Z0820
DSH1800T	DSH600+DSH600+DSH600	3"1/8	2" 1/8	1" 5/8	8556244	Left	Not needed	-	120Z0712
						Right			

Oil equalization design DSH180E to DSH368E

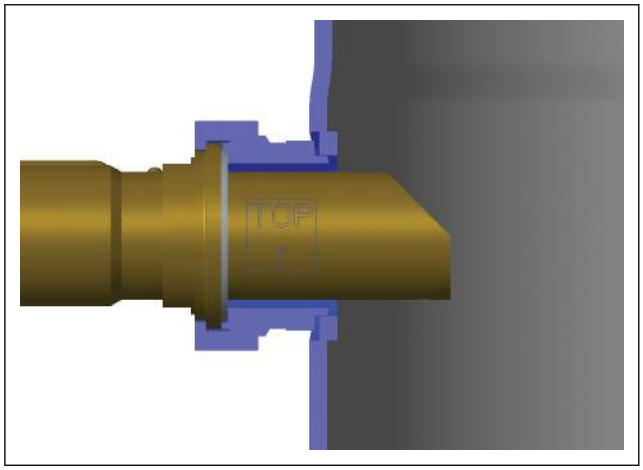
The oil level is balanced by a pipe of 1"1/8 oil equalization line.

In order ensure best oil balance, the organ pipe need to be mounted inside the oil equalization port as indicated on below picture. To connect the equalization line on rotolock connections, the organ pipe adaptor and teflon gasket are included in the tandem kit must be used.



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

The organ pipe needs to be installed in the direction indicated by the label attached on pipe surface, which will ensure best oil balance.



Oil equalization design DSH360X-424X-456X-479X-565X

The oil level is balanced by a pipe of 1"3/8 oil equalization line.

In order to ensure best oil balance, the organ pipe need to be mounted inside the DSH120, 161 or 184 oil equalization port as indicated on below picture. DSH240, 295 or 381 has integrated organ pipe inside the oil equalization port.

To connect the equalization line on rotolock connections, the organ pipe, adaptor sleeves, Teflon gaskets included in the tandem accessory kit must be used.

Figure 37: For DSH120, DSH161 or DSH184

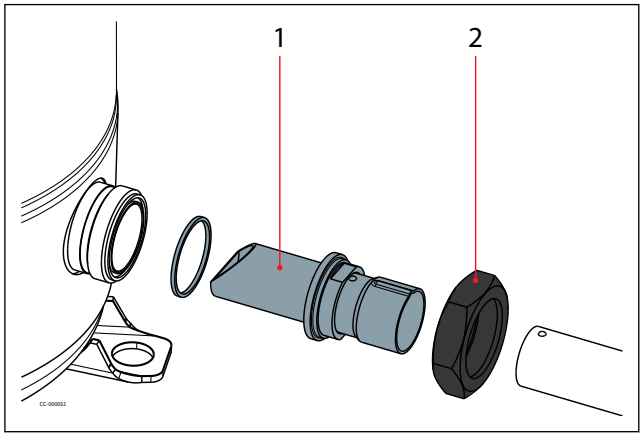
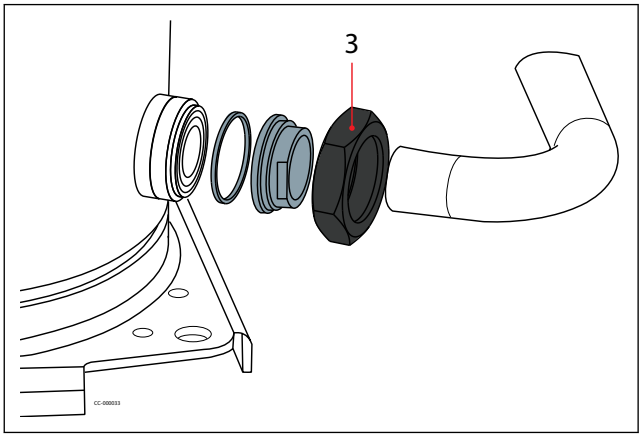


Figure 38: DSH240, DSH295 or DSH381



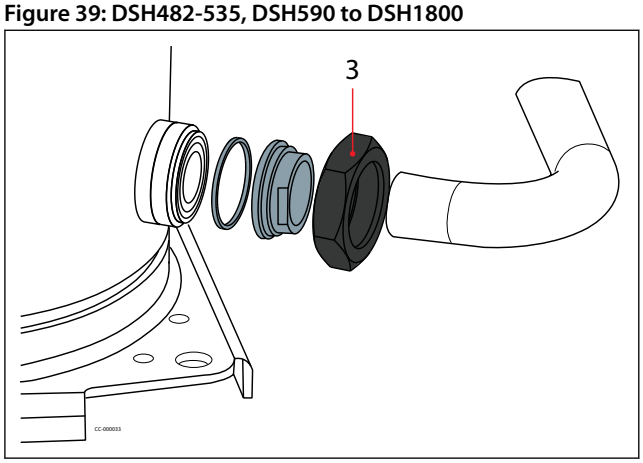
1	Organ pipe
2	Tightening torque 100Nm
3	Tightening torque 145Nm

	Supplied with the compressor
	Included in tandem kit

Oil equalization design DSH482-535, DSH590 to DSH1800

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 39: DSH482-535, DSH590 to DSH1800



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

Electrical connections

Wiring connections

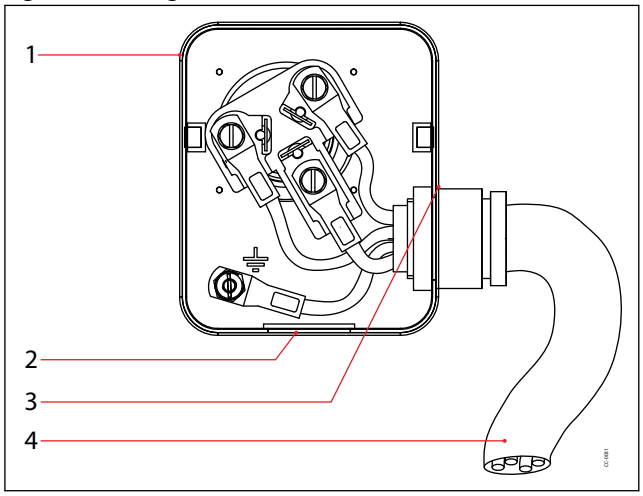
According to compressor model, electrical power is connected to the compressor terminals either by 4.8mm (10-32) screws or by M5 studs and nuts. In both cases the maximum tightening torque is 3 Nm.

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

DSH090-105-120-140-161 (*except DSH140-161 code3)

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

Figure 40: Wiring connections for DSH090-105-120-140-161 (*except DSH140-161 code3)

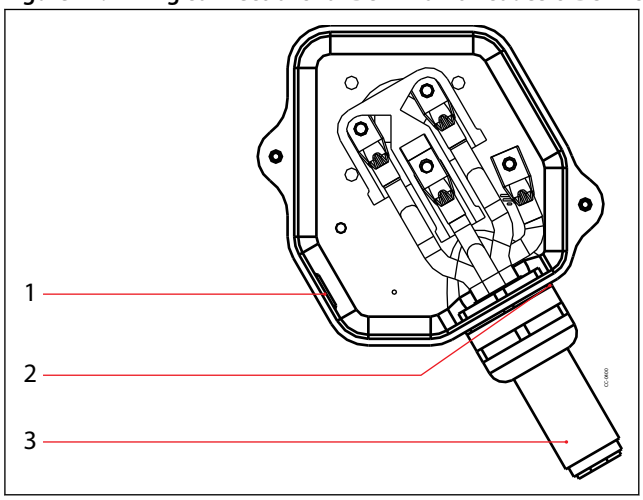


1	Terminal box
2	Ø 29mm (φ1.14inch) knockout
3	Ø 25.5mm (φ1inch) knockout
4	Power supply

DSH140-161 code3 & DSH184

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

Figure 41: Wiring connections for DSH140-161 code3 & DSH184



1	Ø 16.5mm (φ0.65inch) knockout
2	Ø 40.5mm (φ1.59inch) hole
3	Power supply

DSH240-295-381*-485* -600 (*except 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.

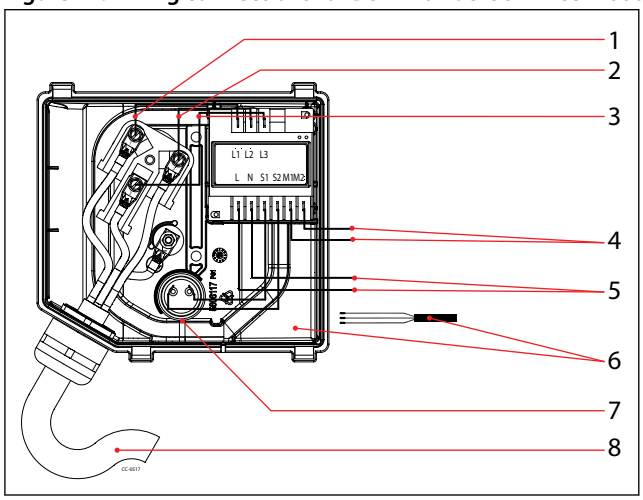
The 3 power supply knockouts accommodate the following diameters:

- 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 others 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 42: Wiring connections for DSH240-295-381*-485* -600 (*except code 3)



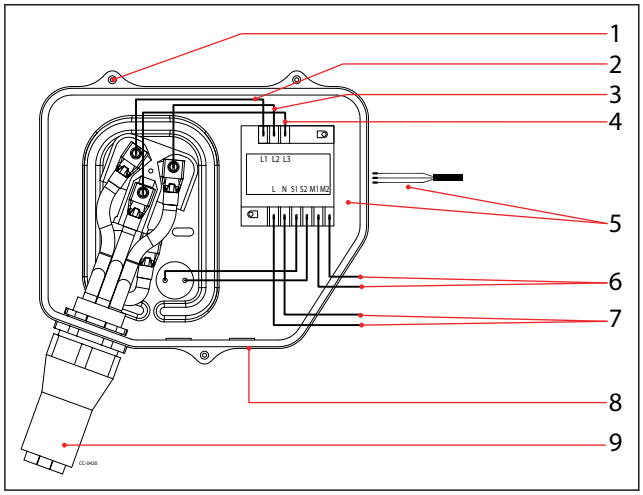
1	Black
2	Blue
3	Brown
4	M1, M2 Control circuit
5	Module power supply
6	Sump heater
7	Faston 1/4" tabs
8	Power supply

DSH381 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 43: Wiring connections for DSH381 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

DSH485 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.

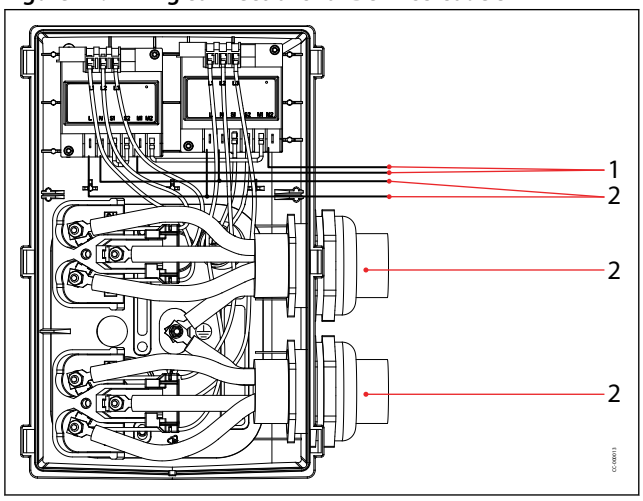
The 2 power supply knockouts accommodate the following diameters:

- 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 44: Wiring connections for DSH485 code 3



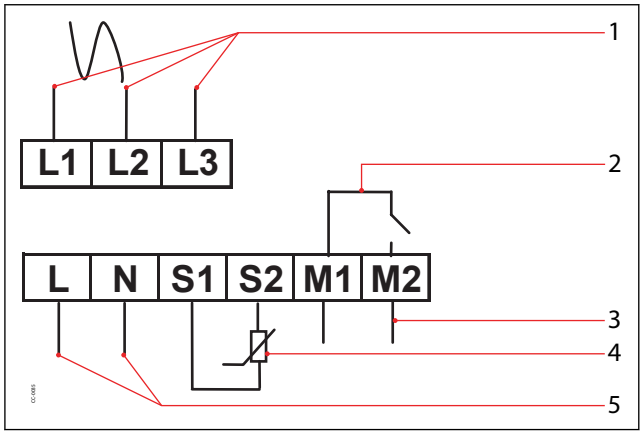
1	M1, M2 Control circuit
2	Power supply

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 45: 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 DSH are available in four different motor voltages as listed below.

Table 21: 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 380V-3ph [1]

[1] DSH240-9 and DSH381

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 22: Motor voltage code 3

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
DSH090	203	31	38	0.39
DSH105	267	36	45	0.27
DSH120	267	44	48	0.27
DSH140	304	46	56	0.24
DSH161	315	49	64	0.22
DSH184	351	54	71	0.22
DSH240	485	75	103	0.16
DSH295	560	87	112	0.13
DSH381	717	110	152	0.09
DSH485	761	143	185	0.07

Table 23: Motor voltage code 4

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
DSH090	98	16	19	1.47
DSH105	142	18	22	1.05
DSH120	142	21	24	1.05
DSH140	147	21	28	0.92
DSH161	158	25	31	0.83
DSH184	197	28	36	0.83
DSH240	215	33	49	0.62
DSH295	260	44	56	0.52
DSH381	294	50	72	0.45
DSH485	344	76	91	0.28
DSH600	427	80	116	0.23

Table 24: Motor voltage code 7

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
DSH090	84	13	14	2.34
DSH105	103	16	17	1.57
DSH120	103	17	19	1.57
DSH140	122	19	22	1.38
DSH161	136	21	24	1.32
DSH184	135	25	28	1.32
DSH240	175	28	38	0.94
DSH295	210	31	44	0.82
DSH381	235	40	58	0.56
DSH485	296	55	71	0.36
DSH600	338	70	91	0.38

Table 25: Motor voltage code 9

Compressor model	LRA	RLA	Max. operating current	Winding resistance
	A	A	A	Ω
DSH090	124	19	23	1.05
DSH105	160	24	26	0.72
DSH120	160	25	29	0.72
DSH140	168	26	33	0.62
DSH161	177	29	37	0.57
DSH184	239	36	41	0.57
DSH240	260	41	58	0.42
DSH295	310	47	69	0.36
DSH381	382	60	88	0.24
DSH485	475	83	109	0.16

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

DSH090 to DSH184

Compressor models DSH 090 to 184 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 the Max Operating Current value (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.

DSH240 to DSH600

Compressor models DSH240-295-381-485-600 are delivered with a pre-installed motor protection module inside the terminal box. This device provides efficient and reliable protection against overheating and overloading as well as phase loss/reversal.

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

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

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

A red/green twin LED is visible on the module (except on DSH485-3). A solid green LED denotes a fault free condition. A blinking red LED indicates an identifiable fault condition:

Figure 46: PTC Overheat

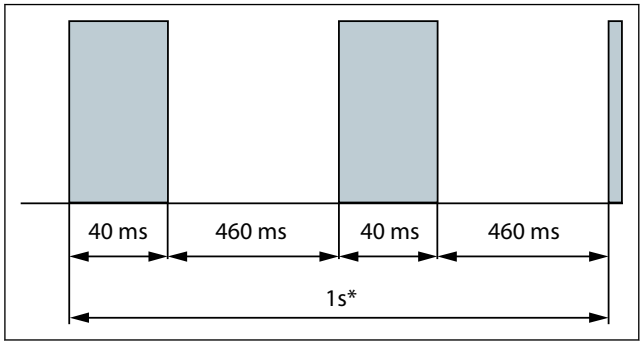
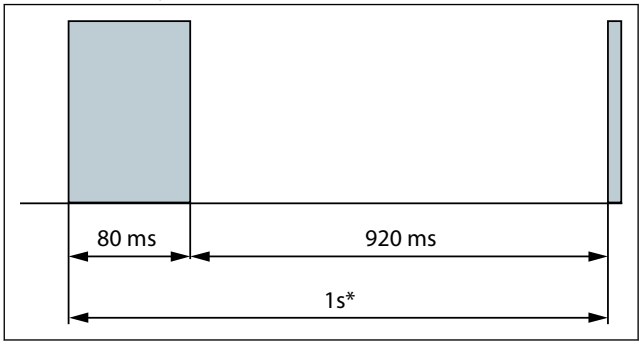


Figure 47: Delay timer active (after PTC over temp.)



*	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

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

DSH090 to DSH184

Compressor models DSH 090 to 184 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.

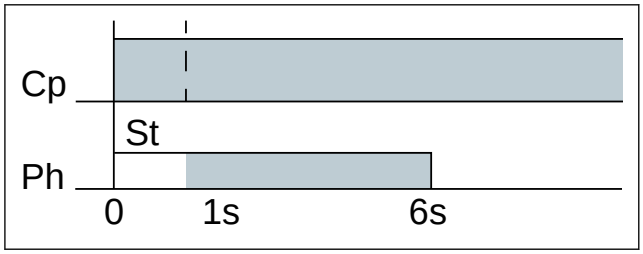
DSH240 to DSH600

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 DSH 240 to 600 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 48: 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 (except on DSH485-3):

Figure 49: In case of phase reverse error

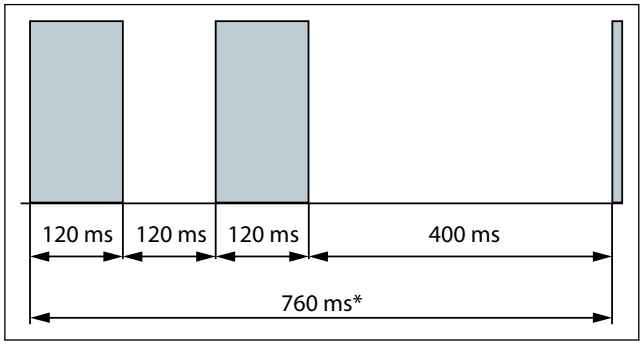
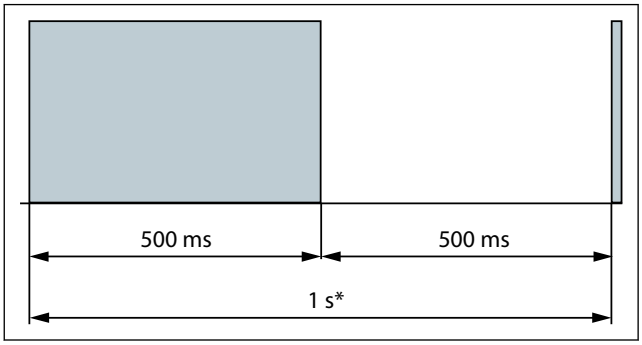


Figure 50: In case of phase loss error:



*	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. For DSH140-184 medium trio models, top-up oil quantity 1L at least as mandatory.

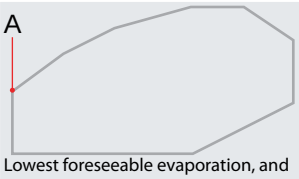
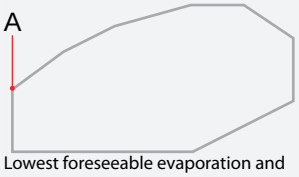
System evaluation

Table 26: 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 27: 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 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)
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 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 for DSH scroll compressors guarantees reliable operations of the compressor for steady-state operation.

Steady-state operation envelope is valid for a suction superheat within 5K to 30K 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.

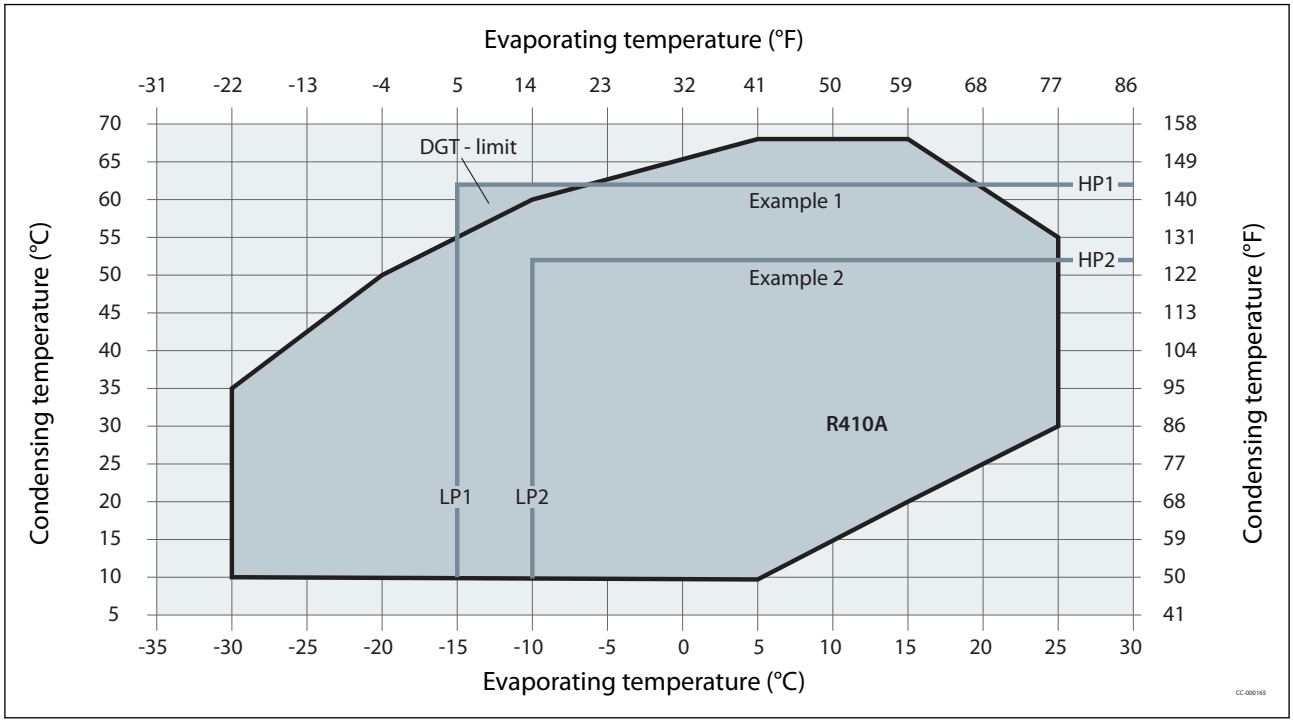
Discharge temperature protection

DSH240 to DSH600 include an integrated discharge temperature protection. Excessive discharge temperature will result in tripping of electronic module ouput relay.

This protection, effective for suction superheat above 5K (9°), 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 additionnal external discharge protection is required. (see below Figure 51: Discharge temperature protection examples)

Figure 51: Discharge temperature protection examples



Example 1 (R410A, SH = 11K)
LP switch setting: LP1 = 3.8 bar (g) (-15°C), HP switch setting: HP1 =38 bar (g) (62°C)
Risk of operation beyond the application envelope.
DGT protection required.

Example 2 (R410A, SH = 11K)
LP switch setting: LP2 = 4.7 bar (g) (-10°C), HP switch setting: HP2 = 31 bar (g) (52°C)
No risk of operation beyond the application envelope.
No DGT protection required.

DSH090 to 184 have no integrated discharge temperature protection, an external protection is required.

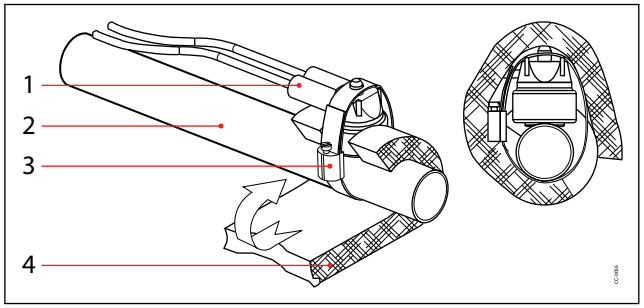
This external protection device can be a thermostat or a temperature sensor. The discharge gas temperature protection must trip the power supply when it reaches the setting point to protect the compressor from overheating.

For R410A application the discharge gas protection should be set to open at a maximum discharge gas temperature of 135°C(275°F). The discharge gas thermostat accessory kit (code 7750009) is recommended.

For R452B/R454B application, the discharge gas protection should be set to open at a maximum discharge gas temperature of 150°C(302°F). A PT1000 is recommended.

The discharge gas thermostat or sensor must be attached to the discharge line within 150mm (5.91 inch) from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe (see Figure 52: Discharge Gas Temperature protection (DGT))

Figure 52: Discharge Gas Temperature protection (DGT)

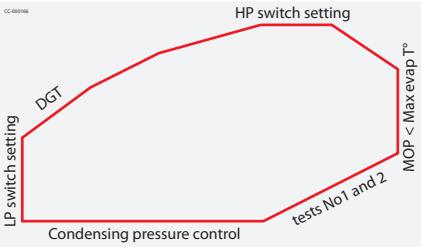


1	Thermostat or temperature sensor
2	Discharge line
3	Bracket
4	Insulation

System evaluation

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

Table 28: System evaluation

Basic	Advanced
• HP and LP switch • MOP (Max Operating Pressure) ensured by expansion device • Condensing pressure control • DGT external setting points: R410A max 135°C (275°F), R454B/R452B max 150°C (302°F)	• HP and LP sensor • Operating envelope limits integrated into control logic • Temperature measurement (monitoring by sensor)
	Whole operating envelope limits integrated into control logic 

Manage superheat

During normal operation, refrigerant enters the compressor as a superheated vapor. Liquid flood back occurs when a part of the refrigerant entering the compressor is still in liquid state.

Liquid flood back can cause oil dilution and, in extreme situations lead to liquid slugging that can damage the compressor.

Requirement

In steady state conditions the expansion device must ensure a suction superheat within 5K to 30K (9 to 54°F).

System evaluation

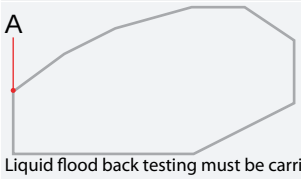
Use the table in relation with the application to quickly evaluate the potential tests to perform.

Table 29: System evaluation

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

Test, criteria and solutions

Table 30: 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: • Lowest foreseeable evaporation, and highest foreseeable condensation. • Minimum number of compressor running. For reversible system, perform test in both heating and cooling mode.	Suction superheat >5K (9°F) and the oil superheat shall not be more than 60 sec below the safe limit defined in the Dilution Chart. (see Dilution Chart - DSH090 to DSH184 R410A)	1. Check expansion valve selection and setting. ◦ For Thermostatic expansion valve (TXV) check bulb position... ◦ For Electronic expansion valve (EXV) check measurement chain and PID.... 2. Add a suction accumulator [1]
	Transient	Tests must be carried out with most unfavorable conditions : • fan staging, • compressor staging • …	Oil superheat shall not be more than 60 sec per hour below the safe limit defined in the Dilution Chart. (see Dilution Chart - DSH090 to DSH184 R452B / 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 per hour below the safe limit defined in the Dilution Chart. (see Dilution Chart - DSH240 to DSH600 R410A/ R452B / R454B)	1. Check defrost logic. In reversible systems, the defrost logic can be worked out to limit liquid floodback effect. (for more details see Control logic). 2. Add a suction accumulator [1]

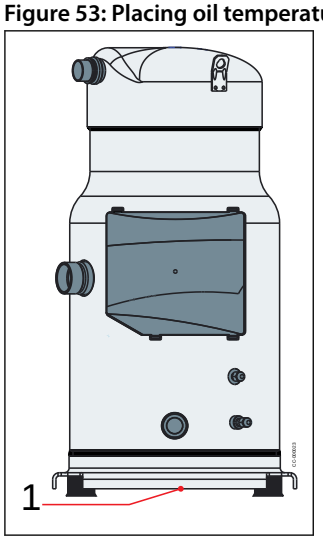
[1] Suction accumulator offers protection by trapping the liquid refrigerant upstream from the compressor. The accumulator should be sized at least 50 % of the total system charge. Suction accumulator dimensions can impact oil return (gas velocity, oil return hole size…), therefore oil return has to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

Placing oil temperature sensor

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

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

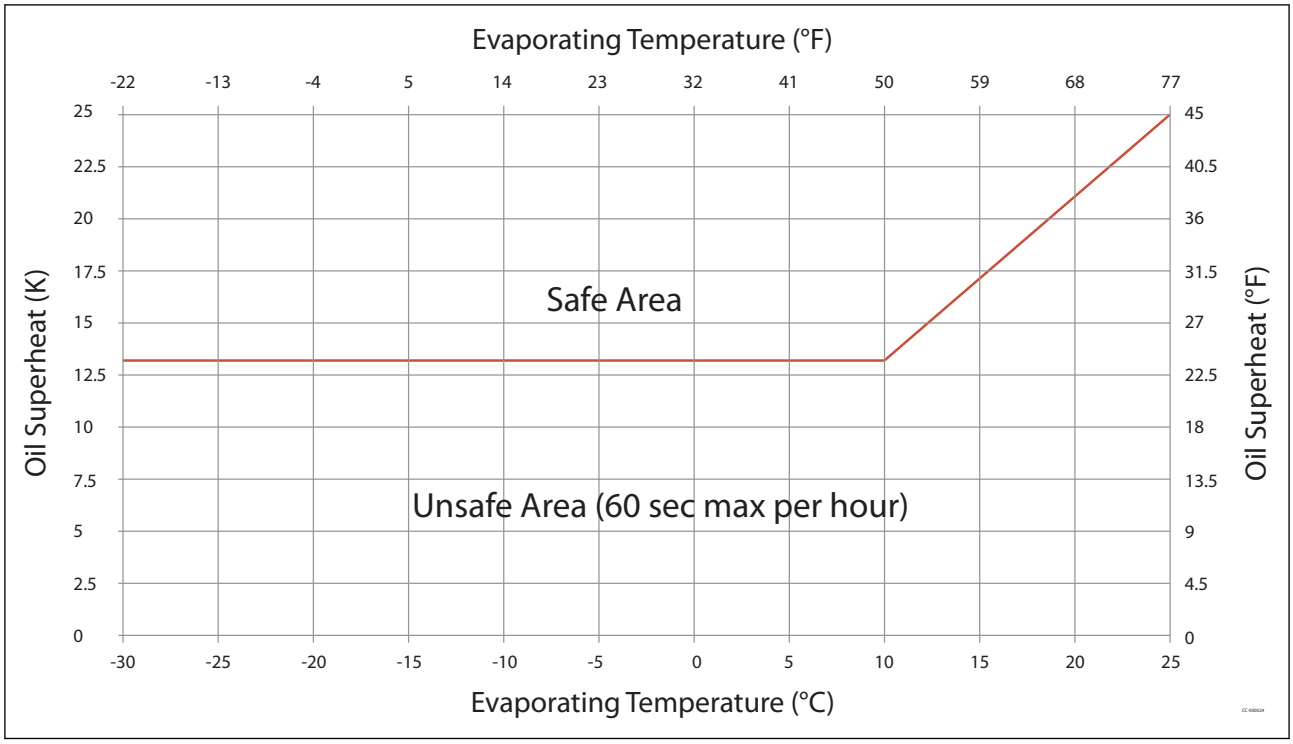
Figure 53: Placing oil temperature sensor



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

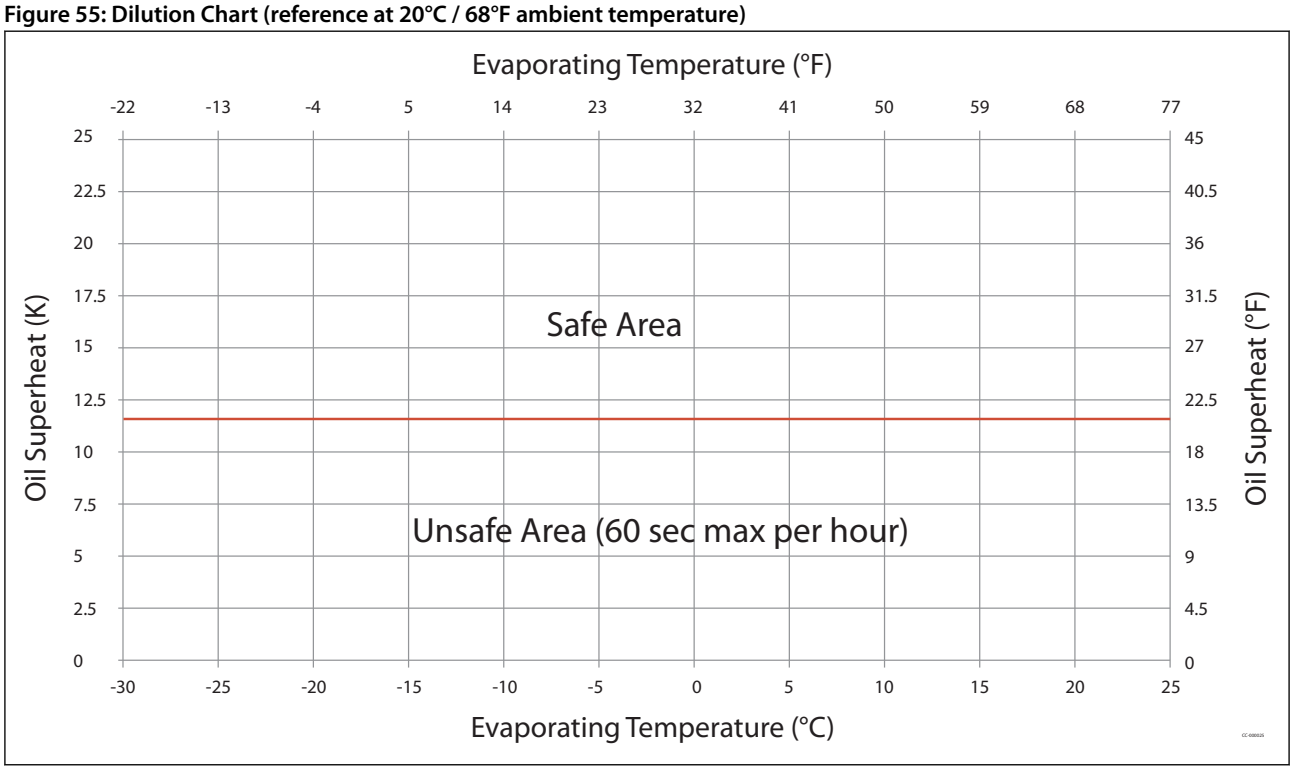
Dilution Chart - DSH090 to DSH184 R410A

Figure 54: Dilution Chart (reference at 20°C / 68°F ambient temperature)



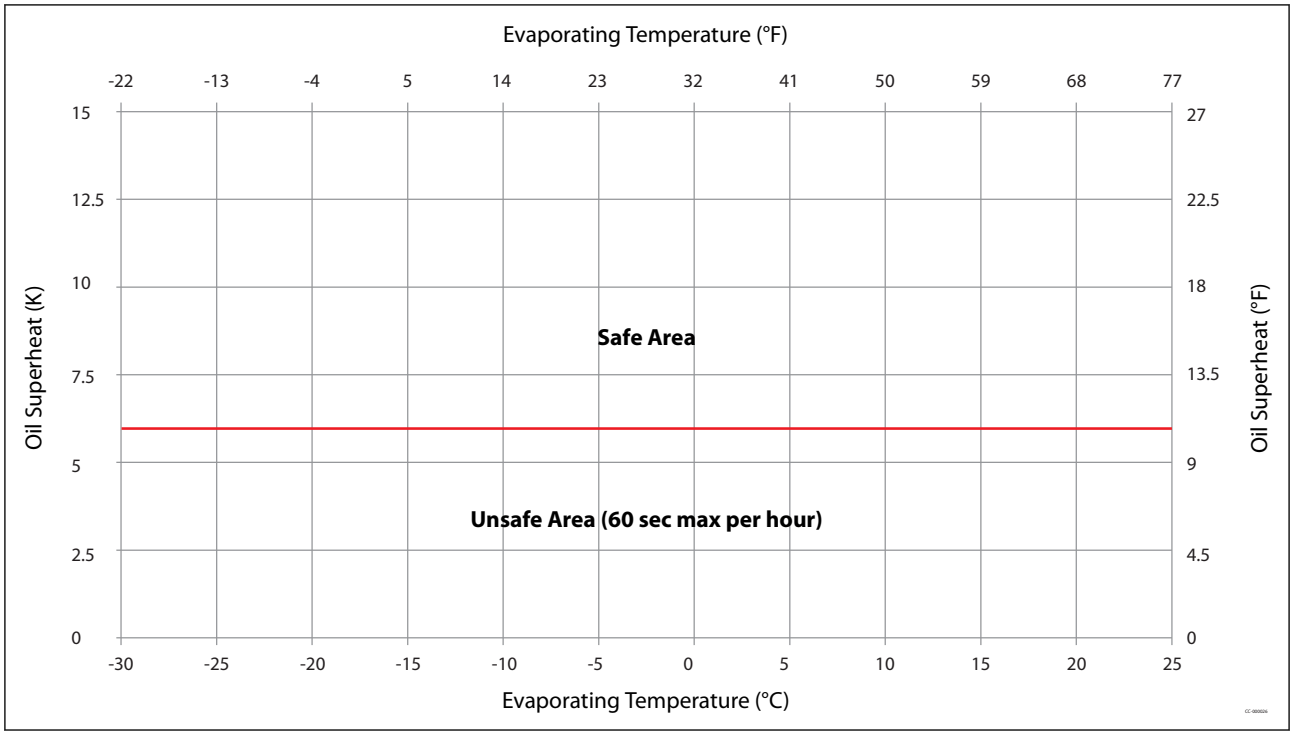
Dilution Chart - DSH090 to DSH184 R452B / R454B

Figure 55: Dilution Chart (reference at 20°C / 68°F ambient temperature)



Dilution Chart - DSH240 to DSH600 R410A/ R452B / R454B

Figure 56: Dilution Chart (reference at 20°C / 68°F ambient temperature)



Manage off cycle migration

Off -cycle refrigerant migration happens:

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

Requirement

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

System evaluation

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

Table 31: System charge

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

Surface Sump heater

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

For DSH090-105-120-140-161-184, the surface sump heater is located on the compressor shell. For better standby energy consumption, Danfoss provides 48W and 80W two optional surface sump heater. The selection of surface sump heater could be refered to Table 32: surface sump selection principle

Figure 57: DSH090 to 184

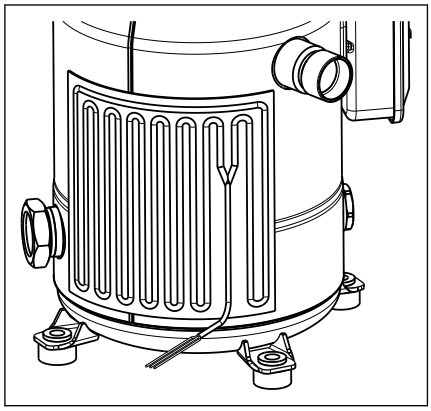
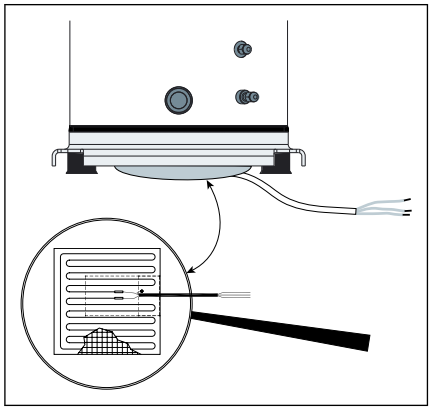


Table 32: surface sump selection principle

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

For DSH240-295-381-485-600, the 56W surface sump seater is located below the sump, associated with a thermal insulation.

Figure 58: DSH240 to DSH485



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

Liquid line solenoid valve (LLSV)

A Liquid line solenoid valve (LLSV) is used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer to the compressor during off -cycles. The quantity of refrigerant on the low-pressure side of the system can be further reduced by using a pump-down cycle in association with the LLSV.

Pump-down cycle

By decreasing pressure in the sump, pump down system:
- evacuates refrigerant from oil
- set the sump saturating pressure much lower than ambiance temperature and due to that, avoid refrigerant condensation in the compressor.

Pump-down must be set higher than 1.7bar(g) (25 psig). For more details on pump-down cycle see section Control logic.

Charge limits

Table 33: Charge limits for single models

Models	Composition	Refrigerant charge limit	
		kg	lbs
DSH090	-	8	18
DSH105	-	10	22
DSH120	-	10	22
DSH140	-	10	22
DSH161	-	10	22
DSH184	-	10	22
DSH240	-	15	33
DSH295	-	15	33
DSH381	-	17	37
DSH485	-	17	37
DSH600	-	17	37

Table 34: Charge limits for Tandem models

Models	Composition	Refrigerant charge limit	
		kg	lbs
DSH180E	2×DSH090	12	26
DSH195U	DSH090 + DSH105	12	26
DSH210U	DSH090 + DSH120	12	26
DSH210E	2×DSH105	12	26
DSH230U	DSH090 + DSH140	12	26
DSH240E	2×DSH120	12	26
DSH251U	DSH090 + DSH161	12	26
DSH260U	DSH140 + DSH120	12	26
DSH274U	DSH090 + DSH184	12	26
DSH281U	DSH161 + DSH120	12	26
DSH280E	2×DSH140	14	31
DSH289U	DSH105 + DSH184	12	26
DSH301U	DSH161 + DSH140	14	31
DSH304U	DSH120 + DSH184	12	26
DSH322E	2×DSH161	14	31
DSH324U	DSH140 + DSH184	14	31
DSH345U	DSH161 + DSH184	14	31
DSH368E	2×DSH184	14	31
DSH360X	DSH120 + DSH240	14	31
DSH424X	DSH184 + DSH240	14	31
DSH456X	DSH161 + DSH295	14	31
DSH479X	DSH184 + DSH295	14	31
DSH565X	DSH184 + DSH381	14	31
DSH482E	2×DSH240	21	46
DSH535U	DSH240 + DSH295	21	46
DSH590E	2×DSH295	25	55
DSH620U	DSH240 + DSH381	21	46
DSH675U	DSH295 + DSH381	25	55
DSH760E	2×DSH381	29	64
DSH725U	DSH240 + DSH485	21	46
DSH780U	DSH295 + DSH485	25	55
DSH865U	DSH381 + DSH485	29	64
DSH895U	DSH295 + DSH600	25	55
DSH970E	2×DSH485	34	75
DSH1085U	DSH485 + DSH600	34	75
DSH1200E	DSH600 + DSH600	44	97

Table 35: Charge limits for Trio models

Models	Composition	Refrigerant charge limit	
		kg	lbs
DSH420T	3×DSH140	14	31
DSH483T	3×DSH161	14	31
DSH552T	3×DSH184	14	31
DSH720T	3×DSH240	21	46
DSH885T	3×DSH295	25	55
DSH971T	2×DSH295 + DSH381	25	55
DSH1140T	3×DSH381	29	64
DSH1245T	2×DSH381 + DSH485	29	64
DSH1350T	DSH381 + 2×DSH485	29	64
DSH1455T	3×DSH485	34	75
DSH1570T	2×DSH485 + DSH600	34	75
DH1685T	DSH485 + 2×DSH600	34	75
DSH1800T	3×DSH600	44	97

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). For DSH090-105-120-140-161-184, phase sequence protection is strongly recommended.
- Compressor models DSH240-295-381-485-600 are delivered with a pre-installed motor protection module inside the terminal box that must be powered on.
- HP safety switch, DGT (only for DSH090 to DSH184) and electronic module relay output (M1-M2, only for DSH240 to DSH600) 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 59: Compressor model DSH 090 - 105 - 120 - 140 - 161 - 184

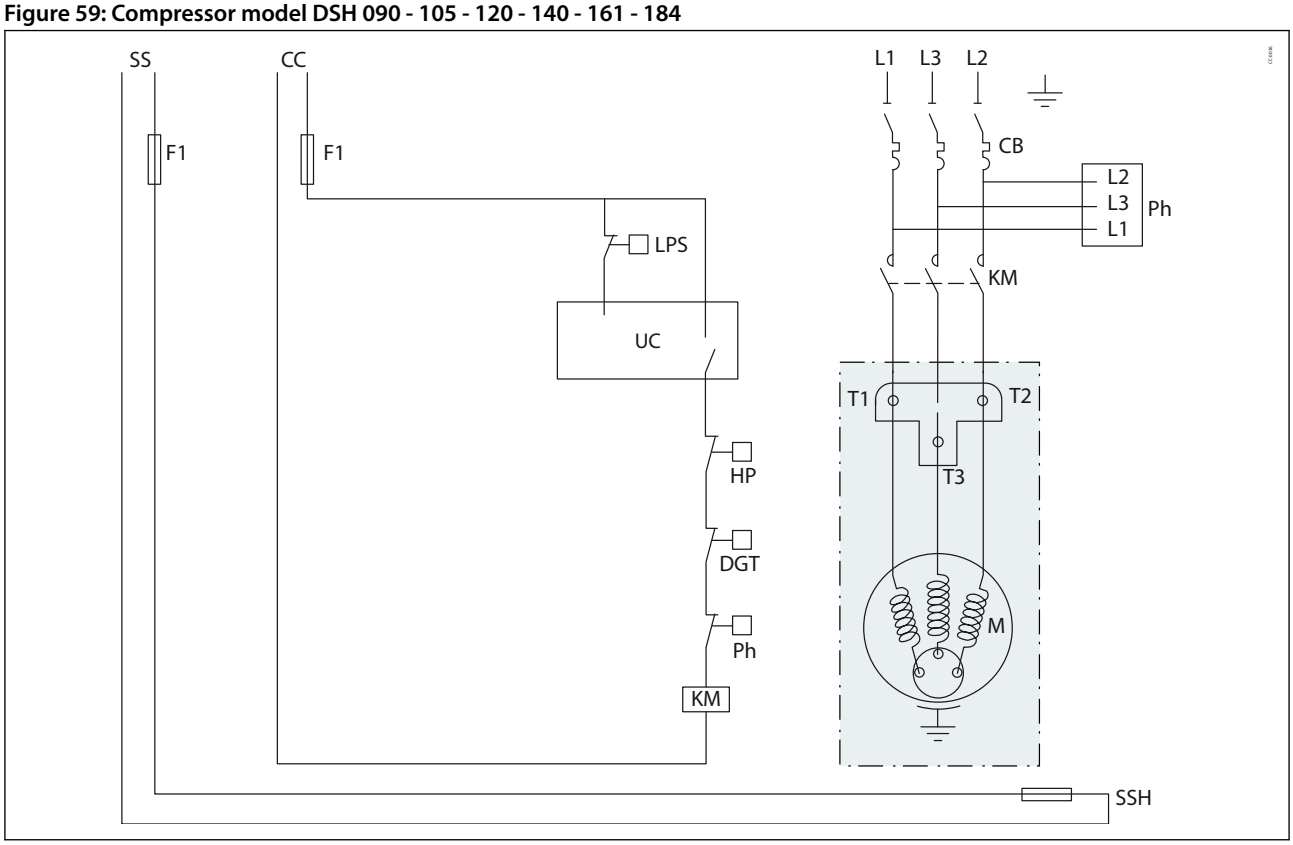


Figure 60: Compressor model DSH240-295-381

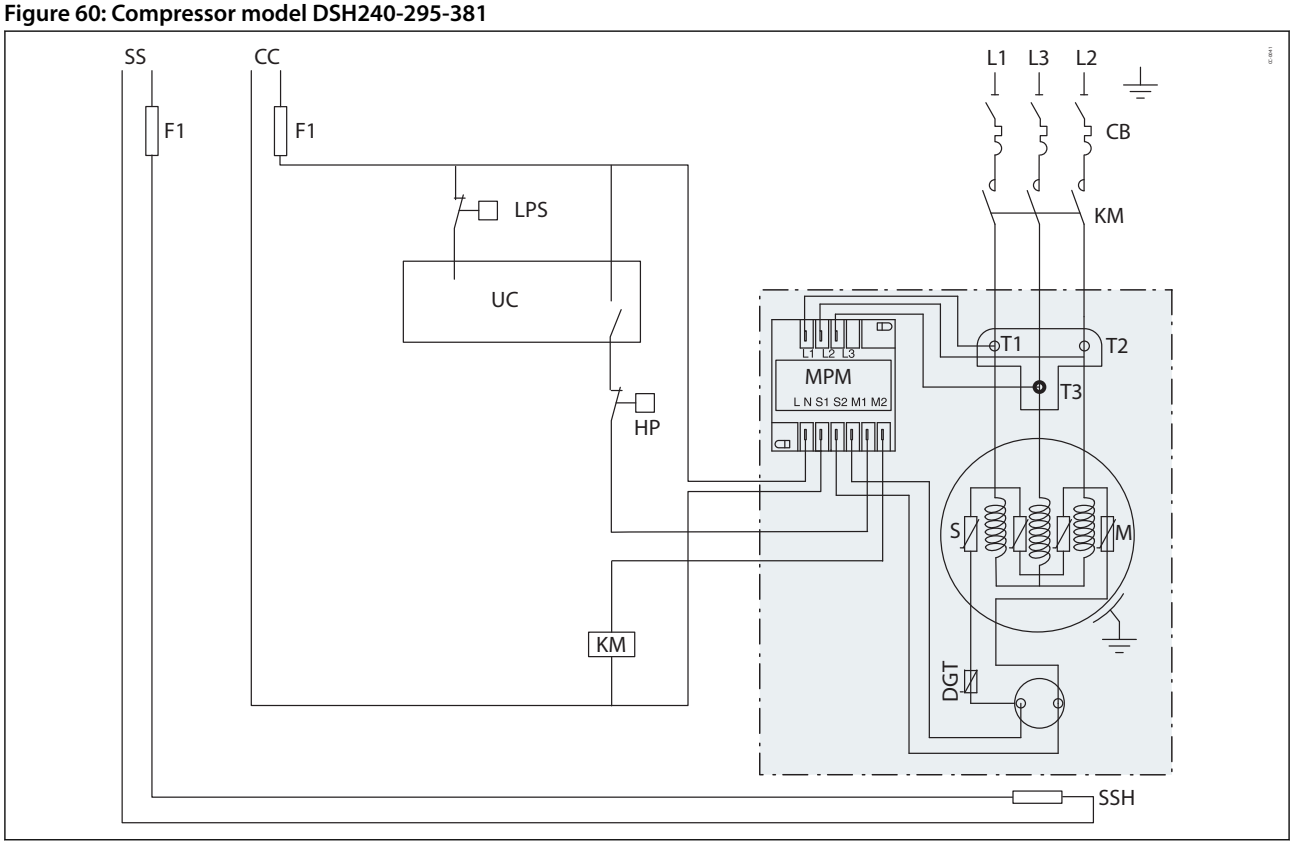


Figure 61: Compressor model DSH485 (except code 3) and model DSH600

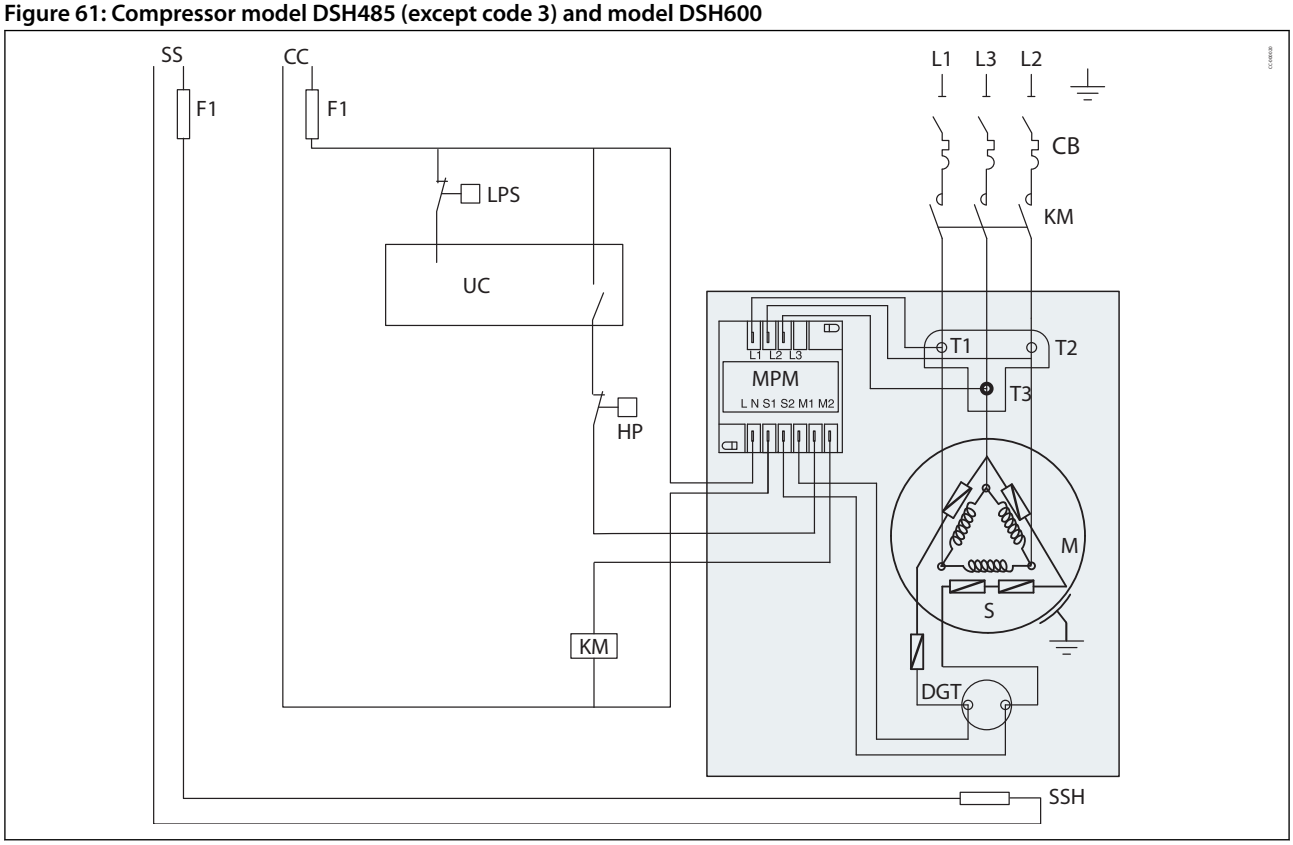
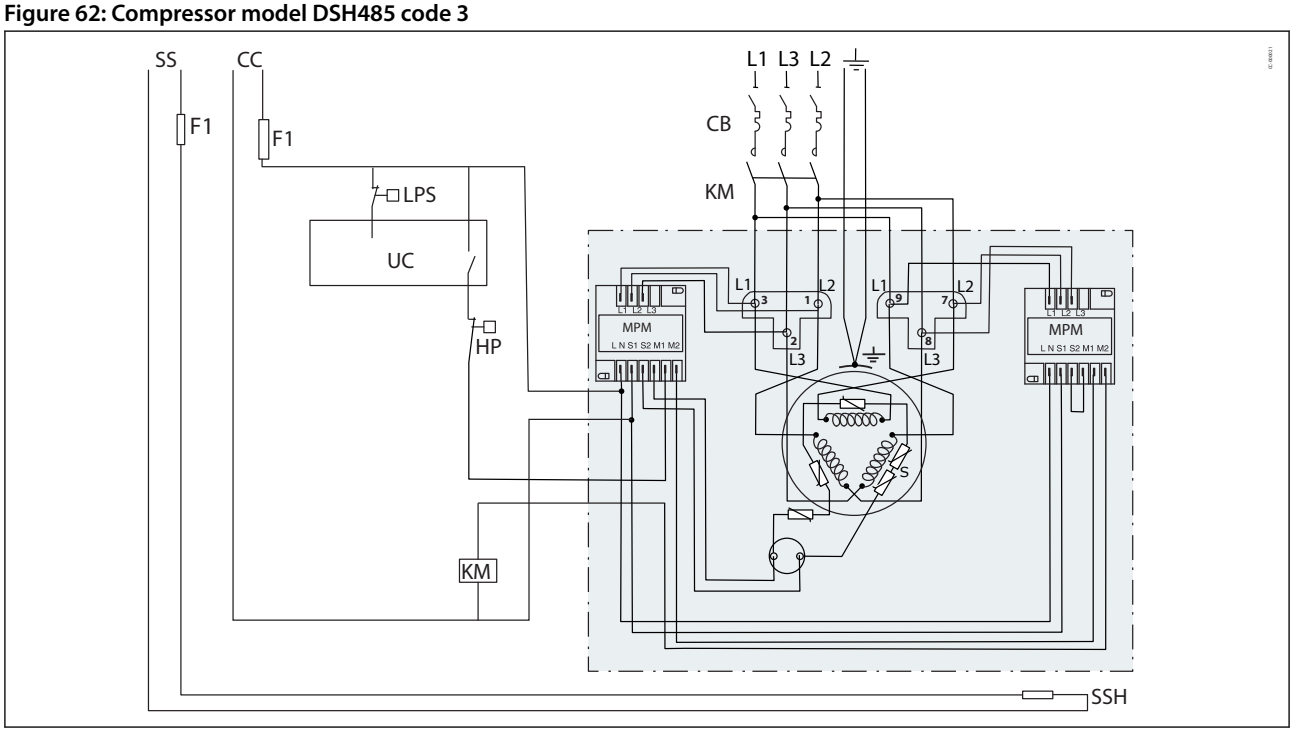


Figure 62: Compressor model DSH485 code 3



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

Soft starts

Soft starters are designed to reduce the starting current of 3-phase AC motors. Soft starters can be used on DSH 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 or R452B make sure that the softstarter selected is compatible with A2L refrigerants.

Control logic

Safety control logic requirements

Table 36: Safety control logic requirements

Safeties	Tripping conditions		Re-start conditions	
	Value	Time	Value	Time
HP safety switch	See Pressure settings table from section Operating envelope data	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) (1)	Contact M1-M2 opened			

(1) Only for DSH240 to DSH600.

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.

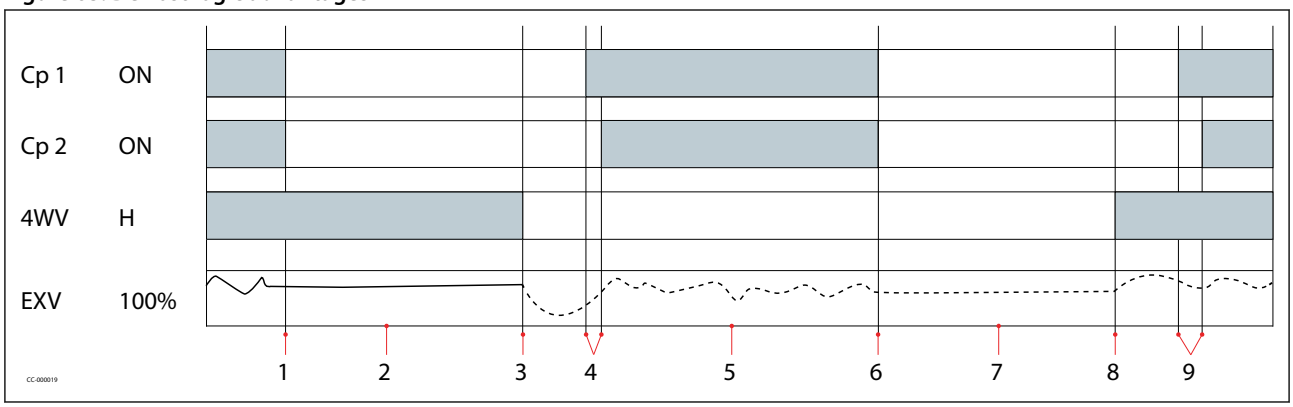
Defrost logic recommendations / Reversible systems

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 63: Defrost logic advantages



Cp 1	Compressor 1
Cp 2	Compressor 2
ON	On
H	Heating
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 Cp 2 with 0.5 seconds delay between 2 successive starts

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.

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 minimum of 1.7bar(g) (25psig). 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)

DSH090 to DSH600 compressors integrate tight internal non return valve (INRV), therefore no external Non Return Valve (NRV) is needed.

Reduce moisture in the system

Excessive air and moisture

- can increase condensing pressure and cause high discharge temperatures.
- can create acid giving rise to copper platting.
- can destroy the lubricating properties of the oil.

All these phenomena can reduce service life and cause mechanical and electrical compressor failure.

Requirements

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

Solutions

To achieve this requirement, a properly sized and type of drier is required. Important selection criteria's include:

- driers water content capacity,
- system refrigeration capacity,
- system refrigerant charge.

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

Assembly line procedure

Compressor storage

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

Compressor holding charge

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

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

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

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

Handling

Each Danfoss DSH 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 64: Heavy



Figure 65: Correct

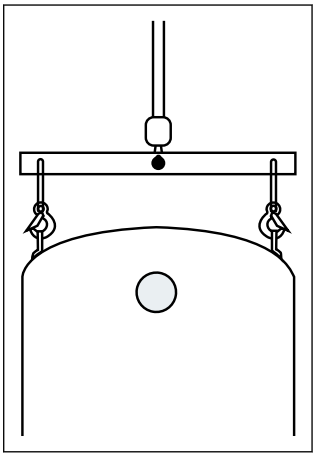


Figure 66: Incorrect

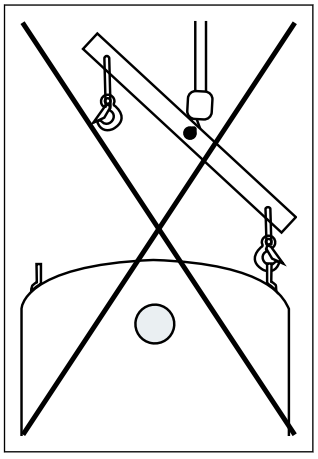
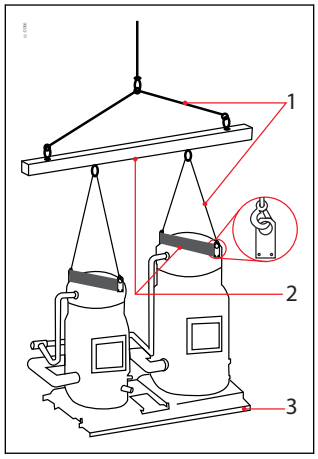


Figure 67: Handling



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 37: 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.

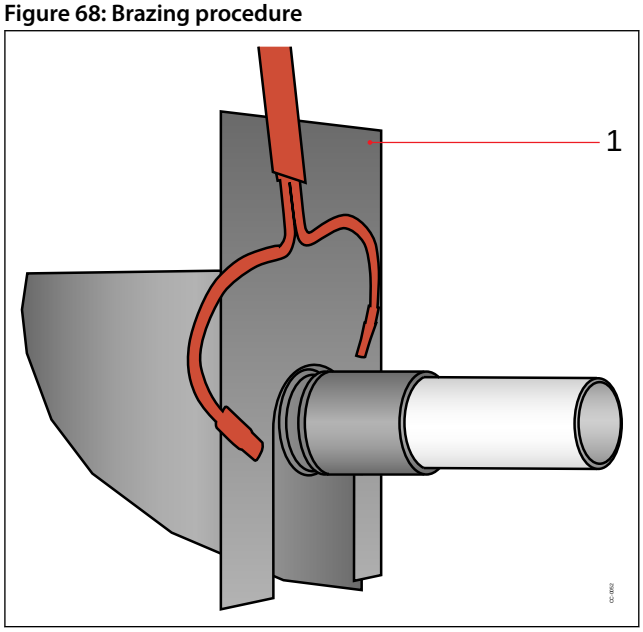
DSH compressors connectors are made of steel copper coated, which benefit to protect against corrosion and facilitate adhesion during brazing operation.

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 68: 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 38: System pressure test and leak detection

Maximum compressor test pressures	DSH090-105-120-140-161-184	DSH240-295 -381-485-600
Maximum compressor test pressure high side (HP)	53.6 bar (g) (777 psig) HP-LP<37 bar (537 psi)	53.6 bar (g) (777 psig) HP-LP<37 bar (537 psi)
Maximum compressor test pressure low side (LP)	36.7 bar (g) (532 psig) LP-HP<5bar (73psi) Maximum speed 4.8bar/s (70psi/s) [1]	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

R Requirements:

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

Recommendations:

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

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

Refrigerant charging

R 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.

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

Commissioning

Preliminary check

R Check electrical power supply:

- Phase order: Reverse rotation is obvious if the compressor do not build up pressure and sound level is abnormal high. For DSH090-184 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.

For DSH240 to DSH600 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

- Surface sump 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 39: Single pack packaging

Compressor model	Length		Width		Height		Gross weight	
	mm	inch	mm	inch	mm	inch	kg	lbs
DSH090	565	22.2	470	18.5	718	28.3	69	152
DSH105	565	22.2	470	18.5	718	28.3	76	168
DSH120	565	22.2	470	18.5	718	28.3	76	168
DSH140	565	22.2	470	18.5	718	28.3	79	174
DSH161	565	22.2	470	18.5	718	28.3	81	179
DSH184	565	22.2	470	18.5	718	28.3	84	185
DSH240	750	29.5	750	29.5	1050	41.3	128	282
DSH295	750	29.5	750	29.5	1050	41.3	131	289
DSH381	750	29.5	750	29.5	1050	41.3	178	392
DSH485	750	29.5	750	29.5	1050	41.3	195	430
DSH600	750	29.5	750	29.5	1050	41.3	234	516

Industrial pack



Table 40: Industrial pack packaging

Compressor model	Compressors per pack	Length		Width		Height		Gross weight		Static stacking pallets
		mm	inch	mm	inch	mm	inch	kg	lbs	
DSH090	8	1150	45.3	950	37.4	680	26.8	494	1089	2
DSH105	8	1150	45.3	950	37.4	750	29.5	544	1199	2
DSH120	8	1150	45.3	950	37.4	750	29.5	544	1199	2
DSH140	8	1150	45.3	950	37.4	750	29.5	566	1248	2
DSH161	8	1150	45.3	950	37.4	750	29.5	582	1283	2
DSH184	8	1150	45.3	950	37.4	750	29.5	606	1336	2
DSH240	6	1150	45.3	965	38	768	30.2	693	1528	2
DSH295	6	1150	45.3	965	38	768	30.2	712	1570	2
DSH381	4	1150	45.3	965	38	800	31.5	678	1494	2
DSH485	4	1150	45.3	965	38	800	31.5	744	1640	2
DSH600	4	1150	45.3	965	38	800	34.7	900	1984	2

Ordering

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

Compressors DSH090 to DSH184 are delivered with flexible grommets.

For compressors DSH240 to DSH600 use in single applications, flexible grommets are available as accessory kit 8156138.

Single pack

Compressors compatible R454B, R452B and R410A

Figure 69: Single pack



Table 41: Single pack compressors compatible R454B, R452B and R410A

Compressor model	Connections	Motor protection	Code no.			
			3	4	7	9
			200-230/3/60	380-400 (415)/3/50 460/3/60	575/3/60	380-400/3/60
DSH090	Brazed	Internal	-	120H1511	-	-
DSH105	Brazed	Internal	-	120H1521	-	-
DSH120	Brazed	Internal	-	120H1531	-	-
DSH140	Brazed	Internal	-	120H1541	-	-
DSH161	Brazed	Internal	-	120H1551	-	-
DSH184	Brazed	Internal	-	120H1561	-	-
DSH240	Brazed	Module 24V AC [1]	120H1749	120H1376	120H1734	-
DSH240	Brazed	Module 110-240V [1]	120H1751	120H1374	120H1735	-
DSH295	Brazed	Module 24V AC [1]	120H1745	120H1372	120H1732	-
DSH295	Brazed	Module 110-240V [1]	120H1747	120H1370	120H1733	-
DSH381	Brazed	Module 24V AC [1]	120H1741	120H1368	120H1730	-
DSH381	Brazed	Module 110-240V [1]	120H1743	120H1366	120H1731	-
DSH485	Brazed	Module 24V AC [1]	120H1737	120H1364	120H1728	-
DSH485	Brazed	Module 110-240V [1]	120H1739	120H1362	120H1729	-
DSH600	Brazed	Module 24V AC [1]	-	contact Danfoss	contact Danfoss	-
DSH600	Brazed	Module 110-240V [1]	-	contact Danfoss	contact Danfoss	-

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

Mounting kit for DSH240-295-381-485 single compressor applications : Ref 8156138

Compressors compatible R410A only

Table 42: Single pack compressors compatible R410A only

Compressor model	Connections	Motor protection	Code no.			
			3	4	7	9
			200-230/3/60	380-400 (415)/3/50 460/3/60	575/3/60	380-400/3/60
DSH090	Brazed	Internal	120H1507	-	120H1513	120H1515
DSH105	Brazed	Internal	120H1517	-	120H1523	120H1525
DSH120	Brazed	Internal	120H1527	-	120H1533	120H1535
DSH140	Brazed	Internal	120H1537	-	120H1543	120H1545
DSH161	Brazed	Internal	120H1547	-	120H1553	120H1555
DSH184	Brazed	Internal	120H1557	-	120H1563	120H1565
DSH240	Brazed	Module 24V AC (1)	120H1291	120H1331	120H1299	120H1315
DSH240	Brazed	Module 110-240V (1)	120H1289	120H1329	120H1298	120H1313
DSH295	Brazed	Module 24V AC (1)	120H1287	120H1327	120H1297	120H1311
DSH295	Brazed	Module 110-240V (1)	120H1285	120H1325	120H1296	120H1309
DSH381	Brazed	Module 24V AC (1)	-	-	-	120H1307
DSH381	Brazed	Module 110-240V (1)	-	-	-	120H1305
DSH485	Brazed	Module 24V AC (1)	-	-	-	120H1303
DSH485	Brazed	Module 110-240V (1)	-	-	-	120H1301
DSH600	Brazed	Module 24V AC (1)	-	120H1380	-	-
DSH600	Brazed	Module 110-240V (1)	-	120H1378	-	-

(1) Electronic motor protection, module located in terminal box.

Mounting kit for DSH240-295-381-485-600 single compressor applications : Ref 8156138

Industrial pack

Compressors compatible R454B, R452B and R410A

Figure 70: Industrial pack



Table 43: Industrial pack compressors compatible R454B, R452B and R410A

Compressor model	Connections	Motor protection	Code no.			
			3	4	7	9
			200-230/3/60	380-400 (415)/3/50 460/3/60	575/3/60	380-400/3/60
DSH090	Brazed	Internal	-	120H1512	-	-
DSH105	Brazed	Internal	-	120H1522	-	-
DSH120	Brazed	Internal	-	120H1532	-	-
DSH140	Brazed	Internal	-	120H1542	-	-
DSH161	Brazed	Internal	-	120H1552	-	-
DSH184	Brazed	Internal	-	120H1562	-	-
DSH240	Brazed	Module 24V AC (1)	120H1748	120H1375	-	-
DSH240	Brazed	Module 110-240V (1)	120H1750	120H1373	-	-
DSH295	Brazed	Module 24V AC (1)	120H1744	120H1371	-	-

Compressor model	Connections	Motor protection	Code no.			
			3	4	7	9
			200-230/3/60	380-400 (415)/3/50 460/3/60	575/3/60	380-400/3/60
DSH295	Brazed	Module 110-240V [1]	120H1746	120H1369	-	-
DSH381	Brazed	Module 24V AC [1]	120H1740	120H1367	-	-
DSH381	Brazed	Module 110-240V [1]	120H1742	120H1365	-	-
DSH485	Brazed	Module 24V AC [1]	120H1736	120H1363	-	-
DSH485	Brazed	Module 110-240V [1]	120H1738	120H1361	-	-

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

Compressors compatible R410A only

Table 44: Industrial pack compressors compatible R410A only

Compressor model	Connections	Motor protection	Code no.			
			3	4	7	9
			200-230/3/60	380-400 (415)/3/50 460/3/60	575/3/60	380-400/3/60
DSH090	Brazed	Internal	120H1508	-	120H1514	120H1516
DSH105	Brazed	Internal	120H1518	-	120H1524	120H1526
DSH120	Brazed	Internal	120H1528	-	120H1534	120H1536
DSH140	Brazed	Internal	120H1538	-	120H1544	120H1546
DSH161	Brazed	Internal	120H1548	-	120H1554	120H1556
DSH184	Brazed	Internal	120H1558	-	120H1564	120H1566
DSH240	Brazed	Module 24V AC [1]	120H1290	120H1330	-	120H1314
DSH240	Brazed	Module 110-240V [1]	120H1288	120H1328	-	120H1312
DSH295	Brazed	Module 24V AC [1]	120H1286	120H1326	-	120H1310
DSH295	Brazed	Module 110-240V [1]	120H1284	120H1324	-	120H1308
DSH381	Brazed	Module 24V AC [1]	-	-	-	120H1306
DSH381	Brazed	Module 110-240V [1]	-	-	-	120H1304
DSH485	Brazed	Module 24V AC [1]	-	-	-	120H1302
DSH485	Brazed	Module 110-240V [1]	-	-	-	120H1300
DSH600	Brazed	Module 24V AC [1]	-	120H1381	-	-
DSH600	Brazed	Module 110-240V [1]	-	120H1379	-	-

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

Accessories and Spare parts

Solder sleeve adapter set

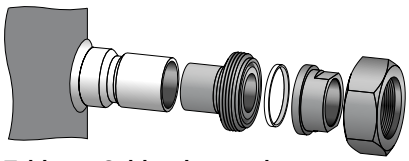


Table 45: Solder sleeve adapter set

Code no.	Description	Application	Packaging	Pack size
120Z0125	Rotolock adaptor set (1"3/4 ~ 1"1/8) , (1"1/4 ~ 7/8")	DSH090 (R410A)	Multipack	8
120Z0405	Rotolock adaptor set (1"3/4 ~ 1"3/8) , (1"1/4 ~ 7/8")	DSH105 to 184 (R410A)	Multipack	8
7765028	Rotolock adaptor set (2"1/4 ~ 1"5/8) , (1"3/4 ~ 1"1/8)	DSH240-295-381 (R410A)	Multipack	6
120Z0504	Rotolock adaptor set (2"1/4 ~ 1"5/8), (1"3/4 ~ 1"3/8)	DSH485 (R410A)	Multipack	6

Rotolock adapter

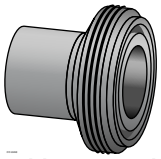


Table 46: Rotolock adapter

Code no.	Description	Application	Packaging	Pack size
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 ODS)	Models with 1"1/8 ODF (R410A)	Multipack	10
120Z0431	Adaptor (1"3/4 Rotolock - 1"3/8 ODS)	Models with 1"3/8 ODF (R410A)	Multipack	10
120Z0432	Adaptor (2"1/4 Rotolock - 1"5/8 ODS)	Models with 1"5/8 ODF (R410A)	Multipack	10

Gaskets



Table 47: Gaskets

Code no.	Description	Application	Packaging	Pack size
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
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 48: 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 (R410A)	Multipack	10
8153008	Solder sleeve P04 (1"1/4 Rotolock - 3/4" ODF)	Models with 1"1/4 rotolock connection (R410A)	Multipack	10
8153012	Rotolock connector P05 (1"1/4 Rotolock - 7/8" ODF)	Models with 1"1/4 rotolock connection (R410A)	Multipack	10

Code no.	Description	Application	Packaging	Pack size
8153013	Solder sleeve P07 (1"3/4 Rotolock - 7/8" ODF)	Models with 1"3/4 rotolock connection (R410A)	Multipack	10
8153003	Solder sleeve P10 (1"3/4 Rotolock - 1"3/8 ODF)	Models with 1"3/4 rotolock connection (R410A)	Multipack	10
8153006	Solder sleeve P03 (2"1/4 Rotolock - 1"5/8 ODF)	Models with 2"1/4 rotolock connection (R410A)	Multipack	10

Rotolock nut



Table 49: Rotolock nut

Code no.	Description	Application	Packaging	Pack size
8153123	Rotolock nut,1"1/4	Models with 1-1/4" rotolock connection	Multipack	10
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 50: Motor protection modules

Code no.	Description	Application	Packaging	Pack size
120Z0584	Electronic motor protection module, 24 V AC	DSH240-295-381-485*-600(*except code 3)	Single pack	1
120Z0585	Electronic motor protection module, 110/240 V	DSH240-295-381-485*-600(*except code 3)	Single pack	1
120Z0624	Electronic motor protection module, 24V AC	DSH485 code 3	Single pack	1

Surface sump heaters

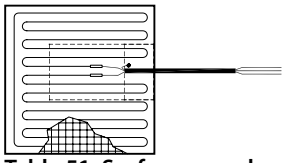


Table 51: Surface sump heaters

Code no.	Description	Application	Packaging	Pack size
120Z0667	48W 24V surface sump heater CE and UL	DSH090 to 184	Single pack	1
120Z0668	48W 230V surface sump heater CE and UL	DSH090 to 184	Single pack	1
120Z0669	48W 400V surface sump heater CE and UL	DSH090 to 184	Single pack	1
120Z0670	48W 460V surface sump heater CE and UL	DSH090 to 184	Single pack	1
120Z0671	48W 575V surface sump heater CE and UL	DSH090 to 184	Single pack	1
120Z0388	80W 24V surface sump heater CE and UL	DSH090 to 184	Multipack	8
120Z0389	80W 230V surface sump heater CE and UL	DSH090 to 184	Multipack	8
120Z0390	80W 400V surface sump heater CE and UL	DSH090 to 184	Multipack	8
120Z0391	80W 460V surface sump heater CE and UL	DSH090 to 184	Multipack	8
120Z0402	80W 575V surface sump heater CE and UL	DSH090 to 184	Multipack	8
120Z0769	56W 24V surface sump heater + bottom insulation, CE & UL	DSH240-295-381-485-600	Industry pack	12
120Z0770	56W 230V surface sump heater + bottom insulation, CE & UL	DSH240-295-381-485-600	Industry pack	12
120Z0771	56W 400V surface sump heater + bottom insulation, CE & UL	DSH240-295-381-485-600	Industry pack	12
120Z0772	56W 460V surface sump heater + bottom insulation, CE & UL	DSH240-295-381-485-600	Industry pack	12
120Z0773	56W 575V surface sump heater + bottom insulation, CE & UL	DSH240-295-381-485-600	Industry pack	12

Discharge temperature protection



Table 52: Discharge temperature protection

Code no.	Description	Application	Packaging	Pack size
7750009	Discharge thermostat kit	DSH090 to 184 (R410A)	Multipack	10
7973008	Discharge thermostat kit	DSH090 to 184 (R410A)	Industry pack	50

Mounting hardware



Table 53: Mounting hardware

Code no.	Description	Application	Packaging	Pack size
120Z0066	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	DSH090 to 184	Single pack	1
8156138	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	DSH240 to 600 in single installation	Single pack	1
7777045	Mounting kit for scroll compressors. including hexagon rigid spacers, Grommets, Sleeves, Bolts, Washers	DSH240 to 600 Manifold installations 50 Hz when mounting directly on rail is not wished	Single pack	1
120Z0495	Mounting kit for scroll compressors. including triangle rigid spacers, Grommets, Sleeves, Bolts, Washers	DSH240 to 600 Manifold installations 60 Hz when mounting directly on rail is not wished	Single pack	1

Lubricant



Table 54: 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 55: Terminal boxes, covers and T-block connectors

Code no.	Description	Application	Packaging	Pack Size
120Z0413	Terminal box cover	DSH184 - DSH140 code3 - DSH161 code3	Single pack	1
8156135	Service kit for terminal box 96 x 115 mm, including 1 cover, 1 clamp	DSH090 to 161 (except DSH140 code3 and DSH161 code3)	Multipack	10
8173230	T block connector 52 x 57 mm	DSH090 to 161 (except DSH140 code3 and DSH161 code3)	Multipack	10
8173021	T block connector 60 x 75 mm	DSH184 - DSH140 code3 - DSH161 code3	Multipack	10
120Z0774	T block connector 80 x 80 mm	DSH240-600	Multipack	10
120Z0458	Terminal box 210 x 190 mm, incl. cover	DSH240-295-381*-485*-600(*except code 3)	Single pack	1
120Z0604	Terminal box 210x340mm, incl. cover	DSH485 code 3	Single pack	1

Acoustic hoods



Table 56: Acoustic hoods

Code no.	Description	Application	Packaging	Pack Size
120Z0034	Acoustic hood for scroll compressor	DSH090	Single pack	1
120Z0035	Acoustic hood for scroll compressor	DSH105 to 161 (except DSH161-140 code3)	Single pack	1
120Z0135	Acoustic hood for scroll compressor	DSH184 - DSH140 code3 - DSH161 code3	Single pack	1
120Z0022	Acoustic hood for scroll compressor	DSH240-295-381*-485*(* except code 3)	Single pack	1
120Z0768	Acoustic hood for scroll compressor	DSH240-295-381*-485* max dgt 150°C(* except code 3)	Single pack	1
120Z0579	Acoustic hood for scroll compressor	DSH381 code 3	Single pack	1
120Z0490	Acoustic hood body for scroll compressor	DSH090 R454B/R452B Max. DGT150°C	Single pack	1
120Z0491	Acoustic hood body for scroll compressor	DSH105-161 R454B/R452B Max. DGT150°C	Single pack	1
120Z0492	Acoustic hood body for scroll compressor	DSH184 R454B/R452B Max. DGT150°C	Single pack	1
120Z0493	Acoustic hood top for scroll compressor	DSH090-184 R454B/R452B Max. DGT150°C	Single pack	1

Miscellaneous



Table 57: 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 58: Tandem kits

Code no.	Description	Application	Packaging	Pack Size
120Z0634	Suction washer, rigid spacer, organ pipe, gasket	DSH180E-210E-240E-280E-322E-368E	Single pack	1
120Z0692	Suction washer, rigid spacer, organ pipe, gasket	DSH260U-281U-301U	Single pack	1
120Z0693	Suction washer, rigid spacer, organ pipe, gasket	DSH274U-289U	Single pack	1
120Z0694	Suction washer, rigid spacer, organ pipe, gasket	DSH195U-210U-230U-251U-304U-324U-345U	Single pack	1
120Z0781	Kit tandem crossplatform	DSH360X-424X-456X-479X-565X	Single pack	1
120Z0792	Kit Tandem, Solid, OEL 1" 3/8	DSH482.590.760E	Single pack	1
120Z0796	Kit Tandem, solid, washer 31mm, OEL 1" 3/8	DSH535.675U	Single pack	1
120Z0791	Kit Tandem, solid, washer 29mm, OEL 1" 3/8	DSH620U	Single pack	1
120Z0786	Kit Tandem, Solid, washer 24mm,OEL 1"5/8	DSH725U	Single pack	1
120Z0788	Kit Tandem, Solid, washer 30mm,OEL 1"5/8	DSH865U	Single pack	1
120Z0787	Kit Tandem, Solid, washer 27mm,OEL 1"5/8	DSH780U	Single pack	1

Code no.	Description	Application	Packaging	Pack Size
120Z0785	Kit Tandem, Solid,OEL 1"5/8	DSH970E	Single pack	1
120Z0726	Kit Tandem, spacer 30mm	DSH895U.DSH1085U (left suction).DSH1200E	Single pack	1
120Z0821	Kit Tandem, spacer 30mm, washer 38mm	DSH1085U (right suction)	Single pack	1

Trio kits

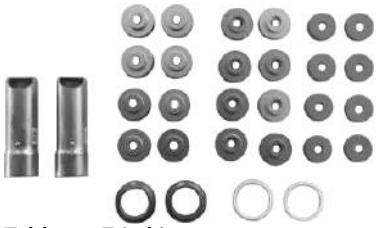


Table 59: Trio kits

Code no.	Description	Application	Packaging	Pack Size
120Z0712	Washers, grommets, sleeve for oil connect	DSH1800T	Single pack	1
120Z0714	Organ pipe, sleeves, rigid spacer, gasket, rubber grommet	DSH420T	Single pack	1
120Z0714	Organ pipe, sleeves, rigid spacer, gasket, rubber grommet	DSH483T	Single pack	1
120Z0714	Organ pipe, sleeves, rigid spacer, gasket, rubber grommet	DSH552T	Single pack	1
120Z0782	Kit Trio,solid,washer 31mm, OEL 1"5/8	DSH1140T (right suction)	Single pack	1
120Z0783	Kit Trio,solid,washer 29/31mm,OEL 1"5/8	DSH1140T (left suction)	Single pack	1
120Z0784	Kit Trio,solid,washer 30mm, OEL 1"5/8	DSH720T.885T (left suction)	Single pack	1
120Z0789	Kit Trio,solid,washer 29mm, OEL 1"5/8	DSH1245T.1350T	Single pack	1
120Z0790	Kit trio,solid,OEL 1"5/8	DSH971T	Single pack	1
120Z0793	Kit Trio,solid,washer 33mm, OEL 1"5/8	DSH1455T (left and right suction)	Single pack	1
120Z0794	Kit Trio,solid,washer 34,5mm, OEL 1"5/8	DSH720T.885T (right suction)	Single pack	1
120Z0819	Kit Trio, spacer 30mm, washer 42mm	DSH1685T (left suction)	Single pack	1
120Z0820	Kit Trio, spacer 30mm, washer 41mm	DSH1685T (right suction)	Single pack	1
120Z0822	Kit Trio, spacer 30mm, washer 36mm	DSH1570T	Single pack	1

ENGINEERING TOMORROW

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