ENGINEERING
TOMORROW

Application guidelines

Danfoss scroll compressors
DSF 090 to 200
Single and manifold

50Hz - 60Hz - R32



www.danfoss.com

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Danfoss scroll 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.

Refrigerant

When choosing a refrigerant, different aspects must be taken into consideration:
- Legislation (now and in the future)
- Safety
- Operating 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

The DSF compressors can be used with refrigerant R32

R32

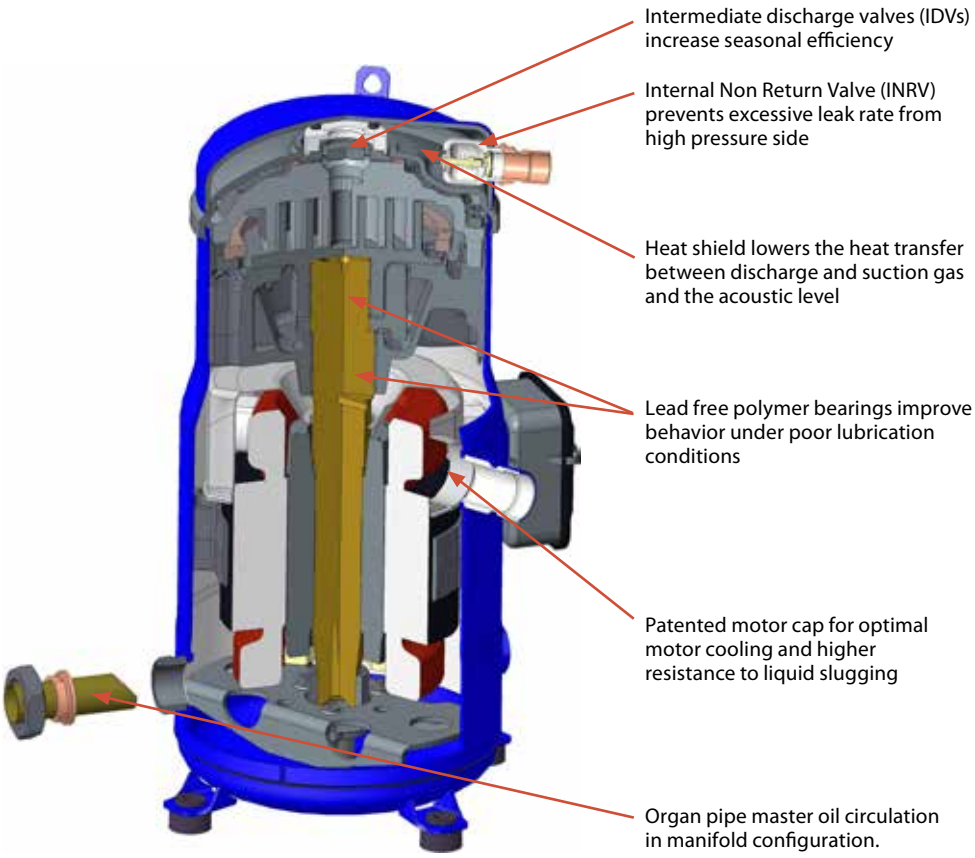
R32 is a pure HFC refrigerant with a zero Ozone Depletion Potential (ODP=0) and a low Global Warming Potential (GWP: 677/AR5; 675/AR4).

R32 leads to higher discharge temperatures than R410A but it offers higher cooling capacities and better efficiencies compared to R410A

R32 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

Overview

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



DSF090-200

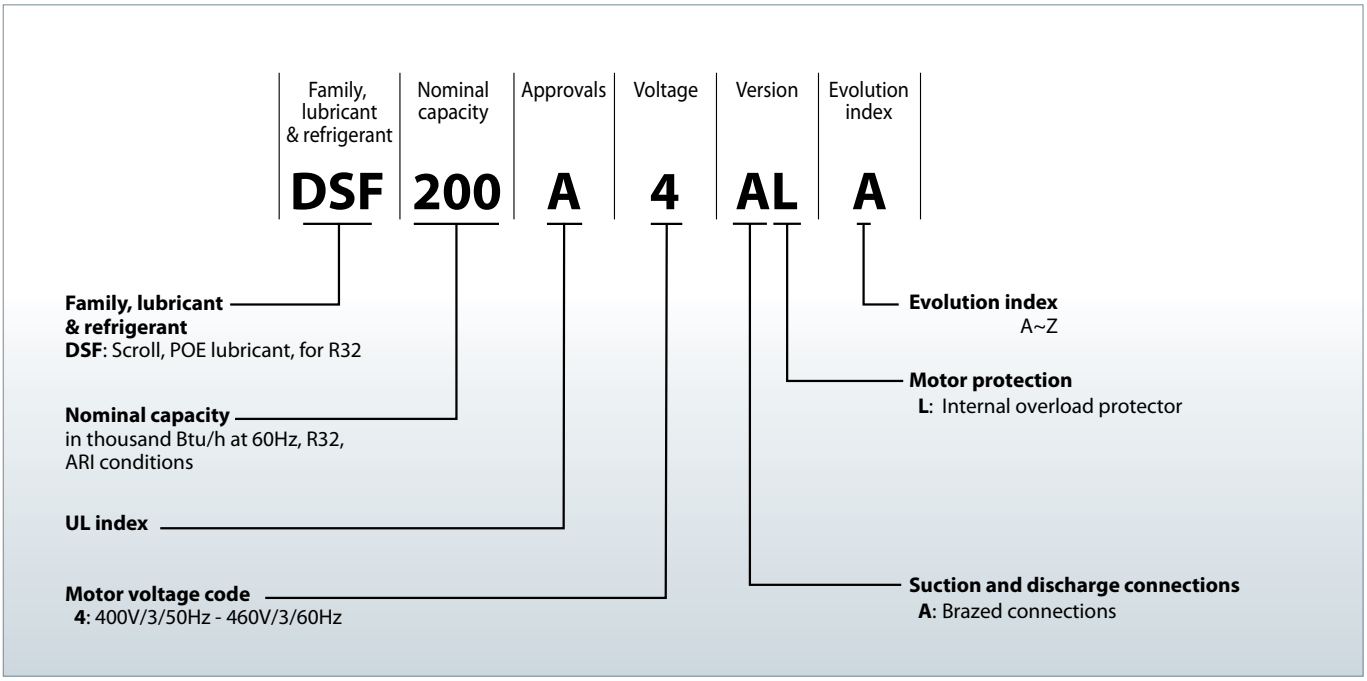
How do IDVs work?

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.



Danfoss scroll compressor DSF for R32 is available as single compressor and can be assembled in tandem or trio combinations. 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 information".

Nomenclature



50-60Hz data
Single compressor

Model		Nominal tons 60Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume		Displacement ①		Oil charge		Net weight ②	
		TR	W	Btu/h	kW	W/W	Btu/h/W	cm^3/rev	cu.in/rev	m^3/h	cu.ft/h	dm^3	oz	kg	lbs
50Hz	DSF090	7.5	19958	68096	6.69	2.99	10.19	81.3	4.96	14.2	500	3.0	102	58	128
	DSF100	8.5	21940	74860	7.13	3.08	10.50	88.4	5.39	15.4	544	3.0	102	58	128
	DSF115	10	26349	89904	8.31	3.17	10.82	103.5	6.32	18	636	3.3	113	64	141
	DSF130	11	29421	100384	9.19	3.20	10.93	116.9	7.13	20.3	717	3.3	113	64	141
	DSF155	13	33772	115232	10.51	3.21	10.97	133	8.12	23.1	816	3.3	113	67	148
	DSF175	15	39172	133655	12.07	3.24	11.07	151.7	9.26	26.4	932	3.3	113	69	152
	DSF200	16.5	43329	147838	13.53	3.20	10.92	170.3	10.39	29.6	1045	3.6	123	71.5	158
60Hz	DSF090	7.5	26938	91911	8.68	3.10	10.59	81.3	4.96	14.2	500	3.0	102	58	128
	DSF100	8.5	29362	100182	9.38	3.13	10.67	88.4	5.39	15.4	544	3.0	102	58	128
	DSF115	10	34923	119157	10.79	3.24	11.04	103.5	6.32	18	636	3.3	113	64	141
	DSF130	11	39465	134653	12.24	3.22	11.00	116.9	7.13	24.6	869	3.3	113	64	141
	DSF155	13	45215	154273	13.82	3.27	11.16	133	8.12	27.9	985	3.3	113	67	148
	DSF175	15	51618	176121	15.70	3.29	11.22	151.7	9.26	31.9	1127	3.3	113	69	152
	DSF200	16.5	57717	196932	17.63	3.27	11.17	170.3	10.39	35.8	1264	3.6	123	71.5	158

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

TR: Ton of Refrigeration,
EER: Energy Efficiency Ratio
COP: Coefficient Of Performance

Standard rating conditions
Refrigerant: R32

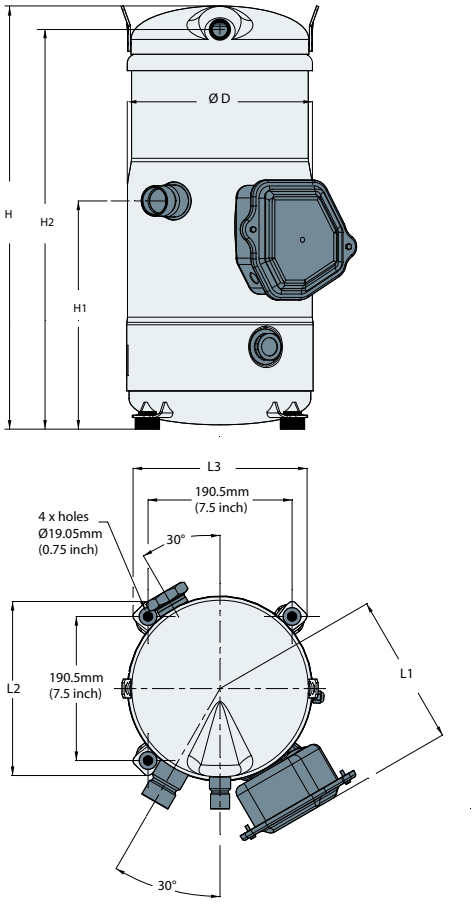
For 50Hz: Evaporating temperature: 5°C (41°F), Condensing temperature: 50°C (122°F), Superheat: 10K (18°F), Subcooling: 0K (0°F)
For 60Hz: Evaporating temperature: 7.2°C (45°F), Condensing temperature: 54.4°C (130°F), Superheat: 11.1K (20°F), Subcooling: 8.3K (15°F)

Subject to modification without prior notification.
Data given for motor code 4 compressor with above condition, for full data details and capacity tables refer to Coolselector®2
www.coolselector.danfoss.com

Tandem and trio performances

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

Single compressors

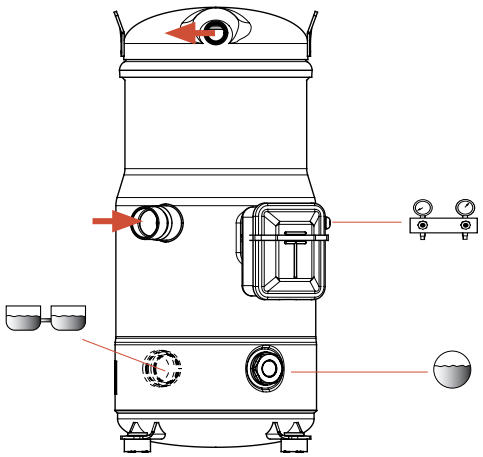


❶

Compressor model	D		H		H1		H2		L1		L2		L3		Outline drawing number	
	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
DSF090-100	243	9.57	485	19.09	235	9.25	451	17.76	180	7.09	230	9.06	230	9.06		8560176
DSF115-175	243	9.57	542	21.34	278	10.94	509	20.04	180	7.09	230	9.06	230	9.06	❶	8560177
DSF200	243	9.57	558	21.97	299	11.77	524	20.63	201	7.91	230	9.06	230	9.06		8560178

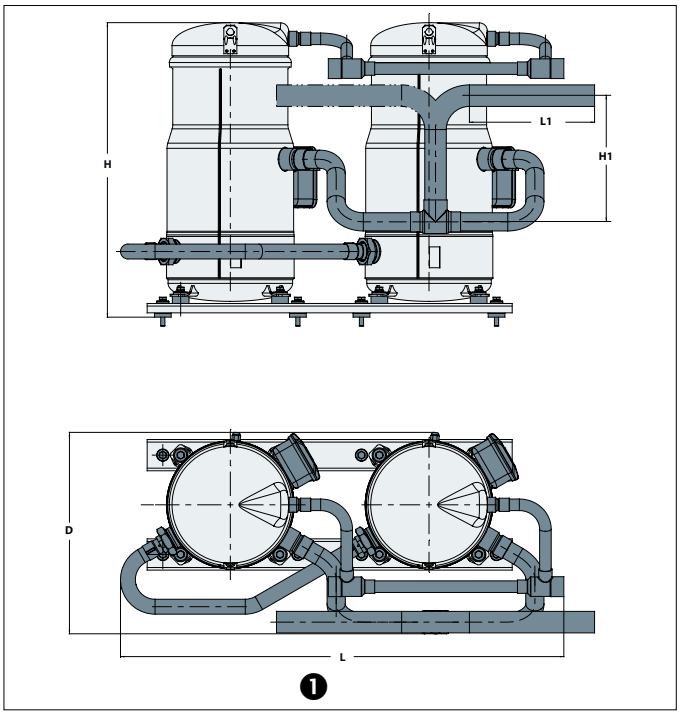
Connection Details

	DSF090-100	DSF115-200
Suction connection	Brazed 1"1/8	Brazed 1"3/8
Discharge connection	Brazed 7/8"	Brazed 7/8"
Oil sight glass	Threaded (1"1/8 – 18 UNEF)	
Oil equalization connection	Rotolock 1"3/4	
Oil drain connection	None	
Low pressure gauge port (Shrader)	Male ¼" Flare incorporating a Schrader valve	
Outline	❶	

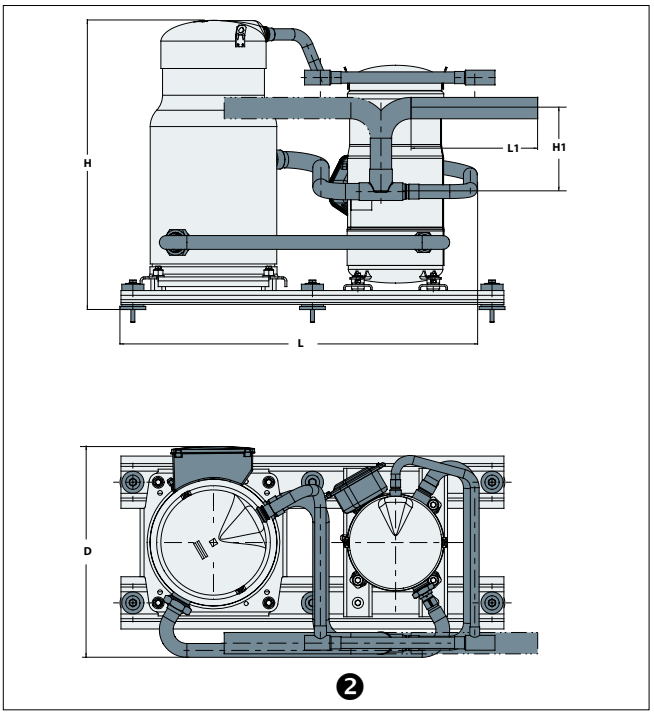


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Tandem assemblies



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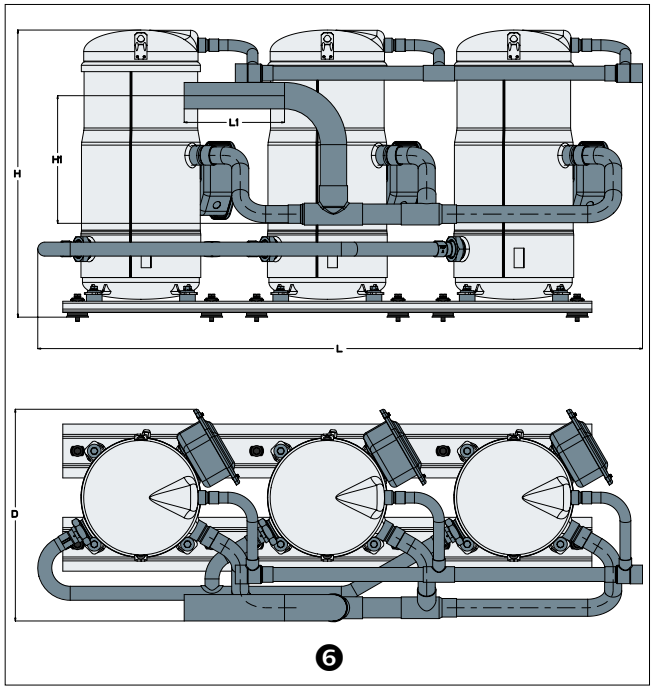
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Tandem model	Composition	L		D		H		L1		H1		Outline drawing number	
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
DSF180E	DSF090+DSF090	850	33.46	384	15.12	507	19.96					❶	8560144
DSF200E	DSF100+DSF100	850	33.46	384	15.12	507	19.96					❶	8560144
DSF230E	DSF115+DSF115	850	33.46	384	15.12	565	22.24					❶	8560145
DSF260E	DSF130+DSF130	850	33.46	384	15.12	565	22.24					❶	8560145
DSF215U	DSF100+DSF115	850	33.46	386	15.20	565	22.24					❶	8560189
DSF230U	DSF100+DSF130	850	33.46	386	15.20	565	22.24					❶	8560189
DSF255U	DSF100+DSF155	850	33.46	386	15.20	565	22.24					❶	8560189
DSF275U	DSF100+DSF175	850	33.46	386	15.20	565	22.24					❶	8560189
DSF285U	DSF130+DSF155	850	33.46	386	15.20	565	22.24					❶	8560168
DSF300U	DSF100+DSF200	850	33.46	428	16.85	580	22.83	240	9.45	242	9.53	❶	8560190
DSF305U	DSF130+DSF175	850	33.46	386	15.20	565	22.24					❶	8560168
DSF310E	DSF155+DSF155	850	33.46	384	15.12	565	22.24					❶	8560145
DSF315U	DSF115+DSF200	850	33.46	428	16.85	580	22.83					❶	8560167
DSF330U	DSF155+DSF175	850	33.46	386	15.20	565	22.24					❶	8560168
DSF331U	DSF130+DSF200	850	33.46	428	16.85	580	22.83					❶	8560167
DSF350E	DSF175+DSF175	850	33.46	384	15.12	565	22.24					❶	8560145
DSF355U	DSF155+DSF200	850	33.46	428	16.85	580	22.83					❶	8560167
DSF375U	DSF175+DSF200	850	33.46	428	16.85	580	22.83					❶	8560167
DSF400E	DSF200+DSF200	850	33.46	428	16.85	580	22.83					❶	8560146
DSF400X	DSF130+DSF270	903	35.55	533	20.98	731	28.78					❷	8560169
DSF470X	DSF200+DSF270	903	35.55	533	20.98	731	28.78	359	14.13	211	8.31	❷	8560170
DSF500X	DSF175+DSF325	903	35.55	533	20.98	731	28.78					❷	8560169
DSF525X	DSF200+DSF325	903	35.55	533	20.98	731	28.78					❷	8560170

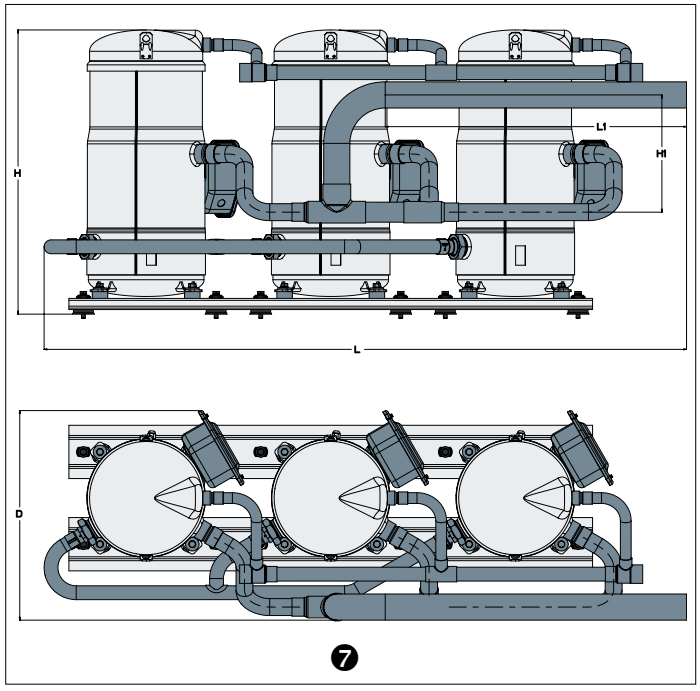
Tandems to be achieved by assembly of individual compressors
By convention, the last letter of tandems designation have been set to help to discern easily which type of manifold we are considering.
U : Uneven tandem
E : Even tandem
X: Crossplatfom (medium-large) tandem

Dimensions

Trio assemblies



6



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Trio model	Composition	L		D		H		L1		H1		Outline drawing number	
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
DSF465T	3 x DSF155	1230	48.4	402	15.8	571	22.5	205	8.1			6	8560172
		1326	52.2	402	15.8	571	22.5	622	24.5			7	8560172
DSF525T	3 x DSF175	1230	48.4	402	15.8	571	22.5	205	8.1	242	9.5	6	8560172
		1326	52.2	402	15.8	571	22.5	622	24.5			7	8560172
DSF 600T	3 x DSF200	1236	48.7	433	17.0	587	23.1	205	8.1			6	8560171
		1326	52.2	433	17.0	587	23.1	622	24.5			7	8560171

Trio to be acheived by assembly of individual compressors

Motor voltage

Danfoss scroll compressors DSF are available in only one motor voltage as listed below.

Motor voltage code		Code 4
50Hz	Nominal voltage	400V-3ph
	Voltage range*	360-440V
60Hz	Nominal voltage	460V-3ph
	Voltage range*	414-506V

* 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.

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:

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

Vavg = Mean voltage of phases 1, 2, 3.

V1-2 = Voltage between phases 1 and 2.

V1-3 = Voltage between phases 1 and 3.

V2-3 = Voltage between phases 2 and 3.

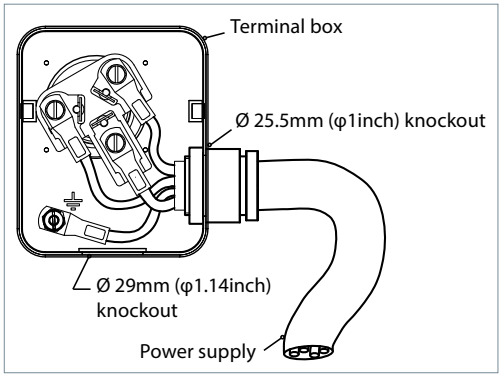
Wiring connections

Electrical power is connected to the compressor terminals by Ø 4.8mm (3/16") screws. The maximum tightening torque is 3Nm. Use a 1/4" ring terminal on the power leads.

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

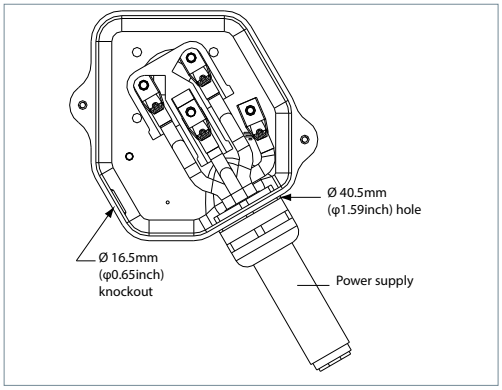
DSF090-175

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



DSF200

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).



IP rating

The compressor terminal box according to IEC529 is IP54 for all models when correctly sized IP54 rated cable glands are used.
First numeral, level of protection against contact and foreign 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. 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

Compressor model		LRA	MCC	Max. operating current	Winding resistance
		A	A	A	Ω
Motor voltage code 4 400V/3ph/50Hz 460V/3ph/60Hz	DSF090	98	24	17	1.47
	DSF100	98	25	19	1.47
	DSF115	142	28	22	1.05
	DSF130	142	32	24	1.05
	DSF155	147	36	27	0.92
	DSF175	158	37	30	0.83
	DSF200	197	40	34	0.83

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.

MCC (Maximum Continuous Current)

The MCC is the current at which the motor protection trips under maximum load and low voltage conditions. This MCC value is the maximum at which the compressor can be operated in transient conditions and out of the application envelope. Above this value, the internal motor protection or external electronic module will cut-out the compressor to protect the motor.

MOC (Maximum Operating Current)

The MOC is the maximum amperage that the compressor will draw staying in its application envelope. MOC can be used to select cables and contactors. In normal operation, the compressor current consumption is always less or equal to the MOC value. Considering the compressors variability, a tolerance of 5% is accepted versus defined MOC value.

Winding resistance

Winding resistance is the resistance between phases at 25°C (77°F) (resistance value +/- 7%). Winding resistance is generally low and it requires adapted tools for precise measurement. Use a digital ohm-meter, a "4 wires" method and measure under stabilised ambient temperature. Winding resistance varies strongly with winding temperature. If the compressor is stabilised at a different value than 25°C (77°F), the measured resistance must be corrected 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
Coefficient a = 234.5

Motor protection

DSF090 to 200

Compressor models DSF090 to 200 are provided with internal overload motor protection to prevent against excessive current and temperature caused by overloading, low refrigerant flow or phase loss. The cutout current is the MCC value listed in table "Three phase electrical characteristics".

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 below MCC value (at max operating current):

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

Phase sequence and reverse rotation protection

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

DSF090 to DSF200

Compressor models DSF090 to 200 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.

Approval and certificates

DSF scroll compressors comply with the following approvals and certificates.

Certificates are listed on:
www.commercialcompressors.danfoss.com/documentation/certificates/

CE 0062 or CE 0038 or CE0871 (European Directive)	CE	All DSF models
UL (Underwriters Laboratories)	c UL us	All DSF models
Other approvals / certificates		Contact Danfoss

Low voltage directive 2014/35/EU

Products	DSF models
Declaration of conformity	Contact Danfoss

Machines directive 2006/42/EC

Products	DSF models
Manufacturer's declaration of incorporation	Contact Danfoss

Pressure equipment directive 2014/68/EU

Products	DSF models
Refrigerant fluids	Group 1
Category PED	III
Evaluation module	H
Maximum / Minimum temperature - Ts	-35°C < Ts < 53°C -31°F < Ts < 127°F
Maximum allowable pressure (Low side) - Ps	32.7bar(g) / 474psig
Maximum allowable pressure (High side) - Ps	48.7 bar(g) / 706 psig
Declaration of conformity	Contact Danfoss

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
DSF090-100	11.7	714	0.7	43	12.4	757
DSF115-175	13.6	830	0.7	43	14.3	873
DSF200	13.9	848	0.7	43	14.6	891

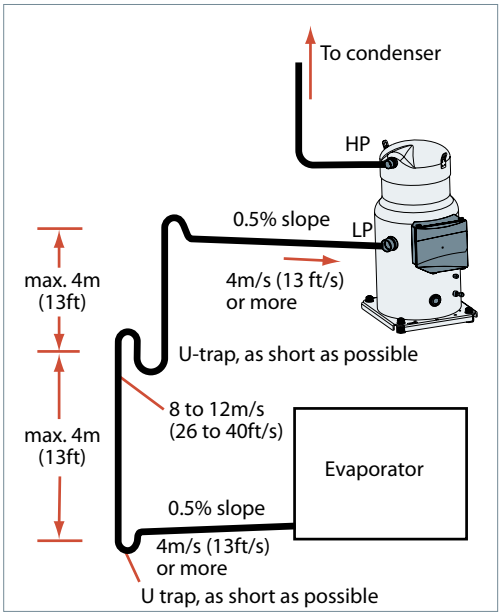
General requirements

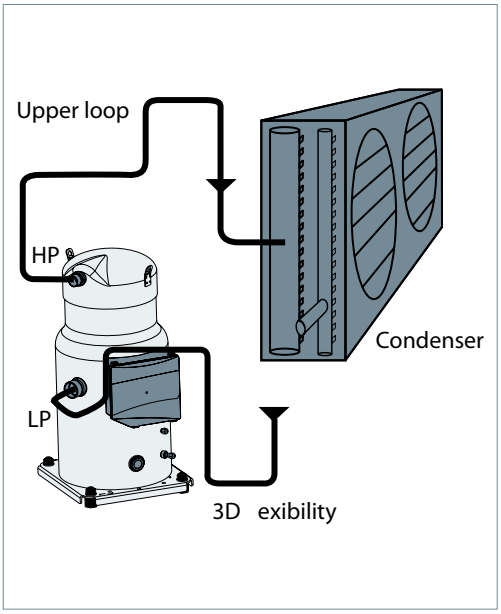
Proper piping practices should be employed to:

1. Ensure adequate oil return, even under minimum load conditions (refrigerant speed, piping slopes…). For validation tests see section "Manage oil in the circuit".

2. Avoid condensed liquid refrigerant from draining back to the compressor when stopped (discharge piping upper loop). For validation tests see section "Manage off cycle migration".

General recommendations are described in the figures below:





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 on: "Sound and vibration management".

Tandem and trio requirements

DSF tandem and trio use static oil balancing principle to equalize oil level between the compressors by pressure. 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, DSF 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.

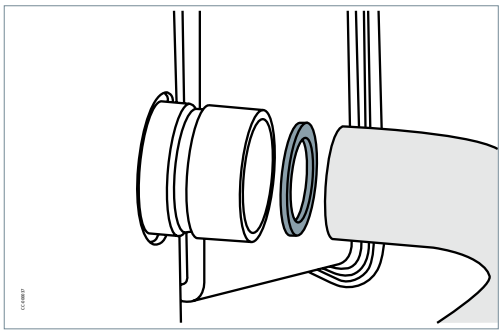
R Suction and oil equalization piping drawings must be respected (diameters, minimum straight lengths, …)

Tandem model	Composition	Suction	Discharge	Oil equalization	Kit tandem code no	Outline drawing number
DSF180E	DSF090+DSF090	1"5/8	1"3/8	1"1/8	120Z0634	8560144
DSF200E	DSF100+DSF100	1"5/8	1"3/8	1"1/8	120Z0634	8560144
DSF215U	DSF100+DSF115	1"5/8	1"3/8	1"1/8	120Z0694	8560189
DSF230E	DSF115+DSF115	1"5/8	1"3/8	1"1/8	120Z0634	8560145
DSF230U	DSF100+DSF130	1"5/8	1"3/8	1"1/8	120Z0694	8560189
DSF255U	DSF100+DSF155	1"5/8	1"3/8	1"1/8	120Z0694	8560189
DSF260E	DSF130+DSF130	1"5/8	1"3/8	1"1/8	120Z0634	8560145
DSF275U	DSF100+DSF175	1"5/8	1"3/8	1"1/8	120Z0694	8560189
DSF285U	DSF130+DSF155	1"5/8	1"3/8	1"1/8	120Z0692	8560168
DSF300U	DSF100+DSF200	1"5/8	1"3/8	1"1/8	120Z0693	8560190
DSF305U	DSF130+DSF175	1"5/8	1"3/8	1"1/8	120Z0692	8560168
DSF310E	DSF155+DSF155	1"5/8	1"3/8	1"1/8	120Z0634	8560145
DSF315U	DSF115+DSF200	1"5/8	1"3/8	1"1/8	120Z0693	8560167
DSF330U	DSF155+DSF175	1"5/8	1"3/8	1"1/8	120Z0692	8560168
DSF331U	DSF130+DSF200	1"5/8	1"3/8	1"1/8	120Z0694	8560167
DSF350E	DSF175+DSF175	1"5/8	1"3/8	1"1/8	120Z0634	8560145
DSF355U	DSF155+DSF200	1"5/8	1"3/8	1"1/8	120Z0694	8560167
DSF375U	DSF175+DSF200	1"5/8	1"3/8	1"1/8	120Z0694	8560167
DSF400E	DSF200+DSF200	1"5/8	1"3/8	1"1/8	120Z0634	8560146
DSF400X	DSF130+DSF270	2"1/8	1"3/8	1"3/8	120Z0709	8560169
DSF470X	DSF200+DSF270	2"1/8	1"3/8	1"3/8	120Z0709	8560170
DSF500X	DSF175+DSF325	2"1/8	1"3/8	1"3/8	120Z0709	8560169
DSF525X	DSF200+DSF325	2"1/8	1"3/8	1"3/8	120Z0709	8560170

Trio model	Composition	Suction	Discharge	Oil equalization	Suction from	Kit tandem code no	Outline drawing number
DSF465T	3xDSF155	2"1/8	1"3/8	1"1/8	Left Right	120Z0714	8560172
DSF525T	3xDSF175	2"1/8	1"3/8	1"1/8	Left Right	120Z0714	8560172
DSF600T	3xDSF200	2"1/8	1"3/8	1"1/8	Left Right	120Z0714	8560171

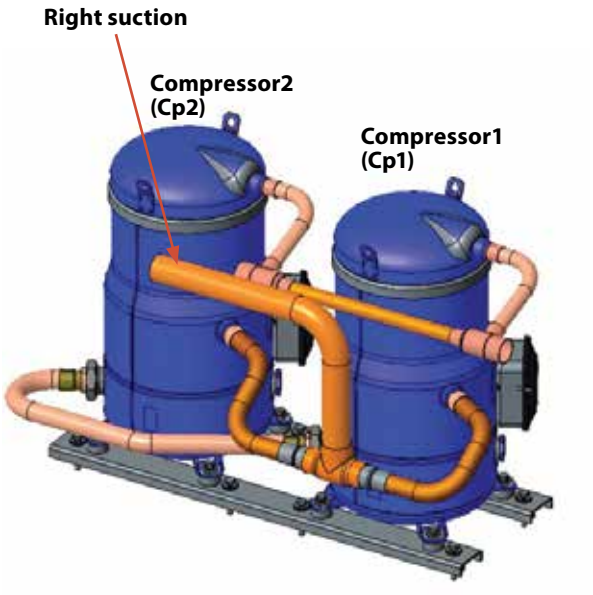
Suction washer position

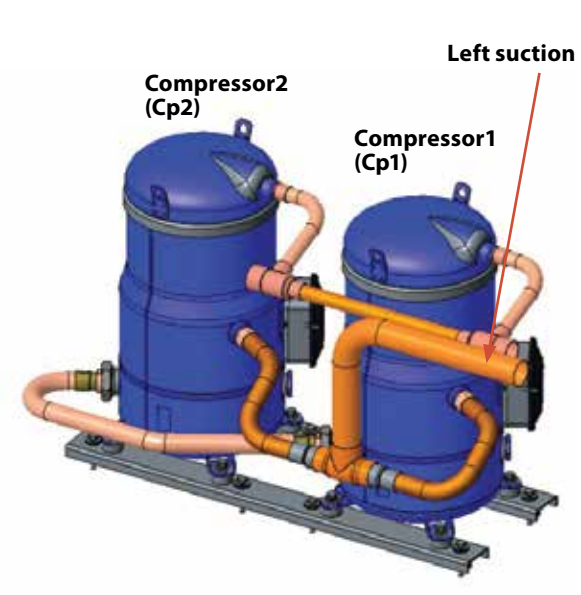
R Depending on manifold configuration, it is essential to equalize the pressure of compressor sumps. Hence, a suction washer must be added on certain compressors according to the table. Suction washers are included in tandem or trio accessory kits as described in the illustrations.



Included in tandem or trio accessory kit

On tandem models





Cp1	Cp2	Tandem model	Suction from	Kit code no to order	Washer reference	Washer inner diameter	Washer in suction of
DSF090	DSF090	DSF180E	Left Right	120z0634	Not needed		
DSF100	DSF100	DSF200E	Left Right	120z0634			
DSF115	DSF115	DSF230E	Left Right	120z0634			
DSF130	DSF130	DSF260E	Left Right	120z0634			
DSF100	DSF115	DSF215U	Left Right	120Z0694	5312497P01 5312497P05	25mm (0.98inch) 26mm (1.02inch)	Cp2 Cp2
DSF100	DSF130	DSF230U	Left Right	120Z0694	5312497P04 5312497P04	27mm (1.06inch) 27mm (1.06inch)	Cp2 Cp2
DSF100	DSF155	DSF255U	Left Right	120Z0694	5312639P05 5312639P05	23mm (0.91inch) 23mm (0.91inch)	Cp1 Cp1
DSF100	DSF175	DSF275U	Left Right	120Z0694	5312639P07 5312639P07	21mm (0.83inch) 21mm (0.83inch)	Cp1 Cp1
DSF130	DSF155	DSF285U	Left Right	120Z0692	5312497P04 5312497P04	27mm (1.06inch) 27mm (1.06inch)	Cp1 Cp1
DSF100	DSF200	DSF300U	Left Right	120Z0693	5312639P01 5312639P01	20mm (0.79inch) 20mm (0.79inch)	Cp1 Cp1

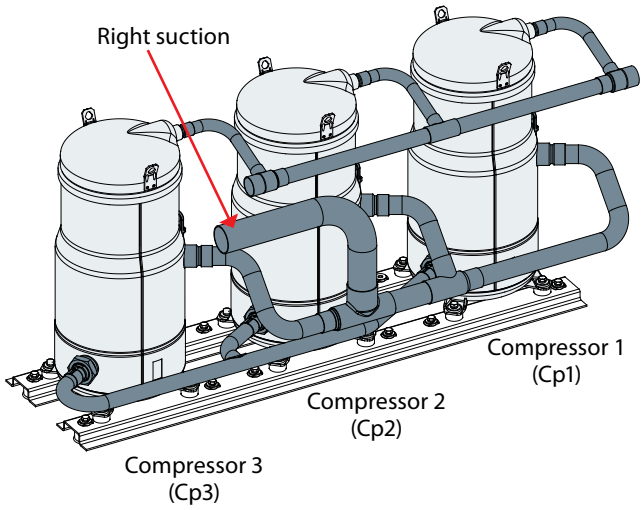
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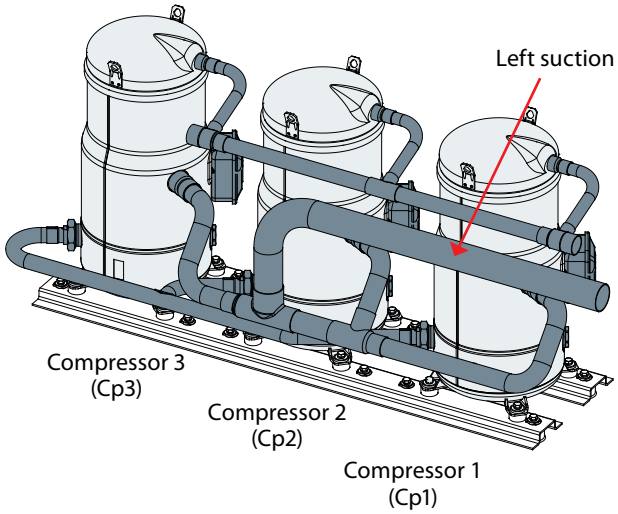
Design piping

Cp1	Cp2	Tandem model	Suction from	Kit code no to order	Washer reference	Washer inner diameter	Washer in suction of
DSF130	DSF175	DSF305U	Left	120Z0692	5312497P01	25mm (0.98inch)	Cp1
			Right		5312497P01	25mm (0.98inch)	Cp1
DSF155	DSF155	DSF310E	Left	120Z0634	Not needed		
			Right				
DSF115	DSF200	DSF315U	Left	120Z0693	5312497P03	23mm (0.91inch)	Cp1
			Right		5312497P03	23mm (0.91inch)	Cp1
DSF155	DSF175	DSF330U	Left	120Z0692	5312497P08	27.5mm (1.08inch)	Cp1
			Right		5312497P05	26mm (1.02inch)	Cp1
DSF130	DSF200	DSF331U	Left	120Z0694	5312497P06	24mm (0.94inch)	Cp1
			Right		5312497P06	24mm (0.94inch)	Cp1
DSF175	DSF175	DSF350E	Left	120Z0634	Not needed		
			Right				
DSF155	DSF200	DSF355U	Left	120Z0694	5312497P01	25mm (0.98inch)	Cp1
			Right		5312497P01	25mm (0.98inch)	Cp1
DSF175	DSF200	DSF375U	Left	120Z0694	5312639P08	27.5mm (1.08inch)	Cp1
			Right		5312639P08	27.5mm (1.08inch)	Cp1
DSF200	DSF200	DSF400E	Left	120Z0634	Not needed		
			Right				
DSF130	DSF270	DSF400X	Left	120Z0709	5312497P06	24mm (0.94inch)	Cp1
			Right		5312497P01	25mm (0.98inch)	Cp1
DSF200	DSF270	DSF470X	Left	120Z0709	5311579P10	35.5mm (1.4inch)	CP2
			Right		5311579P10	35.5mm (1.4inch)	CP2
DSF175	DSF325	DSF500X	Left	120Z0709	5312497P01	25mm (0.98inch)	Cp1
			Right		5312497P05	26mm (1.02inch)	Cp1
DSF200	DSF325	DSF525X	Left	120Z0709	5312497P05	26mm (1.02inch)	Cp1
			Right		5312497P05	26mm (1.02inch)	Cp1

Note: Tandem to be achieved by assembly of individual compressors

On trio models





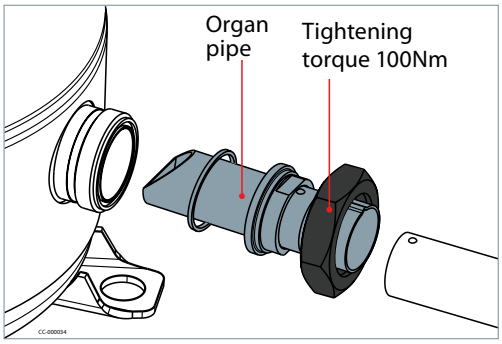
Cp1	Cp2	Cp3	Trio model	Suction from	Kit code no to order	Washer reference	Washer inner diameter	Washer in suction of
DSF155	DSF155	DSF155	DSF465T	Left	120Z0714	5312497P05	26 mm (1.02 inch)	CP1
						5312497P01	25 mm (0.98 inch)	CP3
				Right		5312639P05	26 mm (1.02 inch)	CP1
						5312639P06	24 mm (0.94 inch)	CP3
DSF175	DSF175	DSF175	DSF525T	Left	120Z0714	5312497P05	26 mm (1.02 inch)	CP1
						5312497P01	25 mm (0.98 inch)	CP3
				Right		5312497P05	26 mm (1.02 inch)	CP1
						5312497P01	25 mm (0.98 inch)	CP3
DSF200	DSF200	DSF200	DSF600T	Left	120Z0714	5312497P05	26 mm (1.02 inch)	CP1
						5312497P01	25 mm (0.98 inch)	CP3
				Right		5312639P09	25.5 mm (1.00 inch)	CP1
						5312497P01	25 mm (0.98 inch)	CP3

Oil equalization design

Even/Uneven/Trio

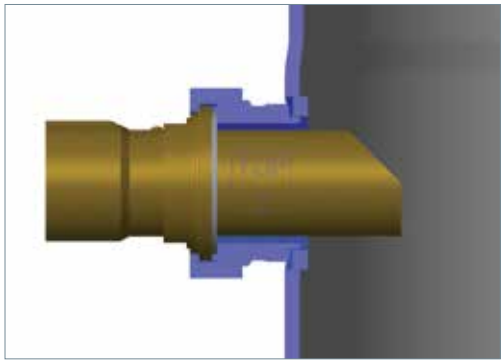
The oil level is balanced by a pipe of 1"1/8 oil equalization line.

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.



Supplied with the compressor
Included in tandem kit

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

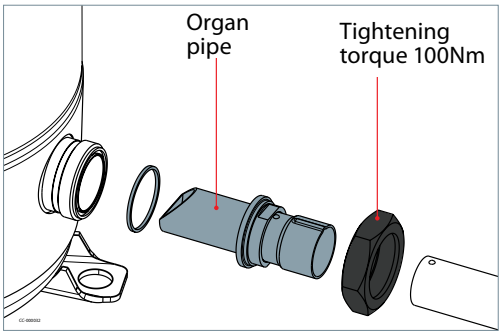


DSF400X-470X-500X-525X

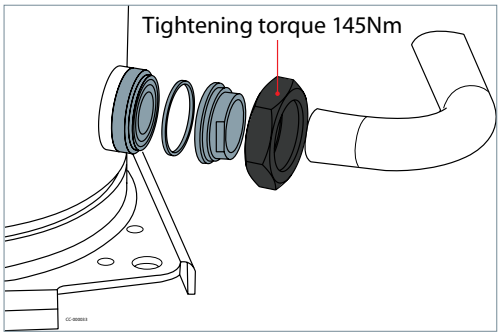
The oil level is balanced by a pipe of 1"3/8 oil equalization line.

In order to ensure best oil balance, the organ pipe need to be mounted inside the DSF130, DSF175, DSF200 oil equalization port as indicated on below picture. DSF270, DSF325 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.



For DSF130, DSF175, DSF200



For DSF270, DSF325

Supplied with the compressor
Included in tandem kit

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.

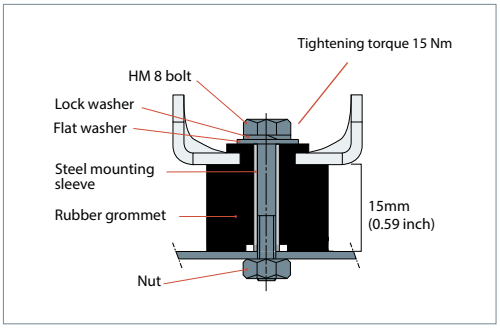
During operation, the maximum inclination from the vertical plane must not exceed 3 degrees.

Single requirements

DSF090-200 mounting

Compressors DSF090-200 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 DSF090-200 compressors is HM8-40. This bolt must be tightened to a torque of 15Nm.



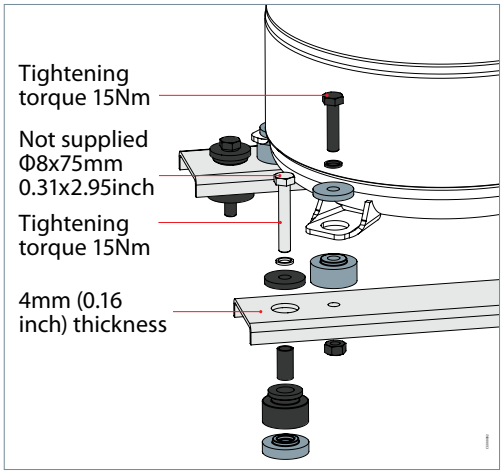
Manifolding requirements

DSF 180E-400E 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.



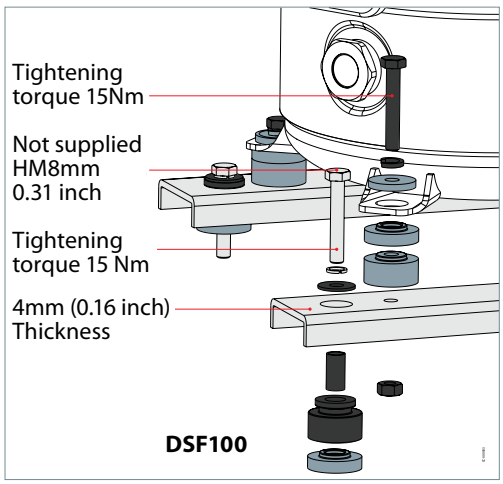
Supplied with the compressor
Included in manifolding kit
Not supplied

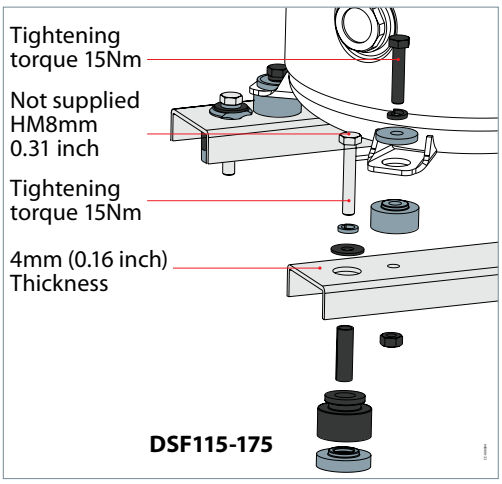
DSF 215U-230U-255U-275U mounting

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.

Because for oil balance port height, DSF100 is 7mm lower than DSF115-175, in order to ensure that the oil equalization connection is at the same level for both compressors, an additional 7mm rigid spacer must be added under DSF100 (see drawing. The 7 mm rigid spacer is supplied with the tandem accessory kit).





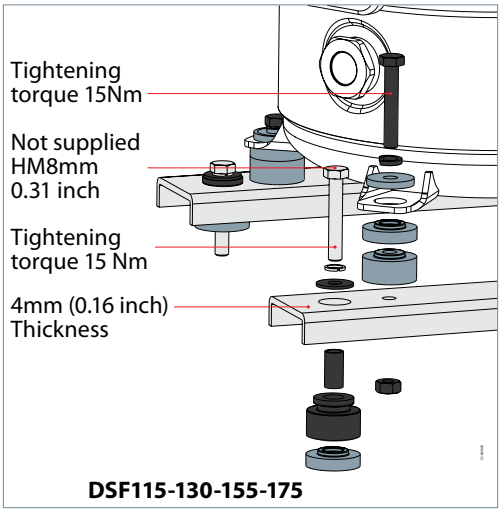
Supplied with the compressor
Included in manifolding kit
Not supplied

DSF 315U-331U-355U-375U mounting

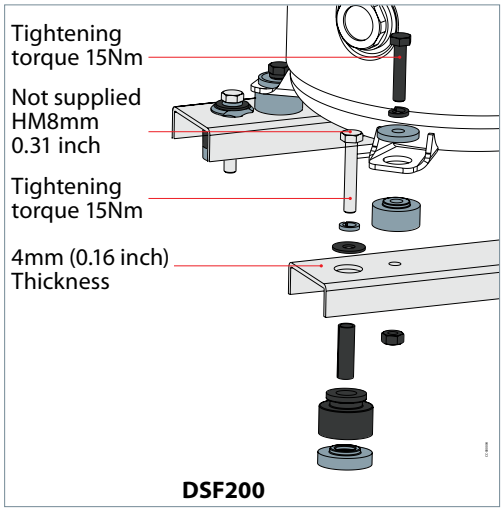
The compressors must be mounted with rigid mounting spacers on rails. Rubber grommets and spacers must be installed below the rails.

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

Because for oil balance port height, DSF115/130/155/175 is 7mm lower than DSF200, in order to ensure that the oil equalization connection is at the same level for both compressors, an additional 7mm rigid spacer must be added under DSF115/130/155/175 (see drawing. The 7 mm rigid spacer is supplied with the tandem accessory kit).



DSF115-130-155-175



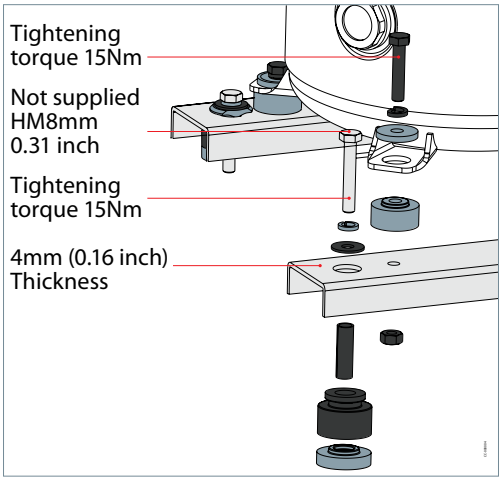
DSF200

Supplied with the compressor
Included in manifolding kit
Not supplied

DSF285U/305U/330U 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.

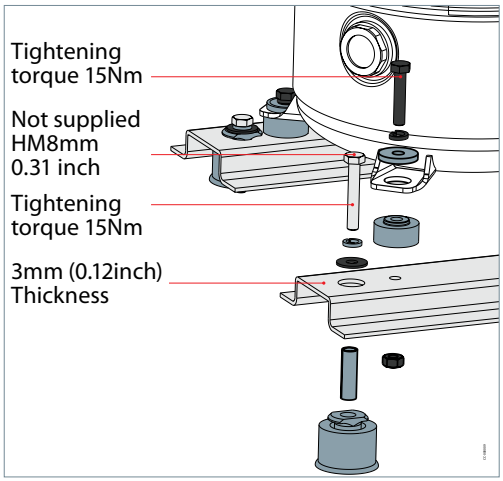


Supplied with the compressor
Included in manifolding kit
Not supplied

DSF465T-525T-600T

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.



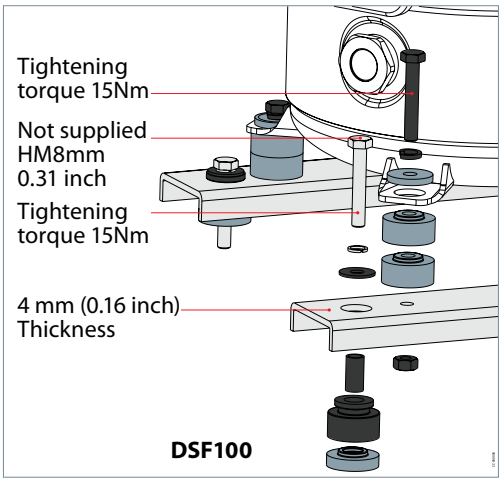
Supplied with the compressor
Included in manifolding kit
Not supplied

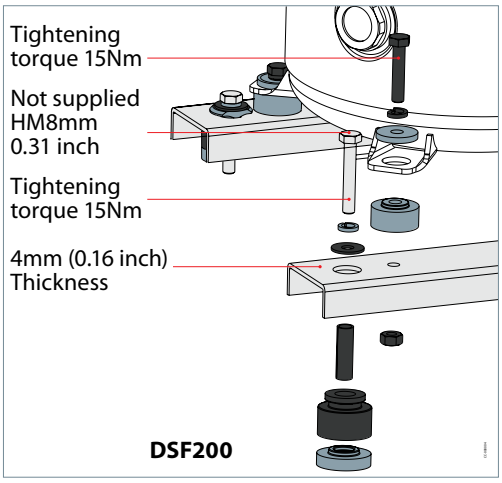
DSF 300U mounting

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.

Because for oil balance port height, DSF100 is 14mm lower than DSF200, in order to ensure that the oil equalization connection is at the same level for both compressors, an additional 14 mm rigid spacer must be added under DSF100 (see drawing. The 14 mm rigid spacer is supplied with the tandem accessory kit).

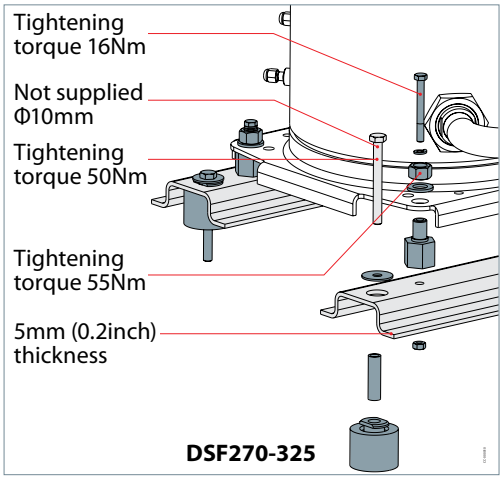


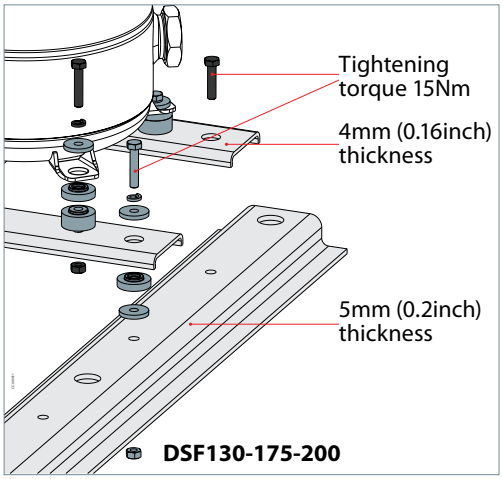


Supplied with the compressor
Included in manifolding kit
Not supplied

DSF400X-470X-500X-525X mounting

The large compressor, DSF270,325, is mounted with rigid spacers on the rails. The DSF130, 175,200 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.





Supplied with the compressor
Included in tandem kit
Not supplied

Requirement

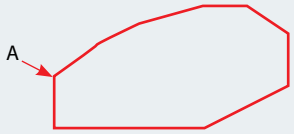
R Oil level must be visible or full in the sight glass when the compressor is running and when all compressors of the circuit are stopped.

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

System evaluation

	Single compressor	Manifold compressors
Non split	Test N°1	Test N°1+2
Split	Test N°1+3	Test N°1+2+3

Test, criteria and solutions

Test N°	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.

Typical sounds and vibrations in systems can be broken down into the following three categories:
- Sound radiation (through air)
- Mechanical vibrations (through parts and structure)
- Gas pulsation (through refrigerant)

The following sections focus on the causes and methods of mitigation for each of the above sources.

Compressor sound radiation

For sound radiating from the compressors, the emission path is air and the sound waves are travelling directly from the machine in all directions.

Sound levels are as follows:
- For compressors running alone:

Compressor model	50 Hz	60 Hz
	Sound power dB(A)	Sound power dB(A)
DSF090	74	77
DSF100	76	79
DSF115-175	78	81
DSF200	80	83

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:

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

Example for the trio DSF465T = 3 x DSF155 (50 Hz)

$L_{DSF155} = 78dB(A)$

$L_{DSF465T} = 78 + 10\ Log_{10}\ 3 = 82.8dB(A)$

- the global sound level of "n" different compressors with respectively Li sound level is:

$$L_{GLOBAL} = \sum_{i=1}^{i=n} 10\ Log_{10}(\Sigma\ 10^{0.1*Li})$$

Example for the tandem

DSF285U = DSF130+DSF155 (50 Hz)

$L_{DSF130} = 78dB(A)$, $L_{DSF155} = 78dB(A)$

$L_{DSF285U} = 10\ Log_{10}(10^{0.1x78}+10^{0.1x78}) = 81dB(A)$

	Model	Composition	Sound power dB(A)	
			50Hz	60Hz
Tandem	DSF180E	DSF090+DSF090	77	80
	DSF200E	DSF100+DSF100	79	82
	DSF230E	DSF115+DSF115	81	84
	DSF260E	DSF130+DSF130	81	84
	DSF215U	DSF100+DSF115	80	83
	DSF230U	DSF100+DSF130	80	83
	DSF255U	DSF100+DSF155	80	83
	DSF275U	DSF100+DSF175	80	83
	DSF285U	DSF130+DSF155	81	84
	DSF300U	DSF100+DSF200	81.4	84.4
	DSF305U	DSF130+DSF175	81	84
	DSF310E	DSF155+DSF155	81	84
	DSF315U	DSF115+DSF200	82	85
	DSF331U	DSF130+DSF200	82.1	85.1
	DSF350E	DSF175+DSF175	81	84
	DSF400E	DSF200+DSF200	83	86
	DSF330U	DSF155+DSF175	81	84
	DSF355U	DSF155+DSF200	82.1	85.1
	DSF375U	DSF175+DSF200	82.1	85.1
	DSF400X	DSF130+DSF270	84.2	87.2
	DSF500X	DSH175+DSH325	84.2	87.2
	DSF470X	DSH200+DSH270	84.8	87.8
	DSF525X	DSH200+DSH325	84.8	87.8
Trio	DSF465T	DSF155 trio	82.8	85.8
	DSF525T	DSF175 trio	82.8	85.8
	DSF600T	DSF200 trio	84.8	87.8

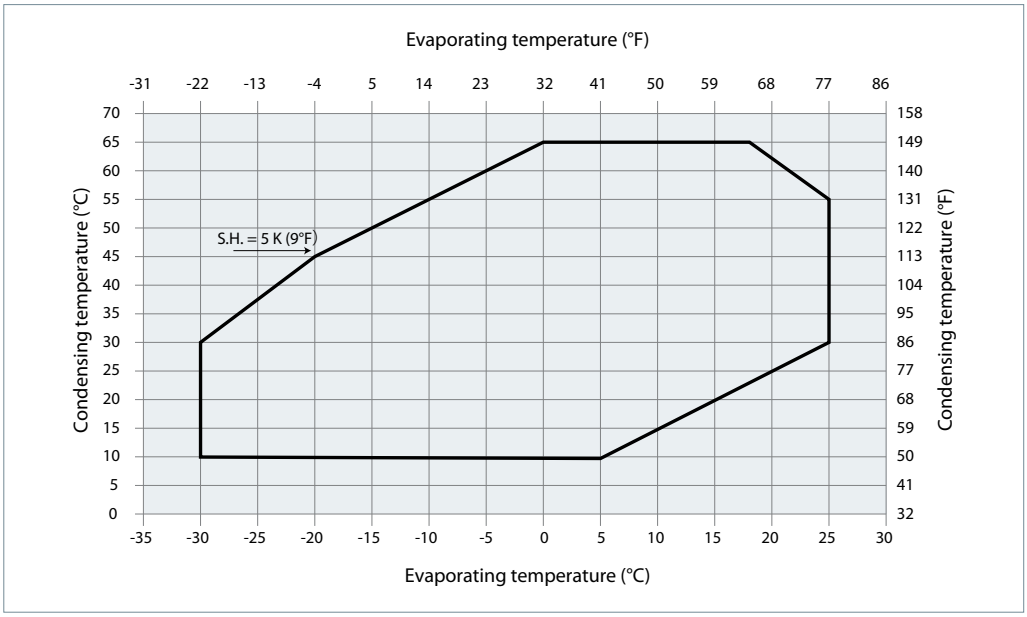
	Mitigations methods: Use of sound-insulation materials on the inside of unit panels is also an effective mean to reduce sound radiation.	Note: During compressor shut down, a short reverse rotation sound is generated. The duration of this sound depends on the pressure difference at shut down and should be less than 3 seconds. This phenomenon has no impact on compressor reliability.
Mechanical vibrations	A compressor generates some vibrations that propagate into the surrounding parts and structure. The vibration level of a DSF compressor alone does not exceed 120µm peak to peak. However, when system structure natural frequencies are close to running frequency, vibrations are amplified due to resonance phenomenon. A high vibration level is damageable for piping reliability and generates high sound levels. **Mitigations methods:** 1. To ensure minimum vibrations transmission to the structure, strictly follow Danfoss mounting	requirements (mounting feet, rails etc..). For further information on mounting requirements, please refer to section "Design compressor mounting". 2. Ensure that there is no direct contact (without insulation) between vibrating components and structure. 3. To avoid resonance phenomenon, pipings and frame must have natural frequencies as far as possible from running frequencies(50 or 60Hz). Solutions to change natural frequencies are to work on structure stiffness and mass (brackets, metal sheet thickness or shape…)
Gas pulsation	DSF 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.

Requirement

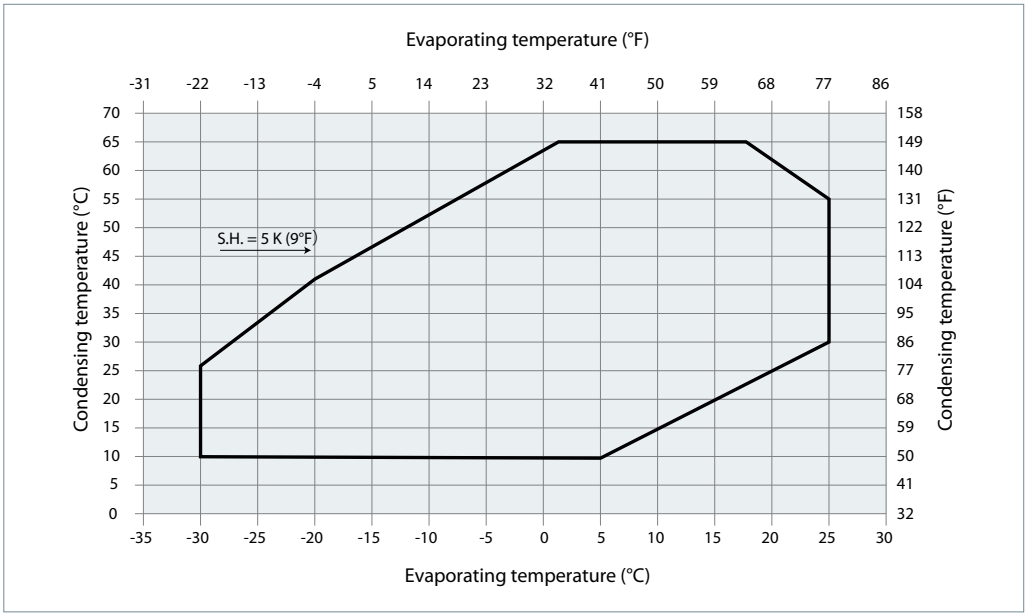
R The operating envelopes for DSF scroll compressors are given in the figures below and guarantees reliable operations of the compressor for steady-state operation.

Steady-state operating envelope is valid for a suction superheat with 5K at nominal Voltage. Maximum discharge gas temperature is 150°C

Operating envelope DSF155 to DSF200



Operating envelope DSF090- 130



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

Pressure settings		R32
Working range high side	bar(g)	10.0-43.1
	psig	145-625
Working range low side	bar(g)	1.7-15.9
	psig	25.2-230
Maximum high pressure safety switch setting	bar(g)	45
	psig	653
Minimum low pressure safety switch setting	bar(g)	1.5
	psig	31.2
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

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

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

HP safety switch must be reset manually.

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

Discharge temperature protection

DSF090 to DSF200

For DSF090 - 200 compressors, the external discharge gas (DGT) protection is required, since the high and low pressure protection settings do not protect the compressor against operation with high discharge temperature.

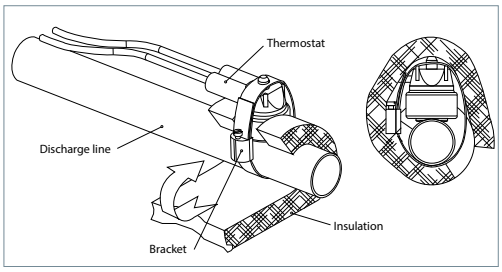
The DGT protection must trip the power supply when DGT reaches the setting point, to protect the compressor from overheating.

This protection device can be a thermostat or a temperature sensor (PT1000 is recommended).

DGT protection device must be installed following the requirements below:

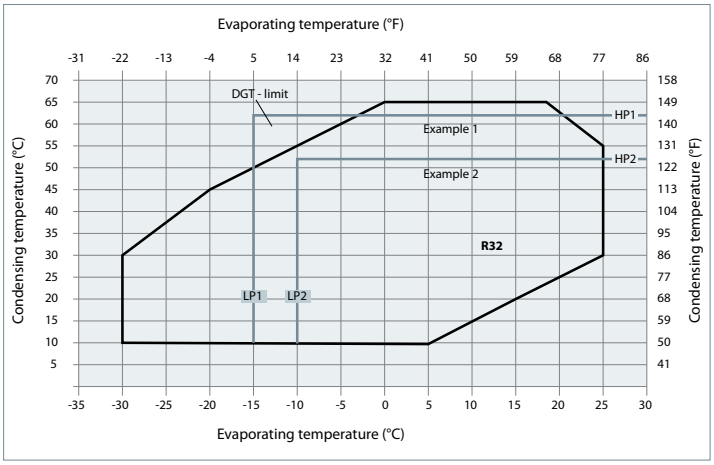
The DGT protection must be attached to the discharge line within 150mm (5.91inch) fromthe compressor discharge port and must be thermally insulated and tightly fixed on the pipe.

The maximum discharge gas temperature is 150°C



Example 1 (R32, SH = 5K)
LP switch setting:
LP1 = 3.9 bar (g) (-15°C)
HP switch setting:
HP1 = 40.2 bar (g) (62°C)
Risk of operation beyond the operating envelope.
DGT protection required.

Example 2 (R32, SH = 5K)
LP switch setting:
LP2 = 4.8 bar (g) (-10°C)
HP switch setting:
HP2 = 32 bar (g) (52°C)
No risk of operation beyond the operating envelope.
No DGT protection required.

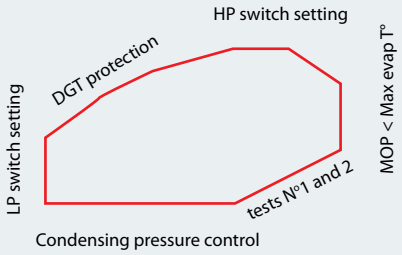


System evaluation

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

Basic:	Advanced:
• HP and LP switch • MOP (Max Operating Pressure) ensured by expansion device • Condensing pressure control • DGT protection external*	• HP and LP sensor • Operating envelope limits integrated into control logic • DGT protection external*

See “Test, criteria and solutions”



Test, criteria and solutions

Test N°	Purpose	Test condition	Pass criteria	Solutions
1	Ensure compressor operate within envelope	Start test at minimum foreseeable evaporating temperature (minimum ambient temerature...)	Continuous running within envelope	Work on compressor staging, fan staging, water flow etc.
2		Perform a defrost test if reversible unit		

	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 10K (9 to 18°F).	
System evaluation	Use the table in relation with the application to quickly evaluate the potential tests to perform.	

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

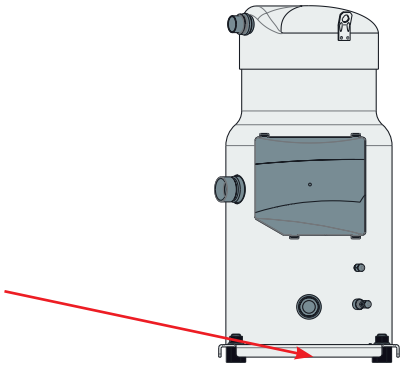
Test, criteria and solutions

Test N°	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)	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*.
	Transient	Tests must be carried out with most unfavorable conditions : • fan staging, • compressor staging • …	Oil superheat shall not be more than 30 sec below the safe limit defined in the Dilution Chart. (see graph below)	
Defrost test	Check liquid floodback during defrost cycle	Defrost test must be carried out in the most unfavorable conditions (at 0°C (32°F) evaporating temperature).	Oil superheat shall not be more than 30 sec below the safe limit defined in the Dilution Chart. (see graph below)	1. Check defrost logic. In reversible systems, the defrost logic can be worked out to limit liquid floodback effect. (for more details see “Control Logic”). 2. Add a suction accumulator*.

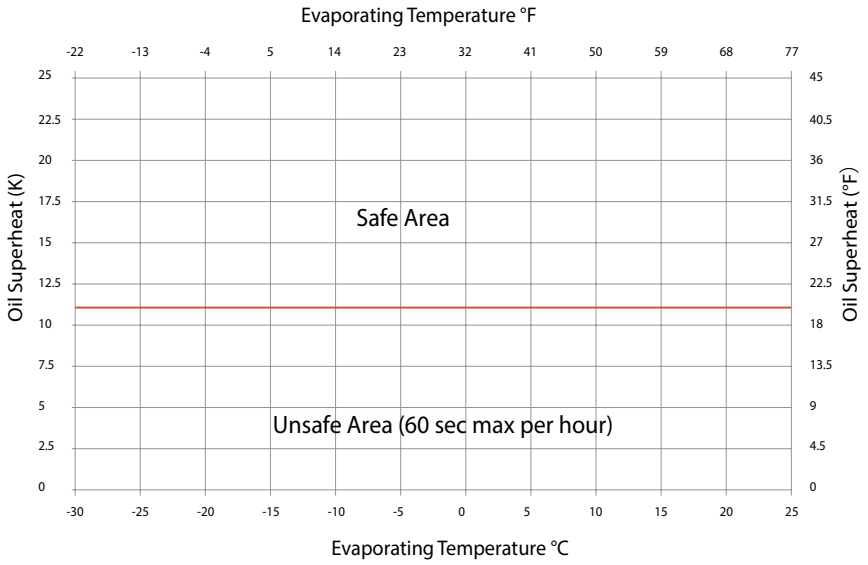
*Suction accumulator offers protection by trapping the liquid refrigerant upstream from the compressor. The accumulator should be sized at least 50 % of the total system charge. Suction accumulator dimensions can impact oil return (gas velocity, oil return hole size…), therefore oil return has to be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

Oil temperature 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)



DSF090-200 Dilution Chart (reference at 20°C / 68°F ambient temperature)



R Off -cycle refrigerant migration happens:

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

Requirement

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

System evaluation

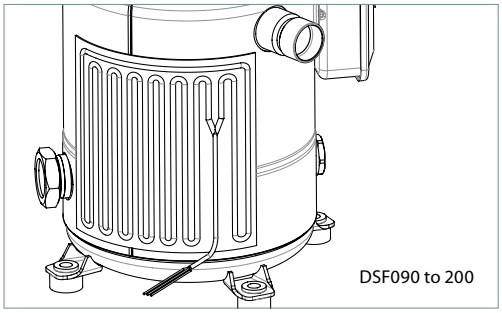
Use the table below in relation with the system charge and the application to quickly define necessary safeties to implement.

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 DSF090-200, 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 refer to below principle:


DSF090 to 200

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

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

Surface sump heater accessories are available from Danfoss (see section "Accessories").

**Liquid line solenoid valve (LLSV)

A LLSV is used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer to the compressor during off -cycles. 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 are defined in the table below :

	Models	Composition	Refrigerant charge limit	
			kg	lbs
Single		DSF090	8	18
		DSF100	8	18
		DSF115	10	22
		DSF130	10	22
		DSF155	10	22
		DSF175	10	22
		DSF200	10	22
Tandem	DSF180E	DSF090+DSF090	12	26
	DSF200E	DSF100+DSF100	12	26
	DSF230E	DSF115+DSF115	12	26
	DSF260E	DSF130+DSF130	12	26
	DSF215U	DSF100+DSF115	12	26
	DSF230U	DSF100+DSF130	12	26
	DSF255U	DSF100+DSF155	12	26
	DSF275U	DSF100+DSF175	12	26
	DSF285U	DSF130+DSF155	12	26
	DSF300U	DSF100+DSF200	12	26
	DSF305U	DSF130+DSF175	12	26
	DSF310E	DSF155+DSF155	14	31
	DSF315U	DSF115+DSF200	12	26
	DSF350E	DSF175+DSF175	14	31
	DSF400E	DSF200+DSF200	14	31
	DSF330U	DSF155+DSF175	14	31
	DSF331U	DSF130+DSF200	12	26
	DSF355U	DSF155+DSF200	14	31
	DSF375U	DSF175+DSF200	14	31
	DSF400X	DSF130+DSF270	14	31
	DSF500X	DSF175+DSF325	14	31
	DSF470X	DSF200+DSF270	14	31
	DSF525X	DSF200+DSF325	14	31
Trio	DSF465T	DSF155 trio	14	31
	DSF525T	DSF175 trio	14	31
	DSF600T	DSF200 trio	14	31

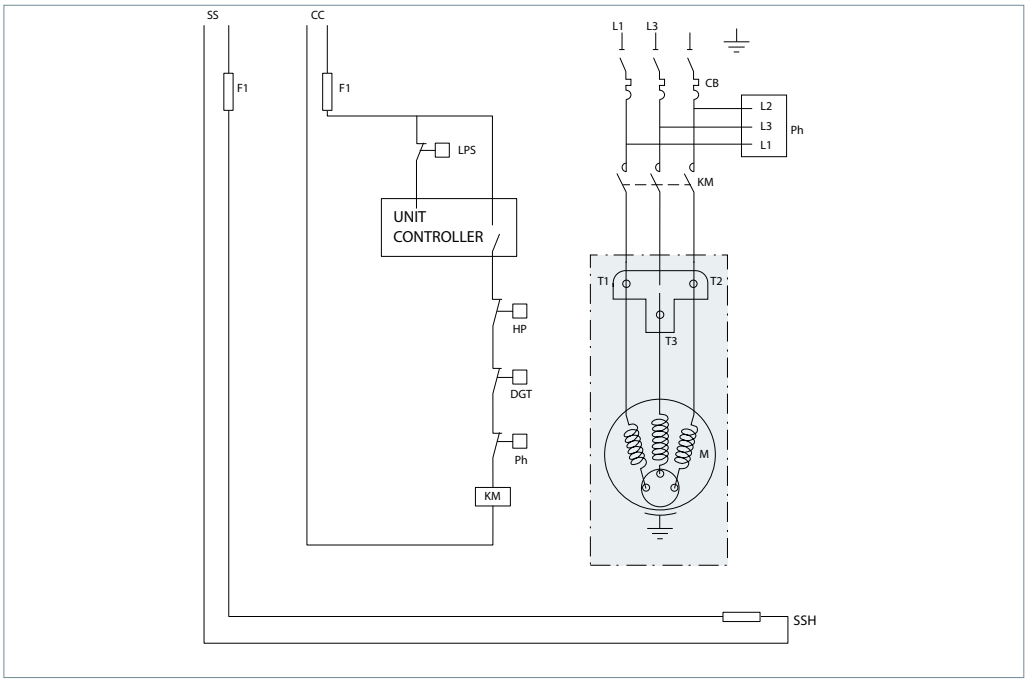
Wiring information

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 DSF090-200, phase sequence protection is strongly recommended.
- HP safety switch, DGT protection 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:

Compressor model DSF090-200



Legends

Fuses F1
Compressor contactor ..... KM
High pressure safety switch ..... HP
Safety pressure switch ..... LPS
Discharge gas temperature protection ..... DGT
Compressor motor ..... M
Surface sump heater ..... SSH
Thermal magnetic motor circuit breaker ..... CB
Phase sequence relay ..... Ph

Safety control logic requirements

Safeties	Tripping conditions		Re-start conditions	
	Value	Time	Value	Time
HP safety switch	See Pressure settings table from section "Manage operating envelope"	Immediate, no delay. No by-pass	Conditions back to normal. Switch closed again	Manual reset
LP safety switch				Maximum 5 auto reset during a period of 12 hours, then manual reset.

Cycle rate limit requirements

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

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

Oil management logic recommendations

In some cases, oil management can be enhanced by control logic:
• If oil return test failed, a function can be integrated in control logic to run all compressors simultaneously during 2 minutes every hour in order to boost oil return. Time and delay can be fine-tuned by oil return test N°1 in section "Manage oil in the circuit". During oil boost, pay special attention to superheat management to avoid liquid flood back.

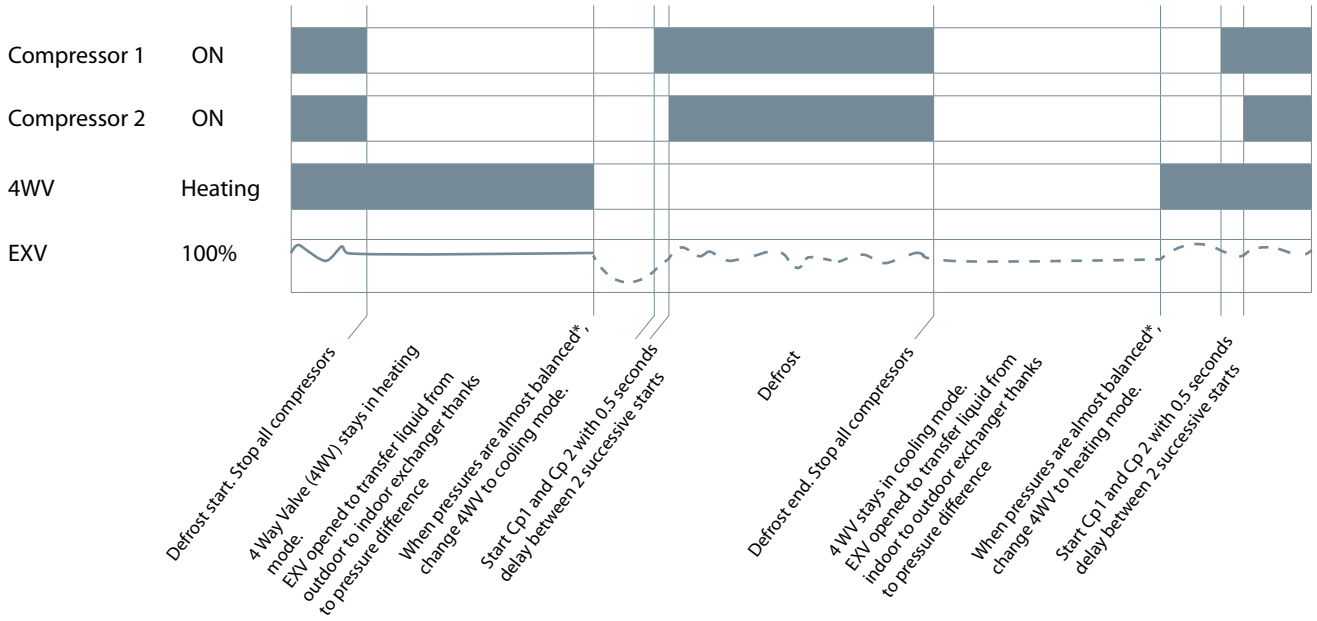
• In manifold system, after running long time in full load, oil unbalance may appears. A function can be implemented in control logic to stop all manifold compressors during one minute every two hours in order to balance oil. Time and delay can be fine-tuned by Oil balancing test N°2 in section "Manage 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 pressures.

The following defrost logic combines both advantages:



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

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

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.

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

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

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 53°C (127°F) when charged with R32 refrigerant.

Compressor holding charge

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

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

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

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

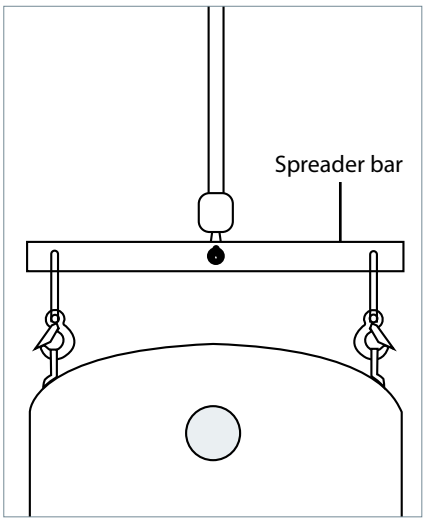
Handling

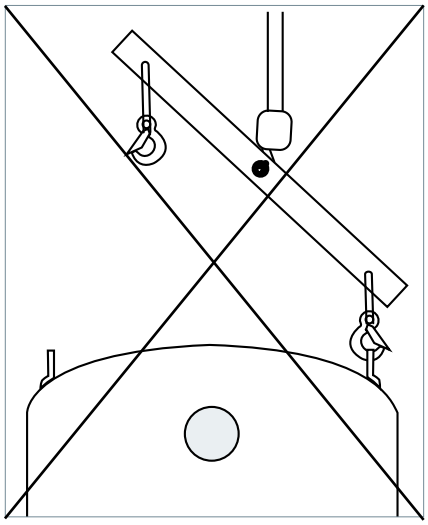
! Each Danfoss DSF scroll compressor is equipped with two lift rings on the top shell.

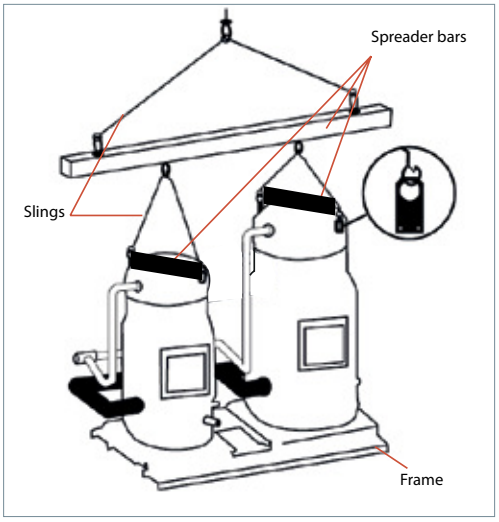
- Always use both these rings when lifting the compressor.
- Use lifting equipment rated and certified for the weight of the compressor or compressor assembly.
- A spreader bar rated for the weight of the compressor is highly recommended to ensure a better load distribution.
- The use of lifting hooks 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).









Piping assembly

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

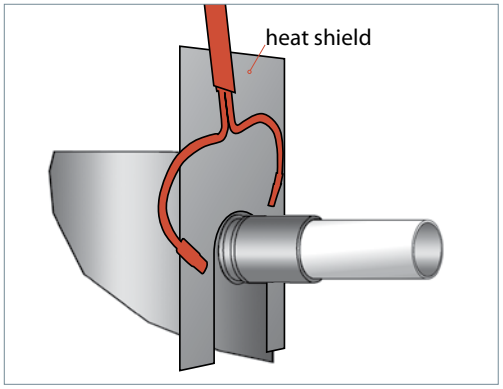
System cleanliness

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.

DSF 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 30% to 40% Ag (Silver) is recommended by Danfoss.
The use of self-flux alloys (as phosphorous alloys) is not recommended by Danfoss. This type of brazing require a higher working temperature, that may overheat the connectors, damaging the thin layer of copper ,resulting in phosphides creation and joint zone embrittlement.



For more detailed information see " Brazing technique for compressors connectors" FRCC. EN.182.

⚠ Before eventual un-brazing of the compressor or any system component, the refrigerant charge must be removed.

System pressure test and leak detection

The compressor has been strength tested and leak proof tested (<3g/year) at the factory.
For system tests:
- Always use an inert gas such as Nitrogen or Helium.
- Pressurize the system on HP side first then LP side.
- Do not exceed the following pressures indicated in table below

Maximum compressor test pressures	DSF090-200
Maximum compressor test pressure high side (HP)	53,6bar (g) (778psig) HP-LP<37bar (537psi)
Maximum compressor test pressure low side (LP)	36.7bar (g) (533psig) LP-HP<5bar (73psi) Maximum speed 4.8bar/s (70psi/s)

Vacuum evacuation and moisture removal

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

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

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

Refrigerant charging

Initial charge:
- For the initial charge, the compressor must not run.
- Charge refrigerant as close as possible to the nominal system charge.
- This initial charging operation must be done in liquid phase between the condenser outlet and the filter drier.

If needed, a complement of charge can be done before evaporator, in liquid phase while compressor is running by slowly throttling liquid in.
Never bypass safety low pressure switch.

For more detailed information see "Recommended refrigerant system charging practice" FRCC.EN.050.

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.

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

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.

Preliminary check

⚠ Check electrical power supply:
- Phase order: Reverse rotation is obvious if the compressor do not build up pressure and sound level is abnormal high.
- For DSF090-200 compressors equipped with internal reverse vent valve which can protect compressor without damage within duration below 24h. For more details refer to section "Phase sequence and reverse rotation protection".
- Voltage and voltage unbalance within tolerance: For more details refer to section "Motor voltage".

Initial start-up

- 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 185SL from new cans.
For more detailed information see "Lubricants filling in instructions for Danfoss Commercial Compressors" TI 2-025-0402



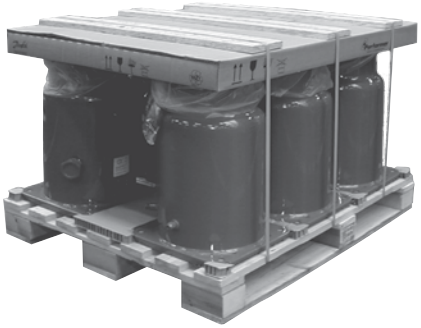
Danfoss recommends that compressors and compressor oil should be recycled by a suitable company at its site.

Single pack



Compressor model	Length		Width		Height		Gross weight	
	mm	inch	mm	inch	mm	inch	kg	lbs
DSF090	565	22.2	470	18.5	718	28.3	69	152
DSF100	565	22.2	470	18.5	718	28.3	69	152
DSF115	565	22.2	470	18.5	718	28.3	76	168
DSF130	565	22.2	470	18.5	718	28.3	76	168
DSF155	565	22.2	470	18.5	718	28.3	79	174
DSF175	565	22.2	470	18.5	718	28.3	81	179
DSF200	565	22.2	470	18.5	718	28.3	84	185

Industrial pack



Compressor model	Nbr*	Length		Width		Height		Gross weight		Static stacking pallets
		mm	inch	mm	inch	mm	inch	kg	lbs	
DSF090	8	1150	45.3	950	37.4	680	26.8	494	1089	2
DSF100	8	1150	45.3	950	37.4	680	26.8	494	1089	2
DSF115	8	1150	45.3	950	37.4	750	29.5	544	1199	2
DSF130	8	1150	45.3	950	37.4	750	29.5	544	1199	2
DSF155	8	1150	45.3	950	37.4	750	29.5	566	1248	2
DSF175	8	1150	45.3	950	37.4	750	29.5	582	1283	2
DSF200	8	1150	45.3	950	37.4	750	29.5	606	1336	2

* nbr: number of compressors per pack

Compressor code numbers

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

Compressors DSF090 to DSF200 are delivered with flexible grommets.

Single pack



Compressor model	Connections	Motor protection	Code no.
			4
			400/3/50 460/3/60
DSF090	Brazed	Internal	120H1635
DSF100	Brazed	Internal	120H1637
DSF115	Brazed	Internal	120H1639
DSF130	Brazed	Internal	120H1503
DSF155	Brazed	Internal	120H1475
DSF175	Brazed	Internal	120H1477
DSF200	Brazed	Internal	120H1479

Industrial pack



Compressor model	Connections	Motor protection	Code no.
			4
			400/3/50 460/3/60
DSF090	Brazed	Internal	120H1636
DSF100	Brazed	Internal	120H1638
DSF115	Brazed	Internal	120H1640
DSF130	Brazed	Internal	120H1502
DSF155	Brazed	Internal	120H1474
DSF175	Brazed	Internal	120H1476
DSF200	Brazed	Internal	120H1478

Ordering codes

Tandem kits

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

- Tubings, according to specific outline drawings.
- Manifolding accessory kit indicated below
- Compressors.

Tandem Model	Cp1	Cp2	Suction From	Tandem Kit Code No.
DSF180E	DSF090	DSF090	Left Right	120z0634
DSF200E	DSF100	DSF100	Left Right	120z0634
DSF230E	DSF115	DSF115	Left Right	120z0634
DSF260E	DSF130	DSF130	Left Right	120z0634
DSF215U	DSF100	DSF115	Left Right	120Z0694
DSF230U	DSF100	DSF130	Left Right	120Z0694
DSF255U	DSF100	DSF155	Left Right	120Z0694
DSF275U	DSF100	DSF175	Left Right	120Z0694
DSF285U	DSF130	DSF155	Left Right	120Z0692
DSF300U	DSF100	DSF200	Left Right	120Z0693
DSF305U	DSF130	DSF175	Left Right	120Z0692
DSF310E	DSF155	DSF155	Left Right	120Z0634
DSF315U	DSF115	DSF200	Left Right	120Z0693
DSF330U	DSF155	DSF175	Left Right	120Z0692
DSF331U	DSF130	DSF200	Left Right	120Z0694
DSF350E	DSF175	DSF175	Left Right	120Z0634
DSF355U	DSF155	DSF200	Left Right	120Z0694
DSF375U	DSF175	DSF200	Left Right	120Z0694
DSF400E	DSF200	DSF200	Left Right	120Z0634
DSF400X	DSF130	DSF270	Left Right	120Z0709
DSF470X	DSF200	DSF270	Left Right	120Z0709
DSF500X	DSF175	DSF325	Left Right	120Z0709
DSF525X	DSF200	DSF325	Left Right	120Z0709

For example: Tandem DSF355U
- Compressor 1: DSF155 Code number 120H1474 (Motor code 4 /Industrial pack)
- Compressor 2: DSF200 Code number 120H1478 (Motor code 4 /Industrial pack)
- Tandem kit DSF355U 120Z0694

Trio kits

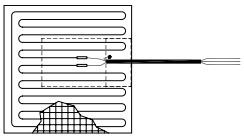
By default, DSF are not factory-built.
To complete an assembly in the field, you will need:
- Tubings, according to specific outline drawings.
- Manifolding accessory kit indicated below
- Compressors.

Trio model	Cp1	Cp2	Cp3	Suction from	Trio Kit code No
DSF465T	DSF155	DSF155	DSF155	Left Right	120Z0714
DSF525T	DSF175	DSF175	DSF175	Left Right	120Z0714
DSF600T	DSF200	DSF200	DSF200	Left Right	120Z0714

For example: Trio DSF465T
- Compressor 1, 2 and 3: DSF155 Code number 120H1474
- Trio kit DSF465T: Code number 120Z0714

Accessories

Surface sump heaters



Code no.	Description	Application	Packaging	Pack size
120Z0667	48W 24V surface sump heater CE and UL	DSF090 to 200	Single pack	1
120Z0668	48W 230V surface sump heater CE and UL		Single pack	1
120Z0669	48W 400V surface sump heater CE and UL		Single pack	1
120Z0670	48W 460V surface sump heater CE and UL		Single pack	1
120Z0671	48W 575V surface sump heater CE and UL		Single pack	1
120Z0388	80W 24V surface sump heater CE and UL		Multipack	8
120Z0389	80W 230V surface sump heater CE and UL		Multipack	8
120Z0390	80W 400V surface sump heater CE and UL		Multipack	8
120Z0391	80W 460V surface sump heater CE and UL		Multipack	8
120Z0402	80W 575V surface sump heater CE and UL		Multipack	8

Mounting hardware



Code no.	Description	Application	Packaging	Pack Size
120Z0066	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	DSF090 to 200	Single pack	1

Lubricant



Code no.	Description	Packaging	Pack Size
120Z0750	POE lubricant 185SL, 1 litre can	Multipack	12

Terminal boxes, covers and T-block connectors



Code no.	Description	Application	Packaging	Pack Size
120Z0413	Terminal box cover	DSF200	Single pack	1
8156135	Service kit for terminal box 96 x 115 mm, including 1 cover, 1 clamp	DSF090 to 175	Multipack	10
8173230	T block connector 52 x 57 mm	DSF090 to 175	Multipack	10
8173021	T block connector 60 x 75 mm	DSF200	Multipack	10

* except code 3

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



Code no.	Description	Application	Packaging	Pack Size
120Z0634	Suction washer, rigid spacer, organ pipe, gasket	DSF260E-310E-DSF350E-DSF400E	Single pack	1
120Z0692	Suction washer, rigid spacer, organ pipe, gasket	DSF285U-305U-330U	Single pack	1
120Z0693	Suction washer, rigid spacer, organ pipe, gasket	DSF300U-315U	Single pack	1
120Z0694	Suction washer, rigid spacer, organ pipe, gasket	DSF331U-355U-DSF375U	Single pack	1
120Z0709	Suction washer, rigid spacer, grommets, organ pipe, sleeve, gasket	DSF400X-470X-DSF500X-DSF525X	Single pack	1

Trio kits



Code no.	Description	Application	Packaging	Pack Size
120Z0714	Organ pipe, sleeves, rigid spacer, gasket, rubber grommet	DSF465T-DSF525T-DSF600T	Single pack	1

Updates

Release date(Year/month)	Guideline codification number	List of changes	Reason for change
2021.01		First release	-

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Danfoss Turbocor Compressors



Danfoss Inverter Scrolls



Danfoss Scrolls



Danfoss Optyma™ Condensing Units



Danfoss Maneurop Reciprocating Compressors



Danfoss Light Commercial Refrigeration Compressors

Our products can be found in a variety of applications such as rooftops, chillers, residential air conditioners, heatpumps, coldrooms, supermarkets, milk tank cooling and industrial cooling processes.

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