ENGINEERING
TOMORROW

Application guidelines

Danfoss scroll compressors
SM SY SZ

R22 - R407C - R134a - R404A - R507A - R513A - 50 - 60 Hz

http://cc.danfoss.com

Danfoss scroll compressors are available both as single compressors and as tandem units. The example below presents the single compressor nomenclature which equals the technical reference as shown on the compressor nameplate.

Code numbers for ordering list are in section "Ordering information & packaging".

For tandem and trio assemblies, please refer to the Danfoss Parallel Application Guidelines documentation FRCC.PC.005.

Nomenclature

Family, lubricant & refrigerant	Nominal capacity		Voltage	Version	Evolution index	
SZ	**185**	**-**	**4**	**R**	**C**	Single compressors
SY	**300**	**A**	**7**	**CA**	**A**	Single compressors

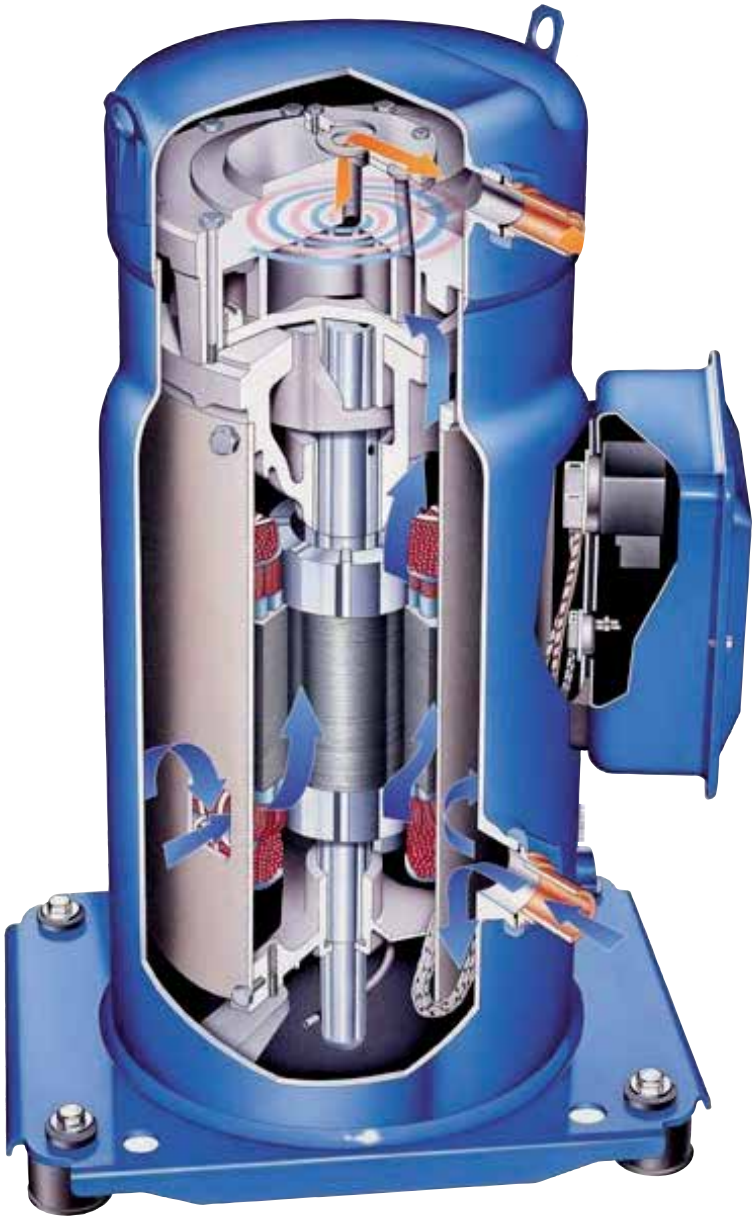
Family, lubricant & refrigerant
SM: Scroll, Mineral oil, R22/R417A*
SY: Scroll, POE lubricant, R22/R417A/ R407C/R134a/R513A**
SZ: Scroll, POE lubricant, R407C - R134a (R404A, R507A for SZ084 to SZ185, R513A for SZ148 to SZ185 **)

Nominal capacity
in thousand Btu/h at 60 Hz, R22, ARI conditions

Motor voltage code
3: 200-230V/3~/60 Hz
4: 380-400V/3~/50 Hz - 460V/3~/60 Hz
SY380: 380-415V/3~/50 Hz - 460V/3~/60 Hz
6: 230V/3~/50 Hz
7: 500V/3~/50 Hz - 575V/3~/60 Hz
9: 380V/3~/60 Hz
SY380: 380-400V/3~/60 Hz

Motor protection type		Connection	Module voltage	Applies to
Internal overload protector	**V**	: brazed		S 084-090-100-110-120-148-161
	A	: brazed		S 112-124-147
Internal thermostat	**C**	: brazed		S175-185
	R	: rotolock		
Electronic protection module	**P**	: brazed	24V AC	S 185
	X	: brazed	110-240V	
	Y	: rotolock	110-240V	
	CA	**C**: brazed	**A**: 24V AC	S 240 - 300
	CB		**B**: 110-240V	
	PA	**P**: rotolock	**A**: 24V AC	
	PB		**B**: 110-240V	
	CA	**C**: brazed	**A**: 24V AC	S 380
	CB		**B**: 110-240V	

* When SM compressors are used with R417A, the factory charged mineral oil 160P must be replaced by polyolester oil 160SZ
** Only motor voltage 4 are qualified with R513A

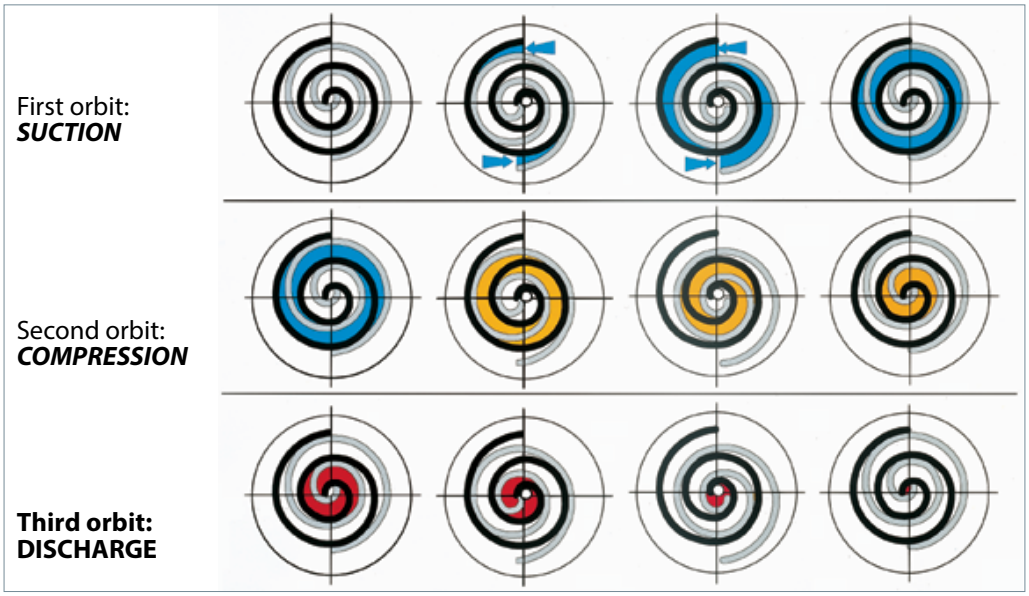


SM / SY / SZ 084-090-100-110-120-148-161-175-185-240-300-380

In a Danfoss SM / SY / SZ scroll compressor, the compression is performed by two scroll elements located in the upper part of the compressor.

Suction gas enters the compressor at the suction connection. As all of the gas flows around and through the electrical motor, thus ensuring complete motor cooling in all applications, oil droplets separate and fall into the oil sump. After exiting the electrical motor, the gas enters the scroll elements where compression takes place. Ultimately, the discharge gas leaves the compressor at the discharge connection.

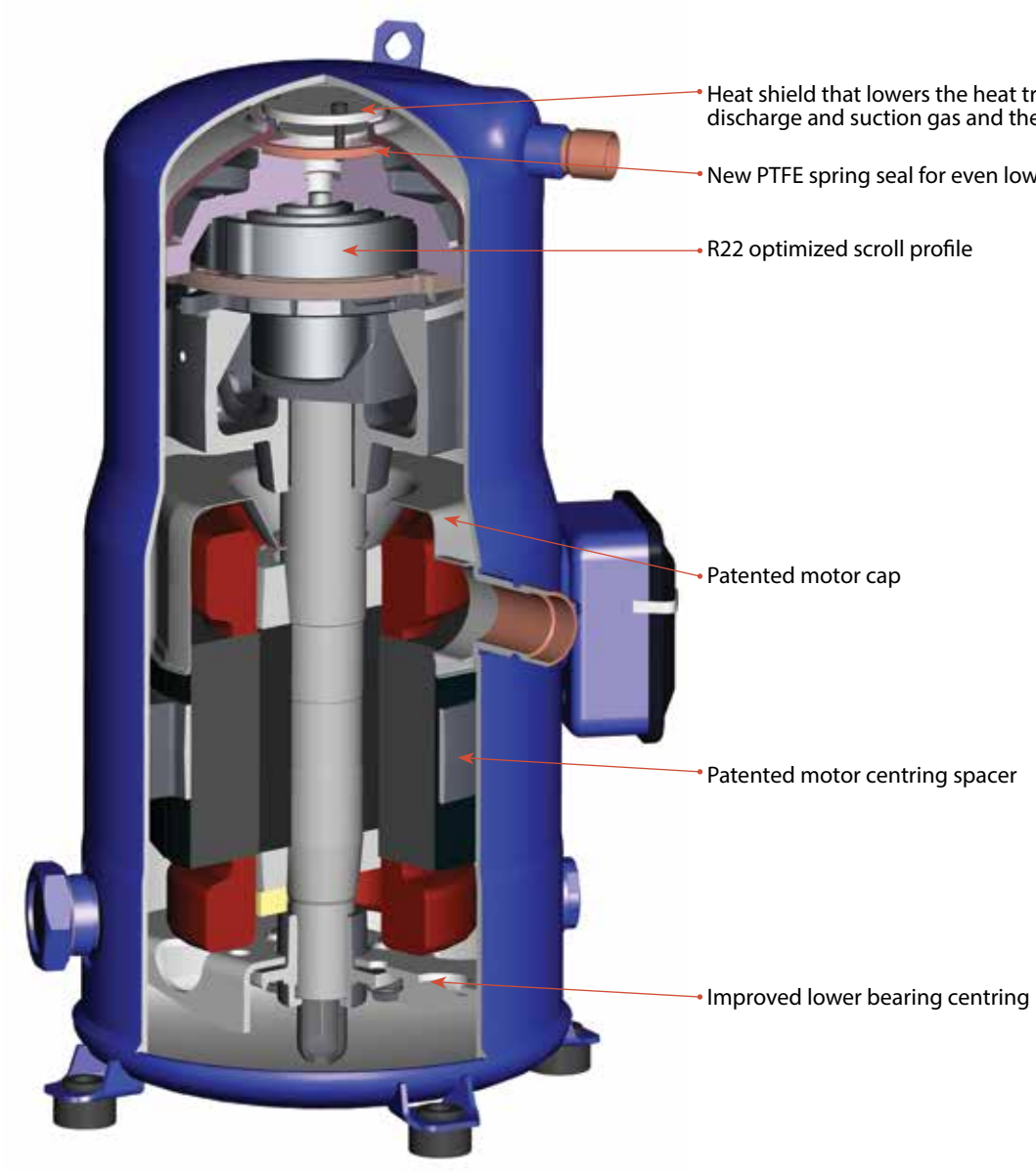
The figure below illustrates the entire compression process. The centre of the orbiting scroll (in grey) traces a circular path around the centre of the fixed scroll (in black). This movement creates symmetrical compression pockets between the two scroll elements. Low-pressure suction gas is trapped within each crescent-shaped pocket as it gets formed; continuous motion of the orbiting scroll serves to seal the pocket, which decreases in volume as the pocket moves towards the centre of the scroll set increasing the gas pressure. Maximum compression is achieved once a pocket reaches the centre where the discharge port is located; this stage occurs after three complete orbits. Compression is a continuous process: the scroll movement is suction, compression and discharge all at the same time.



In addition to the existing SM range compressors previously available, Danfoss is completing its range with 3 compressors.

The new SM112-124 and SM/SZ147 compressors benefit from a further improved design to achieve the highest efficiency.

- Gas circulation, motor cooling and oil behaviour are improved by a new patented motor cap design.
- Part protection and assembly reduces internal leaks and increases life durability.
- Improved part isolation reduces greatly acoustic levels.
- Gas intake design induces higher resistance to liquid slugging.



SM 112-124 - SM/SZ147

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

50 Hz data

	Model	Nominal Cap. 60 Hz	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	m^3/h	dm^3	kg
R22 SINGLE	**SM084**	7	20 400	69 600	6.12	3.33	11.4	114.5	19.9	3.25	64
	SM090	7.5	21 800	74 400	6.54	3.33	11.4	120.5	21.0	3.25	65
	SM100	8	23 100	78 800	6.96	3.33	11.4	127.2	22.1	3.25	65
	SM110	9	25 900	88 400	7.82	3.32	11.3	144.2	25.1	3.25	73
	SM112	9.5	27 600	94 200	7.92	3.49	11.9	151.5	26.4	3.30	64
	SM120	10	30 100	102 700	8.96	3.36	11.5	166.6	29.0	3.25	73
	SM124	10	31 200	106 500	8.75	3.56	12.2	169.5	29.5	3.30	64
	SM147	12	36 000	122 900	10.08	3.57	12.2	193.5	33.7	3.30	67
	SM148	12	36 100	123 200	10.8	3.34	11.4	199.0	34.6	3.60	88
	SM161	13	39 000	133 100	11.59	3.37	11.5	216.6	37.7	3.60	88
	SM175	14	42 000	143 300	12.47	3.37	11.5	233.0	40.5	6.20	100
	SM/SY185	15	45 500	155 300	13.62	3.34	11.4	249.9	43.5	6.20	100
	SY240	20	61 200	208 900	18.2	3.36	11.5	347.8	60.5	8.00	150
	SY300	25	78 200	266 900	22.83	3.43	11.7	437.5	76.1	8.00	157
	SY380	30	94 500	322 500	27.33	3.46	11.8	531.2	92.4	8.40	158
R407C SINGLE	**SZ084**	7	19 300	65 900	6.13	3.15	10.8	114.5	19.9	3.25	64
	SZ090	7.5	20 400	69 600	6.45	3.16	10.8	120.5	21.0	3.25	65
	SZ100	8	21 600	73 700	6.84	3.15	10.8	127.2	22.1	3.25	65
	SZ110	9	24 600	84 000	7.76	3.17	10.8	144.2	25.1	3.25	73
	SZ120	10	28 600	97 600	8.99	3.17	10.8	166.6	29.0	3.25	73
	SZ147	12	34 900	119 079	9.92	3.52	12.0	193.5	33.7	3.30	67
	SZ148	12	35 100	119 800	10.99	3.19	10.9	199.0	34.6	3.60	88
	SZ161	13	38 000	129 700	11.84	3.21	11.0	216.6	37.7	3.60	88
	SZ175	14	40 100	136 900	12.67	3.17	10.8	233.0	40.5	6.20	100
	SZ185	15	43 100	147 100	13.62	3.16	10.8	249.9	43.5	6.20	100
	SY240	20	59 100	201 700	18.55	3.19	10.9	347.8	60.5	8.00	150
	SY300	25	72 700	248 100	22.73	3.20	10.9	437.5	76.1	8.00	157
	SY380	30	89 600	305 800	27.59	3.25	11.1	531.2	92.4	8.40	158
R134a SINGLE	**SZ084**	7	12100	41100	3.83	3.15	10.75	114.5	19.9	3.25	64
	SZ090	7.5	12900	43900	4.08	3.15	10.77	120.5	21.0	3.25	65
	SZ100	8	13800	47000	4.36	3.16	10.78	127.2	22.1	3.25	65
	SZ110	9	15600	53100	4.90	3.17	10.83	144.2	25.1	3.25	73
	SZ120	10	17900	61200	5.62	3.19	10.89	166.6	29.0	3.25	73
	SZ147	12	20800	71000	6.13	3.40	11.59	193.5	33.7	3.25	67
	SZ148	12	21500	73400	6.96	3.09	10.55	199.0	34.6	3.60	88
	SZ161	13	23000	78400	7.30	3.15	10.74	216.6	37.7	3.60	88
	SZ175	14	25300	86200	7.90	3.20	10.91	233.0	40.5	6.20	100
	SZ185	15	26900	91700	8.41	3.20	10.91	249.9	43.5	6.20	100
	SY240	20	35600	121600	11.60	3.07	10.48	347.8	60.5	8.00	150
	SY300	25	44400	151700	14.43	3.08	10.51	437.5	76.1	8.00	157
	SY380	30	55800	190500	17.26	3.23	11.04	531.2	92.4	8.40	158
R513A SINGLE	**SZ148**	12	20665	70512	6.96	2.97	10.13	199.0	34.6	3.60	88
	SZ161	13	23634	80642	7.54	3.14	10.70	216.6	37.7	3.60	88
	SZ175	14	24413	83299	8.07	3.03	10.32	233.0	40.5	6.20	100
	SZ185	15	27438	93621	8.64	3.18	10.84	249.9	43.5	6.20	100
	SY240	20	37450	127783	12.1	3.10	10.59	347.8	60.5	8.00	150
	SY300	25	47497	162065	14.7	3.22	10.99	437.5	76.1	8.00	157
	SY380	30	58537	199734	18.1	3.23	11.03	531.2	92.4	8.40	158

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

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

Rating conditions

Refrigerant	R22	R134a/R513A	R407C
Frequency	50 Hz	50 Hz	50 Hz
Standard rating conditions	ARI	EN12900	-
Evaporating temperature	7.2 °C	5 °C	7.2 °C (dew point)
Condensing temperature	54.4 °C	50 °C	54.4 °C (dew point)
Sub-cooling	8.3 K	10 K	8.3 K
Superheat	11.1 K	0 K	11.1 K

Subject to modification without prior notification

For regular updates and detailed capacities, please refer to **Coolselector®2** www.coolselector.danfoss.com

60 Hz data

	Model	Nominal Cap. 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displace-ment ①	Oil charge	Net weight ②
		TR	W	Btu/h	kW	W/W	Btu/h /W	cm³/rev	m³/h	dm³	kg
R22 SINGLE	**SM084**	7	24600	84000	7.40	3.34	11.4	114.5	24.1	3.25	64
	SM090	7.5	26400	90100	7.80	3.37	11.5	120.5	25.3	3.25	65
	SM100	8	27500	93900	8.10	3.38	11.5	127.2	26.7	3.25	65
	SM110	9	31600	107800	9.30	3.38	11.5	144.2	30.3	3.25	73
	SM112	9.5	34000	116000	9.60	3.53	12.1	151.5	31.8	3.30	64
	SM120	10	36700	125300	10.80	3.40	11.6	166.6	35.0	3.25	73
	SM124	10.5	37700	128700	10.60	3.56	12.2	169.5	35.6	3.30	64
	SM147	12	43600	148800	12.20	3.58	12.2	193.5	40.6	3.30	67
	SM148	12	43800	149500	13.00	3.37	11.5	199.0	41.8	3.60	88
	SM161	13	47600	162500	14.10	3.39	11.6	216.6	45.5	3.60	88
	SM175	14	51100	174400	15.30	3.34	11.4	233.0	48.9	6.20	100
	SM/SY185	15	55300	188700	16.30	3.39	11.6	249.9	52.5	6.20	100
	SY240	20	74100	252900	22.10	3.35	11.4	347.8	73.0	8.00	150
	SY300	25	94500	322500	27.50	3.43	11.7	437.5	91.9	8.00	157
	SY380	30	115300	393500	33.40	3.46	11.8	531.2	111.6	8.40	158
R407C SINGLE	**SZ084**	7	22500	76800	7.10	3.19	10.9	114.5	24.1	3.25	64
	SZ090	7.5	24400	83300	7.60	3.20	10.9	120.5	25.3	3.25	65
	SZ100	8	26500	90400	8.20	3.24	11.1	127.2	26.7	3.25	65
	SZ110	9	30100	102700	9.30	3.24	11.1	144.2	30.3	3.25	73
	SZ120	10	34800	118800	10.70	3.24	11.1	166.6	35.0	3.25	73
	SZ147	12	42300	144328	12.03	3.52	12.0	193.5	40.6	3.30	67
	SZ148	12	42600	145400	13.30	3.19	10.9	199.0	41.8	3.60	88
	SZ161	13	46000	157000	14.30	3.21	11.0	216.6	45.5	3.60	88
	SZ175	14	48700	166200	15.30	3.19	10.9	233.0	48.9	6.20	100
	SZ185	15	51800	176800	16.40	3.15	10.8	249.9	52.5	6.20	100
	SY240	20	71100	242700	22.70	3.14	10.7	347.8	73.0	8.00	150
	SY300	25	87900	300000	27.50	3.20	10.9	437.5	91.9	8.00	157
	SY380	30	107300	366200	33.50	3.20	10.9	531.2	111.6	8.40	158
R134a SINGLE	**SZ084**	7	16700	57100	5.06	3.31	11.29	114.5	24.1	3.25	64
	SZ090	7.5	17700	60300	5.33	3.31	11.31	120.5	25.3	3.25	65
	SZ100	8	18700	63800	5.64	3.32	11.32	127.2	26.7	3.25	65
	SZ110	9	21300	72800	6.41	3.33	11.36	144.2	30.3	3.25	73
	SZ120	10	24800	84700	7.43	3.34	11.40	166.6	35.0	3.25	73
	SZ147	12	28300	96600	8.04	3.52	12.02	193.5	40.6	3.25	67
	SZ148	12	29000	99100	9.37	3.10	10.57	199.0	41.8	3.60	88
	SZ161	13	31500	107500	9.68	3.25	11.10	216.6	45.5	3.60	88
	SZ175	14	34400	117300	10.39	3.31	11.29	233	48.9	6.20	100
	SZ185	15	36600	124800	11.10	3.30	11.25	249.9	52.5	6.20	100
	SY240	20	49400	168600	15.37	3.21	10.97	347.8	73.0	8.00	150
	SY300	25	60600	206900	19.61	3.09	10.55	437.5	91.9	8.00	157
	SY380	30	75800	258600	23.22	3.26	11.14	531.2	111.6	8.40	158
R513A SINGLE	**SZ148**	12	28861	98477	9.32	3.10	10.57	199.0	41.8	3.60	88
	SZ161	13	32617	111292	10.01	3.26	11.12	216.6	45.5	3.60	88
	SZ175	14	33952	115847	10.58	3.21	10.94	233.0	48.9	6.20	100
	SZ185	15	38009	129690	11.33	3.35	11.45	249.9	52.5	6.20	100
	SY240	20	51208	174727	15.9	3.22	10.99	347.8	73.0	8.00	150
	SY300	25	64441	219879	19.5	3.30	11.25	437.5	91.9	8.00	157
	SY380	30	69586	79439	24.7	3.22	10.99	531.2	111.6	8.40	158

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

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

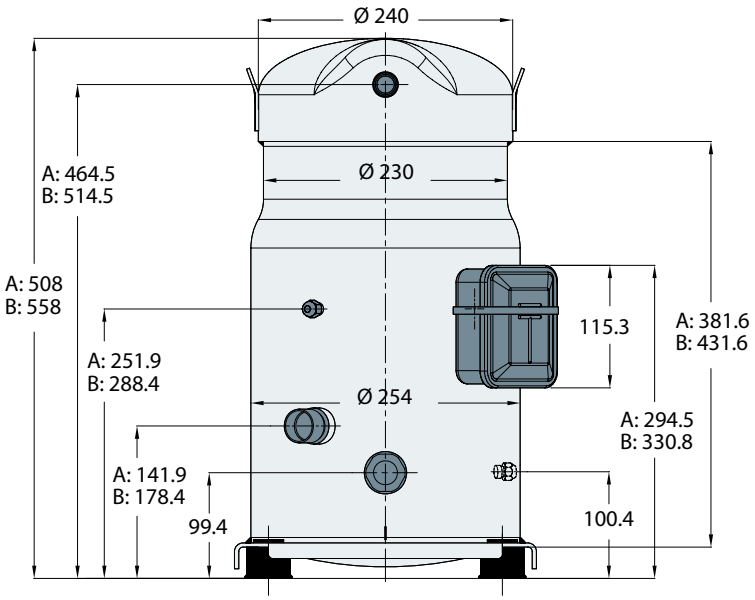
Rating conditions

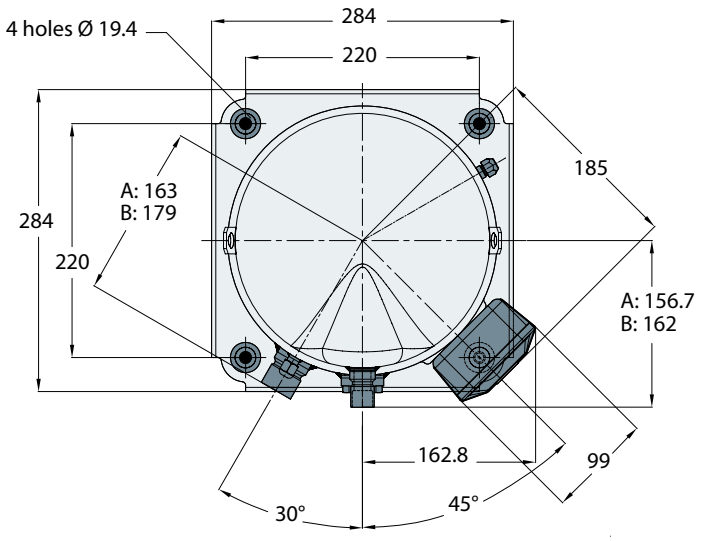
Refrigerant	R22/R134a/R513A	R407C
Frequency	60 Hz	60 Hz
Standard rating conditions	ARI standard conditions	-
Evaporating temperature	7.2 °C	7.2 °C (dew point)
Condensing temperature	54.4 °C	54.4 °C (dew point)
Sub-cooling	8.3 K	8.3 K
Superheat	11.1 K	11.1 K

Subject to modification without prior notification

For regular updates and detailed capacities, please refer to **Coolselector®2** www.coolselector.danfoss.com

SM/SZ 084-090-100-110-120

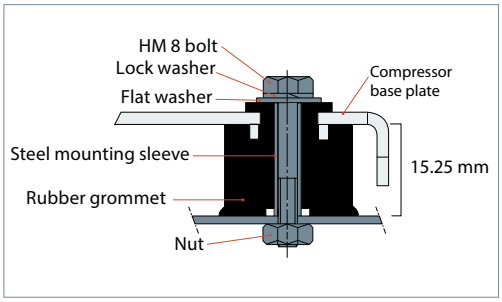




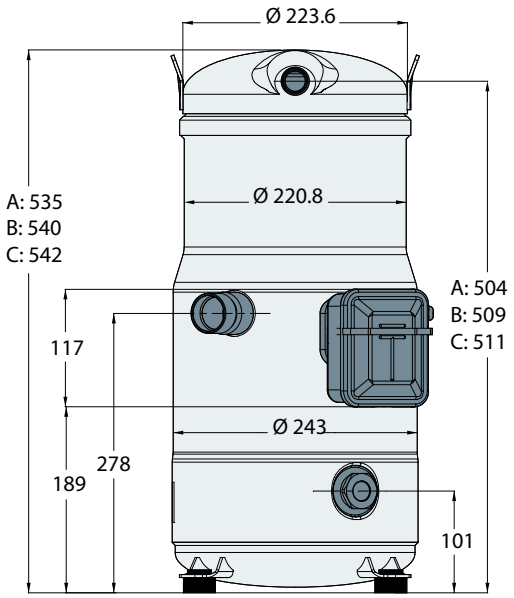
A: SM/SZ 084-090-100
B: SM/SZ 110-120

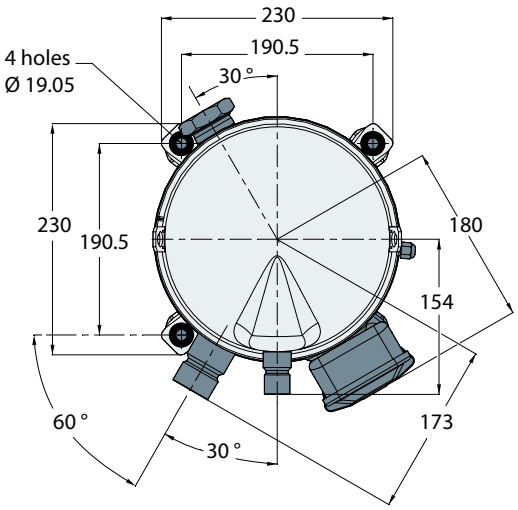
All dimensions in mm

Grommet



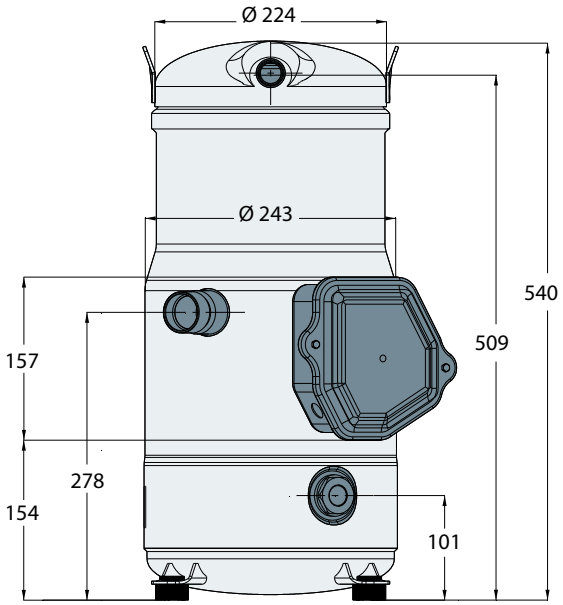
SM 112-124-SM/SZ147*
*** except code 3**

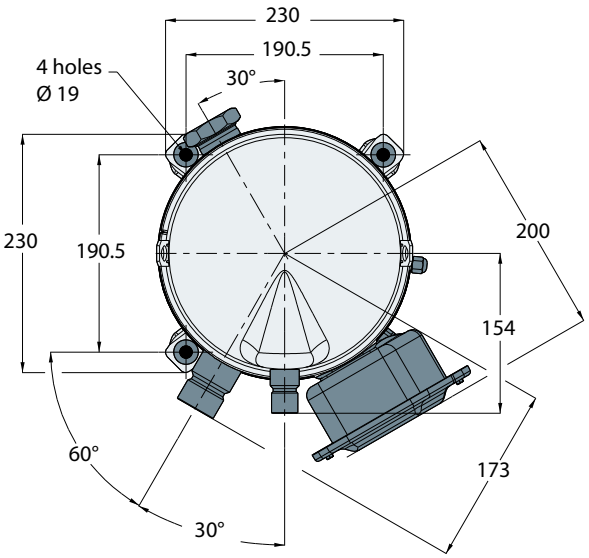




A: SM112
B: SM124
C: SM/SZ147

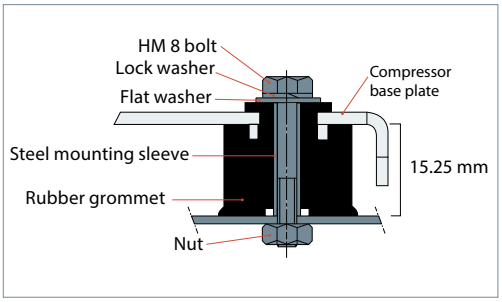
SM/SZ 147 code 3



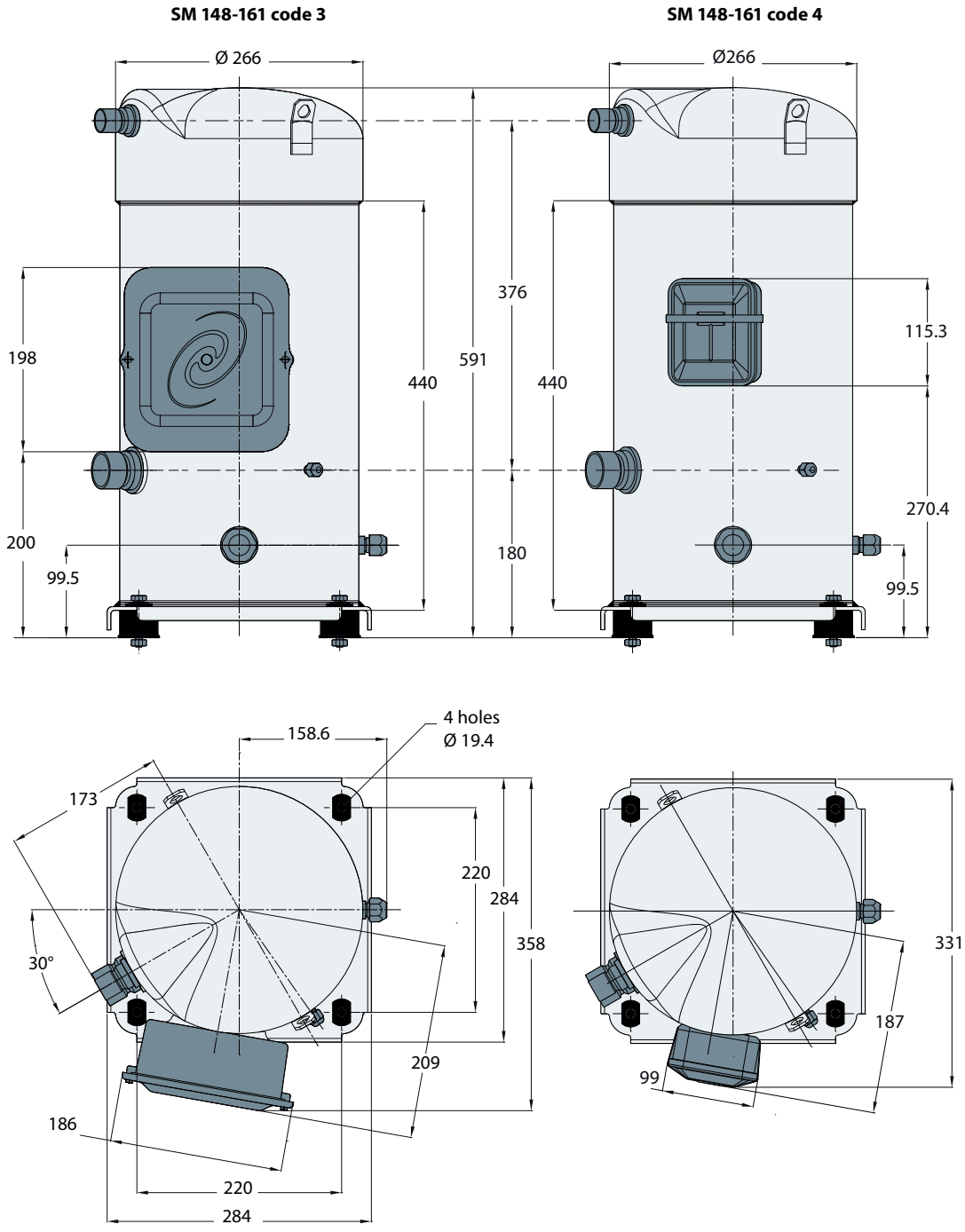


All dimensions in mm

Grommet

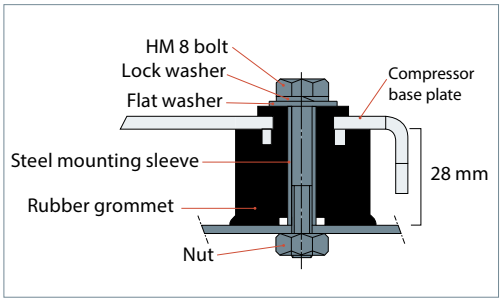


SM/SZ 148-161



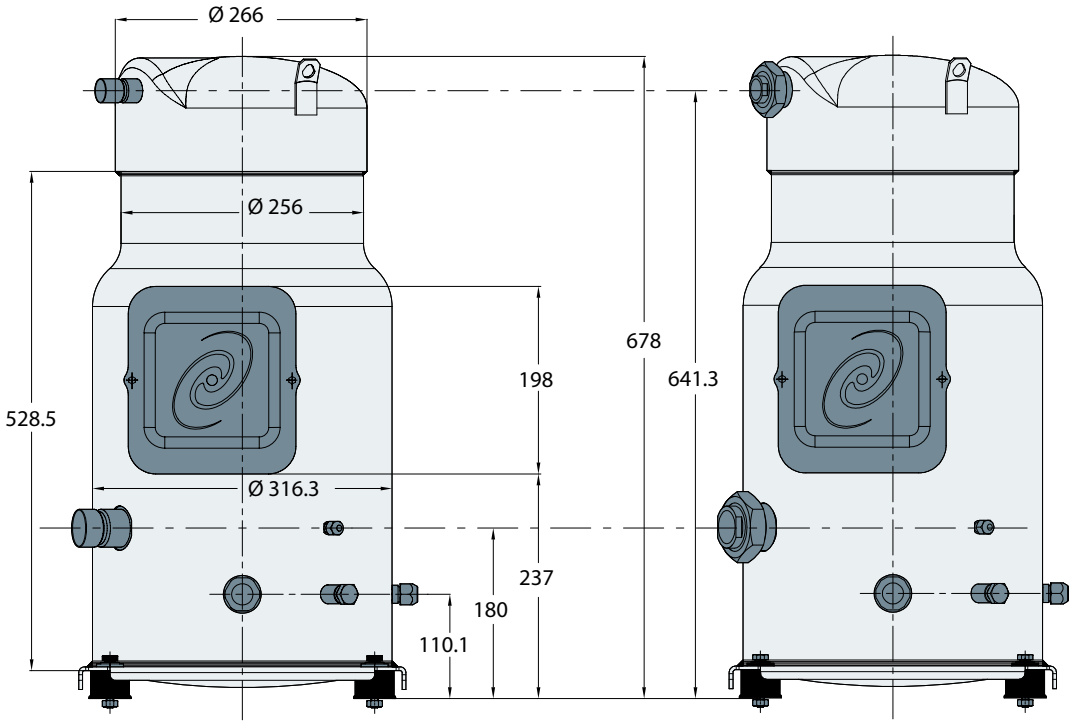
All dimensions in mm

Grommet

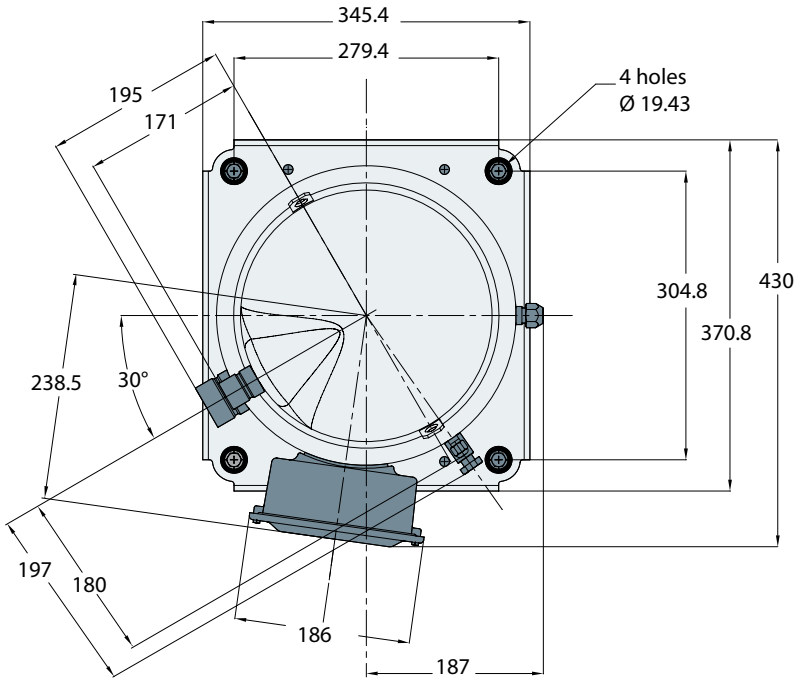


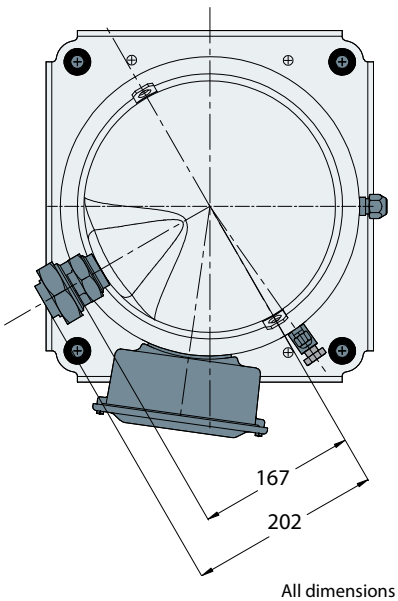
SM/SZ 175-185 & SY185
R and C version

Brazed version



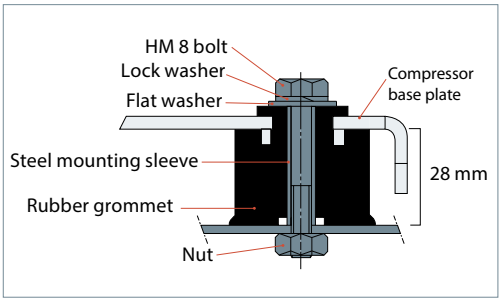
Rotolock version





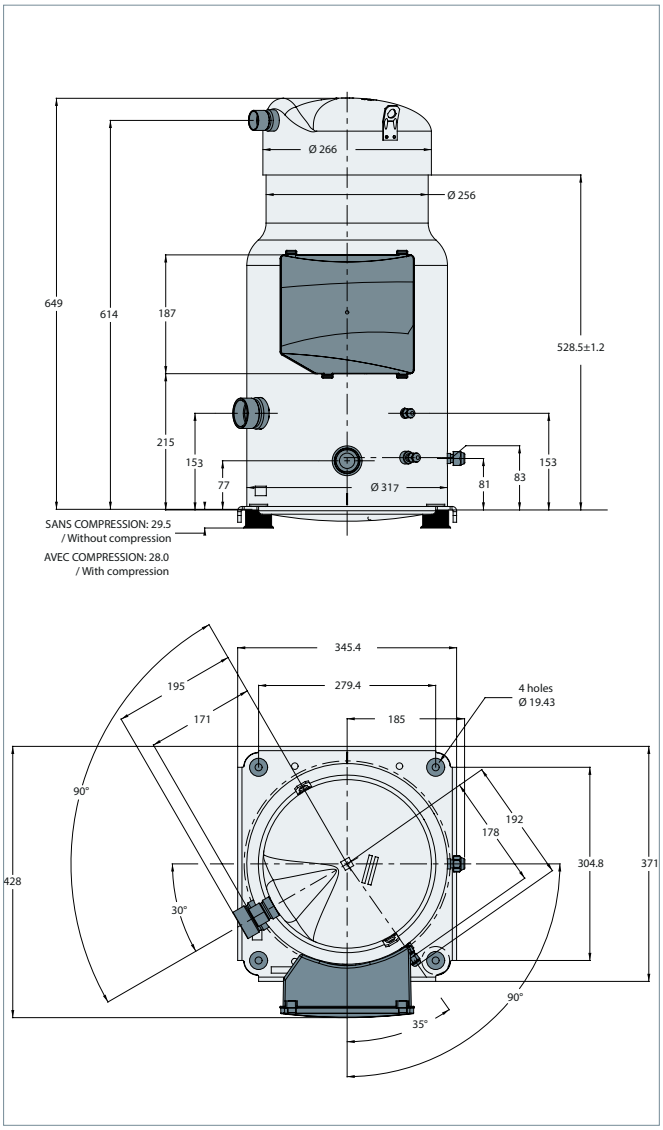
All dimensions in mm

Grommet

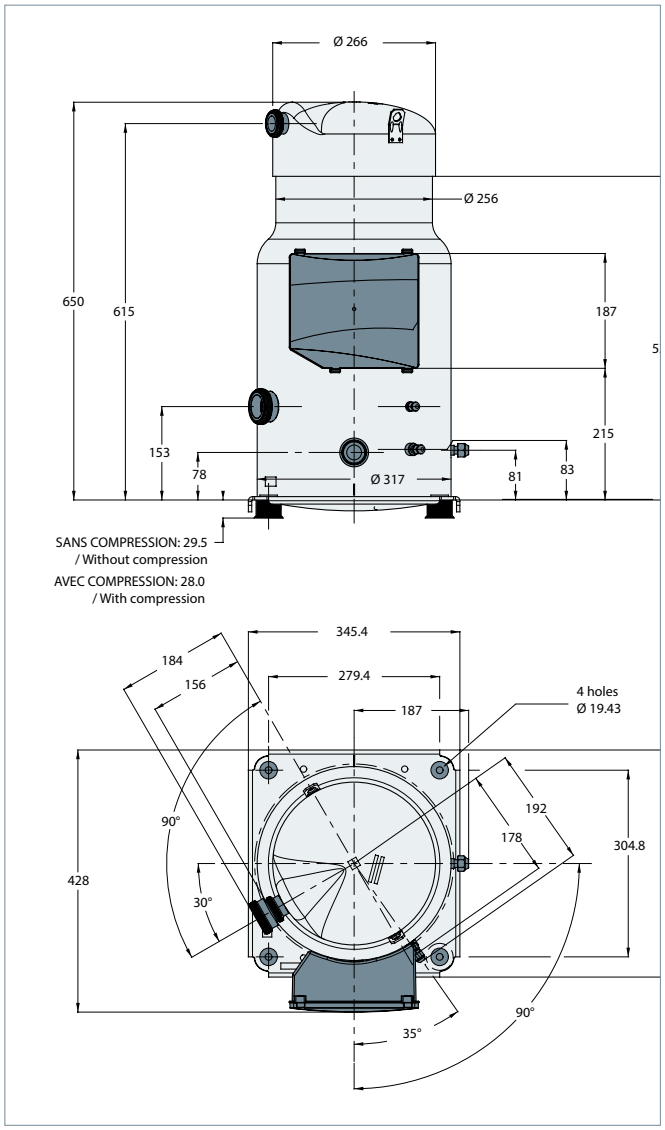


SM/SZ 185 P, X, Y version

Brazed version

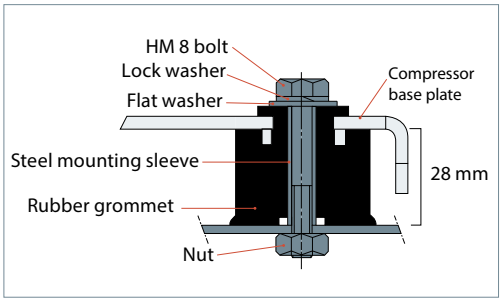


Rotolock version



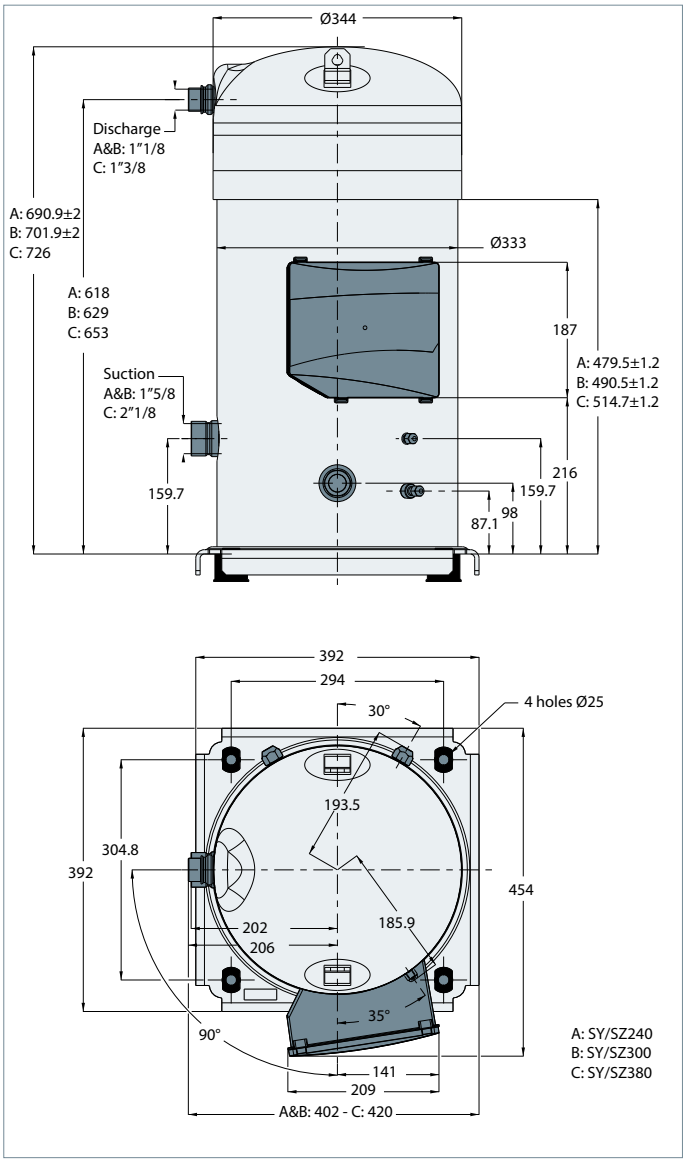
All dimensions in mm

Grommet

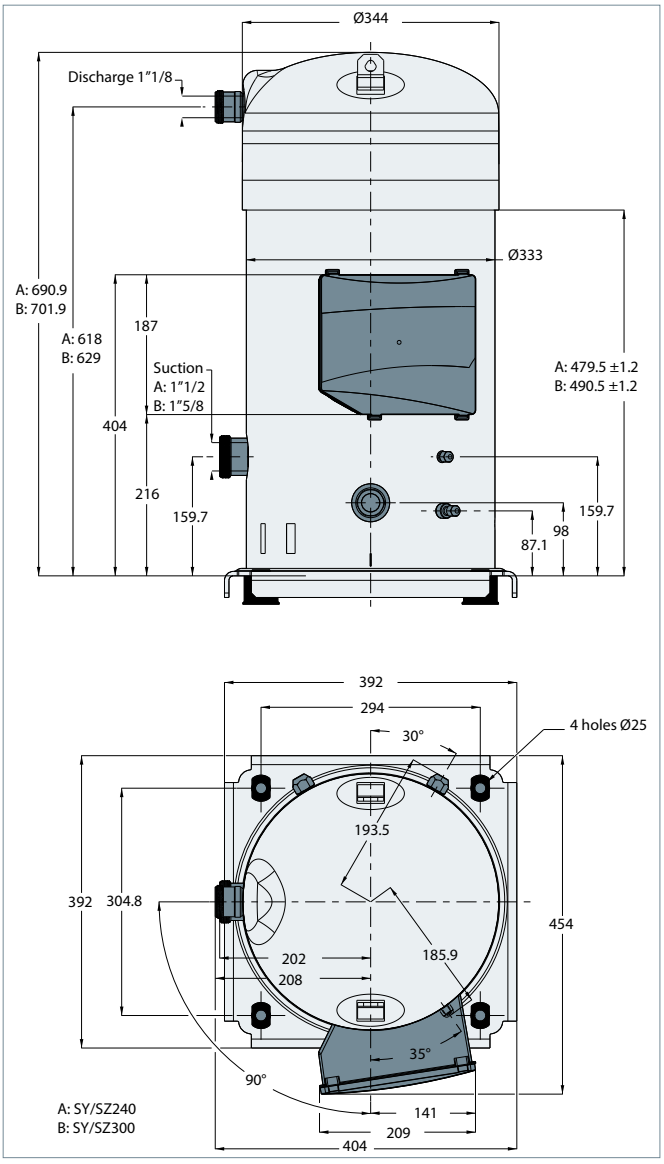


SY 240-300-380

Brazed version

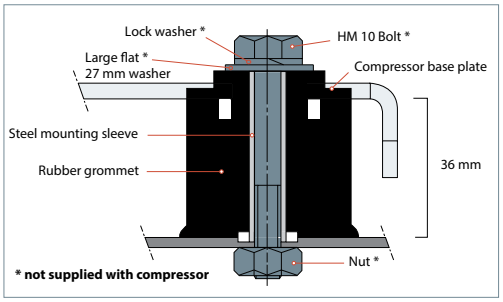


Rotolock version



All dimensions in mm

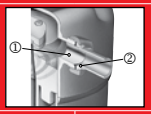
Grommet



Connection details

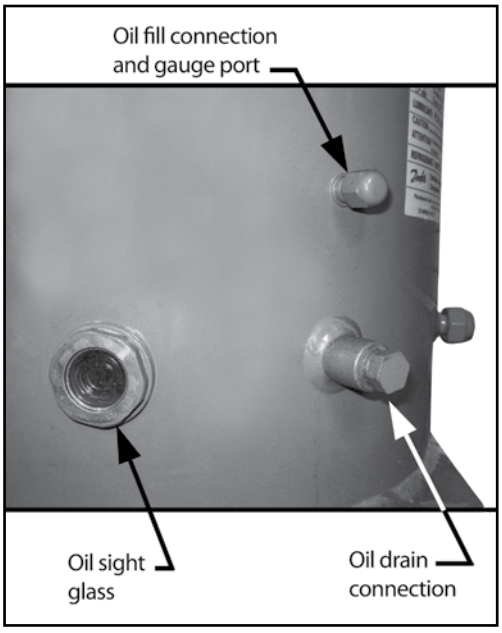
Model	SM/SZ084-090-100-110-120-148-161	SM/SZ175 - SM/SZ/SY185		SM112-124-SM/SZ147	SY240-300		SY380
Version	V	R-Y	C-P-X	AL	MA - MB	AA - AB	AA - AB
Suction and discharge connection	brazed	rotolock	brazed	brazed	rotolock	brazed	brazed
Oil sight glass	threaded	threaded	threaded	threaded	threaded	threaded	threaded
Oil equalisation connection	3/8" flare	3/8" flare	3/8" flare	rotolock 1"3/4	1/2" flare	1/2" flare	1/2" flare
Oil drain connection	-	1/4" flare	1/4" flare	-	1/4" flare	1/4" flare	1/4" flare
Low pressure gauge port (schrader)	1/4" flare	1/4" flare	1/4" flare	1/4" flare	1/4" flare	1/4" flare	1/4" flare

Suction and discharge connections

		Brazed version	Rotolock version	
				
		Brazed	Rotolock ①	Sleeve included ②
SM/SZ084-090-100	Suction	1" 1/8	-	-
	Discharge	3/4"	-	-
SM/SZ110-112	Suction	1" 3/8	-	-
	Discharge	7/8"	-	-
SM/SZ120-124	Suction	1" 3/8	-	-
	Discharge	7/8"	-	-
SM/SZ147-SM148-161	Suction	1"3/8	-	-
	Discharge	7/8"	-	-
SM/SZ175-185	Suction	1" 5/8	2" 1/4	1" 3/8
	Discharge	1" 1/8	1" 3/4	7/8"
SY240-300	Suction	1" 5/8	2" 1/4	1" 5/8
	Discharge	1" 1/8	1" 3/4	1" 1/8
SY380	Suction	2" 1/8	-	-
	Discharge	1" 3/8	-	-

Oil sight glass

All Danfoss SM / SY / SZ scroll compressors come equipped with a sight glass (1"1/8-18 UNEF) which may be used to determine the amount and condition of the oil contained within the sump.



Oil equalisation connection

SM/SZ 112-124-147: 1"3/4 rotolock connector allowing use of 1"3/4-7/8" or 1"3/4-1"1/8
SY240-300-380: 1/2" flare
Other models: 3/8" flare
This connection must be used to mount an oil equalisation line when two or more compressors are mounted in parallel (please refer to Danfoss Parallel Application Guidelines reference FRCC.PC.005 for details).

Oil drain connection

The oil drain connection allows oil to be removed from the sump for changing, testing, etc. The fitting contains an extension tube into the oil sump to more effectively remove the oil. The connection is a female 1/4" flare fitting.
Note: on SY 240 to 380, it is not possible to drain oil from the suction connection.

Schrader

The oil fill connection and gauge port is a 1/4" male flare connector incorporating a schrader valve.

Motor voltage

Danfoss SM / SY / SZ scroll compressors are available in five different motor voltages.

		Motor voltage code 3	Motor voltage code 4	Motor voltage code 6	Motor voltage code 7	Motor voltage code 9
Nominal voltage	50 Hz	-	380 - 400 V - 3 ph 380 - 415 V - 3 ph*	230 V - 3 ph	500 V - 3 ph	-
Voltage range	50 Hz	-	342 - 440 V 342 - 457 V *	207 - 253 V	450 - 550 V	-
Nominal voltage	60 Hz	200 - 230 V - 3 ph	460 V - 3 ph	-	575 V - 3 ph	380 V - 3 ph 380 - 400 V - 3 ph*
Voltage range	60 Hz	180 - 253 V	414 - 506 V	-	517 - 632 V	342 - 418 V 342 - 440 V*

* SY 380

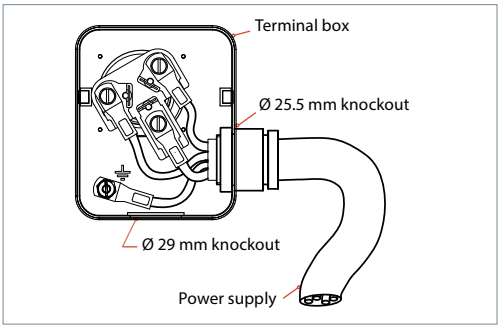
Wiring connections

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.

SM / SZ 084 - 090 - 100 - 110 - 112 - 120 - 124 - 147* -148* - 161*

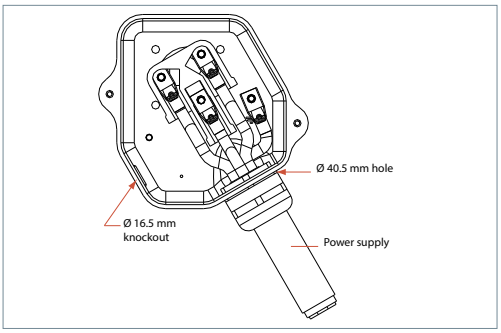
*Except for motor voltage code 3

The terminal box is provided with a Ø 25.5 mm and a Ø 29 mm knockouts.



SM/SZ 147 code 3

The terminal box is provided with a Ø 40.5 mm hole for power supply and a Ø 16.5 mm knockout.



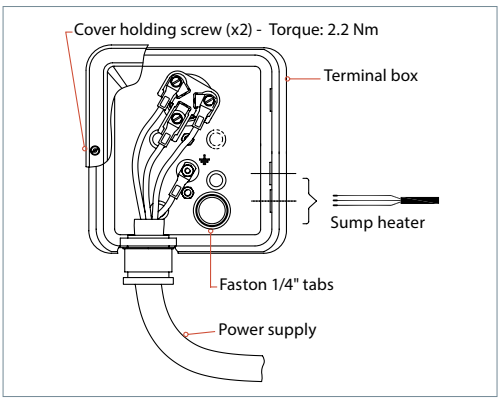
SM / SZ148 & 161 code 3-175-185 & SY185 - R & C version

The terminal box is provided with 2 double knockouts for the power supply and 3 knockouts for the safety control circuit.
The 2 power supply, double knockouts accommodate the following diameters:

- Ø44 mm / Ø1"3/4 hole (for a 1"1/4 conduit) and Ø34mm / Ø1"3/8 hole (for a 1" conduit),
- Ø32.1 mm / Ø1.26" hole & Ø25.4 mm / Ø1" hole

The 3 other knockouts are as follows:

- Ø20.5 mm / Ø0.81"
- Ø22 mm / Ø7/8" (for a 1/2" conduit)
- Ø16.5 mm / Ø0.65"



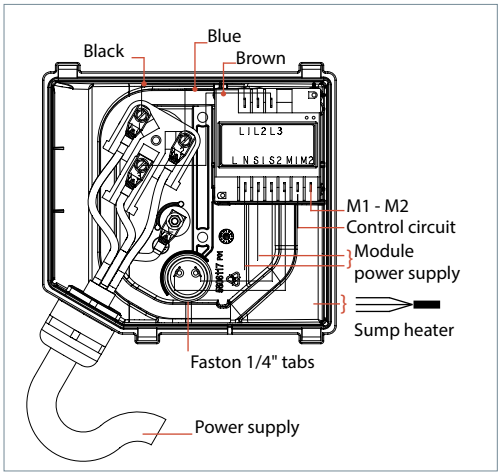
SY 240 – 300 – 380 & SM/SZ 185 - P, X, Y versions

The terminal box is provided with 2 triple knockouts and 1 single knockout for power supply and 4 double knockouts for the safety control circuit.
The 3 power supply knockouts accommodate the following diameters:

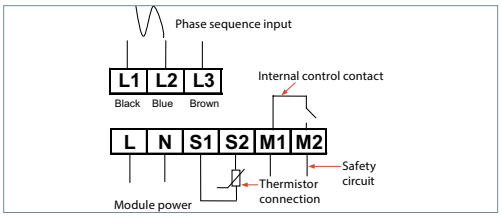
- Ø 50.8 mm (UL 1"1/2 conduit) & Ø 43.7 mm (UL 1"1/4 conduit) & Ø 34.5 mm (UL 1" conduit)
- Ø 40.5 mm (ISO40) & Ø 32.2 mm (ISO32) & Ø 25.5 mm (ISO25)
- Ø 25.5 mm (ISO25)

The 4 others knockouts are as follows:

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



The motor protection module comes preinstalled within the terminal box. Phase sequence protection connections and thermistor connections are pre-wired. The module must be connected to a power supply of the appropriate voltage. The module terminals are 6.3 mm size Faston type.



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 may not exceed 70°C. 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. The installation of ventilation 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 to insure that terminal box temperature does not exceed 70°C.

Three phase electrical characteristics

Compressor model		LRA	MCC	MMT	Max. op. current	Winding resistance
		A	A	A	A	Ω
Motor voltage code 3 200-230V/3 ph/60 Hz	SM/SZ084	170	35		35	0.44
	SM/SZ090	195	35		34	0.38
	SM/SZ100	195	38		32	0.38
	SM/SZ110	237	45		40	0.26
	SM112	267	51		41	0.27
	SM/SZ120	237	50		48	0.26
	SM124	267	51		45	0.27
	SM/SZ147	304	57		52	0.24
	SM/SZ148	255	64		57	0.29
	SM/SZ161	255	64		61	0.29
	SM/SZ175 *	380		75	70	0.19
	SM/SZ185 *	380		75	73	0.19
	SY240	460	109		100	0.14
	SY300	560	130		130	0.12
Motor voltage code 4 380-400V/3 ph/50 Hz 460V/3 ph/60 Hz	SM/SZ084	86	17		17	1.74
	SM/SZ090	98	18.5		17	1.48
	SM/SZ100	98	19		18	1.48
	SM/SZ110	130	22		20	1.05
	SM112	142	25		21	1.05
	SM/SZ120	130	29		24	1.05
	SM124	142	25		23	1.05
	SM/SZ147	147	29		26	0.92
	SM/SZ148	145	32		29	0.94
	SM/SZ161	145	32		31	0.94
	SM/SZ175 *	175		35	34	0.77
	SM/SZ185 *	175		35	35	0.77
	SY/SZ185	175		35	34	0.77
	SY240	215	50		47	0.62
	SY300	270	69		58	0.52
	SY380	300	79		72.7	0.41
Motor voltage code 6 230V/3 ph/50 Hz	SM/SZ084	150	29		27	0.58
	SM/SZ090	165	30		27	0.5
	SM/SZ100	165	30		30	0.5
	SM/SZ110	210	37		35	0.35
	SM/SZ120	210	43		39	0.35
	SM/SZ148	200	50		47	0.38
	SM/SZ161	200	54		51	0.38
	SM/SZ175 *	270		68	57	0.25
	SM/SZ185 *	270		68	59	0.25
Motor voltage code 7 500V/3 ph/50 Hz 575V/3 ph/60 Hz	SM/SZ084	70	13		13	2.58
	SM/SZ090	80	14		13	2.25
	SM/SZ100	80	15		13	2.25
	SM/SZ110	85	18		16	1.57
	SM/SZ120	85	19		18	1.57
	SM/SZ148	102	27		23	1.61
	SM/SZ161	102	25		24	1.61
	SM/SZ175 *	140		28	27	1.11
	SM/SZ185 *	140		28	28	1.11
Motor voltage code 9 380V/3 ph/60 Hz	SM/SZ084	100	20		20	1.22
	SM/SZ090	113	22		20	1.05
	SM/SZ100	113	22		19	1.05
	SM/SZ110	160	27		23	0.72
	SM112	177	32		24	0.72
	SM/SZ120	160	30		28	0.72
	SM124	177	32		27	0.72
	SM/SZ147	181	35		31	0.62
	SM/SZ148	155	38		36	0.75
	SM/SZ161	155	38		38	0.75
	SM/SZ175 *	235		43	42	0.48
	SM/SZ185 *	235		43	43	0.48
	SY240	260	62		62	0.42
	SY300	305	74		74	0.36
	SY380	390	93		84.5	0.28

* For versions with electronic module, see datasheet for electrical data

LRA (Locked Rotor Amp)

Locked Rotor Amp value is the higher current as measured on mechanically blocked compressor tested under nominal voltage. The LRA value can be used as 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.

MMT (Max Must Trip current)

The MMT is defined for compressors without their own motor protection. This MMT value is the maximum at which the compressor can be operated in transient conditions and out of the application envelope. The tripping current of external overcurrent protection (thermal overload relay or circuit breaker not provided with compressor) must never exceed the MMT value.

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.

Max. operating Current

The max. operating current is the current when the compressors operates at maximum load conditions and 10% below the highest value of its nominal voltage (+15°C evaporating temperature and +68°C condensing temperature).

Max Oper. A can be used to select cables and contactors.

In normal operation, the compressor current consumption is always less than the Max Oper. A value.

Winding resistance

Winding resistance is the resistance between indicated terminal pins at 25°C (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, the measured resistance must be corrected with following formula:

$$R_{amb} = R_{25°C} \frac{a + t_{amb}}{a + t_{25°C}}$$

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

Danfoss MCI soft-start controller

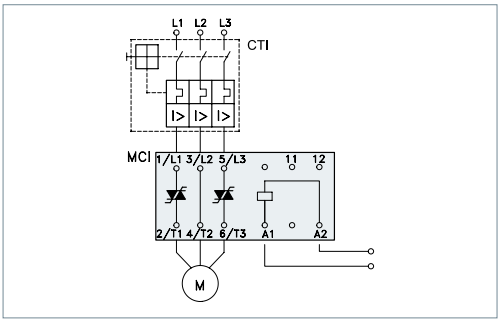
The inrush current for the Danfoss scroll compressors with motor code 4 (400V / 3 / 50Hz or 460V / 3 / 60Hz) can be reduced using the Danfoss digitally-controlled MCI compressor soft starter. MCI soft starters are designed to reduce the starting current of 3-phase AC motors; MCI soft starters can reduce the in-rush current by up to 40%, thereby eliminating the detrimental effects of high starting torque surges and costly demand charges from the resultant current spike. Upon starting, the controller gradually increases the voltage supplied to the motor until full-line voltage has been reached. All settings, such as ramp-up time (less than 0.5 sec) and initial torque, are preset and do not require modification.

Compressor model	Soft start reference ambient max. 40°C	Soft start reference ambient max. 55°C
SM/SZ084	MCI 15C	MCI 15C
SM/SZ090		
SM/SZ100		MCI 25C
SM/SZ110		
SM/SZ120 SM112-124 - SM/SZ147 SM/SZ161-148	MCI 25C	MCI 25C*
SM/SZ175-185 SY240-300-380	MCI 50CM *	

* By-pass contactor (K1) required.

Input controlled soft start

When the control voltage is applied to A1 - A2, the MCI soft starter will start the motor, according to the settings of the ramp-up time and initial torque adjustments. When the control voltage is switched OFF, the motor will switch off instantaneously.

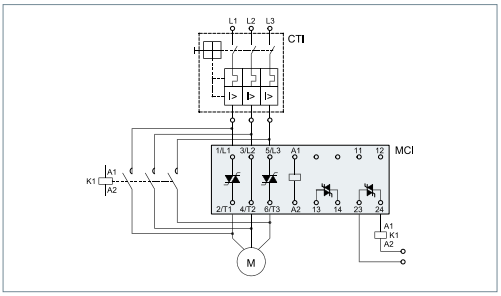


MCI with bypass contactor

By means of the built-in auxiliary contact (23-24) the bypass function is easily achieved, see wiring diagram below.

No heat is generated from the MCI. As the contactor always switches in no-load condition it can be selected on the basis of the thermal current (AC-1).

13-14 contact not applicable with MCI 25C



General wiring information

The wiring diagrams below are examples for a safe and reliable compressor wiring. In case an alternative wiring logic is chosen, it's imperative to respect the following rules.

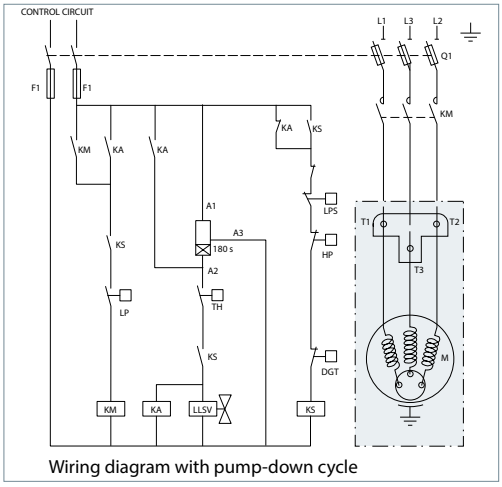
When a safety switch trips, the compressor must stop immediately and must not re-start until the tripping condition is back to normal and the safety switch is closed again. This applies to the LP safety switch, the HP safety switch, the discharge gas thermostat and the motor safety thermostat.

In specific situations, such as winter start operation, an eventual LP control for pump-down cycles may be temporarily bypassed to allow the system to build pressure. But it remains mandatory for compressor protection to apply an LP safety switch.

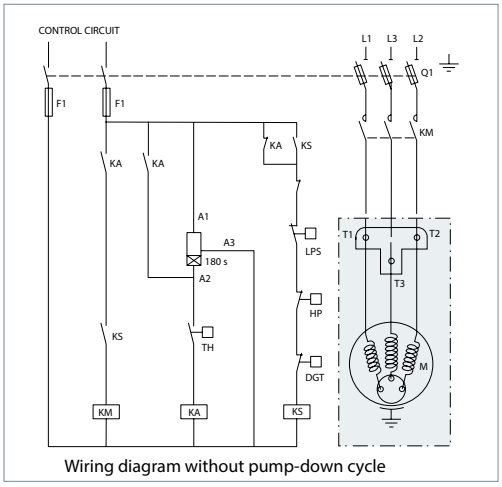
The LP safety switch must never be bypassed. Pressure settings for the LP and HP safety switch and pump-down are in table from "Low pressure" section.

When ever possible (ie. PLC control), it is recommended to limit the possibilities of compressor auto restart to less than 3 to 5 times during a period of 12 hours when caused by motor protection or LP safety switch tripping. This control must be managed as a manual reset device.

Suggested wiring diagrams logic
Compressor models SM / SZ 084 - 090 - 100 - 110 - 112 - 120 - 124 - 147 - 148 - 161

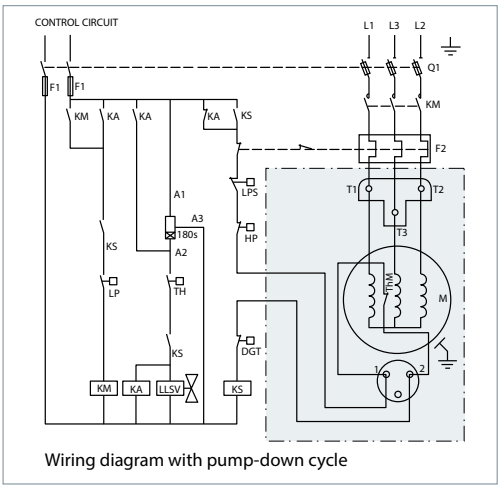


Wiring diagram with pump-down cycle

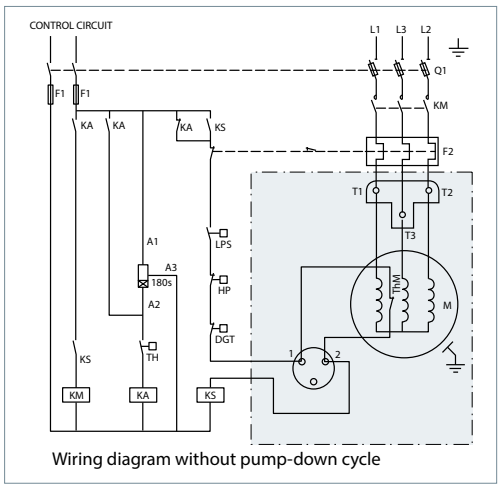


Wiring diagram without pump-down cycle

Compressor models SM / SZ 175 – 185 R and C version

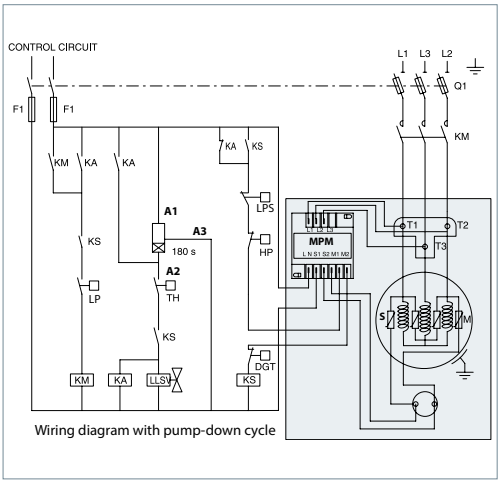


Wiring diagram with pump-down cycle

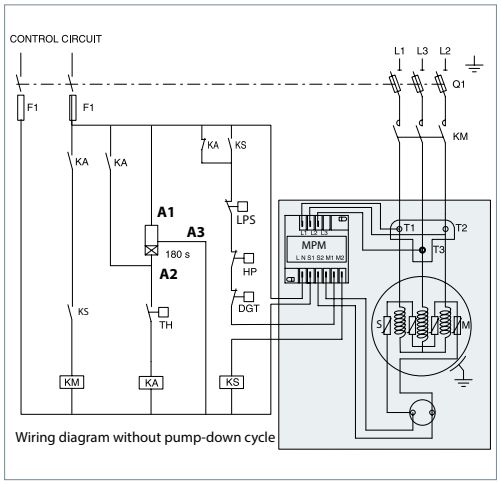


Wiring diagram without pump-down cycle

Compressor models SY 240 - 300 - 380 & SM/SZ-185 (P, X, Y versions)



Wiring diagram with pump-down cycle



Wiring diagram without pump-down cycle

Legends

Fuses F1
Compressor contactor ..... KM
Control relay ..... KA
Safety lock out relay ..... KS
Optional short cycle timer (3 min) ..... 180 s
External overload protection F2
Pump-down pressure switch ..... LP
High pressure safety switch ..... HP
Control device ..... TH
Liquid Line Solenoid valve ..... LLSV
Discharge gas thermostat ..... DGT
Fused disconnect Q1
Motor safety thermostat ..... thM
Compressor motor ..... M
Motor Protection Module ..... MPM
Thermistor chain ..... S
Safety pressure switch ..... LPS

Motor protection

The table below shows the protection method for the various compressors models.

	Overheating protection	Over current protection	Locked rotor protection	Phase reversal protection
SM/SZ 175-185 R & C version	✓ Internal thermostat	REQ External overload protection		✓ Reverse vent.
SM112-124- SM/SZ147		✓ Internal motor protection		REC Phase sequence detector
SM/SZ 084-090-100-110-120-148-161		✓ Internal motor protection		✓ Reverse vent.
SM/SZ 185 P, X, Y version		✓ Electronic module located in terminal box		✓ Reverse vent.
SY/SZ 240-300-380		✓ Electronic module located in terminal box		

REC Recommended REQ Required ✓ No test or additional safeties required

Compressor models SM/SZ084-090-100-110-112-120-124-147-148-161 have been provided with an internal overload motor protection to prevent against excessive current and temperature caused by overloading, low refrigerant flow phase loss or incorrect motor rotation. The cutout current is the MCC value listed in section "Three phase electrical characteristics".

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

While not compulsory, an additional external overload protection 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 external overload protection will trip before the internal protection therefore offering possibility of manual reset.

Compressor models SM/SZ175 - 185 R & C versions have been provided with a bimetallic single-pole, single-throw thermostat located in the motor windings. In the event of motor overheating caused by low refrigerant flow or improper motor rotation, the thermostat will open. Because the thermostat is an automatic reset device, it must be wired within a lockout safety circuit with a manual reset to restart the unit. For over-current and phase loss protection, an external overload protector must be used.

The external overload protector can be either a thermal overload relay or a circuit breaker:

A thermal overload relay should be set to trip at not more than 140% of the compressor-rated load current.

A circuit breaker, on the other hand, should be set at not more than 125% of the compressor rated load current.

The rated load current is the maximum current expected during operations of the considered application.

Further requirements for the external overload protector are:

- **Over-current protection:** the protector must trip within 2 minutes at 110% of the Maximum Must-Trip current (MMT).
- **Locked rotor protection:** the protector must trip within 10 seconds upon starting at a locked rotor current (LRA).
- **Single-phasing protection:** the protector must trip when one of the three phases fails.

Compressor models SY 240 - 300 - 380 and SM/SZ 185 P, X, Y versions are delivered with a pre-installed motor protection module inside the terminal box. This device provides for efficient and reliable protection against overheating and overloading as well as phase loss/reversal.

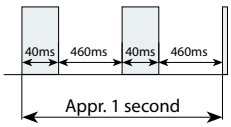
The motor protector comprises a control module and PTC sensors embedded in the motor winding. The close contact between thermistors and windings ensures a very low level of thermal inertia.

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 -ie. 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 ie. contacts M1-M2 are closed. The time delay may be cancelled by means of resetting the mains (L-N disconnect) for approximately 5 sec.

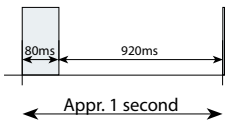
A red/green twin LED is visible on the module. A solid green LED denotes a fault free condition.

PTC overheat



A blinking red LED indicates an identifiable fault condition:

Delay timer active (after PTC overheat)



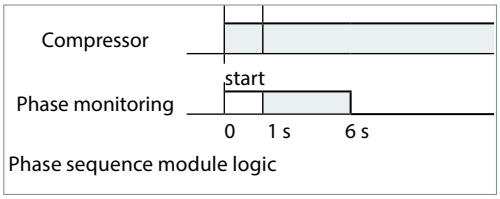
Phase sequence and reverse rotation protection

Use a phase meter to establish the phase orders and connect line phases L1, L2 and L3 to terminals T1, T2 and T3, respectively. The compressor will only operate properly in a single direction, and the motor is wound so that if the connections are correct, the rotation will also be correct.

Compressor model SM112-124-147 have no internal reverse rotation protection. If reverse rotation occurs it will be obvious as soon as power is turned on. The compressor will not build-up any pressure, the sound level will be abnormally high and power consumption will be minimal. In such case, shut down the compressor immediately and connect the phases to their proper terminals. Prolonged reverse rotation will damage the compressor.
⚠ A phase sequence detector is strongly recommended.

Compressor models SM/SZ084 to 185 (except SM112-124 & 147) incorporate an internal reverse vent valve which will react in the presence of reverse rotation and will allow refrigerant to circulate through a by-pass from the suction to the discharge. Although reverse rotation is not destructive, even over long periods of time up to several days it should be corrected as soon as possible. Reverse rotation will be obvious to the user as soon as power is turned on; the compressor will not build up any 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 internal motor protection.

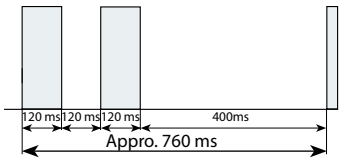
Compressor models SY240 to SY380 are delivered with an electronic module which provides protection against phase reversal and loss at start-up. Apply the recommended wiring diagrams. The circuit should be thoroughly checked in order to determine the cause of the phase problem before re-energizing the control circuit.
The phase sequencing and phase loss monitoring functions are active during a 5 sec. window 1 sec. after compressor start-up (power on L1-L2-L3).



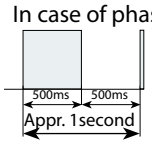
Phase sequence module logic

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:

In case of phase reverse error:



In case of phase loss error:



The lockout may be cancelled by resetting the power mains (disconnect L-N) for approximately 5 sec.

Voltage unbalance

The operating voltage limits are shown in the table section "Motor voltage". The voltage applied to the motor terminals must lie within these table limits during both start-up and normal operations. The maximum allowable voltage unbalance is 2%. Voltage unbalance causes high amperage over one or several phases, which in turn leads to overheating and possible motor damage. Voltage unbalance is given by the formula:

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

Vavg = Mean voltage of phases 1, 2, 3.
V1-2 = Voltage between phases 1 & 2.
V1-3 = Voltage between phases 1 & 3.
V2-3 = Voltage between phases 2 & 3.

Approvals and certificates

SM / SY / SZ scroll compressors comply with the following approvals and certificates.

Certificate are listed on: Documentation for Commercial Compressor | Danfoss

CE 0062 or CE 0038 or CE 0094 (European Directive)	CE	All SM / SY / SZ models
UL (Underwriters Laboratories)	c UL us	All 60 Hz SM / SY / SZ models
Other approvals / certificates		Contact Danfoss

Pressure equipment directive 2014/68/EU

Products	SM084 to 185	SY185	SZ084 to 185	SY 240 to 380
Refrigerating fluids	Group 2	Group 2	Group 2	Group 2
Category PED	II	II	II	II
Evaluation module	D1	D1	D1	D1
Maximum allowable Service temperature - Ts	-35°C < Ts < 63°C	-35°C < Ts < 61°C	-35°C < Ts < 54°C	-35°C < Ts < 52°C
Maximum allowable Service pressure - Ps	25 bar(g)	25 bar(g)	25 bar(g)	20 bar(g)
Declaration of conformity	Contact Danfoss			

Low voltage directive 2014/35/EU

Products	SM/SZ084 to SY380
Declaration of conformity	Contact Danfoss

Machines directives 2006/42/EC

Products	SM/SZ084 to SY380
Manufacturer's declaration of incorporation	Contact Danfoss

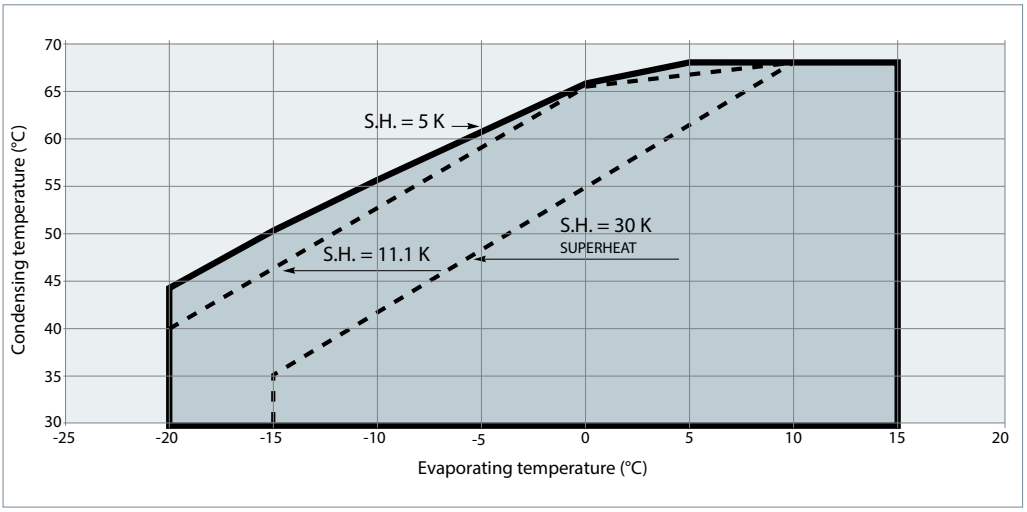
Internal free volume

Products	Internal free volume without oil (litre)
SM/SZ084-090-100	14.1
SM/SZ110-120	14.7
SM112-124-SM/SZ147	14.3
SM/SZ148-161	16.3
SM/SZ175-185 and SY185	31.2
SY240-300	39.1
SY380	40.4

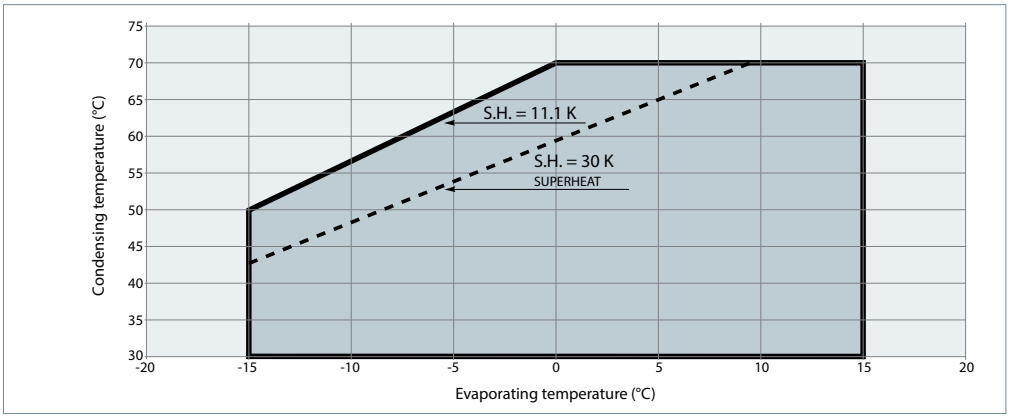
Application Guidelines	Operating conditions	
	The scroll compressor application range is influenced by several parameters which need to be monitored for a safe and reliable operation. These parameters and the main recommendations for good practice and safety devices are explained hereunder.	• **Refrigerant and lubricants** • **Motor supply** • **Compressor ambient temperature** • **Application envelope** (evaporating temperature, condensing temperature, return gas temperature).
Refrigerant and lubricants **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
R22	R22 is an HCFC refrigerant and is still a wide use today. It has a low ODP (Ozone Depletion Potential). Starting from 1st January 2010, the use of virgin R22 refrigerant is no longer allowed in the European Union. Refer to FRCC.EN.049 for R22 retrofit recommendations.	When R22 is applied in refrigeration applications it can lead to high discharge temperature. Carefully check all other parameters that can influence the discharge temperature.
R407C	R407C is an HFC refrigerant and has a zero ozone depletion potential (ODP=0) R407C is a zeotropic mixture and has a temperature glide of 7.4°C	but has a superior thermodynamic properties compared to R22.
R134a	R134a is an HFC refrigerant and has zero ozone depletion potential (ODP = 0). R134a is a pure refrigerant and has zero temperature glide. For	applications with high evaporating and high condensing temperatures, R134a is the ideal choice.
R513A	R513A is an HFO/HFC Blend, with similar thermodynamic properties to the R134a. R513A is an Azeotrope refrigerant with a negligible	glide. R513A has zero ozone depletion potential (ODP=0) and a Global Warming Potential (AR5) at 573
R404A	R404A is an HFC refrigerant and has zero ozone depletion potential (ODP = 0). R404A is especially suitable for low evaporating temperature applications but it can also be applied to medium evaporating temperature applications. R404A is a	mixture and has a very small temperature glide, and therefore must be charged in its liquid phase, but for most other aspects this small glide can be neglected. Because of the small glide, R404A is often called a near-azeotropic mixture.
R507	R507 is an HFC refrigerant with properties comparable to R404A. R507 has no ozone depletion potential (ODP = 0). As with R404A, R507 is particularly suitable for low evaporating	temperature applications but it can also be used for medium evaporating temperature applications. R507 is an azeotropic mixture with no temperature glide.
Mineral oil	Mineral oil can be applied in system using HCFC's refrigerant because it has a good miscibility with HCFC and oil that leave the compressor with refrigerant may not be trapped in lines or	exchangers. The chlorine contained in HCFC's improves lubricity in bearings used with mineral oil. Mineral oil has a very low hygroscopicity but may chemically react with water and form acids.
POE oil	Polyol Ester Oil (POE) is miscible with HFC's (while mineral oil is not), but has to be evaluated regarding lubricate ability in compressors. POE oil has better thermal stability than refrigerant mineral oil.	POE is more hygroscopic and also holds moisture more tightly than mineral oil. It also chemically react with water leading to acid and alcohol formation.

Application Guidelines	Operating conditions	
Motor supply	SM / SY / SZ scroll compressors can be operated at nominal voltages as indicated on "Motor voltage code" section. Under-voltage and over-voltage operation is allowed within the indicated	voltage ranges. In case of risk of under-voltage operation, special attention must be paid to current draw.
Compressor ambient temperature	SM / SY / SZ compressors can be applied from -35°C to +63°C (for SM/SZ084 to 185) and +53°C (for SY/SZ 240 to 380) ambient temperature. The compressors are designed as 100 % suction gas	cooled without need for additional fan cooling. Ambient temperature has very little effect on the compressor performance.
High ambient temperature	In case of enclosed fitting and high ambient temperature it's recommend to check the temperature of power wires and conformity to their insulation specification.	In case of safe tripping by the compressor overload protection the compressor must cool down to about 60°C before the overload will reset. A high ambient temperature can strongly delay this cool-down process.
Low ambient temperature	Although the compressor itself can withstand low ambient temperature, the system may require specific design features to ensure safe	and reliable operation. See section 'Specific application recommendations'.
Application envelope at dew temperatures	The operating envelopes for SM / SY / SZ scroll compressors are given in the figures below, where the condensing and evaporating temperatures represent the range for steady-state operation. Under transient conditions, such as start-up and defrost, the compressor may operate outside this envelope for short periods. The figures below show the operating envelopes for refrigerants R22, R407C, R134a, R404A, R507 and R513A.	The operating limits serve to define the envelope within which reliable operations of the compressor are guaranteed: • Maximum discharge gas temperature: +135°C • A suction superheat below 5 K (10 K for R407C) is not recommended due to the risk of liquid flood back • Maximum superheat of 30 K • Minimum and maximum evaporating and condensing temperatures as per the operating envelopes.

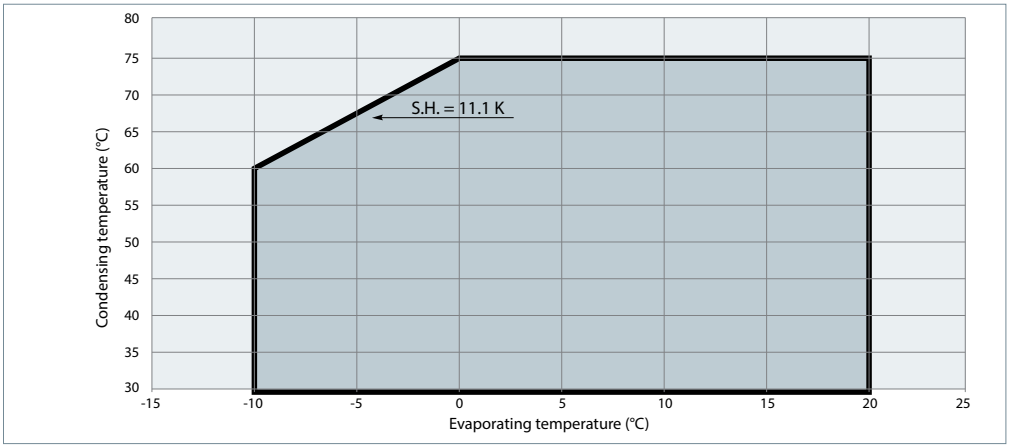
SM084 to 185
SY185 to 380
R22



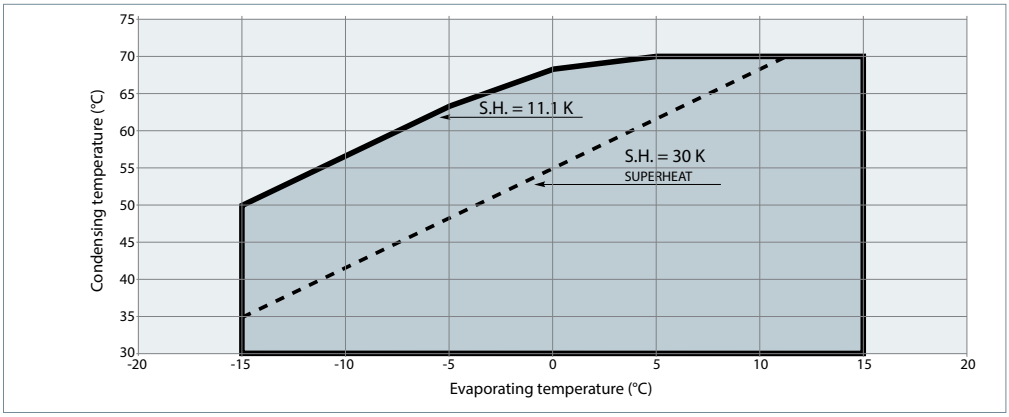
SZ084 to 185 (except SZ147) R134a



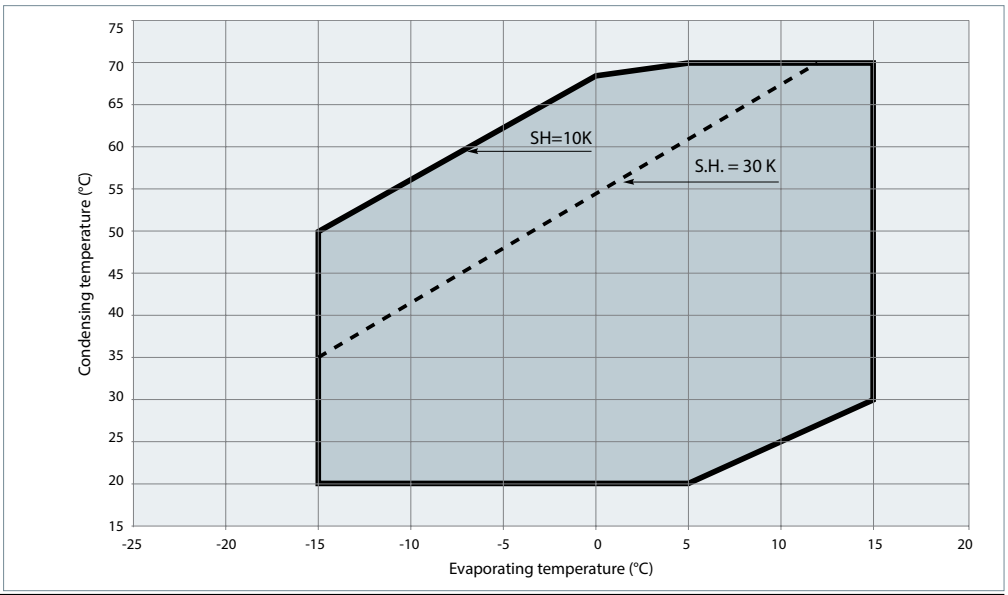
SZ147 R134a



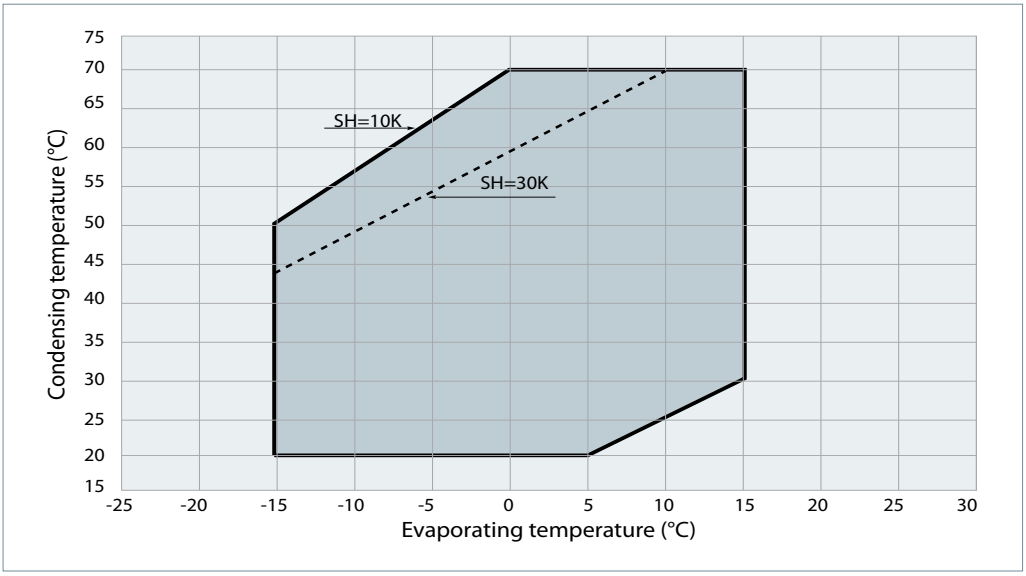
SY240 to 380 R134a



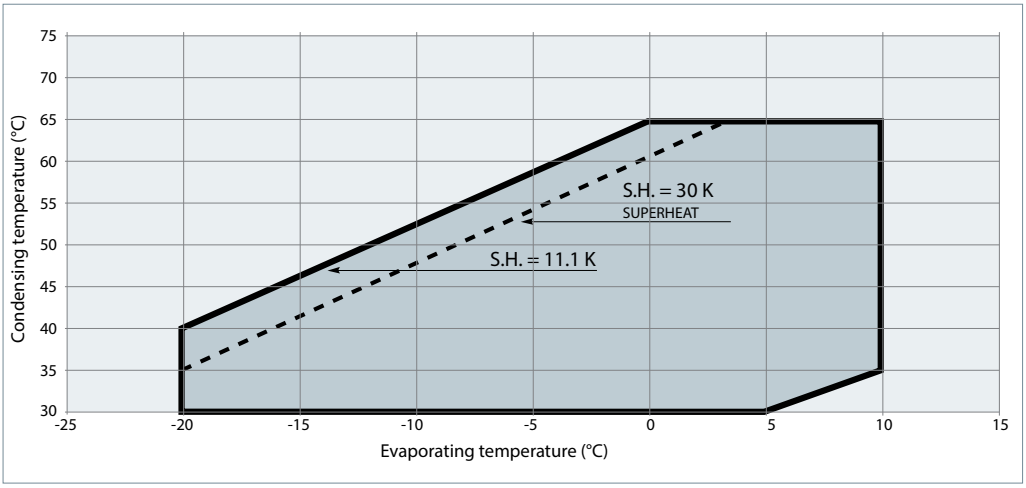
SY240 to 380 R513A



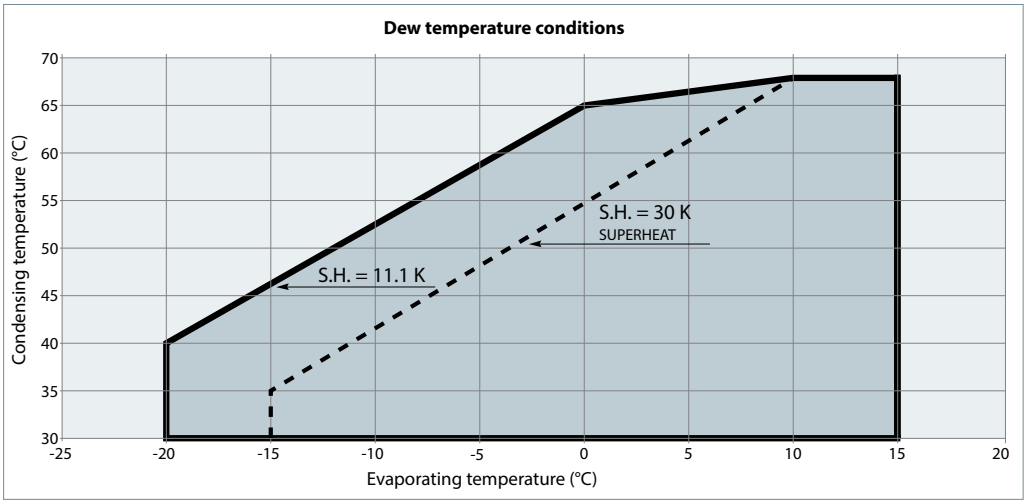
SZ148-185 / SY185
R513A



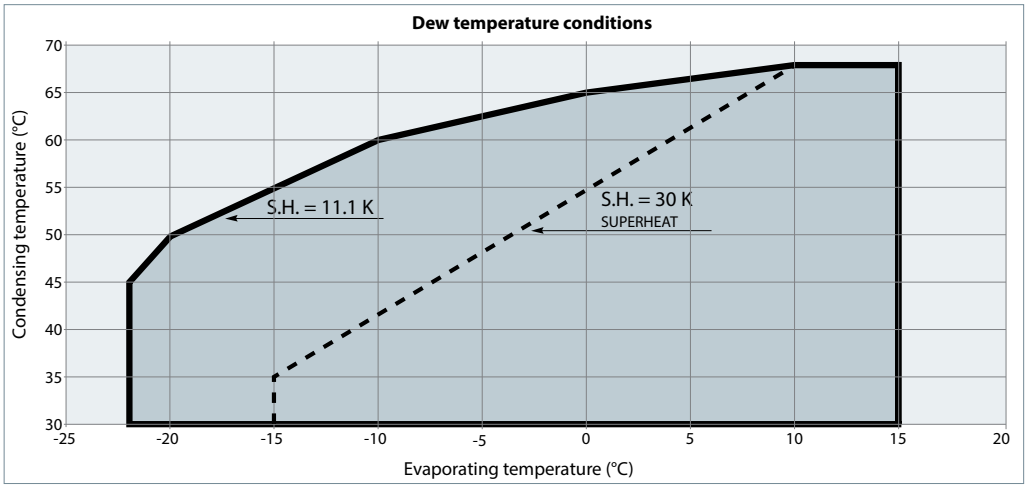
SZ084 to 185
R404A / R507A



SZ084 to 185 & SY185
R407C
at DEW temperature



SY240 to 380 R407C at DEW temperature

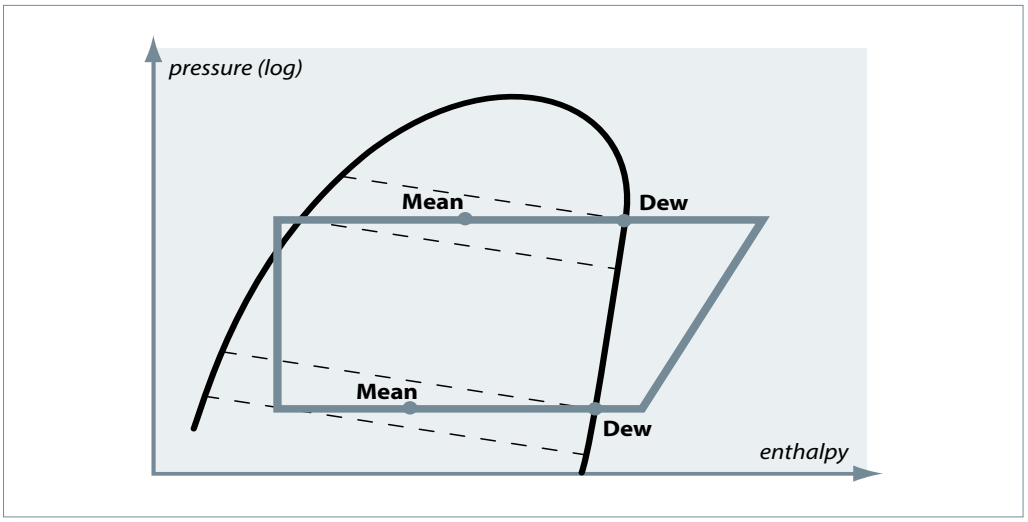


Application envelopes at mean temperatures

Refrigerant R407C is a zeotropic mixture, which causes a temperature glide in both the evaporator and condenser. When discussing evaporating and condensing temperatures therefore, it is important to indicate whether these are DEW point values or MEAN point values. In the figure below, the dashed lines reflect constant temperature and do not correspond with the constant pressure lines. For a given cycle, the MEAN point temperatures are typically about 2 to 3°C lower than DEW point temperatures. In these Selection and Application Guidelines, Danfoss Commercial Compressors displays temperatures as DEW point values.

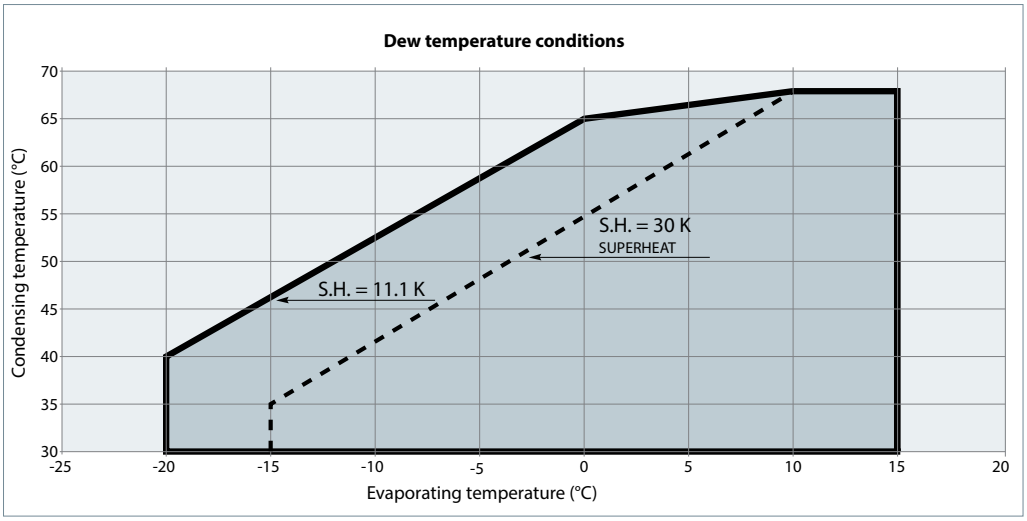
The performance tables for R407C are also based on DEW point values.

Dew temperature and mean temperature for R407C

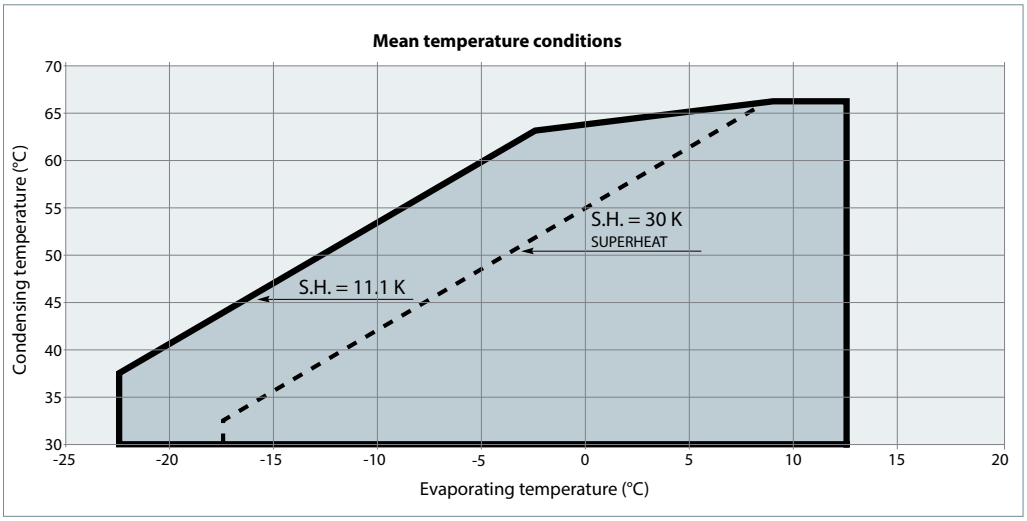


The following operating diagrams show the difference between mean and dew temperature application envelopes.

Dew temperature
Example for SZ 084 to 185



Mean temperature
Example for SZ 084 to 185



Discharge temperature protection

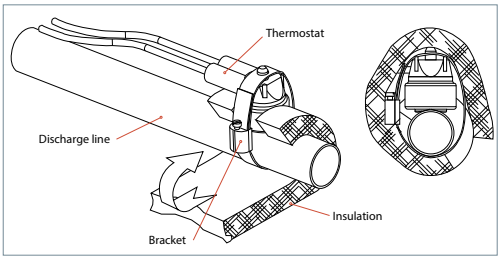
The discharge gas temperature must not exceed 135°C. The discharge gas thermostat accessory kit (code 7750009) includes all components required for installation, as shown below. The thermostat must be attached to the discharge line within 150 mm from the compressor discharge port and must be thermally insulated and highly fixed on the pipe.

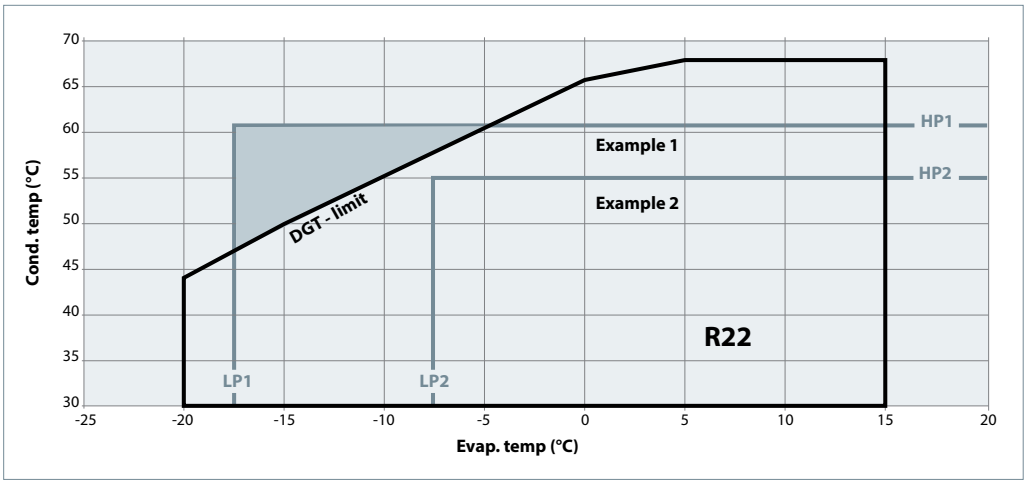
DGT protection is required if the high and low pressure switch settings do not protect the compressor against operations beyond its specific application envelope. Please refer to the examples on following page, which illustrates where DGT protection is required (ex.1) and where it is not (ex.2).

A discharge temperature protection device must be installed on all heat pumps. In reversible air-to-air and air-to-water heat pumps the discharge temperature must be monitored during development test by the equipment manufacturer.

The DGT should be set to open at a discharge gas temperature of 135°C.

The compressor must not be allowed to cycle on the discharge gas thermostat. Continuous operations beyond the compressor's operating range will cause serious damage to the compressor.





Example 1 (R22, SH = 11 K)
LP switch setting:
LP1 = 1.8 bar (g) (-17°C)
HP switch setting:
HP1 = 25 bar (g) (62°C)
Risk of operation beyond the application envelope.
DGT protection required.

Example 2 (R22, SH = 11 K)
LP switch setting:
LP2 = 2.9 bar (g) (-7°C)
HP switch setting:
HP2 = 21 bar (g) (55°C)
No risk of operation beyond the application envelope.
No DGT protection required.

Maximum Operating Pressure (MOP) protection

High evaporating temperature above map border introduce reliability risks for compressors, such as high oil dilution rate in oil sump, leading to low oil viscosity and thus bearing wear. Long time running in this map region may cause ultimately compressor failure. Hence Danfoss recommend customer to use expansion devices (EXV or TXV) with MOP function. The MOP setting value should be never higher than the maximum evaporating pressure specified in the operating envelop.

High and low pressure protection

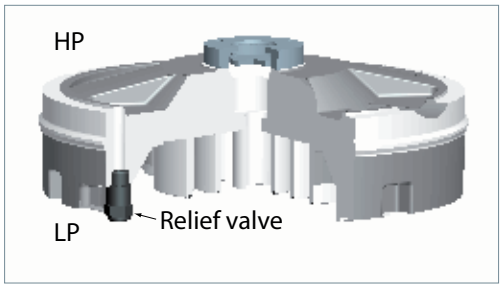
High pressure

A high-pressure (HP) safety switch is required to shut down the compressor should the discharge pressure exceed the values shown in the table next page. The high-pressure switch can be set to lower values depending on the application and ambient conditions. The HP switch must either be placed in a lockout circuit or consist of a manual reset device to prevent cycling around the high-pressure limit. If a discharge valve is used, the HP switch must be connected to the service valve gauge port, which must not be isolated.

Internal pressure relief valve

The SY240 to SY380 incorporate an internal relief valve set to open between the internal high and low pressure sides of the compressor when the pressure differential between the discharge and suction pressures surpasses 31 to 38 bar.

This safety feature prevents the compressor from developing dangerously high pressures should the high pressure cutout, for whatever reason, fail to shut down the compressor.



Low pressure

A low pressure (LP) safety switch must be used. Deep vacuum operations of a scroll compressor can cause internal electrical arcing and scroll instability. Danfoss scroll compressors exhibit high volumetric efficiency and may draw very low vacuum levels, which could induce such a problem. The minimum low-pressure safety switch (loss of charge safety switch) setting is given in the following table. For systems without pump-down, the LP safety switch must either be a manual lockout device or an automatic switch wired into an electrical lockout circuit. The LP switch tolerance must not allow for vacuum operations of the compressor. **LP switch settings for pump-down cycles** with automatic reset are also listed in the table below.

	R22 bar (g)	R407C bar (g)	R134a bar (g)	R404A/R507A bar (g)	R513A bar(g)
Working pressure range high side	10.9 - 27.7	10.5 - 29.1	6.7 - 20.2	12.7 - 31.1	5.12 - 20.87
Working pressure range low side	1.4 - 6.9	1.1 - 6.4	0.6 - 3.9	2 - 7.3	0.83 - 4.26
Maximum high pressure safety switch setting	28	29.5	20.5	31.5	22.27
Minimum low pressure safety switch setting *	0.5	0.5	0.5	0.5	0.5
Minimum low pressure pump-down switch setting **	1.3	1.0	0.5	1.8	0.6

*LP safety switch shall never be bypassed and shall have no time delay.
**Recommended pump-down switch settings: 1.5 bar (R22, R407C, R404A) or 1 bar (R134a) below nominal evaporating pressure.

Note that these two different low pressure switches also require different settings. The low pressure pump down switch setting must always be within the operating envelope, for example 1.3 bar for R22. The compressor can be operated full time under such condition. The minimum low pressure safety switch setting may be outside the normal operating envelope and should only be reached in exceptional (emergency) situations, for example 0.5 bar for R22.

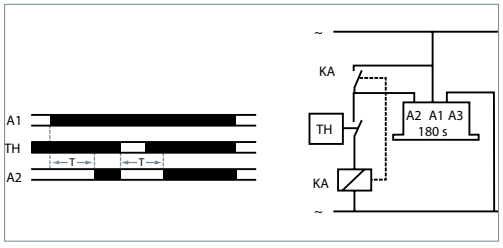
Cycle rate limit

Danfoss recommends a restart delay timer to limit compressor cycling. The timer prevents reverse compressor rotation, which may occur during brief power interruptions.

The system must be designed in a way that guarantees a minimum compressor running time of 2 minutes so as to provide for sufficient motor cooling after start-up along with proper oil return. Note that the oil return may vary since it depends upon system design.

There must be no more than 12 starts per hour (6 when a resistor soft-start accessory is introduced); a number higher than 12 reduces the service life of the motor-compressor unit. If necessary, place an anti-short-cycle timer in the control circuit, connected as shown in the wiring diagram section "Suggested wiring diagrams logic". A three-minute (180-sec) time out is recommended.

Please contact Danfoss Technical Support for any deviation from this guidelines.



General

Successful application of scroll compressors is dependent on careful selection of the compressor for the application. If the compressor is not correct for the system, it will operate beyond the limits given in this manual. Poor performance, reduced reliability, or both may result.

Essential piping design considerations

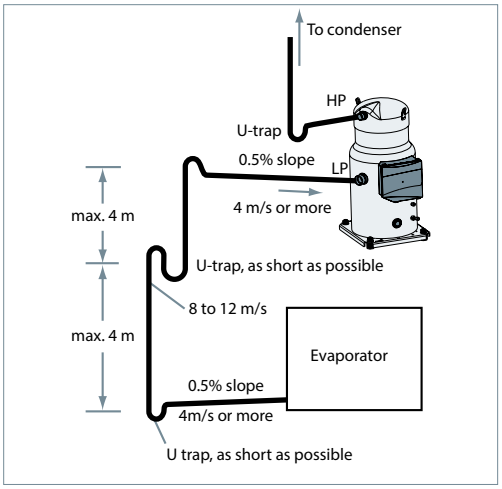
Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and slope of the tubing coming from the evaporator. Tubing returns from the evaporator should be designed so as not to trap oil and to prevent oil and refrigerant migration back to the compressor during off-cycles.

Piping should be designed with adequate three-dimensional flexibility. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. This protection proves necessary to avoid excess vibration, which can ultimately result in connection or tube failure due to fatigue or wear from abrasion. Aside from tubing and connection damage, excess vibration may be transmitted to the surrounding structure and generate an unacceptable noise level within that structure as well (for more information on noise and vibration, see the section on: "Sound and vibration management").

Suction lines

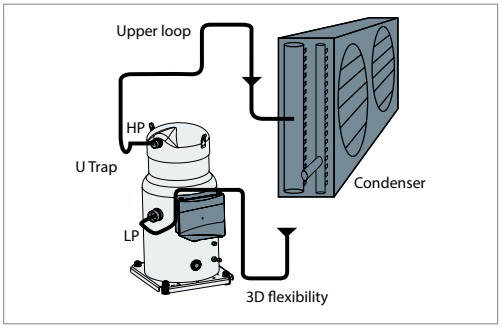
If the evaporator lies above the compressor, as is often the case in split or remote condenser systems, the addition of a pump-down cycle is strongly recommended. If a pump-down cycle were to be omitted, the suction line must have a loop at the evaporator outlet to prevent refrigerant from draining into the compressor during off-cycles.

If the evaporator were situated below the compressor, the suction riser must be trapped so as to prevent liquid refrigerant from collecting at the outlet of the evaporator while the system is idle, which would mislead the expansion valve's sensor (thermal bulb) at start-up.



Discharge lines

When the condenser is mounted at a higher position than the compressor, a suitably sized "U"-shaped trap close to the compressor is necessary to prevent oil leaving the compressor from draining back to the discharge side of the compressor during off cycle. The upper loop also helps avoid condensed liquid refrigerant from draining back to the compressor when stopped.



Heat exchangers

An evaporator with optimised distributor and circuit will give correct superheat at outlet and optimal use of the exchange surface. This is critical for plate evaporators that have generally a shorter circuit and a lower volume than shell & tubes and air cooled coils.

For all evaporator types a special care is required for superheat control leaving the evaporator and oil return.

A sub-cooler circuit in the condenser that creates high sub cooling will increase efficiency at high condensing pressure.

Furthermore, for good operation of the expansion device and to maintain good efficiency in the evaporator it is important to have an appropriate sub cooling. Without adequate sub cooling, flash gas will be formed at the expansion device resulting in a high degree of vapour at the expansion device inlet leading to low efficiency.

Refrigerant charge limit

Danfoss SM / SY / SZ compressors can tolerate liquid refrigerant up to a certain extend without major problems. However, excessive liquid refrigerant in the compressor is always unfavourable for service life. Besides, the installation cooling capacity may be reduced because of the evaporation taking place in the compressor and/or the suction line instead of the evaporator. System design must be such that the amount of liquid refrigerant in the compressor is limited. In this respect, follow the guidelines given in the section: "Essential piping design recommendations" in priority.

Use the tables below to quickly evaluate the required compressor protection in relation with the system charge and the application.

Compressor models	Refrigerant charge limit (kg)
S 084-090-100	8.5
S 110-120	10
S 112-124-147	7.9
S 148-161	12.5
S 175-185	13.5
S 240	16
S 300-380	20

	BELOW charge limit	ABOVE charge limit
Cooling only systems, Packaged units	✓ No test or additional safeties required	REQ Refrigerant migration & floodback test REQ Sump heater
Cooling only systems with remote condensor and split system units	REC Refrigerant migration & floodback test REC Crankcase heater, because full system charge is not definable (risk of overcharging)	REQ Refrigerant migration & floodback test REQ Sump heater REC Liquid receiver (in association with LLSV & pump down)
Reversible heat pump system	REQ Specific tests for repetitive floodback REQ Sump heater REQ Defrost test For more details refer to section "Reversible heat pump system".	

REC Recommended REQ Required ✓ No test or additional safeties required

Note: for special conditions such as low ambient temperature, low refrigerant load or brazed plate heat exchangers please refer to section "Low ambient temperature"

More detailed information can be found in the paragraphs hereafter. Please contact Danfoss Technical Support for any deviation from these guidelines.

Off-cycle migration

Off-cycle refrigerant migration is likely to occur when the compressor is located at the coldest part of the installation, when the system uses a bleed-type expansion device, or if liquid is allowed to migrate from the evaporator into the compressor sump by gravity. If too much liquid refrigerant accumulates in the sump it will saturate the oil and lead to a flooded start: when the compressor starts running again, the refrigerant evaporates abruptly under the sudden decrease of the bottom shell pressure, causing the oil to foam. In extreme situations, this might result in liquid slugging (liquid entering the scroll elements), which must be avoided as it causes irreversible damage to the compressor.

Danfoss SM/SZ/SY scroll compressors can tolerate occasional flooded starts as long as the total system charge does not exceed the maximum compressor refrigerant charge.

A suitable test to evaluate the risk of off-cycle migration is the following:

- Stabilize the non running system at 5°C ambient temperature,
- Raise the ambient temperature to 20°C and keep it for 10 minutes,
- Start the compressor and monitor sump temperature, sight glass indication and sound level.

The presence of liquid in the crankcase can be easily detected by checking the sump level through the oil sight glass. Foam in the oil sump indicates a flooded start.

A noisy start, oil loss from the sump and sump cool down are indications for migration. Depending on the amount of migration graduate measures shall be taken:

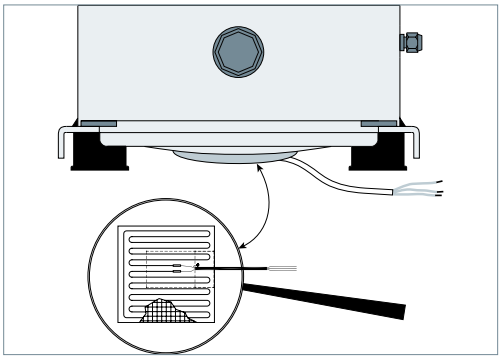
- **Sump heater**
- **Liquid line solenoid valve**
- **Pump down cycle**

Sump heater

The surface sump heaters are designed to protect the compressor against off cycle migration of refrigerant. When the compressor is idle, the oil temperature in the sump of the compressor must be maintained at no lower than 10 K above the saturation temperature of the refrigerant on the low-pressure side. This requirement ensures that the liquid refrigerant is not accumulating in the sump. A sump heater is only effective if capable of sustaining this level of temperature difference. Tests must be conducted to ensure that the appropriate oil temperature is maintained under all ambient conditions (temperature and wind). However, below -5°C ambient temperature and a wind speed of above 5 m/sec, we recommend that the heaters be thermally insulated in order to limit the surrounding energy losses.

Since the total system charge may be undefined, a sump heater is recommended on all stand-alone compressors and split systems. In addition, any system containing a refrigerant charge in excess of the maximum recommended system charge for compressors requires a crankcase heater. A crankcase heater is also required on all reversible cycle applications.

The heater must be energized for a minimum of 6 hours before initial start-up (compressor service valves opened) and must remain energized whenever the compressor is off. Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (eg. seasonal shutdown).



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

Liquid line solenoid valve (LLSV)

An LLSV may be used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer or excessive migration 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

A pump-down cycle represents one of the most effective ways to protect against the off-cycle migration of liquid refrigerant. Once the controls has been satisfied, a solenoid valve closes on the condenser outlet. The compressor then pumps the majority of the system charge into the condenser and receiver before the system stops on the low pressure pump-down switch. This step reduces the amount of charge on the low side in order to prevent off-cycle migration. Recommended settings of the low-pressure pump-down switch can be found in the table section "High and low pressure protection". For suggested wiring diagrams, please see section "Suggested wiring diagram logic".

In certain conditions, the discharge valve may not completely seal and result in compressor restarts during pump down applications. An external, non-bleeding check valve may need to be installed.

Tests for pump down cycle approval:

- As the pump-down switch setting is inside the application envelope, tests should be carried out to check unexpected cut-out during transient conditions (ie. defrost – cold starting). When unwanted cut-outs occur, the low pressure pump-down switch can be delayed. In this case a low pressure safety switch without any delay timer is mandatory.
- While the thermostat is off, the number of pressure switch resets should be limited to avoid short cycling of the compressor. Use dedicated wiring and an additional relay which allows for one shot pump-down.

The pump-down allows to store all the refrigerant in the high pressure side circuit. On unitary or close-coupled systems, where the system refrigerant charge is expected to be both correct and definable the entire system charge may be stored in the condenser during pump-down if all components have been properly sized.

Other application needs a liquid receiver to store the refrigerant.

Receiver dimensioning requires special attention. The receiver shall be large enough to contain part of the system refrigerant charge but it shall not be dimensioned too large. A large receiver easily leads to refrigerant overcharging during maintenance operation.

Liquid flood back

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

Danfoss SM/SY/SZ scroll compressors can tolerate occasional liquid flood back. However system design must be such that repeated and excessive flood back is not possible.

A continuous liquid flood back will cause oil dilution and, in extreme situations lead to lack of lubrication and high rate of oil leaving the compressor.

Liquid flood back test - Repetitive liquid flood back testing must be carried out under expansion valve threshold operating conditions: a high pressure ratio and minimum evaporator load, along with the measurement of suction superheat, oil sump temperature and discharge gas temperature.

During operations, liquid flood back may be detected by measuring either the oil sump temperature or the discharge gas temperature. If at any time during operations, the oil sump temperature drops to within 10K or less above the saturated suction temperature, or should the discharge gas temperature be less than 30K above the saturated discharge temperature, this indicates liquid flood back.

Continuous liquid flood back can occur with a wrong dimensioning, a wrong setting or malfunction of the expansion device or in case of evaporator fan failure or blocked air filters.

A suction accumulator providing additional protection as explained hereunder can be used to solve light continuous liquid flood back.

Suction accumulator

Suction accumulator: a suction accumulator offers protection against refrigerant flood back at start-up, during operations or defrosting by trapping the liquid refrigerant upstream from the compressor. Suction accumulator is highly recommended for system with high refrigerant charge (>0.7kg/TR capacity at ARI 60Hz). The suction accumulator also protects against off-cycle migration by providing additional internal free volume to the low side of the system.

A suction accumulator must be carefully dimensioned, taking into account the refrigerant charge as well as the gas velocity in the suction line.

The accumulator should not be sized for less than 50% of the total system charge. Tests must be conducted to determine the actual refrigerant holding capacity needed for the application.

Depending on the operating conditions it may happen that the recommended connections of the accumulator are one size smaller than the suction line.

Low ambient application

Low ambient start-up

Under cold ambient conditions (<0°C), upon start-up the pressure in the condenser and, if present, the receiver may be so low that a sufficient pressure differential across the expansion device cannot be developed to properly feed the evaporator. As a result, the compressor may go into a deep vacuum, which can lead to compressor failure due to internal arcing and instability in the scroll members. Under no circumstances should the compressor be allowed to operate under vacuum. The low-pressure control must be set in accordance with the table section "High and low pressure protection" in order to prevent this from happening.
Early feeding of the evaporator and management of the discharge pressure could help to attenuate these effects.
Low pressure differentials can also cause the expansion device to "hunt" erratically, which might cause surging conditions within the evaporator, with liquid spillover into the compressor. This effect is most pronounced during low load conditions, which frequently occur during low ambient conditions.

Low ambient operations

The Danfoss SM / SY / SZ scroll compressor requires a minimum pressure differential of 6 to 7 bar between the suction and discharge pressures to force the orbiting scroll down against the oil film on the thrust bearing. Anything less than this differential and the orbiting scroll can lift up, causing a metal-to-metal contact. It is therefore necessary to maintain sufficient discharge pressure in order to ensure this pressure differential. Care should be taken during low ambient operations when heat removal from air-cooled condensers is greatest and head pressure control may be required for low ambient temperature applications. Operation under low pressure differential may be observed by a significant increase in the sound power level generated by the compressor.

It is recommended that the unit be tested and monitored at minimum load and low ambient conditions as well. The following considerations should be taken into account to ensure proper system operating characteristics.

Expansion device: The expansion device should be sized to ensure proper control of the refrigerant flow into the evaporator. An oversized valve may result in erratic control. This consideration is especially important in manifolded units where low load conditions may require the frequent cycling of compressors. This can lead to liquid refrigerant entering the compressor if the expansion valve does not provide stable refrigerant super-heat control under varying loads.

The superheat setting of the expansion device should be sufficient to ensure proper superheat levels during low loading periods. A minimum of 5 K stable superheat is required.

Head pressure control under low ambient conditions: Several possible solutions are available to prevent the risk of compressor to vacuum and low pressure differential between the suction and discharge pressures.

In air-cooled machines, cycling the fans with a head pressure controller will ensure that the fans remain off until the condensing pressure has reached a satisfactory level. Variable speed fans can also be used to control the condensing pressure. In water-cooled units, the same can be performed using a water regulator valve that is also operated by head pressure, thereby ensuring that the water valve does not open until the condensing pressure reaches a satisfactory level.

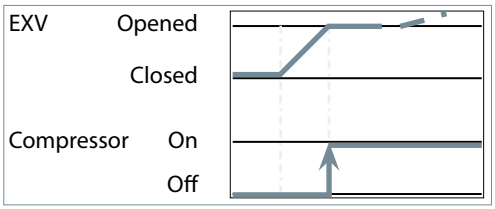
The minimum condensing pressure must be set at the minimum saturated condensing temperature shown in the application envelopes.

Under very low ambient conditions, in which testing has revealed that the above procedures might not ensure satisfactory condensing and suction pressures, the use of a head pressure control valve is recommended. Note: This solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is recommended and special care should be taken when designing the discharge line.

For further information, please contact Danfoss.

Sump heaters

Sump heaters are strongly recommended on all systems where the compressor is exposed to low ambient temperatures, especially split and remote condenser installations. The sump heater will minimize refrigerant migration caused by the large temperature gradient between the compressor and the remainder of the system, please refer to section "Off-cycle migration".

Application Guidelines	Specific application recommendations	
Low load operations	The compressors should be run for a minimum period in order to ensure that the oil has sufficient time to properly return to the	compressor sumps and that the motor has sufficient time to cool under conditions of lowest refrigerant mass flows.
Brazed plate heat exchangers	A brazed plate heat exchanger needs very little internal volume to satisfy the set of heat transfer requirements. Consequently, the heat exchanger offers very little internal volume for the compressor to draw vapour from on the suction side. The compressor can then quickly enter into a vacuum condition; it is therefore important that the expansion device be sized correctly and that a sufficient pressure differential across the expansion device be available to ensure adequate refrigerant feed into the evaporator. This aspect is of special concern when operating the unit under low ambient and load conditions. For further information on these conditions, please refer to the previous sections.	Due to the small volume of the brazed plate heat exchanger, no pump-down cycle is normally required. The suction line running from the heat exchanger to the compressor must be trapped to avoid refrigerant migration to the compressor. When using a brazed plate heat exchanger as the condensing coil, a sufficient free volume for the discharge gas to accumulate is required in order to avoid excess pressure buildup. At least 1 meter of discharge line is necessary to generate this volume. To help reduce the gas volume immediately after start-up even further, the supply of cooling water to the heat exchanger may be opened before the compressor starts up so as to remove superheat and condense the incoming discharge gas more quickly.
Electronic expansion valve	The use of an electronic expansion valve requires a specific compressor start / stop control. A specific compressor start sequence control has to be set when an electronic expansion valve (EXV) is used. The sequence must be adjusted according to the EXV step motor speed to allow time for the EXV to open before the compressor starts to avoid running under vacuum conditions. The EXV should be closed at compressor stop not to let refrigerant in liquid phase entering the	compressor. Ensure that the EXV closes when the supply voltage to the controller is interrupted (ie power cut off) by the use of a battery back-up. 
Reversible heat pump systems	Transients are likely to occur in reversible heat pump systems, i.e. a changeover cycle from cooling to heating, defrost or low-load short cycles. These transient modes of operation may lead to liquid refrigerant carryover (or floodback) or excessively wet refrigerant return conditions. As such, reversible cycle applications require specific precautions for ensuring a long compressor life and satisfactory operating characteristics. Regardless of the refrigerant charge in the system, specific tests for repetitive	floodback are required to confirm whether or not a suction accumulator needs to be installed. A crankcase heater and discharge gas thermostat are required for reversible heat pump applications. The following considerations cover the most important issues when dealing with common applications. Each application design however should be thoroughly tested to ensure acceptable operating characteristics.
Sump heaters	Sump heaters are mandatory on reversible cycle applications given the high probability of liquid migration back to the compressor sump	during off-cycles due to the outdoor location of most units and operations during low ambient conditions.
Discharge temperature thermostat	Heat pumps frequently utilize high condensing temperatures in order to achieve a sufficient temperature rise in the medium being heated. At the same time, they often require low evaporator pressures to obtain sufficient temperature differentials between the evaporator and the outside temperature. This situation may result in high discharge temperature; as such, it is mandatory that a discharge gas thermostat be installed on the discharge line to protect	the compressor from excessive temperatures. Operating the compressor at too high discharge temperatures can result in mechanical damage to the compressor as well as thermal degradation of the compressor lubricating oil and a lack of sufficient lubrication. The discharge gas thermostat should be set to shut down the compressor in the event discharge gas rises above 135°C.

Application Guidelines	Specific application recommendations	
Discharge line, reversing valve, solenoid valves	The Danfoss SM/SY/SZ scroll compressor is a high volumetric machine and, as such, can rapidly build up pressure in the discharge line if gas in the line becomes obstructed even for a very short period of time which situation may occur with slow-acting reversing valves in heat pumps. Discharge pressures exceeding the operating envelope may result in nuisance high-pressure switch cutouts and place excess strain on both the bearings and motor. To prevent such occurrences, it is important that a 1-meter minimum discharge line length be allowed between the compressor discharge port and the reversing valve or any other restriction. This gives sufficient free volume for the discharge gas to collect and to reduce the pressure peak during the time it takes for the valve to change	position. At the same time, it is important that the selection and sizing of the reversing or 4-way valve ensure that the valve switches quickly enough to prevent against too high discharge pressure and nuisance high-pressure cutouts. Check with the valve manufacturer for optimal sizing and recommended mounting positions. In applications with heat recovery or condenser partialisation, servo piloted solenoid valve has to be properly sized or associated with a second small valve in parallel, in order to avoid quick discharge pressure drops when opening. This phenomenon could lead to hammering effects and create constraints on the non return valve integrated in discharge fitting (SM/SY/SZ180 to 380).
Defrost and reverse cycle	The Danfoss SM/SY/SZ scroll compressor has the ability to withstand a certain amount of liquid refrigerant dynamic slug. When compressors are installed in parallel, in order to limit liquid amount handled per compressor when beginning and ending defrost, it is recommended to avoid running part load (keep all compressors running or keep them stopped when moving 4-way valves). For further details, please refer to Parallel application guidelines FRCC.PC.005.	EXV can also be opened when compressors are stopped and before 4 way valve is moving in order to decrease pressure difference. Opening degree and time have to be set in order to keep a minimum pressure difference for 4 way valve moving. Each application design however should be thoroughly tested to ensure acceptable operating characteristics.
Suction line accumulator	The use of a suction line accumulator is strongly recommended in reversible cycle applications as a result of the possibility of a substantial quantity of liquid refrigerant remaining in the evaporator, which acts as a condenser during the heating cycle. This liquid refrigerant can then return to the compressor, either flooding the sump with refrigerant or as a dynamic liquid slug when	the cycle switches back to a defrost cycle or to normal cooling operations. Sustained and repeated liquid slugging and floodback can seriously impair the oil's ability to lubricate the compressor bearings. This situation can be observed in wet climates where it is necessary to frequently defrost the outdoor coil in an air source heat pump. In such cases a suction accumulator becomes mandatory.
Water utilizing systems	Apart from residual moisture in the system after commissioning, water could also enter the refrigeration circuit during operation. Water in the system shall always be avoided. Not only because it can shortly lead to electrical failure, sludge in sump and corrosion but in particular because it can cause serious safety risks. Common causes for water leaks are corrosion and freezing. **Corrosion**: Materials in the system shall be compliant with water and protected against corrosion.	**Freezing**: When water freezes into ice its volume expands which can damage heat exchanger walls and cause leaks. During off periods water inside heat exchangers could start freezing when ambient temperature is lower than 0°C. During on periods ice banking could occur when the circuit is running continuously at too low load. Both situations should be avoided by connecting a pressure and thermostat switch in the safety line.

Starting sound level

During start-up transients it is natural for the compressor sound level to be slightly higher than during normal running. SM / SY / SZ scroll compressors exhibit very little increased start-up transient sound. If a compressor is miswired, the compressor will run in reverse. Reverse compressor rotation is characterized by an objectionable sound. To correct reverse rotation, disconnect power and switch any two of the three power leads at the unit contactor. Never switch leads at the compressor terminals.

Running sound level

Model	50 Hz				60 Hz				Acoustic hood code number	Bottom insulation code n° *
	R22		R407C		R22		R407C			
	Sound power dB(A)	Attenuation dB(A)	Sound power dB(A)	Attenuation dB(A)	Sound power dB(A)	Attenuation dB(A)	Sound power dB(A)	Attenuation dB(A)		
S 084	70	8	71	8	74	8	74	8	7755011	120Z0356
S 090	70	8	72	8	75	8	77	8	7755011	120Z0356
S 100	70	8	73	8	75	8	77	8	7755011	120Z0356
S 110	75	8	77	8	78	8	81	8	7755010	120Z0356
S 112	75	6	-	-	78	6	-	-	120Z0035	-
S 120	75	8	77	8	78	8	81	8	7755010	120Z0356
S 124	73	6	-	-	77	6	-	-	120Z0035	-
S 147 ①	74	6	77	8	78	6	81	8	120Z0035	-
S 148 ②	79	8	79	8	83	8	83	8	7755017	120Z0356
S 161 ②	79.5	8	79	8	84	8	83	8	7755017	120Z0356
S 175	80	8	81	8	82.5	8	84	8	7755007	120Z0353
S 185	80	8	81	8	82.5	8	84	8	7755007	120Z0353
S 240	82	7	83.5	7	85	7	87	7	7755016	120Z0355
S 300	82	7	84	7	86	7	87.5	7	7755016	120Z0355
S 380	87	7	87.5	7	92	7	91	7	7755022	120Z0355

① For SM/SZ147-3 - 50 Hz, use acoustic hood reference 120Z135
② For SM148 - 161 code 3, no acoustic hood available
Sound power and attenuation are given at rated ARI conditions, measured in free space.
* Bottom insulations are provided in surface sump heater accessories.
Materials are UL approved and RoHS compliant.

Stopping sound level

SM / SY / SZ compressors are equipped with a discharge valve which closes at compressor shut down and thus prevents the compressor from running backwards. This reduces the stopping sound to a metallic click caused by the closing valve.

When the pressure difference or gas flow at shut down should be very low, this can delay the discharge valve from closing and lead to a longer noise duration.

Sound generation in a refrigeration or air conditioning system

Typical sound and vibration in Refrigeration and Air-Conditioning systems encountered by design and service engineers may be broken down into the following three source categories.

Sound radiation: This generally takes an airborne path.

Mechanical vibrations: These generally extend along the parts of the unit and structure.

Gas pulsation: This tends to travel through the cooling medium, i.e. the refrigerant.

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

Compressor sound radiation

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

The Danfoss SM / SY / SZ scroll compressor is designed to be quiet and the frequency of the sound generated is pushed into the higher ranges, which not only are easier to reduce but also do not generate the penetrating power of lower-frequency sound.

Use of sound-insulation materials on the inside of unit panels is an effective means of substantially reducing the sound being transmitted to the outside. Ensure that no components capable of transmitting sound / vibration within the unit come into direct contact with any non-insulated parts on the walls of the unit.

Because of the Danfoss scroll's unique design of a full-suction gas-cooled motor, compressor body insulation across its entire operating range is possible. Acoustic hoods are available from Danfoss Commercial Compressors as accessories. They have been developed to meet specific extra low noise requirement. They incorporate sound proofing materials and offer excellent high and low frequency attenuation. These hoods are quick and easy to install and do not increase the overall size of the compressors to a great extend. Refer to section "Running sound level" for sound attenuation and code numbers.

Mechanical vibrations

Vibration isolation constitutes the primary method for controlling structural vibration. Danfoss SM / SY / SZ scroll compressors are designed to produce minimal vibration during operations. The use of rubber isolators on the compressor base plate or on the frame of a manifolded unit is very effective in reducing vibration being transmitted from the compressor(s) to the unit. Rubber grommets are supplied with all Danfoss compressors. Once the supplied rubber grommets have been properly mounted, vibration transmitted from the compressor base plate to the unit are held to a strict minimum. In addition, it is extremely important that the frame supporting the mounted compressor be of sufficient mass and stiffness to help dampen any residual vibration potentially transmitted to the frame. For further information on mounting requirements, please refer to the section on mounting assembly.

The tubing should be designed so as to both reduce the transmission of vibrations to other structures and withstand vibration without incurring any damage. Tubing should also be designed for three-dimensional flexibility. For more information on piping design, please see the section entitled "Essential piping design considerations".

Gas pulsation

The Danfoss SM / SY / SZ scroll compressor has been designed and tested to ensure that gas pulsation has been optimised for the most commonly encountered air conditioning pressure ratio. On heat pump installations and other installations where the pressure ratio lies beyond the typical range, testing should be conducted under all expected conditions and operating configurations to ensure that minimum gas pulsation is present. If an unacceptable level is identified, a discharge muffler with the appropriate resonant volume and mass should be installed. This information can be obtained from the component manufacturer.

Each SM / SY / SZ compressor is shipped with printed Instructions for installation. These instructions can also be downloaded from our web site: www.danfoss.com or directly from: http://instructions.cc.danfoss.com

Compressor handling and storage

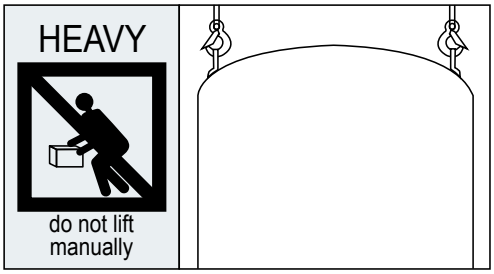
Each Danfoss SM / SY / SZ scroll compressor is equipped with two lift rings on the top shell. Always use both these rings when lifting the compressor. Use lifting equipment rated and certified for the weight of the compressor. A spreader bar rated for the weight of the compressor is highly recommended to ensure a better load distribution. The use of lifting hooks closed with a clasp and certified to lift the weight of the compressor is also highly recommended. Always respect the appropriate rules concerning lifting objects of the type and weight of these compressors. Maintain the compressor in an upright position during all handling manoeuvres (maximum of 15° from vertical).

⚠ Never use only one lifting lug to lift the compressor. The compressor is too heavy for the single lug to handle, and the risk is run that the lug could separate from the compressor with extensive damage and possible personal injury as a result.

Store the compressor not exposed to rain, corrosive or flammable atmosphere between -35°C and 53°C when charged with refrigerant and between -35°C and 70°C when charged with nitrogen.

⚠ When the compressor is mounted as part of an installation, never use the lift rings on the compressor to lift the installation. The risk is run that the lugs could separate from the compressor or that the compressor could separate from the base frame with extensive damage and possible personal injury as a result.

Never apply force to the terminal box with the intention of moving the compressor, as the force placed upon the terminal box can cause extensive damage to both the box and the components contained inside.



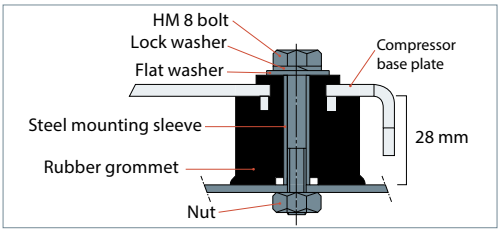
Compressor mounting

Maximum inclination from the vertical plane while operating must not exceed 3 degrees.

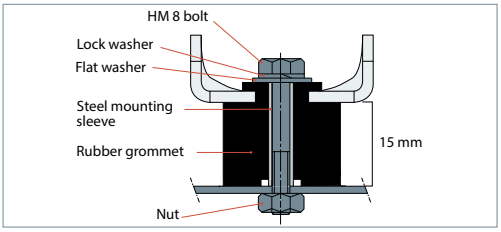
All compressors come delivered with four rubber mounting grommets and metal sleeve liners that serve to isolate the compressor from the base frame. These grommets must always be used to mount the compressor in single application.

These grommets attenuate to a great extent the transmission of compressor vibrations to the base frame. The grommets must be compressed until contact between the flat washer and the steel-mounting sleeve is established.

Mounting of SM/SZ 084-090-100-110-120-148-161-175-185: the required bolt size is HM8. This bolt must be tightened to a torque of 21 Nm. The bolts and washers are supplied with the assembly kit.

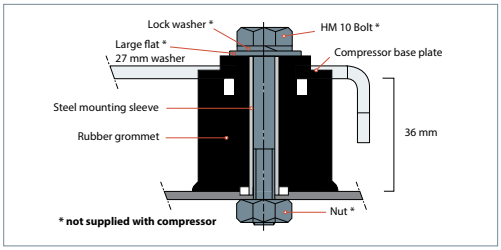


Mounting of SM/SZ 112-124-147: the required bolt size is HM8. This bolt must be tightened to a torque of 15 Nm. The bolt and washers are supplied with the assembly kit. When a surface sump heater is used, it must be applied after grommets are mounted on compressor in order to avoid surface sump heater damage.



Mounting of SY 240-300-380: the required bolt size is HM10. The minimum required flat washer outside diameter is 27 mm. Mounting bolts must be tightened to a torque of 40 Nm. These bolts and washers are not supplied with the compressor.
Note: The large flat washer must be positioned in place before shipping the unit with the compressor installed.

Note: for parallel assemblies see specific recommendations in Danfoss parallel application guidelines, FRCC.PC.005.



Compressor holding charge

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

Before the suction and discharge plugs are removed, the nitrogen holding charge must be released via the suction schrader valve to avoid an oil mist blowout. Remove the suction plug first and the discharge plug afterwards. The plugs shall be removed only just before connecting the compressor to the installation in order to avoid moisture from entering the compressor. When the plugs are removed, it is essential to keep the compressor in an upright position so as to avoid oil spillage.

System cleanliness

The refrigerant compression system, regardless of the type of compressor used, will only provide high efficiency and good reliability, along with a long operating life, if the system contains solely the refrigerant and oil it was designed for. Any other substances within the system will not improve performance and, in most cases, will be highly detrimental to system operations.

The presence of non-condensable substances and system contaminants, such as metal shavings, solder and flux, have a negative impact on compressor service life. Many of these contaminants are small enough to pass through a mesh screen and can cause considerable damage within a bearing assembly. The use of highly-hygroscopic polyester oil in SZ compressors requires that the oil be exposed to the atmosphere just as little as possible.

System contamination is one of main factors affecting equipment reliability and compressor service life. It is important therefore to take system cleanliness into account when assembling a refrigeration system.

During the manufacturing process, circuit contamination may be caused by:
• Brazing and welding oxides,
• Filings and particles from the removal of burrs in pipe-work,
• Brazing flux,
• Moisture and air.

Consequently, when building equipment and assemblies, the precautions listed in the following paragraphs must be taken.

Tubing

Only use clean and dehydrated refrigeration grade copper tubing. Tube cutting must be carried out so as not to deform the tubing roundness and to ensure that no foreign debris remains within the tubing. Only refrigerant-grade fittings should be used and these must be of both a design and size to allow for a minimum pressure drop through the completed assembly. Follow the brazing instructions next pages.

Never drill holes into parts of the pipe-works where fillings and particles can not be removed.

Brazing and soldering

Do not blend the compressor discharge or suction lines or force system piping into the compressor connections, because this will increase stresses that are a potential cause of failure. Recommended brazing procedures and material, are described on following page. Never drill holes into parts of the pipe-works. Where fillings and particles can not be removed.

Copper to copper connections

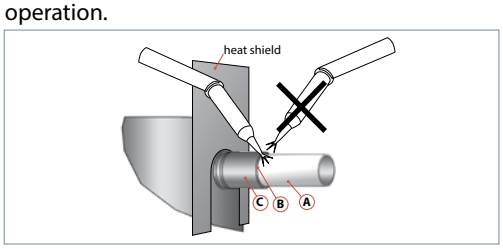
When brazing copper-to-copper connections, the use of a copper / phosphorus brazing alloy containing 5% silver or more with a melting temperature of below 800°C is recommended. No flux is required during brazing.

Dissimilar metals connection

When manipulating dissimilar metals such as copper and brass or steel, the use of silver solder and anti-oxidant flux is necessary.

Compressor connection

When brazing the compressor fittings, do not overheat the compressor shell, which could severely damage certain internal components due to excessive heating. Use of a heat shield and/or a heat-absorbent compound is highly recommended. Due to the relatively sizable tubing and fitting diameters used for the large scroll, a double tipped torch using acetylene is recommended for the S240-300-380 brazing operation.



For rotolock version compressors, solder sleeves are available. For brazing the suction and discharge connections, the following procedure is advised:

- Make sure that no electrical wiring is connected to the compressor.
- Protect the terminal box and compressor painted surfaces from torch heat damage (see diagram).
- Remove the teflon gaskets when brazing rotolock connectors with solder sleeves.
- Use only clean refrigeration-grade copper tubing and clean all connections.
- Use brazing material with a minimum of 5% silver content.
- Purge nitrogen or CO_2 through the compressor in order to prevent against oxidation and flammable conditions. The compressor should not be exposed to the open air for extended periods.
- Use of a double-tipped torch is recommended.
- Apply heat evenly to Area A until the brazing temperature is reached. Move the torch to Area B and apply heat evenly until the brazing temperature has been reached there as well, and then begin adding the brazing material. Move the torch evenly around the joint, in applying only enough brazing material to flow the full circumference of the joint.
- Move the torch to Area C only long enough to draw the brazing material into the joint, but not into the compressor.
- Remove all remaining flux once the joint has been soldered with a wire brush or a wet cloth. Remaining flux would cause corrosion of the tubing.

In addition, for discharge connections equipped with a non return valve integrated in discharge fitting (SY/SZ240-300) the direction of the torch has to be as described on the picture, and maximum brazing time should be less than 2 minutes to avoid NRVI damages.

Ensure that no flux is allowed to enter into the tubing or compressor. Flux is acidic and can cause substantial d amage to the internal parts of the system and compressor.

The polyolester oil used in SY / SZ compressors is highly hygroscopic and will rapidly absorb moisture from the air. The compressor must therefore not be left open to the atmosphere for a long period of time. The compressor fitting plugs shall be removed just before brazing the compressor.

⚠ Before eventual unbrazing the compressor or any system component, the refrigerant charge must be removed from both the high and low pressure sides. Failure to do so may result in serious personal injury. Pressure gauges must be used to ensure all pressures are at atmospheric level.

For more detailed information on the appropriate materials required for brazing or soldering, please contact the product manufacturer or distributor. For specific applications not covered herein, please contact Danfoss Commercial Compressors for further information.

System pressure test

Always use an inert gas such as nitrogen for pressure testing. Never use other gasses such as oxygen, dry air or acetylene as these may form an inflammable mixture. Do not exceed the following pressures:

Maximum compressor test pressure (low side)	SM/SZ 084 - 185: 25 bar (g)	SY240 to 380: 22 bar (g)
Maximum compressor test pressure (high side)	32 bar (g)	
Maximum pressure difference between high and low side of the compressor:	24 bar	

Pressurize the system on HP side first then LP side to prevent rotation of the scroll. Never let the pressure on LP side exceed the pressure on HP side with more than 5 bar.
On SY/SZ240-300 models which have an internal non return-valve in discharge fitting or if an external non return valve is present on the discharge line, we advise to pressurize the system not quicker than 4.8 bar/s to allow enough pressure equalisation between LP and HP side over the scroll elements.

Leak detection

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

- Always use an inert gas such as Nitrogen or Helium
- Pressurize the system on HP side then LP side
- Do not exceed the test pressures indicated in the previous section "System pressure test"

Vacuum evacuation and moisture removal

Moisture obstructs the proper functioning of the compressor and the refrigeration system.

Air and moisture reduce service life and increase condensing pressure, and cause excessively high discharge temperatures, which can destroy the lubricating properties of the oil. Air and moisture also increase the risk of acid formation, giving rise to copper platting. All these phenomena can cause mechanical and electrical compressor failure.

For these reasons it's important to perform a vacuum dehydration on the system to remove all residual moisture from the pipe-work after assembly; SM / SY / SZ compressors are delivered with < 100 ppm moisture level. The required moisture level in the circuit after vacuum dehydration must be < 100 ppm for systems with an SM / SY / SZ.

- Never use the compressor to evacuate the system.
- Connect a vacuum pump to both the LP & HP sides.
- Evacuate the system to a pressure of 500 µmHg (0.67 mbar) absolute.

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

Filter driers

A properly sized & type of drier is required. Important selection criteria include the driers water content capacity, the system refrigeration capacity and the system refrigerant charge. The drier must be able to reach and maintain a moisture level of 50 ppm end point dryness (EPD).

For new installations with SM/SY/SZ compressors with polyolester oil, Danfoss recommends using the Danfoss DML (100% molecular sieve) solid core filter drier. Molecular sieve filter driers with loose beads from third party suppliers shall be avoided. For servicing of existing installations where acid formation is present the Danfoss DCL (solid core) filter driers containing activated alumina are recommended.

The drier is to be oversized rather than under sized. When selecting a drier, always take into account its capacity (water content capacity), the system refrigeration capacity and the system refrigerant charge.

After burn out, remove & replace the liquid line filter drier and install a Danfoss type DAS burn-out drier of the appropriate capacity. Refer to the DAS drier instructions and technical information for correct use of the burnout drier on the liquid line.Also for new installations with SM compressors with mineral oil the Danfoss DCL drier is recommended.

Refrigerant charging

For the initial charge the compressor must not run and eventual service valves must be closed. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. This initial charging operation must be done in liquid phase. The best location is on the liquid line between the condenser outlet and the filter drier. Then during commissioning, when needed, a complement of charge can be done in liquid phase: slowly throttling liquid in on the low pressure side as far away as possible from the compressor suction connection while compressor is running. The refrigerant charge quantity must be suitable for both summer and winter operations.

Vacuum or charge from one side can seal the scrolls and result in a non-starting compressor. When servicing, always ensure that LP/HP pressures are balanced before starting the compressor.

Be sure to follow all government regulations regarding refrigerant reclamation and storage. For more detailed information, see "Recommended refrigerant system charging practice" news bulletin FRCC.EN.050.

Insulation resistance and dielectric strength

Insulation resistance must be higher than 1 megohm when measured with a 500 volt direct current megohm tester.

Each compressor motor is tested at the factory with a high potential voltage (hi-pot) that exceeds the UL requirement both in potential and in duration. Leakage current is less than 5 mA.

SM/SY/SZ scroll compressors are configured with the pump assembly at the top of the shell, and the motor below. As a result, the motor can be partially immersed in refrigerant and oil. 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.

In testing insulation resistance, Danfoss recommends that the system be first operated briefly to distribute refrigerant throughout the system. Following this brief operation, retest the compressor for insulation resistance or current leakage.

Never reset a breaker or replace a fuse without first checking for a ground fault (a short circuit to ground). Be alert for sounds of arcing inside the compressor.

Commissioning

The system must be monitored after initial start-up for a minimum of 60 minutes to ensure proper operating characteristics such as:
- Proper metering device operation and desired super heat readings,
- Suction and discharge pressure are within acceptable levels,
- Correct oil level in compressor sump indicating proper oil return,
- Low foaming in sight glass and compressor sump temperature 10 K above saturation temperature to show that there is no refrigerant migration taking place,
- Acceptable cycling rate of compressors, including duration of run times,
- Current draw of individual compressors within acceptable values (max. operating current),
- No abnormal vibrations and noise.

Oil level checking and top-up

In installations with good oil return and line runs up to 20 m, no additional oil is required. If installation lines exceed 20 m, additional oil may be needed. 1 or 2% of the total system refrigerant charge (in weight) can be used to roughly define the required oil top-up quantity but in any case the oil charge has to be adjusted based on the oil level in the compressor sight glass.

When the compressor is running under stabilized conditions the oil level must be visible in the sight glass.

The presence of foam filling in the sight glass indicates large concentration of refrigerant in the oil and / or presence of liquid returning to the compressor.

The oil level can also be checked a few minutes after the compressor stops.

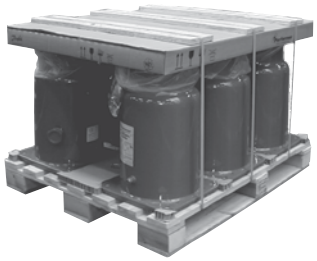
When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

Always use original Danfoss oil from new cans.

Compressor series	Oil
SM	Mineral oil 160P
SY	P.O.E. 320 SZ
SZ	P.O.E. 160 SZ

Top-up the oil while the compressor is idle. Use the schrader connector or any other accessible connector on the compressor suction line and a suitable pump. See News bulletin “Lubricants filling in instructions for Danfoss Commercial Compressors”.

Packaging



Compressor models	Single pack				Industrial pack					
	Length mm	Width mm	Height mm	Gross weight kg	Nbr*	Length mm	Width mm	Height mm	Gross weight kg	Static stacking pallets
SM/SZ084	565	470	671	75	8	1140	950	707	550	3
SM/SZ090	565	470	671	76	8	1140	950	707	566	3
SM/SZ100	565	470	671	76	8	1140	950	707	566	3
SM/SZ110-120	565	470	749	85	8	1140	950	757	638	3
SM112	565	470	718	76	8	1150	950	745	543	3
SM124	565	470	718	76	8	1150	950	745	543	2
SM/SZ147	565	470	718	79	8	1150	950	745	566	2
SM/SZ148-161	565	470	749	100	6	1140	950	790	546	3
SM/SZ175-185 - SY185	565	470	837	115	6	1140	950	877	648	2
SY240	760	600	900	163	4	1140	950	904	635	2
SY300	760	600	900	170	4	1140	950	915	635	2
SY380	760	600	900	171	4	1140	950	939	647	2

* Nbr = number of compressors per pallet

Ordering information

Danfoss scroll compressors may be ordered from Danfoss Commercial Compressors in either industrial packs or in single packs as listed in following tables For tandem assemblies, please refer to the Danfoss parallel application guideline reference FRCC.PC.005.

SM-SY Single

Compressor model	Connections	Motor protection	Code no.		
			3	4	9
			200-230V/3/60Hz	460V/3/60Hz 380-400V/3/50Hz	380V/3/60Hz
SM084	Brazed	Internal	-	SM084-4VI	-
SM090	Brazed	Internal	SM090-3VI	SM090-4VI	-
SM100	Brazed	Internal	SM100-3VI	SM100-4VI	SM100-9VI
SM110	Brazed	Internal	SM110-3VI	SM110-4VI	SM110-9VI
SM112	Brazed	Internal	-	120H0611	-
SM120	Brazed	Internal	SM120-3VI	SM120-4VI	SM120-9VI
SM124	Brazed	Internal	120H0183	120H0185	120H0187
SM147	Brazed	Internal	120H0189	120H0191	120H0197
SM148	Brazed	Internal	SM148-3VAI	SM148-4VAI	SM148-9VAI
SM161	Brazed	Internal	SM161-3VAI	SM161-4VAI	SM161-9VAI
SM175	Brazed	Thermostat	SM175-3CAI	SM175-4CAI	-
	Rotolock	Thermostat	-	SM175-4RI	-
SM185	Brazed	Thermostat	SM185-3CAI	SM185-4CAI	SM185-9CAI
	Brazed	Module 24V AC	-	SM185-4PCI	-
	Brazed	Module 110-240V AC	-	-	-
	Rotolock	Thermostat	SM185-3RI	SM185-4RI	SM185-9RI
	Rotolock	Module 110-240V AC	-	SM185-4YCI	SM185-9YCI
SY185	Brazed	Thermostat	-	SY185-4CAI	-
	Rotolock	Thermostat	-	SY185-4RI	-
SY240	Brazed	Module 24V AC	-	SY240A4CAI	-
	Brazed	Module 110-240V AC	SY240A3CBI	SY240A4CBI	SY240A9CBI
	Rotolock	Module 24V AC	-	SY240A4PAI	-
	Rotolock	Module 110-240V AC	-	SY240A4PBI	-
SY300	Brazed	Module 24V AC	-	SY300A4CAI	-
	Brazed	Module 110-240V AC	SY300A3CBI	SY300A4CBI	SY300A9CBI
	Rotolock	Module 24V AC	-	SY300A4PAI	-
	Rotolock	Module 110-240V AC	-	SY300A4PBI	-
SY380	Brazed	Module 24V AC	-	SY380A4CAI	-
	Brazed	Module 110-240V AC	-	SY380A4CBI	120H1115

SM-SY Industrial

Compressor model	Connections	Motor protection	Code no.		
			3	4	9
			200-230V/3/60Hz	460V/3/60Hz 380-400V/3/50Hz	380V/3/60Hz
SM084	Brazed	Internal	-	SM084-4VM	-
SM090	Brazed	Internal	SM090-3VM	SM090-4VM	SM090-9VM
SM100	Brazed	Internal	SM100-3VM	SM100-4VM	SM100-9VM
SM110	Brazed	Internal	SM110-3VM	SM110-4VM	SM110-9VM
SM112	Brazed	Internal	120H0610	120H0612	120H0614
SM120	Brazed	Internal	SM120-3VM	SM120-4VM	SM120-9VM
SM124	Brazed	Internal	120H0184	120H0186	120H0188
SM147	Brazed	Internal	120H0190	120H0311	120H0198
	Brazed *	Internal	-	120H1179	-
SM148	Brazed	Internal	SM148-3VAM	SM148-4VAM	SM148-9VAM
SM161	Brazed	Internal	SM161-3VAM	SM161-4VAM	SM161-9VAM
SM175	Brazed	Thermostat	-	-	-
	Rotolock	Thermostat	-	SM175-4RM	-
SM185	Brazed	Thermostat	SM185-3CAM	SM185-4CAM	SM185-9CAM
	Brazed	Module 24V AC	-	SM185-4PCM	-
	Brazed	Module 110-240V AC	-	SM185-4XCM	-
	Rotolock	Thermostat	SM185-3RM	SM185-4RM	SM185-9RM
	Rotolock	Module 110-240V AC	-	SM185-4YCM	SM185-9YCM
SY185	Brazed	Thermostat	-	SY185-4CAM	-
SY240	Brazed	Module 24V AC	-	SY240A4CAM	-
	Brazed	Module 110-240V AC	SY240A3CBM	SY240A4CBM	SY240A9CBM
	Rotolock	Module 24V AC	-	SY240A4PAM	-
	Rotolock	Module 110-240V AC	SY240A3PBM	SY240A4PBM	SY240A9PBM
SY300	Brazed	Module 24V AC	-	SY300A4CAM	-
	Brazed	Module 110-240V AC	SY300A3CBM	SY300A4CBM	SY300A9CBM
	Rotolock	Module 24V AC	-	SY300A4PAM	-
	Rotolock	Module 110-240V AC	SY300A3PBM	SY300A4PBM	SY300A9PBM
SY380	Brazed	Module 24V AC	-	SY380A4CAM	-
	Brazed	Module 110-240V AC	-	SY380A4CBM	120H1116

* Single installation version without oil equalization and sight glass

SZ Single

Compressor model	Connections	Motor protection	Code no.		
			3	4	9
			200-230V/3/60Hz	460V/3/60Hz 380-400V/3/50Hz	380V/3/60Hz
SZ084	Brazed	Internal	-	SZ084-4VI	-
SZ090	Brazed	Internal	SZ090-3VI	SZ090-4VI	SZ090-9VI
SZ100	Brazed	Internal	SZ100-3VI	SZ100-4VI	SZ100-9VI
SZ110	Brazed	Internal	SZ110-3VI	SZ110-4VI	SZ110-9VI
SZ120	Brazed	Internal	SZ120-3VI	SZ120-4VI	SZ120-9VI
SZ147	Brazed	Internal	-	120H1096	-
SZ148	Brazed	Internal	SZ148-3VAI	SZ148-4VAI	SZ148-9VAI
SZ161	Brazed	Internal	SZ161-3VAI	SZ161-4VAI	SZ161-9VAI
SZ175	Brazed	Thermostat	-	SZ175-4CAI	-
	Rotolock	Thermostat	-	SZ175-4RI	-
SZ185	Brazed	Thermostat	SZ185-3CAI	SZ185-4CAI	SZ185-9CAI
	Brazed	Module 24V AC	-	SZ185-4PCI	-
	Rotolock	Thermostat	SZ185-3RI	SZ185-4RI	SZ185-9RI

SZ Industrial

Compressor model	Connections	Motor protection	Code no.		
			3	4	9
			200-230V/3/60Hz	460V/3/60Hz 380-400V/3/50Hz	380V/3/60Hz
SZ084	Brazed	Internal	-	SZ084-4VM	-
SZ090	Brazed	Internal	SZ090-3VM	SZ090-4VM	SZ090-9VM
SZ100	Brazed	Internal	-	SZ100-4VM	SZ100-9VM
SZ110	Brazed	Internal	SZ110-3VM	SZ110-4VM	SZ110-9VM
SZ120	Brazed	Internal	SZ120-3VM	SZ120-4VM	SZ120-9VM
SZ147	Brazed	Internal	-	120H1097	-
SZ148	Brazed	Internal	SZ148-3VAM	SZ148-4VAM	-
SZ161	Brazed	Internal	SZ161-3VAM	SZ161-4VAM	SZ161-9VAM
SZ175	Rotolock	Thermostat	-	SZ175-4RM	-
SZ185	Brazed	Thermostat	SZ185-3CAM	SZ185-4CAM	SZ185-9CAM
	Brazed	Module 24V AC	-	-	-
	Brazed	Module 110-240V	-	SZ185-4XCM	-
	Rotolock	Thermostat	-	SZ185-4RM	SZ185-9RM

Solder sleeve adaptator set

Type	Code n°	Description	Application	Packaging	Pack size
	7765005	Solder sleeve adapter set (1"3/4~1"1/8), (1"1/4~3/4")	SM/SZ084-090-100	Multipack	6
	120Z0405	Solder sleeve adapter set (1"3/4~1"3/8), (1"1/4~7/8")	SM110-112-120-124-148-161&SM/SZ147& SZ110-120-148-161	Multipack	8
	7765006*	Solder sleeve adapter set (1"3/4~1"3/8), (1"1/4~3/4")	SM110-112-120-124-148-161&SM/SZ147& SZ110-120-148-161	Multipack	6
	7765028	Solder sleeve adapter set (2"1/4~1"5/8), (1"3/4~1"1/8)	SM/SZ175-185, SY 240-300	Multipack	6

* Diameter restrictor

Rotolock adaptor

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0366	Adaptor (1"1/4 Rotolock -3/4" ODS)	Models with 3/4" ODF	Multipack	10
	120Z0367	Adaptor (1"1/4 Rotolock - 7/8" ODS)	Models with 7/8" ODF	Multipack	10
	120Z0364	Adaptor (1"3/4 Rotolock -1"1/8 ODS)	Models with 1"1/8 ODF	Multipack	10
	120Z0431	Adaptor (1"3/4 Rotolock -1"3/8" ODS)	Models with 1"3/8 ODF	Multipack	10
	120Z0432	Adaptor (2"1/4 Rotolock -1"5/8 ODS)	Models with1"5/8 ODF	Multipack	10

Gaskets

Type	Code n°	Description	Application	Packaging	Pack size
G09	8156131	Gasket, 1"1/4	Models with 1"1/4 rotolock connection	Multipack	10
G09	7956002	Gasket, 1"1/4	Models with 1"1/4 rotolock connection	Industry pack	50
G07	8156132	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Multipack	10
G07	7956003	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Industry pack	50
G08	8156133	Gasket, 2"1/4	Models with 2"1/4 rotolock connection	Multipack	10
G08	7956004	Gasket, 2"1/4	Models with 2"1/4 rotolock connection	Industry pack	50
	8156013	Gasket set 1"1/4 - 1"3/4 2"1/4, OSG gaskets black & white	All Rotolock models	Multipack	10

Solder sleeves

Type	Code n°	Description	Application	Packaging	Pack size
P02	8153004	Solder sleeve P02 (1"3/4 Rotolock - 1"1/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10
P03	8153006	Solder sleeve P03 (2"1/4 Rotolock - 1"5/8 ODF)	Models with 2"1/4 rotolock connection	Multipack	10
P04	8153008	Solder sleeve P04 (1"1/4 Rotolock - 3/4" ODF)	Models with 1"1/4 rotolock connection	Multipack	10
P05	8153012	Rotolock connector P05 (1"1/4 Rotolock - 7/8" ODF)	Models with 1"1/4 rotolock connection	Multipack	10
P07	8153013	Solder sleeve P07 (1"3/4 Rotolock - 7/8" ODF)	Models with 1"3/4 rotolock connection	Multipack	10
P08	8153005	Solder sleeve P08 (2"1/4 Rotolock - 1"3/8 ODF)	Models with 2"1/4 rotolock connection	Multipack	10
P10	8153003	Solder sleeve P10 (1"3/4 Rotolock - 1"3/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10

Rotolock nuts

Type	Code n°	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

Rotolock service valve

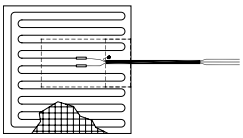
Type	Code n°	Description	Application	Packaging	Pack size
	7703009	Valve set, V02 (1"3/4 ~ 1"1/8), V04(1"1/4 ~ 3/4")	SM / SZ 084 to 100 - 110* to 161*	Multipack	6
	7703392	Valve set, V10 (1"3/4 ~ 1"3/8), V05(1"1/4 ~ 7/8")	SM / SZ 110 to 161	Multipack	6
	7703010	Valve set, V08 (2"1/4 ~ 1"3/8), V07 (1"3/4 ~ 7/8")	SY / SM / SZ 175/185*	Multipack	6
	7703383	Valve set, V03 (2"1/4 ~ 1"5/8), V02 (1"3/4 ~ 1"1/8)	SY / SM / SZ 175/185 SY 240-300	Multipack	4

* diameter restriction

3-phase soft start equipment

Type	Code n°	Description	Application	Packaging	Pack size
MCI15C	7705006	Electronic soft start kit, MCI 15 C	SM/SZ084-110	Single pack	1
MCI25C	7705007	Electronic soft start kit, MCI 25 C	SM/SZ120-185	Single pack	1
MCI50CM	037N0401	Electronic soft start kit, MCI 50 CM	SY240 to SY380	Single pack	1

Surface sump heaters



	Code n°	Accessory description	Application	Packaging	Pack size
	120Z0388	80W 24V surface sump heater CE & UL	SM112-124 - SM/SZ147147	Multipack	8
	120Z0389	80W 230V surface sump heater CE & UL		Multipack	8
	120Z0390	80W 400V surface sump heater CE & UL		Multipack	8
	120Z0391	80W 460V surface sump heater CE *		Multipack	8
	120Z0402	80W 575V surface sump heater CE *		Multipack	8
	120Z0361	48W 24V surface sump heater + bottom insulation, CE & UL	SM/SZ084 - 090 -100 - 110 - 120 - 148 - 161	Multipack	6
	120Z0380	48W 230V surface sump heater + bottom insulation, CE & UL		Multipack	6
	120Z0381	48W 400V surface sump heater + bottom insulation, CE & UL		Multipack	6
	120Z0382	48W 460V surface sump heater + bottom insulation, CE *		Multipack	6
	120Z0383	48W 575V surface sump heater + bottom insulation, CE *		Multipack	6
	120Z0360	56W 24V surface sump heater + bottom insulation, CE & UL	SM/SZ175 & SM/SY/SZ185	Multipack	6
	120Z0376	56W 230V surface sump heater + bottom insulation, CE & UL		Multipack	6
	120Z0377	56W 400V surface sump heater + bottom insulation, CE & UL		Multipack	6
	120Z0378	56W 460V surface sump heater + bottom insulation, CE *		Multipack	6
	120Z0379	56W 575V surface sump heater + bottom insulation, CE *		Multipack	6
	120Z0372	80W 230V surface sump heater + bottom insulation, CE & UL	SY240 to SY380	Multipack	4
	120Z0373	80W 400V surface sump heater + bottom insulation, CE & UL		Multipack	4
	120Z0375	80W 575V surface sump heater + bottom insulation, CE *		Multipack	4

Discharge temperature protection

Type	Code No	Description	Application	Packaging	Pack Size
	7750009	Discharge thermostat kit	All models	Multipack	10
	7973008	Discharge thermostat kit	All models	Industry pack	50

Mounting hardware

Type	Code No	Description	Application	Packaging	Pack Size
	8156138	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	SM/ SZ084-090-100-110-120-148-161-175-185	Single pack	1
	8156147	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers, rotolock nuts, solder sleeves, gaskets	SM/SZ148-161-175-185	Single pack	1
	8156144	Mounting kit for scroll compressors. Grommets, sleeves	SY240-300-380	Single pack	1
	120Z0066	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	SM112-124-SM/SZ147	Single pack	1

Acoustic hoods

Type	Code No	Description	Application	Packaging	Pack Size
	7755011	Acoustic hood for scroll compressor S084-S090-S100	SM/SZ084-090-100	Single pack	1
	7755010	Acoustic hood for scroll compressor S110-S120	SM/SZ110 & SM/SZ120	Single pack	1
	7755017	Acoustic hood for scroll compressor S148-S161 (except code 3)	SM/SZ148.161 except code 3	Single pack	1
	7755007	Acoustic hood for scroll compressor S175-S185	SM/SZ175-185	Single pack	1
	7755016	Acoustic hood for scroll compressor S240-S300	SY240-300	Single pack	1
	7755022	Acoustic hood for scroll compressor S380	SY380	Single pack	1
	120Z0035	Acoustic hood for scroll compressor, SM112-124-147	SM112-124 & SM/SZ147 (except SM/SZ147 code 3)	Single pack	1
	120Z0135	Acoustic hood for scroll compressor, SM147-3	SM/SZ147 code 3	Single pack	1
	120Z0356	Bottom insulation	SM/SZ084-090-100-110-120-148-161	Single pack	1
	120Z0353	Bottom insulation	SM/SZ175&SM/SY/SZ185	Single pack	1
	120Z0355	Bottom insulation	SY240 to SY380	Single pack	1

Motor protection modules

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0584	Electronic motor protection module, 24 V AC	SY240-300-380 SM/SZ-185 with electronic module	Single pack	1
	120Z0585	Electronic motor protection module, 110/240 V		Single pack	1

Terminal boxes, covers & T-block connectors

Type	Code No	Description	Application	Packaging	Pack Size
	8156139	Terminal box 186 x 198 mm, incl cover	SM/SZ148-3.161-3.175.185	Single pack	1
	120Z0413	Terminal box cover	SM/SZ147-3	Single pack	1
	8156135	Service kit for terminal box 96 x 115 mm, including 1 cover, 1 clamp	SM084.090.100.110.112.120.124.147 .148.161 (except SM148-3.161-3) & SZ084.090.100.110.120.148.161 (except SZ148-3. 161-3)	Multipack	10
	8173230	T block connector 52 x 57 mm	SM/SZ084-110.120.148 (except -3). 161 (except -3). & SM112-124, SM/SZ147 (except -3)	Multipack	10
	8173021	T block connector 60 x 75 mm	SM/SZ147-3.148-3.161-3.175.185 & SZ175.185	Multipack	10
	120Z0774	T block connector 80 x 80 mm	SY240-300-380	Multipack	10
	120Z0458	Terminal box 210 x 190 mm, incl cover	SY240.300.380 SM/SZ185 with electronic module	Single pack	1
	120Z0462	Terminal box 210 x 190 mm, incl cover and module wiring for 250 x 208 mm terminal box replacement	SY240.300.380	Single pack	1

Lubricant

Type	Code No	Description	Application	Packaging	Pack Size
160SZ	7754023	POE lubricant, 160SZ, 1 litre can	SZ with R407C, R134a, R404A, R513A	Multipack	12
160SZ	120Z0571	POE lubricant, 160SZ, 2.5 litre can	SZ with R407C, R134a, R404A, R513A	Multipack	4
320SZ	7754121	POE lubricant, 320SZ, 1 litre can	SY with R22, R407C, R134a, R513A	Multipack	12
320SZ	120Z0572	POE lubricant, 320SZ, 2.5 litre can	SY with R22, R407C, R134a, R513A	Multipack	4
160P	7754001	Mineral oil, 160P, 2 litre can	SM with R22	Multipack	8
160P	7754002	Mineral oil, 160P, 5 litre can	SM with R22	Multipack	4

Miscellaneous

Type	Code No	Description	Application	Packaging	Pack Size
	8156019	Sight glass with gaskets (black & white)	All models	Multipack	4
	8156129	Gasket for sight glass, 1"1/8 (white teflon)	All models	Multipack	10
	7956005	Gasket for sight glass, 1"1/8 (white teflon)	All models	Multipack	50
	8154001	Danfoss Commercial Compressors blue spray paint	All models	Single pack	1

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Danfoss Commercial Compressors

is a worldwide manufacturer of compressors and condensing units for refrigeration and HVAC applications. With a wide range of high quality and innovative products we help your company to find the best possible energy efficient solution that respects the environment and reduces total life cycle costs.

We have 40 years of experience within the development of hermetic compressors which has brought us amongst the global leaders in our business, and positioned us as distinct variable speed technology specialists. Today we operate from engineering and manufacturing facilities spanning across three continents.

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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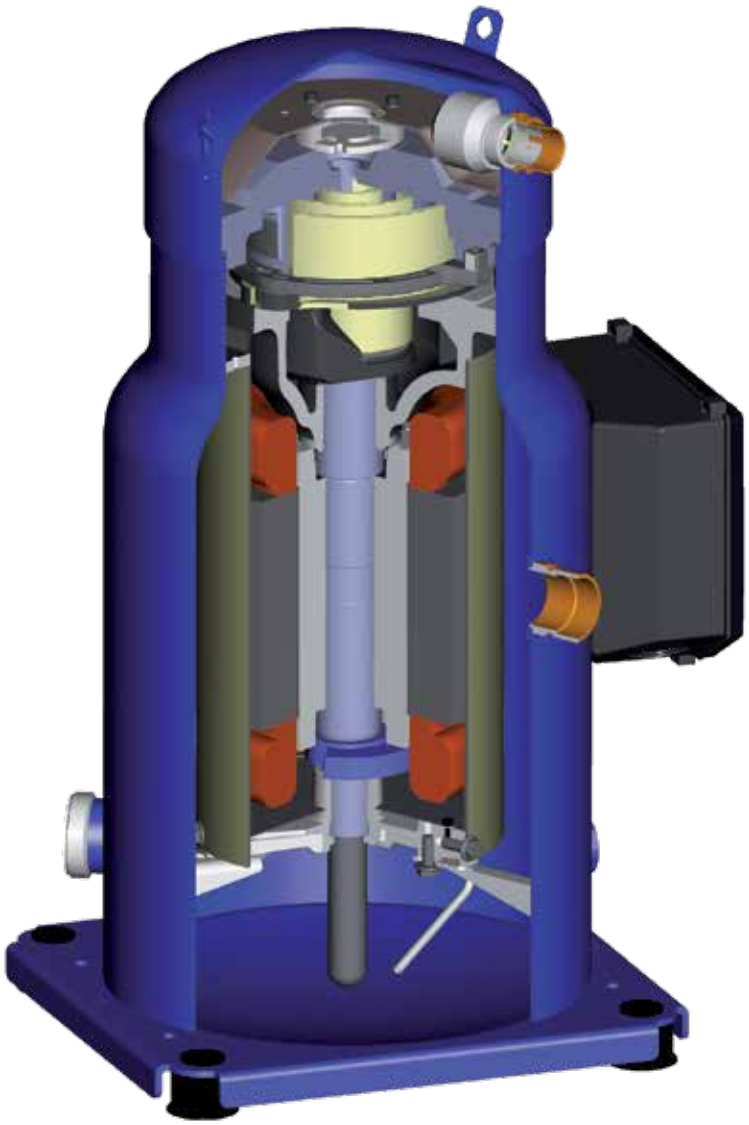
Application guidelines

Danfoss scroll compressors
SH090 to SH380 - single

50 Hz - 60 Hz - R410A

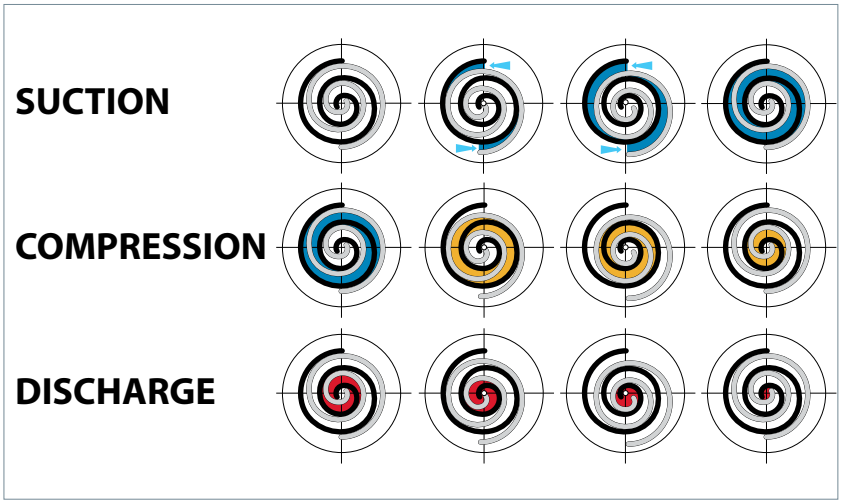
http://cc.danfoss.com



In a Danfoss SH scroll compressor, the compression is performed by two scroll elements located in the upper part of the compressor.

Suction gas enters the compressor at the suction connection. As all of the gas flows around and through the electrical motor, thus ensuring complete motor cooling in all applications, oil droplets separate and fall into the oil sump. After exiting the electrical motor, the gas enters the scroll elements where compression takes place. Ultimately, the discharge gas leaves the compressor at the discharge connection.

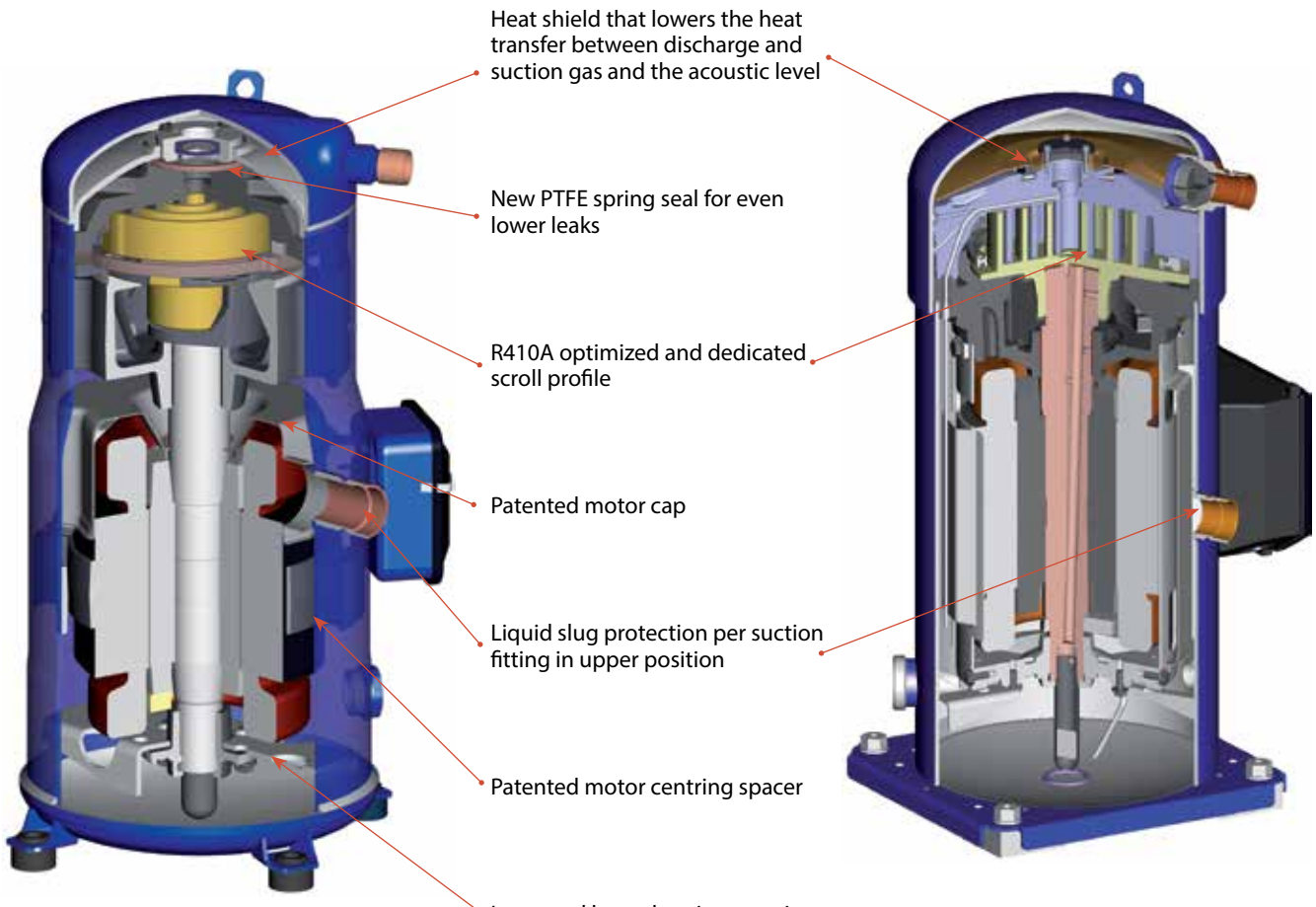
The figure below illustrates the entire compression process. The centre of the orbiting scroll (in grey) traces a circular path around the centre of the fixed scroll (in black). This movement creates symmetrical compression pockets between the two scroll elements. Low-pressure suction gas is trapped within each crescent-shaped pocket as it gets formed; continuous motion of the orbiting scroll serves to seal the pocket, which decreases in volume as the pocket moves towards the centre of the scroll set increasing the gas pressure. Maximum compression is achieved once a pocket reaches the centre where the discharge port is located; this stage occurs after three complete orbits. Compression is a continuous process: the scroll movement is suction, compression and discharge all at the same time.



SH range is composed of SH090-105-120-140-161-184 (light commercial platform) and SH180-240-295-380 (large commercial platform).

The SH090-105-120-140-161-184 compressors benefit from a further improved design to achieve the highest efficiency.

- Gas circulation, motor cooling and oil behaviour are improved on light commercial platform models by a new patented motor cap design.
- Part protection and assembly reduces internal leaks and increases life durability.
- Improved part isolation reduces greatly acoustic levels.
- Gas intake design induces higher resistance to liquid slugging.



SH090-105-120-140-161-184

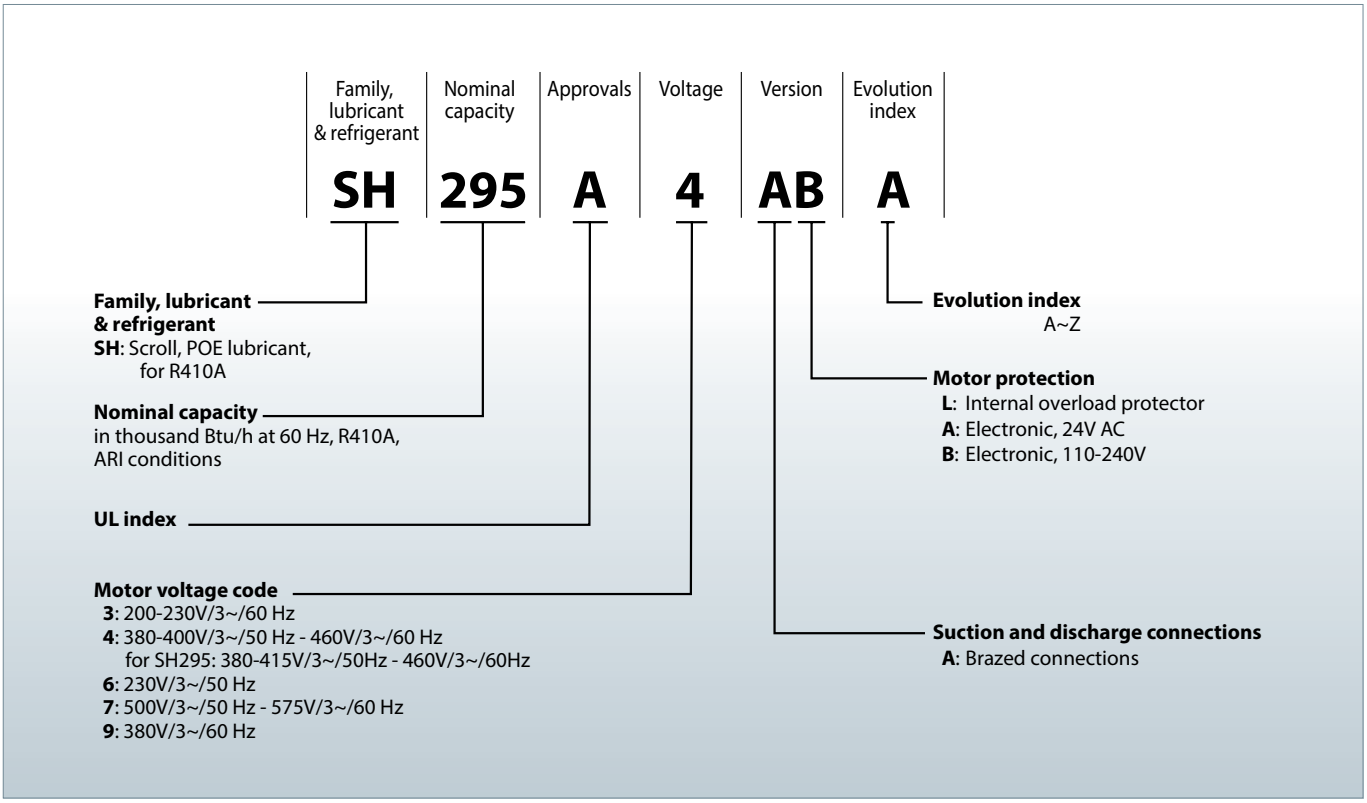
SH180-240-295-380

Danfoss SH scroll compressors for R410A are available as single compressors. The example below presents the compressor nomenclature which equals the technical reference as shown on the compressor nameplate.

Code numbers for ordering are listed section "Ordering information and packaging".

For tandem and trio assemblies, please refer to the Danfoss SH scroll compressor Parallel Application Guidelines, FRCC.PC.008.

Nomenclature



50-60 Hz data

Model		Nominal tons 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displace-ment ①	Oil charge	Net weight ②
		TR	W	Btu/h	kW	W/W	Btu/h/W	cm3/rev	m3/h	dm3	kg
50 Hz	SH090	7.5	22300	76100	7.19	3.10	10.58	88.40	15.4	3.0	58.0
	SH105	9	26800	91500	8.47	3.17	10.82	103.50	18.0	3.3	64.0
	SH120	10	30000	102400	9.46	3.17	10.82	116.90	20.3	3.3	64.0
	SH140	12	34700	118400	10.58	3.28	11.19	133.00	23.1	3.3	67.0
	SH161	13	38800	132400	12.15	3.19	10.89	151.70	26.4	3.3	69.0
	SH184	15	44700	152600	13.73	3.25	11.09	170.30	29.6	3.6	71.5
	SH180	15	44500	151900	13.87	3.21	10.96	170.20	29.6	6.7	108.0
	SH240	20	59700	203800	18.50	3.23	11.02	227.60	39.6	6.7	108.0
	SH295*	25	73200	249800	22.51	3.25	11.09	276.20	48.1	6.7	111.0
	SH380	30	90500	308900	28.18	3.21	10.96	345.00	60.0	6.7	159.0
60 Hz	SH090	7.5	27100	92500	8.57	3.16	10.78	88.40	18.6	3.0	58.0
	SH105	9	32100	109600	9.96	3.22	10.99	103.50	21.8	3.3	64.0
	SH120	10	36800	125600	11.25	3.27	11.16	116.90	24.6	3.3	64.0
	SH140	12	42300	144400	12.77	3.31	11.30	133.00	27.9	3.3	67.0
	SH161	13	47200	161100	14.43	3.27	11.16	151.70	31.9	3.3	69.0
	SH184	15	54000	184300	16.45	3.28	11.19	170.30	35.8	3.6	71.5
	SH180	15	54300	185300	16.58	3.27	11.16	170.20	35.7	6.7	108.0
	SH240	20	72200	246400	22.10	3.27	11.16	227.60	47.8	6.7	108.0
	SH295*	25	88500	302000	27.21	3.25	11.09	276.20	58.0	6.7	111.0
	SH380	30	109600	374100	33.99	3.22	10.99	345.00	72.3	6.7	159.0

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

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

Standard rating conditions: ARI standard
Refrigerant: R410A

Evaporating temperature: 7.2 °C
Condensing temperature: 54.4 °C

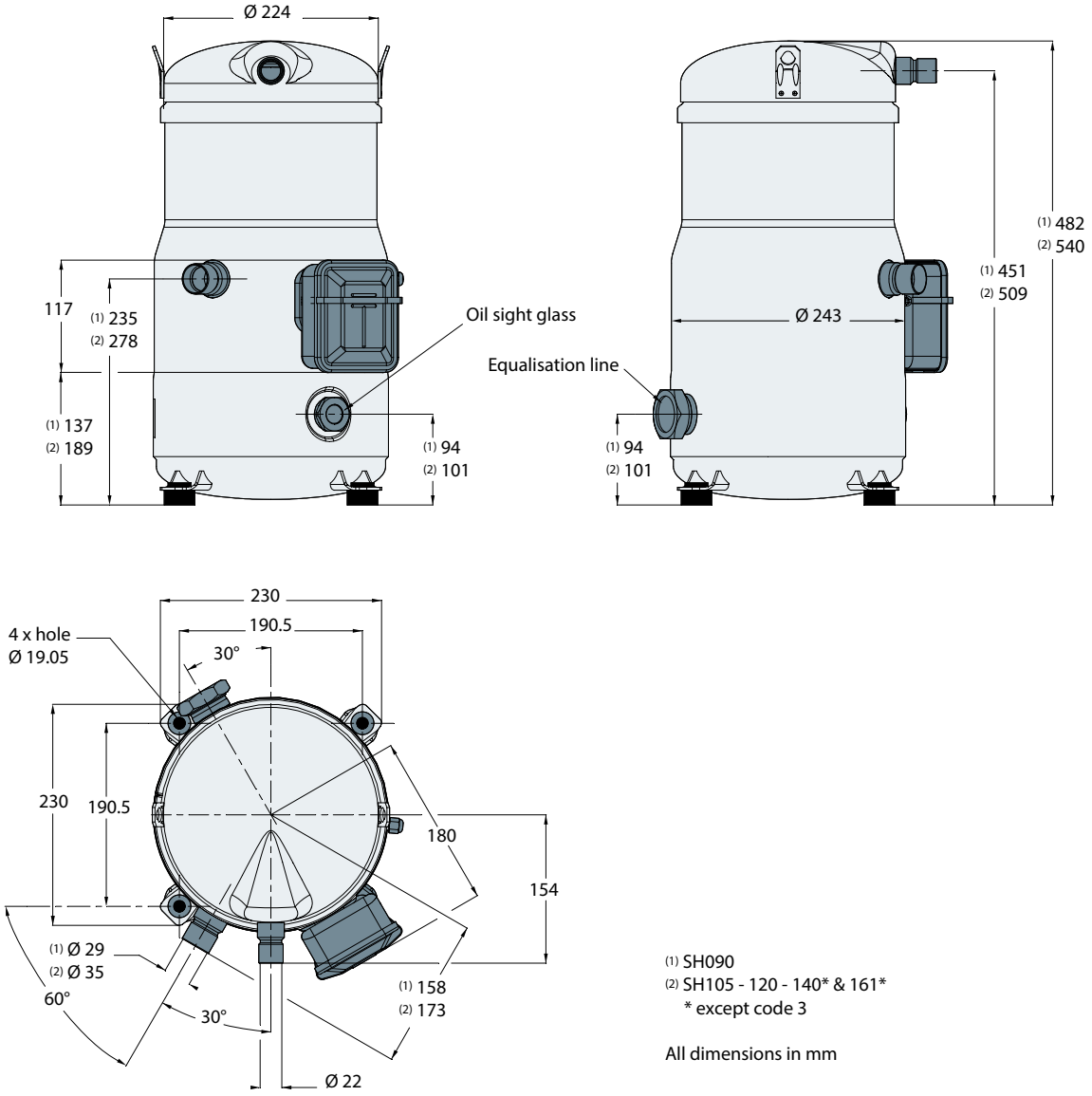
Superheat: 11.1 K
Subcooling: 8.3 K

Subject to modification without prior notification.
Data given for motor code 4 compressor, for full data details and capacity tables refer to Online Datasheet Generator: www.danfoss.com/odsg

* SH295 replaces SH300. SH300 model remains available for after-market, please refer to datasheets for technical details.

SH090-105-120-140* and 161*

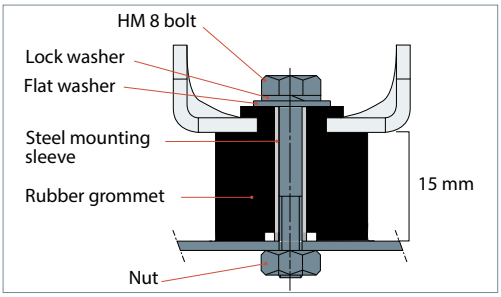
(* except code 3)



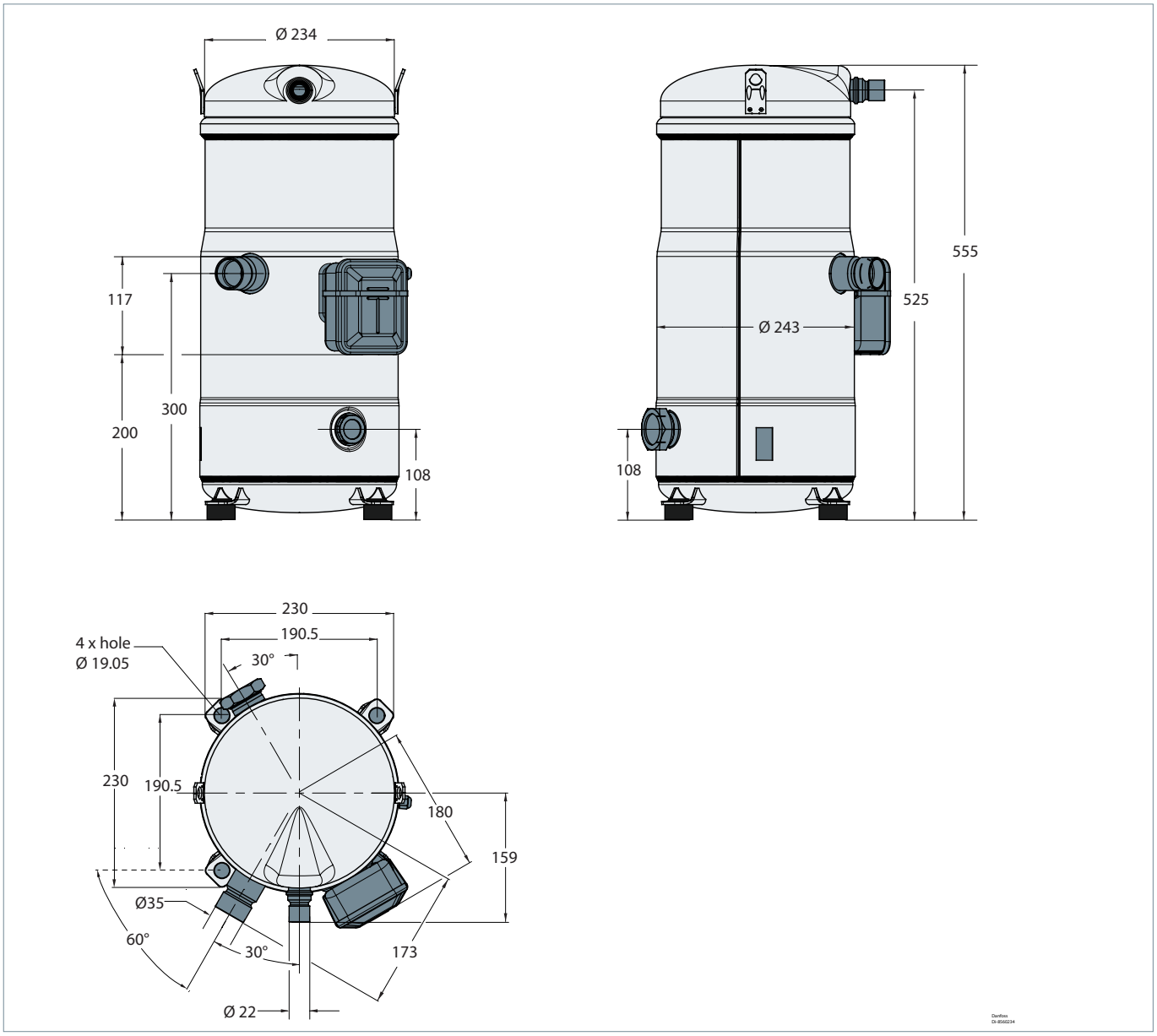
(1) SH090
(2) SH105 - 120 - 140* & 161*
* except code 3

All dimensions in mm

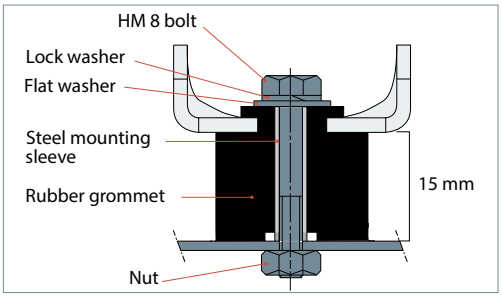
Flexible grommet



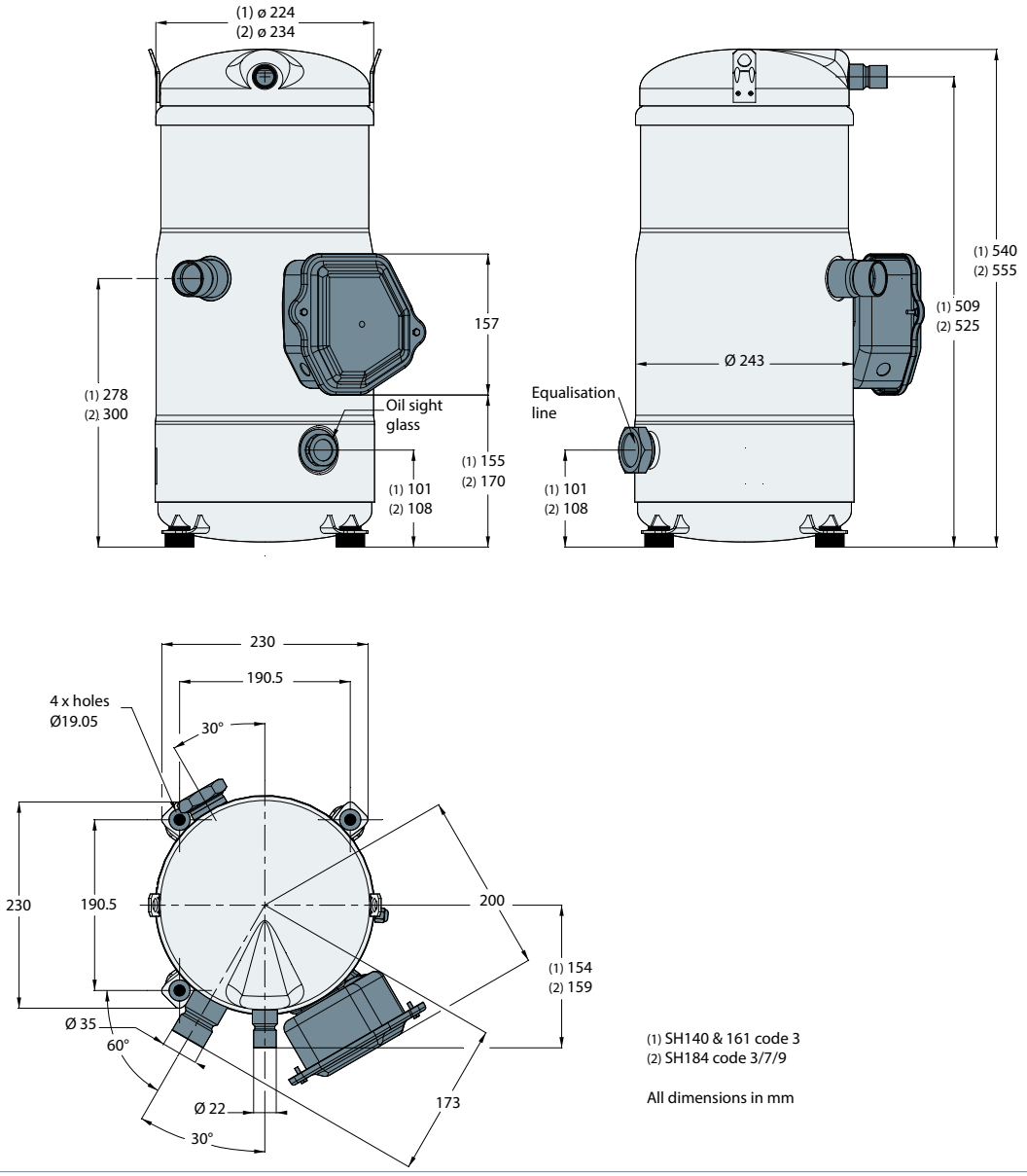
SH184 code 4



Flexible grommet



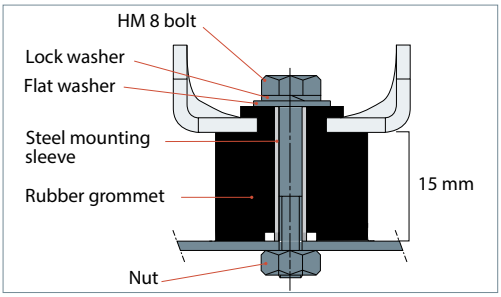
SH140-161 code 3 and SH184 code 3/7/9



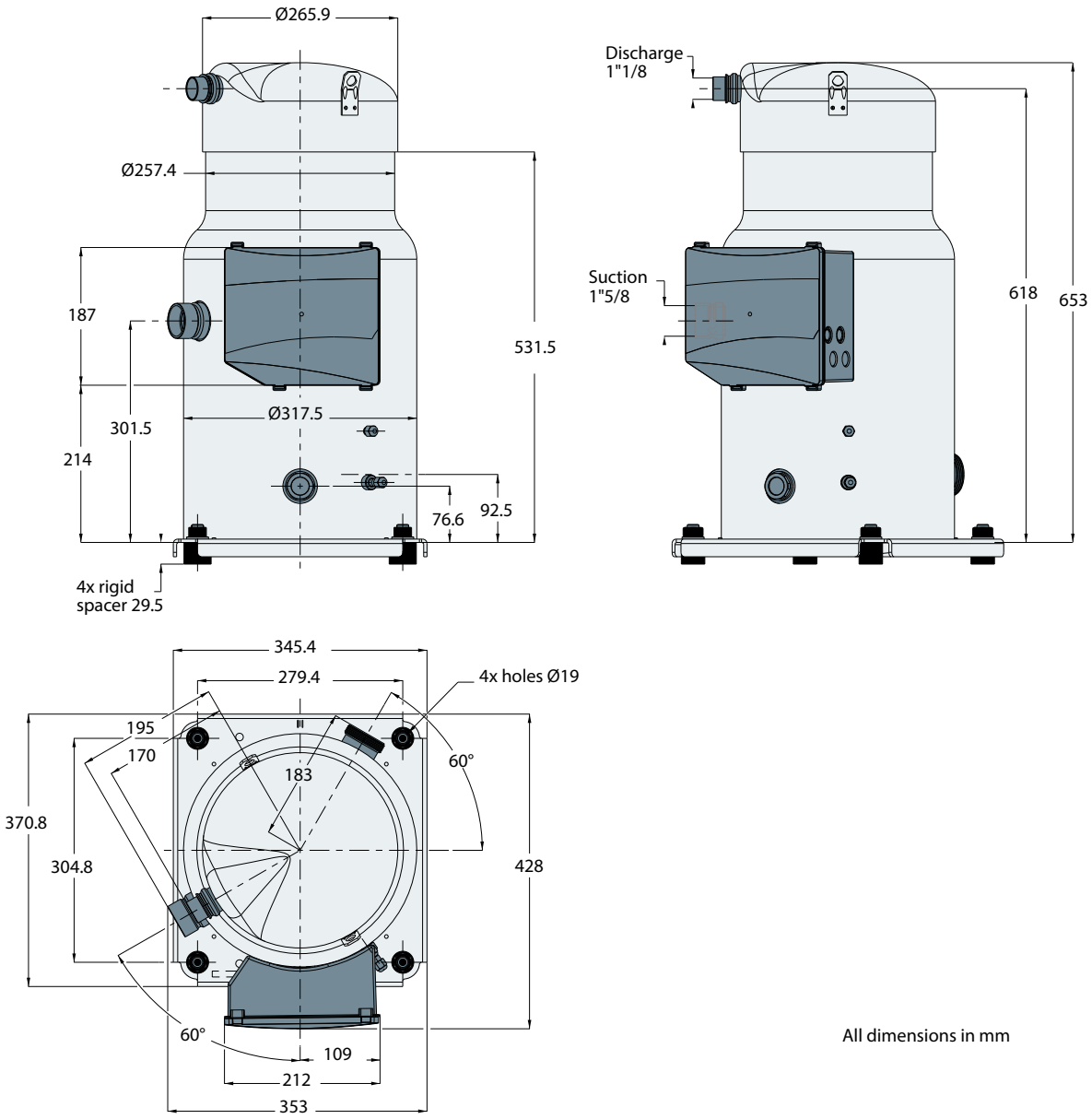
(1) SH140 & 161 code 3
(2) SH184 code 3/7/9

All dimensions in mm

Flexible grommet

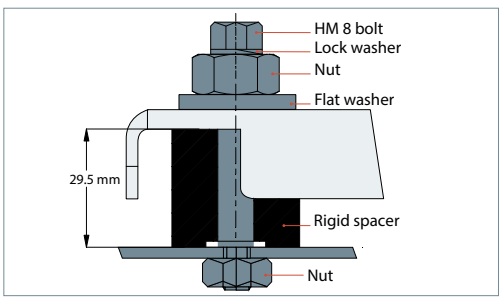


SH180-240-295

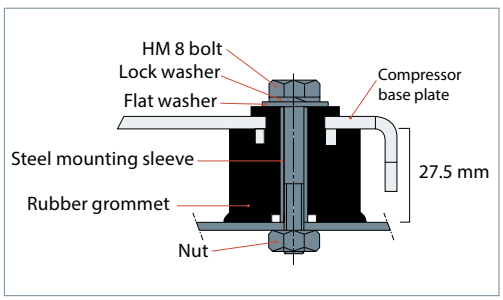


All dimensions in mm

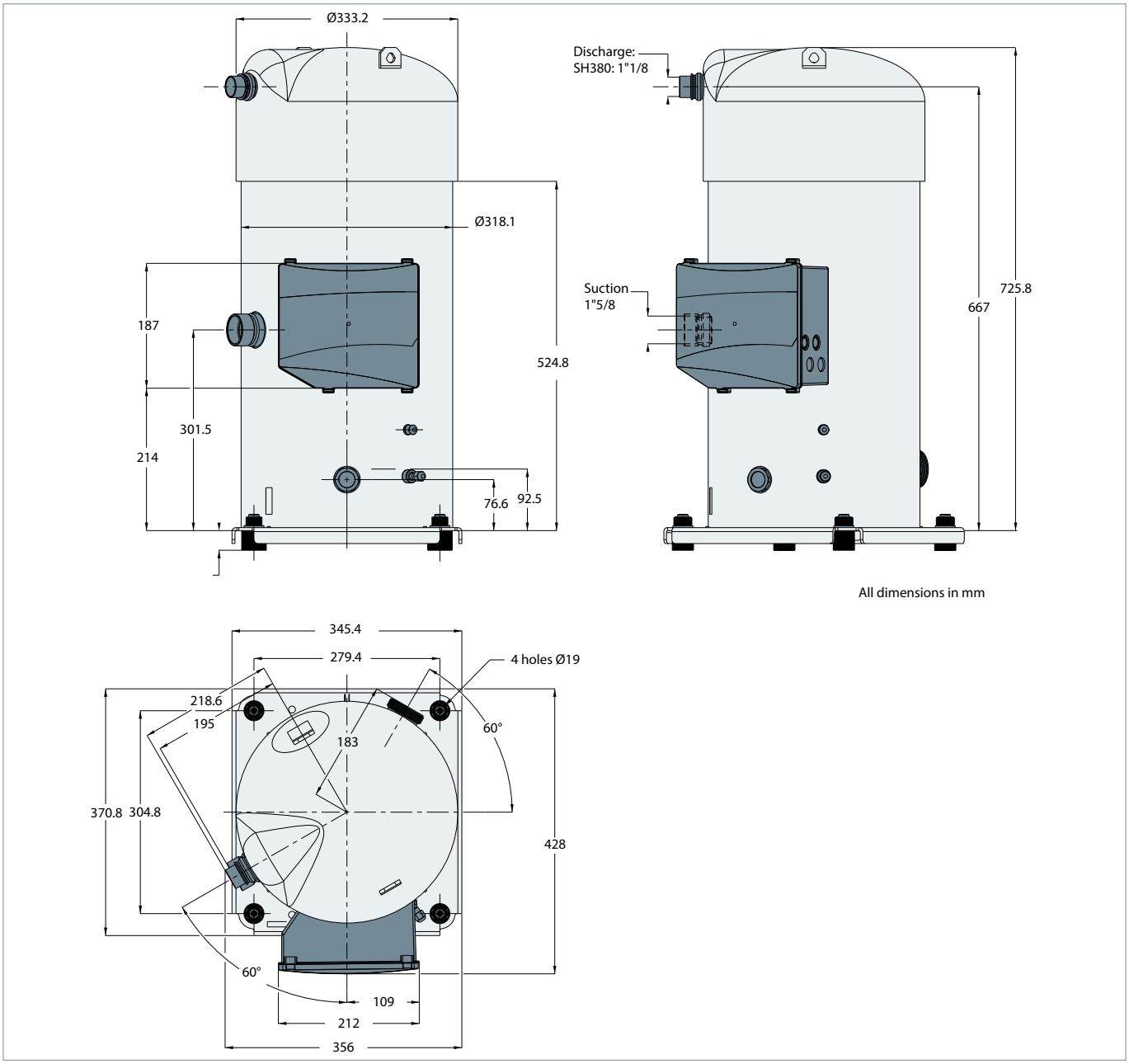
Rigid spacer



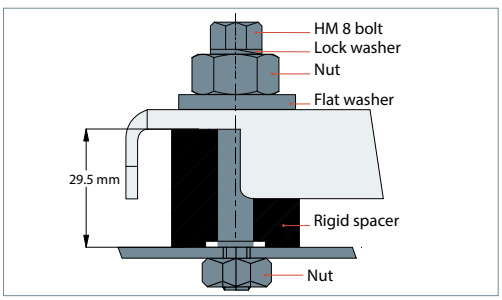
Flexible grommet



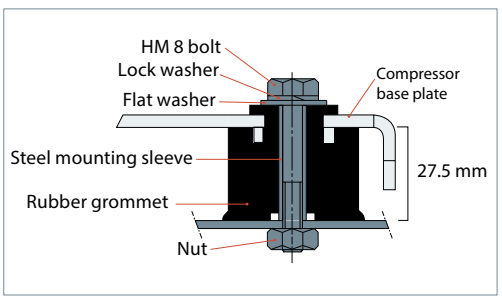
SH380 (Except code 3)



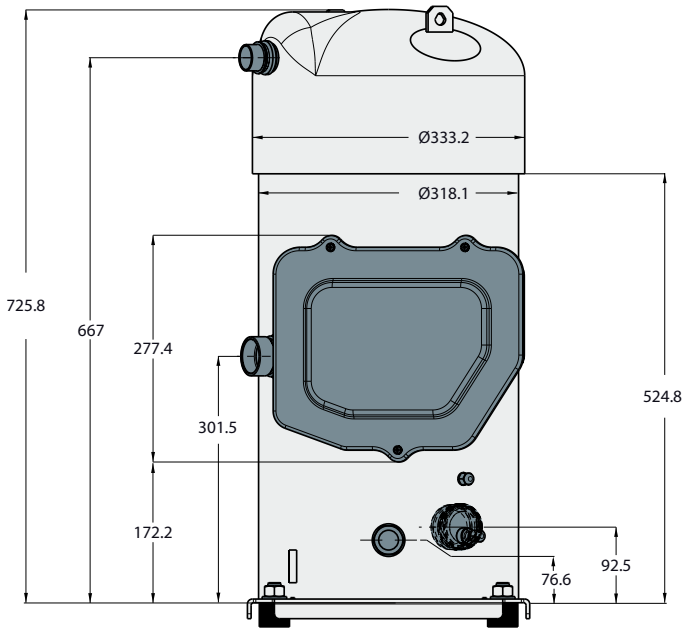
Rigid spacer

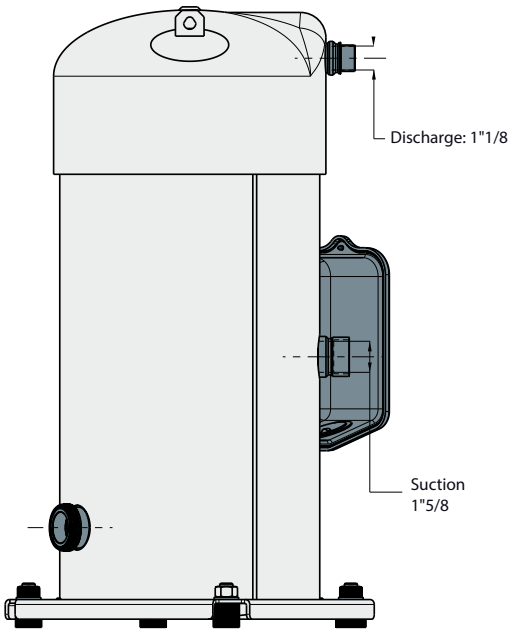


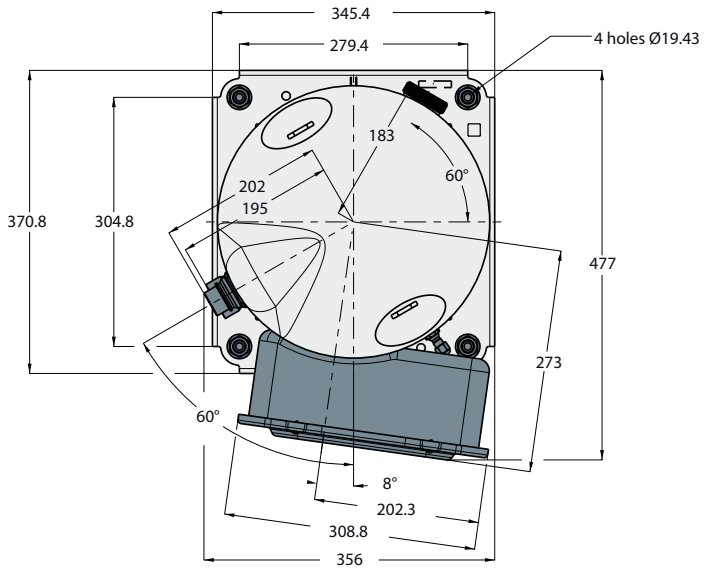
Flexible grommet



SH380 code 3

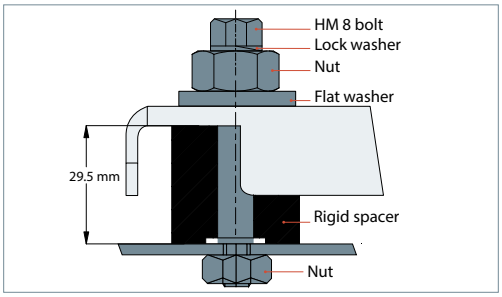




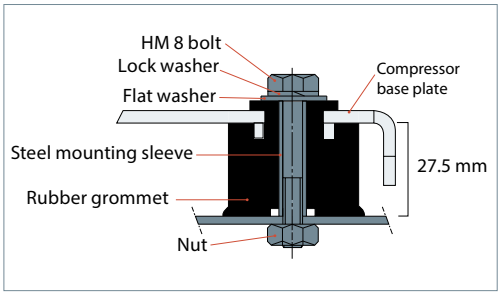


All dimensions in mm

Rigid spacer



Flexible grommet



Connection details

	SH 090 - 105 - 120 - 140 - 161 - 184	SH 180 - 240 - 295 - 380
Version	AL	
Suction and discharge connections	Brazed	Brazed
Oil sight glass	Threaded	Threaded
Oil equalisation connection	rotolock 1"3/4	rotolock 2"1/4
Oil drain connection	none	1/4" flare
Low pressure gauge port (schrader)	1/4" flare	1/4" flare

Suction and discharge connections

		Brazed version  Tube ODF
		Brazed
SH090	Suction	1"1/8
	Discharge	7/8"
SH105 -120-140-161-184	Suction	1"3/8
	Discharge	7/8"
SH180-240-295-380	Suction	1"5/8
	Discharge	1"1/8

Oil sight glass

All Danfoss SH scroll compressors come equipped with a sight glass (1"1/8 - 18 UNEF) which may be used to determine the amount and condition of the oil contained within the sump.

Oil equalisation connection

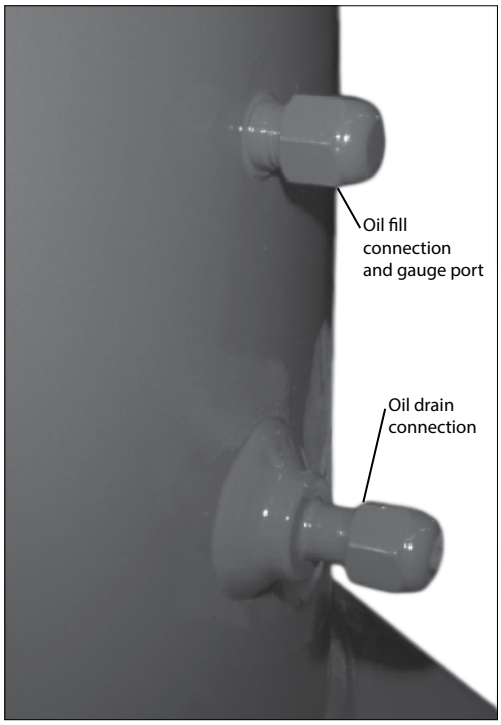
SH090-105-120-140-161-184: 1"3/4 rotolock connector allowing use of 1"3/4 - 7/8" or 1"3/4 - 1"1/8 sleeve.
SH180-240-295-380: 2"1/4 rotolock connector allowing the use of 2"1/4 - 1"3/8 or 2"1/4 - 1"5/8 sleeve.
This connection must be used to mount an oil equalisation line when two or more compressors are mounted in parallel (please refer to Danfoss SH Parallel Application Guidelines FRCC.EC.008. for details).

Oil drain connection

The oil drain connection allows oil to be removed from the sump for changing, testing, etc. The fitting contains an extension tube into the oil sump to more effectively remove the oil. The connection is a female 1/4" flare fitting incorporating a schrader valve and is mounted on SH180 - 240 - 295 - 380 models only.

Schrader

The oil fill connection and gauge port is a 1/4" male flare connector incorporating a schrader valve.



Motor voltage

Danfoss SH scroll compressors are available in five different motor voltages as listed below.

Motor voltage code		Code 3	Code 4	Code 6	Code 7	Code 9
50 Hz	Nominal voltage	-	380-400V - 3 ph 380-415V - 3 ph*	230V - 3 ph	500V - 3 ph	-
	Voltage range**	-	342-440 V 342-457V*	207-253 V	450 - 550 V	-
60 Hz	Nominal voltage	200-230V - 3 ph	460V - 3 ph	-	575 V-3 ph	380V- 3 ph
	Voltage range**	180-253 V	414-506 V	-	517-632 V	342-418 V

* SH295
** 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.

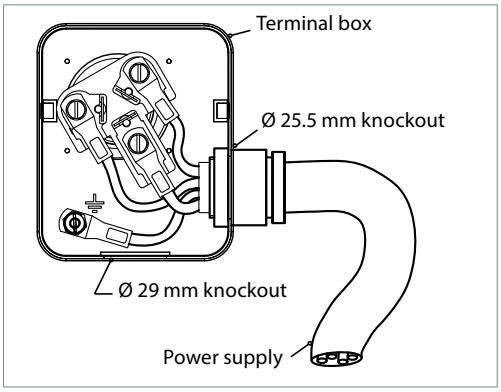
Wiring connections

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.

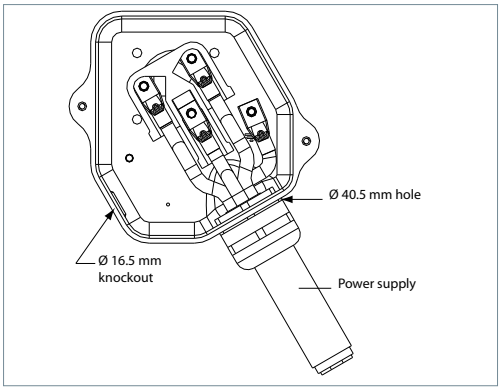
SH090-105-120-140-161-184
Except SH140-161 code 3 and SH184 code 3/7/9

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



SH140&161 code 3 and SH184 code 3/7/9

The terminal box is provided with a Ø40.5 mm hole (ISO40) for power supply and a Ø16.5 mm knockout (ISO16).

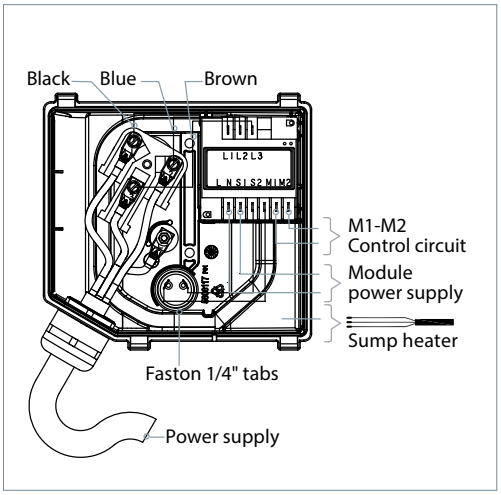


SH180-240-295-380*
Except code 3

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.

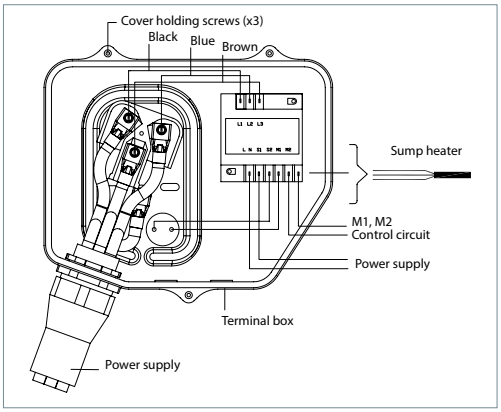
The 3 power supply knockouts accommodate the following diameters:
- Ø 50.8 mm (UL 1"1/2 conduit) and Ø 43.7 mm (UL 1"1/4 conduit) and Ø 34.5 mm (UL 1" conduit)
- Ø 40.5 mm (ISO40) and Ø 32.2 mm (ISO32) and Ø 25.5 mm (ISO25)
- Ø 25.5 mm (ISO25)

The 4 others knockouts are as follows:
- Ø 22.5 mm (PG16) (UL 1/2") and Ø 16.5 mm (ISO16) (x2)
- 20.7 mm (ISO20 or PG13.5) (x2)

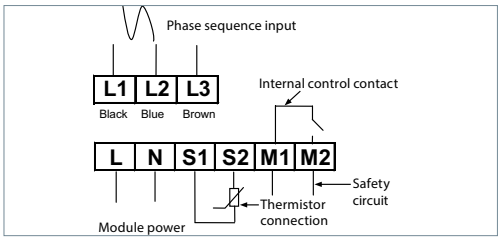


SH380 code 3

The terminal box is provided with Ø 50.5 mm (ISO50) (UL 1"1/2 conduit) hole with possible Ø 63.5 mm (ISO63) (UL 2" conduit) knockout for power supply and 2 x Ø 22.5 mm (PG16) (UL 1/2" conduit) knockouts for safety control circuit.



The motor protection module comes preinstalled within the terminal box. Phase sequence protection connections and thermistor connections are pre-wired and should not be not be removed. The module must be connected to a power supply of the appropriate voltage. The module terminals are 6.3-mm size Faston type.



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 may not exceed 70°C. 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. The installation of ventilation 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 to insure that terminal box temperature does not exceed 70°C.

Three phase electrical characteristics

Compressor model		LRA	MCC	Max. operating current	Winding resistance
		A	A	A	Ω
Motor voltage code 3 200-230V / 3ph / 60 Hz	SH090	203	43	38	0.39
	SH105	267	51	45	0.27
	SH120	267	61	48	0.27
	SH140	304	64	56	0.24
	SH161	315	69	64	0.22
	SH184	351	75	71	0.22
	SH180	380	78	71	0.19
	SH240	485	105	103	0.16
	SH295	560	128	112	0.13
	SH380	717	170	155	0.09
Motor voltage code 4 380-400 V / 3ph / 50 Hz * 460V / 3ph / 60hZ	SH090	98	22	19	1.47
	SH105	142	25	22	1.05
	SH120	142	29	24	1.05
	SH140	147	30	28	0.92
	SH161	158	35	31	0.83
	SH184	197	38.6	36	0.83
	SH180	170	38	34	0.8
	SH240	215	51	49	0.62
	SH295	260	62	56	0.52
	SH380	320	79	72	0.42
Motor voltage code 6 230 V / 3ph / 50 Hz	SH090	157	40	32	0.5
	SH105	223	43	38	0.35
	SH120	223	51	41	0.35
	SH140	236	53	49	0.31
	SH161	236	57	53	0.31
	SH184	236	57	56	0.31
Motor voltage code 7 500 V / 3ph / 50 Hz 575 V / 3 ph / 60 Hz	SH090	84	18	14	2.34
	SH105	103	22	17	1.57
	SH120	103	24	19	1.57
	SH140	122	26	22	1.38
	SH161	136	29	24	1.32
	SH184	135	35	28	1.32
	SH180	135	30	28	1.20
	SH240	175	41	38	0.94
	SH295	210	45	44	0.82
	SH380	235	60	58	0.56
Motor voltage code 9 380 V / 3ph / 60 Hz	SH090	124	26	23	1.05
	SH105	160	33	26	0.72
	SH120	160	35	29	0.72
	SH140	168	37	33	0.62
	SH161	177	41	37	0.57
	SH184	239	51	41	0.57
	SH180	210	46	44	0.52
	SH240	260	60	58	0.42
	SH295	310	72	69	0.36
	SH380	382	90	88	0.24

* 380-415V/3ph/50Hz for SH295

LRA (Locked Rotor Amp)

Locked Rotor Amp value is the higher average current as measured on mechanically blocked compressor tested under nominal voltage. The LRA value can be used as 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.

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.

Max. 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 cables and contactors selection.

Winding resistance

Winding resistance is the resistance between phases at 25°C (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, the measured resistance must be corrected using following

formula:

$$R_{tamb} = R_{25°C} \frac{a + t_{amb}}{a + t_{25°C}}$$

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

Soft starts

Softstarters are designed to reduce the starting current of 3-phase AC motors

the compressor start-up time is always less than 0.5 seconds.

Softstarters can be used on DSH compressor but, in order to ensure proper lubrication of compressor parts, the settings must ensure that

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

General wiring information

The wiring diagrams below are examples for a safe and reliable compressor wiring. In case an alternative wiring logic is chosen, it is imperative to respect the following rules:

When a safety switch trips, the compressor must stop immediately and must not re-start until the tripping condition is back to normal and the safety switch is closed again. This applies to the LP safety switch, the HP safety switch, the discharge gas thermostat and the motor safety thermostat.

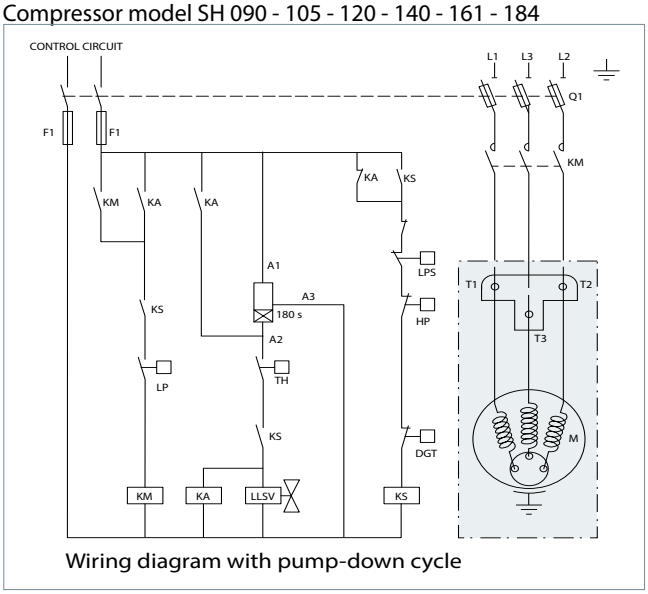
In specific situations, such as winter start operation, an eventual LP control for pump-down cycles may be temporarily bypassed to allow the system to build pressure. But it remains mandatory for compressor protection to apply an LP safety switch. The LP safety switch must never be bypassed.

Pressure settings for the LP and HP safety switch and pump-down listed in table from section "Low pressure".

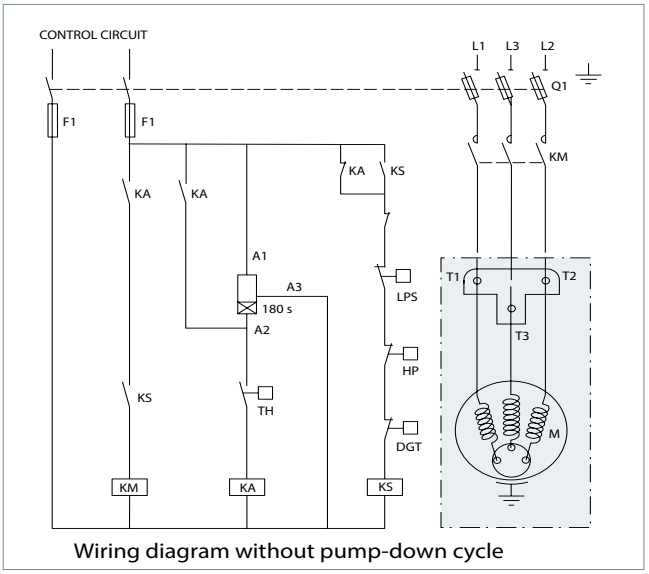
When ever possible (ie. PLC control), it is recommended to limit the possibilities of compressor auto restart to less than 3 to 5 times during a period of 12 hours when caused by motor protection or LP safety switch tripping. This control must be managed as a manual reset device.

Suggested wiring diagrams logic

Compressor model SH 090 - 105 - 120 - 140 - 161 - 184

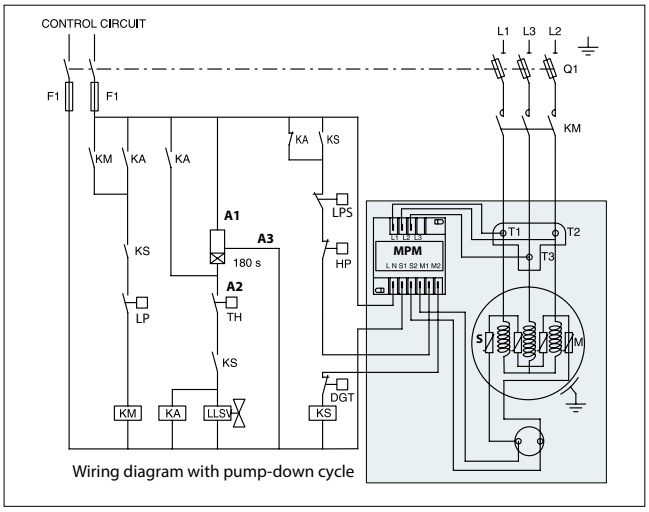


Wiring diagram with pump-down cycle

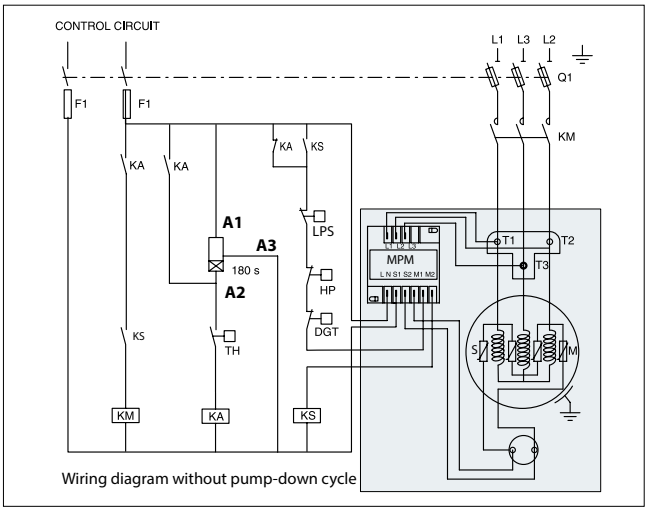


Wiring diagram without pump-down cycle

Compressor model SH180-240-295-380



Wiring diagram with pump-down cycle



Wiring diagram without pump-down cycle

Motor protection

Compressor model	Overheating protection	Over current protection	Locked rotor protection	Phase reversal protection
SH 090 - 105 - 120 - 140- 161 - 184	✓ Internal motor protection			Internal reverse vent
SH 180	✓ Electronic module located in terminal box			Internal reverse vent
SH240 - 295 - 380	✓ Electronic module located in terminal box			

Compressor models SH090-105-120-140-161-184 have been provided with an 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 section "Three phase electrical characteristics".

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

While not compulsory, an additional external overload 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 external overload protection will trip before the internal protection therefore offering possibility of manual reset.

Compressor models SH180-240-295-380 are delivered with a pre installed motor protection module inside the terminal box. This device provides for efficient and reliable protection against overheating and overloading as well as phase loss/reversal.

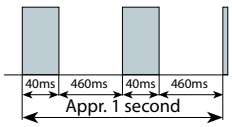
The motor protector comprises a control module and PTC sensors embedded in the motor winding. The close contact between thermistors and windings ensures a very low level of thermal inertia.

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.

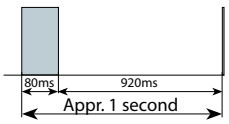
After this delay has elapsed, the relay is once again pulled in – i.e. contacts M1-M2 are closed. The time delay may be cancelled by means of resetting the mains (L-N -disconnect) for approximately 5 sec.

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

PTC overheat



Delay timer active (after PTC over temp.)



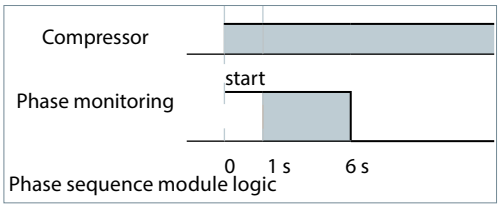
Phase sequence and reverse rotation protection

Use a phase meter to establish the phase orders and connect line phases L1, L2 and L3 to terminals T1, T2 and T3, respectively. The compressor will only operate properly in a single direction, and the motor is wound so that if the connections are correct, the rotation will also be correct.

Compressor models SH090-105-120-140-161-184, incorporate 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 longer than 24hours 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.

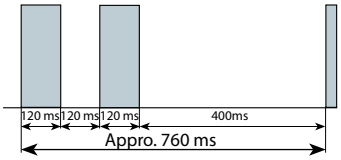
Compressor models SH180, 240 to 380 are delivered with an electronic module which provides protection against phase reversal and phase loss at start-up. Apply the recommended wiring diagrams from section "Suggested wiring diagram logic". The circuit should be thoroughly checked in order to determine the cause of the phase problem before re energizing the control circuit.

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).

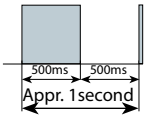


Should one of these parameters be incorrect, the relay would lock out (contact M1-M2 open). The red led on the module will show the following blink code:

In case of phase reverse error:



In case of phase loss error:



The lockout may be cancelled by resetting the power mains (disconnect L-N) for approximately 5 seconds.

Voltage imbalance

The operating voltage limits are shown in the table section "Motor voltage". The voltage applied to the motor terminals must lie within these table limits during both start-up and normal operations. 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.

Approvals and certificates

SH scroll compressors comply with the following approvals and certificates.

Certificate are listed on: Documentation for Commercial Compressor | Danfoss

CE 0062 or CE 0038 or CE 0094 (European Directive)	CE	All SH models
UL (Underwriters Laboratories)	c UL us	All 60 Hz SH models
Other approvals / certificates		Contact Danfoss

Pressure equipment directive 2014/68/EU

Products	SH090-105-120-140-161-184	SH180-240-295	SH380
Refrigerating fluids	Group 2	Group 2	Group 2
Category PED	II	II	III
Evaluation module	D1	D1	H
Maximum / Minimum temperature - Ts	-35°C < Ts < 55°C	-35°C < Ts < 52°C	-35°C < Ts < 52°C
Maximum allowable pressure (LP side) - Ps	33.3 bar(g)	31.1 bar(g)	31.1 bar(g)
Declaration of conformity	Contact Danfoss		

Low voltage directive 2014/35/EU

Products	SH090 to 380
Declaration of conformity	Contact Danfoss

Machines directive 2006/42/EC

Products	SH090 to 380
Manufacturer's declaration of incorporation	Contact Danfoss

Internal free volume

Products	Internal free volume without oil (litre)
SH090	12.4
SH105-120-140-161	14.3
SH184	14.6
SH180	31.6
SH240-295	31.0
SH380	34.3

The scroll compressor application range is influenced by several parameters which need to be monitored for a safe and reliable operation.

These parameters and the main recommendations for good practice and safety devices are explained hereunder.

- **Refrigerant and lubricants**
- **Motor supply**
- **Compressor ambient temperature**
- **Application envelope** (evaporating temperature, condensing temperature, return gas temperature)

Refrigerant and lubricants

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 and Guidelines

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

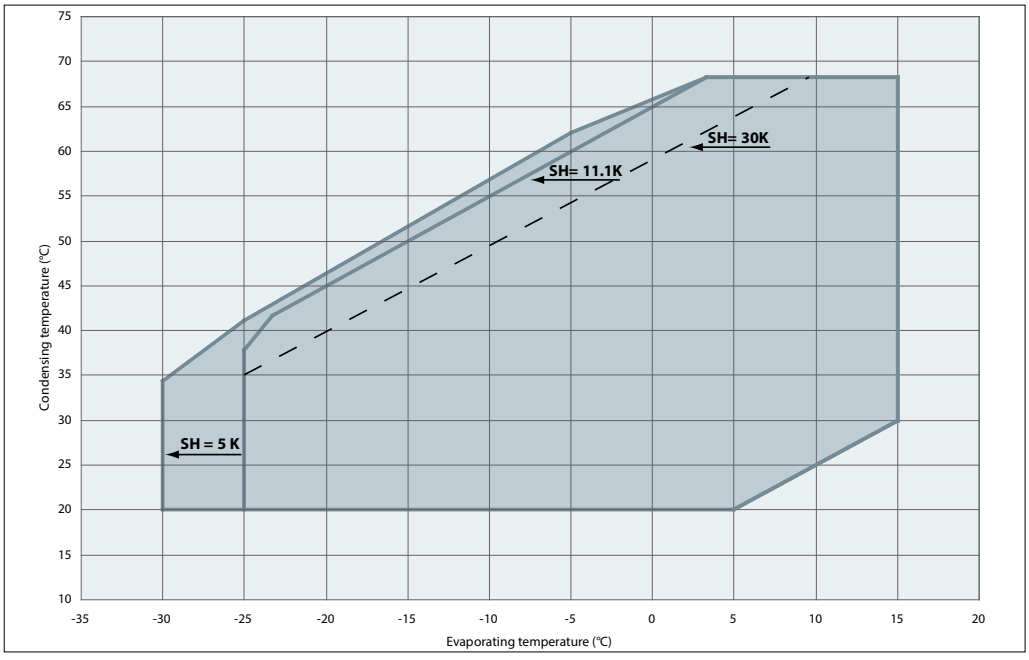
Danfoss Commercial Compressors, along with the whole refrigeration and air conditioning industry, shares today's concern about the environmental issues that are ozone depletion, global warming and overall energy consumption. Usual HCFCs refrigerant fluids such as R22 are known to be implicated in these harmful phenomena, especially ozone depletion due to their chlorinated content. These substances are scheduled to be phased-out from production and use in coming years, in accordance with the international Montreal Protocol (1984).
As a result, new chlorine-free molecules have been recently developed and are now ready to replace former fluids. Among those refrigerants, the HFC blend R410A is admitted by a great majority of manufacturers to be the most promising in terms of environmental impact, stability and efficiency, and is already seen as the R22 replacement.

	Refrigerant	R22	R407C	R410A
Chemical properties	Chlorine content	yes	no	no
	Zeotropic	pure refrigerant	zeotropic mixture	near azeotropic mixture
	Composition	R22	R32/R125/R134a	R32/R125
Environmental impact	ODP	0.05	0	0
	GWP	1500	1526	1725
Thermodynamic properties	Vapour pressure (bar) at 25°C	10.4	11.9	16.5
	Cooling capacity of liquid (kJ/kg.K) at 25°C	1.24	1.54	1.84
	Cooling capacity of vapor (kJ/kg.K) at 1 atm, 25 °C	0.657	0.829	0.833
	Temperature glide (°C)	0	7.4	<0.2

R410A

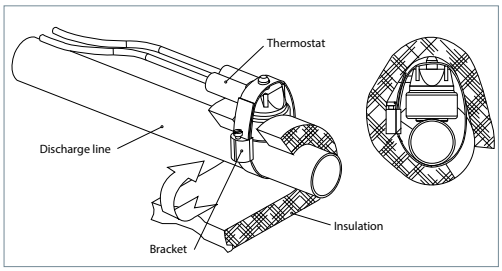
SH compressors are to be used with R410A refrigerant, with polyolester oil.
- R410A's superior thermodynamical properties compared to R22 and R407C refrigerants allow for today's massive – and necessary – switch to high efficiency systems.
- Zero Ozone Depletion Potential (ODP): R410A does not harm the ozone layer.
- Global warming potential (GWP): R410A shows a relatively high warming potential. However, the GWP index denotes direct warming effect, which is relevant only in case of release to the atmosphere. A more accurate index is T.E.W.I., for Total Equivalent Warming Impact, which takes into account indirect contributions due to running energy costs.
- Because of the higher system efficiency it allows to achieve, R410A is in this regard the best refrigerant.
- As a near-azeotropic mixture, refrigerant R410A behaves like an homogeneous substance, whereas other zeotropic mixtures such as R407C and other blends suffer a temperature glide during phase change that lessens thermal efficiency and makes them difficult to transfer from a container to another.
- Reduced refrigerant mass flow, permitted by a higher heat capacity, induce a lower sound level of the installation as well as more compact and lighter systems.

Application Guidelines	Operating conditions	
POE oil	Polyolester oil (POE) is miscible with HFC's (while mineral oil is not), but has to be evaluated regarding lubrication ability in compressors. POE oil has better thermal stability than refrigerant mineral oil.	POE is more hygroscopic and also holds moisture more tight than mineral oil. It also chemically reacts with water leading to acid and alcohol formation.
Motor supply	SH scroll compressors can be operated at nominal voltages as indicated section "Motor voltage". Under-voltage and over-voltage	operation is allowed within the indicated voltage ranges. In case of risk of under-voltage operation, special attention must be paid to current draw.
Compressor ambient temperature	SH compressors can be applied from -35°C to 55°C ambient temperature for SH090-105-120-140-161-184 and 51°C ambient temperature for SH180-240-295-380. The compressors are	designed as 100% suction gas cooled without need for additional fan cooling. Ambient temperature has very little effect on the compressor performance.
High ambient temperature	In case of enclosed fitting and high ambient temperature, it is recommended to check the temperature of power wires and conformity to their insulation specification.	In case of safe tripping by the internal compressor overload protection, the compressor must cool down to about 60°C before the overload will reset. A high ambient temperature can strongly delay this cool-down process.
Low ambient temperature	Although the compressor itself can withstand low ambient temperature, the system may require specific design features to ensure safe	and reliable operation. See section 'Specific application recommendations'.
Application envelope	The operating envelope for SH scroll compressors is given in the figure below, where the condensing and evaporating temperatures represent the range for steady-state operation at nominal voltage. Under transient conditions, such as start-up and defrost, the compressor may operate outside this envelope for short periods. The operating limits serve to define the envelope within which reliable operations of the compressor are guaranteed:	• Maximum discharge gas temperature: +135°C, • A suction superheat below 5 K is not recommended due to the risk of liquid flood back, • Maximum superheat of 30 K, • Minimum and maximum evaporating and condensing temperatures as per the operating envelopes.



Discharge temperature protection

The discharge gas temperature must not exceed 135°C.



For SH090 to 380, DGT protection is required if the high and low pressure switch settings do not protect the compressor against operations beyond its specific application envelope. Please refer to the examples below, which illustrate where DGT protection is required (Ex.1) and where it is not (Ex.2).

A discharge gas temperature protection device must be installed on all heat pumps. In reversible air-to-air and air-to-water heat pumps the discharge temperature must be monitored during development test by the equipment manufacturer.

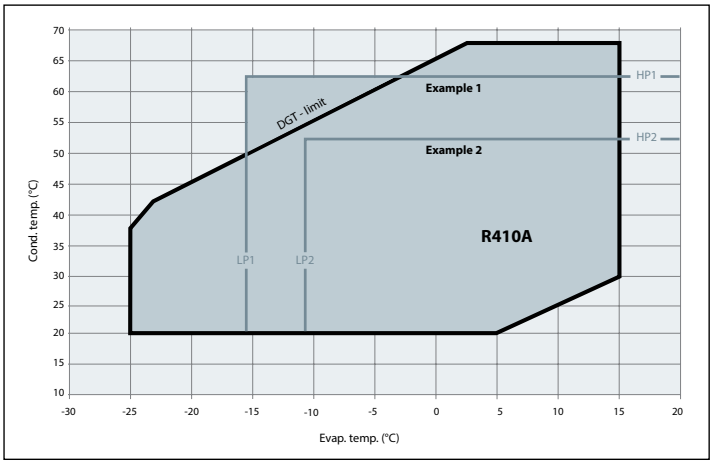
The discharge gas thermostat accessory kit (code 7750009) includes all components required for installation as shown above. The thermostat must be attached to the discharge line within 150 mm from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe.

The DGT should be set to open at a discharge gas temperature of 135°C.

⚠ The compressor must not be allowed to cycle on the discharge gas thermostat. Continuous operations beyond the compressor's operating range will cause serious damage to the compressor!

Example 1 (R410A, SH = 11 K)
LP switch setting:
LP1 = 3.3 bar (g) (-15.5°C)
HP switch setting:
HP1 = 38 bar (g) (62°C)
Risk of operation beyond the application envelope.
DGT protection required.

Example 2 (R410A, SH = 11 K)
LP switch setting:
LP2 = 4.6 bar (g) (-10.5°C)
HP switch setting:
HP2 = 31 bar (g) (52°C)
No risk of operation beyond the application envelope.
No DGT protection required.



High and low pressure protection

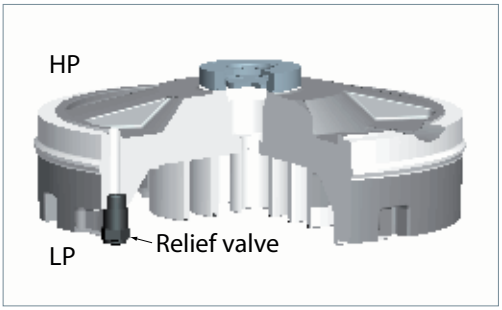
High pressure

A high-pressure (HP) safety switch is required to shut down the compressor should the discharge pressure exceed the values shown in the table section "System pressure test". The high-pressure switch can be set to lower values depending on the application and ambient conditions. The HP switch must either be placed in a lockout circuit or consist of a manual reset device to prevent cycling around the high-pressure limit. If a discharge valve is used, the HP switch must be connected to the service valve gauge port, which must not be isolated.

Internal pressure relief valve

The SH380 incorporates an internal relief valve set to open between the internal high and low pressure sides of the compressor when the pressure differential between the discharge and suction pressures surpasses 42.4 bar.

This safety feature prevents the compressor from developing dangerously high pressures should the high pressure cut-out, for whatever reason, fail to shut down the compressor.



Low pressure

A low-pressure (LP) safety switch must be used. Deep vacuum operations of a scroll compressor can cause internal electrical arcing and scroll instability. Danfoss SH scroll compressors exhibit high volumetric efficiency and may draw very low vacuum levels, which could induce such a problem. The minimum low-pressure safety switch (loss-of-charge safety switch) setting is given in the following table. For systems without pump-down, the LP safety switch must either be a manual lockout device or an automatic switch wired into an electrical lockout circuit. The LP switch tolerance must not allow for vacuum operations of the compressor. LP switch settings for pump-down cycles with automatic reset are also listed in the table below.

Pressure settings		R410A
Working pressure range high side	bar (g)	13.5 - 44.7
Working pressure range low side	bar (g)	1.7 - 11.6
Maximum high pressure safety switch setting	bar (g)	46.1
Minimum low pressure safety switch setting *	bar (g)	1.5
Minimum low pressure pump-down switch setting **	bar (g)	1.7

* LP safety switch shall never be bypassed and shall have no time delay.
** Recommended pump-down switch settings: 1.5 bar below nominal evap. pressure with minimum of 1.7 bar(g)

Note that these two different low pressure switches also require different settings. The low pressure pump down switch setting must always be within the operating envelope, for example 1.7 bar for R410A. The compressor can be operated full time under such condition.

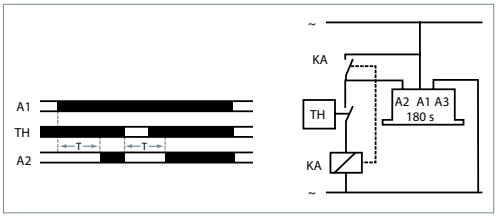
The minimum low pressure safety switch setting may be outside the normal operating envelope and should only be reached in exceptional (emergency) situations, for example 1.5 bar for R410A.

Cycle rate limit

Danfoss recommends a restart delay timer to limit compressor cycling. The timer prevents reverse compressor rotation, which may occur during brief power interruptions.

The system must be designed in a way that guarantees a minimum compressor running time of 2 minutes so as to provide for sufficient motor cooling after start-up along with proper oil return. Note that the oil return may vary since it depends upon system design.

There must be no more than 12 starts per hour, a number higher than 12 reduces the service life of the motor-compressor unit. A three-minute (180-sec) time out is recommended.



General

Successful application of scroll compressors is dependent on careful selection of the compressor for the application. If the compressor is not correct for the system, it will operate beyond the limits given in this manual. Poor performance, reduced reliability, or both may result.

Essential piping design recommendations

The working pressure in systems with R410A is about 60% higher than in systems with R22 or R407C. Consequently, all system components and piping must be designed for this higher pressure level.

Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and slope of the tubing coming from the evaporator. Tubing returns from the evaporator should be designed so as not to trap oil and to prevent oil and refrigerant migration back to the compressor during off-cycles.

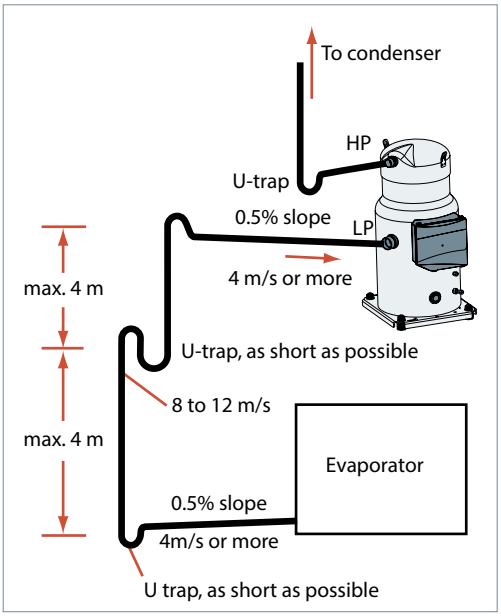
In systems with R410A, the refrigerant mass flow will be lower compared to R22/R407C systems. To maintain acceptable pressure drops and acceptable minimum gas velocities, the refrigerant piping must be reduced in size compared to R22 / R407C systems. Take care not to create too high pressure drops since in R410A systems the negative impact of high pressure drops on the system efficiency is stronger than in R22/R407C systems.

Piping should be designed with adequate three-dimensional flexibility. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. This protection proves necessary to avoid excess vibration, which can ultimately result in connection or tube failure due to fatigue or wear from abrasion. Aside from tubing and connection damage, excess vibration may be transmitted to the surrounding structure and generate an unacceptable noise level within that structure as well. For more information on noise and vibration, see the section on: "Sound and vibration management".

Suction lines

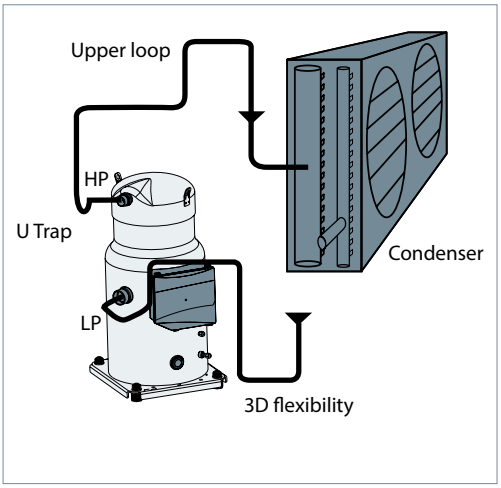
If the evaporator lies above the compressor, as is often the case in split or remote condenser systems, the addition of a pump-down cycle is strongly recommended. If a pump-down cycle were to be omitted, the suction line must have a loop at the evaporator outlet to prevent refrigerant from draining into the compressor during off-cycles.

If the evaporator were situated below the compressor, the suction riser must be trapped so as to prevent liquid refrigerant from collecting at the outlet of the evaporator while the system is idle, which would mislead the expansion valve's sensor (thermal bulb) at start-up.



Discharge lines

When the condenser is mounted at a higher position than the compressor, a suitably sized "U"-shaped trap close to the compressor is necessary to prevent oil leaving the compressor from draining back to the discharge side of the compressor during off cycle. The upper loop also helps avoid condensed liquid refrigerant from draining back to the compressor when stopped.



External non return valve

For SH090-105-120-140-161-184, an External Non-return valve is mandatory for unit with water condenser (W/W or reversible A/C Chiller)

Heat exchangers

To obtain optimum efficiency of the complete refrigerant system, optimised R410A heat exchangers must be used. R410A refrigerant has good heat transfer properties: it is worthwhile designing specific heat exchangers to gain in size and efficiency.

An evaporator with optimised R410A distributor and circuit will give correct superheat at outlet and optimal use of the exchange surface. This is critical for plate evaporators that have generally a shorter circuit and a lower volume than shell and tubes and air cooled coils.

For all evaporator types a special care is required for superheat control leaving the evaporator and oil return.

A sub-cooler circuit in the condenser that creates high sub cooling will increase efficiency at high condensing pressure. In R410A systems the positive effect of sub cooling on system efficiency will be significantly larger than in R22/R407C systems.

Furthermore, for good operation of the expansion device and to maintain good efficiency in the evaporator it is important to have an appropriate sub cooling. Without adequate sub cooling, flash gas will be formed at the expansion device resulting in a high degree of vapour at the expansion device inlet leading to low efficiency.

Refrigerant charge limit

Danfoss SH compressors can tolerate liquid refrigerant up to a certain extent without major problems. However, excessive liquid refrigerant in the compressor is always unfavourable for service life. Besides, the installation cooling capacity may be reduced because of the evaporation taking place in the compressor and/or the suction line instead of the evaporator. System design must be such that the amount of liquid refrigerant in the compressor is limited. In this respect, follow the guidelines given in the section "Essential piping design recommendations" in priority.

Use the tables below to quickly evaluate the required compressor protection in relation with the system charge and the application.

Model	Refrigerant charge limit (kg)
SH090	5.9
SH105-120-140-161-184	7.9
SH180-240-295	13.5
SH380	14.5

System evaluation

Application	BELOW charge limit	ABOVE charge limit
All	Ensure tightness between condenser & evaporator when system is OFF • Thermostatic expansion Valve (TXV) , Liquid Line Solenoid Valve LLSV* strongly recommended • Electronic expansion valve (EXV) must close when system stop including in power shut down situation	
Non split	External Non-return valve is mandatory for unit with water condenser (W/W or reversible A/C Chiller) (For SH090-105-120-140-161-184)	• Surface Sump Heater** • External Non-Return Valve (For SH090-105-120-140-161-184)
Split	Since each installation is unique, refrigerant charge may vary • Surface Sump Heater** • Liquid Line Solenoid Valve*+ pump-down cycle • External Non-Return Valve (For SH090-105-120-140-161-184)	

* 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.

** The surface sump heaters are designed to protect the compressor against off-cycle migration of refrigerant. For this compressor, the surface sump heater is located on the compressor shell. The heater must be turned on whenever all the compressors are off. Surface sump heater accessories are available from Danfoss.

Off-cycle migration

Off-cycle refrigerant migration is likely to occur when the compressor is located at the coldest part of the installation, when the system uses a bleed-type expansion device, or if liquid is allowed to migrate from the evaporator into the compressor sump by gravity. If too much liquid refrigerant accumulates in the sump, it will saturate the oil and lead to a flooded start. When the compressor starts running again, the refrigerant evaporates abruptly under the sudden decrease of the bottom shell pressure, causing the oil to foam, and can also take much oil out of compressor, the result is oil loss in sump. This will be risky of bearing seizing especially for system with large refrigerant and without oil separator.. In extreme situations, this might result in liquid slugging (liquid entering the scroll elements), which must be avoided as it causes irreversible damage to the compressor.

Danfoss SH scroll compressors can tolerate occasional flooded starts as long as the total system charge does not exceed the maximum compressor refrigerant charge.

A suitable test to evaluate the risk of off-cycle migration is the following:

Stabilise the non running system at 5°C ambient temperature,

Raise the ambient temperature to 20°C and keep it for 10 minutes,

Start the compressor and monitor sump temperature, sight glass indication and sound level.

The presence of liquid in the crankcase can be easily detected by checking the sump level through the oil sight glass. Foam in the oil sump indicates a flooded start.

A noisy start, oil loss from the sump and sump cool down are indications for migration. Depending on the amount of migration graduate measures shall be taken:

- **Sump heater**
- **Liquid line solenoid valve**
- **Pump down cycle**

Sump heater

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

When the compressor is idle, the oil temperature in the sump of the compressor must be maintained at no lower than 10 K above the saturation temperature of the refrigerant on the low-pressure side. This requirement ensures that the liquid refrigerant is not accumulating in the sump. A sump heater is only effective if capable of sustaining this level of temperature difference.

Tests must be conducted to ensure that the appropriate oil temperature is maintained under all ambient conditions (temperature and wind). Note that below -5°C ambient temperature and a wind speed of above 5m/second, we recommend that the heaters be thermally insulated in order to limit the surrounding energy losses.

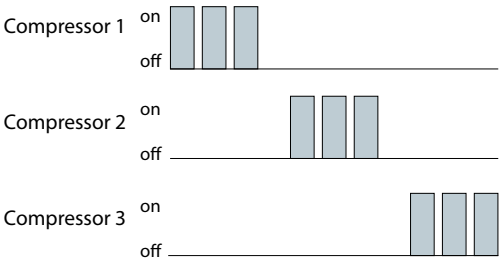
For SH090-105-120-140-161-184 models, in order to get a better standby energy consumption, Danfoss provides 48W and 80W two optional surface sump heater.

The selection of surface sump heater could refer to below principle:

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 & ambient temperature <-5°C	80W SSH + additional SSH/thermal insulation

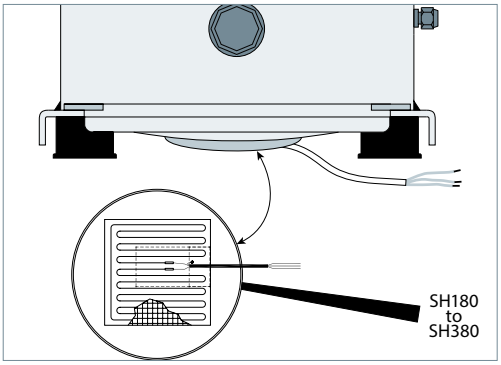
Since the total system charge may be undefined, a sump heater is recommended on all stand-alone compressors and split systems. In addition, any system containing a refrigerant charge in excess of the maximum recommended system charge for compressors requires a sump heater. A sump heater is also required on all reversible cycle applications.

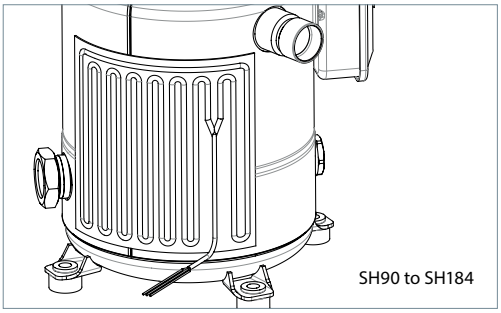
At initial start-up or after power shortage, it is recommended to energize surface sump heater to remove refrigerant 6 hours in advance. A quicker start-up is possible by "jogging" the compressor to evacuate refrigerant in the compressor. Start the compressor for 1 second, then wait for 1 to 2 minutes. After 3 or 4 jogs the compressor can be started. This operation must be repeated for each compressor individually:



The heater must be energized whenever the compressor is off to avoid liquid refrigerant entering the compressor.

Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (e.g. seasonal shutdown).
Surface sump heater accessories are available from Danfoss (see section "Accessories").





Liquid line solenoid valve (LLSV)

A LLSV may be used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer or excessive migration 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

A pump-down cycle represents one of the most effective ways to protect against the off-cycle migration of liquid refrigerant. Once the system has reached its set point and is about to shut off, the LLSV on the condenser outlet closes. The compressor then pumps the majority of the refrigerant charge into the condenser and receiver before the system stops on the low pressure pump-down switch. This step reduces the amount of charge on the low side in order to prevent off-cycle migration. The recommended low-pressure pump-down switch setting is 1.5 bar below the nominal evaporating pressure. It shall not be set lower than 1.7 bar(g). For suggested wiring diagrams, please see section "Suggested wiring diagrams logic".

In certain conditions, the discharge valve in the SH090 - 105 - 120 - 140 - 161 - 184 compressor may not completely seal and result in compressor restarts during pump down applications. An external, non-bleeding check valve may need to be installed.

Tests for pump down cycle approval:

- As the pump-down switch setting is inside the application envelope, tests should be carried out to check unexpected cut-out during transient conditions (i.e. defrost – cold starting). When unwanted cut-outs occur, the low pressure pump-down switch can be delayed. In this case a low pressure safety switch without any delay timer is mandatory.
- While the thermostat is off, the number of pressure switch resets should be limited to avoid short cycling of the compressor. Use dedicated wiring and an additional relay which allows for one shot pump-down.

The pump-down allows to store all the refrigerant in the high pressure side circuit. On unitary or close-coupled systems, where the system refrigerant charge is expected to be both correct and definable the entire system charge may be stored in the condenser during pump-down if all components have been properly sized.

Other application needs a liquid receiver to store the refrigerant.

Receiver dimensioning requires special attention. The receiver shall be large enough to contain part of the system refrigerant charge but it shall not be dimensioned too large. A large receiver easily leads to refrigerant overcharging during maintenance operation.

Liquid flood back

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

Danfoss SH scroll compressors can tolerate occasional liquid flood back. However, system design must be such that repeated and excessive flood back is not possible.

A continuous liquid flood back will cause oil dilution and, in extreme situations, lead to lack of lubrication and high rate of oil leaving the compressor.

Liquid flood back test - Repetitive liquid flood back testing must be carried out under expansion valve threshold operating conditions: a high pressure ratio and minimum evaporator load, along with the measurement of suction superheat, oil sump temperature and discharge gas temperature.

During operations, liquid flood back may be detected by measuring either the oil sump temperature or the discharge gas temperature. If at any time during operations, the oil sump temperature drops to within 10K or less above the saturated suction temperature, or should the discharge gas temperature be less than 35K above the saturated discharge temperature, this indicates liquid flood back.

Continuous liquid flood back can occur with a wrong dimensioning, a wrong setting or malfunction of the expansion device or in case of evaporator fan failure or blocked air filters.

A suction accumulator providing additional protection as explained hereunder can be used to solve light continuous liquid flood back.

Suction accumulator: a suction accumulator offers protection against refrigerant flood back at start-up, during operations or defrosting by trapping the liquid refrigerant upstream from the compressor. The suction accumulator also protects against off-cycle migration by providing additional internal free volume to the low side of the system.

A suction accumulator must be carefully dimensioned, taking into account the refrigerant charge as well as the gas velocity in the suction line.

The accumulator should not be sized for less than 50 % of the total system charge. Tests must be conducted to determine the actual refrigerant holding capacity needed for the application.

Depending on the operating conditions it may happen that the recommended connections of the accumulator are one size smaller than the suction line.

Low ambient application

Low ambient start-up

Under cold ambient conditions (<0°C), upon start-up the pressure in the condenser may be so low that a sufficient pressure differential across the expansion device cannot be developed to properly feed the evaporator.

As a result, the compressor may go into a deep vacuum, which can lead to compressor failure due to internal arcing and instability in the scroll wraps. Under no circumstances should the compressor be allowed to operate under vacuum. The low-pressure control must be set in accordance with the table section "Low pressure" in order to prevent this from happening.

Early feeding of the evaporator and management of the discharge pressure could help to attenuate these effects.

Low pressure differentials can also cause the expansion device to "hunt" erratically, which might cause surging conditions within the evaporator, with liquid spillover into the compressor. This effect is most pronounced during low load conditions, which frequently occur during low ambient conditions.

Low ambient operations

The Danfoss SH scroll compressor requires a minimum pressure differential between the suction and discharge pressures (please refer to operation envelop) to force the orbiting scroll down against the oil film on the thrust bearing. Anything less than this differential and the orbiting scroll can lift up, causing a metal-to-metal contact. It is therefore necessary to maintain sufficient discharge pressure in order to ensure this pressure differential. Care should be taken during low ambient operations when heat removal from air-cooled condensers is greatest and head pressure control may be required for low ambient temperature applications. Operation under low pressure differential may be observed by a significant increase in the sound power level generated by the compressor.

It is recommended that the unit be tested and monitored at minimum load and low ambient conditions as well. The following considerations should be taken into account to ensure proper system operating characteristics.

Expansion device: The expansion device should be sized to ensure proper control of the refrigerant flow into the evaporator. An oversized valve may result in erratic control. This consideration is especially important in manifolded units where low load conditions may require the frequent cycling of compressors. This can lead to liquid refrigerant entering the compressor if the expansion valve does not provide stable refrigerant super-heat control under varying loads.

The superheat setting of the expansion device should be sufficient to ensure proper superheat levels during low loading periods. A minimum of 5 K stable superheat is required.

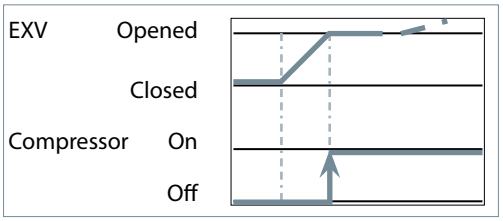
Head pressure control under low ambient conditions: Several possible solutions are available to prevent the risk of compressor to vacuum and low pressure differential between the suction and discharge pressures.

In air-cooled machines, cycling the fans with a head pressure controller will ensure that the fans remain off until the condensing pressure has reached a satisfactory level. Variable speed fans can also be used to control the condensing pressure. In water-cooled units, the same can be performed using a water regulator valve that is also operated by head pressure, thereby ensuring that the water valve does not open until the condensing pressure reaches a satisfactory level.

The minimum condensing pressure must be set at the minimum saturated condensing temperature shown in the application envelopes.

Under very low ambient conditions, in which testing has revealed that the above procedures might not ensure satisfactory condensing and suction pressures, the use of a head pressure control valve is recommended. Note: This solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is recommended and special care should be taken when designing the discharge line.

For further information, please contact Danfoss.

Application Guidelines	Specific application recommendations	
Sump heaters	Sump heaters are strongly recommended on all systems where the compressor is exposed to low ambient temperatures, especially split and remote condenser installations. The sump heater	will minimize refrigerant migration caused by the large temperature gradient between the compressor and the remainder of the system, please refer to section "Accessories".
Low load operation	The compressors should be run for a minimum period in order to ensure that the oil has sufficient time to properly return to the	compressor sumps and that the motor has sufficient time to cool under conditions of lowest refrigerant mass flows.
Brazed plate heat exchangers	A brazed plate heat exchanger needs very little internal volume to satisfy the set of heat transfer requirements. Consequently, the heat exchanger offers very little internal volume for the compressor to draw vapour from on the suction side. The compressor can then quickly enter into a vacuum condition. It is therefore important that the expansion device is sized correctly and that a sufficient pressure differential across the expansion device is available to ensure adequate refrigerant feed into the evaporator. This aspect is of special concern when operating the unit under low ambient and load conditions. For further information on these conditions, please refer to the previous sections.	Due to the small volume of the brazed plate heat exchanger, no pump-down cycle is normally required. The suction line running from the heat exchanger to the compressor must be trapped to avoid refrigerant migration to the compressor. When using a brazed plate condenser heat exchanger, a sufficient free volume for the discharge gas to accumulate is required in order to avoid excess pressure build-up. At least one meter of discharge line is necessary to generate this volume. To help reduce the gas volume immediately after start-up even further, the supply of cooling water to the heat exchanger may be opened before the compressor starts up so as to remove superheat and condense the incoming discharge gas more quickly.
Electronic expansion valve	The use of an electronic expansion valve requires a specific compressor start / stop control. A specific compressor start sequence control has to be set when an electronic expansion valve (EXV) is used. The sequence must be adjusted according to the EXV step motor speed to allow time for the EXV to open before the compressor starts to avoid running under vacuum conditions. The EXV should be closed at compressor stop not to let refrigerant in liquid phase entering the	compressor. Ensure that the EXV closes when the supply voltage to the controller is interrupted (ie power cut off) by the use of a battery back up. 
Reversible heat pump systems	Transients are likely to occur in reversible heat pump systems, i.e. a changeover cycle from cooling to heating, defrost or low-load short cycles. These transient modes of operation may lead to liquid refrigerant carry-over (or flood back) or excessively wet refrigerant return conditions. As such, reversible cycle applications require specific precautions for ensuring a long compressor life and satisfactory operating characteristics. Regardless of the refrigerant	charge in the system, specific tests for repetitive flood back are required to confirm whether or not a suction accumulator needs to be installed. The following considerations cover the most important issues when dealing with common applications. Each application design however should be thoroughly tested to ensure acceptable operating characteristics.

Application Guidelines	Specific application recommendations
Sump heaters	Sump heaters are mandatory on reversible cycle applications given the high probability of liquid migration back to the compressor sump during off-cycles due to the outdoor location of most units and operations during low ambient conditions.
Discharge temperature thermostat	Heat pumps frequently utilize high condensing temperatures in order to achieve a sufficient temperature rise in the medium being heated. At the same time, they often require low evaporating pressures to obtain sufficient temperature differentials between the evaporator and the outside temperature. This situation may result in high discharge temperature; as such, it is mandatory that a discharge gas thermostat be installed on the discharge line to protect the compressor from excessive temperatures. Operating the compressor at too high discharge temperatures can result in mechanical damage to the compressor as well as thermal degradation of the compressor lubricating oil and a lack of sufficient lubrication. The discharge gas thermostat should be set to shut down the compressor in the event discharge gas rises above 135°C.
Discharge line, reversing valve, solenoid valves	The Danfoss SH scroll compressor is a high volumetric machine and, as such, can rapidly build up pressure in the discharge line if gas in the line becomes obstructed even for a very short period of time which situation may occur with slow-acting reversing valves in heat pumps. Discharge pressures exceeding the operating envelope may result in nuisance high-pressure switch cutouts and place excess strain on both the bearings and motor. To prevent such occurrences, it is important that a 1-meter minimum discharge line length be allowed between the compressor discharge port and the reversing valve or any other restriction. This gives sufficient free volume for the discharge gas to collect and to reduce the pressure peak during the time it takes for the valve to change position. At the same time, it is important that the selection and sizing of the reversing or 4-way valve ensure that the valve switches quickly enough to prevent against too high discharge pressure and nuisance high-pressure cutouts. Check with the valve manufacturer for optimal sizing and recommended mounting positions. In applications with heat recovery or condenser partialisation, servo piloted solenoid valve has to be properly sized or associated with a second small valve in parallel, in order to avoid quick discharge pressure drops when opening. This phenomenon could lead to hammering effects and create constraints on the non return valve integrated in discharge fitting (SH180 to 380).
Defrost and reverse cycle	The Danfoss SH scroll compressor has the ability to withstand a certain amount of liquid refrigerant dynamic slug. When compressors are installed in parallel, in order to limit liquid amount handled per compressor when beginning and ending defrost, it is recommended to avoid running part load (keep all compressors running or keep them stopped when moving 4-way valves). For further details, please refer to Parallel application guidelines FRCC.PC.008. EXV can also be opened when compressors are stopped and before 4 way valve is moving in order to decrease pressure difference. Opening degree and time have to be set in order to keep a minimum pressure difference for 4 way valve moving. Each application design however should be thoroughly tested to ensure acceptable operating characteristics. R 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).

Application Guidelines	Specific application recommendations	
Suction line accumulator	The use of a suction line accumulator is strongly recommended in reversible-cycle applications. This because of the possibility of a substantial quantity of liquid refrigerant remaining in the evaporator, which acts as a condenser during the heating cycle. This liquid refrigerant can then return to the compressor, either flooding the sump with refrigerant or as a dynamic liquid slug when the cycle switches back to a defrost cycle or to normal cooling operations.	Sustained and repeated liquid slugging and flood back can seriously impair the oil's ability to lubricate the compressor bearings. This situation can be observed in wet climates where it is necessary to frequently defrost the outdoor coil in an air source heat pump. In such cases a suction accumulator becomes mandatory.
Water utilizing systems	Apart from residual moisture in the system after commissioning, water could also enter the refrigeration circuit during operation. Water in the system shall always be avoided. Not only because it can quickly lead to electrical failure, sludge in sump and corrosion but in particular because it can cause serious safety risks. Common causes for water leaks are corrosion and freezing.	Corrosion: Materials in the system shall be compliant with water and protected against corrosion. Freezing: When water freezes into ice its volume expands which can damage heat exchanger walls and cause leaks. During off periods water inside heat exchangers could start freezing when ambient temperature is lower than 0°C. During on periods ice banking could occur when the circuit is running continuously at too low load. Both situations should be avoided by connecting a pressure and thermostat switch in the safety line.

Starting sound level

During start-up transients it is natural for the compressor sound level to be slightly higher than during normal running. SH scroll compressors exhibit very little increased start-up transient sound. If a compressor is miswired, the compressor will run in reverse. Reverse compressor rotation is characterised by an objectionable sound. To correct reverse rotation, disconnect power and switch any two of the three power leads at the unit contactor. Never switch leads at the compressor terminals.

Running sound level

Compressor acoustic hoods have been developed to meet specific extra-low noise requirements. The acoustic hoods incorporate sound proofing materials and offer excellent high and low frequency attenuation.

Model	50 Hz		60 Hz		Acoustic hood code number
	Sound power dB(A)	Attenuation dBA ①	Sound power dB(A)	Attenuation dbA ①	
SH090	70	6	72	6	120Z0034
SH105	71.5	6	74	6	120Z0035
SH120	72.5	6	75	6	120Z0035
SH140 *	72.5	6	76	6	120Z0035
SH161 *	73.5	6	77	6	120Z0035
SH184	75	6	78	6	120Z0135
SH180	80	6	85	4	120Z0022
SH240	82	6	86	4	120Z0022
SH295	82	6	86	4	120Z0022
SH380 **	83	6	87	4	120Z0022

Sound power and attenuation are given at ARI conditions, measured in free space
Data given for motor code 4 compressor, for full data details refer to online datasheet generator: www.danfoss.com/odsg

* For SH140 code 3 and SH161 code 3 use acoustic hood reference 120Z0135
** For SH380 code 3 use acoustic hood reference 120Z0579
① Attenuation given with acoustic

Materials are UL approved and RoHS compliant

Stopping sound level

SH compressors are equipped with a discharge valve which closes at compressor shut down and thus prevents the compressor from running backwards. This reduces the stopping sound to a metallic click caused by the closing valve. When the pressure difference or gas flow at shut down should be very low, this can delay the discharge valve from closing and lead to a longer noise duration.

Sound generation in a refrigeration or air conditioning system

Typical sound and vibration in refrigeration and air conditioning systems encountered by design and service engineers may be broken down into the following three source categories.

Sound radiation: this generally takes an airborne path.

Mechanical vibrations: these generally extend along the parts of the unit and structure.

Gas pulsation: this tends to travel through the cooling medium, i.e. the 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 compressor, the emission path is airborne and the sound waves are travelling directly from the machine in all directions.

The Danfoss SH scroll compressor is designed to be quiet and the frequency of the sound generated is pushed into the higher ranges, which not only are easier to reduce but also do not generate the penetrating power of lower-frequency sound.

Use of sound-insulation materials on the inside of unit panels is an effective means of substantially reducing the sound being transmitted to the outside. Ensure that no components capable of transmitting sound/vibration within the unit come into direct contact with any non-insulated parts on the walls of the unit.

Due to the unique Danfoss design of a full-suction gas-cooled motor, compressor body insulation across its entire operating range is possible. Acoustic hoods are available from Danfoss as accessories. They have been developed to meet specific extra low noise requirements. They incorporate sound proofing materials and offer excellent high and low frequency alternative.

These hoods are quick and easy to install and do not increase the overall size of the compressors to a great extend.

Refer to section "Running sound level" for sound attenuation and code numbers.

Mechanical vibrations

Vibration isolation constitutes the primary method for controlling structural vibration. Danfoss SH scroll compressors are designed to produce minimal vibration during operations. The use of rubber isolators on the compressor base plate or on the frame of a manifolded unit is very effective in reducing vibration being transmitted from the compressor(s) to the unit. Once the supplied rubber grommets have been properly mounted, vibrations transmitted from the compressor base plate to the unit are held to a strict minimum. In addition, it is extremely important that the frame supporting the mounted compressor be of sufficient mass and stiffness to help dampen any residual vibration potentially transmitted to the frame. For further information on mounting requirements, please refer to the section on mounting assembly.

Note: for parallel assemblies see specific recommendations in Danfoss SH parallel application guidelines FRCC.PC.008 (rigid mounting).

The tubing should be designed so as to both reduce the transmission of vibrations to other structures and withstand vibration without incurring any damage. Tubing should also be designed for three-dimensional flexibility. For more information on piping design, please see the section entitled "Essential piping design recommendations".

Gas pulsation

The Danfoss SH scroll compressor has been designed and tested to ensure that gas pulsation has been optimised for the most commonly encountered air conditioning pressure ratio. On heat pump installations and other installations where the pressure ratio lies beyond the typical range, testing should be conducted under all expected conditions and operating configurations to ensure that minimum gas pulsation is present. If an unacceptable level is identified, a discharge muffler with the appropriate resonant volume and mass should be installed. This information can be obtained from the component manufacturer.

Each SH compressor is shipped with printed Instructions for installation. These instructions can also be downloaded from our website:

www.danfoss.com or directly from:
http://instructions.cc.danfoss.com

Compressor handling and storage

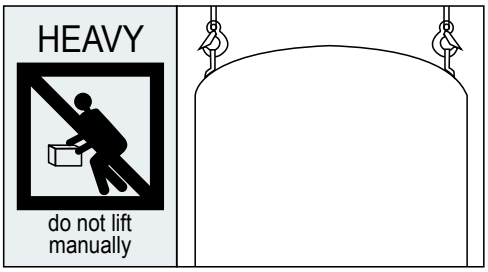
Each Danfoss SH scroll compressor is equipped with two lift rings on the top shell. Always use both these rings when lifting the compressor. Use lifting equipment rated and certified for the weight of the compressor. A spreader bar rated for the weight of the compressor is highly recommended to ensure a better load distribution. The use of lifting hooks closed with a clasp and certified to lift the weight of the compressor is also highly recommended. Always respect the appropriate rules concerning lifting objects of the type and weight of these compressors. Maintain the compressor in an upright position during all handling manoeuvres (maximum of 15° from vertical).

⚠ Never use only one lifting lug to lift the compressor. The compressor is too heavy for the single lug to handle, and the risk is run that the lug could separate from the compressor with extensive damage and possible personal injury as a result.

Store the compressor not exposed to rain, corrosive or flammable atmosphere and between -35°C and 51°C when charged with R410A refrigerant and between -35°C and 70°C when charged with nitrogen.

⚠ When the compressor is mounted as part of an installation, never use the lift rings on the compressor to lift the installation. The risk is run that the lugs could separate from the compressor or that the compressor could separate from the base frame with extensive damage and possible personal injury as a result.

Never apply force to the terminal box with the intention of moving the compressor, as the force placed upon the terminal box can cause extensive damage to both the box and the components contained inside.



Compressor mounting

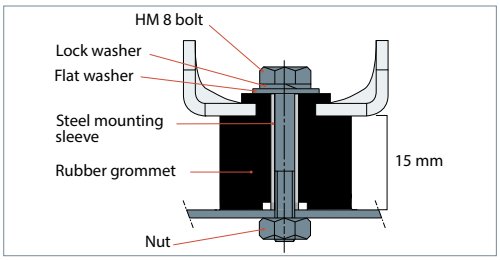
Maximum inclination from the vertical plane while operating must not exceed three degrees.

Mounting of SH090-105-120-140-161-184

Compressors SH090-105-120-140-161-184 come delivered with four rubber mounting grommets and metal sleeve liners that serve to isolate the compressor from the base frame. These grommets must always be used to mount the compressor in a single application. The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The grommets attenuate to a great extent the transmission of compressor vibrations to the base frame.

The required bolt size for the SH 090 -105-120-140-161-184 compressors is HM8-40. This bolt must be tightened to a torque of 15 Nm.

For parallel assemblies see specific recommendations in Danfoss SH parallel application guidelines (rigid mounting).



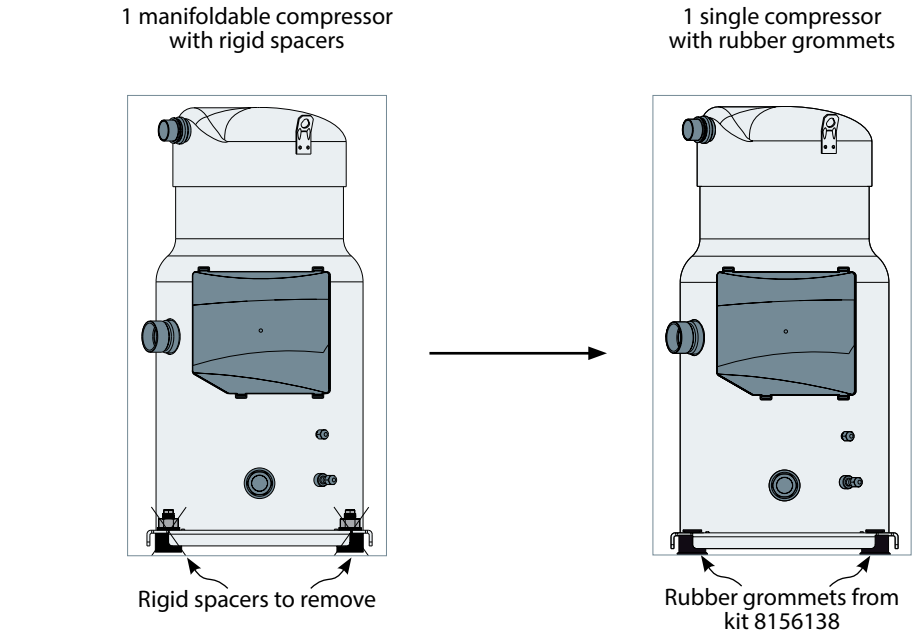
When a surface sump heater is used, it must be applied after the grommets are mounted on compressor feet, in order to avoid surface sump heater damage.

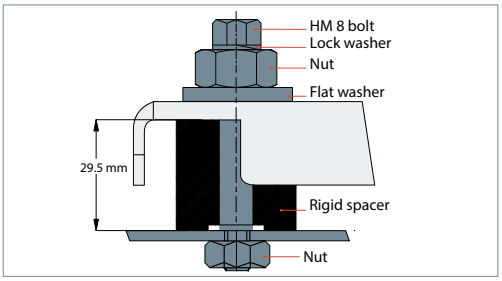
Mounting of SH180-240-295-380

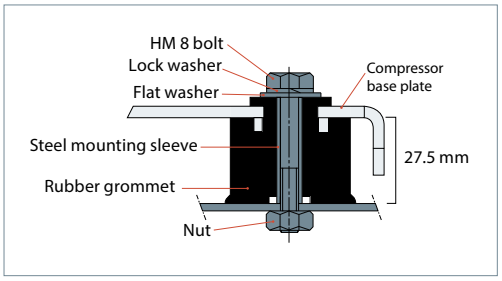
Compressors SH180-240-295-380 come delivered with rigid mounting spacers for parallel mounting.

If used in single applications, the compressor must be mounted with the flexible grommets as available in accessory conversion kit 8156138. The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The grommets attenuate to a great extent the transmission of compressor vibrations to the base frame.

The required bolt size for the SH180-240-295-380 compressors is HM8-55. This bolt must be tightened to a torque of 21 Nm.







Compressor holding charge

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

Before the suction and discharge plugs are removed, the nitrogen holding charge must be released via the suction schrader valve to avoid an oil mist blowout. Remove the suction plug first and the discharge plug afterwards. The plugs shall be removed only just before connecting the compressor to the installation in order to avoid moisture from entering the compressor. When the plugs are removed, it is essential to keep the compressor in an upright position so as to avoid oil spillage.

System cleanliness

The refrigerant compression system, regardless of the type of compressor used, will only provide high efficiency and good reliability, along with a long operating life, if the system contains solely the refrigerant and oil it was designed for. Any other substances within the system will not improve performance and, in most cases, will be highly detrimental to system operations.

The presence of non-condensable substances and system contaminants such as metal shavings, solder and flux, have a negative impact on compressor service life. Many of these contaminants are small enough to pass through a mesh screen and can cause considerable damage within a bearing assembly.

The use of highly hygroscopic polyolester oil in R410A compressors requires that the oil be exposed to the atmosphere as little as possible.

System contamination is one of main factors affecting equipment reliability and compressor service life. It is important therefore to take system cleanliness into account when assembling a refrigeration system.

During the manufacturing process, circuit contamination may be caused by:

- Brazing and welding oxides
- Filings and particles from the removal of burrs in pipe-work
- Brazing flux
- Moisture and air.

Consequently, when building equipment and assemblies, the precautions listed in the following paragraphs must be taken.

Tubing

Only use clean and dehydrated refrigeration-grade copper tubing. Tube-cutting must be carried out so as not to deform the tubing roundness and to ensure that no foreign debris remains within the tubing. Only refrigerant grade fittings should be used and these must be of both a design and size to allow for a minimum pressure drop through the completed assembly. Follow the brazing instructions on next pages. Never drill holes into parts of the pipe-work where filings and particles can not be removed.

Brazing and soldering

Do not bend the compressor discharge or suction lines or force system piping into the compressor connections, because this will increase stresses that are a potential cause of failure. Recommended brazing procedures and material, are described section “Compressor connection”.

These operations must be performed by a qualified personnel in compliance with all pertinent practices and safety procedures.

Copper to copper connections

When brazing copper-to-copper connections, the use of copper/phosphorus brazing alloy containing 5% silver or more with a melting temperature of below 800°C is recommended. No flux is required during brazing.

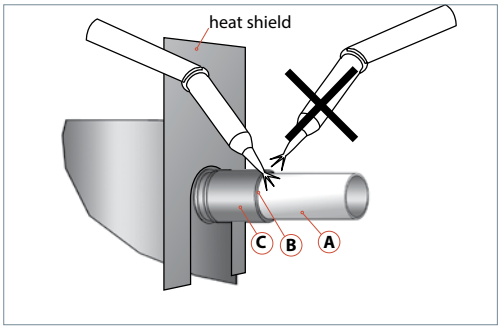
Dissimilar metals connection

When manipulating dissimilar metals such as copper and brass or steel, the use of silver solder (5% or more) and anti-oxidant flux is necessary.

Please contact Danfoss Technical support for any deviation from this guidelines.

Compressor connection

When brazing the compressor fittings, do not overheat the compressor shell, which could severely damage certain internal components due to excessive heating. Use of a heat shield and/or a heat-absorbent compound is highly recommended. Due to the relatively sizable tubing and fitting diameters a double-tipped torch using acetylene is recommended for brazing operation on Danfoss SH scroll compressors.



For brazing the suction and discharge connections, the following procedure is advised:

- Make sure that no electrical wiring is connected to the compressor.
- Protect the terminal box and compressor painted surfaces from torch heat damage (see diagram).
- Remove the Teflon gaskets when brazing rotolock connectors with solder sleeves.
- Use only clean refrigeration-grade copper tubing and clean all connections.
- Use brazing material with a minimum of 5% silver content.
- Purge nitrogen or CO_2 through the compressor in order to prevent against oxidation and flammable conditions. The compressor should not be exposed to the open air for extended periods.
- Use of a double-tipped torch is recommended.
- Apply heat evenly to area **A** until the brazing temperature is reached. Move the torch to area **B** and apply heat evenly until the brazing temperature has been reached there as well, and then begin adding the brazing material. Move the torch evenly around the joint, in applying only enough brazing material to flow the full circumference of the joint.
- Move the torch to area **C** only long enough to draw the brazing material into the joint, but not into the compressor.
- Remove all remaining flux once the joint has been soldered with a wire brush or a wet cloth. Remaining flux would cause corrosion of the tubing.

In addition, for discharge connections equipped with a non return valve integrated in discharge fitting (SH180-240-295-380) the direction of the torch has to be as described on the picture, and maximum brazing time should be less than 2 minutes to avoid NRVI damages.

Ensure that no flux is allowed to enter into the tubing or compressor. Flux is acidic and can cause substantial damage to the internal parts of the system and compressor.

The polyolester oil used in SH compressors is highly hygroscopic and will rapidly absorb moisture from the air. The compressor must therefore not be left open to the atmosphere for a long period of time. The compressor fitting plugs shall be removed just before brazing the compressor. The compressor should always be the last component brazed into the system

⚠ Before eventual unbrazing the compressor or any system component, the refrigerant charge must be removed from both the high- and low-pressure sides. Failure to do so may result in serious personal injury. Pressure gauges must be used to ensure all pressures are at atmospheric level.

For more detailed information on the appropriate materials required for brazing or soldering, please contact the product manufacturer or distributor. For specific applications not covered herein, please contact Danfoss for further information.

System pressure test

Always use an inert gas such as nitrogen for pressure testing. Never use other gasses such as oxygen, dry air or acetylene as these may form an inflammable mixture. Do not exceed the following pressures:

Maximum compressor test pressure (low side)	34.3 bar (g) for SH180 to 380 36.7 bar (g) for SH090 to 184
Maximum compressor test pressure (high side)	48.7 bar (g)
Maximum pressure difference between high and low side of the compressor	37 bar (g)

Pressurize the system on HP side first then LP side to prevent rotation of the scroll. Never let the pressure on LP side exceed the pressure on HP side with more than 5 bar.

On SH180-240-295-380 models which have an internal non return valve in discharge fitting or an external non return valve is present on the discharge line, we advise to pressurize the system not quicker than 4.8 bar/s to allow pressure equalization between LP and HP side over scroll elements.

Leak detection

Leak detection must be carried out using a mixture of nitrogen and refrigerant or nitrogen and helium, as indicated in the table below. Never use other gasses such as oxygen, dry air or acetylene as these may form an inflammable mixture.
Pressurize the system on HP side first then LP side.

Leak detection with refrigerant	Leak detection with a mass spectrometer
Nitrogen and R410A	Nitrogen and Helium

Note 1: Leak detection with refrigerant may be forbidden in some countries. Check local regulations.
Note 2: The use of leak detecting additives is not recommended as they may affect the lubricant properties.

Vacuum evacuation and moisture removal

Moisture obstructs the proper functioning of the compressor and the refrigeration system.

Air and moisture reduce service life and increase condensing pressure, and cause excessively high discharge temperatures, which can destroy the lubricating properties of the oil. Air and moisture also increase the risk of acid formation, giving rise to copper platting. All these phenomena can cause mechanical and electrical compressor failure.

For these reasons it is important to perform a vacuum dehydration on the system to remove all residual moisture from the pipe-work after assembly;

SH compressors are delivered with < 100 ppm moisture level. The required moisture level in the circuit after vacuum dehydration must be < 100 ppm for systems with an SH.

- 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) absolute.

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

Filter driers

A properly sized and type of drier is required. Important selection criteria include the driers water content capacity, the system refrigeration capacity and the system refrigerant charge. The drier must be able to reach and maintain a moisture level of 50 ppm end point dryness (EPD).

For new installations with SH compressors with polyolester oil, Danfoss recommends using the Danfoss DML (100% molecular sieve) solid core filter drier. Molecular sieve filter driers with loose beads from third party suppliers shall be avoided. For servicing of existing installations where acid formation is present the Danfoss DCL (solid core) filter driers containing activated alumina are recommended.

The drier is to be oversized rather than under sized. When selecting a drier, always take into account its capacity (water content capacity), the system refrigeration capacity and the system refrigerant charge.

After burn out, remove and replace the liquid line filter drier and install a Danfoss type DAS burn-out drier of the appropriate capacity. Refer to the DAS drier instructions and technical information for correct use of the burnout drier on the liquid line.

Refrigerant charging

For the initial charge the compressor must not run and eventual service valves must be closed. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. This initial charging operation must be done in liquid phase. The best location is on the liquid line between the condenser outlet and the filter drier. Then during commissioning, when needed, a complement of charge can be done in liquid phase: slowly throttling liquid in on the low pressure side as far away as possible from the compressor suction connection while compressor is running. The refrigerant charge quantity must be suitable for both summer and winter operations.

Vacuum or charge from one side can seal the scrolls and result in a non-starting compressor. When servicing, always ensure that LP/HP pressures are balanced before starting the compressor.

Be sure to follow all government regulations regarding refrigerant reclamation and storage.

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

Insulation resistance and dielectric strength

Insulation resistance must be higher than 1 megohm when measured with a 500 volt direct current megohm tester.

Each compressor motor is tested at the factory with a high potential voltage (hi-pot) that exceeds the UL requirement both in potential and in duration. Leakage current is less than 5 mA.

SH scroll compressors are configured with the pump assembly at the top of the shell, and the motor below. As a result, the motor can be partially immersed in refrigerant and oil. 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.

In testing insulation resistance, Danfoss recommends that the system be first operated briefly to distribute refrigerant throughout the system. Following this brief operation, retest the compressor for insulation resistance or current leakage.

Never reset a breaker or replace a fuse without first checking for a ground fault (a short circuit to ground). Be alert for sounds of arcing inside the compressor.

Commissioning

The system must be monitored after initial start-up for a minimum of 60 minutes to ensure proper operating characteristics such as:

- Proper metering device operation and desired superheat readings
- Suction and discharge pressure are within acceptable levels
- Correct oil level in compressor sump indicating proper oil return
- Low foaming in sight glass and compressor sump temperature 10K above saturation temperature to show that there is no refrigerant migration taking place
- Acceptable cycling rate of compressors, including duration of run times
- Current draw of individual compressors within acceptable values (max operating current)
- No abnormal vibrations and noise.

Oil level checking and top-up

In installations with good oil return and line runs up to 20 m, no additional oil is required. If installation lines exceed 20 m, additional oil may be needed. 1 or 2% of the total system refrigerant charge (in weight) can be used to roughly define the required oil top-up quantity but in any case the oil charge has to be adjusted based on the oil level in the compressor sight glass.
When the compressor is running under stabilised conditions the oil level must be visible in the sight glass.
The presence of foam filling in the sight glass indicates large concentration of refrigerant in the oil and / or presence of liquid returning to the compressor.

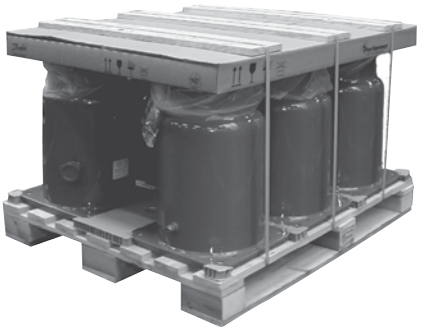
The oil level can also be checked a few minutes after the compressor stops.
When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.
Always use original Danfoss POE oil 160SZ from new cans.
Top-up the oil while the compressor is idle. Use the schrader connector or any other accessible connector on the compressor suction line and a suitable pump. See News bulletin "Lubricants filling in instructions for Danfoss Commercial Compressors".

Packaging

Single pack

Compressor models	Length (mm)	Width (mm)	Height (mm)	Gross weight (kg)
SH090	565	470	718	69
SH105	565	470	718	76
SH120	565	470	718	76
SH140	565	470	718	79
SH161	565	470	718	81
SH184	565	470	718	84
SH180	750	750	1050	126
SH240	750	750	1050	126
SH295	750	750	1050	129
SH380	750	750	1050	176

Industrial pack



Compressor models	Nbr*	Length (mm)	Width (mm)	Height (mm)	Gross weight (kg)	Static stacking pallets
SH090	8	1150	950	680	494	2
SH105	8	1150	950	750	544	2
SH120	8	1150	950	750	544	2
SH140	8	1150	950	750	566	2
SH161	8	1150	950	750	582	2
SH184	8	1150	950	750	606	2
SH180	6	1150	965	768	685	2
SH240	6	1150	965	768	683	2
SH295	6	1150	965	768	702	2
SH380	4	1150	965	800	671	2

* nbr: number of compressors per pack

Ordering information

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

Compressors SH180-240-295-380 with rigid mounting spacers are dedicated for parallel mounting. For use in single applications the rigid spacers must be replaced by flexible grommets which are available as accessory kit 8156138, see section "Accessories".

Single pack

Compressor model	Connections	Mounting feet	Motor protection	Code no.			
				3	4	7	9
				200-230/3/60	460/3/60 380-400/3/50	575/3/60 500/3/50	380/3/60
SH090	Brazed	Flexible	Internal	120H0001	120H0003	120H0007	120H0009
SH105	Brazed	Flexible	Internal	120H0209	120H0211	120H0215	120H0217
SH120	Brazed	Flexible	Internal	120H0011	120H0013	120H0017	120H0019
SH140	Brazed	Flexible	Internal	120H0199	120H0201	120H0205	120H0207
SH161	Brazed	Flexible	Internal	120H0021	120H0023	120H0027	120H0029
SH184	Brazed	Flexible	Internal	120H0359	120H0361	120H0365	120H0367
SH180	Brazed	Rigid	Module 24V AC *	-	120H0267	-	-
	Brazed	Rigid	Module 110-240V *	120H0273	120H0275	-	120H0279
SH240	Brazed	Rigid	Module 24V AC *	120H0289	120H0291	-	-
	Brazed	Rigid	Module 110-240V *	120H0297	120H0299	120H0301	120H0303
SH295	Brazed	Rigid	Module 24V AC*	120H0851	120H0825	-	120H0841
	Brazed	Rigid	Module 110-240V*	120H0853	120H0827	-	120H0843
SH380	Brazed	Rigid	Module 24V AC *	-	120H0253	-	120H0261
	Brazed	Rigid	Module 110-240V *	120H0152	120H0255	120H0259	120H0263

* Electronic motor protection, module located in terminal box

Industrial pack

Compressor model	Connections	Mounting feet	Motor protection	Code no.		
				3	4	9
				200-230/3/60	400/3/50 460/3/60	380/3/60
SH090	Brazed	Flexible	Internal	120H0002	120H0004	120H0010
SH105	Brazed	Flexible	Internal	120H0210	120H0212	120H0218
SH120	Brazed	Flexible	Internal	120H0012	120H0014	120H0020
SH140	Brazed	Flexible	Internal	120H0200	120H0202	120H0208
SH161	Brazed	Flexible	Internal	120H0022	120H0024	120H0030
SH184	Brazed	Flexible	Internal	120H0360	120H0362	120H0368
SH180	Brazed	Rigid	Module 24V AC *	120H0266	120H0268	-
	Brazed	Rigid	Module 110-240V *	-	120H0276	120H0280
SH240	Brazed	Rigid	Module 24V AC *	120H0290	120H0292	120H0296
	Brazed	Rigid	Module 110-240V *	120H0298	120H0300	120H0304
SH295	Brazed	Rigid	Module 24V AC*	120H0852	120H0826	120H0842
	Brazed	Rigid	Module 110-240V*	120H0854	120H0828	120H0844
SH380	Brazed	Rigid	Module 24V AC *	-	120H0254	120H0262
	Brazed	Rigid	Module 110-240V *	120H0252	120H0256	120H0264

* Electronic motor protection, module located in terminal box

Solder sleeve adapter set

Code n°	Description	Application	Packaging	Pack size
120Z0125	Rotolock adaptor set (1"3/4 ~ 1"1/8) , (1"1/4 ~ 7/8")	SH090	Multipack	8
120Z0405	Rotolock adaptor set (1"3/4 ~ 1"3/8) , (1"1/4 ~ 7/8")	SH105-120-140-161-184	Multipack	8
7765028	Rotolock adaptor set (2"1/4 ~ 1"5/8) , (1"3/4 ~ 1"1/8)	SH180-240-295-380	Multipack	6

Rotolock adapter

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0367	Adaptor (1"1/4 Rotolock - 7/8" ODF)	Models with 7/8" ODF	Multipack	10
	120Z0364	Adaptor (1"3/4 Rotolock - 1"1/8 ODF)	Models with 1"1/8 ODF	Multipack	10
	120Z0431	Adaptor (1"3/4 Rotolock - 1"3/8 ODF)	Models with 1"3/8 ODF	Multipack	10
	120Z0432	Adaptor (2"1/4 Rotolock - 1"5/8 ODF)	Models with 1"5/8 ODF	Multipack	10

Gaskets

Type	Code n°	Description	Application	Packaging	Pack size
G09	8156131	Gasket, 1"1/4	Models with 1"1/4 rotolock connection	Multipack	10
G09	7956002	Gasket, 1"1/4	Models with 1"1/4 rotolock connection	Industry pack	50
G07	8156132	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Multipack	10
G07	7956003	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Industry pack	50
G08	8156133	Gasket, 2"1/4	Models with 2"1/4 rotolock connection	Multipack	10
G08	7956004	Gasket, 2"1/4	Models with 2"1/4 rotolock connection	Industry pack	50
	8156013	Gasket set 1"1/4 - 1"3/4 - 2"1/4, OSG gaskets black and white	All Rotolock models	Multipack	10

Solder sleeve

Type	Code n°	Description	Application	Packaging	Pack size
P02	8153004	Solder sleeve P02 (1"3/4 Rotolock - 1"1/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10
P03	8153006	Solder sleeve P03 (2"1/4 Rotolock - 1"5/8 ODF)	Models with 2"1/4 rotolock connection	Multipack	10
P05	8153012	Solder sleeve P05 (1"1/4 Rotolock - 7/8" ODF)	Models with 1"1/4 rotolock connection	Multipack	10
P07	8153013	Solder sleeve P07 (1"3/4 Rotolock - 7/8" ODF)	Models with 1"3/4 rotolock connection	Multipack	10
P08	8153005	Solder sleeve P08 (2"1/4 Rotolock - 1"3/8 ODF)	Models with 2"1/4 rotolock connection	Multipack	10
P10	8153003	Solder sleeve P10 (1"3/4 Rotolock - 1"3/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10

Rotolock nut

Type	Code n°	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

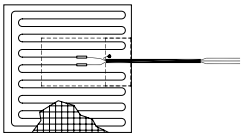
Rotolock service valve set

Type	Code n°	Description	Application	Packaging	Pack size
	7703008	Valve set, V02 (1"3/4 ~ 1"1/8), V05 (1"1/4 ~ 7/8")	SH090	Multipack	6
	7703392	Valve set, V10 (1"3/4 ~1"3/8), V05 (1"1/4 ~ 7/8")	SH105-120-140-161-184	Multipack	6
	7703383	Valve set, V03 (2"1/4 ~ 1"5/8), V02 (1"3/4 ~ 1"1/8)	SH180-240-295-380	Multipack	4

Motor protection modules

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0584	Electronic motor protection module, 24 V AC	SH180-240-295-380	Single pack	1
	120Z0585	Electronic motor protection module, 110-240 V		Single pack	1

Surface sump heaters



Type	Code no.	Accessory description	Application	Packaging	Pack size
	120Z0388	80W 24V surface sump heater CE and UL	SH090-105-120-140-161-184	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
	120Z0360	56W 24V surface sump heater + bottom insulation, CE and UL	SH180-240-295-380	Multipack	6
	120Z0376	56W 230V surface sump heater + bottom insulation, CE and UL		Multipack	6
	120Z0377	56W 400V surface sump heater + bottom insulation, CE and UL		Multipack	6
	120Z0378	56W 460V surface sump heater + bottom insulation, CE and UL		Multipack	6
	120Z0379	56W 575V surface sump heater + bottom insulation, CE and UL		Multipack	6
	120Z0667	48W 24V surface sump heater CE and UL	SH090-105-120-140-161-184	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

Discharge temperature protection

Type	Code No	Description	Application	Packaging	Pack Size
	7750009	Discharge thermostat kit	SH090 to SH380	Multipack	10
	7973008	Discharge thermostat kit	SH090 to SH380	Industry pack	50

Mounting hardware

Type	Code No	Description	Application	Packaging	Pack Size
	120Z0066	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	SH090-105-120-140-161-184	Single pack	1
	8156138	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	SH180-240-295-380	Single pack	1
	120Z0495	Mounting kit for 1 scroll compressor including 4 triangle rigid spacer, 4 sleeves, 4 bolts, 4 washers	SH180 -240-295-380 in parallel installation	Single pack	1

Acoustic hoods

Type	Code No	Description	Application	Packaging	Pack Size
	120Z0034	Acoustic hood for scroll compressor	SH090	Single pack	1
	120Z0035	Acoustic hood for scroll compressor	SH105-120-140-161 (except SH161 - 140 code 3)	Single pack	1
	120Z0135	Acoustic hood for scroll compressor	SH184-SH161 code 3 -SH140 code 3	Single pack	1
	120Z0022	Acoustic hood for scroll compressor	SH 180-240-295-380*	Single pack	1
	120Z0579	Acoustic hood for scroll compressor	SH 380 code 3	Single pack	1

* except code 3

Terminal boxes, covers and T-block connectors

Type	Code No	Description	Application	Packaging	Pack Size
	120Z0413	Terminal box cover	SH184 code 3/7/9-140 and 161 code 3	Single pack	1
	8156135	Service kit for terminal box 96 x 115 mm, including 1 cover, 1 clamp	SH090-105-120-140-161-184 (except SH140-3 and SH161-3 and SH184 code 3/7/9)	Multipack	10
	8173230	T block connector 52 x 57 mm	SH090-105-120-140-161-184 (except 140-3 and 161-3 and SH184 code3/7/9)	Multipack	10
	8173021	T block connector 60 x 75 mm	SH140-3,161-3,184 code 3/7/9	Multipack	10
	120Z0774	T block connector 80 x 80 mm	SH180-240-295-380	Multipack	10
	120Z0458	Terminal box 210 x 190 mm, incl. cover	SH180-240-295-380	Single pack	1

* except code 3

Lubricant

Type	Code No	Description	Application	Packaging	Pack Size
160SZ	7754023	POE lubricant, 1 litre can	All models	Multipack	12
160SZ	120Z0571	POE lubricant, 2.5 litre can	All models	Multipack	4

Miscellaneous

Type	Code No	Description	Application	Packaging	Pack Size
	8156019	Sight glass with gaskets (black and white)	All models	Multipack	4
	8156129	Gasket for oil sight glass, 1"1/8 (white teflon)	All models	Multipack	10
	7956005	Gasket for oil sight glass, 1"1/8 (white teflon)	All models	Multipack	50
	8154001	Danfoss Commercial Compressors blue spray paint	All models	Single pack	1

Release date (Year/Month)	Guideline codification number	List of changes	Reason for change
2021/01	AB243586442172en-001401	• Page 14: Updated Motor voltage • Page 22: Updated Pressure equipment directive 2014/68/EU • Page 41: Updated System pressure test	-
2022/04	AB243586442172en-001501	• Page 14: Updated Wiring connections • Page 50: Updated spare part table for Terminal boxes, covers and T-block connectors	-
2023/01	AB243586442172en-001502	• Page 28: Added External non return valve • Page 29: Updated System evaluation	-
2023/02	AB243586442172en-001601	• Removed the contents of SH485 and phased out models	-

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is a worldwide manufacturer of compressors and condensing units for refrigeration and HVAC applications. With a wide range of high quality and innovative products we help your company to find the best possible energy efficient solution that respects the environment and reduces total life cycle costs.

We have 40 years of experience within the development of hermetic compressors which has brought us amongst the global leaders in our business, and positioned us as distinct variable speed technology specialists. Today we operate from engineering and manufacturing facilities spanning across three continents.

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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Danfoss Commercial Compressors, BP 331, 01603 Trévoux Cedex, France | +334 74 00 28 29

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