ENGINEERING
TOMORROW

Application guidelines

Danfoss scroll compressors
SM SY SZ

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

http://danfoss.us.com/

Compressor model designation

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 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 **)

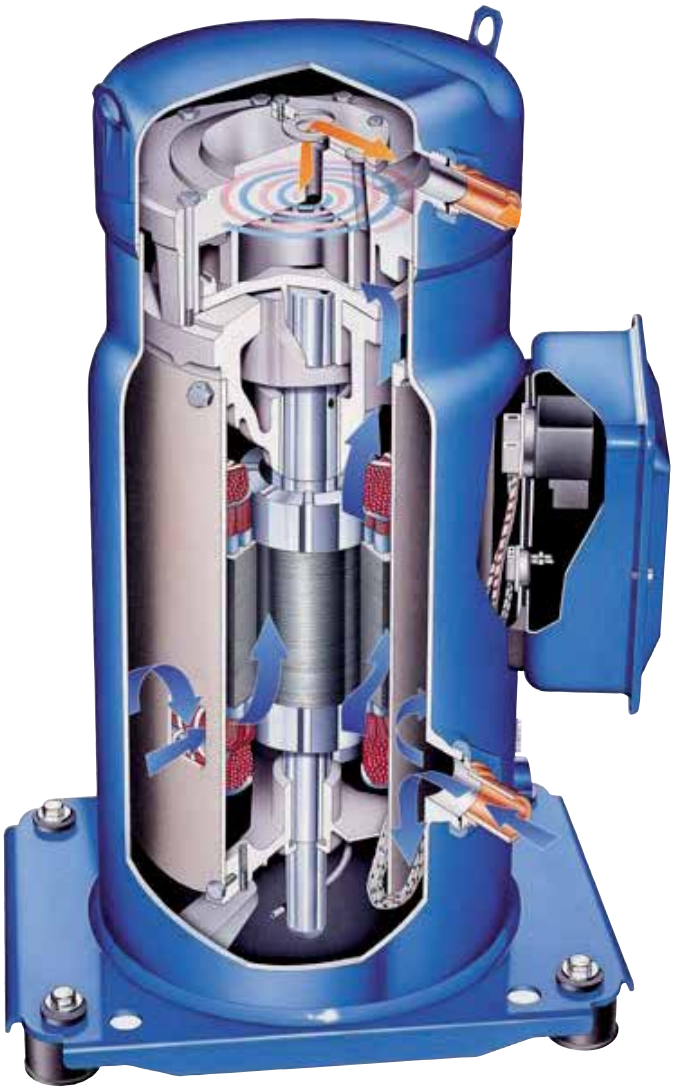
Nominal capacity
in thousand Btu/h at 60 Hz, R22, ARI conditions

Motor voltage code
3: 200-230V/3~/60 Hz
4: 380-400V/3~/50 - 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	24 V 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**: 110-240 V	

* 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

Danfoss scroll compression principle



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.

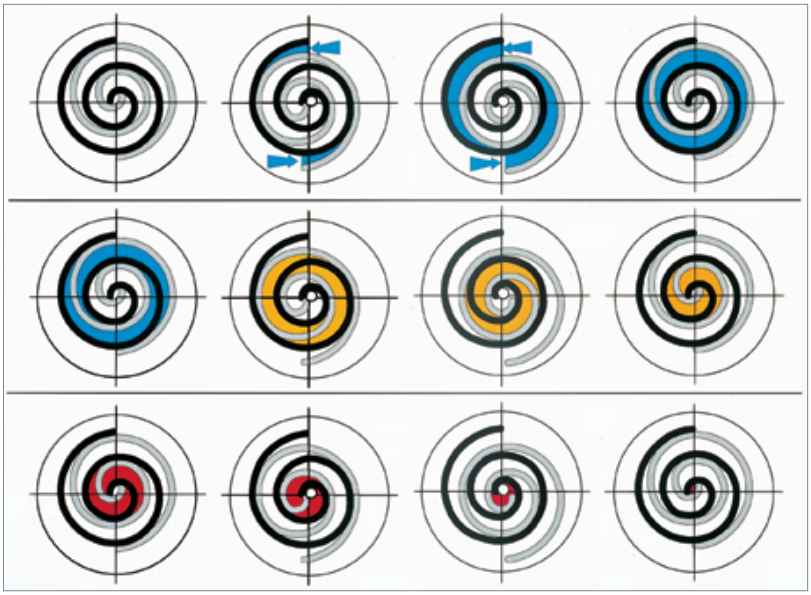
Suction gas enters the compressor at the suction connection. As all of the gas flows around and through the electrical motor, thus ensuring complete motor cooling in all applications, oil droplets separate and fall into the oil sump. After exiting the electrical motor, the gas enters the scroll elements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

First orbit:
SUCTION

Second orbit:
COMPRESSION

Third orbit:
DISCHARGE



Features

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

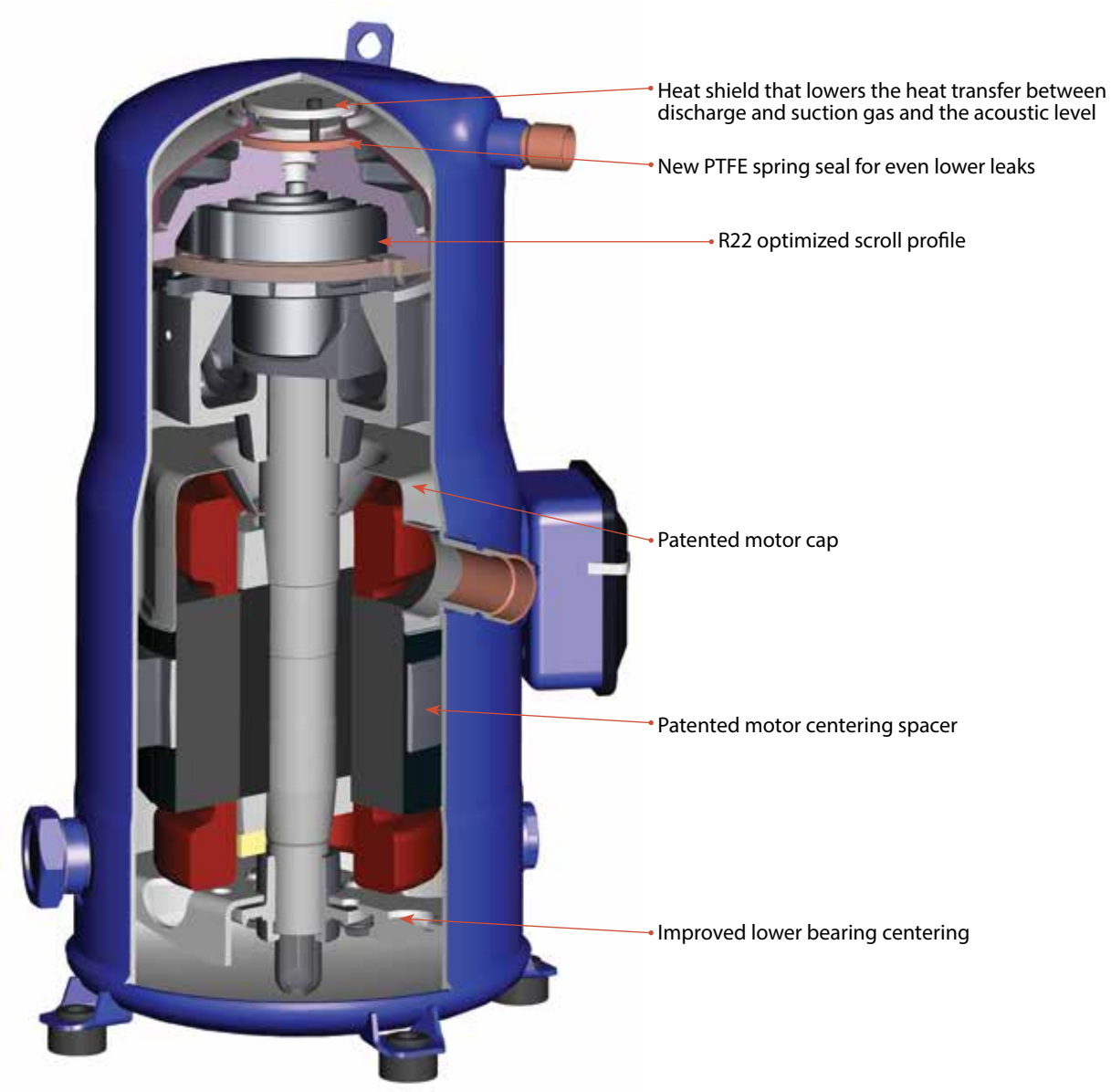
The new SM112-124-147 and SZ147 compressors benefit from a further improved design to achieve the highest efficiency.

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.



SM112-124-147 and SZ147

50 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	cu.in/rev	cu.ft/h	oz	lbs
R22 SINGLE	SM084	7	20400	69600	6.12	3.33	11.4	6.99	703	112.08	141
	SM090	7.5	21800	74400	6.54	3.33	11.4	7.35	741	112.08	143
	SM100	8	23100	78800	6.96	3.33	11.4	7.76	782	112.08	143
	SM110	9	25900	88400	7.82	3.32	11.3	8.80	886	112.08	161
	SM112	9.5	27600	94200	7.92	3.49	11.9	9.25	931	112.08	141
	SM120	10	30100	102700	8.96	3.36	11.5	10.17	1024	112.08	161
	SM124	10	31200	106500	8.75	3.56	12.2	10.34	1042	112.08	141
	SM147	12	36000	122900	10.08	3.57	12.2	11.81	1190	112.08	148
	SM148	12	36100	123200	10.8	3.34	11.4	12.14	1222	122.26	194
	SM161	13	39000	133100	11.59	3.37	11.5	13.22	1331	122.26	194
	SM175	14	42000	143300	12.47	3.37	11.5	14.22	1432	210.57	220
	SM/SY185	15	45500	155300	13.62	3.34	11.4	15.25	1535	210.57	220
	SY240	20	61200	208900	18.2	3.36	11.5	21.22	2137	271.70	331
	SY300	25	78200	266900	22.83	3.43	11.7	26.70	2687	271.70	346
	SY380	30	94500	322500	27.33	3.46	11.8	32.42	3263	285.28	348
R407C SINGLE	SZ084	7	19300	65900	6.13	3.15	10.8	6.99	703	112.08	141
	SZ090	7.5	20400	69600	6.45	3.16	10.8	7.35	741	112.08	143
	SZ100	8	21600	73700	6.84	3.15	10.8	7.76	782	112.08	143
	SZ110	9	24600	84000	7.76	3.17	10.8	8.80	886	112.08	161
	SZ120	10	28600	97600	8.99	3.17	10.8	10.17	1024	112.08	161
	SZ147	12	34900	119100	9.92	3.52	12.0	11.81	1190	112.08	148
	SZ148	12	35100	119800	10.99	3.19	10.9	12.14	1222	122.26	194
	SZ161	13	37900	129700	11.84	3.21	11.0	13.22	1331	122.26	194
	SZ175	14	40100	136900	12.67	3.17	10.8	14.22	1432	210.57	220
	SZ185	15	43100	147100	13.62	3.16	10.8	15.25	1535	210.57	220
	SY240	20	59100	201700	18.55	3.19	10.9	21.22	2137	271.70	331
	SY300	25	72800	248100	22.73	3.2	10.9	26.70	2687	271.70	346
	SY380	30	89600	305800	27.59	3.25	11.1	32.42	3263	285.28	348
R134a SINGLE	SZ084	7	12100	41100	3.83	3.15	10.75	6.99	703	112.08	141
	SZ090	7.5	12900	43900	4.08	3.15	10.77	7.35	741	112.08	143
	SZ100	8	13800	47000	4.36	3.16	10.78	7.76	782	112.08	143
	SZ110	9	15600	53100	4.90	3.17	10.83	8.80	886	112.08	161
	SZ120	10	17900	61200	5.62	3.19	10.89	10.17	1024	112.08	161
	SZ147	12	20800	71000	6.13	3.40	11.59	11.81	1190	112.08	148
	SZ148	12	21500	73400	6.96	3.09	10.55	12.14	1222	122.26	194
	SZ161	13	23000	78400	7.30	3.15	10.74	13.22	1331	122.26	194
	SZ175	14	25300	86200	7.90	3.20	10.91	14.22	1432	210.57	220
	SZ185	15	26900	91700	8.41	3.20	10.91	15.25	1535	210.57	220
	SY240	20	35600	121600	11.60	3.07	10.48	21.22	2137	271.70	331
	SY300	25	44400	151700	14.43	3.08	10.51	26.70	2687	271.70	346
	SY380	30	55800	190500	17.26	3.23	11.04	32.42	3263	285.28	348
R513A SINGLE	SZ148	12	20665	70512	6.96	2.97	10.13	12.14	1222	122.26	194
	SZ161	13	23634	80642	7.54	3.14	10.70	13.22	1331	122.26	194
	SZ175	14	24413	83299	8.07	3.03	10.32	14.22	1432	210.57	220
	SZ185	15	27438	93621	8.64	3.18	10.15	15.25	1535	210.57	220
	SY240	20	37450	127783	12.1	3.10	10.59	21.22	2137	271.70	150
	SY300	25	47497	162065	14.7	3.22	10.99	26.70	2687	271.70	157
	SY380	30	58537	199734	18.1	3.23	11.03	32.42	3263	285.28	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 - 50 Hz

Refrigerant	R22	R134a/R513A	R407C
Frequency	50 Hz	50 Hz	50 Hz
Standard rating conditions	ARI	EN12900	-
Evaporating temperature	45 °F	41 °F	45°F (dew point)
Condensing temperature	130 °F	122 °F	130°F (dew point)
Sub-cooling	15 °F	18 °F	15°F
Superheat	20 °F	0 °F	20°F

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	cu.in/rev	cu.ft/h	oz	lbs
R22 SINGLE	**SM084**	7	24600	84000	7.4	3.34	11.4	6.99	849	110	141
	SM090	7.5	26400	90100	7.8	3.37	11.5	7.35	894	110	143
	SM100	8	27500	93900	8.1	3.38	11.5	7.76	943	110	143
	SM110	9	31600	107800	9.3	3.38	11.5	8.80	1069	110	161
	SM112	9.5	34000	116000	9.6	3.53	12.1	9.25	1124	112	141
	SM120	10	36700	125300	10.8	3.4	11.6	10.17	1236	110	161
	SM124	10.5	37700	128700	10.6	3.56	12.2	10.34	1257	112	142
	SM147	12	43600	148800	12.2	3.58	12.2	11.81	1435	112	148
	SM148	12	43800	149500	13	3.37	11.5	12.14	1476	122	194
	SM161	13	47600	162500	14.1	3.39	11.6	13.22	1606	122	194
	SM175	14	51100	174400	15.3	3.34	11.4	14.22	1728	210	220
	SM/SY185	15	55300	188700	16.3	3.39	11.6	15.25	1853	210	220
	SY240	20	74100	252900	22.1	3.35	11.4	21.22	2579	272	331
	SY300	25	94500	322500	27.5	3.43	11.7	26.70	3245	272	346
	SY380	30	115300	393500	33.4	3.46	11.8	32.42	3939	285	348
R407C SINGLE	**SZ084**	7	22500	76800	7.1	3.19	10.9	6.99	849	110	141
	SZ090	7.5	24400	83300	7.6	3.2	10.9	7.35	894	110	143
	SZ100	8	26500	90400	8.2	3.24	11.1	7.76	943	110	143
	SZ110	9	30100	102700	9.3	3.24	11.1	8.80	1069	110	161
	SZ120	10	34800	118800	10.7	3.24	11.1	10.17	1236	110	161
	SZ147	12	42300	144300	12.03	3.52	12.0	11.81	1435	112	148
	SZ148	12	42600	145400	13.3	3.19	10.9	12.14	1476	122	194
	SZ161	13	46000	157000	14.3	3.21	11.0	13.22	1606	122	194
	SZ175	14	48700	166200	15.3	3.19	10.9	14.22	1728	210	220
	SZ185	15	51800	176800	16.4	3.15	10.8	15.25	1853	210	220
	SY240	20	71100	242700	22.7	3.14	10.7	21.22	2579	272	331
	SY300	25	87900	300000	27.5	3.2	10.9	26.70	3245	272	346
	SY380	30	107300	366200	33.5	3.2	10.9	32.42	3939	285	348
R134a SINGLE	**SZ084**	7	16700	57100	5.06	3.31	11.29	6.99	849	110	141
	SZ090	7.5	17700	60300	5.33	3.31	11.31	7.35	894	110	143
	SZ100	8	18700	63800	5.64	3.32	11.32	7.76	943	110	143
	SZ110	9	21300	72800	6.41	3.33	11.36	8.80	1069	110	161
	SZ120	10	24800	84700	7.43	3.34	11.40	10.17	1236	110	161
	SZ147	12	28300	96600	8.04	3.52	12.02	11.81	1435	112	148
	SZ148	12	29000	99100	9.37	3.10	10.57	12.14	1476	122	194
	SZ161	13	31500	107500	9.68	3.25	11.10	13.22	1606	122	194
	SZ175	14	34400	117300	10.39	3.31	11.29	14.22	1728	210	220
	SZ185	15	36600	124800	11.10	3.30	11.25	15.25	1853	210	220
	SY240	20	49400	168600	15.37	3.21	10.97	21.22	2579	272	331
	SY300	25	60600	206900	19.61	3.09	10.55	26.70	3245	272	346
	SY380	30	75800	258600	23.22	3.26	11.14	32.42	3939	285	348
R513A SINGLE	**SZ148**	12	20665	70512	6.96	2.97	10.13	12.14	34.6	122	194
	SZ161	13	23634	80642	7.54	3.14	10.70	13.22	37.7	122	194
	SZ175	14	24413	83299	8.07	3.03	10.32	14.22	40.5	210	220
	SZ185	15	25699	87689	8.64	2.97	10.15	15.25	43.5	210	220
	SY240	20	51208	174727	15.9	3.22	10.99	21.22	73.0	272	331
	SY300	25	64441	219879	19.5	3.30	11.25	26.70	91.9	272	346
	SY380	30	69586	79439	24.7	3.22	10.99	32.42	111.6	285	348

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

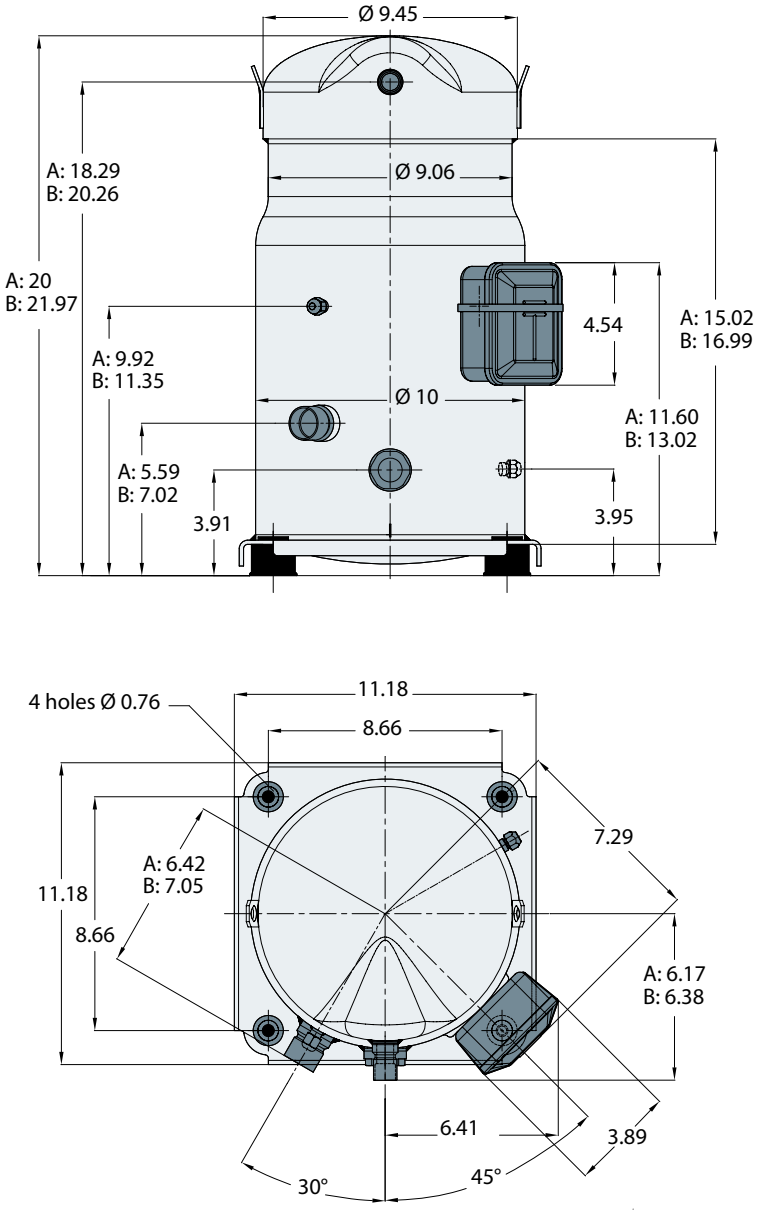
Rating conditions - 60 Hz

Refrigerant	R22/R134a/R513A	R407C
Frequency	60 Hz	60 Hz
Standard rating conditions	ARI standard conditions	-
Evaporating temperature	45°F	45°F (dew point)
Condensing temperature	130°F	130°F (dew point)
Sub-cooling	15°F	15°F
Superheat	20°F	20°F

Subject to modification without prior notification

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

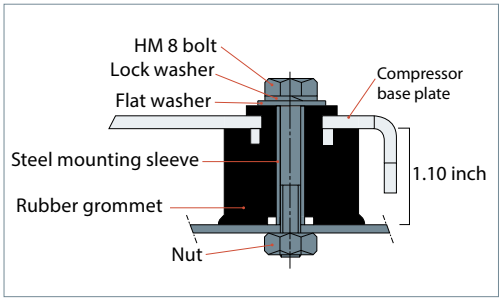
SM/SZ 084-090-100-110-120



All dimensions in inch

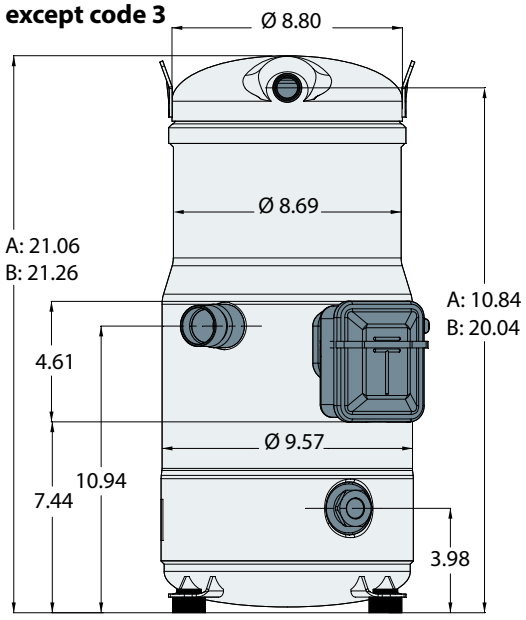
A: SM/SZ 084-090-100
B: SM/SZ 110-120

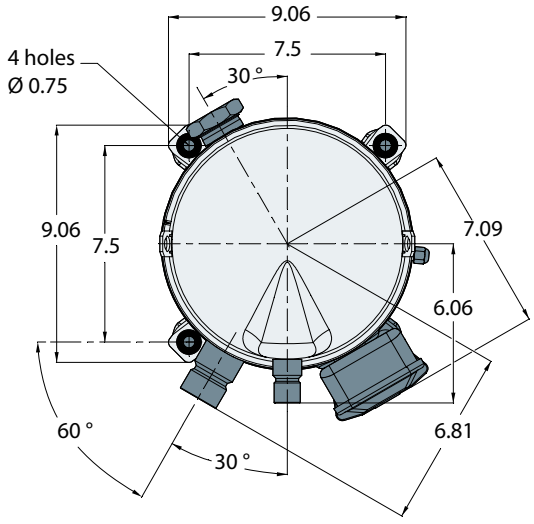
Grommet



SM 112-124-SM/SZ147*

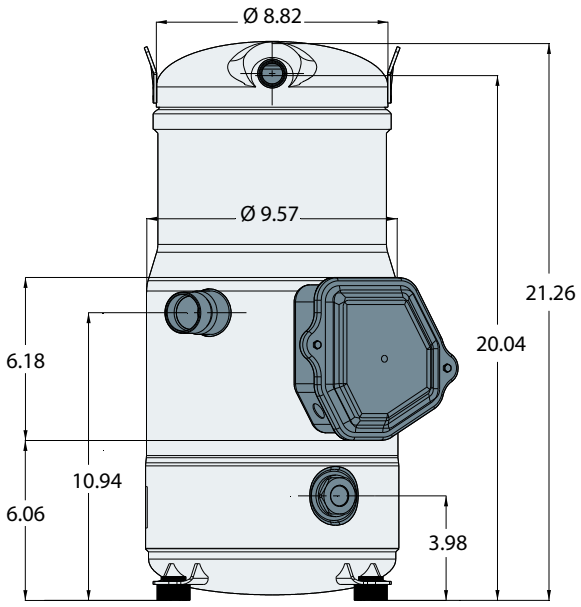
*** except code 3**

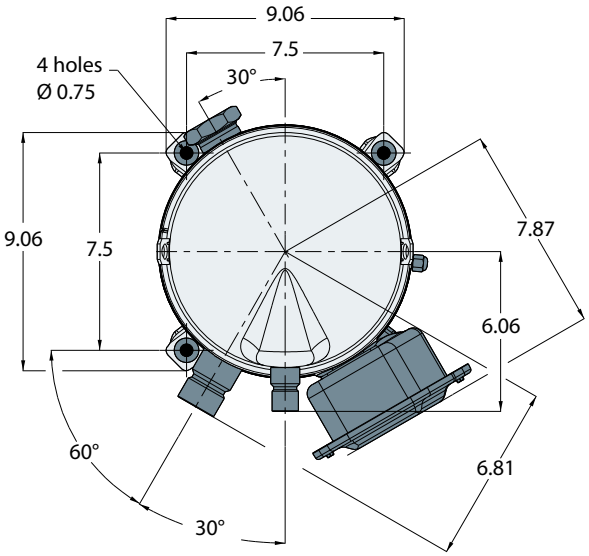




A: SM112
B: SM124-147

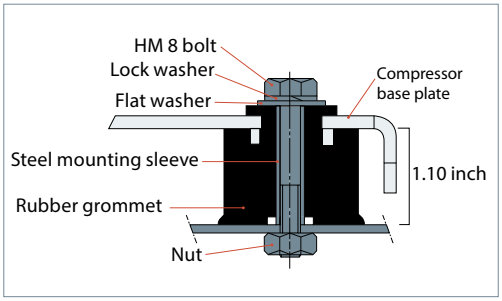
SM/SZ147 code 3





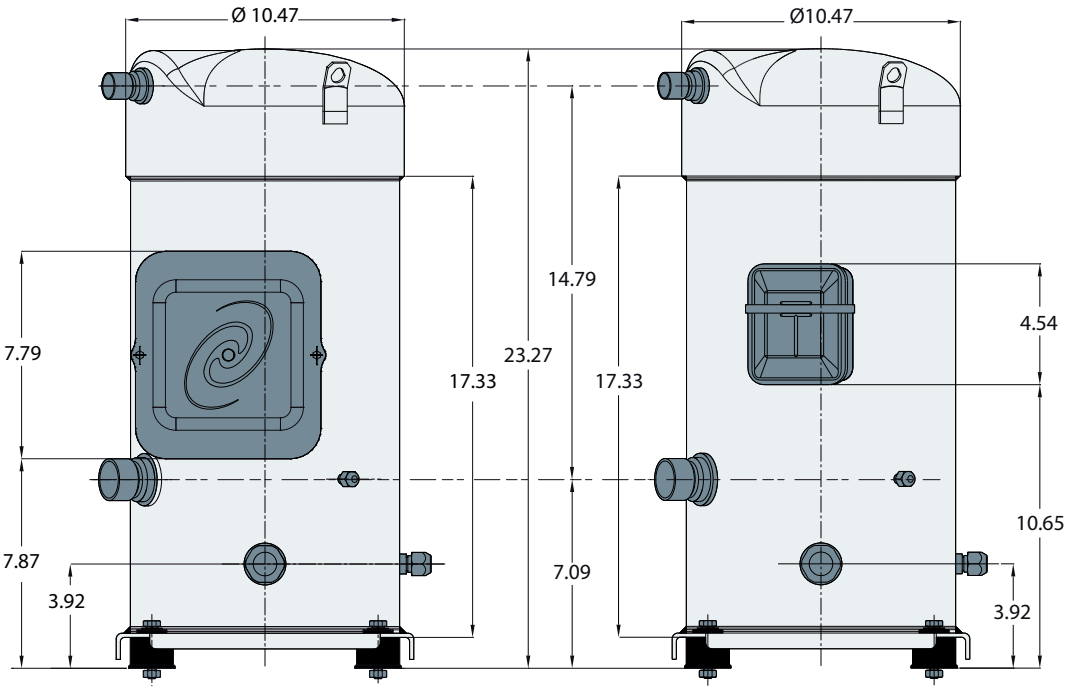
All dimensions in inch

Grommet

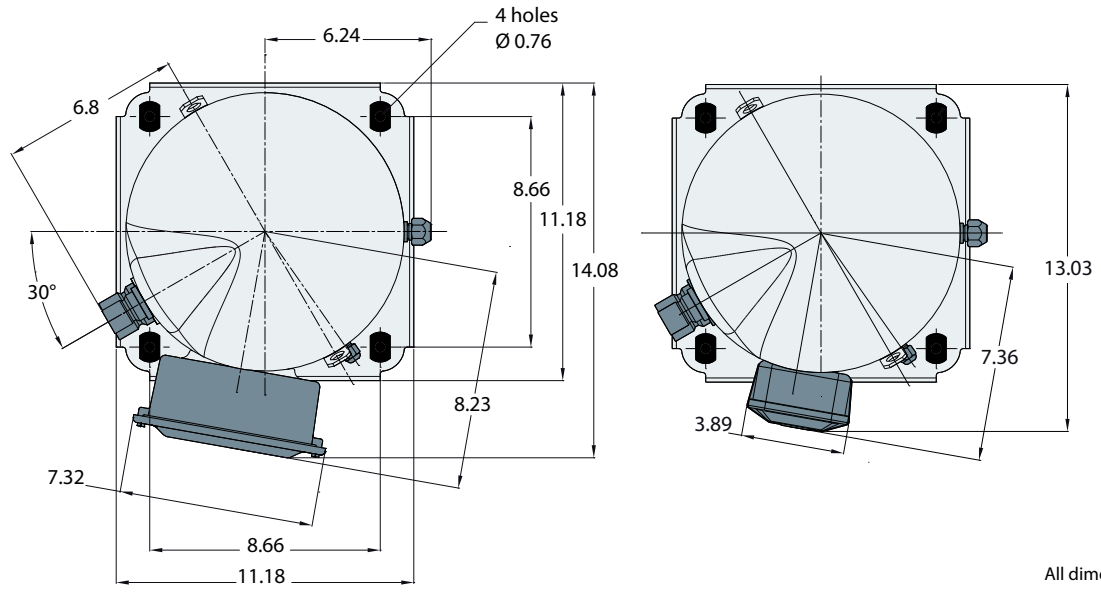


SM/SZ 148-161

SM 148-161 code 3

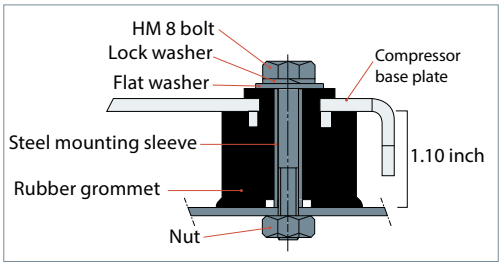


SM 148-161 code 4



All dimensions in inch

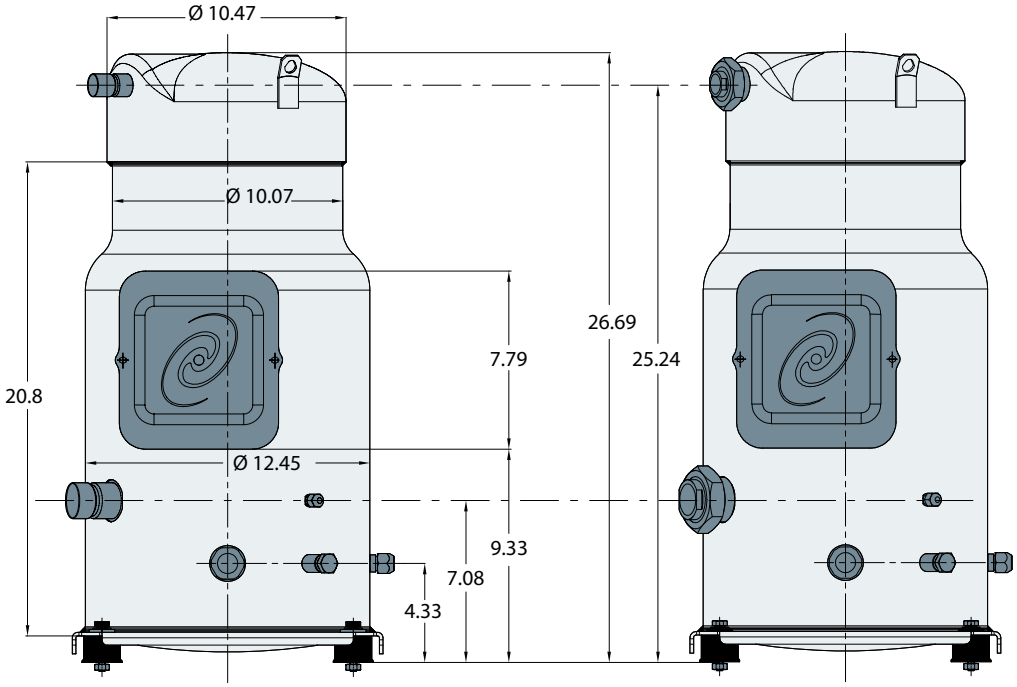
Grommet

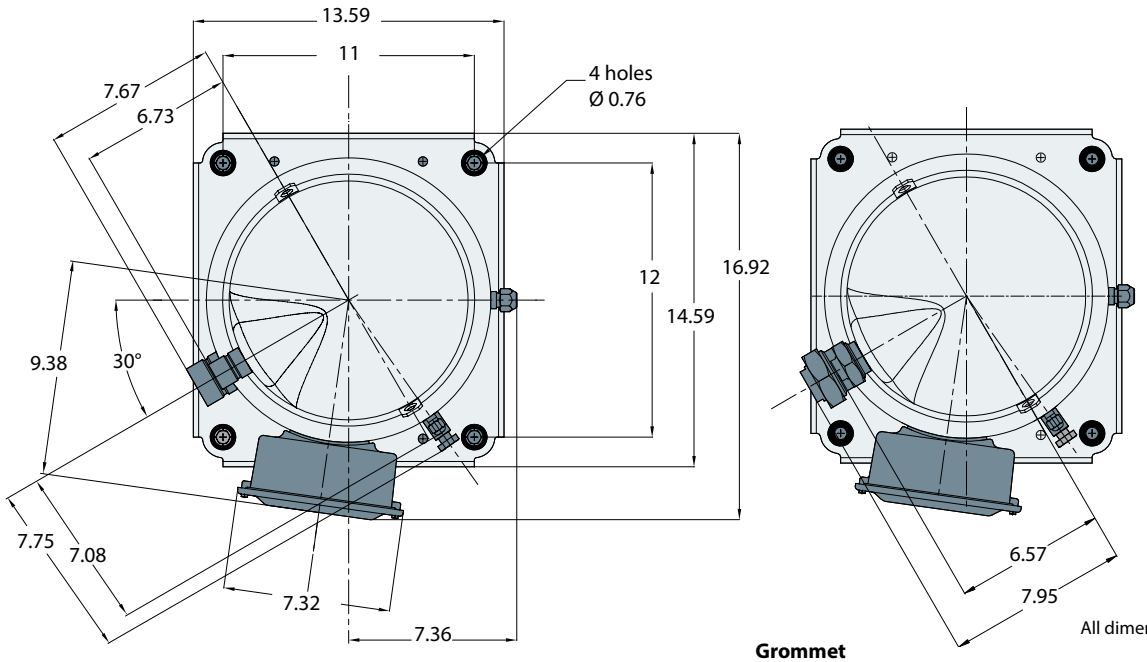


SM/SZ 175-185 & SY185
R and C version

Brazed version

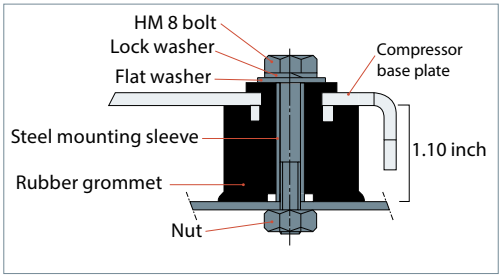
Rotolock version





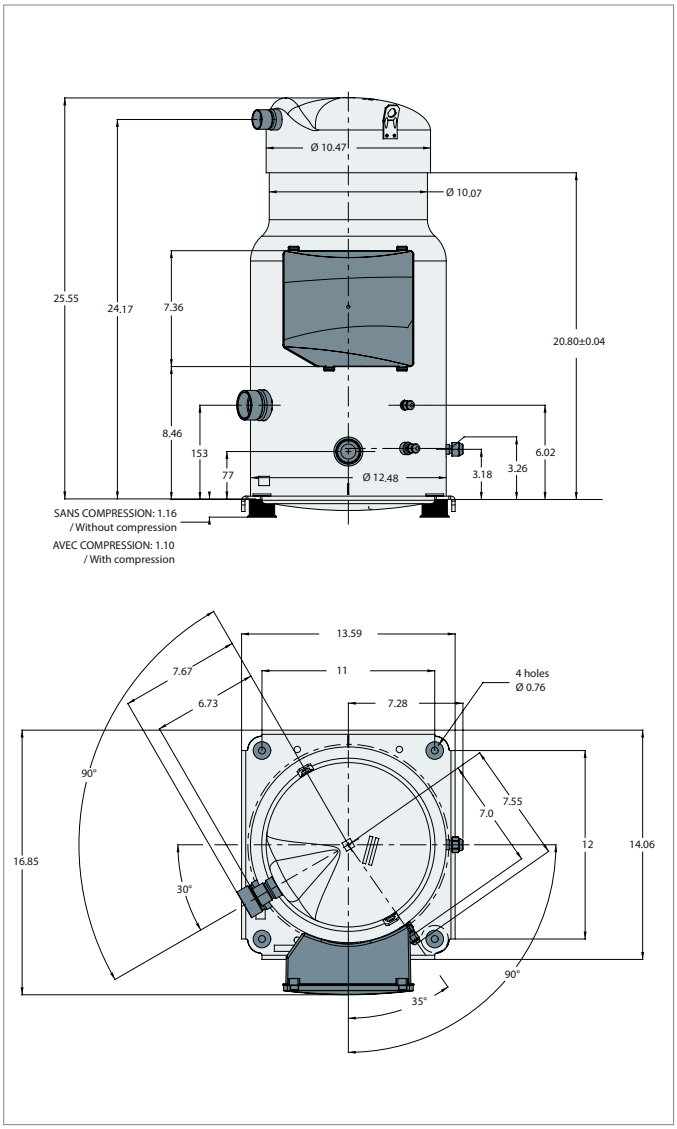
All dimensions in inch

Grommet

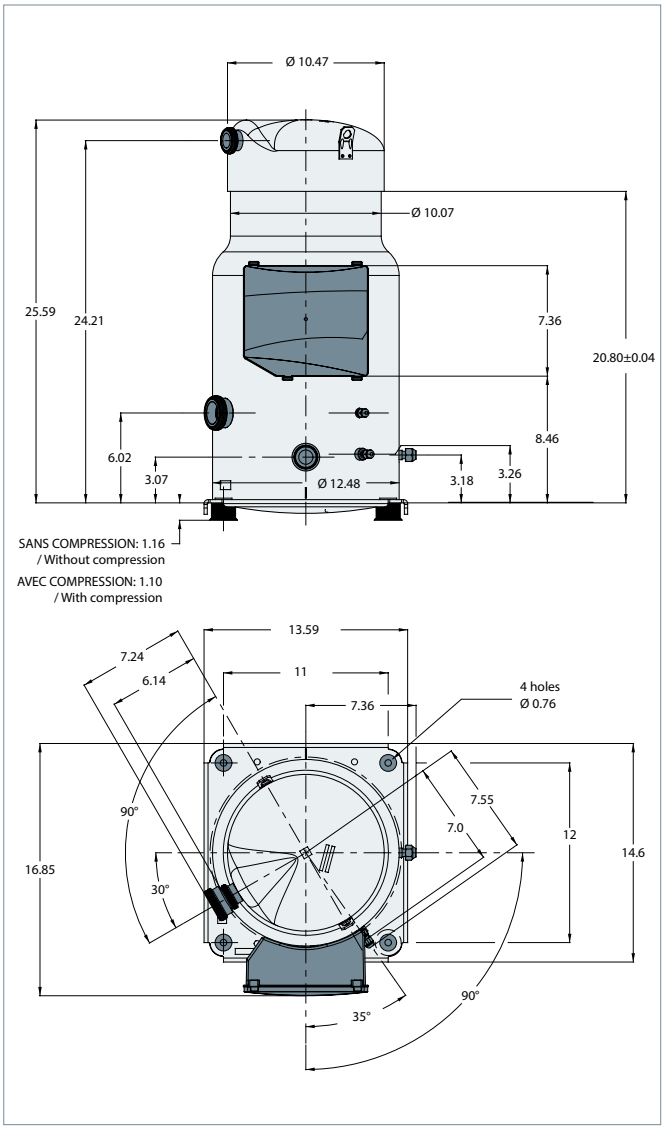


SM/SZ 185 P, X, Y version

Brazed version

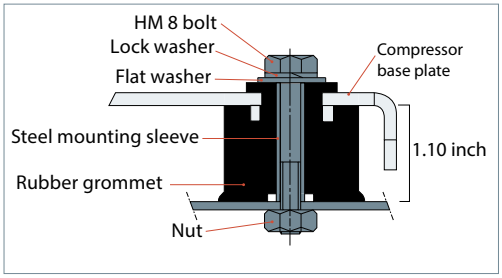


Rotolock version



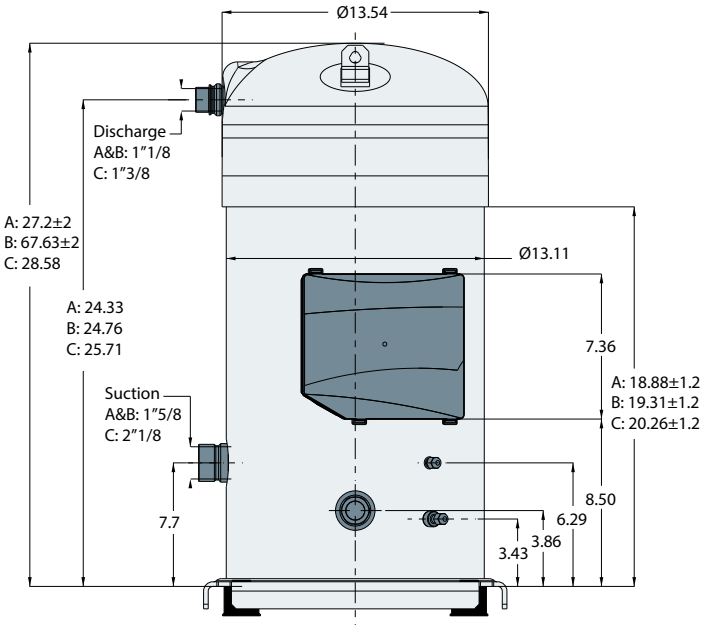
All dimensions in inch

Grommet

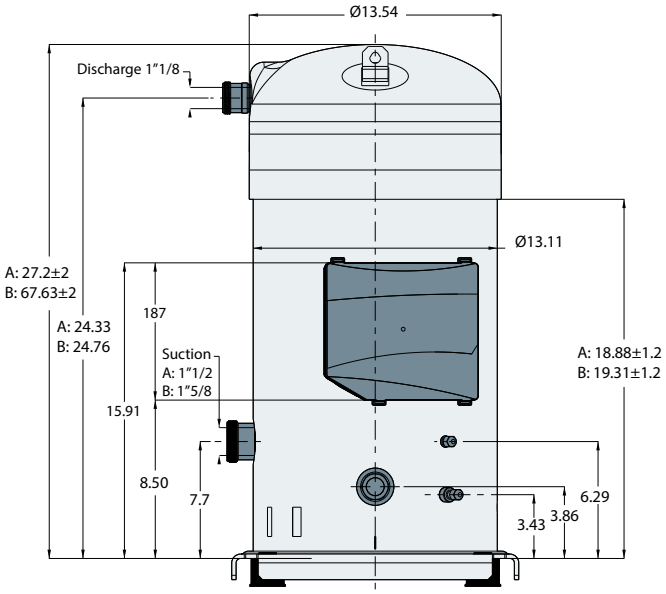


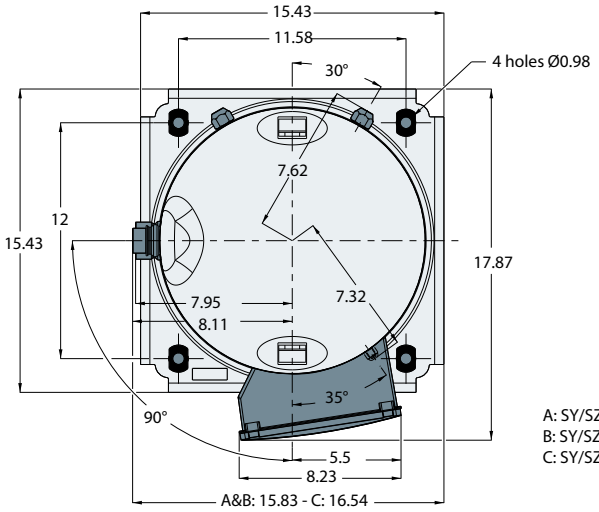
SY 240-300-380

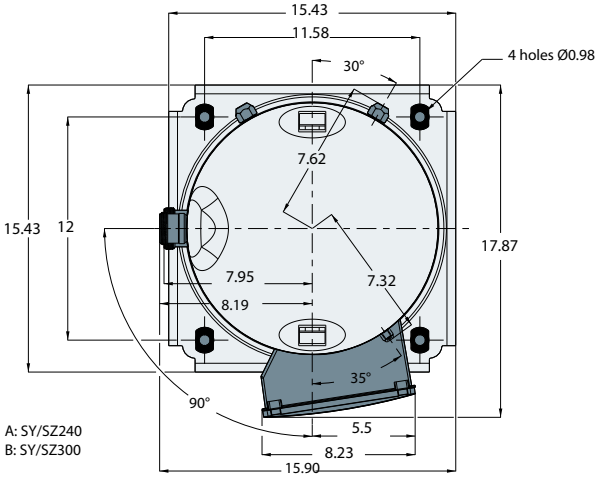
Brazed version



Rotolock version

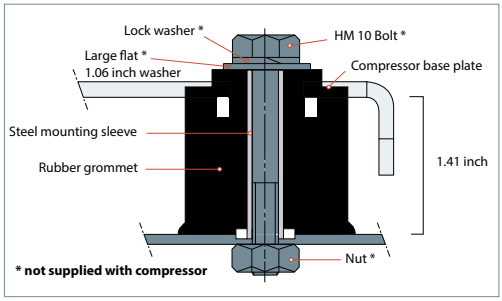






All dimensions in inch

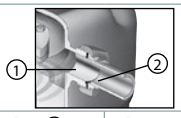
Grommet



Connection details

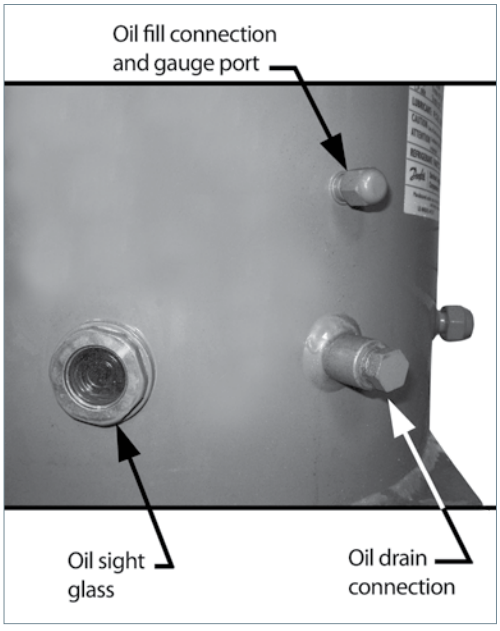
Model	SM/SZ084-090-100-110-120-148-161	SM/SZ 175 - SM/SZ/SY185		SM 112-124 - SM/SZ 147	SY 240 - 300		SY 380
Version	V	R-Y	C-P-X	AL	MA - MB	AA - AB	AA - AB
Suction and discharge connection	brazed	rotolock	brazed	brazed	rotolock	brazed	brazed
Oil sight glass	threaded	threaded	threaded	threaded	threaded	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/SZ 084-090-100	Suction	1" 1/8	-	-
	Discharge	3/4"	-	-
SM/SZ 110-112-120-124-147-SM148&161	Suction	1" 3/8	-	-
	Discharge	7/8"	-	-
SM/SZ 175-185	Suction	1" 5/8	2" 1/4	1" 3/8
	Discharge	1" 1/8	1" 3/4	7/8"
SY 240-300	Suction	1" 5/8	2" 1/4	1" 5/8
	Discharge	1" 1/8	1" 3/4	1" 1/8
SY 380	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
SY 240-300-380: 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 SY240 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

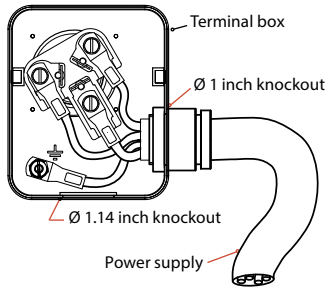
Wiring connections

Electrical power is connected to the compressor terminals by Ø 3/16" (4.8 mm) screws. The maximum tightening torque is 2.2ft.lb. Use a 1/4" ring terminal on the power leads.

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

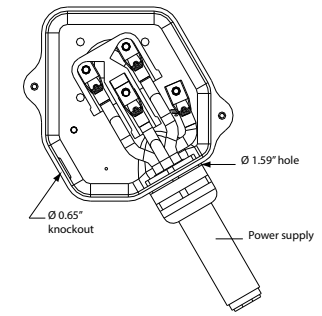
*Except for motor voltage code 3

The terminal box is provided with a Ø 1" and a Ø 1.14" knockouts.



SM/SZ 147 code 3

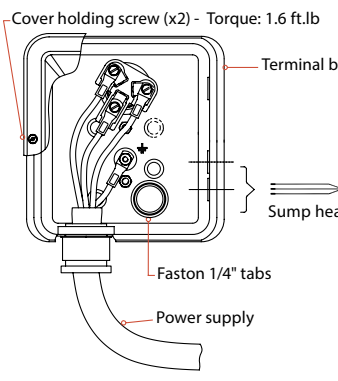
The terminal box is provided with a Ø 1.59" hole for power supply and a Ø 0.65" knockout.



SM / SZ 148 & 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:
- Ø 1"3/4 hole (for a 1"1/4 conduit) and Ø 1"3/8 hole (for a 1" conduit),
- Ø 1.26" hole & Ø 1" hole

The 3 other knockouts are as follows:
- Ø 0.81"
- Ø 7/8" (for a 1/2" conduit)
- Ø 0.65"



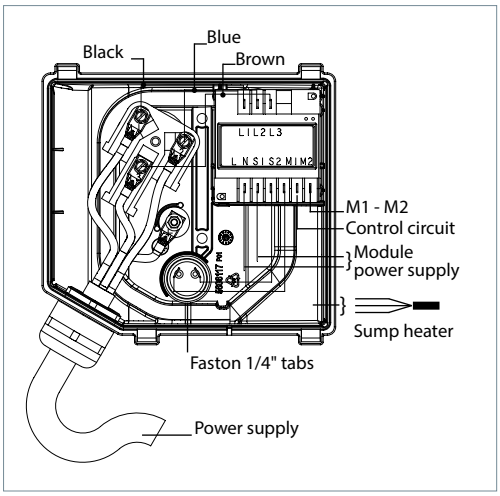
SY 240 – 300 – 380 & SM/SZ 185 - P, X, Y versions

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:

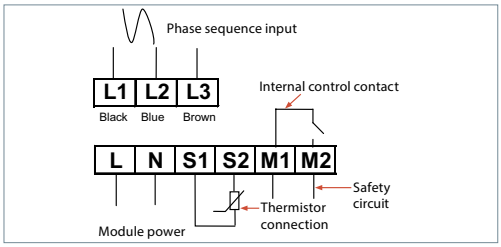
- Ø 2 inch (UL 1"1/2 conduit) & Ø 1.72 inch (UL 1"1/4 conduit) & Ø 1.36 inch (UL 1" conduit)
- Ø 1.59 inch (ISO40) & Ø 1.27 inch (ISO32) & Ø 1 inch (ISO25)
- Ø 1 inch (ISO25)

The 4 others knockouts are as follows:

- Ø 0.89 inch (PG16) (UL 1/2") & Ø 0.65 inch (ISO16) (x2)
- 0.81 inch (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 0.25" 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 158°F. Consequently, if the compressor is installed in an enclosure, precautions must be taken to avoid that the temperature around the compressor and in the terminal box would rise too much. 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 158°F.

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 (59°F evaporating temperature and 154.4°F 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 77°F (resistance value +/- 7%).
Winding resistance is generally low and it requires adapted tools for precise measurement. Use a digital ohm-meter, a "4 wires" method and measure under stabilised ambient temperature. Winding resistance varies strongly with winding temperature ; if the compressor is stabilised at a different value than 77°F, the measured resistance must be corrected with following formula:

$$R_{amb} = R_{77°F} \frac{a + t_{amb}}{a + t_{77°F}}$$

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

Danfoss MCI soft-start controller

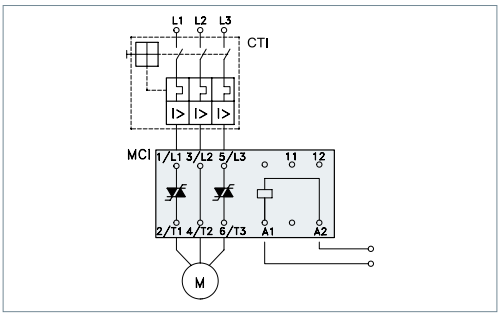
The inrush current for the Danfoss scroll compressors with motor code 4 (400V / 3 / 50Hz or 460V / 3 / 60Hz) can be reduced using the Danfoss digitally-controlled MCI compressor soft starter. MCI soft starters are designed to reduce the starting current of 3-phase AC motors; MCI soft starters can reduce 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. 104°F	Soft start reference ambient max. 131°F
SM / SZ 084	MCI 15C	MCI 15C
SM / SZ 090		
SM / SZ 100		MCI 25C
SM / SZ 110		
SM / SZ 120 SM 112-124 - SM/SZ147 SM / SZ 161 - 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.

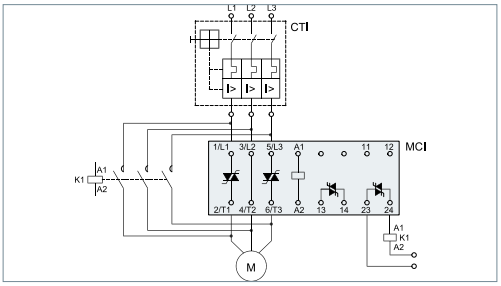


MCI with bypass contactor

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

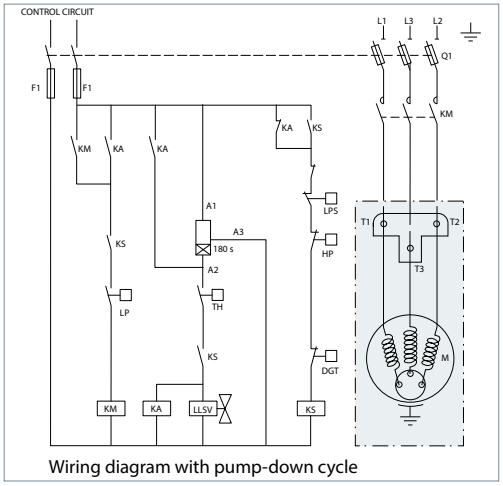


General wiring information

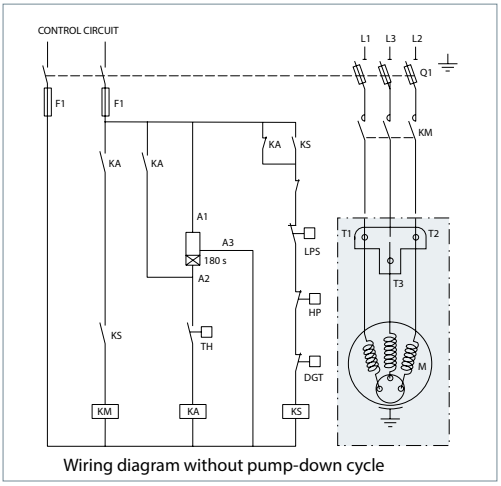
The wiring diagrams below are examples for a safe and reliable compressor wiring. In case an alternative wiring logic is chosen, it's imperative to respect the following rules.
When a safety switch trips, the compressor must stop immediately and must not re-start until the tripping condition is back 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 indicated section "Operating conditions".
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

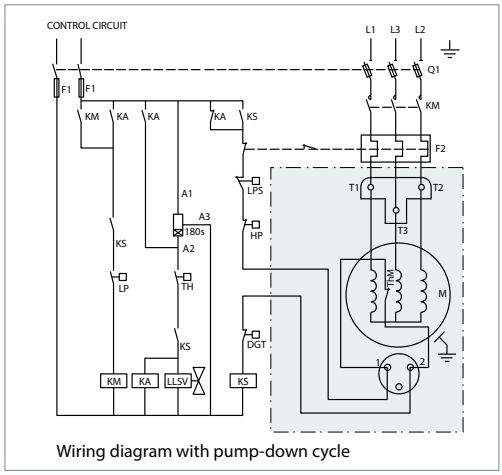


Wiring diagram with pump-down cycle

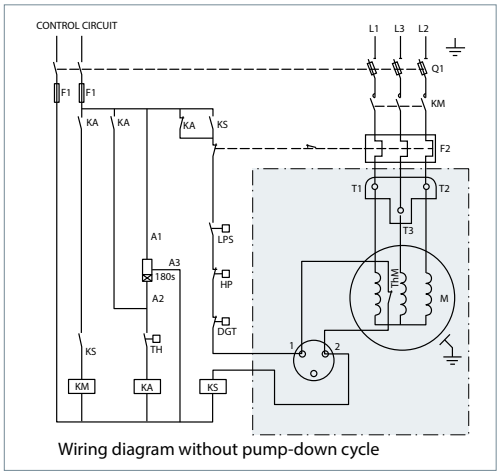


Wiring diagram without pump-down cycle

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

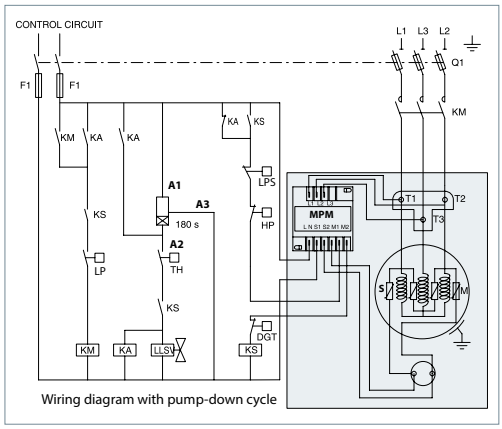


Wiring diagram with pump-down cycle

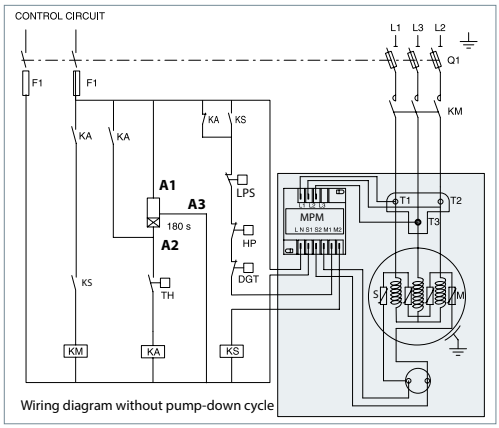


Wiring diagram without pump-down cycle

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

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 115-125-160-175-185 R & C version	✓ Internal thermostat	REQ External overload protection		✓ Reverse vent.
SM 112- 124-147		✓ Internal motor protection		REC Phase sequence detector
SM/SZ 084-090-100-110-120-148-161 - SZ147		✓ 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.

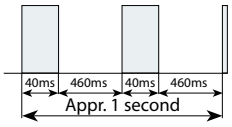
The motor temperature is being constantly measured by a PTC thermistor loop connected on S1-S2.

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.

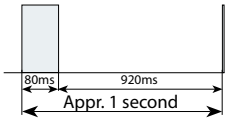
A red/green twin LED is visible on the module. A solid green LED denotes a fault free condition.

A blinking red LED indicates an identifiable fault condition:

PTC overheat



Delay timer active (after PTC overheat)



Phase sequence and reverse rotation protection

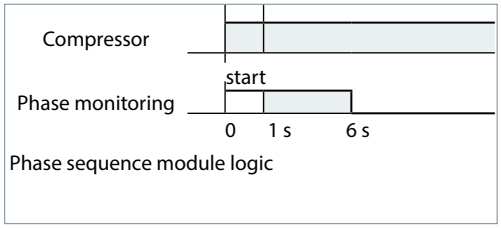
Use a phase meter to establish the phase orders and connect line phases L1, L2 and L3 to terminals T1, T2 and T3, respectively. The compressor will only operate properly in a single direction, and the motor is wound so that if the connections are correct, the rotation will also be correct.

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 / SZ 084 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.

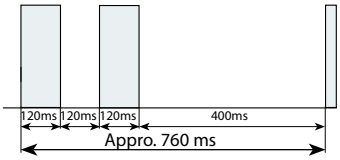
Compressor models SY240 to SY380 are delivered with an electronic module which provides protection against phase reversal and loss at start-up. Apply the recommended wiring diagrams. The circuit should be thoroughly checked in order to determine the cause of the phase problem before re-energizing the 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).



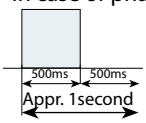
Phase sequence module logic

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.

Certificates are listed on the product datasheets: http://www.danfoss.com/odsg

CE 0062 or CE 0038 or CE0871 (European Directive)	CE	All SM / SY / SZ models
UL (Underwriters Laboratories)	cULus	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	-31°F < Ts < 145°F	-31°F < Ts < 142°F	-31°F < Ts < 129°F	-31°F < Ts < 126°F
Maximum allowable Service pressure - Ps	368 psig	363 psig	363 psig	290 psig
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

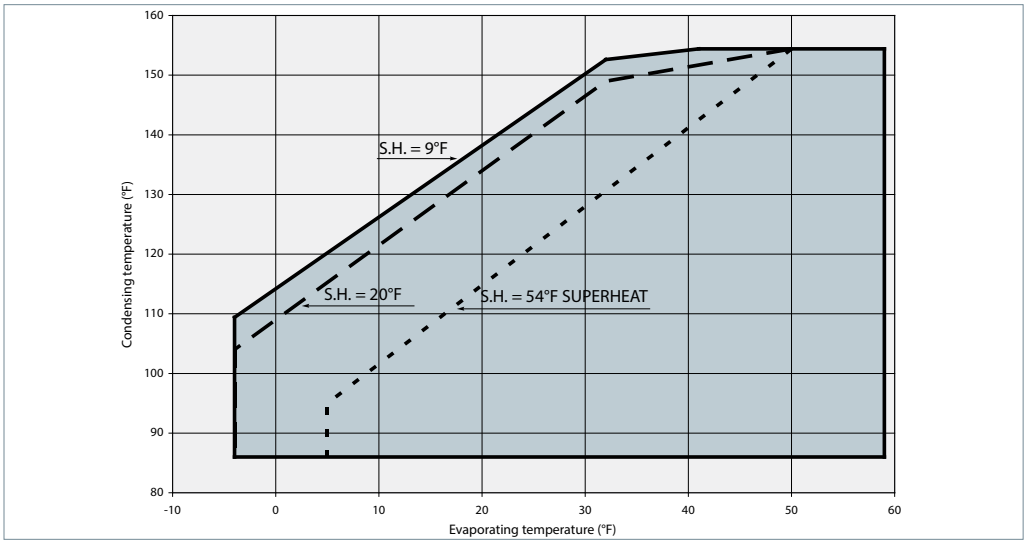
Internal free volume

Products	Internal free volume without oil (in^3)
SM/SZ084 - 090 - 100	860
SM/SZ 110 - 120	897
SM 112 - 124 - SM/SZ 147	872
SM/SZ 148-161	1196
SM/SZ 175 - 185 and SY185	2014
SY 240 - 300	2307
SY 380	2392

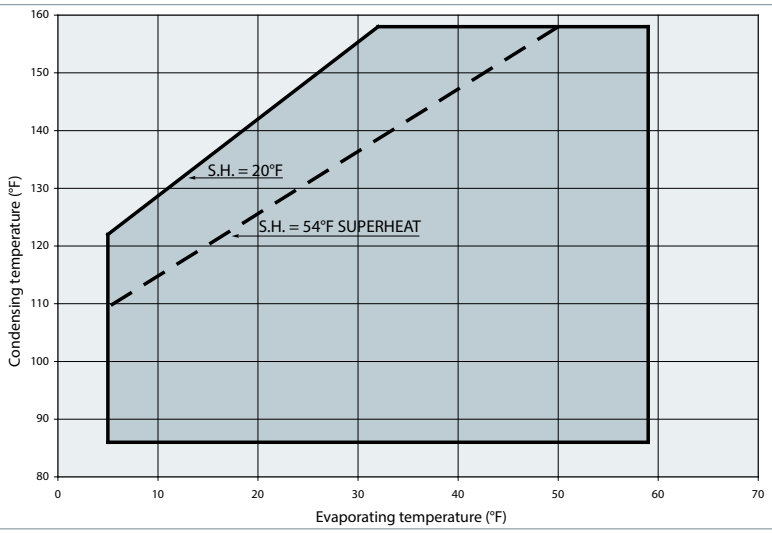
Application guidelines	Operating conditions	
	The scroll compressor application range is influenced by several parameters which need to be monitored for a safe and reliable operation. These parameters and the main recommendations for good practice and safety devices are explained hereunder.	• **Refrigerant 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 45.3°F	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 page 18. 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 -31°F to 145.4°F (for SM/SZ084 to 185) and 127.4°F (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 140°F 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: 275°F • A suction superheat below 9°F (18°F for R407C) is not recommended due to the risk of liquid flood back • Maximum superheat of 54°F • Minimum and maximum evaporating and condensing temperatures as per the operating envelopes.

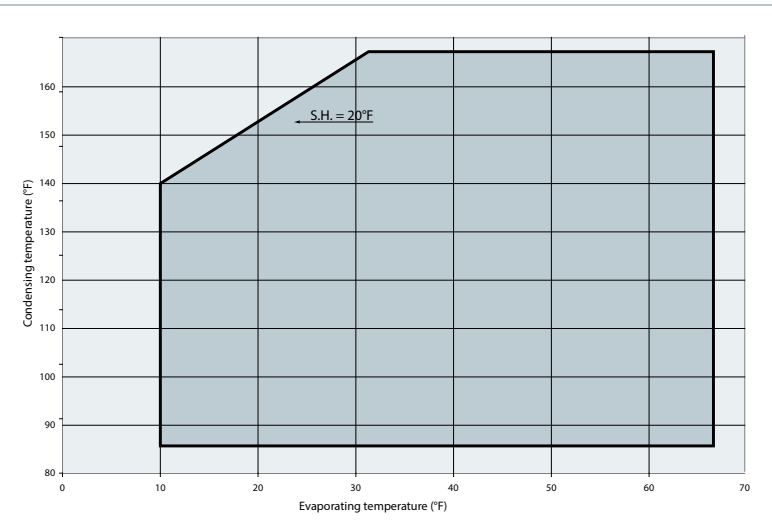
SM084 to 185
SY185 to 380
R22



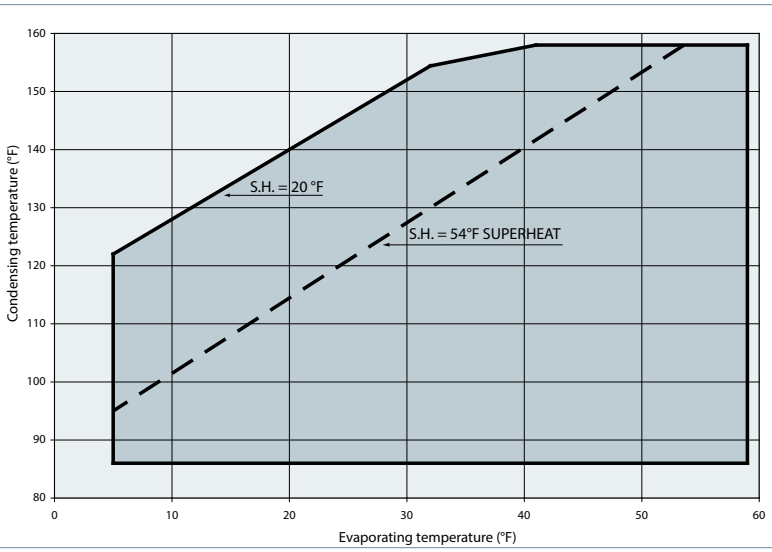
SZ084 to 185 (except SZ147) R134a



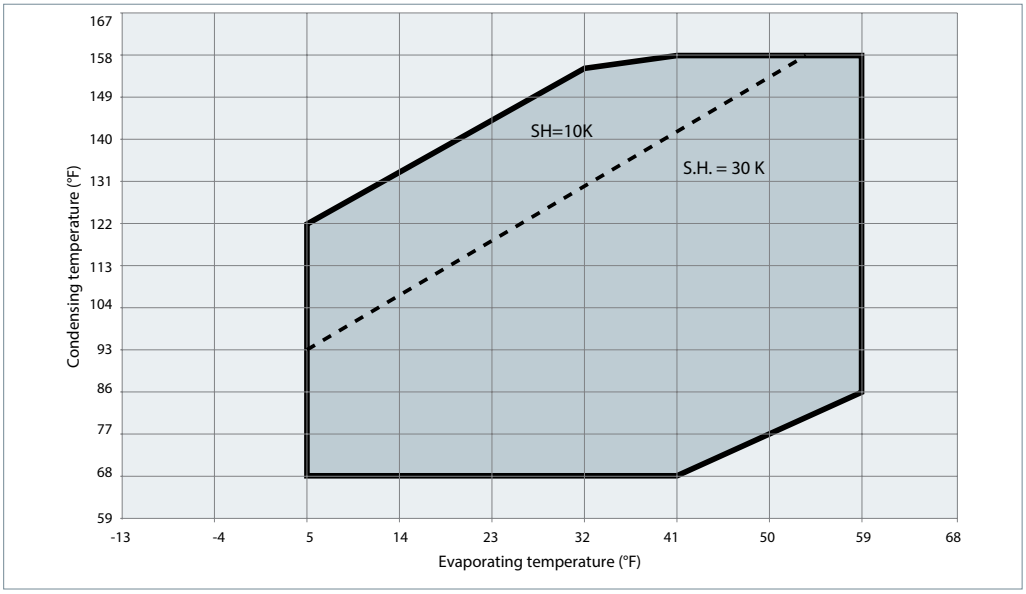
SZ147 R134a



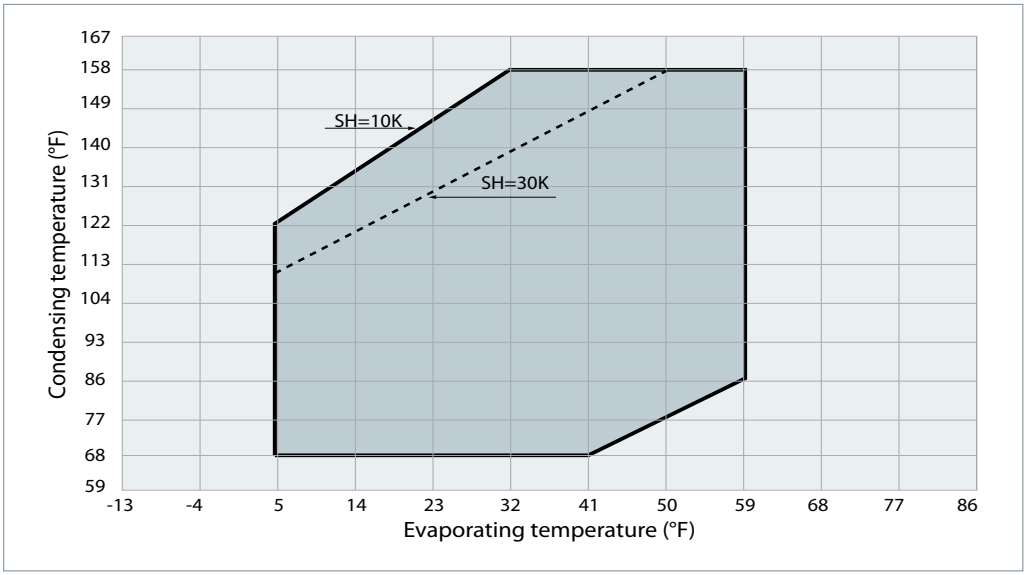
SY240 to 380 R134a



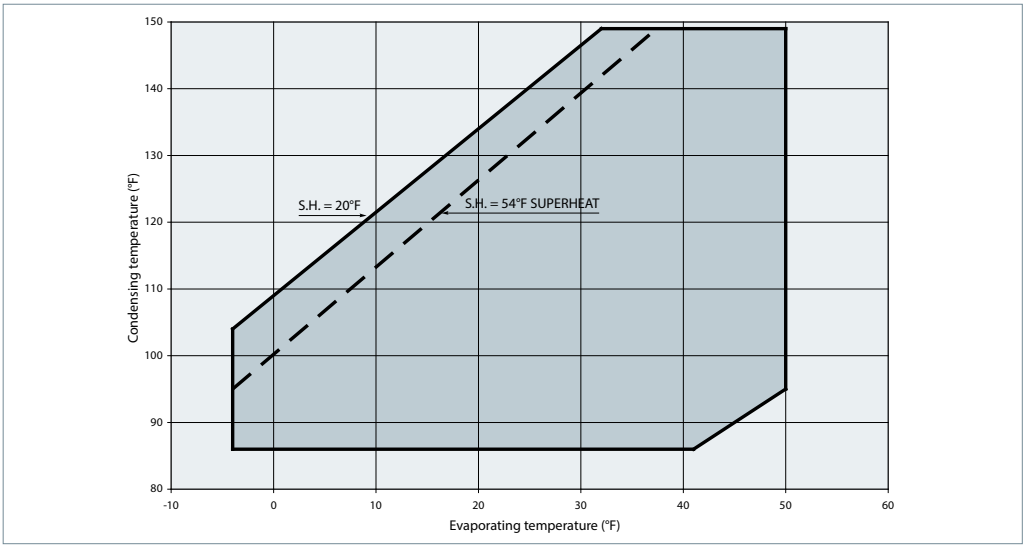
SY240 to 380
R513A



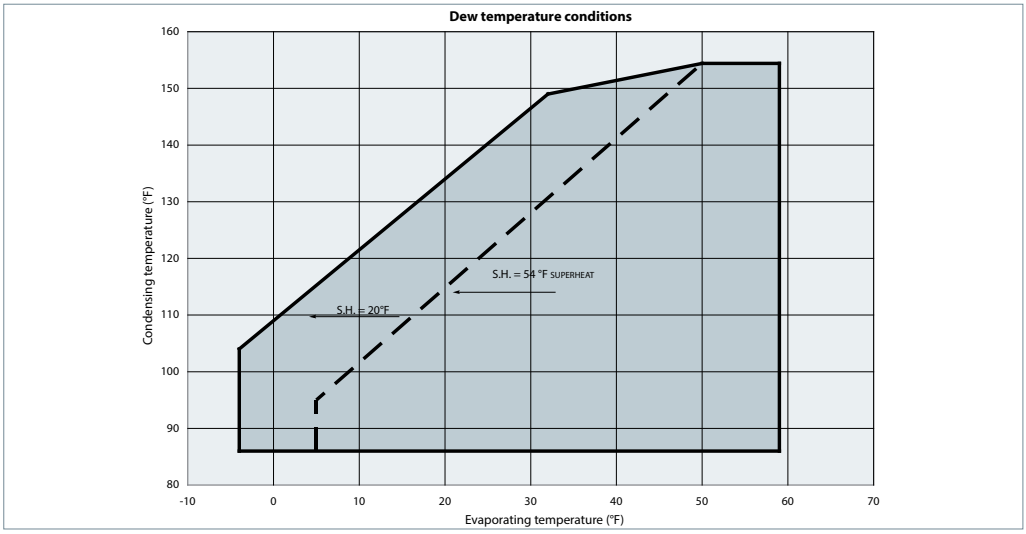
SZ148-185 / SY185
R513A



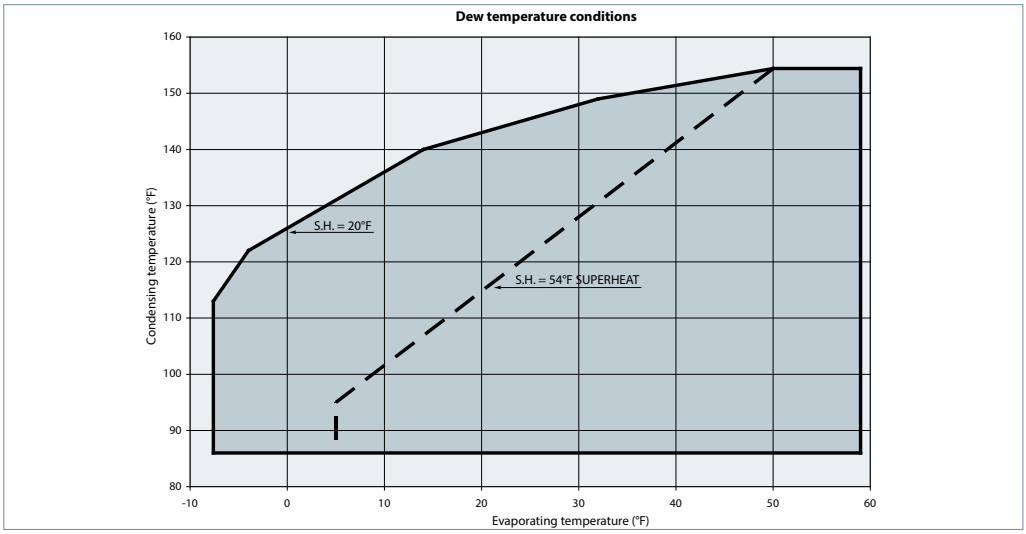
SZ084 to 185
R404A / R507A



SZ084 to 185 & SY185 R407C at DEW temperature



SY240 to 380 R407C at DEW temperature

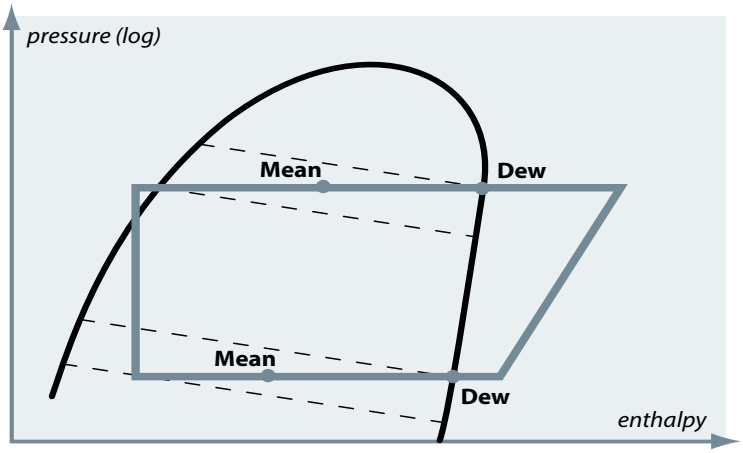


Application envelopes at mean temperatures

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 3.5° to 5.4°F lower than DEW point temperatures. In these Selection and Application Guidelines, Danfoss Commercial Compressors displays temperatures as DEW point values.

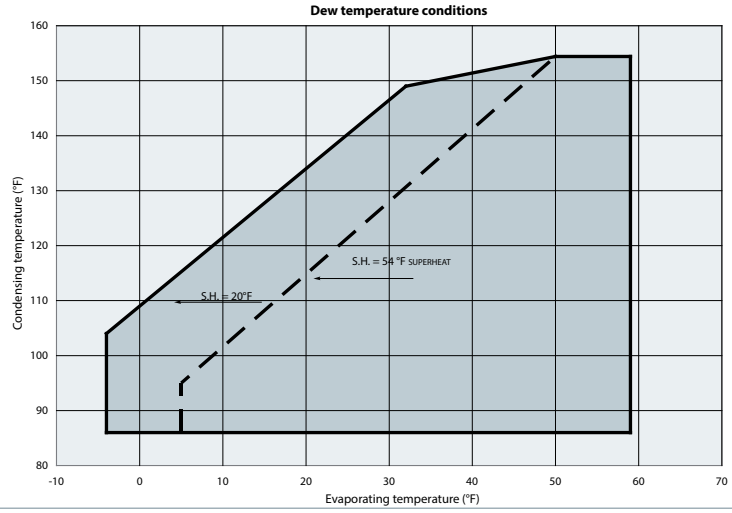
The performance tables for R407C are also based on DEW point values.

Dew temperature and mean temperature for R407C

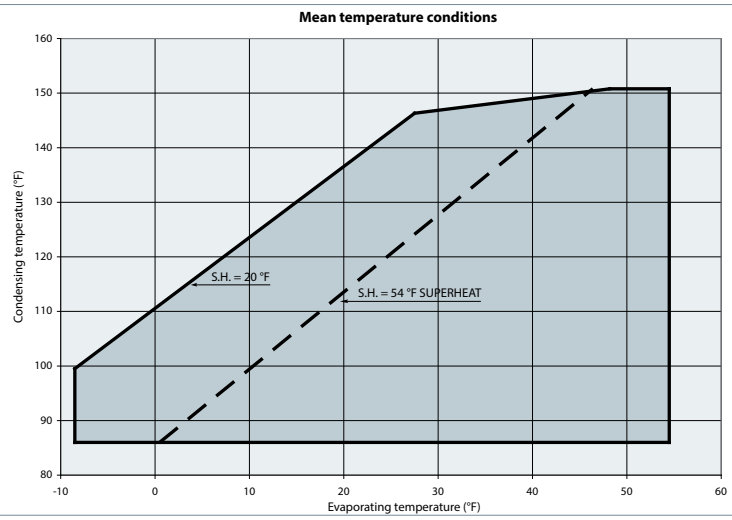


The following operating diagrams show the difference between mean and dew temperature application envelopes.

Dew temperature
Example for SZ 084 to 185



Mean temperature
Example for SZ 084 to 185



Discharge temperature protection

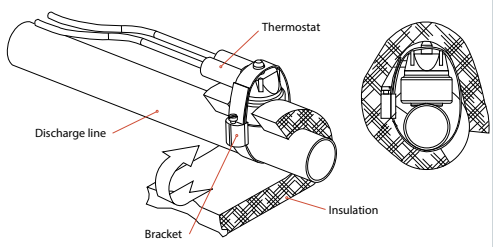
The discharge gas temperature must not exceed 275°F. The discharge gas thermostat accessory kit (code 7750009) includes all components required for installation, as shown below. The thermostat must be attached to the discharge line within 150 mm from the compressor discharge port and must be thermally insulated and highly fixed on the pipe.

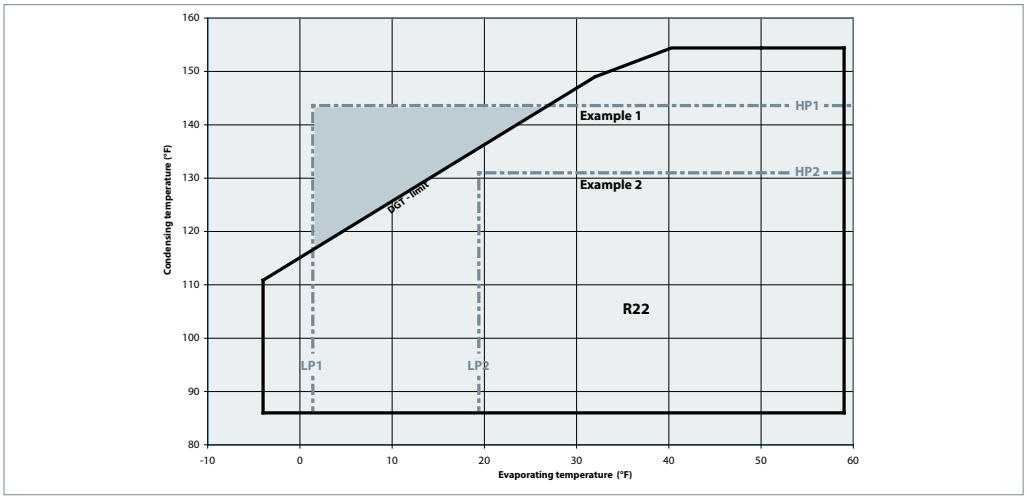
DGT protection is required if the high and low pressure switch settings do not protect the compressor against operations beyond its specific application envelope. Please refer to the examples on following page, which illustrates where DGT protection is required (ex.1) and where it is not (ex.2).

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 275°F.

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 = 20°F)
LP switch setting:
LP1 = 26 psig (1.4°F)
HP switch setting:
HP1 = 363 psig (143.6°F)
Risk of operation beyond the application envelope.
DGT protection required.

Example 2 (R22, SH = 20°F)
LP switch setting:
LP2 = 42 psig (19.4°F)
HP switch setting:
HP2 = 305 psig (131°F)
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

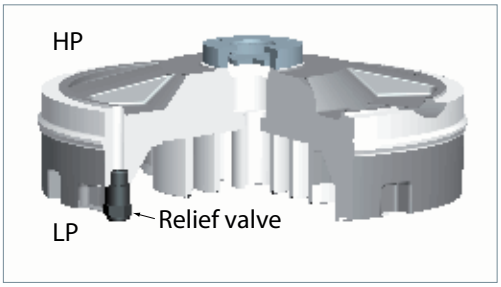
High pressure

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 450 to 551 psi.

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 psig	R407C psig	R134a psig	R404A/R507A psig	R513A psig
Working pressure range high side	158 - 401	152 - 422	97 - 292	184 - 451	74 - 303
Working pressure range low side	20 - 100	15 - 92	8 - 56	29 - 106	12 - 62
Maximum high pressure safety switch setting	406	427	297	457	323
Minimum low pressure safety switch setting *	7	7	7	7	7
Minimum low pressure pump-down switch setting **	18	14	7	26	9

*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 13 psi 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 7 psi for R22.

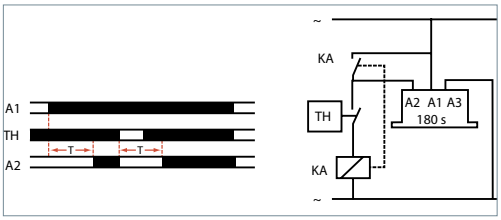
Cycle rate limit

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

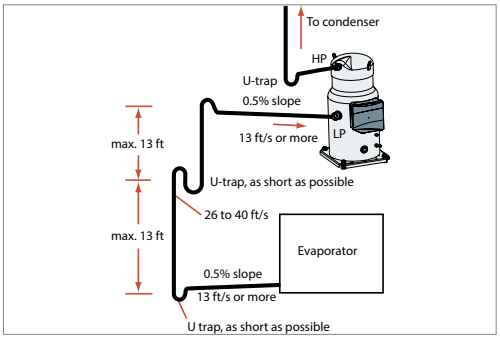
Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and slope of the tubing coming from the evaporator. Tubing returns from the evaporator should be designed so as not to trap oil and to prevent oil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

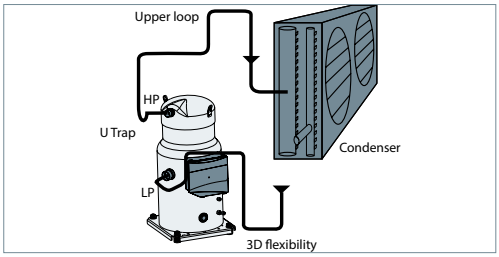
If the evaporator lies above the compressor, as is often the case in split or remote condenser systems, the addition of a pump-down cycle is strongly recommended. If a pump-down cycle were to be omitted, the suction line must have a loop at the evaporator outlet to prevent refrigerant from draining into 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 optimized 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 vapor 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 unfavorable 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 (lbs)
S 084-090-100	19
S 110-120	22
S 112-124-147	17
S 148-161	28
S 175-185	30
S 240	35
S 300-380	44

	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 corresponding section "Specific application recommendations".

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 41°F ambient temperature,
- Raise the ambient temperature to 68°F 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:

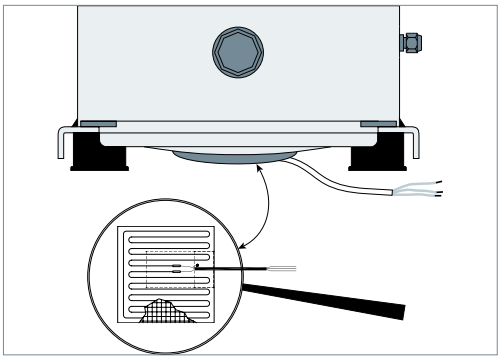
- **Sump heater**
- **Liquid line solenoid valve**
- **Pump down cycle**

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 18°F 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 23°F ambient temperature and a wind speed of above 16 ft/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 vapor. 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 54°F 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.

Application guidelines	Specific application recommendations

Low ambient application

Low ambient start-up

Under cold ambient conditions (<32°F), 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 87 to 102 psi 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 9 °F stable superheat is required.

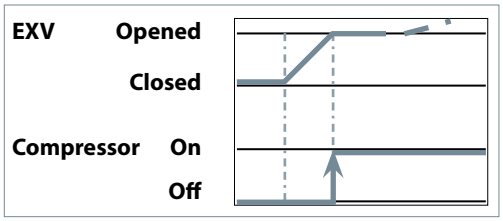
Head pressure control under low ambient conditions: Several possible solutions are available to prevent the risk of compressor to vacuum and low pressure differential between the suction and discharge pressures.

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 "Off-cycle migration".
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 vapor 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.

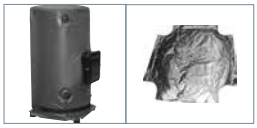
Application guidelines	Specific application recommendations	
Sump heaters	Sump heaters are mandatory on reversible cycle applications given the high probability of liquid migration back to the compressor sump	during off-cycles due to the outdoor location of most units and operations during low ambient 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 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 275°F.
Discharge line and 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.

Application guidelines	Specific application recommendations	
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 32°F. 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'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 optimized 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

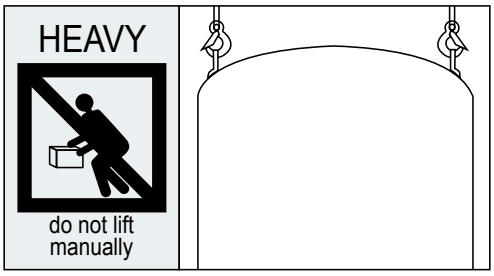
Each Danfoss SM / SY / SZ scroll compressor is equipped with two lift rings on the top shell. Always use both these rings when lifting the compressor. Use lifting equipment rated and certified for the weight of the compressor.
A spreader bar rated for the weight of the compressor is highly recommended 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 -31°F and 127°F when charged with refrigerant and between -31°F and 158°F 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.

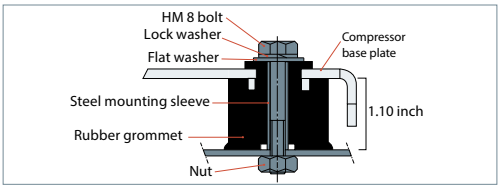
Never apply force to the terminal box with the intention of moving the compressor, as the force placed upon the terminal box can cause extensive damage to both the box and the components contained inside.



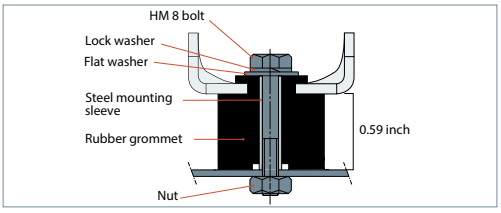
Compressor mounting

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.

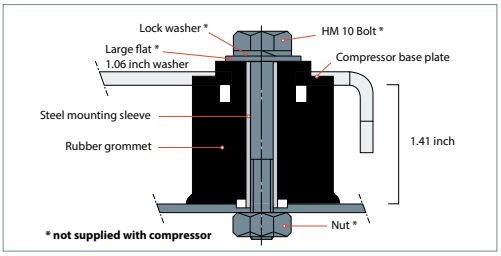
Mounting of SM/SZ 084-090-100-110-120-148-161-175-185: the required bolt size is HM8. This bolt must be tightened to a torque of 15 ft.lbs. The bolts and washers are supplied with the assembly kit.



Mounting of SM/SZ 112-124-147: the required bolt size is HM8. This bolt must be tightened to a torque of 11 ft/lbs. 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 20 ft.lbs. Mounting bolts must be tightened to a torque of 30 ft.lbs. 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 4 and 10 psi 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

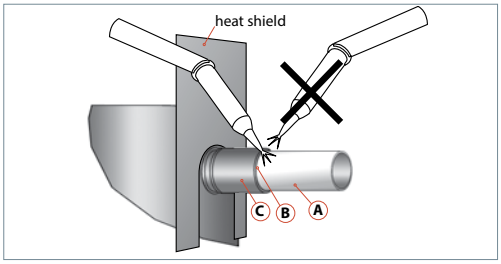
When brazing copper-to-copper connections, the use of a copper / phosphorus brazing alloy containing 5% silver or more with a melting temperature of below 1472°F is recommended. No flux is required during brazing.

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: 363 psig	SY 240 to 380: 319 psig
Maximum compressor test pressure (high side)	464 psig	
Maximum pressure difference between high and low side of the compressor:	348 psig	

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 72 psi.
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 70 psi/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 0.02 inHg (300 µm Hg) 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 5mA.

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 18°F 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 66 ft, no additional oil is required. If installation lines exceed 66 ft, 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.

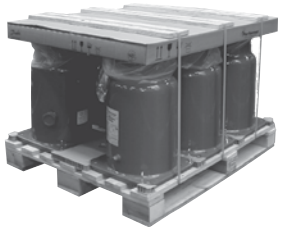
When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

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 in	Width in	Height in	Gross weight lb	Nbr*	Length in	Width in	Height in	Gross weight lb	Static stacking pallets
SM/SZ084	22.2	18.5	26.4	165	8	44.9	37.4	27.8	1213	3
SM/SZ090	22.2	18.5	26.4	168	8	44.9	37.4	27.8	1248	3
SM/SZ100	22.2	18.5	26.4	168	8	44.9	37.4	27.8	1248	3
SM/SZ110-120	22.2	18.5	29.5	187	8	44.9	37.4	29.8	1407	3
SM112	22.2	18.5	28.3	168	8	45.3	37.4	29.3	1197	3
SM124	22.2	18.5	28.3	168	8	45.3	37.4	29.3	1197	2
SM/SZ147	22.2	18.5	28.3	174	8	45.3	37.4	29.3	1248	2
SM/SZ148-161	22.2	18.5	29.5	220	6	44.9	37.4	31.1	1204	3
SM/SZ175-185 - SY185	22.2	18.5	33.0	254	6	44.9	37.4	34.5	1429	2
SY240	29.9	23.6	35.4	359	4	44.9	37.4	35.6	1400	2
SY300	29.9	23.6	35.4	375	4	44.9	37.4	36.0	1400	2
SY380	29.9	23.6	35.4	377	4	44.9	37.4	37.0	1426	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

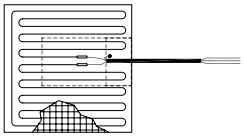
Type	Code n°	Description	Application	Packaging	Pack size
	7703009	Valve set, V02 (1"3/4 ~ 1"1/8), V04(1"1/4 ~ 3/4")	SM / SZ084 to 100 - 110* to 161*	Multipack	6
	7703392	Valve set, V10 (1"3/4 ~ 1"3/8), V05(1"1/4 ~ 7/8")	SM / SZ110 to 161	Multipack	6
	7703010*	Valve set, V08 (2"1/4 ~ 1"3/8), V07 (1"3/4 ~ 7/8")	SY / SM / SZ175/185*	Multipack	6
	7703383	Valve set, V03 (2"1/4 ~ 1"5/8), V02 (1"3/4 ~ 1"1/8)	SY / SM / SZ175/185 SY240 - 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/SZ 084-110	Single pack	1
MCI25C	7705007	Electronic soft start kit, MCI 25 C	SM/SZ 120-185	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 - 147 - SZ147	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	SM112-124-147 - 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	SM112-124-147 (except SM147 code 3) SZ147	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, 24V AC	SY240-300-380 SM/SZ185 with electronic module	Single pack	1
	120Z0585	Electronic motor protection module, 110-240V		Single pack	1

Terminal boxes, covers & T-block connectors

Type	Code No	Description	Application	Packaging	Pack Size
	8156139	Terminal box 7.3 x 7.8 inch, 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 3.8 x 4.5 inch, including 1 cover, 1 clamp, 1 T block connector 2 x 2.2 inch	SM084.090.100.110.112.120.124.14 7.148.161 (except SM148-3.161-3) & SZ084.090.100.110.120.148.161 (except SZ148-3. 161-3)	Multipack	10
	8173230	T block connector 2 x 2.2 inch	SM/SZ084-110.120.148 (except -3). 161 (except -3). & SM112-124, SM/SZ147 (except -3)	Multipack	10
	8173021	T block connector 2.4 x 3 inch	SM/SZ147-3.148-3.161-3.175.185 & SY240.300.380 (except SY240-3.300-3) & SZ175.185	Multipack	10
	8173331	T block connector 3.1 x 3.1 inch	SY240.300-3	Multipack	10
	120Z0458	Terminal box 8.27 x 7.48 inch, incl cover	SY240.300.380 SM/SZ185 with electronic module	Single pack	1
	120Z0462	Terminal box 8.27 x 7.48 inch, incl cover and module wiring for 10.16 x 8.19 inch terminal box replacement	SY240.300.380	Single pack	1

Lubricant

Type	Code No	Description	Application	Packaging	Pack Size
160SZ	7754023	POE lubricant, 160SZ, 1.05 quart can	SZ with R407C, R134a, R404A, R513A	Multipack	12
160SZ	120Z0571	POE lubricant, 160SZ, 2.64 quart can	SZ with R407C, R134a, R404A, R513A	Multipack	4
320SZ	7754121	POE lubricant, 320SZ, 1.05 quart can	SY with R22, R407C, R134a, R513A	Multipack	12
320SZ	120Z0572	POE lubricant, 320SZ, 2.64 quart can	SY with R22, R407C, R134a, R513A	Multipack	4
160P	7754001	Mineral oil, 160P, 2.64 quart can	SM with R22	Multipack	8
160P	7754002	Mineral oil, 160P, 5.28 quart 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 glasse, 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

ENGINEERING
TOMORROW

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.

http://danfoss.us.com

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

member of:
ASERCOM
www.asercom.org

AB237986441643en-US0701