MAKING MODERN LIVING POSSIBLE

Performer® scroll compressors

SM - SY - SZ - 50 / 60 Hz

R-22 - R-407C - R-134a - R-404A - R-507A

REFRIGERATION &
AIR CONDITIONING

SELECTION & APPLICATION
GUIDELINES

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PERFORMER® SCROLL COMPRESSION PRINCIPLE

In a Danfoss Performer® scroll compressor, compression is performed by two scroll elements located above the motor (see adjacent figure). Suction gas enters the compressor at the suction connection, enters at the bottom of the motor housing and flows around the motor. Oil droplets separate from the suction gas and fall into the oil sump. All suction gas passes around the electric motor, ensuring complete motor cooling in all applications. After cooling the electric motor, the gas enters the scroll elements where compression takes place.

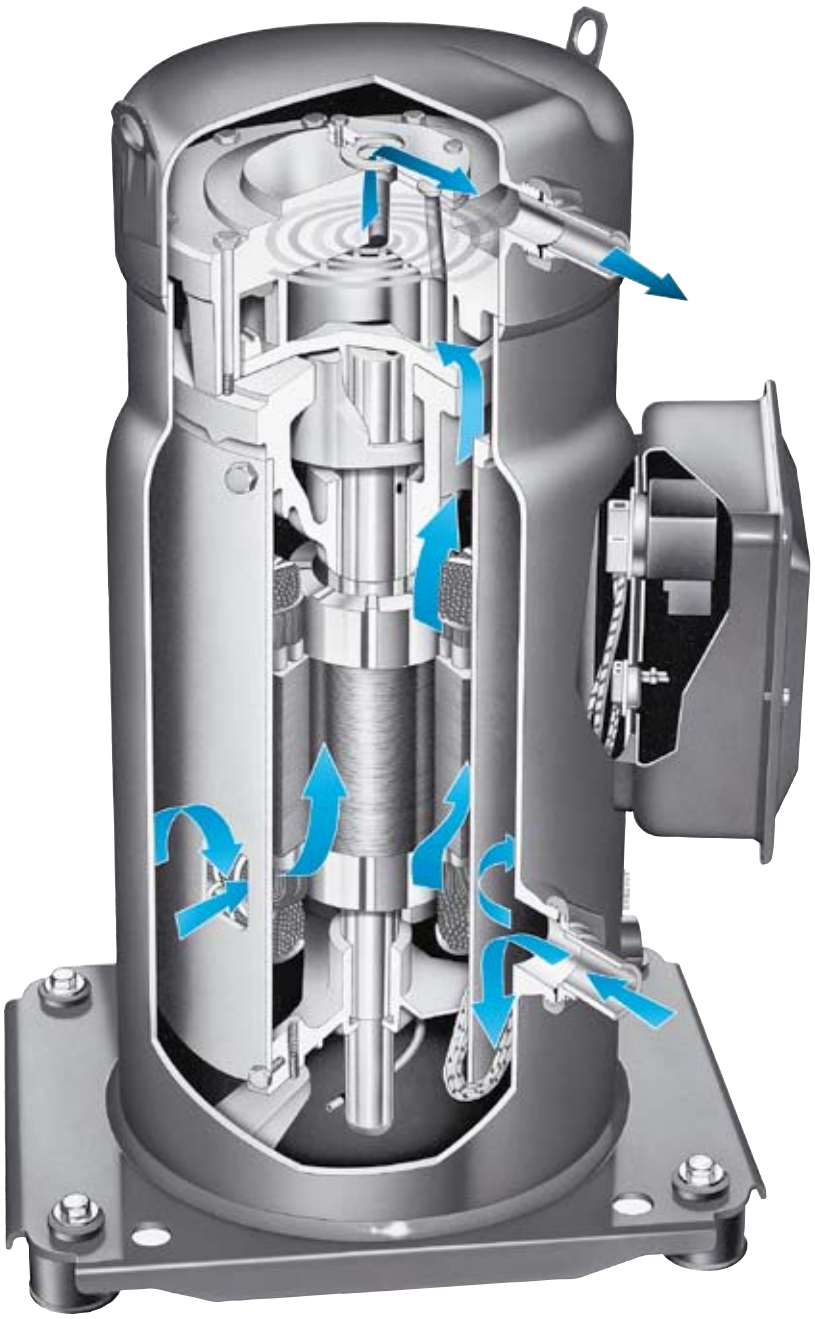
A check valve is located directly above the fixed scroll discharge port; this feature prevents the compressor from running backwards once the power has been switched off.

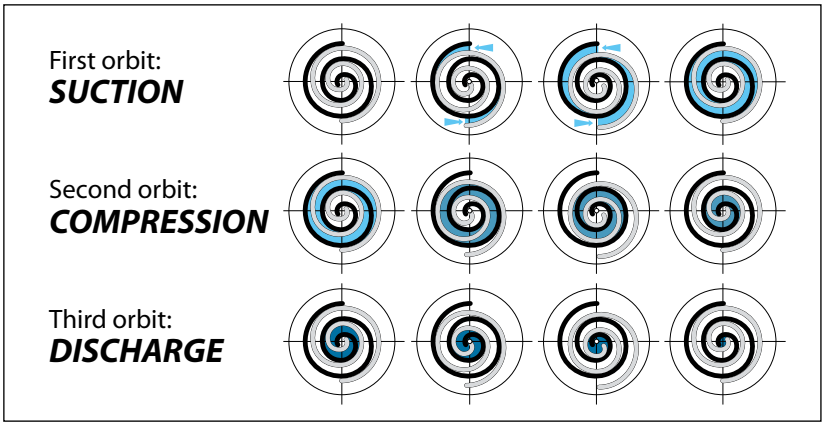
The figure below illustrates the entire compression process.

There are two scroll elements: an orbiting scroll and a fixed scroll. The center of the orbiting scroll traces a circular path around the center of the fixed scroll. This movement creates symmetrical compression pockets between the two scroll elements. Low pressure gas is trapped in 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 toward the center of the scroll .

During three complete orbits the pocket of gas becomes smaller and pressure rises. After the third orbit, the gas, at maximum pressure, has reached the central discharge port where it leaves the compressor.

Compression in a scroll is a continuous process: when one pocket of gas is being compressed during its second orbit, another quantity is entering the scrolls and yet another is being discharged all at the same time.





COMPRESSOR MODEL DESIGNATION

Performer® scroll compressors are available both as single compressors and as tandem units. The example below presents single compressor nomenclature.

For tandem assemblies, please refer to the Performer® Parallel Application Guidelines documentation.

Nomenclature

Family, lubricant & refrigerant	Nominal capacity		Voltage	Version	Evolution Index
S Z S Y	1 8 5 3 0 0	S A	4 9	R A A	C A

Family, lubricant & refrigerant
SM: Scroll, mineral oil, for R-22
SY: Scroll, POE lubricant, for R-22
SZ: Scroll, POE lubricant, for R-407C - R-134a

Nominal capacity
in thousand Btu/h at 60 Hz, R-22, ARI conditions

UL index

Voltage
Motor voltage code:
3: 200-230/3/60
4: 380-400/3/50 - 460/3/60
6: 230/3/50
7: 500/3/50 - 575/3/60
9: 380/3/60

Motor protection type	**Version**	Description		Applies to
Internal overload protector	V	V: brazed		S 084 - 090 100 - 110 - 120 148 - 161
Internal thermostat	C	C: brazed		S 115 - 125 160 - 175 - 185
Internal thermostat	R	R: rotolock		S 115 - 125 160 - 175 - 185
Electronic protection module	AA	A: brazed	A: 24V	S 240* - 300* - 380*
	AB	A: brazed	B: 115/230V	
	MA	M: rotolock	A: 24V	
	MB	M: rotolock	B: 115/230V	

*For trio assemblies, please contact Danfoss

Connection details

Model	SM/SZ 084 - 090 - 100 110 - 120 - 148 - 161	SM/SZ 115 - 125 - 160 - 175 - 185		SY/SZ 240 - 300		SY/SZ 380
Version	V	R	C	MA MB	AA AB	AA AB
Suction and discharge connection	brazed	rotolock	brazed	rotolock	brazed	brazed
Oil sight glass	threaded	threaded	threaded	threaded	threaded	threaded
Oil equalization connection	3/8" flare	3/8" flare	3/8" flare	1/2" flare	1/2" flare	1/2" flare
Oil drain connection	-	1/4" NPT	1/4" NPT	1/4" NPT	1/4" NPT	1/4" NPT
Low pressure gauge port (schrader)	1/4" flare	1/4" flare	1/4" flare	1/4" flare	1/4" flare	1/4" flare

TECHNICAL SPECIFICATIONS

50 Hz data

	Model	Nominal Cap. 60 Hz TR	Nominal cooling capacity** W	Btu/h	Power input kW	A max (code 4) A	Efficiency COP W/W	E.E.R. Btu/h /W	Sound power dB(A)	Swept volume cu.in/rev	Displace-ment cu.ft/h	Oil charge oz	Net weight lb*
R-22 SINGLE	SM084	7	20400	69 600	6.12	17	3.33	11.4	70	6.99	703	111.6	159
	SM090	7.5	21800	74 400	6.54	17	3.33	11.4	70	7.35	741	111.6	159
	SM100	8	23100	79 000	6.96	19	3.33	11.3	70	7.76	782	111.6	159
	SM110	9	25900	88 600	7.82	20	3.32	11.3	75	8.80	886	111.6	176
	SM115	9.5	28000	95 600	8.31	25	3.37	11.5	76	9.46	952	128.5	176
	SM120	10	30100	102 800	8.96	29	3.36	11.5	75	10.17	1024	111.6	176
	SM125	10	30100	102 800	8.93	25	3.37	11.5	76	10.17	1024	128.5	176
	SM148	12	36100	123 100	10.80	32	3.34	11.4	79	12.14	1222	121.7	176
	SM160	13	39100	133 500	11.60	29	3.37	11.5	79.5	13.22	1331	135.3	207
	SM161	13	39000	133 200	11.59	32	3.37	11.5	79.5	13.22	1331	121.7	190
	SM175	14	42000	143 400	12.46	35	3.37	11.5	80	14.22	1432	209.6	227
	SM185	15	45500	155 300	13.62	35	3.34	11.4	80	15.25	1535	209.6	227
	SY240	20	61200	208 700	18.20	50	3.36	11.5	82	21.22	2137	270.5	353
	SY300	25	78200	267 000	22.83	69	3.43	11.7	82	26.70	2687	270.5	353
	SY380	30	92000	313 900	26.82	79	3.43	11.7	85	32.42	3263	284.0	359
R-407C SINGLE	SZ084	7	19300	66 000	6.13	17	3.15	10.7	71	6.99	703	111.6	159
	SZ090	7.5	20400	69 600	6.45	17	3.16	10.8	72	7.35	741	111.6	159
	SZ100	8	21600	73 700	6.84	19	3.15	10.8	73	7.76	782	111.6	159
	SZ110	9	24600	84 000	7.76	20	3.17	10.8	77	8.80	886	111.6	176
	SZ115	9.5	26900	91 700	8.49	25	3.16	10.8	77	9.46	952	128.5	176
	SZ120	10	28600	97 600	8.98	29	3.18	10.9	77	10.17	1024	111.6	176
	SZ125	10	28600	97 500	8.95	25	3.19	10.9	78	10.17	1024	128.5	176
	SZ148	12	35100	119 800	10.99	32	3.19	10.9	79	12.14	1222	121.7	176
	SZ160	13	37600	128 200	11.58	29	3.24	11.1	80.5	13.22	1331	135.3	207
	SZ161	13	37900	129 500	11.83	32	3.21	10.9	79	13.22	1331	121.7	190
	SZ175	14	40100	136 900	12.67	35	3.17	10.8	81	14.22	1432	209.6	227
	SZ185	15	43100	147 100	13.62	35	3.16	10.8	81	15.25	1535	209.6	227
	SZ240	20	59100	201 800	18.60	50	3.18	10.9	83.5	21.22	2137	270.5	353
	SZ300	25	72800	248 300	22.70	69	3.20	10.9	84	26.70	2687	270.5	353
	SZ380	30	89600	305 900	27.60	79	3.25	11.1	86.5	32.42	3263	284.0	359

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

* with oil charge & accessories
** at nominal speed
2900 rpm at 50 Hz
3500 rpm at 60Hz

Rating conditions

	SM/SY compressors	SZ compressors
Refrigerant	R-22	R-407C
Frequency	50 Hz	50 Hz
Standard rating conditions	ARI standard conditions	-
Evaporating temperature	45 °F	45 °F (dew point)
Condensing temperature	130 °F	130 °F (dew point)
Subcooling	15 °F	15 °F
Superheat	20 °F	20 °F

Subject to modification without prior notification
For full data details and capacity tables refer to Online Datasheet Generator : **www.danfoss.com/odsg**

TECHNICAL SPECIFICATIONS

60 Hz data

	Model	Nominal Cap. 60 Hz TR	Nominal cooling capacity** W	Btu/h	Power input kW	A max (code 4) A	Efficiency COP W/W	E.E.R. Btu/h /W	Sound power dB(A)	Swept volume cu.in/rev	Displace-ment cu.ft/h	Oil charge oz	Net weight * lb
R-22 SINGLE	SM084	7	24600	84 000	7.38	17	3.34	11.4	74	6.99	703	111.6	141
	SM090	7.5	26400	90 000	7.82	17	3.37	11.5	75	7.35	741	111.6	143
	SM100	8	27500	94 000	8.14	19	3.38	11.5	75	7.76	782	111.6	143
	SM110	9	31600	107 800	9.35	20	3.38	11.5	78	8.80	886	111.6	161
	SM115	9.5	33700	115 200	10.08	25	3.35	11.4	79	9.46	952	128.5	172
	SM120	10	36700	125 300	10.80	29	3.40	11.6	78	10.17	1024	111.6	161
	SM125	10	37000	126 400	10.99	25	3.37	11.5	79	10.17	1024	128.5	172
	SM148	12	43800	149 500	13.01	32	3.37	11.5	83	12.14	1222	121.7	194
	SM160	13	47700	163 000	14.22	29	3.36	11.5	84	13.22	1331	135.3	198
	SM161	13	47600	162 600	14.07	32	3.39	11.5	84	13.22	1331	121.7	194
	SM175	14	51100	174 300	15.27	35	3.34	11.4	82.5	14.22	1432	209.6	220
	SM185	15	54300	185 400	16.22	35	3.35	11.4	82.5	15.25	1535	209.6	220
	SY240	20	74100	252 700	22.10	50	3.35	11.4	84.7	21.22	2137	270.5	331
	SY300	25	94500	322 500	27.50	69	3.43	11.7	85.9	26.70	2687	270.5	346
R-407C SINGLE	SZ084	7	22500	76 900	7.06	17	3.19	10.9	74	6.99	703	111.6	141
	SZ090	7.5	24400	83 300	7.63	17	3.20	10.9	77	7.35	741	111.6	143
	SZ100	8	26500	90 500	8.18	19	3.24	11.0	77	7.76	782	111.6	143
	SZ110	9	30100	102 800	9.29	20	3.24	11.1	81	8.80	886	111.6	161
	SZ115	9.5	32800	112 000	10.22	25	3.21	10.9	81	9.46	952	128.5	172
	SZ120	10	34800	118 900	10.75	29	3.24	11.1	81	10.17	1024	111.6	161
	SZ125	10	34900	119 200	10.89	25	3.21	10.9	81	10.17	1024	128.5	172
	SZ148	12	42600	145 400	13.35	32	3.19	10.9	83	12.14	1222	121.7	194
	SZ160	13	45500	155 400	14.08	29	3.23	11.0	83	13.22	1331	135.3	198
	SZ161	13	46000	156 900	14.32	32	3.21	10.9	83	13.22	1331	121.7	194
	SZ175	14	48700	166 200	15.28	35	3.19	10.9	84	14.22	1432	209.6	220
	SZ185	15	51800	176 800	16.43	35	3.15	10.7	84	15.25	1535	209.6	220
	SZ240	20	71100	242 800	22.70	50	3.14	10.7	87	21.22	2137	270.5	331
	SZ300	25	87900	300 000	27.49	69	3.20	10.9	87.5	26.70	2687	270.5	346
	SZ380	30	108500	368 500	33.40	79	3.25	11.0	89.5	32.42	3263	284	348

TR = Ton of Refrigeration
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EER = Energy Efficiency Ratio

* with oil charge & accessories
** at nominal speed
2900 rpm at 50 Hz
3500 rpm at 60Hz

Rating conditions

	SM/SY compressors	SZ compressors
Refrigerant	R-22	R-407C
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Condensing temperature	130 °F	130 °F (dew point)
Subcooling	15 °F	15 °F
Superheat	20 °F	20 °F

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OPERATING ENVELOPES

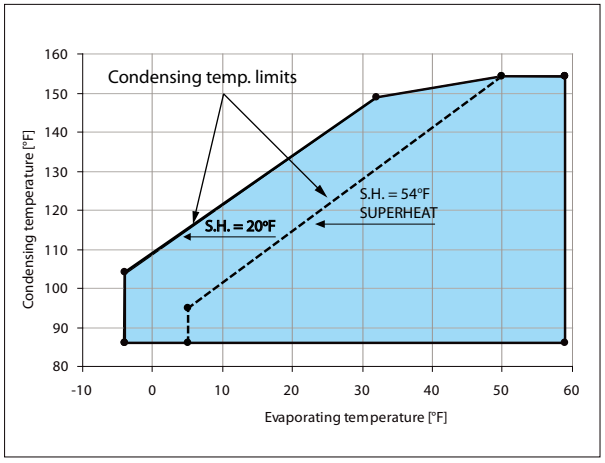
Application envelopes at dew temperatures

The figures below show the operating envelopes for SM / SY compressors with refrigerant R-22 and for SZ compressors with refrigerants R-407C, R-134a, R-404A and R-507A. Operating limits define the envelope within which reliable compressor operation is guaranteed.

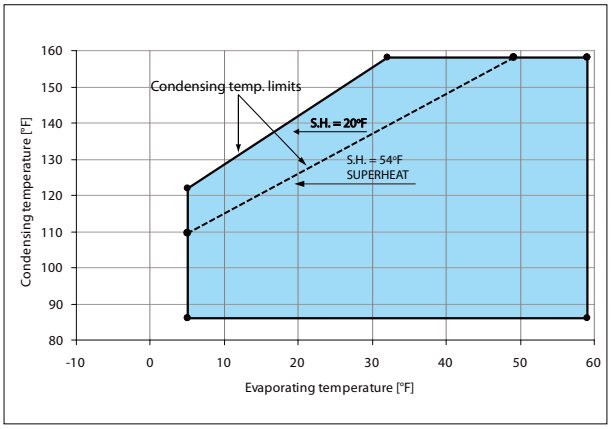
Because discharge temperature depends on the combination of evaporating temperature, condensing temperature and suction gas superheat, discharge temperature limits are indicated by a double line. The solid line represents the limit when the superheat is 20°F or less. The dotted line shows the limit when the superheat is 54°F. Interpolate for superheat values between 20°F and 54°F.

- Maximum discharge gas temperature: +275°F
- Maximum ambient temperature: +145°F (for SM / SZ 084 to 185), +125°F (for SY / SZ 240 to 380)
- A suction superheat below 10°F is not recommended due to risk of liquid floodback
- Maximum superheat: 54°F
- Minimum and maximum evaporating and condensing temperatures as per the operating envelopes.

SM 084 to SM 185
SY 240 to SY 380
R-22

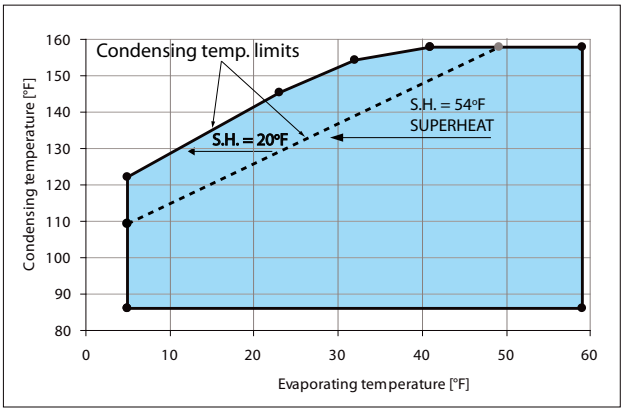


SZ 084 to SZ 185
R-134a

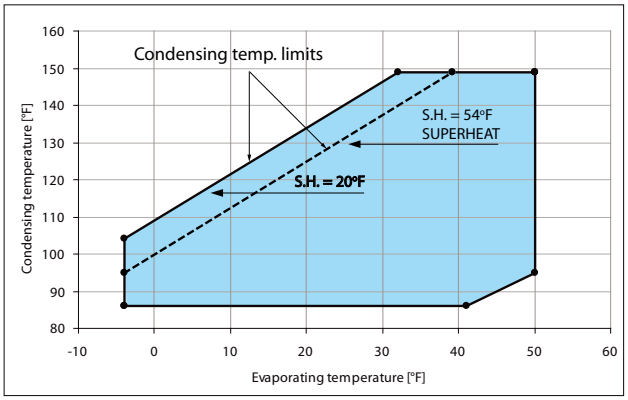


OPERATING ENVELOPES

SZ 240 - 300
R-134a

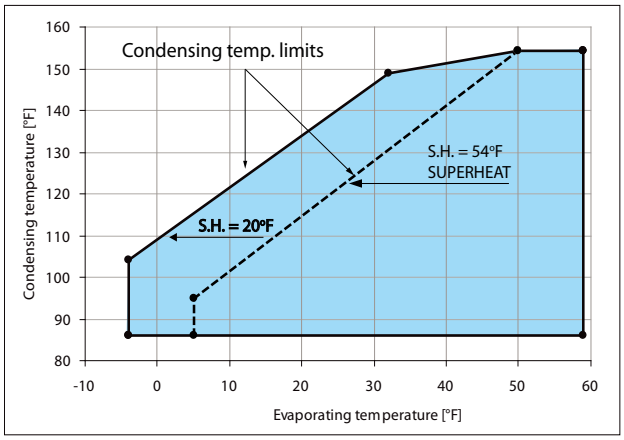


SZ 084 to SZ 185
R-404A / R-507A



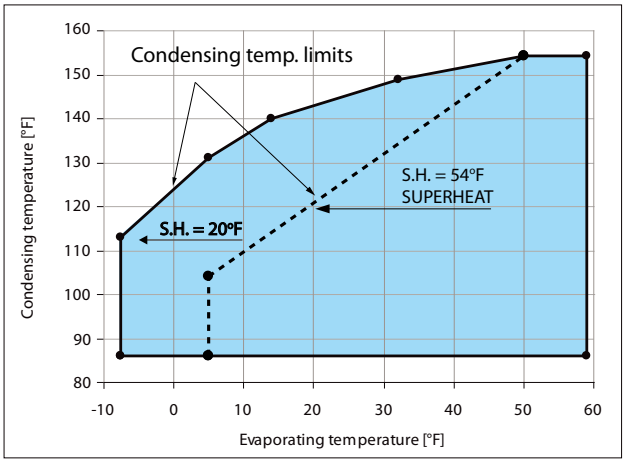
SZ 084 to SZ 185
R-407C
at DEW temperature

(refer to the explanation p.10)



SZ 240 to SZ 380
R-407C
at DEW temperature

(refer to the explanation p.10)

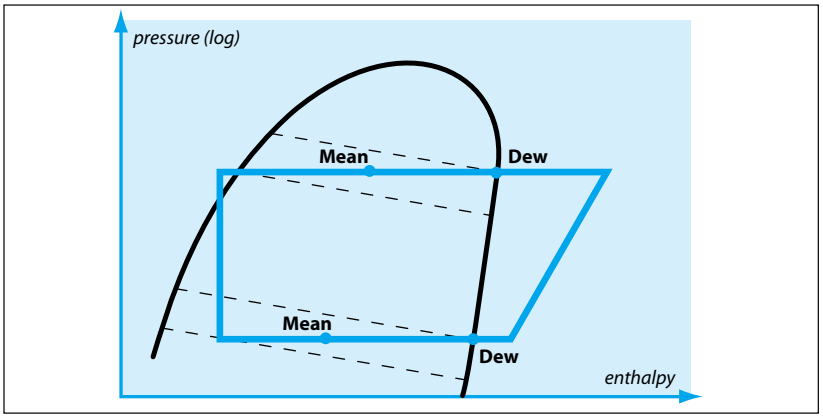


OPERATING ENVELOPES

Application envelopes at mean temperatures

Refrigerant R-407C is a zeotropic mixture with a temperature glide in both evaporator and condenser. Therefore, when discussing evaporating and condensing temperatures, it is important to indicate whether these are DEW POINT values or MEAN 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 5.5°F lower than DEW point temperatures. In these Selection and Application Guidelines, we displays temperatures as DEW point values.
The performance tables for R-407C (see p. 6-7) are also based on DEW point values.

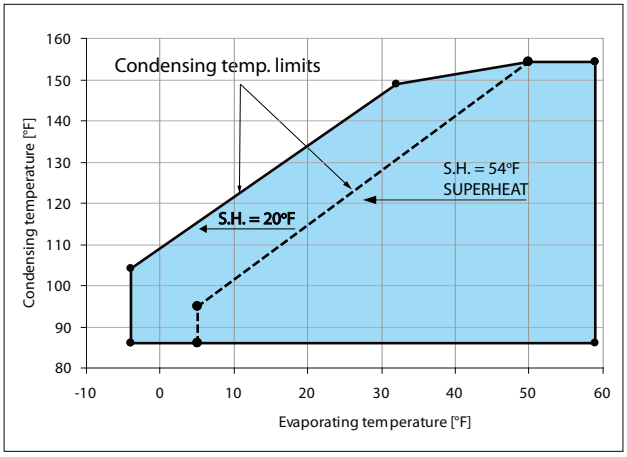
Dew temperature and mean temperature for R-407C



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

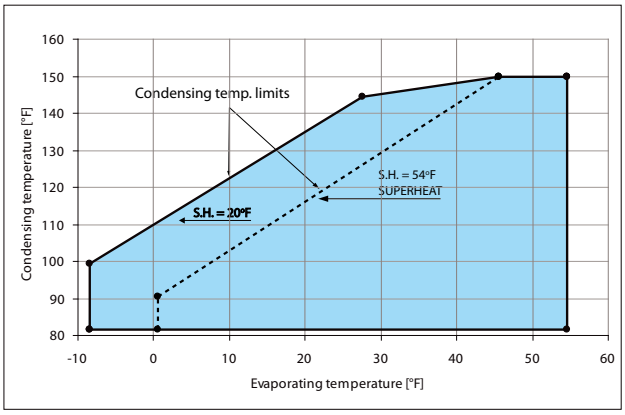
Dew temperature

Example for SZ 084 to 185



Mean temperature

Example for SZ 084 to 185



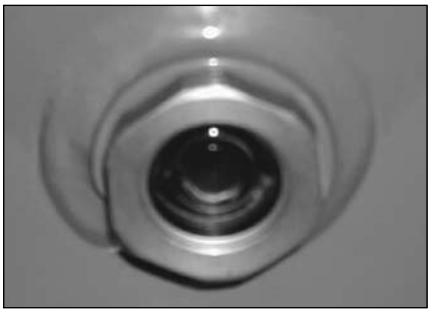
PIPING CONNECTIONS

Suction and discharge connections

		Brazed version	Rotolock version	
				
		Brazed	Rotolock ①	Sleeve included ②
SM / SZ 084	Suction	1" 1/8	-	-
	Discharge	3/4"	-	-
SM / SZ 090	Suction	1" 1/8	-	-
	Discharge	3/4"	-	-
SM / SZ 100	Suction	1" 1/8	-	-
	Discharge	3/4"	-	-
SM / SZ 110	Suction	1" 3/8	-	-
	Discharge	7/8"	-	-
SM / SZ 115	Suction	1" 3/8	1" 3/4	1" 1/8
	Discharge	7/8"	1" 1/4	3/4"
SM / SZ 120	Suction	1" 3/8	-	-
	Discharge	7/8"	-	-
SM / SZ 125	Suction	1" 3/8	1" 3/4	1" 1/8
	Discharge	7/8"	1" 1/4	3/4"
SM / SZ 148	Suction	1" 3/8	-	-
	Discharge	7/8"	-	-
SM / SZ 161	Suction	1" 3/8	-	-
	Discharge	7/8"	-	-
SM / SZ 160	Suction	1" 5/8	2" 1/4	1" 3/8
	Discharge	1" 1/8	1" 3/4	7/8"
SM / SZ 175	Suction	1" 5/8	2" 1/4	1" 3/8
	Discharge	1" 1/8	1" 3/4	7/8"
SM / SZ 185	Suction	1" 5/8	2" 1/4	1" 3/8
	Discharge	1" 1/8	1" 3/4	7/8"
SY / SZ 240	Suction	1" 5/8	2" 1/4	1" 5/8
	Discharge	1" 1/8	1" 3/4	1" 1/8
SY / SZ 300	Suction	1" 5/8	2" 1/4	1" 5/8
	Discharge	1" 1/8	1" 3/4	1" 1/8
SY / SZ 380	Suction	2" 1/8	-	-
	Discharge	1" 3/8	-	-

Sight glass

All Performer® scroll compressors come equipped with a sight glass that may be used to determine the amount and condition of the oil in the sump.



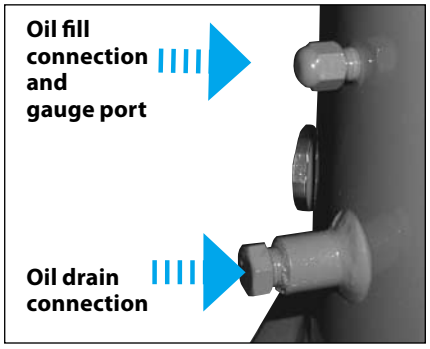
Schrader

The oil fill connection and gauge port is a 1/4" male flare connector that incorporates a Schrader valve.

Oil drain

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 for more effective oil removal. The connection is female 1/4" NPT .

Note: on SY/SZ 240-380, it is not possible to drain oil from the suction connection.



ELECTRICAL CONNECTIONS AND WIRING

Motor voltage

Performer® scroll compressors are available for five different motor voltages. Motor voltage codes 3 and 9 are for 60 Hz only, code 6 for 50 Hz only, and codes 4 and 7 for both 50 and 60 Hz.

		Motor voltage code 3	Motor voltage code 4	Motor voltage code 6	Motor voltage code 7	Motor voltage code 9
Nominal voltage	50 Hz	-	380-400V - 3 - 50 Hz	230V - 3 - 50 Hz	500V - 3 - 50Hz	-
Voltage range	50 Hz	-	340-440V	207 - 253V	450 - 550V	-
Nominal voltage	60 Hz	200-230V - 3 - 60 Hz	460V - 3 - 60 Hz	-	575V - 3 - 60 Hz	380 - 3 - 60 Hz
Voltage range	60 Hz	180 - 253 V	414 - 506V	-	517 - 632V	342 - 418 V

Electrical connections

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

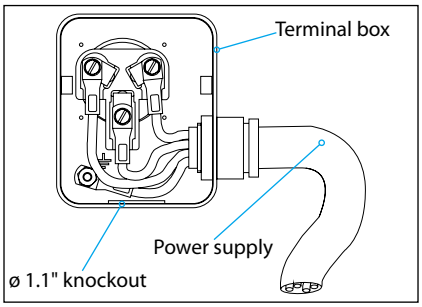
Terminal box wiring for SM / SZ 084 - 090 - 100 - 110 - 120 - 148* - 161* compressors

*** Except for motor voltage code 3**

• The terminal box is provided with a Ø 1.1" (29 mm) hole for the power supply and a Ø 1.1" (29 mm) knockout.

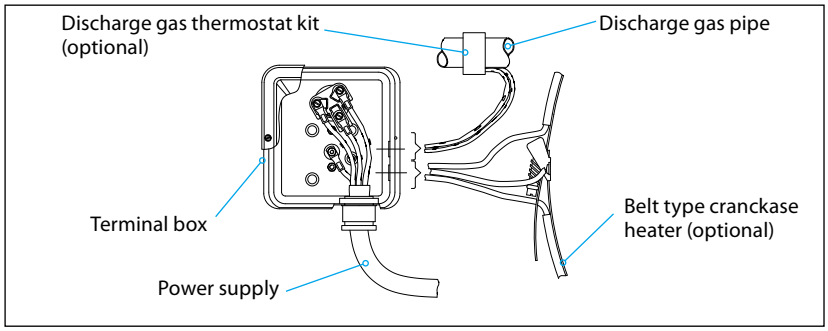
• The protection rating of the terminal box is IP54 when correctly sized IP54-rated cable glands are used.

IP ratings according to IEC 529



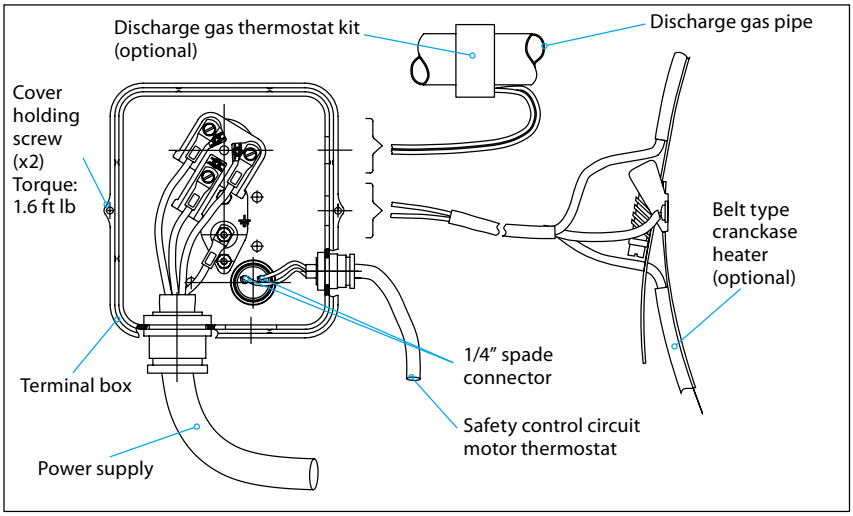
Terminal box wiring for SM / SZ 148 - 161 compressors

motor voltage code 3



Terminal box wiring for SM / SZ 115 - 125 - 160 - 175 - 185 compressors

The terminal box is provided with 2 double knockouts for the power supply and 3 knockouts for the safety control circuit.



ELECTRICAL CONNECTIONS AND WIRING

The 2 double power supply knockouts accommodate the following diameters:
Ø 1"3/4 / Ø 44 mm (for 1"1/4 conduit)
Ø 1"3/8 / Ø 34mm (for 1" conduit),
Ø 1.26" / Ø 32.1 mm and
Ø 1" / Ø 25.4 mm

The 3 additional knockouts are :
Ø 0.81" / Ø 20.5 mm
Ø 7/8" / Ø 22 mm (for 1/2" conduit)
Ø 0.65" / Ø 16.5 mm

The protection rating of the terminal box is IP54 when correctly sized IP54-rated cable glands are used.

Connect the internal safety thermostat with 1/4" female spade connectors.

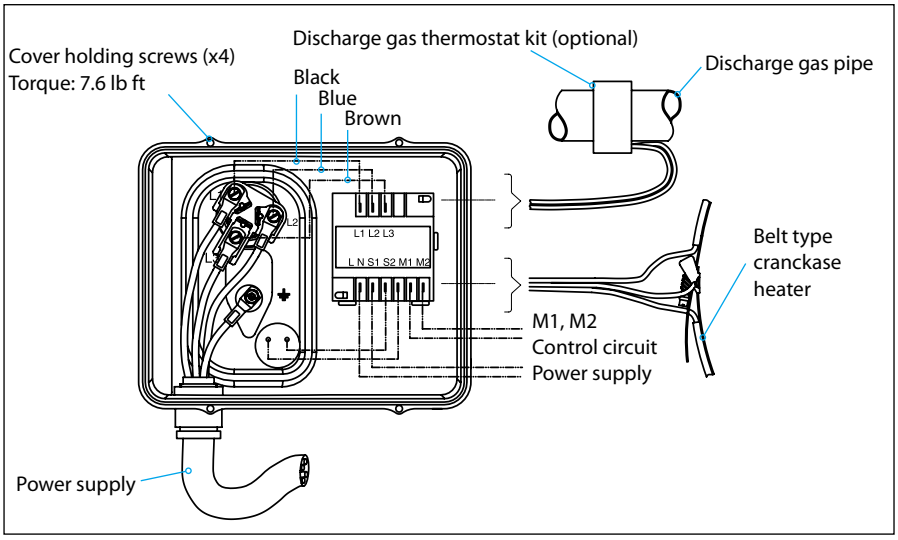
Terminal box wiring for SY / SZ 240 – 300 – 380

The terminal box is provided with 4 double power supply knockouts and 4 knockouts for the safety control circuit. The power supply knockouts accommodate have these diameters:
Ø 7/8" / Ø 22 mm and
Ø 0.65" / Ø 16.5 mm
Ø 7/8" / Ø 22 mm and
Ø 0.65" / Ø 16.5 mm
Ø 1"23/32 / Ø 43.7 mm and
Ø 1"23/64 / Ø 34.5 mm
Ø 1.59" / Ø 40.5 mm and
Ø1.27" / Ø 32.2 mm

The 4 other knockouts are:
Ø 0.81" / Ø 20.5 mm
Ø 0.81" / Ø 20.5 mm
Ø 1" 31/32 / Ø 50 mm
Ø 0.99" / Ø 25.2 mm

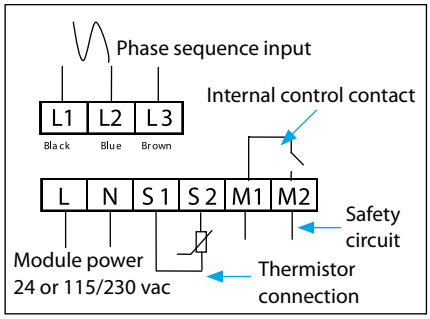
The protection rating of the terminal box is IP54 when correctly sized IP54-rated cable glands are used.

IP ratings according to IEC 529.



Electronic protection module wiring

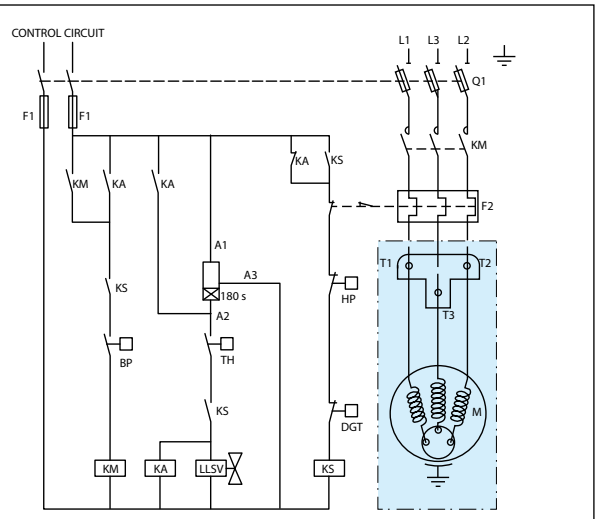
The motor protection module is factory-installed in the terminal box and has both phase sequence protection and pre-wired thermistor connections. The module must be connected to a power supply of appropriate voltage. The module terminals are 1/4" size Faston type.



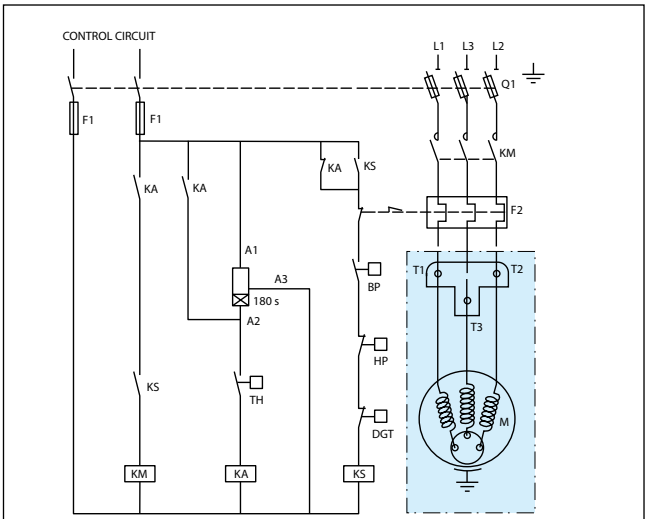
ELECTRICAL CONNECTIONS AND WIRING

Suggested wiring diagrams

Compressor models SM / SZ 084 – 090 – 100 – 110 – 120 – 148 - 161



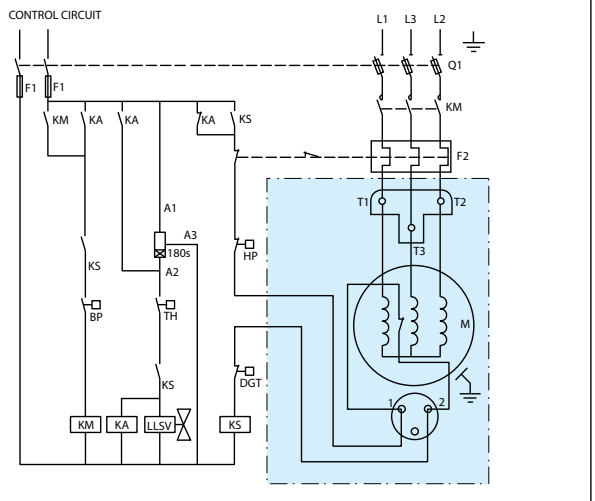
Wiring diagram with pump-down cycle



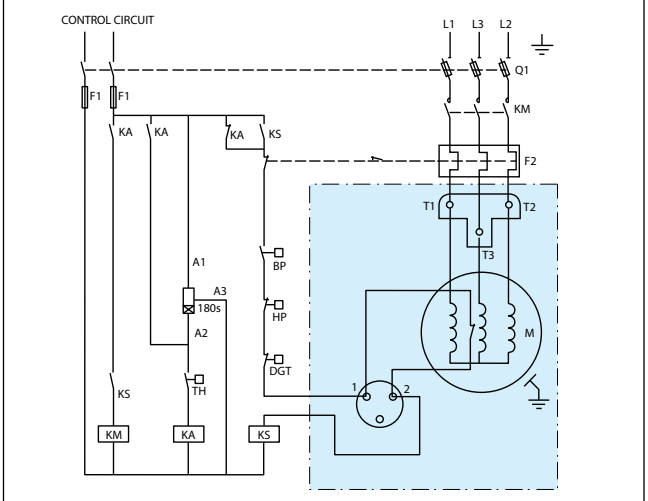
Wiring diagram without pump-down cycle

Suggested wiring diagrams

Compressor models SM / SZ 115 – 125 – 160 – 175 – 185

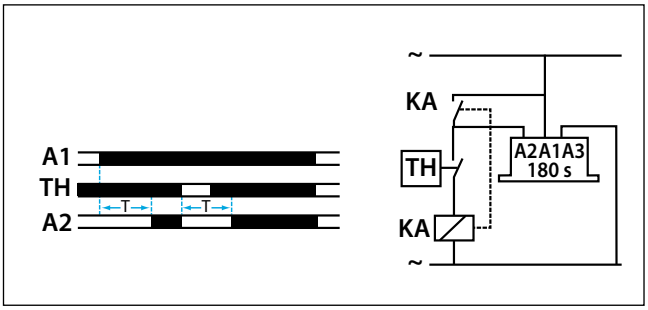


Wiring diagram with pump-down cycle



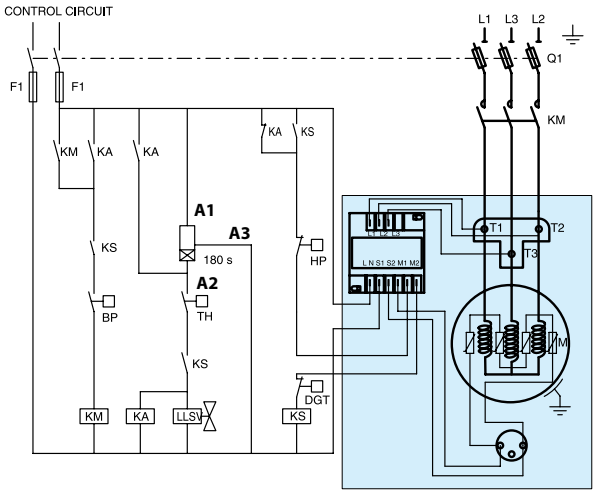
Wiring diagram without pump-down cycle

Short cycle timer function

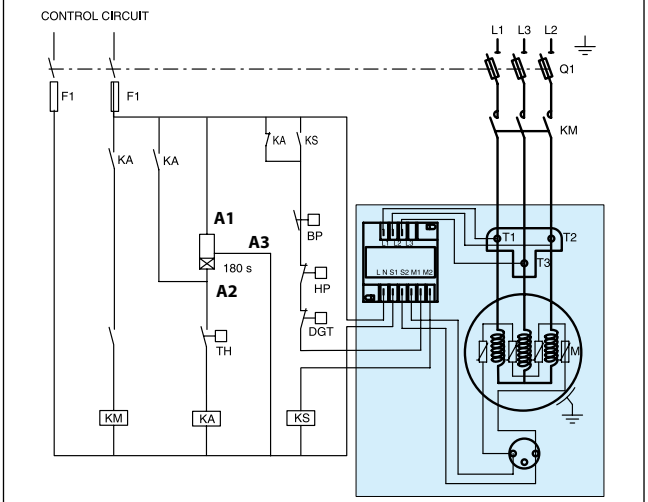


Suggested wiring diagrams

Compressor models SY / SZ 240 - 300 - 380



Wiring diagram with pump-down cycle



Wiring diagram without pump-down cycle

Legends

Control device	*TH*
Optional short cycle timer (3 min)	*180 s*
Control relay	*KA*
Liquid line solenoid valve	*LLSV*
Compressor contactor	*KM*
Safety lock out relay	*KS*
Pump-down control & L.P. switch	*BP*
H.P. safety switch	*HP*
Fused disconnect	*Q1*
Fuses	*F1*
External overload protection	*F2*
Compressor motor	*M*
Motor safety thermostat	*thM*
Discharge gas thermostat	*DGT*
Motor protection module	*MPM*
Thermistor chain	*S*

Danfoss MCI soft-start controller

For Performer® scroll compressors with motor code 4 (400V / 3 / 50Hz or 460V / 3 / 60Hz) the inrush current can be reduced by use of a Danfoss digitally-controlled MCI compressor soft starter. MCI soft starters are designed to reduce the starting and stopping current of 3-phase AC motors; MCI soft starters can reduce 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 and initial torque, are preset at the factory 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 115 -125	MCI 25C	MCI 25C*
SM / SZ 120		
SM / SZ 160 - 161 - 148		
SM / SZ 175 - 185		
SY / SZ 240 - 300 - 380	MCI 50CM	

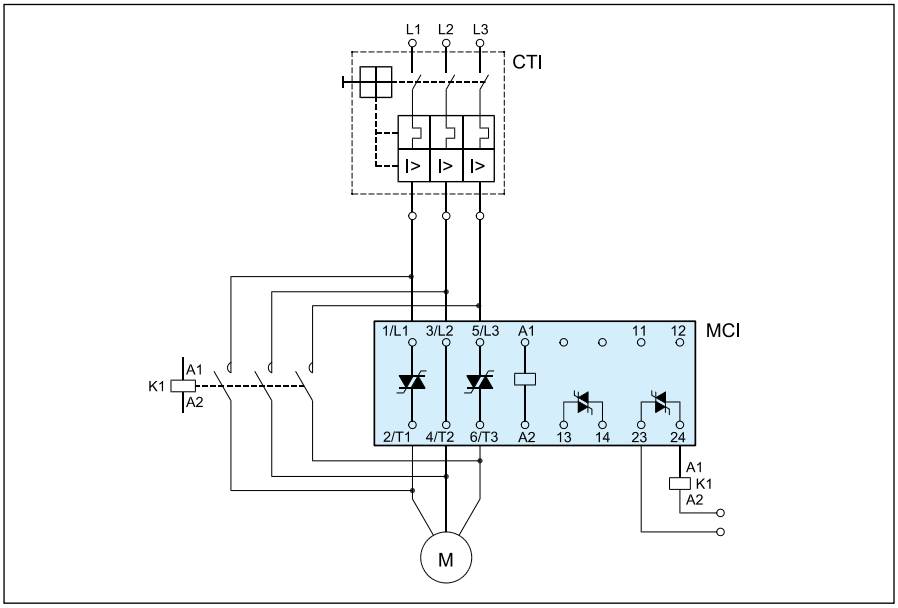
* By-pass contactor (K1) required.
See application example p.16

MCI with bypass contactor

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

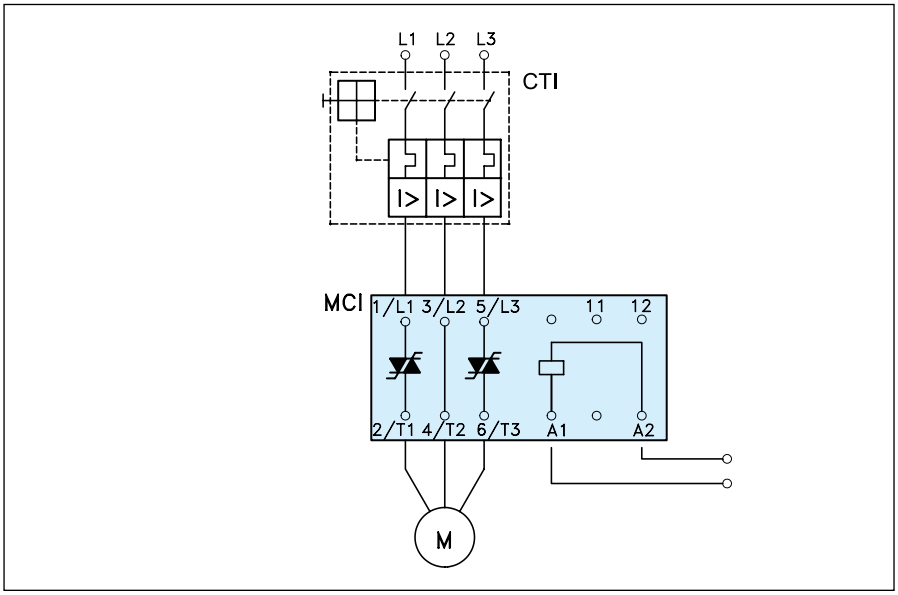
No heat is generated by the MCI. As the contactor always switches in no-load condition it can be selected on the basis of the thermal current (AC-1).

(Contacts 13-14 are not applicable with MCI 25C)



Input controlled soft start

When 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.



Refrigerant charge limit and compressor protection

Performer® scroll compressors incorporate internal safety devices such as motor temperature protection, reverse rotation protection, and a discharge gas check valve. Additional safety devices or system components, however, may be required to ensure adequate protection of the compressor. Depending on the system configuration and application, one or several of the following methods should be considered.

Crankcase heater

When the compressor is idle, the oil temperature in the sump must be at least 18°F above the saturation temperature of the refrigerant on the low pressure side. This ensures that liquid refrigerant does not accumulate in the sump. A crankcase heater is only effective if capable of sustaining a temperature difference of 18°F or more. Tests must be conducted to ensure that the appropriate oil temperature is maintained under all ambient conditions (temperature and wind).
Below 23°F ambient temperature with wind speed above 11 mph, however, we recommend thermal insulation of crankcase heaters in order to limit the energy losses to the surrounding air. Since the total system charge may be undefined, a crankcase 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.
Notes: Belt-type crankcase heater accessories are available from Danfoss (see page 34). The heater must be energized for a minimum of 12 hours before initial start-up (with compressor service valves open), 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).

Liquid line solenoid valve (LLSV)

An LLSV may be used to isolate the liquid charge on the condenser side, thereby preventing 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 is one of the most effective ways to protect against the off-cycle migration of liquid refrigerant. Once the low pressure cut off is activated, a solenoid valve closes on the condenser outlet. The compressor then pumps the majority of the system charge into the condenser, and the system stops on the low pressure switch. This reduces the amount of charge on the low side and prevents off-cycle migration. Recommended settings for the low pressure switch can be found in the table on p. 22. For suggested wiring diagrams, please see p. 14-15.

Suction accumulator

A suction accumulator offers protection against refrigerant floodback at start-up, during operation, or after heat pump defrosting. Sustained and repeated liquid slugging and floodback can seriously impair the oil's ability to lubricate. The suction line accumulator also protects against off-cycle migration by providing additional internal free volume on the low side of the system. The accumulator should be sized for not less than 50% of the total system charge. Tests must be conducted to determine the actual refrigerant-holding capacity needed for the application.

SYSTEM DESIGN RECOMMENDATIONS

Liquid receiver

A liquid receiver is strongly recommended on split systems and remote condenser systems with a total refrigerant charge in excess of the recommended maximum for the compressor. Because of their long refrigerant lines, such systems have a relatively high system charge that is hard to define with accuracy. Also, these systems quite often tend to be overcharged in the field. By installing a liquid receiver, a pump-down cycle can be introduced in order to safely store the refrigerant charge during off-cycles, greatly reducing the chance of refrigerant migration back to the compressor.
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.

Protection against flooded starts and liquid floodback

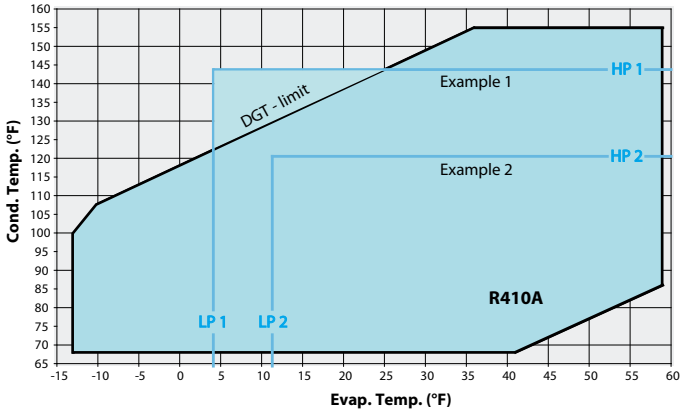
A flooded start occurs when there is a large quantity of liquid refrigerant in the compressor. Liquid finds its way into a compressor by means of off-cycle migration. Liquid floodback occurs when liquid refrigerant returns to a compressor while it is running. Excessive liquid refrigerant in the compressor will cause oil dilution, washout of oil from the bearings, or loss of oil from the sump. The crankcase heater will not be effective if the system design allows for uncontrolled floodback to the compressor during running or starting.
Performer® scroll compressors can tolerate occasional flooded starts as long as the system charge does not exceed that given in the table in the following section. Performer® scrolls can also handle intermittent floodback, but system design must be such that repeated and excessive floodback is not possible.
Off-cycle refrigerant migration occurs when the compressor is located at the coldest part of the installation, when the system uses a bleed-type expansion device, or if liquid can migrate from the evaporator into the compressor sump by gravity. If the system charge exceeds the limit shown in the table, a crankcase heater must be used.
During operation, liquid floodback may be detected by measuring either the oil sump temperature, which should be at least 18°F above the saturated suction temperature, or the discharge gas temperature, which should be at least 54°F above the saturated discharge temperature.
If at any time during operation the oil sump temperature drops below 18°F above the saturated suction temperature, or if discharge gas temperature falls below 54°F above the saturated discharge temperature, the lubricant will become excessively diluted and tests will have to be performed in order to select an appropriate method for compressor protection. Repetitive liquid floodback testing must be carried out under TXV threshold operating conditions: high pressure ratio and minimum load, with the measurement of both suction superheat and discharge gas temperature.

Discharge gas temperature protection (DGT)

DGT protection is required if the high and low pressure switch settings do not protect the compressor against operating beyond its specific application envelope. Please refer to the examples on page 18, which show (1) where DGT protection is required (example 1) and (2) where it is not (example 2).
Every heat pump must have a discharge temperature protection device. In reversible air-to-air and air-to-water heat pumps the discharge temperature must be monitored during development tests by the equipment manufacturer.

⚠ The DGT should be set to open at a discharge gas temperature of 275°F

Notes: The compressor must not be allowed to cycle on the discharge gas thermostat. Continuous operation beyond the compressor's operating range will cause serious damage to the compressor!
A DGT accessory is available from Danfoss: refer to page 35.



Example 1 (R-22, SH = 20°F)
LP switch setting:
LP1 = 26 psig (1°F)
HP switch setting:
HP1 = 363 psig (144°F)
Risk of operation beyond the application envelope.
DGT protection required.

Example 2 (R-22, SH = 20°F)
LP switch setting:
LP2 = 42 psig (19°F)
HP switch setting:
HP2 = 305 psig (131°F)
No risk of operation beyond the application envelope.
No DGT protection required.

Refrigerant charge limits and compressor protection

The refrigerant charge limits given in the table below will help to evaluate the need for compressor protection **Note:** for reversible heat pump systems and other specific applications, please refer to section "Specific Application Recommendations".

Compressor models	S 0 84 - 090 - 100	S 110 - 120	S 115 - 125	S 148 - 160 - 161	S 175 - 185	S 240	S 300 - 380
Refrigerant charge limit (lb)	18.8	22.0	24.0	27.5	29.8	35.0	44.0

	BELOW charge limit	ABOVE charge limit
Cooling only systems, Packaged units	✓ No test or additional safeties required	REQ Refrigerant migration & floodback test REQ Crankcase 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 Crankcase heater REC Liquid receiver
Reversible heat pump system	REQ Specific tests for repetitive floodback REQ Crankcase heater REQ Discharge gas thermostat	

REC Recommended REQ Required
✓ No test or additional safeties required

The above chart represents basic guidelines for reliable compressor operations and safety. Please contact Danfoss technical support for any deviations from these guidelines.

Motor protection

Internal motor protection

Compressor models SM / SZ 084 - 090 - 100 - 110 - 120 - 148 - 161 have internal motor protection to protect 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 the data sheets. The protector is located in the star point of the motor and, if activated will cut out all three phases. It resets automatically. While not compulsory, additional external overload protection is advisable for either alarm or manual reset.

Compressor models SM / SZ 115 - 125 - 160 - 175 - 185 have a bimetallic single-pole, single-throw thermostat located in the motor windings. This thermostat will open In the event of motor overheating caused by low refrigerant flow or by incorrect motor rotation. Because the thermostat is an automatic reset device, it must be wired in a lockout safety circuit with a manual reset to restart the unit. For overcurrent and phase loss protection, an external overload protector must be used for the SM / SZ 115, 125, 160, 175 and 185 models. The table below shows the protection method for the various compressor models.

Compressor models SY / SZ 240 - 300 - 380 are delivered with a factory-installed motor protection module in the terminal box. This device provides efficient, reliable protection against overheating, overloading, and phase loss or reversal. Connected to the module are 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 constantly measured by the (PTC) thermistor loop connected on S1-S2 (refer to the electronic protection module wiring on page 13).
If any thermistor exceeds its response temperature, its resistance increases above the trip level (4,500 Ω) and the output relay opens the contacts M1-M2. After cooling below the response temperature (resistance < 2,750 Ω), a 5 minute time delay is activated. After this delay, the relay closes the contacts M1-M2. The time delay may be cancelled by interrupting main power (L-N disconnect) for approx. 5 seconds. The monitoring fuction, however, is inactive for 20 seconds after shutdown.

Compressor model	Overheating protection	Overcurrent protection	Locked rotor protection	Single-phasing protection
SM / SZ 084 - 090 - 100 - 110 - 120 - 148 - 161	Internal	Internal	Internal	Internal
SM / SZ 115 - 125 - 160 - 175 - 185	Internal	Compulsory external overload protector		
SY / SZ 240 - 300 - 380	Internal	Internal	Internal	Internal

External motor protection

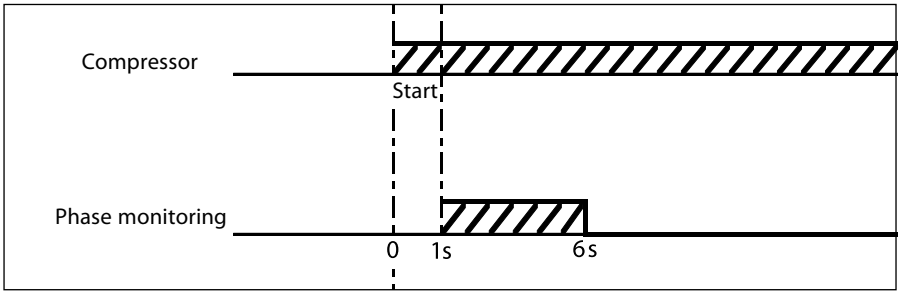
All safety devices must comply with the local safety requirements. The external overload protector can be either a thermal overload relay or a circuit breaker. A thermal overload relay should be set to trip at not more than 140% of the compressor's rated load current. A circuit breaker, on the other 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 operation in the application; it can be found either in the corresponding data sheets or in the of Danfoss RS+3™ Compressor and Condensing Unit Selection Software, available from the Danfoss web site. The tripping current must never exceed the MMT (Maximum Must-Trip)

current value found in the data sheets; the MMT value appears as "A.Max" on the compressor nameplate.
Further requirements for the external overload protector are:

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

Phase sequence and reverse rotation protection

Use a phase meter to establish the phase orders and connect line phases L1, L2, and L3 to terminals T1, T2, and T3, respectively. The compressor will only operate properly in a single direction, and the motor is wound so that if the connections are correct, the rotation will also be correct.
Compressor models SM / SZ 084 to 185 incorporate an internal reverse vent valve which will react in the presence of reverse rotation and allows refrigerant to circulate through a by-pass from suction to 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 its internal motor protection.
Compressor models SY / SZ 240 to 380 are delivered with an electronic module which provides protection against phase reversal and phase loss at start-up. Use the recommended wiring diagrams from page 15. 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). Should one of these parameters be incorrect, the relay would lock out (contact M1-M2 open). The lockout may be cancelled by resetting the power mains (disconnect L-N) for approximately 5 sec.



Phase sequence module logic

Cycle rate limit

The system must be designed in a way that guarantees a minimum compressor run time of 2 minutes, so as to provide for sufficient motor cooling after start-up and proper oil return. 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 present); exceeding these limits reduces the service life of the compressor. If necessary, place an anti-short-cycle timer in the control circuit, connected as shown in the wiring diagram (p. 14-15). A three-minute (180-sec) setting is recommended.

SYSTEM DESIGN RECOMMENDATIONS

Voltage imbalance

Operating voltage limits are shown in the table on page 12. The voltage applied to the motor terminals must lie within these table limits during both start-up and normal operations. The maximum allowable voltage imbalance is 2%. Voltage imbalance causes high amperage on one or more phases, which in turn leads to overheating and possible motor damage. Voltage imbalance is given by the formula:

$$\text{\% voltage imbalance} = \frac{|V_{avg} - V_{1-2}| + |V_{avg} - V_{1-3}| + |V_{avg} - V_{2-3}|}{2 \times V_{avg}} \times 100$$

V_{avg} = Mean voltage of phases 1, 2, 3.
V_{1-2} = Voltage between phases 1 & 2.
V_{1-3} = Voltage between phases 1 & 3.
V_{2-3} = Voltage between phases 2 & 3.

High and low pressure protection

High pressure

A high pressure (HP) safety switch is required to shut down the compressor if discharge pressure exceeds the values shown in the table below. The high pressure switch can be set to lower values depending on the application and ambient conditions. To prevent cycling around the high pressure limit, the HP switch must be placed in a lockout circuit or it must require manual reset. If a discharge valve is used, the HP switch must be connected to the service valve gauge port, which must not be isolated.
NOTE: Because the power consumption of scroll compressors is almost directly proportional to discharge pressure, the high pressure control can be used to indirectly limit the maximum current draw. A high pressure control used in this manner, however, can never replace an external overload protector.

Low pressure

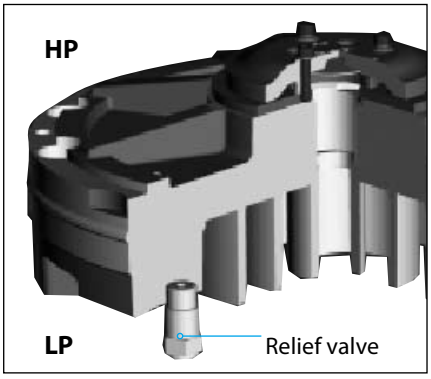
A low pressure (LP) safety switch must always be used. Deep vacuum operation of a scroll compressor can cause internal electrical arcing and scroll instability. Performer® scroll compressors exhibit high volumetric efficiency and may draw very deep vacuum levels, which could induce such a problem. The 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 be either 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:

		R-22	R-407C	R-134a	R404A/R507A
Working pressure range high side	psig	158 - 402	152 - 422	97 - 293	184 - 464
Working pressure range low side	psig	20 - 100	16 - 93	9 - 7	29 - 106
Maximum high pressure safety switch setting	psig	406	428	297	471
Minimum low pressure safety switch setting *	psig	7	7	7	7
Minimum low pressure pump-down switch setting **	psig	19	14	7	26

*LP safety switch shall never be bypassed.
**Recommended pump-down switch settings: 22 psi (R-22, R-407C, R404A) or 14.5 psi (R-134a) below nominal evaporating pressure.

Internal pressure relief valve

The SY/SZ240 to SY/SZ380 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 550 psi.
This safety feature prevents the compressor from developing dangerously high pressures should the high pressure cutout fail to shut down the compressor for any reason.



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 also to prevent oil and refrigerant migration back to the compressor during off-cycles.
If the evaporator is situated above the compressor, as is often the case in split or remote condenser systems, a pump-down cycle is strongly recommended. Without a pump-down cycle, 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 is situated below the compressor, the suction riser must be trapped so as to prevent liquid refrigerant from collecting at the thermal expansion valve bulb location (see fig. 1).

When the condenser is above 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 (see fig. 2).
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. The tubing mount is necessary to avoid excess vibration, which can in time 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, generating an unacceptable noise level. (For more information on noise and vibration, see the section on: "Sound and vibration management" p.27).

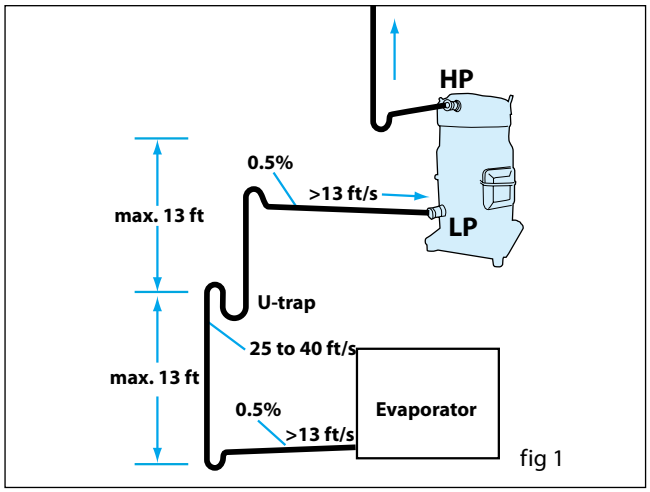


fig 1

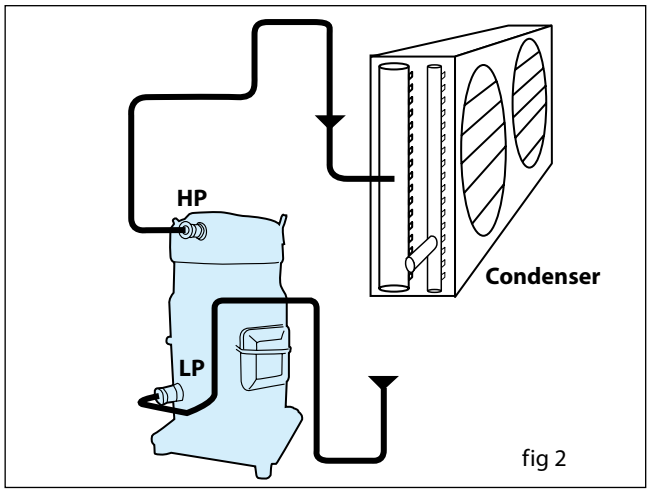


fig 2

Low ambient compressor operations

Low ambient operations and minimum pressure differential

The Performer® scroll compressor requires a minimum pressure differential of 43 to 58 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.

Low ambient start-up

Under low ambient temperature conditions (< 32°F), start-up pressure in the condenser and receiver (if present) may be so low that there is not sufficient pressure differential across the expansion device to properly feed the evaporator. A deep vacuum may result, which can lead to compressor failure due to internal arcing and instability of 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 on page 22 in order to prevent vacuum operation.
Low pressure differentials can also cause the expansion device "hunting," which can cause surging in the evaporator with liquid spillover into the compressor. This effect is most pronounced during low load conditions that frequently occur during low ambient temperature conditions.

Head pressure control under low ambient conditions

Several possible solutions are available to prevent the compressor from developing vacuum at start-up under low ambient conditions. For air-cooled units, cycling the fans with a head pressure controller will ensure that the fans remain off until condensing pressure reaches a satisfactory level. For water-cooled units, the same can be performed using a water regulator valve operated by condensing pressure, thereby ensuring that the water valve does not open until condensing pressure reaches a satisfactory level.

Note**:** 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 liquid receiver with condenser and receiver pressure regulators would be possible.
For further information, please contact Danfoss Technical Support.

Crankcase heaters

Crankcase heaters are strongly recommended on all systems where the compressor is exposed to cold ambient temperatures, especially in split and remote condenser installations. The crankcase heater will minimize refrigerant migration caused by the large temperature gradient between the compressor and the remainder of the system.

SPECIFIC APPLICATION RECOMMENDATIONS

Low load operations

It is recommended that the unit be tested and monitored at minimum load and if possible during low ambient conditions as well. During low load conditions, implement the following to ensure proper system operating characteristics.

• The superheat setting on the expansion valve must be set to ensure proper superheat operation during low load periods. A minimum of 9°F stable superheat is required. In addition, the refrigerant charge should be sufficient to ensure proper sub-cooling in the condenser to avoid the risk of flashing in the liquid line ahead of the expansion device. The expansion device should be sized to ensure proper control of 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 frequent cycling of compressors. This can lead to liquid refrigerant entering the compressor if the expansion valve does not provide stable refrigerant superheat control under varying loads.

• Condenser fans cycling should ensure that minimum pressure differential is maintained between the suction and discharge pressures. Variable-speed fans can also be used to control the amount of heat removed from the condenser.

• Compressors should be run for a minimum period to ensure proper oil return and also to allow sufficient time to cool the motor under conditions of lowest refrigerant mass flow.

Brazed plate heat exchangers

Brazed plate heat exchange needs very little internal volume to satisfy 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 a 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 the condenser is a brazed plate heat exchanger, a sufficient free volume is required for the accumulation of discharge gas in order to avoid excess pressure buildup. At least 3 ft of discharge line is necessary to generate the free volume. To help reduce the gas volume even further immediately after start-up, the supply of cooling water to the heat exchanger may be opened before the compressor starts up. This will remove superheat, and the incoming discharge gas will condense more quickly.

Reversible heat pump systems

Anytime during change over from cooling to heating, or during defrost or during low load short cycling, there is a possibility of liquid refrigerant floodback. Reversible cycle applications therefore require specific precautions for ensuring long compressor life and satisfactory operating characteristics. Regardless of the system refrigerant charge, specific tests for repetitive floodback are required in order to determine 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 for common applications. Each application design , though, should be thoroughly tested to ensure acceptable operating characteristics.

Crankcase heaters

Most reversible cycle units are located outdoors and operate during conditions of low ambient temperature. In these applications, crankcase heaters are mandatory because of the high probability of liquid migrating back to the compressor sump during off-cycles.

Discharge temperature thermostat

Heat pumps frequently use high condensing temperatures in order to achieve sufficient temperature rise in heated medium. They also often require low evaporator pressures in order to obtain sufficient temperature differentials between the evaporator and the outside ambient temperature. These can result in high discharge temperature and so 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 discharge temperatures that are too high can result in mechanical compressor damage as well as thermal degradation of the lubricating oil and lack of sufficient lubrication.
The discharge gas thermostat should be set to shut down the compressor in the event discharge gas temperature rises above 275°F.

Discharge line and reversing valve

The Performer® 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 time. This situation may occur with slow-acting reversing valves in heat pumps. Discharge pressures exceeding the operating envelope may result in nuisance high pressure switch cut-outs and may place excess strain on both bearings and motor.
To prevent such problems, it is important to allow a 3 ft minimum discharge line length between the compressor discharge port and the reversing valve or any other restriction. This gives sufficient free volume for collection of discharge gas and reduction of the pressure peak during the time it takes for the valve to operate. At the same time, it is important to select and size a 4-way reversing valve so as to ensure a quick switch over. This would prevent from building up to a high discharge pressure and the resulting nuisance high pressure cut-outs.
Check with the valve manufacturer for optimal sizing and recommended mounting positions.

Suction line accumulator

The use of a suction line accumulator is strongly recommended in reversible cycle applications due to 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.

Sound generation in a refrigeration / air conditioning system

There are three typical sources of sound and vibration in refrigeration and air conditioning systems that design and service engineers encounter:

Sound radiation:
This generally takes an airborne path.

Mechanical vibrations:
These generally extend along the parts of the unit and the structure where it is mounted.

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

The sections that follow will focus on the causes of sound from these sources and measures to take to prevent it.

Compressor sound radiation

Sound radiates through the air in all directions from the compressor.
The Performer® scroll compressor is designed for quiet operation. Compared to most other compressors, the Performer® generates sound at higher frequency. High frequency sound lacks the penetrating power of lower frequencies and is easier to quiet.
Use of sound insulation materials on the inside surface of unit panels is an effective means of substantially reducing sound transmitted to the outside. Ensure that no components that might transmit sound or vibration come into direct contact with any uninsulated parts on unit walls.
Because of the Performer's unique design, with its motor cooled entirely by suction gas, the compressor can be insulated across its entire operating range. Acoustic hoods are available from Danfoss as accessories. These hoods are easy to install quickly and do not greatly increase the overall size of the compressor. Refer to page 35 for sound attenuation hoods and code numbers.

Mechanical vibrations

Vibration is most effectively controlled by isolation. Performer® scroll compressors are designed to produce minimal vibration during operation. Rubber isolaters on the compressor base plate or on the frame of a manifolded unit are effective in reducing vibration transmitted from the compressor(s) to the unit. Rubber grommets are supplied with all Performer® compressors. Properly mounted, the supplied grommets hold transmitted vibration from the compressor to a strict minimum.

It is also extremely important that the frame supporting the compressor be of sufficient mass and stiffness to help dampen vibration that could be transmitted to the frame. For further information on mounting requirements, please refer to the section on mounting assembly.

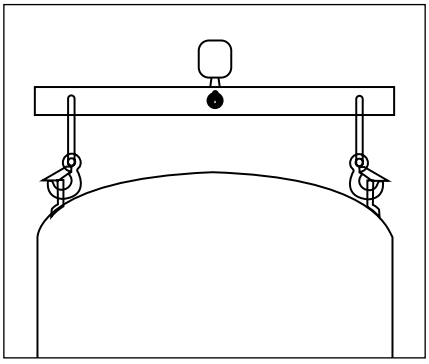
Tubing should be designed for three dimensional flexibility, to reduce transmission of vibration to other structures, and to withstand vibration without damage. For more information on piping design, please see the section entitled "Essential piping design considerations" p. 23.

Gas pulsation

The Performer® scroll compressor have been designed and tested to ensure that gas pulsations are minimized at the most commonly encountered air conditioning pressure ratio. In heat pump applications and other installations where the pressure ratio is beyond the typical range, testing should be conducted under all expected conditions and in all operating configurations to ensure that minimum gas pulsations occur. If the level is unacceptable, install a discharge muffler with appropriate resonant volume and mass. This information can be obtained from the muffler manufacturer.

Compressor handling

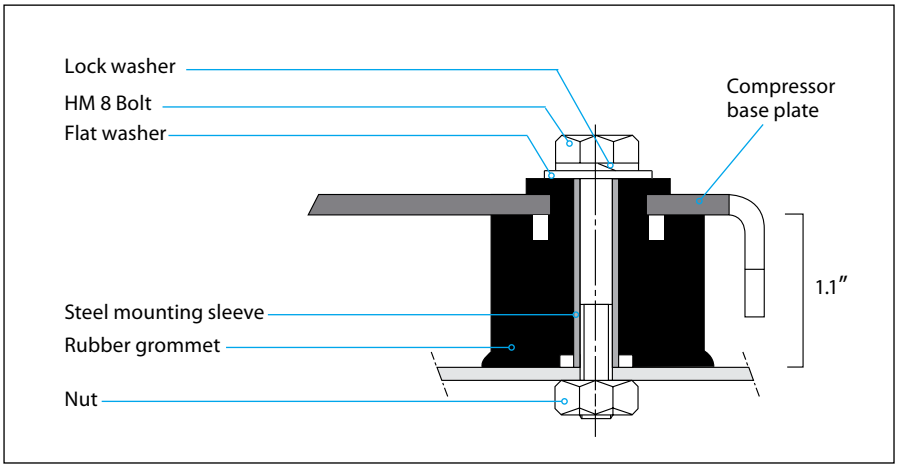
Each Performer® scroll compressor is delivered with two lift rings. Always use these rings when lifting the compressor. A spreader bar rated for the mass of the compressor is highly recommended to ensure better load distribution. Because the compressor's center of gravity is very high, using only one lifting lug will result in an unstable load. The compressor mass is too great for the single lug to handle, and there is a risk that the lug could break off from the compressor resulting in extensive damage and possible personal injury. The use of lifting hooks closed with a clasp and certified to lift the weight of the compressor is also highly recommended (see the adjacent figure).
Always follow the appropriate rules concerning lifting objects of the type and weight of these compressors.
When the compressor is mounted as part of an installation, never use the lift rings on the compressor to lift the entire installation.
Keep the compressor upright during all handling maneuvers.
Never apply force to the terminal box with the intention of moving the compressor, as the force placed upon the terminal box will cause extensive damage to both the box and the motor protection module component inside.



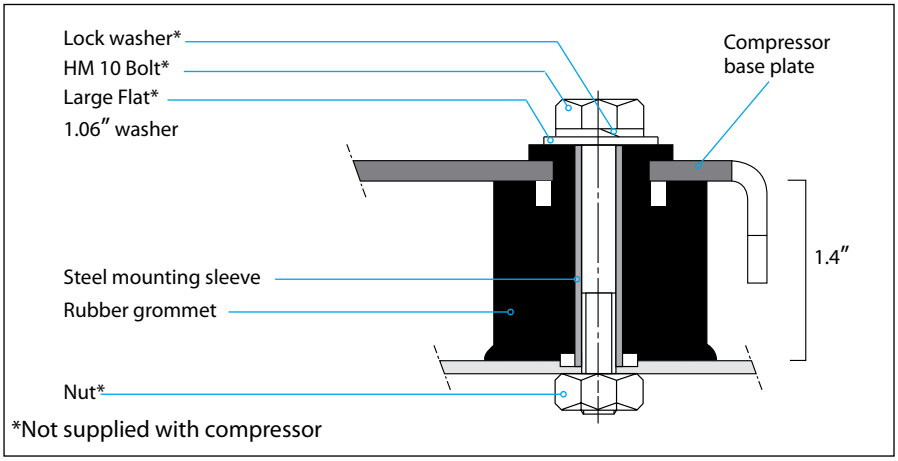
Mounting

All compressors are delivered with four rubber mounting grommets and metal sleeve liners that serve to isolate the compressor from the base frame. To a great extent, these grommets limit transmission of compressor vibration to the unit base frame. The rubber grommets must be compressed until contact between the flat washer and the steel-mounting sleeve is established.
The required bolt size for the SM / SZ 084 to 185 compressors is HM8. This bolt must be tightened to a torque of 15.5 ft lb. Bolts and washers are supplied with the assembly kit.
The required bolt size for the SY / SZ 240 to 380 compressors is HM10. The minimum required flat washer outside diameter is 1.05". Mounting bolts must be tightened to a torque of 30 ft lb. These bolts and washers are not supplied with the compressor.
Note: The large flat washer must be put in place before shipping a unit with the compressor installed.

SM-SZ 084 to 185



SY-SZ 240 to 380



Removing connections shipping plugs

Before suction and discharge plugs are removed, the nitrogen holding charge must be released through the suction Schrader valve to avoid an oil mist blowout. Remove the suction plug first, then the discharge plug. Remove the plugs just before connecting the compressor to the installation in order to avoid moisture 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, will only provide high efficiency, good reliability, and a long operating life if the system contains only the refrigerant and oil for which it was designed. Other substances in the system will not improve performance and in most cases will be very detrimental.
The presence of non-condensables 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 to a bearing assembly. The use of highly hygroscopic polyolester oil in R-407C compressors requires that the oil be exposed to the atmosphere as little as possible.

System contamination is one of main factors affecting equipment reliability and compressor life. It is important therefore to consider system cleanliness when assembling a refrigeration system.
During the manufacturing process, system 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

Tubing

Only use clean and dehydratated refrigeration grade copper tubing. Tube cutting must be done so as not to deform the tubing roundness. Ensure that no foreign debris remains in the tubing. Only refrigeration grade fittings should be used and these must be selected and sized to minimize pressure drop in the completed assembly. Follow the brazing instructions in the following pages.
Never drill holes into the pipe-work after installation.

Filter driers

For new installations with SY / SZ compressors with polyolester oil, Danfoss recommends using Danfoss DML 100% molecular sieve solid core filter driers. Molecular sieve filter driers with loose beads must be avoided. For servicing existing installations where acid formation is present, Danfoss DCL solid core filter driers containing activated alumina are recommended. For new installations using SM compressors with mineral oil the Danfoss DCL drier is recommended.
The drier is should be oversized rather than undersized. When selecting a drier, always take into account its water content capacity, the system refrigeration capacity, and the system refrigerant charge.

Brazing and soldering

Copper to copper brazing

When brazing copper-to-copper connections, the use of a copper/ phosphorus brazing alloy containing 5% or more silver, with a melting temperature below 1500°F is recommended. No flux is required during brazing.

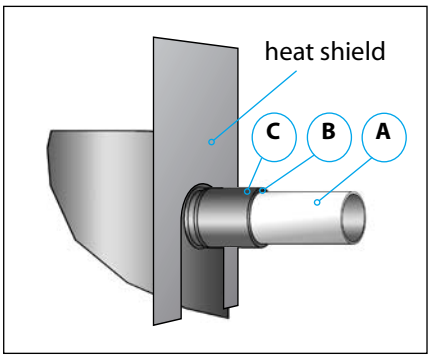
Brazing dissimilar metals

When brazing 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 fittings, do not overheat the compressor shell. Overheating can severely damage internal components. Using a heat shield, a heat-absorbing compound (or both) is recommended. Due to the relatively large tubing and fitting diameters used for larger scrolls, a double tipped acetylene torch is recommended for S240-300-380 brazing operation.
For compressors with rotolock connections, 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 painted surfaces of the compressor 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 oxidation and flammable conditions. The compressor should not be exposed to open air for extended periods.

- Use of a double-tipped torch is recommended.
- Apply heat evenly to area A until brazing temperature is reached. Move the torch to area B and apply heat evenly until brazing temperature has been reached there as well, and then begin adding the brazing material. Move the torch evenly around the joint, 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.
• Use a wire brush or wet cloth to remove all remaining flux once the joint has been soldered. Flux left behind will cause corrosion.
⚠ **Ensure that no flux enters the tubing or compressor. Flux is acidic and can cause substantial damage to the internal parts of the system and compressor.**

⚠ **The polyolester oil used in SY / SZ compressors is very hygroscopic and will rapidly absorb moisture from the air. The compressor must not therefore be left open to the atmosphere for a long period of time. The compressor fitting plugs must only 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 appropriate materials for brazing or soldering, please contact the material manufacturer or distributor. For specific applications not covered herein, please contact Danfoss for information.

System pressure test

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

Maximum compressor test pressure (low side)	SM/SZ 084 - 185 360 psig	SZ/SY240 - 380 290 psig
Maximum compressor test pressure (high side)	460 psig	
Maximum pressure difference between high and low side of the compressor:	350 psig	

Pressurize the system on the HP side first then the LP side to prevent scroll rotation.

Leak detection

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

Pressurize the system on HP side first then LP side.

Compressor model	Leak detection with refrigerant	Leak detection with a mass spectrometer
SM-SY compressors	Nitrogen & R-22	Nitrogen & Helium
SZ compressors	Nitrogen & R-134a or R-407C	Nitrogen & Helium

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

Vacuum pump-down and moisture removal

Moisture and air impede proper compressor and system functioning, reducing service life by increasing condensing pressure and presenting risk of acid formation.
High condensing pressure brings abnormally high discharge temperatures that degrade the oil's lubricating properties. Acid formation can lead to copper plating. These undesirable phenomena may cause both mechanical and electrical compressor failures. The typical method for avoiding such problems is pump-down with a vacuum pump, to a minimum vacuum of 500 microns (0.67 mbar). Please refer to Bulletin "Vaccum pump down and dehydration procedure".

Refrigerant charging

Initial charging must be done in the liquid phase as far away from the compressor as possible, with the compressor stopped and service valves closed. The best location for charging is on the liquid line between condenser outlet filter drier.
Charge as close as possible to the nominal system charge before starting the compressor. Add charge in liquid phase as needed during commissioning, slowly throttling liquid in on the low pressure side as far away as possible from the compressor suction connection. The refrigerant charge quantity must be suitable for both summer and winter operations.

Commissioning

The system must be monitored after initial start-up for a minimum of 60 minutes to ensure proper operating characteristics such as:
- Proper metering device operation and desired superheat readings,
- Suction and discharge pressure 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 and run time duration,
- Current draw of individual compressors within acceptable values (RLA ratings),
- No abnormal vibrations or noise.

Oil level checking and top-up

When the compressor running conditions are stabilized, the oil level must be visible in the sight glass.
The presence of foam in the sight glass undicates a large concentration of refrigerant in the oil, presence of liquid returning to the compressor, or both.
The oil level can also be checked a few minutes after the compressor stops, the level must be between 1/4 and 3/4 of sight glass.

Oil level check

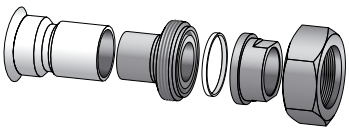
⚠ **When compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil**.

Oil top-up

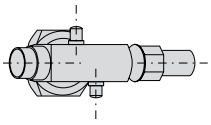
Always use the original oil specified by Danfoss as shown on page 33. Use oil from new cans only.
Top-up the oil while the compressor is running. Use the schrader connector and a suitable pump or any other accessible connector on the compressor suction line. See Bulletin "Lubricants, filling in instructions for Danfoss Commercial Compressors".
⚠ **Please note that SZ and SY use different viscosity POE oil, Danfoss 160SZ and 320SZ respectively.**

ACCESSORIES

Connectors and valves

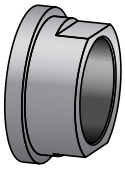


Solder sleeve adaptator set



Rotolock valve set

Model	Standard ODF		Solder sleeve adaptator set (to convert brazed to rotolock)			Rotolock valve set		
			Kit code no.	Solder sleeve ODF	Rotolock diameter	Code no.	Type	Valve ODF
SM/SZ084 - 090 - 100	Suction	1"1/8	7765005	1"1/8	1"3/4	7703009	V02	1"1/8
	Discharge	3/4"		3"4	1"1/4		V04	3"/4
SM/SZ110-115-120-125-148-161	Suction	1"3/8	7765006	1"1/8	1"3/4	7703009	V02	1"1/8
	Discharge	7/8"		3/4"	1"1/4		V04	3/4"
SM/SZ160-175-185-SY/SZ 240-300	Suction	1"5/8	7765028	1"5/8	2"1/4	7703010	V08	1"3/8
	Discharge	1"1/8		1"1/8	1"3/4		V07	7/8"
SY/SZ 380	Suction	2"1/8	solder sleeve adaptator not available			rotolock valve set not available		
	Discharge	1"3/8						



For other solder sleeves and rotolock valves, see our spare parts catalogue.

Lubricants

SM / SY / SZ compressors use different oil types as indicated below.
Always use the original oil specified by Danfoss as shown below. Use oil from new cans only.

For initial compressor oil charge refer to page 6-7. Please refer to "Lubricant, filling in instructions for Danfoss Commercial Compressors" for detailed oil specifications and top-up method.

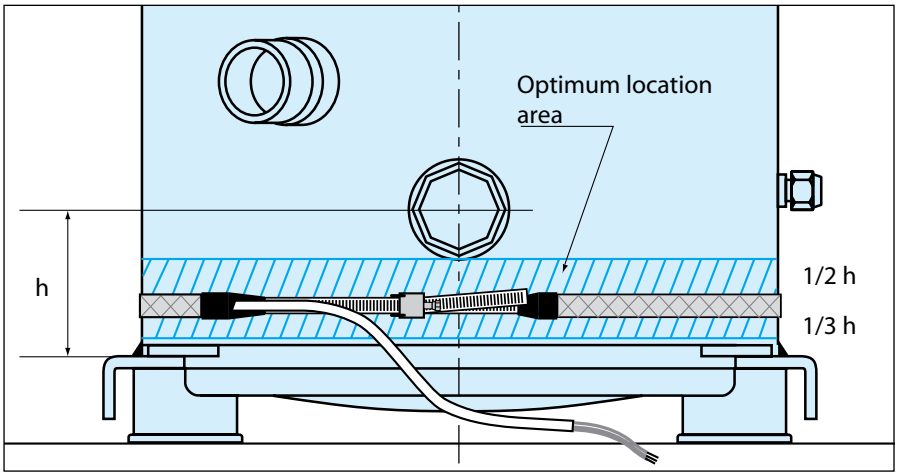
Compressor model	Oil type	Oil name	Code no.*
SM compressors	Mineral	160P	5402007
SZ compressors	P.O.E.	160 SZ	7754207
SY compressors	P.O.E.	320 SZ	-

* 1 gallon can

ACCESSORIES

Crankcase heaters

Accessory belt-type crankcase heaters are designed to protect the compressor against off-cycle refrigerant migration.

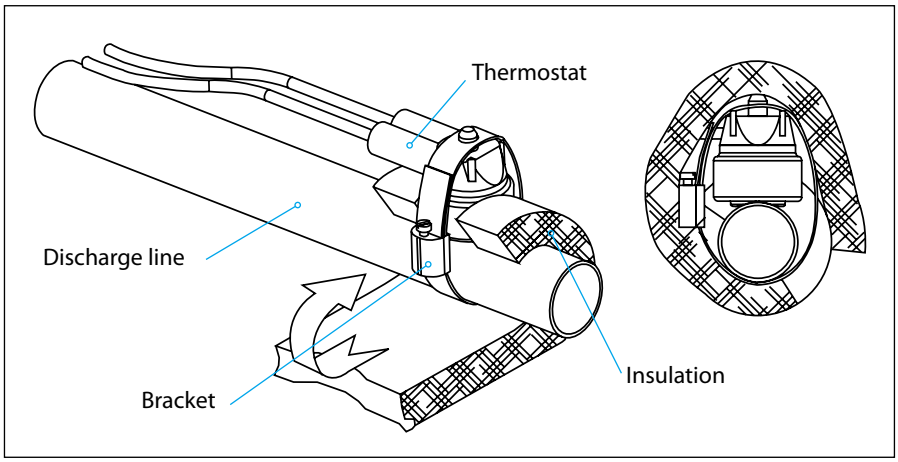


Code no.	Description	Application	Pack size
7773109	Belt type crankcase heater, 65 W, 110 V, CE mark, UL	SM/SZ084-161	6
7973001	Belt type crankcase heater, 65 W, 110 V, CE mark, UL	SM/SZ084-161	50
7773107	Belt type crankcase heater, 65 W, 230 V, CE mark, UL	SM/SZ084-161	6
7973002	Belt type crankcase heater, 65 W, 230 V, CE mark, UL	SM/SZ084-161	50
7773117	Belt type crankcase heater, 65 W, 400 V, CE mark, UL	SM/SZ084-161	6
7773010	Belt type crankcase heater, 50 W, 110 V, UL	SM/SZ084-161	6
7773003	Belt type crankcase heater, 50 W, 240 V, UL	SM/SZ084-161	6
7773009	Belt type crankcase heater, 50 W, 400 V, UL	SM/SZ084-161	6
7773006	Belt type crankcase heater, 50 W, 460 V, UL	SM/SZ084-161	6
7773119	Belt type crankcase heater, 75 W, 575 V, UL	SM/SZ084-161	6
7773110	Belt type crankcase heater, 75 W, 110 V, CE mark, UL	SM/SZ175-185	6
7773108	Belt type crankcase heater, 75 W, 230 V, CE mark, UL	SM/SZ175-185	6
7973005	Belt type crankcase heater, 75 W, 230 V, CE mark, UL	SM/SZ175-185	50
7773118	Belt type crankcase heater, 75 W, 400 V, CE mark, UL	SM/SZ175-185	6
7773012	Belt type crankcase heater, 100 W, 110 V, UL	SM/SZ175-185	6
7773007	Belt type crankcase heater, 100 W, 240 V, UL	SM/SZ175-185	6
7773011	Belt type crankcase heater, 75 W, 400 V, UL	SM/SZ175-185	6
7773015	Belt type crankcase heater, 75 W, 480 V, UL	SM/SZ175-185	6
7773120	Belt type crankcase heater, 75 W, 575 V, UL	SM/SZ175-185	6
7773121	Belt type crankcase heater, 130 W, 110 V, CE mark, UL	SY/SZ240-300-380	4
7773122	Belt type crankcase heater, 130 W, 230 V, CE mark, UL	SY/SZ240-300-380	4
7973007	Belt type crankcase heater, 130 W, 230 V, CE mark, UL	SY/SZ240-300-380	50
7773123	Belt type crankcase heater, 130 W, 400 V, CE mark, UL	SY/SZ240-300-380	4

Discharge temperature protection

Discharge gas temperature must not exceed 275°F.
The discharge gas thermostat accessory kit includes all components required for installation as shown below. The thermostat must be attached to the discharge line within 6" of the compressor discharge port.

Discharge thermostat kit code number: 7750009.



Compressor acoustic hoods

Acoustic compressor hoods have been developed to meet specific extra-low noise requirements. These hoods incorporate soundproofing materials and offer excellent high and low frequency attenuation.

Compressor model	Attenuation* (at 50Hz) dB(A)	Hood code number
SM / SZ 084 - 090 - 100	7	7755011
SM / SZ 110 - 120	8.5	7755010
SM / SZ 115 - 125	8	7755009
SM / SZ 160	8	7755008
SM / SZ 148 - 161**	8	7755017
SM / SZ 175 - 185	8	7755007
SY / SZ 240 - 300	7	7755016
SY / SZ 380	7	7755022

* Attenuation of compressor sound power level measured in free space
** Not available for code 3 version compressors

ORDERING INFORMATION AND PACKAGING

Ordering information

Performer® scroll compressors may be ordered from Danfoss in either industrial pack or in single packs.

The tables below list the code numbers for industrial packs. For ordering single packs please replace the last digit with an "I".

SM /SY compressors in industrial-pack

R-22

Compressor model	Design	Connections	Motor protection	Code no.			
				3	4	7	9
				200-230/3/60	460/3/60 380-400/3/50	575/3/60 500/3/50	380/3/60
SM084	Single	Brazed	Int	SM084-3VM	SM084-4VM	SM084-7VM	SM084-9VM
SM090	Single	Brazed	Int	SM090-3VM	SM090-4VM	SM090-7VM	SM090-9VM
SM100	Single	Brazed	Int	SM100-3VM	SM100-4VM	SM100-7VM	SM100-9VM
SM110	Single	Brazed	Int	SM110-3VM	SM110-4VM	SM110-7VM	SM110-9VM
SM115	Single	Brazed	T	SM115-3CAM	SM115-4CAM	SM115-7CAM	SM115-9CAM
		Rotolock	T	SM115-3RM	SM115-4RM	SM115-7RM	SM115-9RM
SM120	Single	Brazed	Int	SM120-3VM	SM120-4VM	SM120-7VM	SM120-9VM
SM125	Single	Brazed	T	SM125-3CAM	SM125-4CAM	SM125-7CAM	SM125-9CAM
		Rotolock	T	SM125-3RM	SM125-4RM	SM125-7RM	SM125-9RM
SM148	Single	Brazed	Int	SM148-3VAM	SM148-4VAM	SM148-7VAM	SM148-9VAM
SM160	Single	Brazed	T	SM160-3CBM	SM160-4CBM	SM160-7CAM	SM160-9CBM
		Rotolock	T	SM160-3RAM	SM160-4RAM	SM160-7RAM	SM160-9RAM
SM161	Single	Brazed	Int	SM161-3VAM	SM161-4VAM	SM161-7VAM	SM161-9VAM
SM175	Single	Brazed	T	SM175-3CAM	SM175-4CAM	SM175-7CAM	SM175-9CAM
		Rotolock	T	SM175-3RM	SM175-4RM	SM175-7RM	SM175-9RM
SM185	Single	Brazed	T	SM185-3CAM	SM185-4CAM	SM185-7CAM	SM185-9CAM
		Rotolock	T	SM185-3RM	SM185-4RM	SM185-7RM	SM185-9RM
SY240	Single	Brazed	M24	SY240A3AAM	SY240A4AAM	SY240A7AAM	SY240A9AAM
		Brazed	M230	SY240A3ABM	SY240A4ABM	SY240A7ABM	SY240A9ABM
		Rotolock	M24	SY240A3MAM	SY240A4MAM	SY240A7MAM	SY240A9MAM
		Rotolock	M230	SY240A3MBM	SY240A4MBM	SY240A7MBM	SY240A9MBM
SY300	Single	Brazed	M24	SY300A3AAM	SY300A4AAM	SY300A7AAM	SY300A9AAM
		Brazed	M230	SY300A3ABM	SY300A4ABM	SY300A7ABM	SY300A9ABM
		Rotolock	M24	SY300A3MAM	SY300A4MAM	SY300A7MAM	SY300A9MAM
		Rotolock	M230	SY300A3MBM	SY300A4MBM	SY300A7MBM	SY300A9MBM
SY380	Single	Brazed	M24	-	SY380A4CAM	-	-
		Brazed	M230	-	SY380A4CBM	-	-

Int = Internal motor protection
T = Internal thermostat. Additional external protection required
M24 = Electronic motor protection module located in terminal box 24 V
M230 = Electronic motor protection module located in terminal box 115 / 230 V
SY380: only 50 Hz version available

ORDERING INFORMATION AND PACKAGING

SZ compressors in industrial-pack

R-407C / R-134a

Compressor model	Design	Connections	Motor protection	Code no.			
				3	4	7	9
				200-230/3/60	460/3/60 380-400/3/50	575/3/60 500/3/50	380/3/60
SZ084	Single	Brazed	Int	SZ084-3VM	SZ084-4VM	SZ084-7VM	SZ084-9VM
SZ090	Single	Brazed	Int	SZ090-3VM	SZ090-4VM	SZ090-7VM	SZ090-9VM
SZ100	Single	Brazed	Int	SZ100-3VM	SZ100-4VM	SZ100-7VM	SZ100-9VM
SZ110	Single	Brazed	Int	SZ110-3VM	SZ110-4VM	SZ110-7VM	SZ110-9VM
SZ115	Single	Brazed	T	SZ115-3CAM	SZ115-4CAM	SZ115-7CAM	SZ115-9CAM
		Rotolock	T	SZ115-3RM	SZ115-4RM	SZ115-7RM	SZ115-9RM
SZ120	Single	Brazed	Int	SZ120-3VM	SZ120-4VM	SZ120-7VM	SZ120-9VM
SZ125	Single	Brazed	T	SZ125-3CAM	SZ125-4CAM	SZ125-7CAM	SZ125-9CAM
		Rotolock	T	SZ125-3RM	SZ125-4RM	SZ125-7RM	SZ125-9RM
SZ148	Single	Brazed	Int	SZ148-3VAM	SZ148-4VAM	SZ148-7VAM	SZ148-9VAM
SZ160	Single	Brazed	T	SZ160-3CBM	SZ160-4CBM	SZ160-7CAM	SZ160-9CBM
		Rotolock	T	SZ160-3RAM	SZ160-4RAM	SZ160-7RAM	SZ160-9RAM
SZ161	Single	Brazed	Int	SZ161-3VAM	SZ161-4VAM	SZ161-7VAM	SZ161-9VAM
SZ175	Single	Brazed	T	SZ175-3CAM	SZ175-4CAM	SZ175-7CAM	SZ175-9CAM
		Rotolock	T	SZ175-3RM	SZ175-4RM	SZ175-7RM	SZ175-9RM
SZ185	Single	Brazed	T	SZ185-3CAM	SZ185-4CAM	SZ185-7CAM	SZ185-9CAM
		Rotolock	T	SZ185-3RM	SZ185-4RM	SZ185-7RM	SZ185-9RM
SZ240	Single	Brazed	M24	SZ240A3AAM	SZ240A4AAM	SZ240A7AAM	SZ240A9AAM
		Brazed	M230	SZ240A3ABM	SZ240A4ABM	SZ240A7ABM	SZ240A9ABM
		Rotolock	M24	SZ240A3MAM	SZ240A4MAM	SZ240A7MAM	SZ240A9MAM
		Rotolock	M230	SZ240A3MBM	SZ240A4MBM	SZ240A7MBM	SZ240A9MBM
SZ300	Single	Brazed	M24	SZ300A3AAM	SZ300A4AAM	SZ300A7AAM	SZ300A9AAM
		Brazed	M230	SZ300A3ABM	SZ300A4ABM	SZ300A7ABM	SZ300A9ABM
		Rotolock	M24	SZ300A3MAM	SZ300A4MAM	SZ300A7MAM	SZ300A9MAM
		Rotolock	M230	SZ300A3MBM	SZ300A4MBM	SZ300A7MBM	SZ300A9MBM
SZ 380	single	Brazed	M24	-	SZ380A4CAM	-	-
		Brazed	M230	-	SZ380A4CBM	-	-

Int = Internal motor protection
T = Internal thermostat. Additional external protection required
M24 = Electronic motor protection module located in terminal box 24 V
M230 = Electronic motor protection module located in terminal box 115 / 230 V
SY380: only 50 Hz version available

ORDERING INFORMATION AND PACKAGING

Packaging

Multipack

Single pack

Multipack							Single pack			
Compressor models	Nbr*	Length in.	Width in.	Height in.	Gross weight lb	Static stacking pallets	Length in.	Width in.	Height in.	Gross weight lb.
SM/SZ 084	6	44.9	37.4	29.0	941	3	18.5	14.6	23.5	148
SM/SZ 090	6	44.9	37.4	29.0	968	3	18.5	14.6	23.5	152
SM/SZ 100	6	44.9	37.4	29.0	968	3	18.5	14.6	23.5	152
SM/SZ 110-120	6	44.9	37.4	29.0	1087	3	24.0	24.0	37.0	197
SM/SZ 115-125	6	44.9	37.4	32.0	1140	3	24.0	24.0	37.0	197
SM/SZ 160	6	44.9	37.4	32.0	1338	3	24.0	24.0	37.0	228
SM/SZ 148-161	6	44.9	37.4	32.0	1219	3	24.0	24.0	37.0	211
SM/SZ 175-185	6	48.4	37.4	33.0	1444	2	24.0	24.0	37.0	248
SY/SZ 240	4	44.9	37.4	36.25	1413	2	20.1	18.3	30.7	344
SY/SZ 300	4	44.9	37.4	36.25	1413	2	20.1	18.3	30.7	355
SY/SZ 380	4	44.9	37.4	37.2	1440	2	20.1	18.3	31.7	362

* Nbr = number of compressors per pallet

Industrial pack						
Compressor models	Nbr*	Length in.	Width in.	Height in.	Gross weight lb.	Static stacking pallets
SM/SZ 084	8	44.90	37.4	27.8	1213	3
SM/SZ 090	8	44.90	37.4	27.8	1248	3
SM/SZ 100	8	44.90	37.4	27.8	1248	3
SM/SZ 110-120	8	44.25	38.0	29.0	1467	3
SM/SZ 115-125	6	44.25	38.0	29.0	1114	3
SM/SZ 160	6	44.25	38.0	30.0	1299	3
SM/SZ 148-161	6	44.25	38.0	30.0	1194	3
SM/SZ 175-185	6	44.25	38.0	33.0	1419	2
SY/SZ 240	4	44.90	37.4	35.6	1400	2
SY/SZ 300	4	44.90	37.4	36.0	1400	2
SY/SZ 380	4	44.90	37.4	37.0	1426	2


Industrial pack

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