

*Danfoss*

Selection  
& Application Guidelines

**Performer<sup>®</sup>**  
**scroll compressors**  
**Single 20 to 110 kW**  
**50 - 60 Hz**

R22, R407C, R134a, R404A/R507A



 **Performer**  
SCROLL COMPRESSORS

REFRIGERATION AND  
AIR CONDITIONING

# CONTENTS

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<b>PERFORMER® SCROLL COMPRESSION PRINCIPLE</b> .....	4
<b>COMPRESSOR MODEL DESIGNATION</b> .....	5
Nomenclature .....	5
Connection details .....	5
<b>TECHNICAL SPECIFICATIONS</b> .....	6
50-Hz data .....	6
60-Hz data .....	7
<b>OPERATING ENVELOPES</b> .....	8
Application envelopes at dew temperatures .....	8
Application envelopes at mean temperatures .....	10
<b>PIPING CONNECTIONS</b> .....	11
Suction and discharge connections .....	11
Sight glass .....	11
Schrader .....	11
Oil drain .....	11
<b>ELECTRICAL CONNECTIONS AND WIRING</b> .....	12
Motor voltage .....	12
Electrical connections .....	12
Suggested wiring diagrams logic .....	14
Danfoss MCI soft-start controller .....	15
<b>SYSTEM DESIGN RECOMMENDATIONS</b> .....	17
Refrigerant charge limit and compressor protection .....	17
Crankcase heater .....	17
Liquid line solenoid valve (LLSV) .....	17
Pump-down cycle .....	17
Suction accumulator .....	17
Liquid receiver .....	18
Protection against flooded starts and liquid floodback .....	18
Discharge gas temperature protection (DGT) .....	18
Refrigerant charge limits and compressor protection .....	19
Motor protection .....	20
Internal motor protection .....	20
External motor protection .....	20
Phase sequence and reverse rotation protection .....	21
Cycle rate limit .....	21
Voltage unbalance .....	22
High and low pressure protection .....	22
High pressure .....	22
Low pressure .....	22
Internal pressure relief valve .....	23
Essential piping design considerations .....	23
<b>SPECIFIC APPLICATION RECOMMENDATIONS</b> .....	24
Low ambient compressor operations .....	24
Low ambient operation and minimum pressure differential .....	24
Low ambient start-up .....	24
Head pressure control under low ambient conditions .....	24
Crankcase heaters .....	24

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## CONTENTS

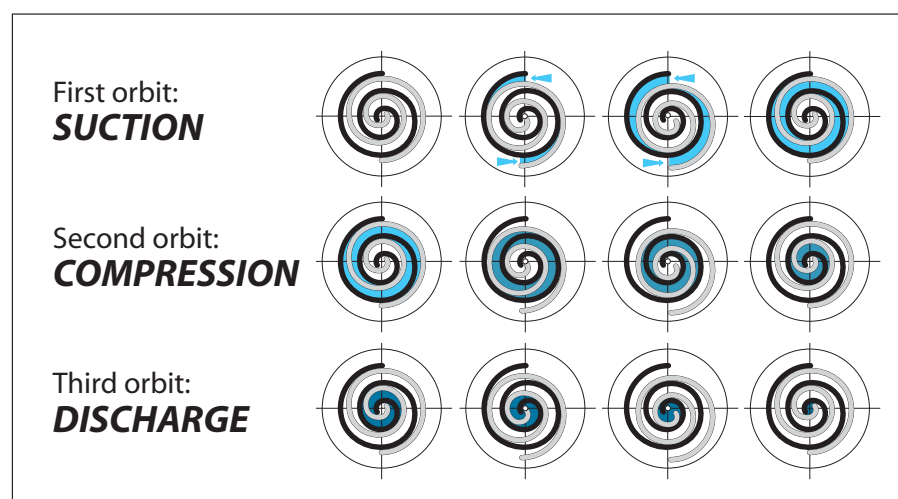
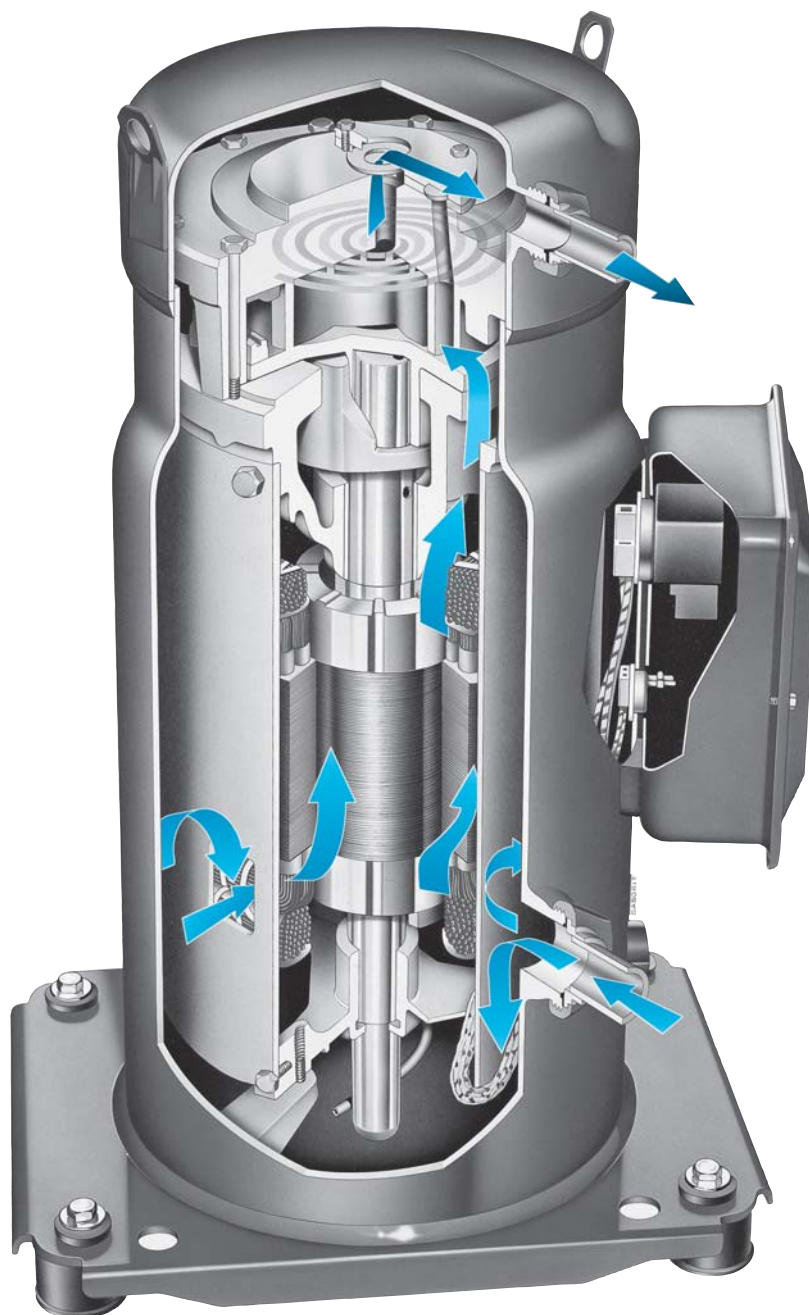
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Low load operations .....	25
Brazed plate heat exchangers .....	25
Reversible heat pump systems .....	25
Crankcase heaters .....	26
Discharge temperature thermostat .....	26
Discharge line & reversing valve .....	26
Suction line accumulator .....	26
<b>SOUND AND VIBRATION MANAGEMENT</b> .....	27
Sound generation in a refrigeration / air conditioning system .....	27
Compressor sound radiation .....	27
Mechanical vibrations .....	27
Gas pulsation .....	27
<b>INSTALLATION</b> .....	28
Compressor handling .....	28
Mounting .....	28
Removing connections shipping plugs .....	29
System cleanliness .....	29
Tubing .....	29
Filters driers .....	30
Brazing and soldering .....	30
Copper to copper connections .....	30
Dissimilar metals connection .....	30
Compressor connection .....	30
System pressure test .....	31
Leak detection .....	31
Vacuum pump-down and moisture removal .....	32
Refrigerant charging .....	32
Commissioning .....	32
Oil level checking and top-up .....	32
Oil level check .....	32
Oil top-up .....	32
<b>ACCESSORIES</b> .....	33
Connectors and valves .....	33
Lubricants .....	33
Crankcase heaters .....	34
Discharge temperature protection .....	35
Compressor acoustic hood .....	35
<b>ORDERING INFORMATION AND PACKAGING</b> .....	36
Ordering information .....	36
Packaging .....	38

## PERFORMER® SCROLL COMPRESSION PRINCIPLE

In a Danfoss Performer® scroll compressor, the compression is performed by two scroll elements located in the upper part of the compressor above the motor (see adjacent figure). Suction gas enters the compressor at the suction connection. The gas then flows around the motor and enters at the bottom side through the openings as shown. Oil droplets separate from the suction gas and fall into the oil sump. All of the suction gas passes through the electrical motor, thus ensuring complete motor cooling in all applications. After exiting the electrical 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. Ultimately, the discharge gas leaves the compressor at the discharge connection.

The figure below illustrates the entire compression process. 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 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 center of the scroll set increasing the gas pressure. Maximum compression is achieved once a pocket reaches the center where the discharge port is located; this stage occurs after three complete orbits. Compression is a continuous process: when one quantity of gas is being compressed during the 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 the single compressor codification (technical reference

shown on compressor nameplate).

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

### Nomenclature

Family, lubricant & refrigerant	Nominal capacity	UL index	Voltage	Version	Evolution Index
<b>S Z</b> <b>S Y</b>	<b>1 8 5</b> <b>3 0 0</b>	<b>S</b> <b>A</b>	<b>4</b> <b>9</b>	<b>R</b> <b>AA</b>	<b>C</b> <b>A</b>

**Family, lubricant & refrigerant**  
**SM:** Scroll, mineral oil, for R22  
**SY:** Scroll, POE lubricant, for R22  
**SZ:** Scroll, POE lubricant, for R407C - R134a

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

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

\*For trio assemblies, please contact Danfoss

### Connection details

MODEL	SM/SZ 084 - 090 - 100 110 - 120 - 148 - 161		SM/SZ 115 - 125 - 160 170 - 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	brazed
Oil sight glass	threaded	threaded	threaded	threaded	threaded	threaded	threaded
Oil equalization connection	3/8" flare	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	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	1/4" flare

## TECHNICAL SPECIFICATIONS

### 50-Hz data

Model	Nominal Cap. 60 Hz TR	Nominal cooling capacity		Power input kW	A max A	Efficiency		Sound power dB(A)	Swept volume cm <sup>3</sup> /rev	Displacement m <sup>3</sup> /h	Oil charge dm <sup>3</sup>	Net weight kg	
		W	Btu/h			COP W/W	E.E.R. Btu/h/W						
<b>R22 SINGLE</b>	<b>SM084</b>	7	20400	69 600	6.12	17	3.33	11.4	70	114.5	19.92	3.3	72
	<b>SM090</b>	7.5	21800	74 400	6.54	17	3.33	11.4	70	120.5	20.97	3.3	72
	<b>SM100</b>	8	23100	79 000	6.96	19	3.33	11.3	70	127.2	22.13	3.3	72
	<b>SM110</b>	9	25900	88 600	7.82	20	3.32	11.3	75	144.2	25.09	3.3	80
	<b>SM115</b>	9.5	28000	95 600	8.31	25	3.37	11.5	76	155.0	26.97	3.8	80
	<b>SM120</b>	10	30100	102 800	8.96	29	3.36	11.5	75	166.6	28.99	3.3	80
	<b>SM125</b>	10	30100	102 800	8.93	25	3.37	11.5	76	166.6	28.99	3.8	80
	<b>SM148</b>	12	36100	123 100	10.80	32	3.34	11.4	79	199.0	34.60	3.6	86
	<b>SM160</b>	13	39100	133 500	11.60	29	3.37	11.5	79.5	216.6	37.69	4.0	94
	<b>SM161</b>	13	39000	133 200	11.59	32	3.37	11.5	79.5	216.6	37.69	3.6	86
	<b>SM175</b>	14	42000	143 400	12.46	35	3.37	11.5	80	233.0	40.54	6.2	103
	<b>SM185</b>	15	45500	155 300	13.62	35	3.34	11.4	80	249.9	43.48	6.2	103
	<b>SY240</b>	20	61200	208 700	18.20	50	3.36	11.5	82	347.8	60.50	8.0	160
	<b>SY300</b>	25	78200	267 000	22.83	69	3.43	11.7	82	437.5	76.10	8.0	160
<b>SY380</b>	30	92000	313 900	26.82	72	3.43	11.7	85	531.2	92.40	8.4	163	
<b>R407C SINGLE</b>	<b>SZ084</b>	7	19300	66 000	6.13	17	3.15	10.7	73	114.5	19.92	3.3	72
	<b>SZ090</b>	7.5	20400	69 600	6.45	17	3.16	10.8	73	120.5	20.97	3.3	72
	<b>SZ100</b>	8	21600	73 700	6.84	19	3.15	10.8	73	127.2	22.13	3.3	72
	<b>SZ110</b>	9	24600	84 000	7.76	20	3.17	10.8	77	144.2	25.09	3.3	80
	<b>SZ115</b>	9.5	26900	91 700	8.49	25	3.16	10.8	78	155.0	26.97	3.8	80
	<b>SZ120</b>	10	28600	97 600	8.98	29	3.18	10.9	77	166.6	28.99	3.3	80
	<b>SZ125</b>	10	28600	97 500	8.95	25	3.19	10.9	78	166.6	28.99	3.8	80
	<b>SZ148</b>	12	35100	119 800	10.99	32	3.19	10.9	80.5	199.0	34.60	3.6	86
	<b>SZ160</b>	13	37600	128 200	11.58	29	3.24	11.1	80.5	216.6	37.69	4.0	94
	<b>SZ161</b>	13	37900	129 500	11.83	32	3.21	10.9	80.5	216.6	37.69	3.6	86
	<b>SZ175</b>	14	40100	136 900	12.67	35	3.17	10.8	81	233.0	40.54	6.2	103
	<b>SZ185</b>	15	43100	147 100	13.62	35	3.16	10.8	81	249.9	43.48	6.2	103
	<b>SZ240</b>	20	59100	201 800	18.60	50	3.18	10.9	83.5	347.8	60.50	8.0	160
	<b>SZ300</b>	25	72800	248 300	22.70	69	3.20	10.9	84	437.5	76.10	8.0	160
<b>SZ380</b>	30	89600	305 900	27.60	72	3.25	11.1	86.5	531.2	92.40	8.4	163	

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

### Rating conditions

	SM/SY compressors	SZ compressors
Refrigerant	R22	R407C
Frequency	50 Hz	50 Hz
Standard rating conditions	ARI standard conditions	-
Evaporating temperature	7.2 °C	7.2 °C (dew point)
Condensing temperature	54.4 °C	54.4 °C (dew point)
Sub-cooling	8.3 K	8.3 K
Superheat	11.1 K	11.1 K

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

## TECHNICAL SPECIFICATIONS

### 60-Hz data

Model	Nominal Cap. 60 Hz TR	Nominal cooling capacity		Power input kW	A max A	Efficiency		Sound power dB(A)	Swept volume cm <sup>3</sup> /rev	Displacement m <sup>3</sup> /h	Oil charge dm <sup>3</sup>	Net weight kg	
		W	Btu/h			COP W/W	E.E.R. Btu/h/W						
<b>R22 SINGLE</b>	<b>SM084</b>	7	24600	84 000	7.38	17	3.34	11.4	75	114.5	24.05	3.3	72
	<b>SM090</b>	7.5	26400	90 000	7.82	17	3.37	11.5	75	120.5	25.31	3.3	72
	<b>SM100</b>	8	27500	94 000	8.14	19	3.38	11.5	75	127.2	26.71	3.3	72
	<b>SM110</b>	9	31600	107 800	9.35	20	3.38	11.5	78	144.2	30.28	3.3	80
	<b>SM115</b>	9.5	33700	115 200	10.08	25	3.35	11.4	79	155.0	32.55	3.8	80
	<b>SM120</b>	10	36700	125 300	10.80	29	3.40	11.6	78	166.6	34.99	3.3	80
	<b>SM125</b>	10	37000	126 400	10.99	25	3.37	11.5	79	166.6	34.99	3.8	80
	<b>SM148</b>	12	43800	149 500	13.01	32	3.37	11.5	83	199.0	41.80	3.6	86
	<b>SM160</b>	13	47700	163 000	14.22	29	3.36	11.5	84	216.6	45.49	4.0	94
	<b>SM161</b>	13	47600	162 600	14.07	32	3.39	11.5	84	216.6	45.49	3.6	86
	<b>SM175</b>	14	51100	174 300	15.27	35	3.34	11.4	82.5	233.0	48.93	6.2	103
	<b>SM185</b>	15	54300	185 400	16.22	35	3.35	11.4	82.5	249.9	52.48	6.2	103
	<b>SY240</b>	20	74100	252 700	22.10	50	3.35	11.4	84.7	347.8	73.00	8.0	160
	<b>SY300</b>	25	94500	322 500	27.50	69	3.43	11.7	85.9	437.5	91.90	8.0	160
<b>SY380</b>	30	110000	375 300	33.54	72	3.28	11.7	88.0	531.2	111.60	8.4	163	
<b>R407C SINGLE</b>	<b>SZ084</b>	7	22500	76 900	7.06	17	3.19	10.9	78	114.5	24.05	3.3	72
	<b>SZ090</b>	7.5	24400	83 300	7.63	17	3.20	10.9	78	120.5	25.31	3.3	72
	<b>SZ100</b>	8	26500	90 500	8.18	19	3.24	11.0	78	127.2	26.71	3.3	72
	<b>SZ110</b>	9	30100	102 800	9.29	20	3.24	11.1	81	144.2	30.28	3.3	80
	<b>SZ115</b>	9.5	32800	112 000	10.22	25	3.21	10.9	81	155.0	32.55	3.8	80
	<b>SZ120</b>	10	34800	118 900	10.75	29	3.24	11.1	81	166.6	34.99	3.3	80
	<b>SZ125</b>	10	34900	119 200	10.89	25	3.21	10.9	81	166.6	34.99	3.8	80
	<b>SZ148</b>	12	42600	145 400	13.35	32	3.19	10.9	85	199.0	41.80	3.6	86
	<b>SZ160</b>	13	45500	155 400	14.08	29	3.23	11.0	85	216.6	45.49	4.0	94
	<b>SZ161</b>	13	46000	156 900	14.32	32	3.21	10.9	85	216.6	45.49	3.6	86
	<b>SZ175</b>	14	48700	166 200	15.28	35	3.19	10.9	84	233.0	48.93	6.2	103
	<b>SZ185</b>	15	51800	176 800	16.43	35	3.15	10.7	84	249.9	52.48	6.2	103
	<b>SZ240</b>	20	71100	242 800	22.70	50	3.14	10.7	87	347.8	73.00	8.0	160
	<b>SZ300</b>	25	87900	300 000	27.49	69	3.20	10.9	87.5	437.5	91.90	8.0	160
<b>SZ380</b>	30	108500	368 500	33.40	72	3.25	11.0	89.5	531.2	111.60	8.4	163	

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

### Rating conditions

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

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

## OPERATING ENVELOPES

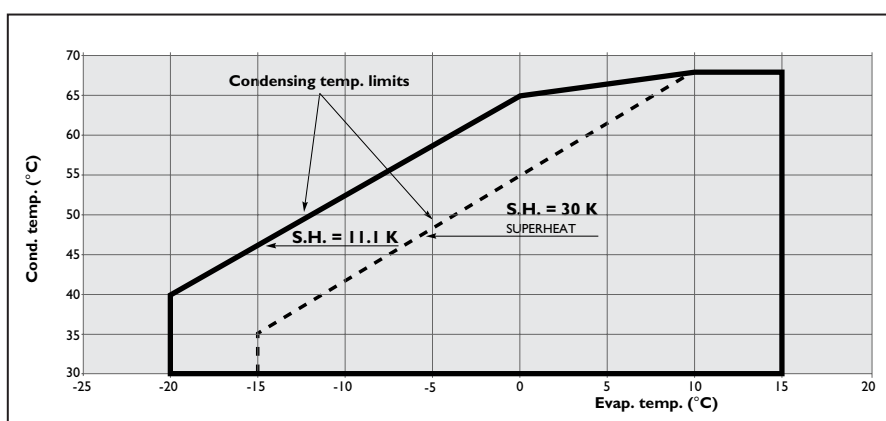
### Application envelopes at dew temperatures

The figures below show the operating envelopes for SM / SY compressors with refrigerant R22 and for SZ compressors with refrigerants R407C, R134a, R404A and R507A. The discharge temperature depends on the combination of evaporating temperature, condensing temperature and suction gas superheat. Because of this dependence, discharge temperature limits are indicated by a double line. The solid line represents the limit should the superheat be 11.1 K or less. The dashed line, on the other hand, provides the limit when the superheat is 30 K. For superheat values between 11.1 K and 30 K, these two lines may

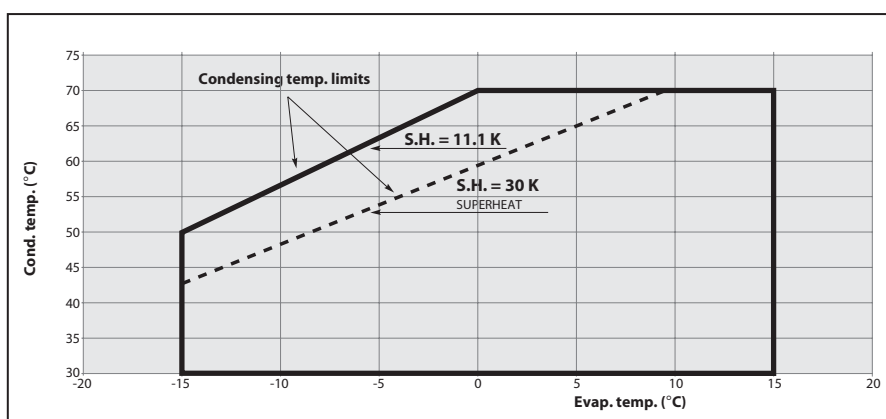
be interpolated. The operating limits serve to define the envelope within which reliable operations of the compressor are guaranteed:

- Maximum discharge gas temperature: +135°C
- Maximum ambient temperature: +63°C (for SM / SZ 084 to 185), + 52°C (for SY / SZ 240 to 380)
- A suction superheat below 5 K is not recommended due to the risk of liquid floodback
- Maximum superheat of 30 K
- Minimum and maximum evaporating and condensing temperatures as per the operating envelopes.

### SM 084 to SM 185 SY 240 to SY 380 R22



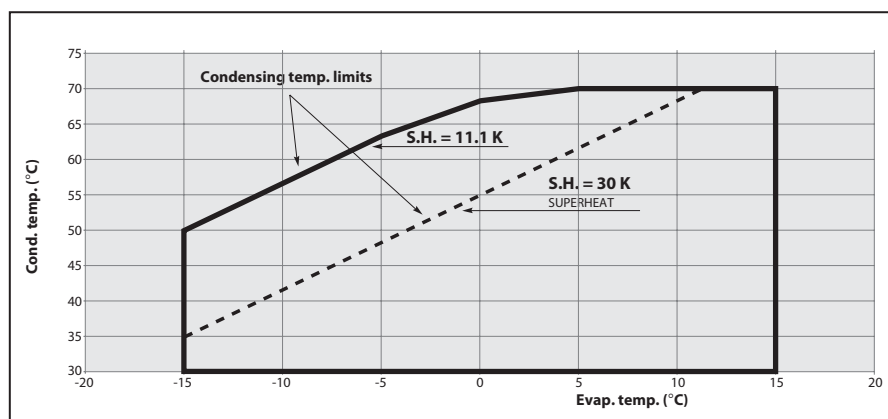
### SZ 084 to SZ 185 R134a



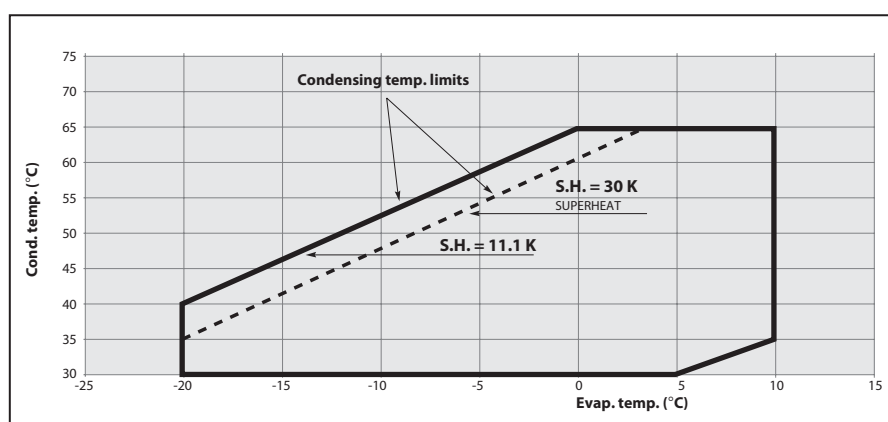


## OPERATING ENVELOPES

### SZ 240 - 300 R134a

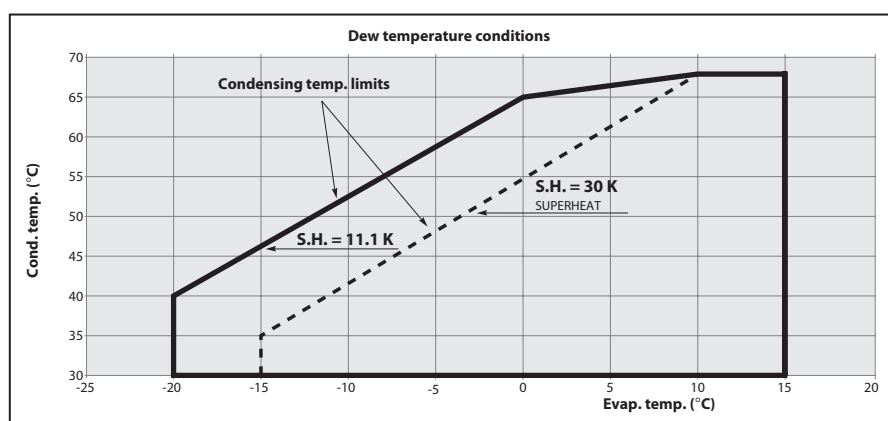


### SZ 084 to SZ 185 R404A / R507A



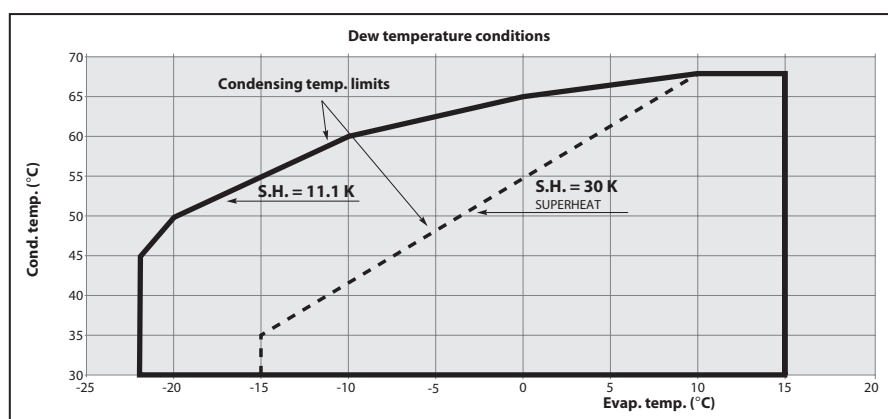
### SZ 084 to SZ 185 R407C at DEW temperature

(refer to the explanation p.10)



### SZ 240 to SZ 380 R407C at DEW temperature

(refer to the explanation p.10)



## OPERATING ENVELOPES

### Application envelopes at mean temperatures

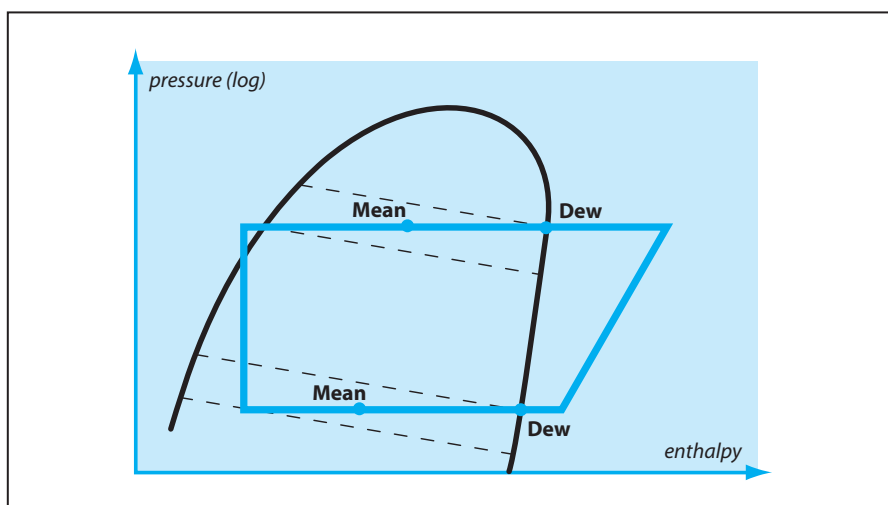
Refrigerant R407C is a zeotropic mixture, which causes a temperature glide in both the evaporator and condenser. When discussing evaporating and condensing temperatures therefore, it is important to indicate whether these are DEW point values or MEAN point values. In the figure below, the dashed lines reflect constant temperature and do not correspond with the constant pressure lines.

For a given cycle, the MEAN point temperatures are typically about 2° to 3°C lower than DEW point temperatures. In these Selection and Application Guidelines, Danfoss Commercial Compressors displays temperatures as DEW point values.

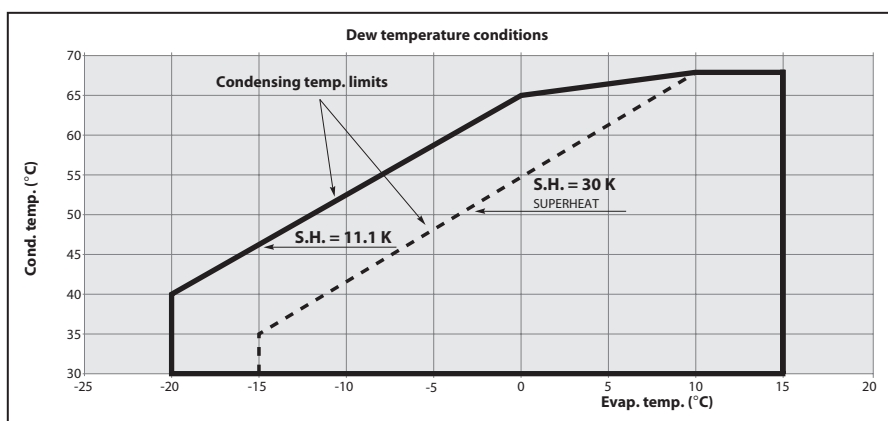
The performance tables for R407C (see p. 6-7) are also based on DEW point values.

### Dew temperature and mean temperature for R407C

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

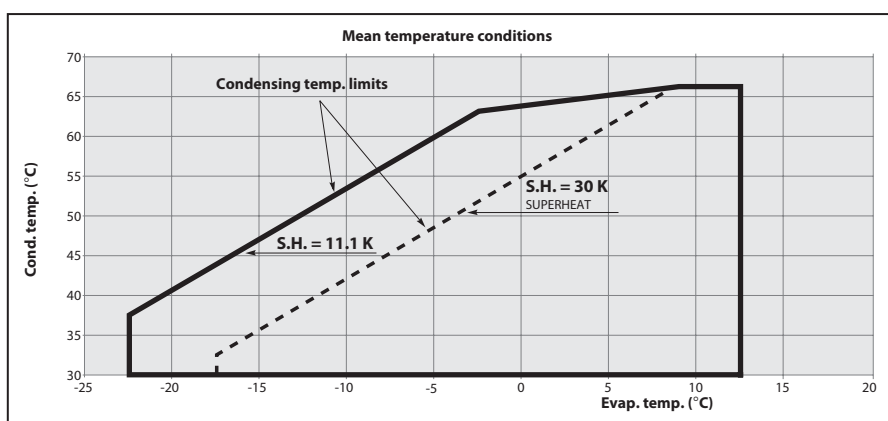


### Dew temperature



Example for SZ 084 to 185


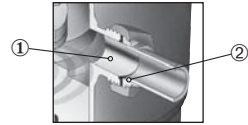
### Mean temperature



Example for SZ 084 to 185

## PIPING CONNECTIONS

### Suction and discharge connections

		Brazed version		Rotolock version	
					
		Brazed	Rotolock ①	Adaptor 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 which may be used to determine the amount and condition of the oil contained within the sump.



### Schrader

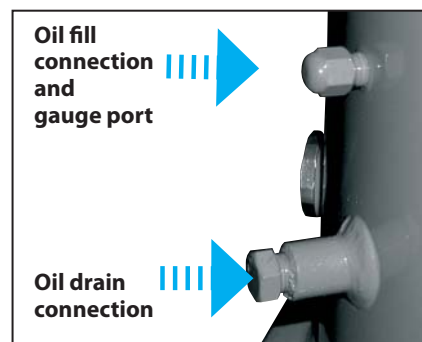
The oil fill connection and gauge port is a 1/4" male flare connector incorporating a Schrader valve.

### 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 to more effectively remove the oil. The connection is composed of a female 1/4" NPT fitting.

#### 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 in five different motor voltages. Motor voltage code 3 and 9 for 60 Hz, motor code 6 for 50 Hz and motor code 4 and 7 for both 50 and 60 Hz.

	Motor voltage code 3	Motor voltage code 4 with thermostat protector and internal overload (S 084 - S 185)	Motor voltage code 4 with PTC and electronic module (S 240 - S 380)	Motor voltage code 6	Motor voltage code 7	Motor voltage code 9
Nominal voltage 50 Hz	-	380-400V - 3 - 50 Hz	400V - 3 - 60 Hz	230V - 3 - 50 Hz	500V - 3 - 50Hz	-
Voltage range 50 Hz	-	340-440V	360 - 440 V	207 - 253V	450 - 550V	-
Nominal voltage 60 Hz	200-230V - 3 - 60 Hz	460V - 3 - 60 Hz	460V - 3 - 60Hz	-	575V - 3 - 60 Hz	380 - 3 - 60 Hz
Voltage range 60Hz	180 - 253 V	414 - 506V	414 - 506V	-	517 - 632V	342 - 418 V

### Electrical connections

Electrical power is connected to the compressor terminals by Ø 4.8 mm (3/16") screws. The maximum tight-

ning torque is 3 Nm. Use a 1/4" ring terminal on the power leads.

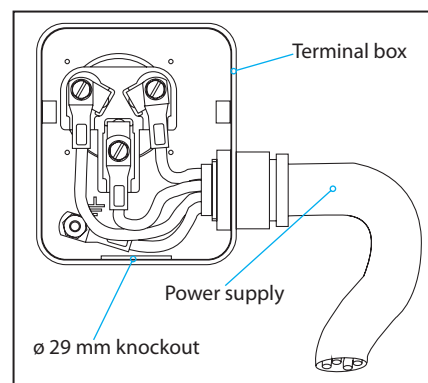
#### Terminal box wiring for SM / SZ 084 - 090 - 100 - 110 - 120 - 148 - 161\* compressors

\* Except for motor voltage code 3

- The terminal box is provided with a Ø 29 mm hole for the power supply and a Ø 29 mm knockout.

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

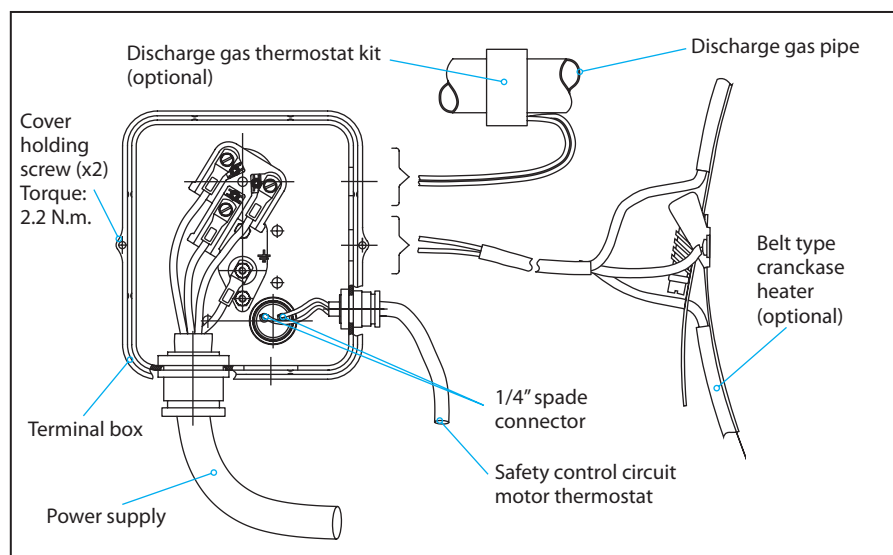
IP ratings according to IEC 529



#### Terminal box wiring for SM / SZ 115 - 125 - 160 - 161 (motor code 3) - 175 - 185

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 power supply, double knockouts accommodate the following diameters:  
 $\varnothing$  44 mm /  $\varnothing$  1 $\frac{3}{4}$ " hole (for a 1 $\frac{1}{4}$ " conduit) and  $\varnothing$  34mm /  $\varnothing$  1 $\frac{3}{8}$ " hole (for a 1" conduit),  
 $\varnothing$  32.1 mm /  $\varnothing$  1.26" hole and  
 $\varnothing$  25.4 mm /  $\varnothing$  1" hole.

The 3 other knockouts are as follows:  
 $\varnothing$  20.5 mm /  $\varnothing$  0.81"  
 $\varnothing$  22 mm /  $\varnothing$  7/8" (for a 1/2" conduit)  
 $\varnothing$  16.5 mm /  $\varnothing$  0.65"

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

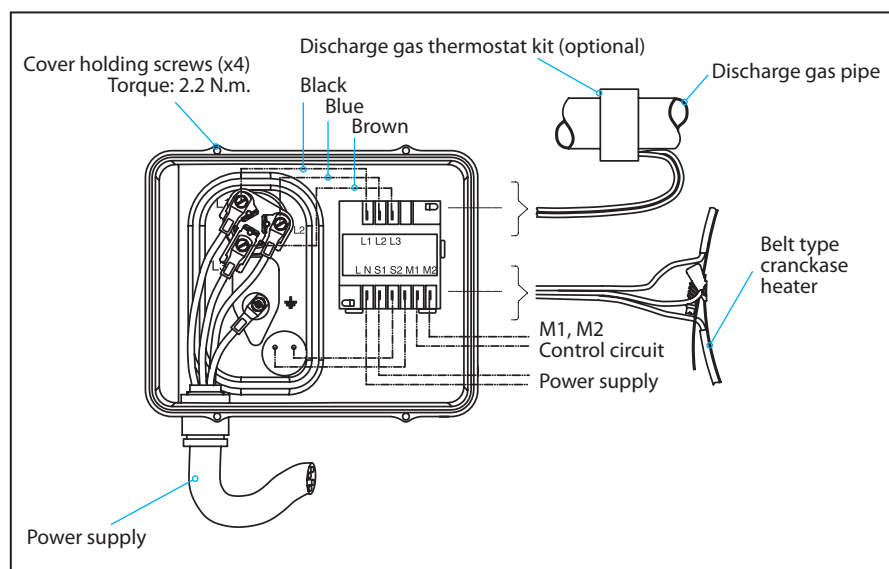
The terminal box is provided with 4 double knockouts for the power supply and 4 knockouts for the safety control circuit. The 4 power supply double knockouts accommodate the following diameters:

$\varnothing$  22 mm /  $\varnothing$  7/8" hole and  $\varnothing$  16.5 mm /  $\varnothing$  0.65" knockout  
 $\varnothing$  22 mm /  $\varnothing$  7/8" hole and  $\varnothing$  16.5 mm / 0.65" knockout  
 $\varnothing$  43.7 mm /  $\varnothing$  1 $\frac{23}{32}$ " hole and  $\varnothing$  34.5 mm / 1 $\frac{23}{64}$ " knockout  
 $\varnothing$  40.5 mm /  $\varnothing$  1.59" hole and  $\varnothing$  32.2 mm / 1.27" knockout

The 4 others knockouts are as follows:  
 $\varnothing$  20.5 mm /  $\varnothing$  0.81"  
 $\varnothing$  20.5 mm /  $\varnothing$  0.81"  
 $\varnothing$  50 mm /  $\varnothing$  1 $\frac{31}{32}$ "  
 $\varnothing$  25.2 mm /  $\varnothing$  0.99"

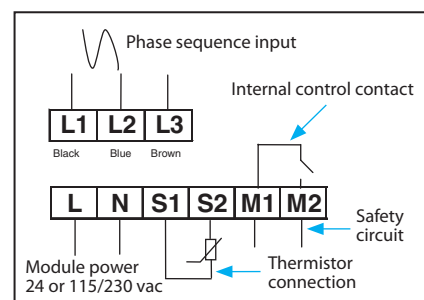
The protection rating of the terminal box is IP54 when correctly sized IP54-rated cable glands are used.

IP ratings according to IEC 529.



### Electronic protection module wiring

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

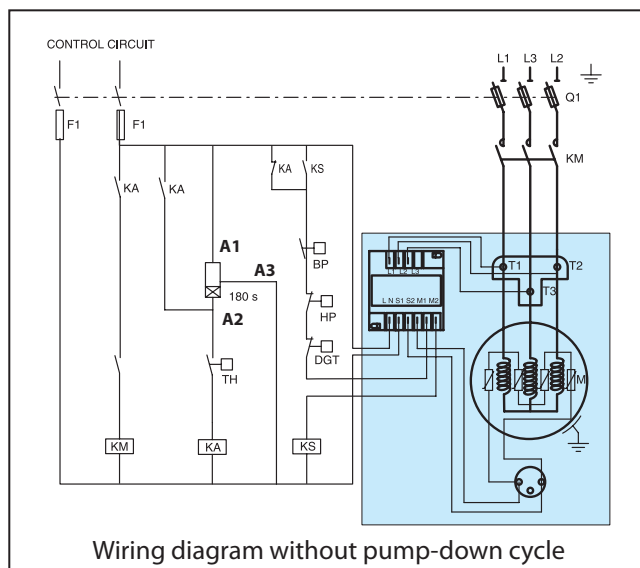
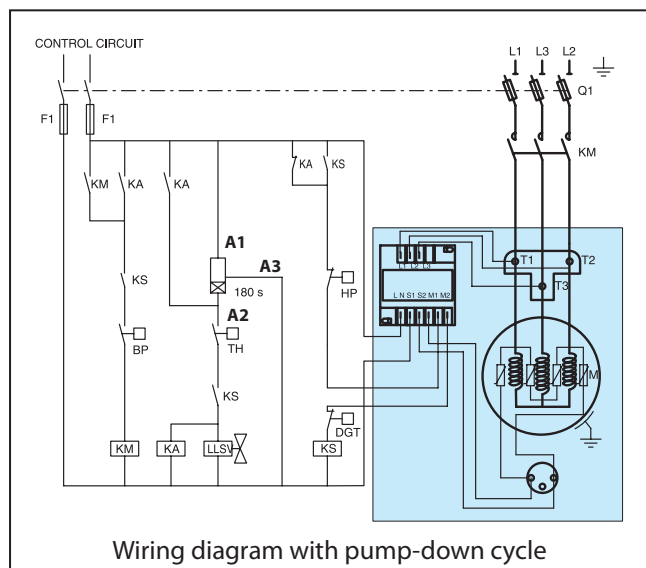




## ELECTRICAL CONNECTIONS AND WIRING

### Suggested wiring diagrams logic

Compressor models SY / SZ 240 - 300 - 380



#### Legends

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

### Danfoss MCI soft-start controller

The inrush current for the Performer® 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 and stopping 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 and initial torque, are preset at the factory and do not require modification.

Compressor model	Soft start reference ambient max. 40°C	Soft start reference ambient max. 55°C
SM / SZ 084	MCI 15C	MCI 15C
SM / SZ 090		MCI 25C
SM / SZ 100		
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	MCI 50C*	
SY / SZ 380	Contact Danfoss	

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

## ELECTRICAL CONNECTIONS AND WIRING

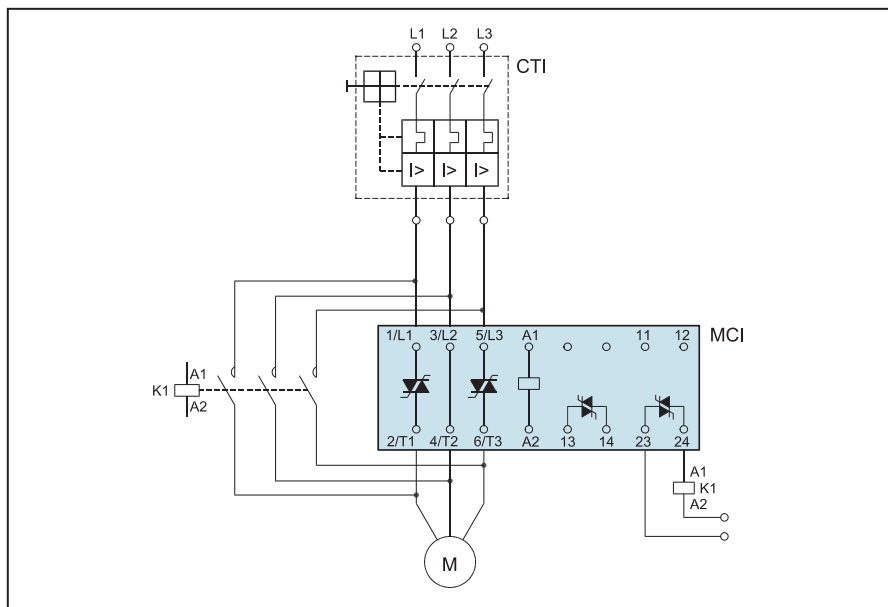
### MCI with bypass contactor

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

no-load condition it can be selected on the basis of the thermal current (AC-1).

No heat is generated from the MCI. As the contactor always switches in

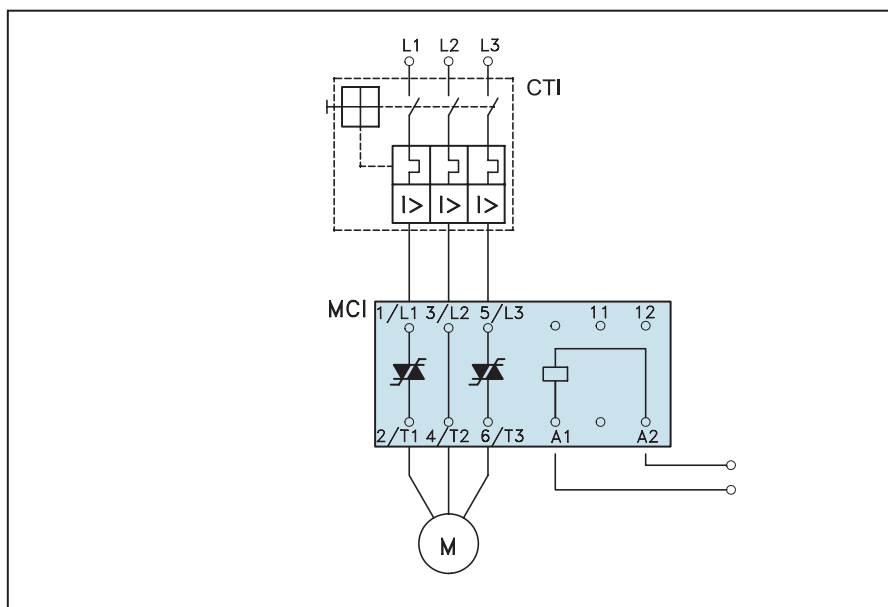
(13-14 contact not applicable with MCI 25C)



### 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.





## SYSTEM DESIGN RECOMMENDATIONS

### 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 may

however 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 of the compressor must be maintained at no lower than 10 K above the saturation temperature of the refrigerant on the low-pressure side. This requirement ensures that the liquid refrigerant is not accumulating in the sump. A crankcase heater is only effective if capable of sustaining this level of temperature difference. Tests must be conducted to ensure that the appropriate oil temperature is maintained under all ambient conditions (temperature and wind). However, below  $-5^{\circ}\text{C}$  ambient temperature and a wind speed of above 5 m/sec, we recommend that the heaters be thermally insulated in order to limit the surrounding energy losses. Since the total system charge may be undefined, a 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 (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).

### 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 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 operations or after defrosting (heat pump). 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 to the low side of the system. 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.

## SYSTEM DESIGN RECOMMENDATIONS

### Liquid receiver

A liquid receiver is highly recommended on split systems and remote condenser systems with a total refrigerant charge in excess of the recommended maximum for the compressor. Because of the long refrigerant lines these systems have a relatively high system charge which is hard to define with accuracy. Further these types of systems quite often tend to be overcharged in the field. By installing a liquid receiver, a pump-down cycle can then be intro-

duced in order to safely store the refrigerant charge during the off-cycles, which greatly reduces 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

Flooded starts occur when a compressor starts up with 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, liquid 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, yet 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 operations, liquid floodback may be detected by measuring either the oil sump temperature, which should be at least 10 K above the saturated suction temperature, or the discharge gas temperature, which should be at least 30 K above the saturated discharge temperature. If at any time during operations, the oil sump temperature drops to within 10 K or less above the saturated suction temperature, or should the discharge gas temperature be less than 30 K above the saturated discharge temperature, the lubricant will become excessively diluted and tests would have to be performed in order to select an appropriate compressor protection method. Repetitive liquid floodback testing must be carried out under TXV threshold operating conditions: a high pressure ratio and minimum load, along 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 operations beyond its specific application envelope. Please refer to the examples below, which illustrates where DGT protection is required (Example 1) and where it is not (Example 2).

**Example 1** (R22, SH = 11 K)

LP switch setting:

LP1 = 1.8 bar (g) (-17°C)

HP switch setting:

HP1 = 25 bar (g) (62°C)

Risk of operation beyond the application envelope.

DGT protection required.

**Example 2** (R22, SH = 11 K)

LP switch setting:

LP2 = 2.9 bar (g) (-7°C)

HP switch setting:

HP2 = 21 bar (g) (55°C)

No risk of operation beyond the application envelope.

No DGT protection required.

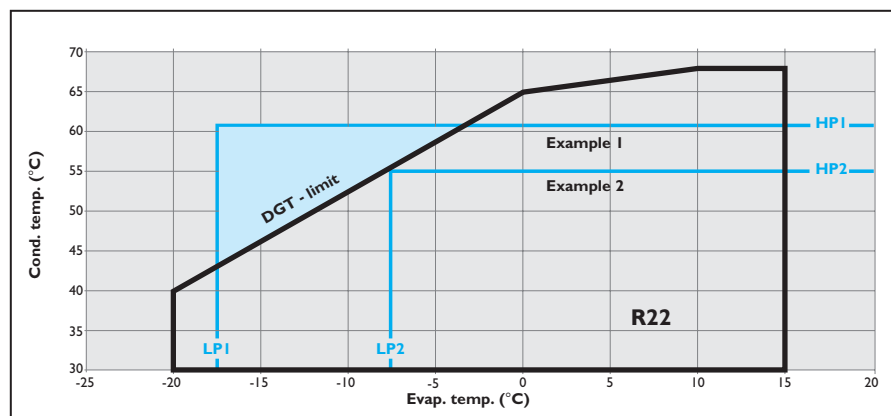
## SYSTEM DESIGN RECOMMENDATIONS

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

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

**Notes:** 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!

A DGT accessory is available from Danfoss Commercial Compressors: refer to page 35.



### Refrigerant charge limits and compressor protection

The refrigerant charge limits listed in the table below will help evaluate the required compressor protection in relation with the system charge and the application.

**Notes:** For reversible heat pump systems and other specific applications, please refer to section "Specific Application Recommendations".

Compressor models	S 084 S 090 S 100	S 110 S 120	S 115 S 125	S 148 S 160 S 161	S 175 S 185	S 240	S 300 S 380
Refrigerant charge limit (kg)	8.5	10	11	12.5	13.5	16	20

	BELOW charge limit	ABOVE charge limit
<b>Cooling only systems, Packaged units</b>	<input checked="" type="checkbox"/> No test or additional safeties required	<b>REQ</b> Refrigerant migration & floodback test <b>REQ</b> Crankcase heater
<b>Cooling only systems with remote condensor and split system units</b>	<b>REC</b> Refrigerant migration & floodback test <b>REC</b> Crankcase heater, because full system charge is not definable (risk of overcharging)	<b>REQ</b> Refrigerant migration & floodback test <b>REQ</b> Crankcase heater <b>REC</b> Liquid receiver
<b>Reversible heat pump system</b>	<b>REQ</b> Specific tests for repetitive floodback <b>REQ</b> Crankcase heater <b>REQ</b> 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.

## SYSTEM DESIGN RECOMMENDATIONS

### Motor protection

#### Internal motor protection

**Compressor models SM / SZ 084 - 090 - 100 - 110 - 120 - 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 the data sheets. While not compulsory, an additional external overload protection is still advisable for either alarm or manual reset. 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.

**Compressor models SM / SZ 115 - 125 - 160 - 175 - 185** 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 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 preinstalled 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  $\Omega$ ) and the output relay then trips (i.e. contacts M1-M2 are open). After cooling to below the response temperature (resistance < 2,750  $\Omega$ ), a 5 minute time delay is activated. After this delay has elapsed, the relay is once again pulled in (i.e. contacts M1-M2 closed). The time delay may be cancelled by means of resetting the mains (L-N disconnect) for approx. 5 sec.

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 requirements of the pertinent certification authorities in the country where the compressor will 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; it can be found either in the corresponding data sheets or in the Danfoss Commercial Compressors selection program

## SYSTEM DESIGN RECOMMENDATIONS

### Phase sequence and reverse rotation protection

for all compressors. The tripping current must never exceed the MMT 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 minu-

tes at 110% of the Maximum Must-Trip 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.

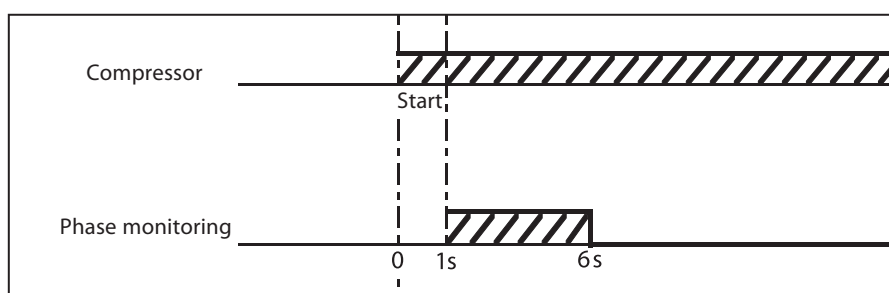
Use a phase meter to establish the phase orders and connect line phases L1, L2 and L3 to terminals T1, T2 and T3, respectively. The compressor will only operate properly in a single direction, and the motor is wound so that if the connections are correct, the rotation will also be correct.

**Compressor models SM / SZ 084 to 185** incorporate an internal 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 SY / SZ 240 to 380** are delivered with an electronic module which provides protection against phase reversal and loss at start-up. Apply 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 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 (p14-15). A three-minute (180-sec) time out is recommended.

## SYSTEM DESIGN RECOMMENDATIONS

### Voltage unbalance

The 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

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:

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

$V_{avg}$  = 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 should the discharge pressure exceed the values shown in the table below. 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.

**Note:**

Because 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 be used. Deep vacuum operations of a scroll compressor can cause internal electrical arcing and scroll instability. Performer® 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	R407C	R134a	R404A/R507A
Working pressure range high side	bar (g)	10.9 - 27.7	10.5 - 29.1	6.7 - 20.2	12.7 - 32
Working pressure range low side	bar (g)	1.4 - 6.9	1.1 - 6.4	0.6 - 3.9	2 - 7.3
Maximum high pressure safety switch setting	bar (g)	28	29.5	20.5	32.5
Minimum low pressure safety switch setting *	bar (g)	0.5	0.5	0.5	0.5
Minimum low pressure pump-down switch setting **	bar (g)	1.3	1.0	0.5	1.8

\*LP safety switch shall never be bypassed.

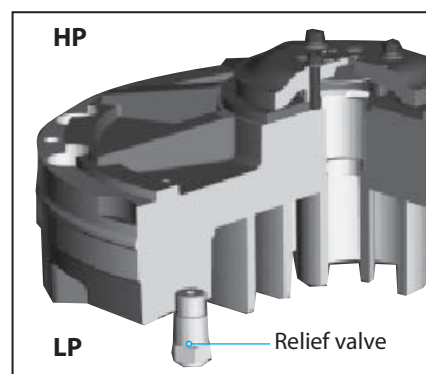
\*\*Recommended pump-down switch settings: 1.5 bar (R22, R407C, R404A) or 1 bar (R134a) below nominal evaporating pressure.

## SYSTEM DESIGN RECOMMENDATIONS

### Internal pressure relief valve

The SY / SZ 240 to SY / SZ 380 incorporate an internal relief valve set to open between the internal high and low pressure sides of the compressor when the pressure differential between the discharge and suction pressures surpasses 31 to 38 bar.

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



### 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.

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 thermal bulb location (see fig. 1).

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 (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. 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" p.27).

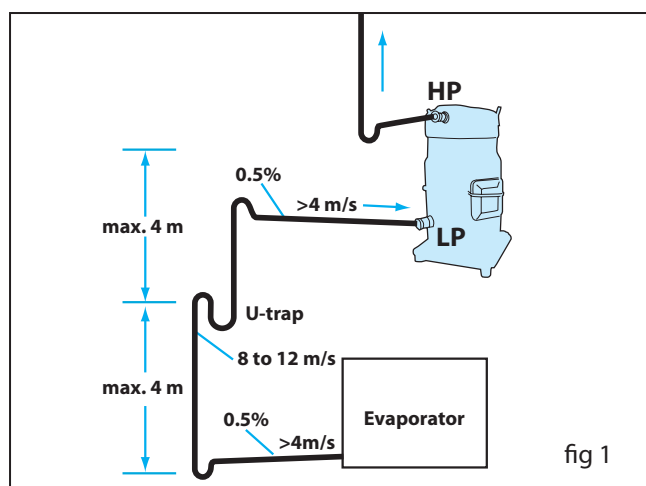


fig 1

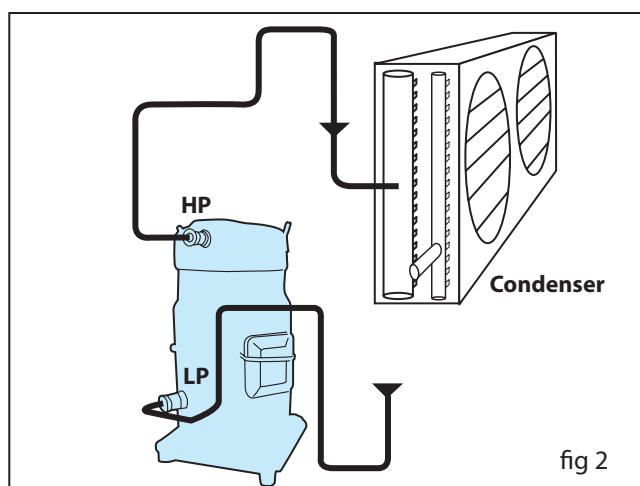


fig 2

## SPECIFIC APPLICATION RECOMMENDATIONS

### Low ambient compressor operations

#### Low ambient operations and minimum pressure differential

The Performer® scroll compressor requires a minimum pressure differential of 3 to 4 bar between the suction and discharge pressures to force the orbiting scroll-down against the oil film on the thrust bearing. Anything less than this differential and the orbiting scroll can lift up, causing a metal-to-metal contact. It is therefore necessary to maintain sufficient discharge pressure in order to ensure this pressure diffe-

rential. 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 cold ambient conditions ( $<0^{\circ}\text{C}$ ), upon start-up the pressure in the condenser and, if present, the receiver may be so low that a sufficient pressure differential across the expansion device cannot be developed to properly feed the evaporator. As a result, the compressor may go into a deep vacuum, which can lead to compressor failure due to internal arcing and instability in the scroll members. Under no circumstances should the compressor be

allowed to operate under vacuum. The low-pressure control must be set in accordance with the table on page 22 in order to prevent this from happening. 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.

#### Head pressure control under low ambient conditions

Several possible solutions are available to prevent the compressor from drawing down to a vacuum upon start-up under low ambient conditions. 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. 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.

#### 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 refrigerant systems where the compressor is exposed to cold ambient temperatures, especially split and remote condenser installa-

tions. 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 conditions of low load on the system, the following considerations should be taken into account to ensure proper system operating characteristics.

- The superheat setting of the expansion device should be sufficient to ensure proper superheat levels during low loading periods. A minimum of 5 K stable superheat is required. In addition, the refrigerant charge should be sufficient to ensure proper sub-cooling within the condenser so as to avoid the risk of flashing in the liquid line before the 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 con-

trol. 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 superheat control under varying loads.

- Condenser fans should be cycled in such a way that the minimum pressure differential is maintained between the suction and discharge pressures. Variable-speed fans can also be used to control the amount of heat to be removed from the condenser.

- 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

Brazed plate heat exchange 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.

### 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 in the realm of common applications. Each application design however should be thoroughly tested to ensure acceptable operating characteristics.

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## SPECIFIC APPLICATION RECOMMENDATIONS

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### Crankcase heaters

Crankcase heaters are mandatory on reversible cycle applications given the high probability of liquid migration back to the compressor sump during

off-cycles due to the outdoor location of most units and operations during low ambient conditions.

### Discharge temperature thermostat

Heat pumps frequently utilize high condensing temperatures in order to achieve a sufficient temperature rise in the medium being heated. At the same time, they often require low evaporator pressures to obtain sufficient temperature differentials between the evaporator and the outside temperature. This situation may result in high discharge temperature; as such, it is mandatory that a discharge gas thermostat be installed on the discharge

line to protect the compressor from excessive temperatures. Operating the compressor at too high discharge temperatures can result in mechanical damage to the compressor as well as thermal degradation of the compressor lubricating oil and a lack of sufficient lubrication.

The discharge gas thermostat should be set to shut down the compressor in the event discharge gas rises above 135°C.

### 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 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.

### 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.

## SOUND AND VIBRATION MANAGEMENT

### Sound generation in a refrigeration / 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 traveling directly from the machine in all directions.

The Performer® 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 Performer'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. These hoods are quick and easy to install and do not increase the overall size of the compressors to a great extent. Refer to page 35 for sound attenuation and code numbers.

### Mechanical vibrations

Vibration isolation constitutes the primary method for controlling structural vibration. Performer® scroll compressors are designed to produce minimal vibration during operations. The use of rubber isolaters 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 Performer® 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" p. 23.

### Gas pulsation

The Performer® 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.

## INSTALLATION

### 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 a better load distribution. Given that the center of gravity on the scroll is very high, the use of one lifting lug will result in an unstable load. The compressor mass is too great 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.

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).

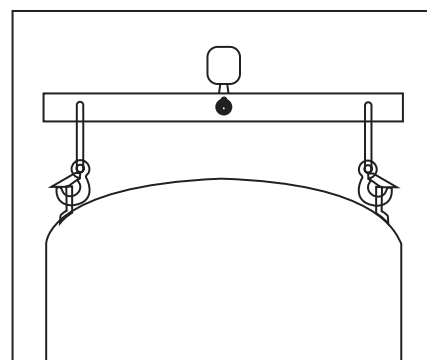
Always respect the appropriate rules concerning lifting objects of the type and weight of these compressors.

When the compressor is mounted as part of an installation, never use the

lift rings on the compressor to lift the entire installation, which may be too heavy for lifting in this manner.

Maintain the compressor in an upright position 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 eventual motor protection module compo-



### Mounting

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

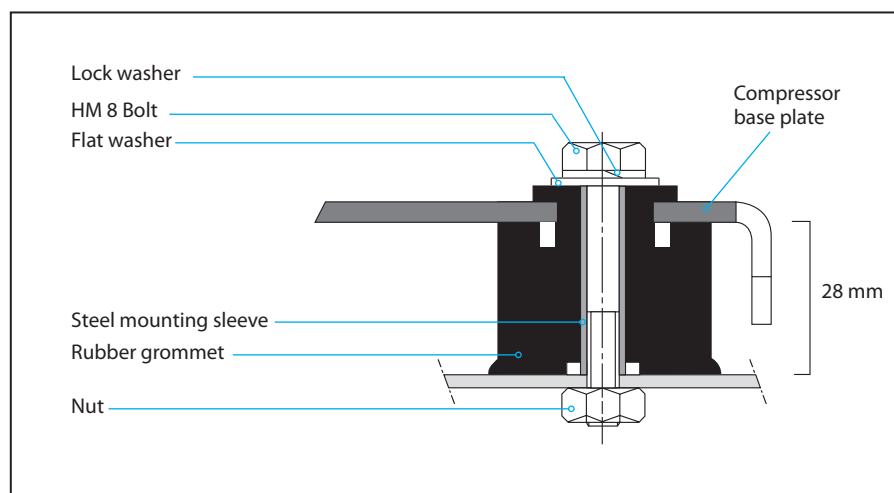
The required bolt size for the SM / SZ 084 to 185 compressors is HM8. This bolt must be tightened to a torque of

21 Nm. The 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 27 mm. Mounting bolts must be tightened to a torque of 40 Nm. These bolts and washers are not supplied with the compressor.

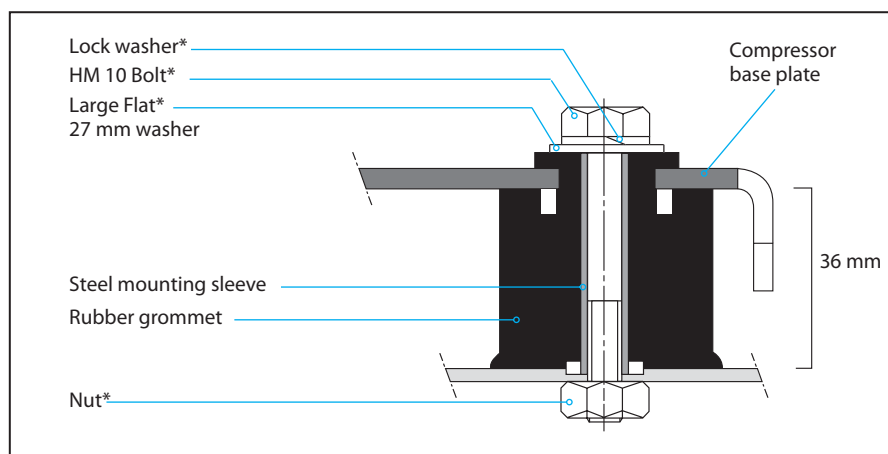
**Note:**

The large flat washer must be positioned in place before shipping the unit with the compressor installed.



SM-SZ 084 to 185

## INSTALLATION



SY-SZ 240 to 380

\*Not supplied with compressor

### Removing connections shipping 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 be-

fore 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 R407C 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 following precautions must be taken:

Never drill holes into the pipe-work after installation.

### 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 refrige-

rant-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.

## INSTALLATION

### Filter driers

For new installations with SY / SZ compressors with polyolester oil, Danfoss Commercial Compressors recommends using the Danfoss DML 100%-moleculair 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 alu-

mina are recommended. Also for new installations with SM compressors with mineral oil the Danfoss DCL drier is recommended.

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

### Brazing and soldering

#### Copper to copper connections

When brazing copper-to-copper connections, the use of a copper/phosphorus brazing alloy containing 5%

silver or more with a melting temperature of below 800°C is recommended. No flux is required during brazing.

#### Dissimilar metals connection

When manipulating dissimilar metals such as copper and brass or steel, the

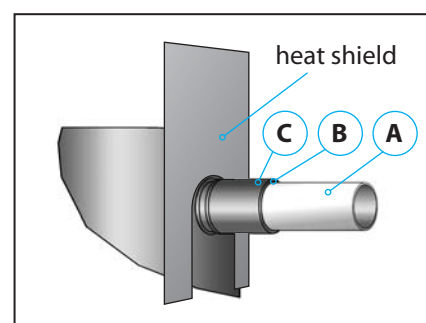
use of silver solder and anti-oxidant flux is necessary.

#### Compressor connection

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

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

- Make sure that no electrical wiring is connected to the compressor.
- Protect the terminal box and compressor painted surfaces from torch heat damage (see diagram).
- Remove the teflon gaskets when brazing rotolock connectors with solder sleeves.
- Use only clean refrigeration-grade copper tubing and clean all connections.
- Use brazing material with a minimum of 5% silver content.



- Purge nitrogen or CO<sub>2</sub> 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

## INSTALLATION

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.

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

**⚠ The polyolester oil used in 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)	25 bar (g)
Maximum compressor test pressure (high side)	32 bar (g)
Maximum pressure difference between high and low side of the compressor:	24 bar

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

### 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 Low side.

Compressor model	Leak detection with refrigerant	Leak detection with a mass spectrometer
SM-SY compressors	Nitrogen & R22	Nitrogen & Helium
SZ compressors	Nitrogen & R134a or R407C	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.

## INSTALLATION

### Vacuum pump-down and moisture removal

Moisture obstructs the proper functioning of both the compressor and the refrigeration system. Air and moisture reduce service life and increase condensing pressure, which causes abnormally high discharge temperatures that are then capable of degrading the lubricating properties of the oil. The risk of acid formation is also increased by air and moisture, and this condi-

tion can also lead to copper plating. All these phenomena may cause both mechanical and electrical compressor failures. The typical method for avoiding such problems is a vacuum pump-down executed with a vacuum pump, thus creating a minimum vacuum of 500 microns (0.67 mbar). Please refer to Bulletin "Vacuum pump down and dehydration procedure".

### 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 as much as possible away from the compressor: 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. 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 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 com-

pressor sump temperature 10 K above saturation temperature to show that there is no refrigerant migration taking place,

- Acceptable cycling rate of compressors, including duration of run times,
- Current draw of individual compressors within acceptable values (RLA ratings),
- No abnormal vibrations and noise.


### Oil level checking and top-up

#### Oil level check

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

The presence of foam filling in the sight glass indicates large concentration of refrigerant in the oil and / or presence of liquid returning to the compressor. The oil level can also be checked a few

minutes after the compressor stops, the level must be between 1/4" and 3/4" of sight glass.


 **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 original Danfoss Commercial Compressors specified oil type from new cans.

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,

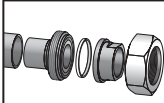

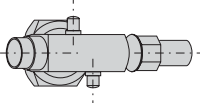
filling in instructions for Danfoss Commercial Compressors".

 **Please note that the compressors SZ and SY use different viscosity POE oil, respectively 160SZ and 320SZ.**



## ACCESSORIES

### Connectors and valves

Model								Rotolock size of: Rotolock version compressors, solder sleeve, adaptor set and rotolock valve	
	Solder sleeve adaptor set	Solder sleeve		Rotolock valve set				Suct.	Disch.
	Code n°	Suct. ODF	Disch. ODF	Suct. ODF	Disch. ODF	Type	Code n°	Suct.	Disch.
SM/SZ 084	7765005 *	7/8"	3/4"	7/8"	3/4"	V07-V04	7703006	1"3/4	1"1/4
		1"1/8	3/4"	1"1/8	3/4"	V02-V04	7703009		
		1"3/8	7/8"	1"3/8	7/8"	V10-V05	7703392		
SM/SZ 090	7765005 *	7/8"	3/4"	7/8"	3/4"	V07-V04	7703006	1"3/4	1"1/4
		1"1/8	3/4"	1"1/8	3/4"	V02-V04	7703009		
		1"3/8	7/8"	1"3/8	7/8"	V10-V05	7703392		
SM/SZ 100	7765005 *	7/8"	3/4"	7/8"	3/4"	V07-V04	7703006	1"3/4	1"1/4
		1"1/8	3/4"	1"1/8	3/4"	V02-V04	7703009		
		1"3/8	7/8"	1"3/8	7/8"	V10-V05	7703392		
SM/SZ 110	7765006 *	1"1/8	3/4"	1"1/8	3/4"	V02-V04	7703009	1"3/4	1"1/4
		1"3/8	7/8"	1"3/8	7/8"	V10-V05	7703392		
SM/SZ 115	7765006 **	1"1/8	3/4"	1"1/8	3/4"	V02-V04	7703009	1"3/4	1"1/4
		1"3/8	7/8"	1"3/8	7/8"	V10-V05	7703392		
SM/SZ 120	7765006 *	1"1/8	3/4"	1"1/8	3/4"	V02-V04	7703009	1"3/4	1"1/4
		1"3/8	7/8"	1"3/8	7/8"	V10-V05	7703392		
SM/SZ 125	7765006 **	1"1/8	3/4"	1"1/8	3/4"	V02-V04	7703009	1"3/4	1"1/4
		1"3/8	7/8"	1"3/8	7/8"	V10-V05	7703392		
SM/SZ 148	7765006 *	1"1/8	3/4"	-	-	-	-	1"3/4	1"1/4
		1"3/8	7/8"	1"3/8	7/8"	V10-V05	7703392		
SM/SZ 160	7765028 **	1"3/8	7/8"	1"3/8	7/8"	V08-V07	7703010	2"1/4	1"3/4
		1"5/8	1"1/8	1"5/8	1"1/8	V03-V02	8168028		
SM/SZ 161	7765006 *	1"1/8	3/4"	-	-	-	-	1"3/4	1"1/4
		1"3/8	7/8"	1"3/8	7/8"	V10-V05	7703392		
SM/SZ 175	7765028 **	1"3/8	7/8"	1"3/8	7/8"	V08-V07	7703010	2"1/4	1"3/4
		1"5/8	1"1/8	1"5/8	1"1/8	V03-V02	8168028		
SM/SZ 185	7765028 **	1"3/8	7/8"	1"3/8	7/8"	V08-V07	7703010	2"1/4	1"3/4
		1"5/8	1"1/8	1"5/8	1"1/8	V03-V02	8168028		
SY/SZ 240	-	1"5/8	1"1/8	1"5/8	1"1/8	V03-V02	7703383	2"1/4	1"3/4
SY/SZ 300	-	1"5/8	1"1/8	1"5/8	1"1/8	V03-V02	7703383	2"1/4	1"3/4
SY/SZ 380	-	Solder sleeve adaptor set not available at printing date						-	-

ODF: Outer diameter female.

\* Solder sleeve adaptor set accessory required to convert brazed version compressor to rotolock.

\*\* Rotolock version compressors exist for these compressor models.

**Solder sleeves** Sizes of solder sleeves included in the solder sleeve adaptor set accessory. Also denotes the standard sleeve sizes supplied with rotolock version compressors.

**Rotolock valves** Standard rotolock valve sets.

### Lubricants

SM / SY / SZ compressors use different oil types as indicated below.

Always use original Danfoss Commercial Compressors specified oil type from new cans.

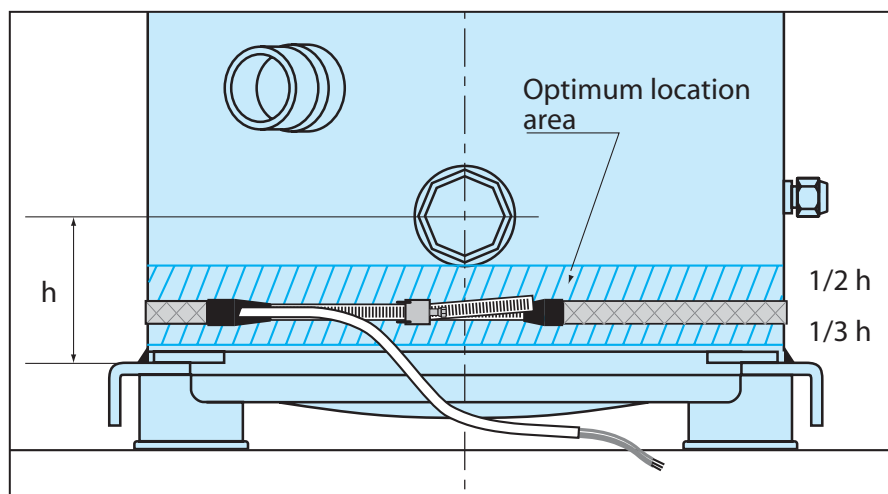
For initial compressor oil charge refer to page 6-7. Please refer to "Lubricant, filling in instructions for Danfoss Commercial Compressors" for detailed oil specifications and top-up method.

Compressor model	Oil type	Oil name	code number		
			1 litre can	2 litre can	5 litre can
SM compressors	Mineral	160P	-	7754001	7754002
SZ compressors	P.O.E.	160 SZ	7754023	7754024	-
SY compressors	P.O.E.	320 SZ	7754121	7754122	-

## ACCESSORIES

### Crankcase heaters

The belt-type crankcase heater accessories are designed to protect the compressor against off-cycle migration of refrigerant



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
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	4
7773122	Belt type crankcase heater, 130 W, 230 V, CE mark, UL	SY/SZ240-300	4
7973007	Belt type crankcase heater, 130 W, 230 V, CE mark, UL	SY/SZ240-300	50
7773123	Belt type crankcase heater, 130 W, 400 V, CE mark, UL	SY/SZ240-300	4

## ACCESSORIES

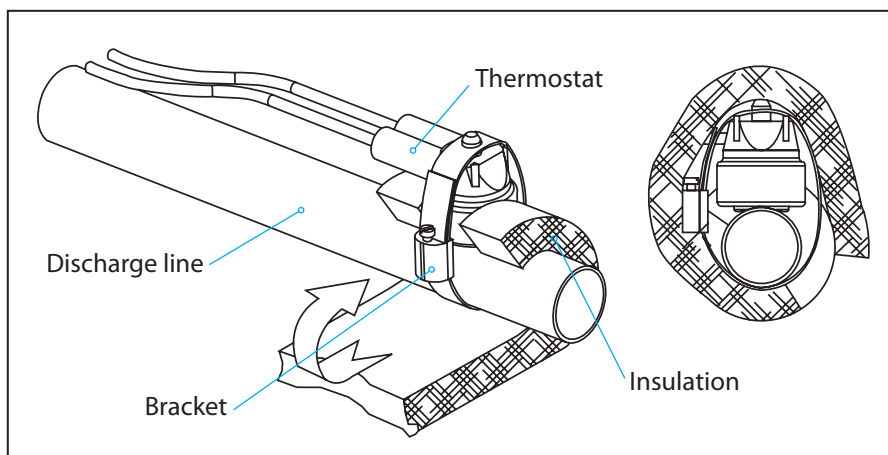
### Discharge temperature protection

The discharge gas temperature must not exceed 135°C.

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 150 mm from the compressor discharge port.

Discharge thermostat kit code number: 7750009.



### Compressor acoustic hoods



Compressor acoustic hoods have been developed to meet specific extra-low noise requirements. The covers incor-

porate 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 Commercial Compressors in either industrial packs (Multiple packaging) or in single packs (Individual packaging).

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

#### SM /SY compressors in industrial-pack (Multiple packaging)

## R22

Compressor model	Design	Connections	Motor protection	Code no.				
				3	4	6	7	9
				200-230/3/60	460/3/60 400/3/50	230/3/50	575/3/60 500/3/50	380/3/60
SM084	Single	Brazed	Int	SM084-3VM	SM084-4VM	SM084-6VM	SM084-7VM	SM084-9VM
SM090	Single	Brazed	Int	SM090-3VM	SM090-4VM	SM090-6VM	SM090-7VM	SM090-9VM
SM100	Single	Brazed	Int	SM100-3VM	SM100-4VM	SM100-6VM	SM100-7VM	SM100-9VM
SM110	Single	Brazed	Int	SM110-3VM	SM110-4VM	SM110-6VM	SM110-7VM	SM110-9VM
SM115	Single	Brazed	T	SM115-3CAM	SM115-4CAM	SM115-6CAM	SM115-7CAM	SM115-9CAM
		Rotolock	T	SM115-3RM	SM115-4RM	SM115-6RM	SM115-7RM	SM115-9RM
SM120	Single	Brazed	Int	SM120-3VM	SM120-4VM	SM120-6VM	SM120-7VM	SM120-9VM
SM125	Single	Brazed	T	SM125-3CAM	SM125-4CAM	SM125-6CAM	SM125-7CAM	SM125-9CAM
		Rotolock	T	SM125-3RM	SM125-4RM	SM125-6RM	SM125-7RM	SM125-9RM
SM148	Single	Brazed	Int	SM148-3VAM	SM148-4VAM	SM148-6VAM	SM148-7VAM	SM148-9VAM
SM160	Single	Brazed	T	SM160-3CBM	SM160-4CBM	SM160-6CBM	SM160-7CAM	SM160-9CBM
		Rotolock	T	SM160-3RAM	SM160-4RAM	SM160-6RAM	SM160-7RAM	SM160-9RAM
SM161	Single	Brazed	Int	SM161-3VAM	SM161-4VAM	SM161-6VAM	SM161-7VAM	SM161-9VAM
SM175	Single	Brazed	T	SM175-3CAM	SM175-4CAM	SM175-6CAM	SM175-7CAM	SM175-9CAM
		Rotolock	T	SM175-3RM	SM175-4RM	SM175-6RM	SM175-7RM	SM175-9RM
SM185	Single	Brazed	T	SM185-3CAM	SM185-4CAM	SM185-6CAM	SM185-7CAM	SM185-9CAM
		Rotolock	T	SM185-3RM	SM185-4RM	SM185-6RM	SM185-7RM	SM185-9RM
SY240	Single	Brazed	M24	SY240A3AAM	SY240A4AAM	SY240A6AAM	SY240A7AAM	SY240A9AAM
		Brazed	M230	SY240A3ABM	SY240A4ABM	SY240A6ABM	SY240A7ABM	SY240A9ABM
		Rotolock	M24	SY240A3MAM	SY240A4MAM	SY240A6MAM	SY240A7MAM	SY240A9MAM
		Rotolock	M230	SY240A3MBM	SY240A4MBM	SY240A6MBM	SY240A7MBM	SY240A9MBM
SY300	Single	Brazed	M24	SY300A3AAM	SY300A4AAM	SY300A6AAM	SY300A7AAM	SY300A9AAM
		Brazed	M230	SY300A3ABM	SY300A4ABM	SY300A6ABM	SY300A7ABM	SY300A9ABM
		Rotolock	M24	SY300A3MAM	SY300A4MAM	SY300A6MAM	SY300A7MAM	SY300A9MAM
		Rotolock	M230	SY300A3MBM	SY300A4MBM	SY300A6MBM	SY300A7MBM	SY300A9MBM

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: data not available at the printing date of this document

## ORDERING INFORMATION AND PACKAGING

### SZ compressors in industrial-pack (Multiple packaging)

## R407C / R134a

Compressor model	Design	Connections	Motor protection	Code no.				
				3	4	6	7	9
				200-230/3/60	460/3/60 400/3/50	230/3/50	575/3/60 500/3/50	380/3/60
SZ084	Single	Brazed	Int	SZ084-3VM	SZ084-4VM	SZ084-6VM	SZ084-7VM	SZ084-9VM
SZ090	Single	Brazed	Int	SZ090-3VM	SZ090-4VM	SZ090-6VM	SZ090-7VM	SZ090-9VM
SZ100	Single	Brazed	Int	SZ100-3VM	SZ100-4VM	SZ100-6VM	SZ100-7VM	SZ100-9VM
SZ110	Single	Brazed	Int	SZ110-3VM	SZ110-4VM	SZ110-6VM	SZ110-7VM	SZ110-9VM
SZ115	Single	Brazed	T	SZ115-3CAM	SZ115-4CAM	SZ115-6CAM	SZ115-7CAM	SZ115-9CAM
		Rotolock	T	SZ115-3RM	SZ115-4RM	SZ115-6RM	SZ115-7RM	SZ115-9RM
SZ120	Single	Brazed	Int	SZ120-3VM	SZ120-4VM	SZ120-6VM	SZ120-7VM	SZ120-9VM
SZ125	Single	Brazed	T	SZ125-3CAM	SZ125-4CAM	SZ125-6CAM	SZ125-7CAM	SZ125-9CAM
		Rotolock	T	SZ125-3RM	SZ125-4RM	SZ125-6RM	SZ125-7RM	SZ125-9RM
SZ148	Single	Brazed	Int	SZ148-3VAM	SZ148-4VAM	SZ148-6VAM	SZ148-7VAM	SZ148-9VAM
SZ160	Single	Brazed	T	SZ160-3CBM	SZ160-4CBM	SZ160-6CBM	SZ160-7CAM	SZ160-9CBM
		Rotolock	T	SZ160-3RAM	SZ160-4RAM	SZ160-6RAM	SZ160-7RAM	SZ160-9RAM
SZ161	Single	Brazed	Int	SZ161-3VAM	SZ161-4VAM	SZ161-6VAM	SZ161-7VAM	SZ161-9VAM
SZ175	Single	Brazed	T	SZ175-3CAM	SZ175-4CAM	SZ175-6CAM	SZ175-7CAM	SZ175-9CAM
		Rotolock	T	SZ175-3RM	SZ175-4RM	SZ175-6RM	SZ175-7RM	SZ175-9RM
SZ185	Single	Brazed	T	SZ185-3CAM	SZ185-4CAM	SZ185-6CAM	SZ185-7CAM	SZ185-9CAM
		Rotolock	T	SZ185-3RM	SZ185-4RM	SZ185-6RM	SZ185-7RM	SZ185-9RM
SZ240	Single	Brazed	M24	SZ240A3AAM	SZ240A4AAM	SZ240A6AAM	SZ240A7AAM	SZ240A9AAM
		Brazed	M230	SZ240A3ABM	SZ240A4ABM	SZ240A6ABM	SZ240A7ABM	SZ240A9ABM
		Rotolock	M24	SZ240A3MAM	SZ240A4MAM	SZ240A6MAM	SZ240A7MAM	SZ240A9MAM
		Rotolock	M230	SZ240A3MBM	SZ240A4MBM	SZ240A6MBM	SZ240A7MBM	SZ240A9MBM
SZ300	Single	Brazed	M24	SZ300A3AAM	SZ300A4AAM	SZ300A6AAM	SZ300A7AAM	SZ300A9AAM
		Brazed	M230	SZ300A3ABM	SZ300A4ABM	SZ300A6ABM	SZ300A7ABM	SZ300A9ABM
		Rotolock	M24	SZ300A3MAM	SZ300A4MAM	SZ300A6MAM	SZ300A7MAM	SZ300A9MAM
		Rotolock	M230	SZ300A3MBM	SZ300A4MBM	SZ300A6MBM	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

## ORDERING INFORMATION AND PACKAGING

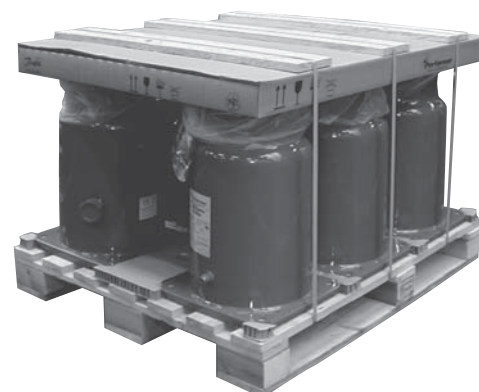
### Packaging



Multipack							Single pack (Individual packaging)			
Compressor models	Nbr*	Length mm	Width mm	Height mm	Gross weight kg	Static stacking pallets	Length mm	Width mm	Height mm	Gross weight kg
SM/SZ 084	6	1140	950	737	427	3	470	370	596	67
SM/SZ 090	6	1140	950	737	439	3	470	370	596	69
SM/SZ 100	6	1140	950	737	439	3	470	370	596	69
SM/SZ 110-120	6	1140	950	737	493	3	470	370	596	78
SM/SZ 115-125	6	1140	950	812	517	3	470	370	671	82
SM/SZ 160	6	1140	950	812	607	3	470	370	671	98
SM/SZ 148-161	6	1140	950	812	553	3	470	370	671	88
SM/SZ 175-185	6	1230	970	839	655	2	470	400	698	106
SY/SZ 240	4	1140	950	921	641	2	510	465	780	156
SY/SZ 300	4	1140	950	921	641	2	510	465	780	161
SY/SZ 380	4	1140	950	945	653	2	510	465	804	164

\* Nbr = number of compressors per pallet

Industrial pack (Multiple packaging)						
Compressor models	Nbr*	Length mm	Width mm	Height mm	Gross weight kg	Static stacking pallets
SM/SZ 084	8	1140	950	707	550	3
SM/SZ 090	8	1140	950	707	566	3
SM/SZ 100	8	1140	950	707	566	3
SM/SZ 110-120	8	1140	950	757	638	3
SM/SZ 115-125	6	1140	950	768	510	3
SM/SZ 160	6	1140	950	830	600	3
SM/SZ 148-161	6	1140	950	790	546	3
SM/SZ 175-185	6	1140	950	877	648	2
SY/SZ 240	4	1140	950	904	635	2
SY/SZ 300	4	1140	950	915	635	2
SY/SZ 380	4	1140	950	939	647	2





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