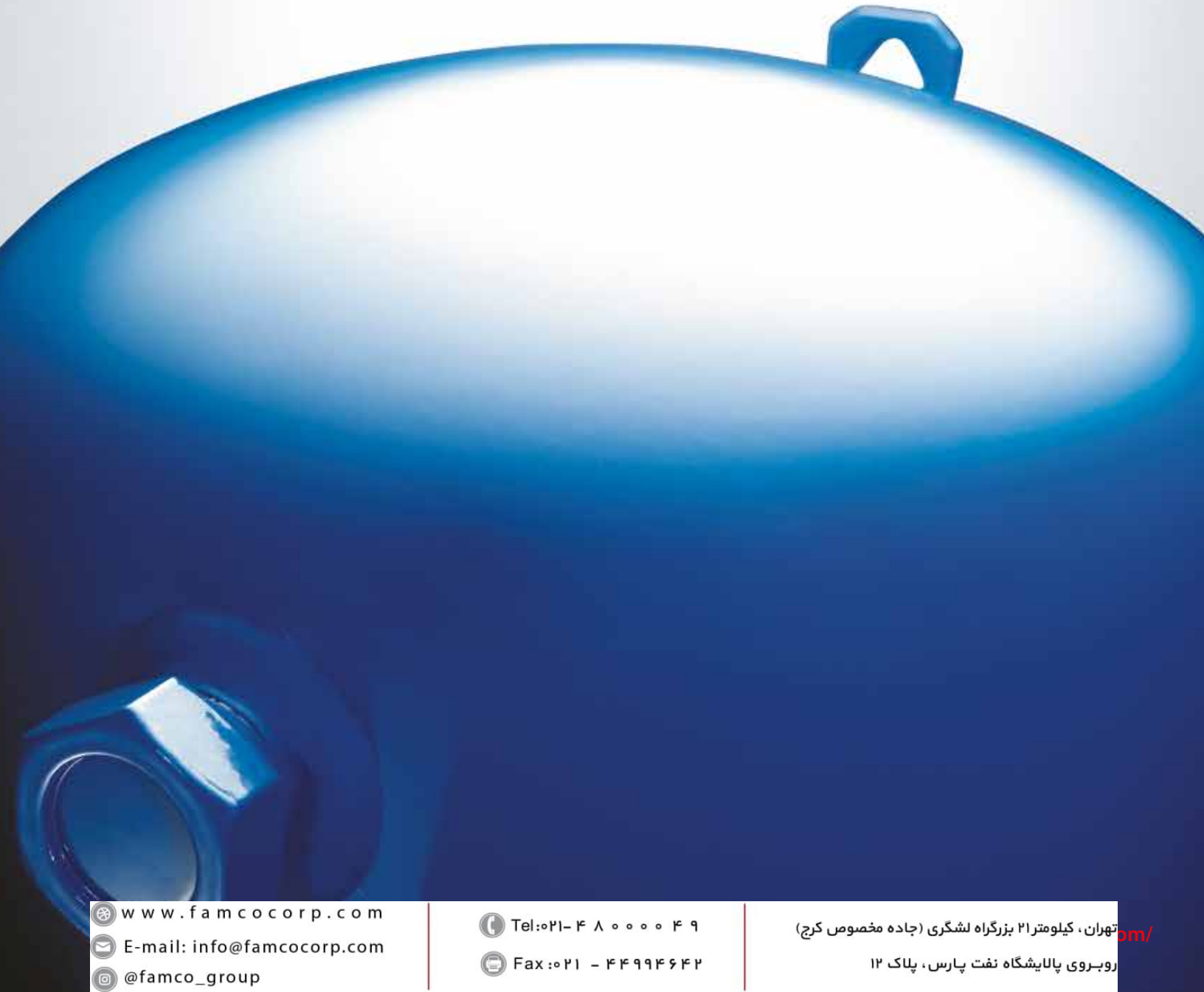
ENGINEERING
TOMORROW

Danfoss

Application guidelines

Maneurop® reciprocating compressors **MT / MTZ**

50 - 60 Hz - R22 - R417A - R407A/C/F - R134a - R404A / R507



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Maneurop® reciprocating compressors from Danfoss Commercial Compressors are specially designed for applications with a wide range of operating conditions. All components are of high quality and precision in order to assure a long product life.

Maneurop® MT and MTZ series compressors are hermetic reciprocating type designed for medium and high evaporating temperature applications.

The positive benefits of internal motor protection, high efficiency circular valve design and high torque motors provide for a quality installation.

MT & MTZ have the same mechanical and motor design.

MT is charged with mineral oil while MTZ with polyester oil.

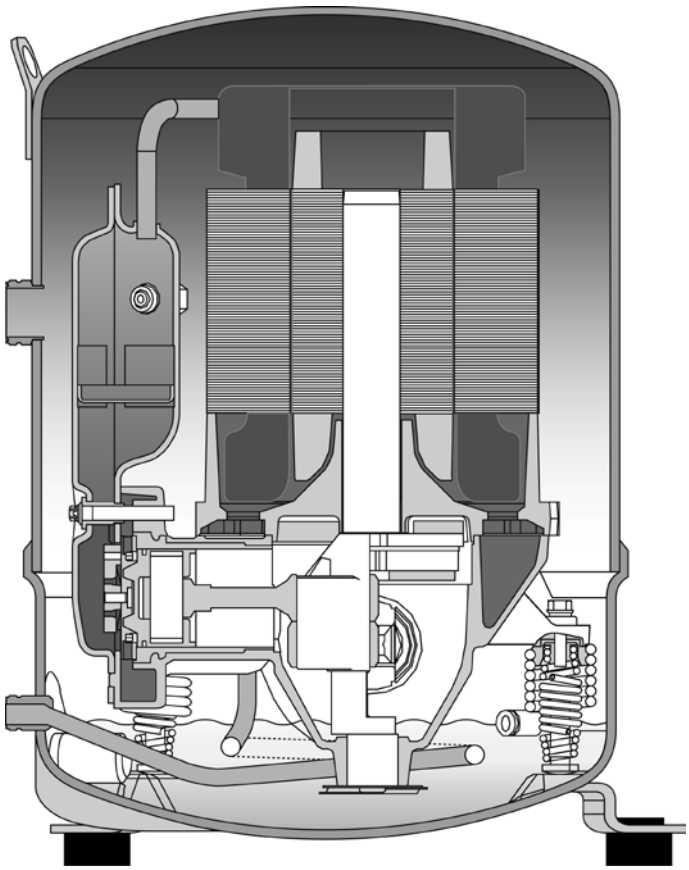
These compressor ranges can be used with a large choice of refrigerants according their compatibility with the oil.

MTZ compressors can be used in new installations and also to replace Maneurop® MTE compressors in existing installations.

MT and MTZ compressors have a large internal free volume that protects against the risk of liquid hammering when liquid refrigerant enters the compressor.

MT and MTZ compressors are fully suction-gas cooled. This means that no additional compressor cooling is required and allows the compressors to be insulated with acoustic jackets, to obtain lower sound levels, without the risk of compressor overheating.

MT and MTZ compressors are available in 16 different models with displacement ranging from 1.84 to 16.57 in^3/rev. Seven different motor voltage ranges are available for single and three phase power supplies at 50 and 60 Hz. All compressors are available in VE version (oil equalisation + oil sight glass).



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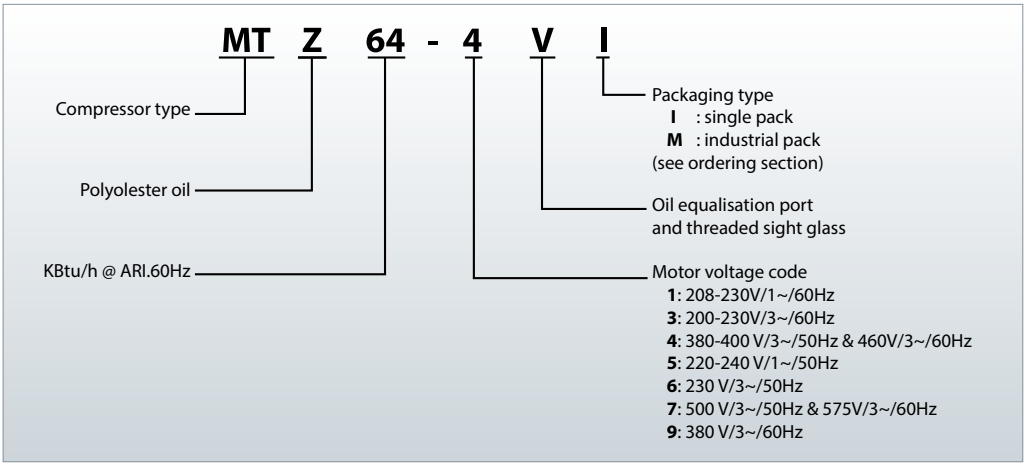
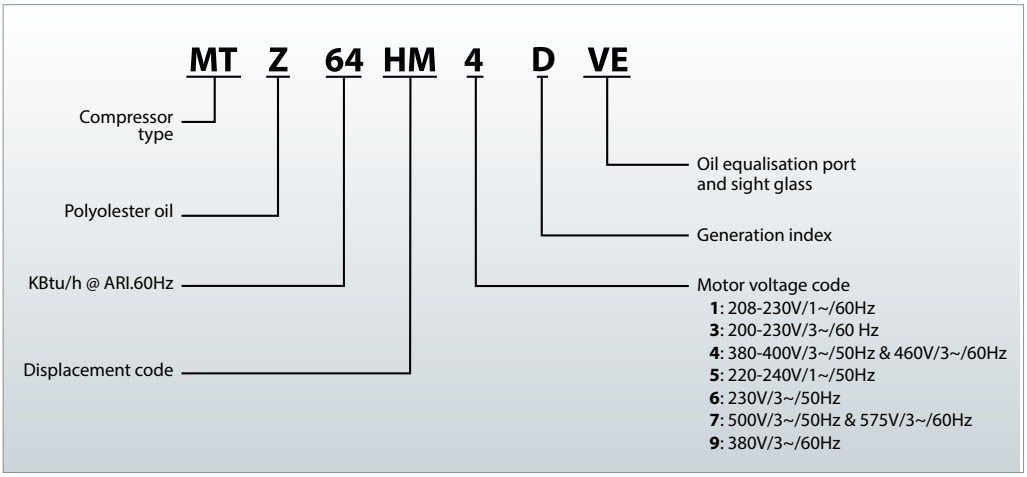
Code numbers (for ordering)



Available code numbers are listed section "Ordering information and packaging"

Compressor reference (indicated on the compressor nameplate)



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Technical specifications

Compressor model	Displacement			Cyl. number	Oil charge oz	Net weight lbs	Available motor voltage codes						
	Code	in3/rev	cfh at 3600 rpm				1	3	4	5	6	7	9
MT/MTZ018	**JA**	1.84	231	1	32	46	●	●	●	●	-	-	-
MT/MTZ022	**JC**	2.33	291	1	32	46	●	●	●	●	●	-	●
MT/MTZ028	**JE**	2.93	367	1	32	51	●	●	●	●	●	-	○
MT/MTZ032	**JF**	3.29	411	1	32	53	●	●	●	●	●	○	●
MT/MTZ036	**JG**	3.69	461	1	32	55	●	●	●	●	●	○	●
MT/MTZ040	**JH**	4.14	518	1	32	57	●	●	●	-	●	-	-
MT/MTZ044	**HJ**	4.65	581	2	61	77	●	●	●	-	○	○	●
MT/MTZ050	**HK**	5.23	653	2	61	77	●	●	●	-	●	○	●
MT/MTZ056	**HL**	5.87	733	2	61	82	●	●	●	-	●	●	●
MT/MTZ064	**HM**	6.57	822	2	61	82	●	●	●	-	●	-	●
MT/MTZ072	**HN**	7.38	922	2	61	88	-	●	●	-	●	-	●
MT/MTZ080	**HP**	8.29	1036	2	61	88	-	●	●	-	●	-	●
MT/MTZ100	**HS**	10.45	1306	4	132	132	-	●	●	-	●	●	●
MT/MTZ125	**HU**	13.15	1643	4	132	141	-	●	●	-	●	●	●
MT/MTZ144	**HV**	14.76	1845	4	132	148	-	●	●	-	●	●	●
MT/MTZ160	**HW**	16.57	2071	4	132	148	-	●	●	-	●	●	●

● Available in MT and MTZ ○ Available in MTZ only

Approvals and certificates

Maneurop® MT/MTZ compressors comply with the following approvals and certificates.

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

CE 0062 or CE 0038 (European Directive)	CE	All models
UL (Underwriters Laboratories)	c UL us	All 60 Hz models
CCC (China Compulsory Product Certification)	CCC	Models code 4 and 5 under CC scope
EAC Eurasian conformity mark	EAC	All models voltage code 4 and 5

Pressure equipment directive 2014/68/EU

Products	MT/ MTZ018 to 040	MT/ MTZ044 to 160
Refrigerating fluids	Group 2	Group 2
Category PED	I	II
Evaluation module	no scope	D1
Maximum/minimum allowable temperature - TS	122°F > Ts > -31°F	122°F > Ts > -31°F
MT maximum allowable pressure - PS	267 psig	267 psig
MTZ maximum allowable pressure - PS	328 psig	328 psig

Low voltage directive 2014/35/EU

Products	MT/ MTZ018 to 040	MT/ MTZ044 to 160
Manufacturer's declaration	contact Danfoss	contact Danfoss

Machinery directive 2014/30/EU

Products	MT/MTZ 018 to 040	MT/MTZ 044 to 160
Manufacturer's declaration	contact Danfoss	contact Danfoss

Internal free volume

Products	Volume (gallon)	
	Low side	High side
1 cyl.	2.049	0.074
2 cyl.	4.525	0.166
4 cyl .	8.506	0.317

Nominal performance data for R404A and R22

R404A	Refrigeration											
Compressor model	50 Hz, EN12900 ratings To = 14°F, Tc = 113°F, SC = 0 F, SH = 18°F				50 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F				60 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4*	6500	1.21	2.73	5.40	7100	1.31	2.86	5.42	9000	1.76	2.86	5.10
MTZ022-4*	9000	1.48	3.06	6.05	9700	1.62	3.24	5.97	12300	2.05	3.27	6.01
MTZ028-4*	11700	1.96	4.04	5.98	12600	2.15	4.30	5.89	16000	2.68	4.23	5.96
MTZ032-4*	13600	2.16	4.25	6.29	14600	2.37	4.56	6.15	17500	2.99	4.56	5.85
MTZ036-4*	15900	2.58	4.95	6.19	17100	2.83	5.33	6.03	20200	3.34	5.10	6.05
MTZ040-4*	18200	2.95	5.87	6.17	19400	3.25	6.30	5.98	23000	3.77	5.89	6.11
MTZ044-4*	18300	2.78	5.35	6.60	19800	3.02	5.68	6.54	24300	3.85	5.85	6.31
MTZ050-4*	21400	3.22	5.95	6.64	22900	3.50	6.33	6.54	28600	4.42	6.53	6.47
MTZ056-4*	22900	3.51	6.83	6.52	24800	3.85	7.26	6.44	32500	4.98	7.53	6.51
MTZ064-4*	27200	4.20	7.82	6.48	29400	4.60	8.35	6.38	36100	5.67	8.32	6.36
MTZ072-4*	30400	4.69	8.95	6.50	32700	5.12	9.51	6.40	40900	6.53	9.74	6.26
MTZ080-4*	35700	5.61	10.20	6.37	38200	6.14	10.95	6.23	46500	7.82	11.36	5.95
MTZ100-4*	41900	6.76	12.21	6.20	45000	7.36	12.95	6.12	52900	8.72	12.79	6.07
MTZ125-4*	53600	8.44	13.79	6.35	57500	9.22	14.87	6.23	68300	11.37	15.41	6.00
MTZ144-4*	63100	9.78	16.29	6.46	67300	10.66	17.48	6.32	80500	13.00	17.94	6.19
MTZ160-4*	69300	11.08	18.26	6.26	74100	12.10	19.65	6.12	87400	14.74	20.18	5.93

* 50 Hz, EN12900 data for indicated models are Asercom certified

R404A data are also valid for refrigerant R507

R22	Refrigeration				Air conditioning							
Compressor model	50 Hz, EN12900 ratings To = 14°F, Tc = 113°F, SC = 0 F, SH = 18°F				50 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				60 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MT018-4	5770	1.00	2.27	5.77	13240	1.45	2073	9.13	15900	1.74	2.73	9.14
MT022-4	8500	1.29	2.55	6.59	18290	1.89	3.31	9.68	21980	2.27	3.31	9.68
MT028-4	12730	1.81	3.59	7.03	25190	2.55	4.56	9.88	30200	3.06	4.56	9.87
MT032-4	13480	2.11	3.73	6.39	27510	2.98	4.97	9.23	33040	3.58	4.97	9.23
MT036-4	16420	2.35	4.30	6.99	31640	3.37	5.77	9.39	37990	4.05	5.77	9.38
MT040-4	17820	2.67	4.86	6.67	35770	3.86	6.47	9.27	42900	4.63	6.47	9.27
MT044-4	16590	2.46	5.02	6.74	35900	3.53	6.37	10.17	43990	4.32	6.42	10.18
MT050-4	20030	2.94	5.53	6.81	41740	4.19	7.20	9.96	50140	5.04	7.26	9.95
MT056-4	21980	3.18	6.39	6.91	46930	4.58	8.19	10.25	56380	5.58	8.23	10.10
MT064-4	26450	3.64	7.03	7.27	53690	5.27	9.16	10.19	64330	6.32	9.33	10.18
MT072-4	29730	4.19	8.48	7.10	62120	6.12	10.98	10.15	74540	7.33	10.77	10.17
MT080-4	35360	4.89	9.52	7.23	70780	7.08	12.48	10.00	84910	8.50	12.34	9.99
MT100-4	38670	5.79	11.82	6.68	79860	7.98	14.59	10.01	95840	9.58	14.59	10.00
MT125-4	52080	7.55	12.28	6.90	103860	10.66	17.37	9.74	124610	12.8	17.37	9.74
MT144-4	58980	8.47	17.06	6.96	117200	11.95	22.75	9.81	140650	14.35	22.75	9.80
MT160-4	65490	9.49	16.81	6.90	130610	13.40	22.16	9.75	156760	16.08	22.16	9.75

To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)

SC: Subcooling
SH: Superheat

ARI capacity and power input data are +/- 5%
Asercom: Association of European Refrigeration Compressor and Controls Manufacturers
ARI: Air Conditioning and Refrigeration Institute

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Nominal performance data for R407C and R134a

R407C	Air conditioning											
Compressor model	50 Hz, EN12900 ratings To = +41°F, Tc = 122°F, SC = 0F, SH = 18°F				50 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				60 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4*	11840	1.27	2.73	9.32	13140	1.38	2.86	9.52	17240	1.73	2.82	9.96
MTZ022-4*	15530	1.71	3.27	9.08	17130	1.86	3.47	9.21	21430	2.26	3.45	9.48
MTZ028-4*	20070	2.17	4.30	9.25	22320	2.36	4.57	9.46	28050	2.82	4.41	9.95
MTZ032-4*	22700	2.43	4.57	9.34	25020	2.65	4.90	9.44	30680	3.20	4.80	9.59
MTZ036-4*	25630	2.93	5.58	8.75	28260	3.21	5.99	8.80	34100	3.90	5.78	8.74
MTZ040-4*	29560	3.40	6.46	8.69	32700	3.71	6.92	8.81	40000	4.46	6.69	8.97
MTZ044-4*	31160	3.12	5.84	9.99	34470	3.38	6.18	10.20	43450	4.25	6.34	10.22
MTZ050-4*	35560	3.69	6.51	9.64	39350	4.01	6.95	9.81	48160	4.87	7.06	9.89
MTZ056-4*	39860	4.02	7.45	9.92	44370	4.37	7.91	10.15	54780	5.40	8.03	10.14
MTZ064-4*	45600	4.61	8.35	9.89	50680	5.02	8.91	10.10	61710	6.14	9.01	10.05
MTZ072-4*	52290	5.42	9.85	9.65	58190	5.87	10.48	9.91	70920	7.30	10.61	9.72
MTZ080-4*	59320	6.29	11.31	9.43	65970	6.83	12.08	9.66	78050	8.24	11.99	9.47
MTZ100-4*	69900	7.38	13.05	9.47	77470	8.00	13.83	9.68	96310	9.86	14.22	9.77
MTZ125-4*	91740	9.48	15.14	9.68	101640	10.32	16.28	9.85	121570	12.83	18.07	9.48
MTZ144-4*	101600	10.68	17.55	9.51	112830	11.59	18.80	9.74	139590	14.42	19.81	9.68
MTZ160-4*	116350	12.40	20.08	9.38	129040	13.46	21.50	9.59	154330	16.64	22.46	9.27

* 50 Hz, EN12900 data for indicated models are Asercom certified

R134a	Refrigeration				Air conditioning							
Compressor model	50 Hz, EN12900 ratings To = 14°F, Tc = 113°F, SC = 0 F, SH = 18°F				50 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				60 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4	3670	0.69	1.92	5.33	8640	0.99	2.19	8.73	10370	1.19	2.29	8.73
MTZ022-4	4800	0.82	2.16	5.89	11380	1.20	2.51	9.50	13660	1.44	2.62	9.50
MTZ028-4	6220	1.02	2.83	6.10	14400	1.53	3.30	9.40	17280	1.84	3.44	9.40
MTZ032-4	7090	1.25	3.33	5.68	16750	1.87	3.94	8.95	20110	2.25	4.11	8.95
MTZ036-4	9390	1.45	3.32	6.48	20530	2.13	4.09	9.61	24640	2.56	4.26	9.61
MTZ040-4	9940	1.61	3.81	6.18	21650	2.34	4.89	9.27	25980	2.80	5.10	9.27
MTZ044-4	9980	1.49	4.05	6.68	23340	2.22	4.73	10.51	28010	2.67	4.94	10.51
MTZ050-4	11480	1.80	4.32	6.37	27160	2.63	5.20	10.32	32600	3.16	5.43	10.32
MTZ056-4	12030	1.88	5.31	6.39	29440	2.85	6.17	10.34	35330	3.42	6.44	10.34
MTZ064-4	14300	2.17	5.71	6.60	34340	3.27	6.81	10.51	41210	3.92	7.10	10.51
MTZ072-4	16630	2.50	6.67	6.64	39420	3.78	7.99	10.42	47300	4.54	8.33	10.42
MTZ080-4	19980	2.93	7.22	6.82	45280	4.36	8.84	10.39	54340	5.23	9.21	10.39
MTZ100-4	22580	3.65	8.67	6.19	52760	5.28	10.25	9.99	63310	6.34	10.69	9.99
MTZ125-4	28340	4.17	8.35	6.79	64670	6.29	10.81	10.27	77600	7.55	11.27	10.28
MTZ144-4	36620	5.40	11.02	6.78	80360	7.83	13.79	10.26	96430	9.40	14.39	10.26
MTZ160-4	40610	5.84	11.37	6.96	88010	8.58	14.68	10.26	105600	10.30	15.31	10.25

To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)

SC: Subcooling
SH: Superheat

ARI capacity and power input data are +/- 5%
Asercom: Association of European Refrigeration Compressor and Controls Manufacturers
ARI: Air Conditioning and Refrigeration Institute

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Nominal performance data for R407A and R407F

R407A	Refrigeration											
Compressor model	50 Hz, EN12900 ratings To = 14°F, Tc = 113°F, SC = 0 F, SH = 18°F				50 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F				60 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4	5900	1.02	2.46	5.81	6600	1.12	2.58	5.91	8000	1.35	2.69	5.91
MTZ022-4	8200	1.26	2.75	6.49	9100	1.39	2.91	6.50	10900	1.67	3.04	6.50
MTZ028-4	10700	1.67	3.63	6.41	11900	1.85	3.87	6.41	14200	2.22	4.04	6.41
MTZ032-4	12400	1.84	3.82	6.74	13700	2.04	4.10	6.70	16400	2.45	4.28	6.70
MTZ036-4	14500	2.19	4.45	6.64	16000	2.43	4.80	6.56	19200	2.92	5.00	6.56
MTZ040-4	16700	2.51	5.28	6.63	18300	2.80	5.67	6.51	21900	3.37	5.92	6.51
MTZ044-4	16700	2.36	4.81	7.08	18500	2.60	5.11	7.12	22200	3.12	5.33	7.12
MTZ050-4	19500	2.73	5.35	7.13	21500	3.01	5.70	7.14	25800	3.61	5.94	7.14
MTZ056-4	20900	2.98	6.14	7.00	23200	3.30	6.53	7.03	27800	3.96	6.81	7.03
MTZ064-4	24800	3.57	7.04	6.95	27500	3.95	7.52	6.95	33000	4.75	7.84	6.95
MTZ072-4	27800	3.98	8.05	6.98	30700	4.40	8.56	6.97	36800	5.28	8.92	6.97
MTZ080-4	32600	4.76	9.17	6.84	35800	5.28	9.86	6.78	43000	6.34	10.28	6.78
MTZ100-4	38200	5.74	10.98	6.66	42100	6.32	11.65	6.67	50600	7.59	12.16	6.67
MTZ125-4	48900	7.17	12.40	6.82	53800	7.93	13.38	6.79	64600	9.52	13.96	6.79
MTZ144-4	57600	8.32	14.65	6.92	63100	9.18	15.73	6.87	75700	11.03	16.41	6.87
MTZ160-4	63200	9.42	16.42	6.71	69400	10.43	17.69	6.65	83300	12.52	18.45	6.65

To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)
SC: Subcooling
SH: Superheat

R407F	Refrigeration											
Compressor model	50 Hz, EN12900 ratings To = 14°F, Tc = 113°F, SC = 0 F, SH = 18°F				50 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F				60 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4	6300	1.08	2.53	5.82	7100	1.19	2.66	5.96	8500	1.43	2.78	5.96
MTZ022-4	8700	1.33	2.83	6.52	9700	1.48	3.01	6.57	11600	1.77	3.14	6.57
MTZ028-4	11300	1.76	3.74	6.45	12700	1.96	4.00	6.48	15200	2.35	4.17	6.48
MTZ032-4	13200	1.94	3.93	6.78	14600	2.16	4.24	6.77	17600	2.59	4.42	6.77
MTZ036-4	15400	2.32	4.58	6.67	17100	2.58	4.96	6.63	20500	3.10	5.17	6.63
MTZ040-4	17600	2.65	5.43	6.66	19500	2.96	5.86	6.58	23400	3.55	6.11	6.58
MTZ044-4	17700	2.49	4.95	7.12	19900	2.76	5.28	7.20	23800	3.31	5.51	7.20
MTZ050-4	20700	2.90	5.50	7.14	23000	3.21	5.88	7.18	27600	3.85	6.14	7.18
MTZ056-4	22200	3.16	6.31	7.03	24900	3.51	6.75	7.09	29800	4.21	7.04	7.09
MTZ064-4	26400	3.78	7.23	6.99	29500	4.20	7.76	7.03	35400	5.03	8.10	7.03
MTZ072-4	29500	4.21	8.27	7.00	32900	4.67	8.84	7.04	39400	5.60	9.22	7.04
MTZ080-4	34600	5.04	9.43	6.87	38400	5.60	10.18	6.86	46100	6.72	10.62	6.85
MTZ100-4	40600	6.07	11.28	6.69	45200	6.71	12.04	6.74	54300	8.05	12.56	6.74
MTZ125-4	51900	7.58	12.75	6.85	57700	8.41	13.83	6.86	69200	10.09	14.42	6.86
MTZ144-4	61100	8.78	15.06	6.96	67600	9.73	16.25	6.95	81100	11.67	16.95	6.95
MTZ160-4	67100	9.95	16.88	6.75	74300	11.04	18.27	6.73	89200	13.25	19.06	6.73

To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)
SC: Subcooling
SH: Superheat

Asercom: Association of European Refrigeration Compressor and Controls Manufacturers
ARI: Air Conditioning and Refrigeration Institute

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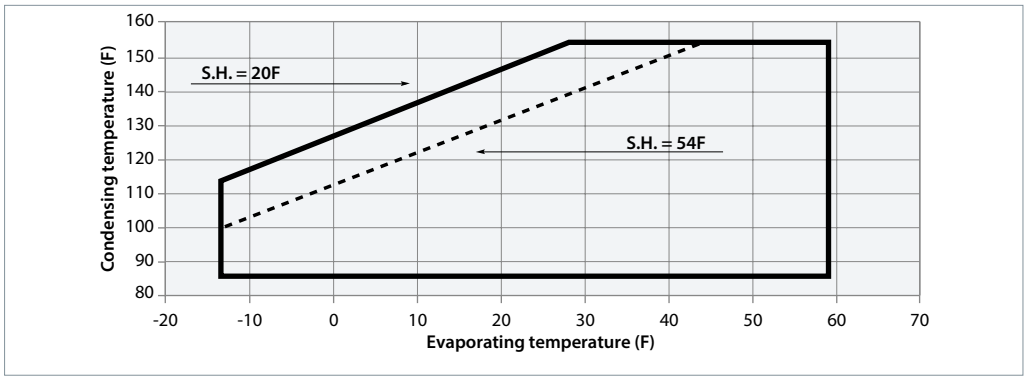
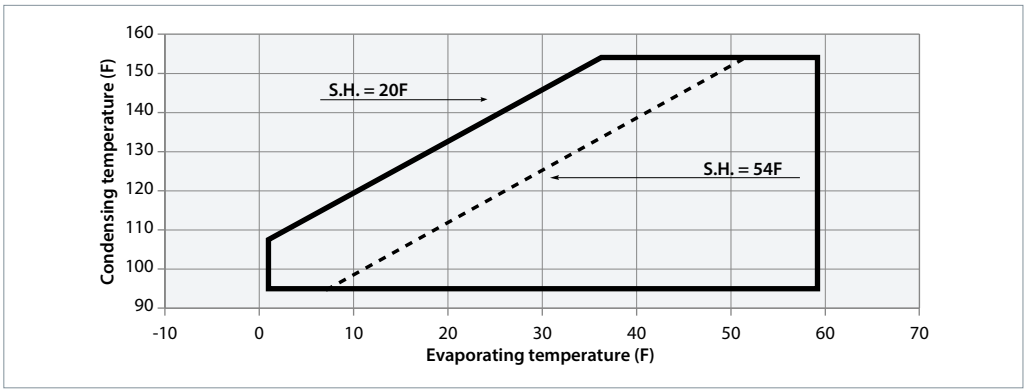
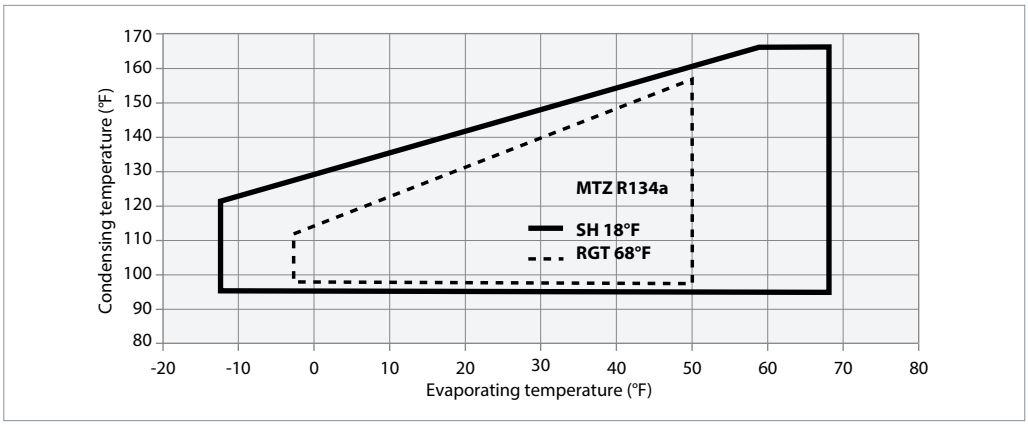
MT - R22 - R417A



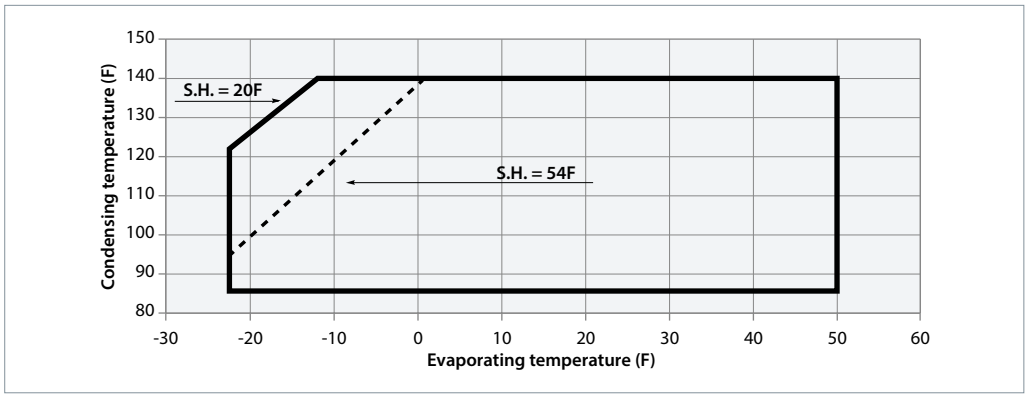
MTZ - R407C at DEW point



MTZ - R134a

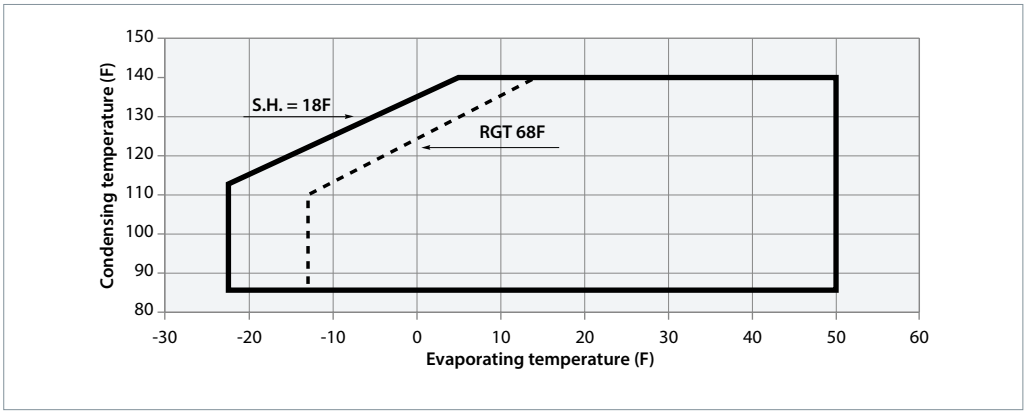


MTZ - R404A / R507

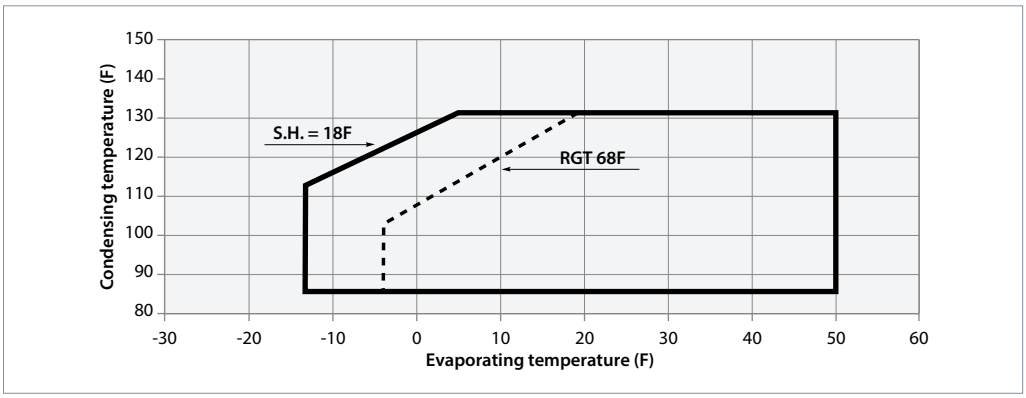


Application guidelines — Operating envelopes

MTZ – R407A at Dew Point



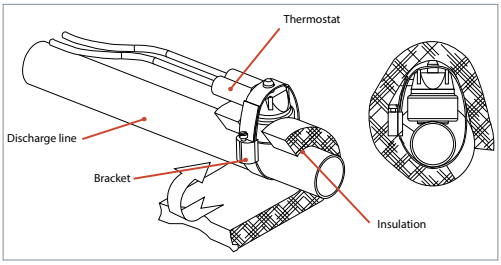
MTZ – R407F at Dew Point



Discharge temperature protection

Even when the motor windings are protected against overheating by the internal motor protection, the compressor discharge gas temperature could exceed the maximum allowed value of 275°F when the compressor is operated outside its application envelope. The most effective protection against too high discharge gas temperature is to mount a discharge gas thermostat. An accessory kit is available from Danfoss which includes the thermostat, mounting bracket and insulation.

The thermostat must be attached to the discharge line as indicated below at no more than 5.90 inch from the discharge connection.



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Zeotropic refrigerant mixtures

Refrigerant mixtures can be either zeotropic or azeotropic.

An azeotropic mixture (like R502 or R507) behaves like a pure refrigerant. During a phase transition (from vapor to liquid or from liquid to vapor) the composition of vapor and liquid stays the same.

In a zeotropic mixture (like R407C) on the other hand the composition of vapor and liquid changes during the phase transition. When the effect of this phase transition is very small, the mixture is often called a near-azeotropic mixture. R404A is such a near-azeotropic mixture.

The composition change causes phase shift and temperature glide.

Phase shift

In system components where both vapor and liquid phase are present (evaporator, condenser, liquid receiver), the liquid phase and vapor phase do not have the same composition. In fact both phases form two different refrigerants. Therefore zeotropic refrigerants need some special attention. Zeotropic refrigerants must always be charged in liquid phase. Flooded evaporators and suction accumulators should not be applied in systems with zeotropic refrigerants. This also applies to near-azeotropic mixtures.

Temperature glide

During the evaporating process and the condensing process at constant pressure, the refrigerant temperature will decrease in the condenser and rise in the evaporator. Therefore when speaking about evaporating and condensing temperatures, it is important to indicate whether this is a dew point temperature or a mean point value. In the figure below, the dotted lines are lines of constant temperature.

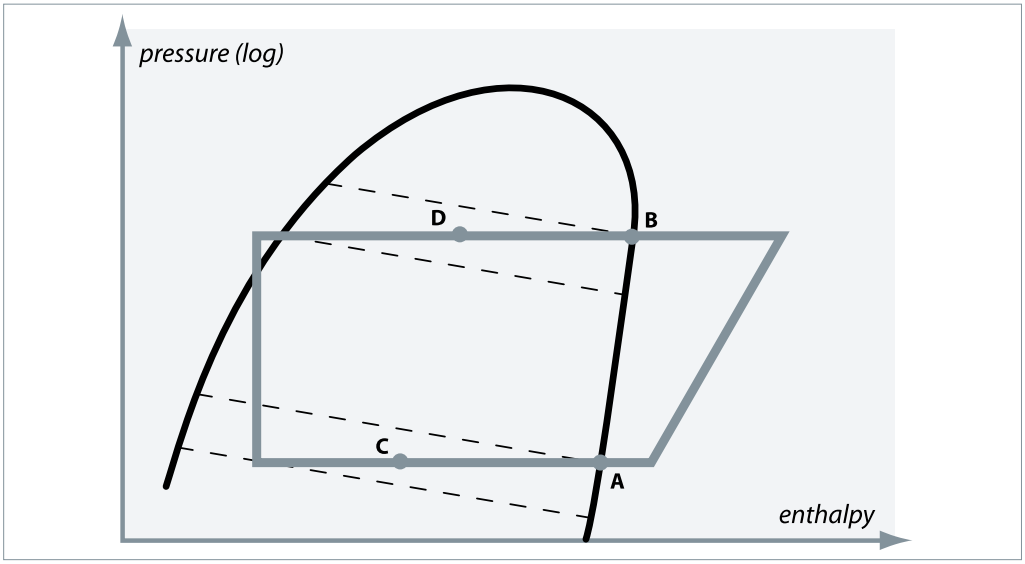
They do not correspond to the lines of constant pressure.

Points A and B are dew point values. These are temperatures on the saturated vapor line.

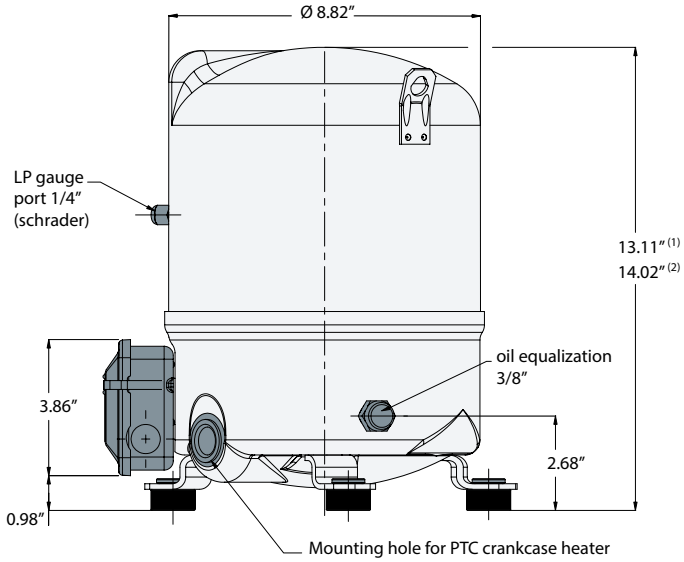
Points C and D are mean point values. These are temperatures which correspond more or less with the average temperature during the evaporating and condensing process. For the same cycle, mean point temperatures are typically about 3.6°F lower than dew point temperatures. According to Asercom recommendations, Danfoss Commercial Compressors uses dew point temperatures for selection tables and application envelopes etc.

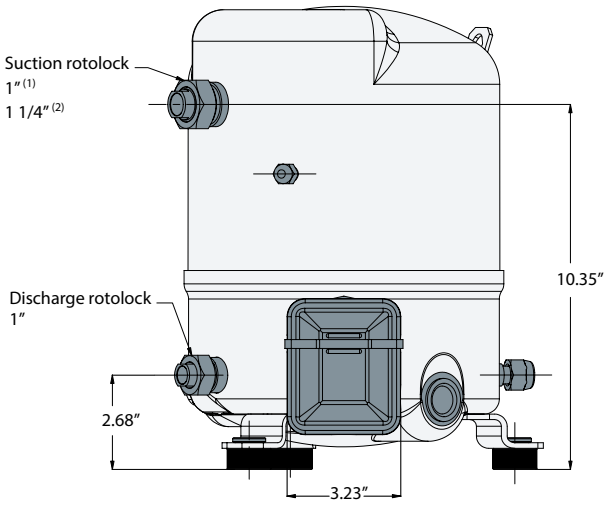
To obtain exact capacity data at mean point temperatures, the mean point temperatures must be converted to dew point temperatures with help of refrigerant data tables from the refrigerant manufacturer.

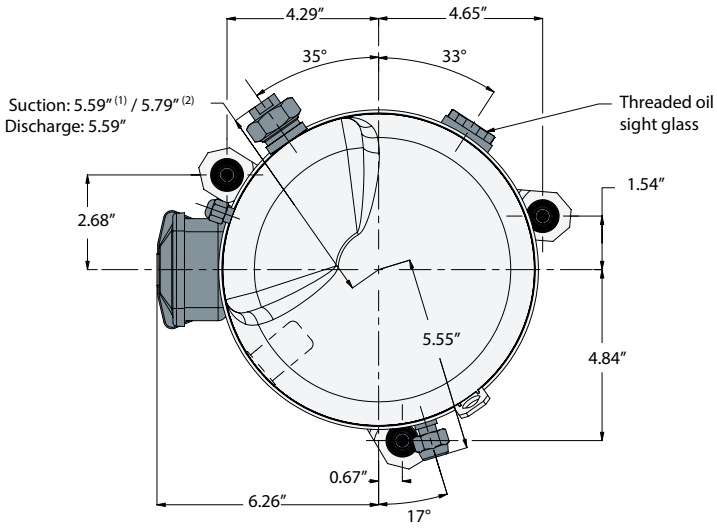
Dew temperature and Mean temperature for R407A/C/F



1 cylinder

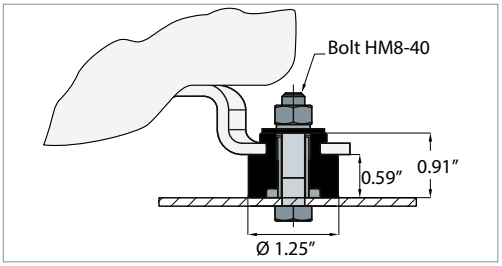




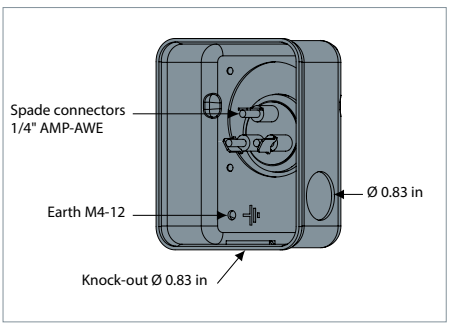


Model	Code						
	1	3	4	5	6	7	9
MT/MTZ018	(1)	(1)	(1)	(1)	-	-	-
MT/MTZ022	(2)	(1)	(1)	(1)	(1)	-	(1)
MT/MTZ028	(2)	(1)	(1)	(1)	(1)	-	(1)
MT/MTZ032	(2)	(2)	(2)	(2)	(2)	(2)	(2)
MT/MTZ036	(2)	(2)	(2)	(2)	(2)	(2)	(2)
MT/MTZ040	(2)	(2)	(2)	-	(2)	-	-

Silent bloc



Terminal box



IP rating: 55 (with cable gland)

	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
MT/MTZ018-022 (3/4/5/6/9)-028 (3/4/5/6)	1"	1"	1/2"	3/8"	V06	V01
MT/MTZ022/1-028/1-032 - 036 - 040	1 1/4"	1"	5/8"	1/2"	V09	V06

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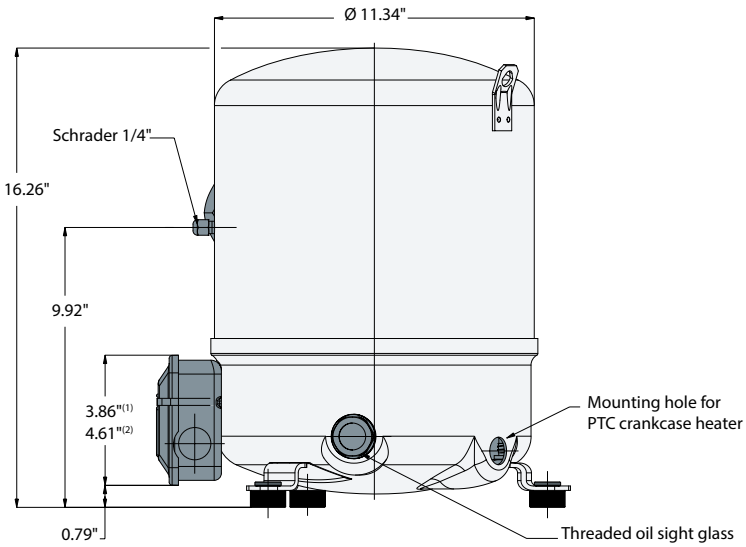
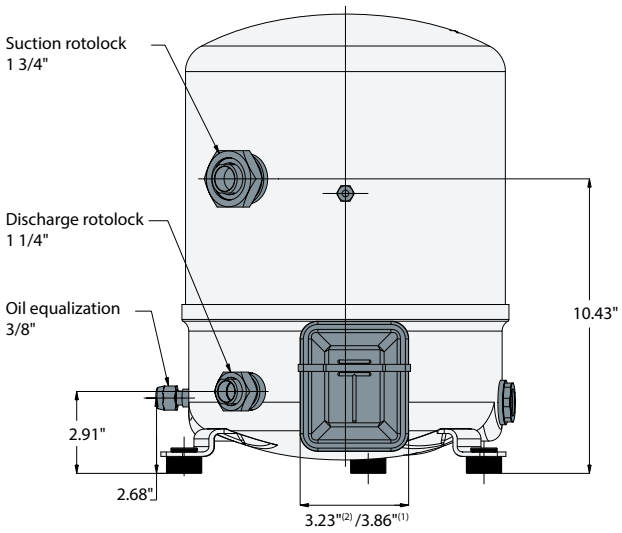
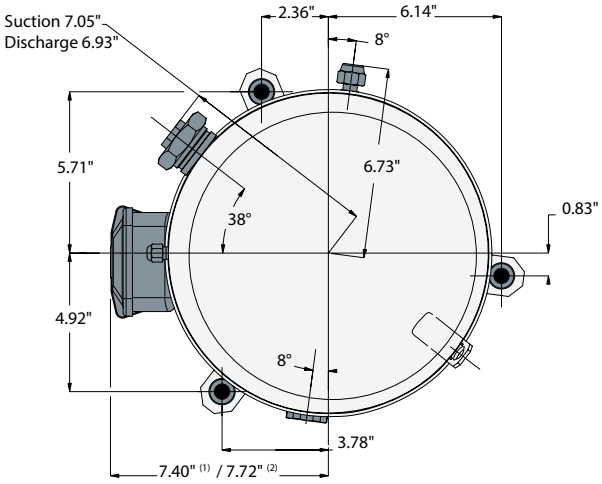
2 cylinders

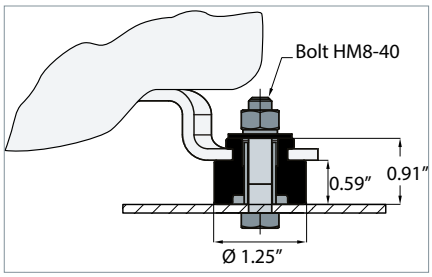




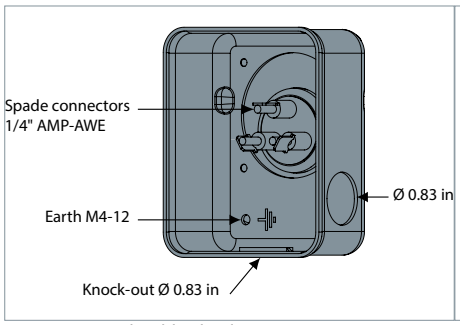


Model	Code					
	1	3	4	6	7	9
MT/MTZ044	(1)	(1)	(1)	(2)	(1)	(1)
MT/MTZ050	(2)	(1)	(1)	(2)	(1)	(1)
MT/MTZ056	(2)	(1)	(1)	(2)	(1)	(1)
MT/MTZ064	(2)	(1)	(1)	(2)	-	(1)
MT/MTZ072	-	(1)	(1)	(2)	-	(1)
MT/MTZ080	-	(2)	(1)	(2)	-	(1)

Silent bloc

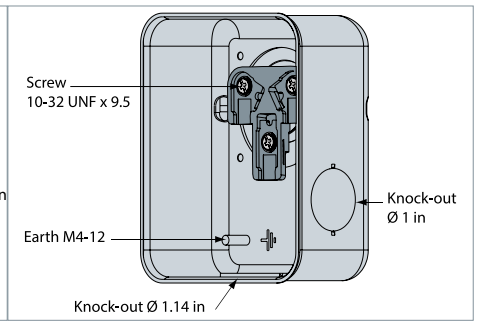


Terminal box for model (1)



IP rating: 55 (with cable gland)

Terminal box for model (2)



IP rating: 54 (with cable gland)

	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
MT/MTZ044 - 050 - 056 - 064 - 072	1 3/4"	1 1/4"	7/8"	3/4"	V07	V04
MT/MTZ080	1 3/4"	1 1/4"	1 1/8"	3/4"	V02	V04

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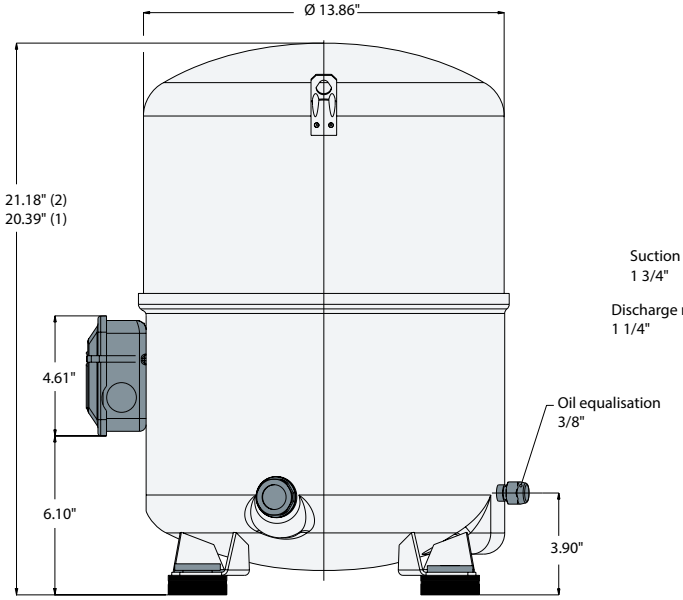
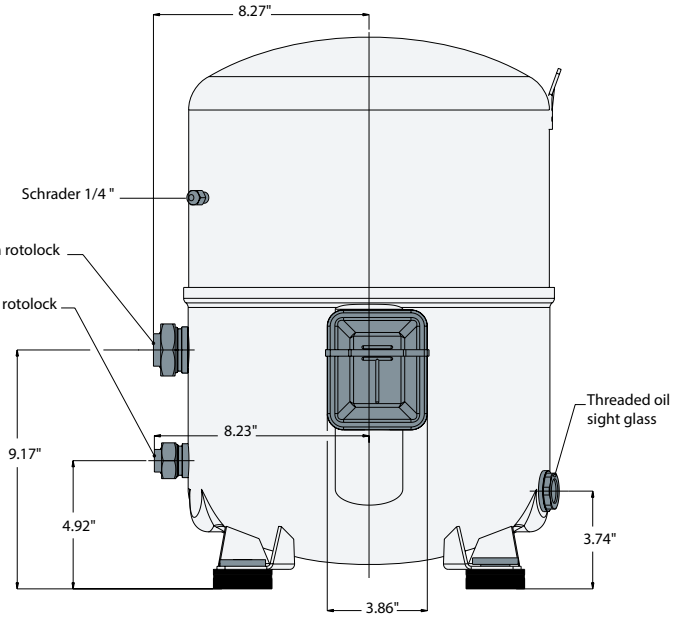
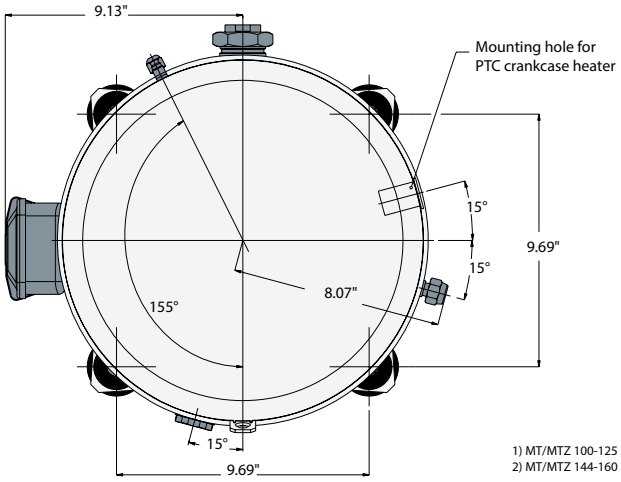
4 cylinders

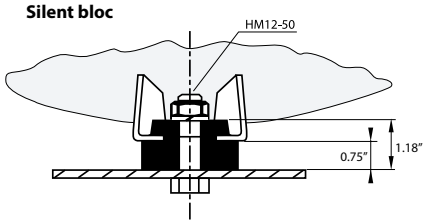




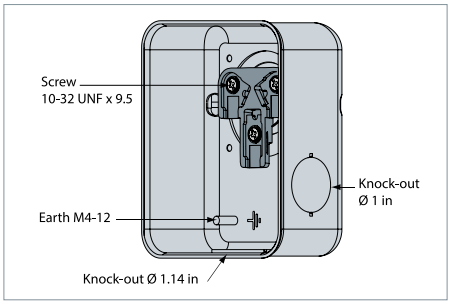


1) MT/MTZ 100-125 3/4/6/7/9
2) MT/MTZ 144-160 3/4/6/7/9

Silent bloc



Terminal box



IP rating: 54 (with cable gland)

	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
MT/MTZ100 - 125 - 144 - 160	1 3/4"	1 1/4"	1 1/8"	3/4"	V02	V04

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Single phase electrical characteristics

	LRA - Locked Rotor Current (A)		MCC - Maximum Continuous Current (A)		Winding resistance (Ω) (± 7 % at 68° F)			
Motor Code	1	5	1	5	1		5	
Winding					run	start	run	start
MT/MTZ018	51	40	13	10	1.32	4.16	1.32	3.75
MT/MTZ022	49.3	41	17	15	1.18	2.26	1.32	3.75
MT/MTZ028	81	51	25	20	0.67	1.80	1.05	3.19
MT/MTZ032	84	70	26.5	20	0.62	2.84	0.78	4.14
MT/MTZ036	84	60	30	22	0.62	2.84	0.78	4.14
MT/MTZ040	99	-	34	-	0.53	1.83	-	-
MT/MTZ044	97	-	31	-	0.45	1.90	-	-
MT/MTZ050	114	-	36	-	0.37	1.79	-	-
MT/MTZ056	136	-	42.5	-	0.32	1.61	-	-
MT/MTZ064	143	-	46	-	0.32	2.10	-	-

Nominal capacitor values and relays

	Models	PSC/CSR*		CSR only	
		Run capacitors (1)		Start capacitors (2)	Start relay
		(A) µF	(C) µF	(B) µF	
50 Hz	MT/MTZ018 JA-5	20	10	100	3ARR3J4A4 /RVA6AMKL
	MT/MTZ022 JC-5	20	10	100	
	MT/MTZ028 JE-5	20	10	100	
	MT/MTZ032 JF-5	25	10	135	
	MT/MTZ036 JG-5	25	10	135	
60 Hz	MT/MTZ018 JA-1	15	10	100	3ARR3J4A4 /RVA6AMKL
	MT/MTZ022 JC-1	30	15	100	
	MT/MTZ028 JE-1	25	25	135	
	MT/MTZ032 JF-1	25	20	100	
	MT/MTZ036 JG-1	25	20	100	
	MT/MTZ040 JH-1	35	20	100	
	MT/MTZ044 HJ-1	30	15	135	
	MT/MTZ050 HK-1	30	15	135	
	MT/MTZ056 HL-1	35	20	200	
	MT/MTZ064 HM-1	30	25	235	

* PSC: Permanent Split Capacitor
CSR: Capacitor Start Run
(1) Run capacitors: 440 volts
(2) Start capacitors: 330 Volts

Trickle circuit

The trickle circuit provides the facility of heating the compressor crankcase by feeding a small current to the auxiliary winding and the run capacitor (See the drawings page 14.)

By using PSC or CSR starting systems, compressor models MT / MTZ 018 - 022 can be operated without crankcase heaters as the heater function is provided by the trickle circuit.

For the larger single phase compressor models MT / MTZ 028 - 064, the use of the PTC crankcase heater is recommended.

PSC wiring

PSC wiring may be used for refrigerant circuits with capillary tubes or expansion valves with bleed ports. Pressure equalization must be ensured before start-up because of the low starting torque characteristics of this system.

CSR wiring

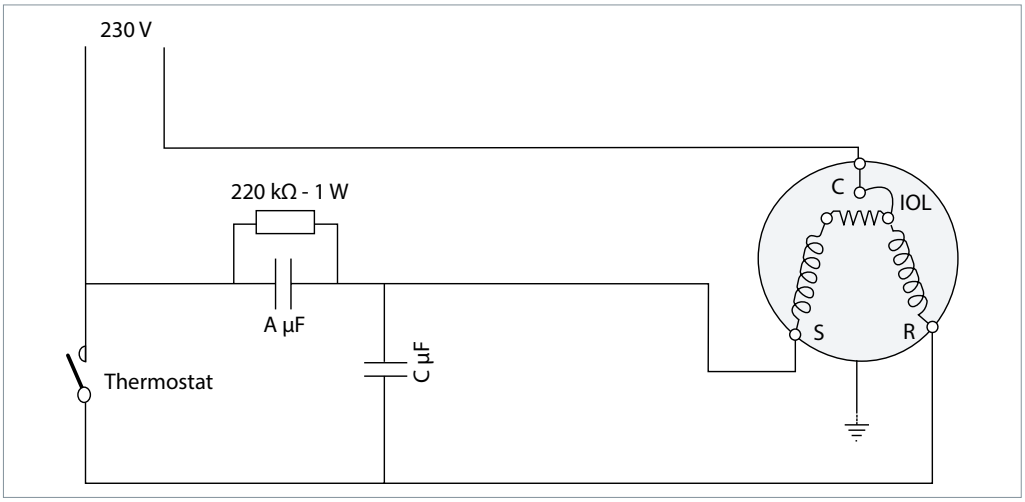
CSR wiring provides additional motor torque at start-up, by the use of a start capacitor in combination with the run capacitor. This system can be used for refrigerant circuits with capillary tubes or expansion valves. The start capacitor is only connected during the starting operation, a potential relay is used to disconnect it after the start sequence.

Some applications with high differential pressure can require a very high starting torque. For such cases the CSR starting kit can be converted to a very high starting torque kit by an additional start capacitor of 100 µF parallel to the start capacitor of the CSR kit. This configuration can also be used to reduce erratic starting at unfavorable conditions such as very low ambient temperature or weak voltage.

Suggested wiring diagrams

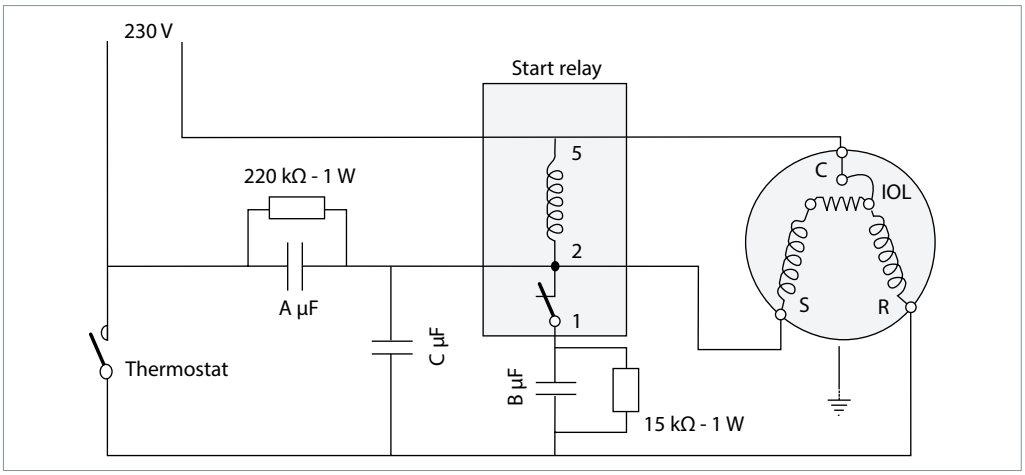
Single phase - PSC wiring with trickle circuit

IOL Motor protector
A & C Run capacitors
C Common
S Start winding (auxiliary)
R Run winding (main)



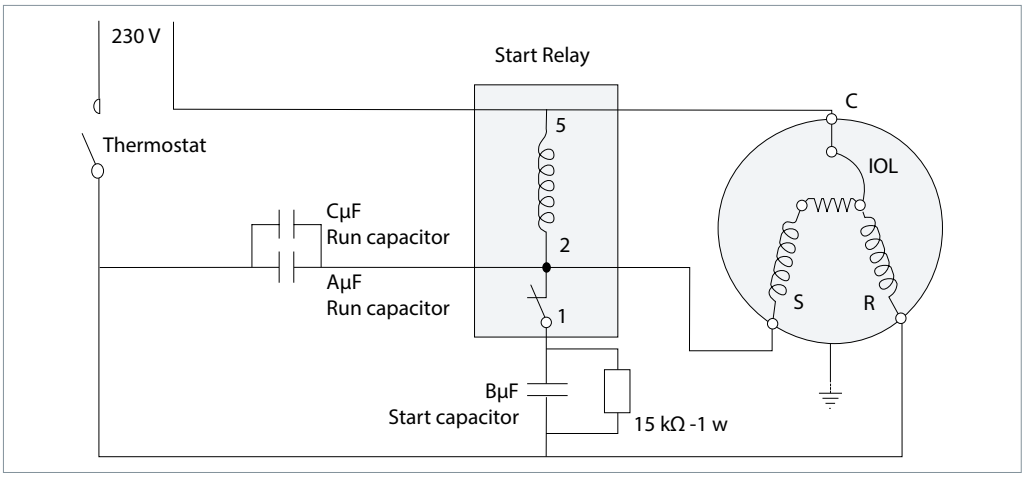
Single phase - CSR wiring with trickle circuit

IOL Motor protector
A & C Run capacitors
B Start capacitor
C Common
S Start winding (auxiliary)
R Run winding (main)



Single phase - CSR wiring without trickle circuit

IOL Motor protector
A+C Run capacitors
B Start capacitor
C Common
S Start winding (auxiliary)
R Run winding (main)
Capacitors A and C can be replaced by a single capacitor of size A + C
B capacitor delivered in two parts for MT(Z)56 & 64-1



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روبروی پالایشگاه نفت پارس، پلاک ۱۲

Three phase electrical characteristics

Motor Code	LRA - Locked Rotor Current (A)					MCC - Maximum Continuous Current (A)					Winding resistance (Ω) (± 7 % at 68° F)				
	3	4	6	7	9	3	4	6	7	9	3	4	6	7	9
MT/MTZ018	38	20	-	-	-	9	5	-	-	-	2.29	9.18	3.34	-	-
MT/MTZ022	38	20	30	-	22.5	11	6	8.5	-	6.5	2.29	11.6*	3.34	-	7.15
MT/MTZ028	57	23	41	-	32	16	7.5	11.5	-	8.5	1.38	6.17	1.18	-	4.62
MT/MTZ032	60	25	44	22	35	18	8	13	5.5	9	1.29	6.32	1.97	9.90	3.33
MT/MTZ036	74	30	74	26	35	17	9	17	7	9.5	1.08	5.43	1.08	7.76	3.33
MT/MTZ040	98	38	74	-	-	22	10	18	-	-	0.87	3.97	1.08	-	-
MT/MTZ044	115	48.5	77	44	78	22	9.5	16	8.5	13	0.74	3.22	1.13	5.83	1.68
MT/MTZ050	115	48.5	77	44	78	25	11.5	19	10	13.5	0.72	3.35	1.39	5.83	1.68
MT/MTZ056	130	64	105	50	72	24	12	23	11	15	0.55	2.39	0.76	3.86	1.64
MT/MTZ064	137	64	124	-	72	29	14	25	-	17.5	0.57	2.39	0.76	-	1.64
MT/MTZ072	135	80	143	-	100	30	17	27	-	18.5	0.55	1.90	0.56	-	1.32
MT/MTZ080	140	80	132	-	102	36	19	29	-	22.5	0.48	1.90	0.56	-	1.30
MT/MTZ100	157	90	126	62	110	43	22	35	17	26	0.50	1.85	0.67	3.10	1.26
MT/MTZ 125	210	105	170	75	150	54	27	43	22	30	0.38	1.57	0.43	2.51	0.84
MT/MTZ 144	259	130	208	90	165	64	36	51	25	40	0.27	1.19	0.37	2.00	0.72
MT/MTZ 160	259	130	208	99	165	70	36	51	29	46	0.27	1.19	0.37	1.76	1.10

* Motor windings made of Aluminium wires.

Winding resistance

Winding resistance is the resistance between indicated terminal pins at 68°F (resistance value +/- 7%).
Winding resistance is generally low and it requires adapted tools for precise measurement. Use a digital ohm-meter, a '4 wires' method and measure under stabilised ambient temperature.
Winding resistance varies strongly with winding temperature ; If the compressor is stabilised at a different value than 68°F, the measured resistance must be corrected with following formula:

$$R_{tamb} = R_{68°F} \quad \frac{a + t_{amb}}{a + t_{68°F}}$$

$t_{68°F}$: reference temperature = 68°F

t_{amb}: temperature during measurement (°F)

$R_{68°F}$: winding resistance at 68°F

R_{amb}: winding resistance at t_{amb}

coefficient a= 234.5 copper wires motor

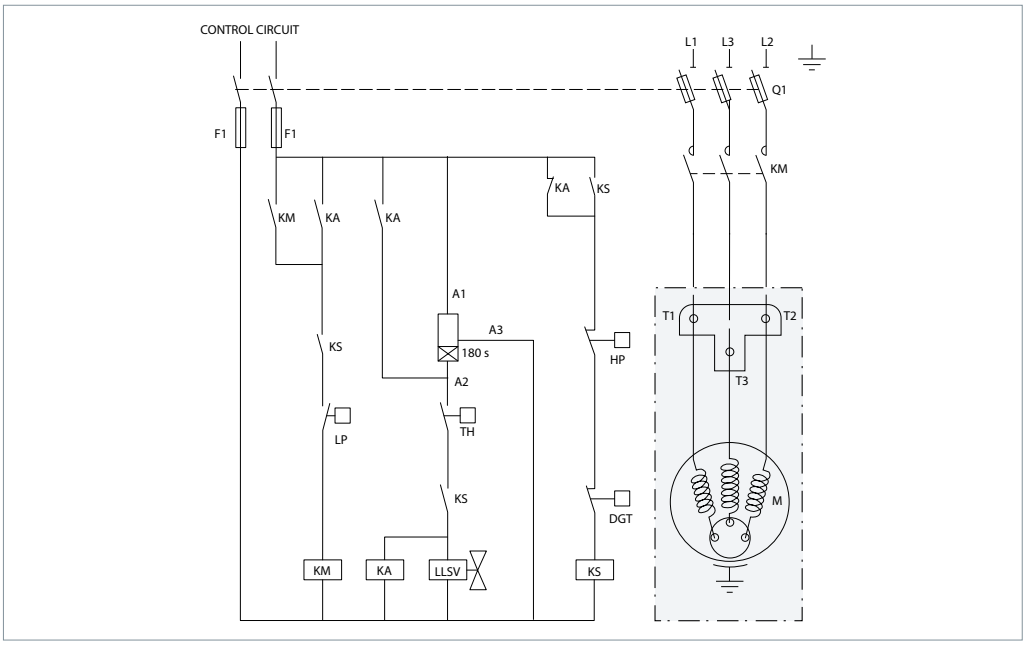
coefficient a= 232.6 aluminium wires motor

Motor protection and suggested wiring diagrams

The 3-phase compressors are protected by an internal motor protector, connected to the neutral point of the star connected stator windings, the protector cuts out all 3-phases simultaneously.

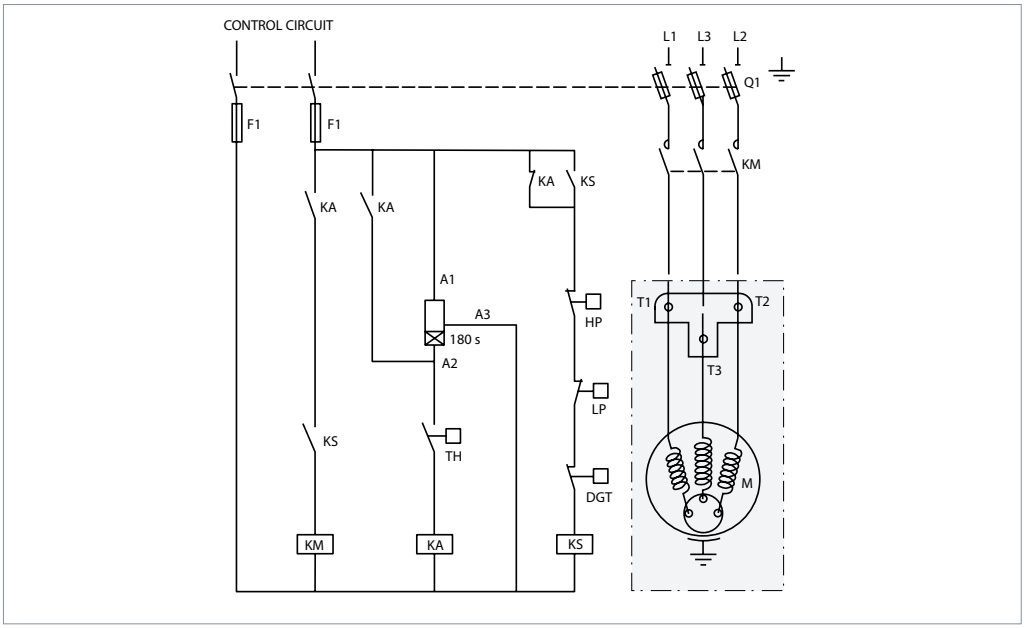
Note: once the overload protector has tripped it may take up to 3 hours to reset and restart the compressor.
For all 3-phase compressors, a PTC crankcase heater is required.

Suggested wiring diagram with one shot pump-down cycle and safety lock-out relay



Control device ..... TH
Optional short cycle timer (3 min) ..... 180 s
Control relay ..... KA
Liquid Solenoid valve ..... LLSV
Compressor contactor ..... KM
Safety lock out relay ..... KS
Pump-down control & LP switch ..... LP
H.P. switch ..... HP
Fused disconnect Q1
Fuses F1
Compressor motor ..... M
Discharge gas thermostat ..... DGT

Wiring diagram without pump-down cycle



Control device ..... TH
Optional short cycle timer (3 min) ..... 180 s
Control relay ..... KA
Compressor contactor ..... KM
Safety lock out relay ..... KS
High pressure switch ..... HP
Low pressure switch ..... LP
Fused disconnect Q1
Fuses F1
Compressor motor ..... M
Discharge gas thermostat ..... DGT

Soft starters

Starting current of Maneurop® 3-phase compressors can be reduced by using a soft starter. Two different versions are available: CI-tronic™ soft starters type MCI (recommended) and soft start kits with statoric resistors type SCR. The starting current can be reduced by up to 50% depending on the compressor model and the type of soft starter. Also mechanical stresses that occur at starting are reduced which increases the life of the internal components.

For details of the CI-tronic™ MCI soft starters, please refer to literature DKACT.PD.C50.

For details of the SCR soft start kits, please contact Danfoss.

The number of starts should be limited to 6 per hour. HP/LP pressure equalization is required before starting.

Voltage application range

Motor Code	Nominal voltage	Voltage application range
1	208-230 V / 1 ph / 60 Hz	187 - 253 V
3	200-230 V / 3 ph / 60 Hz	180 - 253 V
4	380-400 V / 3 ph / 50 Hz	340 - 440 V
	460 V / 3 ph / 60 Hz	414 - 506 V
5	220-240 V / 1 ph / 50 Hz	198 - 264 V
6	230 V / 3 ph / 50 Hz	207 - 253 V
7	500 V / 3 ph / 50 Hz	450 - 550 V
	575 V / 3 ph / 60 Hz	517 - 632 V
9	380 V / 3 ph / 60 Hz	342 - 418 V

IP rating

The compressor terminal boxes IP rating according to CEI 529 are shown on the outline drawings section.

The IP ratings are only valid when correctly sized cable glands of the same IP rating are applied.

IP 5 5

1st numeral, level of protection against contact and foreign objects

5 complete protection against contact and against harmful dust deposits

2nd numeral, level of protection against water

4 protection against water splashing from any direction

5 protection against jets of water from any direction

MT/ MTZ 1cyl = IP55 -- MT/ MTZ 2 cyl check section outline drawings -- MT/MTZ 4cyl = IP54

General information

When choosing a refrigerant, different aspects must be taken into consideration:

- Legislation (now and in the future)
- Safety
- Application envelope in relation to expected running conditions
- Compressor capacity and efficiency
- Compressor manufacturer recommendations & guidelines

Additional points could influence the final choice:

- Environmental considerations
- Standardization of refrigerants and lubricants
- Refrigerant cost
- Refrigerant availability

The table below gives an overview of the different refrigerant - lubricant - compressor combinations for Maneurop®, MT & MTZ compressors.

Refrigerant	Type	Lubricant type	Compressor type	Danfoss lubricant	Application
R22	HCFC	Mineral	MT	Mineral oil, 160P	Medium / High temperature
R417A	HFC	Polyolester	MT	Polyolester oil 160PZ	Medium / High temperature
R407A/C/F	HFC	Polyolester	MTZ	Polyolester oil 160PZ	Medium / High temperature
R134a	HFC	Polyolester	MTZ	Polyolester oil 160PZ	Medium / High temperature
R404A	HFC	Polyolester	MTZ	Polyolester oil 160PZ	Medium temperature
R507	HFC	Polyolester	MTZ	Polyolester oil 160PZ	Medium temperature
Alternative R22 retrofit with HFC refrigerants		POE	MT/MTZ	Polyolester oil 160PZ	Medium / High temperature
Hydrocarbons	Danfoss does not authorize the use of hydrocarbons in Maneurop® MT/MTZ compressors				

Capacity and other data for HFC blends refrigerants are not published in this document. Maneurop® compressors however are suitable for use with these refrigerants and can still be used as replacements in existing installations, see technical news FRCC.EN.049. and FRCC.EN.085. for more information on retrofit.

R22

R22 is an HCFC refrigerant and is still in use today. It has a low ODP (Ozone Depletion Potential) and therefore it will be phased out in the future. Check local legislation. Always use mineral oil 160P with R22.

The Maneurop® MT compressor is supplied with an initial mineral oil charge.

Alternatives R22, HFC retrofit

A wide variety of HFC blends exist. There were developed as temporary HCFC and HFC high GWP alternatives. Some examples are R422A/D - R427A, ... Retrofit technical news have been issued to advice about use of these refrigerants.

Application guidelines	Refrigerants and lubricants	
R407C	Refrigerant R407C is an HFC refrigerant with similar thermodynamic properties to those of R22. R407C has zero ozone depletion potential (ODP=0). Many installers and OEMs consider R407C to be the standard alternative for R22. R407C is a zeotropic mixture and has a temperature glide of about 11°F. For more	specific information about zeotropic refrigerants; refer to section "zeotropic refrigerant mixtures". R407C must be charged in the liquid phase. Always use the Maneurop® MTZ compressors with Danfoss 160PZ polyolester oil, which is supplied with the MTZ compressor for R407C applications.
R134a	Refrigerant R134a is an HFC refrigerant with thermodynamic properties comparable to those of the CFC refrigerant R12. R134a has zero ozone depletion potential (ODP = 0) and is commonly accepted as the best R12 alternative. For applications with high evaporating and high condensing temperatures, R134a is the	ideal choice. R134a is a pure refrigerant and has zero temperature glide. For R134a applications always use the Maneurop® MTZ compressor with Danfoss 160PZ polyolester oil which is supplied with the MTZ compressor.
R404A	Refrigerant R404A is an HFC refrigerant with thermodynamic properties comparable to those of the CFC refrigerant R502. R404A has zero ozone depletion potential (ODP = 0) and is commonly accepted as one of the best R502 alternatives. R404A is especially suitable for low evaporating temperature applications but it can also be applied to medium evaporating temperature applications. R404A is a mixture and has a very small temperature glide, and therefore must be charged in its liquid phase, but for most	other aspects this small glide can be neglected. Because of the small glide, R404A is often called a near-azeotropic mixture. For more information refer to section "zeotropic refrigerant mixtures". For low evaporating temperature applications down to -49°F, Maneurop® NTZ compressors should be used. Refer to the NTZ selection and application guidelines. For medium temperature R404A applications, always use the Maneurop® MTZ compressor with 160PZ polyolester oil which is supplied with the MTZ compressor.
R507	Refrigerant R507 is an HFC refrigerant with thermodynamic properties comparable to those of the CFC refrigerant R502 and virtually equal to those of R404A. R507 has no ozone depletion potential (ODP = 0) and is commonly accepted as one of the best R502 alternatives. As with R404A, R507 is particularly suitable for low evaporating temperature applications but it can also be used for medium evaporating	temperature applications. R507 is an azeotropic mixture with no temperature glide. For low evaporating temperature applications down to -49°F, Maneurop® NTZ compressor should be used. Refer to the NTZ selection and application guidelines. For medium temperature R507 applications, always use the Maneurop® MTZ compressor and Maneurop® 160PZ polyolester oil which is supplied with the MTZ compressor.

Application guidelines	Refrigerants and lubricants	
R407A	Refrigerant R407A is an HFC with similar thermodynamic properties to those of R404A, R407A is a zeotropic refrigerant and has a temperature glide of about 6,6K. For more specific information about zeotropic refrigerant, refer to section "zeotropic refrigerants mixtures" and read FRCC.EN.085. R407A must be charged	in liquid phase, Use of R407A allow to comply with the new Fgaz regulation from 2015. R407A GWP is stated at 2107 [CO2=1,0]. Always use the Maneurop MTZ compressors with danfoss 160PZ polyolester oil, which is supplied with the MTZ compressors for R407A applications.
R407F	Refrigerant R407F is an HFC with similar thermodynamic properties to those of R404A, R407F is a zeotropic refrigerant and has a temperature glide of about 6,4K. For more specific information about zeotropic refrigerant, refer to section "zeotropic refrigerants mixtures" and read FRCC.EN.085. R407F must be charged in liquid phase, Use of R407F allow to comply with	the new Fgaz regulation from 2015. R407F GWP is stated at 1825 [CO2=1,0]. R407F is mainly suitable for high & medium temperature application- Always use the Maneurop MTZ compressors with danfoss 160PZ polyolester oil, which is supplied with the MTZ compressors for R407F applications..
Hydrocarbons	Hydrocarbons such as propane, isobutane etc. are extremely flammable. Danfoss does not authorize the use of hydrocarbons with Maneurop® MT	or MTZ compressors in any way, even with a reduced refrigerant charge.

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روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

Piping design

Oil in a refrigeration circuit is required to lubricate moving parts in the compressor. During normal system operation small oil quantities will continuously leave the compressor, with the discharge gas. With good system piping design this oil will return to the compressor. As long as the amount of oil circulating through the system is small it will contribute to good system operation and improved heat transfer efficiency. However, too large amounts of oil in the system will have a negative effect on condenser and evaporator efficiency. If, in a poorly designed system, the amount of oil returning to the compressor is lower than the amount of oil leaving the compressor, the compressor will become starved of oil and the condenser, evaporator and/or refrigerant lines will become filled with oil. In such situations, additional oil charge will only correct the compressor oil level for a limited period of time and increase the amount of surplus oil in the rest of the system.

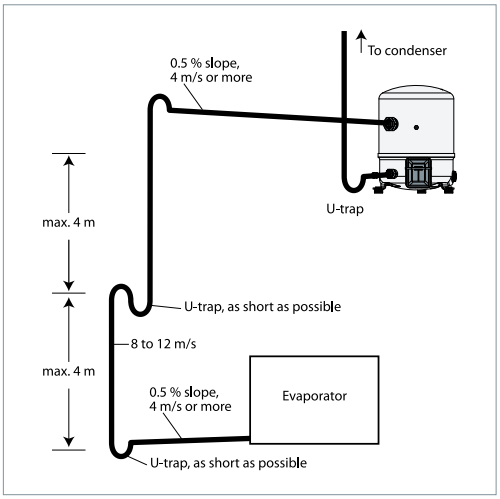
Only correct piping design can ensure a good oil balance in the system.

Suction lines

Horizontal suction line sections shall have a slope of 0.5% in the direction of refrigerant flow (5/8" per 10 ft of pipe). The cross-section of horizontal suction lines shall be such that the resulting gas velocity is at least 13 ft/s. In vertical risers, a gas velocity of 26 to 40 ft/s is required to ensure proper oil return. A U-trap is required at the foot of each vertical riser. If the riser is higher than 4 m, additional U-traps are required for each additional 4 meters. The length of each U-trap must be as short as possible to avoid the accumulation of excessive quantities of oil (see figure below).

For compressors mounted in parallel, the common suction riser should be designed as a double riser. Also refer to the News bulletin "Mounting instructions for installation of Maneurop® compressors in parallel " and "Parallel application guidelines".

Gas velocities higher than 40 ft/s will not contribute to significantly better oil return. However they will cause higher noise levels and result in higher suction line pressure drops which will have a negative effect on the system capacity.



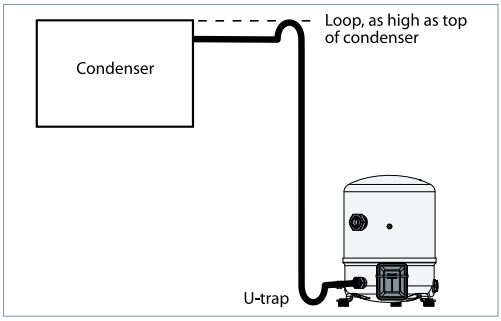
Note that the suction rotolock valves, which can be ordered from Danfoss as accessories, are designed for average pipe sizes, selected for systems running at nominal conditions.

The pipe sizes selected for specific systems may differ from these recommended sizes.

It is recommended that the suction lines are insulated to limit suction gas superheat.

Discharge line

When the condenser is mounted above the compressor, a loop above the condenser and a U-trap close to the compressor are required to prevent liquid draining from the condenser into the discharge line during standstill.



Oil charge and oil separator

In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 66 ft, or with many oil traps or an oil separator, additional oil may be required. In installations with the risk of slow oil return such as in multiple evaporator or multiple condenser installations, an oil separator is recommended.

Filter driers

For new installations with MTZ compressors Danfoss recommends using the Danfoss DML 100%-molecular sieve, solid core filter drier. Molecular sieve filter driers with loose beads from third party suppliers shall be avoided.

For servicing of existing installations where acid formation is present the Danfoss DCL solid core filter driers containing activated alumina are recommended.

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

Operating limits

High pressure

A high pressure safety switch is required to stop 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 in a lockout circuit, or be a manual reset device to prevent compressor cycling around the high pressure limit. When a discharge valve is used, the HP switch must be connected to the service valve gauge port, which cannot be isolated.

Low pressure

A low pressure safety switch is recommended to avoid compressor operation at too lower suction pressures.

		MT		MTZ				
		R22 160P	R417A 160PZ	R407A 160PZ	R407C 160PZ	R407F 160PZ	R134a 160PZ	R404A / R507 160PZ
Test pressure low side	psig	360	360	360	360	360	360	360
Working pressure range high side	psig	158 - 402	135 - 370	168 - 374	181 - 426	175 - 348	114 - 328	191 - 402
Working pressure range low side	psig	15 - 100	8 - 82	8 - 86	21 - 95	14 - 91	1 - 68	15 - 104
*Relief valve opening pressure difference	psig	435	435	435	435	435	435	435
*Relief valve closing pressure difference	psig	115	115	115	115	115	115	115

* Relief valve fitted on 2 and 4 cyl.

Low ambient temperature operation

At low ambient temperatures, the condensing temperature and condensing pressure in air cooled condensers will decrease.

This low pressure may be insufficient to supply enough liquid refrigerant to the evaporator. As a result the evaporator temperature will strongly decrease with the risk of frosting. At compressor start-up, the compressor can pull a deep vacuum and it can be switched off by the low pressure protection. Depending on the low pressure switch setting and delay timer, short cycling can occur. To avoid these problems, several solutions are possible, based on reducing condenser capacity:

- Indoor location of condensers
- Liquid flooding of condensers (note: this solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is required and special care should be taken when designing the discharge line.)
- Reduce air flow to condensers.

Other problems can also occur when the compressor is operating at low ambient temperature. During shut down periods, liquid refrigerant can migrate to a cold compressor.

For such conditions a belt-type crankcase heater is strongly recommended.

Note that with 100% suction gas cooled motors, Maneurop® compressors can be externally insulated.

Refer to section "Liquid refrigerant control & charge limits" for more details.

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Application guidelines	System design recommendations

Operating voltage and cycle rate

Operating voltage range

The operating voltage limits are shown in the table on "Voltage application range" paragraph. The voltage applied to the motor terminals must always be within these table limits. The maximum allowable voltage unbalance for 3-phase compressors is 2%. Voltage unbalance causes high current draw on one or more phases, which in turn leads to overheating and possible motor damage.

Voltage unbalance is given by the formula:

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

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

Cycle rate limit

There may be no more than 12 starts per hour (6 when a soft start accessory is used). A higher number reduces the service life of the motor-compressor unit. If necessary, use an anti-short-cycle timer in the control circuit. A time-out of six minutes is recommended. The system must be designed in such a way to guarantee a minimum compressor running time in order to provide proper oil return and sufficient motor cooling after starting.
Note that the oil return rate varies as a function of the system design.

Liquid refrigerant control and charge limit

Refrigeration compressors are basically designed as gas compressors. Depending on the compressor design and operating conditions, most compressors can also handle a limited amount of liquid refrigerant. Maneurop® MT and MTZ compressors have a large internal volume and can therefore handle relatively large amounts of liquid refrigerant without major problems. However even when a compressor can handle liquid refrigerant, this will not be favorable to its service life. Liquid refrigerant can dilute the oil, wash oil out of bearings and result in high oil carry over, resulting in loss of oil from the sump. Good system design can limit the amount of liquid refrigerant in the compressor, which will have a positive effect on the compressor service life.

Liquid refrigerant can enter a compressor in different ways, with different effects on the compressor.

Off-cycle migration

During system standstill and after pressure equalization, refrigerant will condense in the coldest part of the system. The compressor can easily be the coldest spot, for example when it is placed outside in low ambient temperatures. After a while, the full system refrigerant charge can condense in the compressor crankcase. A large amount will dissolve in the compressor oil until the oil is completely saturated with refrigerant. If other system components are located at a higher level, this process can be even faster because gravity will assist the liquid refrigerant to flow back to the compressor. When the compressor is started, the pressure in the crankcase decreases rapidly. At lower pressures the oil holds less refrigerant, and as a result part of the refrigerant will violently evaporate from the oil, causing the oil to foam. This process is often called "boiling".

The negative effects from migration on the compressor are:
• oil dilution by liquid refrigerant
• oil foam, transported by refrigerant gas and discharged into the system, causing loss of oil and in extreme situations risk for oil slugging
• in extreme situations with high system refrigerant charge, liquid slugging could occur (liquid entering the compressor cylinders).

Liquid floodback during operation

During normal and stable system operation, refrigerant will leave the evaporator in a superheated condition and enter the compressor as a superheated vapor. Normal superheat values at compressor suction are 9 to 54°F. However the refrigerant leaving the evaporator can contain an amount of liquid refrigerant due to different reasons:
• wrong dimensioning, wrong setting or malfunction of expansion device

Application guidelines	System design recommendations	
	• evaporator fan failure or blocked air filters. In these situations, liquid refrigerant will continuously enter the compressor. The negative effects from continuous liquid floodback are:	• permanent oil dilution • in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could occur.
Liquid floodback at change over cycles in reversible heat pumps	In heat pumps, change over from cooling to heating cycles, defrost and low load short cycles may lead to liquid refrigerant floodback or saturated refrigerant return conditions.	The negative effects are: • oil dilution • in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could appear.
Liquid floodback and zeotropic refrigerants	Liquid floodback in systems working with a zeotropic refrigerant such as R407C introduces additional negative effects. A part of the refrigerant leaves the evaporator in liquid phase	and this liquid has a different composition than the vapor. This new refrigerant composition may result in different compressor operating pressures and temperatures.
Crankcase heater	A crankcase heater protects against the off-cycle migration of refrigerant and proves effective if oil temperature is maintained 18°F above the saturated LP temperature of the refrigerant. Tests must thereby be conducted to ensure that the appropriate oil temperature is maintained under all ambient conditions. A PTC crankcase heater is recommended on all stand-alone compressors and split systems. PTC crankcase heaters are self-regulating. Under extreme conditions, such as very low ambient temperature, a belt type crankcase heater could be used in addition to the PTC heater; although this is not a preferred solution for 1 and 2 cylinder compressors. The belt crankcase heater must be positioned on the	compressor shell as close as possible to the oil sump to ensure good heat transfer to the oil. Belt crankcase heaters are not self-regulating. Control must be applied to energize the belt heater once the compressor has been stopped and then to de-energize it while the compressor is running. The belt heater must be energized 12 hours before restarting the compressor following an extended down period. If the crankcase heater is not able to maintain the oil temperature at 18°F above the saturated LP temperature of the refrigerant during off cycles or if repetitive floodback is present a the Liquid Line Solenoid Valve (LLSV) + pump-down cycle is required, eventually in conjunction with a suction accumulator.
Liquid line solenoid valve & pump-down	In refrigeration applications, the Liquid Line Solenoid Valve (LLSV) is highly recommended. During the off-cycle, the LLSV isolates the liquid charge in the condenser side, thus preventing against refrigerant transfer or excessive migration of refrigerant into the compressor. Furthermore, when using a LLSV in conjunction with a pump-	down cycle, the quantity of refrigerant in the low-pressure side of the system will be reduced. A pump-down cycle design is required when evaporators are fitted with electric defrost heaters.
Suction accumulator	A suction accumulator offers considerable protection against refrigerant floodback at start-up, during operation or after the defrost operation. This device also helps to protect against off-cycle migration by means of providing additional internal free volume to the low pressure side of the system. The suction accumulator must be selected in accordance with the accumulator manufacturer	recommendations. As a general rule, Danfoss recommends to size the accumulator for at least 50% of the total system charge. Tests however must be conducted to determine the optimal size. A suction accumulator shall not be used in systems with zeotropic refrigerant mixtures.

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Sound

Running compressors cause sound and vibration. Both phenomena are closely related.

Sound produced by a compressor is transmitted in every direction by the ambient air, the mounting feet, the pipework and the refrigerant in the pipework.

The easiest way to reduce the sound transmitted through ambient air is to fit a Danfoss acoustic hood accessory.

Because Maneurop® compressors are 100% suction gas cooled, and require no body cooling, they can be insulated. Values for the sound reduction achieved with acoustic hoods are shown also in the table below. For inside mounted compressors, sound insulation of the plantroom is an alternative to sound insulation of the compressor.

Sound transmitted by mounting feet, pipework and refrigerant should be treated the same way as for vibration. Please refer to the next section.

	Sound power level at 50 Hz dB(A)		Sound power level at 60 Hz dB(A)		Acoustic hood accessory
	without hood	with hood*	without hood	with hood*	
MTZ018	73	65	73	66	120Z0575
MTZ022	74	68	77	71	
MTZ028	71	64	73	66	
MTZ032	71	64	73	66	
MTZ036	70	64	76	69	
MTZ040	70	65	72	67	
MTZ044	80	74	82	76	120Z0576
MTZ050	83	76	84	78	
MTZ056	81	74	81	74	
MTZ064	80	74	84	78	
MTZ072	79	72	82	75	
MTZ080	79	73	84	78	
MTZ100	85	79	87	81	120Z0577
MTZ125	84	78	86	80	
MTZ144	83	77	86	80	
MTZ160	83	77	86	80	

Sound power level for MTZ with R404A, motor code 4 Te = 14°F, Tc= 113°F
* Sound data with hood are valid for the Danfoss acoustic hood accessory.
As first approach, use these figures with -3 dBA reduction for MT models applied with R22.

Vibration

The mounting grommets delivered with the compressor should always be used. They reduce the vibration transmitted by the compressor mounting feet to the base frame.

The base on which the compressor is mounted should be sufficiently rigid and of adequate mass to ensure the full effectiveness of the mounting grommets.

The compressor should never be directly mounted to the base frame without the grommets, otherwise high vibration transmission would occur and the compressor service life reduced. Suction and discharge lines must have adequate flexibility in 3 planes. Eventually vibration absorbers may be required.

Care must be taken to avoid tubing having resonant frequencies close to those of the compressor frequency.

Vibration is also transmitted by the refrigerant gas. Maneurop® compressors have built in mufflers to reduce this vibration.

To further reduce vibration an extra muffler can be installed.

Note: Maneurop® MT & MTZ compressors have been designed and qualified for stationary equipment used in A/C and Refrigeration applications. Danfoss doesn't warrant these compressors for use in mobile applications, such as trucks, railways, subways, etc...

System cleanliness

System contamination is one of the main factors affecting equipment reliability and compressor service life.

Therefore it is important to ensure system cleanliness when manufacturing a refrigeration system. During the manufacturing process, system contamination can be caused by:
- Brazing and welding oxides
- Filings and particles from removing burrs from pipe-work
- Brazing flux
- Moisture and air.

Only use clean and dehydrated refrigeration grade copper tubes and silver alloy brazing material. Clean all parts before brazing and always purge nitrogen or CO_2 through the pipes during brazing to prevent oxidation. If flux is used, take every precaution to prevent leakage into the piping. Do not drill holes (e.g. for schräder valves) in parts of the installation that are already completed, when filings and burrs can not be removed. Carefully follow the instructions below regarding brazing, mounting, leak detection, pressure test and moisture removal. All installation and service work shall only be done by qualified personnel respecting all procedures and using tools (charging systems, tubes, vacuum pump, etc.) dedicated for the refrigerant that will be used.

Compressor handling, mounting and connection to the system

Compressor handling

Maneurop® MT and MTZ compressors are provided with a lifting lug. This lug should always be used to lift the compressor. Once the compressor is installed, the compressor lifting lug should never be used to lift the complete installation.
Keep the compressor in an upright position during handling.

Compressor mounting

Mount the compressor on a horizontal plane with a maximum slope of 3 degrees. All compressors are supplied with three or four rubber mounting grommets, each complete with metal sleeves and nuts and bolts. Refer to the section "Outline drawings". These grommets largely attenuate the compressor vibration transmitted to the base frame. The compressor must always be mounted with these grommets. Refer to the table below for torque values.

Designation		Recommended torque (lbf.ft)
Cable screw of T connector in electrical box	screw 10/32 - UNF x 3	2
Rotolock valves and solder sleeves	1"	59
	1"1/4	66
	1"3/4	81
Mounting grommet bolts	1 - 2 - 4 cylinder	11
Oil sight glass	-	37
Oil equalization connection	1 - 2 - 4 cylinder	22

Compressor connection to the system

New compressors have a protective nitrogen holding charge. The suction and discharge caps should only be removed just before connecting the compressor to the installation to avoid air and moisture entering the compressor.

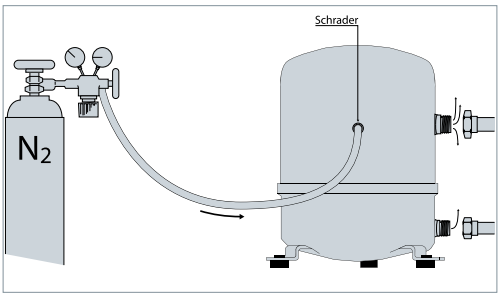
Whenever possible the compressor must be the last component to be integrated into the system. It is advisable to braze the solder sleeves or service valves to the pipework before the compressor is mounted. When all brazing is finished and when the total system is ready, the compressor caps can be removed and the compressor can be connected to the system with a minimum exposure to ambient air.

If this procedure is not possible, the sleeves or valves may be brazed to the pipes when mounted on the compressor.

In this situation nitrogen or CO_2 must be purged through the compressor via the schrader valve to prevent air and moisture ingress. Purging must start when the caps are removed and proceeded during the brazing process.

When rotolock valves are used on the compressor, they shall be closed immediately after mounting, thus keeping the compressor isolated from atmosphere or from a not yet dehydrated system.

Note: When the compressor is built into a "pack" or "rack" configuration which is not installed immediately on its final location, a vacuum pull-down and moisture removal must be performed to this pack (rack) as if it were a complete system (see below). The pack must be charged with nitrogen or CO_2 and open tubes must be blocked with caps or plugs.



System pressure test

It is recommended that an inert gas such as nitrogen be used for pressure testing. Dry air may also be used but care should be taken since it can form an inflammable mixture with the compressor oil. When performing a system pressure test, the maximum allowed pressure for the different components should not be exceeded.

For MT/MTZ compressors the maximum test pressures are shown in the table beside.

	1-2-4 cylinder compressors
Maximum compressor test pressure, low side	362 psi(g)
Maximum compressor test pressure, high side	435 psi(g)

Do not exceed 435 psig pressure difference between high pressure side and low pressure side of the compressor because this will open the internal compressor relief valve.

Leak detection

Whenever possible (if valves are present) the compressor must be kept isolated from the system. Perform a leak detection using the final refrigerant. Pressurize with nitrogen or another neutral gas and use a leak detector for the applied refrigerant. Any spectrometric detection system using helium can also be applied.

Eventual leaks shall be repaired respecting the instructions written above. It is not recommended to use other gasses such as oxygen, dry air or acetylene as these gasses can form an inflammable mixture. Never use CFC or HCFC refrigerants for leak detection of HFC systems.

Note 1: Leak detection with refrigerant may not be allowed in some countries. Check local regulations.

Note 2: Leak detecting additives shall not be used as they may affect the lubricant properties.

Warranty may be voided if leak detecting additives have been used.

Vacuum pull-down moisture removal

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

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

To eliminate these factors, a vacuum pull-down according to the following procedure is recommended:
① Whenever possible (if valves are present) the compressor must be kept isolated from the system. ② After the leak detection, the system must be pulled-down under a vacuum of 500 microns. A two stage vacuum pump shall be used with a capacity appropriate to the system volume. It is recommended to use connection lines with a large diameter and to connect these to the service valves and not to the schrader connection to avoid too high pressure losses.
③ When the vacuum level of 500 micron is reached, the system must be isolated from the vacuum pump. Wait 30 minutes during which the system pressure should not rise. When the pressure rapidly increases, the system is not leak tight.
A new leak detection must be performed and the vacuum pull-down procedure should be restarted from step 1. When the pressure slowly increases, this indicates the presence of moisture. In this case step 2 and 3 should be repeated.
④ Connect the compressor to the system by opening the valves. Repeat step 2 and 3.
⑤ Break the vacuum with nitrogen or the final refrigerant.
⑥ Repeat step 2 and 3 on the total system.
At commissioning, system moisture content may be up to 100 ppm. During operation the filter drier must reduce this to a level < 20 ppm.

Warning : Do not use a megohmmeter or apply power to the compressor while it is under vacuum, as this may cause motor winding damage.
Never run the compressor under vacuum as it may cause compressor motor burn-out.

Start-up

Before initial start-up or after a prolonged shut down period, energise the crankcase heater (if fitted) 12 hours prior to start-up, or turn on power for single phase compressors with trickle circuit.

Refrigerant charging

Zeotropic and "near-azeotropic" refrigerant mixtures such as R407C and R404A must always be charged in the liquid phase. For the initial charge, the compressor must not run and service valves must be closed. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. Then slowly add refrigerant in the liquid phase, on the low pressure side as far away as possible from the running compressor.

The refrigerant charge quantity must be suitable for both winter and summer operation. Refer also to section "Protection against flooded starts and liquid floodback" for information about refrigerant charge limits.

WARNING: when a liquid line solenoid valve is used, the vacuum in the low pressure side must be broken before applying power to the system.

Oil charge and oil level

The oil charge must be checked before commissioning (1/4 to 3/4 of the oil sight glass). Check the oil level again after a minimum of 2 hours operation at nominal conditions. In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 66 ft or with many oil traps or an oil separator, additional oil may be required. Normally the quantity of oil added should be no more than 2% of the total refrigerant charge (this percentage does not take into account oil contained in accessories such as oil separators or oil traps). If this amount has already been added and the oil level in the compressor keeps decreasing, the oil return in the installation is insufficient. Refer also to section "Piping design".

In installations where slow oil return is likely such as in multiple evaporator or multiple condenser installations, an oil separator is recommended. Refer to the table section "Refrigerants and lubricants" to select the correct oil.

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Suction gas superheat

The optimum suction gas superheat is 18°F. A lower superheat value will contribute to better system performance (higher mass flow and more efficient use of evaporator surface). Low superheat values however increase the risk of unwanted liquid floodback to the compressor.

For very low superheat values an electronically controlled expansion valve is recommended.

The maximum allowable superheat is about 54°F. Higher values can be accepted but in these cases, tests have to be performed to check that the maximum discharge temperature of 266°F will not be exceeded. Note that high superheat values decrease the compressor application envelope and system performance.

Packaging

	Model	Single pack		Multipack				Industrial pack			
		Dimensions (in)	Gross weight (lbs)	Nbr	Dimensions (in)	Gross weight (lbs)	Static stacking	Nbr	Dimensions (in)	Gross weight (lbs)	Static stacking
1 cylinder	MT/MTZ 018	l: 13.0 w: 11.6 h: 15.2	50.7	8	l: 45.3 w: 31.5 h: 20.1	435	4	12	l: 45.3 w: 31.5 h: 19.7	613	4
	MT/MTZ 022		50.7			435				613	
	MT/MTZ 028		55.1			470				666	
	MT/MTZ 032		57.3			487				693	
	MT/MTZ 036		59.5			505				719	
	MT/MTZ 040		59.5			505				719	
2 cylinders	MT/MTZ 044-050	l: 15.6 w: 14.4 h: 17.9	86.0	6	l: 45.3 w: 31.5 h: 23.6	538	4	6	l: 45.3 w: 31.5 h: 23.6	520	4
	MT/MTZ 056-064		90.4			565				547	
	MT/MTZ 072-080		94.8			591				573	
4 cylinders	MT/MTZ 100	l: 22.4 w: 15.7 h: 26.4	154.4	4	l: 45.3 w: 31.5 h: 32.3	642	4	6	l: 45.3 w: 31.5 h: 28.0	840	4
	MT/MTZ 125		161.0			668				880	
	MT/MTZ 144		167.6			695				920	
	MT/MTZ 160		167.6			695				920	

Single pack: One compressor in a cardboard box.
In some publications this packaging may be indicated as "individual packaging".

Multipack: A full pallet of compressors, each individually packed in a cardboard box. Mainly dedicated to wholesalers and Danfoss distribution centers.

Industrial pack: A full pallet of unpacked compressors. Mainly dedicated to OEM customers.
In some publications this packaging may be indicated as "Multiple packaging".

Nbr: Number of compressor in a pack

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MT compressors in industrial pack

R22

Compressor model	Code no.				
	1	3	4	5	9
	208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50	380/3/60
MT018	MT18-1VM	MT18-3VM	MT18-4VM	MT18-5VM	-
MT022	MT22-1VM	MT22-3VM	MT22-4VM	MT22-5VM	MT22-9VM
MT028	MT28-1VM	MT28-3VM	MT28-4VM	MT28-5VM	MT28-9VM
MT032	MT32-1VM	MT32-3VM	MT32-4VM	MT32-5VM	MT32-9VM
MT036	MT36-1VM	MT36-3VM	MT36-4VM	MT36-5VM	MT36-9VM
MT040	MT40-1VM	MT40-3VM	MT40-4VM	-	-
MT044	MT44-1VM	MT44-3VM	MT44-4VM	-	MT44-9VM
MT050	MT50-1VM	MT50-3VM	MT50-4VM	-	MT50-9VM
MT056	MT56-1VM	MT56-3VM	MT56-4VM	-	MT56-9VM
MT064	MT64-1VM	MT64-3VM	MT64-4VM	-	MT64-9VM
MT072	-	MT72-3VM	MT72-4VM	-	MT72-9VM
MT080	-	MT80-3VM	MT80-4VM	-	MT80-9VM
MT100	-	MT100-3VM	MT100-4VM	-	MT100-9VM
MT125	-	MT125-3VM	MT125-4VM	-	MT125-9VM
MT144	-	MT144-3VM	MT144-4VM	-	MT144-9VM
MT160	-	MT160-3VM	MT160-4VM	-	MT160-9VM

VM = Compressor, threaded oil sight glass, 3/8" oil equalization connection

MT compressors in single pack

R22

Compressor model	Code no.						
	1	3	4	5	6	7	9
	208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50	230/3/50	575/3/60 500/3/50	380/3/60
MT018	MT18-1VI	MT18-3VI	MT18-4VI	MT18-5VI	-	-	-
MT022	MT22-1VI	MT22-3VI	MT22-4VI	MT22-5VI	MT22-6VI	-	MT22-9VI
MT028	MT28-1VI	MT28-3VI	MT28-4VI	MT28-5VI	MT28-6VI	-	-
MT032	MT32-1VI	MT32-3VI	MT32-4VI	MT32-5VI	MT32-6VI	-	MT32-9VI
MT036	MT36-1VI	MT36-3VI	MT36-4VI	MT36-5VI	MT36-6VI	-	MT36-9VI
MT040	MT40-1VI	MT40-3VI	MT40-4VI	-	MT40-6VI	-	-
MT044	MT44-1VI	MT44-3VI	MT44-4VI	-	-	-	MT44-9VI
MT050	MT50-1VI	MT50-3VI	MT50-4VI	-	MT50-6VI	-	MT50-9VI
MT056	MT56-1VI	MT56-3VI	MT56-4VI	-	MT56-6VI	MT56-7VI	MT56-9VI
MT064	MT64-1VI	MT64-3VI	MT64-4VI	-	MT64-6VI	-	MT64-9VI
MT072	-	MT72-3VI	MT72-4VI	-	MT72-6VI	-	MT72-9VI
MT080	-	MT80-3VI	MT80-4VI	-	MT80-6VI	-	MT80-9VI
MT100	-	MT100-3VI	MT100-4VI	-	MT100-6VI	MT100-7VI	MT100-9VI
MT125	-	MT125-3VI	MT125-4VI	-	MT125-6VI	MT125-7VI	MT125-9VI
MT144	-	MT144-3VI	MT144-4VI	-	MT144-6VI	MT144-7VI	MT144-9VI
MT160	-	MT160-3VI	MT160-4VI	-	MT160-6VI	MT160-7VI	MT160-9VI

VI = Single compressor, threaded oil sight glass, 3/8" oil equalization connection

MTZ compressors in industrial pack

R404A / R507 / R134a / R407A/C/F

Compressor model	Code no.				
	1	3	4	5	9
	208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50	380/3/60
MTZ018	MTZ18-1VM	MTZ18-3VM	MTZ18-4VM	MTZ18-5VM	-
MTZ022	MTZ22-1VM	MTZ22-3VM	MTZ22-4VM	MTZ22-5VM	MTZ22-9VM
MTZ028	MTZ28-1VM	MTZ28-3VM	MTZ28-4VM	MTZ28-5VM	MTZ28-9VM
MTZ032	MTZ32-1VM	MTZ32-3VM	MTZ32-4VM	MTZ32-5VM	MTZ32-9VM
MTZ036	MTZ36-1VM	MTZ36-3VM	MTZ36-4VM	MTZ36-5VM	MTZ36-9VM
MTZ040	MTZ40-1VM	MTZ40-3VM	MTZ40-4VM	-	-
MTZ044	MTZ44-1VM	MTZ44-3VM	MTZ44-4VM	-	MTZ44-9VM
MTZ050	MTZ50-1VM	MTZ50-3VM	MTZ50-4VM	-	MTZ50-9VM
MTZ056	MTZ56-1VM	MTZ56-3VM	MTZ56-4VM	-	MTZ56-9VM
MTZ064	MTZ64-1VM	MTZ64-3VM	MTZ64-4VM	-	MTZ64-9VM
MTZ072	-	MTZ72-3VM	MTZ72-4VM	-	MTZ72-9VM
MTZ080	-	MTZ80-3VM	MTZ80-4VM	-	MTZ80-9VM
MTZ100	-	MTZ100-3VM	MTZ100-4VM	-	MTZ100-9VM
MTZ125	-	MTZ125-3VM	MTZ125-4VM	-	MTZ125-9VM
MTZ144	-	MTZ144-3VM	MTZ144-4VM	-	MTZ144-9VM
MTZ160	-	MTZ160-3VM	MTZ160-4VM	-	MTZ160-9VM

VM = Compressor, threaded oil sight glass, 3/8" oil equalization connection

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MTZ compressors in single pack

R404A / R507 / R134a / R407A/C/F

Compressor model	Code no.						
	1	3	4	5	6	7	9
	208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50	230/3/50	575/3/60 500/3/50	380/3/60
MTZ018	MTZ18-1VI	MTZ18-3VI	MTZ18-4VI	MTZ18-5VI	-	-	-
MTZ022	MTZ22-1VI	MTZ22-3VI	MTZ22-4VI	MTZ22-5VI	MTZ22-6VI	-	MTZ22-9VI
MTZ028	MTZ28-1VI	MTZ28-3VI	MTZ28-4VI	MTZ28-5VI	MTZ28-6VI	-	MTZ28-9VI
MTZ032	MTZ32-1VI	MTZ32-3VI	MTZ32-4VI	MTZ32-5VI	MTZ32-6VI	MTZ32-7VI	MTZ32-9VI
MTZ036	MTZ36-1VI	MTZ36-3VI	MTZ36-4VI	MTZ36-5VI	MTZ36-6VI	MTZ36-7VI	MTZ36-9VI
MTZ040	MTZ40-1VI	MTZ40-3VI	MTZ40-4VI	-	MTZ40-6VI	-	-
MTZ044	MTZ44-1VI	MTZ44-3VI	MTZ44-4VI	-	MTZ44-6VI	MTZ44-7VI	MTZ44-9VI
MTZ050	MTZ50-1VI	MTZ50-3VI	MTZ50-4VI	-	MTZ50-6VI	MTZ50-7VI	MTZ50-9VI
MTZ056	MTZ56-1VI	MTZ56-3VI	MTZ56-4VI	-	MTZ56-6VI	MTZ56-7VI	MTZ56-9VI
MTZ064	MTZ64-1VI	MTZ64-3VI	MTZ64-4VI	-	MTZ64-6VI	-	MTZ64-9VI
MTZ072	-	MTZ72-3VI	MTZ72-4VI	-	MTZ72-6VI	-	MTZ72-9VI
MTZ080	-	MTZ80-3VI	MTZ80-4VI	-	MTZ80-6VI	-	MTZ80-9VI
MTZ100	-	MTZ100-3VI	MTZ100-4VI	-	MTZ100-6VI	MTZ100-7VI	MTZ100-9VI
MTZ125	-	MTZ125-3VI	MTZ125-4VI	-	MTZ125-6VI	MTZ125-7VI	MTZ125-9VI
MTZ144	-	MTZ144-3VI	MTZ144-4VI	-	MTZ144-6VI	MTZ144-7VI	MTZ144-9VI
MTZ160	-	MTZ160-3VI	MTZ160-4VI	-	MTZ160-6VI	MTZ160-7VI	MTZ160-9VI

VI = Single compressor, threaded oil sight glass, 3/8" oil equalization connection

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Previous Version	Current Version
• Page 7: Approvals & certificates, Pressure equipment directive 97/23/EC, Low voltage directive 2006/95/EC & Machine directive 2006/42/EC	• Page 7: Updated Approvals & certificates, Pressure equipment directive **2014/68/EU**, Low voltage directive **2014/35/EU** & Machinery directive **2014/30/EU**
• Page 19: Three phase electrical characteristics	• Page 19: Updated Motor code 4 & 9 for models MT/MTZ-018-022 in Three phase electrical characteristics (Winding resistance)
• Page 26: Low pressure settings	• Page 26: Updated Low pressure settings

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Danfoss Commercial Compressors

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

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

Danfoss Scrolls

Danfoss Inverter Scrolls

Danfoss Turbocor Compressors

Danfoss Light Commercial Refrigeration Compressors

Danfoss Maneurop Reciprocating Compressors

Danfoss Optyma Condensing Units

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

http://danfoss.us.com

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روبروی پالایشگاه نفت پارس، پلاک ۱۲

MPZ - Refrigeration 1 cyl. range

Medium temperature 50 - 60 Hz

R404A / R507A

SELECTION &

تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)

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CONTENTS

MPZ RECIPROCATING COMPRESSORS

The MPZ series from Danfoss Commercial Compressors is a range of hermetic reciprocating compressors for medium / high evaporating temperature applications.

The MPZ is engineered as a true refrigeration compressor, optimised at -10°C with an extended application range from -30°C to +10°C.

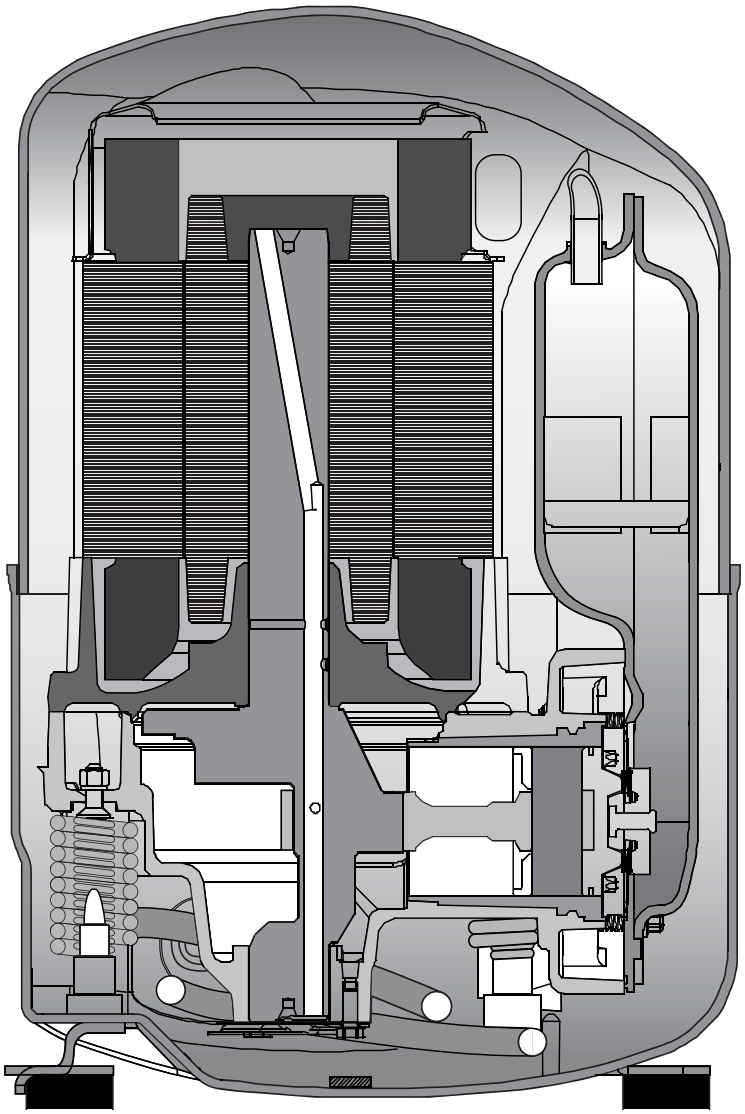
The Danfoss MPZ series is specifically designed for use with R404A / R507A, using 160MPZ polyolester oil as lubricant.

The level of performance combined with extra low sound characteristics rank the MPZ series among the best compressors in their class.

Further, its new shell housing with solder connections is designed to be as compact as possible.

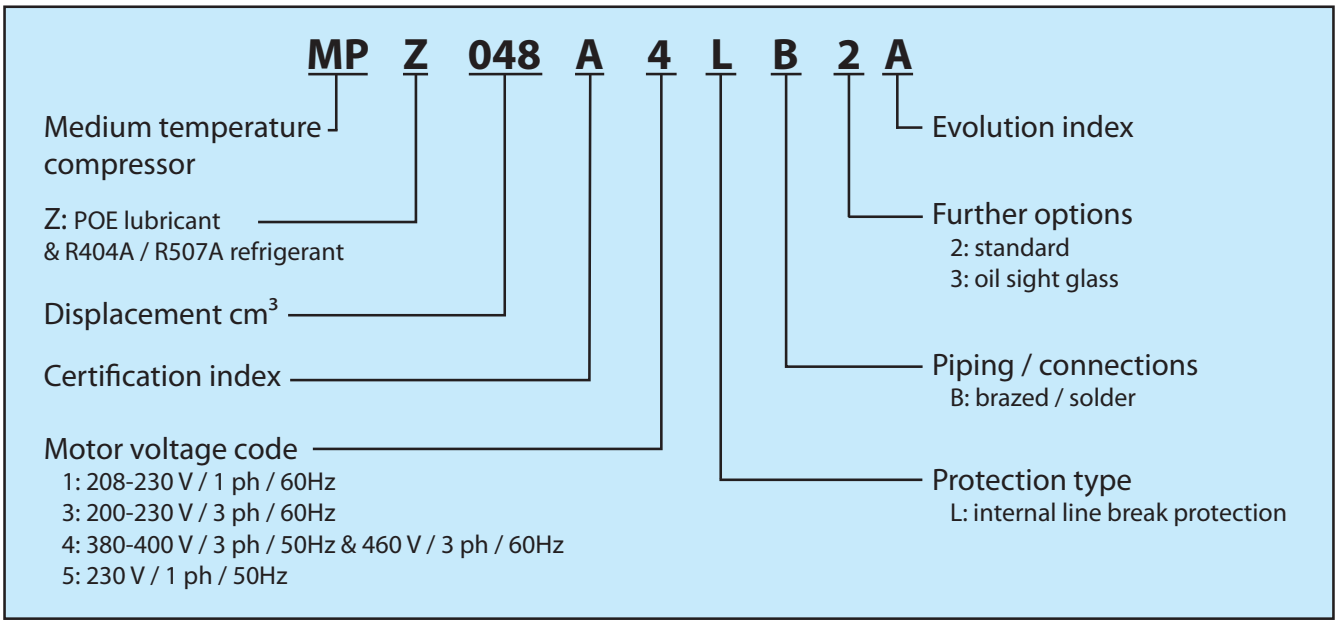
The compressors can be operated at a return gas temperature (suction gas temperature) of 20°C on most of its application window.

The electrical motor is fully suction gas cooled which means that additional body cooling is not required. The compressors can therefore be installed in a sealed compartment and even can be insulated with an acoustic insulation hood when the installation requirements call for extra low sound characteristics.



COMPRESSOR MODEL DESIGNATION

Compressor reference



SPECIFICATIONS

Technical specifications

Compressor model	Displacement			Cyl. number	Oil charge	Net weight *
	cm^3/rev	m^3/h at 2900 rpm	m^3/h at 3500 rpm		dm^3	kg
MPZ038	38	6.6	8.0	1	1.1	25.2
MPZ048	48	8.4	10.1	1	1.1	25.2
MPZ054	54	9.4	11.3	1	1.1	25.2
MPZ061	61	10.6	12.7	1	1.1	25.75
MPZ068	68	11.8	14.3	1	1.1	25.75

* Net weight apply only on code 4

Approvals and certificates

Danfoss MPZ compressors comply with the following approvals and certificates.

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

CE (European Directive)	All models
UL (Underwriters Laboratories)	All 60 Hz models
CCC (China Compulsory Product Certification)	All 50 Hz models
Gost certificate (for Russia)	All 50 Hz models

SPECIFICATIONS

Nominal performance data - R404A

50 Hz

Compressor model	To = -10°C, Tc = 45°C, RGT= 20°C, SC = 0 K				To = -10°C, Tc = 45 °C , SH = 10 K, SC = 0 K				To = 5°C, Tc = 50°C , RGT = 20°C, SC = 0 K			
	Cooling capacity W	Power input W	Current input A	COP W/W	Cooling capacity W	Power input W	Current input A	COP W/W	Cooling capacity W	Power input W	Current input A	COP W/W
MPZ038	2995	1419	2.9	2.11	2795	1419	2.86	2.0	5049	1837	3.4	2.75
MPZ048	4005	1896	3.5	2.11	3738	1896	3.49	2.0	6446	2515	4.4	2.56
MPZ054	4464	2154	3.9	2.07	4167	2154	3.86	1.9	7329	2906	5.0	2.52
MPZ061	5030	2522	4.9	1.99	4695	2522	4.86	1.9	8080	3357	6.2	2.41
MPZ068	5707	2905	5.5	1.96	5327	2905	5.48	1.8	9027	3928	7.1	2.30

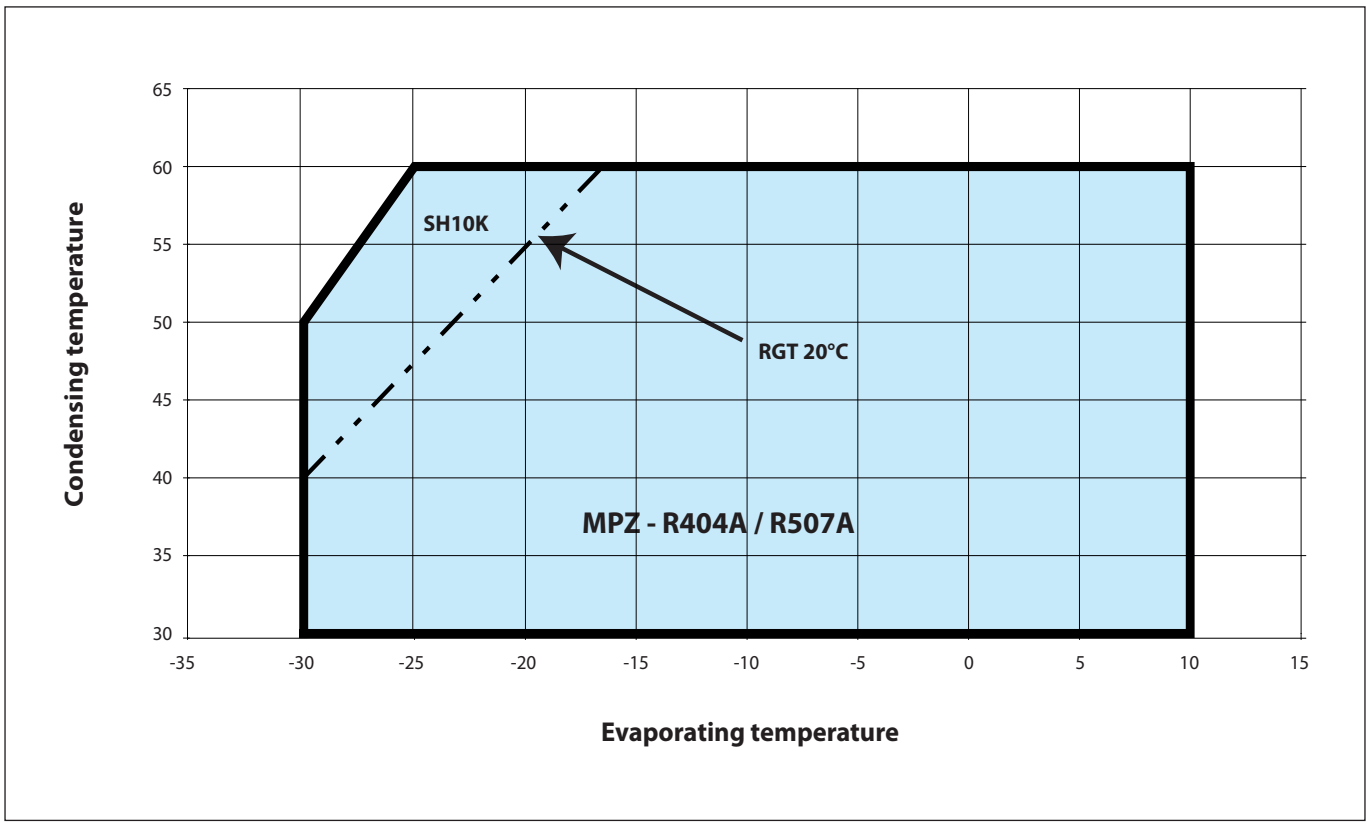
To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)
SC: Subcooling,
SH: Superheat
3 phase - 400 V

60 Hz

Compressor model	To = -10°C, Tc = 45°C, RGT= 20°C, SC = 0 K				To = -10°C, Tc = 45 °C , SH = 10 K, SC = 0 K				To = 5°C, Tc = 50°C , RGT = 20°C, SC = 0 K			
	Cooling capacity W	Power input W	Current input A	COP W/W	Cooling capacity W	Power input W	Current input A	COP W/W	Cooling capacity W	Power input W	Current input A	COP W/W
MPZ038	3545	1657	2.7	2.14	3309	1657	2.71	2.0	5925	2175	3.3	2.72
MPZ048	4680	2271	3.4	2.06	4368	2271	3.43	1.9	7554	2975	4.3	2.54
MPZ054	5306	2576	3.8	2.06	4952	2576	3.81	1.9	8593	3523	5.0	2.44
MPZ061	5912	2978	4.7	1.99	5518	2978	4.71	1.9	9581	3975	5.9	2.41
MPZ068	6765	3410	5.2	1.98	6314	3410	5.21	1.9	10773	4668	6.9	2.31

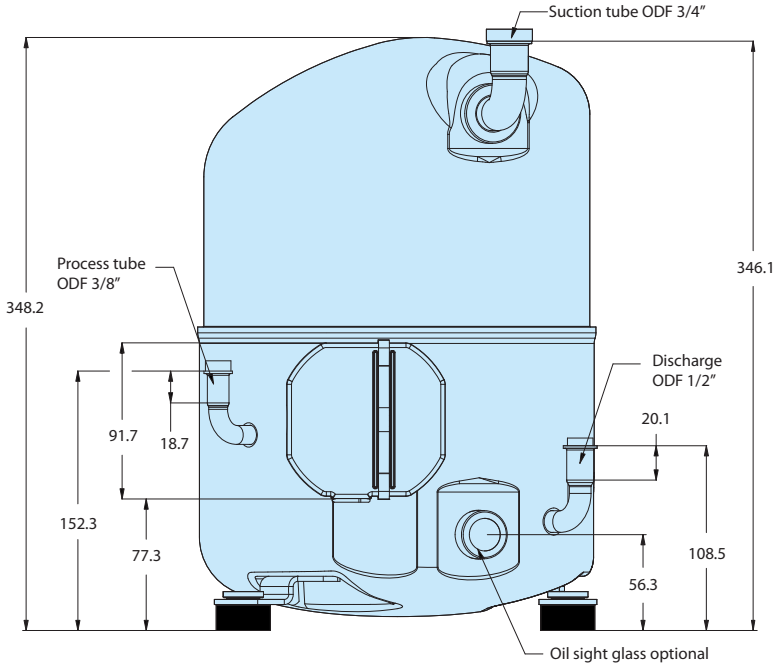
To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)
SC: Subcooling,
SH: Superheat
3 phase - 460 V

OPERATING ENVELOPE

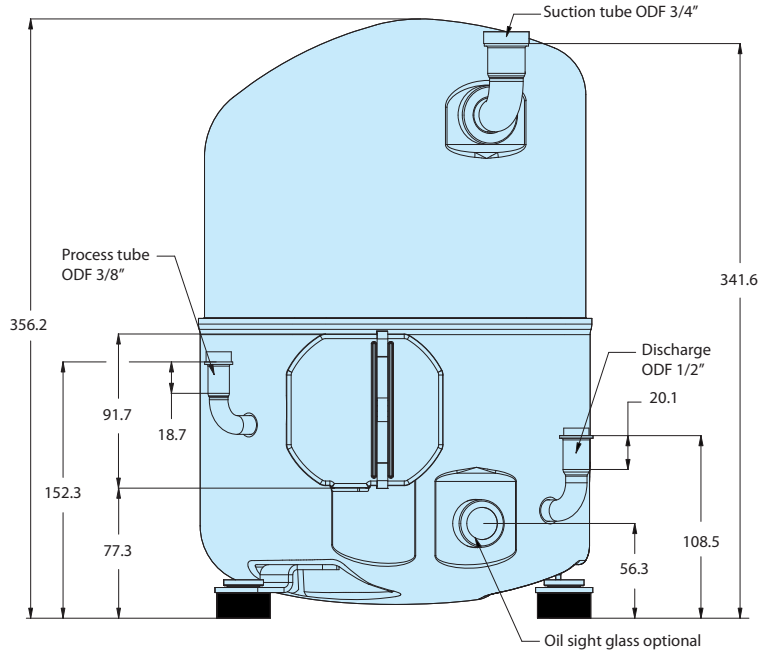


OUTLINE DRAWINGS

Side view, 3 phase models

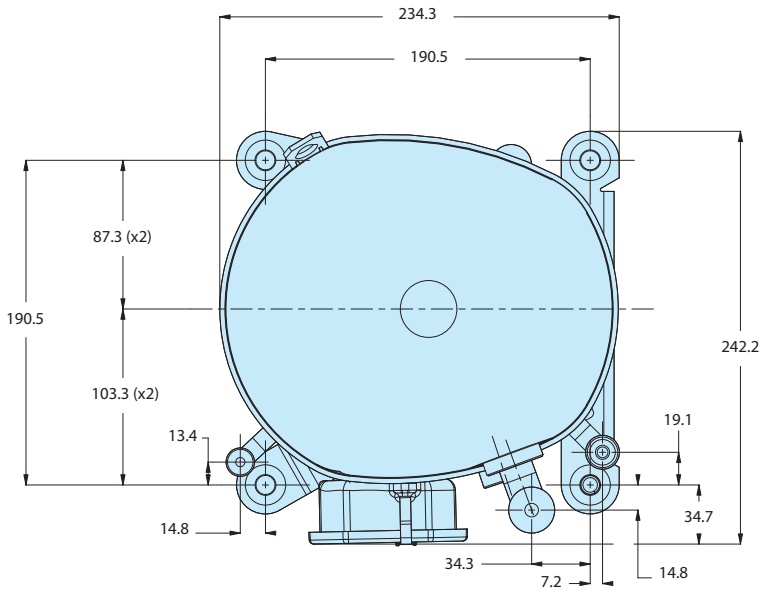


Side view, single phase models



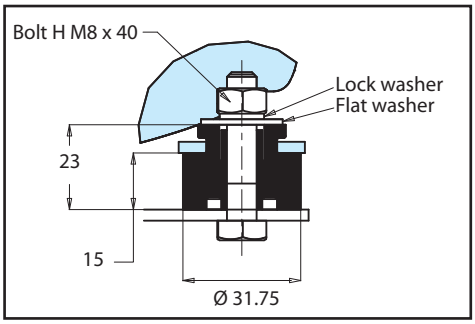
OUTLINE DRAWINGS

Top view, all models



Silent block

Grommet compression not included
(around 1 mm)



ELECTRICAL CONNECTIONS AND WIRING

Three phase electrical characteristics

	LRA - Locked Rotor Current (A)		MCC Maximum Continuous Current (A)		Winding resistance (Ω) (± 7 % at 20° C)	
Motor Code	3	4	3	4	3	4
MPZ038	71.6	29.2	11.5	6.3	1.15	5.6
MPZ048	71.6	29.2	12.2	6.0	1.15	5.6
MPZ054	71.6	29.2	12.5	6.4	1.15	5.6
MPZ061	95	38.1	19	8.5	0.9	4.3
MPZ068	95	38.1	19.6	9.0	0.9	4.3

Single phase electrical characteristics

	LRA - Locked Rotor Current (A)		MCC - Maximum Continuous Current (A)		Winding resistance (Ω) (± 7 % at 20° C)			
Motor Code	1	5	1	5	1		5	
Winding					run	start	run	start
MPZ038	70.5	56	16.7	14	0.63	2.13	0.75	2.54
MPZ048	70.5	56	17.1	17	0.63	2.13	0.75	2.54
MPZ054	70.5	56	24.6	19	0.63	2.13	0.75	2.54
MPZ061	87.5	61	30	26	0.56	1.73	0.69	1.95
MPZ068	87.5	61	32.2	25.5	0.56	1.73	0.69	1.95

Nominal capacitor values and relays

50 Hz / 60 Hz	PSC/CSR*	CSR only	
Models	Run capacitors (1) (A) µF	Start capacitors (2) (B) µF	Start relay
MPZ038	40	100	RVA-6AMKL
MPZ048	40	100	
MPZ054	40	100	
MPZ061	45	100	
MPZ068	45	100	

* PSC: Permanent Split Capacitor
CSR: Capacitor Start Run
(1) Run capacitors: 440 volts
(2) Start capacitors: 330 Volts

Note: the single phase compressor motors are internally protected by a temperature / current sensing bimetallic protector, which senses the main and start winding currents, and also the winding temperature. Once the protector has tripped, it may take up to two to four hours to reset and restart the compressor.
Check that power supply corresponds to compressor characteristics (refer to compressor nameplate).

PSC wiring

PSC wiring may be used for refrigerant circuits with capillary tubes or expansion valves with bleed ports. Pressure equalisation must be ensured before start-up because of the low starting torque characteristics of this system.

CSR wiring

CSR wiring provides additional motor torque at start-up, by the use of a start capacitor in combination with the run capacitor. This system can be used for refrigerant circuits with capillary tubes or expansion valves. The start capacitor is only connected during the starting operation, a potential relay is used to disconnect it after the start sequence.
Some applications with high differential pressure can require a very high starting torque. For such cases the CSR starting kit can be converted to a very high starting torque kit by an additional start capcitor of 100 µF parallel to the start capacitor of the CSR kit. This configuration can also be used to reduce erratic starting at unfavourable conditions such as very low ambient temperature or weak voltage.

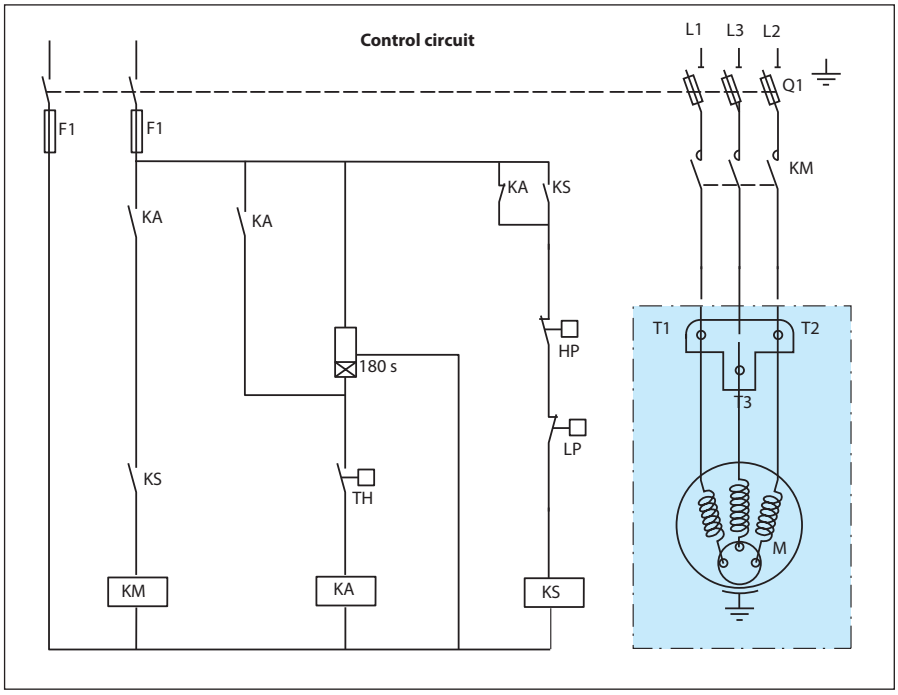
Models	Very high starting torque configuration		
	Run capacitors (µF)	Start Capacitors (µF)	Start relay
MPZ038-048-054	40	100 + 100	RVA6AMKL

ELECTRICAL CONNECTIONS AND WIRING

Three phase

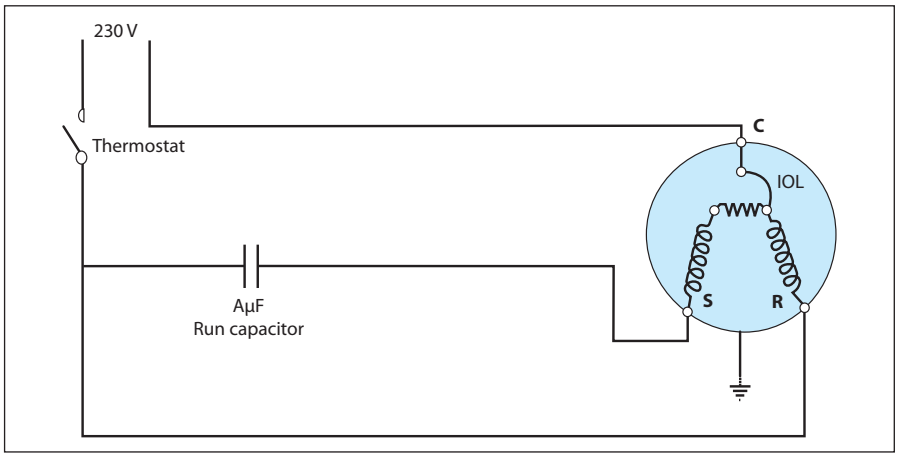
Suggested wiring diagram with safety lock-out relay

Control device	TH
Optional short cycle timer (3 min) 5 pts	180 s
Control relay	KA
Compressor contactor	KM
Safety lock out relay	KS
High pressure switch	HP
Low pressure switch	LP
Fused disconnect	Q1
Fuses	F1
Compressor motor	M

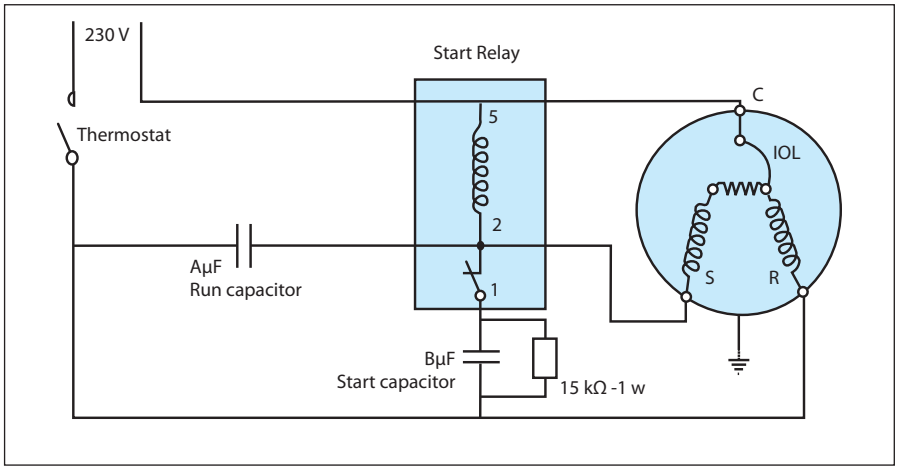


Single phase

PSC wiring



CSR wiring



ELECTRICAL CONNECTIONS AND WIRING

Soft starters

Starting current of Danfoss MPZ 3-phase compressors can be reduced by using a Danfoss electronic soft starter. The starting current can be reduced by up to 50% depending on the compressor model. Also mechanical stresses that occur at starting are reduced which increases the life of the internal components.

For details of the Danfoss CI-tronic™ MCI soft starters, please refer to literature DKACT.PD.C50.

Use of a soft starter requires that the number of starts is limited to 6 per hour. HP/LP pressure equalisation is required before starting.

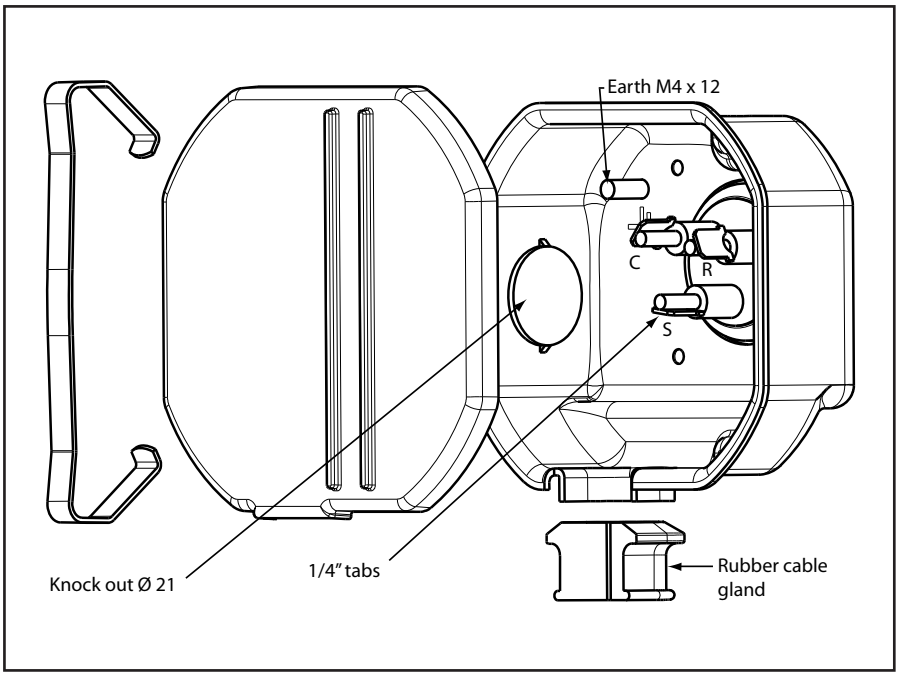
Voltage application range

Motor Code	Nominal voltage	Voltage application range
1	208 - 230 V / 60 Hz	187 - 253 V
3	200 - 230 V / 60 Hz	180 - 253 V
4	380 - 400 V / 50 Hz	340 - 440 V
	460 V / 60 Hz	414 - 506 V
5	230 V / 50 Hz	207 - 253 V

Terminal box

The MPZ terminal box has 1/4" faston terminal tabs for power supply. Note the C, S & R positions which are different from those in MTZ series compressors.

The main entry is at the bottom side through the rubber cable gland, however a Ø 21 mm knock out at the left side can be used for additional cable entry. The terminal box IP rating according to CEI 529 is IP54 provided that adapted diameter cable is used. The rubber cable gland internal diameter is 12 mm. For instance cable reference H07RN-F 4G2.5 is well adapted to this cable gland.



SYSTEM DESIGN RECOMMENDATIONS

Piping design

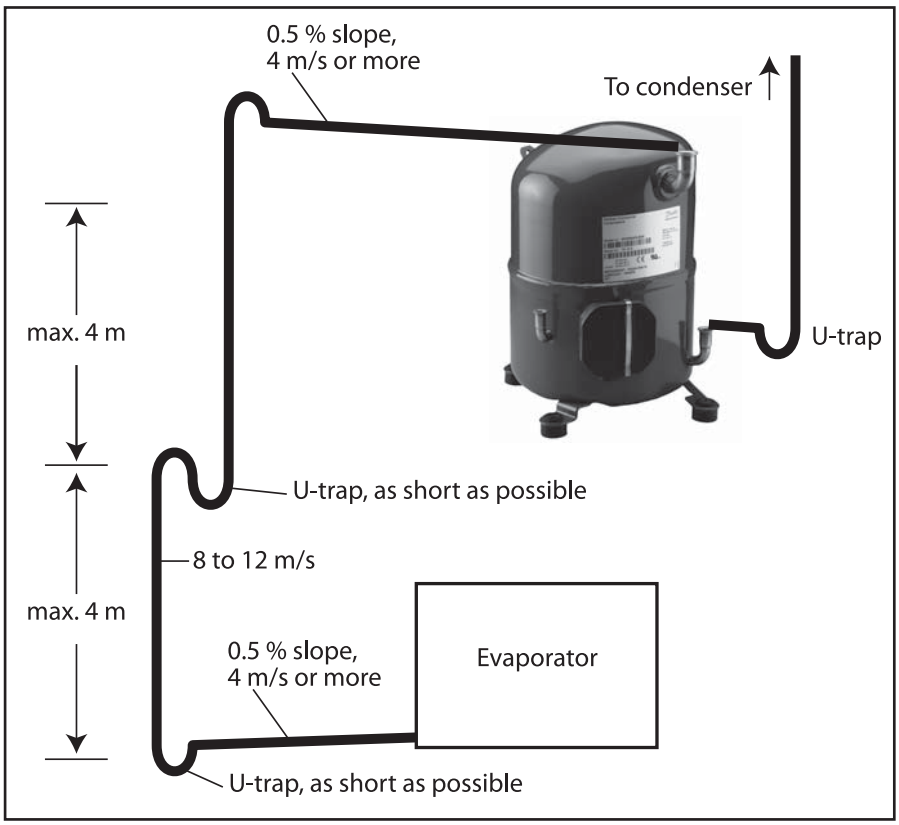
Oil in a refrigeration circuit is required to lubricate moving parts in the compressor. During normal system operation small quantities of oil will continuously leave the compressor, with the discharge gas. With good system piping design this oil will return to the compressor. As long as the amount of oil circulating through the system is small it will contribute to good system operation and improved heat transfer efficiency. However, too large amounts of oil in the system will have a negative effect on condenser and evaporator efficiency. If, in a poorly designed system, the amount of oil returning to the compressor is lower than the amount of oil leaving the compressor, the compressor will become starved of oil and the condenser, evaporator and/or refrigerant lines will become filled with oil. In such situations, additional oil charge will only correct the compressor oil level for a limited period of time and increase the amount of surplus oil in the rest of the system.

Only correct piping design can ensure a good oil balance in the system.

Suction lines

Horizontal suction line sections shall have a slope of 0.5% in the direction of refrigerant flow (5 mm per meter). The cross-section of horizontal suction lines shall be such that the resulting gas velocity is at least 4 m/s. In vertical risers, a gas velocity of 8 to 12 m/s is required to ensure proper oil return. A U-trap is required at the foot of each vertical riser. If the riser is higher than 4 m, additional U-traps are required for each additional 4 meters. The length of each U-trap must be as short as possible to avoid the accumulation of excessive quantities of oil (see figure below).

Gas velocities higher than 12 m/s will not contribute to significantly better oil return. However they will cause higher noise levels and result in higher suction line pressure drops which will have a negative effect on the system capacity.



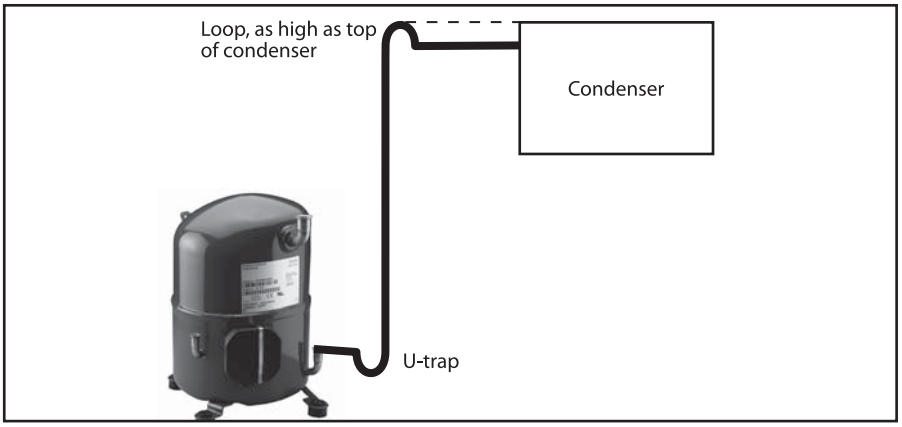
SYSTEM DESIGN RECOMMENDATIONS

The pipe sizes selected for specific systems may differ from these recommended sizes.

It is recommended that the suction lines are insulated to limit suction gas superheat.

Discharge line

When the condenser is mounted above the compressor, a loop above the condenser and a U-trap close to the compressor are required to prevent liquid draining from the condenser into the discharge line during standstill.



Filter driers

For new installations with MPZ compressors Danfoss recommends using the Danfoss DML 100%-molecular sieve, solid core filter drier. Molecular sieve filter driers with loose beads from third party suppliers shall be avoided.

For servicing of existing installations where acid formation is present the Danfoss DCL solid core filter driers containing activated alumina are recommended.

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

Operating limits

High Pressure

A high pressure safety switch is required to stop 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 in a lockout circuit, or be a manual reset device to prevent compressor cycling around the high pressure limit. When a discharge valve is used, the HP switch must be connected to the service valve gauge port, which cannot be isolated.

Low pressure

A low pressure safety switch is recommended to avoid compressor operation at too low suction pressure.

Test pressure low side	25 bars(g)
Working pressure range high side	13.2 - 27.7 bars(g)
Working pressure range low side	1 - 7.2 bars(g)
Free internal volume at low side	6.72 litres

SYSTEM DESIGN RECOMMENDATIONS

Low ambient temperature operation

At low ambient temperatures, the condensing temperature and condensing pressure in air cooled condensers will decrease.

This low pressure may be insufficient to supply enough liquid refrigerant to the evaporator. As a result the evaporator temperature will strongly decrease with the risk of frosting. At compressor start-up, the compressor can pull a deep vacuum and it can be switched off by the low pressure protection. Depending on the low pressure switch setting and delay timer, short cycling can occur. To avoid these problems, several solutions are possible, based on reducing condenser capacity:

• Indoor location of condensers

• Liquid flooding of condensers (note: this solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is required and special care should be taken when designing the discharge line.)

• Reduce air flow to condensers.

Other problems can also occur when the compressor is operating at low ambient temperature. During shut down periods, liquid refrigerant can migrate to a cold compressor.

For such conditions a belt-type crankcase heater is strongly recommended.

Note that with 100% suction gas cooled motors, Danfoss MPZ compressors can be externally insulated.

Refer to section "Liquid refrigerant migration & charge limits" for more details.

Operating voltage and cycle rate

Operating voltage range

The operating voltage limits are shown in the table on page 14. The voltage applied to the motor terminals must always be within these table limits. The maximum allowable voltage unbalance for 3-phase compressors is 2%. Voltage unbalance causes high current draw on one or more phases, which in turn leads to overheating and possible motor damage.

Voltage unbalance is given by the formula:

$$\%\ \text{VOLTAGE UNBALANCE:}\quad \frac{|V_{AVG} - V_{1\text{-}2}| + |V_{AVG} - V_{1\text{-}3}| + |V_{AVG} - V_{2\text{-}3}|}{2 \times V_{AVG}} \times 100$$

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

Cycle rate limit

There may be no more than 12 starts per hour (6 when a soft start accessory is used). A higher number reduces the service life of the motor-compressor unit. If necessary, use an anti-short-cycle timer in the control circuit.

A time-out of three minutes is recommended. The system must be designed in such a way to guarantee a minimum compressor running time in order to provide proper oil return and sufficient motor cooling after starting.

Note that the oil return rate varies as a function of the system design.

SYSTEM DESIGN RECOMMENDATIONS

Liquid refrigerant control and charge limits

Refrigeration compressors are basically designed as gas compressors. Depending on the compressor design and operating conditions, most compressors can also handle a limited amount of liquid refrigerant. Danfoss MPZ compressors have a large internal volume and can therefore handle relatively large amounts of liquid refrigerant without major problems. However even when a compressor can handle liquid refrigerant, this will not be favourable to its service life. Liquid refrigerant can dilute the oil, wash oil out of bearings and result in high oil carry over, resulting in loss of oil from the sump. Good system design can limit the amount of liquid refrigerant in the compressor, which will have a positive effect on the compressor service life.

Liquid refrigerant can enter a compressor in different ways, with different effects on the compressor.

Off-cycle migration

During system standstill and after pressure equalisation, refrigerant will condense in the coldest part of the system. The compressor can easily be the coldest spot, for example when it is placed outside in low ambient temperatures. After a while, the full system refrigerant charge can condense in the compressor crankcase. If the entire system is at a uniform temperature and there are no obstructions to vapor flow during the off cycle the refrigerant charge will slowly migrate to the compressor because of the solubility of refrigerant in the oil. If other system components are located at a higher level, this process can be even faster because gravity will assist the liquid refrigerant to flow back to the compressor. When the compressor is started, the pressure in the crankcase decreases rapidly.

At lower pressures the oil holds less refrigerant, and as a result part of the refrigerant will violently evaporate from the oil, causing the oil to foam. This process is often called “boiling”.

The negative effects of migration on the compressor are:

• oil dilution by liquid refrigerant

• oil foam, transported by refrigerant gas and discharged into the system, causing loss of oil and in extreme situations risk for oil slugging

• in extreme situations with high system refrigerant charge, liquid slugging could occur (liquid entering the compressor cylinder).

Liquid floodback during operation

During normal and stable system operation, refrigerant will leave the evaporator in a superheated condition and enter the compressor as a superheated vapour.

Normal superheat values at compressor suction are 5 to 30 K. However the refrigerant leaving the evaporator can contain an amount of liquid refrigerant due to different reasons:

• wrong dimensioning, wrong setting or malfunction of expansion device

• evaporator fan failure or blocked air filters.

In these situations, liquid refrigerant will continuously enter the compressor.

The negative effects from continuous liquid floodback are:

• permanent oil dilution

• in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could occur.

SYSTEM DESIGN RECOMMENDATIONS

Liquid floodback at change over cycles in reversible heat pumps

In heat pumps, change over from cooling to heating cycles, defrost and low load short cycles may lead to liquid refrigerant floodback or saturated refrigerant return conditions.

The negative effects are:
• oil dilution
• in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could appear.

Crankcase heater

Tests must be conducted to ensure that the appropriate oil temperature is maintained under all ambient conditions.

According our standard recommendation oil temperature has to be maintained 10K above the saturated LP temperature of the refrigerant.

Under extreme conditions such as very low ambient temperature a belt type crankcase heater could be used. The belts crankcase heater must be positioned on the compressor shell as close as possible to the oil sump to ensure good heat transfer to the oil.

Belt crankcase heaters are not self-regulating. Control must be applied to energise the belt heater once the compressor has been stopped and then to de-energise it while the compressor is running. The belt heater must be energised 12 hours before restarting the compressor following an extended shutdown period.

If the crankcase heater is not able to maintain the oil temperature at 10 K above the saturated LP temperature of the refrigerant during off cycles or if repetitive floodback is present, a Liquid Line Solenoid Valve (LLSV) + pump-down cycle is required, possibly in conjunction with a suction accumulator.

The use of the trickle circuit wiring is allowed on single phase MPZ compressors. This specific wiring allows heating of the compressor during off period, feeding the auxiliary winding through the "trickle" capacitor with a small current.

Frequency	Models	Standard wiring	Trickle wiring	
		Permanent capacitor (µf)	Trickle capacitor (µf)	Additional capacitor (µf)
230V 50 Hz	MPZ038-048-054	40	30	10
	MPZ061-068	45	35	10
208-230V 60 Hz	MPZ038-048-054	40	25	15
	MPZ061-068	45	25	20

Liquid line solenoid valve & pump-down

In refrigeration applications, the Liquid Line Solenoid Valve (LLSV) is highly recommended. During the off-cycle, the LLSV isolates the liquid charge in the condenser side, thus preventing refrigerant transfer or excessive migration of refrigerant into the compressor. Furthermore, when using a LLSV in conjunction with a pump-down cycle, the quantity of refrigerant in the low-pressure side of the system will be reduced.

A pump-down cycle design is required when evaporators are fitted with electric defrost heaters.

Suction accumulator

A suction accumulator offers considerable protection against refrigerant floodback at start-up, during operation and in hot gas defrost systems.

The suction accumulator must be selected in accordance with the accumulator manufacturer recommendations. As a general rule, Danfoss recommends to size the accumulator for at least 50% of the total system charge. Tests however must be conducted to determine the optimal size.

SOUND AND VIBRATION MANAGEMENT

Sound

Running compressors vibrate and generate refrigerant gas pulsations. These vibrations, when coupled to ambient air, are heard as sound. Those vibrations and pulsations conducted through connecting tubing as well as the vibrations reaching the compressor feet continue to other parts of the system and structure where they may also generate sound.

Danfoss MPZ compressors are 100% suction gas cooled, and require no body cooling, thus they can be insulated. For inside mounted compressors, sound insulation of the enclosed location of the compressor is an alternative to sound insulation of the compressor.

For treatment of vibration please refer to the next section.

	Sound power level at 50 Hz dB(A)	Sound power level at 60 Hz dB(A)
MPZ038	71	74
MPZ048	68	71
MPZ054	68	71
MPZ061	68	71
MPZ068	68	71

Sound power level for Danfoss MPZ with R404A, motor code 4, Te = -10°C, TC = 45°C

Vibrations

There are best practises to check whether vibration paths are designed in the best possible way.

Grommets: the mounting grommets delivered with the compressor should always be used. They reduce the vibration transmitted by the compressor mounting feet to the base frame.

The compressor should never be directly mounted to the base frame without the grommets, otherwise high vibration transmission will occur and the compressor service life will be reduced.

The base on which the compressor is mounted should be sufficiently rigid and well connected to the main frame of the application to ensure the full effectiveness of the mounting grommets.

Tubes: suction and discharge lines must have adequate flexibility in 3 planes. Eventually vibration absorbers may be required. Take care that the tubes are correctly formed and located in front of the connector before fitting to avoid any constraint on the compressor. Using a shock loop with a generous bending diameter is a good means of vibration transmission through the piping. Soft copper tubing and smaller diameter tubing should be used to make smooth flexible connections.

Care must be taken to avoid tubing having resonant frequencies close to those of the compressor frequency.

Vibration is also transmitted by refrigerant gas pulsation. Danfoss MPZ compressors have built in mufflers to reduce this vibration.

Note: MPZ compressors have been designed and qualified for stationary equipment used in refrigeration applications.

Danfoss doesn't warrant these compressors for use in mobile applications, such as trucks, busses, railways, subways, etc...

System cleanliness

System contamination is one of the main factors affecting equipment reliability and compressor service life.

Therefore it is important to ensure system cleanliness when manufacturing a refrigeration system. During the manufacturing process, system contamination can be caused by:

- Brazing and welding oxides
- Filings and particles from removing burrs from pipe-work
- Brazing flux
- Moisture and air.

Only use clean and dehydrated refrigeration grade copper tubes and silver alloy brazing material. Clean all parts before brazing and always purge nitrogen or CO_2 through the pipes during brazing to prevent oxidation. If flux is used, take every precaution to prevent the leakage of flux into the piping. The use of gas flux core or flux coated braze wire or rod instead of brush applied paste flux is strongly recommended. Do not drill holes (e.g. for schräder valves) in parts of the installation that are already completed, when filings and burrs can not be removed. Carefully follow the instructions below regarding brazing, mounting, leak detection, pressure test and moisture removal. All installation and service work shall only be done by qualified personnel respecting all procedures and using tools (charging systems, tubes, vacuum pump, etc.) dedicated for the refrigerant used.

Compressor handling, mounting and connection to the system

Compressor handling

Danfoss MPZ compressors are provided with a lifting lug. This lug should always be used to lift the compressor. Once the compressor is installed, the compressor lifting lug should never be used to lift the complete installation.
Keep the compressor in an upright position during shipping and handling.

Compressor mounting

Mount the compressor on a horizontal plane with a maximum slope of 3 degrees. All compressors are supplied with four rubber mounting grommets, each complete with metal sleeves and nuts and bolts. Refer to the outline drawings on page 10.

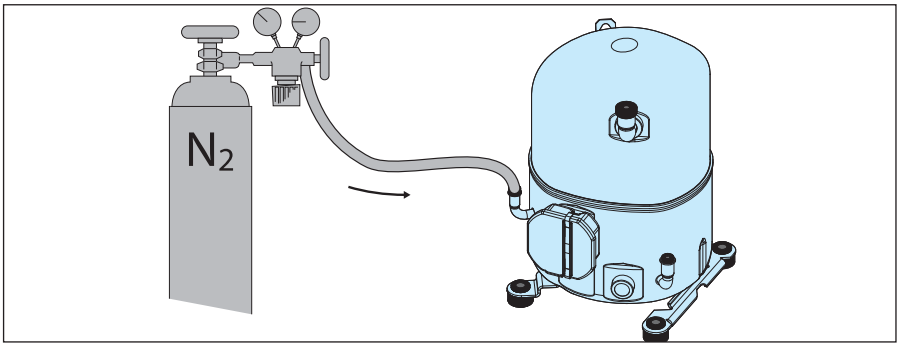
These grommets largely attenuate the compressor vibration transmitted to the base frame. The compressor must always be mounted with these grommets. Recommended mounting torque: 12 - 18 Nm.

Compressor connection to the system

New compressors have a protective nitrogen holding charge. The suction and discharge caps should only be removed just before connecting the compressor to the installation to avoid air and moisture entering the compressor.

Whenever possible the compressor must be the last component to be integrated in the system. When all brazing is finished and when the total system is ready, the compressor caps can be removed and the compressor can be connected to the system with a minimum exposure to ambient air.
In this situation nitrogen or CO_2 must be purged through the compressor via the process tube to prevent air and moisture ingress. Purging must start when the caps are removed and maintained during the brazing process.

INSTALLATION AND SERVICE



System pressure test

It is recommended that an inert gas such as nitrogen be used for pressure testing. Always use the appropriate pressure regulator with gas cylinders. Any attempt to use a high pressure gaz supply without a suitable pressure regulator can lead to personal injury or death as well as system damage. Dry air may also be used but care should be taken since it can form an inflammable mixture with the compressor oil. When performing a system pressure test, the maximum allowed pressure for the different components should not be exceeded.

For Danfoss MPZ compressors the maximum test pressure is 25 bar(g).

Leak detection

Perform a leak detection test on the complete system by means of electronic detector after circuit pressurization with nitrogen and R404A.

The low side test pressure must not exceed 25 bar(g). Should a leak be discovered, proceed with repair steps and repeat the leak detection.

It is forbidden to use other gasses such as oxygen, dry air or acetylene as these gasses can form an inflammable mixture. Never use CFC or HCFC refrigerants for leak detection of HFC systems.

Note 1: Leak detection with refrigerant may not be allowed in some countries. Check local regulations.
Note 2: Leak detecting additives shall not be used as they may affect the lubricant properties.

Warranty may be voided if leak detecting additives have been used.

Vacuum pull-down moisture removal

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

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

To eliminate these factors, a vacuum pull-down according to the procedure below is recommended:

1. Whenever possible (if valves are present) the compressor must be kept isolated from the system.

2. After the leak detection, the system must be pulled-down under a vacuum of 500 microns (0.67 mbar). A two stage vacuum pump shall be used with a capacity appropriate to the system volume. It is recommended to use connection lines with a large diameter and to connect these to the 3/8" process tube connection.

INSTALLATION AND SERVICE

3. When the vacuum level of 500 micron is reached, the system must be isolated from the vacuum pump. Wait 30 minutes during which the system pressure should not rise. When the pressure rapidly increases, the system is not leak tight. A new leak detection must be performed and the vacuum pull-down procedure should be restarted from step 1. When the pressure slowly increases, this indicates the presence of moisture. In this case step 2 and 3 should be repeated.

4. If suction and discharge line valves are used, connect the compressor to the system by opening the valves.

5. Break the vacuum with nitrogen or the final refrigerant.

6. Repeat step 2 and 3 on the total system. At commissioning, system moisture content may be up to 100 ppm. During operation the filter drier must reduce this to a level < 20 ppm.

Warning : do not use a megohmmeter or apply power to the compressor while it is under vacuum, as this may cause motor winding damage. Never run the compressor under vacuum as it may cause compressor motor burn-out.

Refrigerant charging

"Near-azeotropic" refrigerant mixtures such as R404A must always be charged in liquid phase. For the initial charge, the compressor must not run. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. Then slowly add refrigerant in the liquid phase, on the low pressure side as far away as possible from the running compressor.

The refrigerant charge quantity must be suitable for both winter and summer operation. Refer also to section "Protection against flooded starts and liquid floodback" for information about refrigerant charge limits.

Warning: when a liquid line solenoid valve is used, the vacuum in the low pressure side must be broken before applying power to the system.

Oil sight glass

Standard MPZ compressors are delivered without oil sight glass. The sight glass can be omitted in most OEM applications which have run approval tests to ensure correct oil and refrigerant circulation.

However, the capacity of the MPZ range offers the possibility to use them in locally constructed refrigeration applications with remote evaporators, oil separator and suction accumulator. In such case, the MPZ with optional sight glass allows for verification of the circuit after commissioning and during maintenance.

The oil sight glass is welded in the compressor shell. It does not allow for any other connections.

Suction gas superheat

The minimum suction gas superheat measured on the suction tube 20 cm far from the compressor body is 8K. Lower superheat values increase the risk of unwanted liquid floodback to the compressor.

For very low superheat values an electronically controlled expansion valve is recommended.

High superheat can be accepted but in these cases, tests have to be performed to check that the maximum discharge temperature of 130°C will not be exceeded. Note that high superheat values decrease the compressor application envelope and system performance.

ORDERING INFORMATION AND PACKAGING

Ordering - Single pack

Compressor model	Design	Code no.			
		Motor voltage code			
		1	3	4	5
		Nominal voltage			
		208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50
MPZ038	Standard	120F0093	120F0118	120F0047	120F0143
	Sight Glass	120F0098	120F0123	120F0052	120F0148
MPZ048	Standard	120F0094	120F0119	120F0048	120F0144
	Sight Glass	120F0099	120F0124	120F0053	120F0149
MPZ054	Standard	120F0095	120F0120	120F0049	120F0145
	Sight Glass	120F0100	120F0125	120F0054	120F0150
MPZ061	Standard	120F0096	120F0121	120F0050	120F0146
	Sight Glass	120F0101	120F0126	120F0055	120F0151
MPZ068	Standard	120F0097	120F0122	120F0051	120F0147
	Sight Glass	120F0102	120F0127	120F0056	120F0152

Ordering - Industrial pack

Compressor model	Design	Code no.			
		Motor voltage code			
		1	3	4	5
		Nominal voltage			
		208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50
MPZ038	Standard	120F0103	120F0128	120F0057	120F0153
	Sight Glass	120F0108	120F0133	120F0062	120F0158
MPZ048	Standard	120F0104	120F0129	120F0058	120F0154
	Sight Glass	120F0109	120F0134	120F0063	120F0159
MPZ054	Standard	120F0105	120F0130	120F0059	120F0155
	Sight Glass	120F0110	120F0135	120F0064	120F0160
MPZ061	Standard	120F0106	120F0131	120F0060	120F0156
	Sight Glass	120F0111	120F0136	120F0065	120F0161
MPZ068	Standard	120F0107	120F0132	120F0061	120F0157
	Sight Glass	120F0112	120F0137	120F0066	120F0162

Packaging

Model	Single pack		Multipack				Industrial pack			
	Dimensions (mm)	Gross weight (kg)	Nbr	Dimensions (mm)	Gross weight (kg)	Static stacking	Nbr	Dimensions (mm)	Gross weight (kg)	Static stacking
MPZ038	385 x 280 x 360	26.3	8	1150 x 800 x 510	223	4	12	1150 x 800 x 520	317	4
MPZ048										
MPZ054										
MPZ061		26.9			227				323	
MPZ068										

Single pack: One compressor in a cardboard box.
Multipack: A full pallet of single packs.
Industrial pack: A full pallet of unpacked compressors.
Nbr: Number of compressors per pallet.

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Maneurop® reciprocating compressors

MT/MTZ 50 - 60 Hz

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

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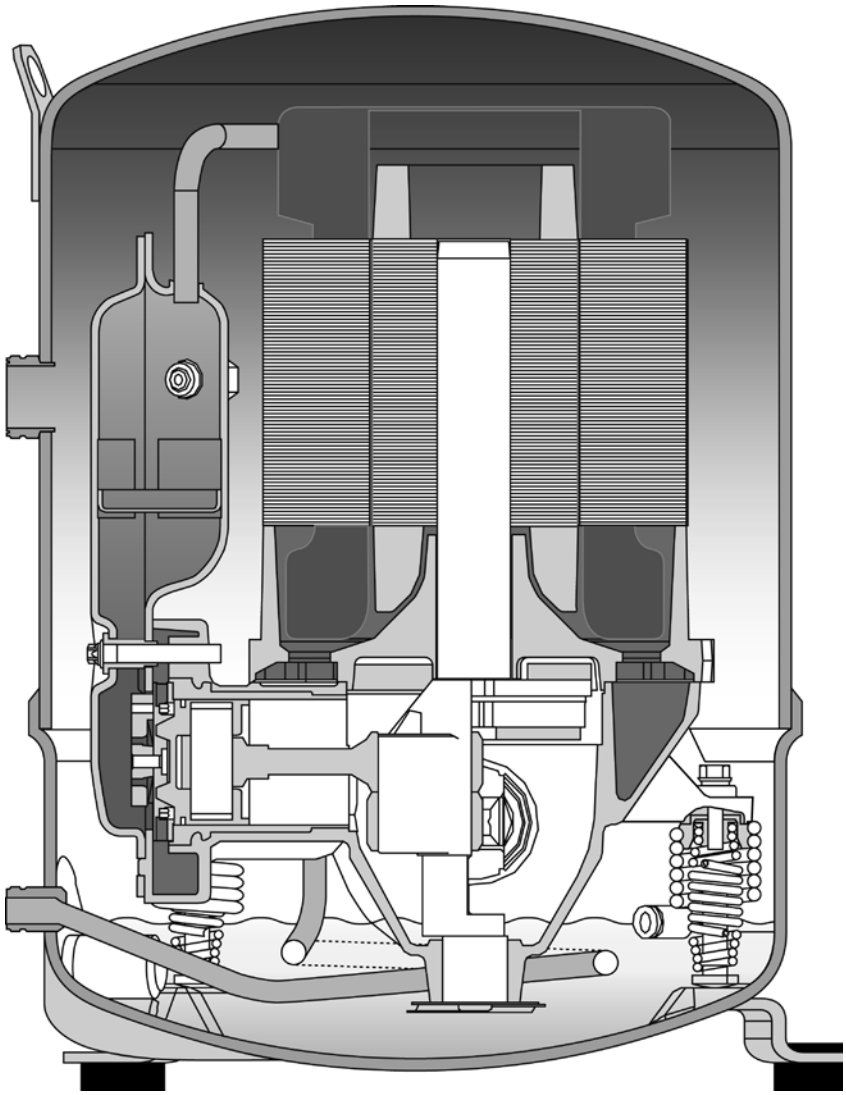
SELECTION &
تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

CONTENTS

MANEUROP® RECIPROCATING COMPRESSORS

Maneurop® reciprocating compressors from Danfoss Commercial Compressors are specially designed for applications with a wide range of operating conditions. All components are of high quality and precision in order to assure a long product life.

Maneurop® MT and MTZ series compressors are of the hermetic reciprocating type and are designed for medium and high evaporating temperature applications.



The compressor design allows for the motor to be 100% suction-gas cooled.

The positive benefits of internal motor protection, high efficiency circular valve design and high torque motors provide for a quality installation.

The MT series is designed for use with the "traditional" R-22 refrigerant, using Danfoss mineral oil 160P as lubricant.
The MT series can also be applied with several R-22 based refrigerant blends (substitute refrigerants), using 160 ABM alkylbenzene as lubricant. The MTZ series is specifically designed for use with the HFC refrigerants R-407C, R-134a, R-404A, and R-507A, using 160PZ polyester oil as lubricant.
MTZ compressors can be used in new installations and also to replace Maneurop® MTE compressors in existing installations.

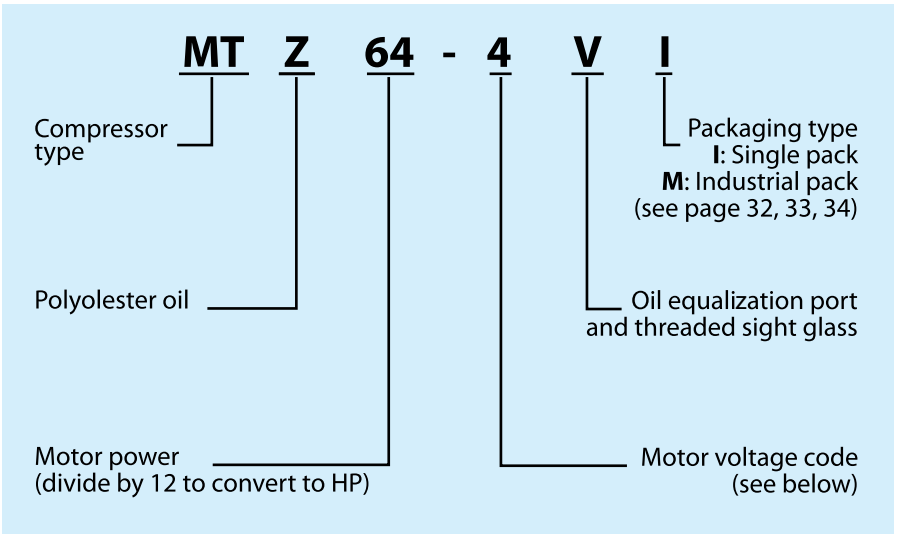
MT and MTZ compressors have a large internal free volume that protects against the risk of liquid hammering when liquid refrigerant enters the compressor.

MT and MTZ compressors are fully suction-gas cooled. This means that no additional compressor cooling is required and allows the compressors to be insulated with acoustic jackets to obtain lower sound levels, without the risk of the compressor overheating.

MT and MTZ compressors are available in 26 different models with displacement ranging from 231 to 4142 cfh. Seven different motor voltage ranges are available for single and three phase power supplies at 50 and 60 Hz. Most compressors exist in two versions:
- standard version
- VE version (oil equalization + oil sight glass).

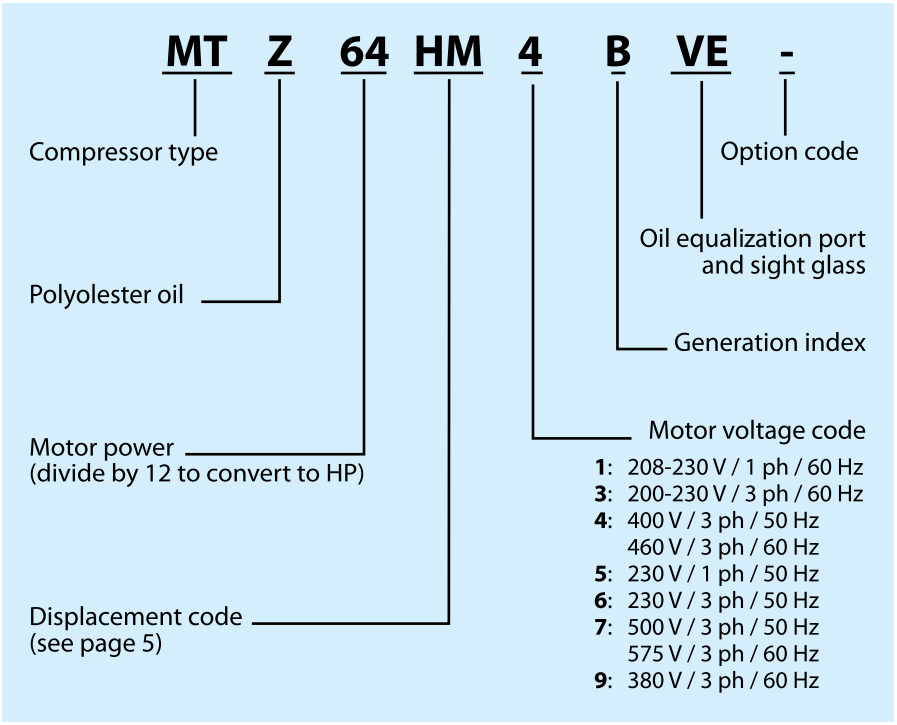
COMPRESSOR MODEL DESIGNATION

Code numbers
(for ordering)



Available code numbers are listed on pages 32-33

Compressor reference
(indicated on the compressor nameplate)



Versions

	S version (standard)		VE version (optional)	
Models	**Oil sight glass**	**Oil equalization connection**	**Oil sight glass**	**Oil equalization connection**
MT/MTZ018-040 (1 cyl.)	-	-	threaded	3/8"flare
MT/MTZ044-081 (2 cyl.)	-	-	threaded	3/8"flare
MT/MTZ100-160 (4 cyl.)	brazed	-	threaded	3/8"flare

SPECIFICATIONS

Technical specifications

Compressor model	Displacement			Cyl. number	Oil charge	Net weight	Available motor voltage codes						
	Code	in³/rev	cfh at 3600 rpm		oz	lbs	1	3	4	5	6	7	9
MT/MTZ018	JA	1.84	231	1	32	46	●	●	●	●	○	-	-
MT/MTZ022	JC	2.33	291	1	32	46	●	●	●	●	●	-	●
MT/MTZ028	JE	2.93	367	1	32	51	●	●	●	●	●	-	●
MT/MTZ032	JF	3.29	411	1	32	53	●	●	●	●	●	○	○
MT/MTZ036	JG	3.69	461	1	32	55	●	●	●	●	●	○	●
MT/MTZ040	JH	4.14	518	1	32	57	●	●	●	-	●	-	-
MT/MTZ044	HJ	4.65	581	2	61	77	●	●	●	-	●	●	●
MT/MTZ045	HJ	4.65	581	2	61	77	-	●	●	-	-	-	-
MT/MTZ050	HK	5.23	653	2	61	77	●	●	●	●	●	●	●
MT/MTZ051	HK	5.23	653	2	61	77	-	●	●	-	-	-	-
MT/MTZ056	HL	5.87	733	2	61	82	●	●	●	-	●	●	●
MT/MTZ057	HL	5.87	733	2	61	82	-	●	●	-	-	-	-
MT/MTZ064	HM	6.57	822	2	61	82	●	●	●	-	●	-	●
MT/MTZ065	HM	6.57	822	2	61	82	-	●	●	-	-	-	-
MT/MTZ072	HN	7.38	922	2	61	88	-	●	●	-	●	-	●
MT/MTZ073	HN	7.38	922	2	61	88	-	●	●	-	-	-	-
MT/MTZ080	HP	8.29	1036	2	61	88	-	●	●	-	●	-	●
MT/MTZ081	HP	8.29	1036	2	61	88	-	●	●	-	-	-	-
MT/MTZ100	HS	10.45	1306	4	132	132	-	●	●	-	●	●	●
MT/MTZ125	HU	13.15	1643	4	132	141	-	●	●	-	●	●	○
MT/MTZ144	HV	14.76	1845	4	132	148	-	●	●	-	●	●	●
MT/MTZ160	HW	16.57	2071	4	132	152	-	●	●	-	●	●	●

● Available in MT and MTZ ○ Available in MTZ only

Approvals and certificates

Maneurop® MT/MTZ compressors comply with the following approvals and certificates

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

CE (European Directive) 0062	All models
UL (Underwriters Laboratories) c UL us	All 60 Hz models
CCC (China Compulsory Product Certification)	Depending on the model and motor voltage code.
Gost certificate (for Russia)	Depending on the model and voltage code.

SPECIFICATIONS

Nominal performance data for R-404A and R-22

R-404A	Refrigeration											
Compressor model	50 Hz, EN12900 ratings To = 14°F, Tc = 113°F, SC = 0 F, SH = 18°F				50 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F				60 Hz, ARI ratings To = 20°F, Tc = 120°F, SC = 0°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4*	6500	1.21	2.73	5.40	7070	1.31	2.86	5.40	8980	1.76	2.86	5.09
MTZ022-4*	8950	1.48	3.06	6.04	9665	1.62	3.24	5.96	12300	2.05	3.27	6.00
MTZ028-4*	11700	1.96	4.04	5.98	12600	2.14	4.30	5.88	15980	2.68	4.23	5.95
MTZ032-4*	13600	2.16	4.25	6.28	14550	2.37	4.56	6.15	17450	2.98	4.56	5.85
MTZ036-4*	15950	2.58	4.95	6.18	17400	2.83	5.33	6.02	20150	3.33	5.09	6.04
MTZ040-4*	18200	2.95	5.87	6.18	19400	3.24	6.29	5.97	23000	3.76	5.88	6.11
MTZ044-4	17600	3.16	6.37	5.57	18900	3.43	6.66	5.51	24250	4.18	6.58	5.79
MTZ045-4*	18350	2.77	5.35	6.59	19750	3.02	5.67	6.53	24250	3.85	5.85	6.30
MTZ050-4	27000	3.61	6.53	5.81	22470	3.92	6.92	5.73	28300	4.82	7.04	5.87
MTZ051-4*	21380	3.22	5.95	6.63	22880	3.50	6.33	6.54	28550	4.42	6.53	6.46
MTZ056-4	23900	4.00	7.07	5.98	25600	4.38	7.57	5.85	31800	5.44	7.80	5.84
MTZ057-4*	22900	3.51	6.83	6.52	24750	3.85	7.25	6.43	32400	4.98	7.52	6.50
MTZ064-4	27760	4.54	8.30	6.11	29700	4.96	8.84	5.99	36730	6.11	8.98	5.91
MTZ065-4*	27250	4.20	7.82	6.49	29340	4.60	8.35	6.37	36000	5.67	8.31	6.35
MTZ072-4	31250	4.99	8.64	6.28	33330	5.45	9.28	6.11	40470	6.91	9.76	5.85
MTZ073-4*	30460	4.69	8.95	6.49	32680	5.11	9.50	6.39	40850	6.53	9.73	6.25
MTZ080-4	35930	5.84	10.12	6.15	38250	6.38	10.87	5.99	45760	8.03	11.35	5.70
MTZ081-4*	35750	5.61	10.20	6.39	38780	6.14	10.94	6.22	46450	7.81	11.35	5.94
MTZ100-4*	41940	6.76	12.21	6.22	44500	7.35	12.94	6.11	52850	8.72	12.79	6.06
MTZ125-4*	53650	8.44	13.79	6.35	57380	9.21	14.86	6.22	68200	11.37	15.41	6.00
MTZ144-4*	63150	9.78	16.29	6.45	67240	10.65	17.47	6.31	80350	12.99	17.93	6.18
MTZ160-4*	69350	11.08	18.26	6.25	73970	12.09	19.64	6.11	87300	14.73	20.17	5.92

* 50 Hz, EN12900 data for indicated models are ASERCOM certified

R-404A data are also valid for refrigerant R-507A

R-22	Refrigeration				Air Conditioning							
Compressor model	50 Hz, EN12900 ratings To = 14°F, Tc = 113°F, SC = 0 F, SH = 18°F				50 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				60 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. W/W	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MT018-4	5770	1.00	2.27	5.77	13250	1.45	2.73	9.16	15900	1.74	2.73	9.16
MT022-4	8500	1.29	2.55	6.63	18305	1.89	3.31	9.69	22000	2.27	3.31	9.69
MT028-4	12750	1.81	3.59	7.04	25200	2.55	4.56	9.87	30200	3.06	4.56	9.87
MT032-4	13500	2.11	3.73	6.39	27500	2.98	4.97	9.22	33000	3.58	4.97	9.22
MT036-4	16400	2.35	4.30	6.97	31650	3.37	5.77	9.38	38000	4.05	5.77	9.38
MT040-4	17800	2.67	4.86	6.66	35800	3.86	6.47	9.27	42900	4.63	6.47	9.27
MT044-4	18100	2.72	6.03	6.66	37700	3.89	7.37	9.69	45200	4.66	7.37	9.69
MT045-4	16600	2.46	5.02	6.76	35900	3.53	6.37	10.17	44000	4.32	6.42	10.18
MT050-4	19850	2.95	5.22	6.73	42100	4.32	8.46	9.74	50500	5.18	8.46	9.74
MT051-4	20050	2.94	5.53	6.83	41800	4.19	7.20	9.97	50200	5.04	7.26	9.95
MT056-4	23300	3.44	6.21	6.80	47000	5.04	10.27	9.32	56400	6.05	10.27	9.32
MT057-4	22000	3.18	6.39	6.93	47000	4.58	8.19	10.24	56400	5.58	8.23	10.10
MT064-4	26100	3.89	7.06	6.69	54000	5.66	9.54	9.53	64800	6.80	9.54	9.53
MT065-4	26470	3.64	7.03	7.27	53700	5.27	9.16	10.18	64400	6.32	9.33	10.18
MT072-4	29100	4.29	7.58	6.80	58500	6.31	10.54	9.26	70200	7.57	10.54	9.26
MT073-4	29750	4.19	8.48	7.10	62100	6.12	10.98	10.15	74600	7.33	10.77	10.16
MT080-4	33200	4.84	8.24	6.86	66700	7.13	11.58	9.36	80000	8.55	11.58	9.36
MT081-4	35380	4.89	9.52	7.24	70800	7.08	12.48	9.99	85000	8.50	12.34	10.00
MT100-4	38700	5.79	11.82	6.69	79900	7.98	14.59	10.00	95900	9.58	14.59	10.00
MT125-4	52100	7.55	12.28	6.90	103900	10.66	17.37	9.74	124700	12.80	17.37	9.74
MT144-4	59000	8.47	17.06	6.97	117300	11.95	22.75	9.80	140700	14.35	22.75	9.80
MT160-4	65540	9.49	16.81	6.90	130700	13.40	22.16	9.75	156900	16.08	22.16	9.75

To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)
SC: Subcooling,

ARI capacity and power input data are +/- 5%
ASERCOM: Association of European Refrigeration Compressor and Controls Manufacturers

SPECIFICATIONS

Nominal performance data for R-407C and R-134a

R-407C	Air Conditioning											
Compressor model	50 Hz, EN12900 ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				50 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				60 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4*	11850	1.27	2.73	9.32	13150	1.38	2.86	9.53	17250	1.73	2.82	9.98
MTZ022-4*	15540	1.71	3.27	9.12	17140	1.86	3.47	9.23	21450	2.26	3.45	9.48
MTZ028-4*	20080	2.17	4.30	9.29	22340	2.36	4.57	9.45	28070	2.82	4.41	9.93
MTZ032-4*	22700	2.43	4.57	9.36	25030	2.65	4.90	9.43	30702	3.20	4.80	9.61
MTZ036-4*	25650	2.93	5.58	8.74	28280	3.21	5.99	8.82	34120	3.90	5.78	8.74
MTZ040-4*	29580	3.40	6.46	8.71	32720	3.71	6.92	8.81	40030	4.46	6.69	8.98
MTZ044-4	30530	3.34	6.10	9.12	33710	3.63	6.49	9.27	43030	4.36	6.84	9.85
MTZ045-4*	31180	3.12	5.84	10.01	34490	3.38	6.18	10.21	43480	4.25	6.34	10.23
MTZ050-4	34800	3.79	6.90	9.19	38490	4.11	7.34	9.34	48150	4.95	7.33	9.72
MTZ051-4*	35590	3.69	6.51	9.66	39380	4.01	6.95	9.82	48190	4.87	7.06	9.89
MTZ056-4	39960	4.32	7.85	9.26	44190	4.69	8.36	9.42	54370	5.66	8.41	9.60
MTZ057-4*	39900	4.02	7.45	9.90	44400	4.37	7.91	10.16	54880	5.40	8.03	10.15
MTZ064-4	45010	4.84	8.79	9.29	49830	5.26	9.35	9.47	60450	6.35	9.47	9.50
MTZ065-4*	45630	4.61	8.35	9.90	50720	5.02	8.91	10.10	61750	6.14	9.01	10.05
MTZ072-4	50540	5.50	9.81	9.19	55940	5.97	10.48	9.36	67930	7.21	10.78	9.41
MTZ073-4*	52230	5.42	9.85	9.66	58230	5.87	10.48	9.91	70970	7.30	10.61	9.72
MTZ080-4	57204	6.29	11.02	9.08	63280	6.83	11.83	9.25	76910	8.24	12.35	9.33
MTZ081-4*	59360	6.29	11.31	9.43	66010	6.83	12.08	9.67	78100	8.24	11.99	9.47
MTZ100-4*	69940	7.38	13.05	9.49	77520	8.00	13.83	9.69	96380	9.86	14.22	9.77
MTZ125-4*	91880	9.48	15.14	9.70	101740	10.32	16.28	9.85	121650	12.83	18.07	9.47
MTZ144-4*	101670	10.68	17.55	9.53	112940	11.59	18.80	9.74	139680	14.42	19.81	9.68
MTZ160-4*	116420	12.40	20.08	9.39	129160	13.46	21.50	9.59	154430	16.64	22.46	9.27

* 50 Hz, EN12900 data for indicated models are ASERCOM certified

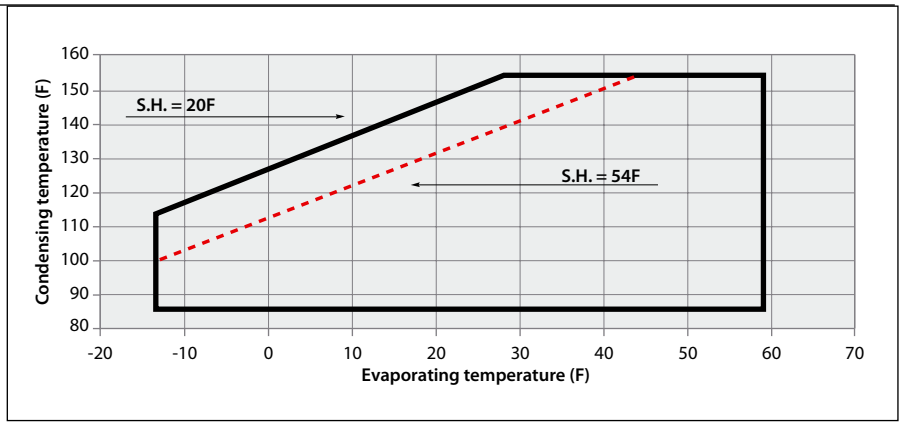
R-134a	Air Conditioning											
Compressor model	50 Hz, EN12900 ratings To = 41 °F, Tc = 122 °F, SC = 0 °F, SH = 18 °F				50 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F				60 Hz, ARI ratings To = +45°F, Tc = 130°F, SC = 15°F, SH = 20°F			
	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh	Cooling capacity BTU/h	Power input kW	Current input A	E.E.R. BTU/Wh
MTZ018-4	7890	0.92	2.12	8.57	8710	0.99	2.19	8.81	11200	1.22	2.09	9.20
MTZ022-4	10250	1.11	2.42	9.22	11440	1.20	2.51	9.56	14860	1.54	2.56	9.63
MTZ028-4	12740	1.41	3.18	9.05	14380	1.53	3.30	9.40	19260	2.04	3.37	9.43
MTZ032-4	14990	1.74	3.80	8.61	16910	1.87	3.94	9.03	20940	2.39	3.89	8.76
MTZ036-4	18240	1.97	3.88	9.26	20490	2.13	4.09	9.60	24490	2.75	4.20	8.91
MTZ040-4	19470	2.15	4.58	9.08	27860	2.33	4.89	9.36	27870	3.08	4.72	9.03
MTZ044-4	20900	2.36	5.51	8.88	23460	2.52	5.65	9.29	29850	3.14	5.47	9.51
MTZ045-4	20800	2.06	4.56	10.11	23390	2.22	4.73	10.53	30120	2.84	4.70	10.59
MTZ050-4	24490	2.68	5.33	9.12	27560	2.88	5.50	9.57	34460	3.60	5.36	9.57
MTZ051-4	24280	2.44	5.02	9.96	27360	2.63	5.20	10.39	34530	3.29	5.33	10.48
MTZ056-4	27460	2.99	5.61	9.19	30980	3.21	5.83	9.63	38010	3.95	5.92	9.62
MTZ057-4	26230	2.62	5.93	10.01	29780	2.84	6.17	10.47	38870	3.82	6.37	10.16
MTZ064-4	31280	3.36	6.66	9.32	35350	3.62	6.96	9.77	45290	4.68	7.11	9.67
MTZ065-4	30600	3.02	6.53	10.11	34700	3.26	6.81	10.63	44400	4.20	6.77	10.56
MTZ072-4	36000	3.74	6.83	9.63	40470	4.01	7.20	10.09	50000	5.19	7.59	9.64
MTZ073-4	34940	3.50	7.66	9.97	39790	3.78	7.99	10.52	50000	4.81	7.88	10.39
MTZ080-4	47260	4.31	8.03	9.56	46380	4.64	8.45	10.00	56520	5.99	8.79	9.42
MTZ081-4	40130	4.02	8.44	9.97	45490	4.35	8.83	10.44	56320	5.47	8.68	10.29
MTZ100-4	47030	4.89	9.84	9.60	53040	5.28	10.24	10.04	63970	6.50	10.11	9.84
MTZ125-4	57990	5.84	10.24	9.94	65130	6.29	10.80	10.35	79920	7.71	11.09	10.23
MTZ144-4	71820	7.27	13.11	9.87	80670	7.83	13.78	10.30	96960	9.81	14.28	9.87
MTZ160-4	78820	7.98	13.90	9.87	88320	8.57	14.67	10.29	107650	10.91	15.54	9.86

To: Evaporating temperature at dew point (saturated suction temperature)
Tc: Condensing temperature at dew point (saturated discharge temperature)
SC: Subcooling,
S

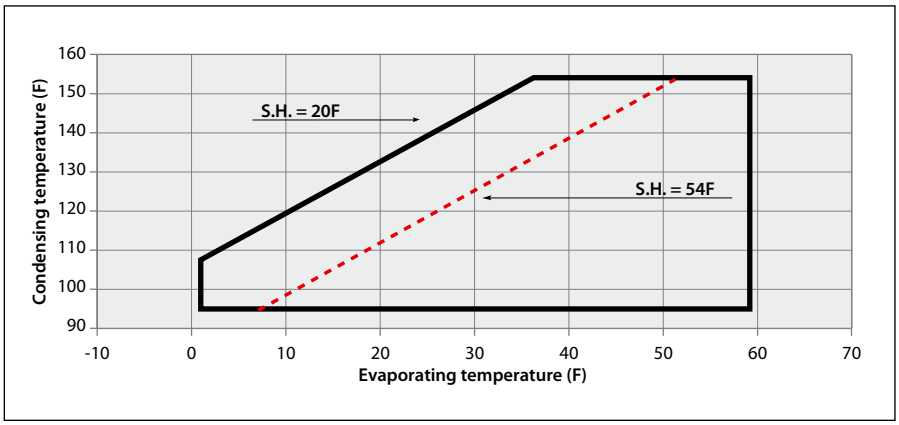
ARI capacity and power input data are +/- 5%
ASERCOM: Association of European Refrigeration Compressor and Controls Manufacturers

OPERATING ENVELOPES

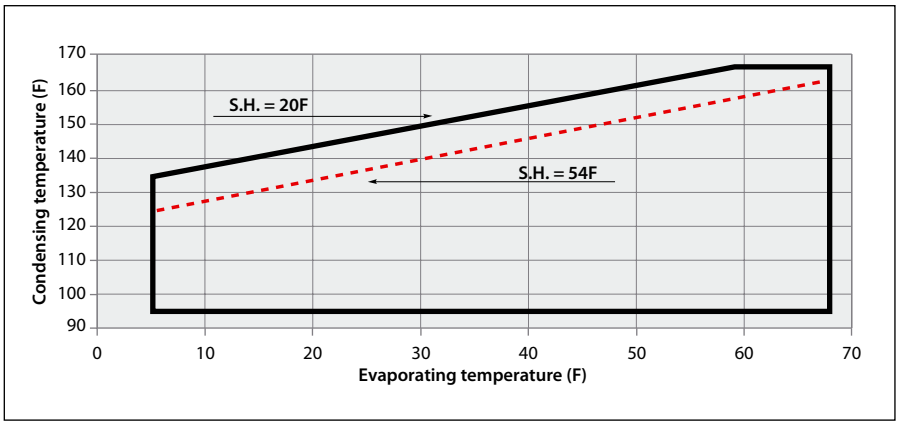
MT
R-22



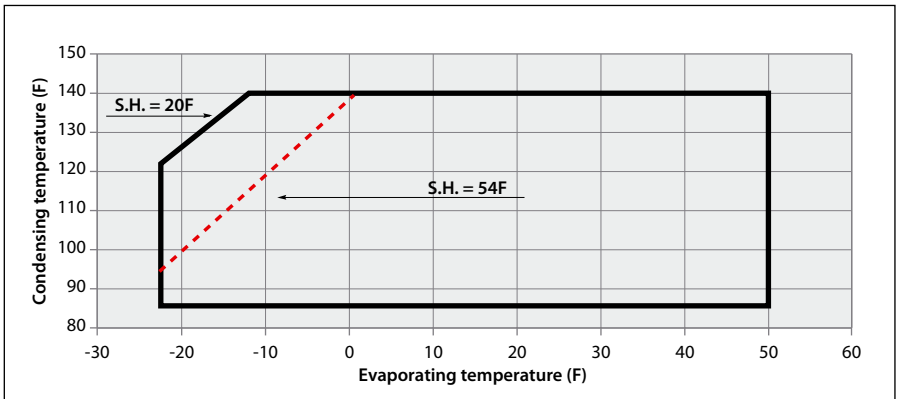
MTZ
R-407C at DEW point



MTZ
R-134a



MTZ
R-404A/R-507A



OPERATING ENVELOPES

Zeotropic refrigerant mixtures

Refrigerant mixtures can be either zeotropic or azeotropic.
In a zeotropic mixture (like R-407C) on the other hand the composition of vapor and liquid changes during the phase transition. When the effect of this phase transition is very small, the mixture is often called a near-azeotropic mixture. R-404A is such a near-azeotropic mixture.

An azeotropic mixture, on the other hand, (like R-502 or R-507A) behaves like a pure refrigerant. During a phase transition (from vapor to liquid or from liquid to vapor) the composition of vapor and liquid stays the same.
The composition change causes phase shift and temperature glide.

Phase shift

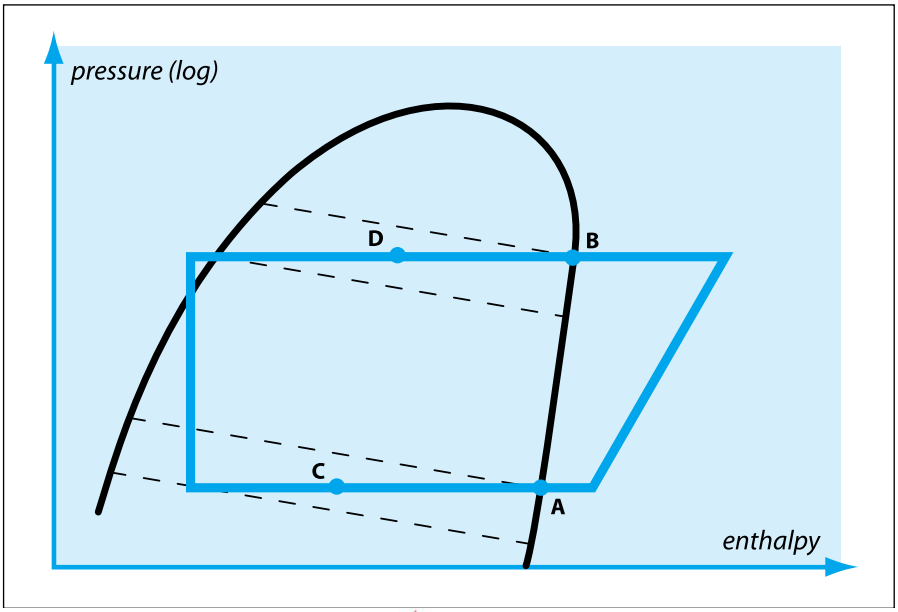
In parts of the system where both vapor and liquid phase are present (evaporator, condenser, liquid receiver), the phases do not have the same composition. In fact both phases form two different refrigerants. Therefore zeotropic refrigerants need some special attention.

Zeotropic refrigerants must always be charged in liquid phase. Flooded evaporators and suction accumulators should not be applied in systems with zeotropic refrigerants. This also applies to near-azeotropic mixtures.

Temperature glide

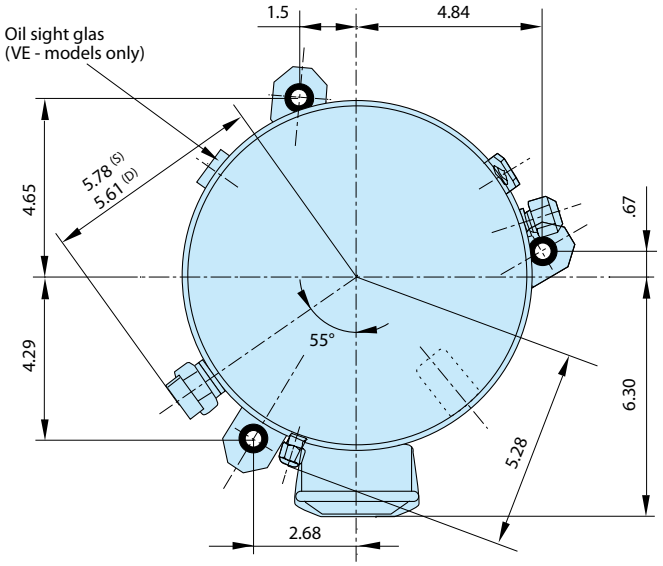
During the evaporating process and the condensing process at constant pressure, the refrigerant temperature will decrease in the condenser and rise in the evaporator. Therefore when speaking about evaporating and condensing temperatures, it is important to indicate whether the temperature under discussion is a dew point temperature or a mean point value.
In the figure below, the dotted lines are lines of constant temperature. They do not correspond to the lines of constant pressure. Points A and B are dew point values on the saturated vapor line. Points C and D are mean point values.
These are temperatures that correspond more or less with the average temperature during the evaporating and condensing process. For the same R-407C cycle, mean point temperatures are typically about 3.5°F to 5.5°F lower than dew point temperatures. In accordance with ASERCOM recommendations, Danfoss Commercial Compressors uses dew point temperatures for selection tables, application envelopes, etc.
To obtain exact capacity data at mean point temperatures, the mean point temperatures must be converted to dew point temperatures, using refrigerant data tables from the refrigerant manufacturer.

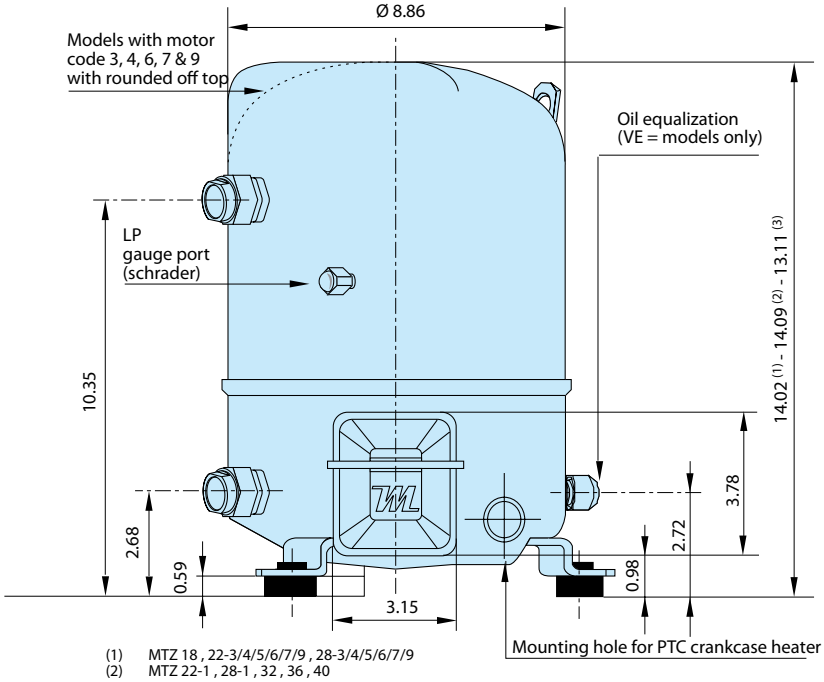
Dew point temperature and mean temperature for R-407C



OUTLINE DRAWINGS

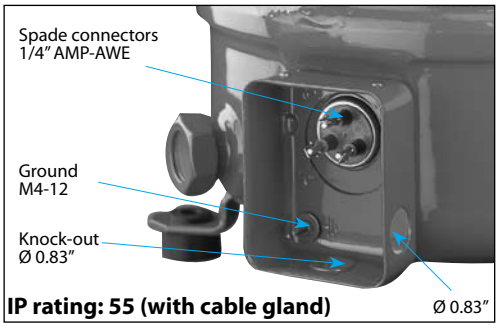
1 cylinder



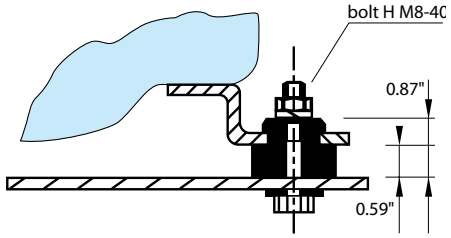


(1) MTZ 18 , 22-3/4/5/6/7/9 , 28-3/4/5/6/7/9
(2) MTZ 22-1 , 28-1 , 32 , 36 , 40

Terminal box



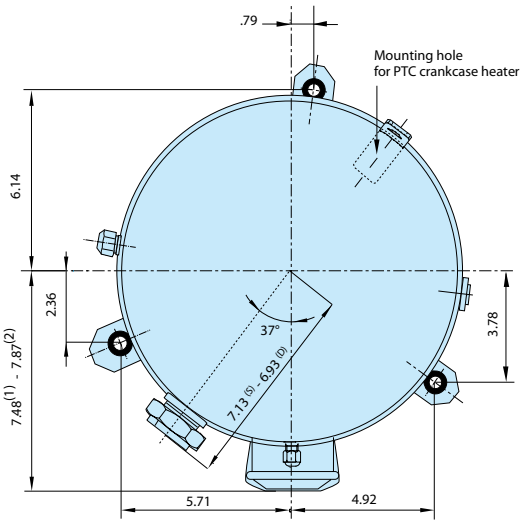
Silent block

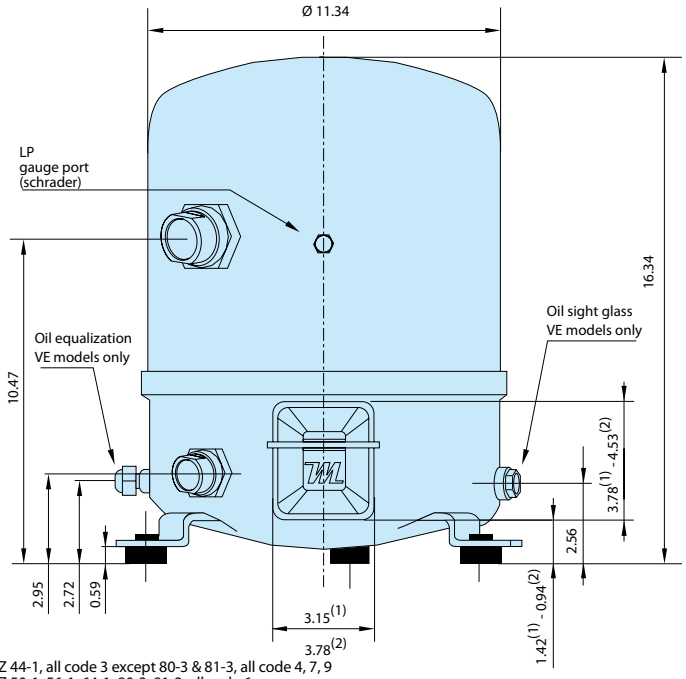


	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
MT/MTZ018 MT/MTZ022 - 3/4/5/6 MT/MTZ028 - 3/4/5/6	1″	1″	1/2″	3/8″	V06	V01
MT/MTZ022 - 1	1″1/4	1″	5/8″	3/8″	V09	V01
MT/MTZ028 - 1 MT/MTZ032 MT/MTZ036 MT/MTZ040	1″1/4	1″	5/8″	1/2″	V09	V06

OUTLINE DRAWINGS

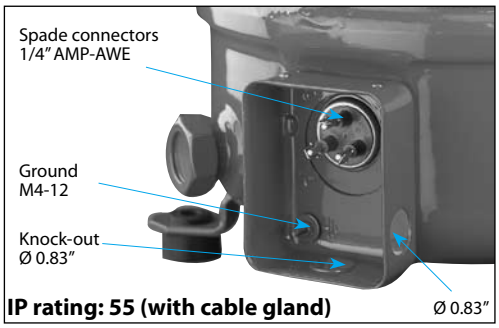
2 cylinders





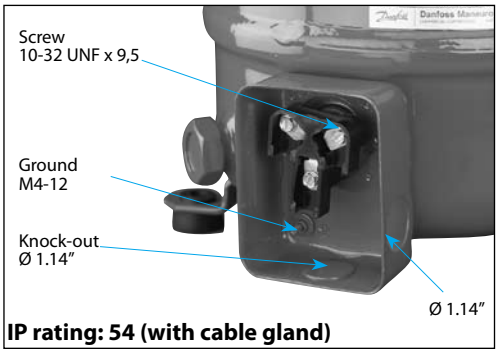
(1) MTZ 44-1, all code 3 except 80-3 & 81-3, all code 4, 7, 9
(2) MTZ 50-1, 56-1, 64-1, 80-3, 81-3, all code 6

Terminal box for model (1)



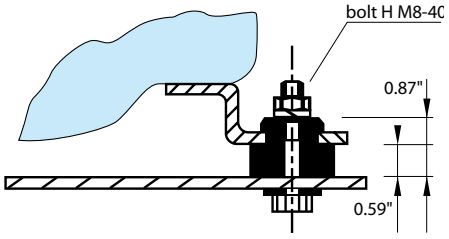
IP rating: 55 (with cable gland)

Terminal box for model (2)



IP rating: 54 (with cable gland)

Silent block



	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	**Discharge**	**Suction**	**Discharge**	**Suction**	**Discharge**
MT/MTZ044 MT/MTZ045 MT/MTZ050 MT/MTZ051 MT/MTZ056 MT/MTZ057 MT/MTZ064 MT/MTZ065 MT/MTZ072 MT/MTZ073	1"3/4	1"1/4	7/8"	3/4"	V07	V04
MT/MTZ080 MT/MTZ081	1"3/4	1"1/4	1"1/8	3/4"	V02	V04

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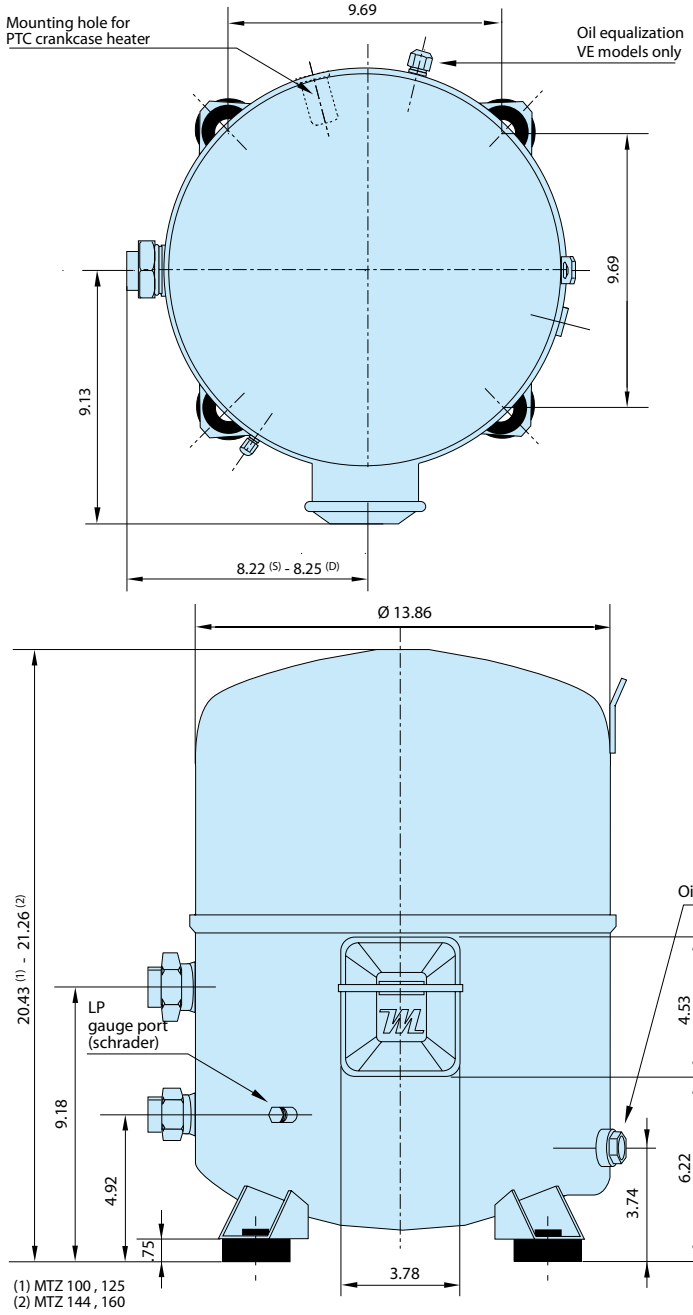
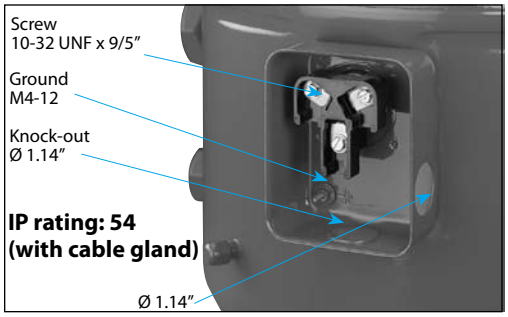
روبروی پالایشگاه نفت پارس، پلاک ۱۲

OUTLINE DRAWINGS

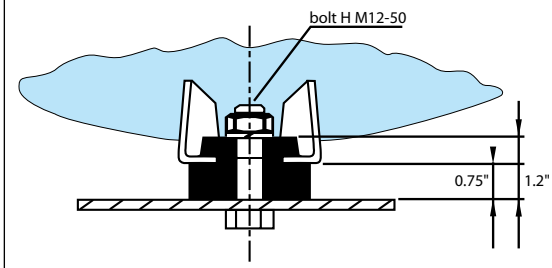
4 cylinders



Terminal box



Silent block



	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
MT/MTZ100 MT/MTZ125 MT/MTZ144 MT/MTZ160	1"3/4	1"1/4	1"1/8	3/4"	V02	V04

ELECTRICAL CONNECTIONS AND WIRING

Single phase electrical characteristics

	LRA - Locked Rotor Current (A)		MCC - Maximum Continuous Current (A)		Winding resistance (Ω) (± 7 % at 68° F)			
Motor Code	1	5	1	5	1		5	
Winding					run	start	run	start
MT/MTZ018	51	40	13	10	1.36	4.82	1.80	4.70
MT/MTZ022	49.3	41	17	15	1.25	2.49	1.78	4.74
MT/MTZ028	81	51	25	20	0.74	1.85	1.16	3.24
MT/MTZ032	84	70	26.5	20	0.64	2.85	0.90	4.30
MT/MTZ036	84	60	30	22	0.64	2.85	0.89	4.35
MT/MTZ040	99	-	34	-	0.53	2.00	-	-
MT/MTZ044	97	-	31	-	0.45	1.90	-	-
MT/MTZ050	114	92	36	29	0.37	1.79	0.52	2.65
MT/MTZ056	136	-	42.5	-	0.32	1.61	-	-
MT/MTZ064	143	-	46	-	0.32	2.10	-	-

Nominal capacitor values and relays

50 Hz	PSC/CSR*		CSR only	
Models	Run capacitors (1)		Start capacitors (2)	Start relay
	(A) µF	(C) µF	(B) µF	
MT/MTZ018 JA-5	20	10	100	3ARR3J4A4
MT/MTZ022 JC-5	20	10	100	
MT/MTZ028 JE-5	20	10	100	
MT/MTZ032 JF-5	25	10	135	
MT/MTZ036 JG-5	25	10	135	
MT/MTZ050 HK-5	30	15	135	

60 Hz	PSC/CSR*		CSR only	
Models	Run capacitors (1)		Start capacitors (2)	Start relay
	(A) µF	(C) µF	(B) µF	
MT/MTZ018 JA-1	15	10	100	3ARR3J4A4
MT/MTZ022 JC-1	30	15	100	
MT/MTZ028 JE-1	25	25	135	
MT/MTZ032 JF-1	25	20	100	
MT/MTZ036 JG-1	25	20	100	
MT/MTZ040 JH-1	35	20	100	
MT/MTZ044 HJ-1	30	15	135	
MT/MTZ050 HK-1	30	15	135	
MT/MTZ056 HL-1	35	20	200	
MT/MTZ064 HM-1	30	25	235	

* PSC: Permanent Split Capacitor
CSR: Capacitor Start Run

(1) Run capacitors: 440 volts

(2) Start capacitors: 330 Volts

Trickle circuit

The trickle circuit provides for heating the compressor crankcase by feeding a small current to the auxiliary winding and the run capacitor. *See the drawings page 14.*
By using PSC or CSR starting systems, compressor models MT/MTZ018-022 can be operated without crankcase heaters as the heater function is provided by the trickle circuit. For the larger single phase compressor models MT/MTZ028-064, the use of the PTC crankcase heater is recommended.

PSC wiring

PSC wiring may be used for refrigerant circuits with capillary tubes or expansion valves with bleed ports. Pressure equalization must be ensured before start-up because of the low starting torque characteristics of this system.

CSR wiring

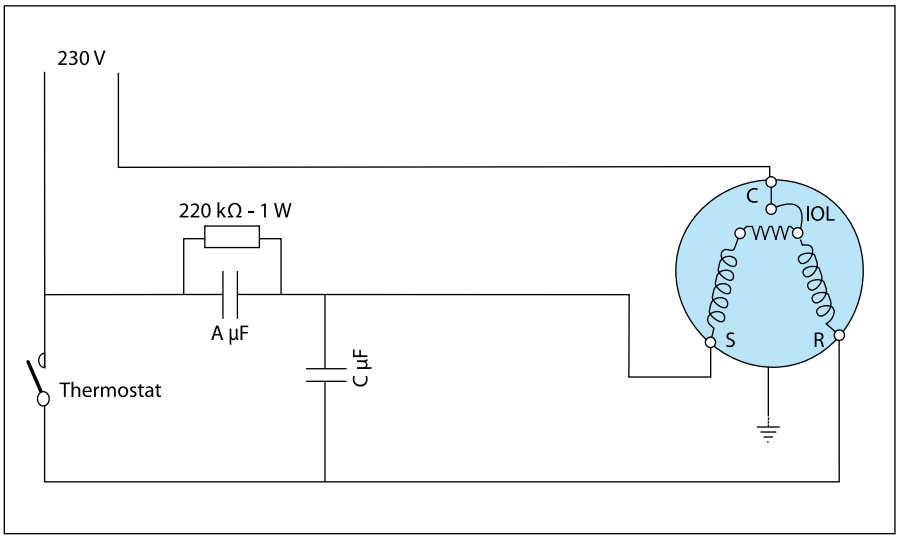
CSR wiring provides additional motor torque at start-up by the use of a start capacitor in combination with the run capacitor. This system can be used for refrigerant circuits with capillary tubes or expansion valves. The start capacitor is only connected during starting; a potential relay is used to disconnect the capacitor after the start sequence.
ternally protected by a temperature and current sensing bimetallic protector, which senses the main and start winding currents and the winding temperature. Once the protector has tripped, it may take from two to four hours for the compressor to reset and restart.
Check that the power supply corresponds to compressor characteristics (refer to compressor nameplate).

ELECTRICAL CONNECTIONS AND WIRING

Suggested wiring diagrams

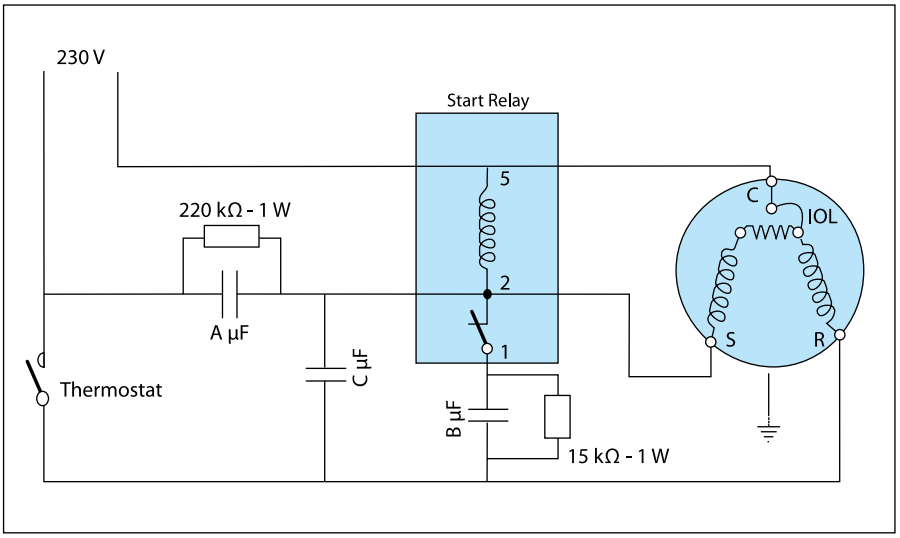
Single phase PSC wiring with trickle circuit

IOL Motor protector
A & C Run capacitors
C Common
S Start winding (auxiliary)
R Run winding (main)



Single phase CSR wiring with trickle circuit

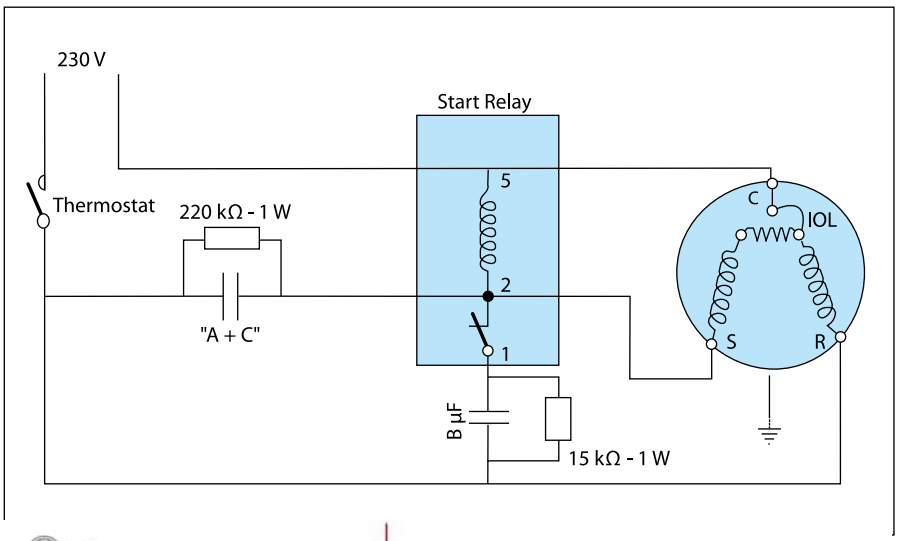
IOL Motor protector
A & C Run capacitors
B Start capacitor
C Common
S Start winding (auxiliary)
R Run winding (main)



Single phase CSR wiring without trickle circuit

IOL Motor protector
A + C Run capacitors
B Start capacitor
C Common
S Start winding (auxiliary)
R Run winding (main)

Capacitors **A** and **C** are replaced by a single capacitor of size **A + C**



ELECTRICAL CONNECTIONS AND WIRING

Three phase electrical characteristics

	LRA - Locked Rotor Current (A)					MCC - Maximum Continuous Current (A)					Winding resistance (Ω) (± 7 % at 68° F)				
Motor Code	**3**	**4**	**6**	**7**	**9**	**3**	**4**	**6**	**7**	**9**	**3**	**4**	**6**	**7**	**9**
MT/MTZ018	38	20	30	-	-	9	5	7	-	-	2.49	10.24	3.38	-	-
MT/MTZ022	38	16	-	-	22.5	11	6	8.5	-	6	2.49	10.24	3.38	-	6.58
MT/MTZ028	57	23	-	-	32	16	7.5	11.5	-	8.5	1.37	7.11	2.30	-	4.80
MT/MTZ032	60	25	44	22	35	18	8	13	5.5	9	1.27	6.15	1.27	8.90	4.20
MT/MTZ036	74	30	74	26	35	17	9	17	7	9.5	1.16	5.57	1.16	8.60	4.10
MT/MTZ040	98	38	74	-	-	22	10	18	-	-	0.95	4.56	0.95	-	-
MT/MTZ044	115	42	77	44	78	22	9.5	16	8.5	13	0.74	3.80	1.13	5.83	1.68
MT/MTZ045	115	48.5	-	-	-	17	9.5	-	-	-	0.69	3.22	-	-	-
MT/MTZ050	115	42	77	44	78	25	12	19	10	13.5	0.72	3.80	1.39	5.83	1.68
MT/MTZ051	120	48.5	-	-	-	22	11.5	-	-	-	0.69	3.60	-	-	-
MT/MTZ056	130	60	105	50	72	26	12	23	11	15	0.57	2.41	0.76	3.86	-
MT/MTZ057	130	64	-	-	-	24	12	-	-	-	0.55	2.39	-	-	-
MT/MTZ064	137	67	124	-	72	29	15	25	-	17.5	0.57	2.41	0.76	-	1.64
MT/MTZ065	135	64	-	-	-	28	14	-	-	-	0.55	2.39	-	-	-
MT/MTZ072	135	80	143	-	100	30	15.5	27	-	18.5	0.55	1.90	0.56	-	1.32
MT/MTZ073	155	80	-	-	-	32	17	-	-	-	0.48	1.90	-	-	-
MT/MTZ080	140	80	132	-	102	36	18	29	-	22.5	0.48	1.90	0.56	-	1.30
MT/MTZ081	140	80	-	-	-	36	19	-	-	-	0.48	1.90	-	-	-
MT/MTZ100	157	90	126	62	110	43	22	35	17	26	0.50	1.85	0.67	3.10	1.26
MT/MTZ 125	210	105	170	75	150	54	27	43	22	30	0.38	1.57	0.43	2.51	0.84
MT/MTZ 144	259	115	208	90	165	64	30	51	25	40	0.27	1.19	0.37	2.00	0.72
MT/MTZ 160	259	140	208	99	165	70	36	51	29	46	0.27	1.10	0.37	1.76	1.10

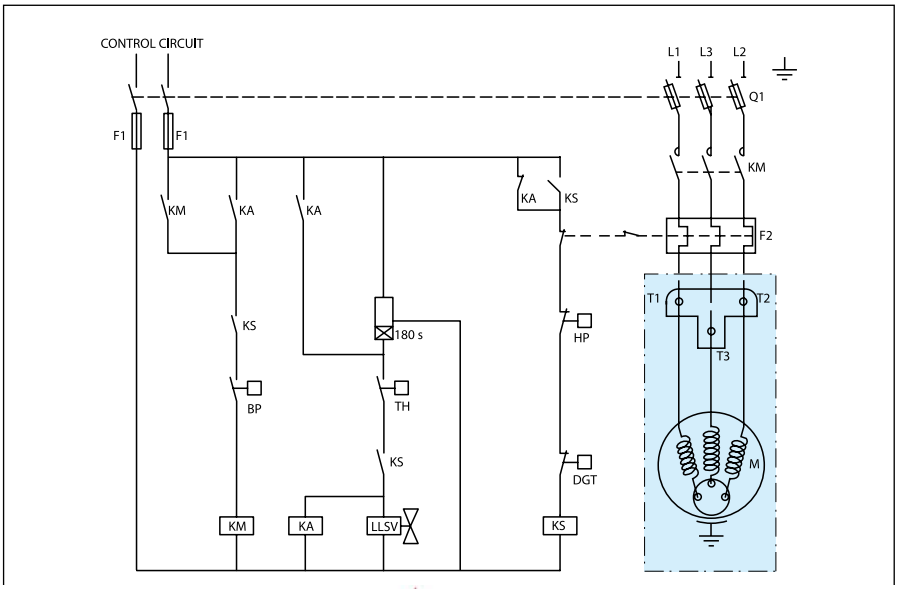
Motor protection and suggested wiring diagrams

MT and MTZ 3-phase compressors are protected by an internal motor protector connected to the neutral point of star connected stator windings. The protector cuts out all 3 phases simultaneously.

Note: once the overload protector has tripped it may take up to 3 hours to reset and restart the compressor.

For all 3-phase compressors, a PTC crankcase heater is required.

Wiring diagram with pump-down cycle



Control device ..... TH
Optional short cycle timer (3 min) 5 pts ..... 180 s
Control relay ..... KA
Liquid Solenoid valve ..... LLSV
Compressor contactor ..... KM
Safety lock out relay ..... KS
Pump-down control & L.P. switch ..... BP
H.P. switch ..... HP
Fused disconnect Q1
Fuses F1
External overload protection F2
Compressor motor ..... M
Motor safety thermostat ..... thM
Discharge gas thermostat ..... DGT

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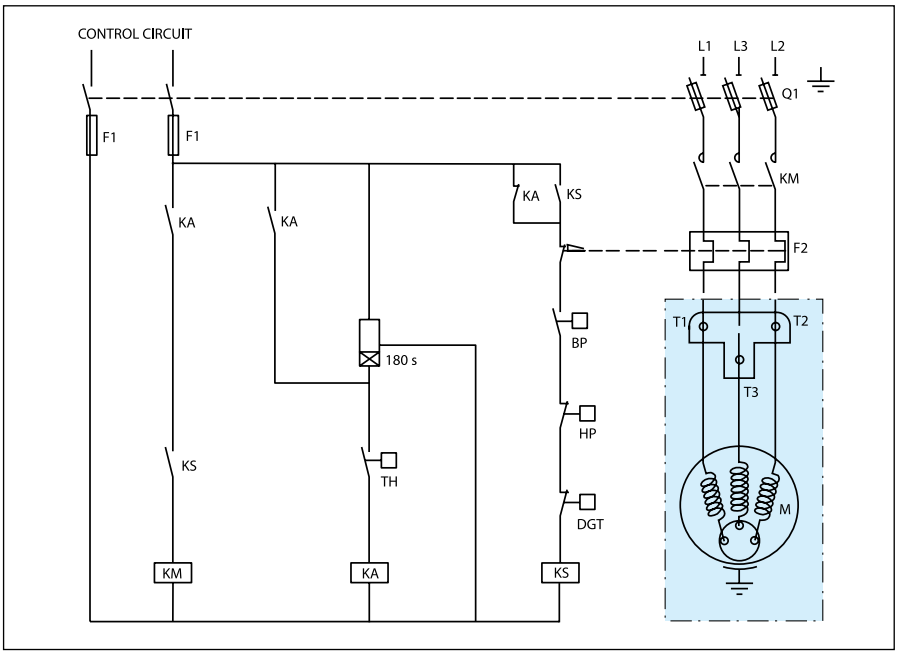
تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

ELECTRICAL CONNECTIONS AND WIRING

Wiring diagram without pump-down cycle



Control device	TH
Optional short cycle timer (3 min) 5 pts	180 s
Control relay	KA
Compressor contactor	KM
Safety lock out relay	KS
H.P. switch	HP
Fused disconnect	Q1
Fuses	F1
External overload protection	F2
Compressor motor	M
Discharge gas thermostat	DGT

Soft starters

Starting current of Maneurop® 3-phase compressors can be reduced by using a soft starter. Two different versions are available: CI-tronic™ soft starters type MCI (recommended) and soft start kits with statoric resistors (type SCR). Starting current can be reduced by up to 50% depending on the compressor model and the type of soft starter. Also mechanical stresses that occur at starting are reduced, which increases the life of internal components.

For details of the CI-tronic™ MCI soft starters, please refer to literature DKACT.PD.C50.C1.02.

For details of the SCR soft start kits, please contact Danfoss.

The number of starts should be limited to 6 per hour. HP/LP pressure equalization is required before starting.

Voltage application range

Motor Code	Nominal voltage	Voltage application range
1	208-230 V / 1 ph / 60 Hz	187 - 253 V
3	200-230 V / 3 ph / 60 Hz	180 - 253 V
4	400 V / 3 ph / 50 Hz	360 - 440 V
	460 V / 3 ph / 60 Hz	414 - 506 V
5	230 V / 1 ph / 50 Hz	207 - 253 V
6	230 V / 3 ph / 50 Hz	207 - 253 V
7	500 V / 3 ph / 50 Hz	450 - 550 V
	575 V / 3 ph / 60 Hz	517 - 632 V
9	380 V / 3 ph / 60 Hz	342 - 418 V

IP rating

The IP rating of the compressor terminal boxes, according to CEI 529, are shown in the outline drawings section.

The IP ratings are only valid when correctly sized cable glands of the same IP rating are applied.

IP 5 5

First numeral, level of protection against contact and foreign objects

5 Complete protection against contact and against harmful dust deposits

Second numeral, level of protection against water

4 Protection against water splashing from any direction

5 Protection against jets of water from any direction

REFRIGERANTS AND LUBRICANTS

General information

When choosing a refrigerant, various factors must be taken into consideration:
- Legislation (now and in the future)
- Safety
- Application envelope in relation to expected running conditions
- Compressor capacity and efficiency
- Compressor manufacturer recommendations & guidelines

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

The table below gives an overview of the different refrigerant - lubricant - compressor combinations for Maneurop®, MT & MTZ compressors.

Refrigerant	Type	Compressor type	Lubricant type	Danfoss lubricant	Application
R-22	HCFC	MT	Mineral	White oil, **160P**	Medium / High temperature
R-407C	HFC	MTZ	Polyolester	Polyolester oil **160PZ**	Medium / High temperature
R-134a	HFC	MTZ	Polyolester	Polyolester oil **160PZ**	Medium / High temperature
R-404A	HFC	MTZ	Polyolester	Polyolester oil **160PZ**	Medium temperature
R-507A	HFC	MTZ	Polyolester	Polyolester oil **160PZ**	Medium temperature
Transitional refrigerants, R-22 based		MT	Alkylbenzene (ABM)	Alkylbenzene oil **160 ABM** **Note:** Initial mineral oil charge has to be replaced by 160 ABM oil.	Medium / High temperature
Hydrocarbons		Danfoss does not authorise the use of hydrocarbons in Maneurop® MT/MTZ compressors			

The Montreal protocol states that CFC refrigerants such as R-12 and R-502 may no longer be applied in new installations in the signatory members countries.
Therefore capacity and other data for these refrigerants are not published in this document. Maneurop® MT compressors, however, are suitable for use with these refrigerants and can still be used as replacements in existing installations.

R-22

R-22 is an HCFC refrigerant and is still a wide use today. It has a low ODP (Ozone Depletion Potential) and therefore it will be phased out in the future. Check local legislation. Always use mineral white oil 160P with R-22.

The Maneurop® MT compressor is dedicated for R-22 and is supplied with an initial mineral oil charge.

R-407C

Refrigerant R-407C is an HFC refrigerant with thermodynamic properties similar to those of R-22.
R-407C has zero ozone depletion potential (ODP=0). Many installers and OEMs consider R-407C to be the standard alternative for R-22. R-407C is a zeotropic mixture and has a temperature glide of about 11 K. For more specific information about zeotropic refrigerants; refer to section "Zeotropic refrigerant mixtures". R-407C must be charged in the liquid phase.

Always use Danfoss 160PZ polyolester oil with Maneurop® MTZ compressors which is supplied with the MTZ compressor for R-407C applications.
Maneurop® MT compressors should never be used with R-407C, even when the mineral oil is replaced with polyolester oil.

REFRIGERANTS AND LUBRICANTS

R-134a

Refrigerant R-134a is an HFC refrigerant with thermodynamic properties comparable to those of the CFC refrigerant R-12. R-134a has zero ozone depletion potential (ODP=0) and is commonly accepted as the best R-12 alternative. For applications with high evaporating and high condensing temperatures, R-134a is the ideal choice. R-134a is a pure refrigerant and has no temperature glide. For R-134a applications always use the Maneurop® MTZ compressor. Use Danfoss 160PZ polyolester oil, which is supplied with the MTZ compressor.
Maneurop® MT compressors should never be used for R-134a, even when the mineral oil is replaced by polyolester oil.

R-404A

Refrigerant R-404A is an HFC refrigerant with thermodynamic properties comparable to those of the CFC refrigerant R-502. R-404A has zero ozone depletion potential (ODP = 0) and is commonly accepted as one of the best R-502 alternatives. R-404A is especially suitable for low evaporating temperature applications but it can also be used with medium evaporating temperature applications. R-404A is a mixture with a very small temperature glide, therefore must be charged in its liquid phase, but for most other aspects this small glide can be ignored. Because of the small glide, R-404A is often called a near-azeotropic mixture. For more information refer to section "Zeotropic refrigerant mixtures". For low evaporating temperature applications down to -49°F, Maneurop® NTZ compressors should be used. Refer to the NTZ selection and application guidelines. For medium temperature R-404A applications, always use the Maneurop® MTZ compressor with 160PZ polyolester oil, which is supplied with the MTZ compressor.
Maneurop® MT compressors should never be used with R-404A, even if the mineral oil replaced by polyolester oil.

R-507A

Refrigerant R-507A is an HFC refrigerant with thermodynamic properties comparable to those of the CFC refrigerant R-502 and virtually equal to those of R-404A. R-507A has no ozone depletion potential (ODP = 0) and is commonly accepted as one of the best R-502 alternatives. As with R-404A, R-507A is particularly suitable for low evaporating temperatures but it can also be used in medium evaporating temperature applications. R-507A is an azeotropic mixture with no temperature glide. For low evaporating temperature applications down to -49°F, Maneurop® NTZ compressors should be used. Refer to the NTZ selection and application guidelines. For medium temperature R-507A applications, always use the Maneurop® MTZ compressor and Maneurop® 160PZ polyolester oil which is supplied with the MTZ compressor.
Maneurop® MT compressors should never be used for R-507A, even with the mineral oil replaced by polyolester oil.

R-22 based transitional refrigerants

A wide variety of R-22 - based transitional refrigerants exist (also called service refrigerants or drop-in blends). These were developed as temporary R-12 or R-502 alternatives. Some examples are R401A, R401B, R409A and R409B as R-12 alternatives and R402A, R402B, R403A and R403B as R-502 alternatives. Because of the R-22 component, they all have a (low) ozone depletion potential. Maneurop® MT compressors can be applied with these transitional refrigerants. In such applications, the initial mineral oil charge must be replaced by Maneurop®160 ABM alkylbenzene oil.

Hydrocarbons

Hydrocarbons such as propane, isobutane, etc. are extremely flammable. Danfoss does not approve the use of hydrocarbons with Maneurop® MT or MTZ compressors in any way, even with a reduced refrigerant charge.

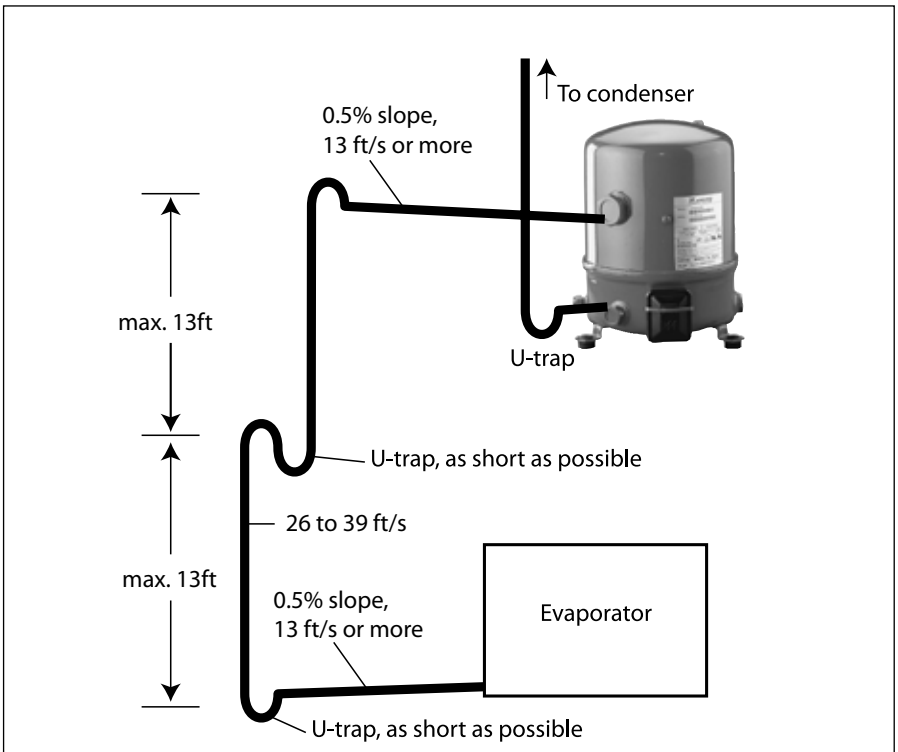
SYSTEM DESIGN RECOMMENDATIONS

Piping design

Oil in a refrigeration circuit is required to lubricate moving parts in the compressor. During normal system operation small quantities of oil will continually leave the compressor, with the discharge gas. With good system piping design this oil will return to the compressor. As long as the amount of oil circulating through the system is small it will contribute to good system operation and improved heat transfer efficiency. Excess oil in the system, however, will have a negative effect on condenser and evaporator efficiency. If, in a poorly designed system, the amount of oil returning to the compressor is lower than the amount of oil leaving the compressor, the compressor will become starved of oil and the condenser, evaporator and/or refrigerant lines will become filled with oil. In such situations, additional oil charge will only correct the compressor oil level for a limited period of time and increase the amount of surplus oil in the rest of the system.
Only correct piping design can ensure a good oil balance in the system.

Suction lines

Horizontal suction line sections shall have a slope of 0.5% in the direction of refrigerant flow (5/8" for every 10' of pipe). The cross-section of horizontal suction lines shall be such that the resulting gas velocity is at least 13 fps. In vertical risers, a gas velocity of 26 to 40 fps is required to ensure proper oil return. A U-trap is required at the foot of each vertical riser. If the riser is higher than 13 ft, additional U-traps are required for each additional 13 ft. The length of each U-trap must be as short as possible to avoid the accumulation of excessive quantities of oil (see figure below).
For compressors mounted in parallel, the common suction riser should be designed as a double riser. Also refer to the News bulletin "Mounting instructions for installation of Maneurop® compressors in parallel" and "Parallel application guidelines".
Gas velocities higher than 40 fps will not contribute significantly to better oil return. They will, however, cause higher noise levels and result in higher suction line pressure drops which will have a negative effect on system capacity.

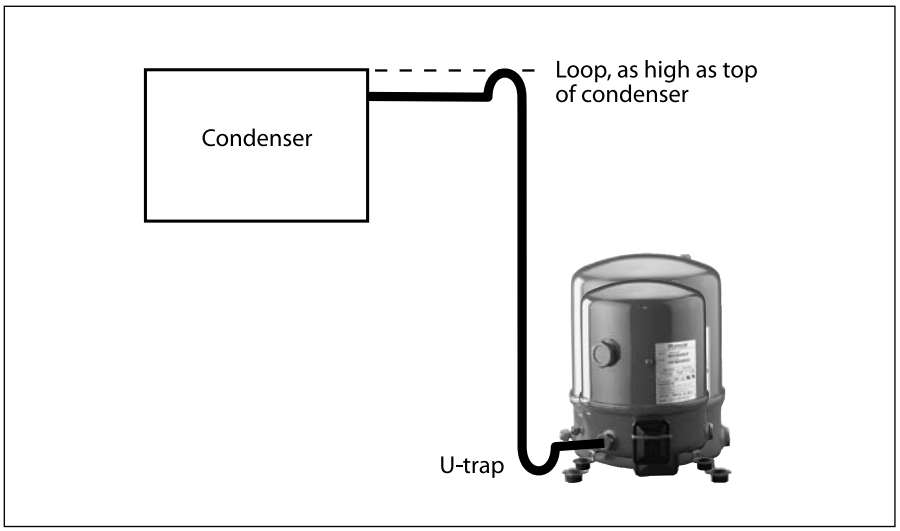


SYSTEM DESIGN RECOMMENDATIONS

The suction rotolock valves that can be ordered from Danfoss as accessories are designed for average pipe sizes, and selected for systems running at nominal conditions.
The pipe sizes selected for specific systems may differ from these recommended sizes.
It is recommended that the suction lines be insulated to limit suction gas superheat.

Discharge line

When the condenser is mounted above the compressor, a loop above the condenser and a U-trap close to the compressor are required to prevent liquid draining from the condenser into the discharge line during standstill.



Oil charge and oil separator

In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 20 m, or with many oil traps, or an oil separator, additional oil may be required. In installations with risk of slow oil return, such as in multiple evaporator or multiple condenser installations, an oil separator is recommended. Also refer to page 29.

Filter driers

For new installations with MTZ compressors, Danfoss recommends using the Danfoss DML 100%-molecular sieve solid core filter drier. Molecular sieve filter driers with loose beads from third party suppliers should be avoided.

For servicing of existing installations where acid formation is present, Danfoss DCL solid core filter driers containing activated alumina are recommended.

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

Operating limits

High Pressure

A high pressure safety switch is required to stop 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 in a lockout circuit, or be a manual reset device to prevent compressor cycling around the high pressure limit. When a discharge valve is used, the HP switch must be connected to the service valve gauge port, which cannot be isolated.

SYSTEM DESIGN RECOMMENDATIONS

Low pressure

A low pressure safety switch is recommended to avoid compressor operation at too lower suction pressures.

		MT R-22	MTZ R-407C	MTZ R-134a	MTZ R-404A / R-507A
Test pressure low side	psig	360	360	360	360
Working pressure range high side	psig	158 - 402	181 - 426	115 - 328	191 - 402
Working pressure range low side	psig	15 - 102	20 - 96	9 - 68	15 - 104
Relief valve opening pressure difference	psig	435	435	435	435
Relief valve closing pressure difference	psig	115	115	115	115

Low ambient temperature operation

At low ambient temperatures, the condensing temperature and condensing pressure in air cooled condensers will decrease. These lower pressures may be insufficient to supply enough liquid refrigerant to the evaporator. As a result, the evaporator temperature will sharply decrease with risk of frosting. At compressor start-up, the compressor can pull a deep vacuum and it can be cut off by low pressure protection. Depending on the low pressure switch setting and delay timer, short cycling can occur. To avoid these problems, several solutions are possible, all based on reducing condenser capacity:

- Locating condensor indoors
- Liquid flooding of condensers (note: this solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is required and special care should be taken when designing the discharge line.)
- Reduce air flow to condensers.

Other problems can occur when the compressor is operating at low ambient temperature. For example, during shut down periods, liquid refrigerant can migrate to a cold compressor. For such conditions a belt-type crankcase heater is strongly recommended.

Because Maneurop compressor motors are 100% suction gas cooled, they can be externally insulated.

Refer to section "Liquid refrigerant migration & charge limits" for more details.

Operating voltage and cycle rate

Operating voltage range

Operating voltage limits are shown in the table on page 4. The voltage applied to the motor terminals must always be within these limits. The maximum allowable voltage unbalance for 3-phase compressors is 2%. Voltage unbalance causes high current draw on one or more phases, which in turn leads to overheating and possible motor damage.

Voltage unbalance is given by the formula:

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

V_{avg} = Mean voltage of phases 1, 2 and 3
$V_{1\text{-}2}$ = Voltage between phases 1 and 2
$V_{1\text{-}3}$ = Voltage between phases 1 and 3
$V_{2\text{-}3}$ = Voltage between phases 2 and 3.

Cycle rate limit

There may be no more than 12 starts per hour (6 when a soft start accessory is used). A higher number reduces the service life of the motor-compressor unit. If necessary, use an anti-short-cycle timer in the control circuit.

A time-out of six minutes is recommended. The system must be designed in such a way to guarantee a minimum compressor run time in order to provide proper oil return and sufficient motor cooling after starting.

Note that the oil return rate varies as a function of the system design.

SYSTEM DESIGN RECOMMENDATIONS

Liquid refrigerant control and charge limits

Refrigeration compressors are basically designed as gas compressors. Depending on the compressor design and operating conditions, most compressors can also handle a limited amount of liquid refrigerant. Maneurop® MT and MTZ compressors have a large internal volume and can therefore handle relatively large amounts of liquid refrigerant without major problems. However even when a compressor can handle liquid refrigerant, it is not favorable to a long service life. Liquid refrigerant can dilute the oil, wash oil out of bearings and result in high oil carry over, resulting in loss of oil from the sump. Good system design can limit the amount of liquid refrigerant in the compressor, and have a positive effect on the compressor service life.
Liquid refrigerant can enter a compressor in different ways, with different effects on the compressor.

Off-cycle migration

During system standstill and after pressure equalization, refrigerant will condense in the coldest part of the system. The compressor can easily be the coldest spot, for example when it is placed outside in low ambient temperatures. After a while, the full system refrigerant charge can condense in the compressor crankcase. A large amount will dissolve in the compressor oil until the oil is completely saturated with refrigerant. If other system components are located at a higher level, this process can be even faster because gravity will speed the flow of liquid refrigerant to flow back to the compressor. When the compressor is started, the pressure in the crankcase decreases rapidly.
At lower pressures the oil holds less refrigerant, and as a result part of the refrigerant will violently evaporate from the oil, causing the oil to foam. This process is often called "boiling".
The negative effects on the compressor from migration are:

- oil dilution by liquid refrigerant
- oil foam, transported by refrigerant gas and discharged into the system, causing loss of oil and in extreme situations risk of oil slugging
- in extreme situations with high system refrigerant charge, liquid slugging could occur (liquid entering the compressor cylinders).

Liquid floodback during operation

During normal and stable system operation, refrigerant will leave the evaporator in a superheated condition and enter the compressor as a superheated vapor.
Normal superheat values at compressor suction are 9°F to 54°F. The refrigerant leaving the evaporator, however, can contain an amount of liquid refrigerant for various reasons:

- wrong dimensioning, wrong setting or malfunction of expansion device
- evaporator fan failure or blocked air filters.

In these situations, liquid refrigerant will continuously enter the compressor.
The negative effects from continuous liquid floodback are:

- permanent oil dilution
- in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could occur.

Liquid floodback at changeover cycles in reversible heat pumps

In heat pumps, changeover from cooling to heating cycles, defrost, and low load short cycles may lead to liquid refrigerant floodback or saturated refrigerant return conditions.
The negative effects are:

- oil dilution
- in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could occur.

Liquid floodback and zeotropic refrigerants

Liquid floodback in systems working with a zeotropic refrigerant such as R-407C introduces additional negative effects. A part of the refrigerant leaves the evaporator in liquid phase and this liquid has a different composition than the vapor.
This new refrigerant composition may result in different compressor operating pressures and temperatures

SYSTEM DESIGN RECOMMENDATIONS

Crankcase heater

A crankcase heater protects against the off-cycle migration of refrigerant and proves effective if oil temperature is maintained 18°F above the saturated LP temperature of the refrigerant. Tests must be conducted, therefore, to ensure that the appropriate oil temperature is maintained under all ambient conditions. A PTC crankcase heater is recommended on all stand-alone compressors and split systems. PTC crankcase heaters are self-regulating.
Under extreme conditions such as very low ambient temperature a belt type crankcase heater could be used in addition to the PTC heater, although this is not a preferred solution for 1 and 2 cylinder compressors. The belt crankcase heater must be positioned on the compressor shell as close as possible to the oil sump to ensure good heat transfer to the oil.
Belt crankcase heaters are not self-regulating. Control must be applied to energize the belt heater once the compressor has been stopped and then to de-energize it while the compressor is running. The belt heater must be energized 12 hours before restarting the compressor following an extended down period.
If the crankcase heater is not able to maintain the oil temperature 18°F above the saturated LP temperature of the refrigerant during off cycles or if repeated floodback is occuring, a pump-down cycle using an LLSV is required. In such cases, a suction accumulator is recommended.

Liquid line solenoid valve & pump-down

In refrigeration applications, a Liquid Line Solenoid Valve (LLSV) is highly recommended. During the off-cycle, the LLSV isolates the liquid charge in the condenser side, thus preventing refrigerant transfer or excessive migration of refrigerant into the compressor. Furthermore, when using an LLSV in with a pumpdown cycle, the quantity of refrigerant in the low-pressure side of the system will be reduced.
A pump-down cycle design is also required when evaporators are fitted with electric defrost heaters.

Suction accumulator

A suction accumulator offers considerable protection against refrigerant floodback at start-up, during operation or after the defrost operation. This device also helps to protect against off-cycle migration by means of providing additional internal free volume to the low pressure side of the system.
The suction accumulator must be selected in accordance with the accumulator manufacturer's recommendations. As a general rule, Danfoss recommends sizing the accumulator for at least 50% of the total system charge. Tests, however, must be conducted to determine the optimal size.
A suction accumulator must not be used in systems with zeotropic refrigerant mixtures.

SOUND AND VIBRATION MANAGEMENT

Sound

Running compressors cause sound and vibration. These phenomena are closely related.
Sound produced by a compressor is transmitted in every direction in all media: ambient air, the mounting feet, the pipework and the refrigerant in the pipework.
The easiest way to reduce the sound transmitted in ambient air is to fit a Danfoss acoustic hood accessory. Because Maneurop® compressors are 100% suction gas cooled, and require no body cooling, they can be insulated. Values for the sound reduction achieved with acoustic hoods are shown also in the table below. For compressors mounted inside, sound insulation of the plantrom is an alternative to sound insulation of the compressor.
Sound transmitted by mounting feet, pipework and refrigerant should be reduced in the same way as vibration.
Please refer to the next section.

Sound power level for MTZ with R-404A, motor code 4
Te = 14°F,
TC = 113°F

	Sound power level at 50 Hz dB(A)		Sound power level at 60 Hz dB(A)	
	without hood	with hood*	without hood	with hood*
MTZ018	73	65	73	66
MTZ022	74	68	77	71
MTZ028	71	64	73	66
MTZ032	71	64	73	66
MTZ036	70	64	76	69
MTZ040	70	65	72	67
MTZ044	80	74	82	76
MTZ045	80	74	82	76
MTZ050	83	76	84	78
MTZ051	83	76	84	78
MTZ056	81	74	81	74
MTZ057	81	74	81	74
MTZ064	80	74	84	78
MTZ065	80	74	84	78
MTZ072	79	72	82	75
MTZ073	79	72	82	75
MTZ080	79	73	84	78
MTZ081	79	73	84	78
MTZ100	85	79	87	81
MTZ125	84	78	86	80
MTZ144	83	77	86	80
MTZ160	83	77	86	80

* Sound data with hood are valid for the Danfoss acoustic hood accessory.

Model	Acoustic hood accessory	code no.
MT/MTZ018 - 040	Acoustic hood for 1 cyl compressors	**7755001**
MT/MTZ044 - 081	Acoustic hood for 2 cyl compressors	**7755002**
MT/MTZ100 - 160	Acoustic hood for 4 cyl compressors	**7755003**

SOUND AND VIBRATION MANAGEMENT

Vibration

The mounting grommets delivered with the compressor should always be used. They reduce vibration transmitted by the compressor mounting feet to the base frame.
The base on which the compressor is mounted should be sufficiently rigid and of adequate mass to ensure the full effectiveness of the mounting grommets.
The compressor should never be directly mounted to the base frame without the grommets. If it is, significant high vibration transmission will occur and the compressor service life will be reduced.
Suction and discharge lines must have adequate flexibility in 3 planes. Vibration absorbers may be required.
Care must be taken to avoid tubing having frequencies resonant close to the compressor frequency.
Vibration is also transmitted by the refrigerant gas. Maneurop® compressors have built in mufflers to reduce this vibration.
To further reduce vibration an additional muffler can be installed.

Note: Maneurop® MT & MTZ compressors have been designed and qualified for stationary equipment used in A/C and refrigeration applications.
Danfoss does not warrant these compressors for use in mobile applications, such as trucks, railways, subways, etc.

INSTALLATION AND SERVICE

System cleanliness

System contamination is one of the main factors affecting equipment reliability and compressor service life.
It is, therefore, important to ensure system cleanliness when constructing a refrigeration system. During the building process, system contamination can be caused by:

- Brazing and welding oxides
- Filings and particles from removing burrs from pipe-work
- Brazing flux
- Moisture and air.

Only use clean and dehydrated refrigeration grade copper tubes and silver alloy brazing material. Clean all parts before brazing and always purge nitrogen or CO_2 through the pipes during brazing to prevent oxidation. If flux is used, take every precaution to prevent it entering the piping. Do not drill holes (e.g. for Schräder valves).
in parts of the installation that are already completed, when filings and burrs can not be removed. Carefully follow the instructions below regarding brazing, mounting, leak detection, pressure test and moisture removal. All installation and service work must be done only by qualified personnel using correct procedures and using tools (charging systems, tubes, vacuum pump, etc.) dedicated for the refrigerant that will be used.

Compressor handling, mounting and connection to the system

Compressor handling

Maneurop® MT and MTZ compressors are provided with a lifting lug. This lug should always be used to lift the compressor. Once the compressor is installed, the compressor lifting lug should never be used to lift the complete installation.
Keep the compressor in an upright position during handling.

Compressor mounting

Mount the compressor on a horizontal plane with a maximum slope of 3°. All MT and MTZ compressors are supplied with three or four rubber mounting grommets, each complete with metal sleeves, nuts, and bolts. Refer to the outline drawings on page 18 to 21.

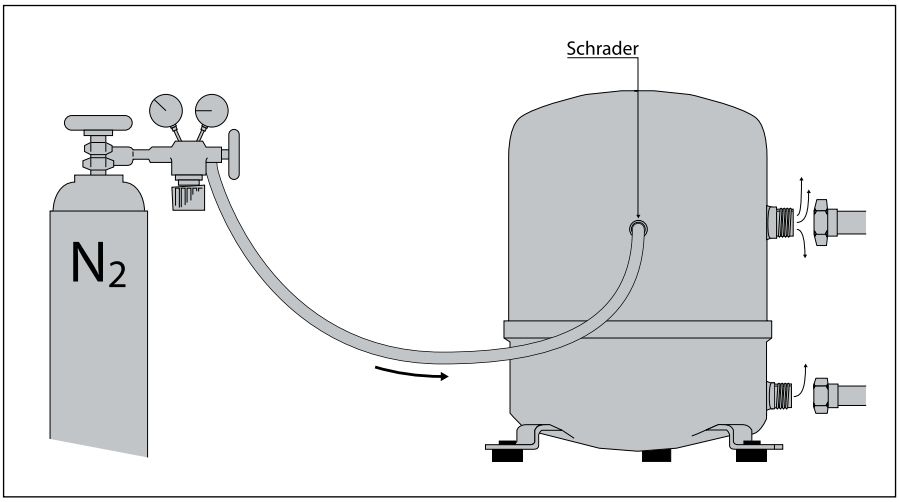
The grommets largely attenuate compressor vibration transmitted to the base frame. The compressor must always be mounted with these grommets. Refer to the table below for torque values.

Designation		Recommended torque in. lb
Cable screw of T connector in electrical box	screw 10/32 - UNF x 3	17
Rotolock valves and solder sleeves	1"	59
	1"1/4	66
	1"3/4	81
Mounting grommet bolts	1 - 2 - 4 cylinder	11
Oil sight glass	-	37
Oil equalization connection	1 - 2 - 4 cylinder	22

Compressor connection to the system

New compressors have a protective nitrogen holding charge. The suction and discharge caps should only be removed just before connecting the compressor to the installation to avoid air and moisture entering the compressor.
Whenever possible, the compressor must be the last component to be integrated in the system. It is advisable to braze the solder sleeves or service valves to the pipework before the compressor is mounted. When all brazing is finished and when the entire

system is ready, the compressor caps can be removed and the compressor connected to the system with a minimum exposure to ambient air.
If this procedure is not possible, the sleeves or valves may be brazed to the pipes when mounted on the compressor.
In this situation nitrogen or CO_2 must be purged through the compressor via the Schräder valve to prevent air and moisture ingress. Purging must start when the caps are removed and continue during the brazing process.
When rotolock valves are used on the compressor, they must be closed immediately after mounting, thus keeping the compressor isolated from the atmosphere or from a system not yet dehydrated.
Note: When the compressor is built into a "rack" or "pack" configuration that is not installed immediately in its final location, a vacuum pull-down and moisture removal must be performed to the rack as if it were a complete system (see below). The rack must be charged with nitrogen or CO_2 and open tubes must be blocked with caps or plugs.



System pressure test

It is recommended that an inert gas or nitrogen be used for pressure testing. Dry air may also be used but care should be taken since it can form a flammable mixture with the compressor oil. When performing a system pressure test, the maximum allowed pressure for the different components should not be exceeded.
For MT/MTZ compressors the maximum test pressures are shown in the table below.

	1-2-4 cylinder compressors
Maximum compressor test pressure, low side	362 psi(g)
Maximum compressor test pressure, high side	435 psi(g)

Do not exceed 435 psig pressure differential between high pressure side and low pressure side of the compressor because this will open the internal compressor relief valve.

Leak detection

Whenever possible (if valves are present) the compressor must be kept isolated from the system. Perform leak detection using the final refrigerant. Pressurize with nitrogen or another system-neutral gas and use a leak detector for the applied refrigerant. A helium leak detector can also be used.
Leaks must be repaired respecting the instructions written above. Use of other gasses such as oxygen, dry air, or acetylene is not recommended, as these gasses can form a

flammable mixture. Never use CFC or HCFC refrigerants for leak detection in HFC systems.
Note 1: Leak detection with refrigerant may not be allowed in some countries. Check local regulations.

Note 2: Leak detecting additives shall not be used as they may affect the lubricant properties.
Warranty may be voided if leak detecting additives have been used.

Vacuum pull-down moisture removal

Moisture interferes with proper functioning of compressors and refrigeration systems.
Air and moisture reduce service life, increase condensing pressure, and cause excessively high discharge temperatures, that can destroy the lubricating properties of the oil. Air and moisture also increase the risk of acid formation, giving rise to copper plating. All these phenomena can cause mechanical and electrical compressor failure.
To eliminate these factors, a vacuum pull-down according to the procedure given below is recommended.

1. Whenever possible (if valves are present) the compressor must be kept isolated from the system.

2. After leak detection, the system must be pulled down under a vacuum of 500 microns. A two stage vacuum pump must be used, with a capacity appropriate to the system volume. Use connection lines with a large diameter and connect them to the service valves and (not to the Schräder connection) to avoid too high pressure losses.

3. When a vacuum level of 500 microns is reached, the system must be isolated from the vacuum pump. Wait 30 minutes, during which the system pressure should not rise. When the pressure rapidly increases, the system is not leak tight. Leak detection must be repeated and the vacuum pull-down procedure should be restarted from step 1. When the pressure slowly increases, this indicates the presence of moisture. In this case steps 2 and 3 should be repeated.

4. Connect the compressor to the system by opening the valves. Repeat steps 2 and 3.

5. Break the vacuum with nitrogen or the final refrigerant.

6. Repeat steps 2 and 3 on the total system.
At commissioning, system moisture content may be up to 100 ppm. During operation the filter drier must reduce this to a level < 20 ppm.
Warning :
Do not use a megohmmeter or apply power to the compressor while it is under vacuum, as this may cause motor winding damage.
Never run the compressor under vacuum as it may cause compressor motor burn-out.

Start-up

Before initial start-up, or after a prolonged shut down period, energize the crankcase heater (if fitted) 12 hours prior to start-up, or turn on power for single phase compressors with trickle circuit.

Refrigerant charging

Zeotropic and "near-azeotropic" refrigerant mixtures such as R-407C and R-404A must always be charged in the liquid phase. For the initial charge, the compressor must not run and service valves must be closed. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. Then slowly add refrigerant in the liquid phase, on the low pressure side as far away as possible from the running compressor.
The refrigerant charge quantity must be suitable for both winter and summer operation. Refer also to section "Protection against flooded starts and liquid floodback" for information about refrigerant charge limits.
Warning: when a liquid line solenoid valve is used, the vacuum in the low pressure side must be broken before applying power to the system.

INSTALLATION AND SERVICE

Oil charge and oil level

The oil charge must be checked before commissioning (1/4 to 3/4 of the oil sight glass). Check the oil level again after a minimum of 2 hours operation at nominal conditions. In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 20 m or with many oil traps or an oil separator, additional oil may be required. Normally the quantity of oil added should be no more than 2% of the total refrigerant charge (this percentage does not take into account oil contained in accessories such as oil separators or oil traps). If oil has already been added, and the oil level in the compressor keeps decreasing, the oil return in the installation is insufficient. Refer also to section "Piping design".
In installations where slow oil return is likely such as in multiple evaporator or multiple condenser installations, an oil separator is recommended. Refer to the table on page 17 to select the correct oil.

Suction gas superheat

Optimum suction gas superheat is 15°F. A lower superheat will contribute to better system performance (higher mass flow and more efficient use of evaporator surface). Low superheat values however increase the risk of unwanted liquid floodback to the compressor.
For very low superheat values an electronically controlled expansion valve is recommended.
Maximum allowable superheat is about 54°F. Higher values can be accepted but in these cases, tests have to be performed to check that the maximum discharge temperature of 265°F will not be exceeded. Note that high superheat values decrease the compressor application envelope and system performance.

ACCESSORIES AND SPAREPARTS

The tables below show an extract of the available accessories and spare parts for Maneurop® reciprocating compressors. For an exhaustive list please refer to Accessories & Spare parts catalogue, ref. FRCC.EK.002.A1.02

Rotolock accessories

Type	Code no.	Description	Application	Packaging	Pack size
V06-V01	**7703004**	Valve set, V06 (1"~1/2"), V01 (1"~3/8")	MT/MTZ018-028 (exept 028 code 1)	Multipack	4
V09-V06	**7703005**	Valve set, V09 (1-1/4"~5/8"), V06 (1"~1/2")	MT/MTZ032-040 (& 028 code 1)	Multipack	4
V07-V04	**7703006**	Valve set, V07 (1-3/4"~7/8"), V04 (1-1/4"~3/4")	MT/MTZ044-072	Multipack	6
V02-V04	**7703009**	Valve set, V02 (1-3/4"~1-1/8"), V04 (1-1/4"~3/4")	MT/MTZ080-160	Multipack	6
C06-C01	**7703011**	Angle adapter set, C06 (1"~1/2"), C01 (1"~3/8")	MT/MTZ018-028 (exept 028 code 1)	Multipack	4
C09-C06	**7703012**	Angle adapter set, C09 (1-1/4"~5/8"), C06 (1"~1/2")	MT/MTZ032-040 (& 028 code 1)	Multipack	4
C07-C04	**7703013**	Angle adapter set, C07 (1-3/4"~7/8"), C04 (1-1/4"~3/4")	MT/MTZ044-072	Multipack	6
C02-C04	**7703014**	Angle adapter set, C02 (1-3/4"~1-1/8"), C04 (1-1/4"~3/4")	MT/MTZ080-160	Multipack	6
G01	**8156130**	Gasket, 1"	Models with 1" rotolock connection	Multipack	10
G01	**7956001**	Gasket, 1"	Models with 1" rotolock connection	Industry pack	50
G09	**8156131**	Gasket, 1-1/4"	Models with 1-1/4" rotolock connection	Multipack	10
G09	**7956002**	Gasket, 1-1/4"	Models with 1-1/4" rotolock connection	Industry pack	50
G07	**8156132**	Gasket, 1-3/4"	Models with 1-3/4" rotolock connection	Multipack	10
G07	**7956003**	Gasket, 1-3/4"	Models with 1-3/4" rotolock connection	Industry pack	50
	8156009	Gasket set, 1", 1-1/4", 1-3/4", Oil sight glass gaskets black & white	All 1-2-4 cylinder models	Multipack	10

Crankcase heaters

Type	Code no.	Description	Application	Packaging	Pack size
PTC35W	**7773001**	PTC crankcase heater, 35 W, incl. heat transfer paste	All models	Multipack	10
PTC35W	**7973009**	PTC crankcase heater, 35 W, incl. heat transfer paste	All models	Industry pack	50
PTC35W	**7773125**	PTC crankcase heater, 35 W, mounting without paste	All models	Multipack	10
PTC35W	**7973011**	PTC crankcase heater, 35 W, mounting without paste	All models	Industry pack	50
	7773106	Belt type crankcase heater, 55 W, 230 V, CE mark, UL	MT/MTZ018-040	Multipack	4
	7773002	Belt type crankcase heater, 54 W, 240 V, UL	MT/MTZ018-040	Multipack	4
	7773013	Belt type crankcase heater, 54 W, 400 V, UL	MT/MTZ018-040	Multipack	4
	7773111	Belt type crankcase heater, 54 W, 460 V, UL	MT/MTZ018-040	Multipack	4
	7773109	Belt type crankcase heater, 65 W, 110 V, CE mark, UL	MT/MTZ044-081	Multipack	6
	7973001	Belt type crankcase heater, 65 W, 110 V, CE mark, UL	MT/MTZ044-081	Industry pack	50
	7773107	Belt type crankcase heater, 65 W, 230 V, CE mark, UL	MT/MTZ044-081	Multipack	6
	7973002	Belt type crankcase heater, 65 W, 230 V, CE mark, UL	MT/MTZ044-081	Industry pack	50
	7773117	Belt type crankcase heater, 65 W, 400 V, CE mark, UL	MT/MTZ044-081	Multipack	6
	7773010	Belt type crankcase heater, 50 W, 110 V, UL	MT/MTZ044-081	Multipack	6
	7773003	Belt type crankcase heater, 50 W, 240 V, UL	MT/MTZ044-081	Multipack	6
	7773009	Belt type crankcase heater, 50 W, 400 V, UL	MT/MTZ044-081	Multipack	6
	7773006	Belt type crankcase heater, 50 W, 460 V, UL	MT/MTZ044-081	Multipack	6
	7773119	Belt type crankcase heater, 75 W, 575 V, UL	MT/MTZ044-081	Multipack	6
	7773110	Belt type crankcase heater, 75 W, 110 V, CE mark, UL	MT/MTZ100-160	Multipack	6
	7773108	Belt type crankcase heater, 75 W, 230 V, CE mark, UL	MT/MTZ100-160	Multipack	6
	7973005	Belt type crankcase heater, 75 W, 230 V, CE mark, UL	MT/MTZ100-160	Industry pack	50
	7773118	Belt type crankcase heater, 75 W, 400 V, CE mark, UL	MT/MTZ100-160	Multipack	6
	7773004	Belt type crankcase heater, 75 W, 240 V, UL	MT/MTZ100-160	Multipack	6
	7773014	Belt type crankcase heater, 75 W, 400 V, UL	MT/MTZ100-160	Multipack	6
	7773008	Belt type crankcase heater, 75 W, 460 V, UL	MT/MTZ100-160	Multipack	6
	7773105	Belt type crankcase heater, 75 W, 575 V, UL	MT/MTZ100-160	Multipack	6

Acoustic hoods

Type	Code no.	Description	Application	Packaging	Pack size
	7755001	Acoustic hood for 1 cylinder compressor	MT/MTZ018-040	Single pack	1
	7755002	Acoustic hood for 2 cylinder compressor	MT/MTZ044-081	Single pack	1

ACCESSORIES AND SPAREPARTS

3-phase soft start equipment

Type	Code no.	Description	Application	Packaging	Pack size
SCR01	**7702003**	Soft start kit with statoric resistors, prewired box, SCR01	MT/MTZ044-081	Single pack	1
SCR03	**7705001**	Soft start kit with statoric resistors, prewired box, SCR03	MT/MTZ100-160	Single pack	1
MCI 15 C	**7705006**	Electronic soft start kit, MCI 15C	MT/MTZ018-081	Single pack	1
MCI 25 C	**7705007**	Electronic soft start kit, MCI 25C	MT/MTZ100-160	Single pack	1

Single phase PSC starting kits

Type	Code no.	Description	Application	Packaging	Pack size
PSC	**7701026**	PSC starting kit, 20 µF, 10 µF	MT/MTZ018-028 code 5	Multipack	4
PSC	**7701024**	PSC starting kit, 25 µF, 10 µF	MT/MTZ032-036 code 5	Multipack	4
PSC	**7701025**	PSC starting kit, 15 µF, 10 µF	MT/MTZ018 code 1	Multipack	4
PSC	**7701035**	PSC starting kit, 30 µF, 15 µF	MT/MTZ022 & 044-050 code 1 & 050-5	Multipack	4
PSC	**7701151**	PSC starting kit, 25 µF, 25 µF	MT/MTZ028 code 1	Multipack	4
PSC	**7701152**	PSC starting kit, 25 µF, 20 µF	MT/MTZ032-036 code 1	Multipack	4
PSC	**7701153**	PSC starting kit, 35 µF, 20 µF	MT/MTZ040 code 1	Multipack	4
PSC	**7701036**	PSC starting kit, 30 µF, 20 µF	MT/MTZ056 code 1	Multipack	6
PSC	**7701037**	PSC starting kit, 30 µF, 25 µF	MT/MTZ064 code 1	Multipack	6

Single phase CSR starting kits & starting kits in prewired box

Type	Code no.	Description	Application	Packaging	Pack size
CSR	**7701022**	CSR starting kit, 20 µF, 10 µF, 98 µF	MT/MTZ018-028 code 5	Multipack	4
CSR	**7701030**	CSR starting kit, 25 µF, 10 µF, 98 µF	MT/MTZ032-036 code 5	Multipack	4
CSR	**7701021**	CSR starting kit, 15 µF, 10 µF, 98 µF	MT/MTZ018 code 1	Multipack	4
CSR	**7701038**	CSR starting kit, 15 µF, 30 µF, 98 µF	MT/MTZ022 code 1	Multipack	4
CSR	**7701154**	CSR starting kit, 25 µF, 25 µF, 140 µF	MT/MTZ028 code 1	Multipack	4
CSR	**7701155**	CSR starting kit, 25 µF, 20 µF, 98 µF	MT/MTZ032-036 code 1	Multipack	4
CSR	**7701156**	CSR starting kit, 35 µF, 20 µF, 98 µF	MT/MTZ040 code 1	Multipack	4
CSR	**7701042**	CSR starting kit, 30 µF, 15 µF, 140 µF	MT/MTZ044-051 code 1	Multipack	6
CSR	**7701043**	CSR starting kit, 30 µF, 20 µF, 98 µF + 98 µF	MT/MTZ056 code 1	Multipack	6
CSR	**7701044**	CSR starting kit, 30 µF, 25 µF, 98 µF + 140 µF	MT/MTZ064 code 1	Multipack	6
CSR	**7701028**	CSR starting kit, prewired box, 20 µF, 10 µF, 98 µF	MT/MTZ018-028 code 5	Single pack	1
CSR	**7701054**	CSR starting kit, prewired box, 25 µF, 10 µF, 98 µF	MT/MTZ032-036 code 5	Single pack	1
CSR	**7701147**	CSR starting kit, prewired box, 15 µF, 30 µF, 98 µF	MT/MTZ022 code 1	Single pack	1
CSR	**7701148**	CSR starting kit, prewired box, 25 µF, 25 µF, 140 µF	MT/MTZ028 code 1	Single pack	1
CSR	**7701149**	CSR starting kit, prewired box, 25 µF, 20 µF, 98 µF	MT/MTZ032-036 code 1	Single pack	1
CSR	**7701150**	CSR starting kit, prewired box, 35 µF, 20 µF, 98 µF	MT/MTZ040 code 1	Single pack	1
CSR	**7701049**	CSR starting kit, prewired box, 30 µF, 15 µF, 140 µF	MT/MTZ044-050 code 1	Single pack	1

Kickstart kits

Type	Code no.	Description	Application	Packaging	Pack size
	7701060	Kickstart kit; relay + start capacitor 227 µF	MT/MTZ018 code 1 & 5	Single pack	1
	7701059	Kickstart kit; relay + start capacitor 280 µF	MT/MTZ022-064 code 1 & 5 excl 050-5	Single pack	1

Lubricants

Type	Code no.	Description	Application	Packaging	Pack size
160PZ	**7754019**	POE lubricant, 160PZ, 33.8 oz can	MTZ with R-404A, R-507A, R-134a,	Multipack	12
160PZ	**7754020**	POE lubricant, 160PZ, 67.6 oz can	MTZ with R-404A, R-507A, R-134a,	Multipack	8
160P	**7754001**	Mineral oil, 160P, 67.6 oz can	MT or LT with R-22 or R-502	Multipack	8
160P	**7754002**	Mineral oil, 160P, 169 oz can	MT or LT with R-22 or R-502	Multipack	4
160ABM	**7754009**	Alkylbenzene oil 160ABM, 67.6 oz can	MT or LT with transitional refrigerants	Multipack	8

ORDERING INFORMATION AND PACKAGING

Ordering information

Maneurop® MT & MTZ reciprocating compressors can be ordered from Danfoss Commercial Compressors in either industrial packs (also called multiple packaging) or in single packs (also called individual packaging).

The code numbers ending in "M" in the tables represent compressors in industrial pack. For ordering single units, please replace the last letter "M" by letter "I".

MT compressors in industrial pack (multiple packaging)

R-22

Compressor model	Design[1])	Code no.						
		1	3	4	5	6	7	9
		208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50	230/3/50	575/3/60 500/3/50	380/3/60
MT018	S	-	MT18-3M	MT18-4M	MT18-5M	-	-	-
	VE	MT18-1VM	MT18-3VM	MT18-4VM	MT18-5VM	-	-	-
MT022	S	MT22-1M	MT22-3M	MT22-4M	MT22-5M	-	-	-
	VE	MT22-1VM	MT22-3VM	MT22-4VM	MT22-5VM	MT22-6VM	-	MT22-9VM
MT028	S	MT28-1M	MT28-3M	MT28-4M	MT28-5M	MT28-6M	-	-
	VE	MT28-1VM	MT28-3VM	MT28-4VM	MT28-5VM	MT28-6VM	-	MT28-9VM
MT032	S	-	MT32-3M	MT32-4M	MT32-5M	MT32-6M	-	-
	VE	MT32-1VM	MT32-3VM	MT32-4VM	MT32-5VM	MT32-6VM	-	-
MT036	S	-	MT36-3M	MT36-4M	MT36-5M	MT36-6M	-	-
	VE	MT36-1VM	MT36-3VM	MT36-4VM	MT36-5VM	MT36-6VM	-	MT36-9VM
MT040	S	MT40-1M	MT40-3M	MT40-4M	-	MT40-6M	-	-
	VE	MT40-1VM	MT40-3VM	MT40-4VM	-	MT40-6VM	-	-
MT044	S	MT44-1M	MT44-3M	MT44-4M	-	-	-	MT44-9M
	VE	MT44-1VM	MT44-3VM	MT44-4VM	-	MT44-6VM	MT44-7VM	MT44-9VM
MT045	S	-	-	MT45-4M	-	-	-	-
	VE	-	MT45-3VM	MT45-4VM	-	-	-	-
MT050	S	-	MT50-3M	MT50-4M	-	-	-	MT50-9M
	VE	MT50-1VM	MT50-3VM	MT50-4VM	MT50-5VM	MT50-6VM	MT50-7VM	MT50-9VM
MT051	S	-	MT51-3M	MT51-4M	-	-	-	-
	VE	-	MT51-3VM	MT51-4VM	-	-	-	-
MT056	S	-	MT56-3M	MT56-4M	-	-	MT56-7M	MT56-9M
	VE	MT56-1VM	MT56-3VM	MT56-4VM	-	MT56-6VM	MT56-7VM	MT56-9VM
MT057	S	-	-	MT57-4M	-	-	-	-
	VE	-	MT57-3VM	MT57-4VM	-	-	-	-
MT064	S	-	MT64-3M	MT64-4M	-	-	-	MT64-9M
	VE	MT64-1VM	MT64-3VM	MT64-4VM	-	MT64-6VM	-	MT64-9VM
MT065	S	-	MT65-3M	MT65-4M	-	-	-	-
	VE	-	MT65-3VM	MT65-4VM	-	-	-	-
MT072	S	-	MT72-3M	MT72-4M	-	-	-	MT72-9M
	VE	-	MT72-3VM	MT72-4VM	-	MT72-6VM	-	MT72-9VM
MT073	S	-	MT73-3M	MT73-4M	-	-	-	-
	VE	-	MT73-3VM	MT73-4VM	-	-	-	-
MT080	S	-	-	MT80-4M	-	-	-	MT80-9M
	VE	-	MT80-3VM	MT80-4VM	-	MT80-6VM	-	MT80-9VM
MT081	S	-	-	MT81-4M	-	-	-	-
	VE	-	MT81-3VM	MT81-4VM	-	-	-	-
MT100	Sv	-	MT100-3M	MT100-4M	-	MT100-6M	MT100-7M	MT100-9M
	VE	-	MT100-3VM	MT100-4VM	-	MT100-6VM	MT100-7VM	MT100-9VM
MT125	Sv	-	MT125-3M	MT125-4M	-	MT125-6M	MT125-7M	-
	VE	-	MT125-3VM	MT125-4VM	-	MT125-6VM	MT125-7VM	-
MT144	Sv	-	MT144-3M	MT144-4M	-	-	-	MT144-9M
	VE	-	MT144-3VM	MT144-4VM	-	MT144-6VM	MT144-7VM	MT144-9VM
MT160	Sv	-	MT160-3M	MT160-4M	-	MT160-6M	-	MT160-9M
	VE	-	MT160-3VM	MT160-4VM	-	MT160-6VM	MT160-7VM	MT160-9VM

[1]) S = Single compressor, no oil sight glass, no oil equalization connection
Sv = Single compressor, brazed oil sight glass, no oil equalization connection

ORDERING INFORMATION AND PACKAGING

MTZ compressors in industrial pack (multiple packaging)

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

Compressor model	Design[1])	Code no.						
		1	3	4	5	6	7	9
		208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50	230/3/50	575/3/60 500/3/50	380/3/60
MTZ018	S	MTZ18-1M	MTZ18-3M	MTZ18-4M	MTZ18-5M	-	-	-
	VE	MTZ18-1VM	MTZ18-3VM	MTZ18-4VM	MTZ18-5VM	MTZ18-6VM	-	-
MTZ022	S	MTZ22-1M	MTZ22-3M	MTZ22-4M	MTZ22-5M	MTZ22-6M	-	-
	VE	MTZ22-1VM	MTZ22-3VM	MTZ22-4VM	MTZ22-5VM	MTZ22-6VM	-	MTZ22-9VM
MTZ028	S	MTZ28-1M	MTZ28-3M	MTZ28-4M	MTZ28-5M	MTZ28-6M	-	-
	VE	MTZ28-1VM	MTZ28-3VM	MTZ28-4VM	MTZ28-5VM	MTZ28-6VM	-	MTZ28-9VM
MTZ032	S	MTZ32-1M	MTZ32-3M	MTZ32-4M	MTZ32-5M	MTZ32-6M	MTZ32-7M	-
	VE	MTZ32-1VM	MTZ32-3VM	MTZ32-4VM	MTZ32-5VM	MTZ32-6VM	MTZ32-7VM	MTZ32-9VM
MTZ036	S	MTZ36-1M	MTZ36-3M	MTZ36-4M	MTZ36-5M	MTZ36-6M	-	-
	VE	MTZ36-1VM	MTZ36-3VM	MTZ36-4VM	MTZ36-5VM	MTZ36-6VM	MTZ36-7VM	MTZ36-9VM
MTZ040	S	MTZ40-1M	MTZ40-3M	MTZ40-4M	-	MTZ40-6M	-	-
	VE	MTZ40-1VM	MTZ40-3VM	MTZ40-4VM	-	MTZ40-6VM	-	-
MTZ044	S	-	MTZ44-3M	MTZ44-4M	-	-	MTZ44-7M	MTZ44-9M
	VE	MTZ44-1VM	MTZ44-3VM	MTZ44-4VM	-	MTZ44-6VM	MTZ44-7VM	MTZ44-9VM
MTZ045	S	-	-	MTZ45-4M	-	-	-	-
	VE	-	MTZ45-3VM	MTZ45-4VM	-	-	-	-
MTZ050	S	-	MTZ50-3M	MTZ50-4M	-	-	MTZ50-7M	MTZ50-9M
	VE	MTZ50-1VM	MTZ50-3VM	MTZ50-4VM	MTZ50-5VM	MTZ50-6VM	MTZ50-7VM	MTZ50-9VM
MTZ051	S	-	-	MTZ51-4M	-	-	-	-
	VE	-	MTZ51-3VM	MTZ51-4VM	-	-	-	-
MTZ056	S	-	MTZ56-3M	MTZ56-4M	-	-	MTZ56-7M	MTZ56-9M
	VE	MTZ56-1VM	MTZ56-3VM	MTZ56-4VM	-	MTZ56-6VM	MTZ56-7VM	MTZ56-9VM
MTZ057	S	-	-	MTZ57-4M	-	-	-	-
	VE	-	MTZ57-3VM	MTZ57-4VM	-	-	-	-
MTZ064	S	-	MTZ64-3M	MTZ64-4M	-	-	-	MTZ64-9M
	VE	MTZ64-1VM	MTZ64-3VM	MTZ64-4VM	-	MTZ64-6VM	-	MTZ64-9VM
MTZ065	S	-	-	MTZ65-4M	-	-	-	-
	VE	-	MTZ65-3VM	MTZ65-4VM	-	-	-	-
MTZ072	S	-	MTZ72-3M	MTZ72-4M	-	MTZ72-6M	-	MTZ72-9M
	VE	-	MTZ72-3VM	MTZ72-4VM	-	MTZ72-6VM	-	MTZ72-9VM
MTZ073	S	-	-	MTZ73-4M	-	-	-	-
	VE	-	MTZ73-3VM	MTZ73-4VM	-	-	-	-
MTZ080	S	-	-	MTZ80-4M	-	-	-	MTZ80-9M
	VE	-	MTZ80-3VM	MTZ80-4VM	-	MTZ80-6VM	-	MTZ80-9VM
MTZ081	S	-	-	MTZ81-4M	-	-	-	-
	VE	-	MTZ81-3VM	MTZ81-4VM	-	-	-	-
MTZ100	Sv	-	MTZ100-3M	MTZ100-4M	-	MTZ100-6M	MTZ100-7M	MTZ100-9M
	VE	-	MTZ100-3VM	MTZ100-4VM	-	MTZ100-6VM	MTZ100-7VM	MTZ100-9VM
MTZ125	Sv	-	MTZ125-3M	MTZ125-4M	-	MTZ125-6M	MTZ125-7M	MTZ125-9M
	VE	-	MTZ125-3VM	MTZ125-4VM	-	MTZ125-6VM	MTZ125-7VM	MTZ125-9VM
MTZ144	Sv	-	MTZ144-3M	MTZ144-4M	-	MTZ144-6M	MTZ144-7M	MTZ144-9M
	VE	-	MTZ144-3VM	MTZ144-4VM	-	MTZ144-6VM	MTZ144-7VM	MTZ144-9VM
MTZ160	Sv	-	MTZ160-3M	MTZ160-4M	-	MTZ160-6M	-	MTZ160-9M
	VE	-	MTZ160-3VM	MTZ160-4VM	-	MTZ160-6VM	MTZ160-7VM	MTZ160-9VM

[1]) S = Single compressor, no oil sight glass, no oil equalization connection
Sv = Single compressor, brazed oil sight glass, no oil equalization connection
VE = Single compressor, threaded oil sight glass, 3/8" oil equalization connection

ORDERING INFORMATION AND PACKAGING

Packaging

Model	Single pack		Multipack				Industrial pack			
	Dimensions in	Net weight lb	Nbr	Dimensions in	Gross weight lb	Static stacking	Nbr	Dimensions in	Gross weight lb	Static stacking
1 cylinder										
MT/MTZ018	l: 13.0 w: 11.6 h: 15.2	46	6	l: 39.4 w: 23.6 h: 20.0	313	4	12	l: 47.2 w: 31.5 h: 19.7	615	4
MT/MTZ022		46			313				615	
MT/MTZ028		51			333				650	
MT/MTZ032		53			348				672	
MT/MTZ036		55			362				710	
MT/MTZ040		57			370				725	
2 cylinders										
MT/MTZ044-050	l: 15.6 w: 14.4 h: 17.9	77	6	l: 45.3 w: 31.5 h: 22.0	500	4	6	l: 47.2 w: 31.5 h: 21.7	648	4
MT/MTZ045-051		82			527				675	
MT/MTZ056-064		82			527				675	
MT/MTZ057-065		86			560				734	
MT/MTZ072-080		88			567				754	
MT/MTZ073-081		90			578				765	
4 cylinders										
MT/MTZ100	l: 19.1 w: 15.6 h: 23.6	132	6	l: 47.2 w: 39.4 h: 28.7	877	4	6	l: 47.2 w: 31.5 h: 25.6	855	4
MT/MTZ125		141			912				891	
MT/MTZ144		148			948				926	
MT/MTZ160		152			979				957	

Single pack: One compressor in a cardboard box.
In some publications this packaging may be indicated as 'individual packaging'.

Multipack: A full pallet of compressors, each individually packed in a cardboard box. Mainly available for to wholesalers and Danfoss distribution centers.

Industrial pack: A full pallet of unpacked compressors. Mainly available for to OEM customers.
In some publications this packaging may be indicated as 'Multiple packaging'.

Nbr: Number of compressor in a pack

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ENGINEERING
TOMORROW

Application guidelines

Maneurop® reciprocating compressors **NTZ**

R404A - R507 - 60 Hz

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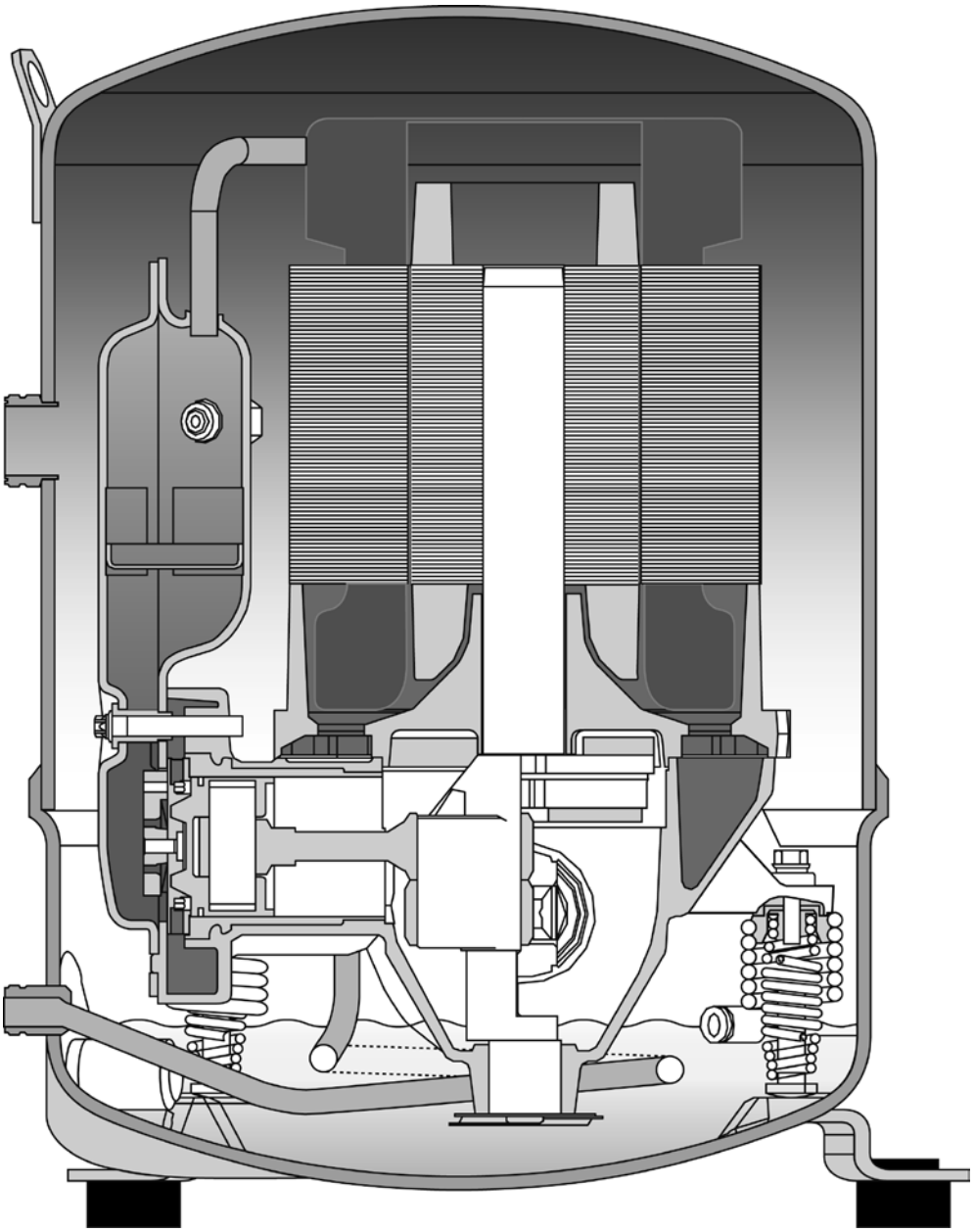
Features

The Maneurop® NTZ series from Danfoss Commercial Compressors is a range of hermetic reciprocating compressors for low evaporating temperature applications. These compressors replace the former LTZ range.

The NTZ series is engineered as a true low temperature compressor, optimised at -31°F with an extended evaporating temperature range from -49°F up to 14°F. The compressors can be operated at a return gas temperature (suction gas temperature) of 68°F even at low evaporating temperatures.

A liquid injection system is not required. All components are of high quality and precision to assure a long product life.

NTZ compressors have a large internal free volume that helps to reduce the risk of liquid hammering. The electrical motor is fully suction gas cooled which means that no additional body cooling is required and it allows the compressor to be insulated with an acoustic hood when the installation requirements call for extra low sound characteristics.



Technical specifications and nominal ratings

Compressor model	Swept volume in³/rev	Displacement		Nominal ratings*				Number of cylinders	Oil charge oz	Net weight lbs
		50 Hz 2900 rpm ft³/hr	60 Hz 3500 rpm ft³/hr	50 Hz		60 Hz				
				Cooling capacity Btu/h	EER Btu/h/w	Cooling capacity Btu/h	EER Btu/h/w			
NTZ048	2.93	295	356	4084	3.99	4887	3.93	1	32	46
NTZ068	4.15	418	504	6935	4.12	8183	4.12	1	32	51
NTZ096	5.86	590	712	8097	4.08	9915	4.12	2	61	77
NTZ108	6.59	664	801	9943	4.22	11470	4.01	2	61	77
NTZ136	8.30	836	1009	12810	3.91	15130	3.98	2	61	77
NTZ215	13.12	1321	1595	19800	4.20	23360	4.20	4	132	137
NTZ271	16.53	1665	2010	27480	4.37	32420	4.37	4	132	141

(*) Motor code 4 operating conditions: R404A, Evap. temp.: -25°F, Cond. temp.: 105°F, RGT: 40°F, SC: 0K
For full NTZ data details and capacity tables refer to Online Datasheet Generator: www.danfoss.com/odsg

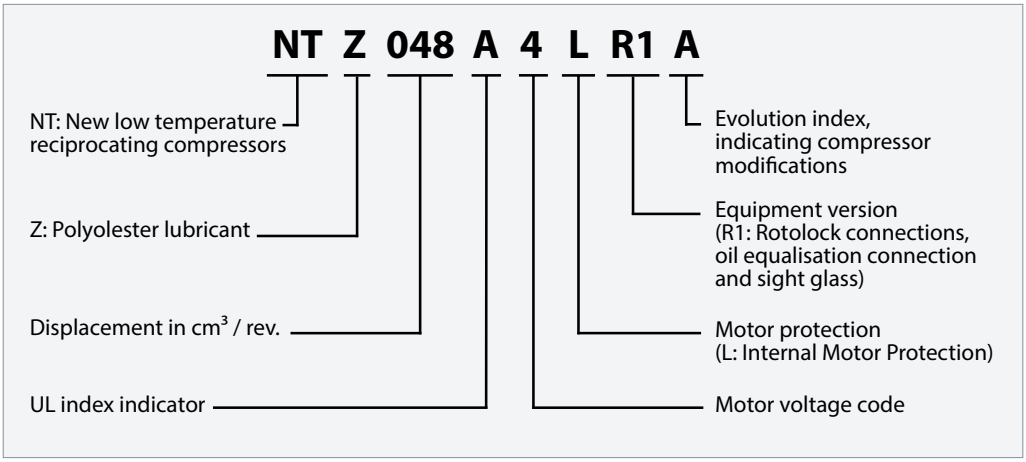
Versions

Available equipment version:

- R1: Rotolock suction and discharge connections, 3/8" flare oil equalisation connection, threaded sight glass.

Compressor reference

(indicated on the compressor nameplate)



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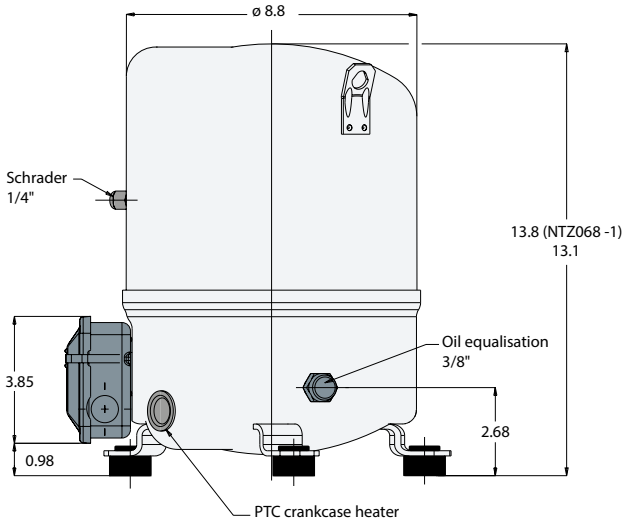
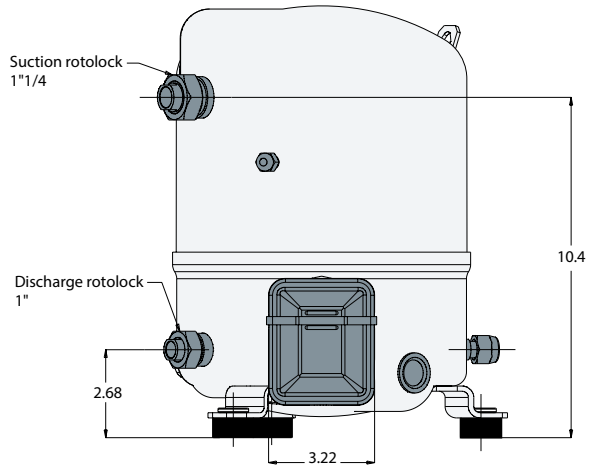
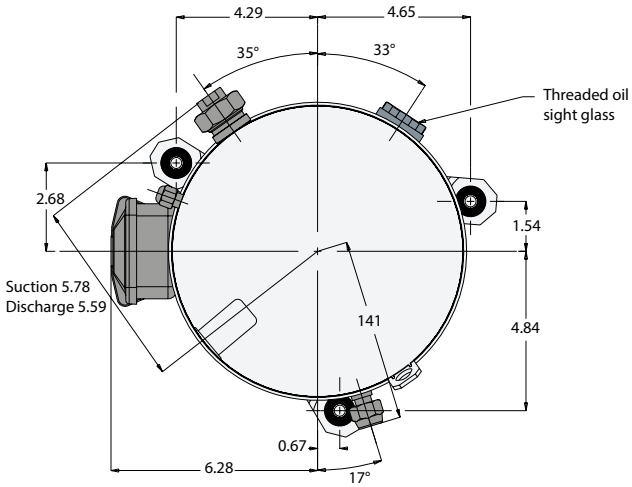
روبروی پالایشگاه نفت پارس، پلاک ۱۲

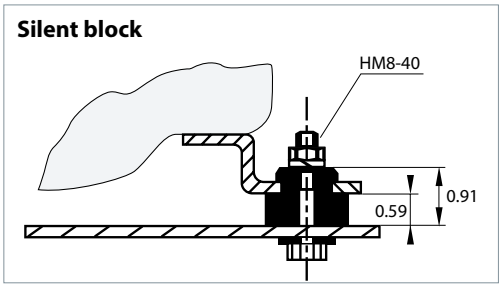
1 cylinder

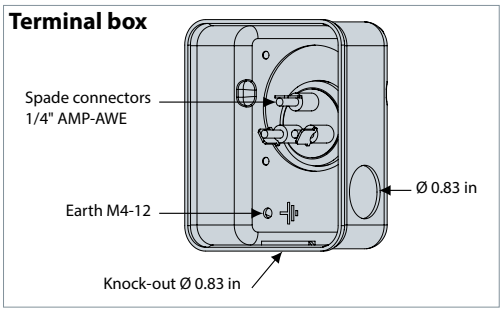




All dimensions in inch



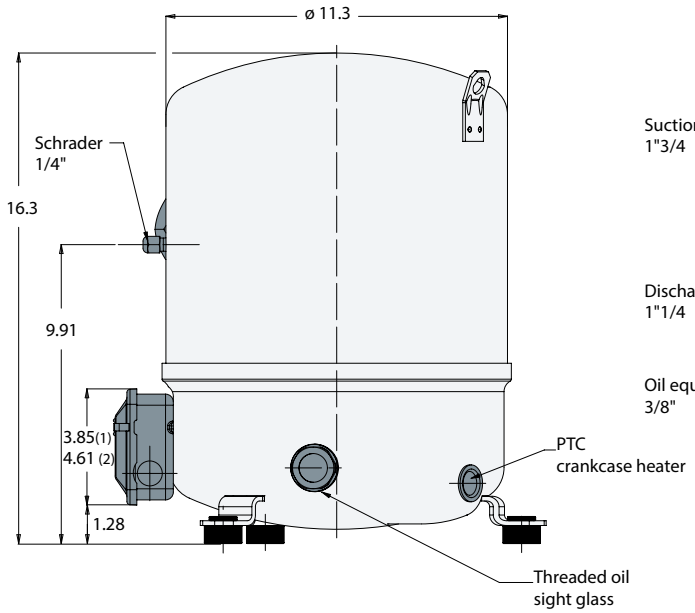


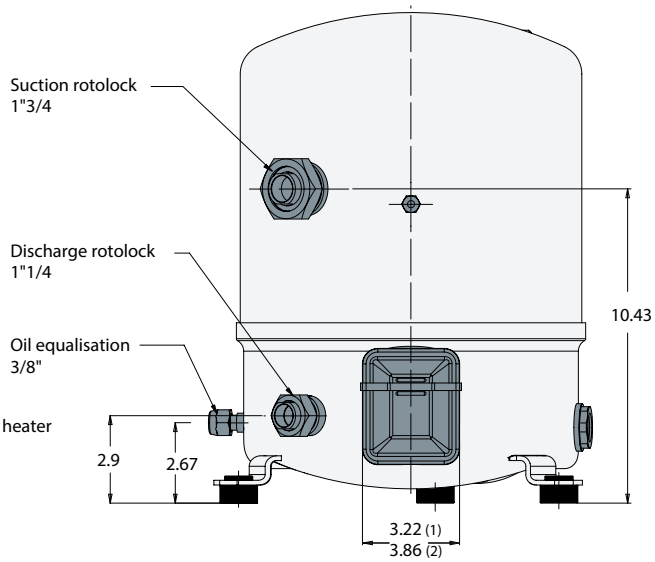


IP rating: 55 (with cable gland)

	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
NTZ048 NTZ068	1"1/4	1"	5/8"	1/2"	V09	V06

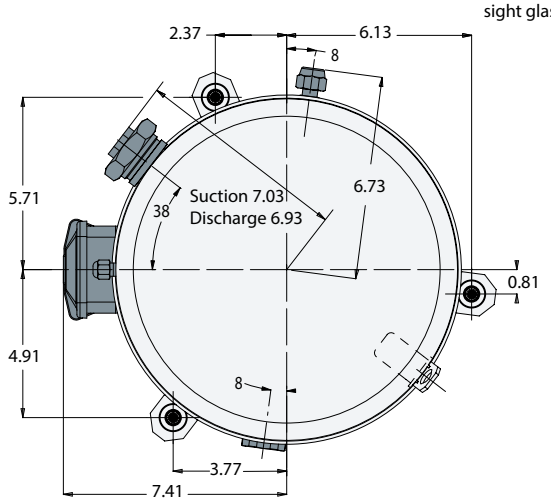
2 cylinders

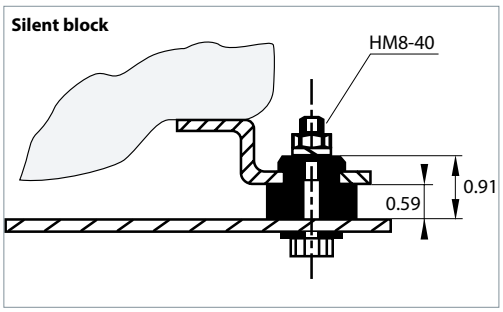


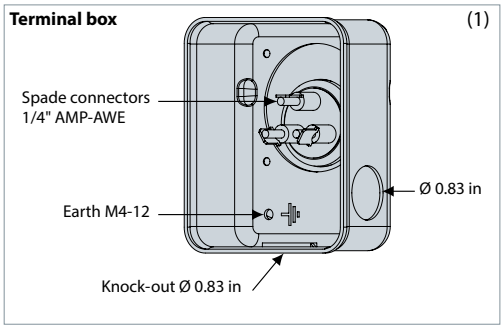


(1) NTZ096 - 108 - 136 except NTZ136-1
(2) NTZ136-1

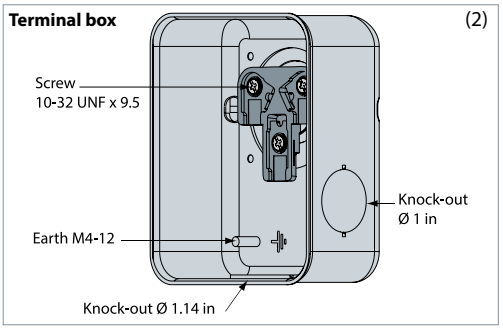
All dimensions in inch







IP rating: 55 (with cable gland)



IP rating: 54 (with cable gland)

	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
NTZ096 - NTZ108	1"3/4	1"1/4	7/8"	3/4"	V07	V04
NTZ136	1"3/4	1"1/4	1"1/8	3/4"	V02	V04

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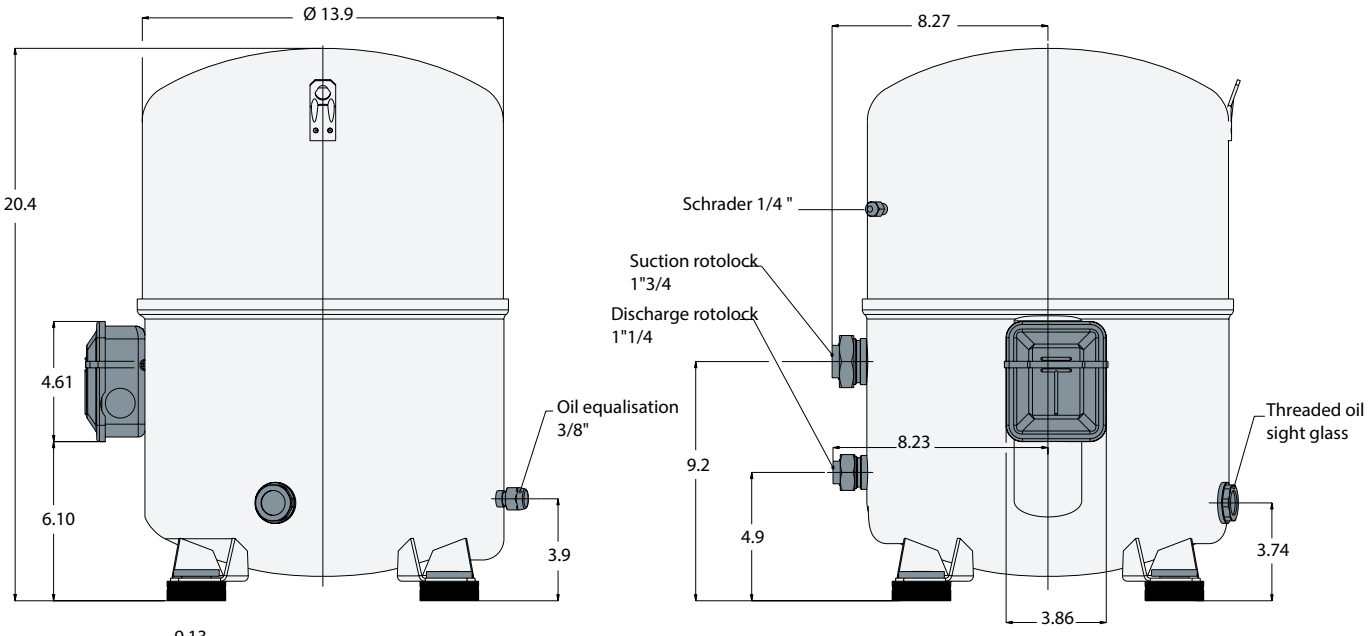
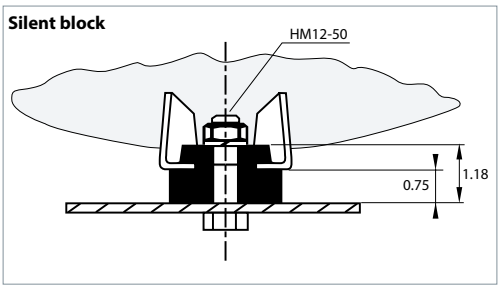
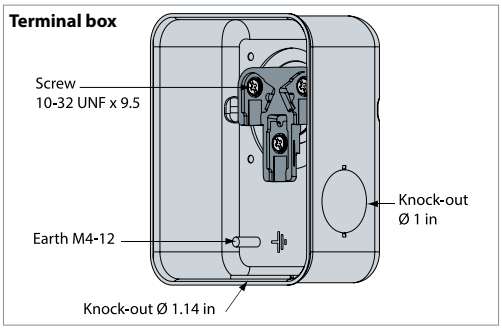
روبروی پالایشگاه نفت پارس، پلاک ۱۲

4 cylinders



All dimensions in inch





IP rating: 54 (with cable gland)

	Rotolock connections size		Pipe sizing		Rotolock valve	
	Suction	Discharge	Suction	Discharge	Suction	Discharge
NTZ215 - NTZ271	1"3/4	1"1/4	1"1/8	3/4"	V02	V04

Voltage application range

Motor voltage code	Nominal voltage	Voltage application range
1	208-230 V / 1 / 60 Hz	187 – 253 V
3	200-230 V / 3 / 60 Hz	180 – 253 V
4	380-400 V / 3 / 50 Hz 460 V / 3 / 60 Hz	340 – 440 V (50 Hz) 414 – 506 V (60Hz)
5	220-240 V / 1 / 50 Hz	198 – 264 V
9	380 V / 3 / 60 Hz	342 – 418 V

Single phase electrical characteristics

	LRA - Locked Rotor Current (A)		MCC - Maximum Continuous Current (A)		Winding resistance (Ω) (± 7 % at 68° F)			
Motor Code	1	5	1	5	1		5	
Winding					run	start	run	start
NTZ048	43.7	37	13.2	11	1.32	4.16	1.62	3.95
NTZ068	72	53	21	17	0.94	2.01	1.05	3.19
NTZ096	97		31		0.45	1.84		
NTZ108	97		33		0.45	1.84		
NTZ136	140		41		0.36	1.73		

Nominal capacitor values and relays

	Models	PSC/CSR*		CSR only	
		Run capacitors (1)		Start capacitors (2)	Start relay
		(A) µF	(C) µF	(B) µF	
50 Hz	NTZ048	20	10	100	RVA6AMKL
	NTZ068	20	10	100	
60 Hz	NTZ048	15	10	100	
	NTZ068	25	25	135	
	NTZ096	30	15	135	
	NTZ108	30	15	135	
	NTZ136	30	15	135	

* PSC: Permanent Split Capacitor
CSR: Capacitor Start Run
(1) Run capacitors: 440 volts
(2) Start capacitors: 330 Volts

Single phase motor protection and suggested wiring diagram

Single phase compressor motors are internally protected by a temperature / current-sensing bimetallic protector which senses the main and start winding current as well as motor winding temperature. If the motor were to be overloaded and the protector trips, it might take up to several hours to reset and restart the compressor.

Trickle circuit

The trickle circuit provides the facility of heating the compressor crankcase by feeding a small current to the auxiliary winding and the run capacitor (See the drawings in section "Electrical connections and wiring"). For the larger single phase compressor models NTZ048-068, the use of the PTC crankcase heater is recommended.

PSC wiring

PSC wiring may be used for refrigerant circuits with capillary tubes or expansion valves with bleed ports. Pressure equalisation must be ensured before start-up because of the low starting torque characteristics of this system.

CSR wiring

CSR wiring provides additional motor torque at start-up, by the use of a start capacitor in combination with the run capacitor. This system can be used for refrigerant circuits with capillary tubes or expansion valves. The start capacitor is only connected during the starting operation, a potential relay is used to disconnect it after the start sequence.

Some applications with high differential pressure can require a very high starting torque. For such cases the CSR starting kit can be converted to a very high starting torque kit by an additional start capcitor of 100 µF parallel to the start capacitor of the CSR kit. This configuration can also be used to reduce erratic starting at unfavourable conditions such as very low ambient temperature or weak voltage.

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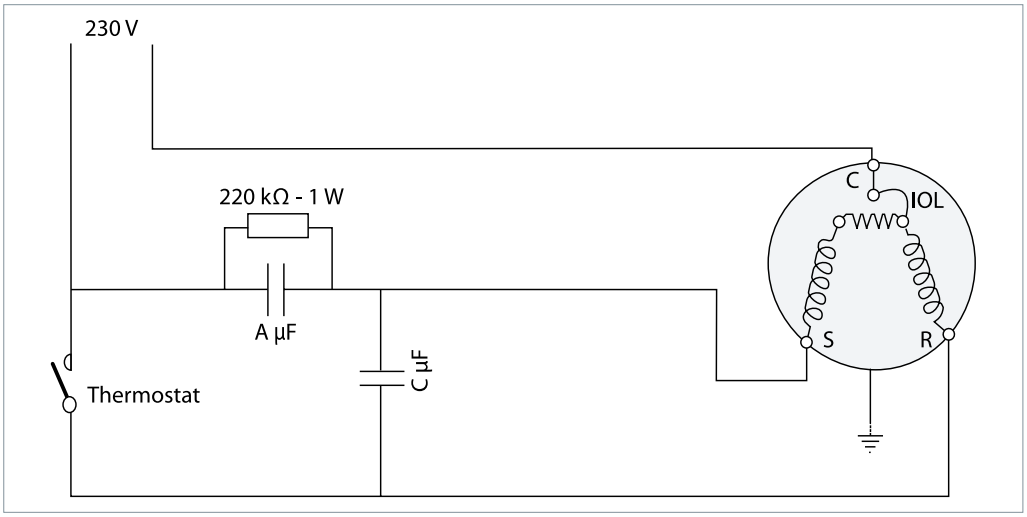
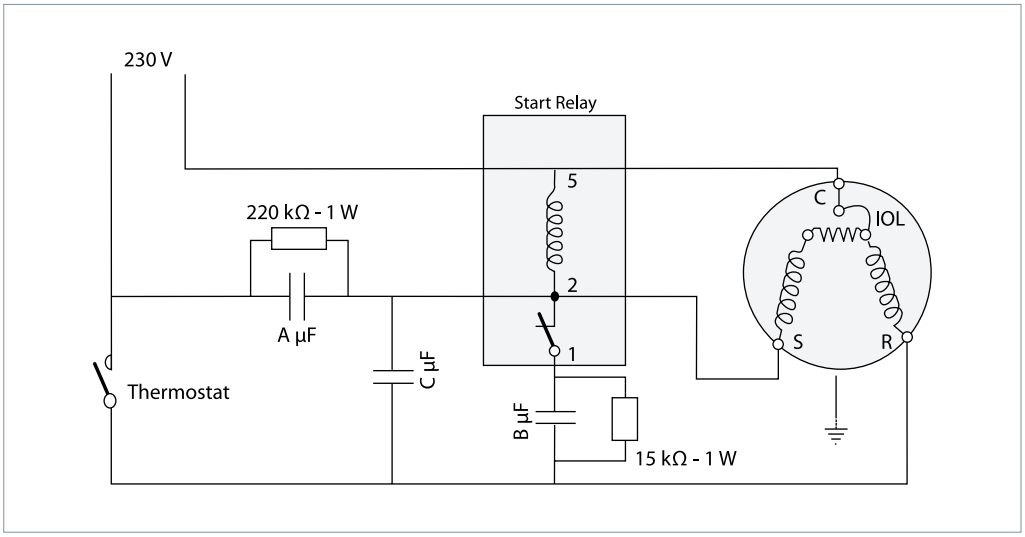
Single phase PSC wiring with trickle circuit



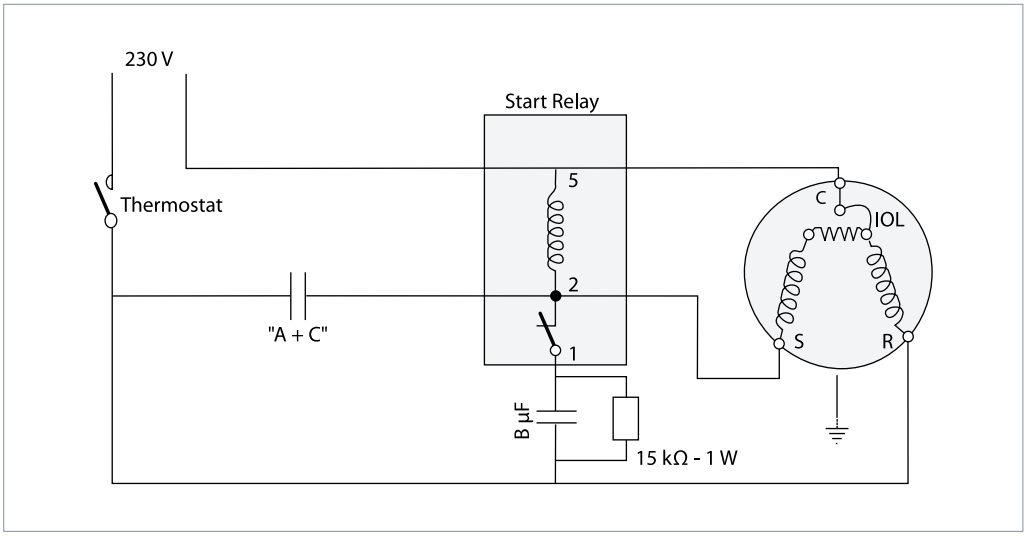
IOL	Motor protector
A & C	Run capacitors
C	Common
S	Start winding (auxiliary)
R	Run winding (main)

Single phase CSR wiring with trickle circuit



IOL	Motor protector
A & C	Run capacitors
B	Start capacitor
C	Common
S	Start winding (auxiliary)
R	Run winding (main)

Single phase CSR wiring without trickle circuit



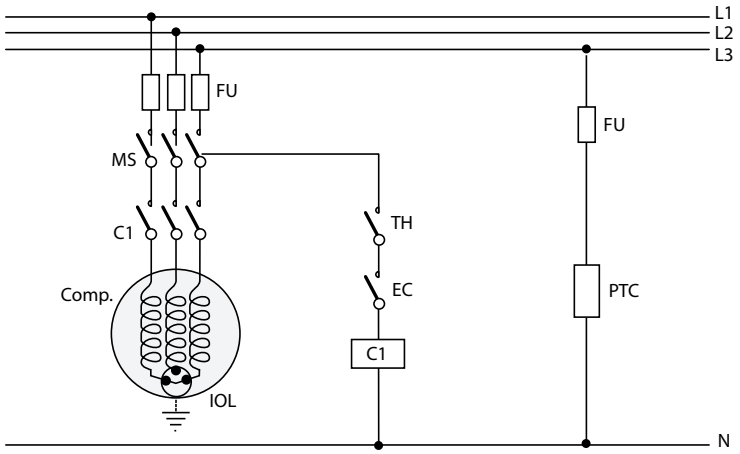
IOL	Motor protector
A + C	Run capacitors
B	Start capacitor
C	Common
S	Start winding (auxiliary)
R	Run winding (main)

Capacitors A and C are replaced by a single capacitor of size A + C

Three phase electrical characteristics

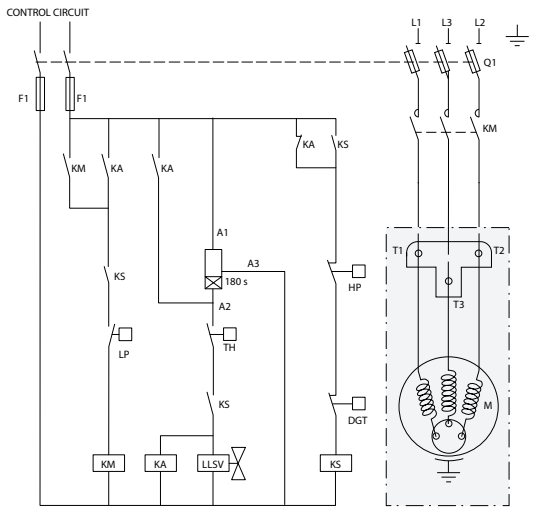
Compressor model	LRA (Locked Rotor Amp) A			MCC (Maximum Continuous Current) A			Winding resistance (Ω) (between phases +/- 7% at 77°F)		
	3	4	9	3	4	9	3	4	9
NTZ048	32	16	22	10.1	4.8	5	2.80	11.55	13.10
NTZ068	48.5	25	29	14.8	8.4	8.5	1.58	7.11	9.70
NTZ096	72	32	-	20.4	10.1	-	1.20	5.03	-
NTZ108	72	45	57	21.4	12.1	11	1.20	4.00	2.54
NTZ136	97.2	51	64	29	14.3	15	0.98	3.80	2.54
NTZ215	147.7	74	110	42.3	22.3	23	0.57	2.23	1.26
NTZ271	198	96	150	56.5	27.0	30	0.41	1.61	0.84

Three phase motor protection and suggested wiring diagram



FU	Fuses
MS	Main switch
C1	Compressor contactor
TH	Thermostat
EC	External controls
COMP	Compressor
PTC	Crankcase heater
IOL	Internal overload line break

Wiring diagram with pump-down cycle



Control device	TH
Optional short cycle timer (3 min) 180 s	
Control relay	KA
Liquid Solenoid valve	LLSV
Compressor contactor	KM
Safety lock out relay	KS
Pump-down control & L.P. switch	BP
H.P. switch	HP
Fused disconnect	Q1
Fuses	F1
Compressor motor	M
Discharge gas thermostat	DGT

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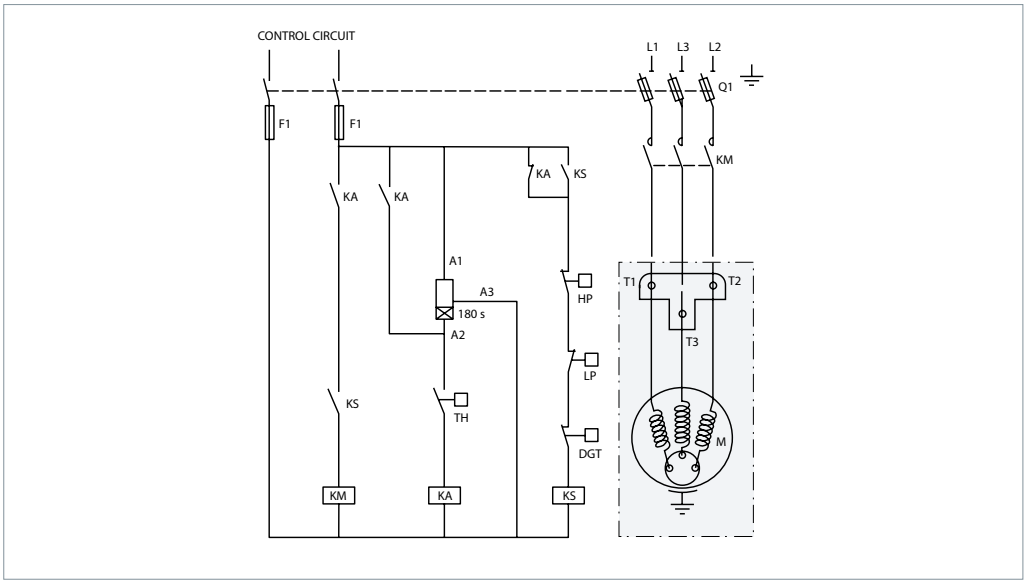
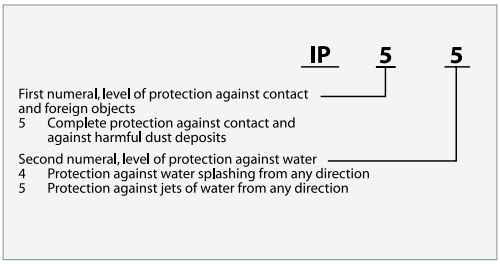
Wiring diagram without pump-down cycle



Control device	TH
Optional short cycle timer (3 min)	180 s
Control relay	KA
Compressor contactor	KM
Safety lock out relay	KS
H.P. switch	HP
Fused disconnect	Q1
Fuses	F1
Compressor motor	M
Discharge gas thermostat	DGT

IP rating

The compressor terminal boxes IP rating according to CEI 529 are:
IP55 for NTZ048-136 except NTZ136-1
IP54 for NTZ136-1 & NTZ215-271
The IP ratings are only valid when correctly sized cable glands of the same IP rating are applied.



Motor protection

Internal motor protection

Three phase compressors are internally protected by a temperature / current-sensing bimetallic protector, connected to the neutral point of the star-connected stator windings. This internal overload line break protects the motor against overheating, current overload and locked rotor conditions. If the motor were to be overloaded and the protector trips, all 3-phases are cut out. It might take up to several hours to reset and restart the compressor.

Voltage unbalance

Operating voltage limits are shown in section "Voltage application range". The voltage applied to motor terminals must lie within these limits during both start-up and normal operation. The maximum allowable voltage unbalance is 2%. Voltage unbalance causes high amperage on one or more phases, which in turn leads to overheating and possible motor damage.

The voltage unbalance is given by the following formula:

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

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

Approvals and certificates

Maneurop® NTZ compressors comply with the following approvals and certificates.

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

CE (European Directive)	CE	All models
UL (Underwriters Laboratories)	c UL us	Models with motor voltage code 1, 3 & 4, NTZ048 - 9 & NTZ068 - 9
CCC (China Compulsory Product Certification)	CCC	Models with motor voltage code 4 & 5.
EAC Eurasian conformity mark	EAC	Models with motor voltage code 4 & 5.

Pressure equipment directive 2014/68/EU

Products	NTZ 048 to 068	NTZ 096 to 271
Refrigerating fluids	Group 2	Group 2
Category PED	I	II
Evaluation module	out of the scope	D1
Maximum / Minimum allowable temperature - TS	122°F > Ts > -31°F	122°F > Ts > -31°F
Maximum allowable pressure - PS	328 psig	328 psig

Low voltage directive 2014/35/EU

Products	NTZ 048 to 271
Declaration of conformity	Contact Danfoss

Machinery directive 2014/30/EU

Products	NTZ 048 to 271
Manufacturer's declaration of incorporation	Contact Danfoss

Internal free volume

Products	Volume (cu.inch)	
	Low side	High side
1 cyl.	473	17.1
2 cyl.	1045	38.4
4 cyl.	1964	73.2

Refrigerants and lubricants

Maneurop® NTZ compressors are designed and optimised for refrigerants R404A and R507.
The use of hydrocarbons is not authorised in NTZ compressors.

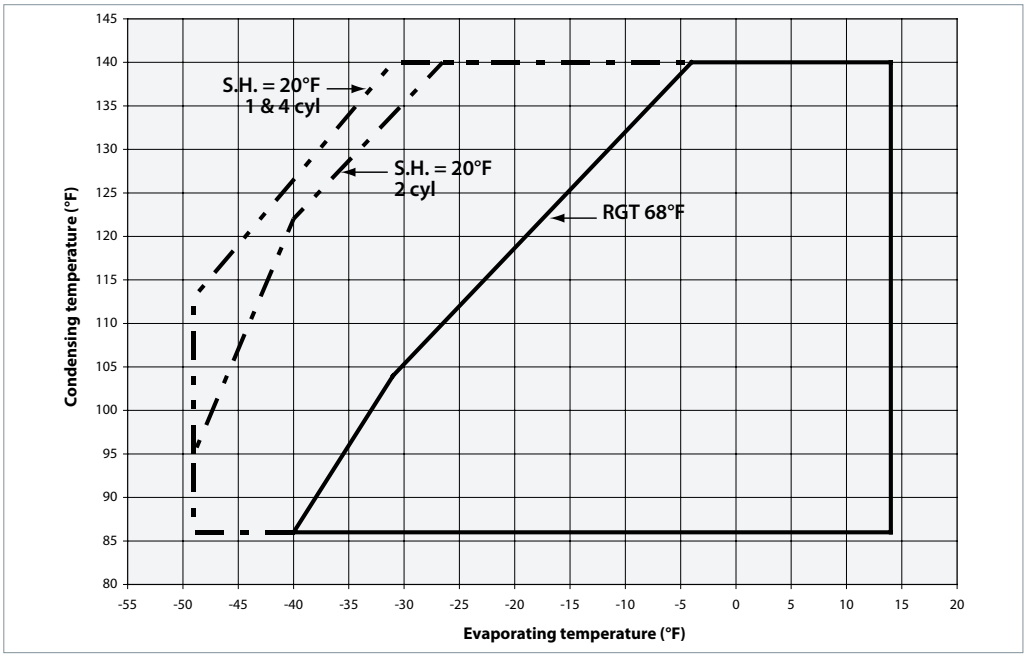
Only approved refrigerants and lubricants as listed in below table may be used.

Refrigerant	Type*	ODP**	Temp.glide*** (°F)	Lubricant
R404A	HFC	0	1.3	160Z polyolester lubricant, factory charged (160SZ - 160PZ allowed alternatively)
R507			0	

*Type: HFC: Hydrofluorcarbon (no chlorine component, "long-term" zero-ODP alternative)
**ODP: Ozone Depletion Potential (base R11; ODP = 1)
*** Temperature glide: difference between saturated vapor temperature and saturated liquid temperature at constant pressure

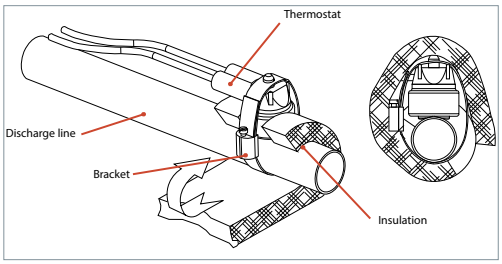
Operating envelope R404A / R507

Because of their thermodynamic properties, R404A and R507 are especially suitable for low and medium temperature applications. Danfoss recommends the use of these refrigerants with NTZ compressors. Note that R404A has a small temperature glide. It must therefore be charged in the liquid phase. For most other aspects however, this small glide may be neglected. R507 is an azeotropic mixture without temperature glide.



Discharge temperature protection

Even when the motor windings are protected against overheating by the internal motor protection, the compressor discharge gas temperature could exceed the maximum allowed value of 275°F when the compressor is operated outside its application envelope. The most effective protection against too high discharge gas temperature is to mount a discharge gas thermostat. An accessory kit is available from Danfoss which includes the thermostat, mounting bracket and insulation. The thermostat must be attached to the discharge line as indicated below at no more than 5.9 inch from the discharge connection.



Operating limits

High pressure

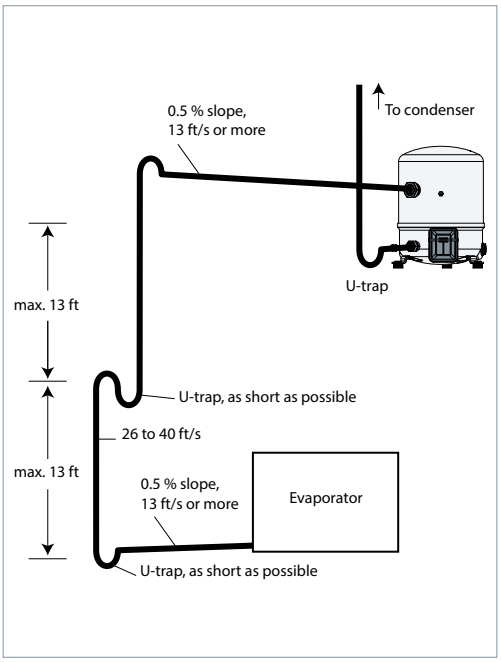
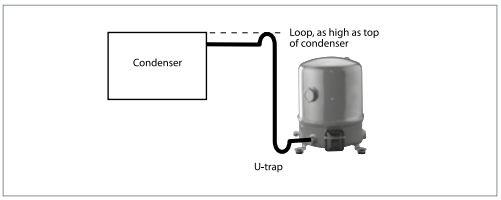
A high-pressure (HP) safety switch is required to shut down the compressor should the discharge pressure exceed the values shown in the table below. This switch can be set at lower values depending on the application and ambient conditions. It must be either located in a lockout circuit or associated with 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 cannot be isolated.

Low pressure

A low-pressure (LP) safety switch must also be used; deep vacuum operations will result in failure. The minimum LP safety switch (loss of charge switch) setting is 0 relative bar (0 bar g). For systems without pump-down feature, the LP safety switch must be either a manual lockout device or an automatic LP safety switch wired into an electrical lockout circuit. LP switch tolerance must not allow for vacuum operation of the compressor. LP safety switch settings for pump-down cycles with automatic reset are listed in the following table.

		NTZ – R404A / R507
Working pressure range, high side	psig	191 - 402
Working pressure range, low side	psig	0.7 - 48
Minimum low pressure safety switch setting	psig	0
Minimum low pressure pump-down switch setting	psig	3
Relief valve opening pressure difference (2 and 4 cycl)	psig	435
Relief valve closing pressure difference	psig	116

Application guidelines	System design recommendations	
	Maneurop® NTZ compressors have been designed and qualified for stationary equipment using standard alternating power supply. Danfoss	does not warrant the compressors for use on mobile applications such as trucks, railways, subways, ships etc.
Piping design	Oil in a refrigeration circuit is required to lubricate moving parts in the compressor. During normal system operation small oil quantities will continuously leave the compressor, with the discharge gas. Therefore, the system piping shall be designed in a way which allows a good oil circulation, avoiding oil being trapped in the system and ensuring a constant oil return to the compressor. As long as the amount of oil circulating through the system is small it will contribute to good system operation and improved heat transfer efficiency.	Lubricant getting trapped in the evaporator or suction lines will affect system performance and will ultimately lead to compressor lubrication failures. Where a poor oil return situation exists, adding lubricant will not help safeguard the compressor. Only a correct piping design can ensure adequate oil circulation maintaining safe oil level in the compressor.
Suction line	Horizontal suction line sections shall have a slope of 0.5% in the direction of refrigerant flow (5/8" per 10 ft of pipe).The cross-section of horizontal suction lines shall be such that the resulting gas velocity is at least 13 ft/s. In vertical risers, a gas velocity of 26 to 40 ft/s is required to ensure proper oil return. A U-trap is required at the foot of each vertical riser. If the riser is higher than 13 ft, additional U-traps are required for each additional 13ft. The length of each U-trap must be as short as possible to avoid the accumulation of excessive quantities of oil (see figure below). Gas velocities higher than 40 ft/s will not contribute to significantly better oil return. However they will cause higher noise levels and result in higher suction line pressure drops which will have a negative effect on the system capacity. Note that the suction rotolock valves, which can be ordered from Danfoss as accessories, are designed for average pipe sizes, selected for systems running at nominal conditions. The pipe sizes selected for specific systems may differ from these average sizes.	The suction line must always be insulated to limit suction gas superheat. 
Discharge line	When the condenser is mounted above the compressor, a loop above the condenser and a U-trap close to the compressor are required to prevent liquid draining from the condenser into the discharge line during standstill.	

Application guidelines	System design recommendations	
Oil charge and oil separator	In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 66 ft, or with many oil traps or an oil separator, additional oil may be required. In	installations with the risk of slow oil return such as in multiple evaporator or multiple condenser installations, an oil separator is recommended. Also refer to the section "Oil charge and oil level".
Filter driers	For new installations with NTZ compressors Danfoss recommends using the Danfoss DML 100% molecular sieve, solid core filter drier. Molecular sieve filter driers with loose beads from third party suppliers shall be avoided. For servicing of existing installations where acid formation is present the Danfoss DCL solid core	filter driers containing activated alumina are recommended. The drier is to be oversized rather than undersized. When selecting a drier, always take into account its capacity (water content capacity), the system refrigerating capacity and the system refrigerant charge.
Suction pressure control	An MOP-type expansion valve or suction pressure regulator (i.e. Danfoss KVL) must be used to limit suction pressure at a maximum of 58 psig relative (23°F). Do not apply both of these devices in combination with one another.	When compressors are mounted onto a rack for a multi-evaporator system (i.e. supermarket) or when evaporators operate at different temperatures, use pressure regulators (Danfoss KVP) without an MOP expansion valve.
Suction line heat exchanger	A suction line heat exchanger is recommended for low temperature applications, better performance and efficiency are expected.	However in hot location this may cause high suction gas superheat which can result in too high discharge temperature.
Low ambient temperature operation	At low ambient temperatures, the condensing temperature and condensing pressure in air cooled condensors will decrease. This low pressure may be insufficient to supply enough liquid refrigerant to the evaporator. As a result the evaporating temperature will decrease, leading to low capacity and eventual poor oil return. At start-up, the compressor will pull into vacuum and it will be switched off by the low pressure protection. Depending on how the low pressure switch and delay timer are set, short cycling can occur. To avoid these problems, several solutions are possible, based on reducing condenser capacity: In air-cooled machines, cycling the fans with a head pressure controller will ensure that the fans remain off until the condensing pressure has reached a satisfactory level. Variable speed fans can also be used to control the condensing pressure. In water-cooled units, the same can be performed using a water regulator valve that is also operated by head pressure, thereby ensuring that the water valve does not open until the condensing pressure reaches a satisfactory level.	The minimum condensing pressure must be set at the minimum saturated condensing temperature shown in the application envelopes. Under very low ambient conditions, in which testing has revealed that the above procedures might not ensure satisfactory condensing and suction pressures, the use of a head pressure control valve is recommended. Note: This solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is recommended and special care should be taken when designing the discharge line. When the compressor is located in a low ambient temperature environment, increased refrigerant migration will occur during shut down periods. For such conditions an extra belt-type crankcase heater is strongly recommended. Note that with 100% suction gas cooled motors, Maneurop® compressors can be externally insulated. Refer to section "Liquid refrigerant migration & charge limits" for more details.

Application guidelines	System design recommendations	
Cycle rate limit	No more than 12 starts per hour (6 when a soft start accessory is used) are allowed. A higher number would reduce the service life of the motor-compressor unit. If necessary, use an anti-short-cycle timer within the control circuit. The system must be designed in a way that guarantees minimum compressor running time so as to provide sufficient motor cooling after	start-up as well as proper oil return from the system to the compressor. A 5-minute delay between two successive compressor starts is being proposed herein, with a 2-minute runtime after each start and a 3-minute idle time between each stop and start. Only during the pump-down cycle may the compressor run for much shorter intervals.
Liquid refrigerant control and charge limits	Refrigeration compressors are basically designed as gas compressors. Depending on the compressor design and operating conditions, most compressors can also handle a limited amount of liquid refrigerant. Maneurop® NTZ compressors have a large internal volume and can therefore handle relatively large amounts of liquid refrigerant without major problems. However even when a compressor can handle liquid refrigerant, this will not be favourable to its service life.	Liquid refrigerant will dilute the oil, wash out the bearings causing wear and eventually seizure. Furthermore, high oil carry over will cause lack of oil in the sump. Good system design can limit the amount of liquid refrigerant in the compressor, which will have a positive effect on the compressor service life. Liquid refrigerant can enter a compressor in various ways, with different effects on the compressor as described in the following points.
Off-cycle migration	During system standstill and after pressure equalisation, refrigerant will condensate in the coldest part of the system which may be the compressor when it is placed in a cold environment. Ultimately, the full system refrigerant charge can condensate in the compressor crankcase. A large amount will dissolve in the compressor oil until the oil is completely saturated with refrigerant. When	the compressor is started, the pressure in the crankcase decreases rapidly and refrigerant will violently evaporate, causing the oil to foam (boiling). Both dilution and foaming reduce the lubrication properties of the oil. In extreme situations liquid could enter the compressor cylinders with immediate compressor break-down as a result.
Liquid floodback during operation	During normal and stable system operation, refrigerant will leave the evaporator in a superheated condition and enter the compressor as a superheated vapour. Normal superheat values at compressor suction are 9 to 54°F. However the refrigerant leaving the evaporator can contain an amount of liquid refrigerant due to different reasons: • wrong dimensioning, wrong setting or malfunction of expansion device • evaporator fan failure or frosted-up evaporator coils.	In these situations, liquid refrigerant will continuously enter the compressor. The negative effects from continuous liquid floodback are: • permanent oil dilution • in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could occur.

Crankcase heater

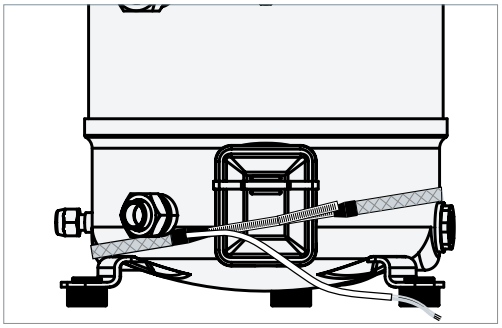
A crankcase heater protects against the off-cycle migration of refrigerant and proves effective if oil temperature is maintained 18°F above the saturated LP temperature of the refrigerant. Tests must thereby be conducted to ensure that the appropriate oil temperature is maintained under all ambient conditions. A PTC crankcase heater is required with all Maneurop®, NTZ compressors. PTC crankcase heaters are self-regulating.

Under extreme conditions such as low ambient temperature at 5°F or lower a belt type crankcase heater could be used in addition to the PTC heater, although this is not a preferred solution for 1 and 2 cylinder compressors. The belt crankcase heater must be positioned on the compressor shell as close as possible to the oil sump to ensure good heat transfer to the oil.

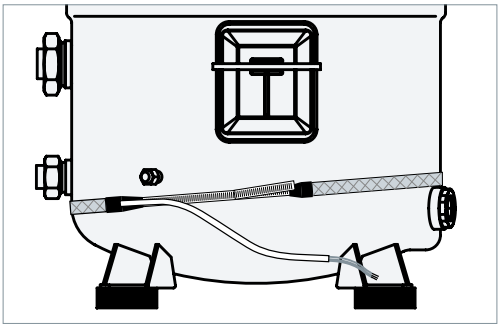
The below illustrated mounting positions are recommended:

Belt crankcase heaters are not self-regulating. Control must be applied to energise the belt heater once the compressor has been stopped and then to de-energise it while the compressor is running. The belt heater must be energised 12 hours before restarting the compressor following an extended down period.

If the crankcase heater is not able to maintain the oil temperature at 18°F above the saturated LP temperature of the refrigerant during off cycles or if repetitive floodback is present a the Liquid Line Solenoid Valve (LLSV) + pump-down cycle is required, possibly in conjunction with a suction accumulator.



Models: NTZ048 - NTZ068 - NTZ096 - NTZ108 - NTZ136



Models: NTZ215 - NTZ271

Liquid line solenoid valve & pump-down

In refrigeration applications, the Liquid Line Solenoid Valve (LLSV) is highly recommended. During the off-cycle, the LLSV isolates the liquid charge in the condensor side, thus preventing refrigerant transfer or excessive migration of refrigerant into the compressor. Furthermore, when using LLSV in conjunction with the pump-down cycle (especially in low-temperature applications), the quantity of refrigerant in the low-pressure side of the system will be reduced.

A pump-down cycle design is required when evaporators are fitted with electric defrost heaters.

Suction accumulator

A suction accumulator offers considerable protection against refrigerant floodback both at start-up and during operation or after the defrost operation. This device also helps protect against off-cycle migration by providing additional internal free volume to the low pressure side of the system.

The suction accumulator must be selected in accordance with the accumulator manufacturer recommendations. As a general rule, Danfoss Commercial Compressors recommends to size the accumulator for at least 50% of the total system charge. Tests however must be conducted to determine the optimal size.

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Sound

Compressors in operation are one of the sources of sound and vibration in a refrigeration system. Both phenomena are closely related.

Sound produced by a compressor is transmitted in every direction by the ambient air, the mounting feet, the pipework and the refrigerant in the pipework. The easiest way to reduce the sound transmitted through ambient air is to fit an acoustic hood accessory. Because Maneurop® NTZ compressors are 100% suction gas cooled and require no external cooling they can be insulated or enclosed in a sound proofing material lined compartment.

Sound transmitted by mounting feet, pipework and refrigerant should be treated the same way as vibration (see next section).

Compressor model	Sound power level* at 50 hz dB(A)		Sound power level* at 60 Hz dB(A)		Acoustic hood code no.
	without hood	with hood	without hood	with hood	
NTZ048	70	65	73	68	120Z0575
NTZ068	65	60	69	64	
NTZ096	82	74	85	77	120Z0576
NTZ108	76	69	80	75	
NTZ136	77	71	80	75	
NTZ215	86	80	88	81	120Z0577
NTZ271	86	80	88	81	

(*) Operating conditions: R404A, Evap. temp.: -31°F, Cond. temp.: 104°F

Vibration

The mounting grommets delivered with the compressor should always be used. They will largely attenuate the compressor vibration transmitted to the base frame. These rubber grommets have been selected and calculated in accordance with the vibration frequencies that are typical for the compressor. For that reason other grommet types or brands shall not be used.

The base on which the compressor is mounted should be sufficiently rigid and of adequate mass to ensure the full effectiveness of the mounting grommets. The compressor should never be rigidly mounted to the base frame otherwise high vibration transmission would occur and the service life reduced. Suction and discharge lines must have adequate flexibility in 3 planes. Eventually vibration absorbers may be required.

Vibration is also transmitted by the refrigerant gas. Maneurop® NTZ compressors have built-in mufflers to reduce pulsation. To further reduce vibration an extra discharge line muffler can be installed.

System cleanliness

System contamination is one of the main factors that affects equipment reliability and compressor service life. Therefore it is important to take care of the system cleanliness when assembling a refrigeration system. During the manufacturing process, circuit contamination can be caused by:

- Brazing and welding oxides,
- Filings and particles from removing burrs from pipe-work,
- Brazing flux,
- Moisture and air.

Only use clean and dehydrated, refrigeration-grade copper tubes and silver alloy brazing material. Clean all parts before brazing and always purge nitrogen or CO_2 through the pipes during brazing to prevent oxidation. If flux is used, take every precaution to prevent the leakage of flux into the piping. The use of flux core or flux coated braze wire or rod instead of brush applied paste flux is strongly recommended. Do not drill holes (e.g. for schrader valves) in parts of the installation that are already completed, when filings and burrs cannot be removed. Carefully follow the instructions below regarding brazing, mounting, leak detection, pressure test and moisture removal. All installation and service work shall only be done by qualified personnel respecting all procedures and using tools (charging systems, tubes, vacuum pumps, etc.) dedicated for R404A and R507.

Compressor handling, mounting and connection

Compressor handling

Maneurop® NTZ compressors must be handled with care and all handling procedures must be performed smoothly and gently. Each NTZ has been fitted with one lift ring which shall always be used to lift the compressor. Once the compressor is installed, the lift ring shall never be used to lift the complete installation.

Always use the proper tools for transporting the compressor. Keep the compressor in an upright position during all handling tasks (manipulating, transport, storage). The angle off the vertical must not exceed 15 degrees.

Compressor mounting

The compressor must be mounted onto a horizontal surface with a maximum slope of 3 degrees. Always use the rubber mounting grommets that are shipped with the compressor. Mounting torques are listed in the below table.

Component	Torque (lbf.in)	
	Min.	Max.
Rotolock suction valve, NTZ048 - NTZ068	710	885
Rotolock suction valve, NTZ096 - NTZ271	885	1060
Rotolock discharge valve, NTZ048 – NTZ068	620	795
Rotolock discharge valve, NTZ096 - NTZ271	710	885
Electrical T-block screws HN°10-32 UNF x 9.5	-	27
Earth screw	-	27
Oil sight glass (with black chloroprene gasket)	355	400
3/8" flare oil equalisation nut	400	440
Schrader nut	100	150
Schrader valve (internal)	3.5	7
Mounting grommet bolt, NTZ048 – NTZ271	105	160
Belt crankcase heater	-	35

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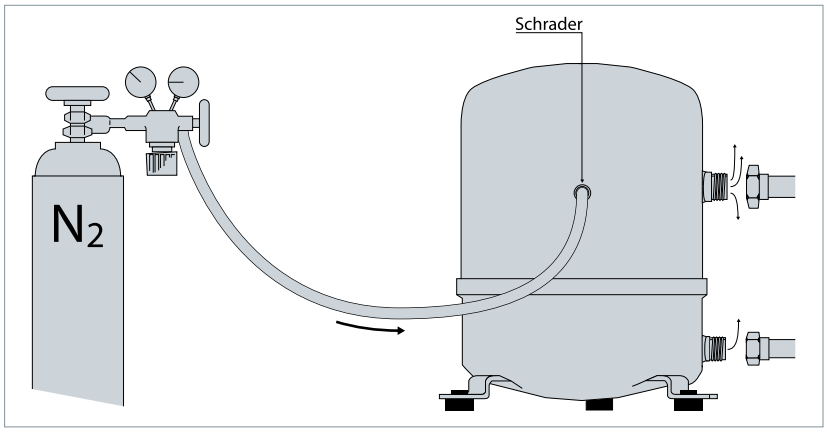
Compressor connection to the system

New compressors have a protective nitrogen holding charge. Only remove the suction and discharge plugs just before connecting the compressor to the installation, so as to prevent air and moisture from entering the compressor. Remove the discharge plug first and the suction plug next; by proceeding as such, the nitrogen holding charge can escape via the discharge connection and the risk of an oil mist blow-out via the suction connection will be minimal.

Whenever possible the compressor must be the last component to be integrated in the system. It is advisable to braze the solder sleeves or service valves to the pipework before the compressor is mounted. when all brazing is finished and when the total system is ready, the compressor plugs can be removed and the compressor can be mounted to the system with a minimum exposure to ambient air. If this procedure is not possible, the sleeves or valves may be brazed to the pipes when mounted on the compressor. In this situation nitrogen or CO_2 must be purged through the compressor via the schrader valve to prevent air and moisture ingress. Purging must start when the plugs are removed and maintained during the brazing process.

When rotolock valves are used on the compressor, they shall be closed immediately after mounting, thus keeping the compressor isolated from atmosphere or from a not yet dehydrated system.

Note: when the compressor is built into a "pack" or "rack" configuration which is not installed immediately on its final location, a vacuum pull-down and moisture removal must be performed to the "pack" or "rack" as if it were a complete system (see below). the pack must be charged with nitrogen or CO_2 and open tubes must be blocked with caps or plugs.



System pressure test

Always use an inert gas such as nitrogen for the pressure test. Never use other gasses such as oxygen, dry air or acetylene. These gasses may form an inflammable mixture with the compressor oil. Always use the appropriate pressure regulator with gas cylinders. Any attempt to use a high pressure gas supply without a suitable pressure regulator can lead to personal injury or death as well as system damage.

The maximum allowed test pressures for NTZ compressors are:

Maximum compressor test pressure at low pressure side (suction side)	362 psi(g)
Maximum compressor test pressure at high pressure side (discharge side)	435 psi(g)
Maximum test pressure difference between high and low pressure side (to avoid that the internal compressor relief valve will open)	435 psi

Leak detection

Whenever possible the compressor must be kept isolated from the system during leak detection by closing the suction and discharge valves. Use a mixture of nitrogen and the final refrigerant (eg. R404A or R507) and use a leak detector for the applied refrigerant. A spectrometric detection system using helium can also be applied. Note that leak detection with refrigerant may not be allowed in some countries. Do not use other gasses such as oxygen, dry air or acetylene as these gasses can form an inflammable mixture with the compressor oil. Never use CFC or HCFC refrigerants for leak detection of HFC systems. Leak detecting additives shall not be used as they may affect the lubricant properties. Warranty may be voided if leak detection additives have been used.

Eventual leaks shall be repaired respecting the instructions written above.

Vacuum pump-down and dehydration procedure

Moisture obstructs proper operation of the compressor and the rest of the refrigeration system. Air and moisture reduce service life, increase condensing pressure and cause excessively high discharge temperatures, which are capable of destroying the lubricating properties of the oil. Air and moisture also increase the risk of acid formation, thus giving rise to copper plating. All these phenomena can ultimately induce mechanical and electrical compressor failure. To eliminate these risks, it is recommended to perform the following vacuum pull-down procedure:

1. To the extent possible (i.e. if valves are present), the compressor must be kept isolated from the system.
2. After leak detection, the system must be pulled-down under a vacuum of 500 microns (0.67 mbar). A two-stage vacuum pump shall be used with a capacity appropriate for the system volume. It is recommended to use connection lines with a large diameter and to connect these lines to the service valves and not to the schrader connection, so as to avoid excessive pressure losses.
3. Once the vacuum level of 500 microns is reached, the system must be isolated from the vacuum pump. Wait 30 minutes during which time the system pressure should not rise. When the pressure rapidly increases, the system is not leak tight. Bring the system pressure up to atmospheric pressure with dry nitrogen or another suitable inert gas in order to reform a new leak detection. After repairing all leaks the vacuum pull-down procedure should be restarted from Step 1. When the pressure slowly increases, this indicates the presence of moisture. In this case Steps 2 and 3 should be repeated.
4. Connect the compressor to the system by means of opening the valves. Repeat Steps 2 & 3.
5. Break the vacuum with either nitrogen or the ultimate refrigerant.
6. Repeat Steps 2 and 3 on the total system.

Upon commissioning, the system moisture content may be as high as 100 ppm. During compressor operation, the filter drier must reduce this content to a level of 20 to 50 ppm.

Warning: do not use a megohmmeter or apply power to the compressor while it is under vacuum as this may cause motor winding damage, and never run the compressor under vacuum as this may cause the compressor motor to burnout.

Start-up

Before initial start-up or after a prolonged shut-down period, energise the crankcase heater 12 hours prior to start-up. If the crankcase heater cannot be energised long enough before start-up, the compressor shall be heated in another way (for example with an electric heater or flood light) to boil off refrigerant from the oil. This is particulary important when ambient temperature is low at commissioning.

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Refrigerant charging

It is recommended that charging be done to the high side of the system. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. Then slowly add refrigerant on the low pressure side as far away as possible from the compressor suction connection. The refrigerant charge quantity must be suitable for both winter and summer operation. R404A is a near-azeotropic mixture and must be charged in the liquid phase. R507 is an azeotropic mixture and can be charged either in liquid or gas phase.

Warning: when a liquid line solenoid valve is used, the vacuum in the low pressure side must be broken before applying power to the system.

Oil charge and oil level

The oil charge must be checked before commissioning (1/4 to 3/4 of the oil sight glass). Watch the oil level at start and for the first 15 minutes after start. Check the oil level again after a minimum of 2 hours operation at nominal conditions. In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 66 ft or with many oil traps or an oil separator, additional oil may be required. Normally the quantity of oil added should be no more than 2% of the total refrigerant charge. This percentage does not take into account oil contained in accessories such as oil separators or oil traps. If this amount has already been added and the oil level in the compressor keeps decreasing, the oil return in the installation is insufficient. Refer to section "Piping design". In installations where slow oil return is likely such as in multiple evaporator or multiple condenser installations an oil separator is recommended. Always use Danfoss 160Z (160PZ/160SZ allowed alternatively) lubricant for systems with NTZ compressors and R404A or R507.

Installation checks

After a few running hours the main system parameters shall be verified to ensure that the system is working correctly or eventually to adjust the settings.

- The evaporating temperature and condensing temperature shall be compared with the design conditions.
- The superheat at the evaporator outlet must be adjusted to optimise the evaporator performance. Generally a value of 18°F is recommended.
- The compressor suction temperature gives information about the suction gas superheat at the compressor. NTZ compressors can be operated at a maximum suction gas temperature of 68°F. Note that extremely low superheat values can increase the risk of unwanted liquid floodback to the compressor. When a too high superheat is noted while the expansion valve setting is correct, the suction line insulation between evaporator and compressor should be checked and eventually replaced by a higher quality insulation.
- A too high discharge gas temperature can indicate a malfunctioning condenser, too high suction gas superheat. Measurements through a probe sensor pushed against the discharge tube are not accurate. From 240°F, we recommend to use a thermocouple, brazed and insulated on the discharge tube, 4 in far from the compressor body. The maximum allowed discharge temperature is 275°F.
- Power and current consumption shall be compared with the table values at measured evaporating and condensing temperature.
- When after commisioning the liquid sight glass indicates moisture, the filter drier must immediately be replaced.

Code numbers (for ordering)

NTZ compressors in single pack (2)

Compressor model	Motor voltage code				
	1	3	4	5	9
	208-230/1/60	200-230/3/60	460/3/60 400/3/50	230/1/50	380/3/60
NTZ048	120F0072	120F0026	120F0001	120F0087	120F0168
NTZ068	120F0073	120F0027	120F0002	120F0088	120F0169
NTZ096	120F0074	120F0028	120F0003		
NTZ108	120F0075	120F0029	120F0004		120F0170
NTZ136	120F0076	120F0030	120F0005		120F0171
NTZ215		120F0031	120F0006		120F0172
NTZ271		120F0032	120F0007		120F0173

NTZ compressors in industrial pack (4)

Compressor model	Motor voltage code		
	3	4	5
	200-230/3/60	460/3/60 400/3/50	230/1/50
NTZ048	120F0033	120F0008	120F0089
NTZ068	120F0034	120F0009	120F0090
NTZ096	120F0035	120F0010	
NTZ108	120F0036	120F0011	
NTZ136	120F0037	120F0012	
NTZ215	120F0038	120F0013	
NTZ271	120F0039	120F0014	

Packaging

Compressor model	Single pack (2)		Multi pack (3)				Industrial pack (4)			
	Weight (lb)	Dimensions (in)	Qty	Weight (lb)	Dimensions (in)	Static stacking	Qty	Weight (lb)	Dimensions (in)	Static stacking
NTZ048	50.7	l: 15.2 w: 11.2 h: 14.6	8	434	l: 45.3 w: 31.5 h: 20.1		12	613	l: 45.3 w: 31.5 h: 19.7	
NTZ068	55.1			470				666		
NTZ096	83.7	l: 15.2 w: 14.8 h: 17.7	6	525	l: 4.3 w: 31.5 h: 23.6	4	6	507	l: 45.3 w: 31.5 h: 23.6	4
NTZ108	83.7			525				507		
NTZ136	83.7			525				507		
NTZ215	158.7	l: 22.4 w: 15.7 h: 26.4	4	659	l: 45.3 w: 31.5 h: 32.3		6	866	l: 45.3 w: 31.5 h: 28.0	
NTZ271	160.9			668				880		

(2) Single pack: one compressor packed in a cardboard box 4 cyl.: cardboard box on 1/4 euro pallet
(3) Multi pack: a pallet filled with single-packs
(4) Industrial pack: a full pallet of unpacked compressors

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Rotolock service valves and valve sets (without gasket)

Type	Code n°	Description	Application	Packaging	Pack size
V01	8168027	Rotolock valve, V01 (1" Rotolock, 3/8" ODF)	Models with 1" rotolock connection	Multipack	6
V06	8168031	Rotolock valve, V06 (1" Rotolock, 1/2" ODF)	Models with 1" rotolock connection	Multipack	6
V04	8168029	Rotolock valve, V04 (1"1/4 Rotolock, 3/4" ODF)	Models with 1"1/4 rotolock connection	Multipack	6
V04	7968006	Rotolock valve, V04 (1"1/4 Rotolock, 3/4" ODF)		Industry pack	42
V05	8168030	Rotolock valve, V05 (1"1/4 Rotolock, 7/8" ODF)	Models with 1"1/4 rotolock connection	Multipack	6
V05	7968007	Rotolock valve, V05 (1"1/4 Rotolock, 7/8" ODF)		Industry pack	36
V09	8168033	Rotolock valve, V09 (1"1/4 Rotolock, 5/8" ODF)	Models with 1"1/4 rotolock connection	Multipack	6
V09	7968005	Rotolock valve, V09 (1"1/4 Rotolock, 5/8" ODF)		Industry pack	50
V02	8168028	Rotolock valve, V02 (1"3/4 Rotolock, 1"1/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	6
V02	7968009	Rotolock valve, V02 (1"3/4 Rotolock, 1"1/8 ODF)		Industry pack	24
V07	8168032	Rotolock valve, V07 (1"3/4 Rotolock, 7/8" ODF)	Models with 1"3/4 rotolock connection	Multipack	6
V07	7968008	Rotolock valve, V07 (1"3/4 Rotolock, 7/8" ODF)		Industry pack	36
V10	8168022	Rotolock valve, V10 (1"3/4 Rotolock, 1-3/8" ODF)	Models with 1"3/4 rotolock connection	Single pack	1
V09, V06	7703005	Valve set, V09 (1"1/4~5/8"), V06 (1"~1/2")	NTZ048-068	Multipack	4
V07, V04	7703006	Valve set, V07 (1"3/4~7/8"), V04 (1"1/4~3/4")	NTZ096-108	Multipack	6
V02, V04	7703009	Valve set, V02 (1"3/4~1"1/8), V04 (1"1/4~3/4")	NTZ136-271	Multipack	6

Rotolock nuts

Type	Code n°	Description	Application	Packaging	Pack size
	8153122	Rotolock nut, 1"	Models with 1" rotolock connection	Multipack	10
	8153123	Rotolock nut, 1"1/4	Models with 1"1/4 rotolock connection	Multipack	10
	8153124	Rotolock nut, 1"3/4	Models with 1"3/4 rotolock connection	Multipack	10

Solder sleeves

Type	Code n°	Description	Application	Packaging	Pack size
P01	8153010	Solder sleeve, P01 (1" Rotolock, 3/8" ODF)	Models with 1" rotolock connection	Multipack	10
P06	8153007	Solder sleeve, P06 (1" Rotolock, 1/2" ODF)	Models with 1" rotolock connection	Multipack	10
P09	8153011	Solder sleeve, P09 (1"1/4 Rotolock, 5/8" ODF)	Models with 1"1/4 rotolock connection	Multipack	10
P04	8153008	Solder sleeve, P04 (1"1/4 Rotolock, 3/4" ODF)	Models with 1"1/4 rotolock connection	Multipack	10
P05	8153012	Rotolock connector, P05 (1"1/4 Rotolock, 7/8" ODS)	Models with 1"1/4 rotolock connection	Multipack	10
P07	8153013	Solder sleeve, P07 (1"3/4 Rotolock, 7/8" ODF)	Models with 1"3/4 rotolock connection	Multipack	10
P02	8153004	Solder sleeve, P02 (1"3/4 Rotolock, 1"1/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10
P10	8153003	Solder sleeve, P10	Models with 1"3/4 rotolock connection	Multipack	10

Gaskets and gasket set

Type	Code n°	Description	Application	Packaging	Pack size
G01	8156130	Gasket, 1"	Models with 1" rotolock connection	Multipack	10
G01	7956001	Gasket, 1"		Industry pack	50
G09	8156131	Gasket, 1"1/4	Models with 1"1/4 rotolock connection	Multipack	10
G09	7956002	Gasket, 1"1/4		Industry pack	50
G07	8156132	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Multipack	10
G07	7956003	Gasket, 1"3/4		Industry pack	50
	8156009	Gasket set, 1", 1"1/4, 1"3/4, OSG gaskets black & white	All 1-2-4 cylinder models	Multipack	10

Belt heaters

Type	Code n°	Description	Application	Packaging	Pack size
	7773106	Belt type crankcase heater, 54 W, 230 V, CE mark, UL	NTZ048-068	Multipack	4
	7773013	Belt type crankcase heater, 54 W, 400 V, UL		Multipack	4
	7773109	Belt type crankcase heater, 65 W, 110 V, CE mark, UL	NTZ096-108-136	Multipack	6
	7973001	Belt type crankcase heater, 65 W, 110 V, CE mark, UL		Industry pack	50
	7773107	Belt type crankcase heater, 65 W, 230 V, CE mark, UL		Multipack	6
	7973002	Belt type crankcase heater, 65 W, 230 V, CE mark, UL		Industry pack	50
	7773117	Belt type crankcase heater, 65 W, 400 V, CE mark, UL		Multipack	6
	120Z0466	Belt type crankcase heater, 65 W, 460 V, CE mark, UL		Multipack	6
	120Z0467	Belt type crankcase heater, 65 W, 575 V, CE mark, UL		Multipack	6
	7773110	Belt type crankcase heater, 75 W, 110 V, CE mark, UL	NTZ215-271	Multipack	6
	7773108	Belt type crankcase heater, 75 W, 230 V, CE mark, UL		Multipack	6
	7973005	Belt type crankcase heater, 75 W, 230 V, CE mark, UL		Industry pack	50
	7773118	Belt type crankcase heater, 75 W, 400 V, CE mark, UL		Multipack	6
	120Z0464	Belt type crankcase heater, 75 W, 460 V, CE mark, UL		Multipack	6
	120Z0465	Belt type crankcase heater, 75 W, 575 V, CE mark, UL		Multipack	6

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PTC heaters

Type	Code n°	Description	Application	Packaging	Pack size
PTC27W	120Z0459	PTC heater 27W	All models	Multipack	10
PTC27W	120Z0460	PTC heater 27W	All models	Industry pack	50

Single phase PSC starting kits

Type	Code n°	Description	Application	Packaging	Pack size
PSC	7701026	Permanent capacitors 440V, 20 µF, 10 µF	NTZ 048-5, 068-5	Multipack	4
PSC	7701035	Permanent capacitors 440V, 30 µF, 15 µF	NTZ096-1, 108-1, 136-1	Multipack	4
PSC	7701151	Permanent capacitors 440V, 25 µF, 25 µF	NTZ 068-1	Multipack	4

Single phase CSR starting kits

Type	Code n°	Description	Application	Packaging	Pack size
CSR	7701021	Relay + Capacitors : run (15 + 10 µF), start (98 µF)	NTZ 048-1	Multipack	4
CSR	7701022	Relay + Capacitors : run (20 + 10 µF), start (98 µF)	NTZ 048-5, 068-5	Multipack	4
CSR	7701154	Relay + Capacitors : run (25 + 25 µF), start (140 µF)	NTZ 068-1	Multipack	4
CSR	7701042	Relay + Capacitors : run (30 + 15 µF), start (140 µF)	NTZ096-1, 108-1, 136-1	Multipack	6

Single phase CSR starting kits, prewired box

Type	Code n°	Description	Application	Packaging	Pack size
	7701028	Relay + Capacitors : run (20 + 10 µF), start (98 µF)	NTZ 048-5, 068-5	Single pack	1
	7701049	Relay + Capacitors : run (30 + 15 µF), start (140 µF)	NTZ096-1, 108-1, 136-1	Single pack	1

Relays and capacitors

Type	Code n°	Description	Application	Packaging	Pack size
	8173022	Starting relay type RVA6AMKL	All Single pack phase models (code 1 & 5)	Single pack	1
	8173001	Start capacitor 330V, 98 µF	CSR starting kits	Multipack	10
	8173002	Start capacitor 330V, 140 µF	CSR starting kits	Multipack	10

Acoustic hoods

Type	Code n°	Description	Application	Packaging	Pack size
1 cyl	120Z0575	Acoustic hood for 1 cyl	NTZ048-068	Single pack	1
2 cyl	120Z0576	Acoustic hood for 2 cyl	NTZ096-136	Single pack	1
4 cyl	120Z0577	Acoustic hood for 4 cyl	NTZ215-271	Single pack	1

Mounting kits

Type	Code n°	Description	Application	Packaging	Pack size
	8156001	Accessory bag with Mounting kit 1 & 2 cyl	NTZ048-136	Single pack	1
	8156007	Accessory bag with Mounting kit 4 cyl	NTZ215-271	Single pack	1

Terminal boxes, covers & T-block connectors

Type	Code n°	Description	Application	Packaging	Pack size
	8156134	Cover 3.15 x 3.78 inch ; clamp	NTZ048-136 (except 136-1)	Multipack	10
	8173230	T-block 2.05 x 2.24 inch, 3 screws H10-32 UNF9.5	NTZ136-1, NTZ215-271	Multipack	10
	8156135	Covers 3.78 x 4.52 inch, clamp	NTZ136-1, NTZ215-271	Multipack	10

Lubricants / oils

Type	Code n°	Description	Application	Packaging	Pack size
160PZ	7754019	POE lubricant, 160PZ, 1 litre can	NTZ with R404A, R507	Multipack	12
160PZ	120Z0573	POE lubricant, 160PZ, 2.5 litre can	NTZ with R404A, R507	Multipack	8

Miscellaneous

Type	Code n°	Description	Application	Packaging	Pack size
	8156145	Oil sight glass gasket (black)	1-2-4 cyl models produced since 2002	Multipack	10
	8156019	Oil sight glass + gaskets	1-2-4 cylinder VE versions	Multipack	4
	8154001	Blue spray paint	All models	Single pack	1

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Previous version	Current version
• Page 6: Technical specifications and nominal ratings	• Page 6: Updated NTZ068 Nominal ratings in Technical specifications and nominal ratings
• Page 10: Voltage application range	• Page 10: Updated Nominal voltage & Voltage application range for Motor voltage code 5. Added Trickle circuit, PSC wiring & CSR wiring
• Page 14: Approval and certifications	• Page 14: Updated all Approval and certifications
• Page 16: Low pressure operating limits	• Page 16: Updated Low pressure operating limits
• Page 21: Sound	• Page 21: Updated NTZ048 & NTZ068 sound values & Acoustic hood code numbers
• Page 30: Accessories	• Page 30: Updated Acoustic hoods, & Lubricants code numbers in Accessories

Danfoss Commercial Compressors

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

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

Danfoss Scrolls

Danfoss Inverter Scrolls

Danfoss Turbocor Compressors

Danfoss Light Commercial Refrigeration Compressors

Danfoss Maneurop Reciprocating Compressors

Danfoss Optyma Condensing Units

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

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ENGINEERING
TOMORROW

Danfoss

Application guidelines

Danfoss scrolls, **H-Series**
Residential and light commercial

50 - 60 Hz - R22 - R407C - R410A

تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
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Contents

Danfoss scroll compressors are designed and manufactured according to the state of the art and to valid European and US regulations. Particular emphasis has been placed on safety and reliability. Related instructions are highlighted with the following icons:

 This icon indicates instructions to avoid safety risk.

 This icon indicates instructions to avoid reliability risk.

You are strongly advise to follow these instructions. For any deviation from the guidelines, please contact Danfoss Technical Support.

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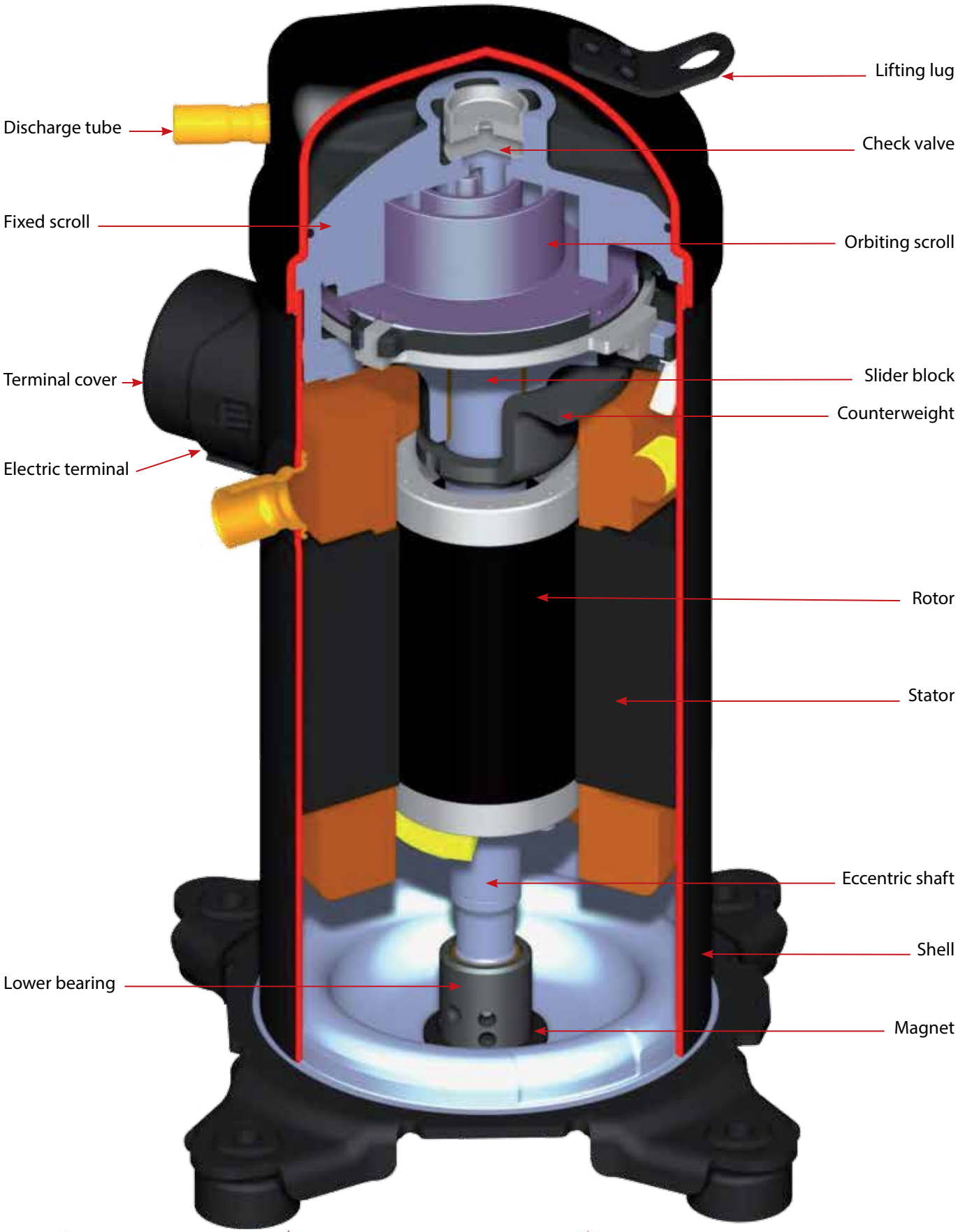
Features

Danfoss H-series scroll compressors are manufactured using the most advanced machining, assembly, and process control techniques. In design of both the compressor and the factory, very high standards of reliability and process control were first priority. The result is a highly efficient product with the highest reliability obtainable, and a low sound level. The H-series compressors can be black or blue depending on the production site.



Compressor model designation

Danfoss H-series scroll compressor for R22/ R407C/R410A is available as single compressor and can be assembled in tandem combinations. The example below presents the compressor nomenclature which equals the technical reference as shown on the compressor nameplate. Code numbers for ordering are listed section “Ordering information and packaging”.

Nomenclature

Type	Size	Motor	Features
HRH	036	U1L	P6

Application:
H: high temperature / air conditioning

Family:
C: commercial scroll
R: residential scroll
L: light commercial scroll

Refrigerant & lubricant:
M: R22, alkylbenzene lubricant
P: R407C, PVE lubricant
H: R410A, PVE lubricant
J: R410A, PVE lubricant

Nominal capacity:
In thousand Btu/h at 60 Hz, ARI conditions

Model variation
T: design optimized for 7.2/54.4°C
U: design optimized for 7.2/37.8°C

Other features

	Oil sight glass	Oil equali-sation	Oil drain	LP gauge port	Gas equa-li-sation port
6	None	None	None	None	None
7	Threaded	None	None	None	None
8	None	Brazed	None	None	Brazed
T	None	Screw	Schrader	None	None

Tubing and electrical connections
P: brazed connections, spade terminals
C: brazed connections, screw terminals

Motor protection
L: internal motor protection

Motor voltage code
1: 208-230V/1~/60 Hz
2: 200-220V/3~/50Hz & 208-230V/3~/60 Hz
4: 380-415V/3~/50 Hz & 460V/3~/60 Hz
5: 220-240V/1~/50 Hz
7: 500V/3~/50 Hz & 575V/ 3~/60 Hz
9: 380V/3~/60 Hz

Feature Version T compressors are built with a threaded oil equalization port to be used with Danfoss variable speed compressors range VZH series.

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Technical specifications

50-60 Hz data

	Model	Nominal tons 60 Hz	Nominal cooling capacity		Power input	MCC	COP	E.E.R	Swept volume	Displacement	Oil charge	Net weight
		TR	W	Btu/h	kW	(A)	W/W	Btu/h/W	cm^3/rev	m^3/h	dm^3	kg
50Hz	HRM025T4	2	5950	20 300	1.86	6.8	3.2	10.9	34.1	5.9	1.06	32
	HRM034U4	2.8	8 350	28 490	2.66	9.5	3.14	10.7	46.2	8.03	1.06	32
	HRM034T4	2.8	8 200	28 000	2.66	9.5	3.29	11.2	46.2	8.03	1.06	32
	HRM038U4	3.2	9 240	31 520	2.94	10.0	3.14	10.7	51.6	8.98	1.06	32
	HRM040U4	3.3	9 710	33 120	2.98	10.0	3.26	11.1	54.4	9.47	1.06	32
	HRM042U4	3.5	10 190	34 770	3.13	11.0	3.26	11.1	57.2	9.95	1.06	32
	HRM042T4	3.5	10 110	34 500	3..08	11.0	3.28	11.2	57.2	9.95	1.06	32
	HRM045U4	3.8	10 940	37 310	3.45	12.0	3.17	10.8	61.5	10.69	1.33	32
	HRM047U4	3.9	11 500	39 250	3.57	12.0	3.23	11	64.1	11.15	1.33	32
	HRM048U4	4	11 510	39 270	3.57	12.5	3.23	11	64.4	11.21	1.57	39
	HRM051T4	4.3	12 390	42 280	3.67	13.0	3.37	11.5	68.8	11.98	1.57	39
	HRM051U4	4.3	12 800	43 690	3.83	13.0	3.34	11.4	68.8	11.98	1.57	39
	HRM054U4	4.5	13 390	45 680	3.97	13.1	3.37	11.5	72.9	12.69	1.57	41
	HRM054T4	4.5	13 300	45 400	3.84	13.1	3.46	11.8	72.9	12.69	1.57	41
	HRM058U4	4.8	14 340	48 930	4.25	15.0	3.37	11.5	78.2	13.6	1.57	41
	HRM060T4	5	14 570	49 720	4.28	15.0	3.4	11.6	81	14.09	1.57	41
	HRM060U4	5	14 820	50 580	4.4	15.0	3.37	11.5	81	14.09	1.57	41
	HLM068T4	5.7	16 880	57 580	5	15.0	3.37	11.5	93.1	16.2	1.57	41
	HLM072T4	6	17 840	60 870	5.29	15.0	3.37	11.5	98.7	17.2	1.57	41
	HLM075T4	6.3	18 430	62 880	5.37	16.0	3.43	11.7	102.8	17.88	1.57	41
	HLM081T4	6.8	19 890	67 880	5.8	17.0	3.43	11.7	110.9	19.3	1.57	41
	HCM094T4	7.8	23 060	78 670	6.8	21.0	3.39	11.6	126	21.93	2.66	47
	HCM109T4	9.1	26 690	91 070	7.77	24.0	3.43	11.7	148.8	25.89	2.66	47
	HCM120T4	10	29 130	99 390	8.51	25.0	3.42	11.7	162.4	28.26	2.66	47
60Hz	HRM025T4	2	7090	24 200	2.22	6.8	3.2	10.9	34.1	7.12	1.06	32
	HRM034U4	2.8	9 810	33 480	3.07	9.5	3.2	10.9	46.2	9.69	1.06	32
	HRM034T4	2.8	9960	34 010	2.98	9.5	3.34	11.4	46.2	9.69	1.06	32
	HRM038U4	3.2	11 130	37 980	3.39	10.0	3.28	11.2	51.6	10.84	1.06	32
	HRM040U4	3.3	11 720	39 980	3.57	10.0	3.28	11.2	54.4	11.43	1.06	32
	HRM042U4	3.5	12 300	41 980	3.75	11.0	3.28	11.2	57.2	12.0	1.06	32
	HRM042T4	3.5	12 160	41 510	3..64	11.0	3.34	11.4	57.2	12.0	1.06	32
	HRM045U4	3.8	13 180	44 980	4.01	12.0	3.28	11.2	61.5	12.9	1.33	32
	HRM047U4	3.9	13 920	47 490	4.22	12.0	3.3	11.3	64.1	13.46	1.33	32
	HRM048U4	4	13 830	47 180	4.25	12.5	3.25	11.1	64.4	13.53	1.57	39
	HRM051T4	4.3	15 030	51 270	4.46	13.0	3.37	11.5	68.8	14.46	1.57	39
	HRM051U4	4.3	15 030	51 280	4.46	13.0	3.37	11.5	68.8	14.46	1.57	39
	HRM054U4	4.5	15 730	53 680	4.62	13.1	3.4	11.6	72.9	15.32	1.57	41
	HRM054T4	4.5	15 820	54 000	4.53	13.1	3.49	11.9	72.9	15.32	1.57	41
	HRM058U4	4.8	16 930	57 780	5.02	15.0	3.37	11.5	78.2	16.41	1.57	41
	HRM060T4	5	17 490	59 670	5.14	15.0	3.4	11.6	81	17.0	1.57	41
	HRM060U4	5	17 490	59 680	5.19	15.0	3.37	11.5	81	17.0	1.57	41
	HLM068T4	5.7	20 190	68 880	5.94	15.0	3.4	11.6	93.1	19.55	1.57	41
	HLM072T4	6	21 330	72 770	6.27	15.0	3.4	11.6	98.7	20.76	1.57	41
	HLM075T4	6.3	22 120	75 480	6.45	16.0	3.43	11.7	102.8	21.58	1.57	41
	HLM081T4	6.8	23 880	81 470	6.96	17.0	3.43	11.7	110.9	23.29	1.57	41
	HCM094T4	7.8	27 690	94 470	8.07	21.0	3.43	11.7	126	26.47	2.66	47
	HCM109T4	9.1	32 020	109 270	9.33	24.0	3.43	11.7	148.8	31.25	2.66	47
	HCM120T4	10	34 950	119 260	10.22	25.0	3.42	11.7	162.4	34.11	2.66	47

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

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

Standard rating conditions: ARI standard
Refrigerant: R22
Superheat: 11.1 K

Evaporating temperature: 7.2 °C
Condensing temperature: 54.4 °C
Sub-cooling: 8.3 K

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

Technical specifications

50-60 Hz data

	Model	Nominal tons 60 Hz	Nominal cooling capacity		Power input	MCC	COP	E.E.R	Swept volume	Displacement	Oil charge	Net weight
		TR	W	Btu/h	kW	(A)	W/W	Btu/h/W	cm^3/rev	m^3/h	dm^3	kg
50Hz	HRP025T4	2.0	5730	19 570	1.86	6.8	3.08	10.5	34.1	5.90	1.06	32
	HRP034T4	2.8	7 940	27 080	2.68	9.5	2.96	10.1	46.2	8.03	1.06	32
	HRP038T4	3.2	8 840	30 150	2.82	10.0	3.14	10.7	51.6	8.98	1.06	32
	HRP040T4	3.3	9 110	31 080	3.14	10.0	2.90	9.9	54.4	9.47	1.06	32
	HRP042T4	3.5	9 580	32 680	3.30	11.0	2.90	9.9	57.2	9.95	1.06	32
	HRP045T4	3.8	10 810	36 890	3.58	12.0	3.02	10.3	61.5	10.69	1.33	32
	HRP047T4	3.9	11 130	37 980	3.69	12.0	3.02	10.3	64.1	11.15	1.33	32
	HRP048T4	4.0	11 100	37 880	3.35	12.5	3.31	11.3	64.4	11.21	1.57	39
	HRP051T4	4.3	12 120	41 370	3.83	13.0	3.17	10.8	68.8	11.98	1.57	39
	HRP054T4	4.5	12 570	42 880	3.97	13.1	3.17	10.8	72.8	12.66	1.57	41
	HRP058T4	4.8	13 470	45 970	4.25	15.0	3.17	10.8	78.2	13.60	1.57	41
	HRP060T4	5.0	13 860	47 280	4.26	15.0	3.25	11.1	81.0	14.09	1.57	41
	HLP068T4	5.7	15 700	53 560	5.10	15.0	3.08	10.5	93.1	16.20	1.57	41
	HLP072T4	6.0	16 620	56 740	5.30	15.0	3.14	10.7	98.7	17.17	1.57	41
	HLP075T4	6.3	18 040	61 550	5.54	16.0	3.26	11.1	102.8	17.88	1.57	41
	HLP081T4	6.8	19 480	66 510	5.99	17.0	3.25	11.1	110.9	19.30	1.57	41
	HCP094T4	7.8	21 590	73 660	6.63	21.0	3.26	11.1	126.0	21.93	2.66	47
	HCP109T4	9.1	26 060	88 950	7.93	24.0	3.28	11.2	148.8	25.89	2.66	47
	HCP120T4	10.0	28 150	96 080	8.88	25.0	3.17	10.8	162.4	28.26	2.66	47
60Hz	HRP025T4	2.0	6880	23 490	2.22	6.8	3.11	10.6	34.1	7.12	1.06	32
	HRP034T4	2.8	9580	32 700	3.20	9.5	3.00	10.2	46.2	9.69	1.06	32
	HRP038T4	3.2	10 670	36 410	3.36	10.0	3.18	10.8	46.2	10.84	1.06	32
	HRP040T4	3.3	10 990	37 510	3.70	10.0	2.97	10.1	54.4	11.43	1.06	32
	HRP042T4	3.5	11 560	39 460	3.93	11.0	2.94	10.0	57.2	12.01	1.06	32
	HRP045T4	3.8	13 050	44 540	4.27	12.0	3.06	10.4	61.5	12.9	1.33	32
	HRP047T4	3.9	12 690	43 300	4.24	12.0	3.00	10.2	64.1	13.46	1.33	32
	HRP048T4	4.0	13 400	45 740	3.99	12.5	3.36	11.5	64.4	13.53	1.57	39
	HRP051T4	4.3	14 380	49080	4.46	13.0	3.23	11.0	68.8	14.46	1.57	39
	HRP054T4	4.5	15 120	51 770	4.73	13.1	3.21	11.0	72.8	15.28	1.57	41
	HRP058T4	4.8	16 260	55 510	5.07	15.0	3.17	10.8	78.2	16.41	1.57	41
	HRP060T4	5.0	16 720	57 010	5.07	15.0	3.30	11.3	81.0	17.01	1.57	41
	HLP068T4	5.7	18 950	64 660	6.08	15.0	3.12	10.6	93.1	19.55	1.57	41
	HLP072T4	6.0	20 060	68 480	6.32	15.0	3.17	10.8	98.7	20.72	1.57	41
	HLP075T4	6.3	21 770	74 330	6.60	16.0	3.30	11.3	102.8	21.58	1.57	41
	HLP081T4	6.8	23 380	79 810	7.14	17.0	3.27	11.2	110.9	23.29	1.57	41
	HCP094T4	7.8	26 060	88 950	7.90	21.0	3.30	11.3	126.0	26.47	2.66	47
	HCP109T4	9.1	31 450	107 350	9.46	24.0	3.32	11.3	148.8	31.25	2.66	47
	HCP120T4	10.0	33 970	115 960	10.59	25.0	3.21	11.0	162.4	34.11	2.66	47

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

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

Standard rating conditions: ARI standard
Refrigerant: R407C
Superheat: 11.1 K

Evaporating temperature: 7.2 °C
Condensing temperature: 54.4 °C
Sub-cooling: 8.3 K

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

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روبروی پالایشگاه نفت پارس، پلاک ۱۲

Technical specifications

50-60 Hz data

	Model	Nominal tons 60 Hz	Nominal cooling capacity		Power input	MCC	COP	E.E.R	Swept volume	Displacement	Oil charge	Net weight
		TR	W	Btu/h	kW	(A)	W/W	Btu/h/W	cm^3/rev	m^3/h	dm^3	kg
50Hz	HRH029U4	2.4	7 120	24 310	2.43	10.0	2.93	10	27.8	4.84	1.06	32
	HRH034U4	2.8	8 500	29 000	2.9	10.0	2.93	10	33.3	5.75	1.06	32
	HRH036U4	3	8 820	30 110	3.13	10.0	2.82	9.62	34.7	6.04	1.06	32
	HRH038U4	3.2	9 250	31 560	3.35	12.0	2.76	9.41	36.5	6.36	1.06	39
	HRH040U4	3.3	10 200	34 810	3.58	12.0	2.85	9.72	39.6	6.9	1.33	39
	HRH041U4	3.3	10 050	34 300	3.43	12.5	2.93	10	39.3	6.8	1.57	39
	HRH044U4	3.7	10 830	36 940	3.92	13.5	2.76	9.41	42.6	7.41	1.57	39
	HRH047U4	3.9	11 340	38 700	3.87	13.5	2.93	10.01	44.4	7.73	1.57	39
	HRH049U4	4.1	12 110	41 320	4.04	13.5	2.99	10.22	47.4	8.24	1.57	39
	HRH051U4	4.3	12 860	43 890	4.21	14.0	3.05	10.42	49.3	8.58	1.57	41
	HRH054U4	4.5	13 340	45 510	4.41	15.0	3.02	10.32	52.1	9.07	1.57	41
	HRH056U4	4.7	13 830	47 200	4.58	15.0	3.02	10.31	54.1	9.42	1.57	41
	HLH061T4	5.1	15 210	51 880	4.89	15.0	3.11	10.61	57.8	10.1	1.57	41
	HLH068T4	5.7	16 880	57 610	5.26	19.0	3.21	10.96	64.4	11.21	1.57	41
	HLJ072T4	6	17 840	60 900	5.56	19.0	3.21	11	68	11.82	1.57	41
	HLJ075T4	6.3	18 600	63 490	5.77	19.0	3.22	11	70.8	12.32	1.57	41
	HLJ083T4	6.9	20 420	69 690	6.28	19.0	3.25	11.1	78.1	13.59	1.57	41
	HCJ090T4	7.5	22 320	76 190	7.19	25.0	3.11	10.6	86.9	15.11	2.66	44
	HCJ091T4	7.5	22 380	76 360	7.03	25.0	3.18	10.87	86.9	15.11	2.46	49
	HCJ105T4	8.8	26 100	89 090	8.25	25.0	3.16	10.8	101.6	17.68	2.66	44
	HCJ106T4	8.8	26 050	88 880	8.07	26.0	3.23	11.01	101.6	17.68	2.46	49
	HCJ120T4	10	29 610	101080	9.53	27.0	3.11	10.6	116.4	20.24	2.66	44
	HCJ121T4	10	29 720	101400	9.22	26.0	3.22	11	116.4	20.24	2.46	49
60Hz	HRH029U4	2.4	8 500	29 000	2.84	10.0	2.99	10.2	27.8	5.84	1.06	32
	HRH031U4	2.6	9 080	30 990	3.04	10.0	2.99	10.2	29.8	6.26	1.06	32
	HRH032U4	2.7	9 380	31 990	3.1	10.0	3.02	10.3	30.6	6.43	1.06	32
	HRH034U4	2.8	10 110	34 510	3.38	10.0	2.99	10.2	33.3	6.94	1.06	32
	HRH036U4	3	10 370	35 390	3.47	10.0	2.99	10.2	34.7	7.3	1.06	32
	HRH038U4	3.2	11 100	37 890	3.79	12.0	2.93	10	36.5	7.67	1.06	39
	HRH040U4	3.3	12 160	41 490	4.03	12.0	3.02	10.3	39.6	8.3	1.33	39
	HRH041U4	3.3	12 100	41 300	4.05	12.5	2.99	10.2	39.3	8.3	1.57	39
	HRH044U4	3.7	13 010	44 390	4.31	13.5	3.02	10.3	42.6	8.95	1.57	39
	HRH047U4	3.9	13 630	46 510	4.56	13.5	2.99	10.2	44.4	9.33	1.57	39
	HRH049U4	4.1	14 360	48 990	4.66	13.5	3.08	10.5	47.4	9.95	1.57	39
	HRH051U4	4.3	15 180	51 780	4.84	14.0	3.14	10.7	49.3	10.36	1.57	41
	HRH054U4	4.5	15 970	54 480	5.14	15.0	3.11	10.6	52.1	10.94	1.57	41
	HRH056U4	4.7	16 670	56 880	5.36	15.0	3.11	10.6	54.1	11.36	1.57	41
	HLH061T4	5.1	18 050	61 580	5.7	15.0	3.17	10.8	57.8	12.13	1.57	41
	HLH068T4	5.7	20 130	68 670	6.3	19.0	3.2	10.9	64.4	13.52	1.57	41
	HLJ072T4	6	21 240	72 500	6.65	19.0	3.19	10.9	68	14.27	1.57	41
	HLJ075T4	6.3	22 320	76 190	6.86	19.0	3.25	11.1	70.8	14.87	1.57	41
	HLJ083T4	6.9	24 340	83 090	7.55	19.0	3.22	11	78.1	16.4	1.57	41
	HCJ090T4	7.5	26 810	91 500	8.47	25.0	3.16	10.8	86.9	18.24	2.66	44
	HCJ091T4	7.5	27 140	92 600	8.37	25.0	3.24	11.07	86.9	18.24	2.46	49
	HCJ105T4	8.8	31 170	106 390	9.75	25.0	3.2	10.9	101.6	21.34	2.66	44
	HCJ106T4	8.8	31 670	108 050	9.67	26.0	3.28	11.18	101.6	21.34	2.46	49
	HCJ120T4	10	35 620	121 600	11.15	27.0	3.2	10.9	116.4	24.43	2.66	44
	HCJ121T4	10	35 940	122 620	11.07	26.0	3.25	11.08	116.4	24.43	2.46	49

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

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

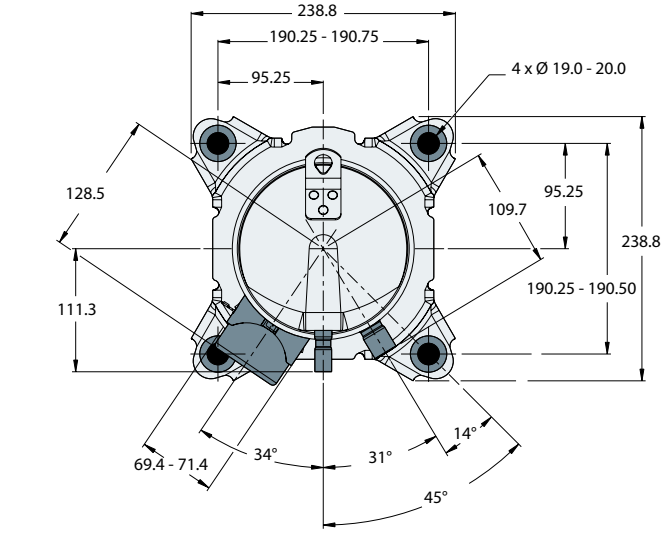
Standard rating conditions: ARI standard
Refrigerant: R410A
Superheat: 11.1 K

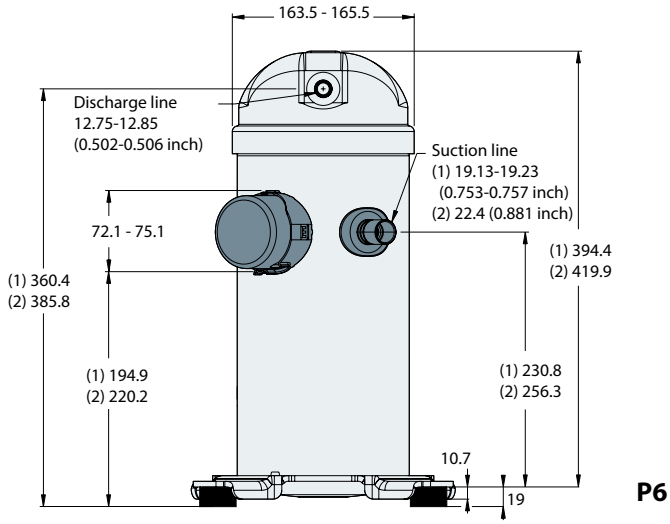
Evaporating temperature: 7.2 °C
Condensing temperature: 54.4 °C
Sub-cooling: 8.3 K

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

Dimensions

HRM032-034-038-040-042 / HRP034-038-040-042 / HRH029-031-032-034-036-038 / HRM-045-047 / HRP-045-047 / HRH039-040



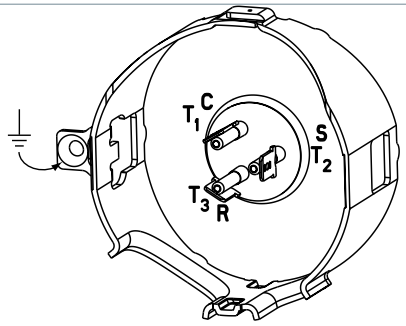


P6

(1) HRM032-034-038-040-042 / HRP034-038-040-042 / HRH029-031-032-034-036-038
(2) HRM-045-047 / HRP-045-047 / HRH039-040

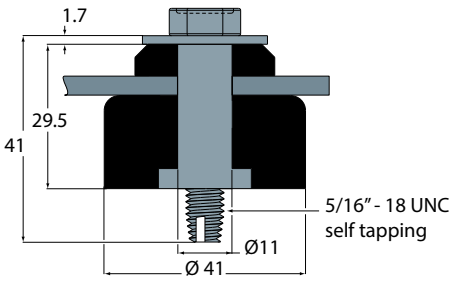
All dimensions in mm

Terminal box



Quick connect spade terminals
P terminal box type

Mounting grommet



Recommended torque for mounting bolts:
11 Nm (±1 Nm)

Refer to section 44 for overview of shipped mounting accessories

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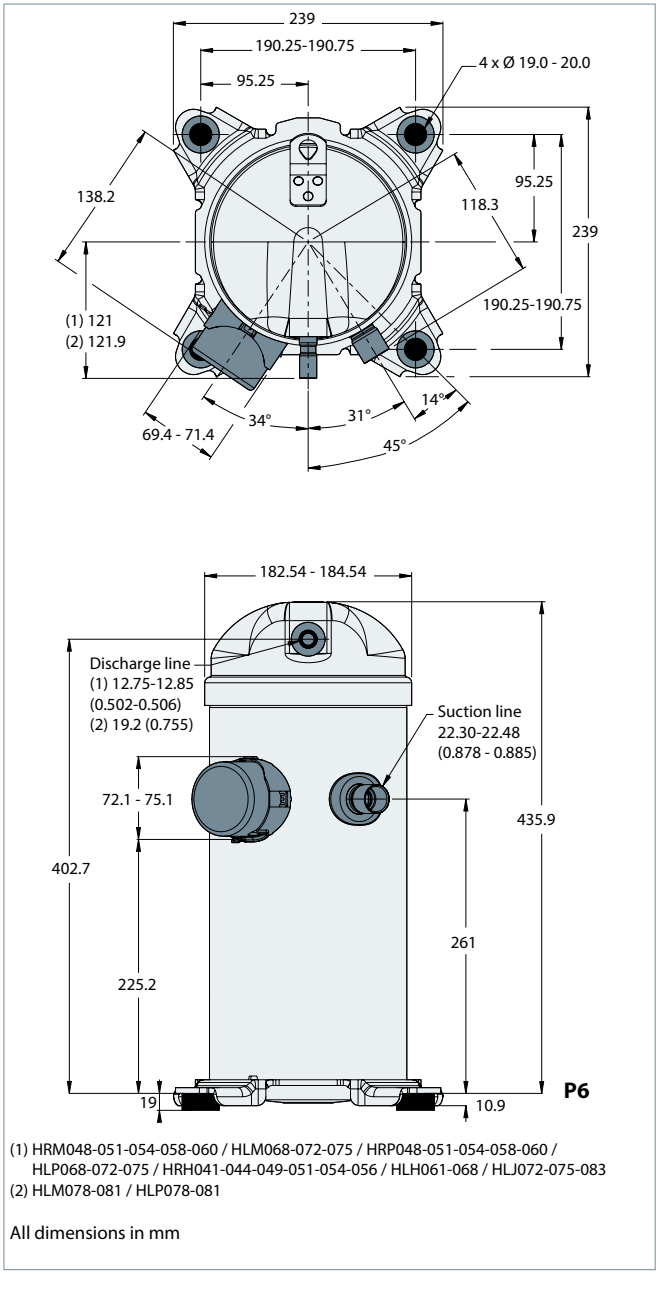
روبروی پالایشگاه نفت پارس، پلاک ۱۲

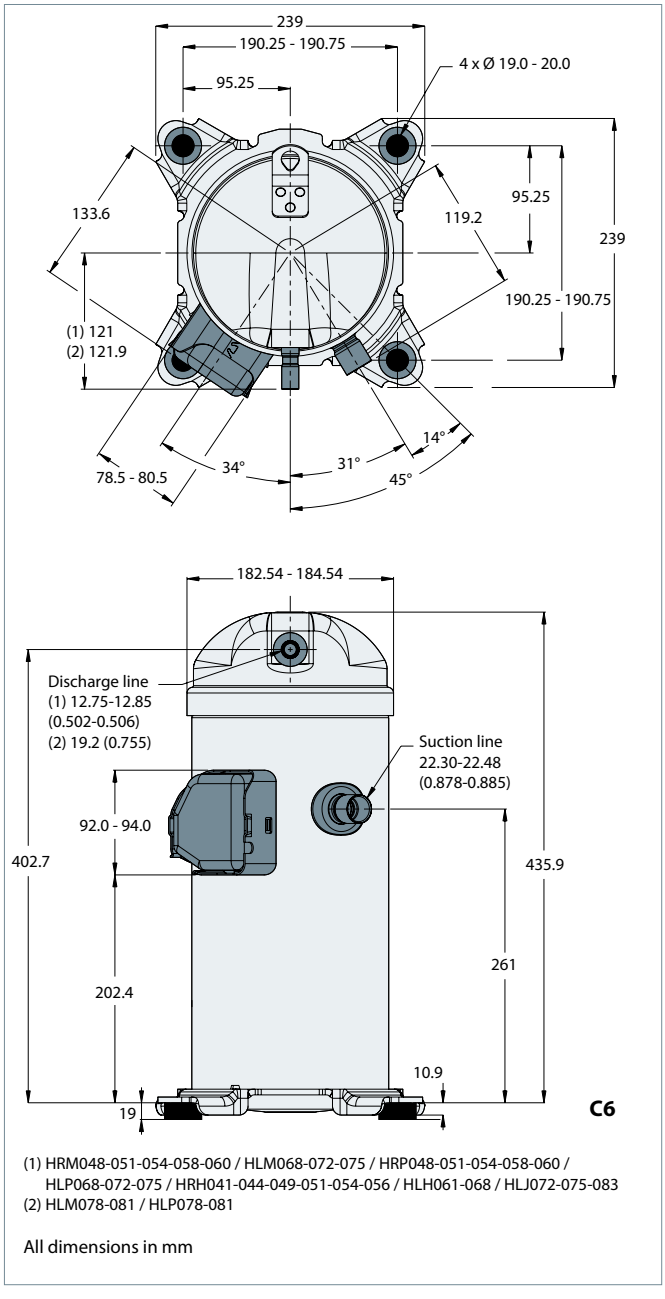
Dimensions

HRM048-051-054-058-060 / HLM068-072-075-078-081 / HRP048-051-054-058-060 / HLP068-072-075-078-081 / HRH041-044-049-051-054-056 / HLH061-068 / HLJ072-075-083



(1) HRM048-051-054-058-060 / HLM068-072-075 / HRP048-051-054-058-060 / HLP068-072-075 / HRH041-044-049-051-054-056 / HLH061-068 / HLJ072-075-083
(2) HLM078-081 / HLP078-081

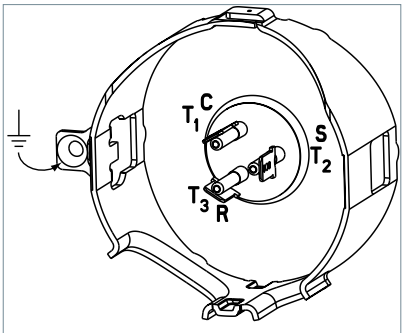
All dimensions in mm



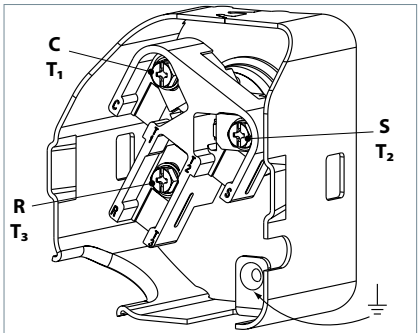
(1) HRM048-051-054-058-060 / HLM068-072-075 / HRP048-051-054-058-060 / HLP068-072-075 / HRH041-044-049-051-054-056 / HLH061-068 / HLJ072-075-083
(2) HLM078-081 / HLP078-081

All dimensions in mm

Terminal boxes

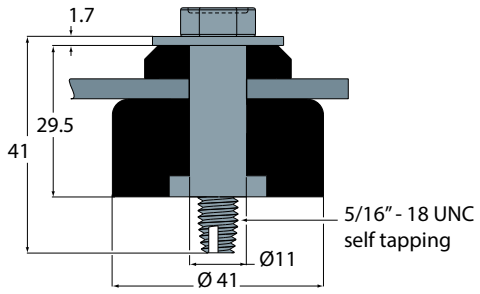


Quick connect spade terminals
P terminal box type



Ring connect screw terminals
C terminal box type

Mounting grommet

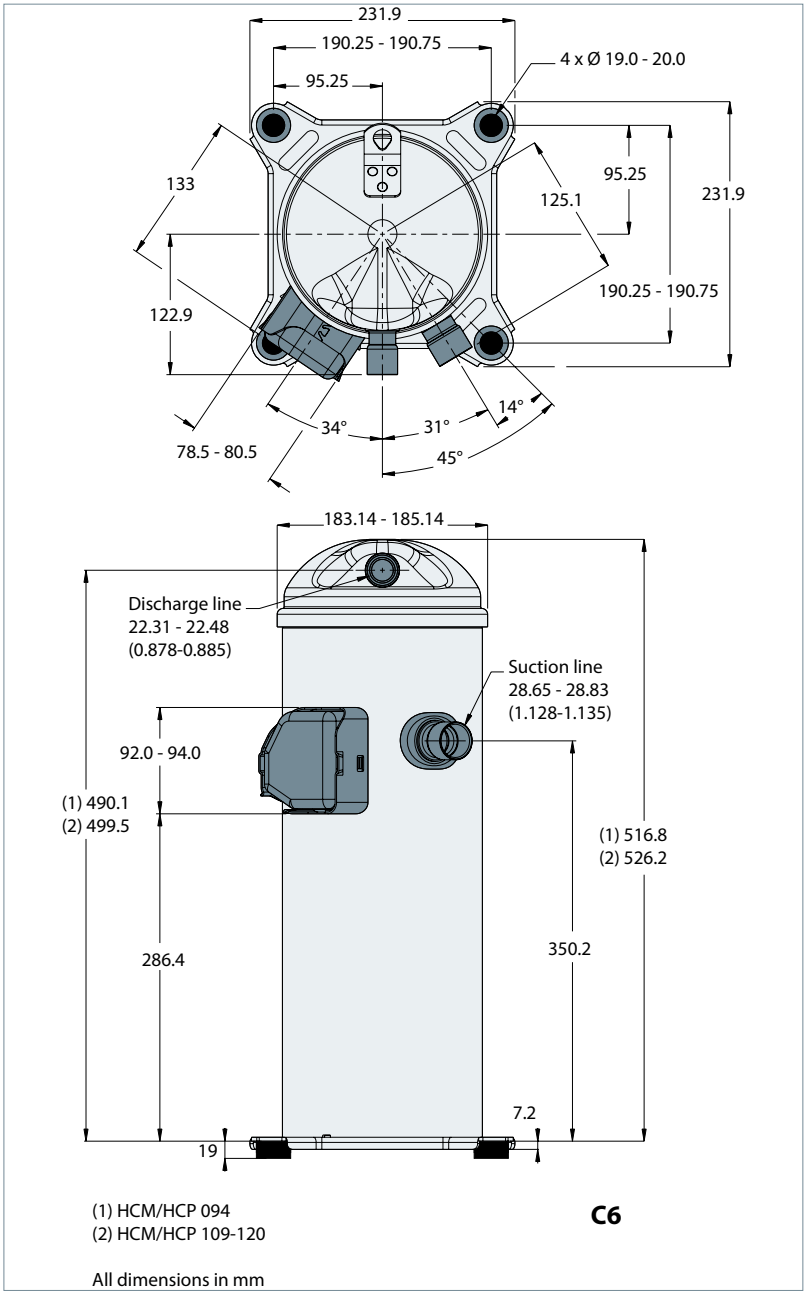


Recommended torque for mounting bolts:
11 Nm (±1 Nm)

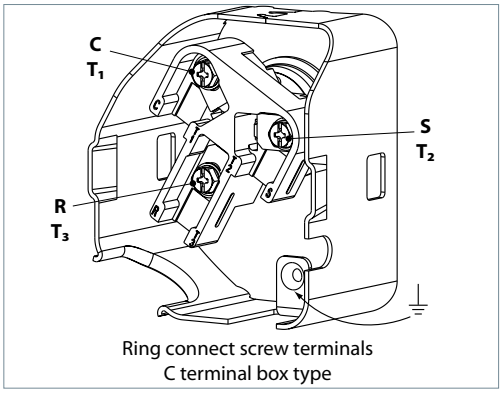
Refer to section 44 for overview of shipped mounting accessories

Dimensions

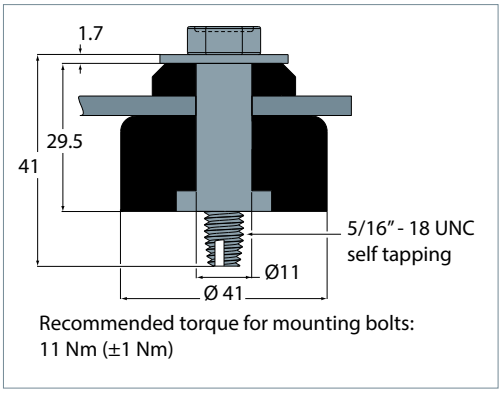
HCM/HCP 094-109-120



Terminal box



Mounting grommet



Refer to section 44 for overview of shipped mounting accessories

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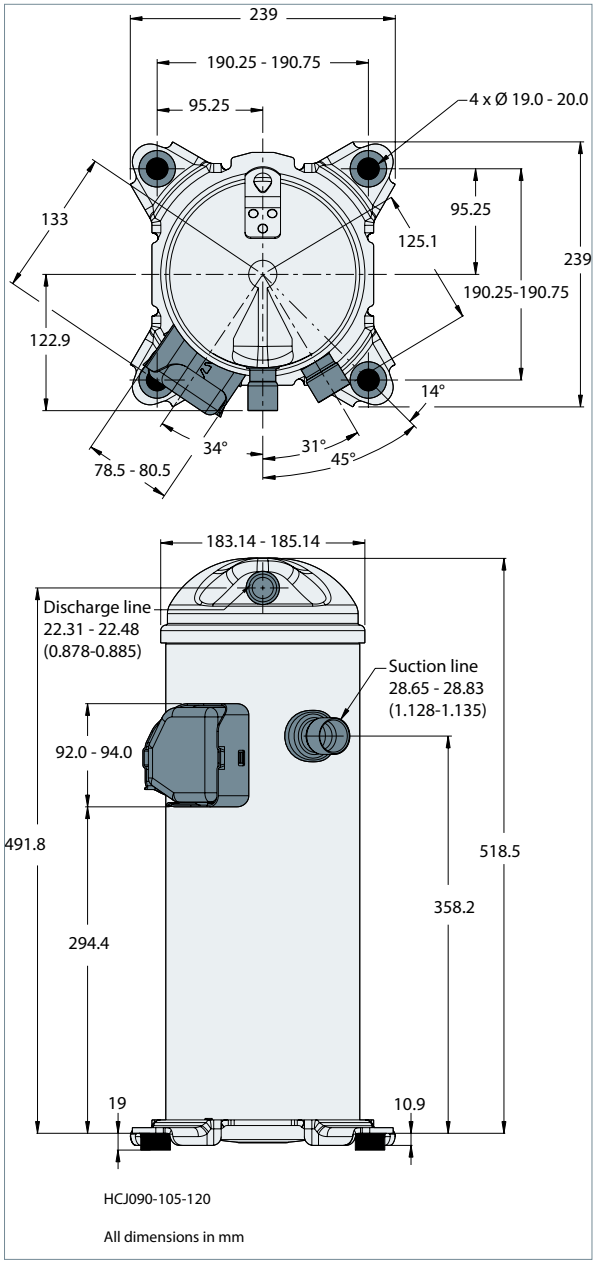
روبروی پالایشگاه نفت پارس، پلاک ۱۲

Dimensions

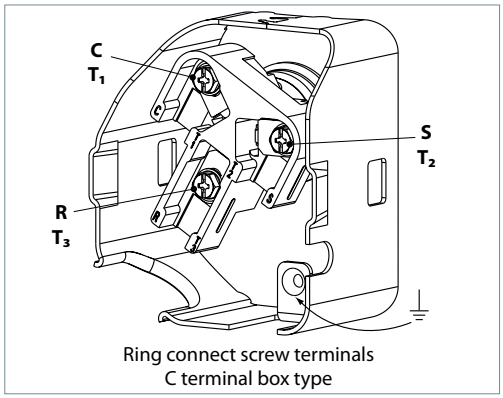
HCJ090-105-120



HCJ090-105-120

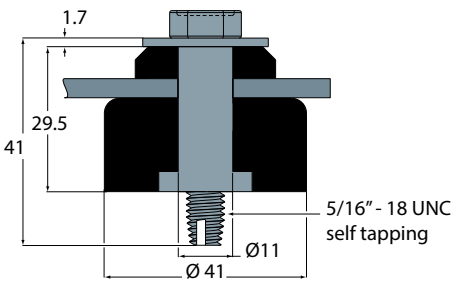
All dimensions in mm

Terminal box



Ring connect screw terminals
C terminal box type

Mounting grommet

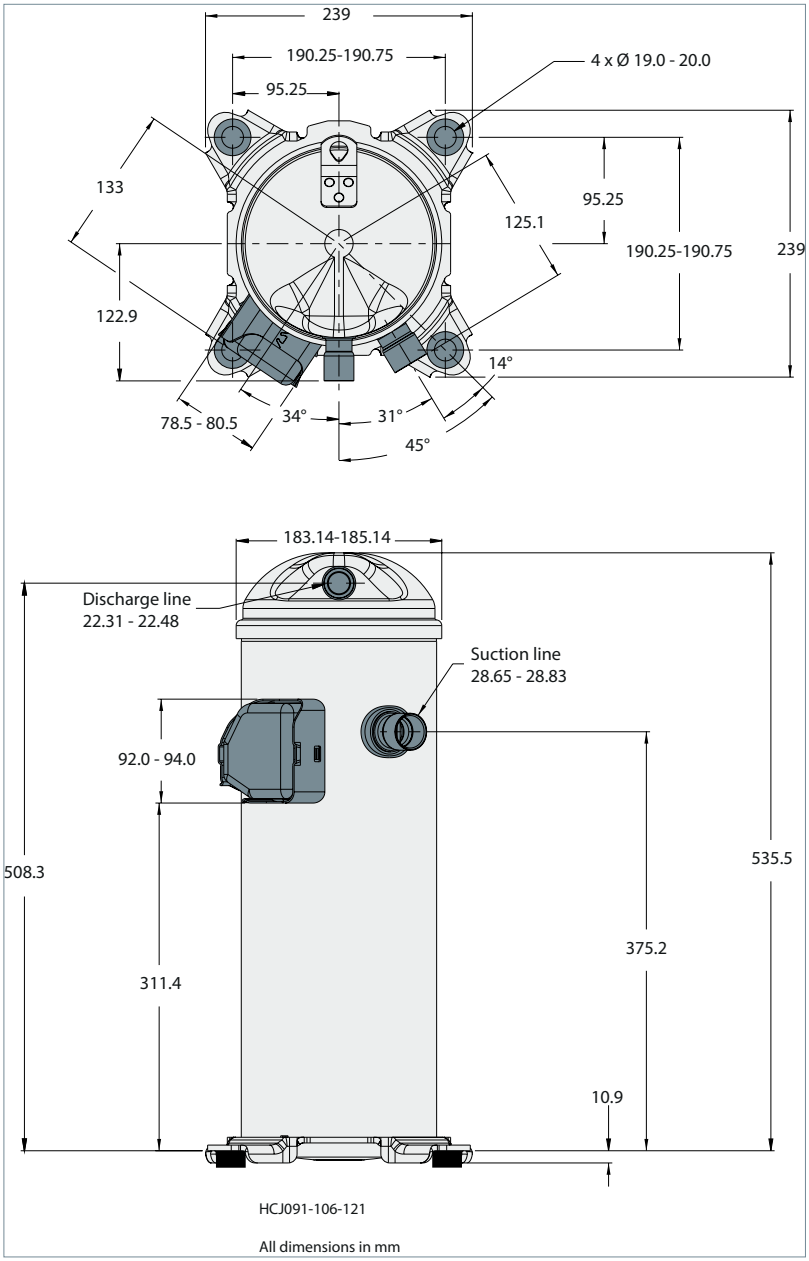


Recommended torque for mounting bolts:
11 Nm (±1 Nm)

Refer to section 44 for overview of shipped mounting accessories

Dimensions

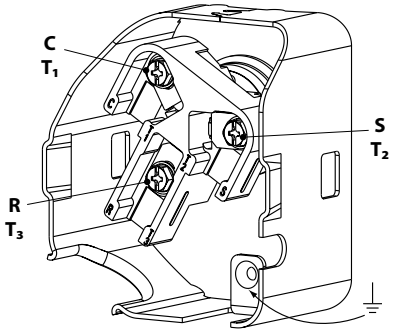
HCJ091-106-121



HCJ091-106-121

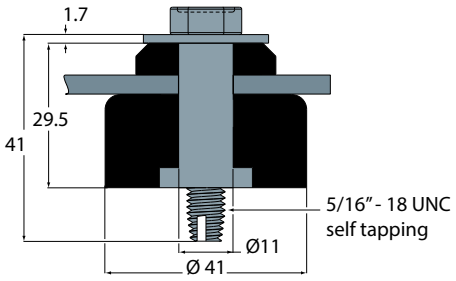
All dimensions in mm

Terminal box



Ring connect screw terminals
C terminal box type

Mounting grommet



Recommended torque for mounting bolts:
11 Nm (±1 Nm)

Refer to section 44 for overview of shipped mounting accessories

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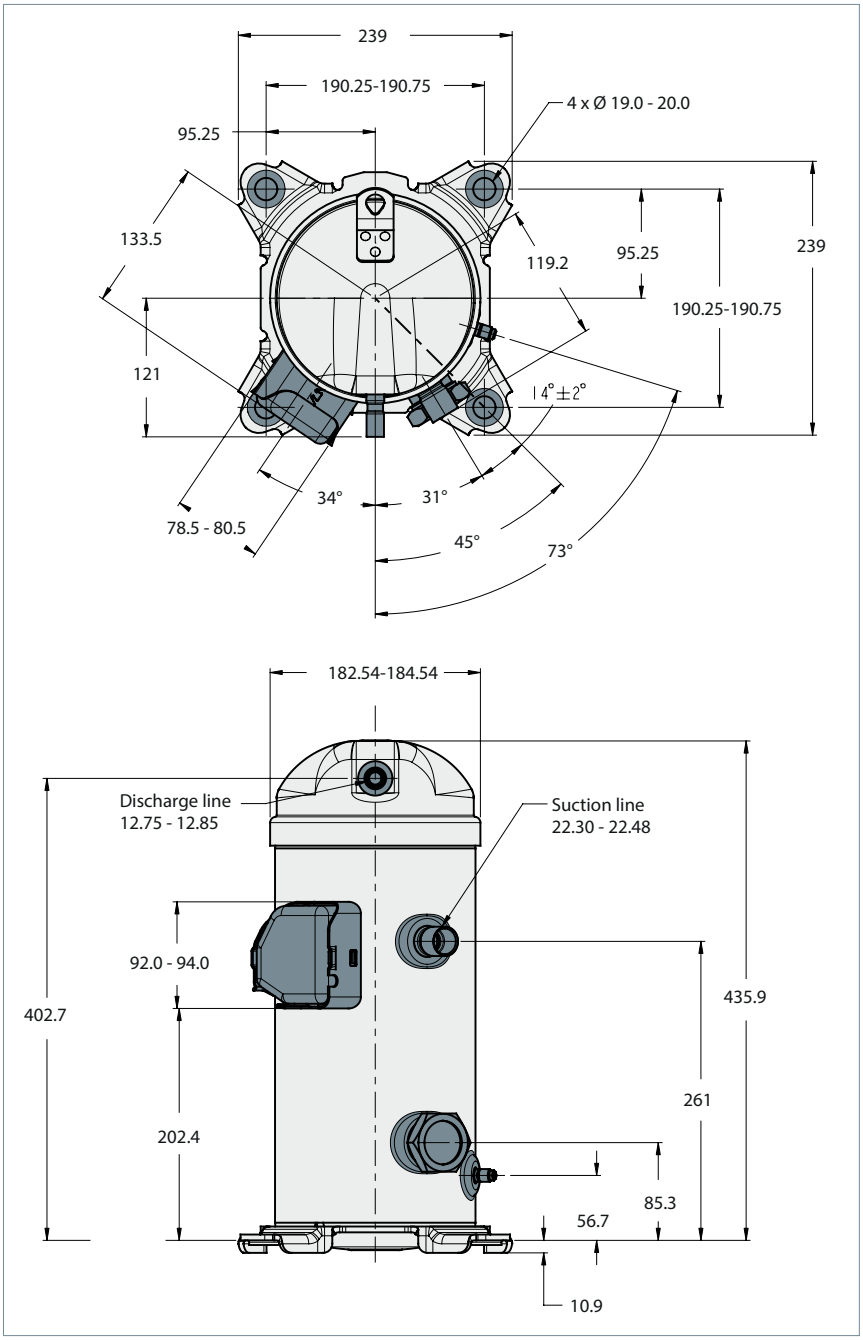
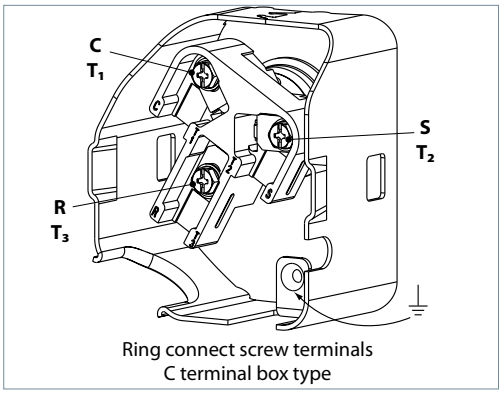
روبروی پالایشگاه نفت پارس، پلاک ۱۲

Dimensions

HLH061-HLJ072-HLJ083

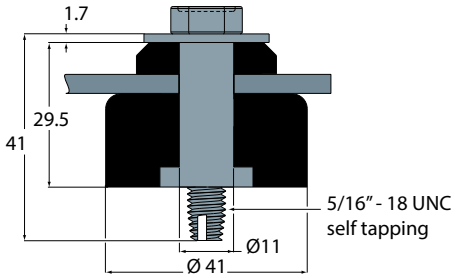


Terminal box



Ring connect screw terminals
C terminal box type

Mounting grommet

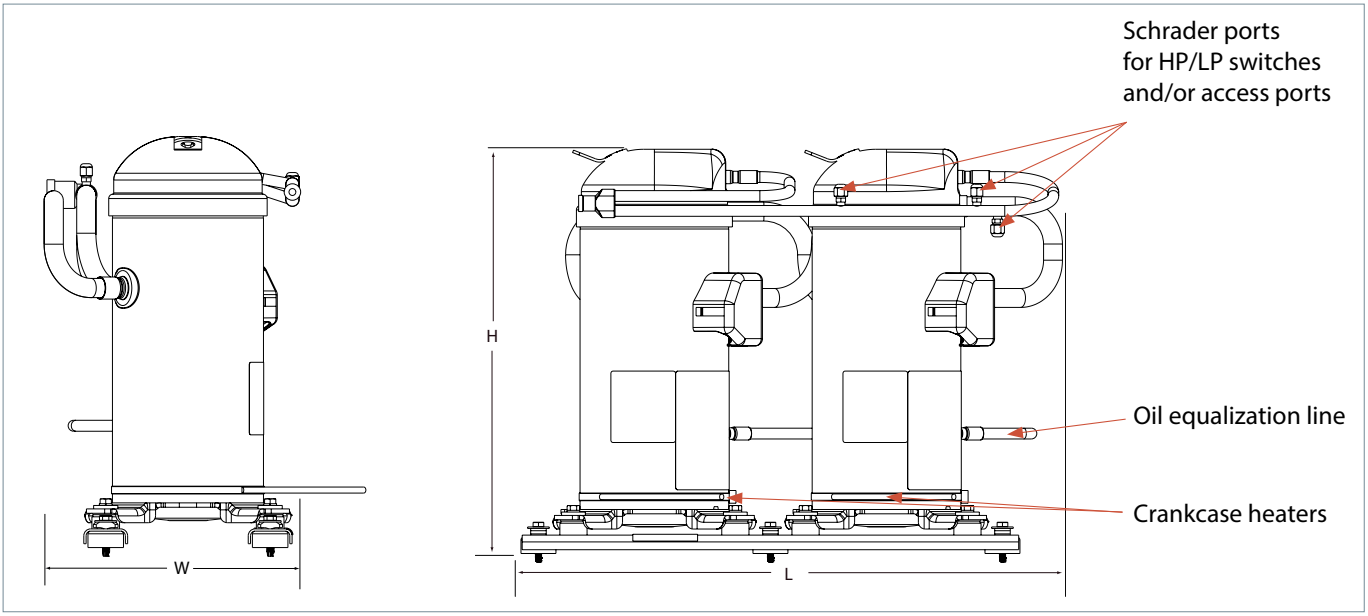


Recommended torque for mounting bolts:
11 Nm (±1 Nm)

Refer to section 44 for overview of shipped mounting accessories

Version T compressors are built with a threaded oil equalization port to be used with our variable speed compressors range VZH.

Dimensions



Tandems to be acheived by assembly of individual compressors, if they are the feature 8 compressor.

Tandem model	Composition	L (mm)	H(mm)	Wmm)	Outline drawing number
TLJ082	HRH041 + HRH041	636	476	297	8556080
TLJ098	HRH049 + HRH049	636	476	297	8556080
TLJ122	HLH061 + HLH061	636	476	297	8556080
TLJ136	HLH068 + HLH068	636	476	297	8556080
TLJ144	HLJ072 + HLJ072	636	476	297	8556080
TLJ166	HLJ083 + HLJ083	636	476	297	8556080
TCJ180	HCJ090 + HCJ090	676	558	312	8556081
TCJ181	HCJ091 + HCJ091	676	575	312	8556153
TCJ210	HCJ105 + HCJ105	676	558	312	8556081
TCJ211	HCJ106 + HCJ106	676	575	312	8556153
TCJ240	HCJ120 + HCJ120	676	558	312	8556081
TCJ241	HCJ121 + HCJ121	676	575	312	8556153

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روبروی پالایشگاه نفت پارس، پلاک ۱۲

Electrical data, connections and wiring

Motor voltage

Danfoss scroll compressors H Series are available in four different motor voltages as listed below.

Motor voltage code	Code 1	Code 2	Code 4	Code 5	Code 7	Code 9
Nominal voltage 50 Hz	-	200-220 V - 3 ph	380-415V - 3 ph	220-240 V -1 ph	500 V - 3 ph	-
Voltage range 50 Hz	-	180 - 242 V	342 - 457 V	198 - 264 V	450 - 550 V	-
Nominal voltage 60 Hz	208-230 V - 1ph	208-230 V - 3 ph	460 V - 3 ph	-	575 V - 3 ph	380 V - 3 ph
Voltage range 60 Hz	187 - 253 V	187 - 253 V*	414 - 506 V	-	517 - 632 V	342 - 418 V

The maximum allowable voltage imbalance is 2%. Voltage imbalance causes high amperage over one or several phases, which in turn leads to overheating and possible motor damage. Voltage imbalance is given by the formula:

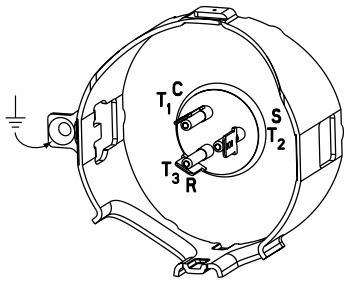
$$\% \text{ voltage unbalance: } \frac{|Vavg - V1\text{-}2| + |Vavg - V1\text{-}3| + |Vavg - V2\text{-}3|}{2 \times Vavg} \times 100$$

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

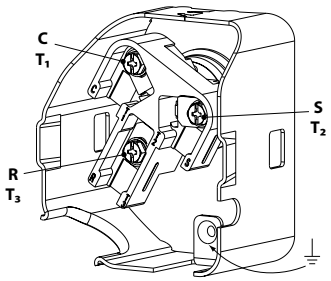
Wiring connections

Danfoss Scroll Compressors H-series will only compress gas while rotating counter-clockwise (when viewed from the compressor top). Since single-phase motors will start and run in only one direction, reverse rotation is not a major consideration. Three-phase motors, however, will start and run in either direction, depending on the phase angles of the supplied power. Care must be taken during installation to ensure that the compressor operates in the correct direction (see "Phase sequence and reverse rotation protection").

The drawings below show electrical terminal labelling and should be used as a reference when wiring the compressor. For three phase applications, the terminals are labelled T1, T2, and T3. For single-phase applications the terminals are labelled C (common), S (start), and R (run).



Quick connect spade terminals
P terminal box type



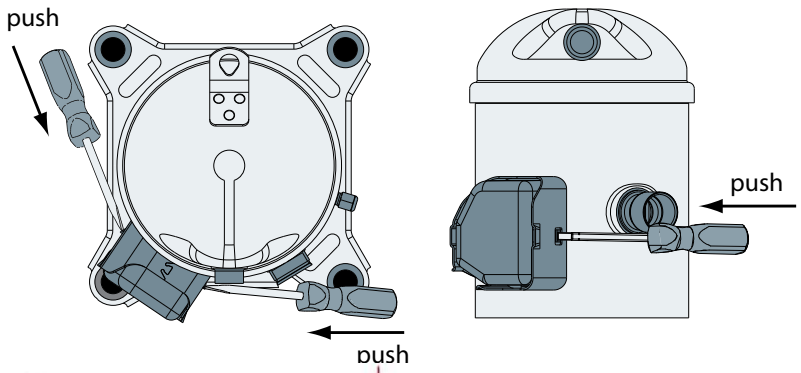
Ring connect screw terminals
C terminal box type

Terminal cover mounting

The terminal cover and gasket should be installed prior to operation of the compressor. The terminal cover has two outside tabs, 180 degrees apart, that engage the terminal fence.

When installing the cover, check that it is not pinching the lead wires. Both the inside of the terminal cover and the gasket have labels for the terminal pins: C (common), R (run), and S (start).

Terminal cover removal



Electrical data, connections and wiring

IP rating

The compressor terminal box IP rating according to CEI 529 is **IP22** for all models. IP ratings is only valid when correctly sized cable glands of the IP rating is applied.

- First numeral, level of protection against contact and foreign objects
  2 protection against object size over 12.5 mm (fingers of similar)

- Second numeral, level of protection against water
  2 protection against dripping water when tilted up to 15°

LRA (Locked Rotor Amp)

Locked Rotor Amp value is the higher average current as measured on mechanically blocked compressors tested under nominal voltage. The LRA value can be used as a rough estimation for the starting current. However, in most cases, the real starting current will be lower. A soft starter can be applied to reduce starting current.

MCC (Maximum Continuous Current)

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

Max. Operating Current

The max. operating current is the current when the compressors operate at maximum load conditions and 10% below nominal voltage (+15°C evaporating temperature and +68°C condensing temperature). Max Oper. A can be used to select cables and contactors. In normal operation, the compressor current consumption is always less than the Max Oper. A. value.

Winding resistance

Winding resistance is the resistance between indicated terminal pins at 25°C (resistance value +/- 7%).
Winding resistance is generally low and it requires adapted tools for precise measurement. Use a digital ohm-meter, a '4 wires' method and measure under stabilised ambient temperature. Winding resistance varies strongly with winding temperature ; If the compressor is stabilised at a different value than 25°C, the measured resistance must be corrected with following formula:

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

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

Motor protection

Danfoss Scroll Compressors H-Series are equipped with an internal line break protector mounted on the motor windings. The protector is an automatic reset device, containing a snap action bimetal switch.

Internal protectors respond to over-current and overheating. They are designed to interrupt motor current under a variety of fault conditions, such as failure to start, running overload, and fan failure.

If the internal overload protector trips out, it must cool down to about 60°C to reset. Depending on ambient temperature, this may take up to several hours.

Phase sequence and reverse rotation protection

The compressor will only operate properly in a single direction. Use a phase meter to establish the phase orders and connect line phases L1, L2 and L3 to terminals T1, T2 and T3, respectively. For three-phase compressors, the motor will run equally well in both directions. Reverse rotation results in excessive noise; no pressure differential between suction and discharge; and suction line warming rather than immediate cooling.

A service technician should be present at initial start-up to verify that supply power is properly phased and that compressor and auxiliaries are rotating in the correct direction.

For H series compressors, phase monitors are required. The selected phase monitor should lock out the compressor from operation in reverse.

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Electrical data, connections and wiring

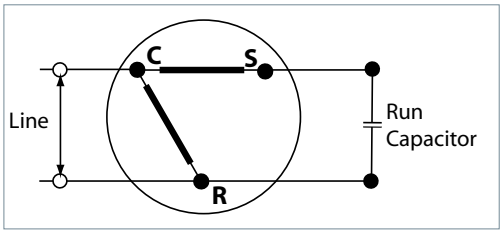
Electrical connections

Danfoss scroll compressors are designed to operate without any assistance if running within the defined nominal voltage. PSC wiring is sufficient (see below).

PSC wiring

The start winding (C-S) of the motor remains in circuit through a permanent (run) capacitor.

This permanent (run) capacitor is connected between the start winding (C-S) and the run winding (C-R).

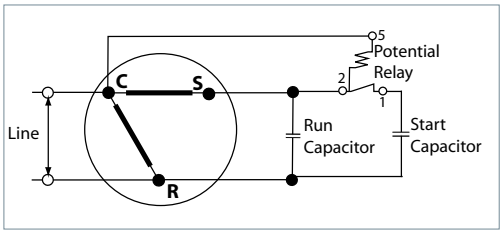


CSR wiring

If start assist is required, in case of operating below the nominal voltage, a CSR starting device is required.

During start-up, the start winding (C-S) is energised through an electromagnetic potential relay and a start capacitor.

A permanent (run) capacitor is wired between the start winding (C-S) and the run winding (C-R).



Nominal capacitor value and relays

		Models	PSC wiring Run capacitor	CSR wiring Start capacitor	Relay	
50 Hz, motor voltage code 5	R22	HRM025-032-034-038-040-042	70 µF	145-175 µF	3ARR3*3AL*	RVA 9CKL
		HRM045-047	60 µF	145-175 µF	3ARR3*3AL*	RVA 9CKL
		HRM051	50 µF	161-193 µF	3ARR3*24AP*	RVA 3EKL
		HRM054	55 µF	161-193 µF	3ARR3*24AP*	RVA 3EKL
		HRM058-060	55 µF	88-108 µF	3ARR3*25AS*	RVA 4GKL
		HLM068-072-075-081	55 µF	88-108 µF	3ARR3*25AS*	RVA 4GKL
	R407C	HRP025-034-038-040-042	70 µF	145-175 µF	3ARR3*3AL*	RVA 9CKL
		HRP045-047	60 µF	145-175 µF	3ARR3*3AL*	RVA 9CKL
		HRP051	50 µF	161-193 µF	3ARR3*24AP*	RVA 3EKL
		HRP054	55 µF	161-193 µF	3ARR3*24AP*	RVA 3EKL
		HRP058-060	55 µF	88-108 µF	3ARR3*25AS*	RVA 4GKL
		HLP068-072-075-081	55 µF	88-108 µF	3ARR3*25AS*	RVA 4GKL
	R410A	HRH029-031-032-034-036	70 µF	145-175 µF	3ARR3*3AL*	RVA 9CKL
		HRH038-040	60 µF	145-175 µF	3ARR3*3AL*	RVA 9CKL
		HRH051-054-056	55 µF	88-108 µF	3ARR3*25AS*	RVA 4GKL
		HLH068, HLJ072-083	55 µF	88-108 µF	3ARR3*25AS*	RVA 4GKL
60 Hz, motor voltage code 1	R22	HRM025-032-034	45 µF	145-175 µF	3ARR3*3M*	RVA 2ACKL
		HRM038	55 µF	88-108 µF	3ARR3*3L*	RVA 2ABKL
		HRM040-042-045-047	60 µF	88-108 µF	3ARR3*3L*	RVA 2ABKL
		HRM048	60 µF	161-193 µF	3ARR3*3L*	RVA 2ABKL
		HRM051-054	70 µF	161-193 µF	3ARR3*3L*	RVA 2ABKL
		HRM058T1-060T1	55 µF	88-108 µF	3ARR3*25S*	RVA A4IKL
		HRM058U1-060U1, HLM068-072-075-081	80 µF	189-227 µF	3ARR3*3L*	RVA 2ABKL
	R407C	HRP051	70 µF	161-193 µF	3ARR3*3L*	RVA 2ABKL
		HLP068-072-075-081	80 µF	189-227 µF	3ARR3*3L*	RVA 2ABKL
	R410A	HRH031	45 µF	145-175 µF	3ARR3*3M*	RVA 2ACKL
		HRH032-034	50 µF	88-108 µF	3ARR3*3L*	RVA 2ABKL
		HRH036	55 µF	88-108 µF	3ARR3*3AL*	RVA 9CKL
		HRH038-039-040	60 µF	88-108 µF	3ARR3*3L*	RVA 2ABKL
		HRH041-044-048-049-050-051	70 µF	161-193 µF	3ARR3*3L*	RVA 2ABKL
		HRH054-056, HLH068, HLJ072-083	80 µF	189-227 µF	3ARR3*3L*	RVA 2ABKL

Approvals and certifications

Approvals and certificates

Danfoss scroll H-series compressors comply with the following approvals and certificates.

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

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

Pressure equipment directive 97/23/EC

Products	All models
Refrigerating fluids	Group 2
Category PED	I
Evaluation module	no scope

Low voltage directive 2014/35/EU

Products	All models
Declaration of conformity ref. Low voltage Directive 2014/35/EU	Contact Danfoss

Machines directive 2006/42/EC

Products	All models
Manufacturer's declaration of incorporation ref. EC Machines Directives 98/392/CE	Contact Danfoss

Internal free volume

Products	Internal free volume at LP side without oil (litre)	Internal free volume at HP side without oil (litre)
HRM/P032-034-038-040-042 HRH029-031-032-034-036-038	2.93	0.49
HRM/P045-047 HRH040	3.20	0.70
HRM/P048-051-054-058-060, HLM/P068-072-075-081 HRH044-049-051-054-056, HLH/J061-068-072-075-083	3.44	0.71
HCM/P094-109-120 HCJ090-105-120	5.92	0.51
HCJ091-106-121	5.75	0.51

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General requirements

Proper piping practices should be employed to:

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

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

General recommendations are described in the figures below:

fig.1

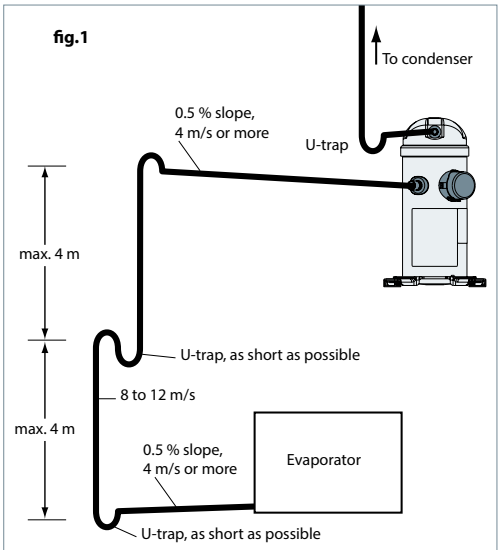
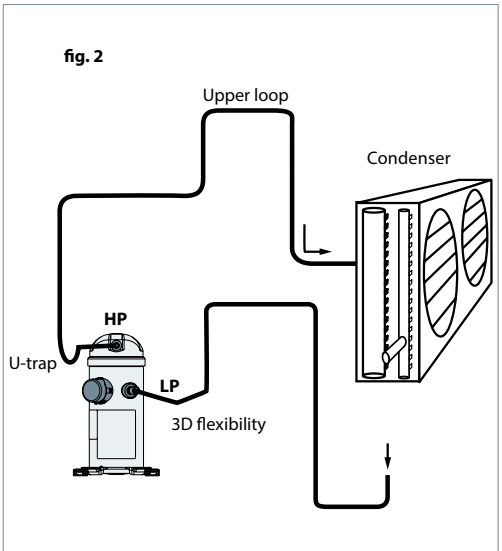


fig. 2

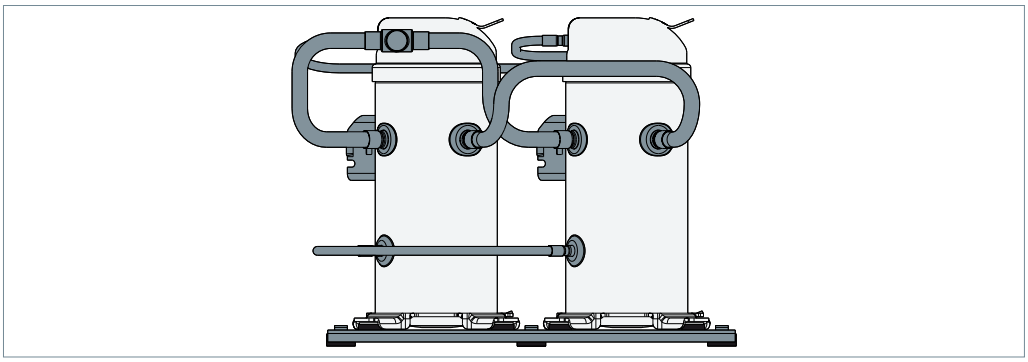


3. Piping should be designed with adequate three-dimensional flexibility to avoid excess vibration. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. For more information on noise and vibration, see section on: "MANAGE SOUND AND VIBRATION".

Tandem requirements

Danfoss scroll compressor H series tandem use static oil balancing principle to equalize oil level between the compressors by gravity. This is ensured by a precise suction and oil equalization piping designs.

The discharge line as no impact on oil balancing and is shown with tees, to indicate that both left and right side discharge header are possible



Danfoss scroll H series compressors in C8 version can be mounted in tandem assemblies.

Such manifolding applications require special design considerations that go beyond the scope of this document. Please contact Danfoss for further information.

For each tandem configuration, specific outline drawings are available as indicated in following tables.

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

Tandem model	Comp.1	Comp.2	Connection Sizes		Oil equalization (in)	Gas equalization (in)	Kit tandem Code No	Outline drawing number
			Suction (in)	Discharge (in)				
TLJ082	HRH041	HRH041	1-1/8"	3/4"	1/2"	7/8"	120Z0636	8556080
TLJ098	HRH049	HRH049	1-1/8"	3/4"	1/2"	7/8"	120Z0636	8556080
TLJ122	HLH061	HLH061	1-1/8"	3/4"	1/2"	7/8"	120Z0636	8556080
TLJ136	HLH068	HLH068	1-1/8"	3/4"	1/2"	7/8"	120Z0636	8556080
TLJ144	HLJ072	HLJ072	1-1/8"	3/4"	1/2"	7/8"	120Z0636	8556080
TLJ166	HLJ083	HLJ083	1-1/8"	3/4"	1/2"	7/8"	120Z0636	8556080
TCJ180	HCJ090	HCJ090	1-5/8"	1-1/8"	1/2"	1-1/8"	120Z0636	8556081
TCJ181	HCJ091	HCJ091	1-5/8"	1-1/8"	1/2"	1-1/8"	120Z0636	8556153
TCJ210	HCJ105	HCJ105	1-5/8"	1-1/8"	1/2"	1-1/8"	120Z0636	8556081
TCJ211	HCJ106	HCJ106	1-5/8"	1-1/8"	1/2"	1-1/8"	120Z0636	8556153
TCJ240	HCJ120	HCJ120	1-5/8"	1-1/8"	1/2"	1-1/8"	120Z0636	8556081
TCJ241	HCJ121	HCJ121	1-5/8"	1-1/8"	1/2"	1-1/8"	120Z0636	8556153

R Depending on manifold configuration, it is essential to equalize the pressure of compressor sumps.

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Design compressor mounting

General requirements

Compressors used in single applications must be mounted with flexible grommets.

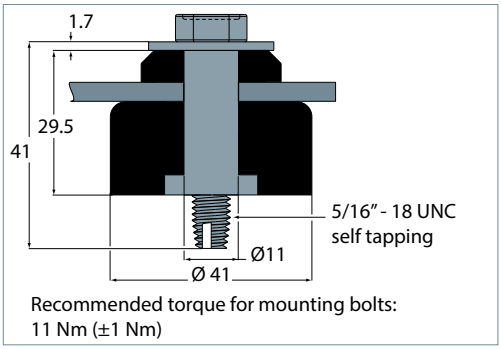
Compressors used in parallel application must be mounted with rigid mounting spacers onto rails and the manifold assembly must be mounted with flexible grommets onto frame.

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

Single requirements

H-series compressors come delivered with flexible grommets, accessory Mounting kit 120Z5064.

The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The required bolt size for the H-series compressors is M8*40mm. This bolt must be tightened to a torque of 11 Nm.



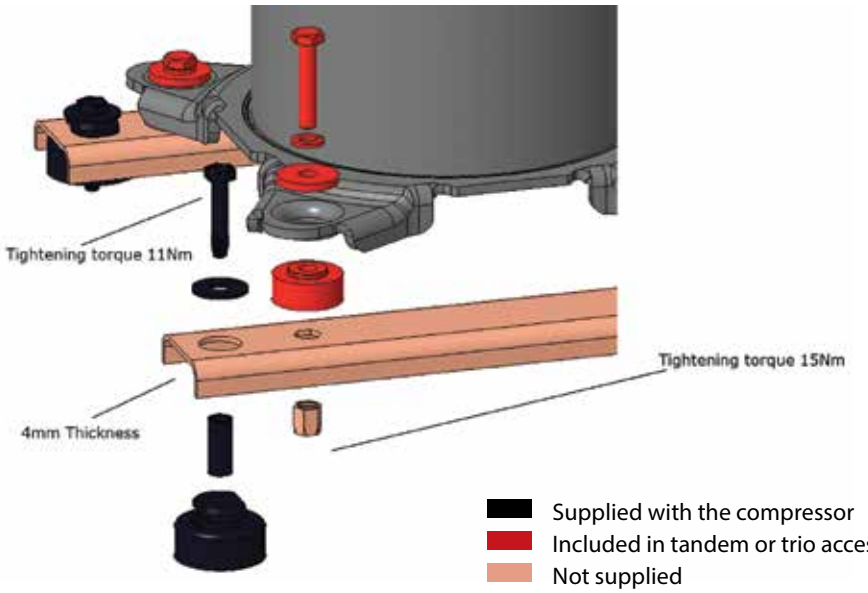
Recommended torque for mounting bolts:
11 Nm (±1 Nm)

Tandem requirements

Parallel mounting feet

For parallel mounting, the compressor must be mounted with rigid mounting spacers (included in the tandem kit 120Z0636) on the rails.

Rubber grommets and sleeves (delivered with the compressor) must be installed below the rails.



Supplied with the compressor
Included in tandem or trio accessory kit
Not supplied

Manage sound and vibration

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

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

Compressor sound radiation

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

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

Compressor model	50 Hz		60 Hz		Acoustic hood code number
	Sound power dB(A)	Attenuation dBA ①	Sound power dB(A)	Attenuation dBA ①	
HRM025-038	66	5	69	5	120Z5043
HRM040-047	67	5	70	5	120Z5043
HRM048-054	68	5	71	5	120Z5044
HRM058-060	69	5	72	5	120Z5044
HLM068-081	70	5	73	5	120Z5044
HCM094	71	5	74	5	120Z5045
HCM109-120	74	5	78	5	120Z5045
HRH029-032	65	5	68	5	120Z5043
HRH034-040	66	5	69	5	120Z5043
HRH041-054	67	5	70	5	120Z5044
HLH061	70	5	73	5	120Z5044
HLH068-HLJ083	71	5	74	5	120Z5044
HCJ090-105-120	72	5	75	5	120Z5045
HCJ091-106-121	73	5	76	5	120Z5045

① Attenuation given with acoustic hood only
Materials are UL approved and RoHS compliant
Sound power and attenuation are given at ARI conditions, measured in free space
H*P series same as H*M series

Note: During compressor shut down, a short reverse rotation sound is generated. The duration of this sound depends on the pressure difference at shut down and should be less than 3 seconds. This phenomenon has no impact on compressor reliability.

Mitigations methods:
We can consider two means to reduce compressors sound radiations:

1. Acoustic hoods are quick and easy to install and do not increase the overall size of the compressors to a great extent. Acoustic hoods are available from Danfoss as accessories. Refer to the table above for sound levels, attenuation and code numbers.
2. Use of sound-insulation materials on the inside of unit panels is also an effective means to reduce radiation.

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Sound and vibration management

Mechanical vibrations

Vibration isolation constitutes the primary method for controlling structural vibration. H-series scroll compressors are designed to produce minimal vibration during operations. The use of rubber isolators on the compressor base plate or on the frame of a manifolded unit is very effective in reducing vibration being transmitted from the compressor(s) to the unit. Rubber grommets are supplied with all H-series scroll 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. The tubing should be designed so as to both reduce the transmission of vibrations to other structures and withstand vibration without incurring any damage. Tubing should also be designed for three-dimensional flexibility. For more information on piping design, please see the section entitled “Essential piping design considerations”.

Gas pulsation

The Danfoss Scroll Compressors H-series has been designed and tested to ensure that gas pulsation has been optimised for the most commonly encountered air conditioning pressure ratio. Manifolded compressors are equivalents to lagged sources of gas pulsation. Therefore pulse level can vary during time.

Mitigations methods:
If an unacceptable level is identified, a discharge muffler with the appropriate resonant volume and mass can be installed.

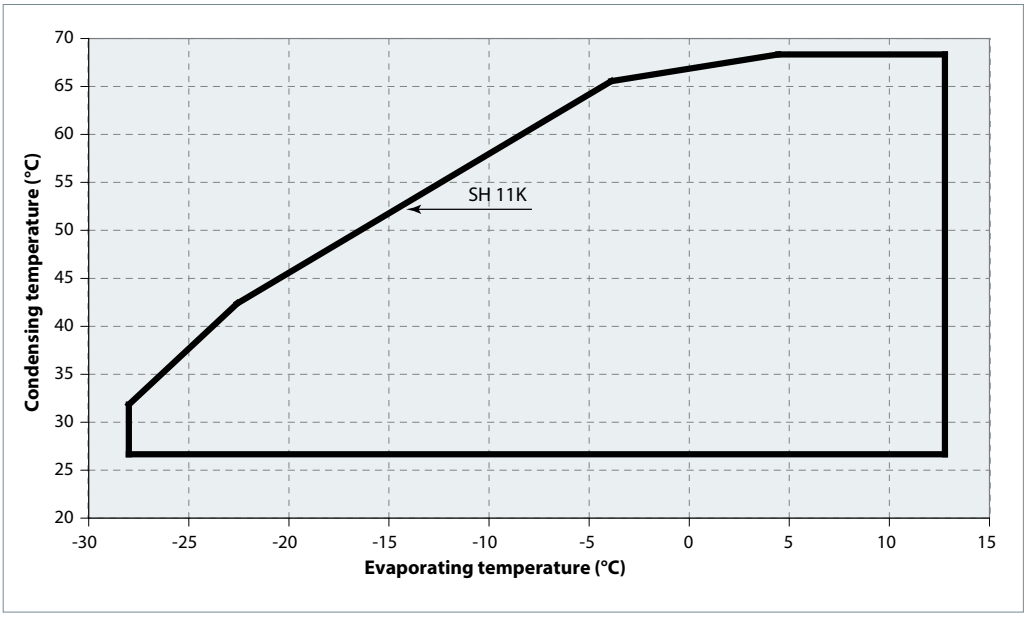
Manage operating envelope

Requirement

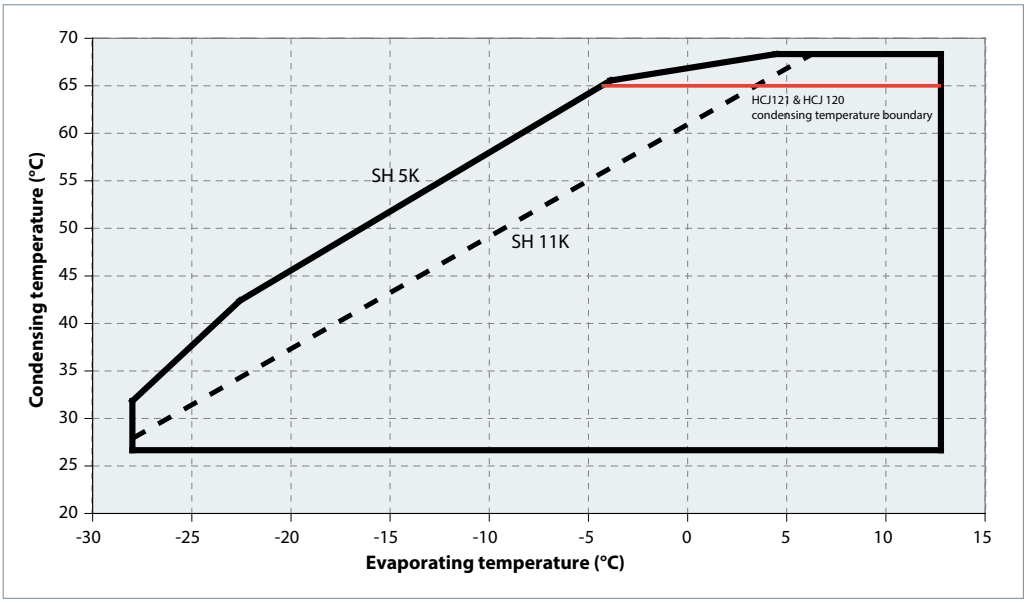
R The operating envelope for H-series scroll compressors is given in the figures below and guarantees reliable operations of the compressor for steady-state and transient operation.

Steady-state operation envelope is valid for a suction superheat within 5K to 30K range.

R22, R407C
Model variation T



R410A
Model variation T



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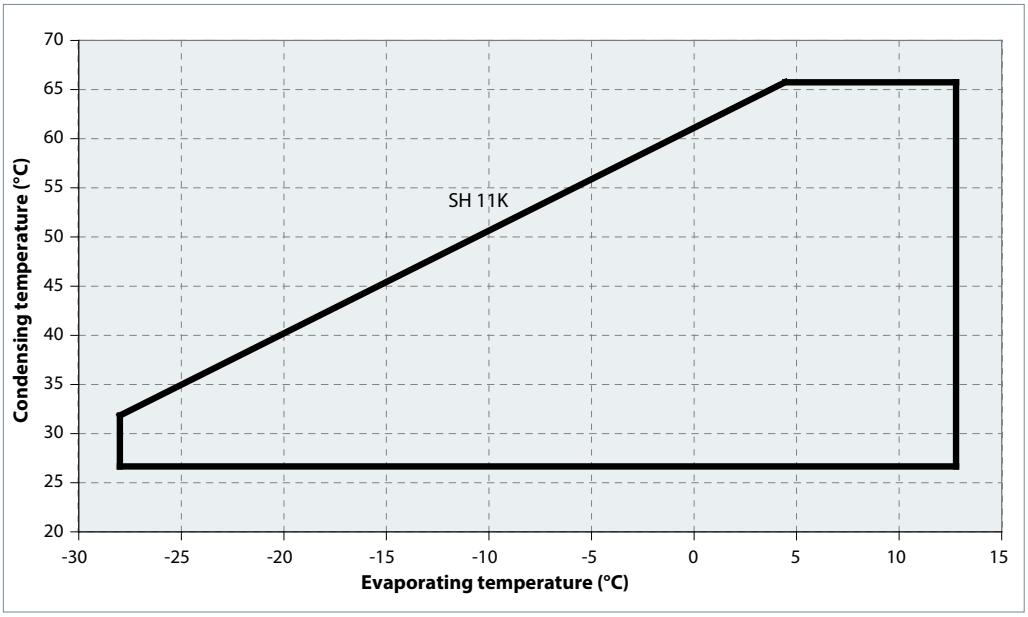
Manage operating envelope

R22, R410A
Model variation U



		R22	R407C	R410A
Working pressure range high side	bar (g)	10.9 - 27.7	10.5 - 29.1	15.8 - 44.5
Working pressure range low side	bar (g)	1.4 - 6.9	1.1 - 6.4	1.9 - 10.8
Maximum high pressure safety switch setting*	bar (g)	29	30	45
Minimum low pressure safety switch setting	bar (g)	0.5	0.5	1.5
Minimum low pressure pump-down switch setting**	bar (g)	1.5	1.3	2.3

* Maximum allowable pressure on high pressure side according to PED regulation.
** Recommended pump-down switch settings: 1.5 bar (R22,R407C) and 2.5 bar (R410a) below nominal evap.

R LP and HP safety switches must never be bypassed nor delayed and must stop all the compressors.

When caused low by LP safety switch, limit the number of auto-restart to maximum 5 times within 12 hours.

HP safety switch must be manual reset

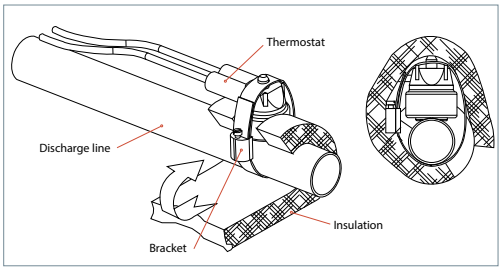
Depending on application operating envelope, you must define HP and LP limits within operating envelope and pressure setting table above.

For H-series compressors, the external Discharge Gas Temperature protection (DGT) is required if the high and low pressure switch settings do not protect the compressor against operations beyond its specific application envelope.

The discharge gas thermostat accessory kit (code 7750009) includes all components required for installation as shown on the right. DGT installation must respect below requirements:

• The thermostat must be attached to the discharge line within 150 mm from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe.

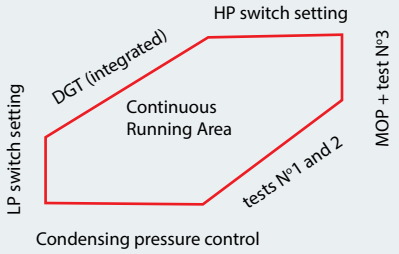
• The DGT should be set to open at a discharge gas temperature of 135°C.



Manage operating envelope

Evaluate the risk

We consider two types of operating envelope management:

Basic:	Advanced:
• HP and LP switch • MOP (Max Operating Pressure) ensured by expansion device • Condensing pressure control • (DGT Integrated)	• HP and LP sensor • Operating envelope limits (permanent and transient) integrated into control logic • (DGT Integrated)
See "Test, criteria and solutions" 	No additional test are required

Test, criteria and solutions

Test N°	Purpose	Test condition	Pass criteria	Solutions
1	Check the compressor operation in the "continuous running area".	Start test at minimum foreseeable evaporating temperature (minimum ambient temerature)	Confirmed compressor stable working in the continuous running area.	Work on compressor staging, fan staging, water flow etc.
2		Perform a defrost test if reversible unit		
3		Perform a start-up test at maximum foreseeable evaporating temperature (max ambient temperature, or start up with hot water)		Improve MOP function. Work on compressor staging,fan staging, water flow etc.

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Manage superheat

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

Liquid flood back can cause oil dilution and, in extreme situations lead to liquid slugging that can damage compression parts.

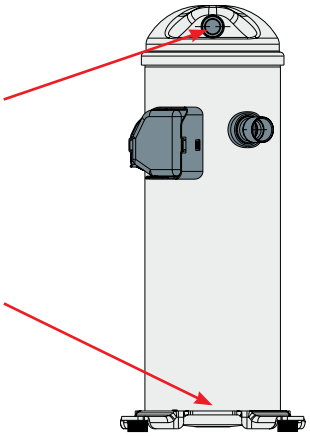
Requirement

In steady state conditions,
- Suction superheat must remain within 5K to 30K
- Discharge superheat must be higher than 15K
- Oil superheat must be higher than 10K

In transient conditions,
- Discharge superheat must be higher than 5K
- Oil superheat must be higher than 10K

Discharge temperature sensor must be placed onto the discharge fitting and be insulated.

Oil temperature sensor must be placed on the mid shell, closed to the lower shell, and be insulated.



Evaluate the risk

Use the tables below in relation with the system charge and the application to quickly evaluate the risk and potential tests to perform.

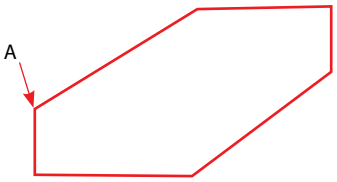
	BELOW CHARGE LIMIT	ABOVE CHARGE LIMIT
Non reversible	No test or additional safeties required	Liquid flood back test
Reversible	Defrost test	Liquid flood back test Defrost test

Charge limit is defined in table below:

	Models	Refrigerant charge limit (kg)
Single	HRM032-034-038-040-042-045-047 HRP034-038-040-042-045-047 HRH029-031-032-034-036-038-039-040-047-048	3.6
	HRM048-051-054-058-060/HLM068-072-075-078-081 HRP048-051-054-058-060/HLP068-072-075-078-081 HRH041-044-049-051-054-056/ HLH061-068-HLJ072-075-083	5.4
	HCM094-109-120 HCP094-109-120 HCJ090 - 091-105-106-120 -121	7.2

Manage superheat

Test, criteria and solutions

Test N°	Purpose	Test condition	Pass criteria	Solutions
Liquid flood back test	Steady-state	Liquid flood back testing must be carried out under expansion valve threshold operating conditions: a high pressure ratio and minimum evaporator load (A). 	Oil superheat>10K Steady-state discharge superheat>15K	1. Check expansion valve selection and setting. 2. Add a suction accumulator*.
	Transient	Tests must be carried out with most unfavorable conditions : • fan staging, • compressor staging • …	Oil superheat>10K Transient discharge superheat >5K	1. Check expansion valve selection and setting. -For Thermostatic expansion valve (TXV) check bulb position... -For Electronic expansion valve (EXV) check measurement chain and PID.... 2. Add a suction accumulator*.
Defrost test	Check liquid floodback during defrost cycle	Defrost test must be carried out in the most unfavorable condition (at 0°C evaporating temperature).	Oil superheat>10K Transient discharge superheat >5K	In reversible systems, the defrost logic can be worked out to limit liquid floodback effect. (for more details see “Control Logic”).

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

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Manage off cycle migration

R Off -cycle refrigerant migration happens:
• when the compressor is located at the coldest part of the installation, refrigerant vapor condenses in the compressor.
• or directly in liquid-phase by gravity.

When the compressor starts running again, the refrigerant diluted in the oil generates poor lubrication conditions. In extreme situations, this leads to liquid slugging that can damage compression parts.

Requirement

Amount of liquid refrigerant in the compressors must not overpass the charge limit (refer to charge limit table in section "Manage superheat").

Evaluate the risk

Use the table below in relation with the system charge (refer to charge limit table in section "Manage superheat") and the application to quickly define necessary safeties to implement and test to perform:

	BELOW CHARGE LIMIT	ABOVE CHARGE LIMIT
Non split	No test or additional safeties required (Internal Non-Return Valve integrated)	• Crank Case Heater* • Migration test • External Non Return Valve
Split	Since each installation is unique, no test can fully evaluate off-cycle migration, therefore the following safeties are required: • Crank Case Heater * • Liquid Line Solenoid Valve**+ pump-down cycle*** • (Internal Non-Return Valve integrated)	

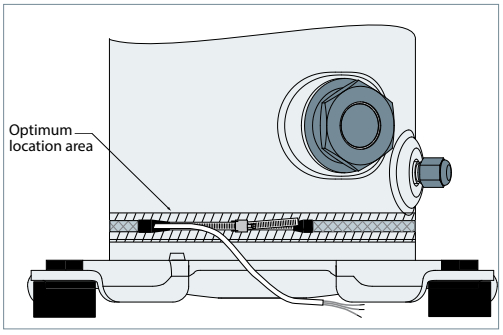
Manage off cycle migration

Test, criteria and solutions

Test N°	Purpose	Test condition	Pass criteria	Solutions
Migration test	Check that there is no migration of refrigerant into the compressor (either liquid or vapour condensating)	Energize CCH*. Stabilize the non-running system at a pressure equivalent to 5°C . Raise the system pressure equivalent to 20°C. When saturated condensing temperature reaches 20°C then start the unit.	When all compressors are idle: • Check in liquid line sight glass that there is no liquid refrigerant transfer • Oil superheat must be >10K during off-cycle After compressors has started: • Oil superheat must remain >10K	1. Check bulb position, tightness of expansion device, 2. add LLSV** 3. add pump down cycle*** 4. Check Crank Case Heater efficiency

Oil temperature sensor must be placed between oil sight glass and compressor baseplate and be insulated.

* Crank case heater (CCH)
The Crank case heaters are designed to protect the compressor against off-cycle migration of refrigerant.
Additional heater power or thermal insulation might be needed in case of ambient temperature below -5°C and a wind speed above 5m/second.
The heater must be energized whenever all the compressors are off.
Crank case heater accessories are available from Danfoss (see section "Accessories").



Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (e.g. seasonal shutdown).

It's recommended that the heater be turned on for a minimum of 12 hours prior to starting the compressor.

**Liquid line solenoid valve (LLSV)
A LLSV is used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer to the compressor during off -cycles. The quantity of refrigerant on the low-pressure side of the system can be further reduced by using a pump-down cycle in association with the LLSV.

***Pump-down cycle
By decreasing pressure in the sump, pump down:
• evacuates refrigerant from oil
• set the sump saturating pressure much lower than ambiance temperature and due to that, avoid refrigerant condensation in the compressor.

For more details on pump-down cycle see section "Control Logic".

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Provide power supply and electrical protection

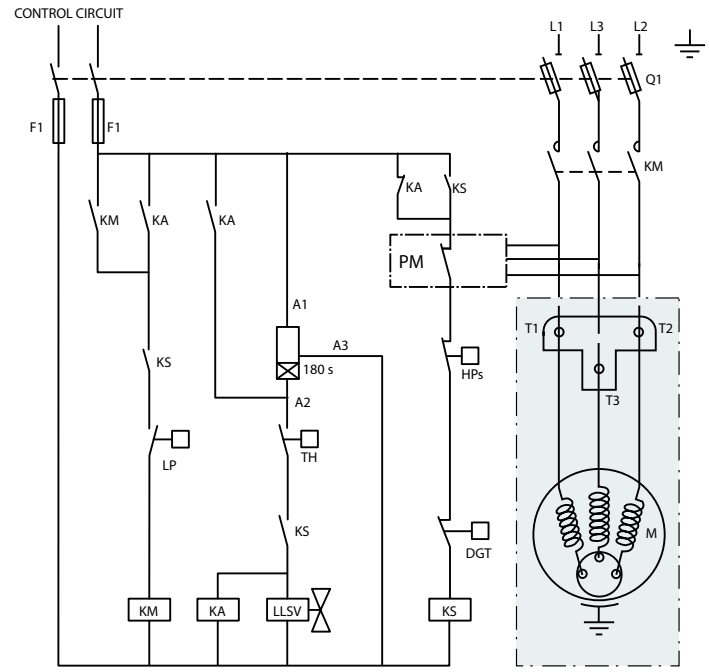
Wiring information

Requirements:

- An additional external overload protection is still advisable for either alarm or manual reset. For overload setting, take the max current you can face on the application and add 10%. Setting must always be lower than Max Operating Current (see table "Three phase electrical characteristics" from the section "Electrical data, connections and wiring")
- HP safety switch and DGT must be wired in the safety chain. Other safety devices such as LP can be either hardware or software managed.
- Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (e.g. seasonal shutdown).

The wiring diagrams below are examples for a safe and reliable compressor wiring:

Control device..... TH
Optional short cycle timer (3 min) ..... 180 s
Control relay ..... KA
Liquid Line Solenoid valve..... LLSV
Compressor contactor..... KM
Phase monitor..... PM
Safety lock out relay..... KS
Pump-down control low pressure switch .. LP
High pressure safety switch..... HPs
Fused disconnect Q1
Fuses F1
Compressor motor ..... M
Discharge gas thermostat..... DGT



Wiring diagram with pump-down cycle

Note:
For H-series compressor, phase monitors are mandatory. The selected phase monitor should lock out the compressor from operation in reverse.

Safety control logic requirements

	Tripping conditions		Re-start conditions	
	Value	Time	Value	Time
HP switch	See Pressure settings table from section "Manage operating envelope"	Immediate, no delay. No by- pass	Conditions back to normal. Switch closed again	Manual reset
LP safety switch				Maximum 5 auto reset during a period of 12 hours, then manual reset.
Electronic module (Motor protection, DGT)	Contact M1-M2 opened			

Cycle rate limit requirements

Danfoss requires a minimum compressor running time of 2 minutes to ensure proper oil return and sufficient motor cooling.
Additionally, compressor service life is based on a maximum of 12 starts per hour.

Therefore, to guarantee these 2 requirements, a three-minute (180- sec) time out is recommended.

Oil management logic recommendations

In some cases, oil management can be enhanced by control logic:

If oil return test failed, a function can be integrated in control to run all compressors simultaneously during one minute every hour in order to boost oil return. Time and delay can be fine-tuned by oil return test N°1 §Manage oil in the circuit. During oil boost, pay special attention to superheat management to avoid liquid flood back and foaming.

If after running long time in full load, oil unbalance appears, then a function can be in control to stop all compressors in manifold during one minute every two hours in order to balance oil between compressors. Time and delay can be fine-tuned by Oil balancing test N°2 § Manage oil in the circuit.

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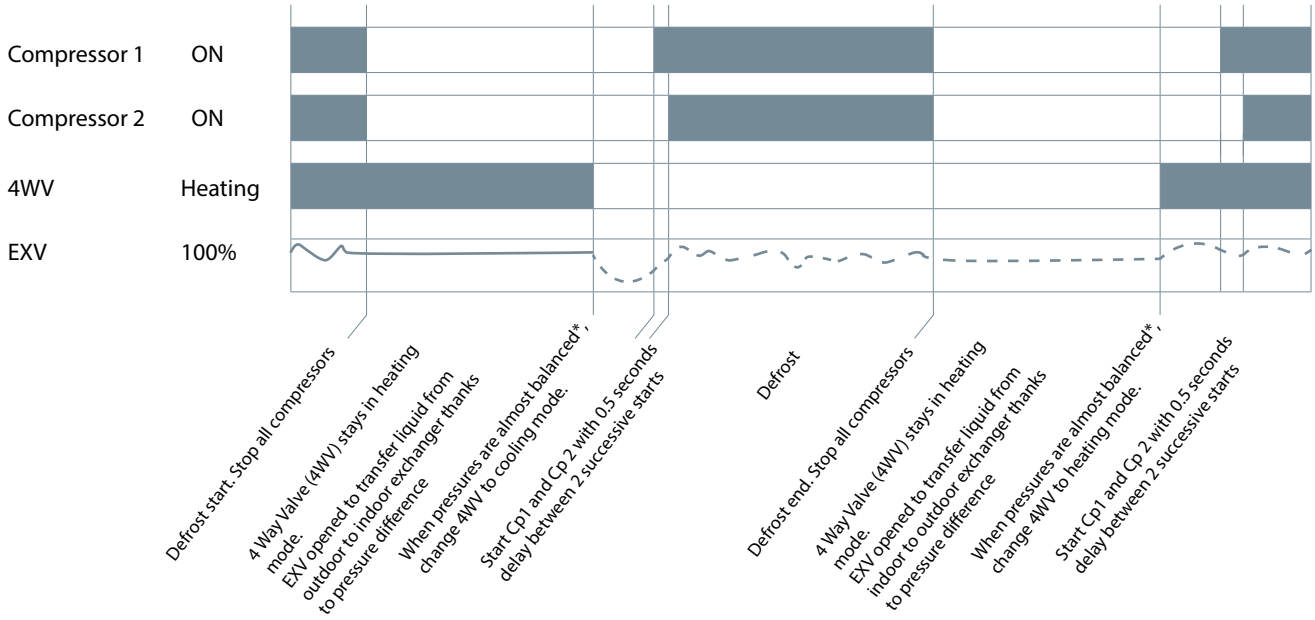
Control logic

Defrost logic recommendations

In reversible systems, the defrost logic can be worked out to limit liquid flood back effect by:
1. Running full load during defrost to share liquid refrigerant between all compressors.
2. Transferring liquid refrigerant from one exchanger to the other one thanks to pressures.

The following defrost logic combines both advantages:



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

Pump-down logic recommendations

Pump down is initiated prior to shutting down the last compressor on the circuit by de-energizing a liquid line solenoid valve or closing electronic expansion valve. When suction pressure reached the cut-out pressure, compressor is stopped, and liquid solenoid valve or electronic expansion valve remains closed.

Two types of pump-down exist:
- One shot pump down (preferred): when last compressor of the circuit stops, suction presssure is decreased 1.5 bar (R22,R407C), 2.5 bar (R410A) below nominal evaporating pressure. Even if suction pressure increases again, the compressor will not restart.
- Continuous pump-down: traditional pump-dow, Compressor restarts automatically when suction pressure increases. A non-return valve in the discharge line is recommended.

Reduce moisture in the system

	Excessive air and moisture • can increase condensing pressure and cause excessively high discharge temperatures. • can create acid giving rise to copper platting.	• can destroy the lubricating properties of the oil. All these phenomena can reduce service life and cause mechanical and electrical compressor failure.
Requirements	H-series compressors are delivered with < 100 ppm moisture level. At the time of commissioning, system moisture content may be up to 100 ppm.	During operation, the filter drier must reduce this to a level between 20 and 50 ppm.
Solutions	To achieve this requirement, a properly sized and type of drier is required. Important selection criteria's include: • driers water content capacity, • system refrigeration capacity, • system refrigerant charge.	For new installations with H-series compressors with polyolester oil, Danfoss recommends using the Danfoss DML (100% molecular sieve) solid core filter drier.

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Assembly line procedure

Compressor storage

Store the compressor not exposed to rain, corrosive or flammable atmosphere between -35°C and 70°C when charged with nitrogen and between -35°C and 52°C when charged with refrigerant.

Compressor holding charge

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

⚠ Respect the following sequence:

- Remove the nitrogen holding charge via the suction Schrader valve to avoid an oil mist blow out.
- Remove the suction plug first and the discharge plug afterwards to avoid discharge check valve gets stuck in open position.

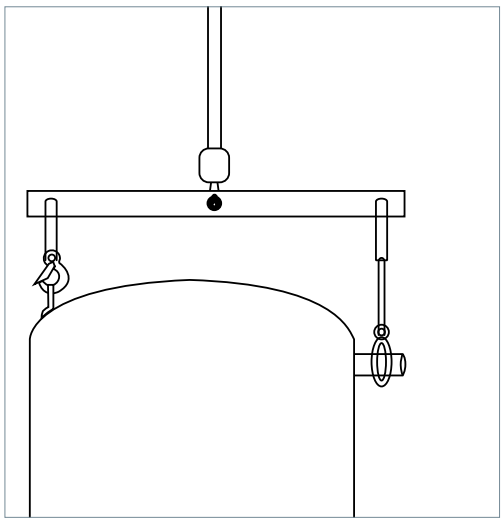
An opened compressor must not be exposed to air for more than 20 minutes to avoid moisture is captured by the PVE oil.

Handling

⚠ Each Danfoss H-series scroll compressor is equipped with the lift ring on the top shell and ring for the discharge port.

- Always use both these rings when lifting the compressor.
- Use lifting equipment rated and certified for the weight of the compressor or compressor assembly.
- A spreader bar rated for the weight of the compressor is highly recommended to ensure a better load distribution.
- The use of lifting hooks closed with a clasp is recommended.
- For tandem and trio assemblies, use a spreader bar and all compressor rings as shown in picture below.
- Never use the lift rings on the compressor to lift the full unit.

Maintain the compressor in an upright position during all handling manoeuvres (maximum of 15° from vertical).



Piping assembly

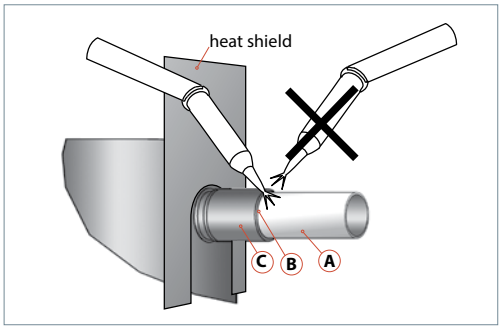
Good practices for piping assembly is a pre-requisite to ensure compressor service life.

System cleanliness

Circuit contamination possible cause:	Requirement:
Brazing and welding oxides	During brazing, flow nitrogen through the system
Filings and particles from the removal of burrs in pipe-work	Remove any particles and burrs generated by tube cutting and hole drilling
Moisture and air	Use only clean and dehydrated refrigeration grade copper tubing Opened compressor must not be exposed to air more than 20 minutes to avoid moisture captured by POE oil.

Brazing procedure:

- Brazing operations must be performed by qualified personnel.
- Make sure that no electrical wiring is connected to the compressor.
- To prevent compressor shell and electrical box overheating, use a heat shield and/or a heat-absorbent compound.
- Clean up connections with degreasing agent
- Flow nitrogen through the compressor.
- Use flux in paste or flux coated brazing rod.
- Use brazing rod with a minimum of 5% silver content.
- It is recommended to use double-tipped torch using acetylene to ensure a uniform heating of connection.
- For discharge connections brazing time should be less than 2 minutes to avoid NRVI damages if any.
- To enhance the resistance to rust, a varnish on the connection is recommended.



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

System pressure test and leak detection

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

- Always use an inert gas such as Nitrogen or Helium.
- Pressurize the system on HP side first then LP side.
- Do not exceed the following pressures:

Maximum compressor test pressures	
Maximum compressor test pressure high side (HP)	45 bar (g), Do keep the low side pressure not exceed 31.3bar(g)
Maximum compressor test pressure low side (LP)	31.1 bar (g)

* On H-series models with internal non return valve in discharge fitting or if an external non return valve is present on the discharge line, maximum pressurizing speed must be respected to ensure pressure equalization between LP and HP side over scroll elements.

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Assembly line procedure

Vacuum evacuation and moisture removal

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

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

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

Refrigerant charging

R

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

If needed, a complement of charge can be done:
- In liquid phase while compressor is running by slowly throttling liquid in.
- On the low pressure side, as far away as possible from the compressor suction connection.
- Never bypass safety low pressure switch.

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

Dielectric strength and insulation resistance tests

The tests are performed on each compressor at the factory between each phase and ground.

- Dielectric strength test is done with a high potential voltage (hi-pot) of 2Un +1000V AC at least, and leakage current must be less than 5 mA. Additional tests of this type are not recommended as it may reduce motor lifetime. Nevertheless, if such a test is necessary, it must be performed at a lower voltage.

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

- Insulation resistance is measured with a 500 V DC megohm tester and must be higher than 1 megohm.
- The presence of refrigerant around the motor windings will result in lower resistance values to ground and higher leakage current readings. Such readings do not indicate a faulty compressor. To prevent this, the system can be first operated briefly to distribute refrigerant.

Preliminary check

⚠ Check electrical power supply:

- Phase order: For H-series compressors equipped with an electronic module, reverse rotation will be automatically detected. For more details refer to section "Motor protection".
- Voltage and voltage unbalance within tolerance: For more details refer to section "Motor voltage".

Initial start-up

- Crank case heaters must be energized at least 12 hours in advance to remove refrigerant.
- A quicker start-up is possible by "jogging" the compressor to evacuate refrigerant.

Start the compressor for 1 second, then wait for 1 to 2 minutes. After 3 or 4 jogs the compressor can be started. This operation must be repeated for each compressor individually.

System monitoring

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

- Correct superheat and subcooling.
- Current draw of individual compressors within acceptable values (max operating current).
- No abnormal vibrations and noise.
- Correct oil level.

If Oil Top-up is needed, it must be done while the compressor is idle. Use the schrader connector or any other accessible connector on the compressor suction line. Always use new cans. For more detailed information see "Lubricants filling in instructions for Danfoss Commercial Compressors" TI 2-025-0402.

Dismantle and disposal

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

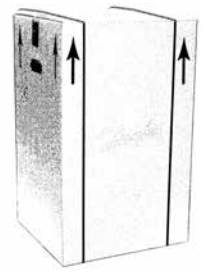
Ordering information and packaging

Packaging

Single pack

Compressors are packed individually in a cardboard box. They can be ordered in any quantity. Minimum ordering quantity = 1. As far as possible, Danfoss will ship the boxes on full pallets of 8,9, or 16 compressors according below table.

- Each box also contains following accessories:
- 4 grommets
- 4 assemblies of self tapping US thread bolts, washers and sleeves
- 4 additional sleeves
- 1 screw for earth connection
- Run capacitors are not provided

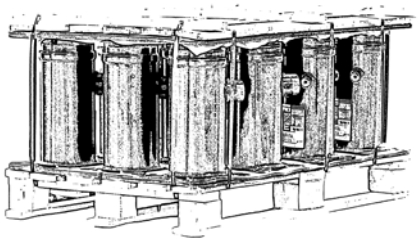


Industrial pack

Compressors are not packed individually but are shipped all together on one pallet. They can be ordered in quantities of full pallets only, multiples of 12 or 16 compressors, according below table.

Each industrial pack pallet contains following accessories:

- 4 grommets per compressor
- 4 sleeves per compressor



Packaging details

According to delivery region, packaging dimensions and compressor quantities are different.

See below for details. For US made H-series compressors (code number starting with 120U)

Delivered region	Packaging	Nbr	Pallet type	Comments
Americas Asia Pacific Middle East	Single pack	16	US pallet	Optimised for overseas container loading
	Industrial pack	16	US pallet	
Europe	Single pack	8	Danfoss pallet	-
	Industrial pack	12	Danfoss pallet	

* Nbr : number of compressors/pallet

For CN made H series compressors (code number staring with 121L)

Delivered region	Packaging	Nbr	Pallet type	Comments
All	Single pack	9	Danfoss pallet	-
	Industrial pack	12	Danfoss pallet	

* Nbr : number of compressors/pallet

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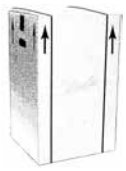
Ordering information and packaging

Compressor code numbers

Danfoss H-series scroll compressors can be ordered in either industrial packs or in single packs.

Please use the code numbers from below tables for ordering.

R22 Single pack



Compressors	Model Variation	Connections	Features	Code no.					
				1	2	4	5	7	9
HRM032	U	P	6	120U0921	120U2029	120U0996			
	T	P	6				120U0956		
HRM034	U	P	6	120U0926	120U1081	120U1001		120U2232	
	T	P	6			120U2367	120U2122		120U2087
HRM038	U	P	6	120U0931	120U1091	120U1011	120U0966	120U1056	
	T	P	6			120U2372	120U2137		120U2092
HRM040	U	P	6	120U0936	120U1101	120U1021	120U2147	120U1061	
	T	P	6			120U2377	120U2142		120U2462
HRM042	U	P	6	120U0941	120U1111	120U1031	120U0971	120U1066	
	T	P	6			120U2127	120U2152		120U2107
HRM045	U	P	6	120U0946	120U1121	120U1041	120U0981	120U1071	
HRM047	U	P	6	120U0951	120U1131	120U1051	120U0991	120U1076	
	T	P	6			120U2132	120U2162		120U2097
HRM048	U	C	8			120U1671			
	U	P	6	120U1496		120U1666		120U1791	
HRM051	T	P	6			120U1676	120U2187		120U2382
	U	P	6	120U1506	120U1866	120U1686	120U2252	120U1801	
HRM054	U	C	6	120U1516					
	U	P	6	120U1511	120U1871	120U1696	120U2257	120U1811	
	T	P	6						120U2292
HRM058	T	C	6	120U1526					
	T	P	6	120U1521					120U2112
	U	C	6	120U1536					
	U	P	6	120U1531	120U1876	120U1711	120U1601	120U1821	
HRM060	T	P	6	120U1541		120U1721			120U2082
	T	C	6	120U2242					
	U	C	6	120U1551	120U2077				
	U	C	8			120U1741			
	U	P	6	120U1546	120U1881	120U1736	120U1611	120U1831	
HLM068	T	C	6		120U1891	120U1746		120U2598	120U2392
	T	P	6	120U1556			120U1616		
HLM072	T	C	6		120U1896	120U1751		120U2602	120U1856
	T	C	8		120U2202	120U2067			
	T	P	6	120U1566			120U1626		
HLM075	T	C	6		120U1901	120U1761		120U1836	
	T	P	6	120U1576			120U1636		
HLM078	T	C	6		120U1906	120U1771			
HLM081	T	C	6		120U1911	120U1776		120U1846	120U2102
	T	C	8			120U2009			
	T	P	6	120U1586			120U1646		
HCM094	T	C	6		120U0891	120U0581		120U0711	120U0746
	T	C	7			120U0586			
	T	C	8		120U0901	120U0596		120U0721	120U0756
HCM109	T	C	6		120U2506	120U0366			
	T	C	7			120U0371			
	T	C	8			120U1924			
HCM120	T	C	6		120U0761	120U0391			
	T	C	7		120U2212	120U0396			
	T	C	8		120U2217	120U2207			

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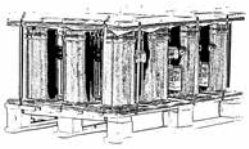
Ordering information and packaging

R22 Industrial pack



Compressors	Model Variation	Connections	Features	Code no.					
				1	2	4	5	7	9
HRM032	U	P	6	120U0918	120U2026	120U0993			
	T	P	6				120U0953		
HRM034	T	P	6			120U2364	120U2119		120U2084
	U	P	6	120U0923	120U1078	120U0998		120U2229	
HRM038	T	P	6			120U2369	120U2134		120U2089
	U	P	6	120U0928	120U1088	120U1008	120U0963	120U1053	
HRM040	T	P	6			120U2374	120U2139		120U2459
	U	P	6	120U0933	120U1098	120U1018	120U2144	120U1058	
HRM042	T	P	6			120U2124	120U2149		120U2104
	U	P	6	120U0938	120U1108	120U1028	120U0968	120U1063	
HRM045	U	P	6	120U0943	120U1118	120U1038	120U0978	120U1068	
HRM047	T	P	6			120U2129	120U2159		120U2094
	U	P	6	120U0948	120U1128	120U1048	120U0988	120U1073	
HRM048	U	C	8			120U1668			
	U	P	6	120U1493		120U1663		120U1788	
HRM051	T	P	6			120U1673	120U2184		120U2379
	U	P	6	120U1503	120U1863	120U1683	120U2249	120U1798	
HRM054	T	P	6						120U2289
	U	C	6	120U1513					
	U	P	6	120U1508	120U1868	120U1693	120U2254	120U1808	
HRM058	T	C	6	120U1523					
	T	P	6	120U1518					120U2109
	U	C	6	120U1533					
	U	C	8			120U1716			
	U	P	6	120U1528	120U1873	120U1708	120U1598	120U1818	
HRM060	T	C	6	120U2239					
	T	P	6	120U1538		120U1718			120U2079
	U	C	6	120U1548	120U2074				
	U	C	8			120U1738			
	U	P	6	120U1543	120U1878	120U1733	120U1608	120U1828	
HLM068	T	C	6		120U1888	120U1743		120U2595	120U2389
	T	P	6	120U1553			120U1613		
HLM072	T	C	6		120U1893	120U1748		120U2599	120U1853
	T	C	8		120U2199	120U2064			
	T	P	6	120U1563			120U1623		
HLM075	T	C	6		120U1898	120U1758		120U1833	
	T	P	6	120U1573			120U1633		
HLM078	T	C	6		120U1903	120U1768			
HLM081	T	C	6		120U1908	120U1773		120U1843	120U2099
	T	C	8			120U2006			
	T	P	6	120U1583			120U1643		
HCM094	T	C	6		120U0888	120U0578		120U0708	120U0743
	T	C	7			120U0583			
	T	C	8		120U0898	120U0593		120U0718	120U0753
HCM109	T	C	6		120U2503	120U0363			
	T	C	7			120U0368			
	T	C	8			120U1921			
HCM120	T	C	6		120U0758	120U0388			
	T	C	7		120U2209	120U0393			
	T	C	8		120U2214	120U2204			

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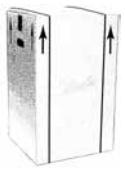
Ordering information and packaging

R407C Single pack



Compressors	Model Variation	Connections	Features	Code no.					
				1	2	4	5	7	9
HRP034	T	P	6			120U2024	120U2019		
HRP038	T	P	6		120U1086	120U1006	120U0961		
HRP040	T	P	6		120U1096	120U1016	120U1929		
HRP042	T	P	6		120U1106	120U1026	120U2157		
HRP045	T	P	6		120U1116	120U1036	120U0976		
HRP047	T	P	6		120U1126	120U1046	120U0986		
HRP048	T	C	8			120U1661			
HRP048	T	P	6			120U1656			
HRP051	T	P	6	120U1501	120U1861	120U1681	120U2192	120U1796	
HRP054	T	P	6			120U1691	120U2197	120U1806	
	T	C	8			120U2004			
HRP058	T	C	8			120U1706			
	T	P	6			120U1701	120U1596	120U1816	
HRP060	T	C	8			120U1731			
	T	P	6		120U2297	120U1726	120U1606	120U1826	
HLP068	T	C	6			120U2014			
	T	P	6	120U1561			120U1621		
HLP072	T	C	6			120U1756			
	T	C	8			120U2072			
	T	P	6	120U1571			120U1631		
HLP075	T	C	6			120U1766		120U1841	
	T	P	6	120U1581			120U1641		
HLP078	T	C	6		120U2458	120U2454			
HLP081	T	C	6		120U1916	120U1781		120U1851	
	T	C	8			120U1786			
	T	P	6	120U1591			120U1651		
HCP094	T	C	6		120U0906	120U0601			
	T	C	7		120U0911	120U0606			
	T	C	8		120U0916	120U0611			
HCP109	T	C	6			120U0376			
	T	C	7			120U0381			
	T	C	8			120U0386			
HCP120	T	C	6		120U0766	120U0401			
	T	C	7		120U2222	120U0406			
	T	C	8		120U2227	120U0411			

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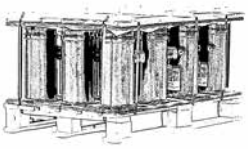
Ordering information and packaging

R407C Industrial pack



Compressors	Model Variation	Connections	Features	Code no.					
				1	2	4	5	7	9
HRP034	T	P	6			120U2021	120U2016		
HRP038	T	P	6		120U1083	120U1003	120U0958		
HRP040	T	P	6		120U1093	120U1013	120U1926		
HRP042	T	P	6		120U1103	120U1023	120U2154		
HRP045	T	P	6		120U1113	120U1033	120U0973		
HRP047	T	P	6		120U1123	120U1043	120U0983		
HRP048	T	C	8			120U1658			
HRP048	T	P	6			120U1653			
HRP051	T	P	6	120U1498	120U1858	120U1678	120U2189	120U1793	
HRP054	T	P	6			120U1688	120U2194	120U1803	
	T	C	8			120U2001			
HRP058	T	C	8			120U1703			
	T	P	6			120U1698	120U1593	120U1813	
HRP060	T	C	8			120U1728			
	T	P	6		120U2297	120U1723	120U1603	120U1823	
HLP068	T	C	6			120U2011			
	T	P	6	120U1558			120U1618		
HLP072	T	C	6			120U1753			
	T	C	8			120U2074			
	T	P	6	120U1568			120U1628		
HLP075	T	C	6			120U1763		120U1838	
	T	P	6	120U1578			120U1638		
HLP078	T	C	6		120U2455	120U2451			
HLP081	T	C	6		120U1913	120U1778		120U1848	
	T	C	8			120U1783			
	T	P	6	120U1588			120U1648		
HCP094	T	C	6		120U0903	120U0598			
	T	C	7		120U0908	120U0603			
	T	C	8		120U0913	120U0608			
HCP109	T	C	6			120U0373			
	T	C	7			120U0378			
	T	C	8			120U0383			
HCP120	T	C	6		120U0763	120U0398			
	T	C	7		120U2219	120U0403			
	T	C	8		120U2224	120U0408			

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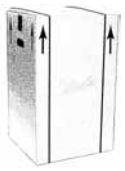
Ordering information and packaging

R410A Single pack



Compressors	Model Variation	Connections	Features	Code no.					
				1	2	4	5	7	9
HRH029	U	P	6	120U2277	120U2282	120U2287			
HRH031	U	P	6	120U1136	120U1251	120U1191	120U1166	120U1216	
HRH032	U	P	6	120U1141	120U1256	120U1196	120U1171	120U1221	
HRH034	U	P	6	120U1146	120U1261	120U2446	120U2650	120U1226	120U2654
HRH036	U	P	6	120U1151	120U1266	120U1201	120U1176	120U1231	
HRH038	U	P	6	120U1156	120U1271	120U1206	120U1181	120U1236	120U2658
HRH039	U	P	6	120U2466					
HRH040	U	P	6	120U1161	120U1276	120U1211	120U1186	120U1241	
HRH041	U	P	6	120U1281	120U1451	120U1356		120U1406	
	U	C	6		120U2412				
	U	C	8		120U2407	120U2397		120U2402	
HRH044	U	P	6	120U1286	120U1456	120U1361		120U1411	
HRH047	U	P	6	120U2362					
HRH048	U	P	6	120U2582					
HRH049	U	P	6	120U1291	120U1461	120U1366		120U1416	
	U	C	8		120U2482	120U2474		120U2478	
HRH050	U	P	6	120U2470					
HRH051	U	P	6	120U1296	120U1466	120U1371	120U1326	120U1421	
HRH054	U	P	6	120U1301	120U1471	120U1376	120U1331	120U1426	
HRH056	U	C	6			120U1386		120U2237	
	U	P	6	120U1306	120U1476	120U1381	120U1336	120U1431	
HLH061	T	C	6		120U2062	120U2052		120U2057	120U2450
	T	P	6	120U2042			120U2047		
	T	C	8		120U2494	120U2486		120U2490	
	T	C	T		121L3169	121L3167			
HLH068	T	C	6		120U1481	120U1391		120U1436	
	T	P	6	120U1311			120U1341		
	T	C	8		120U2427	120U2417		120U2422	
HLJ072	T	C	6		120U1486	120U1396		120U2037	
	T	P	6	120U1316			120U1346		
	T	C	8		120U2177	120U2167		120U2498	
	T	C	T		121L3173	121L3171			
HLJ075	T	C	6		120U2272	120U2267		120U2262	
	T	C	8		120U2442	120U2432		120U2437	
HLJ083	T	C	6		120U1491	120U1401		120U1441	120U2387
	T	P	6	120U1321			120U1351		
	T	C	8		120U2182	120U2172		120U2502	
	T	C	T		121L3177	121L3175			
HCJ090	T	C	6		120U2307	120U2302		120U2312	
	T	C	7		120U2542	120U2534		120U2510	
	T	C	8		120U2546	120U2538		120U2514	
HCJ091	T	C	6			121L3113			
	T	C	8			121L3119			
HCJ105	T	C	6		120U2327	120U2322		120U2332	
	T	C	7		120U2550	120U2574		120U2518	
	T	C	8		120U2554	120U2578		120U2522	
HCJ106	T	C	6			121L3115			
	T	C	8			121L3121			
HCJ120	T	C	6		120U2347	120U2342		120U2352	
	T	C	7		120U2566	120U2558		120U2526	
	T	C	8		120U2570	120U2562		120U2530	
HCJ121	T	C	6			121L3117			
	T	C	8			121L3123			

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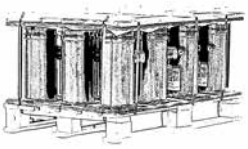
R410A Industrial pack



Compressors	Model Variation	Connections	Features	Code no.					
				1	2	4	5	7	9
HRH029	U	P	6	120U2274	120U2279	120U2284			
HRH031	U	P	6	120U1133	120U1248	120U1188	120U1163	120U1213	
HRH032	U	P	6	120U1138	120U1253	120U1193	120U1168	120U1218	
HRH034	U	P	6	120U1143	120U1258	120U2443	120U2647	120U1223	120U2651
HRH036	U	P	6	120U1148	120U1263	120U1198	120U1173	120U1228	
HRH038	U	P	6	120U1153	120U1268	120U1203	120U1178	120U1233	120U2655
HRH039	U	P	6	120U2463					
HRH040	U	P	6	120U1158	120U1273	120U1208	120U1183	120U1238	
HRH041	U	P	6	120U1278	120U1448	120U1353		120U1403	
	U	C	6		120U2409				
	U	C	8		120U2404	120U2394		120U2399	
HRH044	U	P	6	120U1283	120U1453	120U1358		120U1408	
HRH047	U	P	6	120U2359					
HRH048	U	P	6	120U2579					
HRH049	U	P	6	120U1288	120U1458	120U1363		120U1413	
	U	C	8		120U2479	120U2471		120U2475	
HRH050	U	P	6	120U2467					
HRH051	U	P	6	120U1293	120U1463	120U1368	120U1323	120U1418	
HRH054	U	P	6	120U1298	120U1468	120U1373	120U1328	120U1423	
HRH056	U	C	6			120U1383		120U2234	
HRH056	U	P	6	120U1303	120U1473	120U1378	120U1333	120U1428	
HLH061	T	P	6	120U2039			120U2044		
	T	C	6		120U2059	120U2049		120U2054	120U2447
	T	C	8		120U2491	120U2483		120U2487	
	T	C	T		121L3168	121L3166			
HLH068	T	C	6		120U1478	120U1388		120U1433	
	T	C	8		120U2424	120U2414		120U2419	
	T	P	6	120U1308			120U1338		
HLJ072	T	C	6		120U1483	120U1393		120U2034	
	T	C	8		120U2174	120U2164		120U2495	
	T	P	6	120U1313			120U1343		
	T	C	T		121L3172	121L3170			
HLJ075	T	C	6		120U2269	120U2264		120U2259	120U1443
	T	C	8		120U2439	120U2429		120U2434	
HLJ083	T	C	6		120U1488	120U1398		120U1438	120U2384
	T	C	8		120U2179	120U2169		120U2499	
	T	P	6	120U1318			120U1348		
	T	C	T		121L3176	121L3174			
HCJ090	T	C	6		120U2304	120U2299		120U2309	
	T	C	7		120U2539	120U2531		120U2507	
	T	C	8		120U2543	120U2535		120U2511	
HCJ091	T	C	6			121L3112			
	T	C	8			121L3118			
HCJ105	T	C	6		120U2324	120U2319		120U2329	
	T	C	7		120U2547	120U2571		120U2515	
	T	C	8		120U2551	120U2575		120U2519	
HCJ106	T	C	6			121L3114			
	T	C	8			121L3120			
HCJ120	T	C	6		120U2344	120U2339		120U2349	
	T	C	7		120U2563	120U2555		120U2523	
	T	C	8		120U2567	120U2559		120U2527	
HCJ121	T	C	6			121L3116			
	T	C	8			121L3122			

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Model		Model variation	Voltage code	Connections	Features	Industrial pack	Single pack
R22	HRM025	T	4	P	6	121L2781	121L2784
	HRM034	T	4	P	6	121L2364	121L2367
	HRM034	T	5	P	6	121L2119	121L2122
	HRM038	T	9	P	6	121L2089	121L2092
	HRM042	T	4	P	6	121L2124	121L2127
	HRM051	T	4	P	6	121L1673	121L1676
	HRM054	T	4	P	6	121L2749	121L2752
	HRM060	T	4	P	6	121L1718	121L1721
	HRM060	T	2	P	6	121L2757	121L2760
	HRM060	T	9	P	6	121L2079	121L2082
	HRM060	T	4	C	8	121L3071	121L3072
	HLM072	T	4	C	6	121L1748	121L1751
	HLM072	T	9	C	6	121L1853	121L1856
	HLM081	T	4	C	6	121L1773	121L1776
	HLM081	T	2	C	6	121L1908	121L1911
	HLM081	T	9	C	6	121L2099	121L2102
	HCM094	T	4	C	6	121L0578	121L0581
	HCM109	T	4	C	6	121L0363	121L0366
	HCM120	T	4	C	6	121L0388	121L0391
R407C	HRP054	T	4	P	6	121L1688	121L1691
	HRP060	T	4	P	6	121L1723	121L1726
	HLP072	T	4	C	6	121L1753	121L1756
	HLP081	T	4	C	6	121L1778	121L1781
	HCP094	T	4	C	6	121L0598	121L0601
	HCP109	T	4	C	6	121L0373	121L0376
	HCP120	T	4	C	6	121L0398	121L0401
R410A	HRH047	U	4	P	6	121L2848	121L2851
	HRH049	U	4	P	6	121L1363	121L1366
	HRH051	U	4	P	6	121L1368	121L1371
	HRH054	U	4	P	6	121L1373	121L1376
	HRH054	U	4	C	8	121L3030	121L3033
	HLH061	T	9	C	6	121L2447	121L2450
	HLH061	T	4	C	6	121L2049	121L2052
	HLH061	T	4	C	8	121L2483	121L2486
	HLH068	T	4	C	6	121L1388	121L1391
	HLJ072	T	9	C	6	121L2989	121L2992
	HLJ072	T	4	C	6	121L1393	121L1396
	HLJ072	T	4	C	8	121L2164	121L2167
	HLJ075	T	4	C	6	121L2264	121L2267
	HLJ083	T	4	C	6	121L1398	121L1401
	HCJ091	T	4	C	6	121L3112	121L3113
	HCJ091	T	4	C	8	121L3118	121L3119
	HCJ106	T	4	C	6	121L3114	121L3115
	HCJ106	T	4	C	8	121L3120	121L3121
	HCJ121	T	4	C	6	121L3116	121L3117
	HCJ121	T	4	C	8	121L3121	121L3123

Industrial pack: 12 compressors per pallet

Single pack: 1 compressor in cardboard box, 9pcs on a full pallet

Made in China

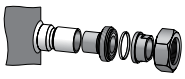
Run capacitors for PSC wiring

Type	Code n°	Description	Application	Packaging	Pack size
70 µF	120Z0051	PSC wiring Run Capacitor 70 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	HRM032-034-038-040-042 - HRP034-038-040-042 - HRH031-032-036	Multipack	10
60 µF	120Z0050	PSC wiring Run Capacitor 60 µF, code 5	HRM045-047 - HRP045-047 - HRH038-040	Multipack	10
55 µF	8173234	PSC wiring Run Capacitor 55 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	HRM054-058-060 / HLM068-072-075-081 - HRP054-058-060 / HLP068-072-075-081 - HRH051-054-056 / HLH068 / HLJ072-083 / HLH061	Multipack	10

Start capacitors and starting relay for CSR wiring

Type	Code n°	Description	Application	Packaging	Pack size
145-175 µF	120Z0399	CSR wiring Start Capacitor 145-175 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	HRM/P032-034-038-040-042-045-047 HRH029-031-032-036-038-040	Multipack	10
161-193 µF	120Z0400	CSR wiring Start Capacitor 161-193 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	HRM/P051-054	Multipack	10
88-108 µF	8173001	CSR wiring Start Capacitor 88-108 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	HRM/P058-060 HLM/P068-072-075-081 HRH051-054-056 HLH068 HLJ072-083	Multipack	10
RVA9CKL	120Z0393	CSR wiring Starting Relay, motor voltage code 5 - 220-240V / 1 / 50Hz	HRM/P032-034-038-040-042-045-047 HRH029-031-032-036-038-040	Multipack	10
RVA3EKL	120Z0394	CSR wiring Starting Relay, motor voltage code 5 - 220-240V / 1 / 50Hz	HRM/P051-054	Multipack	10
RVA2ACKL	120Z0396	CSR wiring Starting Relay, motor voltage code 1 -208-230V / 1 / 60Hz	HRM/P032-034 HRH031	Multipack	10
RVA2ABKL	120Z0397	CSR wiring Starting Relay, motor voltage code 1 -208-230V / 1 / 60Hz	HRM/P038-040-042- 045-047-048-051-054-058U-060U HLM/068- 072-075-081 HRH032-034-038-040-041-044-048-049-050-051-054-056, HLH068,HLJ072-083	Multipack	10
RVAA4IKL	120Z0398	CSR wiring Starting Relay, motor voltage code 1 -208-230V / 1 / 60Hz	HRM058T1-060T1	Multipack	10
RVA4GKL	120Z0395	CSR wiring Starting Relay, motor voltage code 5 - 220-240V / 1 / 50Hz	HRM/P058-060 HLM/P068-072-075-081 HRH051-054-056 HLH068 HLJ072-083 HLH061	Multipack	10

Rotolock adaptor set



Type	Code n°	Description	Application	Packaging	Pack size
	120Z0126	Rotolock adaptor set (1-1/4" ~ 3/4") , (1" ~ 1/2")	HRP/HRM025-034-038-040-042 HRH029-031-032-034-036038 - group 1	Multipack	6
	120Z0127	Rotolock adaptor set (1-1/4" ~ 7/8") , (1" ~ 1/2")	HRP/HRM045-047-051-057-058-060-068-072-075 HRH040-041-044-049-051-056-061-068-072-075-083 - group 2	Multipack	6
	120Z0128	Rotolock adaptor set (1-1/4" ~ 7/8") , (1-1/4" ~ 3/4")	HRM/HRP078-081 - group 3	Multipack	6
	120Z0129	Rotolock adaptor set (1-3/4" ~ 1-1/8") , (1-1/4" ~ 7/8")	HCM/P094-109-120 HCJ090-091-105-106-120-121 - group 4	Multipack	6

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روبروی پالایشگاه نفت پارس، پلاک ۱۲

Spare parts & accessories

Rotolock adaptor

Type	Code n°	Description	Application (see above group)	Packaging	Pack size
	120Z0366	Rotolock adaptor (1-1/4" ~ 3/4")	Group 1 suction	Multipack	10
	120Z0367	Rotolock adaptor (1-1/4" ~ 7/8")	Group 2 & 3 suction	Multipack	10
	120Z0364	Rotolock adaptor (1-3/4" ~ 1-1/8")	Group 4 suction	Multipack	10
	120Z0365	Rotolock adaptor (1" ~ 1/2")	Group 1 & 2 discharge	Multipack	10
	120Z0366	Rotolock adaptor (1-1/4" ~ 3/4")	Group 3 discharge	Multipack	10
	120Z0367	Rotolock adaptor (1-1/4" ~ 7/8")	Group 4 discharge	Multipack	10

Crankcase heater

Type	Code No	Description	Application	Packaging	Pack Size
	120Z0055	Belt type crankcase heater, 40 W, 230 V, CE mark	HRM032-034-038-040-042-045-047 - HRP025-038-040-042-045-047 - HRH029-032-034-036-038-040	Multipack	6
	120Z0056	Belt type crankcase heater, 40 W, 400 V, CE mark		Multipack	6
	120Z0057	Belt type crankcase heater, 50 W, 230 V, CE mark	HRM048-051-054-058-060 / HLM068-072-075 - HRP048-051-054-058-060 / HLP068-072-075 - HRH041-049-051-054-056 / HLH061-068 / HLJ072 / HLJ075	Multipack	6
	120Z0058	Belt type crankcase heater, 50 W, 400 V, CE mark		Multipack	6
	120Z0059	Belt type crankcase heater, 65 W, 230 V, CE mark, UL	HLM078-081 / HCM094-109-120 - HLP081 / HCP094-109-120 - HLJ083 - HCJ090-091-105-106-120-121	Multipack	6
	120Z5011	Belt type crankcase heater, 70 W, 230 V, UL, CE mark		Multipack	6
	120Z0060	Belt type crankcase heater, 65 W, 400 V, CE mark, UL		Multipack	6
	120Z5012	Belt type crankcase heater, 70 W, 460 V, UL, CE mark		Multipack	6
	120Z5013	Belt type crankcase heater, 70 W, 575 V, UL, CE mark		Multipack	6

Discharge temperature protection

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

Spare parts & accessories

Lubricant

Type	Code No	Description	Application	Packaging	Pack Size
	120Z5034	PVE (0.95 liter can) 320HV (FVC68D)	HRH, HLH, HLJ, HCJ, HRP, HLP & HCP	Multipack	1

Mounting hardware

Type	Code No	Description	Application	Packaging	Pack Size
	120Z5017	Mounting grommet	All models	Single pack	1
	120Z5014	Mounting sleeve	All models	Single pack	1
	120Z5031	Mounting kit, including 1 bolt, 1 sleeve, 1 washer	All models	Single pack	1
	120Z5064	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers	All models	Single pack	1

Acoustic hoods

Type	Code No	Description	Application	Packaging	Pack Size
	120Z5043	Acoustic hood	HRM032-047, HRP 032-047, HRH 031-040, HRH047, HRH048, HRH050	Single pack	1
	120Z5044	Acoustic hood	HRM048-081, HRP048-081, HRH044, HRH049, HRH051-056, HLH061-068, HLJ072-083	Single pack	1
	120Z5045	Acoustic hood	HRM094-120, HCP094-120, HCJ090-121	Single pack	1

IP54 upgrade kit

Type	Code No	Description	Application	Packaging	Pack Size
	118U0056	IP54 upgrade kit for round terminal box	HRM, HLM, HCM, HRP, HLP, HCP, HRH, HLH, HLJ	Multipack	6
	118U0057	IP54 upgrade kit for square terminal box	HRM, HLM, HCM, HRP, HLP, HCP, HRH, HLH, HLJ, HCJ	Multipack	6

Terminal box

Code No	Description	Application	Packaging	Pack Size
120Z5015	Round terminal box (P & T version)	P and T version	Multipack	10
120Z5018	Square terminal box (C & Q version)	C and Q version	Multipack	10

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Updates

Previous version	Current version
	• Updated Layout • Page 6: Added General information
• Page 9-10: Technical specifications	• Page 9-11: Updated Technical specifications • Page 18: Added Tandem dimensions
• Page 17: Motor voltage	• Page 19: Updated Motor voltage with Voltage unbalance formula
• Page 19: Nominal capacitor value and relays	• Page 21: Updated Nominal capacitor value and relays
• Page 20: Approvals and certifications	• Page 22: Added Machines directive 2006/42/EC to Approvals and certifications • Page 23-25: Added Design piping & Design compressor mounting • Page 26: Added Manage sound and vibratio • Page 28-30: Added Manage operating envelope • Page 31-32: Added Manage superheat • Page 33-34: Added Manage off cycle migration • Page 35-38: Added Provide power supply and electrical protection & Control logic & Reduce moisture in the system • Page 39-41: Added Assembly line procedure. • Page 42-43: Added Commissioning & Dismantle and disposal
• Page 44-45: Spare parts & accessories	• Page 52-54: Updated Start capacitors and starting relay for CSR wiring, Lubricant, Mounting hardware & added Acoustic hoods, IP54 upgrade kit in Spare parts & accessories

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Danfoss Commercial Compressors

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

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

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Danfoss Scrolls

Danfoss Optyma Condensing Units

Danfoss Maneurop Reciprocating Compressors

Danfoss Light Commercial Refrigeration Compressors

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

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Application guidelines

Danfoss Scroll for Refrigeration
MLM / MLZ
50 - 60 Hz - R404A - R507 - R134a - R22

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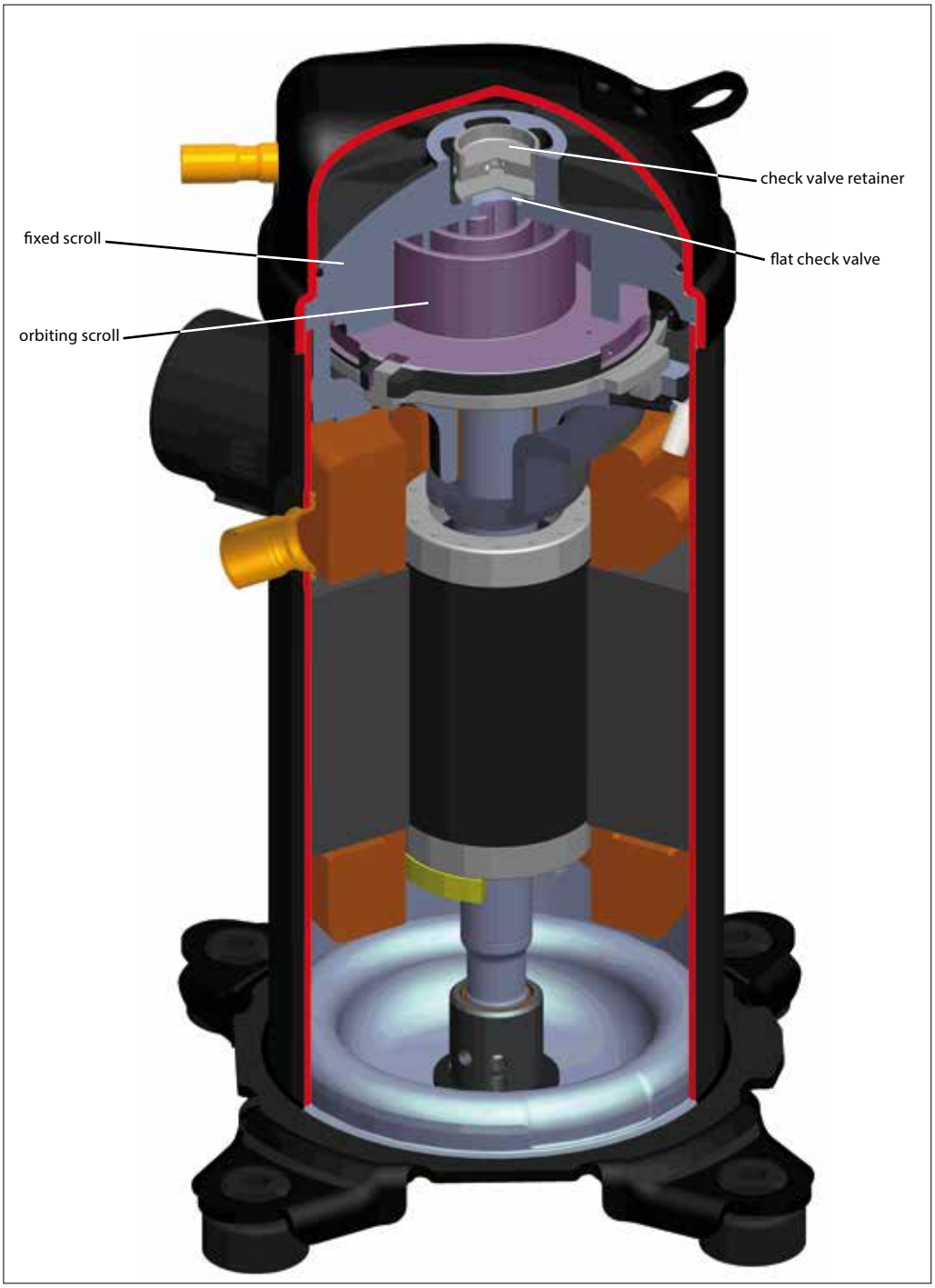
With its unique scroll design and manufacturing process flexibility, the new Danfoss MLZ/ MLM refrigeration compressor offers a highly efficient solution for demanding refrigeration applications.

This new family of refrigeration compressors includes 12 sizes of medium temperature scroll compressors designed for commercial refrigeration applications. These compressors are engineered for refrigeration, and offer cooling capacity from 3.4 to 21 kW (2 to 10 HP) at common voltages and frequencies as well as any of the common refri-gerants (R404A - R134a - R507 - R22).



Thanks to its dedicated refrigeration design, the MLZ/MLM scroll compressor delivers a number of powerful advantages. With its high efficiency motor and optimised scroll design it reduces energy cost in normal operating conditions and delivers high capacity and an optimised pressure ratio for refrigeration applications.

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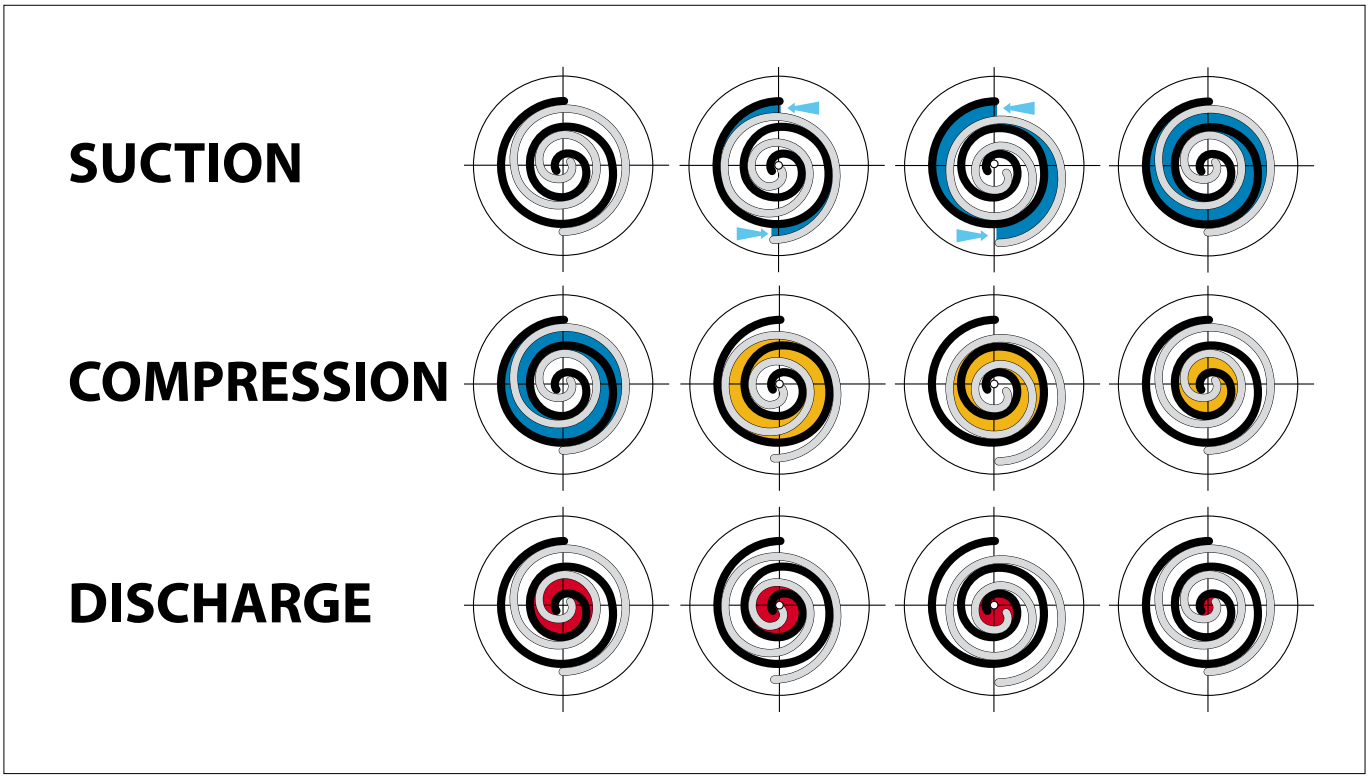
The scroll compression process

The entire scroll compression process is illustrated below. The centre of the orbiting scroll traces a circular path around the centre of the fixed scroll. This movement creates compression pockets between the two scroll elements.

Low pressure suction gas is trapped within each crescent-shaped pocket as it forms; continuous motion of the orbiting scroll serves to seal the pocket, which decreases in volume as the pocket moves towards the centre of the scroll set, with corresponding increase in gas pressure. Maximum compression is achieved, as the pocket reaches the discharge port at the centre.

Scroll compression is a continuous process: when one pocket of gas is being compressed during the second orbit, another gas quantity enters a new pocket formed at the periphery, and simultaneously, another is being discharged.



Danfoss scroll compressors are manufactured using the most advanced machining, assembly, and process control techniques. In design of both the compressor and the factory, very high standards of reliability and process control were first priority. The result is a highly efficient product with the highest reliability obtainable, and a low sound level.

Nomenclature

Type	Size	Motor	Features
M LZ	021	T 4 L	P 9

Application
M: medium temperature refrigeration

Family, Refrigerant & lubricant
LZ: R404A - R507 - R134a - R22, PVE lubricant
LM: R22, alkylbenzene lubricant

Nominal capacity
In thousand Btu/h at 60 Hz,
ARI, MBP conditions

Model variation
T: design optimised for refrigeration

Other features

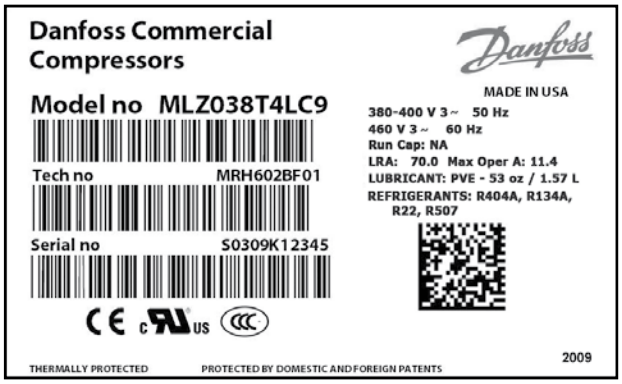
	Oil sight glass	Oil equalisation	Oil drain	LP gauge port	Gas equalisation port
9	Threaded	None	Schrader	None	None

Tubing and electrical connections
P: brazed connections, spade terminals
C: brazed connections, screw terminals
T: rotolock connections, spade terminals
Q: rotolock connections, screws terminals

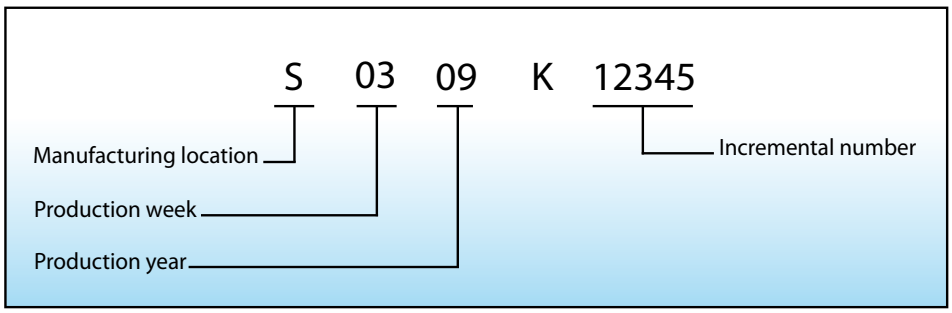
Motor protection
L: internal motor protection

Motor voltage code
1: 208-230V/1~/60 Hz
2: 200-220V/3~/50 Hz & 208-230V/3~/60 Hz
4: 380-400V/3~/50 Hz & 460V/3~/60 Hz
5: 220-240V/1~/50 Hz
7: 500V/3~/50 Hz & 575V/ 3~/60 Hz
9: 380V/3~/60 Hz

Label



Serial number



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50 Hz

	Model	HP	Nominal cooling capacity *		Power input *	Efficiency *		Swept volume	Displacement	Oil charge	Net weight (with oil)
						COP	EER				
			W	Btu/h	kW	W/W	Btu/h/W	cm3/rev	m3/h	Litres	kg
R404A **	MLZ015	2	3300	11300	1.75	1.89	6.45	33.8	5.9	1.1	31
	MLZ019	2.5	4500	15400	2.16	2.06	7.03	43.5	7.6	1.1	31
	MLZ021	3	4700	16000	2.27	2.08	7.10	46.2	8.0	1.1	31
	MLZ026	3.5	5800	19800	2.9	2.00	6.83	57.1	9.9	1.1	31
	MLZ030	4	7100	24200	3.35	2.11	7.20	68.8	12.0	1.6	41
	MLZ038	5	8400	28700	3.86	2.19	7.47	81.0	14.1	1.6	41
	MLZ042	5.5	9500	32400	4.72	2.02	6.89	93.1	16.2	1.6	41
	MLZ045	6	10200	34800	4.81	2.11	7.20	98.6	17.2	1.6	41
	MLZ048	7	11100	37900	5.17	2.14	7.30	107.5	18.7	1.6	41
	MLZ058	7.5	13000	44400	6.08	2.13	7.27	126.0	21.9	2.7	47
	MLZ066	9	15100	51500	7.01	2.15	7.34	148.8	25.9	2.7	47
	MLZ076	10	17300	59000	7.93	2.18	7.44	162.4	28.3	2.7	47
R134a	MLZ015	2	2000	6800	1.02	1.95	6.66	33.8	5.9	1.1	31
	MLZ019	2.5	2600	8900	1.28	1.99	6.79	43.5	7.6	1.1	31
	MLZ021	3	2700	9200	1.33	2.04	6.96	46.2	8.0	1.1	31
	MLZ026	3.5	3300	11300	1.62	2.06	7.03	57.1	9.9	1.1	31
	MLZ030	4	4000	13700	1.93	2.09	7.13	68.8	12.0	1.6	41
	MLZ038	5	4700	16000	2.34	2.02	6.89	81.0	14.1	1.6	41
	MLZ042	5.5	5300	18100	2.74	1.95	6.66	93.1	16.2	1.6	41
	MLZ045	6	5900	20100	2.69	2.17	7.41	98.6	17.2	1.6	41
	MLZ048	7	6200	21200	2.91	2.14	7.30	107.5	18.7	1.6	41
	MLZ058	7.5	7400	25300	3.61	2.06	7.03	126.0	21.9	2.7	47
	MLZ066	9	8600	29400	4.1	2.10	7.17	148.8	25.9	2.7	47
	MLZ076	10	9600	32800	4.67	2.06	7.03	162.4	28.3	2.7	47
R22	MLZ/MLM015	2	3300	11300	1.53	2.15	7.34	33.8	5.9	1.1	31
	MLZ/MLM019	2.5	4300	14700	1.87	2.30	7.85	43.5	7.6	1.1	31
	MLZ/MLM021	3	4600	15700	2.02	2.27	7.75	46.2	8.0	1.1	31
	MLZ/MLM026	3.5	5700	19500	2.43	2.33	7.95	57.1	9.9	1.1	31
	MLZ/MLM030	4	6800	23200	2.93	2.33	7.95	68.8	12.0	1.6	41
	MLZ/MLM038	5	8100	27600	3.45	2.34	7.99	81.0	14.1	1.6	41
	MLZ/MLM042	5.5	9100	31100	4.23	2.15	7.34	93.1	16.2	1.6	41
	MLZ/MLM045	6	9300	31700	4.14	2.24	7.65	98.6	17.2	1.6	41
	MLZ/MLM048	7	10600	36200	4.53	2.33	7.95	107.5	18.7	1.6	41
	MLZ/MLM058	7.5	12300	42000	5.29	2.33	7.95	126.0	21.9	2.7	47
	MLZ/MLM066	9	14100	48100	5.94	2.38	8.12	148.8	25.9	2.7	47
	MLZ/MLM076	10	16600	56700	6.96	2.38	8.12	162.4	28.3	2.7	47

* at EN12900 conditions: To= -10°C, Tc= 45°C, RGT= 20°C, SC= 0K
** R507 performance data are nearly identical to R404A performance data
Motor voltage code 4: 400V/3~/50 Hz & 460V/3~/60 Hz
MLZ/MLM042: motor voltage code 5: 220-240V/1~/50 Hz

60 Hz

	Model	HP	Nominal cooling capacity *		Power input *	Efficiency *		Swept volume	Displacement	Oil charge	Net weight (with oil)
						COP	EER				
			W	Btu/h	kW	W/W	Btu/h/W	cm3/rev	m3/h	Litres	kg
R404A **	MLZ015	2	4100	14000	2.1	1.94	6.62	33.8	7.1	1.1	31
	MLZ019	2.5	5500	18800	2.58	2.11	7.20	43.5	9.1	1.1	31
	MLZ021	3	5800	19800	2.74	2.13	7.27	46.2	9.7	1.1	31
	MLZ026	3.5	7200	24600	3.44	2.1	7.17	57.1	12.0	1.1	31
	MLZ030	4	8500	29000	3.9	2.18	7.44	68.8	14.4	1.6	41
	MLZ038	5	10200	34800	4.7	2.18	7.44	81.0	17.0	1.6	41
	MLZ042	5.5	11800	40300	5.73	2.07	7.06	93.1	19.5	1.6	41
	MLZ045	6	12400	42300	5.64	2.19	7.47	98.6	20.7	1.6	41
	MLZ048	7	13500	46100	6.15	2.2	7.51	107.5	22.6	1.6	41
	MLZ058	7.5	15700	53600	7.35	2.14	7.30	126.0	26.4	2.7	47
	MLZ066	9	18400	62800	8.4	2.18	7.44	148.8	31.2	2.7	47
	MLZ076	10	20900	71300	9.59	2.18	7.44	162.4	34.1	2.7	47
R134a	MLZ015	2	2400	8200	1.19	2.05	7.00	33.8	7.1	1.1	31
	MLZ019	2.5	3100	10600	1.53	2.04	6.96	43.5	9.1	1.1	31
	MLZ021	3	3300	11300	1.58	2.1	7.17	46.2	9.7	1.1	31
	MLZ026	3.5	4100	14000	1.91	2.15	7.34	57.1	12.0	1.1	31
	MLZ030	4	5000	17100	2.35	2.11	7.20	68.8	14.4	1.6	41
	MLZ038	5	5800	19800	2.8	2.09	7.13	81.0	17.0	1.6	41
	MLZ042	5.5	6500	22200	3.33	1.95	6.66	93.1	19.5	1.6	41
	MLZ045	6	7100	24200	3.32	2.14	7.30	98.6	20.7	1.6	41
	MLZ048	7	7600	25900	3.54	2.14	7.30	107.5	22.6	1.6	41
	MLZ058	7.5	9100	31100	4.28	2.13	7.27	126.0	26.4	2.7	47
	MLZ066	9	10400	35500	4.85	2.15	7.34	148.8	31.2	2.7	47
	MLZ076	10	11700	39900	5.61	2.09	7.13	162.4	34.1	2.7	47
R22	MLZ/MLM015	2	3900	13300	1.74	2.26	7.71	33.8	7.1	1.1	31
	MLZ/MLM019	2.5	5200	17700	2.22	2.37	8.09	43.5	9.1	1.1	31
	MLZ/MLM021	3	5600	19100	2.36	2.36	8.05	46.2	9.7	1.1	31
	MLZ/MLM026	3.5	7000	23900	2.93	2.39	8.16	57.1	12.0	1.1	31
	MLZ/MLM030	4	8200	28000	3.46	2.36	8.05	68.8	14.4	1.6	41
	MLZ/MLM038	5	9600	32800	4.06	2.36	8.05	81.0	17.0	1.6	41
	MLZ/MLM042	5.5	10900	37200	5	2.18	7.44	93.1	19.5	1.6	41
	MLZ/MLM045	6	11700	39900	4.91	2.38	8.12	98.6	20.7	1.6	41
	MLZ/MLM048	7	12900	44000	5.36	2.4	8.19	107.5	22.6	1.6	41
	MLZ/MLM058	7.5	14900	50900	6.34	2.34	7.99	126.0	26.4	2.7	47
	MLZ/MLM066	9	17000	58000	7.14	2.38	8.12	148.8	31.2	2.7	47
	MLZ/MLM076	10	20100	68600	8.4	2.39	8.16	162.4	34.1	2.7	47

* at EN12900 conditions: To= -10°C, Tc= 45°C, RGT= 20°C, SC= 0K
** R507 performance data are nearly identical to R404A performance data
Motor voltage code 4: 400V/3~/50 Hz & 460V/3~/60 Hz
MLZ/MLM042: motor voltage code 1: 208-230V/1~/60 Hz

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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

R404A / R507

	Model	To	-25		-20		-15		-10		-5		0		5		10	
		Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
50 Hz	MLZ015T4	30	2300	1.3	2900	1.2	3500	1.2	4300	1.2	5200	1.2	6200	1.2	7400	1.1	8700	1.1
		40	1900	1.6	2400	1.6	3000	1.6	3700	1.5	4400	1.5	5300	1.5	6300	1.5	7400	1.5
		50	-	-	1800	2.1	2400	2.1	2900	2.0	3600	2.0	4300	1.9	5100	1.9	6000	1.9
	MLZ019T4	30	3000	1.5	3800	1.5	4600	1.5	5600	1.5	6700	1.5	8000	1.5	9500	1.5	11200	1.6
		40	2600	1.9	3300	1.9	4000	1.9	4800	1.9	5800	1.9	6900	1.9	8200	1.9	9700	1.9
		50	-	-	2700	2.4	3300	2.4	4000	2.4	4800	2.4	5800	2.4	6800	2.4	8100	2.3
	MLZ021T4	30	3200	1.6	4000	1.6	4900	1.6	5900	1.6	7100	1.6	8500	1.6	10000	1.7	11800	1.7
		40	2800	2.0	3500	2.0	4300	2.0	5100	2.0	6200	2.0	7300	2.0	8700	2.0	10300	2.0
		50	-	-	2900	2.5	3500	2.5	4300	2.6	5100	2.6	6100	2.5	7300	2.5	8600	2.4
	MLZ026T4	30	3900	2.0	4900	2.0	6000	2.0	7300	2.1	8800	2.1	10500	2.1	12500	2.1	14800	2.0
		40	3400	2.6	4200	2.6	5200	2.6	6300	2.6	7600	2.6	9100	2.6	10800	2.6	12800	2.6
		50	-	-	3600	3.3	4400	3.3	5300	3.3	6400	3.3	7600	3.3	9100	3.2	10800	3.2
	MLZ030T4	30	4800	2.3	6000	2.4	7300	2.4	8800	2.4	10600	2.4	12700	2.4	15000	2.4	17700	2.4
		40	4100	3.0	5100	3.0	6300	3.0	7700	3.0	9300	3.0	11100	3.0	13100	3.0	15500	3.0
		50	-	-	4300	3.8	5300	3.8	6400	3.8	7800	3.8	9300	3.8	11100	3.7	13100	3.7
	MLZ038T4	30	5800	2.7	7200	2.7	8700	2.7	10500	2.7	12600	2.8	15000	2.8	17700	2.9	20800	3.0
		40	5000	3.5	6200	3.4	7600	3.4	9200	3.4	11000	3.4	13200	3.5	15600	3.5	18300	3.6
		50	-	-	5100	4.4	6300	4.4	7600	4.4	9200	4.3	11000	4.3	13100	4.4	15400	4.4
	MLZ042T5	30	6300	3.2	7900	3.3	9800	3.4	12000	3.5	14500	3.6	17500	3.6	20900	3.6	24800	3.5
		40	5500	4.1	6900	4.1	8500	4.2	10400	4.2	12500	4.3	15000	4.3	18000	4.3	21500	4.3
		50	-	-	5800	5.3	7100	5.3	8600	5.3	10400	5.3	12600	5.3	15100	5.3	18100	5.3
	MLZ045T4	30	7000	3.4	8600	3.4	10600	3.4	12800	3.5	15400	3.5	18300	3.5	21600	3.4	25300	3.3
		40	6100	4.3	7500	4.3	9100	4.3	11100	4.3	13300	4.3	15900	4.3	18800	4.3	22000	4.2
		50	-	-	6200	5.5	7600	5.4	9200	5.4	11100	5.4	13200	5.4	15700	5.4	18500	5.3
	MLZ048T4	30	7600	3.7	9400	3.7	11500	3.7	13900	3.7	16700	3.7	19900	3.7	23600	3.7	27900	3.6
		40	6600	4.6	8200	4.6	10000	4.6	12100	4.6	14500	4.6	17300	4.6	20500	4.6	24200	4.6
		50	-	-	6800	5.8	8300	5.8	10100	5.8	12100	5.8	14400	5.8	17100	5.8	20300	5.7
	MLZ058T4	30	8700	4.2	10900	4.3	13500	4.3	16400	4.4	19800	4.5	23500	4.5	27800	4.6	32500	4.6
		40	7200	5.3	9300	5.3	11600	5.4	14200	5.4	17200	5.5	20500	5.6	24200	5.6	28400	5.7
		50	-	-	7400	6.8	9400	6.8	11700	6.8	14300	6.9	17100	6.9	20400	6.9	24000	7.0
	MLZ066T4	30	10000	4.9	12600	4.9	15600	5.0	19100	5.0	23100	5.1	27700	5.3	32900	5.4	38900	5.7
		40	8500	6.2	10800	6.2	13400	6.2	16400	6.2	19900	6.3	23900	6.4	28500	6.6	33700	6.7
		50	-	-	8900	7.9	11100	7.9	13600	7.9	16600	8.0	19900	8.1	23800	8.2	28200	8.3
	MLZ076T4	30	12200	5.7	15200	5.7	18500	5.8	22400	5.8	26800	5.9	31900	6.1	37800	6.2	44600	6.3
		40	10600	7.0	13100	7.0	15900	7.1	19100	7.2	22900	7.2	27200	7.3	32300	7.4	38200	7.5
		50	-	-	11000	8.7	13000	8.7	15400	8.8	18300	8.9	21800	8.9	25900	9.0	30800	9.0
60 Hz	MLZ015T4	30	2800	1.5	3500	1.5	4300	1.5	5200	1.5	6200	1.5	7500	1.5	8900	1.4	10500	1.4
		40	2300	1.9	2900	1.9	3600	1.9	4500	1.9	5400	1.9	6400	1.8	7600	1.8	9000	1.8
		50	-	-	2300	2.3	3000	2.4	3700	2.4	4400	2.4	5300	2.3	6300	2.3	7500	2.3
	MLZ019T4	30	3800	1.8	4600	1.8	5700	1.8	6900	1.8	8200	1.8	9700	1.8	11500	1.9	13500	1.9
		40	3200	2.2	4000	2.3	4900	2.3	5900	2.3	7100	2.3	8400	2.3	10000	2.3	11700	2.3
		50	-	-	3300	2.8	4100	2.8	5000	2.9	6000	2.9	7100	2.9	8400	2.8	9900	2.8
	MLZ021T4	30	4000	1.8	4900	1.9	6000	2.0	7300	2.0	8700	2.0	10400	2.0	12200	2.0	14200	2.1
		40	3400	2.3	4300	2.4	5200	2.5	6300	2.5	7600	2.4	9000	2.4	10600	2.4	12400	2.5
		50	-	-	3600	3.0	4400	3.1	5300	3.1	6400	3.1	7600	3.0	9000	3.0	10500	3.0
	MLZ026T4	30	5000	2.3	6100	2.4	7500	2.5	9100	2.5	10900	2.5	12900	2.5	15200	2.5	17800	2.5
		40	4300	2.9	5300	3.0	6500	3.1	7900	3.1	9400	3.1	11200	3.1	13200	3.1	15400	3.1
		50	-	-	4400	3.7	5400	3.8	6600	3.8	7900	3.8	9400	3.8	11100	3.8	13000	3.8
	MLZ030T4	30	5800	2.8	7200	2.8	8800	2.8	10700	2.8	12800	2.9	15200	2.9	17800	2.8	20800	2.8
		40	5100	3.5	6300	3.5	7600	3.5	9300	3.5	11100	3.5	13200	3.5	15500	3.5	18200	3.5
		50	-	-	5200	4.4	6400	4.3	7700	4.4	9300	4.4	11100	4.4	13100	4.4	15400	4.4
	MLZ038T4	30	7000	3.4	8600	3.4	10500	3.4	12700	3.4	15300	3.4	18100	3.4	21400	3.4	25100	3.3
		40	6000	4.2	7500	4.2	9200	4.2	11100	4.2	13300	4.2	15800	4.3	18600	4.2	21800	4.2
		50	-	-	6200	5.2	7700	5.2	9300	5.2	11200	5.3	13300	5.3	15600	5.3	18300	5.2
	MLZ042T1	30	8100	3.9	10100	4.0	12300	4.1	14800	4.1	17700	4.1	21100	4.0	24800	4.0	29100	4.1
		40	7000	5.0	8700	5.1	10700	5.1	12900	5.1	15400	5.1	18300	5.1	21600	5.1	25300	5.1
		50	-	-	7200	6.4	8900	6.4	10800	6.4	12900	6.4	15400	6.3	18200	6.3	21400	6.4
	MLZ045T4	30	8500	4.0	10500	4.0	12800	4.0	15500	4.1	18600	4.1	22000	4.1	26000	4.1	30400	4.1
		40	7400	4.9	9100	5.0	11100	5.0	13400	5.1	16100	5.1	19100	5.1	22600	5.1	26400	5.1
		50	-	-	7600	6.3	9300	6.3	11300	6.3	13500	6.3	16100	6.3	19000	6.3	22300	6.3
	MLZ048T4	30	9300	4.3	11400	4.4	14000	4.4	16900	4.4	20300	4.5	24100	4.5	28400	4.4	33100	4.3
		40	8100	5.4	9900	5.4	12100	5.5	14700	5.5	17600	5.6	21000	5.6	24700	5.6	28800	5.5
		50	-	-	8300	6.8	10100	6.8	12300	6.8	14800	6.9	17600	6.9	20800	6.9	24300	6.8
	MLZ058T4	30	10800	5.2	13600	5.3	16800	5.4	20500	5.5	24800	5.6	29600	5.7	35000	5.8	40900	5.8
		40	9000	6.6	11400	6.5	14200	6.6	17400	6.6	21100	6.8	25300	6.9	29900	7.0	35100	7.0
		50	-	-	8900	8.3	11200	8.2	13900	8.2	17000	8.2	20400	8.3	24300	8.4	28500	8.5
	MLZ066T4	30	12600	6.0	15500	6.1	18900	6.2	22900	6.4	27600	6.5	32800	6.7	38800	6.8	45500	6.9
		40	10900	7.3	13500	7.4	16500	7.5	19900	7.6	23900	7.8	28500	7.9	33600	8.1	39300	8.2
		50	-	-	11200	9.1	13800	9.2	16700	9.3	20100	9.4	23800	9.5	28100	9.6	32900	9.7
	MLZ076T4	30	14600	6.7	17900	6.9	21800	7.1	26400	7.2	31700	7.4	37800	7.6	44800	7.9	52900	8.3
		40	12600	8.2	15500	8.4	18900	8.6	22800	8.7	27300	8.8	32500	9.0	38500	9.2	45300	9.6
		50	-	-	12900	10.4	15700	10.5	18900	10.6	22600	10.7	26800	10.8	31700	11.0	37300	11.3

Legend: To: Evaporating temperature in °C; Tc: Condensing temperature in °C; Qo: Cooling capacity in W; Pe: Power input in kW; RGT= 20°C; Subooling= 0K

Capacity data at other conditions are available in the datasheets at: www.danfoss.com/odsg

R22

	Model	To	-20		-15		-10		-5		0		5		10	
		Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
50Hz	MLZ/MLM015T4	30	2600	1.1	3200	1.1	3800	1.1	4600	1.1	5500	1.2	6600	1.2	7800	1.2
		40	-	-	2800	1.4	3500	1.4	4200	1.4	5100	1.4	6000	1.4	7100	1.4
		50	-	-	-	-	-	-	3800	1.7	4500	1.7	5400	1.8	6400	1.8
	MLZ/MLM019T4	30	3400	1.3	4200	1.3	5000	1.4	6000	1.4	7100	1.4	8500	1.4	10000	1.5
		40	-	-	3800	1.7	4600	1.7	5500	1.7	6500	1.7	7800	1.7	9200	1.8
		50	-	-	-	-	-	-	4900	2.1	5800	2.1	6900	2.1	8300	2.1
	MLZ/MLM021T4	30	3600	1.4	4400	1.5	5300	1.5	6400	1.5	7600	1.6	9000	1.6	10600	1.6
		40	-	-	4000	1.8	4800	1.8	5800	1.9	6900	1.9	8200	1.9	9800	1.9
		50	-	-	-	-	-	-	5200	2.3	6200	2.3	7400	2.3	8800	2.3
	MLZ/MLM026T4	30	4400	1.8	5400	1.8	6600	1.8	7900	1.8	9600	1.8	11500	1.7	13800	1.8
		40	-	-	4900	2.2	6000	2.2	7200	2.2	8800	2.2	10600	2.2	12700	2.2
		50	-	-	-	-	-	-	6500	2.7	7900	2.7	9500	2.7	11400	2.7
	MLZ/MLM030T4	30	5100	2.1	6400	2.1	7900	2.2	9700	2.3	11600	2.3	13800	2.4	16200	2.5
		40	-	-	5800	2.6	7200	2.7	8800	2.7	10700	2.8	12700	2.8	14900	2.9
		50	-	-	-	-	-	-	7900	3.3	9600	3.4	11500	3.4	13600	3.4
	MLZ/MLM038T4	30	5800	2.4	7400	2.5	9200	2.6	11300	2.7	13700	2.8	16300	2.8	19100	2.9
		40	-	-	6800	3.0	8500	3.1	10400	3.2	12600	3.3	14900	3.4	17500	3.4
		50	-	-	-	-	-	-	9400	3.9	11400	4.0	13600	4.0	15900	4.1
	MLZ/MLM042T5	30	9000	3.2	9500	3.1	10800	3.0	12700	3.0	15400	3.1	18500	3.2	22000	3.4
		40	-	-	8400	3.8	9700	3.8	11600	3.8	14000	3.8	16600	3.9	19600	3.9
		50	-	-	-	-	-	-	10300	4.8	12600	4.8	15000	4.8	17600	4.8
	MLZ/MLM045T4	30	7000	3.1	8800	3.1	11000	3.1	13600	3.1	16500	3.1	19700	3.1	23200	3.2
		40	-	-	7900	3.7	9900	3.8	12300	3.8	15000	3.8	18000	3.8	21200	3.8
		50	-	-	-	-	-	-	10800	4.6	13300	4.6	16100	4.7	19100	4.7
	MLZ/MLM048T4	30	8100	3.3	10000	3.4	12200	3.4	14800	3.4	17800	3.4	21300	3.4	25300	3.5
		40	-	-	9000	4.1	11100	4.1	13500	4.1	16300	4.1	19500	4.1	23200	4.2
		50	-	-	-	-	-	-	12200	5.1	14700	5.1	17600	5.1	20900	5.1
	MLZ/MLM058T4	30	9200	3.9	11500	4.0	14300	4.0	17400	4.0	21100	3.9	25300	4.0	30200	4.1
		40	-	-	10500	4.8	13000	4.8	15900	4.8	19300	4.8	23200	4.8	27800	4.9
		50	-	-	-	-	-	-	14100	5.9	17300	5.9	20900	5.9	25100	6.0
	MLZ/MLM066T4	30	10200	4.3	12900	4.4	16200	4.4	20000	4.5	24300	4.5	29100	4.6	34400	4.7
		40	-	-	11900	5.3	14900	5.4	18300	5.4	22300	5.5	26800	5.5	31600	5.7
		50	-	-	-	-	-	-	16500	6.6	20200	6.7	24200	6.7	28700	6.8
	MLZ/MLM076T4	30	12400	5.3	15400	5.3	19000	5.2	23200	5.1	27900	5.1	33300	5.1	39300	5.3
		40	-	-	14100	6.4	17400	6.3	21300	6.3	25600	6.2	30500	6.3	36100	6.4
		50	-	-	-	-	-	-	19100	7.7	23100	7.6	27600	7.7	32600	7.8
60Hz	MLZ/MLM015T4	30	3000	1.2	3800	1.3	4600	1.3	5600	1.3	6700	1.4	7900	1.4	9300	1.5
		40	-	-	3400	1.5	4200	1.6	5100	1.6	6100	1.7	7200	1.7	8500	1.7
		50	-	-	-	-	-	-	4500	2.0	5500	2.0	6500	2.0	7700	2.0
	MLZ/MLM019T4	30	3900	1.6	4900	1.6	6000	1.7	7300	1.7	8800	1.7	10400	1.8	12200	1.8
		40	-	-	4500	2.0	5500	2.0	6700	2.1	8100	2.1	9600	2.1	11300	2.1
		50	-	-	-	-	-	-	6000	2.5	7300	2.5	8700	2.5	10200	2.5
	MLZ/MLM021T4	30	4100	1.7	5200	1.7	6400	1.8	7800	1.8	9400	1.8	11200	1.9	13200	2.0
		40	-	-	4800	2.1	5900	2.2	7200	2.2	8700	2.2	10300	2.2	12100	2.3
		50	-	-	-	-	-	-	6400	2.6	7800	2.7	9300	2.7	11000	2.7
	MLZ/MLM026T4	30	5100	2.0	6300	2.1	7800	2.1	9500	2.2	11500	2.2	13700	2.2	16300	2.2
		40	-	-	5900	2.6	7300	2.6	8900	2.7	10600	2.7	12600	2.8	14900	2.7
		50	-	-	-	-	-	-	8100	3.3	9700	3.4	11500	3.4	13500	3.4
	MLZ/MLM030T4	30	6000	2.4	7500	2.5	9400	2.6	11500	2.7	13800	2.7	16400	2.8	19300	2.9
		40	-	-	6900	3.1	8600	3.1	10500	3.2	12700	3.3	15100	3.3	17800	3.4
		50	-	-	-	-	-	-	9500	3.9	11500	4.0	13800	4.0	16200	4.1
	MLZ/MLM038T4	30	6900	2.8	8800	2.9	11000	3.0	13500	3.1	16300	3.3	19400	3.4	22800	3.4
		40	-	-	8100	3.6	10100	3.7	12400	3.8	15000	3.9	17900	4.0	20900	4.0
		50	-	-	-	-	-	-	11200	4.6	13600	4.7	16200	4.8	19000	4.8
	MLZ/MLM042T1	30	10800	3.8	11400	3.7	12900	3.6	15300	3.6	18400	3.7	22200	3.8	26500	4.0
		40	-	-	10100	4.5	11700	4.5	13900	4.5	16700	4.5	20000	4.5	23500	4.6
		50	-	-	-	-	-	-	12400	5.6	15100	5.7	18100	5.7	21100	5.6
	MLZ/MLM045T4	30	8600	3.5	10800	3.6	13500	3.6	16500	3.7	20000	3.8	23800	3.9	28000	4.0
		40	-	-	9800	4.4	12300	4.5	15100	4.5	18400	4.6	21900	4.6	25800	4.7
		50	-	-	-	-	-	-	13600	5.5	16500	5.6	19800	5.6	23400	5.7
	MLZ/MLM048T4	30	9700	3.8	12200	3.8	15000	3.9	18300	4.0	21900	4.1	26000	4.2	30500	4.4
		40	-	-	10900	4.7	13600	4.8	16700	4.9	20100	5.0	23900	5.1	28200	5.1
		50	-	-	-	-	-	-	14900	6.0	18100	6.1	21600	6.2	25600	6.2
	MLZ/MLM058T4	30	10900	4.5	13800	4.6	17200	4.7	21100	4.9	25600	5.0	30600	5.1	36200	5.3
		40	-	-	12600	5.6	15700	5.8	19300	5.9	23500	6.0	28200	6.1	33400	6.2
		50	-	-	-	-	-	-	17300	7.2	21100	7.3	25500	7.3	30400	7.4
	MLZ/MLM066T4	30	12200	5.0	15500	5.2	19400	5.4	24000	5.5	29200	5.7	35000	5.8	41300	6.0
		40	-	-	14200	6.3	17800	6.5	22100	6.7	26900	6.8	32300	7.0	38200	7.1
		50	-	-	-	-	-	-	20000	8.1	24500	8.2	29400	8.4	34700	8.5
	MLZ/MLM076T4	30	14500	6.1	18300	6.2	22800	6.3	28000	6.4	33900	6.5	40400	6.7	47400	6.9
		40	-	-	16900	7.5	21000	7.6	25800	7.7	31200	7.9	37100	8.0	43500	8.1
		50	-	-	-	-	-	-	23400	9.4	28300	9.6	33700	9.7	39600	9.8

Legend: To: Evaporating temperature in °C; Tc: Condensing temperature in °C; Qo: Cooling capacity in W; Pe: Power input in kW; RGT = 20°C; Subcooling =0 K

Capacity data at other conditions are available in the datasheets at: www.danfoss.com/odsg

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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

R134a

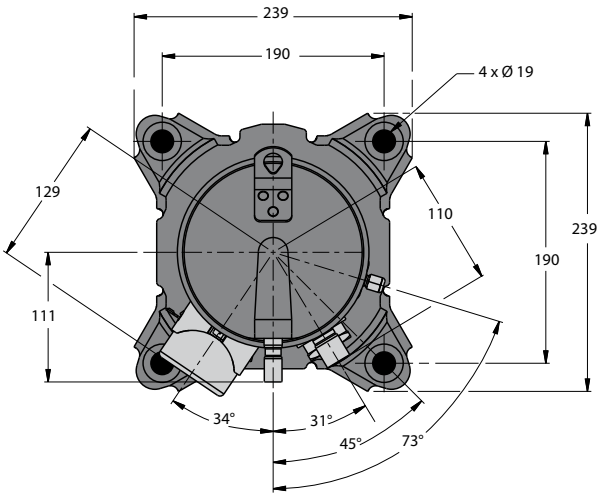
	Model	To	-10		-5		0		5		10		15	
		Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
50Hz	MLZ/MLM015T4	30	2400	0.7	3000	0.8	3700	0.8	4500	0.8	5400	0.8	-	-
		40	-	-	2700	0.9	3300	0.9	4100	0.9	4900	1.0	5900	1.0
		50	-	-	2400	1.1	3000	1.2	3600	1.2	4400	1.2	5200	1.2
	MLZ/MLM019T4	30	3100	1.0	3800	1.0	4700	1.0	5800	1.0	7000	1.0	-	-
		40	-	-	3500	1.2	4300	1.2	5200	1.2	6300	1.2	7600	1.2
		50	-	-	3100	1.4	3800	1.5	4700	1.5	5600	1.5	6700	1.5
	MLZ/MLM021T4	30	3300	1.0	4100	1.0	5000	1.0	6100	1.0	7400	1.0	-	-
		40	-	-	3700	1.2	4600	1.2	5600	1.3	6700	1.3	8000	1.3
		50	-	-	3300	1.5	4000	1.5	4900	1.5	6000	1.5	7200	1.6
	MLZ/MLM026T4	30	4100	1.2	5100	1.2	6200	1.2	7600	1.2	9100	1.3	-	-
		40	-	-	4600	1.5	5600	1.5	6900	1.5	8300	1.5	9900	1.6
		50	-	-	4100	1.8	5000	1.9	6100	1.9	7400	1.9	8900	1.9
	MLZ/MLM030T4	30	4900	1.4	6100	1.4	7500	1.5	9100	1.5	11000	1.5	-	-
		40	-	-	5500	1.8	6800	1.8	8300	1.8	10000	1.8	12000	1.8
		50	-	-	4900	2.2	6000	2.2	7400	2.2	8900	2.2	10700	2.3
	MLZ/MLM038T4	30	5800	1.7	7200	1.8	8800	1.8	10700	1.8	12900	1.8	-	-
		40	-	-	6500	2.2	8000	2.2	9700	2.2	11700	2.2	14000	2.2
		50	-	-	5700	2.6	7100	2.7	8700	2.7	10500	2.7	12500	2.8
	MLZ/MLM042T5	30	6600	2.2	8200	2.2	10100	2.2	12100	2.3	14400	2.4	-	-
		40	-	-	7500	2.6	9200	2.6	11100	2.7	13200	2.7	15700	2.8
		50	-	-	6500	3.1	8100	3.2	9900	3.2	11800	3.2	14100	3.3
	MLZ/MLM045T4	30	7100	2.0	8900	2.0	11000	2.0	13300	2.0	16000	2.0	-	-
		40	-	-	8000	2.5	9900	2.5	12100	2.5	14600	2.5	17400	2.6
		50	-	-	7100	3.0	8800	3.1	10800	3.1	13000	3.1	15600	3.2
	MLZ/MLM048T4	30	7600	2.1	9500	2.2	11600	2.2	14100	2.2	16900	2.2	-	-
		40	-	-	8500	2.7	10500	2.7	12800	2.7	15400	2.7	18300	2.8
		50	-	-	7500	3.3	9300	3.3	11400	3.4	13800	3.4	16400	3.4
	MLZ/MLM058T4	30	9100	2.6	11300	2.7	13800	2.8	16600	2.8	20000	2.9	-	-
		40	-	-	10100	3.3	12400	3.4	15100	3.4	18100	3.5	21600	3.4
		50	-	-	9000	4.1	11100	4.2	13400	4.2	16100	4.2	19200	4.1
	MLZ/MLM066T4	30	10500	3.0	13000	3.1	16000	3.1	19300	3.2	23200	3.2	-	-
		40	-	-	11800	3.8	14500	3.9	17500	3.9	21100	3.9	25000	3.9
		50	-	-	10400	4.6	12800	4.7	15600	4.8	18800	4.8	22300	4.7
	MLZ/MLM076T4	30	11800	3.4	14600	3.5	17900	3.6	21600	3.7	25800	3.7	-	-
		40	-	-	13100	4.3	16100	4.4	19600	4.4	23500	4.5	28000	4.4
		50	-	-	11600	5.3	14300	5.4	17400	5.4	21000	5.4	25000	5.3
60Hz	MLZ/MLM015T4	30	3000	0.9	3700	0.9	4600	0.9	5500	0.9	6600	1.0	-	-
		40	-	-	3400	1.1	4200	1.1	5100	1.1	6100	1.2	7200	1.2
		50	-	-	3000	1.3	3700	1.4	4600	1.4	5500	1.4	6500	1.4
	MLZ/MLM019T4	30	3800	1.2	4800	1.2	5900	1.2	7100	1.2	8500	1.3	-	-
		40	-	-	4300	1.4	5400	1.5	6500	1.5	7800	1.5	9300	1.5
		50	-	-	3900	1.7	4800	1.8	5900	1.8	7100	1.8	8400	1.8
	MLZ/MLM021T4	30	4100	1.2	5100	1.2	6200	1.2	7600	1.3	9100	1.3	-	-
		40	-	-	4600	1.5	5700	1.5	6900	1.5	8300	1.5	9900	1.6
		50	-	-	4100	1.8	5100	1.8	6200	1.9	7500	1.9	8900	1.9
	MLZ/MLM026T4	30	5000	1.4	6300	1.5	7700	1.5	9300	1.5	11200	1.6	-	-
		40	-	-	5700	1.8	7000	1.8	8600	1.9	10300	1.9	12200	1.9
		50	-	-	5100	2.2	6300	2.2	7700	2.3	9300	2.3	11000	2.3
	MLZ/MLM030T4	30	6000	1.8	7500	1.8	9300	1.8	11300	1.9	13500	1.9	-	-
		40	-	-	6800	2.2	8500	2.2	10300	2.2	12400	2.3	14700	2.3
		50	-	-	6100	2.6	7600	2.7	9300	2.7	11200	2.8	13300	2.8
	MLZ/MLM038T4	30	7100	2.1	8800	2.1	10900	2.2	13200	2.2	15900	2.3	-	-
		40	-	-	8000	2.6	9900	2.6	12100	2.7	14600	2.7	17300	2.8
		50	-	-	7200	3.1	8900	3.2	10900	3.2	13200	3.3	15700	3.3
	MLZ/MLM042T1	30	8000	2.6	9900	2.6	12100	2.7	14600	2.8	17300	2.8	-	-
		40	-	-	9000	3.1	11000	3.2	13400	3.2	16000	3.3	19000	3.4
		50	-	-	7900	3.7	9800	3.8	11900	3.8	14400	3.9	17200	4.0
	MLZ/MLM045T4	30	8800	2.5	11000	2.5	13500	2.5	16300	2.6	19500	2.7	-	-
		40	-	-	9900	3.1	12200	3.1	14800	3.1	17800	3.2	21100	3.3
		50	-	-	8600	3.7	10700	3.8	13100	3.8	15800	3.9	18900	3.9
	MLZ/MLM048T4	30	9300	2.6	11600	2.7	14200	2.7	17200	2.8	20600	2.9	-	-
		40	-	-	10400	3.3	12900	3.3	15600	3.4	18800	3.4	22200	3.5
		50	-	-	9200	4.0	11300	4.1	13900	4.1	16700	4.2	19900	4.2
	MLZ/MLM058T4	30	11100	3.1	13700	3.2	16800	3.4	20200	3.5	24000	3.6	-	-
		40	-	-	12400	4.0	15200	4.1	18300	4.2	21900	4.2	25900	4.3
		50	-	-	11000	4.8	13500	5.0	16300	5.1	19600	5.1	23300	5.1
	MLZ/MLM066T4	30	12700	3.6	15700	3.7	19200	3.8	23200	4.0	27600	4.1	-	-
		40	-	-	14200	4.5	17400	4.7	21100	4.8	25200	4.9	29800	4.9
		50	-	-	12600	5.5	15500	5.7	18800	5.8	22500	5.9	26700	5.9
	MLZ/MLM076T4	30	14300	4.1	17600	4.2	21500	4.4	26000	4.5	31000	4.7	-	-
		40	-	-	16000	5.2	19600	5.3	23600	5.5	28300	5.6	33400	5.6
		50	-	-	14200	6.4	17400	6.5	21100	6.6	25300	6.7	29800	6.7

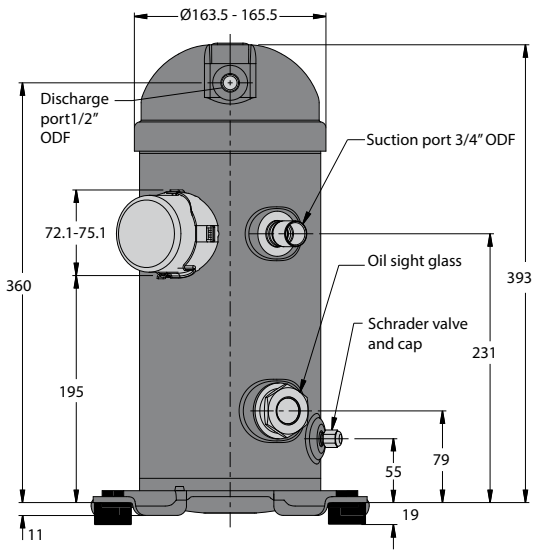
Legend: To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W
Pe: Power input in kW
RGT = 20°C
Subcooling =0 K

Capacity data at other conditions are available in the datasheets at: www.danfoss.com/odsg

MLZ/MLM015-019-021-026

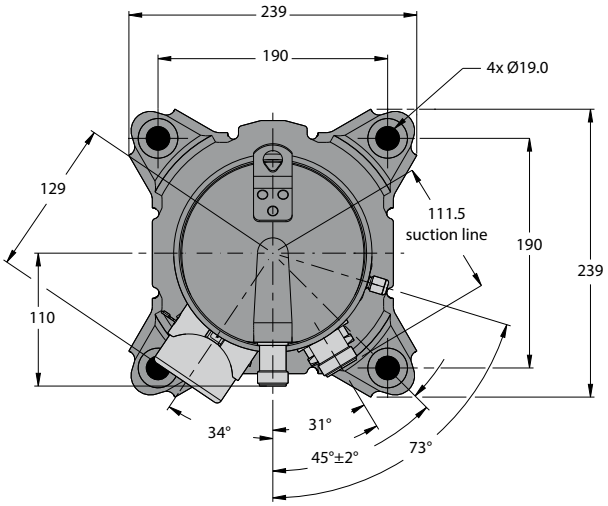
Brazed

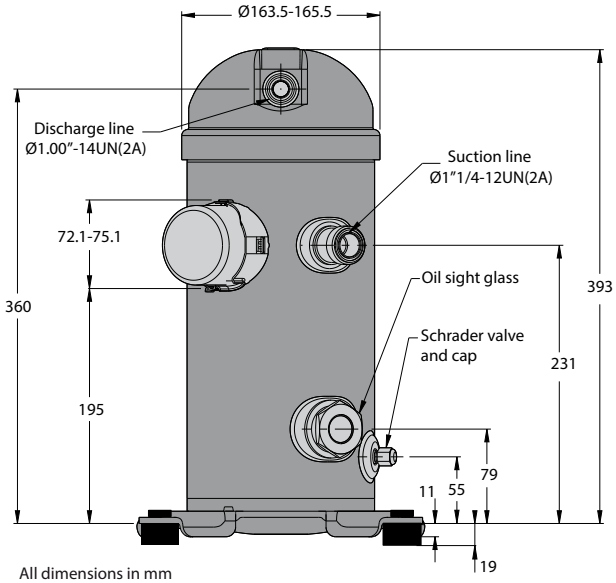




All dimensions in mm

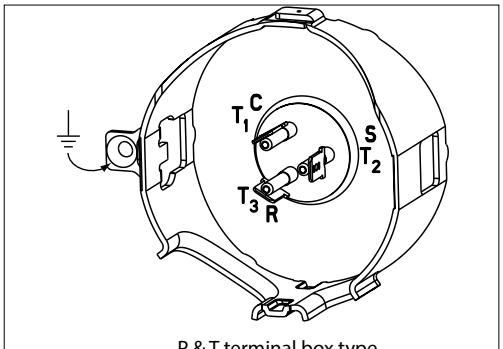
Rotolock





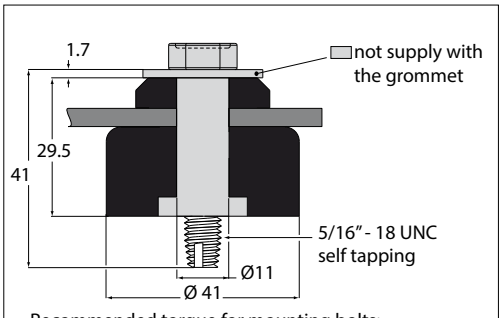
All dimensions in mm

Terminal box P & T (spade terminals)



P & T terminal box type

Mounting grommet



Recommended torque for mounting bolts: 11 Nm (±1 Nm)

Refer to section "Ordering information and packaging" for overview of shipped mounting accessories

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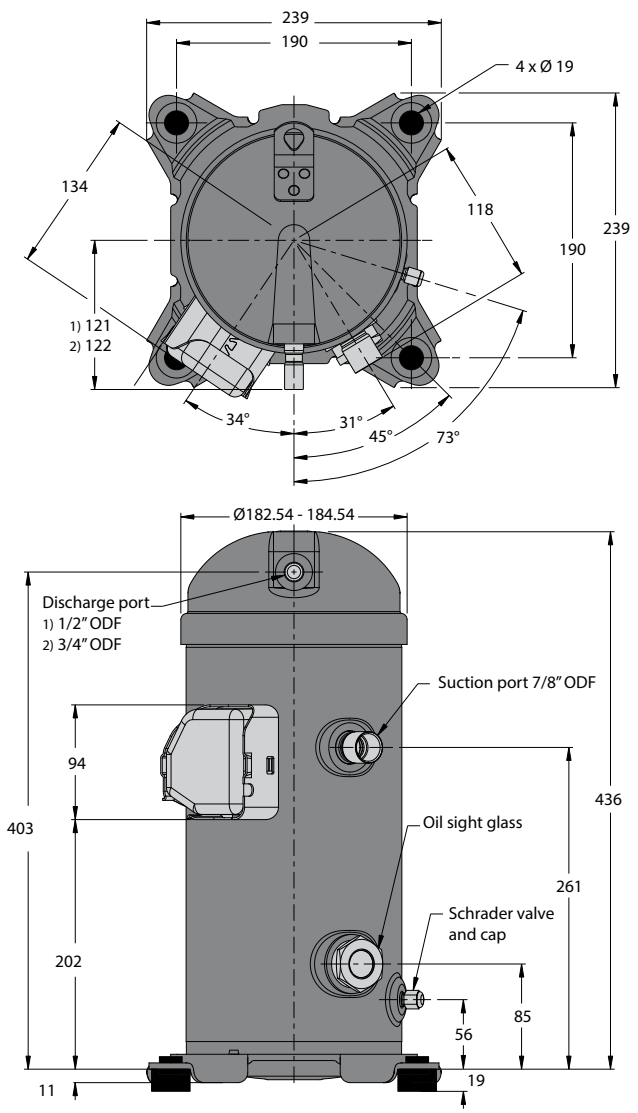
روبروی پالایشگاه نفت پارس، پلاک ۱۲

MLZ/MLM030-038-042-045-048

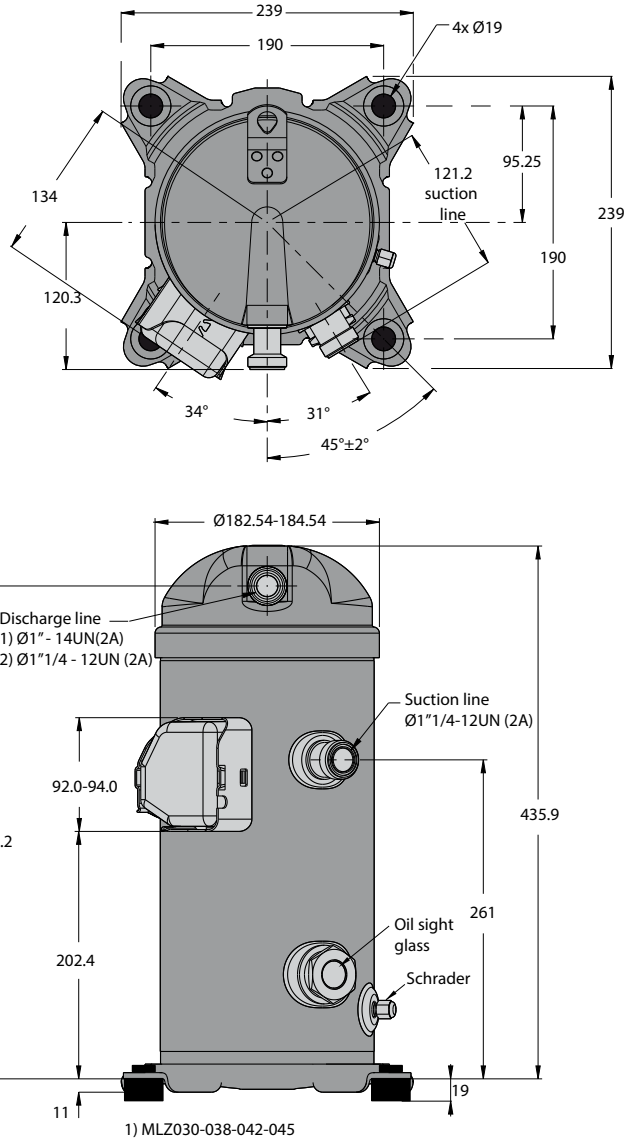
Brazed



1) MLZ/MLM 030-038-042-045
2) MLZ/MLM 048

All dimensions in mm

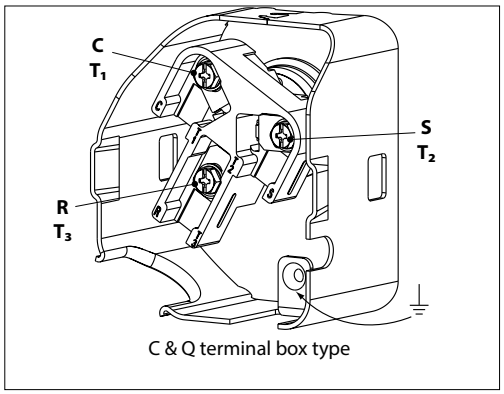
Rotolock



1) MLZ030-038-042-045
2) MLZ048

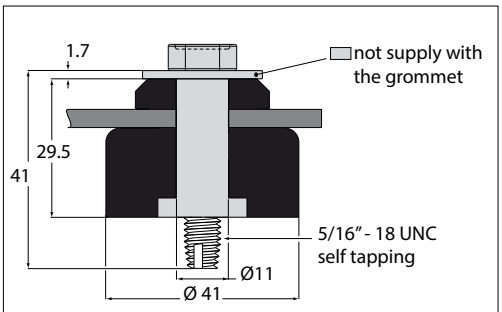
All dimensions in mm

Terminal box C & Q (screw terminals)



C & Q terminal box type

Mounting grommet

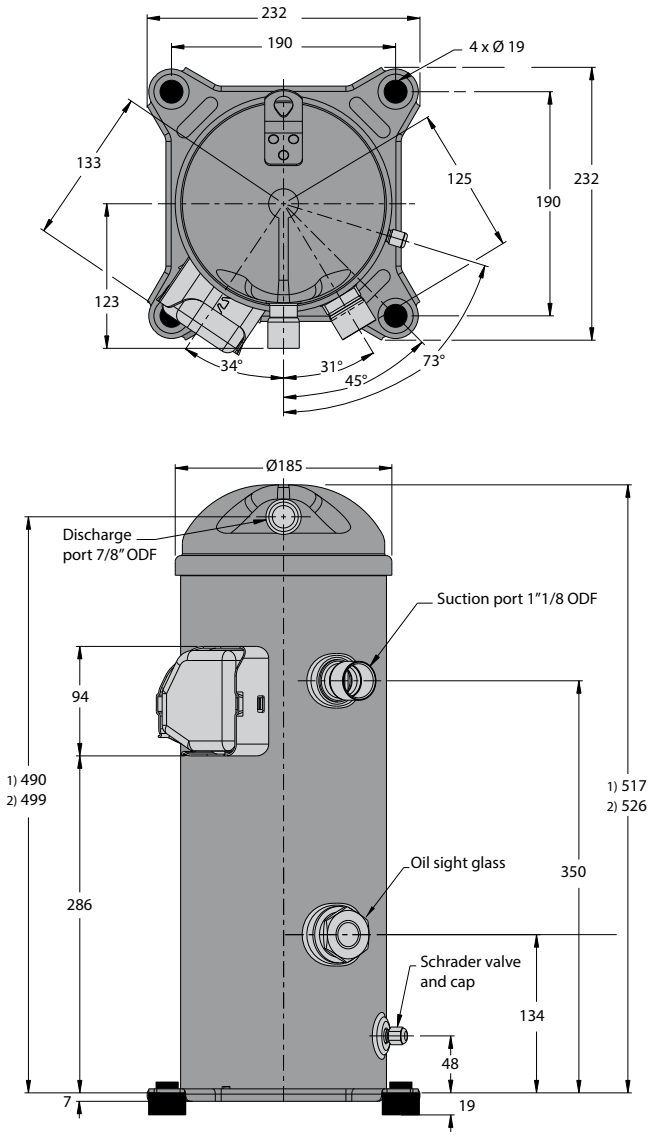


Recommended torque for mounting bolts:
11 Nm (±1 Nm)

Refer to section "Ordering information and packaging" for overview of shipped mounting accessories

MLZ/MLM058-066-076

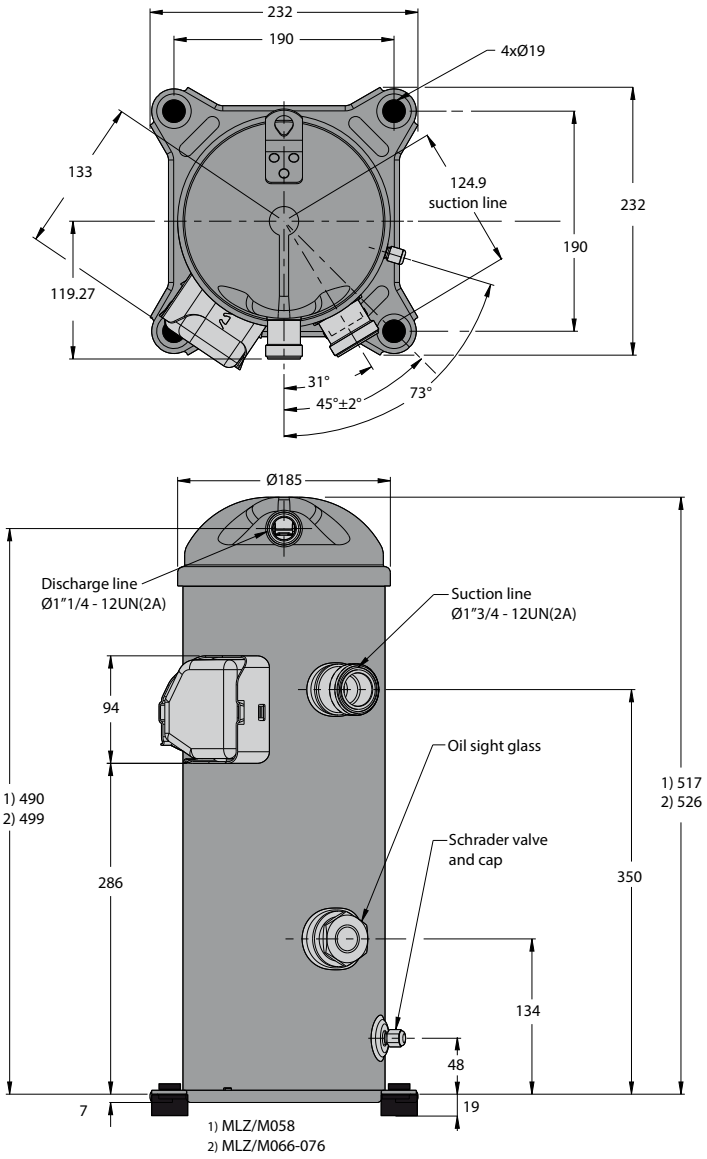
Brazed



1) MLZ/M058
2) MLZ/M066-076

All dimensions in mm

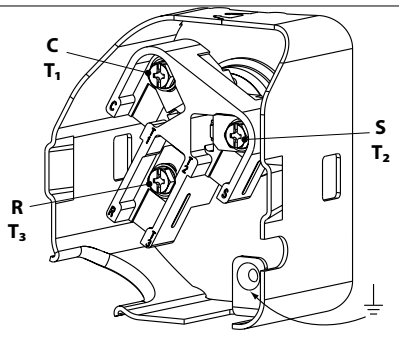
Rotolock



1) MLZ/M058
2) MLZ/M066-076

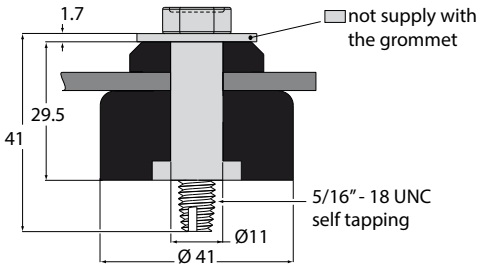
All dimensions in mm

Terminal box C & Q (screw terminals)



C & Q terminal box type

Mounting grommet



Recommended torque for mounting bolts:
11 Nm (±1 Nm)

Refer to section "Ordering information and packaging" for overview of shipped mounting accessories

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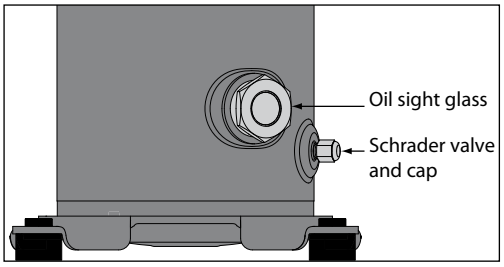
تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

Application Guidelines

Dimensions

Oil sight glass

MLZ / MLM scroll compressors come equipped with a threaded oil sight glass with 1"1/8 - 18 UNEF connection. It can be used for a visual check of the oil amount and condition or it may be replaced by an accessory oil management device. The oil level must be visible in the sight glass during operation.
Torque requirement= 52.5 ±2.5Nm



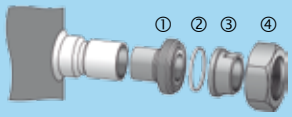
Schrader

The oil fill and drain connection and gauge port is a 1/4" male flare connector incorporating a schrader valve.
Torque requirements:
Schrader valve core: 0.6 ±0.2 Nm
Schrader valve cover: 14.5 ±1Nm

Suction and discharge connections

MLZ / MLM scroll compressors are factory delivered with brazed connections only.

Dedicated rotolock adaptors and adaptor sets are available as accessory.



Compressor models	Brazed connection size		Rotolock adaptor set (①adaptor, ②gasket, ③sleeve, ④nut)			Rotolock adaptor (① adaptor only)
			Rotolock	Solder sleeve ODF	Code Number	Code Number
MLZ/MLM 015-019-021-026	Suction	3/4"	1-1/4"	3/4"	120Z0126	120Z0366
	Discharge	1/2"	1"	1/2"		120Z0365
MLZ/MLM 030-038-042-045	Suction	7/8"	1-1/4"	7/8"	120Z0127	120Z0367
	Discharge	1/2"	1"	1/2"		120Z0365
MLZ/MLM 048	Suction	7/8"	1-1/4"	7/8"	120Z0128	120Z0367
	Discharge	3/4"	1-1/4"	3/4"		120Z0366
MLZ/MLM 058-066-076	Suction	1-1/8"	1-3/4"	1-1/8"	120Z0129	120Z0364
	Discharge	7/8"	1-1/4"	7/8"		120Z0367

Tightening torque for rotolock connection: 90Nm ±20

Motor voltage

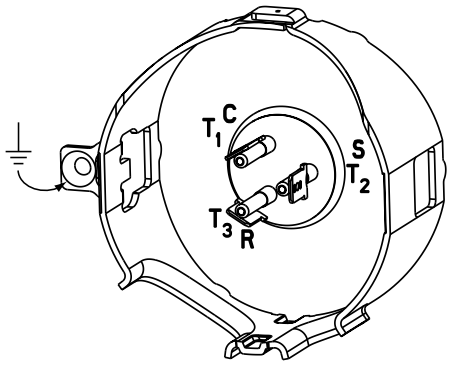
MLZ/MLM scroll compressors are available in 6 different motor voltages.

	Motor voltage code 1	Motor voltage code 2	Motor voltage code 4	Motor voltage code 5	Motor voltage code 7	Motor voltage code 9
Nominal voltage 50 Hz	-	200-220 V - 3 ph	380-400 V - 3 ph	220-240 V - 1 ph	-	-
Voltage range 50 Hz	-	180 - 242 V	340 - 460 V	198 - 264 V	-	-
Nominal voltage 60 Hz	208-230 V - 1 ph	208-230 V - 3 ph	460 V - 3 ph	-	575 V - 3 ph	380 V - 3 ph
Voltage range 60 Hz	187 - 253 V	187 - 253 V	414 - 506 V	-	517 - 632 V	342 - 418 V

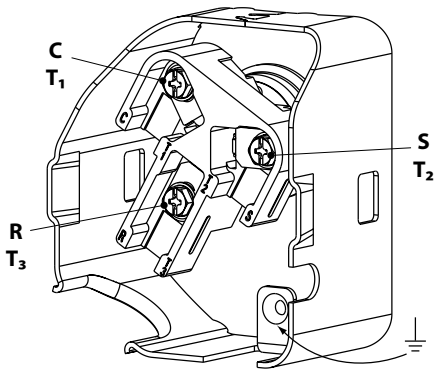
Wiring connections

MLZ/MLM scroll compressors will only compress gas while rotating counter-clockwise (when viewed from the compressor top). Since single-phase motors will start and run in only one direction, reverse rotation is not a major consideration. Three-phase motors, however, will start and run in either direction, depending on the phase angles of the supplied power. Care must be taken during installation to ensure that the compressor operates in the correct direction (see "Phase sequence and reverse rotation protection").

The drawings below show electrical terminal labelling and should be used as a reference when wiring the compressor. For three phase applications, the terminals are labelled T1, T2, and T3. For single-phase applications the terminals are labelled C (common), S (start), and R (run).



P & T terminal box type

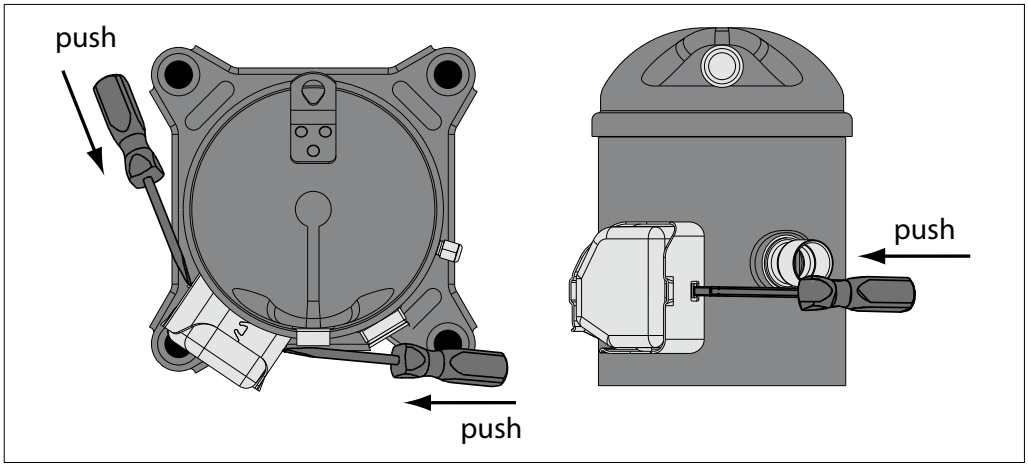


C & Q terminal box type

Terminal cover mounting

The terminal cover and gasket should be installed prior to operation of the compressor. Respect the "up" marking on gasket and cover and ensure that the two outside tabs of the cover engage the terminal box.

Terminal cover removal



IP rating

The compressor terminal box IP rating according to CEI 529 is **IP22** for all models.

- First numeral, level of protection against contact and foreign objects
  2 protection against object size over 12.5 mm (fingers of similar)
- Second numeral, level of protection against water
  2 protection against dripping water when tilted up to 15°

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Three phase electrical characteristics

Compressor model		LRA	MCC	Max Oper A	Winding resistance (Ohm)		
		A	A	A	T1-T3	T1-T2	T2-T3
Motor voltage code 2 200-220 V / 3 ph / 50 Hz. 208-230 V / 3 ph / 60 Hz	MLZ/MLM015T2	60	14.5	9.9	1.23	1.67	1.67
	MLZ/MLM019T2	95	17.5	13.3	0.87	1.18	1.18
	MLZ/MLM021T2	95	17.5	13.6	0.87	1.18	1.18
	MLZ/MLM026T2	95	22.0	16.6	0.87	1.18	1.18
	MLZ/MLM030T2	120	26.0	19.7	0.67	0.67	0.68
	MLZ/MLM038T2	123	26.0	23.5	0.60	0.60	0.61
	MLZ/MLM045T2	170	30.0	28.2	0.48	0.46	0.48
	MLZ/MLM048T2	190	37.0	30.6	0.43	0.44	0.43
	MLZ/MLM058T2	190	40.0	36.1	0.37	0.37	0.37
	MLZ/MLM066T2	235	46.0	40.7	0.32	0.32	0.33
	MLZ/MLM076T2	235	50.0	47.6	0.32	0.32	0.33
Motor voltage code 4 380-400 V / 3ph / 50 Hz. 460 V / 3 ph / 60 Hz	MLZ/MLM015T4	30	7.0	4.9	5.0	6.7	6.7
	MLZ/MLM019T4	45	9.5	6.7	3.4	4.7	4.7
	MLZ/MLM021T4	45	9.5	6.8	3.4	4.7	4.7
	MLZ/MLM026T4	45	11.0	8.3	3.4	4.7	4.7
	MLZ/MLM030T4	60	13.0	9.8	2.6	2.6	2.6
	MLZ/MLM038T4	70	15.0	11.7	2.3	2.3	2.4
	MLZ/MLM045T4	82	15.0	14.1	1.9	1.9	1.8
	MLZ/MLM048T4	87	16.0	15.3	1.7	1.7	1.7
	MLZ/MLM058T4	95	20.0	18.1	1.4	1.4	1.4
	MLZ/MLM066T4	110	24.0	20.3	1.3	1.3	1.3
	MLZ/MLM076T4	140	25.0	23.9	1.1	1.1	1.1
Motor voltage code 7 500 V / 3ph / 50 Hz. 575 V / 3ph / 60 Hz	MLZ/MLM015T7	26	5.5	4.0	7.8	10.6	10.6
	MLZ/MLM019T7	38	7.0	5.4	5.4	7.3	7.3
	MLZ/MLM021T7	38	8.0	5.5	5.4	7.3	7.3
	MLZ/MLM026T7	38	9.0	6.0	5.4	7.3	7.3
	MLZ/MLM030T7	42	9.0	7.8	4.4	4.5	4.4
	MLZ/MLM038T7	53	11.5	9.4	4.0	3.9	4.0
	MLZ/MLM045T7	64	11.5	11.3	2.8	2.9	2.9
	MLZ/MLM048T7	67	14	12.3	2.6	2.6	2.5
	MLZ/MLM058T7	75	16	14.4	2.3	2.3	2.3
	MLZ/MLM066T7	95	17	16.3	2.0	2.0	2.0
	MLZ/MLM076T7	100	20	19.1	1.7	1.7	1.7
Motor voltage code 9 380 V / 3ph / 60 Hz	MLZ/MLM015T9	40	7.5	6.0	3.2	4.4	4.4
	MLZ/MLM019T9	52	11.5	8.1	2.2	3.0	3.0
	MLZ/MLM021T9	52	12	8.3	2.2	3.0	3.0
	MLZ/MLM026T9	52	12.5	10.1	2.2	3.0	3.0
	MLZ/MLM030T9	81	14	11.8	1.5	1.5	1.5
	MLZ/MLM038T9	81	17	14.2	1.5	1.5	1.5
	MLZ/MLM045T9	96	20	17.0	1.3	1.3	1.3
	MLZ/MLM048T9	110	19	18.5	1.1	1.1	1.1
	MLZ/MLM058T9	135	25	21.9	0.91	0.93	0.93
	MLZ/MLM066T9	135	28	24.6	0.88	0.89	0.87
	MLZ/MLM076T9	135	28	28.9	0.88	0.89	0.87

Single phase electrical characteristics

Compressor model		LRA	MCC	Max.Oper.A	Winding resistance (Ω)	
		A	A	A	Run	Start
Motor code 5 220-240 V / 1 ph / 50 Hz	MLZ/MLM015T5	60	19.0	13.8	1.02	1.60
	MLZ/MLM019T5	97	23.0	18.3	0.69	1.51
	MLZ/MLM021T5	97	25.0	19.5	0.69	1.51
	MLZ/MLM026T5	97	26.0	24.2	0.69	1.51
	MLZ/MLM030T5	127	32.0	28.9	0.42	1.31
	MLZ/MLM038T5	130	38.0	33.9	0.39	1.02
	MLZ/MLM042T5	130	40.0	37.1	0.39	1.02
Motor code 1 208-230 V / 1 ph / 60 Hz	MLZ/MLM015T1	69	19.0	13.8	0.84	1.70
	MLZ/MLM019T1	97	25.0	19.9	0.67	1.57
	MLZ/MLM021T1	97	24.5	21.4	0.67	1.57
	MLZ/MLM026T1	115	31.5	26.8	0.55	1.47
	MLZ/MLM030T1	150	38.0	31.9	0.34	0.90
	MLZ/MLM038T1	160	45.0	37.2	0.28	1.76
	MLZ/MLM042T1	189	60.0	46.6	0.23	0.69

LRA (Locked Rotor Amp)

LRA is the higher average current as measured on a mechanically blocked compressor tested under nominal voltage. LRA is printed on the nameplate.

The LRA value can be used as a rough estimation for the starting current. However in most cases, the real starting current will be lower. Many countries have defined limits for the starting current in domestic use. A soft starter can be applied to reduce starting current.

MCC (Maximum Continuous Current)

The MCC is the current at which the internal motor protection trips under maximum load and low voltage conditions.

This MCC value is the maximum at which the compressor can be operated in transient conditions and out of the application envelope. Above this value the overload will switch off to protect the motor.

Max Oper. A (Maximum Operating Amp)

The Max Oper. A is the current when the compressor operates at maximum load conditions and 10% below nominal voltage.

This value which is the max rated load current for the compressor is new on the nameplate.

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

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

Winding resistance

Winding resistance is the resistance between indicated terminal pins at 25°C (resistance value +/- 7%).
Winding resistance is generally low and it requires adapted tools for precise measurement. Use a digital ohm-meter, a '4 wires' method and measure under stabilised ambient temperature. Winding resistance varies strongly with winding temperature ; If the compressor is stabilised at a different value than 25°C, the measured resistance must be corrected with following formula:

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

$t_{25°C}$: reference temperature = 25°C

t_{amb}: temperature during measurement (°C)

$R_{25°C}$: winding resistance at 25°C

R_{amb}: winding resistance at t_{amb}

coefficient a= 234.5

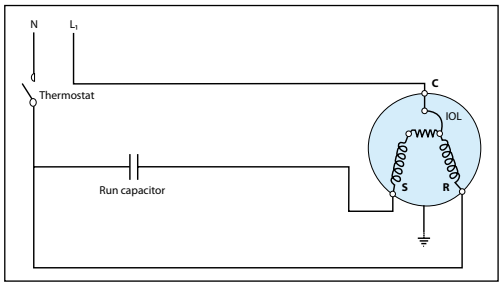
Electrical connections

MLZ / MLM single phase scroll compressors are designed to operate without any assistance. If starting within the defined voltage range, PSC wiring is sufficient.

PSC wiring

PSC wiring with a run capacitor only is the default wiring solution for single phase MLZ and MLM compressors.

The start winding (C-S) of the motor remains in circuit through a permanent (run) capacitor. This permanent (run) capacitor is connected between the start winding (S) and the run winding (R).



PTCSCR wiring

If the starting torque of the PSC wiring is not sufficient due to pressures not fully equalized during the off-cycle or some voltage drop during starting, the PTCSCR wiring might be an option. PTCSRC wiring provides more motor torque than PSC wiring but less than CSR wiring. The PTC is wired in parallel to the run capacitor.

When starting the compressor, the PTC, which is at low resistance, provides additional starting current to the motor's start winding. The current passing through the PTC causes it to heat up and, at a certain temperature, change to a very high resistance. At this time the motor is up to nominal speed and the run capacitor determines the current through the start winding. The PTC

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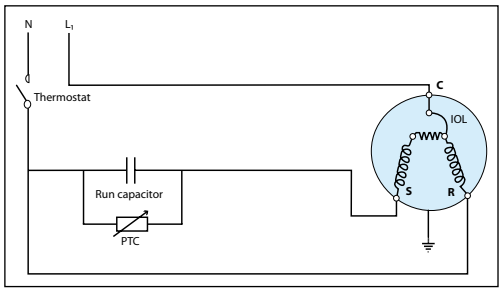
remains at high temperature and thus at high resistance as long as power is connected to the compressor. When the compressor is switched off, the PTC cools down to its initial low resistance and becomes available to support the next compressor start.
It is important to provide sufficient time between motor starts to allow the PTC to cool down close to ambient temperature. Depending on the ambient conditions and the cooling of the PTC, this may take about 5 minutes. A restart before the PTC is back to low resistance may be successful or the motor may stall in a locked-rotor state depending on the ambient and system's conditions. A locked-rotor state causes the internal protector to open and would cause even further delay until the overload is reset.

The following PTC types are recommended for the MLZ/MLM single phase compressors:



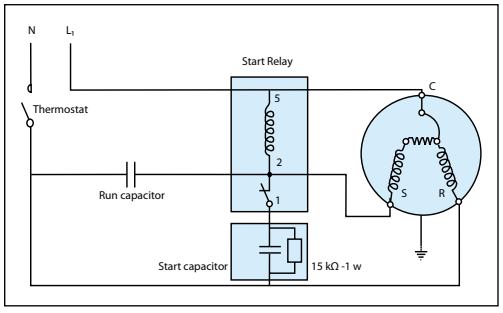
Model	Voltage code 1 208-230 V/1~/60 Hz	Voltage code 5 220-240 V/1~/50 Hz
MLZ/MLM015	305C12*	305C9* / 305C11*
MLZ/MLM019	305C9* / 305C11*	305C9* / 305C11*
MLZ/MLM021	305C9* / 305C11*	305C9* / 305C11*
MLZ/MLM026	305C12*	305C9* / 305C11*
MLZ/MLM030	305C9* / 305C11*	305C9* / 305C11*
MLZ/MLM038	305C9* / 305C11*	305C9* / 305C11*
MLZ/MLM042	305C9* / 305C11*	305C9* / 305C11*

Note: MLZ compressors with PTCSCR are not approved by UL. It is the customers' responsibility to get final approval for the system when required.

CSR wiring

CSR wiring provides additional motor torque at start-up, by the use of a start capacitor in combination with the run capacitor. The start capacitor is only connected during the starting operation, a potential relay is used to disconnect it after the start sequence.

Some applications with high differential pressure and start duty as "soft serve ice cream machine" can require CSR wiring. This configuration can also be used to reduce erratic starting at unfavourable conditions such as very low ambient temperature or weak voltage.

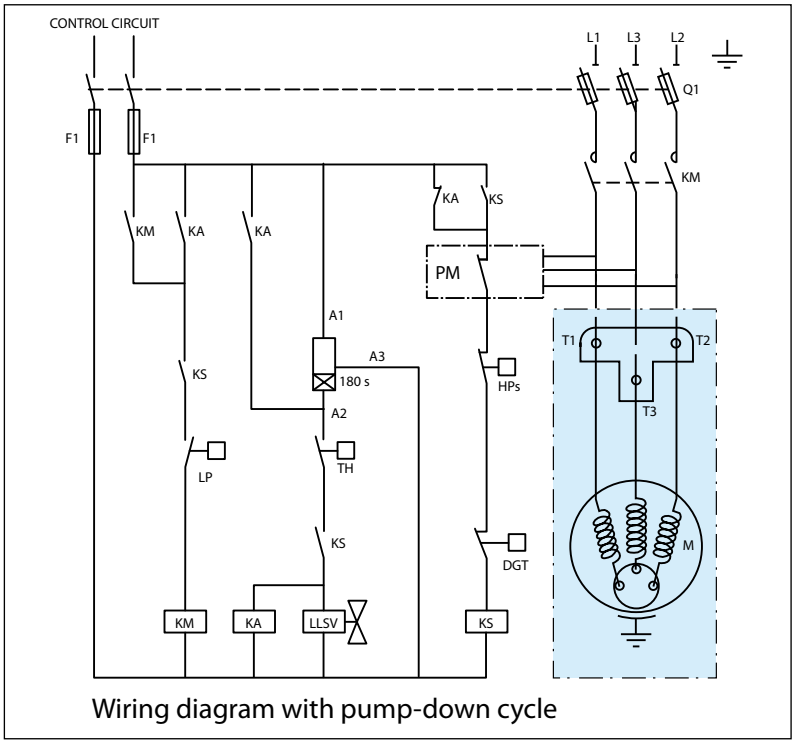


Nominal capacitor value and relays

	Compressor models	Default solution: PSC wiring with run capacitor only		Additionnal components for CSR wiring			
		PSC wiring		CSR wiring			
		Run capacitor		Start capacitor		Relay	
		µF	Volt	µF	Volt	Reference	
220-240 V /1/50 Hz Motor voltage code 5	MLZ/MLM015	40	370	145-175	330	3ARR3J3AL4	RVA9CKL
	MLZ/MLM019-021-026	70	370	145-175	330	3ARR3J3AL4	RVA9CKL
	MLZ/MLM030	50	440	161-193	250	3ARR3J24AP4	RVA3EKL
	MLZ/MLM038-042	55	440	88-108	330	3ARR3J25AS4	RVA4GKL
For information 208-230 V / 1 / 60 Hz Motor voltage code 1 not provided with the compressor	MLZ/MLM015	45	370	145-175	330	3AAR3*3M*	-
	MLZ/MLM019-021	45	370	145-175	250	3AAR3*3M*	-
	MLZ/MLM026	60	370	88-108	330	3ARR3*3L*	-
	MLZ/MLM030	70	370	161-193	250	3ARR3*3L*	-
	MLZ/MLM038	55	440	88-108	250	3ARR3*25S*	-
	MLZ/MLM042	80	370	189-227	330	3ARR3*3L	-

Three phase

Suggested wiring diagram with "one shot" pump down cycle and safety lock-out relay



Wiring diagram with pump-down cycle

Control device..... TH
Optional short cycle timer (3 min) ..... 180 s
Control relay ..... KA
Liquid Line Solenoid valve.....LLSV
Compressor contactor..... KM
Phase monitor ..... PM
Safety lock out relay.....KS
Pump-down control low pressure switch ..LP
High pressure safety switch..... HPs
Fused disconnect Q1
Fuses F1
Compressor motor .....M
Discharge gas thermostat..... DGT

Internal motor protection

MLZ/MLM scroll compressors are equipped with an internal line break protector mounted on the motor windings. The protector is an automatic reset device, containing a snap action bimetal switch.

Internal protectors respond to over-current and overheating. They are designed to interrupt motor current under a variety of fault conditions, such as failure to start, running overload, and fan failure.

If the internal overload protector trips out, it must cool down to about 60°C to reset. Depending on ambient temperature, this may take up to several hours.

Phase sequence and reverse rotation protection

The compressor will only operate properly in a single direction. Use a phase meter to establish the phase orders and connect line phases L1, L2 and L3 to terminals T1, T2 and T3, respectively. For three-phase compressors, the motor will run equally well in both directions. Reverse rotation results in excessive noise; no pressure differential between suction and discharge; and suction line warming rather than immediate cooling.
A service technician should be present at initial start-up to verify that supply power is properly phased and that compressor and auxiliaries are rotating in the correct direction.

MLZ/MLM015-038 scroll compressors are designed to operate for a maximum of 150 hours in reverse, but as a reverse rotation situation can go unnoticed for longer periods, phase monitors are recommended.

For compressors MLZ/MLM048 and larger, phase monitors are required. The selected phase monitor should lock out the compressor from operation in reverse.

At brief power interruptions, reverse rotation can occur with single phase compressors. In this case the internal protector will stop the compressor. It will have to cool down and will restart safely afterwards.

Voltage imbalance

For three-phase applications the voltage measured at the compressor terminals for each phase should be within ± 2% of the average for all phases.

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Approvals and certificates

MLZ scroll compressors comply with the following approvals and certificates.

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

CE 0062 or CE 0038 (European Directive) CE	All MLZ models
UL (Underwriters Laboratories) cULus	Models with motor code 1, 2 & 4 except when using PTCSCR system
Other approvals / certificates	Contact Danfoss

Conformity to directives

Pressure equipment directive 97/23/EC
Machinery directive 98/35/EC annex II b
Low voltage directive 2006 / 95 EC
Electromagnetic compatibility 2004/108/CE

Products	MLZ / MLM 015 to 076
Refrigerating fluids	Group 2
Category PED	I
Evaluation module	no scope
Service temperature - Ts	-35°C < Ts < 55°c
MLZ - Service pressure - Ps	25.44 bar(g)
MLM - Service pressure - Ps	20.74 bar(g)
Declaration of conformity	contact Danfoss
Marking of conformity	CE

Internal free volume

Products	Internal free volume at LP side without oil (litre)
MLZ/MLM 015 - 026	1.85
MLZ/MLM 030-048	1.85
MLZ/MLM 058-076	6.15

Application Guidelines	Operating conditions	
	The scroll compressor application range is influenced by several parameters which need to be monitored for a safe and reliable operation. These parameters and the main recommendations for good practice and safety devices are explained hereunder.	• **Refrigerant and lubricants** • **Motor supply** • **Compressor ambient temperature** • **Application envelope** (evaporating temperature, condensing temperature, return gas temperature)
Refrigerant and lubricants		
General information	When choosing a refrigerant, different aspects must be taken into consideration: • Legislation (now and in the future) • Safety • Application envelope in relation to expected running conditions • Compressor capacity and efficiency • Compressor manufacturer recommendations & guidelines	Additional points could influence the final choice: • Environmental considerations • Standardisation of refrigerants and lubricants • Refrigerant cost • Refrigerant availability
R22	R22 is an HCFC refrigerant and is still a wide use today. It has a low ODP (Ozone Depletion Potential) and therefore it will be phased out in the future. Check local legislation.	When R22 is applied in refrigeration applications it can lead to high discharge temperature. Carefully check all other parameters that can influence the discharge temperature.
R134a	Refrigerant R134a is an HFC refrigerant. R134a has zero ozone depletion potential (ODP = 0) and is commonly accepted as the best R12 alternative. R134a is a pure refrigerant and	has zero temperature glide. For applications with high evaporating and high condensing temperatures, R134a is the ideal choice.
R404A	R404A is an HFC refrigerant. R404A has zero ozone depletion potential (ODP = 0). R404A is especially suitable for low evaporating temperature applications but it can also be applied to medium evaporating temperature applications. R404A is a mixture and has a very	small temperature glide, and therefore must be charged in its liquid phase, but for most other aspects this small glide can be neglected. Because of the small glide, R404A is often called a near-azeotropic mixture.
R507	R507 is an HFC refrigerant with properties comparable to R404A. R507 has no ozone depletion potential (ODP = 0). As with R404A, R507 is particularly suitable for low evaporating	temperature applications but it can also be used for medium evaporating temperature applications. R507 is an azeotropic mixture with no temperature glide.
PVE	Polyvinyl ether (PVE) is an innovative refrigeration lubricant for HFC refrigerant systems. PVE is as hygroscopic as existing polyolester lubricants (POE), but PVE doesn't chemically react with water; no acids are formed and compressor evacuation is easier. As PVE can be mixed with POE, oil top up can be done with up to 25% POE.	The compressor technology applied in MLZ compressors in combination with PVE lubricant provides the best possible result in terms of reliability and compressor lifetime. The PVE lubricant is compatible with R22 which makes the MLZ compressors a very versatile multi- refrigerant solution. Very high care has to be taken for vacuum as PVE is much more hygroscopic than alkylbenzene or mineral oil.
Alkylbenzene oil	Alkylbenzene oil can be applied in systems using HCFC refrigerants (R22). Compared to a mineral oil it provides distinct advantages: excellent miscibility, excellent thermal stability, compatibility with mineral oils and constant quality.	MLM series compressors are charged with Alkylbenzene oil and herewith offer an economically interesting alternative to the MLZ series in regions where R22 is still the predominant refrigerant. Note however that MLM compressors can not be used with HFC refrigerants.

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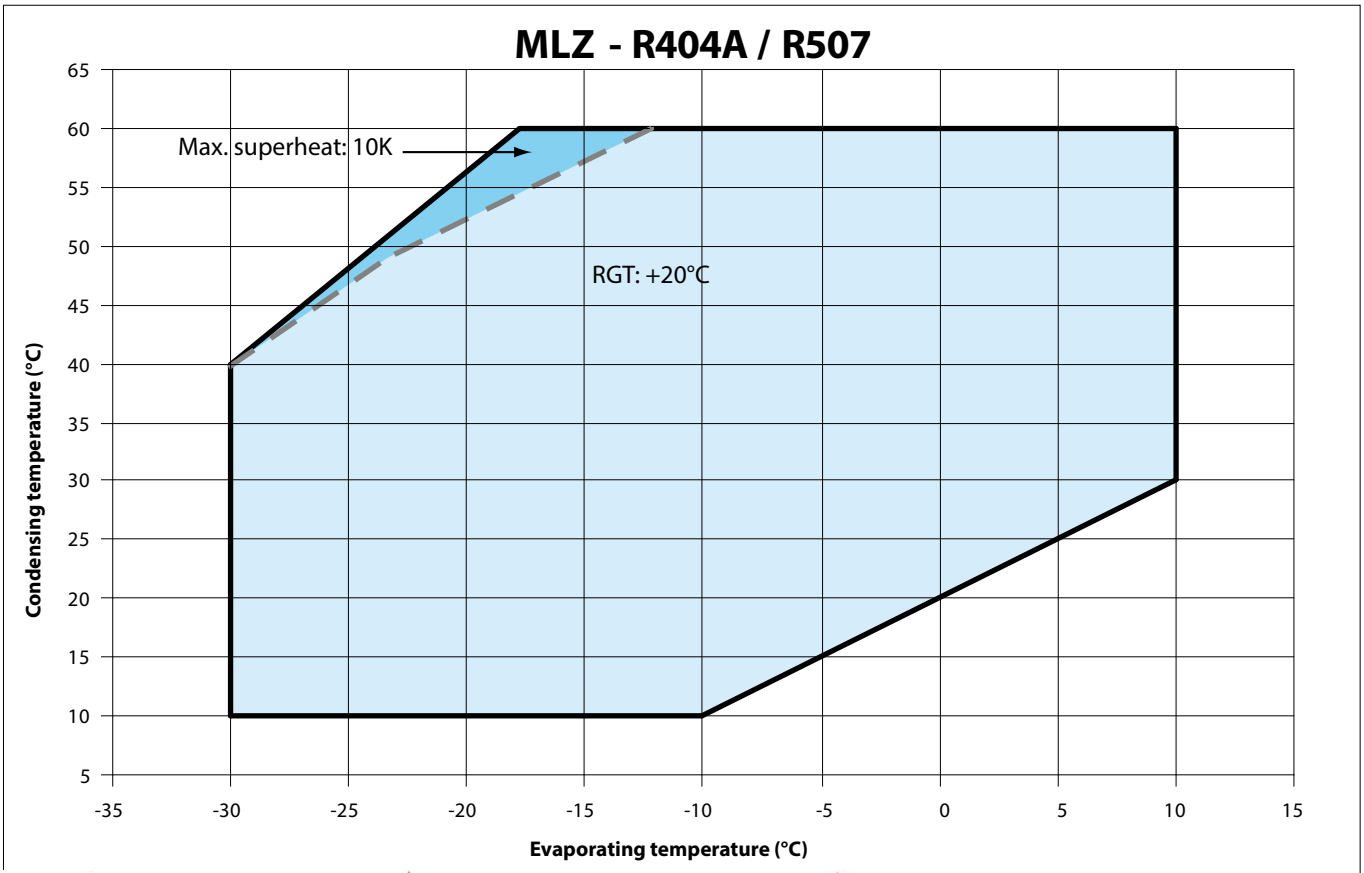
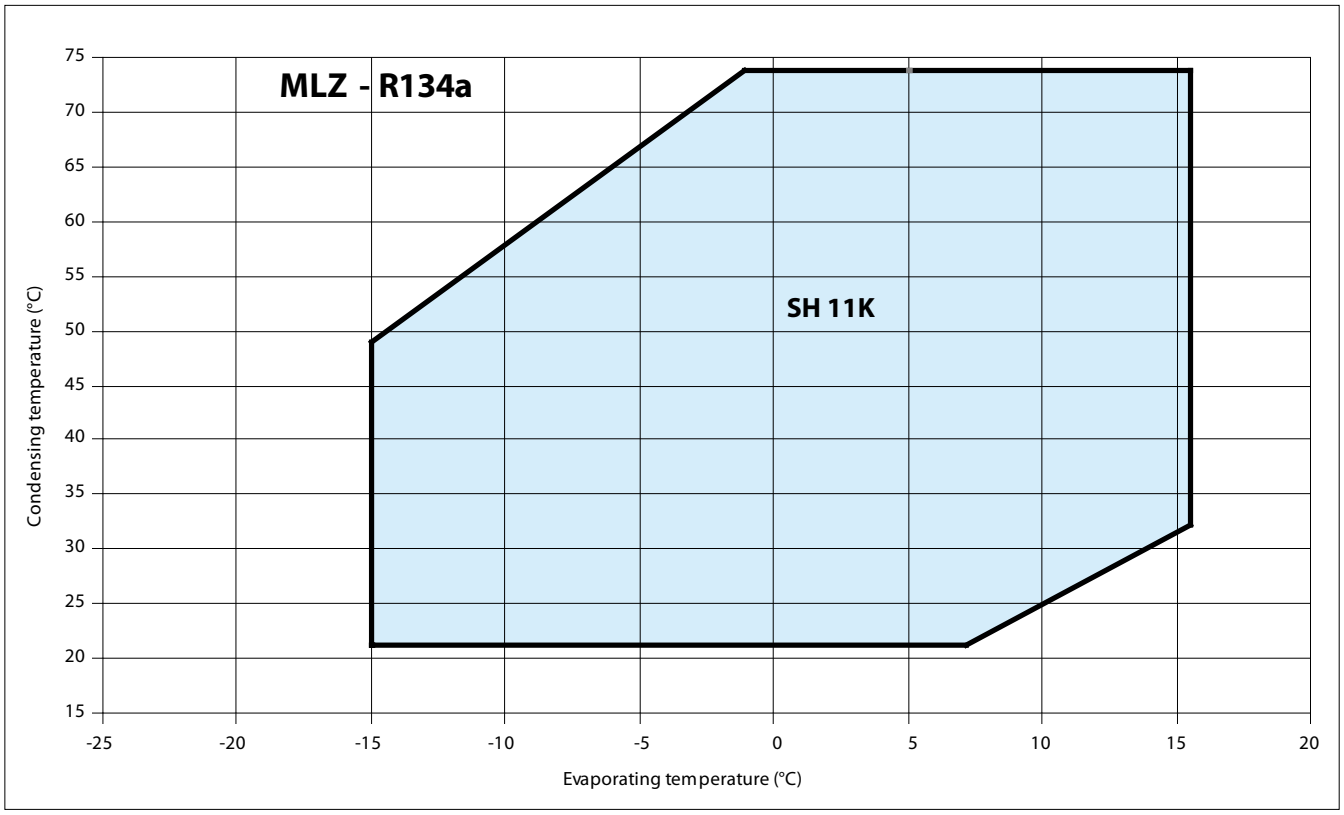
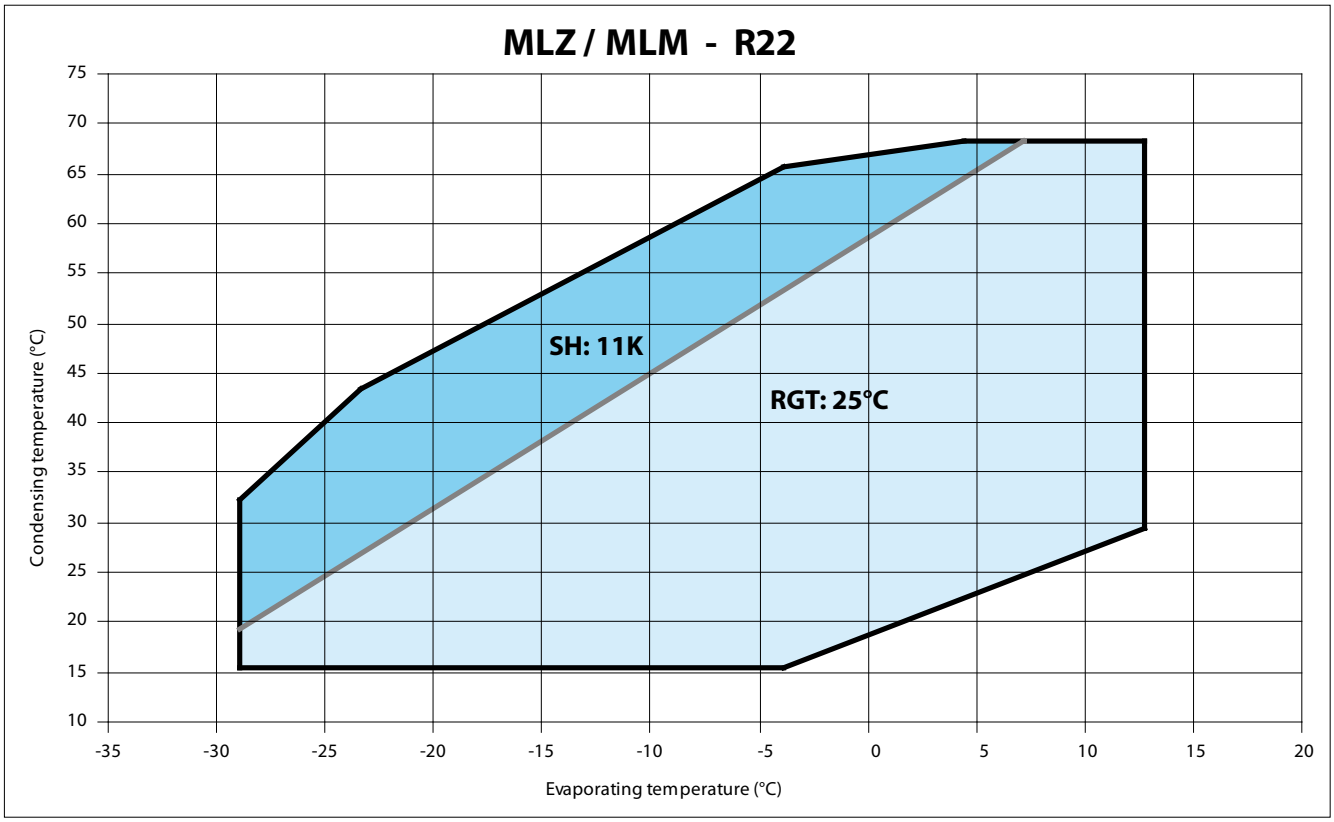
Application Guidelines	Operating conditions	
Motor supply	MLZ / MLM scroll compressors can be operated at nominal voltages as indicated in table section "Motor voltage". Under-voltage and over-voltage operation is allowed within the indicated voltage	ranges. In case of risk of under-voltage operation, special attention must be paid to current draw and start assist for single-phase compressors may be required.
Compressor ambient temperature	MLZ / MLM compressors can be applied from -35°C to 50°C ambient temperature. The compressors are designed as 100 % suction gas	cooled without need for additional fan cooling. Ambient temperature has very little effect on the compressor performance.
High ambient temperature	In case of enclosed fitting and high ambient temperature it's recommend to check the temperature of power wires and conformity to their insulation specification.	In case of safe tripping by the internal compressor overload protection the compressor must cool down to about 60°C before the overload will reset. A high ambient temperature can strongly delay this cool-down process.
Low ambient temperature	Although the compressor itself can withstand low ambient temperature, the system may require specific design features to ensure safe	and reliable operation. See section 'Specific application recommendations'.
Application envelope	The operating envelopes for MLZ/MLM scroll compressors are given in the figures below, where the condensing and evaporating temperatures represent the range for steady-state operation. Under transient conditions, such as start-up and defrost, the compressor may operate outside this envelope for short periods. The figures below show the operating envelopes for MLZ compressors with refrigerants R404A/507, R134a and R22. The operating	limits serve to define the envelope within which reliable operations of the compressor are guaranteed: • Maximum discharge gas temperature: +135°C • A suction superheat below 5 K is not recommended due to the risk of liquid flood back • Minimum and maximum evaporating and condensing temperatures as per the operating envelopes.







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Maximum discharge gas temperature

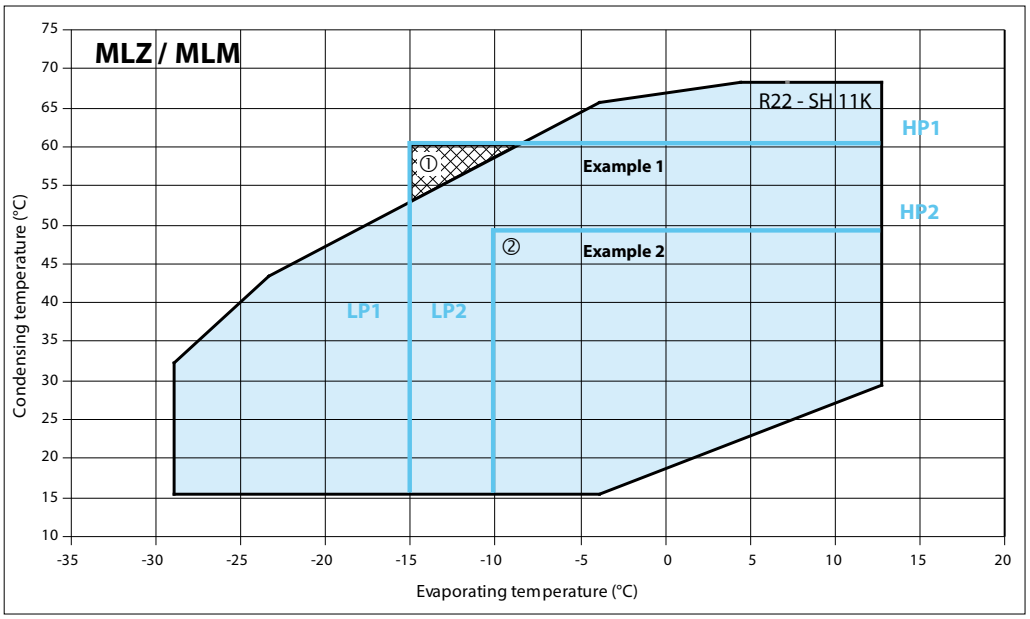
The discharge temperature depends mainly on the combination of evaporating temperature, condensing temperature and suction gas superheat. Discharge gas temperature should be controlled with an isolated thermocouple or thermostat attached to the discharge line 15 cm (6 inches) from the compressor shell. Maximum discharge gas temperature must not exceed 135°C (275°F) when the compressor is running within the approved operating envelope.

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 illustrate where DGT protection is required (n°1) and where it is not (n°2).

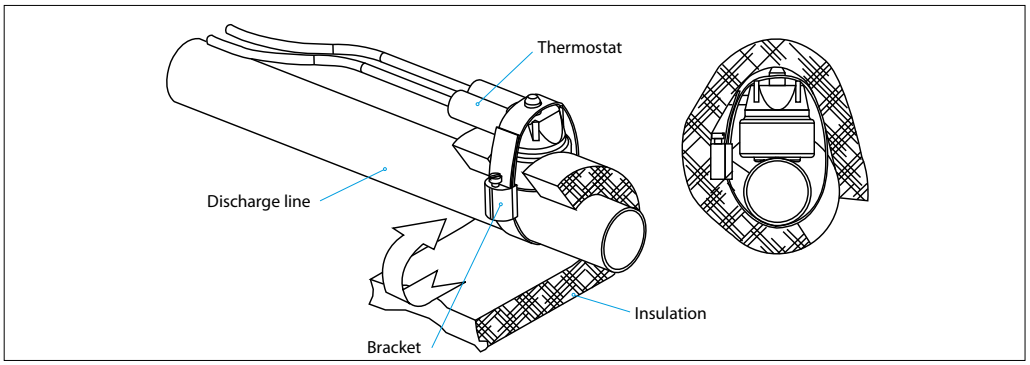
The compressor must not be allowed to cycle on the discharge gas thermostat. Continuous operations beyond the compressor's operating range will cause serious damage to the compressor!

A DGT accessory is available from Danfoss: refer to section "Spare parts & accessories".



Example 1 (R22, SH = 11 K)
LP switch setting: LP1 = 2 bar (g) (-15°C)
HP switch setting: HP1 = 23.8 bar (g) (61°C)
① The LP and HP switches don't protect sufficiently from operation outside the envelope. A DGT protection is required to avoid operation in the hatched area.

Example 2 (R22, SH = 11 K)
LP switch setting: LP2 = 2.5 bar (g) (-10°C)
HP switch setting: HP2 = 18 bar (g) (49°C)
② The LP and HP switches protect from operation outside the envelope. No DGT protection required.



High and low pressure protection

		R22	R404A	R134a
Working pressure range high side	bar (g)	7.03 - 27.9	7.20 - 27.7	4.91 - 22.1
Working pressure range low side	bar (g)	0.71 - 6.4	1.04 - 7.2	0.64 - 4.0
Maximum high pressure safety switch setting	bar (g)	29.8	29.7	23.6
Minimum low pressure safety switch setting ①	bar (g)	0.51	0.80	0.45
Recommended pump-down switch settings		1.5 bar below nominal evaporating pressure		
Minimum low pressure pump-down switch setting	bar (g)	0.94	1.31	0.85
Maximum testing pressure	bar(g)	31		

① LP safety switch shall never have time delay.

High pressure

MLZ/MLM 015-048 scroll compressors are equipped with an internal pressure relief valve (IPRV), for protection against blocked condenser and fan failure conditions (IPRV setting 27-34 bar differential pressure HP / LP). Still, a high pressure (HP) safety switch is recommended.

MLZ/MLM058-068-076 scroll compressors are not equipped with an internal pressure relief valve; therefore a high pressure switch is required to shut down the compressor should the discharge pressure exceed the values shown in the table above.

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.

Low pressure

A low pressure (LP) safety switch is recommended. MLZ/MLM scroll compressors exhibit high volumetric efficiency and may draw very low vacuum levels, which could induce scroll instability and electrical arcing at the internal cluster. The minimum low-pressure safety switch setting is given in the above 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 above.

On/off cycling (cycle rate limit)

Depending on the application, a number higher than 12 starts per hour can reduce the service life of the motor-compressor unit. A one-minute time out is recommended.

The system must be designed in a way that provides 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.

Danfoss recommends a restart delay timer to limit compressor cycling.

Application Guidelines	System design recommendations

General

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

Essential piping design considerations

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

If the evaporator lies above the compressor 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 to ensure the oil return to the compressor (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). The maximum elevation difference between the indoor and outdoor section cannot exceed 8 m. System manufacturers should specify precautions for any applications that exceed these limits to ensure compressor reliability.

Piping should be designed with adequate three-dimensional flexibility (figure 2). 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 sound level within that structure as well (for more information on sound and vibration, see the section on: "Sound and vibration management").

fig.1

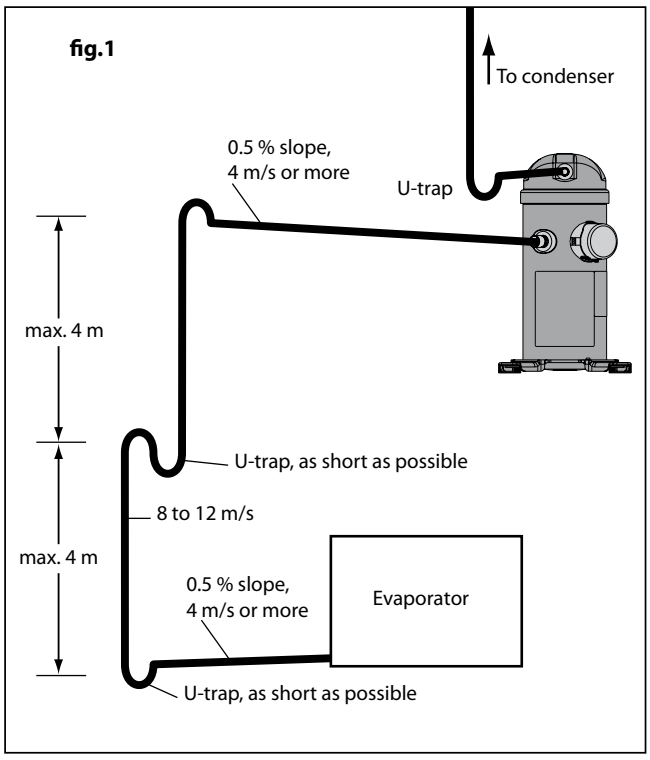
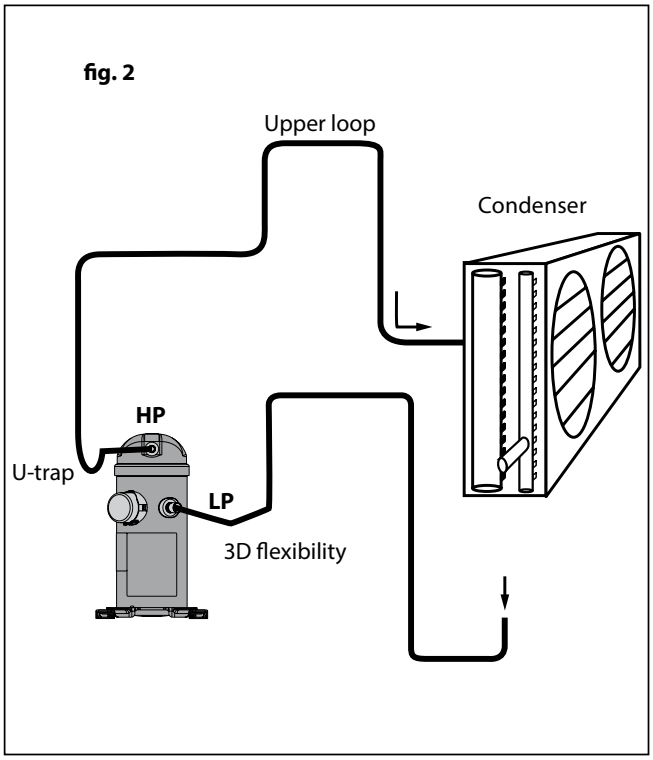


fig. 2



Refrigerant charge limit

MLZ/MLM scroll compressors can tolerate liquid refrigerant up to a certain extend without major problems. However, excessive liquid refrigerant in the compressor is always unfavourable for service life. Besides, the installation cooling capacity may be reduced because of the evaporation taking place in the compressor and/or the suction line instead of the evaporator. System design must be such that the amount of liquid refrigerant in the compressor is limited. In this respect, follow the guidelines given in the section: "essential piping design recommendations" in priority.
Use the tables below to quickly evaluate the required compressor protection in relation with the system charge and the application.
More detailed information can be found in the paragraphs hereafter. Please contact Danfoss for any deviation from these guidelines.

Model	Refrigerant charge limit (kg)
MLZ015-026	3.6
MLZ030-048	5.4
MLZ058-076	7.2

Depending on test results, crankcase heaters, Liquid Line Solenoid Valve, pump down or suction accumulator must be applied see below.

	BELOW charge limit	ABOVE charge limit
Packaged units	✓ No test or additional safeties required	REQ Off cycle migration test REQ Liquid flood back test
System with remote heat exchanger	REC Off cycle migration test	REQ Off cycle migration test REQ Liquid flood back test

REC Recommended REQ Required ✓ No test or additional safeties required

Note: for special conditions such as low ambient temperature, low load operation or brazed plate heat exchangers please refer to corresponding sections

Off-cycle migration

Off-cycle refrigerant migration is likely to occur when the compressor is located at the coldest part of the installation, when the system uses a bleed-type expansion device, or if liquid could migrate from the evaporator into the compressor sump by gravity. If too much liquid refrigerant accumulates in the sump it will saturate the oil and lead to a flooded start: when the compressor starts, the refrigerant evaporates abruptly under the sudden decrease of the bottom shell pressure, causing the oil to foam. In extreme situations, this might result in too much oil leaving the compressor, which must be avoided as it causes irreversible damages due to possible lack of lubrication.
MLZ/MLM scroll compressors can tolerate occasional flooded starts as long as the system has been evaluated.

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

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

The presence of liquid in the crankcase can be easily detected by checking the sump level through the oil sight glass. Foam in the oil sump indicates a flooded start.
A noisy start, oil loss from the sump and sump cool down are indications for migration.
Depending on the amount of migration graduate measures shall be taken:

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

Crankcase heater: when the compressor is idle, the oil temperature in the sump 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). Below –5°C ambient temperature and a wind speed of above 5m/sec, it's recommended to thermally insulated the heaters in order to limit the surrounding energy losses.

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Due to the Danfoss scroll compressors inherent ability to handle liquid refrigerant, crankcase heaters are not required when the system charge does not exceed the recommended maximum charge.

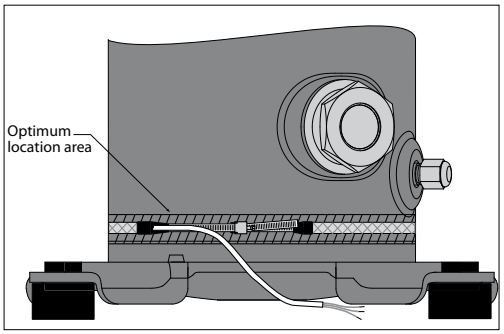
Since the total system charge may be undefined, a crankcase heater is recommended on all systems with remote heat exchangers. In addition, any system containing a refrigerant charge in excess of the maximum recommended system charge for compressors requires a crankcase heater.

Belt-type crankcase heater accessories are available from Danfoss (see section "Spare parts & Accessories").

The heater must be 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).

It is recommended that the heater be turned on for a minimum of 12 hours prior to starting the compressor.



Liquid line solenoid valve (LLSV): This feature is very convenient and can be used on all types of applications.

An LLSV is used to isolate the liquid charge in the high pressure side, thereby preventing against charge transfer or excessive migration to the compressor during off-cycles. The quantity of refrigerant remaining in 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: Once the system has reached its set point and is about to shut off, the LLSV on the liquid line closes. The compressor then pumps the majority of the refrigerant charge into the high pressure side 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.

A pump-down cycle represents one of the most effective ways to protect against the off-cycle migration of refrigerant; however it is only convenient to apply on application with thermostatic control.

Rack application with pressostatic control can use timer delay to empty the evaporators before the stop. Time should be carefully set to not interfere with the low safety pressure switch.

For low pressure pump-down switch settings, refer to section "High and low pressure protection". For suggested wiring diagrams, please see section "Electrical data".

Models MLZ/MLM015-048 incorporate an internal low leak check valve that is appropriate for pump-down operations. This valve prevents the back flow of refrigerant from the high pressure to the low pressure side through the compressor so pump down conditions can be achieved and Models MLZ/MLM058-076 are not equipped with this low leak check valve. Under certain conditions, the internal valve may not completely seal, and due to the refrigerant back flow the compressor might restart during pump-down applications. Repeated short cycling can result in a compressor breakdown. It is recommended to install an external magnetic check valve (such as Danfoss Part No. 120Z5046) close to the compressor's discharge connector so the discharge volume is minimized.

A magnetic check valve is recommended for this as it offers the best solution regarding minimal required and maximal pressure drop over the wide application envelope of the MLZ/MLM compressors. If a Danfoss NRV check valve is applied it has to be carefully selected for the specific operation conditions of the individual system.

Tests for pump down cycle approval:

- As the pump-down switch setting is inside the application envelope, tests should be carried out to check unexpected cut-out during transient conditions (ie. defrost – cold starting). When unwanted cut-outs occur, the low pressure pump-down switch can be delayed. In this case a low pressure safety switch without any delay timer is mandatory.

Application Guidelines	System design recommendations	
	• While the thermostat is off, the number of pressure switch resets should be limited to avoid short cycling of the compressor. Use dedicated wiring and an additional relay which allows for one shot pump-down. The pump-down allows to store all the refrigerant in the high pressure side circuit. On unitary or close-coupled systems, where the system refrigerant charge is expected to be both correct and definable the entire system charge may be stored in the condenser during pump-down if all components have been properly sized.	Other application needs a liquid receiver to store the refrigerant. Receiver dimensioning requires special attention. The receiver shall be large enough to contain part of the system refrigerant charge but it shall not be dimensioned too large. A large receiver easily leads to refrigerant overcharging during maintenance operation.
Liquid flood back	During normal operation, refrigerant enters the compressor as a superheated vapour. Liquid flood back occurs when a part of the refrigerant entering the compressor is still in liquid state.	A continuous liquid flood back will cause oil dilution and, in extreme situations lead to lack of lubrication and high rate of oil leaving the compressor.
	Liquid flood back test - Repetitive liquid flood back testing must be carried out under TXV threshold operating conditions: a high pressure ratio and minimum evaporator load, along with the measurement of suction superheat, oil sump temperature and discharge gas temperature. During operations, liquid flood back may be detected by measuring either the oil sump temperature or the discharge gas temperature. If at any time during operations, the oil sump temperature drops to within 10K or less above the saturated suction temperature, or should	the discharge gas temperature be less than 35K above the saturated discharge temperature, this indicates liquid flood back. Continuous liquid flood back can occur with a wrong dimensioning, a wrong setting or malfunction of the expansion device or in case of evaporator fan failure or blocked air filters. A suction accumulator providing additional protection as explained hereunder can be used to solve light continuous liquid flood back.
	Suction accumulator: a suction accumulator offers protection against refrigerant flood back at start-up, during operations or defrosting by trapping the liquid refrigerant upstream from the compressor. The suction accumulator also protects against off-cycle migration by providing additional internal free volume to the low side of the system.	A suction accumulator must be carefully dimensioned, taking into account the refrigerant charge as well as the gas velocity in the suction line. Depending on the operating conditions it may happen that the recommended connections of the accumulator are one size smaller than the suction line.

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Application Guidelines	Specific application recommendations	
Low ambient application		
Low ambient start-up	Under cold ambient conditions (<0°C), upon start-up the pressure in the condenser may be so low that a sufficient pressure differential across the expansion device cannot be developed to properly feed the evaporator. As a result, the compressor may go into a deep vacuum, which can lead to compressor failure due to internal arcing and instability in the scroll wraps. Under no circumstances should the compressor be allowed to operate under vacuum. The low-pressure control must be set in accordance with the table on page 24 in order to prevent this from happening.	Early feeding of the evaporator and management of the discharge pressure could help to attenuate these effects. Low pressure differentials can also cause the expansion device to «hunt» erratically, which might cause surging conditions within the evaporator, with liquid spillover into the compressor. This effect is most pronounced during low load conditions, which frequently occur during low ambient conditions.
Low ambient operations	It is recommended that the unit be tested and monitored at minimum load and low ambient conditions as well. The following considerations should be taken into account to ensure proper system operating characteristics. The expansion device should be sized to ensure proper control of the refrigerant flow into the evaporator. An oversized valve may result in erratic control. This consideration is especially important in manifolded units where low load conditions may require the frequent cycling of compressors. This can lead to liquid refrigerant entering the compressor if the expansion valve does not provide stable refrigerant super-heat control under varying loads. The superheat setting of the expansion device should be sufficient to ensure proper superheat levels during low loading periods. A minimum of 5 K stable superheat is required. **Head pressure control under low ambient conditions:** Several possible solutions are available to prevent the risk of compressor to vacuum and low pressure differential between the suction and discharge pressures.	In air-cooled machines, cycling the fans with a head pressure controller will ensure that the fans remain off until the condensing pressure has reached a satisfactory level. Variable speed fans can also be used to control the condensing pressure. In water-cooled units, the same can be performed using a water regulator valve that is also operated by head pressure, thereby ensuring that the water valve does not open until the condensing pressure reaches a satisfactory level. The minimum condensing pressure must be set at the minimum saturated condensing temperature shown in the application envelopes. Under very low ambient conditions, in which testing has revealed that the above procedures might not ensure satisfactory condensing and suction pressures, the use of a head pressure control valve is recommended. Note: This solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is recommended and special care should be taken when designing the discharge line. For further information, please contact Danfoss.
Scroll and reciprocating	Unlike the reciprocating compressor, a scroll doesn't have dead volume. Neither does it have a suction valve causing pressure drop. As a result a scroll compressor has a high volumetric efficiency even at low suction pressure. In systems such as ice makers and milk cooling tanks this high capacity at low temperature shortens the cooling time.	When moving from a reciprocating compressor to a scroll compressor, the selection shall always be made based on cooling capacity at the application rating point. Never make a selection based on equivalent displacement.

Application Guidelines	Specific application recommendations	
Low load operations	The compressor should be run for a minimum period to ensure that the oil has sufficient time to properly return to the compressor sump and	that the motor receives enough cooling under conditions of lowest refrigerant mass flow.
Brazed plate heat exchangers	A brazed plate heat exchanger needs very little internal volume to satisfy the heat transfer requirements. Consequently, the heat exchanger offers very little internal volume for the compressor to draw vapour from 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 condenser heat exchanger, a sufficient free volume for the discharge gas to accumulate is required in order to avoid excess pressure build-up. At least 1 meter of discharge line is necessary to generate this volume. To help reduce the discharge gas volume immediately after start-up, the supply of cooling water to the heat exchanger may be opened before the compressor starts, to remove superheat and condense the incoming discharge gas more quickly.
Water utilising systems	Apart from residual moisture in the system after commissioning, water could also enter the refrigeration circuit during operation. Water in the system shall always be avoided. Not only because it can shortly lead to electrical failure, sludge in sump and corrosion but in particular because it can cause serious safety risks. Common causes for water leaks are corrosion and freezing.	Corrosion: Materials in the system shall be compliant with water and protected against corrosion. Freezing: When water freezes into ice its volume expands which can damage heat exchanger walls and cause leaks. During off periods water inside heat exchangers could start freezing when ambient temperature is lower than 0°C. During on periods ice banking could occur when the circuit is running continuously at too low load. Both situations should be avoided by connecting a pressure and thermostat switch in the safety line.

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Starting sound level

During start-up transients it is natural for the compressor sound level to be slightly higher than during normal running. MLZ/MLM scroll compressors exhibit very little increased start-up transient sound. If a 3-phase model is miswired, the compressor will run in reverse. Reverse compressor rotation is characterized by an objectionable sound. To correct reverse rotation, disconnect power and switch any two of the three power leads at the unit contactor. Never switch leads at the compressor terminals.

Running sound level

MLZ/MLM are designed with features to reduce the sound level when a compressor is running. Sound levels are at rated (medium temperature) conditions.

Model	50 Hz		60 Hz	
	Sound power (dBA) Without jacket	Sound power (dBA) With jacket	Sound power (dBA) Without jacket	Sound power (dBA) With jacket
MLZ/MLM015	67	57	71	60
MLZ/MLM019	67	57	71	60
MLZ/MLM021	67	57	71	60
MLZ/MLM026	67	59	71	62
MLZ/MLM030	69	62	73	65
MLZ/MLM038	69	63	74	66
MLZ/MLM042	71	63	74	66
MLZ/MLM045	71	63	74	66
MLZ/MLM048	72	64	74	67
MLZ/MLM058	74	66	78	70
MLZ/MLM066	74	66	78	70
MLZ/MLM 076	74	66	78	70

Maximum sound is +5dBA

Stopping sound level

MLZ/MLM have a unique discharge valve design that minimizes stopping noise. This results in very low shutdown sound.

Sound generation in a refrigeration system

Typical sound and vibration in refrigeration systems encountered by design and service engineers may be broken down into the following three source categories.
Sound radiation: This generally takes an airborne path.
Mechanical vibrations: These generally extend along the parts of the unit and structure.
Gas pulsation: This tends to travel through the cooling medium, i.e. the refrigerant.

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

Compressor sound radiation

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

The MLZ/MLM scroll compressors are 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 unique design of a full-suction gas & oil cooled motor, compressor body insulation across its entire operating range is possible.

Mechanical vibrations

Vibration isolation constitutes the primary method for controlling structural vibration. MLZ/MLM scroll compressors are designed to produce minimal vibration during operations. The use of rubber isolators on the compressor base plate or on the frame of a manifolded unit is very effective in reducing vibration being transmitted from the compressor(s) to the unit. Rubber grommets are supplied with all MLZ/MLM 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. The tubing should be designed so as to both reduce the transmission of vibrations to other structures and withstand vibration without incurring any damage. Tubing should also be designed for three-dimensional flexibility. For more information on piping design, please see the section entitled "Essential piping design considerations".

Gas pulsation

The MLZ/MLM scroll compressors have been designed and tested to ensure that gas pulsation has been minimized for the most commonly encountered refrigeration pressure ratio. On 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.

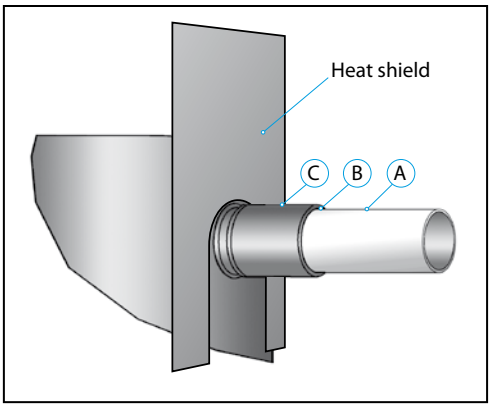
Application Guidelines	Installation	
	Each MLZ/MLM compressor is shipped with printed Instructions for installation. These Instructions can also be downloaded from our web site	www.danfoss.com or directly from: http://instructions.cc.danfoss.com
System cleanliness	The refrigeration system, regardless 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 PVE oil in MLZ compressors requires that the oil be exposed to the atmosphere just as little as possible. 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.
Compressor handling and storage	Compressors are provided with a lifting lug. This lug should always be used to lift the compressor. Once the compressor is installed, the lifting lug should never be used to lift the complete installation. The compressor must be handled	with caution in the vertical position, with a maximum inclination of 15° from vertical. Store the compressor between -35°C and 55°C, not exposed to rain or corrosive atmosphere.
Compressor mounting	Maximum inclination from the vertical plane, while operating must not exceed 7 degrees. All compressors are delivered with 4 rubber grommets and metal sleeves. Compressors	must always be mounted with these grommets. Recommended torque for mounting bolts: 11 Nm (±1 Nm).
Compressor holding charge	Each compressor is shipped with a nominal dry nitrogen holding charge between 0.4 bar and 0.7 bar, and is sealed with elastomer plugs. The plugs should be removed with care to avoid oil loss when the holding charge is released. Remove the suction plug first and the discharge plug	afterwards. The plugs shall be removed only just before connecting the compressor to the installation in order to avoid moisture entering the compressor. When the plugs are removed, it is essential to keep the compressor in an upright position to avoid oil spillage.
Tube brazing procedure	Do not bend the compressor discharge or suction lines or force system piping into the compressor connections, because this will increase	stresses that are a potential cause of failure. Recommended brazing procedures and material, are described on following page.
Brazing material	For copper suction and discharge fittings, use copper-phosphorus brazing material. Sil-Fos® and other silver brazing materials are also acceptable.	If flux is required for the brazing operation, use coated rod or flux core wire. To avoid system contamination, do not brush flux on.

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. 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).
- Use only clean refrigeration-grade copper tubing and clean all connections.
- Purge nitrogen through the compressor in order to prevent against oxidation and flammable conditions. The compressor should not be exposed to the open air for extended periods.
- Use of a double-tipped torch is recommended.
- Apply heat evenly to area A until the brazing temperature is reached. Move the torch to area B and apply heat evenly until the brazing temperature has been reached there as well, and then begin adding the brazing material. Move the torch evenly around the joint, in applying only enough brazing material to flow the full circumference of the joint.
- Move the torch to area C only long enough to draw the brazing material into the joint, but not into the compressor.
- Remove all remaining flux once the joint has been soldered with a wire brush or a wet cloth. Remaining flux would cause corrosion of the tubing.

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 PVE oil used in MLZ 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 for further information.

		Brazed connection ODF tube 	Rotolock connection sizes 
MLZ/MLM015-026	Suction	3/4"	1"1/4
	Discharge	1/2"	1"
MLZ/MLM030-045	Suction	7/8"	1"1/4
	Discharge	1/2"	1"
MLZ/MLM048	Suction	7/8"	1"1/4
	Discharge	3/4"	1"1/4
MLZ/MLM058-076	Suction	1"1/8	1"3/4
	Discharge	7/8"	1"1/4

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روبروی پالایشگاه نفت پارس، پلاک ۱۲

Application Guidelines	Installation	
Vacuum evacuation and moisture removal	Moisture obstructs the proper functioning of the compressor and the refrigeration system. Air and moisture reduce service life and increase condensing pressure, and cause excessively high discharge temperatures, which can destroy the lubricating properties of the oil. Air and moisture also increase the risk of acid formation, giving rise to copper platting. All these phenomena can cause mechanical and electrical compressor failure. For these reasons it's important to perform a vacuum dehydration on the system to remove all residual moisture from the pipe-work after assembly;	MLZ and MLM compressors are delivered with < 100 ppm moisture level. The required moisture level in the circuit after vacuum dehydration must be < 100 ppm for systems with an MLZ and < 300 ppm for systems with an MLM compressor. • Never use the compressor to evacuate the system. • Connect a vacuum pump to both the LP & HP sides. • Evacuate the system to a pressure of 500 µm Hg (0.67 mbar) absolute. • Do not use a megohm meter nor apply power to the compressor while it's under vacuum as this may cause internal damage.
Liquid line filter driers	A properly sized & type of drier is required. Important selection criteria include the driers water content capacity, the system refrigeration capacity, and the system refrigerant charge. The drier must be able to reach and maintain a moisture level of 50 ppm end point dryness (EPD). Danfoss recommends DCL (solid core) driers for the MLM compressor (R22 with Alkylbenzene) and DML (100% molecular sieve) driers for MLZ compressors (R404A, R507, R134a, R22) with PVE oil.	For servicing of existing installations where acid formation may be present, the Danfoss DCL solid core filter drier containing activated alumina is recommended. After burn out, remove & replace the liquid line filter drier and install a Danfoss type DAS burnout drier of the appropriate capacity. Refer to the DAS drier instructions and technical information for correct use of the burnout drier on the liquid line.
Refrigerant charging	It is recommended that system charging be done using the weighed charge method, adding refrigerant to the high side of the system. Charging the high and low sides of a system with gas simultaneously at a controlled rate is also an acceptable method. Do not exceed the recommended unit charge, and never charge liquid to the low side.	Vacuum or charge from one side can seal the scrolls and result in a non-starting compressor. When servicing, always ensure that LP/HP pressures are balanced before starting the compressor. Be sure to follow all government regulations regarding refrigerant reclamation and storage.
Insulation resistance and dielectric strength	Insulation resistance must be higher than 1 megohm when measured with a 500 volt direct current megohm tester. Each compressor motor is tested at the factory with a high potential voltage (hi-pot) that exceeds the UL requirement both in potential and in duration. Leakage current is less than 0.5 mA. MLZ/MLM scroll compressors are configured with the pump assembly at the top of the shell, and the motor below. As a result, the motor can be partially immersed in refrigerant and oil. The presence of refrigerant around the motor windings will result in lower resistance	values to ground and higher leakage current readings. Such readings do not indicate a faulty compressor, and should not be cause for concern. In testing insulation resistance, Danfoss recommends that the system be first operated briefly to distribute refrigerant throughout the system. Following this brief operation, retest the compressor for insulation resistance or current leakage. Never reset a breaker or replace a fuse without first checking for a ground fault (a short circuit to ground). Be alert for sounds of arcing inside the compressor.

Packaging

Single pack

Compressors are packed individually in a cardboard box. They can be ordered in any quantity. Minimum ordering quantity = 1. As far as possible, Danfoss will ship the boxes on full pallets of 6 or 9 compressors according below table.

- Each box also contains following accessories:
- 4 grommets
- 4 assemblies of self tapping US thread bolts, washers and sleeves
- 4 additional sleeves
- 1 screw for earth connection
- Run capacitors are available as accessories for motor code 5 (220-240V/1/50Hz)

Industrial pack

Compressors are not packed individually but are shipped all together on one pallet. They can be ordered in quantities of full pallets only, multiples of 12 or 16 compressors, according below table.

Each industrial pack pallet contains following accessories:

- 4 grommets per compressor
- 4 sleeves per compressor

Packaging details

		Danfoss pallets Optimized for overseas container loading & European storage racks		US pallets Optimized for overseas container loading	
	Code number	121U….		120U….	
	Pack type	Industrial pack	Single pack	Industrial pack	Single pack
	Compressors per pallet	12	6 *	16	16
	Static stacking of pallets **	4	4	4	4
Shipped accessories	Run capacitor (for single phase models)	Not included	Not included	Not included	Not included
	Screw for earth connection	Included	Included	Not included	Included
	4 grommets per compressor	Included	Included	Included	Included
	4 assemblies of self tapping US thread bolt + washer + sleeve per compressor	Not included	Included	Not included	Included
	4 extra sleeves per compressor	Included	Included	Included	Included

* Quantity for full pallets. Single packs can be ordered per 1.
** Stacking only allowed for full pallets with identical products per pallet

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روبروی پالایشگاه نفت پارس، پلاک ۱۲

Single pack

Brazed version

	Compressors	Model variation	Connections	Features	Voltage code 1	Voltage code 2	Voltage code 4	Voltage code 5	Voltage code 7	Voltage code 9
Danfoss pallet	MLZ015	T	P	9	-	120U8036	121U8002	121U8024	-	-
	MLZ019	T	P	9	121U8060	121U8038	121U8004	121U8026	-	-
	MLZ021	T	P	9	121U8062	121U8040	121U8006	121U8028	-	-
	MLZ026	T	P	9	121U8064	121U8042	121U8008	121U8030	-	-
	MLZ030	T	C	9	121U8066	121U8044	121U8010	121U8032	-	-
	MLZ038	T	C	9	121U8068	121U8046	121U8012	121U8034	-	-
	MLZ042	T	C	9	-	-	-	121U8419	-	-
	MLZ045	T	C	9	-	121U8048	121U8014	-	-	-
	MLZ048	T	C	9	-	121U8050	121U8016	-	-	-
	MLZ058	T	C	9	-	121U8052	121U8018	-	-	-
	MLZ066	T	C	9	-	121U8054	121U8020	-	-	-
	MLZ076	T	C	9	-	121U8056	121U8022	-	-	-
US pallet	MLZ015	T	P	9	120U8058	120U8036	120U8002	120U8024	-	120U8413
	MLZ019	T	P	9	120U8060	120U8038	120U8004	120U8026	-	120U8266
	MLZ021	T	P	9	120U8062	120U8040	120U8006	120U8028	-	120U8272
	MLZ026	T	P	9	120U8064	120U8042	120U8008	120U8030	-	120U8278
	MLZ030	T	C	9	120U8066	120U8044	120U8010	120U8032	-	120U8284
	MLZ038	T	C	9	120U8068	120U8046	120U8012	120U8034	-	120U8296
	MLZ042	T	C	9	120U8399	-	-	-	-	-
	MLZ045	T	C	9	-	120U8048	120U8014	-	120U8332	120U8302
	MLZ048	T	C	9	-	120U8050	120U8016	-	120U8338	120U8308
	MLZ058	T	C	9	-	120U8052	120U8018	-	120U8344	120U8314
	MLZ066	T	C	9	-	120U8054	120U8020	-	120U8350	-
	MLZ076	T	C	9	-	120U8056	120U8022	-	120U8356	-

Rotolock version

Compressors	Model variation	Connections	Features	Voltage code 1	Voltage code 2	Voltage code 4	Voltage code 5	Voltage code 7	Voltage code 9
MLZ015	T	T	9	121U8513	121U8553	121U8529	121U8521	121U8537	121U8545
MLZ019	T	T	9	121U8515	121U8555	121U8531	121U8523	121U8539	121U8547
MLZ021	T	T	9	121U8517	121U8557	121U8533	121U8525	121U8541	121U8549
MLZ026	T	T	9	121U8519	121U8559	121U8535	121U8527	121U8543	121U8551
MLZ030	T	Q	9	121U8561	121U8597	121U8573	121U8567	121U8581	121U8589
MLZ038	T	Q	9	121U8563	121U8599	121U8575	121U8569	121U8583	121U8591
MLZ042	T	Q	9	121U8565	-	-	121U8571	-	-
MLZ045	T	Q	9	-	121U8601	121U8577	-	121U8585	121U8593
MLZ048	T	Q	9	-	121U8603	121U8579	-	121U8587	121U8595
MLZ058	T	Q	9	-	121U8627	121U8609	-	121U8615	121U8621
MLZ066	T	Q	9	-	121U8623	121U8605	-	121U8611	121U8617
MLZ076	T	Q	9	-	121U8625	121U8607	-	121U8613	121U8619

Industrial pack

Brazed version


	Compressors	Model variation	Connections	Features	Voltage code 1	Voltage code 2	Voltage code 4	Voltage code 5	Voltage code 7	Voltage code 9
Danfoss pallet	MLZ015	T	P	9	-	120U8035	121U8001	121U8023	-	-
	MLZ019	T	P	9	121U8059	121U8037	121U8003	121U8025	-	-
	MLZ021	T	P	9	121U8061	121U8039	121U8005	121U8027	-	-
	MLZ026	T	P	9	121U8063	121U8041	121U8007	121U8029	-	-
	MLZ030	T	C	9	121U8065	121U8043	121U8009	121U8031	-	-
	MLZ038	T	C	9	121U8067	121U8045	121U8011	121U8033	-	-
	MLZ042	T	C	9	-	-	-	121U8418	-	-
	MLZ045	T	C	9	-	121U8047	121U8013	-	-	-
	MLZ048	T	C	9	-	121U8049	121U8015	-	-	-
	MLZ058	T	C	9	-	121U8051	121U8017	-	-	-
	MLZ066	T	C	9	-	121U8053	121U8019	-	-	-
	MLZ076	T	C	9	-	121U8055	121U8021	-	-	-
US pallet	MLZ015	T	P	9	120U8057	120U8035	120U8001	120U8023	-	120U8412
	MLZ019	T	P	9	120U8059	120U8037	120U8003	120U8025	-	120U8265
	MLZ021	T	P	9	120U8061	120U8039	120U8005	120U8027	-	120U8271
	MLZ026	T	P	9	120U8063	120U8041	120U8007	120U8029	-	120U8277
	MLZ030	T	C	9	120U8065	120U8043	120U8009	120U8031	-	120U8283
	MLZ038	T	C	9	120U8067	120U8045	120U8011	120U8033	-	120U8295
	MLZ042	T	C	9	120U8398	-	-	-	-	-
	MLZ045	T	C	9	-	120U8047	120U8013	-	120U8331	120U8301
	MLZ048	T	C	9	-	120U8049	120U8015	-	120U8337	120U8307
	MLZ058	T	C	9	-	120U8051	120U8017	-	120U8343	120U8313
	MLZ066	T	C	9	-	120U8053	120U8019	-	120U8349	-
	MLZ076	T	C	9	-	120U8055	120U8021	-	120U8355	-

Rotolock version


Compressors	Model variation	Connections	Features	Voltage code 1	Voltage code 2	Voltage code 4	Voltage code 5	Voltage code 7	Voltage code 9
MLZ015	T	T	9	121U8512	121U8552	121U8528	121U8520	121U8536	121U8544
MLZ019	T	T	9	121U8514	121U8554	121U8530	121U8522	121U8538	121U8546
MLZ021	T	T	9	121U8516	121U8556	121U8532	121U8524	121U8540	121U8548
MLZ026	T	T	9	121U8518	121U8558	121U8534	121U8526	121U8542	121U8550
MLZ030	T	Q	9	121U8560	121U8596	121U8572	121U8566	121U8580	121U8588
MLZ038	T	Q	9	121U8562	121U8598	121U8574	121U8568	121U8582	121U8590
MLZ042	T	Q	9	121U8564	-	-	121U8570	-	-
MLZ045	T	Q	9	-	121U8600	121U8576	-	121U8584	121U8592
MLZ048	T	Q	9	-	121U8602	121U8578	-	121U8586	121U8594
MLZ058	T	Q	9	-	121U8626	121U8608	-	121U8614	121U8620
MLZ066	T	Q	9	-	121U8622	121U8604	-	121U8610	121U8616
MLZ076	T	Q	9	-	121U8624	121U8606	-	121U8612	121U8618

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Run capacitors for PSC wiring

Code n°	Description	Application	Packaging	Pack size
8173231	PSC wiring Run capacitor 40 µF, motor voltage code 5 - 220-240V / 1 / 50 Hz	MLZ/MLM015	Multipack	10
120Z0051	PSC wiring Run Capacitor 70 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM019-021-026	Multipack	10
8173233	PSC wiring Run Capacitor 50 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM030	Multipack	10
8173234	PSC wiring Run Capacitor 55 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM038-042	Multipack	10

Start capacitors for CSR wiring

Code n°	Description	Application	Packaging	Pack size
120Z0399	CSR wiring Start Capacitor 145-175 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM015-019-021-026	Multipack	10
120Z0400	CSR wiring Start Capacitor 161-193 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM030	Multipack	10
8173001	CSR wiring Start Capacitor 88-108 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM038-042	Multipack	10

Starting relays for CSR wiring

Code n°	Description	Application	Packaging	Pack size
120Z0393	Starting relay RVA9CKL	MLZ/MLM 015-019-021-026	Multipack	10
120Z0394	Starting relay RVA3EKL	MLZ/MLM 030	Multipack	10
120Z0395	Starting relay RVA4GKL	MLZ/MLM 038-042	Multipack	10

Solder sleeve adapter sets

Code n°	Description	Application	Packaging	Pack size
120Z0126	Rotolock adaptor set (1-1/4" ~ 3/4") , (1" ~ 1/2")	MLZ/MLM 015-019-021-026	Multipack	6
120Z0127	Rotolock adaptor set (1-1/4" ~ 7/8") , (1" ~ 1/2")	MLZ/MLM 030-038-042-045	Multipack	6
120Z0128	Rotolock adaptor set (1-1/4" ~ 7/8") , (1-1/4" ~ 3/4")	MLZ/MLM 048	Multipack	6
120Z0129	Rotolock adaptor set (1-3/4" ~ 1-1/8") , (1-1/4" ~ 7/8")	MLZ/MLM 058-066-076	Multipack	6

Rotolock nuts and sleeves kit

Code n°	Description	Application	Packaging	Pack size
120Z5074	Rotolock nuts 1"1/4 and 1" with sleeves and gaskets	MLZ/MLM015-045	Multipack	6
120Z5076	2 rotolock nuts 1"1/4 with sleeves and gaskets	MLZ/MLM048	Multipack	6
120Z5075	Rotolock nuts 1"1/4 and 1"3/4 with sleeves and gaskets	MLZ/MLM058-066-076	Multipack	6

Rotolock adapters

Code n°	Description	Application	Packaging	Pack size
120Z0366	Rotolock adaptor (1-1/4" ~ 3/4")	MLZ/MLM 015-019-021-026 suction	Multipack	10
120Z0367	Rotolock adaptor (1-1/4" ~ 7/8")	MLZ/MLM 030-038-042-045-048 suction	Multipack	10
120Z0364	Rotolock adaptor (1-3/4" ~ 1-1/8")	MLZ/MLM 058-066-076 suction	Multipack	10
120Z0365	Rotolock adaptor (1" ~ 1/2")	MLZ/MLM 015-019-021-026-030-038-042-045 discharge	Multipack	10
120Z0366	Rotolock adaptor (1-1/4" ~ 3/4")	MLZ/MLM 048 discharge	Multipack	10
120Z0367	Rotolock adaptor (1-1/4" ~ 7/8")	MLZ/MLM 058-066-076 discharge	Multipack	10

Rotolock service valves and valve sets (without gasket)

Code n°	Description	Application	Packaging	Pack size
7968004	Rotolock valve, V06, (1" Rotolock, 1/2" ODF)	Discharge MLM/Z015-026-045	Industry pack	50
8168031	Rotolock valve, V06, (1" Rotolock, 1/2" ODF)		Multipack	6
7968006	Rotolock valve, V04, (1"1/4 Rotolock, 3/4" ODF)	Suction MLM/Z015-026 Discharge MLM/Z048	Industry pack	42
8168029	Rotolock valve, V04, (1"1/4 Rotolock, 3/4" ODF)		Multipack	6
7968007	Rotolock valve, V05, (1"1/4 Rotolock, 7/8" ODF)	Suction MLM/Z030-048 Discharge MLM/Z058-076	Industry pack	36
8168030	Rotolock valve, V05, (1"1/4 Rotolock, 7/8" ODF)		Multipack	6
7968009	Rotolock valve, V02, (1"3/4 Rotolock, 1"1/8 ODF)	Suction MLM/Z058-076	Industry pack	24
8168028	Rotolock valve, V02, (1"3/4 Rotolock, 1"1/8 ODF)		Multipack	6
7703008	Valve set V02 (1"3/4rotolock, 1"1/8 ODF), V05 (Rotolock 1"1/4, 7/8" ODF)	MLZ/MLM058-066-076	Multipack	6

Mounting kits

Code n°	Description	Application	Packaging	Pack size
120Z5005	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers	MLZ/MLM	Single pack	1
120Z5067	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers, rotolock connection kit for suction, discharge and economizer fitting for 1 scroll compressor including 3 Teflon seals, 2 nuts, 3 sleeves	MLZ/MLM015-045 LLZ013-015-018	Single pack	1
120Z5069	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers, rotolock connection kit for suction, discharge fitting for 1 scroll compressor including 3 Teflon seals, 2 nuts, 3 sleeves	MLZ/MLM048	Single pack	1
120Z5068	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers, rotolock connection kit for suction, discharge and economizer fitting for 1 scroll compressor including 3 Teflon seals, 2 nuts, 3 sleeves Teflon seals, sleeves, nuts 1"1/4 and 1"3/4	MLZ/MLM058-076 LLZ024-033	Single pack	1
120Z0407	Rigid grommets and washers for tandem / rack assembly. Set for 8 compressors	MLZ/MLM	Single pack	1

Crankcase heater

Code No	Description	Application	Packaging	Pack Size
120Z5040	Belt type crankcase heater, 65 W, 230 V, CE mark, UL (Wire length: 1270 mm)	MLZ/MLM 015-019-021-026	Multipack	4
120Z5041	Belt type crankcase heater, 55/70W, 400/460 V, CE mark, UL (Wire length: 1270 mm)	MLZ/MLM 015-019-021-026	Multipack	4
120Z5042	Belt type crankcase heater, 70 W, 575 V, CE mark, UL (Wire length: 1270 mm)	MLZ/MLM 015-019-021-026	Multipack	4
120Z0059	Belt type crankcase heater, 65 W, 230V, CE mark, UL (Wire length: 1000 mm)	MLZ/MLM 030-038-042-045-048-058-066-076	Multipack	6
120Z0060	Belt type crankcase heater, 65 W, 400 V, CE mark, UL (Wire length: 1000 mm)	MLZ/MLM 030-038-045-048-058-066-076	Multipack	6
120Z5012	Belt type crankcase heater, 70W, 460V, CE mark, UL	MLZ/MLM030-076	Multipack	4
120Z5013	Belt type crankcase heater, 70 W, 575V, CE mark, UL	MLZ/MLM030-076	Multipack	4

Discharge thermostat kit

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

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Magnetic discharge non return valve

Code No	Description	Application	Packaging	Pack Size
120Z5046	Magnetic discharge non return valve	MLZ/MLM058-066-076	Multipack	6

Lubricant

Code No	Description	Application	Packaging	Pack Size
120Z5034	PVE lubricant, 1 litre can 320HV (FVC68D)	MLZ	Multipack	12

IP54 upgrade kit

Code No	Description	Application	Packaging	Pack Size
118U0056	IP54 upgrade kit for round terminal box	MLZ/MLM015 - 019 - 021 - 026	Multipack	6
118U0057	IP54 upgrade kit for square terminal box	MLZ/MLM030-038-042-045-048-058-066-076	Multipack	6

Acoustic hood

Code No	Description	Application	Packaging	Pack Size
120Z5043	Acoustic hood	MLZ/MLM015 - 019 - 021 - 026	Single pack	1
120Z5044	Acoustic hood	MLZ/MLM030 - 038 - 042 - 045 - 048	Single pack	1
120Z5045	Acoustic hood	MLZ/MLM058 - 066 - 076	Single pack	1

Terminal box

Code No	Description	Application	Packaging	Pack Size
120Z5015	Round terminal box (P & T version)	MLZ/MLM015 - 019 - 021 - 026	Multipack	10
120Z5018	Square terminal box (C & Q version)	MLZ/MLM030-038-042-045-058-066-076	Multipack	10

Manifolding service kit

Code No	Description	Application	Packaging	Pack Size
120Z5073	Oil equalisation kit including: 2 oil sight glass adaptors, rotolock nuts, sleeves and gaskets, feet spacers and washers for 2 compressors	All models	Multipack	6

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

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

Danfoss Inverter scroll compressors

Danfoss Air Conditioning scroll compressors

Danfoss Heat Pump scroll compressors

Maneurop® Inverter reciprocating compressors

Danfoss Refrigeration scroll compressors

Maneurop® Reciprocating Compressors

Optyma™ & Optyma Plus™ Condensing Units

Light commercial reciprocating compressors (manufactured by Secop)

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

Danfoss Commercial Compressors http://cc.danfoss.com

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ENGINEERING
TOMORROW

Danfoss

Application guidelines

Danfoss scroll compressors
SM SY SZ

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

تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
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Danfoss scroll compressors are available both as single compressors and as tandem units. The example below presents the single compressor nomenclature which equals the technical reference as shown on the compressor nameplate.

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

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

Nomenclature

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

Family, lubricant & refrigerant
SM: Scroll, Mineral oil, R22/R417A*
SY: Scroll, POE lubricant, R22/R417A (R407C for SY185 to 380, R134a for SY240 to 380)
SZ: Scroll, POE lubricant, R407C - R134a (and R404A, R507A for SZ084 to SZ185)

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

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

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

* When SM compressors are used with R417A, the factory charged mineral oil 160P must be replaced by polyolester oil 160SZ

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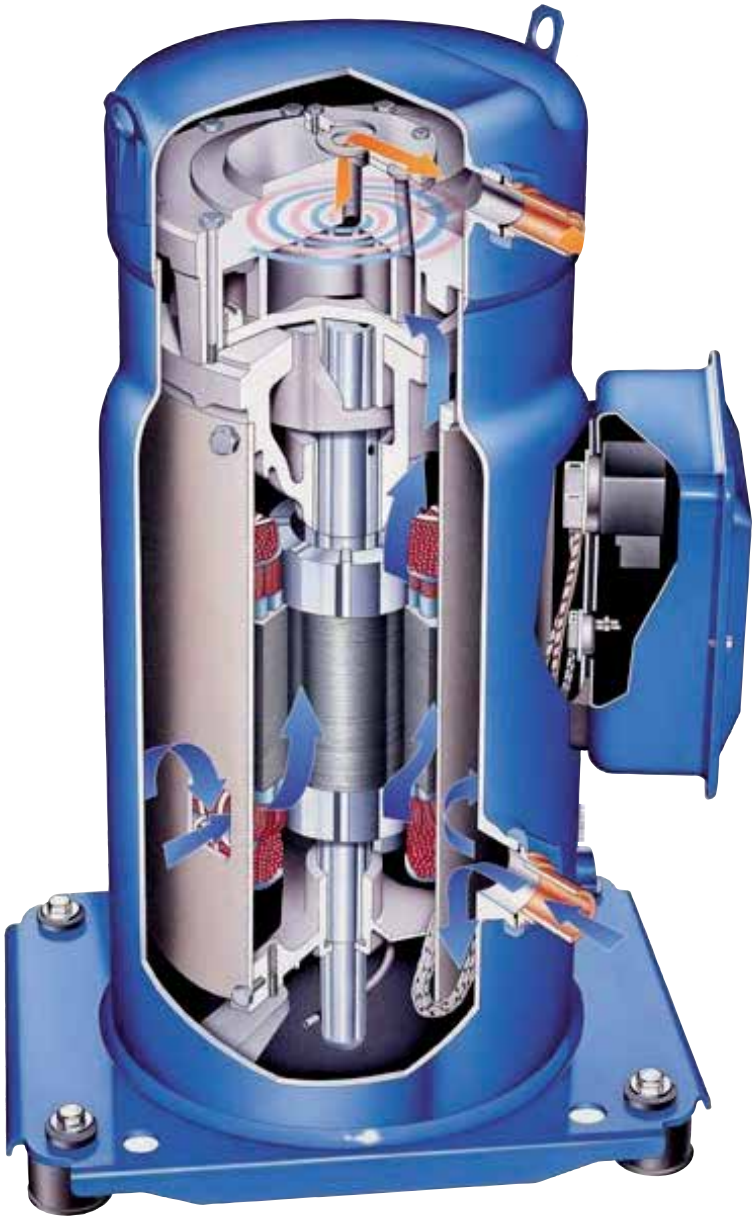
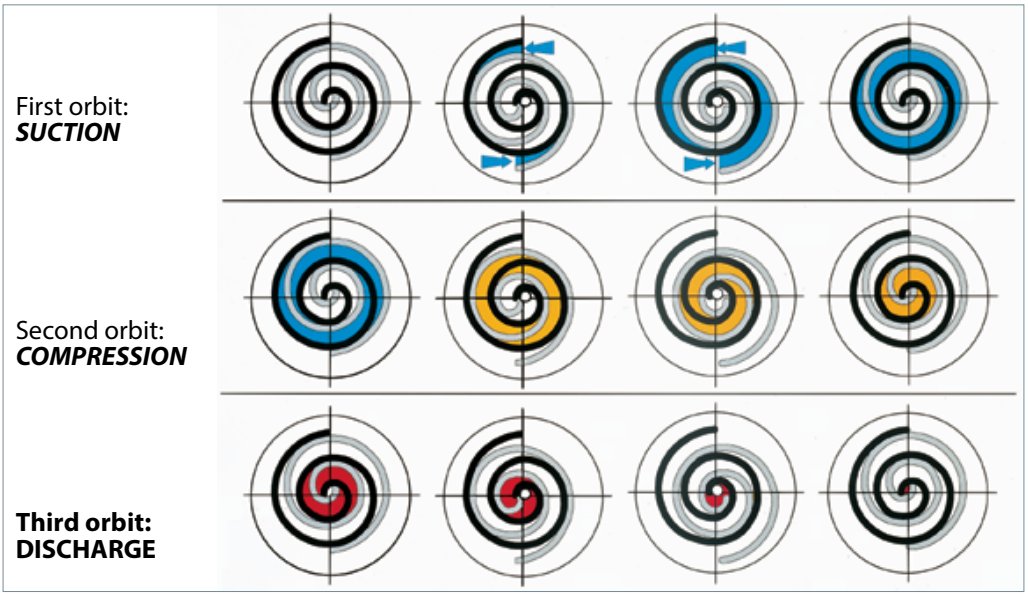


SM / SY / SZ 084-090-100-110-120-148-161-175-185-240-300-380

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

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

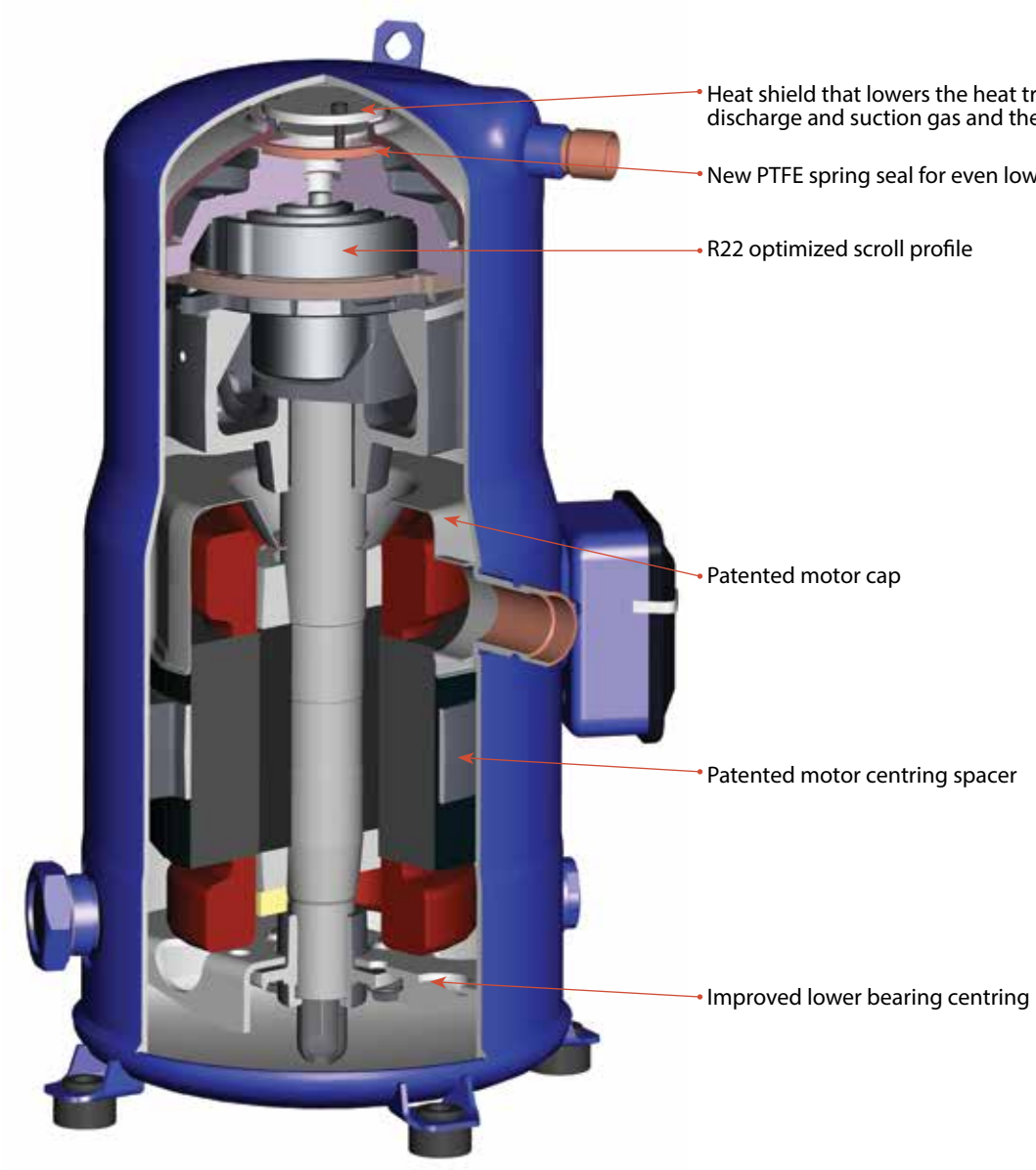
The figure below illustrates the entire compression process. The centre of the orbiting scroll (in grey) traces a circular path around the centre of the fixed scroll (in black). This movement creates symmetrical compression pockets between the two scroll elements. Low-pressure suction gas is trapped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



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

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

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



SM 112-124 - SM/SZ147

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50 Hz data

	Model	Nominal Cap. 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displacement ①	Oil charge	Net weight ②
		TR	W	Btu/h	kW	W/W	Btu/h /W	cm3/rev	m3/h	dm3	kg
R22 SINGLE	**SM084**	7	20 400	69 600	6.12	3.33	11.4	114.5	19.9	3.25	64
	SM090	7.5	21 800	74 400	6.54	3.33	11.4	120.5	21.0	3.25	65
	SM100	8	23 100	78 800	6.96	3.33	11.4	127.2	22.1	3.25	65
	SM110	9	25 900	88 400	7.82	3.32	11.3	144.2	25.1	3.25	73
	SM112	9.5	27 600	94 200	7.92	3.49	11.9	151.5	26.4	3.30	64
	SM120	10	30 100	102 700	8.96	3.36	11.5	166.6	29.0	3.25	73
	SM124	10	31 200	106 500	8.75	3.56	12.2	169.5	29.5	3.30	64
	SM147	12	36 000	122 900	10.08	3.57	12.2	193.5	33.7	3.30	67
	SM148	12	36 100	123 200	10.8	3.34	11.4	199.0	34.6	3.60	88
	SM161	13	39 000	133 100	11.59	3.37	11.5	216.6	37.7	3.60	88
	SM175	14	42 000	143 300	12.47	3.37	11.5	233.0	40.5	6.20	100
	SM/SY185	15	45 500	155 300	13.62	3.34	11.4	249.9	43.5	6.20	100
	SY240	20	61 200	208 900	18.2	3.36	11.5	347.8	60.5	8.00	150
	SY300	25	78 200	266 900	22.83	3.43	11.7	437.5	76.1	8.00	157
	SY380	30	94 500	322 500	27.33	3.46	11.8	531.2	92.4	8.40	158
R407C SINGLE	**SZ084**	7	19 300	65 900	6.13	3.15	10.8	114.5	19.9	3.25	64
	SZ090	7.5	20 400	69 600	6.45	3.16	10.8	120.5	21.0	3.25	65
	SZ100	8	21 600	73 700	6.84	3.15	10.8	127.2	22.1	3.25	65
	SZ110	9	24 600	84 000	7.76	3.17	10.8	144.2	25.1	3.25	73
	SZ120	10	28 600	97 600	8.99	3.17	10.8	166.6	29.0	3.25	73
	SZ147	12	34 900	119 079	9.92	3.52	12.0	193.5	33.7	3.30	67
	SZ148	12	35 100	119 800	10.99	3.19	10.9	199.0	34.6	3.60	88
	SZ161	13	38 000	129 700	11.84	3.21	11.0	216.6	37.7	3.60	88
	SZ175	14	40 100	136 900	12.67	3.17	10.8	233.0	40.5	6.20	100
	SZ185	15	43 100	147 100	13.62	3.16	10.8	249.9	43.5	6.20	100
	SY240	20	59 100	201 700	18.55	3.19	10.9	347.8	60.5	8.00	150
	SY300	25	72 700	248 100	22.73	3.20	10.9	437.5	76.1	8.00	157
	SY380	30	89 600	305 800	27.59	3.25	11.1	531.2	92.4	8.40	158

TR = Ton of Refrigeration
COP = Coefficient Of Performance
EER = Energy Efficiency Ratio
① Displacement at nominal speed: 2900 rpm at 50 Hz, 3500 rpm at 60Hz
② Net weight with oil charge
Data given for code 4 compressor, for full data details and capacity tables refer to Online Datasheet Generator: www.danfoss.com/ODSG

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**

60 Hz data

	Model	Nominal Cap. 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displace-ment ①	Oil charge	Net weight ②
		TR	W	Btu/h	kW	W/W	Btu/h /W	cm^3/rev	m^3/h	dm^3	kg
R22 SINGLE	**SM084**	7	24 600	84 000	7.40	3.34	11.4	114.5	24.1	3.25	64
	SM090	7.5	26 400	90 100	7.80	3.37	11.5	120.5	25.3	3.25	65
	SM100	8	27 500	93 900	8.10	3.38	11.5	127.2	26.7	3.25	65
	SM110	9	31 600	107 800	9.30	3.38	11.5	144.2	30.3	3.25	73
	SM112	9.5	34 000	116 000	9.60	3.53	12.1	151.5	31.8	3.30	64
	SM120	10	36 700	125 300	10.80	3.40	11.6	166.6	35.0	3.25	73
	SM124	10.5	37 700	128 700	10.60	3.56	12.2	169.5	35.6	3.30	64
	SM147	12	43 600	148 800	12.20	3.58	12.2	193.5	40.6	3.30	67
	SM148	12	43 800	149 500	13.00	3.37	11.5	199.0	41.8	3.60	88
	SM161	13	47 600	162 500	14.10	3.39	11.6	216.6	45.5	3.60	88
	SM175	14	51 100	174 400	15.30	3.34	11.4	233.0	48.9	6.20	100
	SM/SY185	15	55 300	188 700	16.30	3.39	11.6	249.9	52.5	6.20	100
	SY240	20	74 100	252 900	22.10	3.35	11.4	347.8	73.0	8.00	150
	SY300	25	94 500	322 500	27.50	3.43	11.7	437.5	91.9	8.00	157
	SY380	30	115 300	393 500	33.40	3.46	11.8	531.2	111.6	8.40	158
R407C SINGLE	**SZ084**	7	22 500	76 800	7.10	3.19	10.9	114.5	24.1	3.25	64
	SZ090	7.5	24 400	83 300	7.60	3.20	10.9	120.5	25.3	3.25	65
	SZ100	8	26 500	90 400	8.20	3.24	11.1	127.2	26.7	3.25	65
	SZ110	9	30 100	102 700	9.30	3.24	11.1	144.2	30.3	3.25	73
	SZ120	10	34 800	118 800	10.70	3.24	11.1	166.6	35.0	3.25	73
	SZ147	12	42 300	144 328	12.03	3.52	12.0	193.5	40.6	3.30	67
	SZ148	12	42 600	145 400	13.30	3.19	10.9	199.0	41.8	3.60	88
	SZ161	13	46 000	157 000	14.30	3.21	11.0	216.6	45.5	3.60	88
	SZ175	14	48 700	166 200	15.30	3.19	10.9	233.0	48.9	6.20	100
	SZ185	15	51 800	176 800	16.40	3.15	10.8	249.9	52.5	6.20	100
	SY240	20	71 100	242 700	22.70	3.14	10.7	347.8	73.0	8.00	150
	SY300	25	87 900	300 000	27.50	3.20	10.9	437.5	91.9	8.00	157
	SY380	30	107 300	366 200	33.50	3.20	10.9	531.2	111.6	8.40	158

TR = Ton of Refrigeration
COP = Coefficient Of Performance
EER = Energy Efficiency Ratio
① Displacement at nominal speed: 2900 rpm at 50 Hz, 3500 rpm at 60Hz
② Net weight with oil charge
Data given for code 4 compressor, for full data details and capacity tables refer to Online Datasheet Generator: www.danfoss.com/ODSG

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

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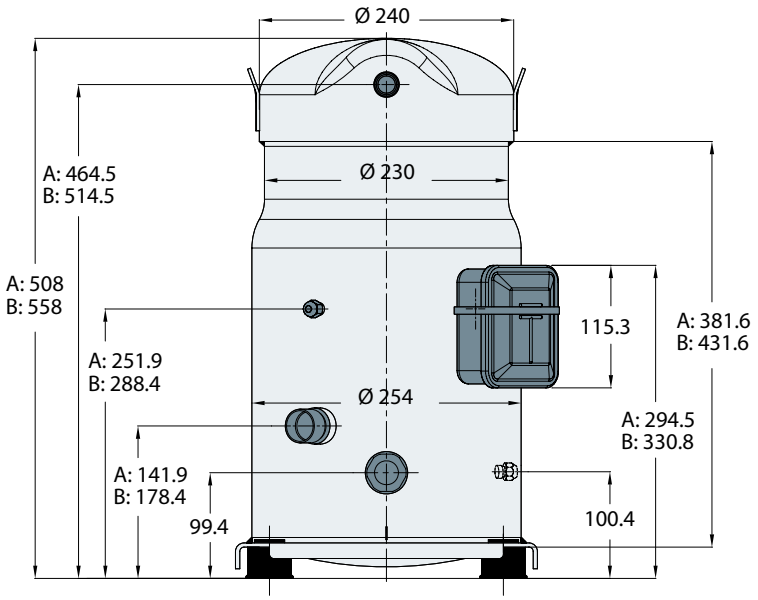
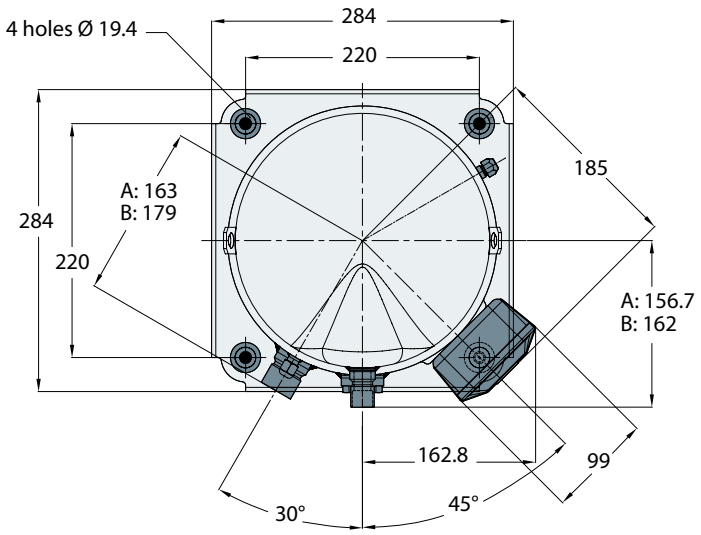
SM/SZ 084-090-100-110-120

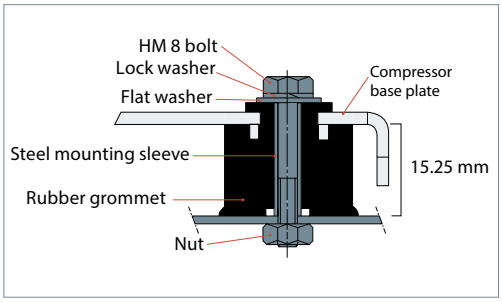




A: SM/SZ 084-090-100
B: SM/SZ 110-120

All dimensions in mm

Grommet



SM 112-124-SM/SZ147*
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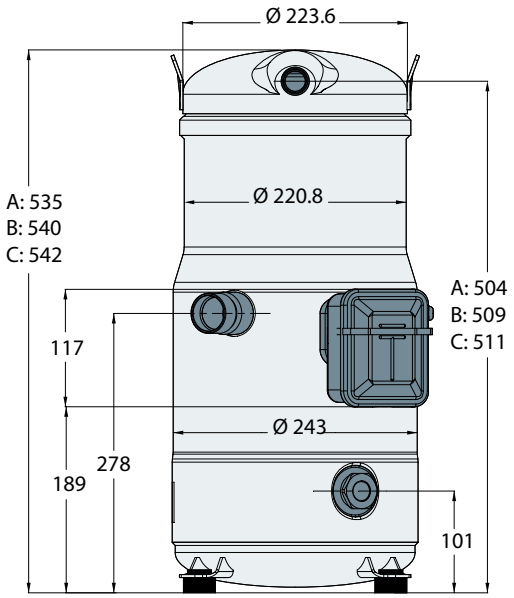

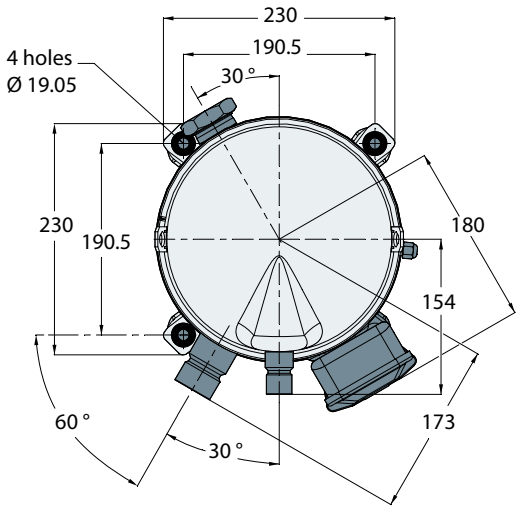

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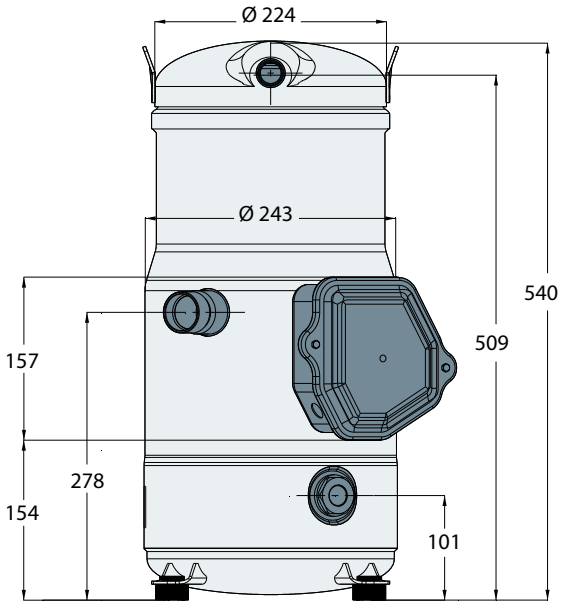
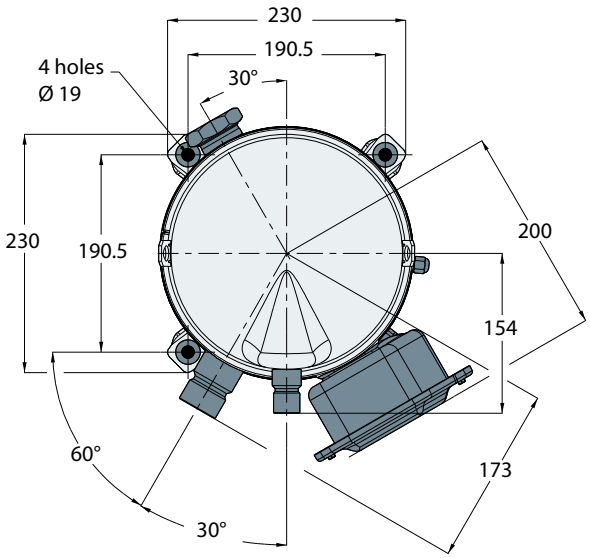
C: SM/SZ147

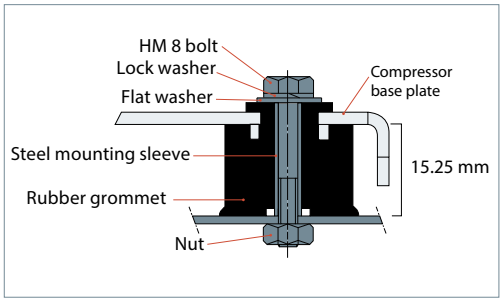
SM/SZ 147 code 3





All dimensions in mm

Grommet



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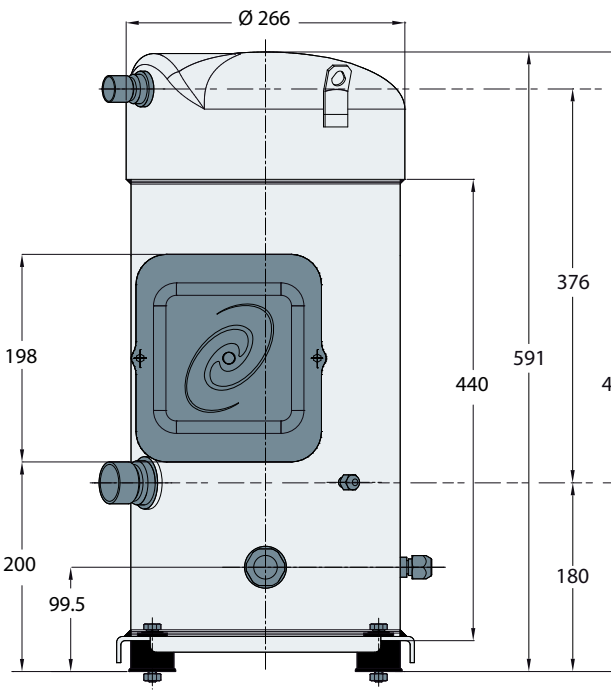
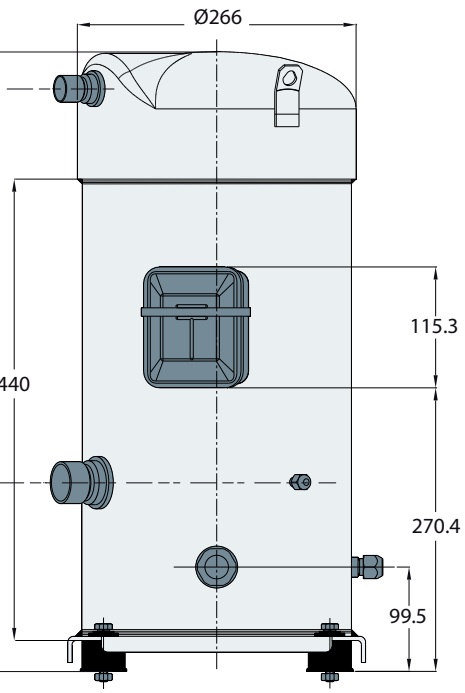
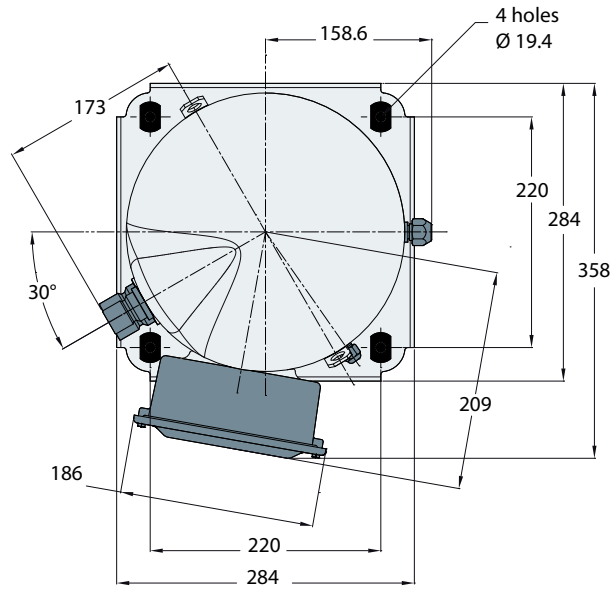
SM/SZ 148-161

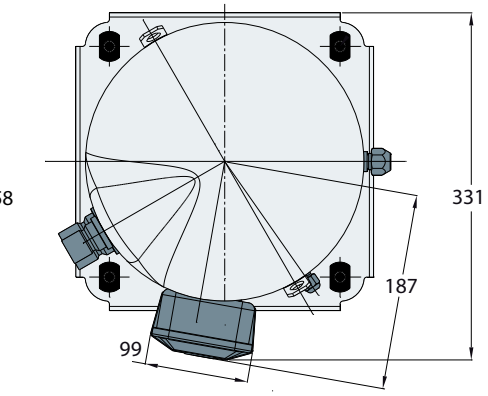
SM 148-161 code 3



SM 148-161 code 4

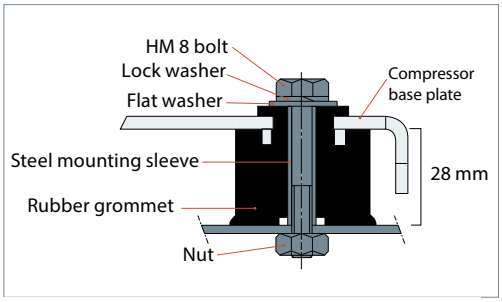






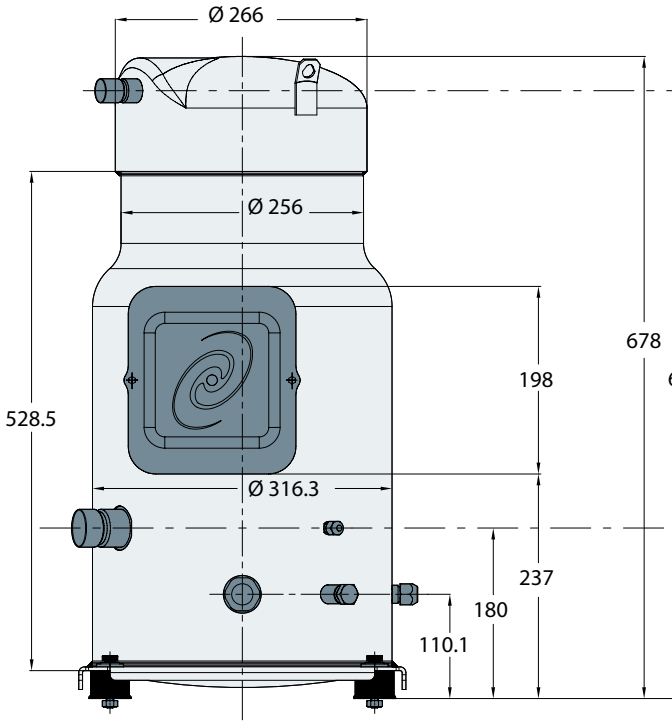
All dimensions in mm

Grommet

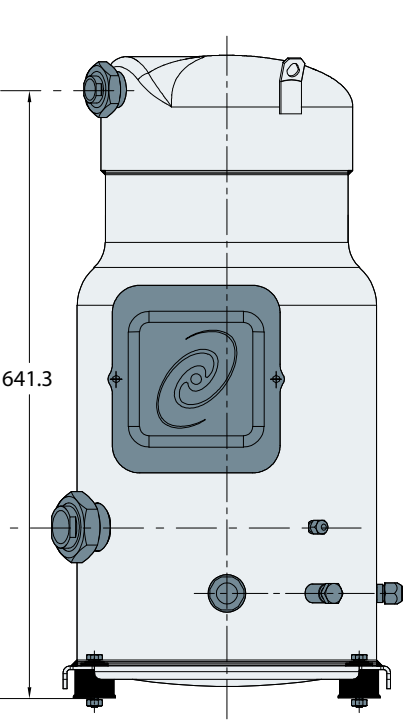


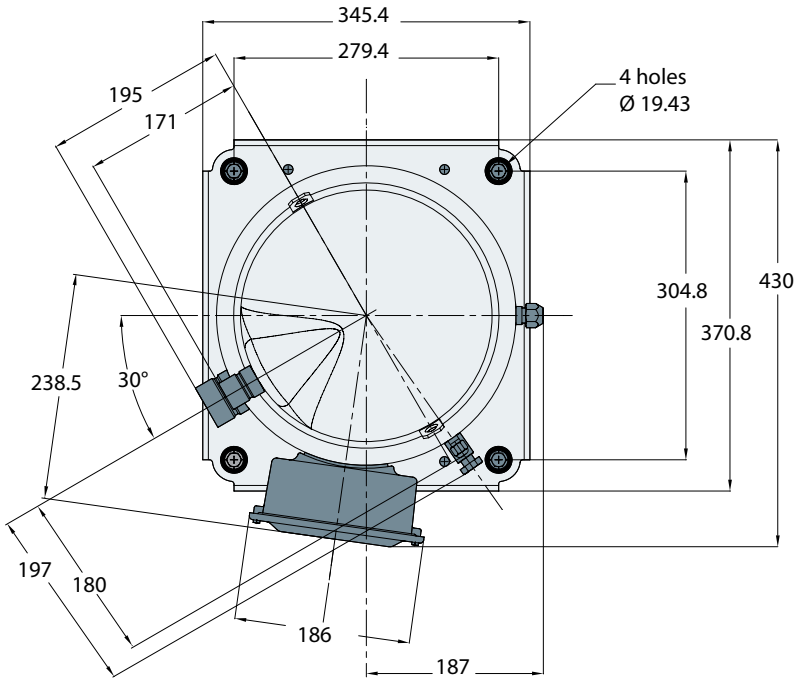
SM/SZ 175-185 & SY185
R and C version

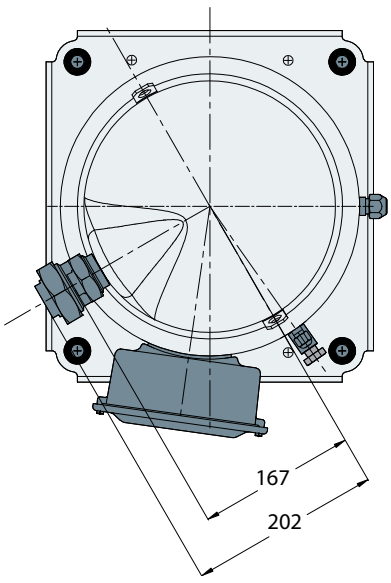
Brazed version



Rotolock version

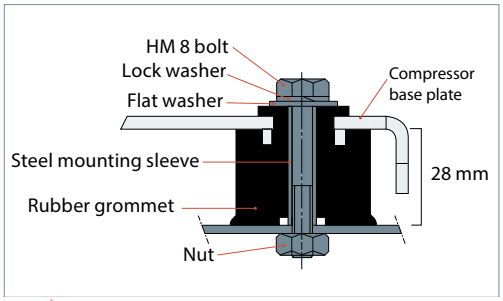






All dimensions in mm

Grommet



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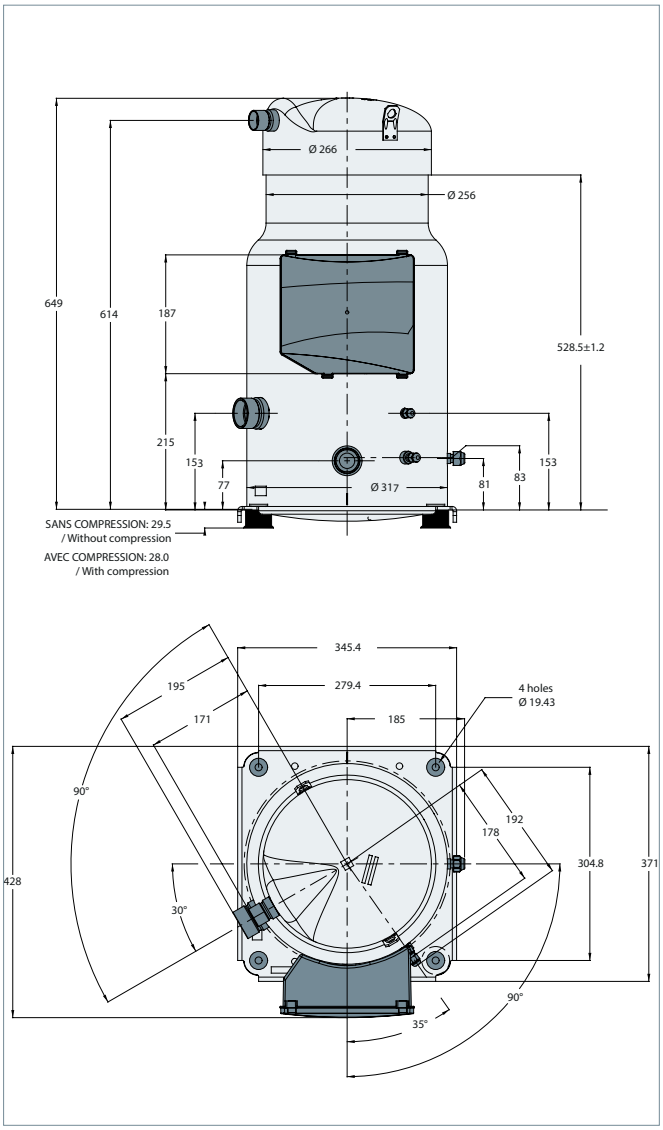
SM/SZ 185 P, X, Y version

Brazed version



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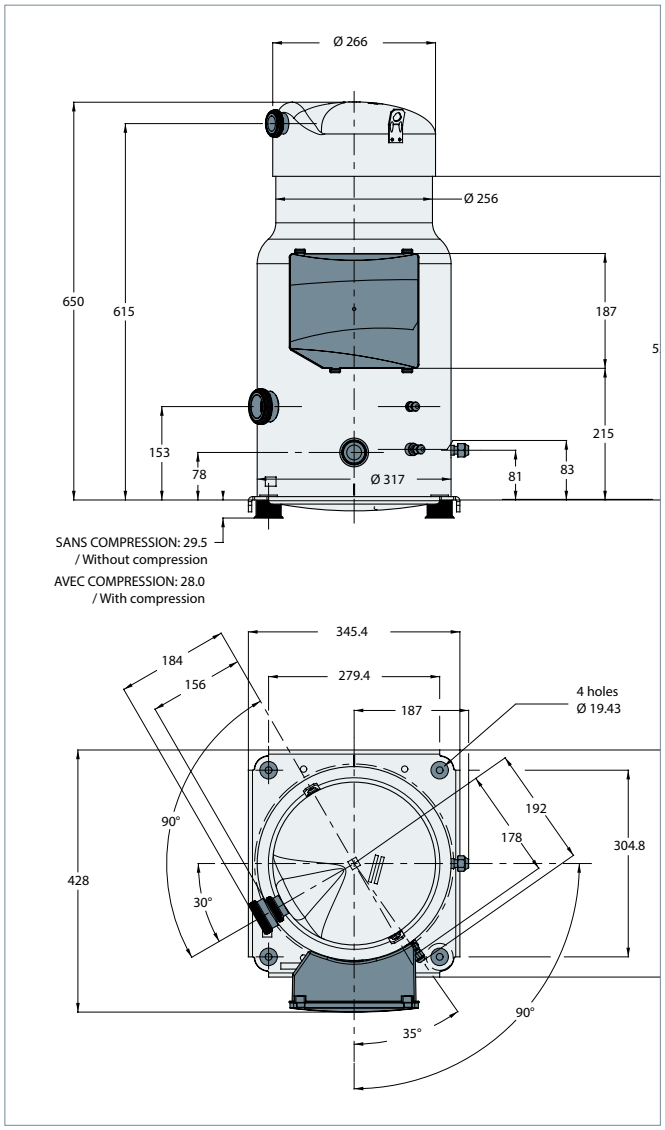
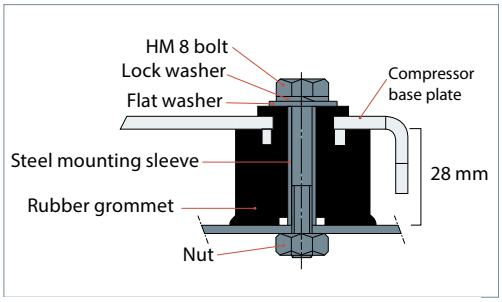


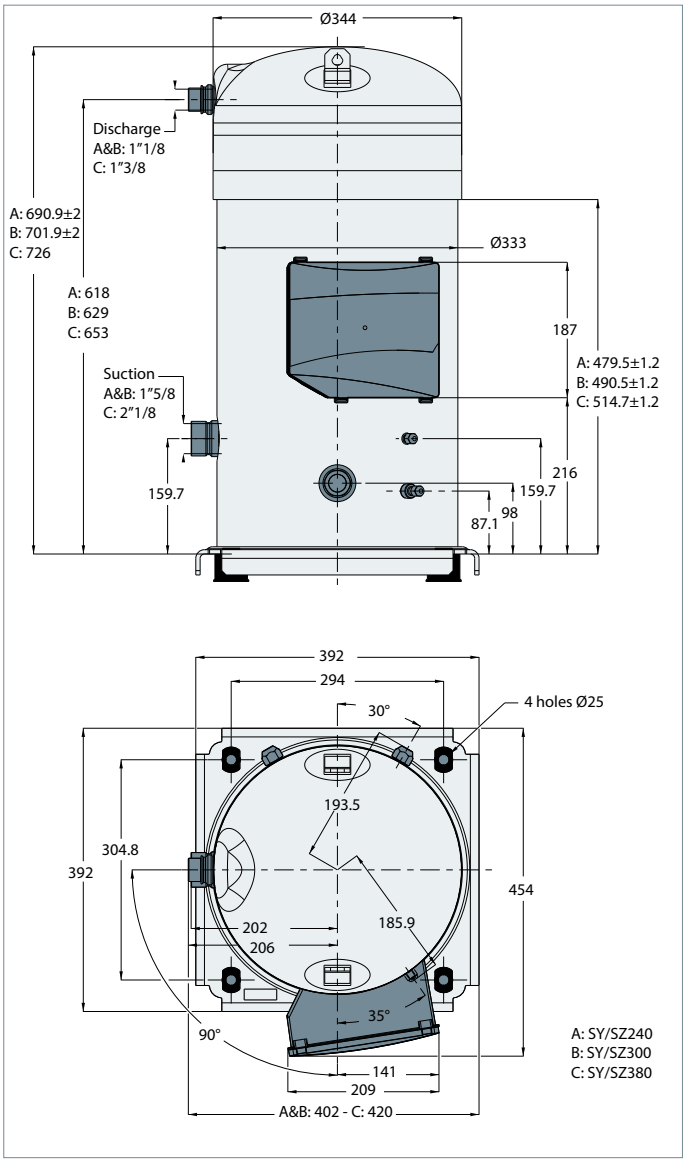
All dimensions in mm

Grommet

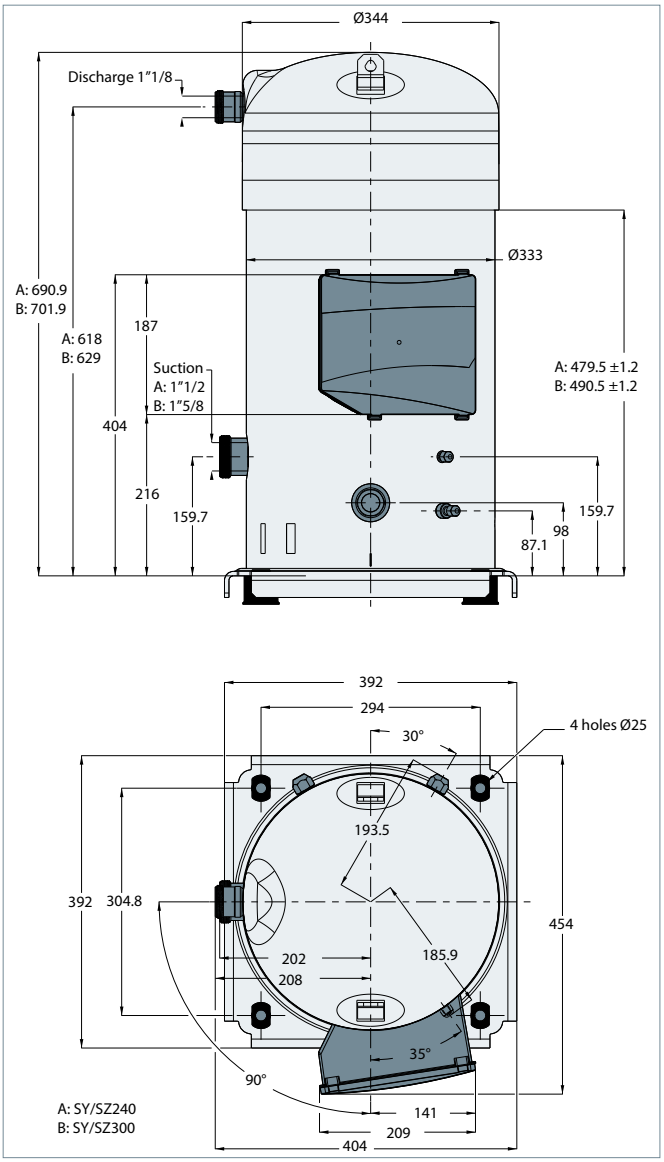


SY 240-300-380

Brazed version

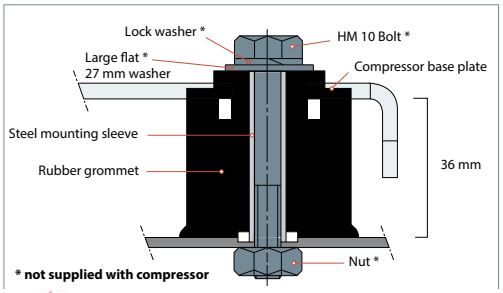


Rotolock version



All dimensions in mm

Grommet



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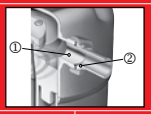
Connection details

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

Suction and discharge connections

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

Oil sight glass

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

Oil equalisation connection

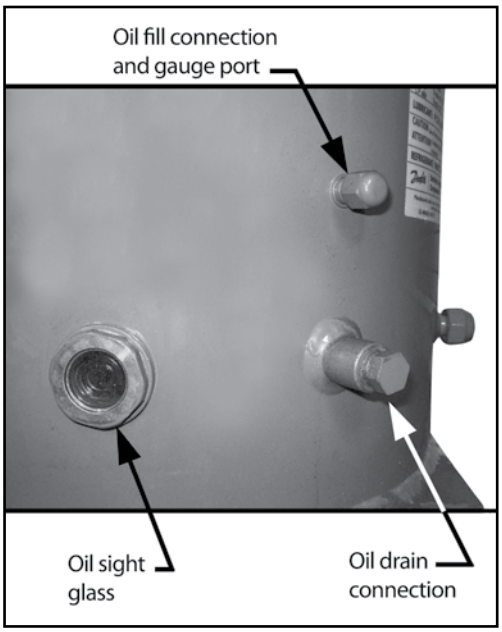
SM/SZ 112-124-147: 1"3/4 rotolock connector allowing use of 1"3/4-7/8" or 1"3/4-1"1/8
SY240-300-380: 1/2" flare
Other models: 3/8" flare
This connection must be used to mount an oil equalisation line when two or more compressors are mounted in parallel (please refer to Danfoss Parallel Application Guidelines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

Oil drain connection

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

Schrader

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



Motor voltage

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

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

* SY 380

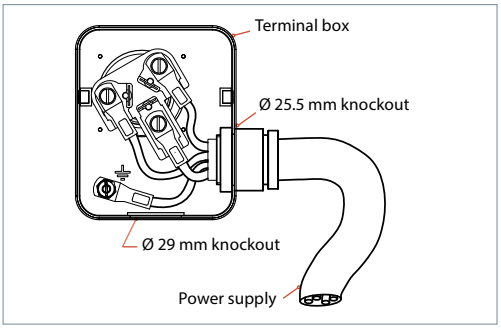
Wiring connections

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

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

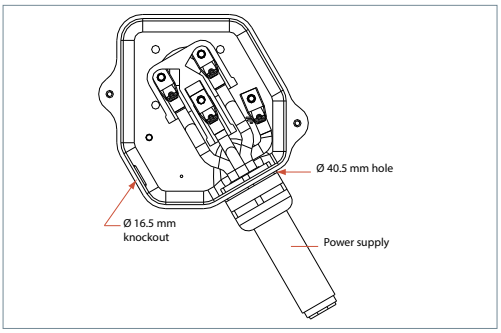
*Except for motor voltage code 3

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



SM/SZ 147 code 3

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



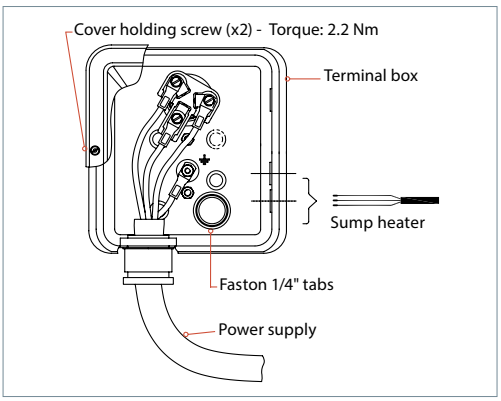
SM / SZ148 & 161 code 3-175-185 & SY185 - R & C version

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

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

The 3 other knockouts are as follows:

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



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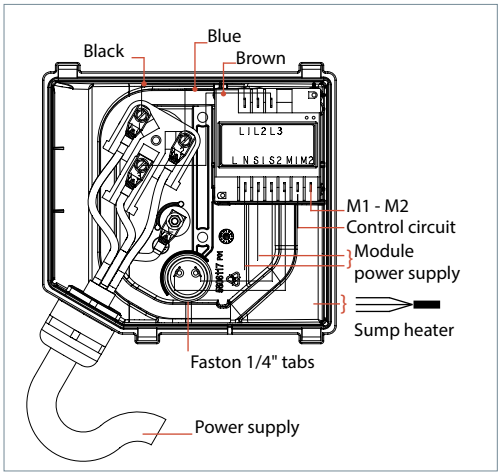
SY 240 – 300 – 380 & SM/SZ 185 - P, X, Y versions

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

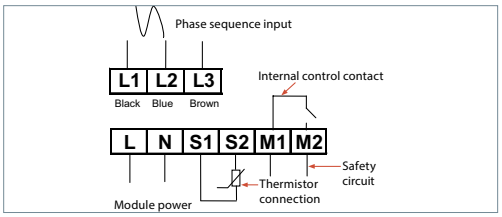
- Ø 50.8 mm (UL 1"1/2 conduit) & Ø 43.7 mm (UL 1"1/4 conduit) & Ø 34.5 mm (UL 1" conduit)
- Ø 40.5 mm (ISO40) & Ø 32.2 mm (ISO32) & Ø 25.5 mm (ISO25)
- Ø 25.5 mm (ISO25)

The 4 others knockouts are as follows:

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



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



IP rating

The compressor terminal box according to IEC529 is IP54 for all models when correctly sized IP54 rated cable glands are used.

- First numeral, level of protection against contact and foreign objects
  5 - Dust protected
- Second numeral, level of protection against water
  4 - Protection against water splashing.

Terminal box temperature

The temperature inside the terminal box may not exceed 70°C. Consequently, if the compressor is installed in an enclosure, precautions must be taken to avoid that the temperature around the compressor and in the terminal box would rise too much. The installation of ventilation on the enclosure panels may be necessary. If not, the electronic protection module may not operate properly. Any compressor damage related to this will not be covered by Danfoss warranty. In the same manner, cables must be selected in a way to insure that terminal box temperature does not exceed 70°C.

Three phase electrical characteristics

Compressor model		LRA	MCC	MMT	Max. op. current	Winding resistance
		A	A	A	A	Ω
Motor voltage code 3 200-230V/3 ph/60 Hz	SM/SZ084	170	35		35	0.44
	SM/SZ090	195	35		34	0.38
	SM/SZ100	195	38		32	0.38
	SM/SZ110	237	45		40	0.26
	SM112	267	51		41	0.27
	SM/SZ120	237	50		48	0.26
	SM/SZ124	267	51		45	0.27
	SM/SZ147	304	57		52	0.24
	SM/SZ148	255	64		57	0.29
	SM/SZ161	255	64		61	0.29
	SM/SZ175 *	380		75	70	0.19
	SM/SZ185 *	380		75	73	0.19
	SY240	460	109		100	0.14
	SY300	560	130		130	0.12
Motor voltage code 4 380-400V/3 ph/50 Hz 460V/3 ph/60 Hz	SM/SZ084	86	17		17	1.74
	SM/SZ090	98	18.5		17	1.48
	SM/SZ100	98	19		18	1.48
	SM/SZ110	130	22		20	1.05
	SM/SZ112	142	25		21	1.05
	SM/SZ120	130	29		24	1.05
	SM/SZ124	142	25		23	1.05
	SM/SZ147	147	29		26	0.92
	SM/SZ148	145	32		29	0.94
	SM/SZ161	145	32		31	0.94
	SM/SZ175 *	175		35	34	0.77
	SM/SZ185 *	175		35	35	0.77
	SY/SZ185	175		35	34	0.77
	SY240	215	50		47	0.62
	SY300	270	69		58	0.52
	SY380	300	79		72.7	0.41
Motor voltage code 6 230V/3 ph/50 Hz	SM/SZ084	150	29		27	0.58
	SM/SZ090	165	30		27	0.5
	SM/SZ100	165	30		30	0.5
	SM/SZ110	210	37		35	0.35
	SM/SZ120	210	43		39	0.35
	SM/SZ148	200	50		47	0.38
	SM/SZ161	200	54		51	0.38
	SM/SZ175 *	270		68	57	0.25
	SM/SZ185 *	270		68	59	0.25
Motor voltage code 7 500V/3 ph/50 Hz 575V/3 ph/60 Hz	SM/SZ084	70	13		13	2.58
	SM/SZ090	80	14		13	2.25
	SM/SZ100	80	15		13	2.25
	SM/SZ110	85	18		16	1.57
	SM/SZ120	85	19		18	1.57
	SM/SZ148	102	27		23	1.61
	SM/SZ161	102	25		24	1.61
	SM/SZ175 *	140		28	27	1.11
	SM/SZ185 *	140		28	28	1.11
Motor voltage code 9 380V/3 ph/60 Hz	SM/SZ084	100	20		20	1.22
	SM/SZ090	113	22		20	1.05
	SM/SZ100	113	22		19	1.05
	SM/SZ110	160	27		23	0.72
	SM/SZ112	177	32		24	0.72
	SM/SZ120	160	30		28	0.72
	SM/SZ124	177	32		27	0.72
	SM/SZ147	181	35		31	0.62
	SM/SZ148	155	38		36	0.75
	SM/SZ161	155	38		38	0.75
	SM/SZ175 *	235		43	42	0.48
	SM/SZ185 *	235		43	43	0.48
	SY240	260	62		62	0.42
	SY300	305	74		74	0.36
	SY380	390	93		84.5	0.28

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

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LRA (Locked Rotor Amp)

Locked Rotor Amp value is the higher current as measured on mechanically blocked compressor tested under nominal voltage. The LRA value can be used as rough estimation for the starting current. However in most cases, the real starting current will be lower. A soft starter can be applied to reduce starting current.

MMT (Max Must Trip current)

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

MCC (Maximum Continuous Current)

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

Max. operating Current

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

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

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

Winding resistance

Winding resistance is the resistance between indicated terminal pins at 25°C (resistance value +/- 7%).

Winding resistance is generally low and it requires adapted tools for precise measurement. Use a digital ohm-meter, a "4 wires" method and measure under stabilised ambient temperature. Winding resistance varies strongly with winding temperature ; if the compressor is stabilised at a different value than 25°C, the measured resistance must be corrected with following formula:

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

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

Danfoss MCI soft-start controller

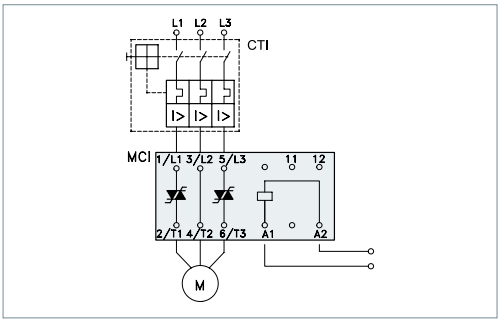
The inrush current for the Danfoss scroll compressors with motor code 4 (400V / 3 / 50Hz or 460V / 3 / 60Hz) can be reduced using the Danfoss digitally-controlled MCI compressor soft starter. MCI soft starters are designed to reduce the starting current of 3-phase AC motors; MCI soft starters can reduce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

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

* By-pass contactor (K1) required.

Input controlled soft start

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

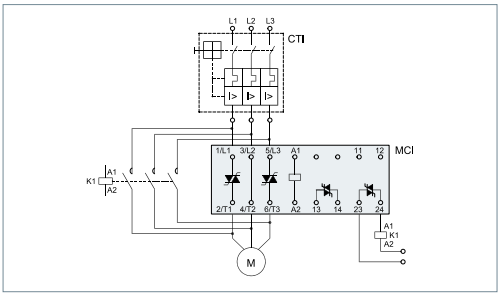


MCI with bypass contactor

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

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

13-14 contact not applicable with MCI 25C



General wiring information

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

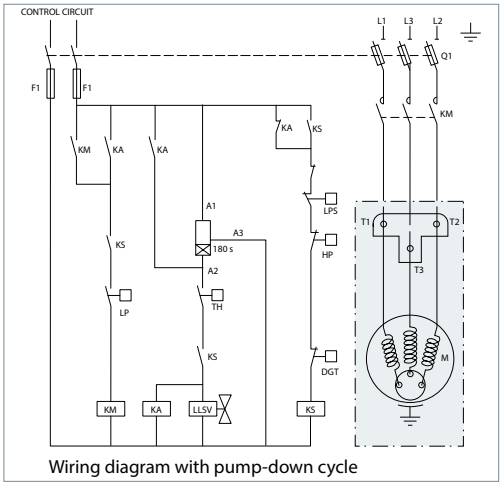
When a safety switch trips, the compressor must stop immediately and must not re-start until the tripping condition is back to normal and the safety switch is closed again. This applies to the LP safety switch, the HP safety switch, the discharge gas thermostat and the motor safety thermostat.

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

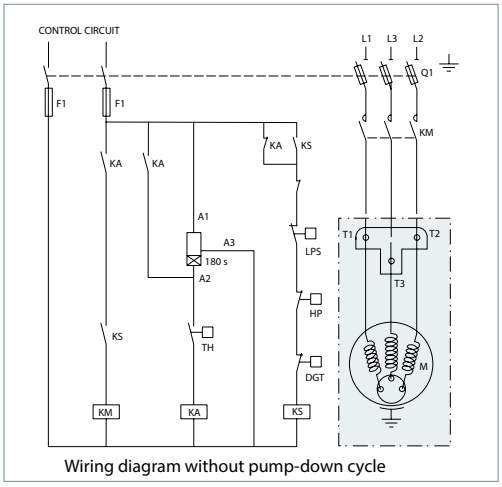
The LP safety switch must never be bypassed. Pressure settings for the LP and HP safety switch and pump-down are in table from "Low pressure" section.

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

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



Wiring diagram with pump-down cycle



Wiring diagram without pump-down cycle

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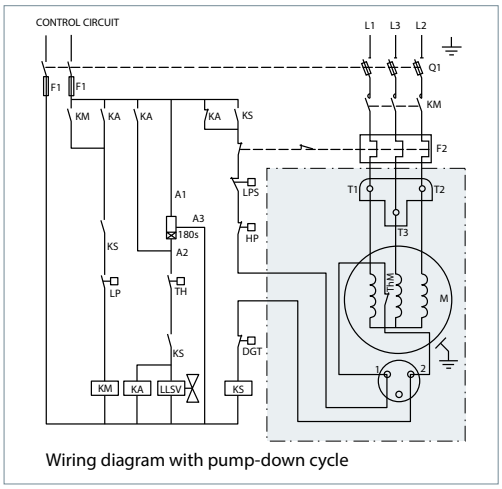
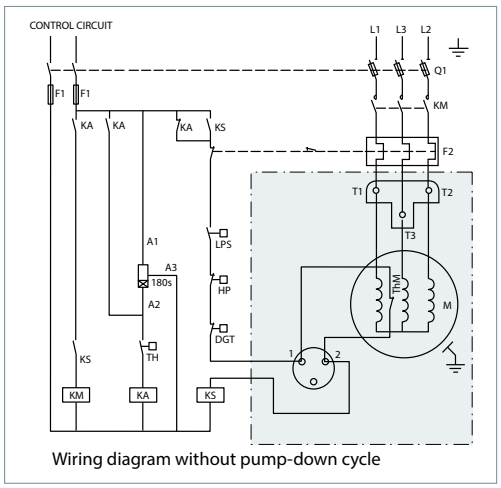
روبروی پالایشگاه نفت پارس، پلاک ۱۲

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

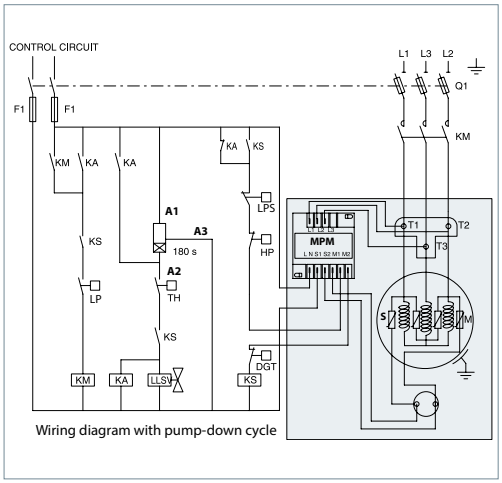


Wiring diagram with pump-down cycle

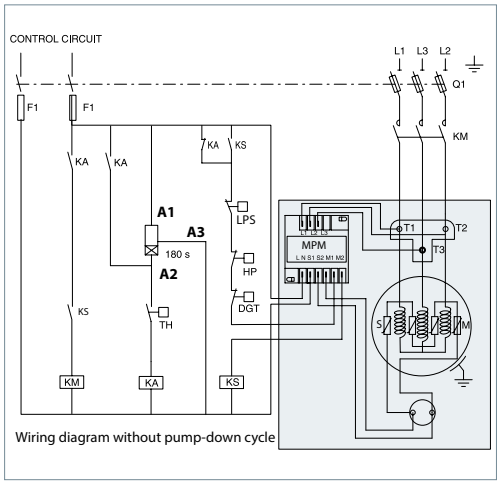


Wiring diagram without pump-down cycle

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



Wiring diagram with pump-down cycle



Wiring diagram without pump-down cycle

Legends

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

Motor protection

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

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

REC Recommended REQ Required ✓ No test or additional safeties required

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

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

While not compulsory, an additional external overload protection is still advisable for either alarm or manual reset.

Then it must be set below MCC value (at max operating current):

- when the motor temperature is too high, then the internal protector will trip
- when the current is too high the external overload protection will trip before the internal protection therefore offering possibility of manual reset.

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

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

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

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

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

Further requirements for the external overload protector are:

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

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

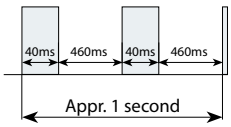
The motor protector comprises a control module and PTC sensors embedded in the motor winding. The close contact between thermistors and windings ensures a very low level of thermal inertia.

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

If any thermistor exceeds its response temperature, its resistance increases above the trip level (4,500 Ω) and the output relay then trips -ie. contacts M1-M2 are open. After cooling to below the response temperature (resistance < 2,750 Ω), a 5 minute time delay is activated. After this delay has elapsed, the relay is once again pulled in ie. contacts M1-M2 are closed. The time delay may be cancelled by means of resetting the mains (L-N disconnect) for approximately 5 sec.

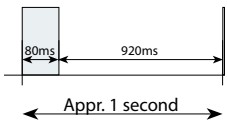
A red/green twin LED is visible on the module. A solid green LED denotes a fault free condition.

PTC overheat



A blinking red LED indicates an identifiable fault condition:

Delay timer active (after PTC overheat)



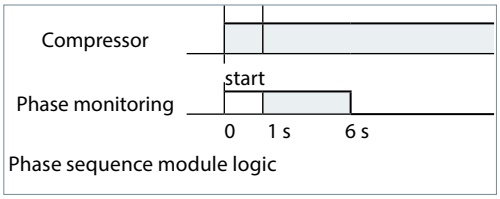
Phase sequence and reverse rotation protection

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

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

Compressor models SM/SZ084 to 185 (except SM112-124 & 147) incorporate an internal reverse vent valve which will react in the presence of reverse rotation and will allow refrigerant to circulate through a by-pass from the suction to the discharge. Although reverse rotation is not destructive, even over long periods of time up to several days it should be corrected as soon as possible. Reverse rotation will be obvious to the user as soon as power is turned on; the compressor will not build up any pressure, the sound level will be abnormally high and power consumption will be minimal. If reverse rotation symptoms occur, shut the compressor down and connect the phases to their proper terminals. If reverse rotation is not halted, the compressor will cycle off on the internal motor protection.

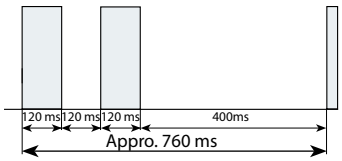
Compressor models SY / SZ 240 to 380 are delivered with an electronic module which provides protection against phase reversal and loss at start-up. Apply the recommended wiring diagrams. The circuit should be thoroughly checked in order to determine the cause of the phase problem before re-energizing the control circuit.
The phase sequencing and phase loss monitoring functions are active during a 5 sec. window 1 sec. after compressor start-up (power on L1-L2-L3).



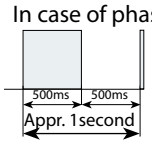
Phase sequence module logic

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

In case of phase reverse error:



In case of phase loss error:



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

Voltage unbalance

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

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

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

Approvals and certificates

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

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

CE 0062 or CE 0038 or CE0871 (European Directive)	All SM / SY / SZ models
UL (Underwriters Laboratories)	All 60 Hz SM / SY / SZ models
Other approvals / certificates	Contact Danfoss

Pressure equipment directive 2014/68/EU

Products	SM084 to 185	SZ084 to 185 & SY185	SY 240 to 380
Refrigerating fluids	Group 2	Group 2	Group 2
Category PED	II	II	II
Evaluation module	D1	D1	D1
Service temperature - Ts	-35°C < Ts < 63°C	-35°C < Ts < 53°C	-35°C < Ts < 53°C
Service pressure - Ps	25 bar(g)	25 bar(g)	20 bar(g)
Declaration of conformity		Contact Danfoss	

Low voltage directive 2014/35/EU

Products	SM/SZ084 to SY380
Declaration of conformity	Contact Danfoss

Machines directives 2006/42/EC

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

Internal free volume

Products	Internal free volume without oil (litre)
SM/SZ084-090-100	14.1
SM/SZ110-120	14.7
SM112-124-SM/SZ147	14.3
SM/SZ148-161	19.6
SM/SZ175-185 and SY185	33.0
SY240-300	37.8
SY380	39.2

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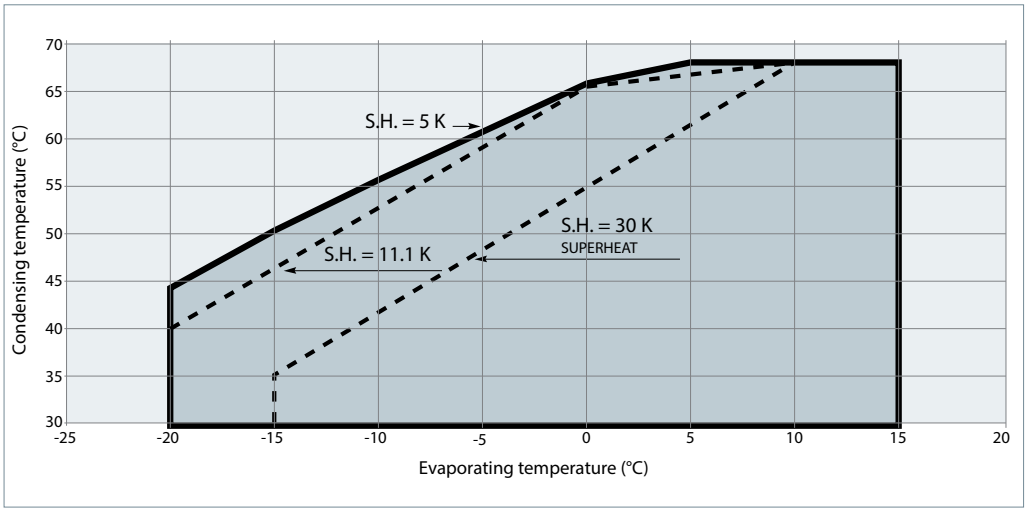
Application Guidelines	Operating conditions	
	The scroll compressor application range is influenced by several parameters which need to be monitored for a safe and reliable operation. These parameters and the main recommendations for good practice and safety devices are explained hereunder.	• **Refrigerant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

Application Guidelines	Operating conditions	
Motor supply	SM / SY / SZ scroll compressors can be operated at nominal voltages as indicated on "Motor voltage code" section. Under-voltage and over-voltage operation is allowed within the indicated	voltage ranges. In case of risk of under-voltage operation, special attention must be paid to current draw.
Compressor ambient temperature	SM / SY / SZ compressors can be applied from -35°C to +63°C (for SM/SZ084 to 185) and +53°C (for SY/SZ 240 to 380) ambient temperature. The compressors are designed as 100 % suction gas	cooled without need for additional fan cooling. Ambient temperature has very little effect on the compressor performance.
High ambient temperature	In case of enclosed fitting and high ambient temperature it's recommend to check the temperature of power wires and conformity to their insulation specification.	In case of safe tripping by the compressor overload protection the compressor must cool down to about 60°C before the overload will reset. A high ambient temperature can strongly delay this cool-down process.
Low ambient temperature	Although the compressor itself can withstand low ambient temperature, the system may require specific design features to ensure safe	and reliable operation. See section 'Specific application recommendations'.
Application envelope at dew temperatures	The operating envelopes for SM / SY / SZ scroll compressors are given in the figures below, where the condensing and evaporating temperatures represent the range for steady-state operation. Under transient conditions, such as start-up and defrost, the compressor may operate outside this envelope for short periods. The figures below show the operating envelopes for SM / SY compressors with refrigerants R22 and for SZ compressors with R407C, R134a, R404A and R507C.	The operating limits serve to define the envelope within which reliable operations of the compressor are guaranteed: • Maximum discharge gas temperature: +135°C • A suction superheat below 5 K (10 K for R407C) is not recommended due to the risk of liquid flood back • Maximum superheat of 30K • Minimum and maximum evaporating and condensing temperatures as per the operating envelopes.

SM084 to 185
SY185 to 380
R22



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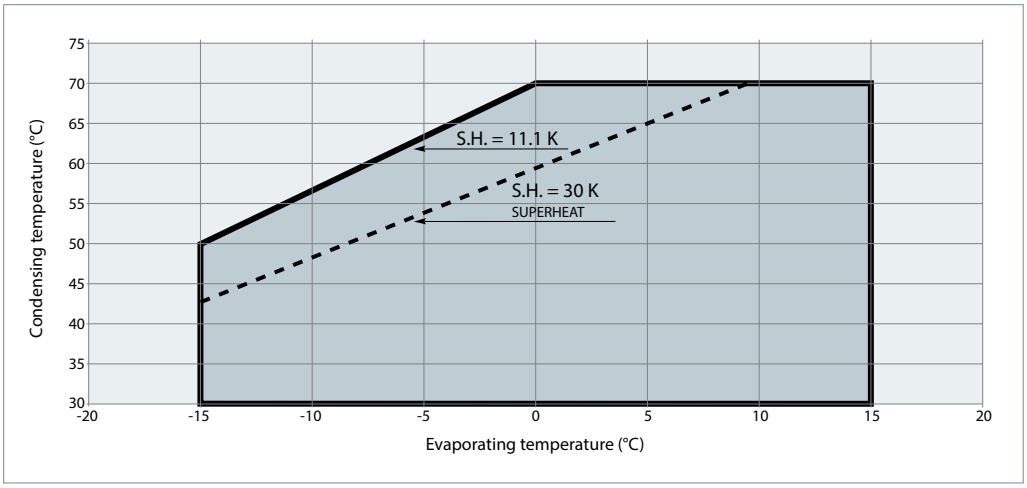
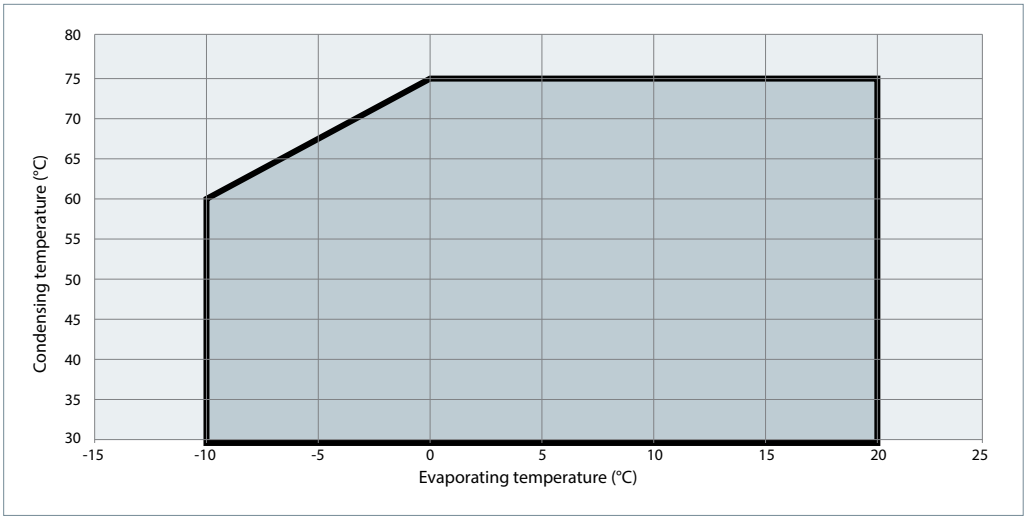
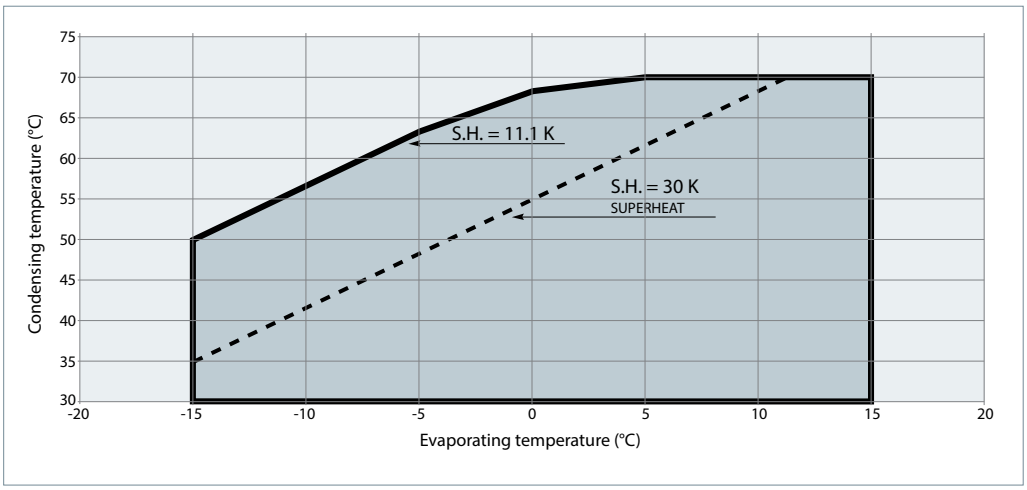
SZ084 to 185 (except SZ112-124-147)
R134a



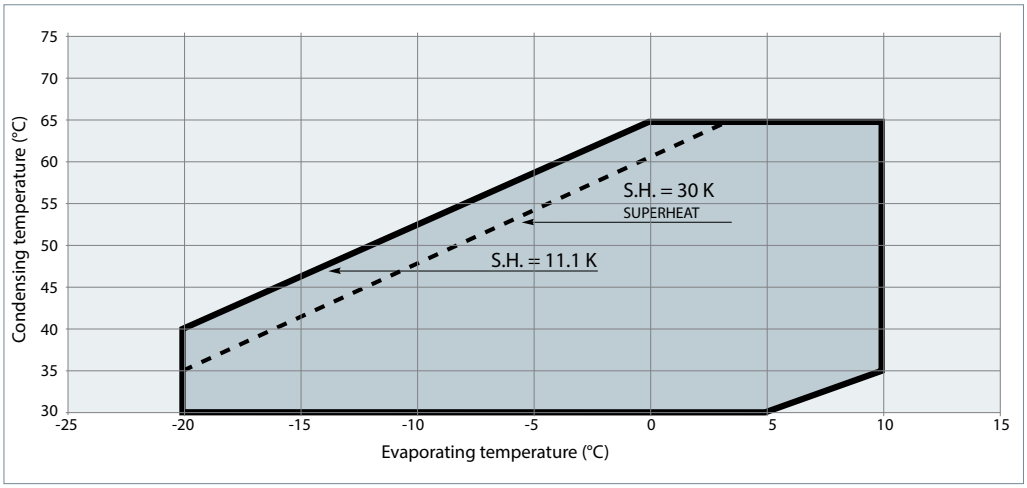
SZ147 R134a



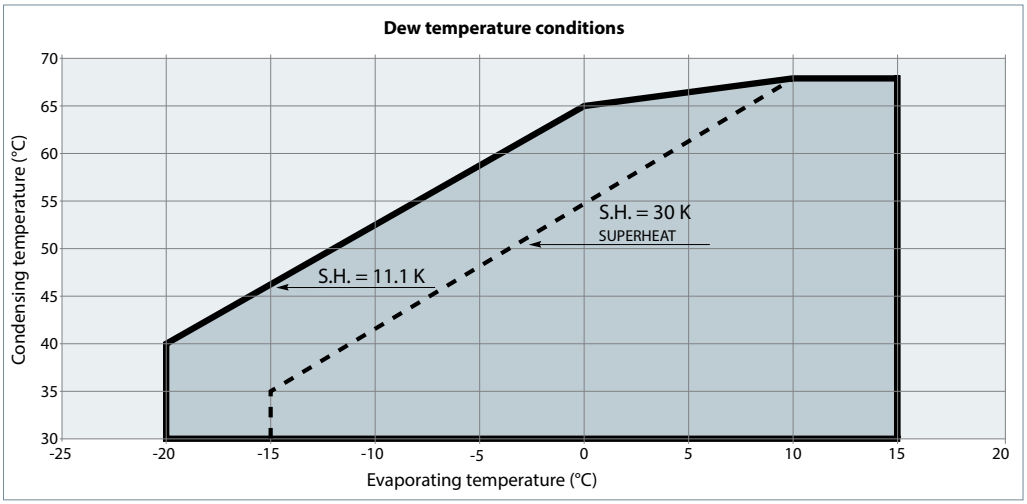
SY240 to 380
R134a



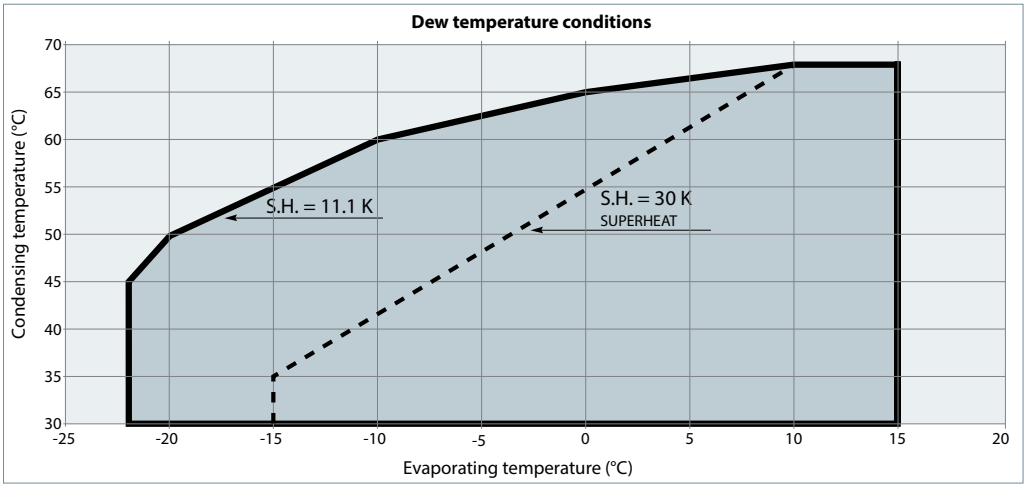
SZ084 to 185
R404A / R507A



SZ084 to 185 & SY185
R407C
at DEW temperature



SY240 to 380
R407C
at DEW temperature



Application envelopes at mean temperatures

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

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

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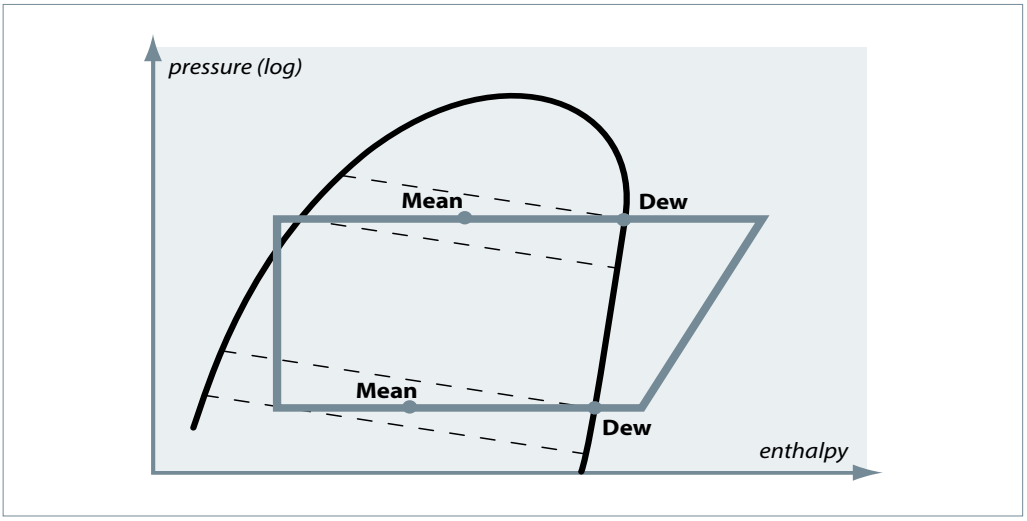
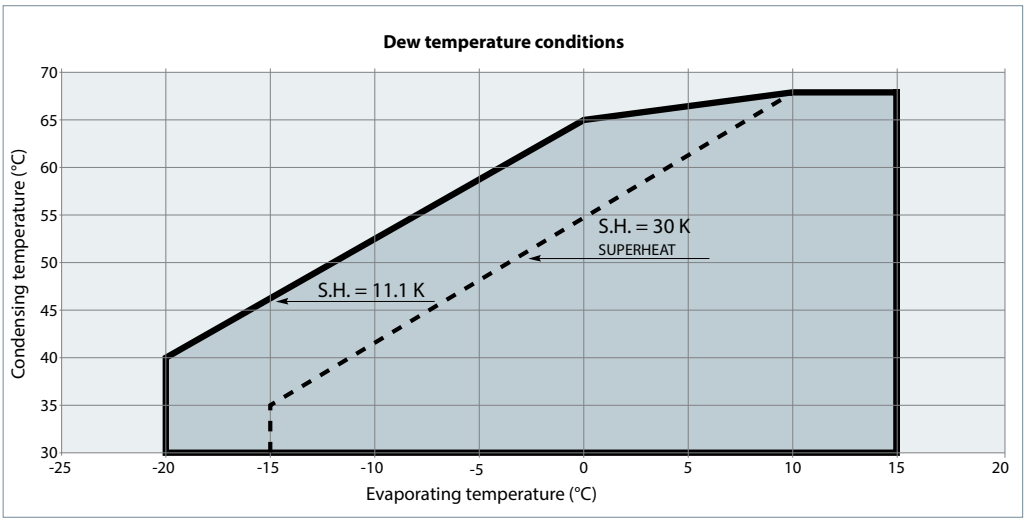
Dew temperature and mean temperature for R407C

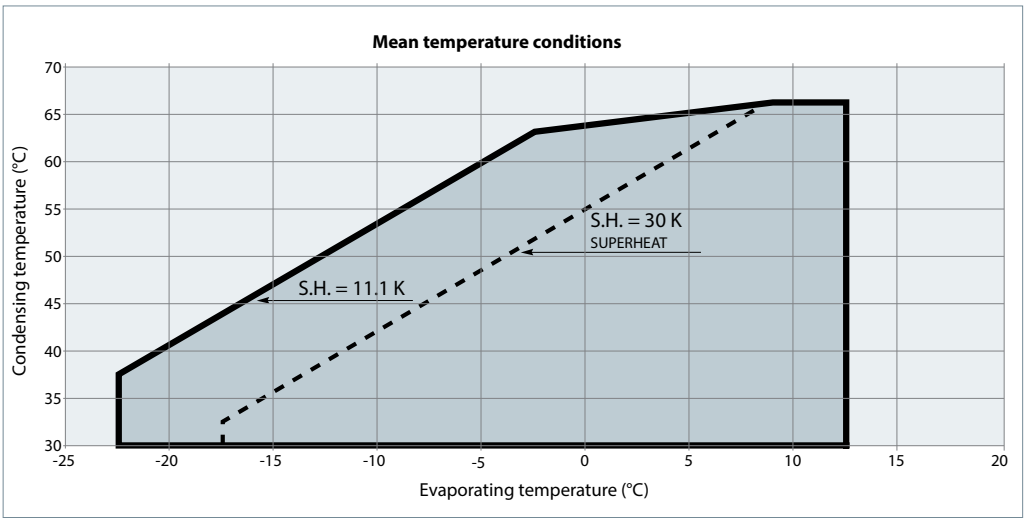


The following operating diagrams show the difference between mean and dew temperature application envelopes.

Dew temperature
Example for SZ 084 to 185



Mean temperature
Example for SZ 084 to 185



Discharge temperature protection

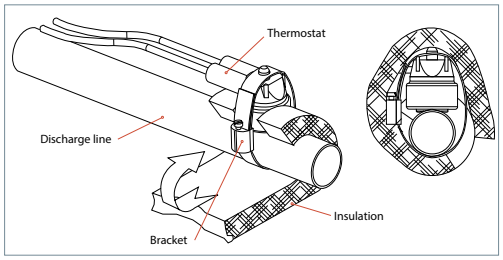
The discharge gas temperature must not exceed 135°C. The discharge gas thermostat accessory kit (code 7750009) includes all components required for installation, as shown below. The thermostat must be attached to the discharge line within 150 mm from the compressor discharge port and must be thermally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

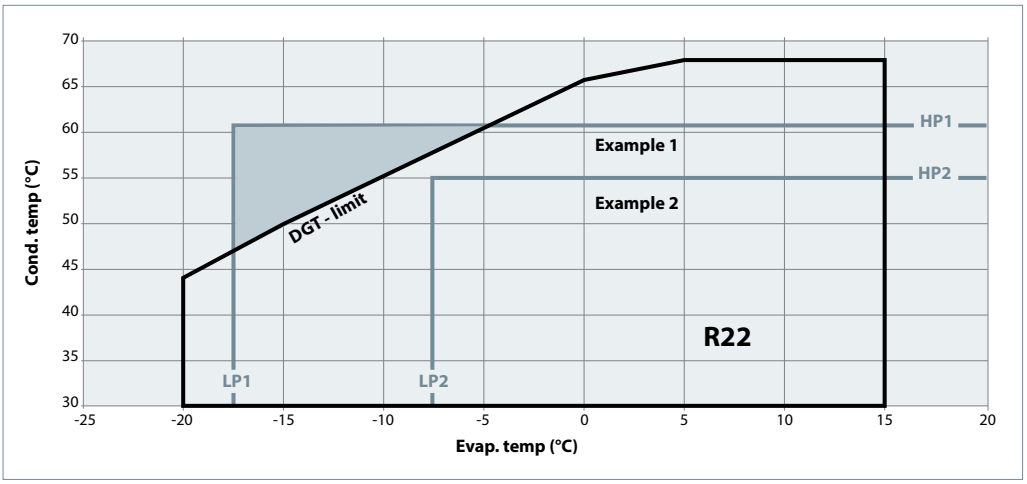
DGT protection is required if the high and low pressure switch settings do not protect the compressor against operations beyond its specific application envelope. Please refer to the examples on following page, which illustrates where DGT protection is required (ex.1) and where it is not (ex.2).

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

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

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





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

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

High and low pressure protection

High pressure

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

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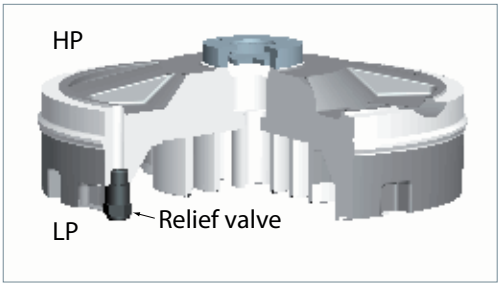
Internal pressure relief valve

The SY/SZ240 to SY/SZ380 incorporate an internal relief valve set to open between the internal high and low pressure sides of the compressor when the pressure differential between the discharge and suction pressures surpasses 31 to 38 bar.

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



Low pressure

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

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

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

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

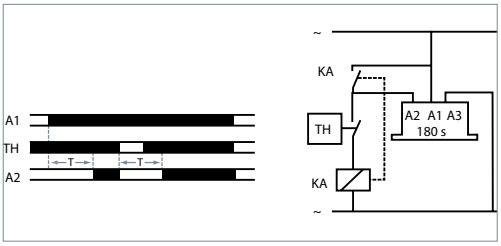
Cycle rate limit

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

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

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

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



General

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

Essential piping design considerations

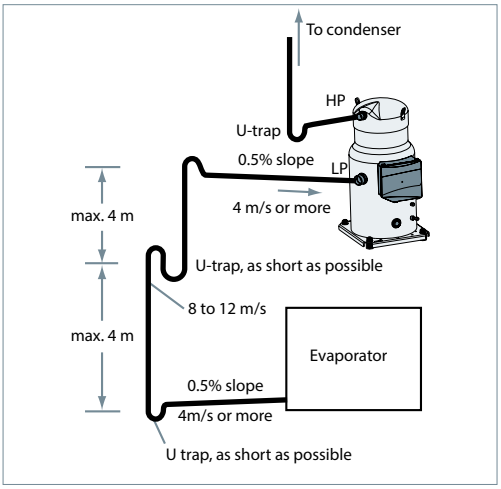
Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and slope of the tubing coming from the evaporator. Tubing returns from the evaporator should be designed so as not to trap oil and to prevent oil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

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

Suction lines

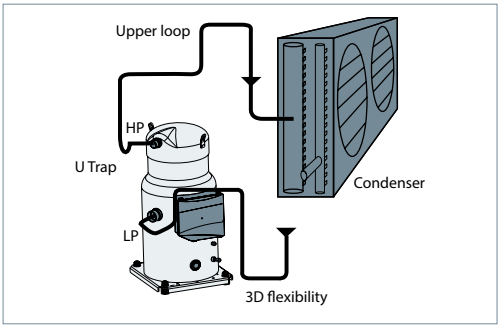
If the evaporator lies above the compressor, as is often the case in split or remote condenser systems, the addition of a pump-down cycle is strongly recommended. If a pump-down cycle were to be omitted, the suction line must have a loop at the evaporator outlet to prevent refrigerant from draining into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

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



Discharge lines

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



Heat exchangers

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

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

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

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

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Refrigerant charge limit

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

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

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

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

REC Recommended REQ Required ✓ No test or additional safeties required

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

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

Off-cycle migration

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

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

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

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

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

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

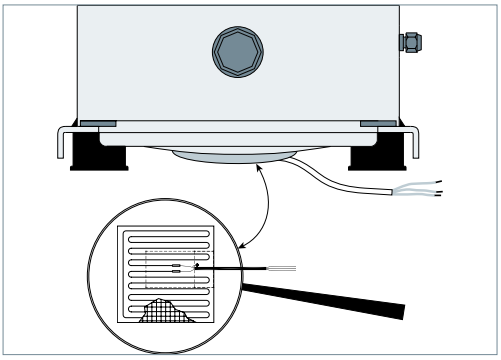
- **Sump heater**
- **Liquid line solenoid valve**
- **Pump down cycle**

Sump heater

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

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

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



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

Liquid line solenoid valve (LLSV)

An LLSV may be used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer or excessive migration to the compressor during off-cycles.

The quantity of refrigerant on the low pressure side of the system can be further reduced by using a pump-down cycle in association with the LLSV.

Pump-down cycle

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

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

Tests for pump down cycle approval:

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

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

Other application needs a liquid receiver to store the refrigerant.

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

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Application Guidelines	System design recommendations	
Liquid flood back	During normal operation, refrigerant enters the compressor as a superheated vapour. Liquid flood back occurs when a part of the refrigerant entering the compressor is still in liquid state. Danfoss SM/SY/SZ scroll compressors can tolerate occasional liquid flood back. However system design must be such that repeated and excessive flood back is not possible. A continuous liquid flood back will cause oil dilution and, in extreme situations lead to lack of lubrication and high rate of oil leaving the compressor.
	Liquid flood back test - Repetitive liquid flood back testing must be carried out under expansion valve threshold operating conditions: a high pressure ratio and minimum evaporator load, along with the measurement of suction superheat, oil sump temperature and discharge gas temperature. **During operations**, liquid flood back may be detected by measuring either the oil sump temperature or the discharge gas temperature. If at any time during operations, the oil sump temperature drops to within 10K or less above the saturated suction temperature, or should the discharge gas temperature be less than 30K above the saturated discharge temperature, this indicates liquid flood back. Continuous liquid flood back can occur with a wrong dimensioning, a wrong setting or malfunction of the expansion device or in case of evaporator fan failure or blocked air filters. A suction accumulator providing additional protection as explained hereunder can be used to solve light continuous liquid flood back.
Suction accumulator	**Suction accumulator**: a suction accumulator offers protection against refrigerant flood back at start-up, during operations or defrosting by trapping the liquid refrigerant upstream from the compressor. The suction accumulator also protects against off-cycle migration by providing additional internal free volume to the low side of the system. A suction accumulator must be carefully dimensioned, taking into account the refrigerant charge as well as the gas velocity in the suction line. The accumulator should not be sized for less than 50% of the total system charge. Tests must be conducted to determine the actual refrigerant holding capacity needed for the application. Depending on the operating conditions it may happen that the recommended connections of the accumulator are one size smaller than the suction line.

Application Guidelines	Specific application recommendations

Low ambient application

Low ambient start-up

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

Low ambient operations

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

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

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

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

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

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

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

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

For further information, please contact Danfoss.

Sump heaters

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

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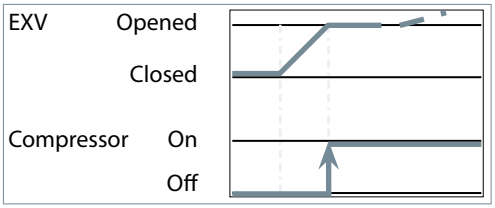
Application Guidelines	Specific application recommendations	
Low load operations	The compressors should be run for a minimum period in order to ensure that the oil has sufficient time to properly return to the	compressor sumps and that the motor has sufficient time to cool under conditions of lowest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

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

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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

Starting sound level

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

Running sound level

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

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

Stopping sound level

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

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

Sound generation in a refrigeration or air conditioning system

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

Sound radiation: This generally takes an airborne path.

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

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

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

Compressor sound radiation

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

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

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

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

Mechanical vibrations

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

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

Gas pulsation

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

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

Compressor handling and storage

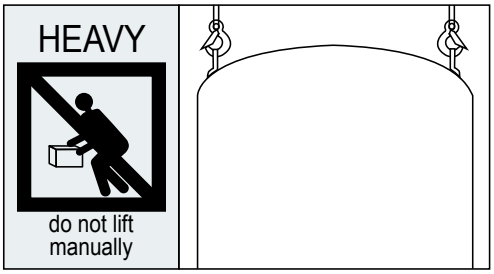
Each Danfoss SM / SY / SZ scroll compressor is equipped with two lift rings on the top shell. Always use both these rings when lifting the compressor. Use lifting equipment rated and certified for the weight of the compressor.
A spreader bar rated for the weight of the compressor is highly recommended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

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

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

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

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



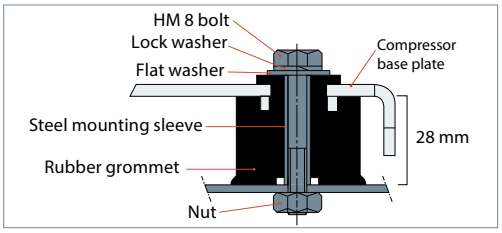
Compressor mounting

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

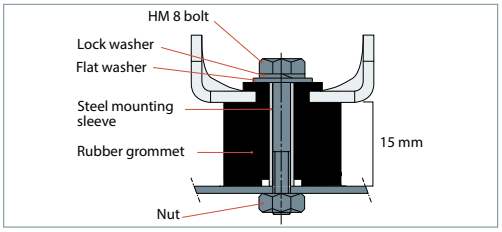
All compressors come delivered with four rubber mounting grommets and metal sleeve liners that serve to isolate the compressor from the base frame. These grommets must always be used to mount the compressor in single application.

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

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

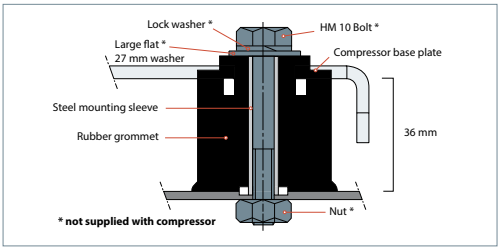


Mounting of SM/SZ 112-124-147: the required bolt size is HM8. This bolt must be tightened to a torque of 15 Nm. The bolt and washers are supplied with the assembly kit. When a surface sump heater is used, it must be applied after grommets are mounted on compressor in order to avoid surface sump heater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



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

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



Compressor holding charge

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

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

System cleanliness

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

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

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

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

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

Tubing

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

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

Brazing and soldering

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

Copper to copper connections

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

Dissimilar metals connection

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

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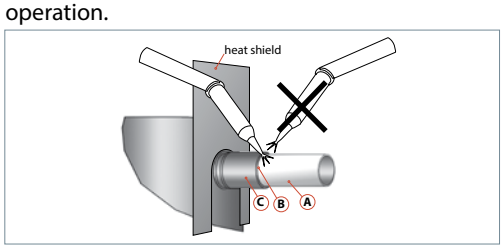
Compressor connection

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 CO2 through the compressor in order to prevent against oxidation and flammable conditions. The compressor should not be exposed to the open air for extended periods.
- Use of a double-tipped torch is recommended.
- Apply heat evenly to Area A until the brazing temperature is reached. Move the torch to Area B and apply heat evenly until the brazing temperature has been reached there as well, and then begin adding the brazing material. Move the torch evenly around the joint, in applying only enough brazing material to flow the full circumference of the joint.
- Move the torch to Area C only long enough to draw the brazing material into the joint, but not into the compressor.
- Remove all remaining flux once the joint has been soldered with a wire brush or a wet cloth. Remaining flux would cause corrosion of the tubing.

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

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

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

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

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

System pressure test

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

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

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

Application Guidelines — Installation

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.

Vacuum evacuation and moisture removal

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

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

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

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

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

Filter driers

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

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

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

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

Refrigerant charging

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

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

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

Insulation resistance and dielectric strength

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

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

SM/SY/SZ scroll compressors are configured with the pump assembly at the top of the shell, and the motor below. As a result, the motor can be partially immersed in refrigerant and oil. The presence of refrigerant around the motor windings will result in lower resistance values to ground and higher leakage current readings. Such readings do not indicate a faulty compressor.

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

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

Commissioning

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

• Proper metering device operation and desired super heat readings,

• Suction and discharge pressure are within acceptable levels,

• Correct oil level in compressor sump indicating proper oil return,

• Low foaming in sight glass and compressor sump temperature 10 K above saturation temperature to show that there is no refrigerant migration taking place,

• Acceptable cycling rate of compressors, including duration of run times,

• Current draw of individual compressors within acceptable values (max. operating current),

• No abnormal vibrations and noise.

Oil level checking and top-up

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

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

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

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

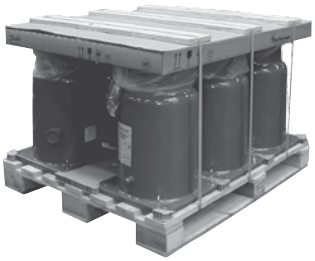
When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

Always use original Danfoss oil from new cans.

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

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

Packaging



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

* Nbr = number of compressors per pallet

Ordering information

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

SM-SY Single

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

SM-SY Industrial

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

* Single installation version without oil equalization and sight glass

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روبروی پالایشگاه نفت پارس، پلاک ۱۲

SZ Single

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

SZ Industrial

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

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Solder sleeve adaptator set

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

* Diameter restrictor

Rotolock adaptor

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

Gaskets

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

Solder sleeves

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

Rotolock nuts

Type	Code n°	Description	Application	Packaging	Pack size
	8153123	Rotolock nut,1"1/4	Models with 1"1/4 rotolock connection	Multipack	10
	8153124	Rotolock nut,1"3/4	Models with 1"3/4 rotolock connection	Multipack	10
	8153126	Rotolock nut,2"1/4	Models with 2"1/4 rotolock connection	Multipack	10

Rotolock service valve

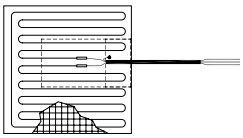
Type	Code n°	Description	Application	Packaging	Pack size
	7703009	Valve set, V02 (1"3/4 ~ 1"1/8), V04(1"1/4 ~ 3/4")	SM / SZ 084 to 100 - 110* to 161*	Multipack	6
	7703392	Valve set, V10 (1"3/4 ~ 1"3/8), V05(1"1/4 ~ 7/8")	SM / SZ 110 to 161	Multipack	6
	7703010	Valve set, V08 (2"1/4 ~ 1"3/8), V07 (1"3/4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

* diameter restriction

3-phase soft start equipment

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

Surface sump heaters



	Code n°	Accessory description	Application	Packaging	Pack size
	120Z0388	80W 24V surface sump heater CE & UL	SM112-124 - SM/SZ147147	Multipack	8
	120Z0389	80W 230V surface sump heater CE & UL		Multipack	8
	120Z0390	80W 400V surface sump heater CE & UL		Multipack	8
	120Z0391	80W 460V surface sump heater CE *		Multipack	8
	120Z0402	80W 575V surface sump heater CE *		Multipack	8
	120Z0361	48W 24V surface sump heater + bottom insulation, CE & UL	SM/SZ084 - 090 -100 - 110 - 120 - 148 - 161	Multipack	6
	120Z0380	48W 230V surface sump heater + bottom insulation, CE & UL		Multipack	6
	120Z0381	48W 400V surface sump heater + bottom insulation, CE & UL		Multipack	6
	120Z0382	48W 460V surface sump heater + bottom insulation, CE *		Multipack	6
	120Z0383	48W 575V surface sump heater + bottom insulation, CE *		Multipack	6
	120Z0360	56W 24V surface sump heater + bottom insulation, CE & UL	SM/SZ175 & SM/SY/SZ185	Multipack	6
	120Z0376	56W 230V surface sump heater + bottom insulation, CE & UL		Multipack	6
	120Z0377	56W 400V surface sump heater + bottom insulation, CE & UL		Multipack	6
	120Z0378	56W 460V surface sump heater + bottom insulation, CE *		Multipack	6
	120Z0379	56W 575V surface sump heater + bottom insulation, CE *		Multipack	6
	120Z0372	80W 230V surface sump heater + bottom insulation, CE & UL	SM240 to SY380	Multipack	4
	120Z0373	80W 400V surface sump heater + bottom insulation, CE & UL		Multipack	4
	120Z0375	80W 575V surface sump heater + bottom insulation, CE *		Multipack	4

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Discharge temperature protection

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

Mounting hardware

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

Acoustic hoods

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

Motor protection modules

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

Terminal boxes, covers & T-block connectors

Type	Code No	Description	Application	Packaging	Pack Size
	8156139	Terminal box 186 x 198 mm, incl cover	SM/SZ148-3.161-3.175.185	Single pack	1
	120Z0413	Terminal box cover	SM/SZ147-3	Single pack	1
	8156135	Service kit for terminal box 96 x 115 mm, including 1 cover, 1 clamp	SM084.090.100.110.112.120.124.147 .148.161 (except SM148-3.161-3) & SZ084.090.100.110.120.148.161 (except SZ148-3. 161-3)	Multipack	10
	8173230	T block connector 52 x 57 mm	SM/SZ084-110.120.148 (except -3). 161 (except -3). & SM112-124, SM/SZ147 (except -3)	Multipack	10
	8173021	T block connector 60 x 75 mm	SM/SZ147-3.148-3.161-3.175.185 & SY240.300.380 (except SY240-3.300-3) & SZ175.185	Multipack	10
	8173331	T block connector 80 x 80 mm	SY240.300-3	Multipack	10
	120Z0458	Terminal box 210 x 190 mm, incl cover	SY240.300.380 SM/SZ185 with electronic module	Single pack	1
	120Z0462	Terminal box 210 x 190 mm, incl cover and module wiring for 250 x 208 mm terminal box replacement	SY240.300.380	Single pack	1

Lubricant

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

Miscellaneous

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

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Previous Version	Current Version
• Page 19: Danfoss MCI soft-start controller	• Page 19: Updated Danfoss MCI soft-start controller • Page 27: Added SZ147 R134a operating map

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

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