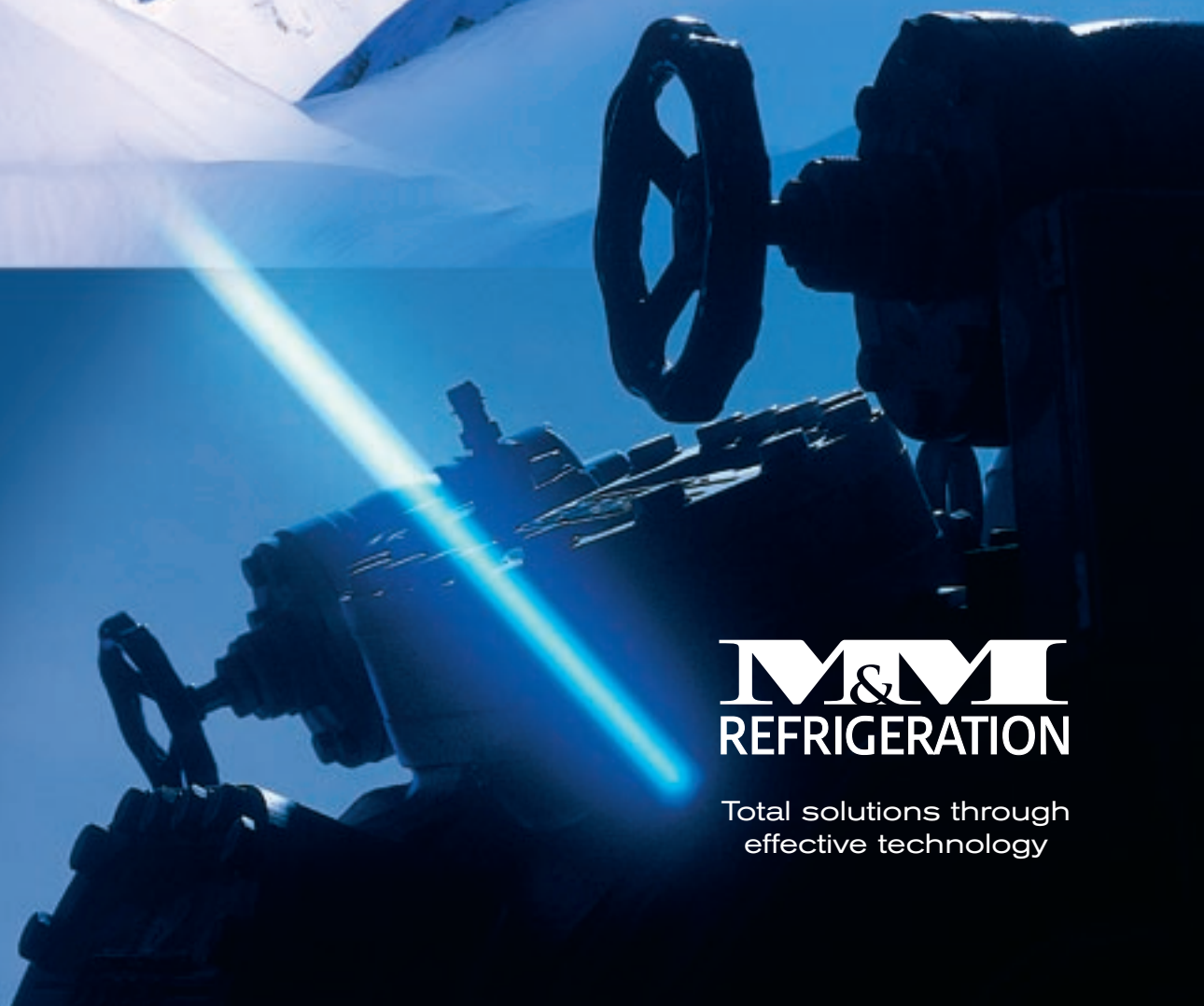


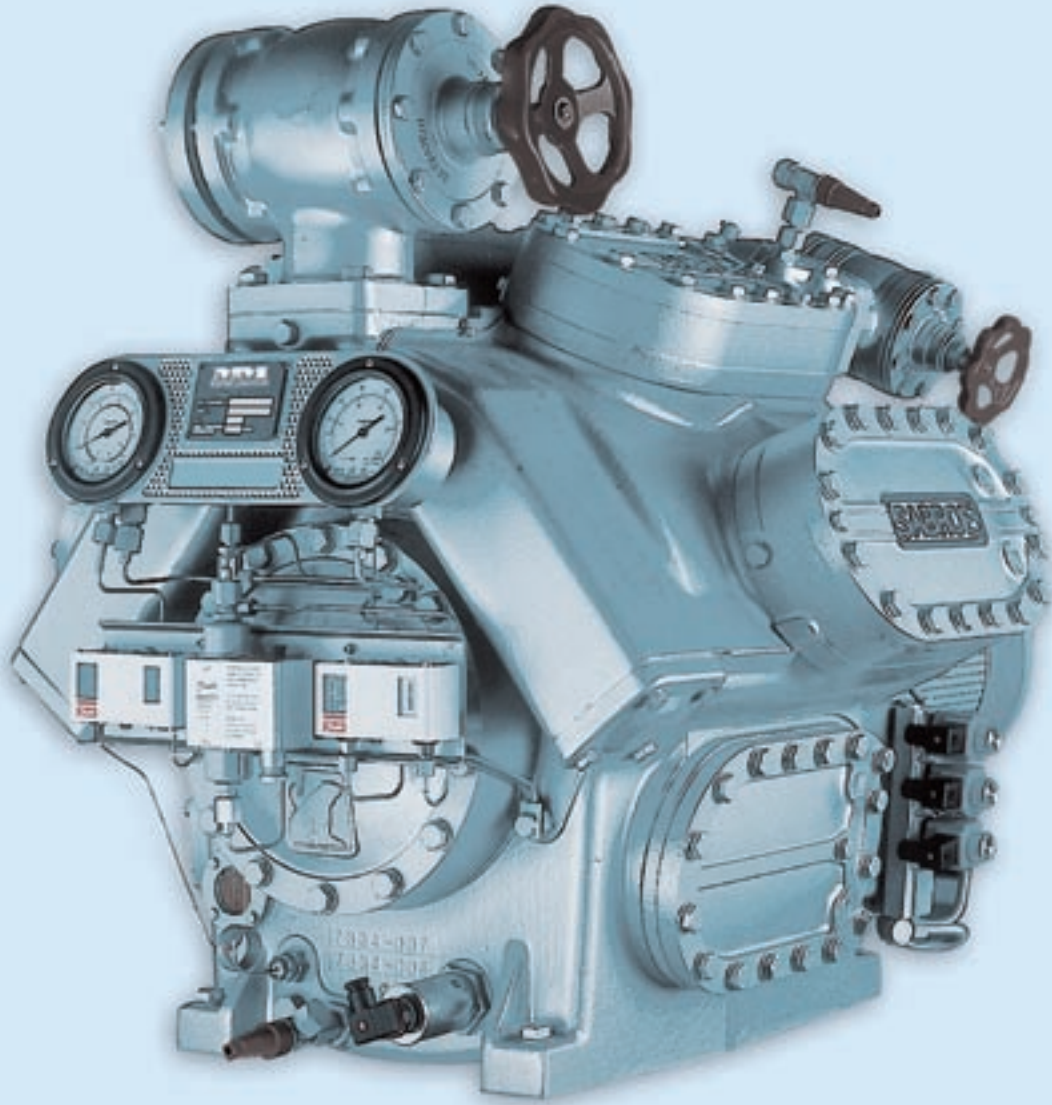
# RECIPROCATING

compressors & packages



**M&M**  
REFRIGERATION

Total solutions through  
effective technology



## PROFILE OF EXCELLENCE

M&M Refrigeration/Sabroe reciprocating compressors are all heavy duty compressors designed for the toughest industrial and marine applications. Suitable for most refrigerants, including HCFC, HFC, hydrocarbons, ammonia, and carbon dioxide, they are well-proven, safe, and reliable. The basic design concept was introduced in 1954. All subsequent design improvements are compatible with early compressor models — a feature which ensures that older compressors can be upgraded to the latest design with improved efficiency.

This process of continuous research and development has resulted in a product line which is superior to any competitor in the market with regard to:

- compressor range
- flexibility
- reliability
- operating efficiency
- environmental safety
- operating safety
- maintenance

These qualities have convinced our customers that M&M Refrigeration/Sabroe reciprocating compressors are second to none.

## QUALITY AND RELIABILITY IN EACH STEP

- Casing, covers, crankshaft, connecting rods, and cylinder liners manufactured at Sabroe's own Meehanite foundries to ensure full process control
- Casing in grey cast iron quality GG25 (nodular ductile cast iron quality GGG50 for 580 psi high pressure compressors)
- Crankshaft in nodular ductile cast iron quality GGG70
- Design pressure: 370 psi for standard single and two stage compressors / 580 and 725 psi for high pressure compressors
- Compact modern industrial design with integrated suction and discharge manifolds
- Resistant to minor slugs of oil and refrigerants due to robust construction including spring loaded safety heads
- Oversized suction filters for protection of vital parts in the compressor
- Reliable lubrication ensured at all conditions through
  - oversized connecting rod bearings and piston pin bearings
  - efficient oil filtering
  - internal gear-type oil pump for pressure lubrication of bearings
- Reduced cylinder and piston wear
  - cylinder liners with nitrited hardening of surface (Ni-temper)
  - hard chromium piston rings
  - lightweight pistons of special design and material
- Gas dampened discharge valves ensure long life
- Stop valves with non-rising spindle in stainless steel for long life and trouble-free operation
- External oil filter
- Water cooled heads removable without opening the refrigerant side of the compressor

## OPERATING EFFICIENCY AND SAFETY

- Easy operation due to the comprehensive standard equipment such as:
  - suction and discharge stop valves
  - electric immersion heater
  - oil charging valve
  - evacuating valve
  - valve for prelubricating of bearings after a long standstill period
  - oil level sight glass
  - high, low, and oil pressure gauges
- High COP and excellent part load characteristics for reduced operating costs
- Automatic capacity regulation
- Fully unloaded start
- Guaranteed ratings according to ISO 916
- Low oil carry over due to highly efficient oil separation
- Oil separators are constructed according to current ASME codes
- Low noise and vibration level
- Internal by-pass valve to avoid excessive pressure
- Safety switches to stop compressor in cases of excessive pressure and temperature, including:
  - high and low pressure switch
  - oil pressure differential switch
  - discharge and oil temperature switch
- Asbestos free gaskets
- Balanced refrigerant tight shaft seal
- Low demand for spares
- Easy maintenance due to good accessibility
- Totally field repairable





## RECIPROCATING COMPRESSOR PROGRAM

Model	Swept vol. at max. RPM CFM	Bore x Stroke (app. inch)	No. Cylinders	Max. RPM	Capacity Steps %
CMO 24	69	2¾" x 2¾"	4	1800	100-75-50-25
CMO 26	103	2¾" x 2¾"	6	1800	100-67-50-33
CMO 28	137	2¾" x 2¾"	8	1800	100-75-50-25
SMC 104 S	133	4" x 3¼"	4	1800	100-50
SMC 104 L	166	4" x 4"	4	1500	100-50
SMC 104 E	199	4" x 4¾"	4	1500	100-50
SMC 106 S	200	4" x 3¼"	6	1800	100-67-33
SMC 106 L	250	4" x 4"	6	1500	100-67-33
SMC 106 E	300	4" x 4¾"	6	1500	100-67-33
SMC 108 S	266	4" x 3¼"	8	1800	100-75-50-25
SMC 108 L	333	4" x 4"	8	1500	100-75-50-25
SMC 108 E	400	4" x 4¾"	8	1500	100-75-50-25
SMC 112 S	399	4" x 3¼"	12	1800	100-83-67-50-33
SMC 112 L	499	4" x 4"	12	1500	100-83-67-50-33
SMC 112 E	599	4" x 4¾"	12	1500	100-83-67-50-33
SMC 116 S	532	4" x 3¼"	16	1800	100-87-75-62-50-37-25
SMC 116 L	666	4" x 4"	16	1500	100-87-75-62-50-37-25
SMC 116 E	800	4" x 4¾"	16	1500	100-87-75-62-50-37-25
SMC 186	755	7⅛" x 5½"	6	1000	100-67-33
SMC 188	1006	7⅛" x 5½"	8	1000	100-75-50-25
TCMO 28	103	2¾" x 2¾"	6LP+2HP	1800	100-67-50-33
TSMC 108 S	200	4" x 3¼"	6LP+2HP	1800	100-67-33
TSMC 108 L	250	4" x 4"	6LP+2HP	1500	100-67-33
TSMC 108 E	300	4" x 4¾"	6LP+2HP	1500	100-67-33
TSMC 116 S	399	4" x 3¾"	12LP+4HP	1800	100-83-67-50-33
TSMC 116 L	499	4" x 4"	12LP+4HP	1500	100-83-67-50-33
TSMC 116 E	599	4" x 4¾"	12LP+4HP	1500	100-83-67-50-33
TSMC 188	755	7⅛" x 5½"	6LP+2HP	1000	100-67-33
HPO 24	69	2¾" x 2¾"	4	1800	100-75-50-25
HPO 26	103	2¾" x 2¾"	6	1800	100-67-50-33
HPO 28	137	2¾" x 2¾"	8	1800	100-75-50-25
HPC 104S	133	4" x 3¼"	4	1500	100-50
HPC 106S	200	4" x 3¼"	6	1500	100-67-33
HPC 108S	266	4" x 3¼"	8	1500	100-75-50-25

### Single Stage Compressors

- 20 sizes - CMO & SMC
- Swept volume: 69 - 1006 CFM
- Capacities R717:  
+15°F / +95°F: 18 - 303 TR  
-40°F / +15°F: 4 - 81 TR
- Capacities R22:  
+30°F / +95°F: 29 - 311 TR

### Two Stage Compressors

- 8 sizes - TCMO & TSMC
- Swept LP volume:  
103 - 755 CFM
- Capacities R717:  
-40°F / +95°F: 7 - 61 TR
- Capacities R22:  
-40°F / +95°F: 7 - 46 TR

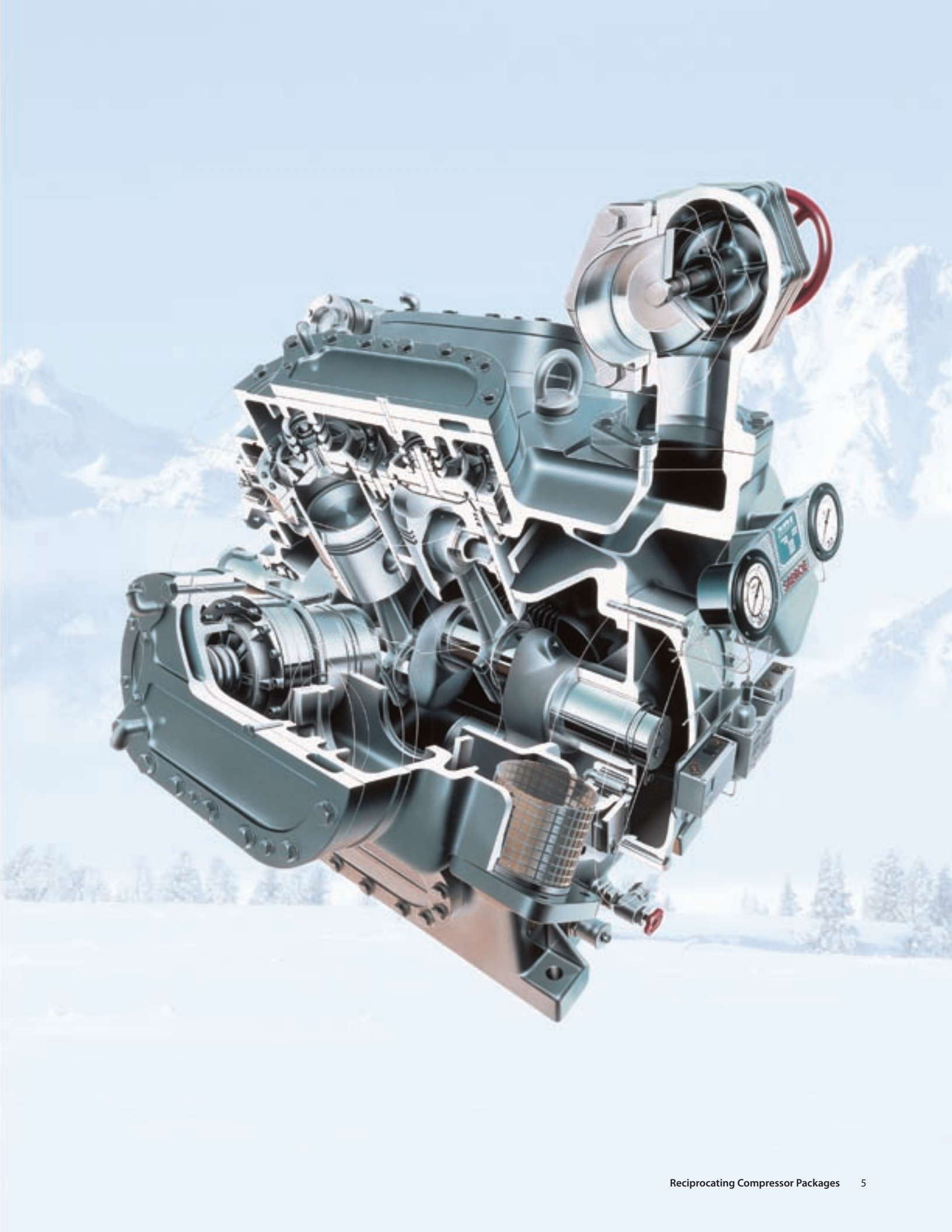
### High Pressure Compressors

- 6 sizes - HPO & HPC
- Swept volume: 69 - 266 CFM
- Capacities R717:  
+75°F / +145°F: 58 - 187 TR
- Capacities R744:  
-55°F / +20°F: 52 - 159 TR



HPO and HPC are high pressure compressors for operating pressure up to 580 lci (psi), for example: in ammonia heat pump applications or CO<sub>2</sub>.

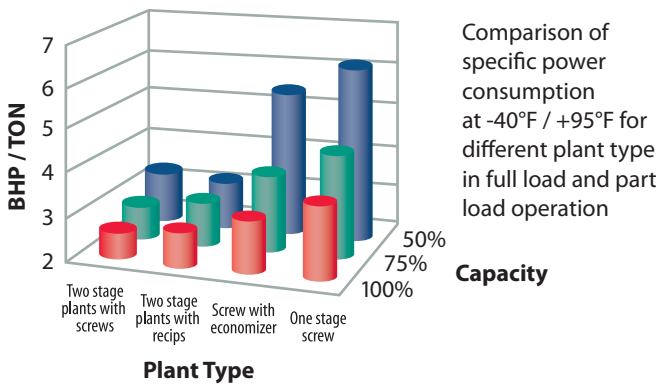
HDO 725 psi is for defrost of CO<sub>2</sub>.



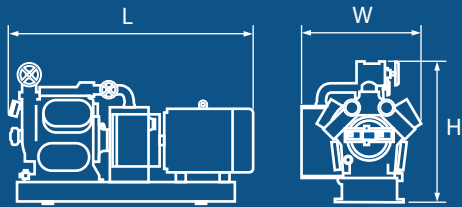
M&M Refrigeration/Sabroe reciprocating compressors can be used in all kinds of industrial refrigeration.

In the application examples listed below, particular benefits can be obtained regarding installation and operating cost.

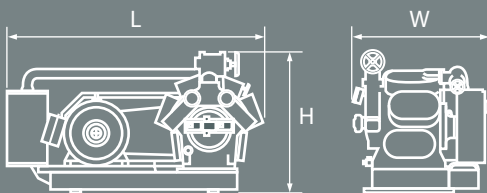
- All small to medium size plants as booster and high stage compressors
- High stage compressors in large plants
- Peak load and "weekend" compressors in large plants with load variations during day/week/year
- All chiller units, especially with load variations during day/week/year
- Chiller units and other applications where immediate capacity cut off is required



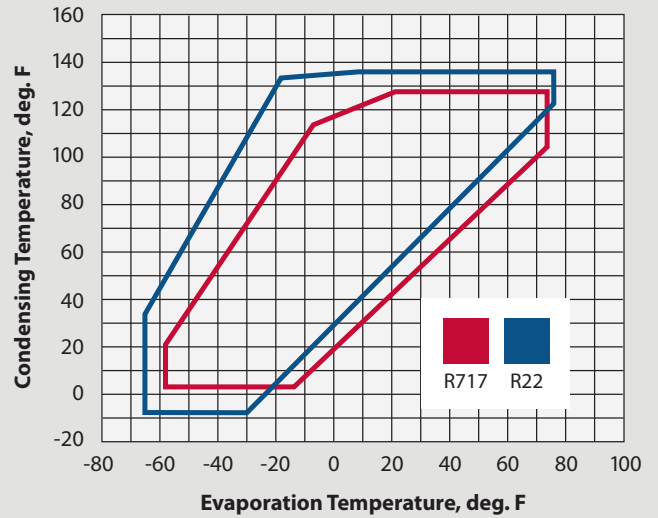
Direct Drive Reciprocating Compressors



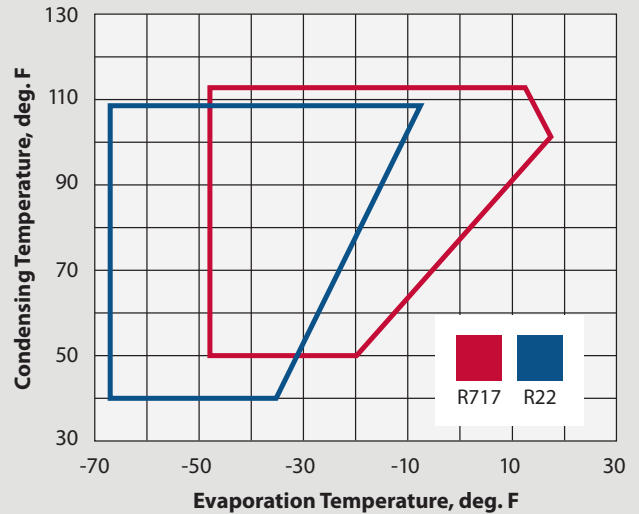
V-Belt Drive Reciprocating Compressors



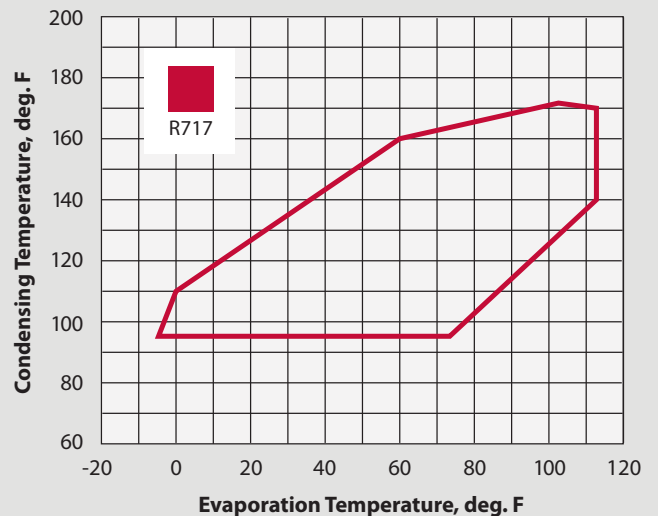
Operating Area: Single Stage Compressors



Operating Area: Two Stage Compressors



Operating Area: High Pressure Compressors



## Single Stage Compressors

Model	Rating R717 -40°/+15°F		Rating R717 +15°/+95°F		Rating R22 +30°/+95°F		Direct Drive Units		V-Belt Drive Units		Connections R717		Connections R22	
	TR	BHP	TR	BHP	TR	BHP	Approximate Dimensions L x W x H	App. Weight Without Motor (Lbs)	Approximate Dimensions L x W x H	App. Weight Without Motor (Lbs)	Suction	Discharge	Suction	Discharge
CMO 24	4.7	6.4	19	24	27	28	64" x 34" x 39"	950	56" x 34" x 39"	1100	2"	2"	2"	2"
CMO 26	7.1	9.7	28	36	40	42	65" x 34" x 39"	1040	56" x 35" x 39"	1190	2½"	2"	2½"	2"
CMO 28	9.4	13	37	47	53	56	66" x 34" x 39"	1100	56" x 36" x 39"	1260	2½"	2"	2½"	2"
SMC 104 S	9.9	13	38	47	69***	67***	84" x 39" x 43"	1830	80" x 45" x 43"	1940	2½"	2½"	3"	2½"
SMC 104 L	13	18	49	59	54*	56*	84" x 39" x 43"	1830	80" x 45" x 43"	1940	2½"	2½"	3"	2½"
SMC 104 E	16	21	60	72	NA	NA	84" x 39" x 43"	1830	80" x 45" x 43"	1940	2½"	2½"	NA	NA
SMC 106 S	15	20	57	70	94***	101***	90" x 39" x 45"	2040	80" x 49" x 44"	2140	3"	2½"	4"	2½"
SMC 106 L	20	26	74	89	82*	85*	90" x 39" x 45"	2040	80" x 49" x 44"	2140	3"	2½"	4"	2½"
SMC 106 E	24	31	90	108	NA	NA	90" x 39" x 45"	2040	80" x 52" x 44"	2140	3"	2½"	NA	NA
SMC 108 S	20	26	76	93	125***	134***	92" x 40" x 44"	2180	80" x 52" x 44"	2270	3"	2½"	4"	2½"
SMC 108 L	26	35	98	119	109*	113*	92" x 40" x 44"	2180	80" x 52" x 44"	2270	3"	2½"	4"	2½"
SMC 108 E	32	43	121	145	NA	NA	92" x 40" x 44"	2180	80" x 52" x 44"	2270	3"	2½"	NA	NA
SMC 112 S	30	39	114	140	188***	202***	112" x 43" x 53"	3660	80" x 75" x 53"	4010	5"	4"	5"	4"
SMC 112 L	40	53	147	178	163*	170*	112" x 43" x 53"	3660	80" x 75" x 53"	4010	5"	4"	5"	4"
SMC 112 E	49	64	181	217	NA	NA	112" x 43" x 53"	3660	80" x 75" x 53"	4010	5"	4"	NA	NA
SMC 116 S	40	53	152	186	250***	268***	114" x 45" x 53"	3880	80" x 78" x 53"	4230	5"	4"	5"	4"
SMC 116 L	53	70	196	238	218*	226*	114" x 45" x 53"	3880	80" x 78" x 53"	4230	5"	4"	5"	4"
SMC 116 E	65	85	241	289	NA	NA	114" x 45" x 53"	3880	80" x 78" x 53"	4230	5"	4"	NA	NA
SMC 186	61	81	228	273	234**	254**	128" x 67" x 66"	7280	124" x 76" x 66"	7830	6"	4"	6"	4"
SMC 188	82	108	303	363	311**	337**	132" x 68" x 66"	7940	125" x 78" x 66"	8380	6"	4"	6"	4"

Ratings are at max RPM: 1800 RPM for CMO, 1500 RPM for SMC 104 - 116, 1000 RPM for SMC 186 - 188. \*Ratings at 1200 RPM. \*\*Ratings at 750 RPM. \*\*\*Ratings at 1800 RPM  
Ratings are based on saturated suction temperature, with 10°F subcooling from condenser. Booster ratings with liquid cooling to intermediate temperature.

## Two Stage Compound Compressors

Model	Rating R717 -40°/+95°F		Rating R22 -40°/+95°F		Direct Drive Units		V-Belt Drive Units		Connections R717				Connections R22			
	TR	BHP	TR	BHP	Approximate Dimensions L x W x H	App. Weight Without Motor (Lbs)	Approximate Dimensions L x W x H	App. Weight Without Motor (Lbs)	LP	HP	LP	HP	LP	HP	LP	HP
TSMO 28	7.1	21	7.2	26	69" x 30" x 32"	1260	66" x 39" x 39"	1420	2½"	1½"	1½"	1¼"	2½"	1½"	1½"	1¼"
TSMC 108 S	15	43	22***	65***	89" x 40" x 45"	2340	84" x 48" x 44"	2490	3"	2"	2½"	2"	4"	2½"	2½"	2"
TSMC 108 L	20	53	16*	54*	89" x 40" x 45"	2340	84" x 48" x 44"	2490	3"	2"	2½"	2"	4"	2½"	2½"	2"
TSMC 108 E	24	68	NA	NA	89" x 40" x 45"	2340	84" x 48" x 44"	2490	3"	2"	2½"	2"	NA	NA	NA	NA
TSMC 116 S	30	85	44***	130***	112" x 47" x 52"	4190	84" x 78" x 52"	4590	5"	3"	4"	2½"	5"	3"	4"	2½"
TSMC 116 L	39	112	31*	107*	112" x 47" x 52"	4190	84" x 78" x 52"	4590	5"	3"	4"	2½"	5"	3"	4"	2½"
TSMC 116 E	48	136	NA	NA	112" x 47" x 52"	4190	84" x 78" x 52"	4590	5"	3"	4"	2½"	NA	NA	NA	NA
TSMC 188	61	172	45**	159**	132" x 68" x 66"	8160	124" x 77" x 66"	8450	6"	4"	4"	2½"	6"	4"	4"	2½"

Ratings are at max RPM: 1800 RPM for TSMO, 1500 RPM for TSMC 108 - 116, 1000 RPM for TSMC 188. \*Ratings at 1200 RPM. \*\*Ratings at 750 RPM. \*\*\*Ratings at 1800 RPM  
Ratings are based on saturated suction temperature, with 10°F subcooling from condenser. R717 ratings are based on intermediate cooling system C. R22 ratings are based on intermediate cooling system A. Dimensions do not include intermediate cooling.

## High Pressure Compressors

Model	Rating R717 +75°/+145°F		Rating R744 -55°/+20°F		Direct Drive Units		Connections	
	TR	BHP	TR	BHP	Approximate Dimensions L x W x H	App. Weight Without Motor (Lbs)	Suction	Discharge
HPO 24	59	51	36	52	56" x 34" x 39"	1100	2"	2"
HPO 26	89	79	54	78	56" x 35" x 39"	1190	2½"	2"
HPO 28	118	102	72	104	56" x 36" x 39"	1260	2½"	2"
HPC 104S	94	79	58	79	87" x 41" x 44"	1875	2½"	2½"
HPC 106S	140	118	87	119	94" x 43" x 45"	2260	3"	3"
HPC 108S	187	158	116	159	96" x 49" x 45"	2425	4"	3"

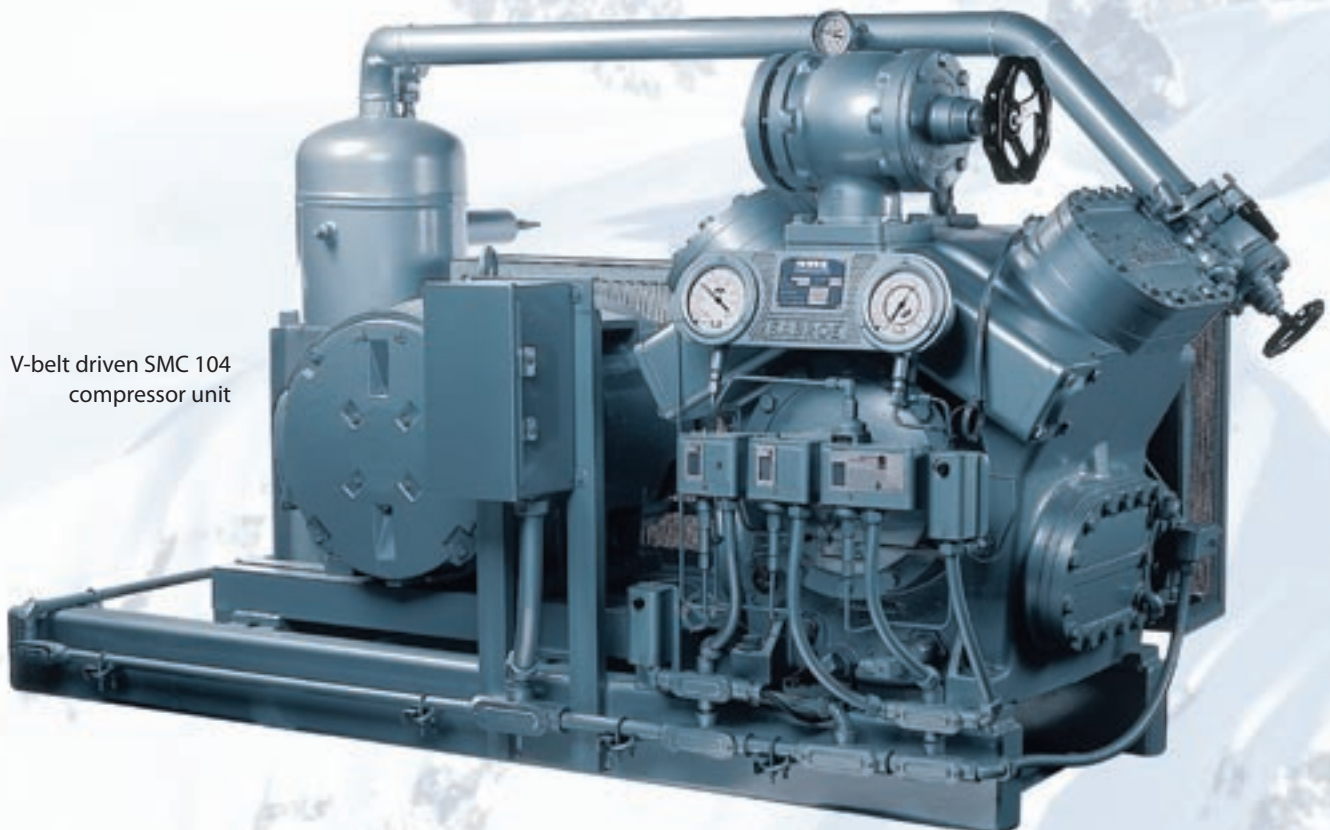
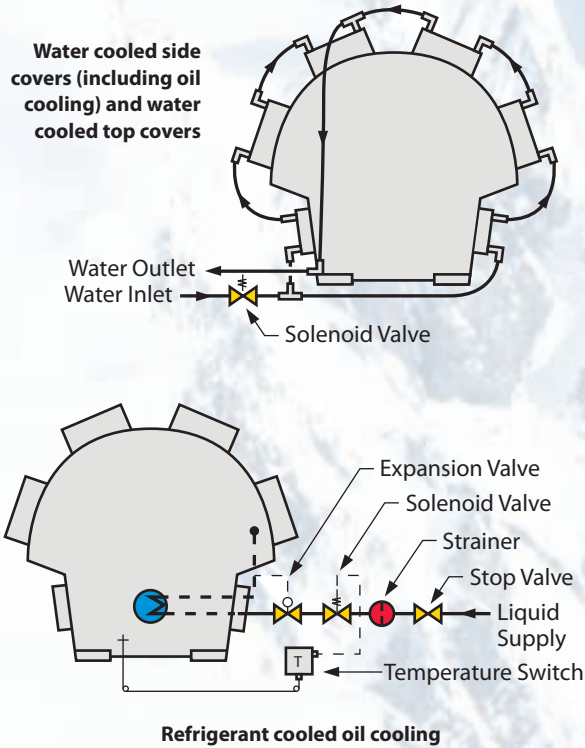
◀ Ratings are at 1170 RPM.  
Ratings are based on saturated suction temperature, with 10°F subcooling from condenser.



## COMPRESSOR COOLING SYSTEMS

Depending on refrigerant and operating conditions, it might be necessary to supplement the basic convection air cooling with one of the following to obtain adequate cooling of the compressor:

- Water cooled top cover
- Water cooled side cover including oil cooling
- Refrigerant cooled oil cooler



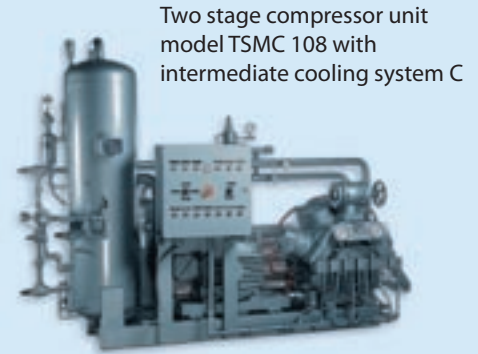
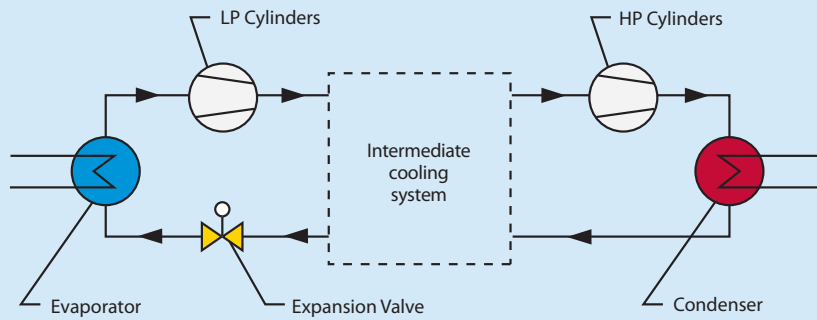


## TWO STAGE COMPRESSOR SYSTEMS

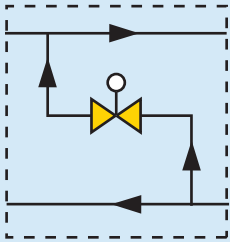
The M&M Refrigeration two-stage compressor integrates a low pressure (LP) and a high pressure (HP) compressor in one housing. The LP cylinders compress the refrigerant gas from evaporator pressure to intermediate pressure. In an intermediate cooling system, the LP discharge gas is cooled to near saturation temperature and then drawn into the HP cylinders, where it is compressed to condensing

pressure. In connection with the intermediate gas cooling, a subcooling of liquid refrigerant from the condenser can be obtained.

Two-stage compression combined with intermediate gas cooling lowers discharge temperature and the pressure ratio in the cylinders. Consequently wear and oil carry-over are reduced and the overall efficiency is improved.

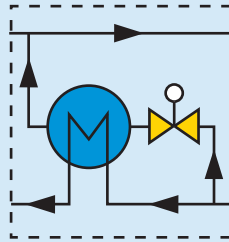


### Four different intermediate cooling systems are available



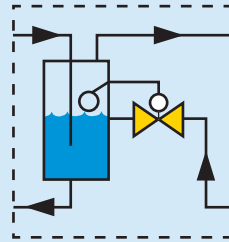
#### Injection interstage gas cooling

**System A** is a simple, inexpensive system which cools the gas by injecting liquid refrigerant into a special intermediate pipe connecting the LP discharge and the HP suction. This system does not contain liquid subcooling and efficiency improvements are limited.



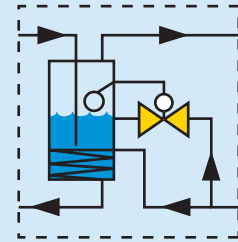
#### Injection interstage gas and liquid cooling

**System B** is similar to System A, but extended with a shell and tube heat exchanger, DX feed, for liquid subcooling down to approximately 15°F above intermediate temperature. Efficiency and unit capacity are considerably improved. Liquid pressure remains at condensing pressure after subcooling. This system is mainly used for R22 and other HCFC and HFC refrigerants.



#### Open flash interstage cooling

**System C** is an open flash intermediate cooling system creating the maximum efficiency and unit capacity improvement. The liquid from the condenser is subcooled down to intermediate temperature. Liquid pressure also equals intermediate pressure, which in some applications can be a disadvantage.



#### Closed flash interstage cooling

**System D** is a closed flash intermediate cooling system creating considerable efficiency and unit capacity improvement. The liquid from the condenser is subcooled down to approximately 10°F above intermediate temperature. Liquid pressure remains at condensing pressure after subcooling. This system can be used as an alternative to System C, and is mainly used for R717.

# Ice Rink Chiller packages

M&M REFRIGERATION, INC.'S series of packaged Ice Rink Chillers is based on the well known M&M Refrigeration/Sabroe reciprocating compressors, highly efficient shell and tube evaporators with integrated surge drum, and the very reliable, user friendly and "state of the art" M&M Microprocessor Control System.

The wide range of standard basic Ice Rink Chillers consists of two-compressor units for single rinks and three-compressor units for double rinks.

As standard refrigerant combinations, ammonia/calcium chloride and R22/ethylene glycol have been chosen. Other refrigerant and compressor combinations can easily be offered on request.

For each of the two standard refrigerant combinations there are 10 sizes with nominal capacities from 66 TR to 282 TR.

## The standard Ice Rink Package includes the following main components:

- Two reciprocating compressor units for Single Rink Packages
- Three reciprocating compressor units for Double Rink Packages
- One flooded evaporator with carbon steel tubes for ammonia and enhanced copper tubes for R22
- Liquid feed with high side float
- Oil separators for reciprocating compressors
- Oil pot for manual oil drain on ammonia packages
- Oil rectifier and automatic oil recovery system on R22 packages
- One brine pump, one stand-by brine pump for Single Rink Packages
- Two brine pumps, one stand-by brine pump for Double Rink Packages
- Microprocessor control system (wired)
- MCP for all the above mentioned equipment plus starter for jacket pump (if required), condenser pump, and condenser fans, all wired with a main breaker
- Mounting and piping of all equipment mentioned above on a common steel base

## The following optional equipment is available:

- Snow melt and under floor heat exchangers including pumps
- Heat exchanger for arena heating including pumps
- Condenser (evaporative, air cooled or water cooled)
- PC based control system with computer graphics for remote monitoring, controls, alarms etc.
- Condenser sump heat control
- Condenser remote sump control
- Monitor non-condensable
- Engine room exhaust fan control
- Leak detection
- KW monitoring
- Single rink 3 outputs lighting control
- Double rink 6 outputs lighting control
- Infrared ice temperature monitoring
- Infrared ice temperature control
- Custom software

## Standard Range

Ammonia/Calcium Chloride				Compressor Motors	Evaporator	Brine Pumps	Brine Flow	Brine Connections		Heat Rejection	Dimensions L x W x H (approx.)	Weight (approx.)
M&M Model No.	Capacity	Compressors						HP	ESSB No.			
	TR	Model No.	RPM	HP	ESSB No.	HP	GPM	Out	In	MBH	Feet	Lbs
IRC-11-A	68	2 x SMC 104 L	1232	2 x 50	8040C4	2 x 25	630	6"	6"	1020	20 x 8 x 8	15500
IRC-12-A	81	2 x SMC 104 L	1490	2 x 60	8040C3	2 x 25	735	6"	6"	1210	20 x 8 x 8	15500
IRC-13-A	94	2 x SMC 106 L	1170	2 x 75	8040C3	2 x 30	865	8"	8"	1400	20 x 8 x 8	16000
IRC-14-A	107	2 x SMC 106 L	1330	2 x 75	8050C2	2 x 30	980	8"	8"	1600	24 x 8 x 8	17000
IRC-15-A	130	2 x SMC 108 L	1232	2 x 100	8050C2	2 x 40	1200	10"	10"	1940	24 x 8 x 8	17500
IRC-16-A	155	2 x SMC 108 L	1490	2 x 125	8050C2	2 x 40	1420	10"	10"	2330	24 x 8 x 8	18000
IRC-21-A	192	3 x SMC 108 L	1170	3 x 100	9060D2	3 x 25	1745	10"	2" x 8"	2850	30 x 8 x 8½	22000
IRC-22-A	215	3 x SMC 108 L	1330	3 x 100	9060D2	3 x 30	1965	10"	2" x 8"	3205	30 x 8 x 8½	22500
IRC-23-A	232	3 x SMC 108 E	1170	3 x 125	9060D2	3 x 40	2125	12"	2" x 10"	3510	30 x 8 x 8½	23000
IRC-24-A	282	3 x SMC 112 L	1170	3 x 150	9060E2	3 x 40	2580	12"	2" x 10"	4200	30 x 9½ x 9	29000

R22/Ethylene Glycol				Compressor Motors	Evaporator	Brine Pumps	Brine Flow	Brine Connections		Heat Rejection	Dimensions L x W x H (approx.)	Weight (approx.)
M&M Model No.	Capacity	Compressors						HP	ESKB No.			
	TR	Model No.	RPM	HP	ESKB No.	HP	GPM	Out	In	MBH	Feet	Lbs
IRC-11-F	66	2 x SMC 104 S	1490	2 x 50	7030A2	2 x 25	570	6"	6"	1010	20 x 8 x 8	14500
IRC-12-F	81	2 x SMC 106 S	1232	2 x 60	8030A2	2 x 25	700	6"	6"	1240	20 x 8 x 8	15000
IRC-13-F	98	2 x SMC 106 S	1490	2 x 75	8030B2	2 x 30	850	8"	8"	1510	20 x 8 x 8	15000
IRC-14-F	108	2 x SMC 108 S	1232	2 x 75	8030B2	2 x 30	940	8"	8"	1655	20 x 8 x 8	15500
IRC-15-F	131	2 x SMC 108 S	1490	2 x 100	8030C2	2 x 40	1140	10"	10"	2025	20 x 8 x 8	16500
IRC-16-F	152	2 x SMC 112 S	1170	2 x 125	8060A1	2 x 40	1325	10"	10"	2325	30 x 9½ x 9	20000
IRC-21-F	182	3 x SMC 108 S	1490	3 x 100	8060A1	3 x 25	1615	10"	2" x 8"	2840	30 x 8 x 8½	20500
IRC-22-F	218	3 x SMC 112 S	1100	3 x 100	8060B1	3 x 30	1885	10"	2" x 8"	3310	40 x 8 x 9	26000
IRC-23-F	232	3 x SMC 112 S	1170	3 x 125	8060B1	3 x 40	2015	12"	2" x 10"	3540	30 x 9½ x 9	27000
IRC-24-F	273	3 x SMC 112 S	1490	3 x 150	8060C1	3 x 40	2425	12"	2" x 10"	4260	40 x 8 x 9	28000

Capacity is based on 17°F inlet brine temperature and 14°F leaving brine temperature. Condensing temperature is 95°F with 5°F subcooling from condenser. Compressors and evaporator are balanced to an evaporating temperature between 5°F and 10°F. Calcium chloride concentration is 21% and ethylene glycol concentration is 40%. Pumps are based on 50 feet of total head in the piping system outside the chiller package. Packages running 1170 RPM are with direct drive compressor units; other RPM are with V-belt driven compressor units. All ratings are based on 60 Hz power supply.







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