

CO₂ Compressor HG(HA)2 CO₂ T

Semi-hermetic Compressor for
transcritical CO₂ applications up to 130 bar



PRODUCT INFORMATION

HG(HA)2 CO₂ T

Important Information

- Transcritical CO₂ applications are still in the development phase
- They require a completely new kind of system and control
- They are not a general solution for the substitution of F-gases
- Therefore, we would specifically draw your attention to the fact that this information is presented according to our current level of knowledge and may change at any time due to further development. Legal claims regarding the accuracy of the information cannot be made at any time and are thus expressly excluded
- Compressors can only be made available for selected projects
- Operation and warranties are subject to a separate agreement

At a Glance

Since the beginning of the 1990's, Bock, together with leading institutes and manufacturers, has concerned itself with the development of compressors for the transcritical CO₂ process.

In 1993 the first open CO₂ compressor was created for bus air-conditioning, which was then presented to the public in a Konvekta air-conditioning system at the 1994 IAA commercial vehicles fair.

Since then, such compressors have been field-tested and form the basis of many CO₂ studies by international institutes.

In 2002, there was a further stage of development, turning this compressor into a semi-hermetic version for stationary test applications. The current compressor generation (suction gas- and air-cooled) are based on the experiences since this time.

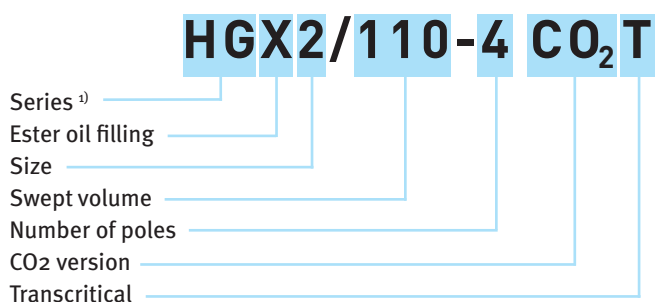
Special Features

- High-strength spheroidal cast iron housing for high operating pressures up to 130 bar on the HP side
- Wear-resistant, long-life mechanism
- Reliable and safe oil supply through pump lubrication
- Good operational characteristics through solid total construction
- Appropriately sized drive motors, available in suction gas-cooled or air-cooled versions, replaceable
- Suction and discharge connections using compression joints for steel pipes (without shut-off valves)
- Safety valves for the suction and discharge area
- Electrical connection box to IP54 with Bock MP10 motor protection

Available models

Type	Swept volume 50 Hz (1.450 ¹ /min) [m ³ /h]
HGX2/90-4 CO ₂ T	7,7
HAX2/90-4 CO ₂ T	
HGX2/110-4 CO ₂ T	9,7
HAX2/110-4 CO ₂ T	
HGX2/130-4 CO ₂ T	11,5
HAX2/130-4 CO ₂ T	

Type Key

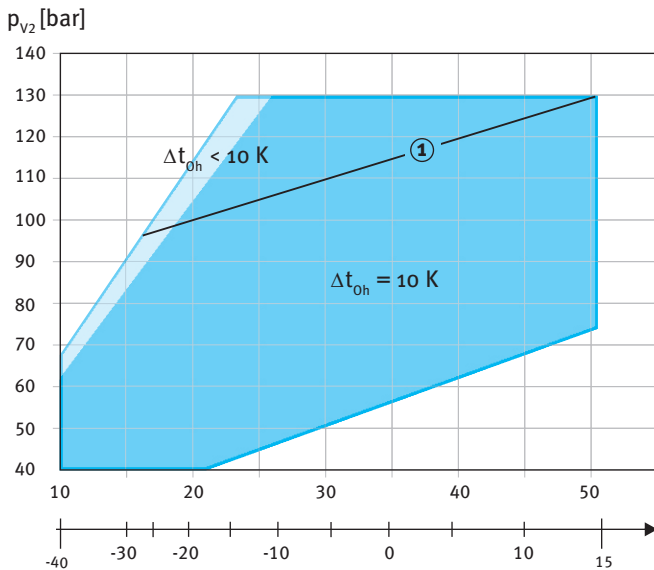


- ¹⁾ HG = Hermetic Gas-cooled
 HA = Hermetic Air-cooled

PRODUCT INFORMATION

HG(HA)2 CO₂ T

Operating Limits HGX2

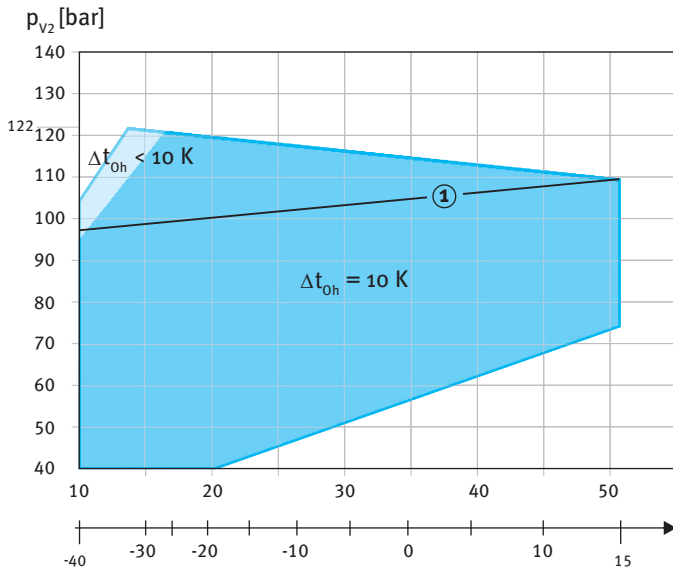


- Unlimited application range
- Supplementary cooling or reduced suction gas temp.

t_o Evaporating temperature (°C)
 Δt_{oh} Suction gas superheat (K)
 p_o suction pressure (bar) ① HGX2/130-4 CO₂ T
 p_{v2} Discharge end pressure (bar) Application limit

Max. allowed operating pressure (HP): 130 bar
 Max. allowed pressure during stand still periods: 90 bar
 Max. allowed discharge end temperature: 160 °C

Operating Limits HAX2



- Unlimited application range
- Reduced suction gas temp.

t_o Evaporating temperature (°C)
 Δt_{oh} Suction gas superheat (K)
 p_o suction pressure (bar) ① HAX2/130-4 CO₂ T
 p_{v2} Discharge end pressure (bar) Application limit

Max. allowed operating pressure (HP): 130 bar
 Max. allowed pressure during stand still periods: 90 bar
 Max. allowed discharge end temperature: 160 °C

Notes

Operating Limits

Compressor operation is possible within the limits shown on the application diagrams. Please note the coloured areas. Compressor application limits should not be chosen for design purposes or continuous operation.

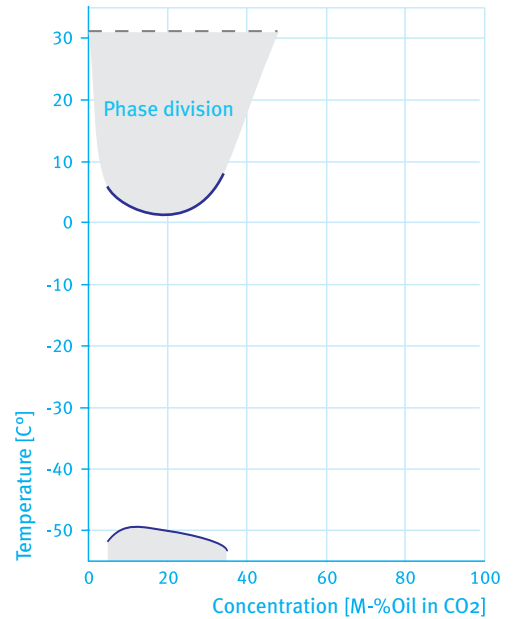
Performance Data

The performance data for CO₂ are based on 10 K suction gas superheat without liquid subcooling, at **50 Hz power supply frequency**. These are **preliminary values** as no uniform reference data are available. Besides which the influence of the oil part on refrigeration performance is largely unknown. **Variations cannot be excluded**. This preliminary data should be helpful for the first planning of CO₂ plant.

Oil

The compressors are equipped with Bock C55E, a special oil filling, which is available directly from Bock. This is a synthetic ester oil with high thermal load resistance, allowing good mixing solubility with CO₂. It possesses a special additive, which protects the compressors against wear, even when subjected to extreme loads, such as those which exist in CO₂ systems. This oil can be used both in transcritical and subcritical systems.

i Bock C55E oil is required for CO₂ applications



CO₂ Performance data 50 Hz

Type	t ₀ °C	p _{v2} (bar)	Cooling capacity \dot{Q}_0 [W]					Power consumption P_e [kW]								
			Gas cooler outlet temperature °C													
			30	35	40	45	50									
HGX2/90-4 CO ₂ T	10	120	Q P	39450 13,35	36250 13,35	32700 13,35	28600 13,35	23750 13,35	110	Q P	39500 12,25	35950 12,25	31800 12,25	26600 12,25	20100 12,25	
		100	Q P	39350 11,05	35250 11,05	29850 11,05	21800 11,05	13650 11,05	90	Q P	38850 9,75	33600 9,75	23200 9,75	12300 9,75	6950 9,75	
		80	Q P	37650 8,40	21550 8,40	9650 8,40	5050 8,40	1750 8,40	0	120	Q P	28600 12,90	26350 12,90	23800 12,90	20900 12,90	17500 12,90
		110	Q P	28750 12,00	26200 12,00	23250 12,00	19550 12,00	14950 12,00	100	Q P	28750 11,05	25800 11,05	21950 11,05	16200 11,05	10350 11,05	
		90	Q P	28550 10,00	24750 10,00	17300 10,00	9500 10,00	5600 10,00	80	Q P	27800 8,90	16200 8,90	7600 8,90	4300 8,90	1900 8,90	
	-10	120	Q P	20150 11,90	18550 11,90	16800 11,90	14750 11,90	12350 11,90	110	Q P	20300 11,25	18500 11,25	16450 11,25	13850 11,25	10650 11,25	
		100	Q P	20350 10,55	18300 10,55	15600 10,55	11550 10,55	7450 10,55	90	Q P	20300 9,75	17650 9,75	12400 9,75	6900 9,75	4150 9,75	
		80	Q P	19850 8,90	11650 8,90	5600 8,90	3250 8,90	1550 8,90	-20	100	Q P	13900 9,60	12500 9,60	10650 9,60	7900 9,60	5100 9,60
		90	Q P	13900 9,05	12100 9,05	8500 9,05	4750 9,05	2850 9,05		80	Q P	13700 8,45	8050 8,45	3850 8,45	2250 8,45	1100 8,45
		80	Q P	13700 8,45	8050 8,45	3850 8,45	2250 8,45	1100 8,45								

50 Hz performance data

Relative to 10 K suction gas superheat, without liquid subcooling

PRODUCT INFORMATION

HG(HA)2 CO₂ T

CO₂ Performance Data

50 Hz

Type	t ₀ °C	P _{v2} (bar)	Cooling capacity \dot{Q}_0 [W]					Power consumption P _e [kW]									
			Gas cooler outlet temperature °C														
			30	35	40	45	50										
HAX2/90-4 CO ₂ T	10	110	Q P	41000 12,20	37350 12,20	33050 12,20	27650 12,20	20900 12,20	100	Q P	40600 11,00	36400 11,00	30850 11,00	22550 11,00	14050 11,00		
		90	Q P	39900 9,65	34500 9,65	23800 9,65	12650 9,65	7100 9,65									
		80	Q P	38450 8,30	22000 8,30	9800 8,30	5150 8,30	1750 8,30									
		110	Q P	30400 12,00	27750 12,00	24600 12,00	20700 12,00	15800 12,00									
	0	110	Q P	30200 11,00	27100 11,00	23100 11,00	17050 11,00	10900 11,00	90	Q P	29750 9,95	25800 9,95	18000 9,95	9900 9,95	5850 9,95		
		80	Q P	28750 8,85	16750 8,85	7850 8,85	4450 8,85	1950 8,85									
		110	Q P	21950 11,35	20050 11,35	17800 11,35	15000 11,35	11500 11,35		-10	100	Q P	21850 10,60	19650 10,60	16750 10,60	12450 10,60	8000 10,60
		90	Q P	21600 9,75	18750 9,75	13150 9,75	7350 9,75	4450 9,75									
	80	Q P	20950 8,85	12300 8,85	5900 8,85	3400 8,85	1650 8,85										
	110	Q P	15400 10,25	14050 10,25	12500 10,25	10550 10,25	8100 10,25										
	-20	100	Q P	15350 9,70	13800 9,70	11800 9,70	8750 9,70	5650 9,70	90	Q P	15200 9,10	13200 9,10	9300 9,10	5150 9,10	3150 9,10		
		80	Q P	14800 8,45	8700 8,45	4150 8,45	2400 8,45	1150 8,45									
		120	Q P	49700 16,85	45700 16,85	41200 16,85	36050 16,85	29950 16,85		10	110	Q P	49750 15,40	45300 15,40	40050 15,40	33500 15,40	25300 15,40
		100	Q P	49550 13,90	44400 13,90	37600 13,90	27500 13,90	17150 13,90									
	90	Q P	48950 12,30	42300 12,30	29200 12,30	15500 12,30	8750 12,30										
	80	Q P	47450 10,55	27150 10,55	12100 10,55	6350 10,55	2150 10,55										
HGX2/110-4 CO ₂ T	10	120	Q P	36050 16,25	33200 16,25	30000 16,25	26350 16,25	22000 16,25	0	110	Q P	36200 15,10	33000 15,10	29300 15,10	24650 15,10	18800 15,10	
		100	Q P	36200 13,90	32500 13,90	27650 13,90	20450 13,90	13050 13,90									
		90	Q P	35950 12,60	31150 12,60	21750 12,60	11950 12,60	7050 12,60									
	0	80	Q P	35000 11,20	20400 11,20	9550 11,20	5400 11,20	2400 11,20									

50 Hz performance data

Relative to 10 K suction gas superheat
without liquid subcooling

t₀ = Evaporating temperature

p_{v2} = Discharge end pressure

PRODUCT INFORMATION

HG(HA)2 CO₂ T



CO₂ Performance Data

50 Hz

Type	t ₀ °C	p _{v2} (bar)	Cooling capacity \dot{Q}_0 [W]					Power consumption P _e [kW]						
			Gas cooler outlet temperature °C											
			30	35	40	45	50	30	35	40	45	50		
HGX2/110-4 CO ₂ T	-10	120	Q P	25350 15,00	23350 15,00	21150 15,00	18600 15,00	15600 15,00	25550 14,20	23300 14,20	20700 14,20	17450 14,20	13400 14,20	
		110	Q P	25650 13,30	23050 13,30	19650 13,30	14550 13,30	9400 13,30	25550 12,30	22200 12,30	15600 12,30	8650 12,30	5250 12,30	
		90	Q P	25050 11,20	14700 11,20	7000 11,20	4100 11,20	1950 11,20	17500 12,10	15750 12,10	13450 12,10	9950 12,10	6450 12,10	
	-20	100	Q P	17500 12,10	15750 12,10	10700 11,40	5950 11,40	3600 11,40	17550 11,40	15200 11,40	10700 11,40	5950 11,40	3600 11,40	
		90	Q P	17250 10,65	10100 10,65	4850 10,65	2800 10,65	1350 10,65	17250 10,65	10100 10,65	4850 10,65	2800 10,65	1350 10,65	
		80	Q P	51650 15,35	47050 15,35	41600 15,35	34800 15,35	26300 15,35	51150 13,80	45850 13,80	38850 13,80	28350 13,80	17700 13,80	
	HAX2/110-4 CO ₂ T	10	110	Q P	50250 12,20	43450 12,20	30000 12,20	15950 12,20	8950 12,20	48400 10,45	27700 10,45	12350 10,45	6450 10,45	2200 10,45
			100	Q P	38300 15,10	34950 15,10	31000 15,10	26050 15,10	19900 15,10	38050 13,90	34150 13,90	29050 13,90	21450 13,90	13700 13,90
			90	Q P	37450 12,55	32500 12,55	22700 12,55	12450 12,55	7350 12,55	36250 11,10	21100 11,10	9900 11,10	5550 11,10	2450 11,10
80			Q P	27650 14,25	25250 14,25	22450 14,25	18900 14,25	14500 14,25	27550 13,30	24750 13,30	21100 13,30	15650 13,30	10100 13,30	
0		110	Q P	27200 12,30	23650 12,30	16600 12,30	9200 12,30	5550 12,30	26400 11,15	15500 11,15	7400 11,15	4300 11,15	2050 11,15	
		100	Q P	19400 12,90	17700 12,90	15750 12,90	13250 12,90	10150 12,90	19350 12,25	17400 12,25	14850 12,25	11000 12,25	7100 12,25	
		90	Q P	19150 11,50	16650 11,50	11700 11,50	6500 11,50	3950 11,50	18650 10,65	10950 10,65	5250 10,65	3050 10,65	1450 10,65	
		80	Q P	18650 10,65	10950 10,65	5250 10,65	3050 10,65	1450 10,65						

50 Hz performance data

Relative to 10 K suction gas superheat
without liquid subcooling

t₀ = Evaporating temperature

p_{v2} = Discharge end pressure

PRODUCT INFORMATION

HG(HA)2 CO₂ T

CO₂ Performance Data

50 Hz

Type	t ₀ °C	p _{v2} (bar)	Cooling capacity \dot{Q}_o [W]					Power consumption P _e [kW]						
			Gas cooler outlet temperature °C											
			30	35	40	45	50	30	35	40	45	50		
HGX2/130-4 CO ₂ T	10	120	Q	58950	54150	48850	42700	35500	19,95	19,95	19,95	19,95	19,95	19,95
		P	19,95	19,95	19,95	19,95	19,95	19,95	19,95	19,95	19,95	19,95	19,95	
		110	Q	58950	53700	47500	39700	30000	18,25	18,25	18,25	18,25	18,25	18,25
		P	18,25	18,25	18,25	18,25	18,25	18,25	18,25	18,25	18,25	18,25	18,25	
		100	Q	58750	52600	44600	32550	20350	16,50	16,50	16,50	16,50	16,50	16,50
	P	16,50	16,50	16,50	16,50	16,50	16,50	16,50	16,50	16,50	16,50	16,50		
	90	Q	58050	50150	34650	18400	10350	14,55	14,55	14,55	14,55	14,55	14,55	
	P	14,55	14,55	14,55	14,55	14,55	14,55	14,55	14,55	14,55	14,55	14,55		
	80	Q	56250	32200	14350	7500	2550	12,50	12,50	12,50	12,50	12,50	12,50	
	P	12,50	12,50	12,50	12,50	12,50	12,50	12,50	12,50	12,50	12,50	12,50		
	0	110	Q	42900	39150	34750	29200	22300	17,90	17,90	17,90	17,90	17,90	17,90
		P	17,90	17,90	17,90	17,90	17,90	17,90	17,90	17,90	17,90	17,90	17,90	
		100	Q	42900	38550	32800	24200	15450	16,50	16,50	16,50	16,50	16,50	16,50
		P	16,50	16,50	16,50	16,50	16,50	16,50	16,50	16,50	16,50	16,50	16,50	
	90	Q	42600	36950	25800	14150	8400	14,95	14,95	14,95	14,95	14,95	14,95	
	P	14,95	14,95	14,95	14,95	14,95	14,95	14,95	14,95	14,95	14,95	14,95		
80	Q	41500	24150	11300	6400	2800	13,30	13,30	13,30	13,30	13,30	13,30		
P	13,30	13,30	13,30	13,30	13,30	13,30	13,30	13,30	13,30	13,30	13,30			
-10	100	Q	30400	27300	23300	17250	11150	15,75	15,75	15,75	15,75	15,75	15,75	
	P	15,75	15,75	15,75	15,75	15,75	15,75	15,75	15,75	15,75	15,75	15,75		
	90	Q	30300	26300	18450	10250	6200	14,60	14,60	14,60	14,60	14,60	14,60	
P	14,60	14,60	14,60	14,60	14,60	14,60	14,60	14,60	14,60	14,60	14,60			
80	Q	29650	17400	8300	4850	2300	13,30	13,30	13,30	13,30	13,30	13,30		
P	13,30	13,30	13,30	13,30	13,30	13,30	13,30	13,30	13,30	13,30	13,30			
-20	90	Q	20750	18050	12650	7050	4250	13,55	13,55	13,55	13,55	13,55	13,55	
	P	13,55	13,55	13,55	13,55	13,55	13,55	13,55	13,55	13,55	13,55	13,55		
80	Q	20450	12000	5750	3350	1600	12,60	12,60	12,60	12,60	12,60	12,60		
P	12,60	12,60	12,60	12,60	12,60	12,60	12,60	12,60	12,60	12,60	12,60			

50 Hz performance data

Relative to 10 K suction gas superheat
without liquid subcooling

t₀ = Evaporating temperature

p_{v2} = Discharge end pressure

CO₂ Performance Data

50 Hz

Type	t ₀ °C	p _{v2} (bar)	Cooling capacity \dot{Q}_o [W]					Power consumption P _e [kW]						
			Gas cooler outlet temperature °C											
			30	35	40	45	50	30	35	40	45	50		
HAX2/130-4 CO ₂ T	10	100	Q	60650	54350	46050	33650	21000	Q	16,40	16,40	16,40	16,40	16,40
			P	16,40	16,40	16,40	16,40	16,40	16,40	16,40	16,40	16,40	16,40	
		90	Q	59600	51500	35550	18900	10600	Q	14,45	14,45	14,45	14,45	14,45
	0	100	Q	57400	32850	14650	7650	2600	Q	12,35	12,35	12,35	12,35	12,35
			P	12,35	12,35	12,35	12,35	12,35	12,35	12,35	12,35	12,35	12,35	
		90	Q	45100	40500	34450	25450	16250	Q	16,45	16,45	16,45	16,45	16,45
	-10	100	Q	44400	38500	26900	14750	8750	Q	14,90	14,90	14,90	14,90	14,90
			P	14,90	14,90	14,90	14,90	14,90	14,90	14,90	14,90	14,90	14,90	
		80	Q	42950	25000	11700	6600	2900	Q	13,20	13,20	13,20	13,20	13,20
	-20	100	Q	32650	29350	25000	18550	11950	Q	15,80	15,80	15,80	15,80	15,80
			P	15,80	15,80	15,80	15,80	15,80	15,80	15,80	15,80	15,80	15,80	
		90	Q	32250	28000	19650	10950	6600	Q	14,55	14,55	14,55	14,55	14,55
-20	100	Q	31300	18350	8750	5100	2450	Q	13,25	13,25	13,25	13,25	13,25	
		P	13,25	13,25	13,25	13,25	13,25	13,25	13,25	13,25	13,25	13,25		
	90	Q	22700	19700	13850	7700	4650	Q	13,60	13,60	13,60	13,60	13,60	
-20	80	Q	22100	12950	6200	3600	1750	Q	12,60	12,60	12,60	12,60	12,60	
		P	12,60	12,60	12,60	12,60	12,60	12,60	12,60	12,60	12,60	12,60		

50 Hz performance data

Relative to 10 K suction gas superheat
without liquid subcooling

t₀ = Evaporating temperature

p_{v2} = Discharge end pressure

PRODUCT INFORMATION

HG(HA)2 CO₂ T

Technical Data

Type	Number of cylinders	Swept volume 50 / 60 Hz	Electrical data ③				Weight	Connections ⑤		Oil charge
			Voltage	Max. working current	Max. power consumption	Starting current (rotor locked)		Discharge line DV	Suction line SV	
			①	②	②					
		m ³ /h		A	kW	A	kg	mm	mm	Ltr.
			PW*1+2		PW*1/PW*1+2					
HGX2/90-4 CO ₂ T	2	7,70 / 9,30	④	24,4	14,4	82 / 107	160	10 x 1	20 x 2	2,5
HAX2/90-4 CO ₂ T	2	7,70 / 9,30	④	20,5	12,0	82 / 107	160	10 x 1	20 x 2	2,5
HGX2/110-4 CO ₂ T	2	9,70 / 11,60	④	32,2	19,2	110 / 141	160	10 x 1	20 x 2	2,5
HAX2/110-4 CO ₂ T	2	9,70 / 11,60	④	26,7	15,7	110 / 141	163	10 x 1	20 x 2	2,5
HGX2/130-4 CO ₂ T	2	11,50 / 13,80	④	43,3	25,7	127 / 161	160	10 x 1	20 x 2	2,5
HAX2/130-4 CO ₂ T	2	11,50 / 13,80	④	31,8	18,5	127 / 161	160	10 x 1	20 x 2	2,5

Oil sump heater 110-240 V - 1 - 50/60 Hz (standard)

› PTC heater, 50-120 W, self-regulating

* PW = Part Winding, motors for part winding start

1 = 1. part winding

2 = 2. part winding



Oil sump heater is necessary due to the high CO₂ solubility in the oil.

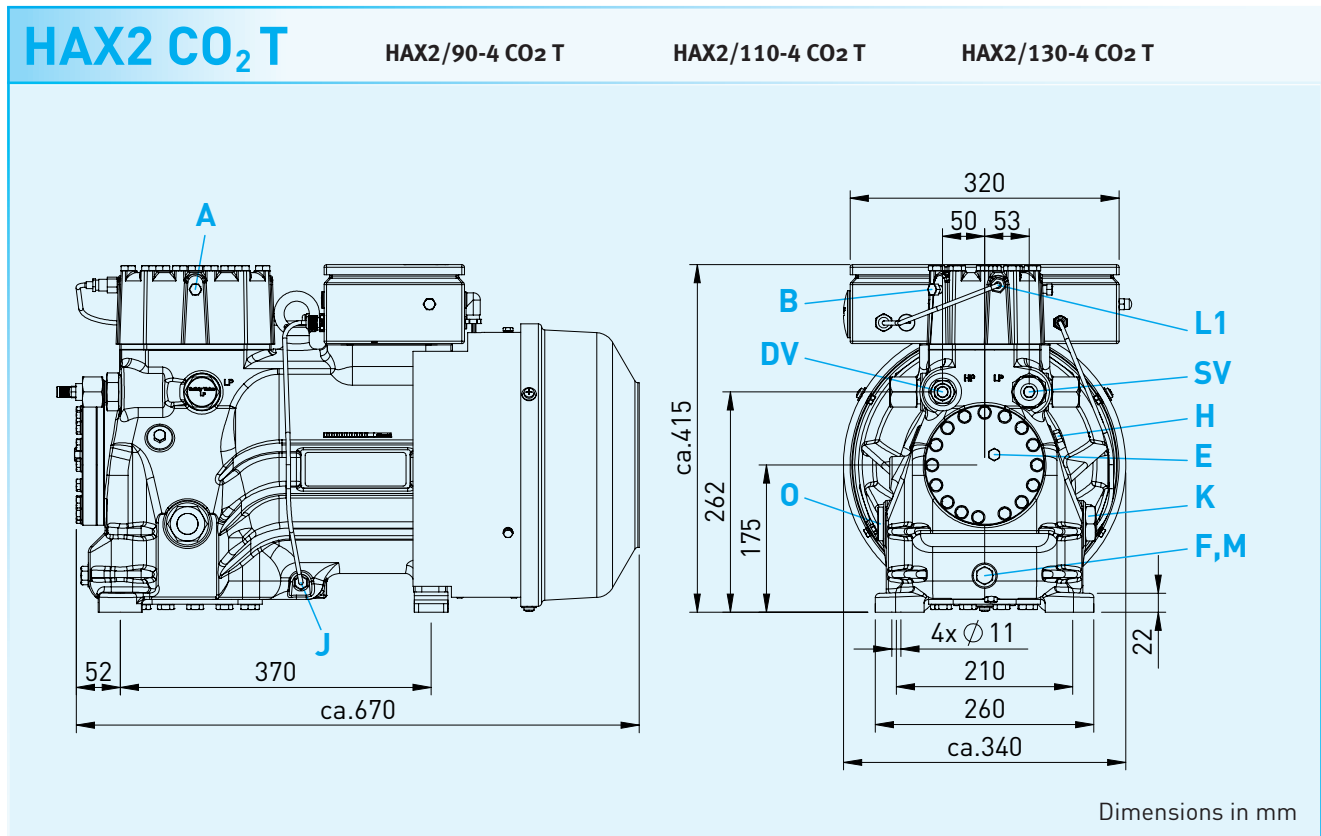
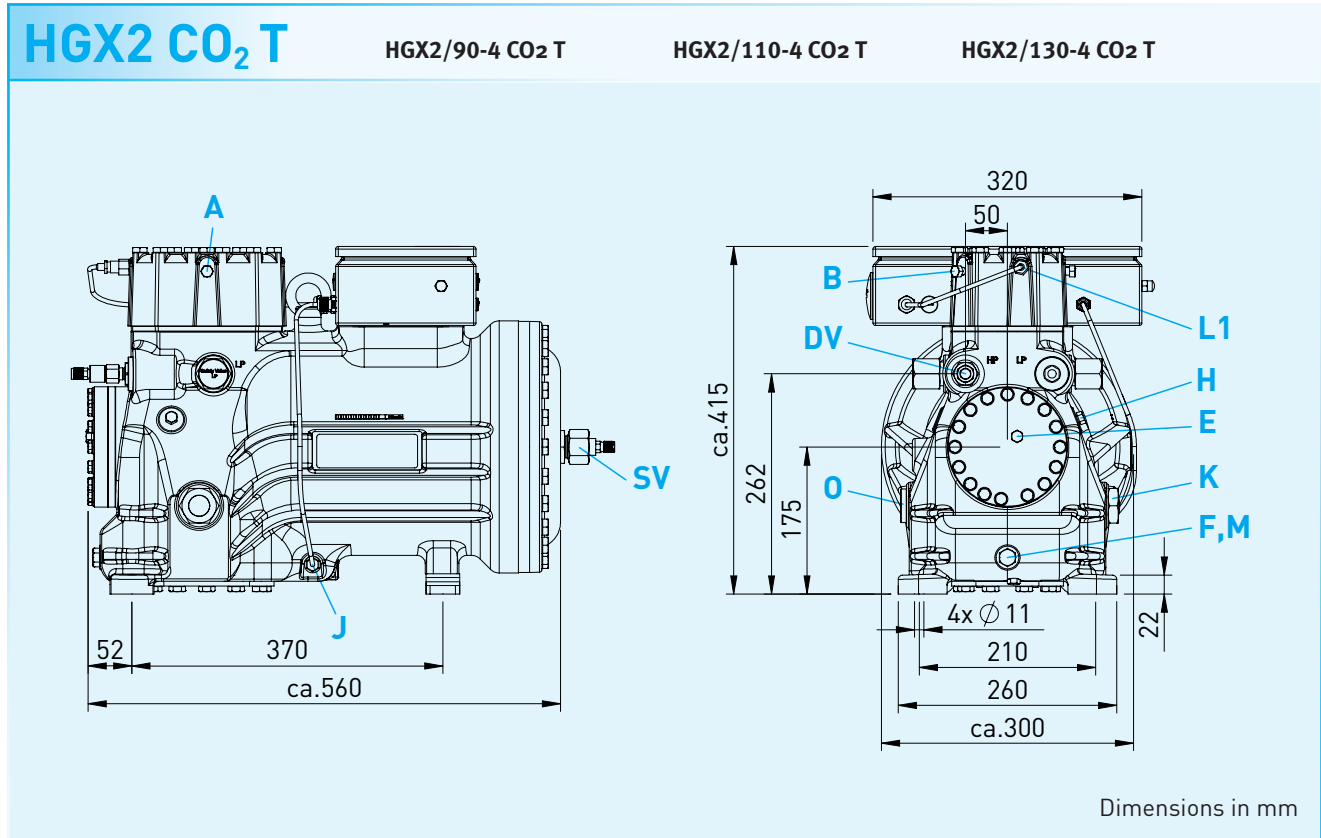
Fan motor for the HA-Version 230 V - 1 - 50/60 Hz

140 W / 0,71 A

Explanations:

- ① Tolerance ($\pm 10\%$) relates to the mean value of the voltage range.
Other voltages and current types on request.
- ② Take account of the max. operating current / max. power consumption when designing contactors, leads and fuses.
Switches: Service category AC₃
- ③ All data are based on the mean value of the voltage range.
- ④ 380-420 V Y/YY - 3 - 50 Hz PW
440-480 V Y/YY - 3 - 60 Hz PW
PW = Part Winding, motors for part winding start
(no start unloader required)
› Winding ratios: 66% / 33%
› Designs for Y/ Δ on request
- ⑤ Cutting ring connection for steel pipes

Dimensional drawing

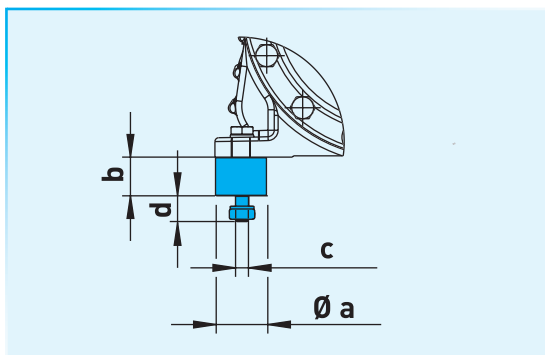


PRODUCT INFORMATION

HG(HA)2 CO₂ T

Dimensions for anti-vibration pads

Type	Ø a	b	c	d
	mm	mm	mm	mm
HGX2 CO ₂ T	50	30	M10	25
HAX2 CO ₂ T	50	30	M10	25



Connections

Connections	HG(HA)2 CO ₂ T
SV Suction line DV Discharge line	Please refer to technical data
A Connection suction side, not lockable	1/8" NPTF
B Connection discharge side, not lockable	1/8" NPTF
E Connection oil pressure gauge	7/16" UNF
F Oil drain	M 22 x 1,5
H Oil charge plug	1/8" NPTF
J Oil sump heater	Ø 15 mm
K Sight glass	G 1"
L1 Thermal protection thermostat	1/8" NPTF
M Oil filter	M 22 x 1,5
O Connection oil level regulator	G 1"

Scope of supply

Semi-hermetic 2 cylinder reciprocating compressor with drive motor
for part winding start – 4 pole version

380-420 VY/YY - 3 - 50 Hz

440-480 VY/YY - 3 - 60 Hz

Single-section compressor housing

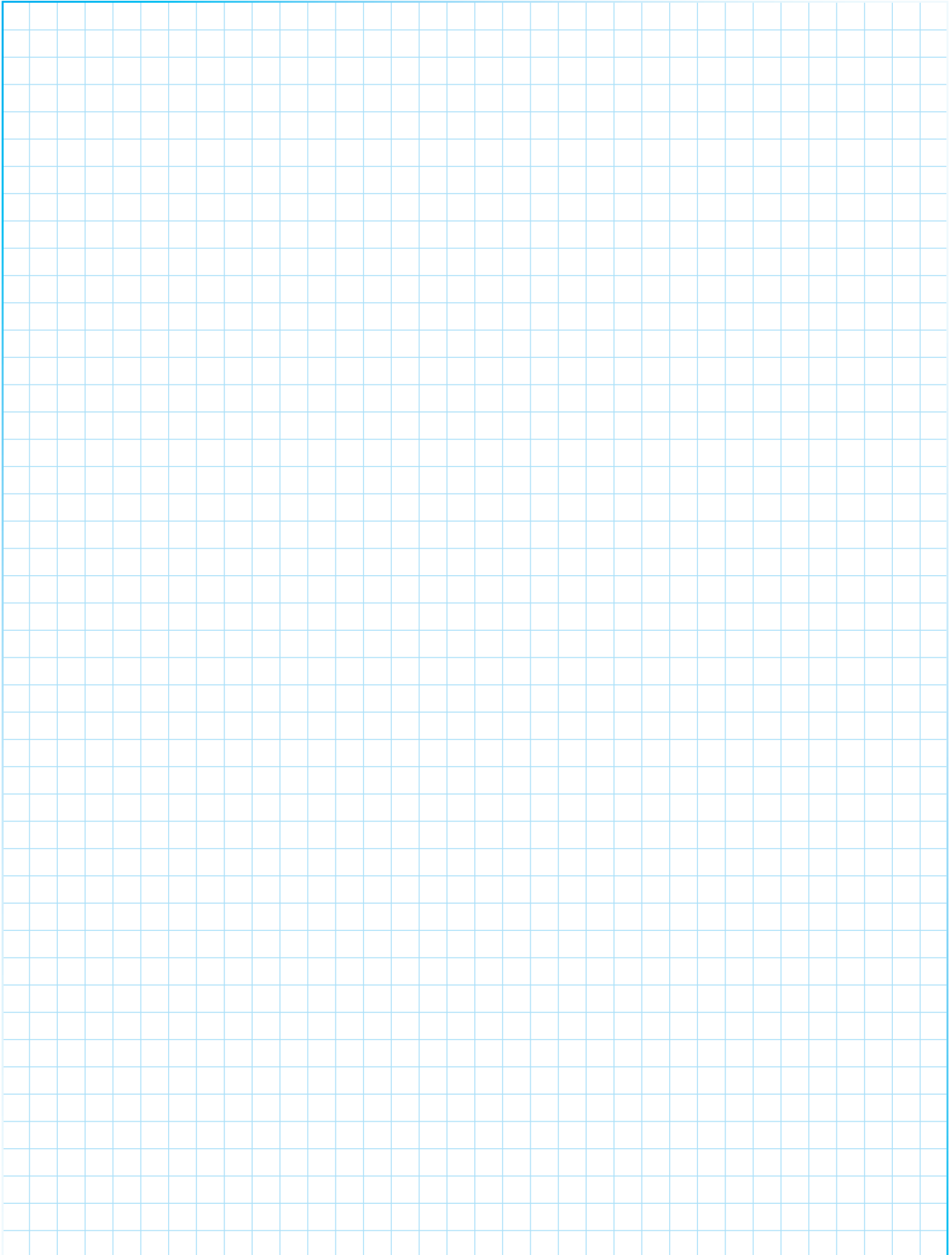
- HA-Version: Motor is cooled by an integrated fan with air deflection hood
230 V - 1 - 50/60 Hz, 140 W 0,71 A
- Winding protection with PTC resistor sensors and electronic motor protection unit MP10
- Thermal protection thermostat (PTC thermistor) IP67
- Oil sump heater 110-240 V - 1 - 50/60 Hz, 50-120 W
PTC heater self regulating
- Oil charge: Bock C55E ¹⁾
- Sight glass
- Compressor safety valve high-pressure and low-pressure side
- Capability of connecting for suction line and discharge line
Design in cutting ring version for steel pipes (without shut off valves)
- Inert gas charge
- 4 anti-vibration pads enclosed

¹⁾ Also available as refill unit in 1 or 5 liter packaging

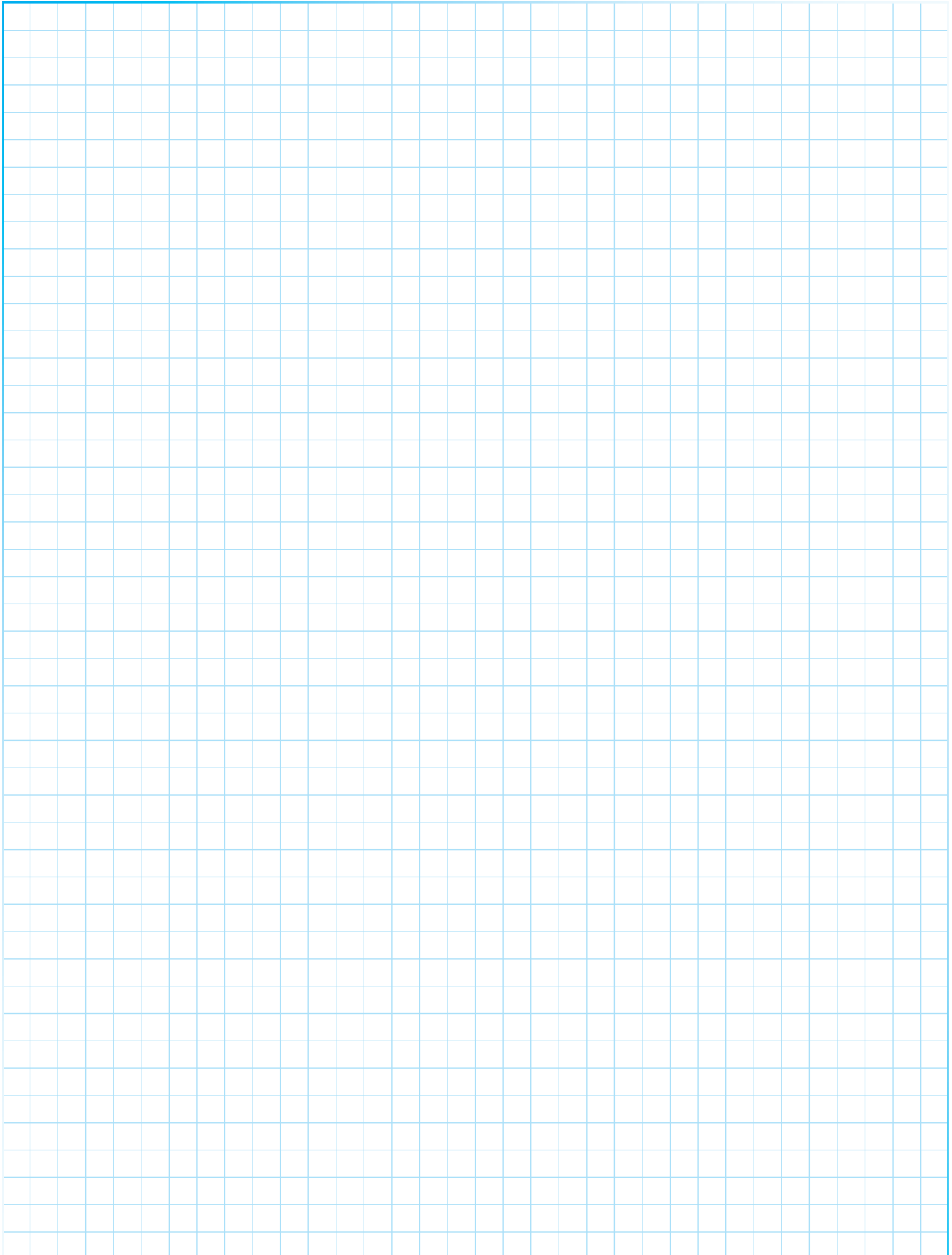
PRODUCT INFORMATION

HG(HA)2 CO₂ T

Notes

A large rectangular area filled with a light blue grid pattern, intended for handwritten notes. The grid consists of small squares and covers most of the page's width and height.

Notes

A large rectangular area filled with a light blue grid pattern, intended for handwritten notes or technical drawings.

PRODUCT INFORMATION

HG(HA)2 CO₂ T

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