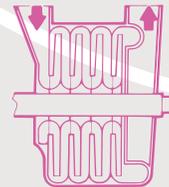
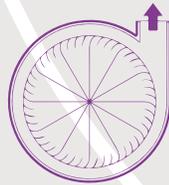


BLOWERS, FANS and COMPRESSORS for BIOGAS, LANDFILL and NATURAL GAS, in conformity with 2014/34/EU Directive (ATEX)



MAPROBioGas
Technology



MAPRO



ISO 9001 - Cert. 1835



Mapro International SpA was established in 1959, under the company name of M.P.R. Italiana SpA, as manufacturer, on order, of special rotary compressors and vacuum pumps to compress and evacuate gaseous fluids. Any problem of conveyance of air or industrial gases can be solved with reliable and economic solutions, thanks to a solid experience acquired through the manufacturing of machines for all industrial sectors, from food to pharmaceutical industry, from textile to printing and paper industry, for all sort of industrial process and for any biomass gas transfer.

Product Conformity

MAPRO® Products are:

- In conformity with Laws and Technical Rules
- In conformity with Customer's requests
- Suitable for the foreseen application
- Safe and Reliable

Main Applicable European Directives:

- 2006/42/EC Safety of Machinery
- 2014/35/EU Low Voltage
- 2014/30/EU Electromagnetic Compatibility
- 2014/68/EU (PED) Pressure Equipment
- 2014/34/EU (ATEX) Equipment intended for use in potentially explosive atmospheres



One of the first special applications

Compressor manufacturing around 1965



Quality Management System

In order to have a **Management System** of all **Internal Processes** fit to **satisfy Customers efficiently and effectively**, in accordance with:

- a. Laws, Norms, Rules and European Directives
- b. Safety
- c. Environment
- d. Ethics and respect

with focus on:

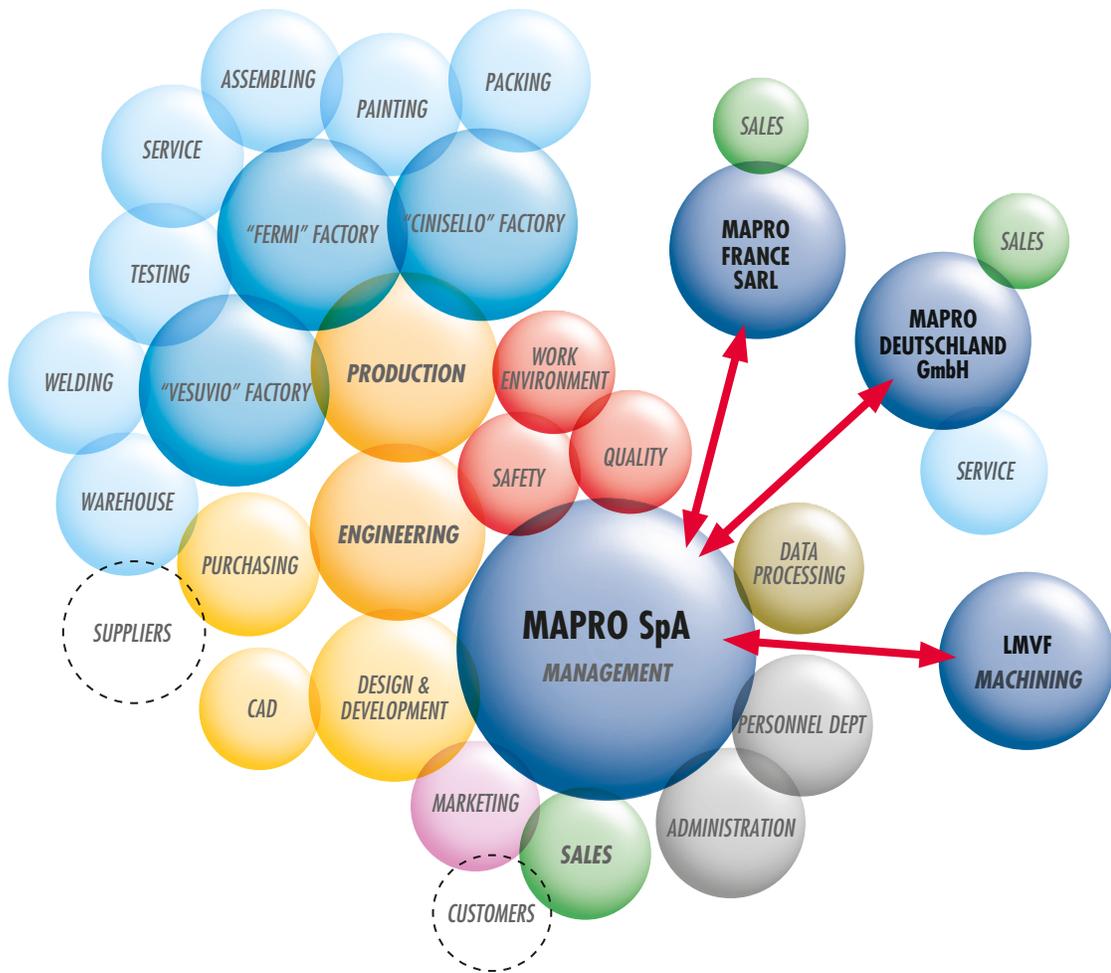
- 1. Continuous improvement
- 2. Staff training
- 3. Cooperation with Customers and Suppliers,

Mapro SpA has implemented the **Quality Management System** as per the requirements of **ISO 9001:2015** Standard and obtained **ICIM Certificate No. 1835** with **International Certification Network IQNet** registration **No. IT-18201**.

This Certification is not an end, but the evidence of our Commitment to a **Continuous** process of **Improvement**.

All over the world, the registered mark **MAPRO®** is **synonymous with product quality, efficiency and durability**.

Activities



For the mixtures of combustible gases, such as biogas and natural gas, MAPRO® has chosen to feature the specific manufacturing technology used for the blowers and the compressors shown in this brochure with the trademark

MAPROBioGas Technology

that highlights their design expressly worked out for the extraction and compression of these gases.



Blowers, Fans and Compressors in conformity with the 2014/34/EU Directive (ATEX)

The 2014/34/EU Directive (ATEX) requires machines comprised in the Equipment-Group II, Category 2, for use in hazardous places, classified as Zone 1, where an explosive atmosphere, consisting of a mixture of air and flammable gases, is likely to occur.

In accordance with the Directive, **MAPRO® has designed a complete range of Blowers, Fans and Compressors**, falling within the aforementioned Group, and classified into **Category 2 both for the surrounding area conditions and for the internals of the machines.**

To issue the Declaration of Conformity of the equipments to the ATEX Directive and affix the CE marking to each piece of equipment, the article 13, paragraph 1, of the Directive states that the manufacturer must follow the Procedure relating to the Internal Production Control referred to in Annex VIII and communicate to a Notified Body the Technical Dossier provided for in paragraph 2 of the Annex.

For the Sliding Vane Rotary Compressors, the Regenerative Blowers (also called Side Channel Blowers), the TBT Blowers and the Multistage Centrifugal Blowers, MAPRO® has communicated the **Technical Dossier provided for in Annex VIII** to the Notified Body **CESI (Identification Number 0722)**; for the Centrifugal Fans, to the Notified Body **ICIM (Identification Number 0425)**.

On the basis of the Technical Dossier contents, **MAPRO®** follows the Procedures relating to the Internal Production Control and **draws up the Declaration of Conformity of the machines to the Directive.**

PRODUCT CERTIFICATION

For the Regenerative Blowers (also called Side Channel Blowers), the Multistage Centrifugal Blowers and the Centrifugal Fans to be used for extraction or compression of combustible gases, such as biological or natural gas, in hazardous places classified as Zone 1, MAPRO® has voluntarily chosen to request the Product Certification.

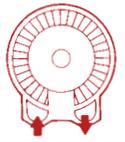
In compliance with the scheme developed by the Certification Body **ICIM**, MAPRO® has therefore decided to carry out, on the manufacture of the Products listed above, tests and controls of higher level than the minimum required for the CE marking according to the Directive 2014/34/EU (ATEX).

This voluntary certification has been requested as reasonable demonstration of well superior quality of the MAPRO® Products compared to the average of similar products sold on the market and it represents a qualitative complement certified by a third party.

In compliance with the Normative Documents of the ICIM Certification Scheme, **MAPRO®** has therefore **obtained, for the Regenerative (or Side Channel) Blowers, the Multistage Centrifugal Blowers and the Centrifugal Fans, the Product Certification No. ICIM - VEX-000004-00** and is authorized to apply on said machines the ICIM Mark provided for this Certification.

The verification of the maintenance of the compliance of the Products with the requirements of the reference Normative Documents is guaranteed by regular surveillance visits (at least once a year) of ICIM inspectors.





Operating principle

The regenerative blower increases the pressure of the aspirated gas by the creation, in the peripheral toroidal channel, of a series of vortices caused by the centrifugal thrust of the impeller.

While the impeller is rotating, the vanes force the gas forward and, because of the centrifugal thrust, outwards, producing a helical motion.

During this motion, the gas is recompressed repeatedly with a consequent linear pressure increase along the length of the channel.



Generalities and construction features in conformity with the 2014/34/EU Directive (ATEX)



The MAPRO® regenerative blowers to be used for extraction or compression of combustible gases, such as biological or natural gas, have been designed in order to fall within the Equipment-Group II as required by the 2014/34/EU Directive, Category 2 both for the surrounding area conditions and for the internals of the machines.

Their main construction features are the following:

- casing and impellers made completely of spark proof aluminium alloy;
 - casing impregnated with Loctite;
 - casing halves sealed;
 - shaft sealing by special double-lip seals which do not require lubrication;
 - two-pole, type of protection “d”, flameproof electric motors, with specific marking Ex II 2 G, additional marking Ex-d IIB T3.
- The simplest solution for the manufacturing of the machines is the so-called “CLOSE COUPLED” version – i.e., a flange mounted electric motor is bolted to the blower casing; the impeller, which is dynamically balanced, is fitted directly onto the motor shaft extension.

Furthermore, we can offer machines with their own shaft and bearings and coupled to the electric motors via flexible shaft couplings or belt drives. In these cases, the safety drive guards are made of spark-free material.

If the area surrounding the equipment is classified as Zone 2, where, for the Group II, Category 3 equipments are accepted, the machine could be equipped with the type of protection “n” non-sparking motor, with specific marking Ex II 3 G, additional marking Ex-nA II T3.

In some particular cases, all the internal aluminium parts wetted by gas can be treated with anodic oxidation; the machine can be supplied with its own shaft and external bearing housings, so that the bearings are completely isolated from the gas handled; and it is also possible to fit lip seals in pairs, with a barrier fluid in between.

IECEX Certification for electric motors

IECEX is a Certification Scheme issued by the International Electrotechnical Commission (IEC), and accepted by the international market, for Conformity Assessment to Standards relating to Equipment for use in Explosive Atmospheres. MAPRO® regenerative blowers, to be used on plants outside Europe, can be supplied, upon request, with ATEX motors dual labelled with IECEX Certification Conformity Mark.





Advantages

The main advantages of using regenerative machines are:

- easy installation;
- low noise level;
- no vibration;
- pulsation free gas flow;
- minimal maintenance.

Moreover no internal lubrication is necessary, and therefore the gas moving through the machine remains uncontaminated and completely oil-free.



The most common fields of application

- Landfill biogas recovery to feed torch, burner or gas engine;
- tank, plant or contaminated soil gas recovery to feed torch or burner;
- extraction of biogas from gasometer, natural gas from pipeline or gasometer, and burner or gas engine feeding.



Machines with gas recirculation (by-pass)

When the gas pressure increase is low and a variable gas flow is required (as for a burner feeding), a “compact by-pass”, directly bolted to the machine and connecting outlet and inlet ports, is a simple and effective solution. A suitable overpressure relief valve is fitted inside the “compact by-pass”.

When the gas demand decreases, the outlet pressure increases, and, when the set pressure is reached, the overpressure relief valve starts to open and by-passes excess gas back to the blower suction.

Usually the “compact by-pass” is capable of handling the full capacity of the blower for a maximum of 5 minutes.

So, during this period the machine can continue to run even if the downstream gas demand is reduced to zero.

For higher differential pressures, where the use of a “compact by-pass” is not allowed because of the high temperature increase when the flow rate is by-passed back to the suction, the machine can be supplied with the overpressure relief valve fitted on an offtake at the outlet side.

In that case the flanged valve discharge shall be piped-back to the blower suction through a by-pass pipe long enough to allow for sufficient gas cooling.

On request, we can supply machines equipped with a suitable gas cooler at the blower outlet, with overpressure relief valve fitted in an offtake at the cooler outlet, and with the complete “by-pass pipe” back to the blower suction side.

We can also supply automatic flow rate adjustment by means of pneumatic or electrically operated flow control valve, fitted in the by-pass line and controlled via the client process parameter “discharge gas pressure”.



Machines controlled via frequency inverter

If the gas demand varies in time (such as for burner or engine feeding), we can supply blowers equipped with a motor intended for control via frequency inverter.

The rpm range of the blower (and therefore the output frequency range of the frequency inverter) can be adjusted according to the foreseen operating conditions, and in particular to the expected differential pressure between blower discharge and suction.

The speed of rotation of the motor shall be controlled via the “discharge gas pressure” process parameter.



Accessories

A complete range of accessories is available, including the following:

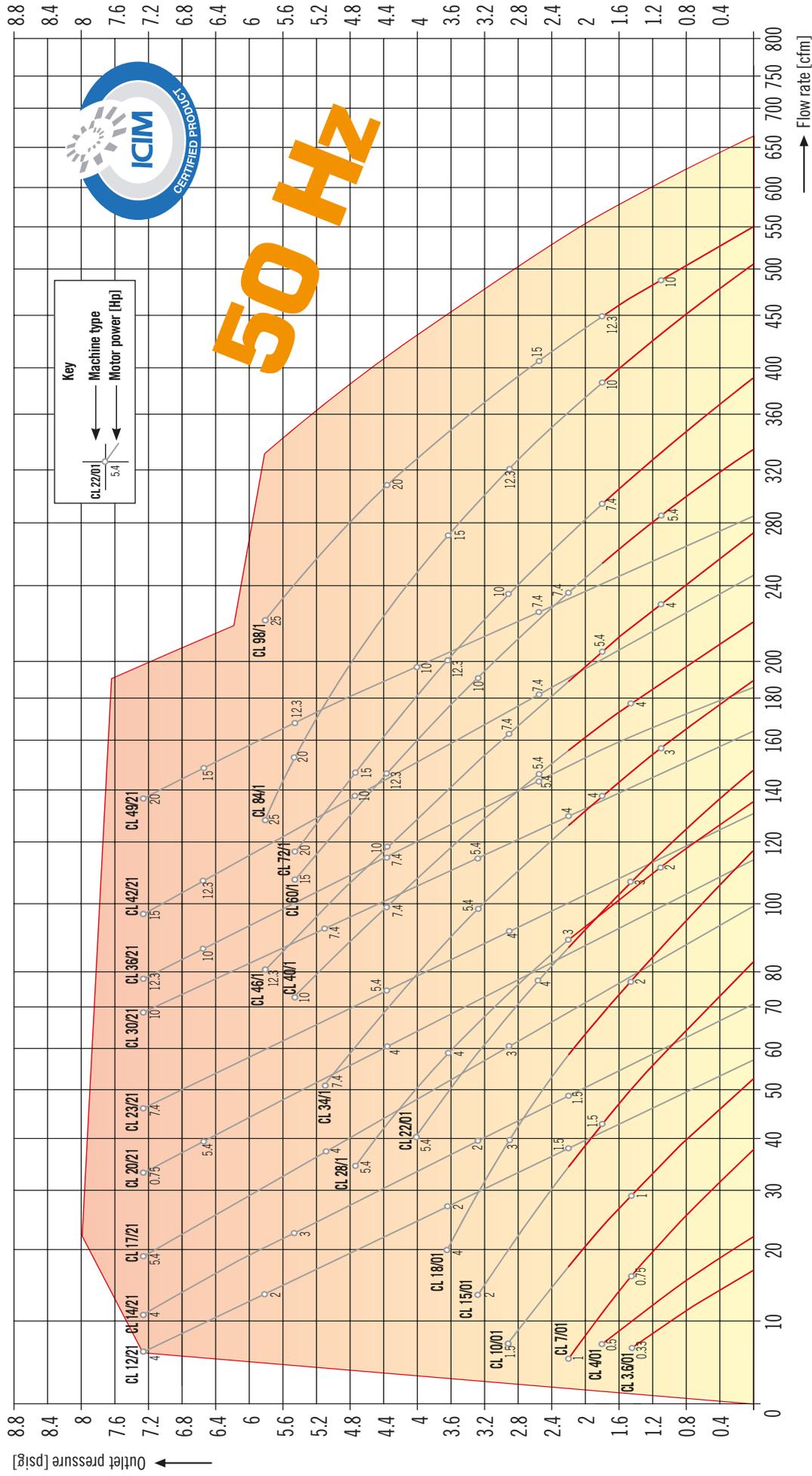
- gas-tight filters;
- stainless steel flanged flexible connection bellows;
- non return valves;
- pressure gauges and thermometers;
- explosion-proof pressure switches and temperature switches;
- intrinsically-safe pressure and temperature transducers;
- manual and automatic cut-off valves;
- acoustic enclosures.



Some installation



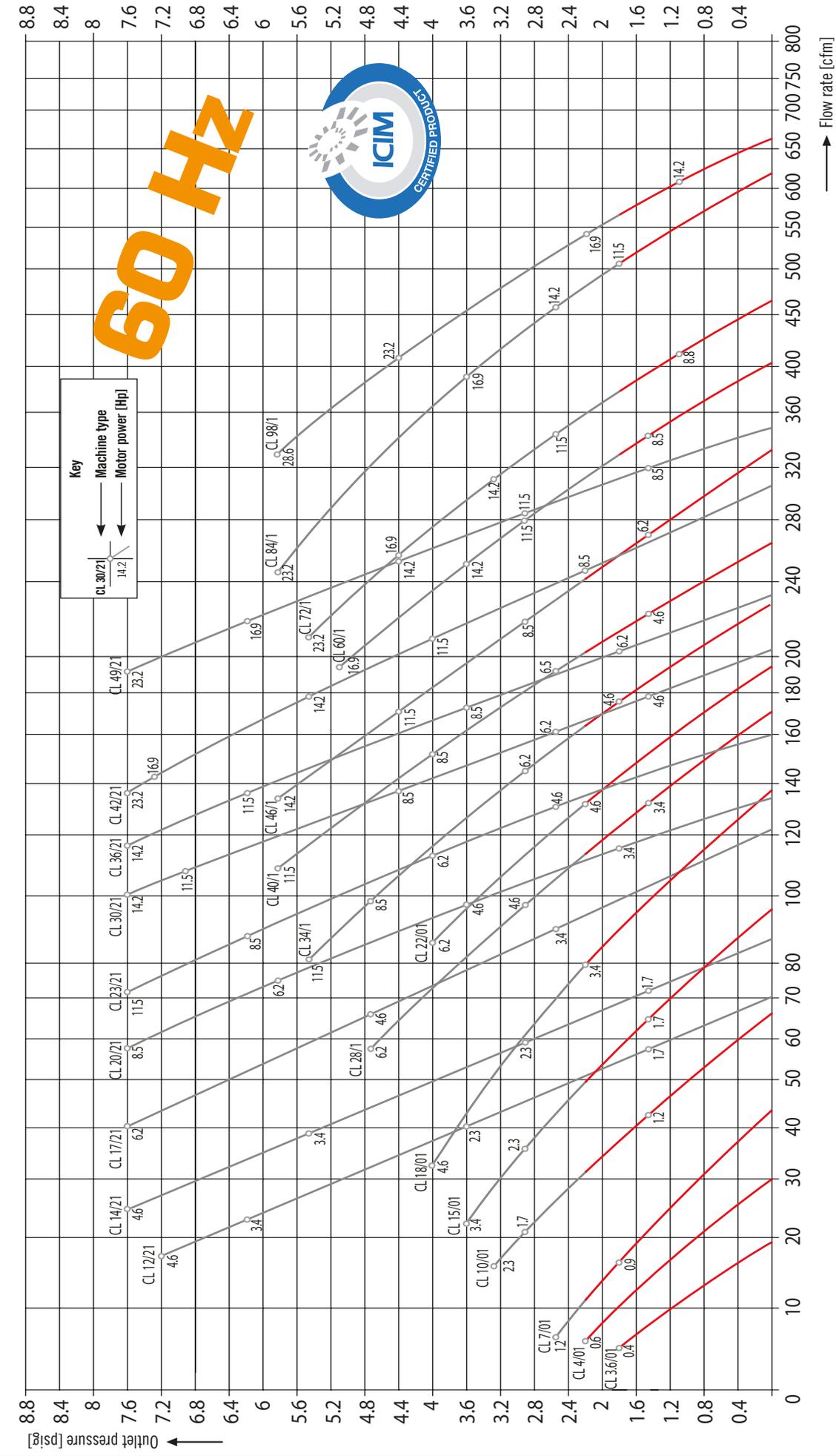
Regenerative blowers for biogas - Range of duty



The performance curves “flow rate - outlet pressure” and the “motor powers” shown in the literature, are given, for informational purposes only, at fixed rpm (50Hz – 2900rpm) and for a biogas with specific weight 0.071 lb/ft³ at 29.92 inHg (abs) and 32°F. The suction pressure is assumed at 0.145 psig and the inlet temperature at 95°F.

The part of the curves in red colour refers to the pressure range in which the blowers fitted with a “compact by-pass” can be used.

Regenerative blowers for biogas - Performance curves



The performance curves "flow rate - outlet pressure" and the "motor powers" shown in the literature, are given, for informational purposes only, at fixed rpm (60Hz – 3500rpm) and for a biogas with specific weight 0.071 lb/ft³ at 29.92 inHg (abs) and 32°F. The suction pressure is assumed at 0.145 psig and the inlet temperature at 95°F.

The part of the curves in red colour refers to the pressure range in which the blowers fitted with a "compact by-pass" can be used.

Dimensions

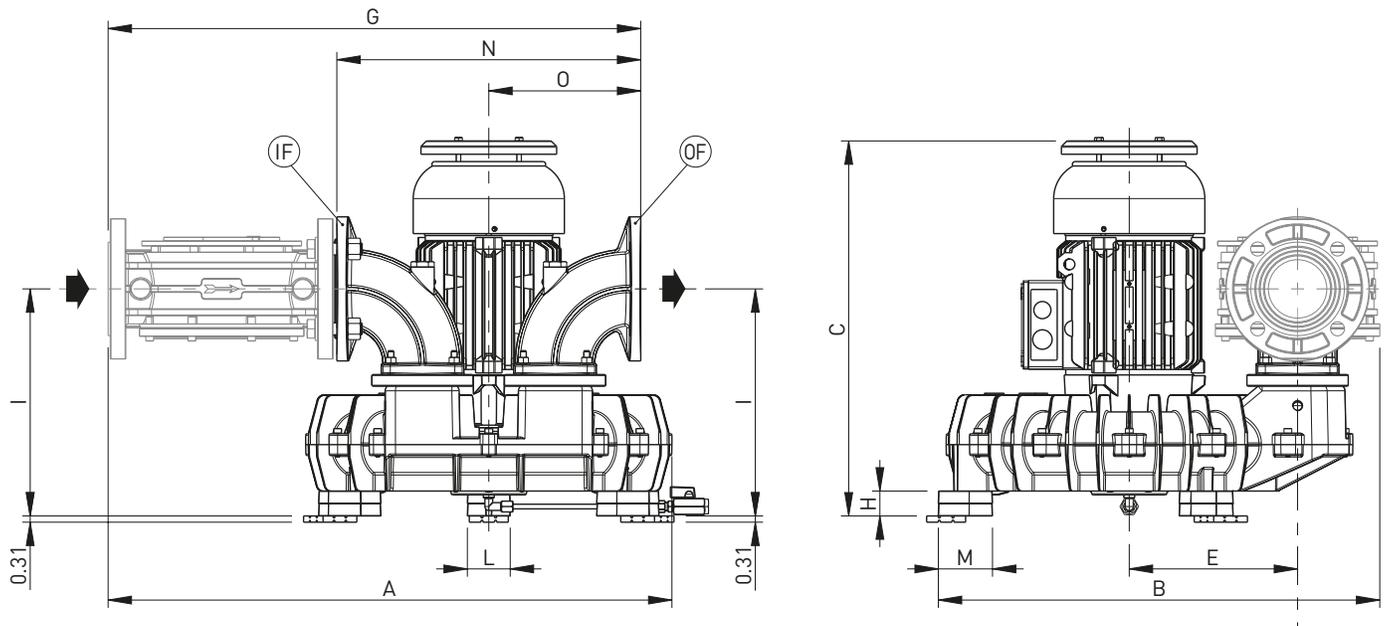
Below, and up to page 13, you can find, for informational purposes only, the dimensions of the single-stage regenerative blowers, for biogas or natural gas, in the so-called "CLOSE COUPLED" version.

The blowers shown are equipped with the type of protection "d" flameproof electric motor, with specific marking Ex II 2 G, additional marking Ex-d IIB T3.

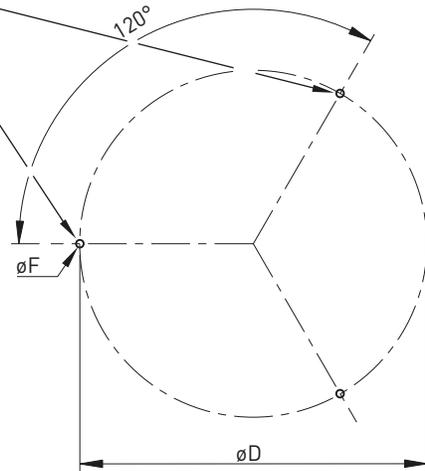
The height and weight, given as well for informational purposes, are for blowers equipped with the motor of the highest power rating amongst those provided for the specific blower model.

For the dimensions and the motor power of any other construction feature, please ask MAPRO® Sales Department.

Regenerative blowers with inlet filter and inlet and discharge flanged elbows



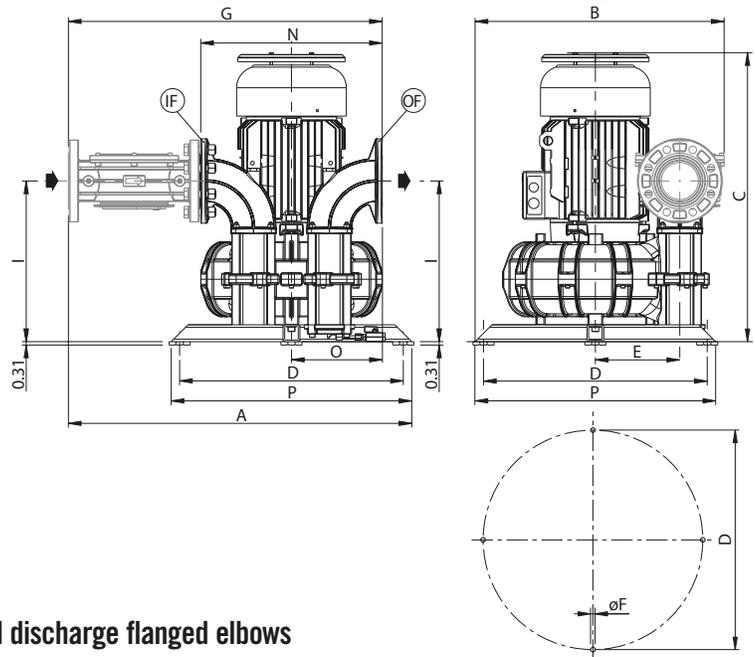
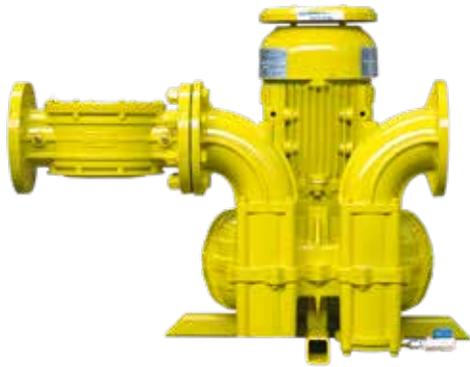
N.B.: the feet position for CL 3.6/01 VG and CL 4/01 VG is turned by 60° compared to the figure



Machine type	60Hz motor powers [Hp]	A	B	C	øD	E	øF	G	H	I	L	M	N	O	FLANGES (IF) and (OF) match 150# ANSI	Weight [lb]
CL 3.6/01 VG	0.4	21.77	13	16	11.42	4.84	0.4	21.77	1.26	5.63	2.17	2.76	12.6	6.3	1"	66
CL 4/01 VG	0.6	21.77	13	16	11.42	4.84	0.4	21.77	1.26	5.63	2.17	2.76	12.6	6.3	1"	66
CL 7/01 VG	0.9 - 1.2	21.06	15	16	13.39	4.92	0.4	20.47	1.26	7.87	2.17	2.76	11.42	5.7	1" 1/2	82
CL 10/01 VG	1.2 - 1.7 - 2.3	21.85	16.5	16.2	14.57	5.7	0.4	20.87	1.26	8.27	2.17	2.76	11.8	5.9	1" 1/2	101
CL 15/01 VG	1.7 - 2.3 - 3.4	22.83	18.1	18.35	16.14	6.7	0.4	21.46	1.26	8.86	2.17	2.76	12.2	6.1	2"	121
CL 18/01 VG	3.4 - 4.6	27.36	21.06	21.1	16.93	7.95	0.4	26.18	1.26	11.02	2.17	2.76	14.5	7.24	2" 1/2	159
CL 22/01 VG	4.6 - 6.2	28.54	22.24	22.1	18.31	8.5	0.4	26.97	1.26	11.61	2.17	2.76	15.35	7.68	2" 1/2	207

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in]

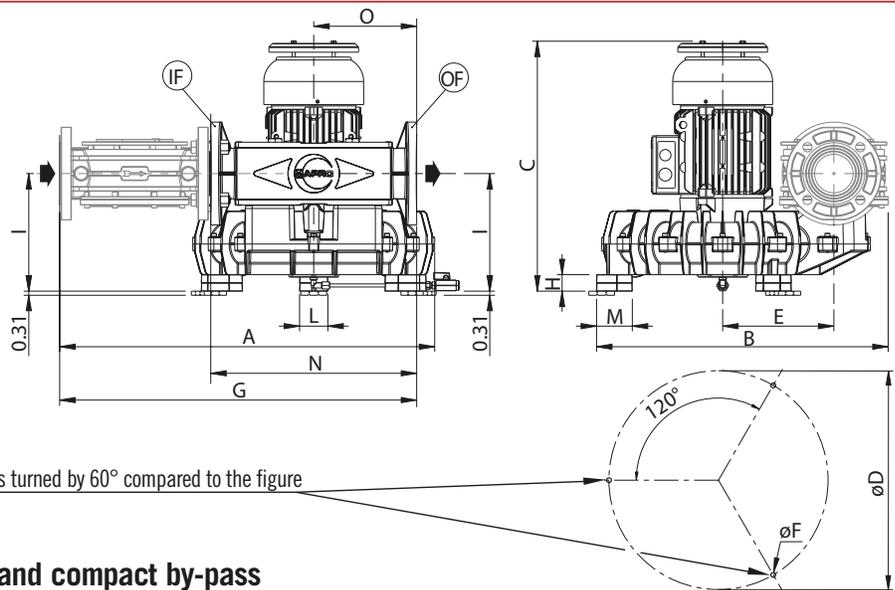


Regenerative blowers with inlet filter and inlet and discharge flanged elbows

Machine type	60Hz motor powers [Hp]	A	B	C	D	E	∅F	G	I	N	O	P	FLANGES (IF) and (OF) match 150# ANSI	Weight [lb]
CL 28/1 VG	3.4 - 4.6	28.5	20.9	23.2	18.1	6.9	0.43	25.79	11.42	14.17	7.1	19.7	2" 1/2	194
CL 34/1 VG	4.6 - 6.2 - 8.5	28.9	21.1	26.2	18.1	7.1	0.43	26.57	12.6	14.96	7.5	19.7	2" 1/2	240
CL 40/1 VG	4.6 - 6.2 - 8.5 - 11.5	31.7	22.8	26.2	20.9	7.5	0.43	28.54	12.8	16.14	8.1	22.44	3"	278
CL 46/1 VG	6.2 - 8.5 - 11.5	32.1	23.2	28.1	20.9	7.9	0.43	29.33	14.17	16.93	8.5	22.44	3"	300
CL 60/1 VG	8.5 - 11.5	32.1	23.2	27.4	20.9	7.9	0.43	29.33	14.96	16.93	8.5	22.44	3"	304
CL 72/1 VG	8.5 - 11.5 - 14.2	34.8	25.8	28.7	22.44	8.7	0.43	31.89	13.39	17.95	9	24	4"	291
CL 84/1 VG	11.5 - 14.2	35.8	28.1	29.3	24.4	10	0.43	31.89	14.37	17.95	9	26	4"	333
CL 98/1 VG	14.2	36.6	29.3	28.9	26	10.4	0.43	31.89	13.98	17.95	9	27.56	4"	337

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in]



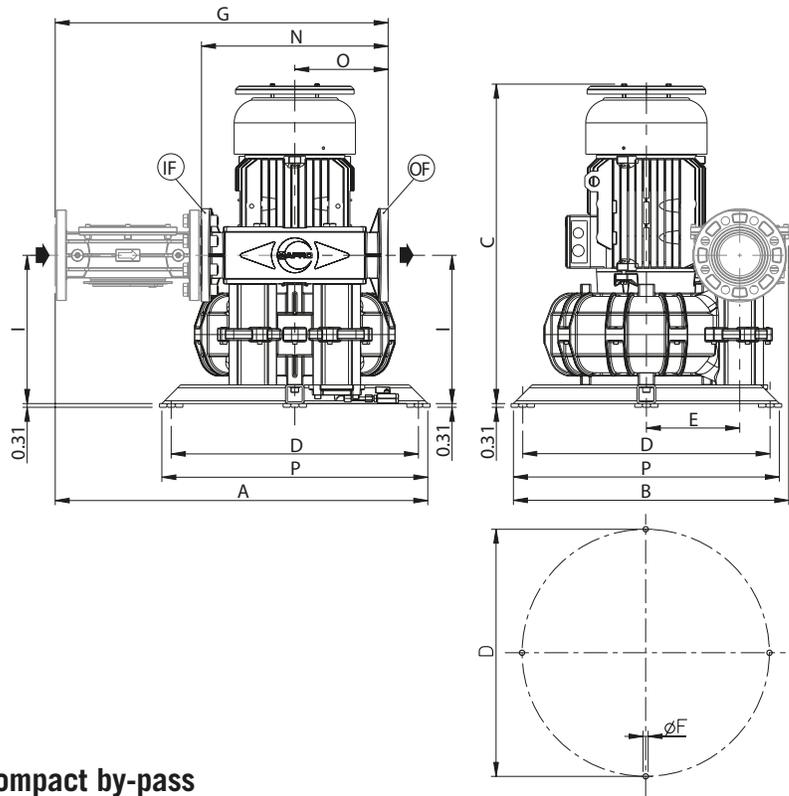
N.B.: the feet position for CL 3.6/01 VG and CL 4/01 VG is turned by 60° compared to the figure

Regenerative blowers with inlet filter and compact by-pass

Machine type	60Hz motor powers [Hp]	A	B	C	∅D	E	∅F	G	H	I	L	M	N	O	FLANGES (IF) and (OF) match 150# ANSI	Weight [lb]
CL 3.6/01 VG	0.4	19.8	12.7	16	11.42	4.84	0.4	19.41	1.26	5.35	2.17	2.76	10.24	5.12	1"	66
CL 4/01 VG	0.6	19.8	12.7	16	11.42	4.84	0.4	19.41	1.26	5.35	2.17	2.76	10.24	5.12	1"	66
CL 7/01 VG	0.9 - 1.2	22.44	15.4	16	13.39	4.92	0.4	22.44	1.26	6.3	2.17	2.76	13.4	6.7	1" 1/2	86
CL 10/01 VG	1.2 - 1.7	22.64	16.7	16.2	14.57	5.7	0.4	22.44	1.26	6.5	2.17	2.76	13.4	6.7	1" 1/2	95
CL 15/01 VG	1.7 - 2.3	23.43	18.5	18.35	16.14	6.7	0.4	22.64	1.26	7.09	2.17	2.76	13.4	6.7	2"	110
CL 18/01 VG	3.4	27.95	21.1	18.5	16.93	7.95	0.4	27.36	1.26	8.46	2.17	2.76	15.76	7.88	2" 1/2	143
CL 22/01 VG	4.6	28.74	22.2	21.3	18.31	8.5	0.4	27.36	1.26	9.06	2.17	2.76	15.76	7.88	2" 1/2	179

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in]



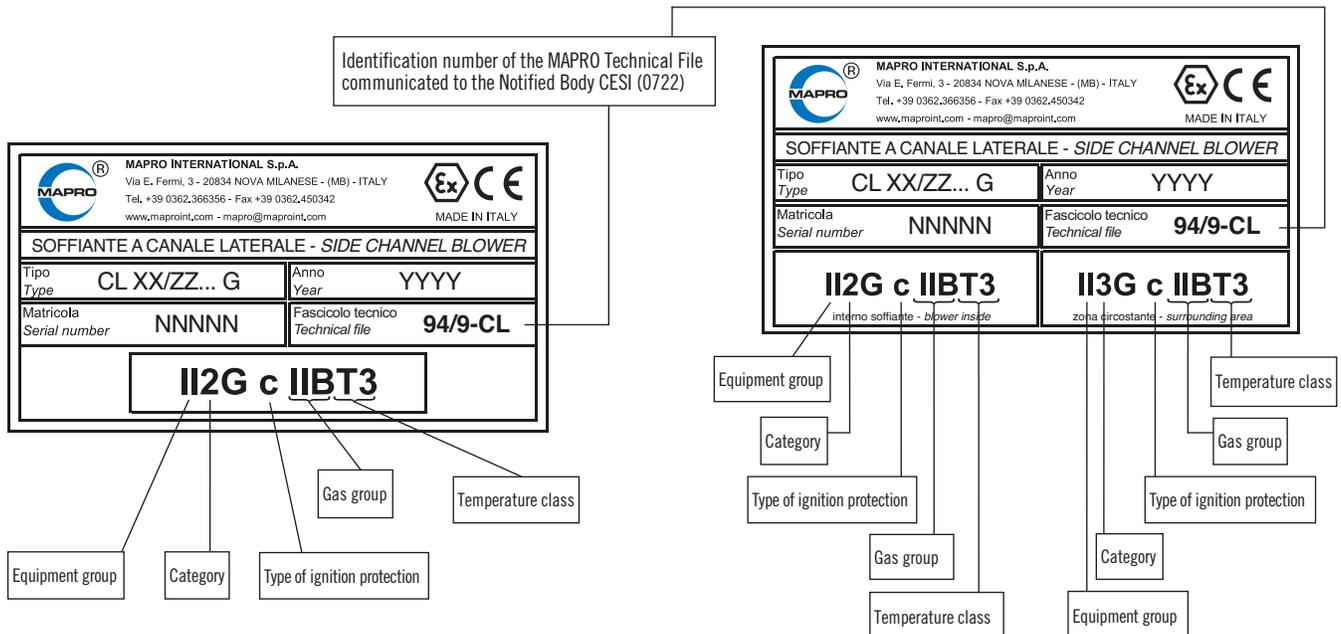
Regenerative blowers with inlet filter and compact by-pass

Machine type	60Hz motor powers [Hp]	A	B	C	D	E	ØF	G	I	N	O	P	FLANGES (IF) and (OF) match 150# ANSI	Weight [lb]
CL 28/1 VG	3.4 - 4.6	29.3	20.9	23.2	18.1	6.9	0.43	27.4	9.65	15.75	7.9	19.7	2" 1/2	170
CL 34/1 VG	4.6 - 6.2	29.3	21.1	24.8	18.1	7.1	0.43	27.4	10.63	15.75	7.9	19.7	2" 1/2	218
CL 40/1 VG	4.6 - 6.2	31.7	23	24.8	20.9	7.5	0.43	28.15	10.24	15.75	7.9	22.44	3"	223
CL 46/1 VG	6.2 - 8.5	31.7	23.4	26.6	20.9	7.9	0.43	28.15	11.6	15.75	7.9	22.44	3"	262
CL 60/1 VG	8.5 - 11.5	31.5	23.4	27.4	20.9	7.9	0.43	28.15	12.4	15.75	7.9	22.44	3"	304
CL 72/1 VG	8.5 - 11.5	40.2	27.4	27	22.44	8.7	0.43	38.6	11.22	19.7	10.4	24	5"	342
CL 84/1 VG	11.5	41.1	29.7	29.3	24.4	10	0.43	38.6	12.2	19.7	10.4	26	5"	359
CL 98/1 VG	14.2 - 16.9	41.9	30.9	29.1	26	10.4	0.43	38.6	12	19.7	10.4	27.56	5"	386

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in]

The ATEX marking of MAPRO® regenerative (or side channel) blowers for biogas or natural gas



N.B.: The nameplates shown in the figure do not reproduce those fitted on the machines.

BLOWERS, CL... -M HG Series, for BIOGAS and NATURAL GAS



Generalities and construction features in conformity with the 2014/34/EU Directive (ATEX)



The MAPRO® regenerative blowers CL...-M HG Series have been designed to be used for the compression, at low pressure values, of combustible gases, such as biological or natural gas, in hazardous places classified as Zone 2.

They are therefore blowers designed in order to fall within the Equipment-Group II, as defined by the 2014/34/EU Directive, Category 3, equipped with two-pole, type of protection “n” non-sparking motor with specific marking Ex II 3G, additional marking Ex-nA II T3.

The main construction features of these machines are:

- casing and impeller made completely of spark proof aluminium alloy;
- casing halves sealed;
- shaft sealing by special double-lip seals which do not require lubrication.

The blowers are manufactured in the so-called “CLOSE COUPLED” version - i.e., a flange mounted electric motor is bolted to the blower casing; the impeller, which is dynamically balanced, is fitted directly onto the motor shaft extension.

The machines are fitted with threaded flanges for the connection to the inlet and discharge gas pipes.



IECEx Certification for electric motors

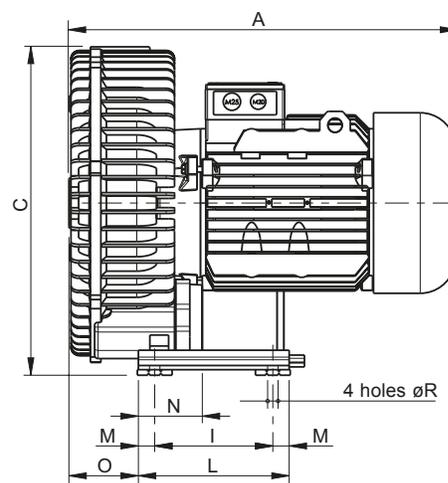
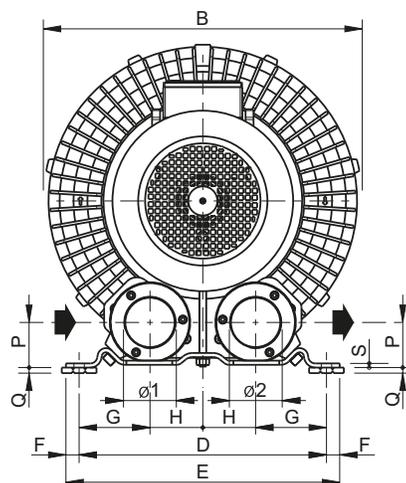
MAPRO® regenerative blowers CL...-M HG Series to be used on plants outside Europe, can be supplied, upon request, with ATEX motors dual labelled with IECEx Certification Conformity Mark.



The most common fields of application

- Landfill biogas recovery to feed torch;
- Tank, plant or contaminated soil gas recovery to feed torch.

Dimensions

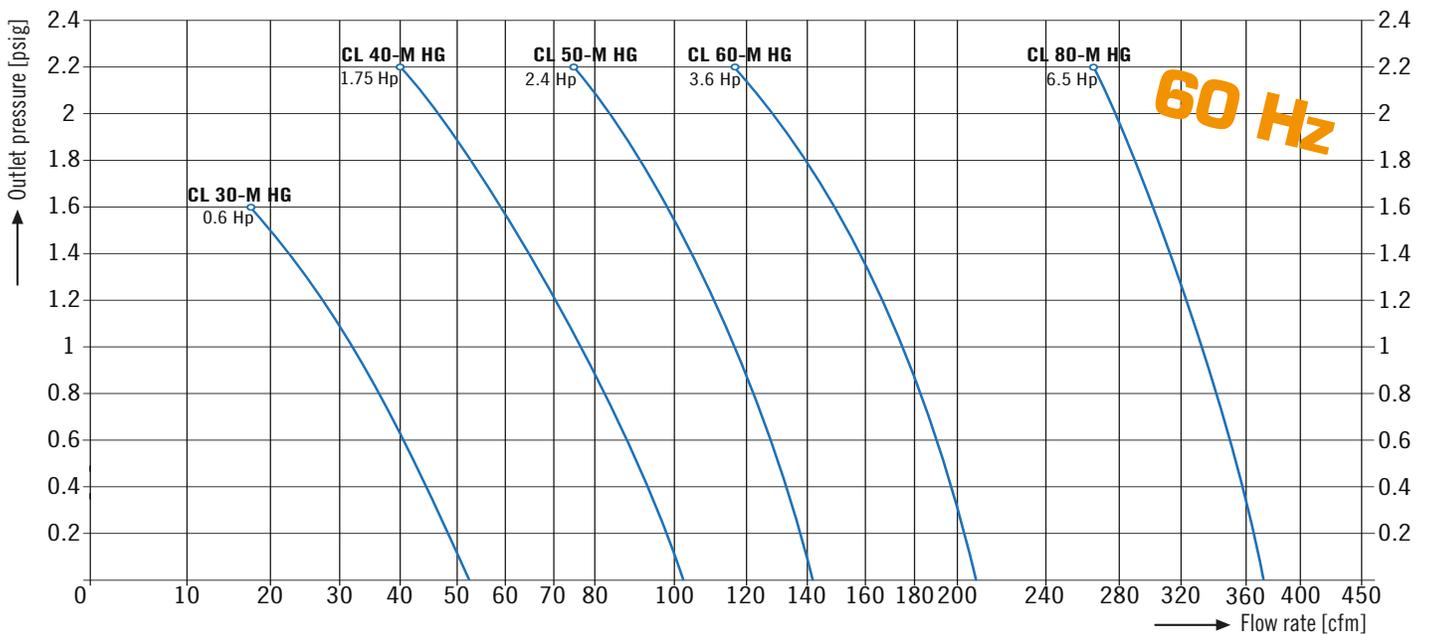
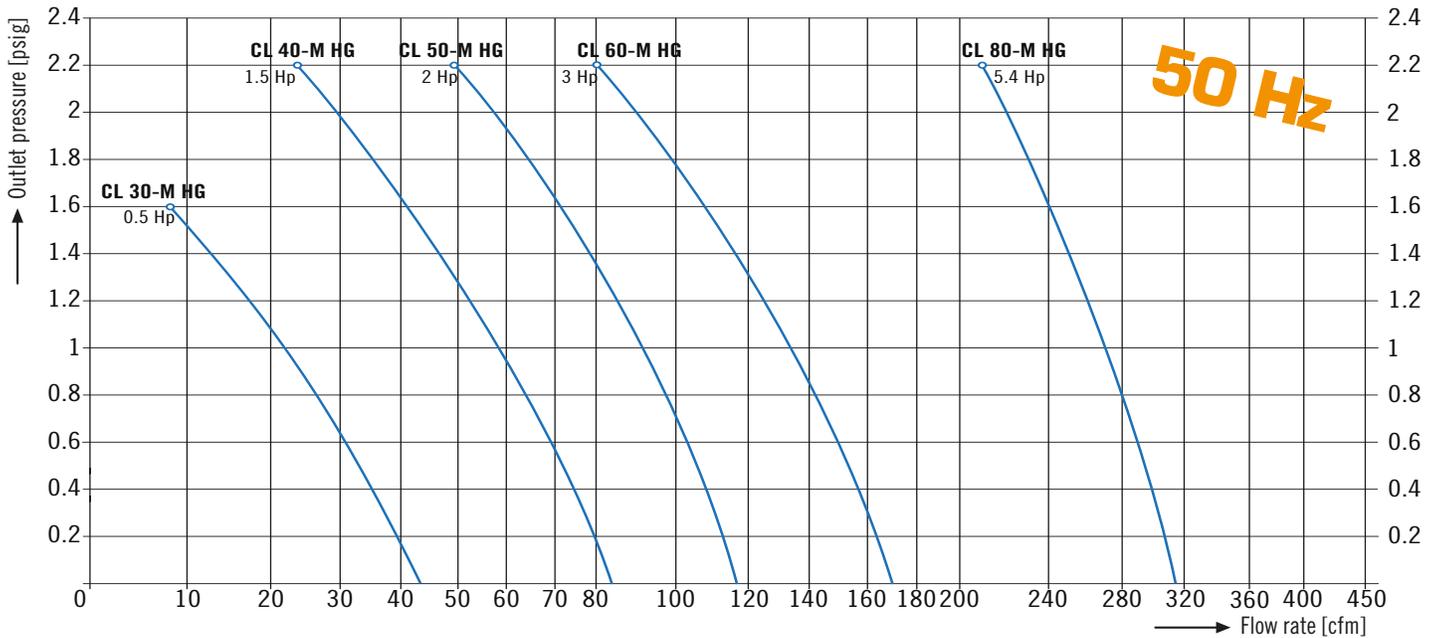


Machine Type	A	B	C	D	E	F	G	H	I	L	M	N	O	P	Q	øR	S	NPSC female thread ports		Weight [lb]
																		inlet ø1	outlet ø2	
CL 30-M HG	12.44	9.92	10.12	8.07	8.98	0.45	2.26	1.77	3.27	4.25	0.49	1.95	2.24	1.54	0.31	0.39	0.1	1" 1/4	1" 1/4	33
CL 40-M HG	12.32	11.3	12.28	8.86	10.04	0.59	2.36	2.07	3.74	5.12	0.69	3.19	2.36	2.05	0.31	0.47	0.12	1" 1/2	1" 1/2	51
CL 50-M HG	15.2	12.91	13.66	10.24	11.61	0.69	2.76	2.36	4.53	6.1	0.79	2.76	2.56	1.89	0.31	0.55	0.16	2"	2"	60
CL 60-M HG	17.72	15.04	15.39	11.42	12.8	0.69	3.25	2.46	5.51	7.09	0.79	2.76	3.54	1.89	0.31	0.59	0.18	2"	2"	77
CL 80-M HG	19.21	17.76	18.62	14.02	15.51	0.75	4.02	2.99	6.69	8.54	0.93	3.62	3.94	2.56	0.31	0.59	0.24	2" 1/2	2" 1/2	112

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in]

Blowers, CL...-M HG Series Flow rate-pressure diagram for biogas



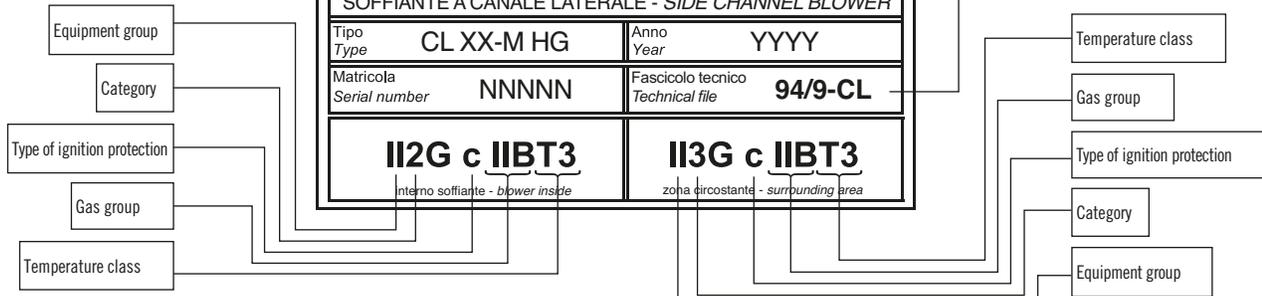
The performance curves are given, for informational purposes only, at fixed rpm (50Hz - 2900rpm) (60Hz - 3500rpm) and for a biogas with specific weight 0.071 lb/ft³ at 29.92 inHg (abs) and 32°F. The suction pressure is assumed at 0.145 psig and the inlet temperature at 95°F.

The ATEX marking of MAPRO® blowers, CL...-M HG Series, for biogas or natural gas



MAPRO INTERNATIONAL S.p.A. Via E. Fermi, 3 - 20834 NOVA MILANESE - (MB) - ITALY Tel. +39 0362.366356 - Fax +39 0362.450342 www.maprint.com - mapro@maprint.com MADE IN ITALY			
SOFFIANTE A CANALE LATERALE - SIDE CHANNEL BLOWER			
Tipo / Type	CL XX-M HG	Anno / Year	YYYY
Matricola / Serial number	NNNNN	Fascicolo tecnico / Technical file	94/9-CL
IIG c IIBT3 interno soffiante - blower inside		IIG c IIBT3 zona circostante - surrounding area	

Identification number of the MAPRO Technical File communicated to the Notified Body CESI (0722)



N.B.: The nameplate shown in the figure does not reproduce the one fitted on the machines.

TBT BLOWER for BIOGAS and NATURAL GAS



Operating principle

The TBT is a machine with a peripheral toroidal channel, and therefore similar to regenerative (or side channel) blowers, but featuring a revolutionary impeller and channel design, developed through long research and testing.

The operating principle and advantages are the same as regenerative blowers. However the wing contour of the impeller vanes and the peripheral channel with the central core, both contribute to the achievement of performances similar to that of positive displacement machines.



Generalities and construction features in conformity with the 2014/34/EU Directive (ATEX)



Construction features are the same as those for regenerative blowers. But, differently from the regenerative machines, the TBT blowers designed to extract or compress combustible gases, such as biological or natural gas, are always manufactured with their own shaft and bearings. Occasionally they are coupled to an electric motor via a flexible shaft coupling, but more frequently via a belt drive. The latter permits a wide range of operating speeds; from 2000 to 5000 rpm. The advantage is that one unit can cover a wide operating range.

The most common fields of application

- Landfill biogas recovery to feed torch, burner or gas engine;
- tank, plant or contaminated soil gas recovery to feed torch or burner;
- extraction of biogas from gasometer, natural gas from pipeline or gasometer, and burner or gas engine feeding.

TBT blowers with gas recirculation (by-pass)

When the gas has to feed a burner or when a variable gas flow is required, the TBT blowers can be supplied with the overpressure relief valve fitted on an offtake at the outlet side. The flanged valve discharge shall be piped-back to the blower suction through a by-pass pipe long enough to allow for the sufficient gas cooling. When the gas demand decreases, the outlet pressure increases, and, when the set pressure is reached, the overpressure relief valve starts to open and by-passes excess gas back to the blower suction.

On request, we can supply TBT blowers equipped with a suitable gas cooler at the blower outlet, with overpressure relief valve fitted in an offtake at the cooler outlet, and with the complete “by-pass pipe” back to the blower suction side.

TBT blowers controlled via frequency inverter

If the gas demand varies in time (such as for burner or engine feeding), we can supply TBT blowers coupled to an electric motor intended for control via frequency inverter. The rpm range of the blower (and therefore the output frequency range of the frequency inverter) can be adjusted according to the foreseen operating conditions, and in particular to the expected differential pressure between blower discharge and suction. The speed of rotation of the motor shall be controlled via the “discharge gas pressure” process parameter.

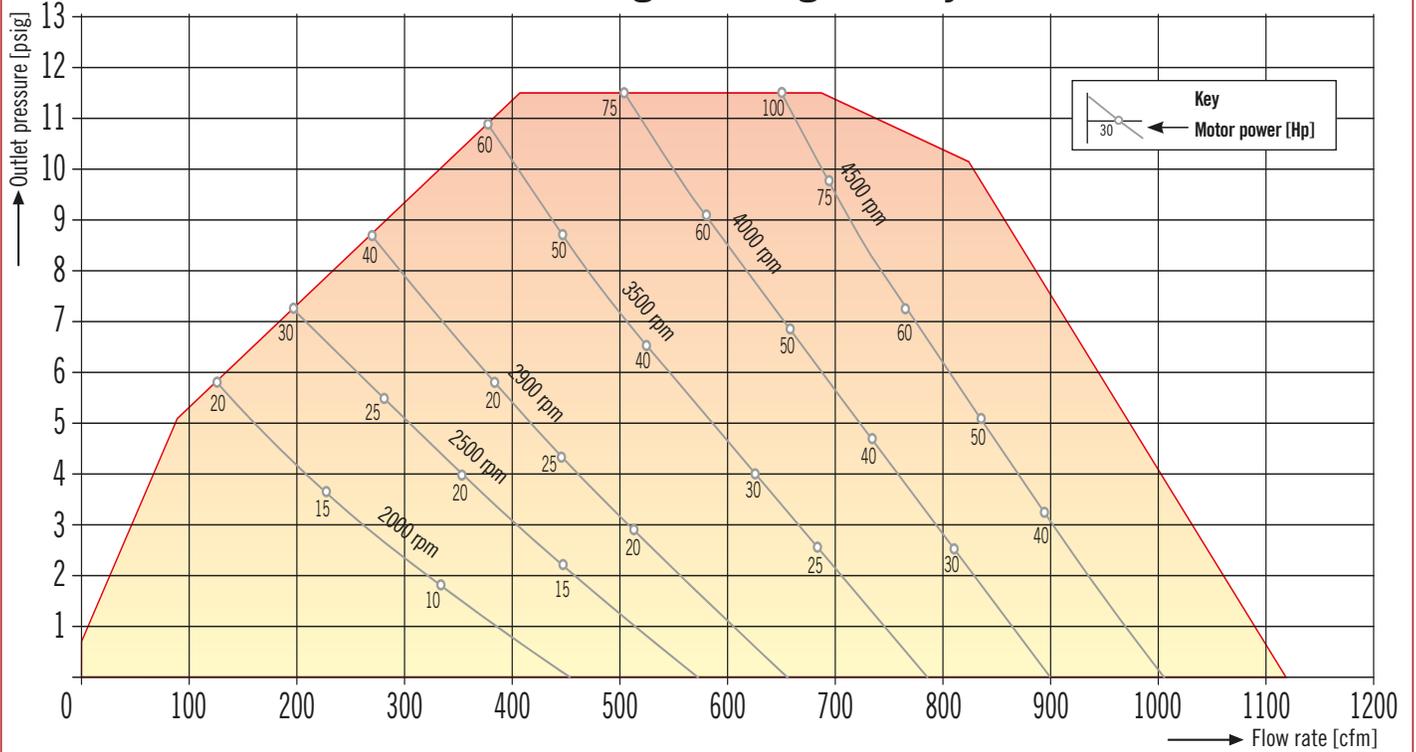
Accessories

A complete range of accessories is available, including the following:

- gas-tight filters;
- stainless steel flanged flexible connection bellows;
- non return valves;
- pressure gauges and thermometers;
- explosion-proof pressure switches and temperature switches;
- intrinsically-safe pressure and temperature transducers;
- manual and automatic cut-off valves;
- acoustic enclosures.



TBT for biogas – Range of duty



The performance curves “flow rate - outlet pressure” and the “motor powers” shown in the literature, are given, for informational purposes only, at fixed rpm and for a biogas with specific weight 0.071 lb/ft³ at 29.92 inHg (abs) and 32°F. The suction pressure is assumed at 0.145 psig and the inlet temperature at 95°F.

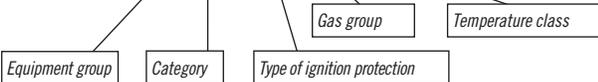


The ATEX marking of the TBT blower for biogas or natural gas

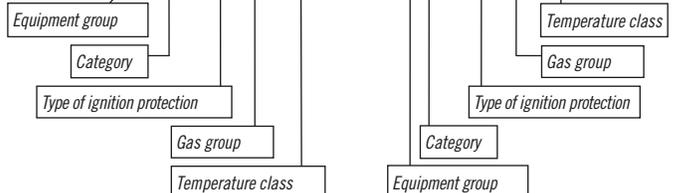


Identification number of the MAPRO Technical File communicated to the Notified Body CESI (0722)

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MADE IN ITALY		
SOFFIANTE TBT - TBT BLOWER		
Tipo Type	TBT G	Anno Year
		YYYY
Matricola Serial number	NNNNN	Fascicolo tecnico Technical file
		94/9-TBT
IIG c IIBT3		



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MADE IN ITALY		
SOFFIANTE TBT - TBT BLOWER		
Tipo Type	TBT G	Anno Year
		YYYY
Matricola Serial number	NNNNN	Fascicolo tecnico Technical file
		94/9-TBT
IIG c IIBT3 <small>interno soffiante - blower inside</small>		IIG c IIBT3 <small>zona circostante - surrounding area</small>



N.B.: The nameplates shown in the figure do not reproduce those fitted on the machines.

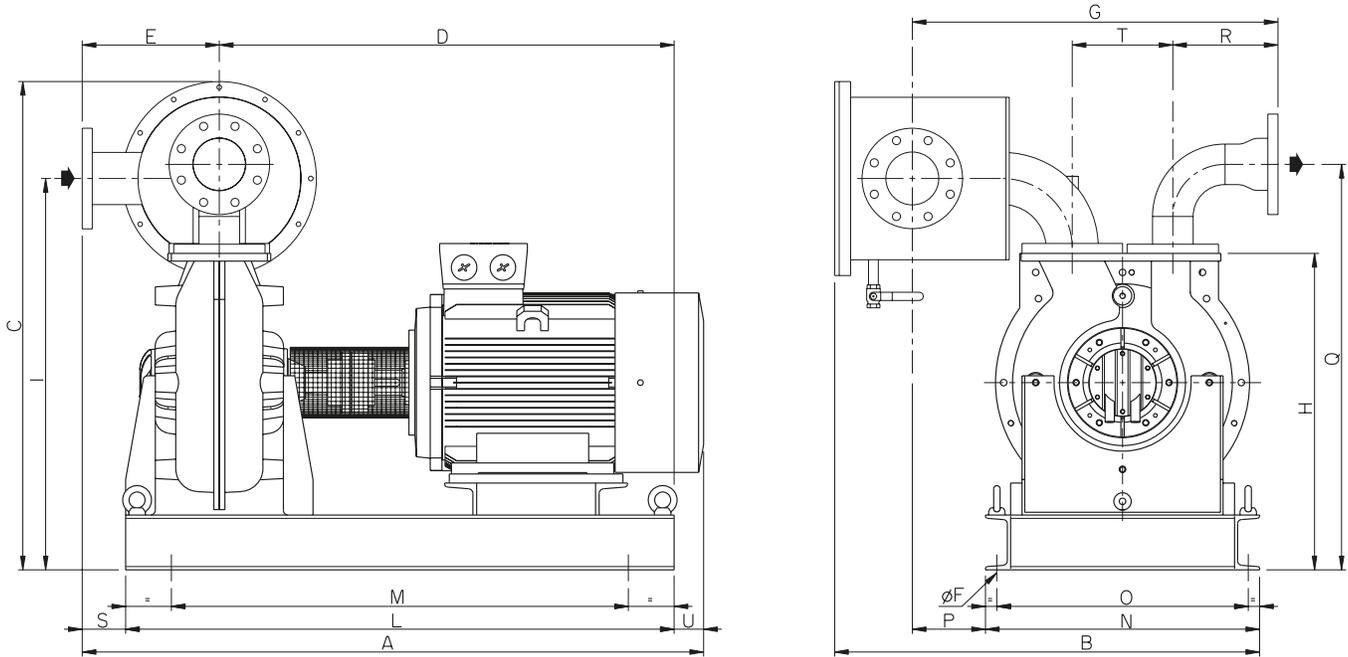
Dimensions

Below and on the next page you can find, for informational purposes only, the dimensions of the TBT blowers for biogas or natural gas. The weights, given as well for informational purposes only, are for blowers equipped with the type of protection “d” flameproof electric motor, with specific marking Ex II 2 G, additional marking Ex-d IIB T3.

When the TBT blower shaft is coupled to the motor via flexible coupling, the electric motors are always two-pole type.

For coupling via belt drives, the electric motors could be two-pole or four-pole type, depending on the expected operating conditions.

TBT blower with inlet filter and coupled to the electric motor via flexible shaft coupling



Motor power [Hp]	A (**)	B	C	D	E	∅F	G (*)	H	I	L	M	N	O	P	Q	R (*)	S	T	U (**)	Weight [lb] (**)
15	51	38.2	42.1	39.2	11.8	0.79	32.5	27.4	33.9	47.2	39.4	23.6	21.65	6.3	37.2	10	3.74	8.66	-	761
20	51																		-	791
25	51																		-	822
30	52																		0.79	847
40	52																		0.79	924
50	52																		0.79	968

Dimensions and Weights not binding and given for informational purposes only

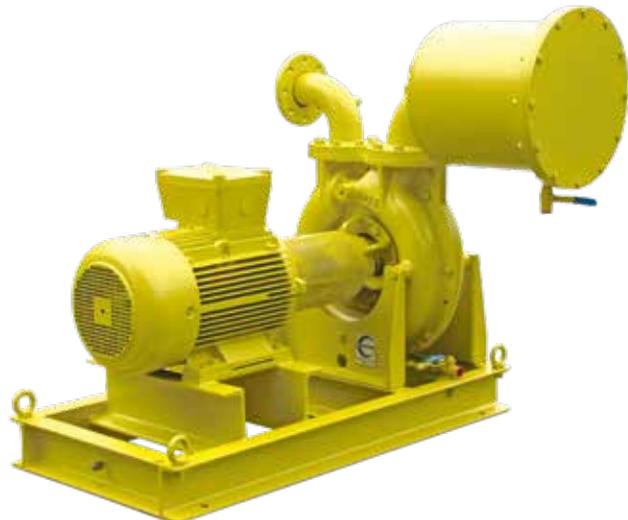
Dimensions [in]

The inlet flange of the filter fitted on TBT blower suction and the discharge flange are:

- 4" 150# ANSI for flow rates ≤ 350 cfm
- 5" 150# ANSI for flow rates > 350 cfm

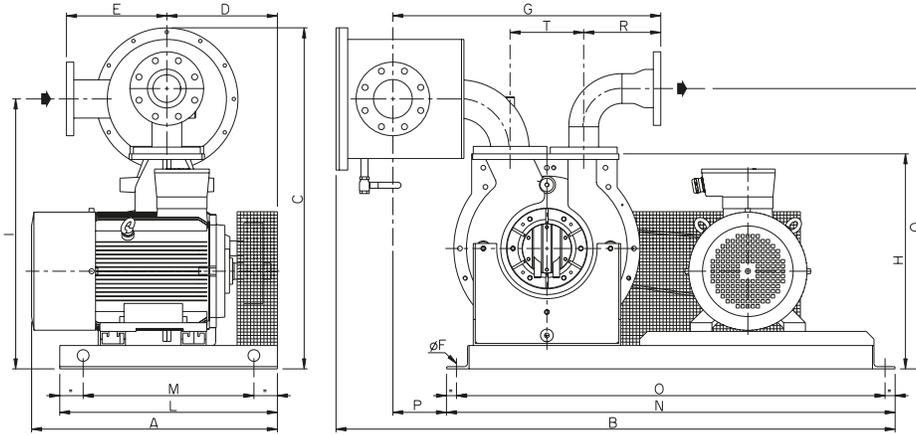
(*) Dimensions are for machines with inlet and outlet flanges 5" 150# ANSI

(**) Dimensions and weights could vary depending on the electric motor brand



TBT blower with inlet filter and coupled to the electric motors via belt drives

For electric motors up to 50 Hp



Motor power [Hp]	A (**)	B	C	D	E	ØF	G (*)	H	I	L	M	N	O	P	Q	R (*)	T	Weight (**)
15	26.4	65.7	40.2	13	11.8	0.79	32.9	25.4	31.9	25.6	20.1	52.8	50.4	6.3	35.2	10.4	8.66	739
20																		772
25																		827
30	29.3	65.7	40.2	13	11.8	0.79	32.9	25.4	31.9	25.6	20.1	52.8	50.4	6.3	35.2	10.4	8.66	871
40																		926
50																		1080

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in]

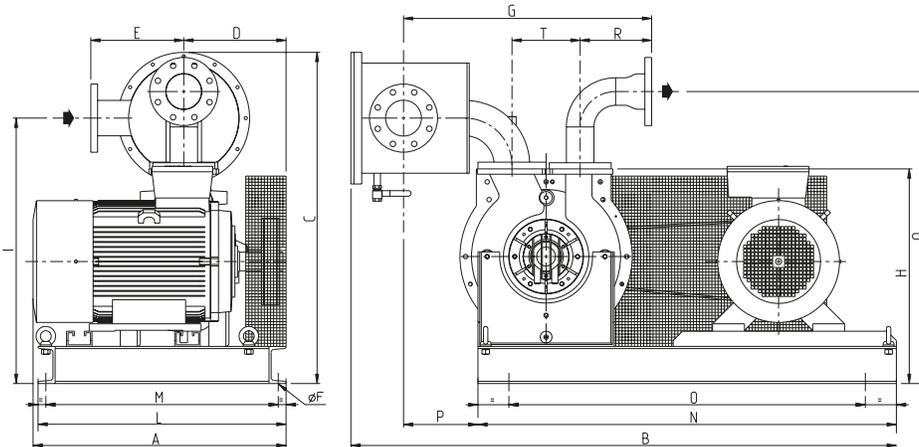
The inlet flange of the filter fitted on TBT blower suction and the discharge flange are:

- 4" 150# ANSI -1 for flow rates ≤ 350 cfm
- 5" 150# ANSI for flow rates > 350 cfm and ≤ 800 cfm
- 6" 150# ANSI for flow rates > 800 cfm

(*) Dimensions are for machines with inlet and outlet flanges 6" 150# ANSI

(**) Dimensions and weights could vary depending on the electric motor brand

For 60 and 75 Hp electric motors



Motor power [Hp]	A (**)	B	C	D	E	ØF	G (*)	H	I	L	M	N	O	P	Q	R (*)	T	Weight (**)
60	31.9	69.3	42.1	13	11.8	0.79	32.9	27.4	33.9	31.5	29.5	53.1	45.3	9.45	37.2	10.4	8.66	1168
75	33.1																	1224

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in]

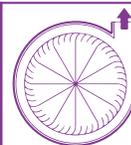
The inlet flange of the filter fitted on TBT blower suction and the discharge flange are:

- 5" 150# ANSI for flow rates ≤ 800 cfm
- 6" 150# ANSI for flow rates > 800 cfm

(*) Dimensions are for machines with inlet and outlet flanges 6" 150# ANSI

(**) Dimensions and weights could vary depending on the electric motor brand

CENTRIFUGAL FANS, MCF Series, for BIOGAS and NATURAL GAS

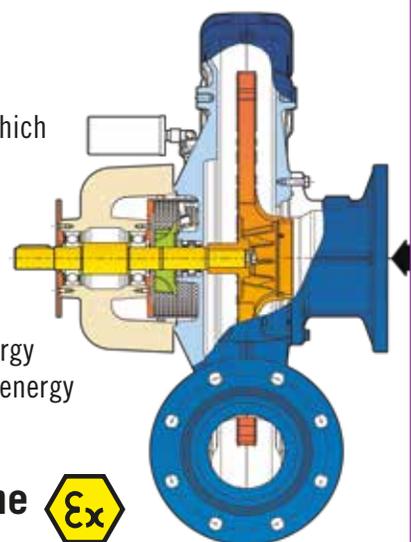


Operating principle

The MAPRO® centrifugal fans, MCF Series, are made of:

- an intake duct conveying the aspirated gas to the impeller inlet, which is coaxial to the shaft;
- a closed impeller with axial flow inlet and radial flow exit;
- a toroidal discharge volute with tangential exit.

While the impeller is rotating, the vanes give a centrifugal thrust to the aspirated gas which is forced outwards into the toroidal discharge volute. The volute collects the gas delivering it to a tangential nosepiece. The compression occurs through the increment of kinetic energy given to the gas by the vanes of the impeller and the subsequent conversion of the kinetic energy into static pressure in the discharge volute.



Generalities and construction features in conformity with the 2014/34/EU Directive (ATEX)



The MAPRO® centrifugal fans, MCF Series, to be used for extraction or compression of combustible gases, such as biological or natural gas, have been designed in order to fall within the Equipment-Group II as defined by the 2014/34/EU Directive, Category 2 both for the surrounding area conditions and for the internals of the machine.

Their main construction features are the following:

- aluminium casted casing, impeller made of spark proof aluminium alloy with caulked vanes, bearings housing made in cast iron and with aluminium casted caps, shaft in carbon steel;
- casing impregnated with Loctite;
- casing halves sealed;
- shaft sealing by a pair of special double-lip seals whose lubrication is provided by an automatic lubricator.

The centrifugal fans are generally coupled to the electric motor via belt drive and the safety drive guard is made of spark-free material.

We can also offer machines coupled to the electric motor via flexible shaft coupling and centrifugal fans manufactured in the so-called "CLOSE COUPLED" version (MCF...CC type) - i.e. a flange mounted electric motor is bolted to the fan casing and the impeller, which is dynamically balanced, is fitted directly onto the motor shaft extension.

If the area surrounding the equipment is classified as Zone 1, the electric motors are flameproof, type of protection "d", with specific marking Ex II 2 G, additional marking Ex-d IIB T3.

If the area surrounding the equipment is classified as Zone 2, where, for the Group II, Category 3 equipments are accepted, the machine could be equipped with the type of protection "n" non-sparking motor, with specific marking Ex II 3 G, additional marking Ex-nA II T3.

The centrifugal fans to be used on plants outside Europe, can be supplied, upon request, with ATEX motors dual labelled with IECEx Certification Conformity Mark.



For particular duties and/or in function of the gas composition, fans with special construction features could be proposed; for example with the aluminium casted parts treated with anodic oxidation and the blades of the impeller in stainless steel; and it is also possible to fit the pair of double-lip seals on the shaft so that they are suitable for a barrier fluid in between.



Advantages

The rotating parts are not in contact with the casing during rotation.

There is therefore no friction during operation and thus no internal lubrication is necessary.

The gas moving through the machine remains uncontaminated and completely oil-free.

The other main advantages of using the MAPRO® MCF centrifugal fans are:

- easy installation;
- low noise level;
- no vibration;
- pulsation free gas flow and no surge;
- minimal maintenance.



The most common fields of application

The most common fields of application for MAPRO® centrifugal fans, MCF Series, are:

- extraction of biogas from gasometer, natural gas from pipeline or gasometer, and burner or gas engine feeding;
- tank or plant gas recovery to feed torch or burner;
- biogas transfer from the production plant to remote satellite CHP units.

The typical "flow rate - pressure" curve, rather flat at fixed rpm, and the absence of surging when decreasing the gas flow, make the MAPRO® centrifugal fans the ideal machines for all the applications in which the gas flow rate could vary, even considerably.

In fact, as the "flow rate - pressure" curve is quite flat on a large range of duty, the fan can immediately and safely react to the flow variations by moving its operating point along the curve itself.

Accessories

A complete range of accessories is available, including the following:

- gas-tight filters;
- stainless steel flanged flexible connection bellows;
- non return valves;
- pressure gauges and thermometers;
- explosion-proof pressure switches and temperature switches;
- intrinsically-safe pressure and temperature transducers;
- manual and automatic cut-off valves;
- acoustic enclosures.

MAPRO® Sales Department, in synergy with the Engineering Department, could design and quote, according to customer requirements, the machines complete with the accessories that better meet the specific needs and peculiarities of the plant.



MCF for biogas - Range of duty

The range of duty shown in the diagrams on the next page refers to a biogas with specific weight 0.071 lb/ft³ at 29.92 inHg (abs) and 32°F.

The suction pressure is assumed at 29.92 inHg (abs) and the inlet temperature at 95°F.

The performance curves “flow rate - outlet pressure”, shown in the range of duty, are given, for informational purposes only, at fixed rpm.

On the performance curves at the lowest and the highest speed of rotation are shown, by way of information, some values of motor power and machine noise level.

The motor powers shown on the curves at 2950 rpm are intended for centrifugal fans in the so-called “CLOSE COUPLED” version (MCF...CC type); those shown on the curves at the highest rpm are intended for fans coupled to the electric motors via belt drives.

The noise level is intended as sound pressure level (SPL), measured in free field, in accordance with the Standard EN ISO 2151.

For the part in violet of the “range of duty” centrifugal fans manufactured in the so-called “CLOSE COUPLED” version (MCF...CC type) and equipped with electric motors intended for control via frequency inverter could be supplied.

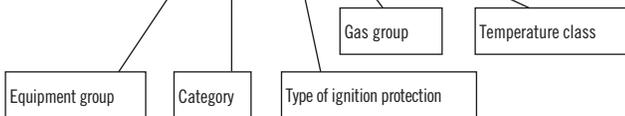


The ATEX marking of the MAPRO® centrifugal fans, MCF Series, for biogas or natural gas

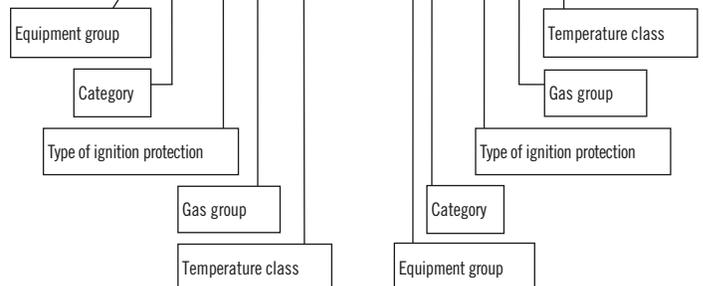


Identification number of the MAPRO Technical File communicated to the Notified Body ICIM (0425)

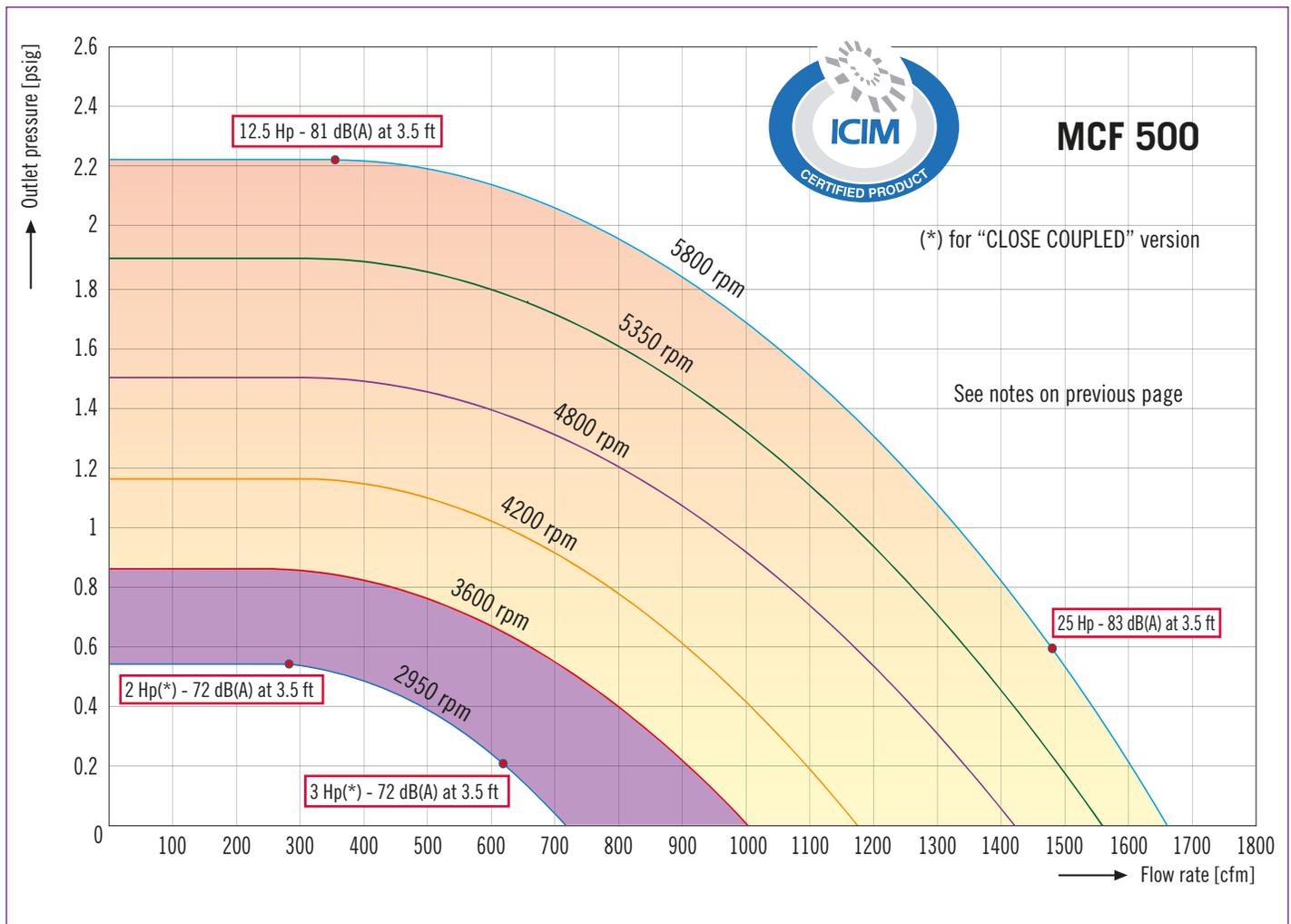
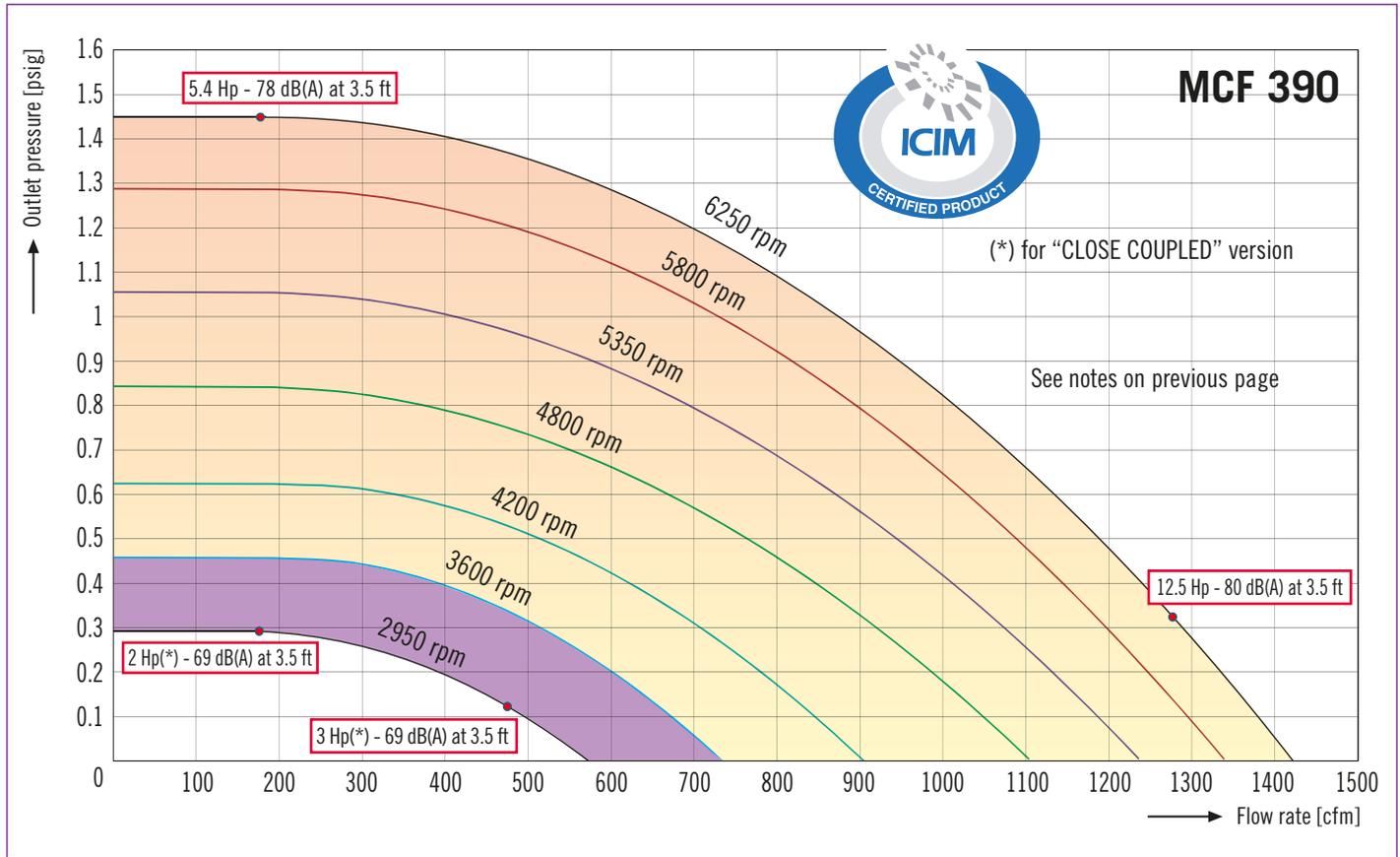
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VENTILATORE CENTRIFUGO - CENTRIFUGAL FAN			
Tipo Type	MCF XXX G	Anno Year	YYYY
Matricola Serial number	NNNNN	Fascicolo tecnico Technical file	94/9-MCF
I12G c I1BT3			



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VENTILATORE CENTRIFUGO - CENTRIFUGAL FAN			
Tipo Type	MCF XXX G	Anno Year	YYYY
Matricola Serial number	NNNNN	Fascicolo tecnico Technical file	94/9-MCF
I12G c I1BT3		I13G c I1BT3	
interno ventilatore - fan inside		zona circostante - surrounding area	

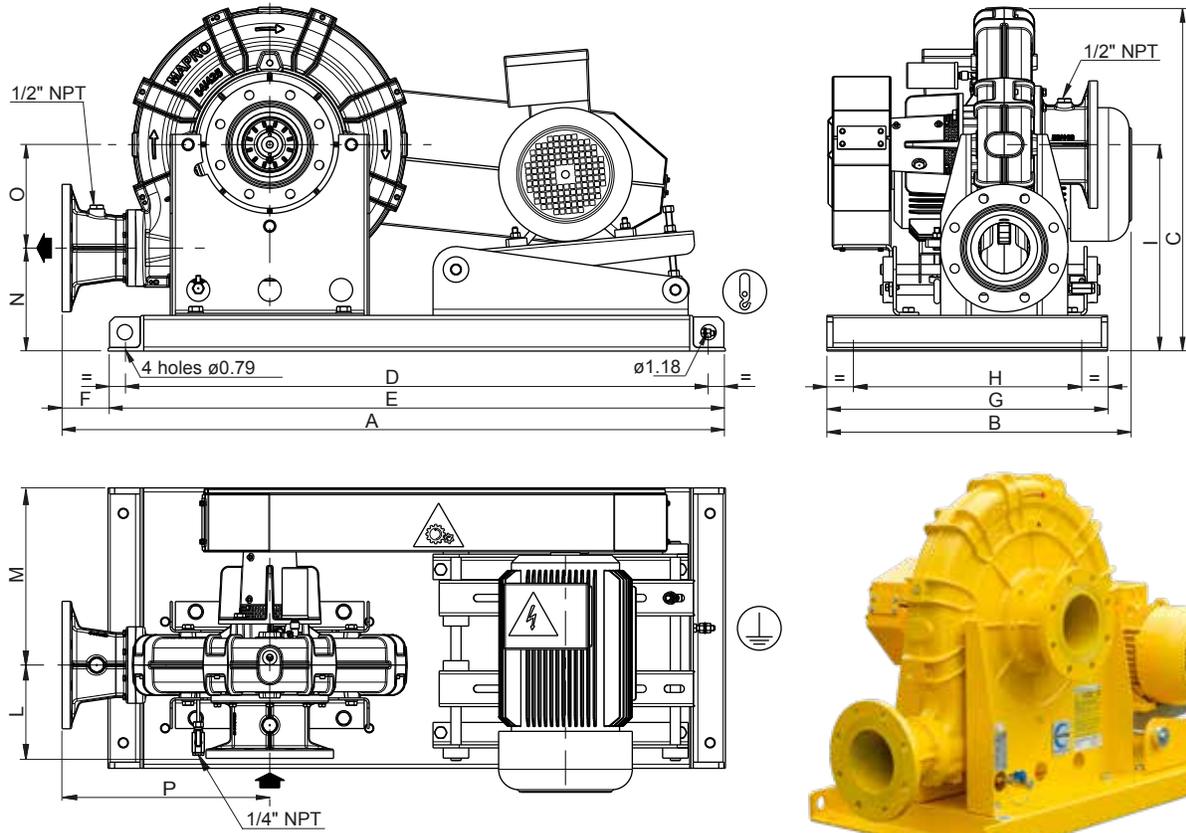


MCF for biogas - Range of duty



Dimensions

Belt drive version



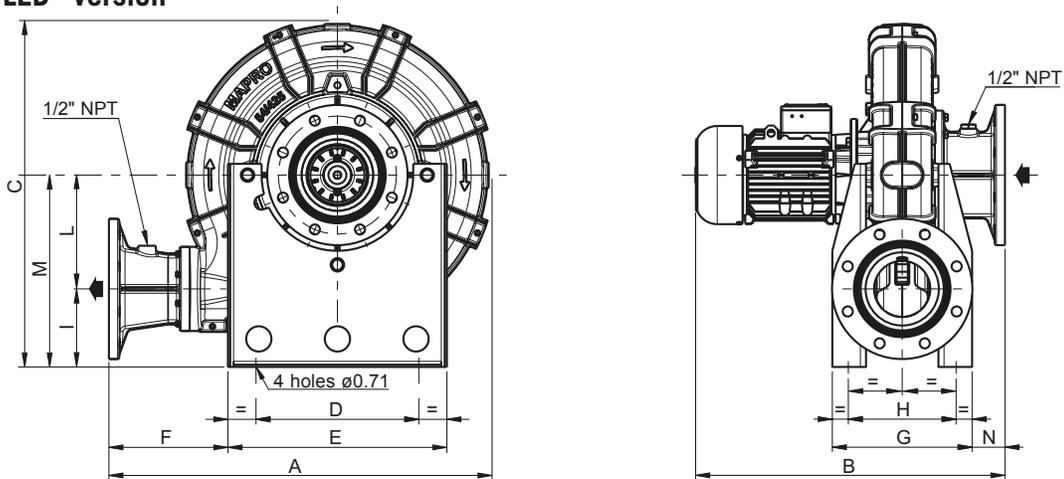
Inlet and outlet connections: 5" flanges match 150# ANSI

Fan Type	A	B (*)	C	D	E	F	G	H	I	L	M	N	O	P	Weight [lb] (*)
MCF 390	51.2	23.6	26.6	45.3	47.6	3.54	21.65	17.7	15.94	7.2	13.7	7.95	7.99	16.02	452
MCF 500	53.54	26.6	31.1	45.3	47.6	5.9	21.65	17.7	18.11	7.2	14.45	7.95	10.16	18.19	584

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in] (*) Dimension B and weight with the largest Ex II 2G motor power

"CLOSE COUPLED" version



Inlet and outlet connections: 5" flanges match 150# ANSI

Fan Type	A	B (*)	C	D	E	F	G	H	I	L	M	N	Weight [lb] (*)
MCF 390 CC	27.05	23.6	24.2	11.4	15.35	8.35	9.8	8.23	5.2	8	13.2	2.32	141
MCF 500 CC	31.38	24.5	28.3	15.75	19.7	8.35	11.4	8.23	5.2	10.16	15.35	1.54	181

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in] (*) Dimension B and weight with Ex II 2G 3 Hp motor



Operating principle

One stage of a MAPRO® multistage centrifugal blower is generally made of:

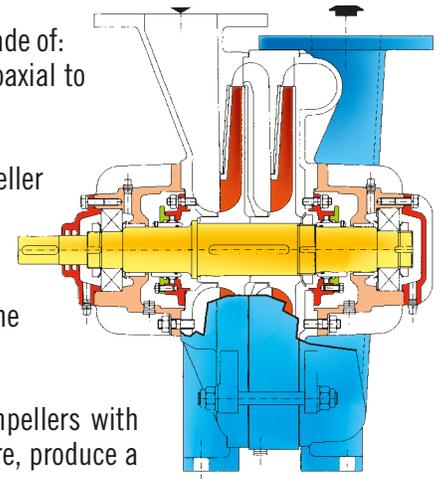
- an intake duct conveying the gas to the impeller inlet, which is coaxial to the shaft;
- a closed impeller with axial flow inlet and radial flow exit;
- a radial diffuser, whose aim is to convert kinetic energy into static pressure at the impeller exit, and a discharge volute.

Actually a centrifugal blower is always used in the multistage configuration.

The gas is sucked into the first stage through an inlet volute, every next single stage is linked to the former one through a return channel, and a discharge volute collects the gas from the exit of the last stage delivering it to the outlet pipe.

The impellers are built with radial exit blades or backward facing blades.

The radial blades allow the achievement of a higher compression ratio, whilst the impellers with backward facing blades, at fixed speed of rotation and for the same differential pressure, produce a characteristic curve with a much wider stable range.



Generalities and construction features in conformity with the 2014/34/EU Directive (ATEX)



The MAPRO® multistage centrifugal blowers, CM Series, to be used for extraction or compression of combustible gases, such as biological or natural gas, have been designed in order to fall within the Equipment-Group II as defined by the 2014/34/EU Directive, Category 2 both for the surrounding area conditions and for the internals of the machines.

Their main construction features are the following:

- heads, intermediate sections, bearing housings and caps made of cast iron; shaft in carbon steel; impellers made completely of spark proof aluminium alloy;
- heads and intermediate sections sealed;
- shaft sealing by special double-lip seals which do not require lubrication.

The blowers are always coupled to the electric motor via belt drives and the safety drive guards are made of spark-free material.

The combination of different impeller types, the possibility to match several stages in series, and the wide speed of rotation range allow to cover, with only one machine frame, a very large range of duty.

Electric motors are flameproof, type of protection “d”, with specific marking Ex II 2 G, additional marking Ex-d IIB T3.

If the area surrounding the equipment is classified as Zone 2, where, for the Group II, Category 3 equipments are accepted, the driving electric motors could be non-sparking, type of protection “n”, with specific marking Ex II 3 G, additional marking Ex-nA II T3.

IECEx Certification for electric motors

MAPRO® multistage centrifugal blowers to be used on plants outside Europe, can be supplied, upon request, with ATEX motors dual labelled with IECEx Certification Conformity Mark.



Advantages

The main advantages of using MAPRO® multistage centrifugal blowers are:

- easy installation;
- low noise level;
- no vibration;
- pulsation-free gas flow;
- no gas contamination;
- minimal maintenance.

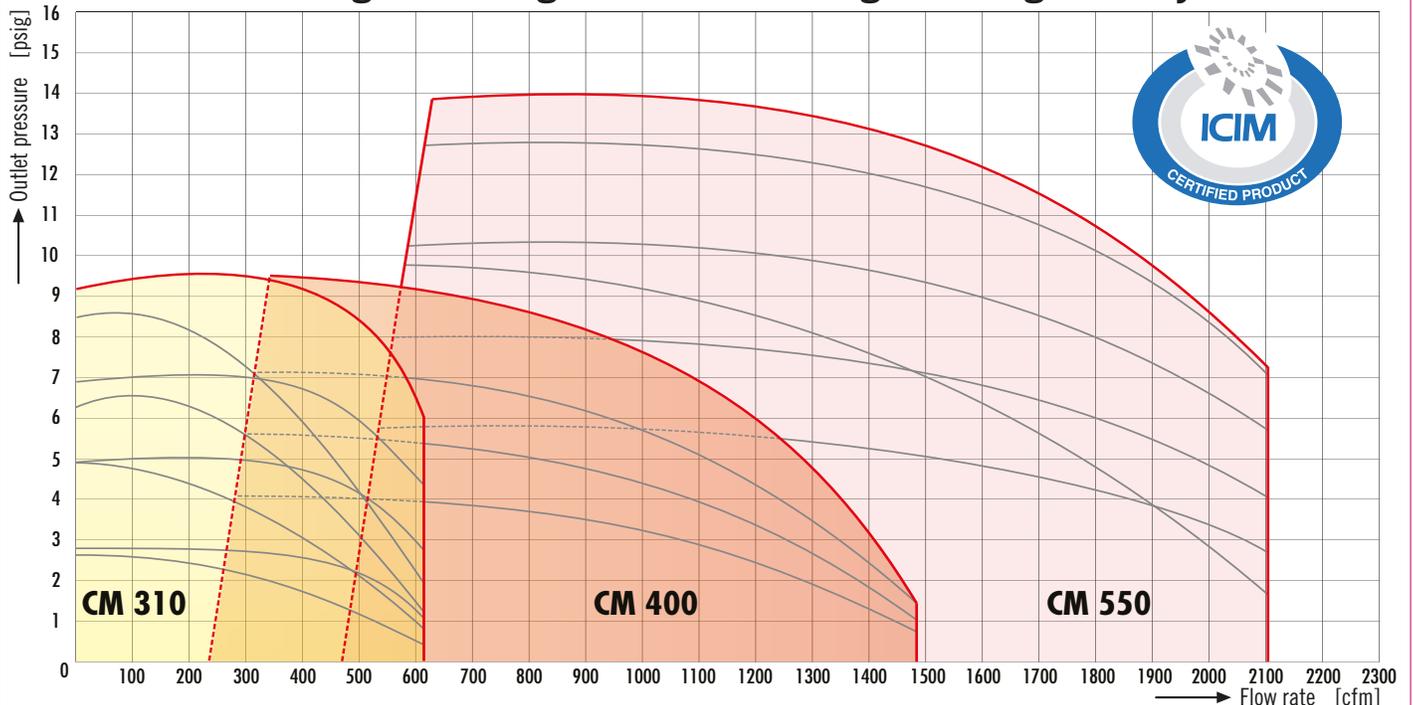


The most common fields of application

• Landfill biogas recovery to feed torch or burner; • tank, plant or contaminated soil gas recovery to feed torch or burner. The typical “flow rate – pressure” curve is much more flat than the performance curve of a regenerative blower and this peculiarity makes the MAPRO® multistage centrifugal blowers the ideal machines for the applications where the gas flow rate to be extracted could vary, even considerably, in time. In short, the operating point moves by simply following the internal characteristic curve of the blower.



Multistage centrifugal blowers for biogas - Range of duty



The performance curves “flow rate - outlet pressure” shown in the literature are given, for informational purposes only, for centrifugal blowers at fixed rpm, with different impeller types and different number of stages.

The range of duty refers to a biogas with specific weight 0.071 lb/ft³ at 29.92 inHg (abs) and 32°F.

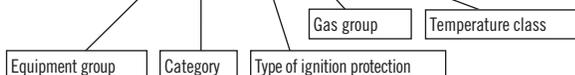
The suction pressure is assumed at 29.92 inHg (abs) and the inlet temperature at 95°F.

The ATEX marking of the multistage centrifugal blowers for biogas or natural gas

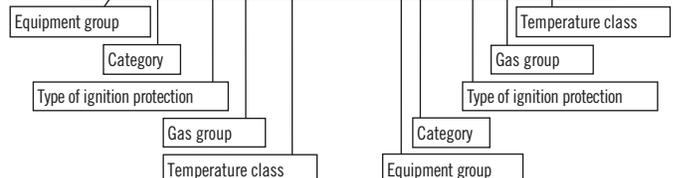


Identification number of the MAPRO Technical File communicated to the Notified Body CESI (0722)

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SOFFIANTE CENTRIFUGA - CENTRIFUGAL BLOWER		
Tipo Type	CM XXX.ZZZ G	Anno Year
		YYYY
Matricola Serial number	NNNNN	Fascicolo tecnico Technical file
		94/9-CM
I12G c I1BT3		



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SOFFIANTE CENTRIFUGA - CENTRIFUGAL BLOWER		
Tipo Type	CM XXX.ZZZ G	Anno Year
		YYYY
Matricola Serial number	NNNNN	Fascicolo tecnico Technical file
		94/9-CM
I12G c I1BT3		I13G c I1BT3
interno soffiante - blower inside		zona circostante - surrounding area



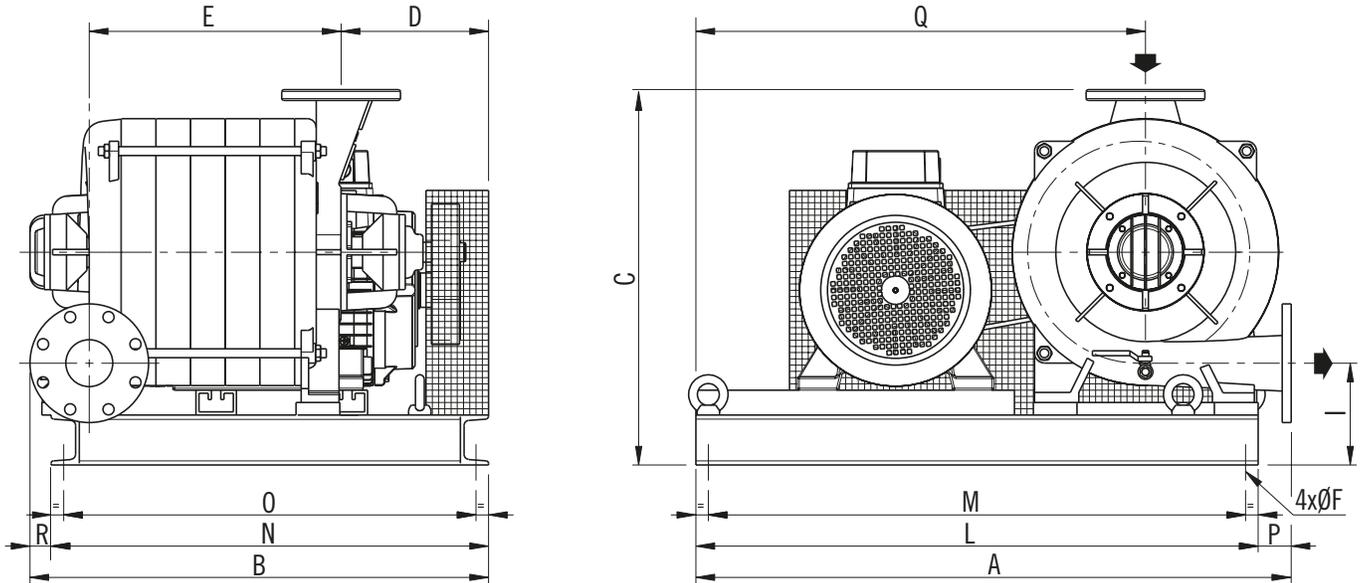
Dimensions

Below and on the next two pages you can find, for informational purposes only, the dimensions of the CM 310, CM 400 and CM 550 multistage centrifugal blowers for biogas or natural gas.

The blowers are always equipped with two pole motors.

The weights are given for blowers equipped with the type of protection “d” flameproof electric motor, with specific marking Ex II 2 G, additional marking Ex-d IIB T3, and they include the weight of the motor of highest power rating amongst those provided for the specific blower.

CM 310



Machine type	Motor powers [Hp]	A	B	C	D	E	ØF	I	L	M	N	O	P	Q	R	INLET CONNECTION	OUTLET CONNECTION	Weight [lb]
CM 310.2	4 ÷ 7.5	37.5	23.6	23.6	9.2	7.13	0.47	6.5	35.4	33.9	23.6	26	2.1	28.35	-	3" flange matches 150# ANSI	3" flange matches 150# ANSI	518
CM 310.3	5 ÷ 10	37.5	27.6	23.6	9.2	9.33	0.47	6.5	35.4	33.9	27.6	26	2.1	28.35	-			595
CM 310.4	7.5 ÷ 20	37.5	27.6	23.6	9.2	11.5	0.47	6.5	35.4	33.9	27.6	26	2.1	28.35	-			750
CM 310.5	10 ÷ 25	37.5	27.6	23.6	9.2	13.7	0.47	6.5	35.4	33.9	27.6	26	2.1	28.35	-			827
CM 310.6	10 ÷ 20	37.5	28.9	23.6	9.2	15.87	0.47	6.5	35.4	33.9	27.6	26	2.1	28.35	1.4			838
	25 ÷ 30	45.4	35.4	25.2	9.2	15.87	0.47	8.1	43.3	41.3	35.4	33.5	2.1	36.2	-			992
CM 310.7	15 ÷ 40	45.4	35.4	25.2	9.2	18.07	0.47	8.1	43.3	41.3	35.4	33.5	2.1	36.2	-			1113
CM 310.8	15 ÷ 50	45.4	35.4	25.2	9.2	20.24	0.47	8.1	43.3	41.3	35.4	33.5	2.1	36.2	-			1213
CM 310.9	15 ÷ 50	45.4	35.4	25.2	9.2	22.4	0.47	8.1	43.3	41.3	35.4	33.5	2.1	36.2	-			1257

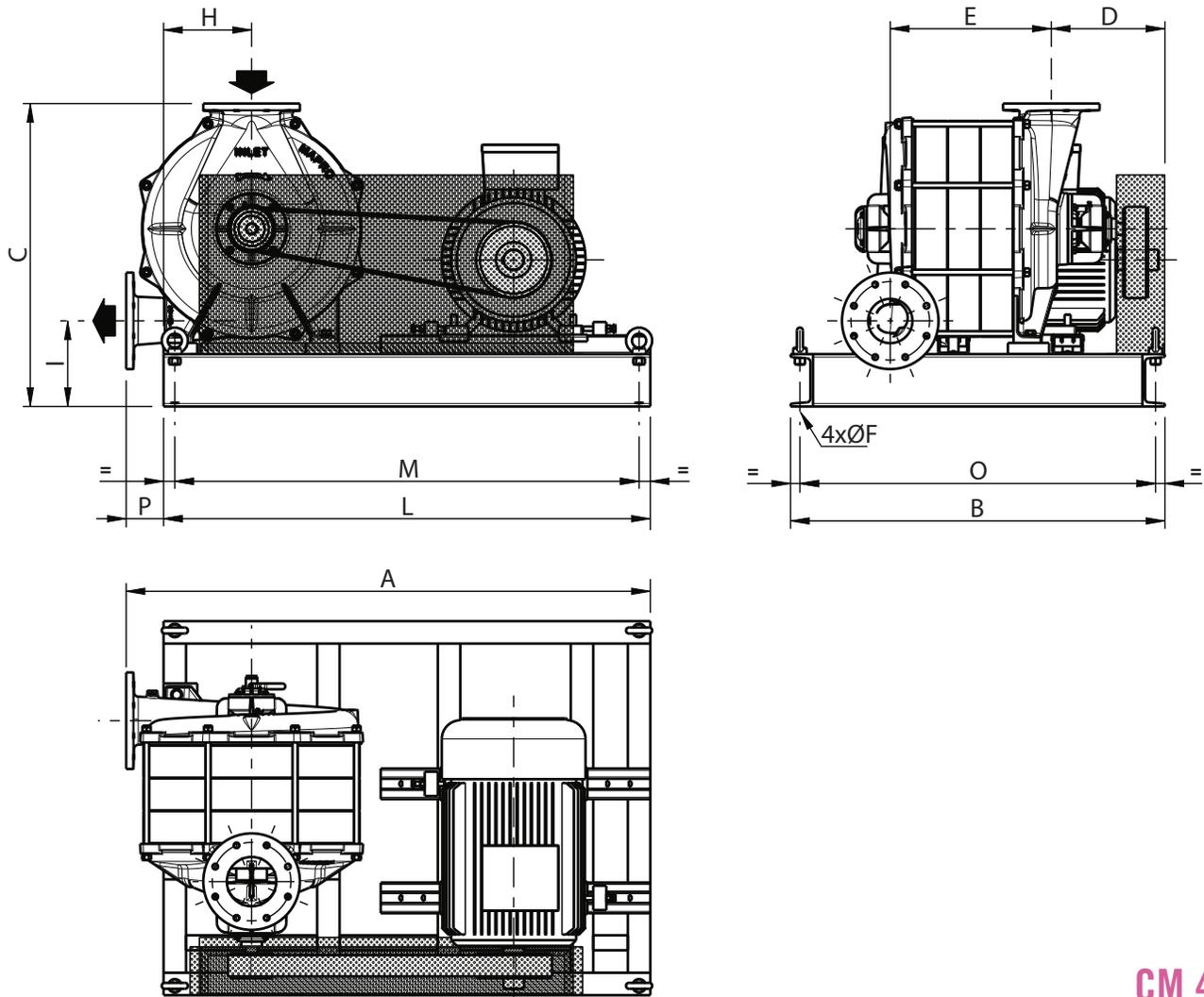
Dimensions and Weights not binding and given for informational purposes only

Dimensions [in]

The number following “CM 310.” in the “Machine type” column, represents the number of stages the centrifugal blower consists of. For instance, CM 310.5 specifies that the blower consists of 5 stages in series.

The blowers could also be supplied with the discharge volute turned through 90°, so that the outlet flange is facing upwards as the inlet flange (see picture of a CM 400 on the next page).





CM 400

Machine type	Motor powers [Hp]	A	B	C	D	E	ØF	H	I	L	M	O	P	INLET CONNECTION	OUTLET CONNECTION	Weight [lb]
CM 400.2	20 ÷ 30	55.1	33.5	31.9	12	10.04	0.8	9.25	9	51.2	48.8	31.5	3.94	5" flange matches 150# ANSI	5" flange matches 150# ANSI	1080
CM 400.3	20 ÷ 30	55.1	33.5	31.9	12	13.5	0.8	9.25	9	51.2	48.8	31.5	3.94			1190
CM 400.4	30 ÷ 50	55.1	39.4	31.9	12	16.93	0.8	9.25	9	51.2	48.8	37.4	3.94			1422
CM 400.5	30 ÷ 50	55.1	39.4	31.9	12	20.39	0.8	9.25	9	51.2	48.8	37.4	3.94			1532
CM 400.6	50 ÷ 60	55.1	47.2	31.9	12	23.82	0.8	9.25	9	51.2	48.8	45.3	3.94			1885
CM 400.7	50 ÷ 60	55.1	47.2	31.9	12	27.28	0.8	9.25	9	51.2	48.8	45.3	3.94			1995
CM 400.8	50 ÷ 75	55.1	53.1	31.9	12	30.71	0.8	9.25	9	51.2	48.8	51.2	3.94			2293
CM 400.9	50 ÷ 75	55.1	53.1	31.9	12	34.17	0.8	9.25	9	51.2	48.8	51.2	3.94			2403

Dimensions and Weights not binding and given for informational purposes only

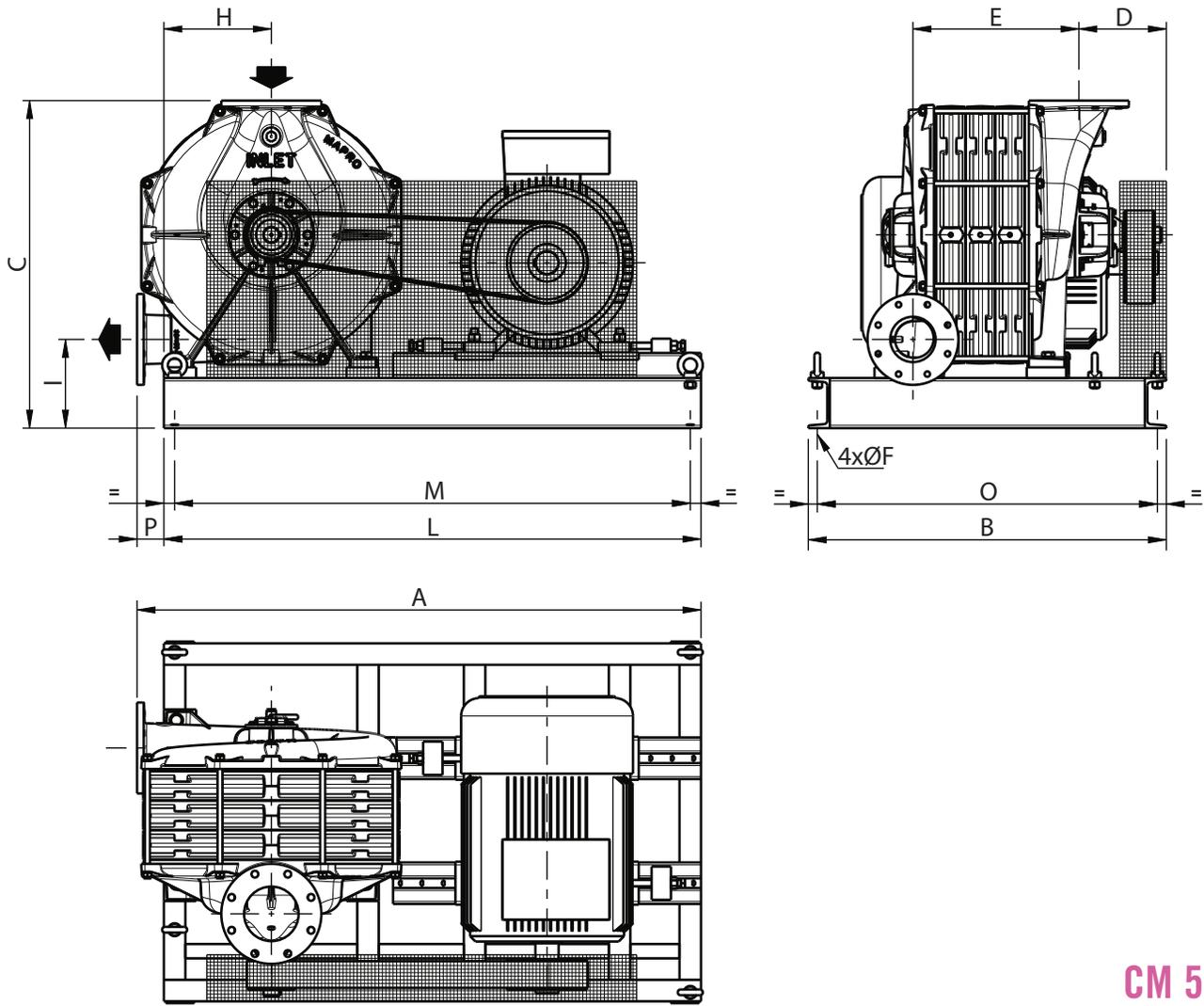
Dimensions [in]

The number following "CM 400." in the "Machine type" column, represents the number of stages the centrifugal blower consists of.

For instance, CM 400.6 specifies that the blower consists of 6 stages in series.

The blowers could be supplied with the discharge volute as shown in the drawing or turned through 90° so that the outlet flange is facing upwards as the inlet flange (see picture aside).





CM 550

Machine type	Motor powers [Hp]	A	B	C	D	E	ØF	H	I	L	M	O	P	INLET CONNECTION	OUTLET CONNECTION	Weight [lb]
CM 550.2	30 ÷ 60	62	33.5	36	9.65	11.73	0.79	11.8	9.76	59.1	56.7	31.5	2.95	6" flange matches 150# ANSI	5" flange matches 150# ANSI	1609
CM 550.3	30 ÷ 75	62	33.5	36	9.65	15	0.79	11.8	9.76	59.1	56.7	31.5	2.95			1830
CM 550.4	30 ÷ 75	62	39.4	36	9.65	18.23	0.79	11.8	9.76	59.1	56.7	37.4	2.95			1984
CM 550.5	30 ÷ 75	62	39.4	36	9.65	21.5	0.79	11.8	9.76	59.1	56.7	37.4	2.95			2138
CM 550.6	50 ÷ 100	62	45.3	36	9.65	24.72	0.79	11.8	9.76	59.1	56.7	43.3	2.95			2657
CM 550.7	50 ÷ 100	62	45.3	36	9.65	27.99	0.79	11.8	9.76	59.1	56.7	43.3	2.95			2811
CM 550.8	50 ÷ 125	62	51.2	36	9.65	31.22	0.79	11.8	9.76	59.1	56.7	49.2	2.95			3097
CM 550.9	50 ÷ 125	62	51.2	36	9.65	34.49	0.79	11.8	9.76	59.1	56.7	49.2	2.95			3252

Dimensions and Weights not binding and given for informational purposes only

Dimensions [in]

The number following "CM 550." in the "Machine type" column, represents the number of stages the centrifugal blower consists of.

For instance, CM 550.4 specifies that the blower consists of 4 stages in series.

The blowers could also be supplied with the discharge volute turned through 90° so that the outlet flange is facing upwards as the inlet flange (see picture of a CM 400 on the previous page).





Operating principle

A cylindrical rotor turns eccentrically in a cylindrical stator of a larger diameter: the free space left between stator and rotor is half-moon shaped.

Some slots are milled in the rotor and stratified plastic blades slide freely into the slots. The blades, as the rotor turns, are forced out against the cylindrical wall of the stator by centrifugal force, so creating individual cells whose volume reduces from a maximum to a minimum during the rotation.

The suction takes place through ports in the stator in the area of increasing volumes; the discharge through ports in the area of decreasing volumes.



Generalities and construction features in conformity with the 2014/34/EU Directive (ATEX)



The MAPRO® sliding vane rotary compressors to be used for compression of combustible gases, such as biological or natural gas, have been designed in order to fall within the Equipment-Group II as defined by the 2014/34/EU Directive, Category 2 both for the surrounding area conditions and for the internals of the machines.

Their main construction features are the following:

- casing (stator and heads) in cast iron, rotor in carbon steel, blades in light stratified spark-free material;
- sealing between stator, heads and covers by gaskets and/or O-rings;
- simple or double mechanical seal, depending on the operating discharge pressure; for the double mechanical seal, the compressor-own oil lubricating system is used as a barrier fluid;
- coupling to the electric motor via belt drive or via flexible coupling, with no metal-to-metal contact between driving and driven parts in case of failure of the coupling pins; safety drive guard made of spark-proof metal;
- type of protection “d” flameproof electric motors, with specific marking Ex II 2 G, additional marking Ex-d IIB T3. If the area surrounding the equipment is classified as Zone 2, where, for the Group II, Category 3 equipments are accepted, the machine could be equipped with the type of protection “n” non-sparking motor, with specific marking Ex II 3 G, additional marking Ex-nA II T3.

The compressors to be used on plants outside Europe, can be supplied, upon request, with ATEX electric motors dual labelled with IECEx Certification Conformity Mark.



The compressor body in itself could be air-cooled or water-cooled. In the air-cooled compressors, ambient air is blown by an axial fan, fitted on compressor shaft, around the finned cylinder and heads to provide cooling. The air is forced between the outer finned surface of the stator and an air conveying guard surrounding the compressor itself.

In water-cooled compressors, an integral water jacket surrounds the cylinder and heads. Heat transfers through the metal to the water more effectively than through metal to air. Thus, water-cooled compressors reduce the internal temperature of the compressed gas more efficiently than air-cooled units. They can therefore compress the gas to a higher pressure than air-cooled units. Moreover the water-cooled compressors are capable of handling flow rates that cover a well larger range than the air-cooled compressors.



Advantages

The main advantages of using MAPRO® sliding vane rotary compressors for compressing biogas or natural gas are:

- **Unchangeable and high efficiency**

The adiabatic compression efficiency is always high, and, in general, between the 70% and the 80% if referred to the compressor displacement. The tight internal clearances allow, as well, a high volumetric efficiency, basically unchangeable as blades wear is self-compensating in time. The power needed for the compression is therefore, in general, lower than that required from other types of compressors, with consequent lower operating costs.

- **Simple and economic maintenance**

The small number of parts in motion simplifies the compressor disassembly and reassembly, so making these operations well less expensive than compared to other types of positive displacement machines.

A specially provided control rod allows a quick evaluation, at fixed time intervals, of the blades wear, without disassembling, even partially, the machine body. It is therefore possible to plan the blades replacement largely in advance, according to the working planning of the plant or to the maintenance needs of other equipments, so simplifying the plant operation and improving its efficiency and economy.

- **Gas flow without pulsations**

The gas flow is continuous (no pulsation) both at the suction and at the discharge, and so there is no need to install storage tanks or gas dampers.

MAPRO® rotary vane compressors are compact machines on which the light unbalance, due to the different radial position of the blades with respect to the axis of rotation, does not cause any significant vibration throughout the running operation. Therefore no special foundations are required.

The rotary vane compressors are, in principle, less noisy than other types of compressors.

Anyway, when required, they can be supplied complete with acoustic enclosures.

- **Internal protection during compression of biogas**

The oil used for purely mechanical purposes, that is for the lubrication of bearings, blades, segments, mechanical seals, plays also two important roles in the biogas rotary vane compressors. The thin film of lubricating oil, constantly renewed, first protects the compressor's internal surfaces from attack of the acids in the biogas; and also tends to incorporate the impurities which are contained in the biogas in form of solid or liquid particles, with an effect of internal cleaning of the compression chamber.

Therefore, the "oil renewed" lubrication makes MAPRO® rotary vane compressor, even if made of ordinary materials such as cast iron and carbon steel, particularly suitable for handling potentially corrosive gases which contain also impurities and moisture saturated. And these are, in general, the biogas peculiarities.



The most common fields of application

- Biogas recirculation into anaerobic digesters for sludge mixing;
- extraction of biogas from gasometer or landfill and delivery to storage systems or gas engine supply;
- extraction of natural gas from pipeline or gasometer, and delivery to storage systems or gas engine supply.

Typical supply components

MAPRO® compressors for biogas or natural gas are normally equipped according to the use they are designed for.

The typical components for the most common applications, namely for the compressors designed for biogas recirculation into anaerobic digesters for sludge mixing and for the supply to gas engines, are listed on the schematic Piping and Instrumentation Diagrams (P&ID) on page 34.

In particular, as regards the supply to gas engines, a gas flow variable in time is required. The rotary vane compressor is a positive-displacement machine and therefore its flow rate, at fixed speed of rotation, is nearly constant.

The most effective and economical solution to meet the variable gas demand is to fit a suitable overpressure relief valve on a “by-pass” connecting the discharge pipe back to the suction. When the flow rate required by the gas engine decreases, the compressor discharge pressure increases, and when the set pressure is reached, the overpressure relief valve starts to open and by-passes the excess gas back to the compressor suction.

The gas discharged by the compressor has to be, usually, cooled, both for the needs of the engine and to avoid overheating when it is “re-circulated” through the overpressure relief valve.

For this purpose, a gas cooler, generally type stationary tube-sheet, is installed directly at the compressor outlet.

The gas cooler, the overpressure relief valve and the “by-pass” pipe are usually designed for the full capacity of the machine and thus the compressor can continue to run even if the downstream gas demand is reduced to zero.

Downstream the gas cooler, and before the offtake of the “by-pass” pipe, a cyclonic separator and a final oil separator are normally installed.

The cyclonic separator is designed to separate and collect the condensates.

The final oil separator consists of one or more stages of high efficiency coalescing candles which reduce the oil residues in the gas to a few ppm.

To reduce the compressors absorbed power when the gas engine demand is reduced, compressors equipped with motors intended for control via frequency inverter can be supplied. In general, the compressor admissible variation in the speed of rotation (and therefore in capacity) is between 100% and 65% of the rated speed.

If the gas engine demand decreases even more, the compressor shall be kept running at the minimum allowed speed of rotation and the excess flow rate shall be piped back to compressor inlet through the overpressure relief valve.

All compressors, equipped as shown on the schematic P&ID on page 34, can be supplied complete with acoustic enclosure.

For the dimensions of the compressor package of any specific request, please ask MAPRO® Sales Department.



Complete Packages

Custom-made increasingly elaborated Packages can be supplied.

They could include, for example, in addition to components listed on schematic P&ID on next page:

- automatic condensate drain systems;
- pneumatically operated or motorized valves for the unloaded compressor starting;
- closed circuit cooling systems for the cooling water, complete with water pump, surge tank, air-water heat exchanger and all related control and safety devices;
- local control panels.

Moreover, all necessary remote power and control cubicle switchboards, including relevant PLC, may be supplied. MAPRO® Sales Department, in synergy with the Engineering Department, could design and quote, according to customer requirements, the “Complete Package” that better meets the specific needs and peculiarities of the plant.



The ATEX marking of MAPRO® sliding vane rotary compressors for biogas or natural gas



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COMPRESSORE ROTATIVO - ROTARY VANE COMPRESSOR			
Tipo <i>Type</i>	RXXX G	Anno <i>Year</i>	YYYY
Matricola <i>Serial number</i>	NNNNN	Fascicolo tecnico <i>Technical file</i>	94/9-R
IIG c IIBT3			

Identification number of the MAPRO Technical File communicated to the Notified Body CESI (0722)

Equipment group

Category

Type of ignition protection

Gas group

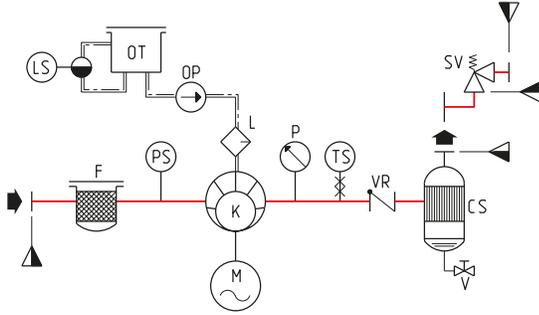
Temperature class

N.B.: The nameplate shown in the figure does not reproduce the one fitted on the compressors.

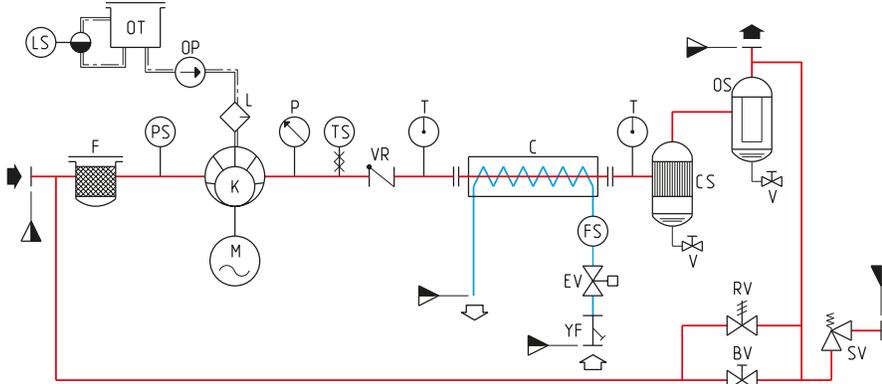
Typical biogas compressor P&ID's

Air cooled compressors

Compressors for sludge mixing into anaerobic digesters



Compressors for gas engine feeding



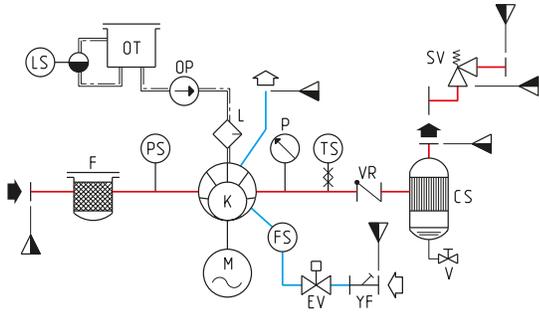
- BV = Butterfly valve
- C = Cooler
- CS = Cyclonic separator
- EV = Solenoid valve
- F = Filter
- FS = Water flow switch
- K = Compressor
- L = Sight-feed lubricators
- LS = Oil level switch
- M = Electric motor
- OP = Oil pump
- OS = Oil separator
- OT = Oil tank
- P = Pressure gauge
- PS = Pressure switch
- RV = Pressure relief valve
- SV = Safety valve
- T = Thermometer
- TS = Temperature switch
- V = Drain ball valve
- VR = Non return valve
- YF = Y type strainer

- Biogas
- Water
- Oil

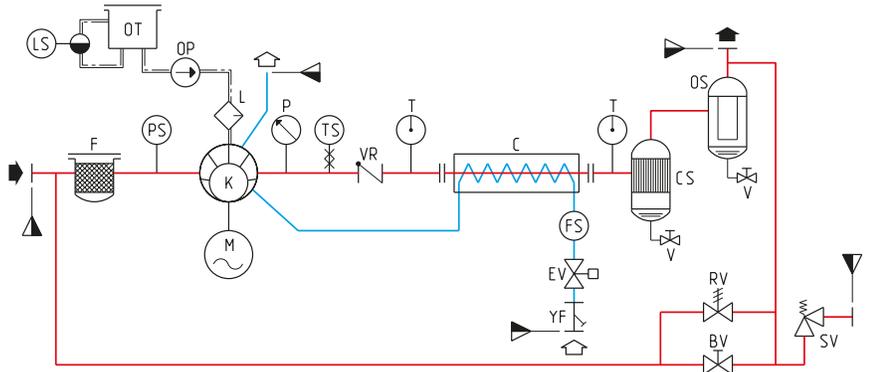
MAPRO Limit of supply
Customer

Water cooled compressors

Compressors for sludge mixing into anaerobic digesters



Compressors for gas engine feeding



- BV = Butterfly valve
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- VR = Non return valve
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- Biogas
- Water
- Oil

MAPRO Limit of supply
Customer

Air cooled single stage rotary compressors for biogas / Performance

Outlet pressure [psig]		7.5		15		17.5		20		22.5		25		30		32.5		35		37.5	
Flow rate		cfm		cfm		cfm		cfm		cfm		cfm		cfm		cfm		cfm		cfm	
Absorbed power			BHp																		
rpm	Compressor type																				
1450	RF 4 G	19.4	1.8	17.7	2.2	17.2	2.3	16.6	2.4	16.1	2.6	15.5	2.7	14.3	3	13.3	3.2	12.3	3.5		
	RF 6 G	31.1	2.6	28.7	3.4	27.9	3.6	27.1	3.9	26.2	4.1	25.4	4.3	23.5	4.8	22.3	5	21.1	5.3		
	RF 9 G	48.8	3.3	45.7	4.5	44.7	4.8	43.7	5.1	42.7	5.5	41.6	5.8	39.6	6.3	38.6	6.6	37.5	6.9		
	RF 12 G	61	4.2	58	5.7	57	6.2	56	6.6	55	7	54	7.3	52	8.1	50.5	8.5	49	8.8		
	RFL 15 G	73	5.4	69.1	7.1	67.8	7.5	66.5	8	65.2	8.5	63.9	8.9	61.3	9.8	60	10.3	58.5	10.8	57	11.3
	RFL 20 G	102	6.7	97	9.1	95.5	9.8	94	10.5	92.5	11.2	91	11.9	87	13.3	85	14	83.5	14.7	82	15.4
	RFL 25 G	128	7.8	122	11.2	120	12.1	118	13	116	14	114	14.9	110	16.7	108	17.7	105	18.6	102	19.5
	RFL 30 G	160	9.8	154	13.7	151	14.9	149	16	146	17.1	144	18.2	138	20.5	135	21.8	131	23.1	127	24.5
	RFL 40 G	226	14.1	214	19.6	210	21	206	22.4	202	23.7	197	25.1	188	27.9	184	29.3	179	30.7	174	32.1
	RFL 50 G	273	16.6	258	23.1	253	24.7	248	26.4	243	28	238	29.6	227	32.9	221	34.6	215	36.3	209	38
	RFL 60 G	323	19	307	26.5	301	28.8	295	30.9	289	32.9	283	35	271	39.2	265	41.3	259	43.4		
RFL 65 G	347	20.3	328	28.3	322	30.5	316	32.8	310	35.1	304	37.4	292	42	286	44.3	280	46.7			

Water cooled single stage rotary compressors for biogas / Performance

Outlet pressure [psig]		15		20		25		30		32.5		35		37.5		40		42.5		45	
Flow rate		cfm		cfm		cfm		cfm		cfm		cfm		cfm		cfm		cfm		cfm	
Absorbed power			BHp																		
rpm	Compressor type																				
1450	R 25 G	136	12	132	13.8	128	15.6	124	17.4	122	18.2	120	19.1	118	20	116	20.9	114	21.8	112	22.7
	R 30 G	170	14.6	165	17	158	19.6	153	21.6	150	22.7	148	23.7	145	24.7	143	25.7	140	26.7		
	R 40 G	217	19.4	211	22.1	205	24.8	199	27.3	196	28.4	193	29.6	190	30.8	187	31.9	184	33.1	181	34.3
	R 48 G	254	22	247	25.2	240	28.4	233	31.6	227	33.8	223	35.5	219	36.9	215	38.3	212	39.7	208	41.1
	R 52 G	286	24.2	279	28.5	271	32	263	35	260	36.8	256	38.4	252	40	248	41.6	244	43.2	240	44.8
	R 61 G	328	27.8	319	32	310	35.9	301	40.3	293	43	288	45	283	46.8	279	48.5	275	50.3	271	52
975	R 60 G	332	29.7	323	34.1	314	38	305	41.7	301	43.6	296	45.5	292	47.4	287	49.2	283	50.9	278	52.6
	R 70 G	383	33.4	373	38.3	362	42.7	344	48.8	339	51.4	334	53.8	329	56	324	58.2	319	60.4	314	62.6
	R 80 G	471	40.3	459	46.3	446	51.8	434	57.3	428	60	422	62.7	416	65.5	410	68	404	70.5	398	73
	R 100 G	544	45.7	530	52.6	516	59	491	67	484	71	477	74.5	470	78	464	81	457	84	450	87
	R 121 G	649	53	632	62	616	69.5	586	80	578	84	571	88	563	92	555	95	547	99	538	103
735	R 140 G	733	61	714	72	696	81	678	89	669	93	660	97	651	101	641	106	632	110	623	114
	R 160 G	810	67	790	78	770	88	749	97	739	102	729	106	719	111	709	116	699	120	688	125
	R 180 G	957	79	933	92	908	104	884	115	872	120	860	125	847	130	835	135	823	141	811	146
	R 190 G	1087	89	1059	104	1030	118	989	133	976	139	963	145	950	152	937	158	924	165	910	171
585	R 250 G	1321	108	1278	127	1240	144	1209	158	1194	165	1179	172	1164	179	1149	187	1133	194	1118	201
	R 300 G	1691	133	1640	159	1592	181	1552	199	1531	209	1511	218	1491	227	1471	236	1450	246	1430	255

Flow rates and absorbed power refer to biogas with specific weight 0.071 lb/ft³ at 29.92 inHg (abs) and 32°F.

The assumed suction conditions are 95°F and 0.3 psig.

Tolerance on the given values in accordance with the Standard ISO 1217:2009



"Vesuvio" factory

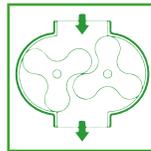


"Fermi" factory

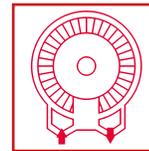


"Cinisello" factory

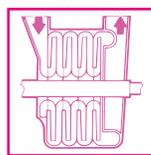
Other MAPRO® products



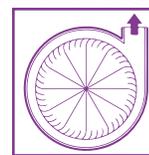
Positive displacement blowers and exhausters for air



Regenerative blowers and exhausters for air



Multistage centrifugal blowers and exhausters for air



Centrifugal fans for air



Sliding vane rotary compressors for air



Rotary vane vacuum pumps, oil recirculating type and oil free



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