

HEINZMANN®



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HEINZMANN®
Digital Electronic Speed Governors

Gas injection valves



MEGASOL 200 & 425

 <p>Warning</p>	<p>Read this entire manual and all other publications appertaining to the work to be performed before installing, operating or servicing your equipment.</p> <p>Practice all plant and safety instructions and precautions.</p>
 <p>Danger</p>	<p>Failure to follow instructions may result in personal injury and/or damage to property.</p> <p>HEINZMANN will refuse all liability for injury or damage which results from not following instructions</p>
 <p>Danger! High Voltage</p>  <p>Danger</p>	<p>Please note before commissioning the installation:</p> <p>Before starting to install any equipment, the installation must have been switched dead!</p> <p>Be sure to use cable shieldings and power supply connections meeting the requirements of the <i>European Directive concerning EMI</i>.</p> <p>Check the functionality of the existing protection and monitoring systems.</p>
 <p>Danger</p>	<p>To prevent damages to the equipment and personal injuries, it is imperative that the following monitoring and protection systems have been installed:</p> <p>Overspeed protection acting independently of the speed governor</p> <p>Overtemperature protection</p> <p>HEINZMANN will refuse all liability for damage which results from missing or insufficiently working overspeed protection</p> <p>Generator installation will in addition require:</p> <p>Overcurrent protection</p> <p>Protection against faulty synchronization due to excessive frequency, voltage or phase differences</p> <p>Reverse power protection</p>
	<p>Overspeeding can be caused by:</p> <p>Failure of the voltage supply</p> <p>Failure of the actuator, the control unit or of any accessory device</p> <p>Sluggish and blocking linkage</p>




 <p>Warning</p>	<p>Electronically controlled injection (MVC) will in addition require to observe the following:</p> <p>With Common Rail systems a separate mechanical flow limiter must be provided for each injector pipe.</p> <p>With Pump-Pipe-Nozzle (PPN) and Pump Nozzle (PNE) systems fuel release may be enabled only by the movement of control piston of the solenoid valve. This is to inhibit fuel from being delivered to the injection nozzle in case of seizure of the control piston.</p>
 <p>Warning</p>	<p>The examples, data and any other information in this manual are intended exclusively as instruction aids and should not be used in any particular application without independent testing and verification by the person making the application.</p>
 <p>Danger</p>	<p>Independent testing and verification are especially important in any application in which malfunction might result in personal injury or damage to property.</p>
	<p>HEINZMANN make no warranties, express or implied, that the examples, data, or other information in this volume are free of error, that they are consistent with industry standards, or that they will meet the requirements for any particular application.</p>
	<p>HEINZMANN expressly disclaim the implied warranties of merchantability and of fitness for any particular purpose, even if HEINZMANN have been advised of a particular purpose and even if a particular purpose is indicated in the manual.</p>
	<p>HEINZMANN also disclaim all liability for direct, indirect, incidental or consequential damages that result from any use of the examples, data, or other information contained in this manual.</p>
	<p>HEINZMANN make no warranties for the conception and engineering of the technical installation as a whole. This is the responsibility of the user and of his planning staff and specialists. It is also their responsibility to verify whether the performance features of our devices will meet the intended purposes. The user is also responsible for correct commissioning of the total installation.</p>



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1 Safety Instructions and Related Symbols

This publication offers wherever necessary practical safety instructions to indicate inevitable residual risks when operating the engine. These residual risks imply dangers to

persons
product and engine
environment.

The symbols used in this publication are in the first place intended to direct your attention to the safety instructions!



Warning

This symbol is to indicate that there may exist dangers to the engine, to the material and to the environment.



Danger

This symbol is to indicate that there may exist dangers to persons. (Danger to life, personal injury))



Danger!
High
Voltage

This symbol is to indicate that there exist particular danger due to electrical high tension. (Mortal danger).



Note

This symbol does not refer to any safety instructions but offers important notes for better understanding the functions that are being discussed. They should by all means be observed and practiced. The respective text is printed in italics.

The primary issue of these safety instructions is to prevent personal injuries!

Whenever some safety instruction is preceded by a warning triangle labelled “Danger” this is to indicate that it is not possible to definitely exclude the presence of danger to persons, engine, material and/or environment.

If, however, some safety instruction is preceded by the warning triangle labelled “Caution” this will indicate that danger of life or personal injury is not involved.

The symbols used in the text do not supersede the safety instructions. So please do not skip the respective texts but read them thoroughly!



In this publication the Table of Contents is preceded by diverse instructions that among other things serve to ensure safety of operation. It is absolutely imperative that these hints be read and understood before commissioning or servicing the installation.

1.1 Basic Safety Measures for Normal Operation

- The installation may be operated only by authorized persons who have been duly trained and who are fully acquainted with the operating instructions so that they are capable of working in accordance with them.
- Before turning the installation on please verify and make sure that
 - only authorized persons are present within the working range of the engine;
 - nobody will be in danger of suffering injuries by starting the engine.
- Before starting the engine always check the installation for visible damages and make sure it is not put into operation unless it is in perfect condition. On detecting any faults please inform your superior immediately!
- Before starting the engine remove any unnecessary material and/or objects from the working range of the installation/engine.
- Before starting the engine check and make sure that all safety devices are working properly!

1.2 Basic Safety Measures for Servicing and Maintenance

- Before performing any maintenance or repair work make sure the working area of the engine has been closed to unauthorized persons. Put on a sign warning that maintenance or repair work is being done.
- Before performing any maintenance or repair work switch off the master switch of the power supply and secure it by a padlock! The key must be kept by the person performing the maintenance and repair works.
- Before performing any maintenance and repair work make sure that all parts of engine to be touched have cooled down to ambient temperature and are dead!
- Refasten loose connections!
- Replace at once any damaged lines and/or cables!
- Keep the cabinet always closed. Access should be permitted only to authorized persons having a key or tools.



- Never use a water hose to clean cabinets or other casings of electric equipment!

1.3 Before Putting an Installation into Service after Maintenance and Repair Works

- Check on all slackened screw connections to have been tightened again!
- Make sure the control linkage has been reattached and all cables have been reconnected.
- Make sure all safety devices of the installation are in perfect order and are working properly!



2 Presentation

The Megasol valves (Metering of Gas by Solenoid) are electrically actuated gas injection valves for industrial engines. They are currently used on gas engines or on dual fuel engines. One Megasol valve is required for each cylinder and the principle is to inject gas for each cylinder close to the inlet valves to have a very reactive engine comportment. It is designed for four-stroke engines with or without turbocharger.

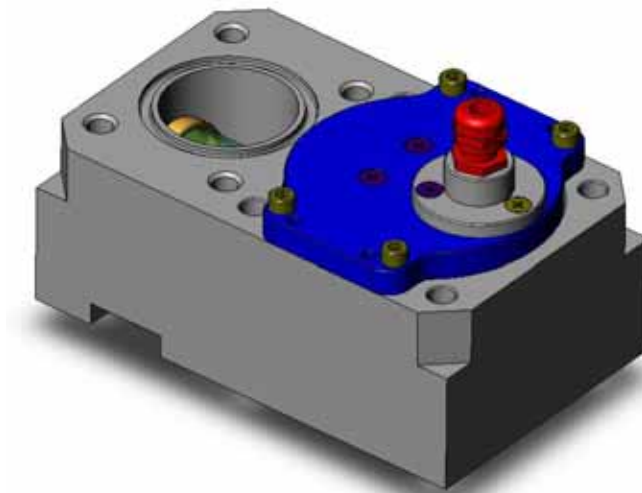


Figure 1: Side view of the Megasol 200 A or Megasol 425 A

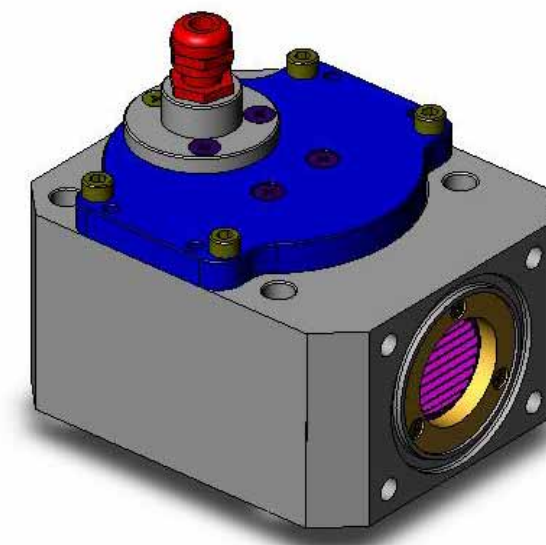


Figure 2: Side view of the Megasol 200 B or Megasol 425 B

The Megasol valve is one component of a complete Heinzmann gas injection system made up of:

- Engine control unit (MVC 04 for example)
- One Megasol valve for each cylinder
- Sensors (speed sensors, etc) and cables
- Other governors according to your needs (waste gate actuator...)

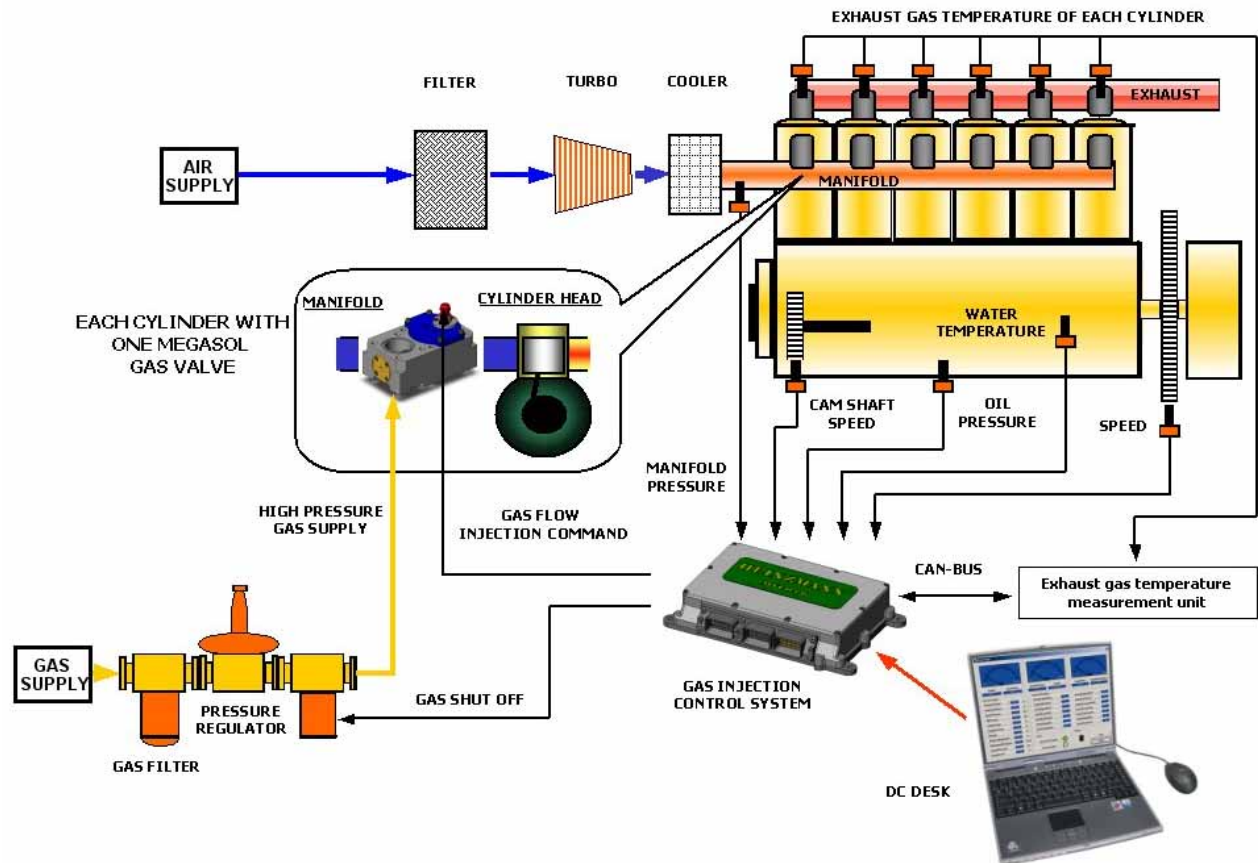


Figure 3: Principle of installation of Megasol valve on engine

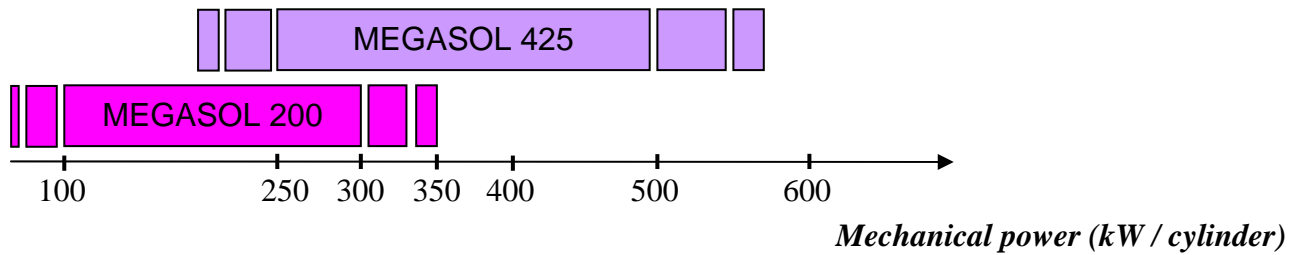
The Megasol valves exist in different sizes for different applications. They can be divided into two main working principles:

- Megasol valve with pressure compensation: **Megasol 200**
- Megasol valve without full pressure compensation but with bigger flow rate: **Megasol 425**

The numbers in the name of the different Megasol valves correspond to the flow section of the valve (in mm²) when it is open. For example the Megasol 425 has a flow section of 425 mm² when it is open.



The Megasol valves cover a large range of power. They can be used for engines with a mechanical power comprised between 100 and 500 kW per cylinder. In special cases the range of power can be under 100 kW per cylinder (with fewer gas pressure) and over 500 kW per cylinder (gas with good heating value).



(These are only indications: it really depends on gas quality and gas pressure relative to air)

Figure 4: Range of power of the Megasol 200 and Megasol 425



3 Advantages

The Megasol valves bring lot of advantages, more especially about the engine dynamic comportment and safety:

- Excellent load response of the engine due to the gas injection near the inlet valve (very few inertia of the gas flow)
- Right dosage of gas for each cylinder. The right engine power and low emissions are reached.
- Adjustment of the gas quantity from cylinder to cylinder
- No risk of backfire
- Possibility to do skip firing (some Megasol stay close)

The Megasol valves are very reactive gas valves with short opening and closing durations. They therefore can be used not only for low-speed engines but also for high-speed engines.



4 Specifications

4.1 Performance

	Megasol 200	Megasol 425
<i>Time to full open after signal on</i>	4 ms	4 ms
<i>Time to full closed after signal off</i>	4 ms	4 ms
<i>Supply voltage</i>	60 V (up to 110 V)	60 V (up to 110 V)
<i>Boost current</i>	8 A during 3,6 ms	15 A during 4 ms
<i>Hold current</i>	1 A the rest of the time	1 A the rest of the time
<i>Leakage</i>	Less than 0,25% of the opened valve flow	Less than 0,25% of the opened valve flow
<i>Maximum gas pressure (absolute)</i>	4.5 bar	6.2 bar
<i>Maximum air pressure (absolute)</i>	2.5 bar	4 bar
<i>Maximum pressure drop</i>	2 bar	2.2 bar
<i>Filtration required</i>	5 μ	5 μ
<i>Operating temperature</i>	-20°C / +105 °C	-20°C / +105 °C
<i>Lifetime</i>	540 million cycles (12 000 hours @ 1 500 rpm)	

Table 1: Performance

4.2 Construction

The Megasol valves can be delivered with two possible bodies:

- The body A has the gas inlet on the upper face.
- The body B has the gas inlet laterally.

The bodies A and B are compatible as well for the Megasol 200 as for the Megasol 425.

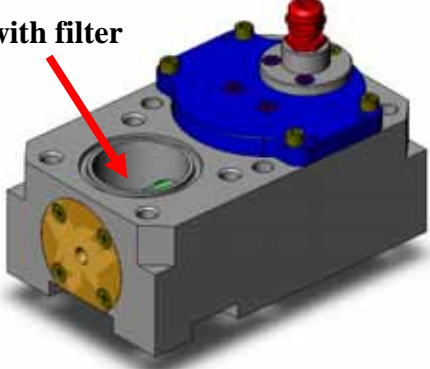
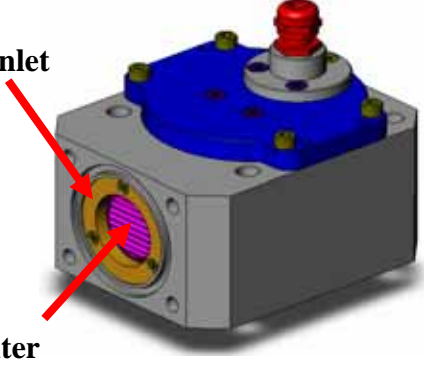
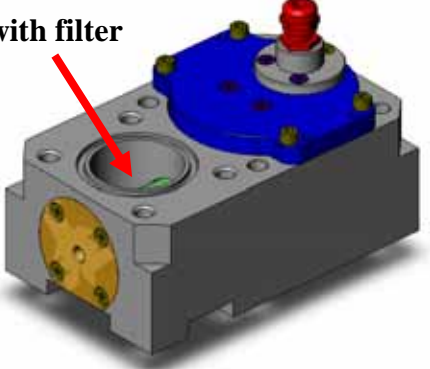
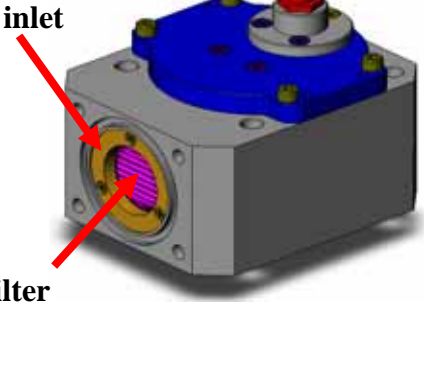
	Body A	Body B
Megasol 200	<p>Gas inlet with filter</p> 	<p>Gas inlet</p>  <p>Filter</p>
Megasol 425	<p>Gas inlet with filter</p> 	<p>Gas inlet</p>  <p>Filter</p>

Table 2: Different bodies for the Megasol 200 & 425 valves

For the mounting dimensions see the drawings in chapter 8. Dimensions. The mounting dimensions are the same for the Megasol 200 or Megasol 425. They are only depending on the body A or B.



5 Working principle

The opening of the Megasol valves is controlled by a powerful solenoid to ensure a quick valve opening. The solenoid exerts strength on a magnetic plate, which opens the valve. The valve is a face-type poppet. It is shut off with a spring, which ensures a quick shutting.

The Megasol valves are split into two different working principles:

- *The Megasol 200 is pressure compensated.*

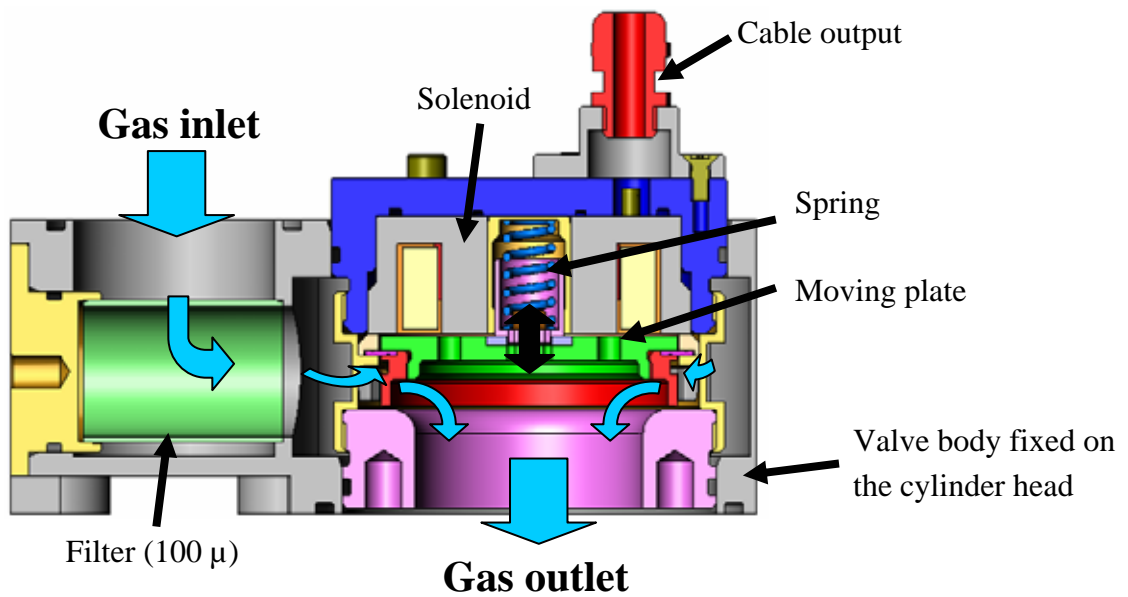


Figure 5: Cross section of the Megasol 200 A

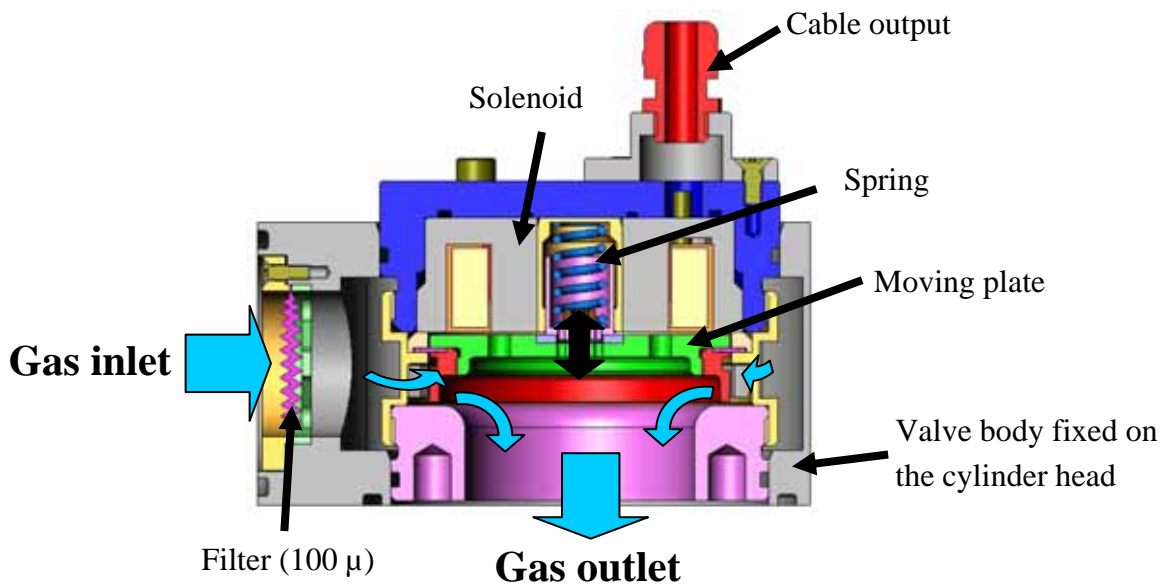


Figure 6: Cross section of the Megasol 200 B



- *The Megasol 425 is not completely pressure compensated but it **has more flow rate** than the Megasol 200.*

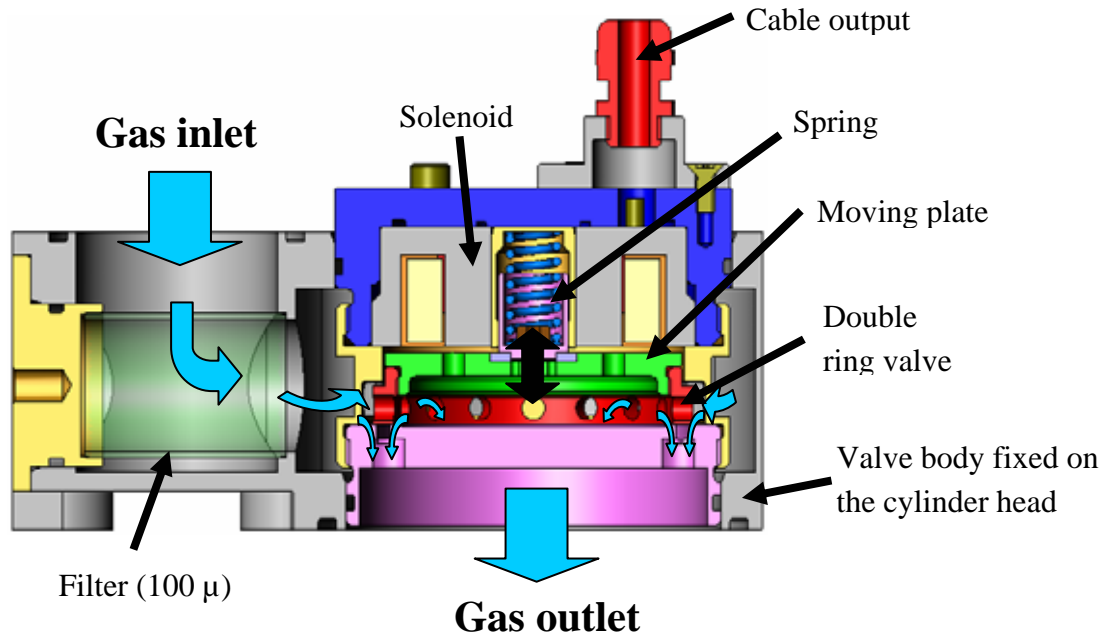


Figure 7: Cross section of the Megasol 425 A

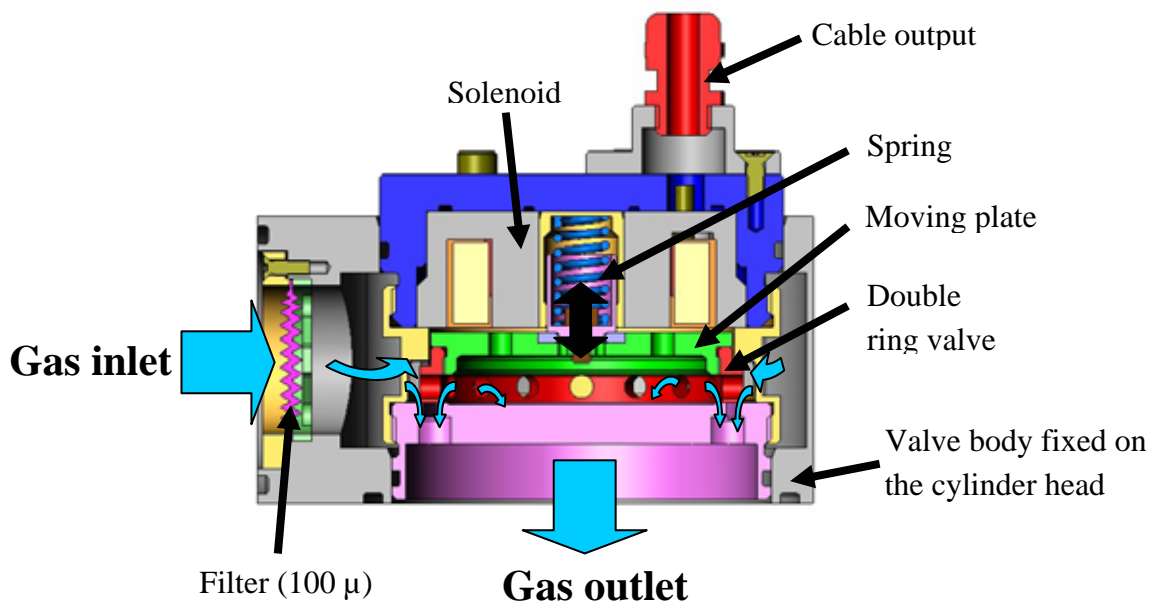


Figure 8: Cross section of the Megasol 425 B



6 Dimensioning

The Megasol valve has to inject gas during the air intake valves are opened. But it has to open after the exhaust valves are closed to avoid to have unburned gas in exhausts. It also has to close before the air intake valves are closed because of the gas flow inertia.

For the stability of the engine speed regulation it is good to have the Megasol's longest opening (in general at point with maximal torque) during approximately the $\frac{3}{4}$ of the air intake valve's opening (without the duration where the exhaust valves are opened). That means that if the Megasol is oversized, then the speed regulation will not be optimal, specially for idle speed, because the opening duration of the Megasol will be very short.

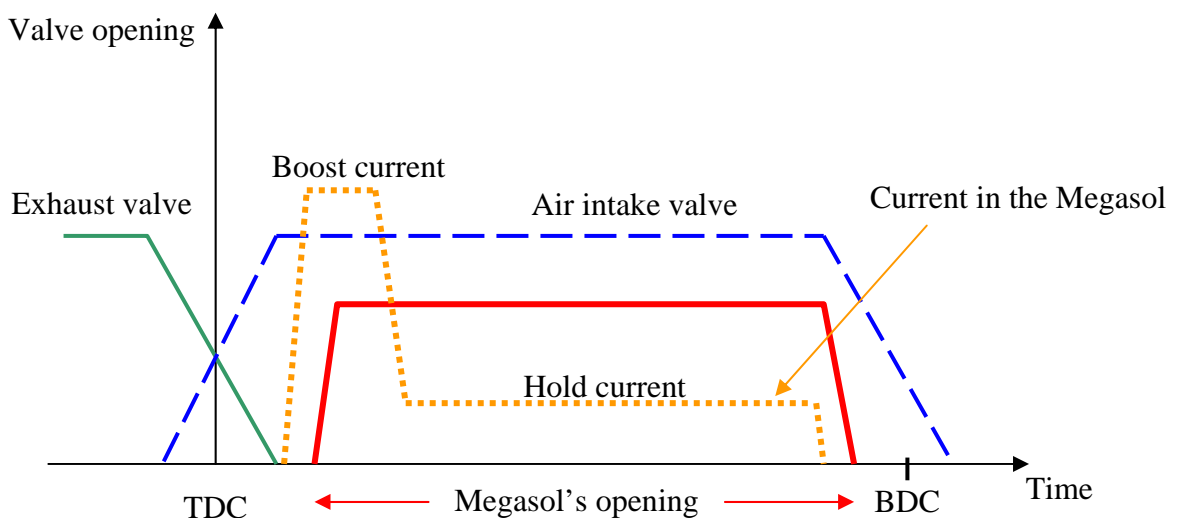


Figure 9: Injection position in the cycle

6.1 Flow rate

To dimension the valve relative to the engine, the flow rate of the Megasol can be calculated or can quickly be read on flow capacity curves.

The flow rate through the Megasol valves depends on the gas upstream pressure at the gas valve inlet, the air pressure at the gas valve outlet, on the gas characteristics and on the flow characteristics of the Megasol valves.



6.1.1 Flow rate calculation

The flow rate can be approximately calculated with the M-values. These M-values characterize the flow rate of the Megasol valves. But this calculation does not replace a real flow measurement.

The Megasol valves have the following M-values:

	Megasol 200	Megasol 425
M-value	45	77

Table 3: M-values

These M-values are used in the following formulas to calculate the flow rate in gram per second when the Megasol valves are open.

Two conditions on the flow have to be taken into account:

- The flow is sub critic (flow speed < speed of sound) when $\frac{P_2}{P_1} \geq \left(\frac{2}{\kappa+1}\right)^{\frac{\kappa}{\kappa-1}}$

$$\text{Then the flow rate is } Q_{(g/s)} = M \cdot \sqrt{\frac{2 \cdot \kappa}{\kappa - 1} \times \rho_{gas0} \times P_1^2 \times \frac{T_0}{T_1} \times \left[\left(\frac{P_2}{P_1}\right)^{\frac{2}{\kappa}} - \left(\frac{P_2}{P_1}\right)^{\frac{\kappa+1}{\kappa}} \right]}$$

- The flow is critic (flow speed = speed of sound) when $\frac{P_2}{P_1} \leq \left(\frac{2}{\kappa+1}\right)^{\frac{\kappa}{\kappa-1}}$

$$\text{Then the flow rate is } Q_{(g/s)} = M \cdot \sqrt{\frac{2 \cdot \kappa}{\kappa - 1} \times \rho_{gas0} \times P_1^2 \times \frac{T_0}{T_1} \times \left[\left(\frac{2}{\kappa+1}\right)^{\frac{2}{\kappa-1}} - \left(\frac{2}{\kappa+1}\right)^{\frac{\kappa+1}{\kappa-1}} \right]}$$

with Q flow rate through the opened Megasol valve (g/s)

κ ratio of gas specific heats (Cp/Cv)

ρ_{gas0} gas gravity (kg/Nm³)

P_1 gas absolute upstream pressure at the valve inlet (bar)

P_2 gas absolute downstream pressure at the valve outlet (bar)

T_0 standard temperature ($T_0 = 273,15$ K)

T_1 gas temperature at the valve inlet (Kelvin)

To calculate the injected gas mass for each cycle, the flow rate value has to be multiplied by the injection duration (in second).



6.1.2 Flow capacity curves

An other way to quickly dimension the Megasol valves without lot of precision is to use the flow capacity curves.

These flow capacity curves are given for methane with different drop pressures between the gas valve inlet and outlet and for different outlet pressures (P2). The injected energy is calculated for 20 ms methane injection with 36 MJ/Nm³ and 0.72 kg/Nm³.

- *Megasol 200*

Delta P	bar	0	0,25	0,5	0,75	1	1,5	2
Outlet pressure - P2	bar	1	1	1	1	1	1	1
Inlet pressure - P1	bar	1	1,25	1,5	1,75	2	2,5	3
Flow	g/s	0,0	25,9	36,1	43,6	49,9	62,4	74,9
Energy (20 ms injection)*	kJ	0,0	25,9	36,1	43,6	49,9	62,4	74,9
Outlet pressure - P2	bar	2	2	2	2	2	2	2
Inlet pressure - P1	bar	2	2,25	2,5	2,75	3	3,5	4
Flow	g/s	0,0	37,0	51,9	63,0	72,2	87,2	99,8
Energy (20 ms injection)*	kJ	0,0	37,0	51,9	63,0	72,2	87,2	99,8
Outlet pressure - P2	bar	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Inlet pressure - P1	bar	2,5	2,75	3	3,25	3,5	4	4,5
Flow	g/s	0,0	41,4	58,2	70,8	81,2	98,3	112,3
Thermal energy (20 ms injection)*	kJ	0,0	41,4	58,2	70,8	81,2	98,3	112,3

* for 20 ms methane injection with 36 MJ/Nm³ and 0,72 kg/Nm³

Table 4: Methane flow across the Megasol 200

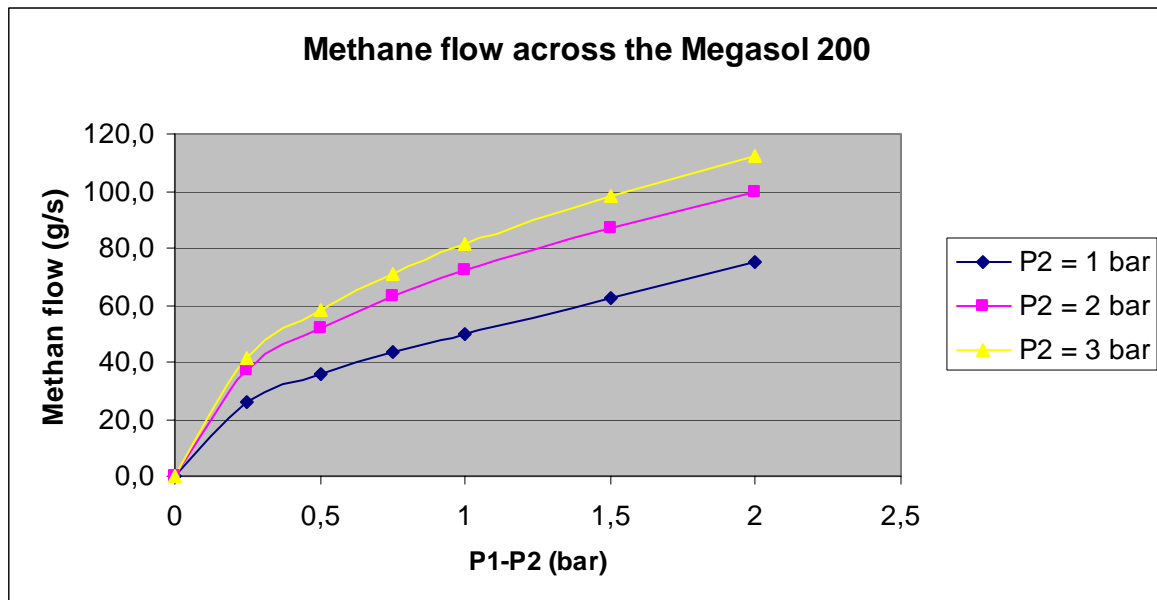


Figure 10: Methane flow across the Megasol 200



- *Megasol 425*

Delta P	bar	0	0,25	0,5	0,75	1	1,25	1,5	1,75	2
Outlet pressure - P2	bar	1	1	1	1	1	1	1	1	1
Inlet pressure - P1	bar	1	1,25	1,5	1,75	2	2,25	2,5	2,75	3
Flow	g/s	0,0	44,1	61,4	74,1	84,9	95,5	106,1	116,7	127,3
Energy (20 ms injection)*	kJ	0,0	44,1	61,4	74,1	84,9	95,5	106,1	116,7	127,3
Outlet pressure - P2	bar	2	2	2	2	2	2	2	2	2
Inlet pressure - P1	bar	2	2,25	2,5	2,75	3	3,25	3,5	3,75	4
Flow	g/s	0,0	62,9	88,2	107,1	122,8	136,3	148,3	159,1	169,7
Energy (20 ms injection)*	kJ	0,0	62,9	88,2	107,1	122,8	136,3	148,3	159,1	169,7
Outlet pressure - P2	bar	3	3	3	3	3	3	3	3	3
Inlet pressure - P1	bar	3	3,25	3,5	3,75	4	4,25	4,5	4,75	5
Flow	g/s	0,0	77,2	108,6	132,3	151,9	169,0	184,2	198,0	210,6
Thermal energy (20 ms injection)*	kJ	0,0	77,2	108,6	132,3	151,9	169,0	184,2	198,0	210,6

* for 20 ms methane injection with 36 MJ/Nm³ and 0,72 kg/Nm³

Table 5: Methane flow across the Megasol 425

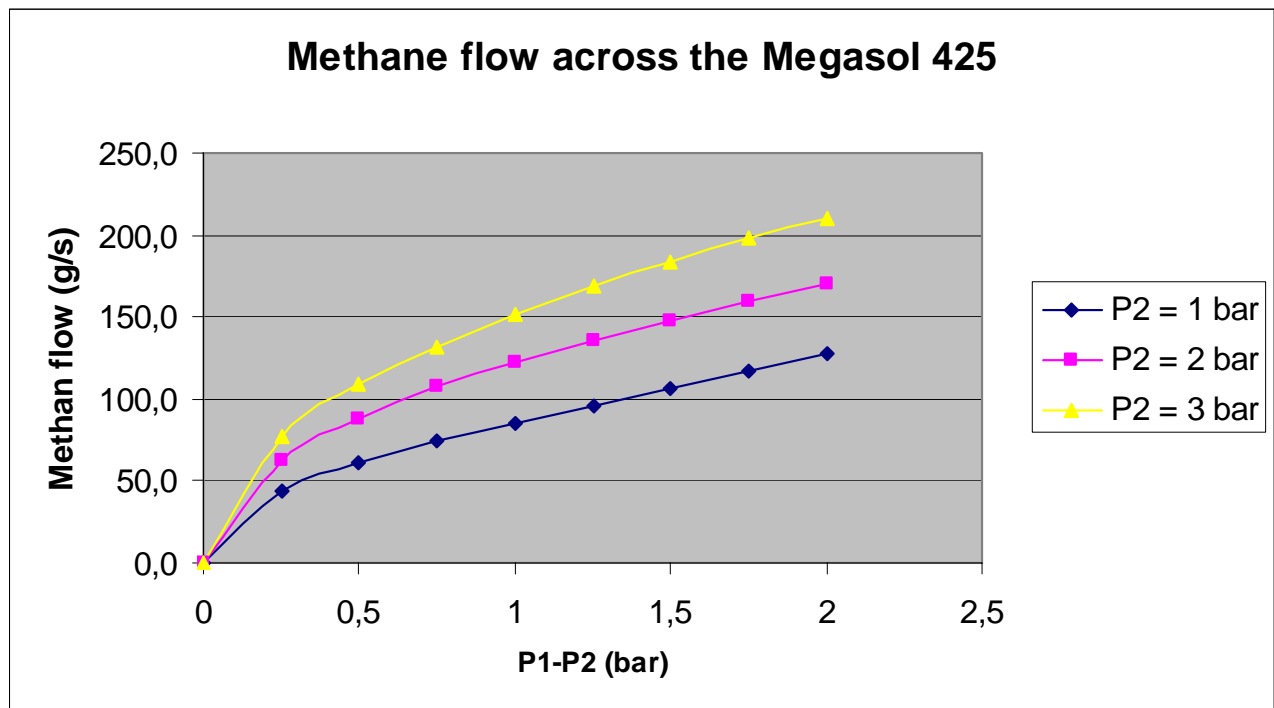


Figure 11: Methane flow across the Megasol 425



7 Installation

7.1 General information about the Megasol installation

One Megasol valve is required for each cylinder. It has to be installed close to the inlet valves. The ideal case is when the gas is injected in the air duct of each cylinder head. By that way the injected gas will not go from one cylinder to an other one.

It can be interesting to use a pipe at the outlet of the Megasol valve to introduce the gas in the middle of air. This enables a better mixing of gas with air.

If it is not possible to fix the Megasol valve on the cylinder head, it could be fixed on the main air duct in front of each cylinder head. In this case a pipe should be used to lead the gas close to the inlet valves.

Each Megasol valve must be connected to the main gas pipe. The cross section of the pipes must be big enough to insure a good gas feeding.

At the gas entrance, upstream from the Megasol valves, it is important to have a filter with a 5 μ filtration to insure a long life for the Megasol valves.

In the case of the Megasol 425 it is necessary to have a gas pressure regulation to insure that the pressure drop between gas and air is always under 2 bar. In the case of the Megasol 200 it is not necessary because it can work with a pressure of 4 bar. But it is recommended to have a gas pressure regulation to have a better engine speed regulation.

7.2 Cable section

All the Megasol must be connected to the engine control unit with shielded cable.

The cable section depends on the cable length.

Cable length	Minimal cable section
From 0 to 10 m	1.5 mm ²
From 10 to 20 m	2.5 mm ²

Table 6: Cable section

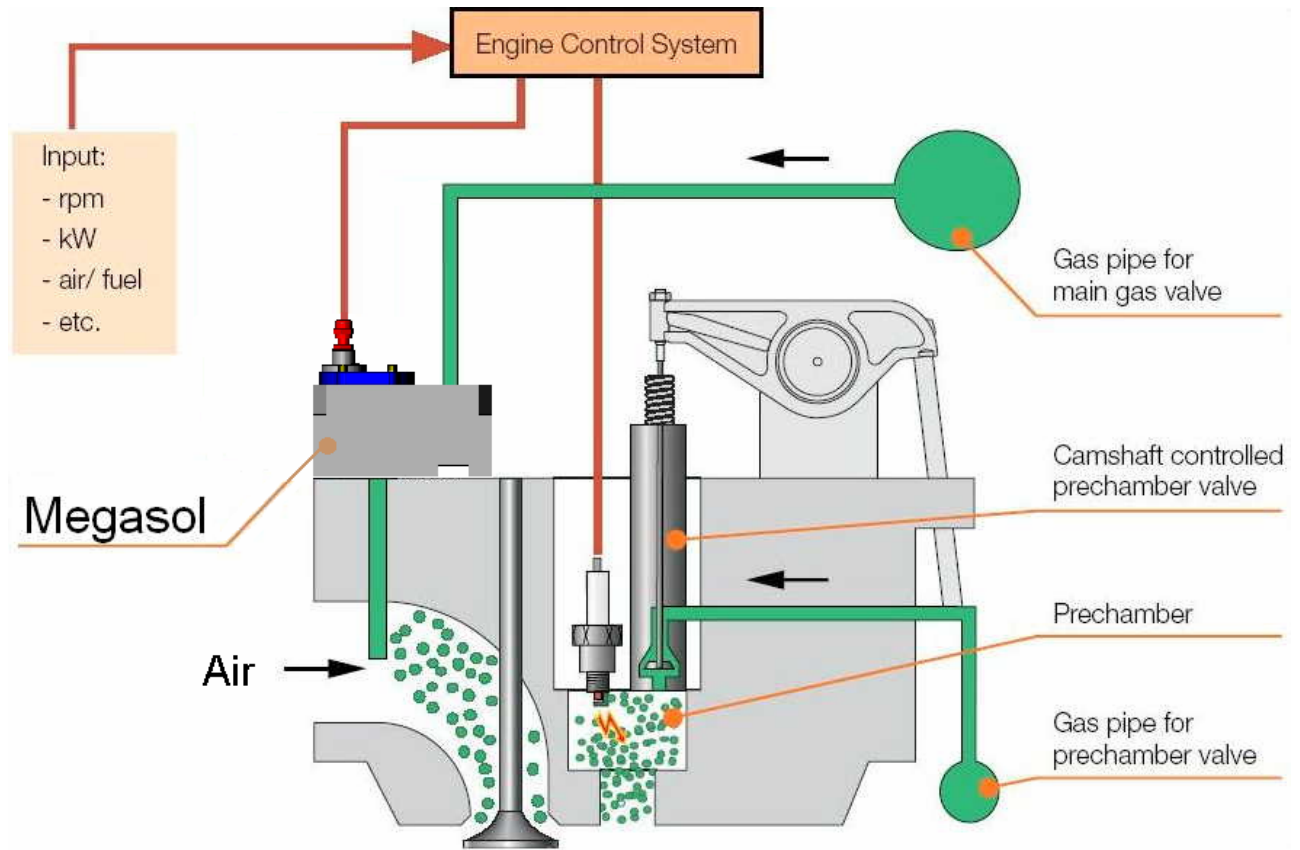
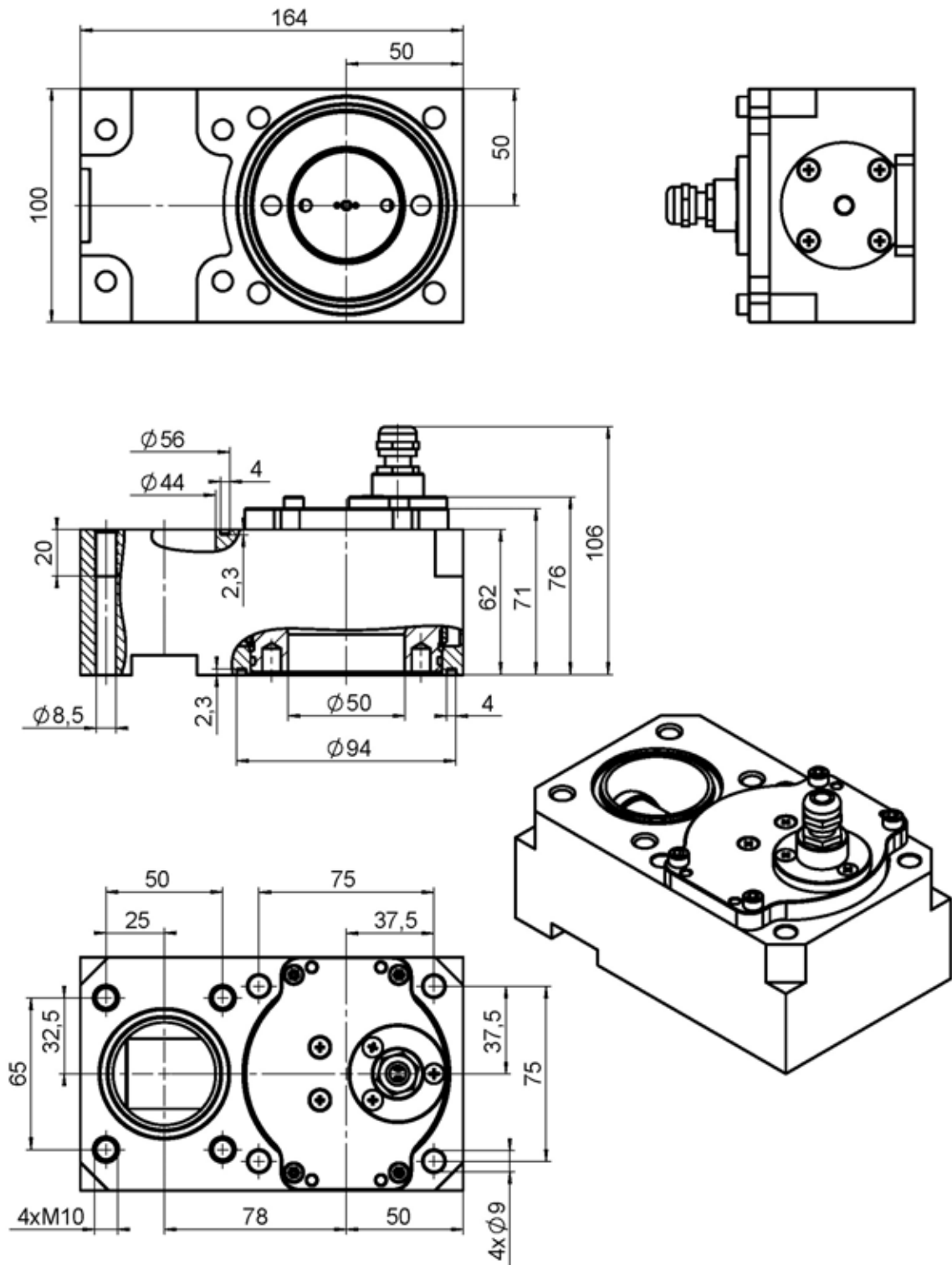


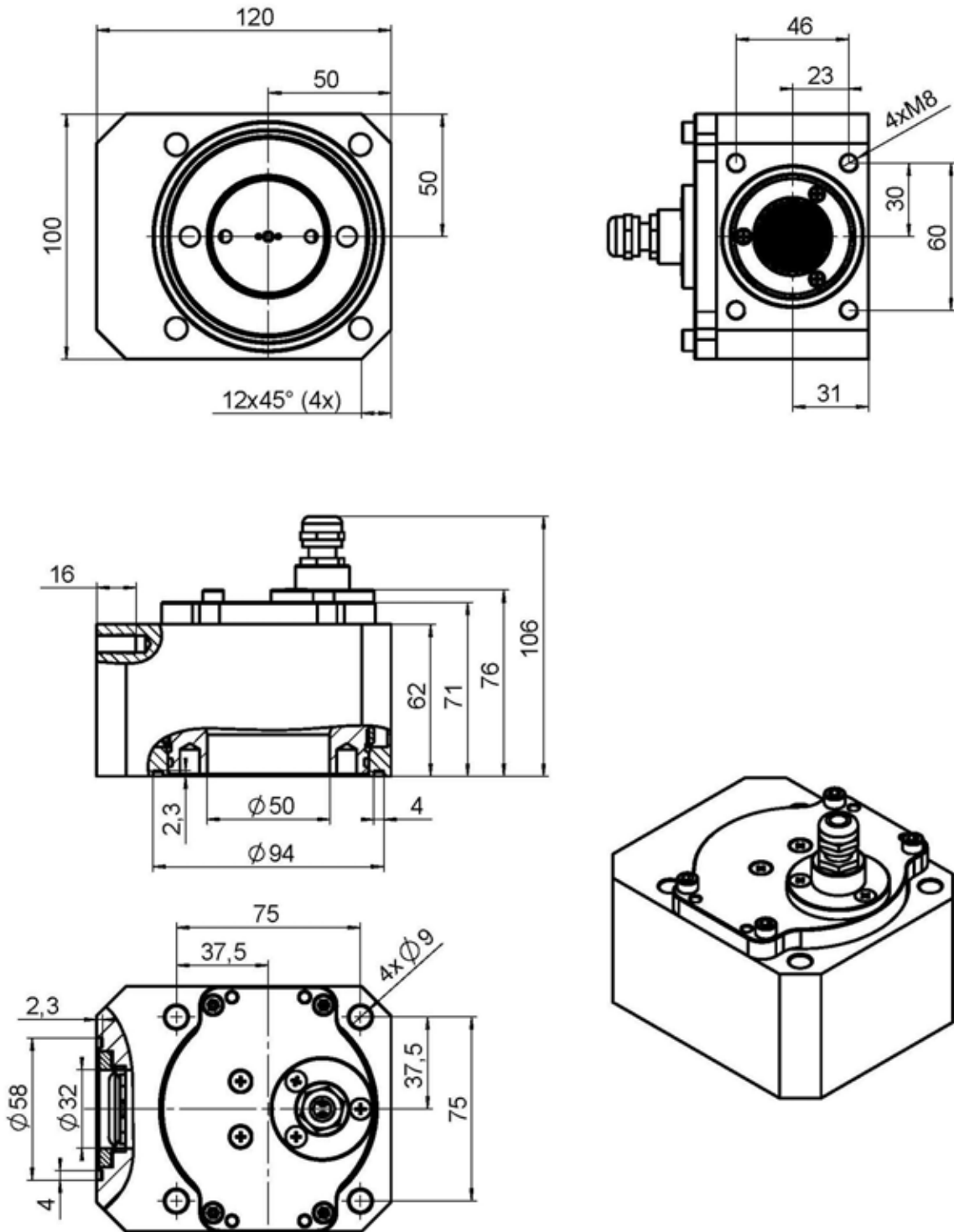
Figure 12: Example of Megasol installation on gas engine



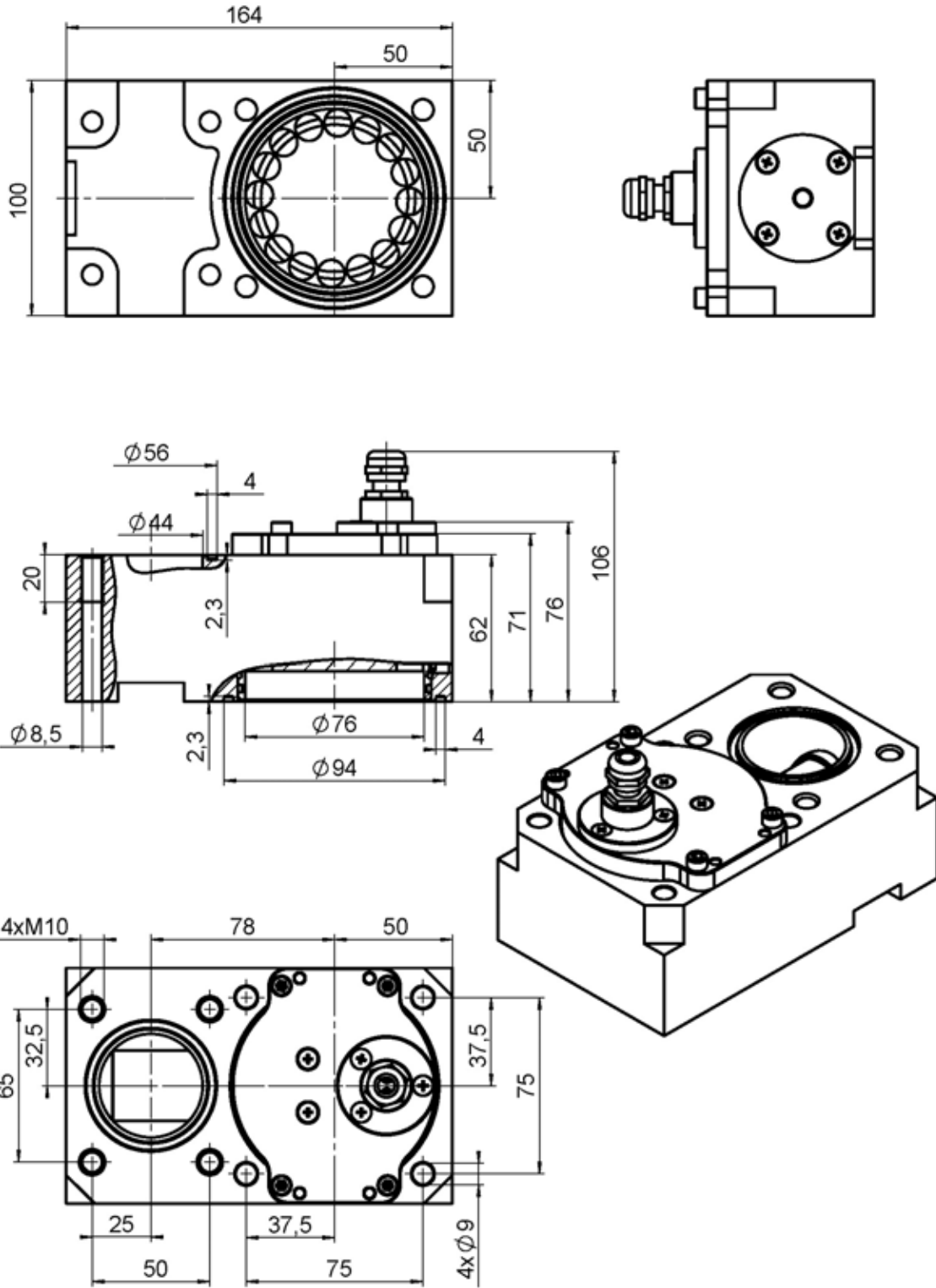
8 Dimensions

Megasol 200 A

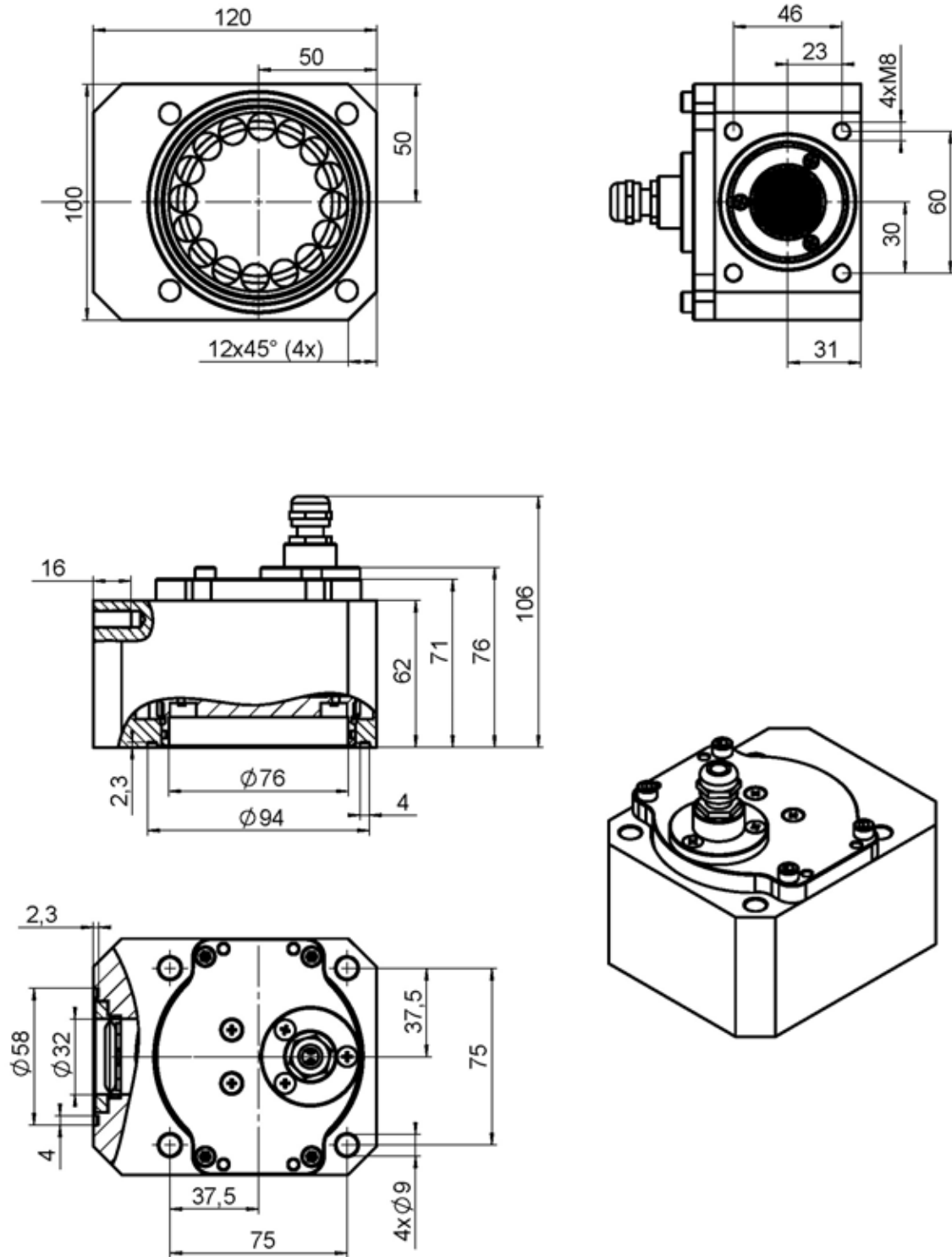
Megasol 200 B



Megasol 425 A



Megasol 425 B



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11 Order Specifications for Manuals

There is no charge for our technical manuals ordered in reasonable quantities.

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