



# VariFuel2-TEM – Air/Gas Mixer

## Assembly Instructions



Original assembly instructions

© Copyright 2025 MOTORTECH GmbH. All rights reserved.

MOTORTECH products and the MOTORTECH logo are registered and/or common law trademarks of the MOTORTECH GmbH. All further trademarks and logos displayed or used in this publication are the property of the respective entitled person and are used for reference purposes only.

Information contained in this publication may be changed without prior notice.

<b>1 General Information</b> .....	<b>5</b>
1.1 What Is the Purpose of this Assembly Instructions? .....	5
1.2 Who Are these Assembly Instructions Targeted To? .....	5
1.3 What Symbols Are Used in the Assembly Instructions? .....	5
1.4 Which Abbreviations/Acronyms Are Used in the Assembly Instructions?.....	6
<b>2 Safety Instructions</b> .....	<b>7</b>
2.1 General Safety Instructions .....	7
2.2 Electrostatic Discharge Hazards .....	8
2.3 Special Safety Instructions for the Device.....	8
2.4 Proper Transport.....	10
2.5 Proper Storage .....	10
2.6 Proper Disposal.....	10
<b>3 Intended Use</b> .....	<b>11</b>
3.1 Functional Description.....	11
3.2 Applications .....	13
<b>4 Product Description</b> .....	<b>15</b>
4.1 Technical Data .....	15
4.1.1 Certifications.....	15
4.1.2 Mechanical Data .....	15
4.1.3 Warning Notices on the Device .....	16
4.1.4 Product Identification – Labeling on the Device.....	16
4.1.5 Technical Data of the Stepper Motor .....	16
4.1.6 Overview Drawings .....	17
<b>5 Installation Instructions</b> .....	<b>20</b>
5.1 Unpacking .....	20
5.2 Mounting.....	20
5.2.1 Dismount Original Gas Mixer .....	21
5.2.2 Install Flow Body.....	22
5.2.3 Install VariFuel2-TEM into Intake Section .....	24
5.2.4 Connect TEM-EVO® System .....	26
<b>6 Operation</b> .....	<b>27</b>
6.1 Start-up.....	27
<b>7 Errors</b> .....	<b>29</b>
7.1 Special Tools for Troubleshooting.....	29
7.2 Possible Faults .....	29
7.3 Fix Shaft.....	31
7.4 Customer Service Information .....	34
7.5 Returning Equipment for Repair/Inspection .....	34
7.6 Instructions for Packaging the Equipment.....	34

# Table of Contents

- 8 Maintenance ..... 35**
- 8.1 Maintenance Instructions ..... 35**
- 8.2 Spare Parts and Accessories ..... 36**
- 9 Index ..... 37**

Prior to use, read these assembly instructions carefully and familiarize yourself with the product. Installation and start-up should not be carried out before reading and understanding this document. Keep these assembly instructions readily available so that you can reference them as needed.

## 1.1 What Is the Purpose of this Assembly Instructions?

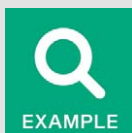
These assembly instructions serve as an aid for the installation and operation of the product and support the technical staff with all operating and maintenance tasks to be performed. Furthermore, these instructions are aimed at preventing dangers to life and health of the user and third parties.

## 1.2 Who Are these Assembly Instructions Targeted To?

These assembly instructions provide a code of conduct for personnel tasked with the setup, operation, maintenance, and repair of gas engines. A certain level of technical knowledge with respect to the operation of gas engines and basic knowledge of the electronic components used are necessary. Persons who are only authorized to operate the gas engine shall be trained by the operating company and shall be expressly instructed concerning potential hazards.

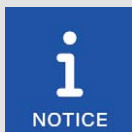
## 1.3 What Symbols Are Used in the Assembly Instructions?

The following symbols are used in these instructions and must be observed:



### Example

This symbol indicates examples, which point out necessary handling steps and techniques. In addition, you receive additional information from the examples, which will increase your knowledge.



### Notice

This symbol indicates important notices for the user. Follow these. In addition, this symbol is used for overviews that give you a summary of the necessary work steps.



### Warning

This symbol indicates warnings for possible risks of property damage or risks to health. Read these warning notices carefully and take the mentioned precautionary measures.

# 1 General Information



## **Danger**

This symbol indicates warnings for danger to life, especially due to high voltage. Read these warning notices carefully and take the mentioned precautionary measures.

## 1.4 Which Abbreviations/Acronyms Are Used in the Assembly Instructions?

The following abbreviations/acronyms are used in the assembly instructions:

<b>Abb.</b>	<b>Term</b>	<b>Description</b>	<b>Explanation</b>
CE	Conformité Européenne	Conformity with EU legislation	Mark based on EU legislation for certain products in conjunction with product safety
ESD	Electrostatic Discharge	Electrostatic discharge	
LNG	Liquefied Natural Gas	Liquefied natural gas	Natural gas liquefied by cooling
LPG	Liquefied Petroleum Gas	Liquefied petroleum gas	Petroleum gas liquefied by cooling and compressing

### 2.1 General Safety Instructions

MOTORTECH equipment is manufactured as state of the art and therefore safe and reliable to operate. Nevertheless, the equipment can cause risks or damage can occur if the following instructions are not complied with:

- The gas engine must only be operated by trained and authorized personnel.
- Observe all safety instructions of the system and all safety instructions of the system operator.
- Operate the equipment only within the parameters specified in the technical data.
- Use the equipment correctly and for its intended use only.
- Never apply force.
- For all work such as installation, conversion, adaptation, maintenance, and repair, all equipment must be disconnected from the mains and secured against unintentional reactivation.
- Perform only such maintenance and repair work as is described in the assembly instructions, and follow the instructions given while working.
- Only use spare parts supplied by MOTORTECH for the maintenance of the device.
- Further work must only be performed by personnel authorized by MOTORTECH. Non-compliance with the instructions will void any guarantee for the proper function of the equipment as well as the responsibility for the validity of the certifications.
- Safety devices must not be dismantled or disabled.
- Avoid all activities that can impair the function of the equipment.
- Operate the equipment only while it is in proper condition.
- Investigate all changes that occur during operation of the gas engine or electronic engine control.
- Ensure compliance with all laws, directives, and regulations applicable to the operation of your system, including such not expressly stated herein.
- If the system is not entirely tight and sealed, gas may escape and result in explosion hazard. The inhalation of gas can also lead to death or severe health damages. Therefore, upon completion of all assembly works, always check the system's tightness.
- Always ensure adequate ventilation of the engine compartment.
- Ensure a safe position at the gas engine.
- There is a risk of burning on hot surfaces. Allow the gas engine to cool down before starting any work.
- Personal protective equipment (PPE), e.g. safety shoes and gloves, must be worn during all work on the gas engine.
- Noise from the system can cause permanent or temporary damage to your hearing. Wear suitable hearing protection at the system.
- Your behavior can reduce possible residual risks to a minimum. Observe responsible handling of the gas engine and the gas-carrying system.

## 2 Safety Instructions

### 2.2 Electrostatic Discharge Hazards

Electronic equipment is sensitive to static electricity. To protect these components from damage caused by static electricity, special precautions must be taken to minimize or prevent electrostatic discharge.

Observe these safety precautions while you work with the equipment or in its vicinity.

- Before performing maintenance or repair work, ensure that the static electricity inherent to your body is discharged.
- Do not wear clothing made from synthetic materials to prevent static electricity from building up. Your clothing should therefore be made of cotton or cotton mix materials.
- Keep plastics such as vinyl and Styrofoam materials as far away from the equipment and the work environment as possible.
- Do not remove the circuit boards from the housing of the device.

### 2.3 Special Safety Instructions for the Device



#### **Gas! Danger to life!**

Leaking gas may cause death or serious health damage if inhaled. Upon completion of all assembly works, always check the system's tightness. When operating a VariFuel gas mixer, make sure that the gauge port is closed.

All works involving gas-carrying parts must be executed by trained personnel only.



#### **Explosion hazard!**

If the system is not entirely tight and sealed, gas may escape and result in explosion hazard. Upon completion of all assembly works, always check the system's tightness.

All works involving gas-carrying parts must be executed by trained personnel only.



#### **Explosion hazard!**

Do not disconnect any connectors while the system is live. If the system is located in a hazardous area, there is a risk of explosion.



**Operational safety!**

Loose connectors can become detached during operation due to vibrations, impairing the controller. To ensure proper operation of the gas mixer, make sure that the screw on the proximity sensor is sufficiently tightened



**Risk of destruction! Operational safety!**

Damage to the gas engine and excessive exhaust gas values can occur if the stepper motor driver is not parameterized correctly. During start-up, check the parameterization of the stepper motor driver and the correct function of the gas mixer.



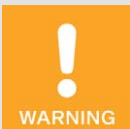
**Operational safety!**

Contaminated gas can lead to blocking of the fuel ring and thus can cause the gas engine to stop. Examine the VariFuel2-TEM regularly for contamination as a part of the regular maintenance intervals customary for your system. Use clean gas preferably.



**Risk of burning!**

The surfaces of the system may heat up to high temperatures.



**Risk of destruction!**

The stepper motor of the VariFuel is not suitable for carrying or lifting a gas mixer. There is a danger that the stepper motor could break, and if the gas mixer were to fall, it could result in injury or property damage.

Always carry or lift the gas mixer by its exterior housing.

## 2 Safety Instructions



### **Operational safety!**

The stepper motor of the gas mixer may overheat if the gas mixer is painted. To ensure proper operation of the gas mixer, the gas mixer must not be painted.

### **2.4 Proper Transport**

Transport the VariFuel2-TEM to the installation site unopened in its original carton.

### **2.5 Proper Storage**

Clean the VariFuel2-TEM gas mixer before storing. Store the VariFuel2-TEM gas mixer in the original packaging in a dry and clean place on even ground.

### **2.6 Proper Disposal**

For the proper disposal of MOTORTECH equipment, observe the information provided at [www.motortech.de](http://www.motortech.de).

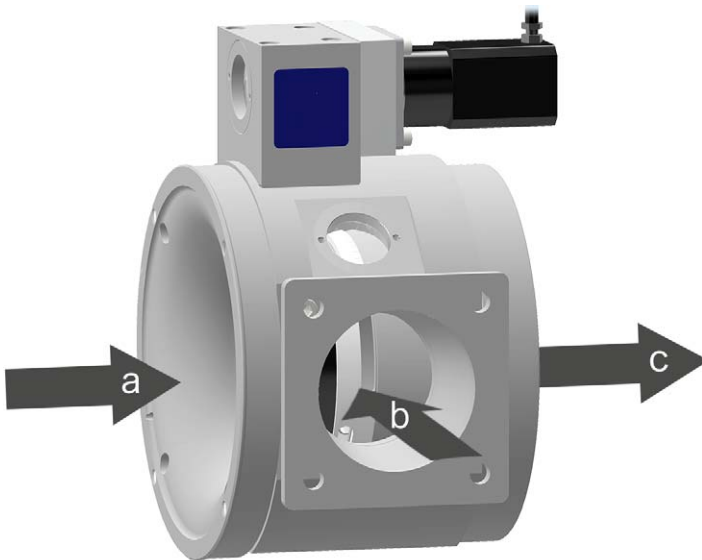
### 3.1 Functional Description

All graphics used in this section represent an example of a VariFuel2-TEM series 200-120.

#### Basic Design

The main task of the gas mixer is to mix the fuel (gas) and the air so that an optimal combustion is ensured within the gas engine. Here, the decisive optimization parameters are a high degree of efficiency and low emissions that comply with relevant regulations.

In the VariFuel2-TEM, gas and air are mixed based on the Venturi principle. Based on the suction pressure of the engine, the air is sucked in through the air inlet **a** into the Venturi nozzle. This creates an underpressure at the narrowest place, which causes the gas to be sucked in through the gas inlet **b**. In this way, both the gas and the air are mixed and released at the mixture outlet **c**. The volume flow and thus the air/gas mixture can be adapted to the respective engine by using different design sizes and different flow bodies in the Venturi nozzle.



## 3 Intended Use

### Mixture Control

The fuel (gas) is guided into the nozzle using the adjustable rectangular openings in a fuel ring **d**. The openings of the fuel ring are adjusted by a stepper motor and a drive belt **e**. The stepper motor of the VariFuel2-TEM is controlled by the superordinate TEM-EVO® system. For this purpose a proximity sensor integrated in the VariFuel2-TEM indicates the closed position of the fuel ring to the TEM-EVO® system.



### Connections

All VariFuel2-TEM gas mixers also have the following connections:

- An impulse line connection for connecting the air inlet to a balance or zero pressure regulator
- A gauge port for measuring the gas pressure at the gas inlet by a pressure gauge

### 3.2 Applications

The VariFuel2-TEM air/gas mixers are designed for use on the following MWM® gas engines with TEM-EVO® system and replace the original mixer from RMG®.

- Series 200-120:
  - TBG 616 V8, TBG 616 V12, TBG 616 V16
  - TCG 2016 V8, TCG 2016 V12, TCG 2016 V16
- Series 250-150:
  - TBG 620 V12, TBG 620 V16
  - TCG 2020 V12, TCG 2020 V16

The following substances are approved as fuels:

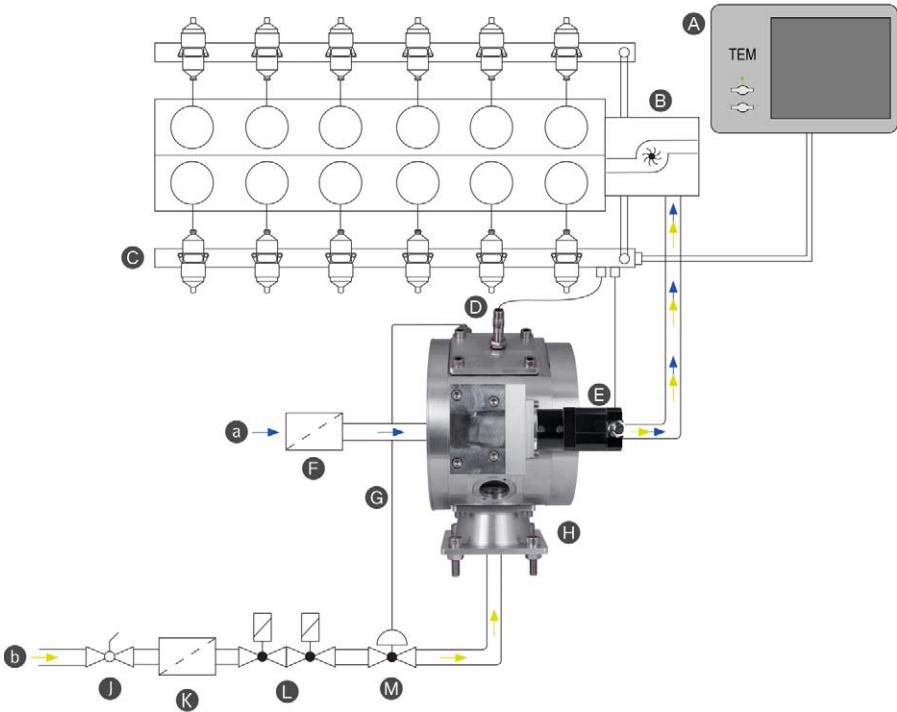
- Natural gas, biogas, landfill gas, sewage gas, wood gas, drilling-related gas, mine gas, liquefied natural gas (LNG), liquefied petroleum gas (LPG)
- Additional special gases may be used upon approval (there may be restrictions in the case of excessive moisture content or foreign materials in the gas such as tar)

Mixing the air and fuel with the VariFuel2-TEM must be done with the same pressure, therefore it is necessary to use a balance or a zero pressure regulator within the gas train.

Any use other than the one described in the assembly instructions shall be considered improper use and will result in the voiding of all any guarantee.

# 3 Intended Use

## System Overview (Example)



- Ⓐ TEM-EVO® system
- Ⓑ Turbocharger
- Ⓒ Multifunctional rail
- Ⓓ Proximity sensor
- Ⓔ Stepper motor
- Ⓕ Air filter
- Ⓖ Impulse line
- Ⓗ VariFuel2-TEM air/gas mixer
- Ⓙ Ball valve
- Ⓚ Gas filter
- Ⓛ Double safety valve
- Ⓜ Balance/Zero pressure regulator
- ⓐ Air
- ⓑ Gas

### 4.1 Technical Data

#### 4.1.1 Certifications

##### Machinery Directive

- The VariFuel2-TEM air/gas mixer is a partly completed machinery pursuant to Article 2g of the EC Machinery Directive.
- The partly completed machinery must not be put into service until the final machinery into which the product is to be incorporated has been declared in conformity with the provisions of the Machinery Directive.

The VariFuel2-TEM air/gas mixer is also certified as follows: CE

The certificates are enclosed with your product.

#### 4.1.2 Mechanical Data

The devices of VariFuel2-TEM series have the following mechanical characteristics:

Feature	Value
Dimensions	See chapter <i>Overview Drawings</i> on page 17
Weight	<b>Series 200-120:</b> 8.8 kg (19.3 lbs) <b>Series 250-150:</b> 23.4 kg (51.6 lbs)
Shape of device	See chapter <i>Overview Drawings</i> on page 17
Climatic environmental conditions	–10 °C to +80 °C (+14 °F to +176 °F) Max. humidity without condensation up to 2,000 m (6,561') above sea level: – 85 % at +80 °C (+176 °F) – 60 % at –10 °C (+14 °F)
Air consumption min./max.	<b>Series 200-120:</b> 500 m <sup>3</sup> /h to 3,200 m <sup>3</sup> /h <b>Series 250-150:</b> 1,800 m <sup>3</sup> /h to 5,200 m <sup>3</sup> /h
Suitable for flow bodies with min./max diameter	<b>Series 200-120:</b> 23 mm to 105 mm <b>Series 250-150:</b> 23 mm to 110 mm

## 4 Product Description

### 4.1.3 Warning Notices on the Device

Warning Symbol on Stepper Motor

Warning of hot surface



### 4.1.4 Product Identification – Labeling on the Device

The necessary numbers for unique product identification are on the device:

Nameplate Air/Gas Mixer on Upper Part of Housing



Abb.	Meaning
P/N	Part number of the air/gas mixer
S/N	Serial number of the air/gas mixer

Illustration example

The field *Flow Body Size* is reserved for the label that comes with the flow body. For further information, refer to the section *Install Flow Body* on page 22.

### 4.1.5 Technical Data of the Stepper Motor

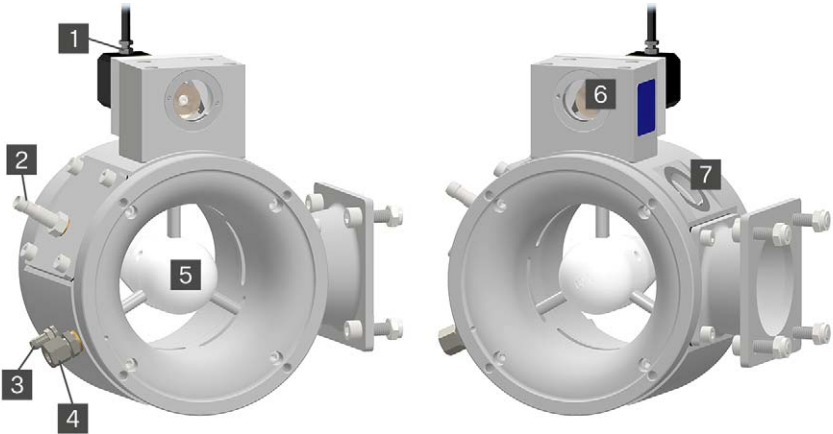
The stepper motor of the VariFuel2-TEM series has the following technical data:

Feature	Value
Design	Stepper motor with gear, 2 phases, bipolar
Maximum phase current	1.2 A

### 4.1.6 Overview Drawings

#### Components

The following drawing shows an example of a VariFuel2-TEM series 200-120. The exact position of the individual parts varies with other series. A detailed layout can be found in the subsequent section *Dimensions*.



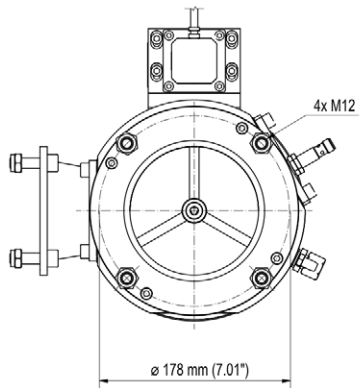
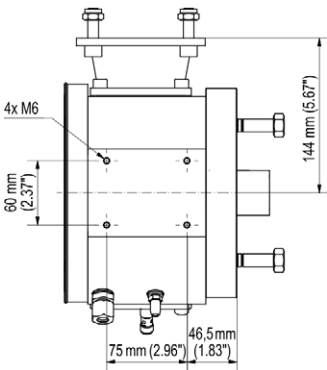
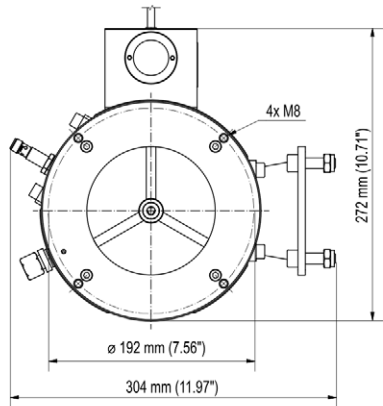
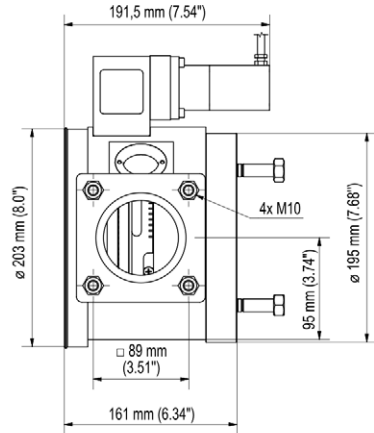
Pos.	Description
1	Stepper motor with connection cable (length 95 cm / 37.4")
2	Proximity sensor for closed position detection
3	Gauge port G1/8 for gas pressure measurement at the gas inlet by a pressure gauge
4	Impulse line connection (cutting-ring connection) G1/4 for connecting the air inlet to a balance or zero pressure regulator
5	Flow body
6	Inspection window on the drive belt
7	Inspection window on the fuel ring

# 4 Product Description

## Dimensions

Series 200-120

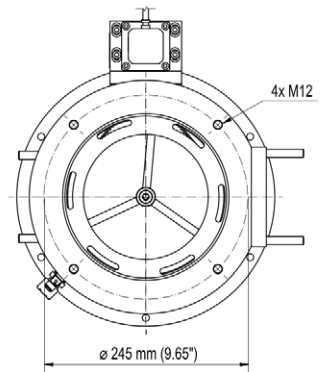
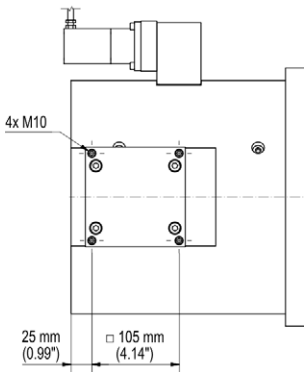
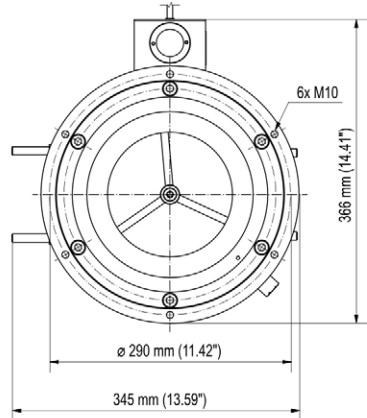
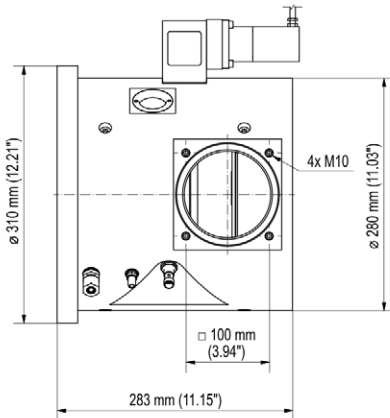
VariFuel2-TEM



## 4 Product Description

MOTORTECH®

Series 250-150  
VariFuel2-TEM



# 5 Installation Instructions

## 5.1 Unpacking



### **Risk of destruction!**

The stepper motor of the VariFuel is not suitable for carrying or lifting a gas mixer. There is a danger that the stepper motor could break, and if the gas mixer were to fall, it could result in injury or property damage.

Always carry or lift the gas mixer by its exterior housing.

Unpack the device, taking care not to damage it, and ensure that the assembly instructions are always stored with the device and are easily accessible. Check the contents for completeness and verify that the device type meets your application requirements.

### Scope of Supply

The scope of supply of the VariFuel2-TEM air/gas mixer consists of the following components:

- VariFuel2-TEM air/gas mixer
- Gasket for mixture outlet flange
- Assembly instructions
- Declaration of Incorporation
- EU Declaration of Conformity

### Accessories

- Flow body
- Cover plate
- Hexagon socket head cap screw for cover plate (4x)

## 5.2 Mounting



### **Risk of destruction!**

The stepper motor of the VariFuel is not suitable for carrying or lifting a gas mixer. There is a danger that the stepper motor could break, and if the gas mixer were to fall, it could result in injury or property damage.

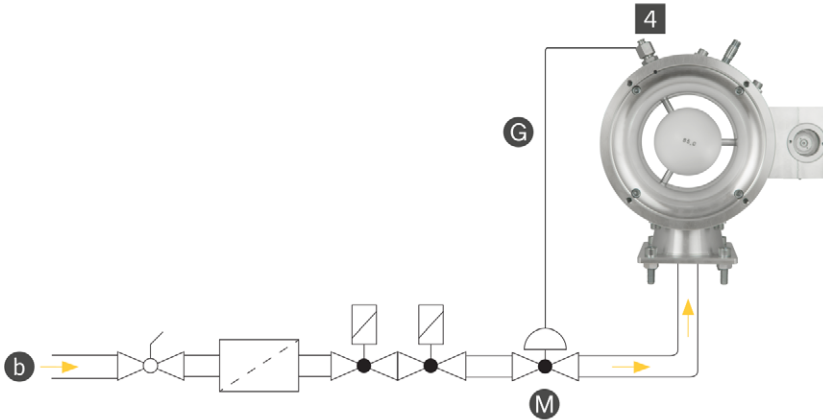
Always carry or lift the gas mixer by its exterior housing.

The following steps must always be carried out and are specified in more detail in the following:

- Dismount original gas mixer
- Install flow body
- Install VariFuel2-TEM into intake section (air and gas inlet plus mixture outlet)
- Connect TEM-EVO® system

For optimum performance according to its design, it is important that air and fuel are mixed in the VariFuel2-TEM at the same pressure. Therefore, only operate the VariFuel2-TEM gas mixer with a balance or zero pressure regulator. The balance or zero pressure regulator must be connected to the impulse line connection of the VariFuel2-TEM and it must be installed in the gas train at a suitable position before the gas inlet of the VariFuel2-TEM.

### Connection Example



Pos.	Description
4	Impulse line connection
G	Impulse line
M	Balance/Zero pressure regulator
b	Gas

### 5.2.1 Dismount Original Gas Mixer

To replace the original RMG® gas mixer of an MWM® gas engine with a VariFuel2-TEM gas mixer, first remove the original gas mixer. Proceed as follows:

- Before dismantling the original gas mixer, first check the following conditions on the gas engine:
  - The gas engine must be switched off.
  - The gas supply to the original gas mixer must be closed.
  - The stepper motor and the proximity sensor of the original gas mixer must not be supplied with voltage.
- Dismount the stepper motor of the original gas mixer according to the manufacturer's instructions. Also remove the connection cable between stepper motor and TEM-EVO® system from the respective connection on the gas engine.

## 5 Installation Instructions

3. Loosen the connection cable between the original gas mixer and the TEM-EVO® system from the proximity sensor of the original gas mixer by unscrewing it. However, leave the connection cable connected to the relevant connection on the gas engine, as the proximity sensor of the VariFuel2-TEM gas mixer will be connected to this cable after the installation of the VariFuel2-TEM.
4. Dismount the original gas mixer including the bar linkage to the stepper motor according to the manufacturer's instructions.
5. By dismantling the stepper motor from the original gas mixer, an opening has been created in the intake section of the gas engine and four threaded holes are exposed. Seal this opening gas-tightly by tightening the supplied cover plate into the threaded holes that have become free with the supplied hexagon socket head cap screws using the appropriate torque:

Series	Hexagon socket head cap screws	
	Thread	Torque
200-120	M5	4 Nm (3 lb-ft)
250-150	M8	15 Nm (11.1 lb-ft)

### 5.2.2 Install Flow Body



#### **Explosion hazard! Risk of destruction!**

The self-locking nut of the flow body secures itself against loosening by buckling a plastic ring in the slot of the nut by force-fit after tightening. If the self-locking nut is loosened, the plastic ring buckles again, so that the nut can no longer be securely tightened. If the flow body were to fall apart due to the use of a no longer securable nut, parts of the system will be destroyed, and it could cause an explosion.

For the safe operation of the VariFuel2-TEM, observe the following guidelines:

- The self-locking nut is pre-mounted on unused MOTORTECH flow bodies. For installation, the self-locking nut may be removed one time, and then used only one time for secure attachment.
- Under no circumstances may the used self-locking nut be used again in the event of flow body replacement.

To install or replace the flow body, free access must be provided at the VariFuel2-TEM both on the air inlet and on the mixture outlet.

Proceed as follows:

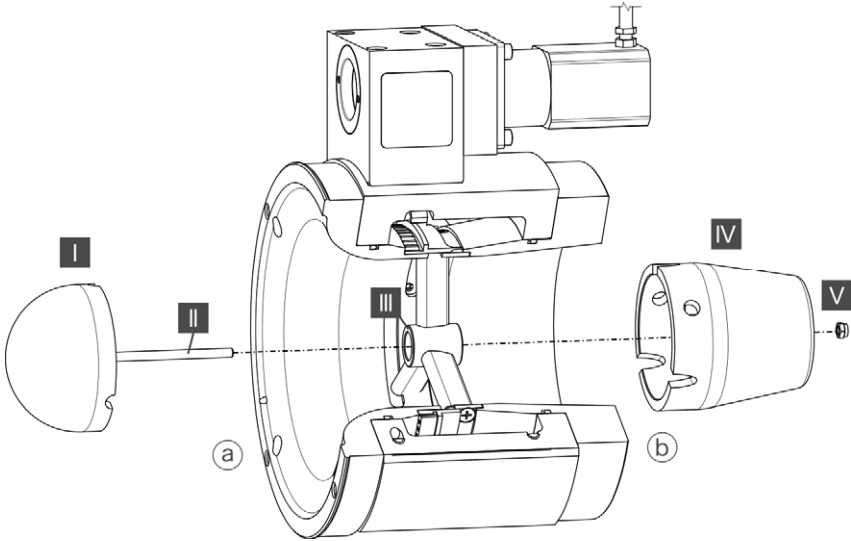


Illustration example

1. A label is enclosed with the flow body. Stick this label onto the field *Flow Body Size* of the VariFuel2-TEM nameplate. This way, you can identify which flow body size is used when the gas mixer is installed.



## 5 Installation Instructions

2. First, completely disassemble the flow body by unscrewing the self-locking nut **V** and disconnecting the two body halves **I** **IV**.
3. To install the flow body, first slide the round half **I** over the central nozzle ring **III** on the air inlet side **(a)**. Note that the smallest flow body ( $\varnothing$  23 mm/0.9") cannot be put on the central nozzle ring, but must be put in front of it.
4. On the mixture outlet side **(b)**, put the second half of the flow body **IV** over the threaded rod **II** of the first half and the central nozzle ring **III**.
5. Secure the threaded rod **II** with the self-locking nut **V**. Apply the adequate torque:
  - Flow bodies made of aluminum: 5 Nm (3.7 lb-ft)
  - Flow bodies made of thermoplastic material: 3 Nm (2.2 lb-ft)

### 5.2.3 Install VariFuel2-TEM into Intake Section

The mounting position of the VariFuel2-TEM gas mixer is arbitrary. For mounting, use the four threaded holes and the flat surface on the bottom side of the device.

The following must be observed during installation:

- The VariFuel2-TEM must be mounted tension-free, i.e. all bores of the flanges must be aligned with the housing bores.
- For the mixture outlet, consider the additional depth of the engine-specific mounting flange.
- For the air inlet, gas inlet and mixture outlet, use only galvanized hexagon bolts.
- Tighten the screws firmly enough so that all connections are gas-tight. Use a suitable torque that matches the strength of the screw.
- Ensure that the inspection window on the fuel ring **7** remains freely accessible and is for example not covered by a pipe.
- Take care that the inspection window on the drive belt **6** remains easily available for checking and setting the belt tension.
- During installation, ensure that the VariFuel2-TEM is electrically conductive connected to the motor block and thus grounded.
- During installation, make sure that no loose parts get into the VariFuel2-TEM.

Generally, you need to connect the following ports:

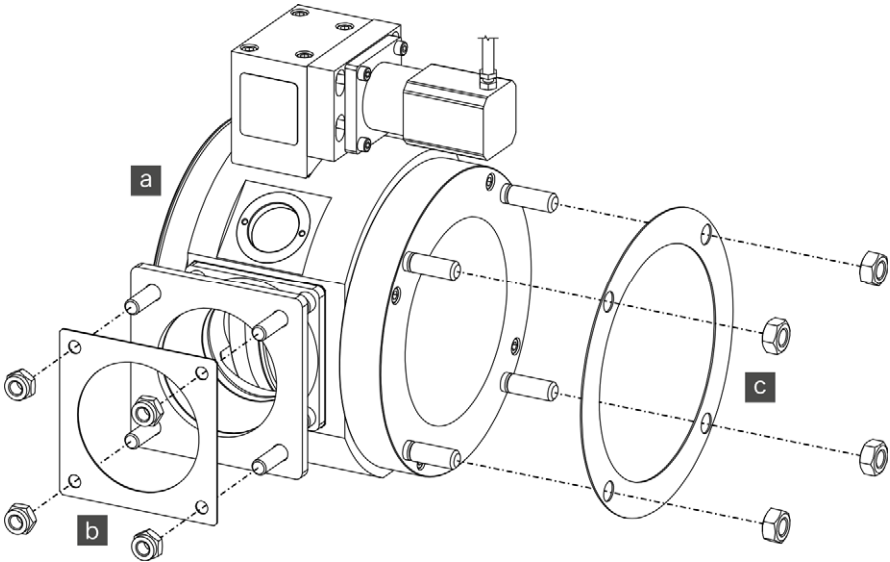


Illustration example



**Explosion hazard!**

If the system is not entirely tight and sealed, the combustible gas mixture may escape and result in an explosion hazard. Therefore, all ports and connections must be gas-tight. Use suitable clean seals and connecting materials.



**Risk of injury!**

When connecting the cables, your fingers may get stuck. For this reason, under no circumstances should you reach into the openings and gaps of the static air/gas mixer when connecting the lines.

## 5 Installation Instructions

- **Air inlet** **a**  
Series 200-120: Hose connection  
Series 250-150: Flange connection
- **Gas inlet** **b**  
Flexible gas line connection via a mounting flange. It is particularly important that the gas line is flexible if the gas mixer is rigidly coupled with the engine.
- **Mixture outlet** **c**  
Flange connection
- **Impulse line connection** **4**  
Connection for the impulse line of the balance or zero pressure regulator for connection to the air inlet of the VariFuel2-TEM (cutting-ring connection). For optimum performance in accordance with its design, the VariFuel2-TEM must be operated with a balance or zero pressure regulator (see section *Mounting* on page 20). The connection is suitable for hoses with an outside diameter of 10 mm (0.4").
- **Optional: Gauge port** **3**  
Connection for the measuring lead of a pressure gauge to measure the gas pressure at the gas inlet of the VariFuel2-TEM. The connection is suitable for hoses with an inside diameter of 8 mm (0.31").

### 5.2.4 Connect TEM-EVO® System

From the VariFuel2-TEM, the stepper motor and the proximity sensor for closed position detection must be connected to the TEM-EVO® system of the MWM® gas engine for proper functioning. In the TEM-EVO® system, the VariFuel2-TEM is operated with the configuration of the original gas mixer from RMG®. As a rule, however, a different start position will be required for the VariFuel2-TEM than for the original RMG® gas mixer. For more information on setting the start position of the VariFuel2-TEM, refer to the section *Start-up* on page 27.

Proceed as follows when connecting the VariFuel2-TEM to the TEM-EVO® system:

1. Connect the connection cable of the stepper motor **1** to the respective stepper motor connection on the gas engine.
2. Connect the proximity sensor **2** to the original connection cable from the gas engine by plugging the cable onto the proximity sensor and screwing it tight.
3. Make sure that the original connection cable between the proximity sensor and the TEM-EVO® system is connected to the respective proximity sensor connection on the gas engine.
4. Restore the power supply for the stepper motor and the proximity sensor.
  - ▶ The VariFuel2-TEM is installed and ready for operation.

## 6.1 Start-up



### Explosion hazard!

If the system is not entirely tight and sealed, the combustible gas mixture may escape and result in an explosion hazard. Always check the tightness of the system before start-up. Upon completion of your works, make sure that you close the gauge port on the VariFuel2-TEM.



### Risk of destruction! Operational safety!

Damage to the gas engine and excessive exhaust gas values can occur if the stepper motor driver is not parameterized correctly. During start-up, check the parameterization of the stepper motor driver and the correct function of the gas mixer.



### Operational safety!

Contaminated gas can lead to blocking of the fuel ring and thus can cause the gas engine to stop. Examine the VariFuel2-TEM regularly for contamination as a part of the regular maintenance intervals customary for your system. Use clean gas preferably.

### Basic Settings of the System

With an ideal design, the VariFuel2-TEM gas mixer is operated in a range between 15 % and 80 % of the fuel ring's opening. In this way the prescribed emission values should be complied with at nominal load. For the engine start, additionally specify a suitable start position in the master control.

The VariFuel2-TEM gas mixer is a Venturi mixer. For optimum performance according to its design, it is important that air pressure and gas pressure are equal, so that the gas is sucked in by the Venturi effect alone. Therefore, operate the VariFuel2-TEM gas mixer solely with a balance or zero pressure regulator connected to the air inlet of the VariFuel2-TEM via the impulse line connection of the VariFuel2-TEM. Also, adjust the balance/zero pressure regulator in such a way that the balance/zero pressure regulator equalizes the gas pressure with the air pressure. Otherwise, if the connection or adjustment is incorrect, the gas will be forced into the gas mixer and not sucked in alone, which can lead to a performance loss.

## 6 Operation

### Problems When Starting

Often the gas engine's problem is its starting performance. With the starting speed the air speed in the gas mixer is very low, which will cause very low suction pressure at the gas inlet. This can lead to not enough gas being sucked into the engine to make the mixture ignite. The following procedures may be helpful:

- MOTORTECH recommends to start with an opening of the fuel ring of 30 % to 35 %. If the engine does not start, open the fuel ring in steps of 1 to 2 %.
- For gases with low fuel value, it may be necessary to set the balance/zero pressure regulator to a slight overpressure (max. 5 mbar for starter speed) for the engine start phase. Do not set the overpressure too high, because too much gas content in the engine can lead to start problems. As soon as the engine is running, set the balance/zero pressure regulator back to pressure balance in idle at nominal speed. This setting guarantees that adequate suction pressure exists at the gas inlet at engine start.

### Engine Does Not Reach Nominal Power

With the prescribed emissions, the engine does not reach its nominal power. The following scenarios might be possible:

#### Scenario 1:

- The opening of the fuel ring is in the range between 15 % and 80 %.
- The nominal power is reached by enriching the mixture.
- At the gauge port of the VariFuel2-TEM, an underpressure greater than 30 mbar is measured.

In this case, it is necessary to increase the air supply. This can be achieved based on the following measures:

- Check air filter for dirt or excessive back pressure. Clean or replace air filter if necessary.
- Check underpressure in the air intake line (standard value: –5 mbar to –25 mbar)
- Install a smaller flow body. To do so, please contact MOTORTECH (see *Customer Service Information* on page 34).

#### Scenario 2:

- The opening of the fuel ring is > 95 %
- The nominal power is not reached by enriching the mixture.
- An underpressure less than 60 mbar is measured at the gauge port of the VariFuel2-TEM.

In this case, it is necessary to increase the gas supply. To achieve this, install a larger flow body. To do so, please contact MOTORTECH (see *Customer Service Information* on page 34).

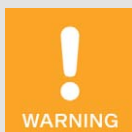
### 7.1 Special Tools for Troubleshooting

Special tools have been developed at MOTORTECH which are needed to carry out certain work safely and conveniently for the maintenance and repair of VariFuel2-TEM gas mixers. The following tools can be obtained from MOTORTECH:

- **VariFuel Locking Tool for Toothed Pulley**  
With this tool, you lock the toothed pulley of a VariFuel2-TEM gas mixer to tighten or loosen the hexagon socket head cap screw with which the toothed pulley is attached to the shaft.
- **VariFuel Tool for Inspection Window**  
You use the VariFuel Tool for Inspection Window to mount and dismount the inspection window on the upper part of the VariFuel2- TEM housing.
- **VariFuel Adjustment Tool for Belt Tension**  
The VariFuel Adjustment Tool for Belt Tension is ideal for adjusting the tension of the drive belt of a VariFuel2-TEM air/gas mixer.

The tools are supplied with brief operating instructions, which must be taken into account during use.

### 7.2 Possible Faults



#### **Explosion hazard!**

If the system is not entirely tight and sealed, the combustible gas mixture may escape and result in an explosion hazard.

The device's tightness is checked and guaranteed by MOTORTECH after production.

If the device is opened by the customer for installation or maintenance purposes, the customer is responsible for restoring the system's leak tightness.

If the customer cannot guarantee this, the device must not be opened and must be replaced and returned to MOTORTECH to remedy any failures.

## 7 Errors

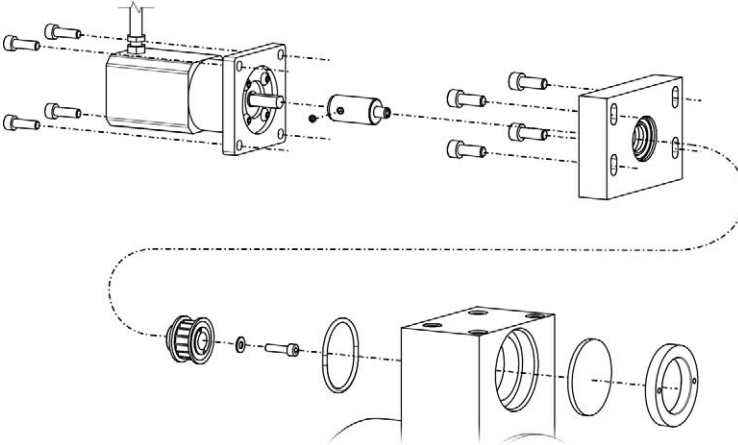
### Troubleshooting

Problem	Possible cause	Solution
Movement of the fuel ring lags.	Belt tension is too low.	Adjust belt tension with the VariFuel Adjustment Tool for Belt Tension.
	Stepper motor is defective.	The stepper motor must be replaced. In case of questions, please contact your MOTORTECH contact person.
Fuel ring does not move.	Fuel ring is dirty.	The VariFuel2-TEM must be cleaned and wearing parts must be replaced if necessary. In case of questions, please contact your MOTORTECH contact person.
	Impact from master control	Check the master control.
	Shaft has loosened from the stepper motor.	Tighten the shaft with the set screw (see <i>Fix Shaft</i> on page 31). Upon completion, check if the system is properly sealed!
	Stepper motor is defective.	The stepper motor must be replaced. In case of questions, please contact your MOTORTECH contact person.
	Wiring of stepper motor and/or control is defective.	Check the wiring and make sure that the supply voltage is available.
	The toothed pulley has detached itself from the shaft of the stepper motor.	Fix the toothed pulley with the VariFuel Locking Tool for Toothed Pulley.
	Belt tension is too high.	Adjust belt tension with the VariFuel Adjustment Tool for Belt Tension.
Stepper motor does not move without interruptions.	There is <b>no</b> malfunction. When the air/fuel ratio is correct, the motor remains in its position.	

### 7.3 Fix Shaft

All graphics used in this section represent an example of a VariFuel2-TEM series 200-120.

To fix the shaft between stepper motor and VariFuel2-TEM, the stepper motor must be completely dismantled. The explosion view provides information on how the stepper motor has been installed.



#### Dismounting



#### Explosion hazard!

A dirty O-ring can lead to leakage of the VariFuel2-TEM, and there is a risk of explosion when put back into operation. Replace a dirty O-ring. Use only O-rings from MOTORTECH (part of MOTORTECH repair kits).

1. Remove the inspection window in the upper part of the housing with the VariFuel Tool for Inspection Window. Proceed as described in the instructions for use of the inspection window tool.
2. Remove the adapter plate with the stepper motor and the respective O-ring from the housing of the VariFuel2-TEM.
3. Disconnect the toothed pulley from the shaft of the stepper motor. To loosen the hexagon socket head cap screw that secures the toothed pulley to the shaft, use the VariFuel Locking Tool for Toothed Pulley and a hex key SW3. Proceed as described in the instructions for use of the locking tool.
4. Remove the adapter plate from the stepper motor.
5. Loosen the set screw from the shaft.

## 7 Errors

### Mounting

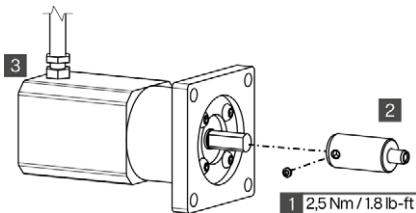
1. Moisten the set screw **1** with medium strength thread lock fluid.
2. Replace the shaft **2** on the axle of the stepper motor **3** and tighten the set screw with the torque stated in the following drawing.



#### Alignment and positioning of the shaft

Observe the following while positioning the shaft:

- The drill hole in the shaft must be aligned with the flattening of the axle.
- Put the shaft onto the axle up to the stop.



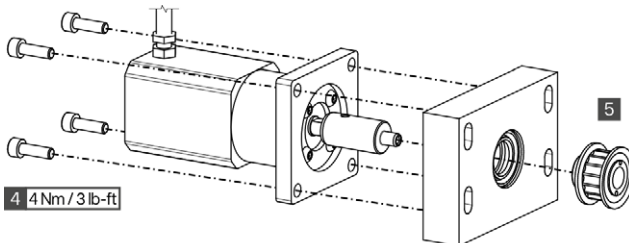
3. Moisten the hexagon socket head cap screws M5x12 **4** with medium strength thread lock fluid.
4. Screw the adapter plate to the stepper motor and place the toothed pulley **5** on the shaft.



#### Observe alignment of the adapter plate and the stepper motor

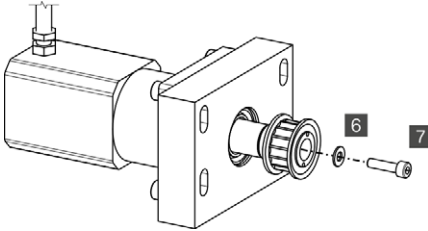
Align the adapter plate as shown in the illustrations.

Align the stepper motor in such a way that you can connect the connection cable to the gas engine as tension-free as possible.

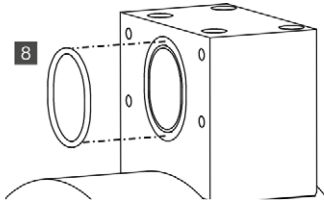


5. Moisten the hexagon socket head cap screw M4x16 **6** with medium strength thread lock fluid.

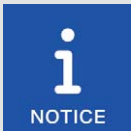
6. Attach the toothed pulley with the washer **7** and the hexagon socket head cap screw M4x16 to the shaft of the stepper motor. To tighten the hexagon socket head cap screw, use the VariFuel Locking Tool for Toothed Pulley and a hex key SW3. Proceed as described in the instructions for use of the locking tool.



7. Insert the O-ring **8** into the housing of the VariFuel2-TEM.

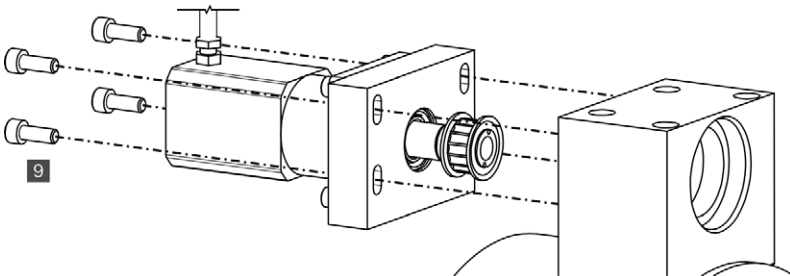


8. Insert the stepper motor into the housing of the VariFuel2-TEM so that the drive belt lies on the toothed pulley, and then attach the stepper motor with the hexagon socket head cap screws M6x16 **9** of the adapter plate to the VariFuel2-TEM.



#### Do not tighten the screws

Do not tighten the hexagon socket head cap screw M6x16 **9**. The stepper motor has to remain movable to enable the correct belt tension to be set.



## 7 Errors

9. Tighten the drive belt with the VariFuel Adjustment Tool for Belt Tension as described in the supplied instructions for use.
  - The stepper motor has been installed.
10. Screw the inspection window back in tightly using the VariFuel Tool for Inspection Window. Proceed as described in the instructions for use of the inspection window tool.

### 7.4 Customer Service Information

You can reach us during our business hours by:

Phone: +49 5141 93 99 0  
Email: service@motortech.de (technical support)  
sales@motortech.de (all other matters)

### 7.5 Returning Equipment for Repair/Inspection

To return the device for repair and inspection, first consult your MOTORTECH contact person (see *Customer Service Information* on page 34). From him you will receive all the information you need to process your order quickly and smoothly. For return shipment, also observe the instructions in the section *Instructions for Packaging the Equipment* on page 34.

### 7.6 Instructions for Packaging the Equipment

For return shipment, equipment should be packaged as follows:

- Use packaging material that does not damage the equipment surfaces.
- Wrap the equipment with sturdy materials and stabilize it inside the packaging.
- Use sturdy adhesive film to seal the packaging.

## 8.1 Maintenance Instructions

**Explosion hazard!**

If the system is not entirely tight and sealed, the combustible gas mixture may escape and result in an explosion hazard.

The device's tightness is checked and guaranteed by MOTORTECH after production.

If the device is opened by the customer for installation or maintenance purposes, the customer is responsible for restoring the system's leak tightness.

If the customer cannot guarantee this, the device must not be opened and must be replaced and returned to MOTORTECH to remedy any failures.

**Risk of injury!**

You could injure yourself or trap your fingers if you expose mechanically moving parts of the gas mixer (e.g. parts of the drive belt) while the stepper motor driver is running.

Always switch off the stepper motor driver during maintenance work and secure the stepper motor against starting up automatically.

Observe the following maintenance instructions:

- All maintenance works which require opening the VariFuel2-TEM (such as fixing the shaft) must only be carried out by personnel trained by MOTORTECH. MOTORTECH offers internal cleaning of the gas mixer. For this purpose, contact your MOTORTECH contact person (see *Customer Service Information* on page 34).
- A visual inspection of the gas mixer must be carried out every time the engine is serviced within the normal service intervals of your system. The visual inspection includes:
  - Checking the fuel ring for dirt
  - Checking the drive belt for signs of material fatigue (e.g. cracks)
  - If necessary, clean the surfaces of mechanical components with a soft brush.
  - Wipe off the stepper motor with a soft cloth.
- Dirty seals (e.g. flat gaskets, O-rings) can lead to leakage of the VariFuel2-TEM. When replacing seals, only use clean seals from MOTORTECH (part of MOTORTECH repair kits).
- Spare parts (e.g. drive belt, fuel ring) are available from MOTORTECH as repair kits. Always use these repair kits, otherwise a proper functionality cannot be guaranteed. Wearing parts must not be reused.
- If a safe repair cannot be carried out, since the gas tightness cannot be tested for example, the device must be returned to MOTORTECH (see *Returning Equipment for Repair/Inspection* on page 34). If needed, a replacement or exchange device can be provided. For this purpose, contact your MOTORTECH contact person (see *Customer Service Information* on page 34).

## 8 Maintenance

### 8.2 Spare Parts and Accessories

For spare parts and accessories, please refer to our current Product Guide, which is available for you to download on the internet at [www.motortech.de](http://www.motortech.de).

## A

Abbreviation.....	6
Accessories .....	29, 36
Application .....	13
Assembly .....	20

## B

Balance pressure regulator	
Connect .....	24
Start-up .....	27

## C

Certification .....	15
---------------------	----

## D

Declaration of conformity .....	15
Declaration of incorporation .....	15
Design .....	17
Dimensions.....	17
Dismounting	
Original gas mixer.....	21
Disposal.....	10

## E

Errors .....	29
--------------	----

## F

Flow body	
Install .....	20
Fuel value .....	13
Function .....	11

## I

Installation .....	20
--------------------	----

## M

Maintenance .....	35
Mechanical data .....	15
MOTORTECH	
Contact .....	34

## O

Original gas mixer	
Dismounting .....	21

## P

Part number .....	16
Proximity sensor	
Connect .....	26

## R

Repair .....	34
Return shipment .....	34

## S

Safety Instructions.....	7
Scope of supply .....	20
Serial number .....	16
Starting performance.....	27
Start-up.....	27
Stepper motor	
Connect.....	26
System configuration.....	27

## T

TEM-EVO® system	
Application .....	13
Connect .....	26
Tools .....	29

## W

Warning notices on the device.....	16
------------------------------------	----

## Z

Zero pressure regulator	
Connect .....	24
Start-up .....	27

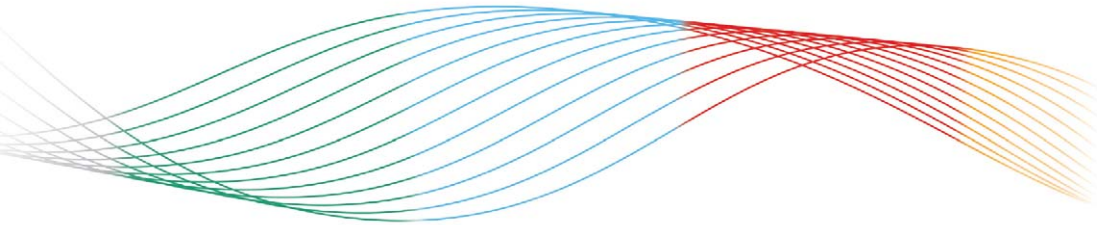


**MOTORTECH GmbH**  
Hunaeusstrasse 5  
29227 Celle  
Germany

☎ +49 5141 93 99 0  
✉ [sales@motortech.de](mailto:sales@motortech.de)  
🌐 [www.motortech.de](http://www.motortech.de)

**MOTORTECH Americas, LLC**  
1400 Dealers Avenue, Suite A  
New Orleans, LA 70123  
USA

☎ +1 504 355 4212  
✉ [info@motortechamericas.com](mailto:info@motortechamericas.com)  
🌐 [www.motortechamericas.com](http://www.motortechamericas.com)



## GAS ENGINE TECHNOLOGY

