Czech Metrology Institute
Notified Body No. 1383
Okružní 31, 638 00 Brno, Czech Republic
tel. +420 545 555 111, fax +420 545 222 728
www.cmi.cz

V 3112

EU-TYPE EXAMINATION CERTIFICATE

Number: TCM 143/14 - 5229

Addition 1

This addition replaces all previous versions of this certificate in full wording.

In accordance: with Directive 2014/32/EU of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments (implemented in Czech Republic by Government Order No. 120/2016 Coll.).

Manufacturer: Metreg Technologies GmbH
Tränkeweg 9
D-15517 Fürstenwalde
Germany

For: volume conversion device

type: MECflexS

MPE 0.5 %

mechanical environment class: M2

electromagnetic environment class: E2

temperature range: -25 °C…+70 °C

Valid until: 28 October 2024

Document No: 0511-CS-A068-14

Description: Essential characteristics, approved conditions and special conditions, if any, are described in this certificate.

Date of issue: 21 June 2017

Certificate approved by:

Český metrologický institut

v.z.

RNDr. Pavel Klenovský

1. Characteristics of instrument

The volume conversion device MECflexS (Fig.no.1 in annex) is an electronic gas volume conversion device which is designed to perform the continuous recalculation of volume at measurement conditions to the volume at base conditions. The volume at measurement conditions is obtained from pulse emitter of gas meter. The measurement of values of temperature and of pressure is performed in optional time periods. The volume conversion device MECflexS is powered by batteries or by mains supply.

The conversion device can be produced:

- in the variant that consists of one temperature transducer and of one pressure transducer. The ratio of compressibility factors is calculated or the ratio of compressibility factors is constant.
- in the variant called T-convertor that consists of one temperature transducer and of no pressure transducer. The value of pressure is constant. The ratio of compressibility factors is calculated or the ratio of compressibility factors is constant.

The conversion device performs the recalculation of the volume at measurement conditions to the volume at base conditions

The base conditions can be:

p_b= 100.000 kPa or 101.325 kPa or 101.592 kPa or 99.994664832 kPa (=14.503 psia) or 101.325352987 kPa (14.696 psia) or 101.559774734 kPa (=14.73 psia)

t_b = 0°C or 15°C (=59 F) or 15.5555556°C (=60 F) or 20°C or 25°C

These values of an absolute pressure at base conditions and of a temperature at base conditions are fixed from manufacturer and the ones can be changed only after breaking of a seal (security mark).

In the software version *4.05* these equations can be used for recalculations:

$$V_m = \frac{N}{k_p} \qquad V_b = V_m * C \quad \text{or} \quad V_b = V_C * C \qquad C = \frac{p}{p_b} * \frac{(t_b + 273.15)}{(t + 273.15)} * \frac{1}{K}$$

Symbol in the software version 4.05	*Represented quantity*	*Units*
C	Conversion factor	-
V_b	Volume at base conditions	m^3
V_m	Volume at measurement conditions	m^3
V_c (optionally)	Corrected volume according to the gas meter error	m^3
V_s *or* V_e	Volume at measurement conditions during faulty condition(s)	m^3
V_{bs} *or* V_{be}	Volume at base conditions during faulty condition(s)	m^3
N	Number of pulses from gas meter	-
k_p	Gas meter constant	imp/m^3
p	Absolute pressure at measurement conditions	kPa
t	Temperature at measurement conditions	°C
p_b	Absolute pressure at base conditions	kPa
t_b	Temperature at base conditions	°C
K *(Z and Z_b can be also displayed.)*	The ratio of compressibility factors $K = \frac{Z}{Z_b}$ where Z is the compressibility factor at measurement conditions Z_b is the compressibility factor at base conditions	-

In the software version *4.06* these equations can be used for recalculations:

$$V_b = \frac{N}{k_p} \qquad V_n = V_b * C \text{ or } V_n = V_C * C \qquad C = \frac{p}{p_n} * \frac{(t_n + 273.15)}{(t + 273.15)} * \frac{1}{K}$$

Symbol in the software version 4.06	*Represented quantity*	*Units*
C	Conversion factor	-
V_b	Volume at measurement conditions (*Betriebvolumen*)	m^3
V_n	Volume at base conditions (*Normvolumen*)	m^3
V_c (optionally)	corrected volume according to the gas meter error	m^3
V_{bS}	Volume at measurement conditions during faulty condition(s)	m^3
V_{nS}	Volume at base conditions during faulty condition(s)	m^3
N	Number of pulses from gas meter	-
k_p	Gas meter constant	imp/m^3
p	Absolute pressure at measurement conditions	kPa
t	Temperature at measurement conditions	°C
p_n	Absolute pressure at base conditions	kPa
t_n	Temperature at base conditions	°C
K *(Z and Z_n can be also displayed.)*	The ratio of compressibility factors $K = \frac{Z}{Z_n}$ where Z is the compressibility factor at measurement conditions; Z_n is the compressibility factor at base conditions	-
V_o	volume which is identical with the volume indicated on the gas meter $V_o = V_b + V_{bs}$	m^3

In the software version *4.06* there other symbols can be used but the correctness of these quantities was not tested and assessed:

V_{bd1} .....for current periodically (hourly) amount of volume at measurement conditions,
V_{bd2} .....for current daily amount of volume at measurement conditions,
V_{nd1} .....for current periodically (hourly) amount of volume at base conditions,
V_{nd2} .....for current daily amount of volume at base conditions,
V_{be1} .....for periodically (hourly) highest amount of volume at measurement conditions on current day,
V_{be2} .....for periodically (hourly) highest amount of volume at measurement conditions in current month,
V_{be3} .....for daily highest amount of volume at measurement conditions in current month,
V_{ne1} .....for periodically (hourly) highest amount of volume at base conditions on current day,
V_{ne2} .....for periodically (hourly) highest amount of volume at base conditions in current month,
V_{ne3} .....for daily highest amount of volume at base conditions in current month.

A corrected volume V_c according to the errors of gas meter in a defined flow rates can be optionally used if HF pulse emitter is used.

The units of values of pressures and of temperatures are optional and can be changed by user.

The conversion device MECflexS counts the pulses from a gas meter and simultaneously the device measures the values of pressure and of temperature of the gas at measurement conditions by independent transducers. The transducers are inseparable from calculator so this device can be called gas volume conversion device type 1 (complete system - see 3.1.18.1. of EN 12405-1/A2).

The value K_1 of the ratio of compressibility factors of natural gas can be computed by methods AGA NX-19 mod., AGA 8 DETAILED CHARACTERIZATION METHOD (designation AGA 8-92DC), SGERG-88, AGA 8 GROSS CHARACTERIZATION METHOD 1 (designation AGA 8-G1) , AGA 8 GROSS CHARACTERIZATION METHOD 2 (designation AGA 8-G2), or the one can be constant ($K_1=1$ or $K_1\neq1$). A user can change the method of calculation of the ratio of compressibility factors of natural gas but in case where the maximum pressure of the pressure transducer p_{max} is above 2000 kPa (20 bar) the temperature range can be reduced in accordance with the used method of compressibility calculation. The method *AGA NX19 mod.* is allowable only in the model with p_{max}=520 kPa (5,2 bar). The change of the method of compressibility calculation is memorised in the setting archive. The actually used method of compressibility calculation is displayed on the LCD together with the corresponding temperature range.

The conversion device MECflexS is also able to calculate the amount of energy but these functions were not tested and assessed. Only if method AGA 8-92DC is used then the calorific value H_s is calculated according to EN ISO 6976 by the conversion device. A fixed value of H_s (changeable by user) is used for other methods.

The conversion device MECflexS consists of a calculator, of a temperature transducer (1 piece), of a pressure transducer (no pressure transducer or 1 piece). The mechanical construction allows connecting internal or external pressure transducers.

The electronics of the conversion device are placed on three boards. In the down part of the device body there is a board for inputs. This board contains also a main battery, a backup battery and terminal box for the connection of pressure sensor and of temperature sensor. Outputs are placed on this board, too. Optionally on this board the other board for connection of another external transducer of pressure or of temperature can be added. This optional transducer is not under scope of this type approval. In the upper part of device there is a board with processor. In the cover of this board there is an opening for the service switch which allows the access for parameters settings. (Fig.no.1 in annex).

The equipment of the conversion device allows to measure the actual values of pressure p at measurement conditions and of temperature t at measurement conditions, to recalculate the volume at measurement conditions to the volume at base conditions, to summarize the increments to the counter of the volume at measurement conditions and to recalculate the increments to the counter of the volume at base conditions. In accordance with the parameter settings these and other data are saved to archives. Furthermore the limits of values, defined alarms and the internal security are watched.

During the faulty conditions (a fault of the transducer, a fault of the device, a crossing of the limits) the volume at measurement conditions and the volume at base conditions are collected to separate counters. The designation of the volumes at faulty conditions is mentioned above in the tables. During the faulty conditions the device begins to count pulses using both counter of volume at measurement conditions and the counter for spare (substitute) volume at measurement conditions. During the faulty conditions the volume at base conditions is not recorded and only the spare (substitute) volume at base conditions is increased using spare (substitute) values for calculation. During faulty conditions no values are saved into the counter of volume at base conditions. When faulty conditions disappear then the saving to the counters of spare (substitute) volumes is stopped and the device starts to save volume at base condition again.

The indication of values is performed using graphical LCD (128x64 points). The local control can be realised using six-button keyboard. Values to be displayed are selected by means of menu but the structure depends also on a configuration via the serial interface and software. To save energy of a power source the LCD is turned off after 20 seconds when the device is powered by battery. The LCD can be turned on by pressing of any button.

All data of actual values or of saved values or of parameters can be read and maintain by special software. The transition of data can be performed via interfaces (RS-232, RS-485 and IEC-1107 (HIE-01, HIE-03 a HIE-04)) using various protocols (ELGAS ver.2, MODBUS®). The communication with master system can performed by various means – telephone modem, radio modem, GSM, GPRS. In this way various data from device can be read and it is possible to perform parameters setting.

Data influencing metrological characteristics of device are protected by metrological switch which is sealed. In the software versions *4.05* and *4.06* there parameters (composition) of natural gas are saved in the *gas changes archive* which is not erasable by user but cyclically overwrite able. It's possible to perform parameter changes via serial interface or via keyboard.

All changes of the configuration setting are saved. The allowed changes are mentioned down:

- values of volume at measurement conditions and of spare (substitute) volume at measurement conditions during faulty conditions;
- the ratio of compressibility factors K as a constant or the method of calculation of the ratio of compressibility K
- parameters of natural gas (In the software versions *4.05* and *4.06* the changes are saved in the *gas changes archive.*)
- pulse constant of gas meter k_p
- units of quantities or of constants
- setting of archives, periods of measurements of quantities
- zeroing of archives with exception of the *setting archive*
- real time setting
- period of recalculation (Maximum period is 30 seconds.)
- spare (substitute) values of temperature and of pressure for measurement at faulty conditions
- the importance of service switch and the password setting

The device is powered by batteries. The device is able to work more then 5 years in the defined mode. After 90 % of battery lifetime an appropriate warning shall be shown. Data are saved when the define procedure of exchange of battery is used. If it is necessary to use the device in the mode with higher consumption of energy then the mains supply has to be used. The device also includes the standby battery which is capable to ensure the saving of the counters of volumes even during the interruption of the power supply. During the interruption of the power supply the circuits are powered by standby battery. That is why the spare (substitute) volumes are still saved and it is possible to continue to count input pulses from gas meter and to maintain the real time.

The absolute pressure transducer is used for pressure measurement. The main part is piezorezistive silicone sensor. The output signal from this sensor is changed in A/D transducer. The electronics perform the correction of non-linearity a of temperature dependence of pressure value.

The temperature is measured with two wires platinum resistance sensor Pt1000. The influence of the length and the properties of the sensor are taking into account during the calibration of the temperature sensor.

The volume at measurement condition is measured by counting the pulses from gas meter with defined pulse constant. The pulse input in the conversion device is able to evaluate pulses from LF emitters (reed contact, contact without potential, Wiegand) or from HF emitters (NAMUR, only with external power source).

The location of transducers of pressure and of temperature in the pipe(s) is recommended by procedure of the manufacturer. The conversion device is approved to be used in the hazardous area.

2. Main characteristics

Maximum permissible error of the conversion factor under reference conditions ±0.5 %

Electromagnetic environments: E2
This class applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in other industrial buildings.

Mechanical environments: M2
This class applies to instruments used in locations with significant or high levels of vibration and shock, e.g. transmitted from machines and passing vehicles in the vicinity or adjacent to heavy machines, conveyor belts, etc.

Climatic environments: -25°C to 70°C
The device is designed for indoor areas with non-condensing humidity.

Mechanical parameters:

- dimensions (width x height x depth)	(193 x 160 x 73) mm
- weight	maximally 1.2 kg
- material of casing	polycarbonate

Ingress protection: IP 66

Explosion proof make:
- identification
  MECflexS — Ⓔx II 1G Ex ia IIC T4/T3 Ga
- area classification — ZONE 0, ZONE 1, ZONE 2
- certificate number — FTZÚ 14 ATEX 0136X

Power supply:
- supplying battery type — lithium 3.6 V/17Ah
- supplying battery voltage — 2.9 V – 3.6 V
- supplying battery life measuring — yes, warning after 90 % of its lifetime
- feeding from external power supply — from recommended source
- voltage of external JB power supply — 4.5 V to 10 V
- standby battery type — lithium 3.6 V/1Ah
- standby battery life — 10 years in defined conditions

Software version in the MECflexS:

Software block	Identification	CRC
Metrology part	Ver.4.05	7D98
Loader	Ver.1.14	2C9A

This software version is approved according to WELMEC 7.2 Guide:
Extension L: Long-term Storage of Measurement Data
Extension T: Transmission of Measurement Data via Communication Network
Extension D: Download of Legally Relevant Software

Software block	Identification	CRC
Metrology part	Ver.4.06	0867
Loader	Ver.1.14	2C9A

This software version is approved according to WELMEC 7.2 Guide (2015):
Specific requirements for embedded SW for a built-for-purpose measuring instrument (type P)
Extension I2: gas meters and gas volume conversion devices
Extension T: transmission o legally relevant data

Period of measurement : 1 s to 30 s

Pressure measurement:
- number of inputs — 0 or 1
- absolute pressure transducer — silicon piezorezistive sensor
- type — KP070
- measuring ranges — (80 ÷ 250) kPa
  (80 ÷ 520) kPa
  (160 ÷ 520) kPa
  (200 ÷ 1000) kPa
  (300 ÷ 1000) kPa
  (400 ÷ 2000) kPa
  (700 ÷ 3500) kPa
  (1400 ÷ 7000) kPa
  (80 ÷1000) kPa
  (400 ÷7000) kPa
- accuracy of measurement — < 0.25 % of a measured value

- maximal overload capacity	125 % of upper limit of measuring range
- make	internal or external
- external sensor cable length	maximum 5 m

Allowed setting of pressure constant (absolute pressure at measurement conditions) if the device is T-convertor	80 kPa - 1000 kPa

Temperature measurement:	
- number of inputs	1
- sensor	resistive Pt1000, 2 wires
- type	TR115
- measuring range	-25°C to +60 °C
- measurement error	±0,2°C
- external sensor cable length	maximum 10 m

Digital inputs:	terminals: DI1-DI4
- number	4
- input options (SW configuration)	NF pulse input, HF pulse input, binary input
NF pulse input:	terminals: DI1-DI2
- maximal frequency	10 Hz
- input type	Reed contact or non-potential output, WIEGAND
- open circuit voltage	2.8 V – 3.6 V
HF pulse input:	terminals: DI1-DI2, with external power supply
- maximal frequency	5 kHz
- input type	NAMUR (DIN 19234)

Interface for communication with master system:	All interfaces share common communication channel.
Metallic interfaces	
- serial communication interface	RS-485 or RS-232
- communication protocol	optional, according to the firmware version
RS-232 line	terminals: TxD, RxD, GND1, CTS
RS-485 line	terminals: U1+, GND1, D1+, D1-
Interface IEC-1107	

The allowed ranges for methods of calculation of the ratio of compressibility factors:

Method	Pressure range	Temperature range
AGA NX-19 mod	(80 ÷ 250) kPa (80 ÷ 520) kPa (160 ÷ 520) kPa	(-25 ÷ +60)°C
AGA 8-92DC	(80 ÷ 250) kPa (80 ÷ 520) kPa (160 ÷ 520) kPa	(-25 ÷ +60)°C

AGA 8-92DC	(200 ÷ 1000) kPa (300 ÷ 1000) kPa (400 ÷ 2000) kPa (700 ÷ 3500) kPa (1400 ÷ 7000) kPa (80 ÷1000) kPa (400 ÷7000) kPa	(-25 ÷ +60)°C
SGERG-88 AGA 8–G1 AGA 8–G2	(80 ÷ 250) kPa (80 ÷ 520) kPa (160 ÷ 520) kPa (200 ÷ 1000) kPa (300 ÷ 1000) kPa (400 ÷ 2000) kPa (80 ÷1000) kPa	(-25 ÷ +60)°C
SGERG-88 AGA 8–G1 AGA 8–G2	(700 ÷ 3500) kPa (1400 ÷ 7000) kPa (400 ÷7000) kPa	(-10 ÷ +60)°C

Note: If a measured value of temperature is out of limits of the used method of calculation of the ratio of compressibility factors then the devise starts to count the volumes into spare (substitute) volumes. In this case the spare (substitute) value of the ratio of compressibility factors is used but the actual value of temperature and the actual value of pressure are used if they are in the ranges of used transducers.

3. Test

Tests and conformity assessment according to the module B were performed in the laboratory of Czech Metrology Institute (department of gas flow) and in the laboratory of manufacturer. Serial number of tested sample was 1709090001. The test results of the other similar types were also taken into account because the constructions and the transducers are similar.

Tests and assessments were performed according to the harmonised standard EN 12405-1/A2 *Gas meters – Conversion devices- Part 1: Volume conversion.* All used standard meters were traceable to national standards and were regularly recalibrated.

The conversion device of type MECflexS complied with all specified requirements and the one is able to fulfil the determined purpose which was designed for.

The results of tests and of assessment are summarised in the ***Test Report No. 5012-PT-A0007-17.***

4. Markings

Each conversion device shall be marked with the following information on the device (Fig. no.2 in annex) :

- type: MECflexS
- serial number/ year of manufacture
- name and address of manufacturer
- MPE at reference conditions
- ingress protection (IP code)
- number of the EU-type examination certificate: **TCM 143/14-5229**
- range of the pressure transducer
- maximal range of the temperature transducer
- identification mark for using in hazardous area Ex II 1G Ex ia IIC T4/T3 Ga
- valid certificate number for explosion (hazardous) area FTZÚ 14 ATEX 0136X
- extreme temperatures of the environmental class T_{amb}
- 'CE' marking and supplementary metrology marking 'M' and the last two digits of the year of its affixing. The identification number of the notified body shall follow the 'CE' marking and supplementary metrology marking.

On the display (LCD) there the following information shall be indicated:

- base conditions
- actual method of calculation of the ratio of compressibility factors
- actual range of the temperature transducer
- parameters (composition) of natural gas if the ratio of compressibility factors K is not constant (or the value of K, if K is constant)
- value(s) of pulse constant(s) of gas meter k_p (imp/m^3)

The language used on labels can be the language of the destination where the device is produced for.

The conversion device that corresponds to this EU-type examination certificate and to other requirements concerning the assessment according to the module F or D is sealed in the way mentioned in Fig. no. 3 in annex. A metrological switch is switched off before sealing. The adhesive stickers are used for sealing. Place of sealing:

- main device label ... 1 sticker
- cover on PCB in the top of the conversion device ... 2 stickers
- label covering the metrology switch ... 1 sticker
- cover on PCB in the bottom of the conversion device ... 1 sticker

Annex:

Figure no.1 Design of the conversion device MECflexS

Figure no.2 Examples of English and of German variants of label on the front (top) panel of MECflexS (Other language variations are allowed.)

Figure no.3 Places of seals (security marks) in form of stickers on the conversion device of type MECflexS

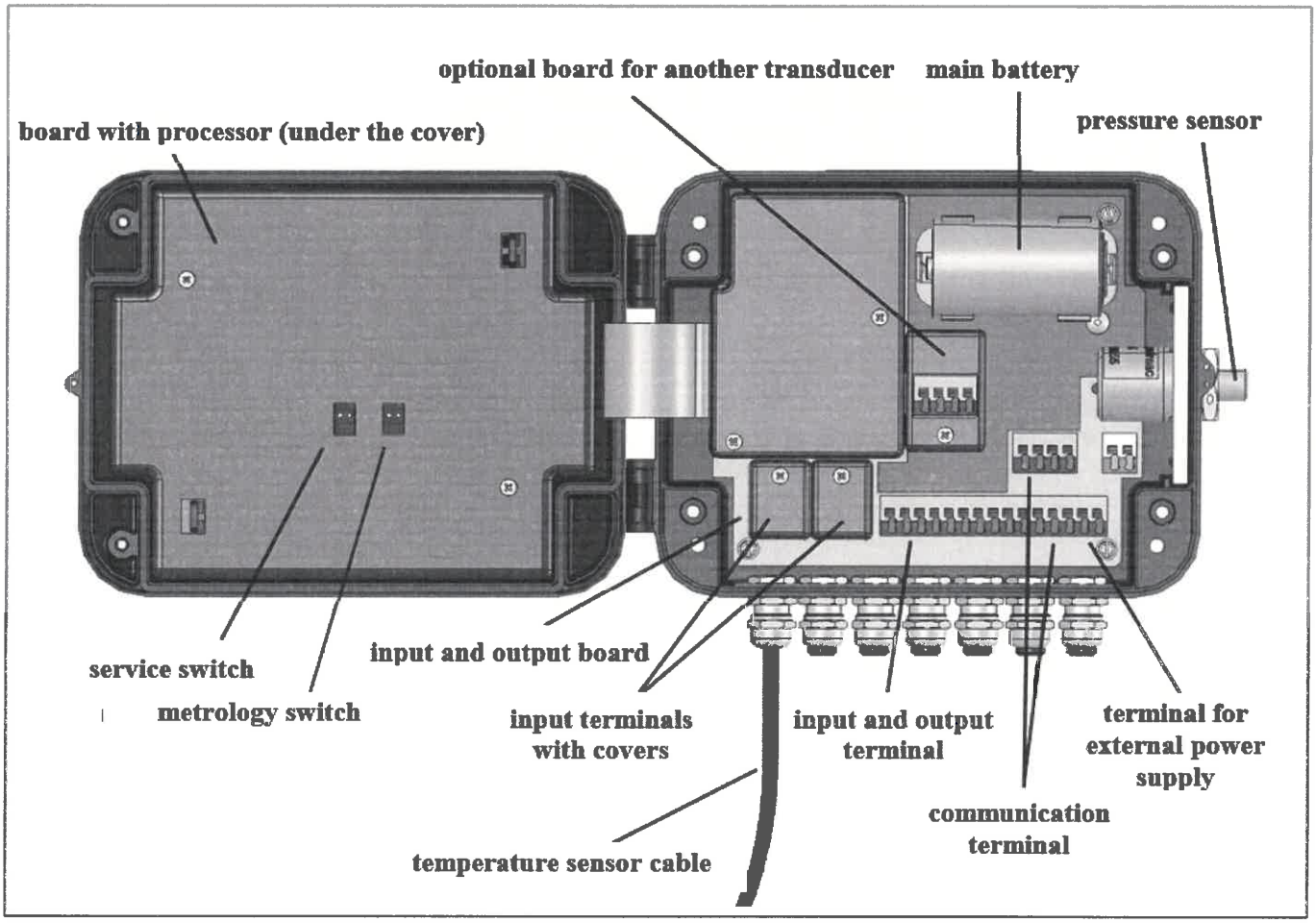
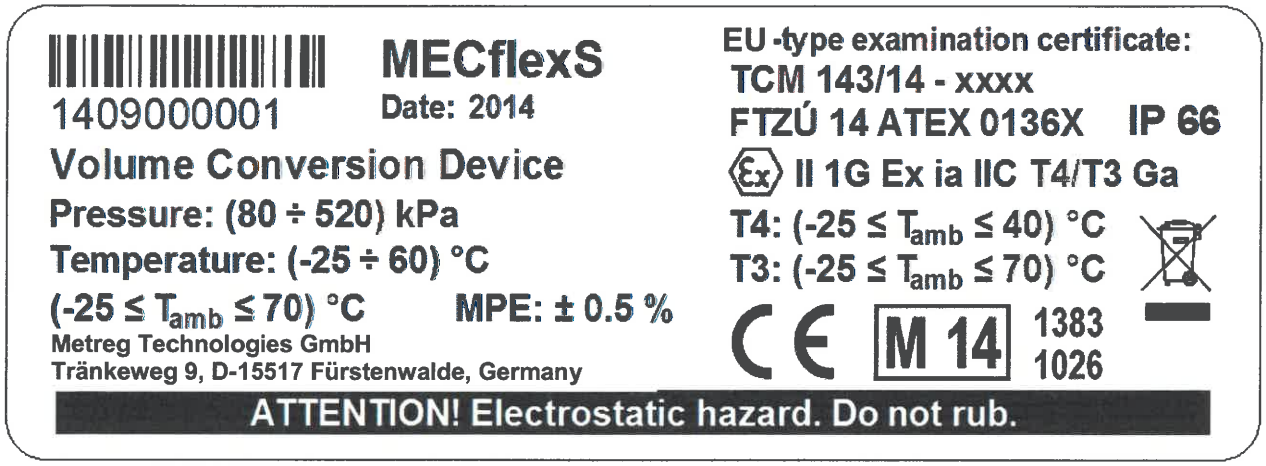


Figure no.1 Design of the conversion device MECflexS



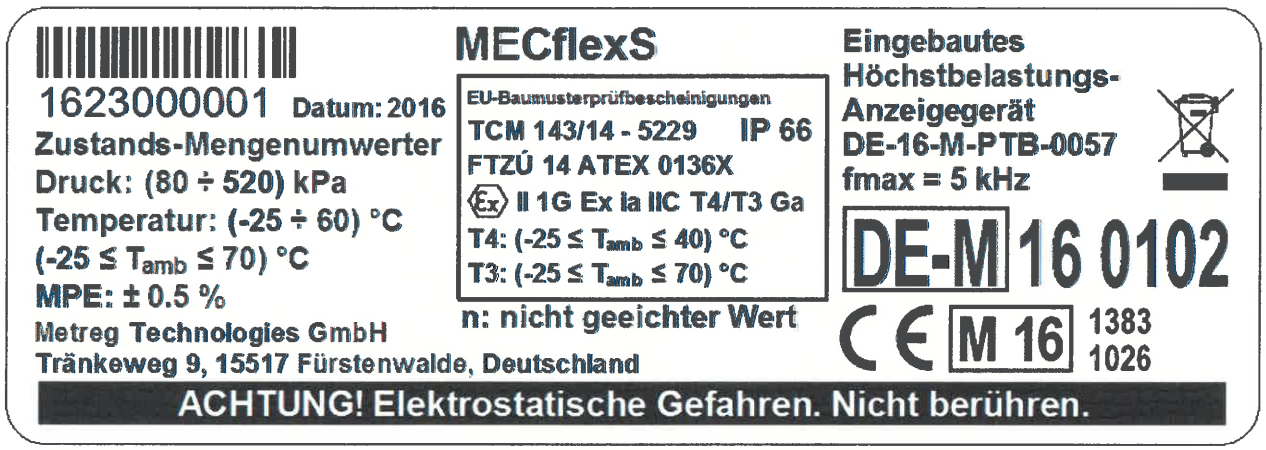


Figure no.2 Examples of English and of German variants of label on the front (top) panel of MECflexS (Other language variations are allowed.)

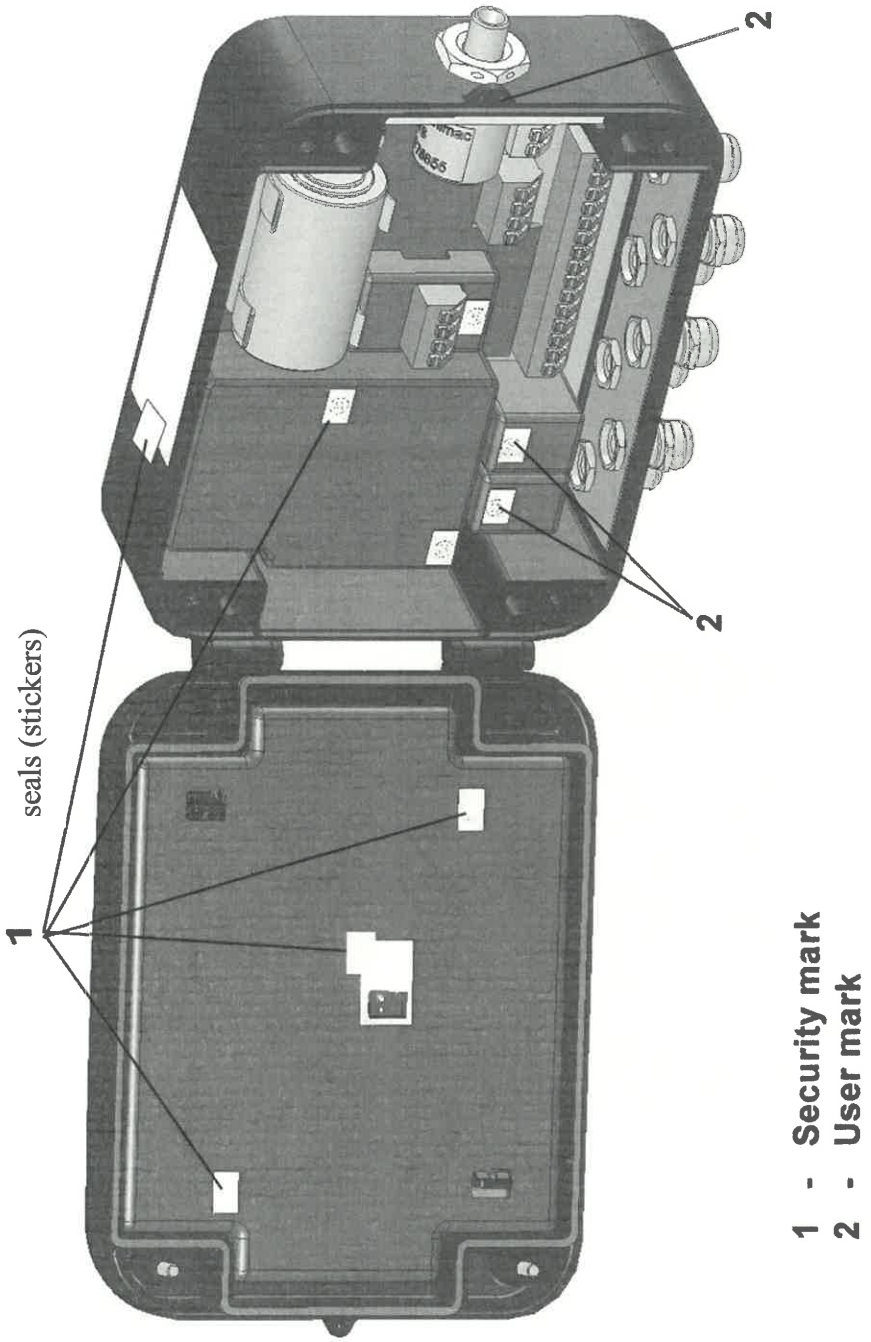


Figure no.3 Places of seals (security marks) in form of stickers on the conversion device of type MECflexS