

Mass flow measuring system for liquefied LPG



Hereby we present electronic LPG delivery recording system designed for installation on tank trucks. This technology, utilizing Coriolis mass flow meter along with auxiliary equipment, has already well proven itself in field and is now available for mobile applications.

Use of the LPG delivery recording system operating on the basis of product mass measurement minimizes product losses caused by inaccurate measurements that might occur on the volumetric systems because of thermal expansion phenomena, thanks to high accuracy and linearity of mass measurements that LPG delivery recording system provides. The main differences between traditional volumetric meters and mass flow meters are that mass flow meters provide much higher accuracy, higher capacity, and do not require any maintenance thanks to lack of moving parts in the construction of mass flow meters. LPG delivery recording system allows for measurement of product density, its temperature and also volume.

General description

Electronic measuring system for LPG tank trucks, designed and assembled by Nebimak, consists of two main components:

- Endress Hauser Coriolis mass flow meter, type LPGmass assembled together with back check valve, strainer, air eliminator and differential valve.
- Electronic register including display, type TE550

Mass flow meter measures mass and density of the product that passes through the meter. Internal sensor the meter is equipped with measures temperature of product.

Basing on the measurements of mass and density the electronic register provides reading of volume of delivered product.

One of the biggest advantages of the mass flow meters is lack of moving parts that could wear. Thanks to this quality maintenance costs are dramatically reduced and the mass flow meter lasts for much longer time than standard volumetric meter.

Electronic register records all events and actions that have been done on the measuring system and stores delivery documents in its memory. Delivery data including mass, uncompensated volume, average temperature of the delivery, density, totalizers and timers can be viewed on the display.

At the end of the shift it is possible to create the delivery report of the day.

The driver operates the electronic register by means of push buttons located on the front panel of the display. It is possible to preset the amount of product that is to be delivered. When this amount is reached the measuring system stops the flow automatically.

Parameters of the system

Coriolis mass flow meter, type LPGmass DN40, PN40

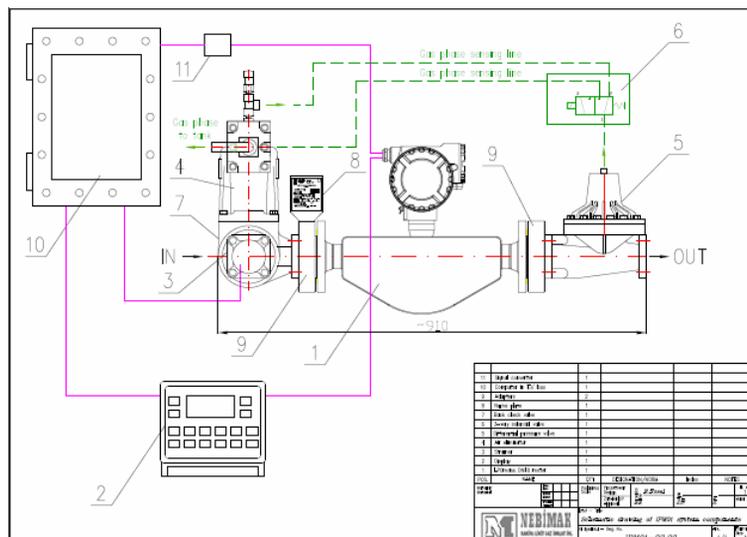
Operating temperatures: -40 +125 °C

Protection electronic: IP67

Materials:

- measuring tubes: stainless steel 1.4539/904L
- housing of sensor: stainless steel 1.4301/304
- flanges: stainless steel 1.4404/316
- housing of transmitter: powder coated die-cast aluminum

Weight of meter: 13,7 kg



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Electronic register, type TE550 Display (LKI)

Graphic display LCD 240x 128 pixels with backlighting by a white LED matrix. Dimensions of visible area: 112x62 mm

Keyboard: 16 keys in fireproof polyester

Power delivery: 12 V DC

Degree of protection: IP66

ATEX certificate: EEX ia IIB T4

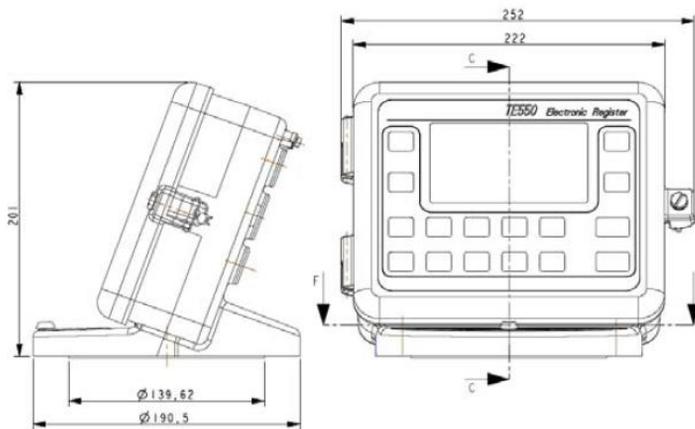
Communication: RS485

Dimensions: 222.3 (length) x 200.86 (width) x 190.5 (height) in mm

Weight: 3 kg

Material: Aluminum alloy

Color: Blue



Electronic register, type TE550 Main enclosure in EExd execution

Power supply: 110/220 V AC or 24 V DC

Power consumption: 15 W

Degree of protection: IP66

ATEX certificate: EEX d ia IIB T4

Communication: RS232 / 422 / 485

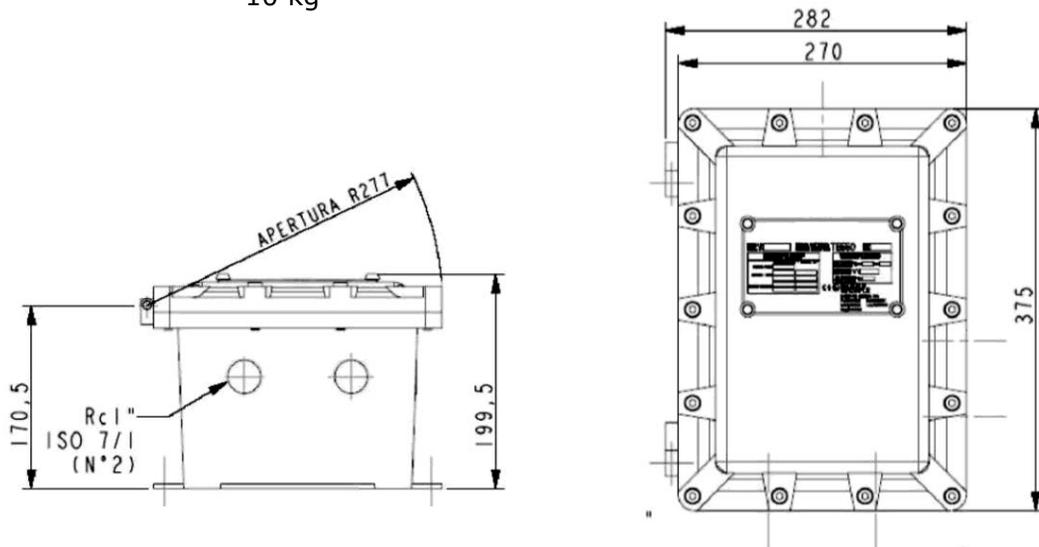
Output: CMOD board (see instruction manual for details)

Digital input: CMOD board (see instruction manual for details)

Analog input: CMOD board (see instruction manual for details)

Dimensions: 375 (length) x 270 (width) x 192 (height) in mm

Weight: 10 kg



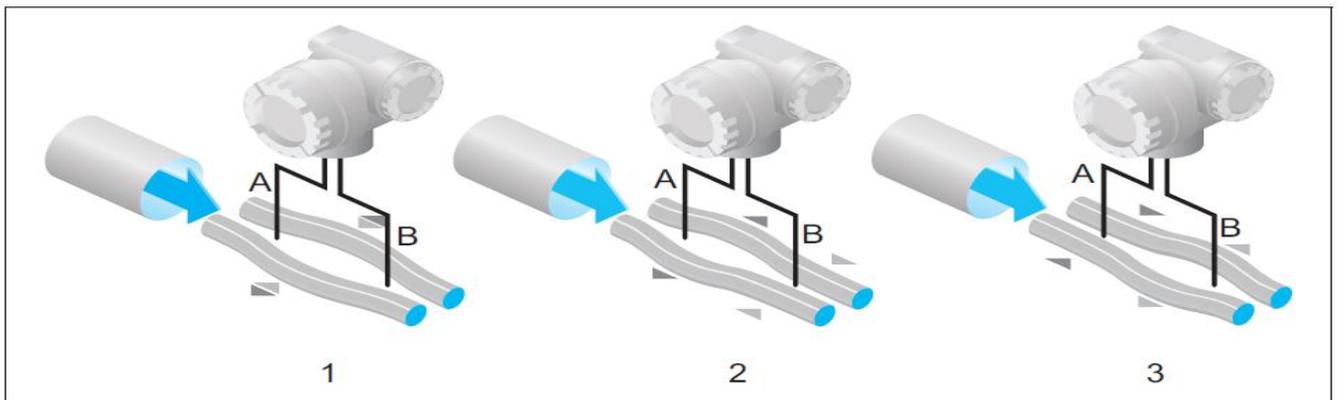
Components of the measuring system

Principle of operation and design of mass flow meter

The measuring principle is based on the controlled generation of Coriolis forces. These forces always occur in a system where translational (linear) and rotational movements are superimposed simultaneously.

In the sensor, two parallel measuring tubes containing flowing fluid oscillate in antiphase, acting like a tuning fork. The Coriolis forces produced at the measuring tubes cause a phase shift in the tube oscillations (see illustration):

- At zero flow, in other words when the fluid is at a standstill, the two tubes oscillate in phase (1).
- Mass flow causes deceleration of the tube oscillation at the inlet (2) and acceleration at the outlet (3).



The phase difference (A-B) increases with increasing mass flow. Electrodynamical sensors register the tube oscillations at the inlet and outlet. System balance is ensured by the antiphase oscillation of the two measuring tubes. The measuring principle works independently of temperature, pressure, viscosity, conductivity and flow profile.

Density measurement

The measuring tubes are always excited at their resonance frequency. A change in the mass and thus the density of the oscillating system (comprising measuring tubes and fluid) results in a corresponding, automatic adjustment in the exciter frequency. Resonance frequency is thus a function of fluid density. The microprocessor utilizes this relationship to obtain a density signal.



Temperature measurement

To make calculations to compensate for temperature effects, the temperature of the measuring tubes is measured. This signal corresponds to the process temperature and is also available as an output signal.

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Components of the measuring system

Electronic register TE550 (main enclosure) being heart of the measuring system

Main enclosure is heart of the measuring system. It contains electronic components that are responsible for control and all functions of the system. Main enclosure was designed specially for rough conditions of mobile service.

Main enclosure design is in full accordance with ATEX directive and therefore is installed close to a meter in the box of the tank truck.



Electronic register TE550 (display)

LCD allows to view details of the operations executed by the measuring system. Following information are available on the LCD during delivery: volume delivered (l), mass delivered (kg), product temperature (C), totalizers (l and kg), rate of flow (l and kg), quantity of product to be delivered (preset quantity). Operator of the system is able to access menu and check the density of the product being delivered. The display is also equipped with push buttons, by use of which, operator is able to control the system – set parameters, quantity of delivery, start and stop the delivery, recall information about the delivery on the screen or print delivery document.



Air eliminator with strainer and back check valve.

The purpose of air eliminator is to separate gas phase from the stream of product being under pressure, prior it enters mass flow meter. Top section of air eliminator is connected by a tube with differential valve that is mounted on the outlet of the meter. These two devices assure that exclusively liquid phase flows through the meter, thus accurate measurement is obtained. Air eliminator is equipped with float and reed assembly. The design of air eliminator chamber as well as float and reed assembly assure separation of gas phase from the stream containing some percentage of gas phase. Air eliminator is assembled with a strainer, which stops particles that might be present in the stream of LPG. Back check valve is installed at the inlet of the strainer and stops the product from returning out of the measuring system. This valve is soft seated one, which allows flow in one direction only.



Electronic temperature compensation

Temperature probe being optional equipment is required if the system is to execute the function of temperature compensation of the delivered product. If the delivery is to be performed in volume units (liters), the uncompensated readings are provided at the actual temperature of the product during delivery. Electronic temperature compensation function allows for obtaining readings in liters compensated to 15°C. Temperature probe provides measurement of actual temperature at delivery, electronic register uses this temperature measurement and basing on the correction tables calculates volume compensated to 15°C

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Differential valve

Differential valve is a diaphragm type, spring loaded valve. Except for the tension of the spring the valve is additionally loaded by pressure that is supplied from the air eliminator installed at the inlet of mass flow meter. The general purpose of the differential valve is to maintain pressure of LPG at level that stops it from vaporization and close flow or slow it down in case of excessive amount of vapor phase in the air eliminator.



Software

Electronic register software is delivered in version no SD-001-550-027-XX. Last two digits of the version number (XX) indicates variation of software that does not influence metrological features of the electronic register. Software version is displayed after turning on the register. Electronic register stores in its memory up to 4100 events.

Mass flow meter software is delivered in version no VI.00.xx where xx means variation of software that does not influence metrological features of the meter.

Control solenoid valve

Solenoid valve provides additional control of the differential valve. Main purpose of solenoid valve is to keep differential valve closed at all times when electronic register is turned off and the system is not in delivery mode. The solenoid valve also provides closure of differential valve when preset quantity of product has been already delivered, when STOP button was pushed or in case the system was turned off for any reason.

Printer

Delivery documents can be printed on standard EPSON printer. The printer utilizes standard printing receipts of 4-1/8" width. Printer should be only installed in the cabin of a truck tractor. Power cable of the printer as well as communication cable is in the scope of supply.



