TrigasDM

Durchflussmesser-Manufaktur

TriLIN

LNA Series

Intelligent Flow Electronics

for Linearization and Temperature Compensation

Operating Manual

TriLIN LNA Series, EN / 10392

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Table of Contents

1 General

Thank you for selecting a TrigasDM product for your flow measurement application.

Flow meter manufacture

As a specialist in flow measurement technology, TrigasDM supplies high-quality measuring instruments, electronics and calibrators for liquids and gases.

Made in Germany

Our products are exclusively developed and manufactured in Neufahrn, 20 km north of Munich, ensuring world-class technical know-how for our customers.

Contact

We are proud of our high-quality products and friendly customer service and welcome you as a valued customer to our growing family. You can benefit from our long-standing experience and our comprehensive technical support.

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This user manual contains information on the description, operation, commissioning and maintenance of the *TrigasDM* TriLIN Linearizer/flow computer. For special applications, repair or further information on this or other products, please contact *TrigasDM* directly.

2 Safety guidelines

2.1 Marking of important information

Important information is specially highlighted in this user manual.

CAUTION
Information related to danger to persons is marked with CAUTION.

ATTENTION
Information related to danger to equipment is marked with ATTENTION.

NOTE
Special information for operation, commissioning and maintenance is marked with NOTE.

Helpful hints

Hints marked with an "i" symbol provide application tips and other useful information, helping to avoid installation and application errors and ensure optimal use of the functions offered by the instrument. The text in the message box is displayed in italics.

2.2 General safety guidelines

Before using your TrigasDM instrument, this user manual and all safety instructions must be carefully read in their entirety and understood.

Take all necessary precautions to ensure the safety of personnel and equipment. These precautions include, but are NOT limited to, the following examples:

- Mechanical and electrical installations must only be carried out by qualified and authorized personnel.
- It must be ensured that the upper limit of the measuring range of the flow meter is not exceeded.
- Do not install measuring instruments and cables in the vicinity of strong magnetic sources, such as electrical cables, electric motors, transformers, welding equipment, relays or high-voltage cables. These sources can cause electrical noise, resulting in incorrect pulse signals.
- Flow meters which are designed for applications in liquids are not suitable for applications in gas.
- Applicable safety standards (for example the ones in accordance with the German Occupational Safety and Health Act) must be observed for the installation and/or operation of the flow meter. Non-observance can result in DANGER to personnel.
- A flow meter is a precision instrument. Do not use compressed air to clean the flow meter or check its function.

3 Description

3.1 List of available models

LNA-RF-11-V1-01-01-00	Basic version without temperature compensation Output signal: TTL pulse + 0-10 V flow rate
LNA-RF-12-V1-01-01-00	Basic version without temperature compensation Output signal: TTL pulse + 4-20 mA flow rate
LNA-RT-11-V1-01-01-00	Version with temperature compensation Output signal: TTL pulse + 0-10 V flow rate
LNA-RT-12-V1-01-01-00	Version with temperature compensation Output signal: TTL pulse + 4-20 mA flow rate
LNA-AT-11-V1-01-02-AC	Version with temperature compensation and TTL input Output signal: TTL pulse + 0-10 V flow rate
LNA-AT-12-V1-01-02-AC	Version with temperature compensation and TTL input Output signal: TTL pulse + 4-20 mA flow rate
LNA-RT-11-V2-06-04-00	With temperature compensation and display Output signal: TTL pulse + 0-10 V flow rate
LNA-RT-12-V2-06-04-00	With temperature compensation and display Output signal: TTL pulse + 4-20 mA flow rate
LNA-RT-11-V1-01-04-00	With temperature compensation and Connectors on one side, Output: TTL pulse + 0-10 V flow rate
LNA-RT-12-V1-01-04-00	With temperature compensation and Connectors on one side, Output: TTL pulse + 4-20 mA flow rate

Designation

- LNA - TriLIN Linearization Electronics / Flow Computer

Input signal options

- RF - RF Pickoff (TriLIN)
- RT - RF pickoff and temperature signal (PT100)
- AT - amplifier pickoff (TTL) and temperature signal (PT100)

Output signal options

- 11 - TTL pulse + 0-10 V Analog flow rate
- 12 - TTL Pulse + 0/4-20 mA Analog flow rate
- 13 - 0-10 V Analog flow rate

Supply voltage

- V1 - 6-36 VDC
- V2 - 9-36 VDC

Housing options

- 01 - Standard TriLIN housing
- 06 - TriLIN housing with display

Connector configuration (input/output)

- 01 - ODU-7 / BNC / ODU-2
- 02 - M12-5 / BNC / M12-5
- 04 - ODU-7 / LEMO-6 / ODU-2
- 05 - ODU-5 / ODU-5 / ODU-2

Wiring

- 00 - Standard
- AC - TTL pulse output with M12 connector pins 1-2

3.2 UVC Function

The TriLIN electronics amplifies and linearizes output signals from flow meters of different types and manufacturers. Optionally, it enables temperature compensation in real time. The FlowHow+ user-friendly software is used for scaling the Analog and Frequency outputs as well as for programming the functions if the Lysis and TriLIN electronics.

The UVC principle is the basis for temperature compensation and has been specifically designed for turbine flowmeters.

- Viscosity Influence

At constant flow, the change in viscosity has the following effect on the frequency output of a turbine flowmeter:

- Viscosity increases → output frequency of the turbine flowmeter decreases
- Viscosity decreases → output frequency of the turbine flowmeter increases

This relationship is illustrated below, in the graph of flowmeter K-factor [pulse/lit] vs frequency [Hz].

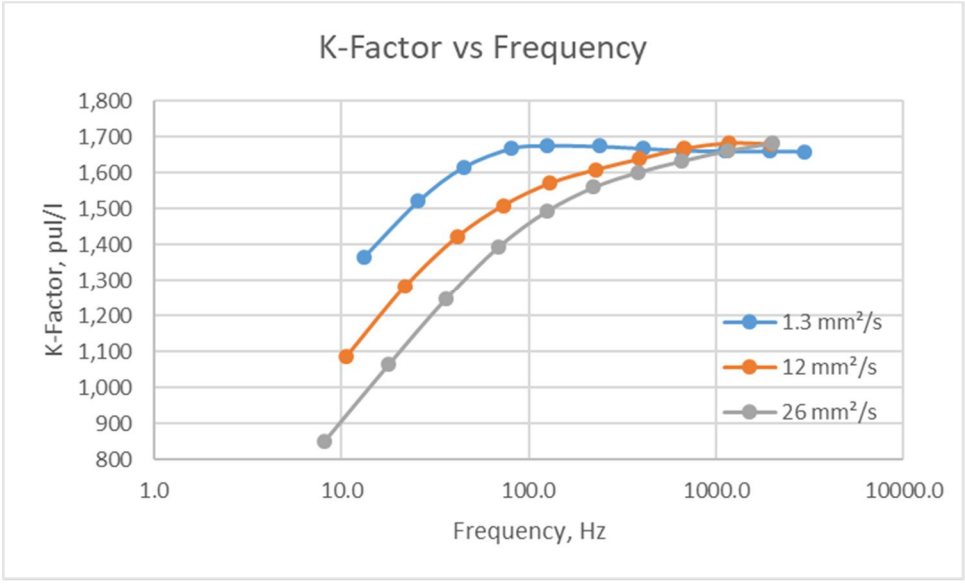

Figure1 Diagram K factor vs frequency

- Compensation of the effect of viscosity
  A turbine flow meter's K-factor can be presented as a single, unique curve when plotted against Reynold's number, which is approximated by the ratio Frequency/Viscosity (Freq/v) as shown graphically below: [Figure2]:

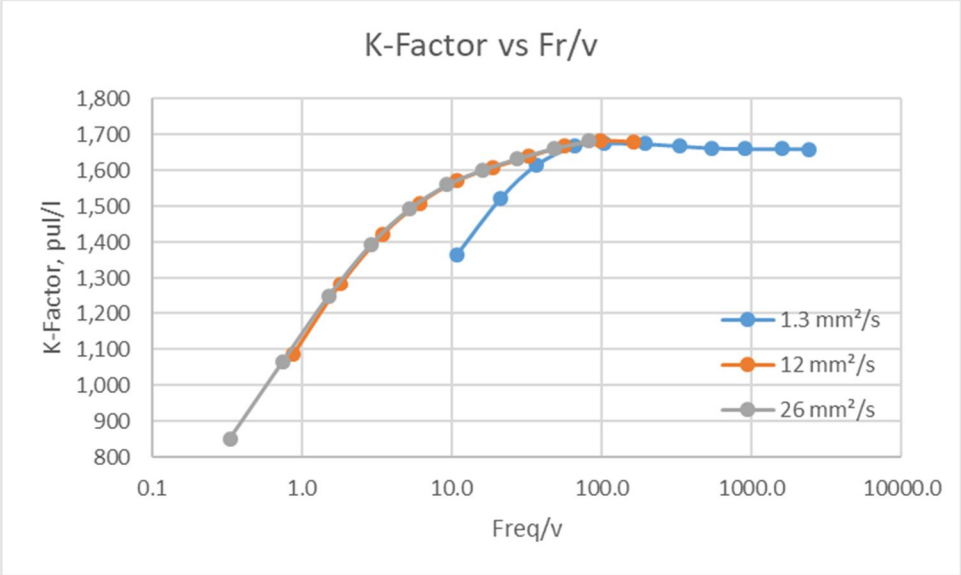

Figure2 UVC graph

It can be seen that there are deviations from ideal behavior at low viscosities and very low flowrates. These deviant calibration points are ignored in the subsequent linearization and temperature compensation.

- Calculation method
  Fluid Properties Tables of Temperature vs Viscosity and Temperature vs Density for the operating medium are programmed into the electronics (See FlowHow+ programming manual). The viscosity of the operating fluid is continuously determined from the Temperature measurement using the fluid tables. The Flow Calculation sequence is as follows:

  - Measurement of the actual flowmeter frequency
  - Measurement of the actual fluid temperature
  - Calculation of the current frequency/viscosity value
  - Determination of the current K-factor from the K-Factor vs Fr/v table (Fig. 2)
  - Calculation of the Volumetric flow rate (Q=frequency/K factor)
    Optional: Calculation of the mass flow rate using the Fluid Properties Tables
  - Scaling the actual temperature Analog output
  - Scaling and output of the current flow at Analog and frequency output

3.3 Technical data

- Power supply: 6 - 36 VDC
- Power consumption: < 0,5 W, about 35 mA @ 12 V
- Weight: ca 350 g, depending on the configuration
- Dimensions
  - Length: 112 mm
  - Width: 108 mm
  - Height: 43 mm
- IP protection class: IP50
- Update rate: 1 ms
- Operating temperature: -40 to +85°C
- Storage temperature: -55 to +125°C
- Ambient humidity: 0 to 85 % relative, non-condensing
- Input/Output: Galvanically isolated

Input signals

The electronics support the following standard signal inputs with an accuracy of 12.5 ns. These can be configured at the factory.

- Carrier frequency signal of carrier frequency signal transducers in the range 0-4 kHz.
  - L = 1 mH
  - R = 10,5 Ω
  - $f_{Carrier}$= 47.5 kHz
- Pulse input of standard frequency outputs in the range 0 - 10 kHz.
  - $U_{Low <}$ 1,5 V
  - $U_{High >}$ 3 - 30 V
  - $Z_{Inlet >}$ 10 kΩ
- Temperature input - PT100, 4 wire

Option: Analog temperature input with 0-10 V can be configured at the factory. See model number guide for details

Outputs

- Frequency, Flow
  Linearized and scaled frequency TTL related to isolated mass
  - Scalable end value up to 10 kHz
  - O_{utput} = 2,2 kΩ
  - Accuracy = 25 ns

The output level can also be configured as follows:

- *10 [V] or*
- *Power supply (in this case there is no galvanic isolation of the frequency from the power supply).*

- Analog, Flow
  0 - 10 V linearized, scalable
  - No zero-point offset
  - Accuracy = 0,0015 % of full Scale
  - Resolution = 16 bits (0,15 mV)
  - Optional: 4 - 20 mA

- Analog, Temperature
  0 - 10 V linearized, scalable
  - No zero-point offset
  - Accuracy = 0,0015 % of final value
  - Resolution = 16 bits (0,15 mV)
  - Optional: 4 - 20 mA

Optionally, a CAN output for temperature and flow can be configured at the factory.

Linearization

The electronics are capable of holding in internal storage for the purpose of linearization and interpolation of up to five different calibration sets, each with up to 64 points in the following forms:

- K factor [pul/l] vs Frequency [Hz] (No Temperature Compensation)
- K factor [pul/l] vs frequency/viscosity [Hz/mm²/s] (with Temperature Compensation)

Cubic Spline

In addition to linear inter- and extrapolation of the Calibration Curve (Figure3), the Lysis/TriLIN electronics also supports Cubic Spline interpolation (Figure4).

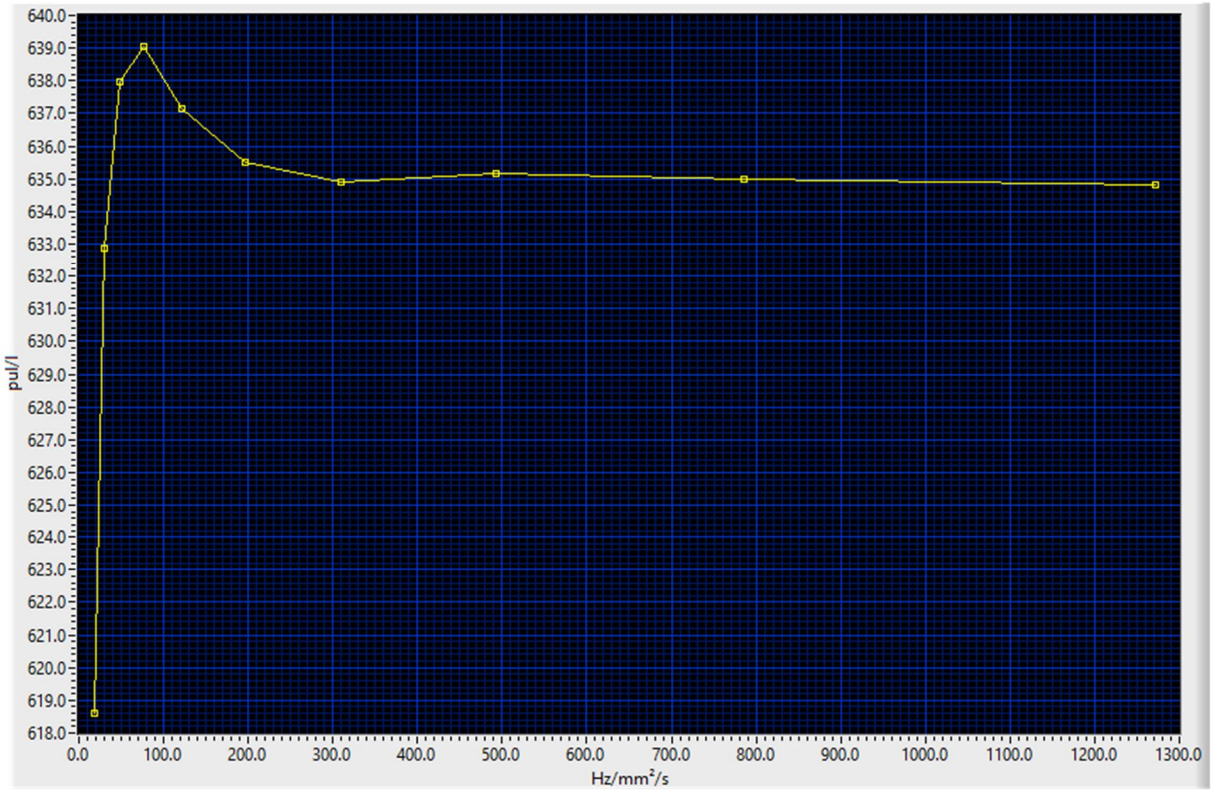

Figure3 Linear interpolation

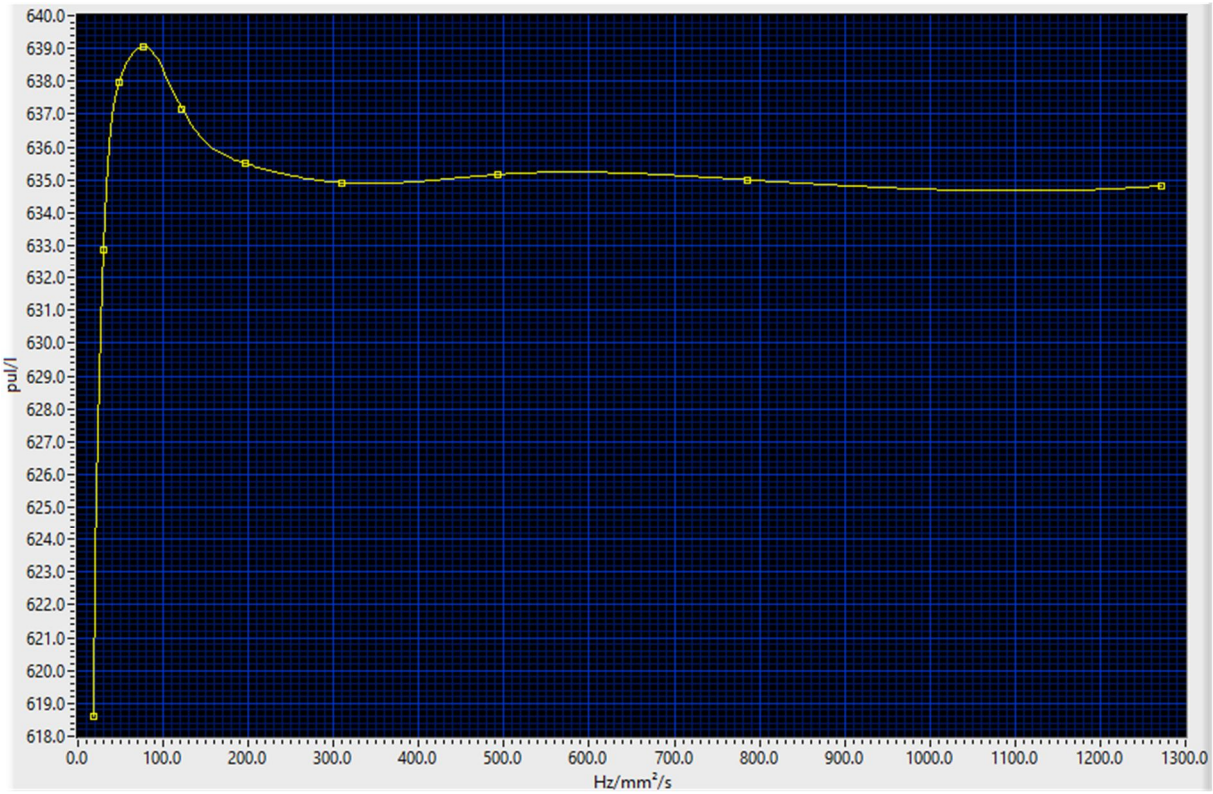

Figure4 Cubic spline interpolation

Liquid Data

The electronics are capable of holding in internal storage for the purpose of linearization and interpolation of up to five different fluid data table sets, each with up to 20 points in the following forms

- Temperature vs viscosity
- Temperature vs density

Detailed information on changing the fluid data is provided in the FlowHow+ programming manual.

Andrade

Andrade equation is a specialized calculation algorithm employed in the Lysis/TriLIN electronics to enable accurate inter- and extrapolation of liquid viscosity data.

Color LED activity explanation

3x Yellow flashing		Power supply active, device powering up.
Red permanently		Data not recognized.
Green permanently		Data recognized, temperature recognized*, no frequency input detected.
Yellow permanently		Data recognized, temperature not recognized*
Flashing red		Data recognized, temperature recognized*, frequency input recognized, flow not in the calibrated range of the flowmeter.
Flashing green		Data recognized, temperature recognized *, frequency input recognized, flow in the calibrated range.

**applies only to TriLIN with temperature compensation. For versions without temperature compensation, the LED can only display the colors red or green.*

4 Installation and commissioning

4.1 After delivery

Please carefully unpack the electronics and ensure that they are free of packaging material leftovers and check for transport damage.

4.2 Programming (See FlowHow+ Programming manual)

The following tools are required for programming the TrigasDM electronics:

- Power supply with 6-36 VDC
- PC with USB interface and Windows operating system
- TrigasDM electronics
- Programming cable/modem
- Multimeter for the functional tests
- FlowHow+ Programming Software

The FlowHow+ software automatically adapts to the hardware configuration. It can thus be used for programming for any TrigasDM electronics. The functionality may vary depending on the configuration of the product.

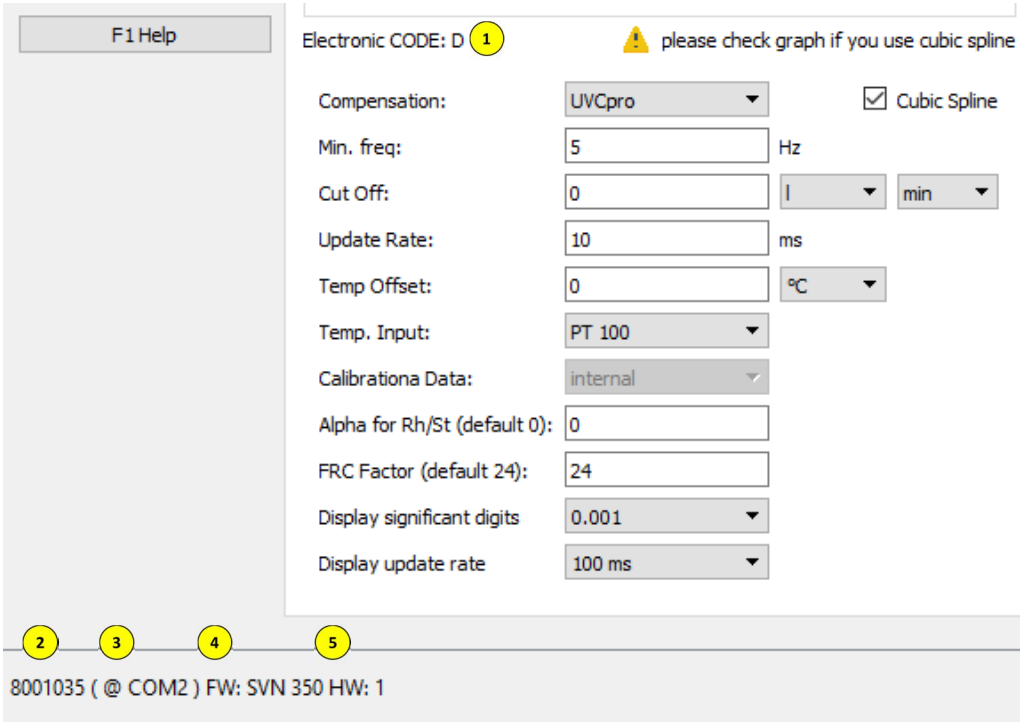

Figure5 Information of the software

(1) Configuration code of the hardware (Figure5**)**
The software functionality is automatically adapted to the configuration code.

(2) PCB serial number (Figure5**)**

(3) COM port (Figure5**)**
Is automatically selected

(4) Firmware rev (Figure5**)**

(5) Hardware rev (Figure5**)**

Only one instance of the The FlowHow+ software can be active on any one computer at any one time.

5 Troubleshooting

5.1 No output signal

If no output signal is detected coming out of the electronics, the following measures can be carried out:

▶ Check supply voltage (6-36 VDC)

The standard power consumption is up to 75 mA @ 6V, depending on the configuration (up to 200mA with display and 4-20mA output)

- Current > 100 mA: The circuit board is defective.
- Current = 0 mA: Electronics have been disconnected incorrectly.

▶ Check the functionality of the flowmeter

Do not test the flow meter with compressed air! It can be damaged!

- Check the functionality of the pickoff:
  - Remove of the pickoff from the flow meter
  - Move iron element back and forth under the pickoff. Pulses should be detected.
- Measure pickoff resistance:
  - RF transducer = 10Ω 15%

▶ Check the status of the electronics in live RUN mode

5.2 Output values are implausible

If the output signal of the electronics is incorrect, the following measures can be carried out:

▶ Check to ensure live RUN mode is turned on in the FlowHow+ software
▶ Check Temperature sensor (or Temperature Analog input signal).
▶ Compare the Analog temperature output with the actual temperature of the medium.

6 Maintenance

The TriLIN electronics are maintenance-free.

However, attention should be paid to performing regular calibration and, if necessary, replacement of defective flowmeters! The recalibration intervals can be defined based on the following:

- Type of flow meter
- System design
- Environmental and operating conditions
- Measuring liquid
- Age

Please consult your flowmeter manual.