BOPP & REUTHER
MESSTECHNIK

Dosing System MID-MDS
Hardware
Electromagnetic flow meters series MID

Converter Card UV14

Operating Manual

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Foreword

I. Transport, Delivery, Storage

Always protect devices against humidity, soiling, impacts and damages.

Delivery Inspection:

Check the delivery for completeness upon receipt. Compare the device data with the data on the delivery note and in the order records.
Report any in-transit damage immediately. Damage reported at a later date shall not be recognized.

II. Warranty

Please refer the contractual terms and conditions relating to delivery for the scope and period of warranty.
Warranty claims shall be conditional to correct installation and commissioning in accordance with the operating instructions of the device. The necessary installation, commissioning and maintenance work should only be carried out by qualified and authorized personnel.

III. General Safety Instructions

1. Electromagnetic flow meters series MID are reliable, high accurate volumetric measuring devices. They should only be used for their intended purpose. Always observe the pressure and temperature limits stated on the type plate, as well as all other technical data and safety information during device installation, start-up and operation.
2. Always observe national and international regulations concerning the operation of devices and systems under pressure.
3. Prior to installation, the operator has to ensure that the pressure bearing parts have not been damaged during transportation.
4. The devices have to be installed, operated and serviced by qualified personnel. The operator has the responsibility to ensure that the personnel have received sufficient and appropriate training. In cause of doubt, please contact the manufacturer.
5. The operator must ensure that the materials used (wetted parts) of the device compared with the measured liquid are chemically resistant.
6. The gaskets or sealing elements must be handled with care according to the operating instructions.
7. The tightening torques for the screw connections at the cover and lower part of the housing, as well as for the flange connections in the pipework are available on request.
8. Symbols used

Warning!
Failure to observe this warning can lead to injury of persons or a security risk.

Attention:
Non-compliance can lead to faulty operation or damage to the device.

1. Identification

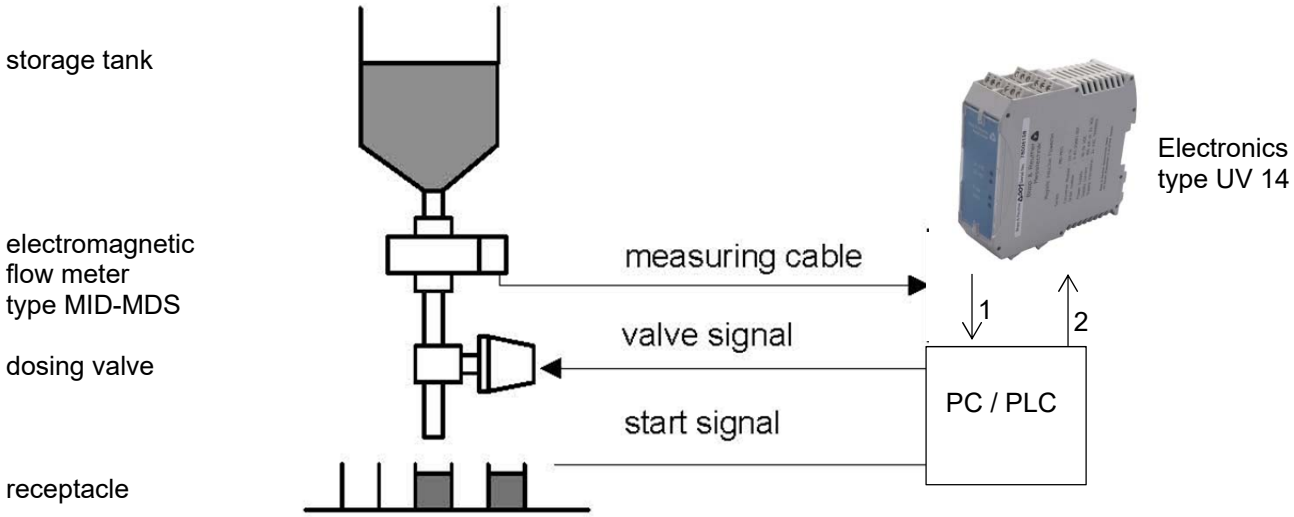
Manufacturer:	Bopp & Reuther Messtechnik GmbH Am Neuen Rheinhafen 4 67346 Speyer / Germany Phone: +49 6232 657-0 Fax: +49 6232 657-505
Product type:	Converter Card UV14
Version No.	A-EN-05801-00Rev.D

2. Application

The Modular Dosing System MID-MDS is used on both linear and rotating filling machines, where high accuracy/repeatability is required. The products must have a minimum conductivity of approx. 1 µS/cm. The minimum dosing time achieved to date is approx. 0.1 sec.
Electromagnetic Flow Meters series MID have no moving parts, and therefore do not apply any "work" to the product which could cause changes to the fluid structure. This also enables CIP/SIP procedures to be carried-out both easily and quickly.

3. Filling system / installation

A filling system/installation generally consists of (Fig.1):

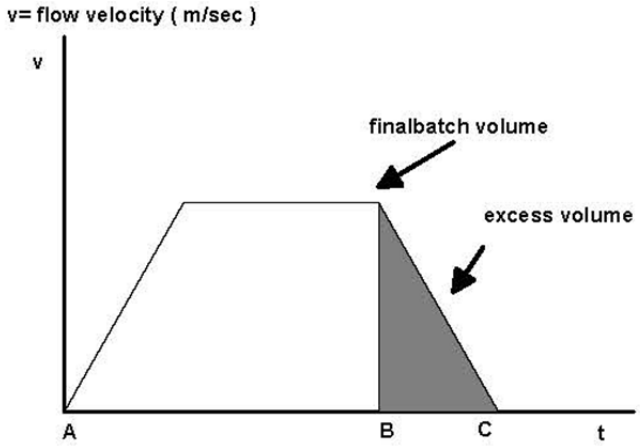


1) Volume pulses
2) valve status

Systems with very short dosing times (min. 0.1 to some sec) need a storage (buffer) tank-see Fig.2- the level of which must be kept more or less constant, e.g. by using a level control system, which automatically opens and closes the feed line to the storage tank. This arrangement supplies a dosing curve (lapse) as shown in (Fig.3):

Fig. 2

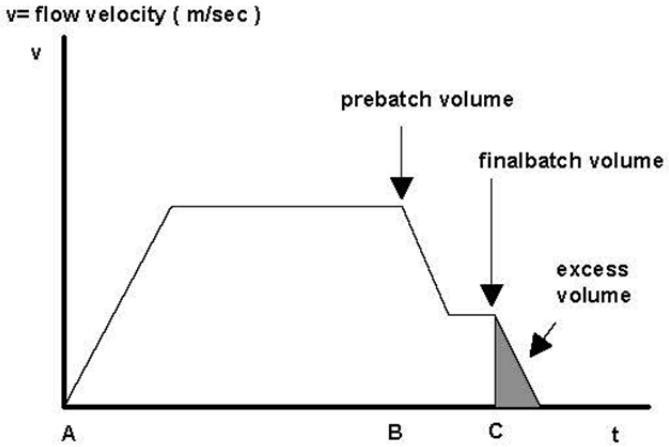
1- stage valve closing



At time A the filling machine starts the batch process and the dosing valve opens. The magnetic flow meter measured the product; the sensed signal is send to the dosing control and also to the preset counter. At the end of the batch (B) the dosing valve receives the signal to close. Because of delay time in the system (mainly the valve) a certain excess volume passes the dosing valve until it is closed and the batch process is finished

Fig. 3

2-stage valve closing



It is possible to decrease the excess volume if a 2-stage valve closing is used. If the valve receives the pre-batch signal (B), then the valve closes to a interposition.
If the valve receives the final batch signal (C) then the valve closes completely.
This kind of valve closing should be used if

- the meter size is > DN 20 or
- the batch is > 0,5 l / sec.
- the velocity in the pipe is > 5 m/sec

4. The components of a filling system should meet the following requirements

a) <u>storage tank (no pressure, head of liquid only)</u>

The tank dimension (dia.height) should be such that a batch process (one filling) only causes a very small level variation (decrease). In the event of a large variation, the head (gravity) decreases rapidly, the excess volume is altered (Fig.4) and both accuracy and reproducibility vary.

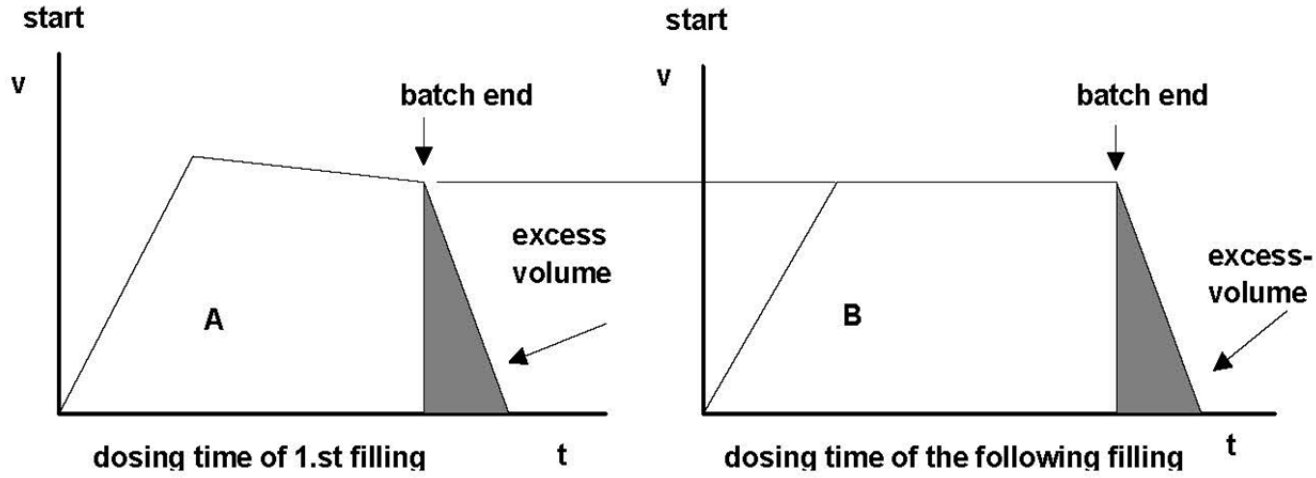
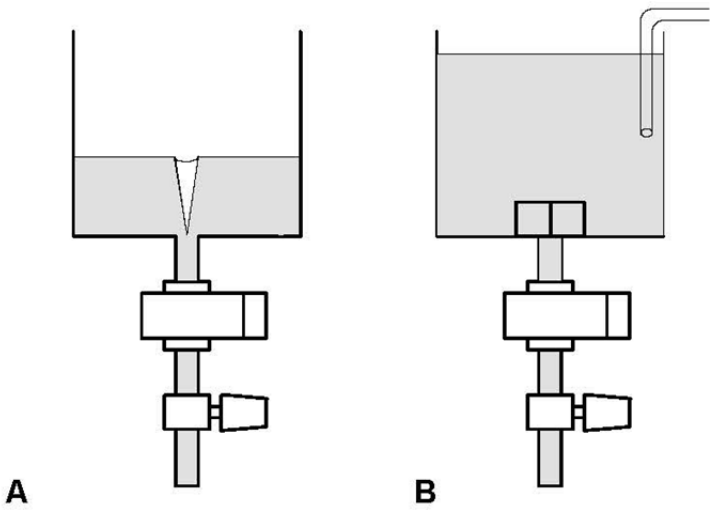


Fig. 4

Due to the decreasing head of liquid, the flow velocity and the flow rate decrease, resulting in the dosing time becoming longer and longer! This effect should be avoided if the dosing time is to be kept constant.

To keep the filling times constant, the liquid level head should be kept within 5%.



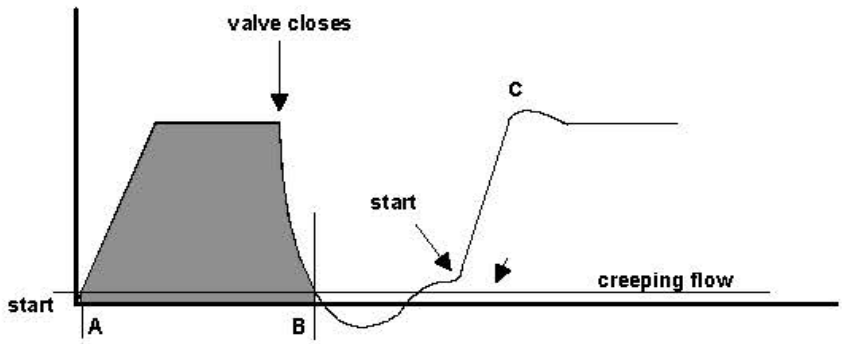
At bigger meter sizes (> DN 15) the liquid level must be more than 30 cm.
If the level < 30 cm, Vortex-effects are possible and resulting accuracy vary (A).

To prevent vortex effects a build – in straightener is advantageous.

Very important is the position of the product line in the tank. The outlet of the pipe must be under the liquid level (B). In other case, air bubbles are in the product and resulting accuracy vary.

b) Piping

Whenever possible rigid metallic piping between storage tank and dosing valve should be installed. If flexible hoses are used, hydraulic vibrations could disturb the batch processes. The piping should be of the same size (DN inner dia) as the electromagnetic flow meter in order that the system can be deaerated easily.



Hydraulic vibrations are to be created, if e.g. diaphragm, hoses or buffer tanks are existing.
The energy in the liquid is decreased with the oscillation of the liquid.

If the velocity cross the creeping flow (B), the pulse output in the converter card is switched off.

If a new start pulse is coming during oscillation, the velocity in the pipe increased (C).

If hoses are used, then the hoses must be metal cased.

c) Dosing valve

The dosing valve is very important for the accuracy/reproducibility of the dosing system. Attention should be paid to the following parameters:

c1) **closing time:** the closing time of the valve has to be in a certain ratio to the dosing time (A to B); the shorter the dosing time the shorter the valve closing time.

Guideline:

<<< the valve closing time should be not more than 10% of the dosing time >>>

If it is more than 10%, the dosing control is only able to register the size of the excess volume, but will not be able to react to it (i.e. compensate / correct it for the next filling). This effect can only be avoided by using a two-stage shut-off (two valves), where the 2nd (final) stage can compensate/correct alterations of the 1.st (pre-) stage.

c2) **power supply**: whenever possible a DC supply should be used to avoid the influence of the shape of sine waves of the AC supply. This is especially if the valve closes with voltage, the valve starts to close when the sine wave has exceeded the starting voltage; in the worst case this can take 10 ms (50 Hz field) and so cause variations of the batched quantity (in accuracies).

c3) **dosing valve:** it is important that only a small volume is displaced during the closing procedure. The displaced volume is part of the measured quantity and thus influences the accuracy and reproducibility of the complete dosing system. It should therefore be kept as constant as possible! An instability of the displaced volume can affect the accuracy of systems where small quantities are dosed. Diaphragm valves with metallic body are recommended, where a diaphragm of a synthetic material (plastic) is oppressed onto a metallic edge. This design has another positive effect: fruit particles and similar solids to be dosed are squeezed off the valve seat.

Diaphragm valve type 625 (GEMÜ)

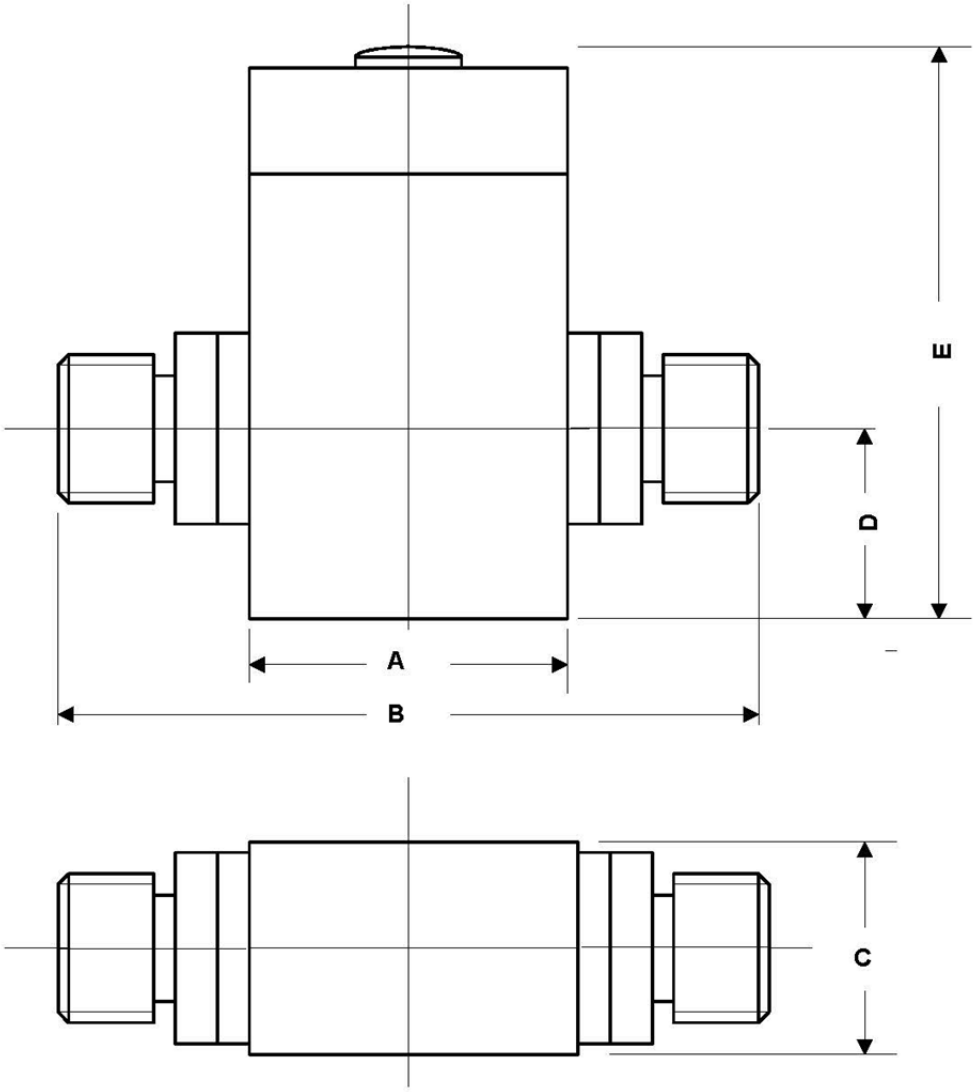
5. Description of the components

a) magnetic inductive flow meter series MID has an integrated and detachable pre-amplifier. The coils for the magnetic field requires a 24 VAC power supply. The cable for interconnection of the meter and the converter card is approx. 5 m long (if a length of more than 5 m is required (max. 200 m), an extension cable of same type is admissible). In the event of a malfunction the pre-amplifier can be detached and replaced; no calibration of the replacement is required! The pre-amplifier is connected via plug and socket. The meter can be installed either horizontally or vertically. Vertical installation is preferred for better deaeration; and also deposits are less likely to be trapped in the meter. In the case of horizontal installation the electrodes must be in horizontal position, i.e. the pre-amplifier must be above or underneath-but not beside- the meter body. If the meter is used together with a converter card UV-14 the flow direction (right to left/left to right or from below to above or vice versa) of the meter is insignificant. The UV-14 switches automatically to the given flow direction and measurement can be started immediately.

Cables for power and signals

It is not allowed to install the meter or the electronic in an area with strong magnetic fields. The measuring cable must be installed separately from cables with power or control signals. The best solution is the installation for the measuring cable in a grounded pipe of metal

Model/Dimensions/Weights



Note : Other connectors on request

Dimension of flow meter with sanitary connectors DIN 405

Diameter DN	Connector DIN 405	A mm	B mm	C mm	D mm	E mm	Actual power W	Current A	Weight kg
10	RD 28x1/8	80	150	60	60	155	4	0,3	3,5
15	RD 34x1/8	80	150	60	60	155	4	0,3	3,5
20	RD 44x1/6	80	150	60	60	155	4	0,3	3,5
25	RD 52x1/6	120	190	80	75	185	5	0,4	7,5

Dimension of flow meter with TRI CLAMP DIN 32676

Diameter DN	Connector DIN 405	A mm	B mm	C mm	D mm	E mm	Actual power W	Current A	Weight kg
10	10	80	150	60	60	155	4	0,3	3,5

Dimension of flow meter with TRI CLAMP ISO 2852

Diameter DN	Connector	A mm	B mm	C mm	D mm	E W	Actual power	Current A	Weight kg
40	2”	120	190	80	75	185	5	0,4	7,5

Note : Other connectors on request

Measuring cable

The measuring cable is a standard cable to DIN series LIYY- LIYCY) with two shielded and four unshielded

colour	signal	voltage	core
white	measurement	0-50 mVAC +/- 2 VDC	shielded
brown	reference voltage	2 hasta 4 VAC	shielded
yellow green	power supply for pre-amplifier	+ 15 VDC - 15 VDC	unshielded
red and blue	power supply for the coils	24 VAC	unshielded

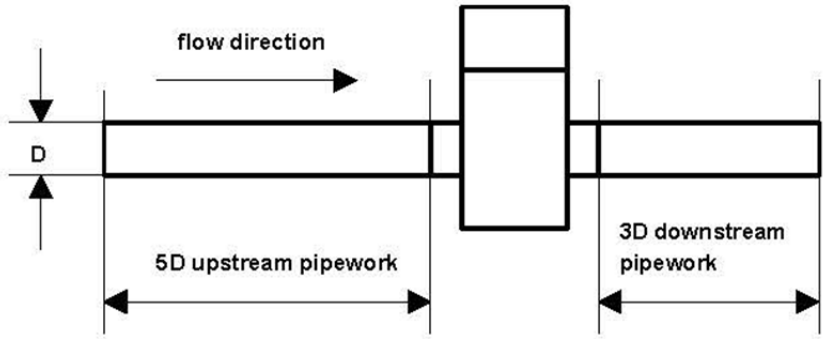
Meter size	24 VAC
DN 10	0.4 A
DN 15	0.4 A
DN 20	0.4 A
DN 25	0.6 A
DN 40	0.6 A

Quick-operating fuses must not be use

6. Installation guideline for transmitter

Inlet/Outlet

For an optimum flow profile it must be installed flow straightener behind and in front of the meter. This can be realized. with straight pipes in the upstream- and downstream pipework.
The upstream pipework must be 5 x DN and the downstream pipework must be 3 x DN. It is not allowed to install any kind of devices up streams. It is forbidden to install in front of the upstream pipework devices which produced effects like spin or vortex, e.g. space bend, butterfly valves or slider. Any regulation devices must be installed behind the meter.
Inclinations must be rotational symmetrical and the angle should be < 8.
The upstream-, downstream pipework and the meter must have the same diameter!



Length of the upstream- and downstream pipework for the meter (mm)

DN	Upstream	Downstream
10	50	30
15	75	45
20	100	60
25	125	75
32	160	100
40	200	120

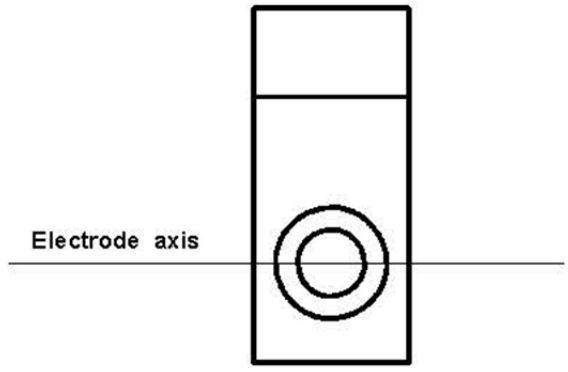
Ground connection for transmitter

The transmitter does not need additional ground connections. Since the transmitter use the pipe potential as reference, the upstream-and downstream pipe must be on ground.
The installation of the meter in plastic pipes is not allowed.

The power supply 24 VAC should be also on ground.

Mounting position of the transmitter

It must be insure, that the meter tube is always completely filled during measuring and is protected against asymmetric formation of deposits. The vertical position is preferred, since it is simple to make the pipe air free.



Is the meter is installed horizontal, then it must be insure, that the electrode axis is also horizontal.

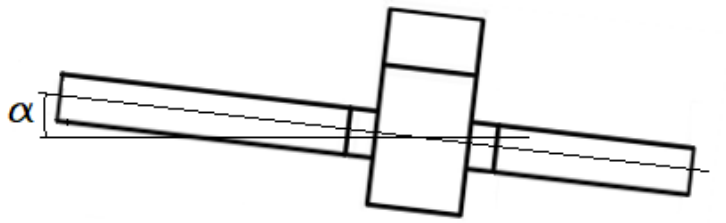
Pipework must be supported adjacent to the meter and connections and provide 3° slope for draining.

If the electrode axis is vertical, then air bubbles can be isolated the electrical connection between the electrodes and the product.
In this case the output signal is undeclared

Self-Draining

For self-draining applications a vertical mounting position is preferable. A minimal angle α of 3° shall be maintained.
Deviating from the above specifications, for the following devices the specified angles must be adhered to.

Device	Angle
MID-MDS-T-CLA-32-1½”-3A	9°
MID-MDS-T-CLA-40-2”-3A	12°



Laying of the measuring cable

It is forbidden to install the meter in areas with strong magnetic fields. The measuring cable must be lay separately from power cables and control cables.
To lay the measuring cable in grounded metal pipes is recommended. Measuring cables can be routed together with other measuring cables.

7. Installation guideline for the electronics

General:

It is forbidden to install the electronics in areas with strong magnetic fields. The wiring must be depending from the function of the cables:

cables for signals	e.g. start, error
cables for control	e.g. cable for control the diaphragm valves
cables for measuring electronics	e.g. measuring cable between the meter and the
cables for power	e.g. 24 VDC, 24 VAC , power for motors

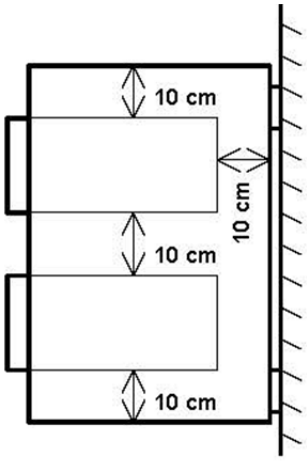
Cables for signals or cables for control can be routed together to a multiple cable.

Measuring cable must be routed with the same cable typ. It is not allowed to bring together several measuring cables to one shielded cable.

If it is necessary to lengthen the measuring cable, then the terminals for the measuring cable must be separate from terminals with power. In general the same principle as for the cable is valid: the terminals must also be separated depending from their function.

Heat development

The produced energy from the electronics must be undisturbed left the housing. It must be insure, that air circulation is possible



Installation of 2 panel housings in a cabinet

If the fan is only installed for air circulation, then it is important to know, that the temperature in the housing can be increased.

If the inside air is exchanged with the air outside of the housing, then a dry air is necessary.
For air circulation with the outside air please ask a manufacturer about special components for installation in a panel cabinet

Power supply

The installation of the cable for power supply 24 VDC/ 24 VAC must be laid star-shaped to each Converter card UV14 Note : The dimension of the wire cross section for 24 VDC must be considering also the current for the solenoid valves

8. Transmitter

Technical data

General:

Nominal diameter:	DN 10, 15, 20, 25, 32, 40 (other connectors on request
Pressure max. in bar:	Sanitary connector PN10
Minimum Conductivity:	1µS/cm
Mounting position:	vertical, if horizontal cannot be avoided, then the electrodes must be in horizontal position. The pipe must be completely filled with product
Mounting length:	DN 10 to 20 → 150 mm DN 25 to 40 → 200 mm
Measuring cable length:	max. 250 m Any extension of the cable built onto the transmitter is possible, but it must be of the same type
Type of measuring cable:	LIYY-LIYCY

Material:

Metering tube:	1.4571
Process connection:	1.4571
Lining:	PTFE
Electrodes:	Hastelloy C22

Housing:	Preamplifier → cast aluminum, plastic coated Housing → Polyurethane

Temperature / Humidity:

Liquid temperature max.:	140°C
Ambient temperature max.:	70°C
Ambient humidity:	< 75 % on average, dew-formation permissible
Protection class:	P 67 according to EN 60 529

Power supply:

Voltage:	24V AC ±10 % sine wave
Frequency:	50Hz ±5% or 60 Hz ±5%
Distortion factor:	max. 1%

9. Converter Modle UV14

Technical data

General:

Housing:	DIN-Rail mounted acc. DIN EN 60715
Wide:	35 mm
Protection class:	IP 20
Power supply:	Nominal 24 VDC
Power supply range:	18 VDC to 36 VDC
Noise:	< 1%
Current consumption:	max. 100 mA at 24 VDC
Ambient temperature:	0 to 50°C
Humanity:	50 %
Measuring range:	Full scale 10 m/sec. (addicted to model type) Full scale 2,5 m/sec. (addicted to model type)

Accuracy at reference conditions:

10-100% of full scale:	± 0,5 %of real value
0-10% of full scale:	± 0,5 % of real value, ± 0,1 % of full scale
Repeatability:	± 0,1 % of real value, ± 0,005 % of full scale
Pulse output:	frequency max. 50 kHz
Pulse wide:	10 µsec.
Digital inputs:	isolated via optocoupler
Input voltage range:	same as power supply range
High-Level:	> 10 VDC
Low-Level:	< 5V VDC
Input resistance:	2,4 kOhm
Digital outputs:	isolated via optocoupler
Output voltage range:	same as power supply range; high sides witch 20 mA max. , short-circuit proofed

DN	Pulses / l
10	63660
15	28293
20	15915
25	10185
32	6216
40	3978

10. Error limits

Reference conditions according DIN 19200 and VDI / VDE 2461

Fluid:	water (free of gas)
Liquid temperature:	+25°C ± 2 K
Ambient temperature:	+22°C ± 2 K
Warm-up time:	30 min.
Installation acc. reference conditions:	up-stream section > 10 DN down-stream section > 5 DN

Error limits according reference conditions

Power supply for transmitter:	24V ± 10 %
Frequency:	50 Hz ±5 % and 60 HZ ± 5% respectively
Power supply for electronics:	18V to 36V DC
Ripple:	< 1 %
Pulse output:	± 0,5 % of measured value plus ± 0,01 % FS FS = 50 kHz at 10 m/s
Repeatability:	± 0,1 % of measured value plus ± 0,005 % FS
Build-up time:	50 ms (10 % to 90 % FS)
Temperature drift during warm-up time : 30 min	± 1 % of measured value plus ± 0,1 % FS
Temperature influence on Transmitter and electronics	± 0,1 % / 10 degr. C

11. Requirements for commissioning

a) the meter must be correctly installed
b) the pipe must be completely filled with product
c) the power supply for meters and dosing control must be switched on
d) the flow velocity must be absolutely zero
e) the start release unit of the filling machine must be connected

12. Requirements for commissioning

a) Zero point setting is not possible:
assumptions: pipe is completely filled with liquid, power supply is switched on

a1) reference voltages:
assumption: 24 VAC is present (LED is on)
check: measure the reference voltage between the brown wire and the shield ; it should be 2,5 to 3,5 VAC!

if this voltage cannot be received: check reference cable (brown wire and shield)

if reference cable is o.k.: replace meter (meter defect)

a2) oscillation zero point:

check: - the whole system (piping, meter , valve) must completely be filled with product and free of gas
- are the valves closed?
- The conductivity of the product must be > 1µ S/cm
- The flow velocity must be > 0,25 m/sec

v (m/sec) = (Q x 1.273,2) : DN²
Q (l/sec) = (v x DN²) : 1.273,2

b) Alternating / oscillating batch quantities:

b1) alternating / oscillating actual quantities (volume / weight of the receptacle):

check: - does the liquid level of the tank decrease filling by filling by more than 5 % of its previous value? The excess volume may differ from filling to filling

Refer to chapter 4, section c)c1)

b2) alternating / oscillating counter quantities:

- If the real / true quantities (appearing in the display) differ by not more than ± 1ml compared with the set quantities, but the contents of the receptacles do (i.e. show bigger differences compared to the set quantities) then the valve outlet is dripping (varying from filling to filling)
  When the valve closes the product must cease lowing instantly!

  Check design / construction of the valve outlet!

13. Accuracy of dosing systems with magnetic flow meters and electronics series MID-MDS

Introduction

Talking about accuracy of dosing systems series MID-MDS (also true for the system MID-NFD) means to talk about repeatability. The absolute accuracy, i.e. the difference between both the measured batch quantity and e. g. the weight is not so important for dosing applications.
All measuring (dosing) systems have inaccuracies. So, a dosing system consisting only of the mag meter and its dosing electronics (valve and nozzle / valve outlet are not includes) has an absolutes accuracy of

=< +/- 0.5 % of reading

Within a velocity range of 0,5 to 10 m/sec.

This absolute (in-) accuracy is a constant quantity and can be eliminated by adjusting (changing) the preset value (batch quantity). With the new software (MDS) the calibration factor for each mag meter can be changed individually and so the preset value (batch quantity) adjusted to an optimum.

But there is an additional uncertainty to be observed, the total repeatability R of the complete system:

$$R_{TOTAL} = \sqrt{R_{MDS}^2 + R_{VALVE}^2 + R_{NOZZLE}^2 + R_{DENSITY}^2}$$

R_{total} = repeatability of the complete system

R_{MDS} = repeatability of the mag meter and dosing electronics
R_{valve} = repeatability of the dosing valve
R_{nozzle} = repeatability of the nozzle / valve outlet
$R_{density}$ = repeatability of the density of the liquid

R_{MDS} = repeatability of the mag meter and dosing electronics
= < 0,1 % of the batch quantity within a velocity range of 0,5 to 10 m/sec

R_{valve} = repeatability of the dosing valve is depending on the batch time.
There is not yet any information known about the repeatability of e. g. GEMÜ valves. According our experience with diaphragm valves: the repeatability is better Than 1 % of the valves delay time; the delay time of GEMÜ valves is approx. 70 milliseconds. After this time has gone the valve is closed.
So, it is only important to know, which quantity passers the valve during this time!
See 2 examples sheet 2

R_{nozzle} = repeatability of the nozzle / valve outlet is very hard to be estimated. In general one must be sure, that always the same quantity passes the nozzle after the valve had been closed. No dripping is acceptable, if it is dripping, the number and the volume of the drops should be constant and cease quickly!

$R_{density}$ = the influence of the density of the liquid is very important, too. It should be known as exact as possible. The liquid temperature should be kept as constant as possible during a machine shift to eliminate this influence. The density alteration of e.g. water is approx. 0,2 ml/degree centigrade.

14. Reference of determination of the meter size

It is possible to fill up with one meter size a wide range of dosing quantities in the same time. The table below shows, which meter size is recommended. It shows the dosing quantity in relationship to the velocity in the meter pipe:

DN	v = 0,5 m/s	v = 1 m/s	v = 2,5 m/s
10	40 ml/s	80 ml/s	200 ml/s
15	88 ml/s	176 ml/s	440 ml/s
20	157 ml/s	314 ml/s	785 ml/s
25	245 ml/s	490 ml/s	1225 ml/s
32	402 ml/s	804 ml/s	2010 ml/s
40	628 ml/s	1256 ml/s	3140 ml/s

The velocity of 1 m/sec is ideal for high product care, accuracy and wear. If the velocity is higher, then the pressure shock increases, if the valve is closing. On the other hand, if the velocity is lower than with several products deposits are possible.

15. Utilization for plastic pipes

It is very important to know that the dosing accuracy and the repeatability are depending on the oscillation of the product in the pipe. A product oscillation is possible, if plastic pipes are installed within the product line. If the valve is closing, then the pressure increase and the plastic pipe works like a memory. If plastic pipes are required, then they must be metal coated. A spiral from metal for reinforcement the plastic pipe is not adequate to guarantee the repeatability.
The length of the plastic pipe must be as short as possible. Are the pipes longer than 1 m, then a mechanical support must be for prevent pipe oscillations, if pressure shocks exists.

16. Internal cleaning of the flowmeter

The following points must be observed for CIP and SIP cleaning:

- Only use cleaning agents against which the materials in contact with the process are sufficiently resistant.
- Observe the maximum permissible medium temperature for the measuring instrument. (see chapter 8.)
- In case of COP, the devices can be cleaned manually with soft brushes or sponges. Care must be taken that the surfaces are not impaired.
- Mounting position should be taken into account. (see chapter 6)

17. Maintenance

The devices are maintenance-free.
In case of uncertainty, a visual inspection may be carried out.
All surfaces shall be smooth and free of pits, folds, crevices and cracks.