# M910 / M910E *Electromagnetic flowmeter*

**User's manual**

*Meatest, spol.s r.o.*
*Ksirova 118A*
*CZ-619 00 Brno*

MEATEST
měřicí a kalibrační technika

## *Certificate of conformity*

| | |
|---|---|
| **Manufacturer** | MEATEST, spol. s.r.o. |
| **Address of the manufacturer** | Kšírova 118A<br>CZ - 619 00 Brno |
| **Declares that product with name** | Electromagnetic Flowmeter |
| **Type** | M910 |

**is conform with following specifications of product**

| | |
|---|---|
| **Safety requirements** | EN 61010-1<br>EN 61010-1/A2 |
| **Electromagnetic compatibility** | EN 61000<br>part 3-2, 3-3,<br>EN 61000<br>4-3, 4-4, 4-5, 4-6, 4-8, 4-11<br>EN 61000 part 6-2<br>EN 50081-1 |

| | | |
|---|---|---|
| **Brno** | **12th January, 2004** | |
| Place | Date | Signature of manufacturer |

# 1 Basic information

## 1.1 Basic features

***The inductive flow meter M-910*** is designed to measure, indicate and record the instantaneous and total flow of the conductive media flowing through the sensor. The flow meter M-910 records both forward and reverse flows. As there are no moving parts in the flow profile the M-910 can be used to measure extremely dirty liquids containing solids. The only limitation is that the flowmeter can be used solely with conductive liquids.

***Range of applications.*** The inductive flow meter M-910 is for use in the Chemical Industry, Paper Industry, Water and Wastewater Treatment Industry and most other process industries.

***Features.*** The inductive flowmeter M-910 is a highly accurate and stable device. The construction of the M-910 flowmeter uses components with long-term, time and temperature stability. Configuration data is backed up and can be recovered after a power failure. The back-up structure enables data recovery even if a partial loss of data occurs as a result of (e.g. high level electrostatic discharge or a noisy power supply). Internal CPU provides all functions usually built in electronic flow meters, incl. low flow rate correction, frequency response setting, bandwidth of sensitivity setting at low flow rates, etc.

***Outputs.*** Flowmeter M-910 is equipped with 6 standard isolated outputs: 4 to 20mA either active or passive, frequency output, impulse output, status (relays) output, RS485 and RS232 output. User can configure these outputs. Status and RS485 outputs are not available for M910E.

***Power supply.*** Both versions of the standard 115V/230V power supply and 24V DC/AC power supply are available.

## 1.2 Standards and approvals

Electromagnetic flowmeter is conformed to requirements for bearing CE mark.

- Electromagnetic flowmeter electronic unit, both remote and compact version meet safety requirements according to standard EN 61010-1 including amendment A2.
- Electromagnetic flowmeter electronic unit, both remote and compact version meets EMC requirements according to standard EN 61000-3, EN 61000-4, EN 61000-6
- Pipe with sensor meets requirements of Pressure Equipment Directive 97/23/EC.
- Both the pipe and electronic unit, meet the requirements of degree of protection provided by enclosure level IP67, according to EN 60529 (IEC 529).

## 1.3 Warranty

Within the manufacturers general supply conditions, all material and manufacturing faults are covered by that. It is up to us whether the warranty obligation includes a repair free of charge or corresponding replacement. Place of the warranty obligation is Czech Republic. Further claims on compensation, especially for loss of production or resultant of damages, are strictly excluded.

Any defects caused by improper use are absolutely not included in the warranty. Excluded from warranty are also expendable items (as i.e. accumulators, batteries, pushbuttons after attained life time, ribbons, etc.)

In case of a warranty claim the user is asked to give detailed description of the defect and also of the application for which you use the product. This information is important in order to avoid time and cost extensive tests and for the eventual achievement of warranty claims from our suppliers and sub-suppliers. For the item or instrument, returned after the expired warranty time, repair or replacement on warranty can only be accepted, if manufacturer has been informed in time that a warranty case has occurred.

Warranty period for all types of electromagnetic flowmeter is 24 months.

***The flowmeter should only be used according to the instructions described in this operating manual.***

# 2 Preparing for start up

## 2.1 Inspecting contents of the package

Basic package includes the following items:

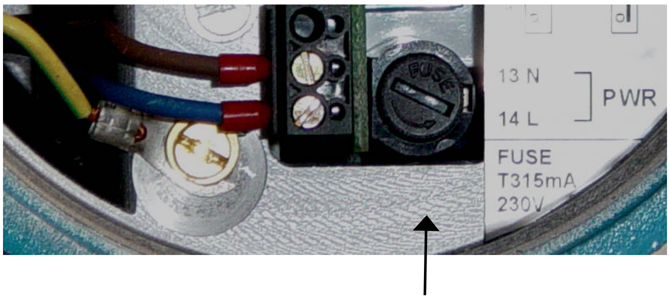
- Flanged sensor
- Electronic Transmitter (can be integral or remote)
- Spare fuse
- Operating manual.
- Calibration certificate
- Special wrench for opening the housing covers
- Magnet for control without opening the housing
- Software Flow910
- RS232 cable

The flowmeter is delivered ready for use after connecting to the power supply. Please check that it has been correctly installed according to chapter "Installation".
Only a power supply with the appropriate voltage and frequency should be used. The flowmeter can be supplied with either 230/115V 50/60Hz, or 24V (12V, 48V) DC/AC power supply, see ordering information in chapter "Power supply".

## 2.2 Fuse replacement

A mains fuse is located behind the back cover. The fuse must only be exchanged by a competent person. Procedure is as follows:

- Disconnect the power supply from the flowmeter.
- Unscrew the back cover using the special wrench (standard part of delivery).
- The fuse holder is located behind the back cover. Remove the fuse. Replace it with new fuse with the same rating.
- Screw on the back cover.




Fuse holder

- Reconnect the power supply.

*Note:*

- *T315mA fuse is used for 115/230 V version*
- *1A fuse is used for 24 and 48 V DC/AC versions*
- *2A fuse is used for 12 V DC*

## 2.3 Power supply

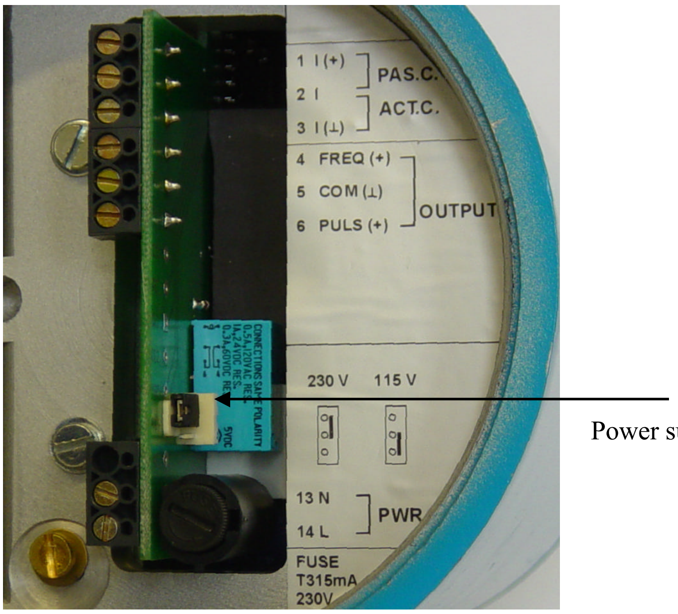
From a power supply point of view the flowmeter is delivered in four basic versions:

- **115/230V** ( +10%, -15%), 50/60Hz, automatic switching for M910 (manual switching for M910E)
- **12V** DC (+20%, -10%)
- **24V** DC (+20%, -10%), 24V 50/60Hz (+10%, -10%)
- **48V** DC (+20%, -10%), 48V 50/60Hz (+10%, -10%)

## 2.4 Power supply voltage selection (M910E, 115/230V version only)

M910E is equipped with a power supply voltage selector, which enables the use of both 115VAC and 230VAC supply voltage. The selector is located on the PC board (see below). It is accessible after removing the cover as follows:

- Disconnect the power supply from the flowmeter.
- Unscrew the back cover using the special wrench (standard part of delivery).
- The power supply voltage selector is located behind the back cover. Move the jumper to the required position.
- Screw on the back cover.
- Reconnect the power supply.




Power supply voltage selector

Note: M910 is equipped with automatic power supply selector.

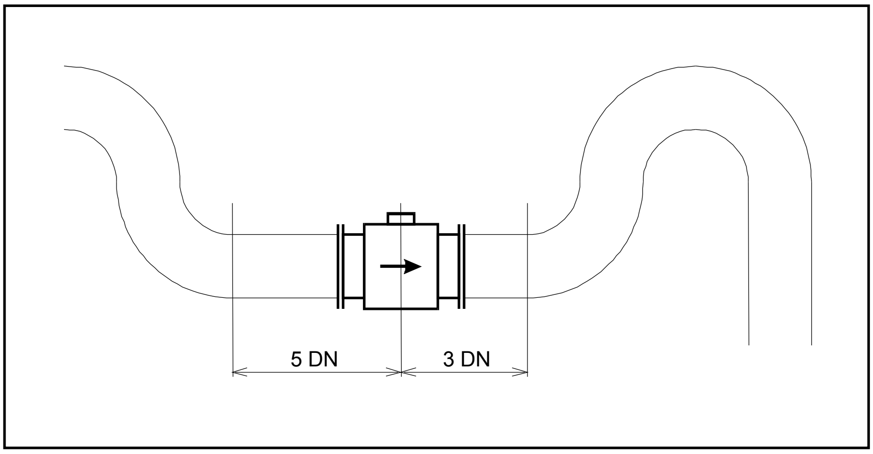
# 3 Installation

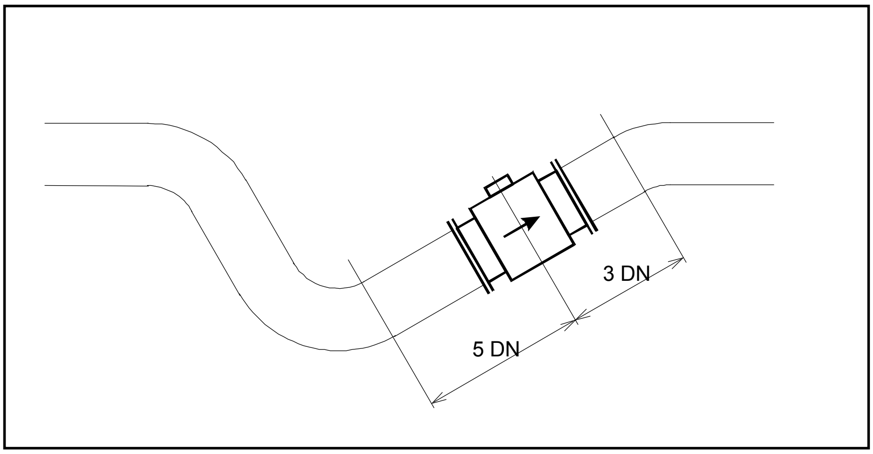
## 3.1 Sensor location

To avoid measuring errors due to gas/air entrainment or to a partly filled pipe, please observe the following:

**Horizontal (standard) mounting**

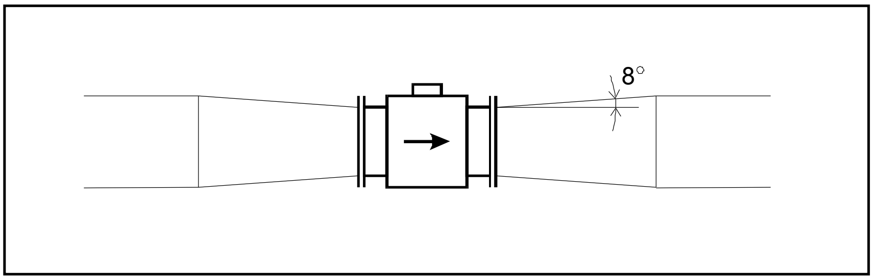
The sensor tube must always remain full. The best way to achieve this is to locate the sensor in a low section of pipe, see the following picture. It is recommended to install the sensor in a section of straight pipe with at least 5 times the pipe diameter before sensor and 3 times after sensor.



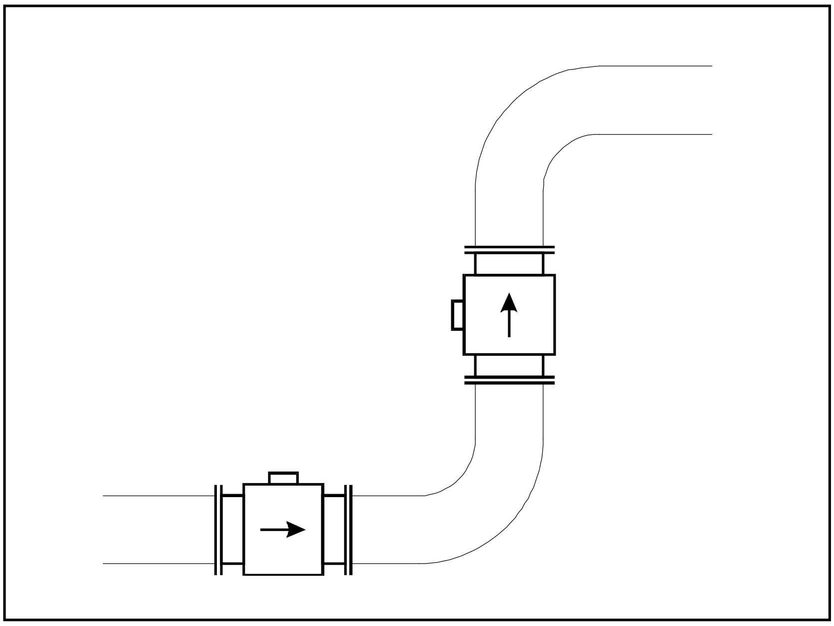

**Pipe reducers**

If the pipe diameter is not the same as the diameter of sensor, then pipe reducers can be used. So as not to lose accuracy of the measurement, the slope of reducers should not exceed 8°.



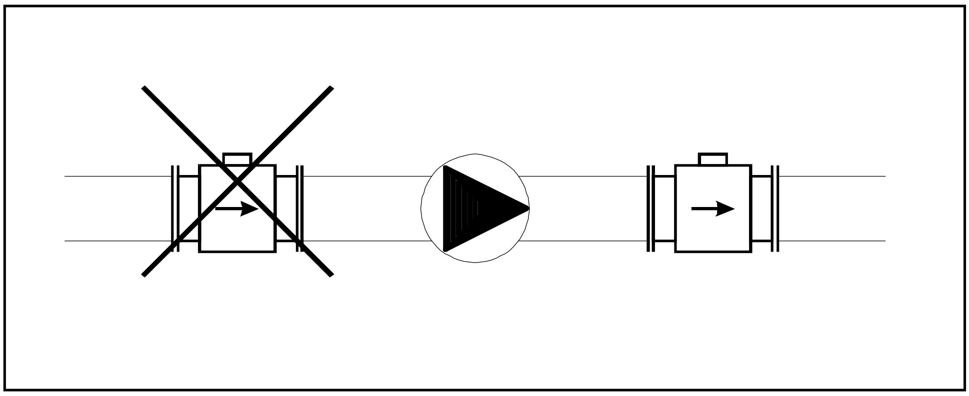

**Vertical mounting**

When the sensor is mounted on a vertical section of pipe, the flow direction must be upwards. In the case of a downward flow direction, air bubbles can collect in the sensor and the measurement could be unstable and inaccurate.



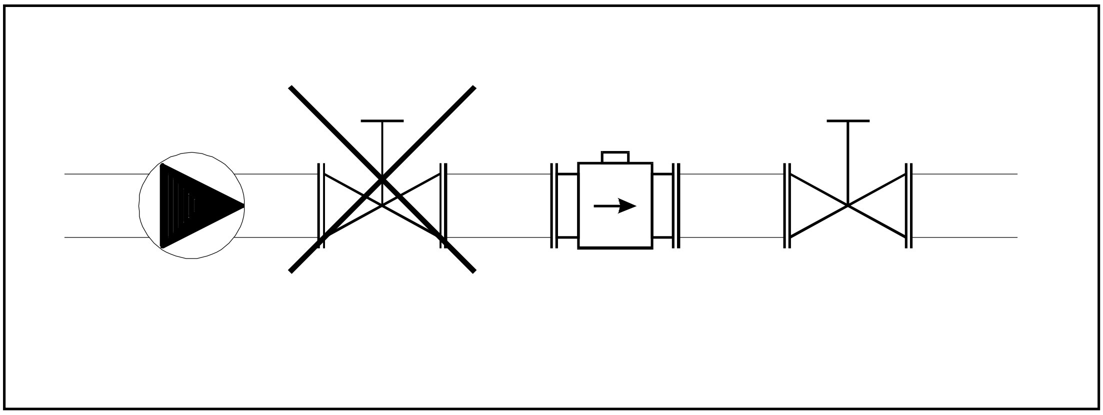
**Pumps**

Never install the sensor on the suction side of a pump or on a section of pipe where a vacuum is possible.



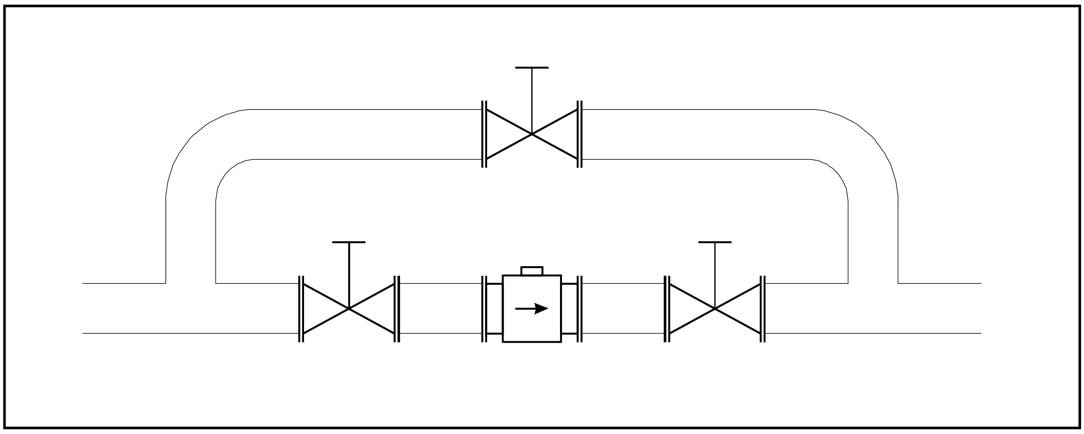
**Valves**

Suitable location of a shutoff valve is downstream of a sensor.



**Removal during maintenance**

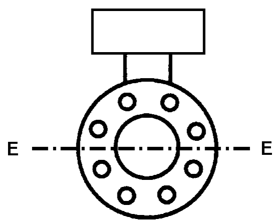
If the application requires removal of the sensor for periodic maintenance, it is recommended to install a bypass section as the following drawing.



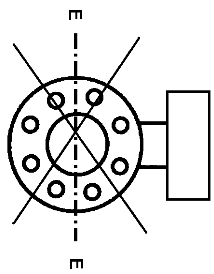
**Position of electrodes**

The axis of measuring electrodes must be approximately horizontal (see picture).

**YES**




**NO**



**Vibration**

To avoid mechanical damage protect both electronic unit and sensor against mechanical vibrations. When strong vibrations are possible, both the input and output pipe must be mechanically fixed or the remote version with a separate electronic unit should be used.

**Overheating**

To avoid overheating, the electronic unit should be protected against direct sunlight especially in areas with a warm climate with ambient temperatures over 30 $^{o}$C. If necessary a sunshade has to be mounted over the electronic unit or a remote version with a separate electronic unit should be used.

## 3.2 Electrical connection

Only a competent person may connect the flowmeter to the mains power supply.

The flowmeter can be connected to the power supply with either a fixed power cable or with a flying lead cable and plug. Cable entries on the electronic unit can be used for flexible electrical cables. Cables with a diameter between 8 and 10 mm must be used to keep protection IP67. It is not recommended to use rigid metal or plastic conduits.

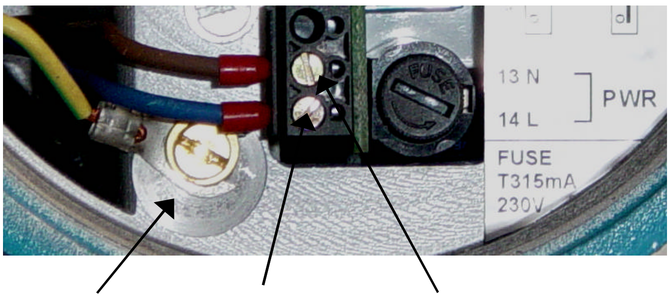
If you use a cable and plug it is recommended that the cable has a cross-section of 3 x 1.5mm$^2$ and with a minimum length of 1 m.

In the case of a fixed connection an independent power switch or circuit breaker should be located close to the flowmeter. Cable cross-section as above.

### 3.2.1 Power supply

To connect the compact version to the power supply the following procedure should be used.

- Unscrew the back cover using the special wrench (standard part of delivery).
- Connect the earth wire (yellow-green colour) to the central grounding point inside the case. The end of earth wire must be hooked (app. 3 mm) and fixed to the earth screw.
- Connect Live and Neutral power cables to the power line terminal clamps with labels 14 (L-wire, brown terminal colour) and 13 (N-wire, blue terminal colour).
- Screw on the back cover.
- Switch on the power supply.




GND central grounding point L line wire N line wire

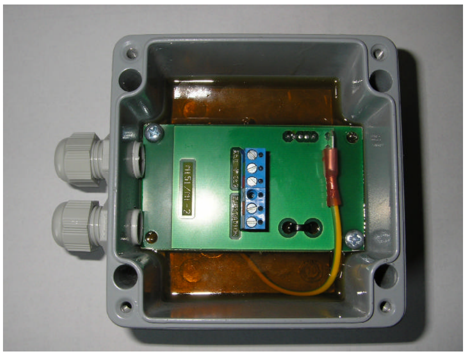
*Note:*

*Be careful to avoid following problems during electrical installation:*

- *Do not cross or loop cables inside electronic unit.*
- *Use separate cable entries for power supply and signal wires.*

### 3.2.2 Electric connection between converter and sensor – Remote version

For remote version converter and flanged sensor are connected with two (2-wire unshielded and 3-wire shielded) cables. Standard length of cables is 6 meter. It is recommended to mount the transmitter not too far from the flanged sensor. Use cables as short as possible.



Five-terminal connector is located in separated box. The same box is used for the converter and also for the sensor. Colours of wires are following:

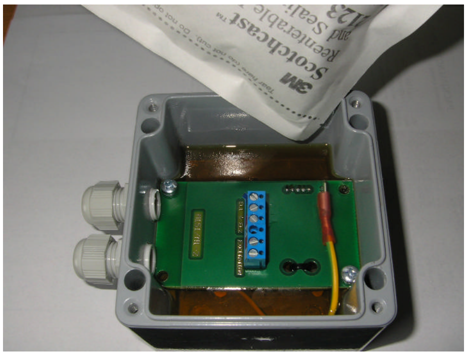
3-wire shielded cable (shielding is connected to the green wire):

| | |
|---|---|
| Blue (Brown): | Electrode 1 (EL1) |
| Green : | Ground |
| Red (White): | Electrode 2 (EL2) |

2-wire cable:

| | |
|---|---|
| Brown : | Excitation 1 (EXCITATION) |
| White : | Excitation 2 (EXCITATION) |

Following procedure should be observed to connect sensor cable to the transmitter or sensor:



- Switch off power supply.
- Dismount top cover of connection box. Four screws must be removed.
- Connect 5 wires to the connector.
- As the basic protection of connection box is IP65 it is important (in case you need better protection) to fill the box (with connected wires) with reenterable insulating and sealing compound. One piece of compound is standard part of delivery. Using this technology will be protection of transmitter IP67 and protection of sensor IP68.
- Mount the cover back.
- Switch on power supply.

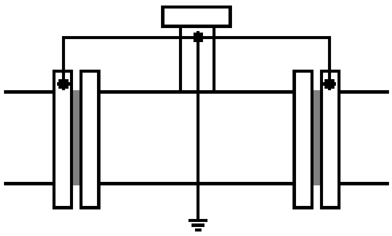
## 3.3 Sensor grounding

To ensure the correct operation of the flowmeter an earthing connection between the sensor and pipeline must be made. The sensor is equipped with screw connection for an earthing wire. This screw has to be connected to the flange on the pipeline. Use Copper wire to connect between the flange and the earth screw on the sensor.

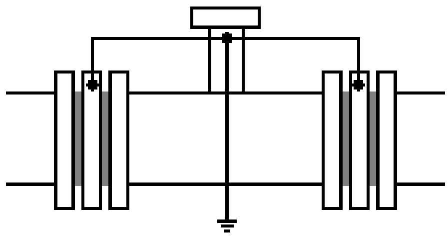
If the pipeline is manufactured from a non-electrically conductive material, or if the pipe is lined with a similar material, special grounding rings must be installed between flanges.

*Note: The flowmeter must not be switched on, if the sensor is not connected /earthed to the rest of pipeline!*

Sensor grounding without grounding rings



Sensor grounding with



grounding rings

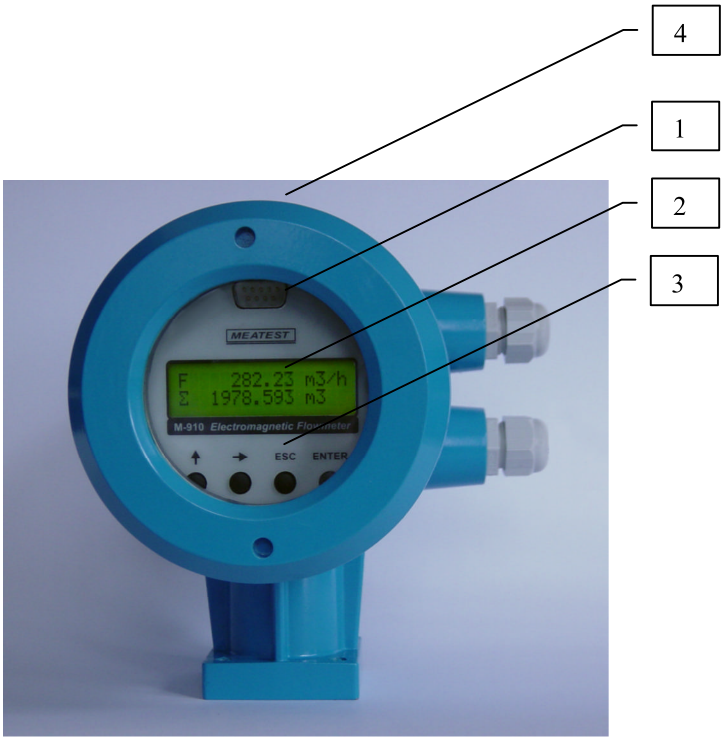
## 3.4 Turning the display panel

The flowmeter M910 (M910E) display can rotated ± 90°. Procedure is as follows:

- Disconnect the power supply from the flowmeter.
- Unscrew the back cover using the special wrench (standard part of delivery).
- Detach the two screws in the front plate and remove the plate.
- Unscrew next two legs and carefully turn the display.
- Reassemble in reverse order.
- Reconnect the power supply.

# 4 Electronic unit description

## 4.1 Front panel (display)




***1 RS232 connector***

RS232 port enables you to connect the flowmeter to a personal computer. Serial port is galvanically isolated from other electronic circuits.

***2 Display***

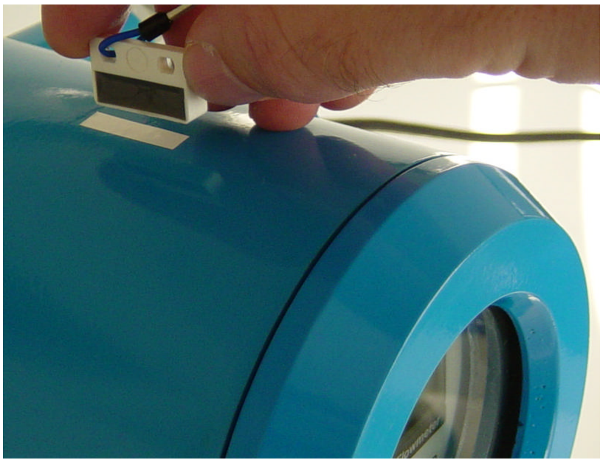
Two-row alphanumerical display is used for displaying all information. The instantaneous flowrate is displayed in upper row. Total volume is displayed in the lower row.

The decimal point position and type of units can be changed in the flowmeter “Setup Menu” (see chapter “Flowmeter configuration”).

***3 Keyboard (M910 only)***

4 keys enable you to change flowmeter configuration and provide flowmeter calibration. These are “UP”, “DOWN”, “ESC” and “ENTER” keys.

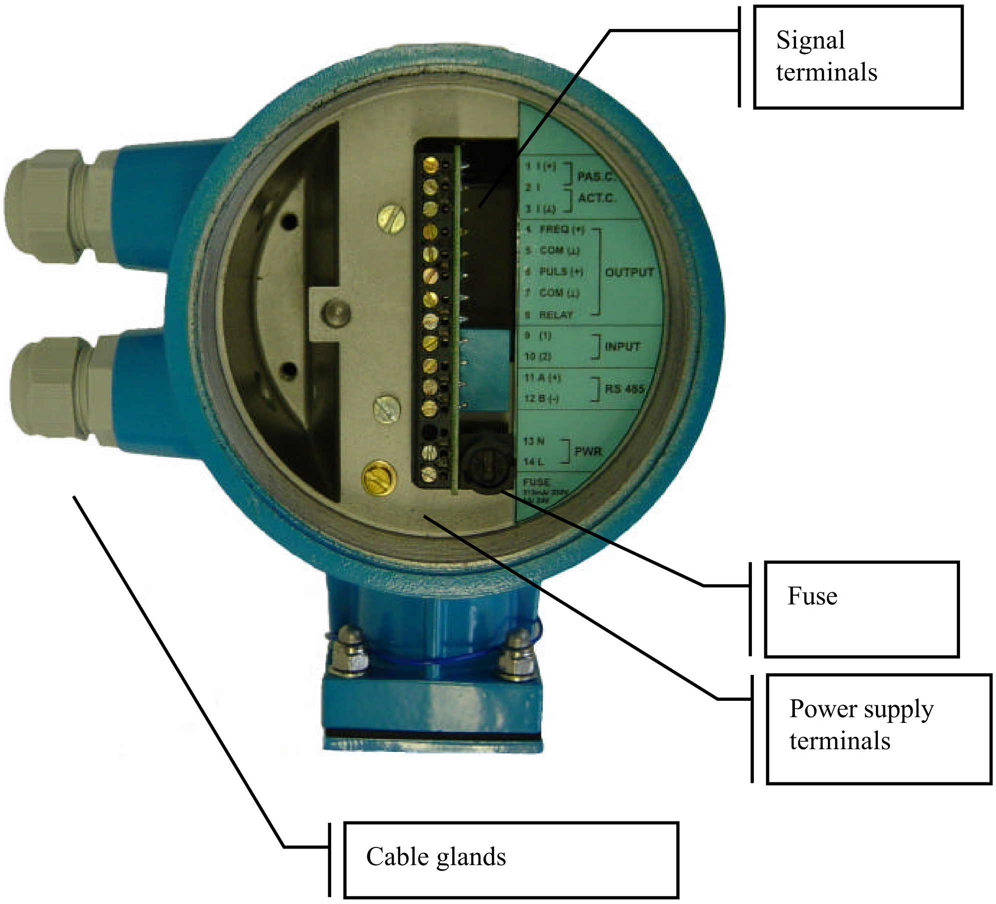
### *4 Magnetic sensor*



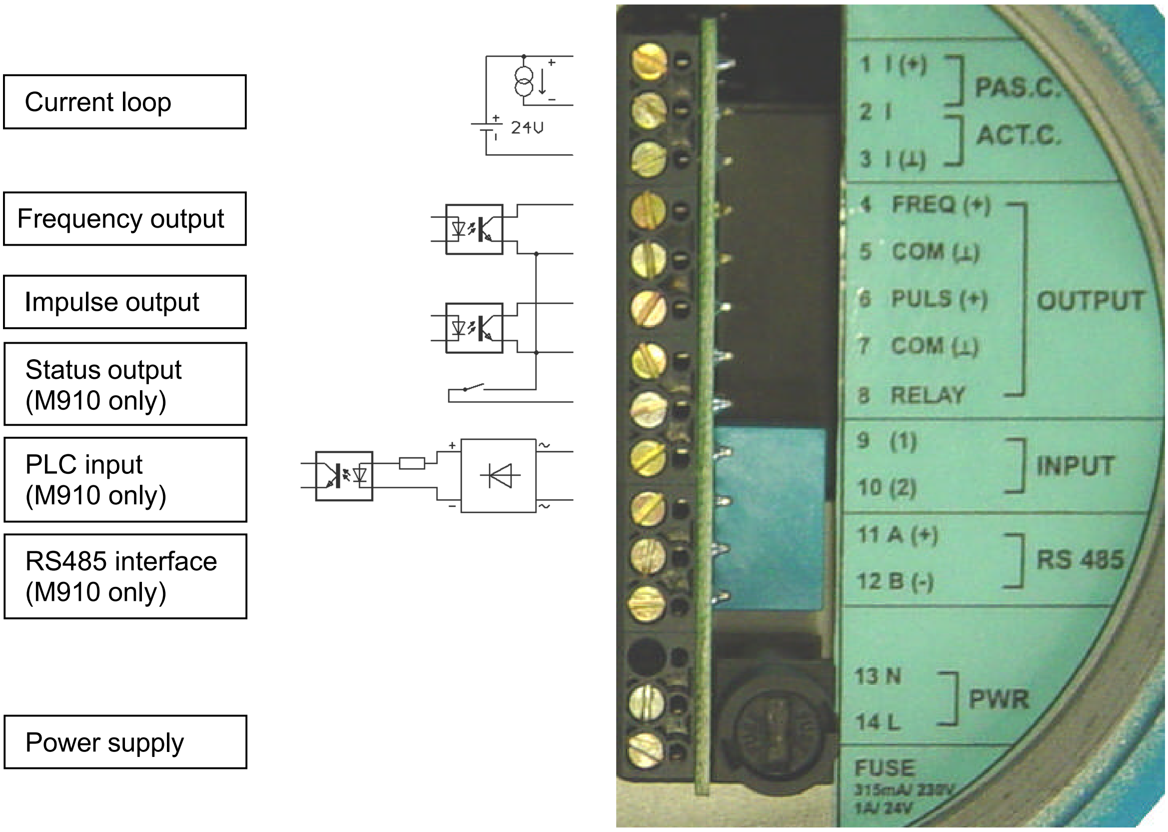
All important displayed information can be read without opening the flowmeter. The sensor display can be activated by using a magnet. Activating the sensor (less than 3 seconds) using a magnet is equal to pushing the "UP" key. Activating the sensor (more than 3 seconds) is equal to pushing "RIGHT" key.

## *4.2 Rear panel (inputs/outputs)*

Under the back cover of the electronic unit are the terminals for input/output signals and supply terminals. The fuse holder is located near the power supply terminals. The top cable gland is for input/output signals cable, bottom cable gland for power supply cable.



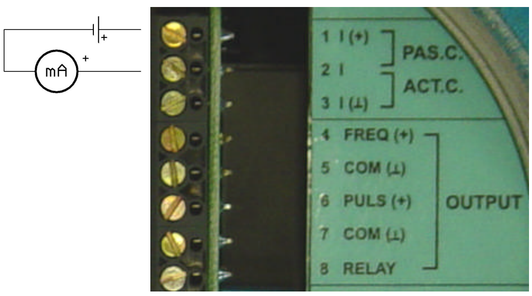
## 4.3 Signal terminals



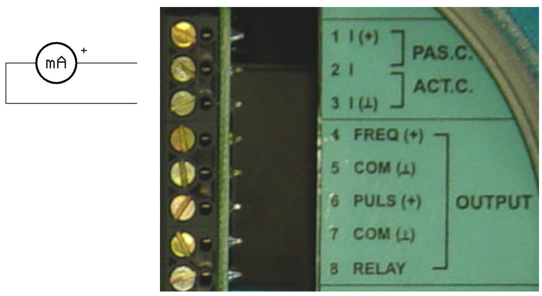

### 4.3.1 Current loop output

The 4 to 20 mA current loop can be set as a passive type between outputs 1, 2 (1 positive, 2 negative) or as an active type between outputs 2, 3 (2 positive, 3 negative). In both cases the outputs are galvanically isolated from all other electronic circuits of the flowmeter. Voltage drop on passive current loop is 4 V. Active current loop can work to a maximum of 800 Ω.

Example of current output connection:




**Passive** current output connection



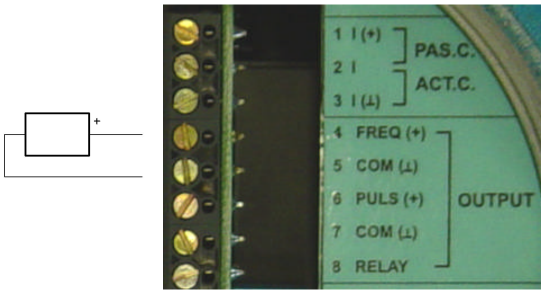

**Active** current output connection

For more information about current output see chapter “*Input and outputs configuration*”.

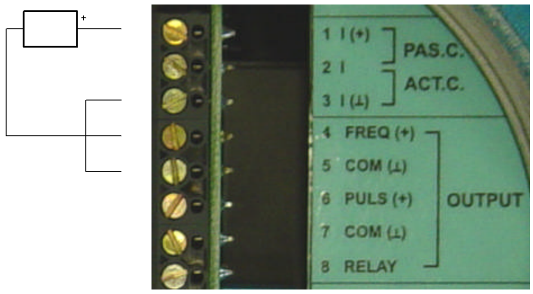
### *4.3.2 Frequency output*

The frequency output is a galvanically isolated transistor NPN switch. Voltage drop on the switch is 1 V in the made status. Maximum switched voltage is 50 V. Maximum switched current should not exceed 100 mA. Positive output is on terminal 4, negative output is on terminals 5 and 7 (internally connected). Frequency range of the output is from 10 Hz to 12 kHz.

<u>Example of the frequency output connection:</u>




**Passive** frequency output connection




**Active** frequency output connection

For more information about frequency output see chapter "*Input and outputs configuration*".

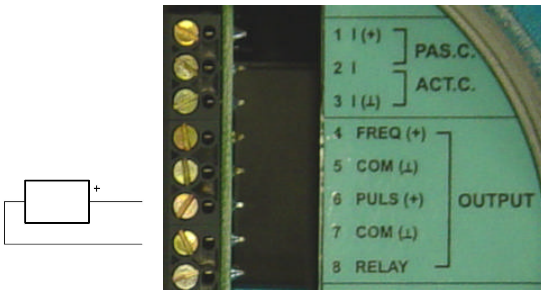
*Note 1: Frequency, impulse and status outputs are galvanically connected to each other and galvanically isolated from other electronic circuits.*

*Note 2: Active frequency output uses the power supply of the current output. Total current take-off from this power supply (terminal nr. 1) must be less than 40 mA. Active frequency output is galvanically connected to current output.*

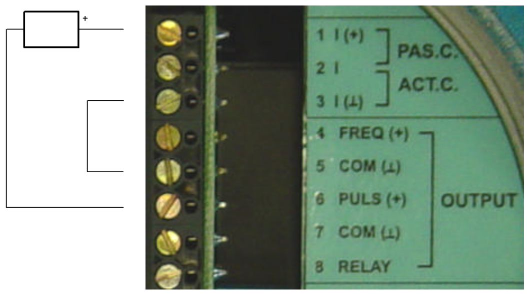
### *4.3.3 Impulse output*

The impulse output is formed by a galvanically isolated transistor NPN switch. Voltage drop on the switch is 1 V in the made mode. Maximum switched voltage is 50 V. Maximum switched current should not exceed 100 mA. Positive output is on terminal 6, negative output is on terminals 5 and 7 (internally connected). Width of the impulse can be set. Maximum frequency of impulse output is limited by impulse width. Maximum frequency is 50 Hz for the shortest impulse 10 ms

<u>Example of impulse output connection:</u>




**Passive** impulse output connection




**Active** impulse output connection

For more information about impulse output see chapter "*Input and outputs configuration*".

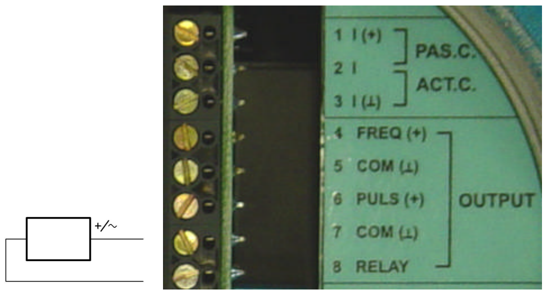
*Note 1: Frequency, impulse and status outputs are galvanically connected to each other and galvanically isolated from other electronic circuits.*

*Note 2: Active impulse output uses the power supply of the current output. Total current take-off from this power supply (terminal nr. 1) must be less than 40 mA. Active impulse output is galvanically connected to current output.*

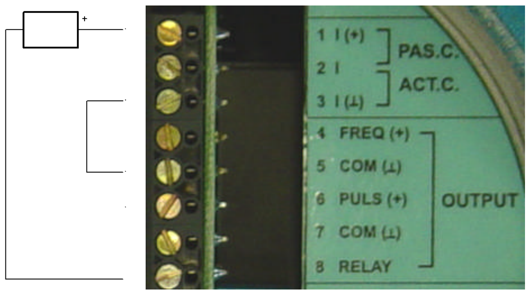
### 4.3.4 Status output (M910 only)

Status output is formed by relays. Maximum switched voltage is 100 V. Maximum switched current should not exceed 500 mA. First output is on terminal 8, second output is on terminal 5 and 7 (internally connected).

Example of status output connection:




**Passive** status output connection




**Active** status output connection

For more information about status output see chapter "*Input and outputs configuration*".

*Note 1: Frequency, impulse and status outputs are galvanically connected to each other and galvanically isolated from other electronic circuits.*

*Note 2: Active status output uses the power supply of the current output. Total current take-off from this power supply (terminal nr. 1) must be less than 40 mA. Active status output is galvanically connected to the current output.*

### 4.3.5 PLC digital input (M910 only)

The digital input is activated with a DC voltage between 5 and 30 V (positive or negative). The digital input is between terminals 9 and 10.

For more information about digital input see chapter "*Input and outputs configuration*".

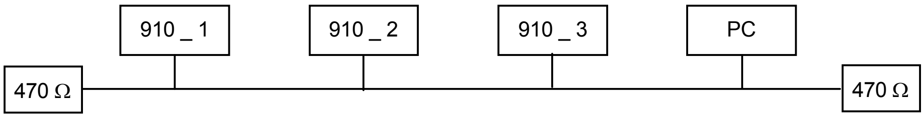
*Note: PLC digital input is galvanically isolated from other electronic circuits.*

### *4.3.6 Serial port RS485 (M910 only)*

The serial port RS485 is assigned for online communication between flowmeter and computer. It is suitable for real time flowmeter monitoring. In contrast to the RS232 serial port, which is suitable for one-shot configuration or calibration of the flowmeter. The RS485 can be connected to up to 16 flowmeters together and the total connection length of all wires can be up to 800 meters. Positive output (A) is on terminal 11, negative output (B) on terminal 12.

Example of three flowmeters and one computer interconnection:

All flowmeters and computer are connected parallel using twisted pair cable. At each end of the communications line should be 470 Ω terminations.




Interconnection of three flowmeters and computer using RS485 bus

Flowmeters are marked with numbers. These numbers are equal to the flowmeters RS485 address.

Program Flow910 is designed for flowmeter control using RS485 or RS232 serial bus.

*Note:* *Communication through the serial port RS485 is a half duplex type. The flowmeter is a listener and sends data only after a query from a computer. Each flowmeter has it's own RS485 address. The range of addresses is 0 to 255. Factory setting of RS485 address is 0. Communication speed is selectable between 4800 and 19200 Bd. For cables over 100m or if there is a noisy power supply voltage (especially peaks generated, usually by motors, etc.), select communication speed below 9600 Bd.*

*Note:* *Serial port RS485 is galvanically isolated from other electronic circuits.*

## *4.4 Serial port RS232*

The connector is located on the front panel and is accessible after removing the electronic unit cover. RS232 enables you to connect the flowmeter to a personal computer. RS232 interface is used for flowmeter configuration and calibration. It's not suitable for online communication during operation, because the flowmeter must be open and IP67 protection is not valid. For such communication use RS485


interface.

RS-232 parameters are fixed:

| | |
|---|---|
| Baud rate | 1200 Bd |
| Data bits | 8 |
| Stop bit | 1 |
| Parity | none |

***Note: Control computer must keep signal RTS in static level between –3 to –12 V and signal DTR in static level +3 to +12V***

Cable between Flowmeter and PC (configuration 1:1)

| PC | D-Sub 1 | D-Sub 2 | Flowmeter |
|---|---|---|---|
| Receiver | 2 | 2 | Transmitter |
| Transmitter | 3 | 3 | Receiver |
| DTR (+3 … +12V) static level | 4 | 4 | Power supply RS232 + |
| Ground | 5 | 5 | Ground |
| RTS (-3 … -12V) static level | 7 | 7 | Power supply RS232 - |

For connection of the flowmeter to the PC a standard RS232 cable (1 : 1) can be used. To connect a PC to the flowmeter, follow this procedure:

- Unscrew the front cover using the special wrench (standard part of delivery).
- Plug the one end of the RS cable onto the serial connector in the flowmeter.
- Connect the opposite end to the serial port in the PC.
- Use the application software (Flow910) to enter new calibration data or to change settings of the flowmeter.
- Disconnect RS232 cable and replace the cover.

*Note: Serial port RS232 is galvanically isolated from other electronic circuits.*

# 5 Operation

## 5.1 *Main menu*

The flowmeter is in *Main menu* after the switching power on or after repeatedly pushing the ESC key. This entire menu can be operated with a magnetic without opening the housing. Short use of the magnet (less than 3 seconds) is equal to pushing “UP” key. Longer use of the magnet (more than 3 seconds) is equal to pushing “RIGHT” key.
The following information can be displayed in the *Main Menu.*
Note: M910E can be operated by a magnetic pointer only.

### 5.1.1 *Current Flowrate / Total Volume*

```
F      120.03 m3/h
Σ   8703.012 m3
```

Basic display (after power on). Current flowrate is displayed on the first line. Total volume is displayed on the second line. Flow in the forward direction is added to this volume, Flow in the reverse direction is subtracted. Measuring parameters (units, resolution, moving average etc.) are selectable in *Setup menu*. After pushing “UP” key “Positive Volume” is displayed.

### 5.1.2 *Positive Volume*

```
Positive Volume
Σ+ 8903.012 m3
```

Total volumetric flow in a forward direction. After pushing “UP” key “Negative Volume” is displayed.

### 5.1.3 *Negative Volume*

```
Negative Volume
Σ-   220.310 m3
```

Total volumetric flow in the reverse direction. After pushing “UP” key “Auxiliary Volume” is displayed.

### 5.1.4 *Auxiliary Volume*

```
Auxiliary Volume
ΣA 5943.942 m3
```

Second Total Volume counter. Can be cleared by pushing “RIGHT” key. It is usually used for measuring volumetric flow during a set period such as day, month etc.. After pushing “UP” key “Maximum Flowrate” is displayed.

### 5.1.5 *Maximum Flowrate / Maximum Flowrate Time (M910 only)*

```
Hi    620.42 m3/h
07:13 04.03.2003
```

Maximum flowrate value indicated since last reset (pushing “RIGHT” key). Date and time of maximum flowrate is displayed in lower row. After pushing “UP” key “Minimum Flowrate” is displayed.

### 5.1.6 *Maximum Flowrate (M910E only)*

```
Hi    620.42 m3/h
Maximum Flowrate
```

Maximum flowrate value indicated since last reset (longer use of the magnet).

### 5.1.7 Minimum Flowrate / Minimum Flowrate Time (M910 only)

```
Lo      26.20 m3/h
20:42 06.03.2003
```

Minimum flowrate value indicated since last reset (pushing "RIGHT" key). Date and time of minimum flowrate is displayed in lower row. After pushing "UP" key "Datalogger" is displayed.

### 5.1.8 Minimum Flowrate (M910E only)

```
Lo      26.20 m3/h
Minimum Flowrate
```

Minimum flowrate value indicated since last reset (longer use of the magnet).

### 5.1.9 Datalogger (M910 only)

```
Datalogger     5%
Samples:      723
```

Number of samples stored in datalogger and percentage used. Individual samples value can be read after pushing "RIGHT" key. In this submenu samples are read

s

e

```
20:42 06.03.2003
F     120.03 m3/h
```

e

ntially. Next sample (Flowrate with Date and Time) is displayed after pushing "UP" key. "Sequential reading" submenu is left after pushing "RIGHT" key or after displaying all values. After pushing "UP" key "Current Flowrate / Total Volume" is displayed. Datalogger capacity is more than 10000 samples (typical 15000 samples).

These formats are changed pushing key "UP" or by short activating of the magnet.

## 5.2 Setup menu

**Note: For version M910E is the "Setup menu" accessible only using the computer and software Flow910.**

In this menu the flowmeter parameters (measuring, output, communication etc.) can be changed. Access to the *Setup menu* is enabled after pushing the "ENTER" key from the *Main menu*.

*Note: The keyboard is accessible after unscrewing the cover of the electronic unit using the special wrench, which is standard part of delivery.*

```
Enter Password
     [00000]
```

Correct password must be entered before entering *Setup menu*. Without correct password the access to the *Setup menu* is refused. Default factory set password is "00000". Return to the *Main menu* is possible after

```
Setup Menu
1  INPUT/OUTPUT
```

pushing the "ESC" key.

*Setup menu* has the following structure (items are changed by pushing "UP" key and selected by pushing "ENTER" key):

**Setup Menu structure**

### 5.2.1 Input and outputs configuration (1 INPUT/OUTPUT)

For the flowmeter outputs and input configuration. After pushing "UP" key next item ("2 FLOWMETER") is selected. After pushing "ENTER" key following submenu is displayed:

#### 5.2.1.1 Current loop output (1.1 CURRENT)

Current loop 4 to 20 mA can be set as passive type between outputs 1, 2 (1 positive, 2 negative) or as active type between outputs 2, 3 (2 positive, 3 negative). In both cases outputs are galvanically separated from all other electronic circuits of the flowmeter. Voltage drop on the passive current loop is 4 V. Active current loop can work to a maximum of 800 Ω.

Current loop output can be programmed in one of the following modes:

| | | |
|---|---|---|
| a) | **Off** | current output is adjusted to 4mA (error message 01 - "Current output" is switched off) |
| b) | **Pos.Flow** | current 4+16*Flowrate / QI [mA] is generated for a positive flowrate direction. For a negative flowrate direction 4mA is generated. |
| c) | **Neg.Flow** | current 4-16*Flowrate / QI [mA] is generated for a positive flowrate direction. For a positive flowrate direction 4 mA is generated. |
| d) | **Abs.Flow** | current 4+16*abs(Flowrate) / QI [mA] is generated for both flowrate directions. |
| e) | **Bip.Flow** | current 12+8*Flowrate / QI [mA] is generated for both flowrate directions. |
| f) | **Fixed** | current output is adjusted to fixed value (4.000 … 20.000 mA) |

QI value represents a flowrate for a current of 20 mA and can be set independently to the nominal diameter of the sensor. QI value can be changed in *"Setup mode"* after selecting modes "b", "c", "d" or "e". Fixed current value can be changed in *"Setup mode"* after selecting mode "f". Following values are pre-set:

**Current loop standard factory setting:**
**Mode** „Positive flowrate".
**QI** flowrate corresponds to maximum required nominal flowrate $Q_N$

#### 5.2.1.2 Frequency output (1.2 OUTPUT F)

Frequency output is a galvanically isolated transistor NPN switch. Voltage drop on the switch is 1 V in the made status. Maximum switched voltage is 50 V. Maximum switched current should not exceed 100 mA. Positive output is on terminal 4, negative output is on terminals 5 and 7 (internally connected). Frequency range of the output is from 10 Hz to 12 kHz.

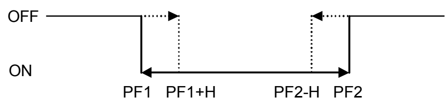
The frequency output can be programmed in one of following modes:

| | | |
|---|---|---|
| a) | **Off** | output is not active (off state). |
| b) | **Pos.Flow** | frequency 1000*Flowrate/QF [Hz] is generated for positive flowrate direction. |
| c) | **Neg.Flow** | frequency -1000*Flowrate/QF [Hz] is generated for negative flowrate direction. |
| d) | **Abs.Flow** | frequency 1000*abs(Flowrate)/QF [Hz] is generated for both flowrate directions. |

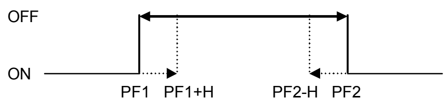
e) **On Pos.** output is off in case of negative flow and made in case of positive flow.
f) **On Neg.** output is off in case of positive flow and made in case of negative flow.
g) **On In** output is on, when flowrate is higher than PF1 and lower than PF2, otherwise it is off.
h) **On Out** output is off, when flowrate is higher than PF1 and lower than PF2, otherwise it is on.
i) **Dose On** output is on, when programmed dose is counting, otherwise it is off.
j) **Dose Off** output is off, when programmed dose is counting, otherwise it is on.
k) **On<F2** output is on, when flowrate is lower than PF2, otherwise it is off.
l) **On>F2** output is on, when flowrate is higher than PF2, otherwise it is off.
m) **Fixed** frequency output is adjusted to fixed value (10 … 12000 Hz)

If setting the flow limit is chosen, hysteresis H can be set too. Hysteresis is a tolerance field on one side of flow limits PF1 and PF2. The output status changes (indicates crossing over the pre-set limit), when the immediate flowrate crosses over the value PF2 (or goes below limit PF1). The output status comes back to the default status, when the immediate flowrate decreases under the value PF2-H (or increases over limit PF1+H) again.

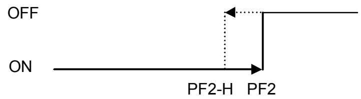
Mode g ) with non-zero hysteresis:



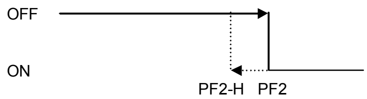

Mode h) with non-zero hysteresis:




Mode k) with non-zero hysteresis:




Mode l) with non-zero hysteresis:




QF value represents flowrate for frequency 1000 Hz and can be set independently to the nominal diameter of the sensor. QF value can be changed after selecting modes "b", "c" or "d". Fixed frequency value can be changed after selecting mode "m". Following values are pre-set:

**Frequency output standard factory setting:**

**Mode** „Positive flowrate".
**QF** flowrate corresponds to the required nominal flowrate $Q_N$
**PF1** limit corresponds to the required nominal flowrate $-Q_N$
**PF2** limit corresponds to the required nominal flowrate $Q_N$
**H** hysteresis corresponds to the required nominal flowrate $Q_N/10$

Parameters PF1, PF2 and H are common for frequency, impulse and status mode.

### *5.2.1.3 Impulse output (1.3 OUTPUT P)*

Impulse output is formed by a galvanically isolated transistor NPN switch. Voltage drop on the switch is 1 V in the made mode. Maximum switched voltage is 50 V. Maximum switched current should not exceed 100 mA. Positive output is on terminal 6, negative output is on terminal 5 and 7 (internally connected).

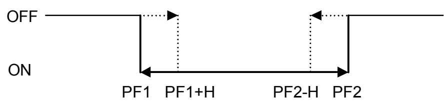
Width of the impulse can be set. Maximum frequency of impulse output is limited by the impulse width. For the shortest impulse 10 ms is maximal frequency 50 Hz.

Impulse output can be programmed in one of the following modes:

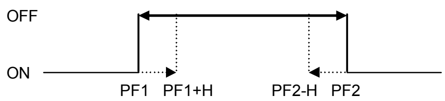
| | | |
|---|---|---|
| a) | **Off** | output is not active (off state). |
| b) | **Pos.Flow** | 1 impulse is generated when total volume QP of liquid has flowed in a positive direction. |
| c) | **Neg.Flow** | 1 impulse is generated when total volume QP of liquid has flowed in a negative direction. |
| d) | **Abs.Flow** | 1 impulse is generated when total volume QP of liquid has flowed in a negative or positive direction. |
| e) | **On Pos** | output is off in case of negative flow and made in case of positive flow. |
| f) | **On Neg** | output is off in case of positive flow and made in case of negative flow. |
| g) | **On In** | output is on, when flowrate is higher than PF1 and lower than PF2, otherwise it is off. |
| h) | **On Out** | output is off, when flowrate is higher than PF1 and lower than PF2, otherwise it is on. |
| i) | **Dose On** | output is on, when programmed dose is counting, otherwise it is off. |
| j) | **Dose Off** | output is off, when programmed dose is counting, otherwise it is on. |
| k) | **On>F1** | output is on, when flowrate is higher than PF1, otherwise it is off. |
| l) | **On<F1** | output is on, when flowrate is lower than PF1, otherwise it is off. |

If setting of flow limit is chosen, hysteresis H can be set too. Hysteresis is a tolerance field on one side of flow limits PF1 and PF2. The output status changes (indicates crossing over pre-set limit), when the immediate flowrate crosses over the value PF2 (or goes below limit PF1). The output status comes back to the default status, when the immediate flowrate decreases under the value PF2-H (or increases over limit PF1+H) again.

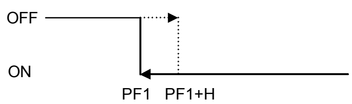
Mode g ) with non-zero hysteresis:



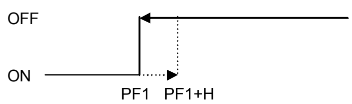

Mode h) with non-zero hysteresis:




Mode k) with non-zero hysteresis:




Mode l) with non-zero hysteresis:




QP value represents volume for 1 impulse and can be set independently to the nominal diameter of sensor. QP value can be changed after selecting modes “b”, “c” or “d”. Following values are pre-set:

**Impulse output standard factory setting:**

**Mode** „Positive flowrate".
**QP** 1 $m^3$
**PF1** limit corresponds to the required nominal flowrate $-Q_N$
**PF2** limit corresponds to the required nominal flowrate $Q_N$
**H** hysteresis corresponds to the required nominal flowrate $Q_N/10$

Parameters PF1, PF2 and H are common for frequency, impulse and status mode.

### *5.2.1.4 Pulse width (1.4 PULSE WIDTH)*

Function enables to change the pulse width of "Impulse Output" in milliseconds after pressing key "ENTER". With keys "UP" and "RIGHT" any value between 10 millisecond and 2500 milliseconds can be set. To change the currently valid value to the new value press the key "ENTER". Key "ESC" discards changes.

*Note: Pulse width can be set with 10 ms resolution (values 10, 20, 30, ...).*

Following values are pre-set:

**Pulse width standard factory setting:**
**Pulse width** 100 milliseconds

### *5.2.1.5 Status output (1.5 OUTPUT S) (M910 only)*

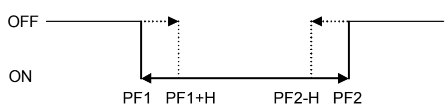
Status output is formed by relays. Maximum switched voltage is 100 V. Maximum switched current should not exceed 500 mA. First output is on terminal 8, second output is on terminals 5 and 7 (internally connected).

Status output can be programmed in one of the following modes:

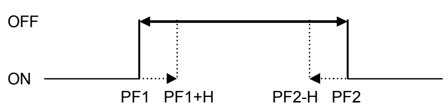
a) **Off** output is not active (off state).
b) **On Pos.** output is off in case of negative flow and made in case of positive flow.
c) **On Neg.** output is off in case of positive flow and made in case of negative flow.
d) **On In** output is on, when flowrate is higher than PF1 and lower than PF2, otherwise it is off.
e) **On Out** output is off, when flowrate is higher than PF1 and lower than PF2, otherwise it is on.
f) **Dose On** output is on, when programmed dose is counting, otherwise it is off.
g) **Dose Off** output is off, when programmed dose is counting, otherwise it is on.
h) **On>F1** output is on, when flowrate is higher than PF1, otherwise it is off.
i) **On<F1** output is on, when flowrate is lower than PF1, otherwise it is off.

If setting of flow limit is chosen, hysteresis H can be set too. Hysteresis is a tolerance field on one side of flow limits PF1 and PF2. The output status changes (indicates crossing over pre-set limit), when the immediate flowrate crosses over the value PF2 (or goes below limit PF1). The output status comes back to the default status, when the immediate flowrate decreases under the value PF2-H (or increases over limit PF1+H) again.

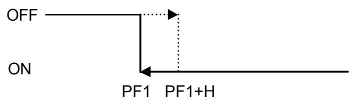
Mode d) with non-zero hysteresis:



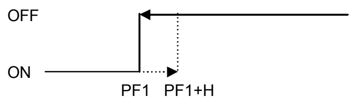

Mode e) with non-zero hysteresis:



Mode h) with non-zero hysteresis:




Mode i) with non-zero hysteresis:




Following values are pre-set:

**Status output standard factory setting:**

**Mode** „Off".
**PF1** limit corresponds to the required nominal flowrate $-Q_N$
**PF2** limit corresponds to the required nominal flowrate $Q_N$
**H** hysteresis corresponds to the required nominal flowrate $Q_N/10$

Parameters PF1, PF2 and H are common for frequency, impulse and status mode.

### *5.2.1.6 PLC digital input (1.6 INPUT) (M910 only)*

Digital input is activated with DC voltage between 5 and 30 V (positive or negative). Digital input is between terminals 9 and 10.

Digital input can be programmed in one of the following modes:

a) **Off** input is not active.
b) **Dose** input activation starts dose QD measuring. Dosing indication can be performed by one of outputs (frequency, impulse or status).
c) **Clr.Vol** input activation clears the Auxiliary volume.

QD value represents volume for dosing. QD value can be changed after selecting mode "b".

Following values are pre-set:

**Digital input standard factory setting:**
**QD** volume 1 $m^3$
**Mode** „Off".

### *5.2.1.7 Low flowrate limit (1.7 LIMIT PF1)*

Function enables you to set low flowrate limit for some functions of digital outputs after pressing "ENTER" key. See "Frequency output", "Impulse output" and "Status output". With the "UP" and "RIGHT" keys any value between +/- $Q_{MAX}$ flowrate can be set. Limit PF1 is displayed in the same format as the flowrate. To change the current valid value to the new value press the "ENTER" key. "ESC" key discards changes.

Following values are pre-set:

**Low flowrate limit standard factory setting:**
**PF1** limit corresponds to the required nominal flowrate $-Q_N$

#### *5.2.1.8 High flowrate limit (1.8 LIMIT PF2)*

Function enables you to set high flowrate limit for some functions of digital outputs after pressing key "ENTER". See "Frequency output", "Impulse output" and "Status output". With the "UP" and "RIGHT" keys any value between +/- $Q_{MAX}$ flowrate can be set. Limit PF2 is displayed in the same format as the flowrate. To change the current valid value to the new value press the "ENTER" key. "ESC" key discards changes.

Following values are pre-set:

**High flowrate limit standard factory setting:**
**PF2** limit corresponds to the required nominal flowrate $Q_N$

#### *5.2.1.9 Hysteresis of flowrate limits (1.9 HYSTERESIS)*

Function enables you to set hysteresis of limit values for some functions of digital outputs after pressing key "ENTER". See "Frequency output", "Impulse output" and "Status output". With the "UP" and "RIGHT" keys any value between +/- $Q_{MAX}$ flowrate can be set. Hysteresis is displayed in the same format as the flowrate. To change the current valid value to the new value press the "ENTER" key. "ESC" key discards changes.

Following values are pre-set:

**Hysteresis standard factory setting:**
**H** limit corresponds to the required nominal flowrate $Q_N/10$

#### *5.2.1.10 RS485 baud rate (1.A RS485 B.R.) (M910 only)*

Function enables you to set parameter baud rate of RS485 interface after pressing "ENTER" key. With the "UP" key any value from the row 4800, 9600 or 19200 Bd can be set. To change the current valid value to the new value press the "ENTER" key. "ESC" key discards changes.

Following values are pre-set:

**Baud rate standard factory setting:**
**Baud Rate** 9600 Bd.

#### *5.2.1.11 RS485 address (1.B RS485 ADDR.) (M910 only)*

Function enables to set parameter address of RS485 interface after pressing "ENTER" key. With the "UP" and "RIGHT" keys any value between 0 and 255 can be set. To change the current valid value to the new value press the "ENTER" key. "ESC" key discards changes.

Following values are pre-set:

**Baud rate standard factory setting:**
**ADDR** 00.

*Note: RS485 address is important in case of connecting more flowmeters to common RS485 bus. Each flowmeter has its own RS485 address. The connected computer can control communication between these flowmeters using theirs addresses. Communication will be excluded in case of two equal addresses.*

### *5.2.2 Flowmeter configuration (2 FLOWMETER)*

For flowmeter parameters configuration. After pushing “UP” key next item (“3 GENERAL“) is selected. After pushing “ENTER” key following submenu is displayed:

#### 5.2.2.1 Flowrate units (2.1 FLOW UNIT)

Function enables you to set flowrate units after pressing the “ENTER” key. With the “UP” key any item from the list “l/s”, “m3/h”, “G/m” and “user” can be set. To change the current valid unit to the selected unit press the “ENTER” key. “ESC” key discards changes.
Available units:

| | |
|---|---|
| l/s | litres per second |
| m3/h | cubic metres per hour |
| G/m | US gallons per minute |
| user | user-defined unit, factory-set is „l/h“ (litres per hour), user defined unit can be changed by computer only |

Following values are pre-set:

**Flowrate units standard factory setting:**
**Flowrate units** m3/h
**User** l/h

#### 5.2.2.2 Flowrate resolution (2.2 FLOW RESOL.)

Function enables you to set flowrate resolution after pressing the “ENTER” key. With the “UP” key any item from the list “0”, “0.0”, “0.00”, “0.000” and “0.0000” can be set. To change the current valid resolution to the selected resolution press the “ENTER” key. “ESC” key discards changes.
Available resolution:

| | |
|---|---|
| 0 | without decimal digits |
| 0.0 | max. 1 decimal digit |
| 0.00 | max. 2 decimal digits |
| 0.000 | max. 3 decimal digits |
| 0.0000 | max. 4 decimal digits |

*Note: selected resolution is the maximal resolution. It is reduced for high values. For example 4 decimal digits resolution is valid up to -99.9999 or 99.9999 displayed value. For higher values, the resolution reduced (999.999).*

Following values are pre-set:

**Flowrate resolution standard factory setting:**
**Resolution** 0.0000 for $Q_{100\%} < 3.0000$
0.000 for $3.000 \leq Q_{100\%} < 30.000$
0.00 for $30.00 \leq Q_{100\%} < 300.00$
0.0 for $300.0 \leq Q_{100\%} < 3000.0$
0 for $Q_{100\%} \geq 3000.0$

#### 5.2.2.3 Volume units (2.3 VOLUME UNIT)

Function enables to set volume units after pressing the “ENTER” key. With the “UP” key any item from the list “m3”, “l”, “US.G” and “user” can be set. To change the current valid unit to the selected unit press the “ENTER” key. “ESC” key discards changes.
Available units:

| | |
|---|---|
| m3 | cubic metres |
| l | litres |
| US.G | US gallons |
| user | user-defined unit, factory-set is „l“ (litres), user defined unit can be changed by computer only |

Following values are pre-set:

**Volume units standard factory setting:**
**Volume units** m3
**User** l

### *5.2.2.4 Volume resolution (2.4 VOL. RESOL.)*

Function enables to set volume resolution after pressing the "ENTER" key. With the "UP" key any item from the list "0", "0.0", "0.00" , "0.000" and , "0.0000" can be set. To change the current valid resolution to the selected resolution press the "ENTER" key. "ESC" key discards changes.
Available resolution:

| | |
|---|---|
| 0 | without decimal digits |
| 0.0 | max. 1 decimal digit |
| 0.00 | max. 2 decimal digits |
| 0.000 | max. 3 decimal digits |
| 0.0000 | max. 4 decimal digits |

*Note: selected resolution is the maximuml resolution. It is reduced for high values. For example 4 decimal digits resolution is valid up to -999.9999 or 9999.9999 displayed value. For higher values the resolution is reduced (99999.999).*

Following values are pre-set:

**Volume resolution standard factory setting:**
**Resolution** 0.000

### *5.2.2.5 Flowrate direction (2.5 FLOW DIREC.)*

Function enables you to switch between "Positive" and "Negative" flow direction (change the sign in flowrate value) after pressing the "ENTER" key. With the "UP" key any item from the list "Positive" and , "Negative" can be set. To change the current valid direction to the selected direction press the "ENTER" key. "ESC" key discards changes.

*Note: flowmeters are working in both flow directions, however they are calibrated for positive direction only.*

Following values are pre-set:

**Flowrate direction standard factory setting:**
**Flow direc.** Positive

### *5.2.2.6 Low-flow cutoff (2.6 L.F.CUTOFF)*

Function enables you to set limit for suppressing low flowrates after pressing "ENTER" key. With the "UP" key and "RIGHT" any value between +/- $Q_{MAX}$ flowrate can be set. Limit is displayed in the same format as the flowrate. To change the current valid value to the new value press the "ENTER" key. "ESC" key discards changes.

*Note: All flowrates below this value will be displayed as 0.00. This setting is valid for display and all outputs.*

Following values are pre-set:

**Low-flow cutoff standard factory setting:**
**L.F.Cutoff** corresponds to the flowrate $Q_{1\%}/2$ (see table 2 M910 Flowrates)

#### *5.2.2.7 Moving average time constant (2.7 TIMECONST)*

Function enables you to change the time for moving average calculating after pressing “ENTER” key. With “UP” and “RIGHT” key any value between 1 second and 20 seconds can be set. To change the current valid value to the new value press the “ENTER” key. “ESC” key discards changes.

Following values are pre-set:

**Time constant standard factory setting:**
**Timeconst** 10 seconds

#### *5.2.2.8 Time setting (2.8 TIME SET.) (M910 only)*

Function enables you to correct time of internal Real time clock after pressing “ENTER” key. With “UP” and “RIGHT” key any time between 00:00:00 and 23:59:59 can be set. To change the current valid value to the new value press the “ENTER” key. “ESC” key discards changes.

Following values are pre-set:

**Time setting standard factory setting:**
**Time set.** Central European Time

#### *5.2.2.9 Date setting (2.9 DATE SET.) (M910 only)*

Function enables you to correct date of internal Real time clock after pressing key “ENTER” key. With “UP” and “RIGHT” key any date between 01.01.2000 and 31.12.2099 can be set. To change the current valid value to the new value press the “ENTER” key. “ESC” key discards changes.

Following values are pre-set:

**Date setting standard factory setting:**
**Date set.** Actual date

#### *5.2.2.10 Datalogger setting (2.A DATALOGGER) (M910 only)*

Function enables you to set sample interval for internal datalogger after pressing “ENTER” key. With “UP” key any value from the row OFF, 5, 10, 15, 30, 45, 60, 120, 180, 240 and CLR can be select. To change the current valid value to the new value press the “ENTER” key. “ESC” key discards changes. Datalogger will be cleared after selection item CLR. This selection doesn’t change datalogger sample interval.

Following values are pre-set:

**Datalogger standard factory setting:**
**Datalogger** OFF

### *5.2.3 General settings (3 GENERAL)*

For general settings configuration or for reading actual settings. After pushing “UP” key next item is selected. After pushing “ENTER” key following submenu is displayed:

### *5.2.3.1 Diameter (3.1 DIAMETER)*

Flowmeters nominal diameter is displayed. After pushing “UP” key “Range” is displayed.

### *5.2.3.2 Nominal flowrate range $Q_N$ (3.2 RANGE)*

Nominal flowrate range $Q_N$ is displayed in flowrate units. After pushing “UP” key “Serial number” is displayed.

### *5.2.3.3 Serial number (3.3 SERIAL NR.)*

Flowmeters Serial number is displayed. After pushing “UP” key “Power supply” is displayed.

### *5.2.3.4 Power supply (3.4 POWER SUP.)*

Information about power supply (voltage and frequency) is displayed. After pushing “UP” key “Self test” is displayed.

### *5.2.3.5 Self-test (3.5 SELFTEST)*

Function enables you to switch an internal self-test (flowrate simulator) “On” or “Off” after pressing “ENTER” key. With “UP” key any item from the list “On” and, “Off” can be set. To change the current valid self-test state press the “ENTER” key. “ESC” discards changes.

*Note: Self-test “Off” state is normal working state of flowmeter. After switching self-test to “On” state, internal flowrate simulator is inserted instead of the pipe. Function can be used for signal converter testing. Number in range (0.980, 1.020) is displayed, if signal converter is OK. Number is displayed in state “On” only. After switching on you have to wait for converter stabilization (up to 20 seconds).*

Following values are pre-set:

**Self-test standard factory setting:**
**Self-test** Off

### *5.2.3.6 Current Loop Test (3.6 C.LOOP TEST)*

Function enables you to switch an internal test of the connected current loop “On” or “Off” after pressing the “ENTER” key. With the “UP” key any item from the list “On” and, “Off” can be set. To change the current valid Current Loop Test state press the “ENTER” key. “ESC” key discards changes.

*Note: If Current Loop Test is in “On” state and current output flows less than 3 mA, error message “01 – Current Output” will be displayed.*

Following values are pre-set:

**Current Loop Test standard factory setting:**
**C.Loop Test** Off

### *5.2.3.7 Basic Menu Password (3.7 PASSWORD MN.)*

Function enables you to enter a new password for basic menu access after pressing the “ENTER” key. With the “UP” and “RIGHT” key any password in range between 00000 and 99999 can be set. To change the current valid password to the new password press the “ENTER” key. “ESC” key discards changes.

Following values are pre-set:

**Basic Menu Password standard factory setting:**
**PASSWORD MN.** 00000

### 5.2.4 Calibration menu (4 CALIBRATION)

**Setting any new value in calibration menu changes calibration data! Calibration should be performed in an appropriate equipped laboratory.**

**We recommended using software Flow910 for easy Calibration. It contains „calibration wizard“ and can prevent flowmeter from incorrect calibration.**

*Calibration menu* is accessible as part 4 of the *Setup menu,* if the correct calibration password has been entered. After entering the *Basic menu password* only parts 1 to 3 of *Setup menu* are accessible. Without the correct password access to the *Calibration menu* is refused. Default factory set Calibration password is “10000”.

*Note: Flowmeter M910 enables calibration at 2, 3 or 4 points. Each calibration point contains 2 values. Nominal value of calibration point is selected by user in range between +/- $Q_{MAX}$ (for maximum flowrates see table 1: M910 flowrates). It is expressed in flowrate units. To this nominal value is attached a calibration constant. Calibration constant doesn't have a unit. In the calibration process you change this calibration constant to reach similarity between standard flowmeter and the calibrated flowmeter. Higher calibration constant means lower displayed value.*
*Calibration constants must be different. In the case of two equal calibration constants, the measured values could be wrong.*

#### 5.2.4.1 Number of Calibration Points (4.1 NR.OF CALP.)

Function enables you to enter a new number of calibration points after pressing the “ENTER” key. With the “UP” and “RIGHT” keys any number in range between 2 and 4 can be set. To change the current valid number to the new number press the “ENTER” key. “ESC” key discards changes.

*Note: Standard number of calibration points is 2. More calibration points are used for special applications when higher accuracy is expected (negative flowrate, low flowrates etc.).*

Following values are pre-set:

**Number of Calibration Points standard factory setting:**
**NR.OF CALP.** 2

#### 5.2.4.2 Calibration point 1 (4.2 CAL.POINT 1)

Function enables you to change nominal and calibration value of Calibration point 1 after pressing the “ENTER” key. With the “UP” and “RIGHT” keys any value in the range of real flowrates can be set. To change the current valid nominal value to the new nominal value press the “ENTER” key. After entering the nominal value a new calibration constant can be set. “ESC” key discards changes.

Following values are pre-set:

**Calibration point 1 standard factory setting:**
**Nominal point** 5 … 10% of required $Q_N$
**Cal. Constant** is assigned according to the calibration

### *5.2.4.3 Calibration point 2 (4.3 CAL.POINT 2)*

Function enables you to change the nominal and calibration value of Calibration point 2 after pressing the "ENTER" key. With "UP" and "RIGHT" key any value in the range of real flowrates can be set. To change the current valid nominal value to the new nominal value press the "ENTER" key. After entering the nominal value new calibration constant can be set. "ESC" key discards changes.

Following values are pre-set:

**Calibration point 2 standard factory setting:**
**Nominal point** 40 … 70% of required $Q_N$
**Cal. Constant** is assigned according to the calibration

### *5.2.4.4 Calibration point 3 (4.4 CAL.POINT 3)*

Function is available only if 3 or 4 calibration points are selected. Function enables you to change the nominal and calibration value of Calibration point 3 after pressing the "ENTER" key. With the "UP" and "RIGHT" key any value in the range of real flowrates can be set. To change the current valid nominal value to the new nominal value press the "ENTER" key. After entering the nominal value a new calibration constant can be set. "ESC" key discards changes.

Following values are pre-set:

**Calibration point 3 standard factory setting:**
**Not used.**

### *5.2.4.5 Calibration point 4 (4.5 CAL.POINT 4)*

Function is available only if 4 calibration points are selected. Function enables you to change the nominal and calibration value of Calibration point 4 after pressing the "ENTER" key. With the "UP" and "RIGHT" keys any value in the range of real flowrates can be set. To change the current valid nominal value to the new nominal value press the "ENTER" key. After entering the nominal value a new calibration constant can be set. "ESC" key discards changes.

Following values are pre-set:

**Calibration point 4 standard factory setting:**
**Not used.**

### *5.2.4.6 Calibration Password (4.6 PASSWORD CA.)*

Function enables you to enter a new password for calibration menu access after pressing the "ENTER" key. With the "UP" and "RIGHT" keys any password in the range between 00000 and 99999 can be set. To change the current valid password to the new password press the "ENTER" key. "ESC" key discards changes.

Following values are pre-set:

**Calibration Password standard factory setting:**
**PASSWORD CA.** 10000

# 6 System control

The flowmeter includes serial lines RS232 and RS485. RS232 connector is located behind the front panel. RS485 terminals are behind the back panel. For the remote control to work properly, bus parameters must be set in the setup menu. Address and baud rate are important for RS485 bus. Communication parameters are fixed for RS232 bus.

## 6.1 RS485 bus properties (M910 only)

To transfer the data using RS485 bus, 8N1 data format is used, i.e. each data word includes 8 bits, no parity and one stop bit. The communication speed can be set using the system menu. Available values: 4800, 9600 and 19200 Bd. Each flowmeter has it's own RS485 address. Range of these addresses is from 0 to 255.

## 6.2 RS232 bus properties

To transfer the data using RS232 bus, 8N1 data format is used, i.e. each data word includes 8 bits, no parity and one stop bit. Communication speed 1200 Bd is fixed.

## 6.3 Command syntax

Communication between flowmeter and computer consists of a flow of periodically alternating commands type command-response or query-response. Command is always a text followed by parameter and ended by control sign <cr>. Response is always ended with control sign <cr>.

Commands described in this chapter can be issued through both buses (RS485 and RS232). The only difference is, that before all commands for RS485 bus is identification in form "#00". Where '#' is the command prefix and "00" is flowmeters address 0 in hexadecimal form. For flowmeter with address 1 it's identification is "#01". Flowmeter answers are prefix in form ">00" for flowmeter 0, ">01" for flowmeter 1 etc.

**Syntax description**

<DNPD> = Decimal Numeric Program Data, this format is used to express decimal number with or without the exponent.

<CPD> = Character Program Data. Usually, it represents a group of alternative character parameters. e.g. {0 | 1 | 2 | 3}.

? = A flag indicating a request for the value of the parameter specified by the command. No other parameter than the question mark can be used.

(?) = A flag indicating a request for the parameter specified by the command. This command permits a value to be set as well as requested.

<cr> = carriage return. ASCII code 13. This code executes the command or query.

## 6.4 Command list

***Device identification***

**IDN?**

Response contains flowmeters model type number.

**Example RS232:**
If query „IDN?<cr>" is sent, flowmeter returns response in format „M910-Vxxxx<cr>" in case of M910.

**Example RS485:**
If query „#00IDN?<cr>" is sent, flowmeter returns response in format „>00M910-Vxxxx<cr>".

***Current output mode setting***

**SCM(?)<CPD> { 0 | 1 | 2 | 3 | 4 }**

Following modes can be set:

- 0 Off
- 1 Pos.Flow
- 2 Neg.Flow
- 3 Abs.Flow
- 4 Bip.Flow
- 5 Fixed

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „SCM1<cr>" sets mode "Positive flowrate" for current output. If query „SCM?<cr>" is sent, flowmeter returns response in format „1<cr>".

***Frequency output mode setting***

**SFM(?)<CPD> { 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 }**

Following modes can be set:

- 0 Off
- 1 Pos.Flow
- 2 Neg.Flow
- 3 Abs.Flow
- 4 On Pos.
- 5 On Neg.
- 6 On In
- 7 On Out
- 8 Dose On
- 9 Dose Off
- 10 On<F2
- 11 On>F2
- 12 Fixed

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „SFM1<cr>" sets mode "Positive flowrate" for frequency output. If query „SFM?<cr>" is sent, flowmeter returns response in format „1<cr>".

***Impulse output mode setting***

**SPM(?)<CPD> { 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 }**

Following modes can be set:

- 0 Off
- 1 Pos.Flow
- 2 Neg.Flow
- 3 Abs.Flow
- 4 On Pos.
- 5 On Neg.
- 6 On In
- 7 On Out
- 8 Dose On
- 9 Dose Off
- 10 On>F1
- 11 On<F1

M910 confirms execution with string „Ok<cr>".

**Example RS232:**
Command „SPM1<cr>" sets mode "Positive flowrate" for impulse output. If query „SPM?<cr>" is sent, flowmeter returns response in format „1<cr>".

***Status output mode setting***

**SSM(?)<CPD> { 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 }**

Following modes can be set:

- 0 Off
- 1 On Pos.
- 2 On Neg.
- 3 On In
- 4 On Out
- 5 Dose On
- 6 Dose Off
- 7 On>F1
- 8 On<F1

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „SSM1<cr>" sets mode "On for positive flowrate" for status output. If query „SSM?<cr>" is sent, flowmeter returns response in format „1<cr>".

***Digital input mode setting***

**SIM(?)<CPD> { 0 | 1 | 2 }**

Following modes can be set:

- 0 Off
- 1 Dose
- 2 Clr.Vol

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „SIM1<cr>" sets mode "Dose" for digital input. If query „SIM?<cr>" is sent, flowmeter returns response in format „1<cr>".

***Current output constant QI***

### SCO(?)<DNPD>

Command sets constant QI, which represents flowrate value for current 20 mA.

<DNPD>

It represents required flowrate in actual units. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set value in actual units.

**Example:**
Command „SCO10.5<cr>" sets value QI to 10.5 in actual units. After query „SCO?<cr>" flowmeter returns string „10.500000<cr>".

***Frequency output constant QF***

### SFO(?)<DNPD>

Command sets constant QF, which represents flowrate value for frequency 1000 Hz.

<DNPD>

It represents required flowrate in actual units. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set value in actual units.

**Example:**
Command „SFO10.5<cr>" sets value QF to 10.5. After query „SFO?<cr>" flowmeter returns string „10.500000<cr>".

***Impulse output constant QP***

### SPO(?)<DNPD>

Command sets constant QP, which represents volume for 1 impulse.

<DNPD>

It represents volume for 1 impulse in actual units. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set value in actual units.

**Example:**
Command „SPO1.0<cr>" sets value QP to 1.0. After query „SPO?<cr>" flowmeter returns string „1.000000<cr>".

***Dosing constant QD***

### SIO(?)<DNPD>

Command sets constant QD, which represents volume for dosing.

<DNPD>

It represents volume for dosing in actual units. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set value in actual units.

**Example:**
Command „SIO1.0<cr>" sets value QD to 1.0. After query „SIO?<cr>" flowmeter returns string „1.000000<cr>".

***Impulse width***

**SPT(?)<DNPD>**

Command sets impulse width in range between 10 and 2500 ms.

<DNPD>

It represents impulse width in milliseconds. Any value in range between 10 millisecond and 2500 milliseconds can be set. M910 confirms execution with string „Ok<cr>”. In case of query M910 returns set value in actual units.

**Example:**
Command „SPT100<cr>” sets impulse width to 100 ms. After query „SPT?<cr>” flowmeter returns string „100<cr>”.

***Fixed current***

**SFC(?)<DNPD>**

Command sets fixed current in range between 4 mA and 20 mA. Current output must be set to “Fixed” mode.

<DNPD>

It represents current for “Current output” in mA. M910 confirms execution with string „Ok<cr>”. In case of query M910 returns set value in mA.

**Example:**
Command „SFC10<cr>” sets current output to 10 mA (it must be set to “Fixed current” mode). After query „SFC?<cr>” flowmeter returns string „10.000000<cr>”.

***Fixed frequency***

**SFF(?)<DNPD>**

Command sets fixed for frequency in range between 10 Hz and 12 kHz. Frequency output must be set to “Fixed” mode.

<DNPD>

It represents frequency for “Frequency output” in Hz. M910 confirms execution with string „Ok<cr>”. In case of query M910 returns set value in Hz.

**Example:**
Command „SFF1000<cr>” sets frequency output to 1000 Hz (it must be set to “Fixed frequency” mode). After query „SFF?<cr>” flowmeter returns string „1000.000000<cr>”.

***Low limit value***

**SF1(?)<DNPD>**

Command sets low limit value PF1.

<DNPD>

It represents flowrate for low limit value PF1 in actual unit. M910 confirms execution with string „Ok<cr>”. In case of query M910 returns set value in actual unit.

**Example:**
Command „SF1-10.5<cr>” sets low limit value to –10.5. After query „SF1?<cr>” flowmeter returns string „-10.500000<cr>”.

***High limit value***

**SF2(?)<DNPD>**

Command sets low limit value PF2.

<DNPD>

It represents flowrate for high limit value PF2 in actual unit. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set value in actual unit.

**Example:**
Command „SF210.5<cr>" sets low limit value to 10.5. After query „SF2?<cr>" flowmeter returns string „10.500000<cr>".

***Hysteresis***

**SHY(?)<DNPD>**

Command sets hysteresis H.

<DNPD>

It represents flowrate for hysteresis H in actual unit. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set value in actual unit.

**Example:**
Command „SHY1.05<cr>" sets hysteresis to 1.05. After query „SHY?<cr>" flowmeter returns string „1.050000<cr>".

***Flowrate unit***

**FFS(?)<CPD> { 0 | 1 | 2 | 3 }**

Following units can be set:

- 0 l/s
- 1 m3/h
- 2 G/m
- 3 "user"

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „FFS0<cr>" sets flowrate unit "l/s". If query „FFS?<cr>" is sent, flowmeter returns response in format „0<cr>".

***Volume unit***

**FVS(?)<CPD> { 0 | 1 | 2 | 3 }**

Following units can be set:

- 0 m3
- 1 l
- 2 US.G
- 3 "user"

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „FVS0<cr>" sets volume unit "m3". If query „FVS?<cr>" is sent, flowmeter returns response in format „0<cr>".

***Flowrate resolution***

**FFR(?)<CPD> { 0 | 1 | 2 | 3 | 4 }**

Following resolution can be set:

- 0 0
- 1 0.0
- 2 0.00
- 3 0.000
- 4 0.0000

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „FFR3<cr>" sets flowrate resolution "0.000". If query „FFR?<cr>" is sent, flowmeter returns response in format „3<cr>".

***Volume resolution***

**FVR(?)<CPD> { 0 | 1 | 2 | 3 | 4 }**

Following resolution can be set:

- 0 0
- 1 0.0
- 2 0.00
- 3 0.000
- 4 0.0000

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „FVR3<cr>" sets volume resolution "0.000". If query „FVR?<cr>" is sent, flowmeter returns response in format „3<cr>".

***Flowrate user unit***

**FFU(?)<CPD>**

Command sets text for flowrate user unit.

<CPD>

It represents user units expressed as 5 ASCII characters. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set user unit.

**Example:**
Command „FFU l/m <cr>" sets flowrate user unit " l/m ". After query „FFU?<cr>" flowmeter returns string „ l/m <cr>".

***Volume user unit***

**FVU(?)<CPD>**

Command sets text for volume user unit.

<CPD>

It represents user units expressed as 5 ASCII characters. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set user unit.

**Example:**
Command „FVU dm3 <cr>" sets volume user unit " dm3 ". After query „FVU?<cr>" flowmeter returns string „ dm3 <cr>".

***Conversion constant for flowrate user unit***

**FFC(?)<DNPD>**

Command sets conversion constant for flowrate user unit with respect to [l/s].

<DNPD>

It represents a constant, which is calculated as a ratio between flowrate in user unit and flowrate in basic unit ( [l/s] ). For example constant for [m3/h] is 3.6. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set constant.

**Example:**
Command „FFC3.6<cr>" sets constant "3.6 ". After query „FFC?<cr>" flowmeter returns „3.600000<cr>".

***Conversion constant for volume user unit***

**FVC(?)<DNPD>**

Command sets conversion constant for volume user unit with respect to [l].

<DNPD>

It represents a constant, which is calculated as a ratio between volume in user unit and volume in basic unit ( [l] ). For example constant for [m3] is 0.001. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set constant.

**Example:**
Command „FVC0.001<cr>" sets constant "0.001 ". After query „FVC?<cr>" flowmeter returns „0.001000>".

***Flowrate direction***

**FFD(?)<CPD> { 0 | 1 }**

Following directions can be set:

- 0 Positive
- 1 Negative

M910 confirms direction with string „Ok<cr>".

**Example:**
Command „FFD0<cr>" sets "Positive direction". If query „FFD?<cr>" is sent, flowmeter returns response in format „0<cr>".

***Low flow cutoff***

**FLF(?)<DNPD>**

Command sets flowrate limit for suppression low flowrates.

<DNPD>

It represents flowrate expressed in actual unit. All flowrates below this limit are displayed as 0. M910 confirms execution with string „Ok<cr>". In case of query M910 returns set low flow cut-off.

**Example:**

Command „FLF0.2<cr>" sets low flow cut-off "0.2". After query „FLF?<cr>" flowmeter returns „0.200000<cr>".

***Time constant***

**FTC(?)<DNPD>**

Command sets time for moving average calculation.

<DNPD>

It represents time expressed in seconds. Any value in range between 1 second and 20 seconds can be set. M910 confirms execution with string „Ok<cr>". In case of query M910 returns time constant.

**Example:**
Command „FTC6<cr>" sets time constant "6" seconds. After query „FLF?<cr>" flowmeter returns „6<cr>".

***Internal self-test (flowrate simulator)***

**FIS(?)<CPD> { 0 | 1 }**

Internal self-test can be switched:

- 0 Off
- 1 On

M910 confirms self-test state with string „Ok<cr>".

**Example:**
Command „FIS0<cr>" switches self-test "Off". If query „FIS?<cr>" is sent, flowmeter returns response in format „0<cr>".

***Current loop test***

**FCE(?)<CPD> { 0 | 1 }**

Internal current loop test can be switched:

- 0 Off
- 1 On

M910 confirms current loop test state with string „Ok<cr>".

**Example:**
Command „FCE0<cr>" switches current loop test "Off". If query „FCE?<cr>" is sent, flowmeter returns response in format „0<cr>".

***Time***

**FTM(?)<CPD> HH:MM:SS**

Command sets new time for internal Real Time Clock.

<CPD>

It represents new time in format HH:MM:SS. Any value in range between 00:00:00 and 23:59:59 can be set. M910 confirms execution with string „Ok<cr>". In case of query M910 returns real time.

**Example:**
Command „FTM14:25:00<cr>" sets new time (2:25:00 pm). After query „FTM?<cr>" flowmeter returns „14:25:00<cr>".

***Date***

**FDT(?)<CPD> DD.MM.YYYY**

Command sets new date for internal Real Time Clock.

<CPD>

It represents new date in format DD.MM.YYYY. Any value in range between 01.01.2000 and 31.12.2099 can be set. M910 confirms execution with string „Ok<cr>". In case of query M910 returns real date.

**Example:**
Command „FDT05.03.2002<cr>" sets new date (March 5, 2002). After query „FDT?<cr>" flowmeter returns „05.03.2002<cr>".

***Auxiliary volume counter Reset***

**CLRAV**

Command resets "Auxiliary volume counter".

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „CLRAV<cr>" resets the *Auxiliary volume counter*.

***Min. / Max. flowrates Reset***

**CLRMM**

Command resets "Min. Flowrate" and "Min. Flowrate" values.

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „CLRMM<cr>" resets both min/max values.

***Flowrate reading***

**RFL?**

Response contains actual "Flowrate" value in selected units.

**Example:**
If query „RFL?<cr>" is sent, flowmeter returns response in format „100.000<cr>". Resolution is designed by Setup menu.

***Volume reading***

**RVO?**

Response contains actual "Volume" counter value in selected units.

**Example:**
If query „RVO?<cr>" is sent, flowmeter returns response in format „100.000<cr>". Resolution is designed by Setup menu.

***Positive volume reading***

**RVP?**

Response contains actual Positive volume counter value.

**Example:**
If query „RVP?<cr>” is sent, flowmeter returns response in format „100.000<cr>“. Resolution is designed by Setup menu.

***Negative volume reading***

**RVN?**

Response contains actual Negative volume counter value.

**Example:**
If query „RVN?<cr>” is sent, flowmeter returns response in format „-100.000<cr>“. Resolution is designed by Setup menu.

***Auxiliary volume reading***

**RVA?**

Response contains actual Auxiliary volume counter value.

**Example:**
If query „RVA?<cr>” is sent, flowmeter returns response in format „100.000<cr>“. Resolution is designed by Setup menu.

***Maximum flowrate value reading***

**RMX?**

Response contains maximum Flowrate value and time & date of this flowrate.

**Example:**
If query „RMX?<cr>” is sent, flowmeter returns response in format „100.000, 08:06 11.04.2002<cr>“ (maximum flowrate value indicated since last reset – command CLRMM).

***Minimum flowrate value reading***

**RMN?**

Response contains minimum Flowrate value and time & date of this flowrate.

**Example:**
If query „RMN?<cr>” is sent, flowmeter returns response in format „0.000, 10:06 11.04.2002<cr>“ (minimum flowrate value indicated since last reset – command CLRMM).

***Nominal diameter reading***

**RDN?**

Response contains actual flowmeters Nominal diameter (DN).

**Example:**
If query „RDN?<cr>” is sent, flowmeter returns response in format „50<cr>“ for nominal diameter 50mm.

***Nominal flowrate reading***

**RQN?**

Response contains actual flowmeters Nominal flowrate ($Q_N$).

**Example:**

If query „RQN?<cr>" is sent, flowmeter returns response in format „80.000<cr>" for nominal flowrate 80 (m3/h…).

***Current loop state reading***

**RCE?**

Response contains state of current loop.

Response is:

- 0 - current loop is closed
- 1 - current loop is disconnected

**Example:**
If query „RCE?<cr>" is sent, flowmeter returns response in format „0<cr>" for closed current loop.

***Datalogger step***

**DST(?)<CPD> { 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 }**

Datalogger can be set:

- 0 Datalogger is Off
- 1 Datalogger sampling rate is 5 minutes.
- 2 Datalogger sampling rate is 10 minutes.
- 3 Datalogger sampling rate is 15 minutes.
- 4 Datalogger sampling rate is 30 minutes.
- 5 Datalogger sampling rate is 45 minutes.
- 6 Datalogger sampling rate is 60 minutes.
- 7 Datalogger sampling rate is 120 minutes.
- 8 Datalogger sampling rate is 180 minutes.
- 9 Datalogger sampling rate is 240 minutes.

M910 confirms datalogger step with string „Ok<cr>".

**Example RS232:**
Command „DST0<cr>" switches datalogger "Off". If query „DST?<cr>" is sent, flowmeter returns response in format „0<cr>".

***Datalogger number of samples***

**DNR?**

Response contains number of flowrate samples stored in datalogger.

**Example:**
If query „DNR?<cr>" is sent, flowmeter returns response in format „252<cr>" for 252 samples in datalogger.

***Datalogger filling***

**DPC?**

Response contains datalogger filling in percent.

**Example:**
If query „DPC?<cr>" is sent, flowmeter returns response in format „14<cr>" for 14% datalogger full.

***Datalogger reading***

**DRT?**

Response contains all values stored in internal datalogger.

**Example:**
If query „DRT?<cr>" is sent, flowmeter returns response in format:

```
14:28 13.10.2003     5.820 l/s
14:33 13.10.2003     4.765 l/s
14:38 13.10.2003     4.712 l/s
14:43 13.10.2003     4.792 l/s
14:48 13.10.2003     4.760 l/s
No Record
```

***Datalogger clear***

**DCLR**

Command clears all data stored in internal datalogger.

M910 confirms execution with string „Ok<cr>".

**Example:**
Command „DCLR<cr>" clears all data in datalogger.

***Internal temperature***

**IT?**

Response contains internal temperature in flowmeters case. Accuracy of temperature value is not guarantied. It's informative value only.

**Example:**
If query „IT?<cr>" is sent, flowmeter returns response in format „35.2<cr>" for internal temperature 35.2 °C.

***Service information***

**ISR?**

Response contains service information (serial number, power supply voltage and power supply frequency).

**Example:**
If query „ISR?<cr>" is sent, flowmeter returns response in format „371561, 0, 50, 2546<cr>".

Where:
371561 is the serial number of instrument
0 is power supply voltage (0 is 230V, 1 is 24V, 2 is 115V)
50 is power supply frequency (0 is DC, 50 is 50Hz, 60 is 60Hz)
2546 is information for service only

***Write to EEPROM***

**WEP**

Command writes all new data in internal EEPROM. If you change some settings (for example Flowrate resolution) is changed, but only in internal RAM memory and after switching the flowmeter off and on, all settings will be lost. You have to use WEP command to save these settings.

**Example:**
Command „WEP<cr>" record all settings in internal EEPROM.

# 7 Error messages

When any error occurs, the flowmeter will display an error message. Errors can arise because of:

- Incorrect control, i.e. faulty connection to the flowmeter, grounding, etc.,
- Flowmeter failure

```
Error 45
Excitation Err.
```

In case of any error, the error message is displayed on the display for approx. 1 second.

After switching on, an internal test of the hardware is performed. If there were any error during the test, the flowmeter would display the appropriate error message.

Types of errors and methods of troubleshooting (if available) are in following table.

| Nr | Error | Meaning | Troubleshooting |
|---|---|---|---|
| 01 | Current output | Current loop is disconnected. | Connect the current output or switch the current output OFF (if it is not used). This message can be disabled in “Setup menu”. |
| 20 | Wrong password (M910 only) | Wrong password for setup / calibration / service menu was used. | Use correct password. |
| 21 | Not a number (M910 only) | Non numerical value | Write the appropriate number. |
| 22 | Value too low (M910 only) | Entry value is to low | Write the appropriate number. |
| 23 | Value too high (M910 only) | Entry value is to high | Write the appropriate number. |
| 24 | Wrong format (M910 only) | Bad date or time format | Write regular date or time format. |
| 25 | Datalogger empty (M910 only) | No records in datalogger | Datalogger is switched OFF or records have been cleared. |
| 26 | Wrong Cal. Point (M910 only) | There are 2 or more calibration constants with the same nominal value. | Correct calibration constant values or reduce number of calibration points. |
| 31 | RS232 Frame Err. | Valid stop bit missing | Communication format RS232 is wrong. Check the Baud rate (1200 Bd). |
| 45 | Excitation Err. | Excitation coils error | Excitation is not working properly. Contact service department. |
| 46 | Empty pipe | No liquid in pipe | Fill the pipe with liquid. |

# 8 Maintenance

The inductive flowmeter is an electronic device with circuits protected with built-in electronic fuses. These protect the instrument against damage caused by the user.

## *8.1 Advice for correct operation*

The following principles should be consider during installation:

- ***If there is a noisy power supply voltage (especially peaks generated, usually by motors, etc.), use an external power supply filter between the flowmeter and power supply.***
- ***Protect the flowmeter and the internal lining of the sensor pipe from mechanical damage, especially during installation or cleaning.***
- ***Protect the flowmeter from direct sunlight. Fit a sunshade if necessary.***
- ***Do not expose the flowmeter to intense vibration.***

## *8.2 Periodical maintenance*

The flowmeter does not require any special maintenance. Dependent on the media being measured it is recommended that approx. once a year, remove the sensor from the pipe and clean the liner. Method of cleaning consists of removing mechanical dirt and any non-conductive coating (like oil film) from the liner. A very dirty liner could cause inaccuracy of the measurement. Check mechanical state of the liner.

## *8.3 What to do in case of failure*

If an **obvious failure** occurs during the operation (e.g. the display is not lit), the flowmeter must be switched off immediately. First, check the fuse located under the electronic board cover.

- Turn off the power to the flowmeter.
- Remove the cover from the transmitter
- The fuse holder is located behind the power supply terminals. Remove the fuse. Replace it with a new fuse of the same rating if necessary
- Replace the cover.
- Connect power supply again.

If an obvious fault is evident, e.g. a measurement range or an operating mode is not functional, the user cannot correct the fault.

**Hidden faults** can cause different symptoms. Usually, they cause instability of some parameters. Hidden defects can be caused by unacceptable distortion, degraded insulation etc. In this case contact Distributor.

The flowmeter can have “hidden defects”, when correct operation rules are not applied. In this case, the fault can be caused by wrong installation. Most frequent cases of false “hidden defects”:

- mains voltage out of tolerance limits or unstable
- poor grounding of the measuring circuit (bad connection of the ground terminal )

large electrostatic or electromagnetic field.

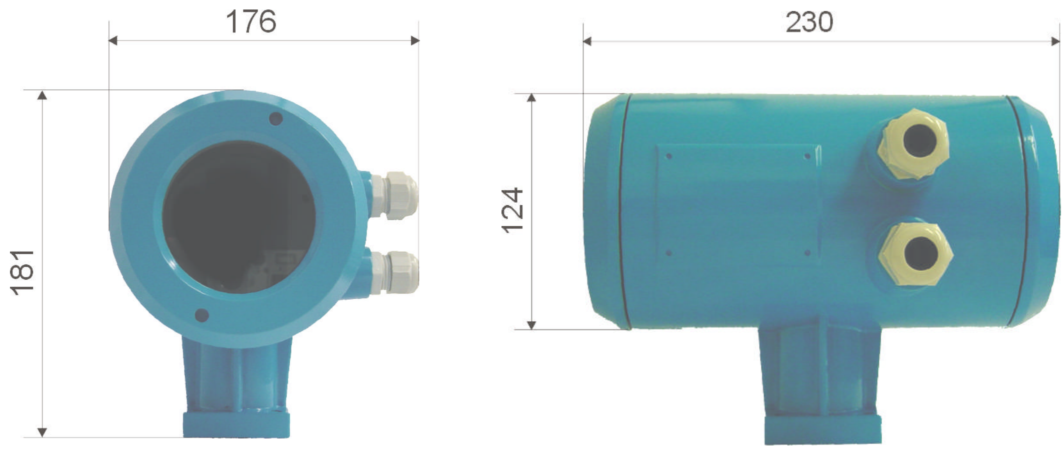
# 9 Application information

## 9.1 Weight and dimensions

Flowmeter weight and dimensions depend mostly on the version (remote or compact) and diameter of the pipe.

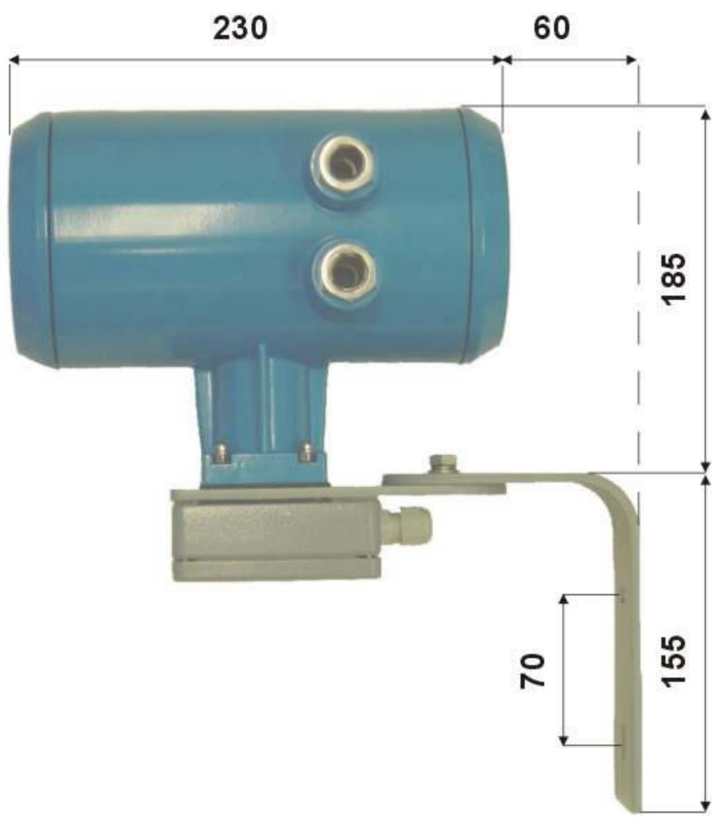
### 9.1.1 Electronic unit – compact version

The pictures below show dimensions of the electronic unit for the compact version. Dimensions are in millimetres.




Weight: 3.8 kg

### 9.1.2 Electronic unit – remote version

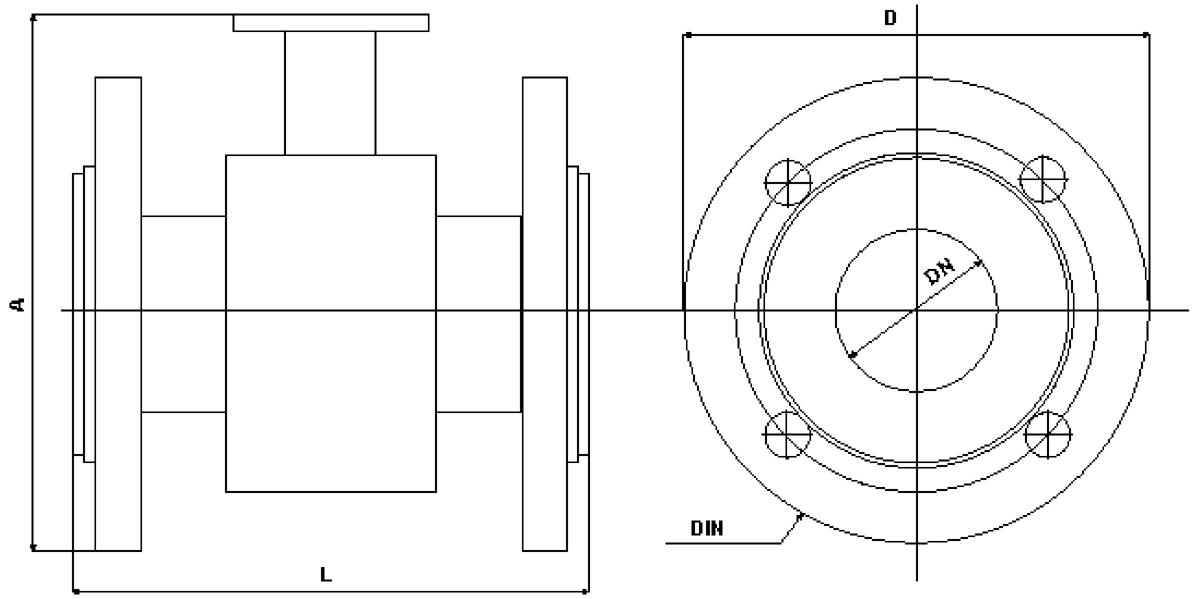



The picture shows dimensions of the electronic unit for the compact version. Dimensions are in millimetres.

Weight: 5.1 kg

### 9.1.3 Sensor

In the table below are the dimensions of the sensor for compact version. In case of remote version add 120 millimetres to dimension "A" for cable gland and cable. Flanges in DIN version meet standard EN1092. Flanges in ANSI version meet requirements of ANSI B 16.5 standard.




| DN (mm) | PN (bar) | D (mm) | A (mm) | L (mm) | Weight (kg) |
|---|---|---|---|---|---|
| 10 | 16 | 90 | 140 | 150 | 2,5 |
| 15 | 16 | 95 | 145 | 200 | 3 |
| 20 | 16 | 105 | 150 | 200 | 3,5 |
| 25 | 16 | 115 | 155 | 200 | 4 |
| 32 | 16 | 140 | 165 | 200 | 5 |
| 40 | 16 | 150 | 175 | 200 | 5 |
| 50 | 16 | 165 | 185 | 200 | 7 |
| 65 | 16 | 185 | 200 | 200 | 8,5 |
| 80 | 16 | 200 | 215 | 200 | 10 |
| 100 | 16 | 220 | 235 | 250 | 13 |
| 125 | 16 | 250 | 265 | 250 | 17 |
| 150 | 16 | 285 | 295 | 300 | 22 |
| 200 | 16 | 340 | 355 | 350 | 31 |
| 250 | 10 | 395 | 435 | 450 | 44 |
| 300 | 10 | 445 | 485 | 500 | 57 |
| 350 | 10 | 505 | 535 | 550 | 72 |
| 400 | 10 | 565 | 580 | 600 | 95 |
| 500 | 10 | 670 | 695 | 600 | 120 |
| 600 | 10 | 780 | 800 | 600 | 160 |
| 700 | 10 | 895 | 900 | 700 | 230 |
| 800 | 10 | 1015 | 1010 | 800 | 330 |

**Table 1: M910 dimensions and weights – DIN flanges**

## 9.2 Used materials

Electromagnetic flowmeter is made from materials, which meet international standards and conventions.

| | | |
|---|---|---|
| **Liner:** | Hard rubber<br>Teflon - PTFE | as standard |
| **Electrodes** | CrNi (stainless) steel 1.4571<br>Hastelloy C276<br>Tantalum | as standard |
| **Sensor tube** | Stainless steel 1.4201, | dimensions according to DIN 17457 |
| **Flange** | Steel 1.0402 or higher, | dimensions according to EN1092, DIN2501(=BS 4504), ANSI B16.5, Sanitary DIN11851, flangeless wafer style |

## 9.3 Flowrate versus diameter

The choice of flowrate for an electromagnetic flowmeter depends on the diameter of the sensor. The higher pipe diameter, the higher flowrate can be measured. A determining parameter for flowrates is maximum velocity of the liquid. Maximum velocity is the speed, where the flow of liquid inside pipe is still laminar. In MAG-910 it is limited to 10m/s (with 125% overload). Speed over 10 m/s is usually too high for industrial applications. Such diameter of pipe is usually selected, where expected flowrate is between $Q_{5\%}$ and $Q_{50\%}$.

In the table bellow applicable flowrates for various diameters is displayed in units l/s and $m^3$/hr.

| | Flowrates [ l/s ] | | | | | | Flowrates [ m3/h ] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DN | $Q_{1\%}$ | $Q_{5\%}$ | $Q_N$ | $Q_{50\%}$ | $Q_{100\%}$ | $Q_{MAX}$ | $Q_{1\%}$ | $Q_{5\%}$ | $Q_N$ | $Q_{50\%}$ | $Q_{100\%}$ | $Q_{MAX}$ |
| 10 | 0,01 | 0,04 | 0,20 | 0,39 | 0,79 | 0,98 | 0,03 | 0,14 | 0,80 | 1,41 | 2,83 | 3,53 |
| 15 | 0,02 | 0,09 | 0,50 | 0,88 | 1,77 | 2,21 | 0,06 | 0,32 | 2,00 | 3,18 | 6,36 | 7,95 |
| 20 | 0,03 | 0,16 | 0,90 | 1,57 | 3,14 | 3,93 | 0,11 | 0,57 | 3,20 | 5,65 | 11,31 | 14,14 |
| 25 | 0,05 | 0,25 | 1,40 | 2,45 | 4,91 | 6,14 | 0,18 | 0,88 | 5,00 | 8,84 | 17,67 | 22,09 |
| 32 | 0,08 | 0,40 | 2,20 | 4,02 | 8,04 | 10,05 | 0,3 | 1,5 | 8,00 | 14,5 | 29,0 | 36,2 |
| 40 | 0,1 | 0,6 | 4,0 | 6,3 | 12,6 | 15,7 | 0,5 | 2,3 | 13,0 | 22,6 | 45,2 | 56,6 |
| 50 | 0,2 | 1,0 | 6,0 | 9,8 | 19,6 | 24,5 | 0,7 | 3,5 | 20,0 | 35,3 | 70,7 | 88,4 |
| 65 | 0,3 | 1,7 | 9,0 | 16,6 | 33,2 | 41,5 | 1,2 | 6,0 | 35,0 | 59,7 | 119,5 | 149,3 |
| 80 | 0,5 | 2,5 | 14,0 | 25,1 | 50,3 | 62,8 | 1,8 | 9,0 | 50,0 | 90,5 | 181,0 | 226,2 |
| 100 | 0,8 | 3,9 | 20,0 | 39,3 | 78,5 | 98,2 | 3 | 14 | 80 | 141 | 283 | 353 |
| 125 | 1 | 6 | 30,0 | 61 | 123 | 153 | 4 | 22 | 150 | 221 | 442 | 552 |
| 150 | 2 | 9 | 50,0 | 88 | 177 | 221 | 6 | 32 | 200 | 318 | 636 | 795 |
| 200 | 3 | 16 | 100 | 157 | 314 | 393 | 11 | 57 | 300 | 565 | 1131 | 1414 |
| 250 | 5 | 25 | 150 | 245 | 491 | 614 | 18 | 88 | 500 | 884 | 1767 | 2209 |
| 300 | 7 | 35 | 200 | 353 | 707 | 884 | 25 | 127 | 800 | 1272 | 2545 | 3181 |
| 350 | 10 | 48 | 300 | 481 | 962 | 1203 | 35 | 173 | 1000 | 1732 | 3464 | 4330 |
| 400 | 13 | 63 | 400 | 628 | 1257 | 1571 | 45 | 226 | 1300 | 2262 | 4524 | 5655 |
| 500 | 20 | 98 | 600 | 982 | 1963 | 2454 | 71 | 353 | 2000 | 3534 | 7069 | 8836 |
| 600 | 28 | 141 | 800 | 1414 | 2827 | 3534 | 102 | 509 | 3000 | 5089 | 10179 | 12723 |
| 700 | 38 | 192 | 1000 | 1924 | 3848 | 4811 | 139 | 693 | 4000 | 6927 | 13854 | 17318 |
| 800 | 50 | 251 | 1200 | 2513 | 5027 | 6283 | 181 | 905 | 5000 | 9048 | 18096 | 22620 |
| 900 | 64 | 318 | 1500 | 3181 | 6362 | 7952 | 229 | 1145 | 6000 | 11451 | 22902 | 28630 |
| 1000 | 79 | 393 | 2000 | 3927 | 7854 | 9817 | 283 | 1414 | 8000 | 14137 | 28274 | 35340 |

**$Q_{1\%}$** - minimum applicable flowrate (minimum flowrate with guaranteed accuracy)
**$Q_{5\%}$** - recommended minimum flowrate (minimum flowrate with best accuracy)
**$Q_N$** - recommended nominal flowrate (expected working flowrate)
**$Q_{50\%}$** - recommended maximum flowrate (maximum flowrate for industrial use)
**$Q_{100\%}$** - maximum applicable flowrate (maximum flowrate with guaranteed accuracy)
**$Q_{MAX}$** - maximum applicable overload (**$Q_{125\%}$**) (flowmeter is still measuring)

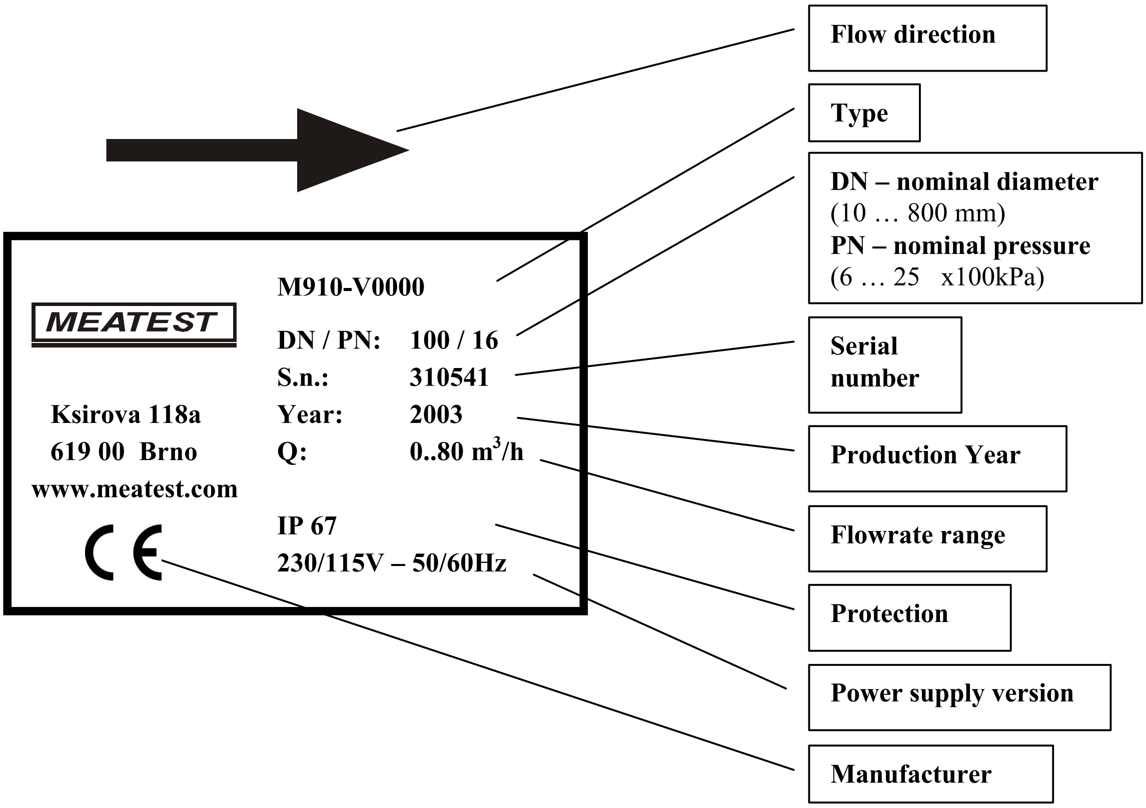
**Table 2: M910 (M910E) flowrates**

A sensor diameter should be chosen to keep real flowrate between $Q_{5\%}$ and $Q_{50\%}$, because in this range the flowmeter has the best accuracy.

# 10 Type plate

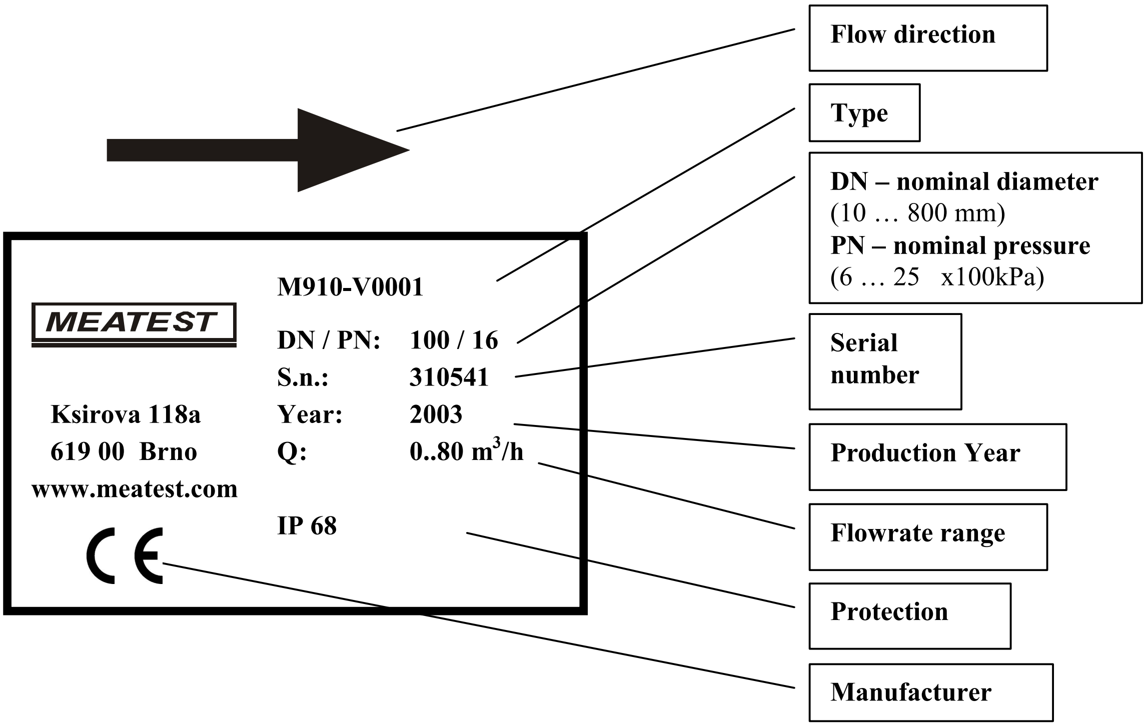
## Compact version

The type plate is located on the sensor. The following information is on the plate:

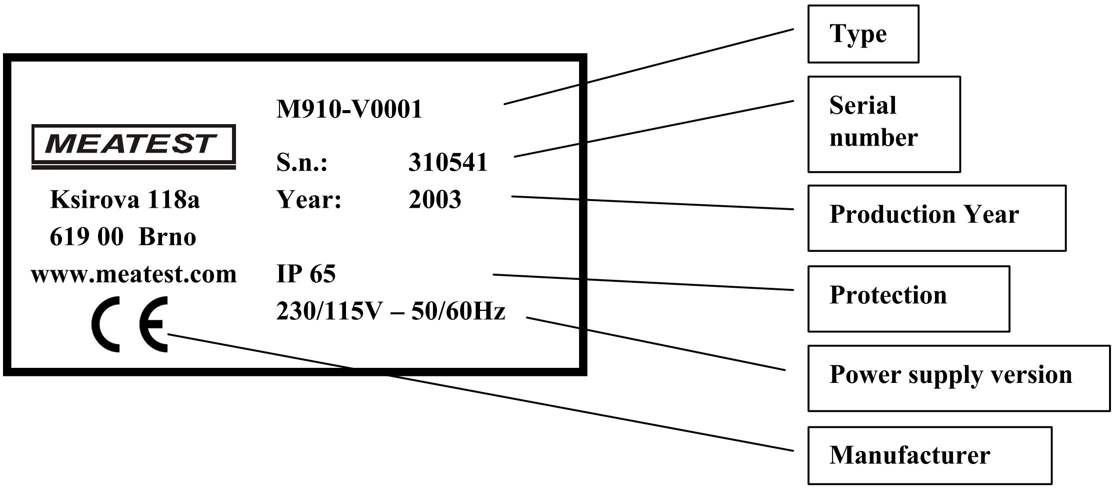


## Remote version

Type plate on the **flanged sensor**:




Type plate on the **converter**:



# 11 Technical data

| | |
|---|---|
| Nominal size | DN10 to DN800 |
| Nominal pressure | PN10 to PN40 (depending on nominal size) |
| Flow range | 0.1 to 10 m/s (0.01 to 5000 l/s) / (0.03 to 18000 m3/h) |
| Accuracy | • 0.5 % (0.5 to 10 m/s) of reading value<br>• 1 % (0.1 to 0.5 m/s) of reading value |
| Maximum media temperature | 70°C (158°F) for rubber liner<br>130°C (266°F) for PTFE liner in remote version |
| Minimum electrical conductivity | ≥ 5 µS / cm |
| Ambient temperature | -20 to 60 °C (-4 to 140°F) |
| Power supply | • 115/230V (+10%,-15%), 50/60Hz, auto selectable (M910-Vxx0x) 115/230V (+10%,-15%), 50/60Hz, manual selectable (M910E-Vxx0x)<br>• 12V DC (+20%, -10%) (M910-Vxx1x), (M910E-Vxx1x)<br>• 24V DC (+20%, -10%), 24V 50/60Hz (+10%, -10%) (M910-Vxx2x), (M910E-Vxx2x)<br>• 48V DC (+20%, -10%), 48V 50/60Hz (+10%, -10%) (M910-Vxx3x), (M910E-Vxx3x) |
| Power consumption | 10 VA (M910), 9 VA (M910E) |
| Liner | • hard rubber<br>• soft rubber<br>• PTFE |
| Electrodes | • CrNi (stainless) steel 1.4571<br>• Hastelloy C276<br>• Tantalum |
| Measuring tube | Stainless steel 1.4201, dimensions according to DIN 17457 |
| Flange | Steel 1.0402 or higher<br>Dimensions according to EN1092, DIN2501 (BS 4504), ANSI B16.5, Sanitary DIN11851, flangeless wafer style |
| Protection category | • Compact version: IP67<br>• Remote version: sensor IP68, converter IP65- optionally IP67 |
| Outputs | • Frequency 0 to 12 kHz with programmable flowrate and function<br>• Pulse 0 to 50 Hz with programmable volume, function and pulse width<br>• Relay contacts 100V/0.5A with programmable function (Mag910 only)<br>• Current loop 4 to 20 mA with programmable flowrate and function |
| Input | PLC digital input with programmable function (M910 only) |
| Communication | • RS485 (M910 only)<br>• RS232 |
| Displayed values | • Flowrate (m3/h, l/s, US.Gal/min, user)<br>• Volume (m3, l, US.Gal, user)<br>• Positive, total, negative and auxiliary (clearable, daily) volume |
| Control | • Keyboard (M910 only)<br>• Magnetic pointer<br>• RS232 and RS485 |

# 12 Ordering information - options

**Liner**

| | |
|---|---|
| M910-V0xxx | hard rubber |
| M910-V1xxx | soft rubber |
| M910-V2xxx | teflon PTFE |

**Electrodes**

| | |
|---|---|
| M910-Vx0xx | CrNi steel |
| M910-Vx1xx | hastelloy C276 |
| M910-Vx2xx | tantalum |

**Power supply voltage/frequency**

| | |
|---|---|
| M910-Vxx0x | power supplying 115V/230V, 50/60 Hz |
| M910-Vxx1x | power supplying 12V DC |
| M910-Vxx2x | power supplying 24V DC/AC, 50/60 Hz |
| M910-Vxx3x | power supplying 48V DC/AC, 50/60 Hz |

**Construction**

| | |
|---|---|
| M910-Vxxx0 | compact version |
| M910-Vxxx1 | remote version |

## *12.1 Example of order*

**M910-V0000 DN50 PN16**

Liner: hard rubber
Electrodes: CrNi steel
Power supply: 115/230 V
Construction: compact version
Nominal diameter: 50 mm
Nominal pressure: 16 bar

**M910E-V2120 DN15 PN25**

Liner: PTFE
Electrodes: hastelloy C276
Power supply: 24 V DC/AC
Construction: compact version
Nominal diameter: 15 mm
Nominal pressure: 25 bar

# 13 Terminology

Special symbols and terms.

**Flowrates:**

**$Q_{1\%}$** - minimum applicable flowrate (the least flowrate which has guaranteed measuring accuracy – depends on diameter – see table 2 M910 flowrates).

**$Q_{5\%}$** - recommended minimum flowrate (least flowrate which has the best measuring accuracy – depends on diameter – see table 2 M910 flowrates).

**$Q_{N}$** - recommended nominal flowrate (nominal flowrate in which is flowmeter usually calibrated – depends on diameter – see table 2 M910 flowrates). You can predetermine this nominal flowrate in your order.

**$Q_{50\%}$** - recommended maximum flowrate (maximum flowrate which is usually used in industrial applications – depends on diameter – see table 2 M910 flowrates).

**$Q_{100\%}$** - maximum applicable flowrate (flowrate limit which has guaranteed measuring accuracy – depends on diameter – see table 2 M910 flowrates).

**$Q_{MAX}$** - maximum applicable overload (**$Q_{125\%}$**) (maximum flowrate which can be still measured – depends on diameter – see table 2 M910 flowrates).

**Abbreviations:**

**QI** - current output constant. It represents flowrate for current 20 mA.

**QF** - frequency output constant. It represents flowrate for frequency 1000 Hz.

**QP** - impulse output constant. It represents volume for 1 impulse.

**QD** - constant for dosing. It represents volume for 1 dose.

**PF1** - flowrate limit constant. It represents low limit flowrate. Crossing this limit activates the appropriate digital output.

**PF2** - flowrate limit constant. It represents high limit flowrate. Crossing this limit activates the appropriate digital output.

**H** - flowrate limit constant. It represents hysteresis by evaluating limits PF1 and PF2.

**Auxiliary volume counter** – second Total Volume counter. Can be cleared by pushing "RIGHT" key. It is usually used for measuring volume during day, month etc.

**RS232** – serial bus. It enables remote control of instruments by a computer. Only one instrument can be connected to one RS232 bus. Cable length between PC and instrument is limited to app. 10 metres.

**RS485** – serial bus. It enables remote control of instruments by a computer. To the RS485 can be connected more instruments (max. 16). Total cable length is limited to app. 800 metres.

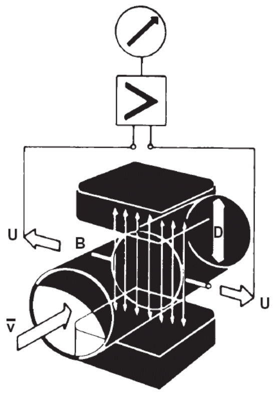
**Auxiliary volume counter** – second Total Volume counter. Can be cleared by pushing "RIGHT" key. It is usually used for measuring passed through volume during day, month etc.

**RS232** – serial bus. It enables remote control of instruments by computer. Only one instrument can be connected to one RS232 bus. Cable length between PC and instrument is limited to app. 10 metres.

**RS485** – serial bus. It enables remote control of instruments by computer. To the RS485 can be connected more instruments (max. 16). Total cable length is limited to app. 800 metres.

# Appendix A Measuring principle

The flowmeter is designed for electrically conductive fluids. Measurement is based on Faraday's law of induction, according to which a voltage is induced in an electrically conductive body, which passes through a magnetic field. The following expression is applicable to the voltage:




U = K x B x v x D

where:

U = induced voltage
K = an instrument constant
B = magnetic field strength
v = mean velocity
D = pipe diameter

Thus the induced voltage is proportional to the mean flow velocity, when the field strength is constant. Inside the electromagnetic flowmeter, the fluid passes through a magnetic field applied perpendicular to the direction of flow. An electric voltage is induced by the movement of the fluid (which must have a minimum
electrical conductivity). This is proportional to the mean flow velocity and thus to the volume of flow. The induced voltage signal is picked up by two electrodes, which are in conductive contact with the fluid and transmitted to a signal converter for a standardized output signal. This method of measurement offers the following advantages:

- No pressure loss through pipe constriction or protruding parts.
- Since the magnetic field passes through the entire flow area, the signal represents a mean value over the pipe cross-section; therefore, only relatively short straight inlet pipes x DN from the electrode axis are required upstream of the primary head.
- Only the tube liner and the electrodes are in contact with the fluid.
- Already the original signal produced is an electrical voltage, which is an exact linear function of the mean flow velocity.
- Measurement is independent of the flow profile and other properties of the fluid.

The magnetic field of the primary head is generated by a square wave current fed from the signal converter to the field coils. This field current alternates between positive and negative values. Alternate positive and negative flowrate-proportional signal voltages are generated at the same frequency by the effect of the magnetic field, which is proportional to the current. The positive and negative voltages at the primary head electrodes are subtracted from one another in the signal converter. Subtraction always takes place when the field current has reached its stationary value, so that constant interference voltages or external or fault voltages changing slowly in relation to the measuring cycle are suppressed. Power line interference voltages coupled in the primary head or in the connecting cables are similarly suppressed.

# Appendix B M910 Menu structure (M910 only)

There are three types of menu for parameters setting:

- ***Setup menu***
- ***Calibration menu***
- ***Service menu***

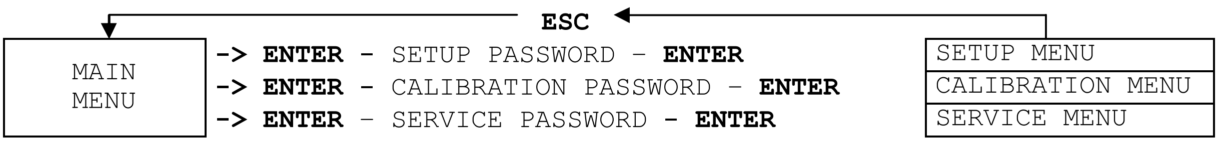
Access to these menus is enabled after pushing the key "ENTER" from the *Main menu*. Each menu has its own password and you can enter this menu using an appropriate password only. Setup password you can change in setup menu, calibration password you can change in calibration menu. Service password is fixed and can be used for service purpose only (it is not described in this manual).

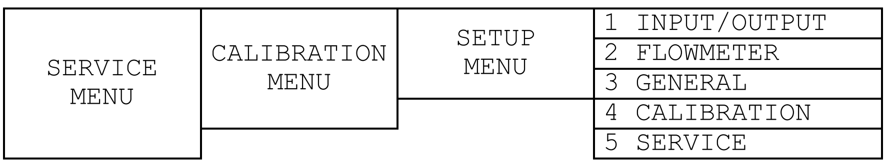
**Setup menu** has following submenus:
1 INPUT/OUTPUT
2 FLOWMETER
3 GENERAL

**Calibration menu** has following submenus:
1 INPUT/OUTPUT
2 FLOWMETER
3 GENERAL
4 CALIBRATION

**Service menu** has following submenus:
1 INPUT/OUTPUT
2 FLOWMETER
3 GENERAL
4 CALIBRATION
5 SERVICE (not described in this manual)

**Menu structure – password required**



**INPUT/OUTPUT submenu structure**

| | | | |
|---|---|---|---|
| 1 INPUT/OUTPUT | 1.B RS485 Addr. | RS485 address | (0 … 255) |
| | 1.A RS485 B.R. | Baud rate | (4800, 9600, 19200) |
| | 1.9 Hysteresis | Flowrate for hyst. | |
| | 1.8 Limit F2 | Flowrate for F2 | |
| | 1.7 Limit F1 | Flowrate for F1 | |
| | 1.6 Digital input (PLC) | Clear Volume | |
| | | Dose | Dosing volume |
| | | Off | |
| | 1.5 Status output (relays) | On < F1 | |
| | | On > F1 | |
| | | Dose Off | |
| | | Dose On | |
| | | On Out | |
| | | On In | |
| | | On Negative | |
| | | On Positive | |
| | | Off | |
| | 1.4 Pulse width | Pulse width in ms. Resolution 10 ms. | |
| | 1.3 Pulse output | On < F1 | |
| | | On > F1 | |
| | | Dose Off | |
| | | Dose On | |
| | | On Out | |
| | | On In | |
| | | On Negative | |
| | | On Positive | |
| | | Absolute Flowrate | Volume for 1 puls |
| | | Negative Flowrate | Volume for 1 puls |
| | | Positive Flowrate | Volume for 1 puls |
| | | Off | |
| | 1.2 Frequency output | Fixed Frequency | Frequency 0.01 … 12 kHz |
| | | On > F2 | |
| | | On < F2 | |
| | | Dose Off | |
| | | Dose On | |
| | | On Out | |
| | | On In | |
| | | On Negative | |
| | | On Positive | |
| | | Absolute Flowrate | Flowrate for 1 kHz |
| | | Negative Flowrate | Flowrate for 1 kHz |
| | | Positive Flowrate | Flowrate for 1 kHz |
| | | Off | |
| | 1.1 Current output | Fixed Current | Current 4 … 20 mA |
| | | Bipolar Flowrate | Flowrate for 20 mA |
| | | Absolute Flowrate | Flowrate for 20 mA |
| | | Negative Flowrate | Flowrate for 20 mA |
| | | Positive Flowrate | Flowrate for 20 mA |
| | | Off (current 4mA) | |

Key UP ↑

Key ENTER →

← Key ESC

**FLOWMETER submenu structure**

Key UP ↑

| 2 FLOWMETER | | | |
|---|---|---|---|
| | 2.A Datalogger | Sampling rate in minutes, datalogger clear | (OFF, 5, 10, 15, 30, 45, 60, 120, 180, 240, CLR) |
| | 2.9 Date setting | Real time clock date setting | |
| | 2.8 Time setting | Real time clock time setting | |
| | 2.7 Time constant | Time for flowrate moving average | 1...20 sec |
| | 2.6 Low-flow cutoff | Flowrate for Low-flow cutoff | |
| | 2.5 Flowrate direction | Positive | |
| | | Negative | |
| | 2.4 Volume resolution | 0 | |
| | | 0.0 | |
| | | 0.00 | |
| | | 0.000 | |
| | | 0.0000 | |
| | 2.3 Volume units | m3 (cubic meter) | |
| | | l (liter) | |
| | | US.G (US gallon) | |
| | | user (user defined units) | |
| | 2.2 Flowrate resolution | 0 | |
| | | 0.0 | |
| | | 0.00 | |
| | | 0.000 | |
| | | 0.0000 | |
| | 2.1 Flowrate units | l/s (liters per second) | |
| | | m3/h (cubic meters per hour) | |
| | | G/m (US gallons per minute) | |
| | | User (user defined units) | |

Key ENTER →

← Key ESC

**GENERAL submenu structure**

Key UP ↑

| 3 GENERAL | | |
|---|---|---|
| | 3.7 Password menu | Password changing |
| | 3.6 Current loop test | On |
| | | Off |
| | 3.5 Self test | On |
| | | Off |
| | 3.4 Power supply | Information only (Power supply voltage and frequency). |
| | 3.3 Serial number | Flowmeter serial number. |
| | 3.2 Nominal range | Flowrate for $Q_N$. |
| | 3.1 Diameter | Diameter in mm. |

Key ENTER →

← Key ESC

**CALIBRATION submenu structure**

| | | | |
|---|---|---|---|
| 4 CALIBRATION | 4.6 Calibration Password | Calibration password changing. | |
| | 4.5 Cal. Point 4 | Nominal value of calibration point 4 (flowrate). | Calibration constant for calibration point 4. |
| | 4.4 Cal. Point 3 | Nominal value of calibration point 3 (flowrate). | Calibration constant for calibration point 3. |
| | 4.3 Cal. Point 2 | Nominal value of calibration point 2 (flowrate). | Calibration constant for calibration point 2. |
| | 4.2 Cal. Point 1 | Nominal value of calibration point 1 (flowrate). | Calibration constant for calibration point 1. |
| | 4.1 Number of Cal. Points | Number of Calibration points. | 2 … 4 |

Key UP ↑

Key ENTER →

← Key ESC

# Appendix C M910 Material selection

## HOW TO USE THIS GUIDE

Chemical names are listed in alphabetical order. Each chemical may have one or more temperature and concentration combination. In instances where the temperature limit is not given or the compatibility information is left blank, this indicates there is no information available.

***Flowtube Liner***

Each liner material has two considerations— compatibility to the chemical and temperature limit. The following codes define the compatibility with each chemical listed:

| ***Compatibility*** | ***Code*** |
|---|---|
| Resistant | A |
| Not Resistant | N |
| No Information | (Blank) |

| ***Temperature Limit*** | ***Code*** |
|---|---|
| 248 °F (120 °C) | 1 |
| 212 °F (100 °C) | 2 |
| 176 °F (80 °C) | 3 |
| 140 °F (60 °C) | 4 |
| 68 °F (20 °C) | 5 |

NOTE:

Temperature limit values are generally conservative and were chosen to best represent data available. Note that if an A1 code is specified the actual temperature limit of the material may be in excess of 248 °F.

***Electrode Material***

Each electrode material has two considerations—corrosion rate per year and temperature limit. The following codes define the compatibility with each chemical listed:

| ***Corrosion Rate Per Year*** | ***Code*** |
|---|---|
| Less than 0.002 in. | A |
| Less than 0.020 in. | B |
| Less than 0.050 in. | C |
| Greater than 0.050 in. | N |
| No Information | (Blank) |

| ***Temperature Limit*** | ***Code*** |
|---|---|
| 248 °F (120 °C) | 1 |
| 212 °F (100 °C) | 2 |
| 176 °F (80 °C) | 3 |
| 140 °F (60 °C) | 4 |
| 68 °F (20 °C) | 5 |

NOTE:

Temperature limit values are generally conservative and were chosen to best represent data available. Note that if an A1 code is specified the actual temperature limit of the material may be in excess of

***Example***

This example illustrates how to use the Material Selection Guide to choose compatible flowtube materials for a given process. The example process fluid is 98% sulfuric acid at 100 °F (38 °C).

## Flowtube Liner / Electrode Material

| Process Liquid | Maximum Concentr. | PTFE Teflon | ETFE Tefzel | PFA | Polyurethane | Neoprene | Hard Rubber | 316 SST | Hastelloy C-276 | Tantalum | Platinum - 10 % Iridium | Titanium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulfuric Acid 70% | A1 | A1 | | N | A3 | N | N | B3 | B1 | A1 | N | |
| Sulfuric Acid 80% | A1 | A1 | | N | N | N | B5 | A5 | B1 | A1 | N | |
| Sulfuric Acid 90% | A1 | A1 | | N | N | N | B5 | A4 | B1 | A1 | | |
| Sulfuric Acid 95% | A1 | A1 | | N | N | N | B3 | | B1 | A1 | N | |
| Sulfuric Acid 98% | A1 | A1 | | N | N | N | B3 | A5 | B1 | A1 | | |
| Sulfuric Acid 100% | A1 | A1 | | N | N | N | B3 | A5 | B1 | A1 | N | |

**Legend:**

Liners:

| | |
|---|---|
| **A** | = Resistant |
| **N** | = Not Resistant |
| **Blank** | = No Information |
| **Miscellaneous Sat** | = Saturated |
| **Conc** | = Concentrated |

Electrodes: (Corrosion Rate per Year)

| | |
|---|---|
| **A** | = Less than 0.002 inches |
| **B** | = Less than 0.020 inches |
| **C** | = Less than 0.050 inches |
| **N** | = Greater than 0.050 inches |
| **Blank** | = No information |

Temperatures:

| | |
|---|---|
| **1** | = 248°F (120 °C) |
| **2** | = 212°F (100 °C) |
| **3** | = 176°F (80 °C) |

Liner Compatibility (from table)

- Teflon - resistant up to 248 °F (120 °C)
- Polyurethane - not resistant
- Tefzel - resistant up to 248 °F (120 °C)
- Neoprene - not resistant
- Natural Rubber - not resistant
- Ryton - not resistant

Electrode Compatibility (from table)

- 316 SST - corrosion rate of less than 0.020 in. per year, up to 176 °F (80 °C)
- Hastelloy C-276 - corrosion rate of less than 0.0020 in. per year, up to 68 °F (20 °C)
- Tantalum - corrosion rate of less than 0.020 in. per year, up to 248 °F (120 °C)
- Platinum-10% Iridium - corrosion rate of less than 0.0020 in. per year, up to 248 °F (120 °C)
- Titanium - corrosion rate of greater than 0.050 in. per year (not recommended)

The proper material selection would be a Teflon or Tefzel liner with platinum-10% Iridium electrodes.

## Flowtube Liner | Electrode Material

| **Process Liquid** | **Maximum Concentr.** | **PTFE Teflon** | **ETFE Tefzel** | **PFA** | **Polyurethane** | **Neoprene** | **Hard Rubber** | **316 SST** | **Hastelloy C-276** | **Tantalum** | **Platinum - 10 % Iridium** | **Titanium** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Acetaldehtde | 100% | A1 | A2 | A1 | N | A2 | N | B4 | A4 | B5 | A5 | A1 |
| Acetamide | 100% | A1 | A1 | A1 | N | A3 | N | B1 | | | | |
| Acetic Acid | 50% | A1 | A1 | A1 | N | A4 | N | B3 | A3 | A1 | A | A1 |
| Acetic Acid | 75% | A1 | A2 | A1 | N | A4 | N | N | A1 | A1 | A | A1 |
| Acetic Acid, Glacial | 100% | A1 | A2 | A1 | N | N | N | A1 | A | A1 | A | A |
| Acetic Anhydride | 100% | A1 | A1 | A1 | N | A5 | N | B1 | A1 | A5 | A2 | A1 |
| Acetone | 50% | A1 | A4 | A1 | N | N | N | B1 | A3 | A3 | A | A3 |
| Acetone | 100% | A1 | A4 | A1 | N | N | N | A1 | A4 | A1 | | A3 |
| Acetophenone | 100% | A1 | A1 | A1 | | N | N | B1 | B3 | B5 | | B3 |
| Acetonitrile | 100% | A1 | A4 | A1 | | | | B4 | | B5 | | |
| Acetyl Chloride (dry) | 100% | A1 | A4 | A1 | N | N | N | B1 | | B5 | A2 | |
| Acetylene | 100% | A1 | A1 | A1 | | A3 | A5 | A1 | B3 | B5 | | B5 |
| Acetylene Tebrabromide | 100% | | A | | | | | | | | | |
| Acetylene Tetrachloride | 100% | | A | | | | | | | | A2 | |
| Acid Mine Water | 100% | | | | | | | | | | | |
| Acrylontrile | 100% | A1 | A4 | A1 | | A4 | A5 | B3 | B3 | B3 | A2 | B3 |
| Adipic Acid | 100% | A1 | A1 | A1 | | A4 | A5 | B3 | A3 | B3 | | A1 |
| Alcohol & Glycerin | 100% | A | | A | N | N | | A | A | A | A | A |
| Alcohol, 2-Aminoethanol | 100% | | | | | | | | | | | |
| Alcohol, Allyl | 100% | A1 | A3 | A1 | | A5 | A5 | A1 | B1 | B1 | A2 | B3 |
| Alcohol, Amyl | 100% | | | | | | | | | | | |
| Alcohol, Butyl | 100% | | | | | | | | | | | |
| Allyl Chloride | 100% | A1 | A3 | A1 | | N | N | A5 | | | A2 | |
| Alum | 10% | A | | A | | N | | B | B | A | A | A |
| Alum | 100% | A1 | A1 | A1 | | A3 | A4 | B3 | B4 | B5 | A | A3 |
| Alumina | 100% | A | | A | N | N | | N | A | A | A | A |
| Aluminium Flouride | 100% | A | A | A | | | | N | N | N | A | |
| Aluminium Hydroxide | 100% | A | A | A | | | | B | N | A | A | |
| Aluminum Ammonium Sulfate | 100% | | A1 | | | | | | | | | |
| Aluminium Sulfate | 100% | A | | A | | | | B | B | A | A | B |
| Aluminum Chloride | 20% | A | A | A | N | A | | N | A | A | A5 | B |
| Aluminum Chloride Aqueous | 100% | A1 | A1 | A1 | A5 | A3 | A4 | N | A3 | B1 | A5 | N |
| Aluminum Chlorohydrate | 100% | A | | A | | | | N | B | A | A | |
| Aluminum Fluoride | Sat | A1 | A1 | A1 | N | A3 | A4 | B5 | | N | A5 | A5 |
| Aluminum Hydroxide | 100% | A1 | A1 | A1 | | A3 | | A1 | B5 | A5 | | B4 |
| Aluminum Oxychloride | 100% | A1 | A1 | A1 | | | | | | | | |
| Aluminum Nitrate | Sat | A1 | A1 | A1 | | A3 | A4 | B3 | B | B5 | A | A3 |
| Aluminum Potassium Sulfate | 100% | A1 | A1 | A1 | N | A3 | A4 | N | | B3 | A3 | A3 |
| Aluminum Sulfate | Sat | A1 | | A1 | N | A3 | A4 | B3 | B3 | A1 | A2 | A3 |
| Amidosulfonic Acid | 100% | A | | A | | | | N | N | A | A | |
| Amino Acids | 100% | | A | | | | | | | | | |
| Ammonia (Anhydrous) | 100% | A1 | A1 | A1 | A5 | A3 | N | A1 | B1 | A1 | | A1 |
| Ammonium Bicarbonate | 50% | A | | A | N | N | | B | N | A | A | A |
| Ammonium Bicarbonate | 100% | A1 | | A1 | | | | B4 | B5 | B3 | A2 | A3 |
| Ammonium Bifluoride | 50% | A | | A | N | N | N | N | B | N | A | N |
| Ammonium Bifluoride | 100% | A1 | A1 | A1 | N | N | N | | B1 | | A5 | |

| | | Flowtube Liner | | | | | | Electrode Material | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Process Liquid** | **Maximum Concentr.** | **PTFE Teflon** | **ETFE Tefzel** | **PFA** | **Polyurethane** | **Neoprene** | **Hard Rubber** | **316 SST** | **Hastelloy C-276** | **Tantalum** | **Platinum - 10 % Iridium** | **Titanium** |
| Ammonium Bisulfate | 100% | A | | A | | A | | | | A | A | A |
| Ammonium Bromide | 5% | A1 | A1 | A1 | | | | B1 | A5 | B3 | A2 | |
| Ammonium Carbamate | 50% | A | | A | N | N | | N | B | | | A |
| Ammonium Carbonate | 50% | A | A | A | N | N | | B | B | A | A2 | |
| Ammonium Carbonate | Sat | A1 | A1 | A1 | | A3 | A4 | B1 | B1 | A3 | A5 | A3 |
| Ammonium Chloride | 50% | A1 | A1 | A1 | | A3 | A4 | N | A3 | A3 | A2 | A3 |
| Ammonium Chloride | Sat | A1 | A1 | A1 | A | A3 | A4 | N | B1 | A1 | A2 | A3 |
| Ammonium Dichromate | 100% | A | | | | | | | | | | |
| Ammonium Flouride | 10% | A1 | A1 | A1 | | A5 | A4 | B5 | A3 | N | A | B5 |
| Ammonium Fluoride | 25% | A1 | A1 | A1 | | A3 | A5 | N | A3 | N | A | A5 |
| Ammonium Fluoride | 100% | A | A | | | | A | N | B | N | A | |
| Ammonium Hydroxide | 25% | A1 | A1 | A1 | A5 | A3 | N | A5 | B1 | A1 | A2 | A5 |
| Ammonium Nitrate | 5% | A | | A | A | N | | A1 | B | A | A1 | A |
| Ammonium Nitrate | 100% | A1 | A2 | A1 | N | A3 | A4 | A1 | | A3 | A1 | |
| Ammounium Perchlorate | 100% | | A | | | | | | | A1 | A1 | |
| Ammonium Persulfate | 100% | A1 | A1 | A1 | N | A3 | A5 | N | N | A5 | A2 | B5 |
| Ammonium Phosphate | 100% | A1 | A1 | A1 | N | A3 | A4 | N | N | A | A | A |
| Ammonium Sulfate | 40% | A1 | A1 | A1 | N | A3 | A4 | B1 | B3 | A1 | A1 | A3 |
| Ammonium Sulfide | 100% | A1 | A1 | A1 | | A4 | | B1 | | B5 | | |
| Ammonium Thiocyanate | 100% | A1 | A1 | A1 | | A3 | | B5 | B3 | B5 | | |
| Amyl Acetate | 100% | A1 | A1 | A1 | N | N | N | A1 | A1 | B1 | A2 | A3 |
| Amyl Alcohol | 100% | A1 | A1 | A1 | N | A4 | A4 | B1 | B3 | B1 | A2 | B4 |
| Amyl Chloride | 100% | A1 | A1 | A1 | | N | N | B4 | A5 | B1 | A2 | |
| Aniline | 100% | A1 | A2 | A1 | N | N | N | A1 | B1 | B3 | A1 | A3 |
| Aniline Hydrochloride | 100% | A1 | A2 | A1 | | N | N | N | N | B3 | A2 | A3 |
| Anthraquinone | 100% | A1 | A1 | A1 | | | | | B3 | B3 | A2 | |
| Anthraquinone-Sulfonic Acid | 100% | A1 | A1 | A1 | | | | | B5 | B3 | | |
| Antimony Pentoxide | 100% | A | | A | | | | N | N | A | A | |
| Antimony Trichloride | 100% | A1 | A3 | A1 | | A4 | | N | B3 | B3 | A2 | B5 |
| Aqua Regia | 100% | A1 | A3 | A1 | N | N | N | N | N | A1 | N | A5 |
| Arsenic Acid | 100% | A1 | A1 | A1 | | A3 | A4 | B1 | B3 | | A2 | |
| Arsenous Acid | 100% | A | | A | | | | N | N | A | A | |
| Asphalt Emulsions | 100% | A1 | | A1 | | N | | A5 | | | | |
| Barium Acetate | 100% | A | | A | | | | N | N | A | A | |
| Barium Carbonate | Sat | A1 | A1 | A1 | | A4 | A3 | B5 | B1 | B5 | A | A5 |
| Barium Chloride | Sat | A1 | A1 | A1 | | A3 | A5 | B3 | A3 | | A2 | |
| Barium Hydroxide | 50% | A | | A | A | A | | A | B | A | A2 | |
| Barium Hydroxide | Sat | A1 | A1 | A1 | | A3 | A4 | B1 | B1 | B1 | A2 | A3 |
| Barium Sulfate | 100% | A1 | A1 | A1 | A | A4 | A3 | B3 | N | B3 | A | A3 |
| Barium Sulfide | 100% | A1 | A1 | A1 | | A4 | A4 | B3 | N | B5 | A4 | B5 |
| Battery Acid | 100% | | A | | | | | | | | | |
| Bauxite Slurry | 100% | B | | B | A | B | | N | A | A | A | A |
| Beer | 100% | A1 | A1 | A1 | N | A5 | A5 | A1 | A5 | A5 | A | B5 |
| Benzaldehyde | 100% | A1 | A3 | A1 | | | | B1 | B3 | B3 | A2 | B5 |
| Benzene | 100% | B1 | A3 | B1 | | | | B1 | B3 | A2 | A2 | A2 |
| Benzene Sulfonic Acid | 100% | A1 | A3 | A1 | | | N | B3 | B3 | | A2 | B3 |
| Benzoic Acid | 100% | A1 | A1 | A1 | N | A3 | A4 | B1 | | A3 | A2 | A1 |
| Benzonitrile | 100% | A1 | A3 | A1 | | | | | | A1 | A2 | A1 |
| Benzoyl Chloride | 100% | A1 | A4 | A1 | | | N | A5 | | A1 | A2 | |
| Benzyl Alcohol | 100% | A1 | A1 | A1 | | N | N | A1 | B3 | B3 | A2 | B3 |
| Benzyl Chloride | 100% | A1 | A1 | A1 | | N | N | B3 | | B2 | A1 | |
| Bismuth Carbonate | 100% | A1 | A1 | A1 | | | | | | B5 | | |
| Black Liquor | 100% | A1 | A1 | A1 | N | A3 | A5 | B5 | C1 | N | A | B |

## Flowtube Liner / Electrode Material

| Process Liquid | Maximum Concentr. | PTFE Teflon | ETFE Tefzel | PFA | Polyurethane | Neoprene | Hard Rubber | 316 SST | Hastelloy C-276 | Tantalum | Platinum - 10 % Iridium | Titanium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bleach, Active Chlorine 12.5% | 100% | A1 | A3 | A1 | N | A5 | A5 | N | A4 | | | |
| Borax | 100% | A1 | A1 | A1 | A | A3 | A4 | A1 | A5 | N | A | B3 |
| Boric Acid | 100% | A1 | A1 | A1 | | A3 | A4 | B1 | A1 | A1 | A | A3 |
| Boron Fluoride | 100% | A | | A | | | | N | N | N | A | N |
| Brine Acid | 100% | A1 | A1 | A1 | | A4 | A3 | N | A4 | A | A | A |
| Bromic Acid | 100% | A1 | A1 | A1 | | A5 | | | | B5 | A2 | |
| Bromine Liquid | 100% | A1 | A1 | A1 | | | | N | | A1 | | |
| Bromobenzene | 100% | A1 | A3 | A1 | | | N | | | A1 | A2 | A3 |
| Bromoform | 100% | | A | | | | | | | | | |
| m-Bromotoluene | 100% | | A | | | | | | | | | |
| Butadiene (Butylene) | 100% | A1 | A2 | A1 | N | A5 | N | B1 | B3 | B5 | | |
| Butane | 100% | A1 | A1 | A1 | A5 | N | N | B1 | B2 | A5 | A2 | A5 |
| Butanediol | 100% | | A | | | | | | | A1 | A2 | A1 |
| Butyl Acetate | 100% | A1 | A2 | A1 | | N | N | B1 | B1 | B5 | A2 | A3 |
| Butyl Acrylate | 100% | | A | | | | | | | | | |
| Butyl Alchol | 100% | A1 | A1 | A1 | | A3 | A4 | A1 | B3 | B5 | | B3 |
| Butyl Alcohol Secondary | 100% | A1 | A1 | A1 | | | | B5 | B5 | B5 | | B3 |
| Butyl Alcohol Tertiary | 100% | A1 | A1 | A1 | | | | B5 | B5 | B5 | | B3 |
| n – Butylamine | 100% | A1 | A5 | A1 | | | | B1 | B3 | | | B3 |
| sec – Butylamine | 100% | | A | | | | | | | | | |
| tert – Butylamine | 100% | | A | | | | | | | | | |
| di-n-Butyl Amine | 100% | | A | | | | | | | | | |
| tri-n-Butyl Amine | 100% | | A | | | | | | | | | |
| Butyl Amine | 100% | | | | | | | | | | | |
| Butyl Bromide | 100% | A1 | A1 | A1 | | | | | | | | |
| Butyl Chloride | 100% | A1 | A1 | A1 | | N | | B5 | B5 | B3 | A2 | B5 |
| Butyl Ether | 100% | A1 | A3 | A1 | | | | A5 | | | | |
| Butyl Phenol | 100% | A1 | A2 | A1 | | N | | A1 | B3 | B2 | A2 | |
| Butyl Phthalate | 100% | A1 | A4 | A1 | | | | B3 | B3 | B3 | | B3 |
| Butylene (Butadiene) | 100% | A1 | A1 | A1 | N | A4 | N | B1 | | B5 | | |
| Butyraldehyde | 100% | A | | A | | | | A2 | A2 | | | |
| Butyric Acid | 100% | A1 | A1 | A1 | | N | N | B1 | A1 | B1 | A2 | A3 |
| n-Butyl Mercaptan | 100% | A1 | A1 | A1 | | | | B3 | B1 | | | |
| Cadmium Chloride | 100% | A | | A | | | | N | N | A2 | A2 | |
| Calcium Bisulfate | 100% | A1 | A1 | A1 | | | | B3 | N | A1 | A | |
| Calcium Bisulfite | 100% | A1 | | A1 | | | A5 | B1 | B5 | A5 | A5 | A3 |
| Calcium Carbonate | 100% | A1 | A1 | A1 | A | A5 | A3 | B3 | B3 | A2 | A2 | A2 |
| Calcium Chlorate | 30% | A | | A | N | A | | B4 | B3 | B3 | A2 | B4 |
| Calcium Chlorate | 100% | A1 | A1 | A1 | | A3 | A4 | B3 | B3 | B3 | A2 | B4 |
| Calcium Chloride | 50% | A | A | A | A | A | | N | A | A1 | A2 | A |
| Calcium Chloride | Sat | A1 | A1 | A1 | A5 | A3 | A4 | B3 | A1 | | A2 | A3 |
| Calcium Hydroxide | 25% | A1 | A1 | A1 | A5 | A2 | A3 | B3 | A4 | A1 | A5 | A2 |
| Calcium Hydroxide | Sat | A1 | A1 | A1 | | A2 | A3 | B3 | | A1 | A2 | A2 |
| Calcium Hypochlorite | Sat | A1 | A1 | A1 | | A5 | A5 | B5 | | B1 | A2 | A3 |
| Calcium Nitrate | 10% | A | | A | | | | B | B | A | A2 | A |
| Calcium Nitrate | 100% | A1 | A1 | A1 | A5 | A3 | A4 | B1 | B3 | B5 | A2 | B3 |
| Calcium Oxide | 100% | A1 | A1 | A1 | | A5 | | B5 | B5 | | | |
| Calcium Sulfate | 10% | A | A | A | N | N | | A | | A | A2 | A |
| Calcium Sulfate | 100% | A1 | A1 | A1 | N | A4 | A3 | B3 | B1 | B3 | A | A3 |
| Calcium Sulfide | 100% | | A | | | | | | | | | |
| Cane Sugar Juice | 100% | A | | A | N | A | | A | A | A | A | A |
| Caprylic Acid | 100% | A1 | A3 | A1 | | | | B1 | B1 | B1 | | B3 |
| Carbon Dioxide (Dry) | 100% | A1 | A1 | A1 | A5 | A3 | A4 | B1 | A1 | B1 | A1 | A5 |
| Carbon Dioxide (Wet) | 100% | A1 | A1 | A1 | A5 | A3 | A4 | B3 | B3 | A1 | A1 | A5 |
| Carbon Disulfide (Bisulfide) | 100% | A1 | A4 | A1 | | N | N | B1 | B3 | A5 | | A3 |
| Carbon Slurry | 100% | N | | N | A | N | | A | A | A | A | A |
| Carbon Tetrachloride | 100% | A1 | A1 | A1 | N | N | N | A1 | A5 | A1 | | A3 |
| Carbonic Acid | 100% | A1 | A1 | A1 | | A5 | A3 | B1 | A5 | B1 | A1 | A3 |
| Castor Oil | 100% | A1 | A1 | A1 | | A4 | A4 | B4 | A5 | | | |
| Caustic Soda | 50% | A | A | A | N | N | | B | | N | A | B |
| Cellosolve | 100% | A1 | A1 | A1 | | N | N | B1 | B3 | B3 | | B3 |
| Cheese | 100% | A | | A | N | N | | A | A | A | A | A |
| Chloral Hydrate | 100% | A1 | A3 | A1 | | | | | | | | |
| Chlorinated Brine | 100% | | A | | | | | | | | | |
| Chlorinated Phenol | 100% | | A | | | | | | | | | |
| Chlorine (Liquid) | 100% | A1 | A | A1 | | N | N | N | A5 | B1 | N | |
| Chlorine Dioxide | 15% | A1 | A1 | A1 | | N | N | N | A4 | A1 | | A3 |

| | | Flowtube Liner | | | | | | Electrode Material | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Process Liquid** | **Maximum Concentr.** | **PTFE Teflon** | **ETFE Tefzel** | **PFA** | **Polyure ethane** | **Neoprene** | **Hard Rubber** | **316 SST** | **Hastelloy C-276** | **Tantalum** | **Platinum - 10 % Iridium** | **Titanium** |
| Chlorine Dioxide | 100% | A | A | A | | N | | N | N | A | N | A |
| Chlorine Water | Sat | A1 | A5 | A1 | | N | A4 | N | A3 | B1 | A | A3 |
| Chloroacetic Acid | 100% | A1 | | A1 | N | N | N | N | A4 | A1 | A2 | A3 |
| Chloroacetic Acid (50% H2O) | 50% | A1 | A2 | A1 | | N | N | N | B3 | A3 | A2 | A3 |
| Chlorobenzene (Phenylchloride) | 100% | A1 | A3 | A1 | | N | N | B1 | A1 | B1 | | B3 |
| Chlorobenzyl Chloride | 100% | | A | | | | | | | | | |
| Chloroform | 100% | A1 | A2 | A1 | N | N | N | A5 | B3 | A3 | A2 | A3 |
| ChlorohydrateAluminum | 100% | A | | A | | | | N | N | A | A | |
| Chlorohydrin | 100% | | A | | | | | | | | A1 | |
| Chlorohydroxide (wet) | 100% | | | | | | | | | | | |
| Chlorophenol, 5% Aqueous | 100% | A1 | | A1 | | | | B1 | A5 | | A2 | |
| Chlorosulfonic Acid | 100% | A1 | A5 | A1 | | N | N | N | A2 | B3 | A1 | A3 |
| Chlorosulfuric Acid | 100% | A | | A | | | | N | B | A | A | |
| Chromic Acid | 30% | A1 | A4 | A1 | | A5 | N | B1 | B3 | B1 | A2 | A3 |
| Chromic Acid | 50% | A1 | A4 | A1 | | A5 | N | B4 | B3 | A1 | A2 | A3 |
| Chromic Acid | 100% | A | A | A | N | N | | N | N | A | A2 | B |
| Chromic Chloride | 100% | | A | | | | | | | | | |
| Chromium Fluoride | 100% | A | | A | | | | | | | | |
| Chromium Sulfate | 50% | A | | A | N | N | | B | B | A | A2 | |
| Chromium Sulfate | 100% | A | | A | | | | N | B | A | A | |
| Chromyl Chloride | 100% | A1 | A3 | A1 | | | | B3 | B3 | B3 | A2 | B5 |
| Clorox Bleach Solution(5.5% Chlorine) | 100% | A1 | A3 | A1 | | N | N | B5 | | | | |
| Citric Acid | 50% | A1 | A3 | A1 | N | A | A4 | B1 | A3 | A1 | A2 | A3 |
| Clay Slurry | 100% | A | | A | A | A | | A | A | A | A | A |
| Coal & Water Slurry | 100% | N | | N | A | A | | N | A | A | A | A |
| Coffee Extract | 100% | A | | A | A | A | | A | A | A | A | A |
| Cola Syrup | 100% | A | | A | A | A | | A | A | A | A | A |
| Copper Chloride | 5% | A | | A | A | A | | N | B | A | N | A |
| Copper Chloride | 100% | A1 | A1 | A1 | | A3 | A4 | N | B3 | A1 | N | A3 |
| Copper Cyanide | 100% | A1 | A1 | A1 | A5 | A4 | A4 | B3 | A4 | B1 | A | A5 |
| Copper Fluoride | 100% | A1 | A1 | A1 | | A4 | | N | N | N | A | |
| Copper Nitrate | 50% | A | A | A | A | | | B | N | A | A | A |
| Copper Nitrate | 100% | A1 | A1 | A1 | | A3 | A3 | A1 | B5 | B1 | A | A5 |
| Copper Oxychloride | 100% | A | | A | | | | N | N | N | A | |
| Copper Sulfate | 40% | A | | A | A | A | | B | A | A | A2 | A |
| Copper Sulfate | 70% | A | | A | A | A | | B | A | A | A | B |
| Copper Sulfate | 100% | A1 | A1 | A1 | | A3 | A4 | B1 | A3 | A1 | | A3 |
| Copper Sulfide | 100% | A | | A | | | | B | B | A | A | |
| Corn Oil | 100% | A1 | | A1 | | A3 | N | B1 | | | | |
| Cottonseed Oil | 100% | A1 | | A1 | | A4 | N | B4 | | | | |
| Cresol | 100% | A1 | A1 | A1 | N | N | N | B5 | B3 | | | B3 |
| Cresylic Acid | 100% | A1 | A1 | A1 | N | N | N | B1 | A1 | B2 | | B5 |
| Cresyldiphenyl Phosphate | 100% | | | | | | | | | | | |
| Croton Aldehyde | 100% | A1 | A3 | A1 | | A5 | | | B3 | B3 | | |
| Crude Oil | 100% | A1 | A1 | A1 | A5 | N | N | A3 | A5 | A5 | | A5 |
| Cupric Chloride | 50% | A1 | | A1 | | A4 | | N | B3 | A5 | N | B3 |
| Cupric Chloride | 100% | A | | A | | | | N | N | A | A | B |
| Cyclohexane | 100% | A1 | A1 | A1 | | N | N | B1 | B3 | B5 | A2 | A1 |
| Cyclohexanol | 100% | A1 | A1 | A1 | | N | | B5 | B5 | B5 | A2 | B5 |
| Cyclohexanone | 100% | A1 | A1 | A1 | | N | N | B3 | B3 | B5 | | B5 |
| DDT | 100% | | A | | | | | | | A2 | A2 | A2 |
| Dairy Products | 100% | A | | A | N | N | | A | A | A | A | A |
| Decalin | 100% | A | | | | | | | | | | |
| Decane | 100% | A | | | | | | | | | | |
| Detergents | 100% | A1 | A1 | A1 | A5 | A3 | | B1 | A5 | A4 | | A4 |
| Dextrin | 100% | A1 | A1 | A1 | | A3 | | | B5 | | | |
| Diacetone Alcohol | 100% | A1 | A3 | A1 | | N | | B1 | A3 | A2 | A2 | A2 |
| 1.2 Dibromo Propane | 100% | | A | | | | | | | | | |
| Dibutyl Phthalate | 100% | A1 | A4 | A1 | | N | N | B1 | B3 | B3 | A1 | B3 |
| Dichloroacetic Acid | 100% | A1 | A4 | A1 | | N | | | | A1 | | A1 |
| Dichlorobenzene | 100% | A1 | A4 | A1 | | N | N | B5 | A1 | | A2 | |
| Dichloroethylene | 100% | A1 | A4 | A1 | | N | | B3 | B3 | B3 | A2 | B3 |
| Dichloropropionic Acid | 100% | | A | | | | | | | | | |
| Diesel Fuel | 100% | A1 | A1 | A1 | | A5 | N | A5 | B3 | | | B3 |
| Diethylamine | 100% | A1 | A2 | A1 | | A5 | A5 | B1 | | | A2 | |

| | | Flowtube Liner | | | | | | Electrode Material | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Process Liquid** | **Maximum Concentr.** | **PTFE Teflon** | **ETFE Tefzel** | **PFA** | **Polyure ethane** | **Neoprene** | **Hard Rubber** | **316 SST** | **Hastelloy C-276** | **Tantalum** | **Platinum - 10 % Iridium** | **Titanium** |
| Diethyl Benzene | 100% | | A | | | | | | | | | |
| Diethyl Cellosolve | 100% | A1 | A1 | A1 | | A5 | | B3 | | | | |
| Diethyl Ether | 100% | A1 | A3 | A1 | | N | N | B2 | B5 | B5 | | B5 |
| Diethylene Triamine | 100% | A1 | A3 | A1 | | | | | | B5 | | A5 |
| Diglycolic Acid | 100% | A1 | A3 | A1 | | A3 | | B1 | B3 | B3 | A2 | B3 |
| Diisobutyl Ketone | 100% | | A | | | | | | | | | |
| Diisobutylene | 100% | | A | | | | | | | | | |
| Dimethylamine | 100% | A1 | A5 | A1 | | N | | | | B5 | A2 | |
| Dimethyl Aniline | 100% | A1 | A1 | A1 | | N | N | | | | A2 | |
| Dimethyl Formamide | 100% | A1 | A1 | A1 | | A4 | N | B1 | | | | |
| Dimethyl Phthalate | 100% | A1 | A3 | A1 | | N | N | A5 | | | | |
| Dimethyl Sulfate | 100% | | A | | | | | | | | | |
| Dimethyl Sulfoxide | 100% | A1 | A3 | A1 | | | | | | | | |
| Dioctyl Phthalate | 100% | A1 | A4 | A1 | | N | N | B5 | | | A2 | |
| Diphenyl Ether | 100% | | A | | | | | | | | | |
| Disulfide | 100% | | | | | | | | | | | |
| p-Dioxane | 100% | | A | | | | | | | | | |
| Divinyl Benzene | 100% | | A | | | | | | | | | |
| Dowtherm (Diphenyl) | 100% | A1 | A4 | A1 | | A3 | N | B3 | B3 | B3 | | B3 |
| Dyes | 100% | A | A | N | | N | A | A | A | A | | A |
| Pichlorhydrin | 100% | A1 | A4 | A1 | | N | N | B1 | A5 | B5 | A2 | |
| Ethylamine | 100% | | A | | | | | | | | | |
| Ethers | 100% | A1 | A3 | A1 | | N | N | A3 | B3 | B3 | | B5 |
| Ethyl Alcohol | 100% | A1 | A1 | A1 | | | | B1 | A2 | A3 | | A3 |
| Ethyl Acetate | 100% | A1 | A4 | A1 | N | N | N | B1 | B1 | B3 | A1 | A3 |
| Ethyl Acrylate | 100% | A1 | A3 | A1 | | N | N | B3 | A3 | B5 | A2 | |
| Ethyl Chloroacetate | 100% | | A | | | | | | | | | |
| Ethyl Chloride | 100% | A1 | A1 | A1 | | N | N | A1 | B3 | A3 | A1 | A3 |
| Ethyl Cyanoacetate | 100% | | A | | | | | | | | | |
| Ethyl Acetoacetate | 100% | | A | | | | | | | | | |
| Ethylene Bromide | 100% | A1 | A1 | A1 | | N | N | A3 | A3 | B5 | | B3 |
| Ethylene Chloride | 100% | A1 | A1 | A1 | | N | N | B2 | | B3 | | A3 |
| Ethylene Chlorohydrin | 100% | A1 | A4 | A1 | | N | N | B3 | B3 | B3 | | B3 |
| Ethylene Diamine | 100% | A1 | A5 | A1 | | N | A5 | B1 | N | B5 | A2 | A5 |
| Ethylene Dichloride | 100% | A1 | | A1 | | N | N | B1 | B2 | A3 | A2 | B3 |
| Ethylene Glycol | 100% | A1 | A1 | A1 | A5 | A4 | A4 | B1 | A1 | A5 | A2 | A3 |
| Ethylene Oxide | 100% | A1 | A2 | A1 | | N | N | B1 | A5 | A5 | A2 | A5 |
| Esters | 100% | | A | | | | | | | | | |
| Fatty Acids | 100% | A1 | A1 | A1 | | A4 | N | A1 | A1 | A1 | A1 | A3 |
| FerricChloride50% H2O | 50% | A1 | A1 | A1 | | A4 | A4 | N | B3 | A3 | A | A3 |
| Ferric Hydroxide | 100% | A1 | A1 | A1 | | A5 | | A5 | A5 | A3 | A5 | B3 |
| Ferric Nitrate | 10% | A1 | A1 | A1 | | A3 | A4 | B1 | A5 | B3 | A2 | A5 |
| Ferric Nitrate | 100% | | A1 | | | | | | | | A2 | |
| Ferric Sulfate | 10% | A | | A | | | | A3 | A4 | A2 | A2 | A2 |
| Ferric Sulfate | 100% | A1 | A1 | A1 | | A3 | A4 | N | B | A3 | A | A |
| Ferrous Chloride | 10% | A | | A | N | N | | N | N | A | A2 | A |
| Ferrous Chloride | Sat | A1 | A1 | A1 | | A5 | A4 | N | B1 | A3 | A2 | A3 |
| Ferrous Hydroxide | 100% | | A | | | | | | | | | |
| Ferrous Nitrate | 100% | A1 | A1 | A1 | | A3 | A4 | B5 | B | A | A | A |
| Ferrous Sulfate | 10% | A | | A | N | N | | N | N | A | A | A |
| Ferrous Sulfate | 50% | A1 | | A1 | N | N | | N | N | A | A | A |
| Ferrous Sulfate | 100% | A1 | A1 | A1 | | A3 | A4 | B3 | B2 | B1 | A | A5 |
| Fluoroboric Acid | 100% | A1 | A1 | A1 | | A4 | A4 | N | A3 | N | | N |
| Fluosilicic Acid | 40% | A | | A | N | N | | N | N | N | A | N |
| Fluosilicic Acid | 100% | A1 | A1 | A1 | | A4 | A5 | B3 | B5 | N | | N |
| Formalhehyde | 35% | A1 | A2 | A1 | N | A4 | | A3 | B3 | A1 | A2 | A3 |
| Formic Acid | 50% | A1 | A1 | A1 | N | A4 | N | B1 | A2 | A1 | A2 | B5 |
| Formic Acid | 80% | A1 | A1 | A1 | N | A4 | N | B1 | A3 | A1 | A2 | B5 |
| Formic Acid | 100% | A1 | A1 | A1 | N | A5 | N | B3 | A2 | A1 | A2 | B5 |
| Freon F-11 | 100% | A1 | A3 | A1 | A5 | A3 | N | B1 | | | | |
| Freon F-12 | 100% | A1 | A2 | A1 | A5 | A3 | N | B1 | A5 | B5 | | B5 |
| Freon F-22 | 100% | A1 | A2 | A1 | N | A5 | N | B1 | B1 | B5 | | B5 |
| Fruit Juices, Pulp | 100% | A1 | | A1 | N | A3 | | B1 | A3 | A5 | A | A5 |
| Fuel Oil | 100% | A1 | A1 | A1 | | A4 | N | B4 | B3 | B3 | | A5 |
| Fumaric Acid | 100% | | A | | | | | | | | | |
| Furane | 100% | | A | | | | | | | | | |
| Furfural | 100% | A1 | A3 | A1 | N | A3 | N | B1 | B5 | A1 | | A3 |
| Gallic Acid | 100% | A1 | A3 | A1 | N | A5 | A4 | B1 | B3 | B5 | | |
| Gas Oil | 35% | A | | A | | | | N | B | N | A | |
| Gas Oil | 100% | A | | A | | | | N | N | N | A | |

| | | Flowtube Liner | | | | | | Electrode Material | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Process Liquid** | **Maximum Concentr.** | **PTFE Teflon** | **ETFE Tefzel** | **PFA** | **Polyurethane** | **Neoprene** | **Hard Rubber** | **316 SST** | **Hastelloy C-276** | **Tantalum** | **Platinum - 10 % Iridium** | **Titanium** |
| Gas –Manufactured | 100% | A1 | A1 | A1 | | | | B5 | | | | |
| Gasoline – Leaded | 100% | A1 | A1 | A1 | A5 | A5 | N | B5 | A5 | A5 | | A5 |
| Gasoline – Unleaded | 100% | A1 | A3 | A1 | A5 | A5 | N | B5 | A1 | A5 | | B5 |
| Gasoline – Sour | 100% | A1 | A1 | A1 | A5 | A5 | N | B5 | B1 | B5 | | |
| Glacial Acetic Acid | 100% | A | | A | | | | N | A | A | A | |
| Glucose (Corn Syrup) | 100% | A1 | | A1 | | A5 | A5 | B1 | A | A | A | A |
| Glycerin (Glycerol) | 100% | A1 | A1 | A1 | A5 | A3 | A4 | A3 | A1 | B5 | A | A3 |
| Glycol | 100% | A1 | A1 | A1 | | A4 | A5 | B5 | | | | |
| Glycolic Acid | 100% | A1 | A1 | A1 | | A3 | | B1 | B3 | B3 | | A3 |
| Green Liquor | 100% | A1 | | A1 | N | A4 | A4 | B | B | A | A | A |
| Heptane | 100% | A1 | A1 | A1 | | A3 | N | B1 | A3 | B3 | A2 | B3 |
| Hexane | 100% | A1 | A1 | A1 | A5 | A5 | N | A1 | A1 | B5 | A2 | A4 |
| Hormaldehyde | 100% | A | | A | | | | N | B | A | A | |
| Hydrazine | 100% | | A | | | | | | | | | |
| Hydrazine Dihydroanioride | 100% | | A | | | | | | | | | |
| Hydriodic Acid | 100% | | A | | | | | | | | | |
| Hydrobromic Acid | 50% | A1 | A1 | A1 | N | N | A5 | N | B5 | A1 | A2 | A3 |
| Hydrochloric Acid | 5% | A | | A | | | | N | N | A | A2 | |
| Hydrochloric Acid | 20% | A1 | A1 | A1 | A5 | A5 | A4 | N | A5 | A1 | A2 | N |
| Hydrochloric Acid | 40% | A1 | A1 | A1 | | A5 | A3 | N | A5 | A1 | A2 | N |
| Hydrocyanic Acid | 10% | A1 | A1 | A1 | N | N | A5 | B3 | B | A | A2 | B |
| Hydrofluoric Acid | 20% | A1 | A1 | A1 | N | A3 | A5 | N | B3 | N | A2 | N |
| Hydrofluoric Acid | 35% | A1 | A1 | A1 | N | A3 | A5 | N | B3 | N | A2 | N |
| Hydrofluoric Acid | 70% | A1 | A1 | A1 | N | A3 | N | N | B3 | N | A2 | N |
| Hydrofluorosilicic Acid | 35% | A1 | A1 | A1 | | A4 | A5 | B5 | B5 | N | A | N |
| Hydrofluorosilicic Acid | 100% | | A | | | | | | | | | |
| Hydrogen Cyanide | 100% | A1 | A1 | A1 | | N | A5 | A5 | A5 | B5 | A | |
| Hydrogen Fluoride | 100% | A1 | | A1 | | N | N | A5 | B1 | N | B | A5 |
| Hydrogen Peroxide | 30% | A1 | A1 | A1 | N | N | N | B1 | A5 | B1 | A2 | A3 |
| Hydrogen Peroxide | 50% | A1 | A4 | A1 | N | N | N | B1 | B5 | B1 | A2 | A3 |
| Hydrogen Peroxide | 90% | A1 | A4 | A1 | N | N | N | A5 | A3 | B1 | A2 | B3 |
| Hydrogen Sulfide | 100% | A1 | A1 | A1 | | A3 | N | B1 | A5 | A1 | | A5 |
| Hydrogen Phosphide | 100% | A1 | A4 | A1 | | | | | | | | |
| Hydroquinone | 100% | A1 | A1 | A1 | | A3 | A5 | B1 | B3 | B3 | A1 | B3 |
| Hydroxy Acetic Acid | 35% | A1 | | A1 | | | | B | B | A | A | |
| Hydroxy Acetic Acid | 70% | A1 | | A1 | | | | B | B | A | A | |
| Hypochlorous Acid | 20% | A | | A | | | | N | B | N | A | B |
| Hypochlorous Acid | 100% | A1 | A1 | A1 | N | N | A4 | N | B5 | B1 | A2 | B5 |
| Iodine | 100% | A1 | A2 | A1 | | N | N | N | A1 | B1 | A1 | A5 |
| Idoform | 100% | A1 | A2 | A1 | | | | A1 | N | B3 | A2 | B2 |
| Iron Chloride | 100% | A | | A | | | | N | B | N | A | |
| Iron Nitrate | 100% | A | | A | | | | N | B | A | A | |
| Iron Sulfate | 100% | A | | A | | | | N | B | A | A | A |
| Isobutyl Alcohol | 100% | | A | | | | | | | | | |
| Isopropylamine | 100% | | A | | | | | | | | | |
| Jet Fuels - JP4 | 100% | A1 | A2 | A1 | N | N | N | B1 | A5 | | | A5 |
| Jet Fuels - JP5 | 100% | A1 | A2 | A1 | N | N | N | B1 | A5 | | | A5 |
| Kerosene | 100% | A1 | A1 | A1 | N | A3 | N | B1 | B2 | B5 | | A5 |
| Ketones | 100% | A1 | A1 | A1 | | N | | B1 | A5 | | | A5 |
| Kraft Liquor | 100% | A1 | | A1 | | A5 | | A5 | A5 | | | |
| Lactic Acid | 100% | A1 | A1 | A1 | | A5 | A5 | B1 | B2 | A1 | A2 | A1 |
| Lard Oil | 100% | A1 | A1 | A1 | | N | N | B5 | A5 | A5 | | |
| Latex | 100% | A | | A | N | N | | A | A | A | A | A |
| Lauric Acid | 100% | A1 | A1 | A1 | | | | B5 | B5 | | A2 | |
| Lauryl Chloride | 100% | A1 | A1 | A1 | | | | | | | | |
| Lauryl Sulfate | 100% | | A | | | | | | | | | |
| Lead Acetate | 100% | A1 | A1 | A1 | | A3 | A5 | B3 | B3 | B3 | A2 | A3 |
| Lead Nitrate | 100% | A1 | A5 | A1 | | A3 | A3 | B5 | B3 | A | A2 | |
| Lime Slurry | 100% | A | | A | A | A | | A | A | A | A | A |
| Linoleic Acid | 100% | A1 | A1 | A1 | | N | N | B1 | B1 | B1 | | B3 |
| Linseed Oil | 100% | A1 | A1 | A1 | | A3 | N | B5 | B5 | B3 | | A5 |
| Lithium Bromide | 100% | A1 | A1 | A1 | | A3 | | B1 | | | | |
| Lithium Chloride | 30% | A1 | A5 | A1 | | | | N | A3 | A3 | A | A3 |
| Lithium Chloride | 100% | A | | A | | | | N | A | A | A | A |
| Lithium Hydroxide | 10% | A1 | A1 | A1 | | | | B3 | B3 | B3 | | |
| Lubricating Oil | 100% | A1 | A1 | A1 | | A3 | N | B4 | | | | A5 |
| M-Cresol (crude) | 100% | | | | | | | | | | | |
| Magnesium Bisulfate | 100% | A | | A | | | | B | B | | | |
| Magnesium Carbonate | 10% | A | | A | | | | B | B | A | | |

| Process Liquid | Maximum Concentr. | PTFE Teflon | ETFE Tefzel | PFA | Polyure ethane | Neoprene | Hard Rubber | 316 SST | Hastelloy C-276 | Tantalum | Platinum - 10 % Iridium | Titanium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Flowtube Liner** | | | | | | **Electrode Material** | | | | |
| Magnesium Carbonate | 100% | A1 | A1 | A1 | | A3 | A3 | B3 | | B3 | A | 5 |
| Magnesium Chloride | 42% | A1 | A1 | A1 | A5 | A2 | A4 | B2 | A1 | A1 | A | A1 |
| Magnesium Chloride | 100% | A1 | A1 | A1 | A5 | A3 | A4 | | A1 | | | |
| Magnesium Hydroxide | 100% | A1 | A1 | A1 | | A3 | A3 | A2 | A2 | A5 | A | A5 |
| Magnesium Nitrate | 100% | A1 | A1 | A1 | | A3 | A4 | B1 | A5 | B3 | A | A5 |
| Magnesium Sulfate | 25% | A | | A | | | | B | N | A | A | B |
| Magnesium Sulfate | 40% | A | | A | | | | A | B3 | A4 | A | A |
| Magnesium Sulfate | 100% | A1 | A1 | A1 | A5 | A3 | A4 | B1 | A | A4 | A | B3 |
| Maleic Acid | 100% | A1 | A1 | A1 | A5 | N | A5 | B1 | B3 | B3 | | A3 |
| Maleic Anhydride | 100% | | A | | | | | | | | | |
| Malic Acid | 100% | A1 | A1 | A1 | | A5 | A5 | A1 | B3 | B3 | | A3 |
| Mercuric Chloride | 60% | A | | A | N | A | | N | N | A | A | A |
| Mercuric Chloride | 100% | A1 | A1 | A1 | | N | A4 | B1 | | A1 | A2 | B3 |
| Mercuric Cyanide | 100% | A1 | A1 | A1 | | N | A4 | B5 | B5 | B1 | | A5 |
| Mercuric Nitrate | 100% | A1 | A1 | A1 | | A5 | A5 | N | | B1 | A2 | |
| Mercury | 100% | A1 | A1 | A1 | A5 | A3 | A4 | A1 | A1 | B1 | N | A1 |
| Methacrylic Acid | 100% | | A | | | | | | | | | |
| Methane | 100% | A1 | A1 | A1 | | A3 | N | A1 | A3 | B1 | | A3 |
| Methane Sulfonic Acid | 50% | A1 | A2 | A1 | | | | | | | | |
| Methyl Alcohol | 100% | A1 | A1 | A1 | A5 | A3 | A4 | B1 | A1 | B1 | | B3 |
| Methyl Benzoate | 100% | | A | | | | | | | | | |
| Methyl Bromide | 100% | A1 | A1 | A1 | | N | N | B1 | | | B3 | |
| Methyl Cellosolve | 100% | A1 | A1 | A1 | | A3 | | B1 | | B5 | | |
| Methyl Chloride | 100% | A1 | A1 | A1 | | N | N | A1 | B5 | B3 | | A3 |
| Methyl Chloroform | 100% | A1 | A4 | A1 | | N | | | | | | |
| Methyl Chloromethyl Ether | 100% | | A | | | | | | | | | |
| Methyl Cyanoacetate | 100% | | A | | | | | | | | | |
| Methyl Ethyl Ketone | 100% | A1 | A2 | A1 | N | N | N | B1 | B3 | B3 | | B3 |
| Methyl Methacrylate | 100% | A1 | A4 | A1 | | N | N | B5 | | B5 | | |
| Methyl Salicylate | 100% | A1 | A3 | A1 | | | N | | | B5 | | |
| Methyl Sulfuric Acid | 100% | A1 | A3 | A1 | | | | B5 | | A1 | | |
| Methyl Isobutyl Ketone | 100% | A1 | A1 | A1 | | N | N | B1 | B3 | B3 | | B3 |
| Methyl Trichlorosilane | 100% | | A | | | | | | | | | |
| Methylene Bromide | 100% | | A | | | | | | | | | |
| Methylene Chloride | 100% | A1 | A3 | A1 | N | N | N | B1 | A3 | N | | A3 |
| Methylene Iodide | 100% | | A | | | | | | | | | |
| Milk | 100% | A1 | | A1 | A5 | A3 | A5 | A1 | A5 | A1 | A | A5 |
| Mineral Oil | 100% | A1 | A1 | A1 | A5 | A3 | N | B1 | | A1 | | A5 |
| Molasses | 100% | A1 | | A1 | N | A3 | A4 | A1 | A5 | A5 | A | A |
| Monochlorobenzene | 100% | A1 | A2 | A1 | | N | N | B5 | B5 | B4 | | B4 |
| Monoethanolamine | 100% | A1 | A4 | A1 | | A5 | A5 | A3 | B3 | A3 | A2 | B3 |
| Morpholine | 100% | A1 | A4 | A1 | | N | | B1 | | | B2 | |
| Motor Oil | 100% | A1 | | A1 | | | | B1 | | | | |
| Mud Drilling | 100% | N | | N | A | N | | A | A | A | A | A |
| Naphtha | 100% | A1 | A1 | A1 | A5 | N | N | B3 | B3 | B5 | A2 | B5 |
| Naphthalene | 100% | A1 | A1 | A1 | | N | N | A1 | B3 | B3 | A1 | A3 |
| Nickel Chloride | 10% | A | | A | | | | N | A | B | A | B |
| Nickel Chloride | 20% | A | | A | | | | N | N | A | A | N |
| Nickel Chloride | 100% | A1 | A1 | A1 | | A3 | A4 | B5 | N | B3 | A2 | A3 |
| Nickel Nitrate | 10% | A | | A | | | | | B | B | A | |
| Nickel Nitrate | 100% | A1 | A1 | A1 | | A3 | A4 | A1 | B1 | B3 | A2 | A5 |
| Nickel Sulfate | 10% | A | | A | | | | B | B | A3 | | B3 |
| Nickel Sulfate | 100% | A1 | A1 | A1 | | A3 | A4 | B3 | B3 | N | A2 | N |
| Nicotine | 100% | A1 | A3 | A1 | | N | | B3 | | B5 | | |
| Nicotonic Acid | 100% | A1 | A1 | A1 | | A3 | | B1 | | | | |
| Nitric Acid (Anhydrous) | 100% | A1 | N | A1 | N | N | N | A5 | B5 | A1 | A2 | B3 |
| Nitric Acid | 10% | A1 | A4 | A1 | N | N | N | A3 | A3 | A1 | A | A1 |
| Nitric Acid | 20% | A1 | A4 | A1 | N | N | N | A5 | A4 | A1 | A2 | A1 |
| Nitric Acid | 40% | A1 | A4 | A1 | N | N | N | A5 | A5 | A1 | A | A1 |
| Nitric Acid | 50% | A1 | A4 | A1 | N | N | N | A5 | A5 | A1 | | A1 |
| Nitric Acid | 70% | A1 | A5 | A1 | N | N | N | A5 | A5 | A1 | A | A1 |
| Nitric Acid-Sulfuric Acid | 50%/50% | A1 | A3 | A1 | | | | A4 | | B5 | | |
| Nitrobenzene | 100% | A1 | A1 | A1 | N | N | N | B1 | N | B3 | A2 | A3 |
| Nitrogen | 100% | A1 | A1 | A1 | | A3 | A3 | A1 | A1 | A1 | | |
| Nitrogen Dioxide | 100% | A1 | A3 | A1 | | | | | | A1 | | |
| Nitromethane | 100% | A1 | A3 | A1 | | N | A5 | B5 | | B5 | | |
| Nitrous Acid | Conc | A1 | A3 | A1 | | N | N | B5 | N | B1 | A2 | |

| Process Liquid | Maximum Concentr. | PTFE Teflon | ETFE Tefzel | PFA | Polyurethane | Neoprene | Hard Rubber | 316 SST | Hastelloy C-276 | Tantalum | Platinum - 10 % Iridium | Titanium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Flowtube Liner** | | | | | | **Electrode Material** | | | | |
| Octane | 100% | A1 | A1 | A1 | | A2 | | B5 | | | | |
| Octene | 100% | | A | | | | | | | | | |
| Oleic Acid | 100% | A1 | A1 | A1 | A5 | N | N | A1 | B3 | B3 | A1 | A5 |
| Oleum | 100% | A1 | A4 | A1 | N | N | N | B5 | | N | A | N |
| Oxalic Acid | Sat | A1 | A2 | A1 | | N | A4 | N | B3 | A3 | A | B5 |
| p-Dioxane | 100% | | | | | | | | | | | |
| Palmitic Acid | Conc | A1 | A1 | A1 | | N | | B1 | B5 | | | |
| Paper Stock | 100% | A1 | A1 | A1 | | | | A | A | A | A | A |
| Perchloric Acid | 10% | A1 | A2 | A1 | N | A5 | A4 | N | | A1 | | N |
| Perchloric Acid | 70% | A1 | A4 | A1 | N | N | | N | B2 | A1 | A | N |
| Perchloric Acid | 100% | A | | A | | | | N | N | A | A | |
| Perchlorethylene | 100% | A1 | A1 | A1 | N | N | N | A5 | B3 | B3 | | A3 |
| Petrolatum | 100% | A1 | A1 | A1 | | A3 | | B1 | | A5 | | |
| Petroleum Oils, Refined | 100% | A1 | A1 | A1 | | A5 | N | B5 | | A1 | | |
| Petroleum Ether | 100% | A1 | A3 | A1 | | | | A5 | A5 | A5 | | A5 |
| Phenol | 10% | A1 | A2 | A1 | N | N | A5 | B3 | B1 | B1 | A | B5 |
| Pheno (Carbolic Acid) | 100% | A1 | A3 | A1 | N | N | N | A1 | A1 | B1 | A1 | A5 |
| Phenolsulfonic Acid | 100% | | A | | | | | | | | | |
| Phenylhydrazine | 100% | A1 | A3 | A1 | | A5 | A5 | | | | A2 | |
| Phenylhydrazine Hydrochloride | 100% | A1 | A3 | A1 | | | | | | | A2 | |
| o-Phenylphenol | 100% | | A | | | | | | | | | |
| Phosgene Liquid | 100% | A1 | A3 | A1 | | | | B2 | | B1 | A1 | |
| Phosphate Slurry | 100% | A | | A | | | | N | A | A | A | A |
| Phosphoric Acid | 30% | A1 | A1 | A1 | A5 | A3 | A4 | B3 | A4 | A1 | | C5 |
| Phosphoric Acid | 85% | A1 | A1 | A1 | N | N | A5 | B1 | A3 | A1 | A | C5 |
| Phosphoric Anhydride | 100% | A1 | | A1 | | A5 | | B3 | | A5 | A2 | |
| Phosphorus | 100% | A1 | | A1 | | | | A5 | A4 | B1 | | |
| Phosphorus Pentoxide | 100% | A1 | A2 | A1 | | | | B5 | N | B5 | A2 | |
| PhosphorusOxychloride | 100% | A1 | A3 | A1 | | | | N | B3 | B1 | A2 | A5 |
| Phosphorus Pentachloride | 100% | | A | | | | | | | | N | |
| Phosphorus Trichloride | 100% | A1 | A1 | A1 | | N | | A5 | B5 | A1 | N | A5 |
| Photographic Solutions | 100% | A1 | | A1 | N | A3 | A4 | A1 | | A5 | | B5 |
| Phthalic Acid | 100% | A1 | A3 | A1 | | A3 | | A1 | B1 | B1 | A1 | A5 |
| Phthalic Anhydride | 100% | A1 | A3 | A1 | | | A4 | A1 | A1 | B1 | | |
| Picric Acid | 100% | A1 | A5 | A1 | | A3 | N | B1 | B1 | B3 | | A5 |
| Polyvinyl Acetate | 100% | A1 | A1 | A1 | | A3 | | A3 | | B5 | | |
| Potassium Aluminum Chloride | 100% | | A | | | | | | | | | |
| Potassium Aluminum Sulfate | 50% | | A | | | | | | | | | |
| Potassium Aluminum Sulfate | 100% | A1 | | A1 | N | A4 | | B5 | A5 | A3 | A | A3 |
| Potassium Bicarbonate | 30% | A1 | A1 | A1 | N | N | | A3 | B3 | B5 | | A3 |
| Potassium Bicarbonate | 100% | A | A | A | | | | B | B | A | A | |
| Potassium Borate | 100% | A1 | A1 | A1 | | A4 | | | | | | |
| Potassium Bromate | 100% | A1 | A1 | A1 | | A4 | | | | | | |
| Potassium Bromide | 30% | A1 | A1 | A1 | | A4 | A4 | B1 | B5 | A5 | | A3 |
| Potassium Carbonate | 50% | A1 | A1 | A1 | | A3 | A4 | A3 | B3 | B1 | A2 | A3 |
| Potassium Chlorate, Aqueous | 30% | A1 | A1 | A1 | | A5 | | A1 | B3 | B5 | A2 | A3 |
| Potassium Chloride | 30% | A1 | A1 | A1 | N | A4 | A4 | A1 | | A1 | A | A3 |
| Potassium Chloride | 60% | A | | A | | | | B | N | A | A | B |
| Potassium Chloride | 100% | A | A | A | N | A | | N | A | A | A | A |
| Potassium Chromate | 30% | A1 | A1 | A1 | | A5 | | B1 | B3 | B5 | | A3 |
| Potassium Cyanide | 30% | A1 | A1 | A1 | | A3 | A4 | B3 | B3 | A5 | A2 | N |
| Potassium Dichromate | 30% | A1 | A1 | A1 | N | N | N | A1 | B3 | A1 | A | A3 |
| Potassium Dichromate | 60% | A | | A | N | A | A | | B | A | A2 | A |
| Potassium Ferricyanide | 30% | A1 | | A1 | | A2 | | N | N | A5 | N | A5 |
| PotassiumFerrocyanide | 30% | A1 | A1 | A1 | | A3 | | N | N | B3 | N | A5 |
| Potassium Fluoride | 100% | A1 | A1 | A1 | | | N | B3 | | B5 | | N |
| Potassium Hydroxide (Caustic Potash) | 10% | B | | A | N | N | | B | N | N | A1 | A |
| Potassium Hydroxide (Caustic Potash) | 50% | A1 | A3 | A1 | | A3 | A5 | B1 | B1 | N | A1 | A3 |
| Potassium Hypochlorite | 40% | A | | A | N | N | | N | B | B | | A |
| Potassium Hypochlorite | 100% | A1 | A1 | A1 | | | | B5 | B3 | B3 | | |

| | | **Flowtube Liner** | | | | | | **Electrode Material** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Process Liquid** | **Maximum Concentr.** | **PTFE Teflon** | **ETFE Tefzel** | **PFA** | **Polyurethane** | **Neoprene** | **Hard Rubber** | **316 SST** | **Hastelloy C-276** | **Tantalum** | **Platinum - 10 % Iridium** | **Titanium** |
| Potassium Nitrate | 80% | A1 | A1 | A1 | N | A3 | A4 | B1 | B3 | B1 | A | A3 |
| Potassium Nitrite | 100% | A1 | | A1 | | | | N | N | A | A | B3 |
| Potassium Perborate | 100% | A1 | A1 | A1 | | | | | | | | |
| Potassium Perchlorate | 100% | A1 | A3 | A1 | | | | B1 | | | | |
| Potassium Permanganate | 10% | A1 | A1 | A1 | | A5 | N | B1 | A5 | B3 | A2 | B5 |
| Potassium Permanganate | 100% | N | A | N | | | | N | N | A | A2 | A |
| Potassium Persulfate | 10% | A | | A | | | | A | N | A | A | A |
| Potassium Persulfate | 100% | A1 | A4 | A1 | | A4 | | B1 | N | A | A | |
| Potassium Sulfate | 10% | A1 | A1 | A1 | A5 | A3 | A4 | A1 | A3 | A5 | A1 | A5 |
| Potassium Sulfate | 20% | A | | A | N | A | | A | A | A | A1 | A |
| Potassium Sulfate | 100% | A | A | A | N | A | | A | A | A | A | A |
| Potassium Sulfide | 10% | A | | A | | | | B | | B | | A |
| Potassium Sulfide | 100% | A1 | A1 | A1 | | A5 | | B3 | B5 | A5 | | A5 |
| Propane | 100% | A1 | A1 | A1 | | A5 | N | B1 | B5 | B5 | | B5 |
| Propionic Acid | 100% | A1 | A3 | A1 | | N | | B3 | A1 | | A1 | |
| Propyl Alcohol | 100% | A1 | A3 | A1 | | A3 | A4 | A1 | A5 | B5 | | A5 |
| Propylene Chlorohydrin | 100% | | | | | | | | | | | |
| Propylene Dibromide | 100% | | A | | | | | | | | | |
| Propylene Dichloride | 100% | A1 | A3 | A1 | | N | | | | | | |
| Propylene Glycol | 100% | A1 | | A1 | | A5 | | B3 | B5 | A5 | | A5 |
| Propylene Oxide | 100% | A1 | A4 | A1 | | N | N | | B5 | | | |
| Pyridine | 100% | A1 | A4 | A1 | | N | N | B1 | A4 | B1 | A2 | B2 |
| Pyrogallol | 100% | A1 | A4 | A1 | | | | B2 | B2 | | | |
| Salicyalldehyde | 100% | A1 | A3 | A1 | | | | | | | | |
| Salicylic Acid | 100% | A1 | A1 | A1 | N | A5 | A5 | B1 | A1 | B3 | A2 | A5 |
| Salt Brine | 100% | | A | | | | | | | | | |
| Sea Water | 100% | A | A | A | N | A | | N | A | A | A | A |
| Sewage, Raw | 100% | A | | A | N | N | | A | A | A | A | A |
| Silicon Tetrachloride | 100% | | A | | | | | | | | | |
| Silver Chloride | 100% | A1 | A1 | A1 | | | | N | | A5 | | A5 |
| Silver Cyanide | 100% | A1 | A1 | A1 | | A3 | | A5 | A5 | A5 | | A5 |
| Silver Nitrate | 50% | A | | A | | | | A5 | A5 | A1 | | A5 |
| Silver Nitrate | 100% | A1 | A1 | A1 | A5 | A3 | A4 | N | | A | A | A |
| Sludge, Activated | 100% | A | | A | N | A | | A | A | A | A | A |
| Sludge, Primary | 100% | A | | A | N | A | | A | A | A | A | A |
| Sludge, Thickened | 100% | A | | A | A | A | | A | A | A | A | A |
| Sludge, Waste | 100% | A | | A | A | A | | A | A | A | A | A |
| Soap Solutions | 100% | A1 | | A1 | A5 | A3 | A4 | B5 | A5 | A5 | A | A5 |
| Sodium Acetate | 100% | A1 | A1 | A1 | N | A3 | | B1 | | A5 | A1 | A2 |
| Sodium Benzene-Sulfonate | 100% | | A | | | | | | | | | |
| Sodium Benzoate | 100% | A1 | A1 | A1 | | | | | B5 | A5 | | A5 |
| Sodium Bicarbonate | 20% | A1 | A1 | A1 | | A3 | A4 | A1 | | A4 | A | A3 |
| Sodium Bicarbonate | 100% | A | A | A | | A | | B | B | A | A | A |
| Sodium Bisulfate | 40% | A | A | A | N | A | | N | N | A | A2 | |
| Sodium Bisulfate | 100% | A1 | A1 | A1 | | A3 | A4 | N | N | A | A | A |
| Sodium Bisulfide | 100% | A | | A | | | | N | B | A | A | |
| Sodium Bisulfite | 40% | A | | A | | | | B2 | B2 | | A2 | B2 |
| Sodium Bisulfite | 100% | A1 | A1 | A1 | | A3 | A4 | B1 | B3 | B5 | A5 | |
| Sodium Borate (Borax) | 100% | A1 | A3 | A1 | | A3 | A4 | B3 | B3 | A5 | A | A5 |
| Sodium Boric Acid | 100% | A | | A | | | | N | N | A | A | |
| Sodium Bromide | 100% | A1 | A3 | A1 | | A5 | | | | B1 | A | B5 |
| Sodium Carbonate | 10% | A | | A | N | A | | A | A | A2 | A2 | A |
| Sodium Carbonate | 20% | A | | A | | | | A | A | A2 | A2 | A |
| Sodium Carbonate | 100% | A1 | A1 | A1 | | A3 | A3 | B1 | B3 | | A2 | A3 |
| Sodium Chloride | Sat | A1 | A1 | A1 | A5 | A3 | A5 | N | A | A1 | A2 | A3 |
| Sodium Chlorate | 40% | A | | A | N | A | | B | B | A | | A |
| Sodium Chlorate | 100% | A1 | A1 | A1 | | A5 | A4 | N | | N | A | A3 |
| Sodium Chloride | 30% | A | | A | | A | | B1 | B2 | A | A | A |
| Sodium Chlorite | 10% | A | | A | | | | N | B | A | B | |
| Sodium Chlorite | 100% | A1 | | A1 | | | A3 | N | N | A1 | B | |
| Sodium Chromate | 80% | A1 | A1 | A1 | | A5 | | A3 | A3 | A | A | A |
| Sodium Cyanide | 100% | A1 | A1 | A1 | | A3 | A3 | A1 | B5 | B2 | N | A5 |
| Sodium Dichromate | 100% | A1 | A3 | A1 | | N | | B5 | A5 | A5 | | |
| Sodium Ferricyanide | 100% | A1 | A1 | A1 | | N | | B1 | A3 | A5 | | |
| Sodium Ferrocyanide | 100% | A1 | A1 | A1 | | | | B5 | B | A5 | | |
| Sodium Fluoride | 100% | A1 | A1 | A1 | | A4 | A4 | N | B3 | N | | A5 |
| Sodium Glutamate | 100% | | A | | | | | | | | | |

## Flowtube Liner / Electrode Material

| Process Liquid | Maximum Concentr. | PTFE Teflon | ETFE Tefzel | PFA | Polyurethane | Neoprene | Hard Rubber | 316 SST | Hastelloy C-276 | Tantalum | Platinum - 10 % Iridium | Titanium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sodium Hydrosulfite | 100% | A1 | | A1 | | | | B | A5 | A5 | A | |
| Sodium Hydroxide | 5% | A1 | | A1 | N | N | | A | | N | A | A |
| Sodium Hydroxide | 10% | A1 | A3 | A1 | A5 | A3 | A4 | A1 | B2 | N | | A3 |
| Sodium Hydroxide | 25% | A | | A | N | N | | N | A | N | A | A |
| Sodium Hydroxide | 30% | A1 | A2 | A1 | A5 | A3 | A4 | A4 | B3 | N | A | A3 |
| Sodium Hydroxide | 40% | A | | A | | | | B | A | N | A | A |
| Sodium Hydroxide | 50% | A1 | A2 | A1 | A5 | A3 | A4 | A4 | A3 | N | A | A5 |
| Sodium Hypochlorite | Conc | A1 | A1 | A1 | N | N | A5 | | | B1 | | |
| Sodium Hypochlorite | 15% | A | | A | | | | N | B | B | A2 | B |
| Sodium Hypochlorite | 20% | A1 | A1 | A1 | N | N | A5 | N | N | B1 | A2 | B3 |
| Sodium Hypochlorite | 25% | A1 | | A1 | | | | N | B | B | A2 | B |
| Sodium Hyposulfite | 5% | A1 | A1 | A1 | | | | N | A5 | A5 | | |
| Sodium Iodide | 100% | A1 | A1 | A1 | | A4 | | | | B5 | | |
| Sodium Lignosulfonate | 100% | | A | | | | | | | | | |
| Sodium Metasilicate | 100% | | A | | | | | | | | | |
| Sodium Methane | 100% | A | | A | | | | | | | | |
| Sodium Nitrate | 40% | A | | A | N | A | | A | | A | A2 | A |
| Sodium Nitrate | 50% | A | | A | | | | N | B | A | A2 | A |
| Sodium Nitrate | 100% | A1 | A1 | A1 | A5 | A3 | A4 | | N | B1 | A2 | A5 |
| Sodium Nitrite | 40% | A | | A | | | | B2 | B2 | A | A | A |
| Sodium Nitrite | 100% | A1 | A1 | A1 | | A4 | | N | N | B3 | A | A3 |
| Sodium Perborate | 10% | A1 | A3 | A1 | | A3 | A4 | B1 | B3 | | | |
| Sodium Perchlorate | 100% | | A | | | | | | | | A2 | |
| Sodium Peroxide | 10% | A1 | A1 | A1 | | A3 | A4 | B1 | B3 | | A2 | |
| Sodium Persulfate | 100% | | A | | | | | | | | | |
| Sodium Phosphate (Mono-Basic) | 100% | A | A | A | N | A | | B | A | A5 | A2 | A2 |
| Sodium Phosphate (Tri-Basic) | 100% | A1 | A1 | A1 | A | A4 | A4 | B3 | B3 | B2 | A2 | B3 |
| Sodium Silicate | 100% | A1 | A1 | A1 | | A3 | A3 | B1 | B3 | B1 | A2 | A3 |
| Sodium Silicofluoride | 100% | | A | | | | | | | | | |
| Sodium Sulfate | 20% | A | | A | | | | | B | A1 | A2 | A2 |
| Sodium Sulfate | 30% | A | | A | N | A | | B | B | A | A2 | B |
| Sodium Sulfate | 100% | A1 | A1 | A1 | A5 | A3 | A4 | A1 | B3 | | | |
| Sodium Sulfide | 10% | A1 | A1 | A1 | | A3 | A4 | B2 | B2 | B2 | A2 | B2 |
| Sodium Sulfide | 50% | A1 | A1 | A1 | | A3 | A4 | B3 | B3 | | A2 | |
| Sodium Sulfide | 100% | A | A | A | | N | | N | N | | A | |
| Sodium Sulfite | 10% | A1 | A1 | A1 | | A3 | A4 | A3 | N | | A2 | |
| Sodium Sulfite | 30% | A | | A | | | | B | N | A | A2 | A |
| Sodium Sulfite | 100% | A | A | A | | N | | B | N | A | A | A |
| Sodium Tetraboric Acid | 100% | A | | A | | | | B | B | A | A | |
| Sodium Thiosulfate (Hypo) | 100% | A1 | A1 | A1 | A5 | A3 | A4 | B1 | B5 | | A2 | |
| Sorbic Acid | 100% | | A | | | | | | | | | |
| Sour Crude Oil | 100% | A1 | A1 | A1 | A5 | | | | A4 | | | |
| Stannic Chloride | 100% | A1 | A1 | A1 | | A3 | A4 | N | | B1 | A | |
| Stannous Chloride | 100% | A1 | A1 | A1 | | A4 | A4 | | B3 | B3 | A2 | A5 |
| Stannous Fluoride | 100% | | A | | | | | | | | | |
| Stearic Acid | 100% | A1 | A1 | A1 | A5 | A3 | N | A1 | A1 | B1 | A1 | A1 |
| Stoddard's Solvent | 100% | A1 | A1 | A1 | | N | N | B5 | A5 | | | |
| Styrene Monomer | 100% | | A | | | | | | | | | |
| Succinic Acid | 100% | A1 | A1 | A1 | | | | B3 | B3 | B1 | | A1 |
| Sulfamic Acid | 100% | A1 | A3 | A1 | | A4 | A4 | | | B1 | | A3 |
| Sugar Juice | 100% | A | | A | N | N | | A | A | A | A | A |
| Sulfinol | 100% | | | | | | | | | | | |
| Sulfolane | 100% | | | | | | | | | | | |
| Sulfur Dioxide (Wet) | 100% | A1 | A2 | A1 | | N | N | B4 | A4 | B1 | A1 | N |
| Sulfur Trioxide | 100% | A1 | A5 | A1 | | N | A4 | B1 | B1 | N | | N |
| Sulfuric Acid | 10% | A1 | A1 | A1 | N | A3 | A4 | N | A3 | B1 | A1 | N |
| Sulfuric Acid | 30% | A1 | A1 | A1 | N | A3 | A4 | N | A5 | B1 | A1 | N |
| Sulfuric Acid | 50% | A1 | A1 | A1 | N | A3 | A5 | N | A5 | B1 | A1 | N |
| Sulfuric Acid | 60% | A1 | A1 | A1 | N | A3 | N | N | A1 | B1 | A1 | N |
| Sulfuric Acid | 70% | A1 | A1 | A1 | N | A3 | N | N | B3 | B1 | A1 | N |
| Sulfuric Acid | 80% | A1 | A1 | A1 | N | N | N | B5 | A5 | B1 | A1 | N |
| Sulfuric Acid | 90% | A1 | A1 | A1 | N | N | N | B5 | A4 | B1 | A1 | |
| Sulfuric Acid | 95% | A1 | A1 | A1 | N | N | N | B3 | A4 | B1 | A1 | |
| Sulfuric Acid | 98% | A1 | A1 | A1 | N | N | N | B3 | A5 | B1 | A1 | N |
| Sulfuric Acid | 100% | A1 | A1 | A1 | N | N | N | B3 | A5 | B1 | | N |
| Sulfuric Acid (Fuming) | 100% | A1 | A5 | A1 | | N | | A5 | B5 | N | A1 | N |
| Sulfurous Acid | 100% | A1 | A2 | A1 | N | N | N | A5 | B1 | A1 | A2 | A4 |

| | | Flowtube Liner | | | | | | | | Electrode Material | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Process Liquid** | **Maximum Concentr.** | **PTFE Teflon** | **ETFE Tefzel** | **PFA** | **Polyure ethane** | **Neoprene** | **Hard Rubber** | **316 SST** | **Hastelloy C-276** | **Tantalum** | **Platinum - 10 % Iridium** | **Titanium** |
| Tall Oil | 100% | A1 | A1 | A1 | | N | N | B1 | A1 | B1 | | |
| Tannic Acid | 100% | A1 | A1 | A1 | | A3 | A5 | B3 | N | B3 | A2 | |
| Tartaric Acid | 100% | A1 | A1 | A1 | | A3 | A4 | A1 | B3 | | A2 | |
| Tetraethyl Lead | 100% | A1 | A1 | A1 | | | | B1 | | | | |
| Tetrahydrofuran | 100% | A1 | A3 | A1 | | N | N | B1 | A5 | | | B3 |
| Tetramethyl Ammonium Hydroxide | 50% | A1 | A3 | A1 | | | | | | | | |
| Thionyl Chloride | 100% | A1 | A3 | A1 | | N | N | N | | B1 | | |
| Tin Chloride | 100% | A1 | | A1 | | A3 | A4 | B4 | B1 | A5 | | |
| Tin Tetrachloride | 100% | | A | | | | | | | | | |
| Titanium Dioxide | 100% | A | A | A | A | A | | A | A | A | A | A |
| Titamium Tetrachloride | 100% | A1 | A2 | A1 | | N | N | B5 | B5 | A5 | | A1 |
| Toluene | 100% | A1 | A1 | A1 | N | N | N | A1 | A3 | A1 | A2 | A3 |
| Tomato Juice | 100% | A1 | A3 | A1 | | A3 | | B1 | B5 | A5 | | |
| Tributyl Phosphate | 100% | A1 | A4 | A1 | | N | N | B5 | B5 | | | |
| Trichloroacetic Acid | 100% | A1 | A3 | A1 | A5 | N | N | N | B3 | B1 | | N |
| Trichlorethylene | 100% | A1 | A1 | A1 | N | N | N | B1 | A3 | B3 | | A3 |
| Trichloromethane | 100% | | A | | | | | | | | | |
| Triethanolamine | 100% | A1 | A4 | A1 | N | A4 | A5 | B5 | B3 | B3 | A1 | |
| Triethylamine | 100% | A1 | A2 | A1 | | | | B5 | | A3 | | |
| Triethyl Phosphate | 100% | | | | | | | | | | | |
| Triphenyl Phosphite | 100% | | | | | | | | | | | |
| Trisodium Phosphate | 100% | A1 | A1 | A1 | A5 | A3 | A4 | | | B5 | A | |
| Turpentine | 100% | A1 | A1 | A1 | N | N | N | A3 | B5 | B5 | A1 | B5 |
| Urea | 50% | A1 | A1 | A1 | N | A4 | A4 | B3 | | | | A3 |
| Varsol | 100% | | A | | | | | | | | | |
| Vinegar | 100% | A1 | A3 | A1 | N | A3 | A4 | B3 | B5 | A5 | | A5 |
| Vinyl Acetate | 100% | A1 | A1 | A1 | | A5 | | A4 | A1 | | | |
| VinylChloride(Monomer) | 100% | A | | | | | | | | | A1 | |
| Water (Pure) | 100% | | A | | | | | | | | | |
| Water, Clean or Dirty | 100% | A | | A | A | A | | A | A | A | A | A |
| Water, Deionized | 100% | | | | | | | | | | | |
| Water, Fresh | 100% | A | | A | A | A | | A | A | A | A | A |
| Water, Salt | 100% | A1 | A1 | A1 | N | A3 | A4 | B1 | A1 | A5 | | A5 |
| Water, Sea | 100% | A1 | A1 | A1 | A5 | A3 | | B1 | A1 | A5 | | A3 |
| Water Sewage | 100% | A1 | A1 | A1 | | A4 | | B5 | | A5 | | A5 |
| Wax | 100% | A | | | | | | | | | | |
| White Liquor | 100% | A1 | | A1 | N | A4 | N | B5 | B5 | N | A | A |
| Xylene | 100% | A1 | A1 | A1 | N | N | N | B3 | A1 | A3 | A1 | A3 |
| Zinc Acetate | 100% | | A | | | | | | | | | |
| Zinc Chloride | 20% | A | A | A | N | A | | B3 | B1 | A2 | A2 | A3 |
| Zinc Chloride | 50% | A | | A | | | | N | N | A | A2 | A3 |
| Zinc Chloride | 100% | A1 | A1 | A1 | | A4 | A4 | N | B1 | A3 | A | |
| Zinc Hydrosulfite | 10% | | A | | | | | | | | | |
| Zinc Sulfate | Sat | A1 | A1 | A1 | N | A4 | A4 | A2 | A2 | A5 | A2 | A5 |
| Zinc Sulfide | 100% | | A | | | | | | | | | |
| Zinc Sulfate | 50% | A | A1 | A | N | A4 | A4 | B3 | B3 | A5 | | A5 |

## Manufacturer

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