

# EasyTREK

SP-500

two-wire integrated ultrasonic level transmitter

Installation and Programming manual



Manufacturer:

**NIVELCO Process Control Co.**

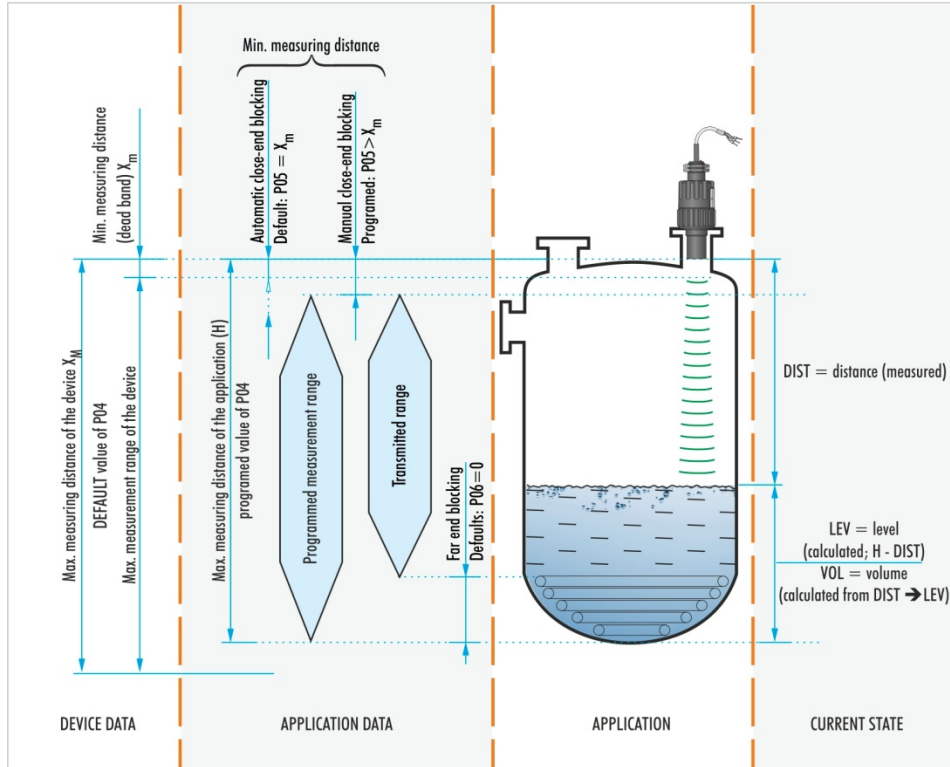
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## BASIC CONCEPTS AND ELEMENTS



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***Thank you for choosing a NIVELCO instrument.  
We are sure that you will be satisfied throughout its use.***

## 1. INTRODUCTION

### Application

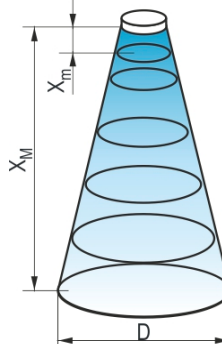
The **EasyTREK** compact ultrasonic level transmitters from **NIVELCO** are excellent tools for level measurement of liquids.

Level measurement technology based on the non-contacting ultrasonic principle is especially suited for applications where, for any reason, no physical contact can be established to the surface of the material to be measured.

### Principle of Operation

The ultrasonic level metering technology is based on the principle of measuring the time required for the ultrasound pulses to make a round trip from the sensor to the level to be measured and back. The sensor emits an ultrasonic pulse train and receives the echoes reflected. The intelligent electronic device processes the received signal by selecting the echo reflected by the surface and calculates from the time of flight the distance between the sensor and the surface which constitutes the basis of all output signals of the **EasyTREK**.

A **Total beam angle** of 5...7° at -3 dB as is featured by most of NIVELCO's SenSonic transducers ensuring a reliable measurement in narrow silos with uneven side walls as well as in process tanks with various protruding objects. Furthermore, as a result of the narrow beam angle – the emitted ultrasonic signals have an outstanding focusing – deep penetration through gases, vapor and foam is ensured.



| X    | D        |
|------|----------|
| 1 m  | – 0.21 m |
| 2 m  | – 0.3 m  |
| 5 m  | – 0.56 m |
| 10 m | – 1 m    |
| 15 m | – 1.45 m |

Diameters corresponding to 5° beam angle.

**Minimum measuring distance ( $X_m$ )** is determined by the design of the unit within which the measurement is not possible (Dead Zone) its value is according with **P05** on page 18. Since measurement is impossible within this range material should not get into this zone.

**Maximum measuring distance ( $X_m$ )** is the greatest distance (determined by the design of the unit) which can be measured by the unit under ideal conditions. (See parameter **P04** on page 17). Maximum measuring distance of the actual application (H) must not be greater than  $X_m$ .

## 2. TECHNICAL DATA

### 2.1. GENERAL DATA

|                                    |                                                                                                                                                                             |                                                                      |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Transducer / enclosure materials   | PP, PVDF                                                                                                                                                                    |                                                                      |
| Process temperature                | PP, PVDF transducers -30...+90 °C [-20...+190 °F]                                                                                                                           |                                                                      |
| Ambient temperature                | -30...+80 °C [-20...+175 °F]                                                                                                                                                |                                                                      |
| Pressure <sup>(1)</sup> (Absolute) | 0.5...3 bar (0.05...0.3 MPa) [7.25...43.5 psi]                                                                                                                              |                                                                      |
| Seals                              | PP transducer: EPDM; All other transducer versions: FPM                                                                                                                     |                                                                      |
| Ingress protection                 | IP68                                                                                                                                                                        |                                                                      |
| Power supply                       | 10 <sup>(3)</sup> ...36 V DC with HART communication                                                                                                                        | 40...720 mW, Galvanic isolation; protection against surge transients |
| Accuracy <sup>(2)</sup>            | ± (0.1% measured + 0.025% max.) or ± (0.05% max.) whichever is greater                                                                                                      |                                                                      |
| Resolution                         | Depending on the measured distance: <2 m: 1 mm, 2...5 m: 2 mm, 5...10 m: 5 mm, >10 m: 10 mm<br>[<6.5 ft: 40 mil, 6.5...16 ft: 78 mil, 16...32 ft: 200 mil, >32 ft: 400 mil] |                                                                      |
| Outputs                            | Analogue: 4...20 mA, (3.9...20.5 mA), $R_{tmax} = (U_i - 10 \text{ V}) / 0.02 \text{ A}$ , Galvanic isolation; protection against surge transients                          |                                                                      |
|                                    | SPDT relay, 30 V / 1 A DC; 48 V / 0.5 A AC                                                                                                                                  |                                                                      |
|                                    | Serial communication: HART® interface (terminal resistor ≥ 250 Ω)                                                                                                           |                                                                      |
|                                    | Programming / diagnostic interface: 3.3 V LVDS, 100 mA max., Galvanic isolated                                                                                              |                                                                      |
| Electrical connection              | 6 x 0.5 mm <sup>2</sup> [AWG20] shielded cable Ø6 mm x 5 m (available max. length 30 m)                                                                                     |                                                                      |
| Electrical protection              | Class III (SELV)                                                                                                                                                            |                                                                      |

(1) For pressures below 1 bar consult with your representative at NIVELCO

(2) Under optimal circumstances of reflection and stabilized transducer temperature.

(3) Only partial operation is provided. Reliable operation without any restrictions is guaranteed at >11 V terminal voltage.

## 5.3.1. SPECIAL DATA

### SPECIAL DATA FOR PP, PVDF AND PTFE TRANSDUCERS (ALSO APPLIES TO Ex MODELS)

| Type                                                               | SP□-5A□-□    | SP□-59□-□     | SP□-58□-□    | SP□-57□-□ | SP□-56□-□ | SP□-54□-□ |
|--------------------------------------------------------------------|--------------|---------------|--------------|-----------|-----------|-----------|
| Transducer material                                                | PP, PVDF     |               |              |           |           |           |
| Max. measuring distance* (X <sub>M</sub> )<br>(m) [ft]             | 3 (10)       | 5 (17)        | 8 (26)       | 10 (33)   | 12 (40)   | 18 (60)   |
| Min. measuring distance*<br>(Dead band) (X <sub>m</sub> ) [m (in)] | 0.15 (6)     | 0.18 (7)      | 0.2 (8)      | 0.25 (10) |           | 0.35 (14) |
| Total beam angle (-3 dB)                                           | 5°           | 6°            | 5°           | 7°        | 5°        |           |
| Measuring frequency                                                | 120 kHz      | 80 kHz        |              | 50 kHz    | 60 kHz    | 40 kHz    |
| Upper process connection                                           | 1" BSP       |               |              |           |           |           |
| Lower process connection                                           | 1" BSP / NPT | 1½" BSP / NPT | 2" BSP / NPT |           | -         |           |

\*(from the transducer face)

## 2.2. ACCESSORIES

- Warranty Card
- Installation and Programming Manual
- Declaration of Conformity

## 2.3. ORDER CODES (NOT ALL COMBINATIONS ARE AVAILABLE)

EasyTREK S P □ - 5 □ □ - □

| HOUSING MATERIAL | CODE |
|------------------|------|
| PP               | A    |
| PVDF             | B    |

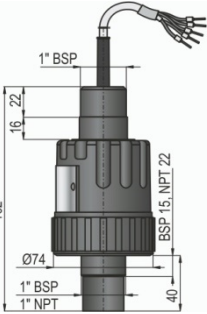
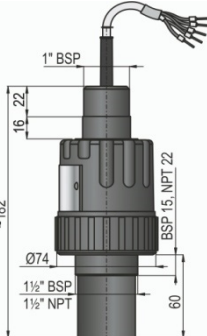
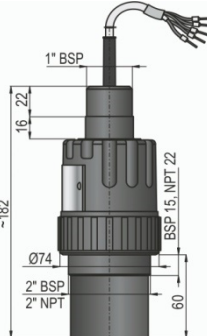
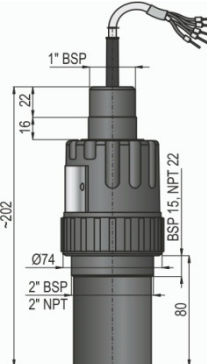
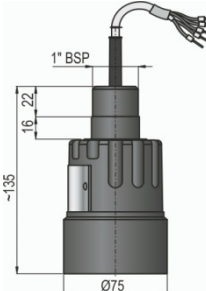
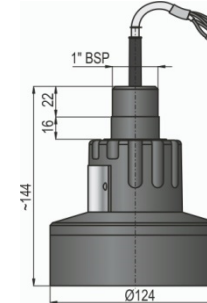
| RANGE M / FEET | CODE |
|----------------|------|
| 18 / 59        | 4    |
| 12 / 39        | 6    |
| 10 / 33        | 7    |
| 8 / 26         | 8    |
| 5 / 16         | 9    |
| 3 / 10         | A    |

| PROCESS CONNECTION     | CODE |
|------------------------|------|
| 1"; 1½", 2" BSP thread | 0    |
| 1"; 1½", 2" NPT thread | N    |

| OUTPUT / Ex              | CODE |
|--------------------------|------|
| 4...20 mA / HART®        | 4    |
| 4...20mA / Relay / HART® | N    |

The order code of an Ex version should end in  
'Ex'

2.4. DIMENSIONS

| EasyTREK<br>SP□-5A□-□ /<br>PP, PVDF                                              | EasyTREK<br>SP□-59□-□ /<br>PP, PVDF                                               | EasyTREK<br>SP□-58□-□ /<br>PP, PVDF                                               | EasyTREK<br>SP□-57□-□ /<br>PP, PVDF                                               | EasyTREK<br>SP□-56□-□ /<br>PP, PVDF                                                 | EasyTREK<br>SP□-54□-□ /<br>PP, PVDF                                                 |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |  |  |  |  |

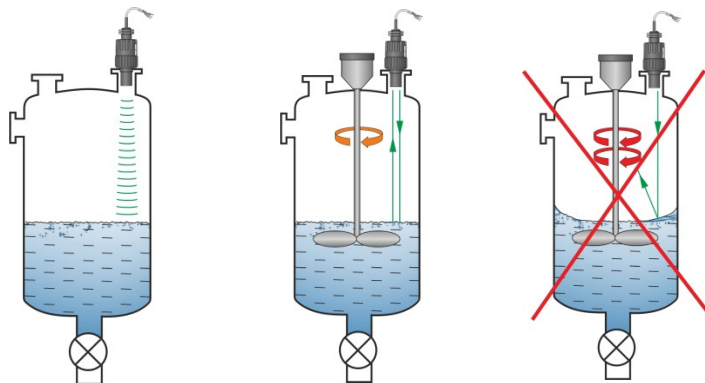


## 3. INSTALLATION

### 3.1. LIQUID LEVEL MEASUREMENT

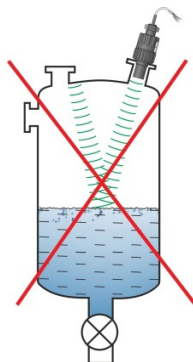
#### POSITION

The ideal position of the **EasyTREK** is on the radius  $r = (0.3 \dots 0.5) R$  of the (cylindrical) tank / silo.  
(Take also sonic cone on page 5 into consideration.)



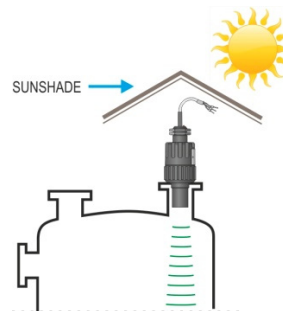
#### SENSOR ALIGNMENT

The sensor face has to be parallel to the surface of the liquid within  $\pm 2 \dots 3^\circ$ .



#### TEMPERATURE

Make sure that the transmitter is protected against overheating by direct sunshine.



## OBSTACLES

Make sure that no objects (cooling pipes, bracing members, thermometers etc.) protrude into the sensing cone of the ultrasonic beam.

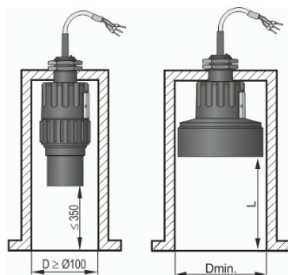
**Remark:** *EasyTREK* programming allows one fixed object that would otherwise disturb the measurement to be blocked out. (see **P29** of programming).

## FOAM

Foaming of the liquid surface may render ultrasonic level metering impossible. If possible, a location should be found, where foaming is the least (device should be located as far as possible from liquid inflow) or a stilling pipe or well should be used.

## STAND-OFF

The structure of the stand off pipe should be rigid; the inner rim where the ultrasonic beam leaves the pipe should be rounded.

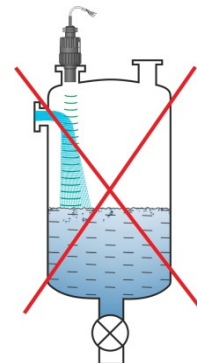


## WIND

Intensive air (gas) movements in the vicinity of the ultrasonic cone is to be avoided. A strong draft of wind may "blow away" the ultrasound. Devices with lower measuring frequency (40, 20 kHz) are recommended.

## FUMES / VAPOURS

For closed tanks containing chemicals or other liquids, which creates fume/gases above the liquid surface especially for outdoor tanks exposed to the sun, a strong reduction of the nominal measuring range of the ultrasonic device is to be considered during device selection. Devices with lower measuring frequency (40, 20 kHz) are recommended in these cases.



| L   | D <sub>min</sub> |         |         |
|-----|------------------|---------|---------|
|     | SP□-59□          | SP□-58□ | SP□-57□ |
| 150 | 50               | 60      | 60      |
| 200 | 50               | 60      | 75      |
| 250 | 65               | 65      | 90      |
| 300 | 80               | 75      | 105     |
| 350 | 95               | 80      | 120     |

| L   | D <sub>min</sub> |
|-----|------------------|
|     | SP□-54□          |
| 90  | 130              |
| 200 | 140              |
| 350 | 150              |
| 500 | 160              |

## 3.2. OPEN CHANNEL FLOW MEASUREMENT

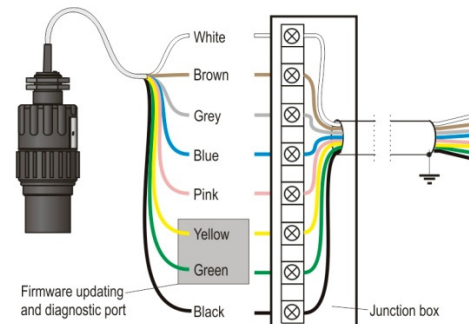
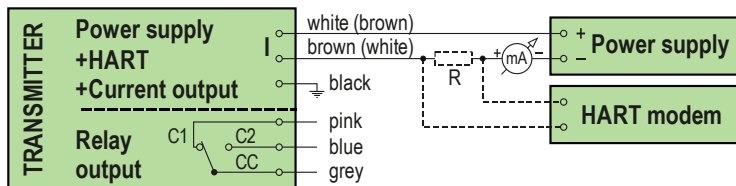
- The unit is suitable for open channel flow measurement with the constructive works listed in 5.3.8.
- For ultimate accuracy, install the sensor as close as possible above the expected maximum water level (see minimum measuring range).
- Install the unit in a place defined by the characteristics of the metering channel along the longitudinal axis of the flume or weir. In case of **Parshall** flumes supplied by NIVELCO the location of the sensor is marked.
- In some cases foam may develop on the surface. Make sure that the surface, opposite to the sensor, remains free of foam for proper sound reflection.
- The unit should be fixed so that its position would not change.
- From measurement accuracy point of view the length of the channel sections preceding and following the measuring flume and their method of joining to the measuring channel section are of critical importance.
- Despite of the most careful installation, the accuracy of flow metering will be lower than that of specified for the distance measurement. The features of the flume or weir applied will determine it.
- Devices should be protected against overheating due to direct sunshine by using sunshades.

## 4. WIRING

- Make sure the terminals in the box are not under power (Use shielded cable 7 x 0.5 mm<sup>2</sup> (AWG20) – with relay output, 4 x 0.5 mm<sup>2</sup> – without relay output suggested in the technical data or stronger).
- After powering the necessary programming can be performed.

### Wire colours:

|      |                   |       |                  |                                                                                 |
|------|-------------------|-------|------------------|---------------------------------------------------------------------------------|
| Pink | – relay C1 output | White | – I <sub>1</sub> | one of the points of current loop, power supply and HART (polarity independent) |
| Grey | – relay CC output | Brown | – I <sub>2</sub> | other point of current loop, power supply and HART (polarity independent)       |
| Blue | – relay C2 output | Black | – GND            | functional earthing and shielding point                                         |



### Extension of the integrated cable:

Should extension be needed the use of connection box is suggested. The shielding of the two cables should be connected and grounded at the signal processing device.

## 5. PUTTING INTO OPERATION

### 5.1. USAGE

Subsequent to powering the correctly wired device would start to tick and after 10...20 s ECHO LED go on and 4...20 mA signal appears on the current output. Measurement will be according to the factory setting. The factory setting is throughout apt to check proper working and to perform simple measurement tasks but features residing in the unit can only be utilised by adjusting the **EasyTREK** to the application by programming. For sound knowledge of the operation features and proper solving of difficult measurement applications the parts of the programming should carefully be studied.

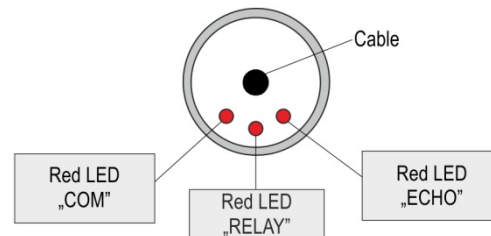
**LED indication:**

- **ECHO-LED**
  - On, if the unit detects proper echo
- **COM-LED**
  - Blinking on HART communication
  - Is ON in the state of remote programming
- **RELAY-LED** (optional)
  - Lits, if CC-C2 is ON
  - Does not lit, if CC-C1 is ON

Device can be reset to factory setting. Default of **EasyTREK SP-500** is the following:

- ⇒ Measurement: level (LEV)
- ⇒ Zero level assigned to the maximum distance
- ⇒ Current output proportional to the level
- ⇒ 4 mA and 0% assigned to zero level.
- ⇒ 20 mA and 100% a assigned to the maximum level (minimum distance)
- ⇒ Error indication by the current output: holds last value.
- ⇒ Damping: 60 s.

View of the transmitter neck from above:



### 5.2. SPECIAL CONDITIONS OF SAFE USE

The cable outside the unit should be fixed so that it should be free of loading.

The terminal box should be selected in accordance with the electrical class of the area.

## 5.3. PROGRAMMING

The HART interface of the **EasyTREK** provides for access to the whole parameter set and possibility of their programming. Parameter set can be reached in two different ways: by the use of the

- **EView2** software run on the PC connected through HART modem to the loop or
- NIVELCO made **MultiCONT** multi-channel process control unit.

Since these access methods differ in their form and handling present manual does not review them. The information is contained in the relevant descriptions and user's manuals.

### 5.3.2. MEASUREMENT CONFIGURATION

P00: - c b a Engineering Units

FACTORY DEFAULT: 000

*Programming of this parameter will result in loading the factory default with the corresponding engineering units.  
Therefore all parameters should be set again!*

| a | Operation                |
|---|--------------------------|
| 0 | Liquid level measurement |

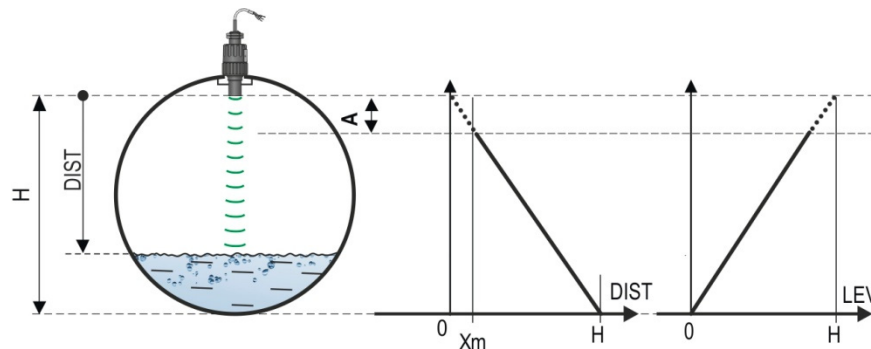
| b | Engineering units<br>(according to "c") |      |
|---|-----------------------------------------|------|
|   | Metric                                  | US   |
| 0 | m                                       | ft   |
| 1 | cm                                      | inch |

| c | Calculation system |
|---|--------------------|
| 0 | metric             |
| 1 | US                 |

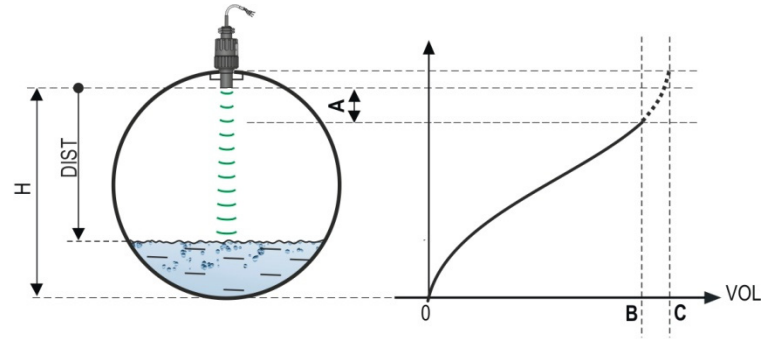
Parameter value "a" will determine the basic measurement value that will be transmitted. Subsequently values for the relays are also relating to these quantities.

| a  | Measurement mode | Transmitted value | Display symbol |
|----|------------------|-------------------|----------------|
| 0  | Distance         | Distance          | <b>DIST</b>    |
| 1  | Level            | Level             | <b>LEV</b>     |
| 2  | Volume           | Volume            | <b>VOL</b>     |
| 3* | Mass             | Mass              | <b>MASS</b>    |
| 4  | Flow             | Flow              | <b>FLOW</b>    |

\* See: P32



| Transmitted value | <b>DIST</b>                         | <b>LEV=H-DIST</b>                              |
|-------------------|-------------------------------------|------------------------------------------------|
| Parameters to set | P00<br>P01(a) = 0<br>P05 $\geq X_m$ | P00<br>P01(a) = 1<br>P04 = H<br>P05 $\geq X_m$ |



| Transmitted value | <b>VOL</b><br><b>f<sub>P40...P45</sub>(H-DIST)</b>                            |
|-------------------|-------------------------------------------------------------------------------|
| Parameters to set | P00<br>P01(a) = 3<br>P02(b)<br>P04 = H<br>P05 ≥ X <sub>m</sub><br>P40 ... P45 |

- A:** Shortest measurable distance  
**B:** Volume (content) pertaining to the greatest measurable level  
**C:** Whole value of the vessel  
**D:** diagram valid for the default value of P10 P11

| a | Temperature |
|---|-------------|
| 0 | °C          |
| 1 | °F          |

This table is interpreted according to P00(c), P01(a) and P02(c) and is irrelevant in case of percentage measurement [ P01(a)= 2 or 4 ]

| b | Volume         |                 | Weight (set also P32) |            | Volume flow          |                       |
|---|----------------|-----------------|-----------------------|------------|----------------------|-----------------------|
|   | Metric         | US              | Metric                | US         | Metric               | US                    |
| 0 | m <sup>3</sup> | ft <sup>3</sup> | –                     | lb (pound) | m <sup>3</sup> /time | ft <sup>3</sup> /time |
| 1 | litre          | gallon          | tons                  | tonnes     | litre/time           | gallon/time           |

| c | Time |
|---|------|
| 0 | s    |
| 1 | min  |
| 2 | hour |
| 3 | day  |

#### Attention!

**EasyTREK** is a level transmitter. Although it can be used for measuring weight, due to factors involved in doing so, accuracy may essentially be influenced.

Temperature compensation mode

| a | Temperature compensation mode |
|---|-------------------------------|
| 0 | Automatic                     |
| 1 | Manual                        |

**Automatic:** The compensation is done with using the value measured by the temperature sensor.

**Manual:** The compensation is done with a fixed setpoint temperature value independently of the measured value (P07).



This is the only parameter that has to be programmed for each application other than distance (however to avoid disturbing effect of possible multiple echoes it is suggested to do this in distance measurement applications too).

The maximum distance to be measured is the greatest distance between the surface of the transducer and the farthest level to be measured. The factory programmed, greatest distances (DEFAULT values) which **can be measured** by the units are listed in the table below. For the actual application the maximum distance **to be measured** i.e. the distance between the sensor and the bottom of the tank should be entered in P04.

| EasyTREK<br>Level transmitter for liquids | Maximum measuring distance $X_M$ [m (ft)] |
|-------------------------------------------|-------------------------------------------|
|                                           | Transducer material PP / PVDF             |
| SP□-5A                                    | 3 (10)                                    |
| SP□-59                                    | 5 (17)                                    |
| SP□-58                                    | 8 (26)                                    |
| SP□-57                                    | 10 (33)                                   |
| SP□-56                                    | 12 (40)                                   |
| SP□-54                                    | 18 (60)                                   |

Since the **level** is determined by calculating the difference between the **value set in P04** and **distance (DIST) is measured** by the unit, it is essential that the correct value of (H) is set in **P04**. To obtain the best accuracy it is suggested that this distance is measured in the empty tank.

|                     |                                                                    |                                                       |
|---------------------|--------------------------------------------------------------------|-------------------------------------------------------|
| <b>P05: - - - -</b> | <b>Minimum measuring distance (Dead zone – Close-end blocking)</b> | <b>FACTORY DEFAULT: <math>X_m</math> as per chart</b> |
|---------------------|--------------------------------------------------------------------|-------------------------------------------------------|

The range, beginning with the sensor’s surface, within which (due to the physical restraint of the ultrasound measurement system) measurement can not be made, is called the dead zone. The **EasyTREK** will not accept any echo within the blocking distance set here.

Close-end blocking may be represented as the extension of the dead zone within which a possible echo will not be taken into consideration making possible to exclude disturbing objects near to the sensor.

**Automatic Close-end blocking = Dead Band control (P05 =  $X_m$ )**

Device with factory default will automatically *set the smallest possible dead band* depending on the conditions of the operation. This will be under optimal conditions a bit smaller in unfavorable circumstances greater than value given in the chart.

**Manual Close-end-blocking with limitation  $\geq$  dead zone (P05 >  $X_m$ )**

By entering a value, higher than the factory default the close-end blocking will be either the value programmed in P05 or the actual dead zone distance (influenced by the actual conditions of the application) whichever is greater.

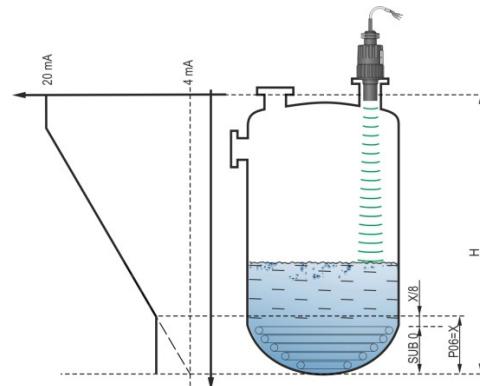
| EasyTREK<br>for liquids | Minimum measuring distance $X_m$ [m (in)] |
|-------------------------|-------------------------------------------|
|                         | Sensor material PP / PVDF                 |
| SP□-5A                  | 0.15 (6)                                  |
| SP□-59                  | 0.18 (7)                                  |
| SP□-58                  | 0.2 (8)                                   |
| SP□-57                  | 0.25 (10)                                 |
| SP□-56                  |                                           |
| SP□-54                  | 0.35 (12)                                 |

Far-end blocking is the range below the level set in parameter **P06**. The far-end blocking can be used to avoid disturbing effect of stirrer or heaters at the bottom of the tanks. Detecting echoes in this range the unit provides special signals.

#### A.) Measuring level or content

*Level sinking below*

- the value of P06 current output is according to the value of the far-end blocking and further
- below SUB 0 (7/8 of P06) the ERROR CODE 10 will be transmitted via HART



- Level rising over value of far-end blocking:*

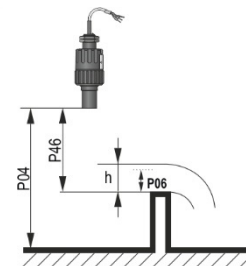
The calculation of level and volume will be based on the programmed tank dimensions, therefore the measured or calculated process values will not be influenced in any way, by the far end blocking value.

#### B.) Open channel flow metering

Far-end blocking will be used for those small levels below which the accurate volume flow calculation is no longer possible.

- Level in the flume/weir sinking below the blocked out range:*
  - Output current value will be according to the value of  $Q = 0$
  - 0 value transmitted via HART for display of „No Flow” or 0
- Level in the flume/weir rising over the blocked out range:*

The calculation of volume flow will be based on the programmed flume/weir data; therefore the measurement values will not be influenced in any way, by the far end blocking value.



Manual temperature compensation value

### 5.3.3. CURRENT OUTPUT

**P08: - - - - Fixed current output**

**FACTORY DEFAULT: 0**

Fixed current output setting parameter

With this parameter the output current can be set to a fixed value between 3.8 mA and 20.5 mA.

This automatically overwrites the 4 mA value set by the HART multidrop mode and the transmitted analogue output current is deactivated.

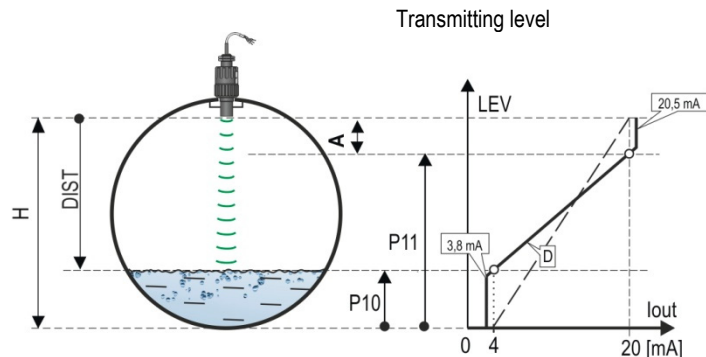
**P10: - - - - Value (of distance, level, volume or flow) assigned to 4 mA current output**

**FACTORY DEFAULT: 0**

**P11: - - - - Value (of distance, level, volume or flow) assigned to 20 mA current output**

**FACTORY DEFAULT:  $X_M - X_m$**

Values are interpreted according to **P01(a)**. Assignment can be made so that the proportion between the change of the (measured or calculated) process value and the change of the current output be either direct or inverse. E.g. level 1 m assigned to 4 mA and level 10 m assigned to 20 mA represents direct proportion and level 1 m assigned to 20 mA and level 10 m assigned to 4 mA represents the inverse proportion.



**A:** Smallest measurable dist.  
**D:** diagram valid for default values of P10 and P11

**Error indication by output current:**

Error will be indicated by the **EasyTREK** transmitter on the current output according to the set value as long as error is present.

(Error codes are given in Chapter 7).

| a | Error indication by output current |
|---|------------------------------------|
| 0 | HOLD (hold last value)             |
| 1 | 3.8 mA                             |
| 2 | 22 mA                              |

**Current output mode:**

| b | Current output mode |
|---|---------------------|
| 0 | Automatic           |
| 1 | Manual              |

**Automatic:** The current output value is calculated from the measured value, the transmitter output is active.

**Manual:** The current output value is not calculated from the measured value, but a fixed (according to P08) current output value is transmitted.

In this mode, the current output error setting is irrelevant.

This parameter overwrites the HART multidrop communication mode 4 mA value!

### 5.3.4. RELAY OUTPUT

#### P13: --- a Relay function

| a | Relay function                                                                                                                                                                                                                                          | Also set:                                                                                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 | <p>DIFFERENTIAL LEVEL CONTROL<br/>(Hysteresis control)</p> <p>Relay is energised if the measured or calculated value exceeds the value set in P14<br/>Relay is de-energised if the measured or calculated value descends under the value set in P15</p> | <p>P14, P15</p> <p>There is a need to set (in level min. 20 mm) hysteresis between P14 and P15</p> <p><b>P14 &gt; P15</b> – normal operation<br/><b>P14 &lt; P15</b> – inverted operation</p> |
| 1 | Relay is energised in case of Echo Loss                                                                                                                                                                                                                 | -                                                                                                                                                                                             |
| 2 | Relay is de-energised in case of Echo Loss                                                                                                                                                                                                              | -                                                                                                                                                                                             |
| 3 | <p>COUNTER</p> <p>Used for open channel flow metering.<br/>A 100 msec pulse is generated every 1, 10, 100, 1.000 or 10.000 m<sup>3</sup> according to P17.</p>                                                                                          | <p>P17 = 0: 1 m<sup>3</sup><br/>P17 = 1: 10 m<sup>3</sup><br/>P17 = 2: 100 m<sup>3</sup><br/>P17 = 3: 1.000 m<sup>3</sup><br/>P17 = 4: 10.000 m<sup>3</sup></p>                               |

In de-energised state of the device the „C1” circuit is closed.

FACTORY DEFAULT: 2

|          |                                   |                    |
|----------|-----------------------------------|--------------------|
| P14: ... | Relay parameter – Operating value | FACTORY DEFAULT: 0 |
| P15: ... | Relay parameter – Releasing value | FACTORY DEFAULT: 0 |
| P17: ... | Relay parameter – Pulse rate      | FACTORY DEFAULT: 0 |

FACTORY DEFAULTS: P14=0, P15=0, P17=0

### 5.3.5. DIGITAL COMMUNICATION

#### P19: --- a Short (HART) address of the unit

FACTORY DEFAULT: 2

These addresses with 0 – 63 are, in accordance with the HART standard, for distinguishing units in the same loop.

- Address: 0 current output of 4...20 mA operational
- Address: 1 – 15 current output is fixed to 4 mA.

### 5.3.6. MEASUREMENT OPTIMISATION

#### P20: --- Damping

FACTORY DEFAULT: 60 SEC

Damping time is used to damp the unwanted fluctuations of the output and display. If the measured value changes rapidly the new value will settle with 1% accuracy after this set time. (damping according to an exponential function).

|                                        | For testing only | Applicable |
|----------------------------------------|------------------|------------|
| No or moderate fume / waves            | 0 sec            | 2 sec      |
| Heavy or dense fume or turbulent waves | >6 sec           | >10 sec    |

#### P22: --- a Dome top tank compensation

FACTORY DEFAULT: 0

This parameter can be used to reduce disturbing effect of possible multiple echoes

| a | Compensation | Remark                                                                                   |
|---|--------------|------------------------------------------------------------------------------------------|
| 0 | OFF          | In case the <b>EasyTREK</b> is not mounted in the centre of the top and the top is flat. |
| 1 | ON           | In case the <b>EasyTREK</b> is mounted in the centre of a tank with dome-shaped top      |

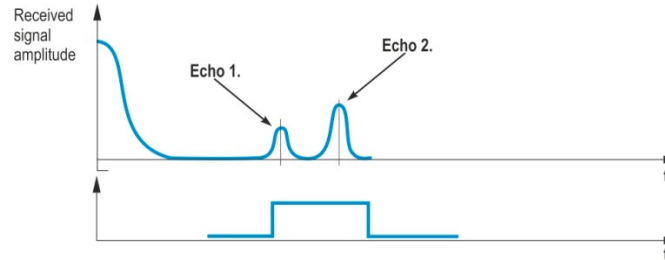
#### P24: --- a Target tracking speed

FACTORY DEFAULT: 0

In this parameter evaluation can be speed up at the expense of the accuracy.

| a | Tracking speed | Remark                                                                                                                                                                                               |
|---|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 | Standard       | For most applications                                                                                                                                                                                |
| 1 | Fast           | For fast changing level                                                                                                                                                                              |
| 2 | Special        | Only for special applications (measuring range is reduced to 50% of the nominal value)<br>The measuring window is inactive and the <b>EasyTREK</b> will respond practically instantly to any target. |

A so-called measuring window is formed around the echo signal. The position of this measuring window determines the flight time for calculation of the distance to the target. (the picture below can be seen on the test oscilloscope)



Some applications involve multiple (target + disturbing) echoes even within the measuring window. Basic echo selection will be done by the QUEST+ software automatically. This parameter influences the echo selection only within the measuring window.

| a | Echo in the window to be selected | Remark                                                                    |
|---|-----------------------------------|---------------------------------------------------------------------------|
| 0 | With the highest amplitude        | Most frequently used                                                      |
| 1 | First one                         | For liquids applications with multiple echoes within the Measuring Window |

These parameters provide additional protection against echo loss in applications involving very heavy fuming. Correct setting increases reliability of the measurement during filling and emptying. The parameters must not be smaller than the fastest possible filling/emptying rate of the actual technology.

**Attention!** Level changing rate is rather different near to the conical or spherical bottom of such a vessel.



| a | Echo loss indication  | Remark                                                                                                                                                                                                                                      |
|---|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 | Delayed indication    | <p>During short echo-loss (for the period of <math>2(b+1)*P20</math>) analogue output will hold last value. After this period the current value according to the setting in <b>P12:a</b> and via HART ERROR CODE 2 will be transmitted.</p> |
| 1 | No indication         | For the time of echo-loss, analogue output will hold last value.                                                                                                                                                                            |
| 2 | Filling simulation    | Losing echo during the filling process, transmitted value will increase according to the filling speed set in <b>P26</b>                                                                                                                    |
| 3 | Immediate indication  | Losing echo, the current value (according to the setting in <b>P12:a</b> ) and the <b>ERROR CODE 2</b> (via HART) will immediately be transmitted.                                                                                          |
| 4 | Empty tank indication | Echo-loss may occur in completely empty tanks with a spherical bottom due to deflection of the ultrasonic beam, or in case of silos with an open outlet. In such cases it may be useful to indicate empty tank instead of echo loss.        |

|                                                                                                                                                                                                                                                                                                                                      |             |                                                                  |                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------|--------------------------------------------------|
| <b>P29</b>                                                                                                                                                                                                                                                                                                                           | <b>----</b> | <b>Blocking out of disturbing object</b>                         | <b>FACTORY DEFAULT: 0</b>                        |
| One fixed object in the tank, disturbing the measurement, can be blocked out. By the use of the Echo Map ( <b>P70</b> ) the precise distance of disturbing object can be read out. This value should be entered in this parameter.                                                                                                   |             |                                                                  |                                                  |
| <b>P31:</b>                                                                                                                                                                                                                                                                                                                          | <b>----</b> | <b>Sound velocity at 20 °C (m/s or ft/s depending on P00(c))</b> | <b>FACTORY DEFAULT: 343.8 (m/s), 1128 (ft/s)</b> |
| This parameter should be used if the sound velocity in the gases above the measured surface differs largely from that of in the air. This is recommended for applications where the gas is more or less homogeneous. If it is not, the accuracy of the measurement can be improved using 32-point linearisation ( <b>P48, P49</b> ). |             |                                                                  |                                                  |
| <i>For sound velocities in various gases see section "Sound Velocities".</i>                                                                                                                                                                                                                                                         |             |                                                                  |                                                  |
| <b>P32:</b>                                                                                                                                                                                                                                                                                                                          | <b>----</b> | <b>Specific gravity</b>                                          | <b>FACTORY DEFAULT: 0</b>                        |
| Entering a value (other than "0") of specific gravity in this parameter, the weight will be displayed instead of VOL.                                                                                                                                                                                                                |             |                                                                  |                                                  |
| Engineering unit should be [kg/dm³] or [lb/ft³] depending on <b>P00</b> (c)                                                                                                                                                                                                                                                          |             |                                                                  |                                                  |

### 5.3.7. VOLUME (CONTENT) MEASUREMENT

P40: - - ba Tank shape

FACTORY DEFAULT: 00

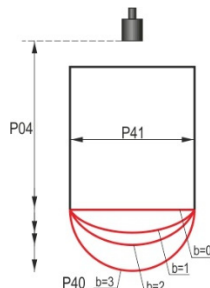
| ba | Tank shape                                              | Also to be set          |
|----|---------------------------------------------------------|-------------------------|
| b0 | Standing cylindrical tank shape (value of "b" as below) | P40 (b), P41            |
| 01 | Standing cylindrical tank with conical bottom           | P41, P43, P44           |
| 02 | Standing rectangular tank (with chute)                  | P41, P42, P43, P44, P45 |
| b3 | Lying cylindrical tank shape (value of "b" as below)    | P40 (b), P41, P42       |
| 04 | Spherical tank                                          | P41                     |

**Attention!**  
The value "a" determining the shape of the tank should be set first.

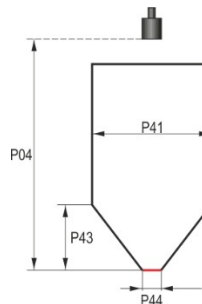
P41-45: - - - Tank dimensions

FACTORY DEFAULT: 0

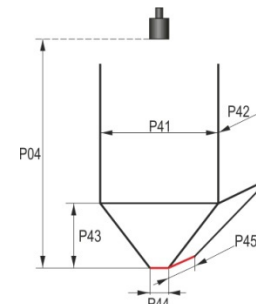
Standing cylindrical tank  
with hemispherical bottom a = 0



Standing cylindrical tank  
with conical bottom a = 1, b = 0

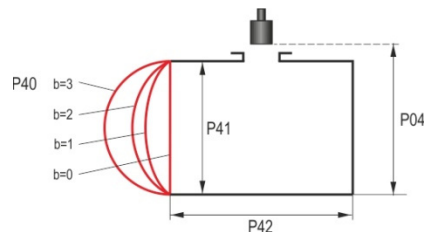


Standing rectangular tank  
with or without chute a = 2, b = 1

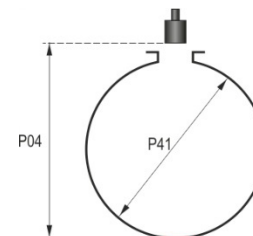


Plain bottom  
P43, P44 and  
P45 = 0

Lying cylindrical tank a = 3



Spherical tank a = 4, b = 0



### 5.3.8. OPEN CHANNEL FLOW MEASUREMENT

P40: -- b a Devices, formula, data

FACTORY DEFAULT: 00

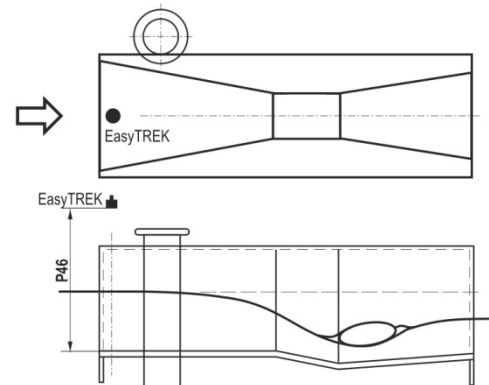
| ba | Devices, formula, data                                                 |         |                                     |                 |                 | Also to be set |
|----|------------------------------------------------------------------------|---------|-------------------------------------|-----------------|-----------------|----------------|
|    | NIVELCO Parshall channels                                              | Type    | Formula                             | $Q_{min}$ [l/s] | $Q_{max}$ [l/s] | "P" [cm]       |
| 00 |                                                                        | GPA-1P1 | $Q [l/s] = 60.87 \cdot h^{1.552}$   | 0.26            | 5.38            | 30             |
| 01 |                                                                        | GPA-1P2 | $Q [l/s] = 119.7 \cdot h^{1.553}$   | 0.52            | 13.3            | 34             |
| 02 |                                                                        | GPA-1P3 | $Q [l/s] = 178.4 \cdot h^{1.555}$   | 0.78            | 49              | 39             |
| 03 |                                                                        | GPA-1P4 | $Q [l/s] = 353.9 \cdot h^{1.558}$   | 1.52            | 164             | 53             |
| 04 |                                                                        | GPA-1P5 | $Q [l/s] = 521.4 \cdot h^{1.558}$   | 2.25            | 360             | 75             |
| 05 |                                                                        | GPA-1P6 | $Q [l/s] = 674.6 \cdot h^{1.556}$   | 2.91            | 570             | 120            |
| 06 |                                                                        | GPA-1P7 | $Q [l/s] = 1014.9 \cdot h^{1.56}$   | 4.4             | 890             | 130            |
| 07 |                                                                        | GPA-1P8 | $Q [l/s] = 1368 \cdot h^{1.5638}$   | 5.8             | 1208            | 135            |
| 08 |                                                                        | GPA-1P9 | $Q [l/s] = 2080.5 \cdot h^{1.5689}$ | 8.7             | 1850            | 150            |
| 09 | General PARSHALL flume                                                 |         |                                     |                 |                 | P46, P42       |
| 10 | PALMER-BOWLUS (D/2)                                                    |         |                                     |                 |                 | P46, P41       |
| 11 | PALMER-BOWLUS (D/3)                                                    |         |                                     |                 |                 | P46, P41       |
| 12 | PALMER-BOWLUS (Rectangular)                                            |         |                                     |                 |                 | P46, P41, P42  |
| 13 | Khafagi Venturi                                                        |         |                                     |                 |                 | P46, P42       |
| 14 | Bottom-step weir                                                       |         |                                     |                 |                 | P46, P42       |
| 15 | Suppressed rectangular or BAZIN weir                                   |         |                                     |                 |                 | P46, P41, P42  |
| 16 | Trapezoidal weir                                                       |         |                                     |                 |                 | P46, P41, P42  |
| 17 | Special trapezoidal (4:1) weir                                         |         |                                     |                 |                 | P46, P42       |
| 18 | V-notch weir                                                           |         |                                     |                 |                 | P46, P42       |
| 19 | THOMSON (90°-notch) weir                                               |         |                                     |                 |                 | P46            |
| 20 | Circular weir                                                          |         |                                     |                 |                 | P46, P41       |
| 21 | General flow formula: $Q [l/s] = 1000 \cdot P41 \cdot h^{P42}$ , h [m] |         |                                     |                 |                 | P46, P41, P42  |

P40=00

**NIVELCO Parshall flumes (GPA1P1 – GPA-1P9)**

For further details see the Manual of the Parshall flume

08



P40=09

**General Parshall flume** $0.305 < P42(\text{width}) < 2.44$ 

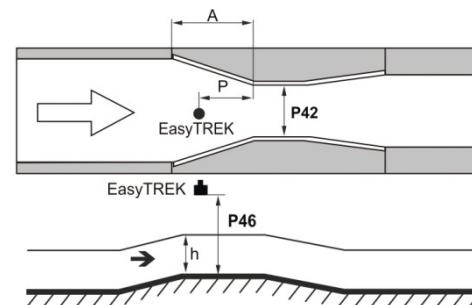
$$Q [l/s] = 372 \cdot P42 \cdot (h/0.305)^{1.569} \cdot P42^{0.026}$$

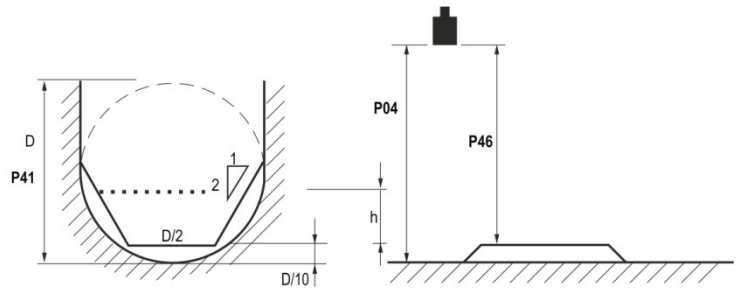
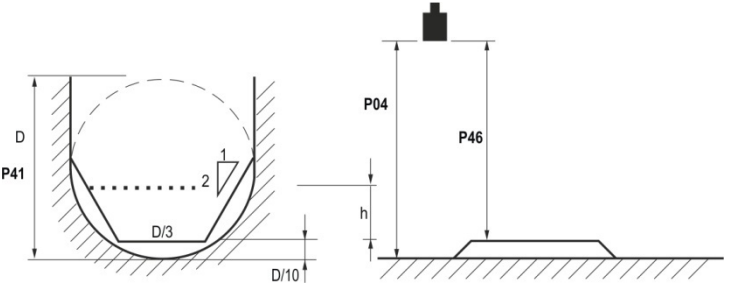
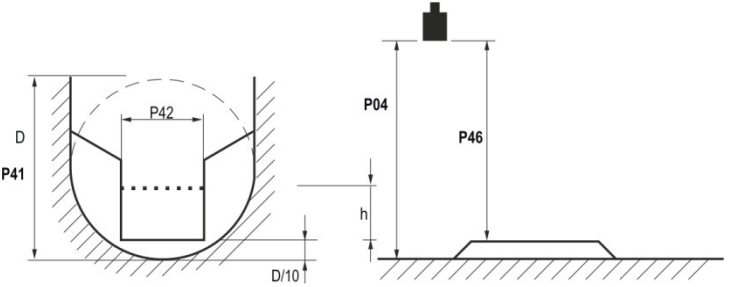
 $2.5 < P42$ 

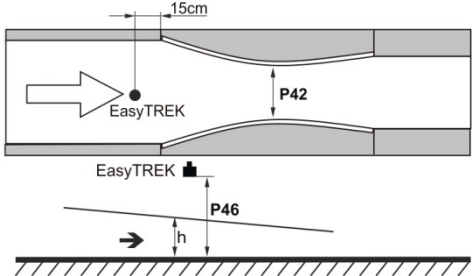
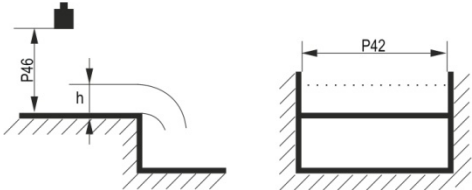
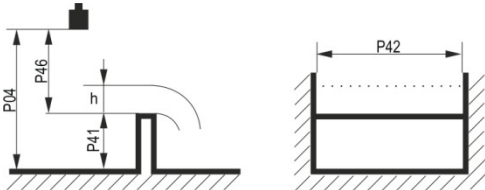
$$Q [l/s] = K \cdot P42 \cdot h^{1.6}$$

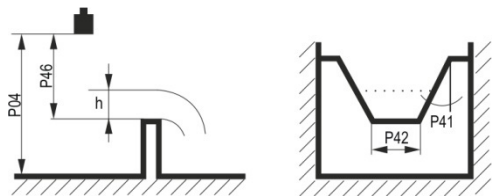
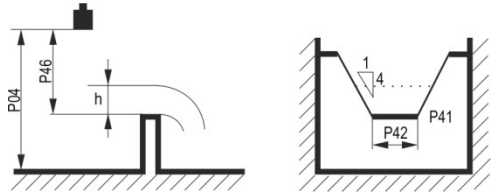
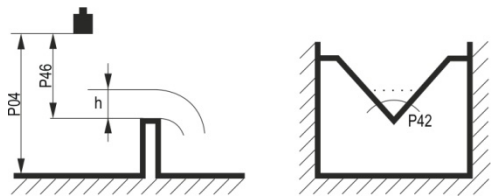
$$P = 2/3 \cdot A$$

| P42 [m] | K     |
|---------|-------|
| 3.05    | 2.450 |
| 4.57    | 2.400 |
| 6.10    | 2.370 |
| 7.62    | 2.350 |
| 9.14    | 2.340 |
| 15.24   | 2.320 |

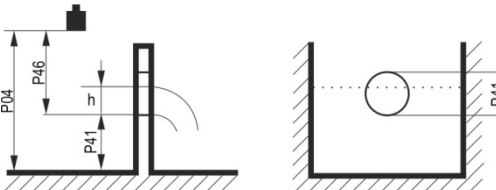


|                      |                                                                                                                                                                             |                                                                                    |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <p><b>P40=10</b></p> | <p><b>Palmer-Bowlus (D/2) flume</b></p> <p><math>Q [m^3/s] = f(h1/P41) \cdot P41^{2.5}</math>, where <math>h1[m] = h + (P41/10)</math></p> <p><b>P41 [m]</b></p>            |   |
| <p><b>P40=11</b></p> | <p><b>Palmer-Bowlus (D/3) flume</b></p> <p><math>Q [m^3/s] = f(h1/P41) \cdot P41^{2.5}</math>, where <math>h1[m] = h + (P41/10)</math></p> <p><b>P41 [m]</b></p>            |  |
| <p><b>P40=12</b></p> | <p><b>Palmer-Bowlus (rectangular) flume</b></p> <p><math>Q [m^3/s] = C \cdot P42 \cdot h^{1.5}</math>, where <math>C = f(P41/P42)</math></p> <p><b>P41 [m], P42 [m]</b></p> |  |

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                    |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <p><b>P40=13</b></p> | <p><b>Khafagi Venturi flume</b></p> <p><math>Q \text{ [m}^3\text{/s]} = 1.744 \cdot \mathbf{P42} \cdot h^{1.5} + 0.091 \cdot h^{2.5}</math></p> <p><b>P42</b> [m]</p> <p><math>h</math> [m]</p>                                                                                                                                                                                                                                                                      |   |
| <p><b>P40=14</b></p> | <p><b>Bottom step weir</b></p> <p><math>0.0005 &lt; Q \text{ [m}^3\text{/s]} &lt; 1</math></p> <p><math>0.3 &lt; \mathbf{P42} \text{ [m]} &lt; 15</math></p> <p><math>0.1 &lt; h \text{ [m]} &lt; 10</math></p> <p><math>Q \text{ [m}^3\text{/s]} = 5.073 \cdot \mathbf{P42} \cdot h^{1.5}</math></p> <p>Accuracy: <math>\pm 10\%</math></p>                                                                                                                         |  |
| <p><b>P40=15</b></p> | <p><b>Suppressed rectangular or BAZIN weir</b></p> <p><math>0.001 &lt; Q \text{ [m}^3\text{/s]} &lt; 5</math></p> <p><math>0.15 &lt; \mathbf{P41} \text{ [m]} &lt; 0.8</math></p> <p><math>0.15 &lt; \mathbf{P42} \text{ [m]} &lt; 3</math></p> <p><math>0.015 &lt; h \text{ [m]} &lt; 0.8</math></p> <p><math>Q \text{ [m}^3\text{/s]} = 1.77738(1+0.1378h/\mathbf{P41}) \cdot \mathbf{P42} \cdot (h+0.0012)^{1.5}</math></p> <p>Accuracy: <math>\pm 1\%</math></p> |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <p><b>P40=16</b></p> <p><b>Trapezoidal weir</b></p> <p><math>0.0032 &lt; Q \text{ [m}^3/\text{s]} &lt; 82</math></p> <p><math>20 &lt; P41[^\circ] &lt; 100</math></p> <p><math>0.5 &lt; P42 \text{ [m]} &lt; 15</math></p> <p><math>0.1 &lt; h \text{ [m]} &lt; 2</math></p> <p><math>Q \text{ [m}^3/\text{s]} = 1.772 \cdot P42 \cdot h^{1.5} + 1.320 \cdot \text{tg}(P41/2) \cdot h^{2.47}</math></p> <p>Accuracy: <math>\pm 5\%</math></p> |  |
| <p><b>P40=17</b></p> <p><b>Special trapezoidal (4:1) weir</b></p> <p><math>0.0018 &lt; Q \text{ [m}^3/\text{s]} &lt; 50</math></p> <p><math>0.3 &lt; P42 \text{ [m]} &lt; 10</math></p> <p><math>0.1 &lt; h \text{ [m]} &lt; 2</math></p> <p><math>Q \text{ [m}^3/\text{s]} = 1.866 \cdot P42 \cdot h^{1.5}</math></p> <p>Accuracy: <math>\pm 3\%</math></p>                                                                                  |  |
| <p><b>P40=18</b></p> <p><b>V-notch weir</b></p> <p><math>0.0002 &lt; Q \text{ [m}^3/\text{s]} &lt; 1</math></p> <p><math>20 &lt; P42[^\circ] &lt; 100</math></p> <p><math>0.05 &lt; h \text{ [m]} &lt; 1</math></p> <p><math>Q \text{ [m}^3/\text{s]} = 1.320 \cdot \text{tg}(P42/2) \cdot h^{2.47}</math></p> <p>Accuracy: <math>\pm 3\%</math></p>                                                                                          |  |



|               |                                                                                                                                                                                                                                                              |                                                                                    |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <b>P40=19</b> | <b>THOMSON (90°-notch) weir</b><br>$0.0002 < Q \text{ [m}^3/\text{s]} < 1$<br>$0.05 < h \text{ [m]} < 1$<br>$Q \text{ [m}^3/\text{s]} = 1.320 \cdot h^{2.47}$<br>Accuracy: $\pm 3\%$                                                                         |   |
| <b>P40=20</b> | <b>Circular weir</b><br>$0.0003 < Q \text{ [m}^3/\text{s]} < 25$<br>$0.02 < h \text{ [m]} < 2$<br>$Q \text{ [m}^3/\text{s]} = m \cdot b \cdot D^{2.5}$ , where $b = f(h/D)$<br>$m = 0.555 + 0.041 \cdot h/P41 + (P41/(0.11 \cdot h))$<br>Accuracy: $\pm 5\%$ |  |

**P46: - - - Distance at Q = 0**

**FACTORY DEFAULT: 0**

Distance between sensor surface and the level at which flow starts has to be entered in this parameter.

### 5.3.9. PROGRAMMING THE VOLUME / MASS / FLOW TABLE (VMFT)

P47: --- a The operation of VMFT

FACTORY DEFAULT: 0

The customer can assign output signals in accordance with optional characteristics to values measured by the transmitter. The characteristic can be defined with maximum 32 points. Between the points the device will calculate the output signal from the measured value with linear interpolation. It can be used for example for assigning optional output signal to the measured value or calculating volume from level in case of tank shapes not included in the selection (e.g. tank with dent).

| a | VMFT mode    |
|---|--------------|
| 0 | doesn't work |
| 1 | works        |

#### Conditions of correct programming of the data pairs

- The table must always start with  $L(1) = 0$  and  $r(1)$  = output value (assigned to 0 level).
- The L column can not include identical values.
- If the table contains less than 32 data pairs, the L column must be ended with a level value "0" in the row following the last relevant data pair.

| i    | L (Left column)<br>Level values measured | r (Right column)<br>Output value |
|------|------------------------------------------|----------------------------------|
| 1    | 0                                        | $r(1)$                           |
| 2    | $L(2)$                                   | $r(2)$                           |
|      | $L(i)$                                   | $r(i)$                           |
| nn   | $L(nn)$                                  | $r(nn)$                          |
| nn+1 | 0                                        |                                  |
| 32   |                                          |                                  |

P48: Number of VMFT elements

Shows the number of data pairs entered to VMFT. Read-only parameter.

### 5.3.10. INFORMATIONAL PARAMETERS (READ ONLY PARAMETERS)

**P60: - - - - Overall operating hours of the unit (h)**

**P61: - - - - Time elapsed after last switch-on (h)**

**P62: - - - - Operating hours of the relay (h)**

**P63: - - - - Number of switching cycles of the relay**

**P64: - - - - Actual temperature of the transducer (°C / °F)**

Broken loop of the thermometer will be indicated by display of the Pt Error message initiated by a signal sent via HART. In this case the transmitter will perform temperature correction corresponding to 20 °C.

**P65: - - - - Maximum temperature of the transducer (°C / °F)**

**P66: - - - - Minimum temperature of the transducer (°C / °F)**

**P70: - - - - Number of Echoes / Echo Map**

Amplitude and position of the echoes can also be read out.

**P71: - - - - Distance of the of Measuring Window**

**P72 - - - - Amplitude of the selected echo [dB] <0**

**P73: Position of the selected echo (time) :(ms) [ms]**

**P74: Signal To Noise Ratio**

| Ratio             | Measurement conditions |
|-------------------|------------------------|
| Over 70           | Excellent              |
| Between 70 and 30 | Good                   |
| Under 30          | Unreliable             |

**P75: - - - - Blocking Distance**

The actual close-end blocking distance will be displayed (provided automatic blocking was selected in **P05**).

### 5.3.11. ADDITIONAL PARAMETERS OF THE FLOW METERING

**P76: - - - - Head of flow (LEV) (Read only parameter)**

The Headwater value can be checked here. This is the “h” value in the formula for flow calculation.

**P77: - - - - TOT1 volume flow totalised (resettable)**

**P78: - - - - TOT2 volume flow totalised (non-resettable)**

### 5.3.12. OTHER PARAMETERS

**P96: - - - - Software code 1 (Read only parameter)**

**P97: - - - - Software code 2 (Read only parameter)**

**P98: - - - - Hardware code (Read only parameter)**

**P99: - - - - Access lock by secret code**

The purpose of this feature is to provide protection against accidental programming or intentional reprogramming of parameters by a person not entitled to do so. The secret code can be any value other than **0000**. Setting a secret code will automatically be activated when the **EasyTREK** is returned to the Measurement Mode. In order to program locked device the secret code should be entered first in **P99**. Thus for entering a new code or erasing the old one the knowledge of the previous code is necessary.

## 6. MAINTENANCE AND REPAIR

**EasyTREK SP** units do not require maintenance on a regular basis. The need for cleaning of the sensor head may occur. Cleaning should be performed by utmost care where scraping or denting of the transducer have to be avoided. Repair under or after the guarantee period should only be carried out by **NIVELCO**. Devices for repair should only be returned duly cleaned and disinfected.

### 6.1. FIRMWARE UPGRADE

Based on the observations & needs of our customers **NIVELCO** constantly improves and revises the operating software of the device. The software can be upgraded with the help of the IrDA communication port of the device. For more information about software updates please contact **NIVELCO**.

## 7. ERROR CODES

| Error Code | Error description                                                                          | Causes and solutions                                                                              |
|------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 1          | Memory error                                                                               | Contact local agent                                                                               |
| No Echo    | Echo loss                                                                                  | See Action 5 and 6                                                                                |
| 3          | Hardware error                                                                             | Contact local agent                                                                               |
| 4          | Display overflow                                                                           | Check settings                                                                                    |
| 5          | Sensor error or improper installation/mounting, level in the dead band                     | Verify sensor for correct operation and check for correct mounting according to the User's Manual |
| 6          | The measurement is at the reliability threshold                                            | Better location should be found.                                                                  |
| 7          | No signal received within the measuring range specified in P04 and P05                     | Check programming, also look for installation mistake                                             |
| 12         | Linearisation table error: both L(1) and L(2) are zero (no valid data-pairs)               | See "Linearisation" Section                                                                       |
| 13         | Linearisation table error: same L(i) data is given twice in the table                      | See "Linearisation" Section                                                                       |
| 14         | Linearisation table error: the r(i) values are not monotone increasing                     | See "Linearisation" Section"                                                                      |
| 15         | Linearisation table error: measured Level is higher than the last Volume or Flow data-pair | See "Linearisation" Section"                                                                      |
| 16         | The check sum of the program is wrong                                                      | Contact local agent                                                                               |
| 17         | Parameter consistency failure                                                              | Check programming                                                                                 |
| 18         | Hardware failure                                                                           | Contact local agent                                                                               |

## 8. PARAMETER TABLE

| Par. | Page | Description                               | Value |   |   |   |
|------|------|-------------------------------------------|-------|---|---|---|
|      |      |                                           | d     | c | b | a |
| P00  | 13   | Application / Engineering Units           |       |   |   |   |
| P01  | 14   | Measurement Mode                          |       |   |   |   |
| P02  | 16   | Calculation units                         |       |   |   |   |
| P03  | 16   | Temperature compensation                  |       |   |   |   |
| P04  | 17   | Maximum Measuring Distance                |       |   |   |   |
| P05  | 18   | Minimum Measuring Distance                |       |   |   |   |
| P06  | 19   | Far End Blocking                          |       |   |   |   |
| P07  | 19   | Manual temperature compensation           |       |   |   |   |
| P08  | 20   | Fixed current output                      |       |   |   |   |
| P09  |      | –                                         |       |   |   |   |
| P10  | 20   | Transmitted value assigned to “4 mA”      |       |   |   |   |
| P11  | 20   | Transmitted value assigned to “20 mA”     |       |   |   |   |
| P12  | 21   | Current output mode                       |       |   |   |   |
| P13  | 22   | Relay function                            |       |   |   |   |
| P14  | 22   | Relay parameter – Operating value         |       |   |   |   |
| P15  | 22   | Relay parameter – Releasing value         |       |   |   |   |
| P16  |      | –                                         |       |   |   |   |
| P17  | 22   | Relay parameter – Pulse rate              |       |   |   |   |
| P18  |      | –                                         |       |   |   |   |
| P19  | 23   | Short address of the unit                 |       |   |   |   |
| P20  | 23   | Damping                                   |       |   |   |   |
| P21  |      | –                                         |       |   |   |   |
| P22  | 23   | Dome top tank compensation                |       |   |   |   |
| P23  |      | –                                         |       |   |   |   |
| P24  | 23   | Target tracking speed                     |       |   |   |   |
| P25  | 24   | Selection of Echo in the measuring window |       |   |   |   |
| P26  | 24   | Level elevation rate                      |       |   |   |   |
| P27  | 24   | Level descent rate                        |       |   |   |   |

| Par. | Page | Description                              | Value |   |   |   |
|------|------|------------------------------------------|-------|---|---|---|
|      |      |                                          | d     | c | b | a |
| P28  | 25   | Echo loss indication                     |       |   |   |   |
| P29  | 26   | Blocking out a disturbing object         |       |   |   |   |
| P30  |      | –                                        |       |   |   |   |
| P31  | 26   | Sound velocity values in different gases |       |   |   |   |
| P32  | 26   | Specific gravity                         |       |   |   |   |
| P33  |      | –                                        |       |   |   |   |
| P40  | 27   | Selection of tank shape / open channel   |       |   |   |   |
| P41  | 27   | Dimensions of tank / Open Channel        |       |   |   |   |
| P42  | 27   | Dimensions of tank / Open Channel        |       |   |   |   |
| P43  | 27   | Dimensions of tank / Open Channel        |       |   |   |   |
| P44  | 27   | Dimensions of tank / Open Channel        |       |   |   |   |
| P45  | 27   | Dimensions of tank / Open Channel        |       |   |   |   |
| P46  | 33   | Level pertaining to flow Q=0             |       |   |   |   |
| P47  | 34   | VMF Table                                |       |   |   |   |
| P48  | 34   | Number of VMFT elements                  |       |   |   |   |
| P49  |      | –                                        |       |   |   |   |
| P50  |      | –                                        |       |   |   |   |
| P51  |      | –                                        |       |   |   |   |
| P52  |      | –                                        |       |   |   |   |
| P53  |      | –                                        |       |   |   |   |
| P54  |      | –                                        |       |   |   |   |
| P55  |      | –                                        |       |   |   |   |

| Par. | Page | Description                             | Value |   |   |   | Par. | Page | Description                | Value |   |   |   |
|------|------|-----------------------------------------|-------|---|---|---|------|------|----------------------------|-------|---|---|---|
|      |      |                                         | d     | c | b | a |      |      |                            | d     | c | b | a |
| P56  | –    |                                         |       |   |   |   | P78  | 36   | TOT2 volume flow totalized |       |   |   |   |
| P57  | –    |                                         |       |   |   |   | P79  | –    |                            |       |   |   |   |
| P58  | –    |                                         |       |   |   |   | P80  | –    |                            |       |   |   |   |
| P59  | –    |                                         |       |   |   |   | P81  | –    |                            |       |   |   |   |
| P60  | 35   | Overall operating hours of the unit     |       |   |   |   | P82  | –    |                            |       |   |   |   |
| P61  | 35   | Time elapsed after last switch-on       |       |   |   |   | P83  | –    |                            |       |   |   |   |
| P62  | 35   | Operating hours of the relay            |       |   |   |   | P84  | –    |                            |       |   |   |   |
| P63  | 35   | Number of switching cycles of the relay |       |   |   |   | P85  | –    |                            |       |   |   |   |
| P64  | 35   | Actual temperature of the transducer    |       |   |   |   | P86  | –    |                            |       |   |   |   |
| P65  | 35   | Maximum temperature of the transducer   |       |   |   |   | P87  | –    |                            |       |   |   |   |
| P66  | 35   | Minimum temperature of the transducer   |       |   |   |   | P88  | –    |                            |       |   |   |   |
| P67  | –    |                                         |       |   |   |   | P89  | –    |                            |       |   |   |   |
| P68  | –    |                                         |       |   |   |   | P90  | –    |                            |       |   |   |   |
| P69  | –    |                                         |       |   |   |   | P91  | –    |                            |       |   |   |   |
| P70  | 35   | Echo Map                                |       |   |   |   | P92  | –    |                            |       |   |   |   |
| P71  | 35   | Position of the measuring window        |       |   |   |   | P93  | –    |                            |       |   |   |   |
| P72  | 35   | Amplitude of the selected echo          |       |   |   |   | P94  | –    |                            |       |   |   |   |
| P73  | 35   | Position of the selected echo           |       |   |   |   | P95  | –    |                            |       |   |   |   |
| P74  | 35   | Signal / noise ratio                    |       |   |   |   | P96  | 36   | Software code 1            |       |   |   |   |
| P75  | 35   | Blocking distance value                 |       |   |   |   | P97  | 36   | Software code 2            |       |   |   |   |
| P76  | 36   | Water head of the flow                  |       |   |   |   | P98  | 36   | Hardware code              |       |   |   |   |
| P77  | 36   | TOT1 volume flow totalized              |       |   |   |   | P99  | 36   | Access lock by secret code |       |   |   |   |

## 9. SOUND VELOCITY VALUES IN DIFFERENT GASES

The following table contains the sound velocity values of various gases measured at 20 °C.

| Gases                | Formula                          | Sound Velocity (m/s) |
|----------------------|----------------------------------|----------------------|
| Acetaldehyde         | C <sub>2</sub> H <sub>4</sub> O  | 252.8                |
| Acetylene            | C <sub>2</sub> H <sub>2</sub>    | 340.8                |
| Ammonia              | NH <sub>3</sub>                  | 429.9                |
| Argon                | Ar                               | 319.1                |
| Benzene              | C <sub>6</sub> H <sub>6</sub>    | 183.4                |
| Carbon dioxide       | CO <sub>2</sub>                  | 268.3                |
| Carbon monoxide      | CO                               | 349.2                |
| Carbon tetrachloride | CCl <sub>4</sub>                 | 150.2                |
| Chlorine             | Cl <sub>2</sub>                  | 212.7                |
| Dimethyl ether       | CH <sub>3</sub> OCH <sub>3</sub> | 213.4                |
| Ethane               | C <sub>2</sub> H <sub>6</sub>    | 327.4                |
| Sulphur hexafluoride | SF <sub>6</sub>                  | 137.8                |

| Gases             | Formula                          | Sound Velocity (m/s) |
|-------------------|----------------------------------|----------------------|
| Ethanol           | C <sub>2</sub> H <sub>5</sub> OH | 267.3                |
| Ethylene          | C <sub>2</sub> H <sub>4</sub>    | 329.4                |
| Helium            | He                               | 994.5                |
| Hydrogen sulfide  | H <sub>2</sub> S                 | 321.1                |
| Methane           | CH <sub>4</sub>                  | 445.5                |
| Methanol          | CH <sub>3</sub> OH               | 347                  |
| Neon              | Ne                               | 449.6                |
| Nitrogen          | N <sub>2</sub>                   | 349.1                |
| Nitrogen monoxide | NO                               | 346                  |
| Oxygen            | O <sub>2</sub>                   | 328.6                |
| Propane           | C <sub>3</sub> H <sub>8</sub>    | 246.5                |

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NIVELCO reserves the right to change technical specifications without notice.