

Operating Instructions



Hand-held Ultrasonic Flowmeter IFX-P200

IFX-P 200 Operating Instructions

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1 Safety instructions

1.1 Symbols used in these operating instructions



Danger

This symbol represents an immediate hazardous situation which could result in **serious injury, death** or **damage to the equipment**. Where this symbol is shown, do not use the equipment further unless you have fully understood the nature of the hazard and have taken the required precautions.



Attention

This symbol indicates important instructions which should be respected in order to avoid damaging or destroying the equipment. Follow the precautions given in these instructions to avoid the hazard. Call our service team if necessary.



Call service

Where this symbol is shown call our service team for advice if necessary.



Note

This symbol indicates a note or detailed set-up tip.



Information point.



Operator keys are printed in bold typeface and placed in pointed brackets.

1.2 Safety instructions

- Do not install, operate or maintain this flowmeter without reading, understanding and following these operating instructions, otherwise injury or damage may result.
- Study these operating instructions carefully before the installation of the equipment and keep them for future reference.
- Observe all warnings, notes and instructions as marked on the packaging, on the equipment, and detailed in the operating instructions.
- Do not use the instrument under wet conditions with the battery cover removed or opened.
- Follow the unpacking, storage and preservation instructions to avoid damage to the equipment.
- Install the equipment and cabling securely and safely according to the relevant regulations.
- If the product does not operate normally, please refer to the service and troubleshooting instructions, or contact Isoil Industria for help.

2 Introduction

Clamp-on transit-time flowmeter

The IFX-P200 is a hand-held, battery operated ultrasonic flowmeter employing clamp-on sensors for the measurement of liquids in full, enclosed pipes. Flow measurements can be undertaken without interruption of the process or interference with the integrity of the pipeline. The clamp-on sensors are attached to the outside of the pipes. The IFX-P200 uses ultrasonic signals for measurement of the flow, employing the transit-time method.

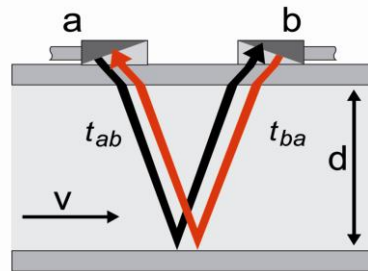


Illustration 1: Clamp-on ultrasonic flowmeter configuration

Measuring principle

Ultrasonic signals are emitted by a transducer installed on a pipe and received by a second transducer. These signals are emitted alternately in the direction of flow and against it. Because the medium is flowing, the transit time of the sound signals propagating in the direction of flow is shorter than the transit time of the signal propagating against the direction of flow. The transit-time difference ΔT is measured and allows the determination of the average flow velocity along the path of acoustic propagation. A profile correction is then performed to obtain the average flow velocity over the cross-sectional area of the pipe, which is proportional to the volumetric flow rate.

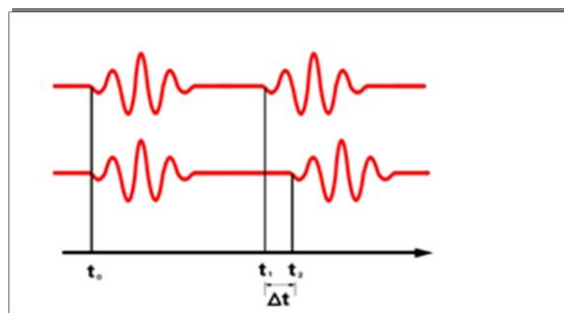


Illustration 2: Transit-time measuring principle

3 Installation

3.1 Unpacking and storage

3.1.1 Unpacking

Care should be taken when opening the box containing the flowmeter, any markings or warnings shown on the packaging should be observed prior to opening. The following steps should then be taken:

- Unpack the flowmeter in a dry area.
- The flowmeter should be handled with care and not left in an area where it could be subject to physical shocks.
- If using a knife to remove packaging care should be taken not to damage the flowmeter or cables.
- The flowmeter package and contents should be checked against the delivery note supplied and any missing items reported immediately.
- The flowmeter package and contents should be checked for signs of damage during transport and any problems reported immediately.
- The vendor accepts no responsibility for damage or injury caused during the unpacking of the instrumentation supplied.
- Excess packing materials should be either recycled or disposed of in a suitable way.

3.1.2 Storage

If storage is necessary, the flowmeter and sensors should be stored:

- in a secure location,
- away from water and harsh environmental conditions,
- in such a way as to avoid damage,
- small items should be kept together in the bags and small plastic boxes provided to avoid loss.

3.1.3 Identification of components

The following items are typically supplied (please refer to your delivery note for a detailed description):

- IFX-P200 hand-held flowmeter
- Clamp-on sensors (usually one or two pairs depending on pipe sizes to be measured)
- Sensor mounting accessories(optional)
- Coupling component (optional)
- Measuring tape
- Operating instructions

3.2 Clamp-on sensor installation

The correct selection of the sensor location is crucial for achieving reliable measurements and high accuracy. Measurement must take place on a pipe in which sound can propagate (see Acoustic propagation) and in which a rotationally symmetrical flow profile is fully developed (see Straight pipe lengths).

The correct positioning of the transducers is an essential condition for error-free measurements. It ensures that the sound signal will be received under optimal conditions and evaluated correctly. Because of the variety of applications and the different factors influencing the measurement, there can be no standard solution for the positioning of the transducers.

The correct position of the transducers will be influenced by the following factors:

- diameter, material, lining, wall thickness and general condition of the pipe,
- the medium flowing in the pipe,
- the presence of gas bubbles and solid particles in the medium.

Check that the temperature at the selected location is within the operating temperature range of the transducers (see technical specification in the Appendix).

Acoustic propagation Acoustic propagation is achieved when the flowmeter is able to receive sufficient signal from the transmitted ultrasonic pulses. The signals are attenuated in the pipe material, the medium and at each of the interfaces and reflections. External and internal pipe corrosion, solid particles and gas content in the medium contribute heavily to signal attenuation.

Straight pipe lengths Sufficient straight lengths of pipe on the inlet and outlet of the measuring location ensure an axi-symmetrical flow profile in the pipe, which is required for good measurement accuracy. If insufficient straight lengths of pipe are available for your application measurements are still obtainable, but the certainty of the measurement can be reduced.

3.3 Installation location

Select an installation location following the recommendations in Table 1 and try to avoid measuring :



- in the vicinity of deformations and defects of the pipe,
- near welding seams,
- where deposits could be building up in the pipe.

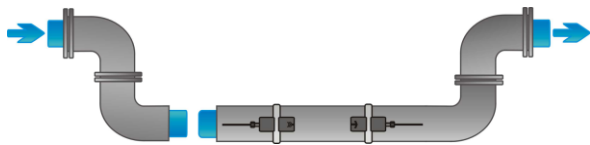
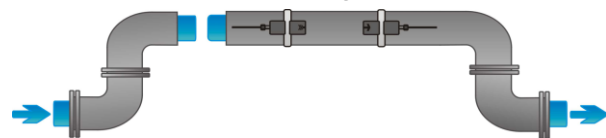
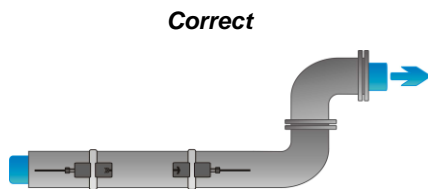
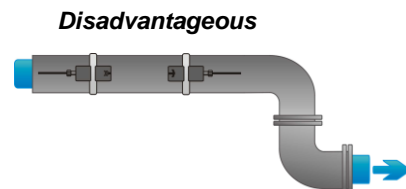
For a horizontal pipe:

Select a location where the transducers can be mounted on the side of the pipe, so that the sound waves emitted by the transducers propagate horizontally in the pipe. In this way, the solid particles deposited on the bottom of the pipe and the gas pockets developing at the top will not influence the propagation of the signal.


Correct

Incorrect
For a free inlet or outlet pipe section:

Select the measuring point at a location where the pipe cannot run empty.


Correct

Disadvantageous

Correct

Disadvantageous
For a vertical pipe:

Select the measuring point at a location where the liquid flows upward to ensure that the pipe is completely filled.

Correct

Incorrect

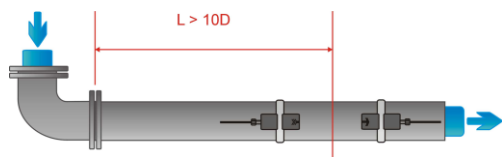

Table 1: Recommendations for sensor mounting location



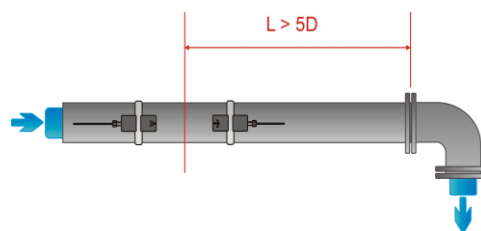
Look for a sensor installation location with sufficient straight pipe to obtain accurate measurements. Please refer to Table 2 as a guideline for recommended distances from disturbance sources.

Disturbance source: 90°-elbow

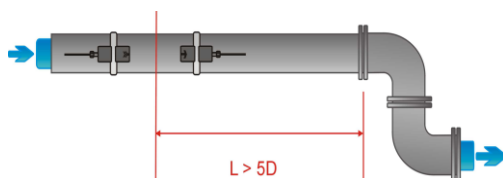
Inlet

 $L \geq 10 D$ 

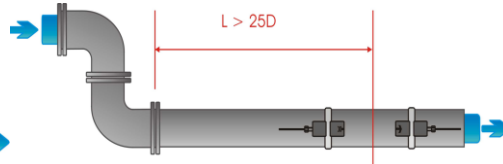
Outlet

 $L \geq 5 D$ **Disturbance source: 2 x 90°-elbows in one plane**

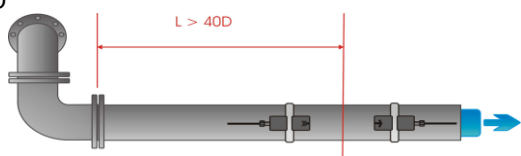
Inlet

 $L \geq 25 D$

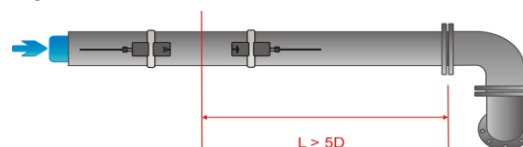
Outlet

 $L \geq 5 D$ **Disturbance source: 2 x 90°-elbows in different planes**

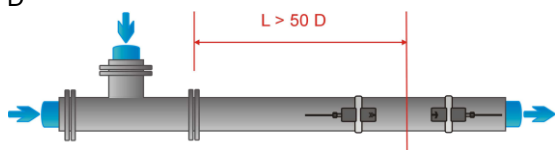
Inlet

 $L \geq 40 D$ 

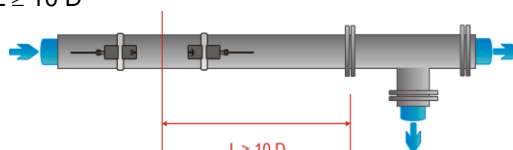
Outlet

 $L \geq 5 D$ **Disturbance source: T-section**

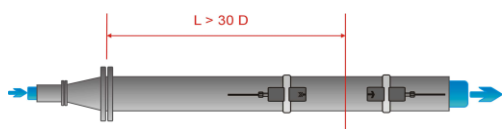
Inlet

 $L \geq 50 D$ 

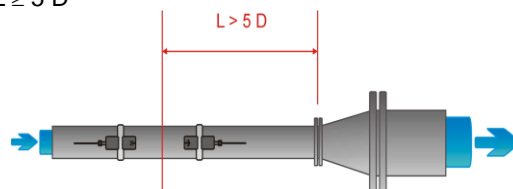
Outlet

 $L \geq 10 D$ **Disturbance source: diffuser**

Inlet

 $L \geq 30 D$ 

Outlet

 $L \geq 5 D$ **Disturbance source: reducer**

Inlet

 $L \geq 10 D$ 

Outlet

 $L \geq 5 D$ 

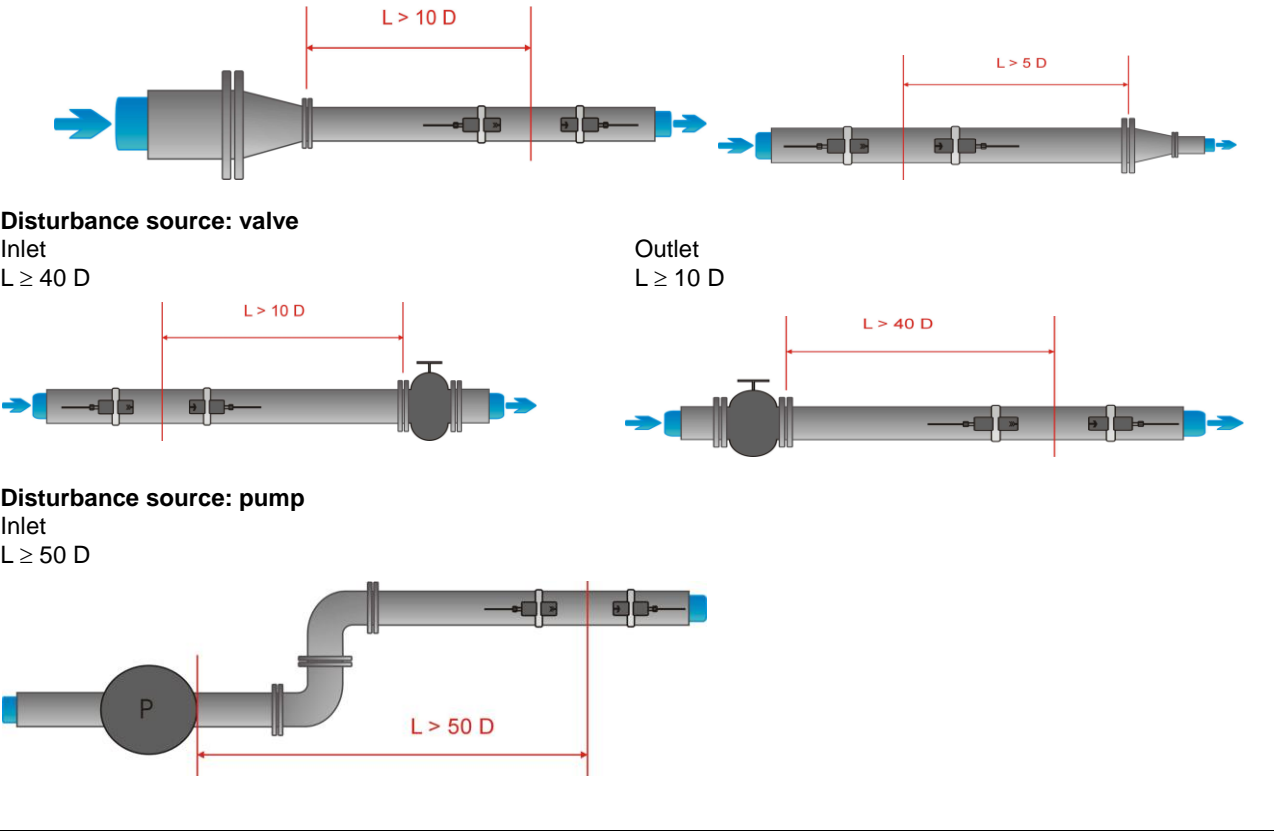


Table 2: Recommended distances from disturbance sources

3.4 Pipe preparation



- Clean dirt and dust from around the area of the pipework where the sensors are to be placed.
- Remove loose paint and rust with a wire brush or file.

Firmly bonded paint does not necessarily need to be removed provided the flowmeter diagnostics indicate sufficient signal strength.

3.5 Clamp-on sensor mounting configurations and separation distance

Reflection Mode

The most common clamp-on sensor mounting configuration is the Reflection Mode, sometimes known as V-Mode (see Illustration 3, sketch (1)). Here, the ultrasonic signal passes twice through the medium (2 signal passes). The Reflection Mode is the most convenient mounting method as the transducer separation distance can be measured easily and the sensors can be accurately aligned. This method should be used whenever possible.

Diagonal Mode

An alternative mounting configuration (Illustration 3, sketch (3)) is the Diagonal mode (Z-Mode). The signals travel only once through the pipe. This method is often used for larger pipes where greater signal attenuation might occur.

Further variation of the Reflection and the Diagonal Modes are possible by altering the number of passes through the pipe. Any even number of passes will require mounting the sensors on the same side of the pipe, while with an odd number of passes, the sensors must be mounted on opposite sides of the pipe. Commonly, for very small pipes, sensor mounting configurations such as 4 passes (W-mode) or 3 passes (N-mode) are used (illustration 3, sketch (2)).

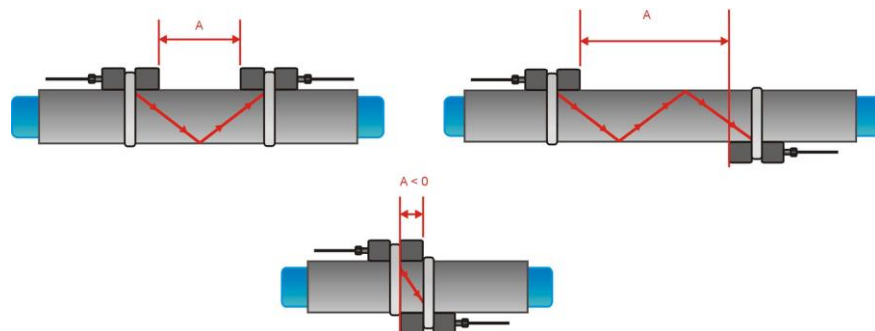


Illustration 3: Clamp-on sensor mounting configurations and sensor spacing

Transducer separation distance

The transducer separation distance A is measured from the inside edges of the sensor heads as shown in illustration 3. It is automatically calculated by the flowmeter based on the parameter entries for pipe outside diameter, wall thickness, lining material and thickness, medium, process temperature, the sensor type and the selected number of signal passes.

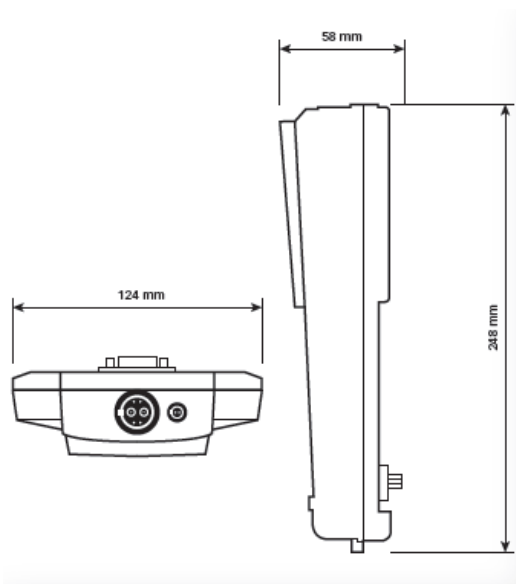
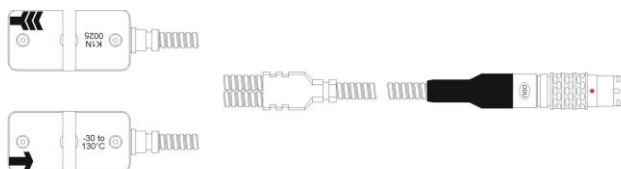
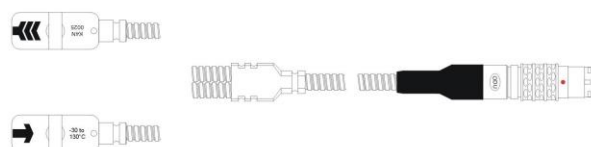


A negative separation distance $A < 0$ can occur for mounting configurations on small pipes where diagonal mode operation has been selected (see Illustration 3, sketch (3)). Negative separation distances may be suggested for reflection mode installations, but are not possible. In these cases, use diagonal mode or a larger number of passes.

3.6 Flowmeter installation

3.6.1 Outline dimensions

The IFX-P 200 is a hand-held, battery operated device with the following outline dimensions.

Flowmeter outline dimensions

K1 type transducer

K4 type transducer


3.7 Clamp-on sensor mounting

Before the sensors can be mounted

- the installation location should have been determined,
- a sensor mounting method should be chosen,
- the flowmeter batteries must be sufficiently charged,
- the sensors must be connected to the transmitter.

Depending on which sensor mounting method is being used, the clamp on sensors are either mounted on the same side of the pipe (Reflection Mode) or on opposite sides of the pipe (Diagonal Mode – See Section 2.5).

3.7.1 Sensor pipe mounting configurations

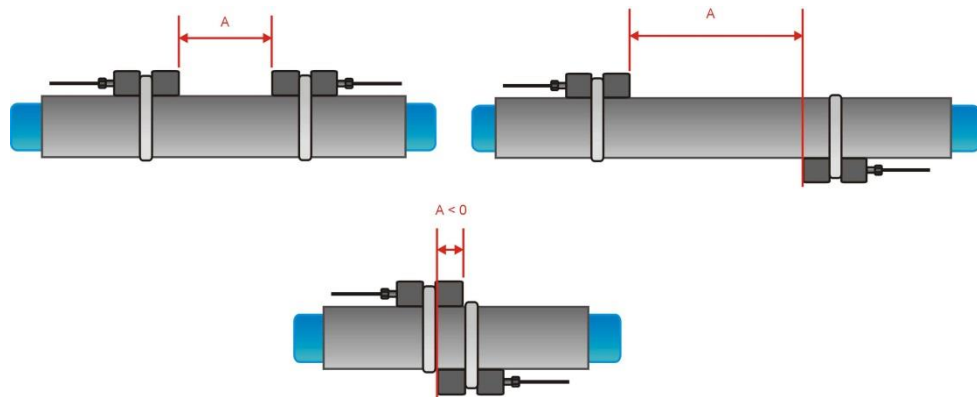


Illustration 4: Sensor pipe mounting configurations

3.7.2 Acoustic coupling gel



In order to obtain acoustical contact between the pipe and the sensors, apply a bead of acoustic coupling gel lengthwise down the centre of the contact area of the sensors.

3.7.3 Correct positioning of the sensors

Correct sensor position

Always mount the transducer pair so that the free front edges of the sensors face each other.

There is a different engraving on the top of each transducer. The transducers are mounted correctly if the engravings on the two transducers form an arrow. The transducer cables should point in opposite directions.

Later, the arrow, in conjunction with the indicated measured value, will help to determine the direction of flow.



The sensor separation distance is automatically calculated by the flowmeter based on the parameter entries for pipe outside diameter, wall thickness, lining material and thickness, medium, process temperature, the sensor type and the selected number of signal passes. The sensor positioning screen (above, and Section 3.3) allows fine adjustment of the sensor location.

3.7.4 Sensor mounting with fixtures and chains



Illustration 5: Sensor mounting with clips and chains

- Insert the retaining clip into the groove on the top of the transducer and secure it using the screw knob.
- Apply some acoustic coupling component to the contact surface of the transducer.
- Place the transducer on the side of the pipe or alternatively up to 45 degrees from the horizontal plane through the pipe.
- This is advisable to establish the best acoustic contact since on top of the pipe air pockets could develop and deposits could accumulate at the bottom of the pipe.

- Take the spring end of the chain in one hand and insert the last ball element in the vertical slot of the retaining clip. Mount the chain around the pipe.
- Pull the chain firmly around the pipe and fasten it in the lateral slot of the retaining clip. There should be no air pockets between the transducer surface and the pipe wall.
- Mount the second transducer the same way.
- Using a measuring tape, adjust the sensor separation distance as suggested by the flowmeter. When the sensor positioning screen (Section 3.3) is displayed, the middle bar allows fine adjustment of the sensor location.



Illustration 6: Sensor mounting with fixtures and chains (retaining clip)

4 Operation

4.1 Switching On/Off

The flowmeter is switched on by holding the **<ON>** key for more than 2 seconds continuously. Equally it can be switched off by pressing the **<OFF>** key for more than 2 seconds.

When switching on, the flowmeter will perform a hardware and software check, including the data logger space. Progress will be indicated by a series of dashes above and a black bar below.

4.2 Battery charging

The internal batteries can be recharged with the external battery charger supplied.

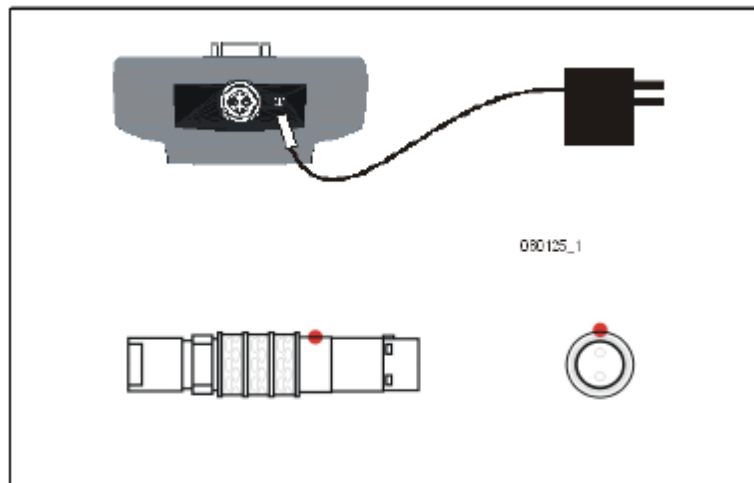


Illustration 7: Battery charging



Important : Ensure that only Nickel Metal Hydride (NiMH) AA size rechargeable batteries are installed – attempting to recharge other battery types is dangerous and may cause damage.

Connect the battery charger to the charging socket of the flowmeter and to the mains supply 100 ... 240 VAC, 50/60 Hz. The battery charger mains plug is supplied for specific countries as shown in the order code.

The red mark on the plug aligns with the mark on the socket. Remove plug by sliding the outer casing away from the socket to release the latch.


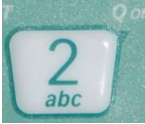




During the charging process, the battery icon will blink. For a fully charged battery all segments of the battery icon will be filled.










Battery charge level is also shown in the diagnostic displays.

4.3 Keypad and display

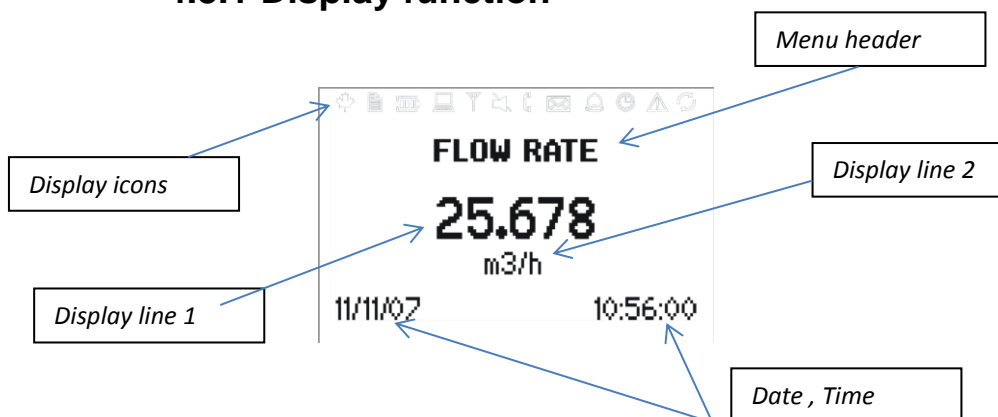













Keypad key functions


| Key | Main function | Secondary function |
|---|---|--|
|  | Character entry: 1 (1 short key stroke) , (2 short key strokes) . (3 short key strokes) _ (4 short key strokes) | Show NEXT available item |
|  | Character entry: A B C 2 / | Q_{ON} = Start / reset totaliser function |
|  | Character entry: D E F 3 ? | Show next DISP lay |
|  | Character entry: G H I 4 < | Q₋ = Reset negative total value |
|  | Character entry: J K L 5 > | |
|  | Character entry: M N O 6 \$ | Q₊ = Reset positive total value |

| | | |
|---|--|---|
|  | Character entry: P Q R S 7 | Toggle MultipleXer (where multi-channel functions are provided) |
|  | Character entry: T U V 8 * | Q_{OFF} = Stop totaliser function |
|  | Character entry: W X Y Z 9 | DIRECT access to trend plot |
|  | Move menu/list selection item UP | Character backspace clear |
|  | Character entry: . (decimal point) | Switch LCD backlight on/off |
|  | Character entry: 0 Space character + = # | |
|  | Move menu/list selection item DOWN | Character entry : - (minus sign) |
|  | ESC ape menu item | Abort entry without saving Switches the instrument OFF if pressed for more than 2 s |
|  | ENTER menu item | Confirm entry with saving Switches the instrument ON if pressed for more than 2 s |

4.3.1 Display function



| Display icon | Function |
|---|--|
|  | On Off Icon not used |
|  | On Datalogger recording Off Datalogger switched off |
|  | On 1 segment = 33% battery power available 2 segments = 66% battery power available 3 segments = 100% battery power available Off < 5% battery power available Outline blinking Battery charging |
|  | On LCD backlight switched on Off LCD backlight switched off |
|  | On Off Not used on KF200 |
|  | On Speaker on Off Speaker off |
|  | On Coupling error Off Sensor operating correctly |
|  | On Off Icon not used |
|  | On Off Icon not used |
|  | On Time/date set Off Clock error |
|  | On Error recorded in error log Off No error detected |


| | |
|---|--|
|  | On Serial output RS 232 switched on Off Serial output RS 232 switched off |
| "L", "LT" or "T" | Displays whether flow is laminar, turbulent or mixed |

4.4 Quick setup wizard

The quick setup wizard allows for a speedy setup of the most important parameters in order to achieve successful measurements in the shortest possible time:

| Display screen | Operation |
|--|--|
| <p style="text-align: center;">MAIN MENU</p> <div style="border: 1px solid black; padding: 5px;"> <p>Quick start</p> <p>Installation</p> <p>Output</p> <p>System</p> </div> | <p>The main menu is displayed after first power on and the boot-up sequence.</p> <p>Use <UP> and <DOWN> cursor keys to select Quick start. Confirm by pressing <ENTER>.</p> |
| <p style="text-align: center;">QUICK START</p> <div style="border: 1px solid black; padding: 5px;"> <p>Setup Wizard</p> <p>Stored Setup</p> <p>Start Measurement</p> </div> | <p>Use cursor keys to select Setup Wizard. Confirm by pressing <ENTER>.</p> <p>If sensors are recognised, the serial number will be shown. If not recognised or not connected, they may be selected from a list.</p> |
| <p style="text-align: center;">MIDDLE UNITS</p> <div style="border: 1px solid black; padding: 5px;"> <p>m³/h</p> <p>m³/m</p> <p>m³/s</p> </div> | <p>Select units of measurement using cursor keys and pressing <ENTER>.</p> |
| <p style="text-align: center;">PIPE MATERIAL</p> <div style="border: 1px solid black; padding: 5px;"> <p>Stainless Steel</p> <p>Carbon Steel</p> <p>Ductile cast iron</p> </div> | <p>Choose pipe material using cursor keys and pressing <ENTER>.</p> |
| <p style="text-align: center;">OUTSIDE DIAMETER</p> <p style="text-align: center; font-size: 2em;">76.1</p> <p style="text-align: center;">mm</p> | <p>Enter outside pipe diameter using alphanumeric keys and confirm by pressing <ENTER>.</p> <p>Use key <UP> as character backspace clear to correct for data entry errors.</p> |

| | |
|---|---|
| <p>WALL THICKNESS</p> <p>3.4 mm</p> | <p>Enter pipe wall thickness using alphanumerical keys and confirm by pressing <ENTER>.</p> <p>Use key <UP> as character backspace clear to correct for data entry errors.</p> |
| <p>FLUID</p> <div data-bbox="472 535 903 663"> <div>Water</div> <div>Saltwater</div> <div>Acetone</div> </div> | <p>Select fluid using cursor keys.</p> <p>Confirm by pressing <ENTER>.</p> |
| <p>TEMPERATURE</p> <p>20.0 C</p> | <p>Enter process temperature using alphanumerical keys and confirm by pressing <ENTER>.</p> <p>Use key <UP> as character backspace clear to correct for data entry errors.</p> |
| <p>LINER MATERIAL</p> <div data-bbox="472 1066 903 1193"> <div>None</div> <div>Epoxy</div> <div>Rubber</div> </div> | <p>Select pipe lining material using cursor keys.</p> <p>Confirm by pressing <ENTER>.</p> |
| <p>PASSES</p> <div data-bbox="472 1352 903 1480"> <div>Auto</div> <div>1</div> <div>2</div> </div> | <p>Select transducer configuration (number of passes) using cursor keys.</p> <p>Auto Automatically 1 1 pass, diagonal mode 2 2 passes, reflection mode 3 3 passes, diagonal mode 4 4 passes, reflection mode 5 5 passes, diagonal mode 6 6 passes, reflection mode ..etc.</p> <p>Confirm by pressing <ENTER>.</p> |
| <p>QUICK START</p> <div data-bbox="472 1704 903 1861"> <div>Setup Wizard</div> <div>Stored Setup</div> <div>Start Measurement</div> </div> | <p>Use cursor keys to select Start Measurement. Confirm by pressing <ENTER>.</p> |

| | |
|--|---|
| <p>CHNL1 SENSOR Spacing 110.5 mm Using 2 passes Signal 26 dB</p>  | <p>Sensor placement screen: Mount transducers with suggested spacing and use middle bar for fine adjustment of position (central position is desired). Observe signal-to-noise (upper bar) and quality (lower bar). These should be of identical length.</p> <p>Confirm by pressing <ENTER> to obtain measurements.</p> <p>Note : Numbers shown are for indication only.</p> |
| <p>CHNL-1 25.678 m³/h</p> <p>11/11/07 10:56:00</p> | <p>Success!</p> |

4.5 Measurements

4.5.1 Main process value (PV) display

Measurements are started using **Start Measurement** in the Quick Start Wizard.

| Display screen | Operation |
|---|--|
| <p>FLOW RATE 25.678 m³/h</p> <p>11/11/07 10:56:00</p> | <p>The main process value can be changed in the "Quick Start" or "Installation" menus.</p> <p>Press <ESC> at any time to return to the main menu.</p> <p>View totalizers by pressing <NEXT>.</p> <p>Change to the Diagnostic display by pressing <DISP>.</p> |

3-line display format

| Display screen | Operation |
|---|---|
| <p>CHNL-1 - 0.0 m³ 25.678 m³/h 1.370 m/s</p> <p>11/11/07 10:56:00</p> | <p>The three-line display screen is configurable to show flow, totalizers and diagnostic functions.</p> <p>Change to diagnostic displays by pressing <DISP> and to totalizer screens by pressing <NEXT>.</p> <p>Cycle through display screens using <NEXT>.</p> |

4.5.2 Diagnostic displays

| Display screen | Operation |
|--|---|
| DIAGNOSTIC 1 55.2 Gain 20.5 Signal -10.0 Noise 11/11/07 10:56:00 | Line 1 shows the amplifier gain. Line 2 displays the signal strength. Line 3 indicates the noise. Change to more diagnostic displays by pressing <NEXT> . Refer to Customer Support for the meanings of each diagnostic screen |

4.5.3 Totalisers

The totaliser displays will only be shown when the totalisers are activated.

| Display screen | Operation |
|---|--|
| TOTALISER -1 - 0.0 m3 0.0 + - 0.0 - 11/11/07 10:56:00 | The flow totaliser can be started or reset by pressing <QON> when a volume measurement is selected as one of the displayed units. Totalizer screens are viewed by pressing <NEXT> from the measurement screen. When top and bottom display lines are set to a volume measurement, the first totalizer screen displays cumulative totals and the second screen shows separate positive and negative totals. Pressing <NEXT> again will return to the main measurement screen. Pressing <Q+> resets the total accumulated flow in the positive flow direction. Pressing <Q-> resets the total accumulated flow in the negative flow direction. The totalisers can be stopped by pressing <QOFF> . Pressing <QON> again will reset to zero. Change to other displays or revert to the totalizer screen without resetting by pressing <DISP> or <NEXT> . |



4.5.4 Datalogger

The datalogger is enabled from the Main Menu, and operates when a non-zero value is entered for the interval.

Items to be logged are selected from the "Selection" screen. "ENTER" selects items, "0" deselects. Up to ten items may be selected.

(Note : If no items are selected the logger will record blank space)

Send logger by serial port to a terminal program by selecting "Log download".

Clear the logger by selecting "Log Erase".

Remaining logger space can be seen in the Diagnostic displays.

Logged data can be downloaded, viewed and exported using the Isoflux+ software except when "wrap" mode has been enabled.

5 Commissioning

5.1 Menu structure

| Main menu | Menu level 1 | Menu level 2 | Description/settings |
|-------------|--------------|----------------------------------|--|
| Quick Start | | | |
| | Setup Wizard | | |
| | | Sensor type | Indication of sensor type and serial number if automatically detected, otherwise select from list ↑↓ K1N,K1L,K1E,, K4N,K4L,K4E,, |
| | | Middle (main displayed) Units | Select from list where available ↑↓ m/s, f/s, in/s, m3/h, m3/min, m3/s, l/h, l/min, l/s, USgal/h, USgal/min, USgal/s, bbl/d, bbl/h, bbl/min, g/s, t/h, kg/h, kg/min, m3, l, USgal, bbl, g, t, kg, W, kW, MW, J, kJ, MJ, Signal dB, noise dB, SNR (dB), C m/s (sound speed), CU (housing temperature), K (correction factor), REY (Reynolds number), SOS, DEN, KIN, SHC (sound speed, density, kinematic viscosity, Specific Heat Capacity from inputs/calculation), TEMP (specified or measured fluid temperature), PRESS (specified or measured fluid pressure), Tin, Tout (inlet and outlet temperature) Other (Assignable input or calculated value), Math (Calculated value – see below). |
| | | Pipe material | Select from list ↑↓ Stainless steel, Carbon steel, Ductile cast iron, Grey cast iron, Copper, Lead, PVC, PP, PE, ABS, Glass, Cement, User (pipe c-speed) |
| | | Pipe c-speed | Only if user pipe material selected 500 ... 5000 m/s |
| | | Outside diameter | 10 ... 3000 mm |
| | | Wall thickness | 0.5 ... 75 mm |
| | | Fluid | Select from list ↑↓ Water, Salt water, Acetone, Alcohol, Ammonia Carbon Tet (carbon tetrachloride), Ethanol, Ethyl alcohol, Ethyl ether, Ethylene glycol, Glycol/water 50%, Kerosene, Methanol, Methyl alcohol Milk, Naphtha, Car oil, Freon R134a, Freon R22 Hydrochloric acid, Sour cream, Sulphuric acid Toluene, Vinyl chloride User (kinematic viscosity, density, medium c-speed) |
| | | Kinematic viscosity | Only if user fluid selected 0 ... 30000 mm ² /s |
| | | Density | Only if user fluid selected 100 ... 2000 kg/m ³ |
| | | Medium c-speed | Only if user fluid selected 800 ... 3500 m/s |
| | | Temperature | -30 ... 300 °C |
| | | Liner Material | Select from list ↑↓ None, Epoxy, Rubber, PVDF, PP, Glass, Cement, User (liner c-speed) |
| | | Liner c-speed | Only if lining material selected 500 ... 5000 m/s |
| | | Liner thickness | Only if lining material selected 1.0 ... 99.0 mm |

| | | | |
|---------------------|--------------------------|-------------------------|---|
| | | Passes | Select from list ↑↓ Auto, 1...16 |
| | Stored Setup | | Load, Save or Delete stored sets of parameters. (Names for different measurement points can be entered on "Save" using the keypad) |
| | Start Measurement | | |
| | | Sensor type | Indication of sensor type and serial number if automatically detected, otherwise select from list ↑↓ (see above) |
| | | SP 1 - Sensor frequency | Only for special, unrecognised sensors 5 ... 80 |
| | | SP 2 - Wedge angle | Only for special, unrecognised sensors |
| | | SP3 – Wedge c-speed | Only for special, unrecognised sensors |
| | | SP4 - Crystal offset | Only for special, unrecognised sensors |
| | | SP5 - Spacing offset | Only for special, unrecognised sensors |
| | | SP6 - Zero flow offset | Only for special, unrecognised sensors |
| | | SP7 - Up-stream offset | Only for special, unrecognised sensors |
| | Sensor placement | | |
| Installation | | | |
| | Pipe | | |
| | | Material | Select from pipe material list |
| | | Outside diameter | 6 ... 6500 mm |
| | | Wall thickness | 0.5 ... 75 mm |
| | | Pipe c-speed | 600 ... 6554 m/s (transverse sound speed) |
| | | Pipe l-speed | 600 ... 8000 m/s (longitudinal sound speed) |
| | | Pipe circumference | 18.8 ... 20420 mm |
| | | Roughness | 0.0 ... 10 mm |
| | Medium | | |
| | | Fluid | Select from fluid list |
| | | Kinematic viscosity | 0 ... 30000 mm ² /s |
| | | Density | 100 ... 2000 kg/m ³ |
| | | C-speed | 800 ... 3500 m/s |
| | | Temperature | -30 ... 300 °C |
| | Lining | | |
| | | Material | Select from material list |
| | | Thickness | 0.1 ... 99.9 mm |
| | | C-speed | 500 ... 5000 m/s |
| | Passes | | Select from list |
| Output | | | |

| | | | |
|---------------|---------------------------------|-------------------|--|
| | Display | | |
| | | Top Line | <i>Units (Select from list ↑↓)</i> |
| | | Middle Line | <i>Units (Select from list ↑↓)</i> |
| | | Bottom Line | <i>Units (Select from list ↑↓)</i> |
| | | Damping | <i>Reduces fluctuations in the display output. 1 ... 255 s</i> |
| | Datalogger | | |
| | | Interval | 0 ... 999 s |
| | | Selection | From list. <ENTER> selects, <0> deselects. Up to ten variables may be logged. |
| | | Low memory | <i>Warning output 0 ... 100 %</i> |
| | | Log Wrap | <i>Saves "selected" items as a continuous stream without headers (Note : this means files cannot be processed by Isoflux+) Yes/No</i> |
| | | Log download | <i>Sends all log data using RS232 serial port</i> |
| | | Log erase | <i>Clears the logger</i> |
| | Serial communication | | |
| | | Mode | <i>Select from list ↑↓ None Printer (output every second of selected values) Diagnostic Download (send logger data using RS232) Cal Test (laboratory calibration, not recommended for field or customer use)</i> |
| | | Baud | <i>Select from list ↑↓ 9600 (Default) 19200, 57600, 115200</i> |
| | | Parity | <i>Select from list ↑↓ None Even (Default) Odd</i> |
| System | | | |
| | Instrument info | | |
| | | Model code | IFX-P200 |
| | | Serial number | <i>Example: 20000003</i> |
| | | HW revision | <i>Example: 2.0, 1.5</i> |
| | | SW revision | <i>Example: 3.2, 3.1</i> |
| | Calculation | | |
| | | Low flow cut off | 0 ... 0.10 m/s |
| | | Max. flow cut off | 0 ... 30 m/s |
| | | Corrected | Yes (flow profile correction) No |
| | | PV offset | -30 ... 30 units |
| | | PV scaling | 0 ... 1000 units |
| | | Zero calibration | Adjust : Zero (Yes/No) : Sets current flow as zero Track (Yes/No) : Zero follows output variations Delta time : Zero flow offset in ns Time up : Upstream offset in ns |
| | User | | |
| | | Identifier | <i>Example: Pump P3A</i> |
| | | Tag number | <i>Example: 1FT-3011</i> |

| | Test | | |
|--------------------|------------------------------------|--------------|--|
| | | Test Modes | Tests integrity of device and features. "Installation" simulates a rising flow rate. |
| | Settings | | |
| | | Date | <i>Example:</i> 03/10/2007 |
| | | Time | <i>Example:</i> 09:27:00 |
| | | Date format | Select from list ↑↓ dd/mm/yy mm/dd/yy yy/mm/dd |
| | | Language | Select from list ↑↓ (as available) English, Italian, Spanish |
| | | Keypad sound | Yes No |
| | | Battery | Low warning : Yes / No Auto off timer 1 ... 59 min |
| | Defaults (Load defaults) | | Yes No |
| Diagnostics | | | |
| | | | Shows measured temperature, available logger memory, battery charge level, battery voltage (Cycle using <ENTER>) |
| Scope | | | |
| | | | Displays the received acoustic pulse (see 5.7) |

5.2 Diagnostics

Diagnostic screens can be viewed directly during measurement or through the menu structure.

5.3 Display settings

Customer specific settings for data to be displayed can be achieved by using the appropriate menu items.

5.3.1 Main PV

The main Process Value (PV) is the primary measurement data.

5.4 Output settings

5.4.1 Serial interface RS 232

The RS 232 serial interface can be used to transmit data on-line or to download the integral datalogger content. The settings can be found in the **Serial Communication** submenu .

5.5 ISOFLUX+ download software

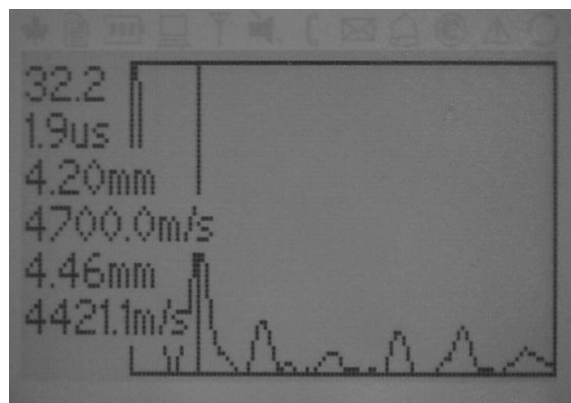
Software can be provided for downloading the contents of the datalogger and communication with the flowmeter.

5.6 Wall thickness measurement (WTM)

Optional sensor probes to measure pipe wall thickness are available. The IFX-P200 will recognise a connected probe when entering the Setup or WTG Wizards, the measurement mode or the Scope function. Use the Setup Wizard or Installation menu to set the pipe material. Select "Start Measurement". The IFX-P200 will recognise the probe and display the measurement screen. Wall thickness will be shown when the sensor is in good acoustic contact with the pipe.

5.6.1 Wall Thickness Gauge (WTG) Wizard

To confirm pipe thickness and sound speed, select the "WTG Wizard" from the "Quick Start" menu. Enter the approximate expected thickness as "Reference THK" and select "Calibrate".

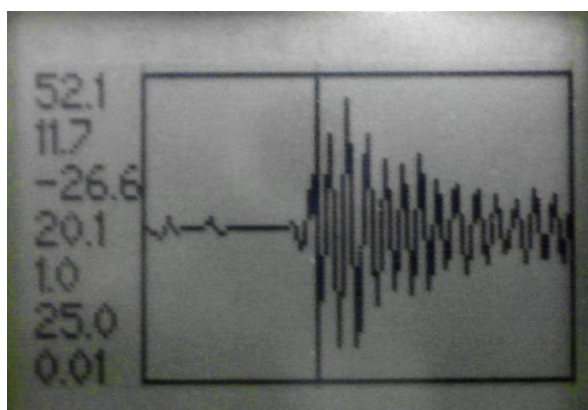


The screen displays the received acoustic pulse and values for the signal strength, the transit time, the reference thickness, the expected sound speed, the measured thickness at the reference sound speed and the measured sound speed at the reference thickness (top to bottom).

On leaving this screen using the <ESC> key, the flowmeter will ask if you wish to store the recorded value of longitudinal sound speed ("L-Speed" in the Pipe Menu).

5.7 Scope function

ISOFLUX flowmeters have an additional scope function which shows a representation of the pulse received by the sensors.



In addition to displaying the received pulse, this screen lists the following data (from top to bottom) :

| |
|--|
| Gain (dB) |
| Signal (dB) |
| Noise (dB) |
| Transit time (us) |
| Delta (ns) - [time downstream minus time upstream] |
| Control unit temperature (degC) |
| Flow (m/s) |

6 Maintenance

ISOFLUX flowmeters are maintenance free concerning the flow measurement functions. Within the scope of periodic inspections, regular inspection for signs of damage or corrosion is recommended for the transducers, the junction box if installed, and the flowmeter housing.

6.1 Service/Repair

ISOFLUX flowmeters have been carefully manufactured and tested. If installed and operated in accordance with the operating instructions, no problems are usually experienced.

Should you nevertheless need to return a device for inspection or repair, please pay attention to the following points:



- Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, Isoil may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.
- This means that Isoil can only service this device if it is accompanied by a Return Authorization Number (RAN) confirming that the device is safe to handle.

If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:



- to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,
- to enclose a certificate with the device confirming that is safe to handle and stating the product used.

7 Troubleshooting

Most problems with measurement are due to poor signal strength or quality. Initial checks should include :



- Has sufficient acoustic coupling paste been applied?
- Can the number of sound passes be changed? As a general rule, more passes will improve accuracy, fewer passes will give better signal strength.
- Are there any nearby sources of noise or disturbance?
- Can the signal be improved by moving the sensors around the circumference of the pipe?
- Are the application parameters correct?

Should there be the need to call customer service, please let us know the following details:

- Model code
- Serial number
- SW, HW revision
- Error log list

Possible error messages may include the following:

Error list

| Error message | Group | Description | Error handling |
|---------------------|----------|------------------------------------|--|
| USB INIT FAIL | Hardware | Internal board communication error | Power on/off, otherwise call customer support |
| NO SERIAL NO. | Hardware | Failed to read from FRAM | Call customer support |
| NO VERSION NO. | Hardware | Failed to read from FRAM | Call customer support |
| PARA READ FAIL | Hardware | Failed to read from FRAM | Load defaults, otherwise call customer support |
| PARA WRITE FAIL | Hardware | Failed to write to FRAM | Load defaults, otherwise call customer support |
| VAR READ FAIL | Hardware | Failed to read from FRAM | Call customer support |
| VAR WRITE FAIL | Hardware | Failed to write to FRAM | Call customer support |
| SYSTEM ERROR | Hardware | | Call customer support |
| VISIBILITY ERR | Hardware | Failed to read from FRAM | Call customer support |
| FRAM LONG WRITE ERR | Hardware | Failed to write to FRAM | Call customer support |
| FRAM READ ERR | Hardware | Failed to read from FRAM | Call customer support |
| RTC ERR | Hardware | Real Time Clock failure | Power on/off, otherwise call customer support |
| EXTMEM ERR | Hardware | Logger memory failure | Power on/off, otherwise call customer support |
| SPI ERR | Hardware | SPI bus failure | Power on/off, otherwise call customer support |
| I2C ERR | Hardware | I2C bus failure | Power on/off, otherwise call customer support |
| MATH ERR | Software | Internal calculation error | Call customer support |
| STACK ERR | Software | Internal calculation error | Call customer support |
| ADDR ERR | Software | Internal calculation error | Call customer support |
| OSC ERR | Software | Internal calculation error | Call customer support |
| ADC ERR | Software | Internal calculation error | Call customer support |

...continued

| Error message | Group | Description | Error handling |
|-------------------|----------|------------------------------|---|
| IO ERR | Software | Internal calculation error | Call customer support |
| TIMING ERR | Software | Internal calculation error | Call customer support |
| COMM INIT ERR | Hardware | Internal communication error | Power on/off, otherwise call customer support |
| COMM START ERR | Hardware | Internal communication error | Power on/off, otherwise call customer support |
| COMM HS0 ERR | Hardware | Internal communication error | Power on/off, otherwise call customer support |
| COMM HS1 ERR | Hardware | Internal communication error | Power on/off, otherwise call customer support |
| COMM READ AVE ERR | Hardware | Internal communication error | Power on/off, otherwise call customer support |
| COMM READ RAW ERR | Hardware | Internal communication error | Power on/off, otherwise call customer support |
| COMM READ HIS- | Hardware | Internal communication | Power on/off, otherwise |

| Error message | Group | Description | Error handling |
|---------------------|-------------|-------------------------------|---|
| TORY ERR | | error | call customer support |
| COMM CRC ERR | Hardware | Internal communication error | Power on/off, otherwise call customer support |
| SENSOR COUPLING ERR | Application | Weak sensor coupling, low SNR | Recouple sensors, check installation, reduce number of passes, look for other location, otherwise call customer support |

Table 3: Error messages

7.1 Data download difficulties

If difficulties are encountered downloading the logger data : -

- Check that the flowmeter is switched on and not in measurement mode.
- Check that the same number COM port is allocated in the "Device Manager" (or equivalent) as is set in the Isoflux+ software.
- Check that the settings (baud, parity, word length, stop bits) are identical.
- Use the supplied connectors – whether connecting to a 9-pin COM port or converting from serial communication to a Universal Serial Bus (USB).
- Is the logger in "Wrap" mode? If "yes", use a terminal program and the "Log download" command. If "No", Isoflux+ software may also be used.

8 Technical data

| Material | Sound Speed* Shear Wave (at 25 °C) | |
|------------------------------|------------------------------------|--------|
| | m/s | ft/s |
| Steel, 1% Carbon, hardened | 3,150 | 10,335 |
| Carbon Steel | 3,230 | 10,598 |
| Mild Steel | 3,235 | 10,614 |
| Steel, 1% Carbon | 3,220 | 10,565 |
| 302 Stainless Steel | 3,120 | 10,236 |
| 303 Stainless Steel | 3,120 | 10,236 |
| 304 Stainless Steel | 3,141 | 10,306 |
| 304L Stainless Steel | 3,070 | 10,073 |
| 316 Stainless Steel | 3,272 | 10,735 |
| 347 Stainless Steel | 3,095 | 10,512 |
| "Duplex" stainless steel | 2,791 | 9,479 |
| Aluminium | 3,100 | 10,171 |
| Aluminium (rolled) | 3,040 | 9,974 |
| Copper | 2,260 | 7,415 |
| Copper (annealed) | 2,325 | 7,628 |
| Copper (rolled) | 2,270 | 7,448 |
| CuNi (70%Cu 30%Ni) | 2,540 | 8,334 |
| CuNi (90%Cu 10%Ni) | 2,060 | 6,759 |
| Brass (Naval) | 2,120 | 6,923 |
| Gold (hard-drawn) | 1,200 | 3,937 |
| Inconel | 3,020 | 9,909 |
| Iron (electrolytic) | 3,240 | 10,630 |
| Iron (Armco) | 3,240 | 10,630 |
| Ductile Iron | 3,000 | 9,843 |
| Cast Iron | 2,500 | 8,203 |
| Monel | 2,720 | 8,924 |
| Nickel | 2,960 | 9,712 |
| Tin (rolled) | 1,670 | 5,479 |
| Titanium | 3,125 | 10,253 |
| Tungsten (annealed) | 2,890 | 9,482 |
| Tungsten (drawn) | 2,640 | 8,661 |
| Tungsten carbide | 3,980 | 13,058 |
| Zinc (rolled) | 2,440 | 8,005 |
| Glass (pyrex) | 3,280 | 10,761 |
| Glass (heavy silicate flint) | 2,380 | 7,808 |
| Glass (light borate crown) | 2,840 | 9,318 |
| Nylon | 1,150 | 3,772 |
| Nylon, 6-6 | 1,070 | 3,510 |
| Polyethylene (LD) | 540 | 1,772 |
| PVC, CPVC | 1,060 | 3,477 |
| Acrylic resin | 1,430 | 4,690 |
| PTFE | 2,200 | 7,218 |

* Please note these values are to be considered nominal. Solids may be inhomogeneous and anisotropic. Actual values depend on exact composition, temperature, and to a lesser extent, on pressure and stress.

All data given at 25 °C (77 °F) unless otherwise stated

| Substance | Chemical Formula | Specific Gravity | Sound Speed | | Change v/°C | Viscosity (Kinematic) | |
|------------------------------------|---|------------------|----------------|-----------------------|-------------|-----------------------|--------------------------|
| | | | m/s | ft/s | m/s/°C | mm ² /s | x10-6 ft ² /s |
| Acetic anhydride | (CH ₃ CO) ₂ O | 1.082 (20 °C) | 1,180 | 3,871.4 | 2.5 | 0.769 | 8.274 |
| Acetic acid, anhydride | (CH ₃ CO) ₂ O | 1.082 (20 °C) | 1,180 | 3,871.4 | 2.5 | 0.769 | 8.274 |
| Acetic acid, nitrile | C ₂ H ₃ N | 0.783 | 1,290 | 4,232.3 | 4.1 | 0.441 | 4.745 |
| Acetic acid, ethyl ester | C ₄ H ₈ O ₂ | 0.901 | 1,085 | 3,559.7 | 4.4 | 0.467 | 5.025 |
| Acetic acid, methyl ester | C ₃ H ₆ O ₂ | 0.934 | 1,211 | 3,973.1 | | 0.407 | 4.379 |
| Acetone | C ₃ H ₆ O | 0.791 | 1,174 | 3,851.7 | 4.5 | 0.399 | 4.293 |
| Acetylene dichloride | C ₂ H ₂ Cl ₂ | 1.26 | 1,015 | 3,330.1 | 3.8 | 0.400 | 4.304 |
| Acetylene tetrachloride | C ₂ H ₂ Cl ₄ | 1.595 | 1,147 | 3,763.1 | | 1.156 (15°C) | 12.44 (15°C) |
| Alcohol | C ₂ H ₆ O | 0.789 | 1,207 | 3,960.0 | 4.0 | 1.396 | 15.02 |
| Ammonia | NH ₃ | 0.771 | 1,729 (33 °C) | (- 5,672.6 (-27 °C)) | 6.68 | 0.292 (-33 °C) | 3.141 (-27 °F) |
| Benzene | C ₆ H ₆ | 0.879 | 1,306 | 4,284.8 | 4.65 | 0.711 | 7.65 |
| Benzol | C ₆ H ₆ | 0.879 | 1,306 | 4,284.8 | 4.65 | 0.711 | 7.65 |
| Bromine | Br ₂ | 2.928 | 889 | 2,916.7 | 3.0 | 0.323 | 3.475 |
| n-Butane(2) | C ₄ H ₁₀ | 0.601 (0°C) | 1,085 (5° C) | (- 3,559.7 (23 °C)) | 5.8 | | |
| 2-Butanol | C ₄ H ₁₀ O | 0.81 | 1,240 | 4,068.2 | 3.3 | 3.239 | 34.851 |
| sec-Butylalcohol | C ₄ H ₁₀ O | 0.81 | 1,240 | 4,068.2 | 3.3 | 3.239 | 34.851 |
| n-Butyl bromide (46) | C ₄ H ₉ Br | 1.276 (20°C) | 1,019 (20°C) | 3,343.2 (68°F) | | 0.49 (15°C) | 5.272 (59°C) |
| n-Butyl chloride (22,46) | C ₄ H ₉ Cl | 0.887 | 1,140 | 3,740.2 | 4.57 | 0.529 (15°C) | 5.692 (59°F) |
| Carbon tetrachloride | CCl ₄ | 1.595 (20°C) | 926 | 3038.1 | 2.48 | 0.607 | 6.531 |
| Carbon tetrafluoride (Freon 14) | CF ₄ | 1.75 (-150 °C) | 875.2 (150 °C) | (- 2,871.5 (-238 °F)) | 6.61 | | |
| Chloroform | CHCl ₃ | 1.489 | 979 | 3,211.9 | 3.4 | 0.55 | 5.918 |
| Dichlorodifluoromethane (Freon 12) | CCl ₂ F ₂ | 1.516 (40 °C) | 774.1 | 2,539.7 | 4.24 | | |
| Ethanol | C ₂ H ₆ O | 0.789 | 1,207 | 3,960 | 4.0 | 1.39 | 14.956 |
| Ethyl acetate | C ₄ H ₈ O ₂ | 0.901 | 1,085 | 3,559.7 | 4.4 | 0.489 | 5.263 |
| Ethyl alcohol | C ₂ H ₆ O | 0.789 | 1,207 | 3,960 | 4.0 | 1.396 | 15.020 |
| Ethyl benzene | C ₈ H ₁₀ | 0.867 (20 °C) | 1,338 (20 °C) | 4,389.8 (68 °F) | | 0.797 (17 °C) | 8.575 (63 °F) |
| Ether | C ₄ H ₁₀ O | 0.713 | 985 | 3231.6 | 4.87 | 0.311 | 3.346 |
| Ethyl ether | C ₄ H ₁₀ O | 0.713 | 985 | 3231.6 | 4.87 | 0.311 | 3.346 |
| Ethylene bromide | C ₂ H ₄ Br ₂ | 2.18 | 995 | 3264.4 | | 0.79 | 8.5 |
| Ethylene chloride | C ₂ H ₄ Cl ₂ | 1.253 | 1,193 | 3,914 | | 0.61 | 6.563 |
| Ethylene glycol | C ₂ H ₆ O ₂ | 1.113 | 1,658 | 5439.6 | 2.1 | 17,208 (20°C) | 185.158 (68°F) |
| Fluorine | F | 0.545 (-143 °C) | 403 (-143 °C) | (- 1322.2 (-225 °F)) | 11.31 | | |
| Formaldehyde, methyl ester | C ₂ H ₄ O ₂ | 0.974 | 1,127 | 3697.5 | 4.02 | | |
| Freon R12 | | | 774.2 | 2540 | | | |
| Glycol | C ₂ H ₆ O ₂ | 1.113 | 1658 | 5439.6 | 2.1 | | |
| 50% Glycol/50% H ₂ O | | | 1,578 | 5,177 | | | |
| Isopropanol | C ₃ H ₈ O | 0.785 (20 °C) | 1,170 (20 °C) | 3,838.6 (68 °F) | | 2.718 | 29.245 |
| Isopropyl alcohol (46) | C ₃ H ₈ O | 0.785 (20 °C) | 1,170 | 3,838.6 | | 2.718 | 29.245 |

| | | | (20 °C) | (68 °F) | | | |
|--------------------------|--|-----------------|------------------|-------------------|-------|-----------------|-----------------|
| Kerosene | | 0.81 | 1,324 | 4,343.8 | 3.6 | | |
| Methane | CH ₄ | 0.162 (-89 °C) | 405 (-89 °C) | 1,328.7 (-128 °F) | 17.5 | | |
| Methanol | CH ₄ O | 0.791 (20 °C) | 1,076 | 3,530.2 | 292 | 0.695 | 7.478 |
| Methyl acetate | C ₃ H ₆ O ₂ | 0.934 | 1,211 | 3,973.1 | | 0.407 | 4.379 |
| Methyl alcohol | CH ₄ O | 0.791 | 1,076 | 3,530.2 | 292 | 0.695 | 7.478 |
| Methyl benzene | C ₇ H ₈ | 0.867 | 1,328 (20 °C) | 4,357 (68 °F) | 4.27 | 0.644 | 7.144 |
| Milk, homogenized | | | 1,548 | 5,080 | | | |
| Naphtha | | 0.76 | 1,225 | 4,019 | | | |
| Natural Gas | | 0.316 (-103 °C) | 753 (-103 °C) | 2,470.5 (-153 °F) | | | |
| Nitrogen | N ₂ | 0.808 (-199 °C) | 962 (-199 °C) | 3,156.2 (-326 °F) | | 0.217 (-199 °C) | 2.334 (-326 °F) |
| Oil, Car (SAE 20a.30) | | 1.74 | 870 | 2,854.3 | | 190 | 2,045.093 |
| Oil, Castor | C ₁₁ H ₁₀ O ₀ | 0.969 | 1,477 | 4,845.8 | 3.6 | 0.670 | 7.209 |
| Oil, Diesel | | 0.80 | 1,250 | 4,101 | | | |
| Oil, Fuel AA gravity | | 0.99 | 1,485 | 4,872 | 3.7 | | |
| Oil (Lubricating X200) | | | 1,530 | 5,019.9 | | | |
| Oil (Olive) | | 0.912 | 1,431 | 4,694.9 | 2.75 | 100 | 1,076.365 |
| Oil (Peanut) | | 0.936 | 1,458 | 4,738.5 | | | |
| Propane (-45 to -130 °C) | C ₃ H ₈ | 0.585 (-45 °C) | 1,003 (-45 °C) | 3,290.6 (-49 °F) | 5.7 | | |
| 1-Propanol | C ₃ H ₈ O | 0.78 (20 °C) | 1,222 (20 °C) | 4,009.2 (68 °F) | | | |
| 2-Propanol | C ₃ H ₈ O | 0.785 (20 °C) | 1,170 (20 °C) | 3,838.6 (68 °F) | | 2.718 | 29.245 |
| Propene | C ₃ H ₆ | 0.563 (-13 °C) | 963 (-13 °C) | 3,159.4 (9 °F) | 6.32 | | |
| n-Propyl-alcohol | C ₃ H ₈ O | 0.78 (20 °C) | 1,222 (20 °C) | 4,009.2 (68 °F) | | 2.549 | 27.427 |
| Propylene | C ₃ H ₆ | 0.563 (-13 °C) | 963 (-13 °C) | 3,159.4 (9 °F) | 6.32 | | |
| Refrigerant 11 | CCl ₃ F | 1.49 | 828.3 (0 °C) | 2,717.5 (32 °F) | 3.56 | | |
| Refrigerant 12 | CCl ₂ F ₂ | 1.516 (-40 °C) | 774.1 (-40 °C) | 2,539.7 (-40 °C) | 4.24 | | |
| Refrigerant 14 | CF ₄ | 1.75 (-150 °C) | 875.24 (-150 °C) | 2,871.6 (-268 °F) | 6.61 | | |
| Refrigerant 21 | CHCl ₂ F | 1.426 (0 °C) | 891 (0 °C) | 2,923.2 (32 °F) | 3.97 | | |
| Refrigerant 22 | CHClF ₂ | 1.491 (-69 °C) | 893.9 (50 °C) | 2,932.7 (122 °F) | 4.79 | | |
| Refrigerant 113 | CCl ₂ F-CClF ₂ | 1.563 | 783.7 (0 °C) | 2,571.2 (32 °F) | 3.44 | | |
| Refrigerant 114 | CClF ₂ -CClF ₂ | 1.455 | 665.3 (-10 °C) | 2,182.7 (14 °F) | 3.73 | | |
| Refrigerant 115 | C ₂ ClF ₅ | | 656.4 (-50 °C) | 2,153.5 (-58 °F) | 4.42 | | |
| Refrigerant C318 | C ₄ F ₈ | 1.62 (-20 °C) | 574 (-10 °C) | 1,883.2 (14 °F) | 3.88 | | |
| Sodium nitrate | NaNO ₃ | 1.884 (336 °C) | 1,763.3 (336 °C) | 5,785.1 (637 °F) | 0.74 | 1.37 (336 °C) | 14.74 (637 °F) |
| Sodium nitrite | NaNO ₂ | 1.805 (292 °C) | 1876.8 (292 °C) | 6157.5 (558 °F) | | | |
| Sulphur | S | | 1177 (250 °C) | 3861.5 (482 °F) | -1.13 | | |
| Sulphuric Acid | H ₂ SO ₄ | 1.841 | 1,257.6 | 4,126 | 1.43 | 11.16 | 120.081 |

| | | | | | | |
|-----------------------------------|---|----------------|------------------|-------------------|-------|-------------|
| Tetrachloroethane | C ₂ H ₂ Cl ₄ | 1553 (20 °C) | 1,170 (20 °C) | 3,838.6 (68 °F) | 1.19 | 12.804 |
| Tetrachloroethene | C ₂ Cl ₄ | 1.632 | 1,036 | 3,399 | | |
| Tetrachloromethane | CCl ₄ | 1.595 (20 °C) | 926 | 3,038.1 | 0.607 | 6.531 |
| Tetrafluoromethane (Freon 14) | CF ₄ | 1.75 (-150 °C) | 875.24 (-150 °C) | 2,871.5 (-283 °F) | 6.61 | |
| Toluene | C ₇ H ₈ | 0.867 (20 °C) | 1,328 (20 °C) | 4,357 (68 °F) | 4.27 | 0.644 6.929 |
| Toluol | C ₇ H ₈ | 0.866 | 1,308 | 4,291.3 | 4.2 | 0.58 6.24 |
| Trichlorofluoromethane (Freon 11) | CCl ₃ F | 1.49 | 828.3 (0 °C) | 2,717.5 (32 °F) | 3.56 | |
| Turpentine | | 0.88 | 1,255 | 4,117.5 | 1.4 | 15.064 |
| Water, distilled | H ₂ O | 0.996 | 1,498 | 4,914.7 | -2.4 | 1.00 10.76 |
| Water, heavy | D ₂ O | | 1,400 | 4,593 | | |
| Water, sea | | 1.025 | 1531 | 5023 | -2.4 | 1.00 10.76 |

| Temperature | | Sound Speed in Water | |
|-------------|------|----------------------|------|
| ° C | ° F | m/s | ft/s |
| 0 | 32.0 | 1402 | 4600 |
| 1 | 33.8 | 1407 | 4616 |
| 2 | 35.6 | 1412 | 4633 |
| 3 | 37.4 | 1417 | 4649 |
| 4 | 39.2 | 1421 | 4662 |
| 5 | 41.0 | 1426 | 4679 |
| 6 | 42.8 | 1430 | 4692 |
| 7 | 44.6 | 1434 | 4705 |
| 8 | 46.4 | 1439 | 4721 |
| 9 | 48.2 | 1443 | 4734 |
| 10 | 50.0 | 1447 | 4748 |
| 11 | 51.8 | 1451 | 4761 |
| 12 | 53.6 | 1455 | 4774 |
| 13 | 55.4 | 1458 | 4784 |
| 14 | 57.2 | 1462 | 4797 |
| 15 | 59.0 | 1465 | 4807 |
| 16 | 60.8 | 1469 | 4820 |
| 17 | 62.6 | 1472 | 4830 |
| 18 | 64.4 | 1476 | 4843 |
| 19 | 66.2 | 1479 | 4853 |
| 20 | 68.0 | 1482 | 4862 |
| 21 | 69.8 | 1485 | 4872 |
| 22 | 71.6 | 1488 | 4882 |
| 23 | 73.4 | 1491 | 4892 |
| 24 | 75.2 | 1493 | 4899 |
| 25 | 77.0 | 1496 | 4908 |
| 26 | 78.8 | 1499 | 4918 |
| 27 | 80.6 | 1501 | 4925 |
| 28 | 82.4 | 1504 | 4935 |
| 29 | 84.2 | 1506 | 4941 |
| 30 | 86.0 | 1509 | 4951 |
| 31 | 87.8 | 1511 | 4958 |
| 32 | 89.6 | 1513 | 4964 |
| 33 | 91.4 | 1515 | 4971 |
| 34 | 93.2 | 1517 | 4977 |

| | | | |
|----|-------|------|------|
| 35 | 95.0 | 1519 | 4984 |
| 36 | 96.8 | 1521 | 4984 |
| 37 | 98.6 | 1523 | 4990 |
| 38 | 100.4 | 1525 | 4997 |
| 39 | 102.2 | 1527 | 5010 |
| 40 | 104.0 | 1528 | 5013 |
| 41 | 105.8 | 1530 | 5020 |
| 42 | 107.6 | 1532 | 5026 |
| 43 | 109.4 | 1534 | 5033 |
| 44 | 111.2 | 1535 | 5036 |
| 45 | 113.0 | 1536 | 5040 |
| 46 | 114.8 | 1538 | 5046 |
| 47 | 116.6 | 1538 | 5049 |
| 48 | 118.4 | 1540 | 5053 |
| 49 | 120.2 | 1541 | 5056 |
| 50 | 122.0 | 1543 | 5063 |
| 51 | 123.8 | 1543 | 5063 |
| 52 | 125.6 | 1544 | 5066 |
| 53 | 127.4 | 1545 | 5069 |
| 54 | 129.2 | 1546 | 5072 |
| 55 | 131.0 | 1547 | 5076 |
| 56 | 132.8 | 1548 | 5079 |
| 57 | 134.6 | 1548 | 5079 |
| 58 | 136.4 | 1548 | 5079 |
| 59 | 138.2 | 1550 | 5086 |
| 60 | 140.0 | 1550 | 5086 |
| 61 | 141.8 | 1551 | 5089 |
| 62 | 143.6 | 1552 | 5092 |
| 63 | 145.4 | 1552 | 5092 |
| 64 | 147.2 | 1553 | 5092 |
| 65 | 149.0 | 1553 | 5095 |
| 66 | 150.8 | 1553 | 5095 |
| 67 | 152.6 | 1554 | 5099 |
| 68 | 154.4 | 1554 | 5099 |
| 69 | 156.2 | 1554 | 5099 |
| 70 | 158.0 | 1554 | 5099 |
| 71 | 159.8 | 1554 | 5099 |
| 72 | 161.6 | 1555 | 5102 |
| 73 | 163.4 | 1555 | 5102 |
| 74 | 165.2 | 1555 | 5102 |
| 75 | 167.0 | 1555 | 5102 |
| 76 | 167.0 | 1555 | 5102 |
| 77 | 170.6 | 1554 | 5099 |
| 78 | 172.4 | 1554 | 5099 |
| 79 | 174.2 | 1554 | 5099 |
| 80 | 176.0 | 1554 | 5099 |
| 81 | 177.8 | 1554 | 5099 |
| 82 | 179.6 | 1553 | 5095 |
| 83 | 181.4 | 1553 | 5095 |
| 84 | 183.2 | 1553 | 5095 |
| 85 | 185.0 | 1552 | 5092 |
| 86 | 186.8 | 1552 | 5092 |
| 87 | 188.6 | 1552 | 5092 |
| 88 | 190.4 | 1551 | 5089 |

| | | | |
|-----|-------|------|------|
| 89 | 192.2 | 1551 | 5089 |
| 90 | 194.0 | 1550 | 5086 |
| 91 | 195.8 | 1549 | 5082 |
| 92 | 197.6 | 1549 | 5082 |
| 93 | 199.4 | 1548 | 5079 |
| 94 | 201.2 | 1547 | 5076 |
| 95 | 203.0 | 1547 | 5076 |
| 96 | 204.8 | 1546 | 5072 |
| 97 | 206.6 | 1545 | 5069 |
| 98 | 208.4 | 1544 | 5066 |
| 99 | 210.2 | 1543 | 5063 |
| 100 | 212.0 | 1543 | 5063 |
| 104 | 220.0 | 1538 | 5046 |
| 110 | 230.0 | 1532 | 5026 |
| 116 | 240.0 | 1524 | 5000 |
| 121 | 250.0 | 1516 | 5007 |
| 127 | 260.0 | 1507 | 4944 |
| 132 | 270.0 | 1497 | 4912 |
| 138 | 280.0 | 1487 | 4879 |
| 143 | 290.0 | 1476 | 4843 |
| 149 | 300.0 | 1465 | 4807 |
| 154 | 310.0 | 1453 | 4767 |
| 160 | 320.0 | 1440 | 4725 |
| 166 | 330.0 | 1426 | 4679 |
| 171 | 340.0 | 1412 | 4633 |
| 177 | 350.0 | 1398 | 4587 |
| 182 | 360.0 | 1383 | 4538 |
| 188 | 370.0 | 1368 | 4488 |
| 193 | 380.0 | 1353 | 4439 |
| 199 | 390.0 | 1337 | 4387 |
| 204 | 400.0 | 1320 | 4331 |
| 210 | 410.0 | 1302 | 4272 |
| 216 | 420.0 | 1283 | 4210 |
| 221 | 430.0 | 1264 | 4147 |
| 227 | 440.0 | 1244 | 4082 |
| 232 | 450.0 | 1220 | 4003 |
| 238 | 460.0 | 1200 | 3937 |
| 243 | 470.0 | 1180 | 3872 |
| 249 | 480.0 | 1160 | 3806 |
| 254 | 490.0 | 1140 | 3740 |
| 260 | 500.0 | 1110 | 3642 |

9 Specification

General

Measuring principle : Ultrasonic time difference correlation principle

Flow velocity range : 0.01 ... 25 m/s

Resolution : 0.25 mm/s

Repeatability : 0.15 % of measured value \pm 0.015 m/s

Accuracy :

Volume flow

\pm 1 ... 3 % of measured value depending on application,

\pm 0.5 % of measured value with process calibration

Flow velocity

\pm 0.5 % of measured value

Turn down ratio : 1/100

Gaseous and solid content of liquid media : < 10 % of volume

Flowmeter

Enclosure : Hand-held

Degree of protection : IP 65 according EN 60529

Operating temperature : -10 ... 60 °C (14 ... 140 °F)

Housing material : ABS (UL 94 HB)

Power supply : Internal rechargeable batteries 4 x NiMH AA 2850 mAh

(daily discharge rate approx. 2% per day, operating range 0-30 °C)

or external power supply 9 V DC

Operating time : > 24 h with fully charged batteries

Display : LCD graphic display, 128 x 64 dots, backlit

Dimensions : H 228 x W 72/117 x D 47 mm

Weight : Approx. 650 g

Power consumption : < 10 W

Signal damping : 0 ... 99 s

Measurement rate : 1Hz standard, higher rates on application

Operating languages : English, Italian, Spanish,

Response time : 1 s

Quantity and units of measurement

Volumetric flow

rate : m³/h, m³/min, m³/s, l/h, l/min, l/s,

USgal/h (US gallons per hour),

USgal/min, USgal/s, bbl/d (barrels

per day), bbl/h, bbl/min, bbl/s

Flow velocity : m/s, ft/s, inch/s

Mass flow rate : g/s, t/h, kg/h, kg/min

Volume : m³, l, gal (US gallons), bbl

Mass : g, kg, t

Internal data logger

Storage capacity : In excess of 1 million data points (16MB)

Logging data : Up to ten selected variables

Communication

Serial interface : RS 232

Data : Instantaneous measured value,

parameter set and configuration,

logged data

Isofolux+ Software

Functionality : Downloading of measured values/parameter sets, graphical presentation, list format, export to third party software, on-line transfer of measured data

Operating systems : Windows 2000, NT, XP, Vista, 7; Linux; Mac (optional)

10 CE Approval

Declaration of Conformity

We, Isoil Industria declare under our sole responsibility that the products listed below to which this declaration relates are in conformity with the EEC directives:

EMC Directive 2004/108/EC for Electromagnetic Compatibility
Low Voltage Directive 2006/95/EC for Electrical Safety

Description of products:

Ultrasonic flowmeters : Isoflux IFX-F100 and IFX-P200 with associated ultrasonic transducers

The mentioned products are in conformity with the following European Standards:

| Class | Standard | Description |
|------------------------------|---|---|
| EMC Directive | BS EN 61326-1:2013 | Electrical equipment for measurement, control and laboratory use - EMC requirements |
| Immunity | BS EN 61326-1:2013 BS EN 61000-4-2:2009 BS EN 61000-4-3:2006 BS EN 61000-4-4:2012 BS EN 61000-4-5:2006 BS EN 61000-4-6:2009 BS EN 61000-4-11:2004 | Electrical equipment for continuous unattended use Electrostatic discharge RF field Electric fast transient/burst Surge RF conducted AC mains voltage dips and interruption |
| Emission | BS EN 61326-1:2013 BS EN 55022:2010 | Electrical equipment Class B Disturbance voltage Class B |
| Low Voltage Directive | BS EN 61010-1:2010 | Safety requirements for electrical equipment for measurement, control and laboratory use |

Cinisello Balsamo 22 October 2013

For and on behalf of Isoil Industria spa



Roberto Guazzoni
Managing Director

11. SERVICE

For any trouble on your IFX ultrasonic meter you can refer to your local distributor or contact Isoil Industria service for direct assistance at following Email addresses:

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Web: www.isoil.com

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