PORTAFLOW PT400

Portable Ultrasonic Flowmeter

User's Guide

Greyline
Precision Flow Measurement
An ONICON Brand

www.greyline.com

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1: General Description

1.1 Introduction

This manual describes the operation of the Greyline Portaflow PT400 portable flowmeter. The flowmeter is designed to work with clamp-on transducers to enable the flow of a liquid within a closed pipe to be measured accurately without needing to insert any mechanical parts through the pipe wall or protrude into the flow system.

Using ultrasonic *transit time* techniques, the Portaflow PT400 is controlled by a micro-processor system which contains a wide range of data that enables it to be used with pipes with an outside diameter ranging from 13mm up to 2000mm and constructed of almost any material. The instrument will also operate over a wide range of fluid temperatures.

The PT400 series comprises two models which are identical in operation but designed to be used with a different range of pipe diameters. The PT400-A can be used with pipes in the range 13mm – 115mm and the PT400-B with pipes in the range 50mm – 2000mm.

Easy to operate, the Portaflow PT400 standard features are:

- Large, easy to read graphic display with backlighting
- Simple to follow dual function keypad
- Simple 'Quick Start' set up procedure
- Continuous signal monitoring
- Pulse output
- 4-20mA, 0-20mA or 0-16mA output
- Rechargeable battery
- Battery management
- Diagnostics

Volumetric flow rates are displayed in l/h, l/min, l/sec, gal/min, gal/h, USgals/min, USgals/h, Barrel/h, Barrel/day, m^3/s, m^3/min, m^3/h. Linear velocity is displayed in metres or feet per second.

When operating in the 'Flow Reading' mode the total volumes, both positive and negative, are displayed up to a maximum 12-digit number.

The flowmeter can be used to measure clean liquids or oils that have less than 3% by volume of particulate content. Cloudy liquids such as river water and effluent can be measured along with cleaner liquids such as demineralised water.

Typical Portaflow PT400 applications include:

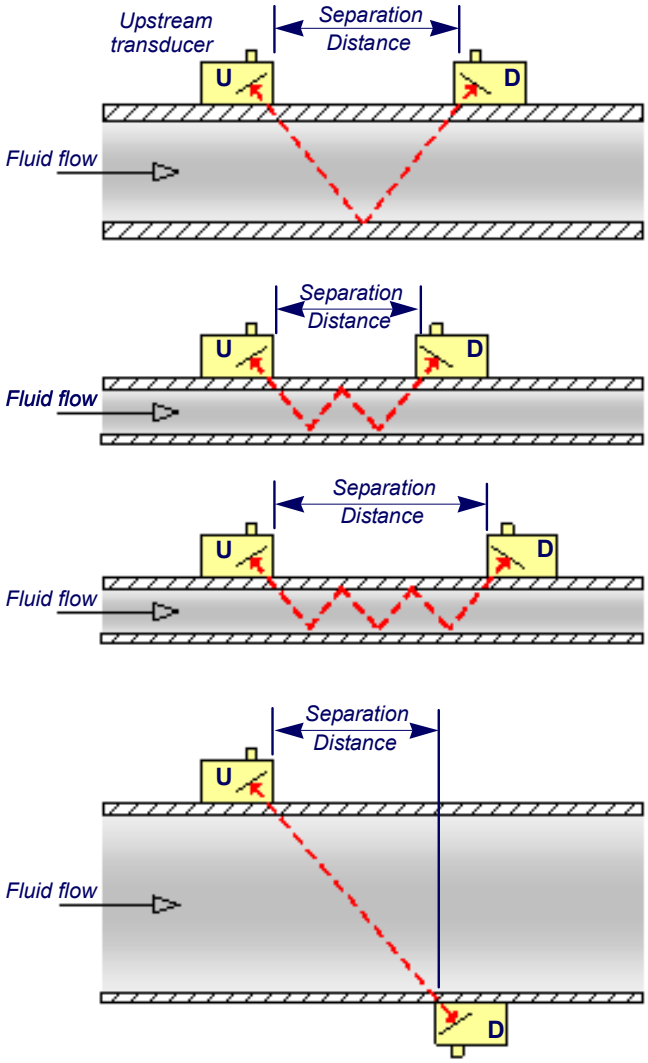
- River water
- Seawater
- Potable water
- Demineralised water
- Treated water

1.2 Principles of Operation

When ultrasound is transmitted through a liquid the speed at which the sound travels through the liquid is accelerated slightly if it is transmitted in the same direction as the liquid flow and decelerated slightly if transmitted against it. The difference in time taken by the sound to travel the same distance but in opposite directions is therefore directly proportional to the flow velocity of the liquid.

The Portaflow PT400 system employs two ultrasonic transducers attached to the pipe carrying the liquid and compares the time taken to transmit an ultrasound signal in each direction. If the sound characteristics of the fluid are known, the Portaflow microprocessor can use the results of the transit time calculations to compute the fluid flow velocity. Once the flow velocity is known the volumetric flow can be easily calculated for a given pipe diameter.

The Portaflow system can be set up to operate in one of four modes determined mainly by the pipe diameter and the type of transducer set in use. The diagram below illustrates the importance of applying the correct separation distance between the transducers to obtain the strongest signal.



Reflex mode
This is the mode most commonly used. The two transducers (U & D) are attached to the pipe in line with each other and the signals passing between them are reflected by the opposite pipe wall. The separation distance is calculated by the instrument in response to entered data concerning the pipe and fluid characteristics.

Reflex mode (double bounce)
In this mode the separation distance is calculated to give a double bounce. This is most likely to occur if the pipe diameter is so small that the calculated reflex mode separation distance would be impractical for the transducers in use.

Reflex mode (triple bounce)
This illustration goes one step further to show a triple bounce situation. This would normally apply when working with very small pipes relative to the transducer range in use.

Diagonal mode
This mode might be selected by the instrument where relatively large pipes are concerned. In this mode the transducers are located on opposite sides of the pipe but the separation distance is still critical in order for the signals to be received correctly.

This mode might be used with the standard 'A' & 'B' transducer sets but for really large pipe installation the optional transducer set 'D' might be recommended.

Figure 1.1 Operating modes

1.3 Supplied Hardware

The Portaflow equipment is supplied in a rugged plastic carrying case fitted with a foam insert to give added protection for transportation. The supplied components are shown in Figure 1.2.

Figure 1.2 Standard Portaflow equipment

Standard equipment

- Portaflow PT400 instrument with backlit graphic display
- Power supply - with UK, US, European adaptors. 110/240VAC
- 4-20mA/Pulse Output cable
- 2 lengths of chain each at 3.3 metres long
- Test block
- Transducer cables (x2) 2 metres long (one red and one blue)
- Transducer set 'A' (Transducers x2)

or

- Transducer set 'B' (Transducers x2)
- Set of guide rails for use with ‘A’ or ‘B’ transducers
- Ruled separation bar (2-piece)
- Manual

1.4 Portaflow PT400 Instrument

The Portaflow PT400 is a microprocessor controlled instrument operated through a menu system using an inbuilt LCD display and keypad. It can be used to display the instantaneous fluid flow rate or velocity, together with totalised values.

The instrument can also provide a current or variable 'pulse' output proportional to the detected flow rate. These outputs, which can be used with a range of external interface devices such as those found in BMS or site monitoring systems, can be calibrated to suit a particular flow range.

1.4.1 Connectors

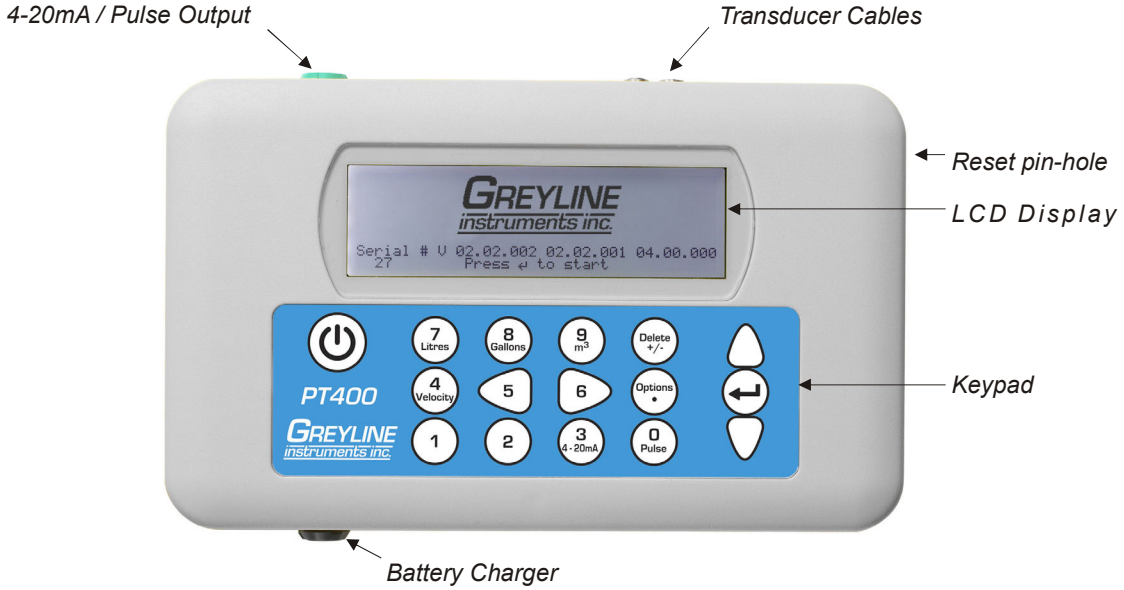


Figure 1.3 Instrument details

Transducer connections

The transducers are connected to two colour-coded miniature coaxial sockets located on the top of the instrument. Using the red/blue connector cables provided, the upstream transducer should always be connected to the RED socket and the downstream transducer to the BLUE one for a positive flow reading. It is safe to connect or disconnect the cable while the instrument is switched on.

4-20mA and Pulse output connection

The 4-20mA / 'pulse' output cable should be connected to the green 7-pin connector on the top of the flowmeter, as shown in Figure 1.3. A single cable that can be adapted for use for either of these output functions is included in the Portaflow PT400 kit. The 'tails' on the free end of the cable must be terminated to suit the intended application.

Red – 4-20mA positive
Black – 4-20mA negative
White – Pulse output
Green – Pulse return
Brown – Set Point (not in present use)
Blue – Set Point return (not in present use)
Thick Black – Cable screen

Battery charger connection

The supplied battery charger is connected to the instrument by means of the grey 2-pin connector on the bottom of the unit, as shown in Figure 1.3.

Note: *The above connectors have different key-ways to prevent incorrect cable connection.*

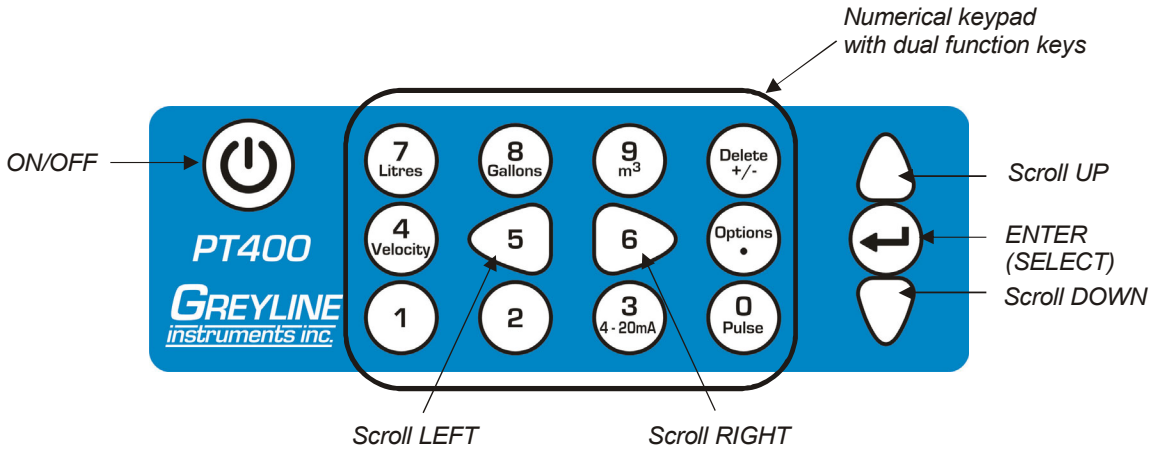


Figure 1.4 Keypad

1.4.2 Keypad

The instrument is configured and controlled via a 16-key tactile membrane keypad, as shown in Figure 1.4.

ON/OFF Key

The ON/OFF key is shown on the top left of the keypad. When turned ON an initialisation screen is displayed on the LCD showing the instrument's serial number and software revision. Once this appears, the instrument can be started by pressing the ENTER key once – the initialization screen is then replaced by a MAIN MENU which provides access to the remaining functions.

Menus and the menu selection keys

The Portaflow PT400 menus are arranged hierarchally with the MAIN MENU being at the top level. Menu navigation is achieved by three keys on the right hand side of the keypad which are used to scroll UP and DOWN a menu list and SELECT a menu item. When scrolling through a menu an arrow-shaped cursor moves up and down the left hand side of the screen to indicate the active menu choice which can then be selected by pressing the ENTER (SELECT) key.

Some menus have more options than can be shown on the screen at the same time, in which case the 'overflowed' choices can be brought into view by continuing to scroll DOWN past the bottom visible item. Menus generally 'loop around' if you scroll beyond the first or last items.

If you select Exit it usually results in taking you back one level in the menu hierarchy, but in some cases it may go directly to the 'Flow Reading' screen.

Some screens require you to move the cursor left and right along the display as well as up and down. This is achieved using keys 5 (scroll LEFT) and 6 (scroll RIGHT).

Dual function numerical keypad

The block of keys shown in the centre of the keypad in Figure 1.4 are dual function keys. They can be used to enter straight-forward numerical data, select the displayed flow units or provide quick access to frequently required control menus.

Note: *Some of the features accessed by these keys are restricted in the Portaflow 220 model range. An "Option not available" message is displayed if you select a restricted function.*

1.4.3 Power supply and battery charging

Operating power is provided by an internal battery that can be charged from the utility supply using the supplied external charger. When you first receive the unit you must put the battery on charge for a minimum of 6.5hrs

before use. A fully charged battery will power the instrument for up to 20hrs depending on the output utilisation and backlight usage.

If the backlight has been enabled the display is illuminated for 10 seconds every time a key is pressed. If the backlight is active continuously it would reduce the available battery operating time to 8hrs. Similarly, if the 4-20mA output is used constantly at 20mA, the battery life would reduce by 50%. It is therefore beneficial to turn off the backlight and 4-20mA output facilities when they are not required.

When the instrument is operating in the 'Flow Reading' mode the percentage battery charge level is displayed symbolically on the LCD screen. A warning message is triggered if the charge falls to approximately 30%, at which point there is up to four hours of battery operation remaining, depending on usage. The battery can be charged both while the instrument is in use or when switched off. The instrument's internal data is stored in non-volatile memory and will not be lost even if the battery discharges completely.

Key Point: The battery is not a user-changeable item. The instrument must be returned to Greyline if the battery needs replacing.

Key Point: Only use the supplied charger, or special adaptor lead. Failure to comply with this will invalidate your warranty.

1.5 Transducers

Different transducer sets are provided with the PF400A and PF400B Portaflow models and are not interchangeable.

Key Point: Always use the transducers that were supplied with the instrument.

Transducer set 'A'

Supplied as standard on PF400A for use on pipes 0.51" to 4.525" (13mm to 115mm) outside diameter.

Transducer set 'B'

Supplied as standard on PF400B for use on pipes 1.97" to 39.37" (50mm to 1000mm) outside diameter.

2: Installation

2.1 Transducer Positioning

In many applications an even flow velocity profile over a full 360° is unattainable due, for example, to the presence of air turbulence at the top of the flow and possibly sludge in the bottom of the pipe. Experience has shown that the most consistently accurate results are achieved when the transducer guide rails are mounted at 45° with respect to the top of the pipe.

The Portaflow equipment expects a uniform flow profile as a distorted flow will produce unpredictable measurement errors. Flow profile distortions can result from upstream disturbances such as bends, tees, valves, pumps and other similar obstructions. To ensure a uniform profile the transducers must be mounted far enough away from any cause of distortion such that it no longer has an effect.

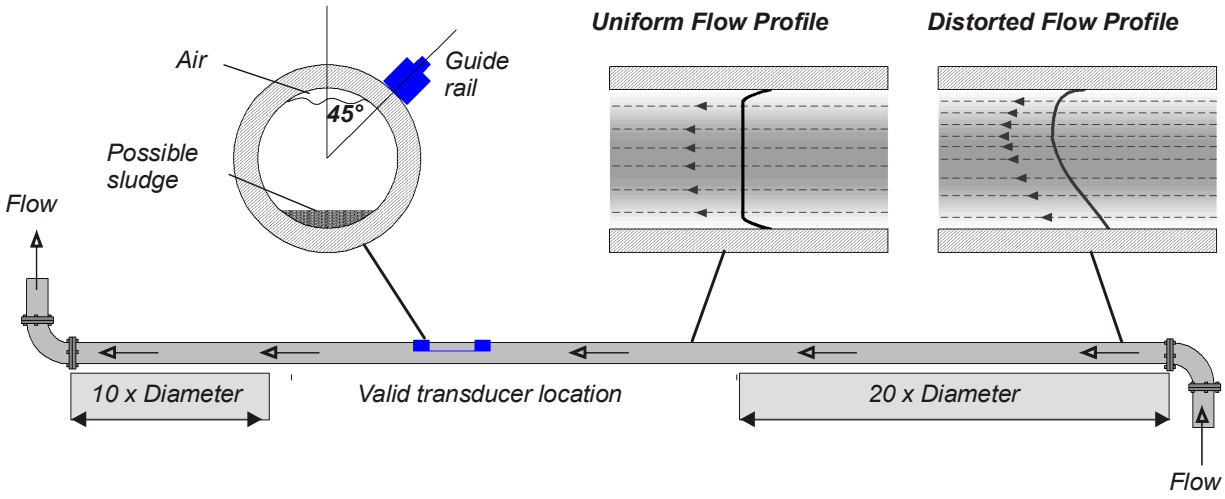


Figure 2.1 Locating the transducers

To obtain the most accurate results the condition of both the liquid and the pipe wall must be suitable to allow the ultrasound transmission along its predetermined path. It is important also that the liquid flows uniformly within the length of pipe being monitored and that the flow profile is not distorted by any upstream or downstream obstructions. This is best achieved by ensuring there is a straight length of pipe upstream of the transducers of at least 20 times the pipe diameter and 10 times the pipe diameter on the downstream side, as shown in Figure 2.1. Flow measurements can be made on shorter lengths of straight pipe, down to 10 diameters upstream and 5 diameters downstream, but when the transducers are positioned this close to any obstruction the resulting errors can be unpredictable.

Key Point: Do not expect to obtain accurate results if the transducers are positioned close to any obstructions that distort the uniformity of the flow profile.

2.2 Transducer Attachment

The transducers are fitted to adjustable guide rails which are secured to the pipe using wrap-around chains and mechanically connected together by a steel separation bar. The separation bar also acts as a ruler to allow the distance between the transducers to be accurately set to the value determined by the Portaflow instrument.

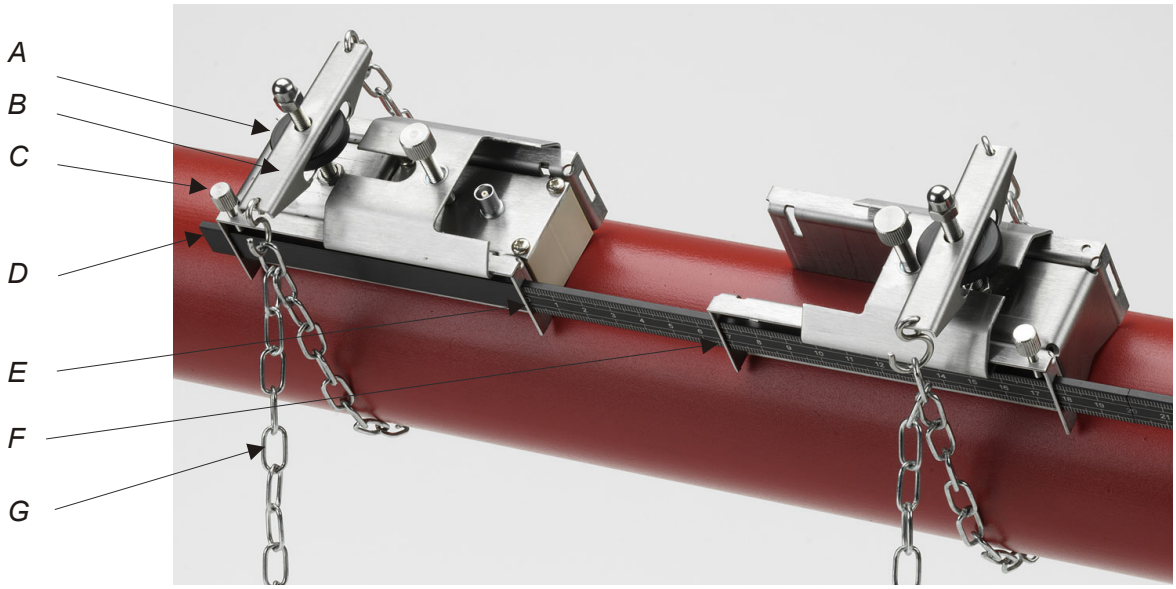
When fitting the guide rails it is easiest to assemble them onto the separation bar and adjust to the required separation distance before attaching them to the pipe.

2.2.1 Preparation

1. Before you attach the transducers you should first ensure that the proposed location satisfies the distance requirements shown in Figure 2.1 otherwise the resulting accuracy of the flow readings may be affected.

2. Prepare the pipe by degreasing it and removing any loose material or flaking paint in order to obtain the best possible surface. A smooth contact between pipe surface and the face of the transducers is an important factor in achieving a good ultrasound signal strength and therefore maximum accuracy.

2.2.2 Attaching the guide rails



A: Tensioning thumb-wheel.
B: Tension bar.
C: Separation bar securing screw.
D: Separation bar.
E: Ruler scale (0).
F: Set Separation distance.
G: Securing chain.

Figure 2.2 Guide rail attachment

1. Slide the separation bar (D) into the front of the left hand guide rail, align the front edge of the guide rail with ‘0’ on the ruler scale (E) and secure it in place by tightening the thumbscrew (C).

2. Slide the other end of the separation bar into the front of the right hand guide rail, align the front edge of the guide rail to the required separation distance (obtained from the Portaflow instrument) on the ruler (F), then secure it in place by tightening the thumbscrew.

3 On each guide rail, attach one end of a securing chain to a hook on the tensioning bar (B), wrap the chain around the pipe (G) and then attach it to the hook on the other end of the tensioning bar whilst keeping the chain as tight as possible.

4. Rotate the complete guide rail assembly so that it is approximately 45° with respect to the top of the pipe. Then tighten the chain by turning the tensioning thumb-wheel (A) on each guide block until the assembly is securely attached to the pipe.

Note: *If you are unable to get sufficient tension on the chain to hold the assembly in place, fully slacken the tensioning thumb-wheel and shorten the effective length of the chain wrapped around the pipe by connecting the tensioning bar to the next link in the chain, then re-tension.*

2.2.3 Mounting the transducers

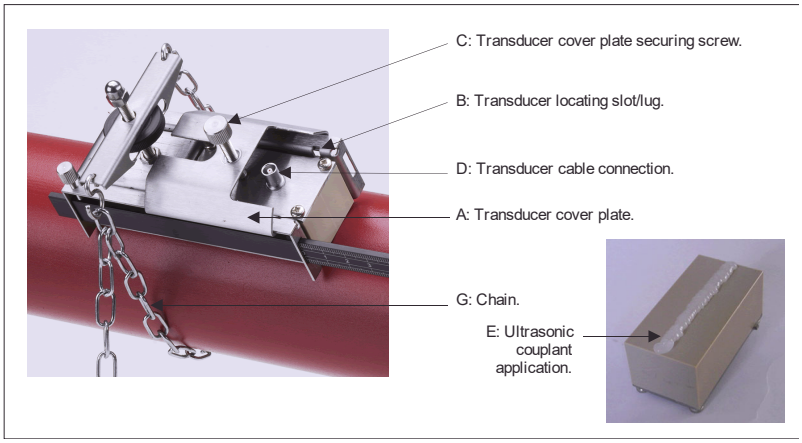


Figure 2.3 Mounting the transducers

1. Slide the transducer cover plate (A) fully towards the outside of the guide assembly to allow sufficient access to fit the transducer.

2. Clean the face of the transducer, removing all traces of dirt and grease.

3. Apply a 1/8” (3mm) bead of ultrasonic couplant along the centre length of the transducer (E).

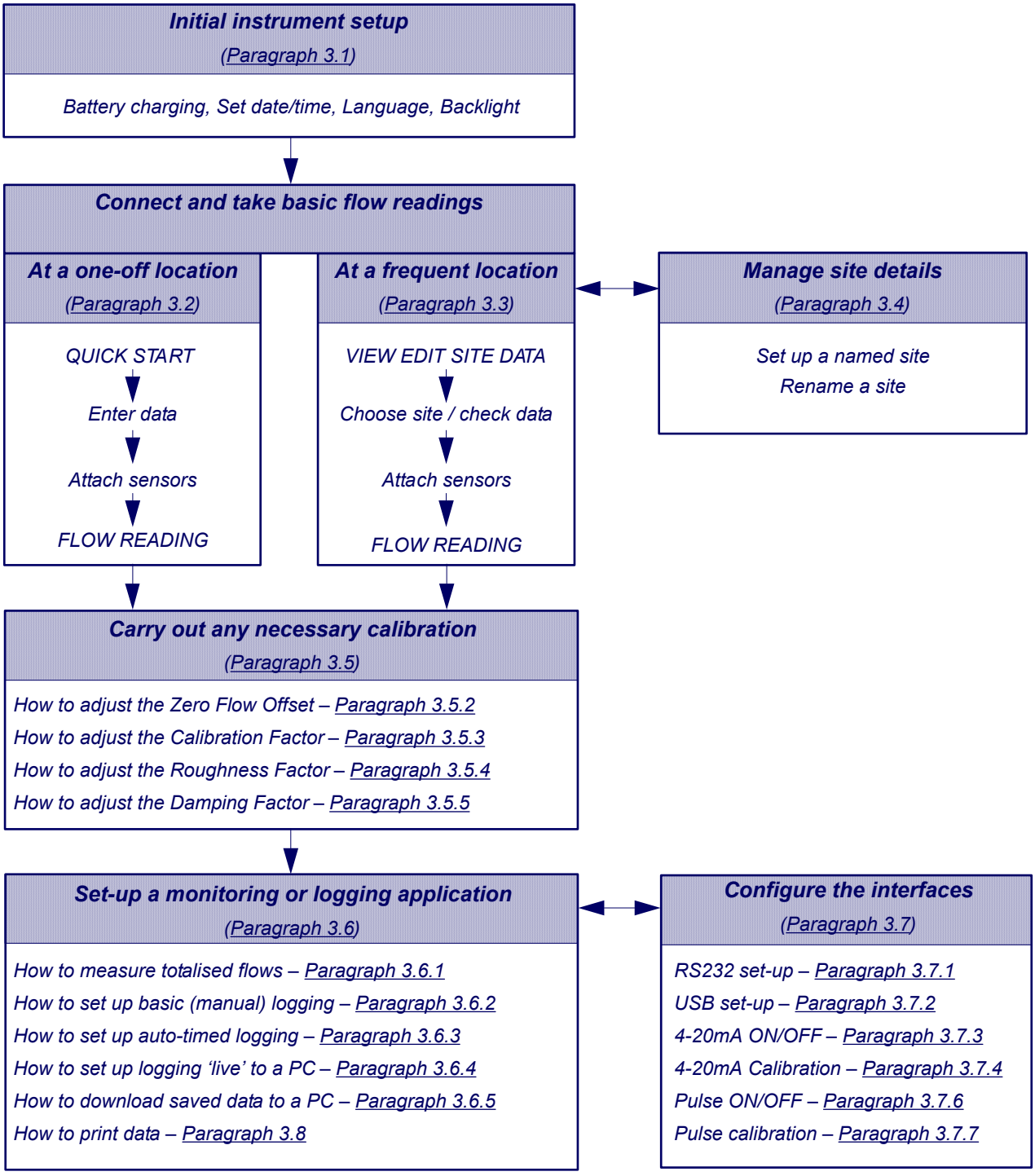
4. Fit the transducer into the guide block – ensuring the lugs on the sides of the transducer are correctly located into the slots on the sides of the guide block (B).

5. Slide the transducer cover plate (A) over the top of the transducer and tighten the thumbscrew (C) finger tight to secure the transducer in place. When securing the cover plate take care to leave sufficient room around the transducer connector (D) to connect the cable.

6. Repeat the above steps for the second transducer.

7. Connect the transducers to the Portaflow instrument using the coaxial cables provided. The RED cable must be connected to the upstream transducer and the BLUE cable to the downstream transducer. If you observe negative flow, swap the red and blue cables at the sensors.

3: Operating Procedures



3.1 Setting-up the Instrument

3.1.1 Using the instrument for the first time

Before you use your Portaflow PT400 for the first time you should first charge the battery, then select the display language and set-up the internal clock, as described below.

Charging the battery

1. Connect the external battery charger to the charger socket at the bottom of the instrument then switch on the utility supply.

2. The instrument should indicate CHARGING and an animated battery symbol indicates that the battery is taking on charge.

3. Leave the instrument on charge for 6.5 hours before using it for the first time.

Selecting a language

The first time you switch on the instrument you may be asked to select a user language.

1. Switch on the instrument by pressing the ON/OFF button.

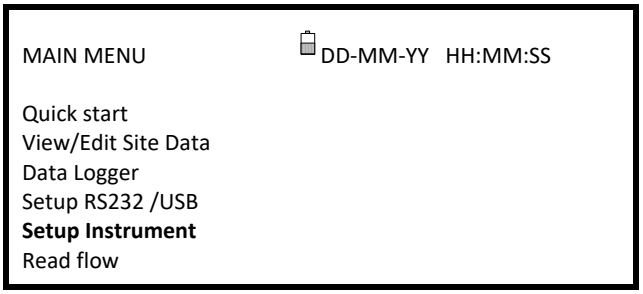
2. If necessary, select the required language using the UP/DOWN scroll keys then press the ENTER key.

3. The selected language will be the default when the instrument is next used. To change the language again select the Change Language option in the SETUP INSTRUMENT screen (see below)

4. The initialisation screen will be displayed, giving details of the instrument's serial number and software revision details.

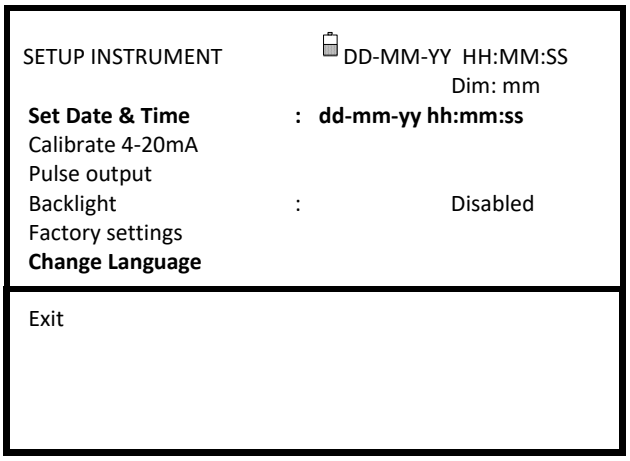
5. Press ENTER to start the instrument.

6. This is the MAIN MENU and is the starting point for all the operations described in this chapter.



Setting the Date & Time

1. Select Setup Instrument from the MAIN MENU. The screen shown here should be displayed.
2. Select Set Date & Time and click ENTER.
3. A flashing cursor should appear under the first date number. Enter the date sequence in dd-mm-yy order then press ENTER.
4. Repeat this action to set the time.
5. Select Exit then press ENTER to return to the MAIN MENU.

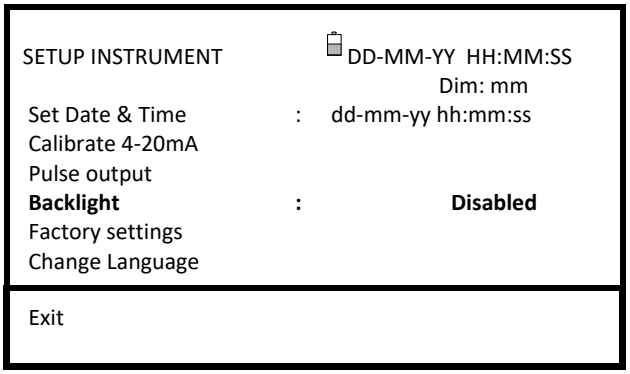


Note: *If you make a mistake when entering the data press the Delete key to move the cursor back to the number you wish to change, then continue. If you enter an invalid number an 'ERR:Invalid Date or Time!' error message is displayed on the second line of the screen. If this occurs repeat the set date/time procedure.*

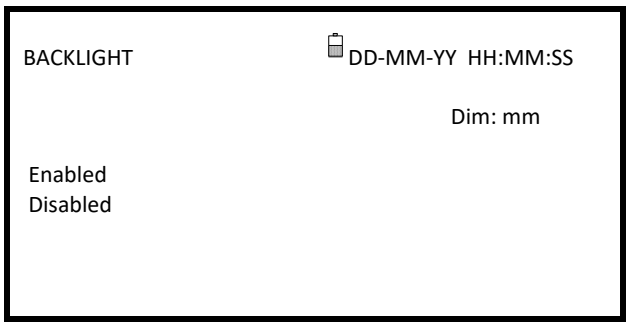
3.1.2 Enabling/disabling the backlight

When the backlight is enabled it will illuminate for 15 seconds every time a key is pressed so if it is not required it is recommended that you disable it to prolong the battery discharge time.

1. Select Setup Instrument from the MAIN MENU.
2. Select Backlight from the SETUP INSTRUMENT screen then press ENTER.



3. Select Enable or Disable as required.
4. Press ENTER to return to the SETUP INSTRUMENT screen.
5. Select Exit then press ENTER to return to the MAIN MENU.



3.2 Using the Quick Start Menu

If you want to perform a 'one-off' flow reading at a particular pipe location the Quick Start menu provides the quickest way to set up the Portaflow system and access the FLOW READING screen.

If the point at which you intend to take the measurement is likely to require regular monitoring it is best to set it up as a 'Site' within the Portaflow PT400, which then stores the site parameters (See Managing Named Sites).

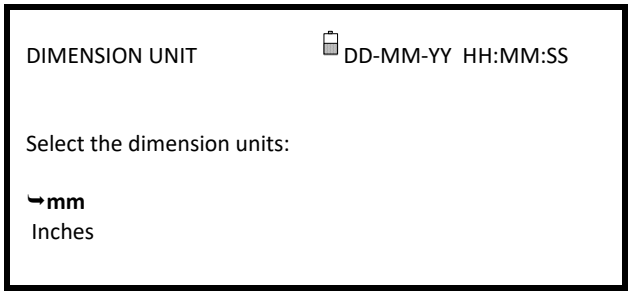
Before you can use the Portaflow system you need to obtain the following details (this information will be required when setting up the Quick Start menu):

- The pipe outside diameter
- The pipe wall thickness and material
- The pipe lining thickness and material
- The type of fluid
- The fluid temperature

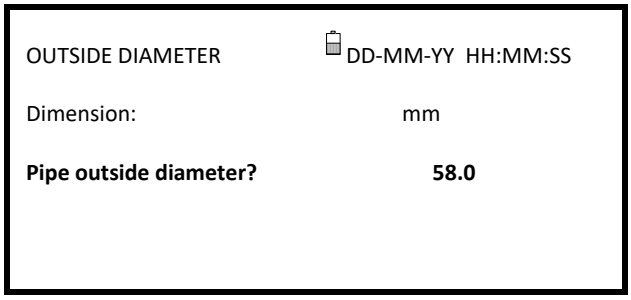
Entering the site data

1. Select Quick Start from the MAIN MENU and press ENTER. You will then be presented with a series of screens in which to enter the data mentioned above.

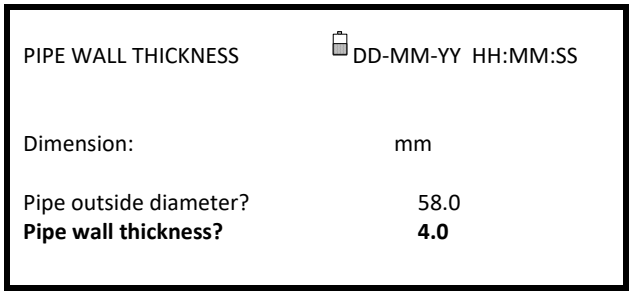
2. Select the dimension units (millimetres or inches) used to measure the pipe, then press ENTER.



3. Enter the pipe outside diameter dimension, then press ENTER.

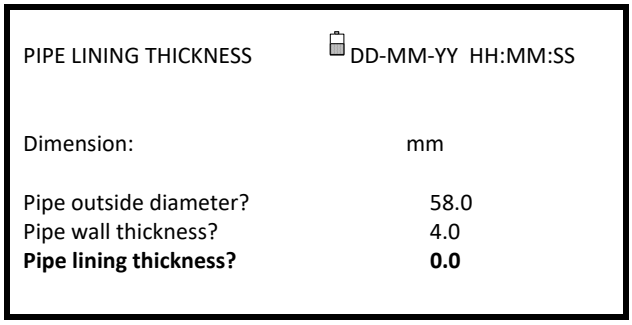


4. Enter the pipe wall thickness dimension, then press ENTER.



5. If the pipe has a lining, enter the lining thickness.
   If nothing is entered the instrument automatically assumes there is no lining.

6. Press ENTER to continue.



7. Select the pipe wall material from the list provided, then press ENTER.

   If the material is not listed select Other and enter the propagation rate of the pipe wall material in metres/sec. Contact Greyline if this is not known.

PIPE WALL MATERIAL DD-MM-YY HH:MM:SS

Select pipe wall material

Mild Steel
S' less Steel 316
S' less Steel 303
Plastic

Cast Iron
Ductile Iron
Copper
Brass
Concrete
Glass
Other (m/s)

8. If a lining thickness value was entered earlier, this screen is displayed to request that you enter the lining material type. If no lining thickness was entered this screen will be bypassed.

9. Select the lining material from the list provided then press ENTER.

   If the material is not listed select Other and enter the propagation rate of the lining material in metres/sec. Contact Greyline if this is not known.

PIPE LINING MATERIAL DD-MM-YY HH:MM:SS

Select pipe lining material

Steel
Rubber
Glass
Epoxy

Concrete
Other (m/s)

10. Select the fluid type from the list provided and press ENTER.

    If the liquid is not listed select Other and enter a propagation rate in metres/second.

FLUID TYPE DD-MM-YY HH:MM:SS

Select fluid type

Water
Glycol/water 50/50
Glycol/water 30/70
Lubricating oil

Diesel
Freon
Other (m/s)

11. If you need to alter the fluid temperature from that shown select either °C or °F with the cursor and press the ENTER key.

12. Enter the new temperature value and press the ENTER key.

13. The new temperature should now be indicated in both °C and °F.

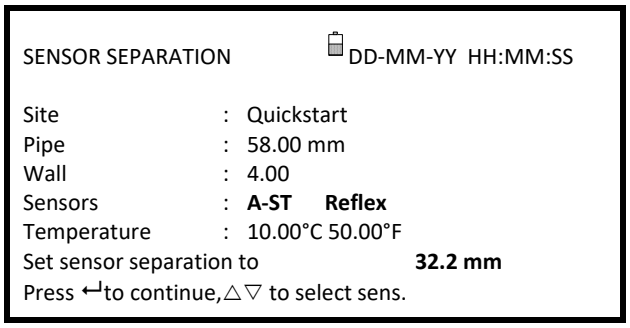
14. Select Continue.. and press ENTER.

FLUID TEMPERATURE DD-MM-YY HH:MM:SS

Enter Fluid Temperature

°C: 5.00
°F: 41.00
Continue..

15. The SENSOR SEPARATION screen now displays a summary of the entered parameters and informs you of the type of sensor to be used, the mode of operation and the distance to set up between the sensors.
In this example it recommends type A-ST (A standard) sensors operating in the 'Reflex' mode spaced at 32.2mm apart.
Take a note of these details



Note: *Do not press ENTER until the transducers are fitted and connected to the instrument.*

Attaching and connecting the transducers

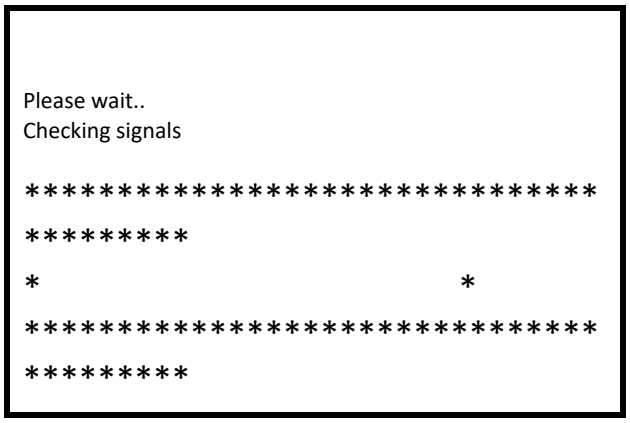
16. Fit the designated sensors to the pipe using the appropriate guide rails as described in Paragraph 2.2. Take great care to set the separation distance as accurately as possible.

17. Connect the red and blue coaxial cables between the sensors and the test instrument, ensuring that the red connector on the instrument is connected to the 'upstream' sensor.

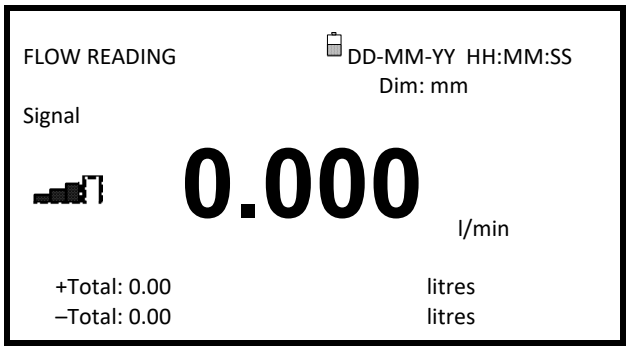
Taking a flow reading

18. Once the transducers have been fitted and connected press the Enter key.

19. This will take you from the SENSOR SEPARATION screen to the FLOW READING screen via a signal-checking screen (shown here).



20. Check that the indicated signal strength on the left of the screen is at least 2 bars (ideally 3 or 4). If less than 2 bars are shown it indicates there could be a problem with the transducer spacing, alignment or connections; or it could be due to an application problem.



Flow monitoring

The FLOW READING screen is the one most used during normal monitoring operation. It shows the instantaneous fluid flow together with totalised values (when enabled). In this mode you can select the flow rate measurement units by pressing keys 7 (litres), 8 (Gallons) or 9 (m^3), or change the display to show velocity by pressing key 4.

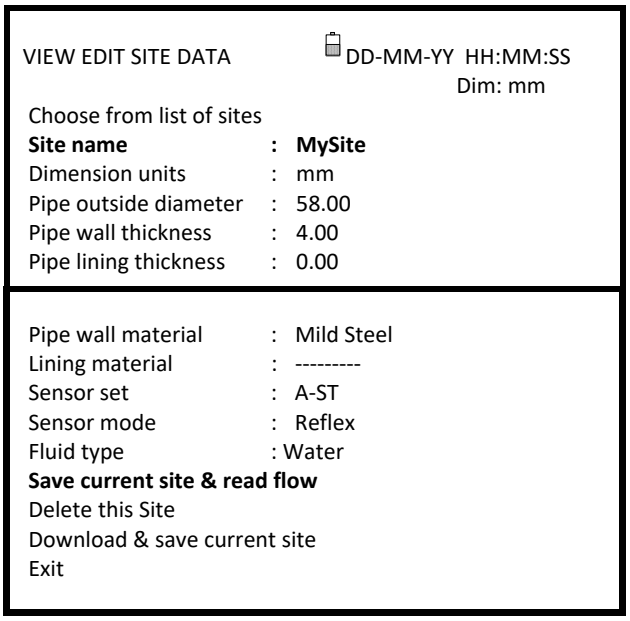
3.3 Using the System at a Regularly Monitored Location

Setting up the Portaflow system using the Quick Start method described in Paragraph 3.2 is easy and the recommended method to use in a 'one-off' situation. But if you have a site location that you want to monitor on a frequent basis it is better to set up a named 'Site' for that location so that you can recall it when needed and so avoid the need to re-enter the site details every time you want to install the equipment there.

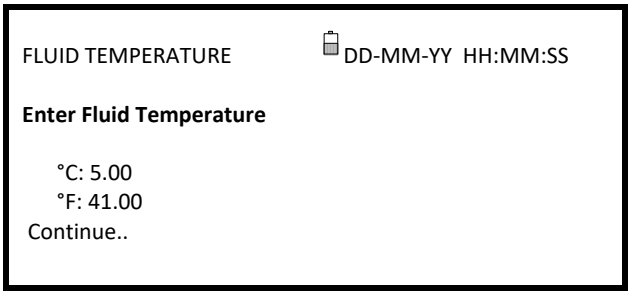
Note: *See Paragraph 3.4 for details of how to set-up and manage site details.*

Use this procedure to install the equipment at a named site.

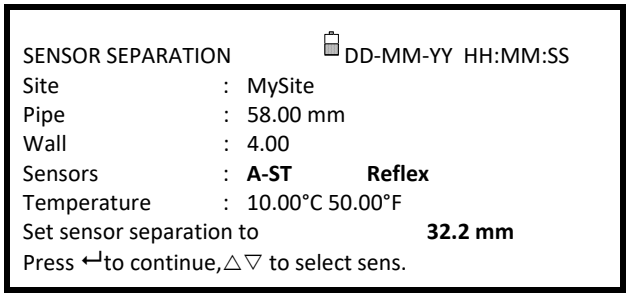
1. Select View Edit Site Data from the MAIN MENU.
2. Select Choose from list of sites.
3. Select one of the sites listed and press ENTER.
4. The Site name will show the selected site and the site parameters will be listed on the screen.
5. Scroll down through the menu list and enter/change the data that might have changed since the last time the site was accessed.
6. When you are satisfied that the parameters are correct select Save current site & read flow.



7. If you need to alter the fluid temperature from that shown select either °C or °F with the cursor and press the ENTER key.
8. Enter the new temperature value and press the ENTER key.
9. The new temperature should now be indicated in both °C and °F.
10. Select Continue.. and press ENTER.



11. The SENSOR SEPARATION screen now displays a summary of the entered parameters and informs you of the type of sensor to be used, the mode of operation and the distance to set up between the sensors.
In this example it recommends type A-ST (A standard) sensors operating in the 'Reflex' mode spaced 32.2mm apart.
Take a note of these details.



Note: *If you press ENTER before the transducers are fitted and connected to the instrument, the instrument will detect a low signal strength and may indicate an ERROR condition.*

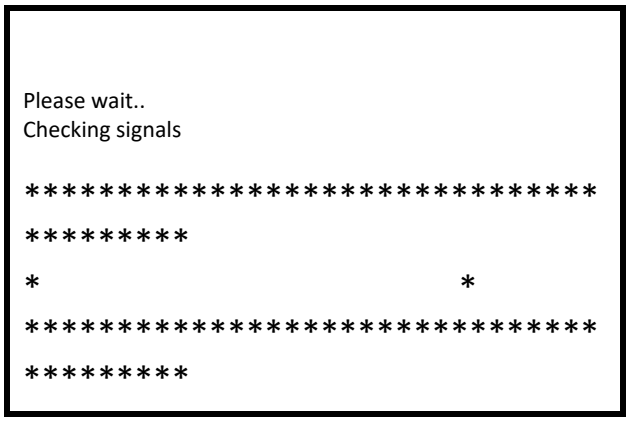
Attaching and connecting the transducers

12. Fit the designated sensors to the pipe using the appropriate guide rails as described in Paragraph 2.2. Take great care to set the separation distance as accurately as possible.
13. Connect the red and blue coaxial cables between the sensors and the instrument, ensuring that the red connector on the instrument is connected to the 'upstream' sensor.

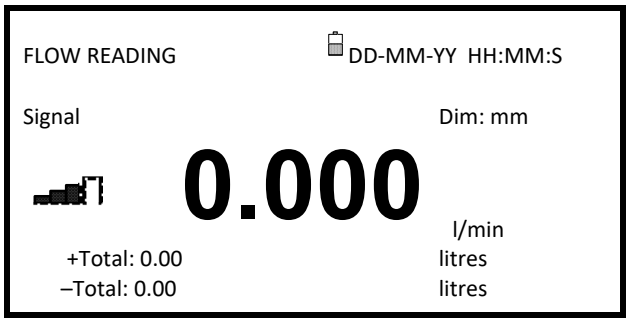
Taking a flow reading

14. Once the transducers have been fitted and connected press the ENTER key.

15. This will take you from the SENSOR SEPARATION screen to the FLOW READING screen via a signal-checking screen (shown here).



16. Check that the indicated signal strength on the left of the screen is at least 2 bars (ideally 3 or 4). If less than 2 bars are shown it indicates there could be a problem with the transducer spacing, alignment or connections; or it could be due to an application problem.



Flow monitoring

The FLOW READING screen is the one most used during normal monitoring operation. It shows the instantaneous fluid flow together with totalised values (when enabled). In this mode you can select the flow rate measurement units by pressing keys 7 (litres), 8 (Gallons) or 9 (m³), or change the display to show velocity by pressing key 4.

3.4 Managing Named Sites

If you want to monitor a particular site location frequently you can set up a named 'Site' to store the installation details, such as pipe dimensions and material, required to set-up the Portaflow PT400 system. These can then be recalled later when revisiting that particular location.

The instrument can store up to 20 sites, the first site is reserved for QUICK START and cannot be renamed; subsequent sites are initially named EmptySite1 through to EmptySite19.

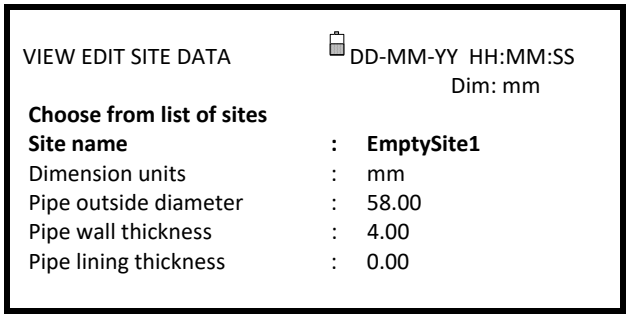
3.4.1 Setting up a new site

1. Select View Edit Site Data from the MAIN MENU.

2. Select Choose from list of sites.

3. Select one of the EmptySites from the presented list (e.g. EmptySite 1 as shown).

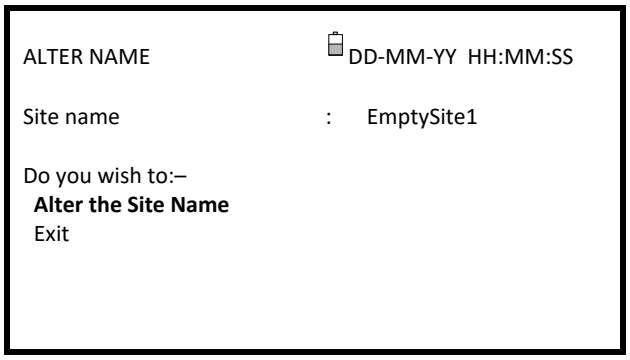
4. Select Site name and press ENTER.



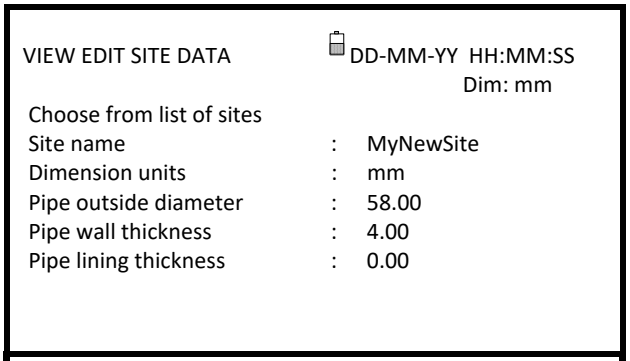
5. This opens the ALTER NAME screen.

6. Select Alter the Site Name and you will be presented with a screen which allows you to enter a new name in much the same way as when composing a mobile text message.

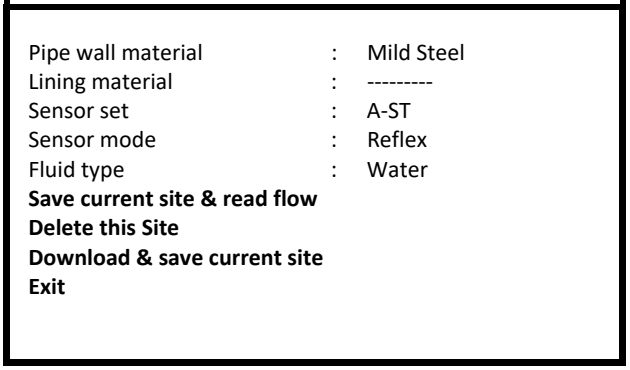
7. On completion press ENTER then select Exit. This will take you back to the VIEW EDIT SITE DATA screen.



8. Scroll down through the menu list and enter/change the pipe parameters and other data pertaining to the site.
Note that this menu allows you to choose a Sensor Set, unlike the QUICK START menu which recommended the sensor set to use. If you enter an inappropriate sensor set in this menu you will be presented with an error message later when you go to the SENSOR SEPARATION screen.



9. When all the data is correct you can either:
   a) Select Save current site & read flow to continue fitting the transducers and opening the FLOW READING screen.
   b) Select Delete this site to delete the site name and values and restore it to the original EmptySite name.
   c) Select Download & save current site to save the site details and download them to a PC via RS232/USB provided the RS232/USB link is connected and correctly set-up.
   d) Select Exit to return to the MAIN MENU.



3.4.2 Changing a site name

To change a site name use the same method described above for generating a new site: but in this case access a current site name to change rather than an EmptySite. If you change a site name while the site is logging the logging will stop.

3.5 Instrument Calibration

The Portaflow is fully calibrated before it leaves the factory; however the following adjustments are provided to allow you to further 'fine tune' your instrument to suit local conditions and application where necessary. Apart from the zero flow offset adjustment, these are normally carried out only where the instrument is to be used in a permanent or semi-permanent location.

3.5.1 Adjusting the zero cut-off

This adjustment allows you to set a minimum flow rate (m/s) below which the instrument will indicate '0'. The default setting is 0.02 m/s but you may adjust this value if required.

1. With the instrument operating in FLOW READING mode, press the Options key to access the FLOW READING OPTIONS menu shown.

2. Select Zero Cutoff (m/s) and press ENTER.

3. Enter the value for the Zero Cutoff (e.g. 0.06 m/s) then press ENTER.

4. Scroll down to select Exit and press ENTER to return to the FLOW READING screen.

FLOW READING OPTION DD-MM-YY HH:MM:SS

Data review
Zero Cutoff (m/s) : 0.00
Set zero flow (m/s) : 0.00
Damping (secs) : 10
Totaliser : Run
Reset +Total

3.5.2 Adjusting the set zero flow offset

The Portaflow instrument operates by comparing the time taken to send an ultrasonic signal between two transducers in either direction. A Set zero flow offset adjustment is provided to compensate for any inherent differences between the two sensors, noise pick-up, internal pipe conditions etc. It can be used to 'zero' the flow indication under no-flow conditions.

If you have adjusted the Zero Cutoff point to anywhere above '0' you must reset it to '0' before you can observe and adjust the Set zero flow offset, as its value is very small. Once the Set zero flow offset has been calibrated you can then reapply the Zero Cutoff if required.

1. Stop the liquid flow.

2. With the instrument in FLOW READING mode press the Velocity function key and observe the reading (m/s). Any reading other than 0.000 indicates an offset error and in practice this will typically be in the range ±0.005m/s (possibly higher on smaller diameter pipes). If a greater figure is shown it is worth calibrating the offset to obtain a more accurate result. Continue as follows:

3. Press the Options key to access the FLOW READING OPTION screen shown.

4. Select Set zero flow (m/s) and press ENTER.

5. Press ENTER on the subsequent screen to accept the change, which will return you to the screen shown.

6. Scroll down to select Exit and press ENTER to return to the FLOW READING screen.

FLOW READING OPTION DD-MM-YY HH:MM:SS

Data review
Zero Cutoff (m/s) : 0.00
Set zero flow (m/s) : 0.00
Damping (secs) : 10
Totaliser : Run
Reset +Total

Key Point: In order to cancel any applied offset you must either read flow via Quick Start or switch the Portaflow instrument OFF & ON. Any value that you trim-out using the offset adjustment will be added/subtracted from the flow reading across the whole range.

3.5.3 Adjusting the calibration factor

Key Point: USE THIS FACILITY WITH CARE & ONLY WHERE NECESSARY

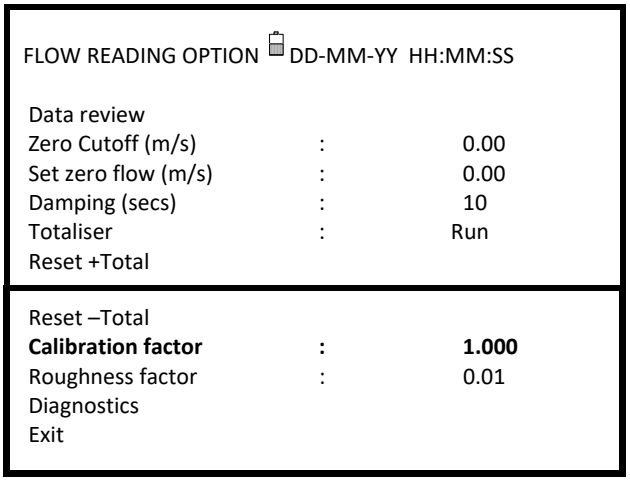
The Portaflow instrument is fully calibrated before leaving the factory and under normal circumstances does not require further calibration when used on site.

This facility can be used to correct the flow indication where unavoidable errors occur due to the lack of a straight pipe or where the sensors are forced to be fitted close to the pipe-end, valve, junction etc.

Any adjustment must be made using a reference flowmeter fitted in the system.

With the system running:

1. Stop (Stall) the Portaflow's totaliser facility and zero it (Paragraph 3.6.1).
2. Run the Portaflow's totaliser to measure the total flow over a 30-60 minute period, and note the total flow indicated by the reference flow meter over the same period.
3. Calculate the % error between the Portaflow and reference meters. If the error is greater than ±1% calibrate the Portaflow as detailed below.
4. Press the Options key to access the FLOW READING OPTION screen shown.
5. Scroll down and select Calibration factor.
6. Change the calibration factor according to the error calculated in step 3. For example, if the Portaflow was reading 1% high then increase the Calibration factor value by 0.010. Conversely, if the reading is 1% low then decrease the calibration factor to 0.990.
7. Press Enter to apply the change.
8. Select Roughness factor or Exit as required.



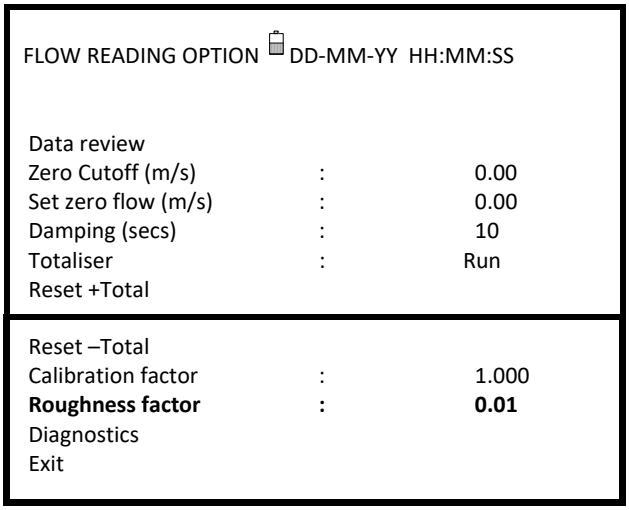
3.5.4 Adjusting the roughness factor

The roughness factor compensates for the condition of the internal pipe wall, as a rough surface will cause turbulence and affects the flow profile of the liquid. In most situations it is not possible to inspect the pipe internally and the true condition is not known. In these circumstances experience has shown that the following values can be used:

Pipe Material	Roughness Factor
Non ferrous metal Glass Plastics Light metal	0.01
Drawn steel pipes: • Fine planed, polished surface • Plane surface • Rough planed surface	0.01
Welded steel pipes, new: • Long usage, cleaned • Lightly and evenly rusted • Heavily encrusted	0.1
Cast iron pipes: • Bitumen lining • New, without lining • Rusted / Encrusted	1.0

With the system running in FLOW READING mode:

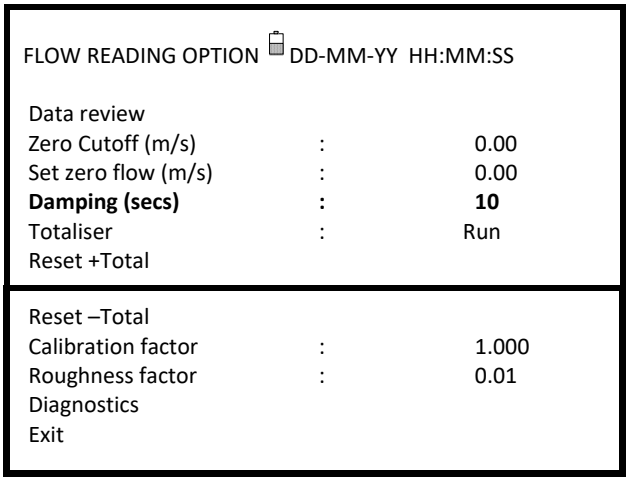
1. Press the Options key to access the FLOW READING OPTION screen shown.
2. Scroll down and select Roughness factor.
3. Change the roughness factor according to the pipe material and condition as described above.
4. Press Enter to apply the change.



3.5.5 Adjusting the damping factor

By averaging-out the flow rate over several seconds, the Damping factor can be used to smooth out rapid changes in flow rate to prevent wild fluctuations in the displayed flow value. It has a range of 1 to 199, with a default setting of 10. With the system running in FLOW READNG mode:

1. Press the Options key to access the FLOW READING OPTION screen shown.
2. Scroll down and select Damping (secs).
3. Change the value of the Damping factor as required to remove any unwanted display fluctuations. Increasing the value applies a greater smoothing affect.
4. Press Enter to apply the change.



Key Point: If the damping factor is set too high the value displayed may appear stable but it may exhibit large step changes when the value is updated.

3.6 Monitoring Functions

3.6.1 How to measure totalised flows (manually)

The basic measurement indicated on the FLOW READING screen is the instantaneous flow rate, which in some applications may vary over a period of time. Average flow rates are therefore often required in order to get a better understanding of an application's true performance. This is simply achieved by noting the total flow over a specific period (for example 30-60 minutes) and then calculating the average flow rate over that period of time.

1. Press the Options key to access the FLOW READING OPTION screen shown.
2. If the Totaliser is indicating Run, select it and change it to Stall. Press ENTER.
3. Select Reset +Total and press ENTER.
4. Press ENTER on the subsequent screen to accept the reset.
5. Press ENTER again to return to the FLOW READING OPTIONS menu.

FLOW READING OPTION DD-MM-YY HH:MM:SS

Data review		
Zero Cutoff (m/s)	:	0.00
Set zero flow (m/s)	:	0.00
Damping (secs)	:	10
Totaliser	**:**	**Stall**
Reset +Total		

6. Select Reset –Total and press ENTER.
7. Press ENTER on the subsequent screen to accept the reset.
8. Press ENTER again to return to the FLOW READING OPTIONS menu.
9. Note and record the current time.
10. Select Totaliser and change it to Run. Press ENTER.
    Note: the totalisers begin to count up as soon as Totaliser is put to Run.

FLOW READING OPTION DD-MM-YY HH:MM:SS

Zero Cutoff (m/s)	:	0.00
Set zero flow (m/s)	:	0.00
Damping (secs)	:	10
Totaliser	**:**	**Run**
Reset +Total		
Reset –Total		

11. Scroll down and select Exit to return to the FLOW READING screen which will now indicate the instantaneous flow together with the totalised flow. Note that in some installation the measured flow can be in either direction. Where this is the case the upstream flow is shown separately in the –Total field.

FLOW READING DD-MM-YY HH:MM:S
Dim:mm

Signal

12.34 l/min

+Total: 300.0 **litres**
–Total: 0.00 litres

Calculating the average flow

To calculate the average flow wait for the allotted monitoring period to expire then divide the indicated total flow by the time taken. This will give you the average flow in m/s, galls/hours or whatever units you select.

Note that in a bi-directional flow situation you must calculate the difference between the indicated positive and negative flow totals before carrying out the average flow rate calculation.

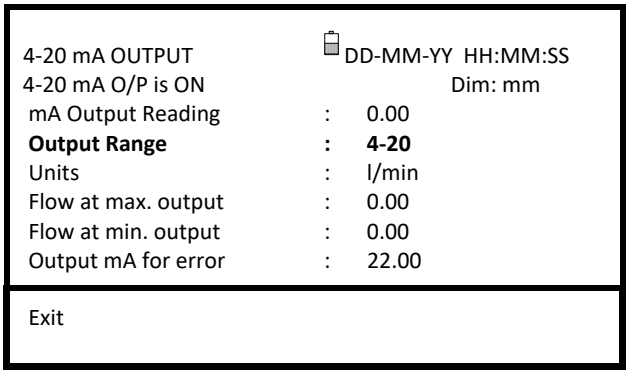
How to stop the totaliser temporarily

If you want to stop the totaliser temporarily for operational reasons, set the Totaliser option to Stall in the FLOW READING OPTIONS screen as described above. This will stop the totaliser operation without affecting its current values.

3.7 Configuring the Portaflow PT400 Interfaces

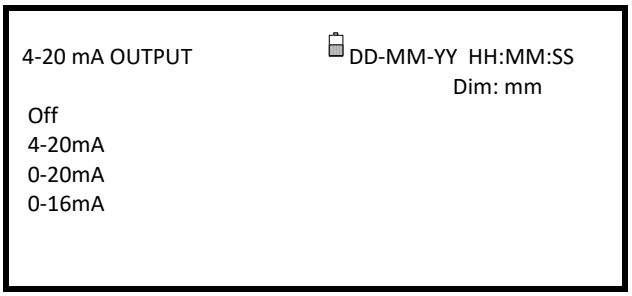
3.7.3 How to turn the 4-20mA output OFF/ON

1. With the instrument operating in the FLOW READING mode, press the 4-20mA function key. This will access the 4-20mA OUTPUT screen.
2. The ON/OFF status of the 4-20mA output is shown on line 2 of the display.
3. To change the ON/OFF status select Output Range and press ENTER.



3.7.3

4. Select Off, to turn OFF the 4-20mA Output or select one of the output ranges to turn it ON.
5. Press ENTER to return to the 4-20mA OUTPUT screen.



3.7.4 4-20mA signal calibration and ranging

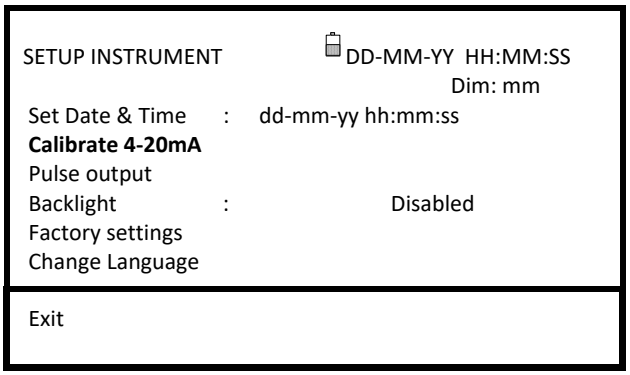
Key Point: The 4-20mA output has been calibrated in the factory and should not require further adjustment. In the rare event that re-calibration is necessary, this procedure should be carried out only by a trained engineer.

3.7.4

This procedure describes how to calibrate the 4-20mA output and 'scale' it to operate over a defined flow-rate range.

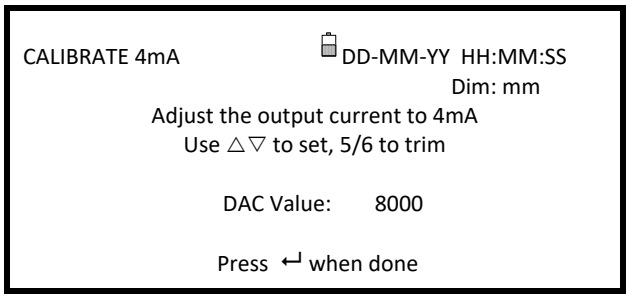
Signal calibration

1. Select Setup Instrument from the MAIN MENU, to access the SETUP INSTRUMENT screen.
2. Select Calibrate 4-20mA.



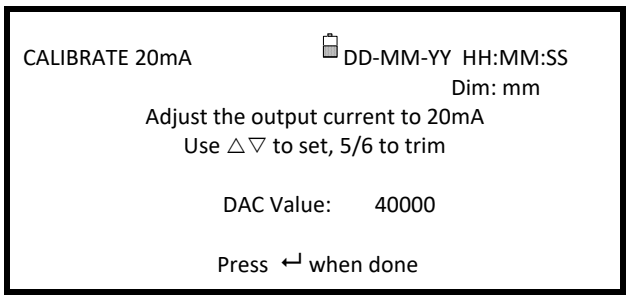
3. Connect a calibrated ammeter to the 4-20mA output and adjust the UP/DOWN Scroll keys (Coarse) and LEFT/RIGHT Scroll keys 5 & 6 (fine) until the output is exactly 4.0mA.
The DAC should indicate approximately 8000.

4. Press ENTER when done.



5. With the meter still connected to the 4-20mA output adjust the Scroll keys to obtain an output of exactly 20mA.
The DAC should indicate approximately 40000.

6. Press ENTER when done.



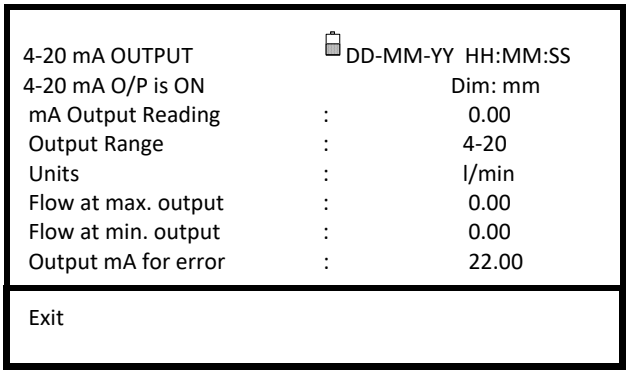
4-20mA Signal scaling

Note: *The 4-20mA can be set to represent a particular flow range. It is also possible to enter a negative figure for the minimum output and this would enable a reverse flow to be monitored.*

7. With the instrument operating in the FLOW READING mode, press the 4-20mA function key. This will access the 4-20mA OUTPUT screen.

8. Select Flow at max. output and enter a value of the flow rate that you want to associate with a 20mA output.

9. Select Flow at min. output and enter a value of the flow rate that you want to associate with a 4mA output.
This could be '0'.

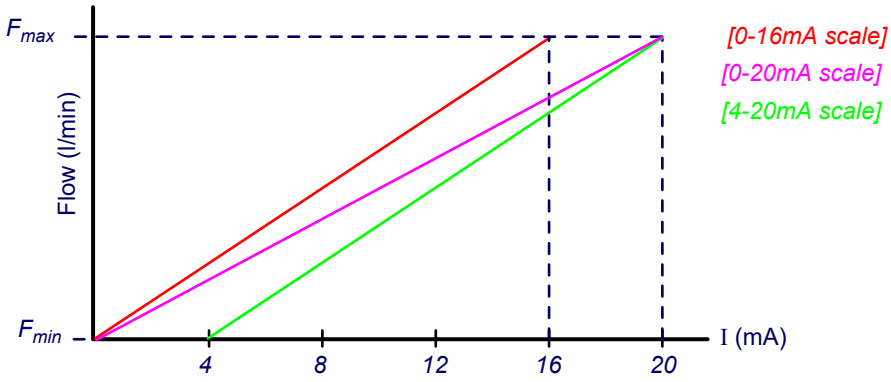


10. Select Output mA for error and enter a value (max of about 23mA) that you want the 4-20mA output to produce in the event of an error (e.g. if the flow-rate is outside the set range).

11. Upon completion press ENTER to return to the FLOW READING screen.

3.7.5 How to convert the measured current to flow rate

Assume the maximum flow rate is F_{max} (l/min) and the minimum flow rate F_{min} is '0' (l/min), as shown.



To calculate the flow rate (l/min) for a measured current I(mA) then:

0-20mA	0-16mA	4-20mA
$\text{Flow rate} = \frac{I \times (F_{max} - F_{min})}{20} + F_{min}$	$\text{Flow rate} = \frac{I \times (F_{max} - F_{min})}{16} + F_{min}$	$\text{Flow rate} = \frac{(I - 4) \times (F_{max} - F_{min})}{(16)} + F_{min}$

3.7.6 How to turn the pulse output OFF/ON

1. With the instrument operating in the FLOW READING mode, press the Pulse function key to access the PULSE OUTPUT screen.
2. A Pulse output is ON message appears in the second line of the display.
3. Select Exit and press ENTER to return to the FLOW READING screen.

PULSE OUTPUT		DD-MM-YY HH:MM:SS
Pulse output is ON		Dim: mm
Flow units	:	litres
Output	:	Off
Vol per pulse	:	10.00
Pulse width (ms)	:	10
Exit		

3.7.7 Pulse output signal calibration

1. With the instrument operating in the FLOW READING mode, press the Pulse function key to access the PULSE OUTPUT screen.
2. To change the flow measurement units select Flow units and press the required units function key (7), (8), (9).

PULSE OUTPUT		DD-MM-YY HH:MM:SS
Pulse output is ON		Dim: mm
Flow units	:	**litres**
Output	:	Off
Vol per pulse	:	**10.00**
Pulse width (ms)	:	**10**
Exit		

3.7.7

3. Select Vol per pulse and enter the required value. (In the example shown, a pulse is produced every 10 litres of flow).
4. Select a Pulse width (in ms) to suit the particular application – e.g. electro-mechanical counter. Refer to the manufacturer's data sheet for the minimum pulse width.
5. Select Exit and press ENTER to return to the FLOW READING screen.

4: Maintenance & Repair

This instrument does not contain any user-serviceable parts. The following notes are provided as a guide to general equipment care

WARNING

Do not disassemble this unit unless advised by Greyline.
Return the unit to an approved service agent or place of purchase for further advice.

1. Ensure the unit is switched off and disconnected from the mains, then wipe the exterior of the instrument with a clean, damp cloth or paper towel. The use of a solvent may damage the surface.
2. The instrument contains a rechargable battery, dispose safely and in accordance with the local regulations in force in the country of operation.
3. Ensure all cables and connectors are kept clean and free from grease or contaminants. Connectors may be cleaned with a general purpose cleaner if necessary.
4. Avoid the use of excessive grease/ultrasonic couplant on the sensors as this may impair the performance of the equipment. Excessive grease/couplant can be removed from the sensors and guide rails using an absorbent paper towel and a general purpose solvent cleaner.
5. We recommend that the ultrasonic couplant is replaced on the sensors every 6 months, especially on pipes where the application is too hot to touch. If the signal level drops below 30% this is also an indication that the sensors need re-greasing.
6. Regularly check all cables/parts for damage. Replacement parts are available from Greyline.
7. Ensure the person who services your instrument is qualified to do so. If in doubt, return the instrument to Greyline with a detailed report on the nature of any problem.
8. Ensure that suitable precautions are taken when using any materials to clean the instrument/sensors.
9. The instrument and sensors should be calibrated at least once every 12 months. Contact Greyline or your local service agent for details.
10. When returning product to Greyline make sure it is clean and please notify Greyline if the instrument has been in contact with any hazardous substances.
11. If the instrument was supplied with dust or dirt caps make sure they are re-fitted when the instrument is not in use.

5: Troubleshooting

5.1 Overview

If you have a problem with your flow monitoring system it can be due to any of the following:

Faulty instrument

If you suspect the instrument is faulty you can check it out using a test block as described in Paragraph 5.4.. This will establish that the instrument is functional and receiving a healthy signal from the connected transducers.

Incorrect setup

A low, or zero, signal could be caused by incorrect set-up such as:

- Incorrect site data entered into the instrument.
- Incorrect or non-matching ultrasonic transducers selected for use.
- Incorrectly fitted transducers – lack of couplant applied, incorrect spacing, insecure attachment.
- Poor connections between the probes and the instrument.

Application problem

If you are certain that the instrument is healthy and suitably set-up for the current site; and the probes are properly assembled and fitted correctly, there could be an application problem concerned with the site.

Check such conditions such as:

Poor pipe outer surface quality

- Uneven surface preventing good surface contact with the transducer.
- Flaking paint (should be removed).
- Variable air gap in concrete-covered pipes affecting the ultrasonic signal quality.

Poor internal pipe construction

- Rough internal pipe walls affecting fluid flow (see roughness factor).
- Internal welds positioned in the transducer signal path affecting the signal quality.
- The ‘drippings’ in galvanised-dipped pipes or other irregularities interfering with the signal path.

Incorrect probe location

- Transducers located too close to bends or valves, disturbing the flow profile.
- Transducers located too close to insertion probes, disturbing the flow profile.
- For horizontal pipework transducers should not be positioned on the top of the pipe.

Poor fluid conditions within the pipe

- Fluid contains bubbles, high particle density or sludge.
- Air in the top of the pipe.

Low fluid flow within the pipe

- Pipe obstructions.
- Malfunctioning valve not opening fully (or closed inadvertently).

Liquid content problems

- Multiple liquid contents do not comply accurately to expected sound speed criteria.
- Very hot pipe almost turns water to steam and therefore exhibits the wrong speed characteristics –could be due to reduced pipe pressure.
- Flashover – liquid turns into a gas because of lower than required pressure.

5.2 General Troubleshooting Procedure

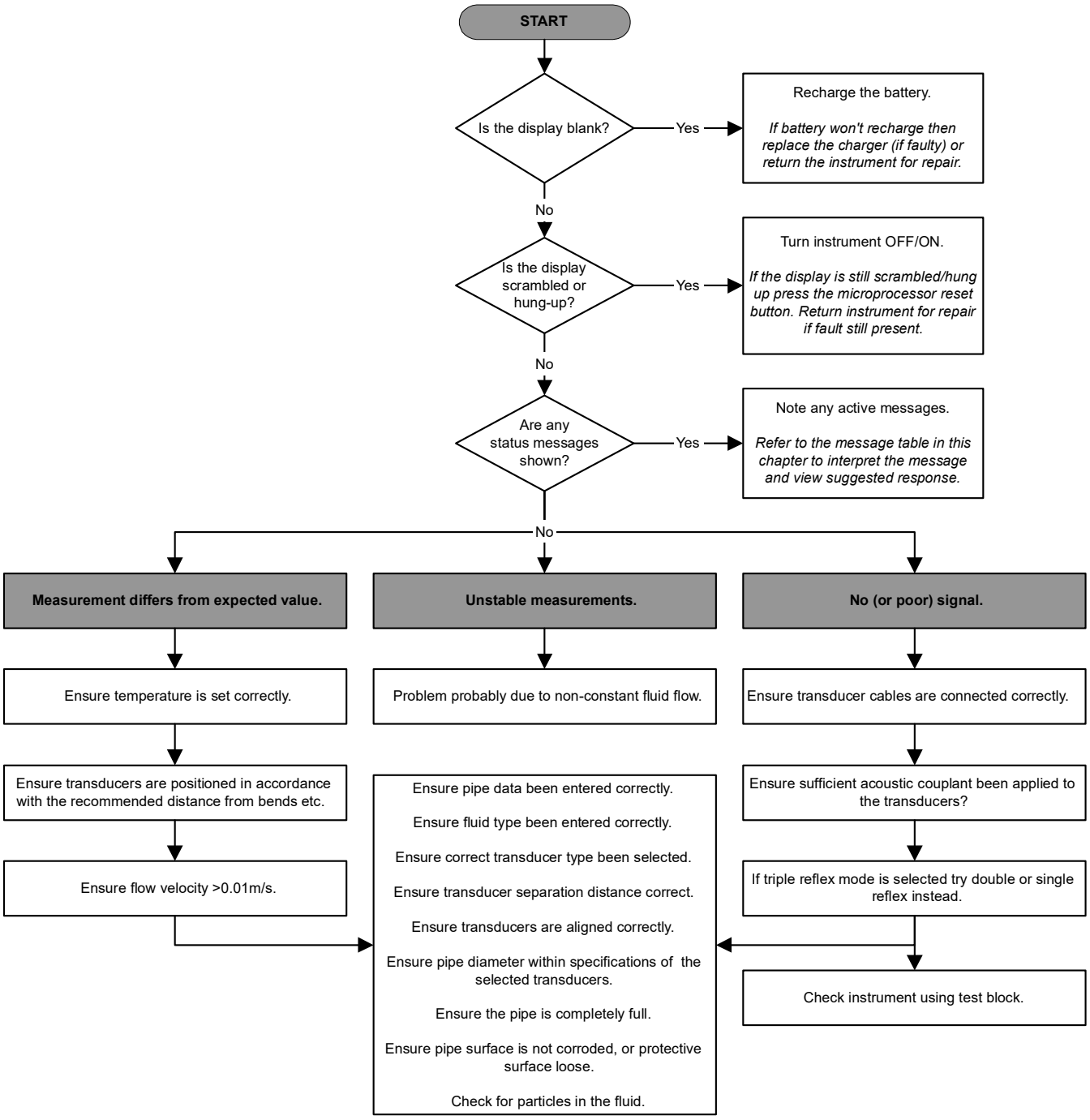


Figure 5.1 Troubleshooting chart

5.3 Warning & Status Messages

FLOW RATE ERRORS	
No flow signal	***Interpretation:*** This message appears when the transducers cannot send or receive signals to each other. ***Response:*** Firstly check that all cables are connected, transducers are on the pipe correctly with sufficient couplant on the face. This condition could also be due to a partially empty pipe, aerated liquid, particulate content too high or when the condition of the pipe being measured is poor.
Flow signal is poor	***Interpretation:*** This warning appears when the signal is lower than 25%. ***Response:*** This could be due to an application problem, a poor quality pipe – see also the conditions for No flow signal (above). Check for sufficient couplant.
Zero cut-off error!	***Interpretation:*** You have entered an out-of-range value in the Zero cutoff field in the Options menu. ***Response:*** Enter a valid number.
Damping error!	***Interpretation:*** You have entered an out-of-range value in the Damping field in the Options menu. ***Response:*** Enter a valid number.
Totaliser beyond maximum!	***Interpretation:*** The totaliser has overflowed its maximum count. The counter will roll-over and restart from zero but this message alerts you to the fact. ***Response:*** Reset the totaliser as described in Paragraph 3.6.1.
PULSE ERRORS	
Pulse Rate > Max	***Interpretation:*** The flow rate exceeds the capability of the pulse output – i.e. too many pulses per second are required than can be achieved. ***Response:*** Narrow the pulse width time or increase the volume per pulse, as described in Paragraph 3.7.7.
Pulse volume error!	***Interpretation:*** You have entered an out-of-range value in the Pulse volume error field in the PULSE OUTPUT menu – see Paragraph 3.7.7. ***Response:*** Enter a valid number.
Pulse width error	***Interpretation:*** You have entered an out-of-range value in the Pulse width error field in the PULSE OUTPUT menu – see Paragraph 3.7.7. ***Response:*** Enter a valid number.

4-20mA ERRORS	
mA out > Max	***Interpretation:*** The actual flow is higher than the maximum set on the mA range. ***Response:*** Re-scale the 4-20mA output to be able to cope with the higher flow – see Paragraph 3.7.4.
Calibration 20mA Error!	NOTE: The 4-20mA output is calibrated before the instrument leaves the factory and should not require further adjustment. ***Interpretation:*** You have adjusted the DAC outside its accepted range when calibrating the 20mA signal output. ***Response:*** Re-calibrate the 4-20mA output – see Paragraph 3.7.4.
Calibration 4mA Error!	NOTE: The 4-20mA output is calibrated before the instrument leaves the factory and should not require further adjustment. ***Interpretation:*** You have adjusted the DAC outside its accepted range when calibrating the 4mA signal output. ***Response:*** Re-calibrate the 4-20mA output – see Paragraph 3.7.4.
BATTERY ERRORS	
Battery Low	***Interpretation:*** The battery has discharged to below 30% remaining. This leaves the instrument with approximately 4 hours remaining, depending on power usage, before it needs recharging. ***Response:*** Recharge the internal battery at the earliest opportunity. Do not leave the instrument for a prolonged period with a fully discharged battery.
Battery Exhausted	***Interpretation:*** The battery is approaching a fully discharged state and the instrument is about to store the internal data and shut-down. ***Response:*** Recharge the battery.
SET-UP ERRORS	
Pipe OD out of range	***Interpretation:*** You have entered an out-of-range value for the pipe outside diameter dimension – i.e. larger or smaller than the unit or sensor can be used on. ***Response:*** Enter a valid number.
Wall thickness out of range	***Interpretation:*** You have entered an out-of-range value for the pipe wall thickness dimension – accepted range is 0.04” - 2.95” (1mm - 75mm). ***Response:*** Enter a valid number.
Lining thickness out of range	***Interpretation:*** You have entered an out-of-range value for the lining thickness dimension – acceptable range is 0” – 0.39” (0mm - 10mm). ***Response:*** Enter a valid number.

Temperature range	***Interpretation:*** You have entered an out-of-range value for the fluid Temperature. Accepted temperature range -4°F to 572°F (-20°C to +300°C). ***Response:*** Enter a valid number.
Invalid Date or Time	***Interpretation:*** The entered Date or Time is invalid, or when setting up 'timed' data logging the Stop time is set earlier than the Start time. ***Response:*** Enter a valid Date and Time.
Sensors: INVALID	***Interpretation:*** The selected temperature is higher than the maximum allowed for the sensor type. ***Response:*** Select alternative sensors or change the temperature.
Mode: Err Typ	***Interpretation:*** The selected sensors are invalid and the mode cannot be verified. ***Response:*** Select a valid sensor type and choose a mode that gives a non-zero separation distance.

Test Block

A test block is included with the Portaflow PT400 equipment to allow the transducers and inter-connecting cables to be functionally checked.

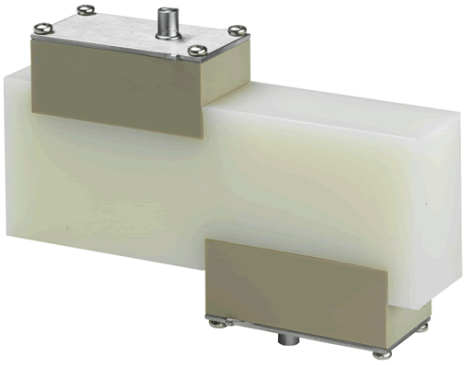


Figure 5.2 Test block

1. Switch ON the instrument.
2. Select Quick start and enter the parameters shown in the table below for the appropriate transducer type (A or B):

Parameter	A Sensors	B Sensors
Pipe outside diameter	1.02” (26.0mm)	2.09” (53.0mm)
Pipe wall thickness	0.24” (6.0mm)	0.28” (7.0mm)
Pipe lining thickness	0.0	0.0
Pipe wall material	Mild Steel	Mild Steel
Fluid type	Water	Water
Temp	68°F (20°C)	68°F (20°C)

3. When the above data is entered, the SENSOR SEPARATION screen will be displayed.
4. Use the UP/DOWN scroll key to go to the SENSOR SELECTION menu. Select the appropriate sensor (the default will be "A") and press ENTER to return to the SENSOR SEPARATION menu.
5. Select Sensor mode and position the cursor at Diagonal and press ENTER to return to the SENSOR SELECTION menu.
6. Select Exit and press ENTER to return to the SENSOR SEPARATION screen.
7. Check that the parameters displayed are correct.
8. Apply acoustic couplant to the sensors and attach them to the test block with the connectors positioned towards the centre of the test block as shown, and temporarily secure them in place using elastic bands or tape.
9. Connect the sensors to the Portaflow PT400 instrument using the cables provided.
10. Press ENTER to go to the FLOW READING screen.
11. Select the Options key to go to the FLOW READING OPTION menu and set the Damping to at least 10 seconds.
12. Select Exit and press ENTER to return to the FLOW READING menu.
13. The flow reading value displayed is not important. The fact that a reading is obtained indicates that the instrument is functioning. This value may fluctuate but this is normal.
14. The signal strength indicator at the left of the display should show 3–4 bars.

5.5 Microprocessor Reset Facility

In the rare event that the Portaflow PT400 instrument appears to totally hang-up, or displays total gibberish, you can reset its microprocessor by carefully inserting a straightened paperclip into the pinhole located in the right-

hand side of the instrument to operate the internal reset switch. Hold the paperclip perpendicular to the instrument while doing this.

5.6 Diagnostics Display

This feature is designed for advanced users and is intended to provide information that will aid the user to diagnose problems – e.g. no signal strength.

When operating in the FLOW READING mode you can access a diagnostics screen by pressing the Options function key and then selecting Diagnostics from the FLOW READING OPTIONS screen. This will display the operating values for the following parameters.

Calculated time (µs)

This is a value the instrument predicts will be the time in µsecs that it should take for the acoustic wave to propagate across a particular pipe size. This value is ascertained from the data entered by the user. i.e. Pipe size, material, sensor set etc.

Actual time (µs)

This is the value the instrument measures as the time taken for the acoustic wave to propagate across the pipe. It is used to see if the signal is being taken from the burst, at the correct time to get the strongest signal. This value is normally a few µs below the calculated µs value. If, however, this value is much greater than the calculated time then there is a problem with the set-up.

Flow (m/s)

This displays flow velocity in m/sec to 3 decimal places.

Signal strength

This is the averaged value of Signal and should be a value between 800 and 1600 – where 800 is approximately 50%, and 1600 is approximately 100%.

UP/DN time difference

The difference in transit times between the upstream and downstream signals due to the fluid flow.

Propagation µs

Not currently in use.

Signal propagation

Not currently in use.

Fluid propagation rate

This is the sound speed of the fluid calculated using the data entered by the user.

Fluid propagation rate

Calculated from the input data concerning the fluid type and temperature.

Sensor separation

The same value as displayed in the setup screen.

5.7 APPLICATIONS HOTLINE

For applications assistance, advice or information on any Greyline Instrument contact your Sales Representative, write to Greyline or phone the Applications Hotline below:

United States:	Tel: 315-788-9400	Fax: 315-764-0419
Canada:	Tel: 613-938-8956	Fax: 613-938-4857
Toll Free:	888-473-9546	
Email:	info@greyline.com	
Web Site:	www.greyline.com	

Greyline Instruments Inc.

Canada:
16456 Sixsmith Drive
Long Sault, Ont. K0C 1P0

USA:
11451 Belcher Road South
Largo, FL 33773

5.8 PRODUCT RETURN PROCEDURE

Instruments may be returned to Greyline for service or warranty repair.

1. Obtain an RMA Number from Greyline -

Before shipping a product to the factory please contact Greyline by telephone, fax or email to obtain an RMA number (Returned Merchandise Authorization). This ensures fast service and correct billing or credit.

When you contact Greyline please have the following information available:

1. Model number / Software Version
2. Serial number
3. Date of Purchase
4. Reason for return (description of fault or modification required)
5. Your name, company name, address and phone number

2. Clean the Sensor/Product -

Important: unclean products will not be serviced and will be returned to the sender at their expense.

1. Rinse sensor and cable to remove debris.

2. If the sensor has been exposed to sewage, immerse both sensor and cable in a solution of 1 part household bleach (Javex, Clorox etc.) to 20 parts water for 5 minutes. Important: do not immerse open end of sensor cable.

3. Dry with paper towels and pack sensor and cable in a sealed plastic bag.

4. Wipe the outside of the enclosure to remove dirt or deposits.

5. Return to Greyline for service.

LIMITED WARRANTY

Greyline Instruments warrants, to the original purchaser, its products to be free from defects in material and workmanship for a period of one year from date of invoice. Greyline will replace or repair, free of charge, any Greyline product if it has been proven to be defective within the warranty period. This warranty does not cover any expenses incurred in the removal and re-installation of the product.

If a product manufactured by Greyline should prove defective within the first year, return it freight prepaid to Greyline Instruments along with a copy of your invoice.

This warranty does not cover damages due to improper installation or handling, acts of nature, or unauthorized service. Modifications to or tampering with any part shall void this warranty. This warranty does not cover any equipment used in connection with the product or consequential damages due to a defect in the product.

All implied warranties are limited to the duration of this warranty. This is the complete warranty by Greyline and no other warranty is valid against Greyline. Some states do not allow limitations on how long an implied warranty lasts or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Greyline Instruments Inc.

Appendix A: Specifications

GENERAL	
NEW! DSP Measurement Technique:	Transit time.
Timing Resolution:	50 pico-second, continuous signal level indication on display.
Improved! Flow Velocity Range:	Minimum Velocity 0.1m/s; Max Velocity 20m/s: Bi-directional.
Turn Down Ratio:	100:1
Accuracy:	±0.5% to ±2% of flow reading for flow rate >0.2m/s and Pipe ID >75mm. ±3% of flow reading for flow rate >0.2m/s and Pipe ID in range 13mm - 75mm. ±6% of flow reading for flow rate < 0.2m/s.
Repeatability:	±0.5% of measured value or ±0.02m/s whichever is the greater.
NEW! Reynolds Number Correction:	Flow velocity corrected for Reynolds number over entire velocity range.
Response Time:	< 400ms depending on pipe diameter.
Selectable Flow Units:	VELOCITY: m/sec, ft/sec. VOLUME: l/s, l/min, l/h, gal/min, gal/h, USgals/min, USgals/h, Barrel/h, Barrel/day, m³/s, m³/min, m³/h.
Selectable Volume Units:	l, gal, USgals, Barrel, m³.
Total Volume:	12 Digits - forward and reverse.
APPLICABLE FLUID TYPES	
Fluid Condition:	Clean liquids or oils that have less than 3% by volume of particulate content. Applications include river water, sea water, potable water, demineralised water, glycol/water mix, hydraulic systems and diesel oil.
APPLICABLE PIPE TYPES	
Pipe Materials:	Any sonic conducting medium such as Carbon Steel, Stainless Steel, Copper, UPVC, PVDF, Concrete, Galvanised Steel, Mild Steel, Glass, Brass. Including Lined Pipes - Epoxy, Rubber, Steel, Plastic.
Pipe Dimension (outside diameter):	Min 13mm; Max 2000mm with B sensor.
Pipe Wall Thickness:	1mm - 75mm.
Pipe Lining:	Applicable pipe linings include Rubber, Glass, Concrete, Epoxy, Steel.
Pipe Lining Thickness:	0mm – 10mm.
Pipe Wall Temperature Range:	Standard sensor operating temperature is -4°F to 275°F (-20°C to +135°C). Optional high temperature sensor operating temperature is -4°F to 392°F (-20°C to +200°C).
TRANSDUCER SETS	
Standard:	Temperature Range -4°F to 275°F (-20°C to +135°C) PF400A – Type 'A-ST' (2MHz) PF400B – Type 'B-ST' (1MHz)

LANGUAGES	
Standard Supported Languages:	English, French, German, Italian, Spanish, Portuguese, Russian, Norwegian, Dutch.
OUTPUTS	
Analog Output: Resolution: Alarm Currents: Isolation: Maximum Load:	4–20mA, 0–20mA, 0–16mA. 0.1% of full scale. Any between 0–26mA. 1400V Opto-isolated. 620 Ohms.
Pulse Output TTL: Pulse Repetition Rate: Pulse Width: Max Current:	Number Available: One open collector opto-isolated digital output. Up to 400 pulses/sec (depending on pulse width). 400ms for 1 pulse/sec. 5ms for 100 pulses/sec. 150mA.
ELECTRICAL	
Supply Voltage:	
Input Voltage Range:	9–24Vdc.
Power Consumption:	10.5W.
Battery:	
Technology:	5-cell NiMH.
Capacity:	3.8AHr.
Operating time:	Typically 20 hours continuous with backlight and 4-20mA output OFF.
Recharge Time:	6.5 Hours.
Service Life:	>400 charge/discharge cycles.
Power Supply/Charger:	
Manufacturer:	ECOPAC Model ECO-181WP12.
Input Voltage Range:	90–264Vac.
Input Frequency Range:	47–63Hz.
Output Voltage:	12Vdc.
Max. Output Current:	1.5A.
Approvals:	UL, CUL, TUV, CB & CE.
MECHANICAL	
Carrying case:	
Rating:	All components are contained in a hard-wearing polypropylene carrying case with a protective moulded foam insert.

Enclosure:	
Material:	Flame retardant injection moulded ABS.
Dimensions:	264mm x 168mm x 50mm.
Weight (Including Battery):	2.5lbs (1.1 kg).
Protection:	IP54.
Keypad:	
No. Keys:	16.
Display:	
Format:	240 x 64 pixel graphic display, high contrast black-on-white, with backlight.
Viewing Angle:	Min 30°, typically 40°.
ENVIRONMENTAL	
Operating Temperature:	-4°F to 122°F (–20°C to +50°C).
Storage Temperature:	-13°F to 149°F (–25°C to +65°C).
Operating Humidity:	90% RH MAX at 122°F (+50°C).
APPROVALS	
Safety:	BS EN 61010.
EMC:	BS EN 61326 - 1:2006, BS EN 61326-2-3:2006.
Battery Charger:	EN61204 - 3.
SHIPPING INFORMATION	
Box Dimensions:	16.15” x 8” x 14” (410mm x 205mm x 355mm).
Weight:	16.5lbs (7.5 kg).
Volumetric Weight:	11lbs (5. kg).

Greyline Instruments reserves the right to alter specifications without notice.

Greyline
Precision Flow Measurement
An ONICON Brand

PIPE CHARTS

Carbon Steel & PVC Pipe

Pipe	Pipe	Standard Schedule 40		Extra Heavy Schedule 80		Dbl. Extra Heavy		Schedule 10		Schedule 20		Schedule 30		Schedule 40	
Size	O.D.	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL
½	.840	.622	.109	.546	.147	.252	.294							.622	.109
¾	1.050	.824	.113	.742	.154	.434	.308							.824	.113
1	1.315	1.049	.133	.957	.179	.599	.358							1.049	.133
1¼	1.660	1.380	.140	1.278	.191	.896	.382							1.380	.140
1½	1.900	1.610	.145	1.500	.200	1.100	.400							1.610	.145
2	2.375	2.067	.154	1.939	.218	1.503	.436							2.067	.154
2½	2.875	2.469	.203	2.323	.276	1.771	.552							2.469	.203
3	3.500	3.068	.216	2.900	.300	2.300	.600							3.068	.216
3½	4.000	3.548	.226	3.364	.318	2.728	.636							3.548	.226
4	4.500	4.026	.237	3.826	.337	3.152	.674							4.026	.237
5	5.563	5.047	.258	4.813	.375	4.063	.750							5.047	.258
6	6.625	6.065	.280	5.761	.432	4.897	.864							6.065	.280
8	8.625	7.981	.322	7.625	.500	6.875	.875			8.125	.250	8.071	.277	7.981	.322
10	10.750	10.020	.365	9.750	.500	8.750	1.000			10.250	.250	10.136	.307	10.020	.365
12	12.750	12.000	.375	11.750	.500	10.750	1.000			12.250	.250	12.090	.330	11.938	.406
14	14.000	13.250	.375	13.000	.500			13.500	.250	13.376	.312	13.250	.375	13.124	.438
16	16.000	15.250	.375	15.000	.500			15.500	.250	15.376	.312	15.250	.375	15.000	.500
18	18.000	17.250	.375	17.000	.500			17.500	.250	17.376	.312	17.124	.438	16.876	.562
20	20.000	19.250	.375	19.000	.500			19.500	.250	19.250	.375	19.000	.500	18.814	.593
22	22.000	21.250	.375	21.000	.500			21.500	.250	21.250	.375	21.000	.500		
24	24.000	23.250	.375	23.000	.500			23.500	.250	23.250	.375	22.876	.562	22.626	.687
26	26.000	25.250	.375	25.000	.500			25.376	.312	25.000	.500				
28	28.000	27.250	.375	27.000	.500			27.376	.312	27.000	.500	26.750	.625		
30	30.000	29.250	.375	29.000	.500			29.376	.312	29.000	.500	28.750	.625		
32	32.000	31.250	.375	31.000	.500			31.376	.312	31.000	.500	30.750	.625		
34	34.000	33.250	.375	33.000	.500			33.376	.312	33.000	.500	32.750	.625		
36	36.000	35.250	.375	35.000	.500			35.376	.312	35.000	.500	34.750	.625		
42	42.000	41.250	.375	41.000	.500					41.000	.500	40.750	.625		

Ductile Iron Pipe - Standard Classes

Size INCH	OUTSIDE DIA. INCH	Class 50		Class 51		Class 52		Class 53		Class 54		Class 55		Class 56		CEMENT LINING **STD THICKNESS	CEMENT LINING **DOUBLE THICKNESS
		WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.		
3	3.96			0.25	3.46	0.28	3.40	0.31	3.34	0.34	3.28	0.37	3.22	0.41	3.14		
4	4.80			0.26	4.28	0.29	4.22	0.32	4.16	0.35	4.10	0.38	4.04	0.44	3.93		
6	6.90	0.25	6.40	0.28	6.34	0.31	6.28	0.34	6.22	0.37	6.16	0.40	6.10	0.43	6.04	.125	.250
8	9.05	0.27	8.51	0.30	8.45	0.33	8.39	0.36	8.33	0.39	8.27	0.42	8.21	0.45	8.15		
10	11.10	0.39	10.32	0.32	10.46	0.35	10.40	0.38	10.34	0.41	10.28	0.44	10.22	0.47	10.16		
12	13.20	0.31	12.58	0.34	12.52	0.37	12.46	0.40	12.40	0.43	12.34	0.46	12.28	0.49	12.22		
14	15.30	0.33	14.64	0.36	14.58	0.39	14.52	0.42	14.46	0.45	14.40	0.48	14.34	0.51	14.28		
16	17.40	0.34	16.72	0.37	16.66	0.40	16.60	0.43	16.54	0.46	16.48	0.49	16.42	0.52	16.36		
18	19.50	0.35	18.80	0.38	18.74	0.41	18.68	0.44	18.62	0.47	18.56	0.50	18.50	0.53	18.44	.1875	.375
20	21.60	0.36	20.88	0.39	20.82	0.42	20.76	0.45	20.70	0.48	20.64	0.51	20.58	0.54	20.52		
24	25.80	0.38	25.04	0.41	24.98	0.44	24.92	0.47	24.86	0.50	24.80	0.53	24.74	0.56	24.68		
30	32.00	0.39	31.22	0.43	31.14	0.47	31.06	0.51	30.98	0.55	30.90	0.59	30.82	0.63	30.74		
36	38.30	0.43	37.44	0.48	37.34	0.62	37.06	0.58	37.14	0.63	37.04	0.68	36.94	0.73	36.84		
42	44.50	0.47	43.56	0.53	43.44	0.59	43.32	0.65	43.20	0.71	43.08	0.77	42.96	0.83	42.84	.250	.500
48	50.80	0.51	49.78	0.58	49.64	0.65	49.50	0.72	49.36	0.79	49.22	0.86	49.08	0.93	48.94		
54	57.10	0.57	55.96	0.65	55.80	0.73	55.64	0.81	55.48	0.89	55.32	0.97	55.16	1.05	55.00		

**REDUCE I.D. BY DIMENSION SHOWN

Stainless Steel, Hastelloy "C" & Titanium Pipe

Pipe Size	Pipe O.D.	Schedule 5 S (a)		Schedule 10 S (a)		Schedule 40 S		Schedule 80 S	
		I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL
½	.840	.710	.065	.674	.083	.622	.109	.546	.147
¼	1.050	.920	.065	.884	.083	.824	.113	.742	.154
1	1.315	1.185	.065	1.097	.109	1.049	.133	.957	.179
1¼	1.660	1.530	.065	1.442	.109	1.380	.140	1.278	.191
1½	1.900	1.770	.065	1.682	.109	1.610	.145	1.500	.200
2	2.375	2.245	.065	2.157	.109	2.067	.154	1.939	.218
2½	2.875	2.709	.083	2.635	.120	2.469	.203	2.323	.276
3	3.500	3.334	.083	3.260	.120	3.068	.216	2.900	.300
3½	4.000	3.834	.083	3.760	.120	3.548	.226	3.364	.318
4	4.500	4.334	.083	4.260	.120	4.026	.237	3.826	.337
5	5.563	5.345	.109	5.295	.134	5.047	.258	4.813	.375
6	6.625	6.407	.109	6.357	.134	6.065	.280	5.761	.432
8	8.625	8.407	.109	8.329	.148	7.981	.322	7.625	.500
10	10.750	10.482	.134	10.420	.165	10.020	.365	9.750	.500
12	12.750	12.438	.156	12.390	.180	12.000	.375	11.750	.500
14	14.000	13.688	.156	13.624	.188				
16	16.000	15.670	.165	15.624	.188				
18	18.000	17.670	.165	17.624	.188				
20	20.000	19.634	.188	19.564	.218				
22	22.000	21.624	.188	21.564	.218				
24	24.000	23.563	.218	23.500	.250				

Pipe Size	Pipe O.D.	Schedule 60		Schedule 80		Schedule 100		Schedule 120		Schedule 140		Schedule 160	
		I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL
½	.840			.546	.147							.466	.187
¼	1.050			.742	.154							.614	.218
1	1.315			.957	.179							.815	.250
1¼	1.660			1.278	.191							1.160	.250
1½	1.900			1.500	.200							1.338	.281
2	2.375			1.939	.218							1.689	.343
2½	2.875			2.323	.276							2.125	.375
3	3.500			2.900	.300							2.624	.438
3½	4.000			3.364	.318								
4	4.500			3.826	.337			3.624	.438			3.438	.531
5	5.563			4.813	.375			4.563	.500			4.313	.625
6	6.625			5.761	.432			5.501	.562			5.189	.718
8	8.625	7.813	.406	7.625	.500	7.439	.593	7.189	.718	7.001	.812	6.813	.906
10	10.750	9.750	.500	9.564	.593	9.314	.718	9.064	.843	8.750	1.000	8.500	1.125
12	12.750	11.626	.562	11.376	.687	11.064	.843	10.750	1.000	10.500	1.125	10.126	1.312
14	14.000	12.814	.593	12.500	.750	12.126	.937	11.814	1.093	11.500	1.250	11.188	1.406
16	16.000	14.688	.656	14.314	.843	13.938	1.031	13.564	1.218	13.124	1.438	12.814	1.593
18	18.000	16.500	.750	16.126	.937	15.688	1.156	15.250	1.375	14.876	1.562	14.438	1.781
20	20.000	18.376	.812	17.938	1.031	17.438	1.281	17.000	1.500	16.500	1.750	16.064	1.968
22	22.000	20.250	.875	19.750	1.125	19.250	1.375	18.750	1.625	18.250	1.875	17.750	2.125
24	24.000	22.064	.968	21.564	1.218	20.938	1.531	20.376	1.812	19.876	2.062	19.314	2.343

Greyline
Precision Flow Measurement
An ONICON Brand

Cast Iron Pipe - ASA Standard

Pipe	Pipe	Class 50		Class 100		Class 150		Class 200		Class 250		Class 300		Class 350	
Size	O.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.	WALL	I.D.
3	3.96	0.32	3.32	0.32	3.32	0.32	3.32	0.32	3.32	0.32	3.32	0.32	3.32	0.32	3.32
4	4.80	0.35	4.10	0.35	4.10	0.35	4.10	0.35	4.10	0.35	4.10	0.35	4.10	0.35	4.10
6	6.90	0.38	6.14	0.38	6.14	0.38	6.14	0.38	6.14	0.38	6.14	0.38	6.14	0.38	6.14
8	9.05	0.41	8.23	0.41	8.23	0.41	8.23	0.41	8.23	0.41	8.23	0.41	8.23	0.41	8.23
10	11.10	0.44	10.22	0.44	10.22	0.44	10.22	0.44	10.22	0.44	10.22	0.48	10.14	0.52	10.06
12	13.20	0.48	12.24	0.48	12.24	0.48	12.24	0.48	12.24	0.52	12.16	0.52	12.16	0.56	12.08
14	15.30	0.48	14.34	0.51	14.28	0.51	14.28	0.55	14.20	0.59	14.12	0.59	14.12	0.64	14.02
16	17.40	0.54	16.32	0.54	16.32	0.54	16.32	0.58	16.24	0.63	16.14	0.68	16.04	0.68	16.04
18	19.50	0.54	18.42	0.58	18.34	0.58	18.34	0.63	18.24	0.68	18.14	0.73	18.04	0.79	17.92
20	21.60	0.57	20.46	0.62	20.36	0.62	20.36	0.67	20.26	0.72	20.16	0.78	20.04	0.84	19.92
24	25.80	0.63	24.54	0.68	24.44	0.73	24.34	0.79	24.22	0.79	24.22	0.85	24.10	0.92	23.96

Cast Iron Pipe - AWWA Standard

Pipe	Class A 100 Ft. 43 PSIG			Class B 200 Ft. 86 PSIG			Class C 300 Ft. 130 PSIG			Class D 400 Ft. 173 PSIG		
Size	O.D.	WALL	I.D.	O.D.	WALL	I.D.	O.D.	WALL	I.D.	O.D.	WALL	I.D.
3	3.80	0.39	3.02	3.96	0.42	3.12	3.96	0.45	3.06	3.96	0.48	3.00
4	4.80	0.42	3.96	5.00	0.45	4.10	5.00	0.48	4.04	5.00	0.52	3.96
6	6.90	0.44	6.02	7.10	0.48	6.14	7.10	0.51	6.08	7.10	0.55	6.00
8	9.05	0.46	8.13	9.05	0.51	8.03	9.30	0.56	8.18	9.30	0.60	8.10
10	11.10	0.50	10.10	11.10	0.57	9.96	11.40	0.62	10.16	11.40	0.68	10.04
12	13.20	0.54	12.12	13.20	0.62	11.96	13.50	0.68	12.14	13.50	0.75	12.00
14	15.30	0.57	14.16	15.30	0.66	13.98	15.65	0.74	14.17	15.65	0.82	14.01
16	17.40	0.60	16.20	17.40	0.70	16.00	17.80	0.80	16.20	17.80	0.89	16.02
18	19.50	0.64	18.22	19.50	0.75	18.00	19.92	0.87	18.18	19.92	0.96	18.00
20	21.60	0.67	20.26	21.60	0.80	20.00	22.06	0.92	20.22	22.06	1.03	20.00
24	25.80	0.76	24.28	25.80	0.89	24.02	26.32	1.04	24.22	26.32	1.16	24.00
30	31.74	0.88	29.98	32.00	1.03	29.94	32.40	1.20	30.00	32.74	1.37	30.00
36	37.96	0.99	35.98	38.30	1.15	36.00	38.70	1.36	39.98	39.16	1.58	36.00
42	44.20	1.10	42.00	44.50	1.28	41.94	45.10	1.54	42.02	45.58	1.78	42.02
48	50.50	1.26	47.98	50.80	1.42	47.96	51.40	1.71	47.98	51.98	1.96	48.06
54	56.66	1.35	53.96	57.10	1.55	54.00	57.80	1.90	54.00	58.40	2.23	53.94
60	62.80	1.39	60.02	63.40	1.67	60.06	64.20	2.00	60.20	64.82	2.38	60.06
72	75.34	1.62	72.10	76.00	1.95	72.10	76.88	2.39	72.10			
84	87.54	1.72	84.10	88.54	2.22	84.10						

Pipe	Class E 500 Ft. 217 PSIG			Class F 600 Ft. 260 PSIG			Class G 700 Ft. 304 PSIG			Class H 800 Ft. 347 PSIG		
Size	O.D.	WALL	I.D.	O.D.	WALL	I.D.	O.D.	WALL	I.D.	O.D.	WALL	I.D.
6	7.22	0.58	6.06	7.22	0.61	6.00	7.38	0.65	6.08	7.38	0.69	6.00
8	9.42	0.66	8.10	9.42	0.71	8.00	9.60	0.75	8.10	9.60	0.80	8.00
10	11.60	0.74	10.12	11.60	0.80	10.00	11.84	0.86	10.12	11.84	0.92	10.00
12	13.78	0.82	12.14	13.78	0.89	12.00	14.08	0.97	12.14	14.08	1.04	12.00
14	15.98	0.90	14.18	15.98	0.99	14.00	16.32	1.07	14.18	16.32	1.16	14.00
16	18.16	0.98	16.20	18.16	1.08	16.00	18.54	1.18	16.18	18.54	1.27	16.00
18	20.34	1.07	18.20	20.34	1.17	18.00	20.78	1.28	18.22	20.78	1.39	18.00
20	22.54	1.15	20.24	22.54	1.27	20.00	23.02	1.39	20.24	23.02	1.51	20.00
24	26.90	1.31	24.28	26.90	1.45	24.00	27.76	1.75	24.26	27.76	1.88	24.00
30	33.10	1.55	30.00	33.46	1.73	30.00						
36	39.60	1.80	36.00	40.04	2.02	36.00						