PORTAFLOW 204 *Plus!*

Flowmeter

Operating Manual

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PORTAFLOW 204 *Plus!!*

INTRODUCTION

The PORTAFLOW 204 *Plus!!!* non-invasive Ultrasonic portable flow meter has been designed to help Service, Maintenance and Commissioning Engineers make quick, accurate flow readings of any liquids in pipes from 13mm internal diameter to 115mm outside Diameter.

These compact, rugged instruments will measure flow rate in litres/second, litres/minute, gallons/minute, US gallons/minute, m^3/hour, metres/second or feet/sec. The total is displayed as litres, gallons, US gallons and m^3.

Simple to set up, the PORTAFLOW is able to accurately measure the flow of clear or cloudy liquids from 0.3 metres per second up to 8 metres per second, in any pipe material and over a temperature range of -20°C to +125°C.

Programming is menu driven with the user supplying OD, wall thickness, pipe material and pipe temperature information when measuring water. Liquid sound speed data is required when measuring other fluids. It is possible to program the instrument and mount the transducers in under 2 minutes, with stable flow data becoming available immediately. The unit is powered by a rechargeable battery pack included in the instrument, which gives an operating life of 8-10 hours from full charge. For continuous operation the meter can be operated from the mains, via the battery charger.

TRANSDUCER MOUNTING

1.	OPERATION	COMMENT
1.1	Remove oxidization, bitumen or rubber from pipe surface where the transducer assembly is to be mounted.	Very thick asbestos, concrete, old porous cast iron tubes and steel pipes with scaled or badly corroded internal surfaces can weaken the signal and prevent the unit from operating correctly.

Mounting transducer assembly.

1.2	Turn the two knurled lock nuts on the rail assembly (figure 3a), CLOCKWISE to withdraw the transducers into the guide rail and then apply ultrasonic couplant as shown in figure 2, page 3.	Straight pipe lengths either side of the flow sensors should be 20 diameters UPSTREAM and 10 diameters DOWNSTREAM. See figures 1a and 1b, page 3.
1.3	Position transducer assembly onto prepared section of pipe as recommended at 1.1. The fixed transducer (Blue) should be DOWNSTREAM from the floating transducer (Red). Strap to pipe securely using the ball chain attached to the rail.	The guide rail assembly must be in alignment with the pipe axis and positioned as shown in figure 3b when attached to a horizontal pipe. If the sensor cables are connected in reverse the instrument will display a negative flow rate, but this will not affect the accuracy of the reading.
1.4	Turn the knurled lock nut for the fixed transducer ANTI-CLOCKWISE to contact pipe surface.	Do not over tighten. Do not lock the floating transducer until the 'separation distance' has been determined after programming the unit.
1.5	Connect transducer assembly to the handset with the cables provided.	The Portaflow is now ready to program.

Fig 1a.

CORRECT

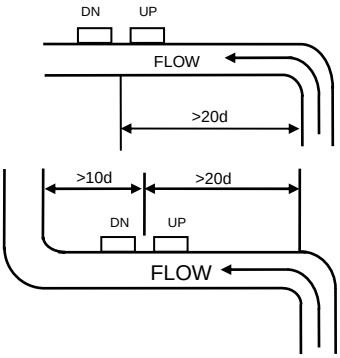


Fig 1b.

INCORRECT

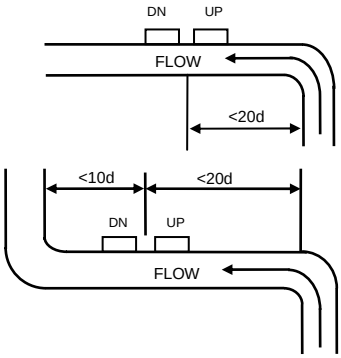


Fig 2. Inverted Plan View of Transducer Assembly

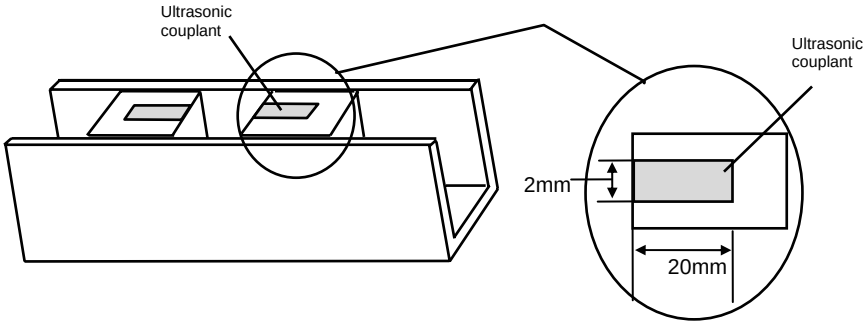


Fig 3a. Guide Rail Assembly

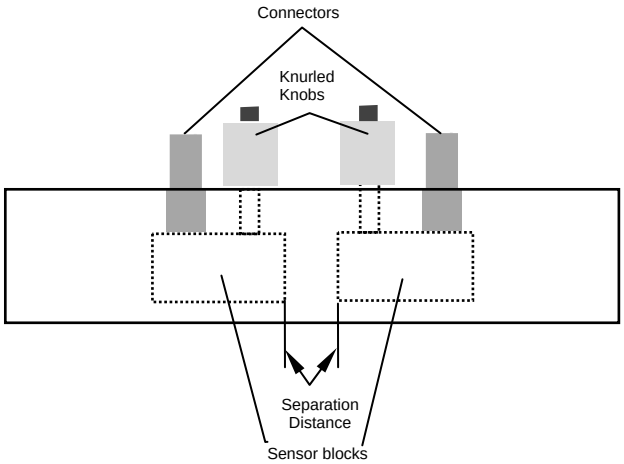
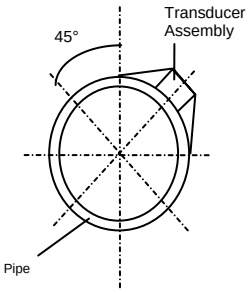


Fig 3b

Mount Transducer Assembly as shown



PROGRAMING-MAIN MENU

Switch 0n…

Micronics Ltd.
PORTAFLOW

204+3 V1.04
Press Enter to start

Main Menu
Press SCROLL up or down to move cursor to the required option and press **ENTER** to select.

MAIN MENU
Quick start
View/Edit Site Data
Sensor set
Data Logger
Set up RS232
Set up Instrument
Read flow

Main Menu - Quick Start
Selecting quick start allows the user to start entering application information. If the instrument has been used previously, it stores the last application data entered. If the unit is to be used on the same application the user can scroll immediately to **Read flow** on the menu, and press enter without spending time entering new data.

If the unit is to be used on a new application select **QUICK START** and proceed with the following routine. Use the scroll keys to select, and then press **ENTER.**

QUICK START

Dimension units?
mm
Inches

The instrument now asks for the **Pipe outside diameter?** After entering the outside diameter in millimetres press **ENTER**.

QUICK START

Dimension units	mm
Pipe O.D.?	58.0

Pipe wall thickness now appears on the display. Enter the pipe wall thickness in millimetres, then press **ENTER.**

QUICK START

Dimension units	MILLIMETRES
Pipe O.D.?	58.0
Wall thick?	4.0

Pipe lining thickness now appears on the display. If the pipe you are measuring has a lining, enter the **Pipe lining thickness**. If nothing is entered the instrument automatically assumes there is no lining. Press ENTER to move on.

QUICK START

Dimension units	MILLIMETRES
Pipe outside diameter?	58.0
Wall thick?	4.0
Lining?	0.0

The instrument now displays **Select pipe wall material**. Using the scroll keys select from the options available and press **ENTER.**

QUICK START

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)

Note: The following will only be displayed if a lining thickness had been entered previously. Use the scroll keys to select the required material, and then press **ENTER**. If **Other** is selected, enter the sound speed of the lining in metres/sec.

QUICK START

Select pipe lining material:
Steel
Rubber
Glass
Epoxy
Concrete
Other (mps)

Select fluid type now appears on the display. Use the scroll keys to select the fluid type and press **ENTER**.

If the liquid you are measuring is not listed select **Other** and enter a liquid sound speed in metres/second. The sound speed information can be found in the back of the manual under **Liquid Sound Speeds.**

QUICK START

Select fluid type:
Water
Glycol/water 50/50
Lubricating oil
Diesel oil
Freon
Other (m/sec)

The instrument will now display the screen below and provide the user with details of the mode of operation and the maximum flow rate that can be achieved from the information entered. At this stage use the keypad to check maximum volumetric flows. If the display reads **double bounce** or **treble bounce** the unit has calculated a larger separation distance, but the transducers should still be set up in reflex mode.

Attach sensor set
in REFLEX mode
Approx. max. flow:
X.XX m/s
ENTER to continue
SCROLL changes mode

Select ENTER and the display will now ask you to enter a temperature.
Enter the application temperature and press **ENTER.** The display will now display a sensor separation distance.

Set sensor
Separation to
XXX

ENTER to continue

Follow the steps below to attach the guide rail and transducers to the pipe.

1. Take the guide rail and apply grease to the sensors as shown on page 3 fig 2.
2. Turn thumbscrews on the top of the guide rail clockwise to retract the sensors back up into the guide rail. This will keep the grease away from the pipe until the guide rail is attached.
3. Now strap the guide rail to the pipe.
4. Screw down the fixed transducer and slide the moveable transducer to the required separation distance (front edge of block), and screw down on to the pipe.
5. Connect the RED and BLUE sensor cables, between the guide rail and the electronics.
6. Press **ENTER** to read flow.

The flow reading now appears on the display.

Batt CHRG
Sig 48%
(ERROR MESSAGES APPEAR HERE)

m/s

When reading volumetric flow the instrument will display a positive and negative total. Selecting OPTIONS from the keypad can reset these totals (See page 8).

The instrument will continually display the battery and signal levels. Signal levels should be above 30%, to obtain an accurate reading.

If there is an error with the site data entered or the application, the instrument will display an Error or warning message (See page 10), which will appear above the flow reading. If there is more than one message it will continually scroll between them.

To stop reading flow, press ENTER **ONCE**. The display will read the following.

This will stop all
outputs

Press ENTER to EXIT
SCROLL to return
to READ FLOW

Pressing ENTER a second time will stop outputs and return the instrument to the **MAIN MENU.**

Press the scroll key to return the instrument to **READ FLOW**.

Main Menu - View/Edit Site Data

The **VIEW/EDIT SITE DATA** mode can be accessed from the main menu. It allows the user to enter application details for up to 20 different sites. This facility is useful if a number of sites are being monitored on a regular basis. Application data can be programmed into each site before getting there! This also allows you to view the last data entered and edit if required.

When scrolling up/down the menu press **ENTER** to select at each prompt.

VIEW/EDIT SITE DATA	
List sites	
Site number	0
Name	QUICK START
Units	MM
Pipe O.D.	58.0
Wall thick	4.0
Lining	0.0
Wall	MILD STEEL
Lining	---------
Fluid	WATER
Read flow	Exit

Note:

- Site Zero is always the **QUICK START** data and cannot be changed.
- Changing the data in any site is automatically saved when leaving this menu. Data will have to be re-entered to over ride the old data.

***View/Edit Site Data* - List Sites**
Selecting **LIST SITES** allows the user to view the names of up to 20 sites, numbers 1-5 appear first.
Pressing ENTER will display sites from 6-10. Pressing again will display sites 11-15, and again to display 15-20.

1 site not named
2 site not named
3 site not named
4 site not named
5 site not named
Press ENTER to continue

***View/Edit Site Data* - Site Number**
Site number allows the user to enter the number of the site data that you wish to be displayed. If the site has not been used then no data would be stored. You can now enter new application data.

***View/Edit Site Data* - Site Name**
Site name allows the user to edit or enter a site name. Use the scroll keys to move the cursor to the letter/figure required and press ENTER to select. Press zero, to return the instrument to **VIEW/EDIT SITE DATA**. The new site name will appear on the display.

SCROLL & ENTER
Select for space, 0 to end

abcdefghijklmnopqr
stuvwxyz01234567890
>…….....<

***View/Edit Site Data* - Units**
Dimension units allow the user to switch between millimetres and inches. The software converts all the application data in a particular site.

***View/Edit Site Data* - Pipe wall/lining thickness** and **Pipe wall/lining material** can now be changed as required. Lining material is ignored if a lining thickness has not been entered. A selection of pipe wall/lining materials will be displayed when these options are selected.

***View/Edit Site Data* - Fluid type**
Fluid type allows the user to scroll through a selection of fluid types. Select **OTHER** in the menu if a liquid is not mentioned. When **Other (m/s)** is selected the user must enter the liquid sound speed in m/s. This can be supplied by Micronics or found in the back of the manual under **Liquid Sound Speeds**.

***View/Edit Site Data* - Read Flow**
Selecting **Read flow** informs the user of the mode of operation and the approximate maximum flow rate. Press the appropriate key can change the units required.

Attach sensor set
in REFLEX mode
Approx. max. flow:
X.XX m/s
ENTER to continue
SCROLL changes mode

Pressing **ENTER** asks the user to enter a temperature in °C.

Fluid temp? 20.0
(°C)

Enter the temperature and press ENTER. The instrument will display the separation distance before displaying flow. Follow the instructions on the screen and the unit will read flow.

***Main Menu* – Sensor set**
When the application information is programmed into the instrument it calculates the optimum separation distance for the transducers in reflex mode, double bounce reflex or triple bounce reflex.

Sensor Mode
All methods displayed are reflex mode, but on smaller pipes the unit will calculate the separation distance in Double or Triple Bounce Reflex. Should the actual flow be higher than the one specified on the instrument, another mode of operation can be selected, but is very unlikely.

Read Flow
Moving the cursor to **Read flow** and pressing **ENTER** informs the user of the mode of operation and the maximum flow capable. Selecting EXIT will take you back to **MAIN MENU**.

***Main Menu* – Data Logger**
Not available on this model.

***Main Menu* – Setup RS232**
Not available on this model.

***Main Menu* – Set up instrument**

***Set up Instrument* - Calibrate 4-20mA** (Note: A meter is required to measure the output.)
The 4-20mA Output is calibrated before it leaves the factory and also allows the user to adjust the calibration to match a specific display. The DAC value is a number between 0 and 40,000 and is a number internal to the Portaflow that will change when calibrating the 4-20mA.

The first stage is to adjust the output current to 4mA. When connected to any device that accepts 4-20mA, it may require adjustment to exactly 4mA or 20mA and this is possible by using the scroll keys or keys 5 and 6. The scroll keys move the DAC value in larger steps of 25 and keys 5 & 6 move the value one at a time.

The DAC value will be approximately 8000 for 4mA and 40000 for 20mA. By watching the actual current value displayed on the meter, it is possible to scroll up and down or use keys **5** and **6** to calibrate the 4-20mA to the exact value.

When the 4mA is adjusted press ENTER. Now adjust the 20mA in the same way. Press ENTER when complete and the display will return to the **SETUP** Instrument menu. If the 4-20mA is **not** connected then the instrument will still display the DAC number but display **Error** instead of **OK**.

yy-mm-dd hh:mm:ss

Adjust to 4mA
Use UP/DOWN to set,
5/6 to trim
DAC value: 8590
mA **OK/ERROR**
Press ENTER when done

***Set up instrument* - Display backlight**
Use the scroll key to select backlight and press **ENTER**. This allows the user to enable or disable the backlight. Enable, means the backlight will stay on for 15secs with every key press. It will stay on permanently with the mains plugged in. Use the scroll key to select and press **ENTER**. The backlight will draw power from the batteries and reduce the operating life of the battery cell. **(follow the application note at the back of the manual)**

***Set up instrument* - Application Options**
Contact Micronics.

***Set up instrument* - Sensor Parameters**
Micronics use only.

***Set up instrument* - Factory Settings**
Micronics use only.

***Set up instrument* - Exit**
Means EXIT and will take you back to the Main Menu.

***Main Menu* - Read Flow**

When choosing the **Read flow** option from the **MAIN MENU** the instrument defaults directly to the data that was last entered. The instrument will have to be reprogrammed if it is to be used on a new application.

KEYPAD OPTIONS

The output options can only be adjusted and operated in flow mode.

Pulse Output Key

Use the scroll key to move the cursor up or down the display. To change the flow units press the key required. This will also change the flow units when returning to the flow mode. Changing the flow units will also re-scale the litres per pulse.

PULSE OUTPUT

Flow units
Output OFF
Max. pulse rate1 per sec
Litres per pulse XXXXX
Exit

Outputs allow the user to select from the following.

1. Selecting **Off** switches the pulse off and returns to the **PULSE OUTPUT** display.
2. Selecting the **Forward total** counts the pulses of the forward flow only.
3. Selecting **Net total** counts the pulses of the sum of the forward total less the reverse total.

OUTPUT

Off
Forward total
Net total

Max. Pulse Rate

This option allows the user to select between fast/slow pulses or large/small pulse width. Select 1 per second for slow pulses and 100 for a fast pulse. The pulse width for 1 per second is 100ms and 5ms for 100 per second.

XXXX per pulse

This will change when the flow units are changed above. When the correct flow units are selected this allows the user to scale the pulses to there own requirements or it can be left in the default setting.

4 - 20mA Output KEY

The 4-20mA Output can be scaled to the minimum and maximum flow rate. It is also possible to enter a negative figure for the minimum output and would enable a reverse flow to be monitored. For example the 4mA would be the maximum reverse flow (e.g. –100 lpm) and the 20mA would be maximum positive flow (e.g. +100 lpm).

mA Out

This displays the current output at any particular time.

yy-mm-dd hh:mm:ss
4-20MA
Units l/m
Flow at max. xxx
Flow at min. xxx
mA for error 22.0
Exit

Output

This option allows the user to select between three different outputs or switching the output off. The display will read as follows. Scroll down the options to select required output, and press ENTER. The display will then revert back to the **4-20mA** menu and **Flow at max. output.**

yy-mm-dd hh:mm:ss
OUTPUT OFF
4 - 20mA
0 - 20mA
0 - 16mA

The Units

The flow units can be changed at this stage by selecting them from the keypad. When selected, scroll down to move onto the next option.

Flow at Max. Output

This sets the output at the top end of the scale so that the maximum flow gives 20mA (or 16mA).

The instrument automatically defaults to the maximum flow rate. The user can press ENTER and set the output to a level required. When selected press ENTER to continue.

If the flow was over the maximum range set, the instrument will go to a maximum of 24.4 mA and stay there until either the flow reduces or the output is re-scaled. The instrument will also display a warning message- **mA out over range-**if the output is greater than 20mA or 16mA.

Flow at Min. Output

This sets the output at the bottom end of the scale so that the minimum flow gives 4mA or 0mA.
The instrument automatically defaults to zero, but the user is able to enter any

figure they wish including a minus figure for reverse flow conditions.

Output mA For Error
This gives an error output to inform the user of loss of signal. The figure set to between zero and 24mA, but defaults to 22mA.

Exit

RS232 Key
Not available on this instrument.

Logger Key
Not available on this instrument.

Delete Key
If anything is entered in error, press the DELETE key and re-enter the information required.

Options Key
This can only be used in flow mode. Scroll down the options then press **ENTER** to select.

OPTIONS	
Cutoff (m/s)	0.05
Set zero	
Total	RUN
Reset + total	
Reset – total	
Damping (sec)	5
Cal Factor	1.00
Corr Factor	1.00
Diagnostics	
Exit	

Options key - Cut Off (m/s)
The instrument has an automatic CUTOFF which defaults to 0.05 m/s. Micronics cannot guarantee measuring flows below this range due to the nature of the applications, installation, and instabilities in the measuring system.

Adjusting the cutoff allows the user not to see or record any flow below that figure. For example it may be that the user may not want to measure flows below 50 LPM in a 50mm pipe which is equivalent to 0.42 m/sec. In this case 0.42 m/sec would be entered into the instrument and nothing would be recorded below that level. The maximum cut off is 1 m/sec.

Options key – Set zero flow
On some applications and in some conditions it may be possible that although there is no flow the instrument may show a small offset due to “noise” or “ringing”. The offset can be cancelled out and will increase the accuracy of the instrument.

Selecting this option and pressing **ENTER** the display will show the following.

Stop the flow COMPLETELY and press ENTER or SCROLL to cancel

Pressing **ENTER** before the flow has stopped will result in a message asking if you **are you sure the flow has stopped**. This occurs when the flow is still above 0.25m/sec.
When this facility has already been selected, press ENTER to cancel the previous instruction, it is then possible to re-set the Zero balance. The option is not available when error messages E1 and E2 (See 10) are being displayed.

Set up instrument - Total
This option allows the user to disable the positive and negative totalizers. When you select either of these options the totaliser will start or stop functioning. It does not zero the total, this is a separate function described below.

Set up instrument - Reset + Total and - Total
The Portaflow 204 *Plus!* has a forward and reverse totaliser that can be reset. Use the scroll keys to select and press **ENTER** to reset. The Total is stored when the unit is switched off or battery goes flat.

Set up instrument - Damping (sec)
Damping maybe used when the flow readings are unstable due to turbulence caused by obstructions or bends etc. Damping or averaging can be used to make the readings more stable. It can be set to up-date the display, anything between 3 and 100 seconds.

Set up instrument - Calibration Factor
This allows the user to calibrate the unit for a specific application. If for example the flow reading is 4% higher than expected entering 0.96 will reduce the reading by 4%. If the reading is 4% lower than expected then entering 1.04 would increase the reading by 4%.

When the instrument is supplied it will always default to 1.00 and when this is changed it will stay in the memory, until such time as it needs to be changed again.

Set up instrument - Correction Factor

This is a facility that can be used when errors occur due to lack of straight pipe or the sensors have been placed too close to a bend, this could give an incorrect reading to what is expected. The user can set this as a % in the same way as the calibration factor, but it will not be stored in the memory, when the unit is switched off.

Set up instrument – Diagnostics

The following list allows Micronics to see if the instrument is functioning correctly, and if the signals are being sent and received in the correct way.

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

Up μs, Dn μs
This is the actual transit time measured by the instrument and will be slightly (5-10μs depending on the pipe size and signal condition) less than the calculated value above.

Measurement μs
A point in the signal transmitted, where the flow measurement is taken from. It is used to see if the signal is being taken from the burst at the correct time to get the strongest signal. It is normally used on smaller pipes when the instrument is being used in double or triple bounce as signals can sometimes interfere with each other. This value is normally a few μs below the **Up μs, Dn μs** value.

Phase up/dn μs
Only valid if **Calculated μs** and **Up μs, Dn μs** are correct. If the reading is zero then there is no signal, which could mean the pipe is empty, or the liquid is contaminated with particles or air.

Phase offset
This value will be between 0 and 15. The exact value is not important and will vary between applications. It should however, be stable when the flow condition is good and velocity is within the range of the transducers being used. As the flow rate increases towards and beyond the maximum, this figure will continuously change. In flow mode the instrument will read unstable or high flow.

Flow (m/s)
This displays flow velocity in m/sec to 3 decimal places.

Signal
This is the average value of **Signal up/dn** and is a value between 800 and 2400 which
Display's the signal strength as a percentage (800=0%, 2400=86%).

Signal up/dn
This value is internal to the electronics and must be greater than 800. There is an option in the **SET UP INSTRUMENT** menu to allow this value to be taken down to 400 in extreme circumstances and is useful on some applications when the signal levels are poor.

Sensor separation
This is a reminder for the user to check for correct sensor separation and sensor mode.

STATUS/ERROR/WARNING MESSAGES

There are three types of message that will appear, Status, Error and Warning. These messages appear under the time and date on the display when in flow mode.

Status Messages

S1: Initialising
Appears when first entering flow mode to show instrument is starting up.

Error Messages

E1: unstable or high flow
This error message occurs when either the sensors have been positioned too near to an obstruction or bend causing turbulence, or the instrument is being used outside its normal flow range. When the instrument is programmed it calculates the maximum flow rate and if this is exceeded then the high flow message occurs.

E2: No Flow Signal
This message appears when the two transducers cannot send or receive signals, which could happen for various reasons. Firstly check that all cables are connected, transducers are on the pipe correctly with grease between the sensor face and the pipe.

No flow signal will happen if:

- The pipe is empty or partially filled.
- The liquid is aerated.
- The particulate content of the liquid is too high.

- The grease has not been applied to the transducers
- The condition of the pipe being measured is poor.

Warning Messages

W1: Check site data
This message occurs when the application information has been entered incorrectly or the wrong sensors have been attached to the wrong pipe size causing the system timing to be in error. The site data needs to be checked and the instrument reprogrammed.

W2: Signal timing poor
Unstable signal timing or differing up/down stream times, indicate that the liquid is aerated or pipe surface is of poor quality.

W3: Flow signals poor
This warning appears when there is a signal lower than 25%. This could be due to the application, a poor quality pipe, amongst others.

W4: mA OUT Overange
The mA output is over-range when the flow is higher than the maximum mA range. Once the 4-20mA has been set up and the flow goes above the range set then this message will appear. It is possible to re-scale the 4-20mA to be able to cope with the higher flow.

W5: BATTERY LOW
The battery low warning occurs when battery indication is on 40%. The instrument has approximately 30 minute's usage before it needs recharging. (See application note at the back of this manual)

W6: mA load too high
The 4-20mA Output is designed to work with a load up to 750Ω. When the load is too high or not connected, the above warning message will be displayed.

Other Messages

The messages below appear mainly when data has been incorrectly entered or the Portaflow 204 *Plus!* is trying to be used on an application that it is not capable of working on.

Pipe OD out of range
The outside diameter of the pipe has been entered and is out of range of the instrument.

Wall thickness out of range
The wall thickness that has been entered is out of range of the instrument.

Lining thickness out of range
The pipe lining thickness has been incorrectly entered.

APPLICATION & PERFORMANCE

WARNING - Users should or note that:

a) The PORTAFLOW is not certified for use in Hazardous areas.

b) The local site safety regulations must be complied with.

c) Work is carried out in accordance with The Health & Safety at Work Act 1974.

The operational temperature of the fluid to be measured is -20°C to +125°C

The velocity of the liquid marginally accelerates the speed at which the ultrasound is transmitted from transducer 'A' to 'B'. However, when the direction of the transmission is reversed, i.e. from transducer 'B' to 'A', a deceleration will occur because the sound is being transmitted against the liquid flow. Therefore the difference in time taken over the same distance is directly proportional to the flow velocity - see fig. 4.

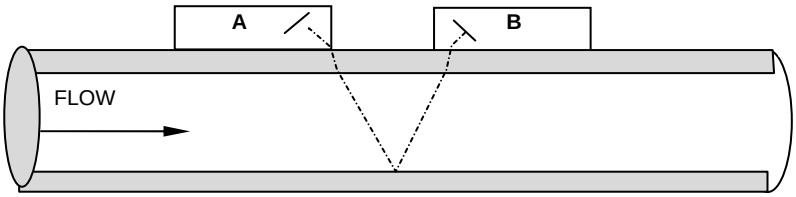


Fig. 4

As it is not possible to determine from the outside what flow conditions prevail inside the pipe, it must be assumed that the liquid is flowing uniformly in either a turbulent or laminar flow condition, and that the flow velocity profile is also uniform for 360 degrees around the pipe axis. Distortion of the flow velocity profile caused by bends, tees or any other type of obstruction may create measurement errors.

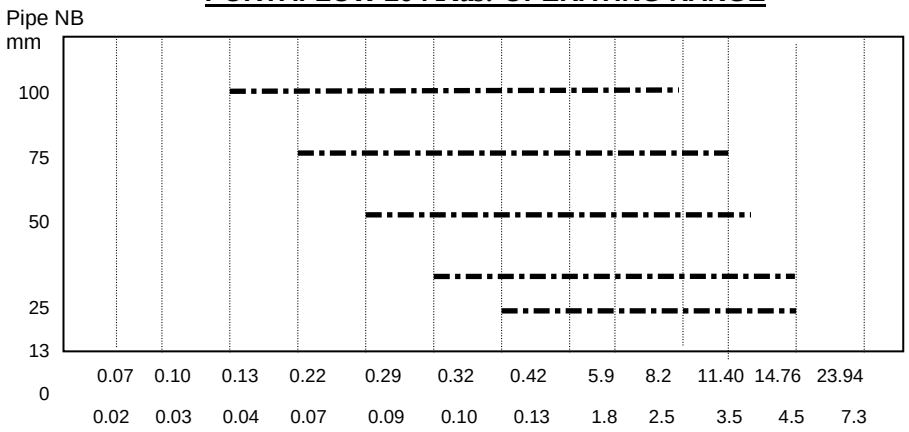
LIQUID CONDITIONS

Transit time ultrasonic meters perform best on liquids that are totally free from entrained air and solids. With sufficient air in the system, the ultrasound beam can be attenuated totally and therefore prevent the instrument from working. Often it is impossible to tell whether there is air in the system or not.

If a flow signal cannot be obtained, a simple test to determine whether the flow is aerated involves cutting off the flow for a period of 10-15 minutes.

During this time, the air bubbles will rise to the top of the pipe and the flow signal should return.
When the flow signal has returned, "switch on" the flow and if entrained air is still present then signal loss

PORTAFLOW 204 *Plus!* OPERATING RANGE



PORTAFLOW 204 *Plus!* SPECIFICATION

Carrying Case	
Outside Dimensions	: 350mmx330mmx170mm
Protection Class	: IP54
Material	: Plastic
Total Weight Complete	: 6 Kilos
Electronics Housing Assembly	
Approximate Dimensions	: 235mmx125mmx42mm
Material	: Pebble Grey Abs
Protection class	: IP 54
Approx. weight	: 400grms
Operating Temp	: 0°C to +45°C
Storage Temp	: -20°C to +55°C
Battery Pack	: 5 AA Nickel Metal Hydride
Data input	
Via 16 Key Tactile Membrane Keypad	
Display	
Graphics LCD Display	
Low Batt' Indication	
Signal Level Indication	
Output data	
Flow Rate Indication	: Litres/sec, litres/min, gallons/min, US gallons/min, m^3/hr : Feet/sec, metres/sec
Totaliser (To 12 Digits)	: Gallons, litres, US gallons, m^3
Pulse Output	: 5 Volts. Maximum 1 pulse per second
Analogue	: 4-20mA in 500 ohms
Display Resolution	
0.1% of the reading or better	
Repeatability	
Changed Transducer Position	:+/- 1·0%
Response Time	
Less than 2 seconds	

204 Plus!	
Transducers	
Clamp on with Ball Chain strapping	
Guide Rail Length	: 210mm x 36mm x 27mm
Operating Range	: -20°C to +125°C
Cable Length	: 2 metres
Pipe range	
13mm to 115mm Outside Diameter	
Accuracy	
	: +/-1-3% within the velocity range. Operating Range.
115mm	: 0.3 metres/sec to 4 metres/sec
13mm	: 0.5 metres/sec to 8 metres/sec
	: Maximum velocity dependent on the pipe size

MICRONICS reserve the right to alter any specification without notification.

WARRANTY

The material and workmanship of the PORTAFLOW 204 *Plus!* is guaranteed by MICRONICS LTD for one year from the date of purchase provided the equipment has been used for the purpose for which it has been designed, and has been operated in accordance with the operating manual supplied.

Misuse by the purchaser, or any other person, will immediately revoke any warranty given or implied.

Repair or replacement will be at MICRONICS LTD discretion and will be made without charge at MICRONICS LTD plant during the warranty period. MICRONICS LTD reserves the right, without prior notices, to discontinue manufacture, redesign or modify any of its products. Your statutory rights are not affected by this warranty.

If any problems develop, customers are requested to take the following steps:

Notify MICRONICS LTD or the Distributor/Agent from whom the flow meter was purchased giving details of the problem. Be sure to include the Model & Serial Number of the instrument. When returning a product to the factory, carefully package and ship freight prepaid. Be sure to include a complete description of the application and problem and identify any hazardous material used with the product. The Warranty of the PORTAFLOW is strictly in accordance with that stated above, and cannot in any way be extended.

CE MARKING

The PORTAFLOW 204 *Plus!* has been tested and found to conform to EN50081 - 1 Emission Standards and EN50082 - 1 Immunity Standards.

The tests were conducted by AQL - EMC Ltd, of 16 Cobham Road, Fern Down Industrial Estate, Windborne, U.K. BH21 7PG.

The unit was tested with all cables as supplied of a maximum length of 3m. While the operation of the unit may not be affected by the use of longer cables, MICRONICS LTD can make no statement about conformance to the above standards when these cables are in use.

The PORTAFLOW 204 *Plus!* is supplied with an external battery-charging unit. This unit is manufactured by Frieman & Wolf, Gerätebau GmbH. P.O. Box 1164 D-48342 Ostbevan, Germany who have CE marked the equipment. MICRONICS LTD have purchased this equipment on the understanding that the manufacturers have tested the unit to the relevant standards prior to CE marking the product. MICRONICS LTD have not tested the charger unit and cannot accept responsibility for any non-conformance from the relevant standards.

LIQUID SOUND SPEEDS

Note: All the following sound speeds are calculated at 25°C.

The speed of sound in liquids at temperatures other than 25°C is calculated as follows.

Example:

Substance	Form Index	Specific Gravity	Sound Speed	Δv/ºC - m/s/ºC
Glycol	$C_2H_6O_2$	1.113	1658	2.1
Water, distilled (49,50)	H_2O	0.996	1498	-2.4

For every 1°C higher than 25°C take off the value in the Δv/°C- m/s/°C column.

Glycol at 50°C = 1658 - (2.1 x 25) = 1605.5

For every 1°C less than 25°C add on the value in the Δv/°C- m/s/°C column.

Glycol at 5°C = 1658 + (2.1 x 20) = 1700

If the value has a minus sign in front of it then do the opposite of above.

Distilled Water at 50°C = 1498 - (-2.4 x 25) =1558

Distilled Water at 10°C = 1498 + (-2.4 x 15) = 1462

Substance	Form Index	Specific Gravity	Sound Speed	Δv/ºC -m/s/ºC
Acetic anhydride (22)	$(CH_3CO)_2O$	1.082 (20ºC)	1180	2.5
Acetic acid, anhydride (22)	$(CH_3CO)_2O$	1.082 (20ºC)	1180	2.5
Acetic acid, nitrile	C_2H_3N	0.783	1290	4.1
Acetic acid, ethyl ester (33)	$C_4H_8O_2$	0.901	1085	4.4
Acetic acid, methyl ester	$C_3H_6O_2$	0.934	1211	
Acetone	C_3H_6O	0.791	1174	4.5
Acetonitrile	C_2H_3N	0.783	1290	4.1
Acetonylacetone	$C_6H_{10}O_2$	0.729	1399	3.6
Acetylene dichloride	$C_2H_2C_{l2}$	1.26	1015	3.8
Acetylene tetrabromide (47)	$C_2H_2Br_4$	2.966	1027	
Acetylene tetrachloride (47)	$C_2H_2Cl_4$	1.595	1147	
Alcohol	C_2H_6O	0.789	1207	4.0
Alkazene-13	$C_{15}H_{24}$	0.86	1317	3.9
Alkazene-25	$C_{10}H_{12}Cl_2$	1.20	1307	3.4
2-Amino-ethanol	C_2H_7NO	1.018	1724	3.4
2-Aminotolidine (46)	C_7H_9N	0.999 (20ºC)	1618	
4-Aminotolidine (46)	C_7H_9N	0.966 (45ºC)	1480	
Ammonia (35)	NH_3	0.771	1729	6.68
Amorphous Polyolefin		0.98	962.6	
t-Amyl alcohol	$C_5H_{12}O$	0.81	1204	
Aminobenzene (41)	$C_6H_5NO_2$	1.022	1639	4.0
Aniline (41)	$C_6H_5NO_2$	1.022	1639	4.0
Argon (45)	Ar	1.400 (-188ºC)	853	
Azine	C_6H_5N	0.982	1415	4.1
Benzene (29,40,41)	C_6H_6	0.879	1306	4.65
Benzol (29,40,41)	C_6H_6	0.879	1306	4.65
Bromine (21)	Br_2	2.928	889	3.0
Bromo-benzene (46)	C_6H_5Br	1.522	1170	
1-Bromo-butane (46)	C_4H_9Br	1.276 (20ºC)	1019	
Bromo-ethane (46)	C_2H_5Br	1.460 (20ºC)	900	
Bromoform (46,47)	$CHBr_3$	2.89 (20ºC)	918	3.1
n-Butane (2)	C_4H_{10}	0.601 (0ºC)	1085	5.8
2-Butanol	$C_4H_{10}O$	0.81	1240	3.3
sec-Butylalcohol	$C_4H_{10}O$	0.81	1240	3.3
n-Butyl bromide (46)	C_4H_9Br	1.276 (20ºC)	1019	
n-Butyl chloride (22,46)	C_4H_9Cl	0.887	1140	4.57
tert Butyl chloride	C_4H_9Cl	0.84	984	4.2
Butyl oleate	$C_{22}H_{42}O_2$		1404	3.0
2,3 Butylene glycol	$C_4H_{10}O_2$	1.019	1484	1.51
Cadmium (7)	Cd		2237.7	
Carbinol (40,41)	CH_4O	0.791 (20ºC)	1076	2.92
Carbitol	$C_6H_{14}O_3$	0.988	1458	
Carbon dioxide (26)	CO_2	1.101 (-37ºC)	839	7.71
Carbon disulphide	CS_2	1.261 (22ºC)	1149	
Carbon tetrachloride(33,35,47)	CCl_4	1.595 (20ºC)	926	2.48
Carbon tetrafluoride (14)	CF_4	1.75 (-150ºC)	875.2	6.61
Cetane (23)	$C_{16}H_{34}$	0.773 (20ºC)	1338	3.71
Chloro-benezene	C_6H_5Cl	1.106	1273	3.6
1-Chloro-butane (22,46)	C_4H_9Cl	0.887	1140	4.57
Chloro-diFluoromethane (3) (Freon 22)	$CHClF_2$	1.491 (-69ºC)	893.9	4.79
Chloroform (47)	$CHCl_3$	1.489	979	3.4
1-Chloro-propane (47)	C_3H_7Cl	0.892	1058	
Chlorotrifluoromethane (5)	$CClF_3$		724	5.26

Substance	Form Index	Specific Gravity	Sound Speed	Δv/ºC -m/s/ºC
Cinnamaldehyde	C_9H_8O	1.112	1554	3.2
Cinnamic aldehyde	C_9H_8O	1.112	1554	3.2
Colamine	C_2H_7NO	1.018	1724	3.4
o-Cresol (46)	C_7H_8O	1.047 (20ºC)	1541	
m-Cresol (46)	C_7H_8O	1.034 (20ºC)	1500	
Cyanomethane	C_2H_3N	0.783	1290	4.1
Cyclohexane (15)	C_6H_{12}	0.779 (20ºC)	1248	5.41
Cyclohexanol	$C_6H_{12}O$	0.962	1454	3.6
Cyclohexanone	$C_6H_{10}O$	0.948	1423	4.0
Decane (46)	$C_{10}H_{22}$	0.730	1252	
1-Decene (27)	$C_{10}H_{20}$	0.746	1235	4.0
n-Decylene (27)	$C_{10}H_{20}$	0.746	1235	4.0
Diacetyl	$C_4H_6O_2$	0.99	1236	4.6
Diamylamine	$C_{10}H_{23}N$		1256	3.9
1,2 Dibromo-ethane (47)	$C_2H_4Br_2$	2.18	995	
trans-1,2-Dibromoethene(47)	$C_2H_2Br_2$	2.231	935	
Dibutyl phthalate	$C_8H_{22}O_4$		1408	
Dichloro-t-butyl alcohol	$C_4H_8Cl_2O$		1304	3.8
2,3 Dichlorodioxane	$C_2H_6Cl_2O_2$		1391	3.7
Dichlorodifluoromethane (3) (Freon 12)	CCl_2F_2	1.516(-40ºC)	774.1	4.24
1,2 Dichloro ethane (47)	$C_2H_4Cl_2$	1.253	1193	
cis 1,2-Dichloro-Ethene(3,47)	$C_2H_2Cl_2$	1.284	1061	
trans 1,2-Dichloro-ethene(3,47)	$C_2H_2Cl_2$	1.257	1010	
Dichloro-fluoromethane (3) (Freon 21)	$CHCl_2F$	1.426 (0ºC)	891	3.97
1-2-Dichlorohexafluoro cyclobutane (47)	$C_4Cl_2F_6$	1.654	669	
1-3-Dichloro-isobutane	$C_4H_8Cl_2$	1.14	1220	3.4
Dichloro methane (3)	CH_2Cl_2	1.327	1070	3.94
1,1-Dichloro-1,2,2,2 tetra fluoroethane	$CClF_2$-$CClF_2$	1.455	665.3	3.73
Diethyl ether	$C_4H_{10}O$	0.713	985	4.87
Diethylene glycol, monoethyl ether	$C_6H_{14}O_3$	0.988	1458	
Diethylenimide oxide	C_4H_9NO	1.00	1442	3.8
1,2-bis(DiFluoramino) butane (43)	$C_4H_8(NF_2)_2$	1.216	1000	
1,2bis(DiFluoramino)- 2-methylpropane (43)	$C_4H_9(NF_2)_2$	1.213	900	
1,2bis(DiFluoramino) propane (43)	$C_3H_6(NF_2)_2$	1.265	960	
2,2bis(DiFluoramino) propane (43)	$C_3H_6(NF_2)_2$	1.254	890	
2,2-Dihydroxydiethyl ether	$C_4H_{10}O_3$	1.116	1586	2.4
Dihydroxyethane	$C_2H_6O_2$	1.113	1658	2.1
1,3-Dimethyl-benzene (46)	C_8H_{10}	0.868 (15ºC)	1343	
1,2-Dimethyl-benzene(29,46)	C_8H_{10}	0.897 (20ºC)	1331.5	4.1
1,4-Dimethyl-benzene (46)	C_8H_{10}		1334	
2,2-Dimethyl-butane (29,33)	C_6H_{14}	0.649 (20ºC)	1079	
Dimethyl ketone	C_3H_6O	0.791	1174	4.5
Dimethyl pentane (47)	C_7H_{16}	0.674	1063	
Dimethyl phthalate	$C_8H_{10}O_4$	1.2	1463	
Diiodo-methane	CH_2I_2	3.235	980	
Dioxane	$C_4H_8O_2$	1.033	1376	
Dodecane (23)	$C_{12}H_{26}$	0.749	1279	3.85
1,2-Ethanediol	$C_2H_6O_2$	1.113	1658	2.1
Ethanenitrile	C_2H_3N	0.783	1290	
Ethanoic anhydride (22)	$(CH_3CO)_2O$	1.082	1180	
Ethanol	C_2H_6O	0.789	1207	4.0
Ethanol amide	C_2H_7NO	1.018	1724	3.4
Ethoxyethane	$C_4H_{10}O$	0.713	985	4.87
Ethyl acetate (33)	$C_4H_8O_2$	0.901	1085	4.4
Ethyl alcohol	C_2H_6O	0.789	1207	4.0
Ethyl benzene (46)	C_8H_{10}	0.867(20ºC)	1338	
Ethyl bromide (46)	C_2H_5Br	1.461 (20ºC)	900	
Ethyliodide (46)	C_2H_5I	1.950 (20ºC)	876	
Ether	$C_4H_{10}O$	0.713	985	4.87
Ethyl ether	$C_4H_{10}O$	0.713	985	4.87
Ethylene bromide (47)	$C_2H_4Br_2$	2.18	995	
Ethylene chloride (47)	$C_2H_4Cl_2$	1.253	1193	
Ethylene glycol	$C_2H_6O_2$	1.113	1658	2.1
50% Glycol/ 50% H_2O			1578	
d-Fenochone	$C_{10}H_{16}O$	0.947	1320	
d-2-Fenechanone	$C_{10}H_{16}O$	0.947	1320	
Fluorine	F	0.545 (-143ºC)	403	11.31
Fluoro-benzene (46)	C_6H_5F	1.024 (20ºC)	1189	
Formaldehyde, methyl ester	$C_2H_4O_2$	0.974	1127	4.02
Formamide	CH_3NO	1.134 (20ºC)	1622	2.2
Formic acid, amide	CH_3NO	1.134 (20ºC)	1622	
Freon R12			774.2	
Furfural	$C_5H_4O_2$	1.157	1444	
Furfuryl alcohol	$C_5H_6O_2$	1.135	1450	3.4
Fural	$C_5H_4O_2$	1.157	1444	3.7
2-Furaldehyde	$C_5H_4O_2$	1.157	1444	3.7
2-Furancarboxaldehyde	$C_5H_4O_2$	1.157	1444	3.7
2-Furyl-Methanol	$C_5H_6O_2$	1.135	1450	3.4
Gallium	Ga	6.095	2870 (30ºC)	
Glycerin	$C_3H_8O_3$	1.26	1904	2.2
Glycerol	$C_3H_8O_3$	1.26	1904	2.2
Glycol	$C_2H_6O_2$	1.113	1658	2.1
Helium (45)	He_4	0.125(-268.8ºC)	183	
Heptane (22,23)	C_7H_{16}	0.684 (20ºC)	1131	4.25
n-Heptane (29,33)	C_7H_{16}	0.684 (20ºC)	1180	4.0
Hexachloro-Cyclopentadiene(47)	C_5Cl_6	1.7180	1150	
Hexadecane (23)	$C_{16}H_{34}$	0.773 (20ºC)	1338	3.71
Hexalin	$C_6H_{12}O$	0.962	1454	3.6
Hexane (16,22,23)	C_6H_{14}	0.659	1112	2.71
n-Hexane (29,33)	C_6H_{14}	0.649 (20ºC)	1079	4.53
2,5-Hexanedione	$C_6H_{10}O_2$	0.729	1399	3.6

Substance	Form Index	Specific Gravity	Sound Speed	Δv/ºC -m/s/ºC
n-Hexanol	$C_6H_{14}O$	0.819	1300	3.8
Hexahydrobenzene (15)	C_6H_{12}	0.779	1248	5.41
Hexahydrophenol	$C_6H_{12}O$	0.962	1454	3.6
Hexamethylene (15)	C_6H_{12}	0.779	1248	5.41
Hydrogen (45)	H_2	0.071 (-256ºC)	1187	
2-Hydroxy-toluene (46)	C_7H_8O	1.047 (20ºC)	1541	
3-Hydroxy-tolune (46)	C_7H_8O	1.034 (20ºC)	1500	
Iodo-benzene (46)	C_6H_5I	1.823	1114	
Iodo-ethane (46)	C_2H_5I	1.950 (20ºC)	876	
Iodo-methane	CH_3I	2.28 (20ºC)	978	
Isobutyl acetate (22)	$C_6H_{12}O$		1180	4.85
Isobutanol	$C_4H_{10}O$	0.81 (20ºC)	1212	
Iso-Butane			1219.8	
Isopentane (36)	C_5H_{12}	0.62 (20ºC)	980	4.8
Isopropanol (46)	C_3H_8O	0.785 (20ºC)	1170	
Isopropyl alcohol (46)	C_3H_8O	0.785 (20ºC)	1170	
Kerosene		0.81	1324	3.6
Ketohexamethylene	$C_6H_{10}O$	0.948	1423	4.0
Lithium fluoride (42)	LiF		2485	1.29
Mercury (45)	Hg	13.594	1449	
Mesityloxide	$C_6H_{16}O$	0.85	1310	
Methane (25,28,38,39)	CH_4	0.162	405(-89.15ºC)	17.5
Methanol (40,41)	CH_4O	0.791 (20ºC)	1076	2.92
Methyl acetate	$C_3H_6O_2$	0.934	1211	
o-Methylaniline (46)	C_7H_9N	0.999 (20ºC)	1618	
4-Methylaniline (46)	C_7H_9N	0.966 (45ºC)	1480	
Methyl alcohol (40,44)	CH_4O	0.791 (20ºC)	1076	2.92
Methyl benzene (16,52)	C_7H_8	0.867	1328	4.27
2-Methyl-butane (36)	C_5H_{12}	0.62 (20ºC)	980	
Methyl carbinol	C_2H_6O	0.789	1207	4.0
Methyl-chloroform (47)	$C_2H_3Cl_3$	1.33	985	
Methyl-cyanide	C_2H_3N	0.783	1290	
3-Methyl cyclohexanol	$C_7H_{14}O$	0.92	1400	
Methylene chloride (3)	CH_2Cl_2	1.327	1070	3.94
Methylene iodide	CH_2I_2	3.235	980	
Methyl formate (22)	$C_2H_4O_2$	0.974 (20ºC)	1127	4.02
Methyl iodide	CH_3I	2.28 (20ºC)	978	
α-Methyl naphthalene	$C_{11}H_{10}$	1.090	1510	3.7
2-Methylphenol (46)	C_7H_8O	1.047 (20ºC)	1541	
3-Methylphenol (46)	C_7H_8O	1.034 (20ºC)	1500	
Milk, homogenized			1548	
Morpholine	C_4H_9NO	1.00	1442	3.8
Naphtha		0.76	1225	
Natural Gas (37)		0.316 (-103ºC)	753	
Neon (45)	Ne	1.207 (-246ºC)	595	
Nitrobenzene (46)	$C_6H_5NO_2$	1.204 (20ºC)	1415	
Nitrogen (45)	N_2	0.808 (-199ºC)	962	
Nitromethane (43)	CH_3NO_2	1.135	1300	4.0
Nonane (23)	C_9H_2O	0.718 (20ºC)	1207	4.04
1-Nonene (27)	C_9H_{18}	0.736 (20ºC)	1207	4.0
Octane (23)	C_8H_{18}	0.703	1172	4.14
n-Octane (29)	C_8H_{18}	0.704 (20ºC)	1212.5	3.50
1-Octene (27)	C_8H_{16}	0.723 (20ºC)	1175.5	4.10
Oil of Camphor Sassafrassy			1390	3.8
Oil, Car (SAE 20a.30)	1.74		870	
Oil, Castor	$C_{11}H_{10}O_{10}$	0.969	1477	3.6
Oil, Diesel		0.80	1250	
Oil, Fuel AA gravity		0.99	1485	3.7
Oil (Lubricating X200)			1530	
Oil (Olive)		0.912	1431	2.75
Oil (Peanut)		0.936	1458	
Oil (Sperm)		0.88	1440	
Oil, 6			1509	
2,2-Oxydiethanol	$C_4H_{10}O_3$	1.116	1586	2.4
Oxygen (45)	O_2	1.155 (-186ºC)	952	
Pentachloro-ethane (47)	C_2HCl_5	1.687	1082	
Pentalin (47)	C_2HCl_5	1.687	1082	
Pentane (36)	C_5H_{12}	0.626 (20ºC)	1020	
n-Pentane (47)	C_5H_{12}	0.557	1006	
Perchlorocyclopentadiene(47)	C_5Cl_6	1.718	1150	
Perchloro-ethylene (47)	C_2Cl_4	1.632	1036	
Perfluoro-1-Hepten (47)	C_7F_{14}	1.67	583	
Perfluoro-n-Hexane (47)	C_6F_{14}	1.672	508	
Phene (29,40,41)	C_6H_6	0.879	1306	4.65
β-Phenyl acrolein	C_9H_8O	1.112	1554	3.2
Phenylamine (41)	$C_6H_5NO_2$	1.022	1639	4.0
Phenyl bromide (46)	C_6H_5Br	1.522	1170	
Phenyl chloride	C_6H_5Cl	1.106	1273	3.6
Phenyl iodide (46)	C_6H_5I	1.823	1114	
Phenyl methane (16,52)	C_7H_8	0.867 (20ºC)	1328	4.27
3-Phenyl propenal	C_9H_8O	1.112	1554	3.2
Phthalardione	$C_8H_4O_3$		1125	
Phthalic acid, anhydride	$C_8H_4O_3$		1125	
Phthalic anhydride	$C_8H_4O_3$		1125	
Pimelic ketone	$C_6H_{10}O$	0.948	1423	4.0
Plexiglas, Lucite, Acrylic			2651	
Polyterpene Resin		0.77	1099.8	
Potassium bromide (42)	Kbr		1169	0.71
Potassium fluoride (42)	KF		1792	1.03
Potassium iodide (42)	KI		985	0.64
Potassium nitrate (48)	KNO_3	1.859 (352ºC)	1740.1	1.1

Substance	Form Index	Specific Gravity	Sound Speed	Δv/ºC -m/s/ºC
Propane (2,13)(-45 to -130ºC)	C_3H_8	0.585 (-45ºC)	1003	5.7
1,2,3-Propanetriol	$C_3H_8O_3$	1.26	1904	2.2
1-Propanol (46)	C_3H_8O	0.78 (20ºC)	1222	
2-Propanol (46)	C_3H_8O	0.785 (20ºC)	1170	
2-Propanone	C_3H_6O	0.791	1174	4.5
Propene (17,18,35)	C_3H_6	0.563 (-13ºC)	963	6.32
n-Propyl acetate (22)	$C_5H_{10}O_2$		1280 (2ºC)	4.63
n-Propyl alcohol	C_3H_8O	0.78 (20ºC)	1222	
Propylchloride (47)	C_3H_7Cl	0.892	1058	
Propylene (17,18,35)	C_3H_6	0.563 (-13ºC)	963	6.32
Pyridine	C_6H_5N	0.982	1415	4.1
Refrigerant 11 (3,4)	CCl_3F	1.49	828.3	3.56
Refrigerant 12 (3)	CCl_2F_2	1.516 (-40ºC)	774.1	4.24
Refrigerant 14 (14)	CF_4	1.75 (-150ºC)	875.24	6.61
Refrigerant 21 (3)	$CHCl_2F$	1.426 (0ºC)	891	3.97
Refrigerant 22 (3)	$CHClF_2$	1.491 (-69ºC)	893.9	4.79
Refrigerant 113 (3)	CCl_2F-$CClF_2$	1.563	783.7	3.44
Refrigerant 114 (3)	$CClF_2$-$CClF_2$	1.455	665.3	3.73
Refrigerant 115 (3)	C_2ClF_5		656.4	4.42
Refrigerant C318 (3)	C_4F_8	1.62 (-20ºC)	574	3.88
Selenium (8)	Se		1072	0.68
Silicone (30 cp)		0.993	990	
Sodium fluoride (42)	NaF	0.877	2082	1.32
Sodium nitrate (48)	$NaNO_3$	1.884 (336ºC)	1763.3	0.74
Sodium nitrite (48)	$NaNO_2$	1.805 (292ºC)	1876.8	
Solvesso 3		0.877	1370	3.7
Spirit of wine	C_2H_6O	0.789	1207	4.0
Sulphur (7,8,10)	S		1177	-1.13
Sulphuric acid (1)	H_2SO_4	1.841	1257.6	1.43
Tellurium (7)	Te		991	0.73
1,1,2,2-Tetrabromo-ethane(47)	$C_2H_2Br_4$	2.966	1027	
1,1,2,2-Tetrachloro-ethane(67)	$C_2H_2Cl_4$	1.595	1147	
Tetrachloroethane (46)	$C_2H_2Cl_4$	1.553 (20ºC)	1170	
Tetrachloro-ethene (47)	C_2Cl_4	1.632	1036	
Tetrachloro-methane (33,47)	CCl_4	1.595 (20ºC)	926	
Tetradecane (46)	$C_{14}H_3O$	0.763 (20ºC)	1331	
Tetraethylene glycol	$C_8H_{18}O_5$	1.123	1586/5203.4	3.0
Tetrafluoro-methane (14) (Freon 14)	CF_4	1.75 (-150ºC)	875.24	6.61
Tetrahydro-1,4-isoxazine	C_4H_9NO		1442	3.8
Toluene (16,52)	C_7H_8	0.867 (20ºC)	1328	4.27
o-Toluidine (46)	C_7H_9N	0.999 (20ºC)	1618	
p-Toluidine (46)	C_7H_9N	0.966 (45ºC)	1480	
Toluol	C_7H_8	0.866	1308	4.2
Tribromo-methane (46,47)	$CHBr_3$	2.89 (20ºC)	918	
1,1,1-Trichloro-ethane (47)	$C_2H_3Cl_3$	1.33	985	
Trichloro-ethene (47)	C_2HCl_3	1.464	1028	
Trichloro-fluoromethane (3) (Freon 11)	CCl_3F	1.49	828.3	3.56
Trichloro-methane (47)	$CHCl_3$	1.489	979	3.4
1,1,2-Trichloro-1,2,2-Trifluoro-Ethane	CCl_2F-$CClF_2$	1.563	783.7	
Triethyl-amine (33)	$C_6H_{15}N$	0.726	1123	4.47
Triethylene glycol	$C_6H_{14}O_4$	1.123	1608	3.8
1,1,1-Trifluoro-2-Chloro-2-Bromo-Ethane	$C_2HClBrF_3$	1.869	693	
1,2,2-Trifluorotrichloro- ethane (Freon 113)	CCl_2F-$CClF_2$	1.563	783.7	3.44
d-1,3,3-Trimethylnor- camphor	$C_{10}H_{16}O$	0.947	1320	
Trinitrotoluene (43)	$C_7H_5(NO_2)_3$	1.64	1610	
Turpentine		0.88	1255	
Unisis 800		0.87	1346	
Water, distilled (49,50)	H_2O	0.996	1498	-2.4
Water, heavy	D^2O		1400	
Water, sea		1.025	1531	-2.4
Wood Alcohol (40,41)	CH_4O	0.791 (20ºC)	1076	2.92
Xenon (45)	Xe		630	
m-Xylene (46)	C_8H_{10}	0.868 (15ºC)	1343	
o-Xylene (29,46)	C_8H_{10}	0.897 (20ºC)	1331.5	4.1
p-Xylene (46)	C_8H_{10}		1334	
Xylene hexafluoride	$C_8H_4F_6$	1.37	879	
Zinc (7)	Zn		3298	

PORTAFLOW 204 *Plus* Battery Charge circuit Operation.

Charging Controller IC:

A Maxim IC MAX712 or MAX713 controls the Ni-Cd and Ni-Mh battery charger. It has two modes, fast charge and trickle charge; an output indicates the fast-charge status. In both modes it supplies, via a PNP power transistor, a constant current to the battery, by keeping a constant voltage across a current sensing resistor. In fast charge mode it is 250mV, in trickle charge mode 31mV, so the trickle charge current is 1/8 of the fast charge current.

By wiring up input pins on the IC, the number of cells is set to 5, the voltage sampling interval to 168 sec, and the fast-charge time limit to 264 minutes (the maximum). The battery temperature limits are not used.

The IC starts the fast-charge timer when a battery is connected or when power is applied. It terminates the fast charge and returns to trickle charge, either after the 264 min (~4.5 hrs) time limit, or when it senses that the battery voltage remains constant or begins to decrease, meaning that the battery is fully charged.

Charging Voltage:

The voltage available to charge the 6V battery is restricted by the 9V charger input and the two diodes in the input. The S2D silicon diodes had a fwd drop of 0.75V, limiting the available charge voltage to 7.5V, which caused the MAX712 to sense that the battery voltage had stopped rising, and therefore prematurely end the fast charge. With several days of trickle charging the battery could however still reach its full capacity.

In Dec.2000 the S2D diodes were replaced by SS14 Schottky diodes with a fwd drop of 0.35V, thus raising the available charge voltage to 8.3V. At the same time the current was increased.

Instrument differences:

The current sensing resistor consists of either 2 or 4 parallel 1.2Ω resistors, giving about 0.4A or 0.8A fast-charge current.

PF-300 and UFM610P:

Battery Capacity 3.5Ah, or 4.0Ah after Oct.2000

Current 0.4A before, 0.8A after Dec.2000

PF 204, PF-SE and 216:

Battery Capacity 1.2Ah

Current 0.4A

Software:

The fast-charge status output is not used by the present software (ver.3.06); in a future software update a message will be added, indicating charging status.

Quicker full charge:

The fastest way to fully charge the battery is to charge for 4.5 hrs, then switch the power supply off and on again, thus re-starting the fast charge for another 4.5 hr period, followed by trickle charge.

Warning:

If the battery is getting warm, that would indicate that it is full, and the power supply should not be connected again - overcharging reduces the life of the battery.

Note:

After a recently fully charged battery is connected to the charger, it seems that it takes the MAX712 about 30 min to sense that the battery voltage stops changing, and go to trickle charge.

Examples:

Older PF-300:- A 15 hour charge consists of 4.5 hrs of fast charge (400mA), followed by 10.5 hrs of trickle charge (50mA): 4.5*0.4+10.5*0.05=2.325Ah=3.5Ah*0.66, which fills the battery to 66% of capacity (3.5Ah).

To fill the remaining 34% at 50mA takes 3.5*0.34/0.05=23.8hrs, +15hrs = 39hrs to 100%.

Assuming 20% losses:

(3.5Ah*20%)/50mA=0.7Ah/0.05A=14hrs of

trickle charge to cover losses, +39hrs=53hrs total.

In fact it needs ~9hrs * 0.4A = 3.6Ah to fill the battery from empty to 103% full capacity.

Assuming 20% losses:

(3.5Ah*20%-0.1)/50mA=0.6Ah/0.05A=12hrs of trickle charge to cover losses, +9hrs=21hrs total.

A third session of fast charge would fill the last 17% in 3.5Ah*17%/0.4A=1.5hrs, = 10.5hrs total.

Newer PF-300:-

4.5hrs fast: 0.8A*4.5h=3.6Ah = 90% of 4.0Ah

Slow: 10%= 0.4Ah/0.1A = 4h, total 8.5h to 100%

with 20% losses: 0.8Ah/0.1A = 8h

Total time fast and slow: 16.5hrs to 120%.

Fast only: 4.0Ah/0.8A=5hrs, +20%=6hrs,

that needs 2 sessions: 4.5hrs + 1.5hrs to 120%.

PF204, PF-SE & 216:- 1.2Ah/0.4A=3hrs to 100% capacity; with 20% losses

3h+20%=3.6hrs total.

This is well within the first 4.5hrs.

PRODUCT CARE AND MAINTENANCE

WARNING:-USE ONLY BATTERIES, CHARGER, ACCESSORIES, CABLES APPROVED FOR THIS PARTICULAR MODEL.

THE USE OF ANY OTHER TYPES MAY INVALIDATE ANY APPROVAL OR WARRANTY APPLYING TO THE INSTRUMENT AND MAY BE DANGEROUS. IF IN DOUBT CONTACT A MICRONICS SALES OR SERVICE REPRESENTATIVE.

- Do not disassemble this unit unless advised by Micronics. Return the unit to the place of purchase for further advice.
- Do not drop.
- Wipe the exterior of the instrument with a clean damp cloth or paper towel-the use of a solvent may damage the paint surface. Ensure the unit is switched off and disconnected from the mains.
- Do not place the instrument electronics near to naked flames or sources of intense heat such as an electric fire or hot pipes in excess 50°C.
- Dispose of any batteries safely and in accordance with any regulations in force in the country of operation.
- Ensure all connectors are kept clean and free from grease. They may be cleaned with a general purpose switch cleaner.
- Avoid the use of excessive grease/ultrasonic couplant on the sensors. This may impair the performance of the equipment. Read the instructions in the manual on how to apply the couplant. Any excessive grease/couplant can be removed from the sensors and guide rails using an absorbent paper towel and a general purpose solvent cleaner.
- Regularly check all cables/parts for damage. Replacement parts are available from Micronics.
- On fixed instruments, it is recommended the ultrasonic couplant is replaced on the sensors every 6 months especially on pipes where the application is too hot to touch. If signal level drops below 30% this is also an indication that the sensors need re-greasing.
- Ensure the person who services your instrument is qualified to do so. If in doubt, return the instrument to Micronics with a detailed report on the nature of the problem.
- Ensure that suitable protective precautions are taken when using any materials to clean the instrument/sensors.
- Calibration of the instrument and sensors is recommended to be done at least once every 12 months.
- If the instrument was supplied with dust or dirt caps make sure they are re-fitted when the instrument is not in use.
- It is the users responsibility to tidy cables so they will not cause harm to other people.
- When returning product to Micronics make sure it is clean. Notify Micronics if the instrument has been in contact with any hazardous substances.

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