Ultraflux NT 214B GB1

Revision : 26/08/2008

MiniSonic _ P
MiniSonic _ P-B
Portable Flowmeters

PREAMBLE :

Thank you for choosing Ultraflux to make your flow measurement.

We offer a full range of portable or fixed flowmeters backed by 30 years' expertise and experience using Ultrasonic techniques:

⊛ The Digisonic and UF 801-P families of Portable flowmeters with integral loggers and signal analysis functions

⊛ The UF322 and UF 8xx families of fixed installation flowmeters:
L - liquids,
G - Gas ,
MC – Multi-chord applications for Liquid and Gas measurement,
CO / RV - Open Channel and River Measurement.

⊛ The MiniSonic family with :
P – Portable Metering with also a two pipe or dual path version P-B
600/2000 single-channel fixed flowmeters,
600-2 and 2000-2 for dual-chord flow metering ,
600-B and 2000-B for dual-pipe flow measurement configurations,
Speed (1 or 2) is for open channel flow velocity measurements.

This manual is specifically concerned with an element from the family and has been drafted to guide you in the stages of installation and commissioning.

Other documents and tools are available on paper or in electronic format:

- A training manual concerning ultrasound measurement, reference NT 122

- A guide about the use of our software in the Windows environment Ref NT 204

- The PC software that is specific to your application, Ref LS 600W _version *** , with an interconnection cord to the PC.

- The JBUS communication protocol with its address table NT 207

All our flowmeters work on the principle of transit time of ultrasonic waves and can be associated with clamp-on or wetted probes as well, depending on the application.

SUMMARY :

1 – Typical Applications:
        Liquid flow measurements and controls
        Clamp on or insertion transducers
        Use for official control or as a standard for calibration

2 – Composition of a measurement point.
        Certifications
        Applicable standards
        MiniSonic limitations
        Recommended accessories

3 – Ergonomics and dimensions

4 – Connections
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        Use of our software and PC for records

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        How to insure fast and good results
        How to manage a temporary installation
        What about the safety in Ex

7 – Setting and commissioning.

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        Q Settings Menu – Flow and Fluid
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1 – <u>TYPICAL APPLICATIONS</u>

MiniSonic P and P-B main purpose is to offer a performing flow measurement solution at a **very competitive price** by saving any installation costs.

With **clamp-on** transducers, there is no need of any spool piece or tapping by keeping the same final accuracy than any flowmeter.

Their conception permits a smart use of the hardware and firmware resources to adapt them end to user flow problem.
For instance the two 4-20 mA outputs can copy other data than the flow (sound speed, gain …) to offer a complete diagnostic on actual flow and liquid quality or density …

The MiniSonic P gives the actual flow value and its direction.

Normally used as a portable instrument, it can also be use for temporary replacement of any flowmeter: **flow indication**, **regulation** but also volume **counter**.

1-1 – <u>Principle of measurement:</u>

The principle of measurement is detailed and commented on in our training manual NT 106.

To summarize, note that it bears on the velocity difference (and therefore the ultrasound wave transit times) in a moving medium, depending on whether the movement is with or against the current.

To achieve this, it is necessary to establish dialogue between two sensors using an L-shaped route whose projection D on the control axis is sufficient, and to measure alternatively the route times $T_{1>2}$ and $T_{2>1}$.

The time measurement, combined with knowledge of the geometry parameters (diameter / thickness of pipe / L / D) allows the volume flow rate to be calculated whatever the developments of the product, its temperature or its pressure.

Precision is even better when the Delta T measurement resolution increases (0.01 nanosecond for MiniSonic) and when the geometrical parameters are controlled, not to forget considerations of a hydraulic order (straight lengths, flow configurations, zero setting) or the frequency of the probes.

An order of magnitude of this Delta T in nanoseconds can be obtained simply by multiplying the flow velocity (V in m/s) times D (in mm) or by the diameter of the pipe (mm).

1-2 - <u>The clamp on solution</u> is available for most of the liquids flowing in metallic or plastic pipes.

Ultraflux offers a very wide transducers range with different sizes and frequencies to be selected depending on the application and pipe diameter from 10 mm I.D. to more than 3 metres.

This solution is very convenient for petrochemical products but also for any water quality including demineralised water with no limitation from the conductivity.

   When pipe wall material (concrete …) or condition (corrosion …) is not suitable for clamp on transducers , we propose <u>insertion transducers</u> with installation possibility by <u>hot tapping</u>.

   When the instrument must have an official use, it is recommended to compare it to a standard and obtain a calibration certificate on a flow rig.
   Then, after some reserves concerning a correct use, the unit can be accepted as a secondary standard.

   Basically, we practice a dry calibration. It reliability is sufficient for a standard use.

   Beside its accuracy, MiniSonic P offers a very good reproducibility.

   If you place transducers at the same location and enter the same settings, you can follow up in the time any pump characteristics or any other flowmeter actual accuracy.

Example with Direct mode:

Meanwhile, Reflex mode (V)
 Is more usual (> 90 %)
and much more easy l.

2 - COMPOSITION OF A MEASUREMENT POINT

- The converter MINI-P or P-B with its carrying bag.
- Its standard accessories: batteries (NIMH) charger and cable
- One or more set of two probes depending on your request / applications
- Integral or optional supports (SU
- Coupling gel (BT = low temperature / HT = high temp.) for clamp-on probes
- Probe / converter link cables (L = 2.5 m) and optionally extensions (L= 5 m)
- PC / converter link cable and software (CD Rom). This cable permits also analog outputs.

CERTIFICATIONS

All equipment is CE certified.

ATEX certification for the relevant probes and standards when this quality is required, accepted and documented. All equipment will be labeled accordingly.

IP Rated as shown on each item.

The MiniSonic-P has a typical IP 67 rating. This requires that all seals are ok and screws correctly tight.
Meanwhile, when the immersion risk exists, we can offer a heavy duty protection case with an IP 67 characteristic.

APPLICABLE STANDARDS :

- Concerning high voltage human safety risks: N/A – Only low voltage (< 60 V) .
- Concerning EMC : EN 61000, EN 55022 et EN 50204
- Concerning tightness (IP) : EN 60529
- Concerning ATEX : Directive 94 / 4 / CE
  MiniSonic-P could be only concerned by Ex m IIC T6 transducers with cables
  + EN 60079-0:   General rules.
  + EN 60079-1 :   Ex d enclosures.
  + EN 60079-7 :   Ex e protection for connections.
  + EN 60079-18 : Ex mb x – protection by encapsulation.
  + EN 60079-11 : Ex ia - Intrinsic safety
  + EN 60079-25 to guide you for your I.S. systems

MINISONIC LIMITATIONS :

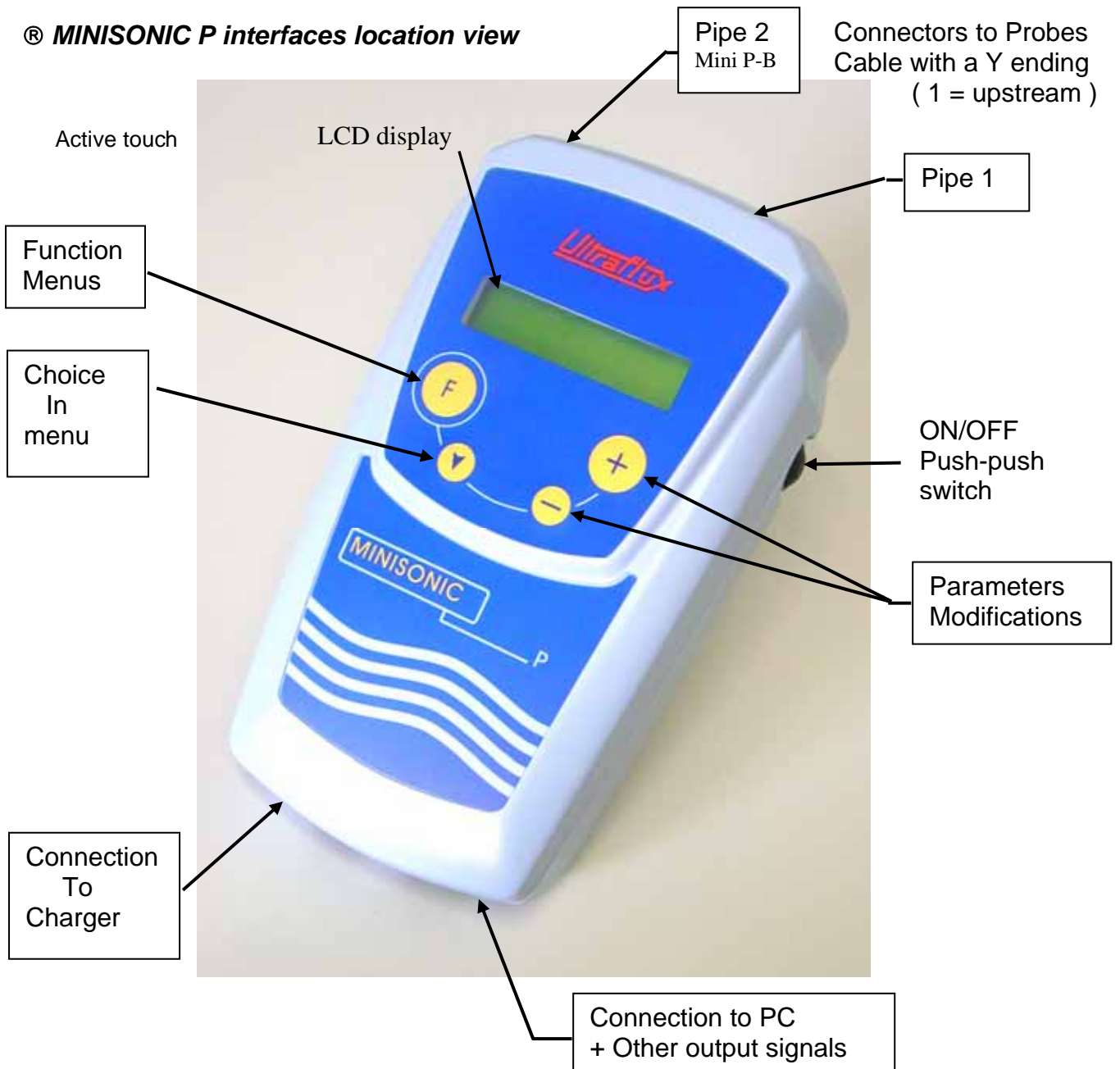MiniSonic-P is designed for pipes up to 3300 mm O.D.

The maximum lengths between transducers (L) are 6600 mm (SM probes)

The maximum axial distances (D) are respectively 4400 mm.(SM probes)

3 - ERGONOMICS AND DIMENSIONS OF THE MINISONIC-P and P-B CONVERTERS

All operations can be done while keeping MiniSonic–P inside its protection bag.

® *MINISONIC P interfaces location view*

Pipe 2
Mini P-B

Connectors to Probes
Cable with a Y ending
(1 = upstream)

Active touch

LCD display

Pipe 1

Function
Menus

Choice
In
menu

ON/OFF
Push-push
switch

Parameters
Modifications

Connection
To
Charger

Connection to PC
+ Other output signals

® MiniSonic-P or P-B mechanical characteristics:

MiniSonic-P & P-B enclosure is in ABS plastic. The case can be cleaned with water, alcohol or detergent by using a sponge or a soft cloth. Never use abrasive or solvents.

MiniSonic-P & P-B outside dimensions are approximately 220 x 115 x 64 mm.
It weights less than 1 kg.

MiniSonic-P & P-B tightness protection is IP 67 but the charger or other accessories.
MiniSonic-P & P-B can be used from –10 °C up to 50 °C as long LCD display permits readings.
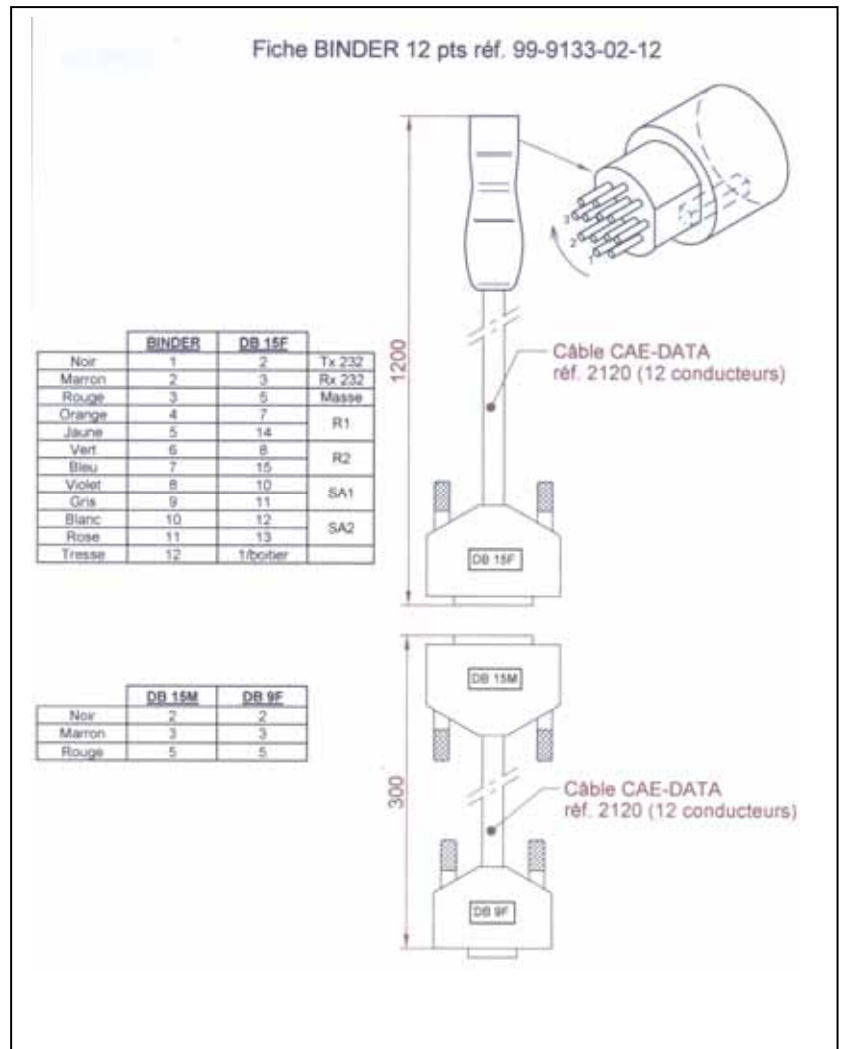
4 –<u>USUAL CONNECTIONS ON MINISONIC-P or P-B</u> :

When there is no need of automatic records, connections as described in § 3 are sufficient.

> To permit records and connection to an external data-logger or to a PC , or to any recorder or transmission device , please **use our cable** and add if necessary connections on 15 pins male connector . Its pin out is as follows:

Relays : solid state
  R on = 10 Ohm
  V < 100 V
  I < 0.1 A

Analog outputs SA :
Active from battery
Max loop Resistor =
    150 Ohm

Fiche BINDER 12 pts réf. 99-9133-02-12

	BINDER	DB 15F	
Noir	1	2	Tx 232
Marron	2	3	Rx 232
Rouge	3	5	Masse
Orange	4	7	R1
Jaune	5	14	
Vert	6	8	R2
Bleu	7	15	
Violet	8	10	SA1
Gris	9	11	
Blanc	10	12	SA2
Rose	11	13	
Tresse	12	1/boitier	

1200

Câble CAE-DATA
réf. 2120 (12 conducteurs)

DB 15F

DB 15M

	DB 15M	DB 9F
Noir	2	2
Marron	3	3
Rouge	5	5

300

Câble CAE-DATA
réf. 2120 (12 conducteurs)

DB 9F

> There are two categories of External data-logger:

- Those which are designed to receive 4–20 mA signals as the USB-4.
- They permit to set records rate and some permit to delay the acquisition or stop it at a given time or other condition. Do wiring on analog output 1 (SA 1) or 2 (SA 2). Do wiring of relay 1 or 2

Flow records are samples. There is no record about what could happen between.

- Those which are designed to record time events. If this event is the volume pulses unit as transmitted by one of our relays, the time between two successive pulses permits to build a curve representing the average flow during this period. These data loggers are normally delivered with the corresponding Software.
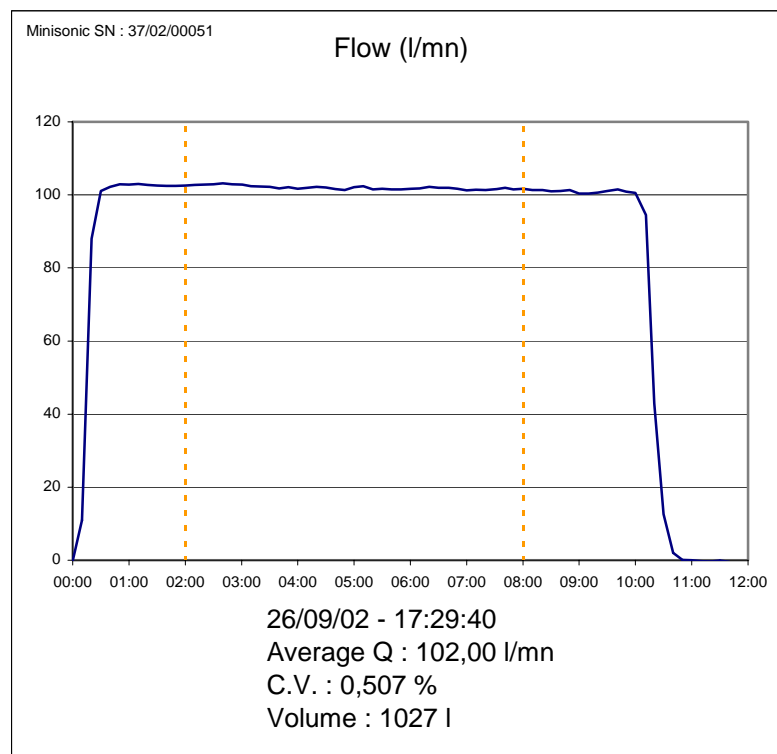
Flow information rate depends on the flow itself. For instance a survey on a potable water pipe will give few points during night and many at peek flow period.

> Automatic records by using our Software on a desk top or lap top PC :

Please refer to our LS 600W x x Software manual (CD Rom)

- Once this software installed on your laptop PC you can set in its configuration menu a sampling period and also the duration of the records. If you want to control manually this duration, you must enter " 0 ".

- When the RS dialog is established between this PC (master) and the MiniSonic-P or P-B, the records start after a click on the Diskette icon and a given name to the new file.

- The main advantage of these records is their richness: <u>you keep trace of all available informations on MiniSonic</u>. Totalizer can be automatically reset before a new record.

You can also record the corresponding calibration file.

- Moreover, our Software includes a Spreadsheet Macro for Excel, which permits an automatic transfer and edition of your results to help your technical report.

Let you guide up to such a final result (example – not contractual):

Minisonic SN : 37/02/00051

Flow (l/mn)

26/09/02 - 17:29:40
Average Q : 102,00 l/mn
C.V. : 0,507 %
Volume : 1027 l

Attention! To have this Macro accepted by Excel and Windows, you must set Excel security level at medium or low (Excel/Tools/Security…)

5 – <u>CONVERTER FIRST HANDLING INSTRUCTIONS</u>:

® **Charging Batteries - <u>Charger/ Adapter + Auxiliary supply</u>**

Cords : EU – Optionally other (US …)
Approval = CE and CB/UL
AC Input Voltage : 100 -240 V 47/63Hz

Output Voltage : 15 V DC - 1 A
Charging time = 14 hours
A green LED is On when supplied.

Batteries : NIMH – No memory effect
Autonomy: up to 35 h. Depends on use
(4-20 mA ; backlight …)
MiniSonic–P has a battery level indicator (%). It takes its calibration from a complete cycle 100 % down to 0% (Real stop occurs on V Batt < 8V)

Be sure that batteries are sufficiently charged before you start your operations.

® **Please read § 7 and § 8 before any measurement try.**

® **Select one probes set depending on your application (see § 6)**

® **Start settings and controls in following order:**

- <u>Switch the MiniSonic-P on</u> and wait for the welcome displays.

- Enter in "<u>Probes / Echo menu</u>" and set correct transducers with mounting mode

- Enter in "<u>Pipe settings</u> " menu and <u>enter</u> corresponding <u>data</u> .

- Enter in "<u>Q settings" menu and confirm liquid characteristics</u> .

- After the measurement menu has displayed <u>requested distance between probes</u>,

- <u>Fix</u> these <u>probes with coupling</u> gel or tape and <u>do connections</u> to MiniSonic - See § 6

- <u>Read results</u> and attached information in "Measurement menu" - See § 8-1

- If not satisfying, proceed to possible corrections - See § 9

- Start measurement records or hand note results upon your own choice.

6- <u>PROBES INSTALLATION</u> – General Procedures.

The MiniSonic P & P-B accept all standard or special transducers of Ultraflux catalogue with frequency from 250 KHz up to 2 MHz : clamp-on , insertion or wetted …

® Unless specified and instructed otherwise in the order, refer to the probe data sheet of the model used .

® The installation of the probes in a conduit should allow for the best the straight lengths, particularly upstream, but also downstream, in order to benefit from a predictable and stabilized hydraulic profile. Provide upstream a minimum of 15 times the pipe diameter.

® Similarly, to avoid the nuisance of deposits or accumulation of gas, planes close to vertical (+/- 30°) will be avoided. A horizontal plane is a good choice excepted when the conduit is vertical.

® **For intrusive probes**, adjust the insertion then the alignment or orientation of the probes for the same pair (> parallel faces).

Important! : once these adjustments finished , it is necessary to measure with accuracy the distance L between transducers face to face and its projection D on flow axis and note these values on a "as built " data sheet for further entering in instrument menu .

! The final accuracy depends on.

L ; D   D
                L

® For external probes, the freedom offered should not prompt the user to ignore the above rules.
However, the choice of direct (\), reflex (V) or even (N or W) installation mode will depend on the decision regarding the conduit (state) and the fluids to be measured.
Therefore, we advise initially a provisional installation known as a validation installation (coupled with gel or grease) and final assembly (supports, solid coupling) once the conditions have been validated.

Since the MiniSonic calculates for you the distance D.S required between the probes, the setting up operations will, in theory, take place once the converter parameters have been set.
Particular attention will be paid to cleaning the conduit at the probe location.

D.S
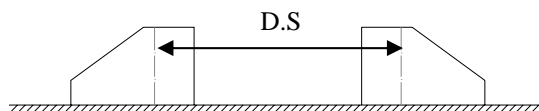
Probes installation : particular recommendations for a portable use :

Please read general recommendations as detailed in our training manual NT 122.
Under header § 2, we give some information about expected accuracy depending on available straight length and transducers mounting modes.

When you will arrive in front a new pipe to be measured, you must have some good reflex, and your experience will help for.

Ⓡ   **First , you must have in hands suitable probes for the application .**

We propose different sizes having each its own frequency: larger they are, lower is the frequency.

- High frequency and small probes are suitable for small pipes, thin pipe wall and highest accuracy in Delta T measurement. But signal could be distorted or damped if pipe or liquid conditions are becoming difficult.
    Example: our SE_1586-E2 – F=2 MHz

- Lower frequency transducers are less sensitive to above conditions and are more suitable for large pipes. For such pipes, the Delta T is more important and thus weights less on the results.
    Example: our SE_1599-I or SE_1595 – F=0.5 MHz

- Between them, we offer a compromise with probes F = 1 MHz
    Example: our SE_1662-A or SE_1596 or better SE_1515 which accept up to 200 °C

Ⓡ   **Most** of these above probes are delivered **with a support** which doesn't let other choice than to place them in Reflex mode. This **V** mode must be preferred to all other mode as far you can place the transducers (distance D.S. and signal = OK).

The probes coupling and its duration are very important for reliable results.

Try always to have a compromise for pipe access and straight lengths. All becomes easier. When you have to do a measurement after a pump, please try as far as possible from it. You will have fewer disturbances or remaining bubbles from cavitations.

Ⓡ   **After installation finished and accepted, you shall be the first critic of the measurements you are doing.**
For this, MiniSonic delivers you complementary information on signal (Gain), on physical measurement (Delta T, on sound speed (C – relation with T °C ?) and on hydraulics (Reynolds number – Kh).

What to do with?
- A too high amplification gain would request to use lower frequency transducers.
- A low Delta T must be compared to the offset risk (Delta To). You have to decide about a possible zero flow compensation.
- A sound speed very different from expected value would signify some mistake in pipe data.
- A Reynolds number near the turbulent to laminar transition area would request the highest attention to the probes location. Even if Reynolds number can predict a laminar flow, it is necessary to have more than 20 x Diam. to establish it after a disturbance.

7 - COMMISSIONING AND PARAMETERING OF MINISONIC P / P-B :

1. Once the cabling has been carried out and verified, power up the system:

> The MiniSonic must display its home screens:
  - Hardware version = MiniSonic P or P-B and P.C. Board version (MK4_M).
  - Firmware version = 18.10-01 (e.g. – make a note of the first figure)
  - Serial number = see if it is identical to the company nameplate
  - Technical information: parameterized probes
  Then it automatically switches to the measurement function (Q = …)

> Check the consistency of these messages with respect to your application. If your instrument is set ready to be used, you can start readings and records.

> However, it is recommended you to check and, if necessary, to optimize the adjustments, taking into consideration the exact dimensions and, if possible, zero flow conditions (see the "Self-zero Adjustment" menu).

2. Parameter settings using the PC software : *Use same version than Firmware*

  > Refer to the manual supplied with the software (CD-ROM) .
  > The fields of the main values to be entered are listed below under Heading **8**.
  > The software offers extended configuration possibilities.
  > At the end of the manual, a printout of a typical file is given.

3. Parameter settings using the keyboard

Successive pressing on the (**F**) key, or (**F**) then (**+**) or (**-**) gives access from the "Measurements Display" menu to the titles of the different menus :
  > Access (Authorization) to Adjustments
  > Pipe parameters
  > Flow rate / Fluid parameters
  > Probe parameters
  > General parameters including Outlets
  > Zero adjustment
  > Tests
  > Optionally : "Current outputs setting" and "Factory Adjustments".

To enter the Menu, use the (**∇**) key in the same way as to move to the next field to be filled in .

To modify (text or values), use (**–**) or (**+**)

Exit from the menu is by the (**F**) key with return to the "Measurement Display" menu
  If there is no action on the keypad for 1 mn , the MiniSonic automatically returns to " Measurement Display" menu .
  When inside a menu, the browser only scrolls forwards. When necessary, do a complete scroll.

Here below we list first the standard P version and at the end of this chapter 8 , in 8-11, we had the extra screen or readings concerning the P-B version .

8 -1 : " Measurement Display " menu:

Every time you return to this menu, MiniSonic displays:

chosen probes and interprobe distances D.S.(if S.E.)

> **Probe = SE xxxx**
> **D.S. = xxxx mm**

Then Flow rate (or other choice as first screen) and associated messages .

> **Q = xxx.xx m3/h**
> **Seek Echo , Fault Q**

▽ Gains (mode and value) and I.Q. quality indicator.

> **Gain (ESC) = xx dB**
> **I.Q. = 100 %**

*If **I.Q**. is less than 33 %, the last Measurement cycle is rejected.*

▽ Velocity of fluid and speed of sound
N.B.: This sound speed is a characteristic of the fluid at actual conditions . Compare this value to expected one at a actual temperature (see NT 122) It is a good indicator for water applications.

> **V = x.xxx m/s**
> **s.sound = xxxx.x m/s**

▽ Physical measurements: time of flight T and difference delta T

> **T = xxx.x µs**
> **DT =   ns**

▽ Totalizers - Reset possible by simultaneously pressing + and -

> **t_1 = xxxx m^3**
> **t_2 = xxxx m^3**

▽ Date and time
® Change by PC + Software

> **06/02/2003**
> **15 : 46 : 22**

▽ Hydraulic Information Calculated K$_H$ and Reynolds number

> **Kh   = 1. 055**
> **Rey = 3,1E5**

▽ Return to menu header

8-2 : « Calibration Allowed » Menu :

® Access = press **F** once from the Measurement Display menu

> ® If the display is:
> Enter this code (1 to 65535)

> **Calibration Allowed : 0**
> **Code ?**

> ® If the display does not request "Code?", there is none (code = 0)

® Press ▽

> ® Enter a code:

> **Access Code = xxxx**

> *! This code will become active after de-energizing.*
> *Remember to make a note of it.   It will be required for any subsequent intervention.*

® In case of loss, contact Ultraflux giving the following information's; the serial number of your MiniSonic MK4*/xx/xx/xxxx as it appears during energizing and the date or dates on which you want action to take place. An operation will be requested, allowing a provisional code to be calculated.

® A second press on ▽ will provide access to the existing <u>Languages</u> choice field.

8-3 : « Pipe Settings » menu :

® Access = Press twice on (F) or (F) once, then (+) and Enter by ▽
(Operations are common to all the menus).

▽ External diameter (mm)
or pipe circumference

> **ext D = xxxx.x**
> **ext C = xxxx.x**

▽ Chosen pipe material
from programmed list :

> **Pipe =**
> **STEEL… PVC … OTHER**

If Other: Characterization of this material by its velocity or <u>CM</u>
This selection will resolve new or special cases and also optimize the parameters for composite pipes having several materials (steel or cast iron + cement)

▽ Total pipe thickness:

> **Thickness = xx.x**
> **mm**

▽ If other:
N.B. :only one input .

> **CM = xxxx m/s**

8-4 : « Q Settings » menu (Flow / Fluid)

⊛ Following data are common to the two pipes.

▽ Choice of Flow unit:
(l/h …tot … m3/s);

$$Q\ unit = m^3/h$$

▽ Scale (graphics on PC only):
Outputs: see menu « General »

$$Qmax\ (unit)$$
$$+/xxxxx.x$$

▽ Product (+ / -):

⊛If WATER: C = 1300 to 1600 m/s

$$Product =$$
$$WATER / OTHER$$

⊛If OTHER:

▽ Fluid Characteristic
and speed of sound range :

$$Co = xxxx\ m/s$$

$$Delta\ C = xxx\ m/s$$

▽ Hydraulic corrections (+ / -)
Prefer mode AUTO.

$$K\ Hydro =$$
$$AUTO / MANUAL$$

▽ Entry of Coefficient K_H or data to do
its calculation.

⊛ If MANUAL: entry of coefficient
depending on profile : Laminar = 1.333
or Turbulent = 1.02 to1.08

$$K\ Hydro = 1.xxx$$

⊛ If AUTO: entry of parameters:

▽ Fluid viscosity:

$$Viscosity\ (cst)$$
$$x.x$$

▽ Pipe roughness:

$$\underline{Roughness\ (\,m\,m)}$$
$$\underline{xx.xx}$$

As well as the critical Turbulent /
Laminar flow transition:

▽ Critical Reynolds Number (Rey C)

$$ReyC = 2800$$

▽ Transition range (LBR):

$$LBR = 3$$

(Recommended values)

8-5 : « Probe / Echo parameter settings » menu :

▽ Choice of probe
From this choice, it results Emitting Frequency, D.S. calculation (S.E.) or Opening of L and D fields (SM)

Probe = SE xxxx **(or SM ou SP. A/B)**

▽ ® if SE (External probes)
/ = single traverse
V = reflex mode
N , W = 3 or 4 paths

® If SM (wetted internal probes)
See parameters L & D

Probe mounting = V **(or / , N , W)**

▽ Management of amplification gains:
ESC Mode recommended.
(ESC= Echo Shape Control)

Otherwise :

® If **MANUAL** :
(Gain adjustment)

® If **AUTO** : Margin
(Over-amplification compared to
critical gain Go.)

Gain = ESC

Gain = xx dB

Margin = xx dB

▽ If SM choice: position of probes depending
on geometrical measurements.

® as distance L between probes,
face to face (chord)

Length = xxx.x mm

▽ ® as projected distance onto flow axis
(Part of L concerned with the flow)

Ax. D = xxx.x mm

8-6 : « General Settings » menu

▽ Setting of LCD back-lighting
(Depending on MiniSonic version)

Back Light
ON / OFF / TIMED

▽ Filter rate of measurements
(Number of 0.5 s cycles)

Filter = ∗∗

▽ Last accepted measure (IQ > 33%)
memorising time :
(Mode ESC : enter Mém. = > 20)

Mémory (s)= ∗∗

▽ Setting of Totalizers 1 & 2

® depending on flow direction:

+ , - , +/-

▽ ® depending on weight or unit :
(rom 1 cl to 100 m3)

Pulse weight =
1 m3

▽ Setting of Relays 1 & 2
® by assignment :

Closed/Open /TOT.1 ou 2 /
Fault Q/ Dir.Q/ Threshold Q

▽ ® If copy of TOT 1 or TOT 2 :
= relay closing time > F maxi

Pulse width (ms)

▽ ®If Threshold: enter value for Q:

Threshold R2 (unit)
Value

▽ Reset to Zero of TOT t1 & t2
This function may be prohibited

Reset t1 & t2
NO / YES

▽ Parameter settings of two outputs
4-20 mA, SA 1 & SA 2
® by assignment :

SA 1/ SA2 Type
Q , V , C , GAIN

® by range (depending on unit)

4mA SA 1 & SA 2
+ / - xxxx.x

20 mA SA 1 & SA 2
+ / - xxxx.x

▽ RS 232 ou 485 Communication
Jbus slave No and Baud Rate:

N. JBUS = 1
BAUD = 9600

8-7 : « Zero / Autozero Settings » menu

Status display:

| **Delta To (ns)** |
| **= xx.xx (ns)** |

Modification by **+ / -**:

® no compensation (reset) :

| **RST Delta To** |

® performs the zero under actual
conditions (flow must be null)

| **Autozero** |

Exit by **F**

! Caution = *to carry out Self-zeroing, the flow rate must be absolutely zero while the display indicates « * dTo * » .*

8-8 : « Output Current Settings» menu (normally reserved to Ultraflux)

It permits adjustment of coefficients
to convert min / max range to 4 / 20mA

| **4 mA (1 & 2) = xxxx** |

! Caution : use an a approved instrument to measure milliamperes .

| **20mA (1 & 2) = xxxx** |

8-9 : « Factory Settings » menu (normally reserved to Ultraflux)

It permits to adjust a coefficient which
optimises the compensation with
clamp on probes (value 0.6 to1.4)

| **Correction S.E. = 1.0** |

Another parameter named " Delta T band " permits to set a compromise between filtering an response time for some difficult applications: please contact Ultraflux .

Factory settings menu includes another facility but only through PC software: the entering of a linearization curve .

8-10 : « I / O Test » menu : simulation on outputs and relays .

Simulated current on SA 1 or SA 2:
(action by **+ / -)**

| **Current 1 & 2 = xx.xx** |
| **mA** |

Simulation of status on Re 1 or Re 2:
(action by **+ / -**)

| **Relay 1 & 2 =** |
| **Open / Closed** |

8-11 : <u>Optional menus or readings concerning MiniSonic P-B two-pipes version</u>

The optional menus concern the second pipe and permit to validate the second probes connector. The first and more important is in the <u>Echo menu : Nb of Chords = 1 or 2</u>
The MiniSonic P-B can calculate a <u>QT result from Q1 & Q2 : sum , difference …</u> Its calculation formula must be entered by using our PC Software .

Concerning specific menus or displays available on LCD and Keypad , we can mention :

<u>Measurement Display menu :</u>

- Display of distance D.S. 1 & 2 for the two sets of probes (same reference)
- Display of calculated flow QT from entered formula
- Display of Gains 1 & 2 plus I.Q. 1 & 2 for the two pipes.
- Display of the two different flows Q1 & Q2 in the two pipes.
- Display of the two flow velocity and also the two sound speeds.
- Display of the two time of flight and the two Delta T on the two pipes.
- Display of the two hydraulic information's Kh 1 & 2 and Reynolds number Rey 1 & 2

<u>Calibration Allowed menu :</u> identical to MiniSonic-P version

<u>Pipe Settings menu :</u>

- Entering for pipe 1 & 2 diameter and circumference: ext D 1 = xxxx.x / ext D 2 = xxxx.x
- Entering of pipe 1 & 2 materials: Pipe 1 =   / Pipe 2 = …
- Entering of pipe 1 & 2 thickness: Thickness 1 = xx.x / Thickness 2 = xx.x (mm)

<u>Q Settings menu :</u> identical to MiniSonic-P version . These data are common to the two pipes.

<u>Probe / Echo Settings menu :</u>

- Number of pipes / chords = 1 or 2
    - If transducer choice is SE, mounting mode (/ , V , N , W) must be the same for the two pipes
    - If choice is SM, it is possible to set separately the distances L 1 & 2 and D & & 2
- Management of amplification gains 1 & 2: Gain 1 = ESC … / Gain 2 = Auto …Manual
- Management of the two gains in Manual mode: Gain 2 = xx dB or
- Management of the two margins in Auto mode: Margin 2 = xx dB

<u>General Settings menu :</u> identical to MiniSonic-P menu but

- Possibility to copy QT or Q1 or Q2 as a 4 – 20 mA output
- Possibility to set Tot 1 or Tot 2 on flows Q& or Q2 or QT

<u>Zero / Auto-Zero Settings menu:</u>

- Possibility to do the Auto-Zero separately on pipes 1 & 2
- Possibility to set or reset separately Delta To 1 & 2

<u>Ouuput current Settings , Factory settings and I/O Test menus:</u> as MiniSonic-P

<u>Echo Display menu:</u> it put multiplexing off for signal controls with oscilloscope.

9- <u>RECOMMENDATIONS</u>

Each application has its priorities. Accordingly, the MiniSonic–P is particularly flexible and can be adapted to extreme situations, meaning that many applications are possible.
Each value or text field is filled in by Ultraflux before the final tests and delivery.
Nevertheless, it is advisable to verify them by running through the various menus, comparing them with files given at the time of order, or with your instructions or particular choices.

More particularly, geometrical descriptions specific to the site and the choice of scale are the responsibility of the end user.

During a run-through of the various menus, it is advisable to fill in the "Probes / Echoes" menu first, followed by those related to the Pipe and the Flow Rate / Fluid (Q) to obtain a measurement to be transmitted according to the instructions entered into the "General" menu

<u>FINAL CHECKS AND TESTS</u>

Once installation, connections and parameters have been set up, several possible situations may arise:

Case 1 – The measurement displayed and transmitted meets your expectations.

Case 2 – The measurement operates but may lack accuracy or is unstable.

Case 3 – The measurement is not reliable or the MiniSonic is displaying a Fault.

> <u>Case 1</u> : Although everything appears to be OK (Flow Rate = OK), check the other values:

- The echo or gain level compared to typical values.
  - For external probes, a gain exceeding 50/60 dB reveals certain difficulties such as the wrong choice of probes, incomplete installation or coupling, rusted pipe, absorbent fluid …
  - For intrusive probes, the gain level is usually low (excepted for gas))
  The ESC mode can decide a high gain margin. Take in account it in your diagnosis.

- The quality index Q.I. is normally close to 100 %.
  By default, it indicates several perturbations = electrical interference, passage of bubbles, highly charged fluid …
  In this case, in-depth investigation is advisable.

- The displayed speed of sound should be close to that expected. It is an index of good control of the geometry or application.

- If the flow rate can be interrupted, check the Zero
  If necessary, carry out adjustment using the Auto-Zero menu.
  By PC and software, it is possible to set the measurement to Zero at very low flow (cut-off = % of Q max) .It is better to don't use this function for portable applications.

> **Case 2** : In addition to the points mentioned above, the possible causes are:

- Poor control of the installed dimensions, or of the product characterization or of the Zero point :
  Correct and reanalyse

- An installation constructed with poor hydraulic conditions :
  If possible, change the location of the probes.
  Otherwise, it is possible to choose K Hydro = Manual and adjust this coefficient to correct the expected flow profile and thus have a reliable flow rate reading: increasing it does flow value decrease.
  With insertion probes, it is also possible to play on Axial D.

- The range of speed of sound to be measured is too wide for the chosen setup :
  With S.E. probes, a direct mode (/) may be preferable to a reflex mode (V)
  Have you correctly set Co and Delta C range?

- An unstable fluid causing the ESC mode to restart too often:
  Try the AUTO mode with a reduced margin ($\sim$ 12 dB or less)

- To permit a greater precision or a wider flow range, the MiniSonic allows the input of a "Linearization" correction law. This function is normally unused with a portable unit. In case of :
  Plot the error curve and use the software to enter the complementary law (Factory Adjustments Menu).

- The Delta t offered by the measurement conditions (Diameter, Flow Rate, Assembly, and Choice of probes) is too low to claim any measurement accuracy.
  Is it possible to revise these choices?

- The measurement conditions reveal poor control of transitions from turbulent to laminar configurations:
  Adapt declared Critical Reynolds and range (LBR) values or play with Kh=manual.

> **Case 3** : The MiniSonic does not operate:

- There is no display or measurement transmission (4 – 20 mA) .
  Is the MiniSonic powered up? Are the batteries loaded?
  Has it failed? If yes, the only solution is to call in our after-sales service.

- If the MiniSonic displays INIT constantly, attempt a power cutoff, then re-energize with if possible charger connected.
  If the fault persists, contact Ultraflux (Problem with the microprocessor).

- If the MiniSonic displays "Flow Rate Fault", this message does not mean that the MiniSonic has failed, but that the ultrasound signals have not reached the expected level or are outside the window [Co +/- Delta C]. There are several possibilities :
  Pipe empty?
  Problem of site?: two-phase fluid or too highly charged or too viscous ?
  Too old pipe, which does not transmit correctly ultrasonic signals?
  Unsuitable installation mode = try Direct mode (\) or other sensors.
  Incorrect sensor installation (orientation, coupling …) .

10 - <u>INVESTIGATIONS</u> :

If there is a difficulty or a problem, logical analysis can be assisted by the implementation of expert apparatus:

- Either an oscilloscope : the MiniSonic-P can optionally receive an additional connector to give access to internal test points for the purpose :

In respect with fix unit arrangement, normal pin out should be:

PT 0 = 0 Volt – Ground
PT 1 = Selection windows .Echo must be inside.
PT 2 = Synchro –Positive edge 0 to 5 Volt
PT 1 = Selection windows .Echo must be inside.
PT 3 = Emission < > Reception transit time.
PT 4 = Echo – Alternating signal, peak to peak 4 Volt (-0.65 V negative threshold).

- Echoes display investigations can also be done by using a DigiSonic E / P portable flowmeter .
- This device permits also ultrasonic thickness gauge option.

- Or measuring instruments for dimensional or alignment measurements

<u>SPARE PARTS</u> :

Ultraflux offers possibilities of purchasing spare cards or, as long as acceptance is granted, the standard replacement of equipment in the event of failure.

Contact the Ultraflux commercial services or the regional dealer.

11 – APPENDIX 1

: Calibration file example with a MiniSonic-P-B with clamp-on probes SE

Settings - U:\...iers_Type\DualPipe_Type_Eng-01.eta (12/01/2004 - 11:21:05)

General

N. JBus = 1	Filter	= 5 Cycle	1st screen =		QT
	Memory	= 30 Cycle	Back light =		Timed
			Line 1	=	ULTRAFLUX
			Line 2	=	FIT_01/02
			Firmware	=	16-

Probe

Number of chords =   2
Probe   =   SE1515-I
Probe mounting   =   V
Stop meas. on   = Zero Crossing
US Impulse   =   1

Pipe 1			**Pipe 2**		
Polarity	= Normal		Polarity	= Reverse	
Type of Gain	= E.S.C.		Type of Gain	= E.S.C.	
Margin	=	15 dB	Margin	=	20 dB
Delta T0 1	=	-0.40 ns	Delta T0 2	=	0.60 ns

Pipe - Product

Pipe 1			**Pipe 2**		
Ext. Diameter	= 412.0 mm		Ext. Diameter	= 216.0 mm	
Material	= Steel		Material	= Pvc	
Thickness	= 6.3 mm		Thickness	= 8.0 mm	

Product	=	Other
C0	=	1380 m/s
Delta C	=	300 m/s
KH Type	= Automatic	
Viscosity	=	2.0 cSt
Roughness	=	0.10 mm
Critical Reynolds	=	2800
L.B.R.	=	3

Flow

Q Unit   =   m3/h
Max Q   = 1000.0
Cut OFF Q =   2 %

QT Calcul

   QT= +1 x Q1 +1 x Q2

Totalizer 1	**Totalizer 2**
Direction = +	Direction = +
Type = Q1	Type = Q2
Pulse weight = 100l	

Relay 1		**Relay 2**	
Type	= Fault QT	Type	= Threshold Q2
Direction	= Normal	Threshold	= 50.0 m3/h
		Direction	= Reverse

Analog Output 1	**Analog Output 2**
Type = Q1	Type = Q2
4 mA = 0.0	4 mA = 0.0
20 mA = 800.0	20 mA = 200.0

APPENDIX 2: Speed of sound in fluids – Relation with density + P & T Influence

The speed of sound in a fluid is a full-fledged physical characteristic which may be linked with others, such as density (d), pressure (P), temperature (T) or the % of two or several miscible products or with another magnitude having good analogy, like compressibility.

For most refined petroleum products or petrochemical bases, experience shows some relationship between the speed of sound and the density of the product for constant P and T, but there are many exceptions. For water, the reliability of the relation allows a number of tests to be run on the installation. Gases have lower speeds of sound than liquids, although some refrigerating fluids come close.

Case of water:

Water has a very reliable "speed of sound < > temperature" relationship which will be put to good use whenever possible for dimensional checking: a simple temperature measurement is a means of predicting the speed of sound to be compared with the result obtained by MiniSonic on the basis of the measured times and the dimensions as set up: A deviation may require these values to be reexamined, like L for intrusive probes or the diameter and thickness of the pipe for external probes.

The following simple equation gives a good estimation of C between 0 and 100°C:

$$C = 1557 - 0{,}0245.(74 - t)^2$$

The following table defines the customary values more accurately.

| t (°C)	C (m/s)	t (°C)	C (m/s)
0	1 403	30	1 506.4
5	1 426.5	35	1 520.1
10	1 447.6	40	1 529.2
15	1 466.3	45	1 536.7
20	1 482.7	50	1 542.9
25	1 497		

The water load has little influence: this table applies to crude or used water.
When compared with other fluids, the water temperature coefficient for C is positive up to 74°C. Beyond that, the water becomes a conventional product again.
The water pressure coefficient is relatively low, at around 0.15 m/s per bar.

The presence of salts solutions increases the value of C by approximately 1 m/s per g / liter (seawater …)

The addition of glycol ethylene or a similar product also increases the speed of sound within the proportions of (50 / 50 % > 1550 m / s)

Superheated water involves curve or graph networks taking into consideration the pressure and the temperature: consult us.

Measurement on petroleum products – values at 15°C / 1 bar (except for butane and propane)**:**
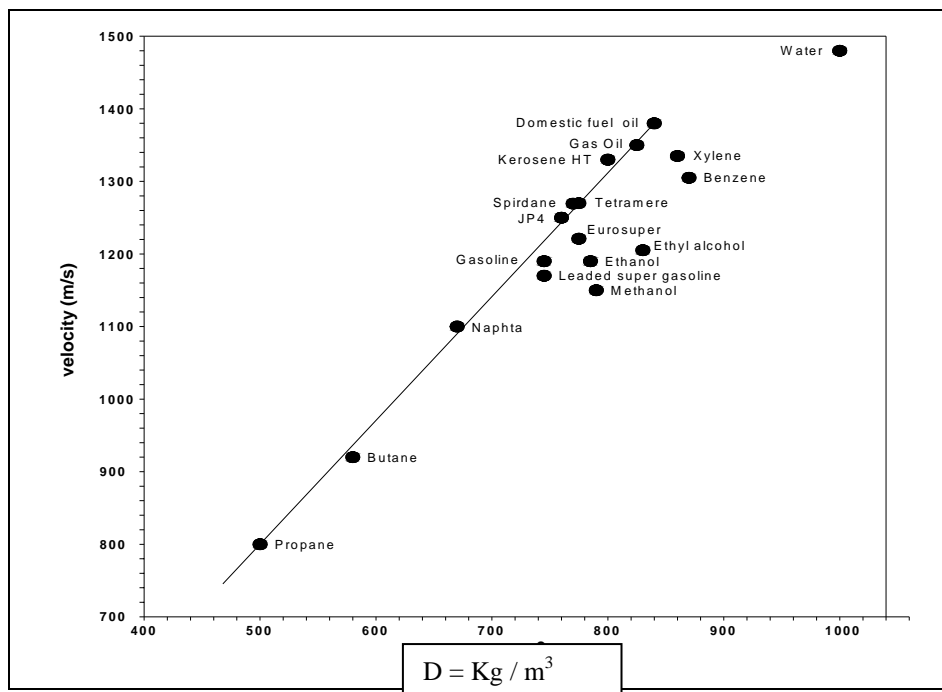
This speed of sound varies with the pressure and temperature and the coefficients rise in proportion to the reduction in the speed of sound. For instance:
- Influence of pressure = + 1 m/s per bar for liquid butane and + 0.4 m/s per bar for diesel oil.
- Influence of temperature = - 6 m/s per °C for butane and – 4 m/s per °C for diesel oil.

Measurements on Gases:

Gases are characterized by speeds of sound far lower than for liquids. Temperature coefficients are positive (0.2% per degree approximately), and pressure coefficients are of the second order. Consult us for more details.

As an example, we give an order of magnitude of these speeds in air and in natural gas:
- Air: C = 341 m/s at 20 °C / 1 bar
- Natural gas: C = 400 m/s at 15 °C / 1 bar