Operating Instructions **Flow Profiling**

ABB Kent-Taylor

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1 INTRODUCTION

The Profiling Software Package is a utility designed for use by water engineers. It allows an AquaProbe point velocity measuring probe to be used to measure and plot velocity profiles within pipes. From these individual measurements the volumetric flowrate can be calculated using the 'Method of Cubics' as detailed in BS 1042 Section 2.4 (ISO 3354)

The utility provides a screen display of the flow profile allowing the operator to visualise what is happening inside the pipe, and calculates the mean velocity and its location.

The utility provides clear, on-screen instructions whenever an action is required.

> ✴ **Note.** You are reminded that this software program ("software") is a proprietary product of ABB Kent-Taylor and is protected by copyright laws and international treaty. You must treat the software like any other copyrighted material, except that you may make one copy of the software solely for backup or archival purposes . Copyright laws prohibit making additional copies of the software for any other reason. You may not copy the written materials accompanying this software.

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2 GENERAL POINTS ON FLOW PROFILING

To do any flow profiling, it is necessary for you to be fully familiar with the operation of the measuring equipment. The manuals supplied with the AquaProbe Electromagnetic Insertion Flowmeter give full details enabling you to become familiar with the equipment before attempting to carry out the first profile.

2.1 Flow Profile Evaluations.

It is necessary to have a stable flow condition throughout the test. It may be that, by careful checking of the characteristics of the installation, a time can be decided upon which provides such a stable flow for the time required. If this is not possible, then another device needs to be available to use as a master which can be used to adjust the velocity readings for variations in flow.

It is also essential that you know the internal pipe diameter section accurately. If it is unknown, it may be measured by using the ABB Kent-Taylor Pipe Measuring Tool available as part of the profiling kit or separately if required.

3 PROFILING

Generally there are two reasons for determining the profile.

- To discover the hydraulic conditions within the pipework.

- To decide the suitability of a particular location as a measuring point either for an AquaProbe or indeed for a full bore meter.

In either case the ABB Kent-Taylor

4 METHOD

AquaProbe Flow Profiling utility will perform the function and present the data.

The ABB Kent-Taylor AquaProbe flow profiling utility uses the Method of Cubics Velocity Area as detailed in the British Standard BS 1042 Section 2.4. (ISO 3354)

This was chosen as the most suitable method for the different profiles which may occur, and because it allows almost any pipe size to be profiled. It automatically compensates for the effect of the tip length of the probe.

Using this method, an odd number of points is required to ensure that a measurement is made on the centre line of the pipe. This is important both to the method and to yourself who will generally want to use the centre line position for any subsequent measurement.

5 SETTING UP THE AQUAPROBE

Before using the AquaProbe / MagMaster system for measuring the flow profile of a given pipe, you must be familiar with the configuration and programming of the MagMaster transmitter. Details of this are given in the MagMaster Configuration Manual.

First, ensure that the two insertion factors Fi and Fp are set to 1. The Insertion Factor (Fi) is in menu location [461] and the Profile Factor (Fp) is in location [462].

It is also necessary to enter the correct internal diameter for the pipework to be profiled. This value, in millimetres, must also be entered into the MagMaster (menu location B3).

To set these factors in the MagMaster transmitter:

1) Switch on the MagMaster transmitter.

2) Connect the PC to the MagMaster using a 'Null Modem' lead, or connect a Psion 3 using a Psion 3-Link lead.

3) Start the communication facility (see MagMaster Configuration Manual).

4) Press **Escape**

5) Press **31* engineer.⏎**
    (this gains access at level 2).

6) Press **Escape**

7) Press **461*1⏎**   (this sets Fi to 1).

8) Press **Escape**

9) Press **462*1⏎**   (this sets Fp to 1).

10) Press **Escape**

11) Press **B3*xxx**   (where xxx is the internal pipe diameter in mm).

12) Press **Escape**

13) Press **45*4**   (this   sets   the response time to four seconds).

14) Press **Escape**

15) Press **22*2**   (this sets the number of decimal places to two).

16) Press **Escape**

17) Press **Q⏎**

18) Press **Menu**   and then using the **arrow** keys select **Special** and then **Exit**
    (this stops the communication facility)

Using the **magnetic wand** supplied with the MagMaster transmitter, switch the top line of

3

the display to read **velocity**.

The MagMaster/AquaProbe is now ready to use for profiling.

6.1 PC Version

6.1.1 Installation.
The profiling utility is supplied on $3^1/_2$ or $5^1/_4$ inch disks, as required, and can be run directly from the floppy disk using the following procedure:
1) Insert the disk in the floppy disk drive.

2) **Type A:**↵ for drive A, (If the drive is B, then type **B:** ↵).

3) Type **PROFILE**↵

The header screen – see Fig. 6.1 – is displayed. Press any key to display the main menu screen – see Fig. 6.2.

If you wish to install the utility on the hard disk of your computer, there is an installation program provided on the disk which installs the utility into a directory called 'profile'.

To do this:
1) Insert the disk in the floppy disk drive

2) Type **A:**↵ for drive A, (If the drive is B, then type **B:**↵)

3) Type **INSTALL.**↵

The utility is now transferred to the hard disk and can then be used directly from drive C. It is important to keep the floppy disk as a master in case of problems.

★ **Note.** The software, whilst not being a 'Windows' package can be run via Windows, and an icon is provided for those customers who wish to do so.

If using in a 'DOS' environment then :

at the command prompt, change to the relevant directory (Profile) and type the command:

PROFILE ↵


```
                    ABB  Kent–Taylor
                    ***************

           AquaProbe  Flow  Profiling  Utility

                   Version  No  1.00



     Calculations  to  B.S.  1042  Section  2.4  (ISO  3354)


                Press  any  key  to  Proceed
```

Fig. 6.1 Header Screen

```
ABB Kent-Taylor Customer Services    Flow profiling Software V1.00


  Press I to Input Data
  Press R to Retrieve Data

  Press X to Exit



  Make Your Selection


Note
Ensure MagMaster Fi & Fp are set to 1.
Menu Locations [461] & [462]
```
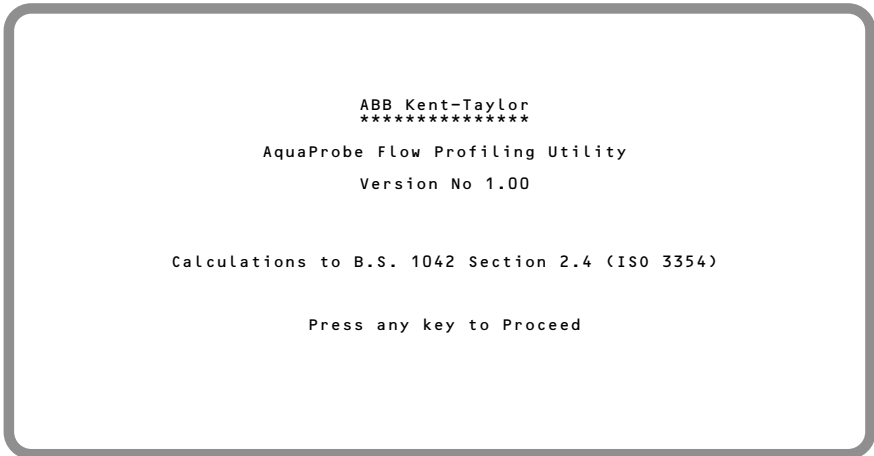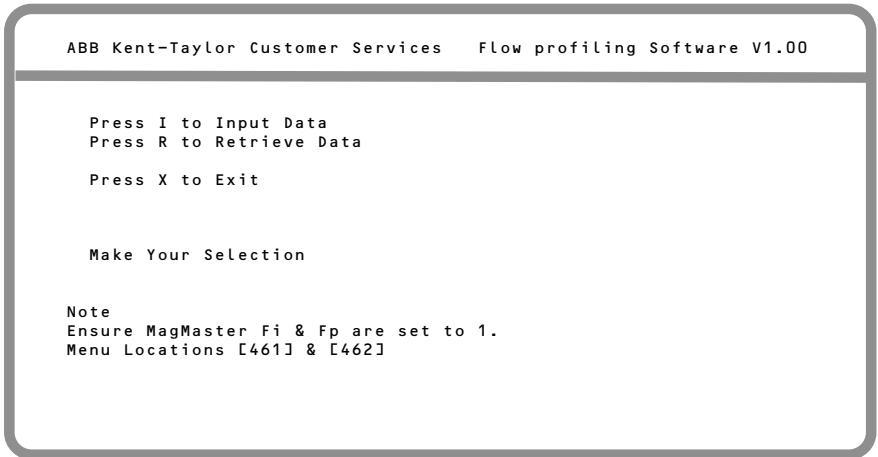
Fig. 6.2 Main Menu

The header screen – see Fig. 6.1 – is displayed. Press any key to display the main menu screen – see Fig. 6.2.

I allows you to input data and is the option which enables you to perform a new profiling operation.

R allows you to retrieve data from previous profiling operations .

X allows you to leave the utility.

6.1.2   Input Data

```
ABB Kent-Taylor Customer Services    Flow profiling Software V1.00

  Select Measurement Units

  Press M for Millimeters
  Press I for Inches

  Make your selection?
```
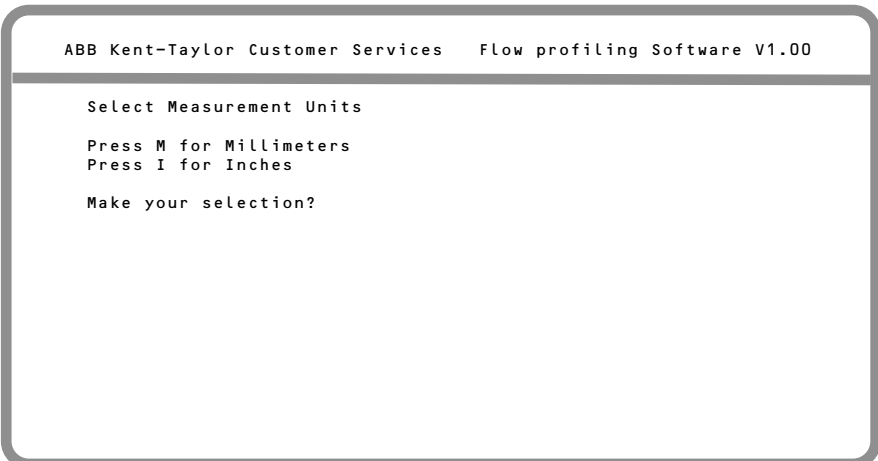
Fig. 6.3 Measurement Unit Selection Screen

Pressing **I** clears the screen and presents the Measurement Unit Selection screen – see Fig. 6.3.

```
   ABB Kent-Taylor Customer Services    Flow profiling Software V1.00


    Internal Diameter...(mm) ?   1000
    Number of Points.........?   11


    Correct (Y/N)?
```
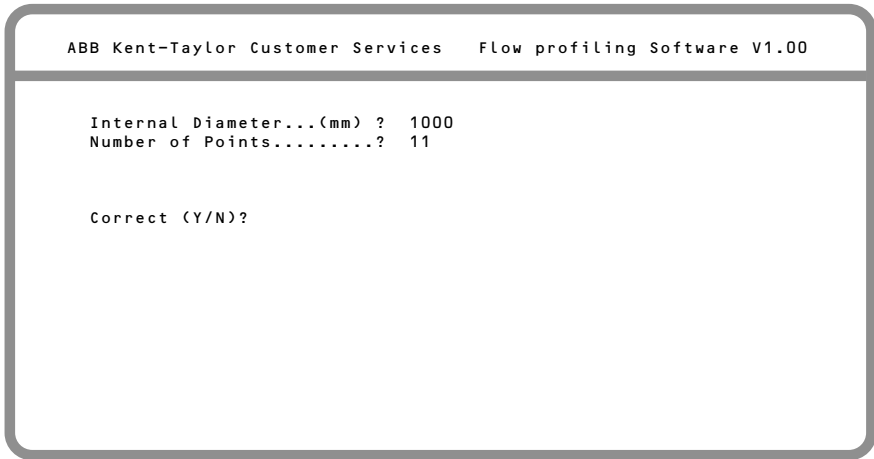
Fig. 6.4 First Input Data Screen

Note. All screen in this manual are shown using metric units.

Selecting either option causes the first data input screen to be displayed – see Fig. 6.4,

where you prompted for the internal diameter of the pipe. As explained previously, It is essential that you know the internal diameter of the pipe accurately.

You are asked how many points you wish to take. It is important that you choose an odd number, such that a measurement is taken on the centre line of the pipe. If you enter an even number, the software rejects it and selects the next largest odd number.

It is also important that you select at least 7 points. Fewer than 7 points will not give sufficient information to the software to enable it to calculate the mean velocity and its location accurately. If you select a number less than 7, then the software will modify the number to be 7.

After entering this information, you are asked to confirm that it is correct; if you answer no, you will again be asked for the internal diameter.

After confirming that the data is correct, the screen clears and you are instructed to move the AquaProbe to a specified location – see Fig. 6.5. You should follow these instructions carefully.

You are asked for the velocity at this point. We recommend that you wait 30 seconds for the flow pattern to stabilise before noting the reading and entering it into the computer. When you have done so, you are asked to check if this is correct; this is your chance to change the measured velocity. If by any chance you made an error in entering it, if it is correct, the true velocity is calculated at that point and displayed together with the measured velocity – see Fig. 6.6.

You are now instructed to withdraw the probe a further distance, giving you both the incremental distance to withdraw and the total withdrawn distance. Again you are prompted for the velocity etc; this sequence continuing until all measuring points are covered – see Fig. 6.7.

The mean velocity in the pipe is now calculated, together with the insertion depth(s) at which this mean velocity can be found.
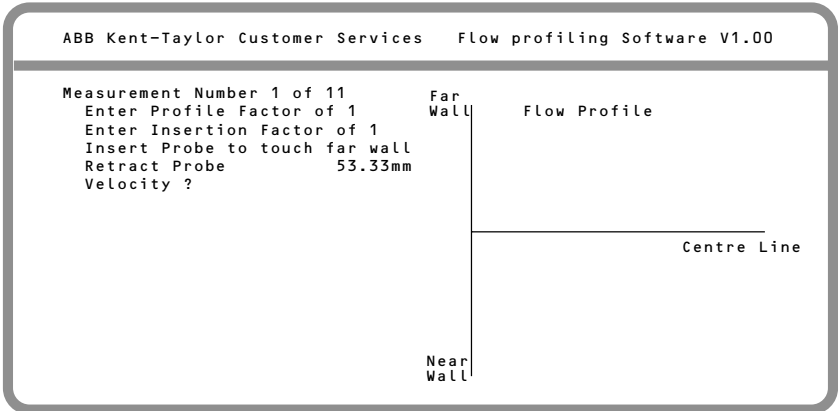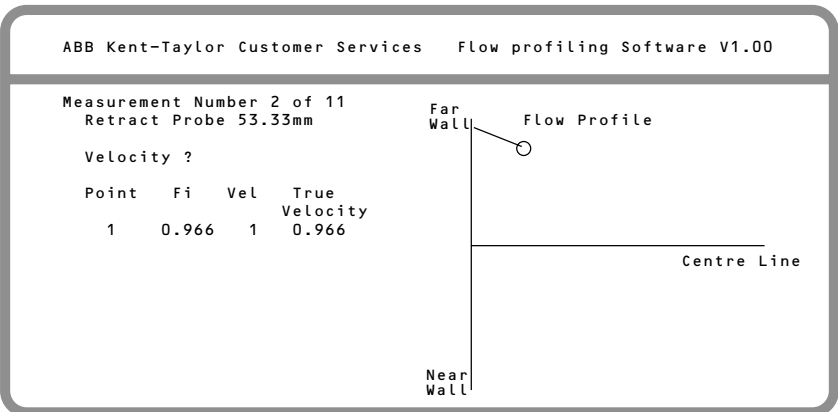
6

```
 ABB Kent–Taylor Customer Services   Flow profiling Software V1.00


 Measurement Number 1 of 11          Far
   Enter Profile Factor of 1         Wall    Flow Profile
   Enter Insertion Factor of 1
   Insert Probe to touch far wall
   Retract Probe          53.33mm
   Velocity ?

                                                            Centre Line


                                     Near
                                     Wall
```

Fig. 6.5 Second Data Input Screen

```
 ABB Kent–Taylor Customer Services   Flow profiling Software V1.00


 Measurement Number 2 of 11          Far
   Retract Probe 53.33mm             Wall    Flow Profile
                                               O
   Velocity ?

   Point   Fi   Vel   True
                      Velocity
     1    0.966   1   0.966
                                                            Centre Line


                                     Near
                                     Wall
```

Fig. 6.6 Third Data Input Screen

```
 ABB Kent–Taylor Customer Services    Flow profiling Software V1.00


 Mean Velocity is  1.098522          Far    Flow Profile
 Mean Point is at 862.709mm Insertion Wall
 Insertion Factor (Fi) is 0.9722
 Profile Factor   (Fp) is 1.0000
 Mean Point is at 118.69mm Insertion
 Insertion Factor (Fi) is 1.0540
 Profile Factor   (Fp) is 1.0000

 If AquaProbe is to be used on Centre Line            Centre Line
 Insertion Factor (Fi) is 1.012244
 Profile Factor   (Fp) is 0.80399

 Data Storage
 Enter Filename if required?         Near
                                     Wall
```
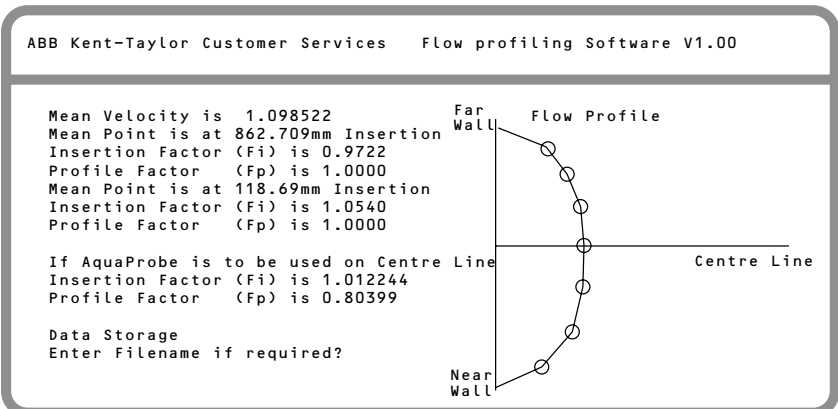
Fig. 6.7 Results Screen

7

If you want to use the AquaProbe as a flow measuring instrument, place it at either of the two points calculated as being the mean points, or at the centre line. Whichever location you choose, the relevant insertion factor (Fi) and Profile factor (Fp) are calculated and displayed.

If you wish to store this data enter a filename when prompted to do so. This must be 8 characters or less and have no spaces, dots or slashes, and is the name used by the system for saving the data. It is therefore important that you choose a name which is appropriate to the site in question for subsequent reference.

It is important that the same name is not used more than once. If you wish to perform a number of profiles at a given site, then choose the name to include a number for example:

> Site Name **Exeter**
> Site reference **Exeter1**

Next test
Site reference **Exeter2**
etc.

Examples of invalid names
> Exeter 1
> Exeter.1
> Exeter\1

6.1.3 Retrieve Data

Pressing **R** causes a list of stored profile data files to be displayed followed with a request to enter a filename. You should enter the required filename and then press **Enter**.

The screen clears and the results screen appears – see Fig. 6.7.

You will be asked finally if you wish to print the data. If you say yes to this, a printed representation of the profile is produced on any normal printer using standard characters. Then follows a of list all the collected and calculated data. The name under which the file has been saved and the date of the operation are also printed.

6.2   Use of Psion Version
The 'Psion' version of the ABB Kent-Taylor AquaProbe Profiling Utility is suitable for use on both Series 3 and series 3a Psion Computers. It is supplied on a Psion Flash Memory pack and needs to be installed onto the Psion before use.

6.2.1   Installation.

1) Put the Flash pack into either the left hand or right hand slot of the Psion, The left hand slot when looking at the screen is drive A, the right hand one is drive B.

2) Turn on the Psion.

3) Ensure that you are not in any application, and you are looking at the system screen.

4) Press the menu key. Using the arrows in the lower right side of the keyboard, select **'APPS'. Press Enter**

5) Select **'Install' Press Enter**

6) When the sub screen appears, it has three lines,

   File Name
   Disk
   Position.

7) Using the Arrows, move to the line **'Disk'**, and then select A or B depending on where you inserted the flash pack.

8) When the correct one has been selected the word **Profile** appears on the top line. Press **Enter**.

9) The AquaProbe profiling icon appears on the system screen and the software is ready for use.

10) Please note that although you have installed the software, it will still be necessary to keep it in the Psion, and keep it in the same disk slot.

6.3   Using the Profiling Utility
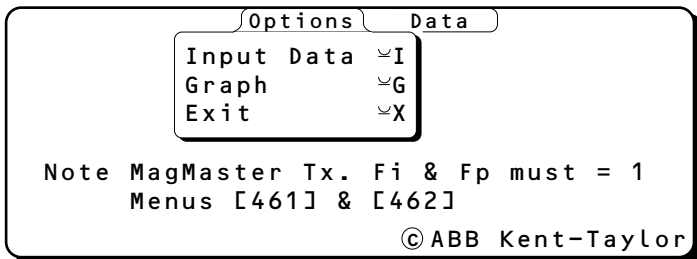Move the highlight bar to the AquaProbe icon and press Enter.

```
            ╱Options╲   Data
           ┌──────────────────┐
           │ Input Data  ⌣I   │
           │ Graph       ⌣G   │
           │ Exit        ⌣X   │
           └──────────────────┘
     Note MagMaster Tx. Fi & Fp must = 1
            Menus [461] & [462]
                    © ABB Kent-Taylor
```
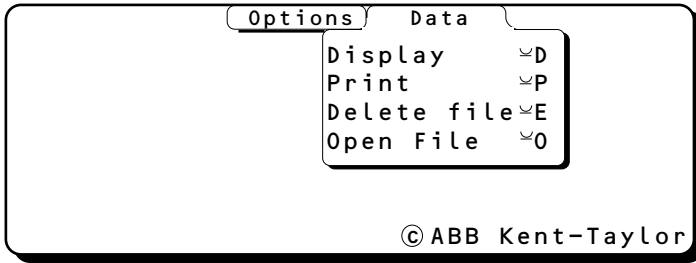
Fig. 6.8 Options Menu

Fig. 6.9 Data Menu

A header screen appears with copyright information.

Pressing any key takes you to the first menu screen. There are two pull-down menus – see Figs. 6.8 and 6.9.

6.3.1   Options Menu (Fig. 6.9)
Options has the following items:

Input data
This enables you to perform a new profiling operation. After completion of the operation, the information is automatically saved .

Graph
This draws a graphical representation of the profile on the screen.

Exit
This closes the utility. The system screen is displayed

6.3.2   Data Menu
Data has the following items:

Display.
This displays a summary of all the information collected for the currently active profile.

Print.
This prints out the data, as listed above, to either a serial or parallel printer. **It is important that a printer is connected to the Psion before this item is selected.**

Delete File.
This deletes the current file from memory. Once deleted, data is irrecoverable.

Fig. 6.10 Measurement Unit Selection Screen

```
Enter Site Ref. (8Chrs)

Enter Internal Pipe ø (mm)
How Many Points in Profile?.....


                         ©ABB Kent-Taylor
```

Fig. 6.11 Input Data Menu

Open File.
This lists the files saved by the system and allows one to be reloaded.

6.3.3   Input Data (Fig. 6.10)
First you are requested to select the measurement units you wish to use. Select either to proceed.

Here (Fig. 6.11) you are asked for a Site reference. This must be 8 characters or less and have no spaces, dots or slashes, and is the name used by the system for saving the data. It is therefore important that you choose a name which is appropriate to the site in question for subsequent reference.

It is important that the same name is not used more than once. If you wish to perform a number of profiles at a given site, then choose the name to include a number for example:

Site Name   **Exeter**
Site reference **Exeter1**
Next test
Site reference **Exeter2**
etc.

Examples of invalid names
       Exeter 1
       Exeter.1
       Exeter\1

Next you are asked for the internal pipe diameter. It is essential that you know the internal diameter of the pipe section accurately. This may be measured by using the ABB Kent-Taylor Pipe Measuring Tool available as part of the profiling kit or separately if required.

You are asked how many points you wish to take. It is important that you choose an odd number, such that a measurement is taken on the centre line of the pipe. If you enter an even number, the software rejects it and selects the next largest odd number.

It is also important that you select at least 7 points. Fewer than 7 points will not give

```
Measurement Number 1 of 7
Insert probe to far wall of pipe
Then retract AquaProbe 53mm Total 156mm
Velocity ?
Measured Vel 1.23 True vel. 1.1.1234
Data Correct?
   (Y)or N               ©ABB Kent-Taylor
```

Fig. 6.12 Input Data Menu

sufficient information to the software to enable it to calculate the mean velocity and its location accurately. If you select a number less than 7, then the software will modify the number to be 7.

After answering these questions, a new screen is displayed (Fig. 6.12). It gives the measurement number and the number of measurements you are to perform.

The system instructs you to move the AquaProbe into a specified location. You should follow these instructions carefully, and then move to the next line.

 Velocity?

Here you should enter the velocity obtained from the display of the MagMaster and then press **Enter**.

Two new lines appear, the first one repeating the measured velocity as entered, and giving the true velocity at that point.

You are asked if data is correct. If it is then press **Y**, if not press **N**.

If you press **N** the question **Velocity?** reappears and you may enter the correct velocity.

When you are satisfied, press **Y** and the screen clears; you are again instructed to
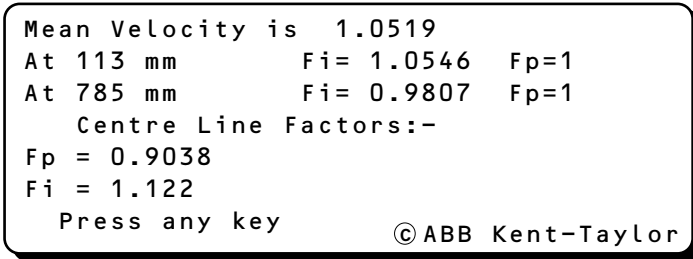
```
Mean Velocity is  1.0519
At 113 mm        Fi= 1.0546   Fp=1
At 785 mm        Fi= 0.9807   Fp=1
    Centre Line Factors:-
Fp = 0.9038
Fi = 1.122
  Press any key        © ABB Kent-Taylor
```

Fig. 6.12 Results

move the probe a further distance, giving the incremental distance to withdraw and the total withdrawn distance, and again asked for the velocity.

This sequence of events repeats until all the points have been entered.

When the final point has been entered, the results screen is displayed (Fig. 6.12).

The results screen gives the following information:

Mean velocity in the pipe.

The locations in the pipe where the liquid is flowing at the mean velocity, together with the insertion factors (Fi) and the Profile Factors (Fp) which you will need if you choose to install the probe at one of these insertion distances to be on the mean velocity point.

The Centre Line Factors. If you choose to install the AquaProbe on the Centre line of the pipe, then these are the Insertion Factor (Fi) and the Profile Factor (Fp) which you will need to use.

The information remains on screen until you press any key. Pressing any key saves the data to a file called by whatever you entered as the site reference. You are then returned to the main
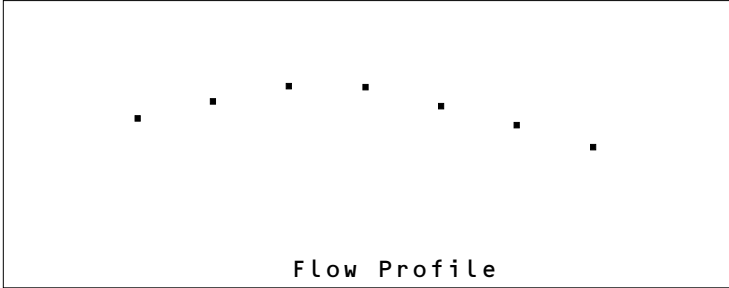

Flow Profile

Fig. 6.13 Input Data Menu

menu.

6.3.4   Graph
Use the Arrows in the lower right hand corner of the screen to select the menu item **Graph**, and press **Enter**.

A graphical representation of the profile is displayed – see Fig. 6.13.

Pressing any key returns you to the main menu.

6.3.5   Exit
As previously stated, selecting **Exit** and pressing **Enter** closes the utility and returns you to the

```
Site Reference − EXETER2
Time − Mon 15 Sep 1993 17:11:14
───────────────────────────────────
Pipe I.D.     = 1000 mm
Mean Velocity = 1.052m/s
Mean Vel Pts At113.48mm/Fi=1.0546 (Fp=1)
             At784.64mm/Fi=0.9807 (Fp=1)
C/L Factors: Fi= 1.0122    Fp= 0.9038
        Press any key to continue
```

Fig. 6.14 Displayed Data

Psion system screen.

6.3.6   Data Menu (see Fig. 6.9)

Display
Move to the **Data** menu, select the item **Display**, and press **Enter**. A summary of the application data collected appears (Fig. 6.14) as follows:

Site Reference – Here you will see the Site Name.
Time – Here you will see the date and time the data was entered.

Pipe I.D.
Mean Velocity
Mean Vel Points – Here you will see the locations in the pipe where the liquid is flowing at the mean velocity, together with the insertion factors (Fi) and the Profile Factors (Fp) which you will need if you choose to install the probe at one of these insertion distances to be on the mean velocity point.

```
Ins Dist/True Vel        Ins Dis/True Vel
 875        0.97
 750        1.08
 625        1.14
 500        1.16
 375        1.16
 250        1.17
 125        1.16
```

Fig. 6.15 Insertion Distances/True Velocities

C/L Factors – Here you will see the Insertion Factor (Fi) and Profile Factor (Fp) needed if you install the probe on the centre line.

Pressing any key causes a list of the insertion distances and true velocities for the current profile to be displayed, see Fig. 6.15.

If there are more than 14 points in the profile, then the screen displays only the first fourteen points; pressing any key causes the next 14 to be displayed, and so on.

Print

If you select this option a sub menu appears offering the choice between serial and parallel printers. When you have selected the one you require, press **Enter** and a complete list of all data in the currently active profile and the graph are printed. The main menu is then displayed.

Delete File

Select this option to delete the current profile information from memory. Once deleted the data is irrecoverable.

Open File

This option is the one to use to load information.

Select this option and press **Enter** to display a list of the files of profile information. At the bottom of the screen, there appears the question:

Select file for display...

Type a name from the displayed list to load that file and be displayed as detailed above.

From PC

…APPENDIX – PRINTED RESULTS

From Psion

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