

***DYNAMETERS***™

**Solenvis**  
experts in **energy** metering

# **Solenvis SL69 Open Channel Meter / Area-Velocity Ultrasonic Flow Meters**

## **DMDF-OP-B Ultrasonic Flow Meter**

**Channels & Partially Filled Pipe**

Operation & Maintenance

Manual

REV 03/2011

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## PART 1 Introduction

DMDP-OP-B Ultrasonic flowmeter is designed for **Open Channel and Partially Filled Pipe** applications. It has the same measurement as the doppler ultrasonic flowmeter of full filled pipe on the fluid velocity measurement.



### 1.1 Overview

DMDP-OP-B Ultrasonic flowmeter includes Flow Calculator and DYNAMETERS Velocity and Level Transducer.

The flow calculator can set the cross-sectional area calculation of partially filled pipe, and for circular pipe, it only need to input the inner diameter. The flow calculator also can used for open channel, it only need to input the width; users also can input up to 20 point coordinates of channel to calculate the cross-sectional area. The flow calculator can display the velocity, level, flow rate and flow totalizer, and is configured with 4-20mA, RS485/MODBUS output, GPRS is optional.

The flow calculator can record data of flow rate and total flow with a SD card (up to 8GB).

DYNAMETERS Velocity and Level Transducer is a unique combination of water velocity, depth and temperature instruments integrated with a solid state logger. It is a new generation of intelligent flow measurement systems.

By using digital signal processing techniques, DYNAMETERS Transducer is able to perform in a wide range of environments. It is used to record flows in pipes, channels and small streams and operates in a wide range of water qualities from fresh streams to primary sewage channels.

DYNAMETERS Transducer is mounted on (or near to) the bottom of the stream/pipe/culvert and measures the velocity and depth of the water flowing above it.

DMDP-OP-B systems have been tested in small streams and pipes, and the calibration has been verified in a tow tank. However, at the time of writing, there is little field experience with the use of acoustics in natural streams. Indications are that different channels have different characteristics and that acoustics can see velocity distributions that, if they are correct, may challenge some conventional ideas.

## **1.2 Typical Applications**

The instrument is intended for economically recording flows in channels, culverts and pipes. It can also be used where existing techniques are unsuitable or too expensive.

It is particularly useful at sites where no stable stage/velocity relationship exists and where flows are affected by variable tailwater conditions, culvert entry blockages, pipe surcharging, other unstable flow conditions, or even reverse flows.

### **MODELS**

5m depth range (Model 051 DMDP-OP-B Kit).

2m depth range (Model 021 DMDP-OP-B Kit).

### 1.3 System Components

Your DMDP-OP-B system consists of:

Flow Calculator.

DYNAMETERS Transducer (including 15m «SQL» signal cable and weatherproof plug).

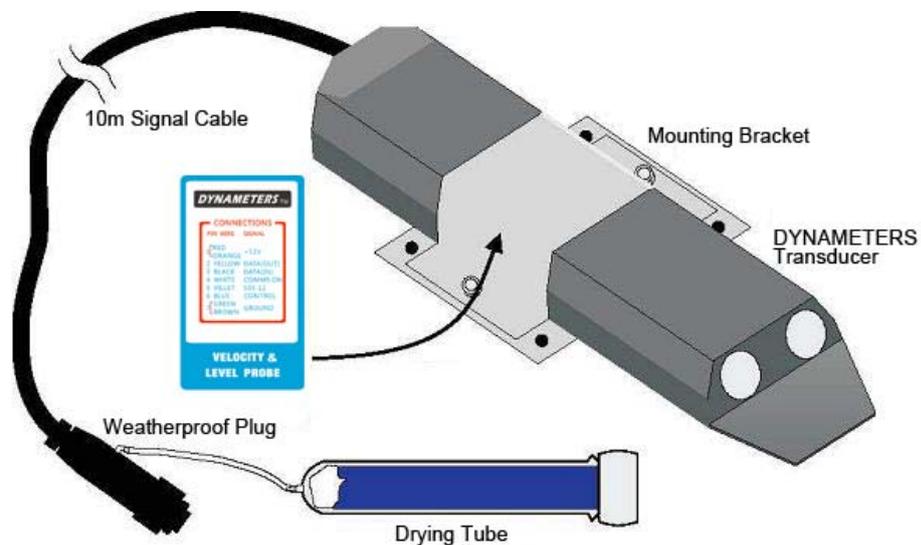
Drying Tube and Desiccant.

Adaptor cable for connecting the DYNAMETERS Transducer to flow calculator.

Stainless Steel Mounting Bracket.

DMDP-OP-B User's Manual. This manual.

If customers do not use flow calculator to DYNAMETERS transducer power supply, customers need to provide a battery yourselves for DYNAMETERS transducer power supply. The battery provides voltage of 12-15V.



### 1.4 Getting Started

To use DMDP-OP-B, follow these steps:

- 1 Install the Flow Calculator and DYNAMETERS Transducer in suitable location.
- 2 Connect IN\_RS232/485 to DYNAMETERS Transducer.
- 3 Connect DC12V OUT "+ -" to DYNAMETERS Transducer power supply.
- 4 Power on Flow Calculator.
- 5 Set parameters and measure. (Note: Flow Calculator must be set closed in External L&V)

Parameter setup in flow calculator:

First, set "Close" in "External L&V";

Second, set measuring type in "Area"; If select "Pipe", then set pipe diameter, offset and dead zone. If select "Rect", then set the width of rectangle. If select "UserR", then set the point coordinates.

The transducer has a 10mm offset, so when use it, the 10mm offset should add to cross-sectional area.

If customer needs output, please set related parameters in "Output".

**Note:** When setup parameter in flow calculator, must connect transducer to flow calculator, if not, pressing key is invalid.

## **PART 2 Operating Principles**

DYNAMETERS Transducer measures velocity, depth and temperature. The measured data are scaled and processed during presentation and processing.

Connect DYNAMETERS Transducer to Flow Calculator, Flow Calculator can get measured data and display level, velocity, flow rate and total flow. Flow Calculator also can logged flow rate and total flow by SD card on main board.

### **2.1 Overview**

Water Velocity in the vicinity of the DYNAMETERS Transducer is measured acoustically by recording the Doppler shift from particles and microscopic air bubbles carried in the water.

Water Depth above the DYNAMETERS Transducer is measured by a pressure Transducer recording the hydrostatic pressure of water above the instrument.

Temperature is measured to refine the acoustic recordings. These are related to the speed of sound in water, which is significantly affected by temperature.

Battery Voltage is measured to allow the DYNAMETERS Transducer to stop operating if the supply voltage is below defined limits.

Flow, flow rate and total flow values are computed by flow calculator from user defined channel dimension information.

### **2.2 How DYNAMETERS Transducer Measures Velocity**

When sound is reflected from a moving target the frequency of the sound is varied by the velocity of the target. This variation is known as a Doppler shift. To measure water velocity in open channels, DYNAMETERS Transducer exploits the particles moving with the water as acoustic targets (or scatterers) from an instrument fixed to the bed or bank.

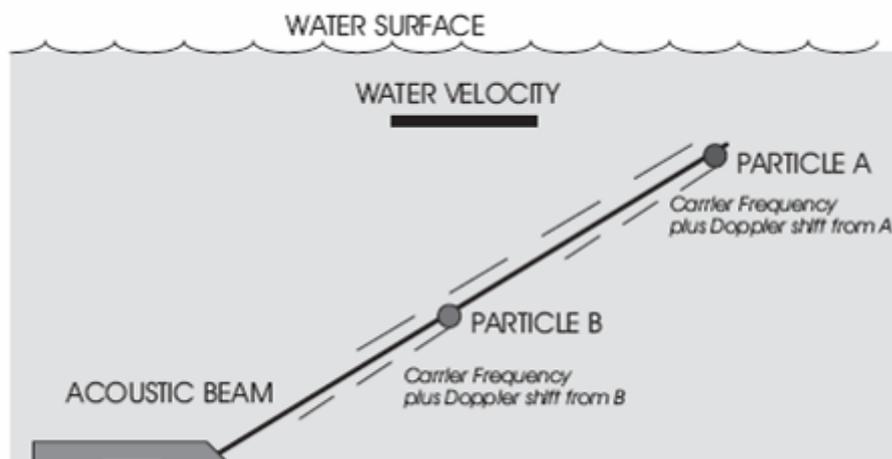
There are two distinct types of doppler instruments that can be used to measure water velocity:

- Coherent (or profiling) dopplers transmit encoded pulses with the carrier frequency at target locations, and only measure signals reflected from these targets. This allows the velocity in a stream to be profiled. These instruments are complex and expensive.
- Incoherent (or continuous) dopplers like the DYNAMETERS Transducer, emit a continuous signal and measure any signals returning from scatterers anywhere and everywhere along the beam. These are resolved to a mean velocity that can be related to a channel velocity at suitable sites.

During a measurement cycle, ultrasonic sound is transmitted continuously at a fixed frequency, called a carrier. A receiver listens for reflected signals from any targets. A measuring circuit detects any frequency changes. A processing system accumulates and analyses these frequency changes and calculates a representative Doppler shift from the range received.

Each Doppler shift is directly related to the water velocity component along the beam. This is a physical relationship and if you know the speed of sound in water you can calculate the velocity of the reflector and thereby the velocity of the surrounding water. DYNAMETERS Transducers do not need calibration for velocity measurement.

The velocity measured is the component along the beam. Because the beam is at an angle to the flow, the Velocity is adjusted by the angle cosine.



## 2.3 Speed of Sound In Water

Velocity measurements are directly related to the speed of sound in water. The factor used to scale DYNAMETERS Transducer Velocity measurement is based on the speed of sound in fresh water at 20°C (see table below). This velocity of sound gives a calibration factor of 0.550mm/sec per Hz of Doppler shift.

This calibration factor may be adjusted for other conditions. For example, the calibration factor for sea water is 0.5618mm/sec/Hz.

The speed of sound varies significantly with water density. Water density is dependent on pressure, water temperature, salinity and sediment content. Of these, temperature has the most significant effect and it is measured by the DYNAMETERS Transducer and applied in the correction of velocity measurements.

The DYNAMETERS Transducer corrects for the variation of the speed of sound in water due to temperature using a factor of 0.00138mm/s/Hz/°C. This correction is a best fit for water temperatures between 0°C to 30°C.

The following table shows how the speed of sound varies with temperature and between fresh and sea water.

VELOCITY OF SOUND IN WATER (m/s) AT ATMOSPHERIC PRESSURE		
TEMPERATURE (°C)	"FRESH WATER"	"SEA WATER"
0	1402	1449
5	1426	1471
10	1447	1490
15	1466	1507
20	1482	1521
25	1497	1534
30	1509	1545
35	1520	1555

Bubbles in the water are desirable as scatterers, but too many can affect the speed of sound. In air the speed of sound is about 350 m/s.

## 2.4 Site Considerations

The Doppler signal received, and the accuracy of the computed velocity, is related to the flow and cross-section characteristics of the site. A suitable site has the following features:

Feature	Description
Flows are laminar and the velocity measured by the Transducer can be related to the mean velocity of the channel.	Velocity is measured from a limited path in front of and above the acoustic sensors. This area varies with the amount of suspended material in the water and the channel characteristics. The user has to determine the relationship between the measured and mean velocity.
The channel cross section is stable.	The relationship between water level and the cross-sectional area is used as part of the flow computation.
Velocities are greater than 20 mm / second.	The Transducer does not process velocities slower than this. The maximum velocity is 5 metres / second. The Transducer will measure velocities in both directions.
Reflectors are present in the water.	Generally the more material in the water the better. DYNAMETERS Transducer generally works well in clean natural streams but problems may be encountered in extremely clean water.
No excessive aeration.	Bubbles are good scatterers and occasional small bubbles will enhance the signal. However the speed of sound can be affected if there are excessive amounts of air entrapped in the flow.
The bed is stable and DYNAMETERS Transducer will not be buried by deposits.	Some coating and partial burying has little effect on the measured velocity but it should be avoided.

Other site considerations relate to the physical suitability for installation and operation of the transducers.

Safe working environment - particularly if you are measuring wastewater pipes or in confined locations.

Access is possible - to check readings of depth and velocity on flow calculator at the Transducer location, to verify the data produced.

Secure installation - resistant to vandalism and as inconspicuous as possible.

## **2.5 Factors Affecting Data Accuracy**

DYNAMETERS Transducer measures velocity to an accuracy of  $\pm 2\%$  and depth to  $\pm 0.25\%$  of calibrated range. This is logged to a resolution of 1 mm/sec and 1mm respectively. The transducers have been calibrated and are expected to be stable for long periods provided they are not physically damaged, blocked or buried.

The purpose of the DYNAMETERS Transducer is to produce FLOW DATA. This is the product of the cross section (derived from measured depth) and velocity data, each of which is modified by user defined factors before use. There are many opportunities for errors to accrue in the process and degrade the result. These can be reduced or eliminated by using the instrument properly. Some of the more significant potential error sources follow.

### **2.5.1 Alignment with Flow**

For the calibration to be valid, the Transducer needs to be horizontally and vertically aligned with the flow. While DYNAMETERS Transducers are calibrated pointing into the flow, they can be pointed downstream with little loss of calibration accuracy. You may want to do this when fouling of the sensor face is a problem.

Any angled flow in the horizontal plane will reduce the recorded velocity. A 10 degree angle will reduce the velocity recorded by 1.5%.

More significant errors will result from angled flow in the vertical plane. The sensors are manufactured to project acoustic signals at  $30^\circ$  above horizontal when the sensor is mounted horizontally. A  $10^\circ$  vertical flow angle change will cause errors of approximately  $+8.5\%$  ( $@20^\circ$ ) and  $-11.5\%$  ( $@40^\circ$ ).

### **2.5.2 Conversion of Logged to Mean Velocity**

The logged velocity data may have to be adjusted during post processing to reflect a mean velocity for the channel. The factors used will be site specific and have to be determined by the operator. This is done by obtaining a mean channel velocity by

conventional techniques and comparing it with the average logged velocity. If necessary this process should be repeated at various discharges.

Where the relationship is complex or unstable, the accuracy of this method is compromised.

In laminar flow conditions the channel mean velocity could be expected to be between 90% and 110% of the logged velocity.

In small channels (say a 500mm diameter pipe) the factor may be close to 100% as a representative area of flow will have been “seen” by DYNAMETERS Transducer and contributed to the logged velocity.

In larger channels only the area adjacent to DYNAMETERS Transducer will be “seen” and the relationship will depend on how this portion relates to the vertical and horizontal velocity distribution in the channel. An instrument located in the centre of the stream would normally be in a higher velocity area. However in a deep channel DYNAMETERS Transducer may only see the slower portion of the velocity profile.

## **2.6 Depth Measurement**

Water depth is measured using a solid state pressure sensor mounted underneath the DYNAMETERS Transducer and vented to atmospheric pressure via a vent tube inside the signal cable.

Water pressure is sensed via a pressure damping manifold which has been designed to sense depth in front of the velocity Transducer.

The shape of the sensing manifold is designed to reduce velocity effects on the pressure sensor. These effects are significant at velocities above 2m/sec.

The vent tube is opened to the atmosphere through the signal cable connector and a vent tube desiccant canister is fitted to ensure moisture does not enter the vent tube.

## **2.7 Flow Rate Calculations**

Most users will record velocity and depth for later analysis. However, Flow Calculator has the capability of performing Flow Rate and Total Flow computations.

From these computed you may display and record Flow Rate and Totalised Flow (volumes).

## **PART 3 Specifications**

### **3.1 Specifications**

#### **Flow Calculator**

Enclosure:	Fixed: NEMA 4X [IP65], cast aluminum
	260L×193W×80H (mm), 10.2L×7.6W×3.2H(inch)
Enclosure:	Portable: NEMA 4X [IP65], ABS
	358L×250W×150H (mm), 14.1L×9.8W×5.9H(inch)
Power Supply:	Fixed: 100~240VAC, 50/60 HZ ±5%, 5VA Max
	Or 12~28VDC, 2.5VA Max.
Power Supply:	Portable: rechargeable lithium battery, 12VDC, 14.4Ah, Over 50 hours working time on a full-charge
	Charger: 100~240VAC, 50/60 HZ ±5%, 3A Max
Outputs:	4-20mA, RS485/Modbus, GPRS (optional), SD card to record data
Temperature:	-40 to +70°C

#### **DYNAMETERS Transducer**

Enclosure:	PVC body. Stainless steel mounting plate.
	290mm x 70mm x 25mm (L x W x H)
Weight:	850g (2kg with 15m cable)
Cable:	15 metre, 9 way vented cable «SQL» Compatible
Temperature:	-17°C to 60°C, Resolution: 0.1°C

**Velocity**

Range: 21mm/s to 4500mm/s bidirectional

Resolution: 1mm/s

Accuracy: 2% of measured velocity

Signal Path: 30° above horizontal

**Depth**

Ranges: Model 021 0 to 2m

Model 051 0 to 5m

Resolution: Model 021 0 to 1m – 1mm

1 to 2m – 2mm

Model 051 0 to 2.5m – 2.5mm

2.5 to 5m – 5mm

Accuracy:  $\pm 0.25\%$  of calibrated lower range

Type: Hydrostatic pressure sensor vented to atmosphere.

Offset 10mm

## PART 4 Flow Calculator Installation and Wirings

### 4.1 Fixed Flow Calculator Mounting

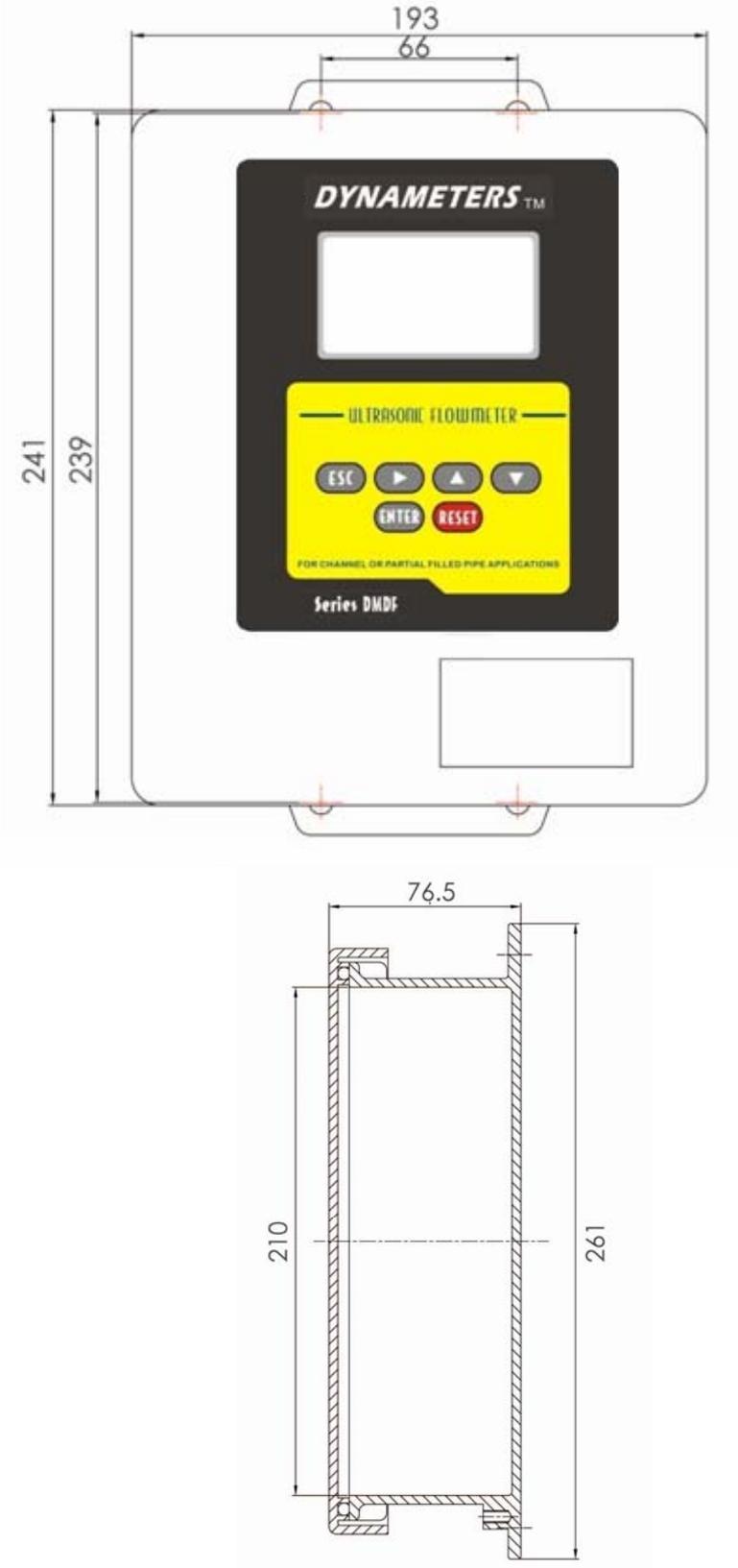
Mount flow calculator in a location that is:

- Where little vibration exists
- Protected from falling corrosive fluids
- Within ambient temperature limits -40 to +158°F (-40 to +70°C)
- Out of direct sunlight. Direct sunlight may increase transmitter temperature to above the maximum limit



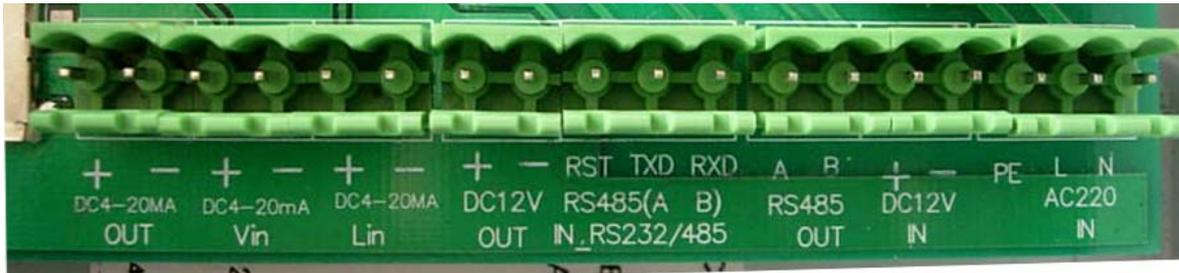
Fixed Flow Calculator

**4.2 Fixed Flow Calculator Mounting Dimensions**



Fixed Flow Calculator Mounting Dimensions

## 4.3 Fixed Flow Calculator Wirings



Fixed Flow Calculator Wiring Diagram

- ◆ In the right of above picture is IN AC220 “PE L N” which is connected to external power supply.
- ◆ IN DC12V “+ -” is connected to external 12VDC power supply.
- ◆ OUT RS485 “A B” is RS232/RS585 output interface.
- ◆ IN\_RS232/485 is connected to DYNAMETERS transducer communication interface.
- ◆ OUT DC12V “+ -” is connected to DYNAMETERS transducer power.
- ◆ Vin DC4-20mA “+ -” is connected to external 4-20mA of velocity.
- ◆ Lin DC4-20mA “+ -” is connected to external 4-20mA of level.
- ◆ OUT DC4-20mA “+ -” is 4-20mA output interface.

Vin DC4-20mA “+ -” and Lin DC4-20mA “+ -” are used with our ultrasonic flowmeter and level meter to measure flow of partially filled pipe. It is for DMDF-OP-A flowmeter.

## 4.4 Portable Flow Calculator Overview



The flow calculator is equipped with a rechargeable lithium battery. This battery will require charging before initial operation. Apply 110-230VAC power, utilizing the enclosed line power cord, to the portable flow calculator for a period of 8 hours prior to using the product for the first time. The line cord connects to the socket connection located on the side of the enclosure as label.

The portable flow calculator’s integral battery provides continuous operation for up to 50 hours on a full-charge. The battery is “maintenance free”, but it still requires a certain amount of attention to prolong its useful

life. To obtain the greatest capacity and longevity from the battery, the following practices are recommended:

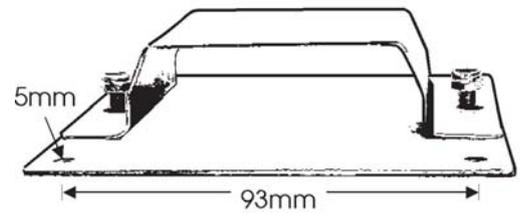
- Do not allow the battery to completely discharge. (Discharging the battery to the point where the LOW BATTERY indicator illuminates will not damage the battery. The internal circuit will switch off the battery automatically. Allowing the battery to stay discharged for long periods of time can degrade the storage capacity of the battery.)

NOTE: Commonly, the battery is charged for a period of 6-8 hours and needn't over charge. Unplug from line power when the CHARGING indicator change from red to green.

- If the portable flow meter is stored for prolonged periods of time, monthly charging is recommended.
- If the portable flow meter is stored for prolonged periods of time, had better store at a temperature below 70°F [21°C].
- Try to avoid the meter working while battery charging.

## PART 5 DYNAMETERS Transducer Installation and Wirings

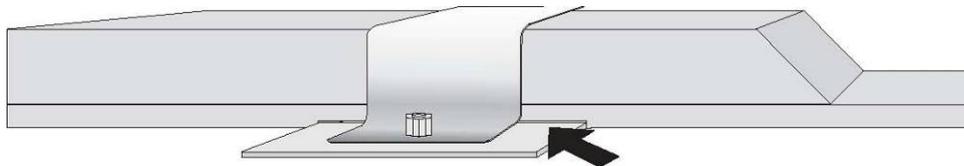
DYNAMETERS Transducer is a very effective alternative to conventional flow measuring installations for small streams. DYNAMETERS Transducer is unobtrusive and ideally suited to flow conditions in culverts, channels and drains. Cost, maintenance and environmental impact of new installations is minimized by avoiding the construction of conventional flow measuring structures.



### 5.1 DYNAMETERS Transducer Mounting

A versatile mounting clamp is available to secure a DYNAMETERS Transducer Instrument into a channel or a pipe. Loosening the nuts enables the instrument to be removed for inspection. The bracket saddle locks the instrument into its correct position and alignment.

Before Tightening Mounting Bracket ...

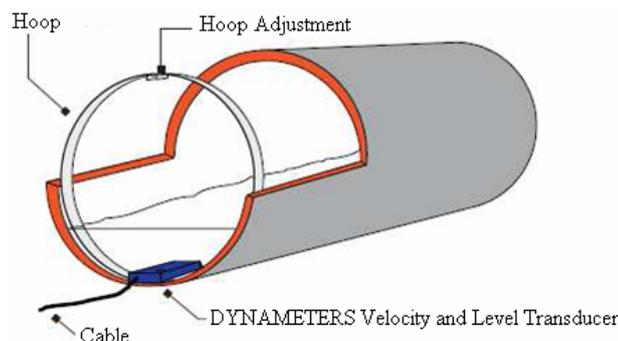


Check there is no debris between it and the DYNAMETERS Transducer.

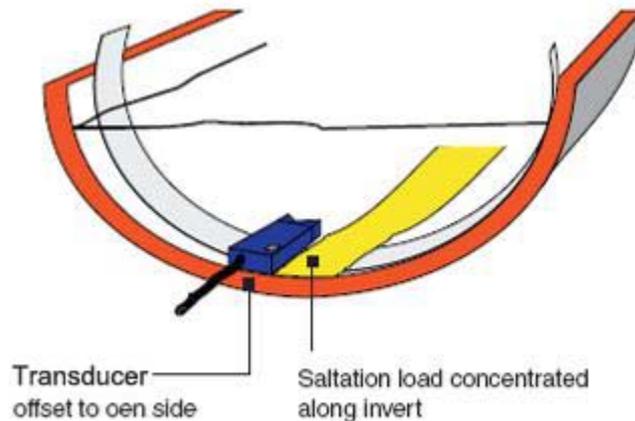
Do not over tighten!

### 5.2 Locating DYNAMETERS Transducer

A typical installation is in a pipe or culvert with diameters between 300 and 2000 mm. DYNAMETERS Transducer should be located near the downstream end of a straight and clean culvert, where non-turbulent flow conditions are maximised. The mounting should ensure the unit sits right on the bottom to avoid debris catching beneath it.

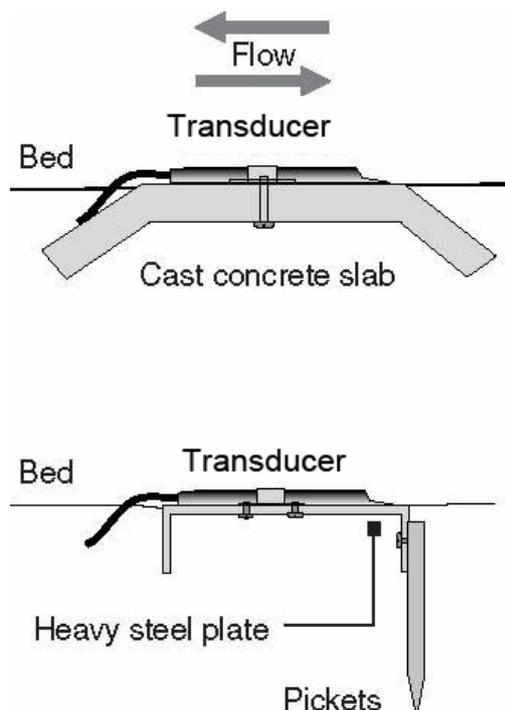


In culverts the transducer can be mounted on a stainless steel hoop that is slipped inside the pipe and expanded to lock it in position. In open channels special mounting brackets may be required. Special protection from vandalism and interference may also be required.



The transducer can be located at the invert of the pipe but may be better located slightly to one side of the invert to avoid alluvial material or heavy debris transported during higher flows. It will not be affected by being located partly up the side of a pipe provided it remains aligned with the flow. For details of installing DYNAMETERS Transducer in a pipe using the Expanding Hoop see the Appendix.

The transducer can also be located in the bed of a natural or artificial channel. Again it should be installed and located in such a way as to avoid accumulating debris, being buried by alluvial material or getting washed away. The cable should be protected from damage.



### **5.3 DYNAMETERS Transducer Pointing Upstream or Downstream?**

DYNAMETERS Transducer can be pointed either upstream or downstream, depending on which would produce more accurate data.

Pointing the transducer end downstream will stop it accumulating debris, however in some channels the transducer body may disturb the velocity distribution unacceptably.

The velocity reading will be positive when pointing upstream and negative when pointing downstream. DYNAMETERS Transducer may be configured to only read positive velocities regardless of water flow direction.

### **5.4 Power Considerations**

DYNAMETERS Transducer is powered from 12VDC output of flow calculator connected to the signal cable.

If customers use a battery to power supply, the battery is not continuously recharged either by a solar recharge system or some other recharge system, it may require replacement.

**If the 12V power falls below 11V, the DYNAMETERS Transducer will stop recording (it enters "Sleep Mode.")**

### **5.5 Signal Cable and Connections**

DYNAMETERS Transducer comes with a 15 metre multi-core, vented signal cable which is terminated into a 7 pin «SQL» weatherproof connector.

The cable connectors are «SQL» compatible and may be extended with «SQL» extensions (or other suitable quality signal cable) up to 35 metres.

**5.6 DYNAMETERS Transducer Cable Connection Table**

9 Wire Vented Cable SQL Pin#	Wire Colour	Power Supply Cable	Signal Description
1		Red	+12VDC
2	Blue		RxD(Receive)
3	Brown		TxD(Send)
4	Black		RTS( Request to Send )
7	Yellow/Green	Black	signal ground

**5.7 Drying Tube and Desiccant**

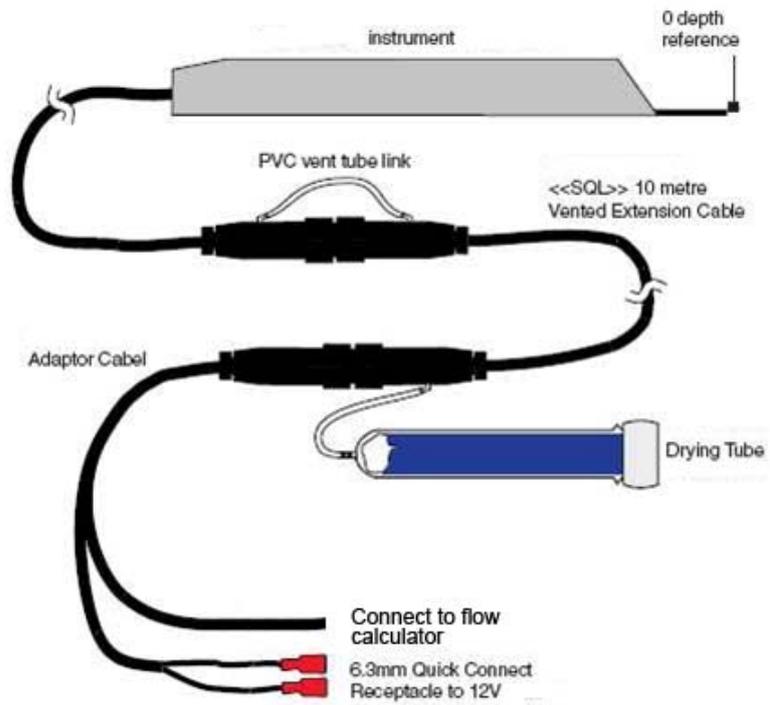
DYNAMETERS Transducer cable contains a tube to vent the water depth pressure sensor to atmospheric pressure. It is very important to ensure that NO MOISTURE enters the vent tube, as this will cause erratic depth measurements.

DYNAMETERS Transducer connector vents the cable through a Drying Tube containing "Silica Gel" desiccant.

Replace or regenerate the desiccant when it changes colour.

**5.8 Extending DYNAMETERS Transducer Cable**

You can use an «SQL» extension cable to extend DYNAMETERS Transducer cable up to 35 metres. If you are able to install the Drying Tube at the cable interconnection, you can use the standard (non-vented) «SQL» cable extensions. Otherwise you need to use «SQL» vented cable extensions and install the drying tube at the end of the cable extension (remembering to interconnect the vent tube with the external PVC vent tube link).



**5.9 Battery, Dry tube and wiring Connection**

The battery, drying tube and wiring connectors must be located in a weatherproof enclosure. If the drying tube or battery is inside this enclosure, then it must not be completely sealed, as the drying tube needs to vent to the atmosphere and the sealed lead acid battery may also vent gas during an overcharge condition.

## PART 6 Flow Calculator Operation

### 6.1 General

DMDP-OP-B flow meter contains a six-key tactile feedback keypad interface that allows user to view and change configuration parameters used by the flow meter operating system.



### 6.2 Key Instruction

#### (1) ESC Key

When choose menu, press it to return superior menu;

When set parameters, press it to cancel the setting, the setting parameter is invalid, and return the last parameter.

#### (2) ▶ Key

When choose menu, press it to see the follow menus;

When set parameters, press it to shift the flashing position to right.

#### (3) ▲ and ▼ Key

When choose menu, press them to shift the flashing position up or down to select menu users need;

When set parameters, press them to change the value.

#### (4) ENTER Key

When choose menu, press it to select menu users need;

When set parameters, press it to save the setting.

#### (5) RESET Key

Press it to restart the meter.

### 6.3 Menu Structure

When DMDP-OP-B is powered on, the screen displays main menu, the main menu is shown as follow:

Depth: 27mm
Velco: 0.050m/s
FLOW: 0.145 m3/h
Total: 13.97220 m3

**Note:** When setup parameter in flow calculator, must connect transducer to flow calculator, if not, pressing key is invalid.

Press **▶** Key from main menu to enter time menu, the time menu displays current date and time.

Press **ENTER** Key from main menu or time menu to enter setting menu.

In setting menu, it has six setting items.

#### 6.3.1 Area

Set pipe type, press **ENTER** Key to enter submenu:

AreaWay: Pipe – circular pipe

Rect – Rectangular pipe or channel

UserR - user define (This function is updating)

Pipe: Set\_Diam – diameter of circular pipe

Set\_Offset – height from bottom of pipe to installation location of transducer

Set\_Deadse – dead sector of circular pipe, when the level in pipe is lower than dead zone, flow meter will not calculator flow rate.

Rectangel: Width – width of rectangle

UserRating: user define

When customers select Rect/UserR, and install the DYNAMETERS transducer, this situation will produce an offset area in cross-sectional area. More details in chapter 6.5.

#### 6.3.2 Communication

Communication setting

Time Check: check the current time, if not right, press **ENTER** key to modify

Up Interval: time of uploading data

Packet: time of heartbeat packet

Redial: time of redial

Protocol: format of data packet

IP Port: destination port

IP Addr: destination IP address

Domain name: domain name

### 6.3.3 **Output**

Output setting

4-20mA: setting 4-20mA, press ENTER key to setting representative flow value of 4mA and 20mA

RS485: Baud: serial communication baud rate

Parity:

None

Odd: odd parity

Even: even parity

MODBUS Addr: MODBUS protocol address

### 6.3.4 **Data logger**

Enable: function selection

Open: enable data storage function

Close: disable data storage function

Save.TM: the interval of data recording time

IN: 00000 m<sup>3</sup>/h

### 6.3.5 **External L&V**

Input external level and velocity

Enable: function selection

Open: enable external level and velocity input

Close: disable external level and velocity input

Level: set level

RangH: Range upper limit

RangL: Range lower limit

Start: begin to zero, when the external input is a 4-20mA signal, the Start value is 1.000V (4mA\*250 Ω).

Velocity: set velocity

RangH: Range upper limit

RangL: Range lower limit

Start: begin to zero, when the external input is a 4-20mA signal, the Start value is 1.000V (4mA\*250 Ω).

### 6.3.6 Service

Input password 021573 to enter service menu.

Set\_Rato: set instrument factor.

Set\_Zero: the manual zero point.

Total: check and modify the totalizer.

## 6.4 Application Example

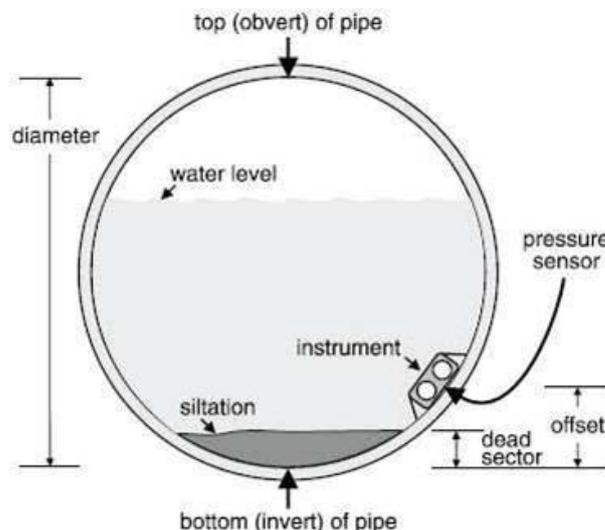
### 6.4.1 Partially Filled Pipe Examples

There are three parameters needed to define a pipe installation.

**Offset (mm)** This defines the offset from the bottom of the pipe to the position of the DYNAMETERS Transducer depth sensor. This is usually 10mm, however, in some installations the DYNAMETERS Transducer may be located away from the bottom (to avoid silt and rubbish).

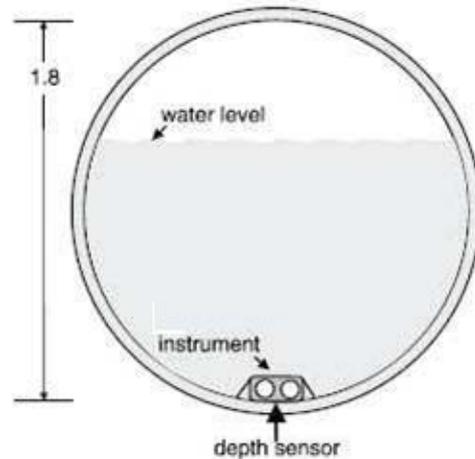
**Pipe Diameter (mm)** Defines the pipe diameter.

**Dead Sector (mm)** The deadband due to siltation (if any).



## Pipe Example 1

Pipe is 1.8m in diameter.  
 A DYNAMETERS Transducer unit is mounted at the bottom.  
 No silt (dead sector) in pipe.

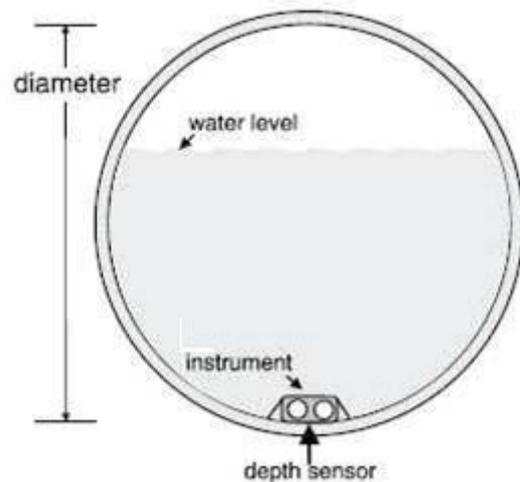


Flow Calculator Setting:

Select "Close" in External L&V;  
 Select "pipe" in AreaWay;  
 Set Set\_Diam "1800" in Pipe;  
 Set Set\_Offset "0010" in Pipe, this value is maybe adjusted through the site;  
 Set Set\_Deadse "0000" in Pipe.

## Pipe Example 2

Pipe is 900mm in diameter.  
 A DYNAMETERS Transducer unit is mounted 100mm up from the bottom and there is 75mm of silt in the pipe.  
 Maximum depth in this application is 800mm (less than 1m).

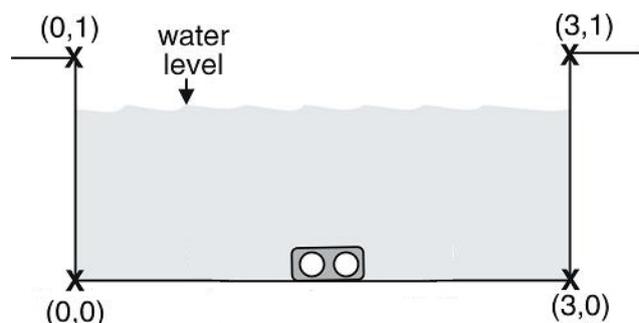


Flow Calculator Setting:

Select "Close" in External L&V;  
 Select "pipe" in AreaWay;  
 Set Set\_Diam "0900" in Pipe;  
 Set Set\_Offset "0110" in Pipe;  
 Set Set\_Deadse "0075" in Pipe.

### 6.4.2 Open Channel Examples

The open channel is 3000mm width.  
 A DYNAMETERS Transducer unit is mounted at the bottom.  
 No silt (dead sector) in channel.



Flow Calculator Setting:

- Select "Close" in External L&V;
- Select "Rect" in AreaWay;
- Set "3000" in Rectangel.
- Set Offset (The method in chapter 6.5).

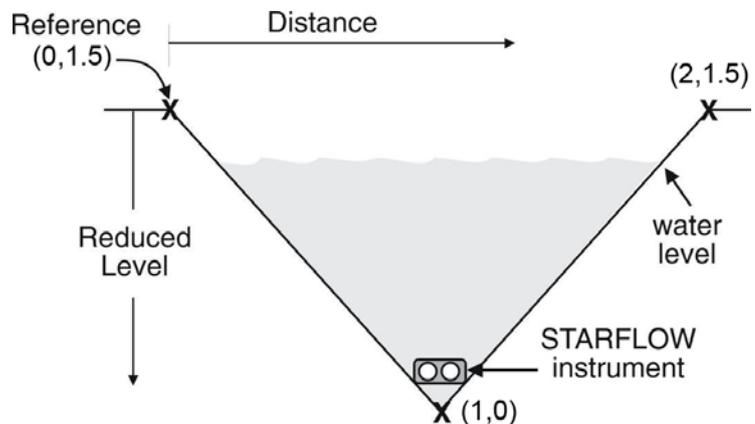
### 6.4.3 User Define Examples

#### User Define Example 1

The channel is triangular as shown. A DYNAMETERS Transducer unit is mounted at the bottom.  
No silt (dead sector) in channel.

Flow Calculator Setting:

- Select "Close" in External L&V;
- Select "UserR" in AreaWay;
- Set Point01 "0000, 1500" in UserRating.
- Set Point02 "1000, 0000" in UserRating.
- Set Point02 "2000, 1500" in UserRating.
- Set Offset (The method in chapter 6.5).



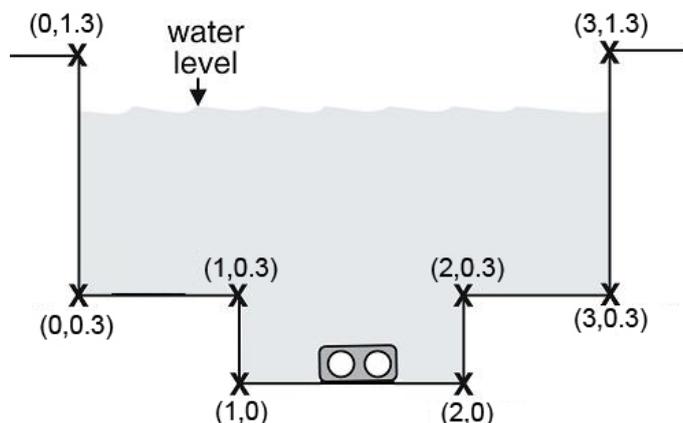
#### User Define Example 1

The channel is as shown. A DYNAMETERS Transducer unit is mounted at the bottom.  
No silt (dead sector) in channel.

Rectangel

Flow Calculator Setting:

- Select "Close" in External L&V;
- Select "UserR" in AreaWay;
- Set Point01 "0000, 1300" in UserRating.
- Set Point02 "0000, 0300" in UserRating.
- Set Point03 "1000, 0300" in UserRating.
- Set Point04 "1000, 0000" in UserRating.
- Set Point05 "2000, 0000" in UserRating.
- Set Point06 "2000, 0300" in UserRating.
- Set Point07 "3000, 0300" in UserRating.



Set Point08 “3000, 1300” in UserRating.  
Set Offset (The method in chapter 6.5).

## 6.5 Dead Zone Setting

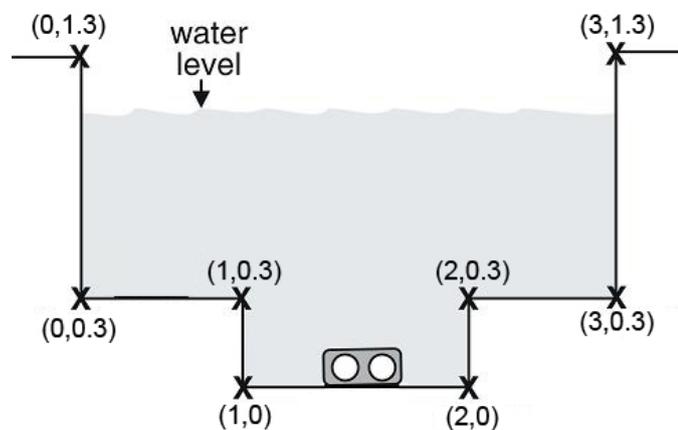
### 6.5.1 Calculate Dead Zone

There is 10mm distance from pressure sensor and transducer bottom, so, this situation will produce an offset area in cross-sectional area. When use DYNAMETERS transducer, it needs to set 10mm offset.

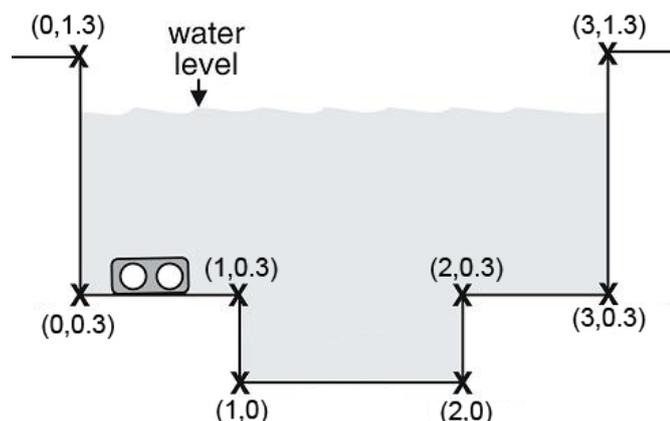
When customers select “Pipe” to measure, and install the DYNAMETERS transducer, if transducer is installed on the bottom, the offset maybe is 10mm, or maybe is more than 10mm (Due to the pipe shape). If transducer is installed on the side, the offset is calculated according to the site.

When customers select “Rect” to measuring, and install the DYNAMETERS transducer, if transducer is installed on the bottom, the offset is 10mm. For example, the width of rectangle channel is 1000mm, the offset zone is  $0.010\text{m}^2(1\text{m}*0.010\text{m})$ . If the transducer is installed 100mm distance from the channel bottom, the offset is 110mm, the offset zone is  $0.110\text{m}^2(1\text{m}*0.110\text{m})$ .

When customers select “UserR” to measuring, and install the DYNAMETERS transducer, if transducer is installed on the bottom, the offset is 10mm. For example, the open channel is shown as below, the offset zone is  $0.010\text{m}^2[(2-1)\text{m}*0.010\text{m}]$ .



If the transducer is installed shown as the following picture, the offset zone is  $0.336\text{m}^2$   $[(2-1)*(0.3-0)+(3-0)*0.010=0.33]$



**6.5.2 Input Dead Zone**

When know the offser or offset zone, need to input it to flow calculator.

For the pipe, set "Set\_Offset" in Pipe menu.

For the channel, after calculating offset zone, the setting steps are as follow:

1. Get a serial port debug software, if do not have, we can send it to you.
2. Connect flow calculator "In\_RS232/485" to computer. (The cable is in the package, one end of cable is connected to computer, and the other end is connected to "In\_RS232/485", the red wire is connected to "RXD", the orange wire is connected to "TXD", the purple wire is connected to "RST", the black wire is connected to "Lin -" or "Vin -", )
3. Before flow calculator power on, press ESC key until power on. Then it will have 3 minutes to setup.
4. In serial port debug software, set baud rate "9600 8 1 none", then open serial port.
5. Send "888888#OARM:01.00#", it means offset zone  $1\text{m}^2$ . If return "#STS:0123;set success!#", it means setup success.
6. Then restart flow calculator, and begin to measure.

## **PART 7 Warranty and Service**

### **7.1 Warranty**

The manufacturer provides one year warranty on all products, free of charge, but the users should be responsible for the one-way transportation fee from the customer to the factory.

### **7.2 Service**

The manufacturer provides instrument installation for our customers, and the charges will be made according to the cost.

For any hardware failure of the instrument, we recommend that our customers send back the instrument to our factory for service, due to the fact that the instrument is made of microprocessors and it will be difficult to perform field maintenance. Before sending back the instrument, please try to contact the factory first to make sure what the problem is.

For other operational problems, please contact our local distributor by telephone, fax or email. In most cases, the problem could be solved immediately.

## Appendix A – Installation Checklist

### Installation Steps

#### *Installing DMDP-OP-B Instrument*

Do the following:

1 Locate DYNAMETERS transducer in such a way to avoid accumulating debris, being buried by alluvial material or getting washed away.

2 Ensure that you have enough cable to reach flow calculator and keep the vent tube dry.

3 Locate flow calculator in such a way to avoid sunlight, corrosive fluids and vibration.

4 Set-up a weatherproof enclosure for drying tube. Ensure that this enclosure is open to the atmosphere. When customers do not purchase flow calculator, you should set-up a weatherproof enclosure for the battery, drying tube and wiring connectors.

5 Connect DYNAMETERS transducer to flow calculator, including power line and communication line.

6 Set Enable of External L&V to be closed, and then you can see the display of flow calculator to check whether DMDP-OP-B instrument works well.

**Note:** When setup parameter in flow calculator, must connect transducer to flow calculator, if not, pressing key is invalid.

## Appendix B – Communication Protocol

When use RS485/ModBus, connect the output from “OUT RS485” terminal, and set flow calculator “4800, 1, none”.

Communication protocol has function code 03, and use 16 bits CRC cyclic redundancy check.

<b>Code</b>	<b>Description</b>
00 01 02 03	Level
04 05 06 07	Velocity
08 09 10 11	Flow Rate
12 13 14 15	Totalizer
16 17 18 19	Current Cross Sectional Area

If need to read all data, send a command:

**01 03 00 00 00 0A C5 CD**

01: MODBUS address in flow calculator.

03: Function code.

00 00: Initial address.

00 0A: From address 00 00, there are 20 bytes data.

C5 CD: 16 bits CRC cyclic redundancy check.

**Return:**

01 03 14 42 C8 E2 E1 41 AC 8A EE 41 E8 EE C1 3F CB 73 A0 3E C0 00 00 3D 95

01: MODBUS address in flow calculator.

03: Function code.

14: Data length of return data.

42 C8 E2 E1: Level (100.44)

41 AC 8A EE: Velocity (21.567)

41 E8 EE C1: Flow rate (29.116)

3F CB 73 A0: Totalizer (1.5894)

3E C0 00 00: Cross sectional area (0.375)

3D 95: 16 bits CRC cyclic redundancy check.

## Appendix C – Expanding Hoop

The expanding hoop allows you to install a DYNAMETERS Transducer instrument into a pipe.

### Features

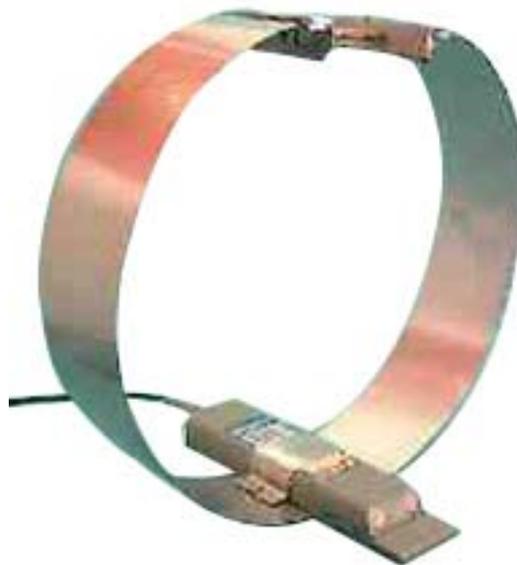
**Modular** – The design is modular, allowing it to fit into any size pipe. The hoop is flexible enough to fit irregular shapes, such as ovoid (egg shaped) sections.

**Robust** – All components are made from stainless steel and the hoop fittings are 100mm wide to fit the standard DYNAMETERS Transducer mount.

**Adjustable** – Although pipes come in standard diameters, their dimensions are not always accurate. This means that an expanding hoop system must allow the installer to make adjustments on site. To achieve this, the expanding hoop system is made so that general assembly can be done in the workshop, whilst adjustments can be made in the field with hand tools. An expanding turn-buckle locks the hoop into the pipe.

### 1.1 Hoop Size Selection

To determine what components are needed for a DYNAMETERS Transducer pipe installation, you need to know the pipe diameter.



Model	Pipe Size	Joiners
OP-H1	Up to 600mm	-
OP-H2	600mm-1200mm	1
OP-H2	1200mm-1800mm	2

- Pipes less than 300mm diameter are NOT RECOMMENDED FOR DYNAMETERS Transducer INSTALLATION due to instrument's size.

## 1.2 Installation

To prepare and install the DYNAMETERS Transducer into a pipe, you need:

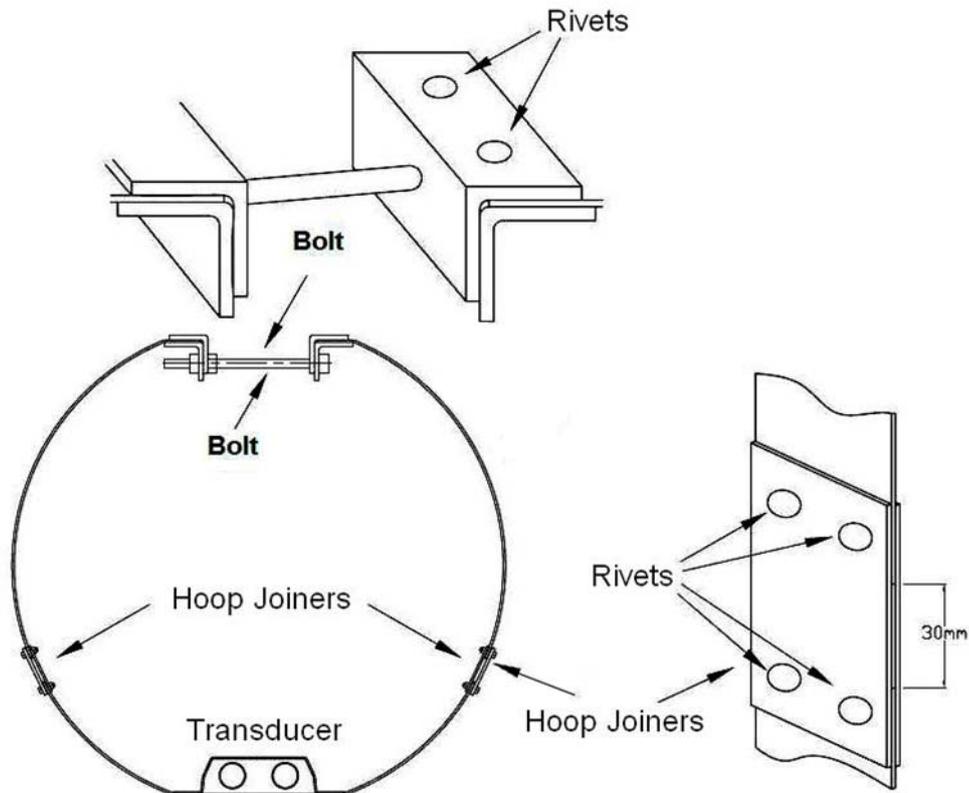
- OP-H Expanding hoop.
- Medium size adjustable spanner.
- Bolts
- Screw caps
- Measuring tape.
- Electric drill.
- Hand "pop rivet" tool.
- Heavy duty metal shears.

Do the following:

1 Arrange hoop(s), bolt and screw caps so that DYNAMETERS Transducer unit will be positioned at the bottom (invert) of the pipe and a bolt at the top (obvert) of pipe (see in the following diagram).

2 Drill 2 x 5mm holes, 94mm spaced in the centre of the hoop to locate the STARFLOW instrument (see diagram next page).

Use a small pilot drill bit (about 2mm) then finish with the 5mm bit. (When drilling stainless steel, DO NOT stop once drilling has begun, as this will immediately blunt the drill bit.)



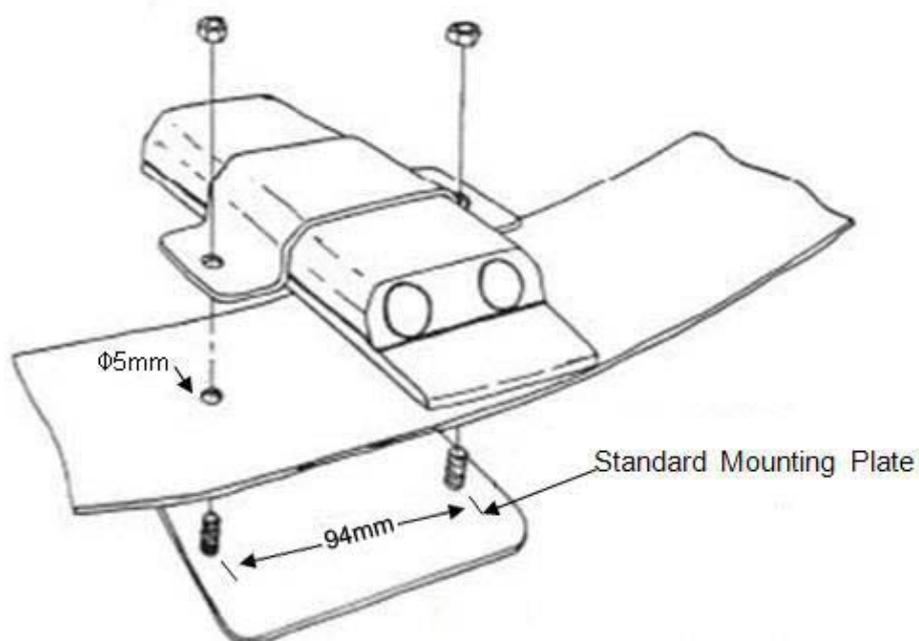
3 “Pop rivet” the hoop sections together (if required) and “pop rivet” the end of one band to the bolt (see diagram). Note: if a “pop rivet” tool is not available, use M3 x 6mm stainless steel self tapping screws (screwed inner to outer).

4 If the inside circumference of the pipe is ACCURATELY known, then cut the hoop assembly to this length LESS 25mm for fitting clearance. (Circumference = Diameter x 22/7)

- Note: the hoop length must be measured to include the bolt (fully closed), hoops and joiners all together as shown.
- Note: if you are unsure of the pipe dimensions, make the final measurement on site and cut the hoop assembly to suit the pipe. Our expanding hoop can be adjusted for more (or less) 20-30mm.

Position and tighten DYNAMETERS Transducer and hoop, then:

- 1 Mounting the Mounting bracket to the hoop (see in the following diagram).
- 2 Fold the hoop into a circle to easily fit inside the pipe.
- 3 Position into place inside the pipe.

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4 Adjust bolt until hoop is tight inside pipe (use spanner if necessary).

5 Slip DYNAMETERS Transducer unit into mount and tighten.

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experts in **energy** metering

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**751 Shulin Road, Eastern New Area**  
**Songjiang Industrial Zone**  
**Shanghai 201611 China**  
**Web: [www.dynameters.com](http://www.dynameters.com)**

**Service Centre: Solenvis Limited**  
**The Peacock Conservatory**  
**Weir Bank, Bray-on-Thames, Maidenhead**  
**Berkshire, United Kingdom, SL62ED**  
**Phone: 01628-636881**  
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**Web: [www.solenvisflowmeters.com](http://www.solenvisflowmeters.com)**