WHY ZERO A TRANSIT TIME METER

INTRODUCTION

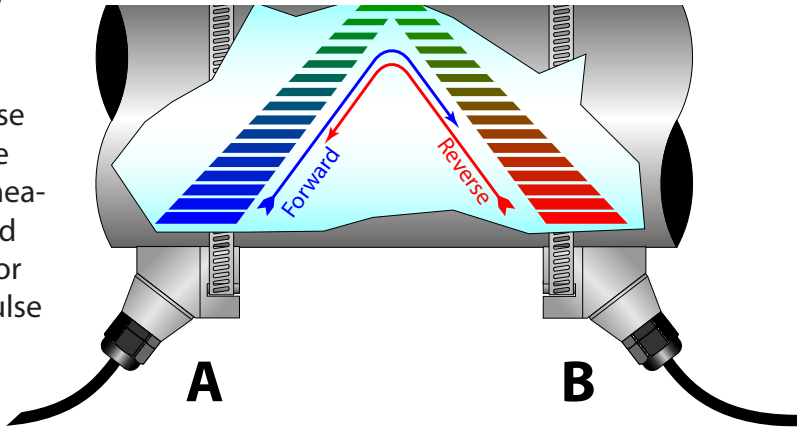
Transit time meter flow meters measure the very small changes in the time it takes for a sound wave to "transit" through a pipe filled with fluid. The time it takes the sound wave to make a trip through the pipe is slightly longer going with the direction of flow than it is going against the direction of flow. It is this difference that the meter uses to calculate the velocity of the fluid going through the pipe.

THEORY

When the transit time meter is first set up information is entered about the fluid being measured and the kind of pipe the fluid is traveling in. Among the information gathered is the sound speed of the fluid, the sound speed of the pipe, and the pipe wall thickness. The digital signal processor uses this information to compensate for the changes in sound transmission angles as the sound waves move through the interface between the pipe and the fluid.

Additional mathematical manipulation produces a spacing figure that is used to mount the transducers in the proper relationship to each other.

Once the meter is properly configure and the transducers are mounted on the pipe the meter must be zeroed on the pipe to adjust for the zero flow transit time offset.



A transit time meter sends an ultrasound pulse from the transmitting transducer through the pipe wall and then through the fluid being measured. The initiation of this pulse is considered time zero. The receiving transducer "listens" for the sound and notes when the ultrasound pulse is received using time zero as a reference.

In the next step the transmitting and receiving transducers exchange functions so that the transmitting transducer from the first pulse becomes the receiving transducer for the second pulse. Similarly the receiving transducer from the first pulse becomes the transmitter for the second pulse.

Under theoretical no flow conditions the first pulse would exactly equal the second pulse and would cancel each other out. Because there is no such thing as a "perfect" installation there is always a small but measurable time difference between the forward and reverse pulses. If this time difference is not accounted for it shows up as an offset when the meter is actually measuring flow.

The offset can be either positive or negative. In other words if the offset is not removed the flow will either be a little greater than the actual flow or in the case of a negative offset the flow will be a little less.

METHODS OF ELIMINATING THE OFFSET

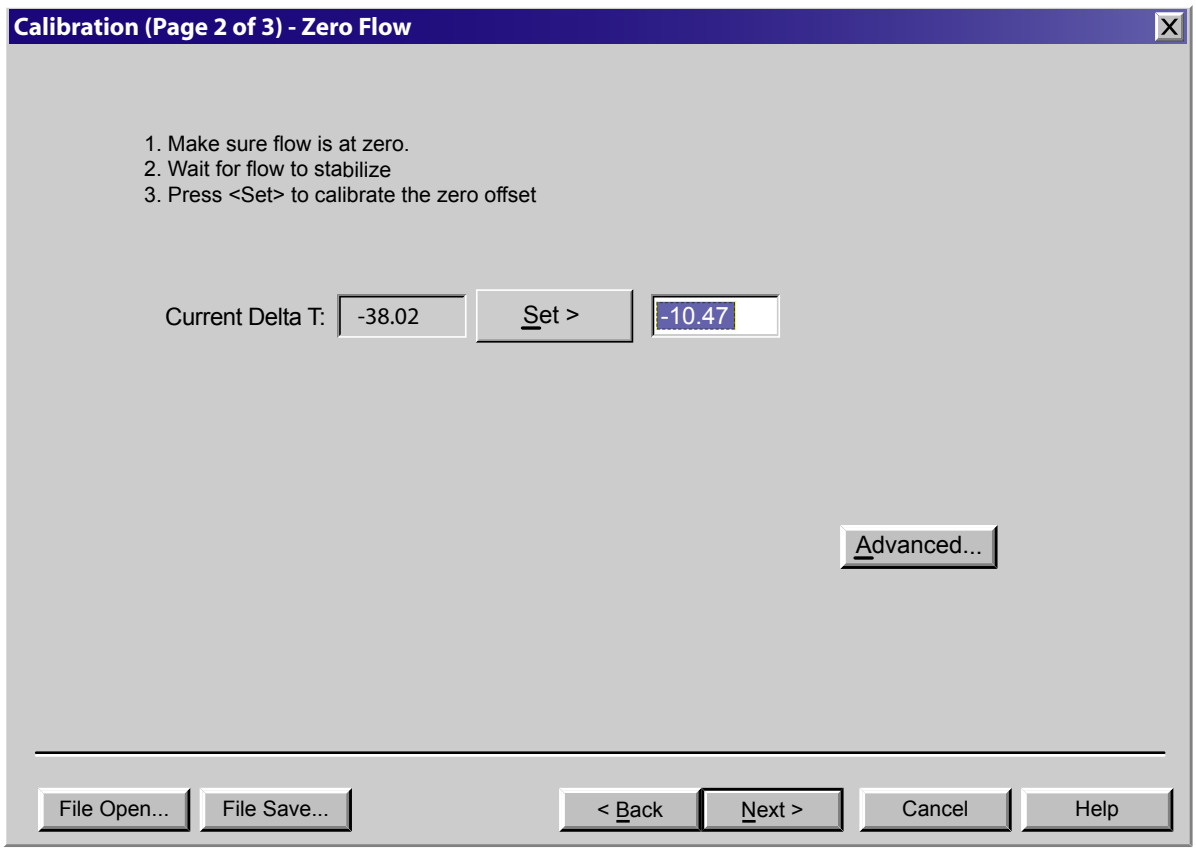
Zero on the pipe (Set Zero)

The best way and also the most convenient way to eliminate the offset is to zero it on the pipe using the UltraLink software utility. UltraLink has a built-in calibration routine that makes zeroing the meter an easy process. For TFX meter with keypads the zeroing function is also available from the keypad menus.

NOTE: *For a proper set zero to be preformed the pipe must be full of fluid and the must not be any flow through the pipe.*

UltraLink:

1) Open UltraLink and click on the "Calibration" tab.
2) Click Next until screen 2 of 3 is visible.
3) Follow the instructions in the upper left hand corner of the screen.
4) Press Next again and then without changing anything in screen 3 of 3 press "Finish"



Zero using a stable flow

Using the keypad navigate to the "Service Menu" and select "Set Zero". Again the pipe must be full of fluid and have no movement of the fluid for the zeroing to be effective.

Alternate zero offset calculation method.

Many times it is not possible to shut down the flow to perform a zero. While not as accurate as zeroing the meter on a pipe it is possible to get a reasonable zero point using the differences in transit time.

This method is only valid for stable flows and relies on measuring the transit time differences between the forward and reverse transducers. The procedure is as follows:

1) Using UltraLink record the transit time value in the forward direction.
2) Reverse the transducers. The preferred method would be to swap the transducer connections without disturbing the transducers. If this is not possible mark precisely where the transducers are positioned and physically exchange the upstream and downstream transducers.
3) Record the transit time with transducers reversed.
4) Find the difference in the absolute values for the forward and reverse transit times. If the difference, of the forward and reverse transit times is zero, or nearly so (within about 2 nS) the unit is properly zeroed. If the difference has a value greater than 2 nS an adjustment using UltraLink is required.
5) Go to screen 2 of 3 in the UltraLink calibration routine. On screen 2 there is a grayed out box labeled "Current Delta T" Add one half of the signed difference found in the last step to the number in the current delta T box. Enter this number into the white box directly to the right of the current delta T box.
6) Press "Set"
7) Press "Next" to advance to screen 3 of 3.
8) Press "Finish" to store the new zero point.

Example:

Forward Transit Time:	87803.56 nS
Reverse Transit Time:	-86925.04 nS
Current Delta T:	28.73 nS

1) Find the difference
[87803.56] – [-86925.04] = 878.52
2) Find one half of the difference

$$\frac{878.52}{2} = 439.26$$

3) Add the calculation of one half of the difference to the Current Delta T
439.26 + 28.73 = 467.99

This is the corrected zero value.

Reset Zero:

The DTFXP has one additional way to provide a zero for the meter. This is the least accurate method for compensating for a zero offset but because the TFXP is used in the field and it is many times impossible to turn off the flow to the pipe being tested, the "Reset Zero" is used.

The Reset Zero function is found in the service menu of the DTFXP. When this menu item is changed to "Yes" and accepted the zero offset will be set to a zero value.