TOTALFLOW
Technical Bulletin 140

Upstream vs Downstream Pressure Tap Explanation

Totalflow Technical Bulletin

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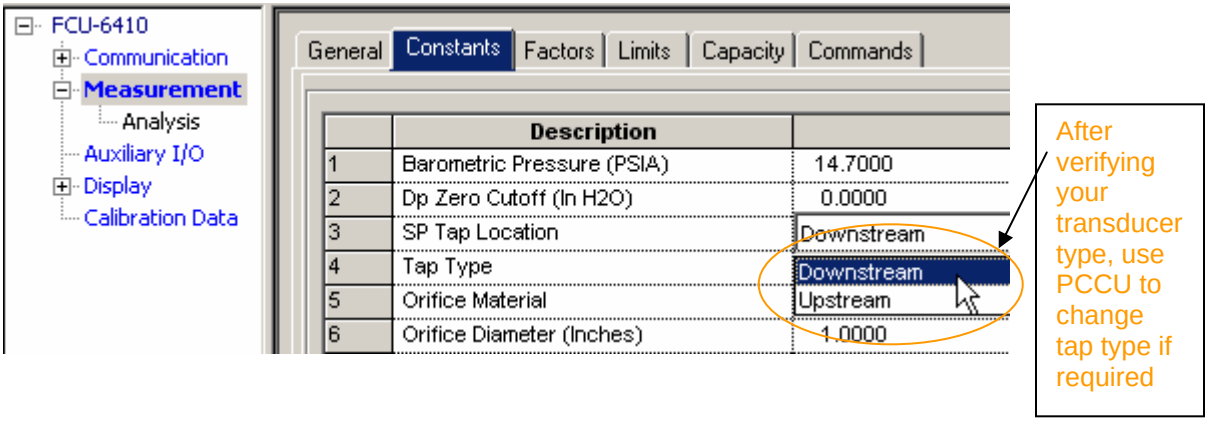
1. **Purpose**

   To describe how past and present Totalflow differential model flow computers measure and use static pressure to perform AGA calculations. This bulletin will also describe the history and changes in transducer technology as it pertains to sensing static pressure.

2. **Issue and Concerns**

   All ABB flow computers and spare part transducers that have shipped since 2003 incorporate an upstream static pressure sensing element in our latest XIMV and existing AMU transducer technology. Customers are now beginning to utilize XIMV technology into existing flow computer installations that in many cases had downstream static pressure AMU's. If the user fails to make the appropriate "tap location" change using PCCU then the pressure measurement will be incorrect, resulting in a slight volume calculation error.

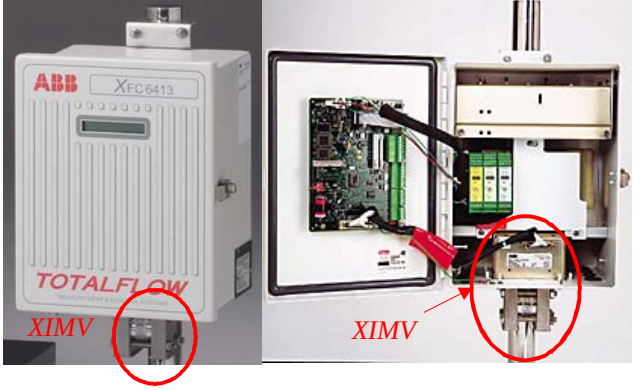


3. **Description**

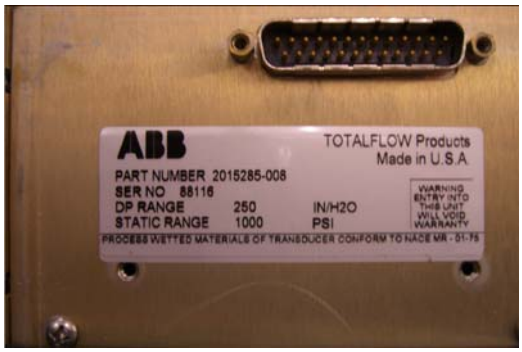
   Totalflow's first generation model 6600 flow computer and the majority of our second generation model 6400/6700 flow computers were equipped with downstream static pressure sensor element. During our second generation offering we began allowing customers to order transducers, as an option, configured for "upstream" static pressure measurement. Totalflow's portable calibration collection unit (PCCU) allows the customer to indicate for flow calculations if the static pressure is sampled on the "downstream" or "upstream" tap location. The user must know which transducer is installed and then make the proper PCCU static pressure tap location setting for the flow computer to compute the AGA equation accurately.

   As described in the table below the microFLO and 6210 EX flow computers are only offered with an upstream static pressure element. PCCU will not allow the user to change the tap type for these two model flow computers.

Generation	Years Produced	Transducer	Downstream Static Pressure Part Numbers Offered	Upstream Static Pressure Part Numbers Offered
1st generation 6600 flow computer	1984 – 1994	Original 45 milli-volt analog transducer	2011809-xxx 2011810-xxx 2012974-xxx	
2nd generation 6400, 6700 flow computer	1994 – 2002	Analog Measurement Unit (AMU)	2015285-xxx 2015317-xxx 2018481-xxx 2018433-xxx 2015397-xxx 2017310-xxx 2101090-xxx	2015332-xxx 2017311-xxx 2018434-xxx 2015318-xxx
XSeries XFC6400, XFC6700 flow computer	2002 -	Analog Measurement Unit (AMU) and XSeries Integral Multivariable (XIMV)		2015332-xxx 2101449-xxx 2101098-xxx
microFLO model 6210 flow computer	2003 -	Integral multivariable (IMV)	Not offered	2100835-xxx 2011483-xxx 2101491-xxx 2101257-xxx
6210 EX flow computer	2006 -		Not offered	2102195-xxx 2102105-xxx



Either the new XIMV utilizing an upstream static pressure sensing element or the AMU which primarily used a downstream static pressure sensing element is illustrated in the picture above. Use the included table to determine if your transducer is utilizing an upstream or downstream sensing element.



Close-up picture of an AMU (part# 2015285-xxx) which utilizes a downstream static pressure sensing element (see table attached to determine if a particular part number incorporates and upstream or downstream static pressure element).

Close-up picture of an AMU or XIMV (part# 2015332-xxx) which utilizes an upstream static pressure sensing element (see table attached to determine if a particular part number incorporates and upstream or downstream static pressure element). A note has been included on all XIMV transducers indicating that these units have an upstream static pressure element and that the “tap location” set by PCCU must match the static pressure location.

Totalflow Calculation Methods as they Pertain to Static Pressure Location

Totalflow flow computer's act differently depending on whether they are configured for AGA3 1985 or AGA3 1992 flow rate equation. This is due to a significant change in how the downstream expansion factor is computed according to the AGA3 1992 standard. The 1992 standard requires an additional compressibility calculation when computing the downstream expansion factor. *Totalflow always uses the upstream expansion factor compution when the AGA3 1992 standard is selected.*

Downstream expansion factor, requires additional compressibility calculations

The equations for upstream expansion factor have not changed. However to compute the downstream expansion factor, real gas effects must now be accounted for. This means an additional Z, compressibility calculation is required when computing the downstream expansion factor.

Totalflow has chosen to always compute an upstream expansion factor for the 1992 standard to avoid computing an additional compressibility that is required if computing downstream expansion factor.

To accomplish the correct expansion computation while giving customer's the flexibility of choosing downstream or upstream static pressure, Totalflow computes the upstream pressure as follows and uses it to compute the upstream expansion factor.

$$P_{f1} = P_{f2} + \frac{\Delta P}{N}$$

where N is a conversion constant from differential pressure to static pressure units.

Static Pressure and Expansion Factor

If downstream expansion factor is used then an additional Z (compressibility) calculation must be performed. To avert the need for this additional processing, Totalflow always uses the upstream static pressure thereby allowing computation of the upstream expansion factor.

The user is allowed to specify either up or down stream for location of the static pressure sensing element. If the upstream location is specified, that pressure measurement is used without modification. However, if the downstream location is specified then the upstream pressure is computed as:

$$P_{f1} = P_{f2} + \frac{\Delta P}{N}$$

This logic and math execute each second thereby always providing the upstream static pressure for use throughout the whole equation.

Further clarifications

You should assume that when AGA31992 equation is selected that the devices always perform the flowrate equation using the upstream pressure.

You should assume that when AGA31985 equation is selected that the devices always perform the flowrate equation according to the pressure tap location setting.

In pseudo code form, PGAS should perform the following logic

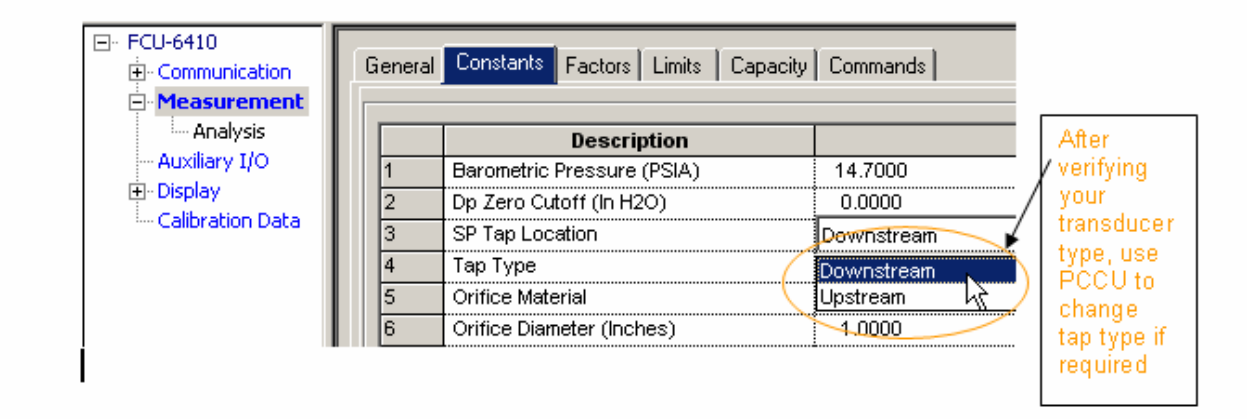
IF (AGA31992) THEN "Pf for calculations is upstream"
ELSE "Pf for calculations is same as pressure tap location setting"

The averages and extensions stored by our devices are based on the pressure actually used in the math. So when using the 1992 equation, all averages and extensions are upstream and when using the 1985 equation, all averages and extensions are a function of the pressure tap location setting.

Tap Type Modification Instructions

Make sure after verifying whether your replacement transducer is using an upstream or downstream pressure sensing element that you make the appropriate "tap type" change using PCCU software.

1. Connect to the flow computer and select "entry" mode.
2. Next, select measurement and "constants" tab and verify and change the tap type if necessary.



Conclusion

Totalflow incorporated several notification methods including added a warning to the AMU/XIMV part number tag (see example below) describing the change to our now standard upstream static pressure element. Hopefully this information will be helpful to verify that all of your flow computers have been installed and configured correctly? If in doubt about how to interpret this document please contact Totalflow Technical Support at 1-800-442-3097 or 1-918-338-4880 option 1.