TACO ACCU-FLO

COMPARATIVE ANALYSIS

With the introduction by Taco of the ACCU-FLO product line, Taco has produced the best flow balancing valve available to the hydronics industry. The ACCU-FLO is a modified venturi flow measuring device with a ball valve flow adjusting mechanism.

The following information is presented for use in answering any questions relative to competitive products.
Prepared by: R. W. Castle, P.E.

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Balancing Valve Competitive Analysis

COMPANY	TACO	B&G	FLOW DESIGN	ARMSTRONG	PRESSO	GERAND	TACO	TOUR ANDERSON	TOUR ANDERSON	TOUR ANDERSON	COMPANY
PRODUCT	ACCU-FLO	CIRCUIT SETTER +	ACCUSETTER	CBV	B - PLUS	BALL VALVE	CIRCUIT SETTER	TBV-S	STAD / STAS	STAF / STAG	PRODUCT
	1/2" - 2" SWT	1/2" - 3/4" SWT	1/2" - 2" SWT	1/2" - 2" SWT	1/2" - 2-1/2" SWT	1/2" - 1" SWT	1/2" - 2" SWT	1/2" - 3/4" SWT	1/2" - 2" SWT		
SIZES	1/2" - 2" NPT	1/2" - 3" NPT	1/2" -2" NPT	1/2" - 2 NPT	1/2" - 2-1/2"NPT	1/2" - 2" NPT	1/2" - 3" NPT		1/2" - 2" NPT	2-1/2" - 6" GROOVED	SIZES
	2-1/2" - 4" FLGD	4" - FLANGED	2-1/2" - 4" MXFNPT		2-1/2" - 10" FLGD		4" - FLANGED			2-1/2" - 12" FLGD	
			2-1/2" - 4" FLGD								
PRESSURE	SWT-300 PSI - 250° F	SWT-200 PSI - 250° F	SWT-400 PSI - 250°F	SWT-250 PSI - 250° F	SWT-400 PSI - 250°F	SWT-250 PSI - 250° F	SWT-250 PSI - 250° F	SWT-125 PSI - 250°F	SWT-300 PSI - 250° F	STAF-250PSI-250°F	PRESSURE
TEMPERATURE	NPT -300 PSI - 250° F	NPT -300 PSI - 250° F	NPT -400 PSI - 250° F	NPT -250 PSI - 250° F	NPT -400 PSI - 250° F	NPT -250 PSI - 250° F	NPT -250 PSI - 250° F		NPT -300 PSI - 250° F	STAD-300PSI-250°F	TEMPERATURE
RATINGS	FLG -175 PSI - 250° F	FLG -125 PSI - 250° F	FXM -400 PSI - 250° F		FLG -250 PSI - 250° F		FLG -175 PSI - 250° F				RATINGS
			FLG -150 PSI - 250° F								
SIZES	Cv	Cv	Cv	Cv	Cv	Cv	Cv	Cv	Cv	Cv	SIZES
1/2"	2.12	1.95	1.25 / 4	3	1.22 / 6 / 6		5.3	3.25	2.92		1/2"
3/4"	3.9	4.15	8	5	3.26 / 16 / 17		9.2	4.52	6.61		3/4"
1"	8.4	6.4	12	13	4.48 / 22 / 23		14.2		10.09		1"
1-1/4"	17.3	15.5	24	17	6.12 / 30 / 32		24.8		16.5		1-1/4"
1-1/2"	28.3	24	48	23	9.92 / 48 / 52		33		22.3		1-1/2"
2"	62.3	52	72	35	13.9 / 68 / 72		62		38.3		2"
2-1/2"	122	82	125	72	27.2 / 133 / 140		90			110	2-1/2"
3"	212	140	200	95	81.6 / 400 / 420		120			139	3"
4"	444	272	440	260	163 / 800 / 840		460			220	4"
PRESSURE CONN.	SHRAEDER	P/T PLUG	SHRAEDER	P/T PLUG	SHRAEDER	SPECIAL	SHRAEDER	P/T PLUG	P/T PLUG	P/T PLUG	PRESSURE CONN.
FLOW RATE MEASUREMENT DEVICE	VENTURI	BALL VALVE	VENTURI	GLOBE VALVE	VENTURI	ORIFICE PLATE	BALL VALVE	GLOBE VALVE	GLOBE VALVE	GLOBE VALVE	FLOW RATE MEASUREMENT DEVICE
ORIFICE TYPE	FIXED AREA	VARIABLE AREA	FIXED AREA	VARIABLE AREA	FIXED AREA	FIXED AREA	VARIABLE AREA	VARIABLE AREA	VARIABLE AREA	VARIABLE AREA	ORIFICE TYPE
SHUT OFF TYPE	BALL VALVE	BALL VALVE	BALL VALVE	GLOBE VALVE	BALL VALVE	BALL VALVE	BALL VALVE	GLOBE VALVE	GLOBE VALVE	GLOBE VALVE	SHUT OFF TYPE
POSITIVE SHUTOFF	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	POSITIVE SHUTOFF
ACCURACY:											ACCURACY:
CLAIMED	± 5%	NO CLAIM	± 2%	±3%	±2%	±1 %	NO CLAIM	NO CLAIM	NO CLAIM	NO CLAIM	CLAIMED
TESTED	± 5%	± 30%	± 11 %	± 20 %	NO DATA	± 30%	± 20%	NO DATA	NO DATA	NO DATA	TESTED
MEMORY STOP	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	MEMORY STOP
TAMPER RESISTANT *	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	TAMPER RESISTANT *
BLOW-OUT PROOF STEM	YES	NO	YES	YES	YES	YES	NO	YES	YES	YES	BLOW-OUT PROOF STEM
DRAIN	YES	YES	OPTIONAL	YES	NO	NO	NO	NO	NO	NO	DRAIN
BI-DIRECTIONAL	NO	YES **	NO	NO	NO	NO	YES	YES **	YES **	YES **	BI-DIRECTIONAL
SLIDE RULE	YES	YES	NO	YES ?	NO	NO	YES	YES	YES	YES	SLIDE RULE

ASHRAE RECOMMENDS TESTING AND BALANCING ACCURACY OF ± 5%.

* TAMPER RESISTANT REQUIRES A TOOL TO ADJUST

** THE DESIGN INDICATES THAT THE PRESSURE DROP WILL NOT BE THE SAME IN BOTH DIRECTIONS

What Type of Device is Best for Flow Measurement?

The characteristics of a good flow measurement device are:

1. **A**ccurate measurement
2. **C**onsistent repeatability
3. **C**areful design
4. **U**nfailing performance
5. **F**unctionality
6. **L**ow head loss
7. **O**perational simplicity

ACCURATE - The TACO ACCU-FLO consists of a modified venturi flow measurement section. Of principal flow measuring methods, the venturi is one of the most accurate designs available. It consists of a precision machined, reduced area section, which creates a pressure drop due to the change in velocity through the reduced area section. Flow measurement using the ACCU-FLO valve does not depend on the position of the stem and ball. The venturi is designed such that there is no influence on flow measurement by the position of the balancing ball. You no longer have to read the position indicator to determine the flow rate.

CONSISTENT REPEATABILITY - Repeatability of flow measurement is assured by the location of the venturi flow measurement section relative to the ball valve. The venturi design, assures repeatability of flow reading. There is no 'position sensitive' nameplate index setting to guess at. The flow measurement function is independent from the balancing function of the valve.

CAREFUL DESIGN - The ACCU-FLO product line was developed using concurrent engineering design concepts. The concurrent design team was composed of multidisciplinary engineers, quality assurance, marketing, customer service, and purchasing representatives to ensure the best product to meet the needs of the field. The utmost forethought and care was exercised by the ACCU-FLO design team at all steps of the development cycle. This product was developed from extensive field investigations drawing upon the needs and requests of the professional balancing community.

UNFAILING PERFORMANCE - The ACCU-FLO product line is manufactured in a state of the art ISO9001 production facility, by a dedicated staff of experienced balancing valve assemblers. Automated equipment tests each ACCU-FLO valve to ensure the highest product performance.

FUNCTIONALITY - The unsurpassed ability to accurately and repeatedly measure fluid flow, matched with the ease of a ball valve for controlling the branch circuit flow makes the TACO ACCU-FLO the circuit balancing valve that will be 'the choice' of balancing contractors and maintenance departments alike.

LOW HEAD LOSS - The venturi design, coupled with the ball valve balancing device, present the smoothest flow path to fluid of any circuit balancing valve. This translates to low head loss through the valve and high regain when in the full open position.

OPERATIONAL SIMPLICITY - Easy to install, whether sweat, threaded or flanged, no special tools are required. Easy to use; PRE-BALANCE - simply preset the valve to the desired head loss using the TACO ACCU-FLO slide rule; BALANCE - connect the differential pressure meter to the pressure port connections and read the flow rate on the ACCU-FLO slide rule.

What You Need to Know to Select a Balancing Valve

The following comments discuss the significance of each of the properties listed on the competitive analysis chart. It will also detail the pluses and minuses of each of the properties.

SIZE: The valve size selected for a branch circuit balancing application is often chosen to be the same as the pipeline size in which it will be installed. This is not always the best choice. It may be the easiest to specify and install, but it may not be the best choice for balancing the loop branch. ASHRAE (1995 Applications Handbook page 34.8) suggests that the valve should, when in the full open position, drop 5 to 10 % of the total loop pressure drop at full flow.

PRESSURE RATING:
The balancing valve pressure rating will be determined by the design pressure of the installed hydronic system. The valve should have a rated pressure equal to or greater than the system design pressure.

TEMPERATURE RATING:
The balancing valve temperature rating should equal or exceed the system design temperature rating. It need not exceed 250° F as this is the limit to stay within the ASME low pressure code.

Cv: The Cv (valve coefficient) relates pressure drop to flow rate by the formula:

$$Q = Cv\sqrt{\Delta P}$$

where; Q = Flow rate in gallons per minute
ΔP = Pressure drop (head loss) in PSI

The only time Cv will be important, is if the valve is intended to be left in the full open position. If the intention is to adjust the valve to introduce a required head loss, then the important consideration is that the valve be capable of operation when adjusted to the required head loss setting. As a balancing valve is adjusted, the Cv will change (reduce). Any valve chosen for the flow loop, will have to drop the required head to properly balance the loop, therefore when properly set, any valve would have the same Cv at the proper setting.

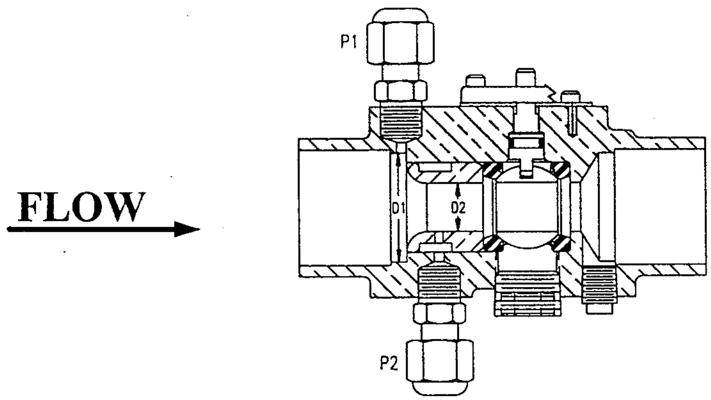
Regain - when water is speeded up through the venturi, it creates a pressure drop. As the water exits the valve and enters into a larger cross sectional area, such as that of the pipe, it slows down and experiences an increase in pressure. This increase in pressure is known as regain. For example, water flowing through an ACCU-FLO may enter at 15 feet of head, go through the venturi section and drop to 10 feet, giving a differential pressure of 5 feet or 60 inches of water. As the flow continues and exits the valve into the pipe, pressure measured just downstream of the pipe entrance could measure 12 feet, a regain of 2 feet of head.

PRESSURE CONNECTION:
The style of pressure connection is a consideration when the valve is to be balanced. The connection must be compatible with the differential pressure gage hoses. Taco Gage Kits are compatible with Shraeder style fittings. The other fitting type in use, P/T plugs, require additional special fittings for use in measuring pressure drop when used with any suppliers differential gage kit. Both P/T plugs and Shraeder style fittings may leak under normal operating conditions. This should not be allowed to create a problem in choosing P/T connections or Shraeder connections.

FLOW RATE MEASUREMENT DEVICE:

The balancing portion of the ACCU-FLO valve is a modified venturi flow measurement device. Of all the methods of measuring flow in a closed pipe, the principal device used for accuracy is the venturi flow meter. The venturi flow meter is a 'primary' flow measurement device. It has been extensively studied in industry and laboratories and has well known characteristics.

The principal of operation of the venturi is the creation of a differential pressure between pressure taps located at two different cross sectional areas of the meter.



As the fluid flows into the valve, it fills the area associated with D1, and flows at velocity V1. As the flow enters the restricted area associated with D2, it speeds up to velocity V2. The change in velocity of the fluid creates a differential pressure from pressure port P1 to P2. By careful design, the effects of the ball closure position are eliminated from the measured pressure drop. The only parts of the valve that affect the differential pressure are the diameters of the venturi section. These diameters are held to very tight tolerances.

Other types of balancing valves which measure pressure drop across a ball, disc or other type of variable orifice device must contend with the uncertainty in the position of the indicator, lost motion in the adjusting linkage, and multiple geometry variations due to several elements (which make up the flow path) with their associated tolerances for determining the differential pressure. All of these variables have a negative effect on the accuracy of the flow measurement device.

ORIFICE TYPE:

The most accurate differential pressure flow measurement device is a fixed area (geometric) device such as a venturi or orifice plate. Both of these devices have high accuracy, however, the venturi has the added benefit of high pressure regain. Variable area devices (i.e. B&G, Armstrong, Taco Circuit Setter, Tour & Anderson) allow inaccuracies due to the nature of how the adjustable area is changed to control flow. Whenever the area must be adjusted, backlash of the operator and interpretation of the valve stem position decreases the accuracy of the flow reading.

SHUT OFF TYPE:

Both ball valves and globe valves are suitable for shut off service.

POSITIVE SHUT OFF:

The ability of a shut off device to close without leakage.

ACCURACY CLAIMED vs TESTED:

The claimed accuracy is that presented by the product literature. The tested accuracy is the accuracy actually achieved across the whole useable flow range of the balancing valve in laboratory tests.

MEMORY STOP:

The device on the balancing valve which permits the use of the valves shut off function, and upon restoring the valve to its balancing function, properly positions the operating portion of the valve to the correct flow position.

TAMPER RESISTANT:

This indicates that tools must be used to adjust the memory stop. Valves are often located in areas that are accessible to casual traffic. It is important that passersby not be able to just reach up and change the memory stop setting.

BLOW OUT PROOF STEM:

The stem design should be such that it not be retained by a snap ring or other such fastener. It is important for long term safety that the stem be retained by the valve body or a gland assembly.

DRAIN:

A separate connection point that may be piped or a valve may be attached to.

BI-DIRECTIONAL FLOW:

The valve can be used with fluid flow going in either direction.

SLIDE RULE:

A differential pressure versus flow calculator in the form of a circular or linear slide rule is available to aid in balancing the valve properly, otherwise the required information must be looked up on a curve or calculated from a formula.

ACCURACY VS. MULTI-TURN:

Many manufactures will extol the virtues of a multi-turn operator as their key selling point. They do this especially if they cannot claim high accuracy. A multi-turn operator will allow fine control in setting the adjustment knob. That is, if you want to change the differential pressure gage reading by some small amount, say 2%, their valve will do it more easily than valves that do not have the multi-turn feature. The problem remains that you still have the same built in inaccuracy of the basic product. If their accuracy is ±20%, it doesn't matter that they can easily perform fine adjustments, they still cannot be more accurate than ±20% when they are finished.

System Sensitivity To Flow Rate Changes

WATER-SIDE BALANCING:

Generally, hydronic systems should be balanced within ± 10% of design conditions. In some cases ± 5% is required for desired operation.

CHILLED WATER COOLING SYSTEM:

Chilled water systems are the least tolerant to flow variations of all types of heat transfer systems. This is due to the smaller differential temperature used in the cooling elements. Typical cooling systems work on a temperature rise of 5°F to 20°F, with working fluid inlet temperatures of around 45°F. The difference between the working fluid and the air to be cooled is around 30°F (75°- 45°).

Cooling systems, due to the smaller differential temperatures which they have to operate under, are more sensitive to the flow rate of the working fluid than heating systems.

A cooling system operating at a design working fluid flow of 100 GPM and temperature differential of 10°F, would have to maintain the coolant flow at 72 GPM (72% of design flow) to obtain 90% of the design heat transfer rate. In a typical cooling system, in order to maintain actual heat transfer between 97% and 101.5% of design, the following accuracy's are required:

1) Supply side temperature = 45°F, ΔT = 10°F; Flow tolerance required = **± 10 %**.
2) Supply side temperature = 50°F, ΔT = 12°F; Flow tolerance required = **± 5%**.

HEATING SYSTEMS:

Heating systems operate on a larger temperature differential and are thus less sensitive to changes in flow rate of the heat transfer fluid. Heating systems typically work on a temperature loss of 10°F to 100°F, with entering water temperatures of about 200°F. The difference between the working fluid and the air to be heated is around 125°F (200°- 75°).

A heating system operating at a design fluid flow of 100 GPM and temperature differential of 20°F, would have to maintain the fluid flow at 52 GPM (52% of design flow) to obtain 90% of the design heat transfer rate.

In a typical heating system, in order to maintain actual heat transfer between 97% and 101.5% of design, the following accuracy's of system flows are required:

1) Supply side temperature = 200°F, ΔT = 20°F; Flow tolerance required = **± 10 %**.
2) Supply side temperature = 180°F, ΔT = 20°F; Flow tolerance required = **± 10%**.

DUAL PURPOSE COOLING AND HEATING SYSTEMS:

Dual purpose cooling and heating systems are similarly flow sensitive, particularly when operating in the cooling mode of operation. This is due to the same limitation in the cooling mode of the relatively small differential temperatures available for heat transfer.

In some cases, dual purpose systems may see a decrease in fluid flow due to the added pressure drop of the chiller unit in the cooling season, further limiting the flow rate.

ACCU-FLO Standard Specification

CIRCUIT SETTER FLOW MEASUREMENT AND BALANCING VALVE:

The 1/2" thru 2" valve sizes shall be available in either NPT or Sweat configuration end connections. The valve shall be the Accu-flo as manufactured by TACO, Inc., or an approved equal. The valve shall have flow measurement independent of the setting position and provide for low loss to the system in the full open position. The valve shall be capable of introducing such loss to the system as is necessary, compatible with approved use. The valve shall be a combination service shut off, balancing and flow measurement device. The materials of construction shall be corrosion resistant brass/bronze bodies of unitary construction. The stem design shall be blow out proof, sealed with an EPDM o-ring. The flow measurement shall be accomplished by means of a fixed geometry venturi style sensor of corrosion resistant materials. Pressure reading ports shall be of Schrader style connection. The valve shall be a double seated ball style, and the seat shall be Teflon™ and designed for shut-off service. The memory stop shall be of a robust design capable of allowing return of the stem/ball to the originally set position after use as a servicing shut off valve. The balancing valve stem shall have wrenching flats for normal setting. The valve stem shall be capable of operation by a 4:1 turn ratio for stem positioning. The valve may have a plugged drain connection. The valve shall be designed for use at 300 psi up to 250° F.

The 2-1/2" thru 4" valve sizes shall be of the flanged end configuration. The valve shall be the ACCU-FLO as manufactured by TACO, Inc. or an approved equal. The valve shall be the same as in above paragraph, except, the body shall be of cast iron construction with flanged ends and shall not have a plugged drain connection. The valve stem shall be capable of operation by a 4:1 turn ratio for stem positioning. The valve shall be designed for use in class 125 applications. The maximum service temperature shall be 250 ° and pressure 175 psi.

ASHRAE Recommended Limits of Use Based on Flow Induced Noise

Residential Applications						
Accu-Flo Valve Size	**Copper Tube I.D.**	**Flow-gpm @ Noise Limit**	**Approx. Pressure Drop (inch H_2O)**	**Pipe I.D.**	**Flow-gpm @ Noise Limit**	**Approx. Pressure Drop (inch H_2O)**
1/2"	0.545	2.9	80	0.622	3.8	140
3/4"	0.785	6.0	100	0.824	6.6	120
1"	1.025	10.3	65	1.049	10.8	70
1-1/4"	1.265	15.7	40	1.38	18.6	55
1-1/2"	1.505	22.2	26	1.61	25.4	35
2"	1.985	38.6	18	2.067	41.8	21
Commercial Applications						
Accu-Flo Valve Size	**Copper Tube I.D.**	**Flow-gpm @ Noise Limit**	**Approx. Pressure Drop (inch H_2O)**	**Pipe I.D.**	**Flow-gpm @ Noise Limit**	**Approx. Pressure Drop (inch H_2O)**
1/2"	0.545	5.8	260	0.622	7.6	550
3/4"	0.785	12.1	400	0.824	13.3	525
1"	1.025	20.6	250	1.049	21.6	300
1-1/4"	1.265	31.3	160	1.38	37.3	235
1-1/2"	1.505	44.4	110	1.61	50.8	145
2"	1.985	77.2	75	2.067	83.7	90
2-1/2"				2.469	119.0	65
3"				3.068	185.0	45
4"				4.026	317.0	35

TACO, INC., 1160 Cranston Street, Cranston, RI 02920 Telephone: (401) 942-8000 FAX: (401) 942-2360.
TACO (Canada), Ltd., 6180 Ordan Drive, Mississauga, Ontario L5T 2B3. Telephone: 905/564-9422. FAX: 905/564-9436.