

# 4. Tools for balancing

## 4.0 Hydronic tools - balancing valves

Hydronic balancing is only possible if the appropriate means to balance are provided. To balance correctly, balancing valves, measuring instruments and an appropriate balancing method are all necessary. Balancing valves must be adjusted to the desired flow, based on the flow measurement throughout the system. To measure flow, Armstrong balancing valves are fitted with two pressure/temperature test valves.

The CBV balancing valve is made so it can also be used as a positive shutoff valve, and features a soft disc and a no-drip seat. Using the CBV balancing valve often eliminates the need for a separate shutoff valve, and this reduces installation costs.

The Armstrong CBV balancing valve provides measurement of the water flow where it is important to check it. If it's necessary to troubleshoot the piping system, the CBV valve permits a flow diagnostic test to see the actual flow and readjust, if required, to avoid excess heating or cooling.

Proper balancing valves must be designed as such. It doesn't make sense to try to convert other types of valves.

## 4.1 The valve characteristic

Balancing valves are designed to regulate water flow, not heat output. At a constant differential pressure, the valve flow is proportional to the degree of opening if a linear characteristic is adopted (see b, Figure 11).

However, if the control valve is in series with a high resistance circuit, the relative effect of the closure of the control valve on the flow is small and an equal-percentage characteristic "c" would give the valve a better control over the flow.

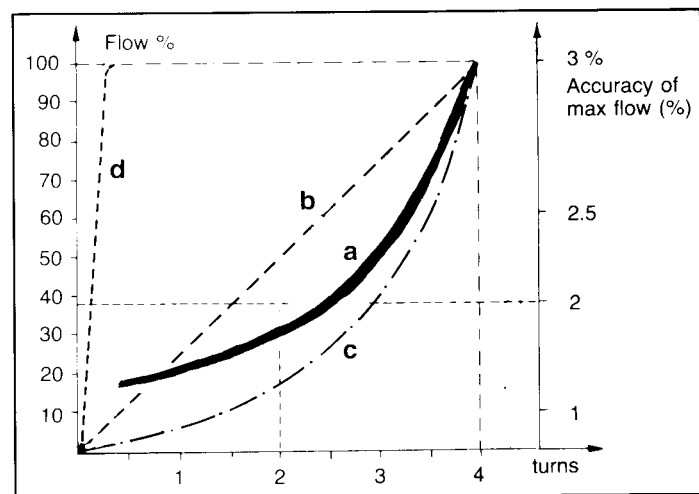


Fig. 18. Comparison of balancing valve characteristic with other valves

- a) Armstrong CBV balancing valve;
- b) Theoretical linear valve characteristic;
- c) Theoretical equal % valve characteristic;
- d) Typical 90° turn balancing valve.

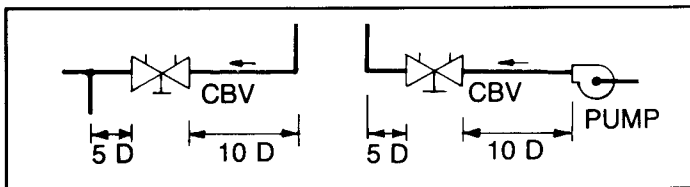
Conversely, if the series circuit is of low resistance, a linear characteristic is preferred. Years of experience in this field have enabled Armstrong engineers to define the ideal balancing valve characteristics.

These characteristics vary according to the valve size but generally follow the general form "a" (Figure 18.) Typical 90° turn balancing valves often have an abrupt characteristic similar to curve "d" in Figure 18. It is easy to understand that such a characteristic is not convenient either in measuring the flow or to adjust it accurately. A small adjustment means a rapid change in the flow rate.

## 4.2 Installation of balancing valves

Armstrong insists on very close dimensional tolerances on valve seats and plugs, which explains the high accuracy of flow obtained.

To assure flow accuracy, large turbulences must be avoided in the inlet of the balancing valve. For this reason, the valve should be located five pipe diameters downstream from a fitting; with two diameters downstream from the balancing valve free from fittings. If a balancing valve is located downstream from a circulating pump, allow a distance of 10 diameters between the pump and balancing valves. (As illustrated)



The distances of straight pipe recommended above are not a product of the valve itself but are a matter of good piping layout. The disturbances created in the flow by passing through a fitting or pump require time to work their way back out of the flow. Briefly stated, you cannot accurately measure the P of water that is full of air or vapor bubbles. To obtain an accurate flow reading at any metering station, good, straight, air-free flow is required.

## 4.3 CBV valve adjustment position

The balancing adjustment accuracy also depends on how easily the position can be set and repeated. This involves the use of a graduated and easily read handwheel. Each turn is indicated by the turn indicator scale 0 to 4 turns. For each rotation of one turn, the position is indicated by graduation from 0 to 9. (see Figure 19)

For valves CBV 1/2 - 2" T (NPT), CBV 1/2 - 2" B (BSP Parallel and Tapered) and CBV 1/2 - 2" S (Soldered) there are 4 turns, making 40 adjustment positions available.

For valves CBV 2-1/2 - 3" G (Grooved and Straight) and CBV 2 1/2" and 3" A (Grooved Angle) there are 5 turns, making 50 adjustment positions.

For valves CBV 4 - 6" G (Grooved Straight) and CBV 4 - 6" A (Grooved Angle) there are 6 turns, making 60 positions available.

Valves CBV 8 - 12" have more than 120 adjustment positions available.

All CBV valves may be set at intermediate positions to give an infinite number of settings and a more accurate adjustment, when this degree of precision is required. The balancing valve may be used as a shut off valve, thus providing tight shut off, control and flow measurement functions in one device.

**4.4 Tamper proof hidden memory setting**

An internal device enables the balanced valve opening to be manually locked at a determined position which is mechanically limited or “memorized.” When reopening the valve, the “hidden memory” ensures this determined position will be obtained immediately (see Figure 19).

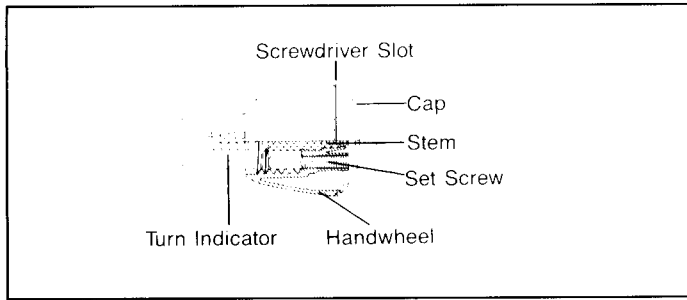


Fig. 19. Balancing valve maximum flow setting, tamper proof “Hidden Memory”

**4.5 The measured differential pressure corresponds to the pressure drop of the valve**

The relationship between flow, valve position and measured differential pressure have been determined experimentally and are shown in Flow/Pressure Drop Curves. This guarantees accurate flow measurement. In certain cases, the control valve is used to create a particular pressure drop and this pressure drop does not necessarily correspond to the differential pressure measured at the pressure tapings.

In the valve, the pressure will change in relation to the fluid velocity and the pressures measured locally at the pressure taps, which are influenced by turbulence which can create random dynamic pressures.

The valve design enables the differential pressure to be determined from the pressure drop of the valve within an accuracy of  $\pm 5\%$ .

**4.6 Calculation of flow**

**A. Determining flow with a flow/pressure drop curve:**

A CBV 2" is set at 3.0 turns.

The differential pressure measured across the valve is 1.65 Ft. What is the water flow?

On the left index of Flow/Pressure Drop Curve locate 1.65 FtWg (feet water gauge), point 1. Move horizontally across curve to the handwheel position line 3.0, which is point 2. At this juncture move vertically downward to intersect the flowrate line and read USGPM.(22 USGPM) at point 3.

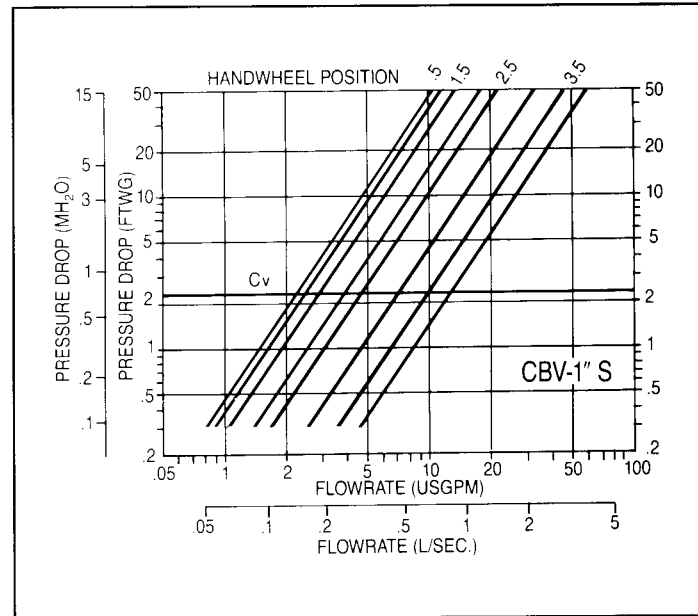


Fig. 20. A typical performance Cv curve, flow/pressure drop curve

**B. Determining valve flow with CBV slide rule:**

A CBV 1-1/4 is set at 3.5 turns and measures 2.5 FtHd. Set handwheel index line on 3.5 turns for 1-1/4" valve size. Read 13.5 USGPM flow opposite 2.5 FtHd.

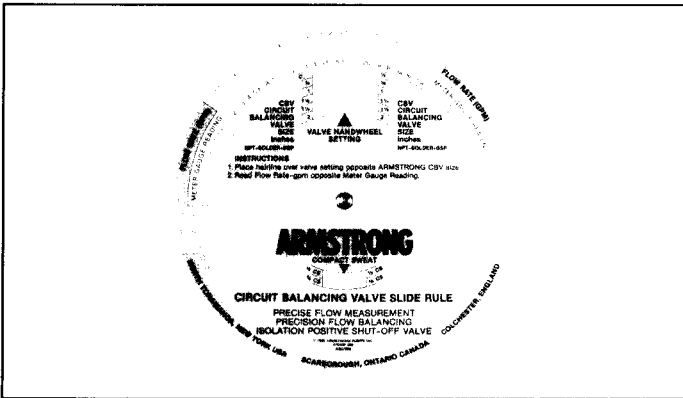


Fig. 21. Armstrong circuit balancing valve slide rule

### C. Pre-determination of a balancing valve position with flow/pressure drop curve:

In a circuit which is to carry a flow of 30 USGPM at a pressure drop of 6 Ft water gauge use a CBV-1-1/2.

Join the points corresponding to 30 USGPM and 6 Ft. On the USGPM scale at 30 USGPM (point 1) draw a vertical line up the curve. On the FtWg scale at 6 Ft (point 2) draw a horizontal line across the curve. Use the intersection of these two lines (point 3) to determine the correct handwheel setting (3.4 turns open). When commissioning the system, the flow obtained can be checked and any necessary correction made.

### D. Pre-determination of CBV balancing valve setting with CBV slide rule:

A flow of 2.8 USGPM is required to flow through a CBV - 3/4" at a 1 FtHd drop across valve. Set 1 Ft gauge reading opposite 2.8 USGPM flow rate; read valve handwheel setting of 3.8 turns for the 3/4" size.

## 4.7 A reliable flow measurement instrument

The differential pressure may be measured using a "U" tube gauge or an Armstrong Differential Pressure Gauge (CBDM-60 or CBVM 135/60) and interpreted using the Flow/Pressure Curve or circular slide rule.

However, it is much simpler to use a COMPUFLO meter (Figure 22). The COMPUFLO is a microprocessor with a memory containing the characteristic curves of the Armstrong CBV valves and many valves from other manufacturers, a 34-key keypad, and a digital display. The instrument reads the differential pressure and also, once the size and position of the valve have been entered, it automatically indicates the water flow.

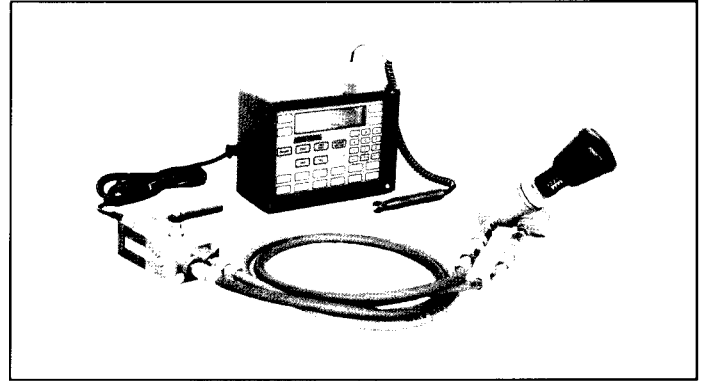


Fig. 22. The COMPUFLO meter connected

This model enables the set position of the valve to be calculated to obtain the required flow and its calculation program is a great help to the balancer when balancing an installation. The COMPUFLO is protected against over differential pressure in case an operator removes either the low pressure hose (blue) or the high pressure hose (red) while the other is still connected.

## 4.8 Quality

CBV from 1/2" to 2" NPT, BSP, or Solder and the CBV-CS 1/2" to 3/4" sweat type are constructed of a bronze/copper alloy. They resist dezincification found in water systems. The valve continues to be easy to adjust years after initial installation and the characteristics remain the same over time.

For CBV valves from 2-1/2" to 12" FLG, the valve trim is made of non ferrous materials and the body is ductile iron.

## 4.9 Other characteristics

Valves (CBV size 1/2 to 2" NPT, BSP and Solder) have an optional insulation package available that will meet the ASTM-E fire code ratings. Flame spread rating of 25 or less and a smoke development rating of 50 or less.

- Insulation is also available as an option for CBV sizes 2-1/2" to 6" FLG or cut grooved body and meets the requirements of the ASTM-E fire code
- Positive isolation is provided with a soft disc ring when valve is used as a shutoff valve
- Stem packing is self-lubricated
- Removeable handle
- Drain connection is optional on CBV 1/2" - 2" sizes

## 4.10 Typical product specifications

### CBV-S

#### (1/2" - 2" solder type)

Furnish and install, as shown on plans and with manufacturer's recommendations, model CBV-S solder type Circuit Balancing Valve.

Each valve shall have metering ports incorporating Nordel check valves on both sides of the seat. All valves shall be "Y" pattern equal percentage globe style, designed either for presetting with a balance schedule or for proportional balancing.

All metal parts are bronze-copper alloy. Each valve shall provide three functions:

1. Precise flow measurement
  2. Precision flow balancing
  3. Positive shutoff with a no-drip soft seat
- A 1/4" NPT tapped drain port shall be provided on each side of the valve seat.

Valves shall have four full 360° adjustment turns of the handwheel (1440°) with a micrometer-type indicator and hidden memory feature to program the valve for a precise, tamper-proof balanced setting. When installed, the handwheel and metering ports shall not be located on the bottom of the valve. (This prevents sediment deposits.) The handwheel scale must be capable of being positioned to be clearly read without the use of mirrors or any special tools. Metering ports shall be interchangeable with drain ports to allow for readout flexibility when installed in tight piping locations.

(Optional) Each solder type CBV-S to be shipped with pre-formed insulation to meet or exceed ASTM-D 1784/class 14253-C, MEA #7-87, ASTM-E-84 and ASTM-E-136 with a flame spread rating of 25 or less and a smoke development rating of 50 or less.

Circuit Balancing Valves shall be Armstrong CBV——S (indicate size 1/2 - 2") solder type.

### CBV-T

#### (1/2" - 2" NPT threaded type)

Furnish and install, as shown on plans and to manufacturer's recommendations, model CBV-T threaded type Circuit Balancing Valve.

Each valve shall have metering ports incorporating Nordel check valves on both sides of the seat.

All valves shall be "Y" pattern equal percentage globe style, designed either for presetting with a balance schedule or for proportional balancing.

All metal parts are bronze copper alloy. Each valve shall provide three functions:

1. Precise flow measurement
2. Precision flow balancing
3. Positive shutoff with a no-drip soft seat

A 1/4" NPT tapped drain port shall be provided on each side of the valve seat.

Valves shall have four full 360° adjustment turns of the handwheel (1440°) with a micrometer-type indicator and hidden memory feature to program the valve for a precise, tamper-proof balanced setting. When installed, the handwheel and metering ports shall not be located on the bottom of the valve. (This prevents sediment deposits.) The handwheel scale must be able to be positioned so that it may be clearly read without the use of mirrors or any special tools. Metering ports shall be interchangeable with drain ports to allow for readout flexibility when installed in tight piping locations.

(Optional) Each solder type CBV-T to be shipped with pre-formed insulation to meet or exceed ASTM-D 1784/class 14253-C, MEA #7-87, ASTM-E-84 and ASTM-E-136 with a flame spread rating of 25 or less and a smoke development rating of 50 or less.

Circuit Balancing Valves shall be Armstrong CBV———T (indicate size 1/2" - 2") threaded type.

### **CBV-P (1/2 - 2" BSP parallel threaded type)**

Furnish and install, as shown on plans and with manufacturer's recommendations, model CBV-P parallel threaded type Circuit Balancing Valve.

Each valve shall have metering ports incorporating Nordel check valves on both sides of the seat.

All valves shall be "Y" pattern equal percentage globe style, designed either for presetting with a balance schedule or for proportional balancing.

All metal parts are bronze-copper alloy. Each valve shall provide three functions:

1. Precise flow measurement
2. Precision flow balancing
3. Positive shut off with a no-drip soft seat

A tapped drain port shall be provided on each side of the seat.

Valves shall have four full 360° adjustment turns of the handwheel (1440°) with a micrometer-type indicator and hidden memory feature to program the valve for a precise, tamper-proof balanced setting. When installed, the handwheel and metering ports shall not be located on the bottom of valve. (This prevents sediment deposits.) The handwheel scale must be able to be positioned so that it may be clearly read without the use of mirrors or any special tools. Metering ports shall be interchangeable with drain ports to allow for readout flexibility when installed in tight piping locations.

(Optional) Each compact, solder type CBV-P is to be shipped with pre-formed insulation to meet or exceed ASTM-D 1784/class 14253-C, MEA #7-87, ASTM-E-84 and ASTM-E-136 with a flame spread rating of 25 or less and a smoke development rating of 50 or less.

Circuit Balancing Valves shall be Armstrong compact, CBV —— P (indicate size 1/2" - 2"). BSP parallel thread.

### **CBV-CS (1/2" and 3/4" solder type)**

Furnish and install, as shown on plans and with manufacturer's recommendations, model CBV-CS solder type Circuit Balancing Valve. Each valve shall have metering ports incorporating Nordel check valves on both sides of the seat. All valves shall be "Y" pattern equal percentage globe style, designed either for presetting with a balance schedule or for proportional balancing.

All metal parts are bronze-copper alloy. Each valve shall provide three functions:

1. Precise flow measurement
2. Precision flow balancing
3. Positive shut off with a no-drip soft seat

Valves shall have one 360° adjustment turn of the handwheel with a positive memory, allowing valve to be shut off and reopened to its balance set point.

(Optional) Each compact, solder type CBV-CS is to be shipped with pre-formed insulation to meet or exceed ASTM-D 1784/class 14253-C, MEA #7.87, ASTM-E-84 and ASTM-E-136 with a flame spread rating of 25 or less and a smoke development rating of 50 or less.

Circuit Balancing Valves shall be Armstrong compact, solder type CBV—— CS (indicate size 1/2" or 3/4).

### **CBV-G or CBV-A**

#### **(2-1/2" - 6" straight or angle pattern)**

Furnish and install, as shown on plans and to manufacturer's recommendations, model CBV-G grooved straight type or CBV-A grooved angle pattern Circuit Balancing Valve. Each valve shall have metering ports incorporating Nordel check valves on both sides of the seat. All valves shall be "Y" pattern equal percentage globe style, designed either for presetting with a balance schedule or for proportional balancing.

Valves shall have ductile iron bodies, with bronze trim. Flanges shall be 125 lb cast iron (250 lb ductile iron flanges or 250 lb grooved ends optional). Each valve shall perform three functions:

1. Precise flow measurement
2. Precision flow balancing
3. Positive shutoff with a no-drip seat

Valves shall have five (2-1/2" and 3") or six (4" through 6") full 360° adjustment turns of the handwheel with a micrometer-type indicator and a hidden memory feature to program the valve for a precise, tamper-proof balanced setting. When installed, the handwheel and metering ports shall not be located on the bottom of the valve. (This prevents sediment deposits.)The handwheel scale must be able to be positioned so that it may be clearly read with-

out the use of mirrors or any special tools. Metering ports should be easily located on either side of the valve body for read-out flexibility when installed in tight piping positions.

(Optional) Each solder type CBV-G or CBV-A to be shipped with pre-formed insulation to meet or exceed ASTM-D 1784/class 14253 - C, MEA #7-87 ASTM-E-84 and ASTM-E-136 with a flame spread rating of 25 or less and a smoke development rating of 50 or less.

Circuit Balancing Valves shall be Armstrong CBV—— G or CBV —— A (indicate size 2-1/2" - 6") Flanged or Grooved type.

## **4.11 Electronic digital microprocessor meter**

Provide an Armstrong COMPUFLO Electronic Digital Microprocessor Meter for use with Armstrong CBV balancing valves, and all other commonly used balancing valves. The digital read-out, computerized meter shall be pre-programmed with CBV and all major balancing valve manufacturers' curves to provide seven functions:

1. Direct flow readout
2. Proportional balancing
3. Computing valve setting
4. Differential pressure measurement
5. Temperature measurement
6. Air flow measurement
7. Perform timed leak test

Each COMPUFLO Meter shall have automatic calibration, air purging and come furnished in an executive-style lockable brief case complete with hoses, fittings, temperature probe, 0 - 30 psi water transducer and quick connect connections necessary to carry out fast, accurate water balancing or commissioning.