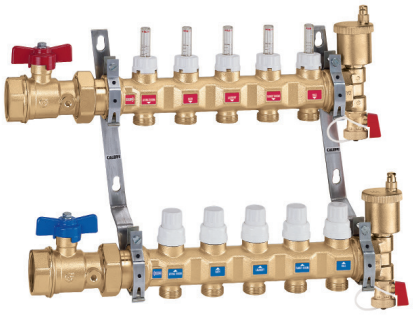
TwistFlow™ Pre-assembled distribution manifolds for radiant panel systems

668S1 series

01170/23 NA
Replaces 01170/08 NA



Function

Distribution manifolds for radiant panels and in-floor systems are used to optimally distribute the heating fluid and improve the control of heat emission from the panels. The manifolds ensure that the flow to each circuit is regulated precisely and also control the shut-off, venting and automatic removal of air from the system.

Product range

Series 668S1 TwistFlow™ pre-assembled distribution manifold for radiant panel systems with built-in sight flow gauge/balancing valve..... Sizes 1" and 1 1/4"

Technical specification

Materials:

Supply manifold
- Body: brass

Flow rate regulating valve
- Control device upper part: brass
- Valve plug: brass
- Flow meter body: PSU
- Spring: stainless steel
- Seals: peroxide-cured EPDM
- Regulating unit cover: ABS

Return manifold
- Body: brass

Shut-off valve
- Control device upper part: brass and PA
- Stem: stainless steel
- Springs: stainless steel
- Seals: peroxide-cured EPDM
- Knob: ABS

Ball valve
- Body: brass
- Ball: brass, chrome plated
- Handle: aluminium

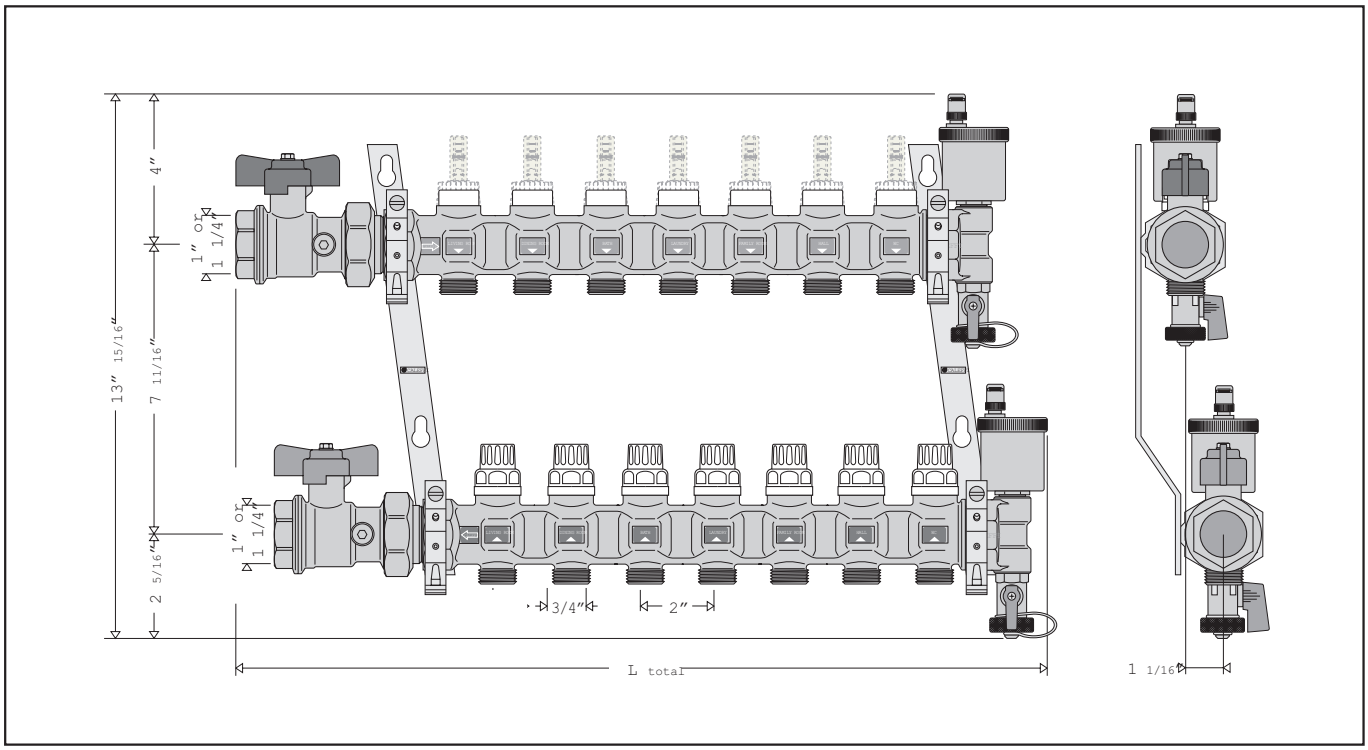
End fitting
- Body: brass

Automatic air vent valve
- Stem: brass
- Spring: stainless steel
- Seals: peroxice-cured EPDM
- Float: PP

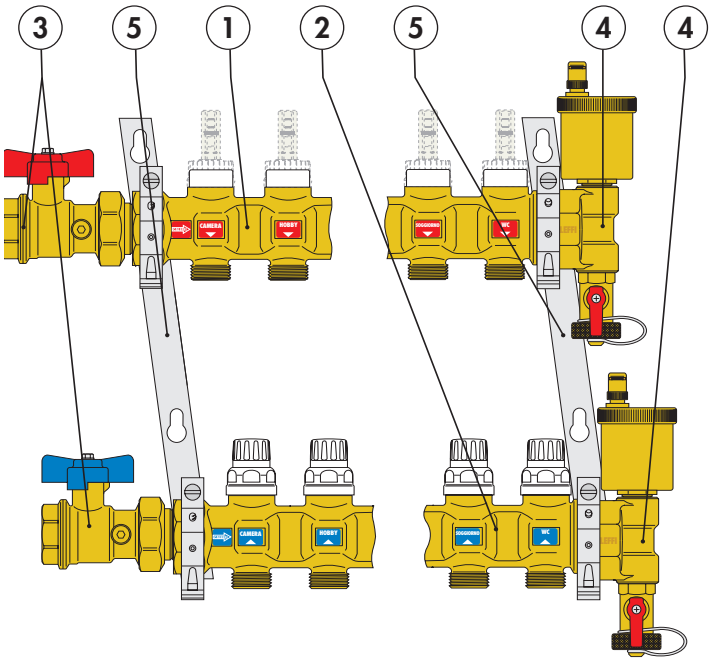
Performance:

Medium:	water, glycol solutions
Max. percentage of glycol:	50%
Max. working pressure:	150 psi (10 bar)
Max. end fitting discharge pressure:	35 psi (2.5 bar)
Working temperature range: - 668S1 series:	32 to 180°F (0 to 80°C)
Flow meter scale for 668S1 series:	1/4–2 GPM - (1–8 l/min)
Accuracy:	±15%
Main connections:	1", 1 1/4" NPT female
Connection center distance:	7 11/16" (195 mm)
Outlets:	3/4" M (18 mm)
Outlet center distance:	2" (50 mm)

Dimensions



Code (1")	668 6C5S1A	668 6D5S1A	668 6E5S1A	668 6F5S1A	668 6G5S1A	668 6H5S1A	668 6I5S1A	668 6L5S1A	668 6M5S1A	668 6N5S1A	668 6O5S1A
Code (1 1/4")	668 7C5S 1A	668 7D5S 1A	668 7E5S 1A	668 7F5S 1A	668 7G5S 1A	668 7H5S 1A	668 7I5S 1A	668 7L5S1A	668 7M5S 1A	668 7N5S 1A	668 7O5S 1A
No. outlets	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Total length	15 3/16 "	17 1/8 "	19"	21"	23"	25	28 1/ 8"	30 1/8 "	32 1/16 "	34 1/16 "	36"
W eight (lb)	17	18	19	21	23	24	26	28	29	31	33



Components

1. Supply manfold, complete with flow meters and buil-in flow rate balancing valve)

2. Return manifold, complete with shut-off valves that can be used with thermo-electric actuators.

3. Shut-off ball valves, complete with port for optional temperature gauge.

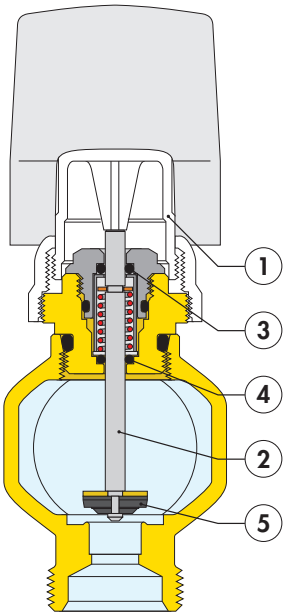
4. End fittings consisting of a 3-way end fitting, and drain valve.

5. Pair of mounting brackets, for use with 659 series boxes or direct wall mounting.

Construction details

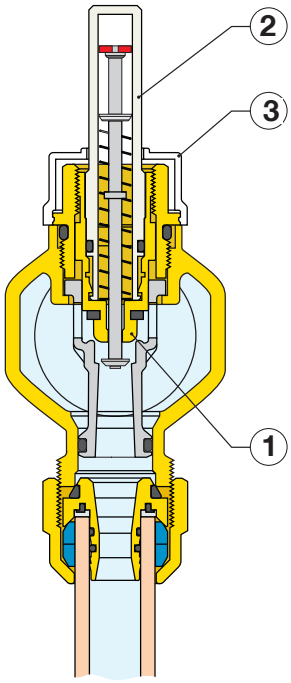
Return manifold

The return manifold is equipped with manual shut-off valves (1) which are used to shut off the flow to individual circuits. They can also be used with a thermo-electric actuator which, when used with a room thermostat, maintains the room temperature at the set limits when thermal load varies. The stem (2) is made of polished stainless steel to minimize friction and prevent the formation of harmful corrosion.
The control device upper part features a double EPDM O-ring seal (3) - (4) on the sliding stem. The valve seat (5) is made of EPDM and is molded to optimize the hydronic characteristics of the valve and minimize noise as the fluid passes through and as it gradually opens and closes when operating with a thermo-electric actuator.



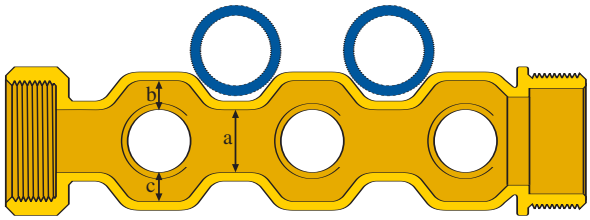
Supply manifold

The supply manifold is equipped with flow meters and built-in flow rate balancing valves.
Acting on the regulating valve with the special cone-shaped valve plug (1), the flow rate to the single circuits can be accurately adjusted to the required value, just by reading the value on the single flow meter with a scale of 1/4 - 2 gpm (2). This simplifies and speeds up the operation of circuit calibration, with no need for reference graphs. After adjustment, the valve can be locked open by means of its tamper-proof cover (3), which also acts as a knob for adjusting the flow rate.
This valve makes it possible to seal off the single circuit, should this be necessary.



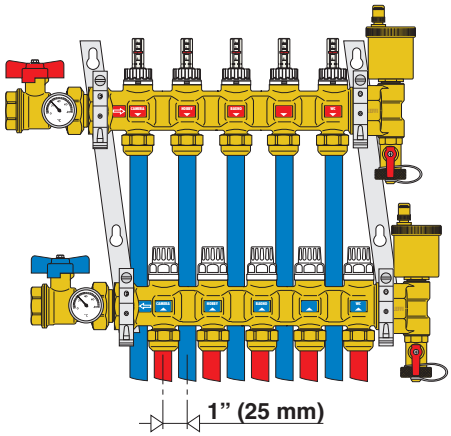
Exterior shape of the manifolds and mounting brackets

The exterior of the manifold is shaped to meet a variety of installation methods. In the example shown below, indentations have been created in the manifold to correspond to the plastic pipes exiting from the upper manifold, thus partially accommodating the pipes and reducing their overall thickness. This does not interfere with the pressure loss values because the sections with the indentations (a) are equal to the sections in which the pipes are branched (b) and (c) and where the regulating parts (micrometric regulating and shut-off valve) obstruct the passage of the fluid.



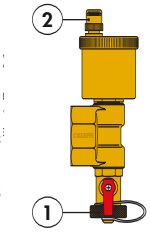
The partial accommodation of the pipes in the indentations created in the manifold is further enhanced by the angle of the mounting brackets, which are slanted to create a 1" (25 mm) offset between the upper and lower manifolds.

As shown in the figure below, this offset positions the pipes so that they perfectly match the profile of the manifold during installation.



End fitting and automatic air vent valve

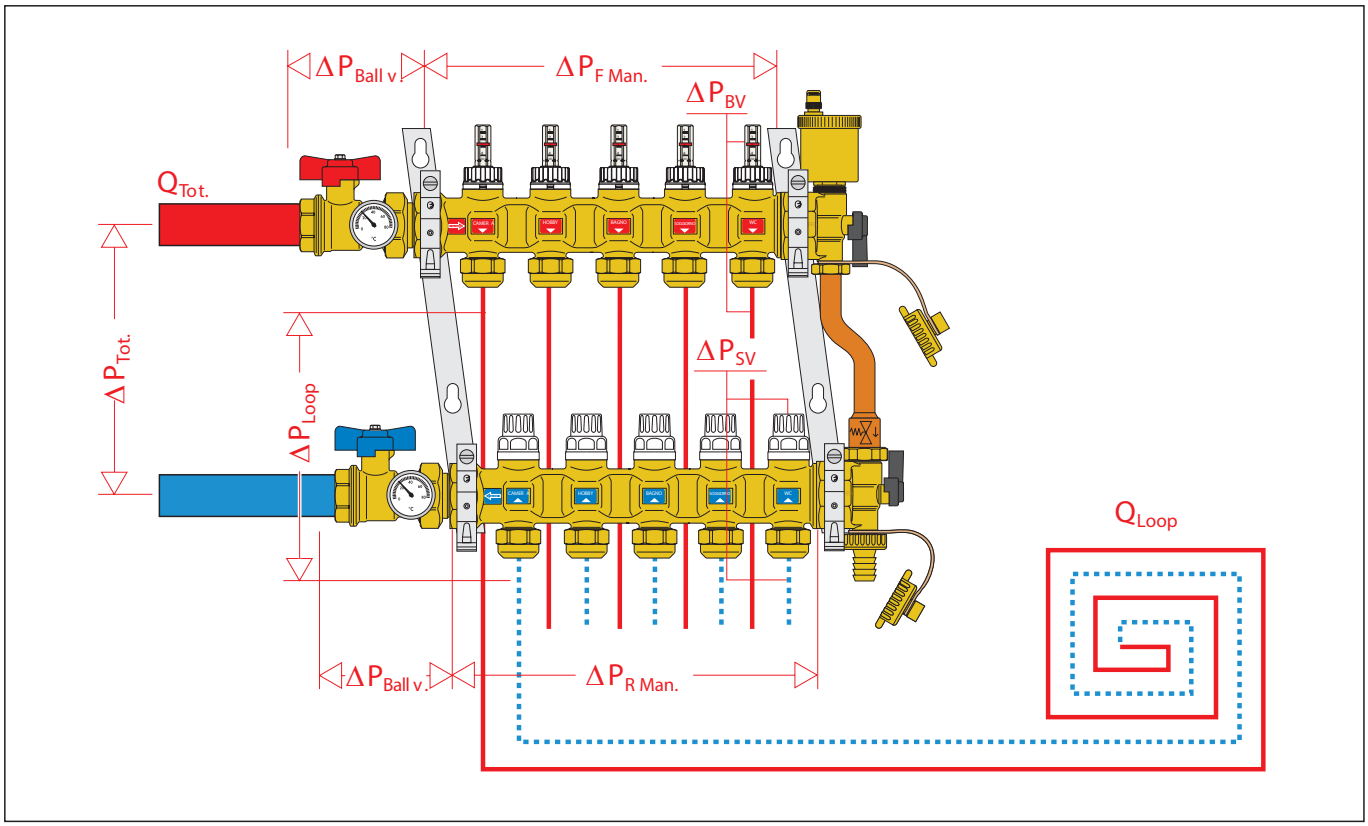
The end fitting consists of a fill/drain valve (1) and an automatic air vent valve with a hygroscopic safety cap (2). It has been specifically designed to close the air vent valve automatically if there is water near the vent itself.

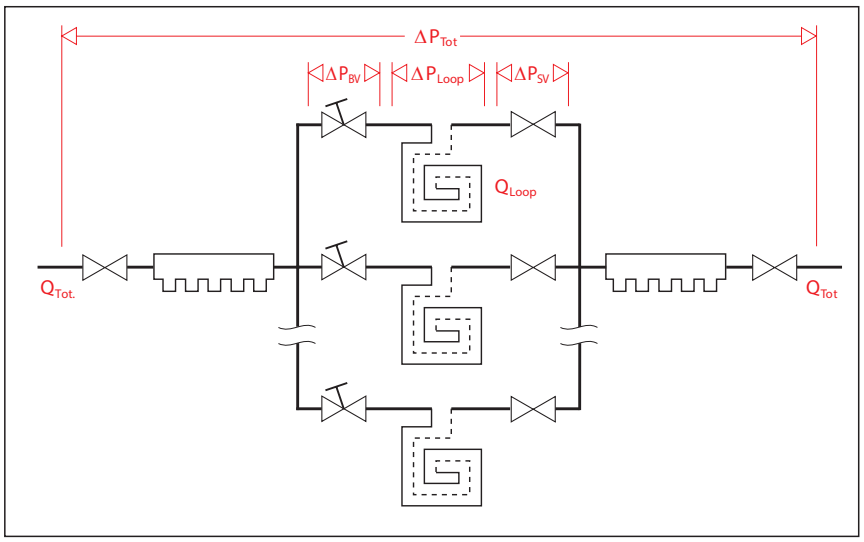


Hydronic characteristics for TwistFlow- 668S1

To determine the hydronic characteristics of the circuit, we must calculate the total pressure loss experienced by the flow of fluid as it passes through the manifold components and the radiant panel circuits.

From a hydronic standpoint, the manifold unit and circuits can be shown as an assembly of hydronic elements that are arranged in series and parallel to each other.





ΔP_{Tot} = Total loss at the manifold heads (Flow + Return + Loop)

ΔP_{BV} = Localized loss at the micrometric balancing valve loop (loop flow)

ΔP_{Loop} = Loop loss (loop flow)

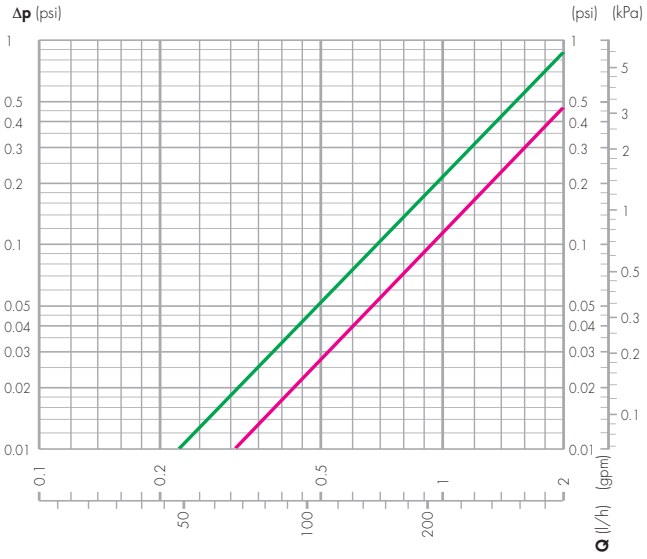
ΔP_{SV} = Localized loss at the shut-off valve in the panel circuit (loop flow)

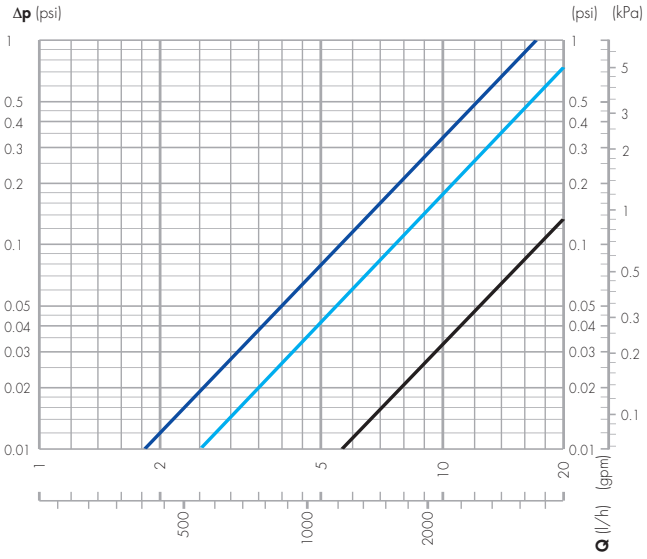
(1.1)

$$\Delta P_{Tot} = \Delta P_{BV} + \Delta P_{Loop} + \Delta P_{SV}$$

After noting the hydronic characteristics of the individual components and the design flows, the total loss can be calculated as the sum of the partial pressure losses of each specific component in the system, as shown in the formula *(1.1)*.

Note: We can ignore the pressure losses associated with the ball valves and manifolds because their values are so low. Generally speaking, the total pressure loss is fairly close to the pressure loss of the branched circuit of the panel.





	Cv
Flow meter with built-in flow rate balancing valve fully open	2.14
Shut-off valve	2.90

Cv = flow in gal/min for a pressure loss of 1 psi

	Cv
Supply or return manifold 3 to 7 outlets	24.3*
Supply or return manifold 8 to 13 outlets	17.3*
Ball valve	54.9

** Average value*

Example of how to calculate the total pressure loss
Suppose we need to calculate the pressure loss of a manifold with three circuits with the following characteristics:
Total manifold flow: 3.0 gpm (400 l/h)
The characteristics of the three piping loops are as follows:

Loop	Flow (gpm)	Tube length (ft)	Δp (psi)*
1	0.7	150	1.13
2	1.3	300	6.90
3	1.0	300	4.32

**Δp Value for each loop calculated from data published by tubing manufacturers*

Each segment of the formula (1.1), is calculated using the following relationship:
$\Delta P=Q^2/Cv^2$
· Q= flow in gpm
· ΔP = pressure loss in psi
· Cv = flow in gpm through the device in question, with a pressure loss of 1 psi

Important: ΔPTot must be calculated taking into account the circuit with the greatest pressure losses distributed along the entire piping loop of the panel.

The circuit in question in our example is circuit 2.

Thus:
$\Delta P_{BV} = 1.3^2/2.14^2 = 0.37$ psi
$\Delta P_{Loop} = 6.9$ psi
$\Delta P_{SV} = 1.3^2/2.90^2 = 0.20$ psi

Using the formula (1.1) we can add all the calculated terms to obtain:
$\Delta P_{Tot} = 0.37 + 6.90 + 0.20 = 7.47$ psi

Using the balancing valves with flow meter

Determine the design flow requirement for each circuit based on the heating requirement.
The balancing valves in the flow manifold make it possible to adjust each individual circuit in the panels to obtain the design flow rates in each loop.

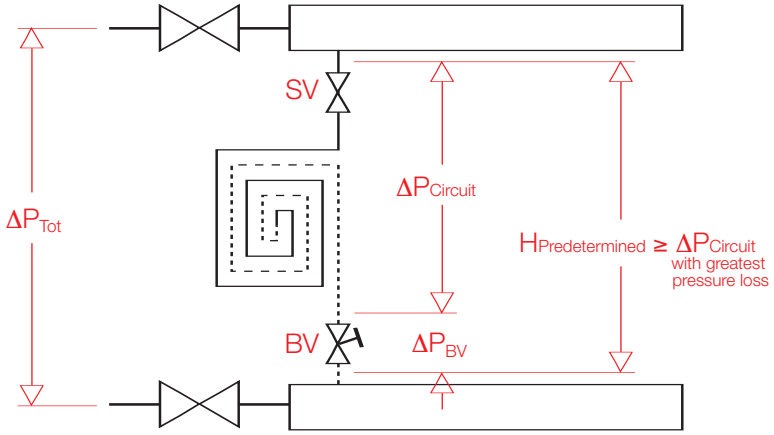
Considering the following data:

- medium flow rate across each circuit
- head loss generated in each circuit by this flow rate: $\Delta P_{Circuit} = \Delta P_{Loop} + \Delta P_{SV}$ ($\Delta P_{Shut\text{-}off\ valve}$)

- available head on the panel circuit or predefined head:

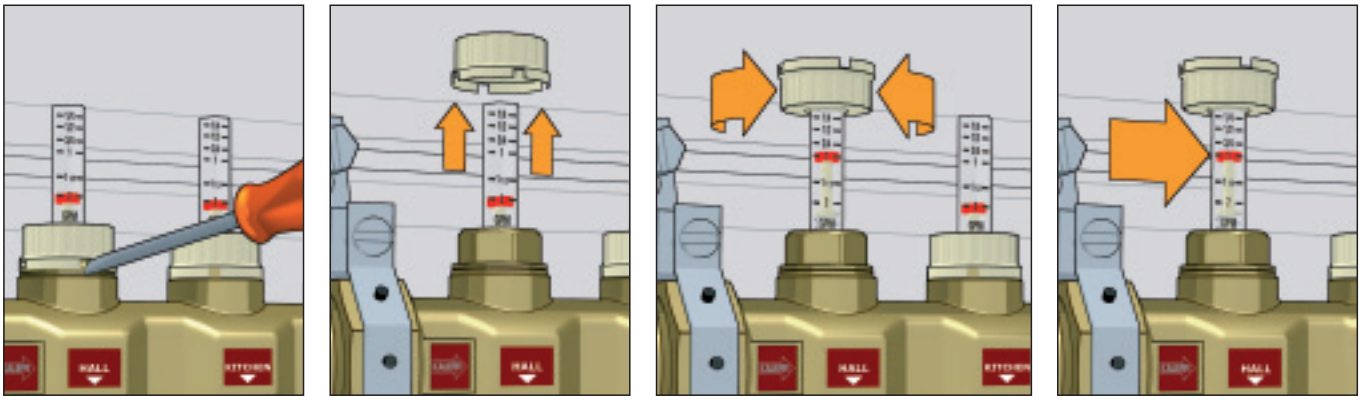
$H_{Predefined} \geq \Delta P_{Circuit\ with\ greatest\ pressure\ loss} = \Delta P_{BV} + \Delta P_{Loop} + \Delta P_{SV}$

Referring to the diagram alongside, for the loop flow rate the balancing valve must provide an additional head loss equal to the difference ΔP_{BV} ($\Delta P_{balancing\ valve}$).

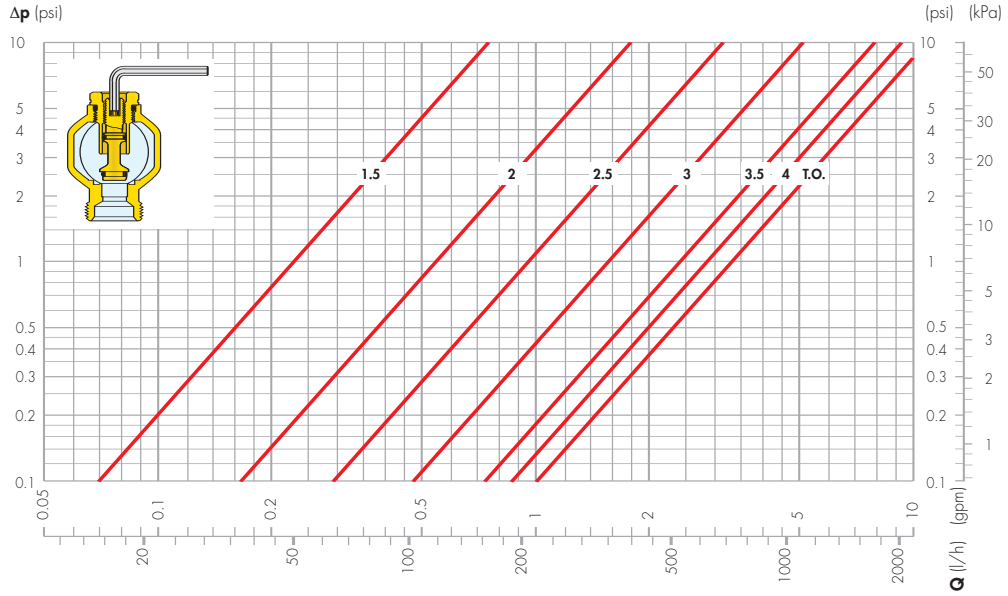


Flow rate adjustment and reading

To balance the circuits start by setting all balancing valves to their wide open positions. Then set the circuit with the greatest flow requirement to its design flow rate (gpm). Adjust the other circuits, reducing to each circuit design flow rate from greatest to least. Remove the flow meter locking cover with the aid of a screwdriver and turn it over onto the flow meter. Adjust the flow rate of the single panels by turning the flow meter body acting on the built-in balancing valve.
The flow rate must be read off the graduated scale, expressed in gpm, printed on the flow meter.
After making all the adjustments, reposition and lock all the knobs in their seat to prevent tampering.



Hydronic characteristics of supply manifold for 663 series only



Adjustment turns	Cv
1.5	0.25
2	0.55
2.5	1.0
3	1.7
3.5	2.5
4	3.0
T.O.	3.2

Cv = flow in gal/min for a pressure loss of 1 psi

SPECIFICATION SUMMARY

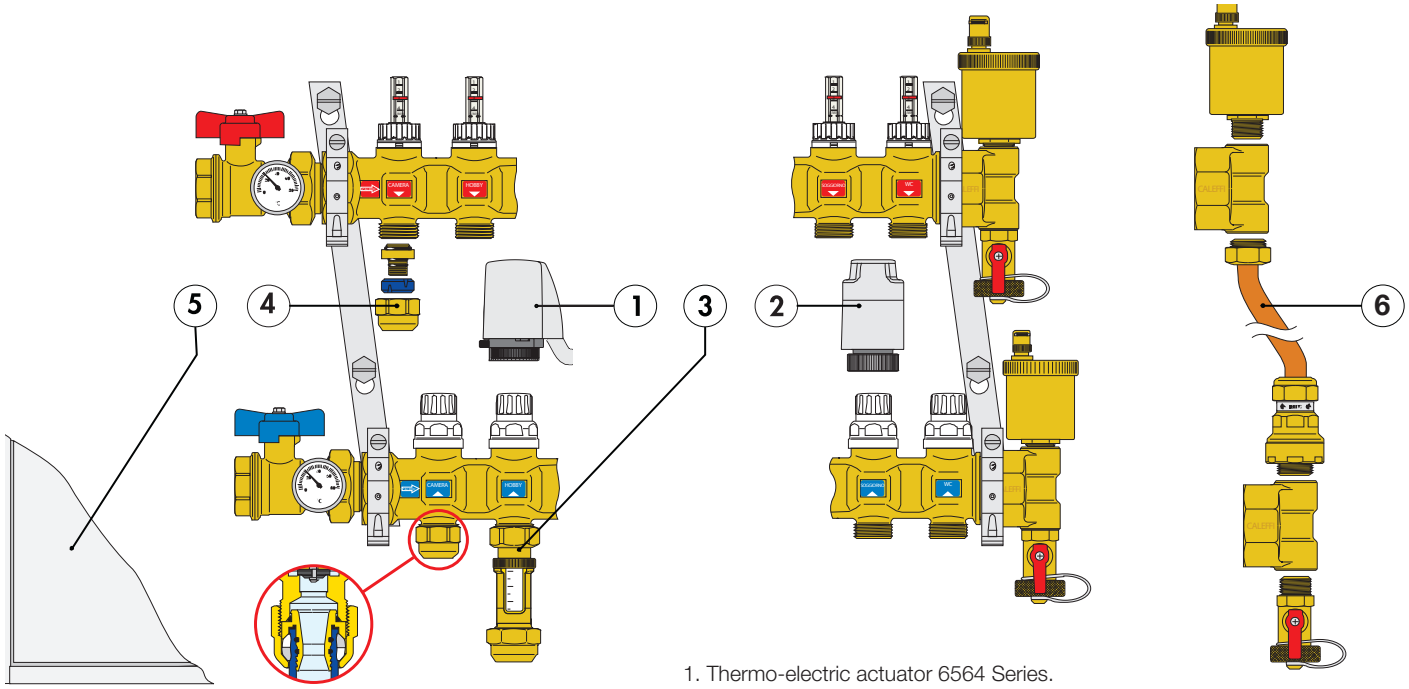
TwistFlow series 668S1

Pre-assembled distribution manifold for radiant panel systems with 3 to 13 outlets. Cast brass body. Peroxid-cured EPDM seals. 1" and 1 1/4" threaded Female connections. 3/4" Male outlet connections. Medium: water, glycol solutions. Maximum percentage of glycol: 50%. Maximum working pressure 150 psi (10 bar). Temperature range 32 to 180°F (0 to 80°C). End fitting maximum discharge pressure 35 psi (2.5 bar).

Consists of:

- Supply manifold complete with sight flow gage with adjustable balancing valves scale from 0–2 gpm;
- Return manifold complete with shut-off valves for use with thermo-electric actuator;
- Pair of end fittings consisting of a fitting with automatic air vent and drain cock;
- Pair of shut-off ball valves complete with port for included dual-scale temperature gauge 30 to 210°F (0 to 100°C);
- Pair of mounting brackets.

Manifold and accessories



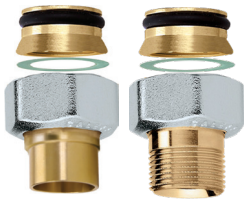
1. Thermo-electric actuator 6564 Series.
2. Thermo-electric actuator with manual open handle, 6563 Series.
3. Flow meter, NA669.
4. Self-adjusting Universal PEX fitting, 680, 682 Series.
5. Inspection wall box, 659 Series.
6. Differential by-pass kit, 668000.

NA669
Flow meter

Brass body, EPDM seals.
Max. working pressure: 150 psi (6 bar)
Max. temperature: 210°F (98°C)
Connection:
3/4" straight male x 3/4" straight female nut

NA669150.....1/4 to 1 GPM, size 3/4"
NA669250.....1/2 to 2 GPM, size 3/4"

NA102/3



Sweat & NPT connection fitting

NA10262.....1/2" sweat, 3/4" straight thread female nut
NA10313.....1/2" NPT male, 3/4" straight thread female nut

(680504A)

680
Universal PEX fittings

Compatible with any ASTM F876 single layer PEX pipe.
Max. working pressure: 150 psi (6 bar)
Working. temperature range for ASTM F876 PEX piping: 40 to 180°F (4 to 80°C)

680507.....5/16" nominal PEX, blue compression ring
680503A.....3/8" nominal PEX, black compression ring
680504A.....1/2" nominal PEX, blue compression ring
680555A.....5/8" nominal PEX, black compression ring
680505A.....3/4" nominal PEX, black compression ring

(682540A)

682
Universal PEX-AL-PEX fittings

Compatible with any ASTM F1281 multilayer PEX-AL-PEX pipe.
Max. working pressure: 150 psi (6 bar)
Working. temperature range for ASTM F1281 PEX-AL-PEX piping: 40 to 200°F (4 to 90°C) with tubing rated 200°F.

682530A.....3/8" nominal PEX-AL-PEX
682540A.....1/2" nominal PEX-AL-PEX
682545A.....5/8" nominal PEX-AL-PEX
682550A.....3/4" nominal PEX-AL-PEX

Off-center differential by-pass assembly with fixed setting code 668000

Function

The distribution circuits of the heating fluid in radiant panel systems may be totally or partially shut off by closing the thermo-electric valves inside the manifolds.
When the flow decreases, the differential pressure inside the circuit may rise to levels that could cause problems with noise, high rates of fluid speed, mechanical erosion and hydronic imbalance of the system itself. The differential by-pass kit for series 663 or 668S1 manifolds maintains the pressure of the supply and return manifold circuits in balance if the flow changes.
The valve can be quickly connected to the series 663 or 668S1 manifolds, reducing overall size to a minimum.

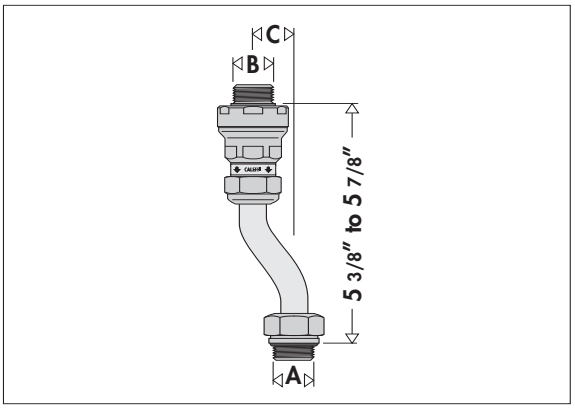
Product range

Code 668000 Off-center differential by-pass assembly with fixed setting ____ Size 1/2" M x 1/2" M

Technical specification

Materials: - body:	brass
- nuts:	brass
- pipe with plate:	copper
- check valve:	PA
- spring:	stainless steel
- seals:	EPDM
- gaskets:	asbestos-free fibre
Medium:	water, glycol solutions
Max. percentage of glycol:	50%
Max. working pressure:	150 psi (10 bar)
Temperature range:	14÷230°F (-10 to 110°C)
Fixed setting pressure:	3.6 psi (2500 mm w.g.)
Connections:	1/2" M x 1/2" M

Dimensions



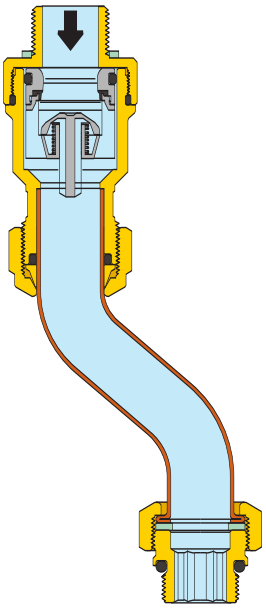
Code	A	B	C	Weight (lb)
668000	1/2"	1/2"	1 3/8"	0.74

Operating principle

The by-bass valve contains a check valve connected to a contact spring. When the fixed setting pressure is reached, the valve plug gradually opens, recirculating the flow in proportion to the closing of the thermo-electric valves and maintaining a constant differential pressure in the manifold circuit.

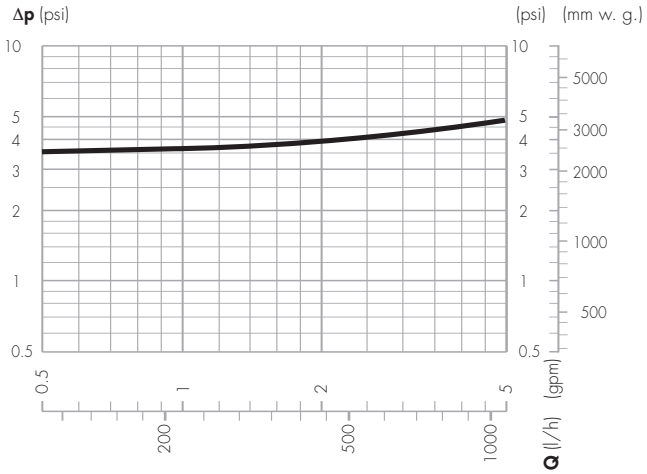
Construction details

The differential by-pass assemby features a fixed setting that cannot be changed because it does not contain accessible adjustment parts. The small, compact size and offset connections make this kit particularly easy to mount after installing thermo-electric valves on the manifold. It does not require a larger or deeper zone box than those used for normal manifolds.



Hydronic characteristics

By-pass differential pressure: 3.6 psi (2500 mm w.g.)



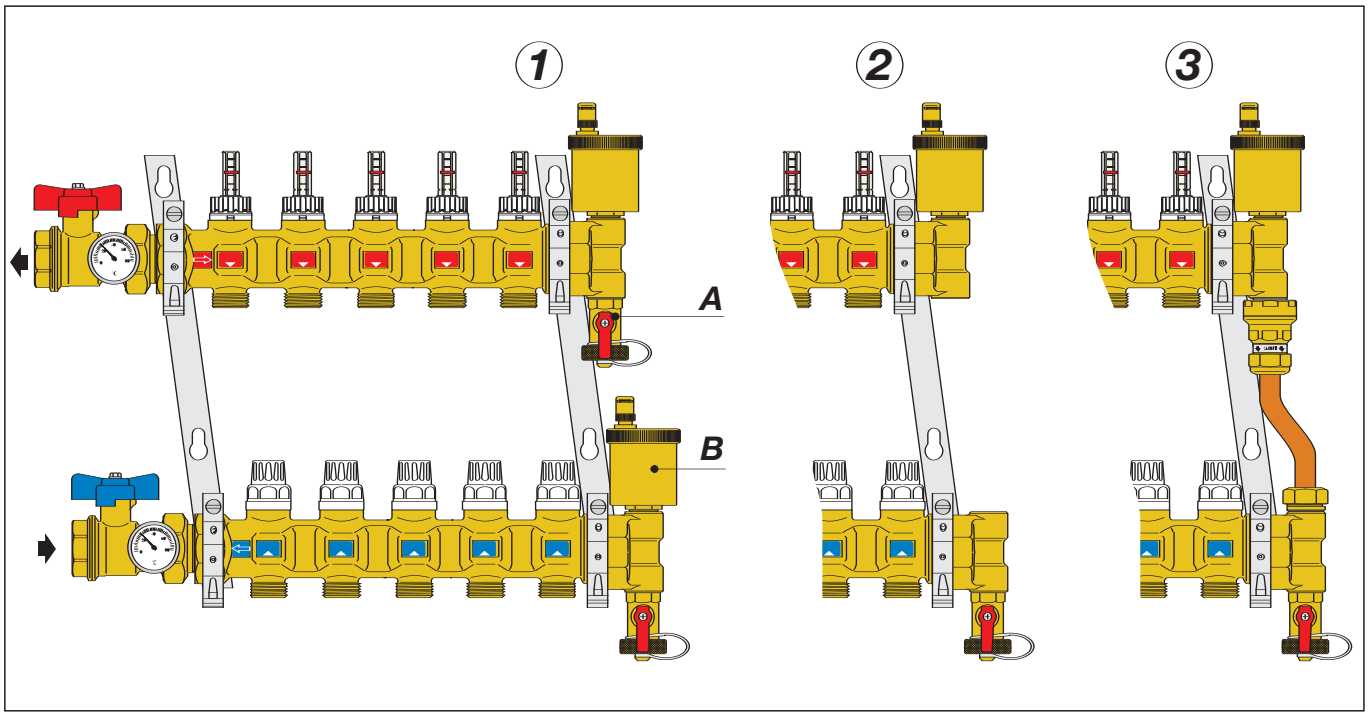
Installation of the differential by-pass valve on series 663 and 668S1 manifolds

The differential by-pass on series 663 or 668S1 manifolds is mounted by following the procedure below:

1) Remove the drain cock (A) on the upper manifold.

2) Remove the automatic air vent (B) on the lower manifold.

3) Install the differential by-pass (code 668000) on the upper manifold and the lower manifold.



6563

TwisTop™ thermo-electric actuator.
Normally closed.
Twist the top to manually open.
With manual open handle.
With green open indicator.
Initial current draw: ≤ 250 mA.
Power consumption: 3 W.
Rating of micro-swich contacts: 5 A (24 V)
31.5” wire lead connection.
US patent 7,617,989 B2.

Code	Description
656344	24 V AC/DC
656354	24 V AC/DC with micro-switch

6564

Thermo-electric actuator.
Normally closed.
Low current draw.
Pop-up feaure.
Initial current draw: ≤ 250 mA.
Power consumption: 3 W.
Rating of micro-swich contacts: 5 A (24 V)
31.5” wire lead connection.

Code	Description
656404	24 V AC/DC
656414	24 V AC/DC with micro-switch

Using the thermo-electric actuator

1. Normal operation of the control in automatic mode.

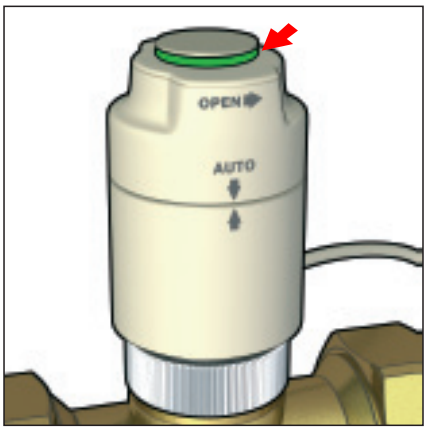
In automatic mode, the thermo-electric actuator opens the valve when it is supplied with electricity.
The opening is displayed by the central disc raising on the top of the knob and by the green circular indicator too.

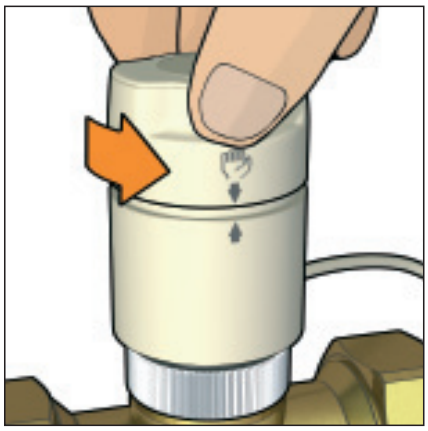
2. Simply twist to manually open actuator (and activate microswitch on 656354)

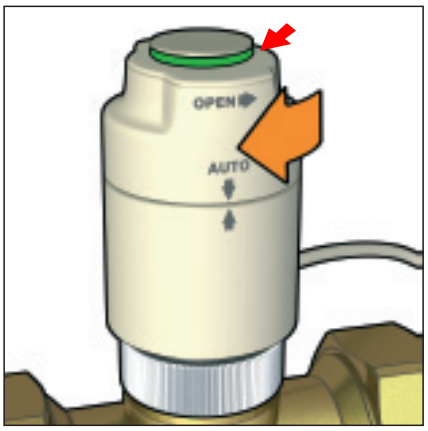
Turn the knob on the top of the control anticlockwise until its limit stop trips and the arrow symbols and ✋ overlap.
To close the valve manually and restore automatic operation of the device, turn the knob clockwise to “AUTO”.
Note: On the series equipped with an auxiliary microswitch, in the manual opening position the micro contact is closed.

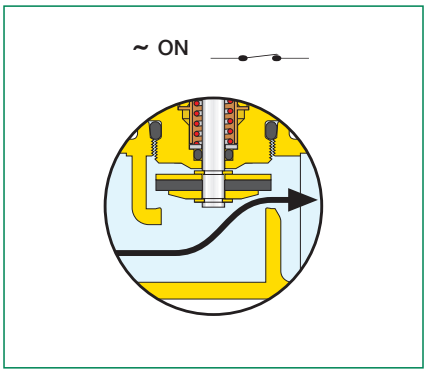
3. When power is applied it returns to Auto position.

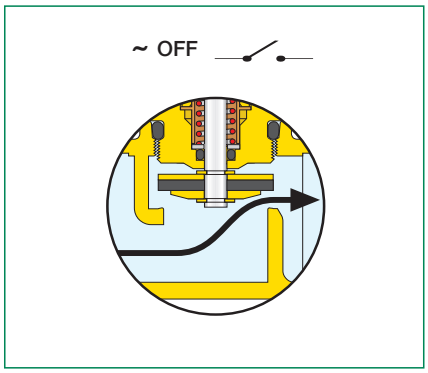
When the control in the manual position is powered, an internal mechanism enables automatic release from this position and a return to normal operation.
A few seconds after powering up, the knob will automatically return to the “AUTO” position and the opening indicator will stay on the open position.

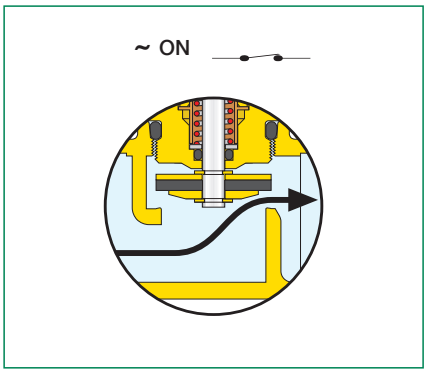










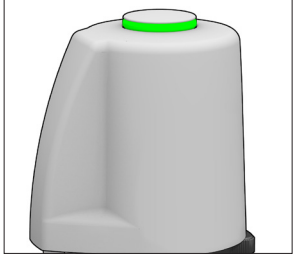


Using the 6564 series actuator

Opening/closing indicator

The 656404 and 656414 thermo-electric actuator, when electrically powered, opens the valve. The opening is displayed by the central disc raising on the top of the knob and the green circular indicator. The opening/closing indicator is especially useful during testing to check for proper operation without having to activate the system.

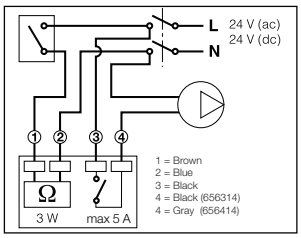
Open



Closed

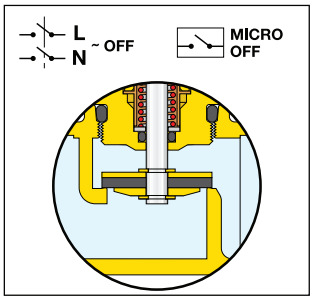
Wiring diagram

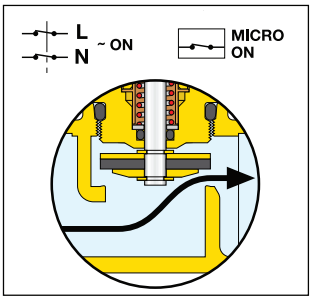
Wiring diagram with auxiliary micro-switch for code 656354 and 656414 actuators:



The auxiliary micro-switch can be used to turn off the pump when there is no call for heat and the valves are closed. If the pump power consumption exceeds the contact rating of 5 A, a relay must be used.

The auxiliary micro-switch shuts off at an average actuator opening value of 80%.





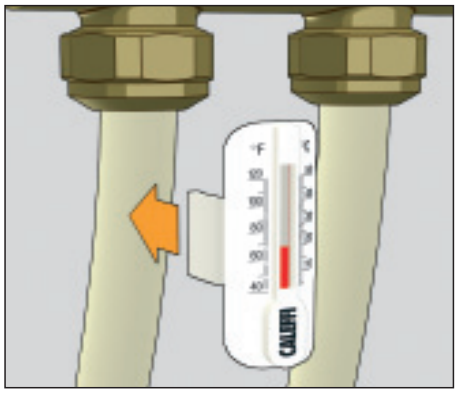
Reference documentation for 6564 series: Tech brochure 01198 NA.

Thermometer

675 Snap-on thermometer

Snap-on thermometer directly to PEX or PEX-AL-PEX piping.

Material: - body: PA6GF
Thermometer fluid: alcohol
Thermometer scale: 40 to 120°F (5 to 50°C)
Max. working temperature: 140°F (60°C)
Range of use of pipe outside (Øe) diam.: from 3/8 to 5/8 inch (15 to 18 mm)
Conducting paste supplied in package



Code

675900A	3/8", 1/2" & 5/8" PEX or PEX-AL-PEX

688

Temperature gauge with well pocket fitting for inserting in connection on supply and return shut-off ball valves.

Working temperature range: 30–210°F
Face dial diameter: 2”

Code

688003A	Gauge with pocket well

End fitting

386

Cap to plug unused manifold outlets.

Code

386500	3/4”

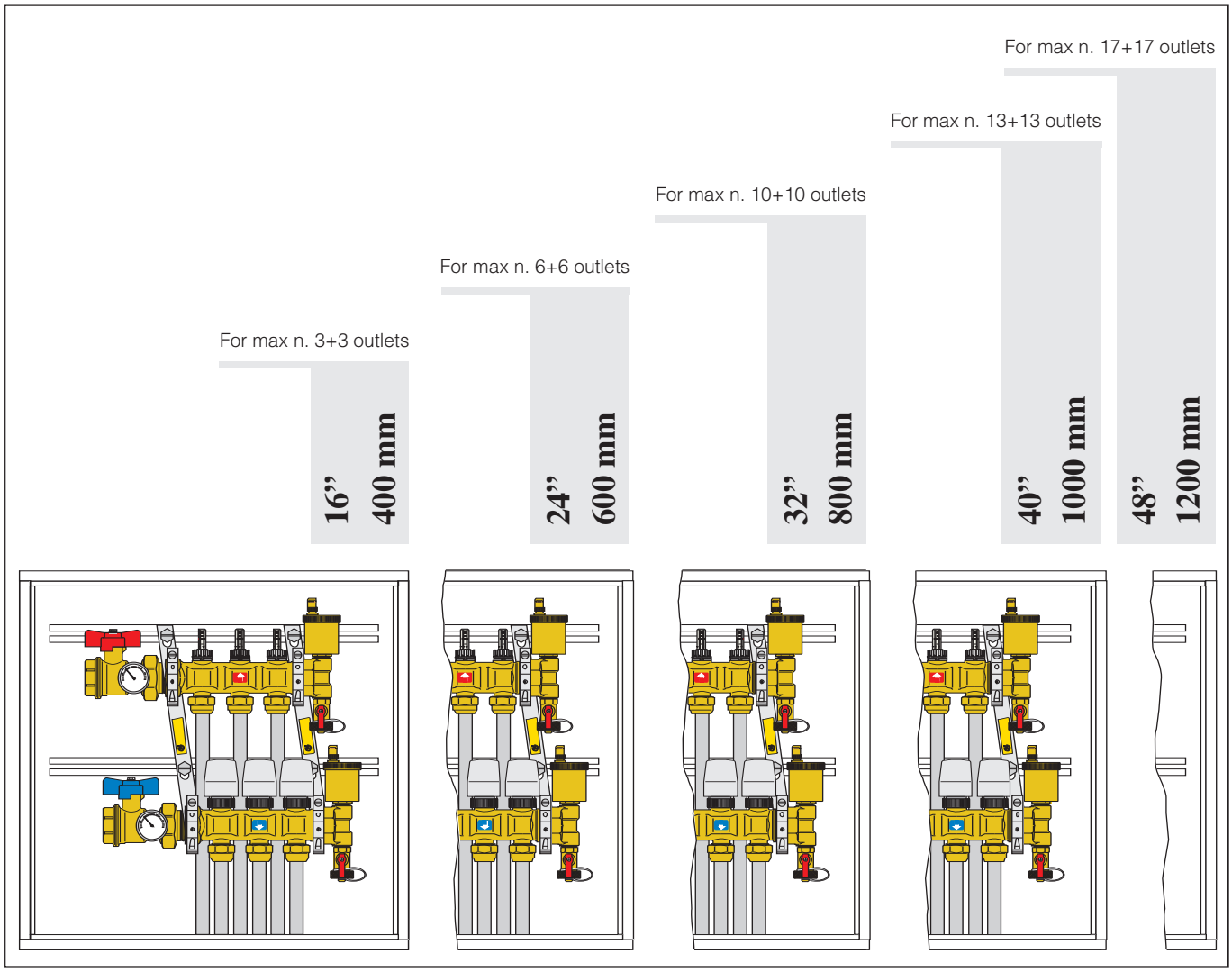
Cabinet

659

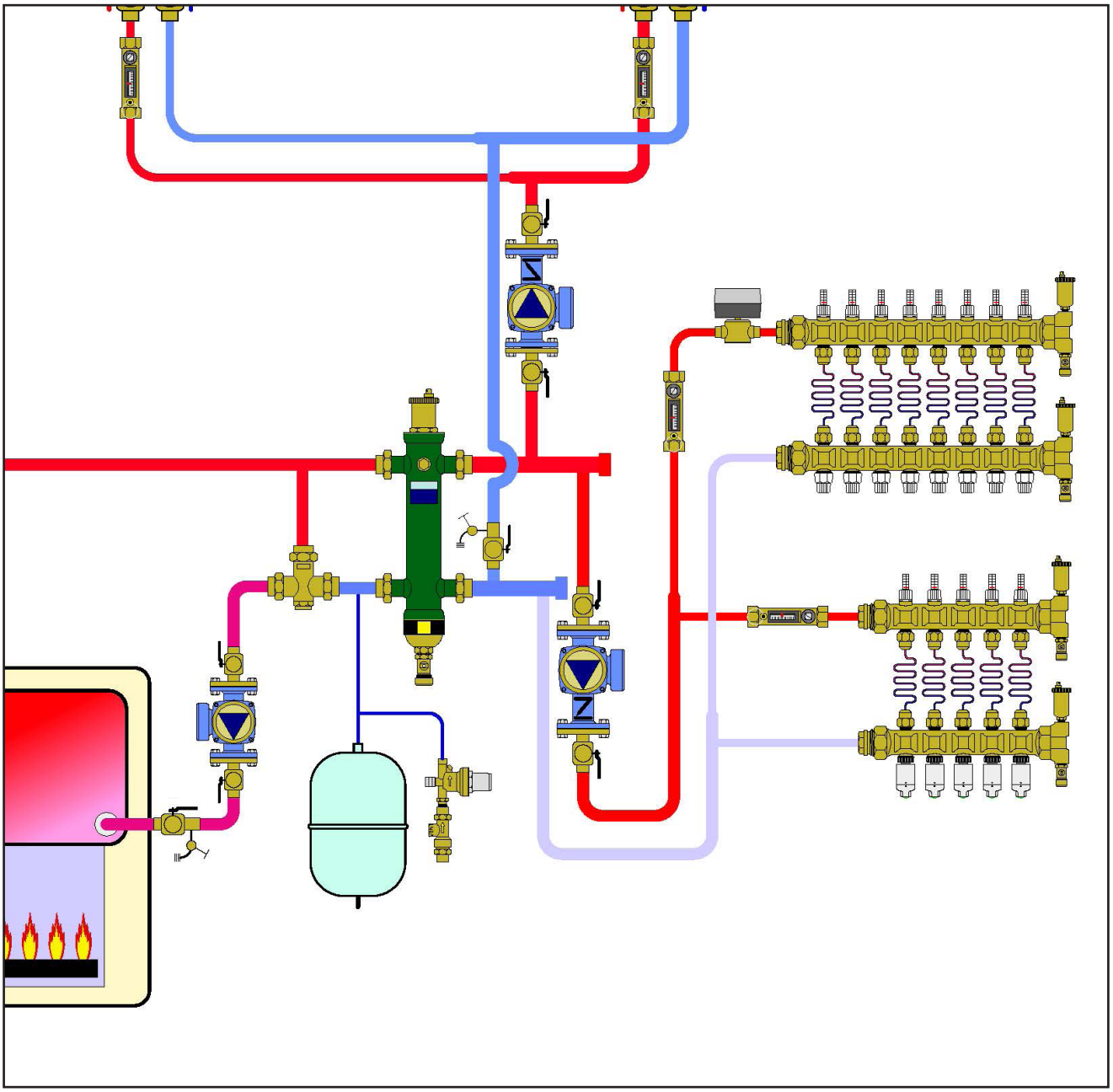
Housing wall box for manifold systems.
With push-fit clamp.
In painted 18 gage sheet steel.
Adjustable depth from 4-3/8" to 5-1/2" (110 to 140 mm).
For manifolds series 668S1.

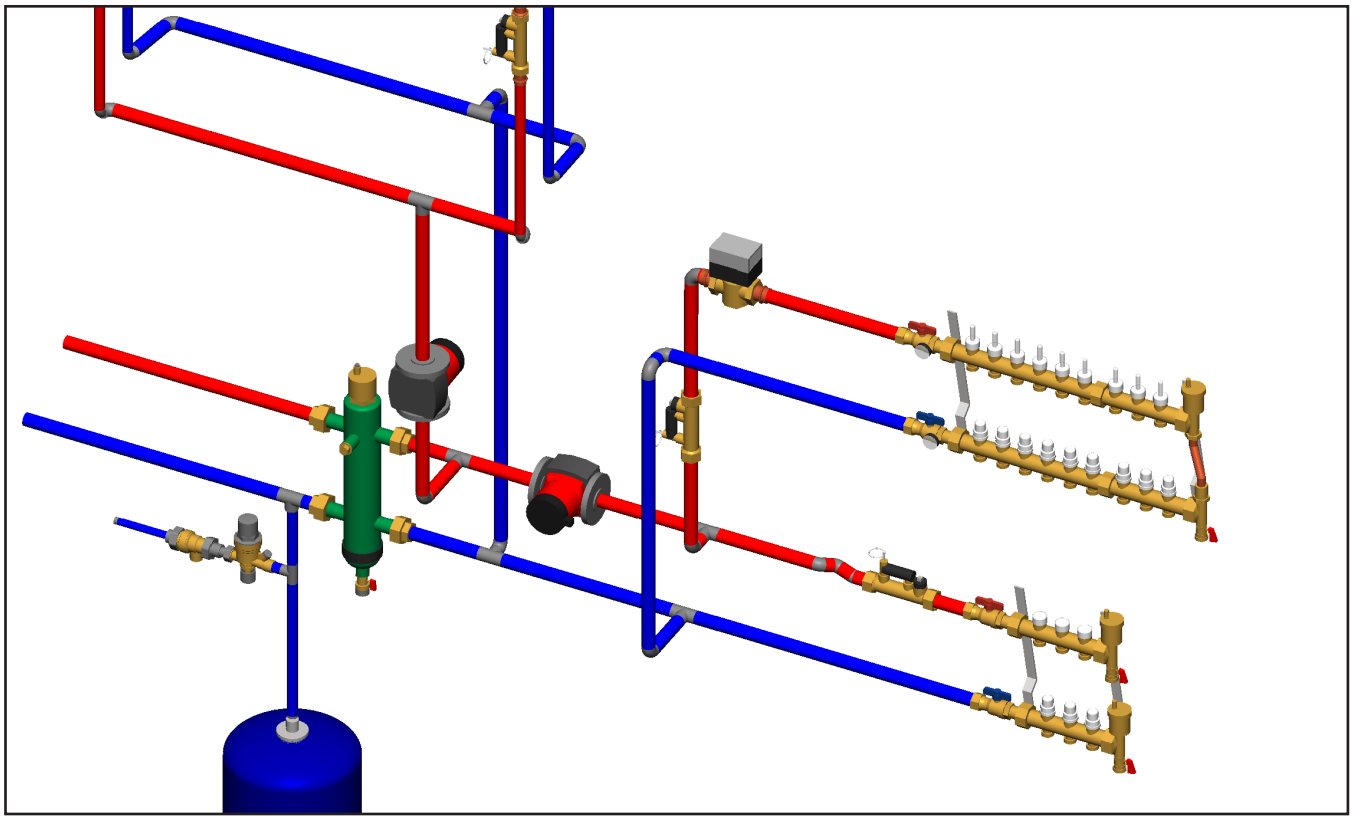
Code	in (h x w x d)	mm (h x w x d)	Max number of outlets
659044	20" x 16" x 4 3/8" to 5 1/2"	500 x 400 x 110 to 140	3
659064	20" x 24" x 4 3/8" to 5 1/2"	500 x 600 x 110 to 140	6
659084	20" x 32" x 4 3/8" to 5 1/2"	500 x 800 x 110 to 140	10
659104	20" x 40" x 4 3/8" to 5 1/2"	500 x 1000 x 110 to 140	13
659124	20" x 48" x 4 3/8" to 5 1/2"	500 x 1200 x 110 to 140	17

659 series housing wall box dimension choice in accordance with the number of outlets



Application diagram





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