HVAC Products

PCS

# Technical submission

**Type of Product** X4 series compact terminal valve assembly with 40mm centre to centre by-pass and EVOPICV axial PICV.


*This technical submittal contains information that to the best of our knowledge correct at the time of publishing. Fratelli Pettinaroli reserves the right to change the specification of our assemblies at any time. Errors and omissions excepted.*

STE0207 - February 2016

FRATELLI PETTINAROLI S.p.A.
CLIMATE SYSTEMS TECHNOLOGY

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# DESIGN AND SELECTION

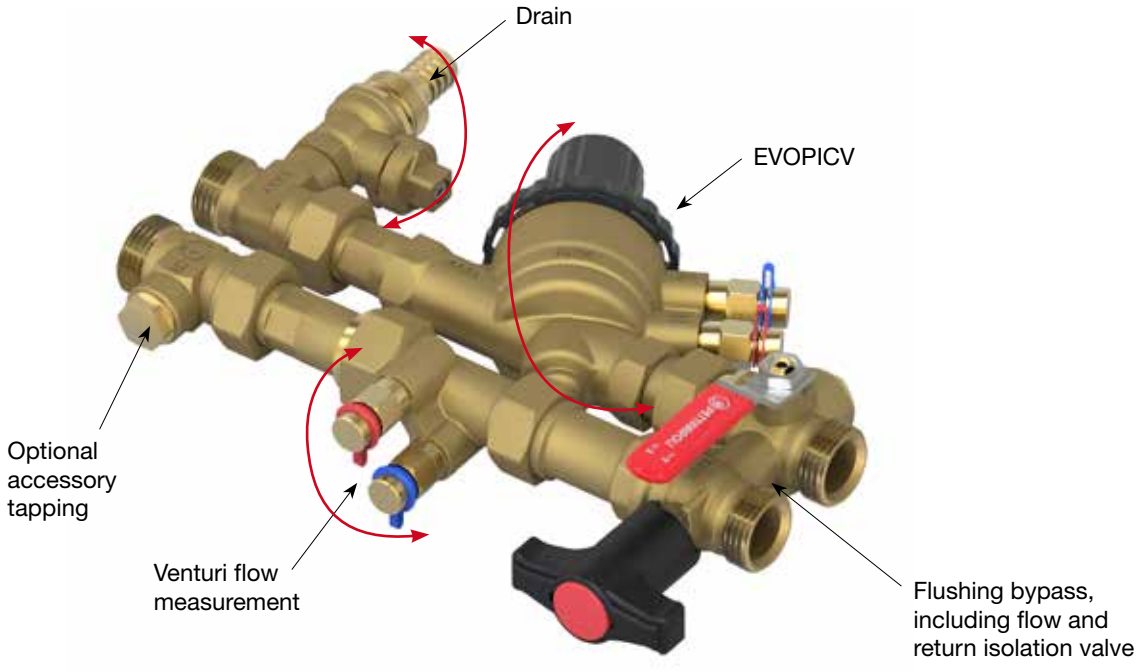
## Introduction

The X4 range of terminal valve assemblies has been designed to include all of the valves and connections for controlling and maintaining a fan coil unit or other hydronic terminal unit. These functions are included in a PCS kit that is designed to be assembled and mounted on to the terminal unit by the terminal unit manufacturer over an extended condensate drip tray.

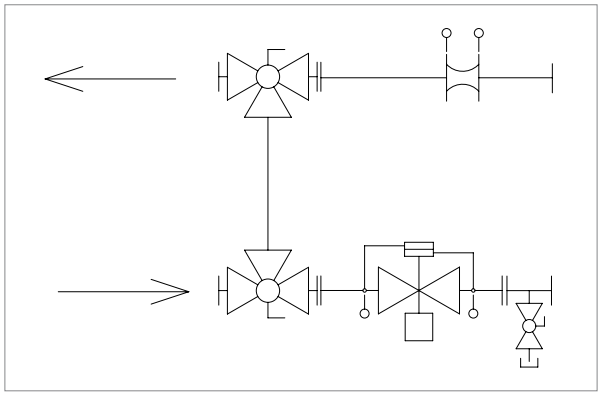
*Example of fully featured X4*

## Function

The X4 kit includes an EVOPICV axial pressure independent control valve to maintain design flow rates and provide modulating temperature control. Also included in the assembly is a venturi flow measurement device for flow verification and on both the inlet and outlet of the X4 kit isolation valves are included. A flushing by-pass and blow down valve are incorporated. This allows the pipe work up to and away from the 'valve set' to be flushed and the Fan Coil unit to be back flushed.
The X4 kit provides maximum flexibility as it can be customized in a number of different configurations. In addition, each specific configuration can be further adjusted by rotating drain, PICV and venturi to the most suitable position.




*Isometric view of the X4 without end connections (horizontal configuration)*



*Schematic Representation*

The valve assembly is offered in four main configurations to suit most terminal designs, and it is offered with a wide range of end connections.

## Configurations

### *Horizontal, left and right.*

For terminal units where the coil connection are mounted either in a parallel orientation to the floor plate or at 45° to the floor plate the Horizontal configuration is the most appropriate. The following drawings show how these units are configured.

*X4 series, physical configurations. Horizontal.*

### *Left and right handed*

For terminal units where the coil connection are mounted perpendicularly to the floor plate then typically left and right handed units will be required. The following drawings show how these units are configured.

*X4 series, physical configurations. From left to right – horizontal, left handed, right handed*

## Selection

Selection is performed on design flow rate. There are several variations of the EVOPICV and venturi; the selection table shows the valve and venturi selections based on flow rate.

Due to the fact that the pressure independent control valve controls the flow rate, irrespective of fluctuations in available differential pressure or the head loss of the coil, the only factor that needs to be considered other than flow rate is that there is enough differential pressure to meet the start- up pressure of the valve.

| Base Code | PICV Size | PICV Type | Suggested flow rates | | Extended range flow rates * | | Venturi size | Kvs | PICV Min ΔP | Assy' Min ΔP |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min [l/h] | Max [l/h] | Min [l/h] | Max [l/h] | [mm] | | [kPa] | [kPa] |
| **X4B_ _3** | 1/2" | 91VL | 50 | 135 | 45 | 150 | 3 | 0.32 | 20 | (20) 25 |
| **X4X_ _3** | 1/2" | 91XVL | 50 | 135 | 45 | 150 | 3 | 0.32 | 20 | (20) 25 |
| **X4B_ _4** | 1/2" | 91L | 100 | 300 | 60 | 600 | 4.25 | 0.70 | 25 | (20) 28 |
| **X4B_ _4** | 1/2" | 91XL | 100 | 300 | 60 | 600 | 4.25 | 0.70 | 25 | (20) 28 |
| **X4B_ _6** | 1/2" | 91L | 200 | 540 | 60 | 600 | 6 | 1.38 | 25 | (30) 40 |
| **X4X_ _6** | 1/2" | 91XL | 200 | 540 | 60 | 600 | 6 | 1.38 | 25 | (30) 40 |
| **X4B_ _7** | 1/2" | 91H | 320 | 700 | 80 | 780 | 7.5 | 2.20 | 35 | (40) 40 |
| **X4X_ _9** | 1/2" | 91XH | 500 | 810 | 90 | 900 | 9 | 3.17 | 30 | (40) 40 |
| **X4B_ _9** | 3/4" | 91L | 500 | 900 | 100 | 1000 | 9 | 3.17 | 30 | (40) 40 |
| **X4B_ _0** | 3/4" | 91H | 600 | 1350 | 150 | 1500 | 10.5 | 4.10 | 35 | (40) 50 |

*Further combinations that Fratelli Pettinaroli can provide are summarized by the base code legend below. In order to choose the suitable PICV and Venturi, see the table 1 on page 7*

*** WARNING: when using the product at flow rates outside recommended range not all features might perform properly.**

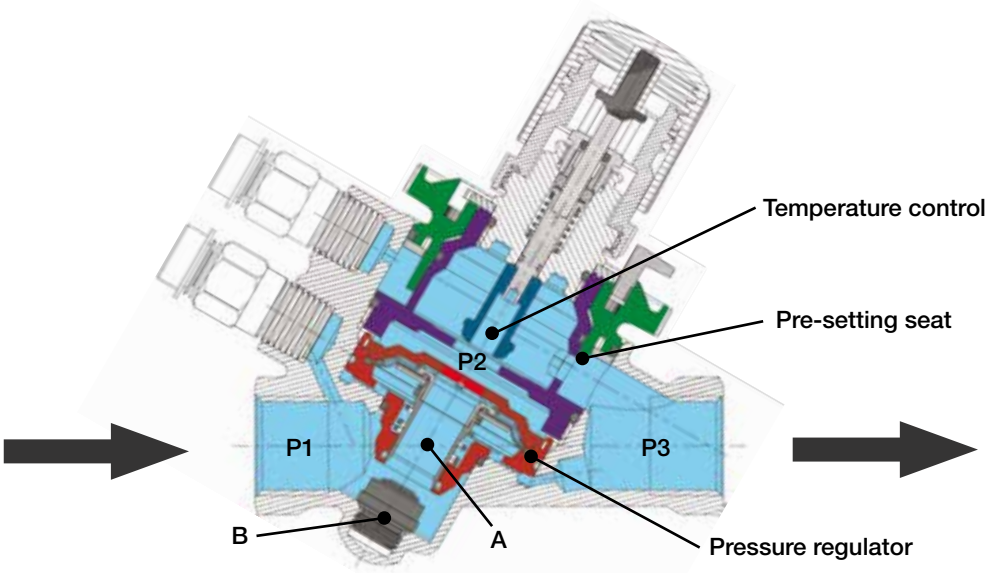
| X4-X-Y-Z-N | | | | |
|---|---|---|---|---|
| **X4** | **X** | **Y** | **Z** | **N** |
| | | | | 3 mm = **3**<br>4.25 mm = **4**<br>6 mm = **6**<br>7.5 mm = **7**<br>9 mm = **9**<br>10.5 mm = **0** |
| | | | | Right = **R**<br>Left = **L**<br>Horizontal right = **H**<br>Horizontal left = **K** |
| | | | | Red = **R**<br>Blue = **B**<br>Neutral = **G** |
| | | | | 91= **B**<br>91X = **X** |
| | | | | **Kit type** |

The letters in the part number indicate that further selection can be made, for configuration and service, however this does not affect the selection parameters.

Suggested flow rate indicates the maximum design flow rates that under normal conditions (at design time) the X4 is selected to serve.
The extended flow rate range indicates the maximum and minimum range of design flow rates that the X4 can be used to control and measure. Understanding the flow rate range allows the quick selection and modification should the design flow rate change post installation. Flows in this extended range may generate signal pressure losses across the venturi of between 0.5 kPa and 15kPa.
PICV Min ΔP is the minimum differential pressure required to provide pressure independent flow control for each PICV selection, where the PICV is 100% open. This value reduces as the valve is regulated.
Assembly Min ΔP is the pressure loss through the X4 with the PICV valve set to provide the maximum extended range flow rate and allowing for the minimum differential pressure requirement of the PICV to be met. This value can be used during pump selection. The value in brackets is the total pressure loss at the selection flow rate.

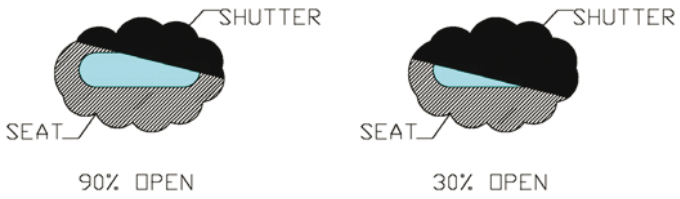
## Flow rate control

The internal pressure regulator (shown in red below) maintains a constant differential pressure across the seats (P2 –P3 in the diagram below) in the EVOPICV. As flow rate is proportional to the product of differential pressure and area of passage, holding the differential pressure constant means that flow rate is only determined by the area of passage. The design flow rate is set using the black hand wheel on the EVOPICV valve. Moving this hand wheel reduces the area of passage through the pre- setting seat of the EVOPICV valve.




*Cross Sectional view of the EVOPICV*

The hand wheel is graduated in percentage of the maximum flow through the valve. Upon receipt of the required design flow rates Fratelli Pettinaroli will return a schedule of valve selections along with the pre-set positions.




*Indication of how the Pre-Setting Seat Operates*

## Temperature control

The EVOPICV also includes an oblique type globe valve for temperature control purposes. This globe valve is capable of being controlled by a wide range of actuators, including TRV actuators, thermo- electric actuators and motorised actuators.

### *Authority*

The authority (n) of a valve can be calculated from the pressure drop across that valve compared with the local system. In this case written as

$$n = \Delta P_v / \Delta P_{sys}$$

In the case of a pressure independent control valve the differential pressure across the control valve is controlled to the same value regardless of whether the valve is fully open, closed or at part load. This means that a pressure independent control valve has an authority of 1.

*For more information on designing PICV systems please see Fratelli Pettinaroli' Definitive guide to Pressure Independent Control Valves.*

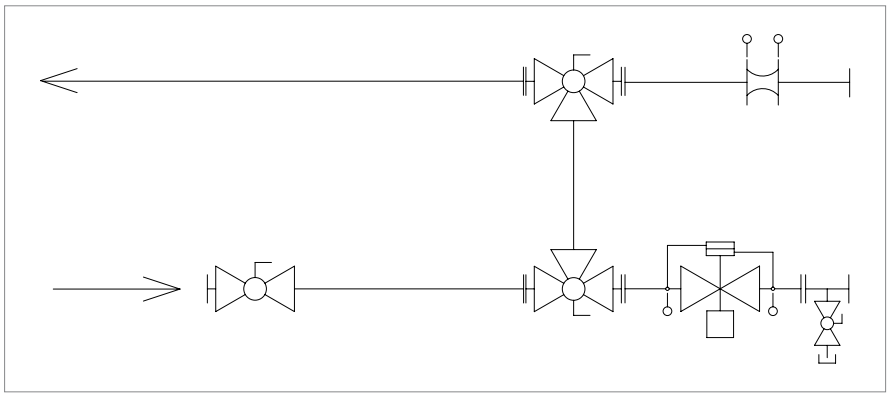
## Additional options

The X4 valve assembly is designed as standard to cover 90% of our customers' requirements with one standard valve assembly. In order to meet the most common variations  at the lowest cost several additional options are available.

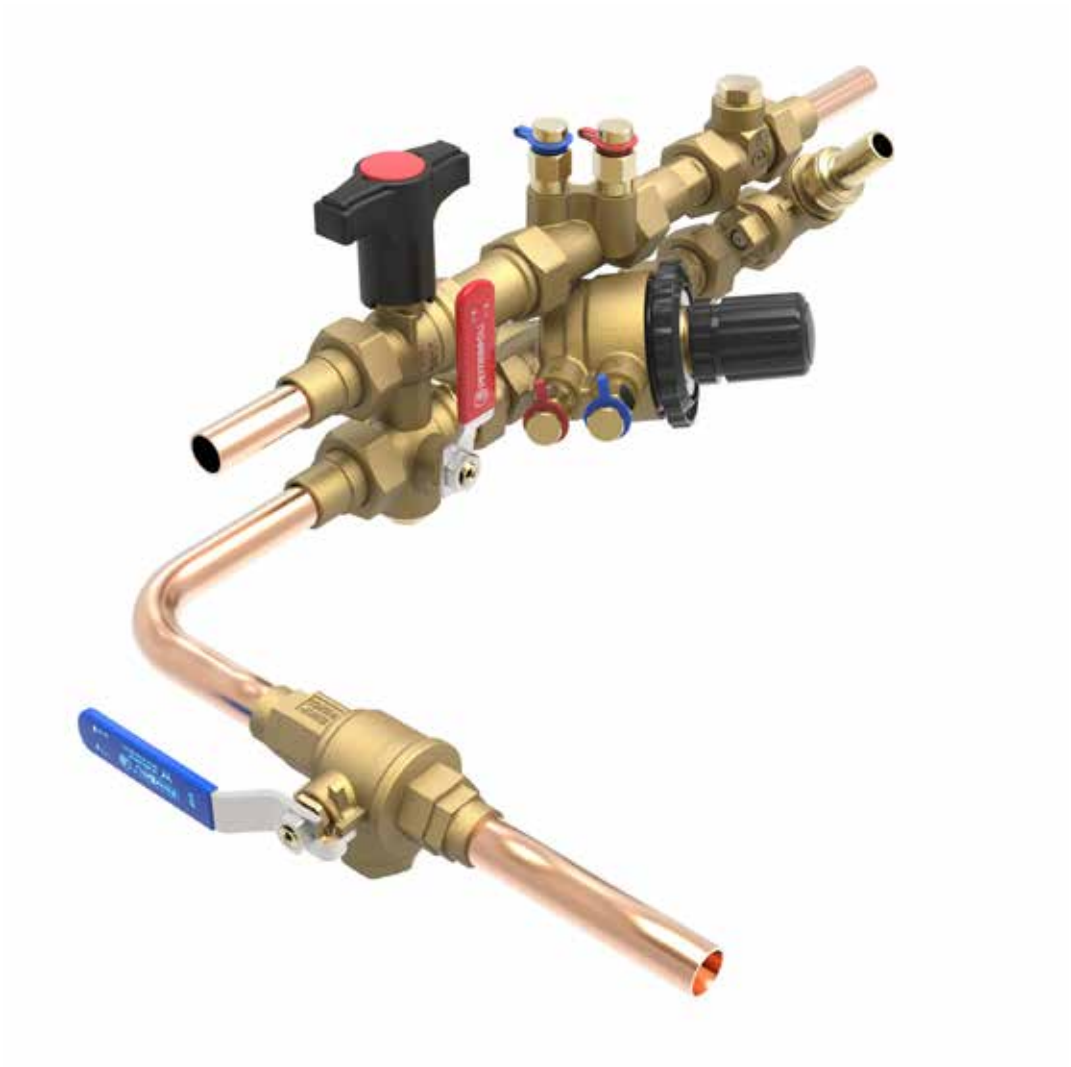
### *Strainers*

As standard, a strainer is not included in the X4 assembly, we recommend that a large bore strainer such as our Filterball be fitted to the beginning of each section branch pipework and at transitions between clean pipework systems (such as copper, press-fit steel and plastic) and black iron pipework.

If a strainer is required for each terminal then a Filterball combined isolation valve and strainer will be offered for mounting directly upstream of the X4 in the flow pipework. The Filterball is compact, and mounting it in this position means that emptying the strainer basket is much easier than if the strainer was mounted against an extended drip tray, or very close to the coil.



*Schematic representation*



*X4with additional strainer, pipe work by others*

### *4 Port control valves (not supplied by Fratelli Pettinaroli S.p.a.)*

On PICV systems, 4 port (3 port control with built in by-pass connection) control valves are commonly used to provide a by-pass path to maintain a minimum flow at the ends of branches. This is in order provide protection against minimum pump turn down and a circulation path to keep water treatment chemicals circulating.

*4 Port Fitting Kit*

A 4 port valve can be added to any X4 by ordering a 4 port fitting kit, this can then either be bolted on directly by the customer or fitted and tested at Fratelli Pettinaroli' Works (for an additional charge).


*X4 with 4 port fitting kit mounted*

When a 4 port valve is installed on the X4, the EVOPICV is used to provide pressure independent flow limiting only; the temperature control function will be achieved by mounting the actuator on the 4 port control valve.

### *Option port*

The option port is usually blanked off, however by request a number of accessories may be fitted and these include manual air vent, automatic air vent and second flushing drain.

## Labelling and identification

As standard each X4 is tagged and labelled in such a way that it is uniquely intended for a particular terminal unit. The labelling is also intended to make the flow and selection criteria clear when to technician is working on it.

### *Venturi colour code*

The venturi insert fitted will be identified by a coloured band on the high pressure test point. This is in addition to the valve tag and body mark. This all gives a quick guide to venturi insert and control valve selection.

| Venturi size | Colour |
|---|---|
| **3 mm** | **WHITE** |
| **4.25 mm** | **GREEN** |
| **6 mm** | **ORANGE** |
| **7.5 mm** | **BLUE** |
| **9 mm** | **YELLOW** |
| **10.5 mm** | **RED** |

### *Serial code sticker*

Each X4 has a sticker detailing its unique serial number. This number can be used by Fratelli Pettinaroli to trace back the valve and venturi selection as dispatched; the serial number is also logged against the leak test results.


### *PICV body marking*

If all other markings have been removed, the size of PICV fitted can be identified by the markings on the setting hand wheel and chrome disk on the head work.

| Valve type | Part Code on Hand Wheel | Chrome Disc Marking | Venturi Size |
|---|---|---|---|
| **91VL** | 91VL ½" 150 l/hr | 150 l/hr | 3 mm |
| **91XVL** | 91XVL ½" 150 l/hr | 150 l/hr | 3 mm |
| **91L** | 91 L ½" 600 l/hr | 600 l/hr | 4.25 mm or 6 mm |
| **91XL** | 91 XL ½" 600 l/hr | 600 l/hr | 4.25 mm or 6 mm |
| **91H** | 91 H ½" 780 l/hr | 780 l/hr | 7.5 mm |
| **91XH** | 91 XH ½" 900 l/hr | 900 l/hr | 9 mm |
| **91L** | 91 L ¾" 1000 l/hr | 1000 l/hr | 9 mm |
| **91H** | 91 H ¾" 1500 l/hr | 1500 l/hr | 10.5 mm |

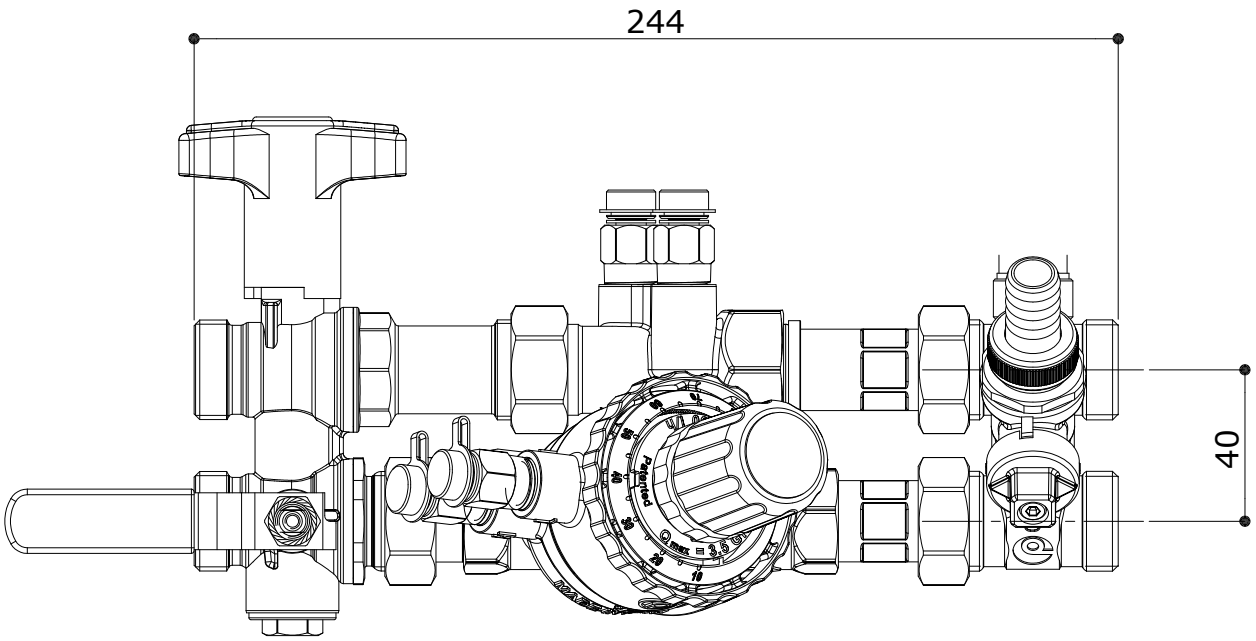
*Table 1*

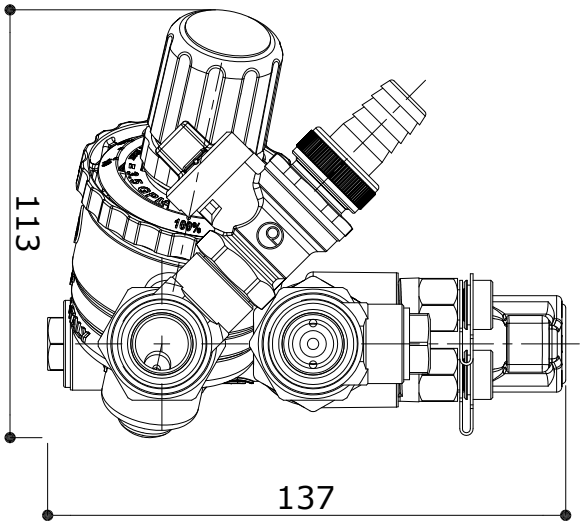
## Testing

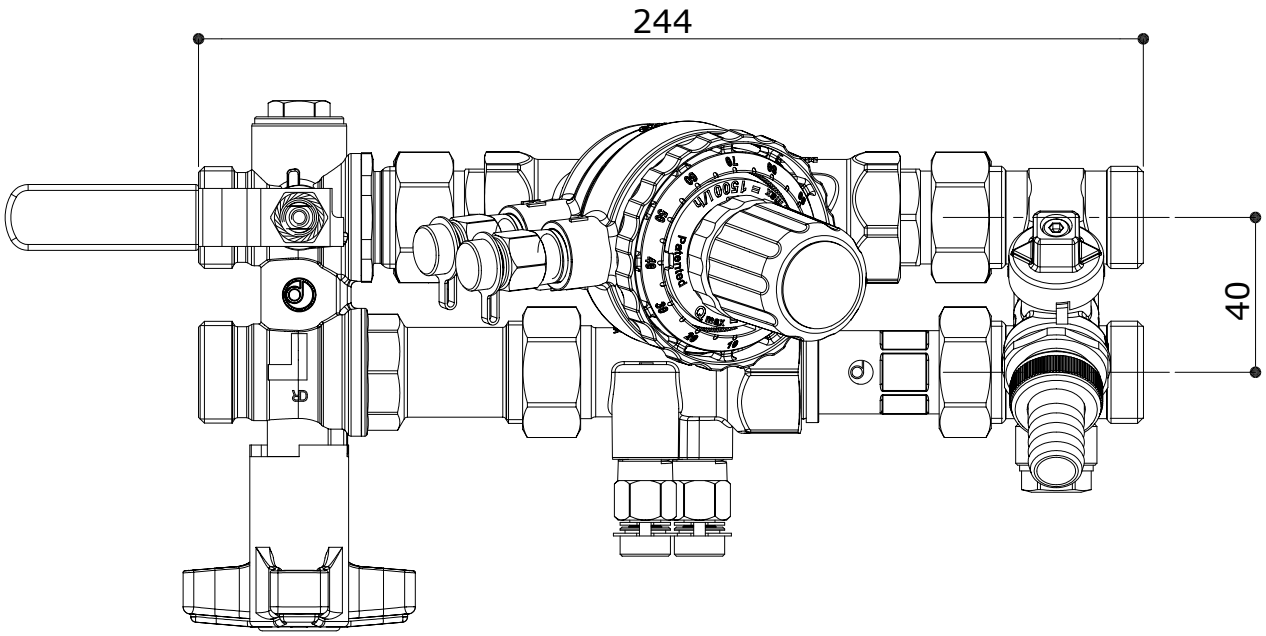
Each valve set is preliminary tested by means of a calibrated stamp in order to check the Venturi hole size; if this test is succeed, the valve set is leak tested by means of air pressure decay using a fill pressure of 4 bar, total test time including filling, stabilisation, and test of 45 seconds against with a maximum acceptable pressure drop of 0.1kPa

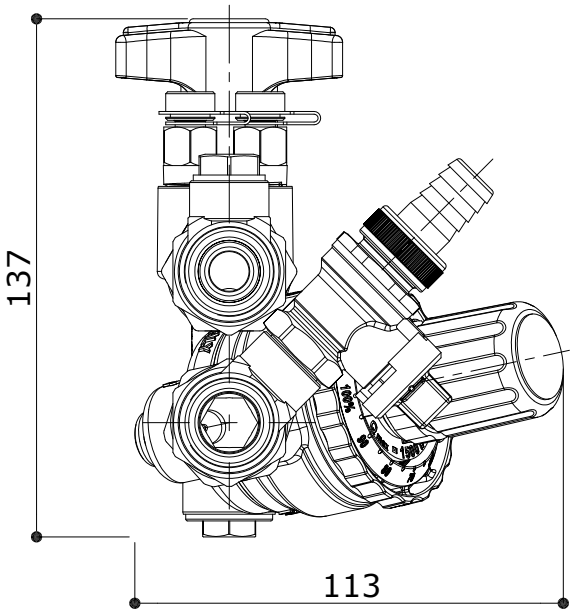
On successful completion of this test the X4 is labelled with the serial code sticker. The test results including test pressure and serial number are logged and traceable.

# DRAWINGS





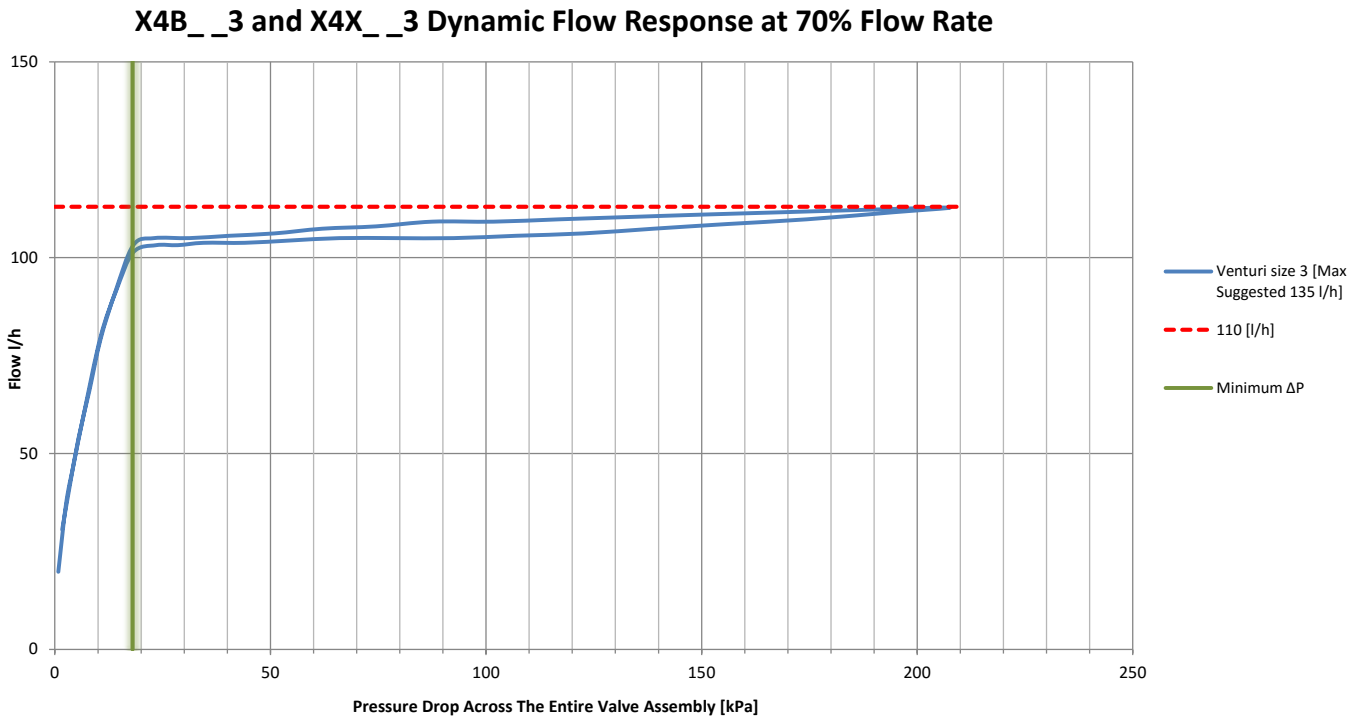

## DATA

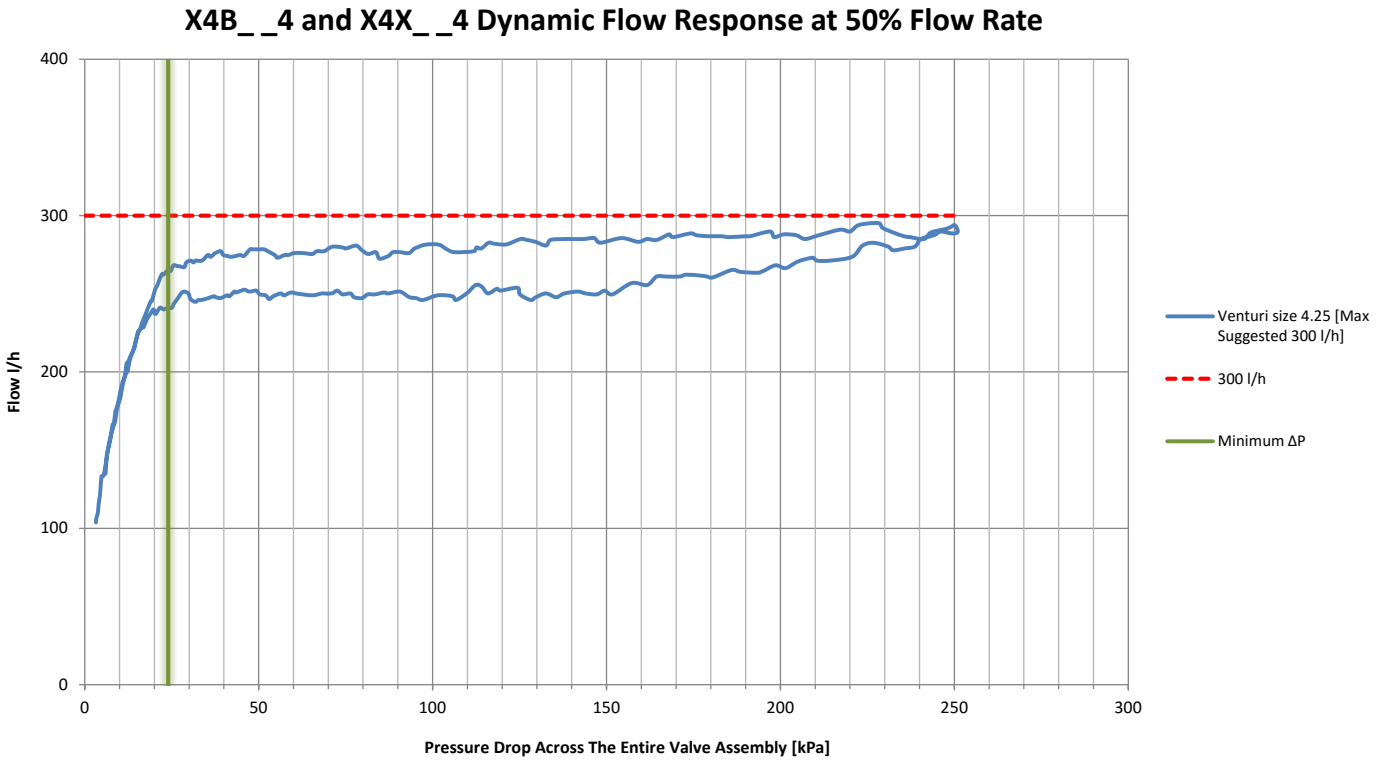
| Characteristic | |
|---|---|
| **Pressure rating** | PN25 |
| **Flow rate range** | 0.013 – 0.42 l/s dependent on valve selection |
| **Working temperature range** | 0 – 100° |
| **Working differential pressure range** | 25 – 600kPa minimum depends on valve and setting |
| **Flow control accuracy (linearity and hysteresis)** | ±10% across working DP range at 100% flow |
| **Control valve characteristic** | Equal percentage depends on actuator |
| **Control valve leakage rate to IEC 60534-4** | Class IV |
| **KV - Flushing bypass (bypass mode)** | 2.1 |

# PERFORMANCE CHARTS

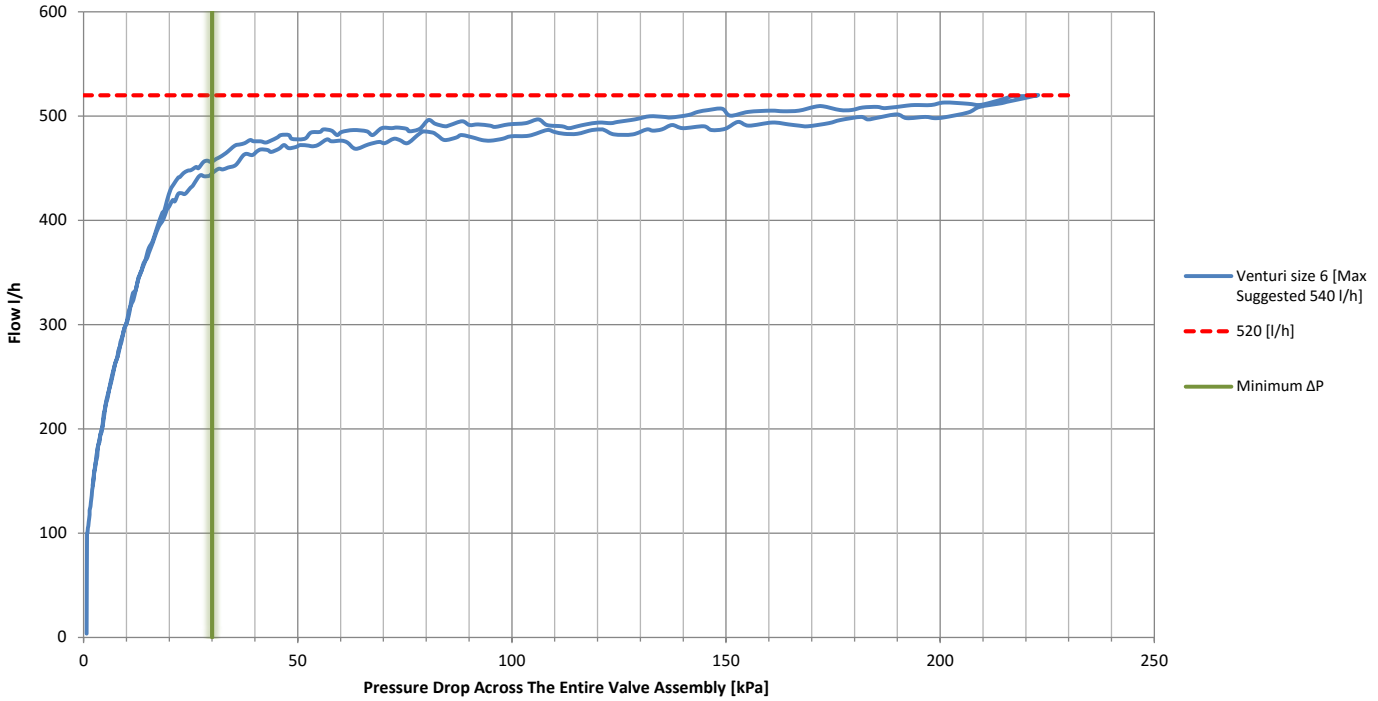
## Dynamic Flow Data

The dynamic flow charts presented below indicate the flow response in l/s for a particular valve setting with varying differential pressure. This allows the performance of the valve to be evaluated and the start-up pressure (the differential at which the valve starts to control the flow rate) to be observed. The charts below show the pressure loss across the entire X4 assembly; measurements were taken at the inlet and outlet connection.

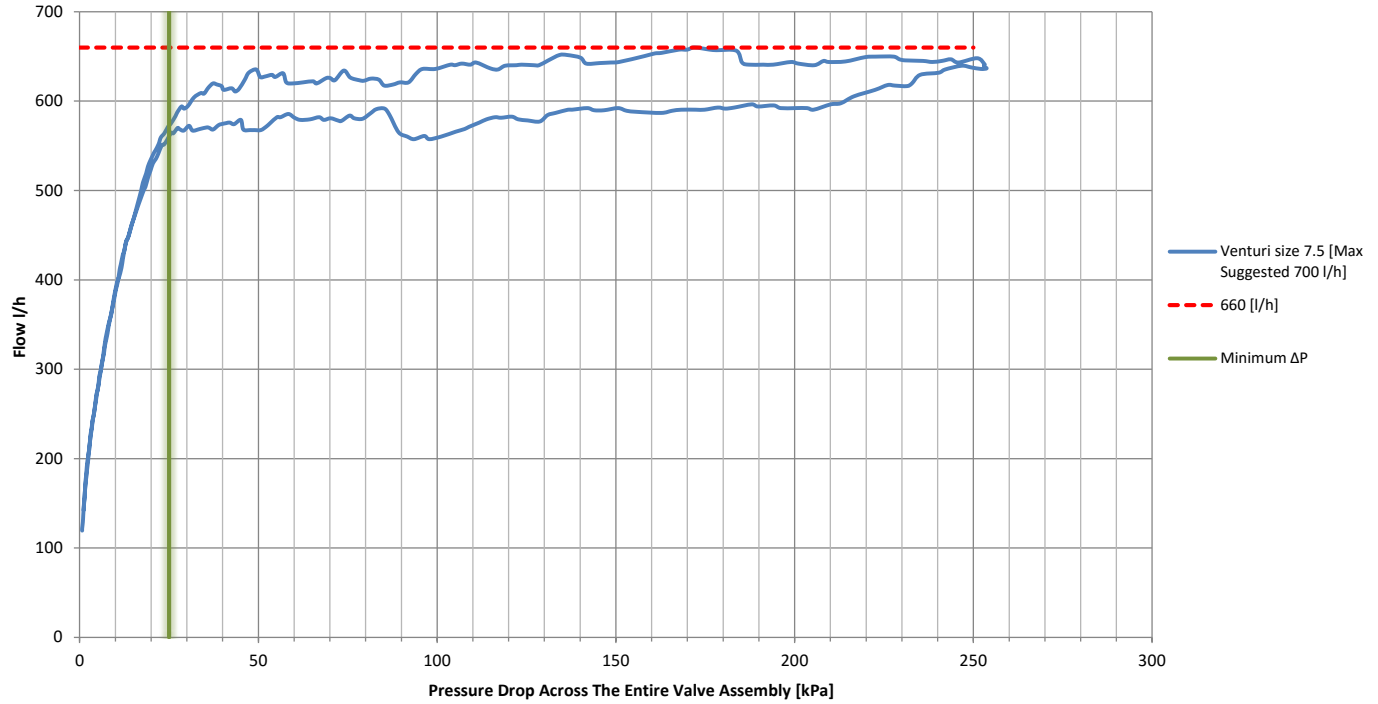


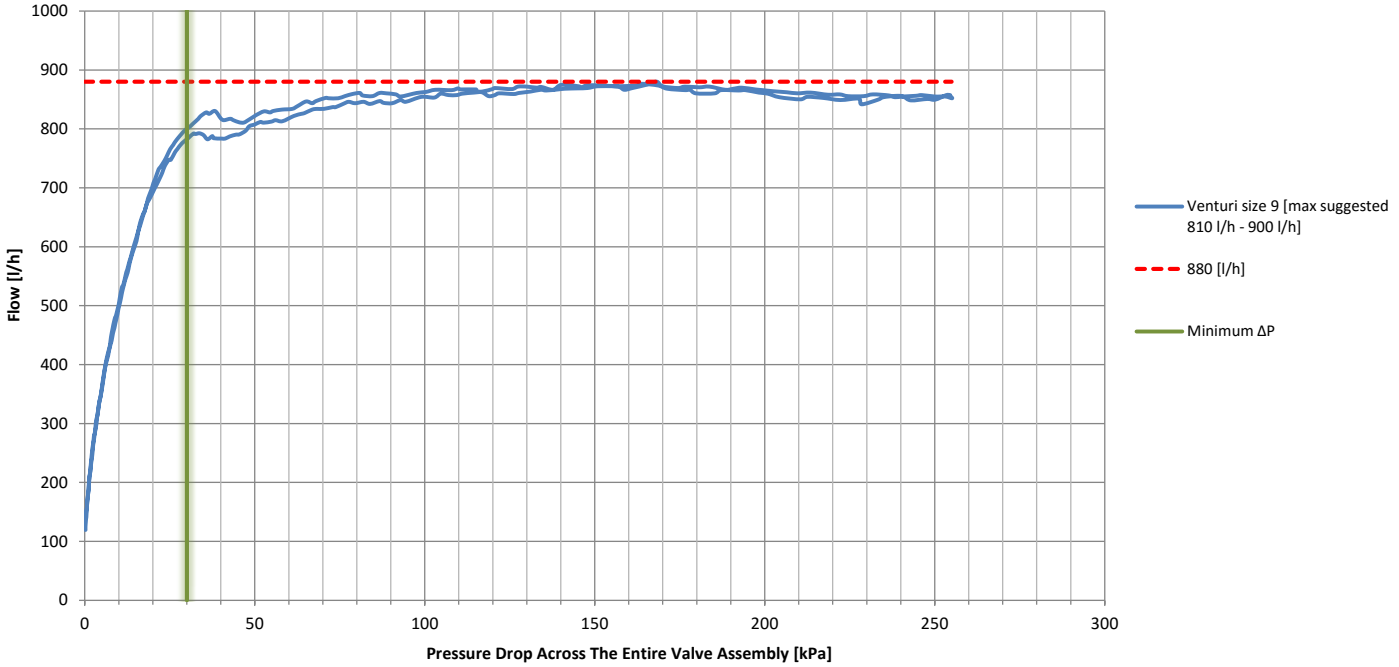
## X4B_ _6 and X4X_ _6 Dynamic Flow Response at 80% Flow Rate



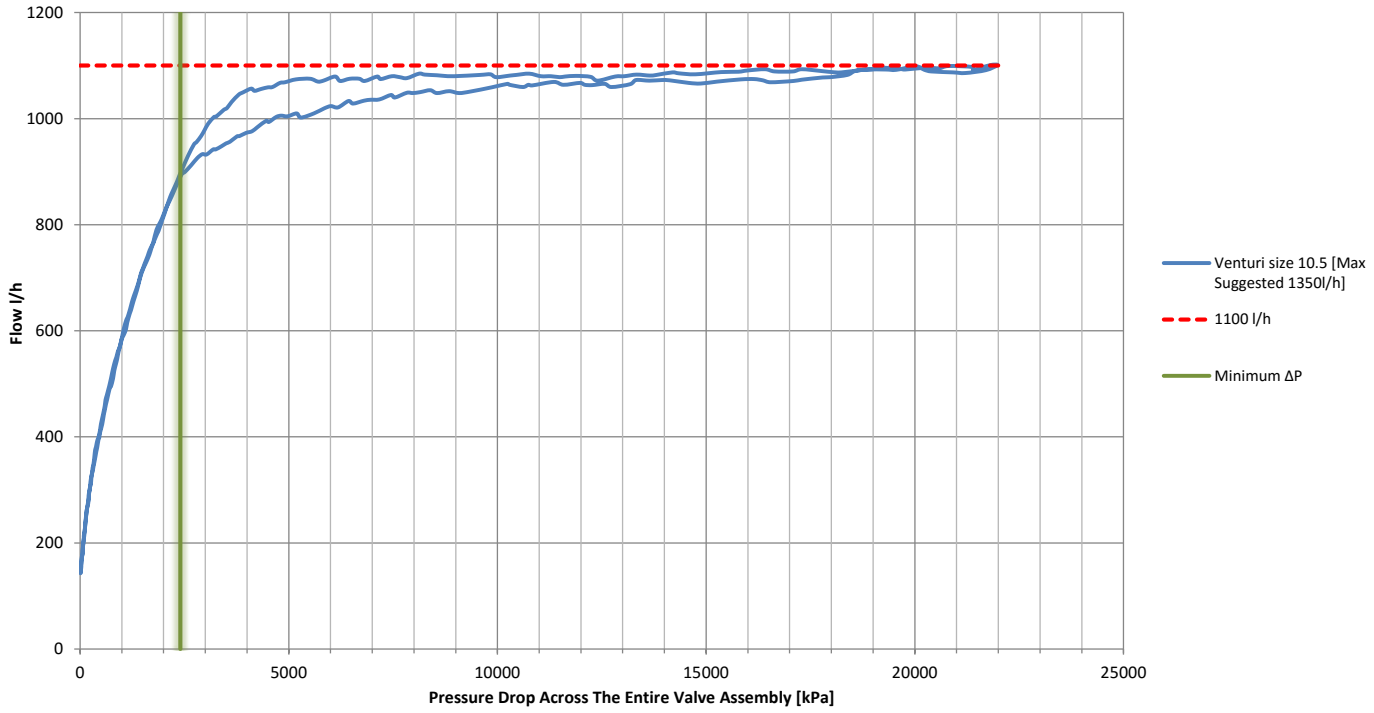

## X4B_ _7 Dynamic Flow Response at 80% Flow Rate



## X4B_ _9 and X4X_ _9 Dynamic Flow Response at 90% Flow Rate

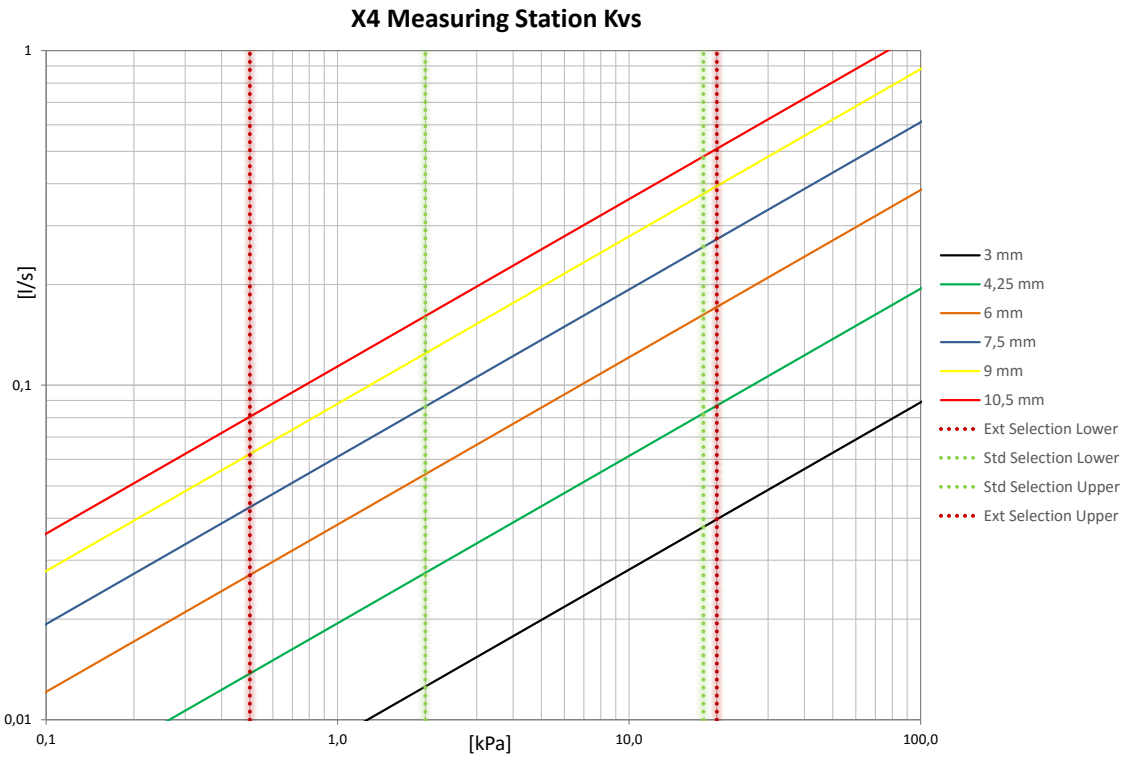



## X4B_ _0 Dynamic Flow Response at 75% Flow Rate



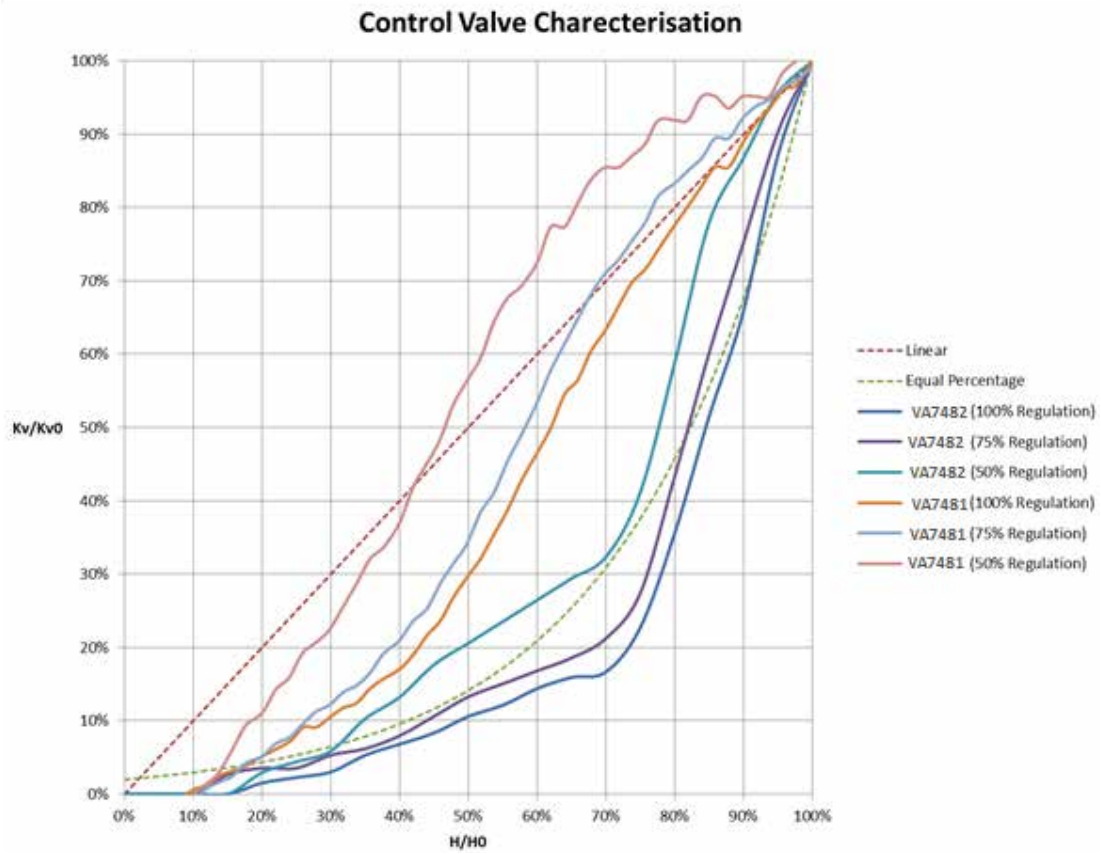
## Flow measurement chart

The chart below plots the Kvs of the various venturi inserts when installed in the complete valve assembly. The selection boundaries are also shown on the chart, the green bars show the typical range of flow rates that each venturi can be selected to measure (between 2 and 10 kPa). The red bars show the maximum useful range of the venturi, readings beneath 0.5kPa will not be as accurate, and above 15kPa the intrinsic pressure loss of the venturi will be too high.




## Control valve characteristic

The plot below shows the normalised control valve characteristic when the X4 is fitted with the two most common actuator combinations. The VA7482 is a 0-10v proportional actuator and the VA7481 is a 3 point floating type.



# INSTALLATION AND OPERATING INSTRUCTIONS

## Installation

Care should be taken when screwing pipe adaptors to the valve set not to over stress the joints, avoiding, where possible, mixing tapered and parallel threads on the same joint. It is also recommend that a liquid pipe sealant or PTFE tape is used in preference to hemp and other fillers.

Fratelli Pettinaroli union connectors incorporate hexagon flats for use with non serrated jawed tools; never use Stilsons or other serrated jawed tools to tighten these or any other brass fittings.

All union nuts in the standard X4 are 30mm across flats; nuts connecting onto the 4 port fitting kit are 24mm across flats. We would recommend the use of a modified flare nut spanner (as detailed below) or a crows foot spanner. Please observe the stated torque requirements ( see fittings kit section ) when tightening union joints and compression fittings.

*30mm Flare Nut Spanner , Modified with 30mm Slot*

Always remove any O-rings from solder fittings before applying heat, do not solder union connections in place.

When connecting end fittings to the X4 ensure that any torque applied is properly countered so that other connections are not loosened and sealants applied by Fratelli Pettinaroli are not damaged. This can generate leakages.

When opening and closing the drain valve use a cabinet key (square drive) of the correct size, using a spanner of excessive length or grips can damage the internal stops of the valve.

The X4 should be properly bracketed to the terminal unit drip dray; the design and construction of the mounting system and ensuring that the drip tray is of sufficient size will be the responsibility of the terminal unit manufacturer. There is an M6 tapped blind hole on the bottom of the flushing by-pass valve intended to facilitate easy and secure bracketing of the valve assembly.

Care should be taken to avoid galvanic corrosion where there is metal on metal contact.

## Flushing and isolation

### *Media quality*

It is expect that the system to which the X4 is fitted be pre-cleaned and flushed in accordance to the standards and principles detailed in the BSRIA guide “Pre commission cleaning of pipework systems” (BG29/2012) and the water quality maintained to standards as detailed in BSRIA guide “Water treatment for closed water systems” (BG50/2013) and UNI8065 standard.
The valves used in the X4 contain a number of O-Rings, washers and seats made variously of NBR, EPDM, PTFE and Viton, please ensure compatibility of these materials with any water treatments, chemical cleaning agents and other compounds exposed to the media such as pipe sealants.

The X4 is intended for use with group 2 non dangerous liquids only (dangerous liquids, group 1, are defined in article 2, paragraph 2 of the Directive 67/548/CEE). Note that it is advisable to get a confirmation from the liquids producers regarding their compatibility with the materials the X4 is composed of.

The valve set is configured such that it can be easily flushed out of circuit (by-passed) and also to allow the back flushing of the connected coil. The valve set only be forward flushed to fill and purge the valve with treated water.

a. So as not to flush dirt through the EVOPICV valve
b. The EVOPICV valve is a flow limiting valve, by forward flushing through this valve the media velocity may not achieve those needed for an adequate flush

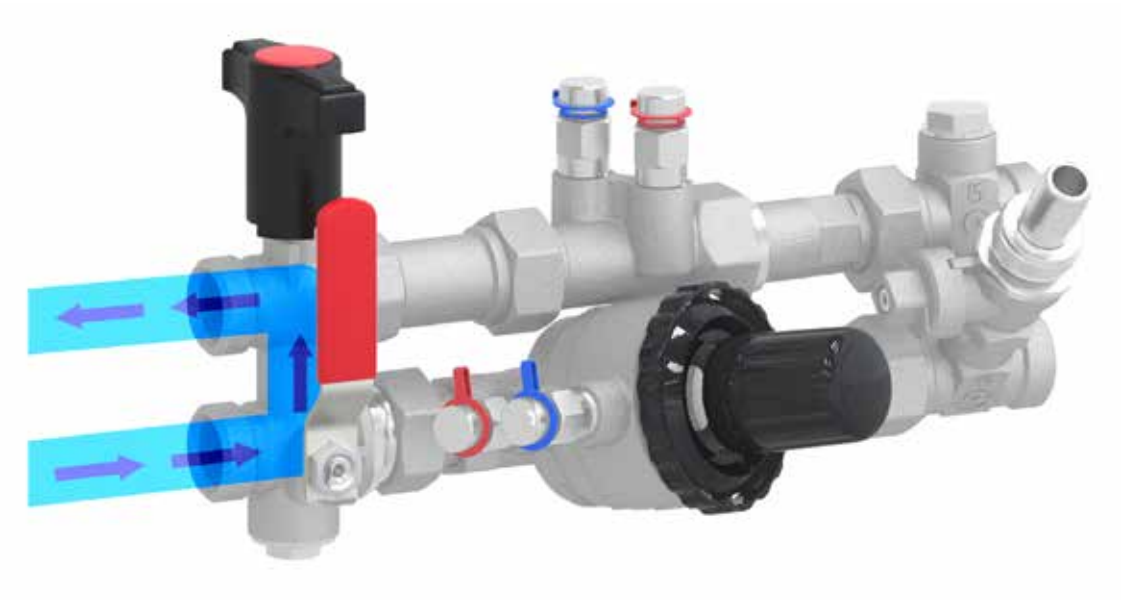
In general the flushing procedure should be as follows

1. Mains flush
2. Back flush to drain
3. Forward flush to fill and purge

### *Mains flush*

To perform a mains flush

1. Isolate the return leg using the isolation valve
2. Open the flushing by-pass valve, so that the handle is perpendicular to the axis of the by- pass inlets, this also isolates the flow leg.



### *Back flush to drain*

The valve set and attached coil can be back-flushed to drain in order to purge and flush the attached coil.

1. Close the EVOPICV either using the knob provided or by driving the actuator closed
2. Open the flushing by-pass valve, so that the handle is perpendicular to the axis of the by- pass inlets. It should still be in this position from the mains flush
3. Open the return isolation valve
4. After attaching a hose to blow down valve using the supplied hose barb, open the blow down valve

Be sure to isolate and cap off the blow down valve before returning the valve set to service.

### *Filling and purging*

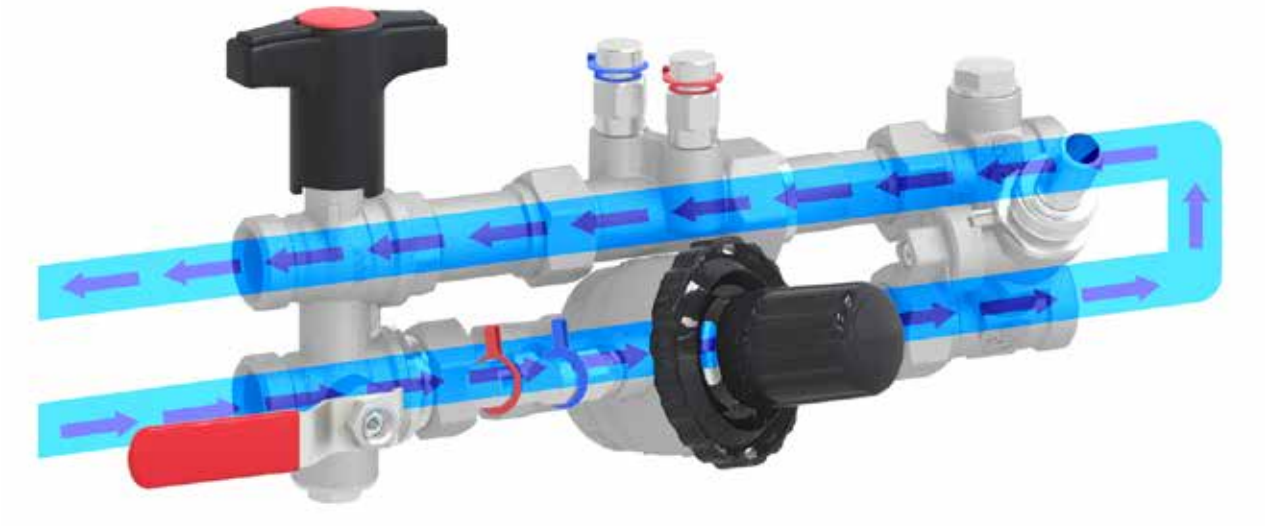
Once the valve set has been back flushed it is prudent to fill the EVOPICV valve with treated water. To do this

1. Close the flushing by-pass valve, so that the handle is parallel to the axis of the by-pass inlets
2. Open the EVOPICV valve
3. Open the blow down valve to allow a small amount of treated water to be drawn into a bucket thus ensuring the entire valve set is full of the treated water
4. Close the blow down valve and ensure that the cap is replaced

### *Normal operation*

The valve set should be configured as follows during normal operation.

1. Return isolation valve is open
2. The flushing by-pass valve is closed, so that the handle is parallel with the axis of the valve inlets
3. Any override clutches on the EVOPICV actuator are disengaged, the valve will be positioned as determined by the BMS controller.



## Setting and commissioning

***For more information on commissioning PICV systems please see Fratelli Pettinaroli' Definitive Guide to Pressure Independent Control Valves.***

The Flow rate can be set by adjusting the black hand-wheel on the EVOPICV to the required position.
The set position is expressed as a percentage of the EVOPICV valve's maximum flow rate and is calculated by dividing the design flow by the maximum nominal flow of the valve and multiplying by 100.

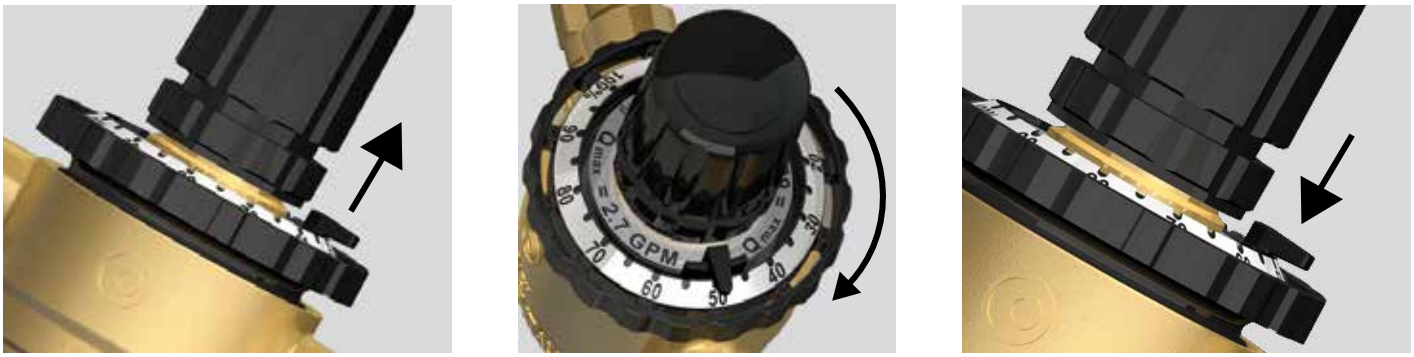
$$Setting = \frac{Design\ Flow\ Rate}{Valve\ Maximum\ Flow\ Rate}$$

For example where the design flow rate is 450 l/h and the valves maximum flow rate is 600 l/h there are to two main approaches to commissioning the valve assembly.

$$Setting = \frac{450}{600} = 75\%$$

### *Pre-setting*

With the valve set in the normal operating mode the EVOPICV can then be pre-set to the calculated position as detailed on the selection schedule; the flow rate can then be measured at a later date using the venturi.



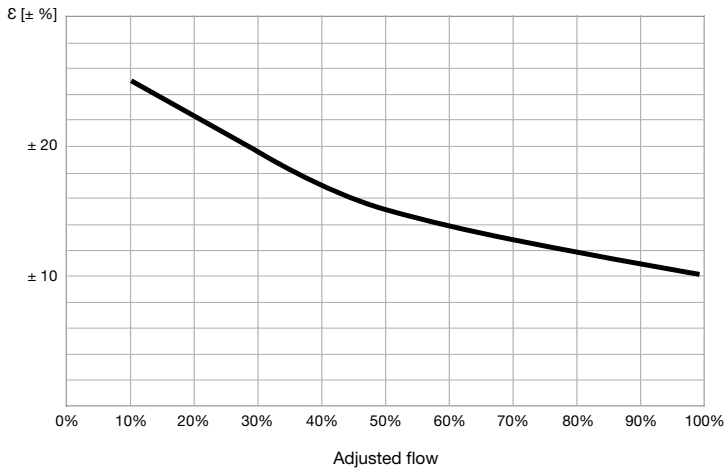

*Lift the lock pin to unlock the hand-wheel. The hand-wheel is graduated from 100% to 10%, turn the hand-wheel to the calculated percentage as indicated by the lock pin. Press the lock pin to lock the hand-wheel in position.*

When the valve is pre-set there will be a wider variation in measured results compared to if the valve was set to a flow rate using the venturi flow measurement device.

### *Setting to a flow rate*

With the manometer connected to the flow measurement station the pre-setting wheel can be adjusted until the correct differential pressure measurement is achieved.

The set position should be recorded on the commissioning documentation along with the manometer readings and flow rate. Deviations of more than 15% from the calculated set position should be cause for investigation as they may indicate problems with the local installation or the PICV.




*Setting Accuracy vs Hand Wheel Position*

## Flow and differential pressure measurements

The X4 valve assembly comes equipped with multiple pressure temperature readout ports. These are all of the binder type and allow for the following measurements to be taken:

a. Flow Rate though the terminal unit
b. Differential pressure or temperature across terminal unit (when provided)
c. Differential pressure across EVOPICV valve (when provided)
d. Static pressure or temperature at the terminal unit

### *To measure the flow rate passing through the terminal unit*

Connect the measurement instrument (U-tube manometer or electronic manometer) to the venturi flow measurement device, being sure to purge the pressure lines. Use the stated Kvs to calculate the flow rate based on the differential pressure reading taken and the following formula:

$Q=(\sqrt{\Delta}P \cdot Kvs)/36$ if Q = volume flow rate in l/s

or

$Q=100\ \sqrt{\Delta}P \cdot Kvs$ if Q = volume flow rate in l/h

Kvs = Valve factor as stated on the valve tag or schedule ΔP = Differential pressure measurement in kPa

### *Differential pressure across the terminal unit (optional)*

Connect the high pressure side of the measuring instrument to the low pressure tapping on the EVOPICV and the low pressure side to the high pressure tapping on the venturi measuring device.

### *Differential pressure across the EVOPICV valve (optional)*

If the EVOPICV has both of it test points fitted then simply connect the measuring instrument to these test points. The high and the low side are indicated by the letters H and L in the body forging.
Please note that flow rate cannot be measured across the EVOPICV valve, if a flow rate is required always use the venturi.

### *Maintenance*

The valve set is maintenance free as far as regular service requirements, however the valve assembly can facilitate some maintenance activities.
If there are any specific requirements e.g. for the end fittings these will be detailed on supplementary sheets.
It should be noted that when in the closed position, the flushing by-pass valve still allows water to by-pass through the connecting loop. Leaving the valve in this position is not recommended when a system has been balanced and is in service as it will provide an uncontrolled water way and potentially affect the balance of the system.
If a particular coil is to be taken out of service for an extended period of time then the valve set should be isolated using a return isolation valve only. The EVOPICV can then be driven to a fully closed position by the actuator or manual protection cap.
Alternatively it is possible to fully isolate the terminal legs of the by-pass by removing the handles when the valves are in the closed position. The balls may then be manually rotated 180°.
Although the flushing by-pass valve will also isolate the flow leg it will simultaneously open the by- pass which may mean that the by-pass circuit itself becomes the most favoured loop on a circuit. This could result in the entire floor being put out of balance.

### *Replacement of the terminal unit*

The valve set comes complete with 2 unions at the coil end. These unions allow the coil unit to be removed whilst leaving the valve set in situ to isolate the pipework. To dismantle these unions please ensure

1. That the return leg isolation valve is closed and that the by-pass valve is opened isolating the flow leg
2. The EVOPICV valve is closed, either by the BMS controller or by means of the override clutch on the actuator
3. The unions require a 30mm spanner (24mm spanner if a DN10 4 port fitting Kit is used)
4. Replace the coil as per the manufacturer's instructions
5. If the coil connection blocks and O-rings are serviceable after they have been dismantled then they may be replaced onto the new coil unit, otherwise contact Fratelli Pettinaroli for replacements

### *Replacement of EVOPICV valve*

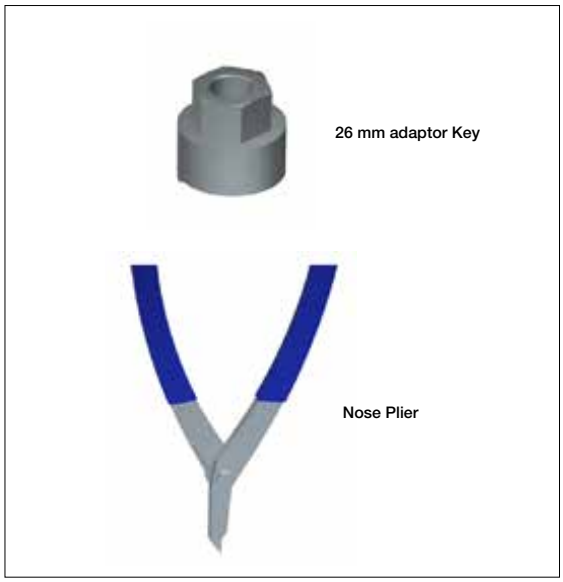
Should the EVOPICV need to be replaced for any reason this can be accomplished by

1. Closing the flow leg isolation valve
2. Open the flushing by-pass valve, so that the handle is perpendicular to the axis of the by- pass inlets. This will also isolate flow leg
3. After attaching a hose union and hose to the blow down valve, open the blow down valve and carefully release the pressure within the coil. Drain as much of the contents off as possible into a bucket before commencing other works
4. The EVOPICV can be removed by using the union joints at the coil end and by-pass end of the EVOPICV valve

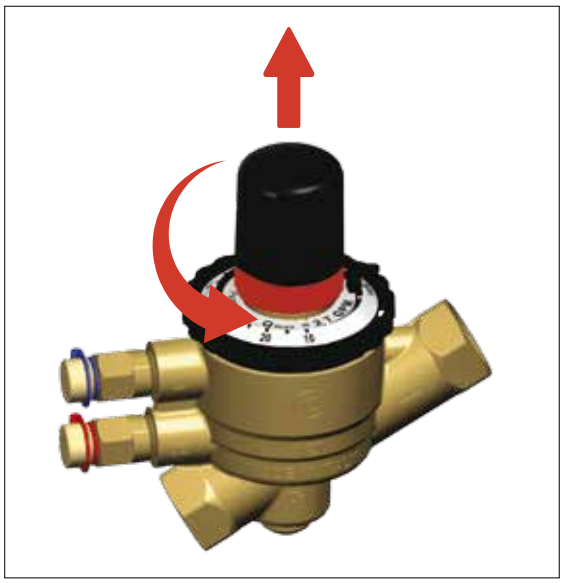
## Replacement of the diaphragm of EVOPICV valve - 091SET maintenance kit

For further information please refer to instruction 208 - 091SET

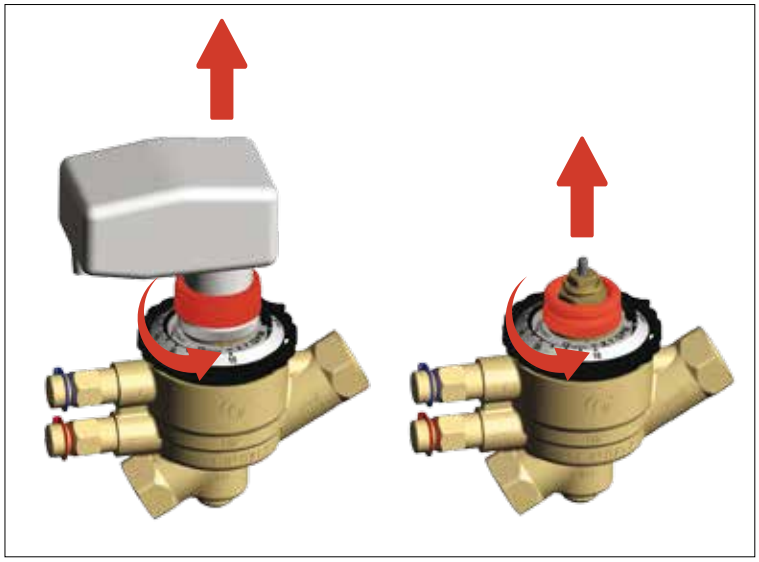
091SET maintenance kit



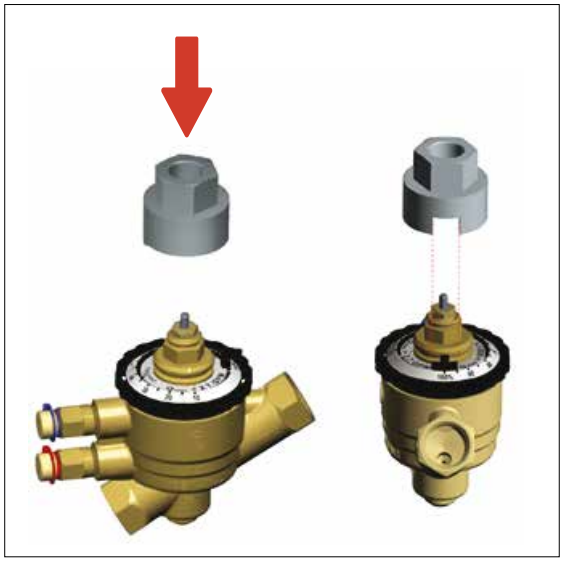

Step 1:remove completely the knob



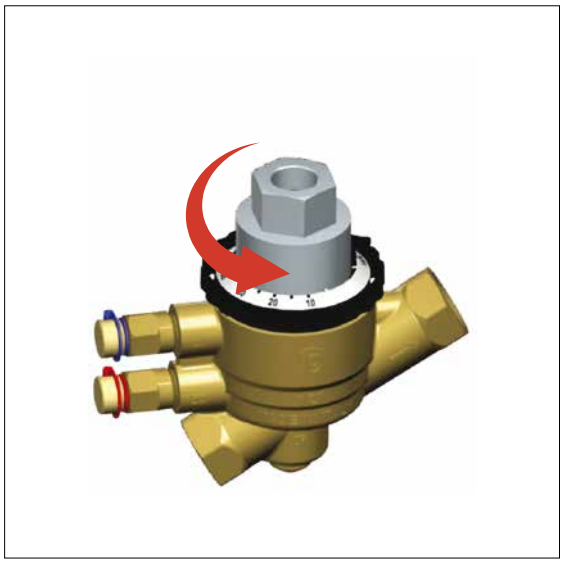
Step 1a: remove the actuator and the adapter.



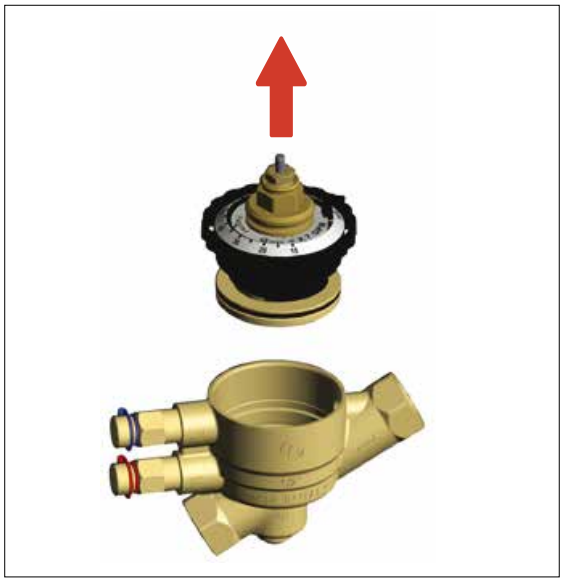
Step 2: using the 26mm adaptor key provided to remove the headwork. Align latches.



Step 3: using a 26mm spanner unscrew the headwork.

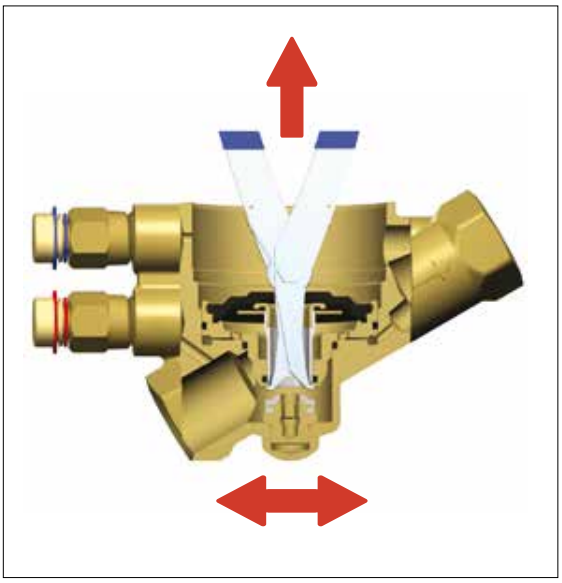


Step 4: remove the headwork.

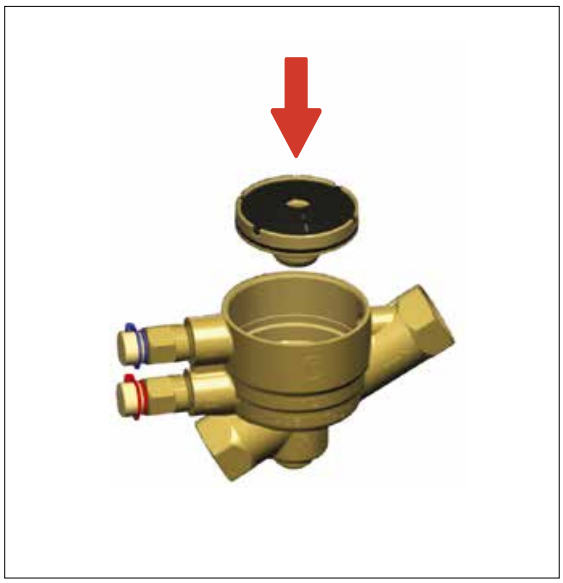


Step 5: Insert the nose pliers through the center of the cartridge

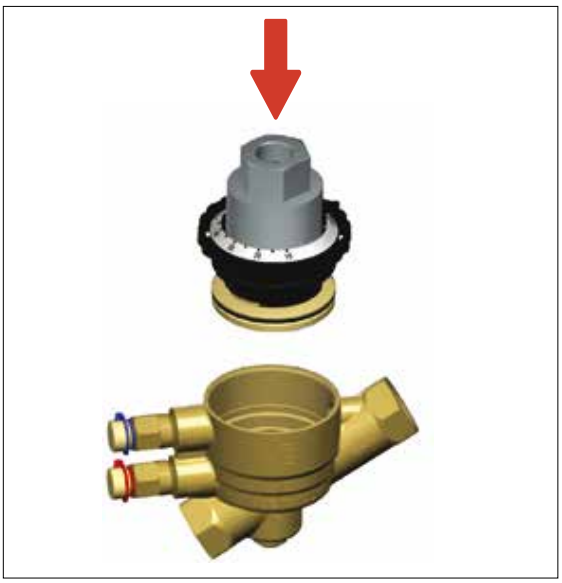
Step 6: open the plier and pull the cartridge up out of the body



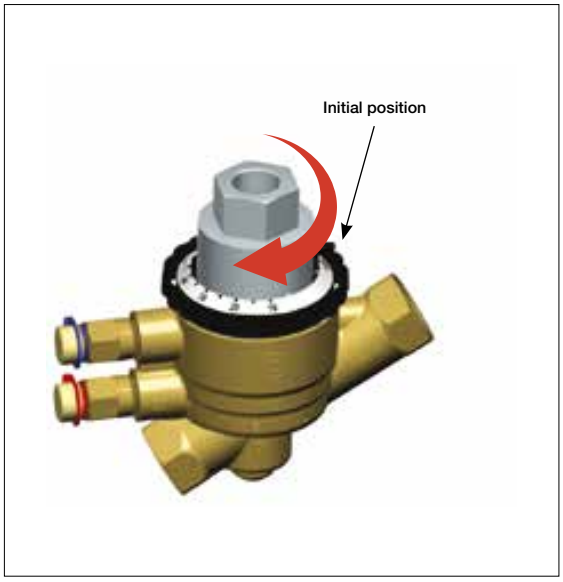
Step 7: Insert the new cartridge



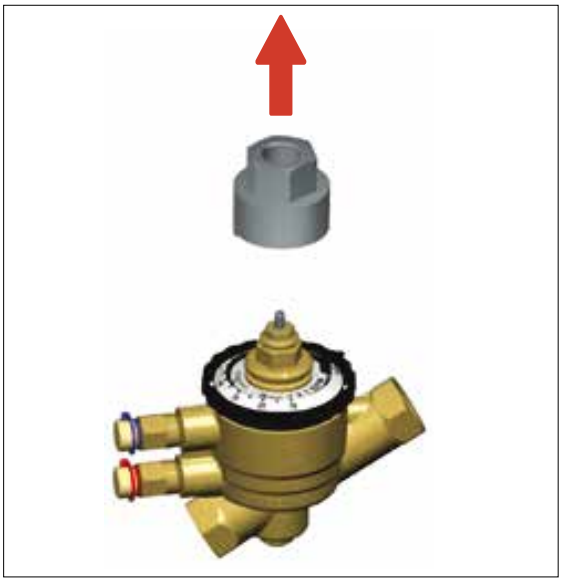
Step 8: Replace the headwork



Step 9: Screw the headwork with 15/20 Nm torque reaching the initial position of the lock pin




Step 10: remove the 26 mm adapter key and replace the actuator a adapter



*Replacement parts*

All parts in the X4 can be field replaced; a ½" control valve may be exchanged for a ¾" one and vice versa. Care must be taken if the control valve is exchanged for another variant that the matching venturi is also installed.

**Venturi**

The venturi can be replaced in the field; for convenience the entire venturi housing and insert along with the inlet union tail will be replaced as a unit. To replace the venturi

1. Isolate flow and return isolation valves
2. The EVOPICV valve is closed, either by the BMS controller or by means of the override clutch on the actuator ( when available )
3. Use blow down valve to de-pressurise and drain the terminal
4. The union nuts require a 30mm spanner, a modified flare nut or crows foot spanner is recommended
5. Loosen the front and back union nut on the return leg
6. Remove old venturi housing
7. Install new venturi housing by following the instructions in reverse

**Control valve**

The EVOPICV control valve can be replaced in the field, for convenience the control valve and union tails will be replaced as a unit. To replace the control valve

1. Isolate flow and return isolation valves
2. Use blow down valve to de-pressurise and drain the terminal
3. The union nuts require a 30mm spanner, a modified flare nut or crows foot spanner is recommended
4. Loosen the front and back union nut on the return leg
5. Remove old control valve
6. Install new control valve by following the instructions in reverse

# INDIVIDUAL COMPONENTS

## EVOPICV

***For more information on commissioning PICV systems please see Fratelli Pettinaroli' Definitive Guide to Pressure Independent Control Valves.***

One of problems associated with 2 port control is sizing and making sure all of the control valves have adequate authority. Whilst this problem is helped by the use of differential pressure controllers it can still be difficult to maintain good authorities without specifying that each terminal unit requires a DPCV. Using traditional valves this would be a very expensive design approach.

The pressure independent control valve (PICV) combines the functions of a differential pressure controller, regulation valve and 2 port control valve into a single body.

The EVOPICV incorporates a small diaphragm type DPCV in order to keep a constant differential pressure across an orifice and to provide a constant flow rate whilst the differential pressure is with the operating limits of the valve. Beyond these working pressures the valve acts as a fixed orifice.

*EVOPICV valve.*

| **Component** | Material |
|---|---|
| **Body** | DZR BRASS CW602N OR BRASS CW617N (EN 12165) |
| **Headwork** | BRASS CW614N (EN 12165) |
| **Cartridge sleeve** | Stainless Steel |
| **Diaphragm** | High resistance EPDM |
| **O-Rings** | EPDM |
| **Adjustment ring** | PSU |

Making this orifice adjustable allows the valve to be pre-set deliver a range of flow rates. In the case of the EVOPICV valve this adjustment can be made in situ without removing any covers or actuators, the adjustment wheel is lockable by means of a combined memory stop and indicator.

The EVOPICV valve also includes 2 port temperature control by means of an oblique pattern globe valve. The plug of the globe valve is machined to give a near equi-percentage flow control characteristic. Due to the fact that the differential pressure across the valve seat is constant it can be said that the authority of this control valve is very close to 1.

The EVOPICV can be fitted with a range of actuators including thermo-electric ON/OFF and modulating actuators, TRV sensors and motorised actuators.
When shut tight, the globe valve is a metal on metal seal and as such the leakage rate should be no more than 0.01% of the nominal maximum flow of the valve as defined by class IV of IEC60534-4.

Due to the way the EVOPICV valve controls the flow rate, irrespective of differential pressure branch and sub mains, balancing valves are not required. The flow rate is maintained at the terminal unit regardless of system conditions making the valve ideal for systems with inverter driven pumps.

| **Characteristic** | |
|---|---|
| **Pressure rating** | PN25 |
| **Flow rate range** | 0.013 – 0.42 l/s dependent on valve selection |
| **Working differential pressure range** | 25 – 600kPa<br>minimum depends on valve and setting, valve will operate up to 600kPa, 400kPa is recommended to avoid unwanted noise |
| **Accuracy (linearity and hysteresis)** | ±10% across working DP range at 100% flow |
| **Temperature range** | 0 – 100° |
| **Leakage rate to IEC 60534-4** | Class IV |

## Venturi flow measurement

The Terminator Interchangeable venturi housing is based on the proven venturi inserts used in our Terminator commissioning valve. The same venturi inserts are used but we have recalculated the Kvs values in situ in an entire X4 valve set close coupled to a terminal unit, this means that each venturi is calibrated for the exact situation in which it is used.

*CV90*
*Interchangeable venturi flow measurement device*

| Component | Material |
|---|---|
| **Body** | DZR BRASS CW602N (EN 12165) |
| **Venturi insert** | BRASS CW614N (EN 12164) |
| **Test point** | BRASS CW617N (EN 12165) |
| **Test point core** | Ethylene propylene rubber EPDM |
| **O-Rings** | EPDM |

Sizing of the venturi is usually carried out to give differential pressure readings between 2 and 10kPa as this is the most accurate range of the venturi but also allows digital manometers to be used.
The venturi allows high signals of up to 15kPa to be achieved without significant residual pressure loss.

The Terminator interchangeable venturi housing is machined from a hot forged DZR brass body.

| Characteristic | |
|---|---|
| **Pressure rating** | PN25 |
| **Working differential pressure range** | 1.5 – 15kPa |
| **Accuracy (linearity)** | ±5% across working DP range |
| **Temperature range** | 0 – 100° |

## Coil connection tee

The coil connection set is intended to provide a simple way of connecting the X4 unit to the terminal coil tails. The coil connection tee can be configured with a number of end connections by means of a fitting kit and has ports for a drain and optional accessory such as an air vent or test plug. The final function of the coil connection tee is to provide a union joint at a position where the coil could be removed whilst the bulk of the X4 remains connected to the pipework providing isolation.
The coil connection tee is manufactured from forged DZR brass.


*Coil connection tee with various accessories*

| Component | Material |
|---|---|
| **Body** | DZR BRASS CW602N (EN 12165) |

| Characteristic | |
|---|---|
| **Pressure rating** | PN25 |
| **Temperature range** | 0 – 100° |

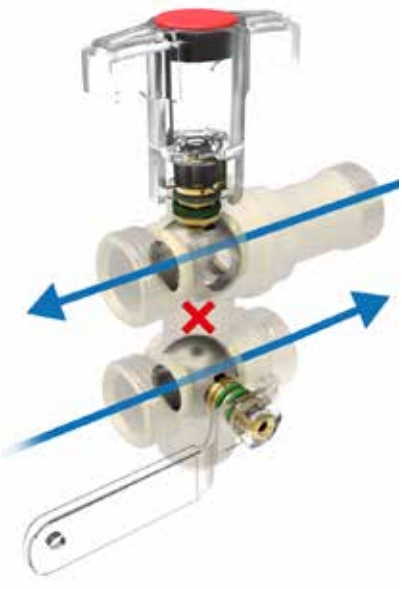
## Flushing by-pass

BSRIA application guide “Pre-Commission cleaning of pipework systems” recommends that all terminal units are fitted with fixed flushing by-passes. This BSRIA guide is referenced in the CIBSE code W “Water Distribution systems”.

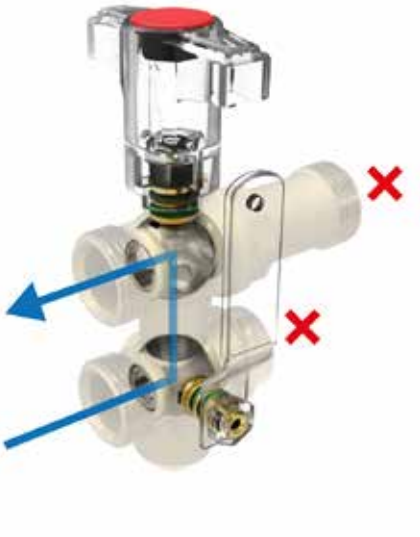
The Fratelli Pettinaroli flushing by-pass valve has been designed specifically with fan coils in mind, although it is suitable for all types of hydronic terminal unit.

*Flushing Bypass*

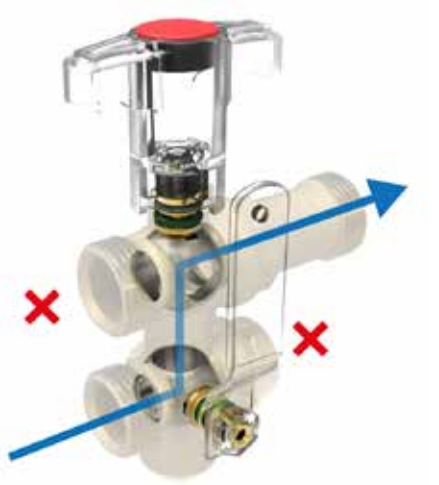
*Operating Mode*



*Mains Flush*



*Back Flush*



| Component | Material |
|---|---|
| **Body** | DZR BRASS CW602N (EN 12165) |
| **Balls** | TEA PLATED BRASS CW614N (EN 12165) |
| **Insert** | DZR BRASS CW602N (EN 12165) |
| **Seats** | PTFE |
| **O-Rings** | FKM / EPDM |
| **Stems** | BRASS CW614N (EN 12164) |

The by-pass valve comprises of two through connections joined by a perpendicular by-pass section. The top connection incorporates a special 4 way ball valve, the bottom through section contains a three ported ball valve which allows for two operation modes - by-pass and flow. These flow sections are arranged at 40mm centres so as to provide a way to directly mount any valve set to a fan coil unit with matching 40mm centre inlet/outlets.

The bottom ball valve has three ports machined in a T configuration. In flow mode, the middle port is sealed against the third and fourth seats preventing water from flowing through the by-pass (Class IV leakage rate as defined by IEC60534-4). As the valve is moved into by-pass mode the outlet side of top flow connection is isolated (Class VI leakage rate as defined by IEC60534-4) whist the by-pass connection is opened allowing the two inlet connections to be flushed through.
The top ball valve has a special 4 port configuration machined in T plus 1 configuration. The bottom port is always open to the by-pass. In normal operation the main through port allows water to flow between the inlet and outlet; the bottom ball will prevent water communicating through the by-pass unless moved to apposition to let it flow. When the ball is rotated through 90° the main through ports are isolated between the seats and the forth port is opened to the mains outlet, this allows water to flow between the by-pass and the outlet but seals the terminal connection.
Connections are of the euroconus type which allows direct connection to many proprietary piping systems in addition to copper, steel and flexible connections.

| Characteristic | |
|---|---|
| **Pressure rating** | PN25 |
| **Temperature range** | 0 – 100° |

## Blow down valve

The blow down valve is of the ball type, the handle is of the square drive type and may be opened and closed using a 12mm square drive or spanner, shut off is positive. The handle is a heavy duty square drive and may be used to lock the valve closed if the handle is removed and then reinstalled rotated 180°. The connection to the X4 is sealed by use of an O-ring. A cap and 14mm hose barb are included.

*346ST*

| Component | Material |
|---|---|
| **Body** | BRASS CW617N (EN 12165) |
| **Ball** | TEA PLATED BRASS CW617N (EN 12165) |
| **Insert** | BRASS CW614N (EN 12164) |
| **Seats** | PTFE |
| **Stem O-Rings** | FKM |
| **Stem** | BRASS CW614N (EN 12164) |
| **O-Ring** | EPDM |

| Characteristic | |
|---|---|
| **Pressure Rating** | PN25 |
| **Temperature Range** | 0 – 100° |

## Union connections

Union connections are machined from hot forged brass billets to maintain fixed lengths in the assembly.

*1007B*

| Component | Material |
|---|---|
| **Body** | BRASS CW617N (EN 12165) |
| **Nut** | BRASS CW617N (EN 12165) |
| **O-Rings** | EPDM |

| Characteristic | |
|---|---|
| **Pressure Rating** | PN25 |
| **Temperature Range** | 0 – 100° |

## Filterball strainer (optional)

The strainer basket is mounted in the ball of the isolation valve itself; a side mounted inspection port allows the strainer basket to be removed for cleaning and maintenance without the need for additional isolation valves.

*51F*

The Filterball is machined from a hot forged DZR brass body, the seats are virgin PTFE and the stem is sealed by a pair of Viton O-Rings in addition to a PTFE gland. As standard the Filterball comes fitted with a 700 micron (28 mesh) strainer basket, grades as coarse as 800 micron and as fine as 150 microns are available as optional extras.

| **Component** | Material |
|---|---|
| **Body** | DZR BRASS CW602N (EN 12165) |
| **Ball** | CHROME PLATED BRASS CW602N (EN 12165) |
| **Insert** | DZR BRASS CW602N (EN 12165) |
| **Stem** | DZR BRASS CW602N (EN 12164) |
| **Seats** | PTFE |
| **O-Rings** | VITON |
| **Strainer basket** | STAINLESS STEEL |
| **Circlip** | POSPHOR BRONZE |

| **Characteristic** | |
|---|---|
| **Pressure rating** | PN25 |
| **Temperature range** | 0 – 100° |
| **Strainer size** | 700 micron (28 Mesh) |
| **KV** | 7.5 |

# ACTUATION

## Actuator selection

The table below shows actuator part numbers for different control types.

| Type | Standard |
|---|---|
| **24v, 0-10v Proportional** | VA7482 |
| **24v, 3 Point Floating** | VA7481 |
| **230v, 3 Point floating** | VA7481 |
| **24v, 0-10v Proportional Thermic** | A544P3 |
| **24v, ON-OFF Thermic** | A544O2 or A544O4 |
| **230v, ON-OFF Thermic** | A542O2 or A542O4 |

## Actuator fitting

### *Motorised actuators*

To mount the actuator, first fully remove the black isolation cap. The actuator is supplied with a separate actuator mounting ring, this is mounted onto the valve headwork, if desired use a spot of thread locking adhesive to ensure the ring is retained with the valve. Making sure that the actuator  is in its fully open position, mount the actuator on the headwork and then tighten the collar nut until it is hand tight.

Prior to removing the actuator it should be driven fully open before being powered down, this will ensure that it can be properly fitted again; do not try to fit an actuator with the spindle in an extended position.

*Fitting motorised actuator to PICV*

### *Thermic actuators – EVOPICV*

To mount the actuator, first fully remove the black isolation cap. The actuator is supplied with a separate actuator mounting ring, this is mounted onto the valve headwork, if desired use a spot of thread locking adhesive to ensure the ring is retained with the valve. To mount the actuator it is then pushed onto the adapter ring until the clips retain the actuator.
Thermic actuators are supplied in a first open position, this means that they can be fitted easily. Once the actuators have been powered on, the actuator will be more difficult to fit unless driven open.

*Fitting thermic actuator to PICV*

### *Self acting actuators*

The self acting actuators mount directly to the PICV. First ensure that the black isolation cap is completely removed, then with the self acting actuator positioned in the fully open position, mount on the headwork and tighten the collar nut.

### *Removing black protection handle*

Do not attempt to fit the actuator if the black handle has not been fully removed. Sometimes the lower portion of the handle is too tight to remove by hand, in this case gently use a pair of grips to remove the handle.

*Correct, handle fully removed*

*Incorrect, handle partially removed*

## Actuator details

### *0-10v Proportional (configurable)*

This is our recommended actuator for the EVOPICV when fitted to forced convection terminal devices such as fan coils and air handing units. The actuator is a compact unit that is field configurable such that is suitable for a wide range of applications.

**Control input**

The actuator can controlled by a number of different signals, including 0-10v, 2-10v, 0-5v, 5-10v and 4-20mA. The actuator is factory set to 0-10v.

**Stroke direction**

The stroke direction is factory set to reverse acting, this may be changed in the field if required.

In order to suit the EVOPICV, the actuator should be set to reverse acting as the EVOPICV is normally open. This will allow the actuator to work with controllers that are set to direct acting without needing any change to the controls.

**Stroke length**

In order to adapt the stroke length to different valves, there is jumper that will change the effective stroke length. This jumper is factory set but can be changed on site if required. Please note that while the actuator will self calibrate to find the closing position, it works on a fixed stroke basis.

**Calibration Cycle**

When the power is applied, the actuator self-calibrates performing a complete cycle. The actuator moves the stem down for a complete mechanical valve stroke until no changes are detected. Once the auto-zero is detected the actuator moves the stem accordingly with the input signal.

**Replaceable Cable**

The connection cable is fitted with a plug so that the actuator can be swapped without unwiring the cable from the controller.

*3 Point motorised actuators*
*0-10v motorised actuator*

### *24v 3 Point motorised*

This a 24v 3 point floating actuator for the EVOPICV, suitable fitted to forced convection terminal devices such as fan coils and air handing units. The actuator is a compact unit that is suitable for several sizes of valve. A 230v version is available for special applications.

**Control input**

The actuator is controlled on a drive open, drive closed basis.

When the signal is applied to the black and red wires, the actuator stem extends. When the signal is removed the actuator remains in position.

If the signal remains applied to the red wire, the actuator will time out and shut off the motor after approximately 90 seconds.

When the signal is applied to the black and orange wires, the actuator stem retracts. When the signal is removed the actuator remains in position.

If the signal remains applied to the orange wire, the actuator will time out and shut off the motor after approximately 90 seconds.

**Controller Strategy**

The actuator has a maximum stroke of 6mm making it suitable for a number of different valves in our range, however there are a few things that need to be taken account of in the BMS controller strategy.

To ensure the best control characterisation it is vital to match drive time to the valve stroke so that that there is no air gap between the actuator spindle and the valve spindle. The drive time should be calculated by multiplying the stroke length of the valve in mm by the time to drive 1mm.

All 3 point actuators need periodic re-synchronisation to account for positional drift, the re- synchronisation time should be set to 90 seconds in the closing direction of the valve.

### *24v or 230v Thermic On/Off*

This actuator is suitable for passive terminal devices such as radiators and chilled beams, it is cost effective and operates silently.
The actuator mechanism uses a PTC resistor- heated elastic element and a compression spring. The wax element is heated by applying the operating voltage and moves the integrated ram. The force generated by the movement is transferred to the valve stem and thus opens and closes the valve.
The actuator is nominally ON/OFF but can be controlled in a more modulating fashion by pulse pausing the controller output (Pulse Width Modulation). Our standard supply of these actuators is premium version with detachable cable

**First-open function**
In its delivery condition, the actuator is normally open due to the first-open function. This enables heating operation during the carcass construction phase even when the electric wiring of the single room control is not yet complete. When commissioning the system at a later date, the first-open function is automatically unlocked by applying the operating voltage (for more than 6 minutes) and the actuator is fully operable.
**Function indicator**
The actuator has a function indicator in the form of a blue band on the actuator stem, this allows identifying the operating condition (valve open or closed) at a glance.
**Hysteresis**
There is an inherent hysteresis in the operation of any thermic type actuator, when the actuator has not been used for a period of time there is an extra warm up period whilst the wax is heated up to its working temperature. When the voltage is removed from the actuator there is also cool down period before the actuator will begin to close due to the thermal mass of the wax.


*Thermic ON/OFF actuator*
*0-10v Thermic actuator*

### *0-10v Proportional thermic*

The 0-10v proportional thermic actuator is offered as an alternative to the motorised proportional actuator.

**Calibration**
For the variant "normally closed", the valve is opened once by 0.5 mm and then closed again after applying the operating voltage of 24 V AC. For this, the first open function is unlocked and the valve closing point is detected. This ensures an optimum match with the specific valve used.
If a control voltage of 0.5 - 10 V DC is applied after the calibration process, the actuator opens the valve - after the dead time has elapsed with the piston movement, evenly and permanently corresponding to the valve travel. An internal optical path measurement controls the temperature required for the maximum stroke of 4 mm (minus over-elevation) and consequently the energy intake of the wax element. No excess energy is stored inside the wax element. If the control voltage is reduced, the electronic control system immediately adapts the heat input to the wax element. In the range of 0 - 0.5 V, the actuator remains in a quiescent state in order to ignore ripple voltage occurring in long cables. After the waiting time is elapsed, the valve is closed evenly with the closing force of the compression spring.
The closing force of the compression spring is matched to the closing force of commercially available valves and keeps the valve closed when de-energised (NC).
**Stand-by operation**
The wax element is maintained at stand-by temperature 20 minutes after the control voltage has dropped below 0.5v
**First-Open Function**
In its delivery condition, the actuator is normally open due to the first-open function. This enables heating operation during the carcass construction phase even when the electric wiring of the single room control is not yet complete. When commissioning the system at a later date, the first-open function is automatically unlocked by applying the operating voltage (for more than 6 minutes) and the actuator is fully operable.
**Function Indicator**
The actuator has a function indicator in the form of a blue band on the actuator stem, this allows identifying the operating condition (valve open or closed) at a glance.
**Hysteresis**
There is an inherent hysteresis in the operation of any thermic type actuator, when the actuator has not been used for a period of time there is an extra warm up period whilst the wax is heated up to its working temperature. When the voltage is removed from the actuator there is also cool down period before the actuator will begin to close due to the thermal mass of the wax.

# FITTING KITS

Various fitting kits are available to adapt the euroconus ends of the X4 to different pipe systems. A fitting kit consists of a pair of fittings (flow and return). Use only suitable fittings, as listed below.

## Fitting kit selection

The matrix below shows the different types and sizes of fitting kits available.

| | Code | 10 mm | 12 mm | 14 mm | 15 mm | 16 mm | 17 mm | 18 mm | 20 mm | ½" | ¾" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Copper compression** | 3625 | √ | √ | √ | √ | √ | | √ | | | |
| **Copper capillary solder** | 1007MS | | | | √ | | | | | | |
| **Female screwed** | 1007WFC | | | | | | | | | √ | |
| **Male screwed** | 1007<br>1007MC | | | | | | | | | √ | √ |
| **Pexal compression** | 3015SCR | | | √ | | √ | √ | √ | √ | | |
| **Flat union adapter** | 0925 | | | | | | | | | | √ |

*Fitting selection matrix*

### *Copper capillary solder*

Capillary solder fittings are available to suit 15mm pipe. Ensure fittings are properly cleaned before soldering and that any O-rings have temporarily removed.

*1007MS*

| Characteristic | |
|---|---|
| **Pressure rating** | PN25 |
| **Temperature range** | 0 – 100° |
| **Tightening torque** | 50 Nm |

### *Copper compression*

Proprietary copper compression fittings are available in diameters 10mm, 12mm, 14mm, 15mm and 18mm. These fittings use an O-ring and a grip ring to secure and seal the pipe rather than the traditional olive.
Fitting instructions are included with the fitting kit, however care must be taken to ensure that maximum tightening torques are not exceeded.

*3625*

| Characteristic | |
|---|---|
| **Pressure rating** | PN25 |
| **Temperature range** | 0 – 100° |
| **Tightening torque** | 30 Nm to 40 Nm |

### *¾" Flat face*

Long and short adapters from ¾" euroconus to ¾" flat face male are used to facilitate the use of proprietary fittings from other manufacturers. Using these adapters also almost all pipe systems to be accommodated by selecting fittings with a ¾" swivel nut.

*0925*

| Characteristic | |
|---|---|
| **Pressure rating** | PN25 |
| **Temperature range** | 0 – 100° |

### *Male BSP screwed*

Short adapters are available in ½" and ¾" male BSP screwed.

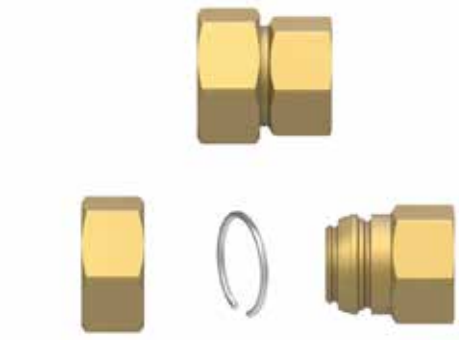
*1007*

*1007MC*

| Characteristic | |
|---|---|
| **Pressure rating** | PN25 (1/2"), PN16 (3/4") |
| **Temperature range** | 0 – 100° |
| **Tightening torque** | 50 Nm max. |

### *Female BSP screwed*

An adapter are available in ½" female BSP screwed.



*1007WFC*

| Characteristic | |
|---|---|
| **Pressure rating** | PN25 |
| **Temperature range** | 0 – 100° |
| **Tightening torque** | 50 Nm max. |

### *Multi-layer pipe fittings*

Adapters are available in both compression type and press type for Valsir Pexal multi-layered composite pipe (PEX - Al - PEX). These are available in 14 mm, 16mm, 17mm, 18mm and 20mm in compression type.

*3015SCR*

| Characteristic | |
|---|---|
| **Pressure rating** | PN25 |
| **Temperature range** | 0 – 100° |
| **Tightening torque** | 30 Nm to 40 Nm |

### *Propriety fittings*

Many manufacturers will have proprietary fittings for metal and plastic pipe systems that conform to the Euroconus standard (EN215, Annex A), these should be compatible with the end fittings on the X4.

# NOTE

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