Pressure Independent Flow & Temperature Control Valves

Function, Application, Benefits & Considerations

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Agenda

- Frese Group Introduction
- Types of Pressure Independent Valves
- Function
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  - Pressure Independent Control Valves
- Applications
- Benefits
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- Testing & Commissioning
- Considerations
Frese Group

- Heating, Ventilating and Air Conditioning
  Efficient indoor climate control for buildings

- Metal and Steel Foundry
  Customised casting components for the toughest applications

- Plumbing
  High quality components for commercial and domestic use

- Marine and Industrial
  Durable flow and pressure control for demanding environments

Please visit www.frese.eu for more details
Types of Pressure Independent Valve

Constant Flow Regulators

Pressure Independent Control Valves
Types of Pressure Independent Valve

Constant Flow Regulators

1. Integral flow regulator
2. Integral differential pressure controller

Pressure Independent Control Valves

1. Integral flow regulator
2. Integral differential pressure controller
3. Actuated temperature controller

\[ Q = K_v \cdot \sqrt{DP} \]
Function
Typical Static Valves vs Typical Dynamic Valves
Typical Static Flow Regulating Valve
Typical Dynamic Flow Regulating Valve (CFR)
Cartridge Type CFRs

Oblique Pattern

Wafer Pattern
CFR Flow Cartridge Design

Variable Orifice Type

Fixed Orifice Type
Internally Adjustable Flow Setting
Externally Adjustable Type CFRs

Typical DZR Brass Threaded CFR

Typical DI Flanged CFR
Externally Adjustable Flow Setting

Frese SIGMA Compact DN15 Low

Flow vs. Pre-set graph showing the relationship between flow rate in l/s and l/h, Kv (m³/h) and minimum Δp kPa.
Pressure Independent Flow Control

![Graph showing the relationship between Pressure Differential (kPa) and Flow rate (l/s) for different Pressure Independent Flow Control systems.](image-url)
Static v Dynamic Balancing
Function
Pressure Independent Control Valves
Pressure Independent Control Valves

Typical DZR Brass Threaded PICV

Typical DI Flanged PICV
Types of Pressure Independent Control Valves

Reducing Stroke PICV

- Design flow is set by restricting the control stroke
- Valve Rangeability reduces at lower design flow settings

Reducing Authority PICV

- Design flow is set by restricting an integral flow regulator
- Valve Authority reduces at lower design flow settings

Full Stroke & Authority PICV

- Design flow in different plane to modulating stroke
- Valve Rangeability and Authority remains unaffected by flow setting
Full Stroke & Authority PICV
Full Stroke & Authority PICV
Flow Limiting

Flow rate (l/s)

Pressure Differential (kPa)

0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50

0 50 100 150 200 250 300 350 400

0.6 1.4 3 4

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Full Stroke & Authority PICV
Modulating Temperature Control

Frese OPTIMA Compact DN20
Hi Flow at 200 kPa with EQ% Motoric Actuator

Flow (%) vs Voltage Signal
Applications
Typical Application

Fan Coils

LEGEND

HEATING OR COOLING TERMINAL UNIT
PRESSURE INDEPENDENT CONTROL VALVE
METERING STATION
PRIMARY PUMP
FLOW LIMITING VALVE

SYSTEM B - FLOW LIMITING VALVE AND THREE PORT CONTROL VALVE ON SYSTEM END
Typical Application
Chilled Beams
Typical Application
Air Handling Unit (Direct Control)
Typical Application
Air Handling Unit (Indirect Control)
Typical Application
Radiators
Typical Application
Under Floor Heating

PLEASE NOTE: TEMPERATURES ARE SHOWN FOR EXAMPLE ONLY
Typical Application
Condensing Boilers

LEGEND

CONDENSING BOILER
PRESSURE INDEPENDENT CONTROL VALVE
CONTROLLER
METERING STATION
PRIMARY PUMP
TEMPERATURE SENSOR (INDOOR)
Typical Application
Chillers (Fixed Speed)
Typical Application
Chillers (Variable Speed)
Typical Application
Plate Heat Exchanger
Benefits
Three Functions in One Valve
High Control Valve Authority

\[ \beta = \frac{\Delta P_1}{\Delta P_1 \pm \Delta P_2} \]

Where,
- \( \beta \) = Authority
- \( \Delta P_1 \) = Pressure (fully open valve)
- \( \Delta P_2 \) = Pressure drop (over influenced circuit)
High Control Valve Turndown

\[ T = \frac{Q}{q} \]

Where,

- \( T \) = Valve Turndown
- \( Q \) = Maximum Controllable Flow
- \( q \) = Minimum Controllable Flow

- The higher the turndown the better the control
- The turndown is halved at an authority of 0.2
- Valve Turndown is equivalent to Rangeability at an authority of 1
High Authority & Turndown

![Graphs showing High Authority & Turndown]
Improved Temperature Control
Heating & Cooling Plant Efficiency Improved

Power & Flow relationship: \[ Q = \frac{kW}{\Delta T \cdot C} \quad \Rightarrow \quad kW = Q \cdot \Delta T \cdot C \]

\( C = \) Specific heat capacity of water (4.186 kJ/°C*kg)
Reduced Pumping Energy Consumed

- Pump speed constant
- Pump speed controlled to maintain constant pressure across pump
- Pump speed controlled to maintain pressure at most remote DPCV

70%
Proportional Balancing versus Flow Verification

Proportional Balancing of Static Balancing Valves

Flow Verification of Dynamic Balancing Valves
Types of Pressure Independent Control Valve Design
Types of PICV Design – Type 1

- Setting the flow below the maximum setting reduces the stroke
- Control authority unaffected by the flow setting
Types of PICV Design – Type 2

- Full stroke irrespective of the maximum flow setting
- Control authority reduced below the maximum flow setting
Types of PICV Design – Type 3

- Full stroke modulation irrespective of the maximum flow setting
- Control authority unaffected by the flow setting
- Same technology throughout the range – DN10 to DN300
Standards & Test Methods
Standards & Test Methods

There is no common, official standard that Pressure Independent Control Valves need to comply with from a design and specification point of view.

However, there is the BTS.1 Test Method for Pressure Independent Control Valves that was developed by BSRIA and released in 2012, with input from many of the major PICV manufacturers.

This Test Method is widely acknowledged as a useful benchmark for PICV performance.
Testing & Commissioning
Testing & Commissioning

For the correct application and commissioning of Dynamic and Pressure Independent Balancing and Control valves:

- BSRIA BG 2/2010: Commissioning Water Systems
- BSRIA BG 51/2014: Selection of Control Valves in Variable Flow Systems
Considerations
PT Plugs Measure DP Not Flow Rate
Do not Forward Flush through CFRs or PICVs
Springs & Diaphragms cause Hysteresis
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