

Digital positioner TZIDC

Efficient quick closing of valves with a ‘non-linear’ characteristic curve



Controlled limited pressure increase in the pipe thanks to the digital positioner

TZIDC
TZIDC-200

Introduction

Valve flaps, ball and plug valves are popular choices for shut-off valves, since in fully opened state, they exhibit minimum pressure and thus energy losses. In times of increasing energy costs, this is a significant aspect.

Typically, these types of valves have a flow characteristic in which the flow rate reacts with disproportionately large flow variations in the range of low opening cross-sections in small positioning increments.

This behavior is reversed in the range of larger opening cross-sections. This means that even large positioning increments and therefore larger variation of the clear cross-section result in comparably marginal flow rate variation.

A typical example of this are valves with equal-percentage characteristic curves in which a defined positioning increment results in a defined percentage variation of the clear cross-section. Figure 02 shows the flow rate characteristic curve and the corresponding pressure before a valve with an equal-percentage characteristic curve.

... Introduction

01 TZIDC positioner installed in a gas distribution system

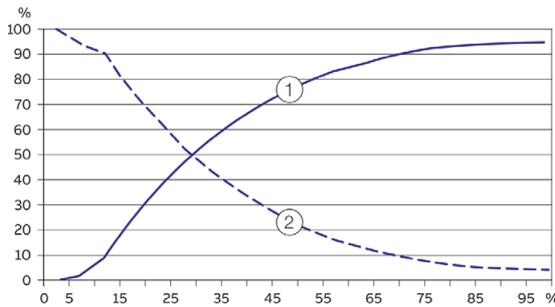
02 Equal-percentage valve characteristic curve

03 TZIDC closing cams Rev. 2.00 (green) and Rev. 3.00 (blue) by comparison



01

For systems in which large mass flows need to be controlled, such behavior during closing of the valve is very problematic due to the mass inertia and the energy saved within. In the worst case, uncontrolled closing can lead to a water hammer, a pressure spike which in turn can cause excessive strain or even destruction of the valve. Even pipe implosion can occur as a consequence of negative pressure which forms behind the valve due to the unrestricted continuously flowing mass.



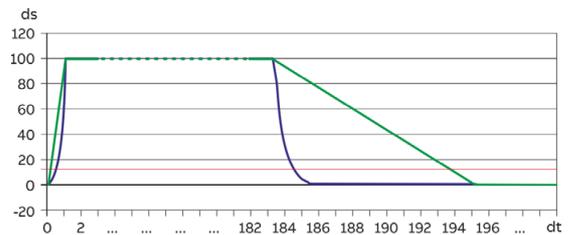
① Flow rate ② Pressure difference

02

Quite critical are ranges < 15 %, in which nearly 50 % of the mass flow needs to be decelerated with less than a fifth of the opening cross-section. The state-of-the-art approach is to close pipes, flanges and valves with the risk of developing water hammers in a controlled manner using mechanic-pneumatic devices or electric multi-turn actuators, whereby additional pipe protection devices are used.

Instrumentation

As an effective means to close these types of critical valves in a controlled manner, the ABB TZIDC positioner Rev. 2.00 already offers a configurable set point ramp which converts sudden set point changes inside the device into a linear set point change extended over time. Since the ramp function also extends the positioning time in ranges without critical flow and therefore pressure variation, the trade-off of the safe closing in the TZIDC Rev. 2.00 is however also an unnecessarily long closing time.



03

The new version of the ABB TZIDC positioner Rev. 3.00 now allows for the combination of a set point ramp with a control characteristic. This type of set point processing is in no way a state-of-art solution for 4 to 20 mA devices. The combination mentioned makes it possible to quickly position the valve in ranges with non-critical pressure increases combined with controlled positioning next to the pressure increase in the 'critical' ranges.

Figure 3 compares the positioning behavior of the TZIDC Rev. 2.00 with that of the TZIDC Rev. 3.00. The red auxiliary line marks the positioning speed of the TZIDC Rev. 3.00 at an opening cross-section of 12 %.

This makes it clear that in spite of the shortened closing time due to the factors, the positioning speed of the TZIDC Rev. 3.00 in the range of critical pressure increase is lower than that of the TZIDC Rev. 2.00.

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04 TZIDC and TZIDC-200
for Ex applications

This means that the TZIDC Rev. 3.00 allows for quicker closing with a visibly reduced risk of a water hammer and without any negative impact on the opening time of a valve.

At the same time, use of this function does not require any costly analog output of a control system. Supplied by a constant current source if 3.8 to 4 mA, the available standard digital output can be used to execute the 'OPEN' and 'CLOSE' valve settings.

In unchanged form, the new revision provides several options for setpoint signal feedback, ranging from the visual position display and retrofittable plug-in module to the analog feedback of the actual position and the redundantly supplied limit and proximity switches.

Benefit analysis

Up until now, complex and therefore expensive mechanical and pneumatic devices have been securing the safe controlled closing of shut-off valves with an equal-percentage characteristic curve. This functionally can now be executed easily and efficiently by the TZIDC digital positioner. In addition, it integrates a variety options, independently supplied feedback of the actual position as needed, which would otherwise have to be created, installed, calibrated and maintained.

Components used

TZIDC and TZIDC-200 digital positioner for Ex applications



04

IP converter tried and tested millions of times:

- Nozzle flapper converter principle
- Unrivaled robust design to protect against shock and vibration

Wide temperature range from 40 to 85 °C

Low air consumption of 0.03 kg/h independent of supply pressure

Very high level of control accuracy:

- The optimized setpoint algorithm positioned like a servo actuator, very quick, very precise and stable over the long term

Extensive diagnosis options:

- e.g.: stress determination, leakage monitoring, valve diagnosis, hardware errors

Automatic adjustment saves time and money

- No manual input is required
- No mechanical range adjustment
- Automatic determination of all parameters
- Improved adjustment accuracy
- Separate parameter sets for opening and closing

Efficient on-site operation

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