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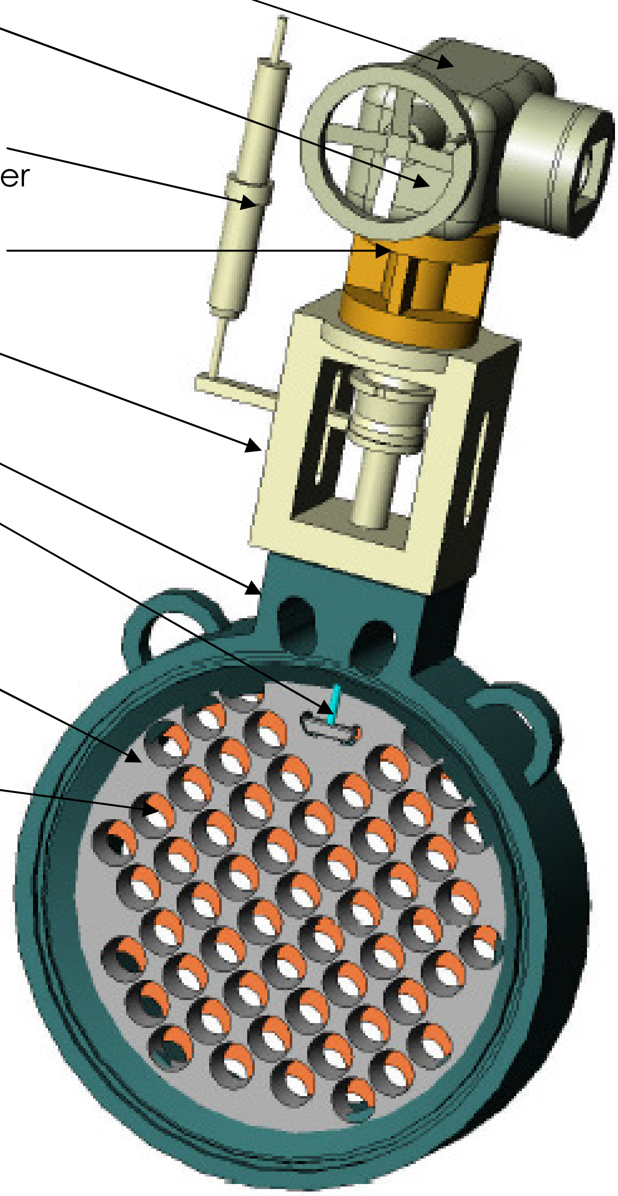
MULTIJET CONTROL VALVES

Discharge and pressure control



The Multijet Control Valves, have been specially designed to adjust the head losses in a hydraulic circuit to allow the control (manual or automatic) of discharges or of associated parameter like pressure, level, temperature, etc.

Its originality consists in the behavior of the fluid energy dissipation: the flow is fractioned into multiples small jets evenly distributed over the cross-section of the pipe.

- Extremely simple and rational design,
- Control on 100% stroke,
- Excellent coefficient of cavitation,
- Sensitive to small variations in opening,
- Elimination of flow-induced fluctuations,
- Low level of vibration and noise.

Because of this design, operating hazards as cavitation, vibration, noise, pressure fluctuation, inducing valve damages, are pactically eliminated assuring the Multijet Control Valve superiority in controlling water flow systems used for Water distribution, Irrigation or industrial purposes.

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Principle

The relative and limited displacement between two perforated plates permit the flow passage section variation that is the value of head losses.

Design

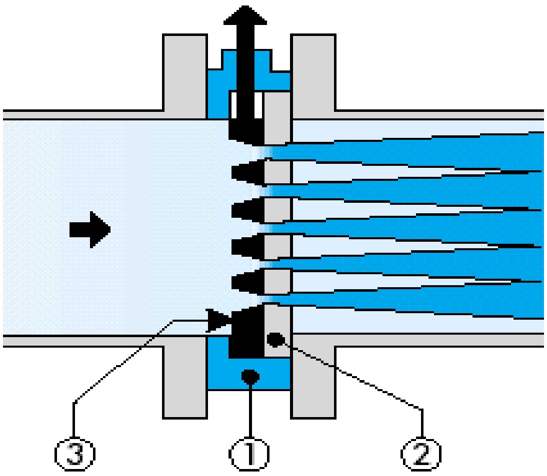
An annular body (1), mounted between pipe flanges houses the two circular plates located perpendicularly to the flow and equally perforated.

The plate on the downstream side (2) is fixed.

The plate on the upstream side (3) is movable and slides onto the fixed plate. In the fully open position the orifices in the plates coincide allowing the larger section for the flow discharge. As the moving plate displaces, the fixed plate orifices are partially closed and the flow discharge section decreases gradually until they are fully closed as a closed valve. The moving plate can be controlled manually or by an actuator (electric, hydraulic, or pneumatic), which may be eventually controlled by the parameter to be adjusted by an electronic regulator controller.

Characteristics and Advantages

A fluid flowing through a valve dissipates part of its energy. This energy loss often causes a disturbance as flow fluctuations and inducing mechanical vibrations, cavitation (bubbles of



air), noise due to turbulence or the sudden collapse of cavitation bubbles.

In Multijet Control Valves, as the flow is divided into several jets evenly distributed in the whole section of plates, the energy dissipation is achieved in better hydraulic conditions to provide the following:

- Flow fluctuations are reduced because the energy is divided by the jets and the turbulence range is reduced by each one of them. Also diminished is the distance through which any disturbances present propagate downstream. In consequence, the generally recommended minimum distance between a valve and the next equipment or circuit element, such as flowmeters, pressure intakes, joints and others is reduced;
- Multijet Control Valves have an initial cavitation value more favorable than those of conventional valves;
- Multijet Control Valves perform well in presence of cavitation by accepting it without any hazard because:

  - The cavities occur solely in the fluid and not in the immediate vicinity of vital parts of the valve.
  - During anticipated conditions of use, no air bubbles are formed and this reduces the hazards, of pressure variation.

Finally, Multijet Control Valves do not have a natural tendency to open or close, which represents a positive safety factor.

Hydraulic characteristics

Hydraulic tests performed in test stands precise characteristic measurement and direct flow visualization, as well feedback the operation of valves already installed, allow to define their characteristics, the application selection and dimensioning criteria of Multijet Control Valves.

We present below the main Multijet Control Valves characteristics and the sizing criteria.

Head loss

The head losses caused by a Multijet Control Valve may be defined by the equation:

$$\Delta H = K\frac{V^2}{2g}$$

in which:

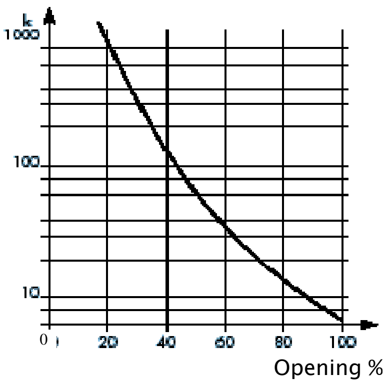
ΔH = the head loss in meters for a given valve opening.

K = the (dimensionless) head loss coefficient.

V = the velocity of the liquid in m/s calculated based on the nominal cross-section of the valves.

g = gravity in m/s^2.

The chart below shows an example curve of coefficient K values for a maximum perforated area.



Specific flow

Specific flow (q_{11}) is defined as the flow passing through a one meter diameter Multijet Control Valve, which causes a head loss equal to one meter.

$$q11 = \frac{Q}{D^2\sqrt{\Delta H}}$$

in which:

Q = Flow in m^3/s

D = Nominal valve diameter in m.

ΔH = Head loss in m.

The characteristic curves for flow and cavitation of Multijet Control Valves on next page, show as an example the curve:

q_{11} = f (valve opening)

Cavitation

The tendency of a valve to cavitate is usually characterized by a cavitation number sigma (σ) defined as:

$$\sigma \frac{P_2 - P_v}{P_1 - P_2}$$

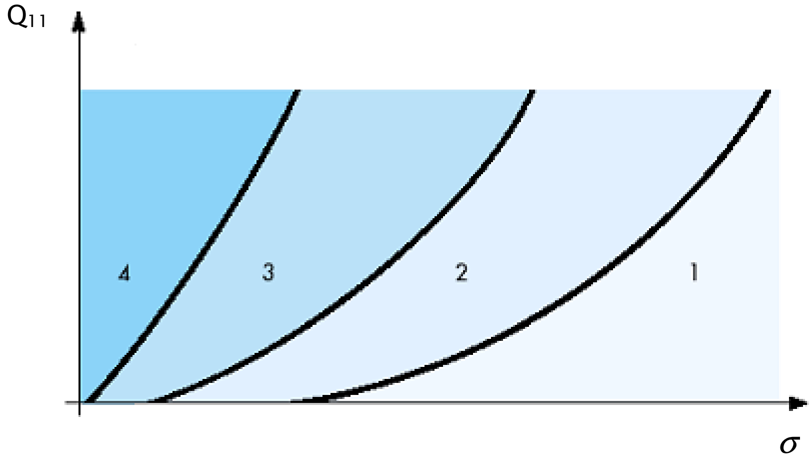
where:

P_1 = absolute upstream pressure of the valve (measured upstream at a distance equal to the pipe diameter).

P_2 = absolute downstream pressure of the valve (measured downstream at a distance equal to ten pipe diameters discounting the head loss for this section).

P_v = vapor pressure of the liquid at the operating temperature.

For a valve of a given opening several different values of sigma are set, corresponding to various degree of cavitation. Also we can define variation of the sigma value for a given valve of the valve opening. These curves can be plotted as required sigma curves, which indicate the degree of cavitation. An example of cavitation curves is given in the graph below:



Operating Zone

1. Nominal operation (excellent zone)
2. Acceptable operation
3. Operation possible, though some risks
4. No operation allowed

Flow and cavitation characteristic curves

The variables of the graph are defined thus:

$$q11 = \frac{Q}{D^2\sqrt{\Delta H}}$$

$$\sigma = \frac{p_2 - P_v}{P_1 - P_2}$$

$$K = \frac{P_1 - P_2}{P_1 - P_v}$$

Multijet Control Valve flow and cavitation characteristic curves are shown in the graph in terms of the specific flow q_{11} in m^3/s.

The three curves on the right define the operating limits of the four cavitation zones. Based on the value of "available sigma" of the system, which must always be greater than the "required sigma", we may define the valve operating zone.

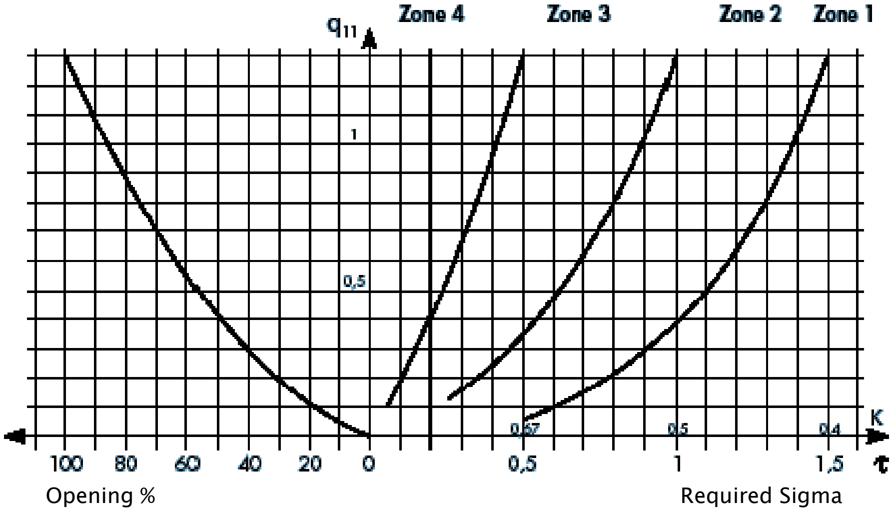
In terms of cavitation region, the fixed and moving plates material is selected as follows:

- Zone 1 : Fixed and moving plate in nodular cast iron.
- Zone 2 : Fixed plate in stainless steel and moving plate in nodular cast iron.
- Zone 3 : Fixed and moving plate in stainless steel.
- Zona 4 : No operation allowed.

Operation and control

Multijet Control Valve operation may be achieved:

- Manually with a wheel with or without gear reducing box and with position micrometric selector,
- Electric actuator,
- Hydraulic or pneumatic actuator.

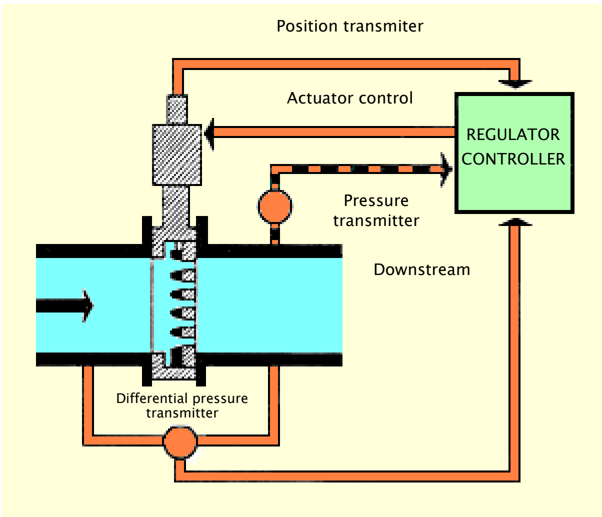


Graphic not applicable for Multijet Control Valve discharging in the atmosphere.
(installed in the pipe end)

A number of features and details with different operating options may be supplied upon request.

Multijet Control Valves when are driven by electric, hydraulic, or pneumatic actuators may be controlled by a regulator associated with detectors of pressure, position, temperature or other parameter subject to possible control.

The diagram below shows a system for downstream pressure and flow control.



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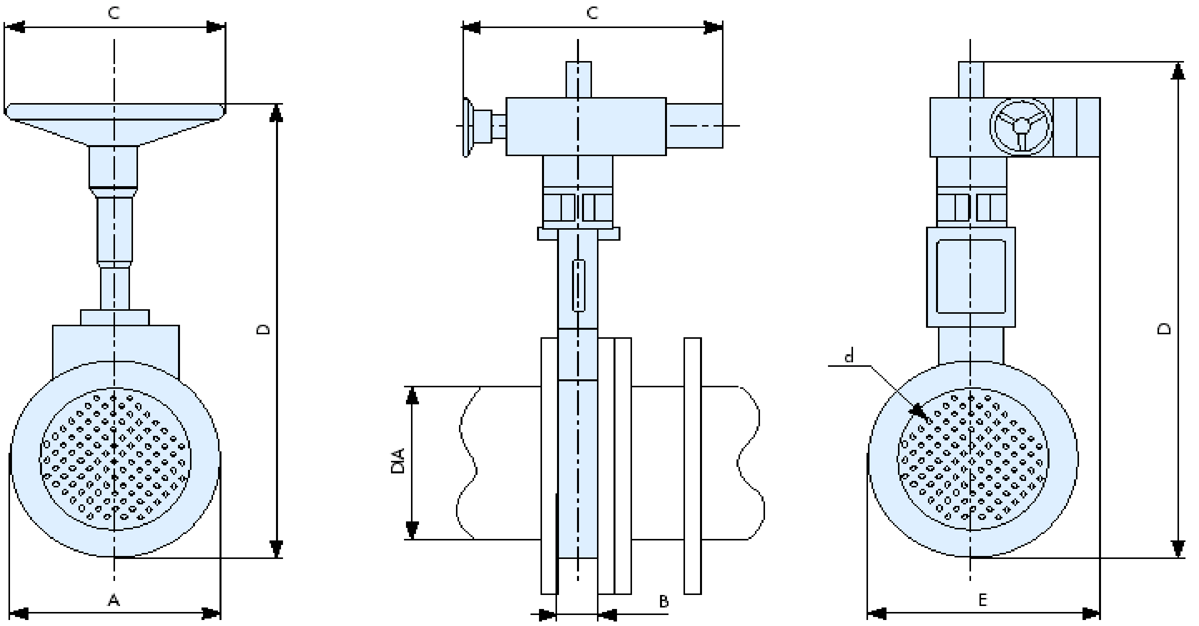
Dimensions (mm)



DN		Actuator	A	B	C	D	E	d	N	Weight
mm	inches	(1)	(4)			(3)			(2)	Kg
100	4"	M	162	60	250	390	–	7	8	11
		E			383	480	290			32
150	6"	M	220	80	250	516	–	11	12	20
		E			383	580	320			38
200	8"	M	290	80	250	587	–	15	15,5	35
		E			383	645	350			46
250	10"	M	350	84	315	727	–	18	19	56
		E			475	795	377			80
300	12"	M	400	95	400	757	–	22	11,5	79
		E			475	850	400			106
400	16"	M	516	110	500	943	–	29	15	148
		E			400	1160	602			215
500	20"	E e M	593	150	580	1720	900	36		480
600	24"	E e M	695	160	580	1840	960	43		560
700	28"	E e M	810	160	580	1920	1010	50		600
800	32"	E e M	917	160	580	2040	1060	58		700
900	36"	E e M	1017	160	580	2150	1120	65		800
1000	40"	E e M	1124	160	580	2280	1170	72		900
1200	48"	E e M	1344	160	580	2460	1280	87		1100
1400	56"	E e M	1552	160	580	2670	1380	102		1400
1500	60"	E e M	1660	160	580	2770	1440	109		1700

(1) M: manual control
E: electric actuator
E and M: electric actuator and manual control with reductor

(2) N: Number of turns between fully open and closed positions

(3) Indicative Dimension in mm

(4) Pipe flanges according to ISO2531 or NBR 7675

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Materials of construction

- Body : DIN1693 - GGG 40 nodular cast iron.
- Fixed and moving plate: DIN 1693 - GGG 40 nodular cast iron or 13% Cr AISI 420 stainless steel.
- Support: DIN 1693 - GGG40 nodular cast iron.
- Stem : 13% Cr AISI 420 stainless steel.
- Seals: 70 Shore A Perbunan.

Other construction materials are available upon request to suit particular operating conditions.

Assembly

Multijet Control Valves are mounted between pipe flanges or at the pipe end.

To facilitate assembly and dismantling, it is recommended that one of the flange connections be of the sliding or sleeve type.

Multijet Control Valves may be installed in:

- Vertical pipes, preferably in descending flow,
- Horizontal pipes; in this case the actuator or manual controller shall be positioned verically on top so to ensure purging through the drain located on its lower body.

Operating limits

- Temperature

Multijet Control Valves made from the standard materials should operate within the temperature range of 0 - 80ºC (32 - 176 fahreinheit).

Multijet Control Valves seal effectiveness may be maintained up to 200ºC by using special seal material. The temperature limits above, originated from the construction technology, are only for guidance and depend on the fluid type and operating pressure, more precisely on the cavitation risk assessment.

- Pressure

Maximum standardized static pressure for valves is:

- 25 bar with com DN 200 to 600 mm (8" to 24");
- 16 bar for valves with DN 700 to 800 mm (28" to 32");
- 10 bar for diameters of 900 to 1000 mm (36" to 40"); and
- 6 bar for larger diameters.

Fields of Application

- Water supply systems,
- Hydraulic distribution, cooling and mixing systems,
- Intake works of water treatment plant,
- Flow relief discharge for pump and turbine units,
- Dam water bottom discharge,
- Laboratory test-rigs.