



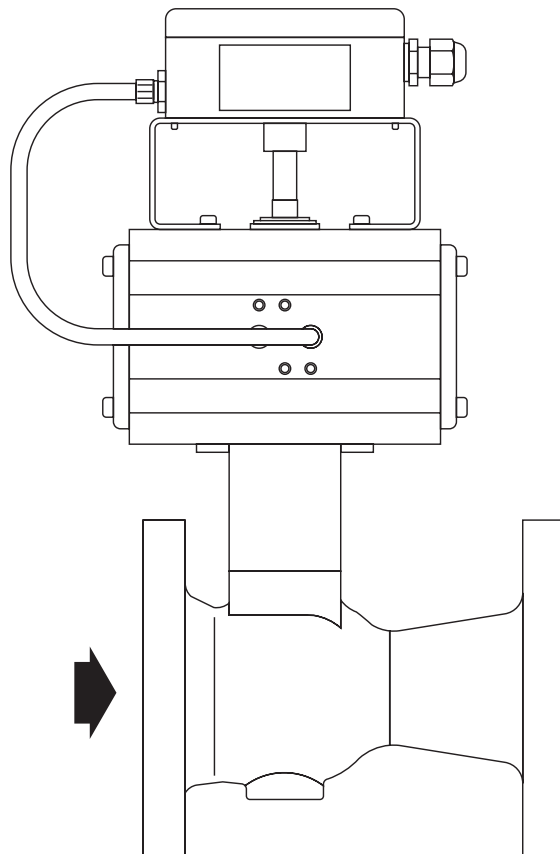
## M45 ISO Ball Valve for Control of Fluids Sizing Sheet

### Description

The M45 ISO ball valve is ideal for control applications. Both ball and seat are manufactured in chrome plated metal which ensures a long life, even with applications that constantly modulate the flow of the fluid. The valve is actuated by a double or single acting pneumatic actuator. The actuator is regulated by an electropneumatic positioner that receives a 4 - 20 mA signal from the process.

### Advantages:

- Inherent equal percentage flow characteristic with high rangeability (32:1).
- Suitable for fluids that contain solids in suspension.
- Capacity is much higher than a same size globe valve.
- Less maintenance than spindle regulating valves.
- Small, compact and easily maintained.



## Sizing

1. Determine the required  $C_v$  for the ball valve using the appropriate equation detailed below. With the first approximation for this calculation it is suggested to use a factor  $FL = 0.68$ , that corresponds to an opening of the valve of  $72^\circ$ .
2. Calculate the diameter of the pipe for maximum flow within the limits of velocity and pressure drop for the fluid.
3. With the  $C_v$  and pipe diameter, use the table on page 4 starting with the column that corresponds to the rotation of  $72^\circ$ , that gives  $FL = 0.68$ .
4. In this column, choose the combination of ball valve diameter and pipe diameter that gives a  $C_v$  result the same or superior to the one calculated in step 1.
5. It is recommended not to use a ball valve with a diameter less than half the pipe diameter, because of excessive tension that can produce vibrations.

### Simplified equations for sizing ( $K_v$ values = $C_v \times 0.86$ )

For liquids		
Where:	Sub-critical flow	Critical flow
$\Delta P_m$ = Maximum $\Delta P$ for sizing, When $P_2 > P_v$ use $\Delta P_m = F_L^2(P_1 - P_v)$ When $P_2 > P_v$ use $\Delta P_m = P_1 - \left[ 0.96 - 0.28 \sqrt{\frac{P_v}{P_c}} \right] P_v$  $C_v$ = Flow coefficient of the valve $F_L$ = Pressure recovery factor $pr$ = Density at inlet temperature (water = 1.0 at STP) $P_1$ = Upstream pressure (bar a) $P_2$ = Downstream pressure (bar a) $P_v$ = Vapour pressure of the liquid at inlet temperature (bar a) $P_c$ = Thermodynamic critical pressure (bar a) $\dot{V}$ = Flowrate in $m^3/h$ $\dot{m}$ = Flowrate in $kg/h$	<b>When:</b> $\Delta P < \Delta P_m$  <b>Volumetric flowrate</b> $C_v = 1.16 \dot{V} \sqrt{\frac{pr}{\Delta P}}$  <b>Mass flowrate</b> $C_v = \frac{\dot{m}}{865 \sqrt{\Delta P pr}}$	<b>When:</b> $\Delta P \geq \Delta P_m$  <b>Volumetric flowrate</b> $C_v = \frac{1.16 \dot{V}}{F_L} \sqrt{\frac{pr}{\Delta P m}}$  <b>Mass flowrate</b> $C_v = \frac{\dot{m}}{865 F_L \sqrt{pr \Delta P m}}$

## Simplified equations for sizing ( $K_v$ values = $C_v \times 0.86$ )

For steam and gases		
Where:	Sub-critical flow	Critical flow
<p><math>C_v</math> = Flow coefficient of the valve</p> <p><math>F_L</math> = Pressure recovery factor</p> <p><math>pr</math> = Specific density of gas (air = 1)</p> <p><math>P_1</math> = Upstream pressure (bar a)</p> <p><math>P_2</math> = Downstream pressure (bar a)</p> <p><math>T</math> = Inlet temperature in °K (°C + 273)</p> <p><math>\dot{V}</math> = Flowrate of gas in Nm<sup>3</sup>/h (at 15°C and 1 bar a)</p> <p><math>\dot{m}</math> = Flowrate of gas in kg/h</p> <p><math>T_{so}</math> = Superheating of steam in °C (Temperature of superheated steam - Temperature of saturated steam)</p> <p><math>\dot{m}_s</math> = Flowrate of steam in kg/h</p> <p><b>Note:</b> These equations are only a simplified version of the original sizing equations of the ISA and IEC regulations. The results are sufficiently close for practical use. There could be a maximum error of 8% in the transition of non-choked flowrate to choked flowrate.</p>	<p><b>When:</b></p> $\Delta P < 0.5 F_L^2 P_1$ <p><b>For gases (volumetric flowrate)</b></p> $C_v = \frac{\dot{V}}{295} \sqrt{\frac{prT}{P_1^2 - P_2^2}}$ <p><b>For gases (mass flowrate)</b></p> $C_v = \frac{\dot{m}\sqrt{T}}{360 \sqrt{(P_1^2 - P_2^2)pr}}$ <p><b>For saturated steam</b></p> $C_v = \frac{\dot{m}_s}{13.81 \sqrt{P_1^2 - P_2^2}}$ <p><b>For superheated steam</b></p> $C_v = \frac{\dot{m}_s (1 + 0.00126 T_{so})}{13.81 \sqrt{P_1^2 - P_2^2}}$	<p><b>When:</b></p> $\Delta P > 0.5 F_L^2 P_1$ <p><b>For gases (volumetric flowrate)</b></p> $C_v = \frac{\dot{V}}{257} \frac{\sqrt{prT}}{F_L P_1}$ <p><b>For gases (mass flowrate)</b></p> $C_v = \frac{\dot{m}\sqrt{T}}{311 F_L P_1 \sqrt{pr}}$ <p><b>For saturated steam</b></p> $C_v = \frac{\dot{m}_s}{11.95 F_L P_1}$ <p><b>For superheated steam</b></p> $C_v = \frac{\dot{m}_s (1 + 0.00126 T_{so})}{11.95 F_L P_1}$

**Cv values (Kv values = Cv x 0.86)**

Valve size	Pipe size	Rotation										
		0°	9°	18°	27°	36°	45°	54°	63°	72°	81°	90°
DN25	25 mm	0.00	0.00	0.96	1.61	2.56	3.88	6.51	9.61	<b>15.50</b>	24.49	31.00
	32 mm	0.00	0.00	0.96	1.61	2.56	3.87	6.48	9.50	<b>15.06</b>	22.85	27.86
	40 mm	0.00	0.00	0.96	1.61	2.56	3.87	6.45	9.42	<b>14.73</b>	21.75	25.92
	50 mm	0.00	0.00	0.96	1.61	2.55	3.86	6.41	9.29	<b>14.24</b>	20.27	23.52
DN40	40 mm	0.00	0.00	2.94	4.93	7.82	11.85	19.91	29.39	<b>47.40</b>	74.89	94.80
	50 mm	0.00	0.00	2.94	4.93	7.81	11.81	19.74	28.86	<b>45.28</b>	67.26	80.57
	65 mm	0.00	0.00	2.94	4.92	7.80	11.78	19.57	28.33	<b>43.30</b>	61.23	70.77
	80 mm	0.00	0.00	2.94	4.92	7.79	11.74	19.38	27.77	<b>41.39</b>	56.16	63.24
DN50	50 mm	0.00	0.00	3.41	5.72	9.08	13.75	23.10	34.10	<b>55.00</b>	86.90	110.00
	65 mm	0.00	0.00	3.41	5.72	9.08	13.74	23.05	33.94	<b>54.33</b>	84.33	104.92
	80 mm	0.00	0.00	3.41	5.72	9.07	13.71	22.93	33.57	<b>52.85</b>	79.08	95.30
	100 mm	0.00	0.00	3.41	5.72	9.06	13.69	22.80	33.15	<b>51.26</b>	74.04	86.83
DN65	65 mm	0.00	0.00	7.15	11.99	19.02	28.81	48.41	71.46	<b>115.25</b>	182.10	230.50
	80 mm	0.00	0.00	7.15	11.99	19.00	28.74	48.09	70.45	<b>111.15</b>	167.10	202.12
	100 mm	0.00	0.00	7.15	11.97	18.96	28.60	47.44	68.43	<b>103.70</b>	144.56	165.48
	150 mm	0.00	0.00	7.14	11.96	18.91	28.44	46.71	66.31	<b>96.71</b>	127.22	140.79
DN80	80 mm	0.00	0.00	8.99	15.08	23.93	36.25	60.90	89.90	<b>145.00</b>	229.10	290.00
	100 mm	0.00	0.00	8.99	15.07	23.91	36.17	60.53	88.71	<b>140.16</b>	211.30	256.20
	150 mm	0.00	0.00	8.99	15.06	23.86	36.00	59.74	86.30	<b>131.20</b>	183.85	211.18
	200 mm	0.00	0.00	8.98	15.06	23.84	35.93	59.40	85.27	<b>127.65</b>	174.44	197.26
DN100	100 mm	0.00	0.00	17.36	29.12	46.20	70.00	117.60	173.60	<b>280.00</b>	442.40	560.00
	150 mm	0.00	0.00	17.35	29.10	46.10	69.66	116.00	168.58	<b>260.27</b>	374.87	438.72
	200 mm	0.00	0.00	17.35	29.08	46.03	69.40	114.81	164.97	<b>247.56</b>	339.58	384.87
	250 mm	0.00	0.00	17.35	29.06	45.98	69.24	114.10	162.89	<b>240.69</b>	322.47	360.47
DN150	150 mm	0.00	0.00	23.25	39.00	61.88	93.75	157.50	232.50	<b>375.00</b>	592.50	750.00
	200 mm	0.00	0.00	23.25	38.99	61.85	93.66	157.07	231.12	<b>369.29</b>	570.71	707.20
	250 mm	0.00	0.00	23.25	38.99	61.82	93.55	156.53	229.43	<b>362.50</b>	546.56	662.73
	300 mm	0.00	0.00	23.25	38.98	61.80	93.47	156.18	228.32	<b>358.16</b>	532.04	637.31

FL		-	-	0.96	0.94	0.92	0.88	0.82	0.75	<b>0.68</b>	0.62	0.50
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