

Introduction of High-speed Opening and Closing Cylinder Valve

1. Introduction

Conventionally, ball valves and butterfly valves have been frequently used as automatic pneumatic valves which can be opened and closed in a short time and have low fluid flow resistance, but there have been difficulties in "durability and high-speed actuation".

Though these difficulties rarely become a problem in normal conditions, they sometimes become problematic in rolling line's cooling water switching valves in steel mills used in high frequency and high-speed operation. The problem is that the valve seat seal part is in sliding contact, and it is difficult to achieve good sealing for a long time because the valve seat is worn and damaged due to the accumulation of the operations. In addition, when the opening and closing operation time is short, the sudden increase in pressure on the primary side of the valve due to the water hammer phenomenon caused by sudden closing causes damage to the valve seat seal, valve support bearing, and operating stem and as a result, the valve may become inoperable.

In this report, we introduce the High-speed opening and closing cylinder valve, which was developed, and has been manufactured and sold about 40 years ago, has added value to solve these problems, and is still being selected by our customers.

2. Features

2-1) long sealing life

Since the valve seat seal is not in sliding contact, there is no deterioration in sealing performance due to friction.

2-2) Good operating reliability

Because of the internal structure is simplified and the number of moving parts is reduced, the occurrence of trouble is extremely low. In addition, since the entire valve has a cylindrical shape has sufficient strength to withstand a sudden pressure load due to the water hammer phenomenon and does not malfunction.

2-3) Compact and easy to handle

As the valve incorporates a drive unit and is integrated, it is compact, light, and easy to handle. Since the drive unit does not protrude, the space for piping can be reduced, and there is no limitation on the mounting procedure. Figure1 shows a sample image of a cylinder valve cut sample.



Figure1 Cylinder valve with built-in drive unit

2-4) High-speed operation

The moving parts are lightweight and have a short working stroke, enabling high-speed operation and good operability. Table1 shows a list of operating times for standard specifications.

Table1 Standard operating time of cylinder valve

FLUID PRESSURE OPERATION NOMINAL SIZE	OPERATION TIME (SEC.)				USE AIR APPARATUS (MADE BY KONAN ELE.)	
	0.98MPa		1.96MPa		SOLENOID VALVE	SPEED CONTROL VALVE
	OPEN SHUT	SHUT OPEN	OPEN SHUT	SHUT OPEN		
15A	0.10	0.10	0.10	0.10	453S202C	SC6-02-8A
20A	0.11	0.10	0.13	0.10		
25A	0.14	0.12	0.17	0.12		
32A	0.21	0.19	0.26	0.17		
40A	0.21	0.19	0.26	0.17	413S302C	SC6-04-10A
50A	0.33	0.28	0.43	0.26		
65A	0.30	0.26	0.36	0.25		
80A	0.34	0.29	0.42	0.27		
100A	0.44	0.38	0.57	0.35	413S603C	SC6-04-15A
125A	0.68	0.59	0.85	0.54		
150A	0.94	0.81	1.2	0.74		
200A	1.7	1.5	2.1	1.3		
250A	2.4	2.0	3.1	1.8	413S604C	SC6-08-20A
300A	2.6	2.1	3.5	1.9		
350A	3.1	2.6	4.0	2.4		
400A	3.4	3.1	3.8	2.8		
450A	4.8	4.5	5.3	4.1	413S806C	

2-5) Low air consumption

The effect of internal fluid pressure on valve operation is minimized, so the effective cylinder area is small. The amount of compressed air required for operation is less than the amount required to operate a ball valve of the same size.

2-6) Low fluid flow resistance

In a valve where the valve seat does not make sliding contact (eg a globe valve), the flow resistance is large because the flow direction of the fluid changes several times, but the flow direction of the cylinder valve is small. In addition, since the flow path is streamlined, the flow resistance is small and can be used for relatively large flow applications. Figure2 shows the relationship between the Cv value, differential pressure and flow rate of the two-way valve.

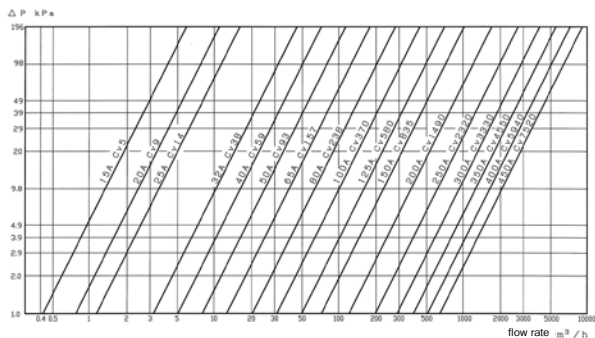


Figure2 Relationship between Cv value, differential pressure, and flow rate

3. Structure and Operation

The main components of the cylinder valve are the main body, the cap, and the piston, and the structure is such that the seal material for each joint and the movable part seal is used. Figure3 shows the cross-sectional diagram of the two-way cylinder valve. Also, a three-way cylinder valve can be made by attaching a T-shaped part to the primary side (body line flange side) of the two-way valve. Figure4 shows the cross-sectional diagram of the three-way cylinder valve.

The piston moves to the valve seat side or the non-valve seat side by switching the operating air pressure supplied to the cylinder (body). When the piston moves to the valve seat side, the tip of the piston is pressed against the valve seat packing, sealing the fluid flowing through the main body flow path and the inside of the piston, and the valve becomes “closed”. Next, when the operating air pressure is switched and the piston moves to the opposite side of the valve seat, the space between the tip of the piston and the packing of the valve seat is opened as a flow path, and the fluid flows through the main body flow path and

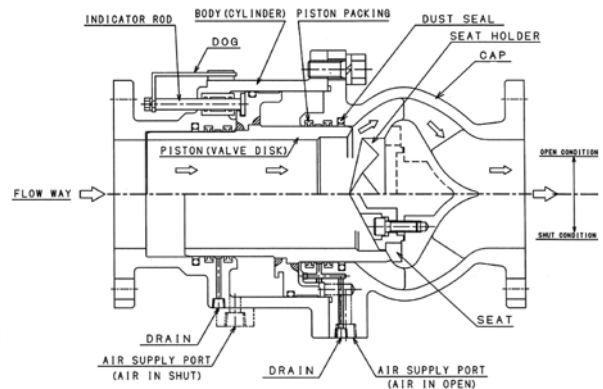


Figure3 Cross-section diagram of 2-way cylinder valve

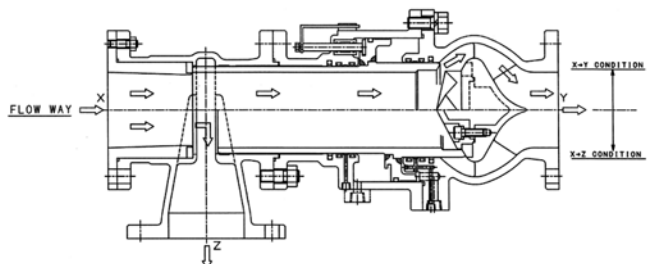


Figure4 Cross-section diagram of 3-way cylinder valve

the cap flow path through the piston inner part and the valves becomes "Open".

The opening and closing state of the valve can be easily checked visually with an opening and closing indicator attached to the piston. In addition, by attaching an operation bar to the opening and closing instruction rod, it is possible to detect the opening and closing state using limit switches and proximity switches, and to attach a positioner and control valves.

4. Standard Specifications

The standard specifications of the cylinder valve are as follows.

- Wetted metal material ... SCS13, SUS304
- Packing material... NBR, AU (Select others depending on the fluid)
- Connection JIS 10k, 20k flanges (CLASS 150 is also acceptable)
- Size Nominal size 15 A ~ 450 A
- Sealing life 500,000 cycles
- Max. operating pressure According to Table2
- Operation Air Pressure 0.4 ~ 0.7MPa
- Operating temperature range Depends on packing material (Consultation required)

Table2 Maximum operating pressure of cylinder valve

	NOMINAL PRESSURE	MAX.ALLOWABLE WORKING PRESSURE
2 WAY VALVE	10K	1.37MPa
	20K	3.33MPa
3 WAY VALVE	10K	0.98MPa
	20K	2.45MPa

Note : In case of 20k, 15A to 25A, both 2-way valve and 3-way valve are 1.97MPa.

5. Applications

5-1) Main application

The steelworks and PSA type nitrogen gas generator, which were the development purposes, are the main applications.

5-1-1) Steelworks (including non-ferrous metals)

Thick plate and hot rolling line product, cooling roll switching valve.

Customer needs: sealing life, operation reliability, high-

speed opening and closing, automatic valve

5-1-2) PSA type nitrogen gas generator

Gas switching valve for PSA type large mounted nitrogen gas generator.

Customer needs: sealing life, sealability, high-speed opening and closing, automatic ON-OFF valve

5-2) Examples of new applications

Recent application examples are introduced below.

5-2-1) Theme Park fountain equipment

Used for shows including fountains in theme parks. Cylinder valves are used as ON-OFF and control valves for fountain effects. The fountain flow rate control with high-speed opening and closing contributes to a more expressive show than ever before.

Customer needs: operation reliability, high-speed opening and closing, automatic ON-OFF valve, control valve

5-2-2) Factory Wastewater Equipment Filter

Factory wastewater is discharged outside the factory when it meets the standards through a filter. The wastewater dust adheres to the filter and filtering ability may deteriorate if it is used continuously. Therefore, dust is removed by air blow, but if the ON-OFF valve is used frequently, air leaks inside and the line must be stopped to perform maintenance.

ON-OFF ball valves are usually used in the above applications, but the sealing life is short because the valve seat is sliding contacts. The adoption of a cylinder valve can contribute to improving the operation rate of wastewater facilities and reducing maintenance man-hours.

Customer needs : sealing life, automatic ON-OFF valve

6. Conclusion

In this report, we introduced the High-speed opening and closing cylinder valve, which solves the customer's difficulties / problems (= challenges) with our reliable seal valve technology solution (= provides value). We believe that our customers continue to use our products because our products maintain high

quality. It is a realization of the fact that our name "Valqua" comes from "Value & Quality". We will continue to explore the potential needs of customers and provide solutions to build a win-win relationship with customers.

7. References

- 1) Japan Valve Manufacturers' Association: New Edition Valve Handbook, 368-370 (2011)
- 2) Masahiro Kitazawa: Valve Technical Report No. 52, 80-81 (2004)



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