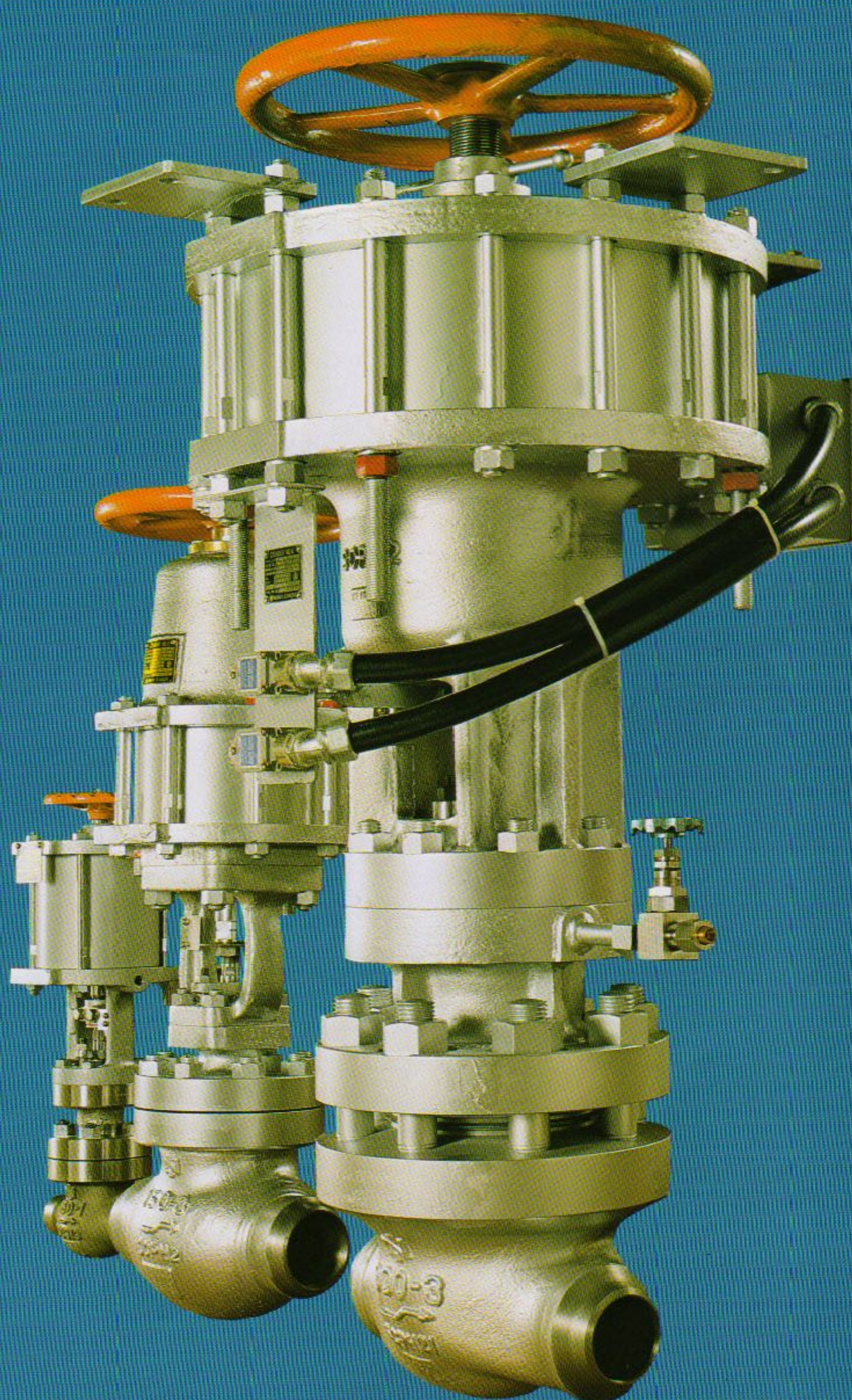




NAKAKITA

NAKAKITA CYLINDER VALVES

CAT.No. 362-1E



PREFACE

- In the pursuit of further economy, safety and reliability, technical innovations are now endlessly appearing in industrial plants. Cylinder valves play important roles in plants as the final process control elements, and diversification of their systems including accessories is required to suit the purpose.
- We, NAKAKITA, producing valves and their systems as a pioneer automatic valve manufacturer in Japan, are constantly striving to develop new techniques and improve the quality of our products. We also do our bests, in our total quality control system, to maintain highly stabilized design and manufacture procedures in accordance with various applicable regulations and standards.
- Plant surveys and inspections conducted by our customers including the utility power industry and plant manufacturers appreciated our technology and quality control system highly, and our plant has been designated as their certified plant. On the other hand, the high quality and reliability of our products are guaranteed by our acquisition of type certification for very strict environmental tests of each classification society.
- The cylinder valves detailed in this catalogue are systematized and many standard models are produced in series, on the basis of our resourceful experiences and past performances in various fields such as nuclear power, thermal power, iron making, ships, low temperature and pollution control. We are also prepared to meet any requirements of special specifications to your satisfaction.
- We believe this catalogue is a much help in your selecting cylinder valves. We hope your selection will be made from the abundant types of [NAKAKITA] cylinder valves. Please remember that our engineers are ready to assist you in your planning, on the basis of our living data produced from our numerous past performances.



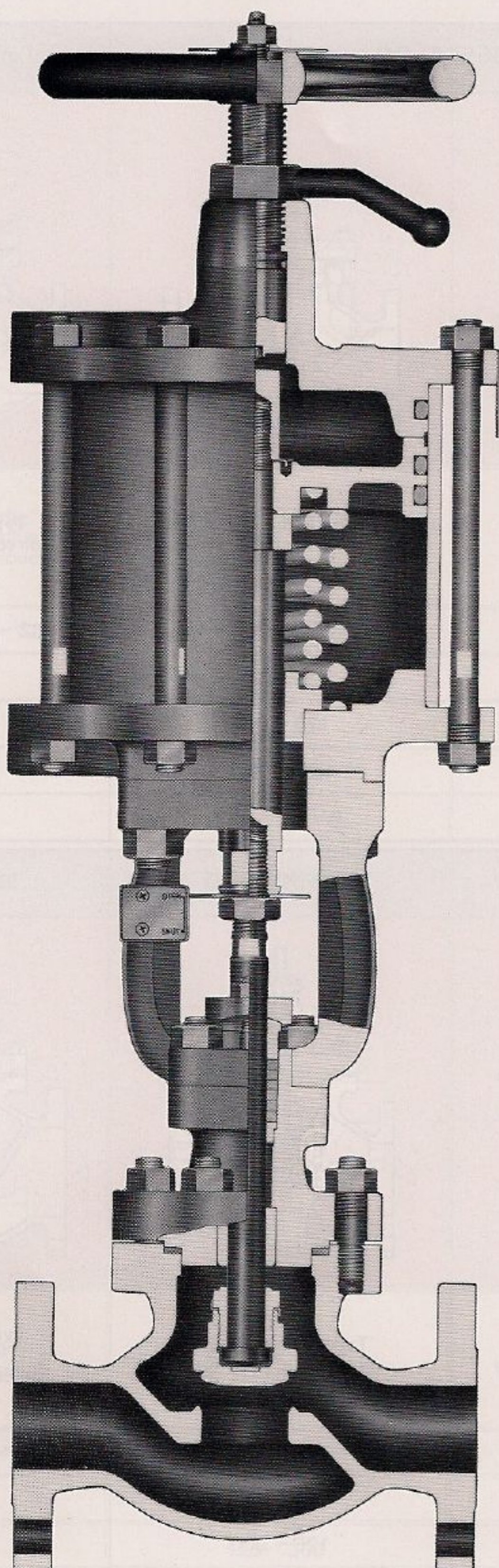
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NAKAKITA CYLINDER VALVES, A WIDER SELECTION OF HIGHLY RELIABLE VALVES!

FEATURES

1	RICH SELECTIONS	<ul style="list-style-type: none"> • [NAKAKITA cylinder valves] have been adopted for services ranging from high temperature and high pressure to cryogenic temperature and vacuum in all types of fields including space development, nuclear power, thermal power, chemical plants and ships.
2	HIGH RELIABILITY	<ul style="list-style-type: none"> • [NAKAKITA cylinder valves] are designed with high level technical standards. The production of valves [In Series] has been established on the basis of high reliability of individual valves which has been confirmed by numerous verification tests conducted by our competent technical staff using the latest facilities.
3	STABLE QUALITY	<ul style="list-style-type: none"> • Every production process is thoroughly controlled by competent NAKAKITA-men well trained for quality control. They are assisted by fully rationalized facilities including numerically controlled machines and by carefully maintained measuring instruments. NAKAKITA assures stable and reliable quality of our products.
4	EXCELLENT INTERCHANGEABILITY	<ul style="list-style-type: none"> • [NAKAKITA cylinder valves] consist of modular body assembly, actuator, hand operated device and various accessories for complete interchangeability and easy maintenance. This modular construction allows simpler replacement of components.
5	POSITIVE ACTIVATION	<ul style="list-style-type: none"> • [NAKAKITA cylinder valves], products of abundant experiences and excellent techniques, are equipped with an actuator which matches the inner valve construction. The actuator assures activating speeds suited to the process requirements and positive shutoff.
6	ECONOMICAL MECHANISM	<ul style="list-style-type: none"> • [NAKAKITA cylinder valves] nurtured by numerous past performances and persistent research and development efforts apply economical mechanism to every module so as to achieve economies.
7	CERTIFICATION OF PUBLIC AGENCIES	<ul style="list-style-type: none"> • We are certified to produce high pressure gas valves for services of 500kgf/cm² and under, and of ranges from high temperature down to cryogenic temperature, by the Minister of International Trade and Industry in accordance with the High Pressure Gas Control Act. We have many actual results in various high pressure gas facilities including LNG facilities. • Our products have passed the environmental test for unmanned machinery space system given by each classification society, and have lived up to the customers' expectation on the seas.



This drawing shows NS650EL00-DA.

CONSTRUCTION

■ VALVE BODY ASSEMBLY

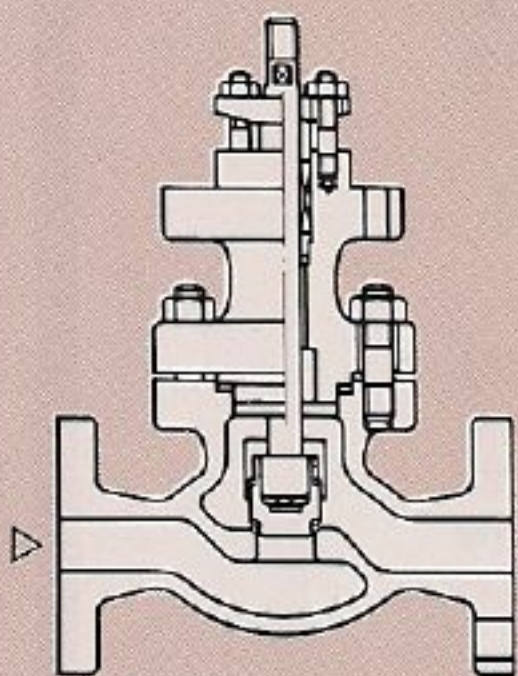
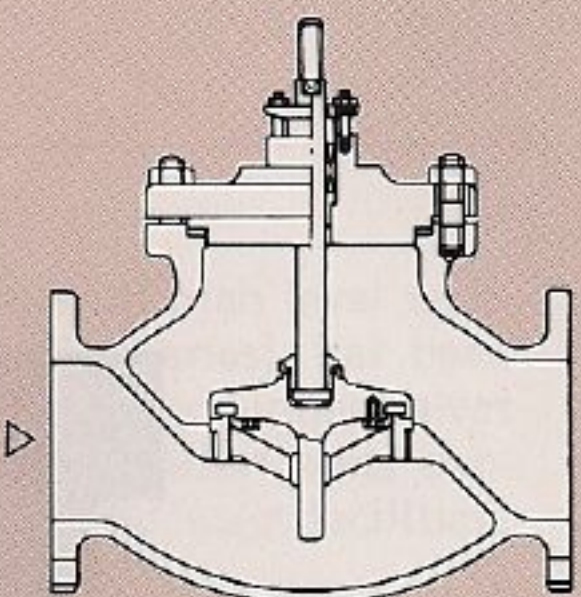
- The pressure containing part consisting of the valve body, bonnet and trim is called the [valve body assembly]. The pressure-temperature rating for materials is determined by the applicable standard. As to the type and size, the optimum selection is made according to your [specifications].
- The valve plug, seat ring, guide bushing, valve stem, etc. are called the [trim]. Its combination is determined according to your [specifications] including the fluid properties and pressure drop.
- The gland packing is selected to provide stable sealing over a long period of time against secular distortion and heat cycle.

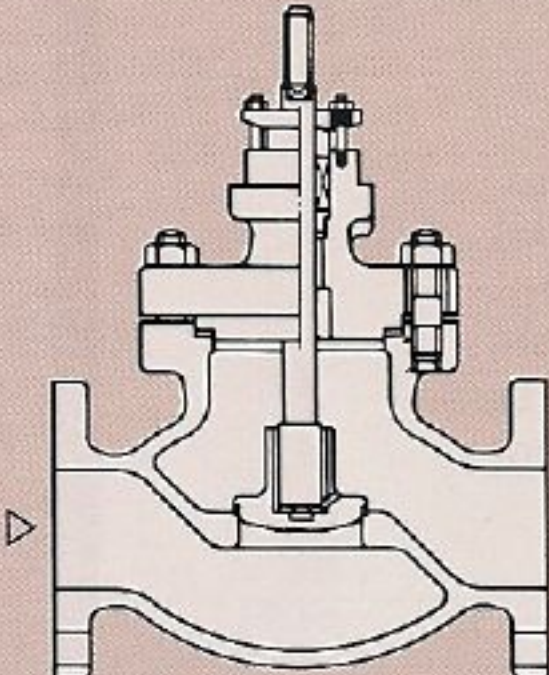
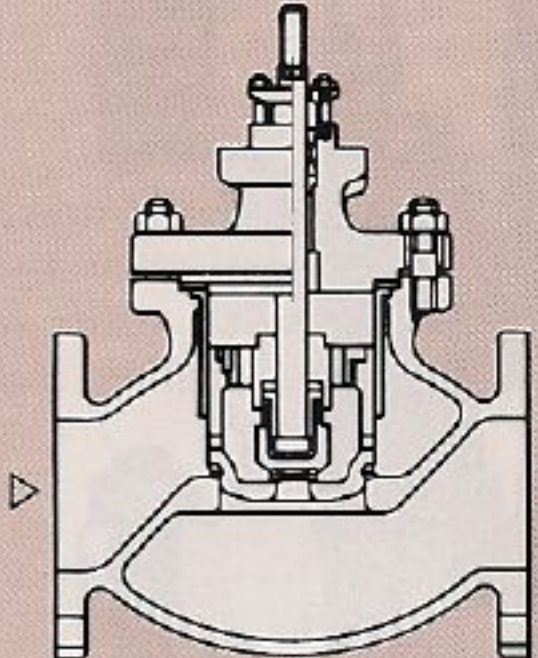
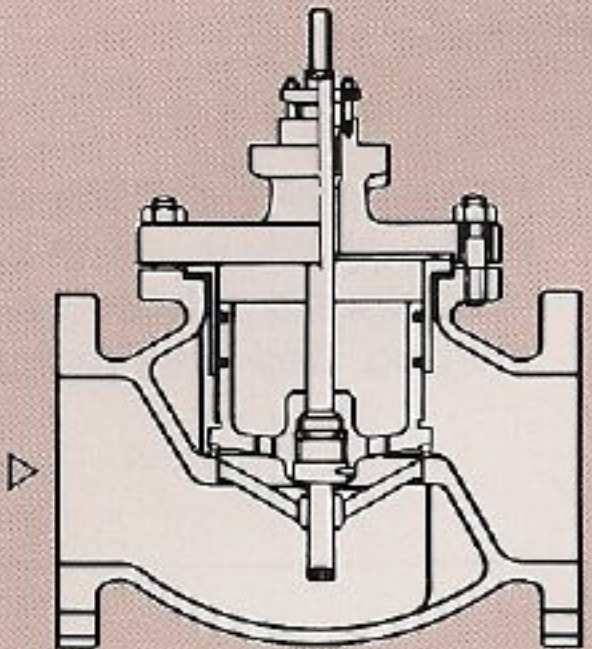
■ ACTUATOR

- The [actuator] generates an activating force from the operating pressure. Actuators are available in single action type (direct and reverse action types) and double action types. The optimal selection is made to meet the requirements of process.
- Necessary accessories such as hand operated devices and open-shut transmitters are available as options.

VALVE BODY ASSEMBLY

- The valve body assemblies listed in the table below are our standard products. We also produce a variety of special ones.

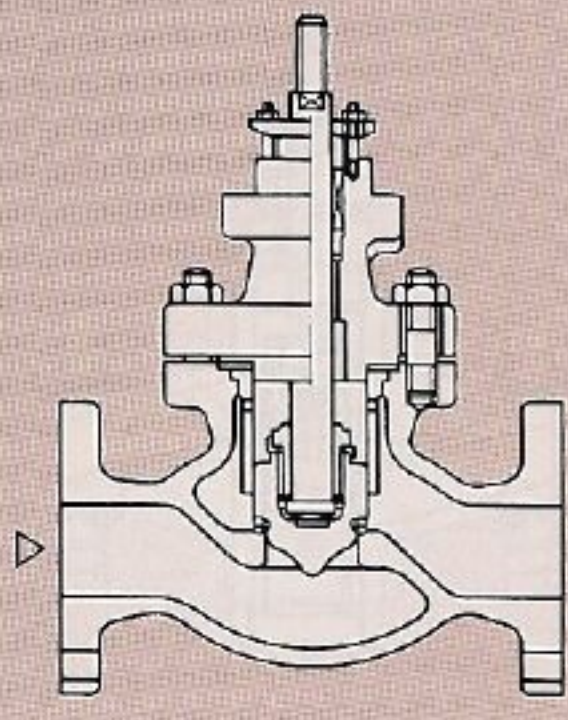
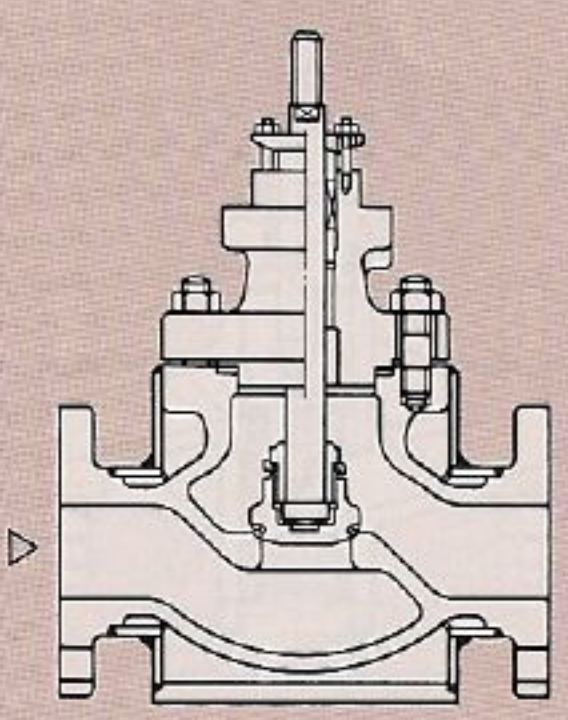
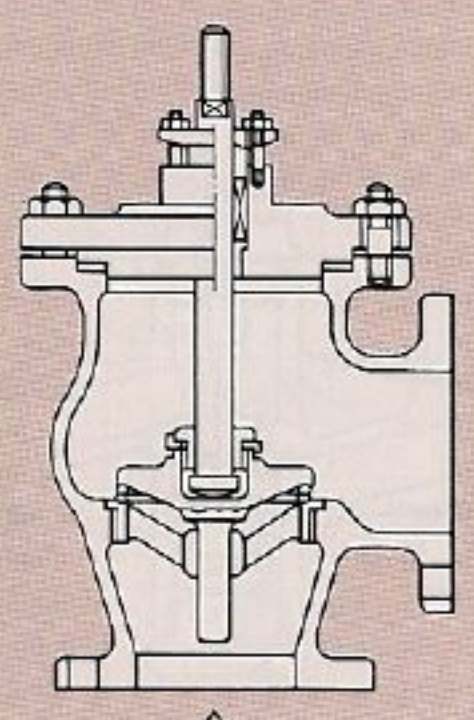
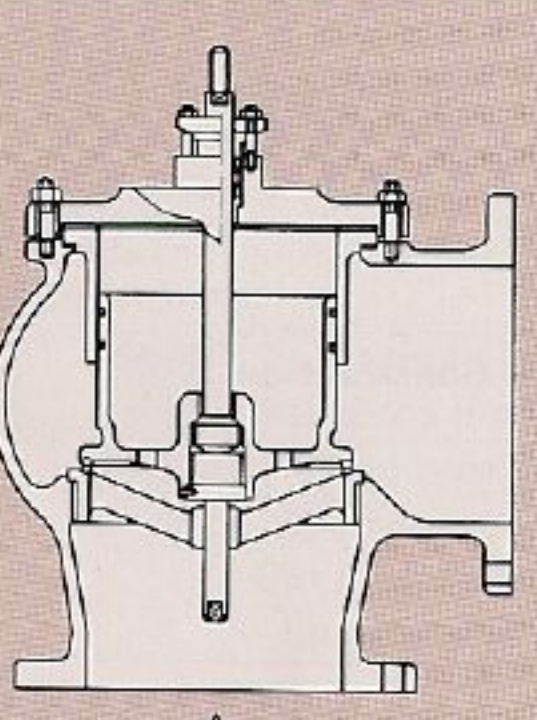
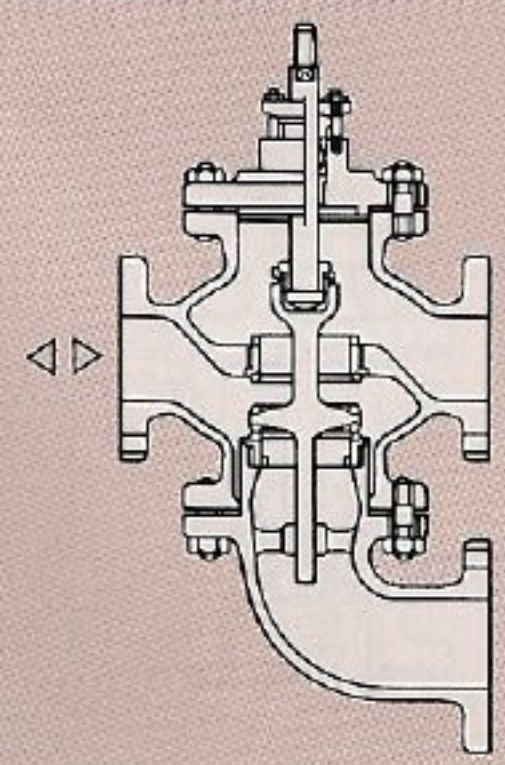
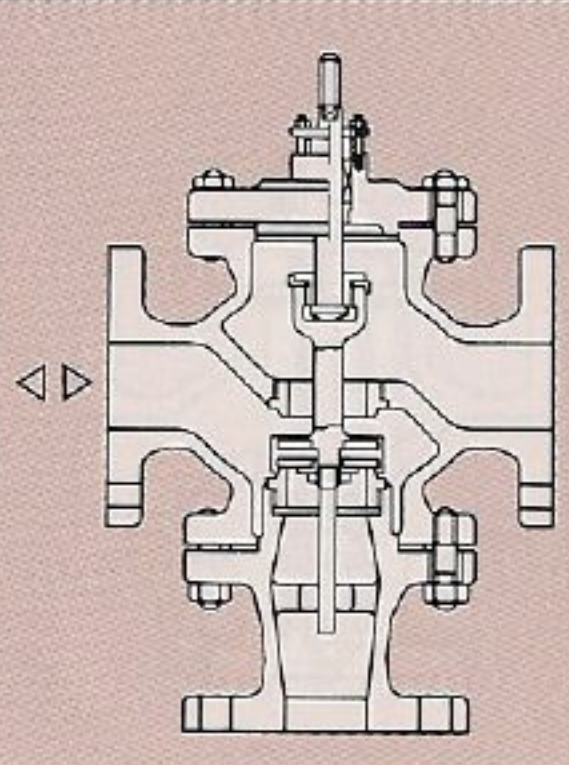
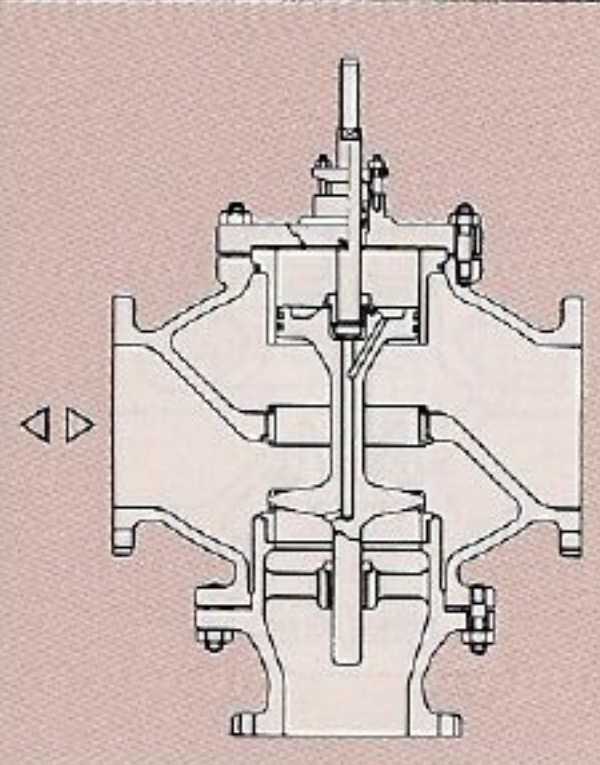
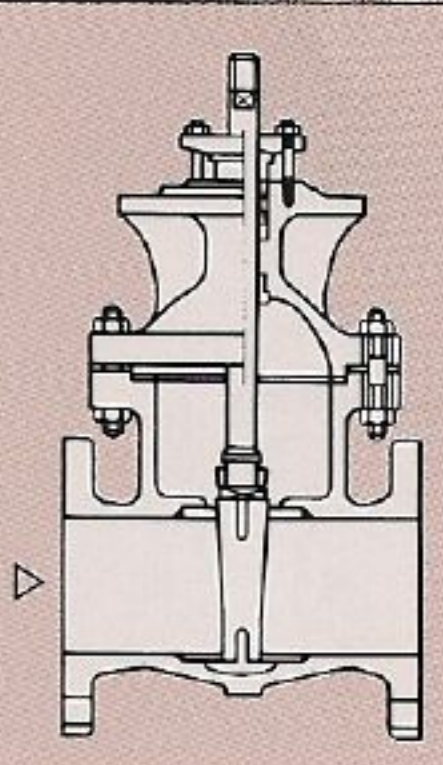
Type		NS650ELOO	NS650ELEO
Construction			
Features		Type E valve body, direct plug, metal touch	Type E valve body, direct plug, soft touch
Nominal bore mm (inch)		15, 20, 25 (1/2, 3/4, 1)	32 ~ 300 (1 1/4 ~ 12)
Pressure rating	JIS kgf/cm ²	5 ~ 63	5 ~ 20
	ANSI (Class)	125 ~ 1500	125 ~ 300
Max. design temperature °C (°F)		550 (1022)	150 (302)* ¹
Max. allowable leakage		IV ~ V*	VI*

Type		NS650ENOO	NS650EPOO	NS650EB00
Construction				
Features		Type E valve body, direct plug, nonreturn type	Type E valve body, direct plug, pilot type	Type E valve body, balance type, direct plug, metal touch
Nominal bore mm (inch)		32 ~ 200 (1 1/4 ~ 8)	65 ~ 300 (2 1/2 ~ 12)	65 ~ 300 (2 1/2 ~ 12)
Pressure rating	JIS kgf/cm ²	5 ~ 20	5 ~ 63	5 ~ 20
	ANSI (Class)	125 ~ 300	125 ~ 900	125 ~ 300
Max. design temperature °C (°F)		550 (1022)	550 (1022)	150 (302)* ¹
Max. allowable leakage		IV ~ V*	IV ~ V*	IV ~ V*

▷: Indicates the direction of flow under normal use.

*: Max. allowable leakage indicates the corresponding leakage class prescribed in ANSI, B16.104.

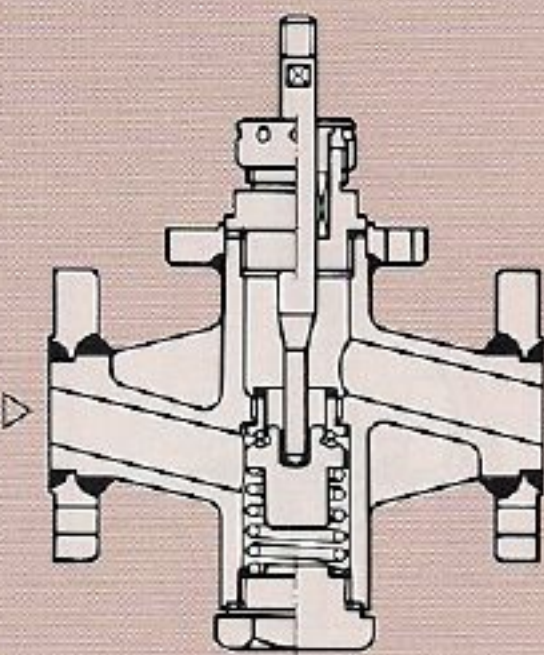
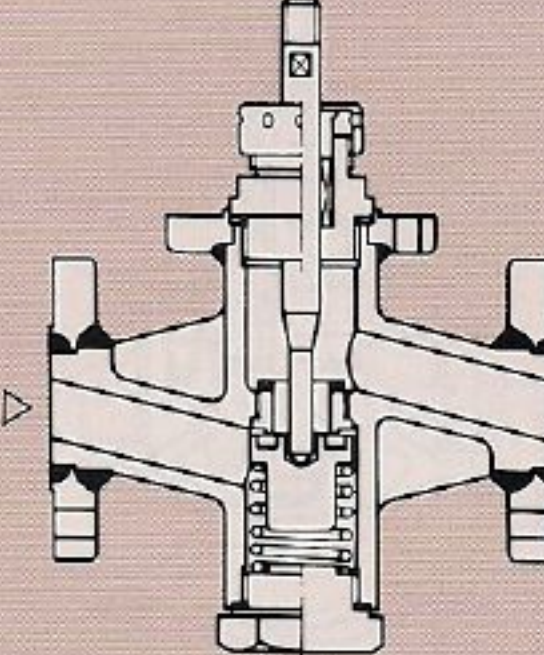
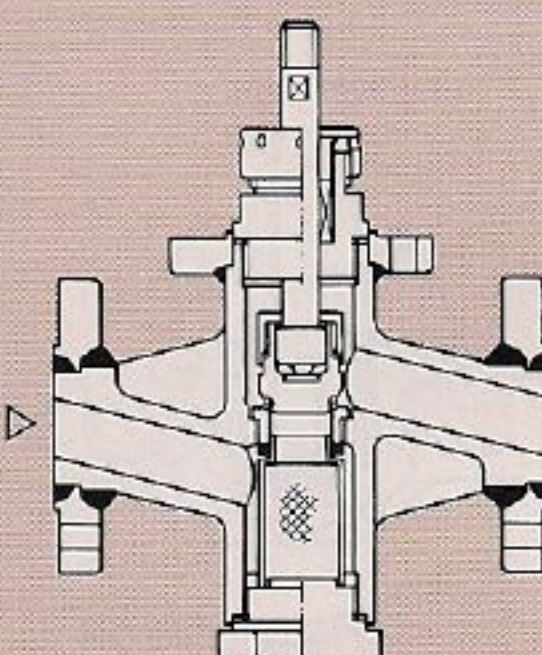
• For type indication codes, refer to the next page.

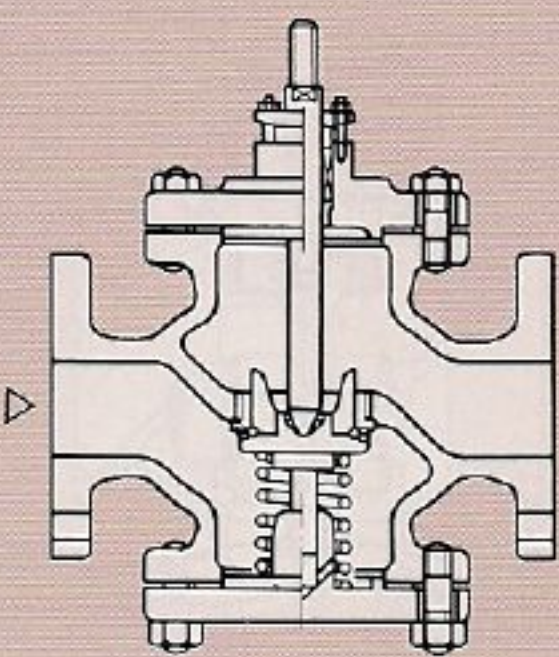
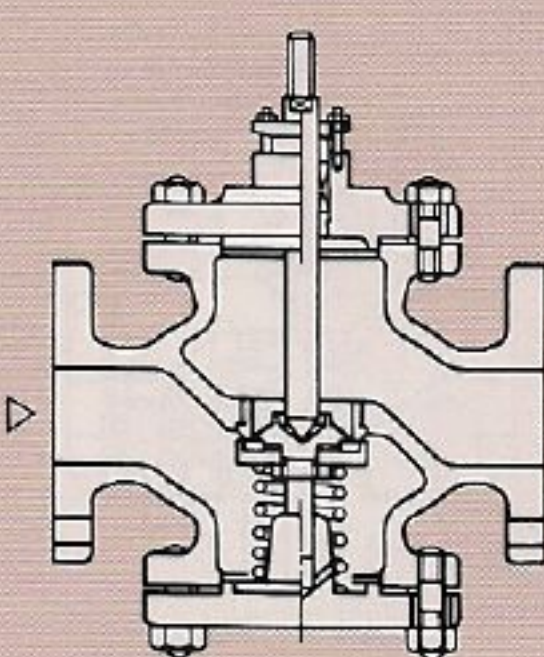
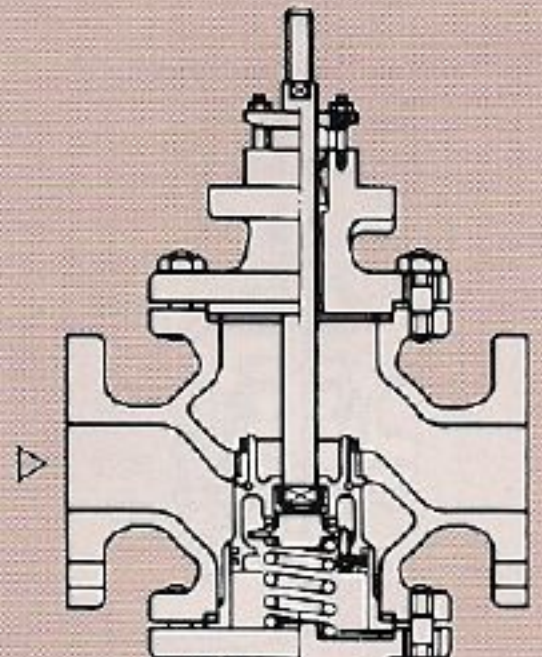
NS650EZ00	NS650ZL00	NS650AL00	NS650AB00
			
Type E valve body, flow characteristic plug, direct plug, metal touch	Angle type valve body, jacket type, direct plug, metal touch	Angle type valve body, direct plug, metal touch	Angle type valve body, balance type, direct plug, metal touch
32 ~ 300 (1 1/4 ~ 12)	32 ~ 300 (1 1/4 ~ 12)	15 ~ 300 (1/2 ~ 12)	65 ~ 300 (2 1/2 ~ 12)
5 ~ 63	5 ~ 63	5 ~ 63	5 ~ 20
125 ~ 900	125 ~ 900	125 ~ 900	125 ~ 300
550 (1022)	550 (1022)	550 (1022)	150 (302)* ¹
IV ~ V*	IV ~ V*	IV ~ V*	IV ~ V*
NS650ST00	NS650STEO	NS650STB0	NS650WL00
			
Type S valve body, 3-way type, metal touch	Type S valve body, 3-way type, soft touch	Type S valve body, 3-way type, balance type	Gate type, metal touch
32 ~ 200 (1 1/4 ~ 8)	32 ~ 200 (1 1/4 ~ 8)	32 ~ 300 (1 1/4 ~ 12)	80 ~ 600 (3 ~ 24)
5 ~ 20	5 ~ 20	5 ~ 20	10 ~ 63
125 ~ 300	125 ~ 300	125 ~ 300	150 ~ 2500
425 (797)	150 (302)* ¹	150 (302)* ¹	593 (1100)
IV ~ V*	VI*	IV ~ V*	IV ~ V*

*¹: The value in the column of maximum design temperature is that for soft touch of fluorine rubber.

VALVE BODY ASSEMBLY

• The valve body assemblies listed in the table below are our standard products. We also produce a variety of special ones.

Type	NS650FG00	NS650FGEO	NS650FLOO
Construction			
Features	Compact, light weight, reverse plug, metal touch	Compact, light weight, reverse plug, soft touch	Compact, light weight, strainer stored, direct plug, metal touch
Nominal bore mm (inch)	15, 20, 25 (1/2, 3/4, 1)	15, 20, 25 (1/2, 3/4, 1)	15, 20, 25 (1/2, 3/4, 1)
Pressure rating	JIS kgf/cm ²	5 ~ 20	5 ~ 20
	ANSI (Class)	125 ~ 300	125 ~ 300
Max. design temperature °C (°F)	425 (797)	150 (302)* ¹	200 (392)
Max. allowable leakage	IV ~ V*	VI*	IV ~ V*

Type	NS650SG00	NS650SGEO	NS650SP00
Construction			
Features	Type S valve body, reverse plug, metal touch	Type S valve body, reverse plug, soft touch	Type S valve body, reverse plug, pilot type
Nominal bore mm (inch)	32 ~ 200 (1 1/2 ~ 8)	32 ~ 200 (1 1/2 ~ 8)	65 ~ 300 (2 1/2 ~ 12)
Pressure rating	JIS kgf/cm ²	5 ~ 20	5 ~ 20
	ANSI (Class)	125 ~ 300	125 ~ 300
Max. design temperature °C (°F)	425 (797)	150 (302)* ¹	425 (797)
Max. allowable leakage	IV ~ V*	VI*	IV ~ V*

▷: Indicates the direction of flow under normal use.

*: Max. allowable leakage indicates the corresponding leakage class prescribed in ANSI, B16.104.

TYPE DESIGNATION

The type designation for NS650 series cylinder valves consist of the following codes.

〈Example〉 NS650 E L O O 300

Cylinder valve series name

Code indicating valve body shape

Mark	Meaning
E	Globe, type E
S	Globe, type S
A	Angle type
F	Forged type
W	Gate type
Z	Special type

Code indicating pressure rating
(See page 36.)

Code indicating bonnet construction

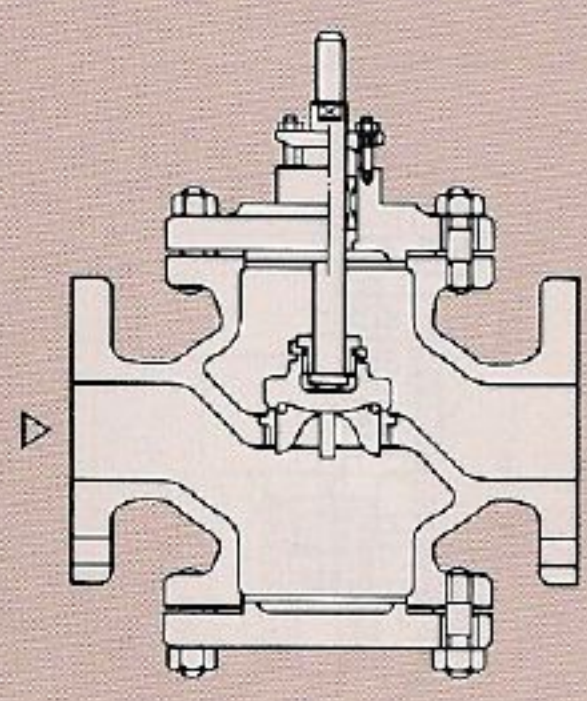
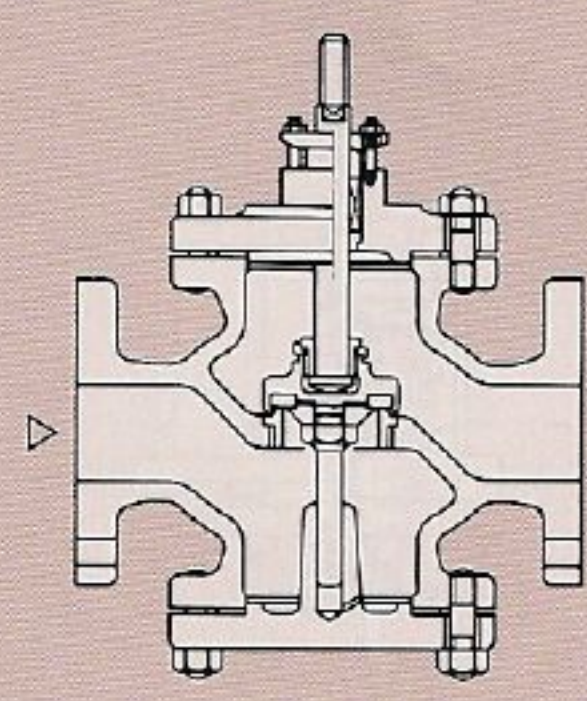
Mark	Meaning
O	Standard type
L	Long type
B	Bellows type
X	Extension type
Z	Special type

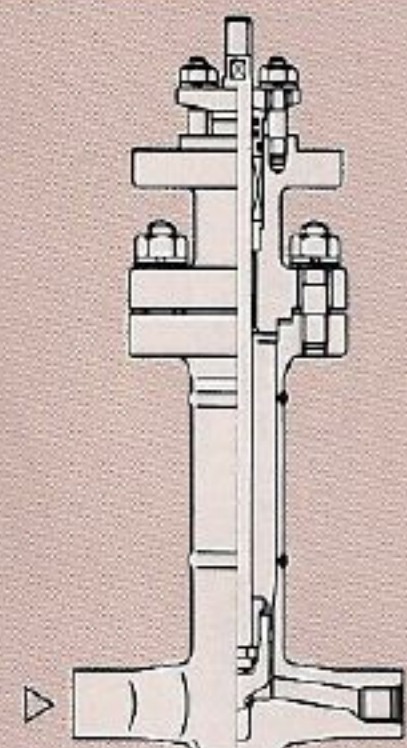
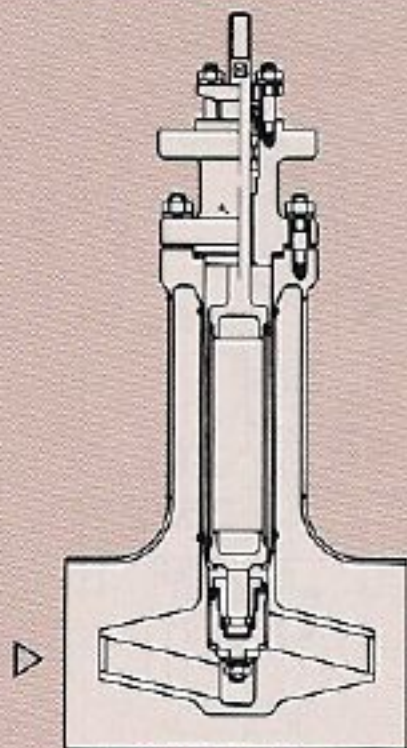
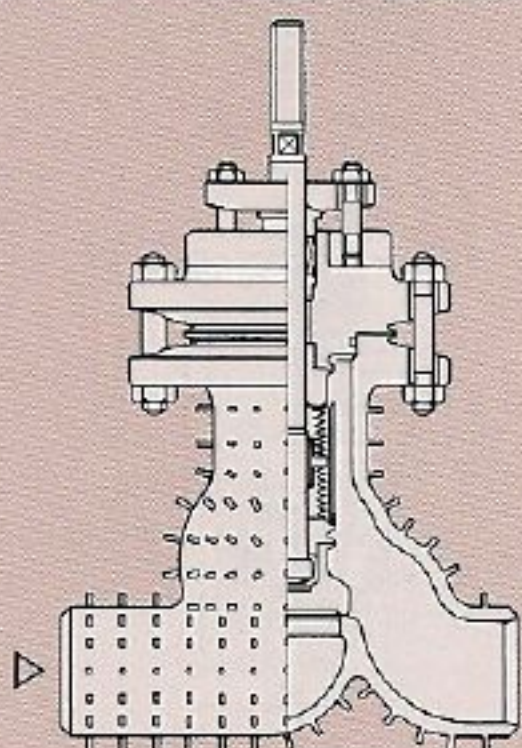
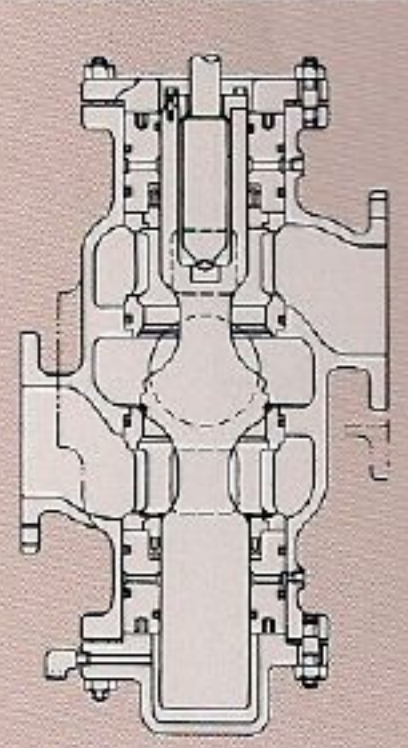
Code indicating plug sealing method

Mark	Meaning
O	Metal touch
E	Soft touch
Z	Special type

Code indicating plug type

Mark	Meaning
L	Direct plug, standard type
G	Reverse plug, standard type
T	3-way type
B	Balance type
P	Pilot type
N	Nonreturn type
Z	Special type

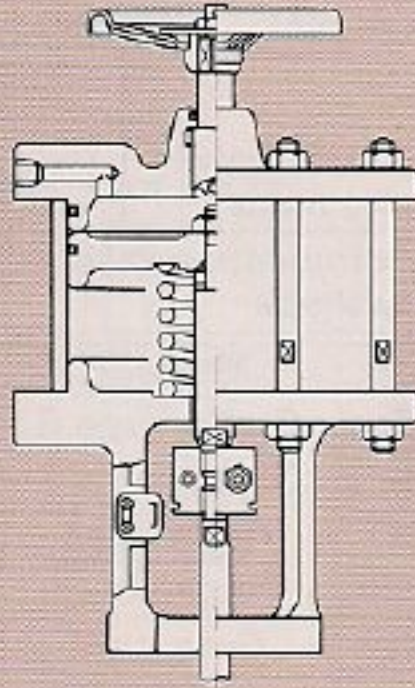
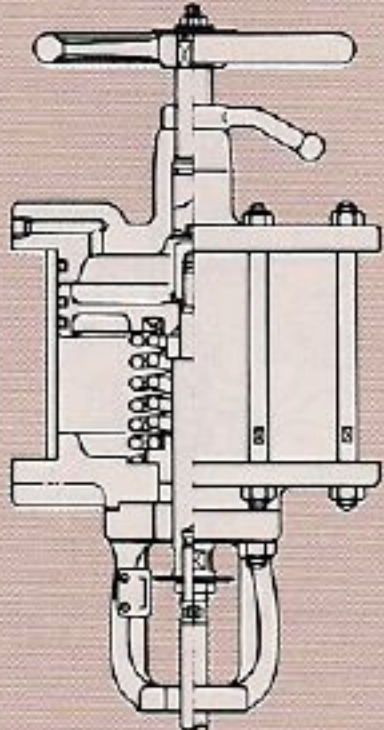
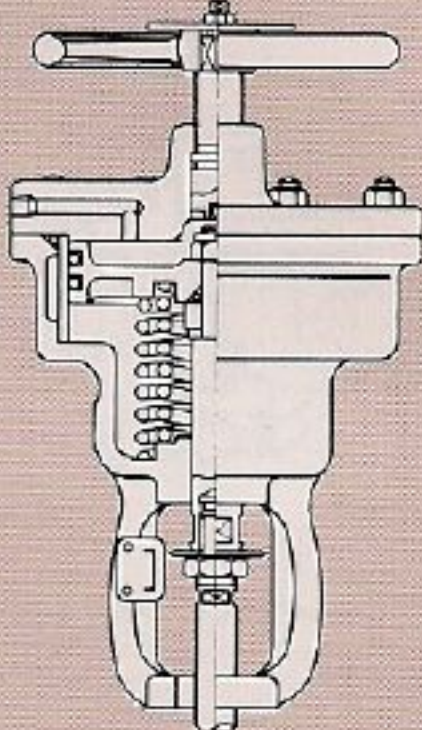
NS650SL00	NS650SLE0
	
Type S valve body, direct plug, metal touch	Type S valve body, regular plug, soft touch
32 ~ 200 (1 1/4 ~ 8)	32 ~ 200 (1 1/4 ~ 8)
5 ~ 20	5 ~ 20
125 ~ 300	125 ~ 300
425 (797)	150 (302)* ¹
IV ~ V*	VI*

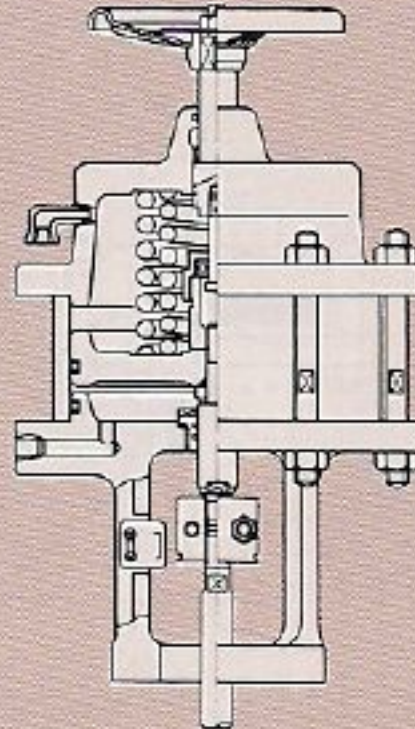
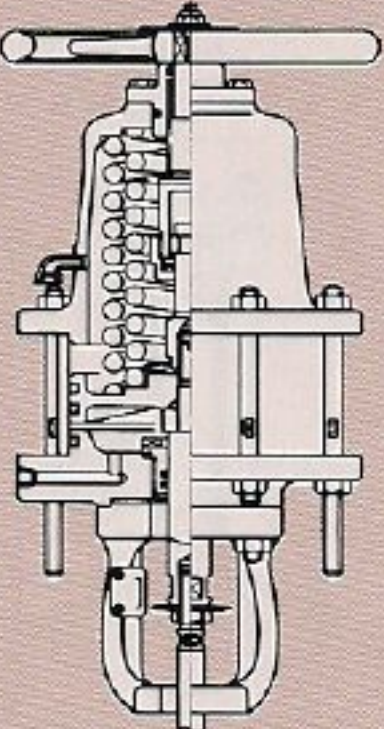
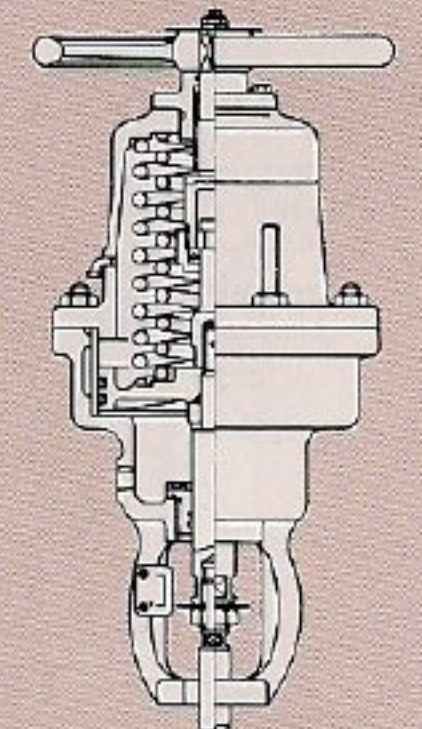
NS650ZLOX	NS650ZLEX	NS650ZLOZ	NS650ZTOZ
			
For cryogenic use, extension type, direct plug, metal touch	For cryogenic use, vacuum jacket type, direct plug, soft touch	For liquid sodium, bellows seal type, direct plug, metal touch	For special use, 3-way type, metal touch
10 ~ 150 (3/8 ~ 6)	10 ~ 150 (3/8 ~ 6)	15 ~ 100 (1/2 ~ 4)	50 ~ 200 (2 ~ 8)
63	63	10	10
900	900	150	150
-196 (-321)	-263 (-442)	525 (977)	80 (176)
VI*	VI*	V*	V*

*¹ : The value in the column of maximum design temperature is that for soft touch of fluorine rubber.

ACTUATOR

- The actuators listed in the table below are our standard products.
- Hand operated devices, limit switches, speed control devices are available as options.

Type	DG	DA	DH
Construction			
Features	Steel pipe cylinder, direct action type	Nuclear power, earthquake resistance, unit type, direct action type	Integrated yoke type (general purpose type), direct action type
Applicable valve bore mm (inch)	25 and under (1 and under)	32 ~ 80 (1 1/4 ~ 3)	32 ~ 80 (1 1/4 ~ 3)
Cylinder nominal size mm	100, 120, 140, 160	160, 200, 240, (280)	120, 160, 200
Travel max. mm	12	15 ~ 25	15 ~ 25
Supply pressure kgf/cm ² g	4 ~ 7 max. 9	4 ~ 7 max. 9	4 ~ 7 max. 9
Yoke material	FC 25*	SCPH 2	FCD 40

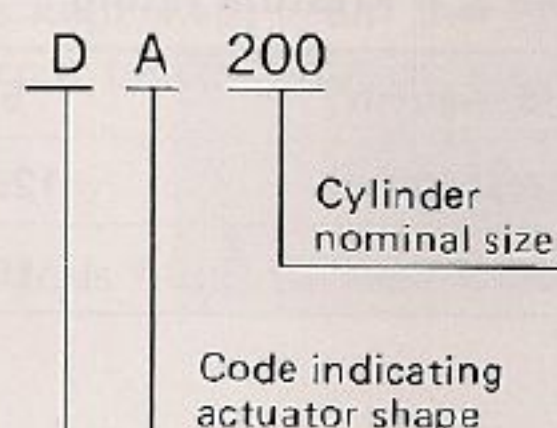
Type	RG	RA	RH
Construction			
Features	Steel pipe cylinder, reverse action type	Nuclear power, earthquake resistance, unit type, reverse action type	Integrated yoke type (general purpose type), reverse action type
Applicable valve bore mm (inch)	25 and under (1 and under)	32 ~ 80 (1 1/4 ~ 3)	32 ~ 80 (1 1/4 ~ 3)
Cylinder nominal size mm	120, 140, 160	160, 200, 240, 280	160, 200
Travel max. mm	12	15 ~ 25	15 ~ 25
Supply pressure kgf/cm ² g	4 ~ 7 max. 9	4 ~ 7 max. 9	4 ~ 7 max. 9
Yoke material	FC 25*	SCPH 2	FCD 40

1. The actuator for Model NS650WL is not included in the table above.
2. We also produce special actuators other than those in the table above.

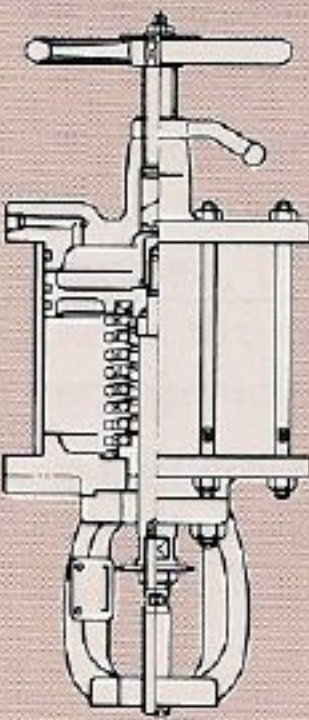
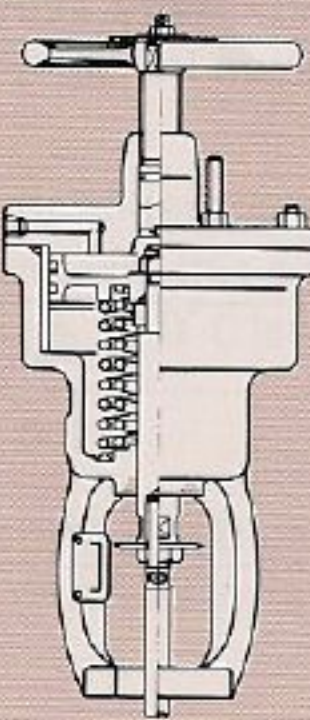
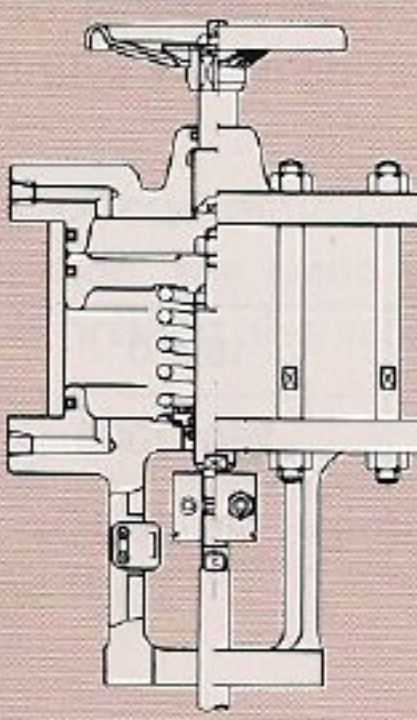
ACTUATOR TYPE DESIGNATION

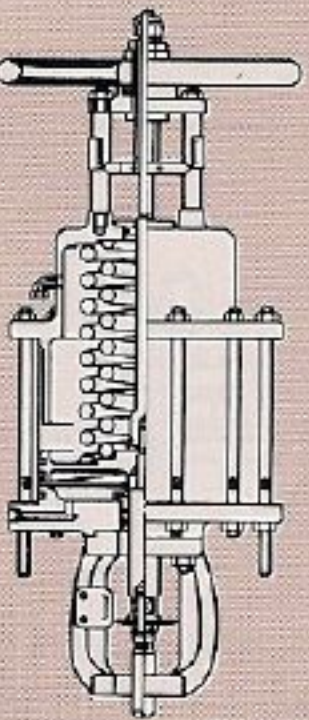
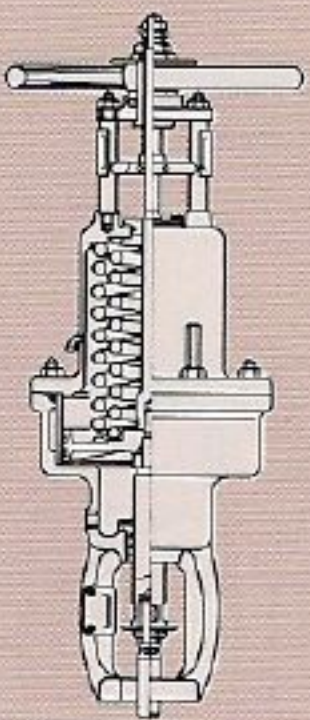
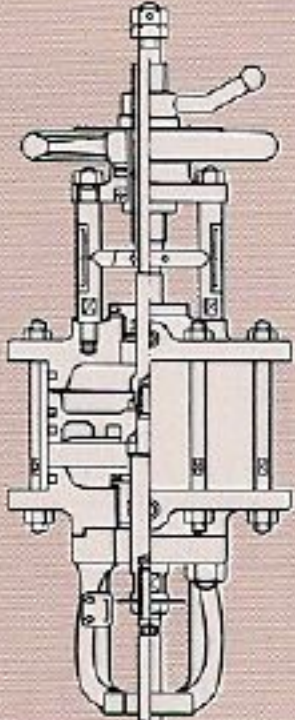
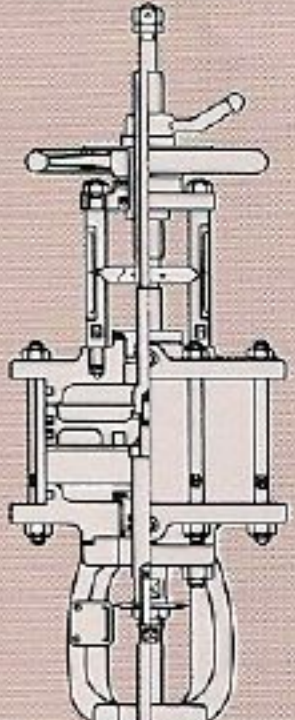
The actuator type designation for NS650 series cylinder valves consists of the following codes.

(Example)



Mark	Meaning
D	Direct action type
R	Reverse action type
W	Double action type
Z	Special type

DB	DI	WG
		
Nuclear power, earthquake resistance, unit type, direct action type	Integrated yoke type (general purpose type), direct action type	Steel pipe cylinder, double action type
100 ~ 150 (4 ~ 6)	100 ~ 150 (4 ~ 6)	25 and under (1 and under)
200, 240, 280 300 (335, 400)	160, 200, 240	100, 120, 140, 160
35 ~ 45 ~ (≤ 100)	35 ~ 45	12
4 ~ 7 max. 9	4 ~ 7 max. 9	4 ~ 7 max. 9
SCPH 2	FCD 40	FC 25*

RB	RI	WA	WB
			
Nuclear power, earthquake resistance, unit type, reverse action type	Integrated yoke type (general purpose type), reverse action type	Nuclear power, earthquake resistance, unit type, double action type	Nuclear power, earthquake resistance, unit type, double action type
100 ~ 150 (4 ~ 6)	100 ~ 150 (4 ~ 6)	32 ~ 80 (1 1/4 ~ 3)	100 ~ 150 (4 ~ 6)
240, 280, 335, 400	240	160, 200, 240 (280)	200, 240, 280 (300, 335, 400)
35 ~ 45 ~ (≤ 100)	35 ~ 45	15 ~ 25	35 ~ 45 ~ (≤ 100)
4 ~ 7 max. 9	4 ~ 7 max. 9	4 ~ 7 max. 9	4 ~ 7 max. 9
SCPH 2	FCD 40	SCPH 2	SCPH 2

3. Yoke of FC25 marked * can not be used for high pressure gas valves.

4. Bores indicated in the applicable valve bore column show standard combinations. Actuators can be used for valve bores smaller than those indicated in the table.

Among various parts composing a valve, the valve body assembly is the most important portion, which is directly exposed to various fluids, changing pressure and temperature conditions. Accordingly, in selecting a valve, due consideration is given to the following factors.

PRESSURE-TEMPERATURE RATING

The maximum allowable pressures for each material of the valve body assembly at various service temperatures are shown in Table 8.2 (See page 36.). The pressure rating of our cylinder valves is as shown in Table 3.1 below.

■ Table 3.1 Pressure rating

JIS kgf/cm ²	5, 10	16, 20	30, 40	63	—	—
ANSI (Class)	125, 150	250, 300	400, 600	900	1500	2500
IEC PN-bar	10, 16	25, 40	64, 100	—	—	—

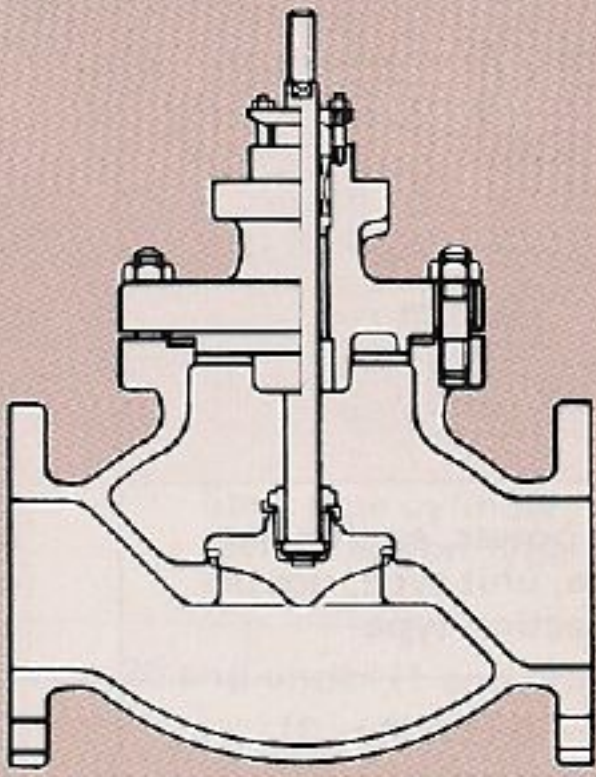
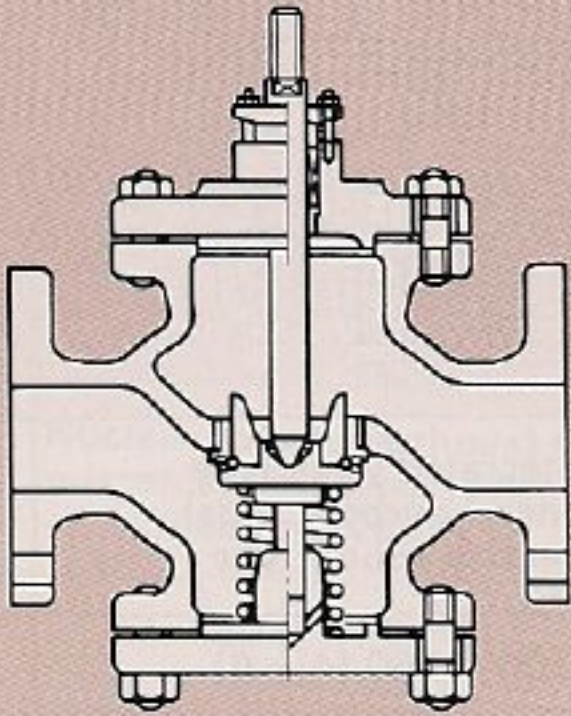
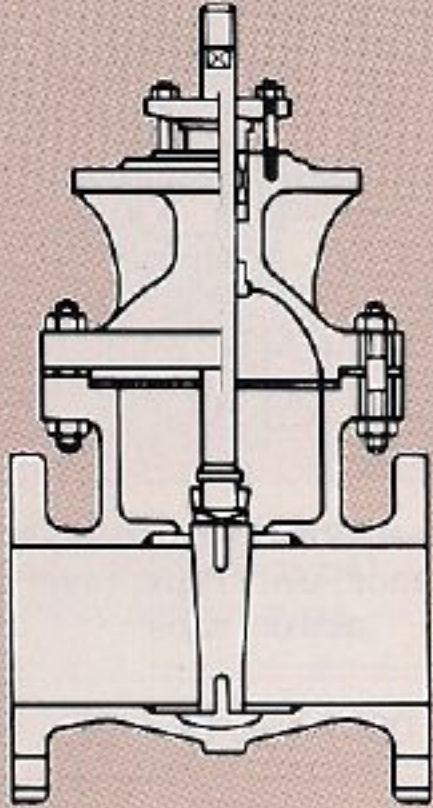
■ Materials

Main materials of the valve body assembly are selected from those listed in Table 3.3. Various other materials are also available for special specifications.

VALVE BODY

- Wall thicknesses of valve body are in accordance with ANSI B16.34.
- As for fittings and piping connections, welding type is available as well as JIS and ANSI flanges, as standard products.
- As for face-to-face dimension, different standards are used according to pressure rating; bodies of class 300 and under are in accordance with ANSI, and those of class 600 with IEC Standard. For those of class 900 (JIS 63K) and over, our standard dimensions are available.

■ Fig. 3A Representative valve body types

Type	Globe type		Gate type
	E	S	
Valve body configuration			
Pressure rating JIS (ANSI)	5 ~ 63 kgf/cm ² (~ class 900)	5 ~ 20 kgf/cm ² (~ class 300)	10 ~ 63 kgf/cm ² (~ class 2500)
Nominal bore mm (inch)	15 ~ 300 (1/2 ~ 12)	32 ~ 200 (1 1/4 ~ 8)	80 ~ 600 (3 ~ 24)
Features of valve body	<ul style="list-style-type: none"> • Wide pressure-temperature range. • Small size, light weight. 	<ul style="list-style-type: none"> • Valve body can also be used for 3-way diverter valves. 	<ul style="list-style-type: none"> • For large bores. • Small pressure loss of line fluid.

BONNET

The following four types of bonnet configuration are normally used according to the application conditions including the kind of fluid, temperature, etc.

■ Standard type

This type is used when the fluid temperature is less than 300°C.

■ Long type

This type is used when the fluid temperature is 300°C and over, or when it is in the range of -50°C and over and below 0°C, so as to protect the gland packing.

■ Extension type

This type is used when the fluid temperature is very low or cryogenic (-268°C and over, and below -50°C) such as liquid oxygen, LNG and liquid helium. In this extension configuration, the gland packing is kept away from the valve body so as to keep the packing's temperature at 0°C and over. This type prevent the valve stem from freezing due to the effects of low or cryogenic temperature fluid.

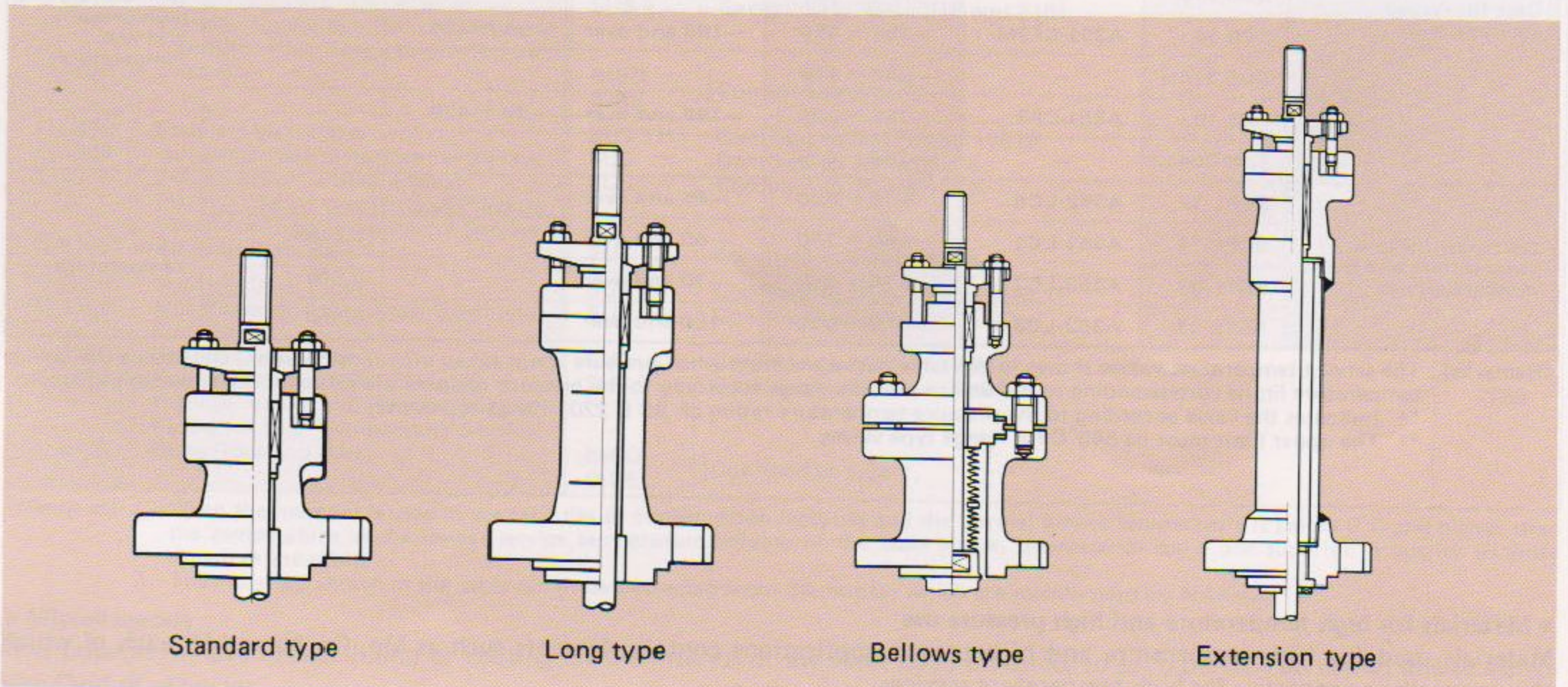
■ Bellows type

This type uses a double structure using bellows and gland packing for handling hazardous fluids such as radioactive, poisonous and corrosive ones. This type prevents external leakage of the fluid.

■ Table 3.2 Applicable temperature range of bonnet

Type	Standard materials	Application
Standard type	Cast steel, cast iron*, bronze*	Over 0°C and below 300°C (those marked * are to be used within the applicable temperature range).
Long type	Cast steel	300°C and over, or -50°C and over and below 0°C.
Extension type	Stainless steel (SUS pipe)	-268°C and over and below -50°C.
Bellows type	Cast steel	For non-leak (nuclear power, etc.). When fluid contamination should be avoided.

■ Fig. 3B Types of bonnet



MATERIALS

■ Valve body assembly

The materials of valve body assembly such as body and bonnet are in accordance with the pressure-temperature ratings of JIS and ANSI. In selecting materials, the following conditions are also taken into consideration:

- Applicable laws and regulations, and standards.
- Corrosion resistance against the fluid to be handled.
- Flashing fluid, high velocity, high pressure drop jet.

When a reduced port valve or a valve of which size is smaller than that of the piping is used, flashing, high velocity, high pressure drop jet, etc. are also taken into consideration.

■ Table 3.3 Service temperature limits of materials

Material	Material mark		Service temperature range (°C)			Main component	Application
	JIS	ASTM	JIS (B8243)	High pressure gas control act	ANSI (B16.34)		
Gray cast iron	FC 20	A 126 Grade A	0 ~ 250 220 and under ^{*1}	0 ~ 250	—		Low pressure
Nodular cast iron	FCD 45	A536 Gr. 65-45-12	0 ~ 350	0 ~ 250	—		
Bronze casting	BC 3	B 584	−196 ~ 225	−196 and over	—		Sea water, corrosion resistance, low temperature
	BC 6	B 584	−196 ~ 225	−196 and over	—		
Cast or forged steel for high temperature and high pressure service	Cast	SCPH 2	A216-WCB	0 ~ 450 425 and under ^{*1}	−5 and over	−29 ~ 425	High temperature and high pressure
	Forged	S25C	—	−10 ~ 450 425 and under ^{*1}	−10 and over	—	
	Cast	SCPH 11	A217-WC1	0 ~ 550 475 and under ^{*1}	−5 and over	−29 ~ 455	
	Forged	—	A182-F1	—	—	−29 ~ 455	
	Cast	SCPH 21	A217-WC6	0 ~ 575 510 and under ^{*1}	−5 and over	−29 ~ 593 ^{*2}	
	Forged	—	A182-F11	—	—	−29 ~ 593 ^{*2}	
	Cast	SCPH32	A217-WC9	0 ~ 650	−5 and over	−29 ~ 593 ^{*2}	
	Forged	—	A182-F22	—	—	−29 ~ 593 ^{*2}	
	Cast	SCPH 61	A217-C5	0 ~ 650	−5 and over	−29 ~ 650 ^{*2}	
	Forged	—	A182-F5a	—	—	−29 ~ 650 ^{*2}	
Cast for forged stainless steel		SCS13	A351-CF8	−196 ~ 800	−196 and over	−29 ~ 800 ^{*2}	Corrosion resistance, high temperature and high pressure, and low temperature
		SUS 304	—	−253 ~ 800	−253 and over	—	
		SCS 14	A351-CF8M	−196 ~ 800	−196 and over	−29 ~ 800 ^{*2}	
		SUS 316	—	−253 ~ 800	−253 and over	—	
		SCS 16	A351-CF3M	−196 ~ 450	−196 and over	−29 ~ 455	
		SUS 316L	—	−268 ~ 450	—	—	
		SCS 19	A351-CF3	−196 ~ 425	−196 and over	−29 ~ 425	
		SUS 304L	—	−268 ~ 425	—	—	
Cast steel for low temperature and high pressure service		SCPL 1	A352-LCB	−45 ~ 350	−45 and over	—	Low temperature
		SCPL 11	A352-LC1	−60 ~ 350	−60 and over	—	
		SCPL 21	A352-LC2	−70 ~ 350	−70 and over	—	
		SCPL 31	A352-LC3	−100 ~ 350	−100 and over	—	

[Remarks] The service temperature values shown in the table above are those when pressure is not taken into consideration. Determine the service temperature limits corresponding to the service pressure range according to the pressure-temperature rating of the applicable standard.

^{*1} Indicates the value according to the pressure-temperature rating of JIS B 2201 flange type valve.

^{*2} The upper limit must be 540°C for flange type valves.

■ Materials for high temperature and high pressure use

Materials used for high temperature and high pressure applications contain elements such as Mo, Cr, Ni and V, each of which shows excellent properties for high temperature services.

■ Materials for low temperature use

Ordinary cast iron and carbon steel show a sudden drop in toughness (impact value) under below zero temperature, namely, low temperature embrittlement.

- We select materials for low temperature use from those shown in Table 3.4, including cast steel for low temperature and high pressure application, copper alloy and austenitic stainless steel.

■ Table 3.4 Demarkasion of the use of valve materials for low temperature service
(Extracted from the Ministry of International Trade and Industry Notice No. 350)

JIS NO.	Designation	Mark	Scope	Lowest service temp. (°C)
G 3201 G 5101 G 5102 G 5151	Carbon Steel Forgings Carbon Steel Castings Steel Castings for Welded Structure Steel Castings for High Temperature and High Pressure Service	SF SC SCW SCPH	All	-5
G 4051 G 3211 G 3212	Carbon Steel for Machine Structural use Quenched and Tempered Carbon and Low Alloy Steel Forgings for Pressure Vessels Quenched and Tempered Vacuum Treated Carbon and Low Alloy Steel Forgings for Pressure Vessels	S-C, S-CK SFV SFW	All	-10
G 3454	Carbon Steel Pipe for Pressure Service	STPG	All	-15
G 3459 G 4105	Stainless Steel Pipes Chromium Molybdenum Steels	SUS TP SCM	Confined to 304HTP, 316HTP, 321HTP and 347HTP. All	-30
G 5121 G 5152 H 3422	Stainless Steel Castings Steel Castings for Low Temperature and High Pressure Service Free Cutting Brass Rods and Bars	SCS SCPL BsBMD BsBME	Confined to type 1. Confined to type 1. Confined to type 2.	-45
G 5152	Steel Castings for Low Temperature and High Pressure Service	SCPL	Confined to type 11.	-60
G 5152	Steel Castings for Low Temperature and High Pressure Service	SCPL	Confined to type 21.	-70
H 3422 H 3423	Free Cutting Brass Rods and Bars Brass Rods and Bars Suitable for Forging	BsBMD BsBME BsBFD BsBFE	Confined to type 1.	-80
G 3460 G 5152	Steel Pipes for Low Temperature Service. Steel Castings for Low Temperature and High Pressure Service	STPL SCPL	Confined to type 2. Confined to type 31.	-100
G 3459 G 5121 H 4600 H 4630 H 4650 H 5111 H 5202 G 3214 H 3426	Stainless Steel Pipes Stainless Steel Castings Titanium Sheets, Plates and Strip Titanium Pipes and Tubes for Ordinary Piping Titanium Rods and Bars Bronze Castings Aluminium Alloy Castings Forged Stainless Steel Flanges, Fittings, Valves and Ports of Pressure Vessel for High-Temperature Service Brass Ber	SUS TP SCS TP, TR TTP TB BC AC SUS F BsBD BsBE	Except 304HTP, 304LTP, 304TP, 316HTP, 316LTP, 316TP, 321HTP, and 347HTP. Confined to types 13, 14, 16, 17, 18, 19 and 21. All Confined to types 2, 3, 6 and 7. All Except 304, 304L, 316 and 316L Confined to type 2.	-196
G 3459 G 4304 G 3214 G 4303	Stainless Steel Pipes Hot Rolled Stainless Sheet and Plate Forged Stainless Steel Flanges, Fittings, Valves and Ports of Pressure Vessel for High-Temperature Service Stainless Steel Bars	SUS TP SUS SUS F SUS	Confined to 304TP and 316TP. Confined to 304 and 316. Confined to 304 and 316. Confined to 304 and 316.	-253
G 3459 G 4304 G 4303 G 3214 H 3426	Stainless Steel Pipes Hot Rolled Stainless Steel Sheet and Plate Stainless Steel Bars Forged Stainless Steel Flanges, Fittings, Valves and Parts of Pressure Vessel for High-Temperature Service Brass Rods and Bars	SUS TP SUS SUS SUS F BsBD BsBE	Confined to 304LTP and 316LTP. Confined to 304L and 316L Confined to 304L and 316L Confined to 304L and 316L Confined to type 1.	-268

- [Remarks] 1. When the material is used in gas facilities or consumption facilities and the normal service temperature is below 0°C and higher than the temperature in the lowest service temperature column of the table above, the material can be one superior in quality to those shown in the table.
2. The materials shown in the table are those extracted from the notice, which are mainly used by NAKAKITA.

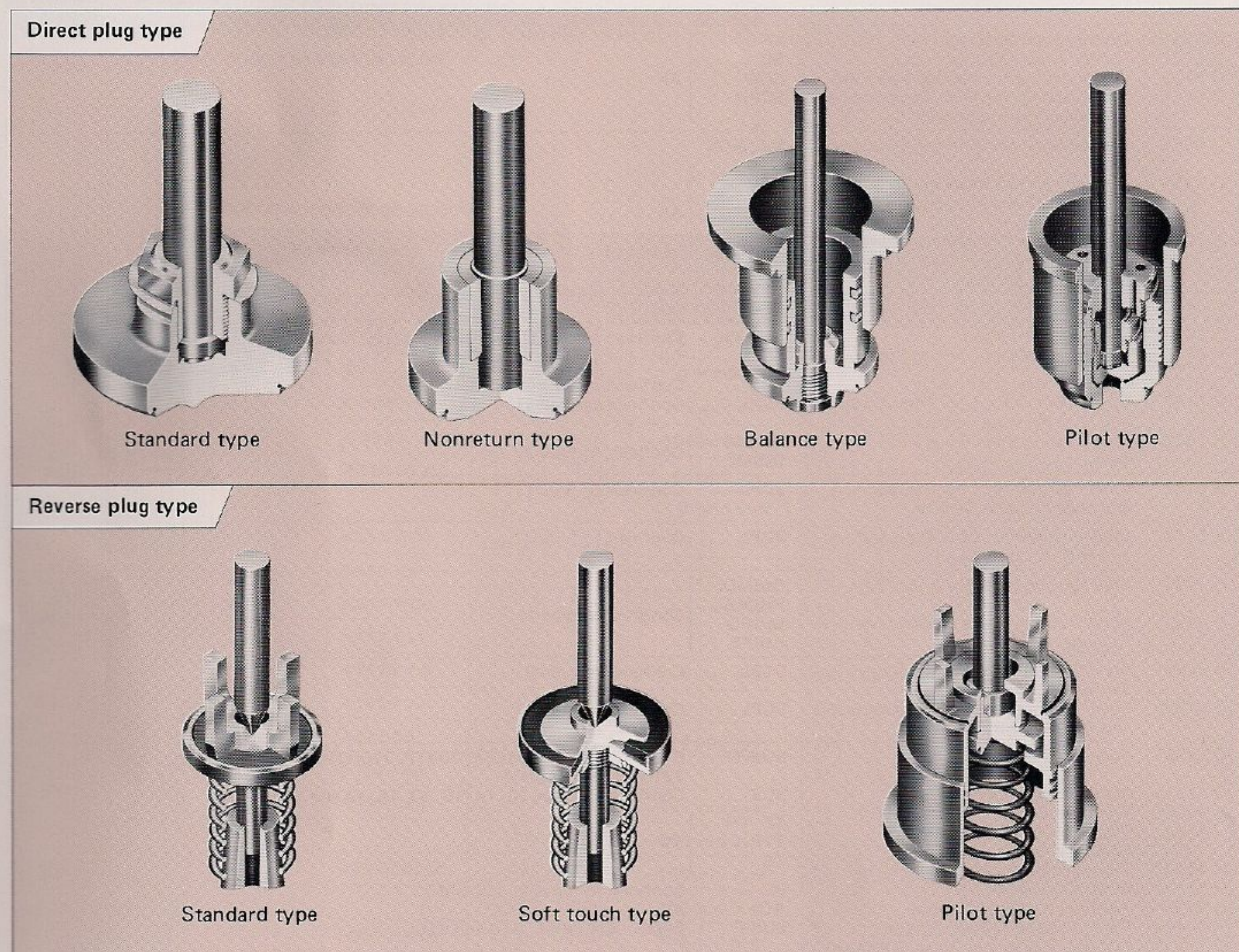
■ Miscellaneous

It is possible to give rubber lining or coating on the interior of the valve body assembly so as to prevent corrosion due to corrosive fluid or seawater.

VALVE PLUG

We produce various types of plug to meet all of your specifications. The details are shown in Fig. 3C and Table 3.5.

■ Fig. 3C Representative plug types



■ Table 3.5 Plug types and applications

Type	Application
Direct plug type	The plug and seat face are provided on the upper side in the valve body. The valve stem moves downward to shut the channel.
Reverse plug type	The plug and seat face are provided on the lower side in the valve body. The valve stem moves upward to shut the channel.
Three-way type	The plug is used in combination with a valve body having three-way channels for diverting the direction of fluid flow or joining flows.
Balance type	The plug has a balance type construction in order to reduce unbalanced thrust generated on the plug. Suited to large bore and high pressure drop applications.
Pilot type	A pilot valve is provided inside the main valve plug. Opening or shutting of the pilot valve is effected with a relatively small operating force, and the main plug is opened or shut by means of the fluid pressure. Suited to high pressure drop applications.
Nonreturn type	The plug of a direct plug type valve has a lift-check construction. The plug automatically shuts when the secondary side pressure exceeds the primary one.
Metal touch	The plug is made of metal. Its touch face, which contacts the seat, is treated by surface hardening, etc., to increase its durability.
Soft touch	Elastic material such as synthetic rubber and PTFE is used as a seal between the plug and the seat. Bubble-tight sealing can be effected by a small operating force.

VALVE FLOW COEFFICIENT (C_v) CALCULATION

■ Valve flow coefficient "C_v"

C_v is a flow coefficient of a valve. This coefficient indicates the flow rate in USgal/min of fresh water through the valve at the differential pressure of 1 psi at 15.6°C (60°F).

C_v values of [NAKAKITA] standard cylinder valves are as shown in Table 3.6 below. Valves of large sizes exceeding nominal bore of 150mm (6 inch) can be made to order.

■ Table 3.6 C_v values of cylinder valves

Nominal bore mm (inch)	15 (1/2)	20 (3/4)	25 (1)	32 (1 1/4)	40 (1 1/2)	50 (2)	65 (2 1/2)	80 (3)	100 (4)	125 (5)	150 (6)
C _v value	4	7.5	10	22	26	43	85	102	190	345	460

■ C_v Formulas

NAKAKITA's C_v formulas are based on the generally accepted formulas (see the table below) of FCI (Fluid Control Institute), unless otherwise specified.

■ Table 3.7 C_v Formulas

Fluids	Pressure Condition	C _v Formulas	Legend
Incompressible Fluids	—	$C_v = \frac{1.17V \sqrt{G}}{\sqrt{\Delta p}} \quad *1$	<p>V : Max. Flow Rate (Incompressible Fluids) m³/h</p> <p>W : Max. Flow Rate (Steam, Vapours) kg/h</p> <p>Q : Max. Flow Rate (Air-Gases)*² m³/h (at 760mmHg abs. 15.6°C)</p> <p>p₁ : Inlet Pressure kgf/cm² abs</p> <p>p₂ : Outlet Pressure kgf/cm² abs</p> <p>Δp : Differential Pressure kgf/cm² (Pressure drop = p₁ - p₂)</p> <p>G : Specific Gravity (Water = 1)</p> <p>G₁ : Specific Gravity (Air = 1)</p> <p>t : Fluids Temperature °C</p> <p>K : Correction Coefficient to Superheat K = 1 + 0.0013 × deg.C of Superheat.</p> <p>V₁ : Specific Volume of p₁ cm³/g</p> <p>V₂ : Specific Volume of p₂ cm³/g</p> <p>V₃ : Specific Volume of (p₁ × 0.5) cm³/g</p>
Air · Gases	(1) Where p ₂ > 0.5p ₁ (or Δp < 0.5p ₁)	$C_v = \frac{Q}{289} \sqrt{\frac{G_1 (t + 273)}{\Delta p (p_1 + p_2)}}$	
	(2) Where p ₂ ≤ 0.5p ₁ (or Δp ≥ 0.5p ₁)	$C_v = \frac{Q \sqrt{G_1 (t + 273)}}{250 \cdot p_1}$	
Steam	(1) Where p ₂ > 0.5p ₁ (or Δp < 0.5p ₁)	$C_v = \frac{W}{13.5 \sqrt{\Delta p (p_1 + p_2)}} \times K$	
	(2) Where p ₂ ≤ 0.5p ₁ (or Δp ≥ 0.5p ₁)	$C_v = \frac{W}{11.7 \cdot p_1} \times K$	
Vapours	(1) Where p ₂ > 0.5p ₁ (or Δp < 0.5p ₁)	$C_v = \frac{W}{1210} \sqrt{\frac{V_1 + V_2}{\Delta p}}$	
	(2) Where p ₂ ≤ 0.5p ₁ (or Δp ≥ 0.5p ₁)	$C_v = \frac{W}{856} \sqrt{\frac{V_1 + V_3}{p_1}}$	

*1 When the viscosity is 20 cSt and under, the formula can be used without considering the viscosity correction.

*2 The flow rate of gases Q m³/h is expressed at "Standard Conditions", or pressure of 14.7 psia (= 760mmHg = 1 atm.) and temperature of 60°F (15.6°C). If the flow rate at "Normal State" or pressure of 1 atm (= 760mmHg) and temperature of 0°C is denoted by Nm³/h, we get Q = 1.057 × N.

BOLTS AND NUTS

The standard materials of bolts and nuts of the valve body assembly are as shown in Table 3.8.

■ Table 3.8 Standard materials of bolts and nuts (nom of materials: JIS)

Valve body material	Temperature °C	Bolt	Nut
FC・FCD・meehanite BC	Within specified values		
SCPH2 (WCB) S25C・S45C		S45C or SNB7	S45C
SCP11 (WC1)・F1 SCPH21 (WC6)・F11 SCPH32 (WC9)・F22 SCPH61 (C5)・F5a		SNB 16	ASTM A194 Gr 4
SCS13 (CF8)・13A SCS14 (CF8M)・14A L materials of the above, SCS16, etc.		SUS 304-D*1	SUS 304
SCPL1 (LCB) SCPL11 (LC1)・LF1 SCPL21 (LC2)・LF2 SCPL31 (LC3)・LF3 BC		SUS 304-D*1	SUS 304

*1 Cold drawn pieces are treated by antiseizing and strain hardening.

As for bolts and nuts for special valves such as those used for nuclear power, to which special requirements are applicable, the requirements in question are satisfied.

GASKETS

As for gaskets, when the rating is 16kgf/cm² and under, joint sheet (standard product of JIS B 2404) is used. When the rating is 20kg/cm² and over, or when strict sealing is required, spiral gasket (standard product of JIS B 2404) is used. Spiral gasket exhibits excellent performance under pressure and heat cycle conditions. It can be widely used for services ranging from cryogenic temperature to high temperature or from high pressure to vacuum by combining a form suited to the service with various hoop and filter materials.

For valves of nuclear power use, gaskets with restricted contents of harmful element ions (like Cl⁻) are used.

■ Table 3.9 Standard selection of gaskets

○ : Applicable item

Application	Joint seat	Spiral gasket		
		Asbestos	PTFE	Flexible graphite
General	○	○	○	○
High temperature and high pressure				○
Low temperature			○	○
Strict sealing				○

GLAND PACKING

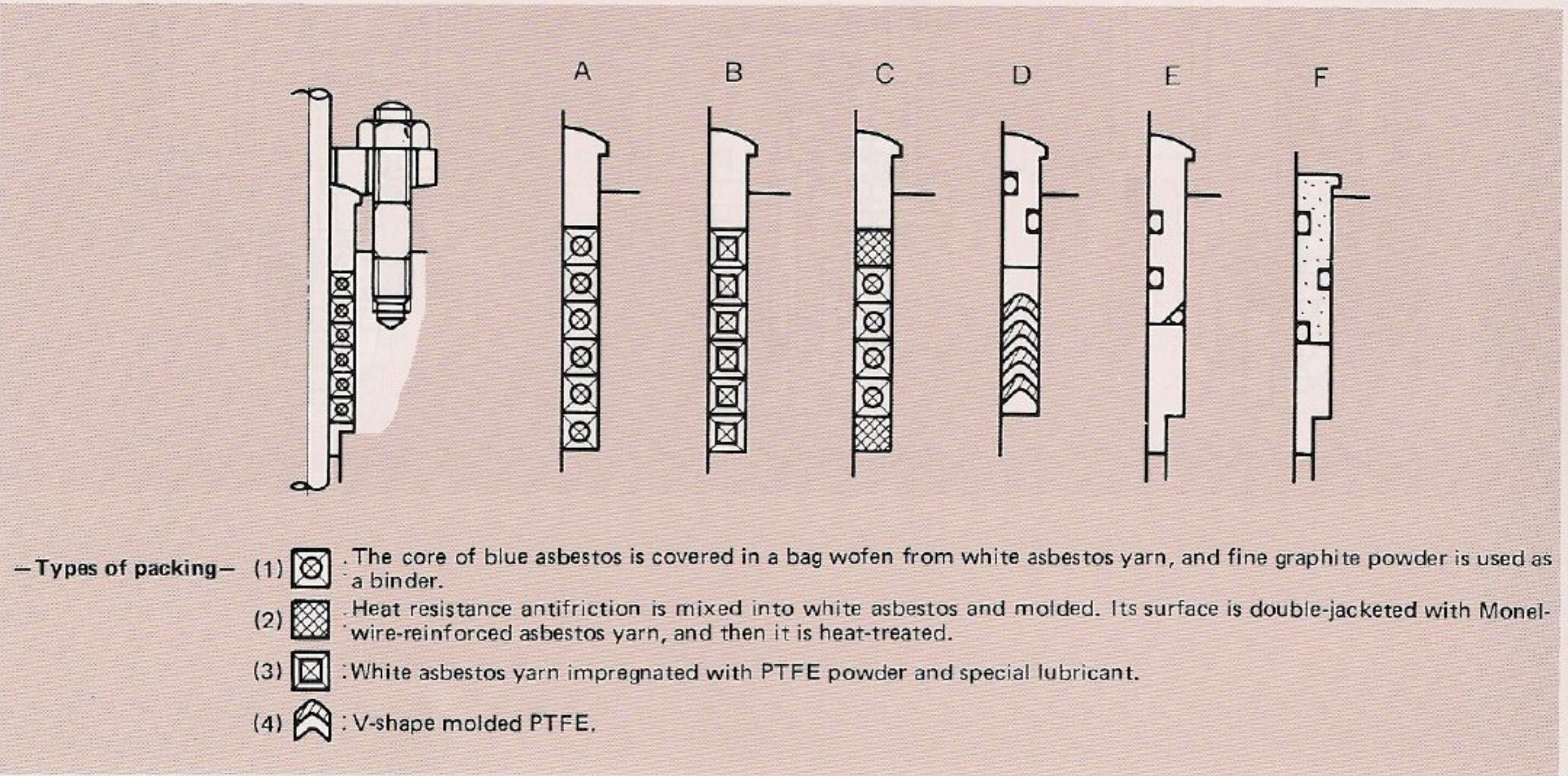
- Gland packing should be resistant to secular distortion and heat cycle so as to possess stable properties of low friction and sealing over a long period. Otherwise, the performance of cylinder valves can not be maintained. Positive sealing effect of this important gland packing is secured by selecting the most stable one on the basis of our past results extending over many years, according to the controlled fluid (properties, temperature and pressure).
- Selection of gland packing is basically made in accordance with Table 3.10. Optimal pieces are selected for ordinary gases, liquids and steam, respectively, except for special chemicals. As for special service conditions, the requirements can be adequately met by altering combination of flexible graphite (like Glafoil packing), etc.

■ Table 3.10 Selection of gland packing

Type packing	Application	Main fluids	Maximum service pressure kgf/cm ² g	Maximum service temperature °C
A	For general purpose	Steam, drain, feedwater, oil, gas	100	400
B		Water, solvent, acid, alkali	100	200
C	For high temperature and high pressure	Steam, drain, feedwater, oil, gas	250	550
D	For low temperature	LNG, LPG, LH ₂	100	200
E	"O" ring type	Water, gas, oil	70	100 (150)
F		Naphtha, light oil, and the like	70	100 (150)

- [Remarks]
1. Pressure and temperature shown in the table do not show combination conditions.
 2. Temperature in () indicates that of fluorine rubber.
 3. The table is not applicable to those for nuclear power use.

■ Fig. 3D Gland packing types and arrangements (Representative cases)



OUTLINE

- The actuator is for opening or shutting the valve plug of the cylinder valve. It is required to exhibit high performance and high reliability under any environmental conditions.
We are constantly striving to further the quality of our cylinder valve; our efforts can be seen in our early acquisition of each classification society's certificate for various environmental tests by conducting demonstration tests.
- The actuator consists of a piston, a cylinder a cover, a yoke, a piston stem, springs, "O" rings, etc.
- As for the output of the actuator, the operating pressure supplied from a compressor, etc. is guided into the cylinder to generate an actuating force proportional to its effective area.
This output should overcome the compression force of the springs, the valve stem thrust generated on the plug, and the sliding resistance of the gland under the actual service conditions.

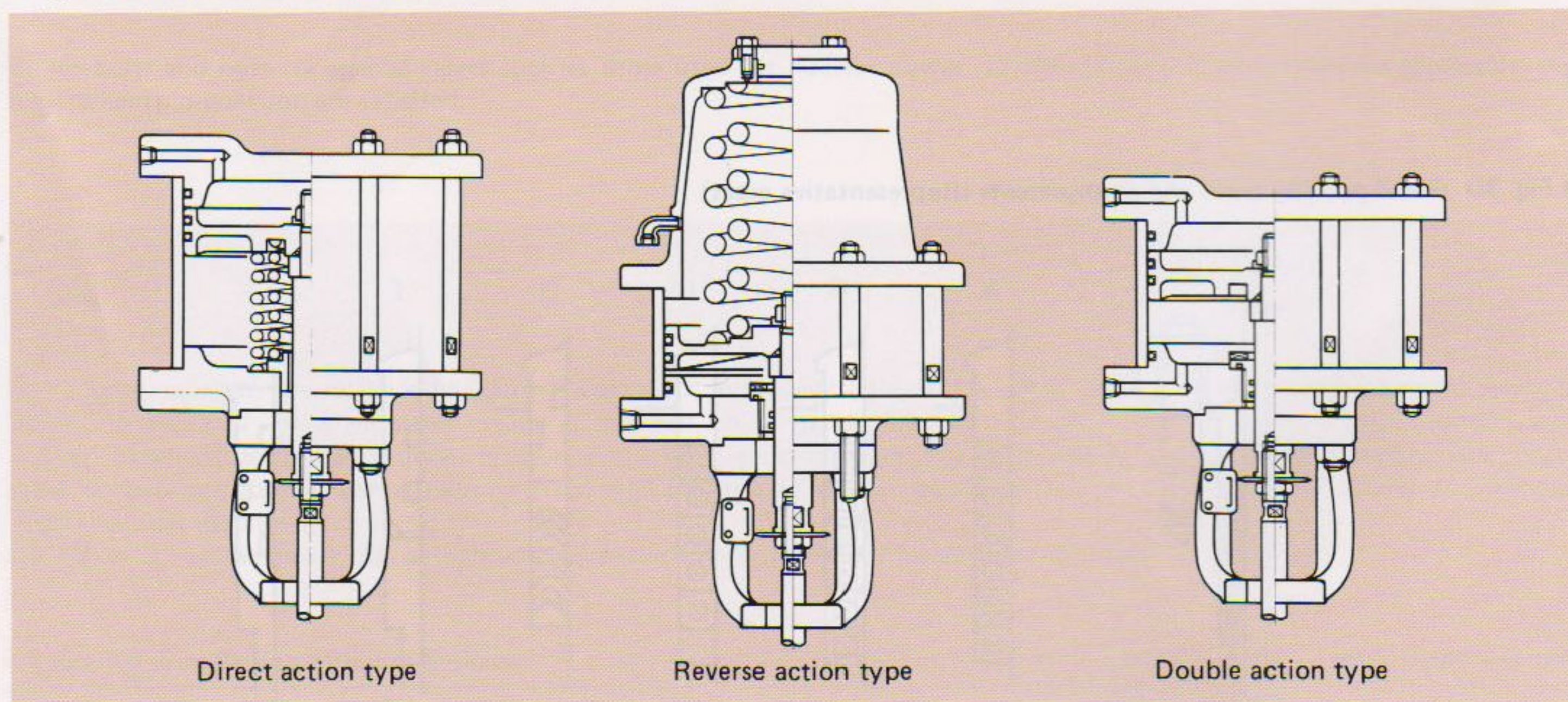
TYPES OF ACTUATOR

Actuators are classified according to action types as shown in the table below.

■ Table 4.1 Classification of actuators

Type	Explanation	Representative type indications
Direction action type	The piston stems moves towards the valve when the operating pressure is increased.	DA. DB. DG. DH. DI.
Reverse action type	The piston stem moves toward the actuator when the operating pressure is increased.	RA. RB. RG. RH. RI.
Double action type	Cylinder chambers are provided for both direct and reverse actions, and the piston stem is reciprocated by the off-balance of the thrusts of both actions.	WA. WB. WG. WH. WI.

■ Fig. 4A Classification of Actuators



SELECTION OF ACTUATOR

■ Selection of size

The size of the actuator for the valve body assembly type is selected according to the fluid pressure, the operating pressure, etc. to be specified in your specification sheet of each cylinder valve (see page 38).

■ Selection of action type

- In selecting the type of the actuator, the operation type of the cylinder valve is determined first by the characteristics of the plant. Then, an appropriate type of actuator is selected according to the plug type, direct plug type or reverse plug type. See Table 4.2 below.

■ Table 4.2 Valve operation types

Valve operation	Plug type	Actuator type	Remarks
Airless-open	Direct plug	Direct action type	
	Reverse plug	Reverse action type	Special case
Airless-shut	Direct plug	Reverse action type	
	Reverse plug	Direct action type	

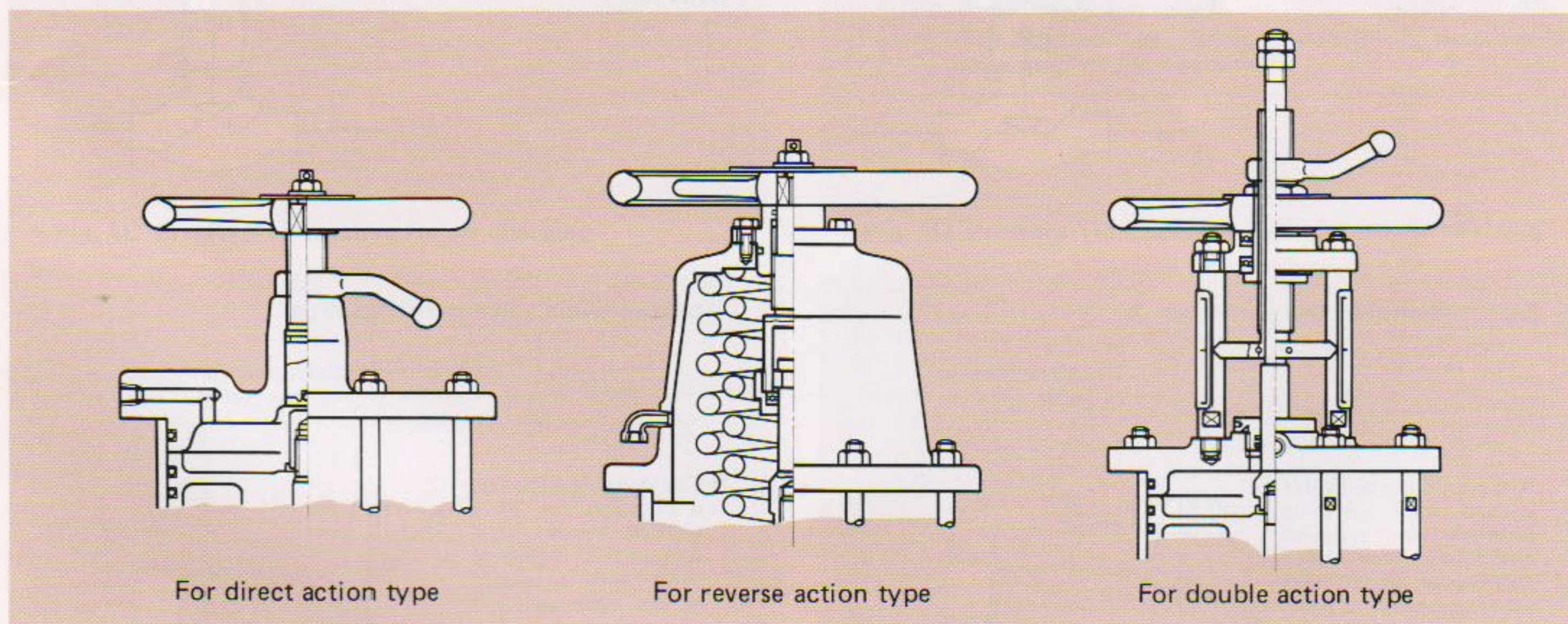
- The valve operation type is determined on the safer side according to the plant characteristics, so as to avoid interference with the process when the operating pressure source is lost.
- In the case of the double action type actuator, as it has no springs, the valve can not be kept in the fully opened or shut position when the operating pressure source is lost. A lock valve or auxiliary air tank should be provided to suit the characteristics of the plant.

HANDWHEEL

This device can be operated by hand when the diverter solenoid valve or the operating pressure system fails. The valve can be fully shut by turning the hand wheel clockwise.

Handwheel types are as shown in Fig. 4B.

■ Fig. 4B Types of handwheel

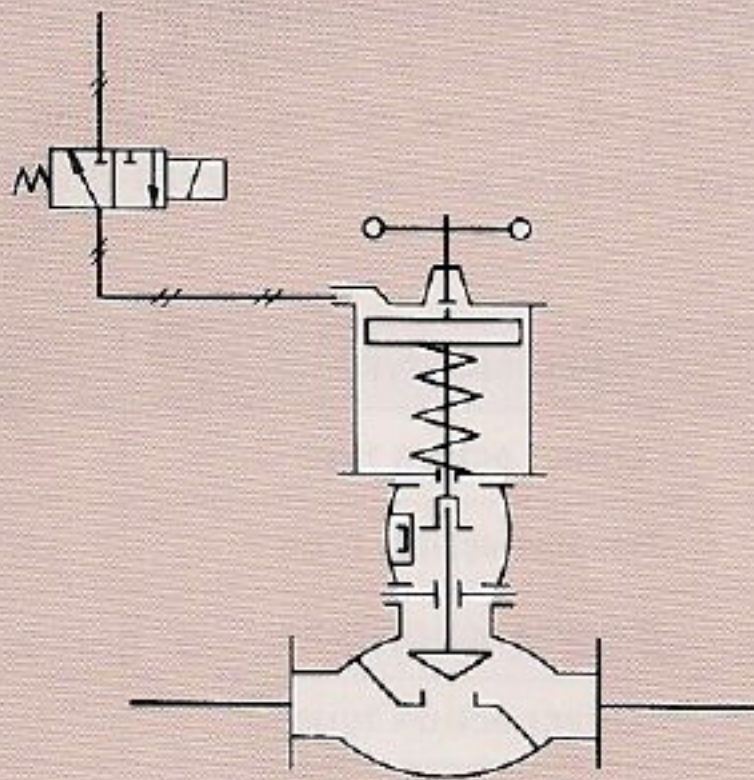


TYPICAL APPLICATIONS

3-port solenoid valve (normally closed valve)

Direct plug,
direct action type
cylinder valve

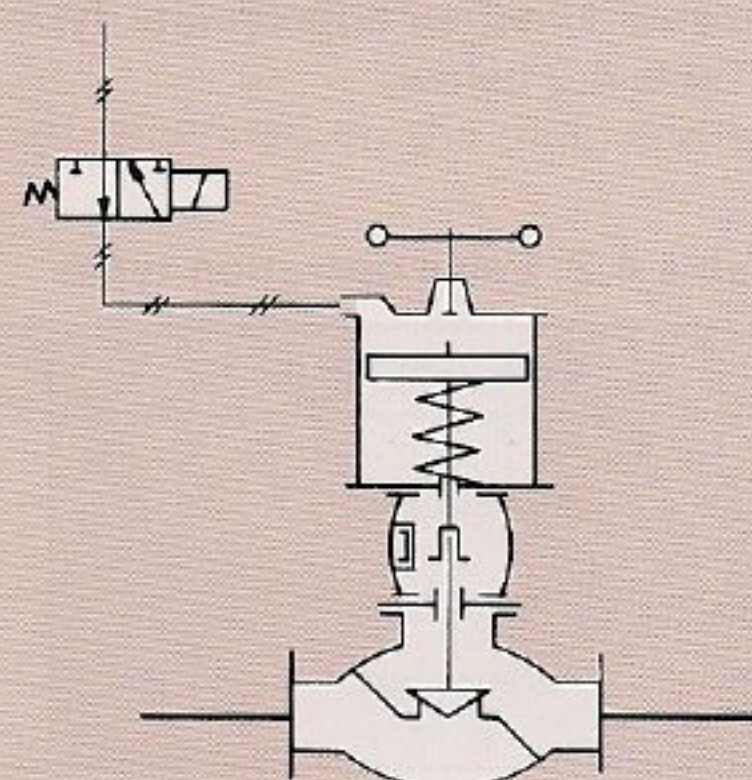
The drawing shows the cylinder valve actuator with its operating pressure removed. The solenoid valve is not energized.



3-port solenoid valve (normally open type)

Direct plug,
direct action type
cylinder valve

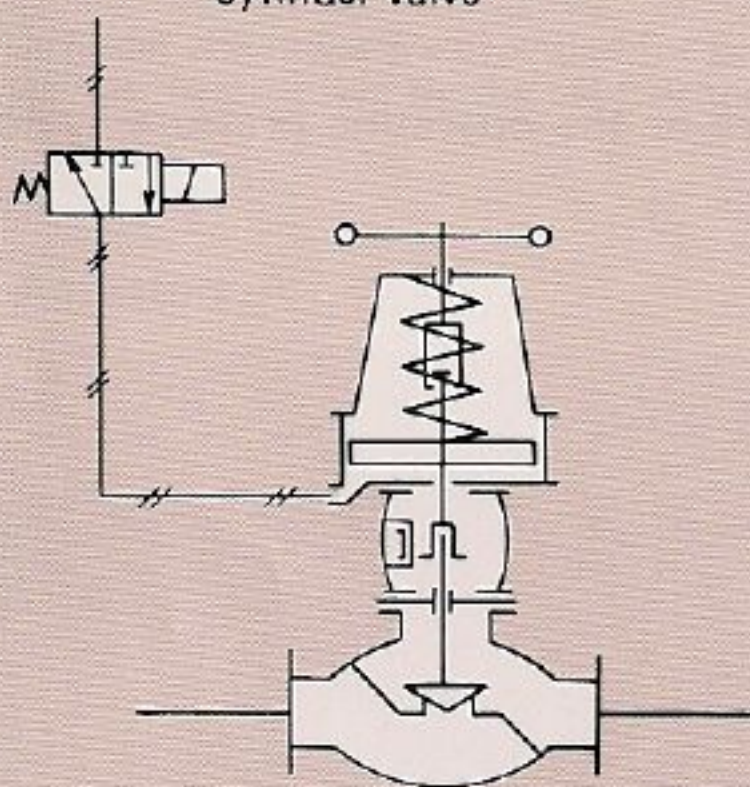
The drawing shows the cylinder valve actuator with its operating pressure applied to. The solenoid valve is not energized.



3-port solenoid valve (normally closed valve)

Direct plug,
reverse action type
cylinder valve

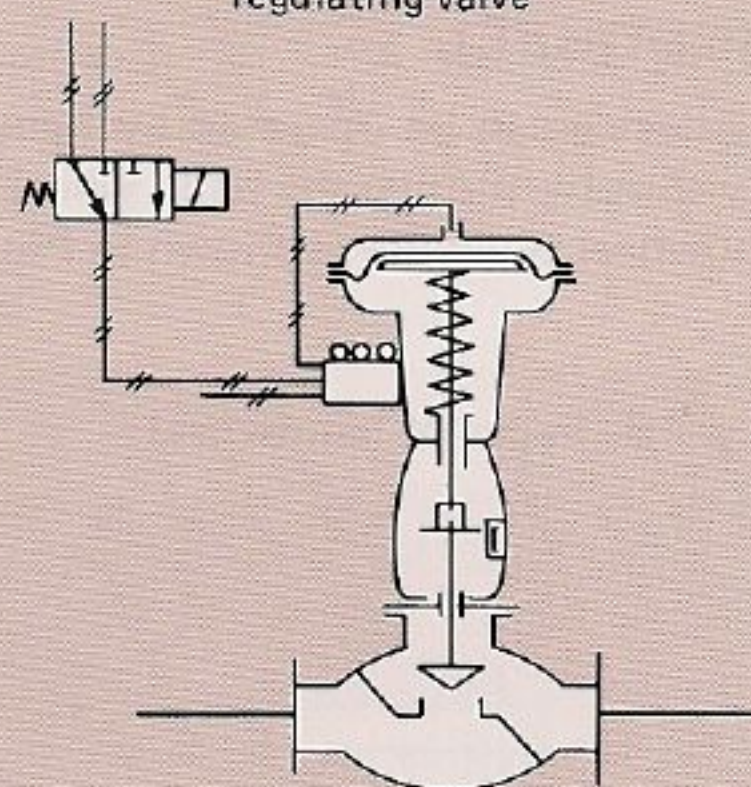
The drawing shows the actuator with its operating pressure removed. The solenoid valve is not energized.



3-port solenoid valve (merging type)

Oil pump
discharge pressure
regulating valve

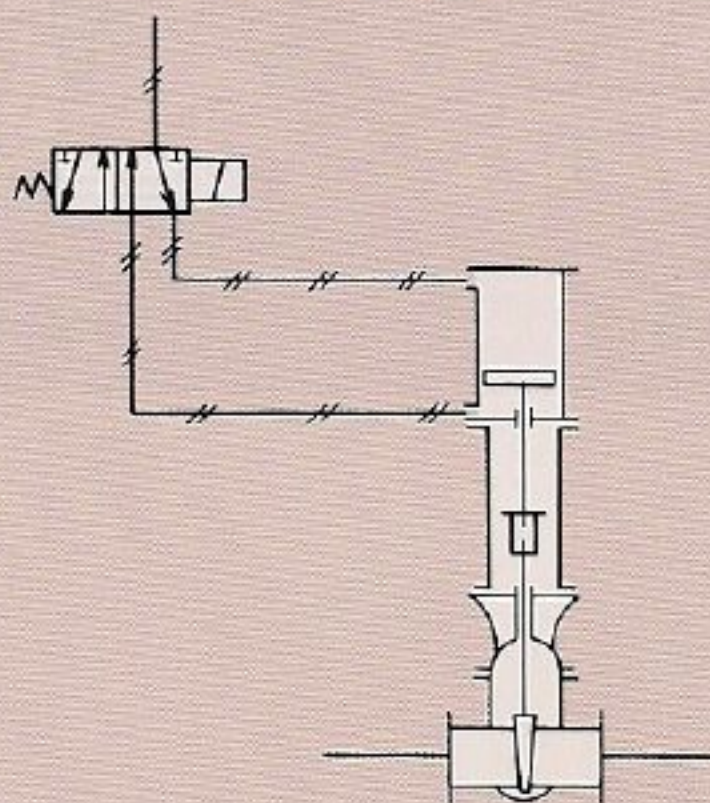
When the oil pump is started up, a merging type solenoid valve is used to set the travel of the pressure regulating valve at a certain level so as to prevent rapid rise in pressure and pulsation.



5-port solenoid valve (basic type)

Double action
cylinder valve

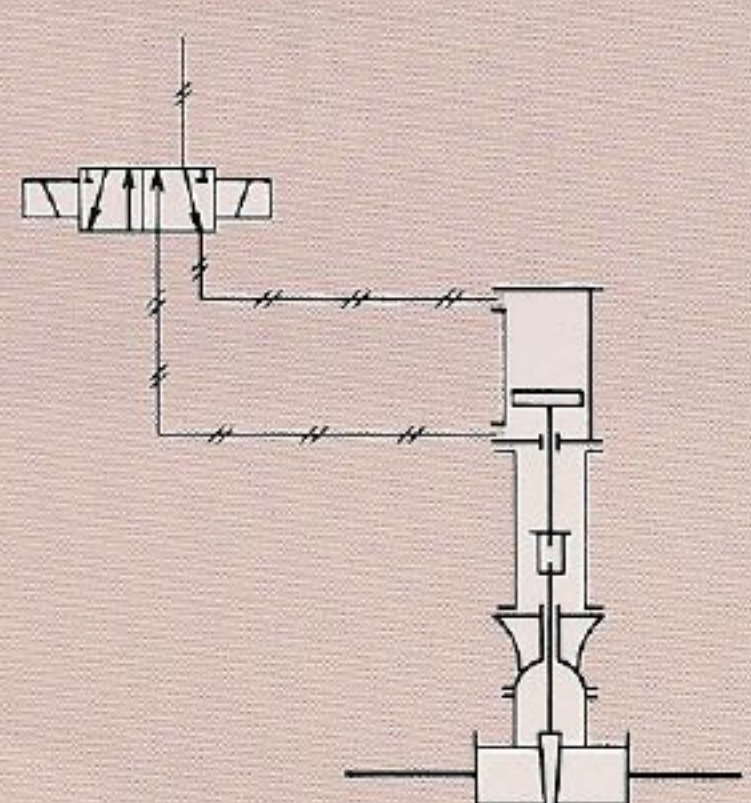
A 5-port solenoid valve is used when operating pressure is supplied alternately from above and below the cylinder valve actuator to operate the valve.



5-port solenoid valve (self-hold type)

Double action type
cylinder valve

- The drawing indicates a combination of a self-hold type (dual solenoid) solenoid valve and a double action type cylinder valve.
- This arrangement is used to prevent automatic resetting of the solenoid valve in case of power failure.



AIR CONSUMPTION AND ACTUATING TIME

For calculating the air consumption and actuating time of the actuator, the following simple formulas are normally used. Under the actual service conditions, however, it is necessary to consider factors such as the volume of the operating pressure piping, efficiency of the orifice, pressure loss in the piping, leak loss from connections, fluctuating load conditions during operation.

■ Calculation of air consumption

$$Q = \frac{(L \cdot A + V) (p + 1)}{1000}$$

Legend		
Q	: Air consumption	Nℓ/activation
L	: Travel	cm
A	: Cylinder effective area	cm ²
V	: Dead space in cylinder	cm ³
p	: Operating pressure	kgf/cm ² g

■ Calculation of actuating time

- Time required for producing full air pressure is given by the formula,

$$T_{nf} = 1.285 T_n$$

T_n is calculated using the formula,

$$T_n = 5.217 \frac{V_0}{\kappa \cdot S}$$

Where $V_0 = (L \cdot A + V)$

- Time required for discharging air pressure in the cylinder to atmosphere.

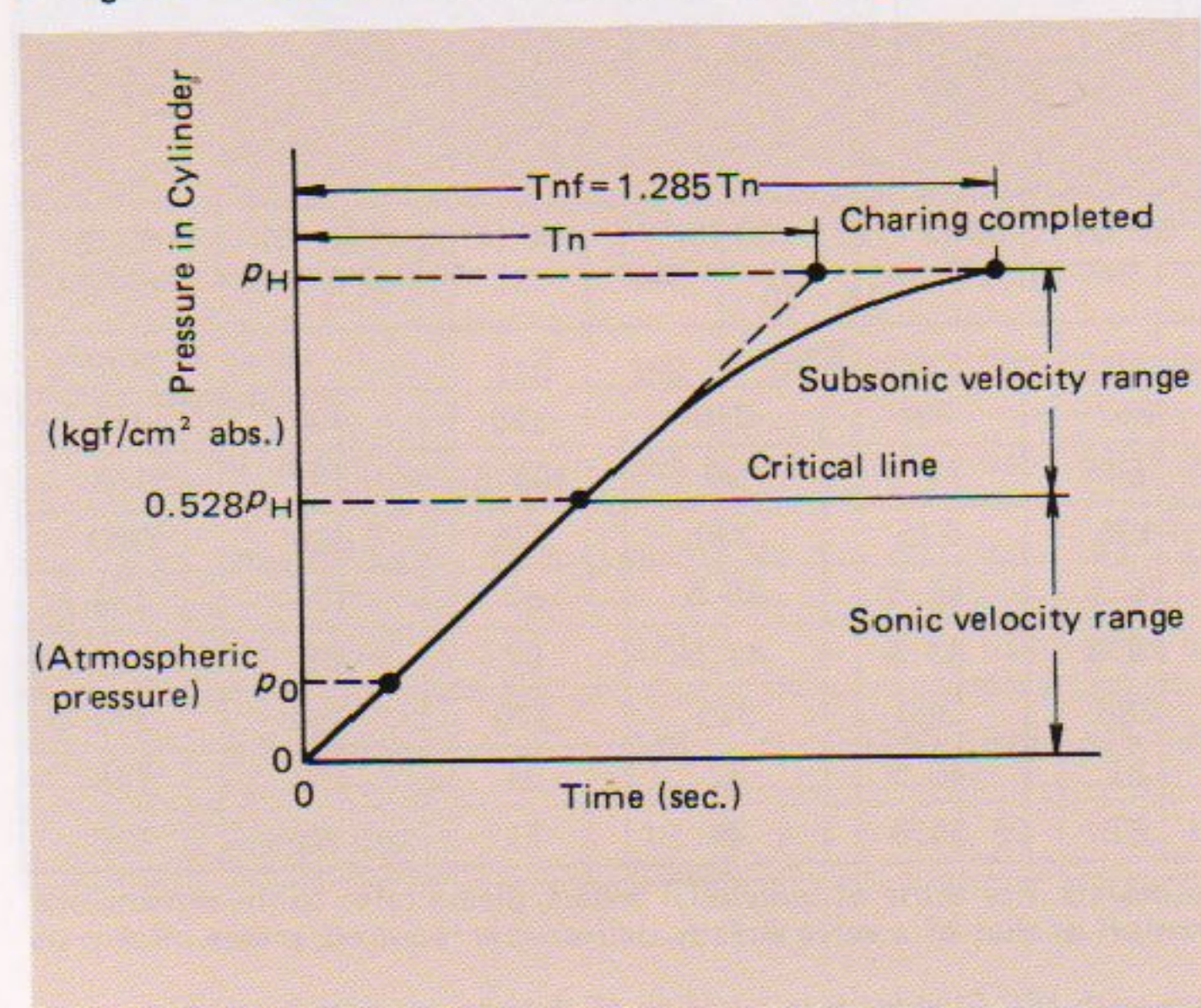
$$T_0 = T_1 + T_2$$

$$T_1 = T_n \frac{2\kappa}{\kappa - 1} \left\{ \left(\frac{p_H}{1.89 p_0} \right)^{\frac{\kappa - 1}{2\kappa}} - 1 \right\}$$

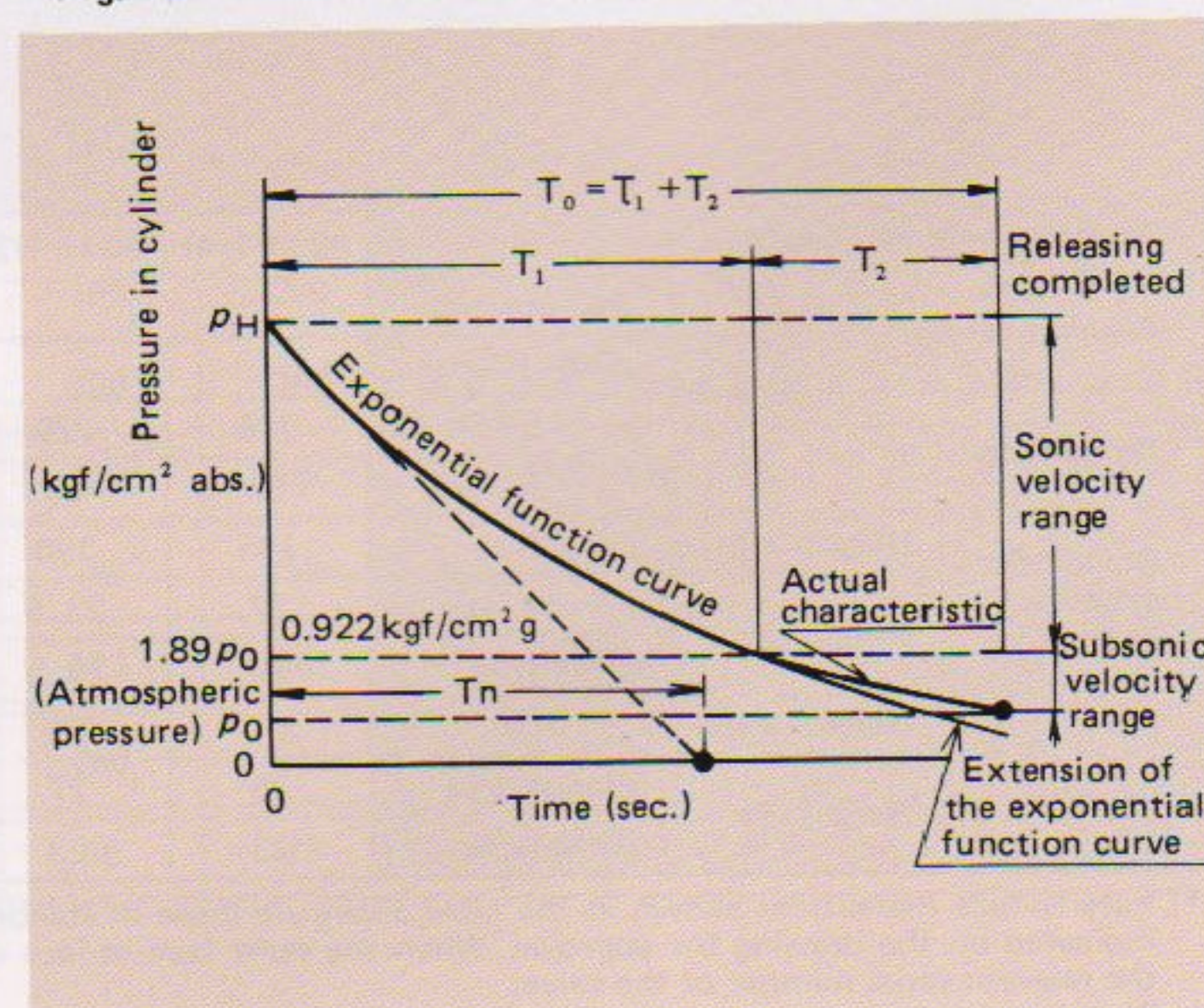
$$T_2 = 0.653 T_n \left(\frac{p_0}{p_H} \right)^{\frac{\kappa - 1}{2\kappa}}$$

Legend		
T_{nf}	: Pressure charging time	sec
T_n	: Time required when charging is made at a constant velocity* ¹	sec
V_0	: Cylinder capacity	ℓ
κ	: Ratio of specific heat (air: 1.40)	
S	: Orifice area	mm ²
T_0	: Pressure discharging time	sec
T_1	: Time required by the full pressure for reaching down to 0.922 kgf/cm ² g	sec
T_2	: Time required by pressure of 0.922 kgf/cm ² g for reaching down to the atmospheric pressure	sec
p_H	: Full charged pressure	kgf/cm ² abs.
p_0	: Atmospheric pressure	kgf/cm ² abs.
* ¹ Time required at the velocity when critical velocity condition is assumed to be continuing.		

■ Fig. 4C Pressure-Time curve for air charging



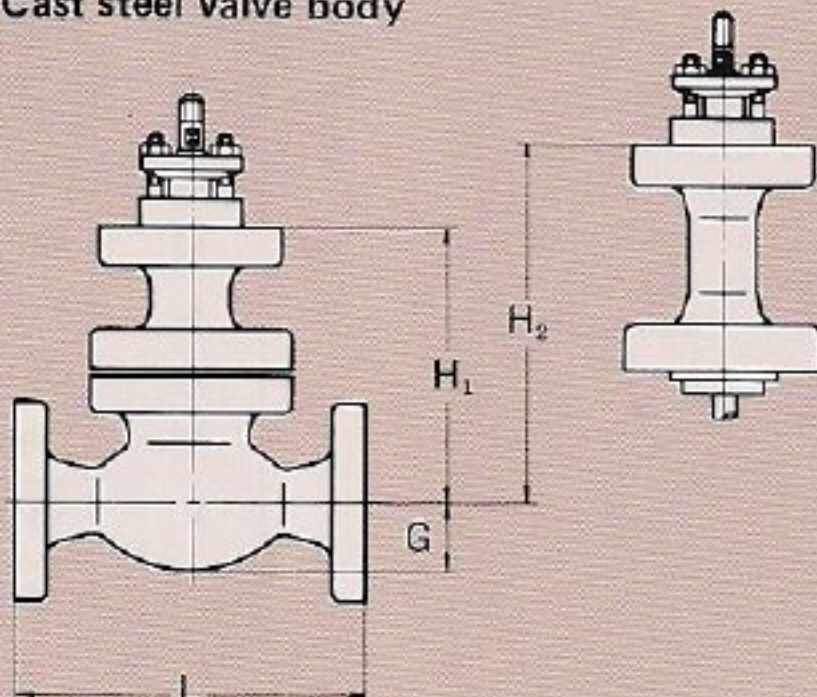
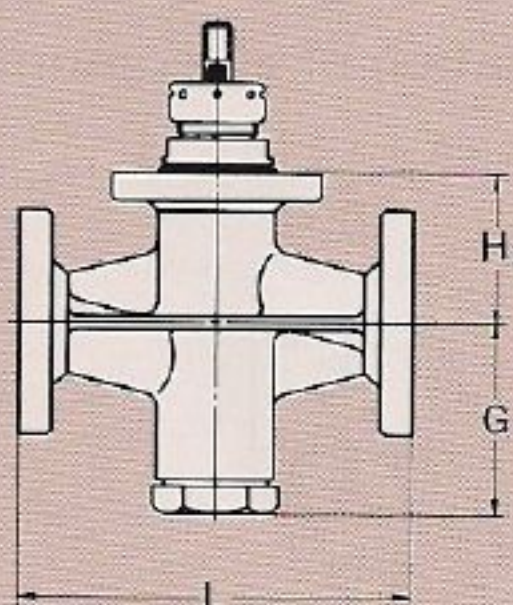
■ Fig. 4D Pressure-Time curve in cylinder for air releasing



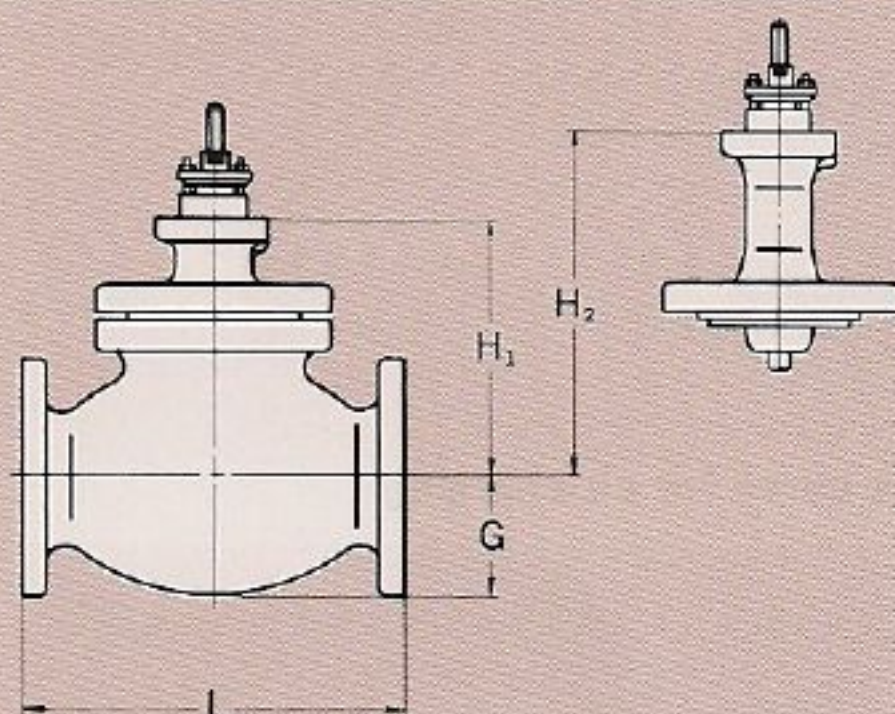
VALVE BODY ASSEMBLY

- The dimensions and weight of each valve body assembly are as shown in the table below.
The table indicates those of which nominal bore is from 15 to 150mm, pressure rating JIS 20kgf/cm² and under, and class 300 and under.

■ Nominal bore 25mm (1 inch) and under

Dimensional drawing			● Cast steel valve body			● Forged steel valve body		
								
Nominal bore mm (inch)			15 (1/2)	20 (3/4)	25 (1)	15 (1/2)	20 (3/4)	25 (1)
Pressure rating		JIS kgf/cm ²	16 · 20			16 · 20		
		ANSI (Class)	300			300		
Overall size mm		L (*)	191	191	216	165	191	216
		G	43	43	43	104	104	104
Standard type bonnet	Height mm	H ₁	171	171	171	83	83	83
	Weight kg	Flange type	15.5	16.5	17	8	10	11.5
		Weld type	14.5	14.5	14.5	7	8	9
Long type bonnet	Height mm	H ₂	222	222	222	—	—	—
	Weight kg	Flange type	16	17	17.5	—	—	—
		Weld type	15	15	15	—	—	—

■ Nominal bore of from 32 to 150mm (1¼ to 6 inch)

Dimensional drawing			● Cast steel valve body							
										
Nominal bore mm (inch)			32 (1 1/4)	40 (1 1/2)	50 (2)	65 (2 1/2)	80 (3)	100 (4)	125 (5)	150 (6)
Pressure rating		JIS kgf/cm ²	16 • 20							
		ANSI (Class)	300							
Overall size mm		L (*)	216	229	267	292	318	356	400	444
		G	53	53	64	77.5	90	108.5	132	153
Standard type bonnet	Height mm	H ₁	185	190	195	215	230	275	300	320
	Weight kg	Flange type	22	23.5	28.5	38.5	50.5	80	106	139
		Weld type	20	19.5	24.5	33.5	42.5	67	89	116
Long type bonnet	Height mm	H ₂	270	275	280	300	315	370	390	410
	Weight kg	Flange type	25	27	31	40.5	52	84	109	143
		Weld type	23	23	27	35.5	44	71	92	120

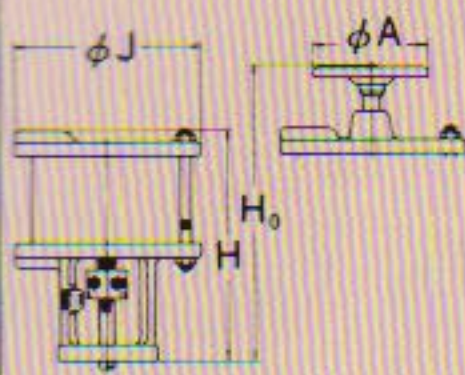
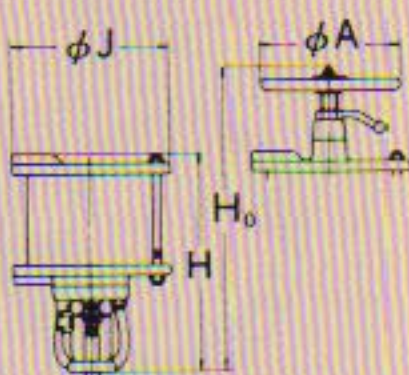
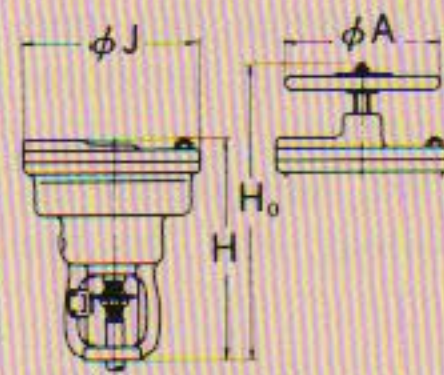
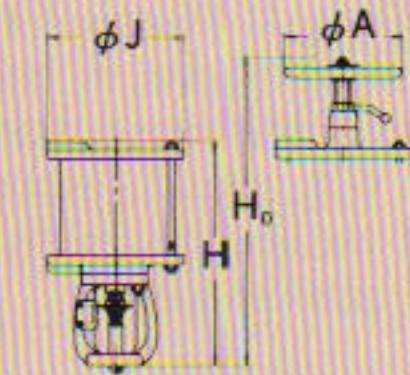
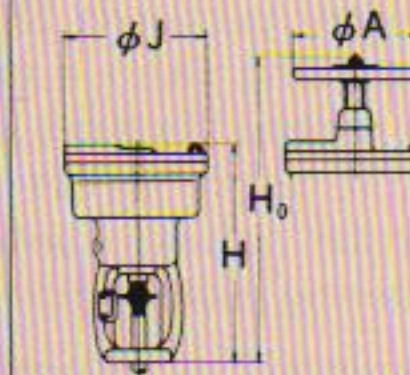
(*) Face-to-face dimensions shown in the table above are those of standard products. For those of individual orders, please refer to the dimensions indicated on the drawing for approval. When the same face-to-face dimension as that of a valve already delivered is required, please inform us the relevant serial number of the valve.

We also manufacture valves which has fact to face dimensions in accordance with IEC Standards in addition to dimensions listed as above.

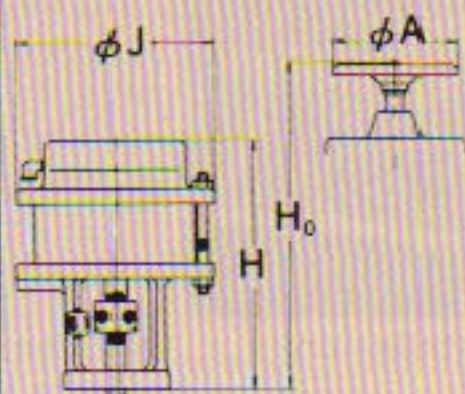
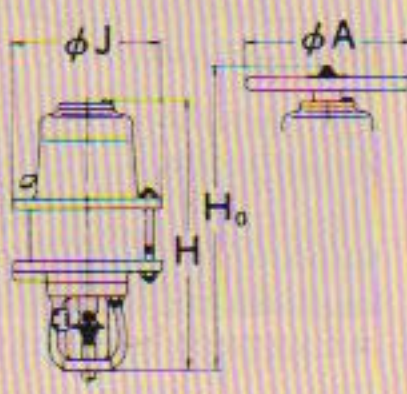
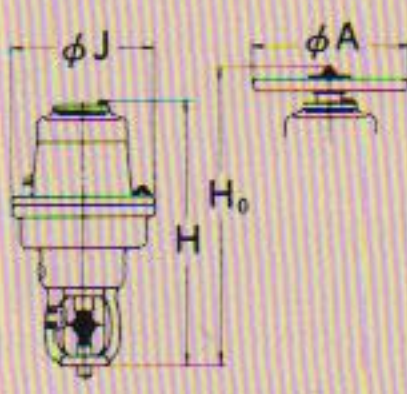
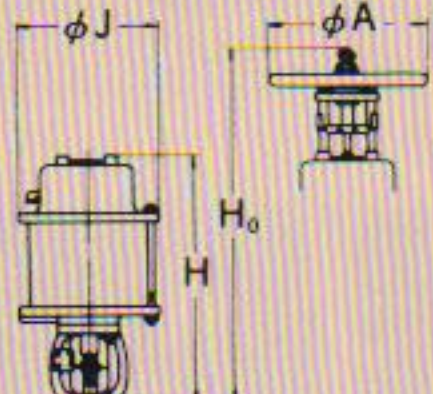
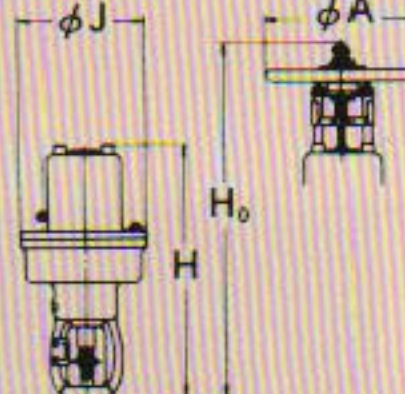
ACTUATOR

- The dimensions and weight of each actuator are as shown in the table below.
The table indicates those of which cylinder nominal size is from 100 to 400.

■ Direct action type

Applicable nominal bore mm (inch)			15 ~ 25 (1/2 ~ 1)				32 ~ 80 (1 1/4 ~ 3)						100 ~ 150 (4 ~ 6)					
Type			Type DG				Type DA			Type DH			Type DB			Type DI		
Dimensional drawing																		
Cylinder nominal size			100	120	140	160	160	200	240	120	160	200	200	240	280	160	200	240
Actuator outer diameter ϕJ mm			150	180	190	220	230	280	320	180	230	280	280	320	360	230	280	320
Handwheel	Not provided	H mm	277				375	445	445	369	375	375	520	520	525	457	457	457
		Weight kg	11	13	15	21	37	61	77	23	33	50	68	85	100	39	56	66
	Provided	H ₀ mm	355				525	615	615	500	500	510	715	715	715	630	630	640
		ϕA mm	140				200	250	280	160	200	250	250	280	315	200	250	280
		Weight kg	12	14	16	22	42	67	85	27	38	56	74	93	109	44	62	74

■ Reverse action type

Applicable nominal bore mm (inch)			15 ~ 25 (1/2 ~ 1)			32 ~ 80 (1 1/4 ~ 3)				100 ~ 150 (4 ~ 6)						
Type			Type RG			Type RA			Type RH		Type RB			Type RI		
Dimensional drawing																
Cylinder nominal size			120	140	160	160	200	240	280	160	200	240	280	340	400	240
Actuator outer diameter ϕJ mm			180	190	220	230	280	320	360	230	280	320	360	415	480	320
Handwheel	Not provided	H mm	285			475	545	565	590	520	560	635	655	655	690	675
		Weight kg	14.5	16.5	21.5	50	69	93	116	46	68	104	126	177	251	91
	Provided	H ₀ mm	370			573	638	658	683	623	663	940	960	960	995	980
		ϕA mm	140			280	315	315	355	280	315	400			400	
		Weight kg	16	18	23	60	83	107	130	56	79	120	142	193	267	107

CYLINDER VALVES FOR LOW TEMPERATURE AND CRYOGENIC TEMPERATURE USES

Today, in low temperature and cryogenic temperature plants, a variety of practical plants are being developed and extended rapidly, on the basis of test plants of cryogenic temperature ranges, and technical innovations in the fields of cold heat and low temperature technologies are rapidly advancing.

To meet the new needs in the fields of low temperature and cryogenic temperature technologies, we have introduced a series of new facilities including clean room and jet cleaning device. We also have been extending the range of certifications by type given to us by the Minister of International Trade and Industry pursuant to the High Pressure Gas Control Act, and conducting various demonstrations in the cryogenic temperature ranges. We have already delivered many valves.

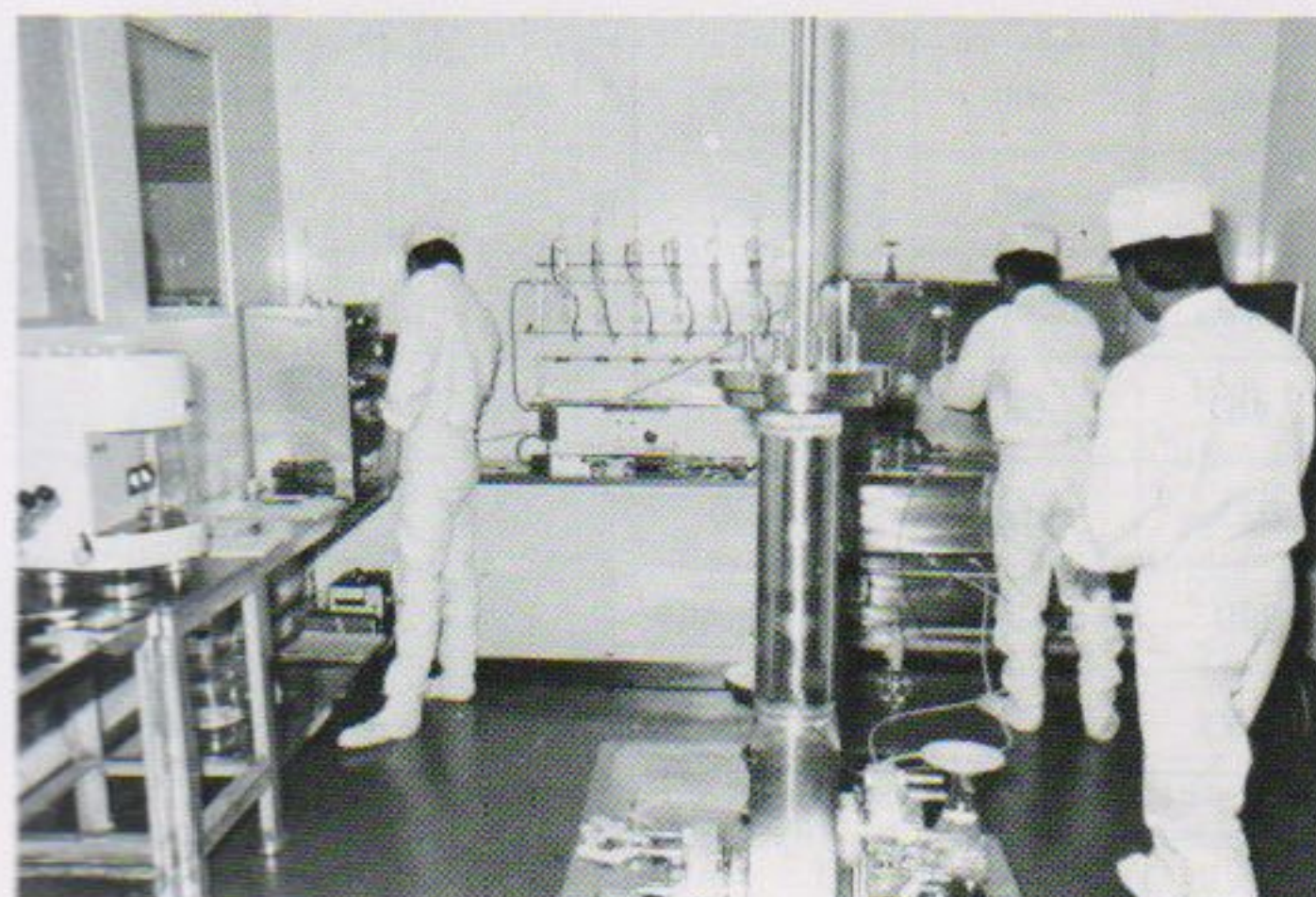
Just to show a part of our actual results, we have delivered cylinder valves, control valves, butterfly valves, etc., to the following plant facilities and devices.

Examples of deliveries

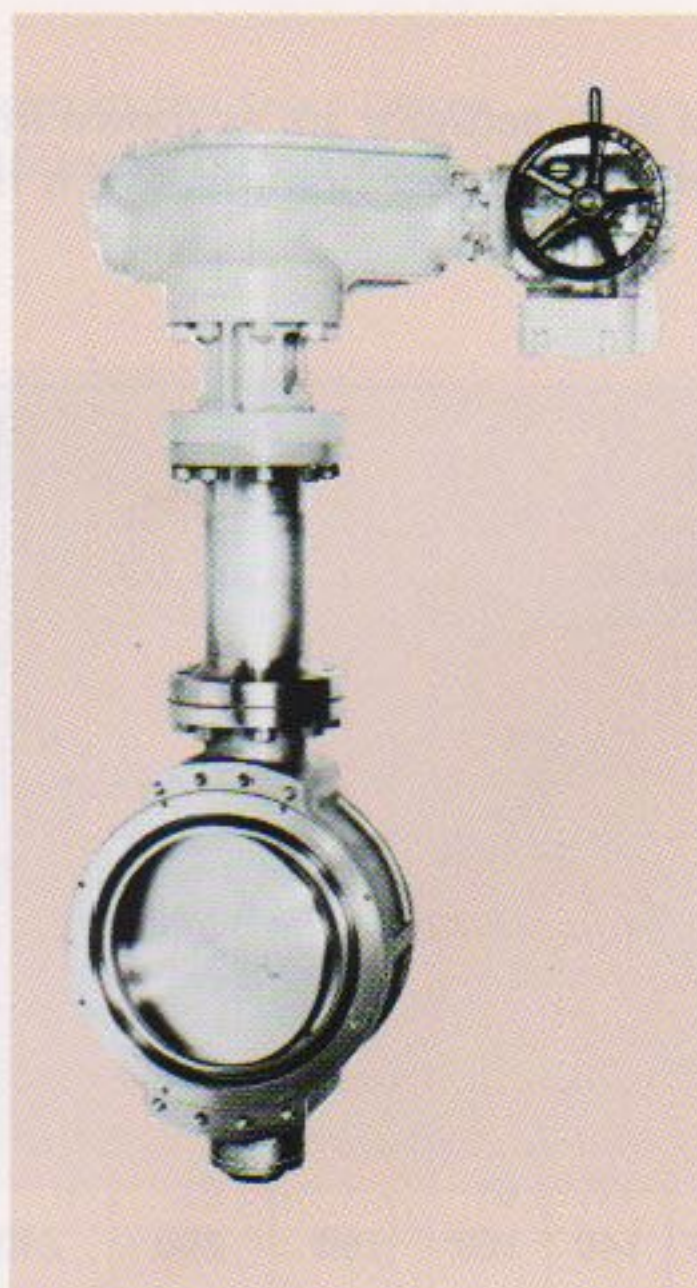
	Working temp.
1. Cylinder valves for LPG facilities	-46°C
2. LNG facilities and LNG carriers	-162°C
3. Large capacity oxygen production unit	
Liquid air	-194°C
Liquid oxygen	-183°C
Liquid argon	-186°C
Liquid nitrogen	-196°C
4. Hydrogen purifier and helium liquifier	
Liquid hydrogen, gas hydrogen	-253°C
Gas helium	-268°C
5. National Space Development Agency:	
Rocket fuel valves	
Liquid oxygen	-183°C
Liquid nitrogen	-196°C
Liquid hydrogen	-253°C
6. Power Reactor and Nuclear Fuel Development Corporation:	
Krypton recovery facilities	
Liquid krypton	-196°C
Gas nitrogen	-96°C
7. Nuclear fusion experiment device	
Liquid helium	-268°C
8. Tokyo University, Space Research Institute:	
Rocket fuel valves	
Liquid oxygen	-180°C
9. Cryogenic temperature functional test device	
Gas nitrogen	-196°C
Gas helium	-268°C



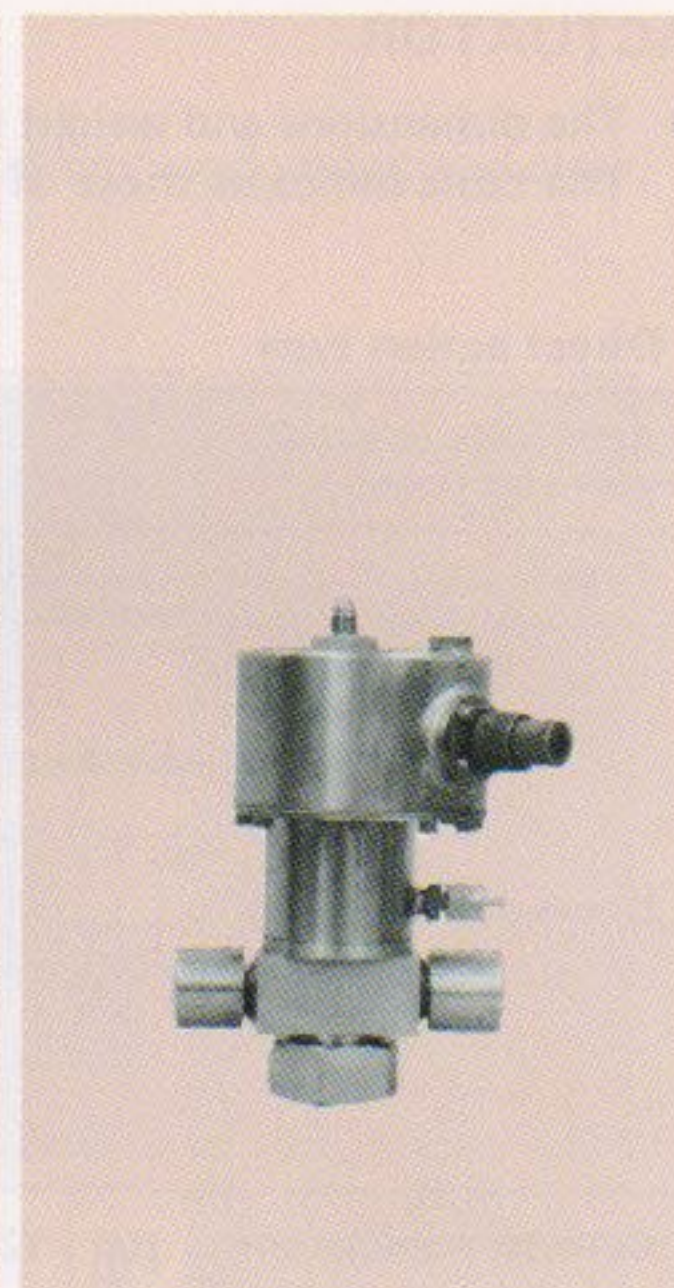
▲ Cryogenic temperature testing device



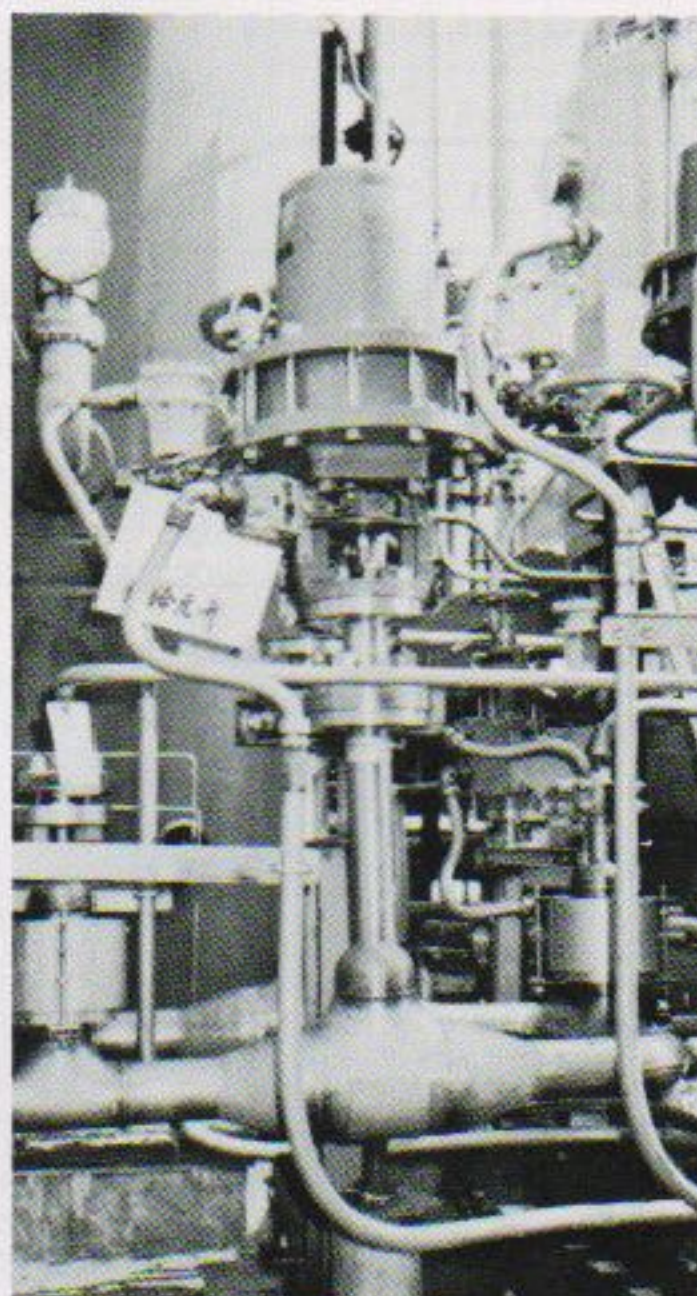
▲ Testing devices in clean room



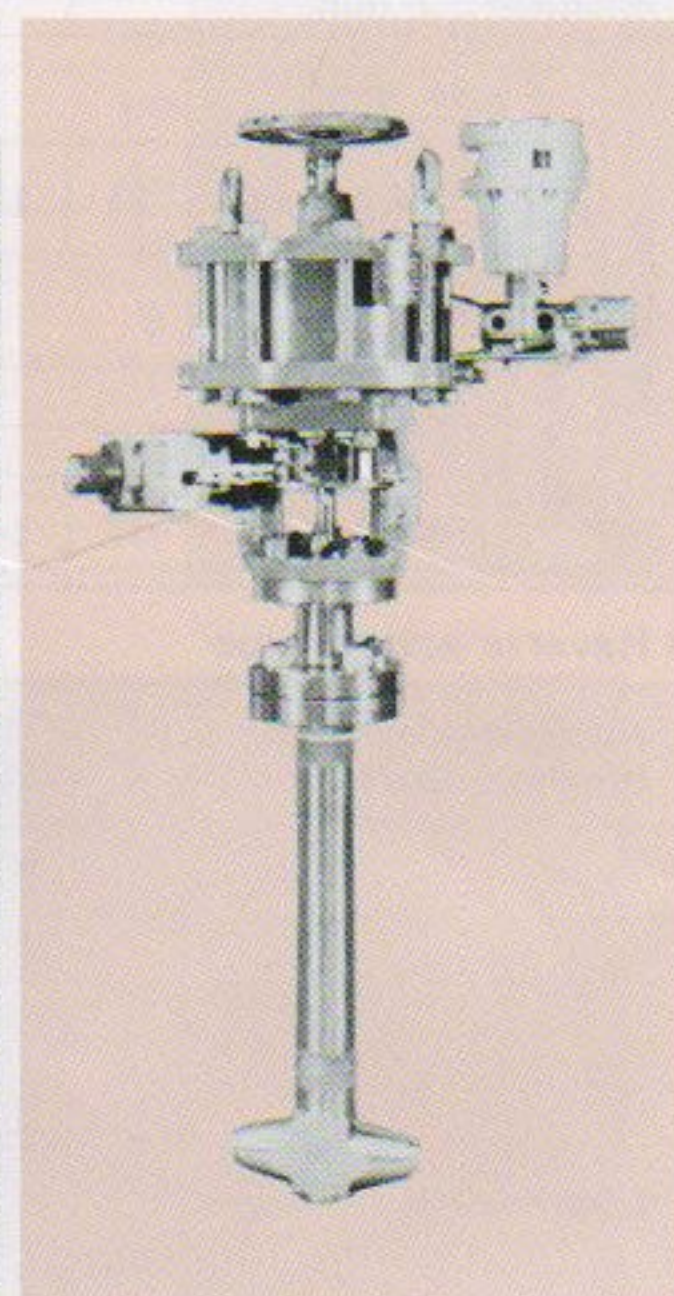
▲ Butterfly valve



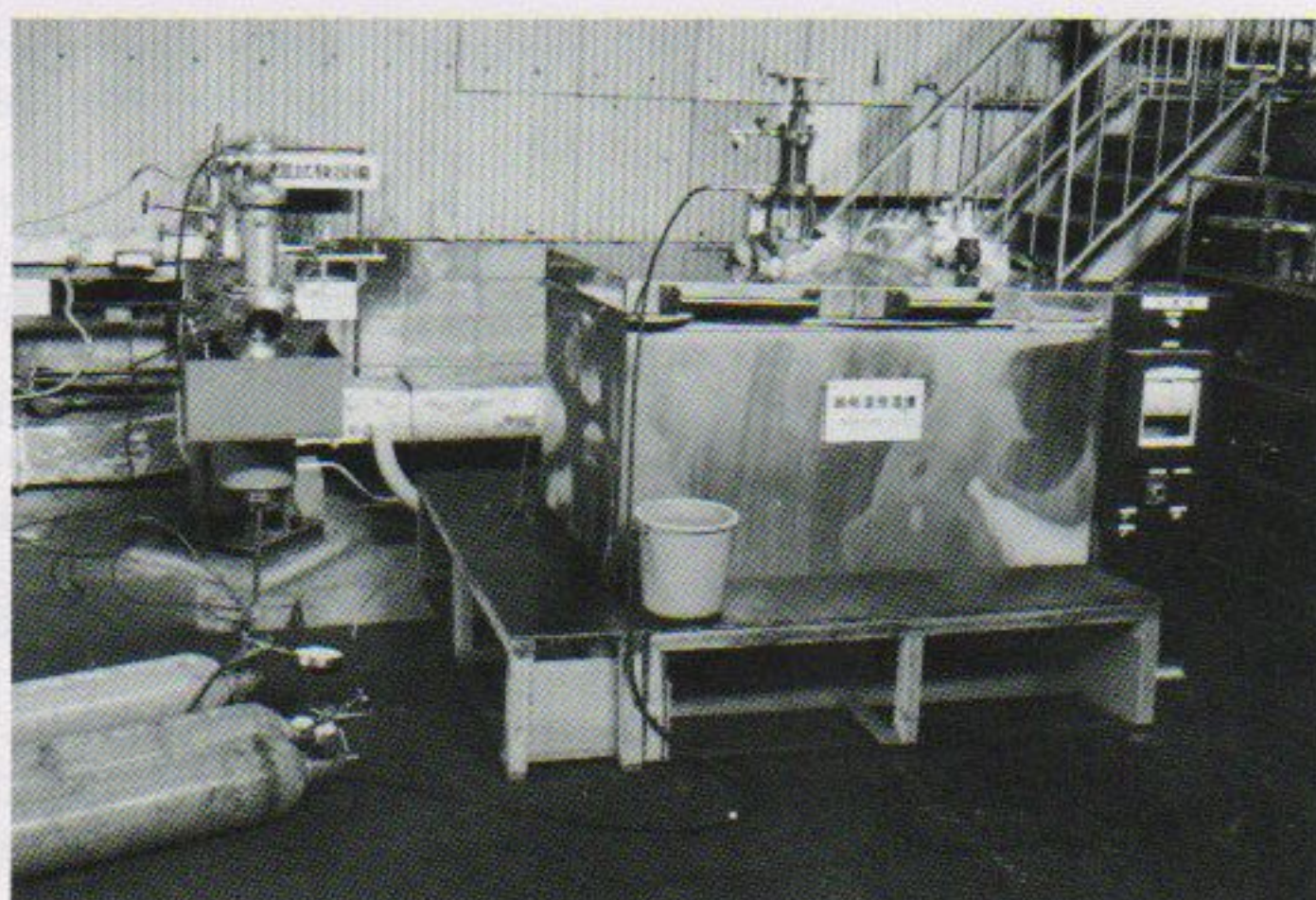
▲ Rocket fuel valve



▲ Example of field installation



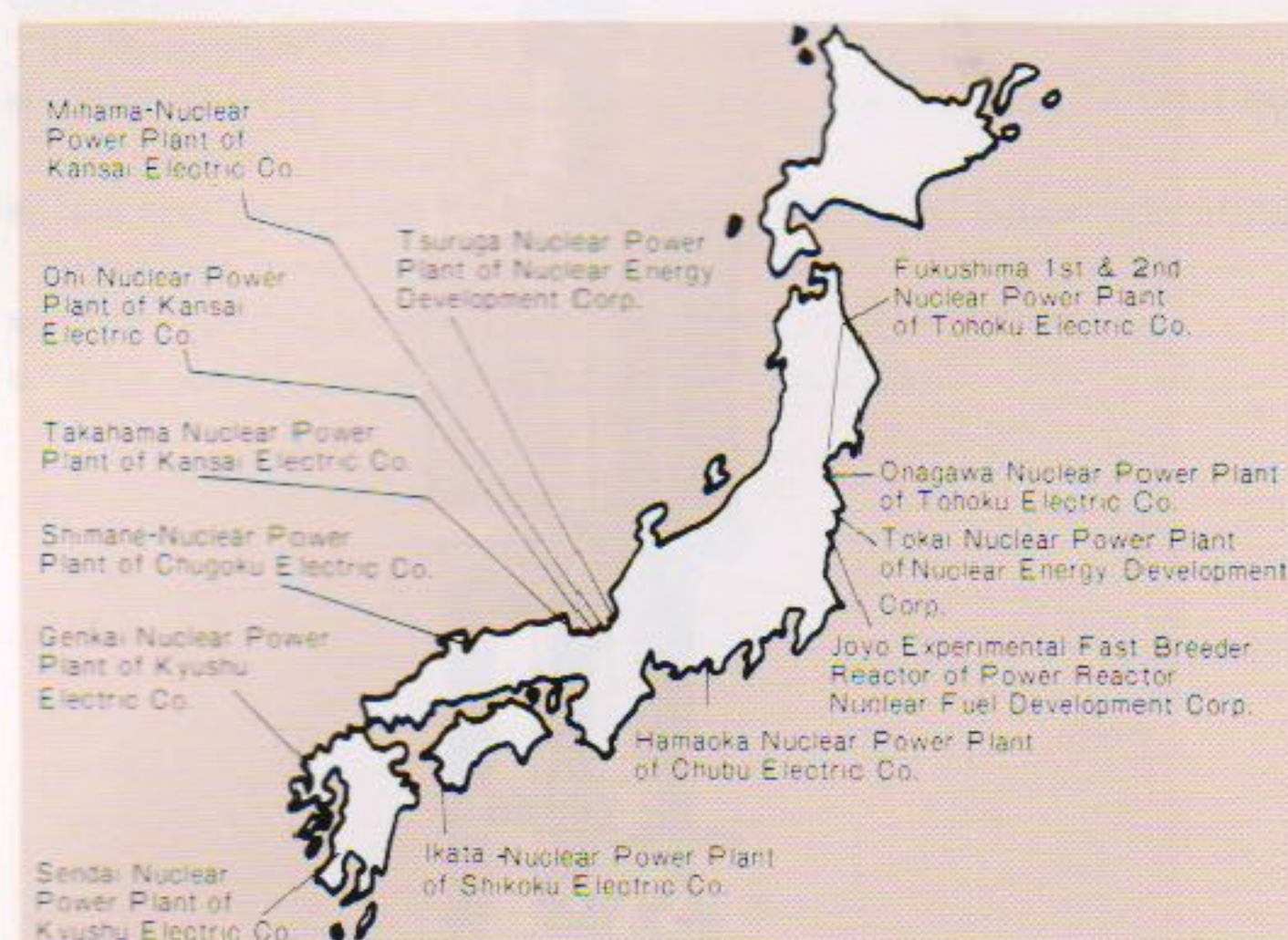
▲ Valve with extension type bonnet



▲ Cryogenic temperature leak test (bubble test)

CYLINDER VALVES FOR NUCLEAR POWER PLANTS

To cope with the present energy situation, it is now urgently required to construct or expand nuclear power plants. We have delivered numerous valves to each power plant as shown below. We are constantly striving to improve the quality of our products by conducting researches and experiments, on the basis of these past performances.



Actual results of delivery

With deliveries to No.1 Machine of Tokai Nuclear Power Plant, nuclear ship the "Mutsu", and No.1 Machine of Mihama Nuclear Power Plant of Kansai Electric Power Co., Ltd. as the start, we have delivered valves to each power plant in Japan as shown above. We have also delivered valves for fast breeder reactor (FBR), advanced thermal reactor (ATR), and spent fuel reprocessing plant. To assure safety of nuclear power plant, valves for nuclear power plant require sophisticated quality control and quality assurance. To meet these requirements, we have established a quality assurance manual and have been exercising adequate quality control all over the production processes, from receiving orders, through designing, accepting materials, manufacturing, inspecting, and up to delivering the products. We have also been conducting various demonstrations on strength and durability, including earthquake resistance, of valves, so as to supply products of high reliability.

Main requirements

Standards:

Notification No.501 of the Ministry of International Trade and Industry, "Technical Standards for Construction and the Like".
Ordinance No.81 of the Ministry of International Trade and Industry, "Technical Standards for Welding of Electric Structures".
ASME SECTION III and other relevant standards.

QA system:

Establishment of quality assurance manual and its application.

Qualifications:

Certification of welding [welder, welding procedure specifications]
Certification of non-destructive tests [NDE personnel, NDE manual]

Design:

[Document]	Documentation manual, manufacturing plan, strength calculation sheet.
[Construction]	Leakage prevention, exclusion of foreign matter, and easy maintenance.
[Strength]	Demonstrations such as earthquake resistance test, durability test, and measurement of natural frequency.
[Function]	Operating test under excessive conditions of emergency.

Materials:

Check of mill sheet of materials of pressure containing part, non-destructive tests (UT, RT, MT and PT), fracture toughness test, Mo check of austenitic stainless steel, ferrite check of welded portion of the same.

Manufacturing processes:

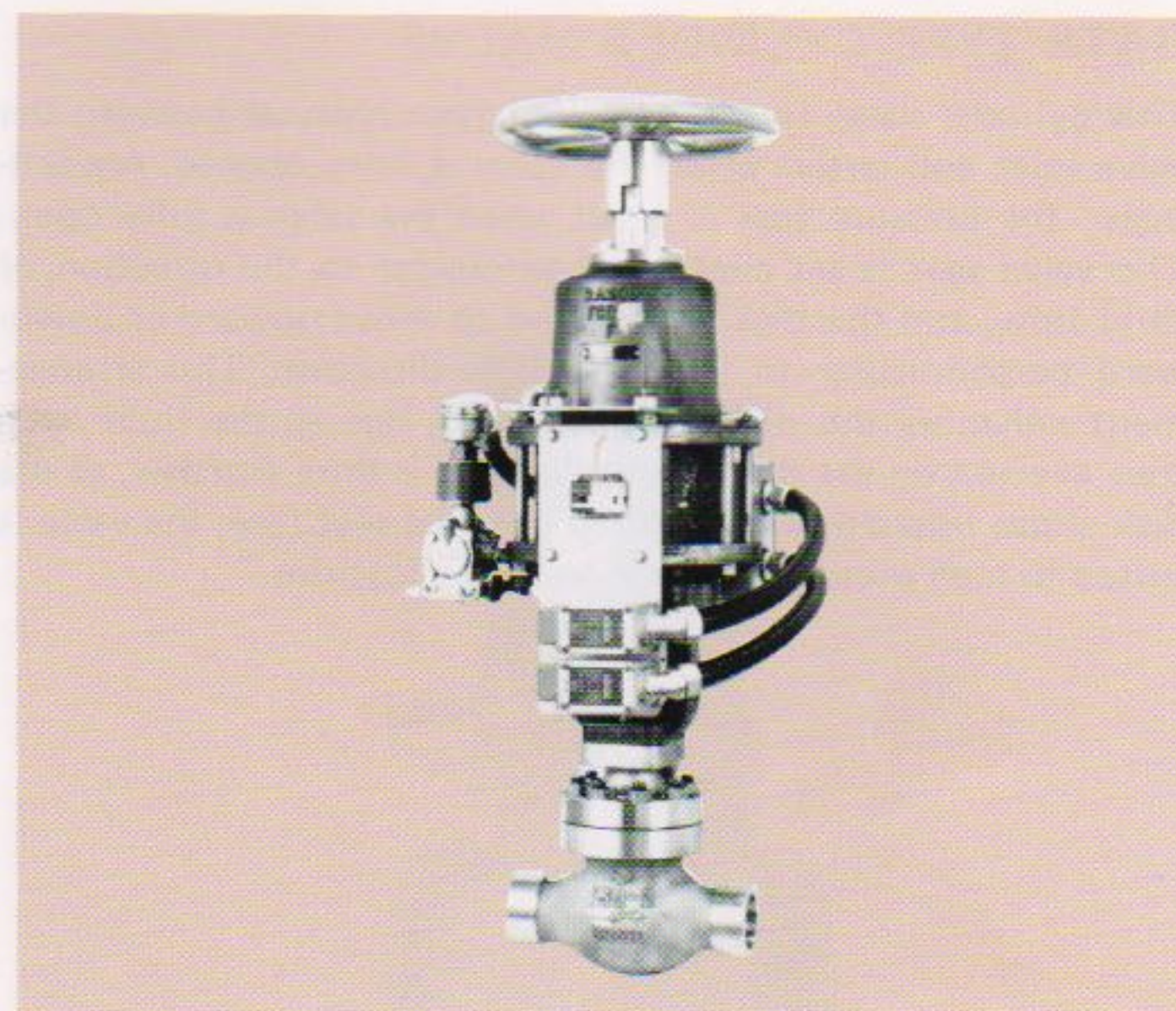
Production process control chart (FS), ad control of specifications by means of traveller.

Tests and inspections:

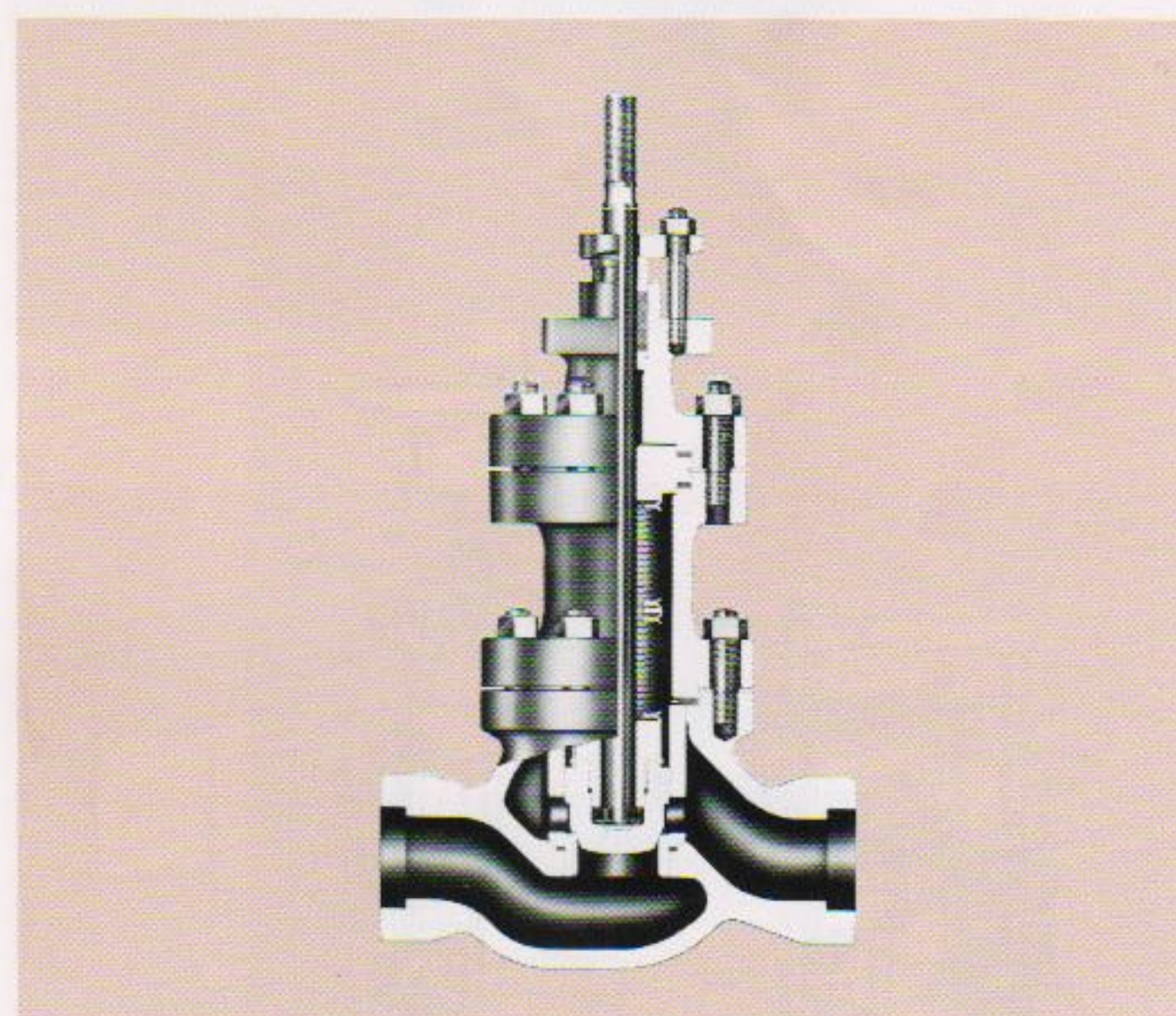
Acceptance inspection, non-destructive test, in-process inspection, and test on completion.

Records:

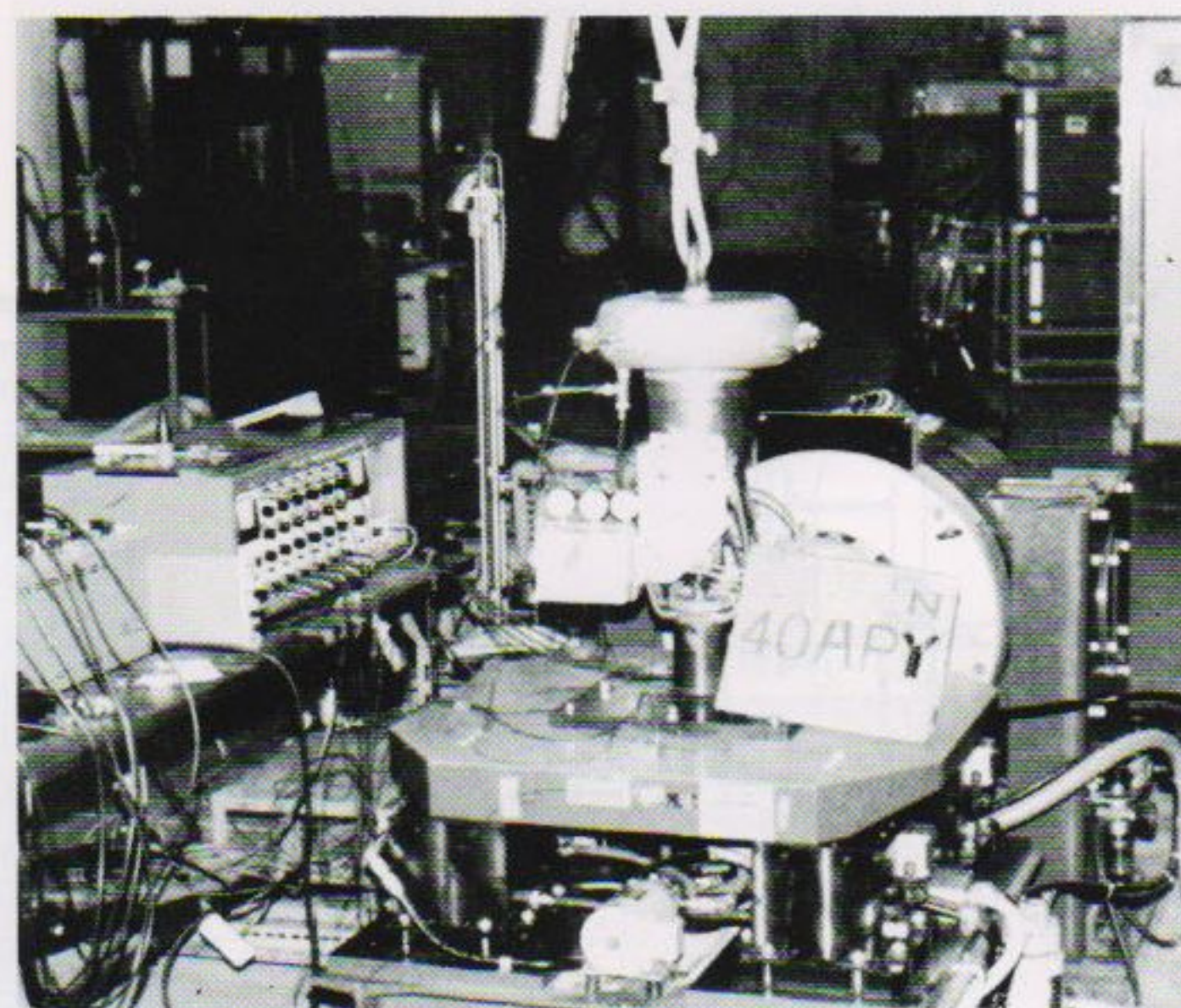
Maintenance of QA/QC records.



▲ Cylinder valves for nuclear power plants



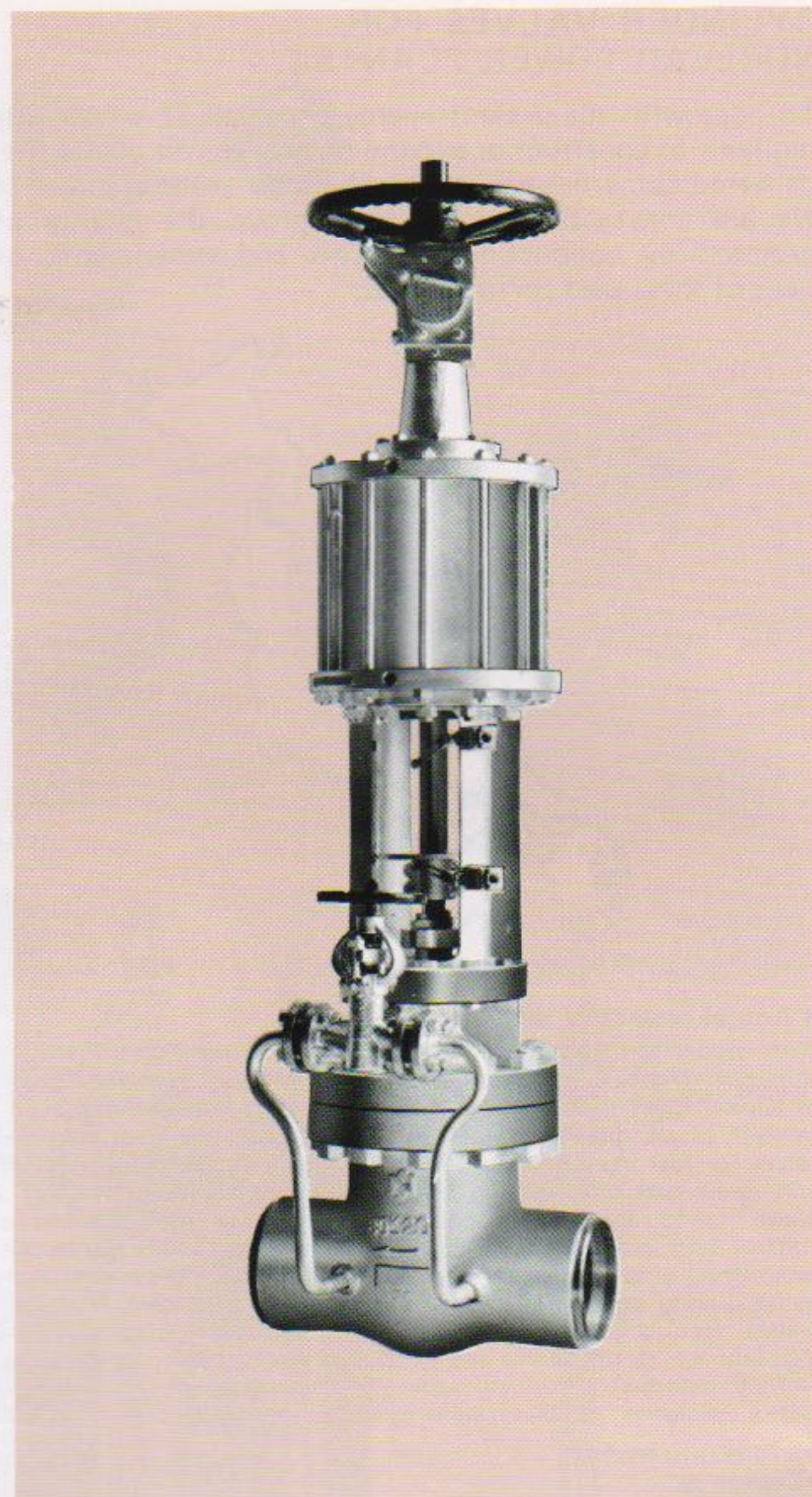
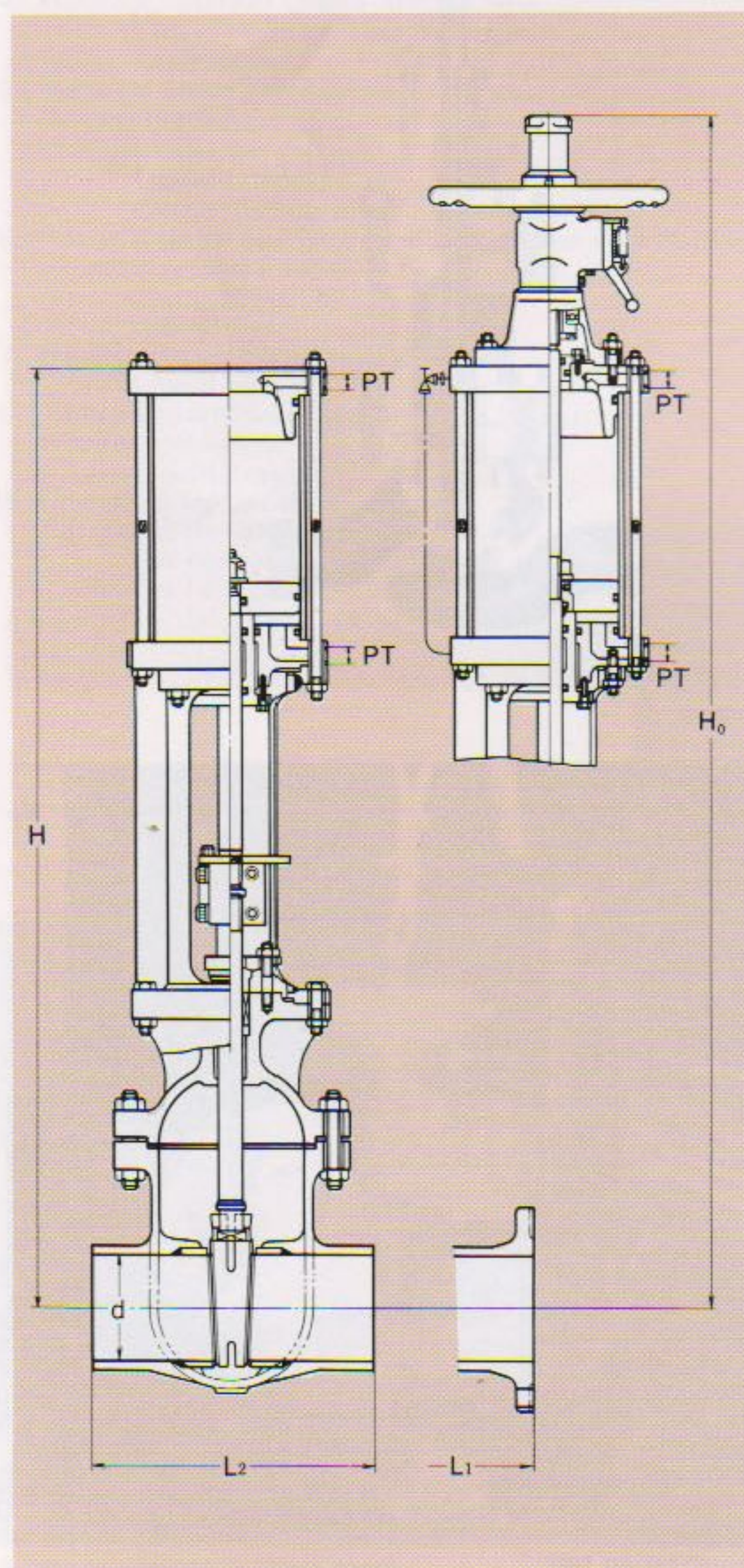
▲ Bellows seal valve



▲ Scene of demonstration test

GATE TYPE CYLINDER VALVE

This cylinder valve forms a straight type channel between the valve inlet and outlet when the valve is fully opened. Accordingly, the pressure loss is small when the valve is fully open. The valve seat is set almost perpendicular to the direction of fluid flow, and the disk is arranged to move upward or downward perpendicular to the fluid flow direction. This arrangement enhances the disk's sealing effect due to the fluid pressure exerted on the disk when the valve is shut. Further, as the disk slides upward or downward over the seat face, the valve is suited to high pressure or large bore applications.



■ Table of dimensions

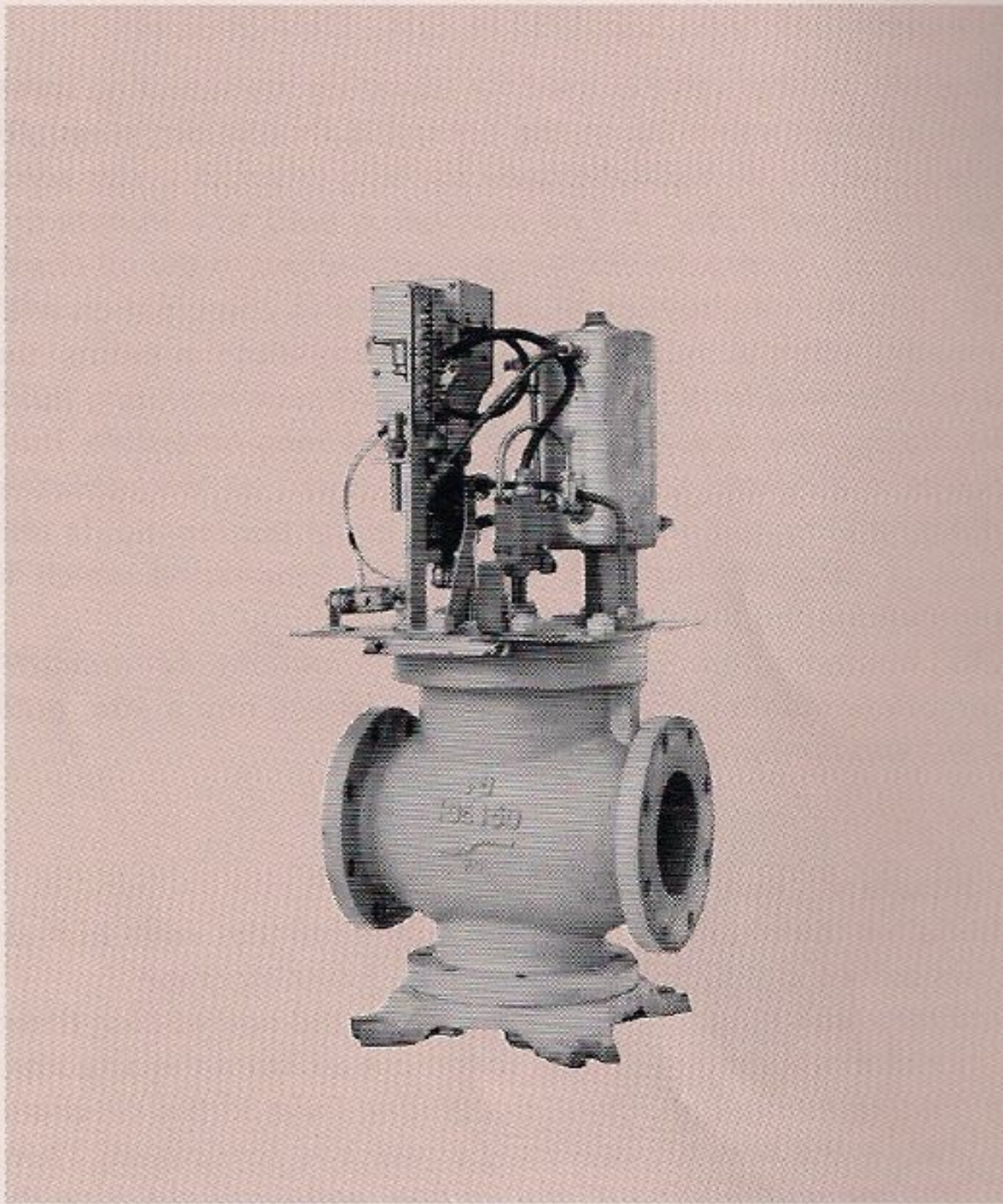
Nominal bore		JIS 10K flange type	Weld type	Without handwheel	With handwheel	Operating press. port
d		L ₁	L ₂	H	H ₀	PT
mm	inch					
80	3	191	283	805	1,130	PT3/8
100	4	217	305	905	1,255	PT3/8
125	5	246	381	1,040	1,400	PT3/8
150	6	259	403	1,215	1,660	PT3/8
200	8	278	419	1,445	2,000	PT3/8
250	10	316	457	1,620	2,250	PT3/8
300	12	424	502	1,850	2,550	PT3/8
350	14	462	572	2,000	2,850	PT3/8
400	16	522	610	2,300	3,260	PT3/4

CYLINDER VALVE FOR INSULATOR & HOT LINE WASHING DEVICE

The insulator and hot line washing device is used for washing insulators and hot lines at power stations and substations in salt damage, smoke damage or dust damage districts. This cylinder valve was developed by NAKAKITA specially for washing application, and we have many actual results of delivery.

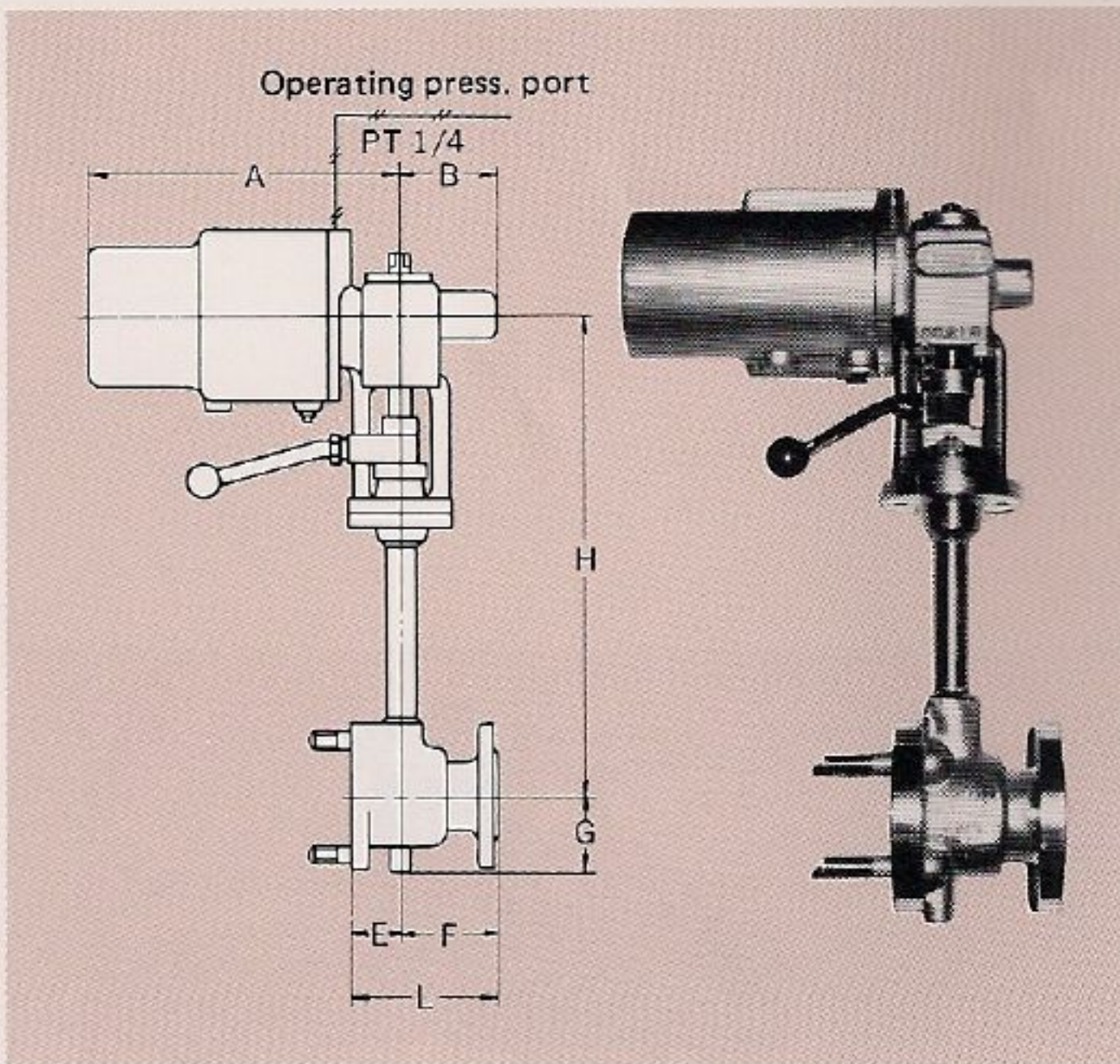
The features of the valve are as follows:

- With the use of a balance type plug, the plug can be shut by its own line pressure.
- As the operating fluid is the line fluid, no other operating pressure is required.
- The opening/shutting action time can be adjusted.
- The construction allows easy maintenance.



EMERGENCY SHUT-OFF VALVE (BALL VALVE)

This cylinder valve is used for emergency shut-off device specified by the General High Pressure Gas Safety Code. A unique mechanism (utility model) is used in the valve stem. This safety mechanism discharges the operating air pressure in emergency, and once the plug is operating, the valve will not open even if the operating air pressure is restored. This valve has such an arrangement that when the ambient temperature rises rapidly due to fire accident, etc., a fuse plug amounted in the actuator will melt down to release the air pressure from the actuator and automatically shut the valve. When the controlled fluid is at an cryogenic temperature, such as liquid oxygen and liquid nitrogen, an extension type bonnet is used.



■ Table of dimensions (JIS 20K flange type)

Nominal bore mm (inch)	A	B	E	F	L	G	H
20 (3/4)	215	62	35	70	105	50	363
25 (1)	215	62	35	70	105	50	363
40 (1 1/4)	245	62	35	85	120	75	408
50 (2)	320	98	50	100	150	80	506

mm

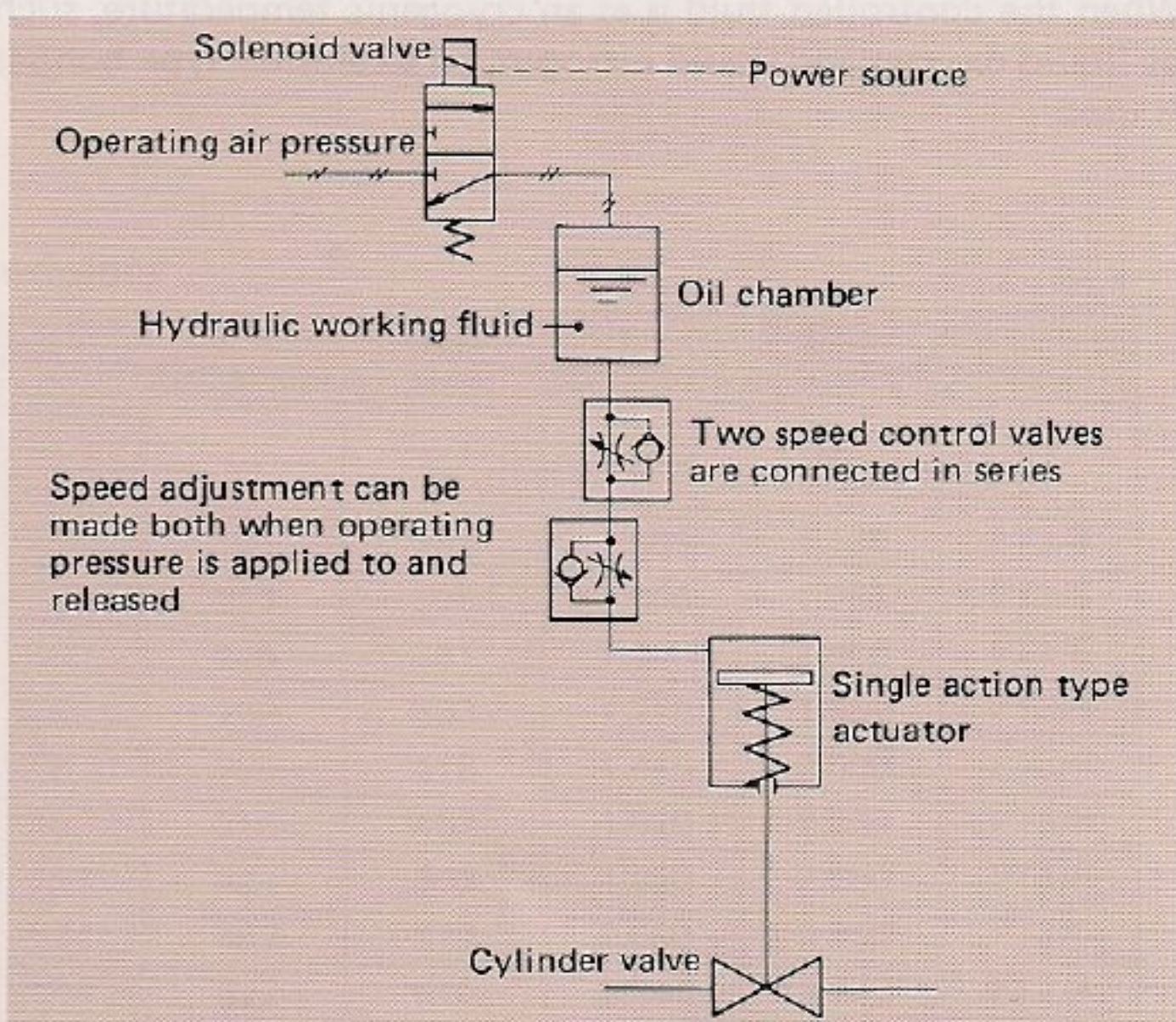
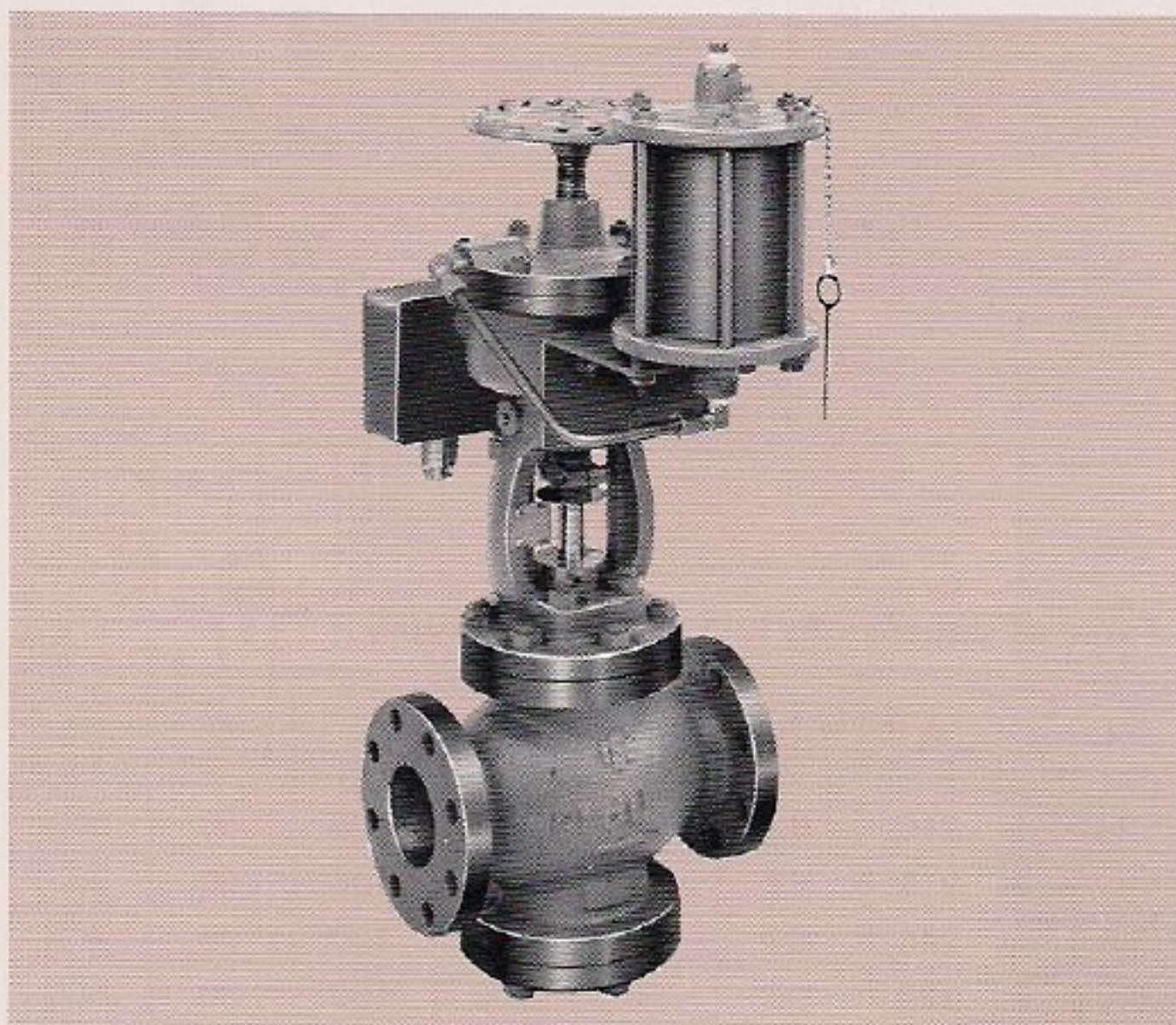
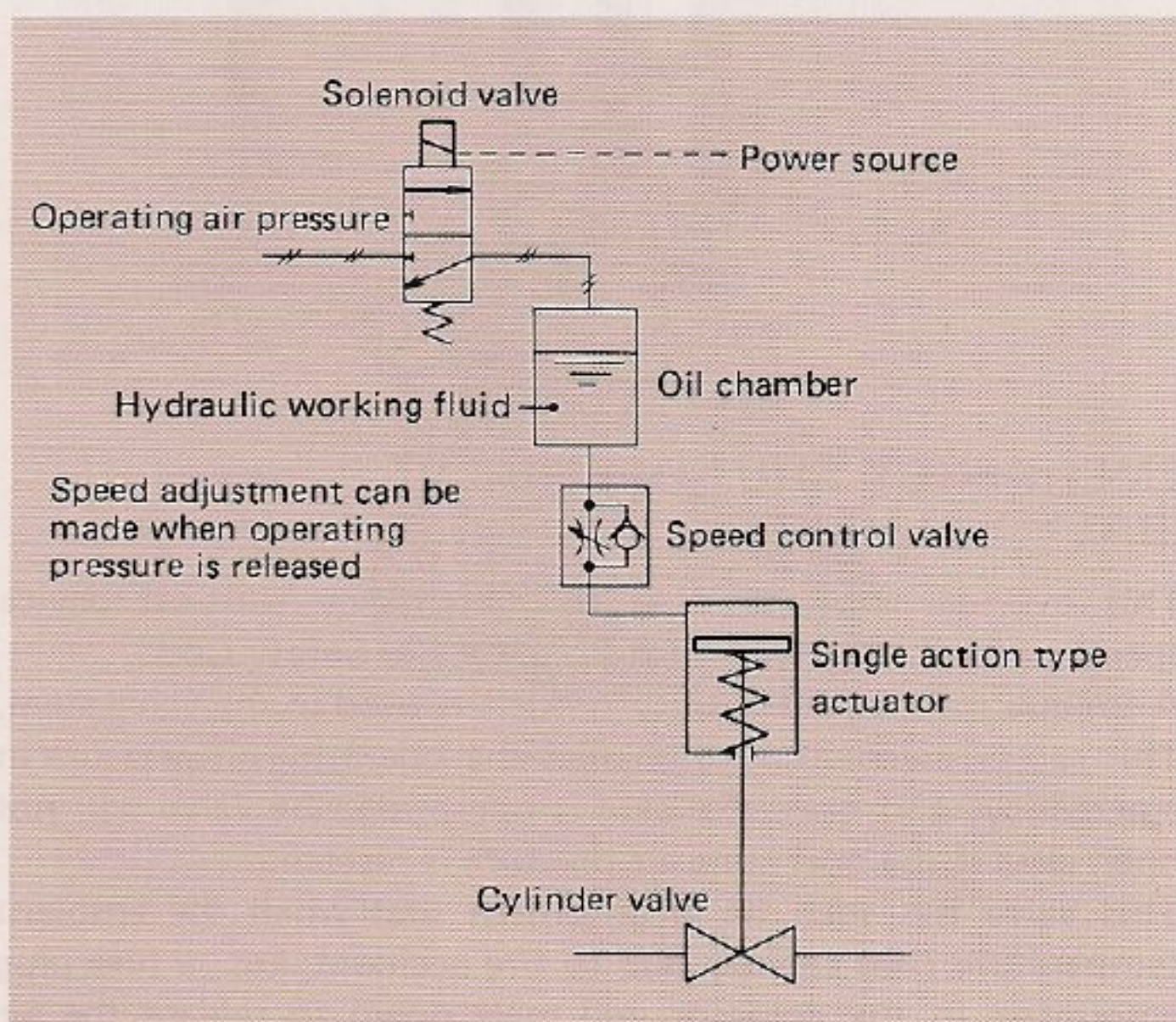
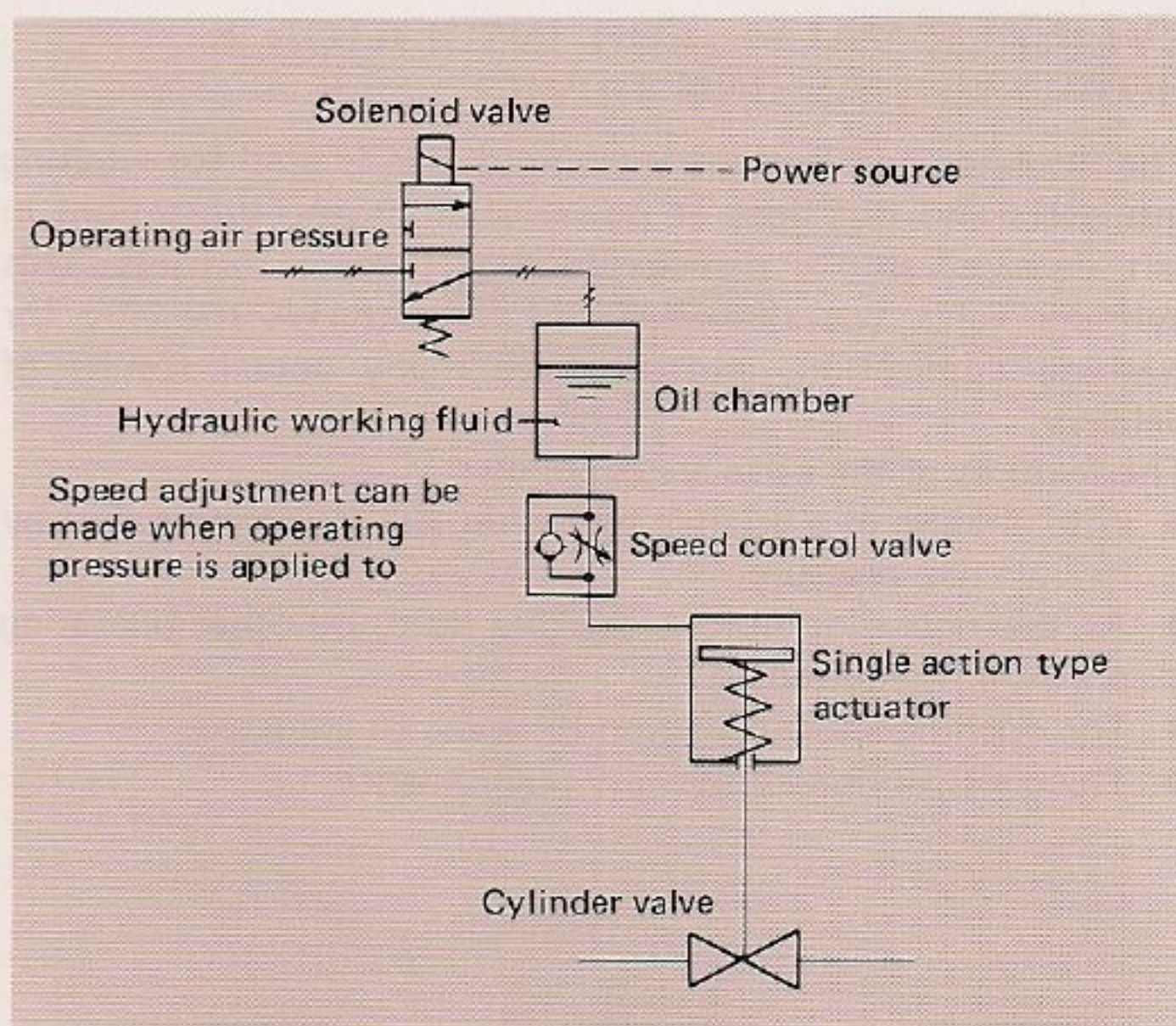
CYLINDER VALVE WITH OIL CHAMBER

A speed control valve is used for adjusting the actuating speed of a cylinder valve. When the operating fluid is compressible, the actuation of the valve may become unstable under some operating conditions. An oil chamber is used to eliminate this instability. Hydraulic operating fluid is sealed in the oil chamber, and the oil chamber is used normally in combination with a speed control valve. Structural arrangement prevents the operating fluid from mixing with the hydraulic operating fluid. Replacing the operating fluid with an incompressible fluid makes it possible to make fine adjustment of the actuating speed, and to give the valve plug a flow characteristic. It also gives a sufficient buffer against water hammering which is generated when the valve is actuated.

The hydraulic operating fluid should be one of excellent corrosion resistance and defoaming, which has a low pour point and contains an antioxidant.

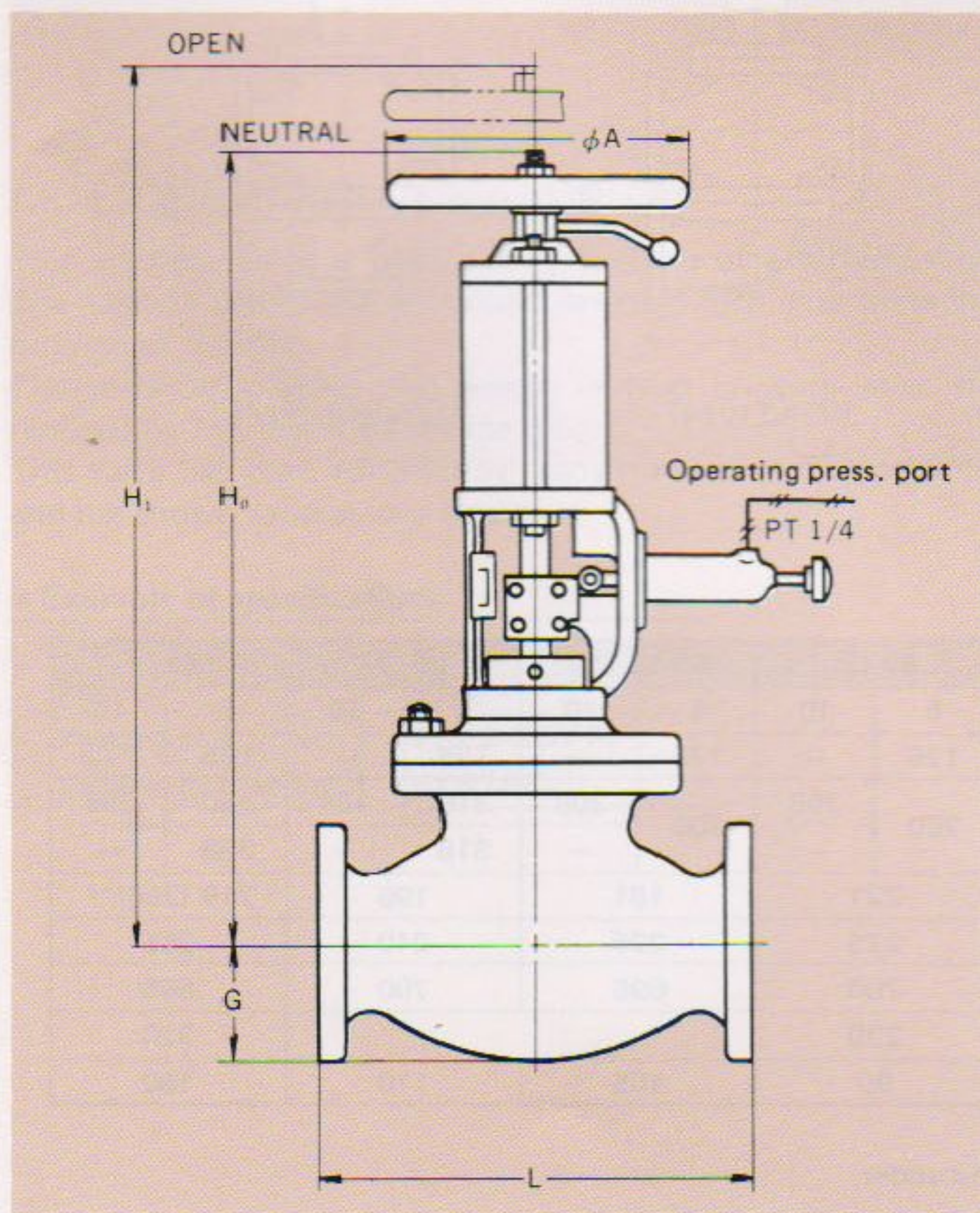
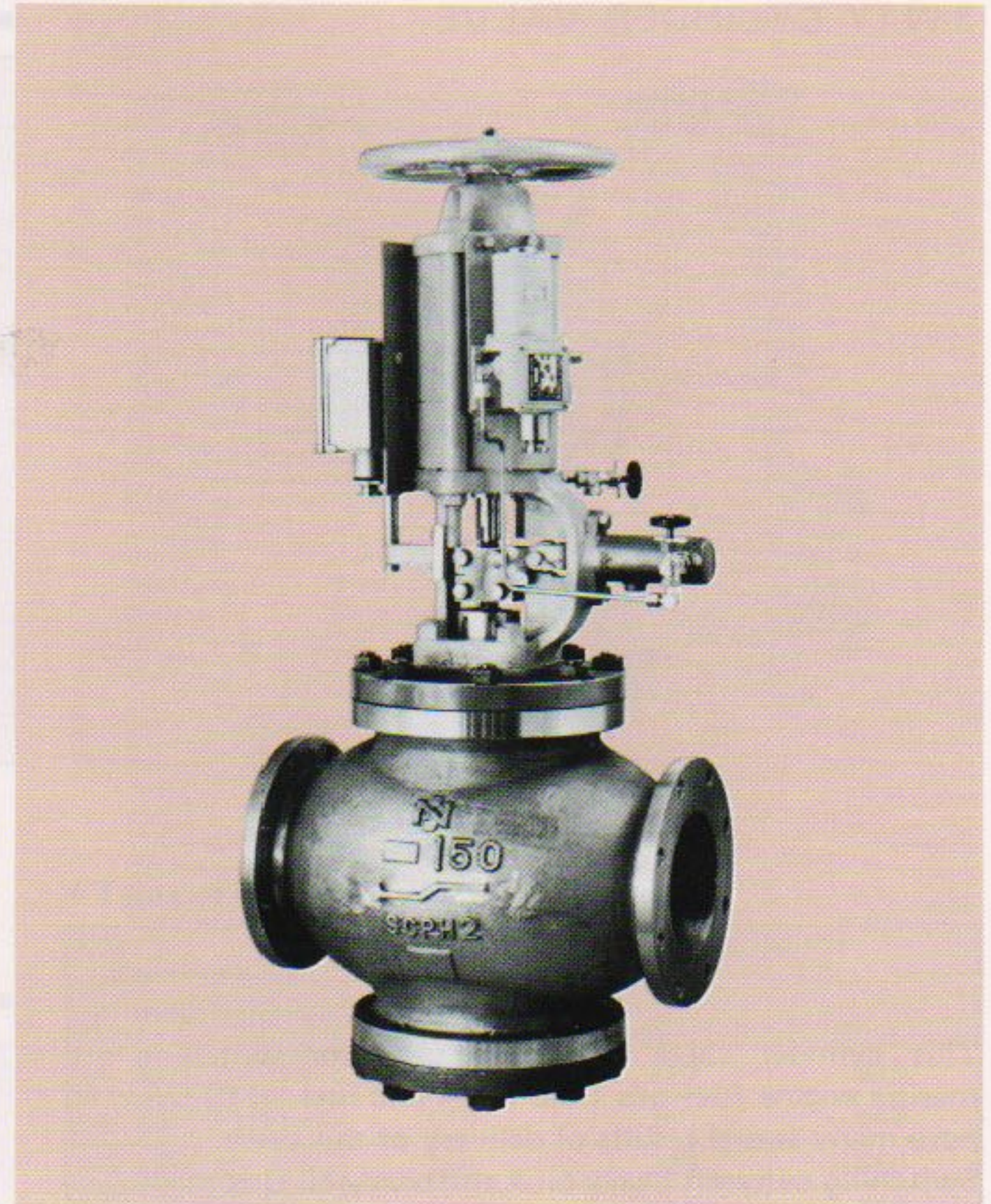
■ Installation instructions

- As for the installation position of the cylinder valve with oil chamber, set it upright as shown in the photograph.
- When installing the valve, remove the red-coated plug fitted on the cylinder cover so as to remove air from the actuator.
- For replenishing hydraulic operating fluid in the oil chamber, make sure the operating pressure is not loaded. Then, disconnect the joint of the air line, and while checking the oil level with the rod gauge provided, fill the fluid up to the green line on the gauge.



EMERGENCY SHUT-OFF VALVE

- This emergency shut-off valve is provided with a handwheel and springs for operation on the top of the valve, and an actuator of a unique mechanism (utility model pending) in the center of the yoke.
- Emergency shut-off valves are required to have high reliability, such as correct actuation, rapid response and positive shutoff.
- This valve uses roller bearings in its resetting mechanism to reduce frictional resistance and ensure ease in actuation. The valve is also provided with a buffer device which absorbs shock at the time of valve shut, and a handwheel automatic resetting mechanism which prevents inadvertent operation of the valve.
- This valve is mainly used in shut-off devices for steam, fuel oil, gas, etc., and the valve body is available in globe type and angle type to suit the application.



■ Table of dimensions (valve body material (JIS): SCPH)

Nominal bore mm (inch)	φA	L	G	H ₀	H ₁
32 (1 1/4)	280	216	53	485	555
40 (1 1/2)	280	229	53	485	560
50 (2)	280	267	64	660	683
65 (2 1/2)	280	292	78	675	700
80 (3)	280	318	90	680	708
100 (4)	280	356	110	700	740
125 (5)	280	400	132	730	780
150 (6)	280	444	153	750	850

3-WAY CYLINDER VALVE

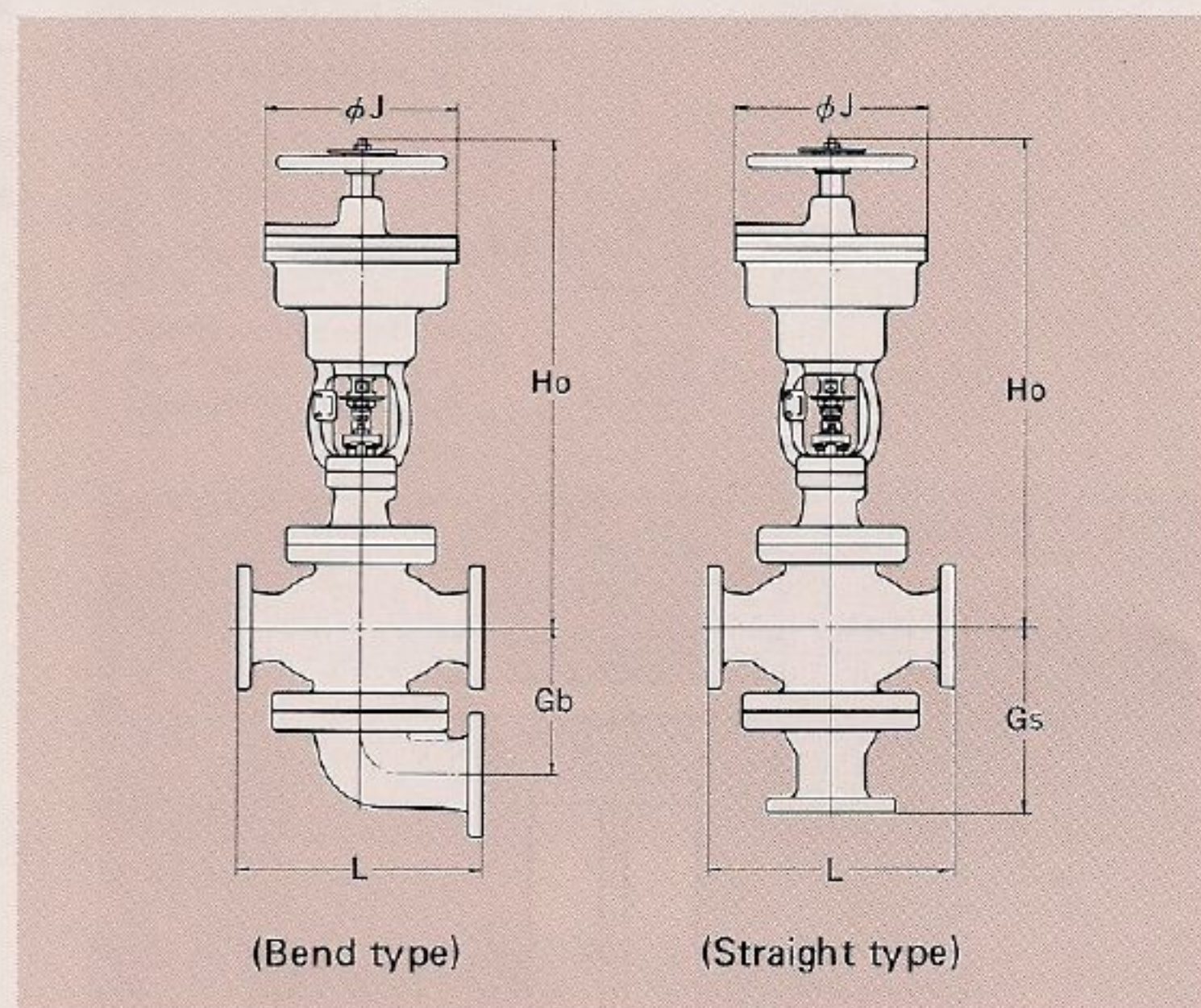


This cylinder valve is mainly used for switching marine engine fuel oils (fuel oil A and fuel oil C). We have many actual results of delivery of this valve. Switching between heavy oil A and heavy oil C is made by remote control according to a predetermined switching program. This valve is used for splitting and return switching, as well as the above-mentioned fuel switching. As for the bottom side connection, bend type and straight type are available.

■ Specifications (nom of materials: JIS)

Valve body assembly type	Standard type bonnet, 3-way valve of casting
Pressure rating	JIS 5K, 10K or ANSI 125
Nominal bore mm (inch)	32~100 (1¼~4)
Service temperature range	0~220°C (32~428°F)
Standard materials	<ul style="list-style-type: none"> Valve body assembly FC20, BC3, SCPH2, SCS13, SCS14 (JIS)
	<ul style="list-style-type: none"> Trim SUS304, SUS316 or SCS13, SUS14 (JIS)
	<ul style="list-style-type: none"> Packing "O" ring (fluorine rubber or NBR)
	<ul style="list-style-type: none"> Gasket Asbestos, etc.
Service fluid	Fuel oil, etc.
Operating pressure kgf/cm ² g	5~7

■ Dimensional drawing



■ Table of dimensions and weight

Nominal bore mm (inch)			32 (1 1/4)		40 (1 1/2)		50 (2)		65 (2 1/2)		80 (3)		100 (4)	
Pressure rating	JIS kgf/cm ²		5	10	5	10	5	10	5	10	5	10	5	10
	ANSI (Class)		125	—	125	—	125	—	125	—	125	—	125	—
Overall size mm *2	L	JIS (FC20)	260	268	260	268	260	268	300	308	316	324	350	358
		ANSI (FC20)	254	—	258	—		—		—	318	—	358	—
	Gb (bend type)		221		221		221		181		196		219 (250)*1	
	Gs (straight type)		210		210		215		225		240		265	
	Ho		700		700		700		695		700		865	
	J		230										320	
	Weight kg *3		85		85		90		105		110		180	

*1 In the table, dimension in () of the Gb column is that of ANSI flange.

*2 Overall size and weight are those when the fluid pressure is 1 kgf/cm² g and under.

*3 Weight indicated includes those of handwheel and limit switch.

OIL HYDRAULIC CYLINDER VALVE FOR MARINE USE

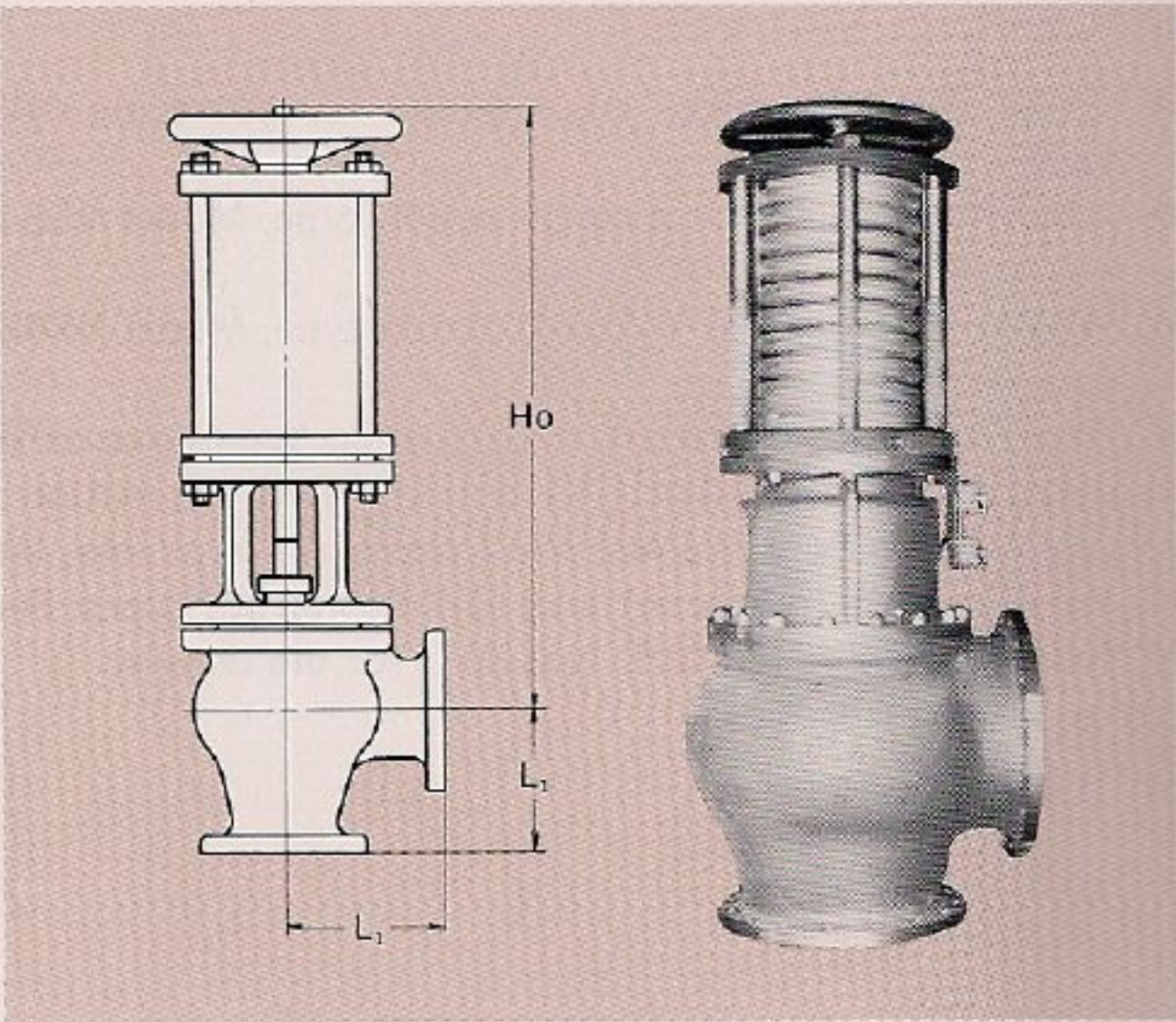
This cylinder valve was developed specially for handling bilge-ballast.

As the actuating system uses high hydraulic pressure, the actuator is small in size and requires smaller quantity of operating oil. Thus, it is possible to operate many valves at a time.

As the valve is equipped with a unique mechanism (patented) which keeps the handwheel stem free from the spring load by a slight movement of the stem, the valve can be opened by turning the handwheel with a small force.

The valve body is available in globe type, angle type, and the valve plug in direct, reverse and nonreturn types, to suit the application.

A valve opening/shutting indication limit switch can be mounted as an option.



■ Table of dimensions (JIS 5K FC valve)

Nominal bore mm (inch)	Angle type valve	Globe type valve	H ₀
	L ₁	L	
50 (2)	100	210	515
65 (2 1/2)	115	250	545
80 (3)	130	280	550
100 (4)	150	340	680
125 (5)	170	410	720
150 (6)	190	480	750
200 (8)	220	570	975
250 (10)	275	740	1160
400 (16)	395	1050	1380

ASTERN GUARDIAN VALVE

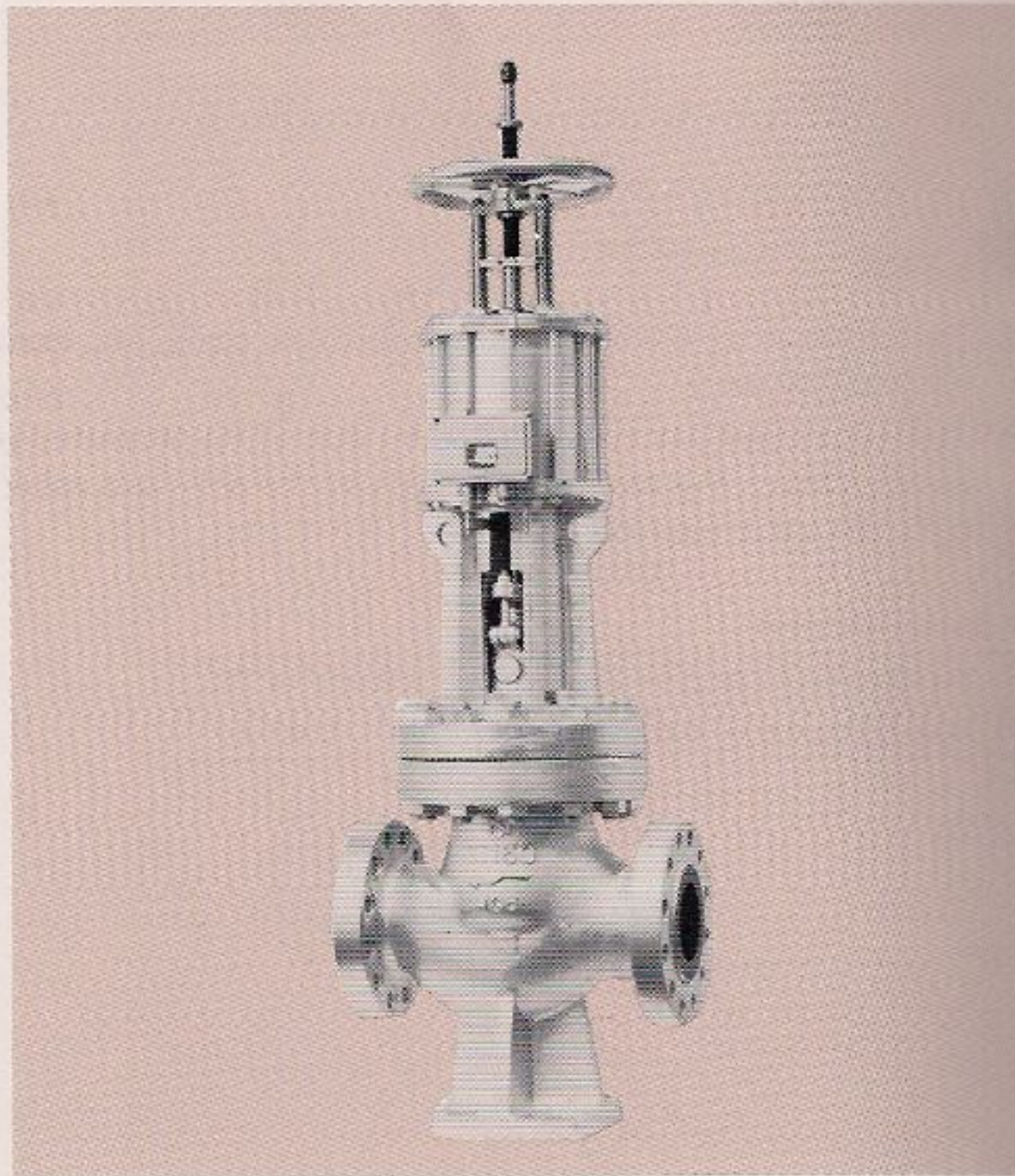
This cylinder valve is used during backing of a turbine ship. The valve is one of the important devices which determine the running of the ship.

The installation space and weight of high pressure valve are reduced by the use of pilot type plug.

This valve has been adopted by many number of turbine ships and has shown satisfactory results.

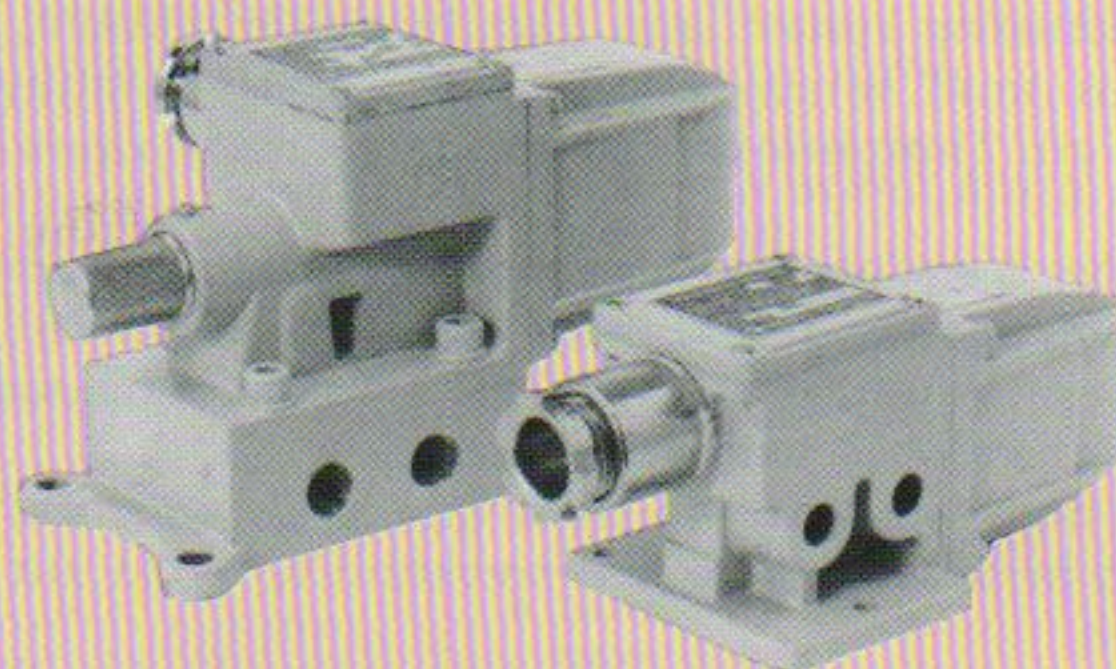
■ Example of specifications

Fluid	Superheated steam
Pressure	60 kgf/cm ² g
Temperature	510° C (950° F)
Valve body material	WC6 (JIS)



SOLENOID VALVES

- These solenoid valves are required for operating cylinder valves.
- When the actuator is a single action type, Model NS642-70 solenoid valve is used.
- When the actuator is a double action type, Model NS662-70 solenoid valve is used.
- These solenoid valves are direct action type ones of which construction is simple. As for solenoid protection construction, various standardized types are available, including dustproof, dripproof and explosionproof types. See the separate catalogue (CAT. No. 361) for the details.

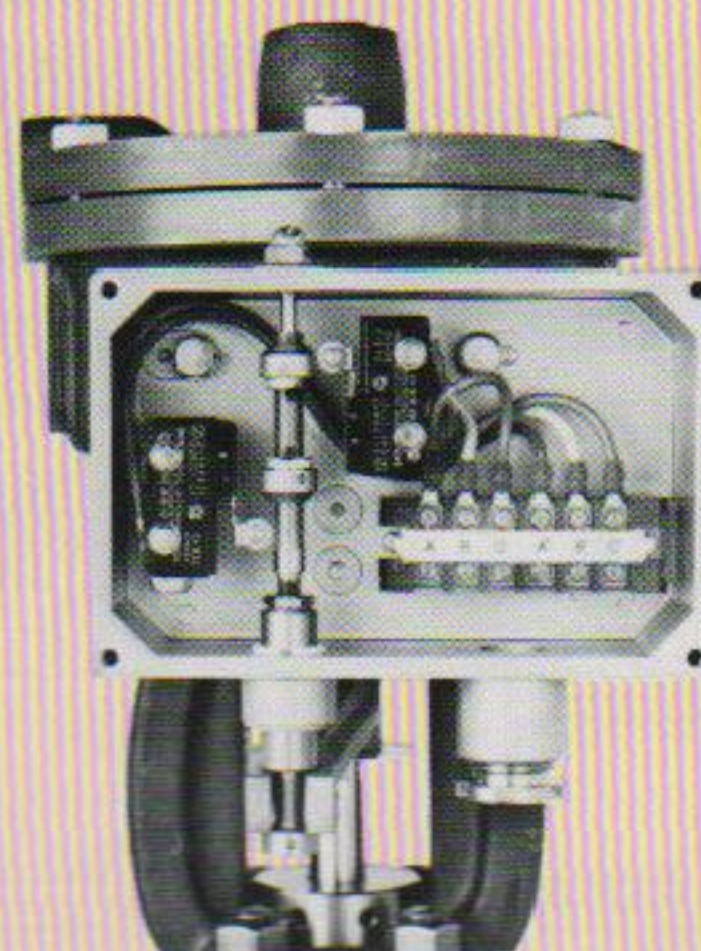


Model NO662-70

Model NS642-70

LIMIT SWITCH

- This limit switch is used for confirming the full opening or full shutting of a valve on a remote control panel in an automatic control system, or for interlocking the operation of a valve with other piece of equipment.
- The standard product stores two microswitches and a terminal block in a switch case of dustproof and dripproof construction. The microswitches are actuated through a lever fixed on the valve stem.
- A variety of switch protection constructions is available to suit the environment of the valve installation site.



FILTER

- This filter is used for removing moisture, scale, etc. contained in the piping.
- The filter supplies clean air to the operating pressure line so as to protect the sealing materials of the solenoid valve and cylinder valve actuator.

Specifications

Maximum service pressure	9.9 kgf/cm ² g
Maximum service temperature	60°C (140°F)

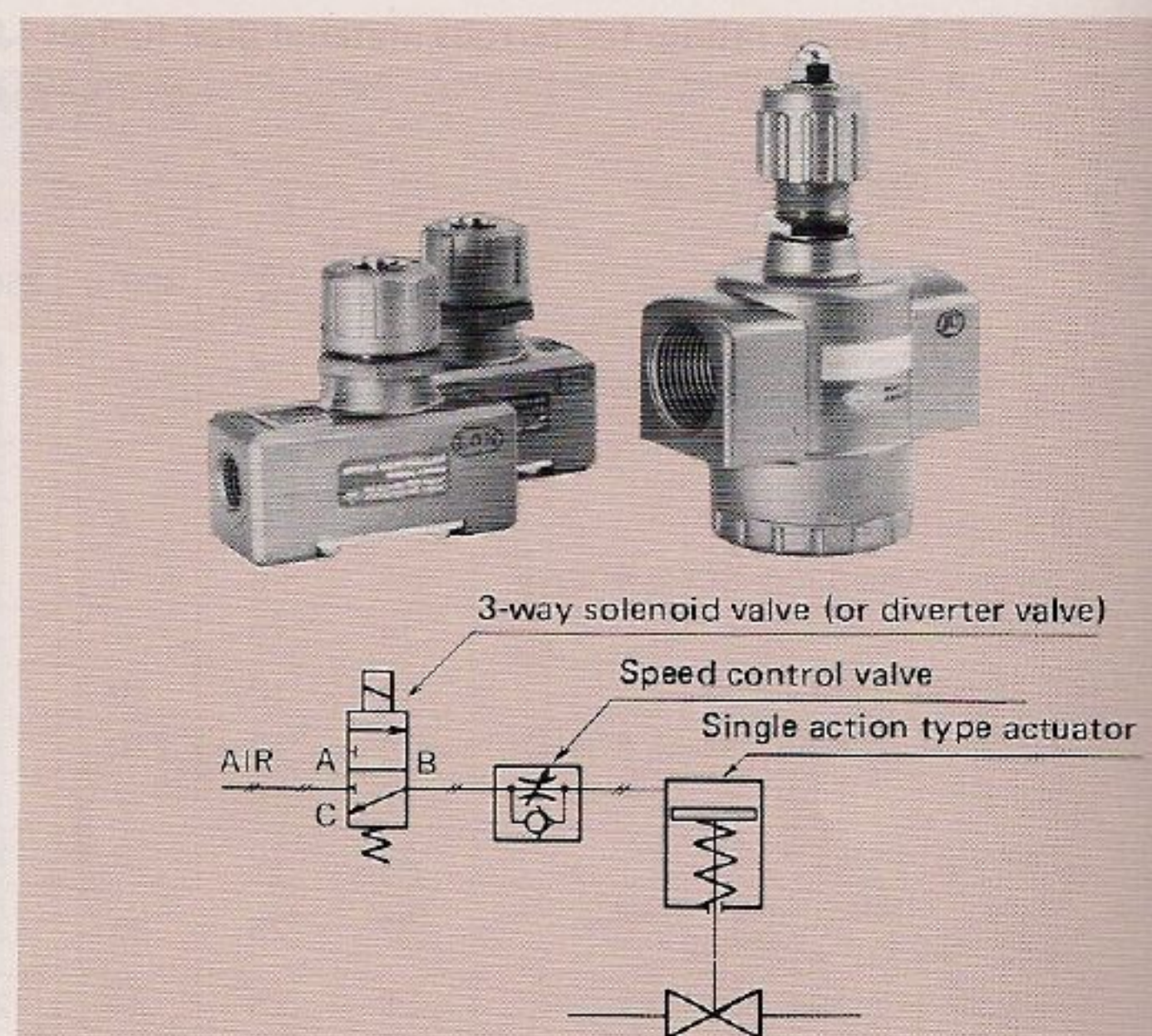


SPEED CONTROL VALVE

- This speed control valve is installed just upstream the piping connection port of the cylinder valve actuator to adjust its actuating speed.
- Its construction is a combination of a needle valve and a check valve. In one direction, the check valve will open to the full and allow the fluid to flow at a large flow rate. In the other direction, the check valve will be shut, and the needle valve will allow only a restricted flow rate.

Specifications

Maximum service pressure	9.9 kgf/cm ² g
Minimum service pressure	0.5 kgf/cm ² g
Maximum service temperature	60°C (140°F)

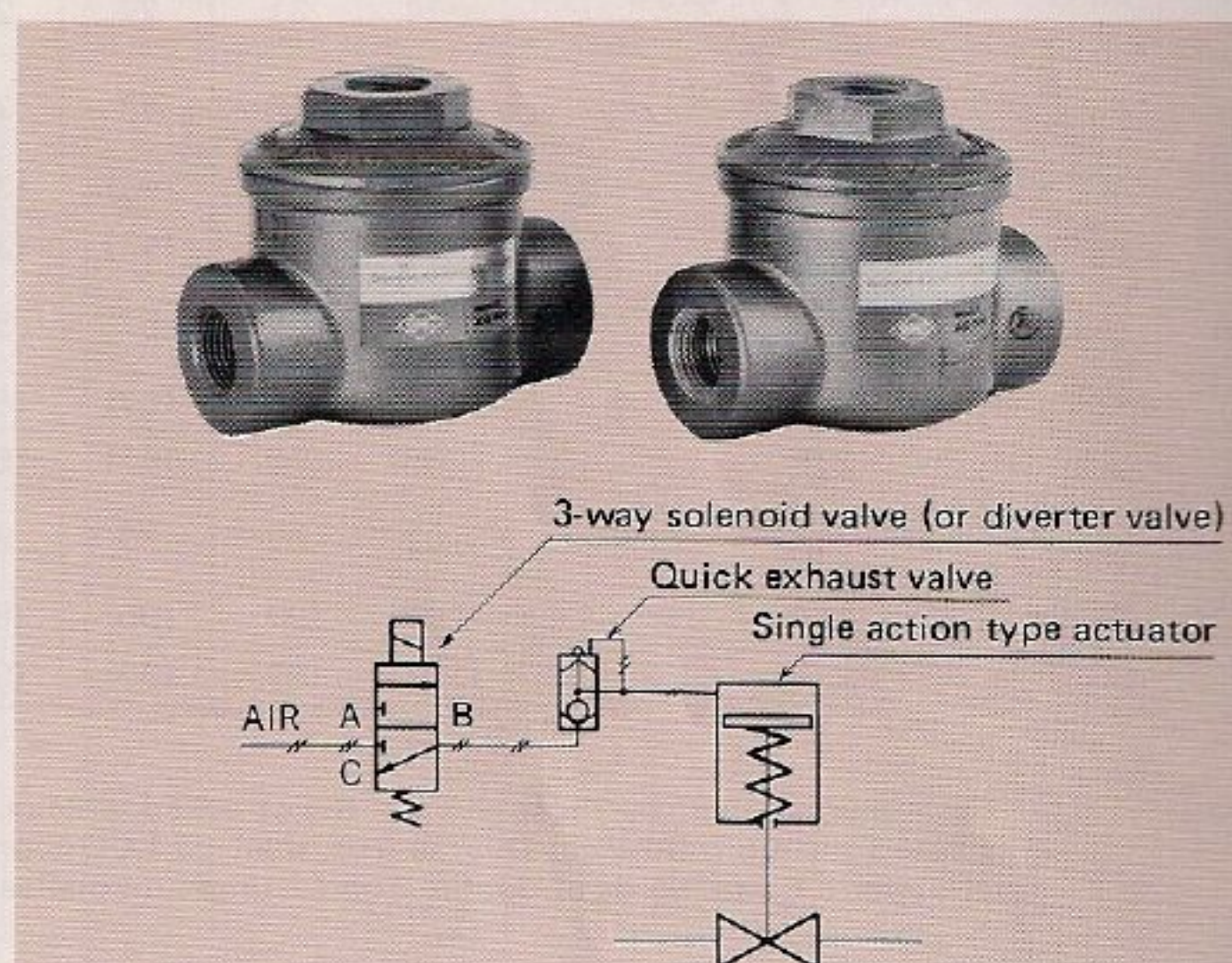


QUICK EXHAUST VALVE

- This quick exhaust valve is installed between the actuator and the diverter valve when it is desirable to quickly release the operating air pressure from the cylinder valve actuator so as to increase the valve actuating speed.
- The installation of this valve is the best measure to take, when the piping distance between the actuator and the diverter valve is large, or when pressure releasing takes time due to pipe friction, etc.

Specifications

Maximum service pressure	9.9 kgf/cm ² g
Maximum service temperature	60°C (140°F)



LOCK VALVES

[Models NS772S and NS772D]

- This lock valve is used for maintaining the status quo of the actuator when the operating pressure source drops.
- This valve is installed in the middle of the operating air piping. The valve will shut the line when the operating pressure source reaches the set pressure. When the operating pressure source is restored to the normal, the lock valve will return to the initial position.

Specifications

Lock set pressure	1.4 ~ 7 kgf/cm ² g
Maximum service pressure	9.9 kgf/cm ² g
Maximum service temperature	60°C (140°F)

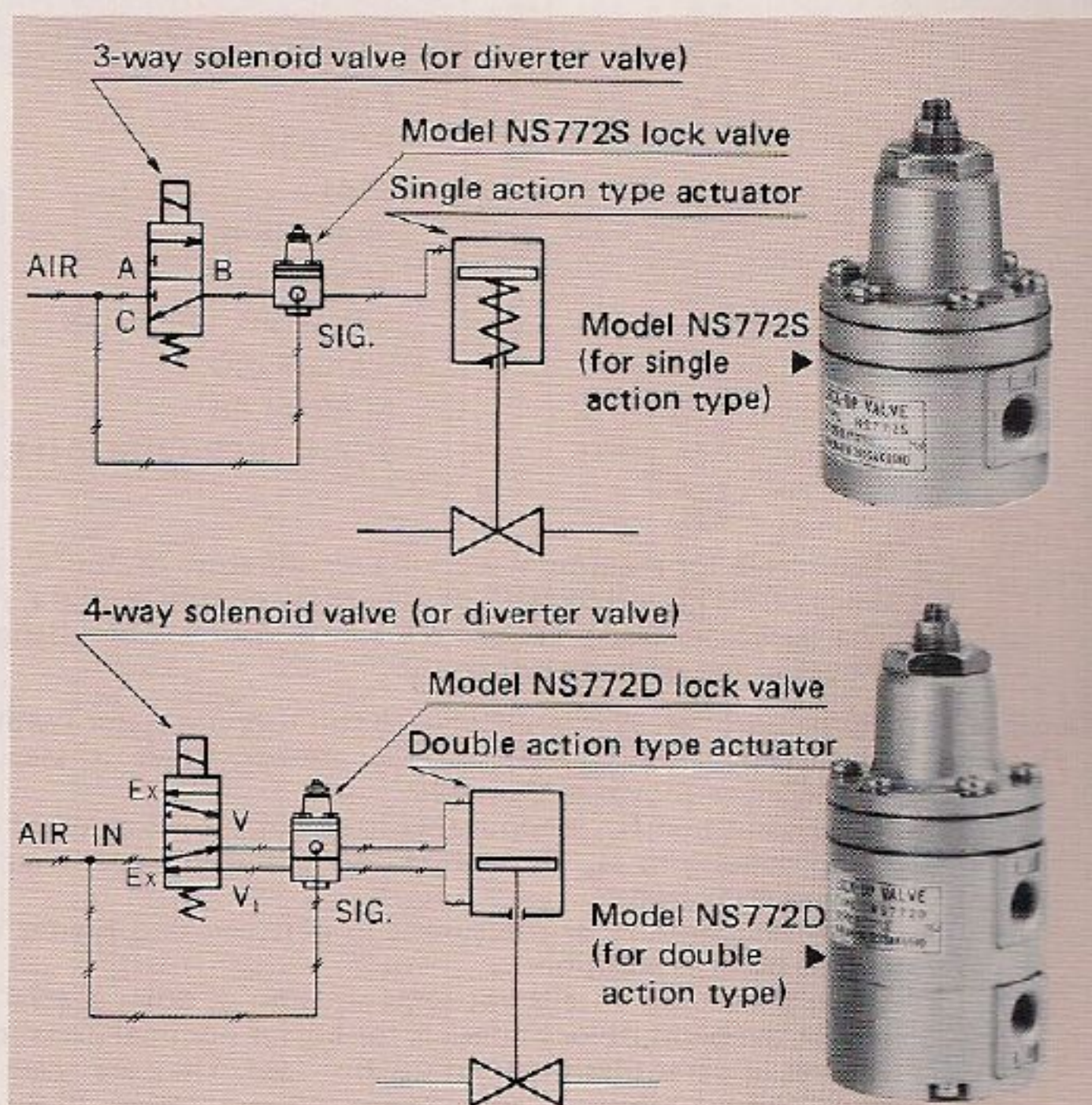


Table 8.1 Pressure ratings for ferrous material pipe flanges (JIS B2201-1976) [Attached table]

kgf/cm²

NOMINAL PRESSURE	MATERIALS ⁽¹⁾	CONDITION OF FLUID AND MAXIMUM WORKING PRESSURE											
		Condition of fluid											Hydraulic test pressure (reference) ⁽⁴⁾
		W	G ₁	G ₂	G ₃	H ₁	H ₂	H ₃	H ₄	H ₅	H ₆	H ₇	
		max. 120°C	max. 220°C	300°C	350°C	400°C	425°C	450°C	475°C	490°C	500°C	510°C	
2	FC20	3	2	—	—	—	—	—	—	—	—	—	4
	SS41, SF40, S20C, SC42	3	2	—	—	—	—	—	—	—	—	—	
5	FC20	7	5	—	—	—	—	—	—	—	—	—	10
	FCMB35, ductile iron	7	6	5	—	—	—	—	—	—	—	—	
	SS41, SF40, S20C, SC42, SCPH1	7	6	5	—	—	—	—	—	—	—	—	
10	FC20	14	10	—	—	—	—	—	—	—	—	—	20
	FCMB35, ductile iron	14	12	10	—	—	—	—	—	—	—	—	
	SS41, SF40, S20C, SC42, SCPH1	14	12	10	—	—	—	—	—	—	—	—	
16	FC20	22	16	—	—	—	—	—	—	—	—	—	32
	FCMB35, ductile iron	22	20	18	16	—	—	—	—	—	—	—	35
	SS41 ⁽²⁾ , SF45, SFV1, S20C, S25C, SC49 ⁽²⁾ , SCPH2	27	25	23	21	18	16	—	—	—	—	—	40
	FCMB35, ductile iron	28	25	23	20	—	—	—	—	—	—	—	44
20	SS41 ⁽²⁾ , SF45, SFV1, S20C S25C, SC49 ⁽²⁾ , SCPH2	34	31	29	26	23	20	—	—	—	—	—	50
	SF45, S25C, SFV1, SC49 ⁽²⁾ , SCPH2	51	46	43	39	34	30	—	—	—	—	—	75
30	SCPH11, SFHV12B	(51)	(46)	(43)	(39)	38	36	34	30 ⁽³⁾	—	—	—	
	SCPH21, SFHV23B	(51)	(46)	(43)	(39)	(38)	(36)	(34)	32	30	—	—	
40	SF45, S25C, SFV1, SC49 ⁽²⁾ , SCPH2	68	62	57	52	46	40	—	—	—	—	—	100
	SCPH11, SFHV12B	(68)	(62)	(57)	(52)	51	48	45	40 ⁽³⁾	—	—	—	
	SCPH21, SFHV23B	(68)	(62)	(57)	(52)	(51)	(48)	(45)	42	40	38	36	
63	SF45, S25C, SFV1, SC49 ⁽²⁾ , SCPH2	107	97	90	81	72	63	—	—	—	—	—	160
	SCPH11, SFHV12B	(107)	(97)	(90)	(81)	80	76	71	63 ⁽³⁾	—	—	—	
	SCPH21, SFHV23B	(107)	(97)	(90)	(81)	(80)	(76)	(71)	66	63	59	56	

Note ⁽¹⁾ The materials shall be those given in the attached table or those satisfying requirement for flanges. The material notation of the table is based on the following. Ductile iron shall be FCD-S prescribed in JIS B 8243-1977 (Construction of Pressure Vessel) "Attached Document 1. Standards of ductile iron castings and malleable iron castings"

Notation	Applicable standards
FC20	JIS G 5501
FCMB35	JIS G 5702
SS41	JIS G 3101
SF40, SF45	JIS G 3201
SFV1	JIS G 3211
SFHV12B, SFHV23B	JIS G 3213
S20C, S25C	JIS G 4051
SC42, SC49	JIS G 5101
SCPH1, SCPH2, SCPH11, SCPH21	JIS G 5151

⁽²⁾ Applicable for maximum working temperature of 350°C.

⁽³⁾ Since SCPH11 and SFHV12B may show ductile fracture, it advisable not to use them for service exceeding 450°C.

⁽⁴⁾ The hydraulic test pressures are test pressures when flange is fitted to pipe, given for reference purpose. If otherwise specified, those shown in the table do not apply.

- Remarks
- Fluid condition W is applicable to still running water (with little pressure fluctuation) of 120°C and under only.
 - Fluid conditions G₁, G₂ and G₃ are applicable to steam, gas, oil or pulsating water (with fluctuating pressure) of the respective temperature shown in the table.
 - Fluid condition H₁ is applicable to steam, air gas or oil of 400°C.
 - Fluid conditions H₂ through H₇ are applicable for steam, air, gas or oil of 425 to 510°C and which may cause creep in material due to high temperature.
 - When temperature or pressure is in between two figures of the table, the maximum working pressure or temperature can be determined by interpolation.
 - When the service entails impact, corrosion or other special condition, materials for the maximum working pressure corresponding to a higher temperature or materials for higher nominal pressure shall be used.
 - Figures in parenthesis are not usually used. They are given for reference in design.
 - When fluid condition is to be expressed in notation, W through H₇ are used.

■ Table 8.2 Pressure-temperature ratings of ANSI

Extracted from Pressure Temperature Ratings of mainly steel materials prescribed in ANSI B 16.34 1977 Steel Valves, Flanged and Butt-Welding End.

Applicable Materials	Temp. in °C	Gage Working Pressure in Bar						
		150	300	400	600	900	1500	2500
Class A216-WCB (SCPH2: JIS)	-29~ 38	19.6	51.1	68.1	102.1	153.2	255.3	425.5
	50	19.2	50.1	66.8	100.2	150.2	250.4	417.3
	100	17.7	46.4	61.8	92.8	139.1	231.9	386.5
	150	15.8	45.2	60.3	90.5	135.7	226.1	376.9
	200	14.0	43.8	58.4	87.6	131.5	219.1	365.2
	250	12.1	41.7	55.6	83.4	125.2	208.6	347.7
	300	10.2	38.7	51.6	77.5	116.2	193.7	322.8
	350	8.4	37.0	49.3	73.9	110.9	184.8	308.0
	375	7.4	36.5	48.6	72.9	109.4	182.3	303.9
	400	6.5	34.5	46.0	69.0	103.5	172.5	287.5
	425	5.6	28.8	38.3	57.5	86.3	143.8	239.6
	450	4.7	20.0	26.7	40.1	60.1	100.2	166.9
	475	3.7	13.5	18.1	27.1	40.6	67.7	112.9
	500	2.8	8.8	11.7	17.6	26.4	44.0	73.3
	525	1.9	5.2	6.9	10.4	15.5	25.9	43.2
	540	1.3	3.3	4.3	6.5	9.8	16.3	27.2

● Permissible, but not recommended for prolonged usage above about 425°C.

Applicable Materials	Temp. in °C	Gage Working Pressure in Bar						
		150	300	400	600	900	1500	2500
Class A217-C5 (SCPH61: JIS)	-29~ 38	20.0	51.7	69.0	103.4	155.2	258.6	431.0
	50	19.2	51.7	69.0	103.4	155.2	258.6	431.0
	100	17.7	51.5	68.7	103.1	154.6	257.7	429.5
	150	15.8	50.2	66.9	100.4	150.6	251.0	418.3
	200	14.0	48.8	65.0	97.6	146.4	243.9	406.6
	250	12.1	46.3	61.8	92.7	139.0	231.7	386.1
	300	10.2	42.4	56.6	84.9	127.3	212.1	353.5
	350	8.4	40.2	53.6	80.5	120.7	201.2	335.3
	375	7.4	38.8	51.7	77.6	116.4	194.0	323.4
	400	6.5	36.6	48.8	73.2	109.8	182.9	304.9
	425	5.6	34.5	46.0	69.0	103.5	172.5	287.5
	450	4.7	30.9	41.2	61.8	92.7	154.5	257.6
	475	3.7	25.9	34.5	51.8	77.7	129.5	215.8
	500	2.8	20.3	27.0	40.5	60.8	101.3	168.9
	525	1.9	15.4	20.6	30.8	46.3	77.1	128.5
	550	1.3*	11.7	15.6	23.4	35.0	58.4	97.3
	575	1.3*	8.8	11.7	17.6	26.4	44.1	73.4
	600	1.3*	6.5	8.7	13.1	19.6	32.6	54.4
	625	1.3*	4.5	6.0	9.0	13.5	22.5	37.5
	650	1.3*	3.0	4.0	6.0	9.0	15.0	25.1

Applicable Materials	Temp. in °C	Gage Working Pressure in Bar						
		150	300	400	600	900	1500	2500
Class A217-WCB (SCPH21: JIS)	-29~ 38	20.0	51.7	69.0	103.4	155.1	258.6	431.0
	50	19.2	51.1	68.2	102.3	153.4	255.7	426.2
	100	17.7	48.8	65.0	97.5	146.3	243.8	406.4
	150	15.8	46.4	61.8	92.7	139.1	231.9	386.4
	200	14.0	45.5	60.6	91.0	136.4	227.4	379.0
	250	12.1	44.5	59.3	88.9	133.4	222.3	370.6
	300	10.2	42.4	56.6	84.9	127.3	212.1	353.5
	350	8.4	40.2	53.6	80.5	120.7	201.2	335.3
	375	7.4	38.8	51.7	77.6	116.4	194.0	323.4
	400	6.5	36.6	48.8	73.2	109.8	182.9	304.9
	425	5.6	35.1	46.8	70.2	105.3	175.5	292.5
	450	4.7	33.8	45.1	67.6	101.4	169.0	281.7
	475	3.7	31.7	42.2	63.3	95.0	158.3	263.8
	500	2.8	27.8	37.1	55.6	83.4	139.0	231.6
	525	1.9	20.3	27.0	40.5	60.8	101.3	168.9
	550	1.3*	12.8	17.0	25.5	38.3	63.8	106.4
	575	1.3*	8.5	11.3	17.0	25.5	42.5	70.8
	600	1.3*	5.9	7.8	11.8	17.6	29.4	49.0
	625	1.3*	3.4	4.5	6.8	10.1	16.9	28.2
	650	1.1*	2.3	3.1	4.6	7.0	11.6	19.3

● Not to be used over 593°C.

Applicable Materials	Temp. in °C	Gage Working Pressure in Bar						
		150	300	400	600	900	1500	2500
Class A351-CF8 (SUS304: JIS)	-29~ 38	19.0	49.6	66.2	99.2	148.9	248.1	413.5
	50	18.4	47.8	63.8	95.7	143.5	239.2	398.6
	100	5.7	40.9	54.5	81.8	122.6	204.4	340.7
	150	13.9	36.3	48.4	72.7	109.0	181.7	302.8
	200	12.6	32.8	43.7	65.5	98.3	163.8	273.0
	250	11.7	30.5	40.7	61.1	91.6	152.7	254.5
	300	10.2	29.1	38.7	58.1	87.2	145.3	242.1
	350	8.4	28.1	37.4	56.1	84.2	140.3	233.8
	375	7.4	27.8	37.0	55.5	83.3	138.8	231.3
	400	6.5	27.5	36.6	54.9	82.4	137.3	228.9
	425	5.6	27.2	36.2	54.3	81.5	135.8	226.4
	450	4.7	26.9	35.8	53.7	80.6	134.3	223.9
	475	3.7	26.6	35.4	53.1	79.7	132.8	221.4
	500	2.8	26.1	34.7	52.1	78.2	130.3	217.2
	525	1.9	23.9	31.8	47.8	71.6	119.4	199.0
	550	1.3*	21.8	29.1	43.6	65.4	109.1	181.8
	575	1.3*	20.1	26.8	40.1	60.2	100.4	167.3
	600	1.3*	16.7	22.3	33.4	50.1	83.6	139.3
	625	1.3*	13.1	17.4	26.2	39.2	65.4	109.0
	650	1.3*	10.5	14.0	21.0	31.6	52.6	87.8
	675	1.3*	7.8	10.3	15.5	23.3	36.8	64.6
	700	1.3*	6.0	8.0	12.0	17.9	29.9	49.8
	725	1.3*	4.6	6.2	9.3	13.9	23.1	38.5
	750	1.3*	3.7	4.9	7.3	11.0	18.3	30.4
	775	1.3*	2.8	3.7	5.6	8.4	14.0	23.3
	800	1.0*	2.1	2.7	4.1	6.2	10.3	17.1

Applicable Materials	Temp. in °C	Gage Working Pressure in Bar						
		150	300	400	600	900	1500	2500
Class A217-WC9 (SCPH32: JIS)	-29~ 38	20.0	51.7	69.0	103.4	155.1	258.6	431.0
	50	19.2	51.2	68.3	102.4	153.6	256.0	426.7
	100	17.7	49.0	65.4	98.1	147.1	245.2	408.7
	150	15.8	46.6	62.2	93.3	139.9	233.2	388.6
	200	14.0	44.8	59.8	89.7	134.5	224.2	373.7
	250	12.1	44.2	59.0	88.4	132.7	221.1	368.5
	300	10.2	42.4	56.6	84.9	127.3	212.1	353.5
	350	8.4	40.2	53.6	80.5	120.7	201.2	335.3
	375	7.4	38.8	51.7	77.6	116.4	194.0	323.4
	400	6.5	36.6	48.8	73.2	109.8	182.9	304.9
	425	5.6	35.1	46.8	70.2	105.3	175.5	292.5
	450	4.7	33.8	45.1	67.6	101.4	169.0	281.7
	475	3.7	31.7	42.2	63.3	95.0	158.3	263.8
	500	2.8	27.8	37.1	55.6	83.4	139.0	231.6
	525	1.9	21.9	29.2	43.8	65.8	109.6	182.7
	550	1.3*	16.4	21.8	32.7	49.1	81.8	136.4
	575	1.3*	11.7	15.6	23.4	35.1	58.5	97.5
	600	1.3*	7.6	10.2	15.3	22.9	38.2	63.6
	625	1.3*	6.6	8.8	13.3	19.9	33.2	55.3
	650	1.3*	3.7	4.9	7.3	11.0	18.3	30.4

- Not to be used over 593°C.
- Working pressure in the table are in bars. For values in kgf/cm², multiply the figures of the table by 1.02.
- Working pressure at a temperature in between two temperatures of the table is to be computed by proportion method.
- For welding end valves only. Flanged end ratings terminate at 540°C.

Applicable Materials	Temp. in °C	Gage Working Pressure in Bar						
		150	300	400	600	900	1500	2500
Class A351-CF8M (SUS316: JIS)	-29~ 38	19.0	49.6	66.2	99.3	148.9	248.1	413.6
	50	18.4	48.1	64.2	96.3	144.4	240.6	401.0
	100	16.2	42.2	56.3	84.4	126.6	211.0	351.7
	150	14.8	38.5	51.3	77.0	115.5	192.5	320.9
	200	13.7	35.7	47.6	71.3	107.0	178.4	297.3
	250	12.1	33.4	44.5	66.8	100.2	166.9	278.2
	300	10.2	31.6	42.2	63.3	94.9	158.1	263.6
	350	8.4	30.4	40.6	60.8	91.3	152.1	253.8
	375	7.4	29.7	39.6	59.4	89.1	148.5	247.5
	400	6.5	29.1	38.8	58.2	87.3	145.6	242.6
	425	5.6	28.7	38.2	57.3	86.0	143.3	238.9
	450	4.7	28.1	37.4	56.2	84.2	140.4	234.0
	475	3.7	27.4	36.5	54.7	82.1	136.8	228.0
	500	2.8	26.8	35.8	53.7	80.5	134.1	223.6
	525	1.9	26.3	35.1	52.6	78.9	131.5	219.1
	550	1.3*	25.0	33.3	49.9	74.9	124.8	208.0
	575	1.3*	24.1	32.1	48.2	72.3	120.5	200.8
	600	1.3*	21.4	28.6	42.9	64.3	107.2	178.6
	626	1.3*	18.3	24.3	36.5	54.8	91.3	152.1
	650	1.3*	14.1	18.8	28.2	42.4	70.6	117.1
675	1.3*	12.6	16.8	25.3	37.9	63.2	105.3	
700	1.3*	9.9	13.3	19.9	29.8	49.7	82.9	
725	1.3*	7.7	10.3	15.4	23.1	38.5	64.2	
750	1.3*	5.9	7.8	11.0	17.6	29.4	49.0	
775	1.3*	4.6	6.1	9.1	13.7	22.8	38.0	
800	1.0*	3.5	4.7	7.0	10.5	17.5	29.2	

0.5% Mo Steel		1% Cr-0.5% Mo Steel	
JIS G5151	ASTM A217	JIS G5151	ASTM A217
SCPH 11	WC 1	SCPH 21	WC 6
0.25	0.25	0.20	0.20
0.50 to 0.80	0.50 to 0.80	0.50 to 0.80	0.50 to 0.80
0.040	0.040	0.040	0.040
0.040	0.045	0.040	0.045
0.60	0.60	0.60	0.60
0.45 to 0.65	0.45 to 0.65	0.45 to 0.65	0.45 to 0.65
—	—	1.00 to 1.50	1.00 to 1.50
—	—	—	—
65,400 (46)	65,000 (45.7)	69,700 (49)	70,000 (49.2)
35,600 (25)	35,000 (24.6)	39,800 (28)	40,000 (28.1)
22	24	17	20
35	35	35	35

0.5% Mo Steel		2.5% Ni Steel	
JIS G5152	ASTM A 352	JIS G5152	ASTM A362
SCPL 11	LC 1	SCPL 21	LC 2
0.25	0.25	0.25	0.25
0.50 to 0.80	0.50 to 0.80	0.50 to 0.80	0.50 to 0.80
0.040	0.040	0.040	0.040
0.040	0.045	0.040	0.045
0.60	0.60	0.60	0.60
0.45 to 0.65	0.45 to 0.65	—	—
—	—	—	—
—	—	2.00 to 3.00	2.00 to 3.00
65,400 (46)	65,000 (45.7)	69,700 (49)	70,000 (49.2)
35,600 (25)	35,000 (24.6)	39,800 (28)	40,000 (28.1)
21	24	21	24
35	35	35	35

19% Cr-10% Ni-2% Mo St. Steel (Low C)		C Steel	
JIS G5121	ASTM A351	JIS G3201	ASTM A105
SCS 16	CF 3M	SF 45A	—
0.030	0.030	0.60	Max 0.35
2.00	1.50	0.30 to 1.20	0.60 to 1.05
0.040	0.040	0.030	0.040
0.040	0.040	0.035	0.050
1.50	1.50	—	0.35
2.00 to 3.00	2.00 to 3.00	—	—
17.00 to 20.00	17.00 to 21.00	—	—
12.00 to 16.00	9.00 to 13.00	—	—
56,900 (40)	70,000 (49.2)	64,000 ~ 78,200 (45 ~ 55)	70,000 (49.2)
25,600 (18)	30,000 (21.1)	32,700 (23)	36,000 (25.3)
33	30	24/19	22
—	—	45/35	30

■ CHEMICAL COMPOSITION & PHYSICAL PROPERTIES

Description	12% Cr St. Castings		16% Cr-3% Ni St. Castings		19% Cr-10% Ni-2% Mo St. Castings		Steel		C Steel	
Symbol	JIS G5121	ASTM A743	JIS G5121	ASTM A747	JIS G5121	ASTM A743	JIS G3101	ASTM A36	JIS G4051	ASTM A194
Grade	SCS 1	CA-15	SCS 24	CB7Cu-1	SCS 14A	CF-8M	SS 41	—	S 45C	2H
C % Max.	0.15	0.15	0.07	0.07	0.08	0.08	—	0.26	0.42 to 0.48	0.40 min.
Mn % Max.	1.00	1.00	1.00	0.70	1.50	1.50	—	—	0.60 to 0.90	—
P % Max.	0.040	0.040	0.040	0.035	0.040	0.040	0.050	0.040	0.030	0.040
S % Max.	0.040	0.040	0.040	0.030	0.040	0.040	0.050	0.050	0.035	0.050
Si % Max.	1.50	1.50	1.00	1.00	1.50	2.00	—	—	0.15 to 0.35	—
Mo %	—	Max. 0.5	—	—	2.00 to 3.00	2.00 to 3.00	—	—	—	—
Cr %	11.50 to 14.00	11.50 to 14.00	15.50 to 17.50	15.50 to 17.70	18.00 to 21.00	18.00 to 21.00	—	—	—	—
Ni %	Max. 1.00	Max. 1.00	3.00 to 5.00	3.60 to 4.60	9.00 to 12.00	9.00 to 12.00	—	—	—	—
Cb% + Ta%	—	—	—	Cb 0.15 to 0.35	—	—	—	—	—	—
Cu %	—	—	2.50 to 4.00	2.50 to 3.20	—	—	—	—	—	—
Nb% + Ta%	—	—	0.15 to 0.45	N 0.05	—	—	—	—	—	—
Tensile Strength Min. psi (kgf/mm ²)	78,200 (55)	90,000 (63)	179,200 (126)	H900 170,000 (120) H1100 100,000 (77.3)	69,700 (49)	70,000 (49.2)	58,300 (41)	58,000 (40.8)	99,500 (70)	—
Yield Point Min. psi (kgf/mm ²)	49,800 (35)	65,000 (45.7)	149,300 (105)	145,000 (102) 135,000 (95)	29,900 (21)	30,000 (21.1)	35,600 (25)	36,000 (25.3)	71,000 (50)	—
Elongation in 2 in. % Min.	16	18	6	5 9	33	30	17	23	17	—
Reduction of Area % Min.	30	30	—	—	—	—	—	—	45	—

■ CHEMICAL COMPOSITION & PHYSICAL PROPERTIES

Description	Cr. Mo Steel		13% Cr. 0.15%C St. Steel		18% Cr Stainless Steel		17% Cr. 4%Ni St. Steel			
Symbol	JIS G4107	ASTM A193	JIS G4303	AISI	JIS G4303	AISI	JIS G4303	ASTM A564		
Grade	SNB 7	B7	SUS 403	403	SUS 440C	440C	SUS 630	630		
C % Max.	0.38 to 0.48	0.37 to 0.49	0.15	0.15	0.95 to 1.20	0.95 to 1.20	0.07	0.07		
Mn % Max.	0.75 to 1.00	0.65 to 1.10	1.00	1.00	1.00	1.00	1.00	1.00		
P % Max.	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040		
S %	0.040	0.040	0.030	0.030	0.030	0.030	0.030	0.030		
Si %	0.20 to 0.35	0.15 to 0.35	0.50	0.50	1.00	1.00	1.00	1.00		
Mo %	0.15 to 0.25	0.15 to 0.25	—	—	Max. 0.75	Max. 0.75	—	—		
Cr %	0.80 to 1.10	0.75 to 1.20	11.50 to 13.00	11.50 to 13.00	16.00 to 18.00	16.00 to 18.00	15.50 to 17.50	15.00 to 17.50		
Ni %	—	—	Max. 0.60	—	Max. 0.60	—	3.00 to 5.00	3.00 to 5.00		
Cb% + Ta%	—	—	—	—	—	—	—	0.15 to 0.45		
Cu %	—	—	—	—	—	—	3.00 to 5.00	3.00 to 5.00		
Nb% + Ta%	—	—	—	—	—	—	0.15 to 0.45	—		
Tensile Strength Min. psi (kgf/mm ²)	125,000 (88)	125,000 (88)	85,300 (60)	110,000 (77.3)	(200)	—	H900 190,500 (134) H1075 145,000 (102)	H900 190,000 (134) H1075 145,000 (102)	H900 190,000 (134) H1075 145,000 (102)	H1075 145,000 (102)
Yield Point Min. psi (kgf/mm ²)	105,000 (74)	105,000 (74)	56,900 (40)	85,000 (59.8)	(193)	—	170,600 (120)	125,100 (88)	170,000 (120)	125,000 (88)
Elongation in 2 in. % Min.	16	16	23	23	2	—	10	13	10	13
Reduction of Area % Min.	50	50	55	65	—	—	40	45	40	45

■ CHEMICAL COMPOSITION & PHYSICAL PROPERTIES

Description	18% Cr-8% Ni St. Steel		10% Cr-10% Ni-2% Mo St. Steel		18% Cr-10% Ni-2% Mo St. Steel (Low C)		Piano Wire	
Symbol	JIS G4303	ASTM A479	JIS G4303	ASTM A479	JIS G4303	AISI	JIS G3522	ASTM A230
Grade	SUS 304	304	SUS 316	316	SUS 316L	316L	SWPA	—
C % Max.	0.08	0.08	0.08	0.08	0.030	0.030	0.80	0.60 to 0.75
Mn % Max.	2.00	2.00	2.00	2.00	2.00	2.00	0.60	0.60 to 0.90
P % Max.	0.045	0.045	0.045	0.045	0.045	0.045	0.025	0.025
S % Max.	0.030	0.030	0.030	0.030	0.030	0.030	0.025	0.030
Si % Max.	1.00	1.00	1.00	1.00	1.00	1.00	0.32	0.15 to 0.35
Mo %	—	—	2.00 to 3.00	2.00 to 3.00	2.00 to 3.00	2.00 to 3.00	Cu Max. 0.20	—
Cr %	18.00 to 20.00	18.00 to 20.00	16.00 to 18.00	16.00 to 18.00	16.00 to 18.00	16.00 to 18.00	—	—
Ni %	8.00 to 10.50	8.00 to 10.50	10.00 to 14.00	10.00 to 14.00	12.00 to 15.00	10.00 to 14.00	—	—
Tensile Strength Min. psi (kgf/mm ²)	75,400 (53)	75,000 (52.7)	75,400 (53)	75,000 (52.7)	70,000 (49)	81,000 (56.8)	206,000 (145)	215,000 (151)
Yield Point Min. psi (kgf/mm ²)	29,900 (21)	30,000 (21.1)	29,900 (21)	30,000 (21.1)	25,600 (18)	34,000 (23.9)	—	—
Elongation in 2 in. % Min.	40	30	40	30	40	55	—	—
Reduction of Area % Min.	60	40	60	40	60	—	—	40



CHEMICAL COMPOSITION & PHYSICAL PROPERTIES

Description	1.8% Si - 1% Mn Spring Steel		0.8% Cr - 0.15% V Spring Steel		0.8% Cr - 0.15% V Spring Steel		2% Cr - 5% Steel	
Symbol	JIS G4801	ASTM A331	JIS G3565	ASTM A232	JIS G4801	ASTM A689	JIS G4404	—
Grade	SUP 6	A29-9255	SWOVC-V	—	SUP10	A322-6150	SKD4	—
C % Max.	0.65	0.51 to 0.59	0.45 to 0.55	0.48 to 0.53	0.45 to 0.55	0.48 to 0.53	0.25 to 0.35	—
Mn % Max.	1.00	0.70 to 0.95	0.65 to 0.95	0.70 to 0.90	0.65 to 0.95	0.70 to 0.90	0.60	—
P % Max.	0.035	0.035	0.030	0.020	0.035	0.035	0.030	—
S % Max.	0.035	0.040	0.030	0.035	0.035	0.040	0.030	—
Si % Max.	1.80	1.80 to 2.20	0.15 to 0.35	0.20 to 0.35	0.15 to 0.35	0.15 to 0.35	0.40	—
W %	—	—	Cu Max. 0.20	—	—	—	5.00 to 6.00	—
Cr %	—	—	0.80 to 1.10	0.80 to 1.10	0.80 to 1.10	0.80 to 1.10	2.00 to 3.00	—
V %	—	—	0.15 to 0.25	0.15	0.15 to 0.25	0.15 Min.	0.30 to 0.50	—
Tensile Strength Min. psi (kgf/mm ²)	177,800 (125)	—	199,000 (140)	190,000 (134)	177,800 (125)	—	—	—
Yield Point Min. psi (kgf/mm ²)	110	—	—	—	156,400 (110)	—	—	—
Elongation in 2 in. % Min.	9	—	—	—	10	—	—	—
Reduction of Area % Min.	20	—	40	40	30	—	—	—

TEMPERATURE

FAHRENHEIT °F °F = °C × $\frac{9}{5}$ + 32



CENTRIGRADE °C

PRESSURE

psi



kgf/cm²

WEIGHT

POUNDS lb



KILOGRAMS kg

GENERAL OFFICE BUILDING

The general office building is the center of our plants for the production of [valves and control systems].

- The lower floor accommodates general offices of General Affairs Dept., Engineering Dept., Quality Assurance Dept., etc.
- The upper floor accommodates Technical Department (Design Section, and Production Technology Section).



▲Design room

MACHINE WORKS

The machine works is functionally laid out to maximize performance of each machine type. Latest NC machines and automatic exclusive machines of our own make are continuously producing interchangeable components of stable quality.



▲Machine works

ASSEMBLY PLANT

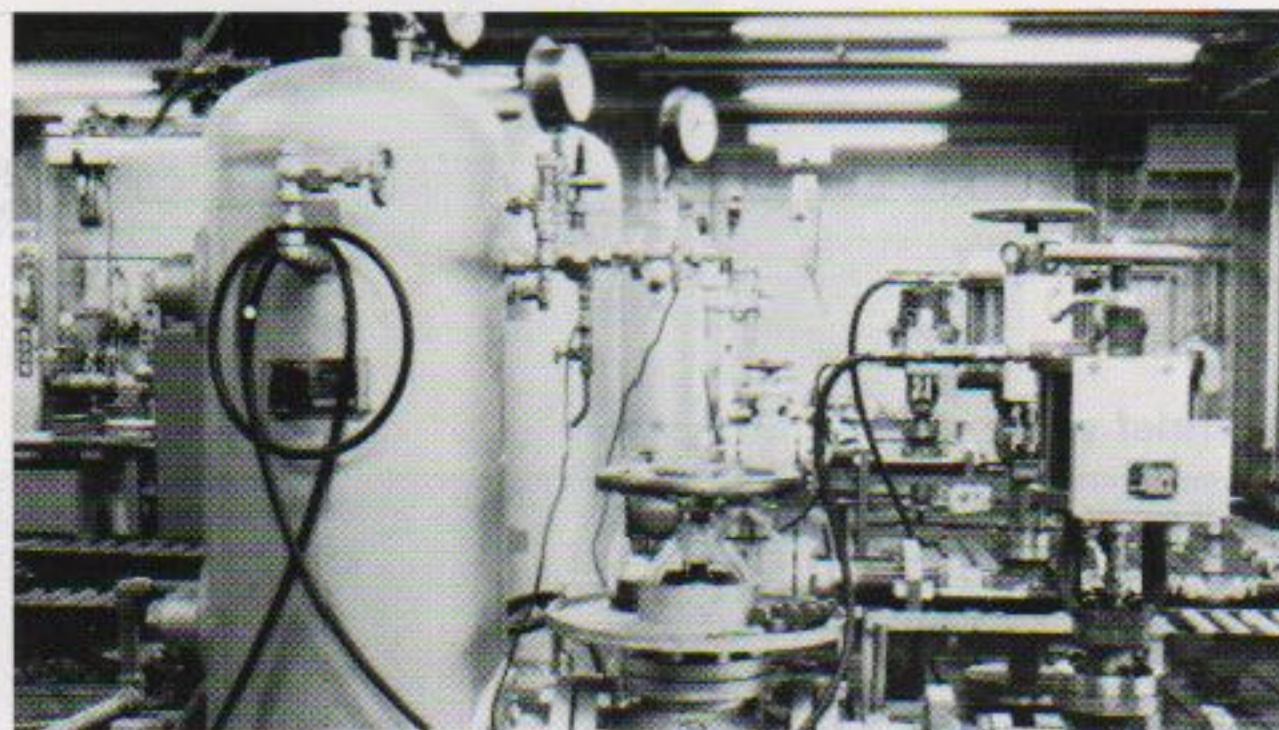
NAKAKITA, a comprehensive maker of valves, is producing valves of many types. Each type is produced by skilful fitters to possess reliable quality on its exclusive assembly floor. Our own heat treatment shop, and cleaning shop assure complete satisfaction of the customers' specifications.



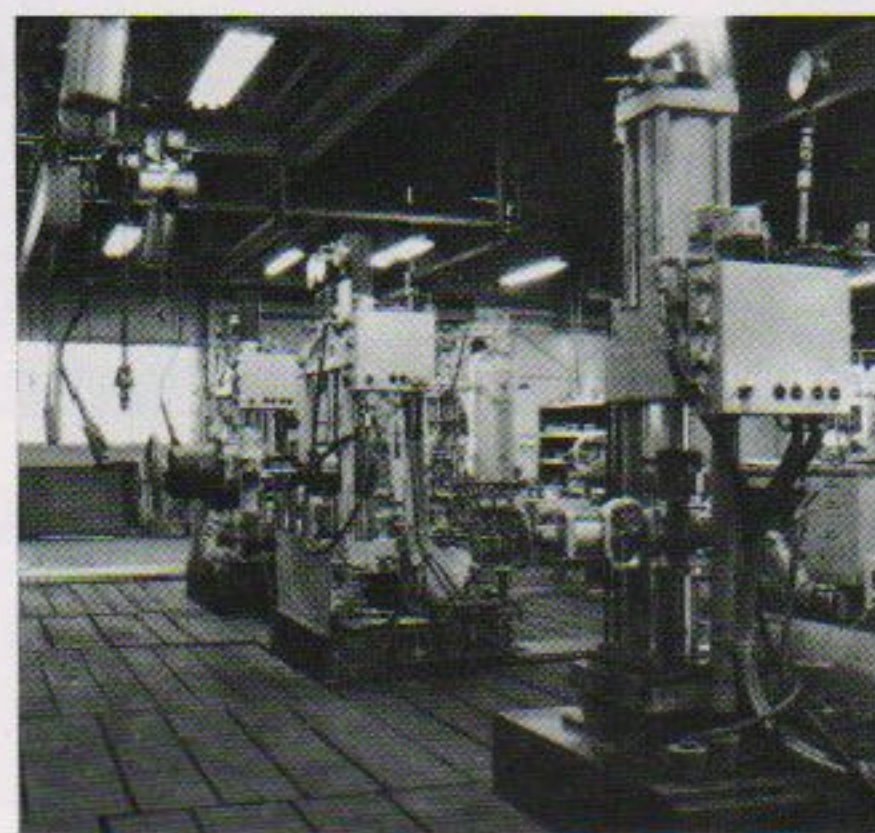
▲Assembly plant

INSPECTION SECTION

Each inspection section is directly connected to the respective assembly plant. Reliable inspectors working on high performance inspection facilities are sending out reliable [NAKAKITA Products] after making strict quality check.



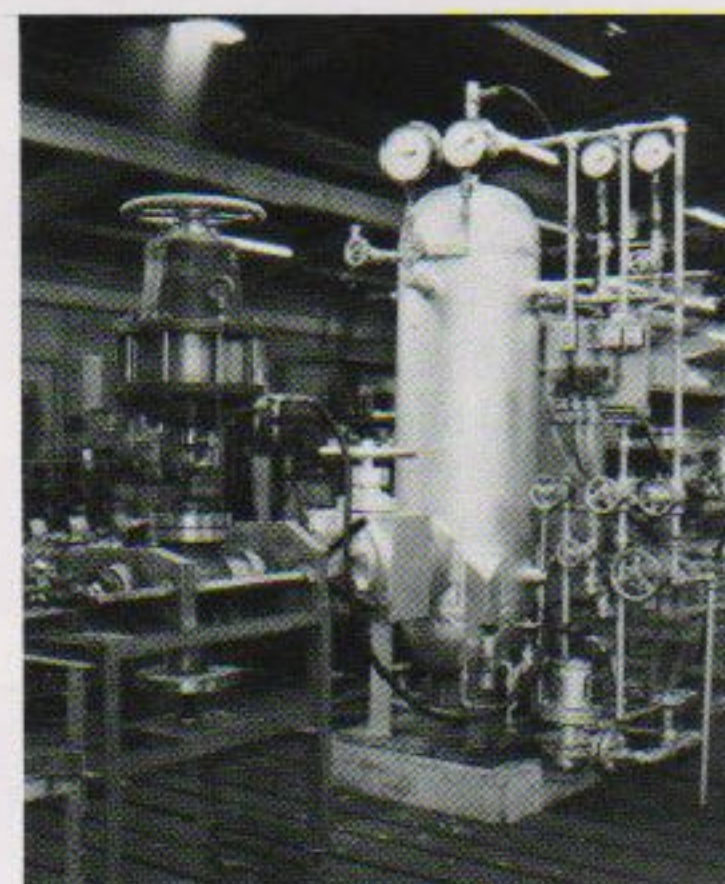
▲Cylinder valve inspection shop



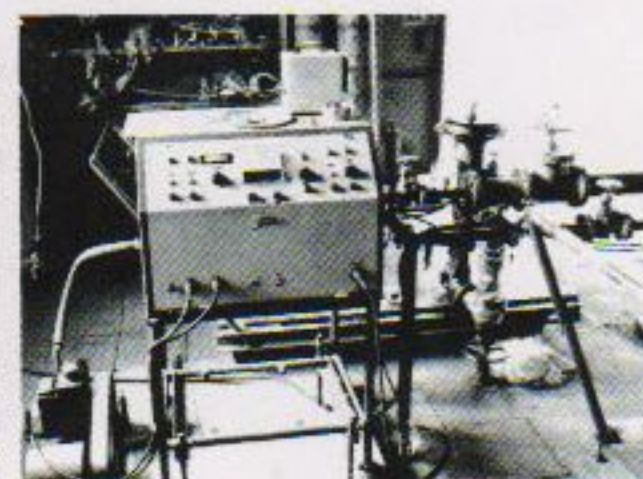
▲Pressure test



▲Non-destructive testing device



▲Performance test



▲He leak detecting device (10^{-10})



▲300 kgf/cm² high pressure air compressor



▲350 kgf/cm² / 650°C super-critical pressure boiler



▲Cryogenic temperature test device



When making an enquiry or placing an order for cylinder valves, please use the following specification sheet. Always specify the items indicated by in the sheet.

Please specify any special matters concerning plant side conditions such as opening/shutting time of valve, atmosphere and special test, if any.

■ Cylinder valve specification sheet

(Example of entry)

Application (name of equipment)		Water curtain spray valve					
Valve number		AVO4-1					
Service Conditions	Fluid	Condensate					
	Specific gravity/viscosity	/					
	Flow rate	m ³ /h	Nm ³ /h	kg/h			
	Valve inlet temperature	°C					
	Valve inlet pressure	kgf/cm ² g					
	Valve outlet pressure	kgf/cm ² g					
	Valve pressure drop	kgf/cm ²					
	Differential pressure (when valve shut)	kgf/cm ²					
	Calculation Cv						
	Valve operation	When operating pressure is increased	Open,	Shut	Open,	Shut	
		When operating pressure is lost	Open,	Shut,	Lock	Open,	Shut,
	Applied standard, regulations						
Bore (inlet/outlet) Sch. No.		2B					
Cylinder Valve	Valve body assembly	Type	NS 650EL00300				
		Nominal bore-pressure rating	2B - 300				
		Maximum service pressure kgf/cm ² g/ Maximum service temperature °C (°F)	/ 17 / 55				
		Connection	ANSI 300Lb R.F. Flange				
		Valve plug	Rated Cv value				
			Style				
	Leakage at full shut						
	Materials	Body and bonnet	SCPH 2				
		Trim					
		Gasket/packing	/				
	Actuator	Type	NS 650DA				
		Operating fluid	Air				
Operating pressure		kgf/cm ² g					
Operating pressure connection port		PT 3/8					
Handwheel		With,	Without	With,	Without		
Accessories	Filter, type						
	Limit, switch, type/power source	Full open, Full shut / AC DC	V	Full open, Full shut / AC DC	110V		
	Solenoid valve, type/power source	/ AC DC	V	Hz	NS642WA-70 / AC DC 110V 60Hz		
	Speed control valve, type						
	Lock valve, type/set pressure	/	kgf/cm ² g	/	kgf/cm ² g		
Painting color (Mancel)		Maker's standard					
Special remarks		Installation site: Ammonia atmosphere. Material should be considered					

ESTABLISHED AFTER SALES SERVICE NETWORK TO ALL OVER THE WORLD



We have set up a perfect after-service network as listed below in order to cover the world-wide requirements and to provide the quick and proper technical service.

DOMESTIC SERVICE NETWORK

SERVICE STATION	No. FOR ENGINEERS	TERRITORY
Main station. Head Office, Osaka	20 Engineers and 25 assistants.	Middle and Western Japan, Shi- koku area and Hok- kaido dis- tricts.
Tokyo station. Tokyo Office.	8 Engineers and 19 assistants.	Eastern and Northern Japan Central Japan.
Kyushu station. Kitakyushu Office	3 Engineers and 11 assistants	Kyushu and Shikoku area, Wes- tern Japan.

OVERSEAS SERVICE NETWORK

SERVICE AGENT	TERRITORY
MANOTHERM B.V. WELPLAATHOEK 20, BOTLEK, ROTTERDAM, NETHERLAND TELEX: 28604 TERMO NL CABLE: THERMO ROTTERDAM TEL: 10-4169011 FAX: 10-4169695	EUROPE
YOKOSIN MARINE CO., (PTE) LTD. 18, KIM CHUAN TERRACE SINGAPORE 1953 TEL: 2863588 (4 LINES) FAX: 2808959 TELEX: RS 37217 YOKMAR	SINGAPORE MALAYSIA and INDONESIA
HONEYWELL LIMITED AUSTRALIA 863 BOURKE STREET, WATERLOO NSW2017 AUSTRALIA TEL: 2-699-0155 FAX: 2-690-9416 TELEX: AA20614 HONEYWL	AUSTRALIA



The International System of Unit (SI)

This Catalog is shown in units of metrology
The SI units may be used for below Conversion Factor

$$1 \text{ kgf/cm}^2 = 0.0980665 \text{ MPa}$$

$$1 \text{ MPa} = 10.1972 \text{ kgf/cm}^2$$

Product List

● Automatic Control Valves

Pneumatic Diaphragm Control Valves
Hydraulic and Electric Control Valves

● Regulating Valves

Reducing Valves for High Pressure and
Temperature Steam Use.
Regulating Valves for Furnace

● Remote Operated Valves

Electric Valves
Pneumatic Cylinder Valves
Hydraulic Cylinder Valves

● Solenoid Operated Valves

Direct Drive Type Solenoid Operated Valves
Pilot Type Solenoid Operated Valves
3-way, 4-way, Change-over Solenoid Operated
valves
Emergency Cut-off Solenoid Operated Valves
Special Solenoid Operated Valves

● Safety Valves

Safety-Relief Valves for Air, Any Gases or
Vapors Service
Safety Valves for Steam Service
Relief Valves for Liquid Service

● Butterfly Valves

Hand and Remote Control Method

● Valves of High Pressure and Temperature

● Valves for Cryogenic (LNG, liquid oxygen)

● Valves for Nuclear Plant

● Pneumatic Automatic Control Equipment

Indication Controllers for flow, differential
pressure, temperature,
Transmitters liquid level, flow rate,
viscosity, etc.

Valve Positioners

Other Instrumentation Accessories.

● Pressure and Temperature Reducing Devices for Super-Heated Steam

● Ship Loading and Ballast Remote Control Devices

Control Panels
Hydraulic Power Units
Other Hydraulic Equipment.

● Remote Tank level Gauges and Alarm Devices

Air Purge Type Remote Level Gauges
Electric Float Wind-up Type Remote Level Gauges

● Float Type Level Switches

● Design and Fabrication of Various Automatic Control Special Valves and Adjustment Devices

● Twin Power Actuators

(Technical Collaboration Product)



NAKAKITA

NAKAKITA SEISAKUSHO CO., LTD.

Head Office; Factory; 1-1 Fukono-Minamimachi, Daito-shi 574-8691, Osaka, Japan.

Tel; 81-72-871-1341, 81-72-871-7871 Fax; 81-72-874-7501

Tokyo Office;

c/o Sanwa Bldg., 27-17, Hamamatsu-cho 1-chome, Minato-ku 105-0013, Tokyo, Japan.

Tel; 81-3-3431-7201 Fax; 81-3-3431-5594

Kitakyushu Office;

c/o Isuzu Bldg., 14-17, Kyomachi 3-chome, Kokurakita-ku, Kitakyushu-shi 802-0002, Japan.

Tel; 81-93-531-5481 Fax; 81-93-521-4993